Draft Environmental and Social Impact Assessment

Project Number: 49241-001
April 2016

Environmental and Social Impact Assessment of 200 MW Wind Project at Village Aspari, District Kurnool, Andhra Pradesh

Mytrah Wind and Solar Power Development Project (India)

Prepared by Voyants Solutions Pvt. Ltd. for the Asian Development Bank.

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

April 2016

IND: Environmental and Social Impact Assessment of 200 MW Wind Project in village Aspari, District Kurnool, Andhra Pradesh

Prepared by **Voyants Solutions Pvt. Ltd.** for the Asian Development Bank. {*GUR_EMS_1437 Final Environmental and Social Impact Assessment_11042016* originally posted in April, 2016 available on {http://www.adb.org/Projects/ Ind: Environmental and Social Impact Assessment of 200 MW Wind Farm Project in village Aspari, district Kurnool, Andhra Pradesh.}

CURRENCY EQUIVALENTS

(AS OF 01.03.2016 @ OANDA.COM)

{The date of the currency equivalents must be within 2 months from the date on the cover.}

CURRENCY UNIT	–	INR	₹
$1.00	=	₹	68.616

ABBREVIATIONS

ADB	Asian Development Bank
APPCB	Andhra Pradesh Pollution Control Board
BOD	Biological Oxygen Demand
BPA	Business Partnership Agreement
BPL	Below Poverty Line
CEA	Central Electricity Authority
CHC	Community Health Centre
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
CTE	Consent to Establish
CTO	Consent to Operate
DISH	Directorate of Industrial Safety and Health
EAC	Expert Appraisal Committee
EHS	Environment, Health and Safety
EPC	Engineering Procurement and Construction
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESZ	Ecologically Sensitive Zone
FGD	Focus Group Discussions
GRM	Grievance Redressal Mechanism
IFC	International Finance Corporation
IMD	Indian Meteorological Department
IPP	Independent Power Producer
MEIL	Mytrah Energy (India) Limited
MEL	Mytrah Energy Limited
MoEF & CC	Ministry of Environment, Forests & Climate Change
MSL	Mean Sea Level
MVTPL	Mytrah Vayu (Tungabhadra) Private Limited
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing and Calibration Laboratories
NOC	No Objection Certificate
O&M	Operation and Maintenance
OBC	Other Backward Caste
PHC	Primary Health Centre
PS	Performance Standard
RTFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation & Resettlement
SC	Scheduled Caste
SCADA	Supervisory Control and Data Acquisition
SEIAA	State Environment Impact Assessment Authority
SEMS	Social and Environmental Management System
SPS	Safeguard Policy Statement
SPV	Special Purpose Vehicle

ST	Scheduled Tribe
TDS	Total Dissolved Solid
VSPL	Voyants Solutions Pvt. Ltd.
WPR	Work Participation Ratio
WTG	Wind Turbine Generator

NOTES

(i) The fiscal year 2015-16 of the Government of India ends on March 31, 2016.

(ii) In this report, "$" refers to US dollars.

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0 EXECUTIVE SUMMARY

0.1 INTRODUCTION

Mytrah Vayu (Tungabhadra) Private Limited (herein after referred as 'MVTPL'), is a subsidiary of MEIL and intends to develop a 200 MW Wind Project in Aspari village, Aluru & Pattikonda Mandal, Kurnool District, Andhra Pradesh (herein after referred to as the 'Project'). The project envisages installation of 30 x 1.7 MW (GE-1.7), 44 x 2.3 MW (GE-2.3), 23 x 2.1 MW (S-111 Suzlon) Wind Turbine Generators (WTG).

In order to ensure that the project is established in a manner that is socially responsible and reflects sound environmental management practices, MVTPL intends to carry out an Environmental and Social Impact Assessment (ESIA) study for the Project, in accordance with Asian Development Bank (ADB) Safeguard Policy Statement (SPS), 2009, International Finance Corporation's (IFC) Performance Standards (PS) on Social and Environmental Sustainability, 2012 and Environment, Health and Safety Guidelines, 2007.

MVTPL intends to set up a 200 MW wind power project spread on twelve revenue villages i.e., Aspari & Joharapuram of Aluru taluka and Burujula, Hosuru, Juturu, Chinna Hulti, Pedda Hulti, Devanabanda, Nalka Doddi, Puchakayalamada, Pattikonda, Chokkanahalli of Pattikonda *taluka* in Adoni division of Kurnool District. The project will comprise of 97 WTGs among which 23 numbers of WTGs of 2.1 MW each of S-111 model have been proposed to be installed by Suzlon Energy. GE will instal 30 numbers of WTGs of 1.7 MW-103 each and 44 numbers of WTGs of 2.3 MW-116 each. Details of WTGs location and specification has been depicted in **Annexure IX**.

For the development of the project, MVTPL has engaged M/s. Suzlon Energy Limited (hereinafter referred as 'Suzlon') and GE India Industrial Pvt. Ltd. as the Erection Procurement and Construction (EPC) Contractor on turnkey basis. Mytrah will be responsible for wind resource assessment, land procurement, obtaining necessary statutory approvals and hereafter GE/ Suzlon will be responsible for supply, installation and commissioning of the project WTGs, construction of internal roads and transmission lines (internal and external). Thereafter, a separate contract will be executed for operation and maintenance of the project between MVTPL and Suzlon/GE.

MVTPL has entered into a comprehensive Business Partnership Agreement (BPA) with Suzlon Energy Ltd. on 08.05.2010 for 300 MW and with GE India Industrial Pvt. Ltd. of installed capacity of wind power. The proposed project of 200 MW forms a part of the proposed capacity to be installed by Suzlon & GE. Operations & Maintenance (O&M) Services for the project are proposed to be provided by Suzlon & GE for a period of 20 years.

0.2 OBJECTIVES

The ESIA study has been undertaken with the following objectives:

- To facilitate an understanding of the elements of the existing baseline conditions prevailing in the study area (10 km buffer zone from project boundary is conditioned as study area);
- To identify the aspects of the project likely to result in significant impact to resources / receptors;

- To analyze stakeholders and document the stakeholder's consultation during the study;
- To predict and evaluate the significance of the impact of project;
- To develop plan for management with mitigation / enhancement measures and monitoring of impacts including plan for ongoing stakeholder's engagement; and
- Formulate and suggest suitable R&R and CSR Plan (if applicable) for the specific project.

0.3 ESIA PROCESS AND METHODOLOGY

The methodology implemented for conducting the ESIA study includes the following:

- A regulatory review was undertaken in order to understand the applicable local, national and international legislation, policy and regulatory frameworks;
- A detailed social and environmental assessment of site and the surrounding areas were undertaken through:
  - Reconnaissance surveys for all the turbine locations to understand site specific issues;
  - Discussion with the local community in the project villages to understand their perception about the project and identification of key issues pertaining to similar projects in the region;
  - Baseline data collection for air, water, soil quality and ambient noise level in the Project area through primary monitoring including meteorology, land use pattern, geology, geomorphology, hydrology with in the study area of 10 km radius of the project site;
  - Ecological assessment for the project area through primary and secondary surveys; and
  - To ascertain whether project footprints or its immediate environment is considered to be the ecologically sensitive with an emphasis on bird / bat species.
- Identification of any probability of significant shadow flicker that would potentially effect human settlement in the vicinity of the project;
- Collection of secondary information on social aspects of the site through consultation with the local community to understand the community perception with regard to the project and its activities;
- Assessment of impacts, including cumulative impacts, based on understanding of the project activities and existing baseline status; and
- Preparation of Environment and Social Management Plan (ESMP) with appropriate mitigation/enhancement measures of identified environmental/ social impacts.

0.4 SITE SETTING

The project site is located approximately 70 km South-West from Kurnool district headquarter and 60 km North-West from Bellari district headquarter. The project villages are well connected with each other with inter village road. All the villages are well connected with Gooty-Adoni Road and SH-78 which further connects the site with district headquarter and NH-7. Hyderabad is the nearest airport which is 240 km NNE from the site and Aspari (4 km SW) & Adoni (20 km NNW) are the nearest Railway Station from the site.

The general topography of the area is gently undulating to flat. It is sloping towards northeast. It is marked with isolated agricultural farms. The main land use pattern was observed to be mainly barren and single crop agriculture is being practiced in the study area. Out Crop of rock boulders mostly Granite in nature is a common feature of this area. The average elevation of land surface is about 480 m above the MSL. The area is dominated by scrubs.

0.5 CURRENT STATUS

The wind power project comprises of 97 turbines and the project is in its planning construction phase during the site visit. Out of the 97 WTGs, locations of all the WTGs have been identified and land procurement is under process. It was observed that construction and excavation works for access roads and internal transmission lines have planned to be initiated as a part of project construction activity. Soil testing, land procurement located at site is under progress.

0.6 POWER EVACUATION SCHEME

The power generated by the respective wind turbines will be transmitted to a 33/220 kV Pooling Substation, located at Juturu village to the north of the site, through single/double circuit 33 kV transmission lines. The power will then be stepped up from 33kV to 220 kV at the Pooling Substation and transmitted through a double circuit 220/11kV transmission line to APTRANSCO interconnection point located at Nansuralla, 23 km away from the site. The width of ROW proposed under the new project for evacuation of electricity is approximately 27 m for the 220 kV transmission line which has been proposed across the barren lands and private agriculture lands.

After getting sanction from APTRANSCO, MVTPL shall construct evacuation system as per approved scheme of AP TRANSCO. The system shall be so designed to suit the specification followed by AP Transco and Electrical Inspectorate norms. All equipment will be suitable for operations in the environmental conditions prevailing at the site.

0.7 PROJECT DEVELOPMENT

The construction phase of the proposed project shall involve land surveying, geotechnical investigation, component delivery; construction of access roads, turbines lay down area called plate form, crane pads, WTG foundation and electrical substations followed by final erection and commissioning of power generating facilities and its auxiliaries. The construction works will also entail site clearance and levelling works along with development of material storage yards.

0.8 CLIMATE CHANGE IMPACT ASSESSMENT

The Intergovernmental Panel on Climate Change (IPCC) Assessment Report (http://www.ipcc.ch/) concluded that climate changes are already occurring at a measurable scale and include warmer temperatures, increases in sea levels (from melting of snow and ice), and an increased frequency of extreme weather events. Most WTGs are designed to withstand occasional extreme wind and temperatures and any long term changes to wind patterns and temperature averages, potentially resulting from climate change, are not expected to adversely affect the Project.

The purpose of the project activity is to generate power from zero emissions wind based power project and thereby reduce the emissions associated with the grid. The project activity will export the Electricity to southern grid. The electricity generated by the WTGs will be monitored through energy meters connected to a set of WTGs at the project site. The calculation of the total GHG emission reduction as 421 tCo2e/year.

0.9 BASELINE SCENARIO, IMPACT AND MANAGEMENT

0.9.1 Air Environment

Baseline:

The locations chosen for sampling are part of four different villages, identified in the project area. Village Hosuru (AAQ-1) is the first sampling location and Pedda Hulthi Village (AAQ-2) is the second location. Joharapuram and Agaraharan Villages are in the downwind direction. All these locations come under the category of residential zone and are chosen based on the direction of wind, habitation around etc. Four samples each are collected on four different days from the locations and sampling is done for duration of 24 hours. The relative humidity of the locations on the days of sampling was in the range of 52-62% and the ambient temperature was approximately 30-31°C.

The concentrations of all the monitoring parameters (PM_{10}, $PM_{2.5}$, CO, SO_2 and NO_x) in the four locations are substantially below the National Ambient Air Quality Standards (NAAQS) prescribed by Central Pollution Control Board. The concentration in Pedda Hulthi is slightly higher in comparison to other villages due to the urbanization of the village. It was also observed that there are no major polluting sources such as industries around the region, and it can attribute to prevailing low pollutant concentration. Hence, it can be concluded that the level of air pollutants in the project area is not alarming as such.

Impact and Mitigation during Construction Phase:

The site clearing activities such as removal of vegetation, grading, leveling and related activities will produce high amount of fugitive dust. Regular water sprinkling is proposed to negate the wind blown fugitive dust likely from the construction / erection activities. Dust generating activities to be avoided/ minimized (when not avoidable). During high wind speeds, appropriate steps to be taken for loose construction material at construction site. Equipments/ machinery will be properly maintained to minimize smoke in the exhaust emissions. Trucks /dumpers will be covered by tarpaulin sheets during off site transportation of friable construction materials and spoil.

Impact during Operation Phase:

During operation of the project no fuel of any kind will be burnt. Therefore, the impact on air quality is not considered.

0.9.2 Water Environment

Surface Water

Baseline:

All the four locations (Hosuru, Nalakadoddi, Joharapuram, Pattikonda villages) are chosen based on the availability of ponds or open water surfaces in the study area, Ponds or open water bodies were seasonal and perennial. It was observed that most of the open water bodies dried up.

Surface Water quality was analysed for a total of four locations i.e. Hosuru, Nalakadoddi, Joharapuram & Pattikonda Village as per Class C limits of IS: 2296.

Water samples from all the four locations – Hosuru, Nalakadoddi, Joharapuram and Pattikonda are well within permissible limit of CPCB standards if the water is used for domestic purposes and not

drinking. Water from pond in Hosuru Village has exceeded the maximum limit of IS: 2296 of Class C of outdoor bathing standards of CPCB in Anionic Detergents and Phenolics. All the four villages – Hosuru, Nalakadoddi, Joharapuram and Pattikonda have observed increased levels of Oil and Grease, BOD and Dissolved Oxygen. Surface water can be used for outdoor cleaning purposes.

Impact and Mitigation during Construction Phase:

The run-off from erection area may pollute the surface water body. Hazardous material like oil, paint, etc. shall be stored in separate designated areas. Adequate arrangement for storm water management in identified area during construction period to be made to avoid sediment run off from the site. Storm water flow during monsoons will be directed to the existing suitable channels. Optimal utilization of water to be ensured throughout the construction phase Leaks.

Ground Water

Baseline:

The ground water in the district is in general suitable for both domestic and irrigation purposes. The electrical conductivity ranges from 565 to 4343 micro Siemens/cm at 25 C. It is observed that EC values are more than 3000 micro Siemens/cm at 25 C in the western part of the district. Out of the 918 villages of the district, 72 villages are facing poor quality problem in ground water.

Half of the total irrigated area and most of the domestic needs of the district depend on ground water. There are about 53,375 ground water structures, which support the irrigation in the district. To meet the domestic water needs of the 918 villages, 12486 hand pumps and 580 seasonal bore wells and 1096-piped water supply schemes through bore wells schemes are constructed. The wells have 1-2 m of water column and sustain pumping by 5 HP motors for 2 to 5 hrs. in two spells, a day. The yield of wells varies from 40-150 cu.m/day during post-monsoon period. The fractured aquifers are tapped by bore wells of 100 to 159 m deep. In general, the discharge of bore wells varies from 1 to 18 cu.m/day for a drawdown of 4 to 10 m.

For Ground Water quality testing, four water samples are collected from villages Hosuru, Nalakadoddi, Joharapuram and Pattikonda.

Observations of the water quality indicate that the water quality of the area is within the ISO 10500:2012 limits for most of the parameters. The TDS levels are above the desirable limits of 500 mg/lit at three locations monitored i.e. Hosuru, Joharapuram and Pattikonda Villages. Total hardness of the water sample at Joharapuram Village is exceptionally above the desirable limit of 300 mg/l. The Chloride and Sulphate levels were observed to be extremely below their respective desirable limits at all locations sampled. Fluoride levels were observed to be within the desirable limit of 1.0mg/l at three locations except Nalakadoddi Village. Only at Joharapuram village, the water has extreme hardness.

All heavy metals analyzed were found to be well below the respective desirable limit. Phenolic compounds at Joharapuram and Pattikonda Villages were observed to be more than the desirable limits at locations. The ground water sample is observed to have no bacteriological contamination in any of sample. Hence the ground water can be used for drinking after treatment.

Impact and Mitigation during Construction Phase:

Run off from construction material can flow along the slopes and contaminate the water bodies downstream. Construction debris and excavated material will be used for filling up of low lying areas and for foundation works of pooling station and maintenance room. All packaging material will be collected at the storing area and sold to vendors. Water through tanker supply by the vendor is proposed for project construction / erection and cleaning during operation phase.

Impact during Operation Phase:

There is no wastewater generation from the wind turbine. The domestic wastewater may be generated from office of the Operation & Maintenance team. Septic tanks with soak pits will be provided to treat sewage during operation phase.

0.9.3 Soil Environment

Baseline:

It is estimated that 61.4% of the total geographical area of Kurnool district is covered by Black Soils followed by 33.3% Red Soils and 5.3% others. Red and Black soils are predominantly present in the district.

The soils in the district are classified as clay, loamy and sandy soils. The black cotton soils are predominant in the mandals of Pattikonda, Nandyal, Allagadda, Koilkuntla, Nadikotkur and Adoni. In the eastern part of the district, red soil of a poor quality largely predominates. These soils although, generally poor in fertility, yield a very good crop with a minimum rainfall. Regar soils are predominant in the mandals of Kurnool and Pattikonda. The availability of alluvial soil is quite small and is confined to a few villages near the Banavasi and the Krishna.

The procedure followed for testing is based on Guidelines by Indian Standards (IS 2720). The values obtained for each characteristic of soil such as pH, electrical conductivity etc. is compared with the prescribed standard values at Aspari Village, Substation at Juturu Village, Joharapuram Village and Puchakayalamada Village.

Table above clearly points out that the texture of soil in Aspari and Joharapuram villages is Silty Clay. Whereas in substation at Juturu village and Puchakayalamada villages, soil texture is Clay. Presence of essential elements such as Sodium and Potassium are within Permissible Limits. Electrical Conductivity of the soil in Substation at Juturu, Puchakayalamada village and Aspari village is more than soil in Joharapuram Village. Heavy metals Zinc, Copper and Iron were observed in the soil samples analyzed at all locations.

Impact and Mitigation during Construction Phase:

The activities associated with site clearing will result in removal of vegetation and lead to loose soil at site. The site clearance for tower erection, access road and ancillary facilities shall be restricted to the necessary footprint area around WTGs. No vegetation shall be removed from land which are not directly required for any project construction activity.

The construction activities will lead to generation of wastes such as construction debris, waste from packaging and crafting material for wind turbine components. The movement of heavy machinery

for site clearance, earth moving, transportation and erection of wind turbine components will generate waste oil. Proper care will be taken in course of generation of any hazardous waste as per the country statute.

Impact during Operation Phase:

There is no significant solid waste generation during operation phase. Therefore, the impact on soil is not envisaged.

0.9.4 Noise Environment

Baseline:

Ambient noise was monitored at four locations (Aspari, Chinnahulthi, Juturu (substation)and Joharapuram villages) in the study area. The locations identified were rural/residential/sensitive areas. The observations of noise monitoring were calculated as L_{eq} Day and Leq Night.

During the field survey, it was observed that the noise levels at the monitoring locations ranged from 47.55 dB(A) to 48.60 dB(A) during day time and 33.36 dB(A) to 35.04 dB(A) during night time. The prescribed standard for equivalent noise levels at rural and residential areas are 55dB(A) for day time (0700 to 2200 hours) and 45 dB(A) for night time (2200 to 0700 hours) as described by IFC. The monitored noise levels were within the prescribed limits of the CPCB norms and the IFC guideline value with respect to noise at all locations. Both the standards /norms will be complied with i.e. IFC and Law of Land (CPCB).

During the construction phase, noise will be generated preliminary during the day time. Noise will be generated from moving vehicles as well as construction equipment including the DG sets utilized for power. As a control measure it will be ensured that noise emission from the vehicles and equipment shall not exceed 85dB(A) as per the latest Environment (Protection) Amendment Rules, 2005. Regular maintenance of the vehicles is proposed. DG 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.

Impact and Mitigation during Construction Phase:

While planning, micro-siting activity of the wind turbines has considered a minimum setback distance to all residential habitation in order to avoid sensitive noise receptors and wind turbines are designed in accordance with the international acoustic design standards to keep noise levels under check.

