Ayana Renewable Power Private Limited

Environmental and Social Impact Assessment of 300 MW Wind Power Project in Gadag, Karnataka

Final Draft Report

09 November 2021

Project No.: 0608925

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Document details	
Document title	**Environmental and Social Impact Assessment of 300 MW Wind Power Project in Gadag, Karnataka**
Document subtitle	Final Draft Report
Project No.	0608925
Date	9 November 2021
Version	1.0
Author	ERM India Private Limited
Client Name	Ayana Renewable Power Private Limited

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
Draft	00	Deepti M., Shruti S., Omesh B.	Rashmi Dutta	Ajay Pillai	16.09.21	Submitted as draft
Draft	01	Deepti M., Shruti S., Omesh B.	Rashmi Dutta	Ajay Pillai	01.10. 21	Submitted after addressing comments
Final Draft	02	Rashmi D; Shruti S., Omesh B.	Rashmi Dutta	Ajay Pillai	09.11.21	Submitted after addressing comments

Signature Page

09 November 2021

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Final Draft Report

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Acronyms and Abbreviations

Abbreviation	Description
AAQ	Ambient Air Quality
AoI	Area of Influence
ATS	Agreement to Sell
BDL	Below Detectable Limit
BEE	Bureau of Energy Efficiency
CEA	Central Electricity Authority
CGWB	Central Ground Water Board
CMS	Condition Monitoring System
CO	Carbon Monoxide
CPCB	Central Pollution Control Board
CPR	Common Property Resources
CR	Critically Endangered
DG	Diesel Generator
DISH	Directorate Industrial Safety and Health Department
EC	Environment Clearance
EHS	Environment, Health and Safety
EIA	Environment Impact Assessment
EMF	Electromagnetic field
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
EPFI	Equator Principles Financial Institutions
ERM	Environmental Resources Management
ESIA	Environment and Social Impact Assessment
ESMP	Environment and Social Management Plan
ESZ	Eco sensitive Zone
FCCC	Framework Convention on Climate Change
FY	Financial Year
GHG	Greenhouse Gas
GIS	Geographic Information System
GoI	Government of India
GP	Gram Panchayat
GSI	Geological Survey of India
GSS	Grid sub-station
GW	Groundwater
IFC	International Finance Corporation
ILO	International Labour Organisation
IMD	Indian Meteorological Department
KL	Kilo litre
KLD	Kilo litre per day
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MoP	Ministry of Power
MSIHC	Manufacture, storage and import of hazardous chemicals
MW	Megawatt

Abbreviation	Description
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing and Calibration Laboratories
NGO	Non-Governmental Organisation
NGT	National Green Tribunal
NH	National Highways
NIWE	National institute of wind energy
NOC	No Objection Certificate
NOx	Oxides of Nitrogen
NQ	Noise Quality
NT	Near Threatened
O&M	Operation and Maintenance
PCC	Pollution Control Committee
PESO	Petroleum and Explosives Safety Organisation
PGCIL	Power Grid Corporation of India
PHC	Public Health Centre
PM	Particulate Matter
PPE	Personal Protective Equipment
PS	Performance Standards
PSS	Pooling Sub-station
PUC	Pollution Under Control Certificate
RoW	Right of Way
SC	Schedule Caste
SCADA	Supervisory Control and Data Acquisition
SDA	State designated agency
SEIAA	State Environmental Impact Assessment Authority
SO2	Sulphur Dioxide
SOP	Standard Operating Procedure
SPS	Safeguard Policy Statement
ST	Schedule Tribe
SW	Surface water
TDS	Total Dissolved Solids
TL	Transmission line
WB	World Bank
WHO	World Health Organization
WTG	Wind Turbine Generator

1. INTRODUCTION

ERM India Private Limited (hereinafter referred as 'ERM') has been commissioned by Ayana Renewable Power Private Limited (hereafter referred to as 'Ayana' or the 'Client') for undertaking an Environmental and Social Impact Assessment of the proposed 300 MW Wind Power Plant in Gadag and Mundaragi taluk of Gadag district, in the state of Karnataka.

1.1 Purpose of Environmental and Social Impact Assessment (ESIA) Study

The purpose of the ESIA is to identify environmental, social and ecological sensitivities and impacts associated with the current planning, construction, operation and decommissioning of the proposed wind plant. The study also suggests mitigation measures for onsite implementation and to reduce potential impacts during the Project life cycle. ERM has conducted the ESIA study to meet the requirements of the specified reference framework as discussed in **Section 1.2**

1.2 Applicable Reference Framework

Applicable reference framework for the ESIA report is given below.

- Applicable National Environmental and Social Legislations and Policies;
- DFC Environmental and Social Policy and Procedures, 2020;
- IFC Performance Standards (2012);
- IFC General EHS Guidelines (available at IFC website) and the associated EHS guidelines notably:
    - EHS Guidelines for Wind Energy (August 2015) – relevant for the O&M Phase; and
    - EHS Guidelines for Electric Power Transmission and Distribution (April 2007) – relevant for the O&M Phase
- Environment and Social Framework of AIIB; and
- NIIFL E&S Principles, 2018.

1.3 Project Overview

Ayana intends to undertake an environment and social impact assessment (ESIA) of their proposed 300 MW wind power plant in Gadag and Mundaragi taluk in Gadag District in the State of Karnataka. Currently, the project is in planning phase where land identification and procurement is underway.

According to the details provided by Ayana and site representatives, approximately 560 acres of land shall be required for the project. Basis document review and consultations with Ayana's site representative and land aggregator, it was understood that, of the 560 acres, 112 acres of land would be purchased and the remaining land would be leased for a period of 29 years and 11 months for WTG erection. This leased land will include access roads and land for transmission lines. Land will be leased for approximately 2 years for developing temporary roads for vehicle, heavy vehicle movement and shall be decided before the construction phase. The land parcels of WTG micro siting identified for setting up the project are Kanaginahal, Harlapur, Adavisomapur, Sambhapur, Balajinagar, Papanashi, Lakkundi, Gadag-Betigeri (CMC), Kadampur, Churchihal, Jantli Shirur, Shingatarayanakeri, Doni, Dambal, Narasapura . Land procurement process in Hatelgeri, Kanaginahal, Adavisomapur, Balajinagar, Panapashi, Gadag-Betigeri (CMC), Shingatarayankeri, Dambal, Narsapura and JantliShirur was not initiated during ERM team site visit.

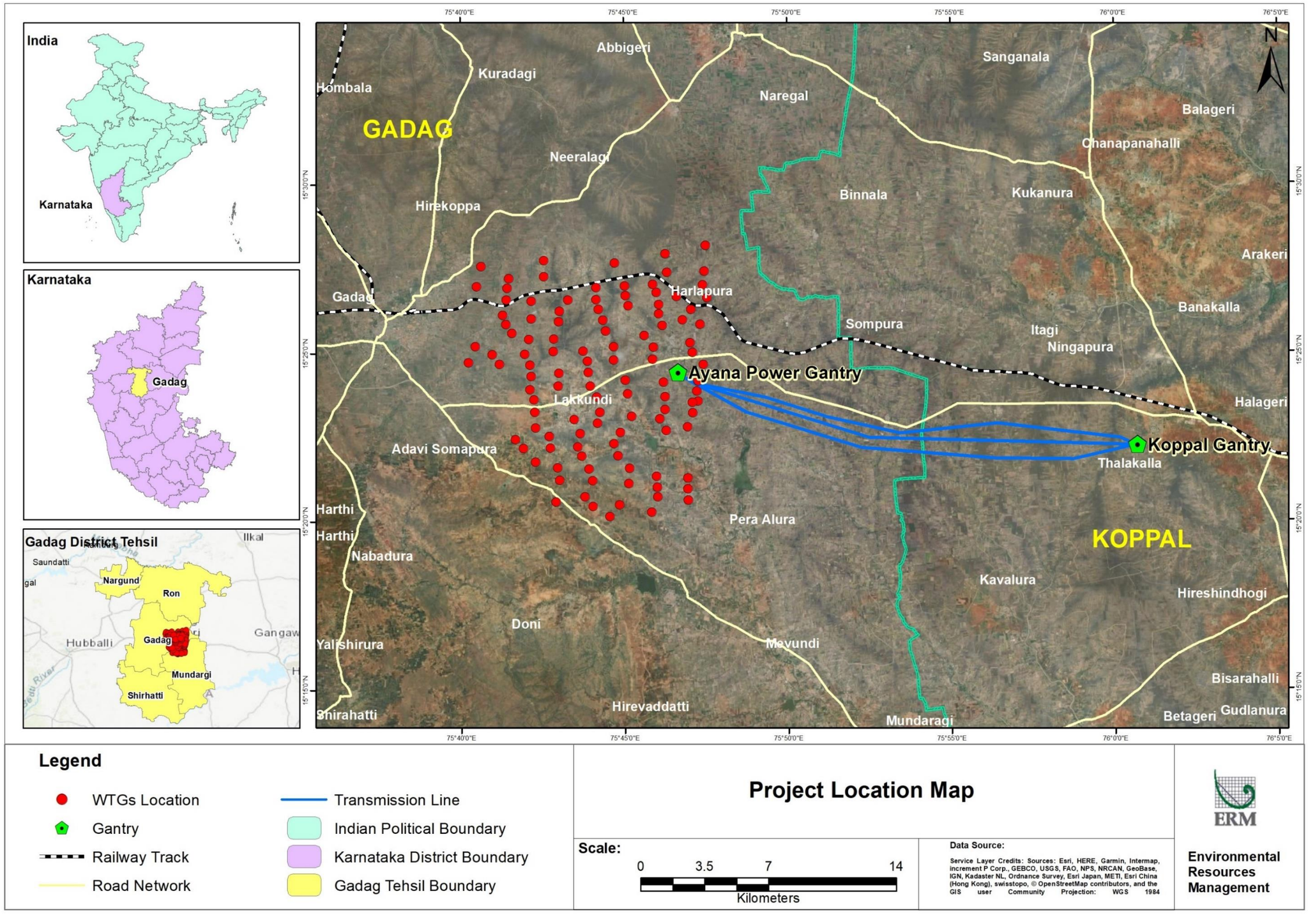
Table 1.1 Snapshot of the Project

Aspect	Details
District	Gadag
Taluk	Gadag and Mundaragi
Core Villages[1]	Kanaginahal, Harlapur, Adavisomapur, Sambhapur, Balajinagar, Papanashi, Lakkundi, Gadag-Betigeri (CMC), Kadampur, Churchihal, Jantli Shirur, Shingatarayanakeri, Doni, Dambal, Narasapura
Total Capacity (MW)	300 MW
Total no. of Turbines	Total 114 WTG locations have been identified by the client out of which approx. 90 locations shall be finalised for WTG installation
Make and Model of Turbines	Envision Energy EN156-3.3, each with individual capacity of 3.3 MW; overall capacity of approximately 300 MW
Project Status	Planning Stage
Internal transmission Line	Route not finalised yet; survey has been completed.
External Transmission Line	26 km of external transmission line shall be laid for Grid Substation (GSS) connection.
Land Requirement	Total 560 acres of land shall be required for the project. Of these 560 acres, 112 acres of land would be purchased and the remaining land would be leased
Power Evacuation	Power evacuation shall be done via external transmission line to Power Grid Corporation of India Limited (PGCIL) Koppal, Grid Substation (GSS) located at an aerial distance of ~ 25 km from the proposed plant.
Power Purchase Agreement	Power Purchase Agreement with Solar Energy Corporation of India Limited has been signed on 8th September 2021

Source: ERM site visit and details provided by Ayana post site visit dated 19 August 2021 and 16 September 2021

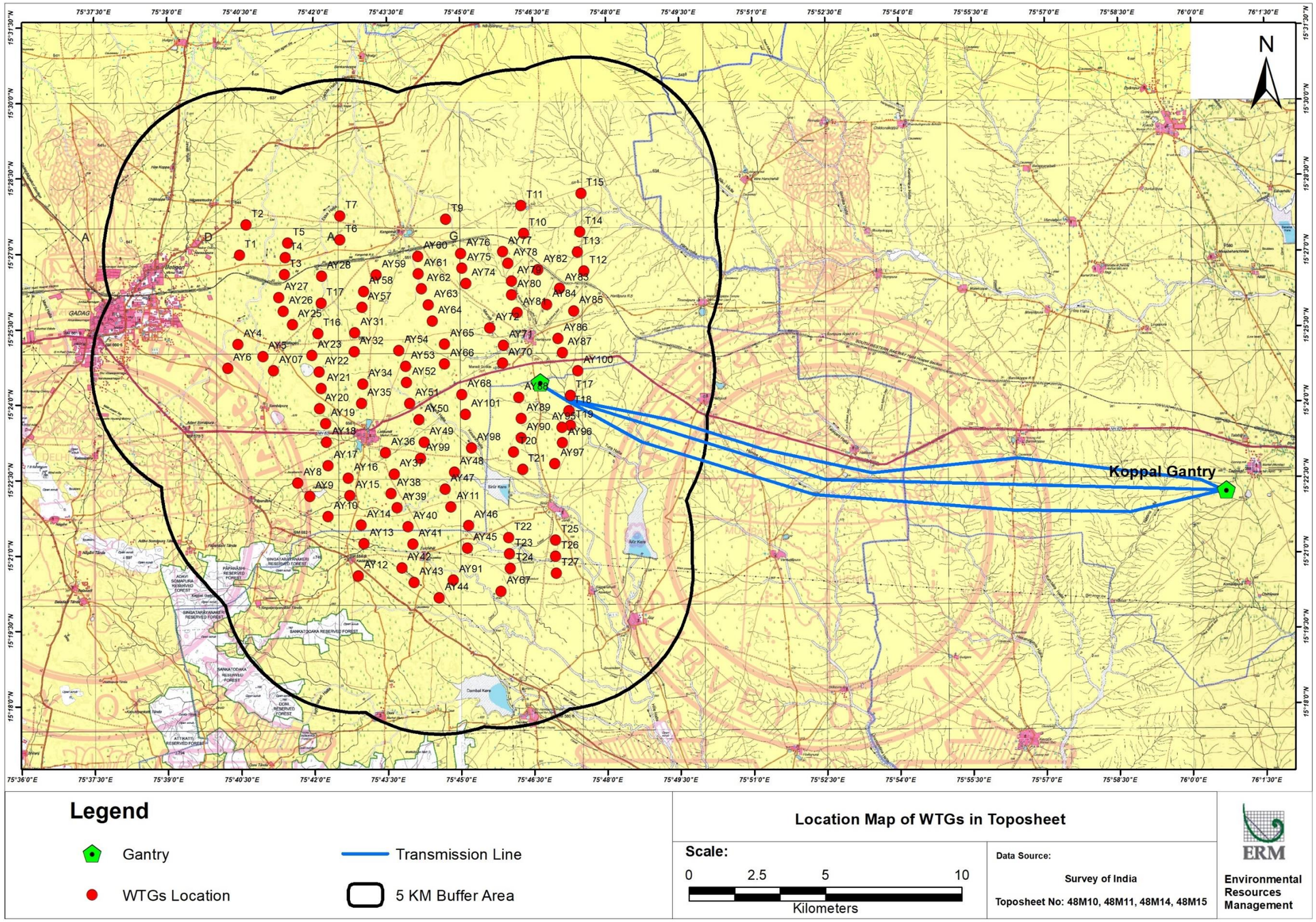
[1] Villages in a range of 0-2kms of the Project Footprint

Figure 1.1 Map showing location of the Project



Note: Ayana has identified 3 transmission line routes given in the map out of which one shall be finalised. Details of the TL are provided in subsequent chapter

Figure 1.2 Map showing Location of WTG's in Toposheet



1.4 Objectives and Scope of Work

1.4.1 Objectives

The main objective of the ESIA study is to assess social, environmental and ecological impacts of the proposed wind power plant. The study also provides management strategies to comply with the reference framework given in ***Section 1.2***. The specific objectives are to:

- Develop a baseline environmental, social and ecological profile of the Project and its surrounding areas;
- Assessment of environmental, social and ecological impacts of the Project on the established baselines;
- Provide mitigation and enhancement measures and prepare an Environmental and Social Management Plan (ESMP); and
- Determine the requirements for additional studies for the project, required if any.

1.4.2 Scope of Work

In order to meet the objectives mentioned above, the scope of work for the ESIA entails:

- Reconnaissance Survey: A reconnaissance site survey of the proposed locations was undertaken to understand site settings, environmental and social baseline and identify potential project specific impacts;
- Review of Project Information: A review of all relevant project documentation and study of various activities during the construction and operational phase of the project was undertaken to identify the impacts on various environmental components as well as the areas/activities that lead to such impacts;
- Understanding and Establishment of Baseline: A review of data on various environmental and social components was collected from authenticated agencies/authorities and published secondary sources to establish the baseline of the study area of 5 km radius from each site location. This included primary ecological and social surveys at project locations, supplemented by secondary information;
- Stakeholder Consultation and Analysis: Consultation and key informant interviews with project affected persons as well as with local community in general were undertaken to inform stakeholders about the objectives and potential impacts of proposed project and understand their perspective of the project;
- Impact Assessment: Based on the project details and baseline information related to location, an assessment of impacts on the environmental and social components has been undertaken for construction, operation and decommission phase. Cumulative impact assessment due to operation of similar existing and proposed projects in the study area has also been undertaken. Basis the aforementioned information, a project categorization has been undertaken which classifies the project into 3 categories baisis the risk involved;
- Preparation of ESMP: An environment and social management plan has been formulated suggesting economically feasible control technologies and procedures to minimize any impact on environment and social parameters and mechanism for continuous consultation and involvement of the community throughout the various stages of project life;
- This ESIA report has been developed based on the location layout of WTGs.

Basis the aforementioned objectives and scope of work, the following screenings have been undertaken for the proposed site.

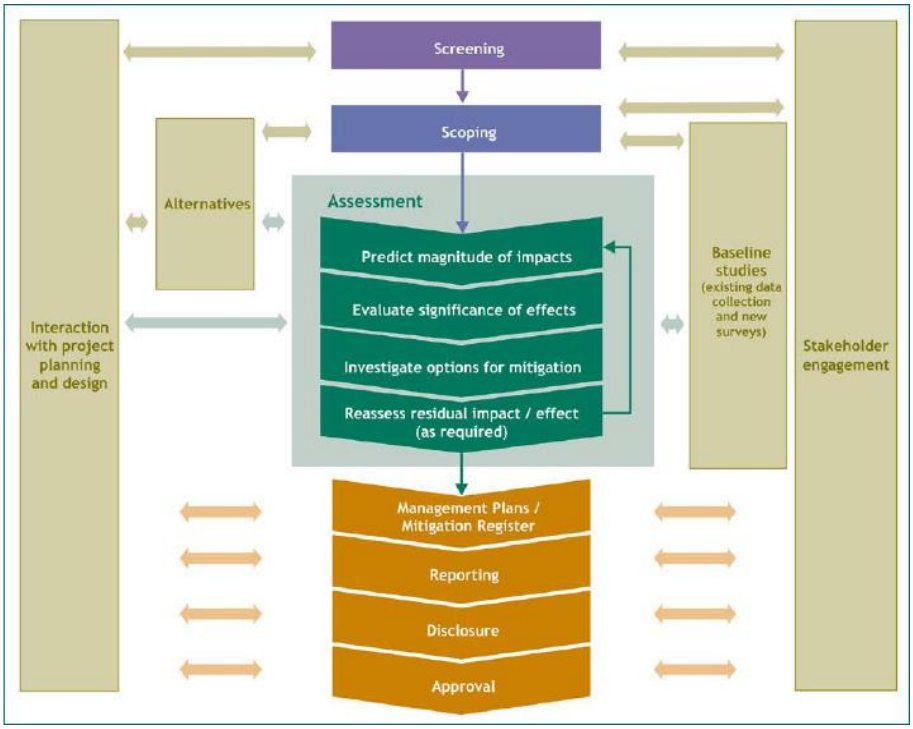
Figure 1.3 Activities Undertaken

Understanding the environmental and social baseline of the proposed site and identifying significant impacts due to proposed project activities	Consultations with the relevant stakeholders to ensure that they are aware of the potential impacts of the proposed project	Desktop GIS assessment to identify the potential environmental, ecology and social issues/risk related to the proposed WTG site locations
Shortlisting / identifying sites with high E&S sensitivities for which physical verification/ site survey was conducted	Identifying whether the proposed site falls in the critical habitat and/or eco-sensitive area or within the 30 kms of the same mentioned area	Identifying whether the proposed site location falls in an area with social sensitivies; notified schedule V area or the presence of tribal population in the area
Identifying any critical ecological issues of concern and any impacts from the projects to a local ecological and biological system.	Identifying the major risks based on the available secondary resources.	Providing final categorization to the project based on sensitivities identified.

1.5 Approach and Methodology

ERM's approach and methodology for the Project has been summarized in ***Figure 1.4*** below.

Figure 1.4 Conceptual ESIA Approach



1.5.1 Kick-Off Meeting

ERM organized a project kick off conference call with representatives of Ayana. The kick off meeting was set up to understandingthe project brief along with scope, approach of the ESIA, key

deliverables, and timelines. Furthermore, the way forward in terms of site visit plan, documentation, etc. were discussed.

1.5.2 Desk Based Assessment

- After receiving tentative site location and other project related information, desk based review of the information/ available secondary resources was initiated;
- Following the desk based review of secondary information, a desktop screening of the physical, biological and social environment of the area was undertaken to understand the location of the Project and determine and E&S sensitivities including presence within Schedule V area, presence of tribal population in the area and presence of areas of cultural and religious significance, natural hazards etc.;
- A Google imagery review was also undertaken to assess the presence of E&S sensitivities in the immediate vicinity (500 m and 1 km) of each WTG locations. The locations were screened on the below mentioned parameters
  - Type of topography and land use of the area;
  - Dwellings/ Habitation within 500m;
  - Distance (m) and direction from road / highway/ railway track;
  - Waterbodies with distance (m) and direction;
  - Structure with archaeological / cultural significance, with distance (m) and direction;
  - Presence of wild life sanctuary, bio reserve/ national park/ eco sensitive zone in 10 km radius, and distance
- External Factors Review: ERM undertook a review of available public (internet based) information to understand any pertinent E&S issues in the project area that can adversely affect the project.

1.5.3 Site Visit

ERM undertook site visits to the proposed wind power plant site between 23rd-24th July 2021 and from 27th - 29th July, 2021. The activities undertaken during this period are provided in the table below.

Table 1.2 Site Activities

Date	Activities Undertaken
23rd and 24th July 2021	■ Visit to WTG's locations; ■ Collection of baseline data for noise, groundwater and surface water; ■ Stakeholder consultations including the landowners whose land has been identified for purchase or lease.
27th to 29th July, 2021	**Ecological survey** ■ Biodiversity Survey; ■ Visit to waterbodies / wetlands and other identified major habitats; ■ Consultation with the forest department and local villagers.

1.5.4 Reporting

- ERM has presented the findings from the preliminary analysis in the form of a draft E&S Screening report dated 05 August 2021 and subsequently on 20 August 2021.

- A detailed impact assessment report (ESIA) (this report) has been prepared and provides the environmental, social and ecological sensitivities and impacts associated with the current planning, construction, operation and decommissioning of the proposed wind power plant.

1.5.5 Impact Assessment

Assessment of potential impacts on the various environmental, ecological and social elements due to the Project activities were carried out for this ESIA study. The likely impacts on loss of land, land-based and non-land based livelihoods, vulnerable groups (women, youth etc.), labour, water environment, air environment, biological environment and socio-economic environment has been identified based on the actual and foreseeable events/Project activities. For the impact assessment, wherever necessary, professional judgement, experience and knowledge on similar projects have been used. The extent and potential consequences of the impacts have been compared against applicable standards and guidelines. Mitigation measures have been suggested for each of the identified potential impacts.

1.5.6 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) has been developed to include the following:

- Introduction of purpose and aims of the ESMP;
- Summary of significant adverse impacts and potential risks;
- Mitigations and control technologies, safeguards etc. to minimize adverse impacts on air, water, soil, ecological and socioeconomic environment;
- Institutional mechanism - roles and responsibilities for ESMP implementation, training of ESMP implementation team;
- Action Plans for effective control measures to minimize adverse impacts/risks; and
- Monitoring program for effective implementation of the mitigations and ascertain efficacy of the environmental management and risk control systems in place.

1.5.7 Limitations

This ESIA report is based on scientific principles and professional judgment applied to facts with resultant subjective interpretations. Professional judgements expressed herein are based on the currently available facts within the limits of the existing data, scope of work, budget and schedule.

There remain certain limitations to the assessment, which are as follows:

- The distances of receptors mentioned in the WTG profiling are approximate distances based on Google Earth review and may vary slightly from actual on ground measurements;
- Land for PSS is not finalised;
- Location of few WTGs were changed post ERM site visit, however the changes in the locations did not impact the project area significantly;
- Additional 16 WTGs were added to project layout post ERM site visit;
- Total 114 locations have been identified and plan is to execute only 90 WTGs with total capacity of 300 MW and all WTGs locations were not physically verified;
- The reconnaissance of the proposed locations were undertaken to locations that were accessible by road;

- As reported by site representatives, land parcels for storage yard and batching plants have not been finalized yet. As reported, all of those shall be included as a part of EPC contract and EPC for the project development has not been identified yet;
- Transmission line route (internal) has not been finalised yet. Survey of three tentative routes was completed during ERM site visit.

1.5.8 Uses of the Report

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

The contents of this report shall not be construed as a warranty or affirmation by ERM that the site and property described in the report are suitable collateral for any loan or that acquisition of such property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

1.5.9 Report Structure

The structure of this ESIA report is as given in ***Table 1.3***.

Table 1.3 Structure of the report

Section	Title	Description
Section 1	Introduction	*(this section)* Introduction to the Project and ESIA methodology
Section 2	Project Description	Technical description of the Project & related infrastructure and activities
Section 3	Administrative Framework	Discussion of the applicable environmental and social regulatory framework and its relevance for the Project.
Section 4	Screening and Scoping	Description of the outcomes of the screening exercise and description of the outcome of the Scoping exercise undertaken as part of the ESIA process.
Section 5	Analysis of Alternatives	Details of no project scenario, alternate site locations and alternate methods of power generation are presented.
Section 6	Environmental, Ecological and Social Baseline	An outline of the environmental, ecological and social baseline status in the area of the Project.
Section 7	Stakeholder Identification and Engagement	An outline of the engagement with the stakeholder groups undertaken as part of the assessment process and the key issues identified from the same.
Section 8	Impact Assessment	This section includes details of identified environmental, social and ecological impacts and

Section	Title	Description
		associated risks due to project activities, assessment of significance of impacts and presents mitigation measures for minimizing and /or offsetting potential impacts identified.
Section 9	Environmental and Social Management Plan	Outline of the Environmental and Social Management Plan (ESMP) taking into account identified impacts and proposed mitigation measures and monitoring requirements.
Section 10	Impact Summary and Conclusion	Summary of impacts identified for the Project.

2. PROJECT DESCRIPTION

This section provides a detailed description of the Project location, its key components, status and organizational management systems.

2.1 Project Setting

2.1.1 Project location and Setting

The proposed wind power plant Project is located primarily on flat to undulating land across 16 villages of Gadag district in the State of Karnataka. Land identified for the Project is private agricultural land. The Project lies between 15°27'37.33"N and 15°20'10.31"N latitudes and 75°40'36.12"E and 75°45'51.49"E longitudes and is located adjacent to Gadag city in west direction.

The proposed site can be accessed through Bellary- Hubli Road in south direction followed by multiple village roads connecting the villages in the Project footprint area. A railway line is falling within the Project footprint in north direction of the wind power plant. The Project is connected to the major road way in the area i.e. National Highway-67 (old NH 63) via a network of village roads, which are a combination of both, bituminous and non-bituminous roads. However, the access roads between WTGs and the nearest available access road shall be developed as part of the Project.

Kappatagudda Wildlife Sanctuary is present about 1.1 km from the WTG AY 9, 10 in south-west direction. Two Important Bird and Biodiversity Areas (IBAs),), Tungabhadra Reservoir and Magadi & Shettikere Wetlands are present at a distance of ~ 12 Km from the proposed route of TL (about 25 km from the proposed wind farm) and grid substation (GSS) located at Koppal and ~ 25 km from the proposed Project site (WTGs) respectively.

According to the Google Earth image for site layout, multiple dendritic and sub dendritic channels emerging from the main channel runs within the project area. Other renewable power projects such as Wind World Power Plant (~200 MW capacity) is located adjacent to the project boundary and Renew solar power project is located within the project boundary near Jantli Shirur village.

The physical feature map of Project and its study area is shown in **Figure 2.1**

The project has identified 114 locations for the WTGs, however only 90 locations will be finalised for project development. Ayana has identified WTGs of 3.3 MW capacity each.

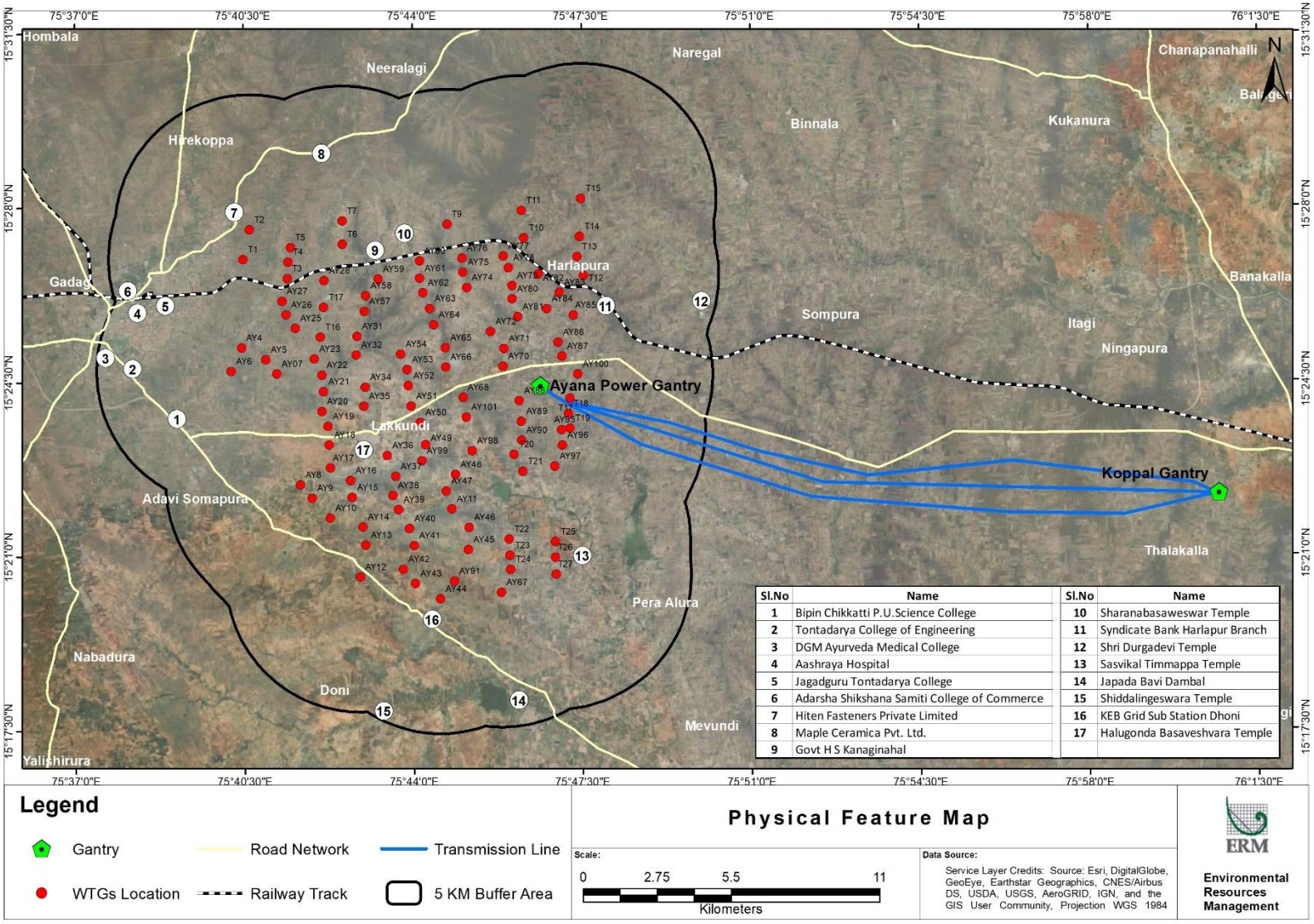
Currently, the project is in planning phase where land identification and procurement is under process. According to the details provided by Ayana and site representatives, approx. 560 acres of land shall be required for the project. Of these 560 acres, 112 acres of land would be purchased and the remaining land would be leased for a period of 29 years and 11 months for WTG erection. This leased land will include access roads and land for transmission lines. Land will be leased for approximately 2 years for developing temporary roads for vehicle, heavy vehicle movement and shall be decided before the construction phase. Land for pooling station has not been finalised at this stage. As informed by Ayana, the project shall be operational by February 2023.

2.2 Project Components

2.2.1 Wind Turbine Generators

The proposed wind power plant will comprise of 90 WTGs out of 114 identified locations of the Envision Energy EN156-3.3, each with individual capacity of 3.3 MW, hence totalling to approximately 300 MW. The technical specifications of the proposed model of WTG has been presented in **Table 2.1**

Figure 2.1 Map Showing Physical Features of the Project Area



Sl.No	Name	Sl.No	Name
1	Bipin Chikkatti P.U.Science College	10	Sharanabasaweswar Temple
2	Tontadarya College of Engineering	11	Syndicate Bank Harlapur Branch
3	DGM Ayurveda Medical College	12	Shri Durgadevi Temple
4	Aashraya Hospital	13	Sasvikal Timmappa Temple
5	Jagadguru Tontadarya College	14	Japada Bavi Dambal
6	Adarsha Shikshana Samiti College of Commerce	15	Shiddalingeswara Temple
7	Hiten Fasteners Private Limited	16	KEB Grid Sub Station Dhoni
8	Maple Ceramica Pvt. Ltd.	17	Halugonda Basaveshvara Temple
9	Govt H S Kanaginahal		

Table 2.1 Technical Specifications of EN156-3.3 turbines

Items	Description
Rated power	3300 kW
Rotor diameter	156 m
Swept area	19113 m^2
Design grade	IEC-S
Rated wind speed for (TI-10-15%) and 1.225 kg/m^3	11 m/s
Cut-in wind speed	3 m/s
Cut-out wind speed	20 m/s
Maximum wind speed (10 min average)	40 m/s
Operating temperature range	Normal type- 10°C to 40°C
	Standard type - 20°C to 40 °C
	Cold type -30°C to 40°C
Survival temperature range	-20°C to 50°C

Source: Ayana, dated 19 August 2021

Associated ancillary facilities and utilities such as the following will be required as a part of the wind power plant project:

- Transmission line for power evacuation from WTGs to Pooling substation (PSS) i.e. internal transmission line;
- Transmission line for connecting pooling substation (PSS) to Grid Substation (GSS) i.e. external transmission line (EHV Line);
- Metering point for measuring production from each WTG;
- Pathways and access roads;
- Material storage yard and stores;
- Batching plant;
- Scrap yard; and
- Central monitoring station building and facilities.

2.2.2 Power evacuation details

Power evacuation shall be done via external transmission line to 220KV/ 400 KV Power Grid Corporation of India Limited (PGCIL) Koppal, Grid Substation (GSS) located at an aerial distance of ~ 25 km from the proposed plant. Route of internal transmission line (from WTGs to pooling substation) and its length is yet to be finalised. Approximately 26 km of external transmission line shall be laid for GSS connection. Survey of the routes have already been conducted with 3 nos. of alternate route, however, exact route is yet to be finalised. Comparison of the alternative routes is provided in the ***Table 2.2*** below.

Proposed route of transmission line is presented in ***Figure 2.2***. Details of transmission line (alternative routes) is as below:

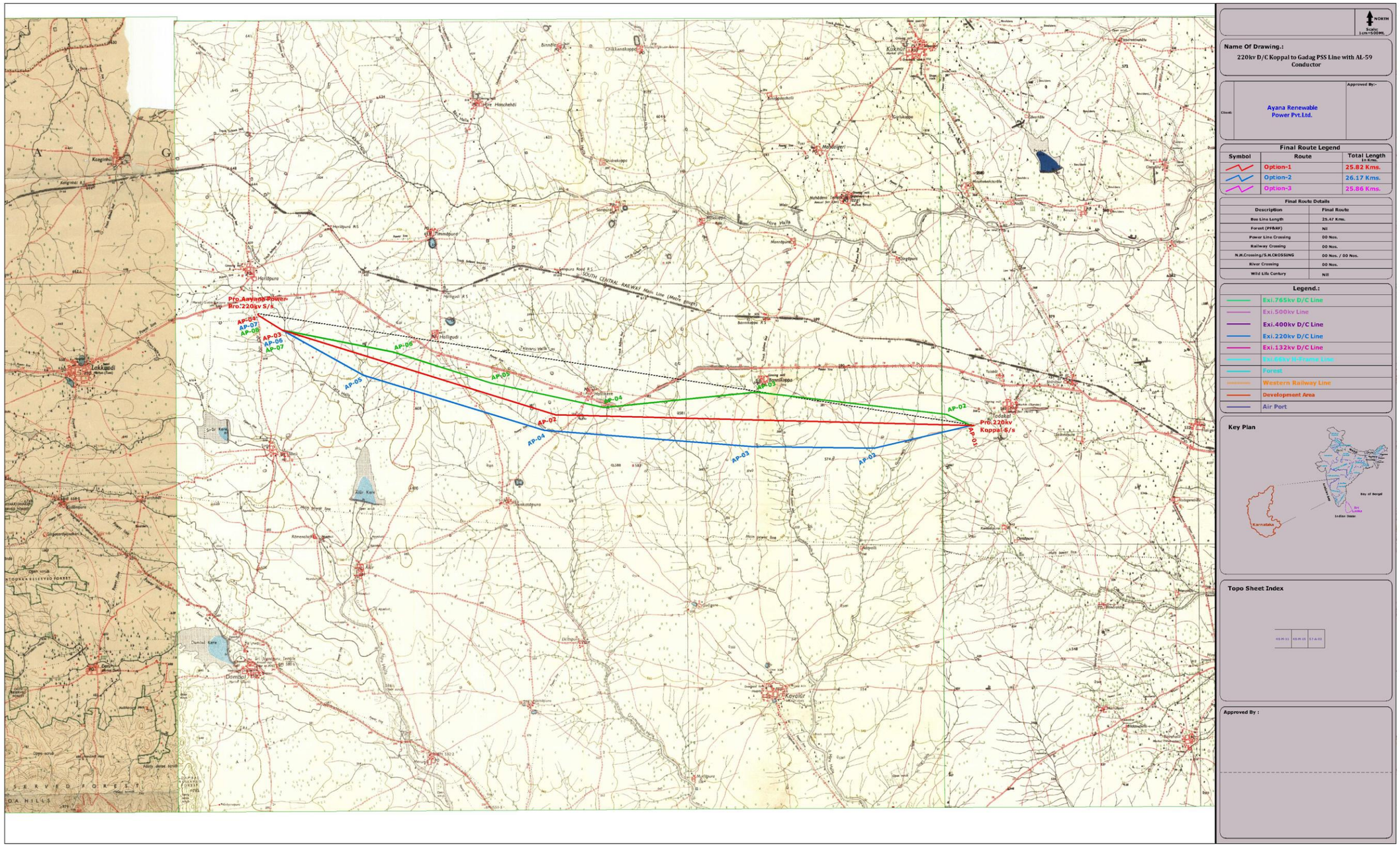
Table 2.2 Details of Alternative Routes of Transmission Line

S.No	Particular	Alternate Route I (Red)	Alternate Route II (Green)	Alternate Route III (Blue)
1.	BEE line length	25.47 km	25.47 km	25.47 km
2.	Route length	25.82 km	26.17 km	25.86 km
3.	No. of angle points	04	07	08
4.	Reserved/ Protected Forest area crossing	Nil	Nil	Nil
5.	Density of trees other than forest	Low	Low	Low
6.	Wildlife Sanctuaries/ National parks crossing	Nil	Nil	Nil
7.	River Crossing (major)	Nil	Nil	Nil
8.	National Highway crossing	Nil	Nil	Nil
9.	State Highway crossing	Nil	Nil	Nil
10.	Railway crossing	Nil	Nil	Nil
11.	Major power line crossing 66 kV and above	Nil	Nil	Nil
12.	Places of archaeological importance	Nil	Nil	Nil
13.	Line pass through historical/ cultural/ religious/ tourist importance	No	No	No
14.	Line pass through any town/ city	No	No	No
15.	Line pass through any army area	No	No	No

Source: Ayana, dated 19 August 2021

As per latest information provided by Ayana on 01 October 2021, shortest route for the transmission line (Red, 25.82 kms) has been considered. The transmission line shall comprise of 77 nos. of towers.

Figure 2.2 Tentative Route of Transmission Line on Toposheet



Source: Ayana, dated 19 August 2021

*Note: As per latest information, red color route has been considered by Ayana

2.2.3 Storage Yard

As discussed with Ayana representatives, it was understood that WTG components as well as heavy lifting vehicles and earth moving machineries will be stored at the storage yard. As informed, location of the storage yard will be identified by the EPC contractor during the construction phase only and shall be taken on lease for a period of two years. It is understood that approximately 20 acres of land shall be required for storage yard during the construction phase of the project.

2.2.4 Batching Plant

As per initial consulation with the site team, batching will be set up by the EPC contractor during construction phase. EPC contractor has not been finalised yet by Ayana. As informed EPC contractor shall be responsible for land identification and procurement for the batching plant.

2.2.5 Access Roads

During the ERM site visit, access to the proposed WTGs and villages was primarily via government bituminous roads and kuccha roads. The Project can be accessed via a network on bituminous roads that extend to non-bituminous road. As on date, there are no internal access roads for the Project and construction of the same would start phase wise as per the proposed construction of WTG's. Route of access road is yet to be finalised.

The project will also entail improvement works for the existing roads prior to transport of heavy construction equipment and widening of intersections for smooth movement of heavy vehicles. Details of the roads requiring improvement are not available currently. Besides the main access roads there will be internal roads for access to each turbine location and associated facilities within the wind power plant area.

2.2.6 Wind Turbine Profiling

The WTG locations for the Project were assessed to ascertain the presence of sensitive receptors around the WTG locations. A detailed WTG profiling is provided in ***Appendix A***

Figure 2.3 Topography of the Project Area as observed during the site visit by the ERM team showing flat land

Source: ERM Site Visit, July 2021

Based on the profiling of WTG's, summary of structures present within 500 m of WTG's is given below

Table 2.3 Summary of Structures Present within 500m from the WTG's

S.N	WTG Code	Receptors	Distance (km) and Direction from WTG	Type of Receptors	Remarks
1.	AY 5	Residential buildings	250-300m NE and SE	Permanent	Hatelgeri village boundary residences
2.	AY 8	Agricultural Sheds*	195m N	Temporary	Multiple scattered Agricultural sheds
3.	AY 9	Agricutural Sheds	450m SE and 450m E	Temporary	2 sheds
4.	AY 10	Agricutural Sheds	436m S, 2 at 499m S	Temporary	3 Agricultural sheds
5.	AY 12	Residential structures	201m S	Permanent	Settlements on village boundary
6.	AY 17	Agricutural Sheds	300-400m N	Temporary	Scattered small agricultural sheds
7.	AY 18	Residential Custer and Agricultural	337m E	Permanent	Extended colony of Lakkundi Village and

S.N	WTG Code	Receptors	Distance (km) and Direction from WTG	Type of Receptors	Remarks
					scattered agricultural sheds
8.	AY 19	Agricultural Sheds	200-300m S and E	Temporary	Scattered small agricultural sheds
9.	AY 35	Residential cluster	350 m E	Permanent	Large residential cluster of Lakkundi village
10.	AY 36	Residential complex	245m N and 327m SW	Permanent	Residential cluster
11.	AY 37	Small house	219m SW	Permanent	-
12.	AY 38	Small house	349m NE	Permanent	
13.	AY 40	Small cluster of houses	454m SE	Permanent	-
14.	AY 41	Small cluster of houses	390m NE	Permanent	-
15.	AY 43	Residential	320m SE	Permanent	Residential complex
16.	AY 59	Apartment Complex	260m W	Permanent	Residential complex
17.	AY 70	Scattered small household structures	300-350m SW		-
18.	AY 81	Residential	478m S	Permanent	Vilage Boundary
19.	AY 91	Agricutural Shed	149m W	Temporary	-
20.	AY 94	Agricutural Shed	400M SW	Temporary	-
21.	AY 95	Agricultural Shed and WTG T19	203 m NW and 312M E	Permenant	
22.	T 17	Residential complex	451m SE	Permenant	-
23.	T19	1 small agricultural shed and WTG Location T19	203 m NW and 312M W	Permenant	-
24.	T22	Small Agricultural Shed	294m NE	Temporary	-
25.	T23	Small Agricultural Shed	264m SW	Temporary	-
26.	T26	2 agricultural sheds	314m NE, 398m NW	Temporary	--

S.N	WTG Code	Receptors	Distance (km) and Direction from WTG	Type of Receptors	Remarks
27.	T25	2 agricultural sheds	344m SE and 496m SW	Temporary	-

Source: ERM site survey and Google Earth Imagery

*Agicultural sheds are temporary structures utilised for temporary storage of farm implements or grain, hay, poutry or any other agricultural products.

Moreover, there are few agricultural sheds near WTGs AY 8, 9, 10, 12,17, 19, 94, 95, T22, T23, T25, T26 falling within 500 m distance.

2.3 Land Requirement and Procurement Process

2.3.1 Land Requirement

Land procurement for the project is currently underway. The total land required for the wind power plant is provided in the table below:

Table 2.4 Land Requirement Statement- All components

Description	Land Required	Unit
Purchase Land for WTG	112	Acres
Purchase Land for Substation (PSS land shall include site office and SCADA control room)	14	Acres
Land on Lease for WTG	448	Acres
Pathway- Easement Rights[2]	140	Acres
Access Road	25	Acres
Storage Area	40	Acres
Transmission line towers	26	Acres

Source: Ayana

2.3.1.1 Transmission Line

The transmission line route survey had been undertaken by Ayana when ERM undertook their site visit. The transmission line would be ~ 26km long with 220kv double circuit power. The land for the transmission line would be private agricultural land (0.3 acre per tower, considering 77 towers in the route) and it would be taken on lease for 29 years, as understood during consultation. Land leasing process has not been initiated during ERM site visit.

2.3.2 Land Procurement Process

Basis document review and consultations undertaken with Ayana's land team and land aggregator, it was understood that the land procurement for the project would entail purchase of land for the WTG machine and leasing the remaining land for swift area. Since the project is still in the planning stage, the identification of land for the project is still underway.

[2] This includes pathway for external transmission lines corridor of 26 kms.

During site visits and consultations with Ayana's site representative, it was understood that, for the land procurement process, Ayana is using one Land Aggregator; BV Patil LLP. This aggregator is reportedly responsible for undertaking the land survey to identify titleholders, getting consent from the titleholders and purchasing/leasing the land under Ayana's name from these titleholders. The sale is made directly under Ayana's name. Detailed consultations with land sellers in Churchihaal and Hatelgeri and the land aggregator were undertaken, through which it was understood that the current circle rate for area is between INR1,00,000-2,00,000 per acre. The land sellers who are sellling their land, reportedly selling for INR 7,00,000 per acre. In terms of land lease rates, the titleholders reported that the lease agreement states a price of INR 38,000/- acre. The land aggregator informed ERM that the land identification criteria included the following; minimal vegetation, no common property resource, no structures (permanent or temporary) and at least 200 m away from habitation. Prior to purchasing or leasing the land, a written consent is obtained from the land seller, that clearly states the titleholders willingness to sell or lease his land for the project. The same was confirmed with some of the land sellers in Churchihaal, Harlapur and Hatelgeri village during consultation. Currently, 86 acres of the 112 acres of land had been identified for purchase on a willing buyer- willing seller basis and 30 land owners have provided signed Agreements to Sell (ATS). Complete details of those 30 landowners and copies of ATS have not been provided to ERM during request for information.

During discussions with Ayana team, it is estimated that there would be approximately 85 titileholders for procurement of land for WTG erection, 250 nos. of titleholders will be involved in leasing swift area and 250 nos. of titleholders shall be involved for leasing area for internal access roads.

2.4 Project Phases and Activities

The development activities envisaged for the project can be divided into four phases: (a) Planning; (b) Construction; (c) Operation & Maintenance and (d) Decommissioning. A summary of the activities to be undertaken during each phase is provided below:

2.4.1 Planning Phase

The planning phase activities will ideally include:

- Selection of potential wind power plant site;
- Site surveys – topographical, geotechnical, electrical, etc.;
- Micro-siting of wind power plant;
- 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, Bird and Bat baseline assessment, critical habitat assessment; and
- Route survey assessment.

As part of planning phase, following activities have been carried out:

- Identification of land area and site;
- Micro siting for the windplant;
- Wind Resource Assessment;
- Selection of tentative locations for pooling substation; and
- Finalization of contractors is in process.

2.4.2 Construction Phase

The construction phase activities that are expected to start from October 2021 will last till January 2023 and will include:

- Site preparation including contractor mobilisation, erection of fencing or suitable barriers, construction of site compound and laying down areas;
- Establishment of labour accommodation for 500-550 workers;
- Establishment of batching plant and storage yard;
- Upgrading and construction of internal roads including laying of cables;
- Site clearance;
- Establishment of borrow pits (if required);
- Laying of turbine foundations, turbine delivery and installation;
- Completion of internal electric connections;
- Turbine testing to verify proper operation of the facility; and
- Commissioning.

2.4.3 Operation and Maintenance

The wind plantpower projects have limited activities for the operations and maintenance (O&M) phase and involve:

- Regular remote monitoring of the WTG operations;
- Normal greasing and cleaning activities;
- Annual shut down for maintenance which will mostly include cleaning and greasing, change of parts etc.; and
- Internal road repairs as and when required.

The average design life of infrastructure as well as the wind plantplants is estimated to be 25 years-30 years from the date of commissioning. This depends on the quality of periodic maintenance of the WTG as well as supporting infrastructure. Regular maintenance would be required to ensure that the turbines are kept in optimal working order. Most day to day facility operations would be done remotely through the use of computer networks using SCADA but some limited maintenance and repair activities would be undertaken on site.

2.4.4 Decommissioning Phase

The decommissioning activities will include:

- Replace operating WTG turbine with new one of higher capacity or superior technology;
- Replace WTG which encounter functional failure;
- Abandon the project operations and remove WTG parts and ancillary facilities;
- Remove transmission line; and
- Return intra-site access roads.

If decommissioned, all components excluding turbine foundations and internal roads of the Project would be removed and the site will be rehabilitated. The concrete pedestals of the turbine foundations would be cut down and concrete removed to below finished ground level and covered with topsoil. Infrastructure (such as road, transmission line, etc.) is likely to be handed over to the government or

private land agencies or individuals. Some roads will be removed and covered with soil and replanted to allow for a return to previous land-use (agriculture and grazing).

2.4.5 Project Schedule

As per data provided by Ayana, land procurement for the project shall be completed by January 2022, whereas construction phase (including WTG erection, pooling substation, transmission line, etc.) will last till January 2023. The commissioning of the project is expected by February 2023.

2.5 Resource Requirements

2.5.1 Manpower requirement

Total number of staff and workers required during construction phase during peak period will be around 520. During discussions it was understood that most of the labour requirement for the Project will be met from the local villages and labourers from other state or different locations will be accommodated in rented facility or labour camps to be established by the EPC contractor. Details of labour accommodation are not available at this stage. As informed, labour camps shall be arranged by contractors on lease.

During operation phases, around 100 persons shall be deployed on the site for various activities.

The details of manpower requirement is provided in **Section 8.5.5, Table 8.49.**

2.5.2 Water Requirement

2.5.2.1 Construction Phase

Tanker water through authorised vendors will be the main source of water for construction activity while bottled water will be used for drinking purpose. Based on initial estimates shared by Ayana, approximately 130 KLD of water will be required for the civil works during the construction phase and will vary depending on the period of construction or type of activities to be undertaken during the construction period. Approximately 8 KLD of water will be required for dust suppression activities. All the water for civil construction shall be sourced via tankers.

As informed by Ayana, water requirement for drinking and sanitation purposes will be around 7 KL per day which shall be sourced from tankers. However, details of source of water tankers is not known at this stage.

2.5.2.2 Operation Phase

Approximately 5 - 7 KL per day of water is envisaged to be required during the operational activities considering that 70-100 employees would be present at any given time. Water for domestic purposes will be sourced via tankers from nearby villages in the Project area while bottled water will be used for drinking purpose. Also water would be required to maintain the earth resistance of 9 ohms at every turbine location as well as the pooling substation.

2.5.3 Raw Materials

2.5.3.1 Construction Phase

Table* 2.5** provides an approximate estimate of the raw materials that would be needed during the construction phase of the Project. ***Table 2.6 lists the equipment that are envisaged for the construction activities of the Project. Sand and aggregates will be procured from government approved quarries and suppliers. Cement and steel will be supplied by local vendors.

Table 2.5 Estimation of the raw materials for the WTG foundation for the 300 MW Project

List of Construction materials	Approximate Quantity tonnes/month (Peak)	Source
Cement	1350	Cement Plant
Stone	3500	Government Approved Stone Quarry
Steel	300	Steel Plant
Sand	2300	Government Approved Sand Quarry
Water	500 KL (including concrete mix in Batching plant)	Tanker water

Source: Ayana

Table 2.6 Equipment type and number to be utilized during the construction phase for the 300 MW Project

Construction equipment	Approximate Equipment Number
Mobile Mixing Plants/ Batching Plants	Batching Plant - 2 Number
Transit Mixer	~12
Concrete Pump	~ 2
200 Tones Crane	6
16 Tones Crane	8
Crane Main 650 Tones	4
JCB / Excavator	6
250 KV DG	3
Compactor	2

Source: Ayana

2.5.3.2 Operation Phase

Raw materials during the operational phase will be in the form of supplies for the site staff and maintenance needs for the WTGs. The supplies for the site staff includes food, water and basic needs, which can be transported from neighbouring towns and villages of Gadag. The maintenance needs for the WTGs, including fuel, oil and spare parts will be procured from the supplier through O&M contract.

2.5.4 Fuel Requirement and Storage

2.5.4.1 Construction Phase

The on-site fuel requirements during construction will be approximately 3 KL per month. Fuel will be transported to site using tanker trucks from nearby petrol pumps retail outlets and will be stored in the DG set tank. In case of extra storage, diesel shall be stored in drums in a designated storage yard.

2.5.4.2 Operation Phase

Approximately 800 litres of oil per WTG will be required for five years for gearbox maintenance activities. Oil will be stored at a designated area in the storage yard. Maintenance will be carried out

regularly during the operation and maintenance phase and waste oil will be sent to an authorized oil recycler, approved by the Karnataka State Pollution Control Board (KSPCB).

2.5.5 Power Requirement

2.5.5.1 Construction Phase

The power requirement for construction activities will be sourced through diesel generator sets (D.G. sets). It is estimated to have 3 mobile D.G. sets of capacity 250 kVA each for construction site including batching plant.

2.5.5.2 Operations Phase

One (01) no. of DG set of 250 kVA capacity shall utilised as power back up at the substation during operation and maintenance activities.

2.6 Pollution Control Measures

2.6.1 Air Emissions

2.6.1.1 Construction Phase

There will be potential impact on air quality due to onsite construction activities. The likely emissions from construction activities would include the following:

- Fugitive emissions from site clearing, digging, filling, material handling, transportation, use of construction machinery, etc.;
- Fugitive dust emissions from unpaved roads;
- Dust emissions from batching plant;
- Vehicular emissions from increased traffic volume from vehicles used for transport of construction material, transportation of WTGs and accessories; and
- Emissions from operation of diesel generators.

To control air emission during construction phase from operation of D.G. sets, adequate stack height as per CPCB norms should be provided. Fugitive dust emission arising from various activities such as excavation, transportation of material (loading and unloading), vehicular movement (on unpaved roads) will be minimized through sprinkling of water and maintaining vehicular speed to 10-15 km/hr. Vehicular emission will be controlled through proper maintenance of vehicles and vehicles with proper PUC will be operated at Project site.

2.6.1.2 Operations Phase

Under normal operations, there will be no gaseous emissions from the operating areas. There will be gaseous and fugitive dust emissions owing to plying of maintenance vehicles. It will be ensured that well maintained vehicles with proper PUC are used during O&M period.

2.6.2 Noise Emissions

2.6.2.1 Construction Phase

During the construction phase noise will be generated primarily during the day time. Noise will be generated from moving vehicles as well as construction equipment and machineries, including the D.G. sets utilized for power. There are villages in the project footprint area that are likely to be impacted by noise during construction. Other receptors of noise pollution are the construction workers.

As a control measure it will be ensured that noise emission from the vehicles and equipment's shall not exceed 91 dB(A) (*for Passenger or commercial vehicles with gross vehicle weight above 12000 kg as specified in Central Motor Vehicles Rules, 1989*). D.G. sets will be provided with acoustic enclosures and workers near noise generating machines will be provided with ear plugs as safeguard against high noise hazards.

2.6.2.2 Operations Phase

While in operation, wind turbines produce noise from mechanical and aerodynamic sources:

Aerodynamic noise emanates from the movement of air around the turbine blades and tower. The types of aerodynamic noise may include low frequency, impulsive low frequency, tonal, and continuous broadband. In addition, the amount of noise may rise with increasing rotation speed of the turbine blades, therefore turbine designs which allow lower rotational speeds in higher winds will limit the amount of noise generated; Mechanical noise may be generated by machinery in the nacelle of the wind turbines.

The Project is proposed to have 90 wind turbine generators (WTGs) of the E156-3.3 make, with a rated capacity of 3.3 MW each. The specifications of WTGs are provided in **Section 2.2.6** and refer to section **8.3.9** for detailed assessment and safeguard proposed**.**

2.6.3 Wastewater Management

2.6.3.1 Construction Phase

The liquid wastewater generated during the construction phase will include domestic sewage from Project site office, labour camps and any other accommodation or office facility established for the Project.

As part of the site preparation stage, a drainage and sewerage system will be constructed for the site office. The sewerage system will consist of soak pits for the collection of wastewater from the camp kitchen and washing areas and office facility. Sewage from the toilets will go into lined septic tanks. Sewage disposal trucks will be used to periodically remove the sludge/sewage from the site.

According to CPCB, per capita wastewater generation projected for year 2021 is around 121litre/capita/day based on the average wastewater generation observed during the studies carried out by the board. The same figure will beused to estimate the total wastewater generation from the site during construction and operation phase.

2.6.3.2 Operations Phase

The operation phase will have negligible wastewater generation. Septic tank and soak pits will be provided at SCADA building and CMS monitoring station for disposal of sewage.

2.6.4 Waste Management

2.6.4.1 Construction Phase

The solid waste generated by the Project will consist of domestic solid waste, packaging waste, metal scrap and excess construction materials. The main types of waste that would ideally be generated and its sources are shown in ***Table 2.7.***

Table 2.7 Waste generated, source of waste and method of disposal to be adopted for the Project

S. No	Waste Type	Source	Method of disposal
Non-Hazardous Waste			

S. No	Waste Type	Source	Method of disposal
1.	Domestic solid waste	Labour activities	Waste will be segregated onsite and will be disposed of at site as approved by local authority.
2.	Construction debris (excavated earth)	Construction of WTG, access road, substation, storage yard etc.	Excavated materials to be used for backfilling and levelling and other debris shall be used for road construction.
3.	Packaging waste containing wood, cardboard and other recyclables.	Packaging material for WTGs and accessories.	Return back to the supplier or used as storage boxes/ racks at site.
4.	Sludge from Septic Tank	Site Office	Collected and disposed off through contractors.
5.	All non-recyclables waste	Construction activities.	Collected and disposed off by the contractor at designated landfill sites.
6	Plastic waste	Packaging material	Will be collected and disposed of through recycler
7	Biomedical waste	First aid kits kept at constriction site and site office	Will be collected, transported and disposed through an authorised agency as prescribed in *Bio-Medical Waste (Management and Handling) Rules 2016*.
8	E waste	PSS and Site Office	Will be collected and disposed off through a government authorised third party duly approved by State Pollution Control Board as per E-Waste (Management) Rules, 2016
9	Batteries	PSS and Site Office	Batteries will be given back to the manufacturer from whom new batteries are purchased under the buy-back arrangement.
Hazardous Waste			
1.	Used oil/waste oil	DG set, construction machinery	Collected and disposed off through approved recyclers in accordance to *Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended*
2.	Oil contaminated rags	Cleaning activities at WTG sites and substation	Collected and disposed off through approved vendors in accordance to *Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended*

Source: *Discussion with Ayana representative*

2.6.4.2 Operational Phase

During the operational phase, the waste generated from the Project would ideally include domestic solid waste at the office building and pooling substation, scrap material like scrap tool, damaged PPEs and hazardous waste like waste oil, lubricants and oil contaminated rags will be generated during maintenance activities.

- The hazardous wastes will be stored onsite at separate designated covered areas provided with impervious flooring. The storage containers/bin/drums will be clearly marked and identified for their hazards;
- The hazardous wastes will be disposed of in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended, through KSPCB approved vendors;
- Non-recyclable material will be collected, segregated onsite and handed over to local Municipal Corporation for disposal; and
- Sewage will be disposed of through septic tanks and soak pits.

2.6.5 Fire Safety and Security

2.6.5.1 Construction

Appropriate firefighting system and equipment shall be provided throughout the construction period. The fire extinguishers will be placed at all strategic locations such as camp site, site office, storage yard, batching plant, heavy construction machinery etc. Besides this, emergency contact numbers shall also be displayed onsite.

2.6.5.2 Operations - Structural fire protection

Wind Turbines comprise predominantly of non-flammable materials. Most components of the WTGs are predominantly metal. The only inflammable components are rotor blades and the panelling of the machine house, which are made from glass-fibre reinforced plastic, electric cables and electrical components, gear box, transformer and hydraulic oils, hoses and other plastic components. It is practically impossible for fire to spread from the transformer station to the wind turbine or vice versa.

2.6.5.3 Operations - Fire prevention

The service personnel will take all appropriate measures to prevent fires. Lightening protection system will be based on lightening protection zone concept and in accordance to IEC 61400- 24, 62305-1, 3, 4 and DIN EN 50164-1, 2. A lightning strike as a cause of fire has been therefore excluded.

Moreover, the WTGs have nacelle fire protection design, brake system fire protection design, hub fire protection design, electrical cabinet fire protection design, and tower and vertical cable fire protection design.

The electrical cabinet (Nacelle main control Cabinet, generator stator box, pitch Cabinet, inverter cabinet) is an enclosed electrical space, and the potential fire hazard is electrical fire, aerosol is preferred as fire extinguishing medium. The automatic fire-fighting device in the electrical cabinet is composed of aerosol fire-fighting device, starting element of temperature sensitive magnetic power generation, thermosensitive wire, and special support for the Cabinet and installation accessories.

Fire extinguishers

As per information provided by Ayana, 2 hand-held dry powder (MFZ/ABC5) fire-fighting devices will be installed on the Nacelle platform, with indication signs hanging above the stored fire-fighting devices. It is used for personnel to use the handheld fire extinguishers to extinguish the fire when a fire is found in the large Nacelle space during Nacelle maintenance.

An ultra-fine dry powder fire extinguishing device will be installed near the high-speed brake disc with temperature sensitive magnetic generating element and Thermosensitive wire.

2.7 Contractors

EPC contractor/s for the Project has not been finalised yet. As discussed, Ayana is in plans to finalise the contractors. It is understood that once EPC contractors are on-board, the sub-contractors will be hired by those EPC for the construction process (civil and mechanical) and electrical installations.

Subcontractors will be utilized for the activities as follows:

- Construction of WTG foundations;
- Civil works, excluding laying WTG foundations;
- WTG installation;
- Construction of transmission line (internal and external) and bay connectivity at the government substation;
- Construction of internal access roads that would connect the WTGs with one another as well as to other proposed facilities such as the SCADA, site office etc.

2.8 Project Organization Structure

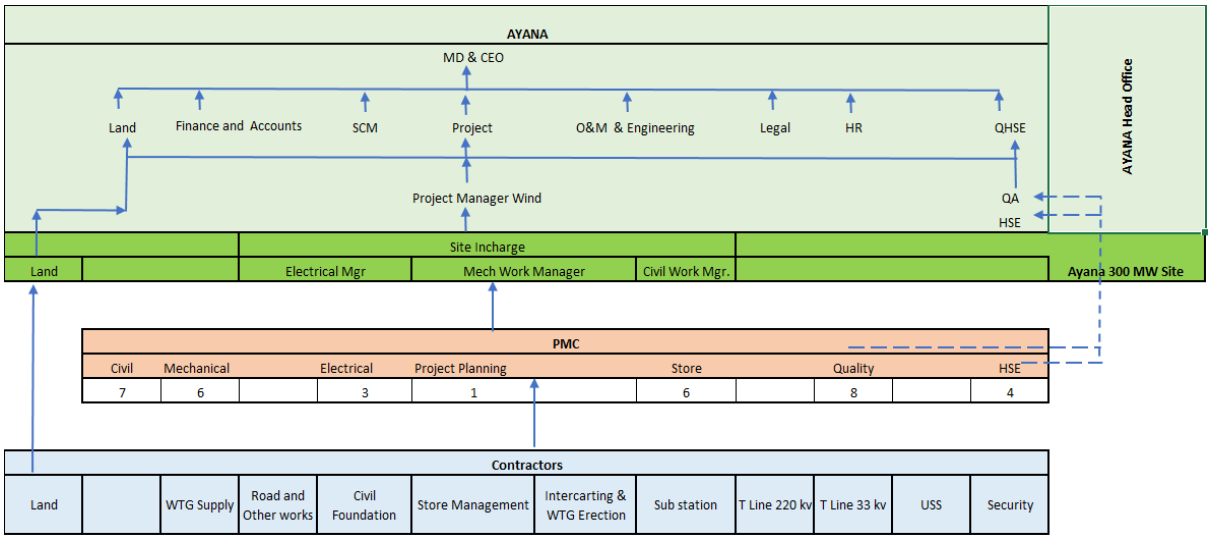
2.8.1 Project Proponent

The Project will be overseen by a management team of Ayana Renewable Power Private Limited at the corporate level and an onsite team at the Project site. It is understood that Ayana will deploy its 5 team members on site during start of the project. The team will be responsible for oversighting of project construction. The team will comprise of Site incharges- Land, Electrical Manager, Mechanical work Manager and Civil work Manager.

