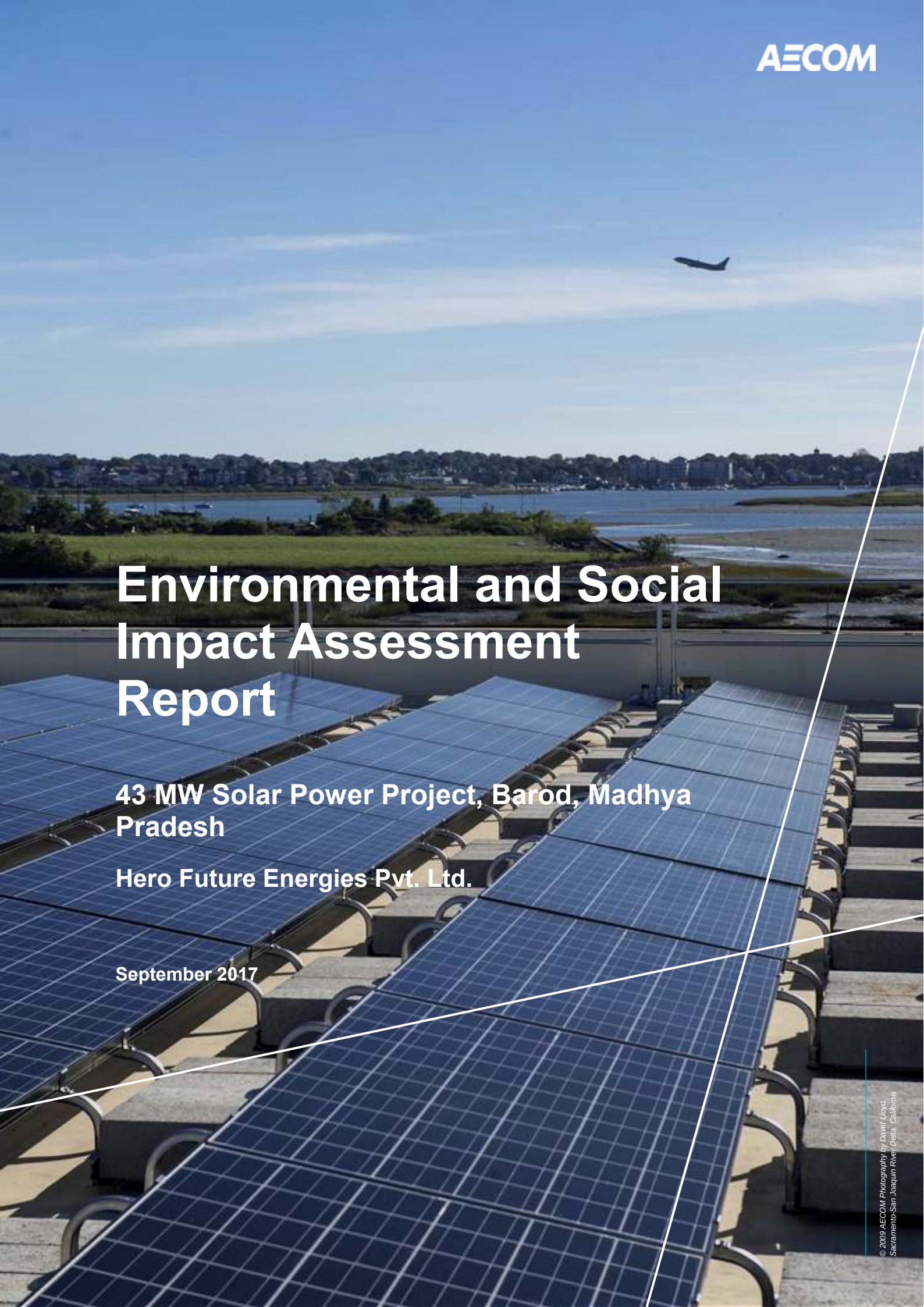

Environmental and Social Impact Assessment Report

43 MW Solar Power Project, Barod, Madhya Pradesh

Hero Future Energies Pvt. Ltd.

September 2017

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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Table of Contents

Figures

Tables

1. Introduction

1.1 Preface

Hero Future Energies Pvt. Ltd. (hereinafter referred as “HFE”), established in 2012, is an Independent Power Producer, and is a fully owned subsidiary of the Hero Group. HFE has established projects in ten states of India with a power generation capacity totalling 360 MW across wind, solar PV (grid connected) and rooftop projects. The company has a pipeline of ~1100 MW of wind projects till 2018-19 and is estimated to secure over 500 MW of solar projects through state and central bidding process.

AECOM India Pvt. Ltd. (hereinafter referred as “AECOM”) understands that HFE, through M/s Rajkot (Gujarat) Solar Energy Private Limited (hereinafter referred as “RGSEPL”), intends to develop a 43 MW solar power project with financial assistance from international lenders / multilaterals. In this context, the project requires evaluation of Environmental and Social risks associated with its construction and operations. Evaluating such risks will help determining mitigation measures to avoid adverse impacts identified as part of the study.

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

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

- Applicable national, state and local regulatory requirements;
- IFC Performance Standards (2012);
- IFC/World Bank EHS General Guidelines (2007).

1.2 Project Background

RGSEPL, a special purpose vehicle (SPV) of Hero Solar Energy Pvt. Ltd. which is a subsidiary of HFE is developing a 43 MW Solar Power Project (hereinafter referred as “Project”) in Kishankot and Hatipura villages of Badod Tehsil of Agar district, Madhya Pradesh, India. The project will generate electricity through utilization of solar power through solar photovoltaic (PV) system.

A Power Purchase Agreement (PPA) has been signed between RGSEPL and Madhya Pradesh Power Management Company Limited (hereinafter referred as “MPPMCL”) dated 18th November 2015 for procurement of power generated by the Project. The switchyard with capacity 33kV will be constructed within the plant premises and power will be evacuated through 4 km of external transmission lines upto Barod Grid Substation.

1.3 Objective and Scope of work

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

- Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions;
- Identify the relevant policies and legislation relevant to the activity;
- Collection of information on forestry, flora and fauna and natural habitats and species of special conservation/scientific interest;
- Collection of additional secondary environmental, social and demographic information;
- Identification and review of the applicable standards and identification of key issues;
- Assessment of potential environment and social impacts of the project and its components;
- Suggesting mitigation measures and plans to maximize project benefits in consultation with affected communities; and

- Preparation of Environmental and Social Action Plan (ESAP) based on the ESIA and suggest procedures for mitigation and monitoring of environment and social impacts on an ongoing basis as well as to identify any requirements that may occur subsequent to the completion of the ESIA.

1.4 Methodology

The methodology adopted for the ESIA broadly includes the following:

1.4.1 Defining the Project/Project Description

The project information includes providing project description with focus on understanding the environmental and social setting and sensitivities for the solar power project. This also includes any related facilities that may be required (e.g., access roads, transmission lines, water supply arrangements, housing, raw material etc). Description of the larger setting in which the project is located has also been provided in *Section 3*.

1.4.2 Outlining Policy, legal, and administrative framework

The policy, legal, and administrative framework within which the assessment is carried out, including host country regulations, obligations under relevant international social and environmental treaties, agreements, and conventions, IFC Performance Standards and subsequently Reviewing the Social and Environmental compliance requirements against afore mentioned requirements, have been provided in *Section 4*.

1.4.3 Generating Baseline Data

Section 5 describes the relevant baseline environmental and social data (primary & secondary, as applicable) relevant to decisions about project location, design, operation, or mitigation measures. Ecological assessment on flora and fauna of the site and study area was taken up through secondary data sources. Review of the land take/lease process to assess any legacy or current/existing issues (like informal settlers, livelihood dependence, other usage etc.) on the purchased/leased land was also assessed.

1.4.4 Consultation

Consultation with local community, stakeholders, household surveys was carried out to review land procurement and compensation process and assess compliance to IFC PS 5 standards.

1.4.5 Assessing Social and Environmental Impacts and Mitigation Measures

Evaluating potential Environment and Social impacts of the Project and its components (including associated facilities like, transmission line, access roads etc. as per the details available) and developing mitigation measures and plans to maximize project benefits in consultation with affected communities including, potential assessment of Cumulative impacts (linked to development of other solar projects), if relevant and as appropriate. The impact assessment identifies mitigation measures for any residual negative impacts that may not be mitigated and also evaluate impacts and risks from associated facilities and other third party activities.

1.4.6 Analysing Alternatives

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

1.4.7 Providing Management Program

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

regulations and to meet the Performance Standards, the management program will include an Action Plan, which is subject to disclosure to the affected communities and ongoing reporting and updating.

1.5 Limitations

The study undertaken is structured around the project information as provided by the project proponent till date, any change in significant activities may result in variation of outcome. The visit to the site was initially undertaken in October 2016 and subsequent visit was conducted in March 2017. Professional judgement and subjective interpretation of facts has been applied for interpretation of various aspects. All information and inferences presented herein are based on the details currently available as per the scope of work, information provided by the client or its representative, existing secondary data, budget and schedule.

1.6 Report structure

The structure of the report is as provided below:

Chapter 1 - Introduction
The section provides description of project background, objectives, scope and organization of the study and approach & methodology.

Chapter 2 - Project Description
This section deals with the technology and specifications of the project. This also deals with the infrastructural development as a part of project during construction and operation phase and resources required.

Chapter 3 – Environment and Social Regulatory Framework
This section provides information on Policy, Legal and Administrative framework applicable to the proposed solar project. The Section defines applicability of IFC Performance Standards of the proposed project.

Chapter 4 - Environmental Baseline Status
This section presents the methodology and findings of field studies undertaken with respect to meteorology, water, soils, land use, ecology, etc. to define the various existing environmental status in the area.

Chapter 5 – Analysis of Alternatives
This chapter presents the analysis of alternatives considered for the proposed solar project considering no project scenario, alternate methods for power generation and technology and alternate routes for transmission line.

Chapter 6 – Socio-economic Profile, Stakeholder Identification and Consultation
This section presents socio-economic profile of the study area based on primary and secondary information on socio-economic aspects of the study area. This chapter also presents stakeholder identification process for the project, details of consultations held with key questions and responses extracted from the survey undertaken during site visit.

Chapter 7 – Impact Prediction, Evaluation with Mitigation Measures
The potential impacts of the proposed project and allied activities, which could cause significant environmental and social concerns, are identified and discussed. This discussion will form the basis for environmental and social management activities.

Chapter 8 – Environmental and Social Management Plan (ESMP)
This section provides recommendation for environmental and social management plan aimed at minimizing the negative environmental and social impacts of the project. Environmental and social monitoring requirements for effective implementation of mitigating measures during development as well as operation of the project have also been delineated along with requisite institutional arrangements for their implementation.

Chapter 9 – Conclusion and Categorization of the Project
This chapter encompasses category assigned to the proposed solar project based on IFC Categorization. A brief conclusion drawn from the impact assessment study has also been presented.

Appendices

Appendix A: Format for Stakeholder Identification
Appendix B: Format for Recording Summary of Consultation Activities
Appendix C: Format for Grievance Record Register

2. Project Description

2.1 Overview

This section provides an overview of project and describes the project in terms of location, associated infrastructure, equipment required and activities to be performed during the construction, operation and decommissioning stages of the project.

2.1.1 Project status

At the time of visit to the site in October 2016, the project construction was underway. The land procurement process for the project was completed and civil works had been initiated at site. During subsequent visit in March 2017, major civil works at site were completed, installation of project components was under progress. Out of the total capacity, 5 MW was commissioned and operational. As on date, the project has been fully commissioned by RGSEPL.

During construction phase, RGSEPL has engaged Schneider for majority of works including civil, erection and commissioning. The list has been provided below:

Table 2-1: EPC Contractor and Subcontractor Responsibilities

S.No.	Contractor	Nature of Work
1	Schneider	Civil Works, Equipment Supplier and E&C
2	Meera Enterprises	Civil Works
3	Maharana Pratap Security Agency	Security

Source: RGSEPL

The responsibility of Operations and Maintenance for the project lies with RGSEPL. An O&M team pf about 10-15 personnel will be engaged at site for operating the plant and carrying out maintenance activities on day to day basis.

2.2 Project Setting

2.2.1 Site Location

The proposed site is located in Hathipura and Kishankot villages in Barod Tehsil of Agar Subdivision of Agar Malwa district in the state of Madhya Pradesh. The site is at a distance of about 6.5 km from Barod Town. The indicative location of the project site has been presented in *Figure 2-1*.

2.2.2 Site setting

The project area is part of Malwa plateau region of Madhya Pradesh and is a complete rural setup with private agricultural land as well as revenue land. The site is located at an elevation of 480-505 m above mean sea level with scattered vegetation. The site is accessible from the Barod Road which is 1 km from the site, as well as the village roads of Hatipura and Kishankot. Surrounding area comprises predominantly of the agricultural land in the west, south and north direction, with a solar farm along the east side of the site.

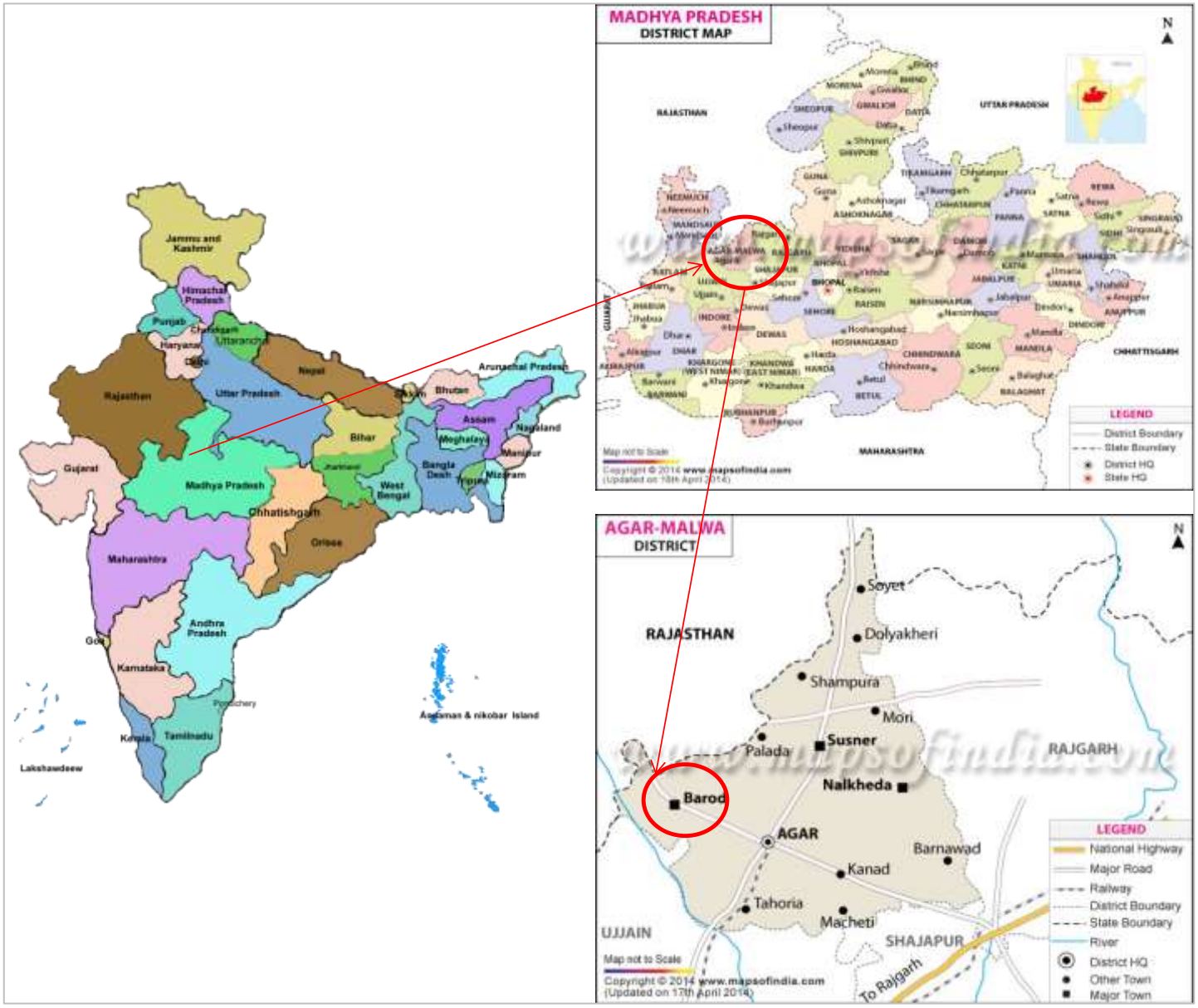


Figure 2-1: Indicative Location of Project

2.3 Project Components

2.3.1 PV Modules

The proposed 43MW (AC) solar power project will be based on Multi-Crystalline or Thin film Solar Photo Voltaic technology. The switchyard with capacity 33kV will be constructed within the plant premises and power will be evacuated through external transmission lines upto the grid substation.

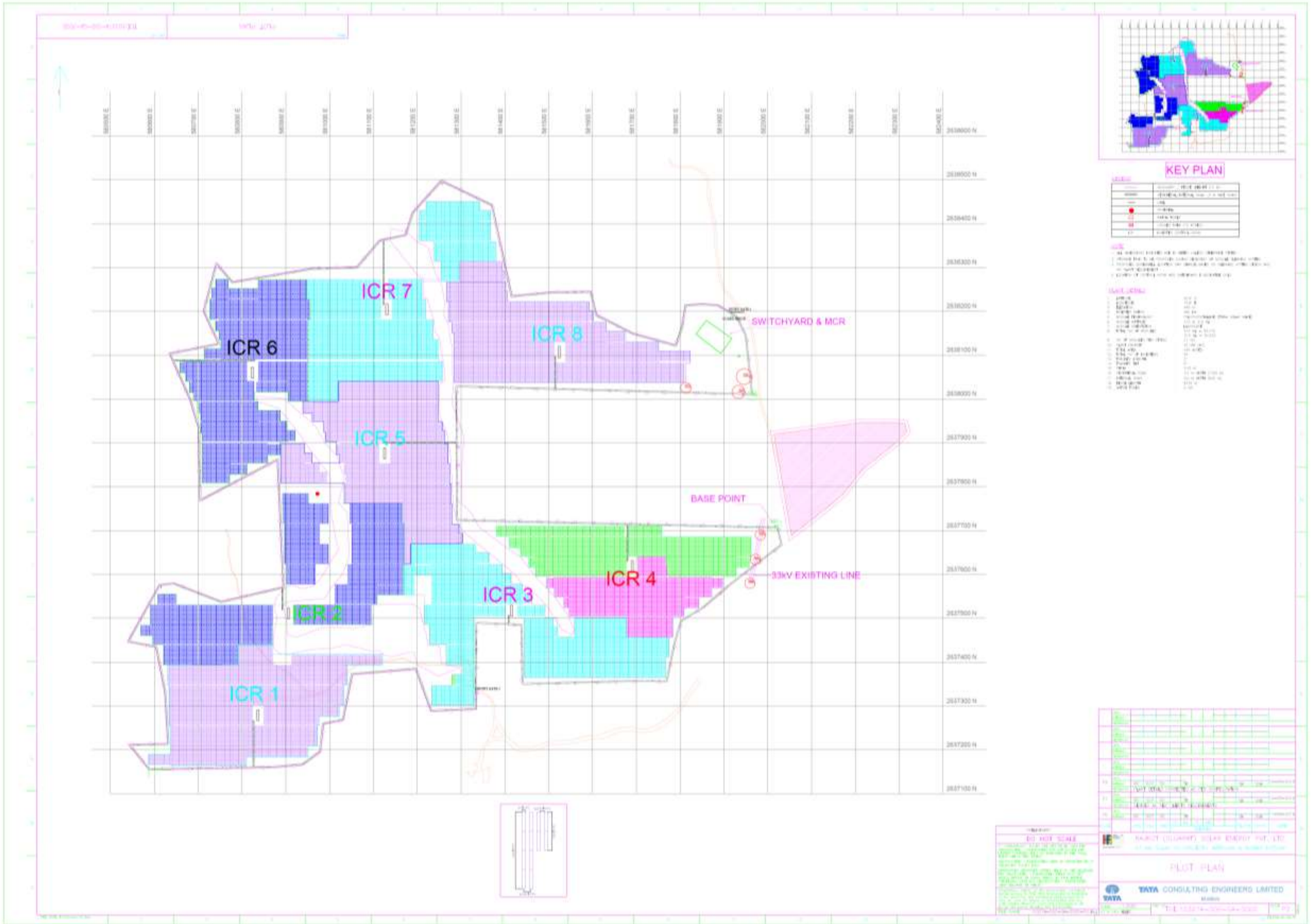
The energy generated will be evacuated at the 132/33 KV grid substation of Madhya Pradesh Power Transmission Company Limited (MPPTCL) located at Barod. The length of the proposed 132 kV single circuit transmission line between power plant and grid substation is expected to be ~4 km. Expected electrical energy generation for sale will be approximately 74.82 million units (kWh) in the first year of operation i.e. 1.74 million units. The salient features of the project components have been presented in *Table 2-2* below and the details have been provided in subsequent sections.

Table 2-2: Technical Specifications of Modules

S. No.	Item Description	Quantity	UOM	Make
1	Solar PV Modules -310 Wp	138710	Nos.	Trina/Yingli/Canadian/equivalent
2	Module Mounting Structure suitable for accommodating 43 MW capacity SPV modules including foundation	4x6 matrix	MT	HFE design
3	Grid Interactive Inverter: 1000 kW as per system capacity of 10 MW	964	Nos.	ABB/Schneider/Hitachi/equivalent
4	String Combiner Boxes	5780	Nos.	ABB/Fairwood/equivalent
5	Cables as per design DC	Set	Mtrs.	Lapp/KEI/Polycab/equivalent
6	Cables as per design AC	Set	Mtrs.	Polycab/KEI/equivalent
7	Substation: Transformers, CTs, PTs, Isolators, Circuit Breakers, Surge Arrestors	Set	Nos.	PCI/ABB/Areva/equivalent
8	Metering-TVM 0.5 s ,415 V LT CT based	Set	Nos.	L&T/Secure/equivalent
9	Lightning Arrestor	Set	Nos.	Jef/Sabo/equivalent
10	Earthing Kit	Set	Nos.	Jef/Sabo/equivalent

Source: Detailed Project Report (DPR) for 43 MW Solar PV Project, January 2016

The layout of the proposed plant has been illustrated in *Figure 2-2* below.



Source: RGSEPL

Figure 2-2: Layout of Proposed Project

2.3.2 Access roads

No new approach roads have been constructed for the project. The existing village road connecting Hatipura village to Barod was being used during construction phase and will be during operation phase.

2.3.3 Power evacuation

Power will be generated at 300 V AC from the solar power plant and will be stepped up to 132 kV for transmission. The plant will be connected to the nearest grid i.e. 132/33 kV Badod Substation in Agar District of Madhya Pradesh. The power generation scheme will primarily consist of Solar PV array, Power Conditioning Units (PCU) which will convert DC to AC power, transformers and associated switch gears (with metering and protection) for transforming the electrical energy generated to 132 kV and can be evacuated to 132/33 kV Badod SS.

A Power Purchase Agreement (PPA) has been executed between RGSEPL and MP Power Management Company Limited (MPPMCL) on 18th November 2015, for purchase of solar power generated by the project.

2.4 Project schedule and activities

The implementation schedule for the project has been shown in *Figure 2-3* below. The land acquisition for the project started in August 2016. As per the schedule, civil works and installation of all equipment related to generating system is to be completed by end of February 2017. The power plant commissioning is envisaged by March 2017.

Sr.No	Activity	Aug-16				Sep-16				Oct-16				Nov-16				Dec-16				Jan-17				Feb-17			
		5	6	7	8	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1.0	**Land Acquisition**																												
1.0	**General**																												
1.1	Topographical Survey and Soil Testing																												
1.2	Boundary Wall Construction																												
1.3	Finalization of EPC contractor																												
2.0	**System Design**																												
2.1	Detailed Civil Engineering																												
2.2	Power Generating System																												
2.3	Evacuation System - Substations																												
2.4	Evacuation System - Transmission Line																												
3.0	**Supply of Generating System**																												
3.1	Solar Modules																												
3.2	Inverters & SMB																												
3.3	Mounting Structures																												
3.4	Inverter Transformer																												
3.5	Cables and Connectors																												
3.6	Earthing System																												
4.0	**Supply of Evacuation System-SubStation**																												
4.1	HT-LT & Control Panel																												
4.2	Transformer																												
4.3	Circuit Breaker, Isolator, CT-PT, LA, Insulators																												
4.4	Conductor & Connector																												
4.5	Structure																												
5.0	**Supply & Execution of Evacuation System-Transmission Line**																												
6.0	**Construction of Main Civil Works**																												
6.1	Control room Building																												
6.2	Inverter room with Inverter Transformer foundation																												
6.3	Switch yard civil work																												
6.4	Internal Road																												
6.5	Internal Drainage																												
7.0	**Installation of Generating System**																												
7.1	Mounting Structure																												
7.2	Fixing Modules																												
7.3	Inverter & Inverter Transformer Installation																												
7.4	Other Works-Earthing																												
8.0	**Installation of Equipments for Switch yard**																												
8.1	Grid Earthing																												
8.2	Structure erection work for all equipments																												
8.3	Equipment Erection work																												
8.4	Structure & Equipment Earthing																												
9.0	**System Testing & Commissioning**																												

Source: RGSEPL

Figure 2-3: Proposed Implementation Schedule

2.5 Required Resources

2.5.1 Manpower

2.5.1.1 Construction Phase

About 150 – 200 skilled and unskilled labour will be required for the construction phase works, with peak requirement of about 300 - 350 labour. The workforce comprises a mix of both migrant labour and local labour. Migrant Labour will be sourced from Rajasthan, Punjab and others part of MP, through labour contractors/ manpower suppliers. The employment of labour for various works is the responsibility of the respective contractor. Labour camps are envisaged to be set up for migrant labour. The technical staff will be accommodated in Barod town.

2.5.1.2 Operation Phase

The manpower requirement for the operation phase of the Project has been estimated to be approximately 10 - 15 staff (engineers, technicians and labour for cleaning of solar panels. About 4- 5 security guards will also be deployed during operation phase. Site-In-Charge will be responsible for all site related issues and will coordinate with security guards, operation contractor, and equipment service provider.

2.5.2 Water Requirement

2.5.2.1 Construction Phase

About 80-85 kilo litres of water[1] will be required for the entire construction phase including water requirements for curing works, batching plant and domestic requirement of workers.

It will be the responsibility of respective contractors for making arrangements to meet water requirements for construction works and domestic purposes. Water tankers from authorized vendors will be sourced from nearby villages. Waste water generation from the construction activities will be limited to washing and cleaning activities. Adequate number of portable toilets[2] with septic tank and soak pits will be provided at site to facilitate the disposal of sewage generated.

2.5.2.2 Operation Phase

The water requirements for the plant will be predominantly for washing of solar PV modules periodically to remove bird droppings, dust and other dirt. Assuming a minimum of 1 litres of water per module, the water requirement for cleaning the whole plant (i.e. 198,415 modules) will be approximately 140 kilo litres, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 280 - 300 kilo litres of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers.

2.5.3 Power Requirement

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

2.6 Land requirement

A total of 250 acres (~101.3 ha.) of revenue land has been obtained by RGSEPL for the purpose of setting up the solar power plant and its associated facilities (Switch yard, access roads etc.). Land Use Permission Agreement has been signed between RGSEPL and the Commissioner New and Renewable Energy Bhopal, Madhya Pradesh. Fifteen (15) revenue land parcels with a cumulative of 101.3 hectares in Kishankot and Hatipura villages of Badod Tehsil, Agar Malwa district have been transferred to RGSEPL for the purpose of the project. The lease period agreement for land usage has been signed for a period of 25 years.

Table 2-3: Component breakup of land area required for the Project

Project Facilities	Land Area (in ha.)	Land Use Classification			Mode of Procurement
		Forest	Government	Private	
Solar Plant	101.3	--	✓	--	Leased for 25 years
External Transmission Lines up to Grid Substation (approx. 4 km length)	500 - 700 sq.ft. per transmission tower; total 16 towers	--	✓	--	Handed over from MPPTCL

Source: RGSEPL, March 2017

2.7 Operation and Maintenance Activities

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

[1] *Considered at a rate of 45 liter/day is considered as domestic water requirement for labour working onsite for full day*
[2] *1 unit for 15 persons as per IFC EHS Guidelines*

1) **Scheduled or preventative maintenance** –Planned in advance and aimed at preventing faults from occurring, as well as keeping the plant operating at its optimum level.

2) **Breakdown maintenance** –carried out in response to failures.

2.7.1 Maintenance Requirement

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

2.7.2 Routine Maintenance

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

1) **General maintenance**: Vegetation will need to be cut back if it starts to cause a fire risk or introduce shading;

2) **Modules**: Visual inspection and replacement of damaged modules will be required. Cleaning of the module glass surface during long dry periods may be considered. Module cleaning needs to be carried out periodically to remove dust, bird dropping etc.;

3) **Wiring and junction box**: Visual inspection for corrosion, damage such as chafing and damage by rodents and birds and for overheating of cables and connections;

4) **Inverter Servicing**: Inverter faults are the most common cause of system downtime in PV power plants and therefore, the scheduled maintenance of inverters should be treated as a centrally important part of the O&M strategy. The preventive maintenance of inverters includes visual inspection, cleaning/replacing cooling fan filters, removal of dust from electronic components, tightening of any loose connections etc.

