Final ESIA Report

Environmental and Social Impact Assessment of Wind-Solar Hybrid Project in Rajkot District, Gujarat

Submitted on: **19 January 2023**

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Abbreviations

AC	Alternating Current
AOI	Area of Influence
ASI	Archeological Survey of India
DC	Direct Current
DG	Diesel Generator Set
EHS	Environment, Health and Safety
ESIA	Environmental and Social Impact Assessment
EMF	Electromagnetic Field
ESMP	Environmental and Social Management Plan
GRM	Grievance Redress Mechanism
GHI	Global Horizontal Irradiance
IBA	Important Bird Area
IFC	International Finance Corporation
LULC	Land use Land cover
MoEFCC	Ministry of Environment, Forests and Climate Change
NOx	Nitrogen Oxides
NCEP	National Centre for Environmental Predictions
NREL	National Renewable Energy Laboratory
O&M	Operation and Maintenance
PM	Particulate Matter
PV	Photovoltaic
SECI	Solar Energy Corporation of India
SPV	Special Purpose Vehicle
SO_2	Sulphur Dioxide
WTG	Wind Turbine Generator

Executive Summary

Background of the Project

Fourth Partner Energy Pvt. Ltd. ("FPEL") is India's leading renewable energy solutions company committed to helping businesses switch to cleaner, cheaper renewable power. Since inception in 2010, they have leveraged technology and innovation to become a one-stop renewable energy solutions platform for India's commercial and industrial sectors.

Fourth Partner Energy Pvt. Ltd. ("FPEL") intends to develop a Solar-Wind Hybrid capacity in Jetpur and Gondal Taluka, Rajkot District in the State of Gujarat, India (hereinafter referred as 'Project'). The project includes the 30.1 MW dc/ 20.3 MW ac solar plant, 14 WTGS 2.7 MW each plus one buffer location and associated facilities like access roads, transmission lines, sub-station, water supply arrangements, waste storage areas, nearby villages etc.

Environmental Management Centre Pvt. Ltd. ("'EMC'") was appointed by FPEL to undertake the ESIA study to evaluate environment and social risks and impacts associated with the Project. The ESIA study comprised of a desk-based assessment study, reconnaissance survey, baseline environmental monitoring, primary ecological survey, data analysis and consultations and discussions with relevant stakeholders.

Project Overview

The Scope of Work includes conducting an Environmental & Social Impact Assessment (ESIA) in accordance with IFC PS 2012. The project includes the 30.1 MW dc/ 20.3 MW ac solar plant, 14 WTGS 2.7 MW each plus one buffer WTG location of 2.7 MW and associated facilities like access roads, transmission lines, sub-station, water supply arrangements, waste storage areas, nearby villages etc.

The Hybrid Power Project is located on mixed parcels of government revenue and private land parcels measuring approximately 109.28 acres excluding the land for PSS. The solar power plant component of the Project measuring 74.28 acres has been purchased comprising six (06) parcels from 11 land sellers in Garnala and Betavad villages under Gondal Taluka (sub district) in Rajkot District, Gujarat. The wind power plant section of the Project measuring 35 acres is on government revenue land leased from nine (09) villages namely, Trakuda, Charkhadi, Padavla, Umrali, Valadungra, Jepur, Rabarika, Mewasa and Jambudi under Gondal and Jetpur Talukas, respectively, in Rajkot District.

The project is spread across a flat terrain with mild undulation. The land parcels in the project area are mainly cropland and shrubland. Most of the locations are accessible by internal village roads and unpaved (kutcha) roads. There are no waterbodies in the project area. However, a number of seasonal streams and reservoirs were reported in the study area. During the visit, two critical water bodies: one near solar site and one near Umrali WTG were identified harbouring high count of avifauna. During the visit it was observed that approx. 250 plus trees were present within the solar site boundary and immediate vicinity. No Protected Area/ Reserved Forests/ IBAs are falling within in the study area limits that can be directly impacted by the project.

Applicable IFC Performance Standards

The following IFC's performance standards (PS) are applicable for this project:

- PS 1: Assessment and Management of Environmental and Social Risks and
- Impacts,
- PS 2: Labour and Working Conditions,
- PS 3: Resource Efficiency & Pollution Prevention,
- PS 4: Community Health, Safety and Security.

The following IFC's performance standards are not applicable for this project:

- PS 5: Land Acquisition and Involuntary Resettlement,
- PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources,
- PS 7: Indigenous People
- PS 8: Cultural Heritage

Project Categorization

As part of the review of environmental and social risks and impacts of a proposed investment, IFC uses a process of environmental and social categorization to reflect the magnitude of risks and impacts.

The Project is categorized as **Category B** in line with IFC guidelines. The reasoning for the categorizations is as follows:

- Although, no critical habitats are present within the study area of the project, the project activities have the potential to cause adverse E&S risks and/or impacts that are diverse, irreversible or unprecedented. This is based on the biodiversity risks associated with the identified native and migratory avifaunal diversity and nesting sites around the water bodies and scrublands spread across the project area and the tree species diversity and count within the solar project boundary.
- The project will not lead to the release of emissions or effluents to pollute the environment.
- Noise and Shadow flicker modelling analysis have shown that the noise and shadow flicker impacts are low.
- Social risks and impacts are expected to be limited as the area around the project site is sparsely populated. There are no Indigenous People in project influence area and the project does not trigger involuntary resettlement.
- The project will also generate employment among locals during construction and operational phase of the project.

Key Impacts during Construction Phase

Land

Some activities like, site clearance and preparation for WTGs, solar land and EHV line, establishment and operation of batching plant, site office; and transient storage of WTG and solar components will lead to change in the land use which is primarily agriculture with some scrubland.

The construction phase is expected to last for another 9-10 months, during which period land use change is expected for temporary facilities. Permanent land use change will only be in the solar land and in small land parcels for WTGS and TL towers. As the change is permanent in nature for Solar land, the impact is **'Moderate'**, while only small parcels are involved in wind, therefore this impact is considered be **'Low'**.

Ecology

The WTG installation and TL line construction activities will disturb the nesting habitat of Chestnut-bellied Sandgrouse (*Pterocles exustus*) in the scrublands near Umrali and Rabarika villages. The excavation related activities for laying the foundation for WTGs, if not appropriately barricaded may cause some mammal and herpetofauna to fall in and be trapped or injured. Construction activity may result in temporary increase in heavy traffic and unsafe driving practices on village roads and unmetalled approach roads may lead to roadkill, especially putting at risk herpetofauna and small mammals. Noise from construction activities may disturb waterbirds and nesting birds as some of the WTGs are in close proximity to their roosting, feeding and nesting habitats. Earth will be excavated for making roads, etc. and vegetation clearance will result in habitat modification in the study area. Domestic animals, herpetofauna may temporarily move away from adjacent suitable habitats but may recolonize once the construction phase is over. The project area is not a designated or qualifying site of national and international importance for biodiversity. Hence, from this aspect, the impact is **'Moderate'.**

Drainage Pattern

The land development activity will alter the natural drainage pattern of the area. After the levelling and paving, increment in surface runoff is expected which should be diverted to the natural drainage/canal exists in nearby area. If it is not carried out, then surface runoff from the site may affect nearby landowners which may cause social agitation.

Construction of reinforced cement concrete structures require aggregates from quarries. Although ready-mix concrete is used for the project, the project would indirectly have some contribution in disruption of natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns and ponding caused due to quarries.

Considering the size of solar land, the impacts on drainage will be '**Moderate'** and the impacts at WTG locations will be **'Low'** as a small piece of land would be used.

Soil Contamination

Spills of fuel, oil and grease from construction equipment and transport vehicles; chemicals such as paints, oils, solvents, improperly managed wastewater generated from construction activities on unpaved areas can contaminate the soil. Absence of sanitation provisions in labour accommodation

and site areas could lead to open defecation, thus indirectly causing soil contamination. The waste generated during construction, such as scrap, debris, concrete waste, hazardous waste (waste oil from DG set and equipment, oil filters, oil-soaked cotton, damaged PV panels), food waste from labour accommodation if not stored in an environmentally safe manner can cause soil pollution.

Considering the small footprint of the project and the fact that it is an short term occurrence, the impact may be **'Low'**.

Surface/Ground Water Pollution

Diesel storage for DG sets and other materials like oils, paints, solvents would have to be stored on impervious floors else they have a long-term impact on soil and surface water quality. The project area receives high and erratic rainfall between June to September and relatively low or no rainfall in the other months, and construction activity is not expected in these months. Due to the rocky nature of the land, permeability of water into the ground is significantly low thus lowering the potential to contaminate the groundwater in the area.

Although, several season waterbodies, streams area located in close proximity to solar and the WTG locations, due to the small foot print of the project area, the impact is likely to be '**Low'**.

Noise Pollution

The operation of construction equipment (for activities such as excavation and earthworks, construction of structures, installation of mounting framework and PV panels etc.) and other construction activities such as movement of materials / vehicles will increase the noise levels in the vicinity during the construction phase.

The impacts on ambient noise levels during construction will be directly experienced in the project area and immediate vicinity (not beyond 500 m). Noise attenuates rapidly with distance from the source. The settlement of Padavala is at a linear distance of 0.6 km from WTG PDV-02 and will be directly exposed to the noise generated due to construction activities and this is likely to impact the village although mitigation measures can be taken to ensure that the impact is negligible.

The birds, reptiles and mammals in the project area are likely to be impacted to a limited extent due to the presence of several seasonal waterbodies in close proximity. However, these will be short term and temporary, limited to construction phase. Overall, the impact from Noise can be expected to be **'Low'**.

Occupational Health and Safety

The construction workers and technicians would be exposed to various health and safety hazards that could cause injury or ill health.

The potential safety hazards include:

- Slips, trips and falls due to uneven surfaces, obstacles, trailing cables
- Fall during work at height
- Burns due to hot works
- Electrical shocks
- Collision with construction equipment and transportation vehicles
- Emergencies such as fire, structure collapse

The potential health hazards include:

- Manual handling and musculoskeletal disorders due to typical construction activities such as lifting, lowering, pushing, pulling and carrying that can cause injury.
- Hand-arm vibration due to operation of hand-held or hand-guided power-tools and machines, such as: pokers and compactors, sanders, grinders and disc cutters, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns.
- Temporary or permanent hearing loss from exposure to high noise levels during operation of construction equipment.
- Heat stress and working during high temperatures
- Dermatitis that can arise from contact with substances such as wet cement, asphalt, solvents used in paints, glues or other surface coatings etc.
- Exposure to fugitive dust emissions and exhausts from construction equipment that could cause respiratory disorders.
- Exposure to disease carrying vectors due to poor construction waste management practices.

Although the impacts are short-term and temporary, these may be fatal if the required mitigation measures are not taken. Therefore, the impact is considered to be **'Moderate'.**

Community Health and Safety

During the construction phase, there would be an influx of employees and labour into the project area. As these persons would have cultural differences with the resident population, potential conflicts may arise on issues related to the environment, safety and privacy issues of the women in the surrounding villages, spread of various communicable diseases, nuisance caused by workers due to improper sanitation facilities, etc.

For transportation of raw material and PV equipment, the traffic from heavy vehicles is expected to increase along the district and village roads. This can lead to congestion on road networks around and within the site. The traffic in the area is generally low and this potential increase in traffic can be a nuisance to the villages of Garnala, Padvala, Jepur, Hadmadiya and Umrali, located in close proximity to approach roads leading to WTG locations and the solar site.

All activities during construction causing air pollution and increasing noise levels have the potential to indirectly affect the health of the local community.

The security personnel appointed for protection of the project area during construction could pose risks to the community due to misbehavior.

The impacts related to community, if not appropriately managed, could lead to agitation. Hence impact is estimated to be **'Moderate'**.

Key Impacts during Operation and Maintenance Phase

Natural Resource Consumption

Cleaning of the solar PV modules is to be carried out in two-cycles every month to prevent dust accumulation which can lead to reduced efficiency of the panel output. This includes a wet cleaning cycle that is estimated to consume 137500 ltr of water for the cleaning of 55,000 modules, generally carried out by using a jet spray system or by extendable hosepipes and a dry-cleaning cycle. It is also proposed that robotic cleaning would be used to further reduce water usage if the site condition permits. The water demand for WTG operations is expected to be about 10000 ltr, up to the end of its operation cycle.

It was reported that the water requirement for PV module cleaning shall be met through the installation of borewells in the project area. This may lead to further depletion of water levels in the area. Based on the current plan for cleaning and maintenance of panel and domestic water requirements the impact during operations may be considered **'Moderate'**. The impact due to WTG operations may be considered **'Low'.**

Ecological Environment

The solar PV panels have the potential of creating a **'lake effect'** due to the glass surface reflecting the sky, wherein birds are drawn towards the facility mistaking it for a water body. The birds drawn towards the plant could be electrocuted causing death due to the electrical ancillaries connected to the PV panels.

A number of small and large water bodies surround the project area with the closest water body at an aerial distance of 2km east of the solar land. The presence of these water bodies may trigger the birds mistaking the project area to be a water body as the project area is surrounded by dense vegetation.

Wind Turbines are planned by micro siting to ensure safe distance from critical infrastructure and habitats. Incorrect siting of WTGs may be a hazard to some bat species in addition to birds**,** which is also documented in Kutch region of Gujarat. Additionally nesting sites have been identified near the WTG locations of Rabarika and high soaring raptor activity in Umrali, suggesting that their behavior and habitat may be affected.

Considering that the footprint of Solar land in not sizable, its operational phase impacts on ecological environment will be **'Low'**. Due to the presence of nesting and roosting sites in the form of season waterbodies the impact of operating WTGs may be considered **'Moderate'**.

Shadow Flicker

Modelling was undertaken using Wind Pro, for shadow flickering using worst case scenario considering the Shadow flicker experienced in terms of total hours per year and the maximum minutes per day.

Shadow flicker- Hours per year

1. Only Two (2) settlements, viz. Umrali and Rabarika villages will experience Shadow flicker exceeding the 30 mins per day as prescribed due to three (3) WTGs no. UMR-09, RBR-10 and RBR-06.
2. Two (2) roads will be exposed to Shadow flicker exceeding the 30 hrs per year as prescribed, viz. SH1 near Umarali village due to WTGs, viz. UMR-09, SH123 near Rabarika village due to WTG no. RBR-10, RBR-06 and JMD-02.

Shadow Flicker- Minutes per day

1. Only One (1) settlement, viz. Umrali village will experience Shadow flicker exceeding the 30 mins per day as prescribed due to two (2) WTGs, viz. UMR-09 and UMR-10.
2. Two (2) major roads will be exposed to Shadow flicker exceeding the 30 mins per day as prescribed, viz. SH1 near Umarali village due to WTG no. UMR-09 and SH123 near Rabarika village due to WTG no. RBR-10.

Based on the shadow Flicker modelling, the estimated impact on receptors due to the overall project may be considered **'Low'**.

Soil Contamination

During O&M of the solar PV plant, soil contamination may occur due to the following causes:

- Broken glass pieces of damaged PV modules can change the soil composition over time rendering it unusable for agriculture post decommissioning of the project.
- Wastewater generated from cleaning of the PV module, if not managed, could cause ponding in the solar park and flow of wastewater into neighbouring agricultural fields.
- Unscientific management of electrical waste generated from plant maintenance activities.
- Domestic wastewater generated from plant office.

Similar to a Solar Plant, for a wind power plant the impacts can arise from regular maintenance activities like:

- Spillage of lubricant oil from gearbox system, hydraulic system of the turbine.
- The accidental spillage of oil/ lubricants and hazardous waste in areas designated for storage of WTG spares, components and maintenance material

As any kind of spillage on bare soil can lead to long term impacts the impact is considered to be **'Moderate'.**

Noise Pollution

Estimated noise generated during operation phase was calculated using Windpro software. DECIBEL is the module of the Windpro program used, which calculates the noise emission and checks if the noise requirements are met at neighbors and noise-sensitive areas.

The ambient noise levels at village level were observed to be within permissible limits specified for Residential area as per Noise Pollution (Regulation and Control) Rules, 2000 (without project),

The background noise levels at WTGs locations without project is expected to be within Residential area as per Noise Pollution (Regulation and Control) Rules, 2000, mainly due to absence of any noise generating residential, commercial, or industrial activity.

Only in two (2) settlements the noise levels are expected to cross the 35dB(A), viz. Umrali due to WTG no. UMR-09 and Padavla village due to WTG nos. PDV-01, PDV-02, PDV-03.

As per the Modelling results It is expected that with WTG operation there will not be any major increment in baseline noise levels near WTG locations and identified receptors considering the

maximum background noise and still being well within the specified increment limit of 3 dB(A) as per IFC's General EHS Guidelines indicates the impact to be of low significance.

Solar Plant operations will have negligible or **'Low'** impact on noise in the vicinity as few settlements exist at close proximity Considering the compounded effect of three (3) turbines on the Padavala village the impact is considered to be **'Moderate'** due to operations of WTGs.

Community Health and Safety

The security personnel appointed for protection of the plant could pose risks to the community due to misbehavior. The operation of solar PV plant is not expected to cause any other impacts on community health and safety.

Blade throws due to non-maintenance or dilapidated turbines may impact settlements near WTG locations, putting life and property at risk. However due to the small footprint the impact is considered to be **'Low'**.

Key Mitigation Measures

Mitigation measures and recommendations have been provided in the report in Section 7.2 and Section 7.3. Appropriate mitigation measures have been planned and recommended in the ESIA report. Some of the key mitigation measures for minimizing the impacts on land, soil, natural resources, water, air, noise, ecology, occupational health and safety and community health and safety are as follows:

For Planning, Pre-Construction and Construction Phase

a) Limit the area of clearance to area required immediately for construction. Conduct compaction of the cleared areas. Ensure revegetation of areas post construction. Proper barricading of excavated areas should be carried out.

b) Provide a separate storage area for hazardous materials. The hazardous materials/products must be labelled with proper identification of its hazardous properties.

c) Fuels and liquid chemicals to be stored on impermeable surface and a bund should be provided all around such storage area to prevent spillage in case of leakages.

d) Different types of wastes such as hazardous, construction, e-waste and solid waste such as material, plastic, paper, etc. to be segregated and stored on impermeable surface to facilitate proper disposal. A dedicated area for temporary storage of waste in the project area to be created.

e) Organize regular waste collection and disposal from the project area.

f) Provide toilets with septic tank and soak pit and bathing areas for construction workers.

g) For movement of heavy machinery using existing roads, provide prior information to local communities and avoid movement near sensitive locations or inform drivers to reduce speed in such stretches.

h) Proper water sprinkling of road should be undertaken to reduce the fugitive emissions during transportation.

i) Conduct periodic preventive maintenance of construction equipment and transport vehicles for optimum engine performance.

j) Preserve large trees on site and obtain permission for felling and transport of trees from relevant authorities

k) As per the FPEL team, no tree will be uprooted. However, in case to accommodate the alignment design if uprooting a tree cannot be avoided, then older trees should be transplanted within the project boundary and FPEL should undertake necessary measures to ensure survival.

l) The crane staging area, intervening areas, overhead clearance for suspended turbine components should be planned in such a way that minimum tree felling is required.

a) Ensure clear signages are in place, such as warning of speed limits, obstructions, allowable widths/heights. etc.

b) Provide PPE to construction workers

- Safety shoes, hard hat/ helmet and hand gloves with grip facility to all workers
- Nose masks for those working in dusty area
- Earplugs for those working in high noise areas
- Nitrile rubber gloves to those engaged in painting activities
- Face shield for those engaged in welding

c) First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. to be maintained on site.

d) Record and investigate injuries to workers.

e) Emergency Preparedness and Response plan to be prepared for the project

f) Grievance Redressal mechanism should be followed by FPEL and its sub-contractors. It should be ensured that a complaint register is maintained onsite so that any complaints from the locals or labours can be registered, investigated and timely resolved.

g) Provide labour camp with sanitation, drinking water, medical, cooking facilities and space for recreation activities after work and ensure workers do not use community infrastructure facilities without prior permission from Panchayats.

For Operational and Maintenance Phase

a) Use air nozzles on hose pipes used for water spraying during cleaning of PV modules

b) Ensure water usage is optimized for the processes of cleaning to prevent over extraction of groundwater

c) Obtain required permits for constructing a borewell and extracting ground water from relevant authorities (CGWA/CGWB).

d) Different types of wastes such as hazardous, e-waste and solid waste such as material, plastic, paper, etc. to be segregated and stored on impermeable surface to facilitate proper disposal. A dedicated area for temporary storage of waste in the project area to be created.

e) Damaged PV modules to be disposed through approved vendors

f) DG set with acoustic enclosure to be used.

g) Preventive maintenance of DG set to be carried out periodically. A plan for the same should be prepared.

h) Wind turbines to be designed in accordance with the international acoustic design standards

i) Ensure regular maintenance of the WTG's to ensure the parts have been well oiled to reduce friction between parts.

j) Implement the recommended complaint resolution procedure (Grievance Redress Mechanism) to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved.

k) During site selection of the project, measures are taken to select the WTGs location at least 300 m from all the temporary and/or permanent structures. However, if the settlements are located within the narrow bands (200m), each dweller will be informed about possible negative impacts i.e. noise, shadow flicker, blade throw etc. If the owner is willing to relocate, the structure will be dismantled with agreement and appropriate compensation will be provided as per local/national regulations and in line with IFC PS' physical and/or economic displacement requirements.

l) A complaint resolution procedure to be formulated as part of grievance redressal and stakeholder engagement for the local community so that any issues or concerns associated with shadow flicker are reported to the site staff.

m) Fire extinguishers and sand buckets to be placed at multiple locations across the project area appropriate to the nature of the potential fire.

n) A thorough background check should be conducted for each security personnel.

o) Where feasible, employ local personnel for providing security services.

p) A fencing/ barricade to be created around the project area to prevent stray animals (cattle and other mammals) from entering the project area.

q) Bird diverters should be installed in transmission lines under the control of FPEL, in close proximity to sensitive areas near the solar plant (along identified water bodies) and WTG locations of Umrali and Rabarika villages.

r) Training for carcass monitoring to be provided to security guards and site tram members along with procedures for documenting the same.

s) As the current study is based on a single season survey a seasonal monitoring of bird and bat collisions and carcass to be done once in two years after commissioning near Rabarika and Umrali villages to monitor nesting and roosting behaviour and collision risks for native and migratory birds.

Conclusion and Recommendation

The hybrid project is not likely to have significant adverse impacts that are diverse and unprecedented. It is envisaged to have low to moderate impacts on land use, surface/ground water pollution, drainage pattern, and community health and safety during the construction phase of the project with negligible impact related to fugitive emissions, natural resource consumption and cultural resources in the study area. The impacts related to the operational and maintenance phase are moderate and mostly related to natural resource consumption especially ground water consumption for solar panel cleaning, crucial ecological impacts and contamination of soil due to spillage of hazardous wastes such as used transformer oil, which can be mitigated by adopting appropriate measures. The noise and shadow flicker impact has been assessed as Low to Moderate and can be controlled with the recommended mitigation measures. However, the ecological impacts identified, especially the avifaunal (bird and

bat) collision risks related to critical habitats identified cannot be ruled out and all the recommendations for mitigating these impacts should be implemented.

1 Introduction

1.1 Background of the Project

Fourth Partner Energy Pvt. Ltd. ("FPEL") is India's leading renewable energy solutions company committed to helping businesses switch to cleaner, cheaper renewable power. Since inception in 2010, they have leveraged technology and innovation to become a one-stop renewable energy solutions platform for India's commercial and industrial sectors.

Fourth Partner Energy Pvt. Ltd. ("FPEL") intends to develop a Solar-Wind Hybrid capacity in Jetpur and Gondal Taluka, Rajkot District in the state of Gujarat, India (hereinafter referred as 'Project'). The project includes the 30.1 MW dc/ 20.3 MW ac solar plant, 14 WTGS 2.7 MW (37.8 MW), plus one buffer location, and associated facilities like access roads, transmission lines, sub-station, water supply arrangements, waste storage areas, nearby villages etc.

Environmental Management Centre Pvt. Ltd. ("'EMC'") was appointed by FPEL to undertake the ESIA study to evaluate environment and social risks and impacts associated with the Project. The ESIA study comprised of a desk-based assessment study, reconnaissance survey, baseline environmental monitoring, primary ecological survey, data analysis and consultations and discussions with relevant stakeholders.

1.2 Need for the Study

Solar and Wind Energy projects are not included in the Schedule of the Environmental Impact Assessment (EIA) Notification 2006 that provides a list of projects which need to undergo EIA studies. An Office Memorandum by Ministry of Environment, Forests and Climate Change (MoEFCC) dated 30th June 2011 provides further clarification that no environmental clearance is required Solar PV and Wind Energy projects in India. A re-categorization of industrial sectors was undertaken by the Central Pollution Control Board (CPCB) in 2016. The category 'white' was introduced during the re-classification which includes industrial sectors that are practically non-polluting. Solar power and Wind projects of all capacities have been classified as 'white' category. Thus, the need for obtaining a 'Consent to Establish' and 'Consent to Operate' from the State Pollution Control Board (SPCB) has been eliminated.

The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise during the development and operation of the project. This study is being undertaken as per the requirements of the IFC Performance Standards (IFC PS) 2012 to understand the environmental and social compliance of the Project in accordance with the Reference Framework.

Additionally, Fourth Partner Energy has identified four UN SDGs as priority focus areas for making a positive contribution through community development initiatives. Therefore, their projects have to align themselves to requirements under Gender Equality (SDG 5), Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7) and Climate Action (SDG 13).

1.3 Scope of the Study

The Scope of Work includes conducting an Environmental & Social Impact Assessment (ESIA) in accordance with IFC PS 2012. The project includes the 30.1 MW dc/ 20.3 MW ac solar plant, 14 WTGs 2.7 MW (37.8 MW), plus one buffer location and associated facilities like access roads, transmission lines, sub-station, water supply arrangements, waste storage areas, nearby villages etc.

The objectives of the Environmental and Social Impact Assessment study for the wind-solar hybrid project are as follows:

- To analyse, quantify the impacts, and design project activities keeping in view environmental and social issues and integrate such issues in the project planning and design;
- To establish the environmental baseline in the study area and to identify any significant environmental issues;
- To prepare an inventory of biodiversity (Flora and Fauna) affected due to project activity;
- To analyse specific risks associated with the Project and its impact considering the Project footprint (including associated facilities);
- To mitigate adverse impacts by provision of the requisite avoidance and compensation measures of proposed project activities;
- To identify and prepare a profile of stakeholders involved in the project, including community, through suitable survey using internationally acceptable tool/s, as applicable;
- To conduct socio economic survey using tools such as Focused Group Discussion (FGD) to identify expectations and concerns of project affected community;
- To establish the socio-economic status of the project affected community based on data collated through secondary as well as primary information;
- To formulate and suggest suitable community development activities (if applicable) for the specific project;
- To develop Environment and Social Management and Monitoring Plan (ESMMP) for implementation & monitoring of the mitigation measures;
- To categorize the Project as per IFC Categorization, based on outcome of the ESIA study.

1.4 Reference Framework

The reference framework for conducting the ESIA is as below:

- Applicable National, State & Local EHS and Social regulations (including relevant approvals, permits and consents obtained);
- IFC Performance Standards Framework 2012;
- World Bank Group (WBG) Environment, Health and Safety (EHS) General Guidelines, 2007;
- IFC/World Bank Group's Environmental, Health and Safety (EHS) Guidelines for Wind Energy, 2015;
- IFC/Work Bank Group's Environmental, Health and Safety (EHS) Guidelines for Electric Power Transmission and Distribution, 2007;
- IFC/WBG Environmental, Health, and Safety Guidelines for Toll Roads, 2007 (limited to approach roads).

1.5 Approach and Methodology

The approach and methodology adopted for conduct of ESIA is presented in the subsequent sub-sections.

1.5.1 Inception Call

On award of the assignment, a conference call was conducted on 21st June 2022 between the EMC team and the Company with the following objectives:

- Explain and agree on the approach and methodology for the conduct of the ESIA, scope, timeline, key focus areas (if any) etc.
- Obtain details and geo-location of the proposed wind-solar hybrid project.

1.5.2 Study Area

For the purpose of scoping & desk-based assessment, an E&S Sensitive Receptors mapping was conducted for an area of 15 km radius from the center of the project area. All associated facilities and project components, viz; transmission lines, access roads, laydown areas, accommodation camps, land requirements and effects on nearby communities were included in the study area. The desk-based assessment report was submitted on 23rd July 2022.

1.5.3 Desk- Based Assessment

1.5.3.1 Project Information Review

Details about the project such as project layout, WTG locations, alignment of transmission line, details on the solar PV modules, WTG make and any related facilities that was required (e.g., access roads, sub-station, water supply arrangements, waste storage, raw materials). etc. were requested from the Company for review. Information such as the number and gender of construction workers, and feasible location for labour campsites ensuring availability of resources such as water, electricity and waste management were assessed. Information related to the land requirements, land acquisition process and fair compensation practices was reviewed.

1.5.3.2 Mapping of E&S Sensitive Receptors

The sensitive environmental and social (E&S) receptors in the study area were identified and mapped. These included:

Water bodies & Watershed	**Sensitive Natural Habitats**
Major Rivers and Waterbodies	National Park/ Wildlife Sanctuary
Reservoirs	Notified Eco-Sensitive Zone
Ground water development	Important Bird Areas
Canals	Ramsar Sites (Wetlands)
	Reserve/ Protected Forest
Natural Hazards	Open Forests/ Social Forests
Earthquakes	Scheduled Areas
Cyclone	
	Connectivity:
Cultural heritage and archaeological important places	Nearest Highway (National and State)
World heritage sites	Airports
Excavations	Railway Station
State Protected Monuments	
Museums	**Others:**
	Defense and Army Installations

	Census data Settlements Land Use Land Cover

The data for the identification of sensitive receptors was sourced from recognized publicly available databases. The sensitive receptors were mapped using GIS software. The outputs were used to develop a stratified sampling strategy for the project area based on the location of sensitive receptors like waterbodies, vegetation, and proximity to sensitive natural habitats. Identification of ecologically important habitats and presence of critically endangered, endangered, threatened, endemic and/or migratory species were taken-up for the study area.

1.5.3.3 Noise Modelling and Shadow Flicker Effect Analysis

Noise Modelling

For identification of E&S sensitive receptors (such as human settlements, biodiversity rich areas, cultural heritage sites, water bodies) that could potentially be impacted by noise from Wind Generator Turbines (WTGs), noise modelling was conducted using the ISO 9613-2:1996 General Model.

To capture the maximum possible impacts, noise modelling was conducted at maximum observed wind speed in the project region at hub height. The permissible limits of noise prescribed by World Bank Group's Environmental Health and Safety (EHS) Guidelines for Wind Energy (August 2015) i.e., 35 dB(A) at a wind speed of 10 meters/second (m/s) at 10 m height during day and night times was referred for identification of impacted receptors. The model computes cumulative noise generated by a cluster of WTGs.

Shadow Flicker Effect Analysis

For identification of E&S sensitive receptors (such as human settlements, biodiversity rich areas, cultural heritage sites, water bodies, airports) that could potentially be impacted by shadow flicker effect of WTGs, modelling was conducted using the Shadow Flicker Model. The elevation profile for conducting the calculations was sourced from SRTM Global (30 m) Data.

The permissible limits of shadow flickers prescribed by World Bank Group's EHS Guidelines for Wind Energy (August 2015) i.e., maximum 30 hours/year and 30 minutes per day on the worst affected day was referred for identification of impacted receptors.

1.5.3.4 Desktop Review on Social Aspects

Demographic data related to population, gender, and work population were reviewed for the project area at the taluka and village levels. Further, the amenities available in the project and study area were reviewed using available secondary data across respective geographical locations.

The desktop review also included an assessment to determine the presence of any indigenous groups in the study area and an assessment of all land transaction-related information such as sale deed, land conversion documents, documentation pertaining to sale negotiation etc.

1.5.4 Baseline Field Studies

A baseline field visit for a duration of six days including environment, ecological and social surveys and monitoring was planned and conducted from 17th October to 21st October 2022 for the project and study area. The activities that were conducted during the visit are described in the subsequent subsections.

1.5.4.1 Verification of data layers

The receptors sensitive to project development mapped during the desk-based exercise were verified on-site through visual inspection. During the site visit, local E&S sensitive receptors (if any) were also identified in addition to those identified through desk research.

1.5.4.2 Baseline Environmental Data

Based on the results of the desk-based assessment, baseline environmental studies for water quality, soil quality, ambient air & noise monitoring were conducted through primary surveys.

The groundwater samples were collected from existing bore wells on-site or off-site as available. Ambient Air & Noise monitoring was performed in critical locations based on the proximity of E&S sensitive receptors.

Additionally, Ecological and Social surveys were carried out based on the outputs of Desktop review, and E&S Sensitivity Receptor Mapping.

To summarize, the baseline environmental studies were carried out for the following parameters:

A. Physical environment

- Meteorological parameters such as Temperature, Wind speed, Wind direction, Wind rose patterns, relative humidity, Rainfall Visibility, Cloud cover, and Solar Radiation were assessed using secondary data obtained from the nearest IMD station.
- Ambient air quality (PM10, PM2.5, SO2, NOx, CO) were monitored at 3 locations-one 24 hourly sample at each location as per CPCB guidelines.
- Noise levels of the study area were monitored and measured at 4 locations-one Day & Night monitoring sample at each location as per CPCB guidelines.
- Groundwater quality assessment (pH, Turbidity, Total Dissolved Solids, Electrical conductivity, Calcium, Chloride, Fluoride, Iron, Magnesium, Sulphate, Total Alkalinity, Total Hardness, Total Coliform bacteria etc.) at 2 locations- one sample at each location were monitored against IS specifications.
- Soil quality (pH, texture, Nitrites, Nitrates, Phosphates, Heavy Metals such as Fe, Pb, Mn, Ni, Ba, Zn, Cu, Cd, Cr, As and Hg, Total Hydrocarbons, Organic Matter, etc.) at one location was monitored and analyzed as per ICAR specification/guidelines.
- Geological & hydrogeological data/information were compiled from secondary sources.
- Land use information/status were assessed with the help of satellite imagery.

B. Ecological environment

- Following desktop-based baseline studies: (a) direct field surveys focusing on critical habitats (b) consultation with local people to identify any records of target species in the survey area focusing on people most likely to be knowledgeable about birds and those most likely to spend time in target species' habitat (e.g., farmers), and (c) incidental recording of any other target species seen during field surveys were carried out as a part of the baseline field survey.
- Local flora and the associated biodiversity, including any observed nesting avifauna, mammal, bat roosting sites, herpetofauna and arthropods was documented during the field survey.

C. Socioeconomic environment

Socio-Economic parameters assessed included the following:

- Demographical information/status were based on census documents and other state/district level databases.
- Socio-economic information and profile outlining data from census and socio-economic surveys, with information on livelihood profile, infrastructure, vulnerability, gender, indigenous peoples (ethnic minorities, scheduled tribes), and labour.
- Identification of historical/ archaeological sites/ monuments in the study area (if any) based on Archaeological Survey of India (ASI)/revenue records.
- Identification of common property resources within the project site and mitigation measures, if any.
- Traffic survey for the present daily traffic, peak hour traffic and traffic composition & any change in traffic composition and volumes due to project development will be undertaken at major junctions and entry points of nearby settlements.
- Identify Indigenous People and vulnerable groups if any in the project target location.
- Identify direct and indirect, individual, and institutional stakeholders that may be affected by project activities.

1.5.4.3 Stakeholder Consultation Plan

A Socioeconomic survey was conducted for a sample size of the project affected population with the help of a structured questionnaire as part of the impact assessment study. The survey helped in identifying impacts on land use, livelihoods, vulnerable households, lost access to communal resources and infrastructure (roads/water points, grazing areas, etc.), and so on, the availability of replacement / alternative land, so the assessment can adequately measure the impacts. Based on the sensitive receptors identified, a Stakeholder consultation plan was prepared.

1.6 Identification of Impacts and Preparation of Environmental and Social Management Plan

1.6.1 Environmental and Social Impact Assessment

Keeping in view with the above and based on the E&S sensitive receptors identified in the study area and activities during different phases of the project, the E&S impacts and risks were identified. Techniques such as graded/weighted impact matrices were used to identify impacts and risks of significance. A taxonomy such as a scale (major/moderate/minor), extent (local/regional), duration (long. Medium/ short) and nature (reversible/irreversible) was computed in arriving at the significance using a rule base. Direct and indirect (second order) impacts were understood using a network diagram.

1.6.2 Analyzing the Alternatives

The alternatives to the proposed project site, technology, design, and operation in terms of their potential environmental and social impacts and the feasibility of mitigating these impacts were compared and analyzed.

1.6.3 Environmental & Social Management and Monitoring Plan

Based on the project and associated activities, management and monitoring measures which include addressing environmental issues, occupational health and safety, community health and safety, land purchase, and social), ecological, were recommended covering all phases of the project (pre-construction, construction, operation and maintenance, and decommissioning including disposal of solar panels and the wind turbines).

1.7 Limitations of the study

The study is based on observations and information review during the project planning and site reconnaissance survey phase. Some of the inferences have been made through data provided by the company and stakeholder consultations. Any meaningful change in the activities at a later stage may result in variation of outcomes. Presented information and facts have been analyzed and inferences have been drawn through professional judgement.

During the baseline field visit, construction activities had already been initiated at multiple WTG locations, hence the site selection criteria does not include biodiversity impacts identified during the current field study analysis.

The study is based on alignment and the WTG locations shared and confirmed by the client during the desk-based assessment and site visit. Any changes made in the configuration further will not be considered a part of the study.

1.8 Organization of the Report

The ESIA report has been organized as follows:

- **Chapter 1** provides a background to the project while specifying the need to undertake the ESIA study, the approach and methodology and limitations of the study.
- **Chapter 2** provides the project details with respect the study area, site salient features and technological details.
- **Chapter 3** outlines the regulatory framework applicable for the project and identifies the project category in accordance with IFC Performance Standards.
- **Chapter 4** describes the Environmental and Social Baseline for the project based on secondary and primary field data
- **Chapter 5** presents the Analysis of Alternatives of the project to come with preferred option.
- **Chapter 6** presents Environmental and Social impacts identified during various phases of the project.
- **Chapter 7** presents the Environmental and Social Management Plan to address the identified impacts.
- **Chapter 8** features the Conclusion and Recommendations.

2 Project Description

2.1 Project Location

The project is located in Jetpur and Gondal taluka in Rajkot District in the state of Gujarat, India. The solar site is located at close proximity to Garnala village, and the WTG locations are spread across seven (7) villages namely Trakuda, Padavala, Charakhdi, Umrali, Mevasa, Jambudi and Rabarika.

Refer *Figure 1, Table 1 and Table 2* for understanding the geographical spread of the project.

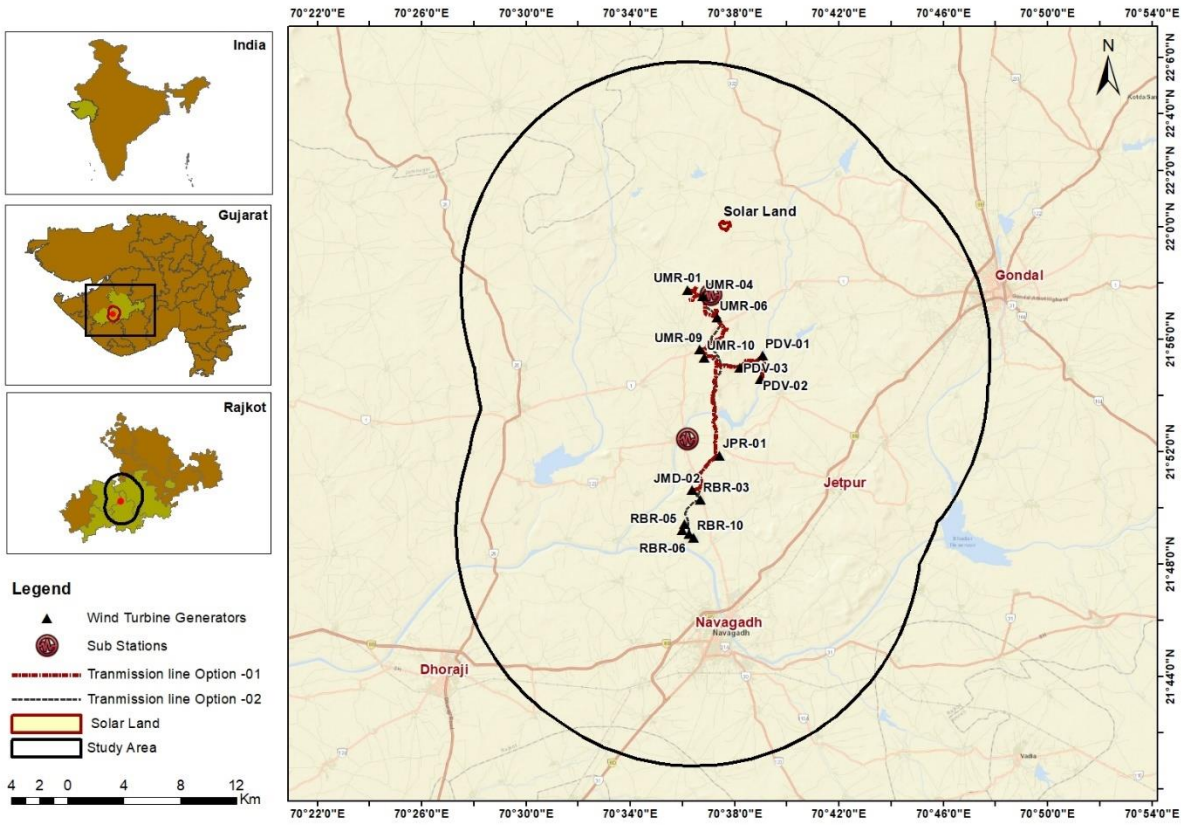


Figure 1: Project Location Map

Table 1: Project Location Co-ordinates

Sr. No. of Execution	Location Code	SPV Name	Off-Taker Name	Latitude	Longitude
1	UMR-04	FPEL Sunrise Pvt. Ltd.	Filatex	21° 57' 32.214" N	70° 36' 46.798" E
2	UMR-01	FPEL Beat Energy Pvt. Ltd.	RLG	21° 57' 46.045" N	70° 36' 12.410" E
3	UMR-06	FP Crysta Energy Pvt. Ltd.	Filatex	21° 56' 46.757" N	70° 37' 19.919" E
4	PDV-03	Euthoria Developers Pvt. Ltd.	Nexus Malls	21° 55' 0.652" N	70° 38' 13.215" E
5	PDV-01	FPEL Flash Energy Pvt. Ltd.	SKF & PI Industries	21° 55' 26.241" N	70° 39' 5.292" E
6	UMR-09	FP Crysta Energy Pvt. Ltd.	Filatex	21° 55' 38.832" N	70° 36' 40.327" E
7	UMR-10	FPEL Sunrise Pvt. Ltd.	Filatex	21° 55' 21.793" N	70° 36' 50.380" E

Sr. No. of Execution	Location Code	SPV Name	Off-Taker Name	Latitude	Longitude
8	RBR-04	FPEL Surya Pvt. Ltd.	Praxair	21° 49' 26.513" N	70° 36' 5.189" E
9	RBR-06	FPEL Surya Pvt. Ltd.	Praxair	21° 49' 5.862" N	70° 36' 15.511" E
10	RBR-10	FPEL Surya Pvt. Ltd.	Praxair	21° 48' 57.493" N	70° 36' 26.839" E
11	RBR-05	FPEL Flash Energy Pvt. Ltd.	SKF & PI Industries	21° 49' 12.910" N	70° 35' 59.675" E
12	JPR-01	FPEL Radiant Energy Pvt. Ltd.	Deccan	21° 51' 52.884" N	70° 37' 26.485" E
13	RBR-03	FPEL Radiant Energy Pvt. Ltd.	Deccan	21° 50' 19.250" N	70° 36' 42.030" E
14	PDV-02*	FP Eco Energy Pvt. Ltd.	Nandan Terry	21° 54' 36.644" N	70° 38' 59.911" E
15	JMD-02			21° 50' 38.938" N	70° 36' 23.968" E
* Buffer Location					

Table 2: Districts and Tehsils in Project and Study Area

#	Tehsil Name	District	State	Inclusion in Project Area	Inclusion in 15km Buffer
1	Jetpur	Rajkot	Gujarat	Partial Inclusion	Partial Inclusion
2	Gondal	Rajkot	Gujarat	Partial Inclusion	Partial Inclusion
3	Jan Kondorna	Rajkot	Gujarat	None	Partial Inclusion
4	Dhoraji	Rajkot	Gujarat	None	Partial Inclusion

2.2 Salient Features

2.2.1 Site Settings

The salient features and key technological component details have been provided in the following section and in *Table 3.* The proposed project is currently in its advanced stages of construction. As reported by the site representative of FPEL, the project is expected to be commissioned in Q1-Q2 2023. Refer *Figure 2 and Figure 3* for site photographs.

- Project site is spread across a flat terrain with mild undulation.
- The project site comprises mainly of cropland and shrubland with few barren land parcels.
- The project is being carried out in Jetpur and Gondal Taluka of Rajkot district of Gujarat.
- No large-scale industries located in and around immediate vicinity of the project area.
- There are no waterbodies in the project area. However, a number of seasonal streams and reservoirs were reported in the study area. During the visit, two critical water bodies: one near solar site and one near Umrali WTG were identified harbouring high count of avifauna.
- During the visit it was observed that around approx. 250 plus trees were present within the solar site boundary and immediate vicinity.
- There are three existing borewells present within the solar site.
- No Protected Area/ Reserved Forests/ IBAs falling within in the study area limits that can be directly impacted by the project. The study area consists of seven Important Bird Areas present within the study area but not within the project area.

Table 3: Salient features of the project

#	Salient features	Details
1	Project Owner	Fourth Partner Energy Pvt. Ltd
2	Project Capacity	30.1 MW dc/ 20.3 MW ac solar plant, 14 WTGS 2.7 MW each *Note: One additional buffer WTG location -has been kept as a replacement option. The project capacity remains unchanged.*
3	Location of Site	Solar: Village Garnala & Betwad Wind: Trakuda, Padavala, Charakhdi, Umrali, Mevasa, Jambudi and Rabarika, Tehsil Gondal and Jetpur, District Rajkot, Gujarat
4	Taluka	Partial part of Jetpur, Gondal Taluka
5	District	Rajkot
6	State	Gujarat
7	Project Coordinates (Center point)	Latitude: 21.894020° Longitude: 70.635877°
8	Nearest Town	Jetpur (Within 5km from nearest WTG location)
9	Nearest Railway Station	Gondal Railway Station
10	Nearest Airport	Rajkot Airport
11	Total Land Area	66.61 Ha (164.59 acres)
12	Type of land	Private and Revenue Land
13	Type of Land use (10 km radius from site)	Agricultural land
14	Present status of the project/project phase	Construction
15	Power evacuation	33kv internal line (solar: 5.8km and wind: 30km) and 2.5km 66kv TL evacuating via 66/33 kV Umrali PSS and connecting to 66/11 kV Mevasa GSS.

16	Location of PSS	21.960207° N, 70.618155° E
17	Transmission Line Length	Internal TL length for Solar is 7.8km and wind is 35km with additional 2.5 km to PSS
18	Grid Sub-station	66 kV GETCO Substation, Mevasa
19	Mode of Implementation	EPC (Engineering, Procurement and Construction)
20	Solar PV Technology	Poly crystalline solar PV
21	Project Life	30 years (based on Land Sub Lease Agreement) & PPA with SECI is for 25 years
22	Solar PV Technology	High Efficiency Monocrystalline Solar Modules.
23	Inverter	Sungrow-295 kVA
24	Module Make	Mono PERC RenewSys 540 wp High Efficiency Monocrystalline Solar Modules.
25	SCADA system	The Hybrid project will be monitored through the SCADA system. This will enable monitoring the status of inverters to gather information on energy generation. Periodic reports of the plant's performance will be provided by the monitoring system. A suitable display system can also be installed in the plant to access live data on the performance of the Wind-Solar system.
26	Robotics Cleaning System	Proposed
27	EPC Contractor	Powerica Ltd
28	O&M Contractor	Powerica Ltd and GE Renewable Energy
29	Wind OEM	Wind OEM supplier will be responsible for material supply. For civil foundation work, they have appointed Powerica Ltd. whose scope will include land acquisition, civil work, transmission line construction, sub-station, internal roads, approvals etc.
30	Wind Contractor for Land/ Evacuation	Powerica Ltd. and Vartaman Wind Energy Pvt. Ltd. to be responsible for land acquisition, permits, civil works, liasoning and construction of evacuation infrastructure.

Figure 2: Solar Site Features

Figure 3: Wind energy site features

2.3 Resource Requirement

2.4.1. Land Scenario/ Status of land

The Hybrid Power Project is located on mixed parcels of government revenue and private land parcels measuring approximately 109.28 acres excluding PSS area. The Solar Power Plant component of the Project measuring 74.28 acres has been purchased comprising six (06) parcels from 11 landsellers in Garnala and Betavad villages under Gondal Taluka (sub district) in Rajkot District, Gujarat. The Wind Power Plant section of the Project measuring 35 acres is on government revenue land leased from nine (09) villages namely, Trakuda, Charkhadi, Padavla, Umrali, Valadungra, Jepur, Rabarika, Mewasa and Jambudi under Gondal and Jetpur Talukas, respectively, in Rajkot District.

Fourth Partner Energy Private Limited has engaged Powerica Limited and Vartaman Wind Energy Private Limited to identify the land parcels most conducive to the requirements of the solar and wind power related aspects of the project. Powerica has been engaged in leasing the land from the Revenue Department for WTG locations and Right of Way while Vartaman has been engaged to negotiate with private landowners and purchase the required contiguous parcels of land for the solar power plant. During the site visit to the project area, land procurement was completed for the solar power plant but still under progress for the wind power plant. EMC, however, was able to visit the entire project area and undertake an assessment of the area. The respective sites were observed to be greenfield with minimal sporadic grazing activity noted at the demarcated solar site due to lack of fencing erected around the site boundary location. The rest of the identified site locations were free of any noted human activities (agriculture, grazing or physical structure).

The solar power site has been purchased from 11 landsellers. As informed during discussion with the landsellers, the land parcels identified for the solar site have not been used for any activity during the purchase period. Vartaman Wind Energy Private Limited as per the provisions of Section 54 of the Saurashtra Gharkhed Tenancy Settlement and Agricultural Land Ordinance, 1949 had applied to the Collector, Rajkot District for granting permission to the entity to purchase land from the said landowner prior to execution of the sale deed due to the setting up of renewable energy project. Basis this grant in permission, the sale deeds have been executed with the respective landsellers and the land transfers have been made to Vartaman Wind Energy Private Limited.

For the wind power site, out of the 14 WTG locations, 11 WTG locations have been approved by the Revenue Department and 3 WTG locations are in the process of being approved. The lease period for each location is for 20-year period.

During the site visit to the project area, it was noted that agricultural activities primarily dependent on monsoon rainfall was undertaken at privately owned land parcels adjacent to the solar power site towards the east, south and west directions and few patches of land parcels towards the north direction from the site. Accessibility to these land parcels is not obstructed by the solar power site and its associated facilities. It was informed by the project land team and confirmed during discussion with the Panchayat members that no grazing land has been affected due to the location of the solar power site and its associated facilities.

The wind power site was noted to be on government revenue land with no economic/occupational/grazing activity being undertaken on any of the 14 identified WTG locations including its associated facilities.

Based on the information shared by the Project Team, the land required for the project area and its associated facilities have been highlighted in *Table 4.*

Table 4: Land Requirement details for the project and associate facilities

Project Facility	Land Area Required	Land Use Classification	Status of Procurement	Mode of Procurement
Solar Power Site				
Solar Project Area	74.28 acres	Private	Sale Deed Executed	Completed
Access Road (External)	4.5 km	Revenue	Existing Public Road	NA
Substation/Switchyard/ Administration Building	In progress	-	-	-
Transmission Lines upto Pooling Sub Station	6.5 Kms (From Solar Land to PSS)	Private and Revenue	ROWs are under execution	In progress
Wind Power Site				
Wind Turbine	Approx. 2.47 acres per WTG	Revenue	Out of 14 Identified Locations, 10 WTG locations are approved by revenue department & 4 locations are in process of approval	Lease period for 20 years
Access Road	Approx. 50 acres	Revenue	Approved for 10 WTG locations	Approved by Revenue Department for 10 locations as per the WTG Locations
Substation/Switchyard/ Administration Building	2.64 acres	Private	All 2.64 Acres Purchased	Completed (Sale Deed Executed)
Transmission Lines up to Pooling Sub Station	30 Km (From all WTG Locations to PSS) – Acres cannot be approximated at this stage	Revenue and Private	ROWs are under execution	In Progress

2.3.1 Water Requirement

During the project construction phase, water is required for preparing foundation and excavation activities, building control room and security rooms, and domestic purpose such as drinking and washing by the construction workers and staff. During operations, wet and dry-cleaning techniques will be incorporated for two cycles a month for the solar site. Robotic cleaning technique is being proposed for cleaning of solar panels at a later stage. Water will be required for domestic purposes by the operations staff. The indicative estimated quantities of water required during the construction and operation phases are presented below in *Table 5.*

Table 5: Water requirement during the construction and operational phase

Solar site		
Construction Phase		
	Quantity in Litres	*Source*
Construction	150000	Groundwater
Sanitary Purpose	450000	Groundwater
Drinking water	18000	RO filtration plant
Operational Phase		
	Quantity/Litres	*Source*
Operations/ Cleaning	1,37,500 litres/month in single cycle	Groundwater
Sanitary Purposes	1000/day	Groundwater
Drinking Water	200/day	RO filtration plant
Wind energy site		
Construction Phase		
	Quantity/Litres	*Source*
Construction	1,34,000 Lts/per one foundation	Groundwater
Sanitary Purpose	84 members/per day/8400 Lts	Industrial
Drinking water	84members/per day/500 Lts	RO filtration plant
Operational Phase		
	Quantity/Litres	*Source*
Operations	10,000 ltr for total operational period of the wind farm	Groundwater, Trakuda village
Sanitary Purposes	-	Industrial
Drinking Water	-	RO filtration plant

2.3.2 Manpower Requirement

As reported, approximately 490 workers including both FPEL and Powerica are estimated to be deployed in the construction phase for the foundation, excavation, assembly, erection, cleaning and other work. The contractor workforce will comprise of both skilled and unskilled laborers. Majority of workers will be sourced from the nearby villages depending on their skills and capabilities.

In the operational phase, a total of 20 personnel (approximate) excluding security are expected to be required. The work force will include operations and maintenance officers and site engineers for O&M activities.

2.4 Organization Structure

The overall responsibility of the project is under the purview of the specially constituted Executive committee, which consists of tasks related to Project Operations, Project Development and People and Processes. The Project lead is responsible for effective implementation at the site level and is supported by Project Managers (Wind & Solar), Project Co-ordinator and Compliance Manager. Head ESG and ESG Manager are responsible for activities at corporate level. The site and corporate level organization structure is presented in the figure provided below.

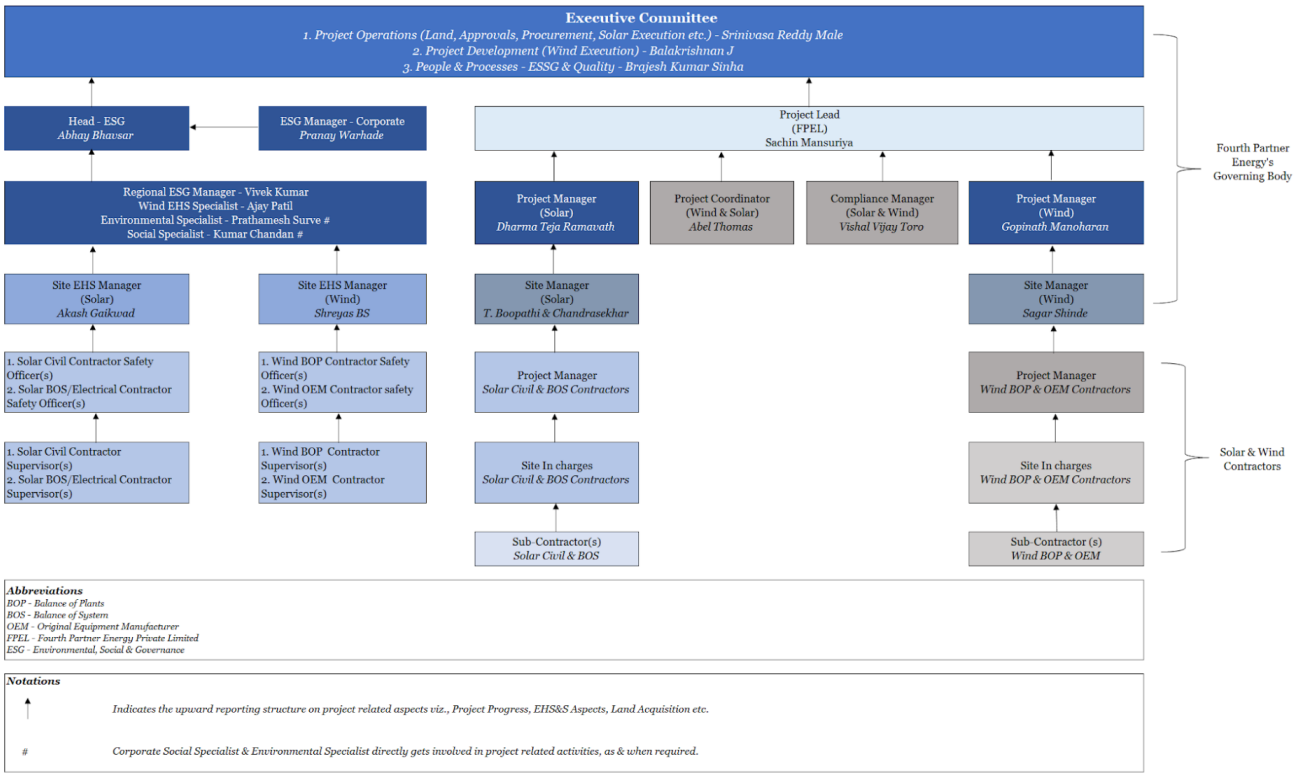


Figure 4: Organization Structure

3 Regulatory framework

3.1 Applicable Regulations

3.1.1 Lifecycle Approach

The legal requirements applicable to the project at the national, state and local level covering various components through the lifecycle of the project from planning to decommission have been identified in the subsequent subsections. Similarly, investor requirements have also been identified. Refer *Figure 5* for a representation of the same.

The applicability of regulations has been identified in **Section 3.2** and the requirements of each applicable regulation across different phases of the project under the various components have been presented in **Sections 3.3 to 3.5.**

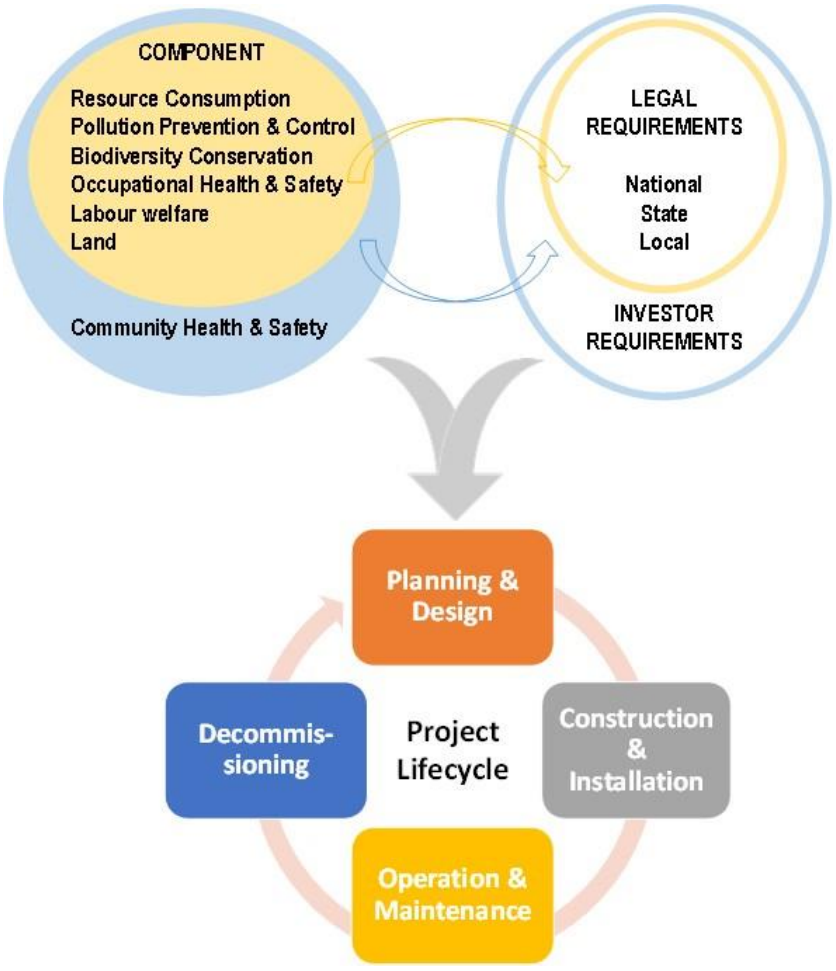


Figure 5: Legal & Investor Requirements in the Project Lifecycle

3.2 Applicable Regulations

Solar and Wind Energy projects are not included in the Schedule of the Environmental Impact Assessment (EIA) Notification 2006 that provides a list of projects which need to undergo EIA studies.

An Office Memorandum by Ministry of Environment, Forests and Climate Change (MoEFCC) dated 30th June 2011 provides further clarification that no environmental clearance is required Solar PV and Wind Energy projects in India.

FPEL, Powerica and Vartaman Wind Energy are responsible for acquiring land for the Project, clearing and levelling where required, and allocating plots for individual projects. Hence provisions under The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 will not be applicable.