Ayana will also hire Project Management Consultancy, that will include electrical, civil and mechanical engineers alsong with 4 nos. of QHSE staff.

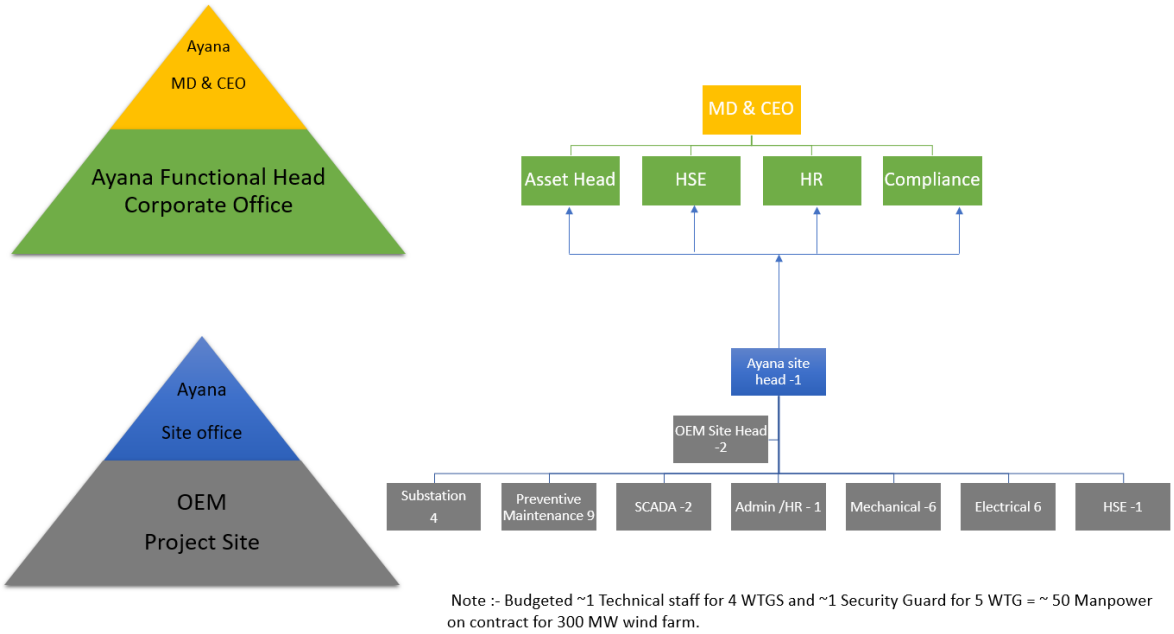
It is to be noted that all contractors will have QHSE personnel on site.

Figure 2.4 Organogram of Ayana during Construction Phase



Source: *Ayana, dated 19 August 2021*

Figure 2.5 Organogram of Ayana during Operation Phase



Source: Ayana

2.8.2 Land Procurement

Land procurement for the project is being undertaken by land procurement contractor agency BV Patil LLP who is also responsible for obtaining all the necessary approvals and NOCs. Land procedure, procurement monitoring is supervised and regularly falls under the responsibility of the project team in Ayana.

3. ADMINISTRATIVE AND REGULATORY FRAMEWORK

3.1 Introduction

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

- Institutional Framework for the implementation of the regulations; and
- Applicable national and international Environmental Standards.

Approval from various regulatory agencies authorized by the Central and State Governments, in the form of Licenses, Permits, or Authorizations, are required for the establishment and operation of proposed Project.

3.2 Permitting Status of the Project

3.2.1 EIA Notification (2006)

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

3.2.2 Central Pollution Control Board

Based on the notification released by the Central Pollution Control Board (CPCB Ref No: B-29012/ ESS (CPA)/2015-20163), “Solar projects, wind power projects and mini hydro projects (less than 25 MW)” have been moved from “green category” to “white category” and there shall be no necessity of obtaining Consent to Operate, an intimation to SPCB/PCC shall suffice.

Also, as per latest amendment in Hazardous Waste (Management& Transboundary Movement) Rules, 2016, “Industries which do not require consent under Water (Prevention and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) Act 1981, are now exempted from requiring authorization also under the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016, provided that hazardous and other wastes generated by such industries are handed over to the authorized actual users, waste collectors or disposal facilities”.

3.2.3 Karnataka Renewable Energy Policy and Regulations specific to the Government of Karnataka

The Department of Renewable Energy is responsible for formulating policies and programmes necessary for popularizing the applications of various non -conventional and renewable sources of energy in the State. It is implementing various schemes concerning utilization of solar energy, biogas, micro hydel, biomass energy etc. The Department is also acting as a State Designated Agency for the implementation of the Energy Conservation Act, 2001 in the State for taking full advantage of fiscal and financial incentives made available by the Ministry of New & Renewable Energy (MNRE), Government of India and Indian Renewable Energy Development Agency (IREDA) and to give impetus to the process of implementation, State Govt. has set up Karnataka Renewable Energy Development Ltd. (KREDL).

[3] http://cpcb.nic.in/uploads/Latest_Final_Directions.pdf

Karnataka Renewable Energy Development Limited (KREDL) has drafted Karnataka Renewable Energy Policy 2021-2026[4] which is currently in draft stage. According to the draft policy, the policy aims to promote the wind energy projects including new wind energy projects and repowering of existing wind energy projects. The Policy as been drafted with its objective to facilitate the development of 20 GW of RE projects with or without energy storage systems in the state, including 2 GW of rooftop solar PV projects. The policy aims to achieve the RPO (renewable purchase obligations targets as specified by Karnataka Electricity Regulatory Commission (KERC).

The incentives provided by the Government of Karnataka for the markets focussed under this policy are; sale of energy, land acquisition, obtaining grid connectivity, project allotment, clearances, energy storage, and metering and connectivity.

3.3 Institution Framework- Enforcement Agencies

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in ***Table 3.1***.

Table 3.1 Enforcement Agencies relevant to the Project

Agency	Functions	Relevance & Applicability to the project
Central Level		
Ministry of Environment, Forest and Climate Change (MoEFCC)	The Ministry of Environment and Forests (MoEFCC), Government of India is responsible for the environment management at Union of India level. The specific functions of MoEFCC are as follows: ■ Environmental policy planning; ■ Effective implementation of legislation; ■ Issuing guidelines under EP Act for environment protection; ■ Monitoring and control of pollution through Central Pollution Control Board and State Pollution Control Boards; ■ Environmental clearance for industrial and development projects covered under EIA Notification; ■ Monitoring of compliance conditions stipulated in Environmental clearance through its regional offices; ■ Promotion of environmental education, training and awareness; ■ Forest conservation, development, and wildlife protection; and ■ Protection of Coastal areas. MoEFCC is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including the EIA notification. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.	As per the EIA Notification (2006) and its amendments, the renewable project does not require any environmental clearance from the Ministry of Environment Forest and Climate Change (MoEFCC) or the State Environmental Impact Assessment Authority (SEIAA).

[4] https://kredlinfo.in/solargrid/Letter%20for%20stake%20holder%20comments.pdf

Agency	Functions	Relevance & Applicability to the project
State Environment Impact Assessment Authority (SEIAA)	The SEIAA is a Central Government Authority that is constituted by the State Government but acts on behalf and reports to the MoEFCC. All the "B" category projects are assessed by SEIAA and issue environment clearance (EC).	
Ministry of New and Renewable Energy (MNRE)	The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to renewable energy. The Ministry facilitates research, design, development, manufacture and deployment of new and renewable energy systems/devices for transportation, portable and stationary applications in rural, urban, industrial and commercial sectors.	Project will be developed based on MNRE guidelines
National Green Tribunal (NGT)	The tribunal will have jurisdiction over all civil cases relating to implementation of the following regulations: ■ The Water Act, 1974; ■ The Water Cess Act, 1977; ■ The Forest Conservation Act, 1980; ■ The Air Act, 1981; ■ The Environmental Protection Act, 1986; ■ The Public Liability Insurance Act,1991; and ■ The Biological Diversity Act, 2002. The Act provides compensation on account of following: ■ Relief and compensation to the victims of pollution and other environmental damage arising under enactment of the above acts; ■ Restitution of property damaged; and ■ Restitution of the environment.	U / s 17, any person responsible for any untoward incidents (defined in Schedule II of the Act) is liable to pay relief or compensation as determined by the tribunal, failing which a penalty (u/s 26 and 27) is imposable which may lead to imprisonment of up to 3 years or fine up to Rs. 10 crores or both and an additional fine of Rs. 25,000 per day for any delay which may be further increased to one lac per day.
Central Electrical Authority (CEA)	The Central Electricity Authority (CEA) is a statutory organisation constituted under Section 3 of the repealed Electricity (Supply) Act, 1948, herein after replaced by the Electricity Act, 2003. Some of the functions performed by CEA include the following: ■ Advise the Central Government on the matters relating to the national electricity policy, formulate short-term and perspective plans for development of the electricity system and coordinate activities of the planning agencies for the optimal utilization of resources to sub-serve the interests of the national economy and to provide reliable and affordable electricity to all consumers;	Project will be developed based on technical standards for CEA for electrical lines and grid connectivity.

Agency	Functions	Relevance & Applicability to the project
	■ Specify the technical and safety standards for construction of electrical plants, electric lines and connectivity to the grid; ■ Specify the safety requirements for construction, operation and maintenance of electrical plants and lines; ■ Advise any State Government licenses or the generating companies on such matters which shall enable them to operate and maintain the electricity system under their ownership or control in an improved manner and where necessary, in coordination with any other Government license or the generating company owning or having the control of another electricity system etc.	
Petroleum and Explosives Safety Organisation (PESO)	The Organisation as a statutory authority is entrusted (by the order of the Chief controller of explosives) with the administration of Explosives Act, 1884 Petroleum Act, 1934; Inflammable Substances Act, 1952 and the following Rules framed under these Acts. Other important rules are The Static and Mobile pressure vessels {Unfired} Rules and Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and the following Amendments framed under these Rules.	The project should adhere to the guidelines that are laid down by PESO. Based on assumptions, fuel storage is envisaged at the site. If fuel storage exceeds the limit as stipulated by PESO, then a license needs to be obtained from PESO.
State Level		
Karnataka State Pollution Control Board (KSPCB)	State Pollution Control Boards are responsible for implementing various environmental legislations in the state, mainly including Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Water (Cess) Act, 1977 and some of the provisions under Environmental (Protection) Act, 1986 and the rules framed there under like, Biomedical Waste (M&H) Rules, 1998; Hazardous Waste (M&H) Rules, 2008; Municipal Solid Waste Rules, 2000 etc. SPCBs functions under the administrative control of Environment Department of the State	As per Central Pollution Control Board's (CPCB) recent notification dated March 7th, 2016 vide No. B-29012/ESS (CPA)/2015-16 for modified directions under Section 18 (1) (b) of the Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981, regarding harmonization of classification of industrial sectors under red/orange/green/white categories. Industrial sectors having Pollution Index scores inclusive and up to 20, will fall under the White Category projects. Wind projects have been categorized as White Category. It has been mentioned in the notification that there shall be no necessity of obtaining CTO for

Agency	Functions	Relevance & Applicability to the project
		White Category industries. Intimation to KSPCB shall suffice for the Project. The Project would generate used oil from DG sets and WTG maintenance. As per latest amendment in Hazardous Waste (Management& Transboundary Movement) Rules, 2016, “Industries which do not require consent under Water (Prevention and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) Act 1981, are now exempted from requiring authorization also under the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016, provided that hazardous and other wastes generated by such industries are handed over to the authorized actual users, waste collectors or disposal facilities”.
Karnataka Renewable Energy Development Ltd. (KREDL)	Karnataka Renewable Energy Development Limited (KREDL), is an organization working under the purview of Energy Department, Government of Karnataka. The objectives of the KREDL is to promote renewable energy in the State and to initiate all necessary actions for Energy Conservation in the State. Mission of KREDL is: ■ To enhance the contribution of environment friendly Renewable Energy sources, to the socio-economic development and supplement rural energy needs through speedy and expeditious commissioning of sustainable Renewable Energy projects. ■ To create conditions conducive to private/ public/community participation and investment in Renewable Energy power projects. ■ To achieve commercial viability and expeditiously operationalize the Renewable Energy Projects	The project to be developed based on the new policy that shall be released by KREDL.

Agency	Functions	Relevance & Applicability to the project
	■ To enhance the contribution of Renewable Energy in the total installed capacity of the state. ■ To conserve Energy through the Energy Efficiency & Energy Conservation measures in all sectors	
Karnataka Forest Department, Govt. of Karnataka	The department plans, executes, co-ordinates and monitors implementation of various forestry and wildlife programs to ensure ecological security and environmental balance by sustainable management of forests. The objectives of the department is: ■ Protection, conservation and consolidation of forests and protected areas (Consolidation, protection and conservation of forests, biodiversity and wildlife, and habitat improvement.) ■ Qualitative and quantitative enhancement of forest cover in the state (Afforestation, reforestation and regeneration of degraded forests, soil and moisture conservation.) ■ Sustainable management of forests (Sustainable harvest and livelihood support through people's participation, capacity building of stakeholders, and effective delivery mechanisms.) ■ Expansion of tree cover outside forests (Agro-forestry, plant-forestry, tree improvement, Extension and Publicity)	Project shall require to take into account ecological impacts of the project.
Gram Panchayat	The local Panchayats are empowered with management of local resources like forests, groundwater, common land and infrastructure like roads, buildings etc.	No Objection Certificates are required to be taken from the Panchayats at the time of initiating a project in local area. Panchayats are also empowered to levy and collect local taxes on land, property and provisioning of facilities. For the proposed project, Land aggregator shall be responsible for obtaining NOC from the concerned panchayat.
State Labour Department	The Department of Labour is responsible for formulation, implementation and enforcement of the labour laws in the Karnataka state. It also undertakes prevention and settlement of industrial disputes, Industrial safety, and health and promotes welfare of workers in the undertakings within the sphere of the State.	Labours to be involved during the construction phase and few in the operation should be provided with wages and other facilities with state as well as local and migrant labour laws and acts.

Agency	Functions	Relevance & Applicability to the project
Directorate Industrial Safety and Health Department (DISH).	The Directorate of Industrial Safety and Health Department enforces the provisions of Factories Act 1948 and Karnataka Factories Rule 1963 and the rules made there under to ensure safety health and welfare of the workers. It also plays a significant role in regularizing working hours, and working conditions and reducing the accident and dangerous occurrences in the factories, redressal of the grievances of the workers in respect of Safety Health and Welfare through a set of policies developed by both the Central and State Govt. Some of the functions of DISH are: ■ Elimination inequality and discrimination in the work place; ■ Enhancing occupational health and safety awareness and compliance in the workplace; ■ Workforce and community participation, to employers, employees, workplaces, communities, businesses and unions; and ■ Providing policy advice and analysis to government on labour and employment related matters.	According to Section 2 k (iii), read as “generating, transforming or transmitting power” and I (I & ii) read as “(i) whereon ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so carried on, or (ii) whereon twenty or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on without the aid of power, or is ordinarily so carried on,” factories act 1948 shall be applicable. Project needs to comply with different rules under jurisdiction of DISH.
Other Institutions		
National institute of wind energy (NIWE)	NIWE has been established in Chennai in the year 1998, as an autonomous R&D institution by the Ministry of New and Renewable Energy (MNRE), Government of India. The Centre provides services such as: ■ R & D for wind turbine technologies; ■ Identification of wind resource rich regions in the country; ■ Testing of complete Wind Turbine Generator Systems (WTGS) according to international standards (IEC) and Type Approval Scheme (TAPS-2000); and ■ Provisional Type Certification of Wind Turbines as per the Indian Certification Scheme.	Project will be developed based on technical standards of WTGs specified by NIWE.

3.4 Applicable Regulatory/Policy Framework

Table 3.2 summarizes the key regulations that are relevant to the project across its lifecycle. This document should be used to update/develop a comprehensive legal register for the Project, which can be regularly monitored for compliance as well as updated to reflect changes/non-applicability of regulations, policies and standards.

3.5 Applicable Environmental Standards

3.5.1 National Level Standards

Taking provision of EPA, 1986, the Central Pollution Control Board (CPCB) has stipulated different environmental standards w.r.t ambient air quality, noise quality, water and wastewater for the country as a whole. Following standards are applicable for the Project and need to be complied with during the Project life cycle.

- National Ambient Air Quality Standards (NAAQ Standards), as prescribed by MoEFCC vide, *Gazette Notification dated 16th November, 2009;*
- Drinking water quality- Indian Drinking Water Standard (IS 10500: 2012);
- General standards for discharge as prescribed under the Environment Protection Rules, 1986 and amendments (G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986);
- Noise standards specified by the MoEFCC vide *Gazette notification dated 14th February, 2000* (Noise Pollution (Regulation and control) Rules, 2000);
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended;
- Construction and Demolition Waste Management Rules, 2016;
- Solid Waste Management Rules, 2016;
- Batteries (Management and Handling) Rules, 2001;
- Plastic Waste Management Rules 2016;
- E-waste (Management) Rules, 2016; and
- Bio-Medical Waste Management Rules, 2016.

3.5.2 IFC/ WB EHS Standards

The General EHS guidelines (30th April 2007) of IFC/ WB have outlined following environmental standards which needs to be complied for the project.

- IFC/WB Air Emissions and Ambient Air Quality Standards;
- IFC/WB Guidelines for treated sanitary sewage discharges; and
- IFC/WB Noise Standards.

Table 3.2 Applicability of Key Legislations in India and Reference Framework in the different phases of life cycle of Project

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
Environment Protection						
Environment Protection Act, 1986 as amended	X	√	√	√	KSPCB CPCB MoEFCC	Permissible limits for ambient air quality, water quality, noise limits has been laid down by CPCB under EP Act, 1986 which required to be complied with.
The Water (Prevention and Control of Pollution) Act, 1974, as amended.	X	√	√	X	KSPCB	Based on the notification released by the Central Pollution Control Board (CPCB Ref No: B-29012/ ESS (CPA)/2015-20161), “Solar projects, wind power projects and mini hydro projects (less than 25 MW)” have been moved from “green category” to “white category” and there shall be no necessity of obtaining Consent to Operate, an intimation to SPCB/PCC shall suffice.
The Air (Prevention and Control of Pollution) Act, 1981, as amended.	X	√	√	X	KSPCB	
The Noise (Regulation and Control) Rules, 2000	X	√	√	√	KSPCB	Ambient noise levels are to be maintained as stipulated in the rules for different categories of areas – residential, commercial, industrial and silence zones. Ayana will need to abide by the limits prescribed for residential zones.
The Motor Vehicles Act, 1988, as amended	√	√	√	√	MORTH	Wind-farm projects require frequent movement of very large engineering goods and components in heavy duty vehicles through narrow/inner community roads. Ayana will need to abide by the Act in terms of drivers holding valid driving license, insurance, registration of motor vehicle, etc.

[1] http://cpcb.nic.in/uploads/Latest_Final_Directions.pdf

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
The Wildlife (Protection) Act, 1972	X	√	√	√	Department of Forest	An Act to provide for the protection of wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto with a view to ensuring the ecological and environmental Security. Ayana shall require to abide by provisions of the act.
The Karnataka Preservation of Trees Act, 1976	X	√	√	√	Department of Forest	An Act to provide for the preservation of trees by regulating the felling of trees and planting adequate no. of trees to restore ecological balance. Ayana shall require to abide by the act in case any tree felling is envisaged for the project development.
Labour and Working Conditions						
The Karnataka Factories Rules,1969	X	√	√	X	Deputy Chief Inspector of Factories	Ayana needs to comply to all requirement of factories rules and participate in periodic inspection during the Operations Phase
Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996;	X	√	√	√	State Department of Labour	Ayana and their contractors need to comply to the requirements of the these regulations
Inter-state Migrant Workmen (Regulation of Employment and Condition of Service) Act, 1979	X	√	√	√		
Contract Labor (Regulation and Abolition) Act 1970	X	√	√	√		
The Child Labour (Prohibition and Regulation) Act, 1986, as amended	X	√	√	√		
The Employees' Compensation Act, 1923, as amended	X	√	√	X		

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
The Payment of Wages (Amendment) Act 2017	X	√	√	X		
The Minimum Wages Act, 1948	X	√	√	X		
The Employees' State Insurance Act, 1948	X	√	√	X		
The Employees' Provident Funds and Miscellaneous Provisions Act, 1952	X	√	√	X		
The Payment of Bonus Act, 1965, as amended	X	√	√	X		
The Payment of Gratuity Act, 1972	X	√	√	X		
Companies Act, 2013	X	X	√	X	Ayana	According to Schedule 135 sub-section 1, the companies meeting the threshold criteria specified should spend in every financial year, at least 2% of the average net profits of the company made during the three immediately preceding financial years, in pursuance of CSR Policy.
Maternity Benefit Act, 2017	X	X	√	X		
The Bonded Labour System (Abolition) Act 1976	X	X	√	X		
Equal Remuneration Act 1976	X	X	√	X		
Workmen's Compensation Act, 1923	X	X	√	X		
Storage of hazardous chemicals						
Manufacture, storage and import of hazardous chemicals (MSIHC) Rules, 1989 and as amended	X	√	√	X	KSPCB	Rules will be applicable during construction and operation stages if chemicals stored at site satisfy the criteria laid down in the Rules.

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
Handling of different type of Wastes						
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended	X	√	√	√	KSPCB	Generation of waste oil and transformer oil at site attracts the provisions of Hazardous and Other Wastes Rules, 2016. The rules provide guidelines for the disposal and treatment of these wastes through approved recyclers.
Construction and Demolition Waste Management Rules, 2016	X	√	X	√	Local authorities	Construction waste generated at site will be handled as per the provisions of Construction and Demolition Waste Management Rules, 2016. This provides guidelines for disposal of waste through local authorities.
Solid Waste Management Rules, 2016	X	√	√	√	Local authorities	Solid waste generated at site will be handled as per provisions of solid waste management rules, 2016.
Batteries (Management and Handling) Rules, 2001	X	X	√	√	KSPCB	Old batteries generated at site attracts provisions of Batteries (Management and Handling) Rules, 2001. This rule provide guidelines on disposal of batteries through authorised agency.
Plastic Waste Management Rules 2016	X	√	√	√	KSPCB	Rules will be applicable for disposal of plastic waste at site.
E-waste (Management) Rules, 2016	X	X	√	√	KSPCB	E-waste (Management) Rules, 2016 will be applicable for disposal of e waste generated at site.
Bio-Medical Waste Management Rules, 2016	X	√	√	√	KSPCB	Bio-medical waste generated at site will attract provisions of Bio-Medical Waste Management Rules, 2016. Biomedical waste generated to be disposed off through authorised agency.
Applicable International Conventions						
Conventions on the Conservation of Migratory Species of Wild Animals and Migratory Species.	√	√	√	√	State Forest Department	Migratory birds in the Project area bear protection from killing under Convention of Migratory Species (CMS) to which India is a signatory. Wetlands being utilized by these species are also protected under this convention.

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
Kyoto Protocol: The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary green-house gas emission reduction agreements.	√	√	√	√	NATCOM	The proposed Project being a wind power generation Project becomes the basis for qualifying for the Clean Development Mechanism
IFC/World Bank Guidelines						
IFC Performance Standards	√	√	√	√	IFC, Equator Principles Financing Institutions (EPFIs)	The ESIA report has to be prepared on lines of the IFC Performance Standards (2012).
IFC/WB General EHS Guidelines	X	√	√	√	IFC, EPFIs	During the construction, operation and decommissioning of the site, these guidelines will need to be followed
IFC Guidelines for Power Transmission and Distribution	X	√	√	√		
IFC Guidelines for Wind Energy Projects	X	√	√	√		Requirements of Environmental, Health and Safety Guidelines for Wind Energy, August 2015 will need to be followed throughout the life cycle of the Project.
IFC Guidelines on Worker Accommodation	X	√	√	√		During the construction stage of the Project, these guidelines will need to be followed.

3.6 International Safeguard

3.6.1 IFC Performance Standards

IFC applies the Performance Standards (1) to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed project. These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

Together, the Client is required to meet the stipulations of all the eight Performance Standards throughout the life of an investment in the case such an investment is being sought either form IFC or any other institution which follows IFC standards (***Table 3.3***)

Table 3.3 IFC Performance Standards (PS), 2012

IFC PS	Description	Objectives and Applicability to the Project
IFC PS 1	Assessment and Management of Environmental and Social Risks and Impacts	**Applicable** This PS aims to assesses the existing social and environmental management systems of Ayana and to identify the gaps with respect to their functioning, existence and implementation of an environmental and social management plan (ESMP), a defined EHS Policy, organization chart with defined roles and responsibilities, risk identification and management procedures as well as processes like stakeholder engagement and grievance management.
IFC PS 2	Labour and Working Conditions	**Applicable** This PS is guided by a number of international conventions and instruments on labour and workers' rights. It recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of fundamental rights of workers. The PS covers themes like human resource policy and management, workers' organization, non-discrimination and equal opportunity, retrenchment, protecting the workforce and occupational health and safety. The project activities will involve hiring of approximately 530 skilled, semi-skilled and unskilled labourers during the peak construction phase and around 100 skilled, semi-skilled and unskilled labourers during operation phase. This will also entail possibility of influx of migrant labourers. The project will have to develop a human resource policy and ensure non-discrimination and equal opportunity, protection of the workforce and occupational health and safety. Therefore, PS 2 is applicable to the Project.
IFC PS 3	Resource Efficiency and Pollution Prevention	**Applicable**

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

IFC PS	Description	Objectives and Applicability to the Project
		PS-3 covers the use resources and materials as inputs and wastes that could affect human health. The objective of PS-3 are: to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; to promote more sustainable use of resources, including energy and water, and to reduce project related GHG emissions. Key themes covered under PS-3 are: pollution prevention, resource conservation and energy efficiency, wastes, hazardous materials, emergency preparedness and response, greenhouse emissions, pesticide use and management. This PS will assess how Ayana intends to minimize pollution related impacts, what management plans and systems are in place, and what measures it plans to take to conserve and use resources more efficiently. The Project construction activities will lead to increased fugitive dust emissions, especially in the area it is being developed due site clearance and excavation related activities. The Project activities will also lead to increase in ambient noise level during the construction phase, which may impact the nearest villages. Therefore, PS 3 is applicable to the Project.
IFC PS4	Community Health, Safety and Security	**Applicable** This PS-4 requires due diligence to anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances. It also requires to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected Communities. Key areas of compliance screened under PS-4 includes: infrastructure/equipment safety, hazardous material safety, natural resource issues, exposure to disease, emergency preparedness and response, and security personnel requirements. The project would affect the health and safety of the communities adjacent to it during construction phase. Transportation of equipment and increased traffic in the area may lead to accidents and other threats on community health and safety, therefore PS 4 is applicable to the Project.

IFC PS	Description	Objectives and Applicability to the Project
IFC PS 5	Land Acquisition and Involuntary Resettlement	**Not Applicable** PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use. The key themes covered under this are: compensation and benefits for displaced persons, consultation and grievance mechanism, resettlement planning and implementation, physical displacement, economic displacement. The PS-5 also prescribes private sector responsibility to supplement government actions and bridge the gap between governments assigned entitlements and procedures and the requirements of PS-5. Based on the site consultation with the local community, the total land requirement for the proposed project is 560 acres, of which 112 will be purchased. Out of 112 acres, 86 acres is already procured Lakkundi, Harlapur, Churchihal, Kadampur and Doni villages on willing-seller willing-buyer basis and remaining is in the stages of being procured. This land identified for the project development is private in nature. Furthermore, it was understood during consultation with the land aggregator that the land acquisition procedure avoids land parcels with temporary or permanent structures. Moreover, consultations with land sellers and land losers revealed that none of them would be rendered landless and the impact on their livelihood would be negligible.Thus, it has been determined that, the project shall not led to any resettlement, physical displacement and/ oreconomic displacement Therefore, PS 5 is not applicable to the project.
IFC PS 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	**Applicable** The requirements of this Performance Standard are applied to projects (i) located in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources (e.g., agriculture, animal husbandry, fisheries, forestry). PS-6 screens relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution. The key themes covered under PS-6 are: natural habitat, critical habitat, legally protected areas, international introduction of alien species, and living natural resources (natural and plantation forest, aquatic resources etc.) are sustainably managed. Kappatagudda Wildlife Sanctuary is located within 5 km (~1.1 km from WTG AY10) of the proposed wind power plant area. Tungabhadra Reservoir is about 12 km from the

IFC PS	Description	Objectives and Applicability to the Project
		proposed route of the transmission line (TL) and grid substation (GSS) located at Koppal and about 25 km from the proposed wind farm. Magadi & Shettikere Wetlands are located at a distance of ~25 km in south west direction from the proposed project. The presence of above mentioned ecological important areas may pose risk to avifauna in terms of bird movement. Therefore, PS 6 is applicable for the Project.
IFC PS 7	Indigenous Peoples	**Not Applicable** This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. PS-7 endeavor to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous People. Key themes covered under PS-7 are: avoidance of adverse impacts, consultation and informed participation, impacts on traditional or customary land under use, relocation of IPs from traditional or customary lands, and cultural resources. Based on the consultation with the Ayana team and site representatives including the land aggregator and review of the Planning Commission list of Schedule V Areas[1], it is understood that project land doesn't fall with the Schedule V area. The Land Aggregator has informed that no land from the tribal community shall be procured for the project development. Therefore, PS-7 is **Not Applicable** to the Project
IFC PS 8	Cultural Heritage	**Not Applicable** For the purposes of PS-8, cultural heritage refers to (i) tangible forms of cultural heritage; (ii) unique natural features or tangible objects that embody cultural values; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes. The requirements of PS-8 apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed.Based on the observations made during the site visit, no cultural heritage is located near within 300 m of proposed WTG locations. Lakkundi Village has been deemed as an archaeological site and is home to nearly 50 historical temples that are maintained by the Archaeological Survey of India (ASI)[2]. The village is full of semi-ruined and preserved historical temples from the period of Chalukyas, Kalachuris, Seuna and the Hoysalas empires of Indian history. The temples belong to Mallikarjuna, Virabhadra, Manikeshwara, Nanneshwara,

[1] https://cuorissa.thinkexam.com/document/notification/ListofScheduleAreainIndia.pdf

[2] https://gadag.nic.in/en/tourist-place/lakkundi/

IFC PS	Description	Objectives and Applicability to the Project
		Lakshminarayana, Someshwara, Nilakanteshwara and many more[1]. Based on the ASI website, of the 43 protected monuments in Gadag district, 6-7 are in Lakkundi Village. The village is also home to a heritage centre with artefacts and remains of ancient scriptures displayed for tourists. There are nearly four (4) proposed WTG locations which are at a distance of 900-1km from the village boundary. However, the distance of the temples from the proposed locations is more than 1km. However, since, the site has archeological artefacts maintained by the ASI, there is small possibility of a chance find procedure[2] being triggered. Moreover, sites of local cultural and religious significance, such as temples, mosques, communal gravesites etc. are in the vicinity of the project area and may be directly or indirectly impacted during construction phase. However,based on the site visit and stakeholder consultations it is assessed that these religious structures are not a critical cultural heritage as they are not internationally recognized or legally protected. Therefore, PS 8 is not applicable to the Project.

Source: Summarised from the IFC Performance Standards on Environmental and Social Sustainability,

3.6.2 NIIF ESG Policy framework Requirements

Details of NIIFs ESG Policy framework requirements are provided in the table below.

NIIF Principle	Description	Objectives and Applicability to the Project
Principle 1	Environmental & Social Risk Assessment and Management Systems	**Applicable** This principle essentially mandates that every project or business activity funded by NIIFL or by third party managers of its sub-funds irrespective of its categorization under NIIFL's E&S Management Policy will institute and operate an appropriate Environmental and Social risk identification, assessment and Management System (ESMS) that addresses all the requirements specified in NIIFL's E&S Management Principles 2 through 4. Ayana shall be required to implement ESMS for E&S risk assessment practices. The ESMS will be inclusive of all environment, health and social policies, procedures, etc.
Principle 2	Environmental Risks and Management	**Applicable** This principle will cover all matters relating to identification and assessment of risks and impacts on environmental resources that will be caused by the development of the Project or business activity to be

[1] https://gadag.nic.in/en/gallery/lakkundi/

[2] A chance find procedure is a project-specific procedure that outlines the actions to be taken if previously unknown cultural heritage is encountered[3] https://www.dfc.gov/sites/default/files/media/documents/DFC_ESPP_072020.pdf

NIIF Principle	Description	Objectives and Applicability to the Project
		funded and management strategies to be formulated to mitigate the risks and impacts. The project activities during construction phase, decommissioning phase and operation phase will cause pollution and therefore Ayana shall be required to minimize pollution related impacts through adoption of monitoring, mitigation and management plans.
Principle 3	Human Resources Management	**Applicable** This principle will cover all matters relating to engagement of human resources through the Project life cycle. The principle will cover all aspects of human resources engagement including but not limited to direct employment, contractual employment, employment offered though third party or petty contractors, occupational health and safety aspects in the workplace, working conditions and terms of employment including equal opportunities, grievance mechanism, prohibition of child or forced or bonded labour practices. The project will have to develop a human resource policy and ensure non-discrimination and equal opportunity, protection of workforce and occupational health and safety.
Principle 4	Social Risks and Management	**Limited Applicability** This Principle will cover all matters relating to identification and assessment of risks and impacts on social aspects that will be caused by the development of the Project or business activity to be funded and management strategies to be formulated to mitigate the risks and impacts. This principle will cover all risks and impacts on social sector including: involuntary land acquisition; physical and economic displacement of project affected peoples (PAPs); vulnerable PAPs; scheduled tribes and cultural heritage resources relevant to local communities. The project development does not result in involuntary land acquisition and/or physical or economic displacement. Furthermore, no land will be procured from Scheduled Tribe households. However, as discussed in **Table 3.3**, the distance of the archelogical sites in Lakkundi village is more than 1km and thus, the project will not have any impact on these structures. However, since, the site has archeological artefacts maintained by the ASI, there is small possibility of a chance find procedure being triggered.

3.6.3 World Bank Group EHS Guidelines for Wind Energy, 2015

The EHS Guidelines for wind energy include information relevant to environmental, health, and safety aspects of onshore and offshore wind energy facilities. It is applicable to wind energy facilities from the earliest feasibility assessments, as well as from the time of the environmental impact assessment, and continue to be applied throughout the construction and operational phases.

The key requirements stated in the EHS guidelines includes but not limited to following:

- Consideration should be given to turbine layout, size, and scale in relation to the surrounding landscape and seascape character and surrounding visual receptors (e.g. residential properties, users of recreational areas/route);
- Consideration should also be given to the proximity of turbines to settlements, residential areas, and other visual receptors to minimize visual impacts and impacts on residential amenity, where possible;
- Wind turbines produce noise through a number of different mechanisms, which can be roughly grouped into mechanical and aerodynamic sources. Noise impacts to be assessed on the receptors according to their environmental sensitivity (human, livestock or wild life);
- Site selection is critical to avoiding and minimizing potential adverse impacts on biodiversity. Site selection should include proximity of the proposed wind energy facility to sites of high biodiversity value in the region (including those located across national boundaries);
- Shadow flicker may become a problem when potentially sensitive receptors (e.g., residential properties, workplaces, learning and/or health care spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility. Impact of shadow flicker to be assessed on potentially sensitive receptors (e.g. residential properties, workplaces, health care spaces, etc.);
- Occupational health and safety hazards during construction, operation and decommissioning;
- Management of community health and safety hazards including but not limited to blade and ice throw, aviation, marine navigation and safety, electromagnetic interference and radiation, public access, etc;
- Environmental Monitoring Programme to be implemented.

3.6.4 Asian Infrastructure Investment Bank (AIIB)'s Environmental and Social Framework

Environmental and Social Framework (ESF) is a system that supports the Bank and its clients in achieving environmentally and socially sustainable development outcomes. The Framework lays out a vision, a policy and three supporting standards that are broadly similar in nature to those of the World Bank (WB), Asian Development Bank (ADB) and other established multilateral development banks. The ESF integrates good international practice on E&S planning and management of risks and impacts into decision-making on, and preparation and implementation of, Bank supported Projects (AIIB, 2017).

Requirement	Brief Summary	Remark
Environmental and Social Policy	The Environmental and Social Policy (the "Policy") sets forth mandatory environmental and social requirements for each project. The Policy sets out the general processes and requirements for project screening and categorization, environmental and social due diligence, environmental and social assessment, environmental and social management plan, environmental and social assessment tools and management plan framework, information disclosure, consultation, monitoring and reporting, as well as grievance redress. It also defines the roles and responsibilities for implementation of environmental and social management system.	
Environmental and Social Standard (ESS) 1 - Environmental and Social Assessment and Management	This standard requires undertaking environmental and social assessment of the project in accordance with the Policy, using appropriate studies proportional to the significance of potential risks and impacts. It requires the assessment process is supported by effective information disclosure and consultation with a grievance mechanism in place and the coverage of the assessment should include pollution prevention, biodiversity impact, resource efficiency, climate change, sustainable use of natural resources,	It cover all the elements of IFC PS 1, PS 2, PS 3, PS 4, PS 6 and PS 8

Requirement	Brief Summary	Remark
	vulnerable groups, access to resources, impact of livelihood, resettlement, cultural resources, working conditions and community health and safety etc.	
Environmental and Social Standard (ESS) 2 - Involuntary Resettlement	This standard aims to avoid Involuntary Resettlement wherever possible; to minimize Involuntary Resettlement by exploring Project alternatives; where avoidance of Involuntary Resettlement is not feasible, to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-Project levels; to improve the overall socioeconomic status of the displaced poor and other vulnerable groups; and to conceive and implement resettlement activities as sustainable development programs, providing sufficient resources to enable the persons displaced by the Project to share in Project benefits.	It covers elements of IFC PS 5
Environmental and Social Standard (ESS) 3 – Indigenous Peoples	This standard aims to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, economies and cultures, as defined by the Indigenous Peoples ("IP") themselves, so that they: (a) receive culturally appropriate social and economic benefits; (b) do not suffer adverse impacts as a result of projects; and (c) can participate actively in projects that affect them. This standard would be applicable in case the project reaches areas where IP (scheduled tribes) might be present.	It covers elements of IFC PS 7

3.6.5 US DFC Environmental and Social Policy and Procedures, 2020

U.S. International Development Finance Corporation (DFC) is America's development bank. In July 2020[1], DFC introduced its Environmental and Social Policy and Procedures (ESPP). The ESPP addresses DFC's commitments regarding the environmental and social dimensions of sustainable development and provides applicants notice of the general environmental and social requirements that are applied in evaluating prospective projects and monitoring ongoing supported projects. DFC ESPP are largely based on IFC Performance Standards and applicable Industry Sector Guidelines, including and revisions issued be IFC and host country laws, regulations and standards related to environmental and social performance, including host country obligations under international law.

[1] https://www.dfc.gov/sites/default/files/media/documents/DFC_ESPP_072020.pdf

4. SCREENING AND SCOPING

4.1 Screening Methodology

As part of ESIA, Ayana planned to identify social, ecological and environmental risks for the proposed project location through preliminary E&S screening. For this ERM undertook discussions with the Project team and conducted a site reconnaissance survey followed by review of the documents available. ERM team also conducted secondary data for screening exercise for the project.

ERM has presented the findings from the preliminary analysis in the form of a draft E&S Screening report dated 05 August 2021.

4.2 Project Categorization

4.2.1 IFC

IFC's Environmental and Social Review Procedure Manual (1) has provided a provisional categorization tool for projects. The tool assigns an E&S category based on risk inherent to the particular sector, as well as on the likelihood of a development taking place and on what can be reasonably ascertained about the environmental and social characterization of the Project's likely geographical setting. The categories are defined as follows:

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

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

4.2.2 NIIFL E&S Policy

NIIFL E&S Policy has provided E&S categories, given below.

1. **Category A:** Projects or business activities with significant adverse environmental or social risks and/or impacts that are direct or indirect, diverse, across different locations, persistent over a period, irreversible, cumulative, or unprecedented will be classified under this category.
2. **Category B:** Projects or business activities with limited adverse environmental or social risks and/or impacts that are direct or indirect, markedly site-specific, manageable over a period, largely reversible, and readily addressed through mitigation measures.
3. **Category C:** Projects or business activities with minimal adverse environmental or social risks and/or impacts.

ERM has categorized the project as **Category 'B'** due to the reasons provided in the subsequent sections.

4.2.3 AIIB's Categories

The Bank assigns each proposed Project to one of the following four categories:

1. **Category A**: A Project is categorized **A** if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works and may be temporary or permanent in nature.
2. **Category B**: A Project is categorized **B** when it has a limited number of potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are

(1) Environmental and Social Review Procedures Manual: Environment, Social and Governance Department (2012): http://www.ifc.org/wps/wcm/connect/190d25804886582fb47ef66a6515bb18/ESRP%2BManual.pdf?MOD=AJPERES. Accessed on 06.09.2016.

irreversible or cumulative; they are limited to the Project area; and can be successfully managed using good practice in an operational setting.

3. **Category C**: A Project is categorized **C** when it is likely to have minimal or no adverse environmental and social impacts.
4. **Category FI**: A Project is categorized FI if the project involves the provision of funds to or through a financial intermediary (FI).

ERM has categorized the project as **Category 'B'** due to the reasons provided in the subsequent sections.

4.2.4 Category Justification

The IFC, AIIB's ESMS framework and NIIFL E&S Policy categories are similar in nature and therefore the selection of **Category B for** Environment, Health & Safety, Ecological and Social risks is based on common reasoning.

Environmental and Social Impacts

- **Reversible risks**: Environmental and social impacts of the Project are anticipated during the construction phase and will encompass limited changes in land-use, increased noise levels, changes in air quality, use and changes in water quality, impacts on terrestrial ecology, occupational health & safety, etc. Most of these impacts are limited to the wind plant components and their immediate vicinity and can be minimized through application of mitigation measures as proposed in the ESMP.
- **Not Unprecedented**: Development of wind plants is occurring in large numbers in the last decade and therefore several such projects are located across India. The project and its surrounding area has number of upcoming and operational wind plant project. Hence the proposed wind plant project can therefore not be considered an unprecedented activity.
- **Limited adverse impacts on the baseline**:

Wind energy development is a non-polluting source of energy and thus is not likely to lead to any potential impacts on the baseline environment during the operation phase.

Noise: Wind energy development is a non-polluting source of energy and thus is not likely to lead to any adverse impacts on the baseline environment during the operation phase. Noise modelling assessment for the project revealed that, daytime overall noise levels (background + predicted) due to operation of WTGs at all receptor locations were noted not exceeding 3 dB (A) increase in noise levels from permissible limits/ baseline noise levels) except at one location. However, during night time impact magnitude of predicted noise levels due to operation of WTGs at 77 receptors (with <3 dB (A) exceedances from baseline) have been noted to be moderate, since most of the receptors appear to be agricultural sheds.

Shadow flicker: Given the guidelines of 30 hours or less per year is considered acceptable, the operation of the wind plant theoretically results in shadow flicker impacts that could be considered not as significant for the purposes of this study. The results show that theoretical shadow flickers impact in real case scenario occur at 18 shadow receptors with higher than 30 shadow hours per year from a total of 105 receptors identified within the Project area.

In terms of social impacts, as mentioned above, the land required is composed mostly of private agricultural land which shall be procured on willing seller- willing buyer basis. Furthermore, the land procurement for the proposed WTG locations for the Project doesn't involve any anticipated settlements and physical displacement. Impacts will be limited to access to land used for grazing, minor negative impact on livelihood as agriculture was observed in intermittent locations around the WTG locations; and positive impacts on livelihood opportunities.

Biodiversity**:** Kappatagudda Wildlife Sanctuary is located within 5 km (~1.1 km from WTG AY10) of the proposed wind power plant area. Tungabhadra Reservoir is about 12 km from the proposed route of the transmission line (TL) and grid substation (GSS) located at Koppal and about 25 km from the proposed wind farm. Magadi & Shettikere Wetlands are located at a distance of more than 25 km in south west direction from the proposed project..

Risk of habitat loss / modification due to the vegetation clearance and construction activities are likely to be reversible upto some extend. Operation of the wind power plant may have potential impact on flora and fauna dependent on the agricultural land and open scrub which are likely to be irreversible. The impacts anticipated to the biodiversity specifically bird and bats will likely be adverse (resulting in loss of population of species), irreversible (to the already threatened species) from operating wind turbine blades (collision risk) and the electrical transmission infrastructure (electrocution and collision risk).

Any planned mitigation can only be suggested based on the long term habitat and species monitoring in the wind power plant and surrounding areas. A detailed Critical Habitat Assessment supported by long term bird and bat monitoring of wind power plant along with the transmission line alignment is required to ascertain what level of mitigation measures will be required.

4.3 Scoping Methodology

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

It is to be noted here that during the period of ESIA study, the Project was in planning stage, however the scoping exercise includes all the phases of the project, i.e., planning and pre-construction, construction, operation and maintenance and decommissioning into consideration.

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

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

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

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

The proposed wind power Project will involve the key activities during its life cycle which will include planning and pre-construction, construction, operation and maintenance and decommissioning phases as described in ***Section 2.3.***

4.4 Scoping Matrix

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

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

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

4.5 Cumulative Impacts

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from other similar activities to create an additional impact. It is been noted that other wind power projects such as Wind World Power Plant (~200 MW capacity) is located adjacent to the project boundary and Renew solar power project is located within the project boundary near Jantli Shirur village. However, the project footprint doesnot overlap with the wind world site and therefore, there will not be any cumulative impact on ambient noise or flickering as per the current assessment this impacts are restricted to within 500m (Refer to **Section 8.6** for detailed cumulative impact assessment)

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

Project Phase and Activity \ Environmental and Social Resources/ Receptors	Land use	Soil/Land Environment	Ambient Air Quality	Water Environment	Ambient Noise Quality	Ecology	Visual / Aesthetics	Occupational Health and Safety	Demography (Influx and Displacement	Local Economy and Employment	Natural /Common Property Resources	Land based Livelihoods	Community Health and Safety (Including Shadow Flicker)	Labour and Human Rights	Social Infrastructure and Services	Culture and heritage
Planning Phase																
Wind Master/ Meteorological Master Installation																
Construction Phase																
Construction and Strengthening of access roads	■	■			■											
Transport and storage of construction material																
Site Clearance for WTGs, PSS, Transmission lines and other ancillary facilities	■	■				■	■									
Mobilization of Construction Machinery								■								
Transportation of WTG Components								■								
Establishment and Operation of Batching Plant		■				■		■								
Operation of D.G sets			■													
Excavation and foundation for WTGs		■						■								
Erection and Installation of WTGs						■	■	■								
Laying of Transmission lines		■				■		■								
Constriction of PSS, CMS and Site Office(s)	■	■				■		■								
Internal Electrical Connections						■		■								
Operation and Maintenance Phase																
Commissioning and Operation of WTGs					■	■	■						■			
Inspection and maintenance activities of each WTG								■								
Operation and maintenance of ancillary facilities																
Inspection and maintenance of transmission lines						■		■								
Inspection and maintenance of access road																
Decommissioning Phase																
Removal of WTG parts and ancillary facilities		■	■		■	■	■	■								
Removal of transmission lines		■			■		■	■								
Returning of access roads																
Restoration of wind plant site	■															

***Note**: The activity-impact interaction matrix has considered one single project component, i.e. the wind plant site.*

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

Table 4.2 Identified interactions that are likely to result in significant impacts

Interaction (between Project Activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
Change in land use	■ Construction of temporary structures – stockyard and batching plant, would lead to changes in the land use albeit for a short period; ■ Clearing of vegetation for Project related activities; ■ Laying of transmission lines and towers, paving and widening of access roads, setting up of WTG towers, components and site office will lead to permanent change in land use; and ■ Restoration of land after Project cycle will reverse the land use to the original one.
Land based Livelihoods	■ Due to use to private land, the WTG construction will impact title, whereby they will lose access to cultivable land ■ Laying of transmissions lines and towers will also occupy some private land where cultivation may exist
Impacts on Land and Soil Environment	■ Decrease of soil quality due to loss of vegetation cover; ■ Higher soil evaporation and loss of soil moisture because of loss of vegetation cover; ■ Impact on land environment because of widening and paving of access/internal roads and laying of transmission lines; ■ Erosion of loose soil during monsoon season and windy periods; ■ Sedimentation of nearby water bodies due to excessive soil erosion and run-off; ■ Compaction of soil due to foundation construction and heavy traffic use; ■ Removal of top soil at WTGs, ancillary facilities and transmission tower sites; ■ Impact on soil and land environment due to improper management of domestic solid waste that is expected to be generated; ■ Storage and handling of hazardous waste (e.g. fuel and lubricant) and accidents/negligence leading to leaks and soil contamination; ■ Generation of hazardous waste during operation of the Project e.g. small amounts of waste oil; and ■ Restoration of wind plant site after Project cycle.
Impact on Water Resources	■ Requirement of water for domestic and construction purposes may put a stress on local water resources especially during hot summer months; ■ Impact on surface water quality due to run off from the storage area and WTG components excavations during monsoon; and ■ Potential discharge of wastewater from labour accommodation, project site office and other facilities.
Impacts to the local air column	■ Decreased environmental resilience to air pollution because of loss of vegetation that has been in the area before the onset of Project activities; ■ Fugitive dust emissions due to movement of machinery and vehicles; ■ Dust emissions from operation of batching plant, excavation, back-filling activities, etc.; and ■ Air emissions due to operations of DG sets to be used for emergency power backup and batching plant.
Visual Landscape	■ The visual landscape of the study area will be altered due to the WTGs and supporting facilities; ■ Presence of construction equipment during construction phase; and ■ Presence of internal and external transmission lines.
Increased Ambient Noise Levels	■ Generation of noise during clearing of vegetation to make way for WTGs, supporting infrastructure and transmission lines; ■ Noise generation due to movement of vehicles and heavy earth moving machineries during construction phase; ■ Noise generation during excavation and drilling of rocky land for WTGs; ■ Noise generation due to widening and paving of access roads; ■ Generation of noise during operation of batching plant and from D.G. Sets;

Interaction (between Project Activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
	■ Generation of noise due to operation of WTGs; and ■ Generation of noise while decommissioning the WTG components and ancillary facilities at the end of the Project life cycle.
Community health and Safety Impacts	■ Potential shadow flicker effect on the habitations located close to the WTGs; ■ Potential noise from operational WTG's to the community; ■ The Community living close to WTGs will also be exposed to the risk of structural failure of the WTGs; and ■ The community living in the vicinity of the WTGs will be exposed to risk of increased traffic, construction activities, and diseases due to influx of workers
Occupational Health and Safety	■ Occupational health hazards due to dust and noise pollution; ■ Safety risk due to wrong handling of construction machinery, working at heights and falling objects; and ■ Exposure of workers to electromagnetic field (EMF) while working in proximity to charged electric power lines during operation and maintenance activities.
Local Economy and Employment	■ Wind power project shall generate employment opportunities for the applicable local community, mostly during the construction phase. Also, during the operational phrase the local community has various employment opportunities such as security related work.

The scoped-out interactions during the proposed Project's life cycle have been presented in ***Table 4.3***.

Table 4.3 Scoped- out interactions during the proposed Project's life cycle

SN.	Impact Title	Reason for Scoping-out
1	Impact on ambient air quality during operation phase	The power generation process will not have any air emissions. The site activities will be mainly remote monitoring of WTGs and scheduled maintenance work.
2	Demography (Influx and Displacement)	The projects will not result in any physical displacement of the local community as the land procurement procedure avoids any permanent or temporary structures. The project may hire migrant workers from other states. However, these workers will be engaged for the duration of the construction phase and will stay in labour camps and therefore are not expected to have a major impact on the local community as the construction phase will last for a short duration
3	Indigenous People	According to the Census records and consultations with the local community, the study areas do not report a significant presence of Scheduled Tribe population within the study area. No direct impacts on indigenous people are envisaged.

5. ANALYSIS OF ALTERNATIVES

This section provides an analysis of alternatives in relation to both phases of the Project, particularly in regard with the Project conception and planning phase. This includes the following:

- No project scenario;
- Alternate location during micro siting of individual WTGs and associated facilities;
- Alternate technology; and
- Alternate methods of power generation.

5.1 No Go Alternative

As per the load generation balance report 2021-22[1] of the Central Electricity Authority (CEA), the current power supply scenario is slightly deficit in supply. The table below shows the actual power scenario in Karnataka and the southern region for the year 2020-21.

Table 5.1 Actual Power supply scenario in 2020-21

State/Region	Requirement (MU)	Availability (MU)	Deficit (MU)	Deficit (%)
Karnataka	68,851	68,831	19	0.0
Southern Region	3,26,885	3,26,836	48	0.0

Source: Load generation balance report 2021-22 of the Central Electricity Authority

In order to meet the slightest gap in demand and supply, renewable/non-conventional sources of power will be required to supplement the conventional sources. The proposed project being renewable source of power generation will contribute towards bridging the gap between demand and supply. The proposed project presents an opportunity to utilize the potential for wind power generation. A “No Project Scenario” will not address the issue of power shortage. Moreover will provide adequate supply to meet the requirements and solve issues of electrictity shortage.

5.2 Alternative Site Location

Wind energy projects are non -polluting energy generation projects which are site specific and dependent on the availability of wind resource. Wind resource mapping and power potential assessment for the Project was done by C-WET, based on which potential areas are notified by C-WET. Hence, the option of choosing an alternative area is not available to a project developer.

Alternate Location for WTGs and Associated Facilities

Within the potential area, there is a possibility as well as flexibility of moving the individual WTG locations (micro siting) to avoid any potential environmental and social issue or risks like:

- Total landlessness of a landowner;
- Impact on environmental sensitive receptors like prime agricultural land, vegetation and tree cover, wetlands, surface water bodies, forests and cultural sites (including historical, archaeological, religious sites) etc.;
- Impacts on nearby residents due to the noise and shadow flickering generated due to the operation of WTGs; and

[1] https://cea.nic.in/wp-content/uploads/l_g_b_r_reports/2020/LGBR_2021_22.pdf

- Impacts on social sensitive receptors like schools, hospitals, human habitation, individual dwellings, irrigated wet lands, government lands, common property resources etc.

As for associated facilities such as transmission lines, access pathways, pooling substation, yards and stores, the land department undertakes identification of alternate sites in consultation and joint field visits held with Power Evacuation team and Projects team which are the concerned internal stakeholders. As for access pathways, land team is careful to choose an alignment that runs along the boundaries of each individual land owners to avoid asset bifurcation of land plots. This process has enabled Ayana to choose the best possible alternative to locate the WTGs and other project associated facilities.

The proposed wind power project site has the following location advantages:

- Pre-approved NIWE (Formerly C-WET) site for wind energy production;
- Project site is not located within a reserve/ protected forest area or designated wildlife sanctuary or National parks;
- No rehabilitation or resettlement is involved in the project;
- Very few village boundaries or receptors around WTGs were observed, mostly comprised of temporary agricultural sheds.

5.3 Alternate Methods of Power Generation

Harnessing wind energy is an eco-friendly process, inexhaustible and possesses a minimal environmental footprint. There are no fuel requirements or large quantities of water for operation of the plant. Wind energy scores over other forms of energy generation as it has a low gestation time. A short lead time is needed to design, install, and start-up (up to a maximum of 2 months after micro siting, approvals and land purchase). ***Table 5.2*** elaborates upon the advantages and disadvantages of various power generation systems.

5.3.1 Greenhouse Gases (GHG) Emission

As per the estimations of International Atomic Energy Agency (IAEA) the grams of carbon-equivalent (including CO_2, CH_4, N_2O, etc.) per kilowatt-hour of electricity (gCeq/kWh) for wind energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy. ***Table 5.3*** highlights GHG emissions that each technology possesses.

Considering various factors such as wind resource potential in the project; favourable environmental and social settings; low GHG emissions in the project life cycle; land availability, governmental assistance, and local community's acceptance of wind energy projects over the last decade in the region, wind energy based power generation is the most appropriate alternative in Karnataka.

Table 5.2 Environmental Advantages and Disadvantages of Power Generations Systems

Mode	Disadvantage	Advantage
Thermal Power Plant	■ High fossil fuel consumption. ■ Large quantities of water requirement for cooling ■ High volume of emissions from operation ■ Accumulation of fly ash (in case of coal powered installations) ■ Upstream impact from mining and oil exploration ■ GHG emission estimated as 228gCeq/kWh	■ Large scale production potential ■ Moderate gestation period ■ Relatively inexpensive ■ Wider distribution potential
Hydropower Plant	■ Site specific, dependent on reservoir/river etc. ■ Downstream impact on flow ■ Long gestation period ■ Acute and chronic social and ecological impacts	■ GHG emission estimated as low as 1.1gCeq/kWh for run of river projects

Mode	Disadvantage	Advantage
Nuclear Power	■ Availability of fuel source ■ Hazards associated with radioactive material ■ High cost of project ■ Long gestation period ■ Risk of fallout and meltdown scenarios and its impacts on the local populace and environment.	■ Cheaper power generation ■ GHG emissions as low as 2.5gCeq/kWh
Wind Power	■ Overall land requirement is small compared to Solar and Thermal ■ Site specific (associated to wind pattern) ■ Expensive installation	■ Pollution levels are insignificant ■ Inexpensive power generation ■ Inexhaustible source ■ GHG emissions as low as 2.5gCeq/kWh for the Production Chain
Solar Power	■ Large land requirement ■ Site specific to solar insolation ■ Expensive installation ■ Concrete foundation on larger area	■ Pollution levels are insignificant ■ Inexpensive power generation ■ Inexhaustible source ■ GHG emissions as low as 8.2gCeq/kWh for the Production Chain

Source: International Atomic Energy Agency (IAEA)

Table 5.3 Green House Emissions from Different Electricity Production Chains

Technology	Mean tonnes (CO_2e/GWh)	Low tonnes (CO_2e/GWh)	High tonnes (CO_2e/GWh)
Lignite	1054	790	1372
Coal	888	756	1310
Oil	733	547	935
Natural Gas	499	362	891
Solar PV	85	13	731
Biomass	45	10	101
Nuclear	29	2	130
Hydroelectric	26	2	237
Wind	26	6	124

Source: World Nuclear Association (WNA)[1], July 2011

5.3.2 Water Consumption

The water requirements for producing the different primary energy carriers vary; also, there are significant differences between the different types of electricity generation. Several evaluation methods are being employed to assess the footprint of electricity generation through various ways. The methods are often referred to those by the developed regions to compare energy and water uses; where certain measurements and statistics are a common and accepted practice.

Solar and wind power projects have been known to use almost insignificant water, in comparison to nuclear and coal based power projects. Wind plants require small amounts of water are used to clean wind turbine rotor blades in arid climates (where rainfall does not keep the blades clean). Similarly, small amounts of water are used to clean photovoltaic panels.

According to the American Wind Energy Association (AWEA), wind therefore uses less than 1/600 as much water per unit of electricity produced as does nuclear, and approximately 1/500 as much as coal. As per AWEA, water consumption (technology gallons/MWh) is as follows: Nuclear – 620; Coal – 490; Oil –

[1] http://www.world-nuclear.org/uploadedFiles/org/WNA/Publications/Working_Group_Reports/comparison_of_lifecycle.pdf

430; Wind – 1; Solar – 30. For current energy investment of 300 MW, Ayana might consume about 300 gallons MW/h; saving almost 186000 gallons MW/h and 147000 gallons MW/h; wrt nuclear and coal respectively.

5.3.3 Carbon Offsetting

Hydro, solar and wind energy projects help in offsetting CO_2 emissions from conventional power generation. According to National Renewable Energy Laboratory, every year 1 MW of wind energy results in 2600 tons of CO_2 offsetting. In case of Ayana, 300 MW can offset approximately 780000 tons CO_2.

5.4 Conclusion

Further to the above-mentioned reasons, ERM concludes that:

- The Project will be environment friendly with minimal greenhouse gas emissions by carbon offsetting;
- It is the most feasible choice of power generation in the state; and
- It will contribute in reducing the power deficit in the state.

6. ENVIRONMENTAL AND SOCIAL BASELINE

Baseline refers to the physical, biological, cultural and human conditions that will prevail in the absence of the Project, including interactions amongst them. Establishing baseline helps in understanding the prevailing environmental, ecological and socio-economic status of the study area. It provides requisite information of the biophysical and social environment for decision makers to take appropriate measures regarding the project.

Establishing the baseline also provides the background environmental and social conditions for prediction of the future environmental characteristics of the area before setting up of the project. It also helps in environmental and social management planning and provides a basis to finalize a strategy for minimizing any potential impact due on surrounding environment due to setting up of the project.

This section establishes the baseline environmental, ecological and socio-economic status of the proposed wind project site and surrounding area to provide a context within which the impacts of the proposed wind power project are to be assessed.

6.1 Area of Influence

For the purpose of the baseline establishment and impact assessment, an Area of Influence (AoI) has been identified. This sub section provides an understanding of the AoI thus identified and the reasons for the same.

6.2 Study Area

The study area considered for ESIA, include an area within 5 km radius from farthest of WTGs. The study area of 5 km has been selected based on the location of Project site and its footprint, nature and spatial distribution of potential social and environmental impacts (based on similar type of projects).

Project footprint Area

The Project Footprint is the area that may reasonably be expected to be physically touched by Project activities, across all phases. Physically, there is no demarcation or fencing for the Project Site boundary and hence it is contiguous with the rest of the area.

The Footprint for Project includes land used for the erection of WTGs, substation, storage of materials, site office, access roads, and internal and external transmission lines.

Project Area of Influence (AoI)

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

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

- **Environmental parameters:** Project site boundary, immediate vicinity,
  - access road and surroundings, i.e. a study area of approximately 5 km (hereafter referred to as the AoI) distance from project line has been used to depict these parameters;
  - **Noise**: Noise impact area (defined as the area over which an increase in environmental noise levels due to the Project can be detected) – typically 1 km from operations (this includes a distance of 10 times the size of the rotor diameter of the WTG);
  - **Air Quality**: Dust emissions, fugitive dust-typically up to 100 m from construction, operation and maintenance area;

- **Land environment:** The impacts on soil and land- typically up to 100 m from project foot print area;

- **Ecological Environment (Terrestrial and Aquatic):** This includes: (a) the direct footprint of the project comprising the wind plant; (b) The areas immediately adjacent to the project footprint within which a zone of ecological disturbance is created through increased dust, human presence and project related activities (e.g., trampling, transportation activities); and the larger Discrete Management Unit largely comprising contiguous habitat components ensuring population viability of Critical Habitat triggers

- **Social and Cultural:** The Area of Influence for social and cultural resources for this wind power project is based on following interactions :

  - Villages impacted due to land procurement for the project;

  - Villages which are not impacted due to land procurement but may have interactions of socio-economic and cultural nature with the villages from where land is being procured;

  - Villages from where project activities may have direct or indirect impacts (read infrastructure related, cumulatively, or economically);

  - Villages from where/on which associated facilities may pass through/ or are located in. These include access roads, transmission lines (both internal and external), storage yards

  - Villages that have culture-religious sites of local and/or regional importance.

- Based on the site visit, satellite imagery and discussions with project team, it was found that:

  - there are 16 villages from where land will be procured;

  - All access roads will pass through the villages from where land will be procured; and there will be usage of existing roads to connect to access roads;

  - Internal roads for access to WTGs will required to constructed;

  - The internal transmission lines to connect the WTGs with the pooling substation will pass through those villages from where land is being procured. However, to account for route changes that may occur, as the internal transmission line route has not been finalised; a buffer of 2 km radius from each WTG has been considered;

  - Main culture-religious sites of local/regional importance were reported to be:

    - Lakkundi village has many archaeological sites (a village from where land is also being procured).

Core and Buffer Zone

This AoI is in turn, divided into a core and buffer zone. This division of the AoI into two zones is based on the understanding that the majority of the impacts from the project (during the mobilization, construction, operations and decommission phase) would be contained within a 1 km radius from the Project Footprint in terms of spread and intensity, with the buffer zone appearing to have limited interaction with the Project.

6.3 Environmental Baseline Methodology

The following sub sections provide an understanding of the methodology followed for the establishment of the environmental baseline.

6.3.1 Site Visit

ERM undertook a site survey between 23rd and 24th July 2021 to understand the site setting and to map environmental and social sensitivities in the area. The collection of water samples and noise monitoring

was also done during that time. Ecological survey was conducted by ecology team from 27th to 29th July 2021.