Only well maintained equipment (proper working conditions within noise standards) will be operated on site. DG sets shall be used for emergency power/ backup (if any). Provision of rubber paddings/noise isolators at equipment/machinery used for construction.

Impact during Operation Phase:

During Operation phase, transmission line will have conductors designed to minimise corona effects. Optimisation of turbine speed will be dome. In high wind, blade speed is controlled as per the desired criteria to avoid blade throw. Provision of noise barrier in terms of green belt near to receptor will be provided, if noise level found crossing the standards during operation phase monitoring.

0.10 IMPACTS AND MANAGEMENT

0.10.1 During Construction Phase

PROCUREMENT OF LAND

Land procurement for wind turbines will be minor adverse impact as the land acquired is a one crop rain-fed agricultural with mix of fallow land and it does not attract any physical and economical displacement. The compensation paid for land will benefit the affected families economically, as they will be able to acquire better land (agricultural land) in adjoining areas, or utilize it in suitable income generating business. The impact on environment and social components from land procurement will have a localised impact with medium duration and a low intensity after mitigation measures are employed.

SITE CLEARING

Wind farm projects require relatively less clearing of vegetation as compared to conventional power projects. The site clearing activities such as removal of vegetation, grading, leveling and related activities will majorly impact the ecology and soil resources and quality at site. The impact on environment and social components from site preparation will have a localised impact with medium duration and a low intensity after mitigation measures are employed.

LABOUR ENGAGEMENT

The construction stage will require 75 workers during normal functions while during peak construction activities will require 175 workers. An additional labour of 100 workers will be required for erection of transmission line. Skilled workers will be hired from outside while unskilled workers will be hired locally. The impact on environment and social components from labour engagement will have a localised impact with short duration and a low intensity after mitigation measures are employed.

MATERIAL HANDLING AND STORAGE

Material handling and storage will include transportation of turbine components, transmission tower structure, conductors, transformers, switch yard components, construction material etc.

The transportation trips will be limited suitably for pickup trucks, construction supervisors/camp site workers. Movement of heavy vehicles will be slow and require continuous monitoring by dedicated person for suitable movement from source to destination. The impact on environment and social components from material handling and storage will have localised impact with medium duration and a low intensity after mitigation measures are employed.

CONCRETE WORK, ERECTION AND INSTALLATION ACTIVITIES

Construction activities will spread over duration of one year, the peak activity will be executed over a period of 6 to 8 months. The impact on environment and social components from concrete work, erection and installation activities will have a localised impact with short duration and a low intensity after mitigation measures are employed.

CONSTRUCTION DEMOBILISATION

Construction demobilisation will require removal of machinery, workers, campsite and other temporary structures. The impact value due to construction demobilization will be minor after mitigation measures are implemented.

0.10.2 During Operation Phase

VISUAL INTRUSION

Wind energy development projects would be clearly visible because of the height and large size of turbine components. All above ground ancillary structures would potentially produce visual contrasts due to their design and result in glare due to reflectivity of their surfaces.

Mitigation

The wind turbine towers and blades will be as per Standard Practice white in order to avoid any differing contrast to the landscape and thereby minimize visual discomfort. An anti-reflective paint coating will also be applied to the turbine towers and blades to mitigate the possible impacts of light reflection/blade glint.

The visual impacts on environment and social components due to operation of the wind turbines will be localised with low intensity after mitigation measures are employed. Hence the overall significance of the impact with mitigation measures will be insignificant.

WATER RESOURCES

The most significant use of water during wind project operation is cleaning of wind turbine rotor blades. It is estimated that about $2m^3$ of water will be required for cleaning of each turbine to avoid deformation the shape of air foil and degradation of performance as part of the annual maintenance schedule. Maximum 45 liters per day of potable/ domestic water is also consumed for limited staffs at wind operation site.

Mitigation

The use of water will be minimal as cleaning/ domestic of all turbines will not be undertaken simultaneously. The impact value on water resources will be insignificant with mitigation measures. The impacts will be localised with short duration and low intensity.

HAZARDOUS WASTE

Hazardous waste generated from operation and maintenance of wind farms is limited to small quantities of waste oil from use of lubricant oil and transformer oil.

Mitigation

Waste oil generated shall be stored in a secure location. Waste oil will only be sold as per the directive of statutory authority. Transformer oil shall be returned to the manufacturers as per the agreement of purchase.

The impacts due to hazardous waste generation will be localised with low intensity. The impact value will be minor with implementation of adequate mitigation measures.

HEALTH AND SAFETY

There are no suggested impacts but working at height for cleaning and maintenance of turbines will require adherence to precautions and safety measures. Emergency Contact number should be displayed at identified areas. The impact value of health and safety related aspects during operation will be minor with implementation of adequate mitigation measures.

CULTURAL/ ARCHEOLOGICAL

There are no suggested impacts for cultural or archaeological aspect for this project.

Mitigation

The siting and location of towers has taken into consideration the proximity to temple and access to the temple. Noise levels at the temple are expected to be within the day time noise guideline, however night time levels may exceed. There are no visitors during night hours, except during festival season and therefore the impact will be minor.

COMMUNITY/ SOCIAL ISSUES

Socio-economic

Migrant Workers

The proposed project will not engage significant migrant labour. Most of the civil works being small in nature will be handled by the local contractors from Kurnool or nearby regions. This would ensure that the workers are largely from within Andhra Pradesh. Only skilled workers for erection of turbines and operation cranes will be sourced from outside states and their numbers will be relatively less.

Mitigation

The local contractors and labours will be engaged during construction to avoid migration of labour from far off places. This will not have any stress on the local and moreover provide job opportunities to the local population.

COMMUNICATIONS

Wind projects may impact communications signals in two ways. Wind turbines and their associated transmission lines can generate electromagnetic noise, which can interfere with telecommunications services, or, more commonly, wind turbines create physical obstructions that distort communications signals. The types of communications systems that may be affected include off-air TV broadcast signals, and mobile telephone services.

Mitigation

The area was surveyed for presence of mobile transmission tower in the immediate vicinity. These effects on off air television apply to analogue modulated television signals and do not affect digital signals in the same way

ECOLOGICAL ENVIRONMENT

A long term bird and bat survey was undertaken to study the potential impact of wind turbines on bat and avifauna population of the proposed project site area. The total area required for the project is approximately 494 acres. The proposed project is spread over 12 revenue villages of Aluru and

Pattikonda Taluka. The land identified for the proposed project site is primarily undulating and mix of single cropped agricultural and barren land. The core zone is mostly single crop land but the buffer zone up to 10 km is predominantly agricultural land interspersed with isolated patches of sparse vegetation and without crop of rocky boulders. The major observations of the present survey are:

i. 24 bats species and 164 bird species are recorded in the whole Kurnool district as per the publically available data. As per the IUCN Criteria the entire mentioned bat species fall under the criteria of Least Concern whereas 5 bird species belong to "Critically Endangered" and 3 species belong to "Endangered" category.
ii. In the project site 88 bird species and 4 bat species were recorded. However, none of them belong to "Critically Endangered" or "Endangered" category of IUCN Red list.
iii. There are no major migratory paths observed during the site study and found as per the available secondary data
iv. Out of 88 bird and bat species 36 species including 26 migratory species were found to be species of concern as per national and different international regulations.

The anticipated impact to the bat and avifauna population due to the project was found to be general in nature common with wind mill projects like mortality due to collision with turbine rotor or accidental body touch with high tension transmission line or in general disturbance in the site due to construction and operation of the project.

The proposed project does not expect to threaten the long term viability/function of any of bat and bird species found in the area. However, mitigation measures are suggested to minimize the project impact on bat and avifauna. The project as per the closure of ESIA falls into the Category B in reference to the ADB environmental and social safeguard policy (2009). The project is expected to be beneficial in improving the power scenario of the area. The detail Bird & Bats study is enclosed as **Annexure XII.**

The impacts on ecology of the project area will be major with long duration and moderate intensity after mitigation measures are employed.

The plant life in an area seems to be fairly disturbed and do not show any integrity. Vegetation clearance and habitat loss are the major impacts associated with construction / erection of the proposed project. Whereas, operation phase impacts are Fatalities of birds and bats (if any), due to possibility of collisions with wind turbines blades and man animal conflicts.

Layout of the project provides adequate spaces between each turbine for movement of birds which would reduce the potential for accidental collision. But in case of bird hit, they will be taken to the nearest Veterinary Hospital by the project staff and the security staff.

Mitigation

Security staff will be instructed to immediately take the injured bird/ bat to the nearest Veterinary Hospital which is discussed in Chapter 5. MVTPL has proposed to engage an expert to periodically assess bat and bird status. The expert shall also train the staff at site to address the incidents of bird hit / injury.

Fire protection measures to avoid any fire due to project are proposed. Record will be developed for man animal conflicts (if occurs) and suggestive action will be taken in consultation with forest

officials. In this context, communication with forest department officials has been conducted, the letter of which has been enclosed as Annexure XIII.

The impacts on ecology of the project area will be major with long duration and moderate intensity after mitigation measures are employed.

SOCIO- ECONOMIC ENVIRONMENT

All the WTG locations falls within twelve (12) village namely Aspari, Joharapuram of Aluru taluka, Buruzulla, Hosuru, Juturu, Chinna Hulti, Pedda Hulti, Devanabanda, Nalka Doddi, Puchakayalamada, Pattikonda, Chokkanahalli of Pattikonda taluka in Adoni division. The total population of the village as per Census, 2011 is 96,623 with total literacy rate of 55.95% in which 67.17% for males and 44.74% for females. The occupations of the local people are agriculture based livelihoods such as cultivators, agricultural labourers and livestock rearing.

During construction phase, the labour requirement will approximately 75 numbers during normal construction and 175 number of workers for peak construction activities. GE and Suzlon will ensure to engage both local and migrant workforce including engineer, store-keeper, manager, welders, fitters, drivers, helpers, operators for a variety of skilled, semi-skilled and unskilled workers. Skilled labour will be hired from outside while unskilled workers will be engaged at the local level.

The operation and maintenance of wind turbines will be undertaken by Suzlon and GE. The site will have approx. 75 personnel at site including maintenance, monitoring and security staff during the operation phase. It is proposed to engage maximum people from local community on the basis of their technical / ground skill suit for the project functions.

SHADOW FLICKER

Shadow flicker is one of the major impact associated with operation of wind turbine. There is anecdotal evidence inter nationally that shadow flicker could lead to stress and headaches. Areas to the west of the wind turbine would experience these effects as the sun rises. Areas to the north would experience the effects during the day. Areas to the east would experience these as the sun sets. The shadows cast by the wind turbine blades will be narrow, be of low intensity and move rapidly at the receptor. The closer a receptor is to the wind turbine, the more intense the shadows, as a greater proportion of the sun is blocked by the rotating wind turbine blades.

A wind turbine's shadow flicker impact area is generally located within approximately 500 meters of the turbine and typically lasts for less than 30 minutes. All the identified project turbine locations are in general away from the main villages with human settlements. However, few locations were identified to be located close to temporary household or crop storage area and temple. During the site survey, thirty-three (33) receptors identified within 1km of the project turbines were identified as potential shadow receptors.

Wind Farm software is used to calculate detailed shadow flicker map across an area of interest with site-specific locations using shadow receptors. Shadow hours per year for the most of the receptors are within the threshold limits i.e. 30 hours per year. However, shadow flicker effect generated by Turbines ASP-22, ASP-23 and ASP-54 found crossing the suggested level of 30 hours of shadow flicker per year at some residential structure of Joharapuram and one independent structure. Revision of the orientation of Turbines no. ASP-22, ASP-23 and ASP-54 is proposed in such a manner that overall

shadow flicker impact remains within suggested threshold standard of 30 hours of shadow flicker per year and 30 minutes of shadow flicker per day (IFC's Environmental, Health, and Safety Guidelines for Wind Energy). However, optimise use of the turbine will also be kept in mind while revising the orientation of above three turbines. Probability of open space / window on other side of the residential property and vegetative shield shall also be checked, so that, overall phsycological impact of the shadow flicker may get reduced.

NOISE GENERATION

During operation phase, the average increment noise level in the project vicinity would be in the tune of 2.59 dB(A). The result of the assessment presents that the expected noise level will be well within the prescribed limit of CPCB's residential standards. The minimum distance between a receptor and wind-turbine is approximately 250m. Noise barrier in terms of tree plantation between turbine and receptor will be developed if noise found exceeding the prescribed standards during post project monitoring.

Mechanical noise will be controlled as there are in built shutdown system in Latest technology in case the noise level increased in WTG. To control Aerodynamic noise latest design of the wind turbine which will be installed at project site are focused on reducing noise without affecting the power generated by the wind turbine. The noise reduction was found to be about 1-1.5 dB(A) for the G58 with a Reynolds number of $1.6x10^6$ and 2-3 dB(A) for the GE94 with a Reynolds number of $3x10^6$ for acoustically optimized airfoils in "silent rotors by acoustic optimization" (SIROCCO) project. Further, noise modeling input data has been enclosed as Annexure XIV. Regular noise monitoring would be the part of post project monitoring plan to have a continuous check on noise increment values.

0.11 ANALYSIS OF ALTERNATIVES

Andhra Pradesh is one of the States in India having windy locations, identified for wind power generation. Reportedly there are no ecologically sensitive areas found around the region and the location is devoid of any bird migratory route. There is neither a requirement to relocate the native people nor any destruction of flora-fauna occurred as part of the project. The land selected for the project is single cropped rain fed and mix of agricultural and barren.

United Nation's Intergovernmental Panel on Climate Change (IPCC) has projected that renewable energy can provide approximately 77% of global primary energy supply by 2050. The state level incentives provided by the new government of Andhra Pradesh are attractive enough to influence the wind power companies.

Harassing wind energy is an eco-friendly process, inexhaustible and possesses a minimal environmental footprint. Greenhouse gas emission is as low as 2.5 gm. of carbon equivalent per kilowatt-hour for the production chain. The project has many advantages like elevating the standard of rural economies, increasing the power supply of the energy deficit state of Andhra Pradesh in an environmentally friendly manner. Hence, the project with all the chosen options – site, mode of power generation, route of transmission line etc. – is the appropriate alternative and is beneficial for the region.

Apart from these factors, the villagers are of the expectation that such projects will elevate the standard of economy and provide them jobs like that of a security guard.

0.12 INFORMATION DISCLOSOURE, CONSULTATION AND PARTICIPATION

From the stakeholder consultations conducted by the consultant, it can be concluded that the perception of land contributors/owners are positive about the proposed wind power project. Villagers found satisfied with the negotiation procedure followed for land procurement and the compensation being paid to them is above the prevailing market rates. Also, the land owners are willing to sell off their non-productive/fallow or single crop land at such prices. During consultation, villagers expressed their positive expectations with proposed project. They are expecting for employment opportunity, community development programs, availability of drinking water etc.

0.13 CONCLUSION

The impacts due to the project is minimal, site specific and has reversible impacts on the micro environment of the project site owing to the construction activities, noise generation from the project turbines and shadow flickering effect which can be readily addressed through mitigation measures. The land required for the project is taken on “willing seller-willing buyer” basis and individual negotiation with the land owners and the project does not involve any physical/economic displacement.

Based on site specific environmental and social impacts identified, the project is categorized as ‘Category B’ on the above criteria and as described below:

The proposed Project is Greenfield Project. Land use of WTG’s, transmission line, pooling sub-station site are private land consisting of barren/ fallow, rain fed single agriculture crop and due to proposed project parcel of land will be converted to industrial land use.

The proposed project’s potential adverse environmental impacts are mostly confined to identified activities and which are site specific and the impacts can be addressed with implementation of proper mitigation measures. The detailed assessment with regard to same is explained in Chapter 5 on the impact assessment.

The proposed project will have no specific impact on indigenous people as the project area or its surroundings are not native to any indigenous people. No material degradation or adverse impact is expected on land resources on which people are dependent. No vulnerable group is impacted due to this project activity.

The project will generate more income earning capacity and possibilities in the area and thus improve the economic status of the population.

1 INTRODUCTION

Voyants Solutions Pvt. Ltd. (herein after referred as The Consultant) has been retained by **Mytrah Vayu (Tungabhadra) Private Limited** at Hyderabad herein referred as MVTPL to conduct an Environmental and Social Impact Assessment for their upcoming Wind farm. Mytrah is all set to further consolidate its position in renewable power. The company aims to participate in renewable energy generation towards a sustainable and clean energy production. MVTPL wishes to carry out **Environment and Social Impact Assessment (ESIA) Study of 200 MW Wind Farms** comprising of approximately 97 Wind Turbine Generators (WTGs) in Aspari Village, Mandal Aluru and Pattikonda, District Kurnool, Andhra Pradesh.

The consultant understands that MVTPL intends to invest in the wind farm projects with financial assistance from lenders/ mutilates etc. In this context, the project requires evaluating the environmental and social risks associated with the proposed project and to implement mitigation measures to avoid adverse impacts during the project lifecycle. In addition to ADB guidelines, the project has to comply with the applicable International Finance Corporation (IFC)/ World Bank (WB) guidelines relating to the environment, social issues and occupational health and safety matters, in addition to complying with local laws and regulations. The aim of the study is to assess whether the project to comply with the requirements of the above mentioned guidelines as necessitated by financial investors. This ESIA report has been prepared on the basis of a reconnaissance survey, baseline environmental monitoring, review of secondary data and consultation with relevant stakeholders. Based on the requirements of the ADB SPSs and IFC PSs, adequate management plan and systems are also expected to be developed as part of this assessment.

1.1 PROJECT PROPONENT

MVTPL is the SPV of Mytrah Energy (India) Limited (MEIL) which is a wholly owned subsidiary of Mytrah Energy Limited (MEL) in India and aims to own and operate 5000 MW of renewable power in India. MEL is a pioneer and one of the largest Independent Power Producer (IPP) in renewable energy in India with 543 MW power generations across six states. MEL has more than 200 wind mats installed across multiple states in India providing a rich source of information from which to select its future projects. MEL currently has an active development pipeline of about 3500 MW. From a standing start in late 2010, MEIL has built a portfolio of over 500 MW of operating wind plants in India with a further 100 MW in 2014. These assets are spread across ten wind farm in six states namely Rajsthan, Gujrat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. The company's portfolio was built using a combination of 'turn-key' developers and in-house projects development with wind turbine purchased from three leading vendors.

MEIL sells power mainly to state grid through 13 to 25 years Power Purchase Agreement. In addition, the 100.5 MW project in Tamil Nadu sells power directly to customers on long term agreement. Additionally, MEIL has the largest wind data bank in India being the only independent power producer that has 200 wind masts across country.

As per the annual report of 2014, MEIL has 543 MW operating facility across 10 wind farm in India.

As per the MEIL Annual Report 2014, further 300 MW of wind power projects are under construction in Andhra Pradesh, Maharastra, Rajsthan and Telangana.

1.2 PROJECT BACKGROUND

The proposed project site is located at Village Aspari, District Kurnool in the state of Andhra Pradesh and the proposed Wind Turbine Generators (WTGs) of the project is spread on 12 revenue villages i.e., Aspari & Joharapuram of Aluru *taluka*, Buruzulla, Hosuru, Juturu, Chinna Hulti, Pedda Hulti, Devanabanda, Nalka Doddi, Puchakayalamada, Pattikonda and Chokkanahalli of Pattikonda *taluka* in Adoni division. There are approximately 97 numbers of wind turbines have been proposed to be installed. Approximately 23 number of WTGs of 2.1 MW each of S-111 model have been proposed to be installed by Suzlon Energy. GE will instal 30 numbers of WTGs of 1.7 MW-103 each and 44 numbers of WTGs of 2.3 MW-116 each. Details of WTGs location and specification has been annexed as **Annexure IX**.

The Aspari site lies approximately 70 km South-West of Kurnool district headquarter and 60 km North-West of Bellari district headquarter. The project villages are well connected with each other with inter village road. All the villages are well connected with Gooty-Adoni Road and SH-78 which connect the site with district headquarter and NH-7. Hyderabad is the nearest airport which is 240 km. NNE from the site and Aspari (4 km. SW), Adoni (20 km. NNW) are the nearest Railway Station from the site.