The key environmental, health and safety, employee welfare (social) regulations applicable to the project during pre-construction, construction & installation and O&M are listed in *Table 6.*

Table 6: Identification of Regulations across Project Lifecycle

Regulation	Pre-Construction	Construction & Installation	Operation & Maintenance
Environment Regulations			
Environment (Protection) Second Amendment Rules, 2002 – Diesel Generator Sets			
The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, Amendment, 2021			
Construction and Demolition Waste Management Rules, 2016			
E-Waste (Management) Rules, 2022			
Plastic Waste Management Rules, Amendment, 2022			
Solid Wastes (Management and Handling) Rules, 2016			
The Batteries (Management & Handling) Rules, Amendment, 2022			
Noise Pollution (Regulation and Control) Rules, 2000			
Ozone Depleting Substances (Regulation & Control) Rules, 2000			
Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951 and Corrigendum Notification 2015 and subsequent GR-2016.			
Occupational Health & Safety			
Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1998			
Central Motor Vehicles Rules, Amendment ,2022			
Indian Electricity Act 2003 and Rules 1956 amended to 2000			

Regulation	Pre-Construction	Construction & Installation	Operation & Maintenance
Central Electricity Authority (Safety Requirements for Operation, Construction and Maintenance of Electric Plants and Electrical Lines) Regulations 2008			
Social (Land and Employee Welfare)			
The Child Labour (Prohibition & Regulation) Act, 1986			
Minimum Wages Act, 1948			
Employees' State Insurance Act (ESI), 1948			
The Employees' Provident Funds (EPF) and Miscellaneous Provisions Act, 1952 amended up to 1996			
Workers Compensation Act 1923			

3.2.1 Legal Requirements at Pre-construction Stage

The environmental and social legal requirements applicable to the project before commencement of construction are provided in *Table 7.*

Table 7: E&S Legal Requirement at Pre-Construction Stage

Key Regulatory Requirement	Reference Regulation
A. Environment	
a) Permission from Gram Panchayat/ Local Authority for dumping of construction debris and excavation spoil	Construction and Demolition Waste Management Rules, 2016
b) Permission for tree cutting and transit permit	Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951 and Corrigendum Notification 2015 and subsequent GR-2016.
B. Occupational Health & Safety	
c) Registration with Labour Department (for recording maximum number of workers to be present at site during construction)	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1998
A. Social	
d) Permission from Gram Panchayat for development of the Project	The Gujarat Panchayats Act, 1993
e) Permission from District Collector for purchasing agricultural land for non-agricultural purposes	Section 54 of the Saurashtra Gharkhed Tenancy Settlement and Agricultural Land Ordinance, 1949

3.2.2 Legal Requirements at Construction Stage

The environmental and social legal requirements applicable to the project during construction are provided in *Table 8.*

Table 8:E&S Legal Requirements at Construction Stage

Key Regulatory Requirement	Reference Regulation
A. Environment	
a) Ensure DG set stack height is as per compliance norms b) Ensure the DG set is enclosed in Acoustic enclosure c) Monitor Stack emission and insertion loss noise monitoring	Environment (Protection) second Amendment Rules, 2002 – Diesel Generator Sets
d) Ensure take back of used oil, spent oil filters and contaminated cotton waste generated from maintenance of DG set	The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2016, Amendment, 2021
e) Collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed or notified by the concerned local authority	Construction and Demolition Waste Management Rules, 2016
f) Ensure e-waste (damaged PV panels, electrical surplus) generated is channelized to authorized collection centre's or registered dismantler or recycler or; returned to pick-up or take back services provided by producers. Maintain records of e-waste generated in Form 2	E-Waste (Management) Rules, 2016, Amendment, 2022
g) Segregate storage of plastic waste at source (generated from packaging waste).	Plastic Waste Management Rules, 2016, Amendment,2022
B. Occupational Health & Safety	
h) Construction equipment and transport vehicles (owned or hired) should possess valid driver's license; registration, permit for transportation, fitness certificate, and insurance	Central Motor Vehicles Rules, Amendment ,2022
i) Engagement of Contractor registered with the Labour Department j) Ensure that Contractor employs measures on worker health and safety during construction	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996; and Rules 1998
k) Employ safety measures specified in Chapter IV of the Rules for all electrical work	Indian Electricity Act 2003 and Rules 1956 amended to 2000 Central Electricity Authority (Safety Requirements for Operation, Construction and Maintenance of Electric Plants and Electrical Lines) Regulations 2008

Key Regulatory Requirement	Reference Regulation
C. Employee Welfare	
l) Ensure that child labour is not engaged for any construction activity	The Child Labour (Prohibition & Regulation) Act, 1986
m) Ensure payment of wages to workers (employed and on contract) as per minimum wages notified	Minimum Wages Act, 1948
n) Ensure deduction and payment of ESI for workers by the Contractor	Employees' State Insurance Act (ESI), 1948
o) Ensure deduction and payment of provident fund by the Contractor	The Employees' Provident Funds (EPF) and Miscellaneous Provisions Act, 1952 amended upto 1996
p) Ensure that Contractor obtains insurance for construction workers	Workers Compensation Act 1923

3.2.3 Legal Requirements at Operational Stage

The environmental and social legal requirements applicable to the project during operational stage of the project are provided in *Table 9.*

Table 9:E&S Legal Requirements during O&M

Key Regulatory Requirement	Reference Regulation
A. Environment	
a) Ensure e-waste generated is channelized to authorized collection centres or registered dismantler or recycler or returned to pick-up or take back services provided by producers. Maintain records of e-waste generated in Form 2	E-Waste (Management) Rules, 2016
b) Deposit used batteries (especially lead acid batteries) with the dealer, manufacturer, importer, assembler, registered recycler, re-conditioner or at the designated collection centres.	The Batteries (Management & Handling) Rules, 2001, Amendment, 2022
B. Occupational Health & Safety	
c) Employ safety measures specified in Chapter IV of the Rules for all electrical work	Indian Electricity Act 2003 and Rules 1956 amended to 2000
C. Employee Welfare	
d) Ensure that child labour is not engaged in the company or by contracted agencies for deployment at the plant	The Child Labour (Prohibition & Regulation) Act, 1986
e) Engagement of Contractor registered with the Labour Department	The Contract Labour (Regulation and Abolition) Act, 1970
f) Ensure payment of wages to workers (employed and on contract) as per minimum wages notified	Minimum Wages Act, 1948

Key Regulatory Requirement	Reference Regulation
g) Ensure deduction and payment of ESI for workers (employed and on contract)	Employees' State Insurance Act (ESI), 1948
h) Ensure deduction and payment of provident fund for workers (employed and on contract)	The Employees' Provident Funds (EPF) and Miscellaneous Provisions Act, 1952 amended upto 1996
i) Obtain insurance for workers (employed and on contract)	Workers Compensation Act 1923

3.3 Application of IFC Performance Standards

The applicability of IFC Performance Standards (version 2012) to the Solar and Wind Energy project has been described in *Table 10***.** All applicable elements from the Performance Standards have been referred while conducting impact assessment and developing the management plan.

Table 10:Establishing Applicability of IFC Performance Standards

Performance Standard	How the Performance Standard is applicable?	Statement on Applicability
Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts	The activities carried out in the plant have the potential to cause environmental and social impacts.	**Applicable**
Performance Standard 2: Labor and Working Conditions	Workers, security, housekeeping will be employed and contracted during construction and O&M phase of the project.	**Applicable**
Performance Standard 3: Resource Efficiency and Pollution Prevention	The project has the potential to cause pollution due to waste generation, air emissions, and effluent during the construction & installation; and waste generation during O&M phase of the project.	**Applicable**
Performance Standard 4: Community Health, Safety, and Security	The project during construction and O&M phases has the potential to impact the community health, safety and security.	**Applicable**
Performance Standard 5: Land Acquisition and Involuntary Resettlement	The Project land area comprises a mix of private and government revenue land parcels. Permissions have been obtained from the District Collector, Rajkot District prior to procurement of private land parcels from the land sellers on 'willing buyer/willing seller' principle. In addition, lease for 11 WTGs from Revenue Departments has been obtained and for 3 WTGs is currently underway. None of the land parcels selected for the project sites and associated facilities as noted have caused any physical/economic	Not Applicable

Performance Standard	How the Performance Standard is applicable?	Statement on Applicability
	displacement of individuals. Hence, this standard is not applicable to the project.	
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	There are no protected forests, reserved forests or wildlife parks in the study area and hence this standard is not applicable.	Not Applicable
Performance Standard 7: Indigenous Peoples	The plant is not located in proximity to a Scheduled Area or tribal area.	Not Applicable
Performance Standard 8: Cultural Heritage	There are no places of cultural heritage located at close proximity to the Solar PV site and thus this standard is not applicable is not located in close proximity to any places of cultural heritage.	Not Applicable

3.3.1 Application of EHS Guidelines

The World Bank Group's General Environmental, Health & Safety (EHS) Guidelines are applicable to the project. The applicable elements of the guidelines were referred to while conducting impact assessment and developing the management plan.

3.3.2 Categorization of Project

As part of the review of environmental and social risks and impacts of a proposed investment, IFC uses a process of environmental and social categorization to reflect the magnitude of risks and impacts. These categories used by the IFC are:

- **Category A**: Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented.
- **Category B**: Business activities with potential limited adverse environmental or social risks and/or impacts that are few, generally site-specific, largely reversible, and readily addressed through mitigation measures.
- **Category C**: Business activities with minimal or no adverse environmental or social risks and/or impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks.
- **Category FI Projects**: Business activities involving investments in financial institutions (FIs) or through delivery mechanisms involving financial intermediation.

Before discussing the project's category on environment, it is necessary to understand basic definitions of some of the terms used in the above categorization criteria.

- ***Diverse Impacts*** – impacts resulting on multiple environmental and social components or receptors over a varying time and spatial scale (*e.g. activities that can cause adverse impacts on local air quality, noise levels, generation of hazardous wastes as well as nuisance to community*)
- ***Irreversible Impacts*** – impacts on environmental and social components that, in all practical terms are permanent in nature and cannot be reversed in spite of the removal of the causal stress factor. (*e.g. construction or change in landuse that permanently alters the natural drainage or destroys habitats used by migratory birds*)
- ***Unprecedented Impacts*** – are impacts that are **first of its kind** in terms of available knowledge of their potential to cause harm to the environmental and social components and their effective mitigation. (*e.g. impact of noise pollution on an endangered faunal species in a geographical region where no prior studies are available on impact tolerance and response of the species*)

For categorization of the present project, the IFC categorization process has been referred to. The E&S risks and impacts of the business activity in focus have been considered in terms of significance and nature. While categorizing the project, available studies and reports undertaken for the project and documents made available for review have been considered.

The Project is categorized as **Category B** in line with IFC guidelines. The reasoning for the categorizations is as follows:

- Although, no critical habitats are present within the study area of the project, the project activities have the potential to cause adverse E&S risks and/or impacts that are diverse, irreversible or unprecedented. This is based on the biodiversity risks associated with the identified native and migratory avifaunal diversity and nesting sites around the water bodies and scrublands spread across the project area and the tree species diversity and count within the solar project boundary.

- The project will not lead to the release of emissions or effluents to pollute the environment.
- Noise and Shadow Flicker analysis have shown that the noise and shadow flicker impacts are low.
- Social risks and impacts are expected to be limited as the area around the project site is sparsely populated. There are no Indigenous People in project influence area and the project does not trigger involuntary resettlement.
- The project will also generate employment among locals during construction and operational phase of the project.

3.3.3 Equator Principles

The Equator Principles adopted by financial institutions for Project Financing ensure that the projects they finance are developed in a manner that is socially responsible and reflects sound environmental management practices. The project's conformance to the Equator Principles has been assessed and presented in Table 11**.**

Table 11:Applicability of Equator Principles

Equator Principles Requirements	Project Conformance Details
Principle 1: Review and Categorization Categorize them based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorization process of the International Finance Corporation (IFC).	Categorization of the project has been carried out using IFC's project categorization based on the magnitude of potential impacts and risks of the Project. **A category rating 'B' has been recommended for this project**. See **Section 3.3.2** for details on categorization.
Principle 2: Environmental and Social Assessment Conduct an Assessment process to address, the relevant E&S risks and impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.	This document presents the Environmental and Social Impact Assessment for the project.
Principle 3: Applicable Environmental and Social Standards Compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental	The host country regulations and their requirements applicable to the projects across the project cycle have been presented in **Chapter 3.** The applicability of IFC Performance Standards to the project has been established in **Chapter 3 Section 3.3.1.** The Impact Assessment presented in **Chapter 6** and

Equator Principles Requirements	Project Conformance Details
and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) (Exhibit III).	Environmental & Social Management Plan presented in **Chapter 7** incorporate applicable items from the EHS Guidelines.
Principle 4: Environmental and Social Management System and Equator Principles Action Plan Develop or maintain an Environmental and Social Management System (ESMS). An Environmental and Social Management Plan (ESMP) will be prepared by the client/ borrower to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP).	Environmental & Social Management Plan has been presented in **Chapter 7.**
Principle 5: Stakeholder Engagement Demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders	Procedures for Stakeholder Engagement and Grievance Mechanism have been presented in **Section 4.12, 4.13 and Annexure IV** respectively.
Principle 6: Grievance Mechanism Establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance	
Principle 7: Independent Review For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.	Not applicable to the project developer
Principle 8: Covenants The covenants would be a part of the contract documents between the borrower and financing institution as well as EPC Contractor based on the following:	Not applicable to the project developer

Equator Principles Requirements	Project Conformance Details
a) to comply with the ESMPs and Equator Principles AP during the construction and operation of the Project in all material respects; and b) to provide periodic reports (at least annually), on (i) compliance with the ESMPs and Equator Principles AP; (ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and c) to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.	
Principle 9: Independent Monitoring and Reporting Require the appointment of an Independent Environmental and Social Consultant or require that the client retain qualified and experienced external experts to verify its monitoring information.	Not applicable to the project developer
Principle 10: Reporting and Transparency Ensure that a summary of the ESIA is accessible and available online. Publicly report GHG emission levels during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually.	The ESIA report will be made accessible to stakeholders. The project is not expected to contribute to direct emissions of GHG.

4 Environmental and Social Baseline

4.1 Study Area

To understand and assess the environmental and social risks associated with the project, the study area was divided into 15km buffer area for desk-based assessment and mapping of sensitive receptors and 5 km around the project site for conducting the baseline site visit. Refer *Figure 6* and *Figure 7* for study area maps.

Below sections describe the existing environmental and social settings of the project area and its immediate surroundings. This includes physical environment comprising air, water, soil and noise components, biological environment, and socio-economic environment.

Information on geology, hydrology, prevailing natural hazards such as floods, and earthquakes have been collected from literature reviews and authenticated information made available by government departments. Primary surveys were carried out to understand and record the biological environment prevailing in the area and the same was verified by the relevant stakeholder consultations and published information and literature. The socioeconomic environment has been studied through consultations with various stakeholders within the study area through published data and Census of India 2021.

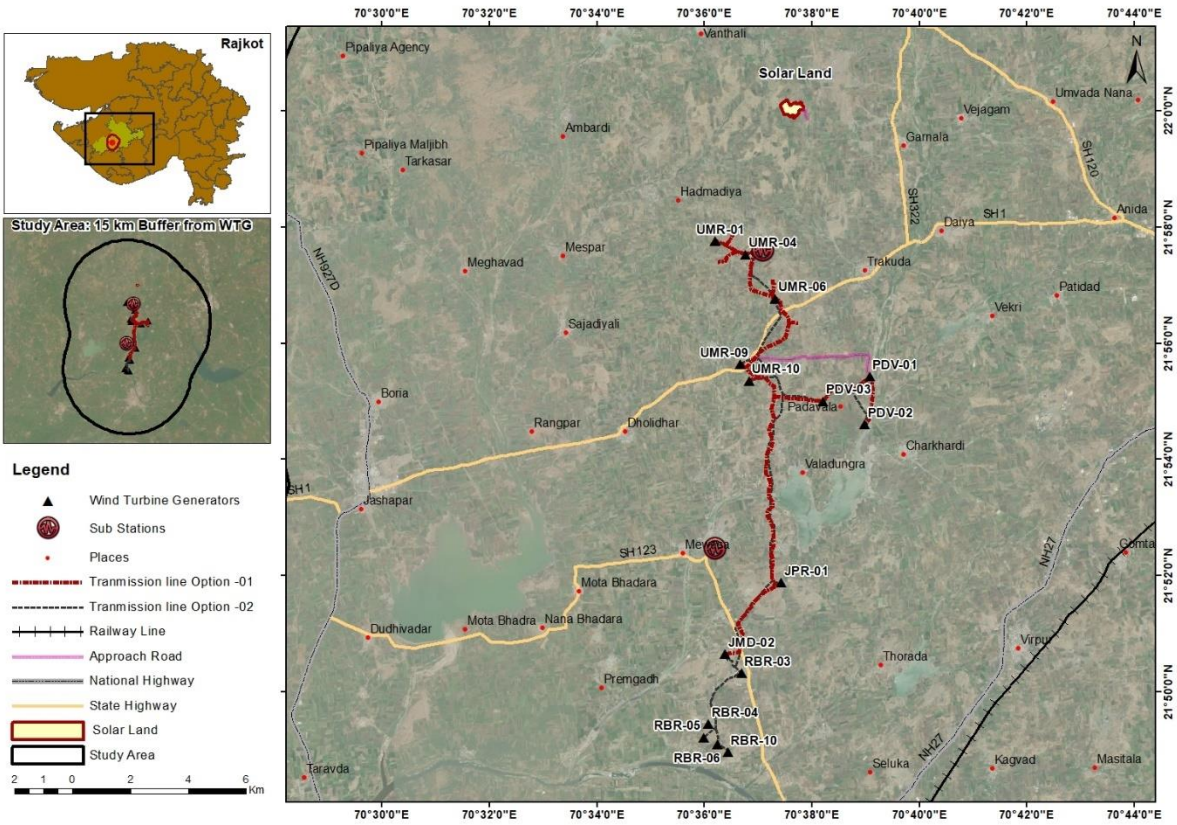


Figure 6: Study area with 15km buffer

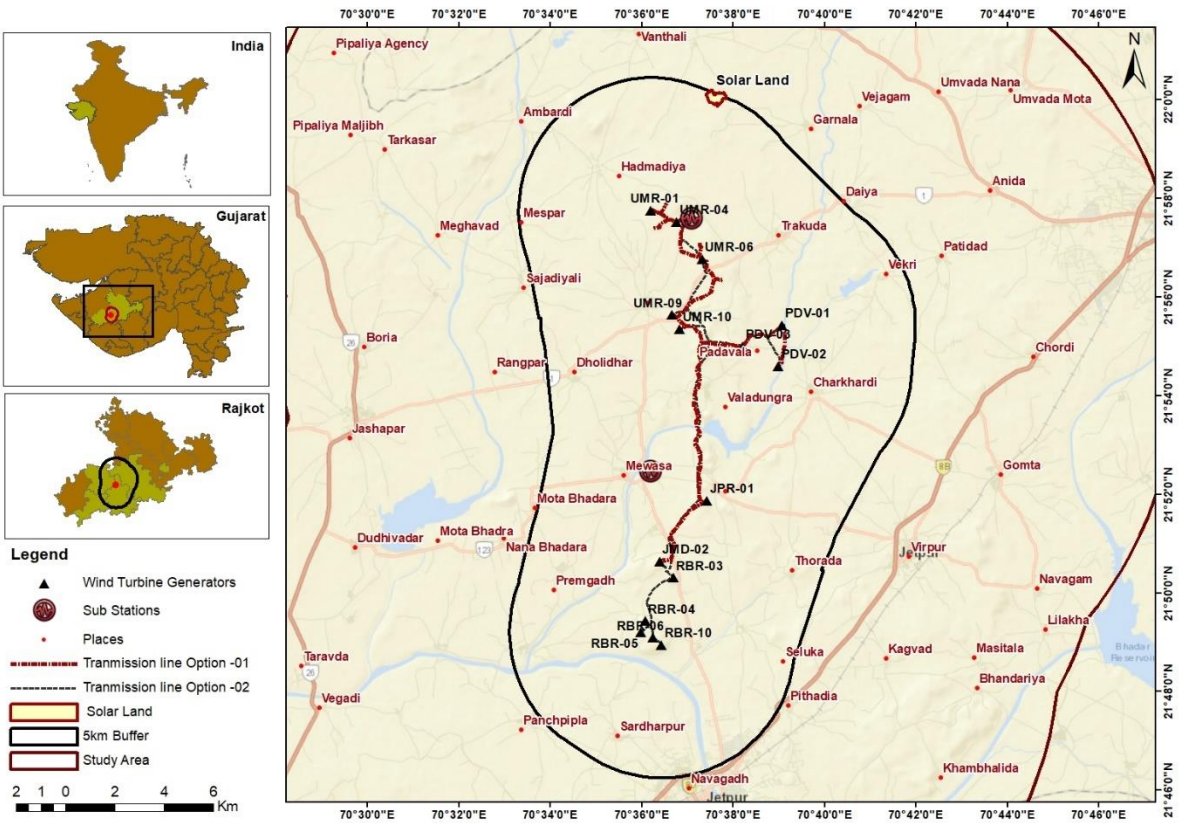


Figure 7: Study area with 5km buffer

4.1.1 Baseline Site Visit

The baseline site visit was carried out from 17th to 21st October 2022. The field visit was conducted by a four-member team comprising of environmental, social and ecological experts. The environment and ecological team were responsible for looking over environmental monitoring and conducting field surveys within the study area to identify any presence of critical habitats and species. The social team was involved in carrying out discussions with landowners/sellers and other relevant stakeholders identified as a part of the project. Discussions were conducted in the villages falling within the study area.

Refer *Figure 8* for the locations surveyed as a part of the site visit.

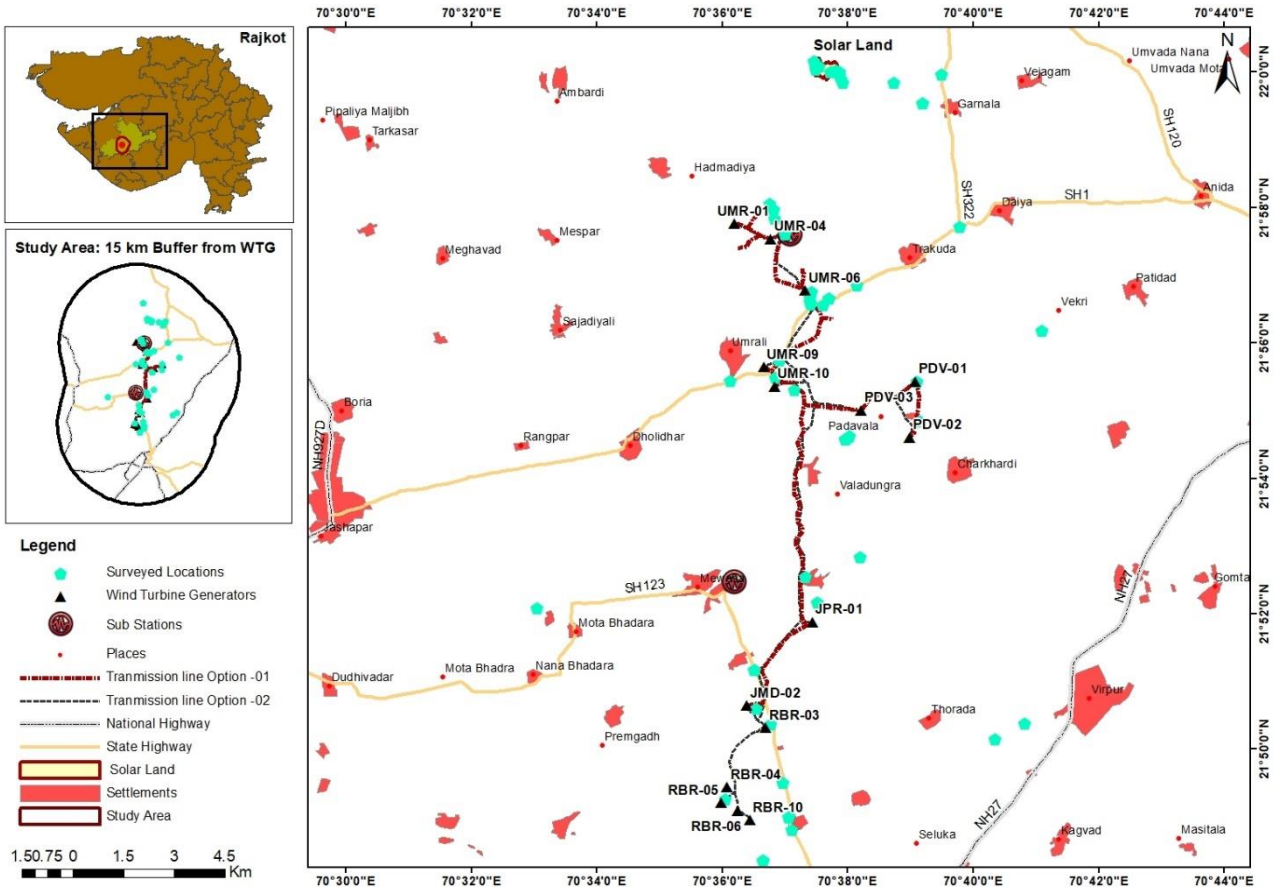


Figure 8: Survey Locations

4.2 Connectivity

The project site is well connected through road and rail connectivity. The nearest railway station to the site is Navagadh station in Jetpur district. The nearest airport is Rajkot Airport which is 64 kms away from Umrali village. The following section provides maps and photographs of the approach road identified for the project.

Solar Site

The approach road to the solar site is an unpaved village road which connects Garnala village at SH 322, which further connects to SH 1. Refer *Figure 9* for the approach road identified and demarcated for the solar site.

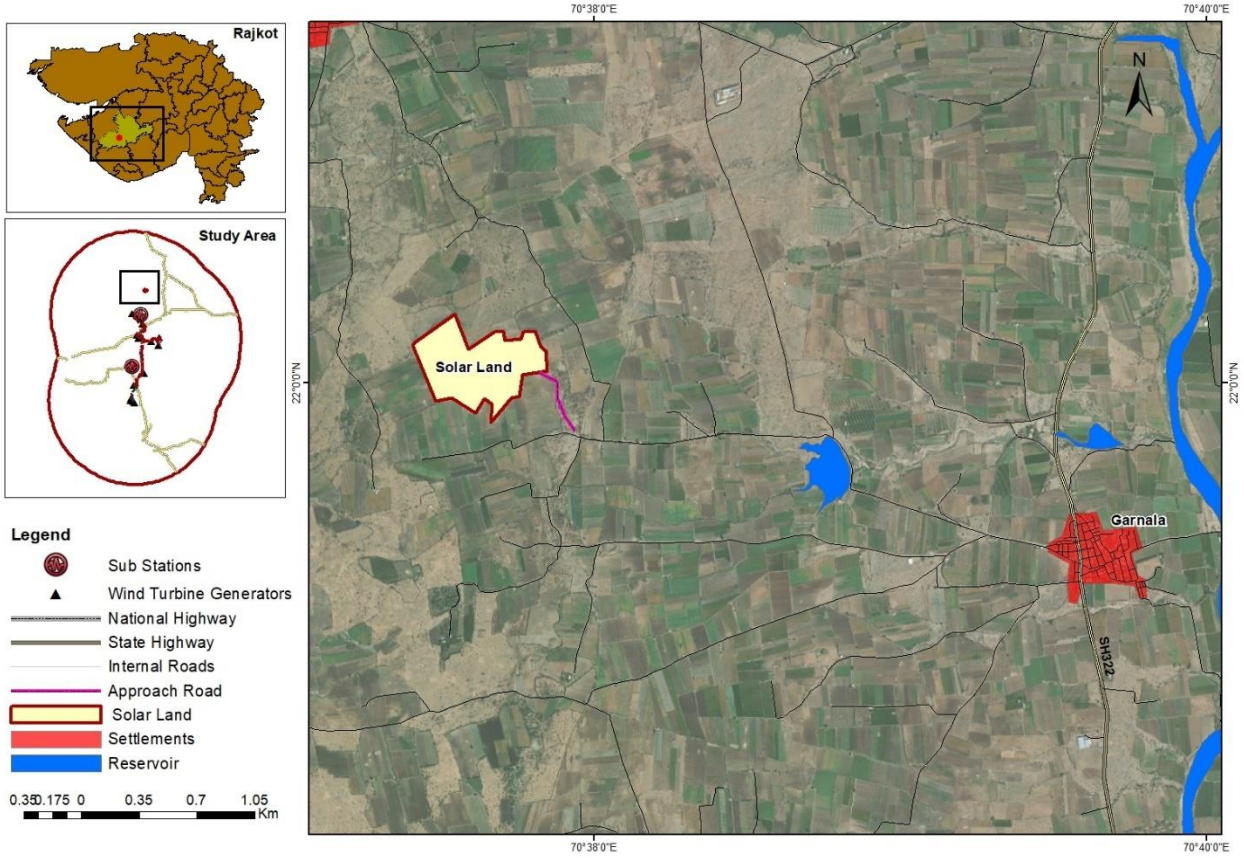


Figure 9: Approach Road to Solar site

Wind energy site

Umrali WTG locations: The approach roads to Umrali WTG locations are unpaved internal roads connecting to village roads of Umrali via Trakuda that can be accessed via SH 1. Refer *Figure 10* for approach road identified a demarcated for Umrali WTGs locations.

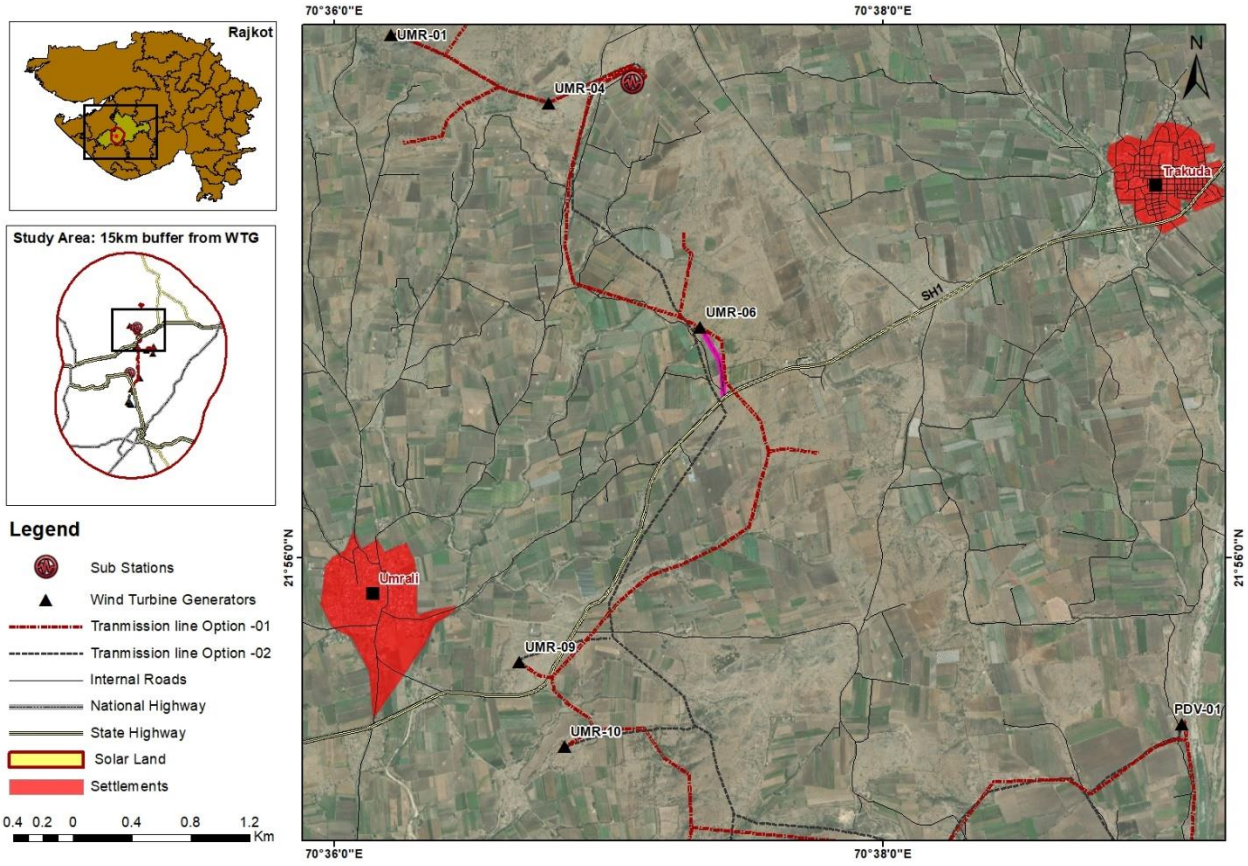


Figure 10: Approach Road to Umrali WTG locations

Padvala WTG locations*:* The approach roads to Padvala WTG locations are internal village roads which can be accessed via SH 1 and Umrali village roads. Refer *Figure 11* for approach roads identified for Padvala WTG locations.

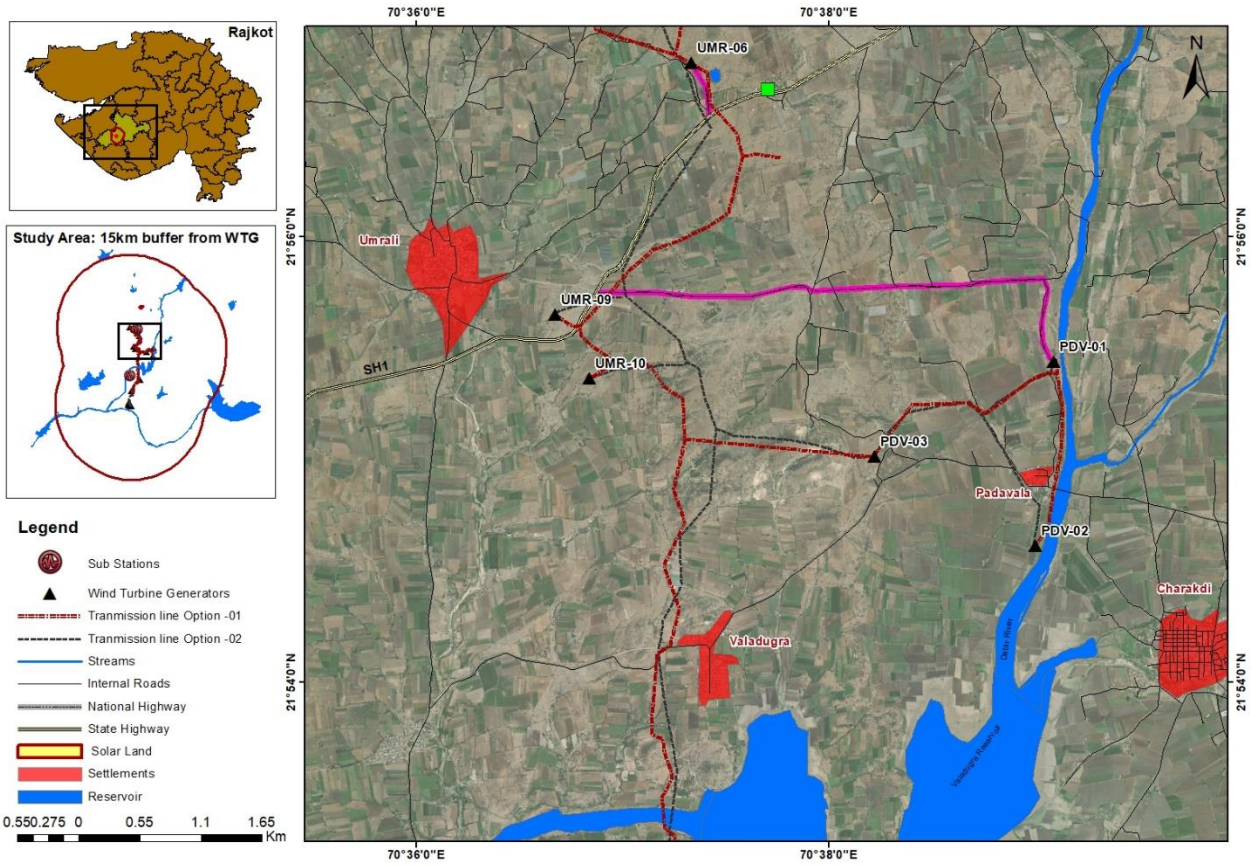


Figure 11: Approach Road to Padvala WTG locations

The approach road for Rabarika and Jepur WTG locations are yet to be finalized, but a tentative unpaved route which can be accessed from Rabarika village road from SH 1 is being proposed.

Solar site approach road

Wind Energy site approach road

Figure 12: Solar and Wind Energy site approach roads

4.2.1 Traffic Volume Survey

Traffic Volume Count Survey

The hybrid project is connected to the NH27 via State highways SH1 and SH123 that pass through Umrali and Mevasa villages respectively. The study of traffic volume count was conducted at 3 locations, with the aim to understand the existing 'Level of Service' of Umrali and Mevasa approach state highways (SH 123) and (SH1). Refer *Figure 13* for the traffic volume count locations.

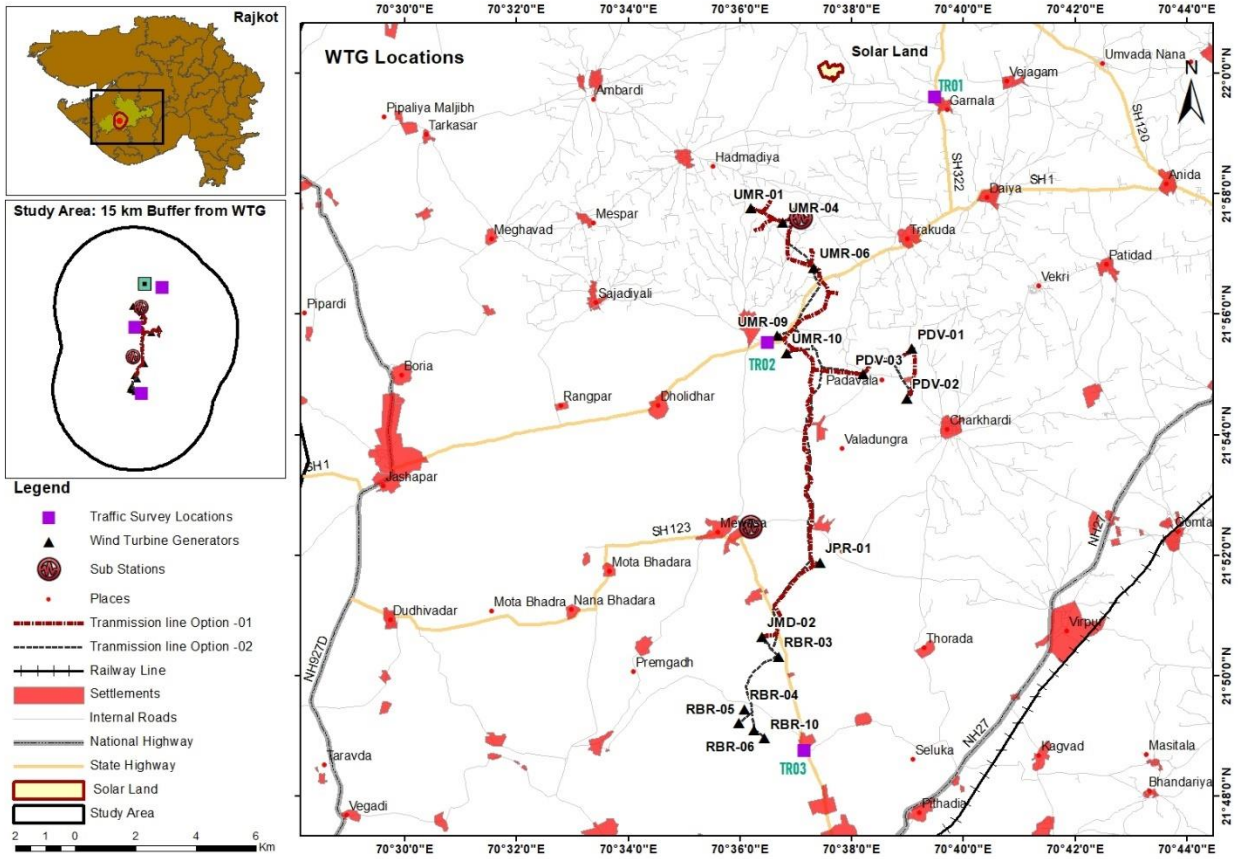


Figure 13: Traffic Volume Survey Locations

The methodology used to conduct the survey is as follows:

- The survey was carried out for the two-time frames (i.e., morning and evening) for one day. The morning survey was conducted between 10 AM to 11 AM while in the evening the survey was conducted between 5 PM to 6 PM.
- The volume of traffic was then divided for passenger vehicles (Car, 2-Wheeler, Bus) and Goods vehicle (Trucks, Tempo and Tractor).
- Based on the volume of vehicles recorded in the two-time frames, Passenger Car Unit (PCU) was calculated to measure the impact for each mode of transport on the traffic variables (density) compared to a single standard passenger car (Refer *Table 12* for PCU values as per IRC).

Table 12: Passenger Car Unit Factor

Vehicle	PCU value
Two Wheelers	0.75
Three Wheelers	1.2
Four Wheelers	1
Six Wheelers	3.7
Bicycles	0.5
Others (Carts)	2

- The PCU for an hour was taken for calculating the V/C Ratio (volume-demand to capacity ratio), where volume is number of vehicles passing in both directions (2 lane highway) and capacity ratio (2800 passenger cars per hour in both directions).
- The 15-minute period in the one-hour band during which maximum traffic volume in terms of number of vehicles is observed is used for calculating the peak hour factor.

This measure reflects the mobility and quality of travel by comparing roadway demand (vehicle volume) with roadway supply (carrying capacity) thus determining the Level of Service (LOS) for stretch. Refer *Table 13*.

Table 13:Level of Service for approach roads

Time		V/C	LOS	Level of Comfort	Nature of Flow	Remarks
Morning	Gondal to Mevasa	0.0370	A	Highest	Free flow	In morning, volume of traffic is low with free flow
	Mevasa to Gondal	0.0346	A	Highest	Free flow	
Evening	Gondal to Mevasa	0.0770	A	Highest	Free flow	In evening, volume of traffic increases but with free flow
	Mevasa to Gondal	0.0703	A	Highest	Free flow	
Morning	Gondal to Umrali	0.0637	A	Highest	Free flow	In morning, volume of traffic is low with free flow
	Umrali to Gondal	0.0529	A	Highest	Free flow	
Evening	Gondal to Umrali	0.0576	A	Highest	Free flow	In evening, volume of traffic increases but with free flow
	Umrali to Gondal	0.0544	A	Highest	Free flow	
Morning	Gondal to Rabarika	0.0523	A	Highest	Free flow	In morning, volume of traffic is low with free flow
	Rabarika to Gondal	0.0559	A	Highest	Free flow	
Evening	Gondal to Rabarika	0.0359	A	Highest	Free flow	In evening, volume of traffic further decreases with free flow
	Rabarika to Gondal	0.0357	A	Highest	Free flow	

Based on the traffic volume count survey conducted at the above three junctions, the traffic volume count was found to be low during the morning and evening peak hours. A Traffic Management Plan is provided in Annexure III.

4.3 Land and Topography

4.3.1 Landuse Landcover

Land Use Land Cover (LULC) was extracted for the study area from World Cover, a global 10m baseline product, based on the Sentinel-1 and 2 data. The distribution of various land cover in the study area is shown in *Figure 14* and *Figure 15.*

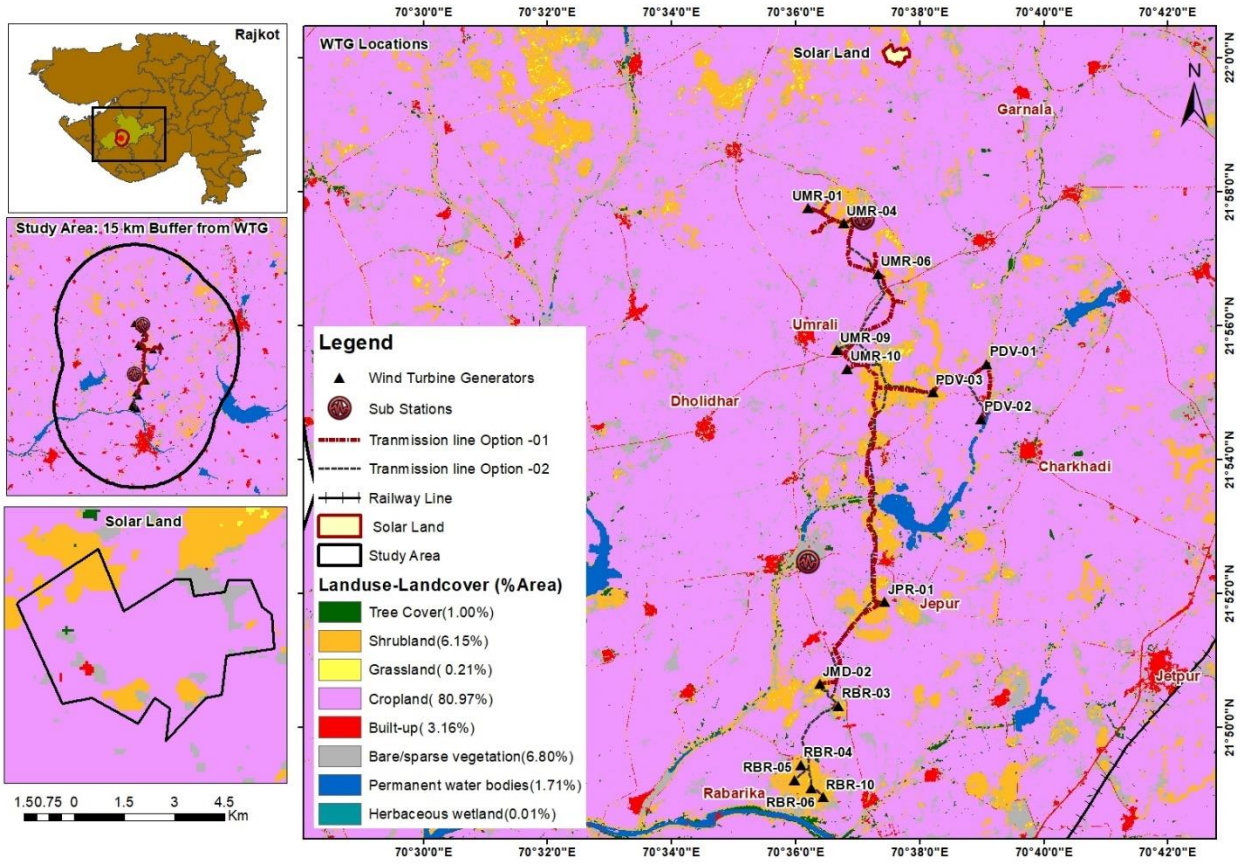


Figure 14: Land Use Land Cover of the study area

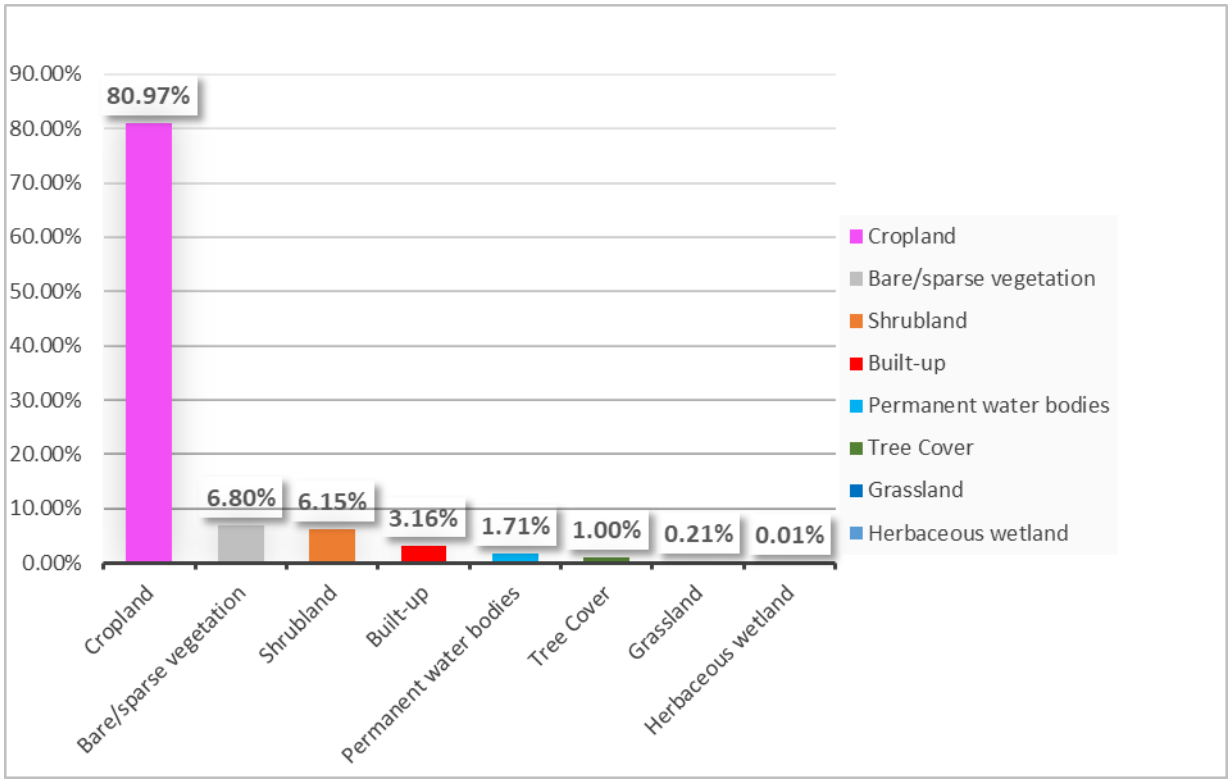


Figure 15:LULC Analysis

It was found that cropland constitute approximately 81% of the study area with negligible tree cover and several large dams and reservoirs.

4.3.2 Soil

The soils in Rajkot district mainly comprise of sandy light brown rocky and rich black soil, the latter known to possess high fertility. These soils vary in depth from 30 to 60 cm. A layer of murum (unconsolidated material of decomposed trap and limestone) is found below a depth of about 40 cm, especially in the Saurashtra region. The soils are silt loam to clay in texture and neutral to alkaline in reaction. These soils are adequately supplied with potassium and poorly supplied with phosphorous and nitrogen. As per the soil data obtained from the Digital Soil Map of the World provided by FAO-UNESCO, higher concentrations

of Chromic vertisols are found in the district**.** *Figure 16* and *Figure 17* highlight the soil types present in the study area.

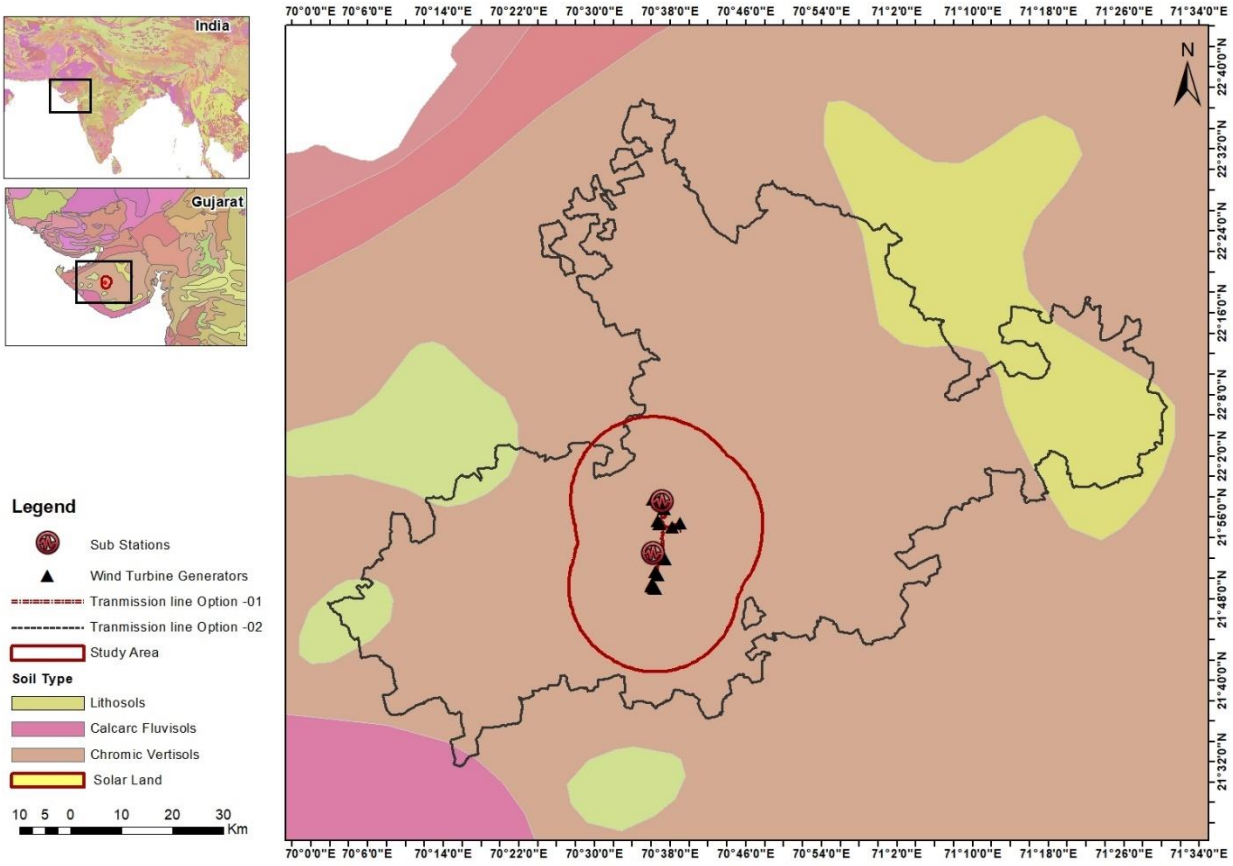


Figure 16: Soils in the Study Area

Figure 17: Photographs of project area highlighting soil type.

4.3.3 Slope

A 30m Digital Elevation Model (DEM) has been used to derive the slope map in Q-GIS.The slope varies across the project area (0%-7%), from flat to gradual. *Figure 18* for slope map of the study area.

Higher slopes are present in certain areas along the transmission lines and where WTGs are located at higher elevations (14%-46%). Solar land has almost flat topography. Generally, a flat terrain would help in easier installations and fewer land grading activities resulting in overall lower impacts on soil and landscape.

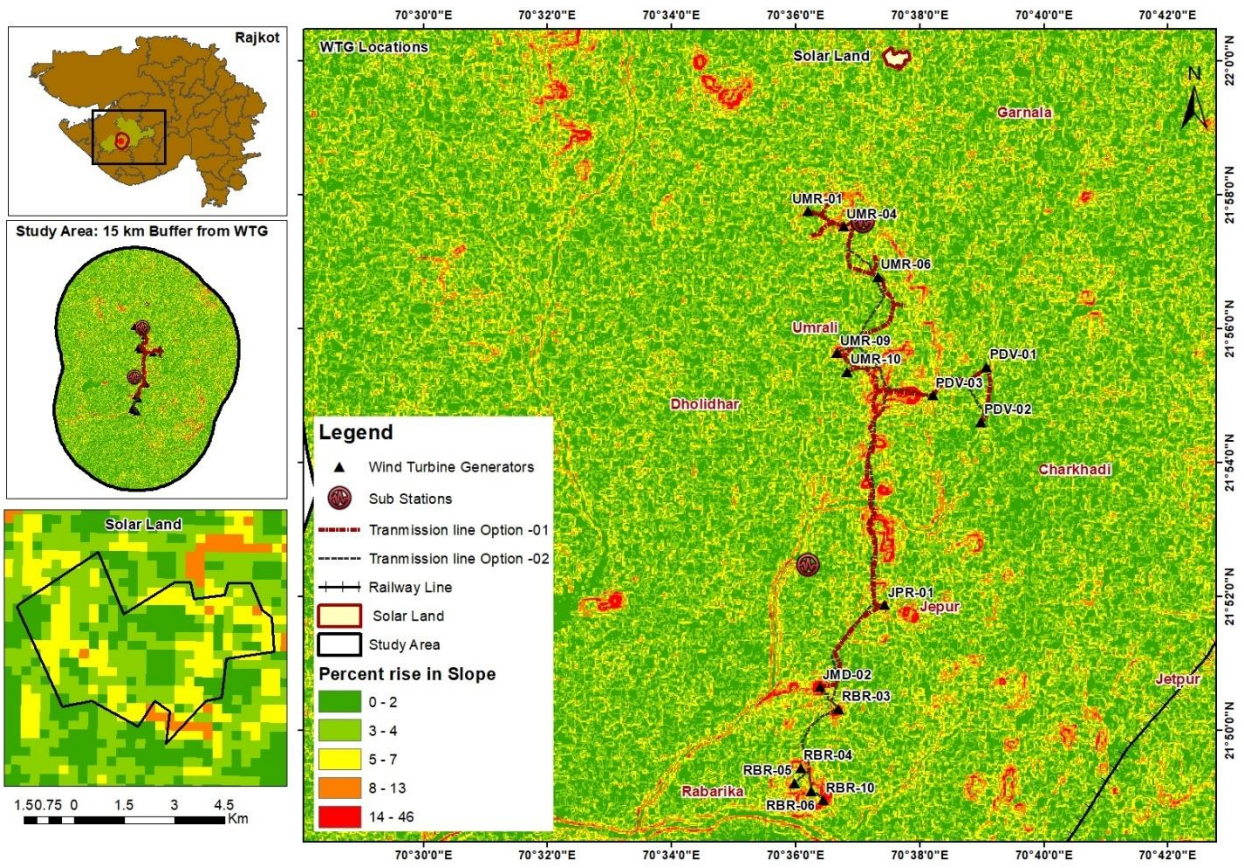


Figure 18 Slope Map in the Study Area

4.3.4 Aspect

A 30m Digital Elevation Model (DEM) has been used to derive the aspect map in Q-GIS, which represents the directions of slope in degrees (flat to 360°). **The Aspect map for the Solar land suggests that the terrain is southward facing with some undulations. Southward facing slopes are considered ideal with respect to orientation of solar panels.** Refer *Figure 19* for Aspect Map of study area.

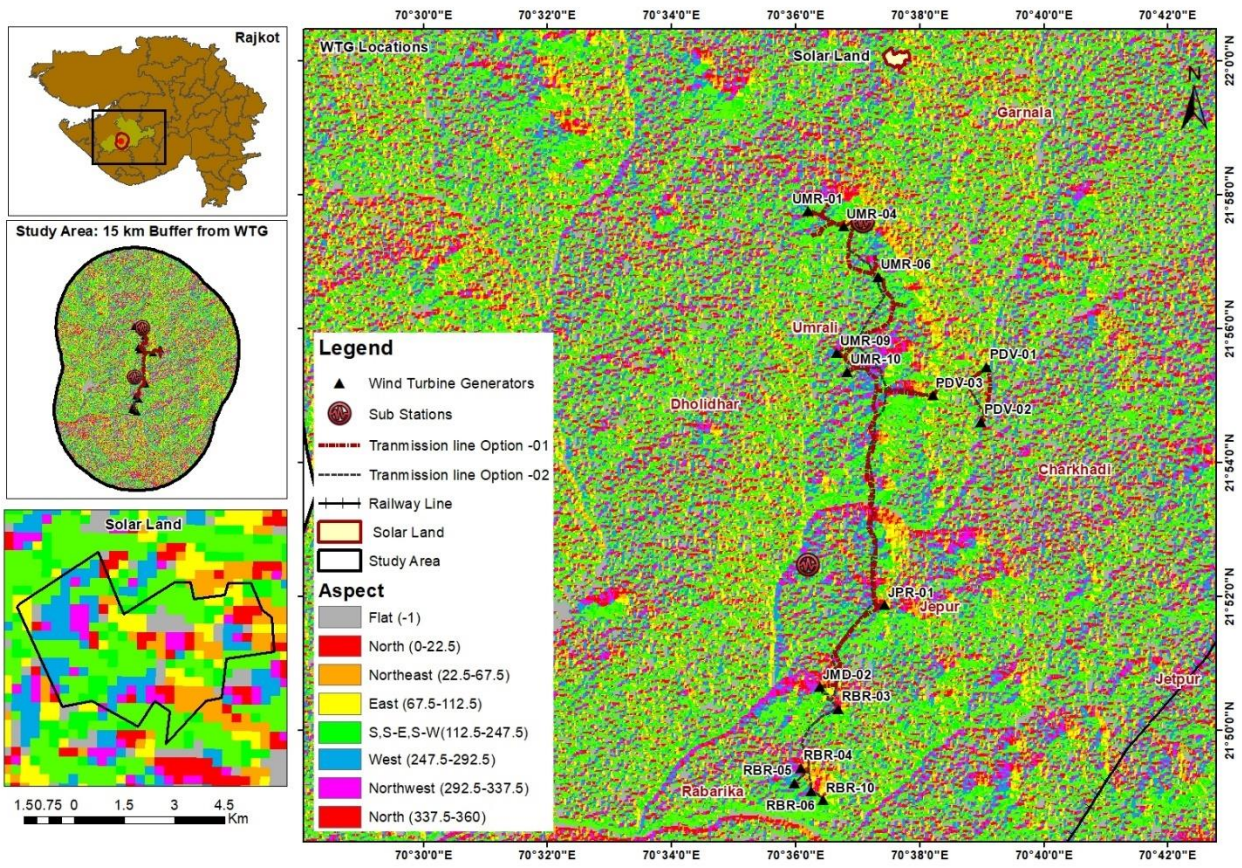


Figure 19: Aspect Map

4.4 Hydrogeology

4.4.1 Surface water

There are three major rivers in the Rajkot District. The river Bhadar, which emerges from Jasdan taluka and flows across the southern part of the district is the biggest of all. The other two major rivers Machhu and Aji, flow toward north. In addition to these, there are 14 rivulets which have a swift and short run to the sea.

Drainage and the order of streams has been derived from the 30m resolution Digital Elevation Model in Q-GIS. Permanent water bodies were derived from Open Streets Maps database.

The Bhadar River cuts through the southern part of the study area. Some other notable rivers cutting across the study area include Champarwadi Nadi, Fofal Nadi, Hemdra Nadi and Gondali Nadi.

Due to the presence of seasonal and perennial streams in the study area, there are multiple reservoirs existing around the project location. The Valadungra Reservoir is located in close proximity to the project site. Apart from this, Bhadar-1 Reservoir, Bhadar-2 Reservoir, Thorala Reservoir, Veri Reservoir, Fofal-1 Dam, Fofal-2 Dam, and Sitla Reservoir are the other reservoirs which exist in the study area. Refer *Figure 20* and *Figure 21* for understanding the spread of stream network and water bodies within the study area.