The site visit included a walkover of the site and associated facilities with Ayana team and the land aggregator team. The rationale of this exercise was to understand the local environmental issues in the area. Understanding of the Project site and surrounding area using available latest high resolution satellite imagery of the study area was initially conducted prior to the site visit to identify environmental and social sensitive receptors located within the AoI.

As part of this site visit, primary data was collected from sensitive spots and other places inside the AoI and secondary information regarding the baseline was collected. The following sub sections provide an understanding of the same.

6.3.1.1 *Primary Baseline Data Collection*

M/s. Netel India Limited, an NABL accredited laboratory was engaged for collection of baseline information on surface water quality, ground water quality and ambient noise quality during the 23rd – 25th of July 2021. The primary baseline data was collected for aspects detailed out in ***Table 6.1.***

Table 6.1 Primary Baseline Data Collection

SN.	Environmental Attribute	No. of Locations/ Area	Frequency	Remarks
1	Ambient noise quality	4 samples	Once for 24 hours during monitoring period	Ambient noise samples were collected over a 24 hr period within a 5km radius from WTGs.
2	Ground water quality	2 samples	Once during monitoring period	Water was collected from bore wells within the study area.
3	Surface water quality	2 samples	Once during monitoring period	Water was collected from surface water bodies/ ponds within the study area.

6.3.1.2 Secondary Baseline Data Collection

Secondary baseline data collection involved identifying and collecting existing published materials and documents. Information on various environment aspects (like geology, hydrology, drainage pattern, ecology etc.), meteorology and socio economic aspects were collected from different institutions, government offices and literatures etc. Secondary data was collected for the aspects as given in ***Table 6.2.***

Table 6.2 Secondary Baseline Data Collection

SN.	Attribute	Source of Data Collection
1	Meteorological data	India Meteorological Department (IMD)
2	Geology, geomorphology, hydrogeology and hydrology	Geological Survey of India (GSI) and Central Ground Water Board
3	Land use	Through Satellite Imageries
4	Natural Hazards	Building Materials & Technology Promotion Council (BMTPC)

Environmental and social baseline data was collected through primary surveys as well as through secondary sources by literature survey and discussions with the concerned departments/agencies. Details of data collected are summarized in subsequent sections.

6.4 Environmental Baseline

6.4.1 Land Use

On review of the land use in the project AoI, it was observed that majority of the land is agricultural land (81.48% of the total area) followed by open scrubs (approximately 8%) and settlements (approximately 3.6% of the total area). The land use statistics of the project AoI has been shown in **Table 6.3,** a map highlighting the same has been presented in **Figure 6.1**.

Table 6.3 Land use break-up of the Project Area of Influence for 300 MW Project

Land use Category	Area (Sq. Km)	% of Area
Agriculture Land	379.11	81.48
Drainage Channels	8.87	1.91
Forest Land	8.09	1.74
Industry	2.408	0.52
Mining Area	0.41	0.09
Open Scrub	37.68	8.10
Power Sub-Station	0.205	0.04
Railway Track	0.96	0.21
Road Network	4.40	0.95
Settlement	16.93	3.64
Solar Park	0.48	0.10
Waterbodies	5.69	1.22
Total	**465.30**	**100**

Source: GIS based assessments of the project

On review of land use of the proposed transmission line AoI i.e. 500m, it was observed that majority of the land is agricultural land (approximately 92% of the total area) followed by open scrubs (approximately 4%).

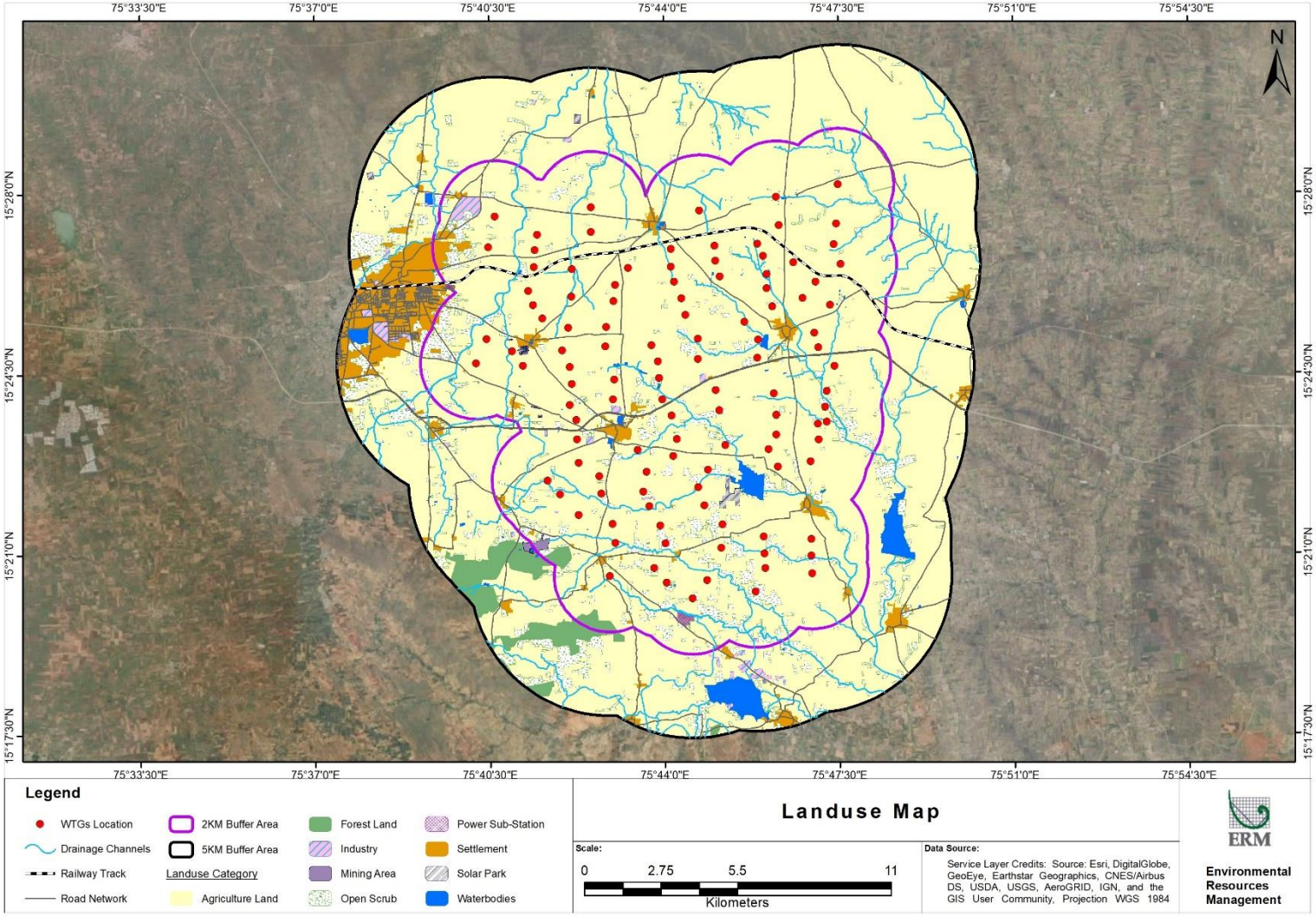
The land use statistics of the transmission line AoI has been shown in **Table 6.4** and a map highlighting the same is provided in **Figure 6.2**.

Table 6.4 Land use break-up of proposed transmission line Area of Influence

Land use Category	Area (Sq. Km)	% of Geog. Area
Agriculture Land	51.13	92.37
Drainage Channel	1.07	1.92
Open Scrub	2.44	4.41
Road Network	0.20	0.36
Settlement	0.20	0.36
Total	**55.36**	**100**

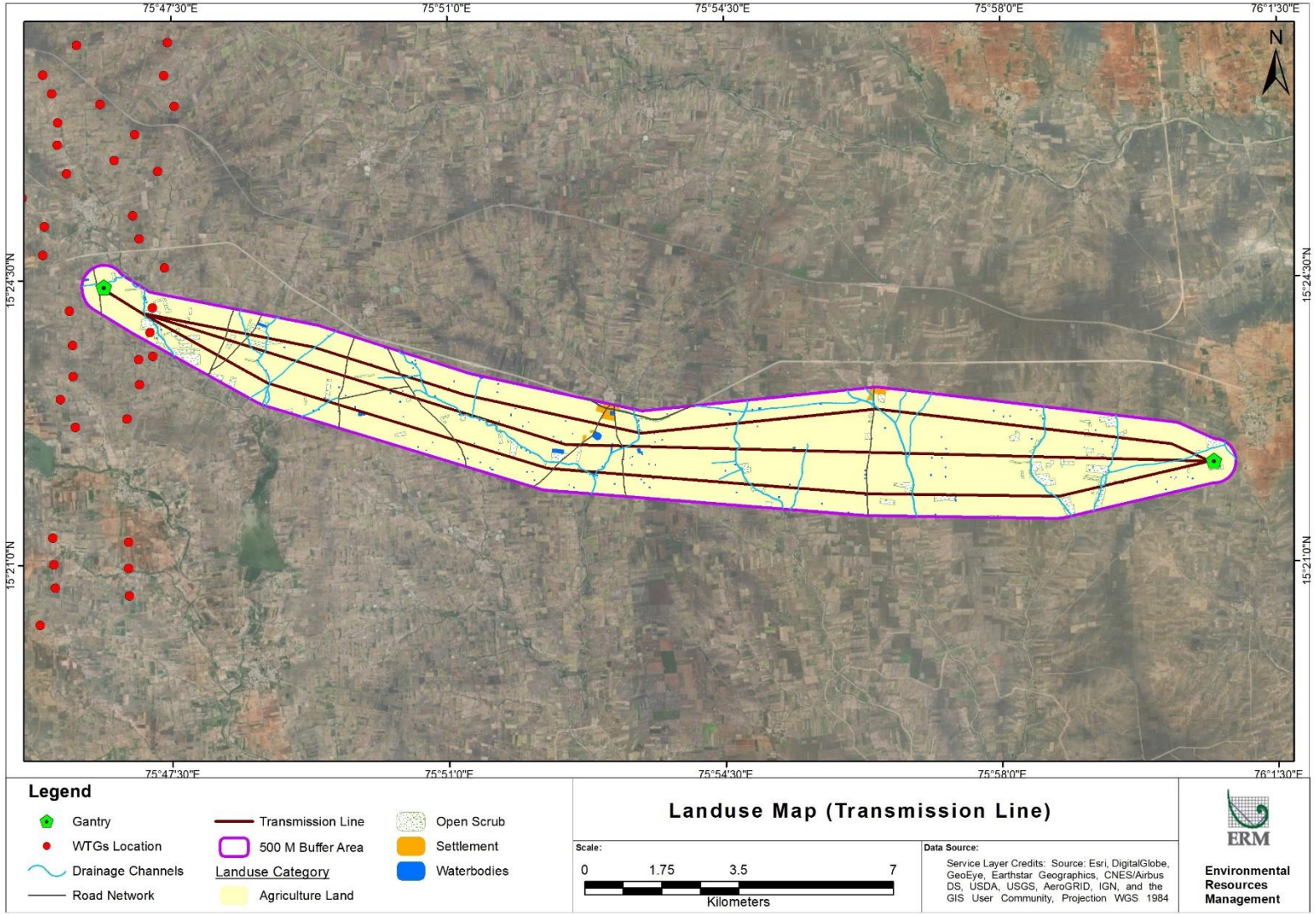
Source: GIS based assessments of the project

Figure 6.1 Land Use Map of Project AoI



Source: GIS Based mapping

Figure 6.2 Land Use map of proposed Transmission line corridor AoI



Source: GIS based Assessment

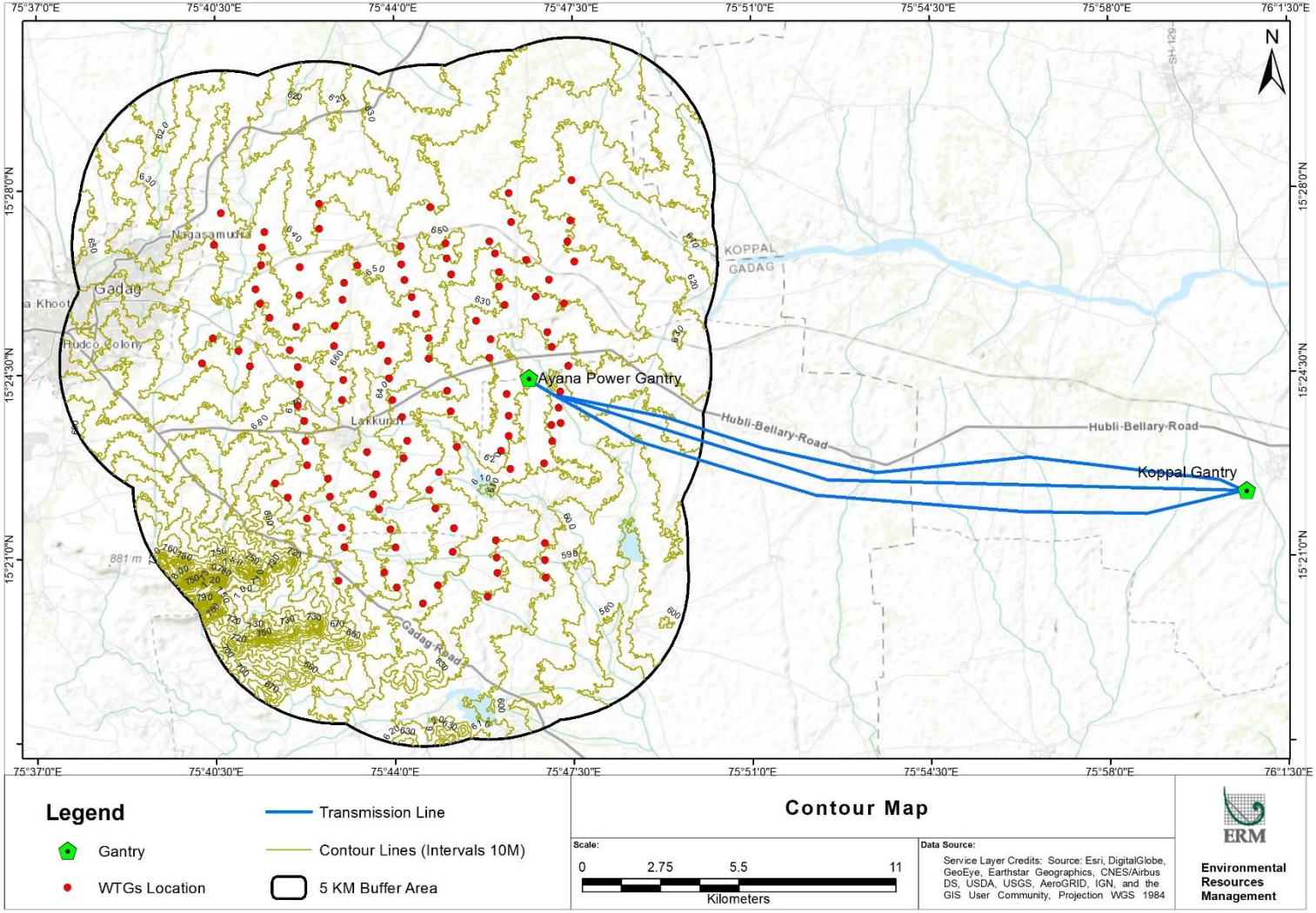
6.4.2 Topographical features

During ERM site visit, it is observed that the proposed wind project will be located on agricultural land with maximum elevation of 679 m above mean sea level (amsl) in the west, lowest elevation of 602 amsl in the east.

The district is a typical hard rock area, characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills dotting the central and south-eastern parts.

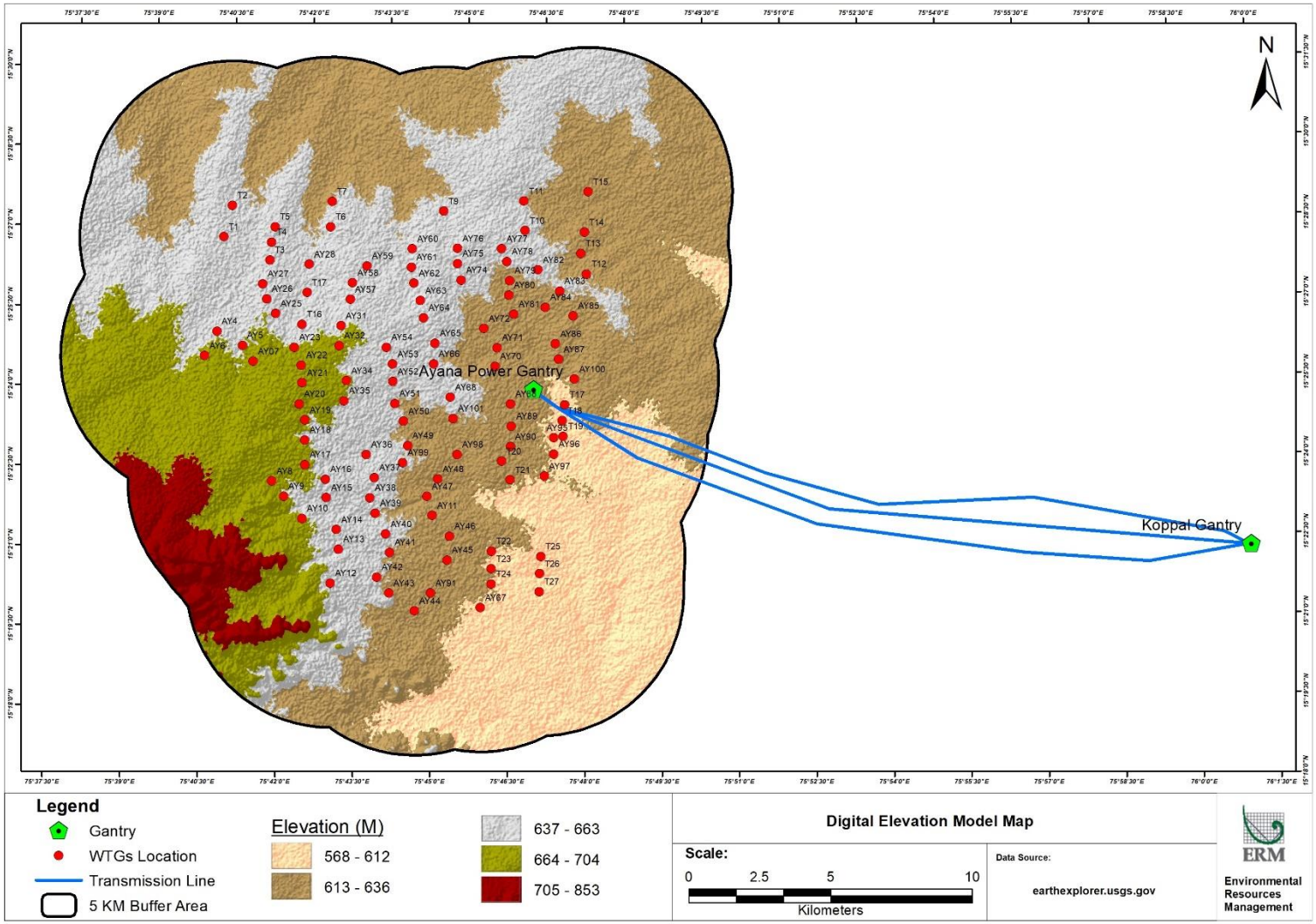
The contour map as well as the digital elevation of the Project AoI is presented in ***Figure 6.3*** and **Figure 6.4*.***

Figure 6.3 Contour Map of the Project AoI



Source: GIS based Assessment

Figure 6.4 Digital Elevation Map of the Project AoI



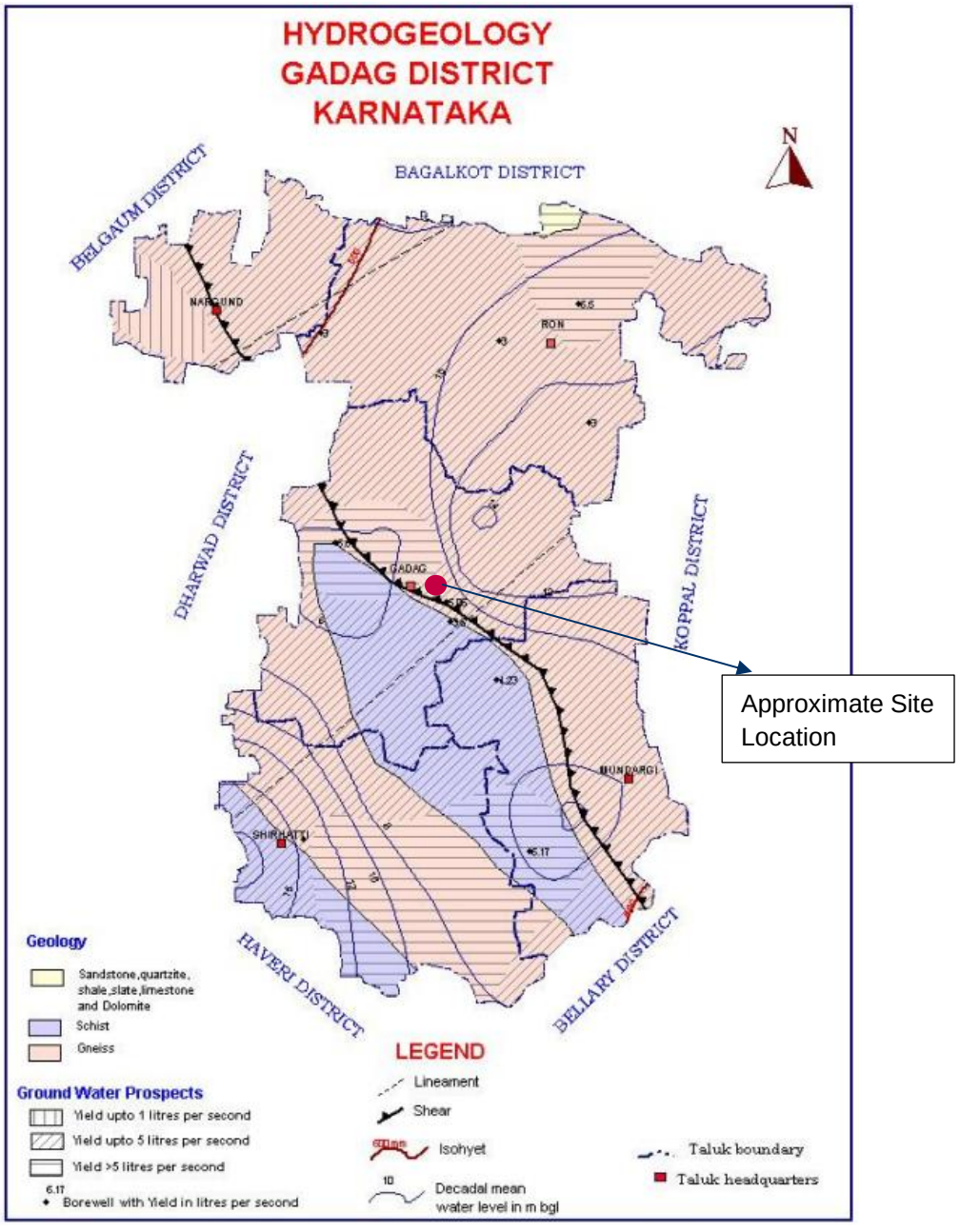
Source: GIS based Assessment

6.4.3 Geology and Hygrogeology

The Gadag taluk is a typical hard rock area, characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills dotting the central and south-eastern parts.The taluk is predominantly covered by medium to deep black soils cover of 1.10 m deep, occasionally extending down to 1.80 m bgl depth.

The district is underlain by hard rock formations like granites, gneisses, and schists. These rocks have no primary porosity or permeability. Ground water occurs under phreatic conditions in weathered zone of these formations. At higher depths ground water occurs under confined to semi-confined conditions in fractures and joints as well as formation contacts, its movement is controlled by the interconnectivity and geometry of the structurally week zones called lineaments. Hydrogeogolocal map of the district is given below.

Figure 6.5 Hydrogeological Map of Gadag district

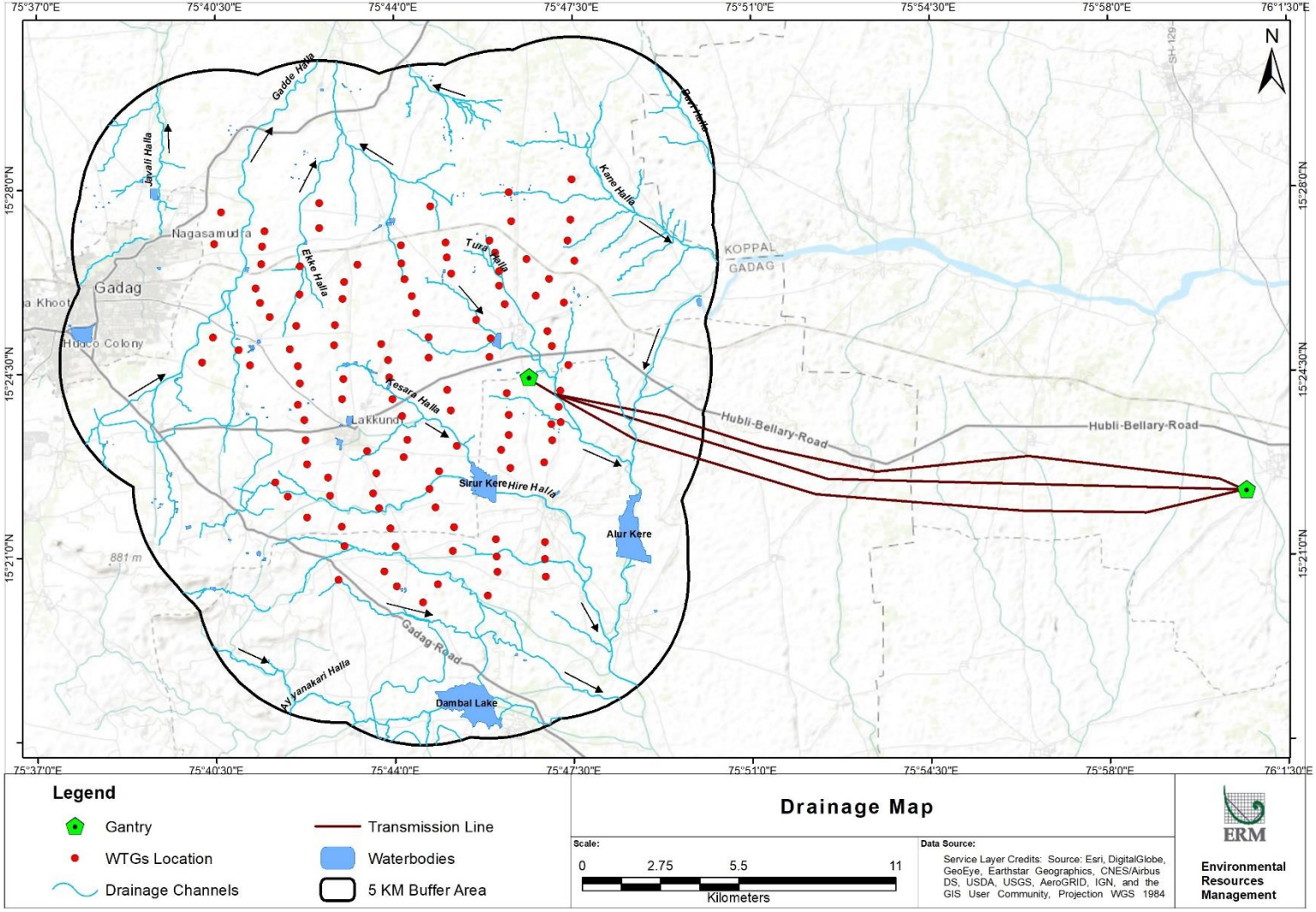


Source: Groundwater Information Booklet, Gadag District, South Western Region, CGWB

6.4.4 Drainage Pattern

Drainage pattern in the taluk is dendritic to sub-dendritic. It lies to the east of the Western Ghats in the rain– shadow region. Hence receives low rainfall and generally drought prone. It is a part of Krishna major basin, as the entire Gadag district is drained by two main rivers namely Malaprabha and Tungabhadra. Malaprabha along with its tributary Bennihalla drains northern parts and two rivers join in the adjoining Ron taluk. During ERM site visit, several seasonal water channels, lakes were observed in the study area of the proposed project site. Drainage map of the proposed project site is provided in the figure below.

Figure 6.6 Drainage Pattern in the Project AoI



Source: GIS Based Assessment

Ground Water Resources

As per report on Aquifer mapping and Ground Water Management for taluka Gadag by CGWB[1], 2017 the proposed project taluka lies in 'Over-exploited' category. As per Ground Water Management for taluka Mundaragi by CGWB[2], 2017, Mundaragi taluka is lies in semi-critical category. Details of ground water resource of the project taluks is presented in ***Table 6.5***.

Table 6.5 Ground Water Details

Taluka	Net Annual Ground Water Availability (Ham)	Existing Gross Ground Water Draft for Irrigation (Ham)	Existing Gross Ground Water Draft For Domestic and Industrial Water Supply (Ham)	Existing Gross Ground Water Draft for all Uses (Ham)	Allocation For Domestic and Industrial Use for Next 25 Years (Ham)	Existing Stage Of Ground Water Development (%)	Category
Gadag	5272	5265	590	5856	692	111	Over-Exploited
Mundaragi	9321	7238	365	7603	394	82	Semi-critical

Source: Aquifer mapping and Ground Water Management for Taluka Gadag and Ground Water Management for Taluka Mundaragi by CGWB

According Aquifer mapping and Ground Water Management for Taluka Gadag and Ground Water Management for Taluka Mundaragi by CGWB, the Depth to water level in Gadag taluka in premonsoon season is between 4.99 to 15.55 m below ground level (bgl) and post monsoon season is between 4.96-11.15 m bgl whereas in Mundargi taluka, depth to water level in premonsson season is between 5.65 to 23.13 m bgl and during post monsoon season is between 3.62- 11.20 m bgl.

During ERM site visit, it was understood that most of the potable water was supplied from Municipal Corporation in the area and fewer places were sourcing water from borewells. Moreover, it was observed that farmers had installed borewells in the agricultural fields for irrigation purposes.

6.4.5 Climate and Meterology

According to the CGWB report, Gadag taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under central dry agro-climatic zone of Karnataka state and is categorized as drought prone. The climate of the study area is quite agreeable and free from extremes. Gadag taluk experiences four seasons; summer from March to May, rainy season or south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry or winter Season from December to February.

The normal annual rainfall in Gadag taluk for the period 1981 to 2010 is 784 mm. Seasonal rainfall pattern indicates that, major amount of (496 mm) rainfall is received during South-West Monsoon seasons, which contributes to about 63% of the annual normal rainfall, followed by North-East Monsoon season (166 mm) constituting about 21% and remaining (122 mm) 16% during pre-monsoon season. As per the CGWB brochure for Gadag taluk, the mean monthly rainfall at Gadag taluk is ranges between 1 mm during January and February to 132 mm during June.

Mundargi taluk has semi-arid climate. The area falls under Northern transitional agro-climatic zone of Karnataka state. The normal annual rainfall in Mundargi taluk for the period 1951 to 2000 is 554 mm. Seasonal rainfall pattern indicates that major amount of rainfall was recorded during South-West Monsoon seasons followed by North-East Monsoon season and remaining part is in Pre-Monsoon season.

The long term meteorology (period 1961-1990) of the region based on data recorded at the nearest observatory station of India Meteorological Department (IMD) at Gadag district is presented in ***Table 6.6*** and described in subsequent sections.

[1] http://cgwb.gov.in/AQM/NAQUIM_REPORT/karnataka/gadag.pdf

[2] http://cgwb.gov.in/AQM/NAQUIM_REPORT/karnataka/Mundargi_report.pdf

Table 6.6 Climatological Data, Gadag District

Months	Temperature (°C)	
	Mean Max	Mean Min
January	30.0	16.5
February	32.9	18.6
March	35.9	21.1
April	37.4	22.4
May	36.2	22.2
June	30.9	21.5
July	28.6	21.1
August	28.5	20.8
September	29.8	20.5
October	30.8	20.4
November	29.7	18.2
December	28.9	16.4
Average	**31.6**	**20.0**

Source: Climatological Table 1961-90, India Meteorological Department

6.4.5.1 Rainfall

As stated above, the normal annual rainfall in Gadag taluk for the period 1981 to 2010 is 784 mm.

Rainfall recorded in Gadag district from 2016-2020 has been presented in Table below.

Table 6.7 Rainfall recorded from 2016-20 in Gadag district

Year	Rainfall in mm												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2016	0.4	0.0	1.3	21.7	73.4	99.5	71.6	44.0	77.0	3.2	0.0	4.1	**396.2**
2017	0.0	0.0	2.6	5.7	73.0	34.3	41.7	74.4	194.1	121.6	8.7	2.1	**558.2**
2018	0.0	2.7	26.6	36.7	198.8	92.8	19.5	36.1	75.9	36.7	6.6	0.1	**532.5**
2019	0.0	0.0	3.2	15.7	27.1	94.2	99.9	149.6	99.1	240.9	34.7	4.1	**768.5**
2020	0.0	0.0	9.2	58.8	103.4	79.1	164.1	102.8	187.2	162.3	1.8	0.0	**868.7**
Average	0.08	0.54	8.58	27.72	95.14	79.98	79.36	81.38	126.66	112.94	10.36	2.08	**624.82**

Source: Customised rainfall information system, India Meteorological Department

https://hydro.imd.gov.in/hydrometweb/(S(vnw3kkndjsub1o55q4rddw55))/DistrictRaifall.aspx

6.4.5.2 Wind Speed and Direction

The average wind speed in the area is 11.3 kmph, with highest in July (18.8 kmph) and lowest in January (7.1 kmph) as presented in ***Table 6.8*** below. The predominant wind direction is recorded to be from W during the summer (March-May) and from SW/ W/ NW during the monsoon season (June – September). Post monsoon (October- November) receives wind predominantly from E/NE and winter season (December – February) experiences wind predominantly from E or remains calm during most of the time. Monthly pre-dominant wind directions during morning and evening time have been presented in **Table 6.9.**

Table 6.8 Mean Wind Speed, Gadag

Month	Mean Wind Speed (kmph)
January	7.1
February	7.3

Month	Mean Wind Speed (kmph)
March	7.9
April	10.0
May	13.6
June	18.2
July	18.8
August	17.4
September	12.7
October	8.0
November	7.2
December	7.4
Average	**11.3**

Source: Climatological tables 1961-1990, India Meteorological Department

Table 6.9 Predominant Wind Direction, Gadag

Month	Morning Time Predominant Winds			Evening Time Predominant Winds		
	I	II	III	I	II	III
January	SE	E	Calm	E	NE	SE
February	Calm	SE	E	E	Calm	NE
March	Calm	SW	W	E	Calm	NE/ SE
April	SW	W	Calm	Calm	E	W
May	W	SW	NW	W	SW	SW
June	W	SW	NW	W	SW	NW
July	W	SW	NW	W	SW	NW
August	W	SW	NW	W	SW	NW
September	W	SW	Calm	W	SW	NW
October	W	E/ Calm	SW	NE/ E	W	Calm
November	E	NE	SE	E	NE	Calm
December	E	SE	NE	E	NE	SE

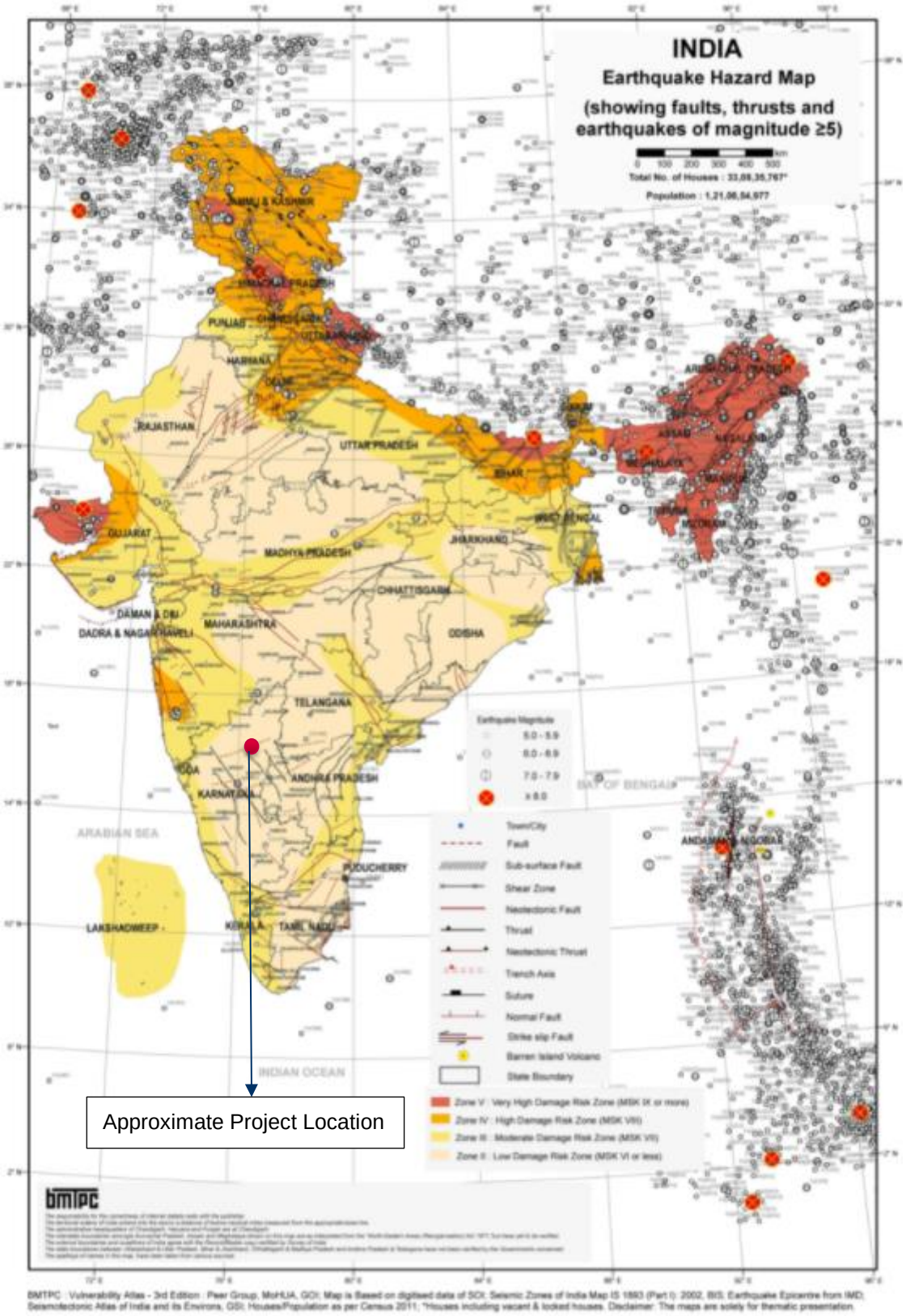
Source: Climatological tables 1961-1990, India Meteorological Department

6.4.6 Natural Hazards

6.4.6.1 Seismicity

As per Natural Disaster maps published by Building Materials & Technology Promotion Council (BMTPC), the Project site is located in Zone II, Low Damage Risk Zone (MSK VI or less).

Figure 6.7 Earthquake Hazard Map

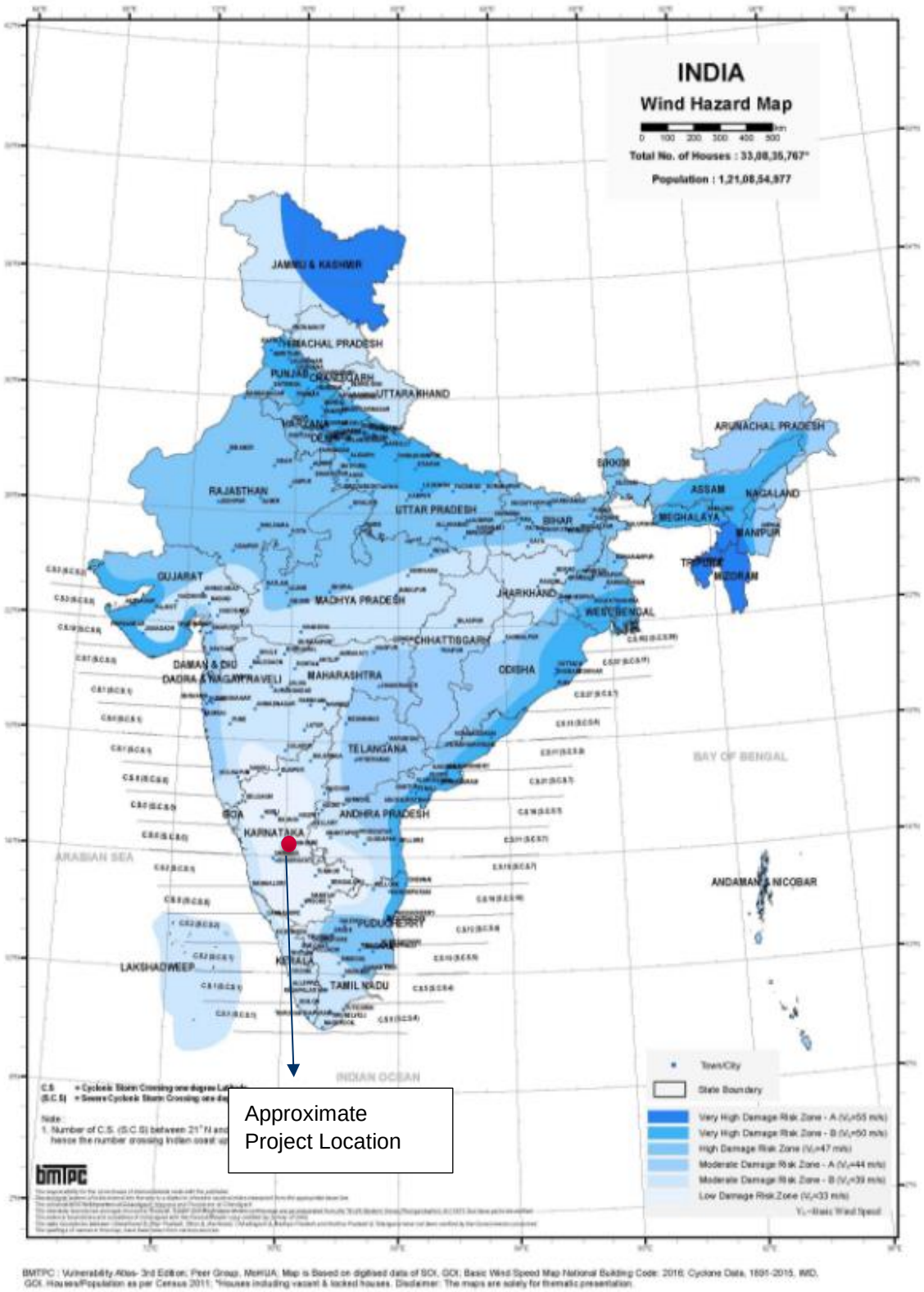


Source: Building Materials & Technology Promotion Council

6.4.6.2 Wind

As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, the Project site falls in an area which is categorised as low damage risk zone with wind velocities Vb= 33 m/s.

Figure 6.8 Wind Hazard Map

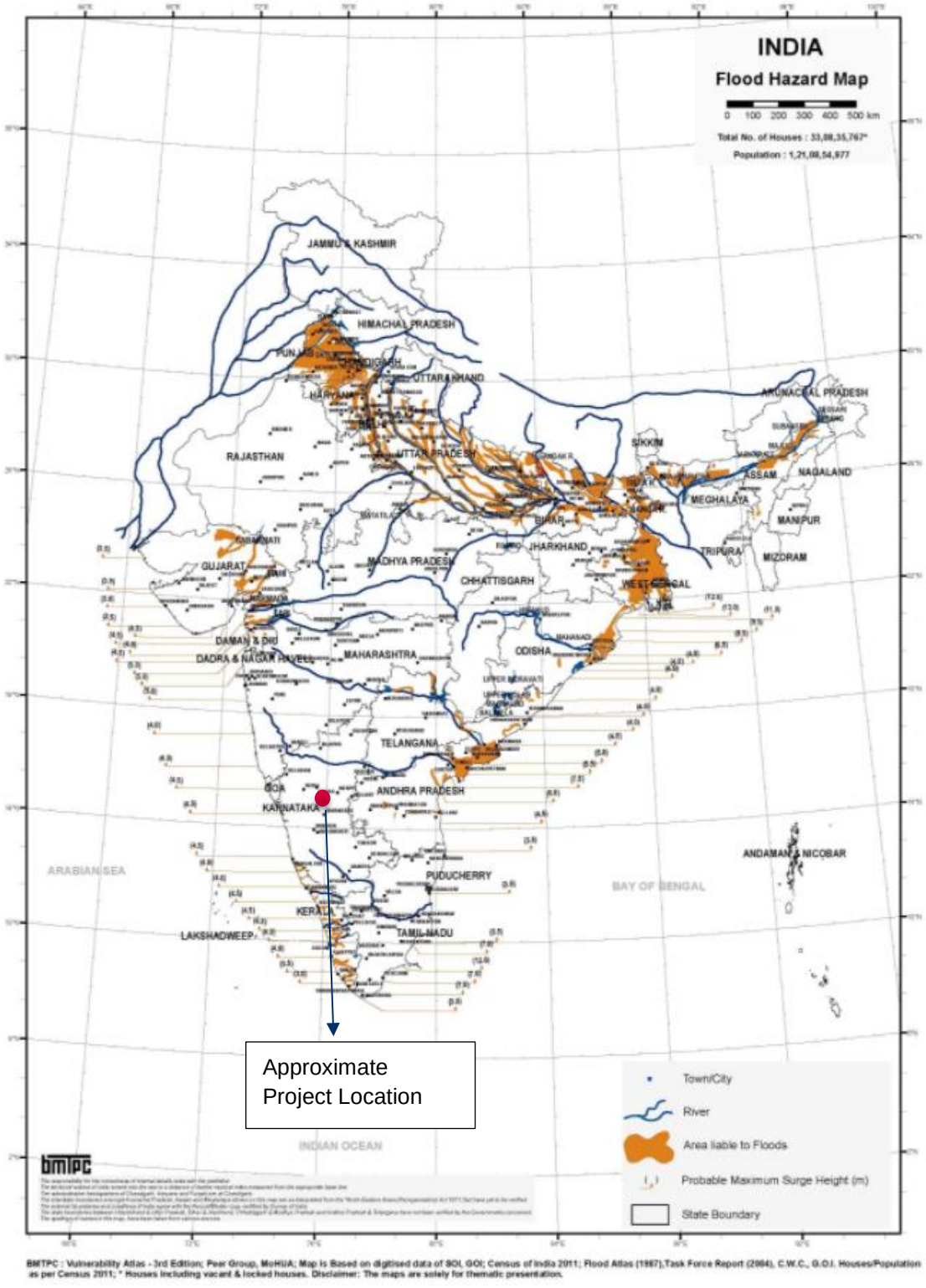


Source: Building Materials & Technology Promotion Council

6.4.6.3 Floods

As per the data released by BMTPC of Government of India and Disaster Management, the Project site falls in an area which is not prone to flooding incidents. However, based on the review of google earth imagery, it was observed that the locations of the turbines are located near to the major drainage channel/ waterbody that may lead to temporary water logging during monsoon season.

Figure 6.9 Flood Hazard Map



Source: Building Materials & Technology Promotion Council

6.4.7 Ambient Noise Quality

The ambient noise levels within the project area was monitored at four (04) locations within a 5 km radius of the site. The details regarding the noise monitoring locations and the results obtained are discussed below. Map showing noise monitoring locations have been presented as **Figure 6.10**.

Table 6.10 Details of Noise Sampling Locations

SN.	Location	Sample Code	Zone	Easting (mE)	Northing (mN)	Distance and direction to Nearest WTG
1	Lakkundi	NQ1	43 P	576410.96	1701611.12	~1 km East of AY 19
2.	Harlapur	NQ2	43 P	583103.89	1705001.23	Village between WTG cluster; ~900 m in West of AY 86
3	Kadampur	NQ3	43 P	576547.05	1697025.65	~ 650 m in SW of AY 13; ~650 m in N of AY 12
4	Hatelgeri	NQ4	43 P	573644.83	1704779.98	~500 m in NE of AY 5

Source: ERM's Site Assessment
Note: The Coordinates have been presented in the UTM Format

Figure 6.10 Map showing location of Noise Monitoring stations and Water sampling locations in the Project AOI

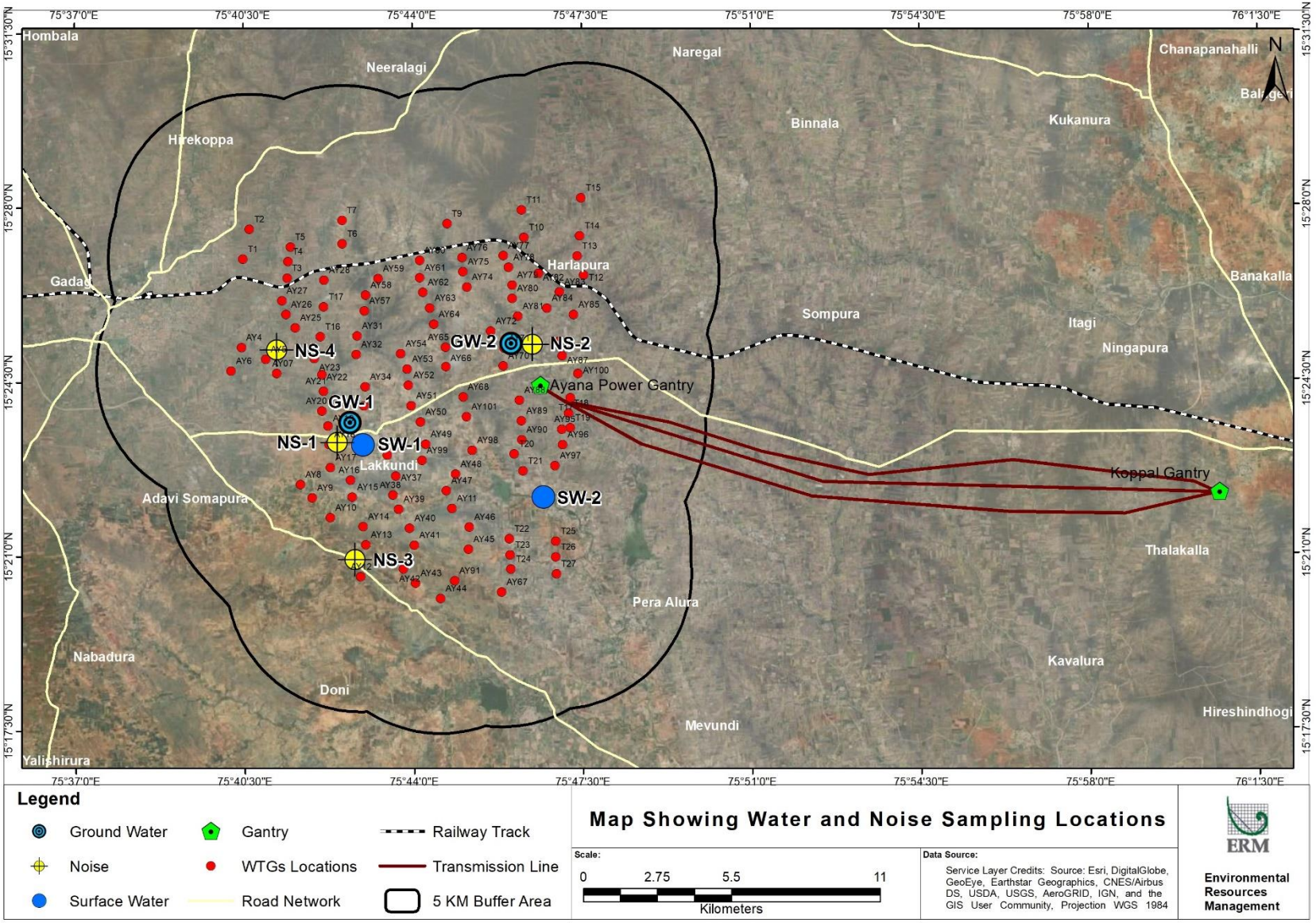


Table 6.11 Noise Level in the study area

S.N.	Location	$L_{eq\ day}$	CPCB and WHO limits* Leq	$L_{eq\ night}$	CPCB and WHO limits Leq
1	Lakkundi	53.5	55	44.6	45
2	Harlapur	54.8	55	42.6	45
3	Kadampur	54.0	55	43.5	45
4	Hatelgeri	54.1	55	43.1	45

* Note: As per CPCB, Day time is considered from 6 am to 10 pm and night time is considered from 10 pm to 6am; As per WHO limits, Day time is considered from 7 am to 10 pm and night time is considered from 10 pm to 7 am

Source: Netel India Limited

Discussion of Results

The observations from noise monitoring at 4 locations in the study area indicate the following:

The L_{eq} values for day were observed to be within the residential area limit of 55 dB(A) at all the villages, L_{eq} value for night was also observed to be within residential area limit of 45 dB(A). However, it was noted that there were heavy movement of agricultural vehicles in the village.

6.4.8 Water Quality

6.4.8.1 Groundwater Quality

The groundwater quality assessment was done to understand the baseline water (ground water) quality of the study area. The groundwater samples were collected from two bore wells from select villages in the study area. A map showing location of ground water sampling is presented as **Figure 6.10**. The details of water sampling locations are presented in ***Table 6.12.***

Table 6.12 Details of Water Sampling Locations

SN.	Location	Sample Code	Zone	Easting (mE)	Northing (mN)
1	Lakkundi	GW1	43 P	576477.75	1701591.23
2.	Harlapur	GW2	43 P	582995.71	1705019.08

Source: ERM's Site Assessment

The groundwater samples obtained from within the Project AoI were analysed against the IS: 10500:2012 standards and the same have been shown below in ***Table 6.13*** and discussed below.

Table 6.13 Groundwater Quality in the Study Area

S.N.	Parameter	Unit	GW1	GW2	IS: 10500, 2012 Limits, Desirable	IS: 10500, 2012 Limits, Permissible
Physico- chemical Tests						
1.	pH at 25 ˚C		7.5	7.7	6.5-8.5	No relaxation
2.	Temperature	° C	25.5	25.2	---	---
3.	Turbidity	NTU	<1	<1	1	5
4.	Colour	Hazen	<5	<5	5	15
Chemical Parameters						
5.	Total Alkalinity	mg/L	300.0	444.0	200	600
6.	Total Dissolved Solids	mg/L	1220.0	898.0	500	2000
7.	Total Suspended Solids	mg/L	<5	<5	---	---

S.N.	Parameter	Unit	GW1	GW2	IS: 10500, 2012 Limits, Desirable	IS: 10500, 2012 Limits, Permissible
8.	DO	mg/L	5.8	4.1	---	---
9.	Chloride (as Cl)	mg/L	307.7	104.2	250	1000
10	Fluorides as F-	mg/L	0.6	0.5	1.0	1.5
11	Total hardness (as CaCO3)	mg/L	838.3	97.0	200	600
12	Sulphate (as SO4)	mg/L	84.6	34.5	200	400
13	Nitrate (as NO3)	mg/L	<0.5	<0.5	45	No Relaxation
14	Total Nitrogen	mg/L			---	---
15	Phosphate as PO4	mg/L	<1	<1	---	---
16	COD	mg/L	12.0	<10	--	--
17	BOD	mg/L	<5	<5	--	--
18	Phenolic Compound (as C6H5OH)	mg/L	<0.001	<0.001	0.001	0.002
19	Iron (as Fe)	mg/L	<0.1	<0.1	0.3	No Relaxation
20	Cadmium (as Cd)	mg/L	<0.003	<0.003	0.003	No Relaxation
21	Copper (as Cu)	mg/L	<0.04	<0.04	0.05	1.5
22	Zinc (as Zn)	mg/L	<0.2	<0.2	5	15
23	Manganese	mg/L	<0.1	<0.1	0.1	0.3
24	Calcium (as Ca)	mg/L	246.4	21	75	200
25	Magnesium (as Mg)	mg/L	53.3	10.7	30	100
Microbiological Parameters						
26	Total Coliform	MPN/100ml	0	0	Shall not be detectable in any 100 ml sample	
27	Faecal Coliform	MPN/100ml	0	0	Shall not be detectable in any 100 ml sample	

Source: Netel India Limited

From the results in table above, it was observed that most the parameters are within permissible limit values except for total hardness in Lakkundi village was found 838.3 mg/l and calcium in same sample was found to 246.4 mg/l. This may be due to geogenic presence of ions in the aquifer. The principal natural sources of hardness in water are dissolved polyvalent metallic ions from sedimentary rocks.

6.4.8.2 Surface Water

To understand the quality of surface water within the project AoI, two surface water samples were collected and analysed against the designated best use classification of Central Pollution Control Board (CPCB) as given in ***Table 6.14*** below and the details of water sampling locations are presented in ***Table 6.15***. Samples were taken from water bodies/ponds in and around the villages in the study area.

Table 6.14 Water Quality Standards by CPCB for Best Designated Usage

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 5mg/l or more

Designated-Best-Use	Class of water	Criteria
		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less
		pH between 6 to 9
		Dissolved Oxygen 4mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5
		Dissolved Oxygen 4mg/l or more
		Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5
		Electrical Conductivity at 25°C micro mhos/cm Max.2250
		Sodium absorption Ratio Max. 26
		Boron Max. 2mg/l
-	Below-E	Not Meeting A, B, C, D & E Criteria

Table 6.15 Details of Surface Water Sampling Locations

SN.	Location	Sample Code	Type of water body	Zone	Easting (mE)	Northing (mN)
1	Lakkundi	SW1	Lake	43P	576749.81	1701264.15
2.	Jantli Shirur	SW2	Reservoir	43P	583517.06	1699338.05

Source: ERM's Site Assessment

The results obtained are shown below:

Table 6.16 Surface Water sampling results

S.N.	Parameter	Unit	SW1	SW2
Physico- chemical Tests				
1.	pH at 25 ˚C	-	7.5	8.0
2.	Temperature	° C	25.4	25.1
3.	Turbidity	NTU	20.3	33.3
4.	Colour	Hazen	<5	<5
Chemical Parameters				
5.	Total Dissolved Solids	mg/l	528.0	1094.0
6.	Total Alkalinity (As CaCO3)	mg/l	192.0	516.0
7.	Total Hardness(As CaCO3)	mg/l	202.0	272.7
8.	TSS	mg/l	18.0	35.0
9.	DO	mg/l	6.3	5.4
10.	COD	mg/l	32.0	12.0
11.	BOD	mg/l	9.0	8.0
12.	Chloride (Cl)	mg/l	124.1	119.1
13.	Sulphate (SO4-2)	mg/l	52.9	49.5
14.	Fluoride (F-)	mg/l	0.7	0.5
15.	Nitrate (NO3-)	mg/l	<0.5	<0.5
16.	Phenolic Compounds	mg/l	<0.001	<0.001
17.	Iron (Fe)	mg/l	<0.1	<0.1
18.	Manganese (Mn)	mg/l	<0.1	<0.1
19.	Cobalt (CO)	mg/l	<0.01	<0.01
20.	Cadmium (Cd)	mg/l	<0.003	<0.003

S.N.	Parameter	Unit	SW1	SW2
21.	Zinc (Zn)	mg/l	<0.2	<0.2
22.	Copper (Cu)	mg/l	<0.04	<0.04
23.	Sodium (Na)	mg/l	144.0	160.0
24.	Potassium (K)	mg/l	3.7	3.1
25.	Magnesium (as Mg)	mg/l	29.1	33.9
26.	Calcium (Ca)	mg/l	32.3	52.5
27.	Phosphate	mg/l	<1	<1
28.	Salinity	ppt	0.25	0.24
29.	Oil & Grease	mg/l	<0.2	<0.2
Microbiological Parameters				
30.	Total Coliform	MPN/100ml	0	0
31.	Faecal Coliform	MPN/100ml	Absent	Absent

Source: Netel India Limited

Surface water sample collected from lake at Lakkundi has no coliform, pH value 7.5 i.e. in the range of 6.5 and 8.5. Dissolved Oxygen more than 6mg/l and BOD more than 4 mg/l, hence meet the criteria for Class D water i.e. Propagation of Wild life and Fisheries. However, it was understood that this lake water is not used for drinking purposes.

Water sample collected from reservoir at Jantli Shirur has no coliforms, pH value of 8.0 i.e. in the range of 6.5 and 8.5, DO more than 5 mg/l, however, BOD is more than 4 mg/l. The water sample meets the criteria of Class D water i.e. Propagation of Wild life and Fisheries and can be used for wildlife propogation activities.

6.5 Ecology and Biodiversiy Baseline

An ecological survey was undertaken between 27th to 29th July, 2021 at the 300 MW Wind Power Project Site. The purpose of the survey was to establish an ecological baseline of the study area, which helps to understand the impacts of the project on species and habitats in the surrounding areas and finally in the management strategy and mitigation.

6.5.1 Objective

The ecological surveys were conducted with following objectives:

6.5.1.1 Flora

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

6.5.1.2 Fauna

- Identification of fauna (specifically birds, mammals and reptiles) based on direct sightings, calls, pugmarks, droppings, nests, etc.;
- Identification and classification of any species recognized as threatened (in accordance with the International Union for the Conservation of Nature [IUCN] Red List Online Version 2021-2) and according to the schedules of the Wildlife (Protection) Act, 1972; and

- Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, over wintering areas including wildlife migratory corridors /avian migratory routes.

6.5.2 Approach and Methodology

6.5.2.1 Determining Study Area

The study area of the ecological baseline assessment has been determined as follows:

- **Core Zone**: of 500 m radius from the proposed wind turbine locations. The core zone has been selected based on past experience of similar sector as species flying in this zone are more likely to be affected by the Project through a net displacement away from the wind power plant or collision with the operating wind turbines.
- **Buffer zone**: of 5 km radius from the proposed wind turbine locations. The buffer zone has been selected based on past studies carried out in the sector as a reasonable estimate for bird and bat movement on a regular basis and therefore a representation of species that could be affected by the operational wind power plant.

It is to be noted that delineation of core and buffer areas varies from those delineated for the environmental baseline due to relatively longer range and more complex impacts on biodiversity receptors.

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

6.5.3 Baseline Ecological Survey

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

6.5.3.1 Secondary Data Collection

Secondary baseline data regarding sensitive ecological habitat (National Park, Sanctuary, Ecological Sensitive Area, Migratory Corridor, habitat of endangered, vulnerable and range restricted species etc.), flora & fauna in the study area, forest cover was collected from reliable sources like published documents, online bird databases such as eBird, Birdlife Data zone on IBAs of Birdlife International etc. Consultations were carried out with local people to understand major flora & fauna in the study area, presence of any Schedule I species, migratory species or other species having conservation value and pressures on forest resource. Key consultations where made with the local communities on the presence of various avifaunal and mammalian species on the presence of CR, EN and Scheduled species (as per IWPA, 1972) in and around the proposed project area.

6.5.3.2 Primary Survey

Habitat Survey:

Different habitats available within study area identified by the desktop review were verified through site visit. Data regarding the type and quality of habitat with reference to flora and fauna supported, were collected.

Floral Survey:

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

Faunal Survey:

Faunal species from the study areas were recorded based on direct sightings, indirect evidences such as dung, droppings, scats, pugmarks, scratch signs, burrows, nests etc. Consultations with local communities were carried out by displaying pictorial representations of species anticipated in the area to confirm whether there have been any recent sightings. The pictorial representation of the species were typically obtained from the authentic sources[17, 18]. The species occurring within the study area were surveyed using the below methods:

a. Amphibians:

Amphibians are often restricted to natural and constructed ponds during the hottest parts of the day[19]. All such water bodies were visited during the hottest parts of the day to determine the presence of amphibians along the shaded ledges of the water body.

b. Reptiles:

Reptile presence was determined through the use of Intensive Time Constrained Search Methods[20,21]. The method was adapted for the terrain by targeting rocks and logs located around water bodies or recently dried streams, hedges and along the trunks of higher vegetation.

c. Avifauna:

An adapted avifaunal survey method for onshore wind farm assessments was utilized for the purpose of this study[22]. The adapted survey method focuses on key habitat features to cover, preferred time of day to ensure maximum bird activity. Any avifaunal species that was identified by visually sighting or hearing of bird calls were recorded. The birds were surveyed around ponds during the coolest parts of the day (morning and evening); along motorable roads and in high-density vegetation areas during the hottest parts of the day. Binoculars and standard field guides[23, 24] were used for avifaunal identification.

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

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

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

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

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

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

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

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

d. Mammals:

Mammal surveys were conducted along motorable roads, near water bodies and agricultural lands. Individuals were identified through indirect methods such as pellets, tracks, paw marks and scat. Species were then identified using standard literature[25, 26].

6.5.4 Results of Baseline Survey

6.5.4.1 Habitat Surveys

As part of the site visit, a site reconnaissance of the Project site and 5 km study area was undertaken to determine the types of habitat that are found. The study area consists of natural habitats (water bodies and forest lands), and modified habitats (water bodies, scrub lands and agricultural lands). The agricultural land is the dominating habitat with about 82% land cover in the study area, open scrub ~8% and water bodies ~ 1%. Few patches of forest land (~2%) are also present in south-west direction from the proposed project site. For complete land use break up of the study area please refer ***Table 6.3***. Photo-documentation of different habitats has been presented in ***Figure 6.11***. The distribution of key habitats found in the study area has been presented in ***Figure 6.12***.