1.3 PURPOSE AND SCOPE OF ESIA

This study is being undertaken as per the requirements of the ADB Guidelines to understand the Environmental and Social impacts associated with the proposed 200 MW Wind Farm Project. The study suggests appropriate mitigation measures and management plans to prevent and minimize all adverse impacts identified. The environmental and social assessment has been carried out against the following reference framework:

- Applicable Indian national, state and local regulatory requirements;
- ADB Safeguard Policy Statement, 2009;
- IFC Performance Standards, 2012;
- IFC/World Bank General EHS Guidelines, 2007;
- IFC/World Band Guidelines for Wind Energy Projects, 2007 & 2015; and
- IFC/ World Bank EHS Guidelines for Electrical Power Transmission and Distribution, 2007.

The scope of work for the entire ESIA study includes the following activities:

- Identification and review of the applicable local, state, national and international environmental legislation and regulatory framework;
- Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions;
- Generation of primary baseline environmental data including air quality, soil quality, water quality and noise quality;
- Collection of additional secondary environmental, social and demographic information;
- Collection of information on forestry, flora and fauna, and natural habitats and species of special conservation/scientific interest through ecological assessment of the study area including endangered/ protected species as well as bird/bat in high risk zone of collision with operational WTG;
- Consultation with local community, stakeholders and review of land acquisition and compensation process;

- Identification of social concerns and issues pertaining to land procurement;
- Assessment of potential environment and social impacts of the Project and its components (including associated facilities like, transmission line, access roads etc. as applicable) and developing mitigation measures and plans to maximize project benefits to the community;
- Preparation of an Environmental Management Plan (EMP) based on the EIA and development of procedures for mitigation and monitoring of environment and social impacts on an ongoing basis as well as to identify any requirements that may occur subsequent to the completion of the EIA;
- Collection of secondary data available in public domain with respect to meteorology, soil, land use, geology, geomorphology, hydrology, ecology, socio-economic profile within the study area of 10 km. radius of the project site;
- Identification of any probability of significant shadow flicker that would potentially effect on human settlement in the vicinity of the project.

The study included Industry Specific Impact Assessment & Management (The IFC, WB sector specific guidelines for Wind Energy Projects) comprising of Environment, Visual, Noise, Species Mortality (e.g. Bird & Bat Study as well as migratory path study) based on only one site visit and secondary data or injury & disturbance (on-shore & off-shore), shadow flicker & blade glint, habitat alternation, water quality, ecology etc. It also covered occupational health and safety, Aircraft/Marine safety, Blade throw, community health and safety. The study further included electromagnetic interference, public accessibility and impact assessment & mitigation as well as performance indicators and management in details.

1.4 OBJECTIVES

Followings are the objective of ESIA study:

- To facilitate an understanding of the elements of the existing baseline conditions prevailing in the study area (10 km buffer zone from project boundary is conditioned as study area);
- To identify the aspects of the project likely to result in significant impact to resources / receptors;
- To analyze stakeholders and document the stakeholder's consultation during the study;
- To predict and evaluate the significance of the impact of project;
- To develop plan for management with mitigation / enhancement measures and monitoring of impacts including plan for ongoing stakeholder's engagement; and
- Formulate and suggest suitable R&R and CSR Plan (if applicable) for the specific project.

1.5 APPROACH AND METHODOLOGY

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

- A regulatory review was undertaken in order to understand the applicable, local and national legislation and regulatory frameworks.
- A detailed social and environmental assessment of site and surrounding areas was undertaken through:
  - Reconnaissance surveys to understand site specific issues;
  - Discussion with the local community and identification of key issues;
  - Baseline environmental data collection of the site through primary/ secondary monitoring;

- Ecological assessment on flora and fauna of the site and study area through primary and secondary surveys.

- Collation of secondary information on social aspect of the site through consultation with the local community to understand community perception with regard to the project and its activities.
- Assessment of impacts, including cumulative impacts, based on understanding of the project activities and existing baseline status.
- Preparation of Environment and Social Management Plan (ESMP).

1.6 LIMITATIONS OF THE ESIA STUDY

The limitations of the ESIA study, pertaining to the availability of information regarding the project, the accessibility of villages and stakeholders and the secondary information for the project. The consultation undertaken during the site visit was based on the present understanding of the project, the WTGs locations and the project footprint area. This understanding may slightly change in case of a significant change in the WTGs finalized at the time of study.

Furthermore, due to the confidential nature of the information required, certain information pertaining to the project such as requirement of all land and records, employment details and management system were limited for review at the time of visit.

The consultations undertaken as part of the impact assessment were restricted to the stakeholders who were available during the site visit. Also, due to the large number of the villages within the study area and the limited time in which the assessment had to be completed, the ESIA team undertook consultation in a sample of the villages with a focus on the villages in the core zone and coverage of maximum number of stakeholder groups.

1.7 REPORT STRUCTURE

The full report presents the findings, analysis and recommendations for the proposed project which have been provided by environmental and social impact assessment (ESIA) team.

Chapter-0: Executive Summary: This section concisely describes the critical facts, significant findings and recommended mitigative actions.

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

Chapter-2: Policy, Legal and Administrative Framework: This chapter presents applicable legal provisions, National environmental and social (including labor) laws and policies as well as the relevant national and international standards and guidelines.

Chapter-3: Description of the project: This chapter deals with project details encompassing layout, land details, site settings, project components etc. This also deals with the infrastructural development as a part of project during construction and operation phase and resources required.

Chapter-4: Description of the Environmental and Social Baseline: This chapter presents an outline of Environmental and Social baseline status in the area of the Project

Chapter-5: Anticipated Environmental Impacts and Mitigation Measures: This chapter includes details of identified environmental impacts and associated risks due to the project activities,

assessment and significance of impacts and presents mitigation measures to minimize adverse impacts identified.

Chapter-6: Analysis of Alternatives: This chapter presents the analysis of alternatives for the proposed wind project considering no project scenario, alternate methods for power generation and technology and alternate routes for transmission line.

Chapter-7: Information Disclosure, Consultation and Participation: This chapter addresses about the public consultation of the surrounding study area and elaborate the outcome result of public consultation. Also briefly discuss about the stakeholder profiling, mapping and analysis, methods for consultation and stakeholder engagement of project.

Chapter-8: Grievance Redress Mechanism: This chapter addresses the description of the grievance redress framework and mechanism for resolving the complaints.

Chapter-9: Environmental Management Plan: This Section provides recommendation for environmental and social management plan aimed at minimizing the negative environmental and social impacts and monitoring requirements of the project.

Chapter-10: Conclusion and Recommendation: This chapter encompasses category assigned to the proposed wind project based on ADB Categorization. A brief conclusion drawn from the impact assessment study has also been presented.

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 INTRODUCTION

This section highlights the environmental and social regulations applicable to the proposed Wind farm project. The section broadly focuses on the institutional framework, applicable environment, health and safety and social legislative requirements and ADB Safeguard Policy Statement relevant to the proposed Project. At the outset, it should be emphasized that this administrative framework focus on:

A. Applicable environmental and social regulations and policies in India and the state of Andhra Pradesh;
B. Institutional framework for the implementation of the regulations; and
C. International Standards and conventions including:
   i. Applicable Indian National, state and local regulatory requirements;
   ii. ADB safeguard policy statement, 2009;
   iii. ADB policy on Social Protection Strategy, 2001;
   iv. ADB policy on Public Communication Policy, 2011;
   v. IFC Performance Standard, 2012;
   vi. IFC and World Bank General EHS Guidelines, 2007;
   vii. IFC and World Bank EHS Guidelines for wind Energy Project, 2007;
   viii. IFC and World Bank EHS Guidelines for Electric Power Transmission and Distribution, 2007; and
   ix. Relevant ILO conventions rectified by Host country covering core labour standards and basic terms and conditions of employment (limited to operational phase of the proposed project).

2.2 NATIONAL REGULATIONS

As per EIA Notification, 2006 and its amendments, the Wind Power Project does not require any environmental clearances from the MOEF & CC or Andhra Pradesh State Environmental Impact Assessment Authority (SEIAA). As per the revised classification of industries into Red, Orange and Green Category, issued by Central Pollution Control Board dated 4th June 2012, the solar power generation through solar photovoltaic cell, Wind Power & mini hydel power (<25 MW) are classified under Green Category Industries and require Consent to Establish and Consent to Operate under Water (Prevention and Control of Pollution) Act, 1974.

However, as per order issued by Government of Andhra Pradesh dated 13th February 2015 under Andhra Pradesh wind power policy 2015- “Wind power projects” have been exempted from obtaining NOC/ Consent for Establishment under pollution control laws from Andhra Pradesh Pollution Control Board. The copy of this Policy has been annexed as **Annexure VIII**.

Some of the policies (including sector specific) have been discussed briefly in the subsequent sections.

2.3 NATIONAL ENVIRONMENTAL POLICY 2006

The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to

ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource. MVTPL shall ensure compliance to the requirements of this policy.

2.4 NATIONAL ELECTRICITY POLICY 2005

The National Electricity Policy 2005 states that Environmental concerns would be suitably addressed through appropriate advance action by way of comprehensive Environmental Impact Assessment and implementation of Environment Action Plan (EAP). As per the policy, adequate safeguards for environmental protection with suitable mechanism for monitoring of implementation of Environmental Action Plan and R&R Schemes should be put in place. Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell to different distribution licensees across the country. This should lead to availability of cheaper power.

2.5 ANDHRA PRADESH WIND ENERGY POLICY, 2015

The Wind Energy Policy has been formulated 13th February 2015 by Energy, Infrastructure & Investment Department, and Andhra Pradesh with the following objectives:

- To encourage, develop and promote wind power generation in the State with a view to meet the growing demand for power in an environmentally and economically sustainable manner;
- To attract private investment to the State for the establishment of large wind power projects; and
- To promote investments for setting up manufacturing facilities in the State to generate local employment.

MVTPL intends to install 200 MW Wind Power farm of 1.7, 2.1 and 2.3 MW rated capacity, which is in-line with above policy. Also, MVTPL hold the responsibility for development of power evacuation facilities along with interconnection scheme and bay equipment along with protection equipment from the proposed project till the grid sub-station of AP TRANSCO.

Environmental and safety related national regulations that are applicable to the Proposed Wind Farm are discussed **Table 2.1**.

Table 2:1: National and International Regulation

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
A	**ENVIRONMENT & FOREST**			
A-1	Environmental (Protection) Act, 1986 and amendment.	To protect and improve overall environment, this umbrella act imposes certain restrictions and prohibitions on new wind projects or activities, or on the expansion or modernization of existing projects or activities based on their potential environmental impacts. It is a comprehensive act covering overall objective to improve environment by prevention and control of air, water, soil pollution etc. Clearances from different authorities are independently obtained. Effective from 1986. The act was last amended in 1991.	CPCB SPCB	Permissible limit for AAQ, Water Quality, Noise limits has been laid down by CPCB under EP Act 1986, which requires to be complied with, though it is not enforced by SPCB due to exemption of Consent (It is exempt as a part of Consent Condition).
A-2	Environmental Impact Assessment (EIA) Notification, 2006 and amendment.	Environmental Impact Notification S.O.1533 (E), dt.14th September 2006, as amended in 2009, issued under Environment (Protection) Act 1986, has made it mandatory to obtain environmental clearance for scheduled development projects. The notification classifies projects under two categories 'A' and 'B'. Category A projects (including expansion and modernization of existing projects) require clearance from MoEF& CC, GoI and category B from State-level SEIAA, constituted by Government of India. 39 categories of projects are covered under this notification.	MoEF& CC– Expert Appraisal Committee (EAC) and State Environmental Impact Assessment Authority (SEIAA)	Wind Projects are not considered to obtaining EIA Clearances from MOEF & CC and APPCB.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
A-3	Forests (Conservation) Act, 1980 and Rules 1981 as amended 2004	The Forest Conservation Act (FCA) was adopted in 1980 to protect and conserve forests. The Act restricts the powers of the State in respect of de-reservation of forests and the use of forestlands for non-forest purposes. An advisory committee has been created to oversee the implementation of the statute. The FCA is relevant for the power sector for the siting guidelines for Wind Farm, and for passage of transmission through forest areas, since it would involve use of forestland for "non-forest" purposes. According to Section 2 of the Act "notwithstanding anything contained in any other law for the time being in force in a State, no State Government, or other authority shall, except with the prior approval of the Central Government, make any order directing: De-reservation of a reserved forest Use any forest land for any non -forest purpose Assign any forest land to any private person or entity not controlled by the Government Clear any forest land of naturally grown trees for the purpose of using it for reforestation	State Forest Dept./ MoEF& CC	Not applicable as no forest land has been taken either for construction or for substation and transmission line pathway.
A-4	Wildlife (Protection) Act 1972, Wildlife (protection) Amendment Act 2002 and 2003 amendment.	The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto. Birds are covered under this Act making it illegal to catch, keep, kill, buy / sell birds or	Chief Conservator Wildlife, State Forest Department &	This act is not applicable for this project. No wild life/eco-sensitive zone has been reported within the study area.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		damage their nests. All indigenous bird species are covered under this Act including peacocks. The application of the Order of the Honorable Supreme Court in WP 460 of 2004 dated 04.12.2006 in the matter of Goa Foundation v. Union of India and other wherein the Honorable Supreme Court has directed that all projects which require environmental clearance and are located within the distance of 10Km of National Park and Sanctuaries must be placed before the standing Committee of the National Board for Wildlife constituted under the Wildlife (Protection) Act, 1972.	MoEF& CC	
A-5	Hazardous Waste (Management, Handling and Trans-Boundary Movement) Rules, 2008 as amended in 2009 and 2010 under EPA, 1986 (HWM Rules, 2008)	The Hazardous Wastes (Management, Handling and Tran's boundary Movement) Rules, 2008 are promulgated under Environment (Protection) Act 1986, which was further amended in July 2009, September 2009, March 2010 and August 2010. With the recent amendment, these rules have become quite comprehensive. The rules define responsibility of hazardous wastes generators, require safe handling practices and maintenance of manifest system during transport of hazardous waste and also describe technological aspects to be followed up by re-refiners and recyclers of hazardous wastes. The rules also cover liabilities of occupier, transporter and operator of a facility for any damages caused due to improper	CPCB, SPCBs	Authorization for collection, reception, storage, transportation and disposal of hazardous wastes; Generation of waste oil & transformer oil (if any) at site attracts the provision of the rules and hazardous waste have to dispose as per the directives of MOEF & CC and CPCB, SPCB.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		handling and disposal of hazardous wastes by reinstating or restoring environmental damages caused.		
A-6	The Air (Prevention and Control of Pollution) Act, 1981 Including Rules 1982 and 1983 and amendment	The Act prohibits the construction and operation of any industrial plant without the consent of SPCBs. The Act assigns powers and functions to the CPCB and the SPCBs for prevention and control of air pollution and all other related matters. For the prevention and control of air pollution, the State Government, in consultation with the SPCB has the powers to set standards for emissions from automobiles, impose restrictions on use of certain industrial plants and prohibit emissions of air pollutants in excess of the standards laid down by the SPCB. It can also make an application to the court for restraining persons from causing air pollution. In addition, it also has the power of entry and inspection, power to obtain information and power to take samples of air emissions and conduct the appropriate follow up. The CPCB, as well as the SPCBs are eligible for contributions from the Central as well as the State Government, respectively, to perform their functions appropriately. The Act also allows for appropriate penalties and procedures for non-compliance.	SPCB	In general, this project falls under Green Category. However, as per AP 'Wind Power Policy 2015', Wind Power Project have been exempted for NOC/consent; issued by SPCB. In tune of it, consent conditions are not applicable under this act/rule.
A-7	The Noise Pollution (Regulation and Control)	As per the Noise Pollution (Regulation and Control) Rules 2000, every operating facility is	SPCB	There will be generation of noise during construction activities and during operation of

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
	Rules, 2000 and the Noise Pollution (Regulation and Control) Amendment) Rules, 2010	required to take all possible steps to meet the ambient noise level standards prescribed in the Rules. The rules prescribe maximum permissible values of day and night time noise levels for zones A, B, C and D representing industrial, commercial, and residential and silence zone respectively.		WTGs. The Rules require activity/processes generating noise to ensure that the ambient noise levels are within the prescribed Standards. The proposed project will result in generation of noise during construction and operation activities. The project is required to maintain the noise limits prescribed for residential (55 dB(A) for daytime and 45 dB(A) for night-time.
A-8	Water Prevention and Control of (Pollution) Act, 1974 including Rules, 1975 (as amended up to 1988)	This Act provides for the prevention and control of water pollution and maintaining or restoring good water quality for any establishment. The Act assigns functions and powers to the CPCB and SPCBs for prevention and control of water pollution and all related matters. Subject to the provisions of the Act, the functions and powers of CPCB as well as the SPCBs have been delineated individually and with respect to each other.	Center Pollution Control Board (CPCB), State Pollution Control Board (SPCBs)	In general, this project falls under Green Category. However, as per AP 'Wind Power Policy 2015', Wind Power Project have been exempted for NOC/consent; issued by SPCB. In tune of it, consent conditions are not applicable under this act/rule.
A-9	The Water Prevention and Control of Pollution), Cess Act, 1977 including Rules 1978 and 1991	This Act provides for levy and collection of Cess on water consumed and water pollution caused. It also covers specifications on affixing of meters, furnishing of returns, assessment of Cess, interest payable for delay in payment of Cess and penalties for non-payment of Cess within the specified time. Industries consuming water less than $10m^3$/day have been exempted from levy of cess provided they are not generating hazardous	SPCB	There is no significant water consumption in Wind Projects in long term basis. Only domestic, potable water is consumed for very few staff of Wind Power Plant due to consumption of very less quantity of water.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		wastes.		
A-10	Electricity Act, 2003	The sections of the Electricity Act, 2003 that are relevant for laying (and repairs) of transmission lines for the supply of energy are described as following: Section 67 details the provisions (a) to open and break up the soil and pavement of any street, railway or tramway; (b) to open and break up any sewer, drain or tunnel in or under any street, railway or tramway; (c) to alter the position of any line or works or pipes, other than a main sewer pipe; (d) to lay down and place electric lines, electrical plant and other works;(e) to repair, alter or remove the same; (f) to do all other acts necessary for transmission or supply of electricity. Section 159 describes that no person shall be engaged in the generation, transmission, distribution, supply or use of electricity, in any way injure any railway, highway, airports, tramway, canal or water-way or any dock, wharf or pier vested in or controlled by a local authority, or obstruct or interfere with the traffic on any railway, airway, tramway, canal or water-way. Section, 160(1) describes that every person generating, transmitting, distributing, supplying or using electricity (hereinafter in this section referred to as the "operator") shall take all	State Electricity Regulation Committee and	MVTPL shall obtain license under the electricity act and ensure that the Health and Safety requirements as per rule 29 and 46 under chapter 6.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		reasonable precautions in constructing, laying down and placing his electric lines, electrical plant and other works and in working his system, so as not injuriously to affect, whether by induction or otherwise, the working of any wire or line used for the purpose of telegraphic, telephone or electric signaling communication, or the currents in such wire or line. Section 34 describes that every transmission licensee shall comply with such technical standards, of operation and maintenance of transmission lines, in accordance with the Grid Standards, as may be specified by the Authority. Section 53 (1) describes that the Authority may in consultation with the State Government, specify suitable measures for –(a) protecting the public (including the persons engaged in the generation, transmission or distribution or trading) from dangers arising from the generation, transmission or distribution or trading of electricity, or use of electricity supplied or installation, maintenance or use of any electric line or electrical plant; (b) eliminating or reducing the risks of personal injury to any person, or damage to property of any person or interference with use of such property ; (c) prohibiting the supply or transmission of electricity except by means of a system which conforms to the specification as		