2.7.3 Breakdown Maintenance

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

3. Environmental and Social Regulatory Framework

3.1 Introduction

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

3.2 National and Regional Enforcement authorities

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

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

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

Table 3-1: Enforcement Agencies and their Functions

S.No	Agencies	Description	Functions
1	Ministry of Environment , Forest and Climate Change (MoEFCC)	Nodal Agency for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry polic ies and programmes	• Environmental policy planning; • Effective implementation of legislation; • Monitoring and control of pollution; • Environmental Clearances for industrial and development projects covered under EIA notification; • Promotion of environmental education, training and awareness; and • Forest conservation, development, and wildlife protection.
2	Centrl Pollution Control Board (CPCB)	For the implementation of the Water (Prevention and Control of Pollution) Act, 1974	• Prevent pollution of streams and wells; • Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; • Co-ordinate the activities of State Pollution Control Board's (SPCB's) and provide them with technical and research assistance; • Establish and keep under review quality standards for surface and groundwater and for air quality; • Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts; and • The CPCB is also responsible for the overall implementation and monitoring of air and water pollution control under the Water Act, 1974, and the Air Act, 1981

S.No	Agencies	Description	Functions
3	Madhya Pradesh Pollution Control Board (MPPCB)	To implements various environmental legislations in the State of Madhya Pradesh, mainly including Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; Water (Cess) Act, 1977; some of the provisions under Environmental (Protection) Act, 1986 and the rules framed there under like, Biomedical Waste (Material and Handling) Rules, 1998; Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 and Municipal Solid Waste (Management and Handling) Rules, 2000 and E-Waste (Management and Handling) Rules, 2011	• To plan comprehensive program for the prevention, control or abatement of pollution and secure executions thereof; • To collect and disseminate information relating to pollution and the prevention, control or abatement thereof; • To inspect sewage or trade effluent treatment and disposal facilities, and air pollution control systems and to review plans, specification or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted; • Supporting and encouraging the developments in the fields of pollution control, wastes recycle reuse and eco-friendly practices; • To educate and guide the entrepreneurs in improving environment by suggesting appropriate pollution control technologies and techniques; and • Creation of public awareness about the clean and healthy environment and attending the public complaints regarding pollution.
4	Department of Housing and Environment, Madhya Pradesh	Headed by the Principal Secretary and is divided into three main sections, namely, housing, development and environment	Deals with • Land management; • Development, planning and management; • Development of Biological Resources; • Control of Pollution; • Environmental Upgradation; and • Capital Project and works related to the capital area
5	Petroluem and Explosives Safety Organization (PESO)	PESO is under the Department of Industrial Policy & Promotion, Ministry of Commerce and Industry,Government of India	To deal with the Provisions of • The Explosive Act, 1884 and Rules, 1983, • The Petroleum Act, 1934 and the Rules 2002, • The Static and Mobile pressure vessels {Unfired} Rules, 1981 and amendment 2000, 2004; • Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and amendment 2000
6	Ministry of Renewable Energy	Nodal ministry of Government of India for all matters related to new and renewable energy	To develop and deploy new and renewable energy for supplementing the energy requirements of the country a stated on its website
7	Madhya Pradesh Urja Vikas Nigam Limited	Nodal agency for implementing various programs and policies of the Government of India and the State Government for the renewable energy sector	• To promote and create awareness about the uses of Solar, Wind, Biomass, Biogas, Renewable Energy and Energy efficient products based various technologies among the public; • To promote the policies and programs necessary for popularizing the applications of various new and renewable energy technologies in the State; • To promote the installation of power plants based on renewable energy sources for Energy Security; • To promote the energy conservation measures for efficient use of energy resources; and • To promote green building design for efficient use of energy in housing, commercial and industrial sector
8	New and Renewable Energy Department (NRED)	Nodal Ministry of the Government of Madhya Pradesh for all matters relating to new and Renewable Energy	• Generation of awareness about new and Renewable Energy technologies; • Promotion of the policies and programmes necessary for popularizing the applications of various new and Renewable Energy technologies

S.No	Agencies	Description	Functions
			in the state; • Promotion of the installation of power plants based on Renewable Energy sources for energy security; • Implementation of demonstration projects based on Energy Efficiency and Renewable Energy; • Rural electrification through Renewable Energy (remote villages) under RVE programme; • Promotion of Energy Conservation measures for efficient use of energy resources; and • Promotion of green building design for efficient use of energy in houses, commercial and industrial sector
9	Central Electricity Authority (CEA)	Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, hereinafter replaced by the Electricity Act, 2003, where similar provisions exists, the office of the CEA is an "Attached Office" of the Ministry of Power.	Is responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions
10	Central Regulatory Election Commission	To promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers	• Improve the operations and management of the regional transmission systems through Indian Electricity Grid Code (IEGC), Availability Based Tariff (ABT), etc.; • Formulate an efficient tariff setting mechanism, which ensures speedy and time bound disposal of tariff petitions, promotes competition, economy and efficiency in the pricing of bulk power and transmission services and ensures least cost investments; facilitate open access in inter-state transmission; • Facilitate inter-state trading; • Promote development of power market; and • Improve access to information for all stakeholders.
11	Central Ground Water Authority	constituted under Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 for the purposes of regulation and control of ground water development and management	• To resort the penal provisions contained in section 15 to 21 of the said act; • To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose; and • Exercise of powers under section 4 of Environment (Protection) Act, 1986 for the appointment of Officers.
12	Gram Sabha or the Panchayats	local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992	• Preparation of plans for economic development and social justice and the implementation of such schemes for economic development and social justice, as may be assigned to them.
13	Madhya Pradesh Power Management Company Limited (MPPMCL)	Main holding company for all the DISCOMS in the State of Madhya Pradesh	• Provide innovative, efficient and tailored electricity products and services with a strong emphasis on risk management for itself and its consumer. • Maximise the value of assets employed in MP power sector by optimising the utilisation of these assets, whether they are generating plants, transmission lines, distribution networks, or other resources. • Create more business opportunities for other segments in MP power sector and enhance the profitability for each of those segment

3.3 Applicable legislations

Various policies released by the Government of India from time to time needs to be addressed while undertaking the projects. Some of the policies (including sector specific) have been discussed briefly in the subsequent sections.

The relevant Acts and Rules pertaining to the proposed project is summarised in *Table 3-2.*

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

National Electricity Policy 2005: The National Electricity Policy 2005 states that Environmental concerns would be suitably addressed through appropriate advance action by way of comprehensive Environmental Impact Assessment and implementation of Environment Action Plan (EAP). As per the policy, adequate safeguards for environmental protection with suitable mechanism for monitoring of implementation of 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.

Madhya Pradesh Solar Policy: The Solar Energy Policy has been formulated in 2012 by Government of Madhya Pradesh (GoMP) with the following objectives:

- To encourage participation of Private Sector to set up Solar Power based projects in the State;
- To define the incentives and benefits to be provided to the participants of the Private Sector in clear terms;
- To build a favourable atmosphere for setting up Solar Power projects; and
- Lay down framework for policy implementation.

Table 3-2: Applicable Environmental and Social Laws, Regulations and Policies

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
1	Environmental Protection	Construction activities will generate air and noise emissions. Scattering of debris and construction material can contaminate the soil, water and surroundings.	The Environment (Protection) Act 1986, as amended in April 2003; EPA Rules 1986, as amended in 2002.	MPPCB MoEFCC CPCB	Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act.
2	Prevention and Control of Water Pollution	Waste water generation from construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	MPPCB	Compliance under the Water Act
3	License under Factories Act, 1948	Factory license is required as 'factory' means '*any premises having ten or more workers involved in a manufacturing process*'.	Chapter I of The Factories Act, 1948	Factories Inspectorate, Madhya Pradesh	Factory License from the State Government or Chief Inspectorate of Factories, Madhya Pradesh
4	Water Cess Collection (a tax on water use and water pollution caused)	Water use and waste water generation	The Water (Prevention and Control of Pollution) Cess Rules 1978, as amended through 16th July 1992and Water (Prevention and Control of Pollution) Cess Act 1977, as amended through 6th May 2003	MPPCB	Filing of monthly returns as per prescribed format (Form I under the Act) Compliance under the Act
5	Prevention and Control of Air Pollution	Operation of diesel generators for power backup at project facilities	The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987. Movement of vehicles, Operation of diesel generators for power at campsite or other construction activities).	MPPCB	Compliance under the Act
6	Noise Emissions	Noise generated from operation of construction machinery	The Noise (Regulation & Control) Rules, 2000 as amended in October 2002. As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by CPCB for different categories of areas like,	MPPCB	There will be generation of Noise during construction activities. Compliance under the rules to maintain stipulated standards.

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
			commercial, residential and silence zones etc.		
7	Hazardous Wastes Management	The proposed project will generate waste oil from diesel generator and transformer oil from switchyard, Solvents and chemicals used or cleaning etc.	Hazardous Wastes (Management Handling and Trans boundary Movement) Rules, 2008 as amended up to 2009 under Environment (Protection) Act, 1986	MPPCB	▪ Authorization for collection, reception, storage, transportation and disposal of hazardous wastes; ▪ Filing of annual return under the rules ; ▪ Other compliance under the rules authorization by Central Pollution Control Boards to vendors accepting waste/used oil; ▪ Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; ▪ The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment; ▪ The occupier and operator of a facility shall be liable to pay a fine as levied by the State Pollution Control Board with the approval of the Central Pollution Control Board for any violation of the provisions under these rules.
8	Electricity Distribution License	Private sector projects to obtain distribution Licenses from the State Electricity Regulation Committee and to have open access to the transmission lines	The Electricity Act 2003	State Electricity Regulation Committee	To obtain license under the electricity act and ensure that the Health and Safety requirements specified under the rules are complied to.
9	Storage of Petroleum products	There will be storage of Diesel at site for operation of generators during construction phase	The Petroleum Act 1934, as amended in August 1976 The Petroleum Rules 1976, as amended in March 2002.	PESO (Chief Controller of Explosives)	The site will store a small quantity of fuel at site. However, in case fuel storage exceeds the limit as stipulated in the Act, required to obtain a license from PESO.
10	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000 The Central Motor Vehicles Rules 1989, as	State Transport Authority	Compliance of stipulated standards under rule 115 Safety compliance under the rules

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
			amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.		
11	Welfare and Work Environment	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Madhya Pradesh Factories Rules, 1962	Deputy Chief Inspector of Factories.	Construction contractor shall comply with all requirement of factories rules and participate in periodic inspection. Ensure that no child labour is engaged.
12	Labour	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Deputy Chief Inspector of Factories	No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage. No pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health.
13	Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Deputy Chief Inspector of Factories	The Act prohibits employment of children in certain occupation and processes. The Act also specifies conditions of work for children, if permitted to work. RGPL will ensure compliance
14	Labour	Engagement of bonded Labour at site	Bonded Labour (Abolition) Act 1976	Deputy Chief Inspector of Factories	All forms of bonded labour is abolished RGPL will ensure compliance
15	Labour	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Deputy Chief Inspector of Factories	Requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act. RGPL will ensure compliance
16	Labour	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Deputy Chief Inspector of Factories	It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature. RGPL will ensure compliance

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
17	Labour	Engagement of Labour at site	Workmen's Compensation Act, 1923	Deputy Chief Inspector of Factories	Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act
18	Public Consultation and Local Grievances	The project is set in rural area.	Madhya Pradesh Panchayat Act 1993	Panchayat Union	Provides for application of consent from the respective panchayat body/village administrative officer etc during the project life cycle. Ensure that all grievances raised by locals related to the project are addressed.
19	Possession of valid license by the engaged contractor.	Contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of valid registration	Building and Other Construction Workers (Regulation Of Employment And Conditions Of Service) Act, 1996 and Contract Labour (Regulation and Abolition) Act, 1970.	Registration Officer	Ensure that contractor/ third party have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.
20	Labour working at the site	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	The Commissioner of Labour, Madhya Pradesh	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

3.4 International Standards

3.4.1 IFC Performance Standards

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

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

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

Performance Standard 1

PS 1 establishes the importance of:

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

Applicability

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

Performance Standard 2

PS 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The objectives of the PS 2 are:

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

Applicability

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

RGSEPL shall take measures to prevent child labour, forced labour and discrimination at site. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be as per the national labour and employment laws. RGSEPL will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. In providing a grievance mechanism through which workers may raise workplace concerns, RGPL should ensure that matters are brought to management's attention and addressed expeditiously. RGSEPL needs to document all grievances and follow up on any corrective actions.

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

Performance Standard 3

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

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

Applicability

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

Performance Standard 4

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

Applicability

The requirements of this PS will be limited to construction period with movement of heavy machinery / vehicles. Labour and security staff to be engaged from local community. If required, an Action Plan will be prepared by RGSEPL and any other relevant project-related information is to enable the influenced communities and relevant government agencies to understand these risks and impacts, and will engage the influenced communities and agencies on an on -going basis consistent with the requirements of PS 1.

Performance Standard 5

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

Applicability

For the proposed project, a total of 101 acres of revenue land has been obtained on lease from the Hathipura and Kishankot villages. The proposed site can be classified as waste fallow land where no agricultural activities

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

Performance Standard 6

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

Applicability

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

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

Performance Standard 7

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

Applicability

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

Performance Standard 8

PS 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

Applicability

There are no culturally important sites in or around the project site. The requirements of PS 8 are therefore not applicable to the project.

3.4.2 IFC Categorization of Projects

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

- ***Category A Projects***: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- ***Category B Projects***: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;

- ***Category C Projects***: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- ***Category FI Projects***: All FI projects excluding those that are Category C projects.

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

3.4.3 Applicable International Conventions

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

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

S.No	International Conventions	Salient Features
1	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17-9-1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March, 2003.
2	UN (Rio) Convention on Biological Diversity	India is a party since: 1994-02-18 by: Ratification; Protocol - Party since: 2003-09-11
3	Conventions on the Conservation of Migratory species of wild animals and migratory species	India is contracting party to the convention on conservation of migratory species of wild animals and migratory species.
4	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change. The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
5	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998
6	International Labour Organization conventions	India has also ratified many of the International Labour Organization conventions that are relevant to the Project including: • C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified); • C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified): • C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified): • C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified); • C29 Forced Labour Convention, 1930 (30:11:1954, ratified) & C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified); • C100 Equal Remuneration Convention, 1951 (25:09:1958, ratified); • C107 Indigenous and Tribal Populations Convention, 1957 • C111 discrimination (Employment and Occupation) Convention,

S.No	International Conventions	Salient Features
		1958 (03:06:1960, ratified)

3.5 Applicable Standards

3.5.1 National Standards

Ambient Air Quality

National Ambient Air Quality (NAAQ), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given in *Table 3-4* below:

Table 3-4: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O_3), µg/m^3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m^3	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO) , mg/m^3	8 Hours	2	2
	1 Hour**	4	4
Ammonia (NH_3), µg/m^3	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6), µg/m^3	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual*	1	1
Arsenic (As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

Source: Environment (Protection) Seventh Amendment Rules, 2009

** Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval*
*** 24 hourly or 8 hourly or 01 hourly values as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days. Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.*

Ambient Noise Standards

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 based on the *A- weighted* equivalent noise level (L_{eq}) are as presented in *Table 3-5* below:

Table 3-5: Ambient Noise Standards

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

Source: MoEF vide gazette notification dated 14 February 2000

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

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

3.5.2 International Guidelines and Standards

Ambient Air Quality

As per the IFC EHS guidelines (December 2008), "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)".

Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (L_{eq} hourly) for day time is **55 dB (A)** while the L_{eq} hourly for night time is prescribed as **45 dB (A).**

Noise Standards for Occupational Exposure

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

Table 3-6: Standards for Occupational Noise Exposure

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

Note: No exposure in excess of 115 dB(A) is to be permitted.
For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

4. Environmental and Social Baseline

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

4.1 Study Area

For the purpose of environment baseline assessment, area falling within 5 km radius from the project boundary has been considered as "Study Area". The proposed project lies in the Barod Tehsil of Agar Subdivision of Agar Malwa district[3] (Ujjain Division), in the state of Madhya Pradesh. The district is located along the western boundary of the state and is surrounded by Ujjain and Ratlam in the south, Rajgarh and Shajapur in the east. The northern boundary is formed with Jhalawar district of Rajasthan. Details pertaining to both the project talukas and district, from authentic government sources, have been presented where project area / project site specific information was not available in public domain.

The proposed site is located in Hathipura and Kishankot villages which lies in the Barod Tehsil of Agar Subdivision of Agar Malwa district and is 6.5 kms from Barod Town. The project area is a part of Malwa plateau region of Madhya Pradesh and is a complete rural setup with private as well as revenue land. The site is located at an elevation of 480-505 m above mean sea level with scattered low vegetation. The Site is accessible from the Barod Road which is 1 km from the site, as well as the village roads of Hatipura and Kishankot. Surrounding area comprises predominantly of the agricultural land in the west, south and the north direction, with a solar farm along the east side of the site.

4.2 Environmental Baseline

4.2.1 Land Use and Land Cover (LULC)

The Agar Malwa district has a geographical area of 272,578 hectares (ha.). As per the latest statistics, the land use pattern of the district is tabulated in *Table 4-1* below.

Table 4-1: Land use pattern of the district

Land Use Type	% Coverage	Land Area (ha)
Forest area	0.017%	4,764
Cultivable Agricultural Land	66.40%	181,008
Uncultivable Land	11.03%	30,090
Industrial Area	0.0004%	11.972
Total Geographical area	--	272,578

Source: Brief Industrial Profile of Agar Malwa District Madhya Pradesh, 2016-17

4.2.1.1 Land use Profile of Study Area

The primary land use of study area is agricultural land with 56.45% followed by fallow land (30.93%). Barren land constitutes 16.25% of the total land use and settlements approximately form 1.8%. Land use of the study area has been presented in *Table 4-2.*

Table 4-2: Land use / Land cover statistics of Study Area

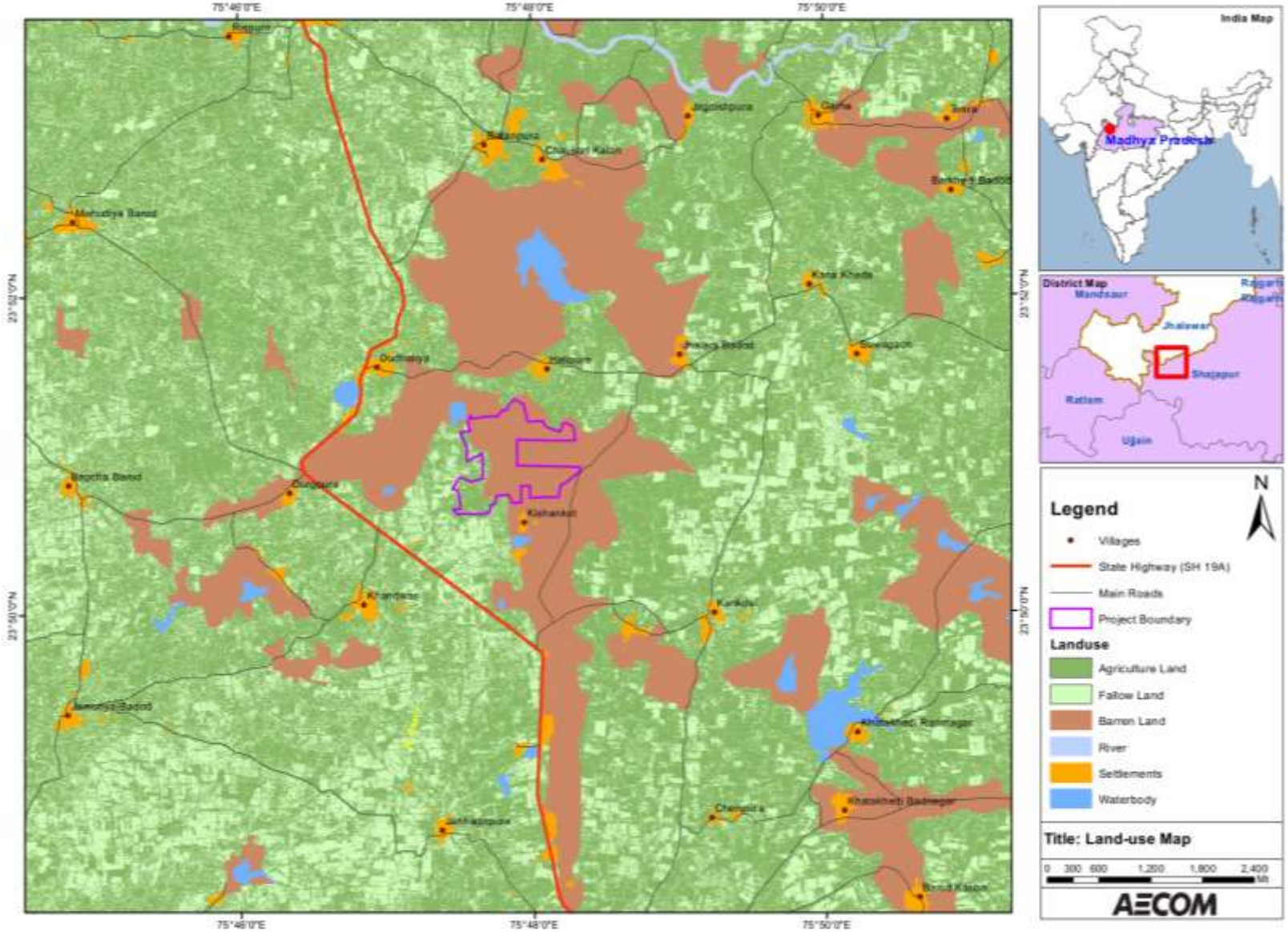
Land type	Area in sq.km	% of total area

[3] *Formerly, a tehsil under Shajapur District, Madhya Pradesh; was bifurcated from Shajapur in 2013 and declared as an independent district.*

Land type	Area in sq.km	% of total area
Agricultural Land	73.30	56.45
Fallow Land	30.93	23.82
Wasteland/ Barren	21.10	16.25
River	0.86	0.67
Built up land and settlement	2.34	1.80
Water bodies	1.31	1.01

Source: AECOM

Figure 4-1 presents the land use and land cover map of study area showing the location of proposed project site.



Source: AECOM

Figure 4-1: Land use / Land cover of the project within 5 km

4.2.2 Topography

The Agar Plateau covers the major areas of Agar Malwa district, which is a part of Malwa Plateau that covers the entire western part of Madhya Pradesh. The soil in the area is black cotton as a result of weathering of basalts. There is a hill tract in the west of Barod town showing scattered hillocks in a north-south direction. The presence of hills in the center has affected the drainage pattern. The height of this tract varies between 500 metres (1,600 ft) and 545 metres (1,788 ft) above the mean sea level and it slopes towards the north.

The Chhoti Kali Sindh, which is the main perennial stream of the region, flows northwards on the western border of the region. The lower part of catchment covers the northern parts of Shajapur, Agar Malwa, Rajgarh, Guna and Southern parts of Jhalawar districts which forms parts of Jhalawar plateau having an average elevation of 300 - 450 m. The land slopes are gentle from south to north and have the characteristics of Malwa Plateau.

Figure 4-2 below shows the physical features within the study area including drainage lines, roads, rivers, settlements and water bodies.

4.2.3 Geology

The Agar Malwa district, which was formerly a part of the Shajapur district, is characterized by a typical Trappean geomorphology comprising extensive plain, low lying hills and hills clusters with gentle northerly slope. The district is a part of Deccan Trap Basalts (Upper Cretaceous to Lower Eocene in age), overlain by variable thickness of Alluvium of Recent origin. Basalts are massive, fractured/jointed and vesicular in nature. Most of the vesicles are filled with secondary minerals like quartz, calcite and zeolite. The uppermost unit of basaltic flow is highly weathered. Alluvium is confined mainly along the rivers and streams, consisting of sand silt and clay, brought by rivers, mixed with line kankar and material derived from nearby hilly terrain.

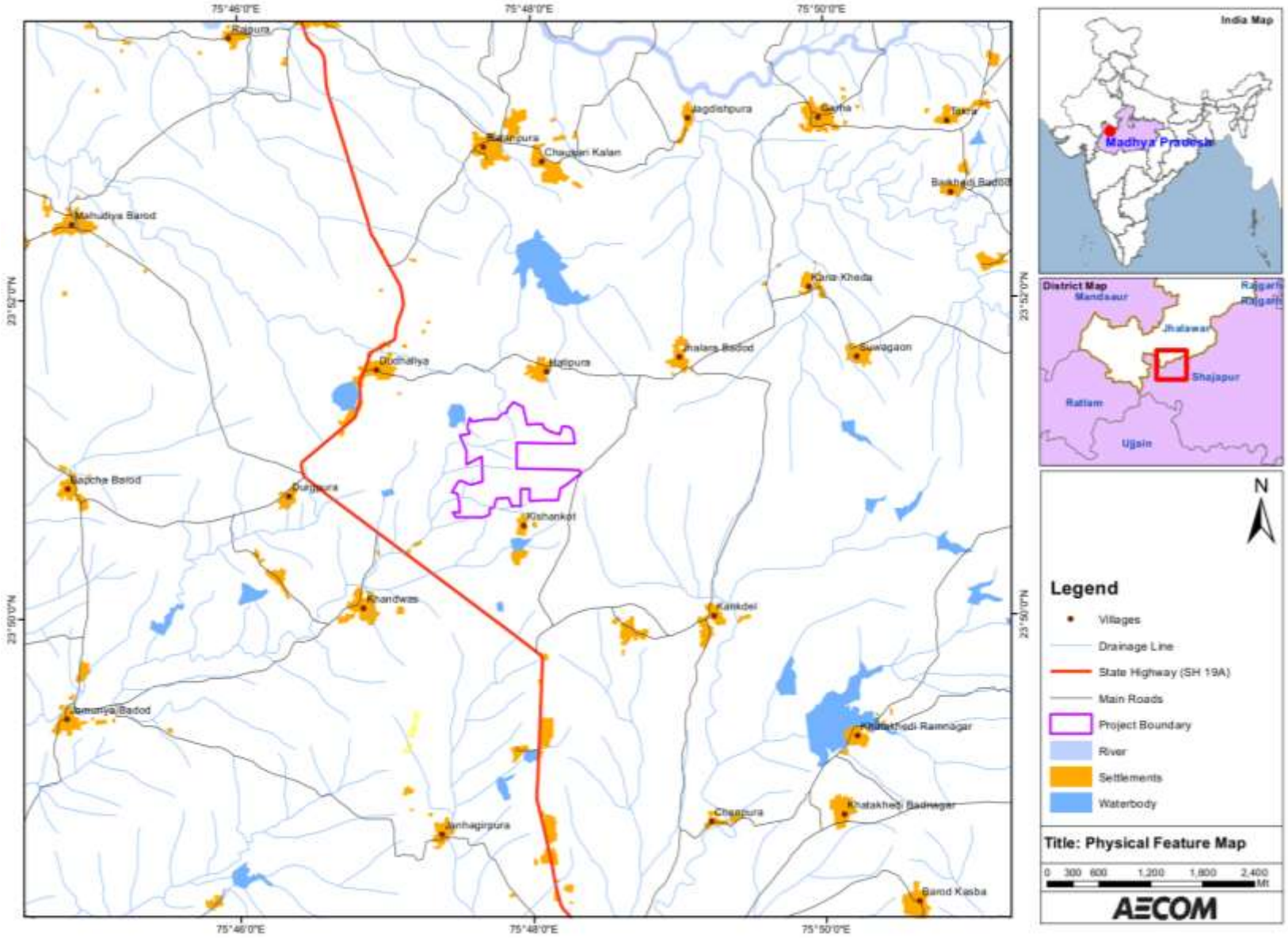
Major portions of this district are highly undulated with broad flat topped hills, cluster terraces and isolated hills. A number of hills caped by laterite are noticed most of the parts of the district. The district has a varied elevation between 450-545m above mean sea level. The geological map of the District is presented in *Figure 4-3.*

4.2.4 Drainage Pattern

The Agar Malwa district lies within Yamuna basin, Chambal sub basin and is drained by prominently northerly flowing rivers like Chhoti Kali Sindh, Kali Sindh, Lakhunder Newaj and Parvati. These rivers and their streams give dendritic drainage.

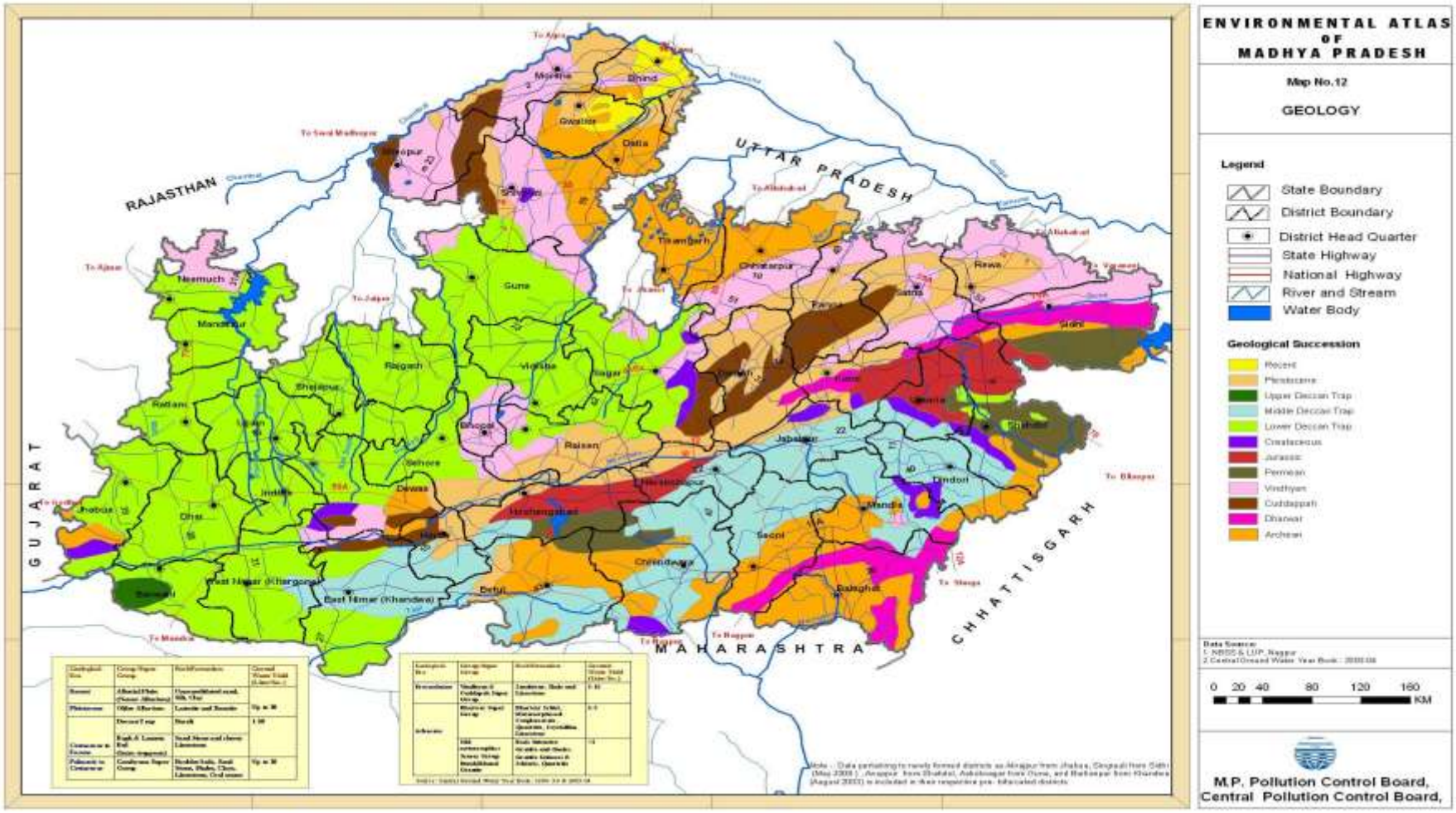
Agar plateau region is delineated over the western part and covers the major areas of Agar Malwa District. Scattered hillocks spread in the district affects the drainage pattern and the hill tract in the west of Barod town shows scattered hillocks in the north-south direction. In the western part of the district there is a continuous chain of hills, which decreases towards the north. Eastern part represents dissected topography where hills are scattered and eroded by streams. Northern part of the district shows a plain topography along Kali Sindh river. Dudhaliya and Kachhol are the main streams in the west, originating from the hill tract and draining towards the west.

Chhoti Kali Sindh River forms the western border of the district. All the rivers of the district flow in the northward direction forming the general slope. Choti Kali Sindh River rises from the vicinity of Dewas and flows to the north-west in Dewas, Ujjain, Shajapur, Agar Malwa and Jhalawar district. In Agar district, it flows mostly along the southwestern and western boundaries.