Figure 6.11 Habitats within the Study Area

Agriculture land with sunflower crop

Water body/Reservoir

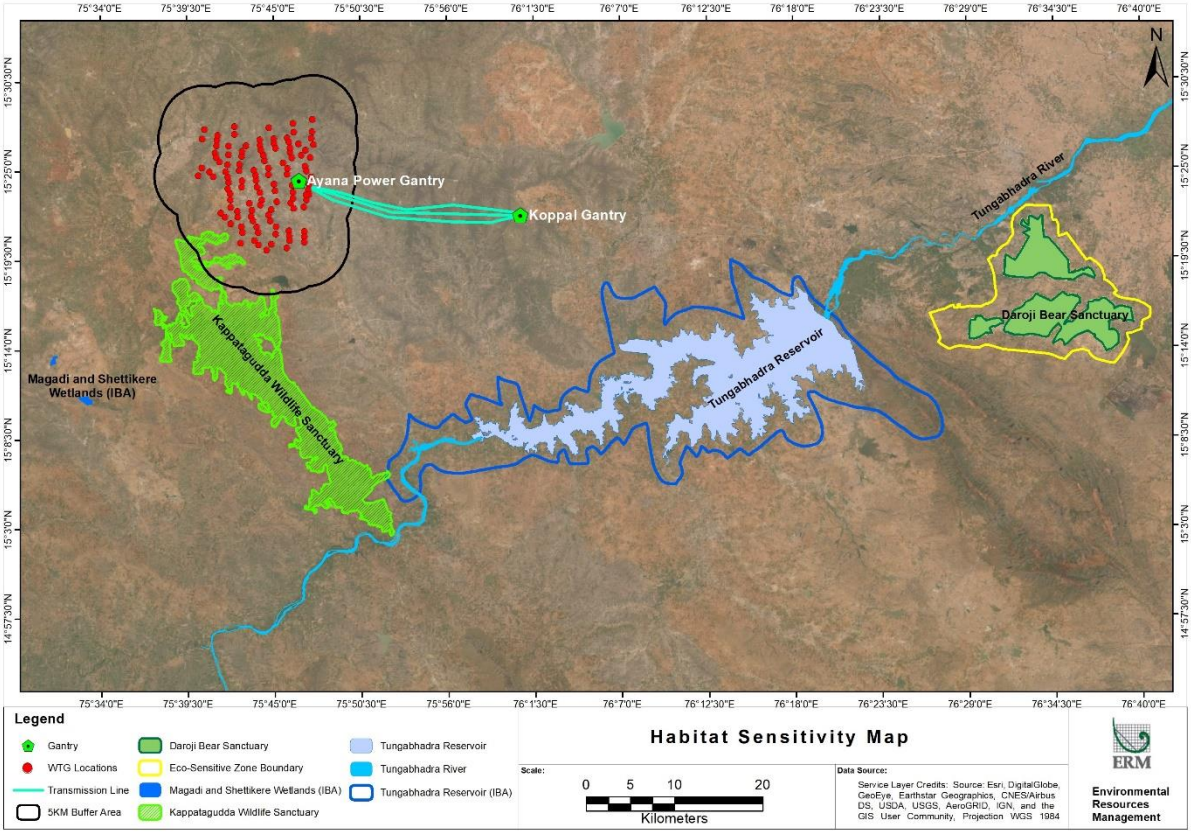
Open scrub

Coconut orchard

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

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

Figure 6.12 Ecological Sensitivity Map



Source: ERM India.

6.5.4.2 Water Body Surveys

As part of the habitat survey, major water bodies in a 5 km radius were identified and visited during the site visit to determine the presence of water and to establish existence of water birds visiting the area. The vegetation in the habitat is dominated with *Acacia nilotica* (L.) Delile, *Alternanthera sessilis* (L.) R.Br. ex DC., *Calotropis procera* (Aiton) Dryand., *Cyperus difformis* L., *Ipomoea aquatica* Forssk., *Ipomoea carnea* Jacq., *Ludwigia octovalvis* (Jacq.) P.H.Raven, *Passiflora foetida* L., *Prosopis juliflora* (Sw.) DC., *Stachytarpheta jamaicensis* (L.) Vahl, *Senna auriculata* (L.) Roxb., etc. The details of the water body survey have been provided in ***Table 6.17.***

Table 6.17 Water Bodies Surveyed near the Wind Power Plant

Sr. No.	Water body	Latitude (N)	Longitude (E)	Availability of Water	Core/Buffer
1	Water body 1 (Near Lakkundi Village)	15.393067°	75.718492°	Yes	Buffer
2	Water body 2 (Near Harlapur Village)	15.418190°	75.767115°	Yes	Buffer
3	Water body 3 (Alur Kere)	15.354801°	75.809818°	Yes	Buffer
4	Water body 4 (Dambal Kere)	15.305432°	75.759664°	Yes	Buffer
5	Water body 5 (Sirur Kere)	15.371533°	75.763125°	Yes	Buffer
6	Water body 6 (Near Lakkundi Village)	15.386182°	75.715204°	Yes	Buffer
7	Water body 7 (Bhishma Kere)	15.420840°	75.631238°	Yes	Buffer

Sr. No.	Water body	Latitude (N)	Longitude (E)	Availability of Water	Core/Buffer
8	Water body 8 (Near Kanaginahal Village)	15.456379°	75.732508°	Yes	Buffer
9	Water body 9 (Near Hatalageri Village)	15.418628°	75.688823°	Yes	Buffer

6.5.4.3 Open Scrubs

Scrub lands are present in the study area in patches along with the agriculture lands. The habitat is vegetated with herbs, shrubs and few trees. The common species of this habitat are, *Abutilon indicum* (L.) Sweet, *Acacia nilotica* (L.) Delile, *Acacia leucophloea* (Roxb.) Willd., *Acacia horrida* (L.) Willd., *Achyranthes aspera* L., *Calotropis procera* (Aiton) Dryand., *Dactyloctenium aegyptium* (L.) Willd., *Dalbergia sissoo* DC., *Euphorbia hirta* L., *Euphorbia tirucalli* L., *Jatropha gossypiifolia* L., *Lantana camara* L., *Opuntia elatior* Mill., *Panicum brevifolium* L., *Parkinsonia aculeata* L., *Parthenium hysterophorus* L., *Phoenix sylvestris* (L.) Roxb., *Prosopis juliflora* (Sw.) DC., *Senna auriculata* (L.) Roxb., *Senna occidentalis* (L.) Link, *Senna tora* (L.) Roxb., etc.

6.5.4.4 Forests

Some patches of forests are also present within the 5 km buffer of the study area in south-west direction. The major forest type present in the area are, Southern thorn forests. Typical representatives of the vegetation are, *Acacia nilotica* (L.) Delile, *Acacia catechu* (L.f.) Willd., *Acacia leucophloea* (Roxb.) Willd., *Acacia horrida* (L.) Willd., *Aegle marmelos* (L.) Corrêa, *Carissa spinarum* L., *Flacourtia indica* (Burm. f.) Merr., *Lantana camara* L., *Ziziphus oenoplia* (L.) Miller, etc.

6.5.4.5 Floral Assessment

The vegetation classification of the region is presented in ***Table 6.18***.

Table 6.18 Vegetation Classification of the Region

Classification Scheme	Classification
Biogeographical Province of India[1]	6E: Deccan Peninsula – Deccan South
Agro Ecological Sub Region (ICAR)[2]	Eastern Ghats, TN uplands and Deccan (Karnataka) Plateau
Agro-Climatic Region[3]	Southern Plateau and Hills Region (X)
Champion and Seth forest classification[4]	Southern Thorn Forest (6A/C1); Southern Thorn Scrub (6A/DS1)

The floral assessment was undertaken in the available habitats within the wind power plant area and 5 km buffer areas. A list of flora found in the encountered habitat around the wind power plant has been given in ***Figure 6.13***.

A total of seventy-five (75) floral species belonging to thirty-five (35) families were observed from the 5 km radius of the wind power plant (***Table 6.19***). Fabaceae was the most dominating family in the area with 20 species. None of the species identified in the region is endangered.

[1] Wildlife Institute of India - ENVIS Centre

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

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

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

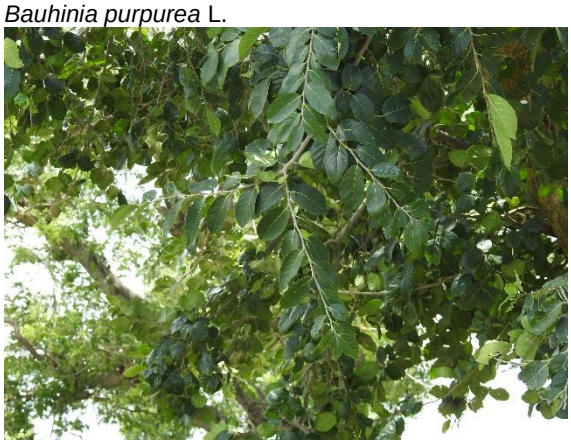
Figure 6.13 Floral species within Study area

Dalbergia sissoo DC.

Parkinsonia aculeata L.

Bauhinia purpurea L.

Muntingia calabura L.



Holoptelea integrifolia Planch.

Acacia nilotica (L.) Delile

Acacia leucophloea (Roxb.) Willd.

Prosopis juliflora (Sw.) DC.

Phoenix sylvestris (L.) Roxb.

Cocos nucifera L.

Senna auriculata (L.) Roxb.

Calotropis gigantea (L.) Dryand.

Ziziphus mauritiana Lamk.

Lantana camara L.

Acacia horrida (L.) Willd.

Capparis decidua (Forssk.) Edgew.

Euphorbia tirucalli L.

Ricinus communis L.

Dodonaea viscosa (L.) Jacq.

Opuntia elatior Mill.

Stachytarpheta jamaicensis (L.) Vahl

Tridax procumbens (L.) L.

Aerva lanata (L.) Juss. ex Schult.

Commelina benghalensis L.

Croton bonplandianus Baill.

Argemone mexicana L.

Datura metel L.

Salvia coccinea Buc'hoz ex Etl.

Cryptostegia grandiflora Roxb. ex R.Br.

Typha domingensis Pers.

Ipomoea carnea Jacq.

Ottelia alismoides (L.) Pers.

Table 6.19 Flora around proposed Wind Power Plant

Sr. No.	Scientific Name	Family	Life form	Observed/ Reported
1	*Abutilon indicum* (L.) Sweet	Malvaceae	Herb	Observed
2	*Acacia catechu* (L.f.) Willd.	Fabaceae	Tree	Reported
3	*Acacia horrida* (L.) Willd.	Fabaceae	Shrub	Observed
4	*Acacia leucophloea* (Roxb.) Willd.	Fabaceae	Tree	Observed
5	*Acacia nilotica* (L.) Delile	Fabaceae	Tree	Observed
6	*Achyranthes aspera* L.	Amaranthaceae	Herb	Reported
7	*Aegle marmelos* (L.) Corrêa,	Rutaceae	Tree	Observed
8	*Aerva lanata* (L.) Juss. ex Schult.	Amaranthaceae	Herb	Observed
9	*Agave americana* L.	Agavaceae	Herb	Observed
10	*Albizia lebbeck* (L.) Benth.	Fabaceae	Tree	Observed
11	*Albizia procera* (Roxb.) Benth.	Fabaceae	Tree	Reported
12	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	Herb	Reported
13	*Argemone mexicana* L.	Papaveraceae	Herb	Observed
14	*Azadirachta indica* A.Juss.	Meliaceae	Tree	Observed
15	*Bauhinia purpurea* L.	Fabaceae	Tree	Observed
16	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	Tree	Observed
17	*Calotropis procera* (Aiton) Dryand.	Apocynaceae	Shrub	Observed
18	*Capparis decidua* (Forssk.) Edgew.	Capparaceae	Shrub	Observed
19	*Carissa spinarum* L.	Apocynaceae	Shrub	Reported
20	*Cascabela thevetia* (L.) Lippold	Apocynaceae	Tree	Observed
21	*Cassia fistula* L.	Fabaceae	Tree	Reported
22	*Cocos nucifera* L.	Arecaceae	Tree	Observed
23	*Commelina benghalensis* L.	Commelinaceae	Herb	Observed
24	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb	Observed
25	*Cryptostegia grandiflora* Roxb. ex R.Br.	Apocynaceae	Climber	Observed
26	*Cyperus difformis* L.	Cyperaceae	Herb	Reported
27	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Grass	Reported
28	*Dalbergia sissoo* DC.	Fabaceae	Tree	Observed
29	*Datura metel* L.	Solanaceae	Herb	Observed
30	*Delonix regia* (Hook.) Raf.	Fabaceae	Tree	Observed
31	*Dicliptera paniculata* (Forssk.) I.Darbysh.	Acanthaceae	Herb	Reported
32	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shrub	Observed
33	*Euphorbia hirta* L.	Euphorbiaceae	Herb	Observed
34	*Euphorbia tirucalli* L.	Euphorbiaceae	Tree	Observed

35	*Ficus benghalensis* L.	Moraceae	Tree	Observed
36	*Ficus religiosa* L.	Moraceae	Tree	Observed
37	*Flacourtia indica* (Burm. f.) Merr.	Salicaceae	Shrub	Reported
38	*Holoptelea integrifolia* Planch.	Ulmaceae	Tree	Observed
39	*Ipomoea aquatica* Forssk.	Convolvulaceae	Herb	Observed
40	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub	Observed
41	*Jatropha gossypiifolia* L.	Euphorbiaceae	Shrub	Reported
42	*Lantana camara* L.	Verbenaceae	Shrub	Observed
43	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree	Reported
44	*Ludwigia octovalvis* (Jacq.) P.H.Raven	Onagraceae	Herb	Reported
45	*Mangifera indica* L.	Anacardiaceae	Tree	Observed
46	*Martynia annua* L.	Martyniaceae	Herb	Observed
47	*Moringa oleifera* Lam.	Moringaceae	Tree	Observed
48	*Muntingia calabura* L.	Muntingiaceae	Tree	Observed
49	*Opuntia elatior* Mill.	Cactaceae	Shrub	Observed
50	*Ottelia alismoides* (L.) Pers.	Hydrocharitaceae	Herb	Observed
51	*Panicum brevifolium* L.	Poaceae	Grass	Reported
52	*Parkinsonia aculeata* L.	Fabaceae	Tree	Observed
53	*Parthenium hysterophorus* L.	Asteraceae	Herb	Observed
54	*Passiflora foetida* L.	Passifloraceae	Climber	Reported
55	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree	Observed
56	*Phyla nodiflora* (L.) Greene	Verbenaceae	Herb	Observed
57	*Pithecellobium dulce* (Roxb.) Benth.	Fabaceae	Tree	Observed
58	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree	Observed
59	*Prosopis juliflora* (Sw.) DC.	Fabaceae	Tree	Observed
60	*Ricinus communis* L.	Euphorbiaceae	Small Tree	Observed
61	*Salvia coccinea* Buc'hoz ex Etl.	Lamiaceae	Herb	Observed
62	*Senna auriculata* (L.) Roxb.	Fabaceae	Shrub	Observed
63	*Senna obtusifolia* (L.) H.S.Irwin & Barneby	Fabaceae	Herb	Observed
64	*Senna occidentalis* (L.) Link	Fabaceae	Herb	Observed
65	*Senna tora* (L.) Roxb.	Fabaceae	Shrub	Reported
66	*Solanum virginianum* L.	Solanaceae	Herb	Observed
67	*Stachytarpheta jamaicensis* (L.) Vahl	Verbenaceae	Shrub	Observed
68	*Syzygium cumini* (L.) Skeels	Myrtaceae	Tree	Observed
69	*Tamarindus indica* L.	Fabaceae	Tree	Observed
70	*Tectona grandis* L.f.	Lamiaceae	Tree	Observed

71	*Thespesia populnea* (L.) Sol. ex Corrêa	Malvaceae	Tree	Observed
72	*Tridax procumbens* (L.) L.	Asteraceae	Herb	Observed
73	*Typha domingensis* Pers.	Typhaceae	Herb	Observed
74	*Ziziphus jujuba* Mill.	Rhamnaceae	Tree	Reported
75	*Ziziphus mauritiana* Lamk.	Rhamnaceae	Tree	Observed

Source: ERM Primary Survey and Forest working plan, Gadag forest division.

Agricultural Profile

The agriculture in the area is dependent upon the rains and water reservoirs as well as groundwater. Chickpea (*Cicer arietinum* L.), Green gram (*Vigna radiate* (L.) R. Wilczek), Sorghum (*Sorghum bicolor* (L.) Moench), Peanut (*Arachis hypogaea* L.), Wheat (*Triticum aestivum* L.), Onion (*Allium cepa* L.), Cotton (*Gossypium* spp.), Maize (*Zea mays* L.) and Sunflower (*Helianthus annuus* L.) are the major crops in the area.

6.5.4.6 Faunal Assessment

The faunal assessment was carried out based on the aforementioned search techniques for each of the target class of fauna - herpetofauna (amphibians and reptiles), avifauna and mammals. The subsequent sections describe the fauna found on the site.

Herpetofauna

Nine (09) species were observed or reported from the 5 km study area of the proposed wind power plant. The list of species with their latest IUCN Red List (Online Version 2021-2) and Wildlife Protection Act, 1972 Schedule status has been presented in ***Table 6.20***.

Figure 6.14 Some Herpetofauna observed in the study area

Oriental Garden Lizard

Common Skittering Frog

Table 6.20 Herpetofauna observed/reported in the study area

Sr. No.	Common Name	Scientific Name	IUCN Red List Status (Online Version 2021-2)	Wildlife Protection Act Schedule	Observed/ Reported
1	Bengal Monitor Lizard	*Varanus bengalensis*	Least Concern	Schedule I	Reported
2	Common Skittering Frog	*Euphlyctis cyanophlyctis*	Least Concern	Schedule IV	Observed
3	Indian Bullfrog	*Hoplobatrachus tigerinus*	Least Concern	Schedule IV	Observed
4	Indian Cobra	*Naja naja*	Least Concern	Schedule II	Reported
5	Indian Rat Snake	*Ptyas mucosus*	Not assessed	Schedule II	Reported

Sr. No.	Common Name	Scientific Name	IUCN Red List Status (Online Version 2021-2)	Wildlife Protection Act Schedule	Observed/ Reported
6	Indian Rock Python	*Python molurus*	Not assessed	Schedule I	Reported
7	Oriental Garden Lizard	*Calotes versicolor*	Not assessed	Not listed	Observed
8	Russell's Viper	*Daboia russelii*	Least Concern	Schedule II	Reported
9	Skink	*Mabuya sp.*	Not assessed	Not listed	Observed

Source: ERM Primary Survey and Forest working plan, Gadag forest division.

Avifauna

A total of 113 bird species were observed/reported in and around the study area of the wind power plant. The observed and reported species have been provided in ***Table 6.21.***

A total of 45 species were directly observed during the study visit. Beside, two Vulnerable (VU) - [Common Pochard (*Aythya farina*) & Greater Spotted Eagle (*Clanga clanga*)]; and 11 Near Threatened (NT) - [Alexandrine Parakeet (*Psittacula eupatria*), Asian Woollyneck (*Ciconia episcopus*), Black-headed Ibis (*Threskiornis melanocephalus*), Black-tailed Godwit (*Limosa limosa*), Eurasian Curlew (*Numenius arquata*), Great Thick-knee (*Esacus recurvirostris*), Oriental Darter (*Anhinga melanogaster*), Painted Stork (*Mycteria leucocephala*), Pallid Harrier (*Circus macrourus*), River Tern (*Sterna aurantia*) & Spot-billed Pelican (*Pelecanus philippensis*)] species, all the species have been classified as 'Least Concern' as per the latest IUCN Red List (Online Version 2021-2). Total therteen (13) species reported or observed from the study area *e.g.* Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caeruleus*), Bonelli's Eagle (*Aquila fasciata*), Brahminy Kite (*Haliastur indus*), Eurasian Spoonbill (*Platalea leucorodia*), Greater Spotted Eagle (*Clanga clanga*), Indian Grey Hornbill (*Ocyceros birostris*), Indian Peafowl (*Pavo cristatus*), Montagu's Harrier (*Circus pygargus*), Osprey (*Pandion haliaetus*), Pallid Harrier (*Circus macrourus*), Shikra (*Accipiter badius*) & Western Marsh-Harrier (*Circus aeruginosus*) are protected and categorized under Schedule I, one (House Crow) is under Schedule V and 95 are under Schedule IV as per the Indian Wildlife Protection Act, 1972. The list of species with their latest IUCN Red List (Online Version 2021-2) and Wildlife Protection Act Schedule status has been presented in

Table 6.21***.***

Twenty-five (25) migratory species namely, Bar-headed Goose (*Anser indicus*), Black-tailed Godwit (*Limosa limosa*), Common Kestrel (*Falco tinnunculus*), Common Pochard (*Aythya farina*), Common Redshank (*Tringa totanus*), Common Sandpiper (*Actitis hypoleucos*), Demoiselle Crane (*Grus virgo*), Eurasian Curlew (*Numenius arquata*), Garganey (*Spatula querquedula*), Glossy Ibis (*Plegadis falceinellus*), Greater Flamingo (*Phoenicopterus roseus*), Greater Spotted Eagle (*Clanga clanga*), Little Stint (*Calidris minuta*), Marsh Sandpiper (*Tringa stagnatilis*), Montagu's Harrier (*Circus pygargus*), Northern Pintail (*Anas acuta*), Northern Shoveler (*Spatula clypeata*), Osprey (*Pandion haliaetus*), Pallid Harrier (*Circus macrourus*), Peregrine Falcon (*Falco peregrinus*), Rosy Starling (*Pastor roseus*), Ruddy Shelduck (*Tadorna ferruginea*), Ruff (*Calidris pugnax*), Western Marsh-Harrier (*Circus aeruginosus*) & Whiskered Tern (*Chlidonias hybrida*) were also reported or observed from 5 km buffer of the wind power plant.

Although, two Endangered, Egyptian Vulture (*Neophron percnopterus*) & Black-bellied Tern (*Sterna acuticauda*) have been reported from the region[1], but there presence in the buffer area has not been confirmed with eBird database[2] and consultation[3].

[1] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[2] eBird Database [https://ebird.org/hotspot/L7351967; https://ebird.org/hotspot/L10818998; https://ebird.org/hotspot/L4874530; https://ebird.org/hotspot/L4985562]

[3] Consultation with the local villagers as well as forest department

Figure 6.15 Some avifauna observed in the study area


Black-winged Kite


Southern Coucal


House Crow


Indian Jungle Crow


Ashy-crowned Sparrow-lark


Baya Weaver


Common Babbler


Black Drongo


Common Myna


Brahminy Starling


White-breasted Kingfisher


Blue-faced Malkoha


Indian Silverbill


Scaly-breasted Munia


Green Bee-eater


Oriental Magpie-Robin


Eurasian Collared-Dove


Laughing Dove


Red-wattled Lapwing


Black-winged Stilt


Oriental Darter


Purple Heron


Eurasian Spoonbill


Painted Stork


Red-naped Ibis


Black-headed Ibis


Little Cormorant


Great Cormorant


Common Coot


Little Grebe


Indian Spot-billed Duck


Lesser Whistling-duck

Table 6.21 Avifauna observed/reported from the study area

Sr. No.	Common Name	Scientific Name	Migratory Status	IUCN Red List Status (Online Version 2021-2)	Wildlife Protection Act Schedule	Observed/ Reported
1	African Comb Duck	*Sarkidiornis melanotos*	R	Least Concern	Schedule IV	Reported
2	Alexandrine Parakeet	*Palaeornis eupatria*	R	Near Threatened	Schedule IV	Reported
3	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV	Observed
4	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	R	Least Concern	Schedule IV	Observed
5	Asian Brown Flycatcher	*Muscicapa dauurica*	R	Least Concern	Schedule IV	Reported
6	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV	Reported
7	Asian Openbill	*Anastomus oscitans*	R	Least Concern	Schedule IV	Reported
8	Asian Woollyneck	*Ciconia episcopus*	R	Near Threatened	Schedule IV	Reported
9	Bar-headed Goose	*Anser indicus*	M	Least Concern	Schedule IV	Reported
10	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV	Observed
11	Bay-backed Shrike	*Lanius vittatus*	R	Least Concern	Not Listed	Reported
12	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV	Observed
13	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I	Reported
14	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV	Observed
15	Black-tailed Godwit	*Limosa limosa*	M	Near Threatened	Schedule IV	Reported
16	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I	Observed
17	Black-winged Stilt	*Himantopus himantopus*	R	Least Concern	Schedule IV	Observed
18	Blue-faced Malkoha	*Phaenicophaeus viridirostris*	R	Least Concern	Schedule IV	Observed

19	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I	Reported
20	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I	Reported
21	Brahminy Starling	*Sturnia pagodarum*	R	Least Concern	Schedule IV	Observed
22	Bronze-winged Jacana	*Metopidius indicus*	R	Least Concern	Schedule IV	Reported
23	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV	Observed
24	Chestnut-shouldered Bush-sparrow	*Gymnoris xanthocollis*	R	Least Concern	Schedule IV	Reported
25	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV	Observed
26	Common Coot	*Fulica atra*	R	Least Concern	Schedule IV	Observed
27	Common Hawk-cuckoo	*Hierococcyx varius*	R	Least Concern	Schedule IV	Reported
28	Common Hoopoe	*Upupa epops*	R	Least Concern	Not Listed	Reported
29	Common Iora	*Aegithina tiphia*	R	Least Concern	Schedule IV	Reported
30	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV	Reported
31	Common Kingfisher	*Alcedo atthis*	R	Least Concern	Schedule IV	Reported
32	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV	Observed
33	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule IV	Reported
34	Common Redshank	*Tringa totanus*	M	Least Concern	Schedule IV	Reported
35	Common Sandpiper	*Actitis hypoleucos*	M	Least Concern	Schedule IV	Reported
36	Common Tailorbird	*Orthotomus sutorius*	R	Least Concern	Schedule IV	Reported
37	Coppersmith Barbet	*Psilopogon haemacephalus*	R	Least Concern	Schedule IV	Reported
38	Cotton Pygmy-goose	*Nettapus coromandelianus*	R	Least Concern	Schedule IV	Reported
39	Demoiselle Crane	*Grus virgo*	M	Least Concern	Schedule IV	Reported
40	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV	Observed
41	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV	Reported

42	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I	Observed
43	Garganey	*Spatula querquedula*	M	Least Concern	Schedule IV	Reported
44	Glossy Ibis	*Plegadis falceinellus*	M	Least Concern	Schedule IV	Reported
45	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV	Observed
46	Great Thick-Knee	*Esacus recurvirostris*	R	Near Threatened	Schedule IV	Reported
47	Great White Egret	*Ardea alba*	R	Least Concern	Schedule IV	Observed
48	Greater Flamingo	*Phoenicopterus roseus*	M	Least Concern	Schedule IV	Reported
49	Greater Spotted Eagle	*Clanga clanga*	M	Vulnerable	Schedule I	Reported
50	Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV	Observed
51	Grey Francolin	*Francolinus pondicerianus*	R	Least Concern	Schedule IV	Reported
52	Grey Heron	*Ardea cinerea*	R	Least Concern	Schedule IV	Observed
53	House Crow	*Corvus splendens*	R	Least Concern	Schedule V	Observed
54	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV	Observed
55	Indian Golden Oriole	*Oriolus kundoo*	R	Least Concern	Schedule IV	Reported
56	Indian Grey Hornbill	*Ocyceros birostris*	R	Least Concern	Schedule I	Reported
57	Indian Jungle Crow	*Corvus macrorhynchos*	R	Least Concern	Schedule IV	Observed
58	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I	Observed
59	Indian Pond Heron	*Ardeola grayii*	R	Least Concern	Schedule IV	Observed
60	Indian Robin	*Saxicoloides fulicata*	R	Least Concern	Schedule IV	Observed
61	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV	Reported

62	Indian Silverbill	*Euodice malabarica*	R	Least Concern	Schedule IV	Observed
63	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV	Observed
64	Indian Thick-knee	*Burhinus indicus*	R	Least Concern	Not Listed	Reported
65	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV	Reported
66	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern	Schedule IV	Observed
67	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV	Observed
68	Little Cormorant	*Microcarbo niger*	R	Least Concern	Schedule IV	Observed
69	Little Ringed Plover	*Charadrius dubius*	R	Least Concern	Schedule IV	Reported
70	Little Stint	*Calidris minuta*	M	Least Concern	Schedule IV	Reported
71	Long-tailed Shrike	*Lanius schach*	R	Least Concern	Not Listed	Reported
72	Malabar Lark	*Galerida malabarica*	R	Least Concern	Schedule IV	Reported
73	Marsh Sandpiper	*Tringa stagnatilis*	M	Least Concern	Schedule IV	Reported
74	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I	Reported
75	Northern Pintail	*Anas acuta*	M	Least Concern	Schedule IV	Reported
76	Northern Shoveler	*Spatula clypeata*	M	Least Concern	Schedule IV	Reported
77	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV	Observed
78	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV	Observed
79	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I	Reported
80	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV	Observed
81	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I	Reported
82	Peregrine Falcon	*Falco peregrinus*	M	Least Concern	Schedule IV	Reported
83	Pied Bushchat	*Saxicola caprata*	R	Least Concern	Schedule IV	Reported
84	Pied Kingfisher	*Ceryle rudis*	R	Least Concern	Schedule IV	Reported

85	Plain Prinia	*Prinia inornata*	R	Least Concern	Schedule IV	Reported
86	Purple Heron	*Ardea purpurea*	R	Least Concern	Schedule IV	Observed
87	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern	Schedule IV	Observed
88	Purple Swamphen	*Porphyrio porphyrio*	R	Least Concern	Schedule IV	Reported
89	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	Least Concern	Schedule IV	Observed
90	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV	Observed
91	Red-rumped Swallow	*Cecropis daurica*	R	Least Concern	Schedule IV	Reported
92	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV	Observed
93	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV	Observed
94	River Tern	*Sterna aurantia*	R	Near Threatened	Schedule IV	Reported
95	Rock Dove	*Columba livia*	R	Least Concern	Schedule IV	Reported
96	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV	Observed
97	Rosy Starling	*Pastor roseus*	M	Least Concern	Schedule IV	Reported
98	Ruddy Shelduck	*Tadorna ferruginea*	M	Least Concern	Schedule IV	Reported
99	Ruff	*Calidris pugnax*	M	Least Concern	Schedule IV	Reported
100	Rufous-tailed Lark	*Ammomanes phoenicura*	R	Least Concern	Schedule IV	Reported
101	Scaly-breasted Munia	*Lonchura punctulata*	R	Least Concern	Schedule IV	Observed
102	Shikra	*Accipiter badius*	R	Least Concern	Schedule I	Reported
103	Southern Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV	Observed
104	Spot-billed Pelican	*Pelecanus philippensis*	R	Near Threatened	Schedule IV	Reported
105	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I	Reported
106	Whiskered Tern	*Chlidonias hybrida*	M	Least Concern	Schedule IV	Reported

107	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV	Observed
108	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV	Reported
109	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern	Schedule IV	Observed
110	White-rumped Munia	*Lonchura striata*	R	Least Concern	Schedule IV	Observed
111	Yellow-eyed Babbler	*Chrysomma sinense*	R	Least Concern	Schedule IV	Reported
112	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	R	Least Concern	Schedule IV	Reported
113	Yellow-wattled Lapwing	*Vanellus malabaricus*	R	Least Concern	Schedule IV	Reported

Source: ERM Primary Survey, Forest working plan, Gadag forest division and ebird database[1]

[1] eBird Database [https://ebird.org/hotspot/L7351967; https://ebird.org/hotspot/L10818998; https://ebird.org/hotspot/L4874530; https://ebird.org/hotspot/L4985562]

Mammals

Fourteen (14) mammals were observed or reported from the 5 km study area of the proposed wind power plant. Beside, one Endangere (EN) - [Indian Pangolin (*Manis crassicaudata*)]; and two Vulnerable (VU) - [Bonnet Macaque (*Macaca radiate*) & Four-horned Antelope (*Tetracerus quadricornis*)] species, all the species have been classified as 'Least Concern' as per the latest IUCN Red List (Online Version 2021-2). Total four (04) species reported or observed from the study area *e.g.* Indian Pangolin (*Manis crassicaudata*), Four-horned Antelope (*Tetracerus quadricornis*), Blackbuck (*Antilope cervicapra*), Indian Wolf (*Canis lupus pallipes*) are protected and categorized under Schedule I as per the Indian Wildlife Protection Act, 1972. The list of species with their latest IUCN Red List (Online Version 2021-2) and Wildlife Protection Act Schedule status has been presented in ***Table 6.22.***

Figure 6.16 Some Mammals observed in the study area

Southern Plains Gray Langur

Five-striped Palm Squirrel

Table 6.22 Mammals observed/reported from the study area

Sr. No.	Common Name	Scientific Name	IUCN Red List Status (Online Version 2021-2)	Wildlife Protection Act Schedule	Observed/ Reported
1	Blackbuck	*Antilope cervicapra*	Least Concern	Schedule I	Reported
2	Bonnet Macaque	*Macaca radiate*	Vulnerable	Schedule II	Reported
3	Five-striped Palm Squirrel	*Funambulus pennanti*	Least Concern	Schedule IV	Observed
4	Four-horned Antelope	*Tetracerus quadricornis*	Vulnerable	Schedule I	Reported
5	Golden Jackal	*Canis aureus*	Least Concern	Schedule II	Reported
6	Indian Creasted Porcupine	*Hystrix indica*	Least Concern	Schedule IV	Reported
7	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern	Schedule II	Observed
8	Indian Hare	Lepus nigricollis	Least Concern	Schedule IV	Observed
9	Indian Pangolin	*Manis crassicaudata*	Endangered	Schedule I	Reported
10	Indian Wolf	*Canis lupus pallipes*	Least Concern	Schedule I	Reported
11	Jungle Cat	*Felis chaus*	Least Concern	Schedule II	Observed
12	Southern Plains Gray Langur	*Semnopithecus dussumieri*	Least Concern	Schedule II	Observed
13	Striped Hyena	Hyaena hyaena	Least Concern	Schedule III	Reported
14	Wild Boar	*Sus scrofa*	Least Concern	Schedule III	Reported

Source: ERM Primary Survey; local consultation and Forest working plan, Gadag forest division.

6.5.4.7 Protected Areas & Key Biodiversity Areas (e.g. Important Bird Areas).

National Parks and Wildlife Sanctuaries

The Project site has one Wildlife Sanctuary within 5 km radius (~ 1.1 km), Kappatagudda Wildlife Sanctuary, Gadag, Karnataka. One more wildlife sanctuary, Daroji Bear Sanctuary is also present about 50 km away from the transmission line (TL) and GSS Koppal in east direction (***Figure 6.12***).

Kappatagudda Wildlife Sanctuary (KWS)

An area of about 244 km^2 of Gadak, Mundargi and Shirahatti taluks of Gadag district was declared as Kappatagudda wildlife sanctuary in 16th May 2019 because of its floral, faunal, geomorphological and ecological importance. It is the only wildlife sanctuary in the Karnataka state with an objective of conserving wild flora[1]. It supports number of medicinal plants as well as variety of wild fauna such as, Leopard, Striped Hyena, Wolf, Fox, Jackal, Jungle Cat, Four Horned Antelope, Blackbuck, Monitor Lizard, etc.[2] A stretch of 60 km of scrub hill ranges, within the sanctuary comprise over 400 medicinal plant species[3].

Working plan of the wildlife sanctuary is not available on public domain and was not shared by Forest Department during the consultation, as it is under preparation, hence secondary data of IBAs (Tungabhadra Reservoir and Magadi & Shettikere Wetlands) to be relied for information on avifaunal diversity in the area.

Before declaring this wildlife sanctuary, several quarries / mines were live in the area. But, in the last year, Mines and Geology Department has issued notice to 14 quarries (11 stone quarries, two sand quarries and one soil quarry) owners/contractors to stop quarrying operating close to the sanctuary (within 1 km)[4]. Several wind turbines are still existing within the boundary of the sanctuary.

As the government notification on the boundary of the sanctuary as well as ESZ is not available on the MoEFCC website. Thus, it is suggested here (to Ayana) to discuss the expected boundary of the ESZ along with the proposed WTGs locations with the forest department through the proper channel, as the forest department was uncomfortable to share any unpublished information during our consultation.

Daroji Bear Sanctuary (DBS)

Daroji Bear Sanctuary (DBS) is situated about 50 km away from the project area in east direction. It is present about 50 km away from the transmission line (TL) and GSS Koppal in east direction.

It spread over an area of about 82 km^2. This rocky scrub jungle was notified as a Bear Sanctuary on 17th October 1994. The sanctuary exhibits a success story of natural regeneration of forest. Abundant growth of dry zone flora and fauna flourishes in this sanctuary owing to strict conservation. This site has been selected an IBA as it holds a significant healthy population of Yellow-throated Bulbul (*Pycnonotus xantholaemus*), a globally Threatened species, of which it is a well-known habitat. Apart from this bulbul, about 230 species of birds are listed in and around this area[5].

[1] https://collectorbazar.com/item/india-2020-black-buck-kappatagudda-wildlife-sanctuary-animals-deer-map-special-cover-18731-231256/

[2] https://collectorbazar.com/item/india-2020-black-buck-kappatagudda-wildlife-sanctuary-animals-deer-map-special-cover-18731-231256/

[3] https://timesofindia.indiatimes.com/city/hubballi/ifs-couple-documents-kappatagudda-wildlife-sanctuarys-medicinal-plants/articleshow/80431026.cms

[4] https://www.deccanherald.com/state/top-karnataka-stories/closure-notice-to-quarries-within-1-km-of-kappatagudda-wildlife-sanctuary-895965.html

[5] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

Important Bird Areas (IBAs)

Two IBAs, Tungabhadra Reservoir and Magadi & Shettikere Wetlands are also located in 50 km radius.

Magadi & Shettikere Wetlands (IBA)

Magadi and Shettikere Wetlands are present about 25 km away from the project site in south-west direction. Magadi and Shettikere are two different wetlands present about 5 away from each other. The water of both the wetlands is brackish (pH ~9.2), and unsuitable for irrigation. Therefore, these wetlands hold water even in drought years, and attract migratory waterfowl. The water level is fairly stable, except for evaporation loss. Magadi wetland attracts a huge number of migratory waterfowl[1]. Magadi wetland attracts a huge number of migratory waterfowl. Notable among them is the Bar-headed Goose (*Anser indicus*). Nearly 5,000 birds visit the tank during winter, and it is one of the largest known wintering grounds in southern India for this species. According to the latest population estimates of waterbirds prepared by Wetlands International (2012), the total population of Bar-headed Goose is between 52,000 to 60,000, and 1% population threshold is 560. This site contains c. 10% of the Bar-headed Goose population of South Asia. Shettikere wetland harbours the same birds as Magadi, but in addition large numbers of Demoiselle Crane (*Grus virgo*) (>4,000) visit the tank in good years, like the winter of 2002–2003. This is 4% of the total wintering population of the Demoiselle Crane in South Asia, as according to Wetlands International (2012) there could be 100,000 Demoiselle Crane wintering in the Indian subcontinent. One IUCN Endangered, Egyptian Vulture (*Neophron percnopterus*) and one IUCN Vulnerable, Asian Woollyneck (*Ciconia episcopus*) and nine Near Threatened avifaunal species have been reported from the wetlands[2].

Both the wetlands are small, but attract huge numbers of migratory waterfowl. Presently, they have no official protection, but the State Forest Department monitors these wetlands during the migration season. Presently, the Karnataka Forest Department ensures that no fishing takes place when the migratory birds are around.

Tungabhadra Reservoir

Tungabhadra Reservoir is about 12 km from the proposed route of the transmission line (TL) in south-east direction and about 25 km from the proposed wind farm.

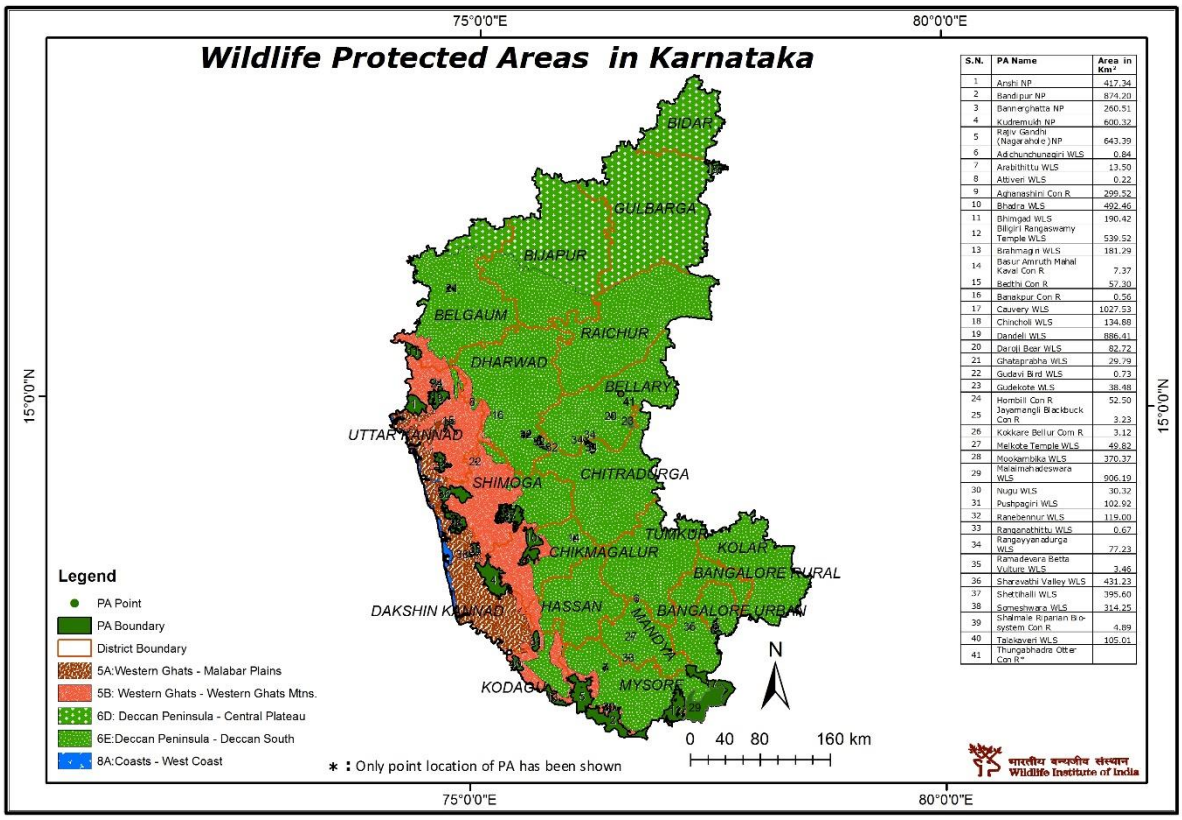
About 200 species of birds have been recorded in and around Tungabhadra Reservoir and more than 20,000 waterbirds are found in winter in the reservoir. Some species occur in much greater numbers than their 1% population threshold such as, Little Cormorant (*Microcarbo niger*), Bar-headed Goose (*Anser indicus*), Other species found in much greater numbers than their 1% population threshold are, Painted Stork (*Mycteria leucocephala*), Asian Openbill (*Anastomus oscitans*), Asian Woollyneck (*Ciconia episcopus*), Black-headed Ibis (*Threskiornis melanocephalus*), Red-naped Ibis (*Pseudibis papillosa*), Northern Pintail (*Anas acuta*), and Glossy Ibis (*Plegadis falcinellus*), One IUCN Endangered, Black-bellied Tern (*Sterna acuticauda*) and one IUCN Vulnerable, Asian Woollyneck (*Ciconia episcopus*) and nine Near Threatened avifaunal species have been reported from the IBA[3].

[1] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[2] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[3] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

Figure 6.17 Protected Areas in Karnataka



6.5.4.8 Migratory Route

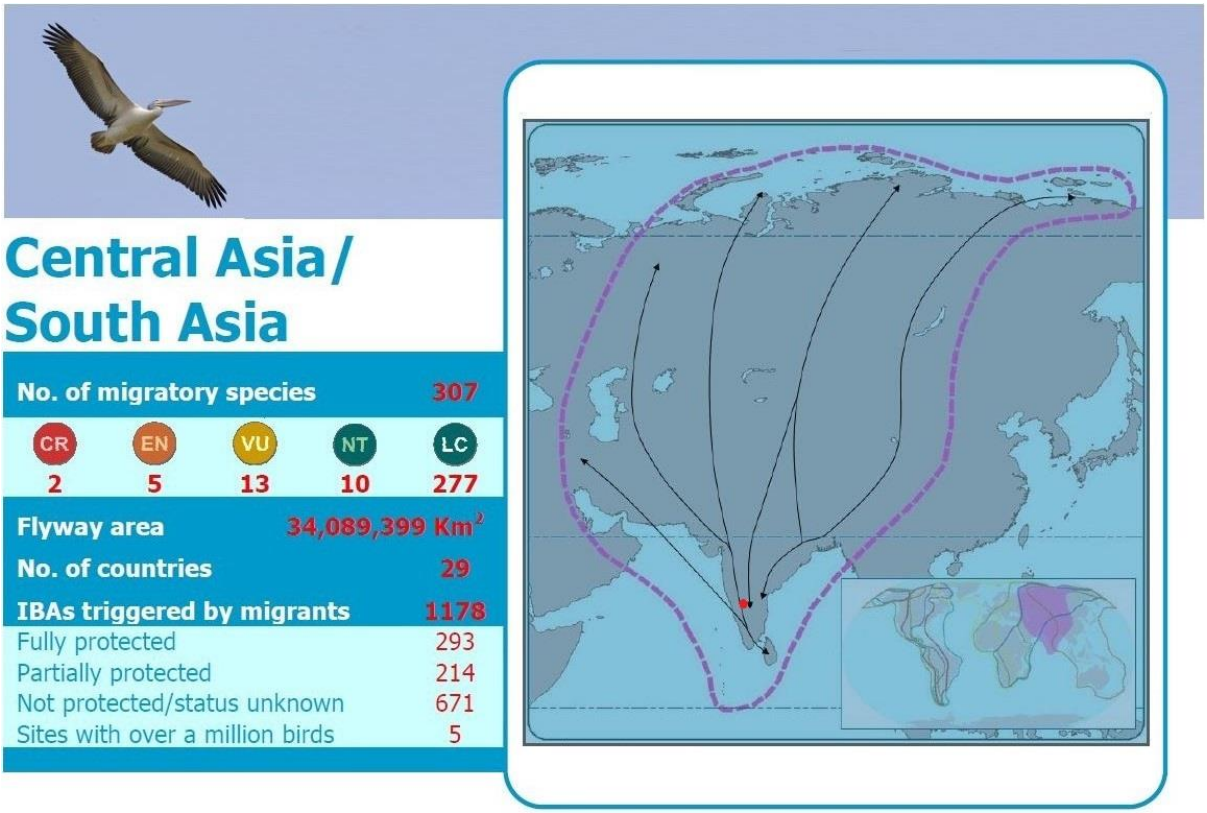
India lies along the Central Asian Flyway, a global migratory pathway that connects the Palearctic (Europe and Northern Asia) to the Indian subcontinent. The birds that utilize this flyway congregate at key water bodies around India. Details on the Central Asian Flyway and migratory routes of the most common family of migratory species has been shown in

Figure 6.18. The available migratory routes passing through India is provided in ***Figure 6.19***, which indicates that the site is situated very close to the Amur Falcon migratory route and about 100 km east to the migratory route of Goos and Coots.

As a portion of the Central Asian Flyway, all the IBAs of the area supports the congregations of migratory bird species (***Figure 6.20***).

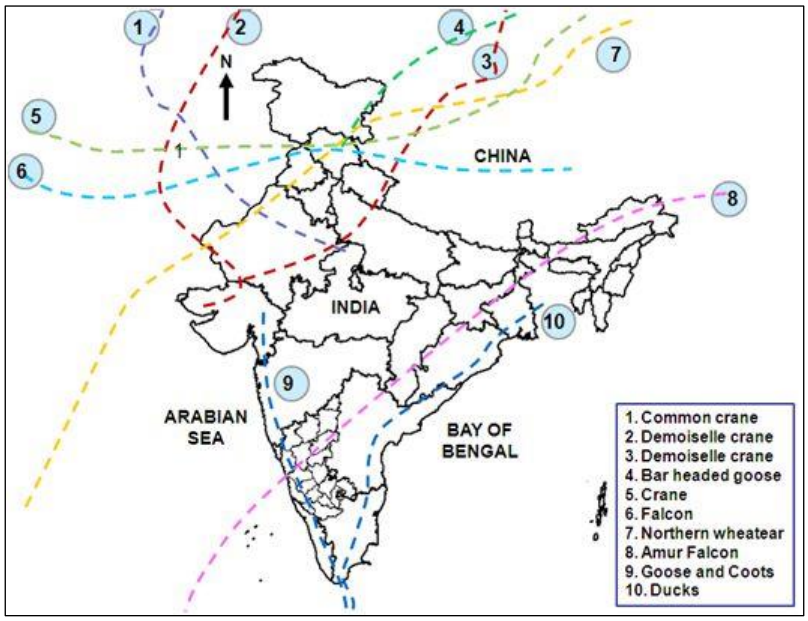
Twenty-five (25) migratory species namely, Bar-headed Goose (*Anser indicus*), Black-tailed Godwit (*Limosa limosa*), Common Kestrel (*Falco tinnunculus*), Common Pochard (*Aythya farina*), Common Redshank (*Tringa totanus*), Common Sandpiper (*Actitis hypoleucos*), Demoiselle Crane (*Grus virgo*), Eurasian Curlew (*Numenius arquata*), Garganey (*Spatula querquedula*), Glossy Ibis (*Plegadis falceinellus*), Greater Flamingo (*Phoenicopterus roseus*), Greater Spotted Eagle (*Clanga clanga*), Little Stint (*Calidris minuta*), Marsh Sandpiper (*Tringa stagnatilis*), Montagu's Harrier (*Circus pygargus*), Northern Pintail (*Anas acuta*), Northern Shoveler (*Spatula clypeata*), Osprey (*Pandion haliaetus*), Pallid Harrier (*Circus macrourus*), Peregrine Falcon (*Falco peregrinus*), Rosy Starling (*Pastor roseus*), Ruddy Shelduck (*Tadorna ferruginea*), Ruff (*Calidris pugnax*), Western Marsh-Harrier (*Circus aeruginosus*) & Whiskered Tern (*Chlidonias hybrida*) were already reported or observed from 5 km buffer of the wind power plant. Although, the IBA present in the area are situated more than 10 km aways, the large to medium sized perennial water bodies present with in the Buffer zone of the proposed wind power plant may support a good population of migratory birds.

Figure 6.18 Project site with respect to the Central Asian Flyway



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

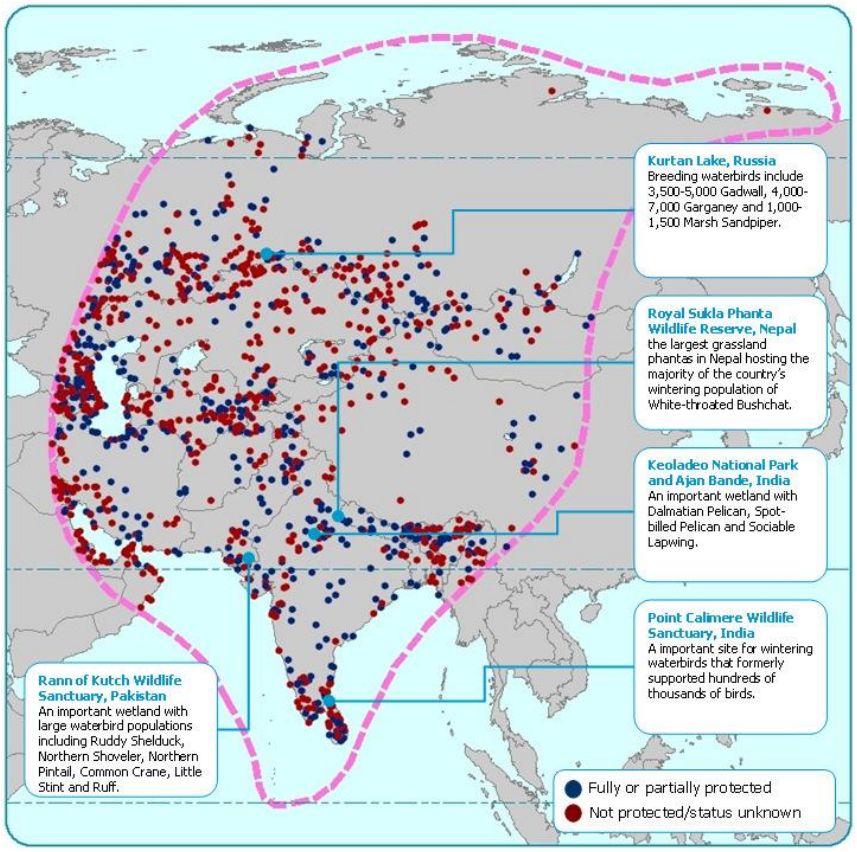
Figure 6.19 Migratory routes passing through India



Source: Ramachandra T.V., Durga Mabhab Mahapatra, M. Boominathan, K. Sankara Rao and Harish R. Bhat, 2011. Environmental Impact Assessment of the National Large Solar Telescope Project and its ecological impact in Merak area., CES

Technical Report : 123, Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012. (Available at: http://wgbis.ces.iisc.ernet.in/biodiversity/pubs/ces_tr/TR123/section6.htm)

Figure 6.20 Important Bird Areas (IBA) on the flyway



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

6.6 Socio Economic Baseline

This section provides an understanding of the following aspects:

- Administrative set up of the district,
- Demographic profile of the villages in the project area,
- Social groups present,
- Livelihood profile of the community,
- Land use patterns in the area,
- Social and physical infrastructure available in terms of the education and health infrastructure; and
- Water supply for irrigation and drinking purposes, sanitation facilities and connectivity.

This understanding is based on the secondary information available at district, sub-district and village level (as per Census of India 2011) as well as consultations undertaken by ERM during the site visit.

6.7 Study area

As described in **Section 6.2**, the study area considered for ESIA, include an area within 5 km radius from farthest of WTGs.The core zone for this study has been considered as 2 km from the project area, where most of the consultations have been conducted and the buffer zone stretches from 2-5km from the site. The study area including both the core and buffer zones. The study area covers a total of 32 villages, in which, the core and buffer zone includes 16 villages each. The villages in the study area fall in 2 districts; Gadag and Koppal. However, the villages in the core zone fall in Gadag District only. The villages in Gadag district fall into 2 Taluk; Gadag and Mundragi and villages in Koppal falls in Yelbarga taluk.

6.8 Administrative Structure

6.8.1 Karnataka state

Karnataka is located in the south-western region of the country and is the seventh largest State in India, in terms of geographical area. The state administers an area of 1, 91,791 sq. km. constituting 5.83 percent of the total geographical coverage of the Country. The most widely accepted etymology suggests that the name Karnataka has been derived from two Kannada words ‘Karu’ meaning ‘Black’ and ‘Nadu’ meaning region indicating the black cotton soil found in the area.

The state shares its boundaries with Maharashtra in the north, Goa in the northwest, the Arabian Sea in the west, Kerala and Tamil Nadu in the south and by Andhra Pradesh and Telangana in the east. Karnataka accounts for 5.05 percent of the total population of India, according to the provisional data of Census 2011. The capital of the State is Bengaluru.

The State has a population of 61,095,297 individuals, of which 61.32 percent of people pre-dominantly reside in the rural parts of the country. The decadal population growth has reduced from 17.51 percent during 1991-2001 to 15.60 percent.

During 2001 to 2011, the sex ratio in the State was recorded as 973, which is higher than 965 in the past decade. The sex ratio of Karnataka is significantly higher than that of India which stands at 940 females per 1000 males as per census 2011 data. The population density of India is 382 persons/sq. km. while that of Karnataka is 319 persons/ sq. km., which is considerably lower for a State with the seventh largest geographical area in the country.

Table 6.23 Demographic Profile of Karnataka

Attribute	Figures
Area (sq. km)	3,08,252
Total population	61,095,297
Male population	30,966,657
Female population	30,128,640
Sex ratio	973
Percentage of rural Population	61.32
Percentage of urban population	38.68
Population density	319
Percentage of SC population	17.1
Percentage of ST population	7.00
Total literacy rate	75.36
Male Literacy rate	82.47
Female Literacy Rate	68.08
Rural Literacy	68.7

Source: Census of India, 2011 Data

6.8.2 Gadag District

Gadag district is located in the central region of Karnataka and is the fifteenth largest district of the state (in terms of geographical area). The district shares boundary with the Bagalkote district on the north, the Koppal district on the east, the Bellary district on the southeast, the Haveri district on the southwest, the Dharwad district on the west and the Belgaum district on the northwest. The district administers an area of 4,656 sq. kms and accounts for a total population of 971,952, according to the provisional data of Census 2011. 64.79 percent of the total population of the district has been classified as rural. The district is divided into 7 taluks – Gadag-Betgeri, Ron, Shirhatti, Nargund, Lakshmeshwar, Gajendragad and Mundargi.

The decadal population growth has reduced from 13.14 percent during 1991-2001 to 9.61 percent during 2001 to 2011. The sex ratio in the district is 978 which is higher than the State figures of 973. The population density of the district is 229 persons/ sq. kms, as compared to that of 382 persons/sq. km. and 319 persons/ sq. km. at the national (India) and State (Karnataka) levels respectively.

Table 6.24 Demographic Profile of Gadag District

Attribute	Gadag District	Gadag Taluk	Mundragi Taluk
Population	971,952	367258	131897
percent of SC population	16.36	14.19	21.96
percent of ST population	5.79	4.8	7.96
Sex Ratio	978	990	973
Literacy Rate	65.77	69.54	62.71
Female Literacy Rate	57.45	62.66	54

Source: PCA, 2011

6.8.3 Koppal District

Koppal district is a recently formed district carved out Raichur district in 1997. The district is located in the norther interiors of Kanataka and shares its boundaries with Raichur district in the east, Gadag district in the West, Bagalkot district in the north, Bellary district in the south. Koppal District headquarters is closest to the world heritage Hampi. The district administers and area of 8,458 sq km and accounts for a total population of 1,389,920. Out of total population, 83.19 percent of population lives in urban areas and 16.81percent lives in rural areas.

The district is divided into 4 Talukas; Gangawati, Koppal, Yelbarga and Kushtagi. The sex-ratio of Koppal district is around 986 compared to 973 which is average of Karnataka state. The population density of 250 per sq.km. as compared to that of 382 persons/sq. km. and 319 persons/ sq. km. at the national (India) and State (Karnataka) levels respectively.

Table 6.25 Demographic Profile of Koppal District

Attribute	Koppal District	Yelbara Taluk
Population	1,389,920	267442
percent of SC population	18.61	19.46
percent of ST population	11.82	11.02
Sex Ratio	986	979
Literacy Rate	58.21	57.72
Female Literacy Rate	49.32	47.2

Source: PCA, 2011

6.9 Demographic Profile- State and District Level

Table 6.26 provides a comparative overview of the key demographic indicators at the state and national level.

Table 6.26 Demographic Profile

Region	Total population	Sex ratio	SC percent	ST percent	Population density	Literacy rate (percent)	Female literacy rate (percent)	Rural population (percent)
Karnataka	61,095,297	973	17.1	7.00	319	75.36	68.08	61.32
Gadag district	971,952	978	16.36	5.79	229	65.77	57.45	64.37
Koppal District	1,389,920	986	18.61	11.82	250	58.21	49.32	16.81

6.9.1.1 SC/ST Population

About 17.15 percent of the total population in the state of Karnataka belongs to Scheduled caste population and about 6.95 percent belongs to the Scheduled Tribe. The state has 68 recognized Scheduled Caste groups, and 35 recognized Scheduled Tribe groups. Karnataka does not have any districts which fall in Schedule V areas. Of the districts in the study area, Koppal district has the highest proportion of SC population and ST population. On the other hand, Gadag District, that has the maximum number of study area villages of core and buffer zones, has the lowest number of SC and ST population.

Kapatagiri and Balajinagar villages in the Gadag district have the maximum concentration 53.56 percent of Schedule Caste populations and Shingatarayanakeri has the highest Schedule Tribe population. On the other hand, Jalshankarnagar, Kappatagiri village in Gadag Taluk and Shivajinagar village in Mundaragi Taluk have no ST population basis the 2011 Census data. Basis consultations undertaken with village community in Lakkundi, Harlapur, Adavi Sompur,Kadampur and Churchihaal villages in Gadag and Mundaragi Taluk it was understood that the ST population in these villages is the significantly lower that the remaining population, which asserts the information stated in the Census 2011 data.

6.9.1.2 Literacy

As can be seen in **Table 6.26,** the literacy rate observed in the state of Karataka is higher than that reported at the national level (67.9 percent). However, literacy rates in all districts are lower than the state average (75.36 percent). Similarly, female literacy rates are considerably lower among all districts as compared to the state average, with Koppal district demonstrating the lowest percentile of female literacy.

6.9.1.3 Land use pattern

Land resources, whether private or common are an extremely important asset for rural communities, especially so in the resource scarce dry/semi-arid tropical regions. At the village level it is the land resources, which allow for the satisfaction of the needs/demands of fuel wood, and fodder for livestock and other everyday resources. At the household level, land holdings are arguably the most valuable asset for rural communities, which serve as an important means for livelihood and source of income. It also serves as an insurance to help tide over financially difficult situations.

The main purpose of the table for land utilization is to indicate broadly the land use at the District level (**Table 6.27**) The classification of area was formerly available under five classes, which has been simplified to fall in line with the standard classification as laid down by the Ministry of Food and Agriculture, Government of India.

Table 6.27 Land use pattern in the study area

Name of the Village	Total Geographical Area (Hectare)	Forest Area	Total Irrigated Area	Total Unirrigated area	Land Under Miscellaneous Tree Crops etc. Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
Gadag Taluk								
Kotumachagi	5142.6	0	8.2	4911.6	0	0	0	4919.8
Kanaginahal	3664.8	0	0	3529	0	0	0	3529
Harlapur	5867.2	0	0	5670.3	0	0	0	5670.3
Timmapur	560.5	0	0	297	0	229	0	297
Hatalageri	1626.2	0	0	1546.8	0	3.4	0	1546.8
Adavisomapur	868.4	0	34.5	502.3	0	0	0	536.8
Sambhapur	744.8	0	53.4	633.2	0	0	0	686.6
Jalashankarnagar	605	0	0	585	0	0	0	585
Balajinagar	516.2	0	15.8	496.4	0	0	0	510.4
Papanashi	501	0	34.4	156.7	0	0	0	191.1
Lakkundi	5755.2	0	437.9	5090.2	0	0	0	5528.1
Kalasapur	1504	0	40.5	1216.1	0	0	0	1257.1
Gadag-Betigeri (CMC)	5457	-	-	-	-	-	-	-
Halligudi	3441.6	0	0	3348.3	0	0	0	3348.3
Kappatagiri	1256.6	0	191.7	1064.9	0	0	0	1256.6
Benakanakoppa	874.4	0	430	387	0	0	0	817
Betigeri(Rural)[1]	0	0	0	0	0	0	0	0
Chikkoppa	659.65	0	2.5	632.5	0	0	0	635
Hirekoppa	1799.4		11	1775	0	0	0	1786
Neeralagi	1165.9	0	85	998.2	0	14.2	14.8	1083.2
Pandurangapur	710.9	0	40.4	670.2	0	0	0	710.9
Nagasamudra	937.6	0	48.6	819.1	0	0	0	867.7
Narasapura	555.5	0	10.2	505.2	0	0	8.2	515.4
Mundaragi Taluk								
Shivajinagar	406.3	0	30.3	212.2	0	0	0	242.5
Kadampur	789.2	0	49.7	671.4	0	0	0	721.1
Churchihal	689.9	0	5.3	661.5	0	0	0	666.8
Jantli Shirur	2572.5	0	534.1	1927.8	0	0	0	2461.9
Venkatapur	2590.7	0	0	2506.9	0	0	0	2506.9
Alur	2449.6	0	466.8	1877.2	0	0	0	2344

[1] Unhabited

Name of the Village	Total Geographical Area (Hectare)	Forest Area	Total Irrigated Area	Total Unirrigated area	Land Under Miscellaneous Tree Crops etc. Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
Shingatarayanakeri	701.5	0	60.8	302.7	0	0	0	363.5
Doni	6494.3	0	24.2	1230.4	0	0	5237.3	1254.6
Dambal	7152.7	0	2015.1	4081.6	0	0	0	6096.7
Yelbarga Taluk								
Yarihanchinal	3447	0	3220.3	86.9	0	0	0	3307.2
Study Area	**66297.5**	**0**	**7281.8**	**43930.7**	**0**	**232.4**	**5245.5**	**51211.5**
Percentage (%)		**0**	**10.98**	**66.26**	**0**	**0.35**	**7.91**	**77.24**

Source: Census of India 2011

The table above denotes that only approximately 11 percent of the land area is categorized as cultivable. On the other hand, almost 66 percent of land area is unirrigated land. The core area has the highest proportion of irrigated land in the study area. The arid climate and sandy soil renders overall low agricultural productivity in comparison to the non-desert regions. A considerable proportion of the landscape comprises of a mix of scrub land, barren rocky/stony waste, inland and coastal sand, degraded forests etc. Overall, it is understood that, there is no land under forest area[1], and Land under Miscellaneous Tree Crops Area. Fallows in the area are also considerably low.