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		may be specified; (d) giving notice in the specified form to the Appropriate Commission and the Electrical Inspector, of accidents and failures of supplies or transmissions of electricity; (e) keeping by a generating company or licensee the maps, plans and sections relating to supply or transmission of electricity; (f) inspection of maps, plans and sections by any person authorized by it or by Electrical Inspector or by any person on payment of specified fee; (g) specifying action to be taken in relation to any electric line or electrical plant, or any electrical appliance under the control of a consumer for the purpose of eliminating or reducing a risk of personal injury or damage to property or interference with its use; Section 165 (1) In section 40, sub-section (1) of clause (b) and section 41, subsection (5) of the Land Acquisition Act, 1894, the term "work" shall be deemed to include electricity supplied or to be supplied by means of the work to be constructed. (2) The Appropriate Government may, on recommendation of the Appropriate Commission in this behalf, if it thinks fit, on the application of any person, not being a company desirous of obtaining any land for its purposes, direct that he may acquire such land under the provisions of the Land Acquisition Act, 1894 in the same manner and on the same conditions as it might be		

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		acquired if the person were a company.		
B. Land and Labor				
B-1	Land Acquisition Act 1894 (Amended in 1984) and The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	Land Acquisition Act 1894 was passed with the purpose of enabling the procurement of land for the purpose of activities which are in the interests of the country. These include procedures for the acquisition of land, declaration of acquisition intent, hearing of objections, and final possession of the land amongst others. In last decade, the LA Act 1894 has been debated over for its archaic characters, which do not fit into the current realities. The current reality surrounding the process of land acquisition has changed tremendously, and therefore, the need was felt for the passing of a new law. A new Land Acquisition Resettlement and Rehabilitation Bill (LARR) 2011, which was renamed to The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RTFCTLARR Act), was passed by both the houses of Parliament and given the President's assent on 26th September 2013. The new law came into force in January 2014 and is applicable to the project. The new law stipulates mandatory consent of at least 70% of affected people for acquiring land for Public Private Partnership (PPP) projects and 80% for acquiring land for private companies. It also	Local Administration District Collector Revenue Officer	Land Procurement has been done under willing buyer/ willing seller basis and direct negotiation to the land seller with best of market price. It does not involve any involuntary displacement; hence RTFCTLARR 2013 is not applicable for this project.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		requires that payment of compensation for the owners of the acquired land will be four times the market value in rural areas and twice in urban areas. It also stipulates that the land cannot be vacated until the entire compensation is awarded to the affected parties. The law has the provision that the companies can lease the land instead of purchasing it. Besides, the private companies will have to provide for rehabilitation and resettlement if land acquired through private negotiations is more than 50 acres and 100 acres in urban and rural areas, respectively.		
B-2	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 &rules 2007	The act basically vests the forest rights and occupation in forest land in forest dwellers (ST and other traditional forest dwellers) who have been residing in forests for generations but whose rights could not be recorded. The act provides a framework for recognizing the forest rights and the nature of evidence required for such recognition and vesting of forest land. Some of the key rights so vested are as follows Right to hold and live in the forest land under the individual or common occupation for habitation or for self-cultivation for livelihood by a member or members of a forest dwelling Scheduled Tribe or other traditional forest dwellers; Community rights such as nistar, by whatever	Ministry of Tribal Affairs Tribal Welfare Department	Not applicable as proposed project does not affect any scheduled tribe or traditional forest dwellers. However, as per Census of India 2011, there are 2.21% Scheduled Tribes are dwelling in the study area.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		name called, including those used in erstwhile Princely States, Zamindari or such intermediary regimes; Right of ownership, access to collect, use, and dispose of minor forest produce which has been traditionally collected within or outside village boundaries; Other community rights of uses or entitlements such as fish and other products of water bodies, grazing (both settled or transhumant) and traditional seasonal resource access of nomadic or pastoralist communities; Rights including community tenures of habitat and habitation for primitive tribal groups and pre-agricultural communities; Rights in or over disputed lands under any nomenclature in any State where claims are disputed; Rights for conversion of Pattas or leases or grants issued by any local authority or any State Government on forest lands to titles; Rights of settlement and conversion of all forest villages, old habitation, un-surveyed villages and other villages in forests, whether recorded, notified or not into revenue villages; Right to protect, regenerate or conserve or manage any community forest resource which they have been traditionally protecting and		

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		conserving for sustainable use; Rights which are recognized under any State law or laws of any Autonomous District Council or Autonomous Regional Council or which are accepted as rights of trial's under any traditional or customary law of the concerned tribes of any State;		
B-3	The Provision of the Panchayats (Extension to the Scheduled Areas) Act, 1996	The Act provides extension of the provisions of Part IX of the Constitution relating to the Panchayats to the Scheduled Areas. Scheduled Areas are defined as per the Clause (1) of Article 244 of the Constitution. The act gives special powers to the Panchayats in case it has been classified as Schedule V area by the constitution. The Panchayats are expected to have special powers given to them through the state Legislatures like: The power to enforce prohibition or to regulate or restrict the sale and consumption of any intoxicant; The ownership of minor forest produce; The power to prevent alienation of land in the Scheduled Areas and to take appropriate action to restore any unlawfully alienated land of a Scheduled Tribe; The power to manage village markets by whatever name called; the power to exercise control over money lending to the Scheduled	Gram Panchayat	A NoC will be obtained for the project from the Gram Panchayat of all the project villages for installation WTGs.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		Tribes; The power to exercise control over institutions and functionaries in all social sectors; The power to control over local plans and resources for such plans including tribal sub-plans; The administration and management of the Panchayat is similar to the non-schedule areas, but the Panchayat has immense powers in case of Scheduled Area.		
B-4	Andhra Pradesh Panchayats Act 1994	The act gives powers to the Panchayats in case there is any grievance arises by the project. There is Provision for application of consent from the respective panchayat body/village administrative officer etc., during the project life cycle.	Panchayat Union	MVTPL will ensure that all grievances raised by locals related to the project are addressed through grievance redressal process.
B-5	The Indian Factories Act, 1948 and State Rules	The Indian Factories Act was promulgated in 1948, to ensure general welfare of the industrial workers. The Act is divided into nine chapters with three chapters exclusively on health and safety (H&S) issues. The Act in its preamble states that "it is the general duty of the occupier (defined in the act as person having the ultimate control over the affairs of the factory) to ensure as far as practicable health, safety and welfare of all workers while they are at work in the factory".	Directorate of Industrial Safety and Health (DISH)/ Deputy Chief Inspector of Factories	Applicable to Proposed Wind Farm and MVTPL will ensure compliance.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		A general policy with respect to H&S of the workers at work should be in the form of a written statement and brought to the notice of the workers per the provision of the Act. The Act in its Chapter 4 deals with the provisions relating to Safety. The specific areas of safety are those relating to the usage of machinery, handling of hazardous substances and the latest amendments include safety measures for hazardous processes. For the usage of machinery there are Acts related to the fencing, casing of the machinery. Restriction of young persons and the employment of women and children to work on machines that is dangerous in nature. The Act also has regulations for working near machinery in motion; development of adequate safety measures during installation and various types of operation of the machinery. The Act also explains preventive and protective measures in safety including proper consideration of explosive or inflammable substances so that the workers are not exposed to hazards during operation. Some of the sections deal with various precautions that are required for handling pressure plants, fire, inflammable dust, gas or explosive. The factory occupier is responsible to maintain safety of the buildings and machinery per this legislation. The Act also gives power to		

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		States to make relevant rules to supplement the need of safety in the facility. The Act also covers provisions for hazardous processes for an occupier to take all practicable measures to ensure prevention of any sorts of explosion due to manufacturing process, which are hazardous. There are permissible limits for exposure of chemicals and toxic substances in the workplace. Workers have the right to know about imminent danger and their participation in safety management. The Act also requires medical check-ups of workers with access to workers to look for outcome of the medical reports. An occupier is to develop a safety policy and form safety committees and provide power to the Central Government to appoint inquiry committee if some extraordinary situation had occurred in the factory which is engaged in the hazardous process.		
B-6	The Bonded Labour System (Abolition) Act 1976	The Bonded Labor System (Abolition) Act 1976: States that all forms of bonded labor stands abolished and every bonded laborer stands freed and discharged from any obligations to render any bonded labor (Ch II, Section 4)	Ministry of Labor & Employment	Applicable to Proposed Wind Farm and MVTPL will ensure compliance.
B-7	Minimum Wages Act, 1948	Minimum Wages Act, 1948 requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years.	Ministry of Labor & Employment	MVTPL should ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the rules as per applicability and

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		The minimum wage as prescribed for the industry by the government is required to be paid by the employers to the staff.		tenure of service.
B-8	The Workmen's Compensation Act, 1923	The Workmen's Compensation Act, 1923 requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act. Applicable to employees with less than or equal to a maximum of basic salary of INR 8000 per month	Ministry of Labor & Employment	Applicable to Proposed Wind Farm and MVTPL will ensure compliance, as per the applicability.
B-9	The Contract Labor (Regulation & Abolition) Act, 1970 and Rules	As per the contract labor act, every principle employer is required to get the establishment registered before employing any contract labor. The contractors are also required to provide at minimum amenities like canteen, urinals, restrooms or alternate accommodation (if night halting labor), first aid, safe drinking water, etc. in case of contractor's failure to provide these amenities, the principle employer is liable to provide such amenities at its cost.	Ministry of Labor & Employment	Applicable to Proposed Wind Farm and MVTPL will ensure compliance.
B-10	The Child Labor (Prohibition and Regulation) Act, 1986	A child is defined as a person who has not completed 14years of age. The Act prohibits employment of children in certain occupation and processes (part II, Section 3). The Act also specifies conditions of work for	Ministry of Labor & Employment	Applicable to Proposed Wind Farm and MVTPL will ensure compliance.

S. No	Act/Law	Description/purpose	Responsible Authority	Applicability
		children, if permitted to work. These include a working day of maximum of 6 hours a day (including rest), no work period exceeding 3 hours at a stretch, and no overtime (Section 7). The Act requires maintenance of a register for employed children (Section 11).		
B-11	ESI Act, 1948 (Employees State Insurance Act, 1948)	The ESI Act provides for certain benefits to employees in case of sickness, maternity and employment injury. These includes periodical payments to any insured person in case of his sickness certified by a duly appointed medical practitioner, periodical payments to an insured woman in case of confinement or miscarriage or sickness arising out of pregnancy, confinement, premature birth of child, periodical payments to an insured person suffering from disablement as a result of an employment injury sustained as an employee, or periodical payments to such dependents of an insured person who dies as a result of an employment injury sustained as an employee amongst others. Applicable to employees with less than or equal to a maximum of basic salary of INR 15000 per month	Ministry of Labor & Employment	Applicable to Proposed Wind Farm and MVTPL will ensure compliance as per the applicability.

Source: Pollution Control Law Series: PCLS/02/2010 (sixth Edition), CPCB June, 2010

2.6 APPLICABLE ENVIRONMENTAL STANDARDS

The central Pollution Control Board (CPCB) has stipulated different environmental standards w.r.t. Ambient Air Quality, Noise Quality, Water and Waste Water for the country as a whole under EP Act, 1986. As per the applicable reference framework WB & IFC guideline values are applicable to the project. Details of the standards are provided below:

2.6.1 Ambient Air Quality

National Ambient Air Quality Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given in **Table 2.2** below.

Table 2:2: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concertation in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30
	24 Hours**	80	80
Particulate Matter (size less than 10 µm) or PM10, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or PM2.5, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O3), µg/m^3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m^3	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO), mg/m^3	8 Hours	2	2
	1 Hour**	4	4
Ammonia (NH_3), µg/m^3	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6), µg/m^3	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual*	1	1
Arsenic (As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

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

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

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

2.6.2 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in **Table 2.3.**

Table 2:3: Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	**A**	➢ Total Coliforms Organism MPN/100ml shall be 50 or Less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6mg/l or more ➢ Biochemical Oxygen Demand 5 days 20oC 2mg/l or less
Outdoor bathing (Organized)	**B**	➢ Total Coliforms Organism MPN/100ml shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5mg/l or more ➢ Biochemical Oxygen Demand 5 days 20oC 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 20oC 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 25oC micro mhos/cm Max.2250 ➢ Sodium absorption Ratio Max. 26 ➢ Boron Max. 2mg/l
	Below E	Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

As per the IFC EHS guidelines, the treated sewage discharge shall meet the following guidelines:

Table 2:4: *Treated Sewage Discharge Guideline IFC*

S. No.	Parameter	Guideline Value
1	Ph	6-9
2	BOD	30 mg/l,
3	COD	125 mg/l,
4	Total Nitrogen	10 mg/l,
5	Total Phosphorus	2 mg/l,
6	Oil and Grease	10 mg/l,
7	Total Suspended Solids	50 mg/l
8	Total Coliform bacteria	400 MPN/100 ml

Notes: MPN = Most Probable Number

Table 2:5: Drinking Water Standard (IS 10500: 2012)

S. No	Parameter	Unit	IS 10500 specifications RA 2012
1	Ph	--	6.5-8.5
2	Turbidity	NTU	5-10
3	EC	µMho/cm	
4	TSS	mg/l	
5	TDS	mg/l	
6	Total Alkalinity as $CaCO_3$	mg/l	
7	Chlorides as Cl^-	mg/l	250-1000
8	Sulphates as SO_4^{-2}	mg/l	200-400
9	Nitrates as NO3	mg/l	45
10	Phosphates as PO_4	mg/l	
11	Total Hardness as $CaCO_3$	mg/l	200-600
12	Calcium as Ca	mg/l	75-200
13	Magnesium as Mg	mg/l	30-100
14	Sodium as Na	mg/l	
15	Potassium as K	mg/l	
16	Flourides as F^-	mg/l	1-1.5
17	Iron as Fe	mg/l	0.3-1
18	Phenolic Compounds	mg/l	0.001-0.002
19	Cyanide as CN^-	mg/l	0.005
20	Residual Chlorine as Cl^-	mg/l	0.2
21	Cadmium as Cd	mg/l	0.01
22	Total Chromium as Cr	mg/l	0.05
23	Lead as Pb	mg/l	0.05
24	Zinc as Zn	mg/l	5-15
25	Manganese as Mn	mg/l	30-100

S. No	Parameter	Unit	IS 10500 specifications RA 2012
26	Copper as Cu	mg/l	0.05-1.5
27	Nickel as Ni	mg/l	3.0-5.0
28	Colour	Hazen	5.00
29	Taste	-	Agreeable
30	Odor	-	Unobjectionable
31	Boron	mg/l	1.00
32	Anionic Detergents	mg/l	0.20
33	Mineral Oil	mg/l	0.01
34	Aluminium as Al	mg/l	0.03
35	Mercury as Hg	mg/l	0.00
36	Pesticides	mg/l	Absent

2.6.3 Ambient Noise Standards

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 based on the *A- weighted* equivalent noise level (Leq) are as presented in **Table 2.6.**

Table 2:6: Ambient Noise Standards

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

*Note: * Day time is from 6 am to 10 pm, Night time is 10 pm to 6.00 am; ** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.*

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

Table 2:7: Ambient Noise Standards by IFC

Receptor	One Hour L_{Aeq} (dBA)	
	Day Time 07:00 – 22:00	Night Time 22:00 – 07:00
Residential, Educational, Institutional	55	45
Industrial and Commercial	70	70

2.6.4 Noise Standards for Occupational Exposure

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

Table 2:8: ***Standards for Occupational Noise Exposure***

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

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

2.7 INTERNATION SAFEGUARD REQUIREMENTS

2.7.1 ADB Safeguard Policy Statement, 2009

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

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

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

The objectives of ADB's safeguard are to:

- Avoid adverse impact of projects on the Environment and affected people, wherever possible;

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

ADB's safeguard policy framework consists of three operational policies on the environment, indigenous peoples and involuntary resettlement. A brief detail of all three operational policies have been mentioned below:

Environmental Safeguard

This safeguard is meant to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision making process.

The proposed project involves generation of power from wind energy which is one of the cleanest sources of energy according to European Wind Energy Association (EWEA). However, the construction and operational activities of the project might result in some adverse impacts on the environment which can be mitigated through implementation of appropriate mitigation measures. The Environmental Safeguard is thus applicable to the proposed project.

Involuntary Resettlement Safeguard

This safeguard has been placed in order to avoid involuntary resettlement whenever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre- project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

The proposed project involves procurement of private land from twelve (12) villages of Aluru and Pattikonda *taluka*, Kurnool districts of Andhra Pradesh. No physical displacement is involved in the process. The project area comprises of rain fed agricultural land. Due to limited rainfall and declining levels of groundwater in the region, agricultural land owners are inclined to sell off some parcels of their land. The land procured is on willing buyer/ willing seller basis and compensation paid is best of the market value hence the project does not entail economic displacement. Therefore, adverse impact due to land procurement is not anticipated.

Indigenous Peoples Safeguard

This safeguard looks at designing and implementing projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems and cultural uniqueness as defined by the Indigenous Peoples themselves so that they receive culturally appropriate social and economic benefits; do not suffer adverse impacts as a result of projects; and participate actively in projects that affect them.

The project area or its surroundings is not native to any indigenous people as described by GOI through its Gazetted Offices. No material degradation or adverse impact is expected on land resources on which indigenous/ST peoples are dependent. Therefore, adverse impact on indigenous people is not anticipated.

Information, Consultation and Disclosure

Consultation and participation are essential in achieving the safeguard policy objectives. This implies that there is a need for prior and informed consultation with affected persons and communities in the context of safeguard planning and for continued consultation during project implementation to identify and help address safeguard issues that may arise. The consultation process begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle. It provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people and is undertaken in an atmosphere free of intimidation or coercion. In addition, it is gender inclusive and responsive and tailored to the needs of disadvantaged and vulnerable groups and enables the incorporation of all relevant views of affected people and other stakeholders into decision making. ADB requires the borrowers/clients to engage with communities, groups or people affected by proposed projects and with civil society through information disclosure, consultation and informed participation in a manner commensurate with the risks to and impacts on affected communities. For projects with significant adverse environmental, involuntary resettlement or Indigenous Peoples impacts, ADB project teams will participate in consultation activities to understand the concerns of affected people and ensure that such concerns are addressed in project design and safeguard plans.

It was informed at the time of site visit that community/village *Panchyat* around the vicinity of the project site has been informally informed about the proposed project by MVTPL. The community is aware of the Site Office premises and the concerned person to contact and is free to get in touch whenever required.

Social Protection Strategy, 2001

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

The proposed project shall ensure that the requirements of the ADB's SPS are complied with. Priority shall be given to any identified vulnerable groups. Based on the gender analysis in the project area, measures for ensuring their overall development shall be taken up by the project proponent. MVTPL shall comply with applicable labour laws in relation to the Project. It shall also take the following measures to comply with the core labour standards for the ADB financed portion of the Project;

(a) Carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged by MVTPL or its contractors);
(b) Not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;

(c) Engage contractors and other providers of goods and services:

- Who do not employ child labor or forced labor;
- Who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (i) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (ii) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and
- Whose subcontracts contain provisions which are consistent with paragraphs (i) and (ii) above.

Public Communications Policy 2011

The Public Communications Policy (PCP) of ADB, originally formulated in 2005 and revised in 2011, is aimed at promoting improved access to information about ADB's operations related to funded projects. It endorses greater transparency and accountability to stakeholders involved in a project. The PCP establishes the disclosure requirements for documents and information related to projects. It mandates project-related documents normally produced during the project cycle to be posted on the web.

MVTPL shall ensure that the requirements of ADB's PCP are complied with. It shall engage regularly with the stakeholders identified for the project throughout the project life cycle with essential communications and information-sharing aspects intrinsic to the project to maintain greater transparency and accountability amongst the project's stakeholders. This will enable the stakeholders to better participate in the decisions that may impact/affect them during the project life cycle.