Source: AECOM

Figure 4-2: Physical Features map of the Study Area



Source: Madhya Pradesh Pollution Control Board[4]

Figure 4-3: Geological map of district

[4]https://www.google.co.uk/imgres?imgurl=http%3A%2F%2Fwww.nchse.org%2Fmpgis%2Fimages%2FMapsPollution%2520Control%2520Board%2Fgeol.jpg&imgrefurl=http%3A%2F%2Fwww.nchse.org%2Fmpgis%2Fintroduction.htm&docid=TDzIS7RJEHEhTM&tbnid=C0g2ic0uVEWlqM%3A&vet=10ahUKEwjG-L-qtYrTAhXElVQKHVirBAMQMwgcKAAwAA..i&w=2245&h=1587&bih=869&biw=1280&q=geological%20map%20of%20madhya%20pradesh&ved=0ahUKEwjG-L-qtYrTAhXElVQKHVirBAMQMwgcKAAwAA&iact=mrc&uact=8#h=1587&imgrc=C0g2ic0uVEWlqM:&vet=10ahUKEwjG-L-qtYrTAhXElVQKHVirBAMQMwgcKAAwAA..i&w=224

4.2.5 Soil types

The soil in the district is of mixed type, majorly deep medium black soil is present. Mixed red and black soil, shallow and medium black and Alluvium Soils are also present. There are three major categories of soils identified in the district;

- Black cotton Soil: These soils are dark grey to black in color, composed of clay and are plastic & sticky in nature. These soils are fertile in nature and derived from decomposition of trappean rocks having thickness of 15 cm to 2m.
- Lateritic soil (Red Soil): These soils consist of sandy loam to clayey loam and brick red to red in colour. These soils are derived from weathered ferruginous basalt.
- Alluvium soil: The alluvium is of mixed origin & comprises of silt & clay and admixtures of these in varying properties. The occurrence of alluvium is confined to the bank of stream and rivers and usually 3 to 4m in thickness.

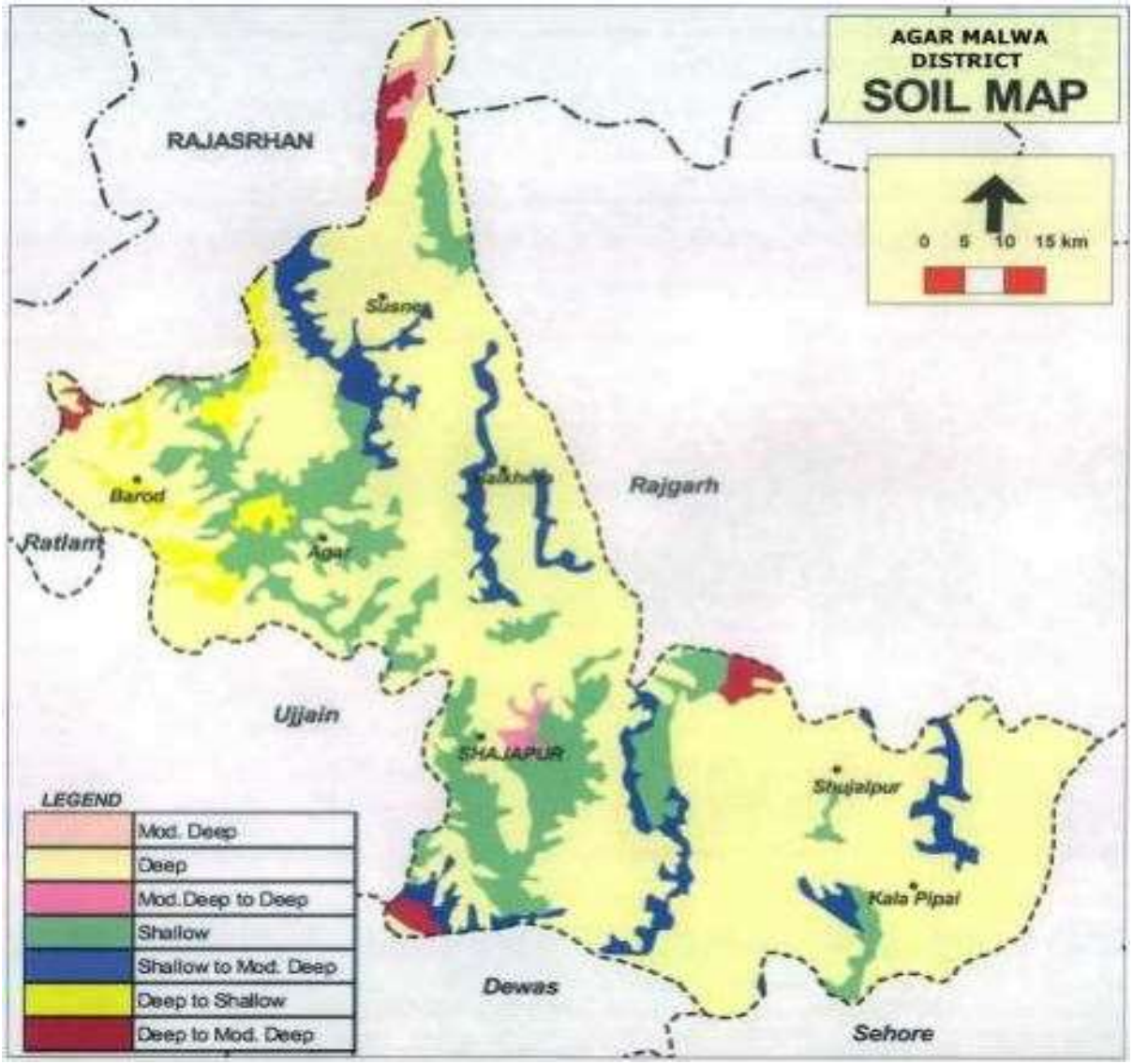
The major portion of the district is covered with deep black soil, which is almost 71.43% of the total geographical area and contains about 20 – 60% clay and has a depth of near about 1 - 2 metres. This soil is highly fertile, while shallow and medium black coloured soils constitute the maximum part of the black soil. They are 15 cm to one metre deep and the colour of soil is grey or light black. These soils comprise of 28.57% of the total area.

The *Table 4-3* below gives the % and the area of the type of soil present in the district. *Figure 4-4* below gives the soil map of the district.

Table 4-3: Major soils of the District

Major Soils	Percentage Cover
Deep Black soil	71.43 %
Medium deep soil	5.02 %
Shallow soils	23.55 %

Source: nicra-icar



Source: nicra-icar

Figure 4-4: Soil map of Agar Malwa district

4.2.6 Hydrogeology

The State of Madhya Pradesh has varied hydrogeological characteristics due to which ground water potential differs from place to place. Deccan Trap basaltic rock occupies the entire Shajapur district. A typical flow unit consist of a lower dense massive, horizon passing upwards into a vesicular, amygdaloidal or jointed basalt. At places, top of individual flows are marked by reddish brown clayey material (Red bole) of few cm to 5 m thickness. Usually the red- bole and vesicular basalt are prone to weathering and give rise extensive black cotton soil. There are sixteen basaltic flows which were identified by Geological Survey of India in a vertical column of 275m between altitude of 335 to 610 m amsl) in entire Shajapur district. The various flows of basalts are at times inter-bedded and fossiliferous inter trappen. The description of various lava flows are presented in the *Table 4-4.*

Table 4-4: Type & Thickness of Basaltic Lava Flows in Shajapur District

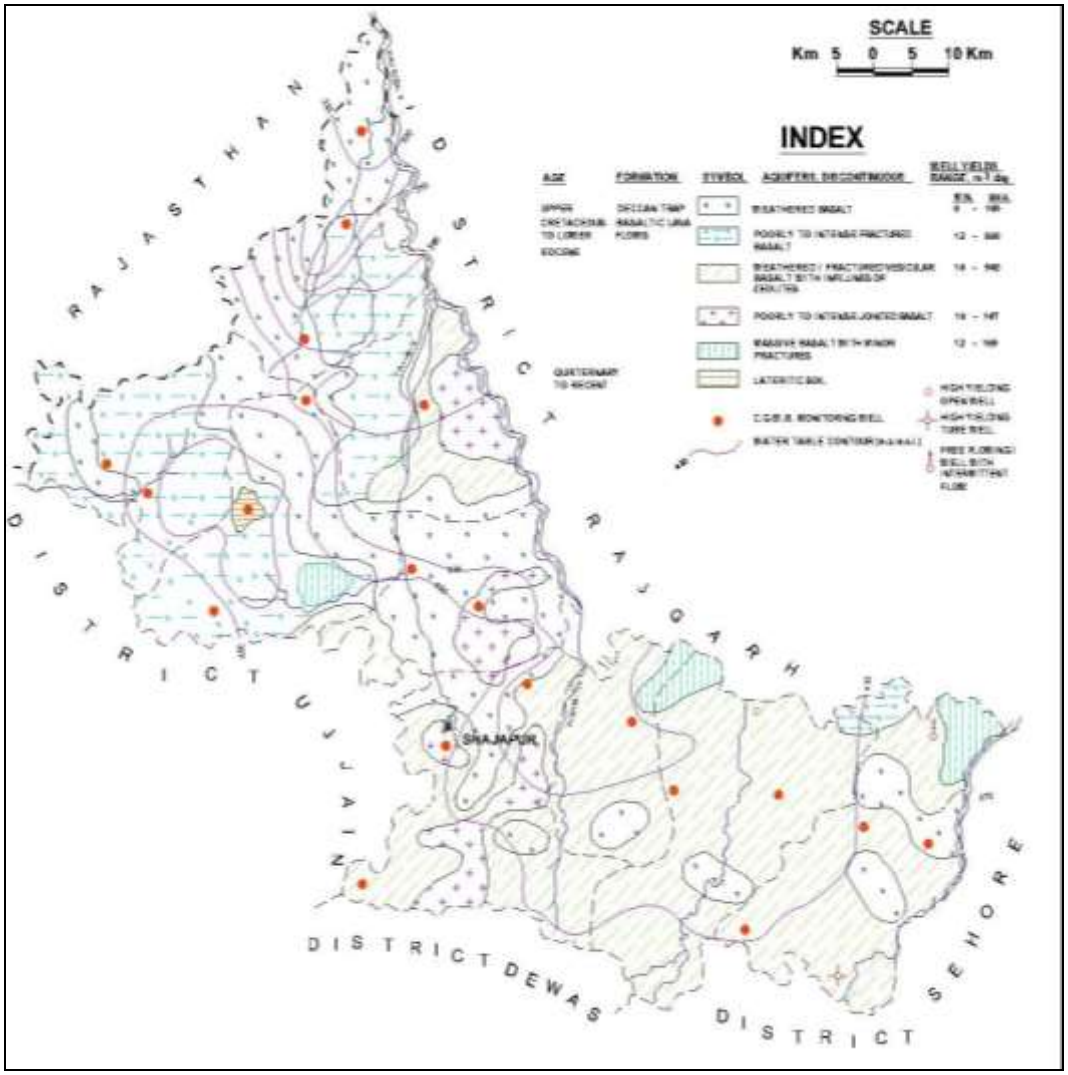
Flow Nos	Thickness	Formation & Description	Age
11 to 16	100m (Elevation above 500m)	Indore Formation, six, fine grained Sparsely porphyritic Aa type flows	Upper cretaceous to lower Eocene
07-10	60M (Elevation 460 m)	Kankariya Purukheri formation, four Aa to Pahoehoe type flows (Fossiliferous inter trappean)	
02-06	100 m (Elevation upper contact at 440-443m)	Kalisindh formation, Five, fine grained sparsely to moderately porphyritic Aa flows	

Flow Nos	Thickness	Formation & Description	Age
00-01	15 M (Elevation 340 m)	Mandleshwar formation fine to medium grained sparely to moderate, porphyric Aa flows	

Source: CGWB- Shajapur

The district lies in the Malwa plateau where the basaltic rocks of the Deccan lava are the predominant formations. These Deccan traps are the most important aquifers in the region. The weathered, fractured, jointed and vesicular units of basalts form moderate to good aquifers. These formations have highly variable yields ranging from 10 to 750 m^3/d. Dugwells range in depth from 4 to 20 m with water levels varying between 2 and 14 mbgl. The specific capacity ranges from 50 to 150 lpm/m of drawdown, hydraulic conductivity varies between 5 and 15 m/d and the specific yield is 5-10%.

The Deccan Traps formations can be tapped by dug-cum-bore and drilled wells. It is observed that the yield increases by 5-10 times when 10-15 m bores extending down to the lower vesicular zone are drilled at the base of dugwells. Yields of 400-600 m^3/d can be obtained in this way. In some areas the control of doleritic dykes on occurrence of ground water can be observed. Wells located on the upstream side of these dykes give better yields. Also wells located on tectonic lineaments give better yields.[5]



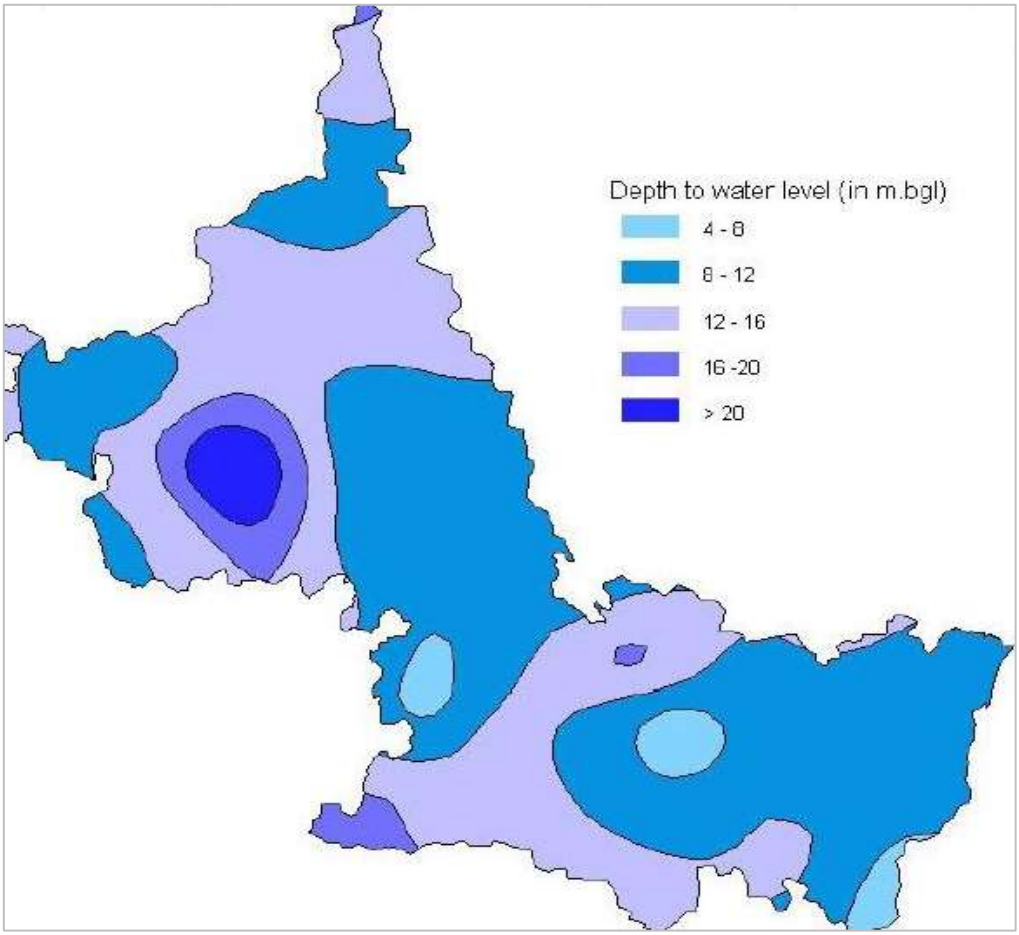
Source: CGWB, Shajapur

Figure 4-5: Hydrogeology of Shajapur District

[5] Ground Water Year book- Madhya Pradesh (2015-2016); Central Ground Water Board, North Central Region, Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India- November 2016

Variation of ground water levels in an area is an important component of Hydrological cycle because of it is a physical reflection of aquifer system. The change in ground water level is directly related to ground water balance and its continuous records provide direct information of sub surface geo environmental changes due to withdrawal of ground water.

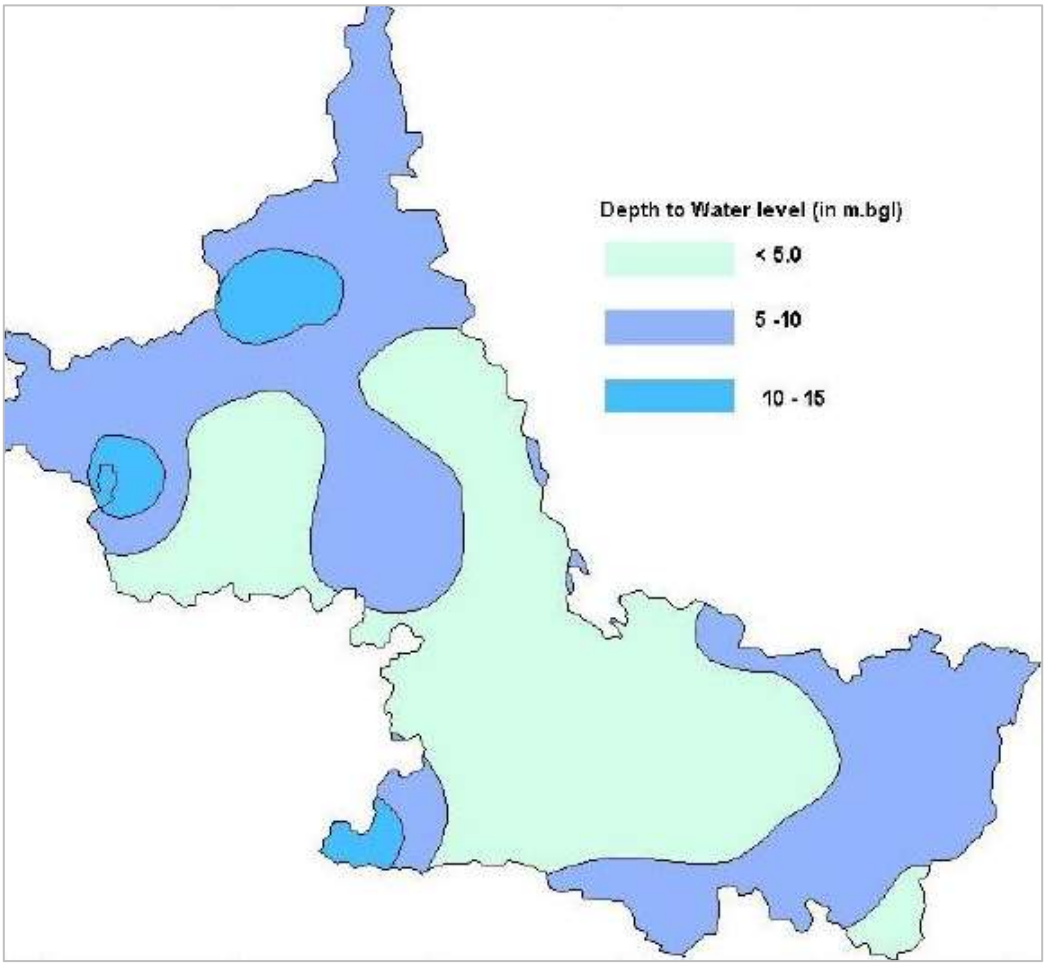
Pre Monsoon (May 2012) - In pre monsoon period, May 2012, depth to water level ranges between 6.90mbgl to 23.40 mbgl. The most part of the district have water level in the range of 8.0 to 12.0 m bgl during the pre-monsoon water level.



Source: CGWB, Shajapur

Figure 4-6: Pre Monsoon Ground water level of the Shajapur District

Post Monsoon (November 2012) - During Post monsoon period November 2012 ,the water level ranges from 1.07 m bgl to 15.08 mbgl. In most part of the district the water level lies within 5.00 mbgl. During post monsoon period, water level between 5-10m bgl occurs in north-western and south-eastern part of the district.



Source: CGWB, Shajapur

Figure 4-7: Post Monsoon Ground water level of the Shajapur District

4.2.7 Climate and Meteorology

The Shajapur district enjoys a mild climate being located on the Malwa plateau. The seasons are well defined. The year may be divided into four seasons. The monsoon breaks by the third or fourth week of June and begins to taper off by September and October. It is warm and humid but the nights begin to get colder from November onwards. The ensuing winter goes upto February with December being the coldest. After February temperature increases steadily with hot and dry summers till mid of June and May generally the hottest month. Winds are generally light which starts strengthening in force during the late summer. Generally winds blow from dilation in between south west and northwest. October and November form the post monsoon or transition period.

4.2.7.1 Temperature

The normal maximum temperature recorded during the month of May is 44.6°C and minimum during the month of January 8.8°C. The normal annual means maximum and minimum temperature of Shajapur district is 44.6°C and 13.9°C respectively.

Table 4-5: Temperature Records for Shajapur District (1981-2010)

		Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Temperature	Max	30.8	34.3	39.2	42.7	44.6	43.2	36.7	33.7	35.6	36.4	33.6	30.8	44.6
	Min	8.8	5.5	10	15.9	21.2	22.1	21.6	21.5	19.7	12.7	8.3	4.8	13.9

Source: Climatological Norms (1981-2010)

4.2.7.2 Humidity

Humidity in district ranges from 18 - 86%. The average humidity in the district usually ranges between 43% and 61%.

Table 4-6: Relative humidity for the Shajapur district (1981-2010)

		Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Relative Humidity	Max	69	57	44	33	42	63	81	86	79	62	59	65	61
	Min	43	33	24	18	22	43	67	76	65	43	43	46	43

Source: Climatological Norms (1981-2010)

4.2.7.3 Rainfall

As per records of rainfall (2005 to 2009), the average rainfall in the district was 733.9 mm in (2005-2006), 977.2 mm (in 2006-2007), 951.0 mm (in 2007-2008) and 688.8 mm (in 2008-2009). The highest annual rainfall was recorded in the year 2007-2008 which was 951.0 mm and the lowest rainfall was 688.8 in the year 2008-2009.

Table 4-7: Rainfall for Shajapur District (1981-2010)

	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Rainy Days	0.6	0.3	0.3	0.51	1.1	4.8	9.3	10.6	6	1.6	0.7	0.4	-
Rainfall (mm)	8	4.2	1.6	3	11.4	95.1	239.4	318.3	126.8	24.9	10.6	4.5	847.7

Source: Climatological Norms (1981-2010)

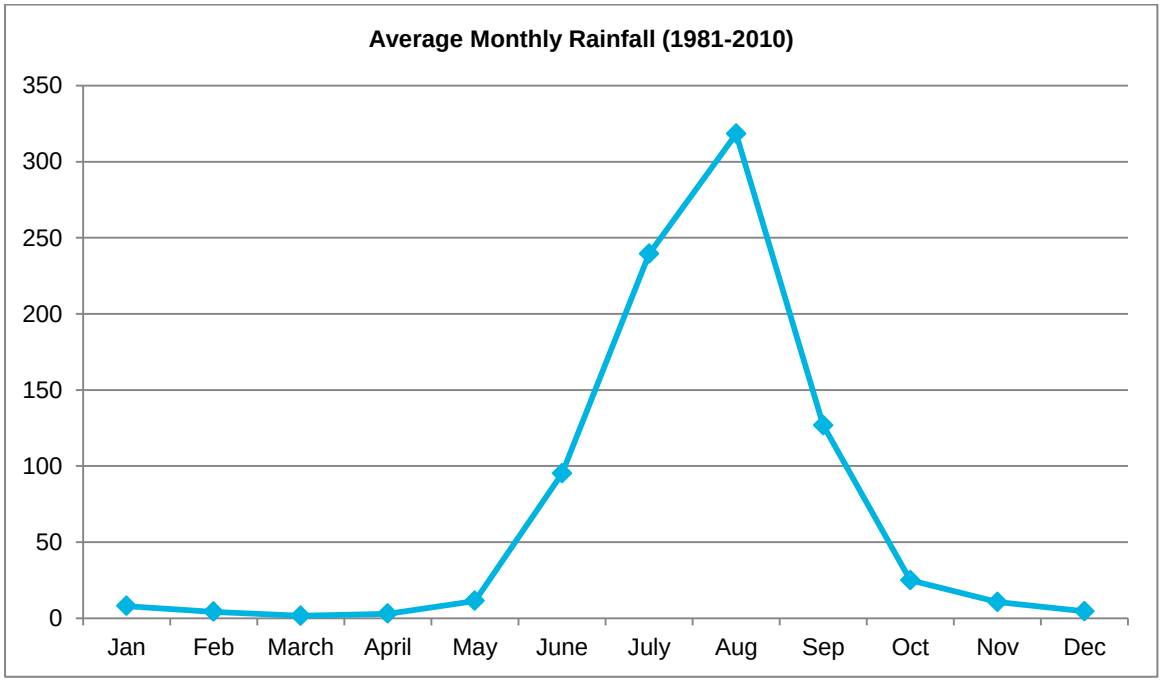


Figure 4-8: Average Monthly Rainfall of District

4.2.7.4 Wind Speed

The average annual wind speed in the District is 4.2 kmph. *Table 4-8* below gives the monthly values of the wind speed. These details have been retrieved from the climatological norms.

Table 4-8: Wind Speed Records for Shajapur District

	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Avg

	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Mean Wind Speed (kmph)	2.4	2.8	3.5	4.9	6.5	7.3	7	5.7	3.9	2.2	2	1.8	4.2

Source: Climatological Norms (1981-2010

4.2.8 Water Environment

Ground Water Quality in Shajapur district is assessed annually by CGWB on the basis of water samples collected from hydrographs stations in the district. Ground water in the district is generally medium to high saline as electric conductivity values ranges between 825 – 2530 µS/cm.

Constituents like Sulphate, Calcium and Magnesium were within the safe limit for drinking water as per BIS standards. Nitrate in the ground water of Shajapur is varying between 36 - 270 mg/l. High nitrate in the village area appears due to excessive use of fertilizers and agricultural waste. Ground water in the district at many places is saline and due care is needed before its use.

Ground Water Quality for Irrigation
High SAR is not good for irrigation as it lead to Sodium hazards. Water samples in the district generally fall in C2S1, C3S1 and C4S1 classes of US Salinity diagram. However, ground water in the district is generally safe for irrigation but proper drainage system is required where EC is more than 1500 µS/cm.

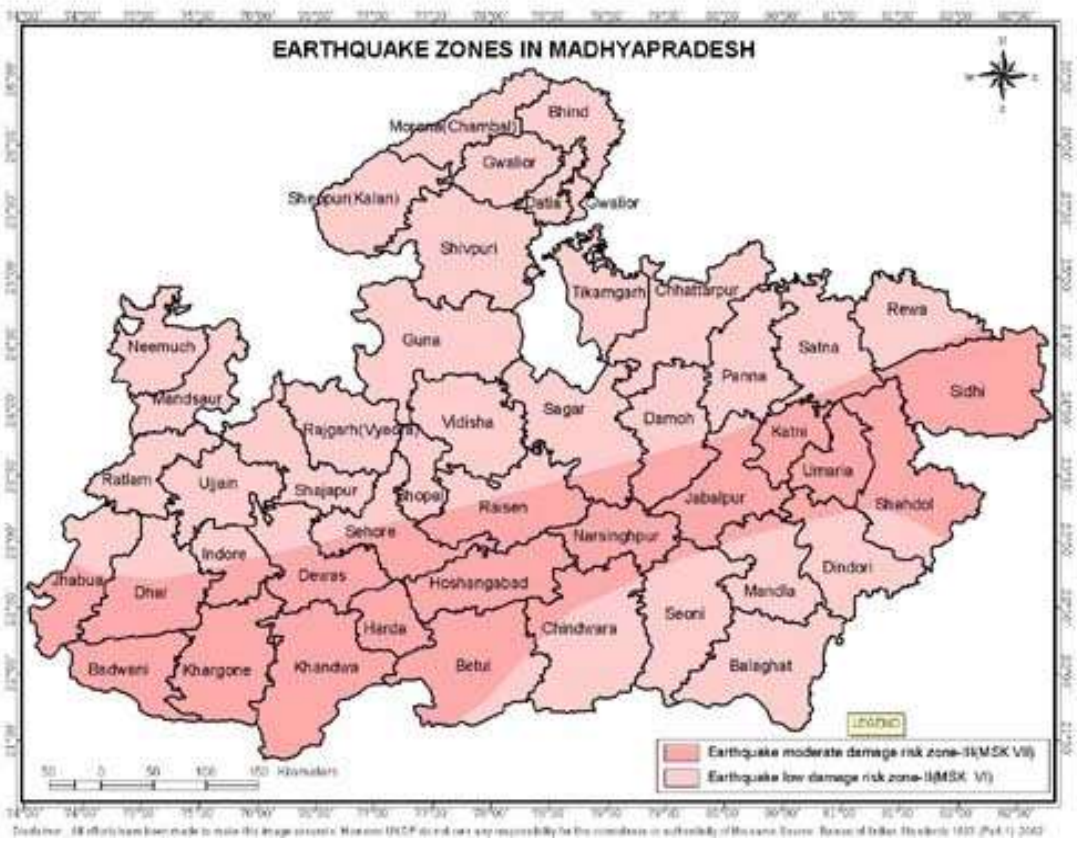
Geogenic problems
Fluoride in the district ranges between 0.01-1.45 in phreatic aquifers and is below 1.50 mg/l. More than 1.50 mg/l is responsible for bone deformation. Due care is needed to use ground water for drinking where, fluoride concentration is more than 1.50 mg/l in deeper aquifers. No Arsenic has been detected in the district.

4.2.9 Natural Hazards

The State of Madhya Pradesh is vulnerable to natural and manmade disasters owning to its unique geo-climatic features and the industrial establishments. The major applicable natural hazards for the State are earthquake, floods, drought, fire etc. Currently the state is separated into 10 divisions, 51 districts out of that, there are 29 districts that come under Zone –III and 22 districts come under Zone – II of Earthquake. Likewise in last 30 years there are 32 districts of the State affected from the flood and around 7 districts highly affected from drought. Other than the Natural disasters, the State is also vulnerable to manmade disasters.

4.2.9.1 Earthquake

Agar District (part of Shajapur district) comes under Zone-II i.e. low damage risk zone. As per the seismic zoning classification of India, this region is liable to MSK VI or less.