6.9.2 Socio-economic Baseline of the Study Area

6.9.2.1 Demography

There are a total of 32 villages that fall within 5 km of the proposed wind power project. The total population as per 2011 Census of India data is 269873 living in 57024 households. The largest village in terms of population in the core zone is the village of Gadag-Betigeri which has been classifed as a City Municipal Corporation[2] (CMC) as per the 2011 Census. The overall population density of the study area is approximately 200 people per square kilometre, which is lower than that of the district (209). The village wise population details are provided below (**Table 6.28**):

[1] **Forest-** This includes all area actually under forest on land so classed under any legal enactment or administered as forest.

[2] A Municipal corporation is a Local government in India that administers urban areas with a population of more than one million.

Table 6.28 Demographic Profile of the villages in the study area[1]

Name of the Village	Number of Households	Total Population	Sex Ratio	Child Sex Ratio	SC %[2]	ST %[3]	Literacy rate (%)	Female literacy rate (%)
Gadag Taluk								
Kotumachagi	1446	7301	998	1002	11.22	6.89	70.66	60.34
Kanaginahal	844	4130	945	969	4.60	8.33	70.85	56.62
Harlapur	996	4714	959	849	10.03	3.99	70.33	57.51
Timmapur	588	3077	967	925	8.38	6.08	70.45	55.22
Hatalageri	603	3218	956	800	5.81	12.43	63.77	51.56
Adavisomapur	784	3758	920	794	3.27	8.57	63.87	53.19
Sambhapur	400	1790	987	1096	15.36	8.83	81.73	72.65
Jalashankarnagar	351	2059	944	945	97.23	0.00	49.91	37.73
Balajinagar	117	769	903	1031	99.87	0.13	83.72	72.91
Papanashi	297	1296	1090	1079	4.24	3.94	77.94	67.17
Lakkundi	2536	11960	986	990	5.89	1.70	77.05	67.39
Kalasapur	712	3510	1009	1005	25.41	11.77	74	65.76
Gadag-Betigeri (CMC)	37072	172612	1009	955	10.57	2.94	85.39	79.89
Halligudi	481	2186	1055	957	6.31	3.06	82.25	73.89
Kappatagiri	249	1452	967	984	94.42	0.00	49.83	39.09
Benakanakoppa	396	2014	1000	1115	9.29	5.71	68.56	55.57
Betigeri(Rural)[4]	244	1090	938	925	10.28	7.06	78.88	58.40
Chikkoppa	509	1608	982	1175	10.92	0.18	71.66	68.50
Hirekoppa	357	1672	995	1000	14.41	9.51	77.21	63.01
Neeralagi	312	1982	1043	939	91.22	0.55	61.93	51.31
Pandurangapur	337	1612	905	804	16.07	9.06	73.88	59.50
Nagasamudra	255	1076	978	1207	4.09	0.46	81.22	69.26
Mundaragi Taluk								
Shivajinagar	376	2551	1012	1119	99.80	0	52.47	39.98
Kadampur	363	1698	972	1222	9.31	17.96	76.81	65.85
Churchihal	180	834	981	1000	15.11	11.51	73.23	62.09
Jantli Shirur	488	2384	951	937	9.65	2.81	71.55	59.67
Venkatapur	443	2164	958	801	12.57	11.88	68.48	54.44
Alur	955	4278	954	877	13.93	2.76	70.29	58.58
Shingatarayanakeri	83	379	964	815	15.83	23.48	60.61	48.78
Doni	1275	6160	960	1039	21.82	6.14	65.40	54.59
Dambal	2328	11351	997	912	17.29	3.37	73.16	64.17
Yelbarga Taluk								
Yarihanchinal	647	3188	921	917	12.70	11.42	67.66	53.44
Study Area	**57024**	**269873**	**975.19**	**974.53**	**24.59**	**6.33**	**70.77**	**59.31**

Source: Primary Census Abstract, Census of India 2011

[1] Betigeri (rural) has been removed from the table as it is unhabited basis census 2011.

[2] SC: Schedule Caste

[3] ST: Schedule Tribe

[4] Unhabited

6.9.2.2 Gender Profile

As can be seen in **Table 6.28**, the overall sex ratio in the study is 977 females per thousand males which is marginally lower than the overall average of the 2 districts sex ratio (979). However, the table also demonstates a positive adult and child sex ratio (above 1000) in 13 villages, mostly in Gadag and Mundaragi taluk.

6.9.2.3 Social Groups

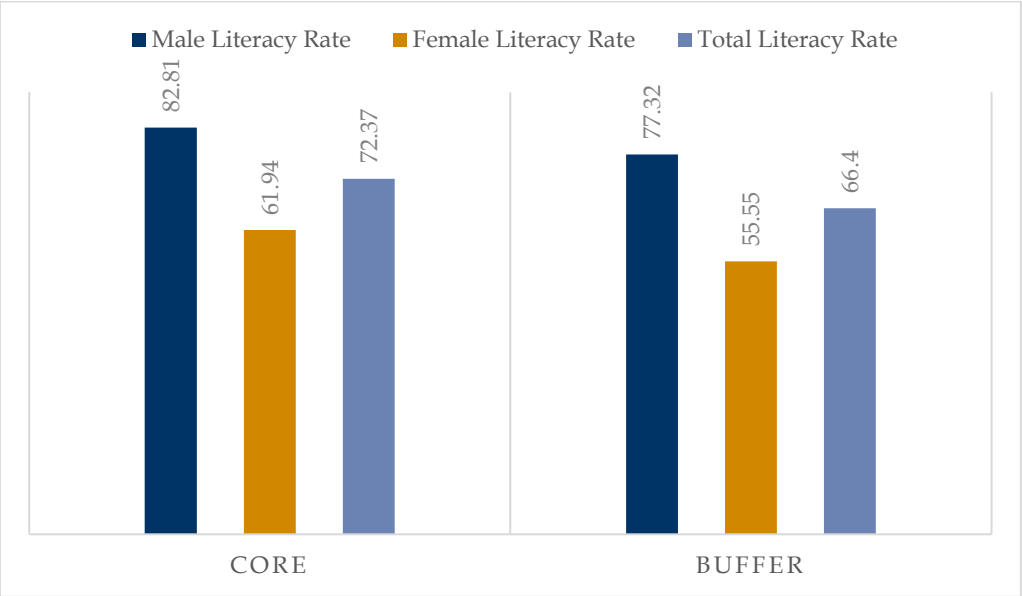
As mentioned in **Section 6.9**, Gadag district has the lowest number of SC and ST population in Karnataka. The study area, as described in **Table 6.28,** has 24.05 percent SC population and only 9.75 percent ST population. Kapatagiri and Balajinagar villages in the Gadag district have the maximum concentration 53.56 percent of Schedule Caste populations and Shingatarayanakeri has the highest Schedule Tribe population. On the other hand, Jalshankarnagar, Kappatagiri village in Gadag Taluk and Shivajinagar village in Mundaragi Taluk have no ST population basis the 2011 Census data. Basis consultations undertaken with village community in Lakkundi, Harlapur, Adavi Sompur,Kadampur and Churchihaal villages in Gadag and Mundaragi Taluk it was understood that the ST population in these villages is the significantly lower that the remaining population, which asserts the information stated in the Census 2011 data.

The dominant communities of the study area Hindus (85.27 percent). Muslims constitue about 13.50 percent of the population. On site visits it was determined that only some villages; Harlapur, Adisompur, Churchihal and Hatelgeri have masjids in the village.

6.9.2.4 Literacy

The literacy rate of the study area as demonstrated in **Table 6.28** is 70.77 percent which is lower than that of the average of the districts, overall; 65.10 percent. Similarly the female literacy rate in the study area (59.31 percent) is also marginally lower than that of the overall average of the districts, 55.67 percent. The female literacy rate is also comparatively lower than the average male literacy rate (72.12 percent) in the study area. On consultations in the core villages, it was understood that though there are educational infrastructure (primary and middle schools) present in and around the villages, there is hesitance and reluctance is sending girl children to school after primary (8th standard). This is potentially due to inavailability of secondary and senior secondary schools in the nearby area and the reluctance of families to send girl children long distances. There is however, a marginal proportion of famiiles who send their daughters to school after primary. These famiiles mostly reside in the more urban parts of the study area. These girls study till higher secondary and sometimes graduation as well.

Figure 6.21 Comparative Overview of the Literacy Rate in Study Area (in percent)

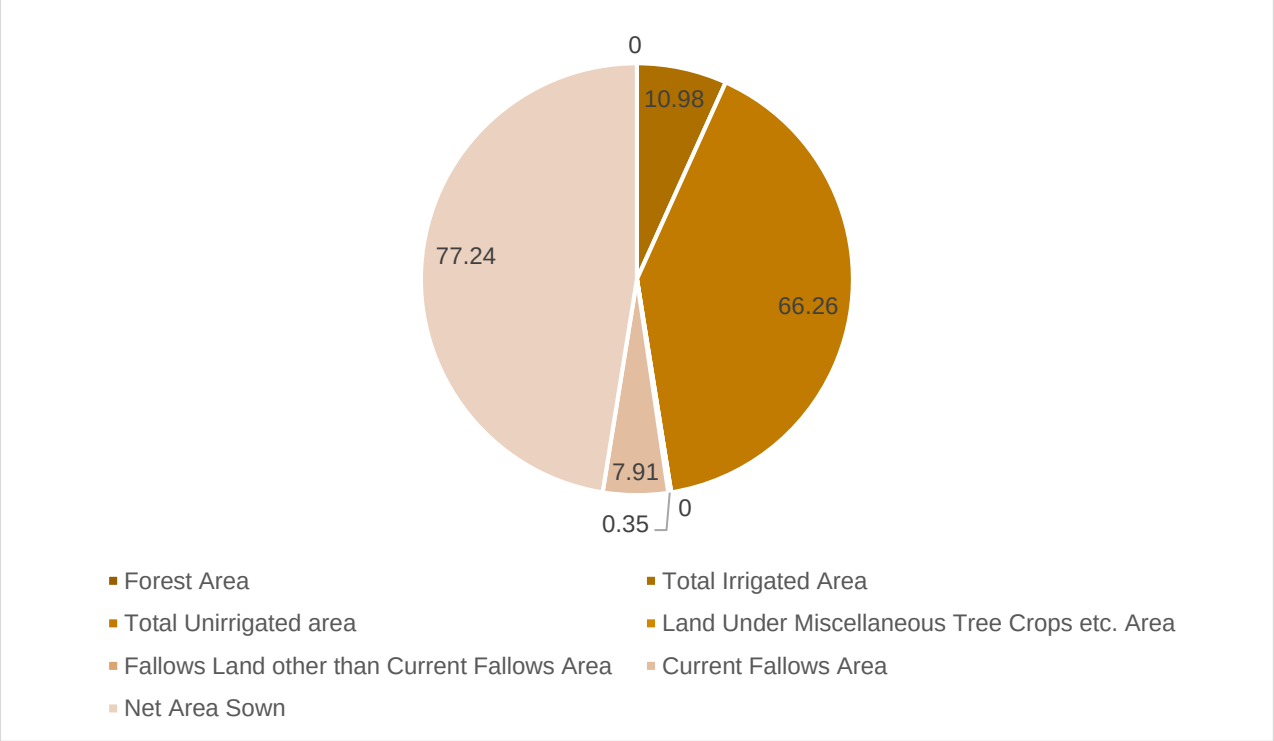


Source: PCA, 2011

6.9.2.5 Land use pattern

The land use in the study area can broadly be defined by the following categories: agricultural, fallows, forest, and barren land.

Figure 6.22 Land Use in the Study Area



Source: Village Directory, Census of India 2011

The figure above denotes that out of the total geographical area of 66297.5 hectares, more than half the proportion of land area (66 percent) is categorized as unirrigated land in the study area. Approximately 6 percent of this land is being used for grazing purposes. This situation was observed to be true during the site assessment as well. On the other hand, almost 77.24 percent of land area is under cultivation. The land use also depicts the dependence on agriculture in the study area. During

site visits it was observed that there was a lot of cultivation that was being undertaken by villagers, primarily lentils, vegetables, cotton, sunflower, jasmine, coconut plantation and maize. Though most of the land is unirrigated as can be seen in **Figure 6.22**, planters do not face any water shortage for irrigation. Most planters use open wells and some have borewells as well. Irrigation is discussed in detail in the section on **Agriculture** below.

Figure 6.23 Agriculture in Gadag

Fig1: Women working in jasmine plantations in Lakkundi

Fig 2: Type of terrain in project footprint

Fig 3: Plantations in Harlapur

Fig 4: Agricultural plots in study area

Fig 5: Plantation in Hatalgeri Village

Fig 6: Sunflower plantations in study area

6.9.2.6 Livelihood Profile

Based on the 2011 Census data, the total working population in the study area is 52.80 percent. Out of the total working population, 81.22 percent are categorised as main workers (i.e. those who have worked for a period of 6 months); and remaining 27.65 percent are marginal workers (i.e. those who

have not worked for a period of 6 months). The proportion of cultivators and agricultural labourers is nearly 42 percent among main workers and 43 percent of marginal workers. Consultations in the core villages, it was understood that there is also a proportion of people are engaged in livestock rearing. These households primarily own cows and buffaloes and use these livestock for their milk. The livestock are fed market-purchased fodder primarily and a very small proportion are dependent on open grazing on private lands.

There is a significant proportion of population as 'other' workers (32.08 percent of main workers and 43.46 percent of marginal workers), those engaged in some economic activity, but are not cultivators or agricultural labourers or in household industry. This indicates that the local working population is also finding employment in sectors such as industries, trades and services. Gadag-Betigeri has undergone significant development in the past decade and has many private industries and offices set up which provide employment opportunities to peope in the nearby villages. As reported during site consultations, a sizeable proportion of migrants have started coming into villages near the Gadag-Betigeri city; Adisompur, Lakkundi, Harlapur etc. in search for employment opportunities. These migrants are reportedly from Gujarat, Tamil Nadu, Andhra Pradesh and Maharashtra.

Women participation in workforce is observed to be significant which is reflected in the Census Data's occupational profile as well. Nearly 46 percent of the total working population is comprised of females of which 38.32 percent are main workers and nearly 66 percent are marginal workers. Women participation is highest as "other" marginal workers i.e. nearly 60 percent followed by agricultural labor (43.2 percent). ***Table 6.29*** lists the working population in the study area.

The unemployment rates are significantly high as compared to the state of Karnataka (nearly 40 percent). During site visits and consultations it was revealed that youth are unable to find employment in the village and are mostly engaging in traditional occupations like agriculture and livestock activities.

Table 6.29 Working Population in Study Area

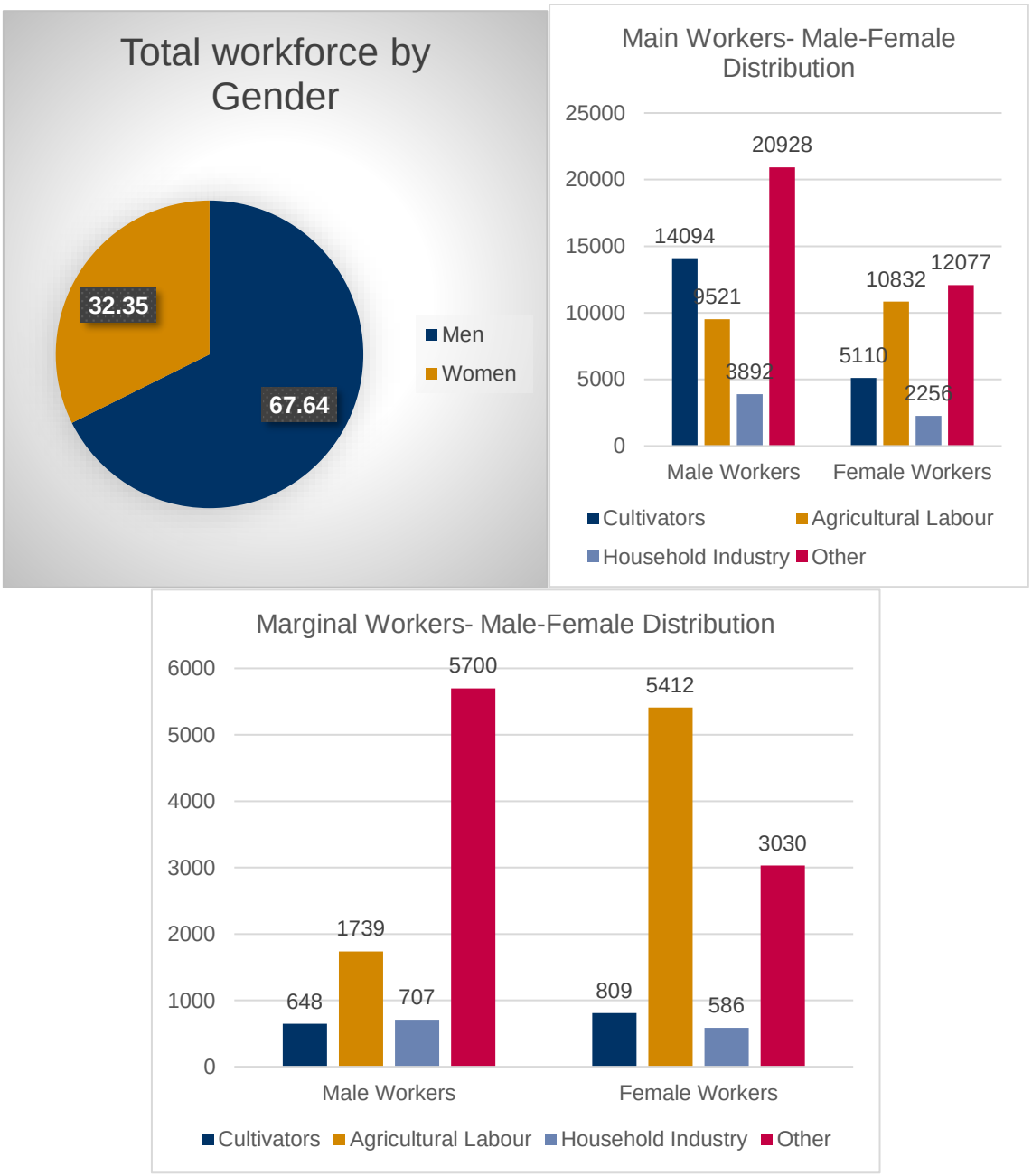
Name of the Village	Total Population	Total Working Population		Main Work Population		Marginal Worker		Non Worker	
Gadag Taluk									
Kotumachagi	7301	4017	55.02	2766	68.86	1251	31.14	3284	44.98
Kanaginahal	4130	2099	50.82	1947	92.76	152	7.24	2031	49.18
Harlapur	4714	2333	49.49	1908	81.78	425	18.22	2381	50.51
Timmapur	3077	1237	40.20	1168	94.42	69	5.58	1840	59.80
Hatalageri	3218	1924	59.79	1800	93.56	124	6.44	1294	40.21
Adavisomapur	3758	2134	56.79	1585	74.27	549	25.73	1624	43.21
Sambhapur	1790	800	44.69	503	62.88	297	37.13	990	55.31
Jalashankarnagar	2059	1117	54.25	863	77.26	254	22.74	942	45.75
Balajinagar	769	436	56.70	432	99.08	4	0.92	333	43.30
Papanashi	1296	620	47.84	616	99.35	4	0.65	676	52.16
Lakkundi	11960	5319	44.47	4722	88.78	597	11.22	6641	55.53
Kalasapur	3510	1417	40.37	1295	91.39	122	8.61	2093	59.63
Gadag-Betigeri (CMC)	172612	63468	36.77	55544	87.51	7924	12.49	109144	63.23
Halligudi	2186	1146	52.42	717	62.57	429	37.43	1040	47.58

Name of the Village	Total Population	Total Working Population		Main Work Population		Marginal Worker		Non Worker	
Kappatagiri	1452	901	62.05	566	62.82	335	37.18	551	37.95
Benakanakoppa	2014	1112	55.21	602	54.14	510	45.86	902	44.79
Betigeri(Rural)[1]	2608	1471	56.40	1209	82.19	262	17.81	1137	43.60
Chikkoppa	1090	609	55.87	471	77.34	138	22.66	481	44.13
Hirekoppa	1672	759	45.39	562	74.04	197	25.96	913	54.61
Neeralagi	1982	960	48.44	924	96.25	36	3.75	1022	51.56
Pandurangapur	1612	945	58.62	896	94.81	49	5.19	667	41.38
Nagasamudra	1076	415	38.57	402	96.87	13	3.13	661	61.43
Mundaragi Taluk									
Shivajinagar	2551	1202	47.12	1151	95.76	467	38.85	1349	52.88
Kadampur	1698	1078	63.49	611	56.68	34	3.15	620	36.51
Churchihal	834	483	57.91	449	92.96	392	81.16	351	42.09
Jantli Shirur	2384	1332	55.87	940	70.57	12	0.90	1052	44.13
Venkatapur	2164	1173	54.21	1161	98.98	588	50.13	991	45.79
Alur	4278	2209	51.64	1621	73.38	84	3.80	2069	48.36
Shingatarayanakeri	379	245	64.64	161	65.71	633	258.37	134	35.36
Doni	6160	3347	54.33	2714	81.09	988	29.52	2813	45.67
Dambal	11351	6213	54.74	5225	84.10	51	0.82	5138	45.26
Yelbarga Taluk									
Yarihanchinal	3188	1866	58.53	1639	87.83	227	12.17	1322	41.47
Study Area	**269873**	**114387**	**52.27**	**97170**	**81.87**	**17217**	**27.06**	**156486**	**47.93**

Source: Primary Census Abstract, Census of India 2011

[1] Unhabited

Figure 6.24 Women Participation in Workforce



Land Holding Pattern

At the outset, it is important to state that the landholdings are mostly large in the study area. As described above, the study area is characterized by primarily agricultural land and most of the land is under cultivation, the average land holding is between 5-12 ha. Land is generally distributed between families so one person cultivates in 2-3 ha of land.

In Kadampur, for instance, where detailed community consultations were held, less than one-third households i.e. 25-30 households out of approximately 400 households were reported to be marginal or landless (less than 1 hectare). On the other hand, more than 50 households may be categorized as medium to large landholders with landholdings over 4 hectares.

Details of land pricing, circle rates have already been provided in Chapter 2 of this ESIA report.

Agriculture

As discussed in the above sections, agriculture is is among the primary sources of income and livelihood for the households in the study area. The proportions of cultivators and agricultural

labourers have been discussed in the previous section. The seasonal calendar for crops grown in the study area is provided below.

Figure 6.25 Seasonal calendar for major crops

	January	February	March	April	May	June	July	August	September	October	November	December
Maize						■	■	■	■	■	■	■
Dal			■	■	■	■	■	■	■			
Chillies	■	■	■	■	■							
Potato						■	■	■	■	■	■	
BT-Cotton								■	■	■	■	■
Sunflower	■	■	■	■	■	■	■	■	■	■	■	■
Jasmine			■	■	■	■	■					
Coconut					■	■	■	■	■	■		

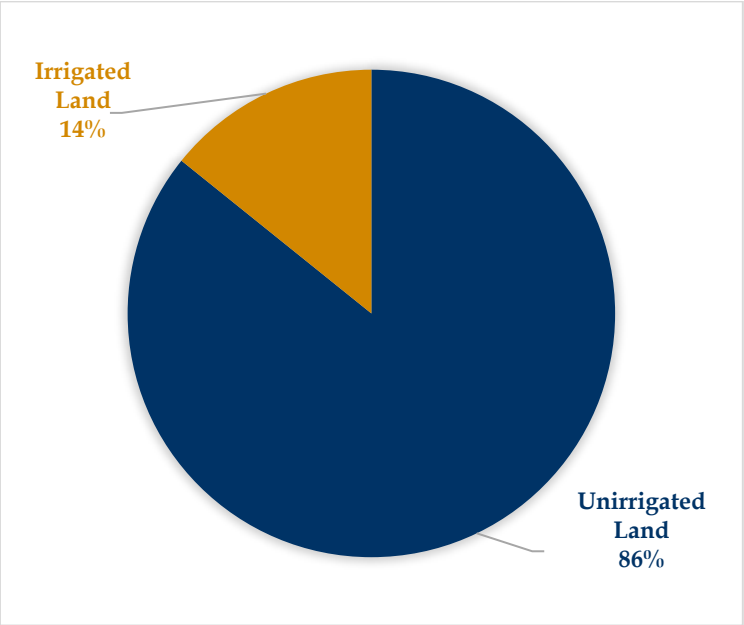
Figure 6.26 Agriculture in the area

Data provided in the figure above shows that, in agriculture sector, a higher proportion of workers is engaged as agricultural labourers in both main and marginal workers category. There are high proportion of workers, especially female workers engaged as marginal agricultural labourers in the study area. Consultations revealed that women are engaged as they provide labor at cheap rates. During site visits it was observed that women are mostly seen working in sunflower and jasmine plantations.

Community consultations revealed that the main source of water, in households and in fields, in majority of the villages is through the Tungabadhra Dam. Some planters in Harlapur, Kadampur and Churchihal also use borewells (200-400ft. deep) and open well, as well. The CGWB data of the distrcits in the study area reveal that overall, the groundwater in the area is “safe”.

In the study area, only 11 percent of the net sown area i.e. 7281.8 ha of 66297.5 ha of land is irrigated.

Figure 6.27 Irrigation in study area



Source: Census of India 2011, Village Directory

Figure 6.28 Pond in Churchihal Village

Source: ERM Site Visit July 2021

Migration

During consultations undertaken at Lakkundi, Harlapur, Adavi Sompur, Kadampur and Churchihaal villages in Gadag and Mundaragi Tehsil, it was understood from the village community that there are very few migrant workers residing in the villages in the study area. These workers come from nearby states for working as agricultural labourers and in Gadag-Betigeri CMC. However, out-migration by locals, specifically local youth, in the study area was minimal but not unfamiliar. This category of people migrate to other cities like Mumbai, Chennai, Hyderabad etc. for studying or for work.

6.9.2.7 Archeological and Cultural Heritage sites

Lakkundi Village in Gadag Tehsil in Gadag District has been deemed as an archaeological site and is home to nearly 50 historical temples. The village is full of semi-ruined and preserved historical temples from the period of Chalukyas, Kalachuris, Seuna and the Hoysalas empires of Indian history. The temples belong to Mallikarjuna, Virabhadra, Manikeshwara, Nanneshwara,

Lakshminarayana, Someshwara, Nilakanteshwara and many more[1]. The village is also home to a heritage centre with artefacts and remains of ancient scriptures displayed for tourists. There are nearly six (6) proposed WTG locations which are at a distance of less than 1km from this villages boundary. However, the distance from the temples is more than 1 km

Figure 6.29 Temples in Lakkundi

Source: ERM Site Visit

[1] https://gadag.nic.in/en/gallery/lakkundi/

6.9.2.8 Physical and Social Infrastructure

Education

Based on information in the district census handbook 2011 for the districts and site visits, it was understood that the education infrastructure in the village is adequete. As discussed in **Table 6.26** and **Section 6.9.1.2**, the literacy rate in the study area is 77.07 percent. Of the total 32 villages in the study, there are nearly 40 primary schools (1-5th standard) and 30 middle schools (5th to 8th standard). These schools are primarily inside the villages in the study area. However, the presence of secondary and senior secondary schools (8th -12th standard) are limited in the area (6). They are mainly located in the. Gadag-Betigeri, Hirekoppa, Neeralagi, Kotumachagi, Harlapur. Colleges for graduation and post-graduation are mainly in Gadag city. Gadag-Betigeri has 6 primary schools, 5 middle schools and 5 secondary and senior secondary schools.

Per consultation it was understood that parents prefer sending their children to private schools stating good facilities, toilets and quality of education in private schools as compared to government schools. However, the provision of mid-day meal schemes in government schools is still one of the major factors of high enrolment ratio, in government schools at primary level.

On consultations in the core villages, it was understood that though there are educational infrastructure (primary and middle schools) present in and around the villages, there is hesitance and reluctance is sending girl children to school after primary (8th standard). This is potentially due to inavailability of secondary and senior secondary schools in the nearby area and the reluctance of families to send girl children long distances. There is however, a marginal proportion of familes who send their daughters to school after primary. These familes mostly reside in the more urban parts of the study area. These girls study till higher secondary and sometimes graduation as well.

Health

In the study area, there are no hospitals except in Gadag-Betigeri CMC. Mostly all villages have PHC or PHCCs with medical practicioners and some villages like Jalshankarnagar, Balajinagar and Papanashi have no medical infrasturture. The table below provides the details of medical infrastructure in village.

Table 6.30 Health Infrastructure in the Study Area

Name of the Village	Community Health Centre	Public Health Centre	Public Health Sub-Centre	Maternity and Child Welfare Centre	Hospital	Dispensary	Veterinary hospital	Mobile health clinic
Gadag Taluk								
Kotumachagi	0	0	1	0	0	1	1	0
Kanaginahal	0	0	1	0	0	0	1	0
Harlapur	0	0		0	0	0	1	0
Timmapur	0	0	1	0	0	0	1	0
Hatalageri	0	0		0	0	0	0	0
Adavisomapur	0	0	1	0	0	0	0	0
Sambhapur	0	0	1	0	0	0	0	0
Jalashankarnagar	0	0		0	0	0	0	0
Balajinagar	0	0		0	0	0	0	0
Papanashi	0	0		0	0	1	1	0
Lakkundi	0	1	2	1	1	1	1	0
Kalasapur	0		1	0	0	0	0	0
Gadag-Betigeri (CMC)	0	0	0	1	2	0	0	0
Halligudi	0	1	1	1			1	0
Kappatagiri	0	0	0	0	0	0	0	0

Name of the Village	Community Health Centre	Public Health Centre	Public Health Sub-Centre	Maternity and Child Welfare Centre	Hospital	Dispensary	Veterinary hospital	Mobile health clinic
Benakanakoppa	0	0		0	0	0	0	0
Betigeri(Rural)[1]	0	0	1	0	0	0	0	0
Chikkoppa	0	0	0	0	0	0	0	0
Hirekoppa	0	0	1	0	0	0	0	0
Neeralagi	0	0	0	0	0	0	0	0
Pandurangapur	0	0	0	0	0	0	0	0
Nagasamudra	0	0	0	0	0	0	0	0
Mundaragi Taluk								
Shivajinagar	0	0	0	0	0	0	0	0
Kadampur	0	1	1	1			1	
Churchihal	0	0	0	0	0	0	0	0
Jantli Shirur	0	0	1	0	0	0	1	0
Venkatapur	0	0	1	0	0	0	0	0
Alur	0	0	1	0	0	0	0	0
Shingatarayanakeri	0	0	0	0	0	0	0	0
Doni	0	0	1	0	0	1	1	0
Dambal	0	1	2	1	0	1	0	0
Yelbarga Taluk								
Yarihanchinal	0	1	0	0	0	0	0	0
Study Area	**0**	**5**	**18**	**5**	**3**	**5**	**11**	**0**

Water Sources

The drinking water supply sources include main water include tap water, River/Canal, Tank/Pond/Lake. Almost all villages in the study area have water supply through municipal supply, from Tungabhadra dam. Consultations revealed no complaints regarding water in the study area. The water from the dam is provided in the residences through taps and some people also store this water in overhead tanks.

Figure 6.30 Overhead water storage

Source: ERM Site Visit July 2021

Sanitation

[1] Unhabited

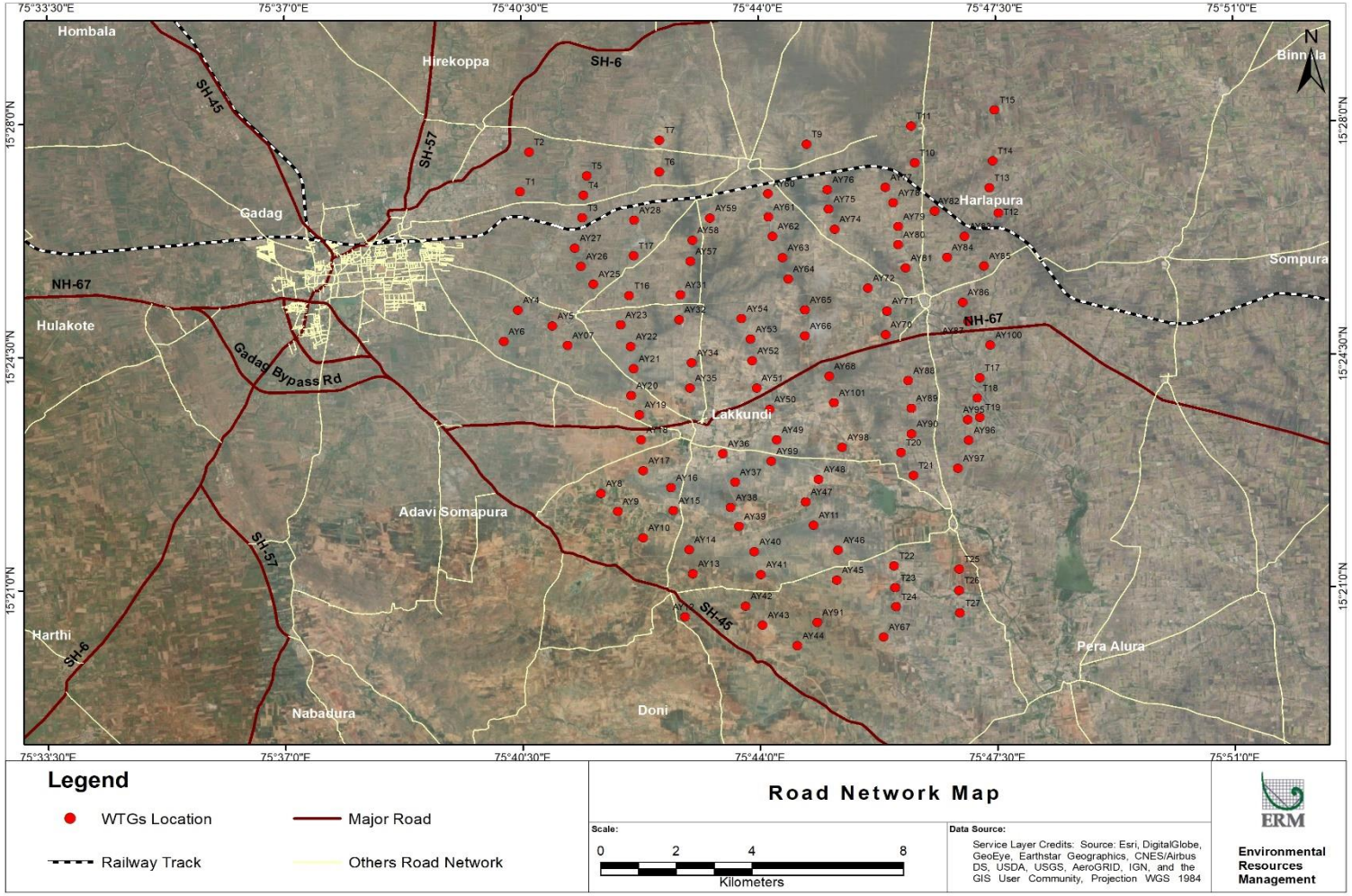
Consultations in villages revealed that almost all households have toilets within their households. Villagers revealed that this was undertaken as a part of the Swachch Bharat Abhiyan drive where toilets were constructed in villages.

Traffic and Road Infrastruture

The proposed wind power project site is well connected to four (4) lane National Highway 67 (old NH 63) and two (2) lane State Highway 45 that are connected to different village roads for transfer of material.

It is understood that Ayana shall assess the adequacy of the village roads for strengthening in order transfer of material within the core area. Map showing connectivity and road network is provided in the figure below.

Figure 6.31: Road Network Map



6.9.3 Key Highlights

The socio-economic baseline description in the above section was aimed at entirely capturing the characteristics and social features in the project area. The baseline also in a way was discussed in order to highlight both the strengths and weaknesses in this particular area. The intention was to capture the statistical trends as presented in the secondary data and to capture the descriptive narratives as presented by the community members at the local level and also through the voices of the administrative officials who form a bridge between the community and good governance.

Most of the major community trends and concerns in the district and in the study area have already been discussed in the context to the study area. The following table provides a summary of the identified areas along with some suggestions of the potential areas to intervene/support. These however could be taken up in collaboration with any of the NGOs or with the Government. However, it must be noted that these are not isolated problems but are closely interlinked and feed into each other.

The list mentioned below is tentative and can be further improvised through continuous engagement with the communities in the study area.

Table 6.31 Key Needs Identified and Potential Areas of Intervention

Key Areas	Problems/Gaps Identified	Potential Areas of Intervention
Education	■ Low female literacy rates; ■ High drop-out rates after primary/middle school; ■ Lack of high schools and higher secondary schools at village level	■ Training/Awareness regarding female education; ■ Establishing adult literacy programs (for females); ■ High schools and Higher secondary schools at village level itself; ■ Supporting school children with books, stationery, toys and other learning material; ■ Provision of drinking water facility and toilets in schools; ■ Providing furniture (benches/chairs) in schools
Agriculture	■ Lack of water and propoer soyrces of irrigation in the area affecting quality of produce ■ Traditional farming methods	■ Training on modern farming methods that includes increasing awareness about multi-cropping system, modern irrigation methods, methods to improve productivity and quality of produce etc.
Health	■ Low levels of institutional deliveries; ■ Health centres lack facilities and any equipment; ■ Access constraints: distance from village to medical care facilities	■ Awareness programmes at village level; ■ Periodical health camps and check-ups targeting women and children at the village itself to ensure continuous monitoring
Alternative employment opportunities	■ Unemployment levels among youth; ■ Lack of skilled labour availability in the study area; ■ Lack of adequate employment opportunities other than agriculture/wage labour; ■ High in-migration patterns and changing socio-economic dynamics	■ Skill training programmes based on promoting agro-allied activities and health care; ■ Aligning livelihood training programs through training in dairy planting, livestock rearing and horticulture; ■ Creating self-employment opportunities

7. STAKEHOLDER IDENTIFICATION AND ENGAGEMENT

The disclosure of project information and consultations with stakeholders has been increasingly emphasised by project finance institutions and government regulatory bodies. A brief overview of the requirements of public disclosure and stakeholder consultation applicable to this project is provided below (***Table 7.1***).Deatiled discussion regarding stakeholder consultations have been provided in

Table 7.1 Overview of Disclosure and Stakeholder Consultation Requirements

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1	■ In keeping with this PS, community engagement is to be undertaken with the affected communities and must be free of external manipulation, interference, or coercion, and intimidation. ■ Furthermore, in situations where an affected community may be subject to risks or adverse impacts from a project, the proponent must undertake a process of consultation so as to provide the affected communities with an opportunity to express their views on the project risks, impacts, and mitigation measures, as well as allow the proponents to consider and respond to them. ■ *Informed participation:* For projects with significant adverse impacts on affected communities, the consultation process must ensure that free, prior and informed consultation with affected communities occurs and that processes exist to facilitate participation by those affected. ■ Apart from such a consultation process, the project proponents are also to establish a Grievance Redressal Mechanism, which will allow the affected communities' concerns and grievances about the project proponent's environmental and social performance to be received and allow for steps to be taken to resolve the same ■ *Broader stakeholder engagement:* The proponent must identify and engage with stakeholders that are not directly affected by the Project but those that have established relationships with local communities and/or interest in the Project – local government, civil society organisations, etc. – and establish a dialogue.

7.1 Categorization of Stakeholders

A stakeholder is "a person, group, or organization that has a direct or indirect stake in a project/organization because it can affect or be affected by the Project/organization's actions, objectives, and policies". Stakeholders thus vary in terms of degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders,** those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the table given below.

Table 7.2 Stakeholder Group Categorization

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Community	■ Local Labourers ■ Land sellers and lessors	■ Local community ■ Agricultural Labourers ■ Vulnerable Community
Institutional Stakeholders	■ Gram Panchayats	■ Village Institutions (schools, health centres);

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Government Bodies	■ Regulatory Authorities; ■ District Administration ■ Land Aggregators	
Other Groups		■ Other industries/projects

7.2 Stakeholder Analysis

The table below provides the profile of the key stakeholders who might have certain direct or indirect impact. These stakeholders have also been classified in accordance with the level of influence they might have over the project as well as their priority to the project proponent in terms of importance. The influence and priority have both been primarily rated as:

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

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

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

Table 7.3 Stakeholder Analysis

Relevant Stakeholders	Profile/Status	Impact/Influence of the Project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the Project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Local Labourers	■ Local area has adequate workforce in unskilled category as mostly working population of the local area are cultivators/agriculture labourers. High proportion of women are seen to be working as marginal workers as well. ■ There are very few industries in the surrounding area and hence there is also immediate availability of unskilled youth for labour purpose; ■ The local availability of wage earners is however linked to the agricultural season.	■ The proportion of locals being employed will only be limited to the construction phases solely. The local wage earners have high expectation of employment from the project; ■ There might be an overall positive perception associated with local employment generation by the project. ■ The employment of local labourers, especially women, might positively influence the project operations, in strengthening project relations with the local community and building a positive rapport.	■ The stakeholder group will play an important role during the project construction phase ■ Aspects such as timely payments for work undertaken, other support for conducive work conditions etc. will lead to either a positive or negative impact on the project	■ The primary concerns for these stakeholders pertain to the timely payment of wages and dues for the work completed, continued employment for the local labourers, engagement of more women workers and an emphasis on the health and safety aspects of the work conditions on site.	Low to Medium
Land sellers and lessors Consultations were undertaken with land sellers and lessors in Churchihaal, Harlapur and Hatelgeri village	The project has identified private agricultural land for 114 WTG locations out of which 90 locations shall be finalised. As informed 30 land owners have signed Agreement To Sale (ATS). ■ It was reported that some of the private land already purchased as well as proposed to be procured for the project were/ are being used for agriculture purpose; ■ The sale of land will not likely result in physical dislocation or landlessness. This was ascertained through consultations with the land team and a few people who had sold their land.	■ It was reported by Ayana's land team and the land aggregators that land purchase is following the willing seller – willing buyer process under the ambit of law; ■ The impact on land sellers from selling land for the project is ascertained to be marginal as the purchase of land for each WTG is only 1 acre, the remaining land has been taken on lease. Basis consultations with those who have sold land and those who have provided ATS, it was understood that the sale of land would not lead to	■ Community consultations in the villages pointed towards the demand of the land sellers which included allocation of construction work relating to the project and employment during the construction as well as operation phases.	■ The major concern of the stakeholder group is that of accessing employment opportunities that the project will generate.	Medium

Relevant Stakeholders	Profile/Status	Impact/Influence of the Project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the Project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
	■ The cultivation in the project footprint is mainly sunflowers, jasmine, vegetables, chillies and BT cotton.	landlessness and the money received from the sale would be used for buying an alternative plot of land or develop the current plot. and ■ The land losers may also be benefitted by means of the local employment opportunities that will be generated for which they will be reportedly be provided preference.			
Land aggregator	■ The land aggregation and leasing of land has been undertaken by BV Patil LLP. ■ As mentioned in **Section 2.3.2**, The aggregator is reportedly responsible for undertaking the land survey to identify titleholders, getting consent from the titleholders and purchasing/leasing the land under Ayana's name from these titleholders.	■ Project will have minimal impact on Land Aggregator.	■ The land aggregator has a significant impact on the project as it is the land aggregator that determines, communicates and executes the terms and conditions of a sale and lease deed as well as determining willing land sellers.	■ Key determinant of keeping project within designated timelines, identifying land free of legacy issues and executing legal terms and conditions of the sale and lease deeds.	Medium
Migrant Workforce	■ There will be a substantial migrant workforce working in the construction phase primarily related to the skilled civil construction works; ■ Typically, for 1 location, the work involves 2-3 days and about 25 men to complete the task; ■ The wage rates vary from INR 500-700 per day to unskilled workers, INR. 800 per day for mason, INR 1000 for supervisors.	■ The project will have an overall positive impact over the migrant workforce by generating employment opportunities ■ The accommodation facilities etc. will be inclusive of room, drinking water, toilets, kitchen facilities etc.	■ Retaining migrant workforce is quite critical for the project as there is a large dependence over them especially during the construction phases of the project. ■ The migrant workforce will reside in a labour camp or rented accommodation.	■ Timely payment of wages; ■ Safe working conditions; ■ Health benefits and support when required; ■ Security to minimize any problems with the host community;	Low

Relevant Stakeholders	Profile/Status	Impact/Influence of the Project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the Project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Local Gram Panchayats Gram panchayat members of Churchihaal and Harlapur villages were consulted with.	■ The Panchayat is the lowest levels of local governance and consists of one or more revenue villages. This body of local governance was accorded with a number of responsibilities and powers as part of the 73rd Amendment to the Constitution. ■ As part of this, most of the rural development schemes and funds for central schemes are channelled through this body of governance. ■ Also, it is the Panchayat who are bestowed with the decision making authority for economic development and social justice. Thus in order for the smooth and proper functioning of the project, the Consent of the Panchayat is imperative.	■ Consultations revealed that the project is expected to have a positive impact over this stakeholder group through extending support in community development activities and by strengthening their role in this entire process of facilitation; ■ The panchayats also expect increase in local employment and improvement in road conditions in the area.	■ GPs play an important role in overall mobilization and shaping the perception and opinions of the people in the project area. ■ They play a role even in demanding community development works for social welfare purpose. ■ Consultation with GP has also been undertaken for permissions regarding traffic flow, road diversions, if any etc.	■ Key concern is of the nature of minimal livelihood impacts, if any, due to the project purpose. ■ Key expectation will include: local employment generation and support through adequate CSR activities; ■ Some potential areas for CSR intervention as indicated by the community and gram panchayats include: - Road improvement; - Support to local schools in form of training, infrastructure, books etc. ; - Health camps; - Watershed development; - Skill development and employment generation.	Medium to High
Regulatory Authorities	■ The office of District Industries Commissioner regulates the Industrialization at the District Level. ■ Power evacuation/grid connectivity authority.	■ The project will ensure compliance with the relevant guidelines and policy recommendations as per the State Govt. ■ The project needs permission and coordination with the DIC for local infrastructure and other	-	■ The key expectations of the regulatory authorities is ensuring that the project proponent meets all the statutory compliances and that the project operations are undertaken as per the conditions put forth by	Medium

Relevant Stakeholders	Profile/Status	Impact/Influence of the Project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the Project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		supports required for smooth industrial operation		the authorities and after having obtained all the necessary permits;	
District/Taluka Administration Consultations were undertaken with Taluka Development Officer at Dayapar.	■ The project area is administered by government bodies at three levels: at the district level, at the block/taluka level and at the Panchayat level in each village/or cluster of villages. ■ The local administration in this regard refers to the district and block level administration comprising of the offices of the Taluka Development Officer, District Collectors, and Revenue officer etc. The revenue department is responsible for registration of land sale, mutation, updating and records and transfer of land. ■ The revenue department (sub registrar) is responsible for registration of land sale, mutation, updating and records and transfer of land.	■ The Taluka Administration play a critical role in facilitating the land registration process which is still ongoing. ■ The project is expected to have a positive influence over the local administration by extending support through these authorities or by collaborating to undertake any community development activities.	■ The construction phase requires a number of permissions and support from the local administration. ■ The procedural complication can cause significant project delay. ■ The land-matters can give rise to unnecessary litigations (especially pertaining to lack of records or encroachment issues in case of access roads etc.).	■ The overall opinion of the local authorities is positive towards the project owing to the fact that it may trigger some local employment and other opportunities in the form of local contractors, hiring local vehicles, dependence on local products/goods etc. ■ The key concern would however remain that the project operations are carried out smoothly with minimal negative impact on the local community.	Medium to High
Local Community Consultations were undertaken in Harlapur, Churchihaal, Hatelgeri, Lakkundi and Kadampur	■ This stakeholder is comprised of the community residing within a radius of 2 km from the proposed wind plant area. ■ The area comprises of Hindu and Muslim religious groups. ■ Of the total, an average of 24 percent of the total population in the study area comprise of SC population.	■ There is anticipation that the project will generate adequate local employment. However, most of the local employment will be limited to the construction phase. ■ There are several from the community member who have been indirectly dependent on the land sold to the project.	■ The local community plays an important role in facilitating, supporting and ensuring smooth operations of the project at a day to day level. ■ During construction phase, the labourers will be mostly provided from the local community.	■ The primary expectation would be adequate employment generation at the local level. ■ In addition, contributing positively through targeted community development activities would be also among the key expectations.	Medium

Relevant Stakeholders	Profile/Status	Impact/Influence of the Project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the Project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
	■ The community in the study area is primarily dependent on agriculture and agricultural labour for their livelihood, followed by wage labour and other activities etc.	■ In addition, the CSR activities focused on education and health, among others will also be targeted at the neighboring villages and the immediate local community which will lead to improvement in livelihood.		■ Some key areas of intervention for CSR activities have been highlighted earlier under 'Local Gram Panchayat' heading of this table.	
Vulnerable Community	As per the discussion with local community in the villages of Harlapur, Churchihaal, Hatelgeri, Lakkundi Adisompur and Kadampur, some households are considered as vulnerable and are targeted for social welfare schemes. This stakeholder group comprises of Scheduled Castes, women, single women-headed households, differently abled people, senior citizens, and BPL families.	■ The project proponent may be required to focus on providing employment opportunities to the vulnerable community members	■ The stakeholder group will have a limited or negligible impact on the project.	■ Key concerns and expectations would range from targeted support to vulnerable families, involving them in the ambit of beneficiaries through community development activities; ■ Support in availing dedicated government social welfare schemes	Low
Civil Society/Local NGOs	■ There are NGOs based in Gadag city focused on improving the livelihood of the rural communities by supporting the various facets of their social life; ■ There are however limited NGOs that are directly active in livelihood projects in the study area villages	■ The project might directly collaborate or indirectly extended support to any of the ongoing activities being carried out or initiate newer ones in the study area. ■ The project will allocate a Development Fund which will be provided to gram panchayats for local area development.	■ The stakeholder group often plays a significant role in representing the interests of the vulnerable sections and related socio-economic issues. ■ On the other hand, the same group may also build community confidence through highlighting the positive impact of the project and the targeted support extended to the	■ The opinion of this stakeholder group may vary depending on whether the project operations have had any negative or positive impact over the community. ■ The expectations of this group will be similar to that of the local community and vulnerable sections of the population.	Medium

Relevant Stakeholders	Profile/Status	Impact/Influence of the Project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the Project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
			community through CSR activities.		

7.3 Details of On-Site Stakeholder Consultation

ERM team undertook stakeholder consultations during the site visit. Details of the same are provided in the table below.

Table 7.4 Details of Stakeholder Consultation

S.No.	Location	Stakeholder	Points of Discussion
23.07.2021			
1.	Project Site	Ayana Site Representative	■ Site walk through ■ Details about status of the project and its various components ■ Land procurement procedure ■ Stakeholder engagement procedures
2.	Land Aggregators office and Project site	Land Aggregator	■ Land identification procedure ■ Land procurement procedure ■ Land survey methods ■ Avoidance parameters ■ Circle Rate land details
3.	Land sellers and lessors in Hatelgeri Village	Hatelgeri Villager	■ Rate at which they are selling land ■ Consent obtaining procedure ■ Land use ■ Information about land parcel; type of land, structures, use etc. ■ Alternate land parcel, if any ■ Investment of money received ■ Level of satisfaction with sale or lease ■ Employment opportunity in project ■ Their perception about project
4.	Village profiling of Lakkundi, Hatelgeri and Kadampur	Lakkundi, Hatelgeri and Kadampur	■ Demographic profile; population, households, social group prevalence, sex ratio, migrant workers etc. ■ Cultural resources in village ■ Education profile and infrastructure ■ Occupational profile; jobs women are involved in, main occupation in the village etc. ■ Main occupation in the villages was understood to be agriculture ■ Physical infrastructure; Education, medical, water, electricity etc.

			Socio-economic issues in village
24.07.21			
5.	Land sellers and lessors in Churchihaal and Harlapur	Churchihaal and Harlapur Village	■ Rate at which they are selling land ■ Consent obtaining procedure ■ Land use ■ Information about land parcel; type of land, structures, use etc. ■ Alternate land parcel, if any ■ Investment of money received ■ Level of satisfaction with sale or lease ■ Employment opportunity in project ■ Their perception about project
6.	Gram Panchayat member of Churchihaal and Harlapur	Churchihaal and Harlapur Village	■ Perception about the project ■ Relationship with project proponent and how they assist in land procurement and identification ■ Demographics of the area ■ Occupational profile of the area Land use of the area
7.	Village profiling of Harlapur, Adavisompur, and Churchihaal	Harlapur, Adavisompur, and Churchihaal villages	■ Demographic profile; population, households, social group prevalence, sex ratio, migrant workers etc. ■ Cultural resources in village ■ Education profile and infrastructure ■ Occupational profile; jobs women are involved in, main occupation in the village etc. ■ Main occupation in the villages was understood to be agriculture and industrial workers ■ Physical infrastructure; Education, medical, water, electricity etc. Socio-economic issues in village
8.	Land sellers and lessors in Churchihaal and Harlapur	Churchihaal and Harlapur Village	■ Rate at which they are selling land ■ Consent obtaining procedure ■ Land use ■ Information about land parcel; type of land, structures, use etc. ■ Alternate land parcel, if any ■ Investment of money received

			■ Level of satisfaction with sale or lease ■ Employment opportunity in project Their perception about project

Figure 7.1 Photographs of Community Consultations

Source: ERM Site Visit, July 2021

8. IMPACT ASSESSMENT

8.1 Introduction

This section elaborates upon the various interactions of the Project with physical, ecological or social environment thereby leading to potential impacts to resources/ receptors. It has been organized as per the various phases of the project life cycle to understand the risks and impacts associated with each phase.

8.1.1 Scope of the Assessment

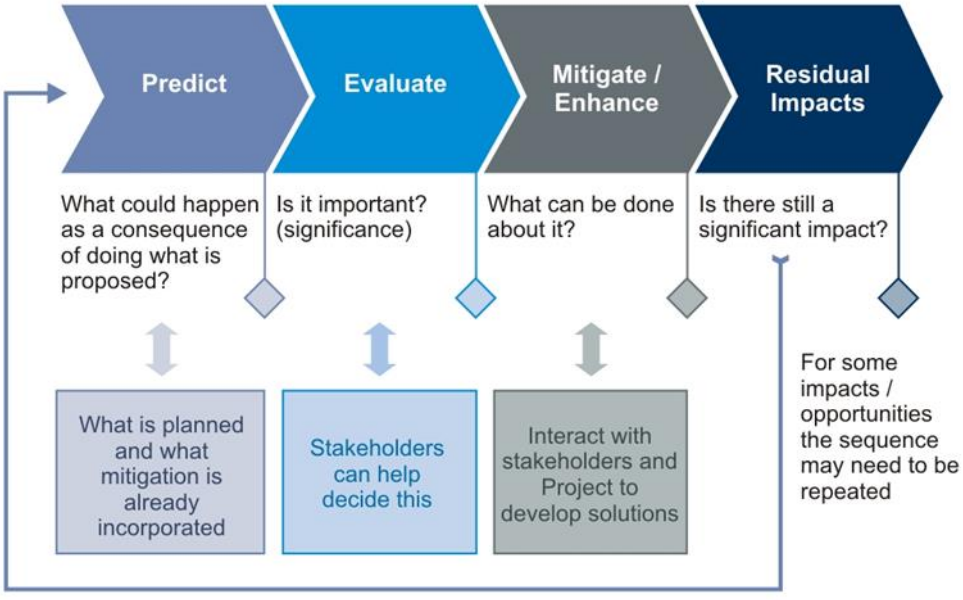
The scope of the assessment captures the understanding on the envisaged risks and impacts assessed during the scoping exercise of this impact assessment study as well as the risks identified during subsequent physical baseline assessment and impact evaluation process. The key environmental and social issues and risks identified are further elaborated in the following sections.

8.1.2 Assessment Methodology

Impact identification and assessment starts with scoping and continues through the remainder of the Impact Assessment (IA) Process. The principal IA steps are summarized in ***Figure 8.1*** and comprises of

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

Figure 8.1 Impact Assessment Process



Source: ERM Impact Assessment Standard

Prediction of Impacts

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

Evaluation of Impacts

Each impact was described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is shown in ***Table 8.1.***

Table 8.1 Impact Characteristic Terminology

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

The definitions for the type designations are given in ***Table 8.2.*** Definitions for the other designations are resource/receptor-specific.

Table 8.2 Impact Type Definitions

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

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is likelihood. The likelihood of an unplanned event occurring was designated using a qualitative scale, as described in ***Table 8.3.***

Table 8.3 Definitions for Likelihood Designations

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

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

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

- Extent
- Duration
- Scale
- Frequency

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

- Positive
- Negligible
- Small
- Medium
- Large

In the case of a positive impact, no magnitude designation (aside from 'positive') was assigned. It was considered sufficient for the purpose of the IA to indicate that the Project was expected to result in a positive impact, without characterising the exact degree of positive change likely to occur. In the case of impacts resulting from unplanned events, the same resource/ receptor-specific approach to concluding a magnitude designation was followed, but the 'likelihood' factor was considered, together with the other impact characteristics, when assigning a magnitude designation.

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

- Low
- Medium
- High

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterised, the significance was assigned for each impact. Impact significance is designated using the matrix shown in ***Figure 8.2.***

Figure 8.2 Impact Significance

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

Source: ERM Impact Assessment Standard

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. *Box* 8.1 provides a context of what the various impact significance ratings imply.

Box 8.1 Context of Impact Significances

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

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

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

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

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

Identification of Mitigation and Enhancement Measures

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

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

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

Management and Monitoring

The final stage in the IA Process was the definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards/ guidelines; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted. This is covered in ***Chapter 9*** under Environmental and Social Management Plan (ESMP).

8.2 Key Potential Impacts

Based on the Potential Interactions Matrix for Project activities and likely impacted resources/ receptors as shown in *Table 4.1* and *Table 4.2* following areas of impacts have been identified:

8.2.1 Key environmental health and safety impacts

- Change in Land use;
- Impacts on Land and Soil Environment;
- Impact on Water resources and quality;
- Ambient Noise Level;
- Visual Impacts;
- Shadow Flicker and noise;
- Occupational Health and Safety.

8.2.2 Key Socio-economic impacts

- Impact on Title-holders
- Impact on Community Health and Safety
- Migrant Labour and Related Impacts
- Impact on Archeological and cultural Sites
- Employment Opportunities
- Impact on Local Public Infrastructure
- Retrenchment

8.2.3 Key Ecological Impacts

- Impact due to vegetation clearance;
- Impact due to construction phase; and
- Impact due to transmission line

8.3 Environmental Impacts of the Project

8.3.1 Change in Land Use

For the purpose of assessment of impacts on land use of the area, the following Project activities leading to alteration in land use of the area during the Project life cycle were considered:

- Construction and strengthening of access roads;
- Site clearance and preparation for WTGs, PSS and EHV line (both internal and external TL);
- Establishment and Operation of batching plant; and
- Transient storage of WTG components.

Criteria

For the assessment of land use, the sensitivity and magnitude criteria is outlined in ***Table 8.4*** and ***Table 8.5*** respectively.

Table 8.4 Sensitivity Assessment Criteria for Land Use

Land Use Sensitivity	Criteria
Low	The Project footprint will be present in wasteland with no human settlement
Medium	The Project will be present in agricultural land or combination of agricultural land and wasteland etc.
High	The Project will be present in any forest land, or national park or of national Importance covered by international and/or national designation.

Table 8.5 Criteria for Impact Magnitude for Assessment of Impact to Land Use

Magnitude	Criteria
Negligible	An imperceptible, barely or rarely perceptible change in land use characteristics. The change may be short term.
Small	A subtle change in land use character over a wide area of a more noticeable change either over a restricted area or infrequently perceived. The change may be short term.

Magnitude	Criteria
Medium	A noticeable change in land use character, frequently perceived or continuous and over a wide area; or a clearly evident change over a restricted area that may be infrequently perceived. The change may be medium to long term and may not be reversible.
Large	A clearly evident, frequently perceived and continuous change in land use characteristics affecting an extensive area. The change may be long term and would not be reversible.

Context

The Project site consists largely of agricultural land which are privately owned. The site is comprised of primarily of flat land with few parcels of minor undulated land with sparse shrubs and bushes.

The project activities are expected to alter the land use of the area during the project life cycle for over a period of time are given in the table below (***Table 8.6***)

Table 8.6 Periodic alteration of land use

SN.	Activity	Estimated Duration (Temporary/ Permanent)
1	Siting of site office, labor camp, batching plant, storage yard	Approximately 10-12 months
2	Access road construction/strengthening and its consequent usage	Throughout the lifecycle of the Project
3	Installation of WTGs, proposed internal transmission towers with transmission lines.	Throughout the lifecycle of the Project

Source: Project Details provided by Ayana.

Structures, albeit of temporary nature, which will support project activities during the construction stage such as batching plants, storage yards, etc. will have an impact on the immediate vicinity of the construction area. The construction phase is expected to last approximately 10-12 months, following which the temporary structures will be dismantled from their respective locations with the returning of land to its acceptable pre-construction state. However, site access roads, internal roads, transmission lines and permanent structures such as WTGs, site office and the pooling substation will remain until the end of the Project life cycle (i.e. 25 years to 30 years depending on the Project). Hence, the change in land use due to project development has been classified as **medium** as per ***Table 8.5*** below.

Embedded/ in-built control

The impacts during the construction activity are envisaged to be of a short duration as the construction phase will be about 10-12 months. Additionally, the potential EPC contractors will be instructed to avoid any unnecessary disturbance to nearby surrounding features or land parcels. Further, construction activities will be restricted to the footprint area of the Project components and remaining area to be kept undisturbed to the extent possible.

Post completion of the construction work, the areas utilised for storage yard, batching plant, etc. are expected to be restored to their near original state as acceptable to owners as part of good practice measures.

Significance of Impact

Land selected for all of the WTGs is on private agricultural land. Land selected for storage yard, pooling substation and batching plant will also be on private agricultural land. Land use change will be on land where WTGs have been erected, access road from the main village road to the individual

WTGs, batching plant site, site office and stockyard site, pooling substation and any erected EHV line towers. As a majority of the above changes are reversible and will occur for only the life cycle of the wind power plant (~ 25 years), the impact magnitude has been assessed to be **moderate**.

Mitigation Measures

The following mitigation measures should be implemented to minimize potential impacts on land use during the construction phase:

- Construction activity should to be restricted to designated area;
- Waste should not be allowed to litter in and around the Project area;
- On completion of the construction activities, land used for temporary facilities will be restored to the extent possible and handed over to the owners;
- The land use around the permanent project facilities will not be disturbed.

Residual Impact Significance

The evaluation of significance is done for the activities that can have impact on land use that can be identified at planning stage and consequently adequate mitigation measures can be adopted. The impact on land use is majorly envisaged during construction stage. The residual impacts is envisaged to be **minor**, post implementation of mitigation measures.

Table 8.7 Impact on land use as a result of the setting up of the of the project

Impact	Changes in land use				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to WTG footprint, construction areas & associated facilities including transmission line				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **moderate**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				

8.3.2 Impacts on Land and Soil Environment

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

Construction phase

- Construction and strengthening of access roads;
- Selective clearing of vegetation in areas designated for WTG installations and other surface infrastructure;
- Stripping and stockpiling of soil layers;
- Heavy vehicle movement across unpaved roads;
- Digging for WTG foundations and electrical poles and towers;
- Storage of materials as well as transport of construction material; and
- General building/construction activities with regards to the site office and the SCADA room to monitor optimal WTG performance.

Operational phase:

- Storage of oil and lubricants;
- Maintenance of access roads;
- Heavy vehicular movement across paved roads;
- Maintenance of TL line route; and
- Storage of oil and lubricants onsite.

Decommissioning:

- Removal of WTGs;
- Removal of infrastructure from soil surfaces;
- Heavy vehicle movement across unpaved roads; and
- Restoration of the project.

Soil Quality Criteria

For the assessment of soil quality, the sensitivity and magnitude criteria outlined in ***Table 8.8*** and ***Table 8.9*** respectively have been used.

Table 8.8 Sensitivity Assessment Criteria for Soil quality (compaction, erosion and contamination)

Sensitivity Criteria	Contributing Criteria	
	Environmental	***Social***
Soil Quality related criteria as compaction, erosion and contamination	■ The extent to which the soil and quality plays an ecosystem role in terms of supporting biodiversity. This includes its role as in supporting a lifecycle stage	■ The extent to which the soil a quality provides a use (agricultural use, fishing) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation
Low	■ The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality.	■ The soil quality has little or no role in provisioning of services as agricultural uses for the local community.
Medium	■ The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the Project AoI.	■ The soil has local importance in terms of provisioning services as agricultural services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality i.e. ready availability across the AoI
High	■ The soil quality supports economically important or	■ The soil is wholly relied upon locally, with no suitable

Sensitivity Criteria	Contributing Criteria	
	Environmental	***Social***
Soil Quality related criteria as compaction, erosion and contamination	■ The extent to which the soil and quality plays an ecosystem role in terms of supporting biodiversity. This includes its role as in supporting a lifecycle stage	■ The extent to which the soil a quality provides a use (agricultural use, fishing) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation
	biologically unique species or provides essential habitat for such species.	technically or economically feasible alternatives, or is important at a regional level for provisioning services.

Table 8.9 Criteria for Impact Magnitude for Assessment of Impact to Soil

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

Receptor sensitivity

The receptor sensitivity has been assessed as **medium** as almost all the WTGs are proposed on agricultural land and temporary land proposed to be used for site office, storage yard, batching plants are likely to be agriculture land.

Soil Compaction and Erosion

Soil compaction and erosion has been considered for construction and decommissioning phase only. In the operation phase, soil compaction and erosion may occur due to vehicular movement, which only happens during the occasional maintenance activities and will be within the access road developed and land foot print acquired already during the construction phase. Soil compaction for operation phase has therefore been considered to be negligible.