2.7.2 IFC Requirement

IFC applies the Performance Standards 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 guideline provide ways and means to identify impact and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

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

Table 2:9: Application of IFC Performance Standards to the Project

IFC Performance Standards	Requirements	Project Information/ Application
Performance Standard 1: Social & Environmental Assessment and Management System	The project should have a social and environmental management system that incorporates the following: (i) policy; (ii) identification of risks and impacts; (iii) management programs; (iv) organizational capacity and competency; (v) emergency preparedness and response; (vi) stakeholder engagement; and (vii) monitoring and review.	This Performance Standard is applicable to the Project. The proposed project will have environmental and social impacts such as generation of noise and small quantities of hazardous wastes (operation of DG sets etc.). PS 1 is therefore applicable for the project and thus requires an Environmental and Social Impact Assessment (ESIA) study to be conducted before commencement of the project. MVTPL also needs to develop and implement a project specific Environmental and Social Management Plan to manage the risks associated with project's operations.
Performance Standard 2: Labor and Working conditions	MVTPL requires to follow requirements on (i) working conditions and management of worker relationship (human resource Conditions policy, working conditions, terms of employment, worker's organizations, non-discrimination equal opportunity, retrenchment, grievance mechanism); (ii) protecting work force (not engaging child labor and forced labor); (iii) occupational health and safety; (iv) workers engaged by third parties; and (v) adverse impacts related to supply chain.	The applicability of PS 2 will be more important during the construction phase as operation phase will only have limited number of staff. It not only covers the main plant employees, but all employees/workers, even those working through contractors/GE/Suzlon. Migrant workers be engaged for the project will stay in rented accommodation in nearby towns. Therefore, standards pertaining to campsites will not be applicable. MVTPL should develop and implement procedures to manage and monitor performance of third parties / GE/Suzlon. These procedures should be integrated in the day-to-day operations of the company and requirements should be clearly communicated to third parties, and if possible to workers engaged by

IFC Performance Standards	Requirements	Project Information/ Application
		contractors.
Performance Standard 3: Pollution Prevention and Amendment	MVTPL requires to consider (i) sustainable resource utilization (water consumption); (ii) pollution prevention (wastes, hazardous materials management, pesticide use and management)	This Performance Standard is applicable to the Project. The proposed project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project will entail generation of wastes like waste water and construction debris. The operation phase will result in generation of minor quantities of waste such as transformer oil and used oil. MVTPL should monitor emissions appropriate the nature to ensure that the requirements of PS 3 are being met.
Performance Standard 4: Community Health, Safety and Security	MVTPL requires to follow requirements on i) infrastructure and equipment design and safety; (ii) hazardous materials management and safety; (iii) ecosystem services; (iv) community exposure to disease; (v) emergency preparedness and response; and (vi) security personnel.	The applicability of this PS shall be established during the ESIA process, resulting in preparation of an Action Plan to be disclosed to the community. The Applicability will be limited to some extent of construction period with movement of heavy machinery / vehicles. Noise levels and shadow flicker impacts at adjoining villages to be kept suitably. Worker / Labour and to be engaged from local community considering individual skill level. The Action Plan and any other relevant project-related information is to enable the influenced communities and relevant government agencies to understand these risks and impacts, and will engage the influenced communities and agencies as and when required.
Performance Standard 5:	Specifies requirements on (i) project design to avoid or	For the proposed project, a total of 494 acres of

IFC Performance Standards	Requirements	Project Information/ Application
Land Acquisition and Involuntary Resettlement	minimize physical and/or economic displacement; (ii) compensation and benefits for displaced persons; (iii) community engagement; (iv) grievance mechanism; (v) resettlement and livelihood restoration planning and implementation; (vi) physical and economic displacement; (vii) private sector responsibilities under government-managed resettlement	private agricultural land has been procured. Prior to the procurement of land, the site was used for single crop cultivation. During site visit and interactions with land owners, it was evident that no physical and economical displacement has been taken place. Compensation for land and other assets have been calculated at the market value plus the transaction costs related to restoring the assets. During the consultations, it was observed that the procurement of land was based on "willing buyer/willing seller," process wherein the households had voluntarily sold their property and assets. MVTPL engaged informal consultation for disclosure of relevant information and participation of Affected Communities during the planning and implementation stage of the project. A Stakeholder Engagement Plan has been developed as a part of environment and social management plan.
Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management	Specifies requirements on (i) protection and conservation of biodiversity (modified, natural, critical habitat, legally protected and internationally recognized areas, invasive alien species); (ii) management of ecosystem services; (iii) sustainable management of natural resources; and (iv) supply chain.	There is no legally notified ecologically sensitive areas viz. National park, wildlife sanctuary etc. within 10 Km of project site. The applicability of this PS shall be detailed out in the Environmental and Social Impact Assessment Study, while implementation of the actions necessary to meet the requirements of this PS shall be managed through the suggested mitigation measures. The operation phase of the proposed project shall ensure protection of fauna and flora of

IFC Performance Standards	Requirements	Project Information/ Application
		the site and surrounding. Baseline studies for ecological aspects have been described in **Chapter 4** of the report. The study has been gathered through site survey, literature review and initial desktop analysis. The extent of the literature review depend on the sensitivity of the biodiversity attributes associated with the project's area of influence and the ecosystem services that may be impacted.
Performance Standard 7: Indigenous Peoples	Specifies requirements on (i) Avoidance of adverse impacts; (ii) Participation and consent; (iii) circumstances requiring free, prior, and informed consent; (iv) mitigation and development benefits; and (v) private sector responsibilities where government is responsible for managing indigenous peoples issues	The project area or its surroundings is not native to any indigenous people. No material degradation or adverse impact is expected on land resources on which people are dependent. Hence, PS7 is not applicable for this project.
Performance Standard 8: Cultural Heritage	Specifies requirements on (i) protection of cultural heritage in project design and execution (chance find procedures, consultation, community access, removal of replicable cultural heritage, removal of non-replicable cultural heritage, critical cultural heritage); and (ii) project's use of cultural heritage	As such the project does not impact any cultural property or structure of archaeological importance. This PS is applicable when tangible forms of cultural heritage, unique natural features or tangible objects that embody cultural values and certain instances of intangible forms of culture are impacted or are proposed to be used for commercial purposes. A small temple, protected by ASI, was observed to be located at a distance of 600 m in West Direction of WTG location no. ASP-122. However, the access to the temple doesn't get restricted as a result of the

IFC Performance Standards	Requirements	Project Information/ Application
		project activities. Hence, PS8 is not applicable for this project.

Source: IFC Performance Standards on Environmental and Social Sustainability, Jan 2012

2.7.3 IFC's EHS Guidelines

The Equator Principle 3 requires follow up of the environmental, health and safety requirements as per the following guidelines released by IFC on 30th April 2007:

- Environmental, Health, and Safety General Guidelines; and
- Environmental, Health, and Safety Guidelines for Wind Energy issued on 7th August, 2015.
- Guidelines for Power transmission and distribution.

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

Table 2:10: Key Requirements as per EHS Guidelines of IFC

S.No	Relevant Requirements as stated in EHS and Wind Energy Guidelines
1.	**Landscape and visual impacts** i Consideration should be given to turbine layout, size, and scale in relation to the surrounding landscape and seascape character and surrounding visual receptors. ii 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. iii Maintain a uniform size and design of turbines (e.g., type of turbine and tower, as well as height). iv Minimize presence of ancillary structures on the site by minimizing site infrastructure v Erosion measures should be implemented and cleared land should be promptly re-vegetated with local seed stock of native species.
2.	**Wastewater and Ambient Water Quality** i Discharges of wastewater from utility operations or storm water to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria ii Wastewater or storm water should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.
3	**Air Emissions and Ambient Air Quality** i Emissions should not result in pollutant concentrations that reach or exceed National Ambient Air Quality Standard.
4.	**Noise** i All modelling should take account of the cumulative noise from all wind energy facilities in the vicinity having the potential to increase noise levels.
5.	**Bio-Diversity** i Baseline biodiversity surveys, where required, should occur as early as possible ii Consider adjustments of cut-in wind speeds to reduce potential bat collisions. iii Eliminate "free-wheeling" (free spinning of rotors under low wind conditions when turbines are not generating power). iv Install bird flight diverters on transmission lines and guy wires from meteorological masts to reduce bird collisions
6.	**Shadow Flicker** i Modelling should be carried out in order to identify the distance to which potential shadow flicker effects may extend For India we do not have any specific standard however we have guideline

S.No	Relevant Requirements as stated in EHS and Wind Energy Guidelines	
		published by CSE related to shadow flickering. The same has been followed while assessing the Impact for the Project. Shadow flickering does not have any international standard so far. Also there is lack of country wise regulations or specific guidance with respect to shadow flicker. In most of the European countries i.e. Germany and Provinces, Spain, Italy, France, UK/England, Scotland, Portugal, Denmark, Netherlands, Sweden, Ireland and western Australia have wind policies and Recommendation which is also presented in **Annexure XI**.
	ii	Wind turbines can be programmed to shut down at times when shadow flicker limits are exceeded.
	iii	Site wind turbines appropriately to avoid shadow flicker being experienced or to meet limits placed on the duration of shadow flicker occurrence.
7.	**Wastewater Discharges**	
	i	Water use efficiency to reduce the amount of wastewater generation.
	ii	Compliance with national or local standards for sanitary wastewater discharges.
8.	**Occupational Health and Safety**	
a.	**Over-exertion**	
	i	Training of workers in lifting and materials handling techniques including the placement of weight limits.
	ii	Planning work site layout to minimize the need for manual transfer of heavy loads.
	iii	Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.
b.	**Slips and Falls**	
	i	Implementing good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths.
	ii	Cleaning up excessive waste debris and liquid spills regularly.
C.	**Work in Heights**	
	i	Training and use of temporary fall prevention devices
	ii	Training and use of personal fall arrest systems
d.	**Stuck by Objects**	
	i	Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap.
	ii	Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes.
e.	**Moving Machinery**	
	i	Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.
	ii	Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.
f.	**Dust**	

S.No	Relevant Requirements as stated in EHS and Wind Energy Guidelines
	i Implementation of Dust suppression techniques such as applying water ii Community Health and Safety
g.	**Disease Prevention** i Providing surveillance and active screening and treatment of workers.
h.	**Traffic Safety** i Adoption of safety measures those are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents. ii Regular maintenance of vehicles and use of manufacturer approved parts.
9.	**Community Health & Safety** i Turbines must be sited at an acceptable distance ("setback") between wind turbines and adjacent sensitive receptors to maintain public safety in the event of blade failure. ii Minimize the probability of a blade failure by selecting wind turbines that have been subject to independent design verification/certification and surveillance of manufacturing quality. iii Ensure that lightning protection systems are properly installed and maintained iv Equip wind turbines with vibration sensors that can react to any imbalance in the rotor blades and shut down the turbine if necessary.
10.	**Public Access**
	i Provide fencing of an appropriate standard around the substation with anti-climb paint and warning signs. ii Prevent access to turbine tower ladders. iii Post information boards about public safety hazards and emergency contact information.
11.	**Occupational Health and Safety Monitoring** i Recording all incidents that occur over the course of project implementation. ii Recording near-miss (also known as near-hit) data during a project in order to identify trends and implement improvements. iii Carrying out workplace and worker auditing to assess the effectiveness of risk management systems and workplace safety culture. iv Conducting worker consultation and feedback via questionnaires or periodic safety meetings

2.8 PROJECT CATEGORIZATION

2.8.1 ADB's Safeguard Categorization

The project classification system of ADB is used to reflect the significance of potential environmental impacts understood as a result of the client's impact assessment and to establish ADB's safeguard requirements. The projects are screened on the following criteria:

Environment: Proposed project was screened according to type, location, scale, sensitivity and the magnitude of their potential environmental impacts including direct, indirect, induced and cumulative impacts.

Involuntary Resettlement: The involuntary resettlement impacts of an ADB funded projects are considered significant if 200 or more persons will be physically displaced from home or lose 10% or more of their productive or income generating assets.

For those involving involuntary resettlement, a resettlement plan is prepared that is commensurate with the extent and degree of the impacts: the scope of physical and economic displacement and the vulnerability of the affected persons.

Indigenous People: The impacts of an ADB funded project on indigenous people is determined by assessing the magnitude of impacts in terms of:

- ***(i)*** Customary right of use and access to land and natural resources;
- ***(ii)*** The right of cultural and communal integrity;
- ***(iii)*** The level of vulnerability of the affected Indigenous people's community;
- ***(iv)*** Socio-economic status;
- ***(v)*** Health, education, livelihood and social security status; and
- ***(vi)*** The recognition of indigenous people.

As per these criteria projects are classified into any of the four categories: A, B, C and F1. The categories used by ADB are:

Category A Projects: Projects which are likely to have significant adverse environmental and social impacts that are irreversible, diverse, or unprecedented.

Category B Projects: Projects with potential adverse environmental and social impacts that are less in number, generally site-specific, mostly reversible and readily addressed through mitigation measures;

Category C Projects: Projects with minimal or no adverse environmental and social impacts;

Category FI Projects: Projects which involve investment of ADB funds to or through a financial intermediary.

2.8.2 IFC Categorization of Projects

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

Category A Projects: Projects with potential significant adverse environmental and social impacts that are diverse, irreversible or unprecedented;

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

Category C Projects: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;

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

IFC therefore categorizes projects primarily according to the significance and nature of impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; associated facilities that are not funded as part

of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project; areas potentially impacted by cumulative impacts from further planned development of the project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

Based on site specific environmental and social impacts identified, the project is categorized as **'Category B'** on both the above criteria and as described below:

The proposed Project is Greenfield Project. Land use of WTG's, transmission line, pooling sub-station site are private land consisting of barren/ fallow, rain fed single agriculture crop and due to proposed project parcel of land will be converted to industrial land use.

- The proposed project's potential adverse environmental impacts are mostly confined to identified activities in construction phase and site specific and the impacts can be addressed with implementation of proper mitigation measures. The detailed assessment with regard to same is explained in **Chapter 5** on the impact assessment.
- The proposed project is a new in the vicinity of the project site and surrounding, hence no cumulative impact anticipated due to proposed project.
- The anticipated impact to the bat and avifauna population due to the project was found to be general in nature common with wind mill projects like mortality due to collision with turbine rotor or accidental electrocution due to high tension transmission line or in general disturbance in the site due to construction and operation of the project. The proposed project does not expect to threaten the long term viability/function of any of bat and bird species found in the area.
- The proposed project does not involve any involuntary resettlement but most part of the project is being developed on private land which mostly comprises of rain fed single cropped agricultural and uncultivable barren land and it is procured on willing seller/willing buyer basis. There is no settlement on this land and impact on private land is restricted to seasonal rain fed agriculture.
- The proposed project will have no specific impact on indigenous people as the project area or its surroundings are not native to any indigenous people. No material degradation or adverse impact is expected on land resources on which people are dependent. No vulnerable group is impacted due to this project activity.

3 DESCRIPTION OF THE PROJECT

This section of the report presents information related to various attributes of the proposed 200 MW Aspari Wind Power Project and the associated infrastructure facilities.

3.1 PROJECT LOCATION

The proposed project site is located at Village Aspari, District Kurnool in the state of Andhra Pradesh and the proposed wind turbine of the project is spread on twelve revenue villages of Aluru and Pattikonda *taluka* of Adoni division. The Aspari site lies approximately 70 km. south-west of Kurnool district headquarter and 60 km. north-west of Bellari district headquarter. The project villages are well connected with each other with inter village road. All the villages are well connected with Gooty-Adoni Road and SH-78 which connect the site with district headquarter and NH-7. Hyderabad is the nearest airport which is 240 km. NNE from the site and Aspari (4 km. SW), Adoni (20 km. NNW) are the nearest Railway Station from the site.

The site is spread across a distance of approximately 15 km along the North to South direction and across a distance of approximately 10 km along the West to East direction. The site has an average MSL of 480 meter.

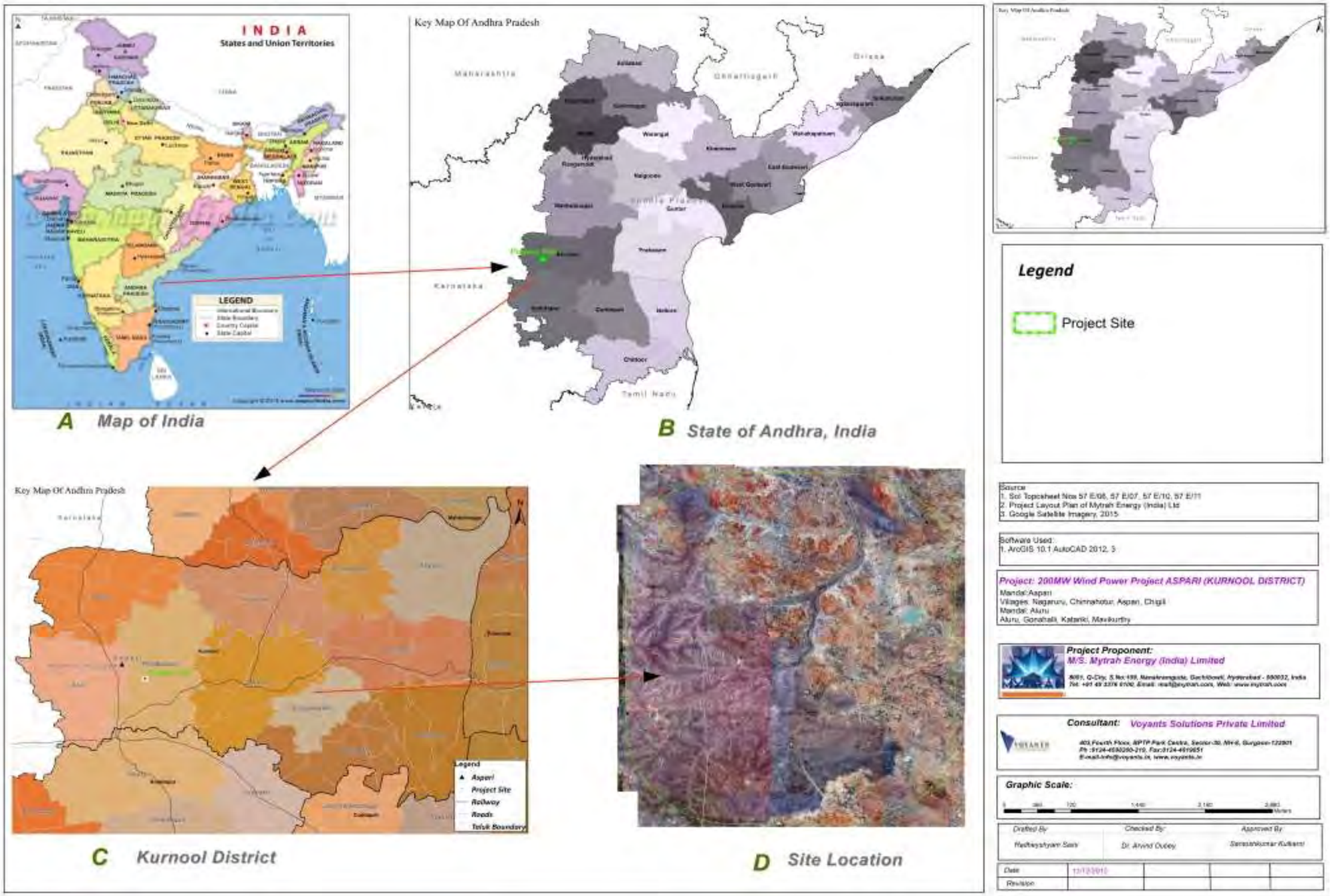

Figure 3:1: Location Map of the Project Area

Proposed project falls under twelve villages of Aluru and Pattikonda *taluka* of Adoni division. The proposed geographic coordinates of the turbines and its position are as presented in **Table 3.1**.