Source: Madhya Pradesh State Disaster Management Authority[6]

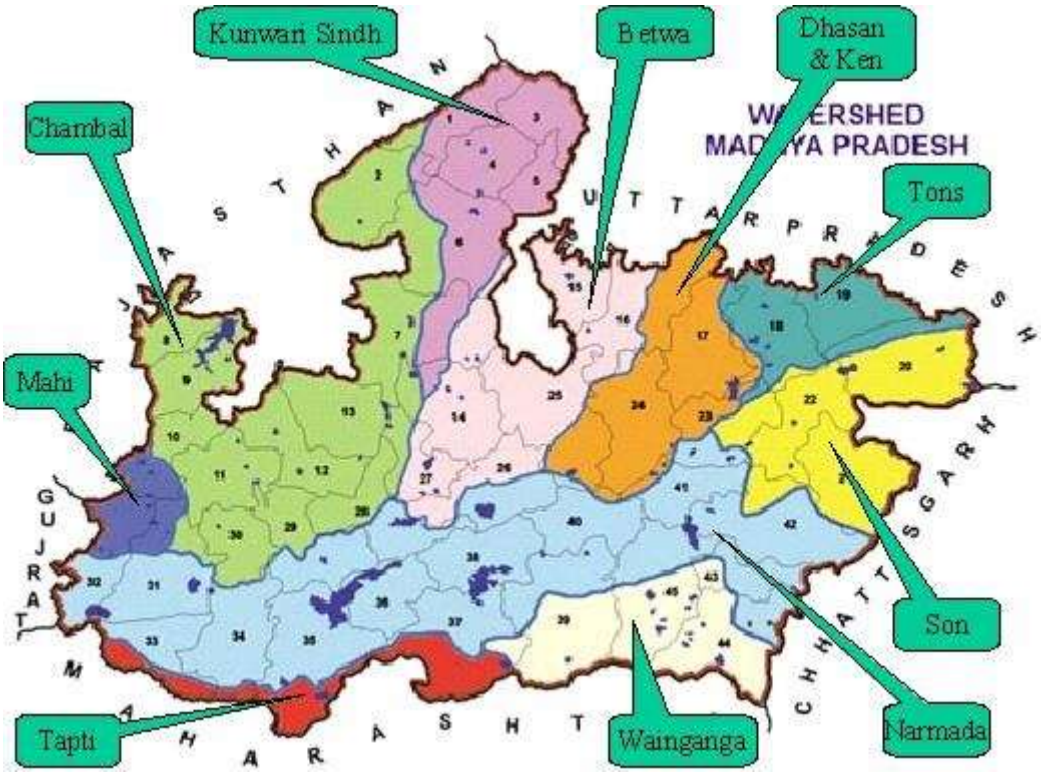
Figure 4-9: Earthquake Prone areas of Madhya Pradesh

4.2.9.2 Flood

Flood is more prone to Shajapur, Shujalpur and Kalapeepal districts because these areas are more close to the rivers and dams are also situated in these districts only. Till now there are major flood disaster occurred in these areas but these areas are vulnerable to the flood and may impact hard during disaster stage.

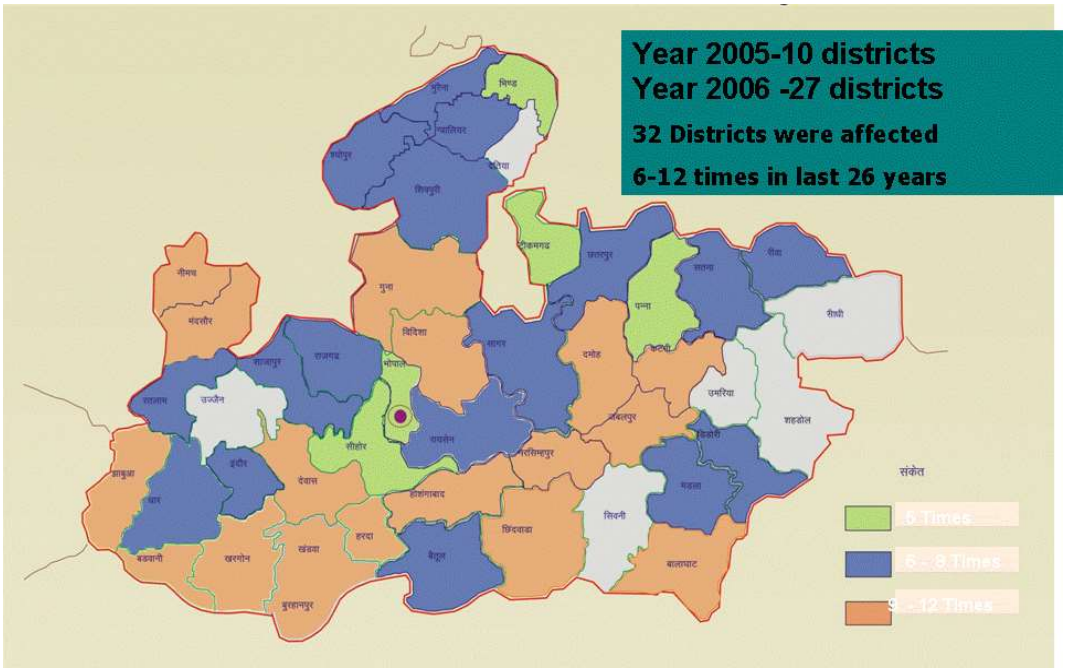
In the year 2005, about 10 districts and in year 2006 about 27 districts were affected by flood. In last 26 years there are 32 districts affected from the flood in the state. *Figure 4-11* shows the project district affected by Chambal drainage.

[6] http://www.mpsdma.mp.gov.in/wp-content/uploads/2015/06/Earthquack.jpg



Source: MPSDMA, http://www.mpsdma.mp.gov.in/floods-2/

Figure 4-10: Flood Prone areas of Madhya Pradesh



Source: MSDMA, nidm- Madhya Pradesh

Figure 4-11: Flood Affected District of the State

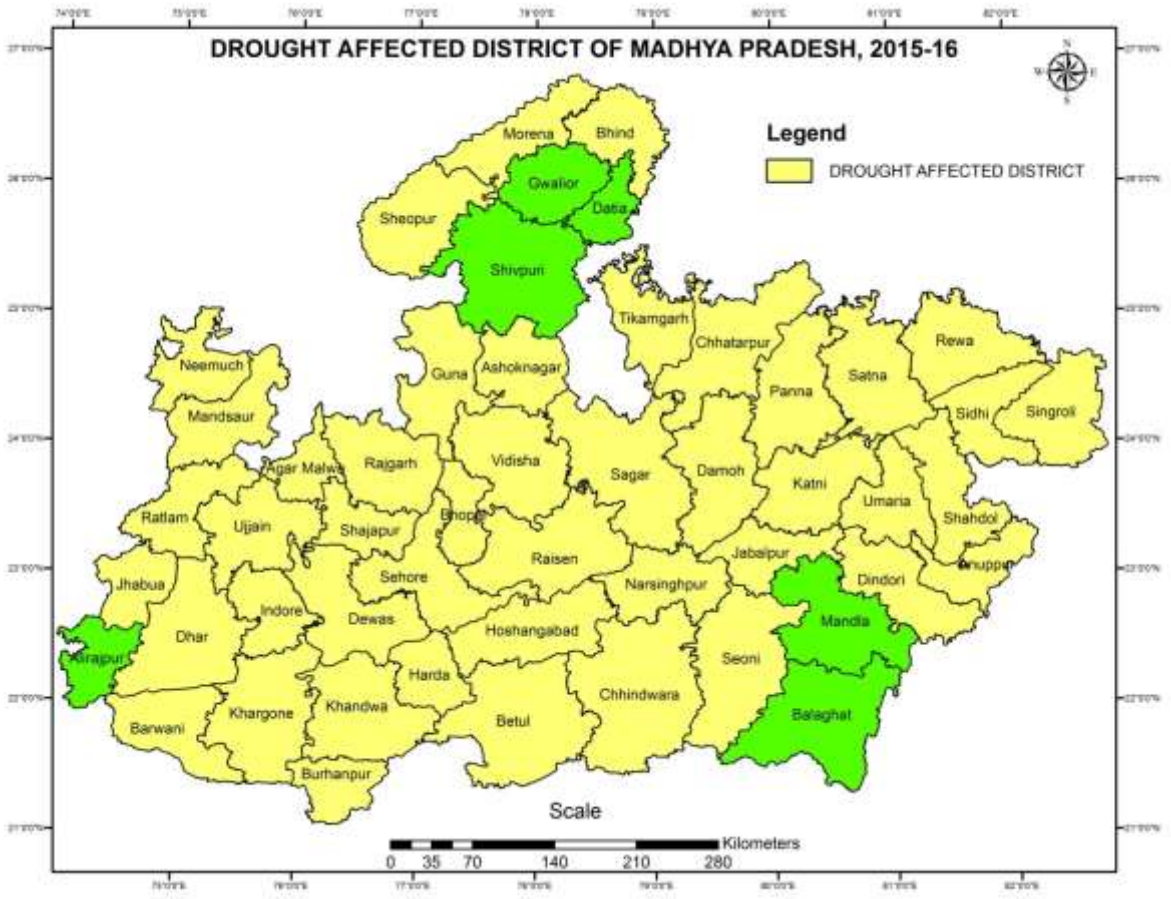
4.2.9.3 Drought

Indian Meteorological Department (IMD) defines the Meteorological Drought as a situation that occurs when a land area receives a mean annual rainfall less than 75% of the normal rainfall. IMD has further classified droughts into broad categories as a) severe drought-when the deficiency of rainfall exceeds 50% of the normal rainfall and b) moderate drought when the deficiency of rainfall is between 25 and 50% of the normal rainfall.

With the vast expanse, geographical features and varying climate conditions, different parts of the State have been perennially prone to drought conditions. Several districts of Madhya Pradesh have been facing a drought situation repeatedly every year. During 2007-08, 39 out of 50 districts (165 Tehsils and one cluster) of Madhya Pradesh have been declared as drought affected. The State has faced drought in the nine out of last ten years. Though irrigated area has increased substantially in the State, yet production in almost 70% agriculture area remains highly dependent on rainfall. Around 7 districts highly affected from drought.

Agar Malwa district experiences uncertain rainfall pattern due to which the district faces drought situation. The impact of drought is mainly felt by farmers because it majorly harms crops, and also the scarcity of drinking water arises for the local population.

Figure 4-12 shows the drought affected districts of Madhya Pradesh in year 2015-16.



Source: http://www.mpsdma.mp.gov.in/drought/

Figure 4-12: Drought affected Districts of the State

4.2.9.4 Seasonality of Hazards

The *Table 4-9* suggests the various periods in a year in which the natural disasters may affect the state of Madhya Pradesh.

Table 4-9: Seasonality of hazards

Hazards	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Flood						→	→	→				
Drought	→	→	→	→	→	→	→	→	→	→	→	→
Loo			→	→	→	→						
Frost	→	→										→

Hazards	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Hailstrom	→	→										→
Earthquake	→	→	→	→	→	→	→	→	→	→	→	→

Source: Shajapur District Disaster Management Plan

4.2.10 Ecology

The ecological assessment for the study area is based on secondary data gathered from past studies conducted by AECOM for similar projects in the study area and surrounding region.

4.2.10.1 Floral Profile

The study area falls within the Agar district (formerly Shajapur district) of Madhya Pradesh. As per the Forest Survey of India report of 1999, there are four types of forest in Madhya Pradesh, namely, the Tropical Moist Deciduous, Tropical Dry Deciduous, Tropical Thorn and Subtropical Broadleaf Hill Forests. The central, southern and eastern parts of the State have a better forest cover than the northern and western parts, which are deficient in forest vegetation. Teak and Sal are the two most important forest formations of the State, covering 18.0% and 16.7% forest area respectively, while miscellaneous forests cover 65.3% of the total forest area. Forest map of Madhya Pradesh is presented in *Figure 4-13* below.

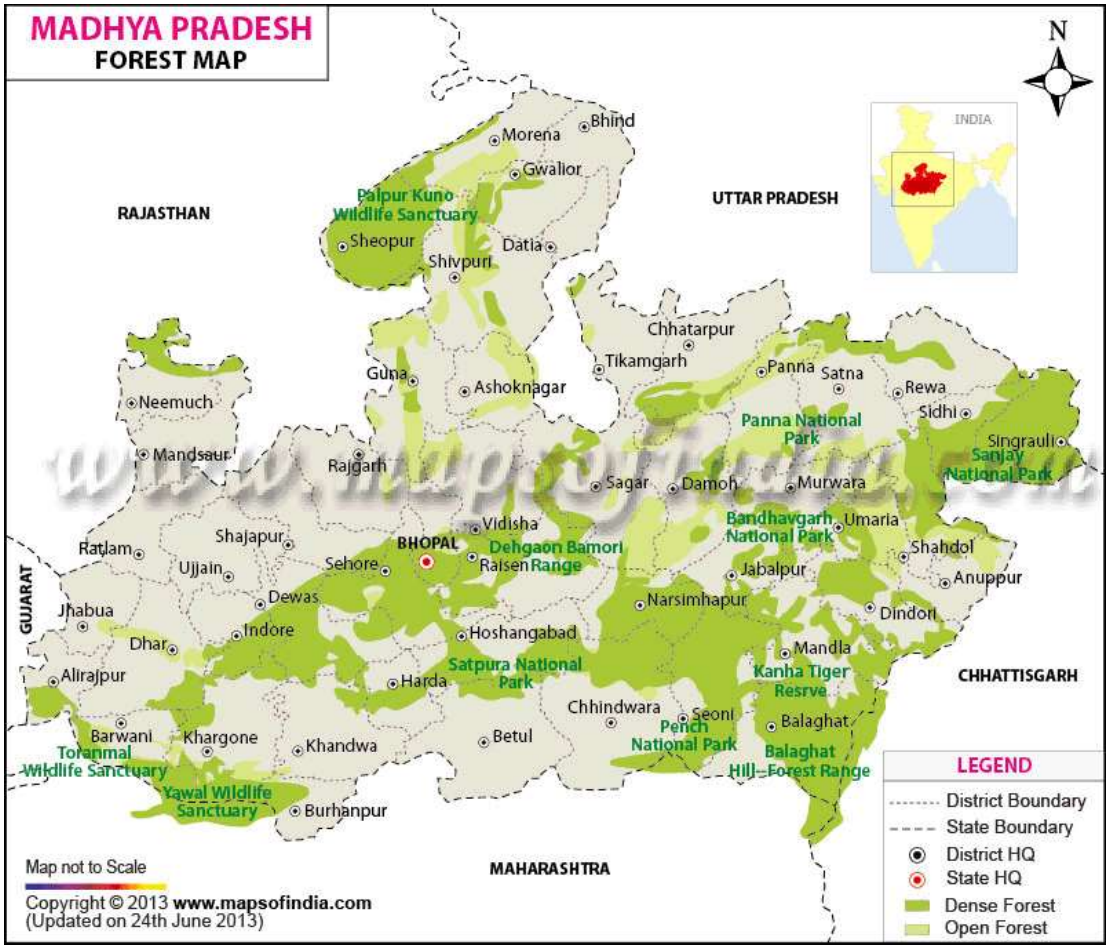


Figure 4-13: Forest Cover Map of Madhya Pradesh

The list of plant species (trees, shrubs, herbs and climbers) commonly present in the region in which the study area is located is presented in *Table 4-10* below.

Table 4-10: List of Plant Species Reported in the Region

Sr. No	Species	Type
1.	*Abutilon sp.*	Shrub

Sr. No	Species	Type
2.	*Acacia auriculiformis*	Tree
3.	*Acacia catechu*	Tree
4.	*Acacia leucophloea*	Tree
5.	*Acacia nilotica*	Tree
6.	*Acacia pennata*	Climber
7.	*Adansonia digitata*	Tree
8.	*Ailanthus excelsa*	Tree
9.	*Albizzia lebbek*	Tree
10.	*Albizzia procera*	Tree
11.	*Alstonia scholaris*	Tree
12.	*Anogeissus latifolia*	Tree
13.	*Anona squamosa*	Tree
14.	*Azadirachta indica*	Tree
15.	*Balanites aegyptica*	Tree
16.	*Bauhinia purpurea*	Tree
17.	*Bauhinia racemosa*	Tree
18.	*Bombax ceiba*	Tree
19.	*Bougainvillea sp.*	Climber
20.	*Butea monosperma*	Tree
21.	*Calotropis gigantea*	Shrub
22.	*Capparis zeylanica*	Climber
23.	*Carissa sp.*	Shrub
24.	*Cassia fistula*	Tree
25.	*Cassia siamea*	Tree
26.	*Cassia sp.*	Shrub
27.	*Clerodendron phlomidis*	Shrub
28.	*Cocos nucifera*	Tree
29.	*Corchorus sp.*	Shrub
30.	*Cordia dichotoma*	Tree
31.	*Dalbergia sissoo*	Tree
32.	*Delonix regia*	Tree
33.	*Diospyros tomentosa*	Tree
34.	*Dendrocalamus strictus*	Bamboo
35.	*Emblica officinalis*	Tree
36.	*Erythrina suberosa*	Tree
37.	*Eucalyptus sp.*	Tree
38.	*Ficus benghalensis*	Tree
39.	*Ficus glomerata*	Tree
40.	*Ficus religiosa*	Tree
41.	*Gardenia latifolia*	Tree
42.	*Grewia tiliaefolia*	Tree
43.	*Hibiscus tetraphyllus*	Shrub
44.	*Ipomoea carnea*	Shrub
45.	*Jatropha curcas*	Tree
46.	*Jatropha gossypifolia*	Shrub
47.	*Lagerstroemia parviflora*	Tree

Sr. No	Species	Type
48.	*Lantana camara*	Shrub
49.	*Lawsonia alba*	Shrub
50.	*Limonia acidissima*	Tree
51.	*Mangifera indica*	Tree
52.	*Melia azedarach*	Tree
53.	*Moringa oleifera*	Tree
54.	*Phoenix sylvestris*	Tree
55.	*Pithecolobium dulce*	Tree
56.	*Polyalthia longifolia*	Tree
57.	*Pongamia pinnata*	Tree
58.	*Prosopis cineraria*	Tree
59.	*Psidium guyava*	Tree
60.	*Pterocarpus marsupium*	Tree
61.	*Ricinus communis*	Shrub
62.	*Santalum album*	Tree
63.	*Sesbania bispinosa*	Shrub
64.	*Syzigium cumini*	Tree
65.	*Tamarindus indica*	Tree
66.	*Tectona grandis*	Tree
67.	*Terminalia arjuna*	Tree
68.	*Terminalia bellerica*	Tree
69.	*Terminalia tomentosa*	Tree
70.	*Ventilago calyculata*	Climber
71.	*Ziziphus mauritiana*	Tree
72.	*Ziziphus nummularia*	Shrub
73.	*Ziziphus oenoplia*	Shrub

4.2.10.2 Avifaunal Profile

The study area harbours a large number of bird species, some of which are listed in *Table 4-11* below.

Table 4-11: List of Birds associated with the study area

S.N.	Common Name	Scientific Name
1.	Grey Francolin	*Francolinus pondicerianus*
2.	Indian Peafowl	*Pavo cristatus*
3.	Spot-billed Duck	*Anas poecilorhyncha*
4.	Ferruginous Pochard	*Athya nyroca*
5.	Indian Grey Hornbill	*Ocyceros birostris*
6.	Common Hoopoe	*Upupa epops*
7.	Indian Roller	*Coracias benghalensis*
8.	Common Kingfisher	*Alcedo atthis*
9.	White-throated Kingfisher	*Halcyon smyrnensis*
10.	Green Bee-eater	*Merops orientalis*
11.	Asian Koel	*Eudynamys scolopacea*
12.	Greater Coucal	*Centropus sinensis*
13.	Rose-ringed Parakeet	*Psittacula krameri*
14.	House Swift	*Apus affinis*
15.	Rock Pigeon	*Columba livia*
16.	Laughing Dove	*Streptopelia senegalensis*
17.	Eurasian Collared Dove	*Streptopelia decaocto*

S.N.	Common Name	Scientific Name
18.	Common Coot	*Fulica atra*
19.	Common Snipe	*Gallinago gallinago*
20.	Common Greenshank	*Tringa nebularia*
21.	Common Sandpiper	*Actitis hypoleucos*
22.	Black-winged Stilt	*Himantopus himantopus*
23.	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
24.	Red-wattled Lapwing	*Vanellus indicus*
25.	Black-shouldered Kite	*Elanus caeruleus*
26.	Black Kite	*Milvus migrans*
27.	Short-toed Snake Eagle	*Circaetus gallicus*
28.	Eurasian Marsh Harrier	*Circus aeruginosus*
29.	Montagu's Harrier	*Circus pygargus*
30.	Shikra	*Accipiter badius*
31.	White-eyed Buzzard	*Butaster teesa*
32.	Steppe Eagle	*Aquila nipalensis*
33.	Common Kestrel	*Falco tinnunculus*
34.	Laggar Falcon	*Falco jugger*
35.	Little Grebe	*Tachybaptus ruficollis*
36.	Little Cormorant	*Phalacrocorax niger*
37.	Little Egret	*Egretta garzetta*
38.	Intermediate Egret	*Mesophoyx intermedia*
39.	Cattle Egret	*Bubulcus ibis*
40.	Indian Pond Heron	*Ardeola grayii*
41.	Grey Heron	*Ardea cinerea*
42.	Asian Openbill	*Anastomus oscitans*
43.	Bay-backed Shrike	*Lanius vittatus*
44.	Long-tailed Shrike	*Lanius schach*
45.	Southern Grey Shrike	*Lanius meridionalis*
46.	House Crow	*Corvus splendens*
47.	Large-billed Crow	*Corvus macrorhynchos*
48.	White-browed Fantail	*Rhipidura aureola*
49.	Black Drongo	*Dicrurus macrocercus*
50.	Common Iora	*Aegithina tiphia*
51.	Rusty-tailed Flycatcher	*Muscicapa ruficauda*
52.	Red-throated Flycatcher	*Ficedula parva*
53.	Oriental Magpie Robin	*Copsychus saularis*
54.	Indian Robin	*Saxicoloides fulicata*
55.	Common Stonechat	*Saxicola torquata*
56.	Pied Bushchat	*Saxicola caprata*
57.	Brahminy Starling	*Sturnus pagodarum*
58.	Rosy Starling	*Sturnus roseus*
59.	Asian Pied Starling	*Sturnus contra*
60.	Common Myna	*Acridotheres tristis*
61.	Red-rumped Swallow	*Hirundo daurica*
62.	Red-vented Bulbul	*Pycnonotus cafer*
63.	Plain Prinia	*Prinia inornata*
64.	Ashy Prinia	*Prinia socialis*
65.	Blyth's Reed Warbler	*Acrocephalus dumetorum*
66.	Common Tailorbird	*Orthotomus sutorius*
67.	Common Babbler	*Turdoides caudatus*
68.	Large Grey Babbler	*Turdoides malcolmi*
69.	Jungle Babbler	*Turdoides striatus*
70.	Ashy-crowned Sparrow Lark	*Eremopteryx grisea*
71.	Rufous-tailed Lark	*Ammomanes phoenicurus*
72.	Greater Short-toed Lark	*Calandrella brachydactyla*
73.	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*

S.N.	Common Name	Scientific Name
74.	Purple Sunbird	*Nectarinia asiatica*
75.	House Sparrow	*Passer domesticus*
76.	Chestnut-shouldered Petronia	*Petronia xanthocollis*
77.	White-browed Wagtail	*Motacilla maderaspatensis*
78.	Citrine Wagtail	*Motacilla citreola*
79.	Baya Weaver	*Ploceus philippinus*

4.2.10.3 Migratory Avifauna

The study area does not coincide with any known major avian migratory flyway. However the study area is known to be a destination for few summer and winter visitors, as also, part of the passage traversed by migratory birds headed elsewhere. Migratory species known to be associated with the region in which the study area is located are listed in *Table 4-12* below.

Table 4-12: List of Migratory species reported in the region

S.N.	Common Name	Scientific Name	Type
1.	Common Quail	*Coturnix coturnix*	Winter Visitor
2.	Greylag Goose	*Anser anser*	Winter Visitor
3.	Ruddy Shelduck	*Tadorna ferruginea*	Winter Visitor
4.	Gadwall	*Anas strepera*	Winter Visitor
5.	Eurasian Wigeon	*Anas penelope*	Winter Visitor
6.	Mallard	*Anas platyrhynchos*	Winter Visitor
7.	Common Teal	*Anas crecca*	Winter Visitor
8.	Garganey	*Anas querquedula*	Winter Visitor
9.	Northern Pintail	*Anas acuta*	Winter Visitor
10.	Northern Shoveler	*Anas clypeata*	Winter Visitor
11.	Red-crested Pochard	*Rhodonessa rufina*	Winter Visitor
12.	Ferruginous Pochard	*Aythya nyroca*	Winter Visitor
13.	Tufted Duck	*Aythya fuligula*	Winter Visitor
14.	Eurasian Wryneck	*Jynx torquilla*	Winter Visitor
15.	Common Hoopoe	*Upupa epops*	Winter Visitor
16.	European Roller	*Coracias garrulus*	Passage Visitor
17.	Blue-cheeked Bee-eater	*Merops persicus*	Passage Visitor
18.	Blue-tailed Bee-eater	*Merops philippinus*	Winter Visitor
19.	Pied Cuckoo	*Clamator jacobinus*	Summer Visitor
20.	Short-eared Owl	*Asio flammeus*	Winter Visitor
21.	Oriental Turtle Dove	*Streptopelia orientalis*	Winter Visitor
22.	Demoiselle Crane	*Grus virgo*	Winter Visitor
23.	Common Crane	*Grus grus*	Winter Visitor
24.	Little Crake	*Porzana parva*	Winter Visitor
25.	Baillon's Crake	*Porzana pusilla*	Winter Visitor
26.	Spotted Crake	*Porzana porzana*	Winter Visitor
27.	Pintail Snipe	*Gallinago stenura*	Winter Visitor
28.	Common Snipe	*Gallinago gallinago*	Winter Visitor
29.	Jack Snipe	*Lymnocryptes minimus*	Winter Visitor
30.	Black-tailed Godwit	*Limosa limosa*	Winter Visitor
31.	Spotted Redshank	*Tringa erythropus*	Winter Visitor
32.	Common Redshank	*Tringa tetanus*	Winter Visitor
33.	Marsh Sandpiper	*Tringa stagnatilis*	Winter Visitor

S.N.	Common Name	Scientific Name	Type
34.	Common Greenshank	*Tringa nebularia*	Winter Visitor
35.	Green Sandpiper	*Tringa ochropus*	Winter Visitor
36.	Wood Sandpiper	*Tringa glareola*	Winter Visitor
37.	Common Sandpiper	*Actitis hypoleucos*	Winter Visitor
38.	Little Stint	*Calidris minuta*	Winter Visitor
39.	Temminck's Stint	*Calidris temminckii*	Winter Visitor
40.	Dunlin	*Calidris alpine*	Winter Visitor
41.	Ruff	*Philomachus pugnax*	Winter Visitor
42.	Kentish Plover	*Charadrius alexandrinus*	Winter Visitor
43.	Sociable Lapwing	*Vanellus gregarius*	Winter Visitor
44.	White-tailed Lapwing	*Vanellus leucurus*	Winter Visitor
45.	Little Tern	*Sterna albifrons*	Winter Visitor
46.	Whiskered Tern	*Chlidonias hybridus*	Winter Visitor
47.	Eurasian Griffon	*Gyps fulvus*	Winter Visitor
48.	Eurasian Marsh Harrier	*Circus aeruginosus*	Winter Visitor
49.	Pallid Harrier	*Circus macrourus*	Winter Visitor
50.	Montagu's Harrier	*Circus pygargus*	Winter Visitor
51.	Steppe Eagle	*Aquila nipalensis*	Winter Visitor
52.	Booted Eagle	*Hieraaetus pennatus*	Winter Visitor
53.	Common Kestrel	*Falco tinnunculus*	Winter Visitor
54.	Great Crested Grebe	*Podiceps cristatus*	Winter Visitor
55.	Grey Heron	*Ardea cinerea*	Winter Visitor
56.	Great Bittern	*Botaurus stellaris*	Winter Visitor
57.	Greater Flamingo	*Phoenicopterus rubber*	Passage Visitor
58.	Glossy Ibis	*Plegadis falcinellus*	Passage Visitor
59.	Black-necked Stork	*Ephippiorhynchus asiaticus*	Winter Visitor
60.	Indian Pitta	*Pitta brachyura*	Summer Visitor
61.	Rufous-tailed Shrike	*Lanius isabellinus*	Winter Visitor
62.	Brown Shrike	*Lanius cristatus*	Winter Visitor
63.	Ashy Drongo	*Dicrurus leucophaeus*	Winter Visitor
64.	Asian Paradise Flycatcher	*Terpsiphone paradisi*	Summer/Passage Visitor
65.	Blue Rock-Thrush	*Monticola solitarius*	Winter Visitor
66.	Dark-throated thrush	*Turdus ruficollis*	Winter Visitor
67.	Red-throated Flycatcher	*Ficedula parva*	Winter Visitor
68.	Verditer Flycatcher	*Eumyias thalassina*	Winter Visitor
69.	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Winter Visitor
70.	Bluethroat	*Luscinia svecica*	Winter Visitor
71.	Black Redstart	*Phoenicurus ochruros*	Winter Visitor
72.	Common Stonechat	*Saxicola torquata*	Winter visitor
73.	Pied Bushchat	*Saxicola caprata*	Winter Visitor
74.	Variable Wheatear	*Oenanthe picata*	Winter Visitor
75.	Desert Wheatear	*Oenanthe deserti*	Winter Visitor
76.	Isabelline Wheatear	*Oenanthe isabellina*	Winter Visitor
77.	Rosy Starling	*Sturnus roseus*	Passage Visitor
78.	Common Starling	*Sturnus vulgaris*	Winter Visitor
79.	Sand Martin	*Riparia riparia*	Winter Visitor

S.N.	Common Name	Scientific Name	Type
80.	Barn Swallow	*Hirundo rustica*	Winter Visitor
81.	Booted Warbler	*Hippolais caligata*	Passage Visitor
82.	Lesser Whitethroat	*Sylvia curruca*	Winter Visitor
83.	Orphean Warbler	*Sylvia hortensis*	Winter Visitor
84.	Common Chiffchaff	*Phylloscopus collybita*	Winter Visitor
85.	Greater Short-toed Lark	*Calandrella brachydactyla*	Winter Visitor
86.	White Wagtail	*Motacilla alba*	Winter Visitor
87.	Citrine Wagtail	*Motacilla citreola*	Winter Visitor
88.	Yellow Wagtail	*Motacilla flava*	Winter Visitor
89.	Grey Wagtail	*Motacilla cinerea*	Winter Visitor
90.	Richard's Pipit	*Anthus richardi*	Winter Visitor
91.	Tawny Pipit	*Anthus campestris*	Winter Visitor
92.	Blyth's Pipit	*Anthus godlewski*	Winter Visitor
93.	Long-billed Pipit	*Anthus similis*	Winter Visitor
94.	Tree Pipit	*Anthus trivialis*	Winter Visitor
95.	Common Rosefinch	*Carpodacus erythrinus*	Winter Visitor
96.	Grey-necked Bunting	*Emberiza buchanani*	Winter Visitor
97.	Black-headed Bunting	*Emberiza melanocephala*	Winter Visitor
98.	Red-headed Bunting	*Emberiza bruniceps*	Winter Visitor

The project site does not have dense vegetation or forest cover to provide roosting /nesting areas. No large water bodies are present within the project area which may serve as staging-point for migratory birds.