Impact Magnitude

During the construction phase, the top soil will be susceptible to soil erosion to some extent due to site clearance activities. The scale of site clearance will be small at WTG footprint at different parcels of land, whereas in areas of new internal road construction, excavated loose soil would be susceptible to erosion. The removal of stabilised top soil would result in slope destabilisation and increase in soil erosion.

The off-site indirect impacts of soil erosion include movement of the soil particles to nearby waterways leading to disruption of aquatic ecosystem of receiving water bodies and reduced water quality during monsoon season as the project site and surrounding area has number small ponds and other water bodies.

Embedded/in-Built Control

- Using existing roads to access the site to the extent possible;
- Construction materials and wastes will be stored in designated areas;
- Stripping of topsoil shall not be conducted earlier than required; (vegetation cover will be maintained for as long as possible) in order to prevent the erosion (wind and water) of soil;
- As a means of best practice, retaining walls shall be constructed to arrest soil erosion during the construction phase that is envisaged to occur during the rainy months; and
- Topography shall be restored to the extent possible and re-vegetated to prevent soil erosion to the extent possible.

Significance of Impact

Based on the above the impact after incorporating the embedded control the impact significance is envisaged to be **minor** and is likely to impact the project footprint area during the construction phase.

Additional Mitigation Measures

- Top soil that has been stripped should be stored for landscaping of the site;
- The stock piles of the soil should be kept moist to avoid wind erosion of the soil;
- Soil to be ploughed in compacted area after completion of the construction work;
- Revegetation of the construction boundaries using fast growing local vegetation;
- Site to be restored at the end.

Residual Impact Significance

The significance of residual impacts will be **negligible** taking into account the recommended mitigation measures.

Table 8.10 Impact on soil and the potential of erosion during the construction phase

Impact	Soil Erosion and Compaction (Construction and Decommissioning Phase)				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area (specifically construction areas of the Project)				
Frequency	Construction Phase and Decommissioning phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor**				

Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor		Moderate	Major
	Significance of impact is considered **negligible**				

8.3.3 *Impact on land due to improper waste disposal*

Context

General construction waste generated onsite will comprise of surplus or off-specification materials such as concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, metals etc. Construction debris (excavated earth) will be generated from construction of WTGs, access roads, substation, storage yard, etc. Municipal domestic wastes consisting of food waste, plastic, glass, aluminium cans and waste paper will also be generated by the construction workforce at any canteen facility/ rest area, which shall be constructed for them. A small proportion of the waste generated during construction phase will be hazardous and may include used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid and hazardous waste could create impacts on land. Therefore, the receptor sensitivity has been assessed as **medium.**

Impact Magnitude

The impact magnitude has been assessed as **small** since the client will be implementing management systems for waste and hazardous substances being generated or utilized during the project life cycle as part of their waste management procedure.

Embedded/in-built control

- Excavated materials will be used for backfilling and levelling and other debris shall be used for road construction;
- The construction contractors will have control over the amount and types of waste (hazardous and non- hazardous) produced at the site;
- Workers will be strictly instructed about random disposal of any waste generated from the construction activity; and
- Construction contractor should ensure that no unauthorized dumping of used oil and other hazardous wastes is undertaken from the site.

Significance of Impact

Based on the above the impact after incorporating the embedded control the impact significance is envisaged to be **moderate.**

Additional Mitigation Measures

- Municipal domestic waste generated at site to be segregated onsite and ensure proper collection and handover to local municipal body/ local authority for further disposal;
- Ensure hazardous waste containers are properly labelled and stored onsite provided with impervious surface, shed and secondary containment system awaiting handling and disposal by an authorised vendor (authorised by the KSPCB and as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended;
- Disposal of hazardous wastes to be done strictly as per Hazardous waste rules.

- The construction contractor should ensure daily collection and periodic (weekly) disposal of construction waste generated debris, concrete, metal cuttings wastes as per the Construction and Demolition Waste Management rules 2016;
- It is to be ensured that hazardous waste not stored for more than 90 days;
- Ayana will follow waste management hieracy as per their waste management procedure.

Residual Impact Significance

After implementation of mitigation measures, significance of impacts is envisaged to reduce to **minor.**

Table 8.11 Impact on land due to improper waste disposal during construction phase

Impact	Impact on land due to improper waste generation				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Construction Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Not Significant	Minor	Moderate	Major	
	Significance of impact is considered **moderate**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium	High	
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor**				

8.3.4 Soil Contamination due to Leaks/Spills

Context

Diesel storage will be provided at batching plant onsite during construction phase and other materials such as oil, paints and solvents will be stored in drums in storage area having impervious floors.

Soil contamination during the construction phase may result from leaks and spills of oil, lubricants, or fuel from heavy equipment, improper handling of chemical/fuel storage and wastewater. Such spills could have a long-term impact on soil quality, but are expected to be localised in nature.

Embedded/in-built control

- Spill control measures such as the storage and handling of chemicals and fuel in concrete areas with secondary containment will be implemented to minimize impacts in the event of a spill.

Significance of Impact

- Based on the above the impact after incorporating the embedded control the impact significance is considered to be **minor.**

Additional Mitigation Measures

- Use of spill control kits to contain and clean minor spills and leaks;
- The sewage generated onsite will be treated and disposed through septic tanks and soak pits as per specifications given in IS 2470: 1995 (Part I and II);
- Transport vehicles and equipment should undergo regular maintenance to avoid any oil leakages; and
- Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers trained to prevent/contain spills and leaks.

Residual Impact Significance

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

Table 8.12 Soil contamination due to Leaks/spills during construction phase

Impact	Soil Contamination due to leak / spill during construction phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Construction Phase				
Likelihood	Unlikely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Not Significant	Minor	Moderate	Major	
	Significance of impact is considered **minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Operation phase

The operational phase of the project will have limited impacts on soil in the form of waste generation and soil contamination due to accidental spillages/ leakages.

Context

During operation phase, the waste generated from project will include domestic solid and hazardous waste like waste oil and lubricants and oil containing jutes and rags will be generated during operation and maintenance activities. The quantity of hazardous waste generated will be much lesser quantity than during the construction stage.

Embedded/in-built control

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

Significance of Impact

- Based on the above the impact after incorporating the embedded control the impact significance is envisaged to be **negligible.**

Additional Mitigation measures

As the embedded controls are sufficient to address the impact no mitigation measures are deemed necessary.

Residual Impact Significance

The significance of residual impacts is envisaged to be **negligible**, after implementation of mitigation measures.

Table 8.13 Improper waste disposal during operation phase

Impact	Impact on land due to improper waste disposal during the operation and maintenance phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Operation and maintenance Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Negligible**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Negligible**				

Decommissioning Phase

Impact on Soil and Land environment during decommissioning phase:

The decommissioning activities will cause following impacts on soil:

- Soil compaction due to the increased vehicular and workforce movement, dismantling and storage of WTG components on the adjacent land, removal of internal electric lines/ poles etc.;
- Waste will be generated in form of dismantled WTG components and demolition debris from WTG foundations, storage yard and substation complex. Electric components such as transformers, insulators, wires will be generated. The waste will be mainly of inert nature;
- The possibility of soil contamination during decommissioning phase is very less though may occur due to leakage from machinery and transportation vehicles and during collection of remaining oil/ lubricants in the WTGs.

Embedded/in-built control

- The decommissioning of the wind power plant will be carried out in a planned manner.
- During decommissioning phase, the quantity of waste generated will be high. The waste will be routed through proper collection, storage and disposal. The waste will be evaluated for its recycling/ reuse/ scrap value and disposed of, accordingly.
- Detailed decommissioning plan will be developed prior to the activity and implemented as per the site conditions.

Impact Significance

The overall significance of impacts on soil environment due to decommissioning activities is envisaged to be **minor.**

Additional Mitigation Measures

Following mitigation measures are proposed to reduce the impacts of wind plant decommissioning activities on soil environment:

- The vehicular movement during decommissioning activities should be restricted to the designated route path; and
- The demolition/ dismantling waste should not be left over in whole project area and to be collected and stored at designated area only for further segregation and disposal.

Significance of Residual Impacts

The significance of impact will vary from **minor to negligible** on implementation of mitigation measures.

Table 8.14 Impact to Soil and Land environment during decommissioning phase

Impact	Impact on Soil and Land environment during decommissioning phase			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Limited to Project area			

Frequency	Decommissioning Phase				
Likelihood	Unlikely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor to negligible**				

8.3.5 Impact on Water Resources

The impacts of proposed project on water environment are assessed with respect to following:

- Decreased water availability from the water resources of the area due to consumption of water for carrying out project activities; and
- Water quality being affected due to wastewater release and spills/leaks from project activities.

Criteria

For the assessment of water quality, the sensitivity and magnitude criteria outlined in ***Table 8.15*** and ***Table 8.16*** respectively have been used.

Table 8.15 Sensitivity Assessment Criteria for Water Resources (Surface water and Ground water)

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

Sensitivity Criteria	Contributing Criteria	
Medium	The water resource supports diverse populations of flora and / or fauna but available in the surface water bodies in the region.	The surface water resources have local importance in terms of provisioning services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality.
		The groundwater resource is an important water supply, and is currently used, but there is capacity and / or adequate opportunity for alternative sources of comparable quality.
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species	The surface water resources are wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or transboundary watershed level for provisioning services
		The groundwater resource is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or national level for water supply or contribution to groundwater dependent ecosystems (e.g. transboundary rivers).

Table 8.16 Criteria for Impact Magnitude for Assessment of Impact to Surface and Ground water Resources

Magnitude Criteria	Negligible	Small	Medium	Large
General Criteria	No perceptible or readily measurable change from baseline conditions.	Perceptible change from baseline conditions but likely to be within applicable norms and standards for mode of use.	Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and / or likely to approach and even occasionally exceed applicable norms and standards for mode of use.	Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed applicable norms and standards for mode of use.
Water Quantity	There is likely to be negligible (less than 1% of lean season flow) or no consumption of surface water by the Project at any time	The Project will consume surface water, but the amounts abstracted are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)
	There is likely to be negligible or no abstraction, use of or discharge to the	The Project will consume groundwater or deliver discharge to	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted /	The Project will consume groundwater or discharge to

Magnitude Criteria	Negligible	Small	Medium	Large
	groundwater by the Project at any time.	groundwater, but the amounts abstracted / discharged are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	discharged are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	groundwater, and the amounts abstracted / discharged are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).
Water Quality	Discharges are expected to be well within statutory limits	Discharges are expected to be within statutory limits	Occasional breach(es) of statutory discharge limits (limited periods) expected	Repeated breaches of statutory discharge limits (over extended periods) expected
	Abstractions from or discharge to aquifer(s) are unlikely to cause water quality issues.	Groundwater quality be within ambient levels or allowable criteria or may exceed for 1-2 parameters which is common occurrence due to geological regime of the area. Abstraction or discharge to aquifer(s) may cause small but local changes in water quality in the aquifer system. These can be considered potential short-term localized effects on groundwater quality which is likely to return to equilibrium conditions within a short (months) timeframe.	Groundwater quality exceeds ambient levels or allowable criteria for key parameters. Abstraction or discharge to aquifer(s) are expected to cause potential localized effects on groundwater quality which are likely to be fairly long lasting and / or give rise to indirect ecological and / or socio-economic impacts.	Groundwater quality exceeds ambient levels or allowable criteria. Abstractions or discharge to aquifer(s) are expected to cause potentially severe effects on groundwater quality which are likely to be long-lasting (e.g. years or permanent) and / or give rise to indirect ecological and / or socio-economic impacts.

8.3.5.1 Impact on Water Quality

Construction Phase

Context

There is a potential for contamination of surface and groundwater resources resulting from improper management of sewage at project site office or other accidental spills/leaks at the storage areas. Few water bodies lies within study area of the project, whereas its micro drainage channels lies near the proposed project site therefore the likelihood of impact to surface water body resources is **medium.**

As per results of groundwater and surface water sample test results, it was understood that surface water the area is not potable and borewell water is not used for drinking. Therefore, the receptor sensitivity is assessed to be **medium** and the impact magnitude is assessed to be **moderate to minor.**

Embedded/in-built control

- Provision of septic tank and soak pits onsite for treatment and disposal of sewage, thereby minimizing the impacts of wastewater discharge. Planning of toilets, soak pits and septic tanks, waste collection areas should be away from natural drainage channels;
- Ensure proper cover and stacking of loose construction material at Batching plant site and WTG's site to prevent surface runoff and contamination of receiving water body;
- Use of licensed contractors for management and disposal of waste and sludge;
- Labourers will be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage will be strictly restricted; and
- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages.

Impact Significance

Based on the above the impact is assessed to be **moderate**- **minor**.

Additional Mitigation Measures

As the impacts is sufficiently addressed by the embedded controls, the requirement of additional mitigation measures is not foreseen for this impact.

Residual Impact Significance

Residual significance of impacts during construction phase will be **negligible.**

Table 8.17 Impact on water quality during the construction phase.

Impact	Water Quality				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Construction Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High

Residual Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **minor**			

Operation Phase

Context

During operation phase, wastewater generation is expected to be nil from the power generation process. Only sewage would be generated from substation and SCADA building, this will also be of negligible quantity.

According to CPCB, per capita wastewater generation projected for year 2021 is around 121litre/capita/day based on the average wastewater generation observed during the studies carried out by the board.

Embedded/in-built control

- The drainage and sewerage system will be provided for the collection and treatment of waste water at the SCADA building and substation areas; and
- No wastewater discharge on open land will be practiced.

Impact Significance

The overall significance of impacts on water quality due to operational activities is envisaged to be **negligible.**

Additional Mitigation Measures

As the impact is sufficiently addressed by the embedded controls the requirement of additional mitigation measures is not foreseen for this impact.

Residual Impact Significance

The significance of the residual impacts is envisaged to be **negligible**.

Table 8.18 Impact on water quality during operation phase

Impact	Water Quality				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to SCADA office and pooling substation building				
Frequency	Operation Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Negligible**				

Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Decommissioning Phase

No impact to water resource are envisaged during decommissioning phase of the project.

8.3.5.2 Impact on Water Availability

Context

Water is a prime requirement for the execution of civil works, especially with regard to preparation of raw materials like concrete etc. for civil works associated with the Project (i.e. WTG foundation casting, construction of proposed site office, SCADA room). Approximately 130 KL/day of water will be required for civil works during the construction. Approximately 8 KLD of water will be required for dust suppression activities. Tanker water through authorised vendors will be the main source of water for construction activity while bottled water will be used for drinking purpose. Use of surface water is not proposed for the Project.

Since groundwater resources will be utilized for the project activities, the receptor sensitivity is assessed to be **High.** However, since the construction phase of the Project will last for a short period of time (10-12 months), therefore, magnitude of impact is assessed as **medium**.

Embedded/in-built control

Water tankers should be utilised to fulfil supply required for all purposes, including construction work and site office and local surface water bodies should not be utilised for these purposes.

Impact Significance

As per report on Aquifer mapping and Ground Water Management for taluka Gadag by CGWB[1], 2017 the proposed project taluka lies in 'Over-exploited' category. As per Ground Water Management for district Mundaragi by CGWB[2], 2017, Mundaragi taluka lies in semi-critical category.
As per discussion with villagers it was noted that villages don't have hand pumps, municipal corporation supplies water for domestic and drinking usage. Bore wells, present in agricultural lands are being used for irrigation purpose. The area is generally dry with little rainfall. Seasonal surface water bodies were observed during ERM site visit. The direct negative impact on water resources due to construction activities will be short term and limited mainly to construction phase of the project. Based on the above the impact is assessed to be **major**.

Additional Mitigation Measures

Following mitigation measures are proposed for conservation of water resources of the area:

- Construction labour deputed onsite to be sensitised about water conservation and encouraged for optimal use of water;
- Regular inspection for identification of water leakages and preventing wastage of water from water supply tankers is necessary for efficient utilisation of water;

[1] http://cgwb.gov.in/AQM/NAQUIM_REPORT/karnataka/gadag.pdf
[2] http://cgwb.gov.in/AQM/NAQUIM_REPORT/karnataka/Mundargi_report.pdf

- It should be ensured that water supply for the Project to be procured from CGWB/CGWA /SGWA approved suppliers and the approval copy of the same to be maintained to ensure the right source;
- Blending of low quality water with fresh water for construction uses to ensure efficient use of natural resource.
- Recycling/reusing to the extent possible.

Residual Impact Significance

The significance of impact is envisaged to be **moderate** on implementation of mitigation measures.

Table 8.19 Decreased water availability during the construction phase

Impact	Water Resource Availability				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Construction Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **major**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **moderate**				

Operation Phase

Context

During the operation phase of this project, an estimate of 5-7 KL of water would be required during operation phase to meet domestic requirements of O&M staff and for use in the SCADA building and sub-station complex.

Embedded/in-built control

- Domestic water demand should be met through tankers and bottled potable water purchased and/ or water treatment plants, if available in the surrounding areas;
- Optimising water usage in the SCADA building and substation area by application of water conservation measures such as sensor based taps, low flush urinals etc.

Impact Significance

The overall significance of impacts on water availability due to operational activities is envisaged to be **negligible.**

Additional Mitigation measures

As the impact is sufficiently addressed by the embedded controls additional mitigation measures are not foreseen for this impact.

Residual Impact Significance

The significance of the residual impact is envisaged to be **negligible**

Table 8.20 Impact on water availability during operation phase

Impact	Water Availability				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Operation Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Decommissioning Phase

No impact to water resource are envisaged during decommissioning phase of the project.

8.3.6 Impact on Air Quality

The impact assessment with respect to air quality of the study area has been undertaken for the project activities described below:

- Construction activities including site preparation, construction of WTG foundation, erection of internal and external transmission line, construction of office building;
- Transportation of WTG components, construction material, construction machinery and personnel;
- Operation of batching plant;
- Operation of DG sets for emergency power backup;

- Operation and maintenance activities during operation phase; and
- Decommissioning activities.

Criteria

For the assessment of air quality, the sensitivity and magnitude criteria outlined in ***Table 8.21*** and ***Table 8.22***, respectively, have been used.

The air quality impacts associated with the construction activities have been assessed qualitatively, using professional judgement and based on past experience from similar projects.

Table 8.21 Sensitivity Criteria for Air quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	***Ecological Receptors***
Low	Locations where human exposure is transient.[1]	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Few Receptors settlements) within 500 m of project activity area as roads, batching plant, WTG s etc.	Nationally designated sites.
High	Densely populated receptors (settlements) within 500 m of project activity area as roads, batching plant, WTG s etc.	Internationally designated sites.

Table 8.22 Criteria for Impact Magnitude for Assessment of Impact to Air Quality (Construction Phase)

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

Construction Phase

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

- Fugitive dust emissions from site clearing, excavation work, cutting and levelling work at WTG sites and access/ internal roads, TL tower foot print, stacking of soils, handling of construction material, transportation of material, emission due to movement of vehicles and heavy construction machinery etc.;
- Vehicular emissions due to traffic movement on site and on access roads;

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

- Particulate emissions from operation of batching plant;
- Exhaust emissions from construction machineries, other heavy equipment like bull dozers, excavators, and compactors; and
- Emissions from emergency power diesel generator required during construction activity.

The WTGs are spread across a larger area and the air quality impacts would be confined to 500 m of the construction activity area, batching plant and material storage area and will not have any long term impact on the ambient air quality of the area. Also the excavation for WTG's locations will be undertaken in a phased manner.

Receptors

There are few receptors has been observed to exist within the 500 m radius of the WTGs, which includes residential cluster and apartment complex, agricultural sheds. Details of the same have been provided in **Table 2.3**.

Embedded/in-built control

- Preventive measures such as storage of construction material in sheds, covering of construction materials during transportation will be undertaken for reducing dust as part of the embedded controls;
- Minimize stockpiling by coordinating excavations, spreading, re-grading and compaction activities;
- Speed of vehicles on site will be limited to 10-15 km/hr which will help in minimizing fugitive dust emissions due to vehicular movement;
- Emissions from the emergency D.G. set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained;
- Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures;
- Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate; and
- Idling of vehicles and equipment will be prevented

Impact Significance

The impact on air quality will be local and short-term, restricted to the construction period. The overall impacts are envisaged to be **minor.**

Residual Impact Significance

The residual impact due to the Project on air quality is envisaged to be **negligible.**

Table 8.23 Impact on air quality during construction phase

Impact	Ambient Air Quality			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Limited to Project area and immediate vicinity			
Frequency	Construction Phase			

Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Operation Phase

Source of Impacts

As the Project is a renewable and clean energy development project, the operation phase will be largely free from air emissions and therefore envisaged to be **negligible**.

Decommissioning Phase

The decommissioning activities will have limited impact on the air quality of the area and will be mainly in form of dust emissions due to demolition of office building. The increased vehicular movement for transportation of dismantled WTGs, demolition debris, and scrap materials will also generate fugitive dust emissions.

Significance of Impact

The impact on air quality during decommissioning phase of the Project is assessed to be **minor.**

Additional Mitigation Measures

The following mitigation measures are proposed to reduce impact significance on air quality for the decommissioning phase:

- Barricading the demolition areas;
- Speed of vehicles on site will be limited to 10-15 km/hr which will help in minimising fugitive dust emissions due to vehicular movement;
- Cease or phase down work if excess fugitive dust is observed, investigate source and take suppression measures;
- Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate; and
- Prevent idling of vehicles and equipment.

Residual Impact Significance

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

Table 8.24 Impact on air quality during decommissioning phase

Impact	Ambient Air Quality

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

8.3.7 Visual Impacts and Landscape

Visual impacts are assessed with reference to installation of WTGs, clearance of vegetation for access roads/ transmission lines, erection of ancillary facilities, laying of transmission lines/towers and the temporary presence of a construction site. The visual impacts are evaluated with reference to passing motorists and fixed settlements, primarily the villages present in the vicinity. The Project site is located on flat to undulated land and is visible from considerable distance along the village roads present within the study area. There will be a significant change to visual quality of the area resulting from the development and change in land use that will alter the landscape. Changes in the visual landscape will range from construction phase to commissioning of the turbines and further during operations. An operational wind plant of Wind World is situated in close proximity to the proposed project site.

Receptors

The visual impacts will be perceived by two types of receptors during the construction and operational phases, namely:

- Receptors located at a fix point, such as settlements in the study area; and
- Receptors temporarily viewing the wind plant, such as passing motorists.

Construction Phase

The Project site is located in a rural area and devoid of any high rise/large/ prominent structures visible from a far off distance. Although the turbines will be manufactured off-site and the construction phase will be relatively for a short duration, large equipment's or infrastructure such as cranes, dumpers, transportation vehicles will be required on site during the erection of the WTGs. The significance of the visual impacts will decrease with increasing distance from the Project site.

During the construction phase, visual impact due to the presence of Project infrastructure such as batching plant, labour camp, construction material storage area, temporary site office in the Project site are anticipated.

Impact Significance

The construction phase visual impacts will be slight to moderately significant for fixed receptors. The Project components such as batching plant, site office and construction material storage yard will be located away from the settlements. The visible Project components such as WTG parts, large cranes and vehicles will be visible from surrounding area only for short duration on a particular WTG location. Large cranes and vehicles will keep shifting from one WTG location to another during the construction phase. Temporary receptors will be impacted only while passing through the area. The extent of the visual impacts will be localized. The overall impact significance change in visual landscape without any mitigation measures during construction phase is assessed as **minor**.

Mitigation Measures

The following mitigation measures should be implemented to minimize potential of visual impacts during construction phase:

- The area of the site office, SCADA room and storage yard should be limited to the extent necessary;
- Minimize presence of ancillary structure on site, avoid fencing and minimize access road disturbances; and
- After completion of construction works, areas utilized for batching plant, labour camp and stockyard should be restored to original form keeping in mind the visual aesthetics of the area.

Residual Impact Significance

After implementation of mitigation measures, residual impacts will reduce to **negligible.**

Table 8.25 Impact on visual aesthetics during the construction phase

Impact	Visual impacts and landscape				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project area				
Frequency	Construction Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Operation Phase

Land where WTGs are located comprises of flat terrain which is primarily the agricultural land. During the site visit, structures were observed to be present within 300 m setback distance of the WTGs that form the scope of the assessment. Presence of a structure of height 90 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. Also the project site and surrounding area has operational wind power plant of Wind World presently near the project. Consultation in the villages in the study area showed that the majority of the people in the villages did not find the wind turbines unattractive and rather felt that it did not have any impact on their perception. 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. Also, the visual nature of the turbines was not a major issue because, their concerns were largely related to other issues like financial issues that affected their immediate existence.

Impact Significance

The most prominent source of visual impact during the operational phase is the presence of the wind turbines and the assemblage of transmission lines that evacuate to the Pooling substation and eventually to the grid substation. Assessing the visual impacts is highly subjective, as it depends on the perception of the viewer. People's attitude can differ and presence of wind plant can be viewed as both a positive and a negative impact on the surrounding area. In addition to this, the perception of the villagers of the existing wind plant in the area remains to be seen, during the operation phase of the project. In view of above, impact significance of visual impacts during the operational phase of the Project has been assessed as **minor.**

Mitigation Measures

The following mitigation measures should be implemented to minimize potential of visual impacts during operational phase:

- Signage related to the wind plant should be discrete and confined to entrance gates. No other corporate or advertising signage, particularly billboards to be displayed on site;
- The footprint of operations and maintenance facilities as well as parking and vehicular circulation should be clearly defined and not be allowed to spill over into other areas of the site; and
- Use of certain colours reduces the visual contrast between turbine structures and background (e.g. light grey rather than an off white and use of matt finish to avoid reflection of sunlight).

Residual Impact Significance

After implementation of mitigation measures, residual impacts will be **negligible.**

Table 8.26 Impact on visual aesthetics during the operation and maintenance phase

Impact	Visual Impacts during O&M phase			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	

Impact Scale	Up to 5-6 km depending on the terrain				
Frequency	Operation Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Negligible**				

8.3.8 Occupational Health & Safety

Occupational health and safety needs to be monitored for several activities anticipated for the Project:

Context

- Working at height during erection of WTGs, transmission towers and establishment of transmission lines;
- Working in confined spaces within the WTGs and pooling substation;
- Working with rotating machinery including the batching plant, rollers and layers; and
- Working with live electrical components – transmission towers, lines and WTG internal electrical parts.

The Project site also needs to implement proper measures for fire safety, public accessibility, falling objects, structural safety, use of adequate PPEs, management of labour camps and any emergencies.

The occupational health and safety concerns mentioned above would be consistent across the Project life cycle and therefore the impacts would be similar in nature.

The Project site will also implement proper measures for fire safety, structural safety and any for emergency situations. Therefore, the receptor sensitivity is assessed to be **medium.** Since the construction related activities will last for a short duration (i.e. 10-12 months), the impact magnitude is assessed to be **small.**

Embedded/In-built Controls

- All construction activities should be carried out during daytime hours and vigilance should be maintained for any potential accidents;
- Personal Protective Equipment (PPEs) including safety shoes, helmet, goggles, ear muffs and face masks;
- Structural integrity should be checked before undertaking any work;
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes; and
- Well managed labour camps with adequate lighting and ventilation, availability of first aid facility, sanitation and drainage facilities, firefighting arrangement, emergency preparedness and response plan, availability of adequate potable water etc.

Significance of Impact

Ayana has contractor safety management plan, quality, health, safety and environment plan (QHSE) in-place. The impact significance on occupational health and safety is therefore assessed as **minor.**

Mitigation Measures

- All workers (regular and contracted) should be provided with training on Health and Safety policies in place with appropriate refresher courses throughout the life cycle of the Project;
- Permitting system should be implemented to ensure that cranes and lifting equipment is operated by trained and authorized persons only;
- Appropriate safety harnesses and lowering/raising tools should be used for working at heights;
- Safe drinking water supply should be provided for the workers;
- Security should be deputed at potential accident sites to restrict entry and prevent near miss or fatal incidents;
- An up-to-date first aid box should be provided at all construction sites and a trained person should be appointed to manage it;
- All equipment should be turned off and checked when not in use; and
- A safety or emergency management plan should be in place to account for natural disasters, accidents and any emergency situations. The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan.

Table 8.27 Impact on Occupational Health and Safety during Construction, Operation, Maintenance and Decommissioning Phases

Impact	Occupational health and safety in windplant construction, operation, maintenance and decommissioning.			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	The project will employ local workers primarily on a contractual basis, including semi-skilled and unskilled workers. Skilled workers may be migratory workers as and when is needed by Ayana and its EPC contractors			
Frequency	Throughout the project life cycle			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Vulnerability of Receptors	Low	Medium	High	
	The erection of WTGs will be done through experienced and trained workers. However, construction of other components will involve local workers who may not have earlier experience. Hence, there will be greater vulnerability for accidents.			
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is assessed to be **minor**			
Residual Magnitude	Positive	Negligible	Small	Medium
Residual Impact Significance	Negligible	Minor	Moderate	Major
	Significance of residual impact is assessed to be **negligible**			

8.3.9 Impact on Ambient Noise Levels

The source of ambient noise impact will vary from phase to phase. The phase-wise project impact assessment is given in subsequent sections.

Construction Phase

Context

The project is located in rural setting and therefore prescribes to CPCB and WHO standards set for residential areas (Day time L_{eq} = 55).

Baseline Conditions

The noise monitoring on the Project Site (see Section 6.4.7) shows that noise levels in the selected points across the study area falls below CPCB/ WHO standards at all locations.

Receptors

With respect to human receptors, there are receptors in the Project area and has been elaborated upon in Section 2 of this Report.

Construction Phase activities

The list of project activities that might result in noise impacts is given below:

- Noise from heavy vehicular traffic movement;
- Noise from increased workforce and construction/demolition;
- Noise from cranes, drillers, bulldozers, excavators, etc.; and
- Noise from D.G. sets.

Construction work is expected to last for approximately 10-12 months and construction activities will be restricted to day time. Noise generation from select construction equipment and machinery utilized in the construction of a wind plant are presented in ***Table 8.28***. Specific information about types, quantities, and operating schedules of the construction equipment was not available at the time of assessment and therefore, assumptions have made regarding the type, number and Sound Power Levels (SPLs) of construction equipment, based on similar projects and publicly available data. It has been assumed that only one of each type of equipment will be on-site during any day or night period. Re-assessment of noise levels may be required if the actual construction equipment inventory and SPL vary from the assumed list.

Table 8.28 Assumed construction equipment sound pressure level inventory

Construction Equipment	Average Noise Level at 50ft [dB(A)]
Bulldozer	82
Backhoe	78
Loaders	79
Vibratory roller	102
Fuel truck	85
Cranes	81
Dump truck	76
Grader	85

Construction Equipment	Average Noise Level at 50ft [dB(A)]
Compressors	78
Generators	85
Rock drill	81
Grader	85
Concrete mixer truck	79
Concrete pump truck	81
Scraper	85

Source: The SPLs of the construction equipment have been taken from FHWA noise specification 721.560[1] and ERM's internal database

Impact Significance

The WTGs are located in the vicinity of the settlements as described in Section 2 of the report. With respect to the human receptors, residential cluster of Lakkundi village, Hatelgeri village, Harlapur village are located within core area. The construction work that is expected to produce noise levels will be limited to a period of 10-12 months (across the project area) and this will vary from WTG locations to location in a phased manner (ranged from 1 to 2 months). However, as per the ambient noise levels results presented in **Table 6.11**, the results have been observed to be below the CPCB and WHO limits at all locations. Taking the above fact into consideration, the overall impact significance for ambient noise levels during the construction phase has been assessed to be **minor**.

Mitigation Measures

The following mitigation measures are proposed to reduce noise impacts on surrounding receptors during the construction of the Project:

- Limit the number of heavy vehicles required for the Project to only those that are necessary;
- Access roads for the Project should avoid villages and communities to prevent noise from heavy vehicular traffic to the extent possible;
- Heavy vehicles should limit use of engine breaking to prevent excessive noise;
- All construction work should be carried out during daytime hours (6:00 am to 10:00 pm as per CPCB limits); and
- Vehicles and equipment used for the Project should be well maintained and oiled to prevent excess noise during construction.

Residual Impact Significance

After implementation of mitigation measures, the significance of residual impacts will be **minor.**

Table 8.29 Impact as a result of generation of noise from construction activities and transportation of man/ material

Impact	Noise Generation			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

[1] Construction Noise Handbook. FHWA-HEP-06-15; DOTVNTSC-FHWA-06-02; NTIS No. PB2006-109102. Final Report August 2006 (updated5/20/2010). <http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook

Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project footprint area and surrounding communities				
Frequency	Construction Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor**				

Operation Phase

Criteria

The ambient noise levels have been assessed with respect to Noise Pollution (Regulation and Control) Rules, 2000 and WHO Guidelines as shown in ***Table 8.30*** and ***Table 8.31*** respectively.

Table 8.30 Ambient noise quality standards (1)

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

Note:

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

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

Table 8.31 Noise emission criteria

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

(1) *Source: Schedule of The Noise Pollution (Regulation and Control) Rules, 2000 vide S. O. 123(E), dated 14.2.2000 and subsequently amended vide S.O. 1046(E), dated 22.11.2000, S.O. 1088(E), dated 11.10.2002, S.O. 1569 (E), dated 19.09.2006 and S.O. 50 (E) dated 11.01.2010 under the Environment (Protection) Act, 1986*

Location	Noise Level Limit (dB(A)	
	Daytime (0700 – 2200 hrs)	Night-time (2200 – 0700 hrs)
Residential; institutional; educational	55	45

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

The above standards have been utilized to create a sensitivity criteria for ambient noise (***Table 8.32***) and criteria for impact magnitude for assessment of impact to ambient noise (***Table 8.33***).

Table 8.32 Sensitivity criteria for ambient noise

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

Table 8.33 Criteria for impact magnitude for assessment of impact to ambient noise

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

Receptor Sensitivity

The receptor sensitivity has been assessed as **medium** as per the criteria set in ***Table 8.32*** as some of the proposed WTG (9) locations are having two residential, four religious, two cattle shed and one abandoned structure within the impact zone of 300 m of setback distance.

Sources of Wind Turbine Sound

The emanation of noise form the operation of WTGs is of the following two types: (a) mechanical noise, from interaction of turbine components; and (b) aerodynamic noise, produced by the flow of air over blades. Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearbox
- Generator

- Yaw drives
- Cooling fans
- Auxiliary equipment (e.g. hydraulics)

Aerodynamic sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. Aerodynamic sound generally increases with rotor speed.

The Project will have approximately 90 WTGs. All the proposed WTGs will be of rated capacity 3.3 MW each and rotor diameter of 156 m. The hub height of all the WTGs will be 140 m. The noise generation from the turbines have been taken into consideration during strong wind conditions (with wind velocity $\geqslant$ 8 m/s at 10 m height, which is equivalent to about 11.5 m/s at hub height) for the noise assessment to consider worst case scenario.

Receptors

A total of 72 receptors are considered in the noise study present within 500 m of the WTGs are considered as noise sensitive receptors in this study. Most of these receptors appear to agricultural sheds.

Embedded/in-built control

- Efforts shall be made to select locations that will have no/ negligible impact of noise;
- Regular maintenance of WTGs; and
- Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification.

Prediction of Impacts

Methodology: The environmental noise prediction module (NORD 2000) of WindPro 3.2 was used for modelling noise emissions from the WTGs. In order to consider worst case scenario (with strong wind conditions), it has been assumed that the WTGs are operational at standardised wind speed of $\geqslant$ 6 m/s at 10 m height[1]. Operating of WTGs with 100% usage scenario was modelled to cover the operation phase of the Project. In addition, to represent a worst-case scenario for the assessment, all WTGs were assumed to be operating simultaneously and for 24 hours. Noise generation had been considered at the hub height of 140 m above ground. Local terrain has been considered for putting noise sources as well as receptors in the model. It has been assumed that the noise sensitive receptors are always in downwind direction to consider the worst case scenario. The geo-profile of the area has been considered to define the area types and relative roughness and surface hardness in order to consider the surface absorption and reflection.

Predicted Noise Levels at Receptors: The predicted noise levels within the study domain at 10 receptors during day and night-time with cloudy conditions (which provide a stable atmospheric condition and is suitable for worst case consideration) and with strong wind conditions are presented in ***Table 8.34***.

[1] IEC profile shear has been considered as z0 = 0.05 m

Table 8.34 Predicted Noise Levels at Noise Sensitive Receptors during Operation Phase with Strong Wind Conditions

Receptor Code	Receptor type		Latitude	Longitude	Nearest Noise Monitoring Location	Sound level from WTGs dB(A)/ incremental / predicted noise at the Receptor	Baseline Noise Levels dB(A)		Combined Noise Levels dB(A)		Applicable Standard as per Land use dB(A)*,#	
							Day	Night	Day	Night	Day	Night
A	Residential colony	Permanent	75°40.1082' E	15°26.9887' N	NQ 4	41.5	54.1	43.1	54.33	45.38	55	45
B	Agricultural Shed	Temporary	75°41.5524' E	15°25.7281' N	NQ 4	50.5	54.1	43.1	55.67	51.23	55	45
C	Residential structure	Permanent	75°41.5100' E	15°25.3444' N	NQ 4	46.8	54.1	43.1	54.84	48.34	55	45
D	Residential structure	Permanent	75°41.4899' E	15°25.3308' N	NQ 4	46.5	54.1	43.1	54.80	48.13	55	45
E	Residential structure	Permanent	75°41.4491' E	15°25.3286' N	NQ 4	46.2	54.1	43.1	54.75	47.93	55	45
F	Residential structure	Permanent	75°41.4814' E	15°25.2794' N	NQ 4	45.8	54.1	43.1	54.70	47.67	55	45
G	Residential structure	Permanent	75°41.6581' E	15°25.1470' N	NQ 4	45.9	54.1	43.1	54.71	47.73	55	45
H	Residential structure	Permanent	75°41.0967' E	15°25.0432' N	NQ 4	48.5	54.1	43.1	55.16	49.60	55	45
I	Agricultural Shed	Temporary	75°41.0332' E	15°25.0736' N	NQ 4	49.2	54.1	43.1	55.32	50.15	55	45
J	Agricultural Shed	Temporary	75°42.5979' E	15°27.9990' N	NQ 4	43.8	54.1	43.1	54.49	46.47	55	45
K	Agricultural Shed	Temporary	75°42.2922' E	15°24.1086' N	NQ 1	48	53.5	44.6	54.58	49.63	55	45

Receptor Code	Receptor type		Latitude	Longitude	Nearest Noise Monitoring Location	Sound level from WTGs dB(A)/ incremental / predicted noise at the Receptor	Baseline Noise Levels dB(A)		Combined Noise Levels dB(A)		Applicable Standard as per Land use dB(A)*,#	
							Day	Night	Day	Night	Day	Night
L	Agricultural Shed	Temporary	75°42.1589' E	15°23.7250' N	NQ 1	50.9	53.5	44.6	55.40	51.81	55	45
M	Agricultural Shed	Temporary	75°42.2134' E	15°23.6553' N	NQ 1	54.1	53.5	44.6	56.82	54.56	55	45
N	Agricultural Shed	Temporary	75°42.0676' E	15°23.5817' N	NQ 1	49	53.5	44.6	54.82	50.35	55	45
O	Agricultural Shed	Temporary	75°41.9368' E	15°23.6101' N	NQ 1	46.3	53.5	44.6	54.26	48.54	55	45
P	Agricultural Shed	Temporary	75°42.3478' E	15°23.4068' N	NQ 1	49	53.5	44.6	54.82	50.35	55	45
Q	Agricultural Shed	Temporary	75°42.1203' E	15°23.2340' N	NQ 1	49.8	53.5	44.6	55.04	50.95	55	45
R	Agricultural Shed	Temporary	75°42.1275' E	15°23.2832' N	NQ 1	49.8	53.5	44.6	55.04	50.95	55	45
S	Storage yard	Permanent	75°42.4468' E	15°23.1803' N	NQ 1	47.8	53.5	44.6	54.54	49.50	55	45
T	Agricultural Shed	Temporary	75°42.2935' E	15°23.1063' N	NQ 1	49.9	53.5	44.6	55.07	51.02	55	45
U	Agricultural Shed	Temporary	75°42.2305' E	15°23.0930' N	NQ 1	49.5	53.5	44.6	54.96	50.72	55	45
V	Agricultural Shed	Temporary	75°42.3428' E	15°23.0973' N	NQ 1	49	53.5	44.6	54.82	50.35	55	45
W	Agricultural Shed	Temporary	75°42.3443' E	15°22.9759' N	NQ 1	48.2	53.5	44.6	54.62	49.77	55	45
X	Agricultural Shed	Temporary	75°42.4370' E	15°22.8622' N	NQ 1	48.6	53.5	44.6	54.72	50.06	55	45

Receptor Code	Receptor type		Latitude	Longitude	Nearest Noise Monitoring Location	Sound level from WTGs dB(A)/ incremental / predicted noise at the Receptor	Baseline Noise Levels dB(A)		Combined Noise Levels dB(A)		Applicable Standard as per Land use dB(A)*,#	
							Day	Night	Day	Night	Day	Night
Y	Agricultural Shed	Temporary	75°41.5400' E	15°22.3874' N	NQ 3	49.5	54	43.5	55.32	50.47	55	45
Z	Agricultural Shed	Temporary	75°41.7835' E	15°22.4401' N	NQ 3	50.4	54	43.5	55.57	51.21	55	45
AA	Agricultural Shed	Temporary	75°41.6868' E	15°22.5943' N	NQ 3	48.1	54	43.5	54.99	49.39	55	45
AB	Agricultural Shed	Temporary	75°41.5210' E	15°22.6282' N	NQ 3	45.4	54	43.5	54.56	47.56	55	45
AC	Agricultural Shed	Temporary	75°41.8373' E	15°22.5573' N	NQ 3	47.2	54	43.5	54.82	48.74	55	45
AD	Agricultural Shed	Temporary	75°41.5528' E	15°22.2712' N	NQ 3	47.2	54	43.5	54.82	48.74	55	45
AE	Agricultural Shed	Temporary	75°41.8623' E	15°22.4244' N	NQ 3	48.3	54	43.5	55.04	49.54	55	45
AF	Farm house	Permanent	75°41.1709' E	15°22.0394' N	NQ 3	38.9	54	43.5	54.13	44.79	55	45
AG	Residential structure	Permanent	75°42.4518' E	15°21.4681' N	NQ 3	44.4	54	43.5	54.45	46.98	55	45
AH	Agricultural Shed	Temporary	75°42.3828' E	15°21.5058' N	NQ 3	45.1	54	43.5	54.53	47.38	55	45
AI	Agricultural Shed	Temporary	75°42.1973' E	15°22.0003' N	NQ 3	47	54	43.5	54.79	48.60	55	45
AJ	Agricultural Shed	Temporary	75°42.1371' E	15°22.0224' N	NQ 3	47	54	43.5	54.79	48.60	55	45
AK	Agricultural Shed	Temporary	75°42.1464' E	15°21.5271' N	NQ 3	44.6	54	43.5	54.47	47.10	55	45

Receptor Code	Receptor type		Latitude	Longitude	Nearest Noise Monitoring Location	Sound level from WTGs dB(A)/ incremental / predicted noise at the Receptor	Baseline Noise Levels dB(A)		Combined Noise Levels dB(A)		Applicable Standard as per Land use dB(A)*,#	
							Day	Night	Day	Night	Day	Night
AL	Agricultural Shed	Temporary	75°42.2676' E	15°21.4570' N	NQ 3	44.1	54	43.5	54.42	46.82	55	45
AM	Agricultural shed	Temporary	75°42.8245' E	15°20.4828' N	NQ 3	49.5	54	43.5	55.32	50.47	55	45
AN	Agricultural shed	Temporary	75°42.7933' E	15°20.3852' N	NQ 3	45.4	54	43.5	54.56	47.56	55	45
AO	Fuel station	Permanenrt	75°43.0110' E	15°20.6896' N	NQ 3	48.2	54	43.5	55.01	49.47	55	45
AP	Residential structures	Permanent	75°42.7633' E	15°20.8120' N	NQ 3	44.9	54	43.5	54.50	47.27	55	45
AQ	Residential structures	Permanent	75°43.3760' E	15°26.6972' N	NQ 4	48.3	54.1	43.1	55.11	49.45	55	45
AR	Residential structures	Permanent	75°43.6306' E	15°23.8671' N	NQ 1	45.1	53.5	44.6	54.09	47.87	55	45
AS	Residential structures	Permanent	75°43.7381' E	15°23.8023' N	NQ 1	45.9	53.5	44.6	54.20	48.31	55	45
AT	Residential structures	Permanent	75°43.6975' E	15°23.7171' N	NQ 1	45	53.5	44.6	54.07	47.81	55	45
AU	Agricultural shed	Temporary	75°43.9681' E	15°23.5088' N	NQ 1	47	53.5	44.6	54.38	48.97	55	45
AV	Storage yard	Permament	75°43.6570' E	15°22.0981' N	NQ 3	51.1	54	43.5	55.80	51.80	55	45
AW	Residential structures	Permanent	75°44.1053' E	15°21.5020' N	NQ 3	48.4	54	43.5	55.06	49.62	55	45
AX	Residential structures	Permanent	75°44.1566' E	15°21.4755' N	NQ 3	47.4	54	43.5	54.86	48.88	55	45

Receptor Code	Receptor type		Latitude	Longitude	Nearest Noise Monitoring Location	Sound level from WTGs dB(A)/ incremental / predicted noise at the Receptor	Baseline Noise Levels dB(A)		Combined Noise Levels dB(A)		Applicable Standard as per Land use dB(A)*,#	
							Day	Night	Day	Night	Day	Night
AY	Residential structures	Permanent	75°44.2629' E	15°21.0103' N	NQ 3	45.3	54	43.5	54.55	47.50	55	45
AZ	Residential structures	Permanent	75°44.1683' E	15°20.9142' N	NQ 3	45.6	54	43.5	54.59	47.69	55	45
BA	Agricultural shed	Temporary	75°44.8614' E	15°23.0594' N	NQ 1	45.4	53.5	44.6	54.13	48.03	55	45
BB	Agricultural shed	Temporary	75°45.2495' E	15°22.9078' N	NQ 1	47	53.5	44.6	54.38	48.97	55	45
BC	Residential structure	Permanent	75°45.3542' E	15°22.8795' N	NQ 1	45.6	53.5	44.6	54.15	48.14	55	45
BD	Agricultural shed	Temporary	75°44.4558' E	15°22.2148' N	NQ 3	47	54	43.5	54.79	48.60	55	45
BE	Storage sheds	Temporary	75°45.3826' E	15°21.0024' N	NQ 3	45.8	54	43.5	54.61	47.81	55	45
BF	Agricultural shed	Temporary	75°46.0749' E	15°21.6315' N	NQ 3	44.2	54	43.5	54.43	46.87	55	45
BG	Agricultural shed	Temporary	75°46.0678' E	15°20.6475' N	NQ 3	51.6	54	43.5	55.97	52.23	55	45
BH	Residential structure	Permanent	75°47.0337' E	15°21.5560' N	NQ 2	44	54.8	42.6	55.15	46.37	55	45
BI	Residential structure	Permanent	75°46.9819' E	15°21.6518' N	NQ 2	42.4	54.8	42.6	55.04	45.51	55	45
BJ	Residential structure	Permanent	75°47.2507' E	15°21.6848' N	NQ 2	40.2	54.8	42.6	54.95	44.57	55	45
BK	Residential structures	Permanent	75°46.8519' E	15°21.8000' N	NQ 2	40.8	54.8	42.6	54.97	44.80	55	45

Receptor Code	Receptor type		Latitude	Longitude	Nearest Noise Monitoring Location	Sound level from WTGs dB(A)/ incremental / predicted noise at the Receptor	Baseline Noise Levels dB(A)		Combined Noise Levels dB(A)		Applicable Standard as per Land use dB(A)*,#	
							Day	Night	Day	Night	Day	Night
BL	Temple	Permanent	75°46.6784' E	15°25.8216' N	NQ 2	48.4	54.8	42.6	55.70	49.41	55	45
BM	Residential stuctures	Permanent	75°46.2574' E	15°25.5516' N	NQ 2	46.3	54.8	42.6	55.37	47.84	55	45
BN	Residential stuctures	Permanent	75°46.1963' E	15°25.4181' N	NQ 2	45.5	54.8	42.6	55.28	47.30	55	45
BO	Residential stuctures	Permanent	75°46.2328' E	15°25.3052' N	NQ 2	45.1	54.8	42.6	55.24	47.04	55	45
BP	Residential stuctures	Permanent	75°46.2934' E	15°25.2428' N	NQ 2	44.6	54.8	42.6	55.20	46.72	55	45
BQ	Residential stuctures	Permanent	75°46.3401' E	15°25.1772' N	NQ 2	44.3	54.8	42.6	55.17	46.54	55	45
BR	Temple	Permanent	75°46.2839' E	15°25.0008' N	NQ 2	44.5	54.8	42.6	55.19	46.66	55	45
BS	Agricultural shed	Temporary	75°45.7732' E	15°24.7391' N	NQ 2	50.3	54.8	42.6	56.12	50.98	55	45
BT	Agricultural shed	Temporary	75°45.7844' E	15°24.6778' N	NQ 2	48.7	54.8	42.6	55.75	49.65	55	45

Leq day has been predicted with average temperature of 25°C and clouded sky.

(2) Leq night has been predicted with average temperature of 13°C and clouded sky.

(3) IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:22:00) and night time (22:00-7:00) as 55 and 45 one hour Leq dB(A) respectively. For industrial and commercial receptors it is 70 one hour Leq dB(A) for both night and day time.

(4) Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 as amended in January 2010 based on the *A* weighted equivalent noise level (L_{eq}) for residential areas

Note: Colour coding used to represent exceedance from applicable standards is as follows:

> 10 dB(A)

10 dB(A) < x < 5 dB(A)

5 dB(A) < x < 3 dB(A)

Impact Significance

It is to be noted from ***Table 8.34*** that incremental/ predicted noise level due to WTGs exceeds the limit at 01 location and the exceedance is marginal i.e. less than 3 dB(A) during day time. For the sake of comparison, since majority of the land use is residential, standards/ norms of residential area has been considered i.e. 55 dB(A) during day time. The impact magnitude is considered to be **negligible**. Therefore, the impact of noise on identified receptors due to operation of WTGs during daytime will be **negligible**.

Table 8.35 Impact Significance of Project Induced Noise during daytime

Impact	Noise generation from operation of the WTGs – Day time				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to within 500 m of WTGs.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered as **negligible.**				

During night time impact magnitude of predicted noise levels due to operation of WTGs at 67 receptors (with <3 dB(A) exceedances from baseline) have been noted to be **medium to large**. The receptor sensitivity during night time will vary from **low** to **medium** depending upon receptor distance from the WTGs. Impact significance is assessed to be moderate.
It is understood that most of the receptors are temporary in nature.With the implementation of safeguard measures the residual impact significance is likely to be reduced to **minor**.

Table 8.36 Impact Significance of Project Induced Noise during Night time

Impact	Noise generation from operation of the WTGs – Night time (moderate wind condition)				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to within 500m of WTGs.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered as **moderate** depending upon receptor distance from the WTGs.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
	Negligible	Minor	Medium	Major	

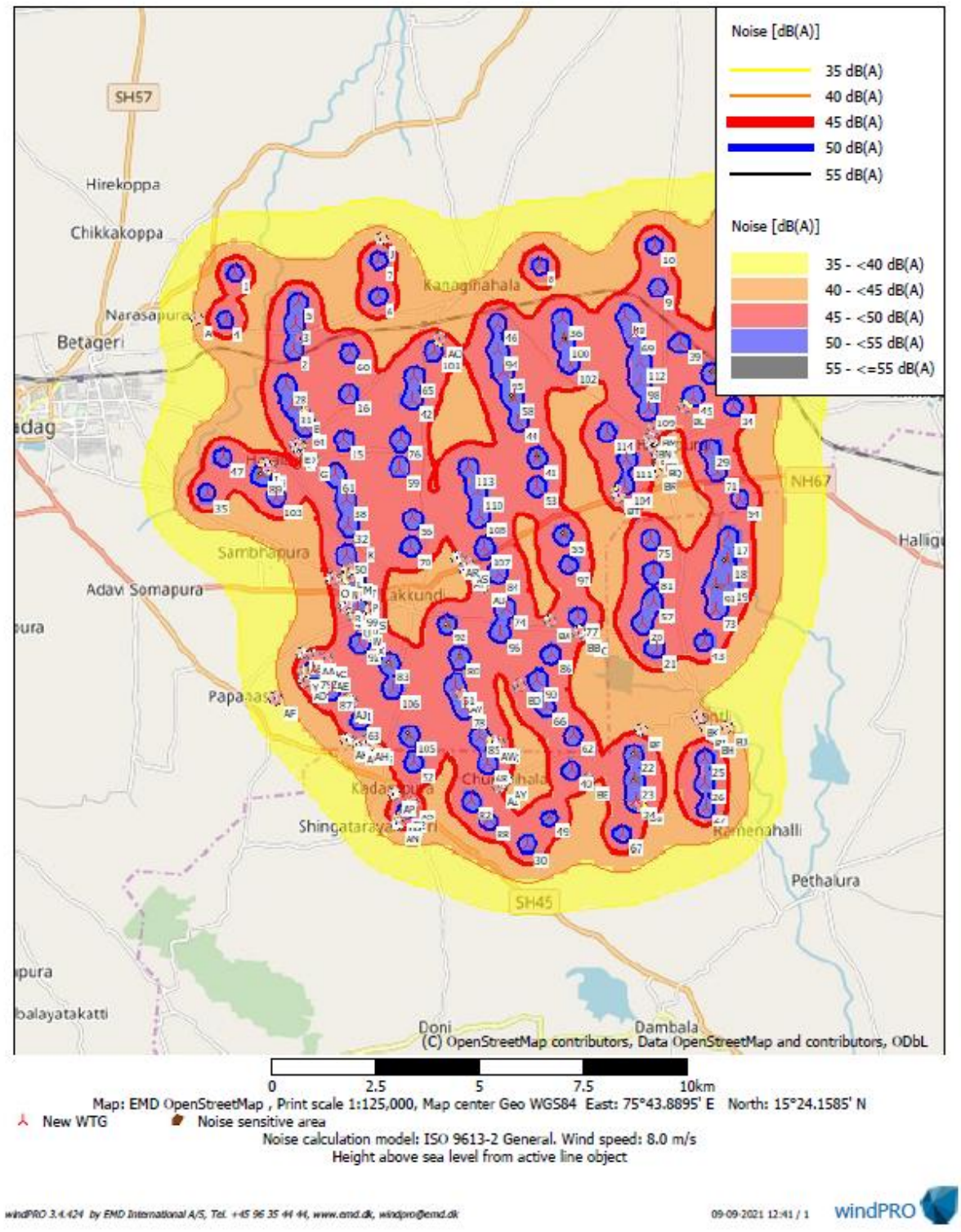
Residual Impact Significance	Significance of impact is considered to be minor depending upon distance of receptor from WTGs

Mitigation Measures

To mitigate operational noise impacts, if any during the operation phase, following measures are proposed:

- Regular maintenance of WTGs.
- Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification.
- Half yearly monitoring of ambient noise levels (during day and night time) at identified residential receptors for determination of actual impact due to operation of WTGs.
- Air tight windows and doors can be provided in the house to reduce noise level during night time. To facilitate air movement within concrete structures, fans and other ventilation structures to be provided.

Figure 8.3 Wind Turbines and noise receptor levels



8.3.10 Shadow Flicker

Shadow flicker is a term used to describe the pattern of alternating light intensity observed when the rotating blades of a wind turbine cast a shadow on a receptor under certain wind and light conditions. Shadow flicker occurs under a limited range of conditions when the sun passes behind the hub of a wind turbine and casts an intermittent shadow over neighbouring properties.

Regulations pertaining to shadow flicker

Indian energy planning and environmental policies and legislations contains no specific shadow flicker requirements and recommendations. 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 (1). They are as follows:

- Shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when potentially sensitive receptors (e.g., residential properties, workplaces, learning and/or health care spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility.
- Potential shadow flicker issues are likely to be more important in higher latitudes, where the sun is lower in the sky and therefore casts longer shadows that will extend the radius within which potentially significant shadow flicker impact will be experienced.
- Where there are nearby receptors, commercially available software can be used to model shadow flicker in order to identify the distance to which potential shadow flicker effects may extend. The same software can typically also be used to predict the duration and timing of shadow flicker occurrence under real weather conditions at specific receptors located within the zone of potential shadow flicker impact.
- If it is not possible to locate the wind energy facility/turbines such that neighbouring receptors experience no shadow flicker effects, it is recommended 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.

Occurrence of shadow flicker in regards to wind power projects

Shadow flicker is most pronounced at sunrise and sunset when shadows are the longest, and at high wind speeds (faster rotating blades leading to faster flicker). There is anecdotal evidence internationally that shadow flicker could lead to stress and headaches. There is also a fear that shadow flicker, especially in the range of 2.5-50 Hertz (2.5-50 cycles per second) could lead to seizures in epileptics and may also scare away livestock.

An analysis of those conditions that may lead to shadow flicker and the location of potential sensitive receptors (residential and community properties) is provided in this section. The timing and duration of this effect can be theoretically calculated from the geometry of the wind turbines, their orientation relative to nearby houses and the latitude of the potential site, using specialised software such as WindPro 3.1. The results provide the total number of hours in a year when a theoretical shadow flicker will occur. However, the actual shadow flicker could be substantially lower compared to theoretical

(1) 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

values because shadow flicker does not occur where there is vegetation or other obstructions between the turbines and the shadow receptors; if windows facing a turbine are fitted with blinds or shutters; or if the sun is not shining brightly enough to cause shadows.

It should be noted that the theoretical calculations done by WindPro does take into account the reduction in shadow flicker due to topographic features, however it does not take into account the reduction in shadow flicker due to these onsite factors i.e. vegetation. Simple geometry relating to the position of the sun and the angle of the turbine blades can also eliminate or significantly reduce the effects of shadow flicker. In addition, shadow flicker will only occur inside the properties where the flicker is occurring through openings (e.g. window, door).

Weather conditions at the site, such as bright sunshine, will greatly enhance the occurrence and intensity of shadow flicker, whereas cloud density, haze or fog will cause a reduction. Receptors further away from the turbines which may have experienced a shadow flicker effect under bright sunshine conditions will, as a result of these weather conditions, experience either no effect or one which is greatly reduced in intensity.

The distance between receptors and turbines has a large effect on the intensity of shadow flicker. Shadow flicker intensity can be defined as the difference in brightness between the presence and absence of a shadow at any given location. This study does not examine variations in intensity but rather the occurrence in number of hours shadow flicker may occur, whether or not this is clearly distinct or barely noticeable. The assessment assumes a conservative worst case of bright sunshine conditions in all periods when flicker may occur.

Due to lack of data regarding epilepsy rates in India and operation levels below of 1 Hz for modern turbines, seizures caused by shadow flicker are considered to be extremely unlikely. The turbines (proposed to be used in this Project) being considered operate at a frequency outside the range where negative health effects may result (1). Potential effects on people are likely to be limited to nuisance.

Considerations and assumptions for the study

Weather conditions at the site, such as bright sunshine, will greatly enhance the occurrence and intensity of shadow flicker, whereas cloud density, haze or fog will cause a reduction. Receptors further away from the turbines which may have experienced a shadow flicker effect under bright sunshine conditions will, as a result of these weather conditions, experience either no effect or one which is greatly reduced in intensity. The distance between receptors and turbines has a large effect on the intensity of shadow flicker. Shadow flicker intensity can be defined as the difference in brightness between the presence and absence of a shadow at any given location. This study does not examine variations in intensity but rather the occurrence in number of hours shadow flicker may occur, whether or not this is clearly distinct or barely noticeable.

Considering all of the above points, the likelihood of shadow flicker occurring is greatest when the circumstances listed below exist simultaneously.

- The receptor is at a position which is between 130° clockwise (2) and anticlockwise from north and located within turbine rotor diameters of the wind turbine (~1500 m).
- The sun is shining and visible in the sky in line with the monthly mean sun-shine hours at nearby location.

(1) See Health and Safety Executive/Local Authority Enforcement Liaison Committee (HELA) circular, entitled 'Disco Lights and Flicker Sensitive Epilepsy' (available at http://www.hse.gov.uk/lau/lacs/51-1.htm). It provides medical details on flicker frequencies likely to give rise to epileptic effects. It states: 'In 1971 the Greater London Council banned the use of flicker rates greater than 8 fps but to be effective the above figures show that any advice on restriction of flicker rate has to limit the frequency to below 5 fps.'

(2) It is acknowledged by this assessment however that India is at lower latitude than the European countries and therefore angles of shadow flicker may be narrower.

- The wind speeds are between 3 m/s and 18 m/s and the turbine is therefore in operation[1].
- The turbine blades are perpendicular to the line between the sun and the observer or receptor most of time.

Standard for shadow flicker

In the Indian context, at present, there is neither regulation nor decided level of shadow flicker identified as causing a significant effect (2). Therefore, IFC EHS Guidelines for Wind Energy dated August 7, 2015 (3) have been followed, which clearly states that if it is not possible to locate the wind energy facility/turbines such that neighbouring receptors experience no shadow flicker effects, it is recommended 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.

Assessment Methodology and Modelling

Shadow flicker calculations have been made using windPRO 3.2.732 SP 3 software. The model used in this analysis is very conservative and assumes the following conditions:

- the average monthly sunshine hours for Gadag (7.75 hours);
- the wind turbines have been considered operational with wind speed more than 3 m/s and for the same, based on annual wind rose and wind frequency data of Gadag, it has been assumed that about 90% time of the year, the wind turbines will be operational;
- the blades of the wind turbines are perpendicular with northwest - southeast orientation have been considered based on the predominant wind direction available from the annual wind rose of Gadag, which could result in maximum possible size circular/ elliptical;
- there are no trees, or vegetation on the surface which may obscure the line of sight between shadow receptor and turbine;
- the sun can be represented as a single point;
- Flicker is ignored if sun is less than 3° above horizon (due to atmospheric diffusion/ low radiation/ sheltering);
- Structures identified within 500 m around the wind turbine locations are considered as shadow receptors.

The following data inputs were used in this study:

- a digital elevation model of the site (National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) Data at 30 m resolution);
- latitude and longitude at centre of the site used to calculate the position of the sun (calculated in GIS using UTM co-ordinates);
- average monthly sun-shine hours recorded;
- turbine locations – coordinates (provided by Ayana);
- turbine rotor diameter for project turbines i.e. Envison EN156-3.3 is 156 m;
- height to bottom of Turbine hub for project turbines is 140 m;
- tilt angle of the 'window' (always assumed vertical);

[1] Envision EN 156-3.3.

(2) Assumption based upon review of the MNRE website and Onshore Wind Energy Policy.

(3) EHS guidelines for wind energy, August 7, 2015. https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy . Accessed 08/09/2021

- shadow receptors contain on openings measuring 1 m by 1 m facing towards the closest wind turbines; and
- height above ground level of the 'window' 1 m.

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non-visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

- Height contours used: Elevation Grid Data Object: KA_Ayana_300MW_EM
- Obstacles used in calculation
- Eye height for map: 1.5 m
- Grid resolution: 1.0 m
- Topographic shadow included in calculation

The model – WindPro Shadow

SHADOW is the WindPro calculation module that calculates how often and in which intervals a specific neighbour or area will be affected by shadows generated by one or more WTGs. These calculations are worst-case scenarios (astronomical maximum shadow, i.e. calculations which are solely based on the positions of the sun relative to the WTG). Shadow impact may occur when the blades of a WTG pass through the sun's rays seen from a specific spot (e.g. a window in an adjacent settlement). If the weather is overcast or calm, or if the wind direction forces the rotor plane of the WTG to stand parallel with the line between the sun and the neighbour, the WTG will not produce shadow impacts, but the impact will still appear in the calculations. In other words, the calculation is a worst-case scenario, which represents the maximum potential risk of shadow impact. A calendar can be printed for any specific point of observation, which indicates the exact days, and time periods where shadow impact may occur.

Apart from calculating the potential shadow impact at a given neighbour, a map rendering the iso-lines of the shadow impact can also be printed. This printout will render the amount of shadow impact for any spot within the project area.

The calculation of the potential shadow impact at a given shadow receptor is carried out simulating the situation. The position of the sun relative to the WTG rotor disk and the resulting shadow is calculated in steps of 1 minute throughout a complete year. If the shadow of the rotor disk (which in the calculation is assumed solid) at any time casts a shadow reflection on the window, which has been defined as a shadow receptor object, then this step will be registered as 1 minute of potential shadow impact. The following information is required:

- The position of the WTGs (x, y, z coordinates)
- The hub height and rotor diameter of the WTGs
- The position of the shadow receptor object (x, y, z coordinates)
- The size of the window and its orientation, both directional (relative to south) and tilt (angle of window plane to the horizontal).
- The geographic position (latitude and longitude) together with time zone and daylight saving time information.
- A simulation model, which holds information about the earth's orbit and rotation relative to the sun.