Table 3:1: Geographical Coordinates of the Turbine

S. No.	Location No.	WTG Model	Geographical Coordinates (zone 43p)		Nearest House/Structure/ Religious Structure	Distance (in km.)	Direction	Land Type	Receptor ID considered
			Easting (m)	Northing (m)					
1	ASP-05	GE 1.7	757261	1711975	Residential Area of Aspari Village	**0.67**	WNW	Private	REC-1
2	ASP-06	GE 1.7	757243	1711584	Residential Area of Aspari Village	**0.9**	NW	Private	REC-1
3	ASP-07	GE 1.7	757310	1711204	Residential Area of Aspari Village	**1.22**	NW	Private	REC-1
4	ASP-08	GE 1.7	757347	1710783	Residential Area of Aspari Village	**1.65**	NNW	Private	REC-1
5	ASP-09	GE 1.7	757502	1710209	Residential Area of Aspari Village	**2.2**	NNW	Private	REC-1
6	ASP-10	GE 1.7	757375	1709837	Residential Area of Aspari Village	**2.48**	NNW	Private	REC-1
7	ASP-11	GE 1.7	757558	1709442	Residential Area of Devnabanda Village	**2.7**	E	Private	REC-1
8	ASP-12	GE / GE 1.7	757588	1709041	Residential Area of Devnabanda Village	**2.7**	E	Private	REC-2
9	ASP-13	GE / GE 1.7	757527	1708697	Residential Area of Devnabanda Village	**2.82**	E	Private	REC-3
10	ASP-14	GE / GE 1.7	757442	1708239	Residential Area of Devnabanda Village	**3**	ENE	Private	REC-4
11	ASP-15	GE / GE 1.7	757288	1707875	Residential Area of Joharapuram Village	**2.8**	S	Private	REC-5
12	ASP-16	GE / GE 1.7	757326	1707485	Residential Area of Joharapuram Village	**2.4**	S	Private	REC-5
13	ASP-17	GE / GE 1.7	757359	1707097	Residential Area of Joharapuram Village	**2**	S	Private	REC-5
14	ASP-18	GE / GE 1.7	758578	1706541	Residential Area of Joharapuram Village	**1.68**	S	Private	REC-6
15	ASP-19	GE / GE 1.7	758419	1706140	Residential Area of Joharapuram Village	**1.2**	S	Private	REC-6
16	ASP-21	GE / GE 1.7	758308	1705654	Residential Area of Joharapuram Village	**0.75**	S	Private	REC-6
17	ASP-22	GE / GE 1.7	758570	1705047	Residence of Joharapuram Village	**0.35**	WSW	Private	REC-6
18	ASP-23	GE / GE 1.7	758653	1704647	Residence of Joharapuram Village	**0.45**	WNW	Private	REC-7
19	ASP-24	GE / GE 1.7	758778	1704140	Residential Area of Joharapuram Village	**0.81**	WNW	Private	REC-8

S. No.	Location No.	WTG Model	Geographical Coordinates (zone 43p)		Nearest House/Structure/ Religious Structure	Distance (in km.)	Direction	Land Type	Receptor ID considered
			Easting (m)	Northing (m)					
20	ASP-25	GE / GE 1.7	758867	1709056	Residential Area of Devnabanda Village	**1.43**	E	Private	REC-9
21	ASP-26	GE / GE 1.7	758895	1708587	Residential Area of Devnabanda Village	**1.5**	ENE	Private	REC-10
22	ASP-27	GE / GE 1.7	759051	1708106	Residential Area of Devnabanda Village	**1.6**	ENE	Private	REC-10
23	ASP-28	GE / GE 1.7	759065	1707554	Residential Area of Devnabanda Village	**1.9**	NE	Private	REC-10
24	ASP-29	GE / GE 1.7	759028	1706962	Residential Area of Joharapuram Village	**2.2**	SSW	Private	REC-11
25	ASP-61	GE / GE 1.7	759968	1702844	Residential Area of Joharapuram Village	**2.7**	NW	Private	REC-12
26	ASP-62	GE / GE 1.7	759612	1702434	Residential Area of Joharapuram Village	**2.8**	NW	Private	REC-12
27	ASP-63	GE / GE 1.7	759085	1702090	Residential Area of Joharapuram Village	**2.8**	NNW	Private	REC-12
28	ASP-64	GE / GE 1.7	758817	1701713	Residential Area of Joharapuram Village	**3**	NNW	Private	REC-12
29	ASP-65	GE / GE 1.7	758728	1701288	Cluster of Houses near to Kottala Village	**2.05**	SSW	Private	REC-13
30	ASP-66	GE / GE 1.7	758475	1700917	Cluster of Houses near to Kottala Village	**1.63**	SSW	Private	REC-14
31	ASP-40	GE / GE-2.3	762045	1703492	Residential Area of Hosuru Village	2.3	SE	Private	REC-15
32	ASP-44	GE / GE-2.3	764159	1705373	Residential Area of Pedda hulti Village	1.08	WSW	Private	REC-16
33	ASP-46	GE / GE-2.3	764756	1704668	Residential Area of Pedda hulti Village	1.8	WNW	Private	REC-16
34	ASP-47	GE / GE-2.3	765128	1704150	Residential Area of Pedda hulti Village	2.2	WNW	Private	REC-17
35	ASP-48	GE / GE-2.3	765098	1703738	Residential Area of Hosuru Village	1.3	SE	Private	REC-18
36	ASP-49	GE / GE-2.3	765260	1703298	Residential Area of Hosuru Village	1	SSW	Private	REC-19
37	ASP-50	GE / GE-2.3	765867	1706402	Residential Area of Chinna hulti Village	1.96	WNW	Private	REC-20
38	ASP-52	GE / GE-2.3	766475	1705879	Cluster of Houses near to pattikonda Village	1.1	SSE	Private	REC-21
39	ASP-53	GE / GE-2.3	766062	1705165	Single structure	0.3	NNE	Private	REC-21
40	ASP-54	GE / GE-2.3	766153	1704752	Single structure	0.3	WNW	Private	REC-22
41	ASP-55	GE / GE-2.3	766602	1704033	Residential Area of Pattikonda Village	1.24	E	Private	REC-23
42	ASP-67	GE / GE-2.3	760739	1700107	Cluster of Houses near to Kottala Village	2.7	WSW	Private	REC-24

S. No.	Location No.	WTG Model	Geographical Coordinates (zone 43p)		Nearest House/Structure/ Religious Structure	Distance (in km.)	Direction	Land Type	Receptor ID considered
			Easting (m)	Northing (m)					
43	ASP-68	GE / GE-2.3	760705	1699716	Cluster of Houses near to Kottala Village	2.58	WSW	Private	REC-24
44	ASP-69	GE / GE-2.3	760529	1699171	Cluster of Houses near to Kottala Village	2.35	W	Private	REC-25
45	ASP-70	GE / GE-2.3	760371	1698780	Cluster of Houses near to Kottala Village	2.23	WNW	Private	REC-26
46	ASP-71	GE / GE-2.3	762453	1702975	Residential Area of Hosuru Village	1.68	SE	Private	REC-27
47	ASP-72	GE / GE-2.3	762368	1702547	Residential Area of Hosuru Village	1.52	ESE	Private	REC-28
48	ASP-73	GE / GE-2.3	762381	1702128	Residential Area of Hosuru Village	1.42	E	Private	REC-28
49	ASP-74	GE / GE-2.3	762375	1701603	Residential Area of Hosuru Village	1.5	E	Private	REC-29
50	ASP-76	GE / GE-2.3	764604	1700636	Residential Area of Hosuru Village	1.16	NNW	Private	REC-30
51	ASP-78	GE / GE-2.3	764632	1699870	Residential Area of Hosuru Village	1.49	ENE	Private	REC-31
52	ASP-79	GE / GE-2.3	764816	1699152	Residential Area of Hosuru Village	1.76	NE	Private	REC-32
53	ASP-80	GE / GE-2.3	764859	1698762	Residential Area of Hosuru Village	2.02	NE	Private	REC-33
54	ASP-81	GE / GE-2.3	767051	1701808	Residential Area of Putchakayalamada Village	1.3	SW	Private	REC-34
55	ASP-82	GE / GE-2.3	767427	1701435	Residential Area of Putchakayalamada Village	1.3	SW	Private	REC-34
56	ASP-83	GE / GE-2.3	767550	1701037	Residential Area of Putchakayalamada Village	1.2	WSW	Private	REC-34
57	ASP-84	GE / GE-2.3	767668	1700663	Residential Area of Putchakayalamada Village	1.24	W	Private	REC-35
58	ASP-85	GE / GE-2.3	767878	1700318	Residential Area of Ramachandrapuram Village	0.84	SSE	Private	REC-36
59	ASP-86	GE / GE-2.3	767882	1699869	Residential Area of Ramachandrapuram Village	0.48	ESE	Private	REC-37
60	ASP-106	GE / GE-2.3	758168	1700496	Cluster of Houses near to Kottala Village	1.16	W	Private	REC-38
61	ASP-107	GE / GE-2.3	760325	1698327	Cluster of Houses near to Kottala Village	2.3	WNW	Private	REC-39
62	ASP-108	GE / GE-2.3	760170	1697883	Cluster of Houses near to Kottala Village	2.39	NW	Private	REC-39
63	ASP-109	GE / GE-2.3	760030	1697431	Cluster of Houses near to Kottala Village	2.5	NW	Private	REC-39

S. No.	Location No.	WTG Model	Geographical Coordinates (zone 43p)		Nearest House/Structure/ Religious Structure	Distance (in km.)	Direction	Land Type	Receptor ID considered
			Easting (m)	Northing (m)					
64	ASP-110	GE / GE-2.3	759935	1696993	Cluster of Houses near to Burujula Village	2.49	ESE	Private	REC-40
65	ASP-111	GE / GE-2.3	759816	1696554	Cluster of Houses near to Burujula Village	2.58	E	Private	REC-40
66	ASP-112	GE / GE-2.3	764928	1698334	Cluster of Houses near to Burujula Village	2.72	WSW	Private	REC-41
67	ASP-122	GE / GE-2.3	765902	1708092	Settlement	0.33	N	Private	REC-42
68	ASP-123	GE / GE-2.3	766228	1707569	Settlement	0.34	N	Private	REC-43
69	ASP-124	GE / GE-2.3	766232	1707077	Settlement	0.88	NNW	Private	REC-44
70	ASP-125	GE / GE-2.3	757066	1699910	Settlement	1.36	NNW	Private	REC-44
71	ASP-126	GE / GE-2.3	756850	1699465	Cluster of Houses near to Kottala Village	0.68	SSE	Private	REC-45
72	ASP-127	GE / GE-2.3	756637	1698966	Cluster of Houses near to Kottala Village	0.58	E	Private	REC-45
73	ASP-128	GE / GE-2.3	759570	1696074	Cluster of Houses near to Burujula Village	2.83	E	Private	REC-46
74	ASP-129	GE / GE-2.3	759365	1695606	Cluster of Houses near to Burujula Village	3.13	ENE	Private	REC-46
75	ASP-01	Suzlon / S-111	758788	1713250	Residential Area of Devnabanda Village	0.3	N	Private	REC-47
76	ASP-03	Suzlon / S-111	759407	1712273	Residential Area of Attikalagundu Village	0.25	SSE	Private	REC-48
77	ASP-30	Suzlon / S-111	760434	1708636	Residential Area of Devnabanda Village	0.34	N	Private	REC-49
78	ASP-31	Suzlon / S-111	760468	1708229	Residential Area of Devnabanda Village	0.73	N	Private	REC-49
79	ASP-32	Suzlon / S-111	760543	1707786	Residential Area of Devnabanda Village	1.19	N	Private	REC-49
80	ASP-33	Suzlon / S-111	760551	1707413	Residential Area of Devnabanda Village	1.56	N	Private	REC-49
81	ASP-35	Suzlon / S-111	760805	1706672	Residential Area of Devnabanda Village	2.29	N	Private	REC-49
82	ASP-36	Suzlon / S-111	761089	1706251	Residential Area of Pedda Hulti Village	1.86	ESE	Private	REC-50
83	ASP-37	Suzlon / S-111	761397	1705875	Residential Area of Pedda Hulti Village	1.44	ESE	Private	REC-50
84	ASP-38	Suzlon / S-111	761504	1705420	Residential Area of Pedda Hulti Village	1.27	E	Private	REC-50
85	ASP-39	Suzlon / S-111	761624	1705031	Residential Area of Pedda Hulti Village	1.09	E	Private	REC-51
86	ASP-41	Suzlon / S-111	761979	1707240	Residential Area of Chinna Hulti Village	1.73	E	Private	REC-52

S. No.	Location No.	WTG Model	Geographical Coordinates (zone 43p)		Nearest House/Structure/ Religious Structure	Distance (in km.)	Direction	Land Type	Receptor ID considered
			Easting (m)	Northing (m)					
87	ASP-42	Suzlon / S-111	762982	1706402	Residential Area of Chinna Hulti Village	0.83	NE	Private	REC-53
88	ASP-43	Suzlon / S-111	763709	1705832	Residential Area of Pedda Hulti Village	0.9	WSW	Private	REC-54
89	ASP-87	Suzlon / S-111	762866	1707824	Residential Area of Chinna Hulti Village	0.93	SE	Private	REC-55
90	ASP-88	Suzlon / S-111	762699	1708556	Residential Area of Chinna Hulti Village	1.61	SSE	Private	REC-55
91	ASP-89	Suzlon / S-111	762535	1708968	Residential Area of Devanabanda Village	1.41	W	Private	REC-56
92	ASP-90	Suzlon / S-111	762295	1709304	Residential Area of Devanabanda Village	1.23	WSW	Private	REC-56
93	ASP-91	Suzlon / S-111	762194	1709790	Residential Area of Devanabanda Village	1.3	SW	Private	REC-56
94	ASP-92	Suzlon / S-111	762147	1710174	Residential Area of Devanabanda Village	1.57	SW	Private	REC-56
95	ASP-93	Suzlon / S-111	761678	1711329	Residential Area of Nalakadoddi Village	1.25	NW	Private	REC-57
96	ASP-94	Suzlon / S-111	761596	1711856	Residential Area of Nalakadoddi Village	0.91	WNW	Private	REC-57
97	ASP-95	Suzlon / S-111	761612	1712235	Residential Area of Nalakadoddi Village	0.8	W	Private	REC-58

3.2 LAND

The total area required for erection of turbines and associated facilities such as, pooling substation and switchyard is approximately 412 acres. All the Wind Turbine Generator (97 numbers) have been proposed on private land. Approximately 400-acre land will be required for WTG and 1 acre per tower land would be required for transmission line which would be 82 acres.

Type of Land

The Land identified for the proposed project site is primarily undulating and mix of single cropped agricultural and barren land, devoid of any physical / archeological infrastructure and do not involve any economical/residential displacement. The proposed land is one crop yielding that depends on rain water and there is no other source of irrigation. Handri Niwas Suzla Srawanti Patthakam canal is being proposed near the site but it does not prove much beneficial to the farmers as it is lack of water.

The detailed breakup of the private and revenue land required for each component of the project, along with the status and mode of acquisition is as provided in **Table 3.2** below:

Table 3:2: Details of Land Requirement

S. No.	Project Facility	Land Area Required (in acre)		Type of Land (Agricultural/barren etc.)	Mode of Acquisition	Status
		Private	Government			
1	Wind Turbine (97numbers)	400 acres (approx.)	NIL	Agriculture	Direct	Out of 400 acres 264.45 acres land has been purchased
2	Transmission Line (From MVTPL sub-station to govt. sub-station)	1 acre per tower (approx.) which would be 82 acres	NIL	Agriculture	By Vendor	Under Process
3	Sub-station	9.75 acres	NIL	Agriculture	Direct	Completed
4	Meteorological Towers Installation	2 acres	NIL	Agriculture	Direct	Completed
Total		**493.75 acres**				

Land Procurement Process

MVTPL has followed its own internal Land Procurement/Land Lease Procedure, used in general for its projects pan in India. Based on the details provided by MVTPL, the process of deciding project site depends on certain key criteria's but not limited to, such as:

a) Area for locating the wind project is generally based on the climatic conditions with preference given to wind study etc.
b) Uncultivated/fallow/barren lands so that the costs on land are viable;
c) Land/Plot identification and evaluation of road connectivity and nearest sub-station;
d) Assessment and evaluation of the land type and hydrogeology of selected plot.

The land procurement follows the following procedure:

- Selected plot details and ownership identification through review of government land title records;
- Evaluation of land related documents as per Indian applicable legislation;
- Direct negotiation with the identified land owner followed by agreement of sale;
- Formulation of Sale Deed and fixing of land price based on prevailing government rates and additional charges for land development to the full satisfaction of the landowner;
- Registration and change of ownerships.

Land Purchase Process

Approximately 494 acres of open single cropped agricultural and barren land has been estimated for 200 MW Wind Power project under willing seller and willing buyer basis and best of the market value in respect to circle rate, defined by government. However, the project proponent will allow the farmer for farming, grazing etc. on unused and vacant land. Based on discussions with village serpent, Village administrative officer and Land seller, it was recorded that the land sold to MVTPL by the land sellers was barren, un-cultivated and single cropped land due to non-availability of irrigation facilities.

Furthermore, this project does not involve any resettlement in terms of physical and economical aspects hence do not attract Resettlement plan as per applicable national/state legislation. The land price was decided after considering willing seller and willing buyer negotiation and best of the market value in respect to circle rate, defined by government. **Table 3.3** reflects government circle rate of the affected villages of the study area:

Table 3:3: Government Circle Rate of the Study Area

S. No.	Name of the village	Nature of Land	Govt. Land Rate INR per Acre	Effective Date (dd/mm/yyyy)
1.	ASPARI	Dry land	130,000	01/08/2015
2.	CHINNAHULTHI	Dry land	100,000	01/08/2015
3.	DEVANABANDA	Dry land	80,000	01/08/2015
4.	HOSUR	Dry land	120,000	01/08/2015
5.	MANDAGIRI	Dry land	90,000	01/08/2015
6.	JUTUR	Dry land	90,000	01/08/2015
7.	J. AGRAHARAM	Dry land	90,000	01/08/2015
8.	NALAKADODDI	Dry land	80,000	01/08/2015
9.	ATIKALAGUNDU	Dry land	80,000	01/08/2015
10.	PATTIKONDA	Dry land	200,000	01/08/2015
11.	PEDDA HULTHI	Dry land	100,000	01/08/2015
12.	PUTCHAKAYALAMADA	Dry land	100,000	01/08/2015

Source: http://registration.ap.gov.in/UnitRateMV.do?method=getDistrictList&uType=U

During consultation it was noted by the consultant that the land owner sold their land as per their own choice and got better compensation than the market and circle rate. As informed by local community and client that no SC and ST land involved in land procurement process and none of the

land seller has become marginal. The **Annexure VII** (sample document of purchased land deal) shared by MVTPL and **Table 3.3** above (govt. circle rate of the study area) reflects the bargaining between seller and buyer is fair.

3.3 PROJECT OVERVIEW

The project details and overview of the proposed wind power project is detailed in the following sub sections. All technical details, designs and dimensions mentioned are based on information currently available from MVTPL and site inspection. There is a potential for some alteration during the execution stage. Those changes are not expected to alter the impacts assessed in this report.

A typical wind power project comprises of the following components:

- Wind turbines mounted on towers,
- An electrical collection system, and
- Transmission /interconnection facilities.

Besides these the associated facilities may include access roads, operation and maintenance facilities, and Meteorological tower.

3.4 WIND TURBINE

A wind turbine consists of five mechanical components: tower, nacelle, generator, rotor, down tower and assembly. These are described in the following subsections:

3.5 ROTOR

The rotor generally consists of three fiber glass blades that extend out from the hub. In most cases the rotor is mounted to a driveshaft within the nacelle (as defined below) to operate upwind of the tower. In some cases, the rotor is located behind the tower and nacelle. The rotor attaches to the drive train emerging from the front of the nacelle. Hydraulic motors within the rotor hub feather each blade according to the wind conditions, which enables the turbine to operate efficiently at varying speeds.

3.6 NACELLE

The nacelle is a large housing that sits on top of the tower behind the rotor. It houses the main mechanical components of the wind turbine: drive train, yaw system and its accessories, etc. The nacelle is generally externally equipped with anemometer and a wind wane that signals wind speed and direction information to an electronic controller. The nacelle is mounted over yaw gear, which constantly positions the rotor upward of the tower. The selected turbine type i.e. Suzlon 2.1 MW-S-111, GE-1.7 MW-103, and GE-2.3MW-116.

3.7 TOWER

The tower supports the nacelle and rotor. Towers are generally made of steel and can either tubular or lattice. Tubular will have an access door and an internal safety ladder and/or elevator to access the nacelle.