4.2.10.4 Protected Higher Fauna

The following higher faunal species protected under the Wildlife Protection Act – Schedules I & II are associated with the region in which the study area is located:

Table 4-13: List of Protected Higher Fauna reported in the region

S.N.	Name	Scientific Name	IUCN* / WPA** Status
1.	Rhesus Macaque	*Macaca mulatta*	LR / II
2.	Hanuman Langur	*Semnopithecus entellus*	LR / II
3.	Blackbuck	*Antelope cervicapra*	V / I
4.	Four-horned Antelope	*Tetracerus quadricornis*	V / I
5.	Indian Gazelle	*Gazella bennettii*	LR / I
6.	Jackal	*Canis aureus*	LR / II
7.	Wolf	*Canis lupus*	DD / I
8.	Indian Fox	*Vulpes benghalensis*	LR / II
9.	Common Leopard	*Panthera pardus*	LR / I
10.	Jungle Cat	*Felis chaus*	LR / II
11.	Leopard Cat	*Prionailurus bengalensis*	V / I
12.	Rusty Spotted Cat	*Prionailurus rubiginosus*	V / I
13.	Honey Badger	*Mellivora capensis*	LR / I
14.	Smooth-coated Otter	*Lutrogale perspicillata*	-- / II
15.	Small Indian Civet	*Viverricula indica*	LR / II
16.	Common Palm Civet	*Paradoxurus hermaphroditus*	LR / II
17.	Grey Mongoose	*Herpestes edwardsii*	LC / II
18.	Ruddy Mongoose	*Herpestes smithii*	LC / II

S.N.	Name	Scientific Name	IUCN* / WPA** Status
19.	Indian Pangolin	*Manis crassicaudata*	LR / I
20.	Indian Peafowl	*Pavo cristatus*	LC / I
21.	Lesser Florican	*Sypheotides indica*	E / I
22.	White-rumped Vulture	*Gyps bengalensis*	CE / I
23.	Long-billed Vulture	*Gyps indicus*	CE / I
24.	Red-headed Vulture	*Sarcogyps calvus*	CE / I
25.	Shikra	*Accipiter badius*	LC / I
26.	Red-necked Falcon	*Falco chicquera*	LC / I
27.	Laggar Falcon	*Falco jugger*	NT / I
28.	Peregrine Falcon	*Falco peregrinus*	LC / I
29.	Eurasian Spoonbill	*Platalea leucorodia*	LC / I
30.	Indian Rock Python	*Python molurus*	NT / II
31.	Olive Keelback Water Snake	*Atretium schistosum*	- / II
32.	Checkered Keelback Water Snake	*Xenochrophis piscator*	- / II
33.	Indian Rat Snake	*Ptyas mucosa*	- / II
34.	Spectacled Cobra	*Naja naja*	- / II
35.	Russell's Viper	*Daboia russelii*	- / II
36.	South Asian Chameleon	*Chamaeleo zeylanicus*	- / II
37.	Bengal Monitor	*Varanus bengalensis*	LC / II
38.	Mugger Crocodile	*Crocodylus paluster*	-- / I
39.	Indian Softshell Turtle	*Aspideretes gangeticus*	- / I
40.	Indian Flapshell Turtle	*Lissemys punctata*	- / I

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where: CE – Critically Endangered, DD – Data Deficient, LC – Least Concern, LR – Lower Risk, E – Endangered, NT – Near Threatened, V – Vulnerable*

****** *Schedule in which declared protected under the Indian Wildlife Protection Act*

4.2.10.5 Endemic Higher Fauna

The few endemic or near-endemic species associated with the region in which the study area is located include: Fulvous Leaf-nosed Bat (*Hipposideros fulvus*) – endemic to the Indian sub-continent, Indian Bustard (*Ardeotis nigriceps*) – endemic to India, Lesser Florican (*Sypheotides indica*) – endemic to the Indian sub-continent, Bristled Grassbird (*Chaetornis striatus*) – endemic to the Indian sub-continent, and Sykes's Lark (*Galerida deva*) – endemic to central and north-western India.

4.2.10.6 Bat Diversity

Though no bat activity was observed during site visit, secondary data suggests the possible presence of the following bat-species in the area.

Table 4-14: List of bat species associated with the region

S.N.	Common Name	Scientific Name
1.	Indian Flying Fox	*Pteropus giganteus*
2.	Fulvous Fruit Bat	*Rousettus leschenaultia*
3.	Lesser Dog-faced Fruit Bat	*Cynopterus brachyotis*
4.	Short-nosed Fruit Bat	*Cynopterus sphinx*
5.	Greater Mouse-tailed Bat	*Rhinopoma microphyllum*
6.	Theobald's Tomb Bat	*Taphozous theobaldi*
7.	Black-bearded Tomb Bat	*Taphozous melanopogon*
8.	Long-winged Tomb Bat	*Taphozous longimanus*

S.N.	Common Name	Scientific Name
9.	Blyth's Horseshoe Bat	*Rhinolophus Lepidus*
10.	Dusky Leaf-nosed Bat	*Hipposideros speoris*
11.	Fulvous Leaf-nosed Bat	*Hipposideros fulvus*
12.	Cantor's Leaf-nosed Bat	*Hipposideros galeritus*
13.	Kelaart's Leaf-nosed Bat	*Hipposideros lankadiva*
14.	Greater False Vampire	*Megaderma lyra*
15.	Hodgson's Bat	*Myotis formosus*
16.	Asiatic Greater Yellow House Bat	*Scotophilus heathii*
17.	Common Pipistrelle	*Pipistrellus ppistrellus*
18.	Indian Pipistrelle	*Pipistrellus coromandra*
19.	Indian Pygmy Bat	*Pipistrellus tenuis*
20.	Kelaart's Pipistrelle	*Pipistrellus ceylonicus*
21.	Dormer's Bat	*Pipistrellus dormeri*
22.	Javan Pipistrelle	*Pipistrellus javanicus*
23.	Chocolate Pipistrelle	*Pipistrellus affinis*

4.2.10.7 Eco-Sensitive Zone

Gandhi Sagar Wildlife Sanctuary

The Gandhi Sagar Wildlife Sanctuary is located at a distance of about 60 km north of the project site. The Sanctuary is spread across a total area of 369 sq. km, and plays home to a variety of flora and fauna. The reservoir has been categorized under "A4iii" criteria, as per the International Bird Conservation Network (IBCN), as the congregation of water birds is reported to exceed 20,000 at some points. The Chambal River passes through the WLS and divides it into two halves.

The Sanctuary is open throughout the year. With a varied terrain of wooded hills – the forest being dry, mixed and deciduous- and flat grasslands around Gandhi Sagar dam submergence, it offers abundant opportunities of sighting a variety of wildlife. The principal tree species found in the Sanctuary are Khair (Acacia catechu), Salai, Kardhai, Dhawda, Tendu, Palash etc.

The predominant wild animal species that inhabits the Sanctuary are the deer, of which the most easily sighted are chinkara or Indian gazelle, nilgai, sambar, leopard, common langur, wild dog, peacock, otter, crocodile etc.

4.2.10.8 Conclusion

The region has been heavily modified by biotic pressures. All possible care should be taken to ensure that turbines or associated infrastructure or human activities do not pose risk to the populations of birds or bats or affect nesting or roosting sites. Care should be taken to maintain natural habitats in good condition in the region, which will support healthy populations of species.

4.3 Socio-economic Environment

4.3.1 Introduction

Socio- economic environment of an area is essential as people are the prime recipients of developmental projects around them. The activities around the area have an impact on the population residing in the area. An understanding of the livelihood activities, social relations and institutions around the area is thereby important to understand the social and economic aspects of the concerned area. Primary research in the form of stakeholder consultations was conducted to understand the perception and degree of engagement with the project. Thereafter, it was followed by secondary research on the social and economic baseline of the area in order to prioritize the requirements and needs of the area to facilitate further development and appropriate contribution to the project area.

The secondary data has been derived from:

1. Primary Census Abstract 2001 and 2011, Office of Registrar and Census Commissioner, Government of India.
2. Brief Industrial Profile of Agar Malwa District, Ministry of MSME, Govt. of India.
3. Agriculture Census of India 2010-11, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India.
4. District website: agarmalwa.nic.in
5. http://www.nicra-icar.in/nicrarevised/images/statewiseplans/madhya%20pradesh/MP51-Agar%20Malwa-07.05.2016.pdf
6. Published articles and papers concerning the District

4.3.2 Project Area

The project area lies in the state of Madhya Pradesh. The Government of Madhya Pradesh (GoMP) has taken note of the growing recognition for impact of climate change at the local, national and global levels and taking lead to this, the GoMP has decided to tap its vast potential for solar energy. The State's New and Renewable Energy Department (NRED) has been promoting solar projects through several measures such as separate solar policy for promotion and implementation of Solar power projects in the state, promotion of manufacturing units in equipment and related ancillaries for solar systems in the state, promotion of Small and Medium Enterprises (SME) sector for manufacturing of various components and systems for solar systems, land allocation preference to solar technology parks, creation of essential facilities for solar technology parks by the government ,single window clearance to solar technology parks for speedy implementation[7]. Madhya Pradesh is endowed with high solar radiation with around 300 days of clear sun. It has the potential of more than 5.5 kWh/sq./per day for installation of solar based power projects[8]. According to the Ministry of Renewable Energy, the commissioning status of solar power projects in Madhya Pradesh as on 31st January 2017 is 850.35 MW.

4.3.3 Profile of Study Area

The project area falls in the Agar Malwa district (erstwhile Shahjapur district). It was bifurcated from the larger Shahjapur district in August 2013 and became the 51st district of Madhya Pradesh. The purpose of the bifurcation was to make administrative functioning more manageable and efficient. Agar Malwa District[9] is situated along the Indore-Kota State Highway (SH) 27 Highway. It is situated between 23.32 and 24.19 north latitude and 75.41 and 77.02 longitude. It is surrounded by Ujjain and Ratlam districts in the south, Rajgarh and Shajapur in the east. The northern boundary is formed with Jhalawar district of Rajasthan. Agar town serves as the district headquarters.

4.3.3.1 Administrative Structure

Agar Malwa district is divided into two (02) revenue sub-divisions of Agar and Susner for administrative purposes. It is divided into four tehsils of Agar, Barod, Susner and Nalkhera and 227 Gram Panchayats with 498 villages under its jurisdiction.

4.3.3.2 Study Area

The study area is spread across two (02) villages of Hatipura and Kishankot villages which fall under the Badod tehsil in the Agar-Malwa District in the state of Madhya Pradesh.

[7] http://www.mpnred.com/Home/SolarOverview.aspx
[8] Madhya Pradesh Solar Policy 2012,
[9] As Agar- Malwa district was formed in 2013, i.e. after the census of 2011, district level census data is unavailable. For the purpose of study, limited district data availability through the Brief Industrial Profile, Agar Malwa, MSME 2016 has been taken into purview and accordingly been provided in the report.

4.3.4 Demographic Profile

Social demography profile enables us to understand the processes that influence the size, growth, characteristics, and distribution of human population. The data presented below has been derived primarily from the Primary Census Abstract 2011.

The following section will elaborate on various variables of social demography:

4.3.4.1 Population

The section below elaborates on the population of the study area focusing primarily on its composition, size and distribution.

District Level Population

Agar Malwa District's population is found below:

Table 4-15: District Level Population

District	Total Population 2011	Population 2011			
		Rural	Urban	Male	Female
Agar Malwa	5,71,278	453949	1,17,329	293052	278226
		(79.4%)	(20.5%)	(51.2%)	(48.7%)

Source: Brief Industrial Profile (Agar Malwa) MSME 2016

It can be inferred from the table above that Agar Malwa is primarily constituted by the rural population at 79.4%. The male –female distribution stands at males (51.2%) and females (48.7%).

Tehsil Level Population

Badod Tehsil's composition of population is found below:

Table 4-16: Tehsil Level Population

Tehsil	Total Population 2011	Population 2011			
		Rural	Urban	Male	Female
Badod	135523	121689	13834	69426	66097
		(89.7%)	(10.2%)	(51.2%)	(48.7%)

Source: Census Data 2011

It can be inferred from the table above that the urban population is minimal in Badod tehsil at 13834(10.2%). The male –female distribution is similar to the district level with the composition of male (51.2%) and female (48.7%).

Village Level Population

The population of the study villages have been provided below:

Table 4-17: Village Level Population

Tehsil	Villages	Total Population 2011	Male	Female
Badod	Hatipura	319	167	152
			(52.3%)	(47.6%)
	Kishankot	463	230	233
			(49.6%)	(50.3%)

Source: Census Data 2011

It can be inferred from the above table that Kishankot village has higher population (463) in comparison to that of Hatipura village (319). Kishankot has a higher female population (50.3%) than the male population (49.6%).

4.3.4.2 Sex Ratio

Sex ratio refers to the number of females per thousand males in an area. It is an important indicator of the social and economic progress of an area. The disparity between the male population and the female population should be minimal or ideally the females' population should be higher. A positive sex ratio depicts that the gender imbalances and discrimination is lower thereby indicating better social conditions for women and girl children. The section below will detail out the sex ratios in the study area.

District Level Sex Ratio

Agar District has a total population of 5, 71,278 with 293052 (51.2%) males and 278226 (48.7%) females. Therefore the Sex Ratio of the district is 949.

Tehsil Level Sex Ratio

Badod Tehsil with a total population of 1, 35,523 has 69426 (51.2%) males and 66097(48.7%) females. The Sex ratio of Badod Tehsil is 952.

Village Level Sex Ratios

The sex ratios for the villages of Hatipura and Kishankot have been provided in the table below.

Table 4-18: Village Level Sex Ratio

Tehsil	Villages	Total Population 2011		Sex Ratio
		Male	Female	
Badod	Hatipura	167	152	910
	Kishankot	230	233	1013

Source: Census Data 2011

The table above reflects that the Sex ratio for Kishankot (1013) village is higher than that of Hatipura (910) village.

4.3.4.3 Literacy

Literacy is an important indicator of social and economic progress. An educated society helps bring about positive changes as education is regarded as a vehicle for broadening an individual's perspective. For the purpose of the census in India, a literate person is regarded as an individual above the age of seven years who can both read and write in any Indian language. The section below elaborates on the literacy rates in the study area.

Tehsil Level Literacy Rate

The literacy level of Badod Tehsil is presented below:

Table 4-19: Tehsil Literacy Rate

Tehsil	Total Population 2011 (Above 7 years)	Total Literate Population 2011			Literacy Rate
		Total	Male	Female	
Badod	115201	68588	42875	25713	59.5%
			(62.5%)	(37.4%)	

Source: Census Data 2011

The above denotes that the proportion of female literates (37.4%) in Badod tehsil is discouraging. The literacy rate of the tehsil is 59.5%.

Village Level Literacy Rates

The literacy rates of villages of Hatipura and Kishankot have been presented below

Table 4-20: Village Literacy Rates

Villages	Total Population 2011 (Above 7 Years)	Total Literate Population 2011			Literacy Rate
		Total	Male	Female	
Hatipura	277	150	98	52	54.1%
			(65.3%)	(34.6%)	
Kishankot	401	348	178	170	86.7%
			(51.1%)	(48.8%)	

Source: Census Data 2011

The table above represents the literacy rate of the study villages. Kishankot has an impressive literacy rate of 86.7% whereas Hatipura village has a literacy rate of 54.1%. The disparity in male and female literates is higher in Hatipura wherein there are 65.3% male literates and 34.6% female literates, Kishankot has better male-female literates distribution with 51.1% males and 48.8% females.

4.3.5 Presence of Vulnerable Communities

Vulnerable communities can be defined as those communities living on the margins on society. These communities are generally denied or have minimal access to resources that are easily available to the mainstream society for betterment of livelihood opportunities or living standards. Their vulnerability lies in their identity to an ethnic community, poverty or religious identity. For the purpose of the study, presence of the Scheduled Caste/Scheduled Tribe (SC/ST) communities, people living below poverty line and religious minorities have been presented and analysed.

4.3.5.1 Scheduled Caste/Scheduled Tribe Communities

These communities in India comprise of the Scheduled Tribes, Scheduled Castes and Other Backward communities (SC/ST/OBC's). In order to promote inclusiveness and widespread development various inclusive programmes and schemes are initiated by the Central and the State Government. For the purpose of protection of their indigenous rights and unique culture, certain areas in the country have been classified as a Scheduled Area (i.e. if fifty percent (50%) of its population have been identified and listed as Scheduled Tribes).Although the State of Madhya Pradesh has been classified as a Scheduled Area, Badod tehsil wherein the project is located does not fall under the Scheduled Area classification. The section below elaborates on the presence of Scheduled Caste/Scheduled Tribe SC/ST communities in the area.

Tehsil Level SC/ST Communities

Scheduled Caste and Scheduled Tribe (SC/ST)communities presence in Badod Tehsil has been presented below:

Table 4-21: Tehsil Level SC/ST Communities

Tehsil	Total Population 2011	Scheduled Caste Population 2011			Scheduled Tribe Population 2011		
		Total	Male	Female	Total	Male	Female
Badod	135523	31822	16435	15387	207	95	112
		(23.4%)	(51.6%)	(48.3%)	(0.15%)	(45.8%)	(54.1%)

Source: Census Data 2011

The table above represents that there is a negligible presence of Scheduled Tribe (ST) population at 0.15% in the tehsil. In the Scheduled Tribe (ST) population, females have a higher representation at 54.1% and the males comprise of 45.8% of the population. The Scheduled Caste (SC) population have a higher representation than the Scheduled Tribe (ST) population at 23.4%.

Village Level SC/ST Communities

The Scheduled Caste and Scheduled Tribe (SC/ST) communities' presence in the study area villages have been presented below:

Table 4-22: Village Level SC/ST Communities

Villages	Total Population 2011	Scheduled Caste Population 2011			Scheduled Tribe Population 2011		
		Total	Male	Female	Total	Male	Female
Hatipura	319	25	15	10	0	0	0
		(7.8%)	(4.7%)	(3.1%)			
Kishankot	463	119	64	55	0	0	0
		(25.7%)	(53.7%)	(46.2%)			

Source: Census Data 2011

It can be inferred from the table above that there is an absence of Scheduled Tribe (ST) communities in both Hatipura and Kishankot villages. The proportion of the Scheduled Caste (SC) population is negligible at Hatipura Village (7.8%) whereas in Kishankot the Scheduled Caste (SC) population comprises of 25.7% of the total population.

4.3.5.2 Poverty Level

Poverty can be defined as restriction to access essential resources for survival. Poverty acts as an obstacle to physical and mental development as there is deprivation of nutritious food, education and access to livelihood opportunities. The benchmark for measuring poverty in India is the Below Poverty Line. The poverty line defines the threshold income. Households having an income below the threshold are considered to be poor.

According to the Planning Commission 2011-12 estimates, the state of Madhya Pradesh has 234.06 lakh persons living below poverty line wherein 190.95 lakhs (35.74%) comprises of the rural population and 43.10 lakhs (21%) of the urban population.[10].

4.3.5.3 Religious Communities

India is renowned for its unity in religious diversity. There are communities of many different faiths coexisting peacefully as well as thriving in the country. According to the Census Data 2011, Madhya Pradesh has a total population of 72,626,809, amongst which there are 66,007,121(90.8%) practise Hinduism, 4,774,695 (6.5%) practise Islam, 213,282 (0.29%) practise Christianity, 151,412(0.20%) practise Sikhism, 216,052 (0.29%) practise Buddhism and 567,028 (0.78%) practise Jainism. The remaining population either have other religions or have not stated their faith. It can therefore be stated that Madhya Pradesh with 90.8% Hindus is predominantly a Hindu state. There is a presence of other faiths in the state as well however they are in minority.

Tehsil Level Religious Communities

The tehsil level religious communities representation is provided below:

Table 4-23: Tehsil Level Religious Communities

Tehsil	Total Population (2011)	Hindu	Muslim	Christian	Sikh	Buddhist	Jain	Other Religions and Persuasions
Badod	135523	126079	7281	34	14	10	2045	7
		(93%)	(5.37%)	(0.02%)	(0.01%)		(1.50%)	

[10] http://planningcommission.nic.in/news/pre_pov2307.pdf

Source: Census Data 2011

The above table represents the proportion of religious communities in Badod Tehsil. It can be inferred from the above table that Hinduism (93%) is the predominant religion that is practised in Badod. Islam (5.37%) has a minor representation followed by Jainism (1.50%). Christianity, Sikhism, Buddhism which have below 1% representation.

4.3.6 Existing Landholding Pattern

Landholding patterns in area provide a perspective on the pattern of income and livelihood in the area. Larger landholdings imply larger area for cultivation consequently higher income gains for the population. The section below elaborates on the existing land holding pattern of the study area.

In order to provide a broad perspective of the landholdings in the area, the land holding pattern at the state level has been provided below.

Table 4-24: Landholding Pattern in Madhya Pradesh

All Size groups		Marginal		Small		Semi-medium		Medium		Large	
Area (in 000 ha)	Number(in 000)	Area (in 000 ha)	Number(in 000)	Area (in 000 ha)	Number(in 000)	Area (in 000 ha)	Number(in 000)	Area (in 000ha)	Number(in 000)	Area (in 000 ha)	Number(in 000)
15836	8872	1915	3891	3466	2449	4510	1655	4545	789	1400	89
		(12.09%)	(43.8%)	(21.8%)	(27.6%)	(28.4%)	(18.6%)	(28.7%)	(8.89%)	(8.84%)	(1%)

Source: Agriculture Census 2010-11

According to the Agriculture Census 2010-11, Madhya Pradesh has higher proportion of marginal (43.8%) landholders followed by Small landholders (27.6%). Large landholdings comprise of only 1% in the state.

Tehsil Level Landholding Pattern

Badod Tehsil's Land holding Pattern has been provided below:

Table 4-25: Land holding Pattern in Badod Tehsil

All Size groups		Marginal		Small		Semi-medium		Medium		Large	
Area (in 000 ha)	Number (in 000)	Area (in 000ha)	Number (in 000)	Area (in 000 ha)	Number (in 000)	Area (in 000ha)	Number (in 000)	Area (in 000ha)	Number(in 000)	Area (in 000 ha)	Number (in 000)
53619	27042	4775	10704	10100	7231	15076	5406	19914	3418	3755	283
		(8.9%)	(39.5%)	(18.8%)	(26.7%)	(28.1%)	(19.9%)	(37.1%)	(12.6%)	(7%)	(1%)

Source: Agriculture Census 2010-11

It can be inferred from the above table that the landholding pattern of Badod Tehsil shows similar pattern to that of the state level with the highest number of marginal landholders (39.5%), followed by small landholders (26.7%).The large landholders comprise of 1% in Badod as well.

4.3.7 Existing Land Use Pattern

Land-use refers to the way in which land has been used by humans and their habitat, usually with accent on the functional role of land for economic activities. The land use/cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Information on land use/cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring

the dynamics of land use resulting out of changing demands of increasing population.[11]According to the Agriculture Census 2010-11, Madhya Pradesh has total holdings area of 15,835,877 ha, amongst which the net cultivated area is 15,481,761 ha (97.7%) The following section will elaborate on the land use pattern of the study area.

Tehsil Level Land Use Pattern

The land use pattern for Badod tehsil is presented below:

Table 4-26: Land Use Pattern of Badod Tehsil

Tehsil	Total Holdings Area (in ha)	Net Area Sown (in ha)	Area Under current Fallows (in ha)	Net cultivated Area (in ha)	Other uncultivated land excluding fallow land (in ha)	Fallow land other than current fallows (in ha)	Culturable Waste land (in ha)	Total Uncultivated Land (in ha)	Land Not available for cultivation (in ha)
Badod	53619	52465	805	53270	83	42	212	337	13
				(99.3%)				(0.62%)	(0.02%)

Source: Agriculture Census 2010-11

The above table represents the land use pattern of Badod Tehsil wherein it can be noted that the net cultivated area comprises 99.3% of the total holdings area. The net area sown comprises of 97.8% of the net cultivated area.

4.3.8 Workforce Population

Workforce population represents that segment of the population which is engaged in productive activities and contribute to the development and growth of the country. The activities that are performed by this workforce population add economic value. The workforce population in India can be further segregated into Main and Marginal Workers. Main workers are those who have been engaged in economically productive activities for more than one hundred eighty three (183) days and Marginal workers are those workers who have been engaged in any economically productive activity for less than one hundred eighty three days (183) days. The section below will elaborate on the number and type of workforce population present in the study area.

Tehsil Level Workforce Population

Tehsil Level Workforce Population has been presented below:

Table 4-27: Tehsil Level Workforce Population

Tehsil	Total Population 2011	Main Workforce Population 2011			Marginal Workforce Population 2011		
		Total	Male	Female	Total	Male	Female
Badod	135523	45365	35166	10199	16460	5404	11056
		(33.4%)	(77.5%)	(22.4%)	(12.1%)	(32.8%)	(67.1%)

Source: Census Data 2011

The table above denotes that the total workforce population in Badod district is 61,825 (45.6%) of the total population. The male representation is higher in the main workforce population (77.5%) whereas the female representation is higher in the marginal workforce population (67.1%).

Village Level Workforce Population

The workforce population of the study villages of Hatipura and Kishankot have been provided below:

[11] http://www.sciencedirect.com/science/article/pii/S1110982315000034

Table 4-28: Village Level Workforce Population

Villages	Total Population 2011	Main Workforce Population 2011			Marginal Workforce Population 2011		
		Total	Male	Female	Total	Male	Female
Hatipura	319	134	102	32	4	2	2
		(42%)	(76.1%)	(23.8%)	(1.2%)	(50%)	(50%)
Kishankot	463	209	130	79	39	13	26
		(45.1%)	(62.2%)	(37.7%)	(8.4%)	(33.3%)	(66.6%)

Source: Census Data 2011

The above table denotes that the total workforce population of Hatipura village is 138(43.2%) of the total population and Kishankot village is 248(53.5%).The main workforce population comprises mostly of males in both the villages of Hatipura (76.1%) and Kishankot (62.2%).

4.3.9 Occupational Pattern

The occupational pattern distribution of a population in an area indicates the development and diversification of an economy. The sectors are primarily divided into primary, secondary and tertiary sectors. Heavy dependency on primary sector is found in undeveloped and developing countries whereas developed countries are characterised by higher dependency on the secondary and tertiary sectors. For the purpose of the Census, the occupations are classified into four (04) categories namely Cultivators, Agricultural labourers, Household industries[12] and Others [13].

The following section elaborates on the occupational pattern of the study area.

Tehsil Level Occupational Pattern

Badod Tehsil's Occupational Pattern is found below:

Table 4-29: Occupational Pattern of Badod Tehsil

Tehsil	Total Workforce Population 2011	Main Workforce Population 2011					Marginal Workforce Population 2011				
		Total	Cultivators	Agricultural Labourers	Household Industries	Others	Total	Cultivators	Agricultural Labourers	Household Industries	Others
Badod	61825	45365	26059	13391	385	5530	16460	3349	12132	311	668
		(73.3%)	(57.4%)	(29.5%)	(0.84%)	(12.1%)	(26.6%)	(20.3%)	(73.7%)	(1.8%)	(4.05%)

Source: Census Data 2011

The table above represents that the main workforce population constitutes (73.3%) of the total workforce population. In the main workforce population the highest numbers of people are engaged as cultivators (57.4%) followed by Agricultural labourers (29.5%). In the marginal workforce population the highest representation of the workforce is found as Agricultural labourers (73.7%).

Village Level Occupational Pattern

The village level descriptions of the occupational pattern are found below:

[12] Household Industry is defined as an industry conducted by one or more members of the household at home or within the village in rural areas and only within the precincts of the house where the household lives in urban areas. It relates to production, processing, servicing, repairing or making and selling (but not merely selling) of goods.
[13] The type of workers that come under this category of 'OW' include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc

Table 4-30: Occupational Pattern of Villages

Villages	Total Workforce Population 2011	Main Workforce Population 2011					Marginal Workforce Population 2011				
		Total	Cultivators	Agricultural Labourers	Household Industries	Others	Total	Cultivators	Agricultural Labourers	Household Industries	Others
Hatipura	138	134	53	74	0	7	4	1	3	0	0
		(97.1%)	(39.5%)	(55.2%)		(5.2%)	(2.8%)	(25%)	(75%)		
Kishankot	248	209	138	54	0	17	39	1	1	0	37
		(84.2%)	(66%)	(25.8%)		(8.1%)	(15.7%)	(2.5%)	(2.5%)		(94.8%)

Source: Census Data 2011

The table above depicts that there are no household industries in both the study villages of Hatipura and Kishankot. In the main workforce population, Hatipura has the highest number of workers as Agricultural Labourers (55.2%) followed by Cultivators (39.5%) whereas in Kishankot the highest number of workers are engaged as Cultivators (66%) followed by Agricultural Labourers (25.8%).In Kishankot village the majority of the marginal workforce is engaged in Other (94.8%) occupations.

4.3.10 Gender Profile of the Study Area

Gender balances and imbalances reflect the social development of a concerned area. Discrimination and restriction of access to resources and opportunities based gender impedes the road to development and progress for the society as a whole. Certain indicators such as female literacy level, participation in workforce help ascertain quality of life of women in the country. The section below tries to analyse these indicators and elaborate on the present scenario in the study area.

Tehsil Female Literacy Level

Badod Tehsil's female literacy level is found below:

Table 4-31: Tehsil Female Literacy Level

Tehsil	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Badod	68588	42875	25713
		(62.5%)	(37.4%)

Source: Census Data 2011

The above table denotes that the disparity between male and female literates is quite high. There are 42,875(62.5%) males literates whereas there are only 25,713 (37.4%).

Village Female Literacy Level

The literacy levels of females in the study villages are presented below:

Table 4-32: Village Female Literacy Level

Villages	Total Literate Population 2011	Male Literate Population 2011	Female Literate Population 2011
Hatipura	150	98	52
		(65.3%)	(34.6%)
Kishankot	348	178	170
		(51.1%)	(48.8%)

Source: Census Data 2011

The table above indicates that both the study villages of Hatipura and Kishankot have female literacy levels below 50%.Hatipura has 34.6% female literates and Kishankot has 48.8% of female literates.

4.3.11 Existing Infrastructure Facilities

Infrastructure facilities facilitate economic growth and development of an area. Development and maintenance of existing infrastructure facilities has been the prerogative of both state and central governments .Better Infrastructure attracts and retains potential investment opportunities. The section below elaborates the existing infrastructure facilities in the study area.

Agar district was reorganized from Shahjapur district in the year 2013. According to the Brief Industrial Profile of Agar Malwa 2016-17, the educational facilities in the district stands at 561 primary schools, 296 middle schools and 52 Secondary and Senior Secondary schools. There are three (03) degree colleges in the area. The health facilities in the district has 72 Primary Health Sub Centres (PHSC), three (03) Primary Health Centres (PHCs) three (03) Community Health Centres (CHC) and four (04) Allopathic Hospitals. It also has seven (07) private health care facilities in the district. The district is connected via rail and road network. The district has well established banking facilities as it has the presence of 22 commercial banks, 08 rural banks and 12 cooperative banks.

5. Stakeholder Identification and Consultation

This section of the report presents detail on stakeholder identification and consultation undertaken for the project.

5.1 Introduction

Stakeholder consultations are an important process through which a two way dialogue is created between the project proponent and the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/ or the ability to influence its outcome, either positively or negatively.

A reconnaissance site visit was undertaken to the study area on 15th and 16th March 2017. The following schedule was adhered to while undertaking the consultations and site visit.