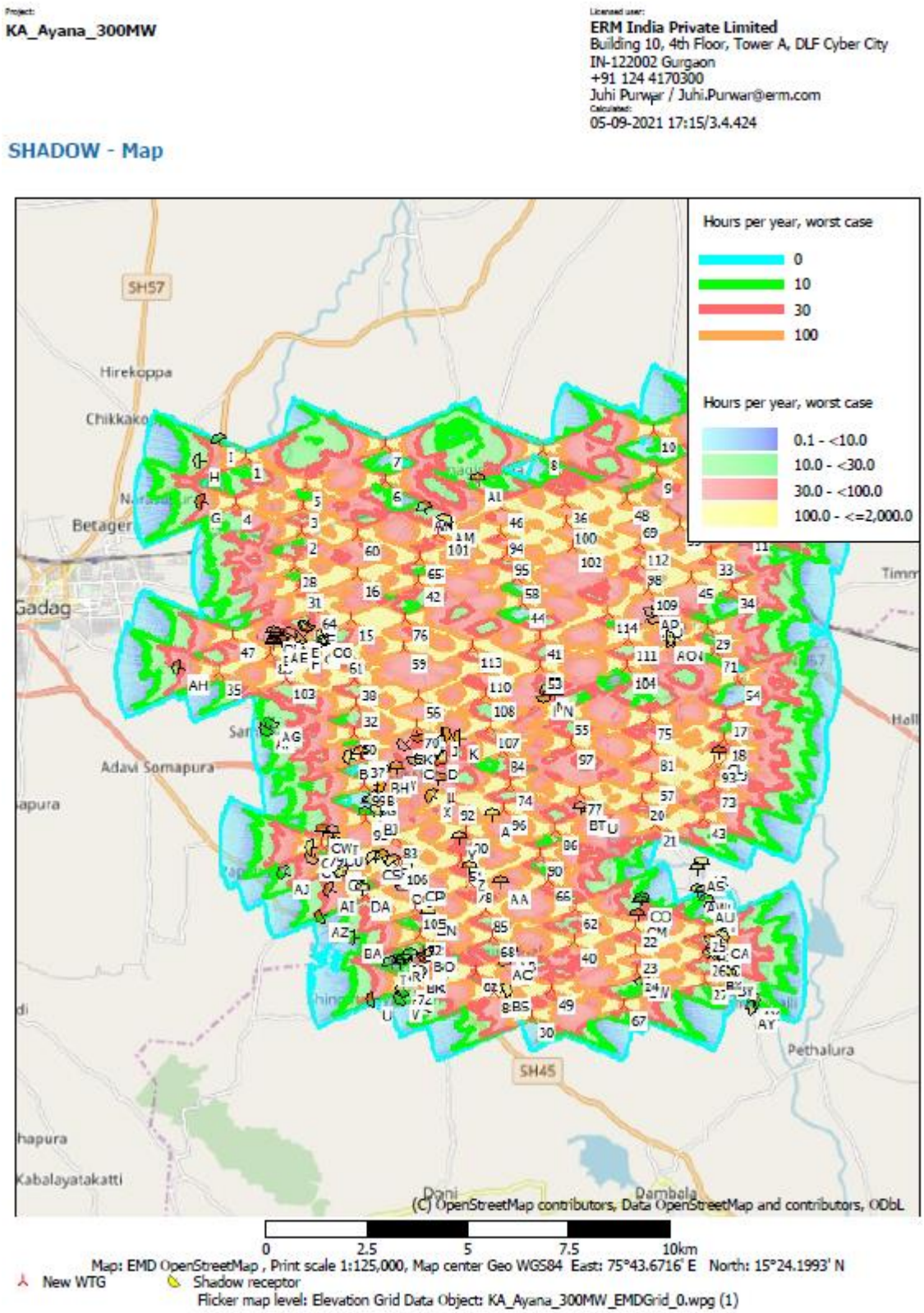
Receptors

The maximum horizontal distance between a receptor affected by shadow flicker and turbine location for example has been identified as being equal to the diameter of the turbine multiplied by ten. In this instance, turbine rotor diameter is 156 m; and therefore an area envelope of 1500 m from the nearest turbine is used in shadow flicker analyses. However, the shadow receptors have been taken into consideration falling within 500 m from each of the WTG as the impact of shadow flicker reduces with distance.

Figure 8.4 presents identified shadow receptors present within 500 m of the wind turbines of the project turbines. A total of 105 receptors[1] have been identified as being within the study area of the wind plantpower project (falling under different villages). All the shadow receptors considered in this study are located within 500 m from any of the WTG location.

(1) [1] The receptors that were identified for this study was obtained from Google earth Imagery dated 24 Dec 2020.

Figure 8.4 Wind turbines and shadow receptors of the Wind Plant



Shadow flicker analysis

Calculated shadow flicker at each identified shadow receptor due to the proposed plantwind power plant is presented in ***Table 8.37***. Shadow main results and shadow graphical calendar illustrate the times of the year at each of the receptors in the analysis where theoretical shadow flicker was predicted to occur are provided in ***Appendix B***.

Table 8.37 Shadow Flicker Analysis at Each Receptor due to the Wind Power Project

Shadow Receptor Code	Longitude (E)	Latitude (N)	Worst Case Scenario			Expected Values/ Real Case Scenario
			Shadow hours per year [hr/year] *	Shadow days per year [days/year]	Max. Shadow hours per day [hr/day]	Shadow hours per year [hr/year] *
A	75°44.0140' E	15°22.8123' N	50:20	95	0:46	30:51
B	75°42.4687' E	15°23.5957' N	146:03	135	1:25	55:04
C	75°42.9600' E	15°23.5844' N	35:59	98	0:33	8:23
D	75°43.2970' E	15°25.1967' N	17:01	85	0:16	7:43
E	75°41.4140' E	15°25.0323' N	67:30	156	0:36	28:50
F	75°41.4138' E	15°26.9782' N	41:09	106	0:43	20:59
G	75°40.0402' E	15°27.5293' N	35:04	58	0:48	14:54
H	75°40.0119' E	15°27.7971' N	18:41	43	0:33	8:05
I	75°40.2737' E	15°23.8941' N	5:32	22	0:23	2:20
J	75°43.3626' E	15°23.8693' N	96:28	156	1:03	24:51
K	75°43.5730' E	15°23.2796' N	94:34	149	0:51	33:30
L	75°43.2904' E	15°24.4777' N	30:25	99	0:31	14:25
M	75°44.7949' E	15°24.4129' N	5:15	35	0:11	2:00
N	75°44.8844' E	15°20.9653' N	19:00	98	0:16	11:19
O	75°43.1114' E	15°20.9365' N	8:09	38	0:16	3:11
P	75°42.9241' E	15°20.9536' N	14:57	88	0:17	6:38
Q	75°42.8067' E	15°20.8779' N	2:30	23	0:08	1:00
R	75°42.8177' E	15°20.8236' N	7:24	54	0:14	3:22
S	75°42.7499' E	15°20.8259' N	5:44	47	0:12	2:36
T	75°42.6315' E	15°20.3582' N	2:35	22	0:09	1:08
U	75°42.4075' E	15°20.3787' N	24:42	56	0:31	6:20
V	75°42.7934' E	15°23.4282' N	10:31	73	0:12	3:45
W	75°42.7066' E	15°23.0682' N	59:57	98	0:43	37:57
X	75°43.2282' E	15°22.4948' N	119:04	136	1:32	51:38
Y	75°43.5710' E	15°22.1001' N	22:26	121	0:21	12:18
Z	75°43.7135' E	15°21.9268' N	4:06	23	0:13	1:52
AA	75°44.1353' E	15°21.0259' N	27:26	84	0:57	12:41
AB	75°44.2542' E	15°20.8982' N	3:34	22	0:12	1:13
AC	75°44.1690' E	15°25.2160' N	84:15	150	0:50	51:18

Shadow Receptor Code	Longitude (E)	Latitude (N)	Worst Case Scenario			Expected Values/ Real Case Scenario
			Shadow hours per year [hr/year] *	Shadow days per year [days/year]	Max. Shadow hours per day [hr/day]	Shadow hours per year [hr/year] *
AD	75°41.2337' E	15°25.1215' N	16:17	64	0:23	8:24
AE	75°41.1153' E	15°23.9820' N	35:25	91	0:35	19:10
AF	75°40.9332' E	15°24.0801' N	9:57	73	0:12	4:18
AG	75°41.0048' E	15°24.7881' N	8:47	50	0:13	3:49
AH	75°39.7101' E	15°21.8265' N	27:00	71	0:38	11:56
AI	75°41.8179' E	15°22.0324' N	48:42	140	0:42	19:35
AJ	75°41.1795' E	15°26.8917' N	15:25	66	0:22	6:26
AK	75°43.1148' E	15°27.2617' N	14:20	82	0:15	7:07
AL	75°43.8292' E	15°26.7106' N	13:01	81	0:13	5:46
AM	75°43.3668' E	15°25.1623' N	2:46	21	0:10	1:26
AN	75°46.5408' E	15°25.1482' N	70:49	141	0:42	29:07
AO	75°46.4457' E	15°25.5561' N	34:11	92	0:36	10:45
AP	75°46.2477' E	15°25.4479' N	6:06	30	0:15	2:25
AQ	75°46.2640' E	15°22.1631' N	24:36	85	0:30	8:59
AR	75°46.9230' E	15°22.0684' N	0:00	0	0:00	0:00
AS	75°46.8495' E	15°21.5636' N	0:00	0	0:00	0:00
AT	75°47.0357' E	15°23.5957' N	5:12	26	0:15	2:56
AU	75°46.9843' E	15°21.6511' N	6:44	32	0:16	4:10
AV	75°46.9480' E	15°21.7712' N	13:29	56	0:16	8:42
AW	75°46.8597' E	15°21.7961' N	0:07	4	0:03	0:04
AX	75°47.6417' E	15°20.3197' N	13:34	42	0:24	2:07
AY	75°47.5875' E	15°20.2243' N	0:00	0	0:00	0:00
AZ	75°41.6868' E	15°21.4765' N	4:42	50	0:09	1:53
BA	75°42.1422' E	15°21.1806' N	6:37	30	0:16	2:52
BB	75°41.0366' E	15°25.0765' N	37:23	100	0:36	20:49
BC	75°41.0267' E	15°25.1026' N	35:23	92	0:34	19:05
BD	75°41.0472' E	15°25.2025' N	20:29	63	0:33	9:05
BE	75°42.0681' E	15°23.5842' N	261:26	178	1:42	92:57
BF	75°42.2143' E	15°23.6551' N	191:33	197	1:13	58:49
BG	75°42.3435' E	15°23.0995' N	0:00	0	0:00	0:00
BH	75°42.5188' E	15°23.4003' N	74:16	78	1:06	45.52
BI	75°42.2779' E	15°22.8236' N	553:28	221	3:18	204:22

Shadow Receptor Code	Longitude (E)	Latitude (N)	Worst Case Scenario			Expected Values/ Real Case Scenario
			Shadow hours per year [hr/year] *	Shadow days per year [days/year]	Max. Shadow hours per day [hr/day]	Shadow hours per year [hr/year] *
BJ	75°42.4377' E	15°22.8616' N	220:38	145	1:45	138:21
BK	75°42.3427' E	15°22.9768' N	2:07	24	0:07	0:58
BL	75°42.8143' E	15°22.1526' N	342:41	184	2:31	88:51
BM	75°42.6689' E	15°22.1926' N	19:03	65	0:26	7:21
BN	75°43.1543' E	15°21.4993' N	9:09	40	0:18	4:08
BO	75°43.1019' E	15°21.0259' N	0:00	0	0:00	0:00
BP	75°43.1209' E	15°20.9969' N	0:00	0	0:00	0:00
BQ	75°42.8237' E	15°20.4872' N	8:58	55	0:14	3:38
BR	75°43.0117' E	15°20.6976' N	64:52	66	1:16	39:55
BS	75°44.1750' E	15°20.4655' N	225:25	151	1:55	106:03
BT	75°45.2515' E	15°22.9075' N	7:56	41	0:15	3:34
BU	75°45.3641' E	15°22.8756' N	51:02	110	0:39	31:21
BV	75°44.7367' E	15°24.4288' N	36:51	119	0:28	9:52
BW	75°46.0662' E	15°20.6470' N	3:21	21	0:12	1:43
BX	75°47.1495' E	15°20.7496' N	120:43	148	1:24	74:47
BY	75°47.2935' E	15°20.6744' N	61:27	116	0:56	30:05
BZ	75°47.0277' E	15°21.1124' N	20:12	95	0:16	10:00
CA	75°47.2002' E	15°21.1900' N	121:29	185	1:14	29:21
CB	75°47.0308' E	15°20.9541' N	490:27	251	2:30	165:16
CC	75°47.0723' E	15°20.9735' N	310:36	216	2:12	136:35
CD	75°41.0271' E	15°25.2343' N	27:27	76	0:34	12:48
CE	75°41.5098' E	15°25.3491' N	25:30	76	0:35	10:55
CF	75°41.4893' E	15°25.3358' N	24:33	78	0:34	10:25
CG	75°41.6990' E	15°25.1920' N	8:36	49	0:14	3:43
CH	75°41.6588' E	15°25.1481' N	17:34	64	0:27	9:52
CI	75°41.5903' E	15°25.0921' N	20:34	66	0:31	11:00
CJ	75°43.0031' E	15°23.8796' N	8:12	28	0:22	3:26
CK	75°42.8398' E	15°23.7863' N	5:16	45	0:10	2:11
CL	75°47.1580' E	15°23.6487' N	241:07	131	2:38	99:36
CM	75°46.0375' E	15°21.4867' N	20:04	82	0:19	11:25
CN	75°46.0679' E	15°21.6408' N	20:58	90	0:20	9:26
CO	75°46.0860' E	15°21.6743' N	22:49	86	0:20	10:29

Shadow Receptor Code	Longitude (E)	Latitude (N)	Worst Case Scenario			Expected Values/ Real Case Scenario
			Shadow hours per year [hr/year] *	Shadow days per year [days/year]	Max. Shadow hours per day [hr/day]	Shadow hours per year [hr/year] *
CP	75°42.9812' E	15°21.9679' N	21:15	70	0:28	11:05
CQ	75°42.7975' E	15°21.9199' N	43:02	121	0:38	20:30
CR	75°42.5037' E	15°22.2485' N	29:51	79	0:33	13:09
CS	75°42.3969' E	15°22.2369' N	64:59	113	0:57	28:37
CT	75°41.8361' E	15°22.5673' N	101:20	106	1:29	59:57
CU	75°41.8620' E	15°22.4268' N	155:32	137	1:28	60:59
CV	75°41.5515' E	15°22.2734' N	64:33	131	0:54	28:43
CW	75°41.6853' E	15°22.5967' N	11:32	73	0:14	5:03
CX	75°41.7814' E	15°22.4392' N	12:55	60	0:17	5:51
CY	75°41.5376' E	15°22.3863' N	264:22	226	2:03	92:26
CZ	75°41.9381' E	15°22.1021' N	0:00	0	0:00	0:00
DA	75°42.2457' E	15°21.8173' N	521:35	237	3:44	178:42

(Figures highlighted represent greater than 30 hours per year of shadow flicker in worst and real case scenario)

Note: Colour coding used to represent exceedance from applicable standards is as follows:

	Shadow hours per year	Max. shadow hours per day
	> 120 hr/year	01:30 hr/day
	120 hr/year < x < 60 hr/year	01:30 hr/day < x < 01:00 hr/day
	60 hr/year < x < 30 hr/year	01:00 hr/day < x < 0:30 hr/day
	< 30 hr/year	< 00:30 hr/day

Impact Assessment

Given the guidelines of 30 hours or less per year is considered to be acceptable, the operation of the wind plant theoretically results in shadow flicker impacts that could be considered as significant for the purposes of this study. The results show that theoretical shadow flickers impact in real case scenario occur at 23 shadow receptors out of total 104 receptors identified within the Project area.

In the real case scenario, maximum shadow flicker would occur at receptor 'BI', (temporary structure) located close to the wind turbine AY 17, with a maximum of 204:22 hr/year followed by receptor 'DA', located close to wind turbine *AY 10*, with a maximum of 178:42 hr/ year.

Few major permanent receptors mapped against the WTG locations suggests that residential structures near AY 43 shall experience maximum shadow flicker with a maximum of 106.03 hr/year. Other permanent structures. The other impacted receptors are highlighted in ***Table 8.37***.

Mapping of few clusters against WTGs is provided in the table below.

S.N	WTG Code	Receptors	Distance (km) and Direction from WTG	Type of receptor	Real Case Scenorio Shadow hours per year [hr/year] *
1.	AY 5	Residential buildings	250-300m NE	Permanent	8:24
2.	AY 8	Agricultural Sheds*	195m N	Temporary	59:57;
3.	AY 10	Agricutural Sheds	436m S, 2 at 499m S	Temporary	178:42
4.	AY 12	Residential structures	201m S	Permanent	39:55
5.	AY 17	Agricutural Sheds	300-400m N	Temporary	204:22
6.	AY 18	Residential Custer and Agricultural	337m E	Permanent	45.52
7.	AY 19	Agricultural Sheds	200-300m S and E	Temporary	92:57
8.	AY 35	Residential cluster	350 m E	Permanent	24:51
9.	AY 41	Small cluster of houses	390m NE	Permanent	12:41
10.	AY 43	Residential	320m SE	Permanent	106:03
11.	AY 59	Apartment Complex	260m W	Permanent	5:46
12.	AY 95	Agricultural Shed and WTG T19	203 m NW and 312M E	Permenant	99:36
13.	T26	2 agricultural sheds	314m NE, 398m NW	Temporary	165:16 136:35

It is relevant to emphasise that predicted hours of shadow flicker effects are real case scenarios with certain assumptions. Assumptions made during the analysis include optimal meteorological, natural light and geometrical conditions for the generation of shadow flicker. The assessment does not account for trees or other obstructions that intervene between receptor and turbine during times when effects may occur. The assessment calculation is therefore an over estimation in the probability of effects. It should also be noted that for shadow effects to occur, properties need to be occupied, with blinds or curtains open and views to the wind turbine unobstructed. However, for the purposes of assessment, it has been assumed that all worst-case circumstances apply.

Considering the above, the impact magnitude is assessed to be **small** as only 23 out 105 receptors will experience shadow flicker higher than 30 shadow hours per year. Moreover, most of identified receptors are temporary sheds. The receptor sensitivity is assessed as **medium** and the overall impact significance is assessed to be **moderate**.

Mitigation Measures

Following mitigation measures are proposed to reduce the intensity of shadow flicker:

- Installation of blinds such as curtains at the concerned receptor window facing the turbines;
- Planting trees and ensure increase in dense vegetation coverage to screen the affected receptor locations;
- Construction of a compound wall up to the height of the window;
- Shadow flickering issue to be included in the grievance redressal mechanism for the project through which community members can record their complaints and relevant actions can be taken, as per the satisfaction of the complainant/ community.

There needs to be close monitoring through engagement with residents during the operation phase where there are predicted impacts from shadow flicker.

Should the impact of shadow flicker be identified and the mitigation measures proposed above prove ineffective, further analysis can be carried out to identify the exact timings and conditions under which shadow flicker occurs and a technical solution sought. This is likely to involve pre-programming the turbine with dates and times when shadow flicker can cause a nuisance for nearby receptors. A photosensitive cell can be used to monitor sunlight and the turbine could potentially then be shut down, when the strength of the sun, wind speed and the angle and position of the sub combines to cause a flicker nuisance.

Assessment of Residual Impacts

The results of the windPro shadow flicker assessment show a real case estimate with certain assumptions and the mitigation measures above will be implemented for the identified properties that experiences shadow flicker.

Residual impacts following the application of required mitigation measures, as discussed above, is likely to result in minor to negligible impacts.

Table 8.38 Impact Significance of Shadow Flickering pertaining to the Project WTGs

Impact	Shadow Flickering during Operation Phase – real case scenario		
Impact Nature	Negative	Positive	Neutral

Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Limited to Project footprint area			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude varies based on distance of receptors from the WTGs and their orientation. Out of the 105 receptors identified in the study, only 23 structures will be impacted which are mostly in temporary in nature.			
Receptor Sensitivity	Negligible	Low	Medium	High
Impact Significance	Negligible	Minor	Moderate	Major
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered to be **minor to negligible**.			

8.4 Ecological Impacts of the project

8.4.1 Assessment Criteria

ERM Impact Assessment Standards define sensitivity of ecological receptors by determining the significance of effects on species and habitats separately. The significance tables for species and habitats are given in ***Table 8.39*** and ***Table 8.40*** respectively.

Table 8.39 Habitat-Impact Assessment Criteria

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

Table 8.40 Species-Impact Assessment Criteria

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

	and species vital to the survival of a high value species.				

8.4.2 Assessment of Impacts in Construction Phase

8.4.2.1 Impact due to Vegetation Clearance

As several locations of proposed WTGs locations, approach roads as well as pooling substations are coming in the agriculture lands and open scrubs, thus the vegetation clearance is required in a limited area of the study site.

Embedded/ In-built Controls

The impacts during the construction activity will be short term and the construction of the Project will be executed in a phased manner. Clearance of vegetation shall be limited to WTG erection site comprising of laydown and crane movement area. The clearance shall be limited to the duration required and once the construction activities cease, the vegetation should be allowed to grow naturally.

Receptor Sensitivity

The ecological baseline section reveal that the tree species located at or within the immediate vicinity of the WTG locations are, *Acacia nilotica* (L.) Delile, *Prosopis juliflora* (Sw.) DC., *Azadirachta indica* A.Juss., *Capparis decidua* (Forssk.) Edgew., *Lantana camara* L., etc. Construction of WTG sites could lead to clearance of these tree species. In addition, vegetation clearance could also remove few shrub and herb species. Vegetation clearance will lead to habitat disturbance for reptiles such as Oriental Garden Lizard (*Calotes versicolor*), birds like Ashy Prinia (*Prinia socialis*), Baya Weaver (*Ploceus philippinus*), Grey Francolin (*Francolinus pondicerianus*), Indian Silverbill (*Lonchura malabarica*), Indian Robin (*Saxicoloides fulicatus*), Purple Sunbird (*Nectarinia asiatica*), Red-vented Bulbul (*Pycnonotus cafer*), Rose ringed Parakeet (*Psittacula krameri*) etc. and mammals such as Bonnet Macaque (*Macaca radiata*), Five-striped Palm Squirrel (*Funambulus pennanti*), Southern Plains Gray Langur (*Semnopithecus dussumieri*), etc.

The site has Endangere (EN) - [Indian Pangolin (*Manis crassicaudata*)]; four Vulnerable (VU) - [Bonnet Macaque (*Macaca radiata*), Four-horned Antelope (*Tetracerus quadricornis*), Common Pochard (*Aythya farina*) & Greater Spotted Eagle (*Clanga clanga*)]; species as per the latest IUCN Red List (Online Version 2021-2); as well as 19 species [Bengal Monitor Lizard (*Varanus bengalensis*), Indian Rock Python (*Python molurus*), Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caeruleus*), Bonelli's Eagle (*Aquila fasciata*), Brahminy Kite (*Haliastur indus*), Eurasian Spoonbill (*Platalea leucorodia*), Greater Spotted Eagle (*Clanga clanga*), Indian Grey Hornbill (*Ocyceros birostris*), Indian Peafowl (*Pavo cristatus*), Montagu's Harrier (*Circus pygargus*), Osprey (*Pandion haliaetus*), Pallid Harrier (*Circus macrourus*), Shikra (*Accipiter badius*), Western Marsh-Harrier (*Circus aeruginosus*), Indian Pangolin (*Manis crassicaudata*), Four-horned Antelope (*Tetracerus quadricornis*), Blackbuck (*Antilope cervicapra*), Indian Wolf (*Canis lupus pallipes*)] are protected under Schedule I of the IWPA and therefore the site has been deemed to have **Medium** for **Habitat** and **Medium** for **Species** sensitivity (***Table 8.39*** and ***Table 8.40).***

Magnitude of Impact

All WTG location are located in scrubland and agricultural habitat. A limited clearance of vegetation will be restricted to WTG construction locations approach roads as well as pooling substations and such changes will be permanent. So extent of impact due to vegetation clearance on habitat will be local but duration of impact will be long term. More over as changes from vegetation clearance will result in slight change in prevailing baseline condition so Intensity of impact is expected to be low However, there is substantial habitat for these species in the region and any impact within the wind power plant area is unlikely to cause loss of habitat viability and function in the region, so overall Impact Magnitude is expected to be **Small** for **Habitat**.

For species also, loss of vegetation is going to cause short term, local impact having no potential to create significant change in baseline condition, thus creating low intensity impact. So overall will not cause a significant change in the population of the above mentioned species magnitude of impact is expected to be **Small** for **Species**.

Significance of Impacts

Based on ***Table 8.39*** and ***Table 8.40 ,*** Significance of Impact on Habitat is expected to be **Minor** as Habitat sensitivity is medium and magnitude of impact is small. Significance of impact on species is also **Minor** as species sensitivity is medium and magnitude of impact on species is small.

Mitigation Measures

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

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

- During vegetation clearance exercise the important sites such as avifauna and other wildlife's roosting and breeding sites, etc. should be avoided;
- Vegetation clearance in the scrub land should be minimised by optimization of internal road, power evacuation line and avoiding construction of ancillary facility, storage, labour camps;
- Vegetation disturbance, clearance and construction activities should be restricted to the project activity area, labour camp and storage areas;
- Areas around the water sources should be avoided to the extent possible during the planning of access/internal roads, storage areas, labour camps and ancillary facilities;
- Topsoil that is disturbed should be stored separately for later restoration of the habitat;
- Simultaneous revegetation using native species on outskirts of Project activity area should be practiced for areas that are determined to have loose or unstable soil to avoid erosion;
- Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement, needless expansion of labour camp and destruction of floral resources should be prohibited; and
- Strict prohibition on use of fuel wood and shrubs from nearby areas as kitchen fuel.

Residual Impacts

Removal of vegetation can have a direct and indirect impact on the local ecology. The impact is limited to the construction phase of the Project, following which the vegetation can recover. The significance of the residual impacts will remain **Minor** for habitats and species after employing the mitigation measures.

Table 8.41 Ecological Impact due to vegetation clearance

Impact	Vegetation Clearance				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Limited to construction area and immediate surrounding				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species				

8.4.2.2 Impact due to Construction Activities

Laying of approach road, excavation for WTG foundation and construction of transmission line increased the anthropogenic movement (men and material transport), noise and chance of sedimentation/contamination of water resources due to excavation and filling activities in the Project study area. These activities are assessed with respect to disturbance of habitats and species.

Excavation for the construction of the WTG foundation and ancillary facilities will have a direct impact on burrowing fauna, such as the Indian Here and an indirect impact on flora/fauna through the changing of soil properties.

Anthropogenic movement will result in an increased stress on fauna in the area that will have to remain alert for an extended period of time and may prevent proper breeding, nesting, mating, socializing and foraging. Noise from anthropogenic movement (men and material transport) along with the construction activities may further disturb fauna in the nearby areas.

Embedded/ In-built Controls

The labour force and the supervisory staff will be provided in-house and external trainings for the situations dealing with wildlife encounters and *dos and don'ts* while dealing with these situations. Selection of labour camps, batching plants and equipment laydown areas will be located away from the areas (Water bodies and other areas towards the Kappatagudda Wildlife Sanctuary) where the wildlife movement is reported.

Receptor Sensitivity

The ecological baseline section reveal that the tree species located at or within the immediate vicinity of the WTG locations are, *Acacia nilotica* (L.) Delile, *Prosopis juliflora* (Sw.) DC., *Azadirachta indica* A.Juss., *Capparis decidua* (Forssk.) Edgew., *Lantana camara* L., etc. Construction of WTG sites could lead to clearance of these tree species. In addition, vegetation clearance could also remove few shrub and herb species. Vegetation clearance will lead to habitat disturbance for reptiles such as Oriental Garden Lizard (*Calotes versicolor*), birds like Ashy Prinia (*Prinia socialis*), Baya Weaver (*Ploceus philippinus*), Grey Francolin (*Francolinus pondicerianus*), Indian Silverbill (*Lonchura malabarica*), Indian Robin (*Saxicoloides fulicatus*), Purple Sunbird (*Nectarinia asiatica*), Red-vented Bulbul (*Pycnonotus cafer*), Rose ringed Parakeet (*Psittacula krameri*) etc. and mammals such as Bonnet Macaque (*Macaca radiata*), Five-striped Palm Squirrel (*Funambulus pennanti*), Southern Plains Gray Langur (*Semnopithecus dussumieri*), etc.

The surrounding area of the proposed wind farm has Endangere (EN) - [Indian Pangolin (*Manis crassicaudata*)]; four Vulnerable (VU) - [Bonnet Macaque (*Macaca radiata*), Four-horned Antelope (*Tetracerus quadricornis*), Common Pochard (*Aythya farina*) & Greater Spotted Eagle (*Clanga clanga*)]; species as per the latest IUCN Red List (Online Version 2021-2); as well as 19 species [Bengal Monitor Lizard (*Varanus bengalensis*), Indian Rock Python (*Python molurus*), Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caeruleus*), Bonelli's Eagle (*Aquila fasciata*), Brahminy Kite (*Haliastur indus*), Eurasian Spoonbill (*Platalea leucorodia*), Greater Spotted Eagle (*Clanga clanga*), Indian Grey Hornbill (*Ocyceros birostris*), Indian Peafowl (*Pavo cristatus*), Montagu's Harrier (*Circus pygargus*), Osprey (*Pandion haliaetus*), Pallid Harrier (*Circus macrourus*), Shikra (*Accipiter badius*), Western Marsh-Harrier (*Circus aeruginosus*), Indian Pangolin (*Manis crassicaudata*), Four-horned Antelope (*Tetracerus quadricornis*), Blackbuck (*Antilope cervicapra*), Indian Wolf (*Canis lupus pallipes*)] are protected under Schedule I of the IWPA and therefore the site has been deemed to have **Medium** for **Habitat** and **Medium** for **Species** sensitivity (***Table 8.39*** and ***Table 8.40*****)**.

Magnitude of Impact

All WTG location are located in scrubland and agricultural habitat. Construction activity will be limited to the WTG locations only as well as along approach road and along the transmission line. So the extent of impact will be Regional as it is spread across the study area. However though the direct loss of habitat due to construction of WTG is long lasting but substantial agricultural and scrubland habitat is present in the study area, so such change is unlikely to cause loss of habitat viability and function in the region, so Intensity of impact is expected to be Low. So overall Impact Magnitude is expected to be **Small** for **Habitat**.

Potential aquatic species including egrets, lapwings, kingfishers etc. will be directly affected by the deterioration in water quality. For most of the species, the effect will be through the loss of foraging resources. This is because floral composition can change from the changes in water quality, as species that are more tolerant to harsher water conditions would thrive along the banks of the waterbody.

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

Impacts from construction activity on species is expected to be local, i.e. limited to study area only, but will be limited to the construction period (approximately few months), i.e. duration of impact will be low. Increased anthropogenic activity may result in local displacement of small & medium mammalian species as well as some avian species, but is not expected to create significant change in baseline condition in the long run, thus creating low intensity impact. So overall will not cause a significant change in the population of the above mentioned species magnitude of impact is expected to be **Small** for **Species**.

Significance of Impacts

Based on ***Table 8.39*** and ***Table 8.40*** Significance of Impact on Habitat is expected to be **Minor** as Habitat sensitivity is medium and magnitude of impact is small.
Significance of impact on species is also **Minor** as species sensitivity is medium and magnitude of impact on species is small.

Mitigation Measures

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

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

- Simultaneous revegetation on outskirts of project activity area should be practiced for areas that have loose or unstable soil to avoid erosion and sedimentation.

Residual Impact Significance

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

Table 8.42 Impact due to Construction activities

Impact	Construction Activities				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Limited to construction area and immediate surrounding				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species				

8.4.3 Assessment of Impacts in Operation and Maintenance Phase

8.4.3.1 Hazards associated with turbine blade movement

The rotating blades and the varying speeds of their movement is a collision hazard to flying birds. The hazard is especially pronounced for aerial hunters that have a flight height that matches the blade height of the WTG. A bird that avoids collision with the blades can still be impacted by the visual movement of the blades, noise from the rotation and/or low air pressure areas created by the blades.

Birds adjust to the presence of the wind power plants by changing their behaviour. Flight deviation, alternate resource utilization, dispersion from the wind power plant area and changing flight heights are types of behavioural changes that the birds can utilize to adjust to the wind power plant. The avoidance behaviour however, is not completely fool-proof with night collisions and collisions due to sudden change in wind speeds still possible. The energy expenditure to avoid the wind power plant can be a strain on birds and decrease energy reserves for foraging, hunting, socializing and breeding. The avoidance and dispersion can also lead to loss of foraging resources, habitats and migration pathways.

During the local movement, the migratory bird species may fly into the high risk zone (Rotor swept area) of the turbines resulting in the increased risk of collision with turbines in the vicinity of important bird habitats.

Embedded / In-built Controls

Embedded controls for wind power plant operation would need to be adopted in the planning and construction stage by designing the wind power plant to minimize collision risk. Some in-built controls are listed below:

- Inter-turbine distance should be large enough that birds can avoid turbine blades, by utilizing their minimal energy;
- Siting of WTGs near important habitat features such as water bodies, tree clusters, etc should be avoided;
- WTGs should be sited in the areas that could be visible from a manoeuvrable distance for flying species and they shouldn't be located near sudden changes of elevation, large trees or be blocked by any other manmade/natural structure; and
- The tower and blade tips should be marked with orange colour, for better visibility of the WTGs.

Receptor Sensitivity

The species which are at the risk of collision with the turbines include all the large winged soaring birds such as Painted Stork - NT, Greater Flamingo - LC, Spot-billed Pelican - NT, Demoiselle Crane - LC, Black Kite - LC, Black-winged Kite - LC, Bonelli's Eagle - LC, Brahminy Kite - LC, Greater Spotted Eagle - VU, Montagu's Harrier - LC, Osprey - LC, Pallid Harrier - NT, Western Marsh-Harrier - LC, etc. These may also include the other migratory species visiting this landscape during winter months. The secondary information[1, 2] on the migratory avifaunal species support the presence of major migratory route along the landscape and presence of several migratory birds [Bar-headed Goose (*Anser indicus*) - LC, Common Kestrel (*Falco tinnunculus*) - LC, Common Pochard (*Aythya farina*) - VU, Demoiselle Crane (*Grus virgo*) - LC, Garganey (*Spatula querquedula*) - LC, Glossy Ibis (*Plegadis falceinellus*) - LC, Greater Flamingo (*Phoenicopterus roseus*) - LC, Greater Spotted Eagle (*Clanga clanga*) - VU, Montagu's Harrier (*Circus pygargus*) - LC, Northern Pintail (*Anas acuta*) - LC, Northern Shoveler (*Spatula clypeata*) - LC, Osprey (*Pandion haliaetus*) - LC, Pallid Harrier (*Circus macrourus*) - NT, Peregrine Falcon (*Falco peregrinus*) - LC, Ruddy Shelduck (*Tadorna ferruginea*) - LC, Western Marsh-Harrier (*Circus aeruginosus*) - LC, etc.]. The consultations[3] also revealed the high activities of migratory birds in the region during winter months.

Therefore the species sensitivity has been assessed as **Medium**.

Magnitude of Impact

Collision risk with wind turbine can be considered as long term risk as it remains throughout the operational life span of the wind power plant. Considering this particular wind power plant is 300 MW having about 90 WTGs, it is spread across a large area, so the extent of impact can be considered regional. The presence of other wind power projects can enhance the negative impacts on susceptible bird and bat species and has to be analysed further.

Thus the impact magnitude has been assessed as **Medium** as the project may cause as substantial change in the abundance and/or reduction in distribution of a population over one, or more generations, but does not threaten the long term viability/ function of that population dependent on it, due to its smaller size.

Significance of Impacts

Based on ***Table 8.39*** and ***Table 8.40*** Significance of impact on species is also **Moderate** as species sensitivity is medium and magnitude of impact on species is also medium.

Mitigation Measures

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

- Long term collision risk assessment for at least two years covering migratory period (Oct-March) and breeding season (April-June) based on representative vantage point, point counts and

[1] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[2] eBird Database [https://ebird.org/hotspot/L7351967; https://ebird.org/hotspot/L10818998; https://ebird.org/hotspot/L4874530; https://ebird.org/hotspot/L4985562]

[3] Consultation with the local villagers as well as forest department

transect surveys covering entire wind plant area and transmission lines should be undertaken in order to assess the long term movement patterns of the migratory birds in the landscape;

- Bird carcass monitoring should be commissioned in operation and maintenance phase, in which all bird carcasses found in the wind plant should be recorded and photographed with details about the distance from the closest wind turbine generator and the name of the wind turbine generator for at least two years;
- Food waste materials should not be left lying around WTG and if any waste is found then it should be cleared immediately so as to not attract birds near the WTG;
- The tower and blade tips should be marked / painted with orange colour for better visibility of the WTGs;
- Wind turbine generators should be properly maintained to ensure that turbine blade speeds are regulated and blade throws are avoided; and
- Restrictions should be imposed so that dead carcasses are not disposed near the WTG areas so that the vultures are not attracted.

Residual Impact Significance

Proper implementation of suggested mitigation measures and in-built controls can reduce the impacts to some extent and the significance of the residual impact may reduce to **Minor**.

Impact	Bird and Bat collision with wind turbine				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Limited to core zone of the wind plant as well as a displacement radius of 1 km for birds that are showing avoidance behaviour				
Frequency	Operation & Maintenance Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat and species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Moderate** for habitats and species				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species				

8.4.3.2 Collision and Electrocution hazards from Transmission Infrastructure

Several species of birds identified during the ecological study were found perched on wires and poles in the area. These transmission lines and poles can potentially constitute an electrocution and collision hazard to birds. Some birds also utilize the transmission towers for nesting by placing the nests across wires or using holes in the tower itself.

Embedded/ In-built Control

Gap between two conductors in the transmission line will be 3 meters, to reduce the risk of electrocution.

Receptor Sensitivity

Many avifaunal species observed / reported during the ecological survey were perching on existing transmission lines and towers. The species included the Schedule I species (as per the Indian Wildlife Protection Act, 1972) - are Black Kite (*Milvus migrans*) - LC, Black-winged Kite (*Elanus caeruleus*) -

LC, Brahminy Kite (*Haliastur indus*) - LC, Greater Spotted Eagle (*Clanga clanga*) - VU, Pallid Harrier (*Circus macrourus*) - NT, etc. The secondary information[1, 2] on the migratory avifaunal species support the presence of major migratory route along the landscape and presence of several migratory birds [Bar-headed Goose (*Anser indicus*) - LC, Common Kestrel (*Falco tinnunculus*) - LC, Common Pochard (*Aythya farina*) - VU, Demoiselle Crane (*Grus virgo*) - LC, Garganey (*Spatula querquedula*) - LC, Glossy Ibis (*Plegadis falceinellus*) - LC, Greater Flamingo (*Phoenicopterus roseus*) - LC, Greater Spotted Eagle (*Clanga clanga*) - VU, Montagu's Harrier (*Circus pygargus*) - LC, Northern Pintail (*Anas acuta*) - LC, Northern Shoveler (*Spatula clypeata*) - LC, Osprey (*Pandion haliaetus*) - LC, Pallid Harrier (*Circus macrourus*) - NT, Peregrine Falcon (*Falco peregrinus*) - LC, Ruddy Shelduck (*Tadorna ferruginea*) - LC, Western Marsh-Harrier (*Circus aeruginosus*) - LC, etc.]. The number of birds that utilize electrical components for roosting can be considered a representative sample of the number of birds that show this behaviour. The numbers could be higher during breeding and migratory season due to greater nesting habitat required and number of species present respectively. There could be an increase in collision risk with transmission wires to water birds moving across wetlands and water bodies in the study area. Due to the likelihood that Schedule I species (protected under the Indian Wildlife Protection Act, 1972) and Vulnerable (VU) as well as Near Threatened (NT) species (as per IUCN Red List Online Version 2021-2) will use the transmission poles, the species sensitivity is assessed as **Medium**.

Magnitude of Impact

Collision and electrocution risk due to transmission infrastructure can be considered as long term risk, as it remains throughout the operational life span of the wind power plant. Considering this particular wind power plant is 300 MW having about 90 WTGs and with tentative transmission line length of about 25 km, it is spread across a large area, so the extent of impact can be considered regional. So overall impact magnitude on species is considered to be **Medium**.

Significance of Impacts

Based on ***Table 8.39*** and ***Table 8.40*** Significance of impact on species is also **Moderate** as species sensitivity is medium and magnitude of impact on species is also medium.

Mitigation Measures

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

- The monitoring of movement of migratory avifaunal species across the landscape of study area can help understanding the high risk areas of the wind plant and transmission line;
- Collection of baseline data on migratory birds visiting the study area by using vantage point, point counts and transect surveys covering various habitats and waterbody survey is required as the monitoring would give probable flight path of migratory birds during their daily movement;
- This will help identify the high risk areas of the transmission line stretch and the mitigation measures can be revised based on the outcomes of the study;
- Restrictions should be imposed so that dead carcasses are not disposed near the WTGs and Transmission lines. The O&M team should be trained on removing any carcasses found around these project components in a timely manner to ensure that no vulture or birds of prey are attracted to the Project site;
- Records of feeder trips due to bird electrocution should be maintained with feeder number, bird species, time of electrocution, location, etc. These should be shared with an expert ornithologist for identification of the species. These will be the areas of high concern and focus for further mitigation;
- Regular checking of the transmission towers to avoid nesting by any of the birds;

[1] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[2] eBird Database [https://ebird.org/hotspot/L7351967; https://ebird.org/hotspot/L10818998; https://ebird.org/hotspot/L4874530; https://ebird.org/hotspot/L4985562]

- Marking overhead cables using diverters (***Figure 8.5***) and avoiding use in areas of high bird concentrations of species vulnerable to collision; and
- The transmission poles should be raised with suspended insulators and perch rejecters in order to reduce the electrocution of bird species (***Figure 8.6*** and ***Figure 8.7***).

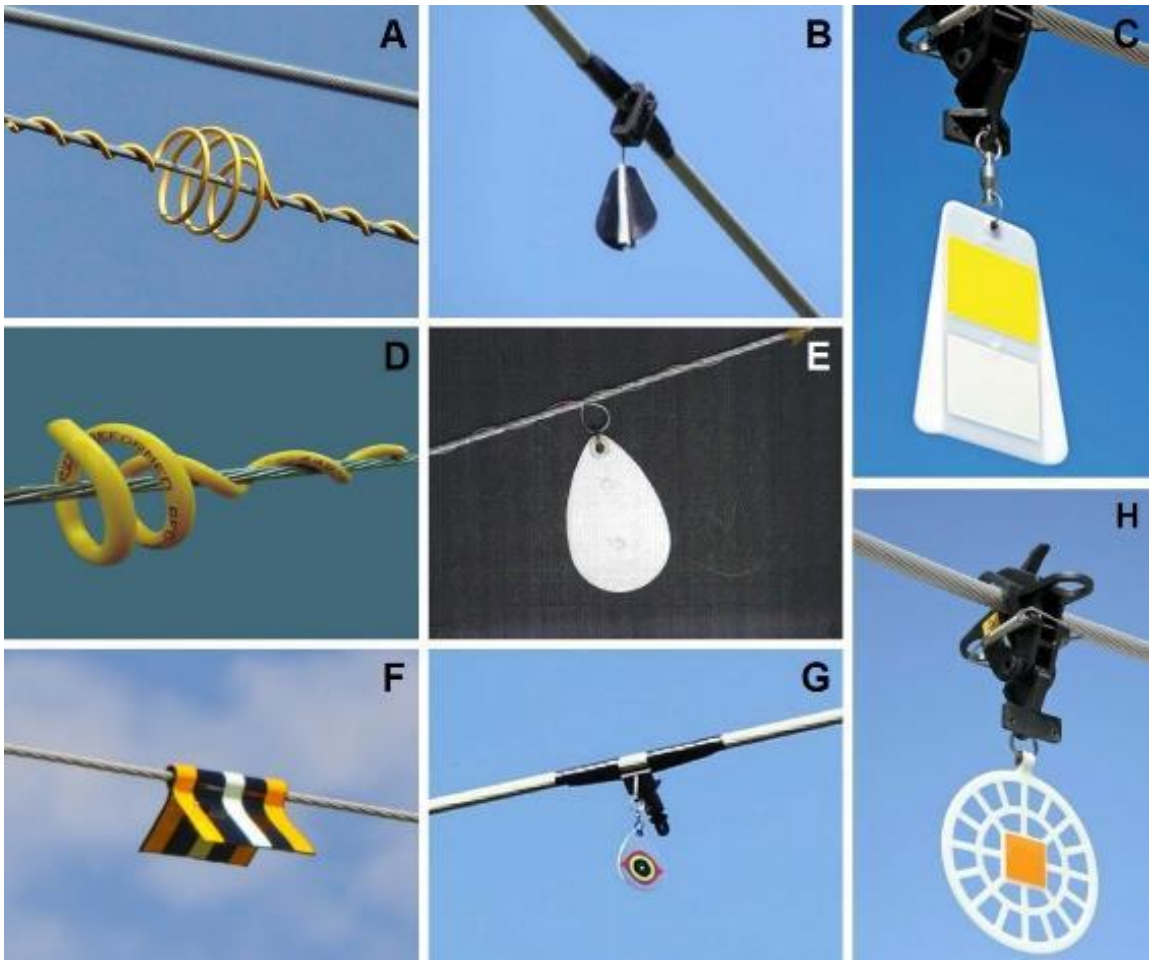
Residual Impact Significance

After implementation of mitigation measures, the significance of residual impacts may be **Minor**. We retain this significance, as while the mitigation measures are likely to reduce mortality, we do not expect complete cessation of mortality.

Table 8.43 Impact due to Transmission Line

Impact	Collision and Electrical hazards				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Limited to electrical components of transmission lines and transmission poles.				
Frequency	Operation & Maintenance Phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat and Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Moderate** for habitats and species				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species				

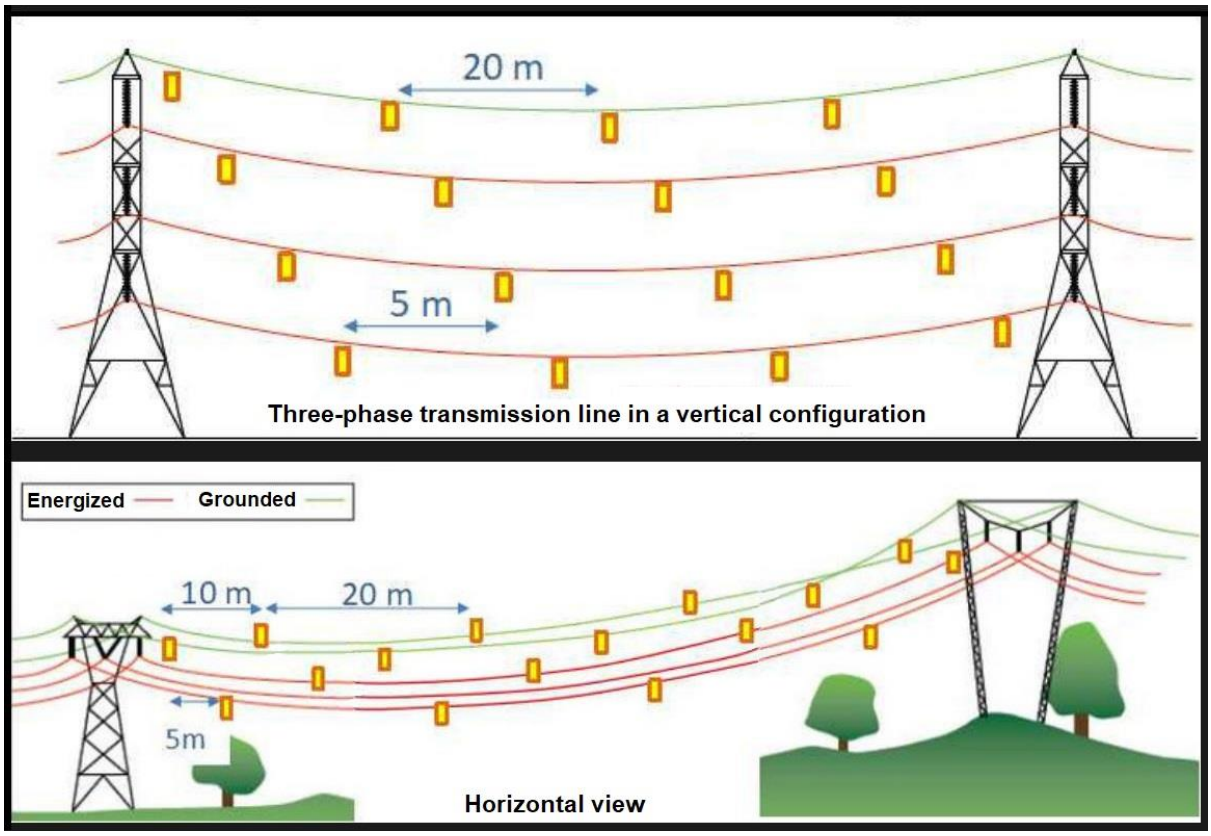
Figure 8.5 Different Kinds of Bird Diverters



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

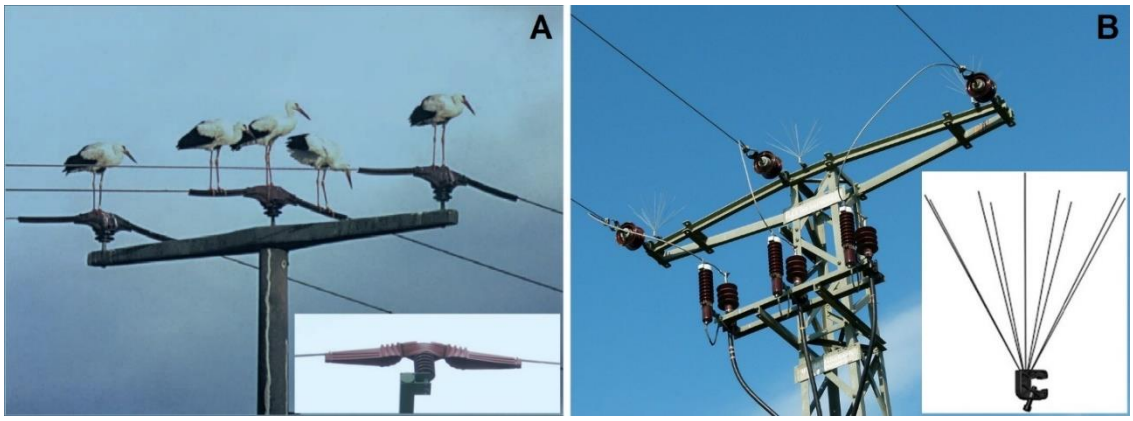
Sources: https://www.fwspubs.org/doi/suppl/10.3996/052016-JFWM-037/suppl_file/052016-jfwm-037.s4.pdf; https://wildlife.onlinelibrary.wiley.com/doi/abs/10.1002/wsb.329; http://www.chinesebirds.net/EN/abstract/abstract170.shtml

Figure 8.6 Recommended Spacing and Design for Installing Bird Diverters



Source: http://www.conservationindia.org/wp-content/files_mf/Power-line-booklet_1-Nov-18.pdf

Figure 8.7 Bird safe poles



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

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

8.5 Key Socio-Economic Impacts

This section discusses socio-economic impacts in the pre-construction, construction, operation & maintenance and decommissioning phase of the project. The overview of key impacts identified in these stages of project life-cycle is provided below.

Table 8.44 Socio-economic Impacts and relevant stages of project life-cycle

S. No	Impact	Project Stage
1.	Impact on Title-holders	Pre-construction
2.	Impact on Community Health and Safety	Construction and Operation

S. No	Impact	Project Stage
3.	Migrant Labour and Related Impacts	Construction
4.	Impact on Archeological and cultural Sites	Pre-construction
5.	Employment Opportunities	Construction and Operations
6.	Impact on Local Public Infrastructure	Construction and Operations
7.	Retrenchment	Construction and Decommissioning

8.5.1 Impact on Titleholders

Source of Impact and Overview of Baseline Conditions

All of the WTG locations fall on private land parcels. In addition, 25km Transmission Line will also fall in private land basis the data shared by Ayana. Further, 112 ha of private land will be permanently procured for the WTG and 14 ha for the pooling station, and 40 ha of land will be taken on lease for temporary facilities such batching plant and storage yard.

Table 8.45 Land Requirement

Description	Area	Unit
Purchase Land for WTG	112	Acres
Purchase Land for Substation	14	Acres
Land on Lease for WTG	448	Acres
Pathway- Easement Rights	140	Acres
Access Road	25	Acres
Storage Area	40	Acres
Transmission line	26	Acres

Source: Ayana

Possible Consequences

For the WTGs Ayana will obtain ownership rights of the land required through purchase of the private land at twice the market rate. For the internal transmission line towers also on private land, rights to place the tower on said land will be procured and a lump sum market value paid for using the land. As mentioned above in **Section 2.3.2**, the current circle rate for area is between INR1,00,000-2,00,000 per acre. The land sellers who have sold their land, reportedly sold it for INR 7,00,000 per acre. In terms of land lease rates, the titleholders reported that the lease agreement states a price of INR 38,000/- acre.

The land procurement for industrial use results in proportionately less land available for agriculture. Consultation revealed that the all of the land to be acquired by the project was cultivated. The productivity of the concerned land was good. Thus, the diversion of agricultural land holding would certainly have an impact on plant-based livelihoods. The number of total titleholders impacted by the project is not known as the procurement process is currently underway.

Basis consultations undertaken with land aggregator during site visits, it was understood that 86 acres of the total locations on private land have been purchased and review of land ownership documents (Form 8A) and consultations undertaken with the land sellers and potential land sellers indicated that none of the land owners will have significant economic impacts or be be rendered landless due to the project as they own other land parcels as well. In terms of productivity of remaining land, enough or relevant data is not available to conclude as land procurement process us currently underway.

Embedded Controls

As per consultations with the land team, it was understood that twice market rate was offered for the land. This was confirmed during consultations with land owners as wel. It was understood that this

amounted to approximately 7 lakhs per acre for land procured for WTG. For remaining land that needs to be purchased, Ayana will follow the same principle and provide compensation over and above market rates. Ayana follows the policy of avoiding procuring land with permanent or temporary residential structures which may lead to physical displacement and avoiding purchasing land from reluctant land owners. Therefore, no physical displacement or forced purchase of land is envisaged at this point of time. Moreover, as mentioned above, none of the land sellers would be rendered landless and consultations revealed that the impact of the project on their livelihood would be minimal and the land sellers would be in a financial position to purchase alternative land, if needed.

Impact Significance

The summary of the impact assessment is provided in Table below

Table 8.46 Significance of impact on Plant based livelihood to Titleholders

Impact	On plant based livelihood				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Purchase of private land is involved in case of all WTG locations, pooling substation, and transmission tower locations. A few access roads as well as towers for internal transmission line that are being developed for project purpose will also eventually fall within private land once the activity for land procurement proceeds.				
Frequency	This will be a one-time impact				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	The impact magnitude will be small as the proportion of loss will be relatively lesser in comparison to the total landholdings of these landowners.				
Resource/Receptors Sensitivity	Low	Medium	High		
	As agriculture is rewarding in terms of productivity and majority of land procured is on lease, hence, vulnerability of the receptor is assessed as low.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor.**				

Mitigation Measures

It is recommend that following measures be examined for protection of livelihood.

- While Ayana has a dedicated land department which oversees land procurement for all of its projects, there is no documented land procurement policy or procedure. It has been noted that elements of willing buyer-willing seller arrangement such as good faith negotiation on land transaction and compensation, information disclosure and change of land use, provision of disagreeing with rates, and saying no to land transaction are followed, there may occur exceptional circumstances, or isolated cases where such practices may not get implemented in totality. To avoid this, Ayana should develop a documented, formal Land Procurement Policy to cover following aspects:
  - Process of government land allotment
  - Process of private land purchase
  - Determination of compensation as per replacement cost
  - Preparation of socio-economic profile and assessment of vulnerability of land owners including land ownership and potential land lessnesses, scheduled castes and scheduled tribes,

below poverty line households, single women headed households, households with people with disabilities etc.

- Provision of special measures such as preferential employment and eligibility in livelihood restoration measures for vulnerable households

- Information disclosure and meaningful consultations based on the principles of Informed Consultation and Participation (ICP)

- Based on consultations held with land sellers, it was understood that loss of livelihood is small as almost all land sellers have alternative land. But as land procurement is undergoing, it is recommended that to ensure livelihood impact is low, the project team should ascertain if the land sellers have alternative livelihood or parcels of land. Therefore, a socio-economic profile of all land owners should be prepared by Ayana.
- If their livelihood is impacted due to selling of land then it is recommended that income generation activities that can be clubbed with CSR activities of the SPV shall be provided.
- Training and assistance should be provided for enhancing agricultural productivity in all villages affected due to land procurement.
- Ayana should provide compensation as per replacement cost principles (i.e. market value plus transaction costs) for all remaining private land locations.
- The water-conservation and watershed improvement and management to be carried out with active participation of the local communities in all the villages in order to improve irrigation access.

8.5.2 Migrant Labour and Related Impacts

Source of Impact and Overview of Baseline Conditions

There will be migrant workers and employees (semi-skilled/skilled/highly skilled) working for project activities such as substation/transformer installation, tower erection, civil foundation works, and electrical works, amongst others.

These migrant labourers will be contracted due to lack of the required skill base (especially in undertaking the steel work for WTG foundation) in local area, the migrant labourers will be employed during the construction work and particularly in civil works. These local labourers will be employed as and when required. No construction activity has started for the project.

Possible consequences

The in-migration of a number of labourers might result in the following key consequences:

- Additional demand on resources (such as food supply, water and sanitation facilities etc.);
- Spread of contagious diseases and communicable diseases such as STDs and HIV/AIDS;
- Conflict with local cultures, values and religious/societal sentiments could arise between project engaged staff/ labourers and local community which may lead to gender based violence as well.

Embedded Controls

To ensure compliance to labour laws, the work order contains details on the safety and labour law compliance requirements that need to be complied with. Additionally, the labour camp will have adequate provisions for water and kitchen facilities.

Impact Significance

The summary of the impact assessment is provided in ***Table*** below.

Table 8.47 Significance of Impact of Labour In-Migration

Impact	Impacts from migrant labour and related issues			
Impact Nature	Negative		Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	The required skill-set being not available at the local level, about 520 workers are estimated to be employed through sub-contractors during the construction phase of the project over a period of 10-12 months.			
Frequency	The impact would continue till the construction work is over.			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	The impact magnitude will be medium as even though the total number of migrant workers is minimal and is limited mainly to the construction period.			
Vulnerability/ Sensitivity of Social Receptors	Low	Medium	High	
	The receptor vulnerability is low as the local community are predominantly engaged in cultivation and do not possess the required skill set to undertake construction work. Furthermore, during consultations with the local community, it was gauged that there are no reported conflicts pertaining to migrant laborers in the area for other project. The accommodation as reported will be provided with adequate facilities with particular attention to water, cooking and sanitation requirements, however aspects such as electricity, ventilation, floor mats/mattresses require additional attention.			
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **minor.**			

Mitigation/Management Measures

The recommended mitigation/management measures to address the impacts related to Labour In-migration will include:

- Quarterly health screening of all the employed labourers at the project site by the contractor/sub-contractor;
- Location of labour camps should be away from settlements;
- Maintenance of hygiene of the labour camp including waste management plan;
- Provision of floor mats/mattresses and ensuring electricity connection for even one light and fan;
- Dedicated grievance mechanism for workers including covering aspects of wages, working conditions, sexual harassment, gender-based violence, health and safety etc.
- All Project personnel will be required to follow a code of conduct that respects local archelogical sites, local cultural traditions and religious festivals, funerals and other traditional events. Induction training for all personnel will include appropriate cultural awareness training.

8.5.3 Impact on Community Health and Safety

Context

The receptors for impacts on community health and safety include the local community within the study area who may be present in the vicinity of the project activities. This will include locals residing close to the WTGs, cultivators whose land is close to the WTGs, and those in the area for grazing purposes. The construction phase activities such as the erection of the WTGs, construction of the transmission line and substations and movement of material and personnel may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery and live transmission power lines. Furthermore, the movement of material and personnel via the access

roads may result in injuries to people or livestock due to accidents. The traffic routes that the Project-related vehicular movement will follow has not been determined at this stage.

According to the IFC EHS guidelines, the community health and safety risks associated with the construction, operations and decommissioning of onshore wind power projects are similar to those of most large industrial facilities and infrastructure projects. The main risks include structural safety of project infrastructure, life and fire safety, public accessibility and management of emergency situations.

Embedded/In Built Controls

As reported Ayana has a health and safety policy in place. The policy will be applicable to all activities being undertaken as part of the project, including the sub-contractor activities. Ayana will have a safety supervisor on site who is responsible for daily monitoring of the project activities. The EPC Contractor will also be involved in monitoring of the project activities to ensure that the requirements of their health and safety standards are met.

Additional Mitigation Measures

In addition to the embedded measures, the following risk mitigation measures are suggested to minimize the risks/hazards of construction activities onsite:

- As part of the stakeholder engagement and information disclosure process, the community will be provided with an understanding of the activities to be undertaken and the precautions taken for safety;
- As part of stakeholder engagement, the project will also propagate health awareness amongst the community, including setting up of health camps;
- The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety
- Vehicular movement through village roads will be planned to avoid traffic jam and inconvenience to local residents;
- The truck drivers carrying construction machinery and materials will be instructed to drive within speed limits with careful consideration for village traffic;
- Adequate traffic management plan including defensive driver training, management of traffic flows, liaising with local authorities and seeking stakeholder feedback shall require to be developed and implemented;
- The workers (both regular and contractual) on the project will be provided with trainings on the Health and Safety policy in place, and their role in the same and refresher courses will be provided throughout the life of the project;
- Put in place a grievance mechanism to allow for the workers and community members to report any concern or grievance related to project activities

Impact	Community Health and Safety				
Impact Nature	Negative			Neutral	
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	Limited to Project Footprint Area				
Frequency	Project Lifecycle				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Vulnerability/ Sensitivity of Social Receptors	Low		Medium		High
	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

	Significance of impact is considered **Moderate.**

Significance of Residual Impact

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

8.5.4 Impact on Cultural Sites and Archeological Sites

Context

As mentioned in **Section 6.9.2.7,** Lakkundi Village has been deemed as an archaeological site and is home to nearly 50 historical temples that are maintained by the Archaeological Survey of India (ASI) [1]. The village is full of semi-ruined and preserved historical temples from the period of Chalukyas, Kalachuris, Seuna and the Hoysalas empires of Indian history. The temples belong to Mallikarjuna, Virabhadra, Manikeshwara, Nanneshwara, Lakshminarayana, Someshwara, Nilakanteshwara and many more[2]. Based on the ASI website, of the 43 protected monuments in Gadag district, 6-7 are in Lakkundi Village. The village is also home to a heritage centre with artefacts and remains of ancient scriptures displayed for tourists. There are nearly four (4) proposed WTG locations which are at a distance of 900-1km from this village. However, the distance of these temples from the proposed WTG locations is more than 1kmThus, the impact of construction work would be minimal on these cultural resources.

Since, the site has archeological artefacts maintained by the ASI, there is slight possibility of a chance find procedure[3] being triggered.

Impact Significance

The project has to address the following key impacts envisaged on the local/ regional cultural environment through the project life cycle:

- Impact due to project traffic passing through religious, archeological, cultural and festival sites/ days, especially within the Lakkundi Village;
- Impact on local culturally sensitive receptors (mosques/temples/grave sites) in and around WTG sites and other subcomponents of the project due to construction activities;
- Chance finds of more archaeological, historical, religious and cultural remains of previous civilizations.
- Possibly discordant construction in or near a historic district or structure might require special design considerations to mitigate “visual” impacts to heritage resources.

Table 8.48 Significance of Impact- Cultural Environment

Impact	Cultural Environment				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Local archeological sites of religious or cultural significance and archeological site of Lakkundi village.				
Frequency	Construction Phase				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		

[1] https://gadag.nic.in/en/tourist-place/lakkundi/

[2] https://gadag.nic.in/en/gallery/lakkundi/

Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor.**			

Proposed Mitigation Measures

- The project will avoid these sites based on routes surveys and consultations with local community;
- WTG location and access roads (the route is yet to be finalised) may impact site of local cultural importance. The project will avoid these sites based on routes surveys and consultations with local community;
- If a cultural heritage site or site with archeological significance is damaged in any way, this will be treated as an incident, investigated and managed in accordance with the approved incident management procedures established for the Project.
- The Project will operate a Chance Finds Procedure in accordance with IFC Performance Standard 8. If any finds are encountered, work will cease immediately and temporary protection of the area will be established. The find will be reported and relevant specialists will be appointed to determine an appropriate course of action.

8.5.5 Employment Opportunities

Source of Impact

The table below is the manpower requirement for the project, as provided by the client.

Table 8.49: Manpower Requirement for the project

	Sl. No	Job	Estimated Number of Workmen		
			Skilled	Semiskilled	Unskilled
Construction	1	Civil (Foundation, Batch Plant)	30	60	20
	2	Turbine erection (Crane, Fitters)	80	20	0
	3	Transmission line	45	15	0
	4	Internal Road	10	30	10
	5	Substation	30	40	30
	6	Security	0	60	0
	7	Store Area / Material Handling	5	15	0
	8	Mis (House Keeping, Admin , etc)	2	2	5
	9	Drivers (site vehicles)	15	0	0
Operation and Maintenance	1	Operation and Maintenance (WTG)	20	0	0
	2	Security	0	50	
	3	Drivers (site vehicles)	6	0	0
	4	Mis (House Keeping, Admin , etc)	3	0	6
	5	Operation and Maintenance (SS)	9	9	0

Source: Ayana

Itis evident from the baseline conditions that more than 50 per cent of the total main workers living in affected villages are engaged in agriculture. It is significant to note that a sizeable share of nearly 40 per cent of people are engaged in non-plant based activities. Furthermore, there is a high proportion of women (nearly 41 percent) who are engaged as marginal workers. During operations & maintenance phase, the project will create employment most of whom are likely to be highly skilled. Locally procured services will include maintenance work for wind plant facilities, 24 hour security and

bush-cleaning etc. Further, housekeeping tasks around the associated infrastructure within the wind plant site (i.e., scrapyard, any temporary housing/site office etc.) will create occasional employment opportunity. There will also be a number of contract jobs including plant maintenance, electrical crane operators/crew of the project will also create rent-earning opportunities for project employees required to stay in project area.