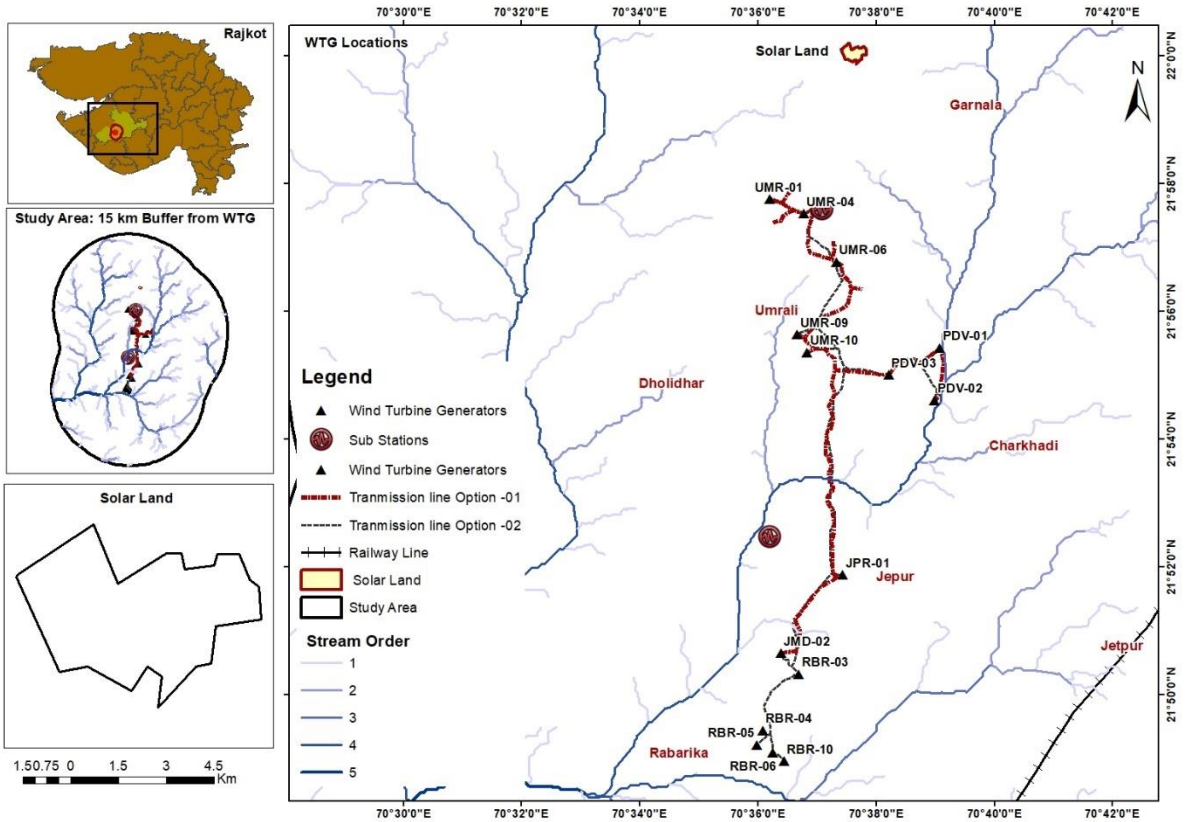


Figure 20: Stream network of the study area

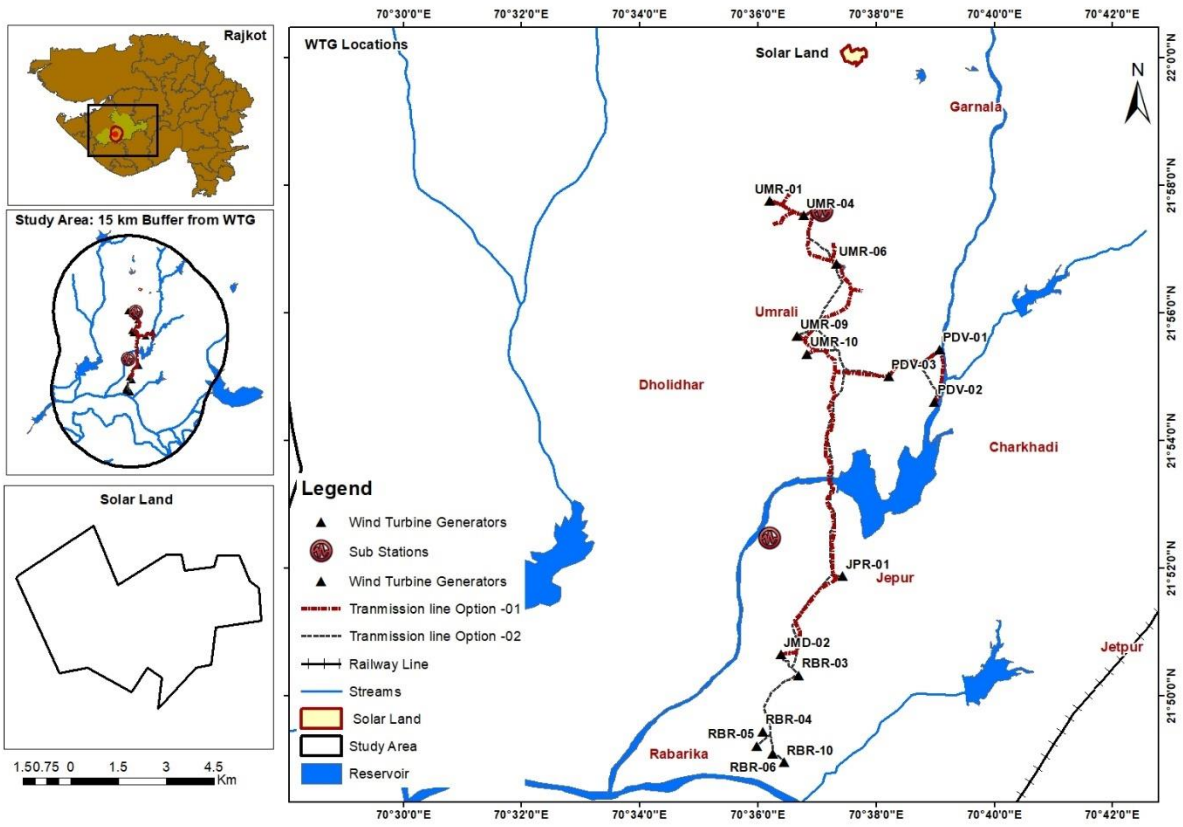


Figure 21: Water bodies present within the study area

Although a number of water bodies are present in the study area, most of them are rain-fed and have a supply of water for approximately 6-8 months in a year. Thus, their usage is limited to washing of clothes and bathing of cattle. Most of the water requirement for drinking is fulfilled through groundwater sourced from the tube wells installed in each village.

During the field visit several seasonal water bodies were identified and surveyed for presence of critical and migratory avifauna. Two seasonal water bodies were found to be present in close proximity to the project sites; one water body was present near the Solar site approach road and adjacent to the internal transmission line corridor (Refer *Figure 22* and Figure *24*); other water body was found to be present within the WTG location-UMR 06 (Refer Figure 23 and Figure 25). The avifaunal species recorded at the above-mentioned water bodies have been highlighted in Section 4.8.3.

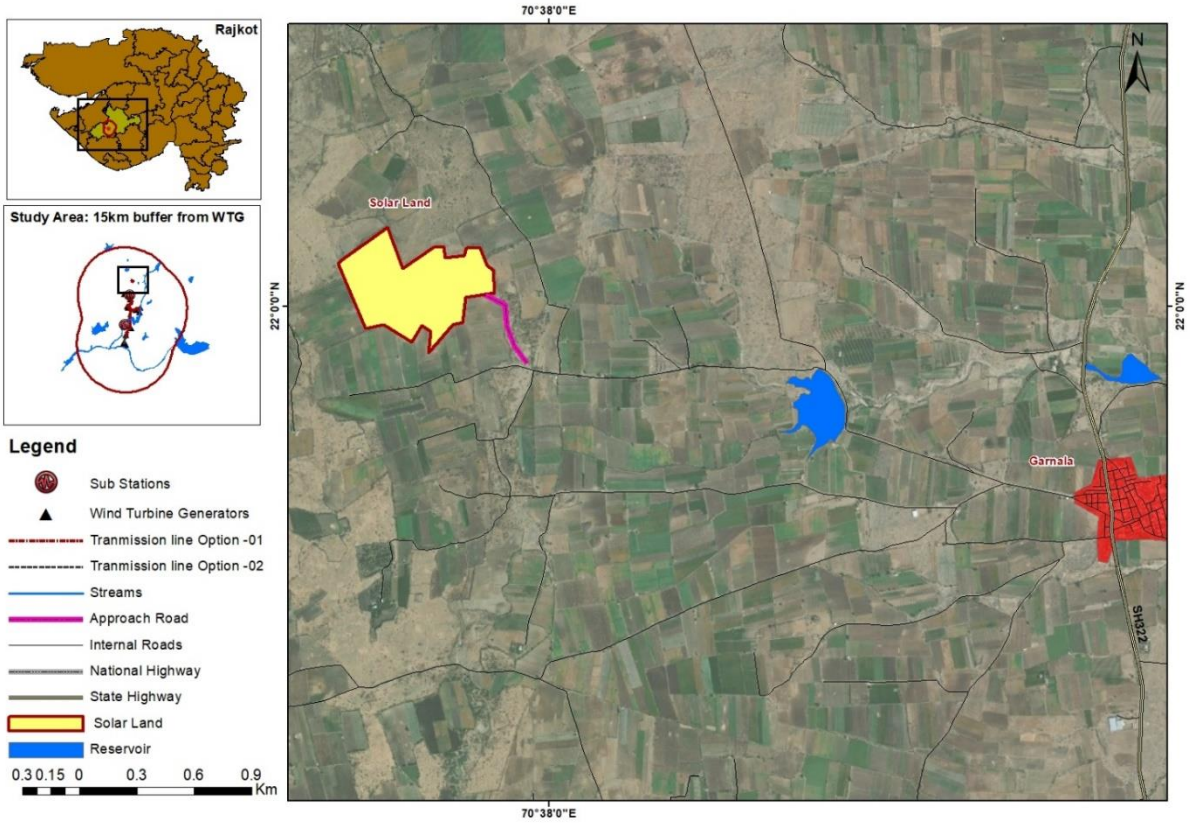


Figure 22: Waterbody near Solar site

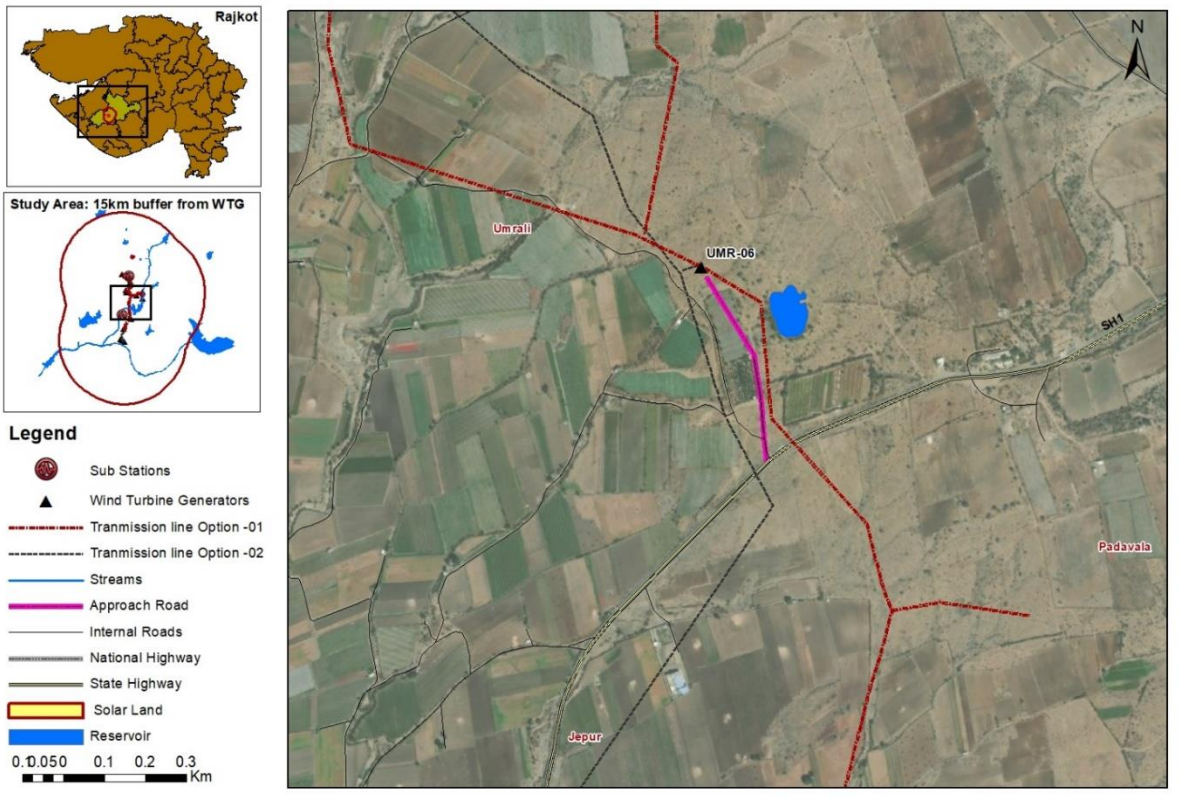


Figure 23: Waterbody near Umrali, UMR-06

Figure 24: Photographs of water body adjacent to solar site

Figure 25: Water body present near UMR 06 WTG location

Figure 26: Water bodies and Reservoirs present in the study area

4.4.2 Groundwater Status

There are two (2) groundwater monitoring stations located within the project study area, namely Hadmadiya (1.9 km) and Umrali (1 km) (Refer Figure 27). **The Ground water development category for the region notified as 'Safe' by the CGWB (Refer *Figure 28*)[1] ,** further primary surveys were conducted at two (2) locations. Consultation with local communities was conducted to corroborate the data. **Seasonal and annual trends in GW levels were confirmed during the site visit and were found to be within safe limits** (Refer *Figure 29* and *Figure 30*).

[1] *Source: http://cgwb.gov.in/District_Profile/Gujarat/Rajkot.pdf*

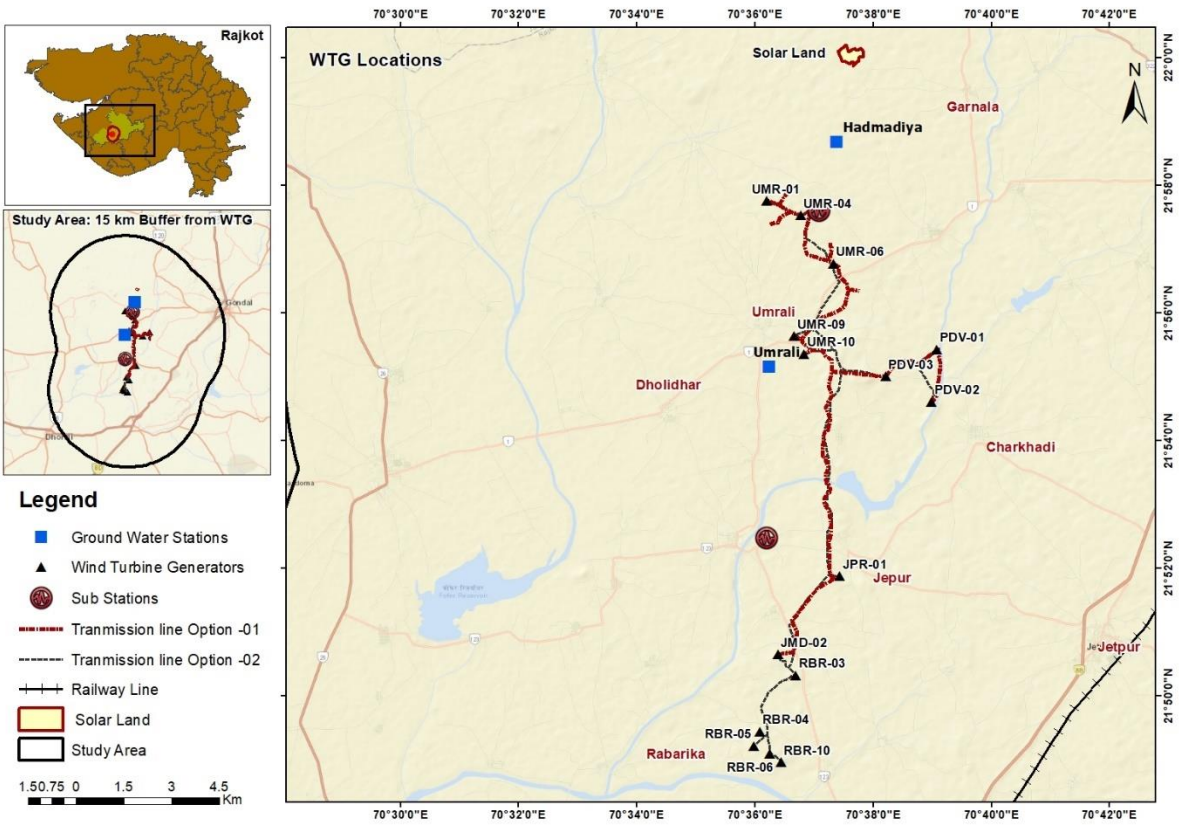


Figure 27: Ground Water Monitoring stations

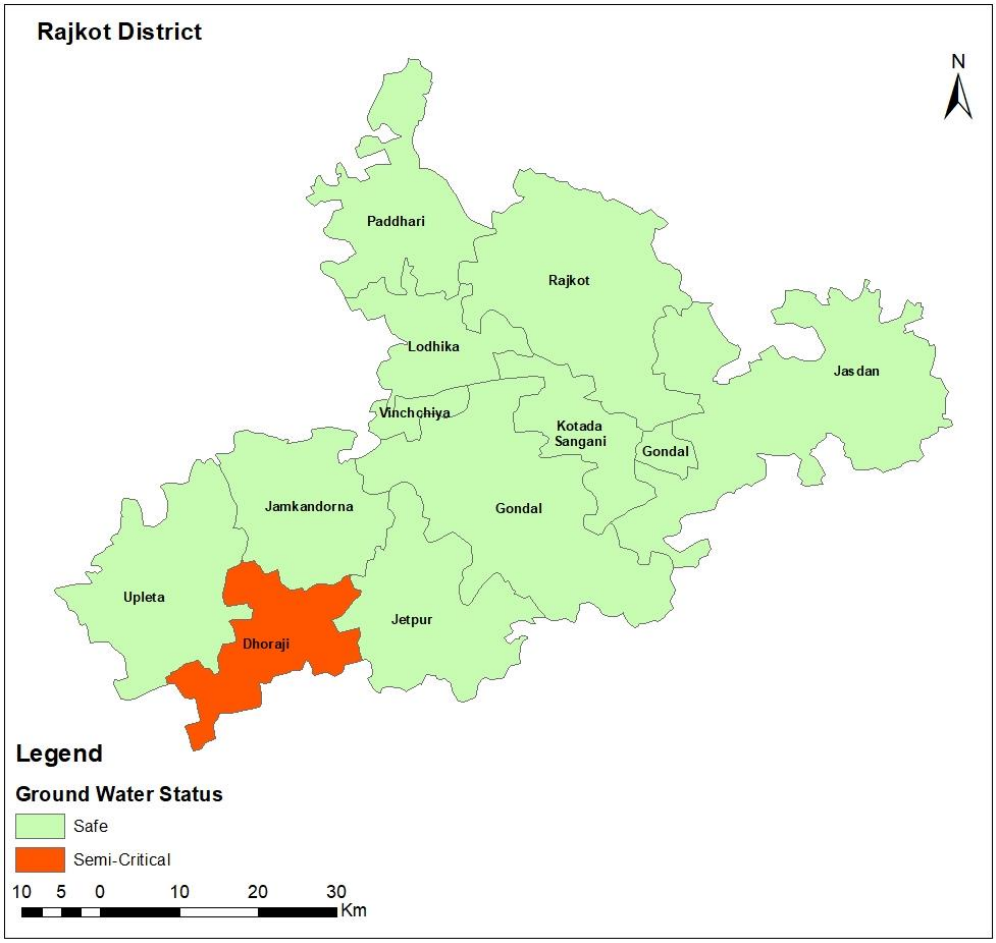


Figure 28: Ground Water status for Rajkot District[2]

[2] *Map data Source: Block wise Ground water Resource Assessment 2020, Block wise Marksheet, CGWB*

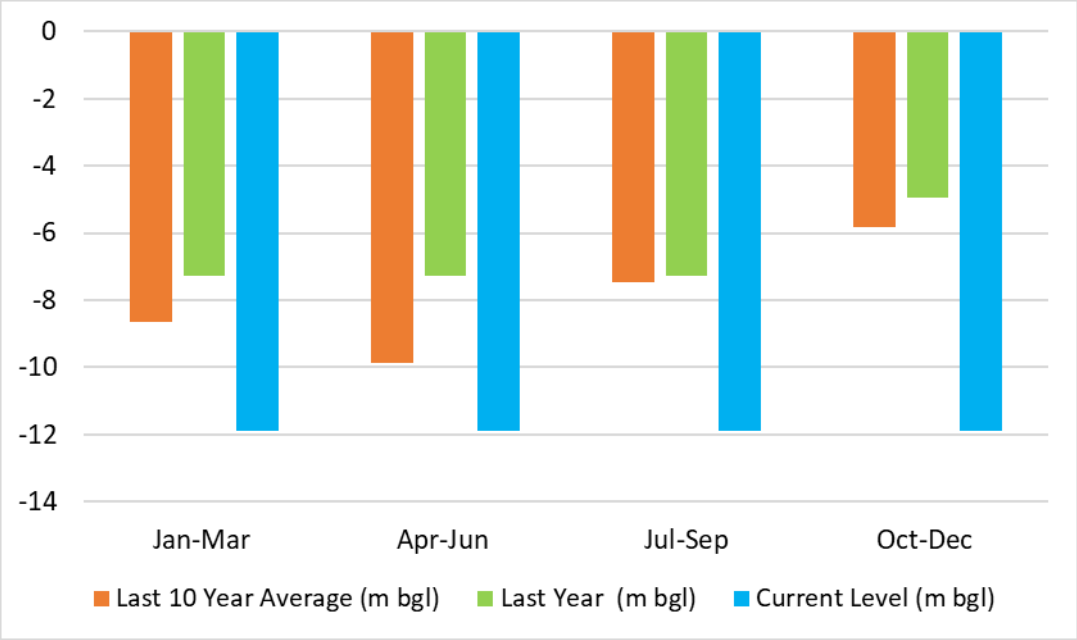


Figure 29: Groundwater trends for Umrali[3]

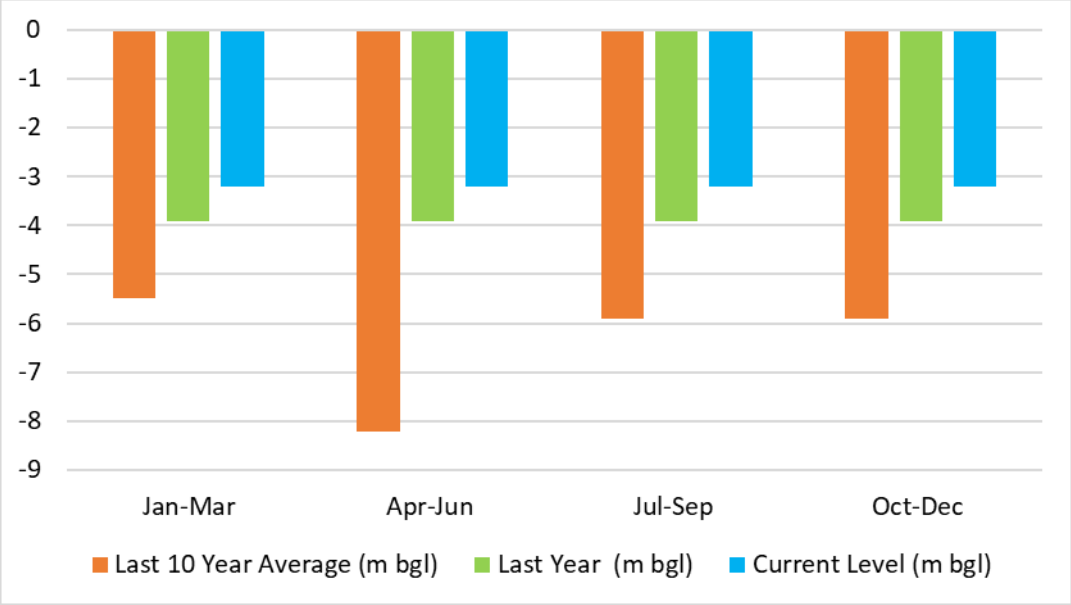


Figure 30: Groundwater trends for Hadmadiya[3]

[3] *Source: indiaWRIS.com, Published in 2021. As accessed on 25th June 2022*

4.5 Settlements

The major settlements in close proximity to the project location are Jetpur and Gondal towns. Around 80 villages are present within the study area and are represented in *Figure 31*.

15 of these villages fall within the 5km buffer of the site location, *Table 14* highlights the distance of the nearest settlement from the solar site and WTG locations.

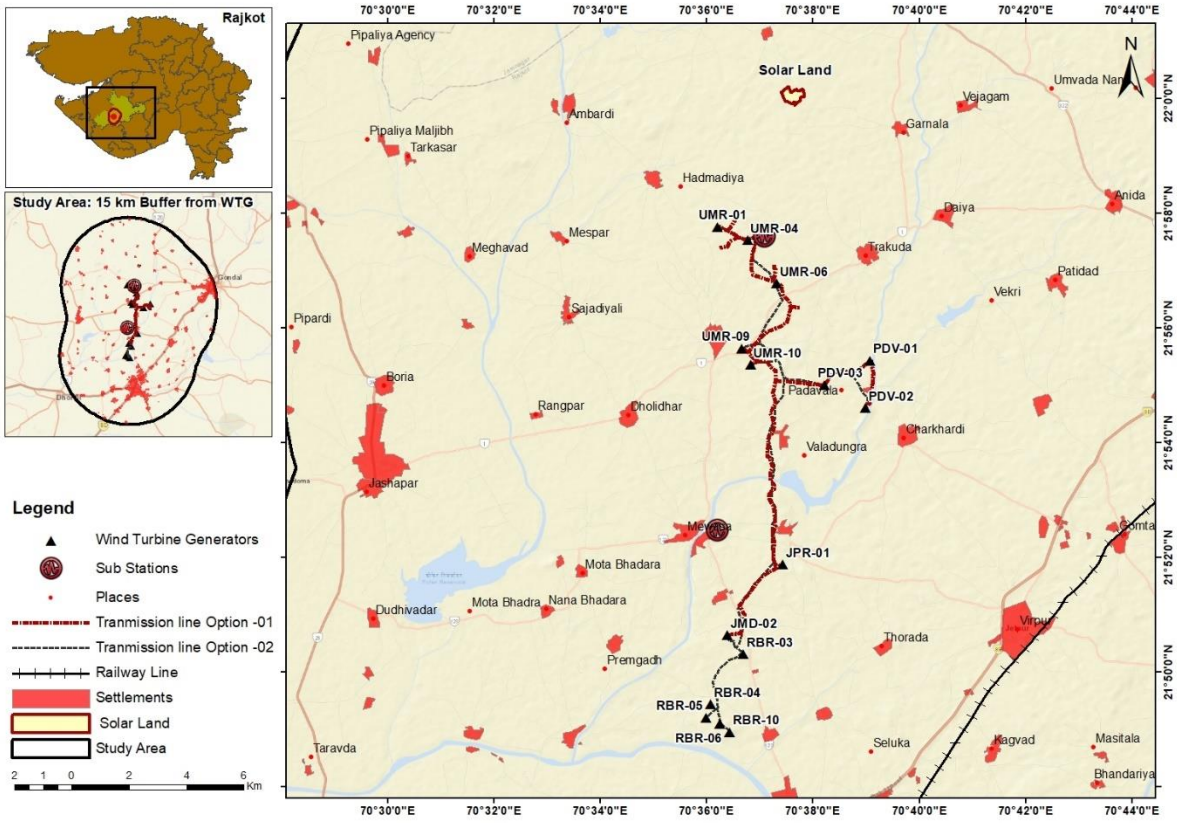


Figure 31: Settlements in study area

Table 14: Project location and nearest settlement

#	Location	Nearest Village	Distance in Meters
1	Solar Site	Garnala	3347
2	WTG locations		
2.1	PDV-01	Padavala	1462
2.2	PDV-02*	Padavala	621
2.3	PDV-03	Padavala	1045
2.4	UMR-01	Hadmadiya	1893
2.5	UMR-04	Hadmadiya	2956
2.6	UMR-06	Umrali	2826
2.7	UMR-09	Umrali	1091
2.8	UMR-10	Umrali	1669
2.9	JMD-02	Jambudi	1117
2.10	JPR-01	Jepur	823
2.11	RBR-03	Jambudi	1837
2.12	RBR-04	Premgadh	3906

#	Location	Nearest Village	Distance in Meters
2.13	RBR-05	Premgadh	3899
2.14	RBR-06	Sardharpur	4213
2.15	RBR-10	Sardharpur	4134
* Buffer Location			

4.6 Places of Cultural Heritage and Archeological Importance

No areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related values were found within the 5 km study area.

However, as per the list of Protected monuments in Gujarat by Archeological Survey of India (ASI), there are two protected monuments, namely Meenal Vav and the Khambhalida Buddhist Caves or Shail Gufao, that are present within the 15 km study area[4]. Refer *Table 15* and *Figure 32*.

There are no World Heritage sites, excavations, or Museums present in the study area. The nearest Archaeological site museum is the Lothal Museum located at an aerial distance of approximately 185 km from the project site.

Table 15: ASI location distance from project location

Monument Name	Distance from solar site in km	Distance from the nearest WTG in km
Shail Gufao	28.3	10.2 (RBR-10)
Meenal Vaav	19.6	9.5 (RBR-03)

[4] *Source: https://asi.nic.in/protected-monuments-in-gujarat/ As accessed on 28th June 2022*

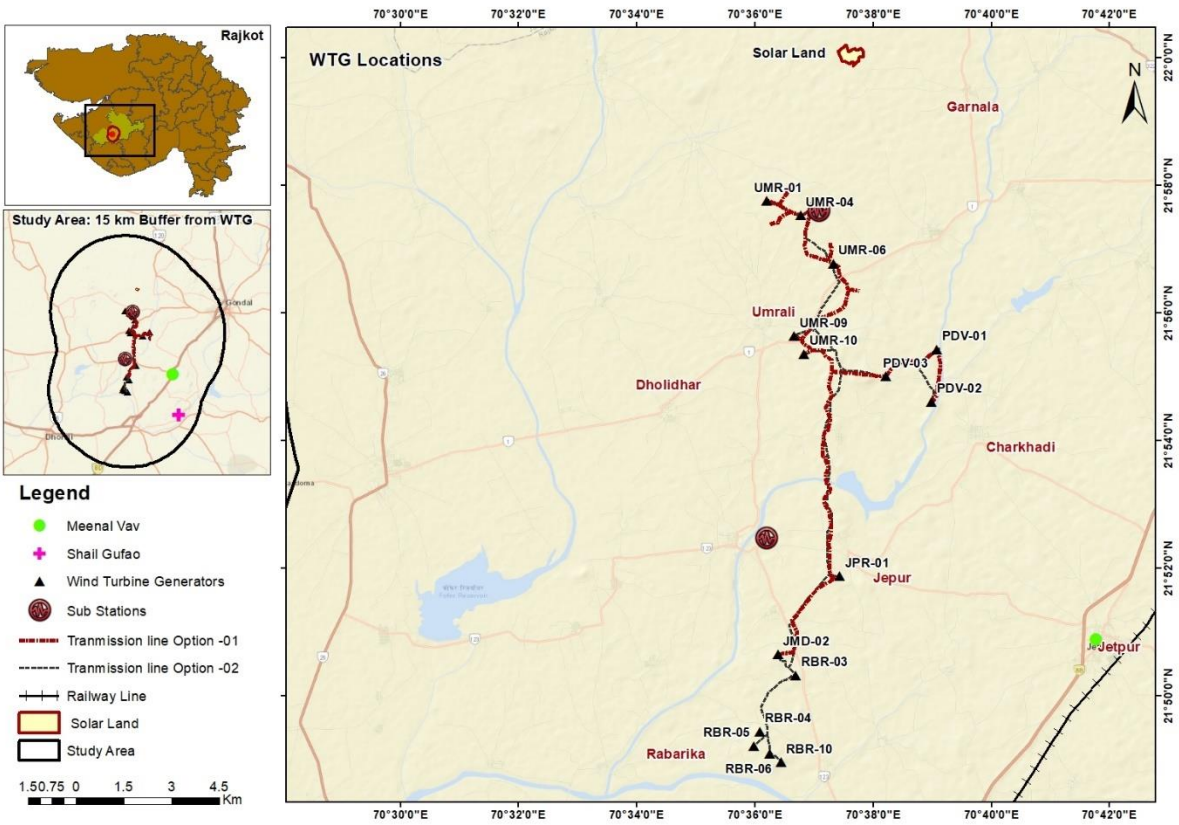


Figure 32: ASI sites within the study area

4.7 Schedule Tribes

Study area is not located in any of the tribal district as per the list of fifth schedule areas. No indigenous communities were found to be present in close proximity to the project locations which was confirmed during the visit. Refer *Figure 33* and *Table 16.*

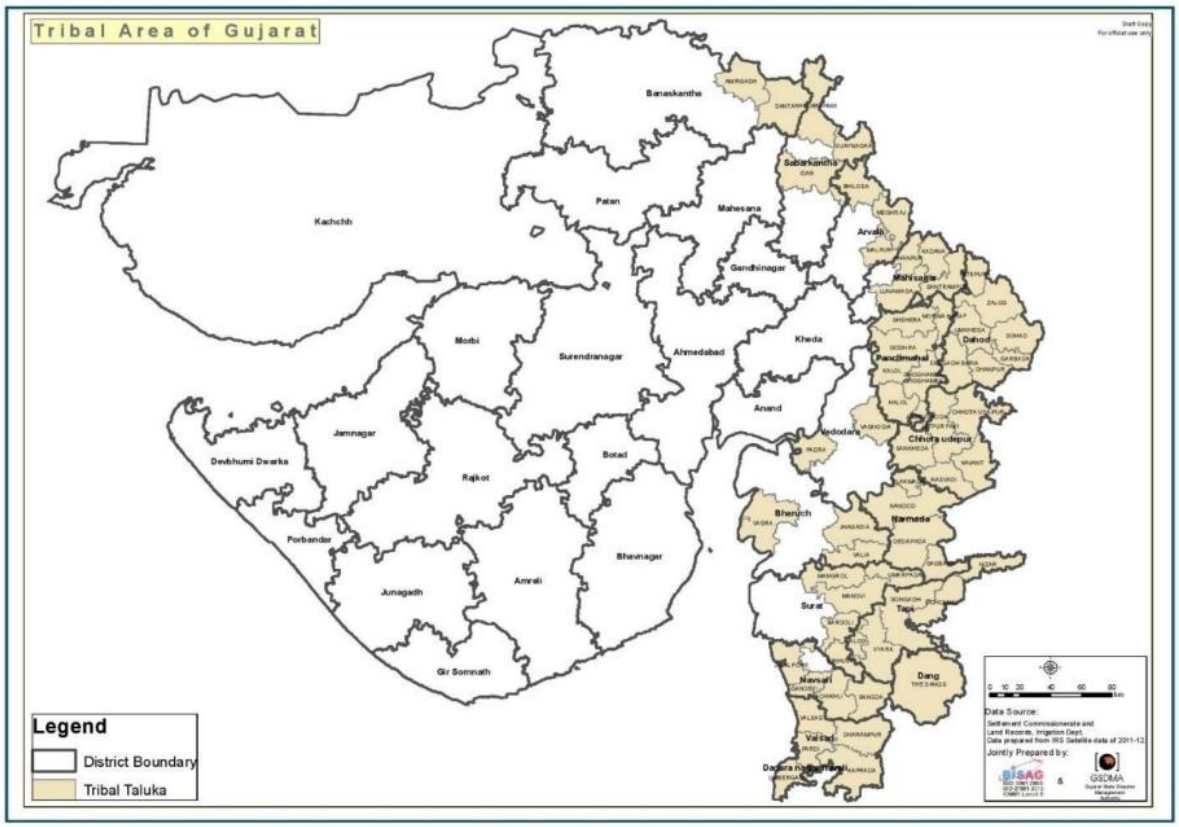


Figure 33: Tribal population of Gujarat[5]

Table 16: State wise list of Fifth schedule areas

State	Areas
Andhra Pradesh	Visakhapatnam, East Godavari, West Godavari, Adilabad,Srikakulam, Vizianagaram, Mahboobnagar, Prakasam (only some mandals are scheduled mandals)
Jharkhand	Dumka, Godda, Devgarh, Sahabgunj, Pakur, Ranchi, Singhbhum (East&West), Gumla, Simdega, Lohardaga, Palamu, Garwa, (some districts are only partly tribal blocks)
Chattisgarh	Sarbhuja, Bastar, Raigad, Raipur, Rajnandgaon, Durg, Bilaspur, Sehdol, Chindwada, Kanker
Himachal Pradesh	Lahaul and Spiti districts, Kinnaur, Pangi tehsil and Bharmour sub-tehsil in Chamba district
Madhya Pradesh	Jhabua, Mandla, Dhar, Khargone, East Nimar (khandwa), Sailana tehsil in Ratlam district, Betul, Seoni, Balaghat, Morena
Gujarat	**Surat, Bharuch, Dangs, Valsad, Panchmahal, Sadodara, Sabarkanta (parts of these districts only)**
Maharashtra	Thane, Nasik, Dhule, Ahmednagar, Pune, Nanded, Amravati, Yavatmal, Gadchiroli, Chandrapur (parts of these districts only)

[5] Source: https://tribal.gujarat.gov.in/ As accessed on 25th June 2022

Orissa	Mayurbhanj, Sundargarh, Koraput (fully scheduled area in these threedistricts), Raigada, Keonjhar, Sambalpur, Boudhkondmals, Ganjam, Kalahandi, Bolangir, Balasor (parts of these districts only)
Rajasthan	Banswara, Dungarpur (fully tribal districts), Udaipur, Chittaurgarh, Siroi (partly tribal areas)

4.8 Ecological Environment

4.8.1 Protected Areas and Ecological Important Habitats

1: 50K Open series Toposheets were procured from Survey of India to identify Reserved forests in the study area. The nearest protected areas to the site location are the Girnar Wildlife Sanctuary, Gir National Park and Gundajalo Reserved Forest which are located at an aerial distance of approximately 10 km, 65 km towards the south and 19 km towards the north-west from the study area boundary respectively (Refer Table 17).

Therefore, there are no National Park/ Wildlife Sanctuary, Notified Eco-Sensitive Zones, Notified Important Bird Areas, Ramsar Sites (Wetlands), Reserve/ Protected Forest, Open Forests/ Social Forests falling within the Study area that can be directly impacted by the project.

Review of literature on Asiatic lion habitats suggests that the nearest suitable habitat is 5km from the study area boundary (15 km buffer boundary) (Refer *Figure 34).* Therefore, the species is not at risk due to the project and man-animal conflict with respect to Asiatic lion at present is not likely. The same was validated through consultations with local communities and officials.

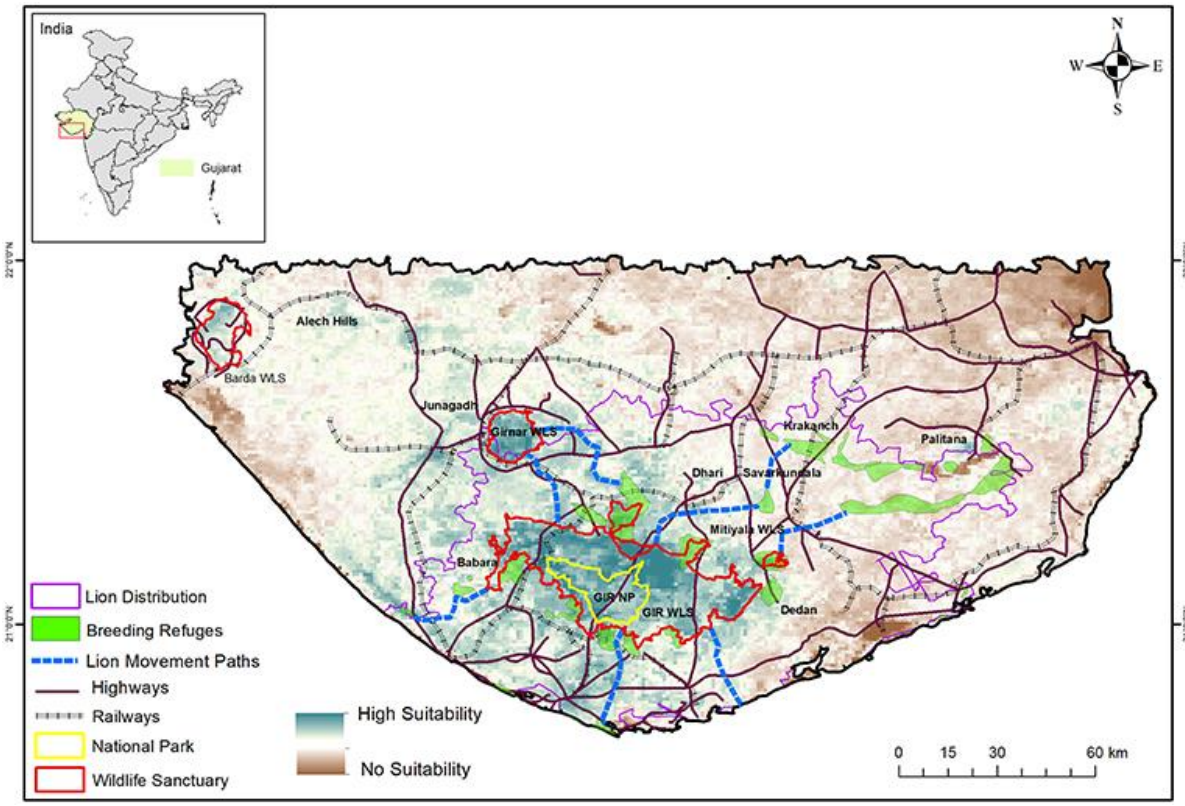


Figure 34: Suitable habitats for Asiatic Lion[6]

Table 17: Distance of project location from protected areas and ecological critical habitats

#	Protected Areas	Distance from Solar in km	Distance from WTG locations in km	Distance from Study Area in km
1	Girnar Wildlife Sanctuary and Gir National Park	45.8	25.7	11
3	Gundajalo Reserved Forest	33	33.7	18.8
Birding Hotspots				
4	Fofal River	12.43	8.43	-
5	Sajadiyali River	10.35	6	-
6	Fofal Dam	19	8.72	-
	Fofal Dam Canal	21	9.83	
7	Valadungra Dam	11.37	2.47	-
8	Bhadar Dam	25	16.71	-

[6] https://www.academia.edu/59747396/Asiatic_Lion_Ecology_Economics_and_Politics_of_Conservation

4.8.2 Flora

A primary floral survey was conducted to record site specific floral species and its diversity. The project location primarily consists of farmland, shrub/scrublands and barren open lands.

Solar Site:

The proposed solar site consisted of approx. 250 plus indigenous species of trees with a few exotic species. The trees were found to be mature within the 25-30 age group.

Species such *Ficus religiosa, Ficus benghalensis, Ficus racemosa, Holoptelia integrefolia, Azadirachta indica, Ziziphus mauritiana, Pongamia pinnata*, etc. were recorded at the solar site which are considered to be keystone species due to the ecosystem services they provide. Very few exotic species of *Peltophorum and Eucalyptus* were recorded.

During the site visit, some patches of the solar site were found to be covered with Congress grass (*Parthenium hysterophorus*), which is a known invasive species and a threat to the native ground cover flora and associated faunal groups.

It is recommended that to control the spread of invasive species like *Parthenium hysterophorus* and *Lantana camara*, existing patches need to be removed using suitable scientific methods before initiating any other activity on the land.

Wind Turbine Generator Location Sites

The WTG sites in the project region are characterized by different habitats due to changes in altitude, availability of water, protection from grazing animals, etc. Overall thick & thin scrub forest was observed in most of the sites consisting of thorny *Acacia* species, *Eucalyptus* and *Ziziphus*. Most of the area was found to be covered with grasses and ground cover like *Vishnukrant*, *Senecio, Vernonia* belonging to the semi-arid region. (Refer Table *18 and* Figure 35 *for recorded list of flora recorded within the site*).

To review and identify the critical species from the observations, the IUCN Redlist categorization of the species was reviewed along with whether the species is native, exotic or invasive. In the state of Gujarat the cutting and transportation of trees is governed by the Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951 and its subsequent corrigendum (2015). As per the Act 86 species of trees in the Annexure A of the act which are exempted from the requirement for a transit permit and felling regulation, 22 species are under Annexure B of the act which are planted under agroforestry and need permission to be felled and transported and finally Annexure B1 includes all trees other than that in A and B, which have a limited protection status.

Based on the review of the species observed on site, out of the 32 tree species, 16 species are exempted from the regulation, but 13 of which are native and play an important role in maintaining local diversity. It is recommended that, as far as possible, native trees must be retained on site. One of the trees observed Bael (*Aegle marmelos)* falls under the Near Threatened Category of IUCN status.

Table 18: List of flora documented during the field survey

#	Common Name	Scientific Name	IUCN Status	Type	Tree cutting permission list
1	Khair	*Acacia catechu*	LC	Native	B
2	Babul	*Acacia nilotica*	LC	Native	B1
3	**Bael**	***Aegle marmelos***	**NT**	**Native**	**B1**
4	Custard apple	*Anona squamosa*	NA	Exotic	A

#	Common Name	Scientific Name	IUCN Status	Type	Tree cutting permission list
5	Jackfruit	*Artocarpus heterophyllus*	NA	Native	A
6	Neem	*Azadirachta indica*	NA	Native	B1
7	Cotton silk tree (Simado)	*Bombax ceiba*	LC	Native	A
8	Palas	*Butea monosperma*	NA	Native	B1
9	Rui	*Calotropis gigantia*	NA	Native	B1
10	Yellow oleander	*Cascabela thevetia*	LC	Exotic	B1
11	Yellow cassia	*Cassia siamea*	LC	Native	A
12	Bhokar	*Cordia dichotoma*	NA	Native	A
13	Nilgiri	*Eucalyptus globules*	NA	Exotic	A
14	Banyan tree	*Ficus benghalensis*	NA	Native	A
15	Payar	*Ficus nervosa*	LC	Native	B1
16	Cluster fig (Umber)	*Ficus racemosa*	LC	Native	B1
17	Peepal	*Ficus Religiosa*	LC	Native	A
18	Indian elm	*Holoptilia integrifolia*	NA	Native	B1
19	Ghaneri	*Lantana camara*	NA	Invasive	B1
20	Kalamb	*Mitragyna parvifolia*	NA	Native	A
21	Drumstick tree	*Moringa oleifera*	LC	Native	A
22	Tut	*Morus alba*	LC	Native	B1
23	Cactus	*Opuntia decumbens*	LC	Native	B1
24	Copper pod	*Peltophorum pterocarpum*	LC	Exotic	B1
25	Amla	*Phyllanthus emblica*	LC	Native	A
26	Indian Beech (Karanj)	*Pongamia pinnata*	LC	Native	A
27	Acacia	*Prosopis cineraria*	NA	Native	B
28	Gando Bawal	*Prosopis juliflora*	LC	Invasive	A
29	Peru	*Psidium guajava*	LC	Native	A
30	Ain	*Terminalia eliptica*	NA	Native	B1
31	Nirgudi	*Vitex negundo*	NA	Native	A
32	Ber	*Ziziphus mauritiana*	LC	Native	A

IUCN Status: LC- Least Concern, VU- Vulnerable, NT- Near Threatened, EN- Endangered, CR- Critically Endangered, NA- Not Applicable.

Tree cutting permission list as per the Corrigendum Notification 2015 to Saurashtra Felling of Trees (*Infliction of Punishment) Act, 1951*: B-List B (Reserved/Restricted), A-List A(Exempted), B1- List (Partially reserved includes all trees other than those in list A&B)

Approx. 250 plus trees within and surrounding the solar site

Mitragyna parvifolia

Peltophorum pterocarpum

Cyanthillium cinereum

Ground cover, Senecio

Ground cover, Tridax procumbens

Prosopis cineraria

Ground cover, Convolvulus arvensis

Rui flowering *(Calotropis procera)*

Uprooted cactus plant

Vishnukrant (Evolvulus alsinoides)

Ground cover, Tricodesmum indicum

Opuntia decumbens

Figure 35: Flora recorded within the study area

4.8.3 Fauna

A study of birds, mammals and herpetofauna was undertaken for the study area with higher importance given to secondary data to address the limitations of a single season survey. A detailed review of existing published literature (including research papers) was carried out to understand the species found in the study area, migration pattern of varied bird species, critical species present in the site, protected area boundary maps and legal requirements (if any) applicable to development projects in terms of critical species and habitats. The checklist of species observed in the area was developed using secondary data prior to the field survey. (Refer **Annexure V)**

Data obtained from processing satellite imagery in the form of a Land Use Land Cover map, wherein habitats were classified based on ecological and anthropogenic factors such as settlement, mine, waterbody were considered for identifying sampling locations. The type of habitat was used to determine diversity of species and pressures present in and around the sampling location. A route map for sampling locations was created using this input.

Fixed point counts of duration 15-20 minutes were conducted at each sampling location across the site area and the species, and the respective counts were noted. Point counts based on vocal cues were undertaken for situations where visual cues were limited.

During the visit to the study area a few mammals and herpetofauna like Blue bull (*Boselaphus tragocamelus*), Indian fox(*Vulpes bengalensis*), Indian hare(*Lepus nigricollis*), Indian Mongoose(*Herpestes edwardsi*), Monitor Lizard (*Varanus bengalensis*) and Indian rat snake (*Ptyas mucosa*)were sighted. **However, after consultation with local villagers, the presence of Black buck *(Antelope Cervicapra)* was also reported by the local community and Panchayat members of the study area. Apart from Black buck, Indian Peafowl *(Pavo cristatus)* was the only Schedule -I species reported from the study area.**

As part of the avifaunal survey, morning and evening point counts were taken across the study area. **Several waterbodies and scrublands were found to be present near the solar site and adjacent to a few WTG locations. Waterbodies were found to harbour several migratory and native avifauna like ducks, and waders. Key species observed during the survey include, Oriental Darter *(Anhinga melanogaster),* Eurasian Spoonbill *(Platalea leucorodia*), Green-winged Teal *(Anas crecca),* Greater painted snipe *(Rostratula benghalensis*), Knob-billed duck *(Sarkidiornis melanotos)* and large congregation of Eurasian Coot *(Fulica atra),* Lesser whistling ducks *(Dendrocygna javanica)* and Indian Spot billed ducks *(Anas poecilorhyncha).***

During the survey conducted in scrublands located near the project locations, soaring species like Eurasian Kestrel *(Falco tinnunculus),* Oriental Honey Buzzard (*Pernis ptilorhynchus),* Booted Eagle *(Hieraaetus pennatus*), Harrier sp. and Shikra *(Accipiter badius)* were spotted besides large congregation of Rosy starlings *(Pastor roseus).* Consultation with residents and cattle herders revealed presence of Vultures in scrublands near Umrali and Rabarika WTG locations, however these could not be visually confirmed. A total of 5-6 nests of Chestnut-bellied Sandgrouse *(Pterocles exustus)* **were observed, with about 10 unhatched eggs in scrublands near Umrali and Rabarika villages.**

Based on the ecological surveys conducted, water bodies near the solar site and scrublands near WTG locations in Rabarika and Umrali were found to be critical in terms of the high soaring faunal species and nesting sites identified. Appropriate recommendations for managing and mitigating risks have been provided in Section 7.2 and Section 7.3.

The IUCN Redlist classifies birds based on the population and habitat status as Vulnerable (VU), Near Threatened (NT), Endangered (EN) and Critically Endangered (CR), in increasing order of their criticality. Based on the review of published literature, a total of 42 species from have been recorded from the Rajkot

district ranging from VU to CR (Refer *Table 19*). **However, there are no recent sightings for some of the species categorized as critically endangered (CR), like the Great Indian Bustard[7] and Vulture species[8].**

Table 19: List of Critical Avifauna from the Rajkot district

#	Common Name	Scientific Name	Sighting during Visit	IUCN Status	Distribution	WPA 1972 Schedule
1	Marbled Teal	*Marmaronetta angustirostris*	N	VU	WM	IV
2	Common Pochard	*Aythya ferina*	N	VU	WM	IV
3	Ferruginous Duck	*Aythya nyroca*	N	NT	WM	IV
4	Lesser Flamingo	*Phoeniconaias minor*	N	NT	WM	IV
5	Yellow-eyed Pigeon	*Columba eversmanni*	N	VU	WM	IV
7	Great Indian Bustard	*Ardeotis nigriceps*	N	CR	R	I
8	Macqueen's Bustard	*Chlamydotis macqueenii*	N	VU	WM	IV
9	Lesser Florican	*Sypheotides indicus*	N	CR	SM	I
10	Sarus Crane	*Antigone antigone*	N	VU	R	IV
11	Great Thick-knee	*Esacus recurvirostris*	N	NT	R	IV
12	Northern Lapwing	*Vanellus vanellus*	N	NT	WM	IV
13	Sociable Lapwing	*Vanellus gregarius*	N	CR	WM	IV
14	Eurasian Curlew	*Numenius arquata*	N	NT	WM	IV
15	Bar-tailed Godwit	*Limosa lapponica*	N	NT	WM	IV
16	Black-tailed Godwit	*Limosa limosa*	N	NT	WM	IV
17	Curlew Sandpiper	*Calidris ferruginea*	N	NT	WM	IV
18	Black-bellied Tern	*Sterna acuticauda*	N	EN	R	IV
19	River Tern	*Sterna aurantia*	Y	VU	R	IV
20	Asian Woolly-necked Stork	*Ciconia episcopus*	N	NT	R	IV
21	Black-necked Stork	*Ephippiorhynchus asiaticus*	N	NT	R	IV
22	Painted Stork	*Mycteria leucocephala*	Y	NT	R	IV
23	Oriental Darter	*Anhinga melanogaster*	Y	NT	R	IV
24	Spot-billed Pelican	*Pelecanus philippensis*	N	NT	WM	IV
25	Dalmatian Pelican	*Pelecanus crispus*	N	NT	WM	IV
26	Black-headed Ibis	*Threskiornis melanocephalus*	Y	NT	R	IV
27	Egyptian Vulture	*Neophron percnopterus*	N	EN	R	IV
28	Cinereous Vulture	*Aegypius monachus*	N	NT	WM	IV
29	White-rumped Vulture	*Gyps bengalensis*	N	CR	R	I
30	Indian Vulture	*Gyps indicus*	N	CR	R	I
31	Indian Spotted Eagle	*Clanga hastata*	N	VU	R	I
32	Greater Spotted Eagle	*Clanga clanga*	N	VU	WM	I
33	Tawny Eagle	*Aquila rapax*	N	VU	R	I
34	Steppe Eagle	*Aquila nipalensis*	N	EN	WM	I
35	Imperial Eagle	*Aquila heliaca*	N	VU	WM	I
36	Pallid Harrier	*Circus macrourus*	N	NT	WM	I
37	Pallas's Fish-Eagle	*Haliaeetus leucoryphus*	N	EN	WM	I
38	Laggar Falcon	*Falco jugger*	N	NT	R	I
39	Saker Falcon	*Falco cherrug*	N	EN	WM	I
40	Alexandrine Parakeet	*Psittacula eupatria*	N	NT	R	IV
41	Blossom-headed Parakeet	*Psittacula roseata*	N	NT	R	IV

[7] http://www.conservationindia.org/articles/great-indian-bustard-the-way-of-the-dodo Accessed on 16 November 2022.

[8] http://gujenvis.nic.in/PDF/vuture%20status.pdf , Accessed on 16 November 2022.

#	Common Name	Scientific Name	Sighting during Visit	IUCN Status	Distribution	WPA 1972 Schedule
42	White-browed Bushchat	*Saxicola macrorhynchus*	N	VU	R	IV

Sighting: Y-Yes, N-No
IUCN Category: LC-Least Concern, VU-Vulnerable, NT-Near Threatened, EN-Endangered, CR-Critically Endangered
Distribution: WM-Winter Migrant, SM-Summer Migrant, R-Resident
Source:
https://avibase.bsceoc.org/checklist.jsp?lang=EN&p2=1&list=clements&synlang=&region=INnwgjra&version=text&lifelist=&highlight=0

During the field survey a total of 77 bird species were recorded from various habitats in the study area which are represented in the *Table 20* and photographs provided in *Figure 36*.

Table 20: List of observed Bird species during the field visit

#	Common Name	Scientific Name	Order-Family	IUCN Status	WPA 1972 Schedule	Distribution
1	Grey Francolin	*Francolinus pondicerianus*	GALLIFORMES: Phasianidae	LC	IV	R
2	Indian Peafowl	*Pavo cristatus*	GALLIFORMES: Phasianidae	LC	I	R
2	Lesser Whistling-duck	*Dendrocygna javanica*	ANSERIFORMES: Dendrocygnidae	LC	IV	R
4	Spot-billed Duck	*Anas poecilorhyncha*	ANSERIFORMES: Anatidae	LC	IV	R
5	Northern Shoveler	*Anas clypeata*	ANSERIFORMES: Anatidae	LC	IV	WM
6	Common Teal	*Anas crecca*	ANSERIFORMES: Anatidae	LC	IV	WM
7	Knob-billed duck	*Sarkidiornis melanotos*	ANSERIFORMES: Anatidae	LC	IV	WM
8	Common Hoopoe	*Upupa epops*	UPUPIFORMES: Upupidae	LC	-	WM
9	Indian Roller	*Coracias benghalensis*	CORACIIFORMES: Coraciidae	LC	IV	R
10	Common Kingfisher	*Alcedo atthis*	CORACIIFORMES: Alcedinidae	LC	IV	R
11	White-throated Kingfisher	*Halcyon smyrnensis*	CORACIIFORMES: Halcyonidae	LC	IV	R
12	Green Bee-eater	*Merops orientalis*	CORACIIFORMES: Meropidae	LC	-	R
13	Asian Koel	*Eudynamys scolopacea*	CUCULIFORMES: Cuculidae	LC	IV	R
14	Sirkeer Malkoha	*Phaenicophaeus leschenaultii*	CUCULIFORMES: Cuculidae	LC	IV	R
15	Greater Coucal	*Centropus sinensis*	CUCULIFORMES: Centropodidae	LC	IV	R
16	Rose-ringed Parakeet	*Psittacula krameri*	PSITTACIFORMES: Psittacidae	LC	IV	R
17	Little Swift	*Apus affinis*	APODIFORMES: Apodidae	LC	-	R
18	Spotted Owlet	*Athene brama*	STRIGIFORMES: Strigidae	LC	IV	R
19	Rock Pigeon	*Columba livia*	COLUMBIFORMES: Columbidae	LC	IV	R
20	Laughing Dove	*Streptopelia senegalensis*	COLUMBIFORMES: Columbidae	LC	IV	R
21	Red Collared Dove	*Streptopelia tranquebarica*	COLUMBIFORMES: Columbidae	LC	IV	R
22	Eurasian Collared Dove	*Streptopelia decaocto*	COLUMBIFORMES: Columbidae	LC	IV	R
23	Common Coot	*Fulica atra*	GRUIFORMES: Rallidae	LC	IV	R

#	Common Name	Scientific Name	Order-Family	IUCN Status	WPA 1972 Schedule	Distribution
24	Chestnut-bellied Sandgrouse	*Pterocles exustus*	CICONIIFORMES: Pteroclidae	LC	IV	R
25	Common Snipe	*Gallinago gallinago*	CICONIIFORMES: Scolopacidae	LC	IV	WM
26	Greater Painted Snipe	*Rostratula benghalensis*	CICONIIFORMES: Scolopacidae	LC	IV	R
27	Black-winged Stilt	*Himantopus himantopus*	CICONIIFORMES: Charadriidae	LC	IV	R
28	Yellow-wattled Lapwing	*Vanellus malarbaricus*	CICONIIFORMES: Charadriidae	LC	IV	R
29	River Tern	*Sterna aurantia*	CICONIIFORMES: Laridae	NT	IV	R
30	Black-shouldered Kite	*Elanus caeruleus*	CICONIIFORMES: Accipitridae	LC	I	R
31	Black Kite	*Milvus migrans*	CICONIIFORMES: Accipitridae	LC	IV	R
32	Montagu's Harrier	*Circus pygargus*	CICONIIFORMES: Accipitridae	LC	I	WM
33	Shikra	*Accipiter badius*	CICONIIFORMES: Accipitridae	LC	I	R
35	White-eyed Buzzard	*Butastur teesa*	CICONIIFORMES: Accipitridae	LC	I	R
36	Honey Buzzard	*Pernis apivorus*	CICONIIFORMES: Accipitridae	LC	I	R
37	Booted Eagle	*Hieraaetus pennatus*	CICONIIFORMES: Accipitridae	LC	I	WM
38	Common Kestrel	*Falco tinnunculus*	CICONIIFORMES: Falconidae	LC	I	WM
39	Little Grebe	*Tachybaptus ruficollis*	CICONIIFORMES: Podicipedidae	LC	IV	R
40	Darter	*Anhinga melanogaster*	CICONIIFORMES: Anhingidae	LC	IV	R
41	Little Cormorant	*Phalacrocorax niger*	CICONIIFORMES: Phalacrocoracidae	LC	IV	R
42	Indian Cormorant	*Phalacrocorax fuscicollis*	CICONIIFORMES: Phalacrocoracidae	LC	IV	WM
43	Great Cormorant	*Phalacrocorax carbo*	CICONIIFORMES: Phalacrocoracidae	LC	IV	WM
44	Little Egret	*Egretta garzetta*	CICONIIFORMES: Ardeidae	LC	IV	R
45	Western Reef Egret	*Egretta gularis*	CICONIIFORMES: Ardeidae	LC	IV	R
46	Grey Heron	*Ardea cinerea*	CICONIIFORMES: Ardeidae	LC	IV	R
47	Purple Heron	*Ardea purpurea*	CICONIIFORMES: Ardeidae	LC	IV	R
48	Great Egret	*Casmerodius albus*	CICONIIFORMES: Ardeidae	LC	IV	R
49	Intermediate Egret	*Mesophoyx intermedia*	CICONIIFORMES: Ardeidae	LC	IV	R

#	Common Name	Scientific Name	Order-Family	IUCN Status	WPA 1972 Schedule	Distribution
50	Cattle Egret	*Bubulcus ibis*	CICONIIFORMES: Ardeidae	LC	IV	R
51	Indian Pond Heron	*Ardeola grayii*	CICONIIFORMES: Ardeidae	LC	IV	R
52	Black-headed Ibis	*Threskiornis melanocephalus*	CICONIIFORMES: Threskiornithidae	NT	IV	R
53	Red Naped Ibis	*Pseudibis papillosa*	CICONIIFORMES: Threskiornithidae	LC	IV	R
54	Eurasian Spoonbill	*Platalea leucorodia*	CICONIIFORMES: Threskiornithidae	LC	I	R
55	Painted Stork	*Mycteria leucocephala*	CICONIIFORMES: Ciconiidae	NT	IV	R
56	Bay-backed Shrike	*Lanius vittatus*	PASSERIFORMES: Laniidae	LC	-	R
57	House Crow	*Corvus splendens*	PASSERIFORMES: Corvidae	LC	IV	R
58	Black Drongo	*Dicrurus macrocercus*	PASSERIFORMES: Corvidae	LC	IV	R
59	Bluethroat	*Luscinia svecica*	PASSERIFORMES: Muscicapidae	LC	IV	WM
60	Indian Robin	*Saxicoloides fulicata*	PASSERIFORMES: Muscicapidae	LC	IV	R
61	Brahminy Starling	*Sturnus pagodarum*	PASSERIFORMES: Sturnidae	LC	IV	R
62	Rosy Starling	*Sturnus roseus*	PASSERIFORMES: Sturnidae	LC	IV	WM
63	Common Myna	*Acridotheres tristis*	PASSERIFORMES: Sturnidae	LC	IV	R
64	White-eared Bulbul	*Pycnonotus leucotis*	PASSERIFORMES: Pycnonotidae	LC	IV	R
65	Red-vented Bulbul	*Pycnonotus cafer*	PASSERIFORMES: Pycnonotidae	LC	IV	R
66	Jungle Babbler	*Turdoides striatus*	PASSERIFORMES: Sylviidae	LC	IV	R
67	Ashy-crowned Sparrow Lark	*Eremopterix grisea*	PASSERIFORMES: Alaudidae	LC	IV	R
68	Purple Sunbird	*Nectarinia asiatica*	PASSERIFORMES: Nectariniidae	LC	IV	R
69	House Sparrow	*Passer domesticus*	PASSERIFORMES: Passeridae	LC	IV	R
70	White Wagtail	*Motacilla alba*	PASSERIFORMES: Passeridae	LC	IV	WM
71	White-browed Wagtail	*Motacilla maderaspatensis*	PASSERIFORMES: Passeridae	LC	IV	R
72	Citrine Wagtail	*Motacilla citreola*	PASSERIFORMES: Passeridae	LC	IV	WM
73	Yellow Wagtail	*Motacilla flava*	PASSERIFORMES: Passeridae	LC	IV	WM
74	Grey Wagtail	*Motacilla cinerea*	PASSERIFORMES: Passeridae	LC	IV	WM

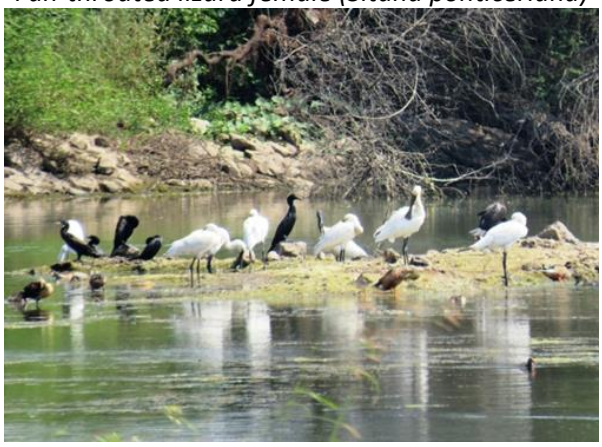
#	Common Name	Scientific Name	Order-Family	IUCN Status	WPA 1972 Schedule	Distribution
75	Tawny Pipit	*Anthus campestris*	PASSERIFORMES: Passeridae	LC	IV	WM
76	Baya Weaver	*Ploceus philippinus*	PASSERIFORMES: Passeridae	LC	IV	R
77	Indian Silverbill	*Lonchura malabarica*	PASSERIFORMES: Passeridae	LC	IV	R

IUCN Category: LC-Least Concern, VU-Vulnerable, NT-Near Threatened, EN-Endangered, CR-Critically Endangered

Distribution: WM-Winter Migrant, SM-Summer Migrant, R-Resident

Fan-throated lizard female (Sitana ponticeriana)

Blue Pansy (Junonia orithya)



Cormorants, spoonbills & other waders near waterbody

Black-shouldered kite (Elanus caeruleus)

Chestnut Bellied Sandgrouse

Chestnut Bellied Sandgrouse Eggs (Scrubland of Rabarika and Umrali)

Asian green bee-eater (Merops orientalis)

Painted Stork

Black headed Ibis

Northern Shoveler

Red-naped Ibis

White Eyed Buzzard

Indian Cormorant

Lesser Whistling Duck

Grey Heron

Montagu's Harrier

Dusky Craig Martin

River Tern

Grey Francolin-Farmlands near Khari

Oriental Honey Buzzard

Green sandpiper

Black-crowned night heron

Figure 36: Fauna including avifauna recorded within the study area

4.9 Meteorology

4.9.1 Rainfall and Temperature

The graph in *Figure 37*Figure 1 represents the average monthly precipitation and monthly average mean temperature for Gondal for the last decade (2012-2021). The highest and lowest values for the monthly average mean temperature in the past 10 years (2012-2021) for Gondal have been recorded as 33.2 deg C and 21.1 deg C.