Table 5-1: Stakeholder Consultation Schedule

S. No.	Places Visited	Tasks	Date
1.	Hero Future Group Site Office, Barod, Madhya Pradesh	Meeting with Hero Future Group Site Representative and discussion on the Project Description	15th March 2017
2.	Hero Future Group Site Office Barod Madhya Pradesh	Meeting with Local Community Members of Hatipura and Kishan Kot villages	15thMarch 2017
3.	Hatipura Village under Jhalara Gram Panchayat	▪ Interviews with local community members of Hatipura village under Jhalara Gram Panchayat. ▪ Interview with Jhalara Gram Panchayat Sarpanch.	16th March 2017
4.	Kishan Kot Village under Khandvas Gram Panchayat	▪ Interviews with local community members of Kishan Kot village under Khandvas Gram Panchayat	16th March 2017

5.2 Stakeholder Identification

The stakeholder for the project was prioritized by identifying the direct and indirect stakeholders. The key stakeholders that were consulted as part of the study included the following,

- Local Leader (Sarpanch) of Jhalara Gram Panchayat
- Local Community Members of Hatipura and Kishan Kot villages
- Site representatives of Hero Group

5.2.1 Methodology Adopted

The stakeholder consultation comprised primarily of a site visit and consultation initiated by the AECOM professional. As solar projects are a novel concept in the area, the consultations revolved around getting information relating to the socio-economic status of the resident population within the study area, the concerns/issues of the local population and benefits/ expectations from the project. The findings of the consultations are based mainly on the use of participatory methods like key informant interviews and natural interviews. These methods give an in-depth and intensity to the discussion and incorporates the local population point of view within a short duration of time.

The process of stakeholder consultation included,

- identification of the relevant stakeholders potentially influenced by or interested in the project;
- imparting information about the project and its potential impacts on their lives in local and simple language;
- verifying if the area proposed for the project does not infringe the formal or informal rights of the local population;
- recording of their concerns and aspirations through discussions; and responding to their queries in a neutral manner

A total of five (05) Community Members Hatipura and Kishankot villages within the study area were consulted along with the Sarpanch of Jhalara Gram Panchayat. In addition, the site representatives from Hero Future Group was also contacted and consulted to enhance the overall understanding of the project and its implications on the surrounding areas.

5.2.2 Details of Land Procured for the Project

The Project Proponent has procured revenue land measuring 250 acres for the project and its associated facilities (Switch yard, access roads etc.) which has been transferred by the Madhya Pradesh Government through a Lease Agreement of 30 year period. As no private land was procured for the project, community consultations were undertaken to gauge the interest of the communities in the vicinity of the project area about the development of the project.

5.3 Consultation undertaken with various Stakeholders

5.3.1 Views expressed by Community Members

A total of five (05) community members belonging to Hatipura and Kishankot villages were consulted during the site visit undertaken on 15th and 16th March 2017. As per the consultations undertaken with the community members, the following information was provided by the identified group,

Table 5-2: Views expressed by Community Members

S.No.	Questions	Broad Response
1.	Awareness of the Project?	All respondents consulted affirmed that they were aware about the project.
2.	What are occupation pattern of the local population in the area.	The local population are all involved in agricultural activities.
3.	What are the types of crops cultivated in the area?	Four type of crops are generally cultivated, namely, Wheat, Orange, Pomegranate and Soya bean.
4.	What was the land use pattern of the project area?	Agriculture waste land and Revenue land.
5.	Any cultural heritage / archaeological site near the project area in your land parcel?	According to the consultations undertaken, there is no cultural heritage or archaeological site near the project area.
6.	Benefit/Expectation from the Project	• All respondents stated that employment opportunities in the area would increase due to the project coming up in the area. • All respondents replied that they expected that the supply of electricity would improve in the area with the project being set up in the vicinity of their village. • Three (03) respondents were of the opinion that health services in the area would improve as similar projects would be developed in the area. • Two (02) respondents were of the opinion that road conditions in the area would improve with the operation of the project. • All respondents replied that they expected the water supply in the area would improve for agriculture. • Two (2) respondents were of the opinion that there would be an improvement in the local transportation system.
7	Concerns/Issues related to the Project	All respondents were of the opinion that there are no concerns/issues related to the project being developed in the area.

5.3.2 View expressed by the Sarpanch of Jhalara Gram Panchayat

As per the consultations undertaken with the Sarpanch of Jhalara Gram Panchayat, the following information was provided,

Table 5-3: Views expressed by Sarpanch of Jhalara Gram Panchayat

S. No.	Questions	Broad Response
1.	Awareness of the Project?	The Sarpanch consulted affirmed that he was aware about the project.

S. No.	Questions	Broad Response
2.	Concerns/Issues relating to the Project	As per the Sarpanch's viewpoint, there are no concerns / Issues relating to the Project.
3.	Expectation from the Project	The respondent was of the opinion that employment opportunities would improve in the area.
4.	Concerns/issues in the area	▪ The respondents were of the opinion that water supply in the area needed improvement. ▪ The respondents were of the opinion that education facilities are inadequate in the area. Hence, they wanted some assistance from the company to improve the education infrastructure.

5.3.3 View Expressed by the Site Representative of Hero Future Group, Badod Tehsil

Consultations were also undertaken with the representatives of HFE, the following information was provided,

Table 5-4: Views expressed by Site Representative of Hero Future Group

S. No.	Questions	Broad Response
1.	Have you obtained No Objection Certificates from the respective Gram Panchayats for the project activities?	No Objection Certificate from Jhalara Gram Panchayat has been obtained for the project activities while the remaining NOC from Khandvas Gram Panchayatis in the process of being obtained.
2.	**Community Engagement:** ▪ How was the community informed about the proposed project? ▪ Has any prior meeting been undertaken by Hero Future Group with the local community?	▪ The community around the vicinity of the project site has been informally informed about the proposed project. The community are aware of the Site Office premises and the concerned person to contact and are free to get in touch whenever required. ▪ There were no formal meetings conducted by Hero Future Group with the local community.
3	**Corporate Social Responsibility (CSR)/Community Development Programme** ▪ Activities undertaken (if any) ▪ CSR Plan for future ▪ Documented Records (if any)	No CSR or Community Development Programmes have been initiated till date by Hero Future Group. However, it was informed that once the project becomes operational, a need assessment would be undertaken in the area to gauge the kind of activities that could be taken up in the future for community development purposes.

5.3.4 Socio economic status of women

To comprehend the existing living pattern of the local population residing across the study area, a look at the socio-economic status of women and the role that women have been playing both at the domestic and economic level needs to be taken into consideration. Even though they constitute almost half the population, various indicators pertaining to literacy level, labour force participation, mortality rate etc. reveal the dismal status of women to that of men.

While interacting with the Sarpanch of the Jhalara and Khandvas Gram Panchayats, information relating to the gender profile in the area was also gathered. It was reported that no government schemes for women have been introduced in either of the Gram Panchayats. Most women are uneducated and those who have received education generally have not studied beyond Grade Five. The main activities undertaken by women were mostly in the form of engagement of agriculture activities and household chores. It was reported that health care centres and employment opportunities for women in the form of vocational training and engagement was required for the development of women. Medical health camps catering to women health issues should also be held regularly to impart information on health and hygiene for adolescent girl child and maternal health.

In addition, vocational centres catering to skillsets like stitching, knitting, handicraft making, etc. should be established so that women while sitting at their homes can take up steps to supplement their economic condition and raise their status in the society.

6. Evaluation of Impacts

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

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

6.1 Impact assessment criteria

Identified impacts have been appraised through social and environmental components and have been presented in *Table 6-1* below. The appraisal criteria are classified according to spread, duration, intensity and nature of the impact. Severity levels have been sub classified under each criterion with specifics outlining the limits of each severity level.

Table 6-1: Impact Assessment Criteria

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

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

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

Table 6-2: Impact Significance Criteria

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

6.2 Impact Identification

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

6.2.1 Impact identification Matrix

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

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

Environment, Health & Safety impact assessment variables	Construction Phase	Operation and Maintenance Phase	Decommissioning Phase
Land Use and Visual Aesthetics			
Site Preparation and Grading	•		
Site/ Vegetation Clearance	•		•
Laying of Transmission Lines	•		
Ecology			
Site Preparation and vegetation Clearance	•		
Hazardous and Non- Hazardous Material and Waste Management	•	•	•
Power Transmission	•	•	
Water Resources and Water Quality			
Material Handling and Storage	•	•	•
Hazardous and Non- Hazardous Material and Waste Management	•	•	•
Washing of Solar Panels		•	
Water Requirement for workers	•	•	•
Ambient Air Quality/ Atmospheric Emissions			
Material Handling and Storage	•		•
Operation of construction equipment	•		
De-mobilization of construction equipments	•		•
Ambient Noise Quality			
Material Handling and Storage	•		
Repair and Maintenance Works of solar panels		•	•
Demobilization of construction equipments	•		
Traffic & Transport			
Material Handling and Storage	•		
Demobilization of construction equipment	•		
Soil Resources			
Site Preparation and vegetation clearance	•		
Demobilization of construction equipments	•		
Hazardous and Non- Hazardous Material and Waste Management	•	•	•
Material Handling and Storage	•	•	•
Occupational Health and Safety			
Employment of Workers	•	•	
Material Handling and Storage	•	•	•
Construction works	•		
Laying of transmission lines	•		
Electrical hazard during solar power generation		•	
Repair and Maintenance Works of solar panels		•	
Land Procurement			
Adequate Compensation	•		
Loss of Agricultural land	•		
Changing occupational opportunities	•		

Influx of migrant Workers				
Presence of an outside agency	•	•		
Conflicts Between Local Residents and Newcomers	•	•		
Income generating opportunities	•	•		
Increase in local employment	•	•		
Introduction of new Social classes	•			
Change in the commercial/industrial focus of the community	•	•		
Stress on local Infrastructure	•			
Loss of jobs				•
Community Infrastructure and property				
Change in community infrastructure		•		
Land acquisition or disposal	•			
Initiation of community development activities	•	•		
Effects on known cultural, historical and archaeological resources				

6.3 Environmental Impacts

6.3.1 Pre-Construction and Construction Phase

6.3.1.1 Land Use

Impacts

The proposed project will be developed on 250 acres of land falling in Hathipura and Kishankot Villages of Badod Tehsil of Agar District. Based on the site surveys conducted, the land for the project comprises of revenue land with some 10% being used for agriculture. The surrounding land use is irrigated agriculture land. Also, as per data, Badod has a drought frequency of almost 40%. Scanty or no vegetation is there which covers the landscape of the project site. No grazing activities take place on the proposed project site. With the development of the proposed Project, the land use of the site will alter to industrial land use.

Mitigation Measures

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

Significance of the Impact

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

Table 6-4: Impact Significance – Land Use

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

6.3.1.2 Soil Quality

Impacts

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

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

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

Mitigation Measures

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

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

Significance of the Impact

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

Table 6-5: Impact Significance – Soil Resource and Quality

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

6.3.1.3 Water Resources, Storage and Quality

Impacts

Limited quantity of construction water will be required for piling and foundation work. It is estimated that about 80-85 kilo litres of water will be required for the entire construction phase (which includes water requirements for

curing works, batching plant and domestic requirement of workers). It is to be ensured that pre-treatment is provided to ground water which will be utilized for drinking.

There is potential for contamination of low lying areas due to sediment runoff from construction activities. Removal of the vegetation cover as well as increased run-off from the construction activities will reduce the rate of infiltration and groundwater recharge. Improper disposal of sewage and wastewater from labour camp and construction debris can contaminate the ground water resources in the area.

Mitigation Measures

The natural slope of the site will be maintained to the extent possible in order to avoid any change in the drainage pattern. Storm water flow will be directed to the existing channels and nearby water bodies with silt traps to avoid sedimentation.

Water for construction activities, flushing and washing purpose will be met from authorized water tankers from local areas. It is to be ensured that pre-treatment is provided to ground water (after taking pre-requisite approvals) if it is utilized for drinking.

Significance of Impact

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

Table 6-6: Impact Significance – Water Resources

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

6.3.1.4 Air Quality

Impacts

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

Dust will be generated mainly during excavation, back filling and hauling operations along with transportation activities. The main source of gaseous emission during the construction phase is movement of equipment and vehicles at site. Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO_2, NO_X, and particulate matter.

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

Mitigation Measures

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

- Sprinkling of water to be carried out to suppress dust from construction, stock piles and transport movement;
- It shall be ensured that all stock piles are covered and storage areas provided with enclosures to minimize dust from open area source;
- Stock piling and storage of construction material will be oriented after considering the predominant wind direction;
- Open burning of solid waste or packaging material will be strictly prohibited;

- Vehicles engaged for the project will be required to obtain “Pollution under Control” (PUC) certificates. Sufficient stack height needs to be provided to D.G. sets as per CPCB norms[14].

Significance of Impact

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

Table 6-7: Impact Significance – Air Quality

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

6.3.1.5 Ecology

Impacts

The construction of the Project will result in disturbance at the site, in particular of the vegetation located within the PV Footprint. There will be a direct clearing of natural vegetation through cutting of small bushes and shrubs; the overall intensity of this impact is rated as *minor*, as the impact is not likely to be of wider significance. Natural drainage channels present within site will not be disturbed and will remain intact. The impacts envisaged on ecology during construction phase are enlisted below:

- Loss of vegetation and avian habitat due to site clearance, building and PV array support construction etc.
- Erosion and clearing of topsoil (loss of habitat and habitat fragmentation).
- Disturbance/displacement of fauna, including avifauna associated with noise and movement of construction equipment and personnel.

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

IFC Performance Standard 6 recognizes that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve. This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner. Performance Standard 6 is designed to protect and conserve biodiversity (among the other objectives listed). Habitat fragmentation due to site clearing will result in limited disturbance to fauna. Noise from construction and frequent movement of vehicles can also disturb the avifauna of the area.

Mitigation Measures

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

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

Significance of Impact

[14] http://cpcb.nic.in/Industry-Specific-Standards/Emission/DieselGeneratorSets.pdf

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

Table 6-8: Impact Significance – Ecology

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

6.3.1.6 Noise Environment

Impacts

Noise and vibration will be caused by the operation of earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. There is potential for disturbance to habitations in proximity of construction site. Movement of traffic during night hours can also disturb the local community. The operation of this equipment will generate noise ranges from 75 – 90 dB (A) which will remain within the site boundary. The noise level is substantially lower near the plant boundary due to attenuation caused over the distance. The nearest noise receptor is Kishankot Village which is located at a distance of less than 1 km in south east direction.

Overall, the impact of generated noise on the environment during construction period is insignificant, reversible and localized in nature.

Mitigation Measures

- RGSEPL shall instruct its contractor to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum.
- Only limited construction activities shall be carried out during night-time. The hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas should be limited.
- It is also to be ensured that village road connecting Hatipura and Kishankot villages is not utilized for movement of equipment reducing project traffic through community areas.
- All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary.
- Rubber padding/noise isolators will be used for construction equipment/machinery. Temporary noise barriers shall be provided surrounding the high noise generating construction equipment.
- The personnel involved in high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels.
- Construction vehicles and machinery will be well maintained and not kept idling when not in use.

Significance of Impact

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

Table 6-9: Impact Significance – Noise

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

6.3.1.7 Traffic and Transport

Impacts

Increase in traffic during construction phase is expected which involves transportation of construction materials, solar modules and mounting structures. It can lead to additional traffic and increased risk of traffic related accidents and injuries to community and to workers. However, the increase in traffic due to the project will remain marginal. Currently, the proposed project is accessible from State highway-SH 19A which will be utilized for transportation of machines and solar modules. The traffic density along the National Highway and village road was observed to be low with peak traffic in morning and evening hours. Village roads connecting the highway to Kishankot and Hatipura villages will be utilized to transport equipment and machinery to site and no new access roads will be constructed. The traffic density along the State Highway is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities.

Mitigation Measures

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

Significance of Impact

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

Table 6-10: Impact Significance – Traffic and Transport

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

6.3.1.8 Occupational Health and Safety Hazards

Impacts

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

Safety Risks

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

Health Risks

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

Mitigation Measures

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

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

Significance of Impact

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

Table 6-11: Impact Significance – Occupational Health and Safety

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

6.3.1.9 Solid Waste Generation

Impacts

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

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

Dust Emission due to Construction Debris

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

Disposal of waste from Labour Camps

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

Disposal of waste from site

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

Mitigation Measures

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

- *Labour Camp:* The construction contractor shall ensure that the campsites provided at site have adequate waste disposal facilities.
  - Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made.
  - Provision of separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made;
  - Washing and bathing areas will be provided with proper drainage system so that wastewater is not accumulated in the campsites;
  - Low lying areas prone to accumulation of water should be sprayed with mosquito repellents on regular basis to prevent health hazards to workers and community;
  - Disposal of sewage shall be made through a septic tank – soak pit arrangement.

- *Management of Hazardous Waste:*
  - Waste/used oil generated from generators and construction machinery and equipment will be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing the 110 percent of the largest tank to be provided;
  - The waste oil, which is characterized as hazardous according to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, will be sold to MPPCB approved vendors at frequent intervals;
  - Empty paint containers will also be stored at a secured area designated for scrap and sold to authorized vendors;
- All packaging material will also be collected at the storage area and sold to scrap dealers.
- Construction debris and excavated material will be stored in a confined area to prevent spread by wind or water.
- The construction debris will be used for backfilling of excavated areas and for foundation works at site and excess soil will be given to the local villagers for filling up of low lying areas in the vicinity.
- The scrap metal waste generated from erection of structures and related construction activities will be collected and stored separately in a stack yard and sold to local recyclers.

Significance of the Impact

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

Table 6-12: Impact Significance – Solid Waste Generation

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

6.3.2 Operation Phase

6.3.2.1 Visual Impacts and Aesthetics

Impacts

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

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

Glare Assessment

A Desktop based glare assessment study has been carried out utilizing the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandi National Laboratory[15] to assess potential glare utilizing latitude and longitudinal coordinates, elevation, sun position, and vector calculations. The PV module orientation, reflectance environment and ocular factors are also considered by the software. If potential glare is identified by the model, the tool calculates the retinal irradiance and subtended angle (size/distance) of the glare source to predict potential ocular hazards according to the glare intensity categories.

Figure 6-1 summarizes the potential impact of different retinal irradiances as a function of subtended source angle for short-term exposures. Three regions are shown: (1) potential for permanent eye damage (retinal burn) (2) potential for temporary after-image (flash blindness), and (3) low potential for temporary after-image. If the retinal irradiance is sufficiently large for a given subtended source angle, permanent eye damage from retinal burn may occur. Note that as the subtended source angle increases, the safe retinal irradiance threshold decreases. For a given retinal irradiance, a larger subtended source angle yields a larger retinal image area and delivers a greater power to the retina that cannot be as easily dissipated from the perimeter of the “hot” retinal image as with a smaller image area. A lower threshold for the retinal irradiance corresponds to permanent eye damage.

Below the retinal burn threshold, a region exists where a sufficiently high retinal irradiance may cause temporary after-image or flash blindness, which is caused by bleaching (oversaturation) of the retinal visual pigments. When this occurs, a temporary after-image appears in the visual field (e.g., the effect after viewing a camera flash in a dim room). The size and impact of the after-image in the field of view depend on the size of the subtended source angle. For a given retinal irradiance, smaller source angles yield smaller after-images, and the potential impact is less. The minimal retinal irradiance based on the illuminance and subtended source angle that yielded at least 1s of after-image is shown in *Figure 6-1.* Brief direct viewing of the sun (0.15 s) has a high potential for producing after-image effects.

[15] https://share.sandia.gov/phlux/sghat/

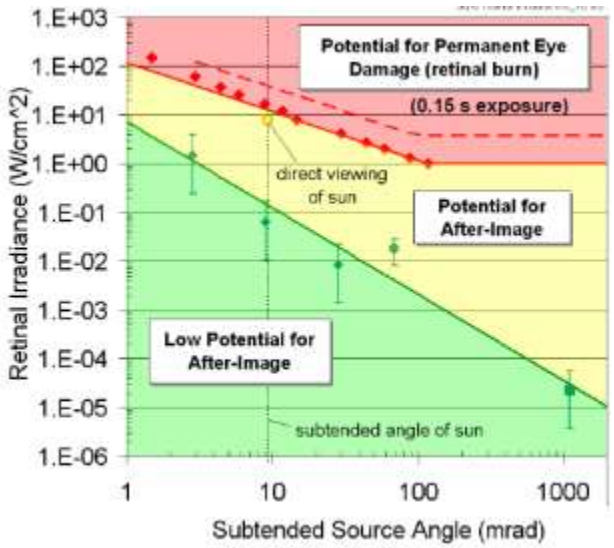


Figure 6-1: Glare Categories

The light reflected from the panels is directly dependent on the amount of sunlight hitting the surface of the panel and the surface reflectivity of the material of the panel. The amount of sunlight reaching the panel is directly based on the location of the farm, time of the year, orientation and the cloud cover. The main elements of the solar plant with the potential to influence glare are the tilt, orientation, and optical properties of the PV modules in the solar array, and the rotational capabilities of the tracking system.

The proposed 43 MW solar power project will be based on crystalline silicon (c-Si) Solar Photo Voltaic technology using Module Make Trina Solar, Model nos TSM-310PD14 & TSM-315PD14 which is Poly Crystalline Silicon Module for power generation. The optimum tilt angle of tracking axis for proposed solar plant has been computed to be 45° and modules facing towards south i.e. the orientation of tracking axis would be 180°, with maximum tracking angle to be 60°. The panels are at a height of 1.2 m

There is an adjacent solar project of 20 MW based on the crystalline silicon (c-Si) Solar Photo Voltaic technology using 3 different kinds of module; (1) Talesun Solar – 310W/315 W (2) JA Solar -310 W/315 W and (3) Astronergy - 310W/315W. These panels are fixed panels height of 1.5 m and with a fix seasonal tilt structure of 30° and 5°, currently @ 30°.

Table 6-13: Extreme Latitude and Longitude for the Proposed Solar Site

S. No	Latitude	Longitude	Ground Elevation (ft)	Height above ground (ft)	Total Elevation (ft)
PV-1 (43 MW)					
1	23.85605	75.79762	1601.51	1.2	1602.71
2	23.85326	75.80444	1620.12	1.2	1621.32
3	23.84545	75.80285	1646.34	1.2	1647.54
4	23.84447	75.79049	1570.88	1.2	1572.08
PV-2 (20 MW)					
1	23.84428	75.8054	1647.86	1.5	1649.36
2	23.85081	75.80898	1660.67	1.5	1662.17
3	23.84846	75.81061	1642.66	1.5	1644.16
4	23.84767	75.8075	1644.59	1.5	1646.09

Solar Glare Analysis has been considered for an area of 250 acres for 43 MW plant and roughly 100 acre for the adjacent 20 MW plant. *Table 6-14* gives the SGHAT Modelling parameters considered for both the plants.

Table 6-14: SGHAT Modelling Parameters for the Two Solar Power Plants

Modelling Parameters	Values	
	43 MW Plant	20 MW Plant
Time Zone	UTC+5	UTC+5
Axis Tracking	Single	Fixed
Tilt of Tracking Axis	45	30
Orientation of tracking Axis	180	-
Offset Angle of Module	0	-
Module Surface Area	Smooth glass without Anti Reflective coating (ARC)	Smooth glass without Anti Reflective coating (ARC)
Maximum Tracking Angle	60	60
Height of panels above ground	1.2 ft	1.5 ft
Slope Error	8.43	8.43
Reflectivity Varies with Incidence angle	Yes	Yes

Source: SGHAT

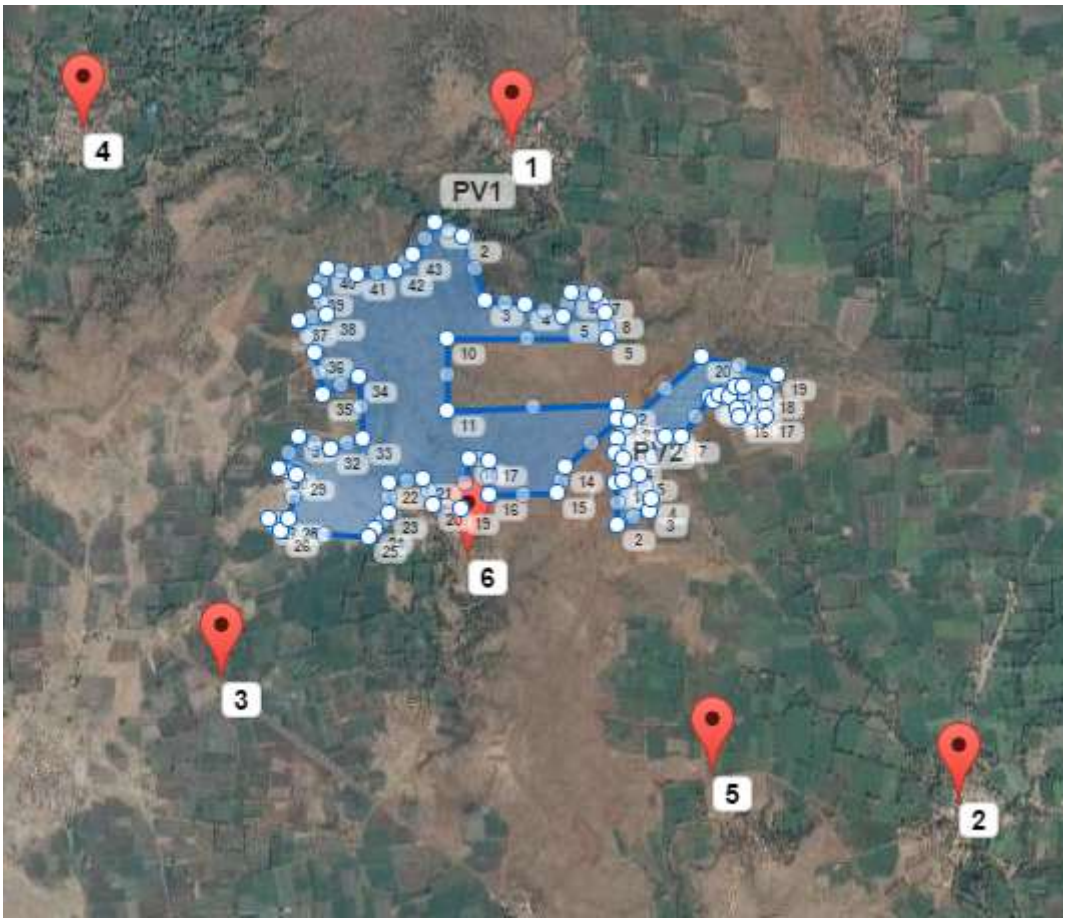


Figure 6-2: Solar Sites with Indicative Observation points

Total of (06) observation points (OP) have been considered around the site. The observation points have been considered in a radius of 3 km from the site. Three (03) points are in the range of 1kms from the site boundary and rest 3 (three) fall in the radius of 3 km from the site. 4 villages are falling in the 4 km radius, Hathipura (500m) in the north of the site; Kishankot (200m) in the south direction; Kankdel (2.5kms) in the south east direction; and Dudhaliya (1.18km) in North West. The Barod road is 800 m South and the Kankdel Village road is 1.11 km South East of the two sites.

Results from the SGHAT

Table 6-15 below gives the observations on glare potential gathered as part of the glare assessment. No glare potential was found throughout the year for the points located in the North & North West from both the Solar Farms whereas from the 20 MW Solar farm no glare was found in South East Direction also. The glare occurrence was found in South west from both the Solar Farms Panels also Glare potential was present in South East Direction due to 20 MW Solar Farm. Anti-Glare reflective coating was absent in both the solar farms.

Table 6-16 below lists outs the details of the glare occurrence. The Solar Glare for the observation are all in the summer months.

The annual occurrence of glare potential is graphically represented in subsequent *Figure 6-3, Figure 6-4* and *Figure 6-5.*

Table 6-15: Observation Points Details with Glare Gauge Results

S .No	Description	Distance from the Nearest Boundary	Latitude (Degrees)	Longitude (Degrees)	Ground Elevation (ft)	Eye Level height above ground elevation (ft)	Glare Potential from PV 1	Glare Potential from PV-2
1	OP-1: Hathipura Village	0.5 kms	23.85903	75.8009	1642.74	5	No Glare	No Glare
2	OP-2: Kankdel Village	2.5 km	23.8334	75.81995	1603.88	5	Green Glare Potential. No potential for Red or Yellow Glare.	No Glare
3	OP-3: A point on Barod Road	0.8 km	23.83811	75.78843	1555.98	4.5	Green Glare Potential. No potential for Red or Yellow Glare.	Green Glare Potential. No potential for Red or Yellow Glare.
4	OP-4: Dudhaliya	1.18 km	23.85966	75.78251	1570.55	5	No Glare	No Glare
5	OP-5: Kankdel Village Road	1.07 km	23.83446	75.80946	1614.25	4.5	Green Glare Potential. No potential for Red or Yellow Glare.	No Glare
6	OP-6: Kishankot	0.2 km	23.84294	75.79898	1635.64	5	Green Glare Potential. No potential for Red or Yellow Glare.	Green Glare Potential. No potential for Red or Yellow Glare.

Source: Solar Glare Hazard Analysis Software

Table 6-16: Findings for the Glare Assessment

Observation Points	Glare Occurrence from 43 MW Solar Farm				Glare Occurrence from 20MW Solar Farm			
	Potential	Intensity	Timings (24 hr Clock)	Months of the Year	Potential	Intensity	Timings (24 hour Clock)	Months of the Year
OP-1: Hathipura Village	No Potential	--	--	--	No Potential	--	--	--
OP-2: Kankdel Village	Low Potential for temporary after image	Continuous	7:00-9:30 hrs	April, May, July and August	No Potential	--	--	--
OP-3:A point on Barod Road	Low Potential for temporary after image	Scattered	13:00- 16:00 hrs	May, June, July & August	Low Potential for temporary after image	Continuous	06:30-07:00 hrs	May, June, July, & August

Observation Points	Glare Occurrence from 43 MW Solar Farm				Glare Occurrence from 20MW Solar Farm			
	Potential	Intensity	Timings (24 hr Clock)	Months of the Year	Potential	Intensity	Timings (24 hour Clock)	Months of the Year
OP-4:Dudhaliya	No Potential	--	--	--	No Potential	--	--	--
OP-5:Kankdel Village Road	Low Potential for temporary after image	Continuous	8:00-11:00 hrs	May, June, July & August	No Potential	--	--	--
OP-6: Kishankot Village	Low Potential for temporary after image	Continuous	06:00-16:00 hrs	Mid-March- October	Low Potential for temporary after image	Scattered	06:30-07:00 hrs	April, May, June, July & August

Source: Solar Glare Hazard Analysis Report.