3.8 TECHNICAL DETAILS

The proposed Wind Farm Project being set up for 200 MW consists of 96 turbines of Suzlon and GE make with G-1.7 MW-103 (30 numbers of WTGs), S-111 of 2.1 MW (25 numbers of WTGs) and G-2.3

MW-116 (28 numbers of WTGs) rated capacity. It will have a rotor diameter of 103m, 111.8m and 116m and a hub height of 80m, 90m and 94m respectively. The tower will be tubular. The key technical details of the wind turbine are as provided in **Table 3.4.**

Table 3:4: Technical Details of the Proposed Turbine and Related Components

S. No.	Particulars	Details		
GENERAL				
1.	Wind Turbine Class	GE/ GE-1.7 MW	GE/ GE-2.3 MW	Suzlon/ S-111-2.1 MW
2.	Hub Height	80 m	94 m	90 m
3.	Type	DFIG Horizontal Axis Wind Turbine with variable Rotor Speed	DFIG Horizontal Axis Wind Turbine with variable Rotor Speed	DFIG Horizontal Axis Wind Turbine with variable Rotor Speed
4.	Power Regulation	Independent electromechanical pitch system for each blade	Independent electromechanical pitch system for each blade	Independent electromechanical pitch system for each blade
5.	Rated Power	1700 kW	2300 Kw	2100 kW
6.	Rotational Speed	Variable, 10 - 17.14 rpm		Variable, 9.4 – 13.0 rpm
7.	Design Life Time	20 years	20 years	20 years
WIND CONDITIONS				
8.	Air Density	1.225 kg/m³	1.225 kg/m³	1.225 kg/m³
9.	Annual Average Wind Speed	7.5m/s	7.5m/s	7.5m/s
10.	Wind shear	0.2	0.2	0.2
11.	Cut-in wind speed	3m/s	3.5m/s	3m/s
12.	Cut-out wind speed	20m/s	22m/s	21m/s
13.	Re cut-in wind speed	17m/s	19m/s	19m/s
14.	Rated wind speed	9.45m/s	11.5m/s	11.5m/s
15.	Survival wind speed	52.5m/s	52.5m/s	52.5m/s
16.	Maximum in-flow angle	8deq	8deq	8deq
ROTOR				
17.	Diameter	103 m	116 m	111.8 m
18.	No. of Blades	3	3	3
19.	Swept Area	8332 m2.	10,568 m2	
20.	Orientation	Upwind	Upwind	Upwind
21.	Direction of Rotation	Clockwise	Clockwise	Clockwise
22.	Cone Angle	3°		3.5°

S. No.	Particulars	Details		
BLADE				
23.	Type	3 rotor blades	3 rotor blades	SB54
24.	Material	Fiber E Glass Resin Epoxy resin Sandwich core PVC foam and Balsa wood		Glass- reinforced Epoxy, vacuum-infused
25.	Profile			Risø C2
26.	Length	50.2m	56.7	54.6 m
HUB				
27.	Hub Type	Spherical hub (with pitch bracket)		Cast spherical hub
28.	Material	Nodular cast iron: EN GJS 400 18U LT (EN 1563)		
PITCH SYSTEM				
29.	Type	Double row four point contact ball bearing	Double row four point contact ball bearing	Electric asynchronous motor, 3-stage planetary gearbox
30.	Lubrication blade bearing	Grease lubrication	Grease lubrication	Centralized automatic lubrication system (CALS)
31.	Drive	Three stage planetary gear with DC motor		
32.	Backup power	UPS	UPS	Planetary gear with AC motors UPS
BREAKING SYSTEM				
33.	Primary Brake System	Individual blade pitch (battery backup)		Hydraulic disc brake, activated by hydraulic pressure (active brake)
GENERATOR				
34.	Type	Doubly fed asynchronous generator	doubly-fed induction type	DFIG asynchronous generator
35.	Cooling			IC616 as per IEC 60034 part 6
36.	Excitation			
37.	Rated Power	1745 kW		2.17 MW
38.	No. of poles	4		6
39.	Winding	Y/Y		
40.	Rated Voltage	690 V	690 V	
41.	Frequency	50 Hz	50 Hz	50 Hz
42.	No. of phases	3	3	
43.	Insulation Class	F-Class		Class H (stator and rotor)
44.	Protection Class			IP 54 (slip ring IP 23)
MAIN SHAFT AND BEARING				
45.	Main Shaft Type	Low alloy forged steel		Forged shaft and flange

S. No.	Particulars	Details		
46.	Material	34 CrNiMo6		
47.	Bearing Type	Double row spherical roller bearing		Spherical roller bearing
48.	Location			
49.	Lubrication			Centralized automatic lubrication system (CALS)
NACELLE				
50.	Material	GFRP	GFRP	GFRP
51.	Maintenance Hoist	Available	Available	Available
52.	Wind Measuring Devices	Two Anemometers one wind vane	Two Anemometers one wind vane	Two Anemometers one wind vane
TOWER				
53.	Type	Tubular type 4 section	Tubular 4 section	4 section tubular steel tower
54.	Material	Structural steel, S355	Structural steel, S355	Welded steel plate according to EN 10025
55.	Height	79.7 m	93.3	89.12 m
56.	Assembly	Bott-nut	Bott-nut	Bott-nut
57.	No. of Platforms and Type	5 (including down tower platform)	5 (including down tower platform)	5 (including down tower platform)
FOUNDATION				
58.	Type	Site Specific	Site Specific	Site Specific

3.9 POWER EVACUATION SYSTEM

The nearest sub-station at Nansuralla is approximately 23 km from the project site. The width of ROW proposed under the new project for evacuation of electricity is approximately 27 m for the 220 kV transmission line which has been proposed across the barren lands and private agriculture lands.

In the proposed project, the generated electricity will be evacuated through a transmission line to the substation at Nansuralla village. Transmission line of 220 kV D/C capacity will be developed by contractor appointed by MEIPL/MVTPL. The approach route identified for the transmission line is based on criteria to reduce the environmental and socioeconomic footprint of the transmission line. The shortest feasible route after considering following factors has been selected for the transmission line:

- Transmission line route does not fall under any habitations and thick vegetation;
- No households or community structures are located in the route of the transmission line;
- All environmentally sensitive sites, archaeologically significant sites, areas of ecological and cultural significance have been avoided while selecting the route;
- Right of way/access roads are shared with local residents of the area wherever possible;

The route map of the transmission line connecting the project site to the 220 kV substation at Nansuralla is shown in **Figure 3.2 below**.

Power generated from wind generators are stepped up to 33 KV level by unit transformers and the same will be evacuated from the WTG to Mytrah 220/33 KV sub-station through 33 kV transmission line and from Mytrah SS to Nansuralla SS by 220 KV line. All these works are awarded to third party contractors. The power will be transmitted through 220 KV level and stepped down to 11KV for further loads connected to Nansuralla substation. APTRANSCO has allocated 2 Nos of bays area of 45 x 50m within the substation to Mytrah for connection to the bus.

A total of 82 nos. transmission towers of (A+B+C+D) type with a maximum height of 32 m (A type) will be set up to facilitate power transmission. The area occupied for tower foundation is 3.6 x 3.6m. This Right-of-way will be acquired through third party appointed by MEIPL. However, during route selection necessary considerations should be made by the contractor to avoid any major human settlements, eco-sensitive areas, water body crossings, agricultural land to the extent feasible.

Compensation for RoW of transmission line will be paid as per guidelines of Ministry of Power for payment of compensation towards damages in regard to Riqht of Way for transmission lines dated October 15, 2015. Details of guideline of Ministry of Power has been enclosed as Annexure XV. After completion of land procurement process, MEIL/MVTPL will summarise it in table showing Plot Number/Survey Number, Circle rate, Rate paid with evidence that MEIL/MVTPL paid at or above market rate.

After getting sanction from APTRANSCO, MVTPL shall construct evacuation system as per approved scheme of AP TRANSCO. The system shall be so designed to suit the specification followed by AP Transco and Electrical Inspectorate norms. All equipment will be suitable for operations in the environmental conditions prevailing at the site.

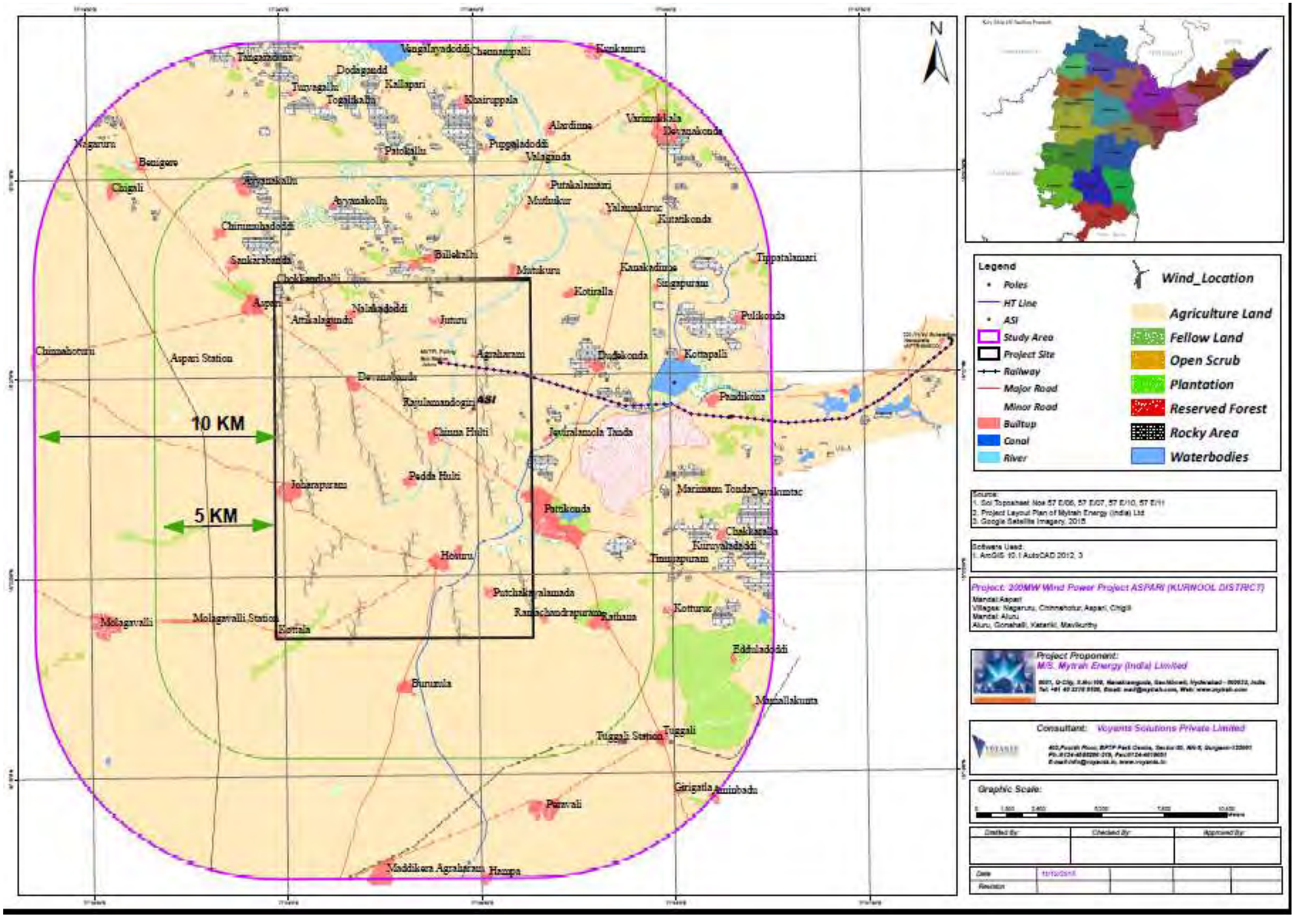

Figure 3:2: Transmission Line Route Map

3.10 CONSTRUCTION ACTIVITIES

3.10.1 Access Road

Establishment of access to site will be one of the preliminary activities that will be undertaken as part of construction process. Two existing village approach roads, with length of 2.5 km and 3.1 km each will be improved by MVTPL, have been proposed for accessing the wind turbine locations. Besides the approach roads there will be internal roads for access to each turbine location and associated facilities within the wind farm area. The roads will be planned with a width of 6m to 9m along the normal course and of 25m to 40m along the curves to enable movement of large wind turbine components particularly the blade vehicles. Existing village road will be used for access road which will be improved accordingly.

3.10.2 Site Development

The erection of wind turbines will require development of site which will involve soil investigation, site survey, site levelling, construction of internal roads etc. The proposed site is an undulating terrain on an elevated plateau; it may not require extensive levelling of the entire area but each turbine location will require clearing and grading of a diameter of 50 to 80m around the tower site. There will be removal of ground vegetation but removal of larges shrubs and trees will be however limited and avoided wherever possible.

3.10.3 Civil Work

The supply and erection and commissioning contracts will be signed between Suzlon, GE (the supplier of equipment) and MVTPL. MVTPL will also sign contracts with different suppliers and contractors for rest of the scope of supplies/works, which is not included in the scope of Suzlon and GE.

The project work would involve the following activities:

- Installation of temporary and/or permanent meteorological towers.
- Installation of wind turbine and associated facilities.
- Construction of underground and/or overhead electrical collection lines to connect turbines to the pooling substation.

The major civil work involves wind turbine foundations, erection, switch yard structure and equipment foundations including power transformer and control room cum administration building. Minor works involve security kiosks, collection substation, fencing, roads and drainage.

The wind turbine towers proposed to be of about 80 to 94 meters' height would require substantial foundations which would extend to a depth of about 2.5 to 3m. The depth of foundation will be dependent on soil and surface conditions. The foundation structure will be non-floating type which is essentially a gravity foundation that relies upon soil overburden and concrete to provide sufficient weight to resist overturning of the foundation at extreme wind loads.

The towers will be initially segmented (about 18-23m at the time of arrival at site and will require bolting works to put the tower together during installation. The erection of tower would require cranes and preparation of platforms for installing cranes. Crane platform will require an area of 0.4 to 0.5 ha which will be prepared soil, rock and gravel to support the weight of the equipment. The

crane will undertake the lifting activities to erect the turbines; the nacelle will be installed at top of the tower first followed by installation generator, rotor with blades.

Construction of related structures will involve civil and steel work for installation of pooling stations, transformers, substation, and electric cables and signal wires.

3.10.4 Labour

During construction phase, the labour requirement will approximately 75 numbers during normal construction and 175 numbers workers for peak construction activities. Mainly GE and Suzlon will engage both local and migrant workforce including engineer, store-keeper, manager, welders, fitters, drivers, helpers, operators for a variety of skilled, semi-skilled and unskilled workers. Unskilled workers will be engaged at the local level while skilled labour will be brought from outside. The accommodation arrangement is primarily in the surrounding locality by GE and Suzlon taking room on rent along with bath and toilet facilities. Bottled water will be facilitated by the GE/Suzlon for drinking purposes. Kitchen facility with safety and hygiene is ensured. Medical facility support is ensured by GE and Suzlon as and when required from nearest PHC in Aspari and Pattikonda. Both GE and Suzlon are reputed International Company and follow and respect the code and conduct of the country as well as MVTPL's ESMS. **Table 3.5** below gives the estimated labour requirement during various stages of construction phase.

Table 3:5: Estimated Labour Requirement during Construction Phase

S. No	Activities	Normal Period	Peak Period
1.	Foundation and Civil Works	30	75
2.	Transportation of turbine components (drivers of construction vehicles and project vehicles)	30	75
3.	Stock yard (security and staff)	10	10
4.	Site Office	5	15
Total		75	175

3.10.5 Water Requirement

The water demand during the construction works will be about 200 m^3/turbine and will be sourced through water tanker (hired locally and water supply through local private wells / bore wells) by GE/Suzlon directly. Measures for disposal of sewage generation during construction phase of the project will be provided such as installation of adequate number of Portable toilets/ temporary toilets which shall be cleaned at regular intervals.

3.10.6 Construction Waste

Construction waste will be limited to packaging and crafting material of turbines and construction debris. Earthmoving activities and construction of wind energy facilities will require use of heavy machinery /equipment which would generate waste oil and other similar substances, these substances and shall be dealt with as per the Standard goods practices, stipulated by statuary Authority and Movement Rules 2008 and its amendments. As per the rules the hazardous waste generated shall be supplied to an authorized vendor.

3.10.7 Wastewater Generation

Since no labour camp sites will be set up during the construction phase of the project, waste water generation from the construction activities will be limited to washing and cleaning activities related to construction activities. Portable toilet with septic tank soak pits will be provided at construction site to facilitate the disposal of sewage generated.

3.10.8 Construction Schedule

The proposed project will be implemented in two phases of 100 MW and 100 MW as per **Annexure X**. The construction activities of Phase I, will require a period of 10-12 months for erection, installation and commission works. The next phase of 100 MW will be completed from 6 months thereafter. The peak construction period will be for about 6-8 months. **Table 3.6** below provides the implementation schedule for the project:

Table 3:6: Estimated Construction Schedule

S. No.	Activities	Expected Date of Commencement	Expected Date of Completion
1.	Procurement of Land (including private and revenue land)	October 2014	February 2015
2.	Site Development	January 2016	February 16
3.	Construction of internal access roads	January 2016	March 2016
4.	Civil Works	January 2016	April 2016
5.	Erection of turbine components	April 2016	June 2016
6.	Commissioning of turbines	June 2016	August 2016
7.	Laying of transmission lines	February 2016	June 2016
8.	Installation of switchyard/administration building	January 2016	June 2016
9.	Installation of pooling substation	January 2016	June 2016
10.	Community development activities	After Completion of the project	

3.11 PROJECT OPERATION ACTIVITIES

Wind projects require a dedicated Operation and Maintenance (O&M) facility for storing equipment and supplies required during operation. An O&M agreement have been signed with Suzlon and GE which entrusts them with responsibility of maintenance and repairs. Suzlon & GE are ISO14001 and OSHA 18001 certified and will accordingly establish EHS requirement. Mytrah is in process for introducing and implementation ESMS at corporate, strategic and policy level as well as in SPV level for implementation the same at assets level. Aspari project will also be triggered in same direction at same directives.

The site shall undertake 24 hours on site monitoring under the supervision of technically skilled and experienced staff to look after the O&M requirements of the entire Wind Farm. There shall be a workshop facility available at site to take care of regular maintenance requirement of the Wind Turbines. A tool room with sufficient stock of tools and spares as well as critical components will be maintained at the site.

There will be a remote O&M facility involving the supervisory control and data acquisition (SCADA) system. This system provides two-way communication with each wind turbine. A SCADA system allows a central computer system to monitor and control each turbine operation.

The typical maintenance and repair activity during operation phase involves preventive and breakdown maintenance of Wind turbines and/or the related equipment in accordance with the safety management plans and procedures as applicable and/or in accordance with accepted industry practices.

3.11.1 Preventive Maintenance

Preventive Maintenance involves labour as well as use of materials and consumables such as lubricants and oils, minor/low value electrical and mechanical parts etc., for preventive maintenance and upkeep of the equipment including (but not limited to):

- Transformer Yard Electrical Maintenance;
- High Tension Line Maintenance;
- Greasing of Main Bearings, Yaw Bearing, Blade Bearings and Rotor Bearing;
- Topping up of hydraulic and topping up of Transformer Oil;
- Painting of equipment;
- Test of oil samples once in 6 months;
- Brake pads for Main Brakes and Yaw Brakes;
- Oil Filters;
- Dry Filters;
- Batteries;
- Carbon Brushes;
- Coolant;
- Cleaning Detergents and solvents;
- Pitch Capacitors;
- All Electrical Panels, etc.;
- Maintenance of Wind Vane and anemometer installed on the Wind Turbine; and
- Checking the high tension switch gears and associated protections.