The monsoon season starts at the end of June which last up till the end of September. October and November constitute the post monsoon season. As per the graph, July month has the maximum average precipitation (2012-2021).

As per the municipal data for Rajkot district, the highest and lowest values for the annual rainfall in the past 10 years (2012-2021) for Rajkot District have been recorded as 1528 mm (2019) and 397 mm (2014). The average annual rainfall for the past decade has been found to be 927.05 mm.

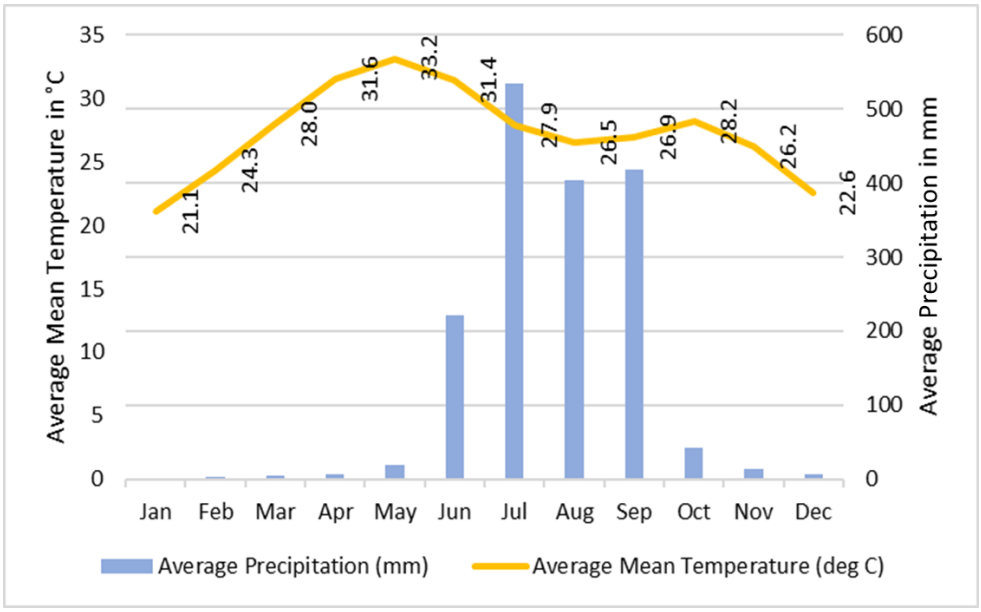


Figure 37: Variation in Rainfall and Temperature in Project Area[9]

4.9.2 Wind Speed and Direction

Gondal town lies in the North-East of the study area. The prevalent wind direction is from West to East direction for Gondal town, followed by West-Southwest to East-Northeast and South-West to North-East winds. (Refer *Figure 38* for wind rose diagram). The wind speed graph alongside shows the wind speed data for Gondal in m/s over the period of 10 years from 2012-2021.

The maximum and minimum values for the wind speed in the past 10 years for Gondal have been recorded as 4.08 m/s and 0.5 m/s. The average wind speed has been found to be 2.03 m/s at 10 mts. height. Windspeed values will be one of the inputs for the Noise and shadow flicker model (Refer *Figure 39*).

Activities in the vicinity of the solar project, that may lead to increased dust suspension, will be recorded during the field visit and its impacts based on prevalent wind direction will be accessed.

[9] *Source: Climate Engine*
Data Source (Temperature): CFSv2 19200 m (1/5-deg) daily reanalysis dataset (NOAA)
Data Source (Precipitation): GPM 11000 m (1/10-deg) daily dataset (NASA/GPM_L3/IMERG_V06)
https://www.rmc.gov.in/RainfallHistory

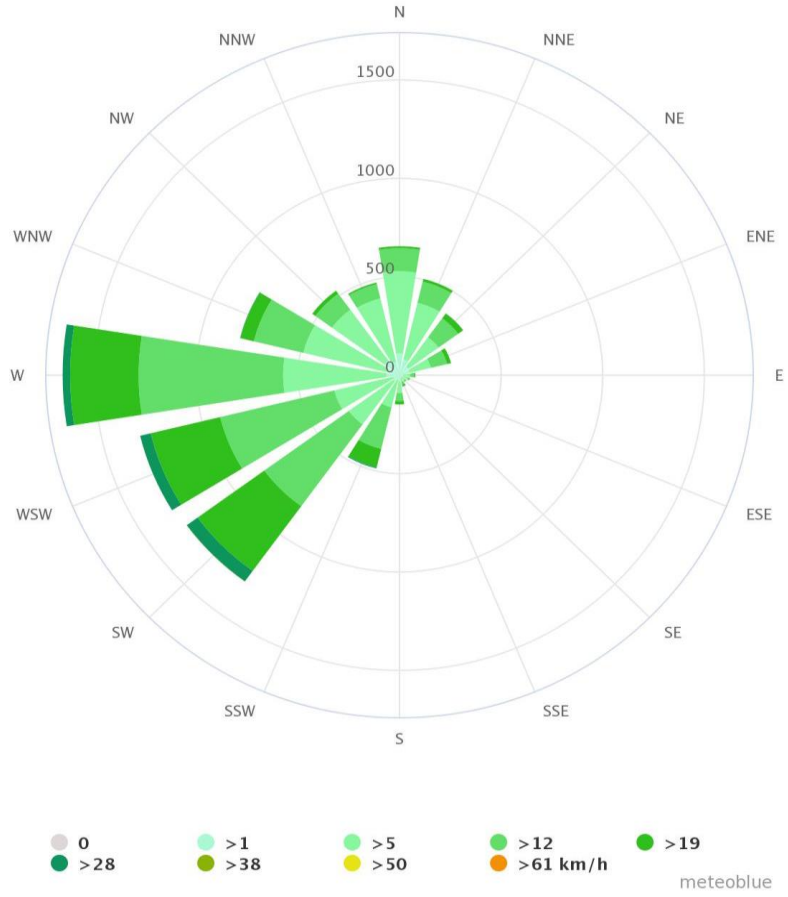


Figure 38: Windrose Map of Gondal town[10]

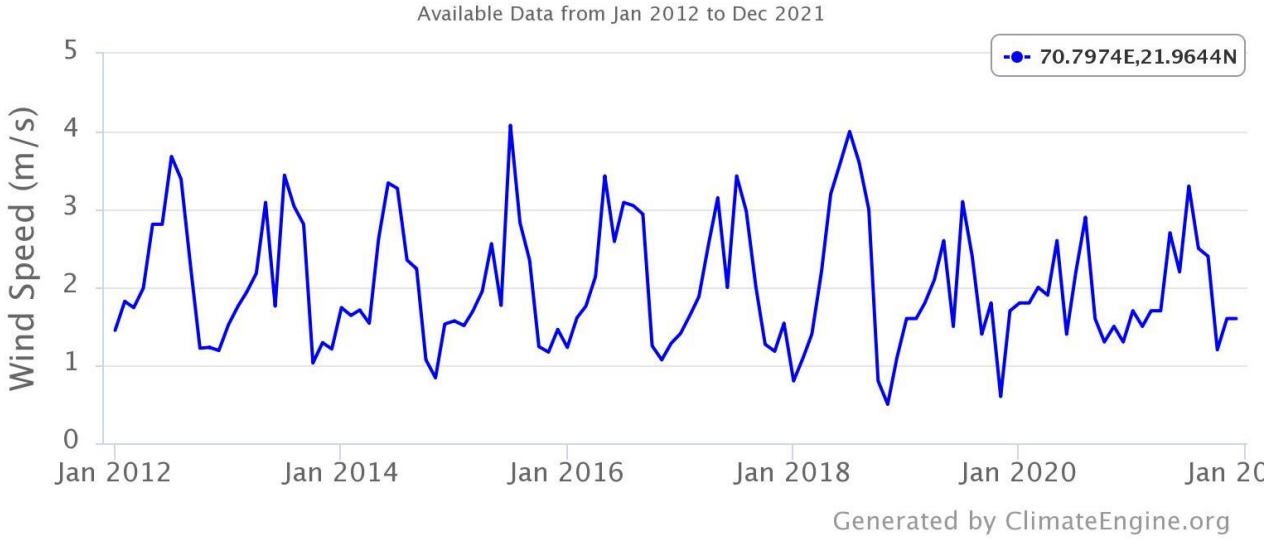


Figure 39: Windspeed over 10-year period from TerraClimate[11]

[10] *Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/gondal_india_1270994*

[11] Generated using Climate Engine, TERRACLIMATE 4000 m (1/24-deg) monthly dataset (University of Idaho)

4.10 Vulnerability to Natural Hazards

Classification of study area with respect to natural hazards is provided in the sections below:

4.10.1 Seismic Activity

An Earthquake Hazard Risk Zonation Map[12] for a return period of 100 years in presented in *Figure 40.* This zonation would typically be used for the design of critical buildings that need to have a mean design service life of 100 years. All of Kachchh, almost the entire coastline of northern Saurashtra that adjoins Kachchh and a small area in Patan district fall into the very severe intensity zone over a 100-year return period.

As per the assessment, the study area falls in the High Damage Risk Zone -IV and Moderate Damage Risk Zone-III. However, there are no recent records of earthquakes in the region[13].

4.10.2 Cyclone Risk

Gujarat has two storm seasons: May and June during the onset of the monsoon and October and November during the retreat of southwestern monsoon.

The study area is classified as Moderate damage risk zone i.e., wind velocity of 48-50 m/s according to the estimated mean taluka basic wind speed (in m/sec) zonation for a 100-year return period represented in *Figure 41.*

4.10.3 Flood Risk

The one-day Probable Maximum Precipitation (PMP) is often higher than the average annual rainfall in most parts of Saurashtra and occasional cyclones and depressions are known to bring heavy rainfall in the Rajkot District. The Flood prone river sections in Saurashtra extend to the upper basins due to the presence of dams in the upper basins, which have to resort to emergency discharge during heavy rainstorms.

As per the Flood Hazard Risk Zonation for Gujarat[14], represented in *Figure 42*, the study area is flanked in the north and the, east and west by villages that have seen flooding 20% of the years in the last 14 years, which may be considered a low occurrence. However, presence of a large number of reservoirs in close proximity to the Solar and some WTG locations suggest that adequate measures need to be taken in terms of efficient drainage and other measure to reduce the risk of flooding in the project areas as well ensure that project infrastructure does not exacerbate flooding risks in the immediate vicinity.

4.10.4 Drought Risk

In Gujarat, 60% of rainfall is uncertain, unprecedented and unequal and the regions of Saurashtra,

Kutch and North Gujarat face famine every third year. Since 1900, the state has faced scarcity of water and food almost 30 times. Drought analysis based on agriculture criteria indicates that the Rajkot district is prone to normal to severe type of droughts. **Occurrence of very severe type of drought is very rare and as represented by the *Figure 43*, the study area is having a moderate drought hazard risk.**

[12] http://gsdma.org/Content/earthquake-4219 , Accessed on 20 November 2022
[13] https://earthquaketrack.com/in-09-rajkot/biggest , Accessed on 20 November 2022
[14] http://gsdma.org/Content/flood-4220 , Accessed on 20 November 2022

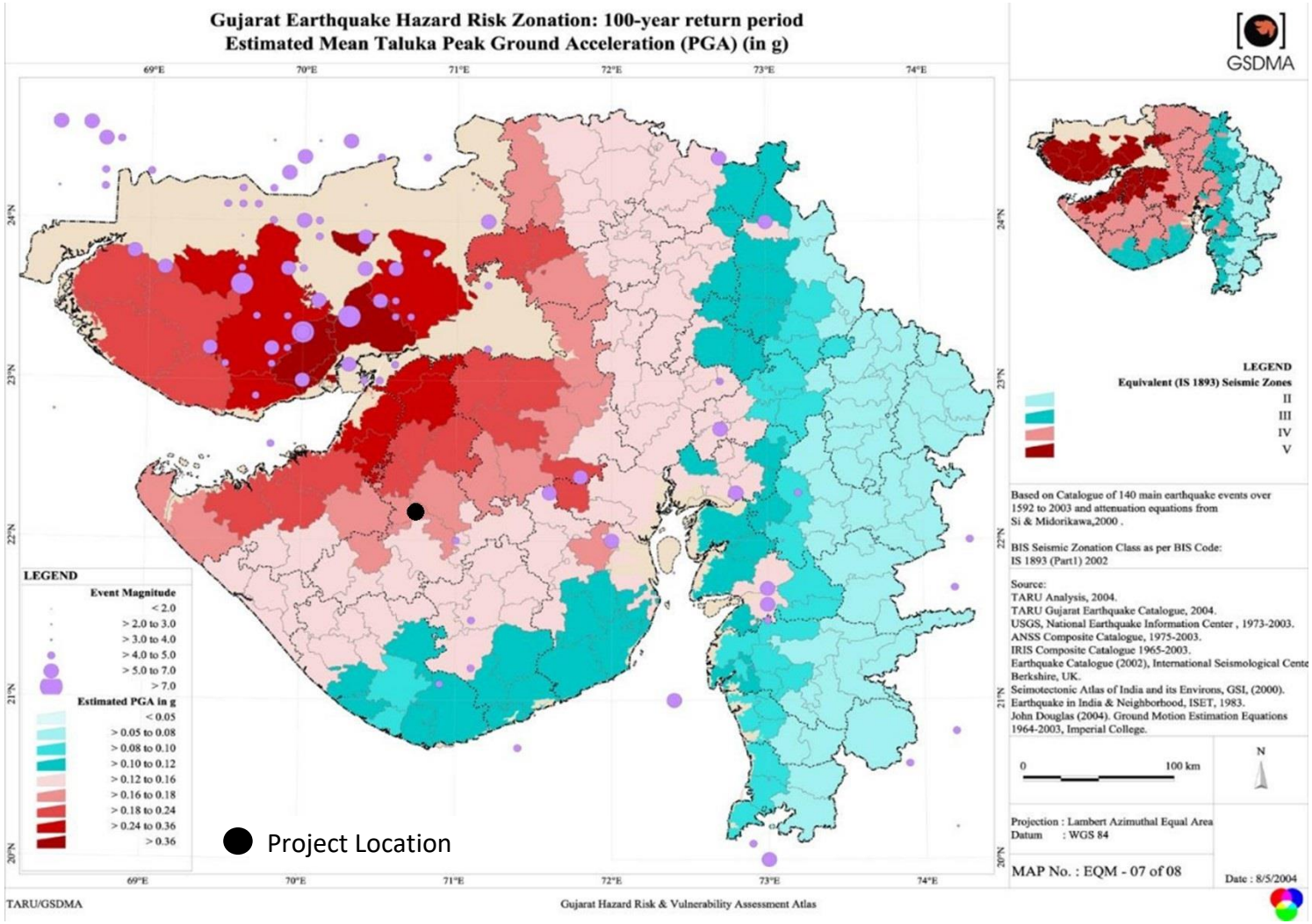


Figure 40: Earthquake Hazard Risk Zonation Map for Gujarat

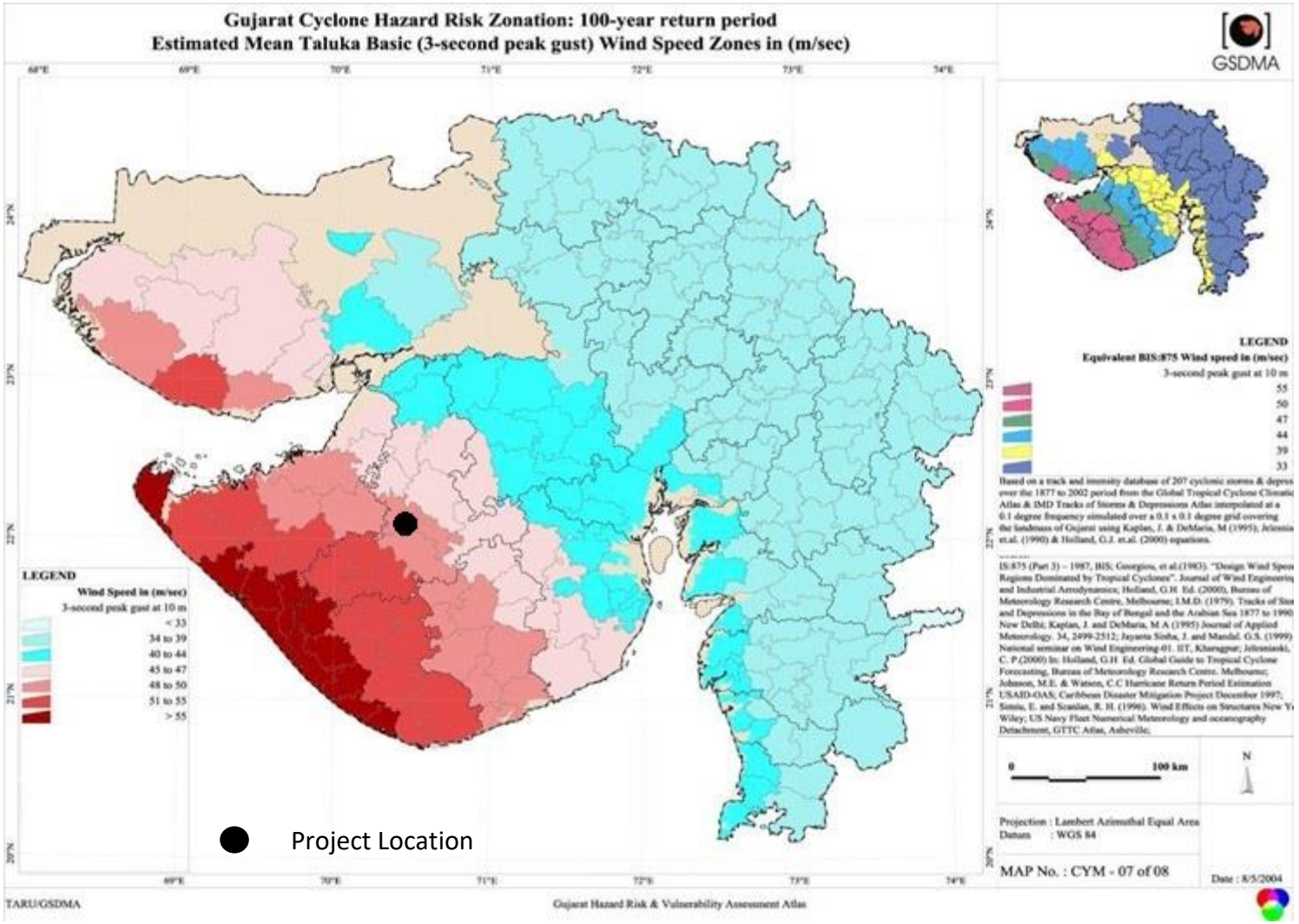


Figure 41: Cyclone Hazard Risk Zonation for Gujarat

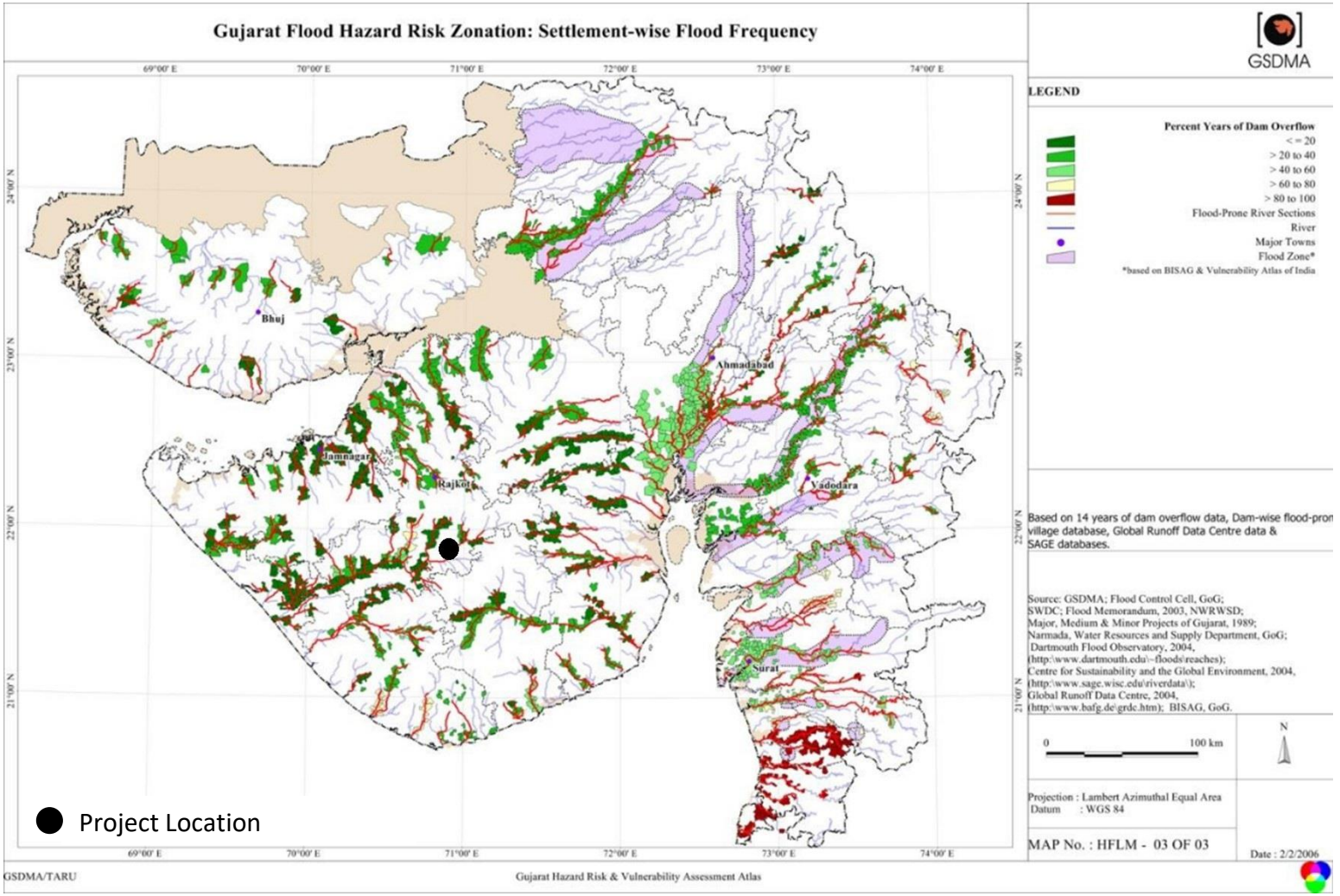


Figure 42: Flood Hazard Risk Zonation for Gujarat

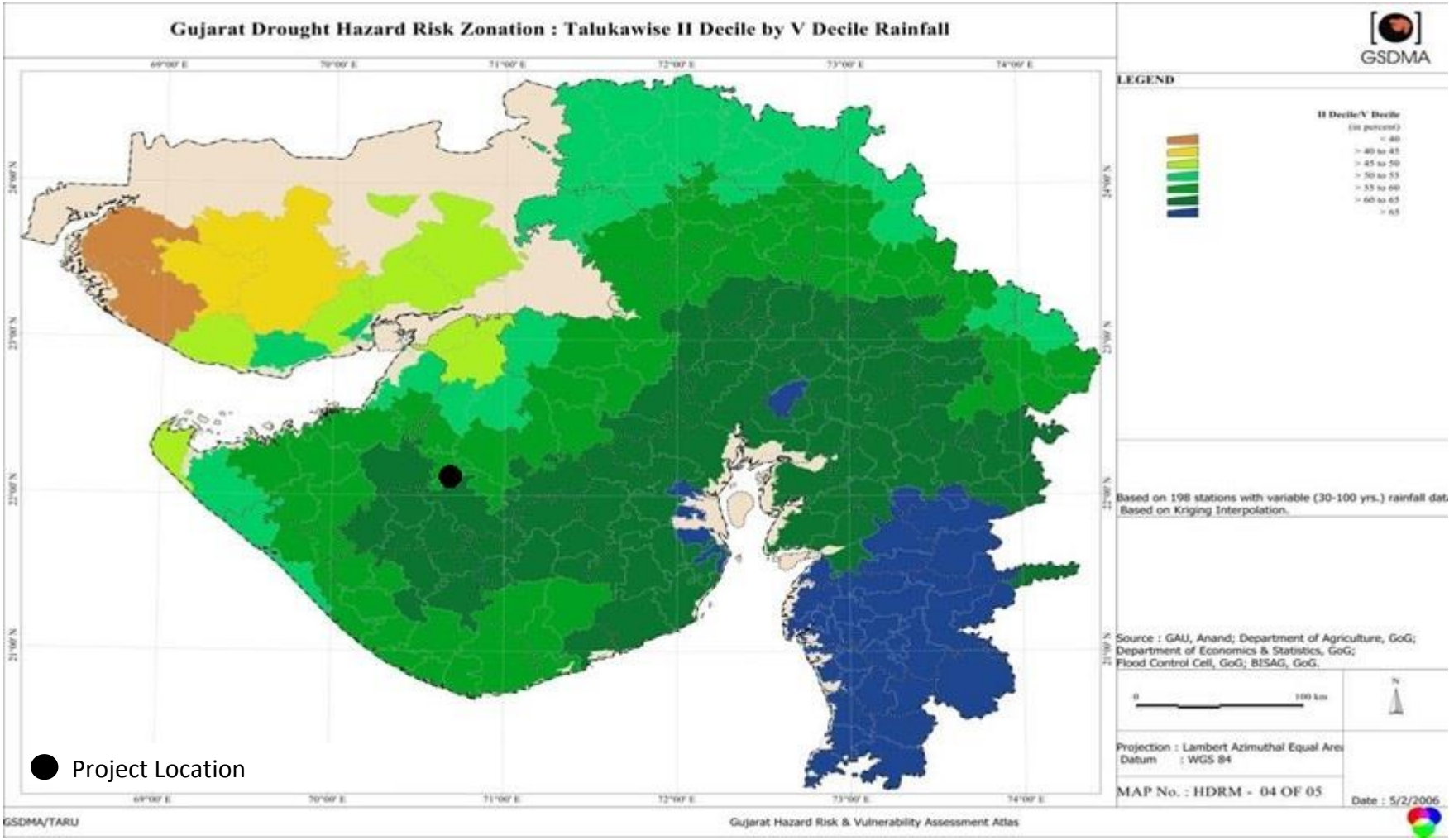


Figure 43: Drought Hazard Risk Zonation

4.11 Environmental Monitoring

Environmental quality monitoring was conducted on 17th -18th October 2022. Details of environmental quality monitoring locations and number of samples monitored are provided below. For testing reports Refer **Annexure VIII.**

Table 21: Environmental Monitoring Sampling details

#	Environmental Attribute	No. of Locations	Frequency	Location Details
1	Ambient Air	3	Once during the study period for PM10, PM2.5, SO2, NOx.	Air quality at settlements near the Solar and WTG locations
2	Ambient Noise	4	Once during the study period (24 hourly continuous monitoring)	Ambient noise samples were collected at junctions and settlements near Solar and WTG locations.
3	Ground water	2	Once during the study period	Groundwater samples were collected from existing open wells within the project and study area (One within the solar site)
4	Soil	1	Once during the study period	Soil samples were collected from existing solar site farmland.

1.1.1 Air Environment

Ambient air monitoring was carried out at three locations (24-hourly sampling for particulate & gaseous pollutants). The monitoring was conducted on 17th and 18th October 2022. Sampling and analysis were done as per the guidelines prescribed by CPCB /IS-5182. Monitoring stations were chosen based on their proximity to sensitive receptors, settlements, topography, and predominant wind direction. Refer *Figure 44* air quality monitoring locations.

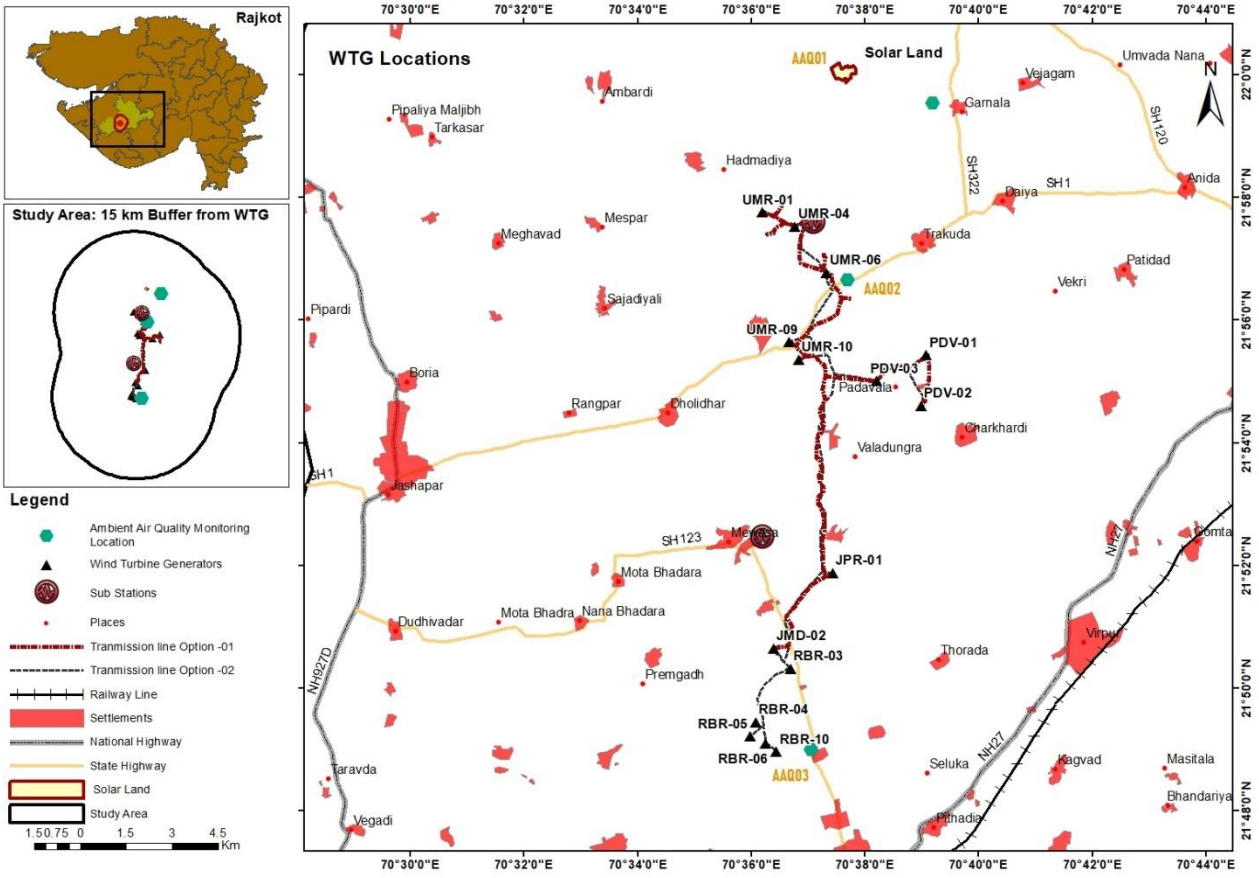


Figure 44: Air Quality Monitoring Sampling Locations

Table 22: Ambient Air Quality Monitoring Results

Parameters	CPCB Standard (24 hours)	WHO Guidelines	Result		
			At Solar land (AAQ1)	Nr. Khodiyar Temple Umrali Road, Umrali (AAQ2)	Nr. Rabarika village (AAQ3)
PM_{10} µg/m³	100	50	26	34	37
$PM_{2.5}$ µg/m³	60	25	09	12	14
SO_2 µg/m³	80	20	9.8	12.7	13.2
NO_x µg/m³	80	40	15.5	18.1	15.7

Analysis of Monitoring Results

- Interpretation of Air Quality Results Concentrations of all the ambient air quality parameters (PM10, PM2.5, SO2, NO2) at all three monitoring stations were observed to be well within the CPCB, WHO and NAAQS 2009 prescribed standards.
- Particulate Matter (PM10) Concentration monitored was in the range of 26 µg/m³ to 37 µg/m³i.e., well within the NAAQS permissible limit of 60 μg/m3. PM2.5, Sulphur dioxide, Nitrogen Oxide and Carbon monoxide too were recorded well below the CPCB permissible limits as depicted in
- Table 22.
- No significant impact on the ambient air is anticipated at this stage.

1.1.2 Noise Level

The baseline ambient noise levels were monitored at four locations. Siting was carried out based on the potential high traffic routes and locations of sensitive receptors around the project area.

Sound pressure level (SPL) measurements in dB(A) were recorded for every hour continuously for 24 hours for the aforesaid monitoring stations and equivalent noise levels in the form of Leq day and Leq night. A tripod stand with a noise meter was used for automated recording of the noise levels. The results obtained were compared with the standard specified in the Noise Pollution (Regulationand Control) Rules, 2000. Refer *Figure 45* for locations of noise monitoring stations.

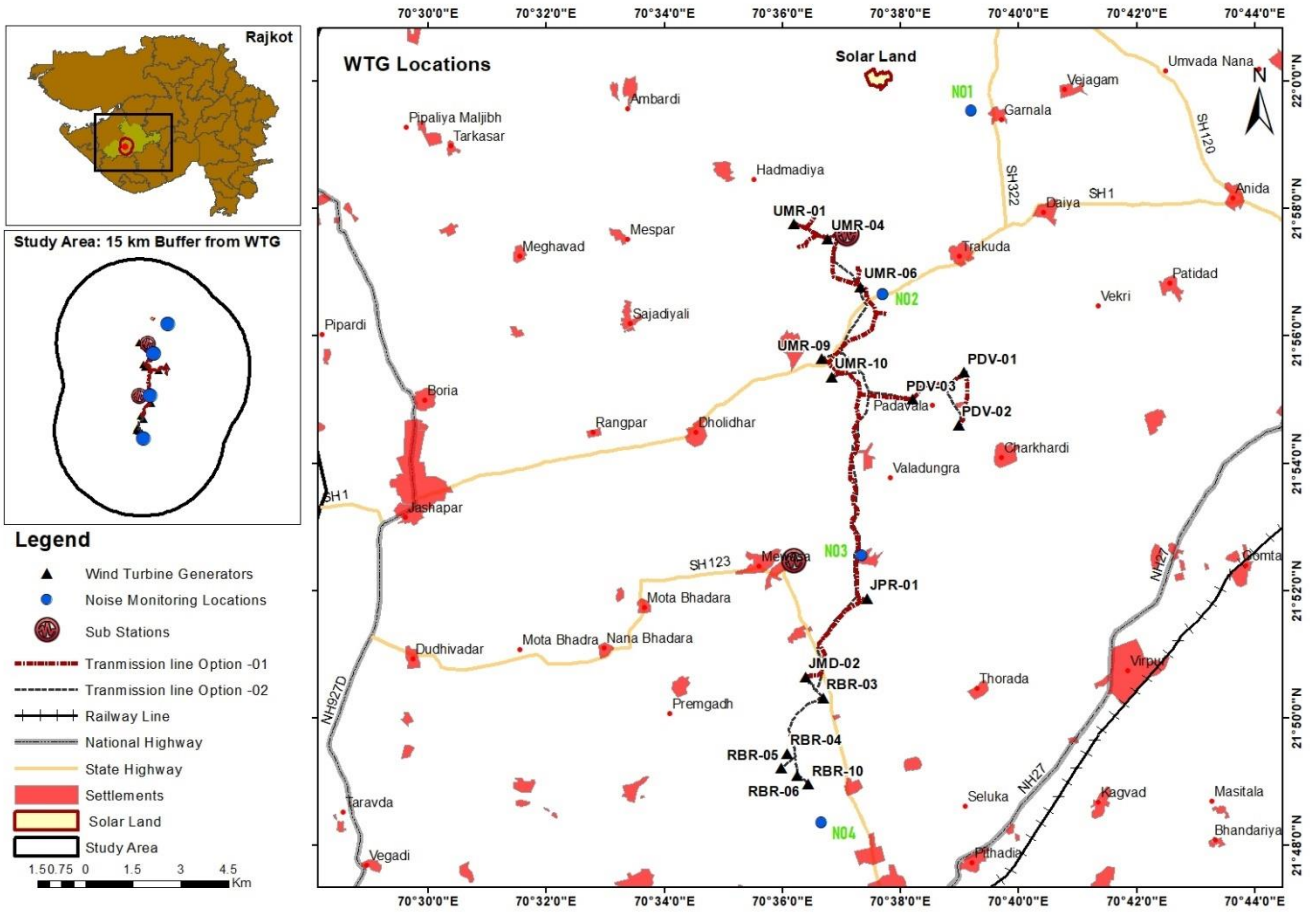


Figure 45: Noise Sampling Location

Table 23: Noise Level Monitoring Results

#	Parameters	At Solar Land (No 1)	Umrali Road (No 2)	Jepur Village (No 3)	Nr. Rabarika Village (No 4)
1	Noise Level: Leq Day (dB(A))	21.65	40.08	34.17	31.41
2	Noise Level: Leq Night (dB(A))	20.05	25.62	21.17	21.01
3	CPCB standard (day-Night) dB(A)	55-45	55-45	55-45	55-45

Analysis of Monitoring Results

On comparison of day and night equivalent values with Ambient Noise Quality Standards in respect to residential areas, the obtained values are well within the prescribed standards of CPCB for residential as depicted in *Table 23.*

1.1.3 Ground Water

As per Central Ground Water Board (CGWB) 2011, Jetpur taluka of Rajkot district has been categorized as **"Safe"** category, the project site falls in the same district. The ground water samples were collected from an existing open well within the solar site and from an existing open well near Rabarika village. *Figure 46* groundwater monitoring locations.

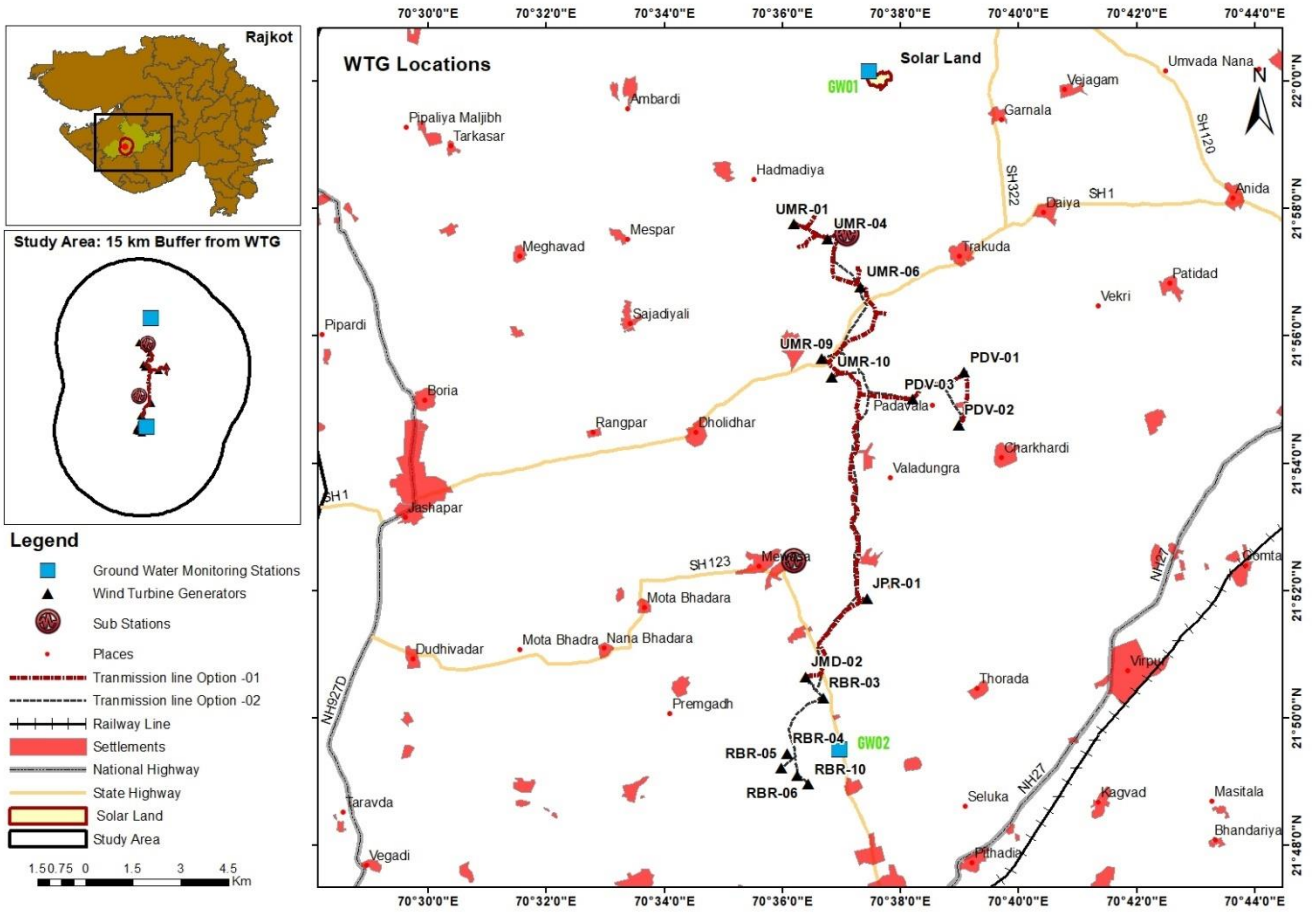


Figure 46: Groundwater Monitoring locations

Table 24: Ground Water Quality Monitoring Results

Parameter	Acceptable Limit (IS 10500:2012)	Permissible Limit (IS 10500:2012)	Result	
			At Solar Land (GW01)	Near Rabarika Village (GW02)
Colour (Hazen)	5	15	<1.0	<1.0
Odour	Agreeable	Agreeable	Agreeable	Agreeable
pH at 25 °C	6.5-8.5	No relaxation	6.75	7.01
Taste	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity (NTU)	1	5	0.3	0.3
Total dissolved solids (mg/L)	500	2000	**540**	**1480**
Aluminum as Al (mg/l)	0.03	0.2	ND	ND
Ammonia as total ammonia-N (mg/l)	0.5	No relaxation	ND	ND
Anionic detergents as MBAS (mg/l)	0.2	1.0	ND	ND
Barium (as Ba) (mg/l)	0.7	No relaxation	ND	ND
Boron (as B) (mg/l)	0.5	1.0	ND	ND
Calcium (as Ca) (mg/l)	75	200	32.46	**78.42**
Chloramines (as Cl2), (mg/l)	4.0	No relaxation	ND	ND
Chloride (as Cl) (mg/l)	250	1000	90.8	**312.69**
Copper (as Cu) (mg/l)	0.05	1.5	ND	ND
Fluoride (as F) (mg/l)	1.0	1.5	ND	0.30
Free residual chlorine (mg/l)	0.2	1	ND	ND
Iron (as Fe) (mg/l)	0.3	No relaxation	ND	ND
Magnesium (as Mg) (mg/l)	30	100	4.26	10.48
Manganese (as Mn) (mg/l)	0.1	0.3	ND	ND
Mineral oil (mg/l)	0.5	No relaxation	ND	ND
Nitrate (as NO3) (mg/l)	45	No relaxation	4.32	6.19
Phenolic compounds (as C6H5OH) (mg/l)	0.001	0.002	ND	ND
Selenium (as Se) (mg/l)	0.01	No relaxation	ND	ND
Silver (as Ag) (mg/l)	0.1	No relaxation	ND	ND
Sulphate (as SO4) (mg/l)	200	400	3.41	12.5
Sulphide (as H2S) (mg/l)	0.05	No relaxation	ND	ND
Total alkalinity as HCO3 (mg/l)	200	600	112.26	**232.46**
Total Hardness as CaC03 (mg/l)	200	600	161.5	**418.6**
Zinc (as Zn) (mg/l)	5	15	ND	ND
Cadmium (as Cd) (mg/l)	0.003	No relaxation	ND	ND
Cyanide (as CN) (mg/l)	0.05	No relaxation	ND	ND
Lead (as Pb) (mg/l)	0.01	No relaxation	ND	ND
Mercury (as Hg) (mg/l)	0.001	No relaxation	ND	ND
Molybdenum (as Mo) (mg/l)	0.07	No relaxation	ND	ND
Nickel (as Ni) (mg/l)	0.02	No relaxation	ND	ND

Parameter	Acceptable Limit (IS 10500:2012)	Permissible Limit (IS 10500:2012)	Result	
			At Solar Land (GW01)	Near Rabarika Village (GW02)
Polychlorinated biphenyls (mg/l)	0.0005	No relaxation	ND	ND
Polynuclear aromatic hydro-carbons (as PAH) (mg/l)	0.0001	No relaxation	ND	ND
Total arsenic (as As) (mg/l)	0.01	0.05	ND	ND
Total chromium (as Cr) (mg/l)	0.05	No relaxation	ND	ND
Alachlor	20	–	BLQ	BLQ
Atrazine	2	–	BLQ	BLQ
Aldrin	0.03	–	BLQ	BLQ
Dieldrin	0.03	–	BLQ	BLQ
Alpha HCH	0.01	–	BLQ	BLQ
Beta HCH	0.04	–	BLQ	BLQ
Butachlor	125	–	BLQ	BLQ
Chlorpyriphos	30	–	BLQ	BLQ
Delta HCH	0.04	–	BLQ	BLQ
2,4- Dichlorophenoxyacetic acid	30	–	BLQ	BLQ
DDT (o, p and p, p – Isomers of DDT,DDE and DDD)	1	–	BLQ	BLQ
Endosulfan (alpha, beta, and sulphate)	0.4	–	BLQ	BLQ
Ethion	3	–	BLQ	BLQ
Gamma — HCH (Undane)	2	–	BLQ	BLQ
Isoproturon	9	–	BLQ	BLQ
Malathion	190	–	BLQ	BLQ
Methyl Parathion	0.3	–	BLQ	BLQ
Monocrotophos	1	–	BLQ	BLQ
Phorate	2	–	BLQ	BLQ
Total Coliforms (Per 100ml)	Absent	No relaxation	Absent	Absent
E.coli (Per 100ml)	Absent	No relaxation	Absent	Absent
BLQ – below limit of quantification, LOQ – limit of quantification, ND - Not-detected.				

Analysis of Monitoring Results

The above tested parameters were compared to IS 10500:2012 Drinking water limits. Parameters such as Total Dissolved Solids (TDS) were found to be exceeding for the sample taken at the solar site. Other parameters such as calcium, chlorides, Total dissolved solids, alkalinity were found to be exceeding the acceptable limits for the sample taken near Rabarika village as depicted in

Table 24.

Rest all tested parameters meet the Drinking Water Limits as per IS: 10500:2012

1.1.4 Soil Quality

Soil analysis was carried out for one location within the project area according to the IS 2720 Part 4 Method. The soil sample was collected from the farmland within the solar site boundary on 17th October 2022. The location for the soil sample is depicted in Figure 47. The physio-chemical characteristics of the soil sample are presented in Table 25.

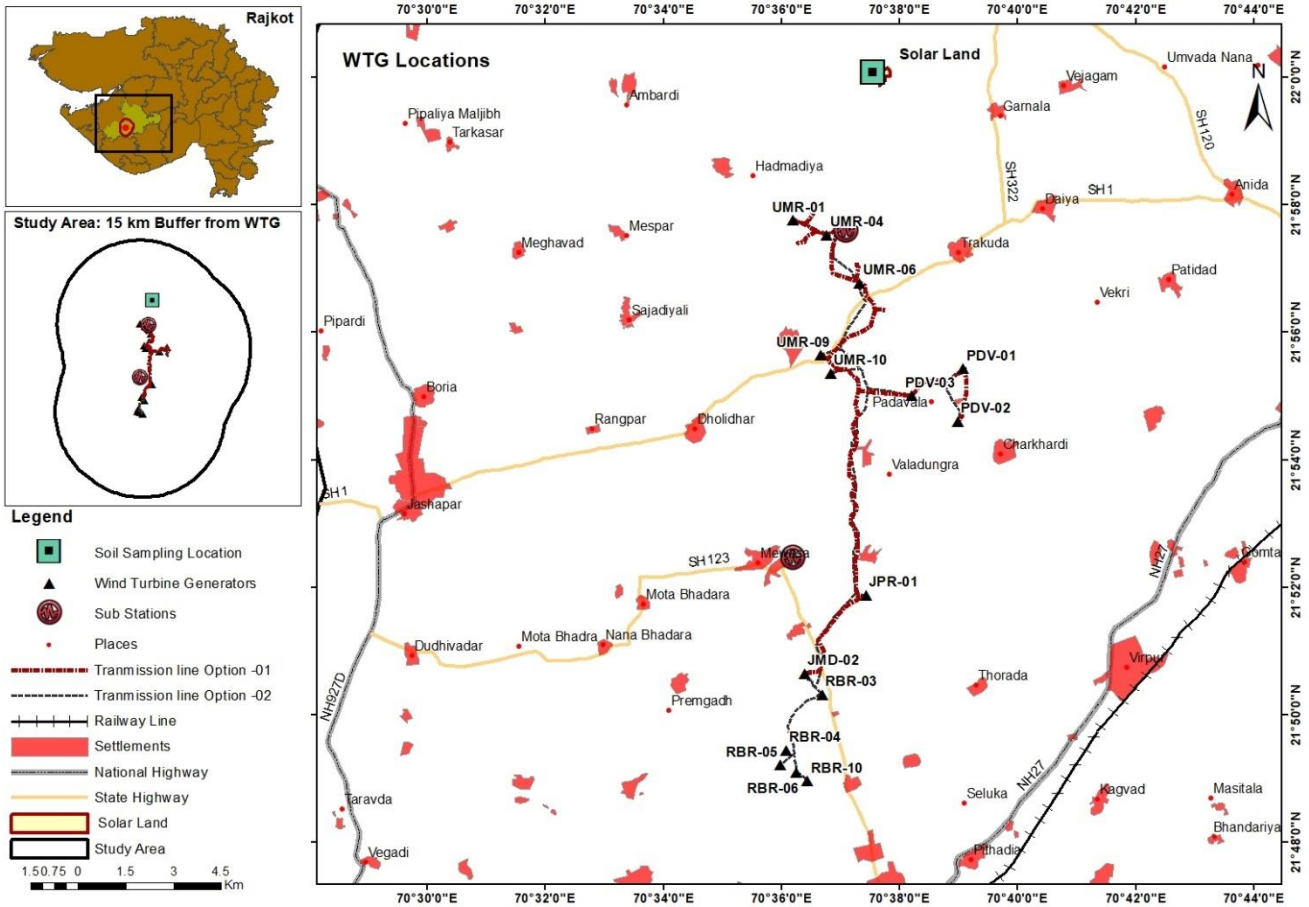


Figure 47: Soil Sampling location

Table 25: Soil Quality Analysis Results

Parameters	Results
Gravel (%)	44
Sand (%)	56
Soil+Clay (%)	0
Texture	Texture for visual
Permeability (mm/sec)	9.33
Porosity (%)	-
pH	7.2
Electric Conductivity (mS/cm2)	1.925
Nitrogen (kg/hector)	90
Phosphorous (kg/hector)	12.5
Potassium (kg/hector)	150
Sodium (mg/kg)	1220
Cation exchange capacity (meq/100gm)	3.5

Analysis of Monitoring Results

Texture: The sample reveals that the soil is sandy.
pH: pH of the soil sample is 7.2 indicating normal to very slightly alkaline soil;
Electrical Conductivity (EC): EC is used to estimate the soluble salt concentration in soil and is commonly used as a measure of salinity. The EC value of soil samples varied from 1.925µS/cm. This indicates low concentration of soluble salts compared to the requirement for germination of crops.
NPK: Nitrogen content is on the lower side, however P and K is present in moderate levels

Figure 48: Environmental Monitoring carried out for the project

4.12 Socio-Economic Profile

District Profile

Rajkot district is situated in the center of Saurashtra Region of Gujarat State. Rajkot District is surrounded by Amreli and Botad District in North, Junagadh and Gir Somnath District in West and Bhavnagar District in East. Arabian sea touches the district boundary in the South. Rajkot District is subdivided into 14 taluka (sub-district), where the main occupation of the population is Agriculture and Animal Husbandry with average rainfall of about 23.6 inches. The climate is characterized by Hot to moderate dry. The main crops of the district are Groundnut, Bajri, Jowar, Cotton and sugarcane.

Administrative Structure

The district comprises of 14 talukas viz. Rajkot, Morbi, Maliya, Wankaner, Paddhari, Lodhika, Kotdasangani, Jasdan, Gondal, Jetpur, Dhoraji, Tankara, Upleta and Jamkandorna. The Headquarter of the district is Rajkot. The district has 13 towns and 856 inhabited villages.

Study Area

A 5 km radius of the proposed site has been demarcated as the study area for the socio-economic profile of the Project. This demarcation takes into consideration the respective solar and wind power sites, the majority of the associated facilities and nearest settlements to the respective sites.

Data Collection:

Both the secondary data and primary data have been used for the socio-economic profiling for this project in order to establish the baseline and assess the risks and impacts associated with the respective sites. Details of relevant data are incorporated in the subsequent sections.

Secondary Data Collection

The secondary source of socio-economic data for the site was retrieved from Primary Census Abstract for district Rajkot, Census of India, 2011, for a purpose to understand a general overview of the project area. Through the use of geographical data present in public domain, it is understood that the project area is spread indicatively across 11 villages - Garnala, Trakuda, Padavala, Charakhdi of Gondal Taluka, and villages Umrali, Mevasa, Jambudi, Rabarika, Valadungra, Jepur, and Haripar, located in the Jetpur Talukas of the Rajkot District.

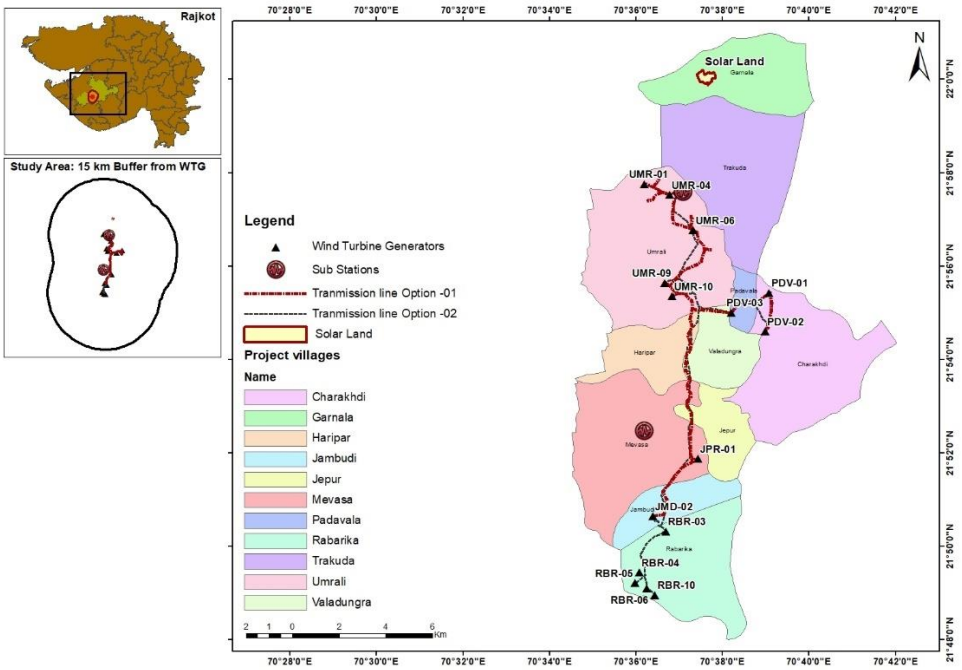


Figure 49: Project villages in the study area

As observed in *Figure 49,* a high cluster density of the settlements is observed in the northern region of the study area. Although, it must be noted that most of these settlements are located at a distance greater than 5 km from the project area and thus do not fall in the high impact zone.

Primary Data Collection:

To understand and identify any impact envisaged from this project on the local habitation, a total of eleven (11) villages (hereinafter referred as 'Study area') were selected to collect primary data for the socio-economic study through a semi structured questionnaire. Based on the proximity of the nearest settlement present at a maximum 05 km radius from the solar and WTG location, the list of these villages was identified which has been presented in the table below.

Within 05 km radius, a total of 02 villages from solar site and 09 villages from WTG site have been considered for the socio-economic profiling and assessment. It was informed during the site visit that each village identified in the study area has their own individual Gram Panchayat. It is to be further noted that based on the site survey and primary data collected, the village Haripar was not included as part of the study area as this village was found to be present at a greater distance from every WTG location. In addition, Betavad village has been added to the list as it is present at a distance of approx. 1.73km from the solar site.

Table 26 and *Figure 50* depicts villages from project location which were selected for collecting socio-economic data.