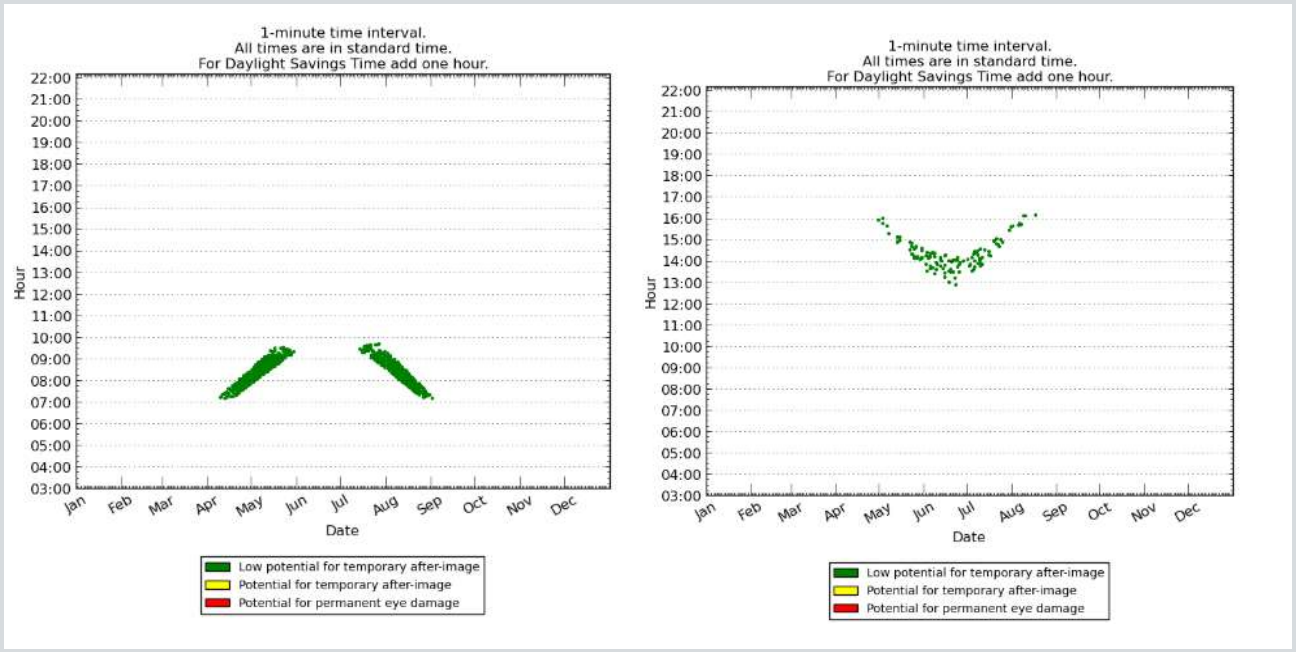


Figure 6-3: Glare Potential Plot for OP-2 and OP-3 from 43 MW Solar Plant

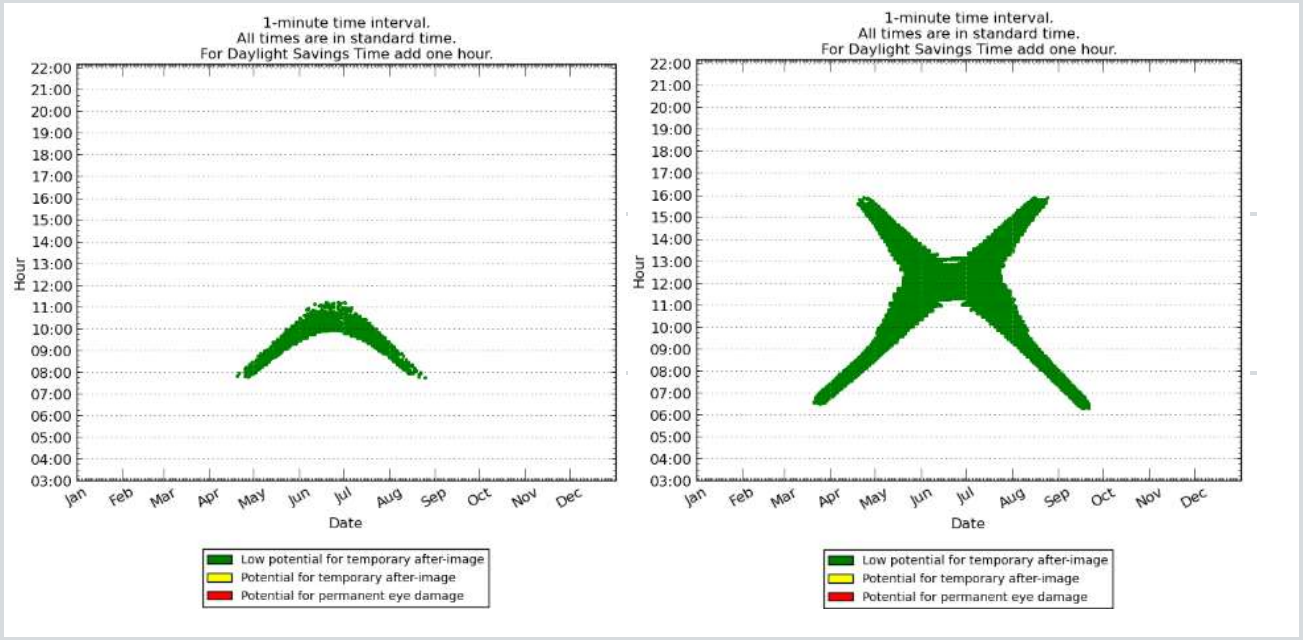


Figure 6-4: Glare Potential Plot for OP-5 and OP-6 from 43 MW Solar Plant

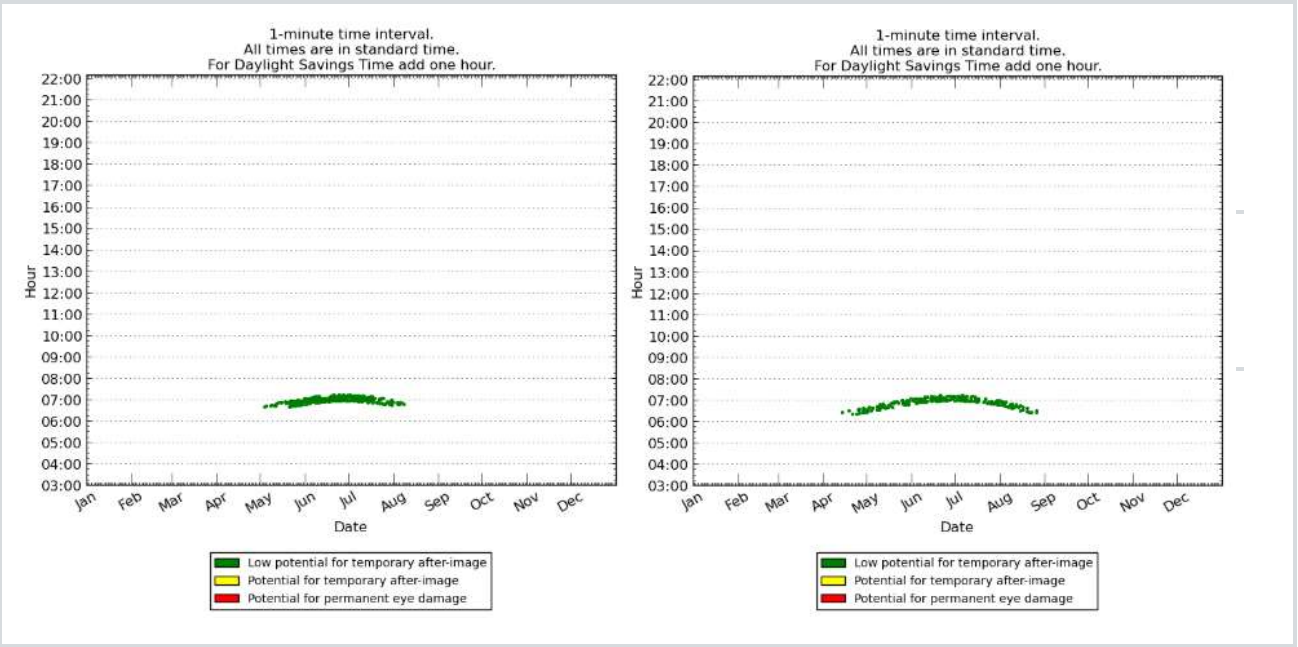


Figure 6-5: Glare Potential Plot for OP-3 and OP-6 from 20 MW Solar Plant

Based on the assumptions and parameters of this desktop assessment, the following results were identified:

a) From 43 MW Solar Plant

- No Glare Potential was identified for the Hathipura Village which is located at 500m north of the south and Dudhaliya village located at the 1.18km north west of the site.
- The potential Glare hazard was identified for OP-2 which is Kankdel Village was in the 'Low Potential for temporary After-Image' category, for 2hrs and 30 mins (7:00 to 9:30) for the summer months of April, May, July and August. The pattern of the glare observed is continuous.
- The potential glare hazard identified for OP-3 located on Barod Road, was in the 'Low Potential for temporary After-Image' category. The glare Occurrence was between 13:00-16:00 for the summer months of May, June, July & August. The pattern of glare is observed to be scattered.
- The potential glare hazard identified for OP-5 which is south east of site was in the 'Low Potential for temporary After-Image' for 2 hours in morning (08:00 to 11:00) during the summer months of May, June, July and August. The Glare occurrence is continuous.
- The potential glare hazard identified for OP-6 located in Kishankot Village (200m from the site) was in the 'Low Potential for temporary After-Image' category, for most of the time of the day ie between (06:00 to 16:00) for almost 6 months of the year (Mid-March to October). The glare pattern is observed to be continuous.

b) From 20 MW Solar Plant:

- No Glare Potential was identified for the Hathipura Village (500m) located in the north west of the site; Kankdel Village (2.5 km) located in the south east direction; Dudhaliya (1.18km) north east of the site; and the kankdel Village Road (1.07km) south of the site.
- The potential Glare hazard was identified for OP-3 which is the Barod Village Road, it was in the 'Low Potential for temporary After-Image' category, for only half an hour per day (6:30 to 7:00) for the summer months of May, June, July and August. The pattern of the glare observed is continuous.
- The potential Glare hazard was identified for OP-6 which is Kishankot Village , it was in the 'Low Potential for temporary After-Image' category, for only half an hour per day (6:30 to 7:00) for the summer months of April, May, June, July and August. The pattern of the glare observed is scattered.

Mitigation Measures

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

The proposed project would include a boundary wall around the perimeter of the project to further obscure the peripheral view of the project and any indirect reflection. Impacts from glare are minor, but since Kishankot village is just adjacent to the site it has a constant glare issue for most of the day. Installation of shades on the window

will solve the issue. The houses on the border of the village will only be affected and rest of the houses won't be affected by the glare.

Significance of the Impact

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

Table 6-17: Impact Significance –Visual and Aesthetics

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

6.3.2.2 Water Resource and Quality

Impacts

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

Assuming a minimum of 1 litres of water per module, the water requirement for cleaning the whole plant (i.e. 198,415 modules) will be approximately 140 kilo litres, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 280 - 300 kilo litres of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers. A centralized water tank is also proposed to be constructed in south- eastern direction of the plant, which will be filled by the water received from water tankers during operation phase. The drinking water requirement will be met through packaged water bottles.

Availability of the water in the area

As per the estimations provided by Central Ground Water Board for Shajapur District in 2013, Barod Tehsil was categorized as 'Semi Critical' zone for ground water abstraction. The net ground water availability as estimated in 2013, was 10567 ha-m, out of which provision for domestic and industrial requirement up to year 2033 is 498 ha-m. It is estimated that cleaning of the solar panels will require about 280 - 300 m^3 of water on monthly basis (considering frequency of cleaning twice a month). Hence, the water requirement on yearly basis is calculated to be 0.36 ha-m (0.03 x 12 months) which is 0.072% of the existing ground water available for domestic and industrial water supply in Barod Tehsil.

Agricultural activities in the area are limited due to poor rainfall. Few locals in the area only depend upon surface water tanks and bore-wells as main source of irrigation. CGWB report also assesses existing gross ground water draft for irrigation which is 2764 ha-m which forms 26% of total net available ground water.

Mitigation Measures

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

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

Significance of Impact

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

Table 6-18: Impact Significance - Water Resources

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

6.3.2.3 Ecology

Impacts

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

Use of Herbicides

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

Use of Dust Settling Chemicals

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

Spillage of Materials

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

Mitigation Measures

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

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

Significance

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

Table 6-19: Impact Significance – Ecology

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

	With Mitigation	Local	Long	Low	**Minor**

6.3.2.4 Soil Quality

Impacts

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

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

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

Mitigation Measures

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

Significance of Impact

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

Table 6-20: Impact Significance- Soil Quality

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

6.3.2.5 Health and Safety

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' health and safety during operation phase due to exposure to risks such as:

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

Mitigation Measures

RGSEPL will implement the following measures:

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

Significance of the Impact

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

Table 6-21: Impact Significance – Health and Safety

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

6.3.3 Decommissioning Phase

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 revegetation.

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

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

Mitigation Measures

The mitigation measures for decommissioning shall include:

- All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site;
- All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work;
- RGSEPL will be committed to ensure all health and safety measures are in place to prevent accidents and\or reduce the consequences of non-conformance events;
- Institution of suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.

Significance of the Impact

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

Table 6-22: Impact Significance – Decommissioning Phase

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

6.4 Socio-Economic Impacts

The solar power project will have potential socio-economic impacts on the community and the surrounding areas. This section intends to elaborate on the anticipated impacts and suggest appropriate mitigation measures.

6.4.1 Pre-Construction Phase

Impacts

Impacts identified on socio economic conditions of the area can be related to:

- Loss of Land: Although the entire land parcel procured for the project falls under revenue land classification. A small portion of the land parcel in one corner was being utilized by the community members for cultivation purposes. On consultations with the community members it was stated that there were three (03) community members who claimed that they used to cultivate crops for consumption purposes only. However they did not have any legal rights on the land parcel.
- Increased Community expectations: The associated impact of the coming of a project in the area leads to increase in the expectations of the community members with regard to the increase in employment and contractor opportunities and improved infrastructure.

Mitigation Measures

- The project proponent shall endeavour to provide employment to the local workforce and on absence of required skill set could employ migrant workers.
- The project proponent shall endeavour to primarily engage local contractors and vendors.

Significance of the Impact

The socio-economic impact value has been provided below:

Table 6-23: Socio-Economic Impact Value-Pre Construction Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall

Loss of Land	Without Mitigation	Local	Medium	Low	Minor
	With Mitigation	Local	Medium	Low	Minor
Increased Community Expectations	Without Mitigation	Local	Medium	Low	Minor
	With Mitigation	Local	Medium	Low	Minor

6.4.2 Construction Phase

Impacts

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

Migrant Labour Engagement

Influx of migrant labourers: In the construction phase it is anticipated that the project proponent will hire skilled workers for specialized work. During the site visit it was observed and stated by the site representative that skilled workers from Rajasthan had been hired for the specialized work. At the time of the site visit there were thirty five (35) skilled workers from Rajasthan. They have been provided accommodation on the project site. There were no women migrant workers engaged in the project at the time of the site visit. There can be a possibility of tension between the local population and workers on the employment of migrant workers for the project.

Impact on existing resources: The influx of migrant workers would lead to pressure on the existing resources such as water supply, waste handling and management, sewage disposal etc. There can be a possibility of friction between the local population and the migrant workers on the usage of these resources.

Impact on the local customs and traditions: With the influx of migrant workers to the project location, the existing local customs and traditions become vulnerable as due to assimilation and intermingling there is a potential for the existing customs and traditions to lose their significance and disrespectful attitudes towards customs and traditions.

Community Health Impacts from Migrant Workers: There is a possibility of increased spread of communicable diseases such as Malaria, Tuberculosis, STD's and AIDS with the influx of migrant labour workforce and their interaction with the local workforce population and the community members.

Increased Vehicular Movement

Increased risk of traffic related accidents and injuries to workers and community members: Increased vehicular movement is anticipated during the construction phase. Transport of raw materials will be done by heavy vehicles. The movement of such vehicles may increase the risk of traffic related incidents in the project area.

Mitigation Measures

- It shall be encouraged by the project proponent to engage local workforce population wherever possible.
- It shall be encouraged by the project proponent that local contracting and vendor opportunities shall be engaged for the project.
- The contractor shall ensure that the labour campsite is well managed. Adequate sanitation and waste disposal facilities are to be arranged.
- The contractor should conduct a medical check-up camp on the arrival of the migrant workforce to identify and mitigate communicable diseases.
- The contractors are to sensitise the migrant workforce on the local customs and traditions.
- The contractors are to intimate the security agency engaged by them to monitor the entry and exit of labour workforce from the campsite area.
- Trained drivers with valid license shall be recruited by the contractor.
- Regular maintenance of vehicles and use of manufacturer approved parts should be adopted.

- The community members shall be made aware about the schedule prior to the movement of trucks and transportation of solar panels in the project area.

Significance of Impact

The socio-economic impact values during construction phase have been provided below:

Table 6-24: Socio-Economic Impact Value during Construction Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Migrant Labour Engagement	Without Mitigation	Local	Medium	Moderate	Minor
	With Mitigation	Local	Medium	Low	Minor
Increased Vehicular Movement	Without Mitigation	Local	Medium	Moderate	Minor
	With Mitigation	Local	Medium	Low	Minor

6.4.3 Operation Phase

Impacts

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

- Impact on Local Economy: During the operation phase, the impact on the local economy is anticipated to be positive. The local vendors and contractors are expected to get work orders for operation of the project. There is a likelihood of increase in employment opportunities of the local people as security personnel and house-keeping workforce. Revenue generation possibilities such as opening of shops by the local people are also a possibility.
- Upgradation of Local Infrastructure: With the coming of the project proponent to the area, it is expected that the project proponent will invest in the local infrastructure development such as existing village road.

Mitigation Measures

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

- The project proponent should wherever possible engage the local workforce population for unskilled jobs.
- The project proponent shall ensure that while engaging contractors and sub-contractors during the operation phase agreements on priority basis shall be made with local contractors and vendors.

Significance of Impact

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

Table 6-25: Socio Economic Impact during Operation Phase

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

6.4.4 Decommissioning Phase

Impacts

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

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

Mitigation Measures

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

Significance of Impact

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

Table 6-26: Socio-Economic Impact during Decommissioning Phase

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

6.5 Cumulative Impacts

The proposed solar project of 43 MW is located at Badod Tehsil. Apart from this proposed project, there is a solar project adjacent to boundary of the proposed 43 MW Solar project .The operational solar project located adjacent to the proposed solar project is of 20 MW owned and operated by Today's Green Energy.

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

6.5.1 Visual Impacts

The cumulative impacts due to presence of two solar plants in the vicinity on visual aesthetics of the area will be limited to glare potential. The results of the cumulative glare assessment have been presented in Section 6.3.2.1.

6.5.2 Impacts on Groundwater Resources

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

6.5.3 Impacts due to Improper Waste Management

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

It is essential that both the operational projects obtain Hazardous waste authorisation from MPPCB for generation of hazardous waste at within site. Therefore, the projects shall comply with all the storage, transportation and disposal rules as specified in the Hazardous Waste Management Handling and Trans-boundary Movement Rules 2016 in order to mitigate the cumulative impacts.

6.5.4 Socio - Economic Impact

There are certain socio-economic impacts anticipated with the existing and proposed solar farm projects in the study area:

- Change in Livelihood Opportunities
- Upgradation of Local Infrastructure

Change in Livelihood Opportunities

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

Upgradation of Local Infrastructure

The existing and proposed solar farm projects would most likely prepare Community Social Responsibility (CSR) activities for the benefit of the community members in the villages of Kishankot and Hatipura. This would lead to the development of existing infrastructure and possibilities of development of new infrastructure facilities in the area.

Change in Land Use Pattern

The land use of Kishankot and Hatipura villages is primarily agricultural land. With the existing and the upcoming solar power projects in the area, the land use pattern of the village would convert from agricultural land to industrial land.

7. Analysis of Alternatives

7.1 Introduction

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

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

7.2 No Project Scenario

As per the Load Generation Balance Report, Ministry of Power, Government of India, the anticipated energy requirement for the state of Madhya Pradesh is 65,675 MU against the availability of 70,890 MU for the year 2015-2016. The power requirement and availability for the year 2015-2016 has been estimated as 10,489 MW and 11,672 MW respectively indicating a power surplus of 1,183 MW which is around 11%.Although these figures suggest that Madhya Pradesh is an energy surplus state but looking at the aggressive growth targets of setting up solar power plants of around 100,000 MW across India by 2020 under Jawaharlal Nehru National Solar Mission, there seems to be a progressive deficit.

The current energy scenario of the state of Madhya Pradesh as per Central Electricity Authority (CEA)[16] has been presented in *Table 7-1:*

Table 7-1: Power Forecasts for Madhya Pradesh (2015-16)

Parameter	Requirement	Availability	Surplus(+)/Deficit (-)	Surplus(+)/Deficit (-)%
Electrical Energy Requirement (GWh)	65,675 MU	70,890 MU	5,215 MU	7.9 %
Peak Electric Load (MW)	10,489 MW	11,672 MW	1,183 MW	11.3 %

Source: Central Electricity Authority

In order to bridge this gap between the current capacity and targets, renewable/non-conventional sources of power are required to supplement the conventional sources. The proposed project being a non-conventional source of power generation intends to contribute towards bridging the demand supply deficit as projected.

India is located in the equatorial sun belt of the earth, thereby receiving abundant radiant energy from the sun. The Meteorological Department of India maintains a nationwide network of radiation stations, which measure solar radiation, and also the daily duration of sunshine. In most parts of India, clear sunny weather is experienced 250 to 300 days a year. The annual global radiation varies from 1600 to 2400 kWh/m^2, which is comparable with radiation received in the tropical and sub-tropical regions. The equivalent energy potential is about 6,000 million GWh of energy per year. *Figure 7-1* below shows the map of India with solar radiation levels in different parts of the country. It can be observed that highest annual global radiation is received in Rajasthan, northern Gujarat, parts of Andhra Pradesh, Madhya Pradesh, Maharashtra, Rajasthan and Ladakh region which also receive fairly large amounts of radiation as compared to many parts of the world especially Japan, Europe and the United States, where development and deployment of solar technologies is maximum. Theoretically, a square piece of land, 55 kilometres each side, in the empty desert, is enough to meet India's current energy demand. With more than 300 sunny days each year, large parts of Rajasthan, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu and Madhya Pradesh can produce 4.0 - 6.4 kilowatts per square metre. Sparsely populated, these areas are ideal for solar energy.

[16] 17th Electric Power Survey

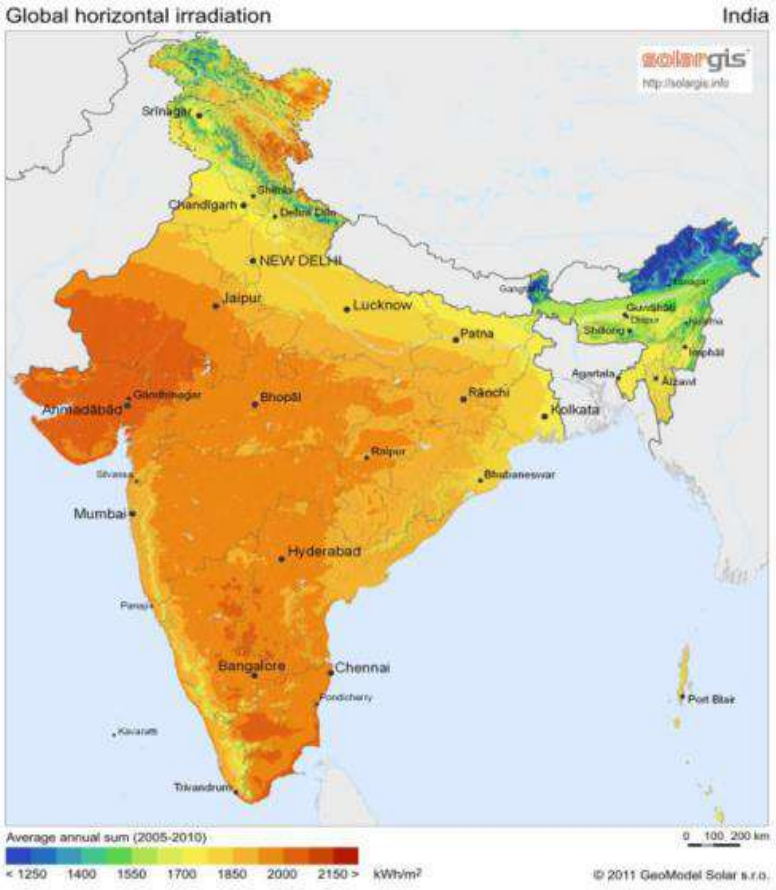


Figure 7-1: Solar Power Potential Map of India

Solar Radiation at Site

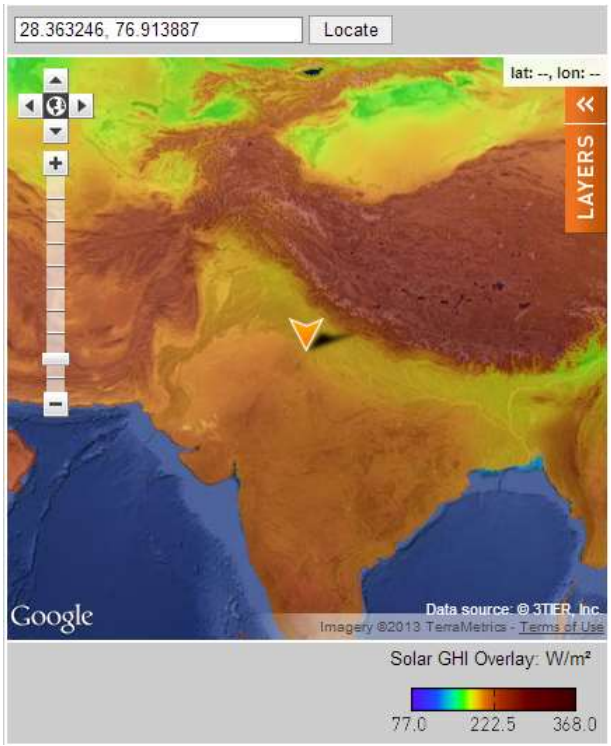


Figure 7-2: Solar Irradiation map for India (source: 3 Tier)

Figure 7-2 represents the solar irradiation map for India. From the above distribution, the Average Global Horizontal Irradiation for Agar Region comes out to be in the range of 1900 kWh/m^2 to 2050 kWh/m^2. The monthly average irradiation on ground for the site is as follows:

Table 7-2: Monthly Average Irradiation

Month	Average Monthly GHI (kWh/m2/mth)
January	142
February	155
March	203
April	213
May	225
June	189
July	145
August	138
September	161
October	174
November	144
December	136

Source: Detailed Project Report

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

7.3 Alternate Scenarios

7.3.1 Alternative site location

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 Madhya Pradesh receives good amount of solar irradiation. The project proponent has carried out assessment studies in order to understand the power generation potential of the site. Mean global daily irradiation on a horizontal plane was observed to be in the range of 3.94 - 6.67 kWh/m^2/day for the proposed site using different solar irradiation data sources. The following additional criteria have been considered for site selection:

- The sites are located away from major settlements;
- The sites do not fall under any reserved or protected forests;
- The land procured for the site comprises of revenue land which is barren in nature and practically unusable for any other purpose; and
- No environmentally sensitive features such as water bodies, forests, archaeological sites are located in the immediate site surroundings.

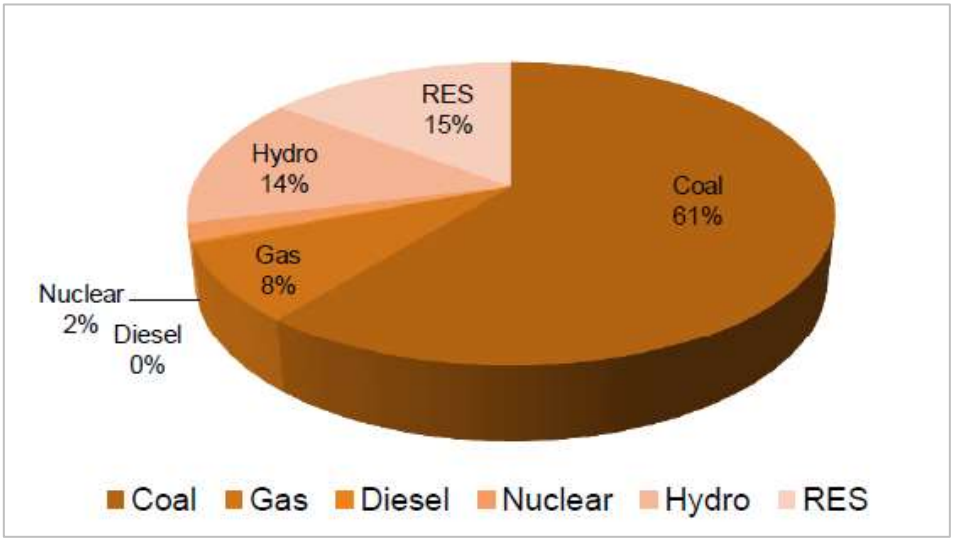
Considering all the above details of the location and site settings, the identified site was chosen as a suitable option for the project.

7.3.2 Alternative Sources of Power Generation

India has an installed capacity of 308.83 GW as of 30th November, 2016. In terms of fuel, coal-fired plants account for 60.8% of India's installed electricity capacity followed by renewable energy and hydropower which accounts for 14.9% and 14.0% respectively. Gas fired thermal power plants and nuclear plants account for 8.2% and 1.9% respectively. The source wise installed capacity in India is presented in *Figure 7-3*. The various power generation options as discussed in the earlier section can be evaluated on the levelised cost of power generation which includes the capital and O&M costs, reliability of power generation in terms of plant load factor and the

greenhouse gas (GHG) emission. The comparative analysis of various power generation options based on these factors has been presented in **Table 6-8**.

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



Source: Ministry of Power, 2012

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

Figure 7-3: Source wise installed capacity

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

Table 7-3: Comparative analysis of Various Power Generation Options

Alternative	Cost (₹/kWh) *	Plant Load Factor **	Average Lifecycle GHG Emission (tonnes CO2e/GWh) ***
Coal	2.5	65 – 85%	888
Natural Gas	3.9	70 – 85%	500
Hydro Power	3.8	30 – 50%	26
Nuclear Power	2.5 – 5.7	65 – 85%	28
Wind Energy	4.2	25 – 40%	26
Solar	15.3 – 17.1	10 -15%	85

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

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

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

states have come up with their state Solar Policies to provide an enabling framework for growth of Renewable Energy in India.

The proposed power plant has been allotted by Solar Energy Corporation of India (SECI) under Jawaharlal Nehru National Solar Mission (JNNSM) Phase II, Batch III for Karnataka. The benefits of the Jawaharlal Nehru National Solar Mission (JNNSM) which is part of the eight mission documents under India's National Action Plan on Climate Change (NAPCC), and a significant contribution to low carbon sustainable development strategy for the Indian economy are as follows;

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

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

7.3.3 Alternate Technology for Project

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

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

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

Figure 7-4: Comparison of GHG Emission from Different Sources

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

The energy accumulated from the solar panels will be converted from DC to suitable AC power for feeding to the grid and subsequently to the Substation. This process is environmentally advanced than creating battery bank for storage of energy, which minimizes the hazards related to handling and disposal of batteries. A comparison of the characteristics of the most popular cell technologies have been presented in *Table 7-4:*

Table 7-4: Characteristics of some PV Technology Classes

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

7.3.4 Alternate Routes of Transmission Lines

Power from the solar PV plant is proposed to be evacuated to the grid substation at Barod which is located at a distance of about 4 km from the site. The route for the transmission line has been selected based on the following factors:

- Transmission line route has been planned to avoid any habitations along the route;

- Right of way has been secured on revenue land and private agricultural land has been avoided;
- Areas requiring extensive clearing of vegetation have been avoided; and
- Selection of the transmission route avoids any environmental sensitive site.