In addition to this, security persons who guard the WTG locations and protect them from any unauthorised entry, theft and malignant acts will be required and largely sourced form affected villages. The vegetation growth in WTG premise, RoW of maintenance road and transmission route will also require some maintenance too.

Possible Consequences

The requirement of these services will create employment opportunities for people with a range of skill sets. The technical staff will be on regular work while a few maintenance services may be rendered by intermittent visit of specialised technical staff. The security services are to be round the clock hence would provide employment to semi-skilled people from the locality. The vegetation maintenance or landscaping work will create casual employment opportunities.

Embedded Provisions

Company provides the security service contract to a local agency which recruits people from the community.

Enhancement Measures

Following enhancement measures are recommended to enhance the positive impacts of the local employment opportunities created by the project:

- Project should demonstrate transparency in employment and adopt policy of non-discrimination and equal opportunity;
- It may adopt a policy which gives preference to families who sold land to the project;
- As most of the local recruitment would be through third party, a periodic audit and monitoring should be made part of the service agreement; and
- Project should disclose the information on local employment to Gram Panchayats and on its web-site for public access.

8.5.6 Impact on Local Public Infrastructure and Services

Source of Impact

The public infrastructures such as roads would be used for transporting the construction material and machines to the project site. The staff and work force would also use the local road to commute to the project site, offices and their residences. The project execution will also require banking services and policing to ensure smooth operation.

Possible Consequences

The banking services will improve as it would enhance their transactions and incomes. The policing of the project area are expected to improve the general law and order situation of the project area. However, impact on main road infrastructure would be negative. The local roads are not designed to carry heavy loads and will have to be reinforced/repaired.

On the other hand the internal road network (mostly unpaved) will be developed for maintenance of the WTGs and connected to the existing public road network. There is also possibility of access rods

connecting hamlets and villages which may fall on the access roads routes. Thus, it will improve the existing local road network.

Impact Significance

Table 8.50 Significance of impact on local public infrastructure

Impact	on local public infrastructure				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	There are road repairing and maintenance required at several places. New approach roads have provided alternate routes and short-cuts to various villages				
Frequency	Once				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Vulnerability/ Sensitivity of Social Receptors	Low	Medium	High		
	Improvement in road condition is a much admired local benefit. The project will improve local road network too.				
Impact Significance	Negligible	Minor	Moderate	Major	
	The significance of impact on local infrastructure will vary from minor to moderate depending on the extent of improvements made at various locations.				

Mitigation/Management Measures

Following mitigation measures are recommended to mitigate the negative impacts on the local infrastructure or to enhance the positive impacts for greater public benefit:

- The damage to the roads due to transportation of heavy machinery and construction materials should be appraised with the local Gram Panchayat. After discussions with the respective stakeholders, rectification measures shall be undertaken. ;
- Any loss of private or public assets due to widening of the road should be adequately compensated;
- Cultural sites should be avoided for construction of access roads;
- The road network created for WTG maintenance should be shared with local community with reasonable restrictions for ensuring public safety.

Significance of Residual Impact

There are both positive and negative impacts on the local infrastructure. Hence, the impact is classified as neutral. With the mitigation measures recommended above, the negative impacts will be reduced and positive impacts will be enhanced.

8.5.7 Retrenchment and loss of employment

Source of Impact

The end of construction phase and decommissioning of the wind plant will result in temporary loss of livelihood for construction workers at the end of construction stage, and staff retrenchment and loss of livelihood for others who are economically dependent on wind plant such as locally sourced security workers and housekeeping workers. .

The retrenchment would also result from reduction of staffing requirements or due to any downsizing operation or restructuring of the workforce.

Possible Consequences

The end of construction and decommissioning will therefore result in job-losses and consequently loss of income for their families. The scale is expected to be higher at the end of construction, and related to contracted construction workers. In a scenario of downsizing or partial retrenchment, the process may lead to loss of involvement, low morale, legal and reputational risks.

Impact Significance

Table 8.51 Significance of impact of retrenchment and loss of employment

Impact	Retrenchment and loss of employment				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	The retrenchment will affect construction workers, staff members of Ayana and security staff deployed at site through sub-contractor.				
Frequency	Once				
Likelihood	low				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Vulnerability of Social Receptors	Low	Medium	High		
	The skilled workforce will get alternate jobs, however, the local un-skilled workforce would find it difficult for a change of job and ensure alternative earning source. As the area has limited industrial presence, it acts as a further constraint in finding an alternative source of employment.				
Impact Significance	Negligible	Minor	Moderate	Major	
	The impact significance is assessed as **minor**.				

Mitigation/Management Measures

Following recommendations are made to manage the retrenchment process if it becomes necessary.

- Prepare a project specific Retrenchment Plan for end of construction stage, which clearly states the conditions on which preparation of a retrenchment triggers and entitlements thereof;
- Alternatives to job-losses to be explored before retrenchment is initiated for permanent employees and security guards engaged for operations stage. Due to large size of the project, it is assumed that approximately 50 security guards may be required.
- Key-stakeholders will be consulted at an early stage and their views to be incorporated in the process to the extent feasible;

8.6 Cumulative Impact Assessment

At the time of ERM site visit, an operational wind power project and one operational solar project were observed. It is understood that the wind power project is outside Ayana's proposed project boundary, however, solar plant of ReNew is present within the project footprint area.

Note: ERM cannot speculate about the installed operational capacity of projects in the proposed study area of 5 km of proposed project, since ERM did not consult with the developers of said operational projects and information regarding the same is limited on the public domain.

8.6.1 Environmental Impacts

The environmental impacts listed below have been considered for cumulative impact assessment.

- Impact on land environment;
- Impact on soil environment;
- Impact on water environment;
- Impact on air environment;
- Impact on ambient noise; and
- Visual impacts

8.6.1.1 Impact on land environment

As mentioned previously in the report, land use in the Project study area is primarily agricultural land, with the proposed 300 MW Project being developed over private agricultural land. Other operational wind power project of Wind World (~200 MW capacity) was observed towards north, northwest and western directions. Towards the east and northeast directions, no operational or upcoming wind power project were observed. Therefore, wind power projects will lead to change in land use restricted to the project footprint area. Furthermore, project related activities can potentially lead to land pollution in cases of mismanagement of wastes (solid, wastewater and hazardous) and hazardous materials. With a number of wind turbines installed in the study already, the chances of land pollution will increase. However, these projects are being developed by companies have an extensive wind power portfolio in India and have experience in managing said projects. Therefore, activities that may lead to pollution and contamination will be carefully undertaken.

Considering the above, the resource sensitivity is assessed to be **medium.** Since the existing and upcoming projects will lead to the private agricultural land being converted to industrial land, the impact magnitude is assessed as **medium** as well.

8.6.1.2 Impact on Soil environment

Impacts on soil environment have been discussed in sections 8.3.2 and 8.3.4. Since the upcoming projects will require clearance of the vegetation in the area, the amount of soil being eroded may increase. Another major concern in terms of soil environment is soil compaction considering the projects will develop a network of internal access road to provide access to the WTGs through already existing village roads during construction phase and for logistical support. Furthermore, waste generated on site during a particular project's life cycle can lead to increased contamination of the soil if not maintained and managed properly, considering the amount of projects that are operational or being developed in the area. Therefore, the resource sensitivity in the area is assessed to be **medium**.

The impact magnitude is assessed **medium** as well considering the access roads that will lead to soil compaction, increased soil erosion during windy days and the fact that the soil in the project area is sandy in nature with high infiltration capacity. Therefore, oils and lubricants can easily percolate inside the soil in the event of accidental leakage.

8.6.1.3 Impact on Water Environment

Increased number of wind power projects in the study area of 5 km can lead to increased stress on water resources of the area, especially during the construction phase. Projects utilising tankers sourcing water from nearby surface water bodies will affect the surface water resources in the area and projects utilising groundwater can lead to groundwater resources in the area being depleted. It has been observed with respect to wind power projects that use of tankers, sourcing water from nearby surface water bodies and/or sourcing groundwater from nearby villages, is trend that is prevalent.

With respect to impacts on water quality, groundwater/ surface water in the area can be severely impacted. As for leakages impacting the surface water resources, the projects are being developed in

an area consisting of drainage channels that are seasonally filled (during monsoon season). The local community use these seasonal water bodies and cases of accidental leakages and spills may lead to the surface water bodies being contaminated. Considering all the existing and upcoming wind power projects will consist of proper systems for waste management and leakage/spill management, the resource sensitivity is assessed to be **medium**. The impact magnitude therefore is assessed to be **medium** as well.

8.6.1.4 Impact on Air Environment

Impact on air quality in the region will arise during the construction as well as decommissioning phases due to the following activities:

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

The receptors of the above will be the various villages present within the study area of 5 km. The operational projects in the study area will not lead to any adverse impacts on the air quality of the area. Whereas, the construction activities will be for a short duration (10-12 months) for the entire project or approx. one month on WTG footprint basis, with air quality improving during the operational phase. Considering the present scenario, in which the existing projects are operational, air quality impacts during the construction phase identified for the proposed 300 MW Ayana project will prevail (receptor sensitivity assessed as **medium** and impact magnitude assessed as **small**).

8.6.1.5 Visual impacts

Presence of a structure of height 140 m where prominent structures are absent would be a visual impact to the nearby villagers and passing motorists. In addition, the Project site and surrounding areas have operational wind plant along with HT transmission lines present within 5 km. Based on consultations in the villages of the study area, majority of the people in the villages did not find the wind turbines unattractive and rather felt that it did not have any impact on their perception. The visual nature of the turbines was not a major issue because villagers concerns were largely related to other issues like drought, lack of availability of food for the cattle and unemployment that affected their immediate existence.

The most prominent source of visual impact during the operational phase is the presence of the wind turbines and the assemblage of transmission lines that evacuate to the Pooling substation and eventually to the grid substation. Assessing the visual impacts is highly subjective, as it depends on the perception of the viewer. People's attitude can differ and presence of wind plant can be viewed as both a positive and a negative impact on the surrounding area. In addition to this, the perception of the villagers of the existing wind plant in the area remains to be seen during the operation phase of the Project. In view of above, cumulative impact significance of visual impacts has been assessed as **minor**.

Significance of Impact

Taking the above mentioned environmental impacts into consideration, the overall cumulative impact significance is assessed to be **minor to moderate**. The cumulative impact significance will not go beyond moderate for environment impacts since wind power projects are projects with very low dependence on natural resources and are being developed to enhance the renewable energy sources in the country. Maximum dependence and impacts of wind power projects on natural resources and ambient environment is during the construction phase, which lasts for a short duration. Considering that the proposed 300 MW wind power project is being developed as per IFC Performance Standards/ AIIB/ DFC and NIIFL standards, mitigation measures and management plans in place for impacts arising due to such projects can easily help mitigate any environmental impacts.

Mitigation Measures

It is recommended that the proposed 300 MW Project diligently follows the mitigation measures already in place and additional mitigation measures proposed for all potential environmental impacts in ***Chapter 8*** and the environmental and social management plan in **Chapter 9**.

Residual impact significance

The implementation of mitigation measures and sound environmental practices will depend upon how a developer goes about ensuring that the natural environment of a region is not disturbed to a point where impacts become irreversible. Based on the aspects discussed for cumulative impacts, it can be concluded that developers within the 5 km study area of the proposed Ayana 300 MW wind power project will implement management plans to ensure any potential environmental impact is readily mitigated. Based on said assumption, the overall residual impact significance for cumulative environmental impacts is assessed to be **minor**.

8.6.2 Social Impacts

The project is set-up in Gadag and Mundargi taluk of Gadag district, considering the availability of land and good wind potential and the establishment of many projects (as discussed above). Due to the above-mentioned factors, the following cumulative impact given below has been envisaged in the AoI:

- Community Health and Safety
- Employment Opportunity
- Impact on Land holding and Agricuture Land

The details of each cumulative impacts is delineated below:

8.6.2.1 Community Health and Safety

The receptor for this impact will be the local community during the entire lifecycle of the project. The local community will include locals residing close to the WTGs, cultivators whose land is close to the WTGs, and those in the area for grazing purposes.

The construction phase activities such as the erection of the WTGs, construction of the transmission line and substation and movement of material and personnel may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery for the transportation of WTGs' part and other material. Furthermore, the movement of material and personnel via the access roads may result in injuries to people or livestock due to accidents.

The operation phase activities will include the accidental impacts-blade throw and Natural Disasters. Any communities lying in close proximity to the WTG are receptors of this type of impact. Blade throw risk for public safety is treated as extremely low as in the event of a failure the blade can reach between 15-100 m from the wind turbine. Furthermore, the live transmission line may result in injuries to the local community.

The decommissioning phase, such as the demolition of WTGs, and movement of heavy material may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery for the transportation of WTGs' part and other material.

The significance of the wind power project in the community health and safety is considered to be **Moderate.**

8.6.2.2 Employment Opportunity

Coming of wind project will have **Positive Impact** on the employment opportunity of the local people. The wind power infrastructure will create employment opportunity for the local people, who are having limited livelihood opportunity. The local community is likely to benefit from the economic opportunities to be created from the following activities in the AoI:

- Civil works during the construction phase including, construction of WTGs mounting area, transformer yard, internal roads, and transmission line,
- Self- employment options for individuals possessing vocational or technical training skills like electricians, welders, fitters etc.; and
- Contracting opportunities for locals possessing tractors, dumper trucks or other vehicles which would be needed to carry away excavated soil and other material. Creation of indirect employment for the local community through establishing small shops like tea stalls, the supply of intermediate raw materials, repair outlets, hardware stores etc. However, these are likely to be temporary.

The projects in the AoI has a positive impact in terms of employment generation for the local people during the entire project lifecycle.

8.6.2.3 Land Holding and Agricultural Land

The AoI is consists of agricultural land with patches of fallow land. The coming of wind projects in the AoI and the land purchase made by them of the agricultural land will result in a change of the titleholders. It will reduce the landholding of the local community in the area. As reported land required for installing a WTG is in the range of 4-5 acres and the land requirement increases by 3-4 acres per MW, which including access road and other utilities required for power generation. WTGs are usually located in a dispersed manner; as a consequence, even the land adjoining the WTG sites is used for carriage and vehicular movement during the construction phase of the project. Thus, the projects establishing in the AoI would result in land fragmentation and decrease in landholding in the AoI.

The project may result in an increase of landlessness in the area and in fragmentation/division of landholding. Fragmentation may be rendered certain land parcels unusable for planting, which will in turn adversely affected the livelihood of its owners, sharecroppers and agricultural labourers engaged in cultivation on it. It is understood that 85 nos. of survey nos. for WTG land, 250 nos. of land parcels for swift area (on lease) and 250 nos. of parcles (on lease) shall be involved.

However, land leasing will provide guaranteed income to the land owners. Thus, taking into consideration the argument as mentioned above, the impact of projects is anticipated to be **moderate** in the AoI.

Significance of Impacts

Taking the above mentioned social impacts into considerations, the overall cumulative impact significance is assessed to be **minor to moderate.**

Mitigation Mesaure

It is recommended that the project diligently follow the mitigation measures already in place and additional mitigation measures proposed for all potential social impacts and the environmental and social management plan.

Residual Impact Significance

The implementation of mitigation measures and sound social practices will depend upon how a developer goes ensuring that the social environment of the AoI is not disturbed to a point where impacts become irreversible. Based on the aspects discussed for cumulative impacts, it can be concluded that developer with the 5 km AoI of the 300 MW wind power project will implement management plans to ensure any potential social impact is readily mitigated. Based on said assumption, the overall residual impact significance for cumulative social impact is assessed to be **minor.**

Impact	Cumulative Impact Assessment-Social Impacts			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

Impact Extent	Local	Regional	International		
Impact Scale	Limited to the 5 km radius of the proposed 300 MW wind power project.				
Frequency	Project Lifecycle				
Likelihood	High				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	The impact significance is assessed as **moderate to minor**.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Magnitude	Negligible		Minor	Moderate	Major

8.6.3 Ecological Impacts

Individually a wind power plant may have minor impacts on the ecology of the region; however, presence of multiple projects in an area may increase the impact on avifaunal species by manifolds. Additionally, the Project site falls inside the Central Asian and West Asian-East African Flyways and supports the turnover high numbers of migratory birds in winter. The existing wind power projects and some future projects coming in this landscape may lead to an increased risk to these avifaunal species. Also siting of wind power plant in the natural habitats thereby affecting the scrub vegetation.

Many raptor species (Black Kite, Black-winged Kite, Bonelli's Eagle, Brahminy Kite, Greater Spotted Eagle, Montagu's Harrier, Osprey, Pallid Harrier, etc.) and congregatory species (Demoiselle Crane, Greater Flamingo, etc.) have been reported to be regular winter visitors to this landscape. All these species are likely to be affected to a great extent by the wind plants covering this landscape. The associated facilities such as the transmission lines (internal as well as external) will add to the existing risk of collision and electrocution

The cumulative impacts can be effectively managed by,

- Improved regional management,
- Carrying out planning of wind power industry in this region and strategic environmental and social assessment/regional environmental assessment of the planning, based on long term specific species and general biodiversity assessments,
- Strengthening mitigation measures for all wind power projects in region

8.6.3.1 Barrier Effect and Avoidance Behaviour

The presence of the turbines may act as a barrier to the movement of the avifauna. Also, the birds may try to avoid entire wind power plant area/specific clusters and both of these will force the species to travel longer distances to access the same resources. Both displacement and barrier effects/avoidance will result in energy costs for the concerned species and affecting their ecology, which may ultimately affect their breeding and migration.

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

9.1 Introduction

This *section* presents the Environmental and Social Management Plan (ESMP) for the 300 MW Project. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during different phase of project life cycle, i.e. construction, operation and decommissioning phases. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment. This is in accordance to IFC Performance Standards 1 that emphasizes the importance of managing social and environmental performance through the lifecycle of the Project.

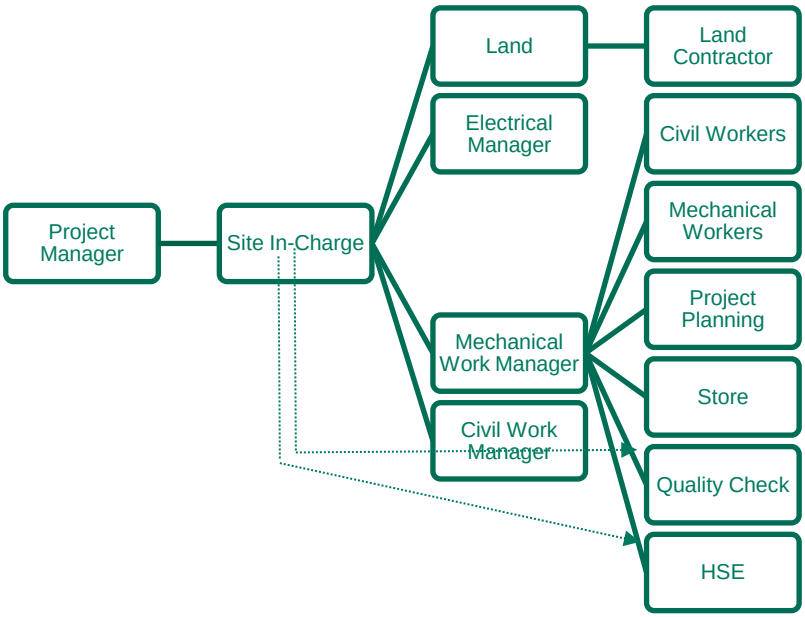
9.2 Environment, Health & Safety and Social Management System

Ayana follows a strategy of self-development of environmentally-friendly, high yielding wind plant after diligent study of the wind resource, careful planning of construction program in conjunction with the local population and obtaining a fully-committed, conservative financing structure. Ayana has already developed some key elements or in the process of formulating the critical elements of a Social and Environmental Management System which include their QHSE Policies and SOPs. These polices and SOPs cover the requirement of various aspects to be covered as part of life cycle of the Project implemented by Ayana and specific Environmental, health and safety conditions or aspects to be implemented by the contractors.
Ayana has also adopted internal environmental and social due diligence process for site selection for its projects.

9.2.1 Organizational Structure

To ensure the efficacy of environmental and social management plan, certain institutional mechanisms with well-defined roles and responsibilities is essential for effective implementation of identified mitigation measures both during construction and operation phases. Site level organisation structure is as presented below:

Figure 9.1 Organisation Structure



9.2.2 Implementation of ESMP

Ayanas site team will have the ultimate responsibility for implementing the provisions of the ESMP. This role will include the on-going management of environmental and social impacts, monitoring of contractor performance as well as development of mechanisms for dealing with environmental and social problems. Ayana will also ensure that the activities of its contractors (both during construction and operation phase) are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation.

The overall management and coordination of the Project will be the responsibility of Site In-Charge. Ayana will engage contractors to undertake construction activities including installation of WTGs, transmission line, pooling substation, site office, etc. The contractors are yet to be finalized. At project level, implementation of management plans and corrective actions are the responsibilities of HSE personnel. In construction and operational phase, HSE personnel will supervise the potential Contractor HSE Engineer's performance to implement the management action plans.

9.2.2.1 Roles and Responsibilities

Ayana will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, and safety, ecological and social issues. An outline for responsibilities are given in **section 2.9**:

9.2.3 Environmental, Health and Safety Department (EHS Department)

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

In general, the EHS department shall perform the following activities:

- Preparation of required documents on environmental and social management;
- Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Implementation of the health and safety measures;
- Collection of the statistics of health of workers;
- Providing support during routine medical check-ups of workers;
- Awareness and implementing safety programmes;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out environmental audits;
- Identify unsafe acts and conditions and suggest remedies;
- Develop safety culture and comply with company's EHS policy and standard requirements;
- Encourage and enforce the use of PPE's;
- Educate all employees for the use of PPE's and safe practices;
- Direct, coordinate and orient the safety activities;
- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

9.2.4 Inspection, Monitoring and Audit

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, Ayana will ensure that the conditions stipulated in various permits are complied. The inspections and audits will be done by the selected EPC contractor (during construction phase), trained team of Ayana's HSE department subject to be reviewed and conducted by external agencies/experts. The entire process of inspections and audits should be documented. The inspection and audit findings are to be implemented by the site in-charge in their respective areas.

9.2.5 Reporting and Documentation

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

9.2.6 External Reporting and Communication

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

9.2.7 Internal Reporting and Communication

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

- Team Briefings,
- On-site work group meetings;
- Work Specific Instructions.

9.2.8 Documentation

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

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

9.2.9 ESMP Review and Amendments

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

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

9.2.10 Training Programme and Capacity Building

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

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

HSE head of Ayana will ensure that Environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and operation of the wind plant.

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

9.2.11 Environmental and Social Management Plan

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

The purpose of ESMP is to:

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

In order to minimize adverse impacts during the different phases of the project lifecycle, mitigation measures, monitoring plan and responsibilities for its implementation are given in Tables below. The responsibility for implementation of ESMP will primarily lie with the HSE department of Ayana with the supervision of the HSE Head.

Table 9.1 Environmental and social management plan

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
1.1	***Land Use***									
1.1.1	■ Construction and strengthening of access road; ■ Site clearance and preparation for WTGs, PSS and EHV line; ■ Establishment and operation of batching plant; and ■ Transient storage of WTG components	Permanent and temporary changes in land use	Construction	■ On completion of construction activities, land used for temporary facilities such as stockyard, batching plant should be restored to the extent possible. ■ The land use in and around permanent project facilities should not be disturbed.	EPC Contractors and Subcontractors engaged by EPC	Site inspection	Upon completion of task	EPC Contractor and their sub-contractor	Ayana HSE officer	Report of restoration and acceptance copy from the land owner
1.2	***Land and Soil***									
1.2.1	■ Construction and Strengthening of access roads; ■ Vehicular movement; and ■ Stripping and stockpiling of soil layers	Soil compaction	Construction and Decommissioning	■ Dust settlement and mitigation strategies like frequent sprinkling to be adopted especially closer to settlements; ■ Vehicles should utilize existing roads to access the site to the extent possible. ■ Existing roads should be widened to have the width and turning radius to accommodate the necessary vehicles for the Project. ■ Soil should be ploughed in compacted areas after completion of construction work.	EPC Contractors and Subcontractors engaged by EPC	Site Inspection	Monthly monitoring	EPC Contractor and their sub-contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.2.2	■ Construction and Strengthening of access roads; ■ Selective clearance of vegetation on areas designated for WTGs erection, PSS and electrical poles; ■ Striping and stockpiling of soil layers; ■ Excavation for WTG foundation and electrical poles; ■ Removal of WTGs; and Removal of infrastructure	Soil erosion	Construction and Decommissioning	■ Stripping soil should be conducted only when required and top soil should be retained for landscaping. ■ Stripping of top soil, excavation and access road construction should not be carried out during the monsoon season or during heavy winds to minimize erosion and run-offs ■ The stock piles of top soil should be kept moist to avoid wind erosion of the soil ■ Revegetation of the construction boundaries using fast growing local vegetation ■ Site should be restored at the end of the Project lifecycle to the pre-project levels.	EPC Contractors and Subcontractors engaged by EPC	Site Inspection and Record Keeping	Monthly monitoring	EPC Contractor and their sub-contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.2.3	Management of solid wastes	Soil contamination	Construction Operation Decommissioning	■ Municipal domestic waste generated at site to be segregated onsite ■ The sub-contractors will ensure daily collection and weekly disposal of construction waste generated debris, concrete,	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection and Record Keeping	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				metal cuttings wastes, waste/used oil etc. ■ The municipal waste will be routed through proper collection and handover to local municipal body for further disposal						
1.2.4	Management of hazardous waste	Soil Contamination	Construction Operation Decommissioning	■ Hazardous waste will be properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance to Hazardous Wastes Rules, 2016 ■ Disposal of hazardous wastes will be done strictly as per the conditions of authorisation granted by KSPCB ■ Hazardous waste will be disposed routinely through approved vendors and proper records will be maintained of the same	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection and Record Keeping	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.2.5	Impacts due to leaks and spills	Soil Contamination	Construction Operation Decommissioning	■ Spill control kits will be used to contain and clean small spills and leaks ■ The sewage generated onsite will be treated and disposed through septic tanks and soak pits as per specifications given in IS 2470: 1995 (Part I and II). ■ Transport vehicles and equipment shall undergo regular maintenance to avoid any oil leakages ■ Offloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers trained to prevent/contain spills and leaks.	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection and Record Keeping	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.3	***Water Resource and Quality***									
1.3.1	• Construction of WTGs; • Domestic water for site staff and workers;	Depletion of water resources	Construction Operation	■ Regular inspection for identification of water leakage and preventing water wastage; ■ Optimum use of water during sprinkling on roads for dust settlement, washing of vehicles, concrete mixing, etc.; ■ Construction Labour deputed onsite to be sensitized about water conservation and encouraged for optimal use of water; ■ For construction uses, the low quality water will be blended with fresh water ; and ■ Recycle and reuse of water to the extent possible.	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection; Record Keeping Training records; Visual Assessment	Monthly	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana and training records
1.3.2	■ Storage of hazardous substances and waste onsite;	Water contamination	Construction Operation Decommissioning	■ The provisions of septic tank and soak pits will be provided (as per specifications given in IS 2470 1995 Part I and Part II)	EPC Contractors and	Site Inspection and Record Keeping	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
	■ Operation of batching plant; and ■ Construction and demolition activities that causes dust and erosion.			onsite for treatment and disposal of sewage, thereby minimizing the impacts of wastewater discharge. ■ Planning of toilets, soak pits and septic tanks, waste collection areas should be away from natural drainage channels; ■ Spill, leakage and clearance plan to be adopted for immediate cleaning of spills and leaks; ■ Ensure proper cover and stacking of loose construction material at Batching plant site and WTG's site to prevent surface runoff and contamination of receiving water body; ■ Use of licensed contractors for management and disposal of waste and sludge; ■ Labourers will be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage will be strictly restricted.	Subcontractors engaged by EPC; O&M Team during Operation phase					department of Ayana
1.4	***Air Quality***									
1.4.1	■ Site preparation and excavation of WTG foundation; ■ Access road widening, strengthening and maintenance; ■ Construction of ancillary facilities; ■ Operation of batching plants; ■ Operation of D.G. sets; ■ Vehicular movement; ■ Demolition activities.	Particulate, fugitive and vehicular emissions	Construction Operation Decommissioning	■ Preventive measures such as storage of construction material in sheds, covering of construction materials during transportation will be undertaken, for reducing dust as part of the embedded controls; ■ Emissions from the emergency DG set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained; ■ Minimize stockpiling by coordinating excavations, spreading, re-grading and compaction activities; ■ Speed of vehicles on site will be limited to 10-15 km/hr which will help in minimizing fugitive dust emissions due to vehicular movement; ■ Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures; ■ Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate; and	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection; Record Keeping Training records; Visual Assessment	Weekly	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana and training records

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				■ Idling of vehicles and equipment will be prevented as part of periodical monitoring and auditing program, seek and review data pertaining to accidents and incidents involving vehicle fleets of the project.						
1.5	***Ambient Noise***									
1.5.1	■ Noise from construction activities; ■ Operation of batching plant; ■ Operation of D.G. sets; and ■ Vehicular movement	Increased noise levels	Construction Operation Decommissioning	■ Normal working hours of construction to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise;	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Only well maintained equipments to be operated on site.	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site inspection and record keeping	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Equipment maintenance log book
				■ If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing all the noise generating equipment such as DG sets, batching plant etc. away from village settlement as possible.	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Machinery and construction equipments that may be in intermittent use should be shut down or throttled down during non-working hours.	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged.	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.5.2	Operation of WTGs	Noise Impact from movement of wind turbines	Operation	■ Regular maintenance of WTGs	O&M Team during Operation phase	Site Inspection	Quarterly	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Periodic monitoring of noise near the sources of generation to ensure compliance with design specifications.	O&M Team during Operation phase	Record Keeping	Quarterly	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Half yearly monitoring of ambient noise levels (during day and night time) at identified	O&M Team during Operation phase	Submission of monitoring reports to corporate office	Half-yearly	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				residential receptors for determination of actual impacts due to the operation of WTGs						department of Ayana
				■ In areas of actual impact, planting of trees and earth berms (raised ground levels) to attenuate noise levels near the receptors.	O&M Team during Operation phase	Site Inspection	Half-yearly	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.6	***Shadow Flicker***									
1.6.1	Shadow flicker from operation of WTGs	Shadow Flicker	Operation	Following mitigation measures are proposed to reduce the intensity of shadow flicker: ■ Installation of blinds such as curtains at the concerned window facing the turbines; ■ Planting trees and ensure increase in dense vegetation coverage to screen the affected receptor locations from sun; ■ Construction of a compound wall till the height of the window; ■ Shadow flickering issue to be included in the GRM for the project through which community members can record their complaints and relevant actions can be taken, as per the satisfaction of the complainant/ community.	O&M Team during Operation phase	Record Keeping	Monthly monitoring	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Close monitoring of residents where predicted impacts from shadow flicker occurs.	O&M Team during Operation phase	Submission of reports to corporate office	Half-yearly	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
				■ Potential shut down of the turbines during times and conditions where the impact is highest and where above mitigation measures proves ineffective.	O&M Team during Operation phase	Record Keeping	Half-yearly	O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.7	***Occupational Health and Safety***									
1.7.1	Project activities of excavation, carrying of load, working at height and in confined spaces, working with rotating machinery and working with live components	Threat to Health and Safety of the construction workers	Construction Operation Decommissioning	■ All the construction activities should be carried out during day time hours and vigilance should be maintained for any potential accidents; ■ Personal Protective Equipments (PPEs) including safety shoes, helmets, goggles, ear muffs and face mask should be provided as necessary; ■ Structural integrity should be checked before undertaking any work; ■ Electrical and maintenance work should not be carried out during poor weather and during lightning strikes; ■ All workers should be provided with training with Health &	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection and Record Keeping	Monthly monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				safety policies in place with appropriate refresher courses throughout the life cycle of the project; ■ Permitting should be implemented to ensure that cranes and other lifting equipment is operated by trained and authorised person only; ■ Appropriate safety harness and lowering/raising tools should be provided for the workers; ■ Safe drinking water should be provided for the workers; ■ Excavated areas to be temporarily fenced to avoid access to outsiders and wildlife; ■ Security should be deputed at potential accident sites to restrict entry and prevent near misses, injuries and fatalities; ■ First aid box to be provided at all the construction sites and trained person should be appointed to manage it; ■ An emergency preparedness and response plan (onsite and offsite emergencies) should be in place to account for natural disasters, accidents and any emergency. The nearest hospital, ambulance, fire station should be identified in the emergency preparedness and response plan. ■ Traffic Management Plan to be developed and sensitization on Motor Vehicles Act and its stipulations with respect to safety and insurance					
1.8	***Visual Landscape***									
		Visual landscape/ visual aesthetic impact	Construction Operation	■ Ancillary structure presence and area should be minimized to the extent necessary; ■ Construction area to restored to the original form; ■ Signages related to wind plant to be discrete and confined to entrance gates; ■ No other corporate or advertising signage should be displayed on site; ■ The footprint of the operation and maintenance facilities as well as parking and vehicular circulation should be clearly defined and not allowed to spill over into other areas of the site; ■ Use of certain colour reduces the visual contrast between the	EPC Contractors and Subcontractors engaged by EPC; O&M Team during Operation phase	Site Inspection	Monthly Monitoring	EPC Contractor and their sub-contractor; O&M Contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				turbine structures and background.						
1.9	***Social Impacts***									
1.9.1	Labor Influx, Traffic Movement	Community Health and Safety/Labour and Working Conditions	Construction	■ Awareness on STD and HIV/AIDS to be conducted among migrant labours and local community ■ Traffic pilots are to be used for assisting other road users and taking preventive measures to ensure road safety	CSR Officer, Sub-contractor for Transport	Record Keeping and Site Inspection	Monthly	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite HSE officer to HSE department of Ayana
1.9.2	Impact on titleholders	Land Procurement	Pre-construction	■ Ayana should develop a documented, formal Land Procurement Policy to cover following aspects: ■ Process of government land allotment ■ Process of private land purchase ■ Avoiding physical displacement ■ Determination of compensation as per replacement cost ■ ■ Preparation of socio-economic profile and assessment of vulnerability of land owners including land ownership and potential land lessnesses, scheduled castes and scheduled tribes, below poverty line households, single women headed households, households with people with disabilities etc. ■ Provision of special measures such as preferential employment and eligibility in livelihood restoration measures for vulnerable households ■ Information disclosure and meaningful consultations based on the principles of Informed Consultation and Participation (ICP) ■ A socio-economic profile of all land owners and non-titleholders should be prepared by Ayana ■ If their livelihood is impacted due to selling of land then it is recommended that income generation activities that can be clubbed with CSR activities of the SPV shall be provided. ■ Training and assistance should be provided for enhancing agricultural productivity in all villages affected due to land procurement. ■ Ayana should provide compensation as per replacement cost principles (i.e. market value plus transaction costs) for all	Land Department, E&S Team	Documented Land Procurement Policy and Procedure and reports of implementation	Before completion of land procurement and ongoing monitoring	Ayana Land Department	Ayana HSE officer	Reporting from Ayana land procurement and monitoring reports

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				remaining private land locations. ■ The water-conservation and watershed improvement and management to be carried out with active participation of the local communities in all the villages in order to improve irrigation access.						
1.9.3	Sharing of Local Public Infrastructure	Use of Public Resources	Construction	■ The damage to the roads due to transportation of heavy machinery and construction materials should be appraised with the local Gram Panchayat. After discussions with the respective stakeholders, rectification measures shall be undertaken. ;	Project team/ CSR/Community Liaison	Site Inspection	Monthly	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
			Construction	■ Any loss of private or public assets due to widening of the road should be adequately compensated;						
			Construction	■ Cultural sites should be avoided for construction of access roads;						
1.9.4	Construction and operations leading to local employment and labour influx	Labour and Working Conditions	Construction, Operations and Decommissioning	■ Ayana will require its sub-contractors to report on the employment provided to local communities.	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ The health check-up of all migrant labours should be done	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ The mixing of local and migrant labours should be prevented as far as possible	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ A code of conduct should be developed for residents of the labour camp to prevent them from being involved in illegal and immoral activities.	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ All Project personnel will be required to follow a code of conduct that respects local archelogical sites, local cultural traditions and religious festivals, funerals and other traditional events. Induction training for all personnel will include appropriate cultural awareness training.	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ Should be made aware about the Sexually Transmitted Diseases and HIV/AIDS.	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ There should be a regular compliance audit of the sub-contractors in each quarter	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				■ The grievance handling system of the Ayana should be extended to the sub-contractors labour to receive and address their grievances	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ Project should demonstrate transparency in employment and adopt policy of non-discrimination and equal opportunity	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ It may adopt an affirmative action policy which gives preference to families who sold land to the project	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
				■ Adopt a retrenchment policy which clearly states the conditions on which preparation of a retrenchment triggers and entitlements thereof	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Monthly during construction and quarterly during operations	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite CSR officer to HSE department of Ayana
1.9.5	Archeological Site	Site is close to a deemed archological site in Lakkundi.	Construction	■ The project will avoid these sites based on routes surveys and consultations with local community; ■ WTG location and access roads (the route is yet to be finalised) may impact site of local cultural importance. The project will avoid these sites based on routes surveys and consultations with local community; ■ If a cultural heritage site or site with archeological significance is damaged in any way, this will be treated as an incident, investigated and managed in accordance with the approved incident management procedures established for the Project; ■ The Project will operate a Chance Finds Procedure in accordance with IFC Performance Standard 8. If any finds are encountered, work will cease immediately and temporary protection of the area will be established. The find will be reported and relevant specialists will be appointed to determine an appropriate course of action	Project team/HR site Manager	Site Inspection/Internal Audits/document verification	Bi-Monthly	Ayana	Ayana site in-charge	Report from onsite Head to HSE department of Ayana
1.9.6	Community Health and Safety	Impact on health and concerns on safety of nearby communities	Project Lifecycle	■ As part of the stakeholder engagement and information disclosure process, the community will be provided with an understanding of the activities to be undertaken and the precautions taken for safety; ■ As part of stakeholder engagement, the project will also propagate health	H&S Team Ayana and EPC Contractor	Surveys and Document verification	Monthly	Ayana and their sub-contractor	Ayana HSE officer	H&S reports

SN.	Project Activity	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				awareness amongst the community, including setting up of health camps, ■ The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety ■ The workers (both regular and contractual) on the project will be provided with trainings on the Health and Safety policy in place, and their role in the same and refresher courses will be provided throughout the life of the project; ■ Put in place a grievance mechanism to allow for the workers and community members to report any concern or grievance related to project activities					
1.9.7	Land Procurement	Land Acquisition and Economic Displacement	Pre-Construction	■ Identification of dependent households on government land to be procured for project	Land Team/Site Manager	Surveys and Document verification	Monthly	Ayana and their sub-contractor	Ayana HSE officer	Report from onsite Land officer to Ayana
				■ Adequate compensation for landowners affected due to transmission line when finalised.						
				■ Consideration of employment for impacted families due to land procurement						

Table 9.2 ESMP for Ecological Aspects

SN.	Project Activity	**Impacts/Issue**	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
1.1										
1.1.1	Vegetation Clearance	Site Preparation	Construction	■ During vegetation clearance exercise the important sites such as avifauna and other wildlife's roosting and breeding sites, etc. should be avoided; ■ Vegetation clearance in the scrub land should be minimised by optimization of internal road, power evacuation line and avoiding construction of ancillary facility, storage, labour camps; ■ Vegetation disturbance, clearance and construction activities should be restricted to the project activity area, labour camp and storage areas; ■ Areas around the water sources should be avoided to the extent possible during the planning of access/internal roads, storage areas, labour camps and ancillary facilities;	EHS Officer	Visual Verification	Duration of the Activity	EPC Sub contractor	EHS Officer	Report from onsite HSE officer to HSE department

				■ Topsoil that is disturbed should be stored separately for later restoration of the habitat; ■ Simultaneous revegetation using native species on outskirts of Project activity area should be practiced for areas that are determined to have loose or unstable soil to avoid erosion; ■ Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement, needless expansion of labour camp and destruction of floral resources should be prohibited; and ■ Strict prohibition on use of fuel wood and shrubs from nearby areas as kitchen fuel.						
1.1.2	Construction Activities	Habitat Disturbance and Road Kill	Construction	■ Construction and transportation activities should be avoided at night (6:00 pm to 6:00 am) and should particularly avoid high activity areas like locations near forest or water bodies during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:30 pm); ■ Areas with pre-existing burrows or ground roosting sites of birds should be avoided when possible; ■ Temporary barriers should be installed on excavated areas ■ Hazardous materials should not be stored near natural drainage channels; ■ Simultaneous revegetation on outskirts of Project activity area should be practiced for areas that have loose or unstable soil to avoid erosion and sedimentation; ■ Efforts should be made to minimize construction noise and the use of noise barriers should be considered for areas with high noise levels; ■ Waste materials should be cleared in a timely manner and the use of artificial lights should be minimized so as to not attract wildlife; ■ Good housekeeping should be followed for construction activities, waste packaging material should be properly disposed; ■ Proper sanitation facilities should be provided at the labour camps; ■ Labour movement should be restricted between construction camps and construction sites; ■ Vehicle movement should be restricted in areas and times where wildlife is most active; ■ Anti-poaching, trapping and hunting policy among employees and contractors should be strictly enforced; ■ General awareness regarding fauna should be enhanced through trainings, posters, etc. among the staff and labourers; and ■ Simultaneous revegetation on outskirts of project activity area should be practiced for areas that have loose or unstable soil to avoid erosion and sedimentation.	EHS Officer	Visual Verification	Duration of the Activity	EPC Sub contractor	EHS Officer	Report from onsite HSE officer to HSE department
1.1.3	Operational Wind Turbine	Collision Risk	Operation	■ Long term collision risk assessment for at least two years covering migratory period (Oct-March) and breeding season (April-June) based	EHS	Third Party Monitoring Agency	Initial 2 years after Operation of Wind power plant	HSE	Project Manager	HSE to Project Manager

				on representative vantage point, point counts and transect surveys covering entire wind plant area and transmission lines should be undertaken in order to assess the long term movement patterns of the migratory birds in the landscape; ■ Bird carcass monitoring should be commissioned in operation and maintenance phase, in which all bird carcasses found in the wind plant should be recorded and photographed with details about the distance from the closest wind turbine generator and the name of the wind turbine generator for at least two years; ■ Food waste materials should not be left lying around WTG and if any waste is found then it should be cleared immediately so as to not attract birds near the WTG; ■ The tower and blade tips should be marked / painted with orange colour for better visibility of the WTGs; ■ Wind turbine generators should be properly maintained to ensure that turbine blade speeds are regulated and blade throws are avoided; and ■ Restrictions should be imposed so that dead carcasses are not disposed near the WTG areas so that the vultures are not attracted.						
1.1.4	Transmission infrastructure	Collision and Electrocution Risk	Operation	■ The monitoring of movement of migratory avifaunal species across the landscape of study area can help understanding the high risk areas of the wind plant and transmission line; ■ Collection of baseline data on migratory birds visiting the study area by using vantage point, point counts and transect surveys covering various habitats and waterbody survey is required as the monitoring would give probable flight path of migratory birds during their daily movement; ■ This will help identify the high risk areas of the transmission line stretch and the mitigation measures can be revised based on the outcomes of the study; ■ Restrictions should be imposed so that dead carcasses are not disposed near the WTGs and Transmission lines. The O&M team should be trained on removing any carcasses found around these project components in a timely manner to ensure that no vulture or birds of prey are attracted to the Project site; ■ Records of feeder trips due to bird electrocution should be maintained with feeder number, bird species, time of electrocution, location, etc. These should be shared with an expert ornithologist for identification of the species. These will be the areas of high concern and focus for further mitigation; ■ Regular checking of the transmission towers to avoid nesting by any of the birds; ■ Marking overhead cables using diverters (Figure 8.5) and avoiding use in areas of high bird	EHS	Third Party Monitoring Agency	Initial 2 years after Operation of Wind Power Plant	HSE	Project Manager	HSE to Project Manager

				concentrations of species vulnerable to collision; and ■ The transmission poles should be raised with suspended insulators and perch rejecters in order to reduce the electrocution of bird species (***Figure 8.6*** and ***Figure 8.7***).						

10. IMPACT SUMMARY AND CONCLUSION

10.1 Introduction

This Environmental and Social impact assessment has been conducted to evaluate the impacts associated with the proposed wind plant project of 300MW capacity. The impact assessment has been conducted in compliance with the Administrative Framework identified herein, including relevant national legislative requirements, international conventions and Ayana's corporate requirements.

10.2 Impacts Requiring Detailed Assessment

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

Table 10.1 Impact Assessment Summary

Impact Description	Impact Nature	Significance of Impact	
		Without Mitigation	With Mitigation
Construction Phase			
Change in Land Use	Negative	Moderate	Minor
Soil Compaction and Erosion	Negative	Minor	Negligible
Waste Generation and Soil Contamination	Negative	Moderate	Minor
Soil contamination due to leaks and spills	Negative	Minor	Negligible
Impact on Water Availability	Negative	Major	Moderate
Impact on Water Quality	Negative	Moderate to minor	Minor
Impact on Air Quality	Negative	Minor	Negligible
Impact on Ambient Noise	Negative	Minor	Negligible
Impact on Occupational Health and Safety	Negative	Minor	Negligible
Impact on Economic Opportunities	Positive	Minor to moderate	
Impact of Labour Influx/Migrant Workforce	Negative	Moderate	Minor
Impact on Economy and Employment	Negative	Moderate	Moderate
Impact on cultural and archeological Resources	Negative	Moderate	Minor
Impact due to Vegetation Clearance	Negative	Minor	Minor
Impact due to Construction Activities	Negative	Minor	Minor
Operation and Maintenance Phase			
Soil Compaction and Erosion	Negative	Minor	Minor- Negligible
Waste Generation and Soil Contamination	Negative	Negligible	Negligible
Impact on Water Availability	Negative	Moderate	Moderate
Impact on Water Quality	Negative	Negligible	Negligible
Impact on Air Quality	Negative	Minor	Negligible

Impact Description	Impact Nature	Significance of Impact	
		Without Mitigation	With Mitigation
Impact on Community Health and Safety	Negative	Minor	Negligible
Impact on economy and employment	Positive		
Hazards associated with turbine blade movement	Negative	Moderate	Minor
Collision and Electrical Hazards from Transmission Infrastructure	Negative	Moderate	Minor
Decommissioning Phase			
Impact on Water Environment	Negative	Moderate	Minor
Impact on Air Quality	Negative	Minor	Minor- Negligible
Impact on Ambient Noise	Negative	Minor	Negligible
Impact on Economy and Employment	Negative	Minor	Negligible

10.3 Conclusion

The proposed project is a green energy project proposing to generate power of 300 MW through wind energy. Impacts due to proposed wind energy project are short term, generally limited to construction phase and operation phase have negligible to critical environmental, ecological and social impacts. The Project and its key components such as access road, site office building, and external transmission lines, are likely to have potential environmental impacts on baseline parameters such as land use, ambient air quality, noise quality in the immediate vicinity of WTGs during the construction phase, the project is also likely have potential impact on night time noise during operation phase and shadow flickers effect on the receptors present within the setback distance of 300 m however most of the receptors present in the receptors were used temporary during day time except one residential receptor. The social impacts from the project are assessed to be generally beneficial in terms of local employment and overall local area development. The project shall prove to be beneficial in terms of employement generation, reduction in greenhouse gases emission, community benefits through corporate social responsibility (CSR) activities.

The Environmental and Social Management Plan (ESMP) and specific management plans describes mitigation measures for impacts specific to project activities and also discuss implementation mechanism. To conclude, the implementation of ESMP will help Ayana in complying with national/ state regulatory framework as well as to meet IFC / DFC /AIIB/ NIIFL reference framework requirements.

APPENDIX A WTG PROFILING

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
AY 4	75°40'22.15"E	15°25'14.95"N	Flat	450km NE	None	1.2km E	None	NA	2	206m S W	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 5	75°40'57.35"E	15°24'57.14"N	Flat	512m N	Hatelgeri Village boundary residences	250-300m NE and SE	None	NA	4	394m N, 375m W and 406 m	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 6	75°40'14.93"E	15°24'41.90"N	Flat	439m S	None	1.25km NE	None	NA	5	77m NE, 190m NE, 295m S, 236m S, 276m S	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 7	75°41'10.54"E	15°24'39.85"N	Flat	698m E	None	1km S	None	NA	2	238m SE and 470m N	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 8	75°41'41.58"E	15°22'29.07"N	Flat	599M NW	Multiple scattered Agricultural sheds	195m N	None	NA	1	199m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 9	75°41'52.07"E	15°22'7.47"N	Flat	331m SE	2 Agricultural Sheds	450m SE and 450m E	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 10	75°42'15.37"E	15°21'43.75"N	Flat	891m E	3 Agricultural sheds	436m S, 2 at 499m S	None	NA	3	356m NW and 430 m NW and 356 m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 11	75°44'48.03"E	15°21'56.97"N	Flat	223m N	None	1.1km W	None	NA	1	444m NW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 12	15°20'34.65"N	75°42'53.98"E	Flat	255m NE and 201m S	4 agricultural sheds and settlements on village boundary	295m NE, 227m SW, 240m S and 413 m SW Village boundary dwelling 480-500m	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 13	75°43'1.08"E	15°21'13.29"N	Flat	325m N	None	821m SW	None	NA	1 well and 1 seasonal waterbody	355m NE and 301m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 14	75°42'57.57"E	15°21'35.27"N	Flat	480m N	None	614m SW	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 15	75°42'39.58"E	15°21'57.33"N	Flat	190m E	None	None	None	NA	1	30m E	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 16	75°42'41.80"E	15°22'31.10"N	Flat	287m E	None	1.2km N	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 17	75°42'32.72"E	15°22'45.29"N	Flat	644m E and 76m NE	Scattered small agricultural sheds	300-400m N	None	NA	None	NA	Agricultural and barren	Yes	1.19 km NE	Yes; Kappatagudda Wildlife Sanctuary
AY 18	75°42'15.48"E	15°23'14.31"N	Flat	294m N, 442m NE and 283km S	Yes	337m East (extended colony of Lakkundi Village) and scattered agricultural sheds	None	NA	None	NA	Agricultural and barren	Yes	1.25 km E	Yes; Kappatagudda Wildlife Sanctuary
AY 19	75°42'14.21"E	15°23'36.80"N	Flat	382km S and 126km S	Scattered small agricultural sheds	200-400m south and east	None	NA	1	113m SE	Agricultural and barren	Yes	1.2 km E	Yes; Kappatagudda Wildlife Sanctuary
AY 20	75°42'6.82"E	15°23'54.41"N	Flat	399km NE	None	1.6km W	None	NA	2	294km SW, 487 km E	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 21	75°42'8.95"E	15°24'18.51"N	Flat	276m SW	None	2.04km SW	None	NA	2	246m NW, 297m NW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
AY 22	75°42'7.20"E	15°24'37.75"N	Flat	646m SW	None	1.4km NW	None	NA	2	313m S, 299m S	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 23	75°41'57.61"E	15°24'58.05"N	Flat	501m N	None	691m NW	None	NA	2	195m NW, 257m N	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°41'52.93"E	15°25'16.99"N	Flat	140m S	Yes	405m W	None	NA	3	460m W, 500m SE and 500m S	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T 16	75°42'5.18"E	15°25'24.43"N	Flat	312m S	None	970m SW	None	NA	1	244m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 25	75°41'37.72"E	15°25'35.16"N	Flat	212m S	None	517m SW	None	NA	1	348m W	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 26	75°41'20.87"E	15°25'49.92"N	Flat	595m SW	None	1.51km S	None	NA	1	396m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 27	75°41'17.31"E	15°26'7.50"N	Flat	1.06km SW	None	1.6km S	Yes	530 m N	1	236m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 28	75°42'9.77"E	15°26'32.53"N	Flat	691m SE	None	2.8km NW	Yes	403 m N	6	284m NW, 355m NW, 166m W, 164m SW, 360m SW and 431m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°42'17.75"E	15°26'5.16"N	Flat	186m S	1	262m SE	None	NA	1	92m N	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T 17	75°42'9.21"E	15°26'0.40"N	Flat	262m SE	1	451m SE	None	NA	1	92m N	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°42'26.26"E	15°25'49.55"N	Flat	364m NW	1 shed	307m NW	None	NA	2	85m NE and 400m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 31	75°42'50.59"E	15°25'25.12"N	Flat	254m S	None	2.3km W	None	NA	1	310m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 32	75°42'49.70"E	15°25'5.00"N	Flat	455m E and 343m N	None	2.1km E	None	NA	1	480m W	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°42'56.66"E	15°24'41.53"N	Flat	319m E	None	1.5km SE	None	NA	1	478M E	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 34	75°43'1.03"E	15°24'21.27"N	Flat	234m E	None	932m S	None	NA	None	NA	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 35	75°42'58.70"E	15°24'0.48"N	Flat	357m E	Large cluster of Lakkundi Village	357m E	None	NA	None	NA	Agricultural and residential	Yes	890 m SE	Yes; Kappatagudda Wildlife Sanctuary
AY 36	75°43'26.38"E	15°22'59.98"N	Flat	245m N and 327m SW	Cluster of houses	245m NW	None	NA	1	263m SW	Agricultural	Yes	870 m NW	Yes; Kappatagudda Wildlife Sanctuary
AY 37	75°43'37.79"E	15°22'35.64"N	Flat	190m W	Small house	219m SW	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 38	75°43'34.63"E	15°22'13.07"N	Flat	349m NE	A storage yard (3.39 ha) and small house	342m SE and 484m NE	None	NA	1	407m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 39	75°43'43.18"E	15°21'56.05"N	Flat	282m E	A storage yard (3.39 ha)	263m N	None	NA	5	183m SE, 184m NE, 256m NE, 410m N, 353m NW,	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
AY 40	75°43'55.19"E	15°21'33.23"N	Flat	260m NE	Small cluster of houses	454m SE	None	NA	3	304m SE, 432m NE and 431m N	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 41	75°44'1.12"E	15°21'12.71"N	Flat	212m E	Small cluster of houses	390m NE	None	NA	None	NA	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 42	75°43'47.54"E	15°20'44.15"N	Flat	430m N	None	566m SE	None	NA	3	139m NW, 289m NE and 451m NE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 43	75°44'1.03"E	15°20'30.80"N	Flat	335m E	1	320m SE	None	NA	3	265m SE, 338m SE and 379m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 44	75°44'33.31"E	15°20'8.36"N	Flat	796m W	None	1.6km NW	None	NA	1	80m E	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 45	75°45'8.35"E	15°21'7.47"N	Flat	321m SW	None	1.3km W	None	NA	5	311m S, 288m SE, 329m S, 286m NE and 452m NE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 46	75°45'9.58"E	15°21'34.48"N	Flat	106m W	None	1.8km SW	None	NA	2	409m S and 467m SW	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 47	75°44'40.96"E	15°22'17.99"N	Flat	471m S	None	1.6km SW	None	NA	None	0	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 48	75°44'52.47"E	15°22'38.32"N	Flat	595m N	None	1.5km W	None	NA	1	73m	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 49	75°44'15.10"E	15°23'14.05"N	Flat	404m S	None	816m SE	None	NA	1	414M S	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 50	75°44'7.91"E	15°23'41.12"N	Flat	413m NW and 286m S	None	977m NW	None	NA	None	NA	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 51	75°43'55.54"E	15°24'1.11"N	Flat	277m S and 340m NW	None	625m W	None	NA	2	388m N and 356m NW	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 52	75°43'54.11"E	15°24'25.33"N	Flat	106m E	None	1.1KM SW	None	NA	2 Large Ponds	255m SW and 500m W	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 53	75°43'52.98"E	15°24'45.88"N	Flat	175m NW	None	1.8km SW	None	NA	1	236m Nw	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 54	75°43'44.10"E	15°25'3.84"N	Flat	243m E	None	2.7km SW	None	NA	2	365m SE and 379m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°43'39.06"E	15°25'24.87"N	Flat	623m SE	None	3.5km N	None	NA	2	92m SE and 190m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°43'38.49"E	15°25'41.93"N	Flat	860m W	None	2.8k	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 57	75°42'59.74"E	15°25'55.30"N	Flat	269m E	None	1.5km NE	None	NA	2	402m NW and 406m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 58	75°43'1.41"E	15°26'14.17"N	Flat	269m E	None	1.04m NE	None	NA	2	340m SW and 338m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
AY 59	75°43'17.11"E	15°26'33.91"N	Flat	260m W	Apartment Complex	260m NE	Yes	638m N	3	317m NW, 266m S and 331m S	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 60	75°44'8.53"E	15°26'55.90"N	Flat	415m E	None	722m NW	Yes	250 m N	2	219m NE and 140m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 61	75°44'10.27"E	15°26'37.59"N	Flat	833m N	None	1.2km NW	Yes	840 m N	1	372m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 62	75°44'12.59"E	15°26'17.32"N	Flat	989m E	None	1.7Km NW	None	NA	1	288m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 63	75°44'21.24"E	15°25'58.16"N	Flat	1.1km NE	None	2.4km NW	None	NA	1	83m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 64	75°44'25.48"E	15°25'40.81"N	Flat	527m S	None	3.1km N	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 65	75°44'40.23"E	15°25'9.28"N	Flat	455m N	None	1.9km SE	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 66	75°44'43.18"E	15°24'48.69"N	Flat	827M S	None	623m S	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 67	75°45'49.45"E	15°20'16.04"N	Flat	644m NE	None	3.1m E	None	NA	8	255m N, 393m N, 430m NE, 402m NW, 440m E, 375m SE, 336m SE, 326m SW	Agricultural and Barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 68	75°44'49.58"E	15°24'0.80"N	Flat	542m NW	None	797m N	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°46'12.10"E	15°24'26.69"N	Flat	556m N	None	546m NE	None	NA	1	304m NW	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 70	75°45'52.22"E	15°24'48.43"N	Flat	385m S	Scattered small houses	300-350m SW	None	NA	0	NA	Barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 71	75°45'53.47"E	15°25'9.71"N	Flat	320m N	None	1km S	None	NA	2	141m SE and 430m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 72	75°45'36.63"E	15°25'30.50"N	Flat	266m S	None	1.1m E	None	NA	1	174m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°45'6.76"E	15°26'3.28"N	Flat	207m NE	None	2.3km SE	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 74	75°45'9.46"E	15°26'22.50"N	Flat	445m W	None	2.5km SE	None	NA	3	335m NW, 385m W and 422m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 75	75°45'2.27"E	15°26'42.02"N	Flat	500m SW	None	2.3km NW	None	NA	4	392m W, 237m W, 335m SW and 348m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 76	75°45'1.26"E	15°26'59.17"N	Flat	835m SW	None	1.9km NW	Yes	500m	5	327m SW, 298km SW, 209km W, 220km NW, 298km NW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
AY 77	75°45'52.28"E	15°27'2.29"N	Flat	604m S	None	2.99 Km S	Yes	430 m NE	3	500m NW, 364m NW, 468m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 78	75°45'59.44"E	15°26'47.32"N	Flat	406m W	None	2.4km S	Yes	700 m E	5	449m W, 355m NE, 227m SE, 376m SE, 461m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 79	75°46'3.98"E	15°26'26.86"N	Flat	175m W	None	1.7km S	None	NA	5	456m N, 184m NE, 266m NE, 346m SE and	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 80	75°46'3.65"E	15°26'9.52"N	Flat	78m E	None	1km S	None	NA	3	469m NE, 129m W and 402 W	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 81	75°46'10.42"E	15°25'48.41"N	Flat	224m NE	Boundary of village	478m S	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 82	75°46'33.72"E	15°26'37.51"N	Flat	271mW	None	2km S	Yes	290 m E	None	NA	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 83	75°47'2.50"E	15°26'17.03"N	Flat	323m NW	None	1.8km SW	Yes	290 m NE	3	112m W, 271m SE, 366m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 84	75°46'46.86"E	15°25'58.08"N	Flat	450m E	None	1.1km S	Yes	950 m N	2	115m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 85	75°47'13.85"E	15°25'44.80"N	Flat	300m S and 317m NW	None	1.7km SW	None	NA	1	145m SE and 444m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 86	75°47'0.66"E	15°25'17.42"N	Flat	465m N	None	739m W	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 87	75°47'5.67"E	15°25'0.35"N	Flat	261m S	None	1.1km NW	None	NA	1	217m NW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 88	75°46'12.23"E	15°24'7.19"N	Flat	710m E	None	1.2km NE	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 89	75°46'8.36"E	15°23'41.27"N	Flat	750m E	None	2.8km N	None	NA	1	244m E	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 90	75°46'9.15"E	15°23'16.53"N	Flat	863m SW	None	2.5km SE	None	NA	7	474m S, 256m S, 273m N, 64m NE, 73m SE, 285m E and 480m E	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 91	75°44'50.58"E	15°20'34.27"N	Flat	786m N	1	149m W	None	NA	3	430m NE, 385m SW and 386m NW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°47'15.55"E	15°24'27.50"N	Flat	770m N	None	1.8km NW	None	NA	3	364m SW, 398m SW and 441m SW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°47'14.60"E	15°24'10.29"N	Flat	1.15Km W	None	2Km NW	None	NA	6	160m SW, 140m NW, 212m NW,	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
										240m NW, 110m NE, 303M SE				
T 17	75°47'15.48"E	15°24'9.43"N	Flat	1.15Km W	None	2Km NW	None	NA	6	160m SW, 140m NW, 212m NW, 240m NW, 110m NE, 303M SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 94	75°47'8.59"E	15°23'53.29"N	Flat	881m W	1 small agricultural shed	400 m SW	None	NA	2	344m E and 386m E	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 95	75°47'4.83"E	15°23'31.59"N	Flat	70m E	1 small agricultural shed and WTG Location T19	203 m NW and 312M E	None	NA	5	Seasonal water bodies- 73m NE, 387m NE, 219, SW, 204m SE and 306m S	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T 19	75°47'15.49"E	15°23'33.75"N	Flat	30m W	1 small agricultural shed and WTG Location T19	203 m NW and 312M W	None	NA	5	Seasonal water bodies- 73m NW, 387m NW, 219, SW, 204m SW and 306m S	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 96	75°47'5.33"E	15°23'12.82"N	Flat	245m E	None	2.1m SW	None	NA	7	354m S, 367m S, 210m E, 357m NE, 453m NE, 397m N and 429m N	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 97	75°46'55.95"E	15°22'47.76"N	Flat	231m E	None	1.3m S	None	NA	5	289m NE, 461m NE, 344m NW, 326m W, 450m W and 386m SW	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 98	75°45'13.44"E	15°23'6.99"N	Flat	324m S	None	1.1km SW	None	NA	None	NA	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 99	75°44'9.75"E	15°22'55.02"N	Flat	193m N	None	827m NE	None	NA	1	171m NE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 100	75°47'24.91"E	15°24'38.80"N	Flat	441m N	None	1.9m NW	None	NA	None	NA	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
AY 101	75°45'6.44"E	15°23'47.27"N	Flat	599m S	None	1.1km NW	None	NA	1 Large water body	359m SE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
	75°46'42.00"E	15°25'41.63"N	Flat	174m W	1	228m NW	None	NA	1	184m SW	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T20	75°46'5.41"E	15°23'2.16"N	Flat	899m E and 320m SW	None	2.2km SE	None	NA	3	61m SE, 211m NE	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary

WTG D	WTG Coordinate (Easting m E)	WTG Coordinate (Northing m N)	Topography	Distance of Road (m)	Dwellings within 500m	Approx. distance of dwelling (m)	Railway Track within 1000 m	Approx. distance of railway track	Waterbodies present within 1000 m. Description	Distance of waterbodies	Type of Land	Archaeological / cultural Significance	Distance of archaeological site/ cultural site	Presence of wild life sanctuary, Bio reserve/ National park/ Eco sensitive Zone in 10 km radius
										and 465m NE				
T21	75°46'16.47"E	15°22'41.58"N	Flat	199m SW and 713m E	None	1.5km SE	None	NA	None	NA	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T22	75°45'59.05"E	15°21'20.15"N	Flat	424m NW	Small Agricultural Shed	294m NE	None	NA	3	101m SE, 297m SE and 430m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T23	75°46'0.02"E	15°21'0.41"N	Flat	674M SW	Small Agricultural Shed	264m SW	None	NA	1	482m SE	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T24	75°46'0.84"E	15°20'43.29"N	Flat	211m S	None	2.9km SE	None	NA	1	463m S	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T27	75°46'57.32"E	15°20'37.38"N	Flat	393m S	None	1.3km SE	None	NA	2	367m SW and 466m SW	Agricultural and barren	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T26	75°46'56.62"E	15°20'57.71"N	Flat	345m W	2 agricultural sheds	314m NE, 398m NW	None	NA	Large Pond	91m S	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary
T25	75°46'56.66"E	15°21'17.07"N	Flat	253m W	2 agricultural sheds	344m SE and 496m SW	None	NA	1	259m NW	Agricultural	None	NA	Yes; Kappatagudda Wildlife Sanctuary