Table 26: Project villages selected for primary data collection

S.No	District	Taluka	Village Name	Distance (Approx)	Direction	Near to
1	Rajkot	Gondal	Betavad	1.73 km	North-West	Solar site
2			Garnala	3 km	East	Solar site
3			Trakuda	2.8 km	East	UMR-06
4			Charkhadi	1.33km	East	PDV-02
5			Padavla	0.5km	North	PDV-02
6		Jetpur	Umrali	0.6 km	West	UMR-09
7			Valadungra	1.83km	South-West	PDV 03
8			Jepur	0.95 km	North	JPR 01
9			Rabarika	1.15 km	East	RBR 10
10			Mewasa	2.61 km	West	JPR 01
11			Jambudi	1.18 km	North	JMD 02

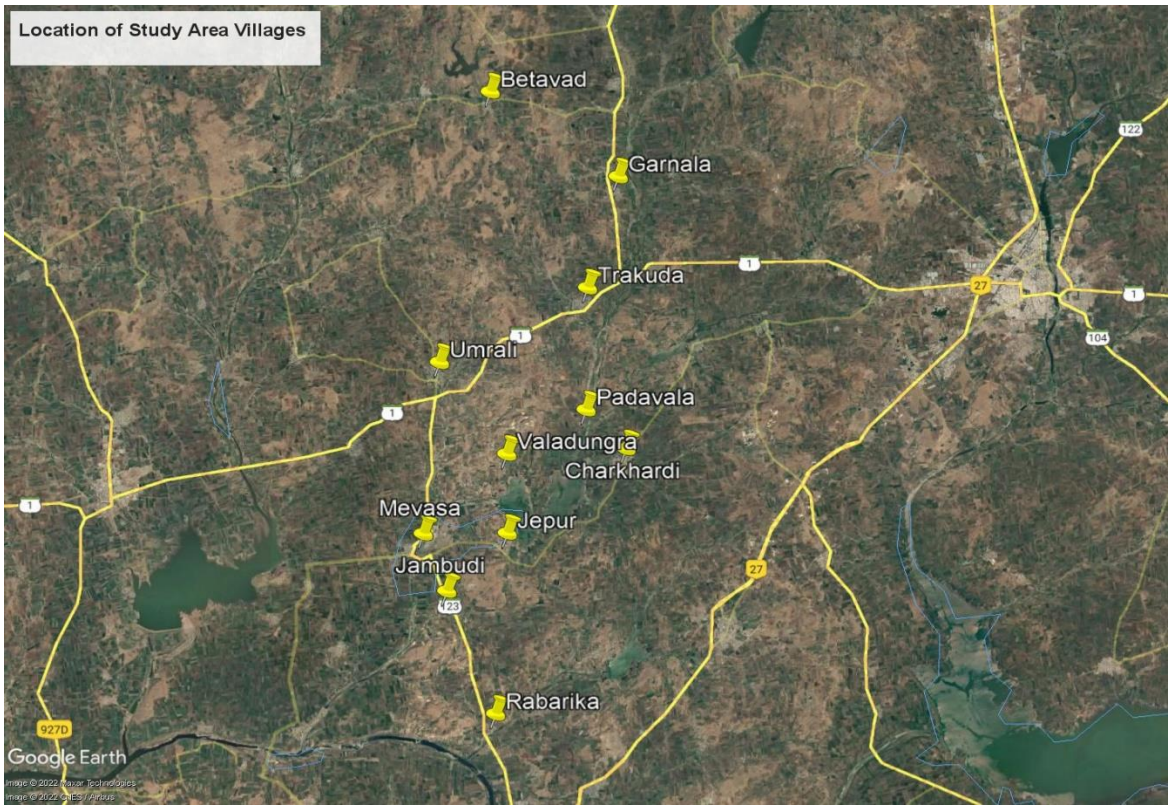


Figure 50: Villages selected for collection of primary socio-economic data

4.12.1 Demographic Profile

Secondary Data

As per the Census 2011 data, Charkhadi village has the highest population of approx. 4213 individuals with 52.93% comprising male population while 47.07 % were female population, followed by second highest population present in Umrali village.

Sex ratio: The sex ratio (females as per 1000 males) among the 11 villages selected was found to be highest in villages of Mewasa and Garnala with 974 and 963 females, respectively to every 1000 males. The lowest sex ratio was noted to be present in Valadungra village with 865 females to every 1000 males.

Refer Table 27 for Population and Sex ratio data of the study area villages. [15]

Table 27: Population and Sex ratio data of the study area village

S.No	Village Name	Total Population	Male Population	Female Population	Sex ratio
1	Haripar	995	526	469	892
2	Garnala	1500	764	736	963
3	Trakuda	2856	1469	1387	944
4	Charkhadi	4213	2230	1983	889
5	Padavla	115	60	55	917
6	Umrali	3415	1771	1644	928
7	Valadungra	1227	658	569	865
8	Jepur	1486	774	712	920
9	Rabarika	1856	946	910	962
10	Mewasa	3368	1706	1662	974
11	Jambudi	1016	543	473	871

[15] *(Source: District Census Handbook, Rajkot District, Census 2011)*

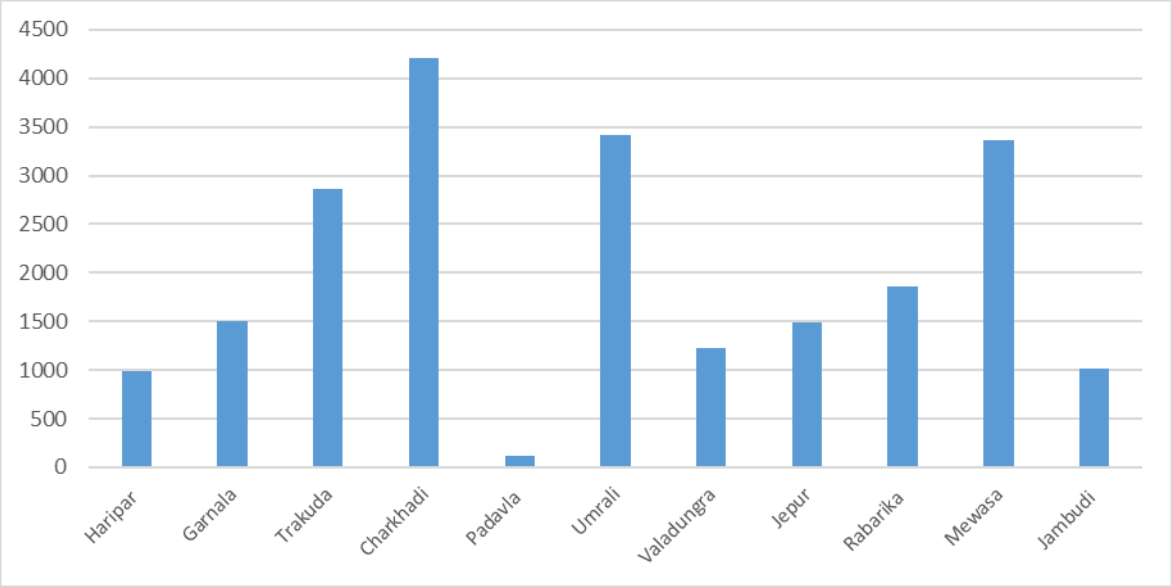


Figure 51: Graph showing total Population in the study area villages

Primary Data

The primary data of the selected villages was collected during site visit, which shows that Charkhadi village has the highest total population of approx. 5055 with approx. 52.62% male population and approx. 47.38% as female population, and second highest population was in village Umrali (approx. 4200), followed by village Mewasa (approx. 4040). Refer *Table 28.*

Table 28: Demographic profile of the study area-Primary data

S.No	Village Name	Total Population	Male Population	Female Population	Sex ratio
1	Betavad	1500	850	650	765
2	Garnala	1800	915	885	964
3	Trakuda	3420	1763	1657	940
4	Charkhadi	5055	2660	2395	900
5	Padavla	140	72	68	944
6	Umrali	4200	1900	2300	1211
7	Valadungra	1500	600	900	1500
8	Jepur	1475	775	776	1001
9	Rabarika	1950	1100	850	773
10	Mewasa	4040	2055	1995	966
11	Jambudi	1200	652	548	840

Source: Information collected from Site Survey

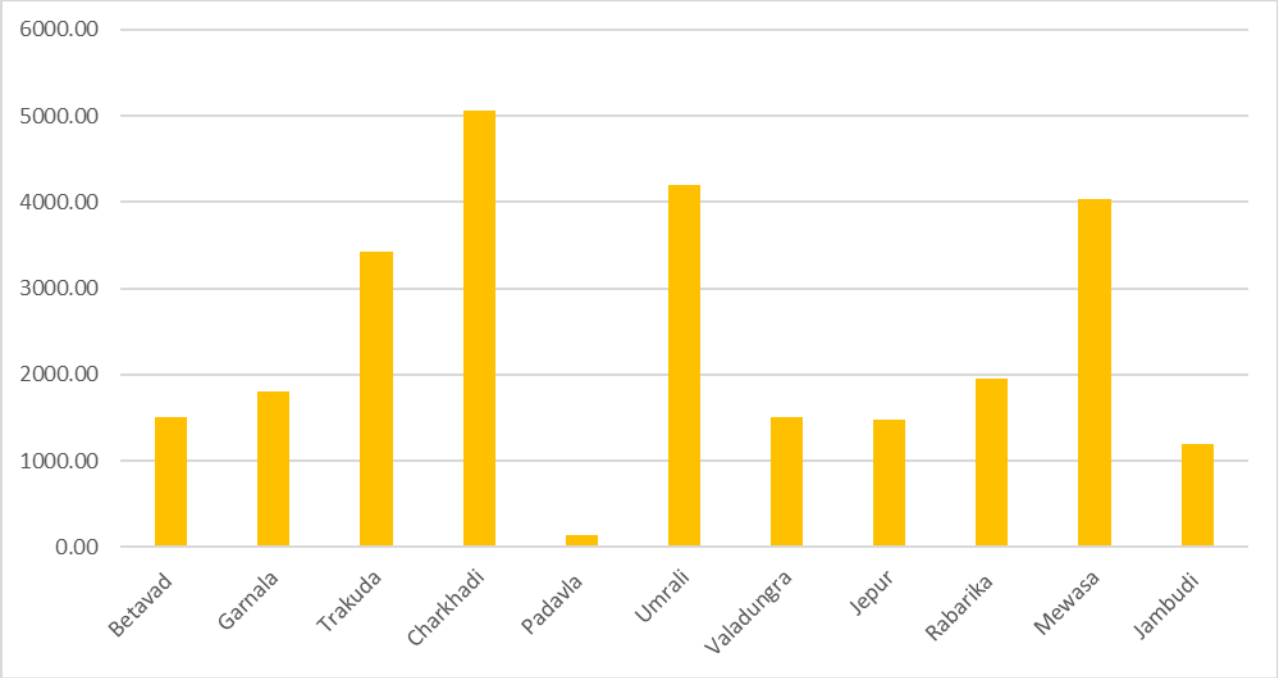


Figure 52: Graph showing total Population in the study area villages

Sex Ratio

As per the primary data collected during the site visit, it is noted that the sex ratio amongst male and female population is highest in village Valadungra followed by Umrali and Jepur. The details of the sex ratio in individual village in the study area has been presented in the table above.

Household Size

Based on the consultation in the study area villages it was found that the overall household size is around 5.5 due to the joint family system followed in the study area.

Religious Demography

As per the consultations undertaken in the study area villages, the majority of population in the villages follow Hinduism (about 95%), followed by Islam and Sikhism religions, respectively.

4.12.2 Population Density

Secondary Data

As per the Census 2011, the population density is found to be maximum in Charakhdi village followed by Jambudi, Valadungra and Jepur which is about 2 persons per hectare.

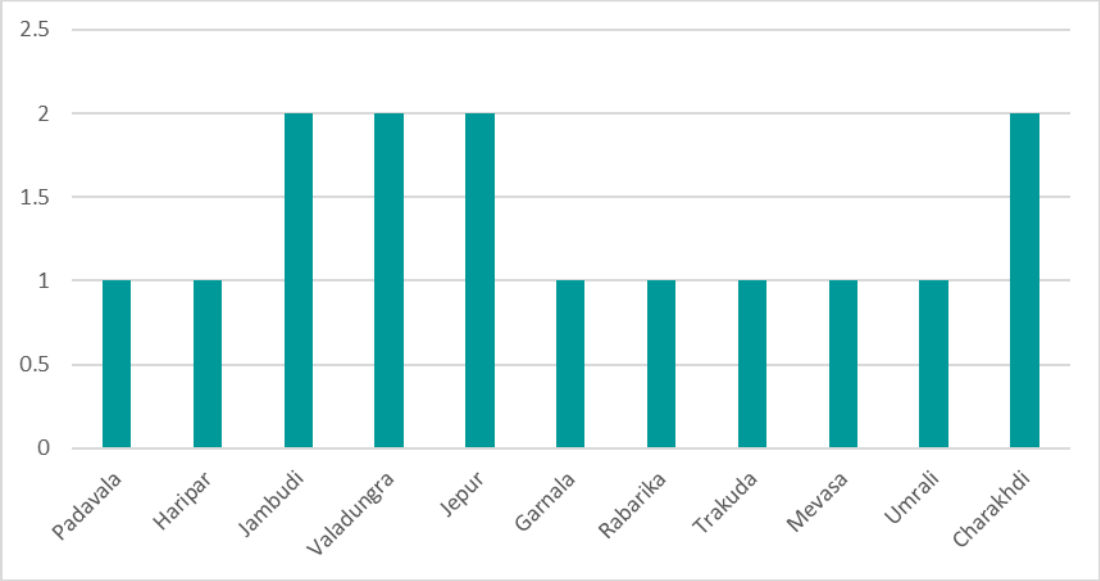


Figure 53: Population Density of Villages in the Study Area[16]

Primary Data

As per the data collected through consultation, it is found that Jambudi village has the highest population density among all eleven villages. Refer *Table 29.*

Table 29: Approximate Population density in the study area villages

S.No	Village Name	Total Population	Area in hectare (approx.)	Population Density
1	Betavad	1500	820	1.83
2	Garnala	1800	1314	1.37
3	Trakuda	3420	1910.73	1.79
4	Charkhadi	5055	2606	1.94
5	Padavla	140	388	0.36
6	Umrali	4200	2746	1.53
7	Valadungra	1500	871	1.72
8	Jepur	1475	750	1.96
9	Rabarika	1950	1903.25	1.03
10	Mewasa	4040	2386.1	1.70
11	Jambudi	1200	563	2.13

[16] *Source: District Census Handbook, Rajkot District, Census 2011*

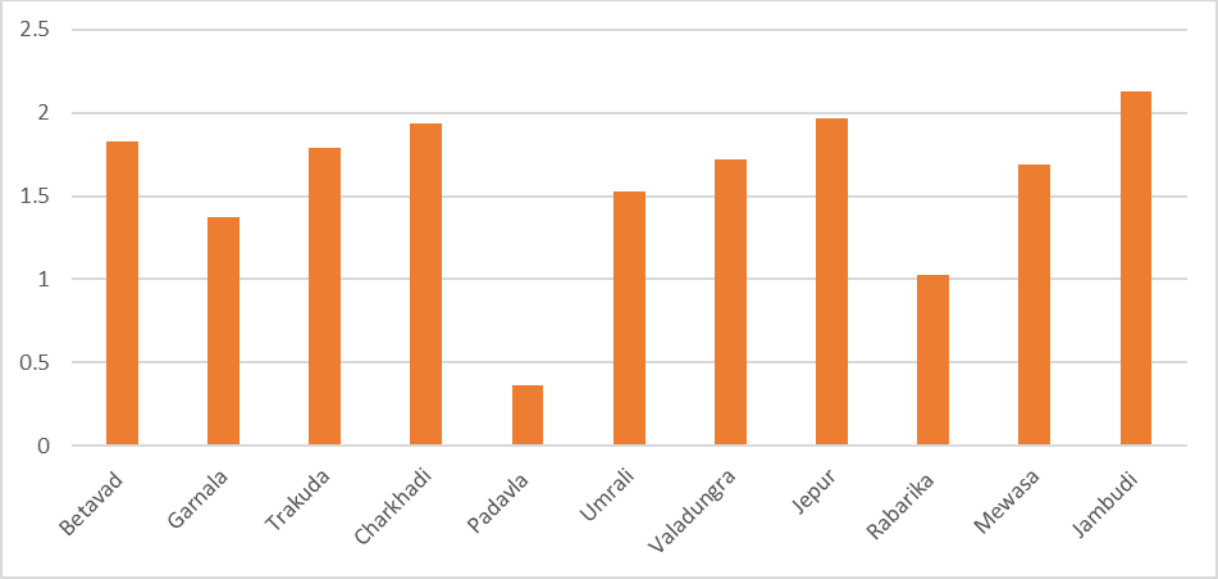


Figure 54: Graph showing population density spread in the study area villages

4.12.3 Literacy Rate

Secondary Data

The *Figure 55* presents the literacy rates in the study area. The literacy rate for total population in these blocks, among males and females has been analyzed. The average literacy rates in project villages are about 72.86 % which is slightly higher than the district (Rajkot) average of 66 %. The literacy rate in the CD blocks of Gondal is 71.46% and Jetpur is 68.89%. As a general trend, the male literacy is higher than the female literacy rates in the area.

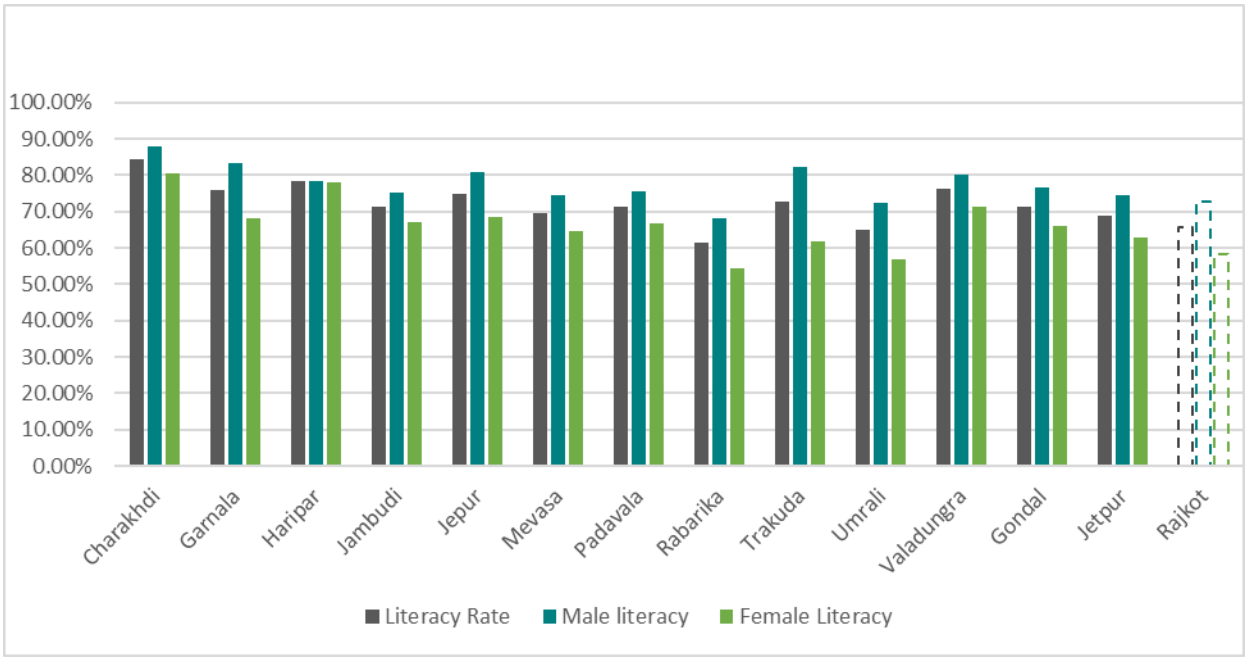


Figure 55:Literacy rate in Project villages[17]

Primary Data

The Literacy data of the selected villages was collected during site visit, which shows that Umrali village has the highest literacy population (90%) comprising 80%of male literate population and 70% of female literate population, followed by Mewasa village with approx. 85% literate population.

[17] *Source: District Census Handbook, Rajkot District, Census 2011*

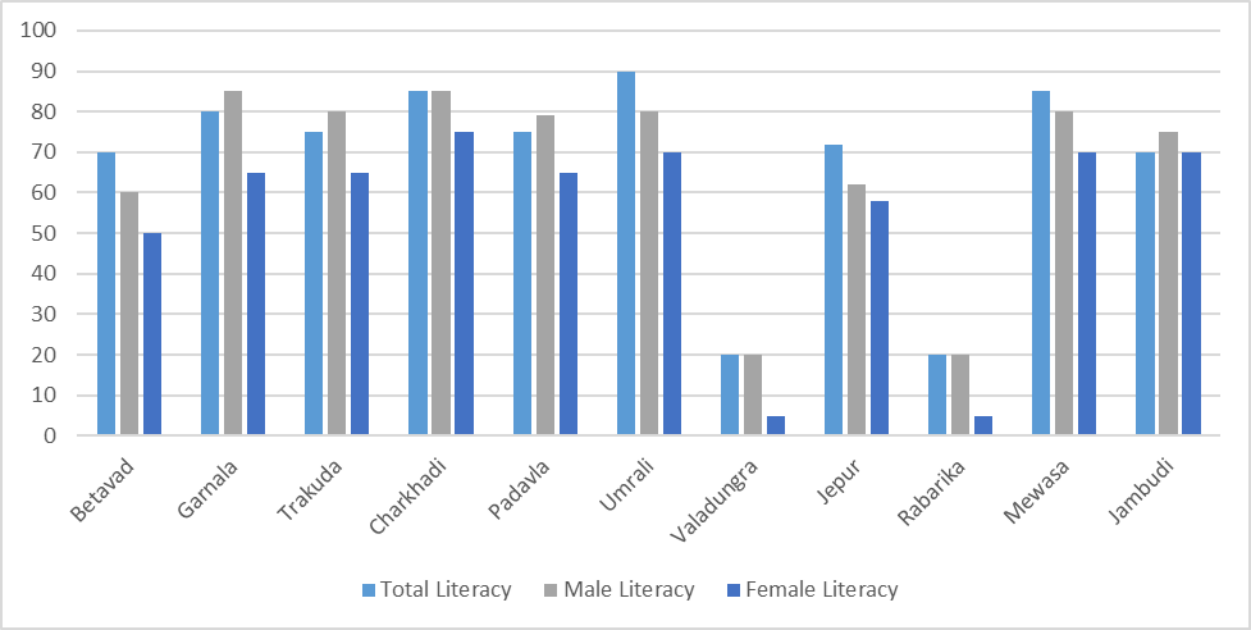


Figure 56: Approximate Literacy Population in the study area villages

4.12.4 Occupational Pattern

Secondary Data

The *Figure 57* presented below represents the proportion of working and non-working population in each of the blocks in the study area. As a general trend, the proportion of non-working population is higher than that of the working group. Highest value of working population is observed in Umrali (58.41%) village while Charakhdi (53.53%) villages recorded the highest value for the non-working population in the study area. The district average working population for Rajkot is 46.54% and for the blocks of Gondal and Jetpur are 43.01% and 50.39% respectively.

The occupational pattern in Rajkot district is primarily dependent on manufacturing and service sector. About 42% of workers are engaged in service activities and 34% in manufacturing sectors.

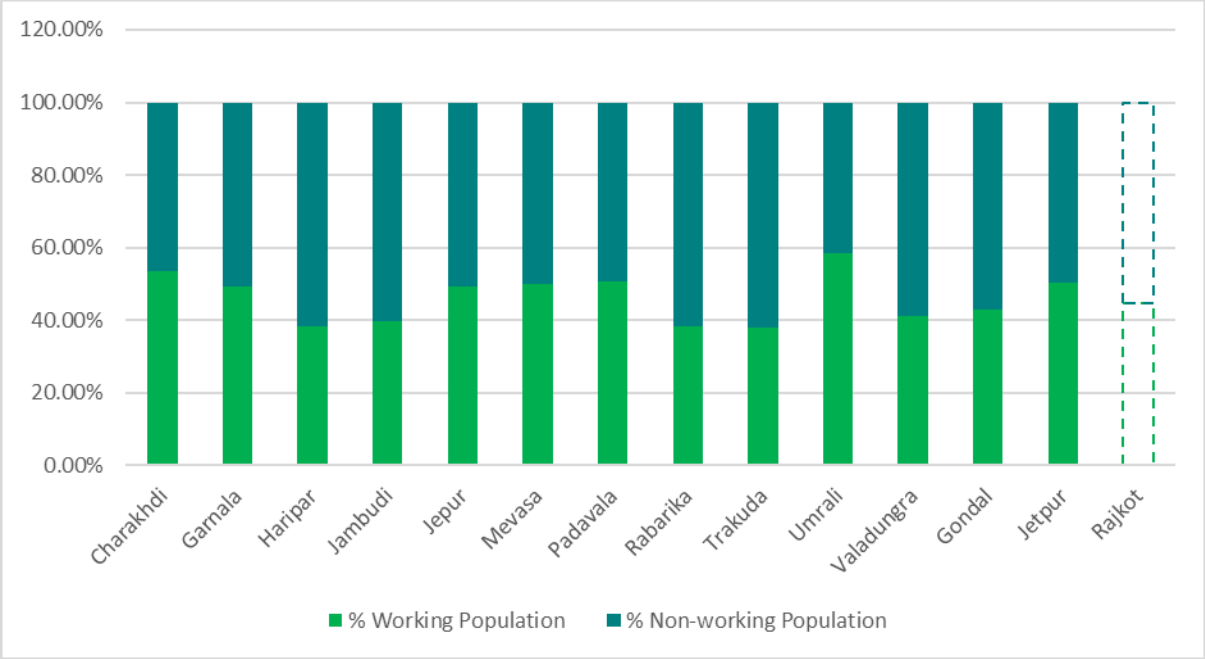


Figure 57: Occupational Pattern in the Study Area

Amongst the working population, the proportion of main and marginal workers is presented in *Figure 58* All blocks have a relatively higher proportion of main workers over marginal workers.

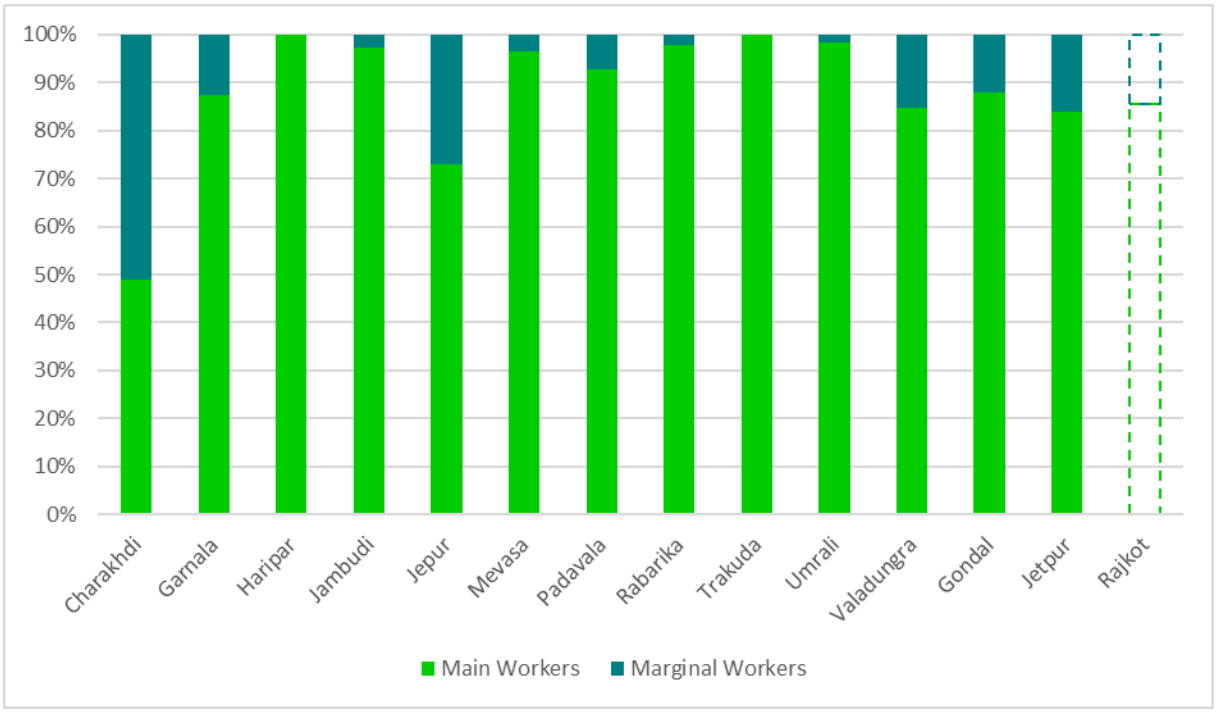


Figure 58 Distribution of Main v/s Marginal workers

The distribution of working population among main and marginal workers across key types (such as cultivators, agricultural labourers, household industry workers and other workers) has been presented in Figure 59 and Figure 60**.**

The distribution shows that among main workers, the proportion of workers listed under 'Main cultivators" occupations is generally higher across all villages except Rabarika, Jambudi and Garnala.

Haripar and Rabarika have reported a higher percentage of other main workers whereas the Trakuda (27%) has highest number of household workers.

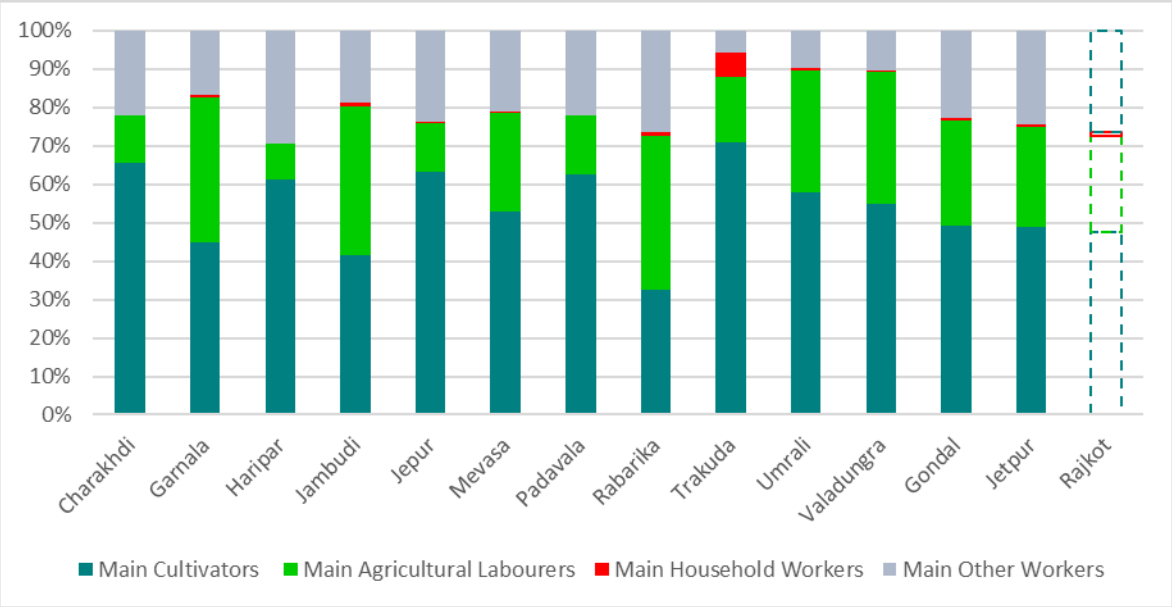


Figure 59: Distribution of Main Workers

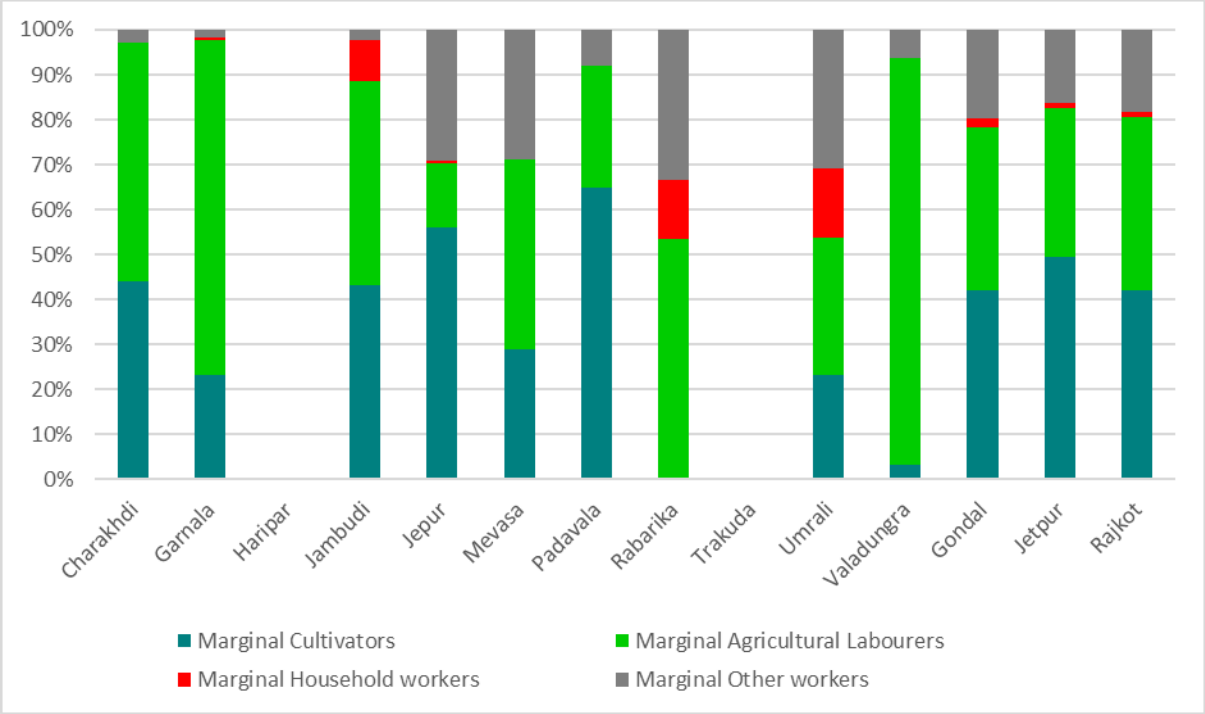


Figure 60: Distribution of Marginal Workers

Among marginal workers, the proportion of agricultural laborer is relatively higher than other occupations; followed by cultivators in the villages. There is absence of marginal workers in the villages of Haripar and Trakuda.

Primary Data

The main occupation population present in the study area villages are farming, agricultural labourers and dairy production. It was further informed that approx. 2-5% of the population work in textile manufacturing facilities present in Gondal and Jetpur cities.

4.12.5 Agriculture

Secondary Data

Rajkot is primarily an agricultural district with Groundnut and Cotton as the predominant crops. The other major crops cultivated are Wheat, Cumin, Gram, Onion and Chilly etc. About 57% of land holdings are with small and marginal farmers and the average size of the holdings is 2.29 ha.

Major crops in the district are Groundnut, Cotton and Onion requiring storage facilities. Creation of scientific storage capacity will reduce post-harvest and handling losses by 15-20%. Most of the godown constructed in the district are at individual farm level and with an average capacity of less than 150 MT[18].

Recently, agricultural activities in the region have been affected due to lack of irrigational facilities leading to the over exploitation of groundwater resources. Unleveled land and low nitrogen level are other constraints. Irrigation and groundwater improvement schemes have been announced and a groundwater

[18] Potential Linked Credit Plan (PLP) for 2016-17, Rajkot, National Bank for Agriculture and Rural Development.

development plan has been put in place along with 'Comprehensive - District Agriculture Plan' by the District Planning Committee.

During consultations with locals in the neighboring villages, it was reported that depths of water levels have only increased over a period in the area. Ground water availability has gone down to depths of 500-600 ft. (152.4 m – 182.88 m).

Primary Data

During the site visit to the study area villages and through consultation it was understood that the main crops grown in the area are cotton and ground nut. It was informed that for the past two years the rainfall has predominantly increased in the area leading to flood condition in some parts of the villages being affected. The main source of water available for agriculture purposes is through borewell, tube well and seasonal rains. Also, some villages as informed source water from nearby reservoir which is approx. at an aerial distance of over 5 km.

4.12.6 Livestock

The dairy sector plays an important role in providing gainful employment throughout the year to the rural population. Availability of green fodder, quality animals and marketing arrangements are the critical interventions required for definitive impact.

During site visit, the consultation with gram panchayat was undertaken and out of eleven (11) villages present in the study area villages, about five (05) village representatives were contacted (04 in person and 01 virtually) and consulted based on their availability to gather baseline information of the five villages in the study area. The details of average livestock present in some of the five villages in the study area is given in table below.

Table 30: Approximate count of livestock in the study area villages

S.No	Village Name	Livestock data			
		Cow	Buffaloes	Goats	Sheep
1	Betavad	100	50	150	--
2	Umrali	1200	1400	650	--
3	Valadungra	60	50	40	40
4	Jepur	50	400	200	--
5	Rabarika	500	1500	300	--

4.12.7 Industries

The occupational pattern in Rajkot is primarily based on the manufacturing and service sector. About 42% of workers are engaged in service activities and 34% in manufacturing activities. Manufacturing activities are concentrated in two main industrial estates – Aji and Bhaktinagar. In the past, Rajkot concentrated around the establishment of cloth mills. The current trend of industrial growth is towards the Engineering and Auto ancillary sector. In this sector, diesel engines are the leading business with around 105 manufacturing units operational in the district. The district also has various manufacturing units for machine tools, industrial equipments, lathe machines, metallurgical industries, electronics, engineering, and auto ancillary sector. Small and medium industries are dominated by foundries, engineering &

automobile works, textile related unit gold & silver jewellery, handicrafts, spices, medicines, and wall clocks; Jetpur taluka of the district is famous for dyeing and printing business; and, Paddhari taluka is known for ginning and pressing business in the entire State[19].

4.12.8 Scheduled Castes and Scheduled Tribes

Secondary Data

The population of the Scheduled castes (SC) and Scheduled Tribes (ST) in the villages surrounding the project area has been presented in the Figure 61. It can be observed that the proportion of Scheduled Caste population is considerable, while proportion of Scheduled Tribe population is negligible in the project villages. The villages of Garnala(14.36%), Mevasa(10.18%) and Umrali(7.27%) have recorded the highest proportion of SC population.

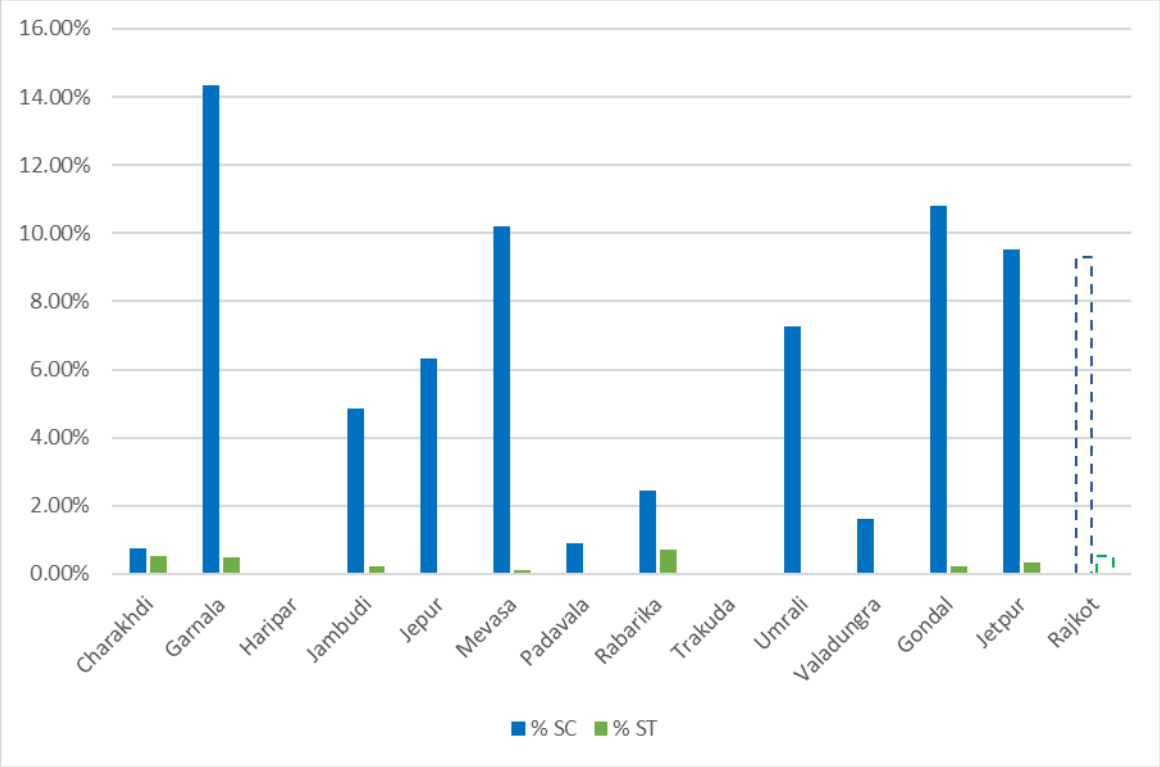


Figure 61: Distribution of Scheduled Castes and Scheduled Tribes in the Study Area

Primary Data

The village Jepur within the study area was found to be having highest schedule caste population of approx. 16%, followed by Umrali (5.14%) and Rabarika village (5%). The villages Garnala (11.33%), Umrali (5.71%) and Trakuda (5.70%) have reported highest proportion of ST population. Other backward classes (OBC) were also present in study area village, and village Valadungra reportedly to have about 99% of its population belonging to OBCs category. The data for village Charakhdi, Padavla and Mewasa was not available during the site visit.

[19] DISTRICT INDUSTRIAL POTENTIALITY SURVEY REPORT, Government of India Ministry of MSME District Industrial Potential Survey Report of Rajkot District (2014-15)

Table 31: Approximate SC, ST and other minority population in the study area villages

S.No	Village Name		Approx. Total SC Population (in %)	Approx. Total ST Population (in %)	Approx. other minority population (such as OBC) (in %)
1	Betavad	1500	3.33	3.33	0.00
2	Garnala	1800	1.33	11.33	2.67
3	Trakuda	3420	4.21	5.70	14.47
4	Charkhadi	5055	Data not available		
5	Padavla	140	Data not available		
6	Umrali	4200	5.14	5.71	33.33
7	Valadungra	1500	0.00	0.00	99.00
8	Jepur	1475	16.95	0.41	61.02
9	Rabarika	1950	5.00	0.92	7.69
10	Mewasa	4040	Data not available		
11	Jambudi	1200	0.25	2.50	6.50

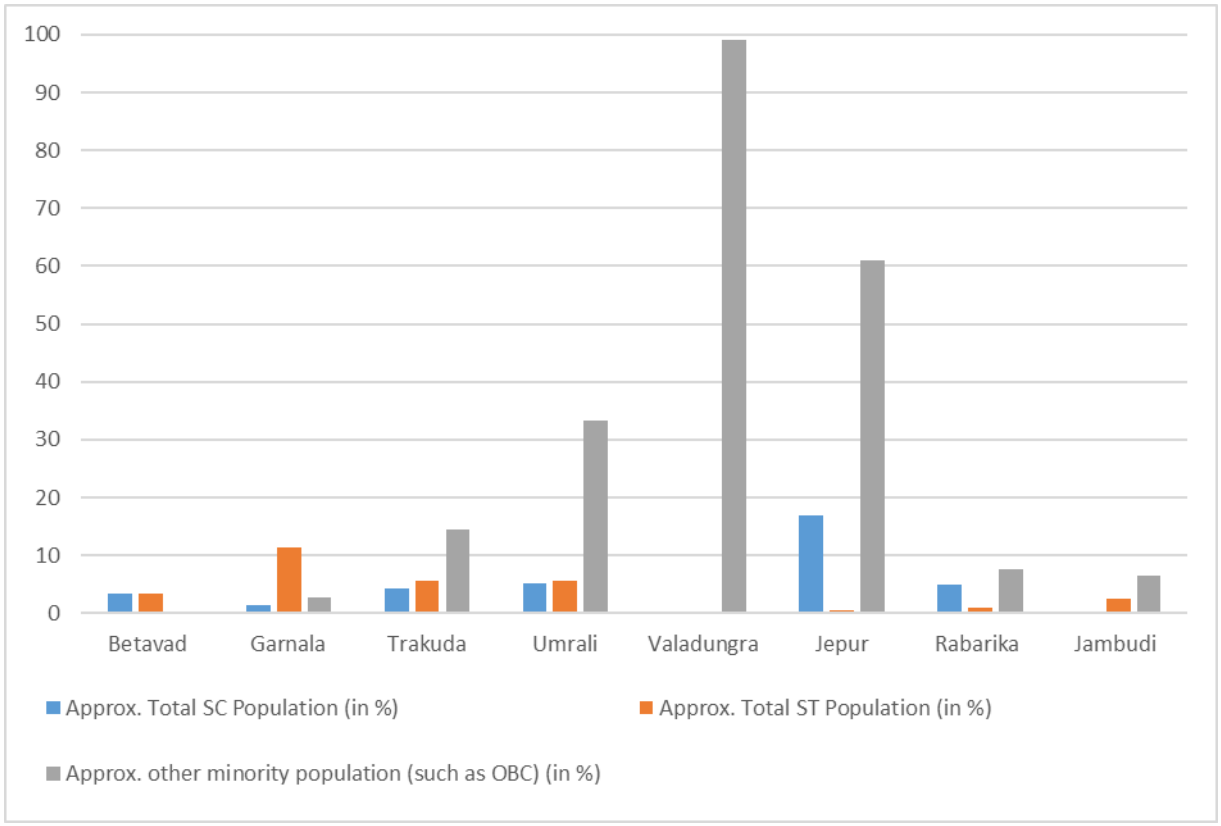


Figure 62: Graphical representation of SC, ST and other minority population in the study area villages

4.12.9 Education Facilities

All the study areas villages were noted to have Anganwadi and primary school present within their area. It was informed during consultations that for higher education, the students travel to cities like Jetpur, Gondal and Rajkot, where higher secondary schools, engineering college, and college for arts, commerce and science are present.

Separate toilets for girls and boys are provided in all visited schools of study area villages. Mid-day meal scheme is provided in schools which is mandated by the government, and it was noted that this programme was provided in all study area villages.

Table 32: Number of Education facilities, students and teachers present in the schools in the study area

S.No	Village Name	Grade	Number	Total Student	Total Boy Student	Total Girl Student	Total Teachers
1	Betavad	01 to 05th	01	Data Not available			05
2	Garnala	01 to 05th	01	92	57	35	03
3	Trakuda	01-08th	01	336	162	174	13
4	Charkhadi	01-08th	01	263	141	122	
5	Padavla	01-08th	01	14	07	08	02
6	Umrali	01-08th	01	263	140	123	12
7	Valadungra	01-08th	01	113	64	49	06
8	Jepur	01-08th	01	161	75	86	07
9	Rabarika	01-08th	01	107	48	59	04
10	Mewasa	01-08th	01	Data not available			
11	Jambudi	01-08th	01	85	41	45	05

4.12.10 Health Facilities

In the study area villages only four villages, *viz.*, Trakuda, Charkhdi, Umrali and Mewasa has the facility of Primary Health Centres (PHC) and in Charkhadi village one Ayurvedic Health Centre is present. During the consultation process it was informed that patients from Betavad and Garnala visit the Trakuda PHC for minor disease or injury or else for major issues or for maternity services, people travel to Gondal, Jetpur or Rajkot city. Hospitals, maternity centers and veterinary services are all present within 15km radius from the study area villages in Gondal and Jetpur city.

4.12.11 Drinking Water

Water tanks are available in all villages of the study area which is connected water pipelines supplied to all households.

4.12.12 Sanitation Facilities

Toilet facility is present in every household of study area villages.

4.12.13 Electricity Supply

Electricity is available in every household of study area villages as well for agriculture purposes too.

4.13 Stakeholder Consultation

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

This section of the report presents details on stakeholder identification and consultation undertaken for the project. Refer Annexure IV and V for project Stakeholder Engagement Plan and Grievance redressal Mechanism.

A reconnaissance survey and consultation were undertaken of the study area villages from 17th -19th October 2022. Details of activities undertaken during the site visits have been provided below in *Table 33.*

Table 33: Site Visits and Consultations undertaken for the Proposed Project

#	Date of Site Visit	Activities Undertaken
1	17th October 2022	• Interview with Land Sellers for the Solar site (Virtual) • Interview in study area villages with Schools principal, Gram Panchayat and Health Centre
2	18th October 2022	• Interview in study area villages with Schools principal, Gram Panchayat and Health Centre • Interview at worker accommodation present in Umrali village for contract workers
3	19th October 2022	• Interview with Land Sellers for the Solar site (In person) and for Wind site (Virtual) • Interview with local community present near the Solar site • Interview with Ayurveda Health Center workers

4.13.1 Stakeholder consultation objectives and scope

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

- Landowners who sold their land for the project and its associated facilities
- Representatives of village Gram Panchayat
- Community members of study area villages
- Project team involved during land procurement and pre-construction phase

4.13.2 Methodology Adopted

The stakeholder consultation comprised primarily of a socio-economic survey and consultation. 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 focus group discussion. These methods give an in depth and intensity to the discussion and incorporate the local population point of view within a short duration of time. The process of stakeholder consultation included:

- identification of the relevant stakeholders including all those individuals, groups and organizations 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 semi structured questionnaire with a list of open-ended questions was used to initiate the discussion process. A total of 04 landowners (02 for solar site and 02 for WTG transmission line) within the study area were interviewed, along with consultation with five (05) gram panchayat representatives from different villages. A sample of the questionnaire used for the consultation purposes has been attached as **Annexure VI.**

4.13.2.1 Nomadic Grazing Community

During the site visit to solar site, it was observed that about 03 families belonging to Gadvi Charan community comprising approx. four (04) to five (05) family members each, were present in a temporary shed on revenue land at a distance of about 4 km from the solar site in the South-East direction. Upon consultation with them, it was understood that only for maximum of six (06) months (June- November) post monsoons these families stay at this particular location for the purpose of grazing their cattle due to the availability of grassy land area, and for rest of the months they travel back to Gondal city in Rajkot District and purchase feed with their own expense. The families have been practicing this trade from the past 30 years. Each family owns about six (06) cows and thirty (30) buffaloes and their main occupation is related to dairy business with milk production capacity of 150 litres per day. The family income per month as informed is about INR 50,000.

It is further informed by these families that upto 04 km radius area from their temporary shed is used for the purpose of grazing. Due to the dismantled fencing of the solar site area, the portion of land was also accessed by the herders. It was confirmed by these families that grazing land is present in ample amount in the adjoining areas for the cattle and no shortage of area will occur even if the solar power plant is established.

Views expressed by Other Stakeholders

4.13.2.2 Landowners

A sample size of 04 landowners (02 for solar site and 02 for WTG transmission line) were consulted to assess the land procurement procedure adopted by the Project Proponent and verify whether the conditions of 'willing buyer/willing seller' were adhered to during the land purchase process. The consultations undertaken with the landowners have been presented in two separate sections in the

following, one on general information obtained from the landowners and second on the perception of the landowners on the Project.

Details of the general information gathered from the landowners during the site survey have been presented in Table 34**.**

Table 34: Details of General Information provided by Landowners

#	Name of the Interviewee	Location No.	Landowner Name	Village	Total Land owned by Landowners (in acres/hectare & gunta)	Total Area Sold for the Project (in acres & gunta or in meter)	Land Status prior to sale of land	Occupation of Landowner	Remarks
For Solar Site									
1	Chirag Dheeraj bhai Bhut	Solar	Chirag Dheerajbhai Bhut	Betavad	Approx. 36 acres	36 acres	Agriculture	Businessman	The landowner informed that the payment received from sale of land is planned to be invested for future land purchase/ business.
2	Praveen Singh Rambha Jadeja	Solar	Praveen Singh Rambha Jadeja	Betavad	Approx. More than 12 hectares (one hectare land remaining post selling of land for project)	27 acres	Agriculture	Farmer	The landowner owns additional land and will not be rendered landless post sale of land for the project
For WTG Transmission line									
1	Meghji Bhai	TL 4/0	Meghji Bhai	Jepur	Approx. 1.5-2.5 acres	8m x 8m	Agriculture	Farmer	The landowner owns additional land and will not be rendered landless post sale of land for the project
2	Babubhau Varmora	TL 5/0	Babubhau Varmora	Jepur	Approx. 1.5-2.5 acres	10m x 10m	Agriculture	Farmer	The landowner owns additional land and will not be rendered landless post sale of land for the project

Perception about the Project

Information on the perception of the Project gathered during the consultation process with the landowners has been broadly provided in *Table 35.*

Table 35: Details on the Perception of the Project by the landowners

#	Key Questions	Broad Replies received from Interviewees
1	Awareness of the Project	All respondents consulted affirmed that they were aware about the project.
2	Status of the land prior to the purchase/ procurement?	All the respondents consulted confirmed that agriculture was being undertaken on the land parcels prior to the procurement process
3	How were the land prices determined?	All respondents were uniform in their replies that land prices were determined on the basis of current market value
4	Was negotiation of the land prices undertaken? Is it above the prevailing market value? If so, how much?	All respondents replied in the affirmative. They were unison in their replies that the land was sold as per the market value.
5	Has the entire amount transferred to your bank account?	All respondents consulted confirmed that they have received the entire amount through account payee cheque.
6	What was the payment (income received from sale of land) used for?	The replies were cumulatively provided by the respondents i.e. one respondent might have provided two to three options and not strictly just one option, One (01) respondent replied that he used the payment for buying new land parcel. One (01) respondent replied that he is planning to use the payment for buying new land parcel. Two (02) respondent replied that they have not yet utilized the money and are in the process of planning on the how to use the payment
7	Has the land prices increased in the area with the coming of the project?	• Only one (01) respondent replied that the land prices have increased in the area. • A total of three (03) respondents replied that there was no difference in the land prices.
8	Concerns/Issues relating to the Project	All respondents replied that they did not have any issues/concerns relating to the project.
9	Benefit/Expectation from the Project	The replies were cumulatively provided by the respondents i.e. one respondent might have provided two to three options and not strictly just one option, • Only one (01) respondent was of the opinion that education and internet connectivity should be improved in the area. • The other three (01) respondents did not have any opinion related to benefits or expectation from the project

4.13.2.3 Gram Panchayat

A total of five (05) gram Panchayat representative (04 for WTG location and 01 for Solar site) from Valadungra, Umrali, Jepur, Rabarika and Betavad villages were consulted during site survey. Information on the perception of the Project gathered during the consultation process with the gram panchayat representative has been broadly provided in *Table 36.*

Table 36: Details on the Perception of the Project by the Gram Panchayat Representative

#	Key Questions	Broad Replies received from Interviewees
1.	Are you aware of the project in the area?	Four respondents out of (1) were in uniform that they are aware of the project. The (1) respondent who was not aware, was the newly recruited Sarpanch (Head). The other members and ex-Sarpanch (Head) present were well aware of the project.
3.	Are there any cultural heritage/ archaeological sites near the project area?	All respondents were uniform in their replies that no such cultural heritage or archaeological site are present nearby the project location. It was further informed that Khambada caves are present at a distance of approx. more than 10-20 km from all villages.
4.	Are there any other development projects in the adjoining area? Nature of the project.	The replies were cumulatively provided by the respondents i.e., one respondent might have provided two to three options and not strictly just one option, • Four (04) respondents replied that no development project is present in adjoining area of the village. • One (01) respondent replied that a solar power plant by Renew Power company is present nearby the village.
5.	Have the land prices gone up in the area?	• Only one (01) respondent replied that the land prices have definitely increased in the area. • A total of four (03) respondents replied that there was no difference in the land prices.
5.	Do you anticipate any risks associated with the project's operation?	All respondents replied that they did not have any anticipated risk associated from the project's operation.
7.	Benefit/Expectation from the Project	The replies were cumulatively provided by the respondents i.e. one respondent might have provided two to three options and not strictly just one option, • One (01) respondent replied that education facility should be improved in the area • Two (02) respondents replied that medical facility should be improved in the area • Two (02) respondents replied that employment opportunities should be increased in the area
8.	Any other remarks/observations	All respondents replied that they did not have any other concerns related to the project

4.13.2.4 Project Team

During the site visit, the project team was consulted on the process adopted in land identification and procurement for the project. It was informed that the Project team surveyed the probable locations of

the respective sites and identified the private landowners. Based on receipt of permission from District Collector, Rajkot District as per Section 54 of the Saurashtra Gharkhed Tenancy Settlement and Agricultural Land Ordinance, 1949, the sale deeds were executed with the respective land sellers. Similarly, the revenue land was surveyed and application to the Revenue Department was made for leasing out the required land parcels. As a practice adopted by the Company, it was informed that the Land Team while undertaking their initial assessment of the site consciously does not consider land parcels wherein active cultivation, grazing and physical structures are present including parcels owned by ST category of population. Details of the private land purchased for the solar site has been presented in the *Table 37.*

Table 37: Details of private land purchased for the solar site

S. No.	Land Procured (acre)	Landowner's Name	Village	Mandal/Tehsil	District	Sale Deed No. & Date	Land Status prior to sale of land
1	11.5	A) Vrajlal Haribhai Maradiya B) Vipulbhai Ramanikbhai Ramoliya C)Nileshkumar Maganbhai Zalavadiya D) Pravinsinh Rambha Jadeja	Garnala	144	Rajkot	11413/2022 (Dated 10.10.2022)	Agriculture
2	26.78	A) Dhanjibhai Ukabhai Kathiriya B)Nileshkumar Maganbhai Zalavadiya C) Pravinsinh Rambha Jadeja D) Vrajlal Haribhai Maradiya E) Sunil Haribhai Maradiya	Betavad	57/5	Rajkot	8332/2022 (Dated 18.07.2022)	Agriculture
3	18	A) Dhirajbhai Dharamshibhai Bhut B) Hemantbhai Kadvabhai Bhut C) Mrs. Nimuben Dhirajbhai Bhut	Betavad	57/19/paiki 1	Rajkot	8929/2022 (Dated 01.08.2022)	Agriculture

S. No.	Land Procured (acre)	Landowner's Name	Village	Mandal/Tehsil	District	Sale Deed No. & Date	Land Status prior to sale of land
		D) Chirag Dhirajbhai Bhut					
		E) Vishal Dhirajbhai Bhut					
4	6	A) Dhirajbhai Dharamshibhai Bhut	Betavad	57/19/paiki 2	Rajkot	8932/2022 (Dated 01.08.2022)	Agriculture
		B) Hemantbhai Kadvabhai Bhut					
		C) Mrs. Nimuben Dhirajbhai Bhut					
		D) Chirag Dhirajbhai Bhut					
		E) Vishal Dhirajbhai Bhut					
5	6	A) Dhirajbhai Dharamshibhai Bhut	Betavad	57/19/paiki 3	Rajkot	8927/2022 (Dated 01.08.2022)	Agriculture
		B) Hemantbhai Kadvabhai Bhut					
		C) Mrs. Nimuben Dhirajbhai Bhut					
		D) Chirag Dhirajbhai Bhut					
		E) Vishal Dhirajbhai Bhut					
6	6	A) Dhirajbhai Dharamshibhai Bhut	Betavad	57/19/paiki 4	Rajkot	8931/2022 (Dated 01.08.2022)	Agriculture
		B) Hemantbhai Kadvabhai Bhut					
		C) Mrs. Nimuben Dhirajbhai Bhut					
		D) Chirag Dhirajbhai Bhut					
		E) Vishal Dhirajbhai Bhut					

Consultation with Primary school principal, Umrali village

Consultations with Sarpanch in Valadungra village

Consultations with Valadungra primary and middle school principal

Consultation with schoolteachers in Primary school Garnala, Village

Consultation with governmental Ayurveda and wellness centre in charakhadi village

Consultation with people present in the temporary shed near to solar site location

Consultation with Farmers present in the neighbouring side of solar location

Consultation with one of the Land sellers for solar site

Figure 63: Socio-economic survey and consultations carried out during the field visit

4.13.3 Need Assessment based on Community Consultation

A need assessment was undertaken amongst the community respondents to highlight the expectations of the local population in the study area from the proposed project proponent. These views were collated in order to comprehend the need of the locals so that prioritizing of welfare activities by the project proponents can be better chalked out in the future in case of implementation of Corporate Social Responsibility (CSR) activities. The detail of the areas wherein utmost priority needs to be given is provided in *Figure 64***.**

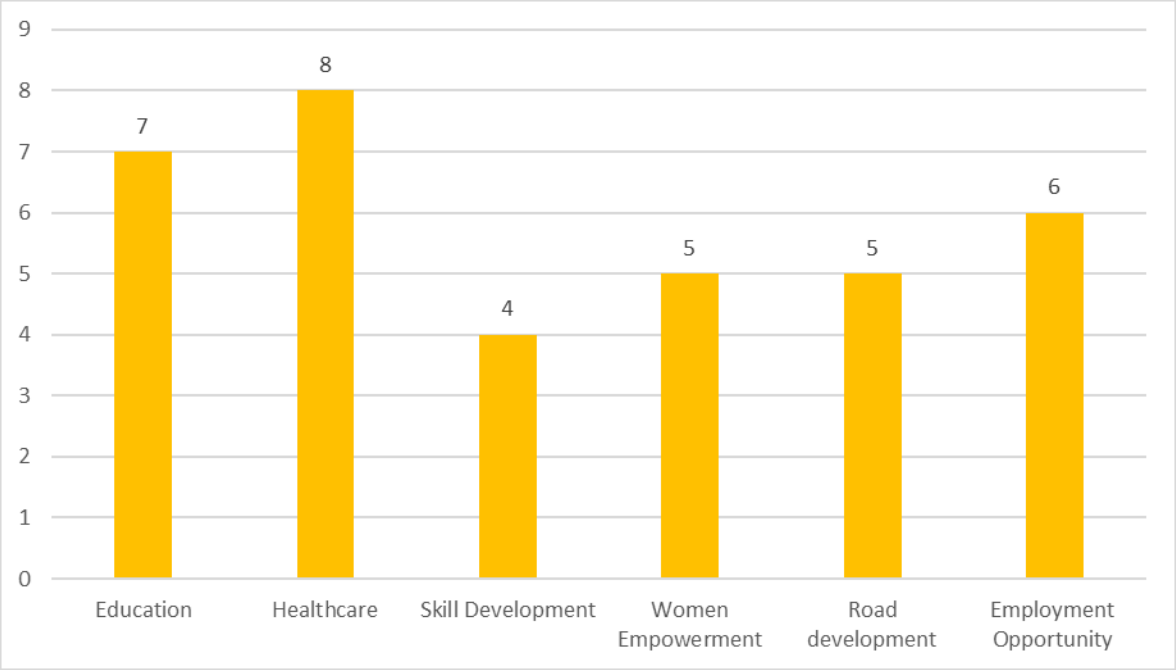


Figure 64: Details of Need Assessment obtained during the Consultation

From the figure above, the following areas had been identified amongst the respondents which require utmost priority in terms of activities to be initiated for social development:

- ***Healthcare Facilities: Improvement in Health care facility in the area is selected as the highest priority by the respondents.*** The project proponent can support the local communities in developing a healthcare facility in the area. In addition, mobile health vans can be introduced in the area with a set of medical professionals accompanying it so that the study area and its neighbouring population can be benefitted by this step.
- ***Educational Services:*** The respondents were in opinion that education services in the area should be improved on priority basis. The project proponent can provide help to the existing schools in the area in terms of infrastructural aid, science camps and in addition, encourage the Government to open schools of more high school level in the area.
- ***Employment Opportunity***: The respondents were of the opinion that employment opportunities would improve in the area and felt that the Project would open up avenues for generation of employment for the local population.
- ***Women Empowerment***: The respondents also prioritize on development of vocational centres by providing skills in tailoring, pickle making, handicraft making etc., these skills can be introduced in the area to give a platform to the women population to engage themselves in other areas besides household activities. This step will bring about women empowerment wherein effects will be noticed in areas like employability, education and health aspects.
- ***Road Development***: The respondents have an opinion that the paved road should be developed more so the connectivity is established to reach from one place to another comfortably.
- ***Skill development:*** Skill development program should be conducted as per the opinion of the respondents, in terms of imparting of modern technology used in agriculture and vocational centres

for women providing courses such as tailoring, animal care, home cooked snacks etc. would help the local population in the area to a large extent.