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

7.4 Conclusion

Under India's National Action Plan on Climate Change (NAPCC), the Jawaharlal Nehru National Solar Mission (JNNSM) was introduced with aggressive targets to achieve 100,000MW of solar power by 2022. With these targets achieved, low carbon sustainable energy would become a substantial share contributor in the total energy requirements in India by 2020. The Government of India has been playing an encouraging role in promoting the production of solar energy in such scales with subsidies and facilitating the process.

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, mode of power generation, selections of technology, transmissions lines etc., is appropriate alternative and is beneficial for the region.

8. Environmental and Social Management Plan

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

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

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

RGSEPL is committed to ensure compliance to all the commitments towards Environment, Social, Health and Safety Standards while executing all the project related activities to 43 MW Solar Power Project. This ESMP is applicable to all the employees of RGSEPL, primary contractors and other sub-contractors if any, engaged during the project lifetime.

8.1 Organization structure

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

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

The project does not foresee any significant adverse social and environment impacts or risks as indicated in the previous sections. The project footprint area is limited to its immediate vicinity and a particular range of stakeholders. It is proposed that the RGSEPL provides professional HSE training to the site-in charge so that along with the technical project aspects he will be capable of supervising the environment, health and safety issues at the site. The HSE supervisor/site in-charge will work in coordination with the HSE staff of contractor. It is proposed to appoint a social officer at project level, who will work in coordination with the contractors and stakeholders for managing the social (including 3rd party workers, staffs and neighbouring community) issues. The proposed organizational structure for project has been presented in *Figure 8-1* below:

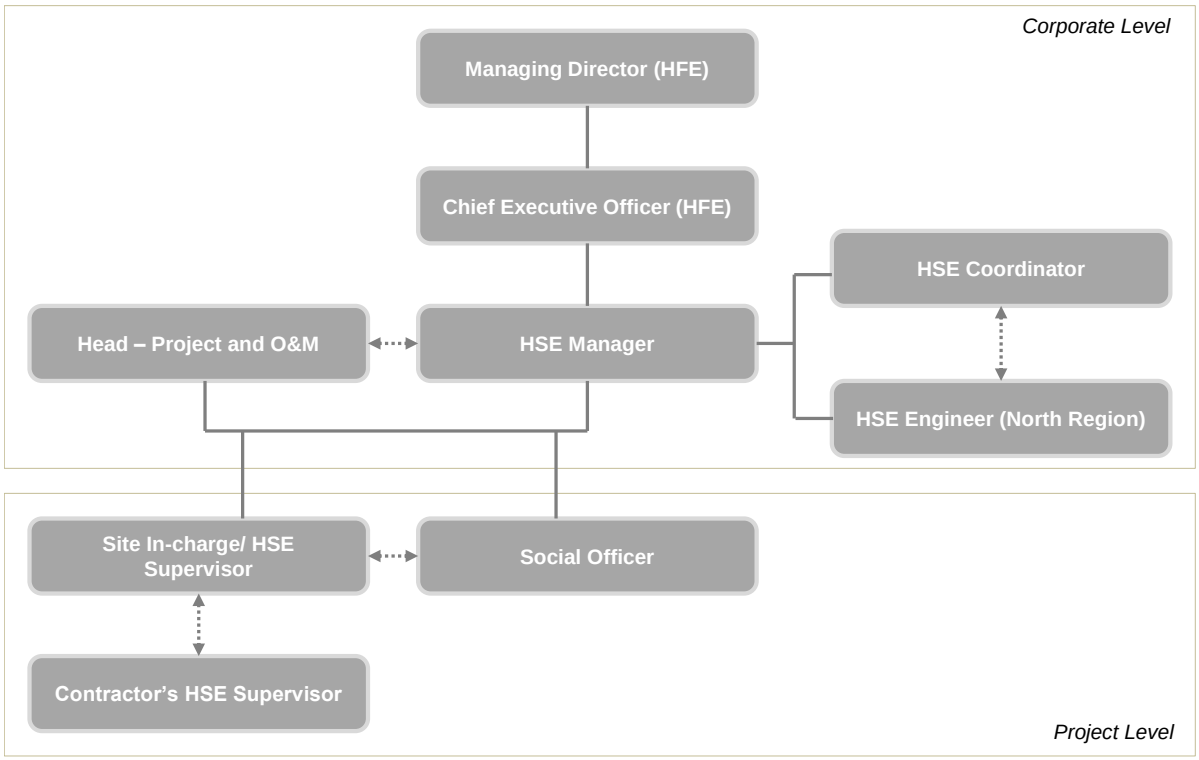


Figure 8-1: Organization Structure for ESMP Implementation

8.1.1 Roles and Responsibilities

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

Site In-charge (RGSEPL)

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

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

HSE Engineer (RGSEPL)

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

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

EHS/ Safety Officer (EPC Contractor)

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

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

Social Officer (RGSEPL)

The Social Officer will have the following responsibilities:

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

8.2 Monitoring and review process

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

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

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

8.3 Reporting and documentation

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

- Documented Environment Management System;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register and issues attended/closed.

8.4 Training

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

An environmental and social management training programme shall be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme shall ensure that all concerned members of the team understand the environmental aspects of the project.

A basic occupational training program and specialty courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards. Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin.

Following are the basic trainings that shall be imparted to the employees, contract workers and community:

Table 8-1: Training Requirements for the project

Topic	Training Content	Targeted Audience
General Project Awareness	• Benefits of the Project • Type of land required for the project • Possible employment Opportunities	Local Communities
Environmental and Social Management training	• Purpose of action plan for the project activities; • Requirements of the specific management plans • Understanding of the sensitive environmental and social features within and surrounding the project areas; and • Understanding of the potential risks from the project activities;	Site Level Officers of EPC Contractor and HFE/RGSEPL and Contract Workers
Occupational Health & Safety Training	• The importance of conforming with all HSE policies; • The HSE impacts of the proposed activities; • HSE benefits of improved personal performance; • Worker roles and responsibilities in achieving conformance with HFE's HSE policy, procedures and this ESMP including associated procedures and emergency preparedness and response requirements; • Mitigation measures required to be implemented when carrying	Site Level Officers of EPC Contractor and HFE/RGSEPL and Contract Workers First Aiders and Fire Fighters

Topic	Training Content	Targeted Audience
	out their work activities. • Use of PPE; – Job Safety analysis – First aid trainings and awareness regarding medicines; – Fire drills and usage of fire extinguishers at the time of emergency; – Maintaining accident and incident investigation reports	

8.5 Project specific Management Plans and Procedures

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

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

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

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

8.5.1 Stakeholder Engagement Plan

Stakeholder Engagement is the process of engaging the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project as well as those who may have interests in a project and/or ability to influence its outcome either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interest, the academic community and other businesses.

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

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

- ***Community Liaison Officer/CSR Officer/Grievance Officer at the Site level:*** The Community Liaison Project Liaison Officer shall be responsible for the implementation of the stakeholder engagement and consultation activities. The Community Liaison Officer in consultation with the HSE Supervisor at the site level shall develop resources and plan for the consultation activities to be conducted. Documentation of all processes such as identification and engagement activities with stakeholders is imperative and shall be done by the Community Project Liaison Officer/CSR Officer.

- ***HSE Supervisor at the Site Level:*** The HSE Supervisor shall assist the Community Liaison Officer/CSR Officer/Grievance Officer to develop stakeholder engagement activity plan for the financial

year. The responsibility for assistance with the execution and implementation of the activity would also be the incumbent's responsibility.

- ***CSR Head/Human Resource (HR) Head at the corporate level:*** The CSR Head/HR Head shall be responsible for the overall budgeting and monitoring of the stakeholder engagement activities undertaken at the site level. Impact Assessment reports should be reviewed by the CSR Head/HR Head and shall determine the feasibility of the implementation of the activity.

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

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

8.5.1.1 Stakeholder Identification and Analysis

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

8.5.1.2 Methods for Stakeholders Engagement

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

Communicative Methods

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

Table 8-2: Communicative Methods

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

Communicative Methods	Objective	Relevance
	Decentralization and Empowerment of the local people.	

8.5.1.3 Information Disclosure

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

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

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

8.5.1.4 Monitoring and Reporting

Internal audits of the stakeholder engagement program should be done. The frequency of the internal audits should be decided upon at the corporate level. Review of the applicability, execution and feedback/response to the programme should to be done. At the site level, the Community Liaison Officer and the HSE Supervisor shall be responsible for the monitoring of the stakeholder engagement activities that have been done and CSR Head/HR Head at the corporate level shall be updated on the stakeholder engagement activities at the site and shall review the stakeholder engagement activities and provide feedback on its implementation.

Record-Keeping of the following should be done:

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

8.5.2 Grievance Redressal Mechanism

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

8.5.2.1 Importance of Grievance Redressal Mechanism

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

8.5.2.2 Stages of Grievance Redressal Mechanism

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

- *Development of Procedures:* RGSEPL shall ensure that there is a procedure in place at the site level to lodge and register complaints. Identification of a community liaison officer is the foremost step to develop a grievance redressal mechanism. It should be followed by the procedure of receiving complaints, assessment of complaints, procedure to identify the appropriate resolution path and decision making on the final resolution process. These procedures are to be given appropriate time frames to ensure effective and suitable redressal.

- *Development of Responses and Suitable Options:* The second step would be to develop appropriate responses for the received/anticipated grievances. Procedures to reach an appropriate resolution should be in place. It could include formal or informal procedures to reach a resolution such as discussions and negotiations. Resolutions can be reached through mediation with the intervention of a third-party generally a community leader or prominent member of the community.

- *Publicise the Grievance Redressal Mechanism:* There is a requirement to publicise the grievance redressal mechanism as when there is awareness creation of the mechanism there will be increased involvement of the stakeholders. Information dissemination to the local community comprises of the next step. The publicising of the GRM can be done through stakeholder engagement activities such as focus group discussions, local community meetings, and development of communicative methods such as printing of pamphlets with the telephone number of the Grievance officer, installation of grievance boxes at suitable locations, updating of websites etc. The GRM should be documented both in the native language (Hindi) and English for wider outreach.

- *Training on Grievance Redressal Mechanism:* As the GRM is now in place, it is a prerequisite that the community members and the workers are informed on the procedures involved in the mechanism. For the workers, at the time of recruitment and formal induction programme they can also be trained on the workings of the GRM. During these trainings the whole process of the GRM should be discussed. It includes the identification and appointment of a local point of contact, process of registering a grievance, timelines for redressal of the complaints and information on the personnel involved in the redressal process.

- *Recording of Grievances:* After the dissemination of the provision of the Grievance Redressal Mechanism, RGSEPL shall start receiving and addressing the grievances. Required grievances boxes, record books and tracking form should be in order to address and record the grievances.

- *Resolution and Follow up Action:* On receiving the complaints and grievances, the corrective action to be taken should be discussed and implemented within stipulated time frames in each level. Record of follow up action in the form of photographs, agreements between the project proponent and the complainant should be documented for reference purposes.

- *Appeals:* On account of the complainant not being satisfied with the follow up action, the individual should be offered an appeal process. Involvement of the RGSEPL in the appeal process is encouraged to maintain transparency and accountability.

8.5.2.3 Proposed Grievance Redressal Mechanism

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

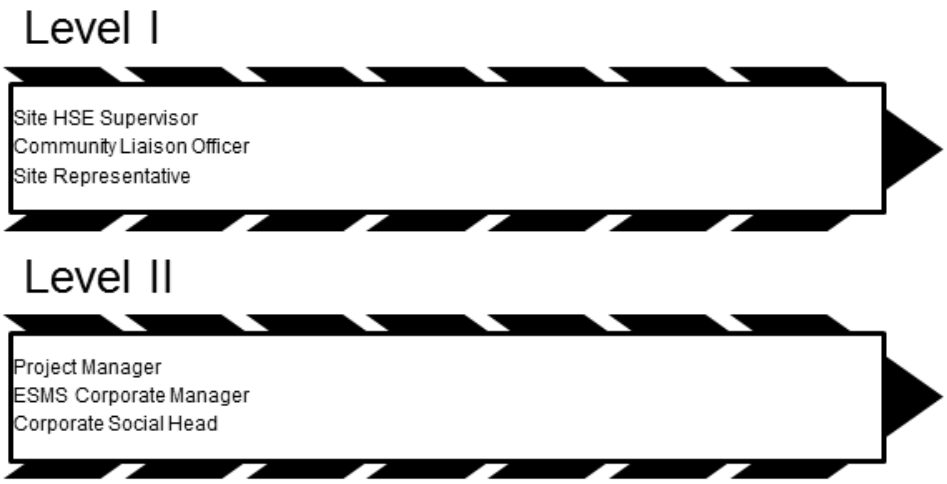


Figure 8-2: Levels of Grievance Redressal Committee

Community Liaison Officer can be designated as the point of contact at the site level. The functions of the Grievance Redressal Committee are:

- To record grievances brought up by the community members and the workers/management staff.
- To assess and prioritize the grievances and redressal of the grievances within a stipulated time-frame.
- To inform the aggrieved community members and workers/management staff on the progress of the grievance redressal and the outcome or decisions taken by the committee.
- Grievance Redressal Committee at the site level should inform the concerned at the corporate level at the event of escalation.
- Grievance Redressal Committee should proactively analyse the received grievance and accordingly act towards redressing it.
- To continually review the existent Grievance Redressal Mechanism and its applicability on the basis of local customary tradition and culture. Thereafter should initiate systemic reforms/modifications if required for better connectivity and implementation of the GRM.

8.5.2.4 Stages of Grievance Redressal Mechanism

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

Receive and Register a Complaint

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

Assessment and Addressal of the Complaint

- The Community Liaison Officer is advised to check and open the grievance boxes every fifteen (15) days.

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

Documentation and Reporting

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

- Grievance Tracking Form: A Grievance Tracking Form should be prepared. It will enable the GRC to trace the grievances and present similar responses.
- Grievances Record Book: GRC will maintain a record book containing all the received complaints and the actions taken. The record book should include the following details:

  1. The Name of Complainant (optional in case anonymity is asked to be maintained)
  2. Date of the complaint
  3. Nature of the complaint
  4. Follow-up Action/Redressal of the complaint
  5. Date of communication to the complainant of the final result
  6. Implementation of the decision.
  7. Appeals to higher levels (if any).

- Maintenance of Minutes of Meetings: The Community Liaison Officer shall be responsible for maintaining the minutes of Meetings with stakeholders, complainants and grievance redressal committee.

8.5.2.5 Engagement of Third Party

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

8.5.2.6 Monitoring and Reporting

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

Monitoring: Depending on the extent of project impacts and the volume of grievances, monitoring measures like internal (identified corporate level staff) and external audits (third party consultants) based on the complexity of the grievances received can be adopted by RGSEPL. The frequency of the audits can be decided upon by the

corporate level. Through the review and analysis of each grievance and its analysis of its effectiveness and efficiency RGSEPL can draw on the complaints to evaluate systemic deficiencies. In addition monitoring of the grievance mechanism helps ensure that the design and implementation of the mechanism in adequately responding to stakeholders grievances in a cost effective manner.

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

8.5.3 Waste Management Plan

8.5.3.1 Scope and Purpose

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

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

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

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

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

- Minimize the potential to cause harm to human health and the environment.
- Comply with IFC's PS and with Indian Environmental Regulations.
- Reduce operational costs and any potential liabilities which may arise from waste handling operations.

This plan also ensures that every waste stream and solid waste materials from the main plant site and the associated facilities will be managed effectively.

8.5.3.2 Waste Characterization

Construction Phase

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

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

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

- Oily rags;

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

Operational Phase

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

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

8.5.3.3 Waste Handling, Management and Disposal

Construction Phase

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

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

Operation Phase

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

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

- The designated area should be isolated and to be established on an impervious surface;
- Proper PPE are provided to the workers handling the broken solar panels;
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of solar panels.

8.5.4 Environment and Social Management Plan

The ESMP aims at ensuring the implementation of proposed mitigation and monitoring measures along with the responsible entity for implementation. Although the ESIA process does not reveal any significantly high adverse impacts due to the project, the following *Table 8-3* provides mitigation measures that further reduce the severity of identified adverse impacts on land and environment due to the project activities.

Table 8-3: Proposed Environment and Social Management Plan

S. No.	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
Pre-construction and Construction Phase				
1	Soil Quality	▪ Removal of vegetation and soil cover will be restricted to only those areas necessary for the development; ▪ Stockpiles will be covered to reduce soil loss as a result of wind or water erosion. ▪ Work areas will be clearly defined. ▪ Fuel, lubricating oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material. ▪ Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed. ▪ Construction vehicles and equipment will be serviced regularly and off site. ▪ Construction vehicles will remain on designated and prepared compacted gravel roads.	Visual inspection of storage material. Storage location of fuel, lubricating and used oil.	RGSEPL to ensure compliance by construction contractors and sub-contractors
2	Water Resource, Storage and Quality	▪ The natural slope of the site will be maintained to the extent possible in order to avoid any change in the drainage pattern. ▪ Storm water flow will be directed to the existing channel and nearby water bodies with silt traps to avoid sedimentation; ▪ It is to be ensured that pre-treatment is provided to ground water (after taking pre-requisite approvals) if it is utilized for drinking; ▪ Portable toilets provided shall be self-contained and cleaned and disinfected on weekly basis by cleaners hired by construction contractor;	Testing of ground water quality for drinking water standards. Visual inspection of natural drainage lines to check contamination or flow of sediments	RGSEPL to ensure compliance by construction contractors and sub-contractors
3	Air Quality	▪ Sprinkling of water to be carried out to suppress dust from construction, stock piles and transport movement; ▪ All stock piles are covered and storage areas provided with enclosures to minimize dust from open area source; ▪ Open burning of solid waste or packaging material will be strictly prohibited; ▪ Vehicles engaged for the project will be required to obtain “Pollution under Control” (PUC) certificates. Sufficient stack height needs to be provided to D.G. sets as per CPCB norms.	Undertake ambient air quality monitoring at construction locations and at labour camp (PM_{10}, $PM_{2.5}$ NOx and SOx)	RGSEPL to ensure compliance by construction contractors and sub-contractors
4	Ecology	▪ Activities generating high noise will be restricted to day time and will be mitigated to minimize the noise level outside the site boundary. ▪ Recovery of vegetation under the PV panels and in other places that do not need to remain	The entire workforce shall be sensitized (by the construction contractor) to possible adverse ecological impacts	RGSEPL to ensure compliance by construction contractors and sub-contractors

S. No.	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		cleared should be encouraged. ▪ Movement of construction and transport vehicles will be restricted to dedicated paths to minimize any harm to small mammals within the site. ▪ Transportation of construction material will be kept to day time hours in order to minimize noise and disturbance to fauna in the area.	during the construction phase by conducting awareness programs.	
5	Generation of Noise	▪ Instruct its contractor to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. ▪ Only limited construction activities shall be carried out during night-time. ▪ The hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas should be limited. ▪ It is also to be ensured that village road connecting Hatipura and Kishankot villages is not utilized for movement of equipment reducing project traffic through community areas. ▪ All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary. ▪ Rubber padding/noise isolators will be used for construction equipment/machinery. ▪ Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. ▪ PPEs will be provided to personnel involved in high noise generating activities. ▪ Construction vehicles and machinery will be well maintained and not kept idling when not in use.	Installation of Temporary noise barriers Usage of PPEs in high noise areas.	RGSEPL to ensure compliance by construction contractors and sub-contractors
6	Traffic and Transport	▪ It is recommended that the proposed access road is constructed prior to site clearance activities. ▪ Only trained drivers with valid license shall be recruited by the construction contractor. ▪ Training programs shall be conducted for all the drivers for raising awareness about road safety. ▪ Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents.	Monitor Vehicles PUC certificates; Training Records of Drivers Engaged to be maintained	RGSEPL to ensure compliance by construction contractors and sub-contractors
7	Occupational Health and Safety	▪ RGSEPL shall formulate a site specific Emergency Preparedness and Response Procedure. ▪ RGSEPL shall ensure that adequate training is provided to staff about raising awareness about use of Personal Protection Equipment (PPE) and emergency response measures. ▪ RGSEPL shall introduce administrative controls into work processes such as job rotation, rest and stretch breaks etc. to reduce overexertion. Work site layout will be well planned to avoid manual transfer of heavy loads. ▪ It shall also ensure good housekeeping at the construction site to avoid slips and falls. Excessive waste debris and liquid spills will be cleaned up regularly. ▪ PPEs such as safety glasses with side shields,	Records and details of PPE usage, Work permits, First Aid and regulatory compliances should be maintained. Accident/ Incident reporting and corrective actions taken	RGSEPL to ensure compliance by construction contractors and sub-contractors

S. No.	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		face shields, hard hats and safety shoes shall be mandatory at construction site. Ear plugs shall be provided for workers placed at high noise areas.		
8	Solid Waste Generation	▪ Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made. ▪ Provision of separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made; ▪ Washing and bathing areas will be provided with proper drainage system so that wastewater is not accumulated in the campsites; ▪ Low lying areas prone to accumulation of water should be sprayed with mosquito repellents on regular basis to prevent health hazards to workers and community; ▪ Disposal of sewage shall be made through a septic tank – soak pit arrangement. ▪ Waste/used oil generated from generators and construction machinery and equipment will be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing the 110 percent of the largest tank to be provided; ▪ The waste oil, which is characterized as hazardous according to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, will be sold to MPPCB approved vendors at frequent intervals; ▪ Empty paint containers will also be stored at a secured area designated for scrap and sold to authorized vendors; ▪ All packaging material will also be collected at the storage area and sold to scrap dealers. ▪ Construction debris and excavated material will be stored in a confined area to prevent spread by wind or water. ▪ The construction debris will be used for backfilling of excavated areas and for foundation works at site and excess soil will be given to the local villagers for filling up of low lying areas in the vicinity. ▪ The scrap metal waste generated from erection of structures and related construction activities will be collected and stored separately in a stack yard and sold to local recyclers.	Visual Inspection of storage areas of hazardous waste. Weekly labour camp inspection.	RGSEPL to ensure compliance by construction contractors and sub-contractors
9	Procurement of Land	▪ Provide employment to the local workforce and on absence of required skill set could employ migrant workers. ▪ Primarily engage local contractors and vendors.	Monitor the skill sets available amongst the community through regular interactions	RGSEPL
10	Influx of Migrant Labours	▪ Engage local population as workforce in the construction activity, as far as possible; ▪ Labour campsite to be well managed. Adequate sanitation and waste disposal facilities are to be arranged; ▪ Contractor should conduct a medical check-up camp on the arrival of the migrant workforce to identify and mitigate communicable diseases; ▪ Contractors are to sensitize the migrant workforce on the local customs and traditions; ▪ Contractors are to intimate the security agency	Records related to wages, age, leave etc. to be maintained; HSE training sessions for all workmen/staffs	RGSEPL to ensure compliance by construction contractors and sub-contractors

S. No.	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		engaged by them to monitor the entry and exit of labour workforce from the campsite area; ▪ Trained drivers with valid license shall be recruited by the contractor. ▪ Regular maintenance of vehicles and use of manufacturer approved parts should be adopted. ▪ The community members shall be made aware about the schedule prior to the movement of trucks and transportation of solar panels in the project area.		
Operation Phase				
1	Visual Aesthetics	▪ The solar panels will be installed at a low height and will be kept closer to the ground so that it does not prop out of the general landscape of the area. ▪ The panels will be arranged in a systematic manner which will give an aesthetic sense to it. ▪ The proposed project would include a boundary wall around the perimeter of the project to further obscure the peripheral view of the project and any indirect reflection. ▪ Installation of shades on the window of houses closest to the plant boundary will solve the issue of glare in Kishankot village.	Records of grievances received pertaining to visual conflicts.	RGSEPL
2	Water resource and quality	▪ The plant site will be provided with adequate drainage facility to drain off wash wastewater and prevent any water-logging at site or in the surroundings. ▪ Wastage of water during cleaning of panels shall be avoided. Various factors such as tilt angle, orientation and tracking are required to be monitored for efficient cleaning of modules. ▪ Ground water shall be extracted only after getting proper approvals from competent authority. ▪ It is to be ensured that water tankers required during operation phase are sourced from authorised vendor. ▪ Rainwater harvesting system by making recharge pits shall be utilised to recharge the ground water. The water harvested will be directed to a recharge pit. ▪ RGSEPL should ensure that rain water collected from the project site will be utilized to recharge the ground water through onsite rain water harvesting tank/pits. ▪ Water use and harvesting/recharging in the project will be a key performance indicator that will be monitored through operation phase of the project.	Ground water sample testing at the project site location. Details of rain water harvesting	RGSEPL
3	Ecology	▪ Vegetation clearing through brush cutting for maintenance activities will be done manually wherever possible. ▪ Any cleared areas which do not have some vegetation cover to protect the soil will be revegetated with locally occurring species and monitored to ensure recovery is taking place. ▪ Vegetation that needs to be reduced in height will be mowed or brush-cut to an acceptable height, and not to ground level except where necessary. ▪ Solar panels will have an anti-reflective coating to minimize the light reflecting off of the panels.	Training the vegetation controlling and cleaning manpower on long term issues of herbicide usage.	RGSEPL

S. No.	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		▪ Strict prohibition on the use of herbicides in the facility and opting for manual weeding to control plant growth in the solar panel area.		
4	Soil Quality	▪ Ensure proper restoration of soil wherever excavation is undertaken. ▪ Explore the option of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise will make arrangements for disposal of defunct panels and waste oil by MPPCB authorised recyclers. ▪ Broken or damaged solar panels will immediately be shifted to a designated area in scrap yard to avoid land contamination. ▪ These broken cells once collected to a certain number will be sent back to the manufacturer with the photographs taken for proper and safe disposal.	Awareness and training about the procedure for proper storage and disposal waste oil and how to act in case of accidental oil spillage; Buy Back agreements for defunct solar panels	RGSEPL
5	Health and Safety	▪ Regular electrical safety training to workers; ▪ Implement Lock out/ Tag Out (LOTO) system; ▪ Use work equipment or other methods to prevent a fall from occurring. ▪ Personal Protective Equipment (PPEs). should be provided to workers handling electricity and related components; ▪ The transformer yard should be provided with fire extinguishers and sand buckets ▪ Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and ▪ An accident reporting and monitoring record shall be maintained.	Workers to be trained for use of Personal Protection Equipment and its importance. All safety related incidents will be recorded and monitored. Training to be provided to the workers regarding health and safety procedures.	RGSEPL
6	Impacts on economy and Upgradation of local Infrastructure	▪ Details of community development activities should be shared with the Panchayat of the village. ▪ Engage the local workforce population for unskilled jobs wherever possible. ▪ Encourage engagement with local contractors and vendors.	Undertaking Community Development Activities according to the plan Stakeholder Engagement and Grievances received	RGSEPL
Decommissioning Phase				
1	Impact on Air, Soil, Noise, Ecology and Socio-Economic Aspects	▪ The proponent shall inform the workers and local community about the duration of work; ▪ The workers shall be clearly informed about the expected schedule and completion of each activity; ▪ A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability; ▪ All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; ▪ All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work; ▪ RGSEPL 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	Information to workers/staffs of close down; Training on safe handling of bulk hazardous wastes generated at site	RGSEPL

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

8.5.5 Environment Monitoring Programme

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

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented in *Table 8-4*.

Table 8-4: Environmental Performance Monitoring

Sl. No.	Topic	Training Content	Targeted Audience
A	**Construction Phase**		
1.	Dust generated from site clearance/ levelling	• Visual observation of dust generation	Daily during site preparation
2.	Noise emissions from vehicles and machineries	• Noise pressure level in dB(A) • Compliance with CPCB noise limits specified for DG sets • Check for valid certificates of Type Approval and also valid certificates of Conformity of Production for equipment particularly DG sets	Quarterly during site Preparation Daily during construction phase
3.	Water resources	• Volume of water sourced and consumed	Daily during construction phase
4.	Fugitive emissions from handling and storage of raw materials	• Visual observation	Daily during construction phase
5.	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during Construction phase
6.	Occupational health and safety	• Health surveillance of workers • Sanitation status of labour camps and canteen • Potable nature of drinking water viz. coliform, pH, TSS, Residual chlorine • Usage of proper PPEs • Safety performance indicators viz. LTIs. Near misses, fatalities etc.	Monthly during construction phase Daily during construction phase
7.	Disposal of sewage	• Visual observation of leaks, Overflows etc. • Odour	Daily during construction phase
8.	Surface run-off Discharge Domestic waste generation, storage, handling and disposal	• Visual observation of water logging due to drainage disruption • CPCB Inland Water Discharge Parameters • Quantity of waste generated and recycled • Visual observation of waste segregation and storage conditions viz. usage of labelled and covered bins, insect repellents etc. • Awareness level of onsite workers	Weekly during construction phase
9.	Hazardous chemicals and waste storage, handling and disposal	• Visual observation of chemical storage conditions viz. presence of spill kits, drip trays, fire extinguisher and display of MSDS etc. • Quantity of waste oil and other hazardous waste generated	Weekly during construction phase

Sl. No.	Topic	Training Content	Targeted Audience
		and recycled to registered recyclers • Awareness level of onsite workers	
10.	Labour Camp Inspection	• Visual inspection of labour camp for accommodation facilities, provision of toilets, housekeeping etc.	Weekly during construction phase
B	**Operation Phase**		
1.	Fugitive emissions	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase
2.	Water resources	• Volume of water sourced and consumed	Daily during operation phase
3.	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during operational phase
4.	Occupational health and safety	• Health surveillance of staffs and other workers • Sanitation status of onsite office building and canteen • Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine • Usage of proper PPEs • Safety performance indicators viz. Near misses, fatalities etc.	Monthly during operational phase Daily during operational phase

9. Conclusion

The Environmental and Social Assessment study for the proposed 43 MW solar power project at Barod, in Agar District of Madhya Pradesh has been undertaken in accordance with IFC's Performance Standards and World Bank's Environment Health and Safety (EHS) Guidelines.

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

The project is assessed to generate limited environmental and social impacts owing to construction related activity which will not extend beyond Solar PV Foot Prints. Mitigation measures for potential impacts on various environmental and socio-economics have been specified through:

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

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

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

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

Appendix A Format for Stakeholder Identification

Name of the Project:_____ Date:_____

Sl. no.	Types of Stakeholders	Description	Groups/Individuals
1.	Direct Stakeholders		
2.	Indirect Stakeholders		

_____

Signature of Community Liaison Officer

Appendix B Format for Recording Summary of Consultation Activities

Name of project: _____ Date: _____

Identified Stakeholder	Objective	Communicative method Utilised	Proposed Timeline	Responsibility

_____

Signature of Community Liaison Officer

Appendix C Format for Grievance Record Register

Name of project: _____ Date: _____

		Particulars of the Complainant			Particulars of the Grievance				
Sl.No	Date of Receipt	Name	Address	Contact no.	Whether acknowledgement given at the time of receipt	Subject of the Grievance	Description of Grievance	Date of acknowledgement	Date of redress

Signature of Community Liaison Officer

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