5 Analysis of Alternatives

The following section gives analysis of alternatives with respect to various factors like technology, project location, TL alignments. The following scenarios have been considered in the sections below:

- No Project Scenario
- Alternate methods of power generation
- Alternate routes of TL Alignments
- Site suitability and justification for the project

5.1 No Project Scenario

The current project presents an opportunity to utilize the potential for solar and wind power generation in the Saurashtra region in the State of Gujarat. As of July 2022, the renewable energy generation in Gujarat is about 44.75% of its total energy production[20]. Additionally thermal energy plants in Gujarat have, however been facing supply chain issues, primarily due to non-availability of coal[21] and several sectors are facing power cuts[22]. A "No Project Scenario" will not address this issue of power shortage and also worsen the supply-demand scenario in the region.

Gujarat is rich in solar resources with about 240-300 sunny days and a good solar radiation of 5.5 to 5.8 kWh/m^2/day. The wind and solar energy potential in the State is estimated in excess of 80,000 MW and 18,382 MW respectively. However, considering recent technological advances, increasing efficiencies and the longest coastline in the country, the actual potential for solar and wind energy is significantly higher than the estimated capacity.

Gujarat also has also taken-up several investor friendly initiatives and policies like the Gujarat Wind-Solar Hybrid Policy, 2018.

5.2 Alternate Methods of Power Generation[23]

As per a 2007 paper by the Ministry of Environment Forests and Climate Change (MoEF&CC), Ministry of Power (MoP)and the Bureau of Energy Efficiency (BEE), titled: 'India: Addressing Energy Security and Climate Change', there is a need for expanding the role of domestic Renewable Energy (RE) sources in the country. Unlike oil, coal or LNG, solar and wind power are not subject to fluctuating fuel prices which drain

[20] "Western region installed capacity" (PDF). *National Power Portal*. Retrieved 16 November 2022.
[21] https://indianexpress.com/article/cities/ahmedabad/coal-shortage-gujarat-buys-rs-150-cr-worth-of-electricity-daily-to-prevent-power-cuts-grim-situation-7568780/, Accessed on 16 November 2022.
[22] https://indianexpress.com/article/cities/ahmedabad/power-crisis-gujarat-govt-mandates-industries-to-shut-a-day-every-week-7845347/ , Accessed on 16 November 2022.
[23] https://inis.iaea.org/collection/NCLCollectionStore/_Public/49/009/49009723.pdf , International Atomic Energy Agency (IAEA), Accessed on 16 November 2022.

India's limited foreign reserves, and in addition, they help in reducing the carbon footprint of the economy.

There are various non-renewable and renewable energy sources which can be utilized for power generation. Each option has its own advantages and disadvantages. Based on the site conditions, availability of resources, environmental & social concerns and project cost, suitable option for power generation need to be selected. Comparison of advantages and disadvantages of various non- renewable and renewable energy is represented in table given below.

Table 38: Advantages and Disadvantages of various non-renewable and renewable energy

Source of Energy	Advantages	Disadvantages
Coal	• Relatively cheap • Large-scale, world-wide availability	• Non-renewable energy source • Large water requirement
	• Reliable source of energy with steady output • Coal is available in India	• High emission and generation of fly ash • Source of greenhouse gases • Mining of coal causes impacts on land and surrounding environment. • Need to import due to inferior quality of domestic coal
Oil & Gas	• Oil and gas can be easily transported by pipes or ships. • Natural gas is the "cleanest" of the fossil fuels	• Non-renewable energy source • Working environment risks to staff and environment • Burning oil and gas releases can cause pollution & health impacts • Releases GHG and hence causes global warming and climate change • Need to import and hence high dependency of raw material outside the country
Nuclear	• Nuclear fuel does not create greenhouse gases when making energy. • Only a very small amount of nuclear fuel is needed to make a lot of energy. • Does not produce significant atmospheric pollutants.	• Expensive, especially in capital costs, maintenance costs • The waste produced from nuclear energy is radioactive and Safe long-term disposal of nuclear waste can be difficult.
Solar	• Energy from the sun is exhaustive & free. • Solar energy does not create greenhouse gases.	• Only specified places are right for solar power. • Solar energy cannot be produced at night
Wind	• Wind power does not create greenhouse gases. • The energy used to build one of the large turbines is repaid in 3-6 months. They last for 25 years.	• Need a lot of turbines to make electricity. • Location specific resource • Wind turbines can only be used where it is windy. On days where there is little wind, less energy will be generated.
	• Hydroelectricity creates no greenhouse gases.	• Hydroelectric power needs enough water to turn the turbines. • Dams are expensive to build.

Hydroelectric	• Energy from water is free and will not run out. • Hydroelectric energy is more reliable than wind or solar power.	• Building large dams can cause damage to water courses which affects people and wildlife, and it can be difficult to find the right site.
Biomass	• Biomass fuel is cheap. • Biomass fuels will not run out. • Biomass crops that are grown absorb the same amount of pollution whilst they are growing as they release when they are burned, so do not create extra greenhouse gases in the atmosphere.	• Growing biomass crops needs a lot of space and could replace growing valuable food crops. • Biomass fuels that are not grown (such as waste products) create greenhouse gases when burned. • Relatively low calorific value and low efficiency

The conventional sources of power generation have high environmental costs when compared to non-conventional sources like solar, wind, hydro, etc. their construction periods are longer with higher environmental risks from emissions. On the contrary, power sources from solar energy are most eco-friendly. It does not have any kind of emissions during operation.

Wind power requires high wind zones to be set up and micro siting along with detailed meteorological analysis is required which is very favorable in Rajkot district, site selection for solar power is relatively easier there as well. Both Solar and Wind power energy is a clean power project with no emissions and feasible for the project area keeping in mind the good solar and wind potential in Rajkot, Gujarat throughout the year.

5.3 Technology Alternatives

The PV module that will be used for the plant shall be a Polycrystalline Silicon Module designed for commercial and solar farm applications.

A number of types of solar cells are available for PV modules. *Table 39* provides a comparison of key characteristics of the available type of solar cells.

Table 39: Comparison between Type of Solar Cells for PV Modules

#	Name of solar cell	Description	
1.	Amorphous Silicon (a-Si Solar Cells)	• Thin-film silicon solar cells • Generally, feature low efficiency (8-13%) • Cell thickness is 0.3-0.7 µm • Cost is less as compared to mc-Si and pc-Si solar cell	
2.	Crystalline Silicon (c-Si Solar Cells or Wafer-based solar cells)	<u>Mono crystalline (mc-Si)</u> • Lab efficiency - 25% (approx.) • On-field efficiency - 20-24% (approx.)	<u>Multi/Poly crystalline (pc-Si)</u> • Lab efficiency - 20.4% (approx.) • On-field efficiency – 15-19% (approx.)

#	Name of solar cell	Description	
		• Most expensive due to the manufacturing process • Work better in low light and warm weather conditions as compared to pc-Si Solar Cells	• Less expensive due to ease in manufacturing process • Shorter life span as compared to mc-Si Solar Cells
3.	Thin Film Solar Cell (TFSC)	• Lab Efficiency - 13.4% (approx.) • On-field - 10% (approx.) • Mass production is simpler & thus cheaper than c-Si solar cells • Can be made flexible • Tend to degrade faster & thus have less warranty period	
4.	Cadmium-Telluride Solar Cell (Cd-Te)	• Lab efficiency - 19.6% (approx.) • On-field efficiency - 13% (approx.) • Cd-Te is the only TFSC technology that has surpassed the cost-efficiency of c-Si solar cell technology • Cd-Te is toxic in nature and possesses threats to the environment	
5.	Copper Indium Gallium Selenide (CIGS/ CIS Solar Cells)	• Lab efficiency - 20.4% (approx.) • On-field efficiency - 15% (approx.) • Commercial production of flexible CIGS panels is stared in Germany in 2011.	
6.	Organic Solar Cells	• A type of photovoltaic that uses conductive organic polymers or small organic molecules for light absorption. • Main disadvantages include low efficiency (around 11±0.3% in lab) and low stability and low strength as compared to inorganic photovoltaic cells such as silicon solar cells.	

The PV module composed of multi-crystalline solar cells has a conversion efficiency ranging from 15.48% to 16.51% and its anti-reflective and anti-soiling nature reduces dust and dirt accumulation leading to reduced power loss due to dust on the PV module surface.

Further, crystalline silicon is not considered a hazardous waste and most of the components of the PV modules are recyclable. The PV module consists of approximately 80% glass and the flat glass recycling industry can treat this product in their current recycling lines. Additionally, the aluminum frame, copper wires and crystalline silicon cells are also recyclable. The PV modules with the structure are high salt and ammonia resistant.

5.4 Alternate Routes for Transmission Lines

As discussed with site team, the route of the transmission line will be selected keeping in mindthe following factors

- Transmission line route is planned to avoid any habitations along the route

- No house or community structures are located under the transmission line
- Flooding risk and proximity to rivers and streams
- Final locations of WTGs

The shortest possible route after considering the above factors will be selected for the transmission lines. Consideration of all the above factors will reduce the environmental and social footprint of the transmission line.

5.5 Conclusion

Various factors are considered such as solar and wind resource potential at the project site, favorable environmental and social settings, and lowest GHG emissions in the project life cycle. Availability and suitability of solar and wind power potential, land and other allied infrastructure availability and various government supporting policies. Considering these factors, it can be concluded that the site is the good location for development of Hybrid power project.

6 Environment and Social Impact Assessment

6.1 Positive Impacts

As part of the Solar and National Wind Energy Mission, India has set several ambitious targets for developing renewable energy projects. This hybrid project is an alternative to conventional form of energy using fossil fuels and thus will contribute to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030. The project will also contribute towards meeting national targets as part of India's Nationally Determined Contributions (NDC) under the Paris Agreement for the Period 2021- 2030, on reduction of greenhouse gas emissions, wherein India has pledged to reduce the emissions intensity of its GDP by 33–35% in 2030 compared to 2005 levels.

The project will generate employment among locals during construction and installation phase of the project.

The project may lead to the introduction of allied industries and services thus initiating promoting development in an otherwise backward area in terms of development.

6.2 Areas of No Significant Impact

The project will not lead to the release of emissions or effluents to pollute the environment during the operational phase.

6.3 Project Activities

Project activities can be categorized in terms of Pre-construction, Construction, Operation and Decommissioning Phase. Activities to be taken up under each phase have been listed in the subsequent sections.

6.3.1 Pre-construction Phase

- Selection of potential windfarm site
- Site surveys – topographical, geotechnical, electrical, etc.
- Micro-siting of windfarm
- Approvals and clearances – power evacuation, grid synchronisation, pollution, safety, etc.
- Design and finalization of contractors
- Land acquisition/ transfer/ lease/allotment
- Undertaking various studies including ESIA
- Land sub lease/purchase process
- Sourcing and transportation of construction material etc.

6.3.2 O&M Phase

- Power generation

- Regular monitoring and preventive maintenance activities of the PV modules and associated electrical equipment and support utilities for safe and consistent operation
- Washing/Cleaning of the PV modules
- On-site and Off-site Maintenance (Road cleaning, Sediment removal from drainage etc.)
- Maintenance of vegetation (de-weeding, maintenance of greenbelt/buffer)
- Vehicular movement carrying Officials on site during routine inspection, maintenance and operation of Wind - Solar Hybrid Power Project
- Periodic maintenance of all solar modules (washing modules)
- Maintenance of ancillary facilities such as store, yard, site office
- Inspection of transmission lines
- Security of Wind - Solar Hybrid Power Project in operation
- Operation of Wind - Solar Hybrid Power Project

6.3.3 Decommissioning phase

Depending on the scale of decommissioning there shall be partial or complete removal of the equipment and facilities. A complete decommissioning would include the following activities:

- Dismantling of all PV panels, ancillary equipment and support structure
- Demolition of civil structures and site clearance
- Transportation of salvaged PV panels and ancillary equipment for recycling and disposal; demolition waste to dumpsite
- Dismantling of WTGs, transformer yards
- Site reclamation and revegetation
- Access roads and other components
- Disconnecting and removal of Inverter Stations, Substation

6.3.4 Construction Phase

The project activities during construction and installation phase of the project are as follows:

- Site Preparation (clearance of existing vegetation, fencing to avoid intrusion)
- Earthwork (Earth moving and filling, Land grading, Levelling and Compaction)
- Construction and Use of Haul Roads
- Operation of heavy vehicles/machinery
- Civil, mechanical and electrical works (Building works, Cabling, Installation of PV module support structures etc.)
- Construction and Installation of Transmission line
- Construction and Installation of Switchyard
- Use of diesel generator sets and diesel-powered vehicles
- Labour camps and Site office/Control room
- Storage and utilization of construction material and chemicals
- Transportation of raw material and construction spoil
- Storage of scrap, solid waste, hazardous waste and construction debris

- Maintenance of equipment and machinery
- Storage and handling of raw material and debris
- Interaction of migrant labour with locals
- Operation of DG sets
- Access road construction
- Site Clearance
- Foundation excavation
- Transformer yard construction
- WTG assembly and erection
- Substation construction
- Laying of transmission lines
- Construction of PSS
- Completion of internal electric connections
- Turbine testing to verify proper operation of the facility; and
- Commissioning

6.4 Impacts during Construction Phase

6.4.1 Land

Solar PV projects require a large expanse of land for setting up the plant in comparison to other types of power generation facilities in relation to the power output generated.

Although WTGs require less area compared to solar plants, impacts on land occur due to approach roads and internal transmission lines connecting each turbine location. Depending on the distribution of the WTG locations the extent of impacts can be regional. However, in the current project, the no. of WTGs and their distribution is limited, leading to a localized impact.

The Project requires both private and government revenue land parcels for setting up the respective sites. The Project Proponent has taken the required permission from Government authorities prior to the land procurement process.

Considering the above, the impacts on land are expected to be **'Moderate'**.

Component	Nature	Extent	Duration	Impact
Solar	Irreversible	Local	Long term	**Moderate**
Wind				

6.4.1.1 Change in Land Use

Some activities like, site clearance and preparation for WTGs, solar land and EHV line, establishment and operation of batching plant, site office; and transient storage of WTG and solar components will lead to change in the land use which is primarily agriculture with some scrubland.

The construction phase is expected to last for another 9-10 months, during which period land use change is expected for temporary facilities. Permanent land use change will only be in the solar land and in small

land parcels for WTGS and TL towers. As the change is permanent in nature for Solar land, the impact is considered to be **'Moderate'**, while only small parcels are involved in wind, therefore this impact is considered be **'Low'**.

Component	Nature	Extent	Duration	Impact
Solar	Irreversible	Local	Long term	**Moderate**
Wind	Irreversible	Local	Long term	**Low**

6.4.2 Natural Resource Consumption

Primarily groundwater is to be used for construction activities, including foundation work and boundary work. Estimated water requirement for various activities in provided in Table 5.

The various construction equipment typically consumes diesel fuel for operations. The transportation of raw material (concrete, reinforcement, PV panels and ancillaries, mounting frame, WTG blades and columns) and hauling of construction spoil for disposal will also consume diesel fuel. These activities are likely to increase consumption and burning of fossil fuels in the project area.

The construction activities (foundation casting and utility building) will consume water that will be sourced from the ground water. The ground water in the project area is classified as 'Safe' zone by CGWB.

The cement and crusher shall be procured from the nearby areas in the Rajula village of Amreli district and Mevasa village in Rajkot District. The sand and gravel shall be locally procured with a portion of it procured from Bhogavo river of the Surendranagar District. Considering the above, the impacts are expected to be **'Low'**.

Component	Nature	Extent	Duration	Impact
Solar	Irreversible	Local	Short term	**Low**
Wind	Irreversible	Regional	Short term	**Low**

6.4.3 Impact on Ecological Environment

The project area has a few patches of scrub forests with sparse vegetation and primarily croplands. As per 1: 50K Open series Toposheets, issued by the Survey of India, there are no Reserved Forests in the study area. There are no National Park/ Wildlife Sanctuary, Notified Eco-Sensitive Zones, Notified Important Bird Areas, Ramsar Sites (Wetlands), Reserve/ Protected Forest, Open Forests/ Social Forests, located within the Study area that can be directly impacted by the project.

The WTG installation and TL line construction activities will disturb the nesting habitat of Chestnut-belied Sandgrouse (*Pterocles exustus*) in the scrublands near Umrali and Rabarika villages. The excavation related activities for laying the foundation for WTGs, if not appropriately barricaded may cause some mammal and herpetofauna to fall in and be trapped or injured. Construction activity may result in temporary increase in heavy traffic and unsafe driving practices on village roads and unmetalled approach roads may lead to roadkill, especially putting at risk herpetofauna and small mammals. Noise from construction activities may disturb waterbirds and nesting birds as some of the WTGs are in close proximity to their

roosting, feeding and nesting habitats. Earth will be excavated for making roads, etc. and vegetation clearance will result in habitat modification in the study area. Domestic animals, herpetofauna may temporarily move away from adjacent suitable habitats but may recolonize once the construction phase is over. The project area is not a designated or qualifying site of national and international importance for biodiversity. Hence, from this aspect, the impact is **'Moderate'.**

To develop the solar farm, vegetation, along with over 250 trees within the solar site may be at risk. It is however proposed that the orientation of the solar plant will be designed such that no tree felling is involved. However, the final layout was under preparation during the current assessment and therefore its actual impact on existing vegetation was not assessed. The construction of the transmission line will also involve loss of some vegetative cover. The loss of vegetative cover and clearing of land will cause loss of habitat for the fauna listed above and thus also cause loss of praying grounds for avifauna in the area. Hence, impact on ecological environment due to vegetation clearance or damage. during construction phase is **"Moderate"** from the project activities.

Component	Nature	Extent	Duration	Impact
Solar	Irreversible	Local	Long Term	**Moderate**
Wind	Irreversible	Local	Long Term	**Moderate**

6.4.4 Alteration of Natural Drainage Pattern

The project area is relatively flat landform comprising of significant vegetation. Grading of the land will require felling and vegetation clearance to a certain extent during project development. The land development activity will alter the natural drainage pattern of the area. After the levelling and paving, increment in surface runoff is expected which should be diverted to the natural drainage/canal exists in nearby area. If it is not carried out, then surface runoff from the site may affect nearby landowners which may cause social agitation.

Construction of reinforced cement concrete structures require aggregates from quarries. Although ready-mix concrete is used for the project, the project would indirectly have some contribution in disruption of natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns and ponding caused due to quarries.

Considering the size of solar land, the impacts on drainage will be '**Moderate'** and the impacts at WTG locations will be **'Low'** as a small piece of land would be used.

Component	Nature	Extent	Duration	Impact
Solar	Reversible	Local	Short term	**Moderate**
Wind	Reversible	Local	Short term	**Low**

6.4.5 Viewscape Impacts

The nearest settlements to the solar land, Betwad and Garnala are located at a distance of 2 km from the north-western corner and 3km from south eastern edge of the project area respectively (Refer Figure 65 and Figure 66). These settlements are located at an elevation of 10-20 m lower than that of the project area.

The approach road to the solar site passes through the Garnala village. Increase in traffic on the road will be for a short duration during the construction phase of the solar plant. The area between the project area and the road is having undulating topography with some higher elevation areas. Hence the potential impacts on viewscape due to the solar project are expected to be **'Low'**.

The presence and movement of vehicles, large equipment or infrastructure such as cranes, dumpers, transportation vehicles along with the construction activity will create a viewscape impact for settlements for a short duration in the vicinity of the WTG locations. However, these impacts may be considered **'low'**, considering that they are for a short duration and temporary in nature.

Component	Nature	Extent	Duration	Impact
Solar	Reversible	Local	Short term	**Low**
Wind				

Figure 65: Solar site viewscape impacts on Betwad village

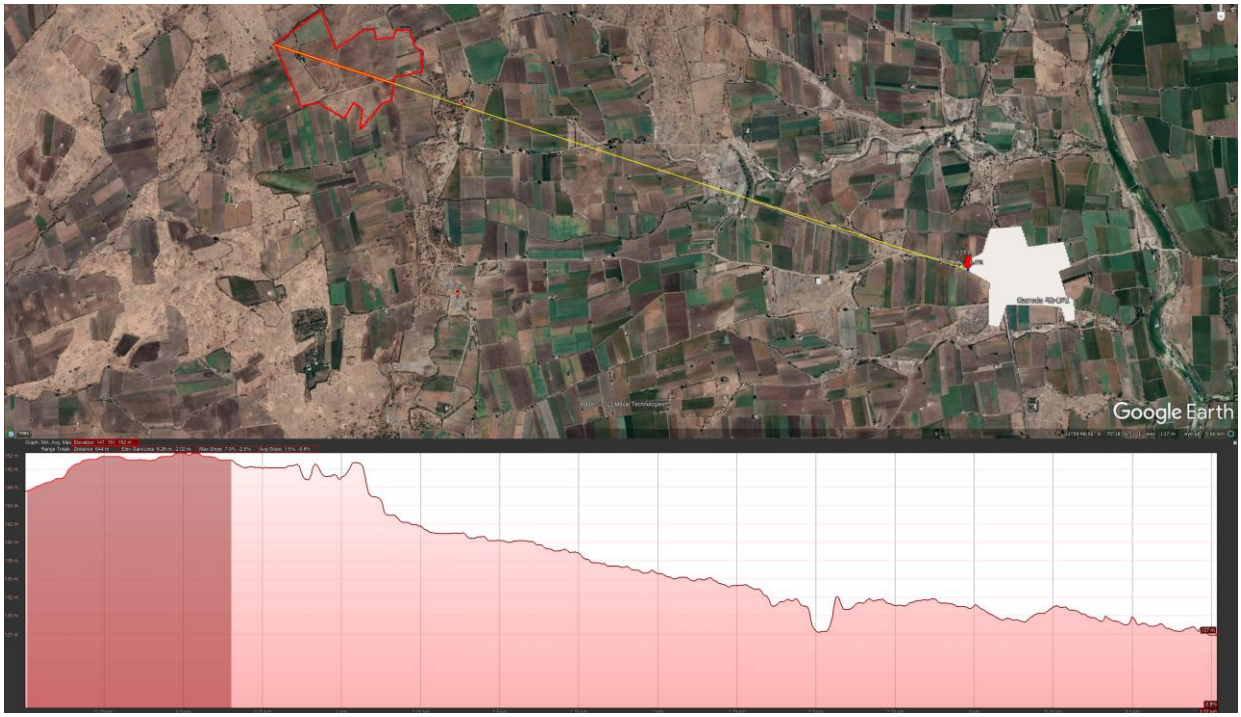


Figure 66: Solar site view scape impacts on Garnala village

6.4.6 Soil Compaction and Erosion

The soil in the project area is comprised of sandy light brown rocky and rich black soil. The topography of the land is flat to gradually sloping with rocky patches. The areas where black soil is present, have a higher water retention capacity thus preventing the soil from eroding easily. In places where gravel and small rock fragments are present, the soil will erode easily with wind movement.

Construction of the solar farm will involve clearing, grubbing and leveling of the land area. The removal of vegetation and crops during site clearance and levelling could loosen the soil further, causing soil erosion. During land clearance and grading of land for the solar farm, the topsoil if not appropriately stored or reused could be lost to other industrial activities. The impact on soil is assessed to be '**low'** in the Solar farm area primarily due to the small footprint of the solar land.

The erection of WTGs and TL towers may result in:

- Removal of Topsoil layer and vegetation within the footprint of the tower base (14 WTGS and __ TL Towers) for laying the foundation.
- Mixing of soil may occur as some of the excavated soil will be backfilled. Although top soil needs to be retained and stored separately and only sub-soil is used for backfilling, some of it may get mixed with the topsoil, thereby reducing it fertility.
- Soil exposure to elements like rain and wind will increase during the excavation of foundations, leading to erosion and sedimentation in the adjoining field and waterbodies.

The impact on soil is assessed to be '**Low'** in the Wind farm area.

The project area receives high and erratic rainfall between June to September and relatively low or no rainfall in the other months. Hence overall, it can be stated that the impact from soil erosion apart from the monsoon is likely to be low.

The movement of vehicles over agricultural land to access construction sites could lead to compaction, however use of existing approach roads will render this impact as **'Low'.**

Component	Nature	Extent	Duration	Impact
Solar	Reversible	Local	Short term	**Low**
Wind				

6.4.7 Soil Contamination

Spills of fuel, oil and grease from construction equipment and transport vehicles; chemicals such as paints, oils, solvents, improperly managed wastewater generated from construction activities on unpaved areas can contaminate the soil. Absence of sanitation provisions in labour accommodation and site areas could lead to open defecation, thus indirectly causing soil contamination. The waste generated during construction, such as scrap, debris, concrete waste, hazardous waste (waste oil from DG set and equipment, oil filters, oil-soaked cotton, damaged PV panels), food waste from labour accommodation if not stored in an environmentally safe manner can cause soil pollution.

Considering the small footprint of the project and the fact that it is a short term occurrence, the impact is considered to be **'Low'**.

Component	Nature	Extent	Duration	Impact
Solar	Reversible	Local	Short term	**Low**
Wind				

6.4.8 Surface/Ground Water Pollution

Diesel storage for DG sets and other materials like oils, paints, solvents would have to be stored on impervious floors else they have a long-term impact on soil and surface water quality. The project area receives high and erratic rainfall between June to September and relatively low or no rainfall in the other months, and construction activity is not expected in these months. Due to the rocky nature of the land, permeability of water into the ground is significantly low thus lowering the potential to contaminate the groundwater in the area.

Although, several season waterbodies, streams area located in close proximity to solar and the WTG locations, due to the small foot print of the project area, the impact is likely to be '**Low'**.

Component	Nature	Extent	Duration	Impact
Solar	Reversible	Local	Short term	**Low**
Wind				

6.4.9 Air Pollution

Increase in air pollution levels could lead to various respiratory disorders in humans and animals. The main sources of air pollution during construction will potentially be fugitive dust emissions and exhaust from transportation vehicles and construction equipment.

The pre-construction activities of site clearance and levelling and various construction activities such as excavation and earth work, haul roads, stockpiles of excavation spoil will cause fugitive dust emissions and thus increase the concentrations of particulate matter in the project area and its immediate vicinity. The soil being sandy will only increase the particulate matter emissions.

The transportation of raw materials to the site will lead to an increase in fugitive dust emissions along the approach roads and also emission of SO_2, NOx, CO into the ambient air by movement of vehicles, thus causing increase in air pollution.

The use of diesel generator sets and construction equipment will increase the concentration of pollutants in the project area and immediate vicinity, SPM, SO_2, NOx, CO due to burning of fuel.

Air quality impacts through installation of WTGs would be minimal. However, vehicular emission and operation of batching plant and exhaust emissions from construction machinery will impact the air quality.

The result of air quality monitoring (Refer **Error! Reference source not found.**) undertaken in the study a re indicate that the parameters are within a permissible limits of Ambient Air Quality set by the Central Pollution Control Board (CPCB). Therefore, the impacts on air quality due to project activities are envisaged to be **'Low'**.

Component	Nature	Extent	Duration	Impact
Solar	Reversible/ easily mitigated	Local	Short term	**Low**
Wind				

6.4.10 Noise Pollution

The operation of construction equipment (for activities such as excavation and earthworks, construction of structures, installation of mounting framework and PV panels etc.) and other construction activities such as movement of materials / vehicles will increase the noise levels in the vicinity during the construction phase.

The impacts on ambient noise levels during construction will be directly experienced in the project area and immediate vicinity (not beyond 500 m). Noise attenuates rapidly with distance from the source. The settlement of Padavala is at a linear distance of 0.6 km from WTG PDV-02 and will be directly exposed to the noise generated due to construction activities and this is likely to impact the village although mitigation measures can be taken to ensure that the impact is negligible.

The birds, reptiles and mammals in the project area are likely to be impacted to a limited extent due to the presence of several seasonal waterbodies in close proximity. However, these will be short term and temporary, limited to construction phase. Overall, the impact from Noise can be expected to be **'Low'**.

Component	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Short term	**Low**
Wind				

6.4.11 Occupational Health and Safety Impacts

The construction activities include site preparation, infrastructure and utilities installation, construction of structures. The construction workers and technicians would be exposed to various health and safety hazards that could cause injury or ill health.

The potential safety hazards include:

- Slips, trips and falls due to uneven surfaces, obstacles, trailing cables
- Fall during work at height
- Burns due to hot works
- Electrical shocks
- Collision with construction equipment and transportation vehicles
- Emergencies such as fire, structure collapse

The potential health hazards include:

- Manual handling and musculoskeletal disorders due to typical construction activities such as lifting, lowering, pushing, pulling and carrying that can cause injury
- Hand-arm vibration due to operation of hand-held or hand-guided power-tools and machines, such as: pokers and compactors, sanders, grinders and disc cutters, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns.
- Temporary or permanent hearing loss from exposure to high noise levels during operation of construction equipment.
- Heat stress and working during high temperatures
- Dermatitis that can arise from contact with substances such as wet cement, asphalt, solvents used in paints, glues or other surface coatings etc.
- Exposure to fugitive dust emissions and exhausts from construction equipment that could cause respiratory disorders.
- Exposure to disease carrying vectors due to poor construction waste management practices.

Although the impacts are short-term and temporary, these may be fatal if the required mitigation measures are not taken. Therefore, the impact is considered to be **'Moderate'.**

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Short term	**Moderate**
Wind				

6.4.12 Community Health and Safety Impacts

During the construction phase, there would be an influx of employees and labour into the project area. As these persons would have cultural differences with the resident population, potential conflicts may arise on issues related to the environment, safety and privacy issues of the women in the surrounding villages, spread of various communicable diseases, nuisance caused by workers due to improper sanitation facilities, etc.

For transportation of raw material and PV equipment, the traffic from heavy vehicles is expected to increase along the district and village roads. This can lead to congestion on road networks around and within the site. The traffic in the area is generally low and this potential increase in traffic can be a nuisance to the villages of Garnala, Padvala, Jepur, Hadmadiya and Umrali, located in close proximity to approach roads leading to WTG locations and the solar site.

All activities during construction causing air pollution and increasing noise levels have the potential to indirectly affect the health of the local community.

The security personnel appointed for protection of the project area during construction could pose risks to the community due to misbehavior.

The impacts related to community, if not appropriately managed, could lead to agitation. Hence impact is estimated to be **'Moderate'**.

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Short term	**Moderate**
Wind				

6.5 Impacts Operational and Maintenance Phase

6.5.1 Natural Resource Consumption

Cleaning of the solar PV modules is to be carried out in two-cycles every month to prevent dust accumulation which can lead to reduced efficiency of the panel output. This includes a wet cleaning cycle that is estimated to consume 137500 ltr of water for the cleaning of 55,000 modules, generally carried out by using a jet spray system or by extendable hosepipes and a dry-cleaning cycle. It is also proposed that robotic cleaning would be used to further reduce water usage.

The water demand for WTG operations is expected to be about 10000 ltr, up to the end of its operation cycle. It was reported that the water requirement for PV module cleaning shall be met through the installation of borewells in the project area. This may lead to further depletion of water levels in the area.

Based on the current plan for cleaning and maintenance of panel and domestic water requirements the impact during operations may be considered **'Moderate'**. The impact due to WTG operations is considered **'Low'.**

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Regional	Long term	**Moderate**
Wind	Reversible/ Easily mitigated	Regional	Long term	**Low**

6.5.2 Impact on Ecological Environment

The solar PV panels have the potential of creating a **'lake effect'** due to the glass surface reflecting the sky, wherein birds are drawn towards the facility mistaking it for a water body. The birds drawn towards the plant could be electrocuted causing death due to the electrical ancillaries connected to the PV panels.

A number of small and large water bodies surround the project area with the closest water body at an aerial distance of 2km east of the solar land. The presence of these water bodies may trigger the birds mistaking the project area to be a water body as the project area is surrounded by dense vegetation.

The solar farm associated infrastructure such as overhead transmission lines and substation can also impact the flora and fauna due to electromagnetic radiation.

Cattle, other mammals and reptiles could stray into the park and get electrocuted causing death due to the electrical ancillaries connected to the PV panels.

Wind Turbines are planned by micro siting to ensure safe distance from critical infrastructure and habitats. Incorrect siting of WTGs may be a hazard to some bat species in addition to birds[24], which is also documented in Kutch region of Gujarat[25]. Additionally nesting sites have been identified near the WTG locations of Rabarika and high soaring raptor activity in Umrali, suggesting that their behavior and habitat may be affected.

Considering that the footprint of Solar land in not sizable, its operational phase impacts on ecological environment will be **'Low'**. Due to the presence of nesting and roosting sites in the form of season waterbodies the impact of operating WTGs is considered **'Moderate'**.

Components	Nature	Extent	Duration	Impact
Solar	Irreversible	Local	Long term	**Low**
Wind	Irreversible	Local	Long term	**Moderate**

6.5.3 Viewscape/ Glint and Glare Impacts

The solar panels are designed to absorb sunlight to convert it into electricity. A mono crystalline silicon PV cell absorbs 2/3rd of the sunlight reaching the panel surfaces. This effectively implies that only 1/3rd of the

[24] https://www.researchgate.net/publication/358117245_Responses_of_birds_and_mammals_to_long-established_wind_farms_in_India, Accessed on 28-11-2022

[25] https://www.researchgate.net/publication/257143264_Bat_mortality_due_to_collision_with_wind_turbines_in_Kutch_District_Gujarat_India , Accessed on 28-11-2022

sunlight reaching the surface of a solar panel is reflected to the atmosphere. The PV panels have a reflectivity of around 30%, in comparison to surface materials such as dry soil which has a reflectivity of around 45%, and grass type vegetation, 25%. The intensity of light reflected from a PV module depends on the amount of sunlight reaching the surface. The glint and glare from a PV module will depend upon the amount of sunlight reaching the surface, geographic location, time of year, cloud cover, and PV module orientation.

There are no archaeological important places in the immediate vicinity of the project area.

The nearest settlements to the solar land, Betwad and Garnala are located at an elevation of 10-20 m lower than that of the project area, however, are beyond 2km, suggesting that the impacts of glint and glare due to the operational solar plant will be **'Low'**.

Land where WTGs and TL towers are located comprises of flat to undulating land. During the site visit, structures were observed to be present within 500 m distance of the WTGs that form the scope of the assessment. The presence of a structure of height 130 m where prominent structures are absent would be a visual impact to the nearby villagers and passing motorists. Additionally, movement of the WTG components and shadow flicker that is generated could also pose a concern with regard to the shadow flicker effects. Further, there are operating wind farms in the surrounding area falling within the project area of influence. The repetitive unified nature of the elements as well as the off-white colour of the turbines allow them to merge into the landscape quite easily and therefore be accepted as part of the existing scene for the villagers. Considering the limited number of WTGs, the impacts will be **'Low'**.

Components	Nature	Extent	Duration	Impact
Solar	Reversible/Mitigative	Local	Long term	**Low**
Wind				

6.5.4 Shadow Flicker

The movement of WTG blades, under certain conditions of lighting and wind speed produce intermittent shadows over surrounding areas. Shadow flicker occurs usually during periods after sunrise and before sunset. During intervals of sunshine, wind turbine generators will cast a shadow on surrounding areas as the rotor blades pass in front of the sun, causing a flickering effect while the rotor is in motion. With the sun in the background, large moving shadows can be produced which some people may find distasteful.

There no specific shadow flicker requirements and recommendations under Indian regulations. The Ministry of New and Renewable Energy (MNRE) has published guidelines for development of onshore wind power projects in October 2016, which specifies certain specific requirements for micro-siting of the projects and includes:

- Developer(s) shall maintain a distance of HH+1/2 RD+ RD+ 5m (Hub Height+ Half Rotor Diameter +5 meters) from Public Roads, railway tracks, highways, buildings, public institutions and EHV lines.
- Developer(s) shall not site wind turbines within 500 m of any dwelling for the mitigation of noise.

- In order to ensure health and safety of people working/residing near the wind power installations the National Institute of Wind Energy (NIWE) will prescribe criteria for noise and shadow flicker in consultation with stakeholders.

Shadow flicker has been elaborated upon in the EHS guidelines for wind energy, by the International Finance Corporation (IFC), dated August 7, 2015 [(26)], which recommends that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario.

6.5.4.1 Shadow Flicker Modelling

Modelling was undertaken using Wind Pro, for shadow flickering using worst case scenario considering the Shadow flicker experienced in terms of total hours per year and the maximum minutes per day.

Shadow flicker- Hours per year (Refer Figure 67)

3. Only Two (2) settlements, viz. Umrali and Rabarika villages will experience Shadow flicker exceeding the 30 mins per day as prescribed due to three (3) WTGs no. UMR-09, RBR-10 and RBR-06.
4. Two (2) roads will be exposed to Shadow flicker exceeding the 30 hrs per year as prescribed, viz. SH1 near Umarali village due to WTGs, viz. UMR-09, SH123 near Rabarika village due to WTG no. RBR-10, RBR-06 and JMD-02.

Shadow Flicker- Minutes per day (Refer Figure 68)

3. Only One (1) settlement, viz. Umrali village will experience Shadow flicker exceeding the 30 mins per day as prescribed due to two (2) WTGs, viz. UMR-09 and UMR-10.
4. Two (2) major roads will be exposed to Shadow flicker exceeding the 30 mins per day as prescribed, viz. SH1 near Umarali village due to WTG no. UMR-09 and SH123 near Rabarika village due to WTG no. RBR-10.

(26) EHS guidelines for wind energy, August 7, 2015.
http://www.ifc.org/wps/wcm/connect/2c410700497a7933b04cf1ef20a40540/FINAL_Aug+2015_Wind+Energy_EHS+Guideline.pdf?MOD=AJPERES. Accessed 05/12/2017

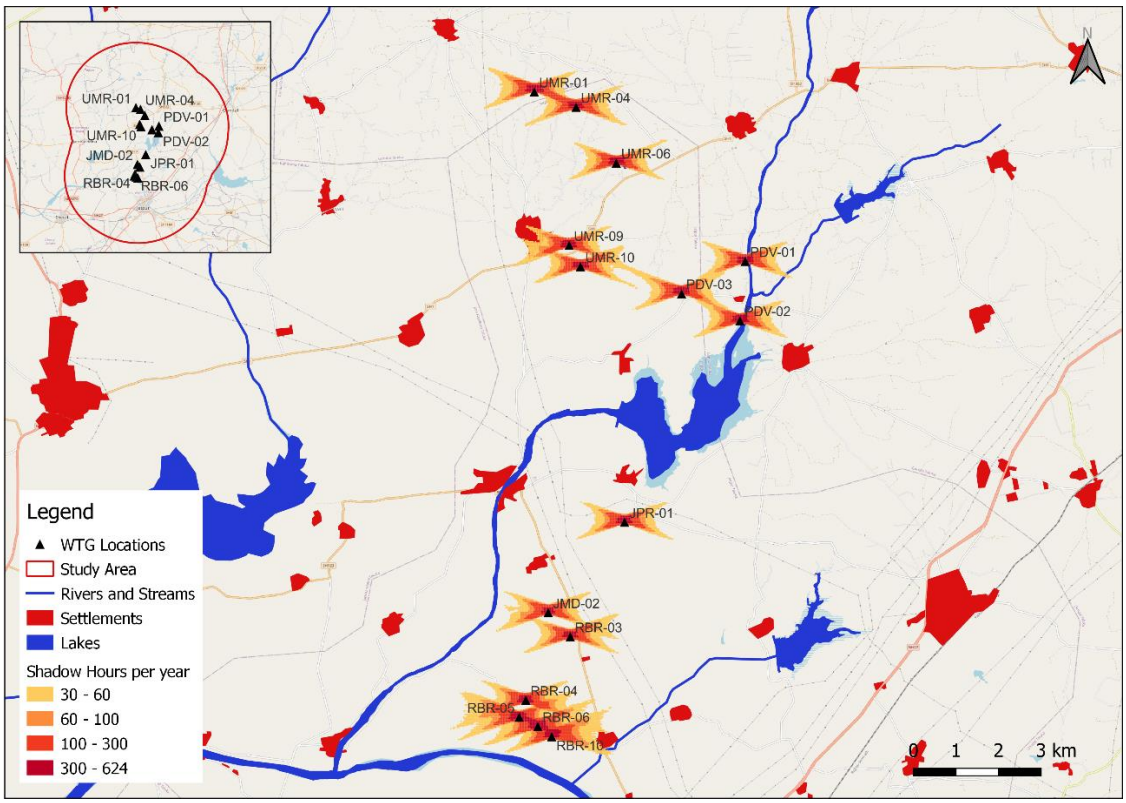


Figure 67: Shadow Flicker Modelling- Shadow hours per year

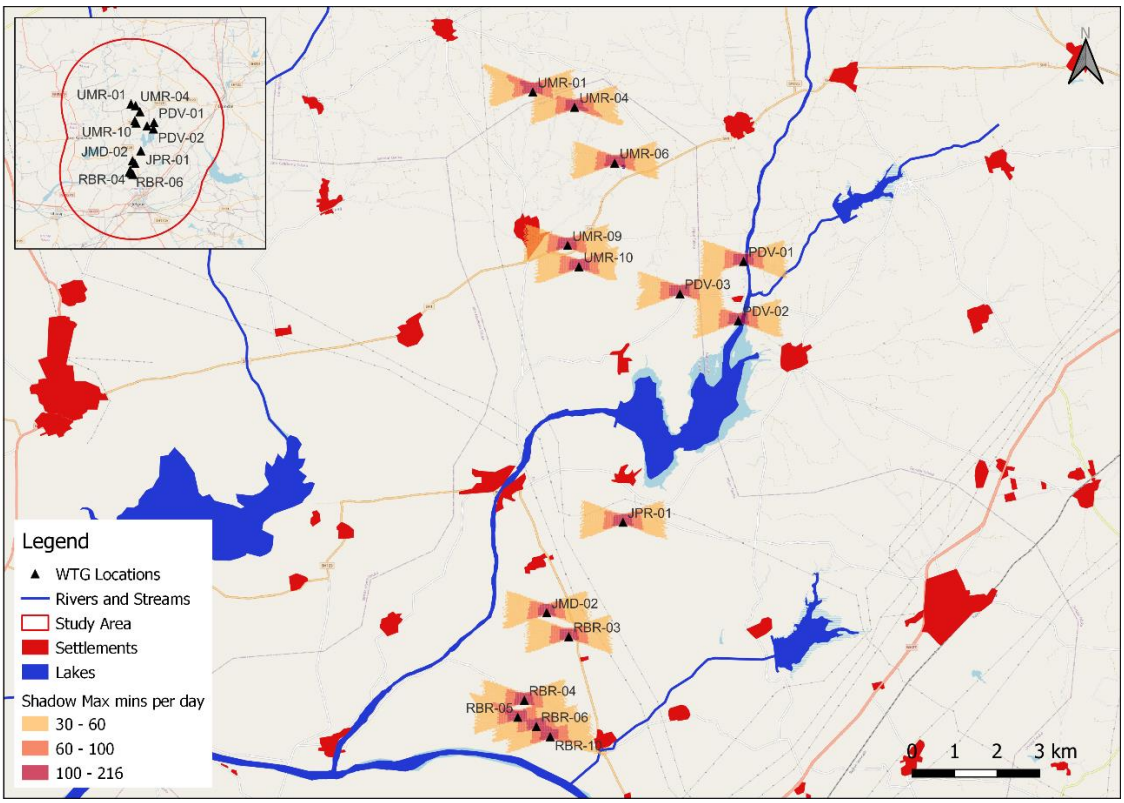


Figure 68: Shadow Flicker Modelling -Shadow minutes per day

Based on the shadow Flicker modelling, the estimated impact on receptors due to the overall project may be considered **'Low'**.

Components	Nature	Extent	Duration	Impact
Solar	**NA**			
Wind	Reversible/Mitigative	Local	Long term	**Low**

6.5.5 Soil Contamination

During O&M of the solar PV plant, soil contamination may occur due to the following causes:

- Broken glass pieces of damaged PV modules can change the soil composition over time rendering it unusable for agriculture post decommissioning of the project.
- Wastewater generated from cleaning of the PV module, if not managed, could cause ponding in the solar park and flow of wastewater into neighbouring agricultural fields.
- Unscientific management of electrical waste generated from plant maintenance activities.
- Domestic wastewater generated from plant office.

Similar to a Solar Plant, for a wind power plant the impacts can arise from regular maintenance activities like:

- Spillage of lubricant oil from gearbox system, hydraulic system of the turbine.
- The accidental spillage of oil/ lubricants and hazardous waste in areas designated for storage of WTG spares, components and maintenance material

As any kind of spillage on bare soil can lead to long term impacts the impact is considered to be **'Moderate'.**

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Long term	**Moderate**
Wind				

6.5.6 Air Pollution

In the initial phases of the project, till the newly developed land surface gets compacted and stabilized, there is a potential for fugitive dust emissions during windy conditions. The solar and wind plants will not generate any point source emissions during O&M phase.

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Short term	**Low**
Wind				

6.5.7 Noise Pollution

The noise generating activities during O&M of the solar PV plant are limited to operation of inverters. The noise generated from this equipment are experienced in the immediate vicinity, which attenuates rapidly as the distance increases.

There are no other operational activities in the solar PV plant that could contribute to increase in ambient noise levels. Therefore, impacts due to Solar plant operations are 'Low'.

Wind turbines produce noise through a number of different mechanisms, and could impact on annoyance, sleep and health of the residents at close proximity to the wind turbines. Baseline field survey highlighted majority of the receptors to be rest house structures with temporary usage (seasonal usage as shelter during agricultural work

In India, there are no specific guidelines for wind power project noise levels. As per IFC's General EHS Guidelines: Environmental, Noise Management Noise, noise impacts should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Estimated noise generated during operation phase was calculated using Windpro software. DECIBEL is the module of the Windpro program used, which calculates the noise emission and checks if the noise requirements are met at neighbors and noise-sensitive areas.

The assumptions made for modelling are:

- Noise modelling has been conducted assuming the fixed wind speed range.
- General Ground attenuation factor is considered as 1.0
- WTG plus ambient noise is compared to ambient noise plus margin
- Fixed penalty added to source noise of WTGs with pure tones
- Impact of Cumulative noise is considered at 10m receptor height.

The ambient noise levels at village level were observed to be within permissible limits specified for Residential area as per Noise Pollution (Regulation and Control) Rules, 2000 (without project),

The background noise levels at WTGs locations without project is expected to be within Residential area as per Noise Pollution (Regulation and Control) Rules, 2000, mainly due to absence of any noise generating residential, commercial, or industrial activity.

Only in two (2) settlements the noise levels are expected to cross the 35dB(A), viz. Umrali due to WTG no. UMR-09 and Padavla village due to WTG nos. PDV-01, PDV-03.

As per the Modelling results It is expected that with WTG operation there will not be any major increment in baseline noise levels near WTG locations and identified receptors considering the maximum background noise and still being well within the specified increment limit of 3 dB(A) as per IFC's General EHS Guidelines indicates the impact to be of low significance. Noise modelling map is depicted in Figure 69.

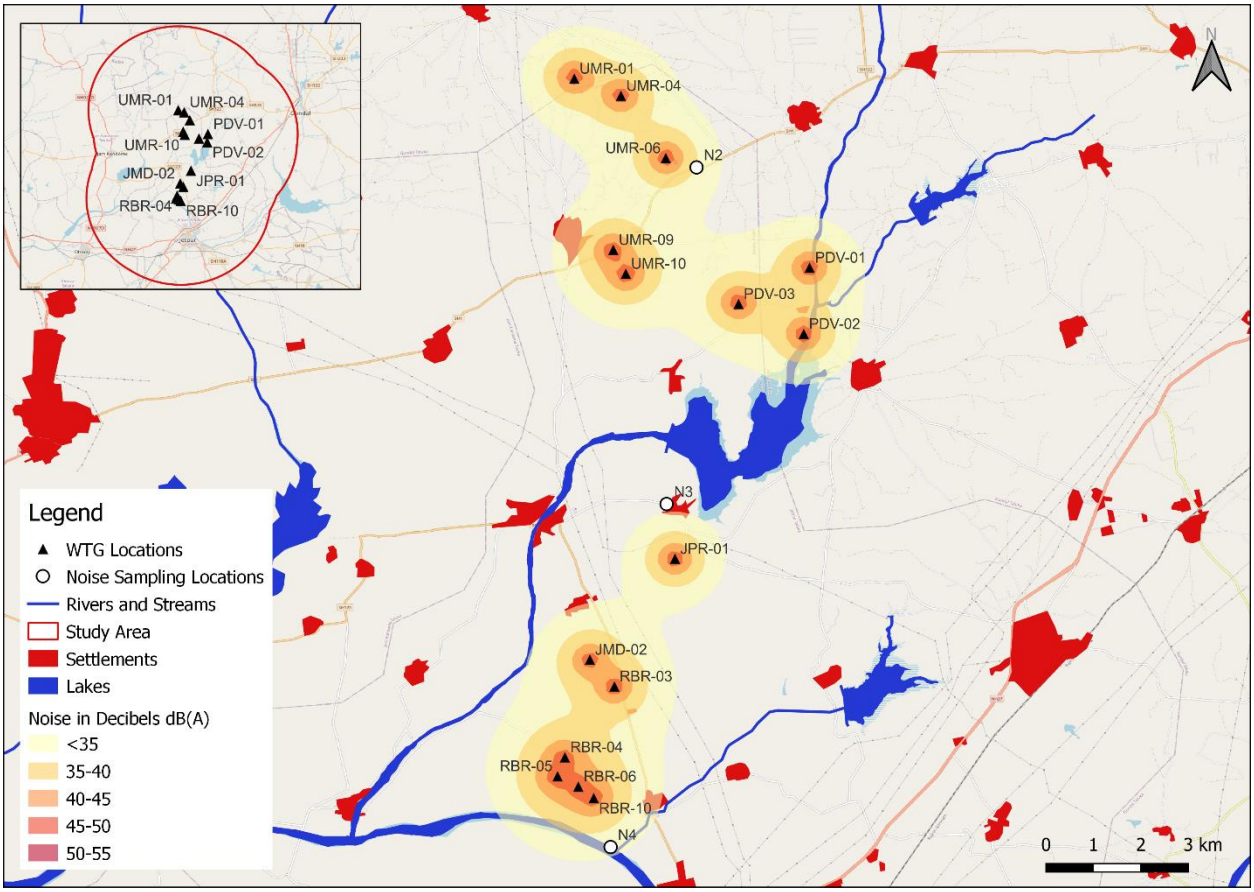


Figure 69: Nosie Modelling Output

Solar Plant operations will have negligible or **'Low'** impact on noise in the vicinity as few settlements exist at close proximity Considering the compounded effect of three (3) turbines on the Padavala village the impact is considered to be **'Moderate'** due to operations of WTGs.

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Long term	**Low**
Wind	Reversible/ Easily mitigated	Local	Long term	**Moderate**

6.5.8 Occupational Health and Safety Impacts

During the O&M phase, the project activities will be limited to security of the solar farm and wind turbines, cleaning of PV panels, and onsite technical support and maintenance activities.

The general health and safety hazards during O&M include:

- Slips, trips and falls due to uneven surfaces, obstacles, trailing cables
- Emergencies such as fire, structure collapse
- Heat stress and working during high temperatures

A large portion of maintenance activities will include electrical maintenance. The maintenance activities along transmission lines will involve work at height. The workers will be exposed to the hazards of falling, falling objects (such as tools and tackles) and working in adverse weather conditions. The personnel working at the sub-station and along the transmission lines will be exposed to the hazards of electromagnetic fields (EMF) generated by power lines and electrical equipment.

Over the years there has been public and scientific concern over the potential health effects associated with exposure to EMF. However, there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment[27]. The maintenance personnel may be exposed to occupational hazards from contact with live power lines during maintenance activities causing electrocution. Considering the remote nature of the locations and the high risks of fatalities for workers the impact is considered '**Moderate'.**

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Long term	**Moderate**
Wind				

6.5.9 Community Health and Safety Impacts

The security personnel appointed for protection of the plant could pose risks to the community due to misbehavior. The operation of solar PV plant is not expected to cause any other impacts on community health and safety.

Blade throws due to non-maintenance or dilapidated turbines may impact settlements near WTG locations, putting life and property at risk. However due to the small footprint the impact is considered to be **'Low'**.

Components	Nature	Extent	Duration	Impact
Solar	Reversible/ Easily mitigated	Local	Long term	**Low**
Wind				

6.6 Impacts during Decommissioning phase

The impacts of full decommissioning of the wind and solar PV plant would be similar to those experienced during construction phase. Where partial decommissioning is undertaken, the impacts would be a combination of those during O&M phase and full decommissioning phase.

The impacts during decommissioning phase would include:

a) Natural Resource Consumption through fuel for equipment and transportation vehicles; use of resources in the labour camp (if established).

b) Soil Erosion due to demolition of foundation on which WTGs, solar PV modules and the mounting framework are fixed.

[27] World Bank Group's Environmental, Health and Safety Guidelines for Electric Power Transmission and Distribution

c) Air Pollution through fugitive dust emissions and exhausts from transportation vehicles and demolition equipment.

d) Noise Pollution from transportation vehicles and demolition equipment.

e) Surface Water Pollution due to soil erosion from demolition activities.

f) Occupational Health and Safety during demolition of structures and dismantling.

g) Floral and Faunal impacts due to earthwork and levelling of land leading to loss of habitat and biodiversity.

The impact of soil contamination during decommissioning would be an enhanced version of that experienced during O&M phase.

Soil Contamination

The solar plant dismantling and structure demolition activities will generate e-waste and demolition waste, which if not managed could contaminate the soil. Broken glass pieces of damaged PV modules could mix with the soil, rendering it unusable for agriculture after restoration.

Considering the temporary and short-term nature the impacts is considered **'Low'**

Components	Nature	Extent	Duration	Impact
Solar	Reversible	Local	Short term	**Low**
Wind				

7 Environment and Social Management Plan

7.1 Methodology for Developing ESMP

Based on the project activities during pre-construction, construction and O&M stages of the project, environmental, occupational health and safety, and community health and safety impacts have been identified in the previous Chapter.

For identification of management measures, the following resources were referred:

- The International Finance Corporation's Environmental and Social Performance Standards (2012)
- World Bank Group's EHS General Guidelines

The hierarchy adopted for planning management measures is elimination, substitution, engineering control, administrative control and personal protective equipment.

7.2 ESMP for Planning, Pre-Construction & Construction Phase

The ESMP for project development/ planning, pre-construction and construction phase impacts is presented in Table 40 **.** The legal requirements to be adhered to during planning, pre-construction and construction phases of the project are provided in Section 3.2 of this report.

The overall responsibility of supervision and ensuring implementation of the ESMP will lie with FPEL through their site office. The measures related to construction activities and equipment management will have to be implemented through the respective Contractors. The implementation of ESMP should be monitored as per the parameters provided in the table to check the effectiveness of the recommended measures.

7.3 ESMP for Operational & Maintenance Phase

The ESMP for O&M phase impacts is presented in Table 41. The legal requirements to be adhered to during operational and maintenance phase of the project are provided in Section 3.2 of this report.

The responsibility of supervision and ensuring implementation of the ESMP will lie with the team deployed at site under supervision of the Site Manager. The implementation of ESMP should be monitored as per the parameters provided in the table to check the effectiveness of the recommended measure.

Table 40: ESMP for Pre-construction and Construction phase

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
A. Physical Environment					
1. Landscape and visual impacts on settlements in close proximity to construction sites due to presence of construction equipment and machinery	Land use, Visual, Local community	**Low**	**Low**	a) Check feasibility of creating pleasant visual barriers, using vegetation and landscaping outside houses that have windows facing the solar plant site. b) Ensure the construction site is left in an orderly state at the end of each workday and construction equipment is parked on Company land and does not block any approach roads c) Construction machinery, equipment, and vehicles not in use should be removed in a timely manner to the extent possible d) Proper handling and disposal of waste streams e) Use reflectors and barricading near approach roads when parking equipment overnight	Physical site inspection
2. Resource consumption such as water and fuel causing depletion	Local community	**Low**	**Low**	a) Conduct preventive maintenance of construction equipment to ensure proper engine performance and optimum level of fuel consumption b) Procure water for construction activities from authorised distributors c) Use air nozzles on hose pipes used for water spraying during curing d) Ensure water usage is optimized for construction activities	Preventive maintenance schedules and associated bills Physical site inspection CGWB/CGWA Certificate

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				e) Obtain required permits for constructing a borewell and extracting ground water from relevant authorities (CGWA/CGWB)	
3. Surface / Ground water pollution due to contaminated runoff from the site, runoff from the portable toilets and soil erosion	Surface water quality, local community	**Low**	**Low**	a) Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into ground or surface water. b) Fuel storage tanks to be stored on paved impervious surface and secondary containment c) Adequate drainage of road based on road width, surface material, compaction and maintenance d) Wastewater holding tanks / septic tank to be located at more than 500 m away from bore wells or surface water resources. e) Implement measures planned to control soil erosion.	Physical site inspection
4. Alteration of natural drainage pattern due to site levelling.	Landform, local community	**Moderate**	**Low**	a) Site preparation to begin only after drainage plan for the site is prepared. b) Consider the natural drainage pattern of the site and its immediate surrounding during site levelling. c) Avoid blocking of natural drainage during site preparation d) Avoid considerable change in topography e) Approach road construction to ensure provision of culverts at drainage points.	Physical site inspection Drainage plan
5. Soil erosion due to site clearance; Loss of fertile topsoil	Community, Soil fertility	**Low**	**Low**	m) Limit the area of clearance to area required immediately for construction. n) Conduct compaction of the cleared areas.	Physical site inspection

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				o) Allow only covered transportation of topsoil within project site. p) Revegetation of areas post construction. q) Construction of bunds around relevant work and storage areas. r) To control soil erosion surface run-off should be collected from all paved working areas into retention ditches to restrict concentration of flows. s) Limit the area of excavation to immediate requirement. f) For construction of solar facilities and WTG foundations, the topsoil (150-200 mm) should be stripped, stockpiled separately with a temporary cover, and spread along the boundaries where greenbelt will be developed. Alternatively, the topsoil could be given to the local villagers for their fields.	
6. Soil contamination due to improper management of construction waste, spills and leaks, absence of sanitation provisions in labour camp or construction sites.	Soil quality, Community	**Low**	**Low**	a) Provide a separate storage area for hazardous materials. The hazardous materials/products must be labelled with proper identification of its hazardous properties. b) Fuels and liquid chemicals to be stored on impermeable surface and a bund should be provided all around such storage area to prevent spillage in case of leakages. c) Different types of wastes such as hazardous, construction, e-waste and solid waste such as material, plastic, paper, etc. to be segregated and stored on impermeable surface to facilitate proper disposal. A dedicated area for temporary storage of waste in the project area to be created.	Disposal bills from Stores Department Physical site inspection Copy of Intimation letter for waste disposal to local authorities Hazardous wastes Vendor certificates and license

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				d) Chemical waste to be stored in accordance with the provisions of Material Safety Data Sheets (MSDS). The contractor to maintain MSDS onsite. e) Provide trash bins within each construction site to prevent littering in the project area and surrounding areas. f) Organize regular waste collection and disposal from the project area. g) Provide toilets with septic tank and soak pit and bathing areas for construction workers. a) Scrape off and collect the soil contaminated by diesel, oil, paint spills and dispose as hazardous waste. b) In case of accidental spills, contaminated soil to be treated as hazardous waste. c) Intimation letter for domestic waste disposal at designated areas to be provided to local authorities. d) Mobile toilets to be provided near construction areas for workers. Sewage to be drained in a soak pit centrally located.	
7. Increase in ambient noise levels due to operation of construction equipment.	Avian fauna, community health, worker health	**Low**	**Low**	a) Conduct periodic preventive maintenance of construction equipment for optimum engine performance. b) Erect barriers around noisy activities or install internal noise shielding for equipment in the form of silencers, acoustic louvers, and enclosures. a) Limit idling of engines when not in use to reduce its contribution to noise emissions. b) Keep stationary equipment at least 500m from settlements	Quarterly Noise monitoring using a portable noise meter near activity areas or nearest sensitive receptors. Preventive maintenance

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				c) Avoid major noise generating activities between 9 PM to 6 AM. d) For movement of heavy machinery using existing roads, provide prior information to local communities and avoid movement near sensitive locations or inform drivers to reduce speed in such stretches.	schedules and associated bills
8. Increase in fugitive dust emissions causing air pollution from site clearance, excavation, raw material transportation, storage of excavation spoil, use of fuel wood in labour camps	Air quality, community health, worker health	**Low**	**Low**	a) Limit the area of clearance to immediate requirement for construction. b) Carry out tillage of cleared land to reduce dust re-suspension c) Proper water sprinkling of road should be undertaken to reduce the fugitive emissions during transportation. d) Limit the area of excavation to immediate requirement. e) Cover exposed earthworks and surfaces when not under active work. f) If possible, reduce activities during windy conditions. g) Build semi-pucca haul roads by spreading and compacting aggregate/ metal. h) Store construction material in covered sheds. i) Speed limit within project area and unmetalled roads to be limited to 20 km/hr c) Trucks transporting construction material to site and waste materials from site to be covered with tarpaulin sheet or any other suitable alternative.	Visual monitoring of dust emissions during earthworks and construction activities.

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
9. Increase in concentrations of PM_{10}, $PM_{2.5}$, SO_2 and NOx from burning of fuel in construction equipment, transportation vehicles and cooking in labour camps.	Air quality, community health, worker health	**Low**	**Low**	a) Conduct periodic preventive maintenance of construction equipment and transport vehicles for optimum engine performance. b) Ensure all vehicles have PUC Certificate. c) Limit idling of engines when not in use. d) Provide LPG in labour accommodation for cooking purpose. j) Provide electricity in labour camp for lighting purpose.	PUC Certificate of vehicles Physical inspection of labour accommodation
B. Ecological Environment					
10. Loss of flora and avian fauna due to site clearance	Flora, avian fauna	**Moderate**	**Moderate**	a) Preserve large trees on site and obtain permission for felling and transport of trees from relevant authorities b) If under any circumstance, the solar plant and WTG location/ orientation requires tree felling. The necessary permissions are to be obtained. c) As far as possible large/ mature trees should be transplanted at other locations d) Planting native, fast growing trees on access roads and/or in nearby barren areas/ schools/ Panchayat office can be done as a good practice, which may also provide give an alternate habitat to the faunal species especially the bird species and maintain the ecological balance.	Tree felling and transport permits No. of trees felled and planted Periodic inspection of re-plantation areas and recording of survival and growth parameters

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				e) Waste to be stored on site within closed container, especially food remnants in labour camp to avoid attracting birds on site. f) Minimize human, equipment and vehicular contact with fauna, including their burrows / nests and feeding grounds. g) If a labour camp is setup at the site, provide fuel for cooking to prevent cutting of trees by the labour for firewood.	
11. Disturbance to local livestock population and Man -Animal conflict	Fauna	**Moderate**	**Moderate**	a) Avoid major noise generating activities between 9 PM to 6 AM. b) Recovery of ground story (mostly grasses and herbs) vegetation under the PV panels and in other places that do not need to remain cleared shall be encouraged to grow. c) Movement of construction and transport vehicles shall be restricted to dedicated paths and to daytime to minimize any harm to small mammals and herpetofauna within the site. d) Transportation of construction material shall be restricted to daytime hours in order to minimize noise and disturbance to fauna in the area. e) General awareness training regarding wildlife shall be enhanced through putting signage, posters, among the staff and labourers. f) Waste shall be collected in a manner that it does not attract wild animals and stored in enclosed designated areas g) Temporary barriers shall be installed on excavated areas.	Physical site inspection Visual monitoring, Periodic site visit, Register for man-animal conflicts like road-kills. Training records

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				h) Planting native, fast growing trees on access roads and/or in nearby barren areas/ schools/ Panchayat office which may also give an alternate habitat to the faunal species especially the bird species and maintain the ecological balance. i) The crane staging area, intervening areas, overhead clearance for suspended turbine components should be planned in such a way that minimum tree felling is required. j) Sign boards on the site approach road and near construction areas should be installed and strict regulations on speed limits should be imposed to control the road kills of animals during transportation of materials k) The site clearance for tower erection, access road and ancillary facilities should be restricted to the necessary footprint area around WTG.	
C. Community and Occupational Health and Environment					
12. Exposure to physical, chemical hazards, exposure to noise, working with construction equipment, fugitive dust, emergencies at site	Construction workers	**Moderate**	**Moderate**	h) The construction safety measures as per site specific EHS and ESMS to be implemented at site i) Implement measures recommended to prevent and mitigate impacts of air and noise pollution. j) Training of workers on safe construction practices. k) Maintain good housekeeping in the construction area. l) Barricade excavated areas. m) Implement work permit system for work at height. n) Avoid work at height where it is reasonably practicable to do so, e.g. by assembly at ground level.	Physical site inspection Equipment maintenance plan and reports Training records EHS Audits

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
				o) Ensure all equipment and vehicles are regularly inspected, serviced and maintained p) Ensure that electrical work is carried out when the electrical lines are turned off. q) Ensure clear signages are in place, such as warning of speed limits, obstructions, allowable widths/heights. Etc. r) Provide PPE to construction workers • Safety shoes, hard hat/ helmet and hand gloves with grip facility to all workers • Nose masks for those working in dusty area • Earplugs for those working in high noise areas • Nitrile rubber gloves to those engaged in painting activities • Face shield for those engaged in welding s) First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. to be maintained on site. t) Record and investigate injuries to workers. u) Emergency Preparedness and Response plan to be prepared for the project v) Fire extinguishers and sand buckets to be placed at multiple locations across the project area appropriate to the nature of the potential fire. w) FPEL through Contractor should ensure that labour receive training on health and safety and emergency preparedness.	

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
13. Exposure to migrant workers, air and noise pollution, project security personnel	Local community	**Low**	**Low**	a) Implement measures recommended to prevent and mitigate impacts of air and noise pollution. b) Provide labour camp with sanitation, drinking water, medical, cooking facilities and space for recreation activities after work. c) Employ security personnel from reputed security agencies. d) Grievance Redressal mechanism should be followed by FPEL and its sub-contractors. It should be ensured that a complaint register is maintained onsite so that any complaints from the locals or labours can be registered, investigated and timely resolved. Refer section on Grievance Mechanism in the subsequent sub-section.	Physical site inspection Grievance register
14. Exposure to migrant workers and social issues resulting from behaviour of migrant workers and security personnel, air and noise pollution, project security personnel.	Local community	**Low**	**Low**	a) Implement measures recommended to prevent and mitigate impacts of air and noise pollution. b) Provide labour camp with sanitation, drinking water, medical, cooking facilities and space for recreation activities after work and ensure workers do not use community infrastructure facilities without prior permission from Panchayats. c) Employment to local people wherever possible, especially as unskilled construction workers and security guards.	Physical site inspection Grievance register
15. Increase in traffic movement in the nearby areas	Local community	**Low**	**Low**	a) Ensure that all trucks and vehicles accessing the facility are operated by licensed operators.	Physical site inspection

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Parameters/ Method
		Solar	Wind		
causing nuisance in the villages				b) Pedestrians Safety: All project vehicles and trucks shall comply with the proposed speed limits. c) Ensure adequate maintenance and inspection of vehicles. e) Presence of flagman at the entrance and exit of the project site to control vehicles and truck movement.	

Table 41: ESMP for O&M and Decommissioning Phase

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Indicators
		Solar	Wind		
A. Physical Environment					
1. Consumption of water for cleaning PV modules and WTG maintenance	Local Community	**Moderate**	**Low**	a) Use air nozzles on hose pipes used for water spraying during cleaning of PV modules. b) Ensure water usage is optimized for the processes of cleaning to prevent over extraction of groundwater. c) Obtain required permits for constructing a borewell and extracting ground water from relevant authorities (CGWA/CGWB) d) If the site is well suited for robotic cleaning, implementation of the same can be considered	Preventive maintenance schedules. Water Consumption records Physical site inspection
2. Soil contamination due to damaged PV modules and unscientific management of	Land quality	**Moderate**	NA	a) Different types of wastes such as hazardous, e-waste and solid waste such as material, plastic, paper, etc. to be segregated and stored on impermeable surface to facilitate proper disposal. A dedicated area for temporary storage of waste in the project area to be created.	Physical site inspection Records EHS audits

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Indicators
		Solar	Wind		
waste (hazardous, e-waste)				b) Scrape off and collect the soil contaminated by diesel, oil, paint spills and dispose of as hazardous waste. e) The soil contaminated with e-wastes to be stripped and disposed of as hazardous waste. f) Damaged PV modules to be disposed through approved vendors	
3. Degradation of ground and surface water quality	Land quality	**Moderate**	**Low**	a) Install soak pits/ septic tanks for sanitation facilities b) Ensure proper functioning mechanisms and regular maintenance and cleaning of septic tanks by vendors	Physical site inspection Records EHS audits
4. Views cape impact for nearby settlements	Local community	**Low**	**Low**	a) There are no settlements in close proximity, however, a buffer plantation should be created to prevent any glare from the PV panels and to reduce the intensity of the viewscape impact.	Visual Inspection
5. Air pollution from fugitive dust emission during windy conditions and operation of DG set	Ambient air quality, community health, worker health	**Low**	**Low**	a) Preventive maintenance of DG set to be carried out periodically. A plan for the same should be prepared. b) The DG set stack height to follow specifications of Central Pollution Control Board. b) The DG set stack emissions be periodically monitored and compared with stipulated standards as per applicable CPCB requirements and capacity.	Stack emission monitoring report DG set maintenance plan
6. Noise generated from operation of DG sets	Worker health	**Low**	**Low**	a) DG set with acoustic enclosure to be used. b) Preventive maintenance of DG set to be carried out periodically. A plan for the same should be prepared.	DG set maintenance plan

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Indicators
		Solar	Wind		
7. Noise levels near WTGs	Community health, biodiversity	**NA**	**Moderate**	a) Wind turbines to be designed in accordance with the international acoustic design standards b) Ensure regular maintenance of the WTG's to ensure the parts have been well oiled to reduce friction between parts. c) Implement the recommended complaint resolution procedure (Grievance Redress Mechanism) to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved. d) Operating turbines in reduced noise mode. e) Building natural barriers like plants/usage of appropriate noise barriers around potentially affected structures, if complaints on the same are received f) All nearby community will be informed about the GRM and the grievance would be addressed on priority bases. g) Plantation would be initiated around the turbine base area to absorb the noise generated by the turbines.	Annual Noise monitoring at sensitive receptors near existing WTGs locations
8. Shadow Flicker effect	Community health,	**NA**	**Moderate**	a) During site selection of the project, measures are taken to select the WTGs location at least 300 m from all the temporary and/or permanent structures. However, if the settlements are located within the narrow bands (200m), each dweller will be informed about possible negative impacts i.e. noise, shadow flicker, blade throw etc. If the owner is willing to relocate, the structure will be dismantled with agreement and appropriate compensation will be provided as per local/national regulations and in line with IFC PS' physical and/or economic displacement requirements. b) A complaint resolution procedure to be formulated as part of grievance redressal and stakeholder engagement for the	Consultation or Grievance records

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Indicators
		Solar	Wind		
				local community so that any issues or concerns associated with shadow flicker are reported to the site staff. c) Landscape features, such as trees could also be used to prevent or limit the potential for shadow flicker. d) Micro siting can be reconsideration, if feasible.	
B. Ecological Impacts					
9. Management of mammals and herpetofauna straying into the solar park	Fauna	**Low**	NA	a) A fencing/ barricade to be created around the project area to prevent stray animals (cattle and other mammals) from entering the project area. b) Ensure no harm to fauna entering site by contacting local animal rescuers	Inspection of physical barricade
10. Impact to local avifauna	Fauna	**Low**	**Moderate**	a) The power pole configuration should be designed to minimize avian electrocution risk b) Bird diverters should be installed in transmission lines under the control of FPEL, in close proximity to sensitive areas near the solar plant (along identified water bodies) and WTG locations of Umrali and Rabarika villages c) Flash lamps on the WTGs should be installed to reduce collision risk to birds & bats at night. d) Training for carcass monitoring to be provided to security guards and site tram members along with procedures for documenting the same. e) As the current study is based on a single season survey a seasonal monitoring of bird and bat collisions and carcass to be done once in two years after commissioning near Rabarika and Umrali villages to monitor nesting and	EHS audits Bird Bat carcass monitoring reports

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Indicators
		Solar	Wind		
				roosting behaviour and collision risks for native and migratory birds.	
C. Community and Occupational Health and Environment					
11. Exposure to physical hazards, exposure to noise, DG stack emissions, emergencies at site	O&M workers	**Low**	**Low**	a) Implement work permit system for work at height. b) Ensure that electrical work is carried out when the electrical lines are turned off. c) For workers exposed to electromagnetic fields d) Use of personal monitors during working activities. e) Limiting exposure time through work rotation f) Increasing the distance between the source and the worker, when feasible g) Use of shielding materials h) For those exposed to live power lines: • Permitting only trained and certified workers to install, maintain, or repair electrical equipment and work on live wires. • Deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity, to the lines. • Personnel to be insulated through use of electrical shoes, electrical gloves of appropriate rating. i) First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. to be maintained on site. j) Record and investigate injuries to workers.	Work permit records Incident reports Physical verification of controls

Nature of Impact	Impacted EHS Component	Impact Classification		Management Measures	Monitoring Indicators
		Solar	**Wind**		
				k) Emergency Preparedness and Response plan to be prepared for the project as per FPEL ESMS l) Fire extinguishers and sand buckets to be placed at multiple locations across the project area appropriate to the nature of the potential fire.	
12. Exposure to misbehaviour of security personnel	Local community	**Low**	**Low**	a) A thorough background check should be conducted for each security personnel. b) Where feasible, employ local personnel for providing security services.	Grievance Register

8 Conclusion and Recommendation

The hybrid project is not likely to have significant adverse impacts that are diverse and unprecedented. It is envisaged to have low to moderate impacts on land use, surface/ground water pollution, drainage pattern, and community health and safety during the construction phase of the project with negligible impact related to fugitive emissions, natural resource consumption and cultural resources in the study area. The impacts related to the operational and maintenance phase are moderate and mostly related to natural resource consumption especially ground water consumption for solar panel cleaning, crucial ecological impacts and contamination of soil due to spillage of hazardous wastes such as used transformer oil, which can be mitigated by adopting appropriate measures. The noise and shadow flicker impact has been assessed as Low to Moderate and can be controlled with the recommended mitigation measures. However, the ecological impacts identified, especially the avifaunal (bird and bat) collision risks related to critical habitats identified cannot be ruled out and all the recommendations for mitigating these impacts should be implemented.

Annexure-I Data Sources

The sources of data used for identification of environmental and social sensitive receptors and method used for validating the data are provided in table below. This table also provides method of data validation where applicable.

#	Spatial Data Layers	Source of Data	Method of Validation
1.	**Administrative Boundaries**	Census of India Administrative Maps 2011 http://censusindia.gov.in/2011census/maps/atlas/administrative_atlas.html	Validated after referring the district Census Handbook
2.	**Connectivity**		
	a. Nearest Highway (National, State and Major District Roads) b. Railways	Open GIS Data acquired from Open Street Maps (OSM) Database.	Validated and Updated through imagery analysis.
	c. Airports d. Railway Station	District websites	Validated through imagery analysis
3.	**Water bodies & Watershed**		
	a. Rivers/ Streams b. Lakes/ Ponds/ Tanks c. Reservoirs/ Check dams d. Canals	Watershed Analysis using Digital Elevation Model (DEM) from National Remote Sensing Centre's Open Database (NRSC - Bhuvan) Land use Landcover Analysis over LandSat8 Satellite Images. OSM Database.	Validated using Survey of India (SOI) Open Series Toposheets (1:50K) and imagery analysis. Validated through imagery analysis and existing LULC data from NRSC-Bhuvan (2011-12)
	e. Ground water development	"Block wise Ground Water Resource Assessment-2020", Publication by Central Ground Water Board.	Not Applicable
4.	**Natural Hazards**		
	a. Earthquakes b. Flood hazard c. Cyclone and Wind related Hazard	Hazard Maps generated by Building Materials and Technology Promotion Council (BMTPC) http://www.bmtpc.org/topics.aspx?mid=56&Mid1=178	Not Applicable
5.	**Cultural heritage and archaeologically important places**		

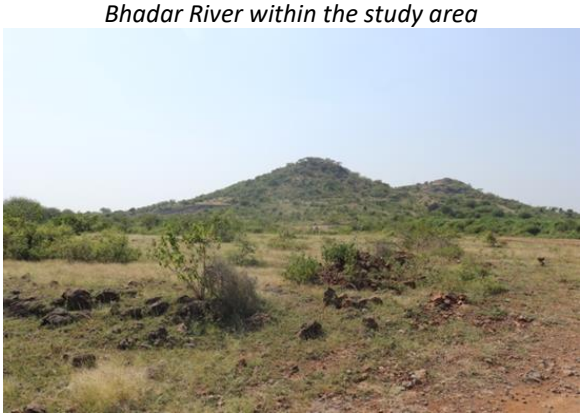
#	Spatial Data Layers	Source of Data	Method of Validation
	a. World heritage sites b. Excavations c. State Protected Monuments d. Museums	Archaeological Survey of India website http://asi.nic.in/ State Tourism Website (Maharashtra Tourism)	Validated through imagery analysis and other tourist location databases. The location needs to be confirmed however on field.
6.	**Sensitive Natural Habitats**		
	a. National Park/ Wildlife Sanctuary	Survey of India (SOI) Open Series Toposheets (1:50K) 55H/16	Validated through imagery analysis and LULC Analysis outputs. Boundaries were updated wherever significant differences were encountered.
	b. Land use Land Cover	WorldCover provides a new baseline global land cover product at 10 m resolution for 2020 based on Sentinel-1 and 2 data accessed from esa.worldcover.org.	Imagery analysis and LULC Analysis outputs. Boundaries were updated wherever significant differences were encountered.
	c. Notified Eco-Sensitive Zone	http://www.moef.nic.in/eco-sensitive_zone	Not Applicable
	c. Important Bird Areas (IBA)	Database on IBAs developed by Bombay Natural History Society Database by Birdlife International	Not Applicable
	e. Reserve/ Protected Forest f. Open Forests/ Social Forests	Survey of India (SOI) Open Series Toposheets (1:50K) [refer point 6 (a)]	Validated through imagery analysis and LULC Analysis outputs.
	g. Scheduled Areas	State Profiles maintained on Ministry of Tribal Affairs website http://tribal.nic.in/Content/StatewiseListofScheduleAreasProfiles.aspx	Not Applicable
7.	**Others**		
	a. Defense and Army Installations	Database of Cantonment locations in India	Not Applicable
	b. Transmission Lines	Survey of India (SOI) Open Series Toposheets (1:50K) [refer point 6 (a)]	Not Applicable
	c. Major Substations	Visual assessment of Imageries	Not Applicable

#	Spatial Data Layers	Source of Data	Method of Validation
8.	**Socio-economic Analysis**	Digital database maintained by Census of India. Census 2011 data used for analysis. http://www.censusindia.gov.in/DigitalLibrary/Archive_home.aspx	Not Applicable
9.	**Meteorological Parameters**		
	a. Temperature b. Rainfall c. Wind	Climate Engine Meteoblu.com	Not Applicable

Annexure II Photolog

Bhadar River within the study area

Valadungra Dam within the study area



Habitat shot from PDV site

Approach road to PDV site

PDV 03 WTG location

Habitat shot of UMR 01 WTG location

Habitat shot of UMR 01 WTG location

Grazing activity, Dependency of local communities

Habitat shot of UMR 04 WTG location

Habitat shot of UMR 06 WTG location

WTG Storage yard unit near Umrali

Excavation and Foundation work at UMR 06 WTG location

Water body near Betavad village

PDV 01 WTG location foundation work

Motisar river adjacent to PDV WTG locations

Internal TL lines passing through farmlands

Scrub forest near UMR 10 WTG location

Foundation work at RBR 03 WTG location

Scrub forest adjacent to RBR WTG locations

Interaction with local communities

Approach road of RBR

Habitat shot of JPR 01

Habitat shot of JMD WTG location

Worker accommodation in Umrali village

Consultation with Rabarika Sarpanch

Discussion with local communities

Annexure III Traffic Management Plan

Increased traffic flow to project locations is envisaged in the study area especially in the construction stage which includes the movement of heavy equipment/ machinery. This traffic management plan addresses the impact of increased movement of traffic on community health and safety in the study area.

During Construction Phase

The following mitigation measures will be implemented during this phase:

1. Project vehicular movement will be restricted to defined access routes.
2. Any road diversions and closures will be informed in advance to the project vehicles accessing the above route. Usage of horns by project vehicles will be restricted near sensitive receptors viz. schools, settlements etc. Though, no such chances are seen so far. Because the project location is absolutely located in isolation.
3. Traffic flows will be timed wherever practicable during period of increased commuter movement in the day.
4. Temporary parking facilities should be provided within the work areas and the construction sites to avoid road congestion.
5. Vehicular movement to be controlled near sensitive locations viz. schools, colleges, hospitals identified along designated vehicular transportation routes.
6. Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.
7. Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with local authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signage.
8. FPEL and Contractor(s) should frame and implement a “No Drug No Alcohol” Policy to prevent road accidents/incidents.

During Operational Phase

Since limited vehicular movement is anticipated during operational phase considering only the daily movement of project personnel any impacts arising from the same can be effectively addressed through implementation of mitigation measures as discussed during the construction phase. In addition, the following measures will be emphasized.

1. Use of horns near the villages along the access road to villages, main plant and internal roads should be restricted.
2. The vehicular movements along the access roads and highways should be restricted during the night-time.
3. All the vehicles entering the access roads and plant should have Pollution under Control (PUC) certificates.
4. The speed limit in the internal roads should be restricted to 20 km/hr. Proper warning signs and road safety awareness posters should be displayed to create road safety awareness among the personnel accessing the site.

5. Periodic Road Safety and Traffic Management campaigns and awareness sessions should be carried out among the villagers and the plant workers/personnel to develop road safety awareness among the people likely to be impacted by the project.
6. An emergency road safety plan should be framed by the Proponent to combat any emergency conditions/accidents along the highways, access roads and within plant area.
7. FPEL/O & M Contractor should frame and implement a "No Drug No Alcohol" Policy to prevent road accidents/incidents.
8. The drivers should be given an induction on road safety and traffic management policy.
9. A permanent parking lot should be provided within the main plant site (in individual work areas) and the associated facilities.
10. Use of seat belts for both drivers and passengers should be made compulsory to minimize death & injuries in the event of an accident.

Annexure IV Stakeholder Engagement Plan and Grievance Redressal Mechanism

A. Stakeholder Engagement Plan

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. They can comprise individuals, communities, social groups, organizations etc. It is often observed that the poor and the marginalized are often ignored either due to the fact that they are unaware or do not have a forum to voice their opinion.

The purpose of the Stakeholder Engagement Plan (SEP) is to ensure that the direct and indirect impacted stakeholders of the project are regularly apprised of the project activities. The plan has been developed in order to draw out an outline wherein the communication process associated with the activities of the project cycle is to be undertaken.

1. Stakeholder Engagement

The stakeholders in the project were identified based on their level of interest and influence over the project activities. The stakeholders were primarily divided into direct and indirect and further regrouped as internal and external. In the table below, the types of stakeholders as per their level of interest and influence have been provided.

Table 42: Types of Stakeholders as per their interest and influence

S. No.	Types of Stakeholders	Description	Groups + Individuals
1	Direct Internal Stakeholders	Direct internal stakeholders comprise the parent company or the project proponent and the employees of the company that are directly controlled by the parent company.	• Fourth Partner (Project Owner) • Powerica (EPC Contractor) • Vartaman (EPC Contractor)
2	Direct External Stakeholders	Direct external stakeholders comprise the project affected people/families, contractors, supply chain and financial intermediary who are directly affected by the project activities but are not directly controlled by the project proponent.	• Project Affected Persons/Families (Landowners) • Gujarat State Power Department • Gujarat Energy Transmission Corporation Limited (GETCO) • Financial Intermediary • Contractors • Vendors
3	Indirect Internal Stakeholders	Indirect internal stakeholders consist of the secondary stakeholders who would have a more indirect interest but within the direct influence of the project.	• Families of Direct Employees
4	Indirect External Stakeholders	Indirect external stakeholders comprise of those stakeholders who might not be involved directly	• Local Community residing within the villages of the project area

		in the day-to-day operation of the project but have an interest in the activities of the project.	• Opinion Leaders of local communities residing within the villages of the project area • Local Government Institutions of Villages • Gujarat State Pollution Control Board • Local Media

1.1 Stakeholder Analysis and Mapping

Stakeholder analysis takes a more comprehensive view of the stakeholder's group interests, how they would be affected and to what extent and influence they could have on the project. These aspects cumulatively provide the basis for constructing the stakeholder engagement strategy. The key stakeholders identified above have been categorised into four major groups: Government Agencies, Positively Influenced Stakeholders, Critical to Engage and Donors. The categorisation list of key stakeholders has been provided in the following table along with their influence on the project.

Table 43: Categorization List of Key Stakeholders and Mapping their influence

Categorization	Key Stakeholders	Influence Mapping
Government Agencies	• Gujarat State Power Department • Gujarat Energy Transmission Corporation Limited (GETCO) • Gujarat State Pollution Control Board	• High • High • High
Positively Influenced Stakeholders	• Project Affected Persons/Families (Landowners) • Families of Direct Employees • Fourth Partner (Project Owner) • Powerica (EPC Contractor) • Vartaman (EPC Contractor) • Local Community residing within the project area • Contractors • Vendors	• Medium • Low • High • High • High • High • High • High
Critical to Engage	• Opinion Leaders of local communities residing within project area • Local Government Institutions of Villages • Local Media	• Medium • Medium • Medium
Lenders	• Financial Intermediary	• High

1.2 Communicative Method

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 audiences, and it can comprise of the following detailed out in the following table:

Table 44: 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 stakeholder knowledge is keen in participating in the development of the project When there is a need to engage local people to analyse, share and enhance their knowledge to plan, manage and evaluate developmental projects.
Participatory Rural Appraisal (PRA)	To enable local people to make their own appraisal, analysis and plan. Decentralization and Empowerment of the local people.	Relevant when there is a need for identification of the community problems.

1.3 Stakeholder Engagement Program

The consultation with the stakeholders will be conducted by the Community Liaison Officer (Powerica/Fourth Partner) who will work in collaboration with the nominated (Grievance Officer) and Site Incharge (Powerica) and Project Manager (Fourth Partner) at the site level. Any grievances from the community relating to any issues that might arise from the project activities will be managed by the nominated Grievance Officer based at the Site Office. The Community Liaison Officer is to report directly to the Project Manager based at the Site level.

Consultations with the government agencies will be conducted as per the schedule that will be created with the Community Liaison Officer and Project Manager. These stakeholders will be informed in advance of the planned project activities.

Consultations with the direct internal stakeholders will involve meetings, information boards announcements and an Intranet system to apprise the direct employees of Powerica and Fourth

Partner regarding the procedures of emergency response system, incident/accident reporting, grievance redressal mechanism, Human Resources Policies and Procedures, welfare measures etc. In addition, communication of general employment conditions, company's code of conduct for work site, EHS concerns, use of PPEs, information and awareness about the requirements of labour laws and minimum wages, working hours, grievance redressal, retrenchment process etc. should also be conducted with workers engaged with contractors.

Project related information will be posted on the informational boards at the site office as well as at the Corporate Level.

In turn, if any issues are raised by the stakeholders, the project proponent management comprising of the Grievance Redressal Committee at the Site Level will respond accordingly in the shortest possible time. Details of which have been provided in the Grievance Redressal Mechanism section of the report.

The responsibility for the Stakeholder Engagement Plan implementation will be held by the Community Liaison Officer (Powerica/Fourth Partner) based at the Site Office. He will be supported by the Project Manager (Fourth Partner), Site Incharge (Powerica) and nominated Grievance Officer at the site level.

A summary of the consultation activities that the project proponent shall undertake as part of the Engagement Plan pertaining to the villages around the project area and other stakeholders have been provided below:

Table 45: Summary of Consultation Activities

Stakeholder	Objective and Consultation Method	Proposed Timeline	Responsibility
Local Community, Opinion Leaders, Local Media at Project Site	• Disclosure of the project at all villages within the project area and progress of the work to be displayed at the Information Board of Gram Panchayats office within the project area.	Before the commissioning of the Project	Community Liaison Officer from the Company and Local Leaders of the villages.
Government Authorities	Information meetings and consultations	On-going on a permanent basis (every six monthly)	Company: Head-Projects (Fourth Partner), Project Manager / HSE Supervisor (Fourth Partner), EHS Officer (Powerica) and Community Liaison Officer (Fourth Partner/Powerica)

Direct Employees	• Internal meetings of direct employees and managers • Day to day contact	• On-going process on a permanent basis: monthly • On-going on a permanent basis	• Company: Project Manager/ EHS Officer & Community Liaison Officer • EHS Officer
Contractors (Third Party)	• Meetings with contractors and their respective managers	On-going on a permanent basis: monthly basis	EHS Officer, Project Manager and Community Liaison Officer
Lenders	• Information on project status • Submission of annual reports, information on any project-related events that could potentially create an increased risk of the project	On-going process on a permanent basis	Company: Project Manager; designated person from Fourth Partner, EHS Officer and Community Liaison Officer.

The stakeholder engagement process should be carried out at two levels, namely, local community and local governing bodies. A summary of the proposed plans that is to be initiated by Fourth Partner/Powerica have been described below:

Table 46: Summary of Proposed Plan of Activities

#	Key Stakeholders	Proposed Plan of Activities
1	Positively Influenced Stakeholders/ Local Communities	• Announcement of vacancies (skilled/unskilled) at proposed site • Announcement of contract work for small scale work associated with the proposed project • CSR Activities to be initiated by Project Proponent • Consultation with village panchayats about movement of heavy vehicles • Information on route and timing of vehicle movement to be provided to village administrations • Set up a grievance redress mechanism and inform the community about the procedure • Discuss the management plan with the community and incorporate the comments
2	Local Governing Bodies	• Compliance with legal requirements

		• Involvement of various CSR Activities
3	Lenders	• Compliance with International Guidelines (IFC Sustainability Framework & other national and local legal requirements) • Regular Reporting

It is to be noted that the proposed plan of activities relating to the stakeholder engagement can change as per the future planning of activities by Fourth Partner/Powerica.

1.4 Monitoring and Evaluation

Monitoring

Internal monitoring of project related activities as well as associated activities involving the local communities should be contemplated upon on a regular yearly basis (by identified staff from the corporate level) to bring in openness in the company's commitment. In addition, external monitoring of a company's environmental and social commitments can strengthen stakeholder engagement processes by increasing transparency and promoting trust between the project and its key stakeholders.

Fourth Partner should undertake a commitment in undertaking internal audits every six-monthly during construction phase and once in a year during operational phase. All related information shall be readily maintained at the site office and produced at the time of the audits.

Internal Audit reports shall be accordingly created after every audit and submitted to Head-Projects. All records of these reports shall be maintained at the site office, Corporate Office and be forwarded to the lender financing the project as per requirement.

Reporting

Performance of Fourth Partner/Powerica will be reviewed six monthly during construction phase and yearly during operational phase against the Stakeholder Engagement Plan. The report will include, but not be limited to, the following:

- Informative materials disseminated, its types, frequency, and location
- Place and time of formal engagement events and level of participation
- Activities of community welfare undertaken
- Feedback on CSR initiatives
- Other interactions with the community; and
- Numbers and types of grievances (both from the community and workers) and the nature and timing of their resolution.

B. Grievance Redressal Mechanism

Grievance Redressal Mechanism (GRM) provides a way to reduce risks for projects, offer communities an effective avenue for expressing concerns and achieving remedies and promote a mutually constructive relationship.[28] It is an important tool through which the community concerns and

[28] A Guide to Designing and Implementing Grievance Mechanisms for Development Projects by The Office of the Compliance Advisor/ Ombudsman for IFC and MIGA, 2008.

complaints are registered and addressed. The mechanism tends to meet the requirements of stakeholder engagement process, prevent and address community concerns, reduce risk, and assist the processes that create positive social change.

The GRM is a means through which acceptance, assessment and resolution of community complaints concerning the performance or behaviour of the project proponent are ascertained and addressed. The GRM prepared should be implemented to the entire life cycle of the proposed project.

1. Steps for Developing a Grievance Mechanism

Fourth Partner/Powerica while developing the Grievance Mechanism are required to adhere to the following steps:

Development of Procedures

Fourth Partner/Powerica should ensure that procedures for lodging and registering of grievances are in place before the plan is implemented at the site level. The procedures of Grievance Mechanism should comprise of identifying the personnel (Grievance Officer at Site level) who will be responsible for receiving and addressing the grievances at the site level and handle the cases at the escalation level. The procedures to be developed should include assessment procedures, procedure to determine the appropriate resolution process, procedures for making decisions on proposed settlements, appropriate time frames for each step in the grievance resolution process and notification procedure to the complainant about eligibility, assessment results, proposed settlements and the like.

Develop Resolution Options and Response

Once Fourth Partner/Powerica developed procedures, formal and informal resolution options should also be developed along with preparation of formulating a response. General approaches to grievance resolution many include proposing a solution, reaching a resolution through discussion or negotiation, using a third party to either informally or formally resolve the matter through mediation and through traditional and customary practices.

Publicise the Grievance Mechanism

Once the procedures for Grievance Mechanism have been developed by Fourth Partner/Powerica, it must be publicised through various stakeholder engagement activities as detailed out in the Stakeholder Engagement Plan. Various communicative methods can be adopted in disseminating the information like printed materials, displays, face to face meetings and website updation. The GRM shall be documented in English and Gujarati and copies shall be kept at the project site office and corporate office. The GRM is also to be displayed at notice board at the project site office and training on the GRM shall also be provided during induction. Fourth Partner/Powerica to ensure that the contractor would keep the workers informed about the grievance mechanism at the time of recruitment and make it easily accessible to them. All the relevant contact numbers to be made available to them.

Training/ Workshops on Grievance Redressal Mechanism

A separate training/ workshop should be undertaken by Fourth Partner/ Powerica at the community and worker level to discuss the process of how a grievance gets registered, the local contact person's/grievance officer details of receiving grievances, the significance of grievance boxes, the timelines for addressing the grievances and the personnel involved in the redressal process.

Recording of Grievances

Once the stakeholders are aware of the mechanism and access it to raise grievances, Fourth Partner/Powerica is required to acknowledge the same and keep the complainant's identity anonymous. Consequently, Fourth Partner/Powerica is required to collect grievances by checking the grievance boxes once every seven days, record and register the grievances that have come in as per the identified formats and track them throughout the redressal process to reflect on their status and important details. A Grievance Log or database emphasising the records and status of the grievance is to be maintained by the identified Grievance Officer at the site level. The Grievance Log can be used to analyse information about grievance and conflict trends, community issues and project operations to anticipate the kinds of conflicts that the project proponents might expect in the future both to ensure that the grievance mechanism is set up to handle such issues and to propose organizational or operational changes.[29]

Appeal

If the grievance redressal solution is not acceptable or agreed by the project proponent, the complainant should be offered to an appeal process. Circumstance revolving around when an appeal can be made should be set by Fourth Partner/Powerica so that accountability and transparency is promoted by them in every step. National Court or convening of a senior and independent panel of individuals to seek appropriate resolution of the case with representation from both government and civil society is often encouraged. This panel may also play the role of providing strategic oversight and assurance of the mechanism through review monitoring and tracking data.

Resolve and Follow Up

Once the corrective action has been agreed upon, a good practice is to collect proof of those actions in terms of taking photographs, documentary evidence, getting confirmation from the complainant and filing the same within the case documentation. In addition, monitoring and follow up on the resolution agreed upon should be conducted once to close the case accordingly.

2. Proposed Grievance Redressal Mechanism for Fourth Partner/Powerica

Fourth Partner/Powerica in order to implement the Grievance Redressal Mechanism are required to identify the contact person/grievance officer involved at the site level for registering the grievances, the process of registering and action taken thereon for the resolution of the grievance, the timeline required in each step and criteria in escalation of the case to the higher level.

A site level approach is proposed to be developed for redressal of all cases of grievances. The steps of grievance redressal for Fourth Partner/Powerica have been provided below:

Receive and Register a Complaint

- Any stakeholder with concerns pertaining to onsite work such as community health and safety, local employment, community risk, migrant labour etc. may register their complaint in writing to the nominated person/grievance officer at site level;
- Secured grievance boxes shall be placed at the entrance of the site office;
- If any stakeholder or community member wishes to remain anonymous, he/she can write down the grievances and drop in the available complaint box;

[29]A Guide to Designing and Implementing Grievance Mechanisms for Development Projects by 'The Office of the Compliance Advisor/ Ombudsman' for IFC and MIGA, 2008.

- Once a complaint has been received it shall be recorded in the grievance log register or data system.

Assessment and Addressal of Complaint

- The identified Grievance Officer will open the complaint boxes every seven (07) days and forward the grievances to the Project Manager for further action;
- The grievance will be assessed by the Project Manager within two (2) working days to determine if the issues raised by the complaint fall within the mandate of the grievance mechanism or not;
- During the assessment of complaints, the GRC team (Site Incharge, EHS Officer, Project Manager, Community Liaison Officer) will gather information about the key issues and concerns and helps determine whether and how the complaint might be resolved;
- The grievances will be redressed at the Site Level by the GRC within 7 working days;
- If the grievance fails to be addressed at this level the complainant will have the option to approach the appropriate court of laws for redress.
- The complainant will have the opportunity to be present at the committee meetings and discuss the grievance faced by him/her.

3. Resources Required for Grievance Mechanism Implementation

For a grievance mechanism to function effectively, it is important to establish a governance structure and assign responsibilities for the mechanism's implementation. The following roles and responsibilities have been identified for grievance mechanism implementation:

Nominated Grievance Officer

The Community Liaison Officer (Fourth Partner/Powerica) based at the Site Level is to be nominated as the Grievance Officer. The incumbent is to work in tandem with the Project Manager, EHS Officer and Site Incharge. They cumulatively form the Grievance Committee at the site level.

Engagement of Third Party

To maintain ultimate transparency and accountability for the grievance mechanism process, third parties such as local governments, local community etc. can at times be involved in the grievance redressal process. These parties can serve as process organizers, places to bring a complaint to be passed on to the company or as facilitators, witnesses, advisors or mediators. Third parties can assist in enhancing the trust level from communities as well as overcome limitations of project-level mechanism.

Through the involvement of third parties as facilitators, the community's confidence in project level grievance mechanism can be increased and the project proponent can gain a better reputation with and greater trust from stakeholders. In addition, cost-efficiency and supplement of internal resources can also be achieved if this step is contemplated upon.

4. Monitoring and Reporting

Monitoring and reporting are requisite tools of measuring the effectiveness of the grievance mechanism, the efficient use of resources, determining broad trends and acknowledging recurring problems so that they can be resolved before they reach a higher level of contention.

Monitoring

Depending on the extent of project impacts and the volume of grievances, monitoring measures like internal (by identified Corporate level staff) and external audits (third party consultants) six monthly during construction phase and once a year during operational phase based on the complexity of the nature of grievances can be adopted by Fourth Partner/Powerica. Grievance records maintained should provide the background information for these regular monitoring exercises. Through the review of each grievance and analysis of its effectiveness and efficiency, Fourth Partner/Powerica can draw on the complaints to evaluate systematic deficiencies.

Reporting

All grievances registered have to be recorded and regularly updated. The site management or Grievance Officer is responsible to discharging this responsibility and he should be able to produce this document whenever any audits take place. All minutes of meetings with stakeholders, complainants and Grievance Committee are to be recorded and documented regularly for reference purposes. The company can also use these monitoring reports to report back to the community on its implementation of the mechanism and the modification/ changes proposed to make it more user-friendly.

Annexure V Avifauna Present within the Study Area

The following checklist of birds has been compiled from secondary sources viz. Government of Gujarat website, online ornithology websites and field guides. The birds sighted during the survey have been highlighted in the table.

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
1	Lesser Whistling Duck	*Dendrocygna javanica*	ANSERIFORMES: Anatidae	LC	R	IV
2	Bar-headed Goose	*Anser indicus*	ANSERIFORMES: Anatidae	LC	WM	IV
3	Greylag Goose	*Anser anser*	ANSERIFORMES: Anatidae	LC	WM	IV
4	Common Shelduck	*Tadorna tadorna*	ANSERIFORMES: Anatidae	LC	WM	IV
5	Ruddy Shelduck	*Tadorna ferruginea*	ANSERIFORMES: Anatidae	LC	WM	IV
6	Marbled Teal	*Marmaronetta angustirostris*	ANSERIFORMES: Anatidae	VU	WM	IV
7	Red-crested Pochard	*Netta rufina*	ANSERIFORMES: Anatidae	LC	WM	IV
8	Common Pochard	*Aythya ferina*	ANSERIFORMES: Anatidae	VU	WM	IV
9	Ferruginous Duck	*Aythya nyroca*	ANSERIFORMES: Anatidae	NT	WM	IV
10	Tufted Duck	*Aythya fuligula*	ANSERIFORMES: Anatidae	LC	WM	IV
11	Garganey	*Spatula querquedula*	ANSERIFORMES: Anatidae	LC	WM	IV
12	Northern Shoveler	*Spatula clypeata*	ANSERIFORMES: Anatidae	LC	WM	IV
13	Gadwall	*Mareca strepera*	ANSERIFORMES: Anatidae	LC	WM	IV
14	Eurasian Wigeon	*Mareca penelope*	ANSERIFORMES: Anatidae	LC	WM	IV
15	Indian Spot-billed Duck	*Anas poecilorhyncha*	ANSERIFORMES: Anatidae	LC	R	IV
16	Mallard	*Anas platyrhynchos*	ANSERIFORMES: Anatidae	LC	WM	IV
17	Northern Pintail	*Anas acuta*	ANSERIFORMES: Anatidae	LC	WM	IV
18	Common Teal	*Anas crecca*	ANSERIFORMES: Anatidae	LC	WM	IV
19	Comb Duck	*Sarkidiornis melanotos*	ANSERIFORMES: Anatidae	LC	WM	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
20	Cotton Pygmy Goose	*Nettapus coromandelianus*	ANSERIFORMES: Anatidae	LC	R	IV
21	Indian Peafowl	*Pavo cristatus*	GALLIFORMES: Phasianidae	LC	R	I
22	Common Quail	*Coturnix coturnix*	GALLIFORMES: Phasianidae	LC	WM	IV
23	Rain Quail	*Coturnix coromandelica*	GALLIFORMES: Phasianidae	LC	R	IV
24	Jungle Bush Quail	*Perdicula asiatica*	GALLIFORMES: Phasianidae	LC	R	IV
25	Rock Bush Quail	*Perdicula argoondah*	GALLIFORMES: Phasianidae	LC	R	IV
26	Black Francolin	*Francolinus francolinus*	GALLIFORMES: Phasianidae	LC	R	IV
27	Painted Francolin	*Francolinus pictus*	GALLIFORMES: Phasianidae	LC	R	IV
28	Grey Francolin	*Francolinus pondicerianus*	GALLIFORMES: Phasianidae	LC	R	IV
29	Greater Flamingo	*Phoenicopterus roseus*	PHOENICOPTERIFORMES: Phoenicopteridae	LC	WM	IV
30	Lesser Flamingo	*Phoeniconaias minor*	PHOENICOPTERIFORMES: Phoenicopteridae	NT	WM	IV
31	Little Grebe	*Tachybaptus ruficollis*	PHOENICOPTERIFORMES: Podicipedidae	LC	R	IV
32	Great Crested Grebe	*Podiceps cristatus*	PHOENICOPTERIFORMES: Podicipedidae	LC	WM	IV
33	Black-necked Grebe	*Podiceps nigricollis*	PHOENICOPTERIFORMES: Podicipedidae	LC	WM	IV
34	Rock Pigeon	*Columba livia*	COLUMBIFORMES: Columbidae	LC	R	IV
35	Oriental Turtle Dove	*Streptopelia orientalis*	COLUMBIFORMES: Columbidae	LC	WM	IV
36	Eurasian Collared Dove	*Streptopelia decaocto*	COLUMBIFORMES: Columbidae	LC	R	IV
37	Red Collared Dove	*Streptopelia tranquebarica*	COLUMBIFORMES: Columbidae	LC	R	IV
38	Spotted Dove	*Streptopelia chinensis*	COLUMBIFORMES: Columbidae	LC	R	IV
39	Laughing Dove	*Streptopelia senegalensis*	COLUMBIFORMES: Columbidae	LC	R	IV
40	Yellow footed Green Pigeon	*Treron phoenicopterus*	COLUMBIFORMES: Columbidae	LC	R	IV
41	Chestnut-bellied Sandgrouse	*Pterocles exustus*	PTEROCLIFORMES: Pteroclidae	LC	R	IV
42	Black-bellied Sandgrouse	*Pterocles orientalis*	PTEROCLIFORMES: Pteroclidae	LC	WM	IV
43	Painted Sandgrouse	*Pterocles indicus*	PTEROCLIFORMES: Pteroclidae	LC	R	IV
44	Grey Nightjar	*Caprimulgus indicus*	CAPRIMULGIFORMES: Caprimulgidae	LC	SM	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
45	Sykes's Nightjar	*Caprimulgus mahrattensis*	CAPRIMULGIFORMES: Caprimulgidae	LC	WM	IV
46	Indian Nightjar	*Caprimulgus asiaticus*	CAPRIMULGIFORMES: Caprimulgidae	LC	R	IV
47	Savanna Nightjar	*Caprimulgus affinis*	CAPRIMULGIFORMES: Caprimulgidae	LC	R	IV
48	Crested Treeswift	*Hemiprocne coronata*	CAPRIMULGIFORMES: Apodidae	LC	R	NA
49	Asian Palm Swift	*Cypsiurus balasiensis*	CAPRIMULGIFORMES: Apodidae	LC	R	NA
50	Alpine Swift	*Tachymarptis melba*	CAPRIMULGIFORMES: Apodidae	LC	R	NA
51	Fork-tailed Swift	*Apus pacificus*	CAPRIMULGIFORMES: Apodidae	LC	R	NA
52	Little Swift	*Apus affinis*	CAPRIMULGIFORMES: Apodidae	LC	R	NA
53	Southern Coucal	*Centropus parroti*	CUCULIFORMES: Cuculidae	LC	R	IV
54	Sirkeer Malkoha	*Taccocua leschenaultii*	CUCULIFORMES: Cuculidae	LC	R	IV
55	Jacobin Cuckoo	*Clamator jacobinus*	CUCULIFORMES: Cuculidae	LC	SM	IV
56	Asian Koel	*Eudynamys scolopaceus*	CUCULIFORMES: Cuculidae	LC	R	IV
57	Grey-bellied Cuckoo	*Cacomantis passerinus*	CUCULIFORMES: Cuculidae	LC	SM	IV
58	Common Hawk Cuckoo	*Hierococcyx varius*	CUCULIFORMES: Cuculidae	LC	R	IV
59	Indian Cuckoo	*Cuculus micropterus*	CUCULIFORMES: Cuculidae	LC	SM	IV
60	Common Cuckoo	*Cuculus canorus*	CUCULIFORMES: Cuculidae	LC	SM	IV
61	Spotted Crake	*Porzana porzana*	GRUIFORMES: Rallidae	LC	WM	IV
62	Brown Crake	*Zapornia akool*	GRUIFORMES: Rallidae	LC	WM	IV
63	Baillon's Crake	*Zapornia pusilla*	GRUIFORMES: Rallidae	LC	WM	IV
64	White-breasted Waterhen	*Amaurornis phoenicurus*	GRUIFORMES: Rallidae	LC	R	IV
65	Watercock	*Gallicrex cinerea*	GRUIFORMES: Rallidae	LC	WM	IV
66	Purple Swamphen	*Porphyrio porphyrio*	GRUIFORMES: Rallidae	LC	R	IV
67	Common Moorhen	*Gallinula chloropus*	GRUIFORMES: Rallidae	LC	R	IV
68	Common Coot	*Fulica atra*	GRUIFORMES: Rallidae	LC	R	IV
69	Sarus Crane	*Antigone antigone*	GRUIFORMES: Gruidae	VU	R	IV
70	Demoiselle Crane	*Grus virgo*	GRUIFORMES: Gruidae	LC	WM	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
71	Common Crane	*Grus grus*	GRUIFORMES: Gruidae	LC	WM	IV
72	Lesser Florican	*Sypheotides indicus*	OTIDIFORMES: Otididae	EN	SM	I
73	Macqueen's Bustard	*Chlamydotis macqueenii*	OTIDIFORMES: Otididae	VU	WM	IV
74	Wilson's Storm-petrel	*Oceanites oceanicus*	PROCELLARIIFORMES: Oceanitidae	LC	DD	IV
75	Swinhoe's Storm-petrel	*Hydrobates monorhis*	PROCELLARIIFORMES: Hydrobatidae	NT	DD	IV
76	Wedge-tailed Shearwater	*Ardenna pacifica*	PROCELLARIIFORMES: Procellariidae	LC	DD	IV
77	Flesh-footed Shearwater	*Ardenna carneipes*	PROCELLARIIFORMES: Procellariidae	NT	DD	IV
78	Painted Stork	*Mycteria leucocephala*	PELECANIFORMES: Ciconiidae	NT	R	IV
79	Asian Openbill	*Anastomus oscitans*	PELECANIFORMES: Ciconiidae	LC	WM	IV
80	Black Stork	*Ciconia nigra*	PELECANIFORMES: Ciconiidae	LC	WM	IV
81	Woolly-necked Stork	*Ciconia episcopus*	PELECANIFORMES: Ciconiidae	LC	R	IV
82	European White Stork	*Ciconia ciconia*	PELECANIFORMES: Ciconiidae	LC	WM	IV
83	Black-necked Stork	*Ephippiorhynchus asiaticus*	PELECANIFORMES: Ciconiidae	NT	R	IV
84	Great White Pelican	*Pelecanus onocrotalus*	PELECANIFORMES: Pelecanidae	LC	WM	IV
85	Spot-billed Pelican	*Pelecanus philippensis*	PELECANIFORMES: Pelecanidae	NT	WM	IV
86	Dalmatian Pelican	*Pelecanus crispus*	PELECANIFORMES: Pelecanidae	VU	WM	IV
87	Great Bittern	*Botaurus stellaris*	PELECANIFORMES: Ardeidae	LC	WM	IV
88	Yellow Bittern	*Ixobrychus sinensis*	PELECANIFORMES: Ardeidae	LC	R	IV
89	Cinnamon Bittern	*Ixobrychus cinnamomeus*	PELECANIFORMES: Ardeidae	LC	WM	IV
90	Black Bittern	*Ixobrychus flavicollis*	PELECANIFORMES: Ardeidae	LC	WM	IV
91	Black-crowned Night Heron	*Nycticorax nycticorax*	PELECANIFORMES: Ardeidae	LC	R	IV
92	Striated Heron	*Butorides striata*	PELECANIFORMES: Ardeidae	LC	R	IV
93	Indian Pond Heron	*Ardeola grayii*	PELECANIFORMES: Ardeidae	LC	R	IV
94	Cattle Egret	*Bubulcus ibis*	PELECANIFORMES: Ardeidae	LC	R	IV
95	Grey Heron	*Ardea cinerea*	PELECANIFORMES: Ardeidae	LC	R	IV
96	Purple Heron	*Ardea purpurea*	PELECANIFORMES: Ardeidae	LC	R	IV

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97	Great Egret	*Ardea alba*	PELECANIFORMES: Ardeidae	LC	R	IV
98	Intermediate Egret	*Ardea intermedia*	PELECANIFORMES: Ardeidae	LC	R	IV
99	Little Egret	*Egretta garzetta*	PELECANIFORMES: Ardeidae	LC	R	IV
100	Western Reef Egret	*Egretta gularis*	PELECANIFORMES: Ardeidae	LC	R	IV
101	Black-headed Ibis	*Threskiornis melanocephalus*	PELECANIFORMES: Threskiornithidae	NT	R	IV
102	Eurasian Spoonbill	*Platalea leucorodia*	PELECANIFORMES: Threskiornithidae	LC	R	I
103	Red- naped Ibis	*Pseudibis papillosa*	PELECANIFORMES: Threskiornithidae	LC	R	IV
104	Glossy Ibis	*Plegadis falcinellus*	PELECANIFORMES: Threskiornithidae	LC	WM	IV
105	Little Cormorant	*Microcarbo niger*	PELECANIFORMES: Phalacrocoracidae	LC	R	IV
106	Great Cormorant	*Phalacrocorax carbo*	PELECANIFORMES: Phalacrocoracidae	LC	WM	IV
107	Indian Cormorant	*Phalacrocorax fuscicollis*	PELECANIFORMES: Phalacrocoracidae	LC	WM	IV
108	Oriental Darter	*Anhinga melanogaster*	PELECANIFORMES: Anhingidae	NT	R	IV
109	Eurasian Thick-knee	*Burhinus oedicnemus*	CHARADRIIFORMES: Burhinidae	LC	R	IV
110	Great Thick-knee	*Esacus recurvirostris*	CHARADRIIFORMES: Burhinidae	NT	R	IV
111	Eurasian Oystercatcher	*Haematopus ostralegus*	CHARADRIIFORMES: Haematopodidae	LC	WM	IV
112	Pied Avocet	*Recurvirostra avosetta*	CHARADRIIFORMES: Recurvirostridae	LC	WM	IV
113	Black-winged Stilt	*Himantopus himantopus*	CHARADRIIFORMES: Recurvirostridae	LC	R	IV
114	Grey Plover	*Pluvialis squatarola*	CHARADRIIFORMES: Charadriidae	LC	WM	IV
115	Pacific Golden Plover	*Pluvialis fulva*	CHARADRIIFORMES: Charadriidae	LC	WM	IV
116	Little Ringed Plover	*Charadrius dubius*	CHARADRIIFORMES: Charadriidae	LC	R	IV
117	Kentish Plover	*Charadrius alexandrinus*	CHARADRIIFORMES: Charadriidae	LC	R	IV
118	Lesser Sand Plover	*Charadrius mongolus*	CHARADRIIFORMES: Charadriidae	LC	WM	IV
119	Greater Sand Plover	*Charadrius leschenaultii*	CHARADRIIFORMES: Charadriidae	LC	WM	IV
120	Yellow-wattled Lapwing	*Vanellus malabaricus*	CHARADRIIFORMES: Charadriidae	LC	R	IV
121	Red-wattled Lapwing	*Vanellus indicus*	CHARADRIIFORMES: Charadriidae	LC	R	IV
122	White-tailed Lapwing	*Vanellus leucurus*	CHARADRIIFORMES: Charadriidae	LC	WM	IV

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123	Greater Painted-snipe	*Rostratula benghalensis*	CHARADRIIFORMES: Rostratulidae	LC	R	IV
124	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	CHARADRIIFORMES: Jacanidae	LC	R	IV
125	Bronze-winged Jacana	*Metopidius indicus*	CHARADRIIFORMES: Jacanidae	LC	R	IV
126	Whimbrel	*Numenius phaeopus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
127	Eurasian Curlew	*Numenius arquata*	CHARADRIIFORMES: Scolopacidae	NT	WM	IV
128	Bar-tailed Godwit	*Limosa lapponica*	CHARADRIIFORMES: Scolopacidae	NT	WM	IV
129	Black-tailed Godwit	*Limosa limosa*	CHARADRIIFORMES: Scolopacidae	NT	WM	IV
130	Ruddy Turnstone	*Arenaria interpres*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
131	Ruff	*Calidris pugnax*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
132	Broad-billed Sandpiper	*Calidris falcinellus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
133	Curlew Sandpiper	*Calidris ferruginea*	CHARADRIIFORMES: Scolopacidae	NT	WM	IV
134	Temminck's Stint	*Calidris temminckii*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
135	Sanderling	*Calidris alba*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
136	Dunlin	*Calidris alpina*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
137	Little Stint	*Calidris minuta*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
138	Pintail Snipe	*Gallinago stenura*	CHARADRIIFORMES: Scolopacidae	LC	PM	IV
139	Common Snipe	*Gallinago gallinago*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
140	Terek Sandpiper	*Xenus cinereus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
141	Common Sandpiper	*Actitis hypoleucos*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
142	Green Sandpiper	*Tringa ochropus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
143	Spotted Redshank	*Tringa erythropus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
144	Common Greenshank	*Tringa nebularia*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
145	Common Redshank	*Tringa totanus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
146	Wood Sandpiper	*Tringa glareola*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
147	Marsh Sandpiper	*Tringa stagnatilis*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV
148	Red-necked Phalarope	*Phalaropus lobatus*	CHARADRIIFORMES: Scolopacidae	LC	WM	IV

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149	Small Buttonquail	*Turnix sylvaticus*	CHARADRIIFORMES: Turnicidae	LC	SM	IV
150	Yellow-legged Buttonquail	*Turnix tanki*	CHARADRIIFORMES: Turnicidae	LC	SM	IV
151	Barred Buttonquail	*Turnix suscitator*	CHARADRIIFORMES: Turnicidae	LC	R	IV
152	Cream-coloured Courser	*Cursorius cursor*	CHARADRIIFORMES: Glareolidae	LC	WM	NA
153	Indian Courser	*Cursorius coromandelicus*	CHARADRIIFORMES: Glareolidae	LC	R	NA
154	Oriental Pratincole	*Glareola maldivarum*	CHARADRIIFORMES: Glareolidae	LC	R	IV
155	Little Pratincole	*Glareola lactea*	CHARADRIIFORMES: Glareolidae	LC	R	IV
156	Pomarine Jaeger	*Stercorarius pomarinus*	CHARADRIIFORMES: Stercorariidae	LC	PM	IV
157	Indian Skimmer	*Rynchops albicollis*	CHARADRIIFORMES: Laridae	VU	WM	IV
158	Slender-billed Gull	*Chroicocephalus genei*	CHARADRIIFORMES: Laridae	LC	R	IV
159	Brown-headed Gull	*Chroicocephalus brunnicephalus*	CHARADRIIFORMES: Laridae	LC	WM	IV
160	Black-headed Gull	*Chroicocephalus ridibundus*	CHARADRIIFORMES: Laridae	LC	WM	IV
161	Pallas's Gull	*Ichthyaetus ichthyaetus*	CHARADRIIFORMES: Laridae	LC	WM	IV
162	Caspian Gull	*Larus cachinnans*	CHARADRIIFORMES: Laridae	LC	WM	IV
163	Little Tern	*Sternula albifrons*	CHARADRIIFORMES: Laridae	LC	WM	IV
164	Gull-billed Tern	*Gelochelidon nilotica*	CHARADRIIFORMES: Laridae	LC	WM	IV
165	Caspian Tern	*Hydroprogne caspia*	CHARADRIIFORMES: Laridae	LC	WM	IV
166	Whiskered Tern	*Chlidonias hybrida*	CHARADRIIFORMES: Laridae	LC	WM	IV
167	White-winged Tern	*Chlidonias leucopterus*	CHARADRIIFORMES: Laridae	LC	PM	IV
168	River Tern	*Sterna aurantia*	CHARADRIIFORMES: Laridae	NT	R	IV
169	Common Tern	*Sterna hirundo*	CHARADRIIFORMES: Laridae	LC	WM	IV
170	Black-bellied Tern	*Sterna acuticauda*	CHARADRIIFORMES: Laridae	EN	R	IV
171	Lesser Crested Tern	*Thalasseus bengalensis*	CHARADRIIFORMES: Laridae	LC	WM	IV
172	Sandwich Tern	*Thalasseus sandvicensis*	CHARADRIIFORMES: Laridae	LC	WM	IV
173	Greater Crested Tern	*Thalasseus bergii*	CHARADRIIFORMES: Laridae	LC	WM	IV
174	Osprey	*Pandion haliaetus*	ACCIPITRIFORMES: Pandionidae	LC	WM	I

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175	Black-winged Kite	*Elanus caeruleus*	ACCIPITRIFORMES: Accipitridae	LC	R	I
176	Oriental Honey Buzzard	*Pernis ptilorhynchus*	ACCIPITRIFORMES: Accipitridae	LC	R	I
177	Egyptian Vulture	*Neophron percnopterus*	ACCIPITRIFORMES: Accipitridae	EN	R	IV
178	Crested Serpent Eagle	*Spilornis cheela*	ACCIPITRIFORMES: Accipitridae	LC	R	I
179	Short-toed Eagle	*Circaetus gallicus*	ACCIPITRIFORMES: Accipitridae	LC	R	IV
180	Red-headed Vulture	*Sarcogyps calvus*	ACCIPITRIFORMES: Accipitridae	CR	R	IV
181	White-rumped Vulture	*Gyps bengalensis*	ACCIPITRIFORMES: Accipitridae	CR	R	I
182	Indian Vulture	*Gyps indicus*	ACCIPITRIFORMES: Accipitridae	CR	R	I
183	Griffon Vulture	*Gyps fulvus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
184	Cinereous Vulture	*Aegypius monachus*	ACCIPITRIFORMES: Accipitridae	NT	WM	IV
185	Creasted Hawk Eagle	*Nisaetus cirrhatus*	ACCIPITRIFORMES: Accipitridae	LC	R	I
186	Black Eagle	*Ictinaetus malaiensis*	ACCIPITRIFORMES: Accipitridae	LC	R	I
187	Indian Spotted Eagle	*Clanga hastata*	ACCIPITRIFORMES: Accipitridae	VU	R	I
188	Greater Spotted Eagle	*Clanga clanga*	ACCIPITRIFORMES: Accipitridae	VU	WM	I
189	Tawny Eagle	*Aquila rapax*	ACCIPITRIFORMES: Accipitridae	LC	R	I
190	Steppe Eagle	*Aquila nipalensis*	ACCIPITRIFORMES: Accipitridae	EN	WM	I
191	Eastern Imperial Eagle	*Aquila heliaca*	ACCIPITRIFORMES: Accipitridae	VU	WM	I
192	Bonelli's Eagle	*Aquila fasciata*	ACCIPITRIFORMES: Accipitridae	LC	R	I
193	Booted Eagle	*Hieraaetus pennatus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
194	Eurasian Marsh Harrier	*Circus aeruginosus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
195	Hen Harrier	*Circus cyaneus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
196	Pallid Harrier	*Circus macrourus*	ACCIPITRIFORMES: Accipitridae	NT	WM	I
197	Montagu's Harrier	*Circus pygargus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
198	Shikra	*Accipiter badius*	ACCIPITRIFORMES: Accipitridae	LC	R	I
199	Eurasian Sparrowhawk	*Accipiter nisus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
200	Pallas's Fish Eagle	*Haliaeetus leucoryphus*	ACCIPITRIFORMES: Accipitridae	VU	WM	I

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201	Grey-headed Fish Eagle	*Icthyophaga ichthyaetus*	ACCIPITRIFORMES: Accipitridae	NT	R	I
202	Brahminy Kite	*Haliastur indus*	ACCIPITRIFORMES: Accipitridae	LC	R	I
203	Black Kite	*Milvus migrans*	ACCIPITRIFORMES: Accipitridae	LC	R	I
204	White-eyed Buzzard	*Butastur teesa*	ACCIPITRIFORMES: Accipitridae	LC	R	I
205	Eurasian Buzzard	*Buteo buteo*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
206	Long-legged Buzzard	*Buteo rufinus*	ACCIPITRIFORMES: Accipitridae	LC	WM	I
207	Common Barn Owl	*Tyto alba*	STRIGIFORMES: Tytonidae	LC	R	IV
208	Brown Hawk Owl	*Ninox scutulata*	STRIGIFORMES: Strigidae	LC	R	IV
209	Jungle Owlet	*Glaucidium radiatum*	STRIGIFORMES: Strigidae	LC	R	IV
210	Spotted Owlet	*Athene brama*	STRIGIFORMES: Strigidae	LC	R	IV
211	Pallid Scops Owl	*Otus brucei*	STRIGIFORMES: Strigidae	LC	WM	IV
212	Oriental Scops Owl	*Otus sunia*	STRIGIFORMES: Strigidae	LC	R	IV
213	Short-eared Owl	*Asio flammeus*	STRIGIFORMES: Strigidae	LC	WM	IV
214	Mottled Wood Owl	*Strix ocellata*	STRIGIFORMES: Strigidae	LC	R	IV
215	Rock Eagle Owl	*Bubo bengalensis*	STRIGIFORMES: Strigidae	LC	R	IV
216	Brown Fish Owl	*Ketupa zeylonensis*	STRIGIFORMES: Strigidae	LC	R	IV
217	Indian Grey Hornbill	*Ocyceros birostris*	BUCEROTIFORMES: Bucerotidae	LC	R	IV
218	Common Hoopoe	*Upupa epops*	BUCEROTIFORMES: Upupidae	LC	WM	NA
219	Eurasian Wryneck	*Jynx torquilla*	PICIFORMES: Picidae	LC	WM	IV
220	Lesser Goldenback	*Dinopium benghalense*	PICIFORMES: Picidae	LC	R	IV
221	Rufous Woodpecker	*Micropternus brachyurus*	PICIFORMES: Picidae	LC	R	IV
222	Greater Goldenback	*Chrysocolaptes lucidus*	PICIFORMES: Picidae	LC	R	IV
223	White-naped Woodpecker	*Chrysocolaptes festivus*	PICIFORMES: Picidae	LC	R	IV
224	Brown-capped pygmy Woodpecker	*Dendrocopos nanus*	PICIFORMES: Picidae	LC	R	IV
225	Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*	PICIFORMES: Picidae	LC	R	IV

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226	Brown-headed Barbet	*Psilopogon zeylanicus*	PICIFORMES: Ramphastidae	LC	R	IV
227	Coppersmith Barbet	*Psilopogon haemacephalus*	PICIFORMES: Ramphastidae	LC	R	IV
228	Green Bee-eater	*Merops orientalis*	CORACIIFORMES: Meropidae	LC	R	NA
229	Blue-tailed Bee-eater	*Merops philippinus*	CORACIIFORMES: Meropidae	LC	SM	NA
230	Blue-cheeked Bee-eater	*Merops persicus*	CORACIIFORMES: Meropidae	LC	SM	NA
231	Indian Roller	*Coracias benghalensis*	CORACIIFORMES: Coraciidae	LC	R	IV
232	Eurasian Roller	*Coracias garrulus*	CORACIIFORMES: Coraciidae	LC	SM	IV
233	Common Kingfisher	*Alcedo atthis*	CORACIIFORMES: Alcedinidae	LC	R	IV
234	Pied Kingfisher	*Ceryle rudis*	CORACIIFORMES: Alcedinidae	LC	R	IV
235	White-throated Kingfisher	*Halcyon smyrnensis*	CORACIIFORMES: Alcedinidae	LC	R	IV
236	Black-capped Kingfisher	*Halcyon pileata*	CORACIIFORMES: Alcedinidae	LC	R	IV
237	Lesser Kestrel	*Falco naumanni*	FALCONIFORMES: Falconidae	LC	WM	I
238	Common Kestrel	*Falco tinnunculus*	FALCONIFORMES: Falconidae	LC	WM	I
239	Red-necked Falcon	*Falco chicquera*	FALCONIFORMES: Falconidae	LC	R	I
240	Amur Falcon	*Falco amurensis*	FALCONIFORMES: Falconidae	LC	PM	I
241	Merlin	*Falco columbarius*	FALCONIFORMES: Falconidae	LC	WM	I
242	Eurasian Hobby	*Falco subbuteo*	FALCONIFORMES: Falconidae	LC	WM	I
243	Laggar Falcon	*Falco jugger*	FALCONIFORMES: Falconidae	NT	R	I
244	Saker Falcon	*Falco cherrug*	FALCONIFORMES: Falconidae	EN	WM	I
245	Peregrine Falcon	*Falco peregrinus*	FALCONIFORMES: Falconidae	LC	WM	I
246	Plum-headed Parakeet	*Psittacula cyanocephala*	PSITTACIFORMES: Psittaculidae	LC	R	IV
247	Alexandrine Parakeet	*Psittacula eupatria*	PSITTACIFORMES: Psittaculidae	NT	R	IV
248	Rose-ringed Parakeet	*Psittacula krameri*	PSITTACIFORMES: Psittaculidae	LC	R	IV
249	Indian Pitta	*Pitta brachyura*	PASSERIFORMES: Pittidae	LC	SM	IV
250	White-bellied Minivet	*Pericrocotus erythropygius*	PASSERIFORMES: Campephagidae	LC	R	IV
251	Small Minivet	*Pericrocotus cinnamomeus*	PASSERIFORMES: Campephagidae	LC	R	IV

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252	Long-tailed Minivet	*Pericrocotus ethologus*	PASSERIFORMES: Campephagidae	LC	R	IV
253	Scarlet Minivet	*Pericrocotus flammeus*	PASSERIFORMES: Campephagidae	LC	R	IV
254	Large Cuckooshrike	*Coracina javensis*	PASSERIFORMES: Campephagidae	LC	R	NA
255	Black-headed Cuckooshrike	*Lalage melanoptera*	PASSERIFORMES: Campephagidae	LC	SM	NA
256	Black-hooded Oriole	*Oriolus xanthornus*	PASSERIFORMES: Oriolidae	LC	R	IV
257	Indian Golden Oriole	*Oriolus kundoo*	PASSERIFORMES: Oriolidae	LC	R	IV
258	Ashy Woodswallow	*Artamus fuscus*	PASSERIFORMES: Artamidae	LC	R	IV
259	Common Woodshrike	*Tephrodornis pondicerianus*	PASSERIFORMES: Vangidae	LC	R	NA
260	Common Iora	*Aegithina tiphia*	PASSERIFORMES: Aegithinidae	LC	R	IV
261	Marshall's Iora	*Aegithina nigrolutea*	PASSERIFORMES: Aegithinidae	LC	R	IV
262	Black Drongo	*Dicrurus macrocercus*	PASSERIFORMES: Dicruridae	LC	R	IV
263	Ashy Drongo	*Dicrurus leucophaeus*	PASSERIFORMES: Dicruridae	LC	WM	IV
264	White-bellied Drongo	*Dicrurus caerulescens*	PASSERIFORMES: Dicruridae	LC	WM	IV
265	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	PASSERIFORMES: Dicruridae	LC	R	IV
266	White-browed Fantail	*Rhipidura aureola*	PASSERIFORMES: Rhipiduridae	LC	R	IV
267	Brown Shrike	*Lanius cristatus*	PASSERIFORMES: Laniidae	LC	WM	NA
268	Isabelline Shrike	*Lanius isabellinus*	PASSERIFORMES: Laniidae	LC	WM	NA
269	Bay-backed Shrike	*Lanius vittatus*	PASSERIFORMES: Laniidae	LC	R	NA
270	Long-tailed Shrike	*Lanius schach*	PASSERIFORMES: Laniidae	LC	R	NA
271	Great Grey Shrike	*Lanius excubitor*	PASSERIFORMES: Laniidae	LC	R	NA
272	Southern Grey Shrike	*Lanius meridionalis*	PASSERIFORMES: Laniidae	LC	R	NA
273	Rufous Treepie	*Dendrocitta vagabunda*	PASSERIFORMES: Corvidae	LC	R	IV
274	House Crow	*Corvus splendens*	PASSERIFORMES: Corvidae	LC	R	IV
275	Indian Jungle Crow	*Corvus culminatus*	PASSERIFORMES: Corvidae	LC	R	IV
276	Black-naped Monarch	*Hypothymis azurea*	PASSERIFORMES: Monarchidae	LC	R	IV
277	Asian Paradise-flycatcher	*Terpsiphone paradisi*	PASSERIFORMES: Monarchidae	LC	SM	IV

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278	Thick-billed Flowerpecker	*Dicaeum agile*	PASSERIFORMES: Dicaeidae	LC	R	IV
279	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	PASSERIFORMES: Dicaeidae	LC	R	IV
280	Purple-rumped Sunbird	*Leptocoma zeylonica*	PASSERIFORMES: Nectariniidae	LC	R	IV
281	Golden-fronted Leafbird	*Chloropsis aurifrons*	PASSERIFORMES: Irenidae	LC	R	IV
282	Black-breasted Weaver	*Ploceus benghalensis*	PASSERIFORMES: Ploceidae	LC	R	IV
283	Baya Weaver	*Ploceus philippinus*	PASSERIFORMES: Ploceidae	LC	R	IV
284	Indian Silverbill	*Euodice malabarica*	PASSERIFORMES: Estrildidae	LC	R	IV
285	White-rumped Munia	*Lonchura striata*	PASSERIFORMES: Estrildidae	LC	R	IV
286	Scaly-breasted Munia	*Lonchura punctulata*	PASSERIFORMES: Estrildidae	LC	R	IV
287	Black-headed Munia	*Lonchura malacca*	PASSERIFORMES: Estrildidae	LC	R	IV
288	House Sparrow	*Passer domesticus*	PASSERIFORMES: Passeridae	LC	R	IV
289	Chestnut-shouldered Petronia	*Gymnoris xanthocollis*	PASSERIFORMES: Passeridae	LC	R	IV
290	Forest Wagtail	*Dendronanthus indicus*	PASSERIFORMES: Motacillidae	LC	WM	IV
291	Tree Pipit	*Anthus trivialis*	PASSERIFORMES: Motacillidae	LC	WM	IV
292	Olive-backed Pipit	*Anthus hodgsoni*	PASSERIFORMES: Motacillidae	LC	WM	IV
293	Richard's Pipit	*Anthus richardi*	PASSERIFORMES: Motacillidae	LC	WM	IV
294	Paddyfield Pipit	*Anthus rufulus*	PASSERIFORMES: Motacillidae	LC	R	IV
295	Blyth's Pipit	*Anthus godlewskii*	PASSERIFORMES: Motacillidae	LC	WM	IV
296	Tawny Pipit	*Anthus campestris*	PASSERIFORMES: Motacillidae	LC	WM	IV
297	Long-billed Pipit	*Anthus similis*	PASSERIFORMES: Motacillidae	LC	R	IV
298	Yellow Wagtail	*Motacilla flava*	PASSERIFORMES: Motacillidae	LC	WM	IV
299	Grey Wagtail	*Motacilla cinerea*	PASSERIFORMES: Motacillidae	LC	WM	IV
300	Citrine Wagtail	*Motacilla citreola*	PASSERIFORMES: Motacillidae	LC	WM	IV
301	White-browed Wagtail	*Motacilla maderaspatensis*	PASSERIFORMES: Motacillidae	LC	R	IV
302	White Wagtail	*Motacilla alba*	PASSERIFORMES: Motacillidae	LC	WM	IV
303	Common Rosefinch	*Erythrina erythrina*	PASSERIFORMES: Fringillidae	LC	WM	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
304	Crested Bunting	*Melophus lathami*	PASSERIFORMES: Emberizidae	LC	R	IV
305	Red-headed Bunting	*Granativora bruniceps*	PASSERIFORMES: Emberizidae	LC	WM	IV
306	Black-headed Bunting	*Granativora melanocephala*	PASSERIFORMES: Emberizidae	LC	WM	IV
307	Grey-necked Bunting	*Emberiza buchanani*	PASSERIFORMES: Emberizidae	LC	WM	IV
308	White-capped Bunting	*Emberiza stewarti*	PASSERIFORMES: Emberizidae	LC	WM	IV
309	Grey-headed Canary-flycatcher	*Culicicapa ceylonensis*	PASSERIFORMES: Stenostiridae	LC	WM	IV
310	White-naped Tit	*Machlolophus nuchalis*	PASSERIFORMES: Paridae	VU	R	IV
311	Rufous-tailed Lark	*Ammomanes phoenicura*	PASSERIFORMES: Alaudidae	LC	R	IV
312	Black-crowned Sparrow Lark	*Eremopterix nigriceps*	PASSERIFORMES: Alaudidae	LC	R	IV
313	Ashy-crowned Sparrow Lark	*Eremopterix griseus*	PASSERIFORMES: Alaudidae	LC	R	IV
314	Singing Bush Lark	*Mirafra cantillans*	PASSERIFORMES: Alaudidae	LC	R	IV
315	Indian Bush Lark	*Mirafra erythroptera*	PASSERIFORMES: Alaudidae	LC	R	IV
316	Great Tit	*Parus major*	PASSERIFORMES: Paridae	LC	R	IV
317	Sand Lark	*Alaudala raytal*	PASSERIFORMES: Alaudidae	LC	R	IV
318	Greater Short-toed Lark	*Calandrella brachydactyla*	PASSERIFORMES: Alaudidae	LC	WM	IV
319	Oriental Sky Lark	*Alauda gulgula*	PASSERIFORMES: Alaudidae	LC	R	IV
320	Crested Lark	*Galerida cristata*	PASSERIFORMES: Alaudidae	LC	R	IV
321	Sykes's Lark	*Galerida deva*	PASSERIFORMES: Alaudidae	LC	R	IV
322	Zitting Cisticola	*Cisticola juncidis*	PASSERIFORMES: Cisticolidae	LC	R	IV
323	Rufous-fronted Prinia	*Prinia buchanani*	PASSERIFORMES: Cisticolidae	LC	R	IV
324	Grey-breasted Prinia	*Prinia hodgsonii*	PASSERIFORMES: Cisticolidae	LC	R	IV
325	Graceful Prinia	*Prinia gracilis*	PASSERIFORMES: Cisticolidae	LC	R	IV
326	Jungle Prinia	*Prinia sylvatica*	PASSERIFORMES: Cisticolidae	LC	R	IV
327	Ashy Prinia	*Prinia socialis*	PASSERIFORMES: Cisticolidae	LC	R	IV
328	Plain Prinia	*Prinia inornata*	PASSERIFORMES: Cisticolidae	LC	R	IV
329	Common Tailorbird	*Orthotomus sutorius*	PASSERIFORMES: Cisticolidae	LC	R	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
330	Booted Warbler	*Iduna caligata*	PASSERIFORMES: Acrocephalidae	LC	PM	IV
331	Sykes's Warbler	*Iduna rama*	PASSERIFORMES: Acrocephalidae	LC	WM	IV
332	Blyth's Reed Warbler	*Acrocephalus dumetorum*	PASSERIFORMES: Acrocephalidae	LC	PM	IV
333	Paddyfield Warbler	*Acrocephalus agricola*	PASSERIFORMES: Acrocephalidae	LC	WM	IV
334	Streak-throated Swallow	*Petrochelidon fluvicola*	PASSERIFORMES: Hirundinidae	LC	R	NA
335	Red-rumped Swallow	*Cecropis daurica*	PASSERIFORMES: Hirundinidae	LC	R	NA
336	Wire-tailed Swallow	*Hirundo smithii*	PASSERIFORMES: Hirundinidae	LC	R	NA
337	Barn Swallow	*Hirundo rustica*	PASSERIFORMES: Hirundinidae	LC	WM	NA
338	Eurasian Crag Martin	*Ptyonoprogne rupestris*	PASSERIFORMES: Hirundinidae	LC	R	NA
339	Dusky Crag Martin	*Ptyonoprogne concolor*	PASSERIFORMES: Hirundinidae	LC	R	NA
340	Plain Martin	*Riparia paludicola*	PASSERIFORMES: Hirundinidae	LC	R	NA
341	Sand Martin	*Riparia riparia*	PASSERIFORMES: Hirundinidae	LC	WM	NA
342	Pale Martin	*Riparia diluta*	PASSERIFORMES: Hirundinidae	LC	WM	NA
343	Red-whiskered Bulbul	*Pycnonotus jocosus*	PASSERIFORMES: Pycnonotidae	LC	R	IV
344	White-eared Bulbul	*Pycnonotus leucotis*	PASSERIFORMES: Pycnonotidae	LC	R	IV
345	Red-vented Bulbul	*Pycnonotus cafer*	PASSERIFORMES: Pycnonotidae	LC	R	IV
346	White-browed Bulbul	*Pycnonotus luteolus*	PASSERIFORMES: Pycnonotidae	LC	R	IV
347	Hume's Leaf Warbler	*Abrornis humei*	PASSERIFORMES: Phylloscopidae	LC	WM	IV
348	Common Chiffchaff	*Phylloscopus collybita*	PASSERIFORMES: Phylloscopidae	LC	WM	IV
349	Sulphur-bellied Warbler	*Phylloscopus griseolus*	PASSERIFORMES: Phylloscopidae	LC	WM	IV
350	Green Leaf Warbler	*Seicercus nitidus*	PASSERIFORMES: Phylloscopidae	LC	PM	IV
351	Greenish Warbler	*Seicercus trochiloides*	PASSERIFORMES: Phylloscopidae	LC	PM	IV
352	Asian Desert Warbler	*Curruca nana*	PASSERIFORMES: Sylviidae	LC	WM	IV
353	Eastern Orphean Warbler	*Curruca crassirostris*	PASSERIFORMES: Sylviidae	LC	WM	IV
354	Lesser Whitethroat	*Curruca curruca*	PASSERIFORMES: Sylviidae	LC	WM	IV
355	Yellow-eyed Babbler	*Chrysomma sinense*	PASSERIFORMES: Sylviidae	LC	R	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
356	Oriental White-eye	*Zosterops palpebrosus*	PASSERIFORMES: Zosteropidae	LC	R	IV
357	Indian Scimitar Babbler	*Pomatorhinus horsfieldii*	PASSERIFORMES: Timaliidae	LC	R	IV
358	Tawny-bellied Babbler	*Dumetia hyperythra*	PASSERIFORMES: Timaliidae	LC	R	IV
359	Puff-throated Babbler	*Pellorneum ruficeps*	PASSERIFORMES: Pellorneidae	LC	R	IV
360	Brown-cheeked Fulvetta	*Alcippe poioicephala*	PASSERIFORMES: Leiothrichidae	LC	R	IV
361	Large Grey Babbler	*Argya malcolmi*	PASSERIFORMES: Leiothrichidae	LC	R	IV
362	Common Babbler	*Turdoides caudata*	PASSERIFORMES: Leiothrichidae	LC	R	IV
363	Jungle Babbler	*Turdoides striata*	PASSERIFORMES: Leiothrichidae	LC	R	IV
364	Large Grey Babbler	*Turdoides malcomi*	PASSERIFORMES: Leiothrichidae	LC	R	IV
365	Rosy Starling	*Pastor roseus*	PASSERIFORMES: Sturnidae	LC	WM	IV
366	Asian Pied Starling	*Gracupica contra*	PASSERIFORMES: Sturnidae	LC	R	IV
367	Brahminy Starling	*Sturnia pagodarum*	PASSERIFORMES: Sturnidae	LC	R	IV
368	Chestnut-tailed Starling	*Sturnia malabarica*	PASSERIFORMES: Sturnidae	LC	WM	IV
369	Common Myna	*Acridotheres tristis*	PASSERIFORMES: Sturnidae	LC	R	IV
370	Bank Myna	*Acridotheres ginginianus*	PASSERIFORMES: Sturnidae	LC	R	IV
371	Jungle Myna	*Acridotheres fuscus*	PASSERIFORMES: Sturnidae	LC	R	IV
372	Indian Robin	*Saxicoloides fulicatus*	PASSERIFORMES: Muscicapidae	LC	R	IV
373	Oriental Magpie Robin	*Copsychus saularis*	PASSERIFORMES: Muscicapidae	LC	R	IV
374	Spotted Flycatcher	*Muscicapa striata*	PASSERIFORMES: Muscicapidae	LC	PM	IV
375	Asian Brown Flycatcher	*Muscicapa dauurica*	PASSERIFORMES: Muscicapidae	LC	WM	IV
376	Brown-breasted Flycatcher	*Muscicapa muttui*	PASSERIFORMES: Muscicapidae	LC	WM	IV
377	Tickell's Blue Flycatcher	*Cyornis tickelliae*	PASSERIFORMES: Muscicapidae	LC	WM	IV
378	Asian Verditer Flycatcher	*Eumyias thalassinus*	PASSERIFORMES: Muscicapidae	LC	WM	IV
379	Indian Blue Robin	*Larvivora brunnea*	PASSERIFORMES: Muscicapidae	LC	PM	IV
380	Bluethroat	*Luscinia svecica*	PASSERIFORMES: Muscicapidae	LC	WM	IV
381	Red-breasted Flycatcher	*Ficedula parva*	PASSERIFORMES: Muscicapidae	LC	WM	IV

#	Common Name	Scientific Name	ORDER-Family	IUCN Status	Distribution	WPA 1972 Schedule
382	Taiga Flycatcher	*Ficedula albicilla*	PASSERIFORMES: Muscicapidae	LC	WM	IV
383	Ultramarine Flycatcher	*Ficedula superciliaris*	PASSERIFORMES: Muscicapidae	LC	WM	IV
384	Black Redstart	*Phoenicurus ochruros*	PASSERIFORMES: Muscicapidae	LC	WM	IV
385	Blue-capped Rock Thrush	*Monticola cinclorhyncha*	PASSERIFORMES: Muscicapidae	LC	WM	IV
386	Blue Rock Thrush	*Monticola solitarius*	PASSERIFORMES: Muscicapidae	LC	WM	IV
387	Common Stonechat	*Saxicola torquatus*	PASSERIFORMES: Muscicapidae	LC	WM	IV
388	Pied Bush Chat	*Saxicola caprata*	PASSERIFORMES: Muscicapidae	LC	WM	IV
389	Isabelline Wheatear	*Oenanthe isabellina*	PASSERIFORMES: Muscicapidae	LC	WM	IV
390	Desert Wheatear	*Oenanthe deserti*	PASSERIFORMES: Muscicapidae	LC	WM	IV
391	Brown Rock Chat	*Oenanthe fusca*	PASSERIFORMES: Muscicapidae	LC	R	IV
392	Variable Wheatear	*Oenanthe picata*	PASSERIFORMES: Muscicapidae	LC	WM	IV
393	Red-tailed Wheatear	*Oenanthe chrysopygia*	PASSERIFORMES: Muscicapidae	LC	WM	IV
394	Orange-headed Thrush	*Geokichla citrina*	PASSERIFORMES: Turdidae	LC	R	IV
395	Indian Blackbird	*Turdus simillimus*	PASSERIFORMES: Turdidae	LC	WM	IV
396	Eyebrowed Thrush	*Turdus obscurus*	PASSERIFORMES: Turdidae	LC	R	IV

IUCN Category: LC-Least Concern, VU-Vulnerable, NT-Near Threatened, EN-Endangered, CR-Critically Endangered

Distribution: WM-Winter Migrant, SM-Summer Migrant, R-Resident

Annexure VI Sample Socio-Economic Questionnaire

Socio-Economic Survey Questionnaire: Study Area

Rohit Solanki

Village :- Barpanch

I. GENERAL PROFILE OF AREA

1.	Village	Valandungra.
	Panchayat & Tehsil	Valadungra, Jetpur Tehsil
	District	Rajkot
	How many villages are present under the Panchayat?	01
	Name of the Villages under Panchayat?	Valadungra
	How many villages fall within 10 kms radius?	Atleast 10 villages.
2.	Total Population in area	Approx 1500
	Male (%)	600 approx
	Female (%)	900 approx
3.	Ethnic Group (% of families in area)	Almost 99% OBC
4.	Religion (% as followed by population of the area)	Hindu 100%
5.	Literacy Level (% of literate, male& female & illiterate)	Overall literacy rate 20%
6.	Main Occupation (primary, secondary, tertiary) in area	Primary: Agriculture Secondary: Business Tertiary: Labor works.
7.	Livestock Details (average % of livestock owned & variety)	cows 60 goats 40 buffalo 50. sheep 40.
8.	Monthly Family Income (average income as per occupation wise)	Farmers :- 8-10000/- Labor :- 8000-10000/-
9.	Government Schemes (available in the area)	Ration card, Ayushyaman Bharat
10.	NGOs working in the area & type of work undertaken	None

II. INFORMATION RELATING TO AMENITIES PRESENT

TYPES OF FACILITIES	Y/N	NO. OF FACILITIES	DISTANCE (< 2km, 2-5 km, > 5km) from area
EDUCATION:			
a. Schools			
• Primary and Anganwadi	Y	01	in village center
• Middle	Y	01	"
• Secondary	N	01	"
• Senior Secondary	N	-	
b. College	N	-	
c. Technical Institutes	N		
d. Vocation Training Centres	N		
e. Medical Schools	N		

Socio-Economic Survey Questionnaire: Study Area

TYPES OF FACILITIES	Y/N	NO. OF FACILITIES	DISTANCE (< 2km, 2-5 km, > 5km) from area
Teacher- Student Ratio:			
Others:			
HEALTH CENTRES:			
a. Hospital	N		
b. Primary Health Centres	N		Mobile medical facilities
c. Pharmacies	N		
d. Private Nursing Homes	N		
e. Maternity Hospitals	N		
f. Veterinary Hospitals	N		Mobile veterinary facilities good
Common Diseases in the Area: Diabetes, B.P, Common Cold Fever.			
OTHER AMENITIES:			
a. Drinking Water	Y	Dam water provided through taps to each household	
b. Sanitation Facilities	Y	Each household has toilet	
c. Electricity Supply	Y	Each house has individual meters	
d. Irrigation Facilities	Y	Lift Irrigation	
e. Transport Facilities (rail connectivity, bus services)	Y	Daily 2 buses to Rajkot	
f. Road Condition	Y	Village Road maintained by Panchayat	
g. Post Office	N	Mobile connectivity and private internet providers	
h. Telecommunication	N		Since last 6 months
i. Banks			

III. GENDER PROFILE IN THE AREA

S. No.	QUESTIONS	REMARKS
1.	What provisions are present specific to women? Specific to Govt. Schemes	Sakhi Mandal by Gujarat Govt. To get loans 1.5% interest. Trying to development workers etc.
2.	What pattern of employment is prevalent among women?	Either farming or housewives.
3.	Do the men go out of the area for employment purpose? If yes, where and what type of work?	Yes to Jetpur in Dairy and plastic factories
4.	Medical problems are prevalent among women	He knows there are problems however doesn't quite know the exact nature of medical problems as women
5.	Are there vocational centres catering to women?	No.

IV. INFORMATION RELATING TO THE PROJECT

S. No.	QUESTIONS	REMARKS
1.	Are you aware of the project in the area?	No

Socio-Economic Survey Questionnaire: Study Area

3.	Are there any cultural heritage/ archaeological sites near the project area?	No
4.	Are there any other development projects in the adjoining area? Nature of the project.	No
5.	Have the land prices gone up in the area?	No change in rates
5.	Do you anticipate any risks associated with the project's operation?	No unawale of any inske
7.	Benefit/Expectation from the Project	Should help develop medical facilities in village as there is no health care units
8.	Any other remarks/observations	—

V. NEEDS ASSESSMENT (Prioritize the areas that need improvement, on a scale from 1 to 10; 1 being the lowest) FOR FUTURE DEVELOPMENT

S.N	Areas	Scale (1-10)	Remarks
1	Education	7	Need for more educational and vocational units
2	Healthcare	10	No health care units dedicated to Village.
3	Infrastructure • Roads • Sanitation	8 57	Roads developed by Panchayat Sanitation is present but people awareness has to be there
4	Skill Development	8	Villagers have no skill other ~~than~~ farming and casual labs
5	Women Empowerment	9	None as women dont interact much
6	Water Supply	2	Village has good water availability due to dam.
7	Power Availability	3	Good to power cuts only once a week
8	Agricultural Development	6	Land acquired during dam construction less land available so only monsoon cultivation is done
9	Any Other	Total 7	Internet connectivity

DATE: 18.10.2022

NOTES:

Annexure VII Signature List of Consultations

S. No.	Name	Gender	Contact Number	Village Name	Signature	Date
1	Smita Vajkal	Female	84695 44355	Gamala	Vaslaal Pooja V.	17/10/2022
2	Pooja Vajkal	Female	〃	Gamala	Vaskala	17/10/2022
3	Alpa Sata	female	9537398510	Gamala	[illegible]	17/10/2022
4	Kanchanben Hirani	female	9687737376	Gamala	[illegible]	17/10/2022
5	Vimal chauhan	male	7327937693	TRAKUDA	[illegible]	17/10/2022
6	Rathod Jignaben	female	9979022966	Trakuda	[illegible]	17/10/2022
7	Kachhad Upesh T.	male	9724524552	Trakuda	[illegible]	17/10/2022
8	Sauhiya Hirenbhai	male	9924104325	Trakuda	[illegible]	17/10/2022
9.	Dabhi Jinalbhai	male	9879285543	Trakuda	[illegible]	17/10/2022
10	Bheladi Jayanti	male	9925424614	Trakuda	J.M. Bheladi	17/10/22
11	Jadeja Harsha	male	9979380980	Rethwad		17/10/2022 (telephonic)
12	Chirag dheerubhai	male	9898508669	Rajkot (telephonic)		
13	Nilesh Kumar Nagarbhai	male				17/10/2022 (telephonic)
14	Pratap Bhai	M	9825409162	Rabarika	[illegible]	18/10/2022
15	Gujera Sonalben	F	9638329594	Rabarika (Prim. Sch)	[illegible]	18/10/2022
16	Kyada Bhavnaben	F	9408214279	〃	B.S. Kyadal	18/10/2022
17	Lukhaniya Asmaben	F	9537514237	〃	[illegible]	18/10/2022

	S. No.	Name	Gender	Contact Number	Village Name	Signature	Date
	18.	Ghanshyambhai	M		Jepur Sarpanch Representative	G.G.-S.	18/10/202
	19.	Sorathiya Dhirajlal	M	99097 42087	Pranchhar J ette.	[illegible]	18/10/2022
Panchayat	20	Ketanbhai	M	7984792587	Gram Panchayat (Umrali)	[illegible]	18/10/2022
Teacher.	21	Dhirajlal N. Rank		9913106490	Umrali.	[illegible]	18/10/22
	22	Prabha ben V.	F	9714713563	Umrali	[illegible]	18/10/22
Nearby solar site	23	Chandraban	M		Bethavad		19/10/2022
	24	Bhikaji	M		Bethavad.		19/10/2022
Equal family nearby solar site	25	Maheshbhai Makani	M		Janvadi, Gondal.		19/10/2022

Stakeholders Signature List

S. No.	Name	Gender	Contact Number	Village Name	Signature	Date
01	DR. HEMAL TANNA	Female	9909145315	G.A.D charakhadi	[illegible]	18/10/22
02	Divyesh Lila	Mal	9825587057	Charkhadi	[illegible]	18/10/22
03	J.J. Gondalia	Mal	7069515018	Charukhadi	[illegible]	18/10/22
04	M. J. Harsoda	male	9904736347	charakhadi	[illegible]	18/10-22
05	P.H. Pithvar.	male	9328718707	Charakhadi	[illegible]	18/10/2022
06	Praveen Singh Jadeja	Male	98252 17292	Garnala	[illegible]	18/10/2022 Cland.
07	Salim Bhai	Male.	7874828370	Padavla	Cant sign	18/10/2022
08	Rohit B. Solanki	M	98638 44444	Veluvdungar	[illegible]	18/10/2022
09	Boraa Jayesh S.	m	9016035971	varasangar	[illegible]	18/10/2022
10	Pethuni Bagreel	m	9925262142	Jambudi	[illegible]	18/10/22
11	Harshad C. Ajaukt	Male	9428268989	MEVASA	[illegible]	18/10/22
12	Meghji Bhai	Male		Jetpur	–	19/10/22 Telephonic
13	Babubhai Varmora	"		"	–	19/10/22

Annexure VIII Environmental Monitoring Reports

GES
Think Today, Enjoy Tomorrow

TC-10299

Global Environment Services

Ambient air Quality Report

Name Of Agency/Company	**Environmental Management Centre Pvt. Ltd** 1308, Wing B, Kohinoor Square,N. C. Kelkar Road, Shivaji Park, Dadar (West), Mumbai – 400 028		
Sampling location	1	**ULR No.**	TC102992200000031F
Date of Sampling	17/10/2022	**Report No.**	22GES10/31
Date of Sample Received	18/10/2022	**Sample collected by**	GES Audit Team
Date of starting Analysis	19/10/2022	**Sampling Time**	1475 Minutes
Date of completion Analysis	22/10/2022	**Gaseous Sampling Flow Rate**	0.5 Liters/Minutes
Time of Sampling	13:05	**Report Date**	22/10/2022
Humidity	52 %	**Average Wind Speed**	2 – 8 Km./Hrs.
GPS Location of Sampling	464	**Ambient Temperature**	29 Degree Centigrade
Dominant Wind Direction From	Southwest	**Sampling by**	Kishan Kapuriya

1.Sampling location : At Solar Land

Sr No.	Parameter	Unit	Method	Permissible Limit	Result
1	PM10	µg/m³	IS 5182 (P-23):2006	100	26
2	PM2.5	µg/m³	As per CPCB	60	09
3	Sulphur Dioxide (SO2)	µg/m³	IS 5182 (P-2):2001	80	9.8
4	Nitrogen Dioxide (NOX)	µg/m³	IS 5182 (P-6):2006	80	15.5

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

Varun Industrial Area, St. No. 5, Shed No. 29, KOTHARIYA - 360 002. RAJKOT

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GES
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Global Environment Services

Ambient air Quality Report

Name Of Agency/Company	**Environmental Management Centre Pvt. Ltd** 1308, Wing B, Kohinoor Square,N. C. Kelkar Road, Shivaji Park, Dadar (West), Mumbai – 400 028		
Sampling location	2	**ULR No.**	TC102992200000032F
Date of Sampling	17/10/2022	**Report No.**	22GES10/32
Date of Sample Received	18/10/2022	**Sample collected by**	GES Audit Team
Date of starting Analysis	19/10/2022	**Sampling Time**	1475 Minutes
Date of completion Analysis	22/10/2022	**Gaseous Sampling Flow Rate**	0.5 Liters/Minutes
Time of Sampling	14:50	**Report Date**	22/10/2022
Humidity	52 %	**Average Wind Speed**	2 – 8 Km./Hrs.
GPS Location of Sampling	466	**Ambient Temperature**	30 Degree Centigrade
Dominant Wind Direction From	Southwest	**Sampling by**	Kishan Kapuriya

2.Sampling location : Nr. Khodiyar Temple Umrali Road, Umrali

Sr No.	Parameter	Unit	Method	Permissible Limit	Result
1	PM10	µg/m³	IS 5182 (P-23):2006	100	34
2	PM2.5	µg/m³	As per CPCB	60	12
3	Sulphur Dioxide (SO2)	µg/m³	IS 5182 (P-2):2001	80	12.7
4	Nitrogen Dioxide (NOX)	µg/m³	IS 5182 (P-6):2006	80	18.1

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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GES
Think Today, Enjoy Tomorrow

TC-10299

Global Environment Services

Ambient air Quality Report

Name Of Agency/Company	**Environmental Management Centre Pvt. Ltd** 1308, Wing B, Kohinoor Square,N. C. Kelkar Road, Shivaji Park, Dadar (West), Mumbai – 400 028		
Sampling location	3	**ULR No.**	TC102992200000033F
Date of Sampling	17/10/2022	**Report No.**	22GES10/33
Date of Sample Received	18/10/2022	**Sample collected by**	GES Audit Team
Date of starting Analysis	19/10/2022	**Sampling Time**	1475 Minutes
Date of completion Analysis	22/10/2022	**Gaseous Sampling Flow Rate**	0.5 Liters/Minutes
Time of Sampling	16:00	**Report Date**	22/10/2022
Humidity	52 %	**Average Wind Speed**	2 – 8 Km./Hrs.
GPS Location of Sampling	471	**Ambient Temperature**	30 Degree Centigrade
Dominant Wind Direction From	Southwest	**Sampling by**	Kishan Kapuriya

3.Sampling location : Nr. Rabarika Village

Sr No.	Parameter	Unit	Method	Permissible Limit	Result
1	PM10	µg/m³	IS 5182 (P-23):2006	100	37
2	PM2.5	µg/m³	As per CPCB	60	14
3	Sulphur Dioxide (SO2)	µg/m³	IS 5182 (P-2):2001	80	13.2
4	Nitrogen Dioxide (NOX)	µg/m³	IS 5182 (P-6):2006	80	15.7

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

Varun Industrial Area, St. No. 5, Shed No. 29, KOTHARIYA - 360 002. RAJKOT

globalenvironment7@gmail.com +91 70169 52782

GES
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Global Environment Services

Report No:22GES10/38	**Date:29/10/2022**
Name Of Agency/Company	M/s. **Environmental Management Center LLP** 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028
Details of sample/Mode of Packing	Sample Packed in Plastic Bottle
Report Issued To	Environmental Management Center LLP
Date Of Sampling.	17/10/2022
Sample Quantity	1 Litters.
Condition of sample during receipt	Satisfactory
Sampling Done By.	Mr. Kishan Kapuriya
Sampling Location	At Solar Land
GPS Location	462
Starting Date Of Test/ Analysis	19/10/2022
Completion Date of Test	22/10/2022

PHYSICO CHEMICAL PARAMETERS Water as IS 10500-2012

Sr. No.	Parameter	Method	Requirement (Acceptable Limit) (IS: 10500-2012)	UNIT	Result
Table 1 Organoleptic and Physical Parameters (Clause 4)					
1.	Colour,	IS: 3025 (P-4)	5 max.	Hazen units	< 1
2.	Odour	IS: 3025 (P-5)	Agreeable	---	Agreeable
3.	pH value	IS: 3025 (P-11)	6.5 to 8.5	---	6.75
4.	Taste	IS: 3025 (P-7 & 8)	Agreeable	---	Agreeable
5.	Turbidit	IS: 3025 (P-10)	1 max.	NTU	0.3
6.	Total Dissolved Solids	IS: 3025 (P-16)	500 max.	mg/l	540
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts (Clause 4)					
7.	Aluminium as Al (mg/l)	IS: 3025 (P-55)	0.03 max.	mg/l	ND
8.	Total Ammonia as N (mg/l)	IS: 3025 (P-34)	0.5 max.	mg/l	ND
9.	Anionic Detergents as MBAS (mg/l)	Anx. K of IS: 13428	0.2 max.	mg/l	ND
10.	Barium as Ba (mg/l)	Anx. F of IS: 13428	0.7 max.	mg/l	ND
11.	Boron as B (mg/l)	Cl.29 of IS: 3025	0.5 max.	mg/l	ND
12.	Calcium as Ca (mg/l)	IS: 3025 (P-40)	75 max.	mg/l	32.46
13.	Chloramines (as Cl2) (mg/l)	IS: 3025 (Part- 26) 1986	4 max.	mg/l	ND
14.	Chloride as Cl (mg/l)	IS: 3025 (P-32)	250 max.	mg/l	90.8
15.	Copper as Cu (mg/l)	IS: 3025 (P-42)	0.05 max.	mg/l	ND
16.	Fluoride as F (mg/l)	IS: 3025 (P-60)	1.0 max.	mg/l	ND

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17.	Free Residual Chlorine (mg/l)	IS: 3025 (P-26)	0.2 min.	mg/l	ND
18.	Iron as Fe (mg/l)	IS: 3025 (P-53)	0.3 max.	mg/l	ND
19.	Magnesium as Mg (mg/l)	IS: 3025 (P-46)	30 max.	mg/l	4.26
20.	Manganese as Mn (mg/l)	IS: 3025 (P-59)	0.1 max.	mg/l	ND
21.	Mineral Oil (mg/l)	Cl. 6 of IS: 3025 (P-39)	0.5 max.	mg/l	ND
22.	Nitrate as NO_3 (mg/l)	IS: 3025 (P-34)	45 max.	mg/l	4.32
23.	Phenolic Compounds as C_6H_5OH (mg/l)	IS: 3025 (P-43)	0.001 max.	mg/l	ND
24.	Selenium as Se (mg/l)	IS: 3025 (P-56)	0.01 max.	mg/l	ND
25.	Silver as Ag (mg/l)	Anx. J of IS: 13428	0.1 max.	mg/l	ND
26.	Sulphate as SO_4 (mg/l)	IS: 3025 (P-24)	200 max.	mg/l	3.41
27.	Sulphide as H_2S (mg/l)	IS: 3025 (P-29)	0.05 max.	mg/l	ND
28.	Total Alkalinity as HCO_3 (mg/l)	IS: 3025 (P-23)	200 max.	mg/l	112.26
29.	Total Hardness as $CaCO_3$ (mg/l)	IS: 3025 (P-21)	200 max.	mg/l	161.5
30.	Zinc as Zn (mg/l)	IS: 3025 (P-49)	5 max.	mg/l	ND
Table 3 Parameters Concerning Toxic Substances (Clause 4)					
31.	Cadmium as Cd (mg/l)	IS: 3025 (P-41)	0.003 max.	mg/l	ND
32.	Cyanide as CN (mg/l)	IS: 3025 (P-27)	0.05 max.	mg/l	ND
33.	Lead as Pb (mg/l)	IS: 3025 (P-47)	0.01 max.	mg/l	ND
34.	Mercury as Hg (mg/l)	IS: 3025 (P-48)	0.001 max.	mg/l	ND
35.	Molybdenum (as Mo) (mg/l)	IS: 3025 (P-2)	0.07 max.	mg/l	ND
36.	Nickel as Ni (mg/l)	IS: 3025 (P-54)	0.02 max.	mg/l	ND
37.	Polychlorinated biphenyls (mg/l)	ASTM 5175	0.0005 max.	mg/l	ND
38.	Polynuclear aromatic hydrocarbons (as PAH) (mg/l)	APHA 6440	0.0001 max.	mg/l	ND
39.	Total Arsenic as As (mg/l)	IS: 3025 (P-37)	0.01 max.	mg/l	ND
40.	Total Chromium as Cr (mg/l)	IS: 3025 (P-52)	0.05 max.	mg/l	ND
Table 4 Pesticide Residues					
41.	Alachlor	US EPA 525.2.1995	20	---	B.L.Q.
42.	Atrazine	US EPA 525.2.1995	2	---	B.L.Q.
43.	Aldrin	US EPA 525.2.1995	0.03	---	B.L.Q.
44.	Dieldrin	US EPA 525.2.1995	0.03	---	B.L.Q.
45.	Alpha HCH	US EPA 525.2.1995	0.01	---	B.L.Q.
46.	Beta HCH	US EPA 525.2.1995	0.04	---	B.L.Q.
47.	Butachlor	US EPA 525.2.1995	125	---	B.L.Q.
48.	Chlorpyriphos	US EPA 525.2.1995	30	---	B.L.Q.
49.	Delta HCH	US EPA 525.2.1995	0.04	---	B.L.Q.
50.	2, 4 – Dichlorophenoxyacetic acid	US EPA 515.1.1995	30	---	B.L.Q.

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51.	o,p DDT (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
52.	p,p DDT (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
53.	o,p DDE (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
54.	p,p DDE (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
55.	o,p DDD (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
56.	p,p DDD (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
57.	Alpha endosulfan (mg/l)	US EPA 525.2.1995	0.4	mg/l	B.L.Q.
58.	Beta endosulfan (mg/l)	US EPA 525.2.1995	0.4	mg/l	B.L.Q.
59.	Endosulfan Sulphate (mg/l)	US EPA 525.2.1995	0.4	mg/l	B.L.Q.
60.	Ethion	US EPA 525.2.1995	3	---	B.L.Q.
61.	Gamma-HCH (Undane)	US EPA 525.2.1995	2	Undane	B.L.Q.
62.	Isoproturon	US EPA 532.2000	9	---	B.L.Q.
63.	Malathion	US EPA 525.2.1995	190	---	B.L.Q.
64.	Methyl Parathion	US EPA 525.2.1995	0.3	---	B.L.Q.
65.	Monocrotophos	US EPA 525.2.1995	1	---	B.L.Q.
66.	Phorate	US EPA 81418 Rev2 Feb 2007	2	---	B.L.Q.
Table 6 Bacteriological Quality of Water					
67.	E. coli / 100ml	IS: 1622-1981	Absent	CFU* / 100 ml	Absent
68.	Total Coliform Bacteria / 100ml	IS: 1622-1981	Absent	CFU* / 100 ml	Absent

^ Action Tendency Scale, # NTU – Nephelometric Turbidity units * N.D.- Not detected,
*CFU-Colony Forming Unit B.L.Q. – Below Limit of Quantification.

REMARKS:
1 This report, in full or in part, shall not be published, advertised, used for any legal action, unless prior permission has been secured from **The Director, Global Environment Services, RAJKOT.**
2 The test report pertains to the sample tested.
3 Sample not drawn by lab representative.

Approved By

Lab Incharge

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For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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Global Environment Services

Report No:22GES10/39	Date:29/10/2022
Name Of Agency/Company	M/s. Environmental Management Center LLP 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028
Details of sample/Mode of Packing	Sample Packed in Plastic Bottle
Report Issued To	Environmental Management Center LLP
Date Of Sampling.	17/10/2022
Sample Quantity	1 Litters.
Condition of sample during receipt	Satisfactory
Sampling Done By.	Mr. Kishan Kapuriya
Sampling Location	Near Rabarika Village
GPS Location	470
Starting Date Of Test/ Analysis	19/10/2022
Completion Date of Test	22/10/2022

PHYSICO CHEMICAL PARAMETERS Water as IS 10500-2012

Sr. No.	Parameter	Method	Requirement (Acceptable Limit) (IS: 10500-2012)	UNIT	Result
Table 1 Organoleptic and Physical Parameters (Clause 4)					
1.	Colour,	IS: 3025 (P-4)	5 max.	Hazen units	< 1
2.	Odour	IS: 3025 (P-5)	Agreeable	---	Agreeable
3.	pH value	IS: 3025 (P-11)	6.5 to 8.5	---	7.01
4.	Taste	IS: 3025 (P-7 & 8)	Agreeable	---	Agreeable
5.	Turbidit	IS: 3025 (P-10)	1 max.	NTU	0.3
6.	Total Dissolved Solids	IS: 3025 (P-16)	500 max.	mg/l	1480
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts (Clause 4)					
7.	Aluminium as Al (mg/l)	IS: 3025 (P-55)	0.03 max.	mg/l	ND
8.	Total Ammonia as N (mg/l)	IS: 3025 (P-34)	0.5 max.	mg/l	ND
9.	Anionic Detergents as MBAS (mg/l)	Anx. K of IS: 13428	0.2 max.	mg/l	ND
10.	Barium as Ba (mg/l)	Anx. F of IS: 13428	0.7 max.	mg/l	ND
11.	Boron as B (mg/l)	Cl.29 of IS: 3025	0.5 max.	mg/l	ND
12.	Calcium as Ca (mg/l)	IS: 3025 (P-40)	75 max.	mg/l	78.42
13.	Chloramines (as Cl2) (mg/l)	IS: 3025 (Part- 26) 1986	4 max.	mg/l	ND
14.	Chloride as Cl (mg/l)	IS: 3025 (P-32)	250 max.	mg/l	312.69
15.	Copper as Cu (mg/l)	IS: 3025 (P-42)	0.05 max.	mg/l	ND
16.	Fluoride as F (mg/l)	IS: 3025 (P-60)	1.0 max.	mg/l	0.30

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17.	Free Residual Chlorine (mg/l)	IS: 3025 (P-26)	0.2 min.	mg/l	ND
18.	Iron as Fe (mg/l)	IS: 3025 (P-53)	0.3 max.	mg/l	ND
19.	Magnesium as Mg (mg/l)	IS: 3025 (P-46)	30 max.	mg/l	10.48
20.	Manganese as Mn (mg/l)	IS: 3025 (P-59)	0.1 max.	mg/l	ND
21.	Mineral Oil (mg/l)	Cl. 6 of IS: 3025 (P-39)	0.5 max.	mg/l	ND
22.	Nitrate as NO_3 (mg/l)	IS: 3025 (P-34)	45 max.	mg/l	6.19
23.	Phenolic Compounds as C_6H_5OH (mg/l)	IS: 3025 (P-43)	0.001 max.	mg/l	ND
24.	Selenium as Se (mg/l)	IS: 3025 (P-56)	0.01 max.	mg/l	ND
25.	Silver as Ag (mg/l)	Anx. J of IS: 13428	0.1 max.	mg/l	ND
26.	Sulphate as SO_4 (mg/l)	IS: 3025 (P-24)	200 max.	mg/l	12.5
27.	Sulphide as H_2S (mg/l)	IS: 3025 (P-29)	0.05 max.	mg/l	ND
28.	Total Alkalinity as HCO_3 (mg/l)	IS: 3025 (P-23)	200 max.	mg/l	232.46
29.	Total Hardness as $CaCO_3$ (mg/l)	IS: 3025 (P-21)	200 max.	mg/l	418.6
30.	Zinc as Zn (mg/l)	IS: 3025 (P-49)	5 max.	mg/l	ND
Table 3 Parameters Concerning Toxic Substances (Clause 4)					
31.	Cadmium as Cd (mg/l)	IS: 3025 (P-41)	0.003 max.	mg/l	ND
32.	Cyanide as CN (mg/l)	IS: 3025 (P-27)	0.05 max.	mg/l	ND
33.	Lead as Pb (mg/l)	IS: 3025 (P-47)	0.01 max.	mg/l	ND
34.	Mercury as Hg (mg/l)	IS: 3025 (P-48)	0.001 max.	mg/l	ND
35.	Molybdenum (as Mo) (mg/l)	IS: 3025 (P-2)	0.07 max.	mg/l	ND
36.	Nickel as Ni (mg/l)	IS: 3025 (P-54)	0.02 max.	mg/l	ND
37.	Polychlorinated biphenyls (mg/l)	ASTM 5175	0.0005 max.	mg/l	ND
38.	Polynuclear aromatic hydrocarbons (as PAH) (mg/l)	APHA 6440	0.0001 max.	mg/l	ND
39.	Total Arsenic as As (mg/l)	IS: 3025 (P-37)	0.01 max.	mg/l	ND
40.	Total Chromium as Cr (mg/l)	IS: 3025 (P-52)	0.05 max.	mg/l	ND
Table 4 Pesticide Residues					
41.	Alachlor	US EPA 525.2.1995	20	---	B.L.Q.
42.	Atrazine	US EPA 525.2.1995	2	---	B.L.Q.
43.	Aldrin	US EPA 525.2.1995	0.03	---	B.L.Q.
44.	Dieldrin	US EPA 525.2.1995	0.03	---	B.L.Q.
45.	Alpha HCH	US EPA 525.2.1995	0.01	---	B.L.Q.
46.	Beta HCH	US EPA 525.2.1995	0.04	---	B.L.Q.
47.	Butachlor	US EPA 525.2.1995	125	---	B.L.Q.
48.	Chlorpyriphos	US EPA 525.2.1995	30	---	B.L.Q.
49.	Delta HCH	US EPA 525.2.1995	0.04	---	B.L.Q.
50.	2, 4 – Dichlorophenoxyacetic acid	US EPA 515.1.1995	30	---	B.L.Q.

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54.	p,p DDE (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
55.	o,p DDD (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
56.	p,p DDD (mg/l)	US EPA 525.2.1995	1	mg/l	B.L.Q.
57.	Alpha endosulfan (mg/l)	US EPA 525.2.1995	0.4	mg/l	B.L.Q.
58.	Beta endosulfan (mg/l)	US EPA 525.2.1995	0.4	mg/l	B.L.Q.
59.	Endosulfan Sulphate (mg/l)	US EPA 525.2.1995	0.4	mg/l	B.L.Q.
60.	Ethion	US EPA 525.2.1995	3	---	B.L.Q.
61.	Gamma-HCH (Undane)	US EPA 525.2.1995	2	Undane	B.L.Q.
62.	Isoproturon	US EPA 532.2000	9	---	B.L.Q.
63.	Malathion	US EPA 525.2.1995	190	---	B.L.Q.
64.	Methyl Parathion	US EPA 525.2.1995	0.3	---	B.L.Q.
65.	Monocrotophos	US EPA 525.2.1995	1	---	B.L.Q.
66.	Phorate	US EPA 81418 Rev2 Feb 2007	2	---	B.L.Q.
Table 6 Bacteriological Quality of Water					
67.	E. coli / 100ml	IS: 1622-1981	Absent	CFU* / 100 ml	Absent
68.	Total Coliform Bacteria / 100ml	IS: 1622-1981	Absent	CFU* / 100 ml	Absent

^ Action Tendency Scale, # NTU – Nephelometric Turbidity units * N.D.- Not detected.
*CFU-Colony Forming Unit B.L.Q. – Below Limit of Quantification.

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2 The test report pertains to the sample tested.
3 Sample not drawn by lab representative.

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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TC-10299

Global Environment Services

Name Of Agency/Company	M/s. Environmental Management Center LLP 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028		
Sampling Locatation	At Solar Land	ULR No.	TC102992200000034F
Date of Sampling	17/10/2022	Sample collected by	GES Audit Team
Analysis Completed on	20/10/2022	Duration of Sampling	24 hours
Date of Reporting	20/10/2022	Report No.	22GES10/34
Reference Method	IS 9989:1991	GPS Lactation	465

Noise Level Monitoring Report

Sr No	Time of Sampling	Unit	Day Time Results In dB(A)	Day Time GPCB Limits In dB(A)	Night Time Results In dB(A)	Night Time GPCB Limits In dB(A)
1	17:00	dB(A)	22.6	50	-	40
2	18:00	dB(A)	21.5	50		40
3	19:00	dB(A)	22.5	50		40
4	20: 00	dB(A)	22.1	50		40
5	21: 00	dB(A)	19.5	50		40
6	22:00	dB(A)	19.8	50		40
7	23:00	dB(A)	-	50	19.4	40
8	00:00	dB(A)	-	50	20.1	40
9	01:00	dB(A)	-	50	21.3	40
10	02:00	dB(A)	-	50	19.8	40
11	03:00	dB(A)	-	50	20.2	40
12	04:00	dB(A)	-	50	19.9	40
13	05:00	dB(A)	-	50	19.7	40
14	06:00	dB(A)	19.8	50	-	40
15	07:00	dB(A)	19.4	50	-	40
16	08:00	dB(A)	19.9	50	-	40
17	09:00	dB(A)	19.5	50	-	40
18	10:00	dB(A)	19.8	50	-	40
19	11:00	dB(A)	20.1	50	-	40

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20	12:00	dB(A)	21.8	50	-	40
21	13:00	dB(A)	22.5	50	-	40
22	14:00	dB(A)	25.6	50	-	40
23	15:00	dB(A)	26.3	50	-	40
24	16:00	dB(A)	25.4	50	-	40

Remarks: Noise level Monitoring Carried Out during Day Time between 6:00A.M. To 10:00P.M. & Night Time between 10:00P.M. To 6:00A.M.

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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Name Of Agency/Company	M/s. Environmental Management Center LLP 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028		
Sampling Locatation	Umrali Road	ULR No.	TC102992200000035F
Date of Sampling	17/10/2022	Sample collected by	GES Audit Team
Analysis Completed on	20/10/2022	Duration of Sampling	24 hours
Date of Reporting	20/10/2022	Report No.	22GES10/35
Reference Method	IS 9989:1991	GPS Lactation	467

Noise Level Monitoring Report

Sr No	Time of Sampling	Unit	Day Time Results In dB(A)	Day Time GPCB Limits In dB(A)	Night Time Results In dB(A)	Night Time GPCB Limits In dB(A)
1	17:00	dB(A)	46.1	50	-	40
2	18:00	dB(A)	42.6	50	-	40
3	19:00	dB(A)	57.2	50	-	40
4	20: 00	dB(A)	38.1	50	-	40
5	21: 00	dB(A)	37.8	50	-	40
6	22:00	dB(A)	40.1	50	-	40
7	23:00	dB(A)	-	50	29.4	40
8	00:00	dB(A)	-	50	30.1	40
9	01:00	dB(A)	-	50	28.3	40
10	02:00	dB(A)	-	50	28.8	40
11	03:00	dB(A)	-	50	22.2	40
12	04:00	dB(A)	-	50	20.9	40
13	05:00	dB(A)	-	50	19.7	40
14	06:00	dB(A)	24.8	50	-	40
15	07:00	dB(A)	31.4	50	-	40
16	08:00	dB(A)	40.9	50	-	40
17	09:00	dB(A)	19.5	50	-	40
18	10:00	dB(A)	43.8	50	-	40
19	11:00	dB(A)	20.1	50	-	40

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20	12:00	dB(A)	55.6	50	-	40
21	13:00	dB(A)	48.5	50	-	40
22	14:00	dB(A)	41.6	50	-	40
23	15:00	dB(A)	45.3	50	-	40
24	16:00	dB(A)	48.1	50	-	40

Remarks: Noise level Monitoring Carried Out during Day Time between 6:00A.M. To 10:00P.M. & Night Time between 10:00P.M. To 6:00A.M.

Approved By

Lab Incharge

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For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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Name Of Agency/Company	M/s. Environmental Management Center LLP 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028		
Sampling Locatation	Jepur Village	ULR No.	TC102992200000036F
Date of Sampling	17/10/2022	Sample collected by	GES Audit Team
Analysis Completed on	20/10/2022	Duration of Sampling	24 hours
Date of Reporting	20/10/2022	Report No.	22GES10/36
Reference Method	IS 9989:1991	GPS Lactation	469

Noise Level Monitoring Report

Sr No	Time of Sampling	Unit	Day Time Results In dB(A)	Day Time GPCB Limits In dB(A)	Night Time Results In dB(A)	Night Time GPCB Limits In dB(A)
1	17:00	dB(A)	47.6	50	-	40
2	18:00	dB(A)	29.8	50	-	40
3	19:00	dB(A)	28.5	50	-	40
4	20: 00	dB(A)	36.2	50	-	40
5	21: 00	dB(A)	28.4	50	-	40
6	22:00	dB(A)	25.1	50	-	40
7	23:00	dB(A)	-	50	22.4	40
8	00:00	dB(A)	-	50	20.1	40
9	01:00	dB(A)	-	50	22.3	40
10	02:00	dB(A)	-	50	21.8	40
11	03:00	dB(A)	-	50	21.2	40
12	04:00	dB(A)	-	50	20.9	40
13	05:00	dB(A)	-	50	19.5	40
14	06:00	dB(A)	25.8	50	-	40
15	07:00	dB(A)	26.4	50	-	40
16	08:00	dB(A)	32.9	50	-	40
17	09:00	dB(A)	35.5	50	-	40
18	10:00	dB(A)	39.8	50	-	40
19	11:00	dB(A)	45.6	50	-	40

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20	12:00	dB(A)	36.5	50	-	40
21	13:00	dB(A)	33.5	50	-	40
22	14:00	dB(A)	37.6	50	-	40
23	15:00	dB(A)	35.3	50	-	40
24	16:00	dB(A)	36.4	50	-	40

Remarks: Noise level Monitoring Carried Out during Day Time between 6:00A.M. To 10:00P.M. & Night Time between 10:00P.M. To 6:00A.M.

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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TC-10299

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Name Of Agency/Company	M/s. Environmental Management Center LLP 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028		
Sampling Locatation	Nr Rabarika Village	ULR No.	TC102992200000037F
Date of Sampling	17/10/2022	Sample collected by	GES Audit Team
Analysis Completed on	20/10/2022	Duration of Sampling	24 hours
Date of Reporting	20/10/2022	Report No.	22GES10/37
Reference Method	IS 9989:1991	GPS Lactation	472

Noise Level Monitoring Report

Sr No	Time of Sampling	Unit	Day Time Results In dB(A)	Day Time GPCB Limits In dB(A)	Night Time Results In dB(A)	Night Time GPCB Limits In dB(A)
1	17:00	dB(A)	36.6	50	-	40
2	18:00	dB(A)	38.5	50		40
3	19:00	dB(A)	26.5	50		40
4	20: 00	dB(A)	31.1	50		40
5	21: 00	dB(A)	29.8	50		40
6	22:00	dB(A)	25.1	50		40
7	23:00	dB(A)	-	50	23.4	40
8	00:00	dB(A)	-	50	21.3	40
9	01:00	dB(A)	-	50	19.4	40
10	02:00	dB(A)	-	50	21.3	40
11	03:00	dB(A)	-	50	20.4	40
12	04:00	dB(A)	-	50	19.6	40
13	05:00	dB(A)	-	50	21.7	40
14	06:00	dB(A)	22.8	50	-	40
15	07:00	dB(A)	25.3	50	-	40
16	08:00	dB(A)	28.7	50	-	40
17	09:00	dB(A)	36.3	50	-	40
18	10:00	dB(A)	47.8	50	-	40
19	11:00	dB(A)	38.3	50	-	40

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TC-10259

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20	12:00	dB(A)	41.5	50	-	40
21	13:00	dB(A)	39.5	50	-	40
22	14:00	dB(A)	38.5	50	-	40
23	15:00	dB(A)	29.6	50	-	40
24	16:00	dB(A)	41.4	50	-	40

Remarks: Noise level Monitoring Carried Out during Day Time between 6:00A.M. To 10:00P.M. & Night Time between 10:00P.M. To 6:00A.M.

Approved By

Lab Incharge

Global Environment Services RAJKOT

For Global Environment Services

Authorized Signatory
Mr. Jay Trada
(Quality Manager)

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SOIL TEST REPORT

Report No	22GES10/40
Name Of Agency/Company	M/s. Environmental Management Center LLP 1308, Wing B, Kohinoor Square, N.C. Kelkar Road,Sivaji Park,Dadar(West),Mumbai 400028
Details of sample/Mode of Packing	Sample Packed in Plastic Bag
Date Of Sampling	17/10/2022
Sample Quantity	500 gm
Sampling Location	At Solar Land
GPS Location	463
Starting Date Of Test/ Analysis	19/10/2022
Completion Date of Test	29/10/2022
Sample Description	Soil
Date of Reporting	29/10/2022

PHYSICO CHEMICAL PARAMETERS

Sr. No.	TESTS	UNIT	Method	RESULT
1	Gravel	%	IS 2720 Part 4	44
	Sand	%		56
	Soil + Clay	%		0
2	Texture	-	-	Texture for Visual
3	Permeability	mm/sec	IS 2720 Part 17	9.33
4	Porosity	%	IS 2720	-
5	pH	---	IS 2720 Part 26	7.2
6	Electric Conductivity	mS/Cm2	IS 14767	1.925
7	Nitrogen	kg/hector	IS 14684	90.0
8	Phosphorous	kg/hector	IS 6092 Part 3	12.5
9	Potassium	kg/hector	IS 6092 Part 4	150
10	Sodium	mg/Kg	SOP.QUFL.05	1220
11	Cation Exchange Capacity	meq/100 gm	IS 2720	3.5

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