3.11.2 Breakdown Maintenance

The breakdown repair work involves labour and use of sub-assemblies/equipment, components, spares and consumables in the event of any breakdown or suspected breakdown due to any reasons. Major breakdown maintenance anticipated for wind farms include (but not limited to):

- Repairs/replacement of Generator and Motors;
- Repairs/Replacement of Nacelle, Rotor Unit, Hub;
- Rewinding/Repairs of Transformers;
- Repairs/replacement of transformer Yard Equipment's;
- Repairs/replacement of Blades;
- Repairs/replacement of Frequency Converter Panels and Control Panels;
- Repairs/replacement of Tower Components and Electricals;
- Replacement of oil in Transformers;
- Servicing of Anemometer, Wind vanes, wind sensors and other sensors, Limit switches, etc.

3.11.3 Other Activities

Routine Operational Services

Routine activities during operation phase include cleaning and upkeep of the equipment such as:

- Tower Torqueing;
- Blade Cleaning;
- Nacelle and Tower head torqueing and cleaning;
- Transformer Oil Filtration;
- Frequency Converter Panel and Low Tension Panel Maintenance;
- Site and Transformer Yard Maintenance;
- Checking oil levels in transformers.

Security

Adequate security arrangements will be required to watch and ward the Wind Farm and the Equipment. About 10-15 security staff will be available at site to undertake watch and ward activities. The security staff will be locally hired.

Monitoring and Reporting

The following records will be maintained during operational phase:

- Data logging records for power generation, Wind Speeds, grid availability, machine availability, Machine breakdown, etc. shall be prepared;
- Daily and Monthly performance reports will be made on daily basis;
- Monthly meter reading for State Electricity Board; and
- Visual observation record of wind farm and its components.

Staff

The operation and maintenance of wind turbines will be outsourced to the O&M Contractors. The site will have 40-50 personnel at site including maintenance, monitoring and security staff during the operation phase. Most of the staff will be residing in rented accommodation in the nearest town at Adoni. **Table 3.7** below gives the break-up of the staff requirement during O&M phase:

Table 3:7: Estimated Staff Requirement

S. No.	Phase	Number of staff	Peak Period
1.	Construction phase	75	175
2.	Operation phase	75	

3.12 CLIMATE CHANGE IMPACT ASSESSMENT

The comparison of the climate changes caused by wind turbines with the climate changes that would have been caused by fossil fuel burned to make the same amount of electricity. Thus the purpose of the project activity is to generate power from zero emissions wind based power project and thereby reduce the emissions associated with the grid. The project activity will export the Electricity to southern grid. The electricity generated by the WTGs will be monitored through energy meters connected to a set of WTGs at the project site. The calculation of the total GHG emission reduction as 421 tCo2e/year. This section considers the potential effects of environmental (climatic) conditions

on the Project. The respective climate events and conditions are discussed below and the potential effects are discussed, along with a brief assessment of the potential impact and measures to minimize or mitigate the risk. The environmental conditions within the Kurnool area addressed within this section include a summary of extreme weather, including high and low temperatures, rain and snow falls, snow and ice, winds, lightning, fog and clouds, and fire. At the end, the beneficial effects of the Project in addressing climate change are briefly summarized. The Project is engineered and designed to integrate into its environmental surroundings and operate safely and reliably over the lifetime of the Project.

It is important to note that the potential effects of other natural events, such as earthquakes and floods, are expected to be insignificant. The tower foundations will be designed to the current standards related to potential earthquakes, and the risk is expected to be minimal based on the competent ground conditions and the modest potential for earthquakes in the south Indian Region. As the Project is located away from the sea shore, it will not be affected by potential flooding.

A lighting strike at a single WTG will not necessarily effect other WTG's, as each has its own protection due to the independent nature of the wind farm generation.

3.12.1 Futuristic Climate Change Effect

Climate change is predicted to impact India's natural resource base, including water resources, forestry and agriculture, through changes in precipitation, temperatures, monsoon timings, and extreme events. Gosain et al. (2006) studied the climate change effects on Indian River basins and concluded that the flows may be reduced in Krishna River with catchments from both Andhra Pradesh and Telangana causing droughts. Chowdhury et al. (2013) has made sensitivity analysis of crop growing seasons and found that the shift of wheat growing season might conserve significant amount of groundwater.

The Indian Institute of Tropical Meteorology (IITM) in collaboration with the Hadley Centre for Climate Prediction and Research, UK carried out an analysis of climate change scenarios for India.

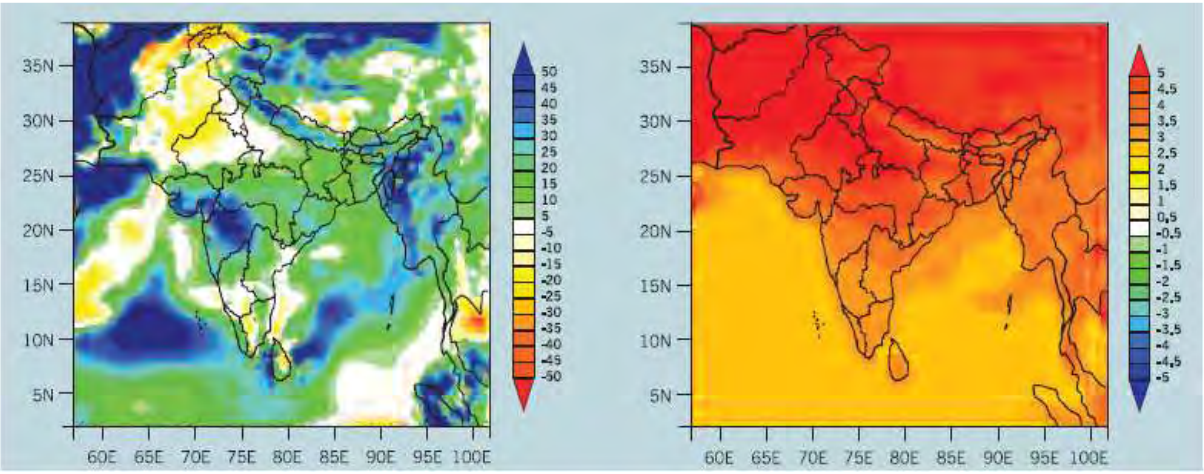

Figure 3:3: *Spatial patterns of the changes in (a) summer monsoon rainfall (%) and (b) annual mean* surface air temperature (ºC) for the period 2071-2100 with reference to the baseline of 1961-1990, under the A2 scenario

Precipitation: IPCC AR5 report indicated the decrease in rainfall in southern part of the country with extreme events of drought, and its frequency, decrease in rainy days which are primarily concerns of

rain-fed agriculture. The two states of Andhra Pradesh and Telangana have maximum area (67%) under rain-fed agriculture with major crops of maize, cotton, groundnut and pigeon pea grown in the 16 districts of two states. There are substantial spatial differences in the projected rain fall changes. The maximum expected increases in rainfall (10 to 30%) occur over central India.

There is no clear evidence of any substantial change in the year-to-year variability of rainfall over the next century.

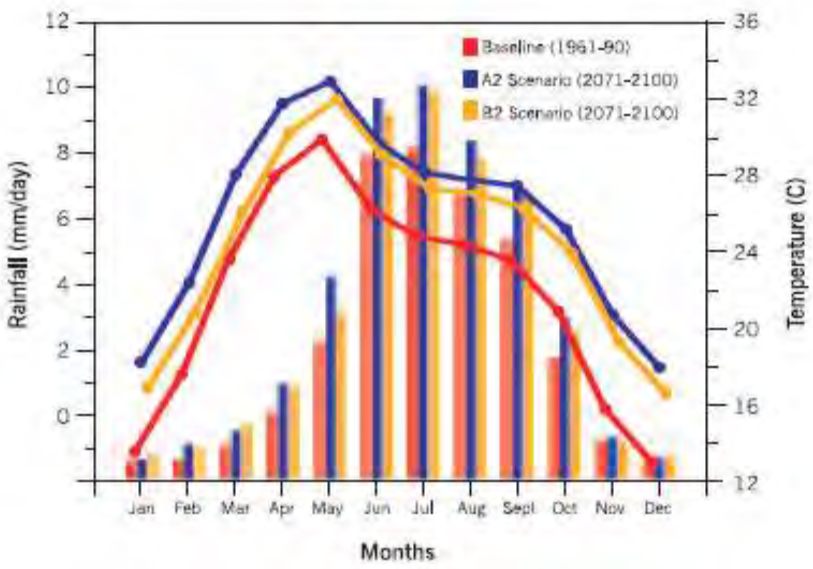

Figure 3:4: *Mean Annual cycles of all- India Rainfall and temperature Baseline and Simulated*

Temperature: The temperatures are projected to increase by as much as 3 to 4°C towards the end of the 21st century. The warming is widespread over the country, and relatively more pronounced over northern parts of India.

3.12.2 Wind Pattern over Indian Sub- continent

The Indian Ocean south of the equator is comparatively cooler and so temperature and pressure gradients are formed from south to north. The pressure gradient leads to a cross-equatorial flow, which, when combined with the Earth's rotation, yields the familiar C-shape of boreal summer monsoon winds in the lower troposphere as seen in **Figure 3.4**.

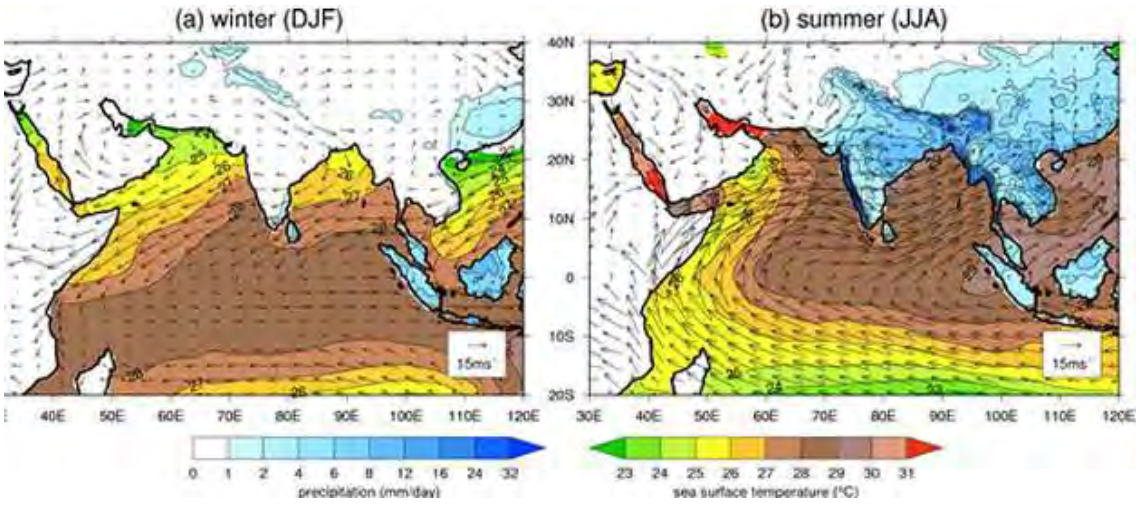

Figure 3:5: *Schematic diagram of boreal winter (December-February; left) and summer (June-August; right) daily mean winds at 850hPa taken from the ERA-40 Reanalysis (Uppala et al., 2005) in m s-1. All data shown are from the 1958-2001 period.*

These winds carry moisture evaporated from the warm Indian Ocean to converge over the mountains on the west coast of India, before continuing to the Bay of Bengal. There they turn north and towards the west, around the low pressure "monsoon trough" of northern India, where more rain falls. The distinct difference between winter and summer wind and precipitation patterns is what characterises the monsoon over this region.

3.12.3 How will the Indian monsoon change in the future?

Simulations of future climate generally suggest an increase in monsoon rainfall on a seasonal mean, area-average basis. This is due to the twin drivers of an increasing land-sea thermal contrast, but more importantly, warming over the Indian Ocean which allows more moisture to be carried to India. Typically increases in total rainfall over India may be in the region of 5-10%, although some climate models suggest more and some less. Climate simulations also show different patterns of rainfall change, so it is difficult to predict how rainfall might change within India.

A 5-10% change in total rainfall sounds small – does it really matter to life in India? The Indian monsoon is remarkably stable as a whole, with a mean total of around 850mm in the months of June to September, and an inter-annual (year-to-year) variation of only around 10% in most cases. Even these relatively small variations in the Indian monsoon can influence things like agricultural production and the stocks and commodities market, so a 5-10% change on top could have significant impacts.

3.12.4 Extreme Winds

In addition to the potential for effects from extreme winds resulting in wind throw damage on the Project (especially electrical) infrastructure, extreme winds also have the potential to break or damage blades by placing severe stress on the structures. For equipment safety reasons, if winds generally reach speeds between approximately 80 to 100 km/hr, the WTGs, equipped with sensors, will be shut down. When wind speeds return to a normal operating range, the WTGs will automatically resume normal operation. In windy conditions, fugitive dust may also present a potential problem for the workers and the Project infrastructure. Based on the design of current WTGs, the occurrence of extreme winds is expected to have minimal impact on the project infrastructure, and thus minimal effect on the ability of the Project to generate electricity.

3.12.5 Fog and Low Clouds

There was no evidence on the extent of fog, or low-lying cloud within study area. To ensure appropriate visibility, the turbines and meteorological towers will adhere to the respective lighting requirements / regulations, as required for aircraft visibility and navigation.

Fog and low clouds are not expected to have a direct impact or effect on the Project, and thus minimal effect on the ability of the Project to generate electricity.

3.12.6 Frequency of Extreme Events

In India, around 68% of the country is prone to drought in varying degrees and 35% of which receives rainfall between 750 mm and 1125 mm is considered drought prone while 33% receiving

less than 750 mm is chronically drought prone (MoWR, 2014). Climate change will cause increased frequency of extreme events such as floods and droughts. India will lose more than 20% of their crop net revenue due to temperature rise of 1.5°C.

YEAR	EVENT
Heat Waves in May 2015	The death toll in the sizzling heat wave sweeping many parts of the country on 30/05/2015 rose to 2207, with 202 more deaths being reported since Friday from Andhra Pradesh, Telangana and Odisha. The overall toll in various parts of the country till Friday stood at 2005.The heat wave was witnessed in many parts of the country, but Nagpur in Maharashtra recorded the highest temperature of 47.1 degrees Celsius. Andhra Pradesh reported 146 more deaths on Saturday, raising the toll 1636 since Friday. Prakasam district has recorded the maximum number of 333 deaths, followed by Guntur district (233) and followed by East Godavari (192), Visakhapatnam (185), Vizianagaram (177), Nellore (163), Krishna (78), Chittoor (64), Srikakulam (60), Anantapur (56), Kadapa (38), Kurnool (34) and West Godavari (23). According to the MeT department, heat wave conditions prevailed on Saturday over some parts in the districts of Guntur and Kurnool of Rayalaseema
26-28 August, 2000	131 persons died. Hyderabad flooded. Many areas under 3 metre of water. Paddy, chilly crop worth hundreds of crores damaged.
July to August 1st week 1988	109 people died. Paddy crop in 3 lakh hectares 1st week 1988 completely damaged.
13-15 July 1965	Severe flooding over Nizamabad district in Andhra Pradesh

3.12.7 Drought Prone District in Andhra Pradesh

DISTRICT	MINOR	MODERATE	SEVERE	EXTREME	ANY
ANANTPUR	6.1	7.8	41.7	-	3.2
PRAKASAM	6.8	8.9	29.4	-	3.4
RANGAREDDY	7.5	7.7	35.7	500	3.4
NALGONDA	7.4	6.8	41.7	-	3.3
CHITTOOR	6.5	9.6	38.5	500	3.5
CUDDAPAH	6.3	9.1	35.7	250	3.3
KURNOOL	6.8	7.9	38.5	500	3.3
MAHABUBNAGAR	6.8	7.5	41.7	500	3.3
8 DISTRICT	6.8	8.2	38.5	-	3.3

Source: *Extreme Weather Events over India in the last 100 years by U.S. De, R.K.Dube and G.S.Prakasa Rao*

3.12.8 GHG emission reduction

We have compared the climate changes caused by wind turbines with the climate changes that would have been caused by fossil fuel burned to make the same amount of electricity. Thus the purpose of the project activity is to generate power from zero emissions wind based power project and thereby reduce the emissions associated with the grid. The project activity will export the Electricity to southern grid. The electricity generated by the WTGs will be monitored through energy meters connected to a set of WTGs at the project site. We have calculated the total GHG emission reduction as 421 tCo2e/year. The technology of electricity generation from wind power is

environment friendly as it does not use any fossil fuel. It thereby reduces the greenhouse gas emissions associated with fossil fuel based electricity generation system.

The availability and reliability of wind power depend largely on current and future climate conditions, which may vary in the context of climate change. Climate change also presents risks and threats to wind energy in terms of wind resources as follows:

S. No	Possible Impact on WTG Due to Climate Change	Mitigation Measures
1.	A higher sea level may make foundations in coastal areas more prone to flooding, and more salinity can increase corrosion damage	Since Our project site is away from the Coastal area and as per the technical document provided by GE and Suzlon there will not be any impact of higher sea level on the WTG at project site.
2.	Component materials fare differently in different temperatures. Rubber seals can become more brittle in the cold, and different lubricants are needed if temperatures rise.	Since temperature variation over the site is between 18 to 43^{0}C so there are not possibility of temperature effect on WTG in next 25 years which is also supported by the technical specification provided by the Suzlon/GE, with the latest technology that WTG can be workable in the extreme temperature condition.
3.	Changes in the wind resource distribution	Wind turbines take energy from the atmosphere and turn it into electricity: so we know they must have some impact on the atmosphere's flow. As per the latest technology, Turbine efficiency will result in turbines that can produce more power with less wind. A research paper published in 2010 by atmospheric scientist Diandong Ren, then of the University of Texas in Austin, compared various climate projections and found that, on average, higher temperatures would reduce wind power density at turbine hub height in China by about 14% by 2100, equivalent to a 5% reduction in wind speed. However, that is not enough of a reduction to affect long-range wind development planning at project site. So there will not be any impact of changes in the wind resource distribution at project site.
4.	Capability of the facility against the extreme weather event like flooding	Most WTGs are designed to withstand occasional extreme wind and temperatures and any long term changes to wind patterns and temperature averages, potentially resulting from climate change, are not expected to adversely affect the Project.

3.12.9 CONCLUSION

The Intergovernmental Panel on Climate Change (IPCC) Assessment Report (http://www.ipcc.ch/) concluded that climate changes are already occurring at a measurable scale and include warmer temperatures, increases in sea levels (from melting of snow and ice), and an increased frequency of extreme weather events. Most WTGs are designed to withstand occasional extreme wind and temperatures and any long term changes to wind patterns and temperature averages, potentially resulting from climate change, are not expected to adversely affect the Project.

4 DESCRIPTION OF THE ENVIRONMENTAL AND SOCIAL BASELINE

The following section describes the relevant physical, biological and socio-economic conditions within the study area of 10 km radius around the site. The baseline data is generated through primary baseline monitoring, social survey, reconnaissance survey and available secondary information about the site and surroundings.

The consultant undertook a reconnaissance survey of the proposed site (at Aspari) and surroundings in order to understand the environmental and social setting of the proposed wind farm project. The reconnaissance survey was followed by primary baseline data generation for environment and social aspects of the study area. The photo-documentation of the study is presented as **Annexure V.**

4.1 PHYSICAL ENVIRONMENT

Site Settings

The project site area falls in villages of Aspari, Nalkadoddi, Juturu, Agaraharan, Devanabanda, Joharapuram, Chinnahulti, Peddahulti, Pattikonda, Hosuru and Puchakayalamada located in Kurnool District, Andhra Pradesh. The site is spread across a distance of approximately 15 km from North to South and also spread across a distance of approximately 10 km from West to East. The site is located on average elevation of 480 meters above MSL. Details of proposed project location have been described in section **3.1** of **Chapter 3**.

There is no forest land in the project site. However, Pattikonda Reserve Forest and Tuggali Reserve Forest is identified within 10km radius arial of the project site in East and North East direction. These reserved forests show scrub vegetation. The project area is undulating terrain with elevated patches of land with few scattered cultivated patches. Vegetation at the site and its surrounding areas are open/barren land with scattered single cropped agricultural area. **Figure 4.1** below shows the project influence area and its boundary with 5km and 10km distance from the project influence area boundary.

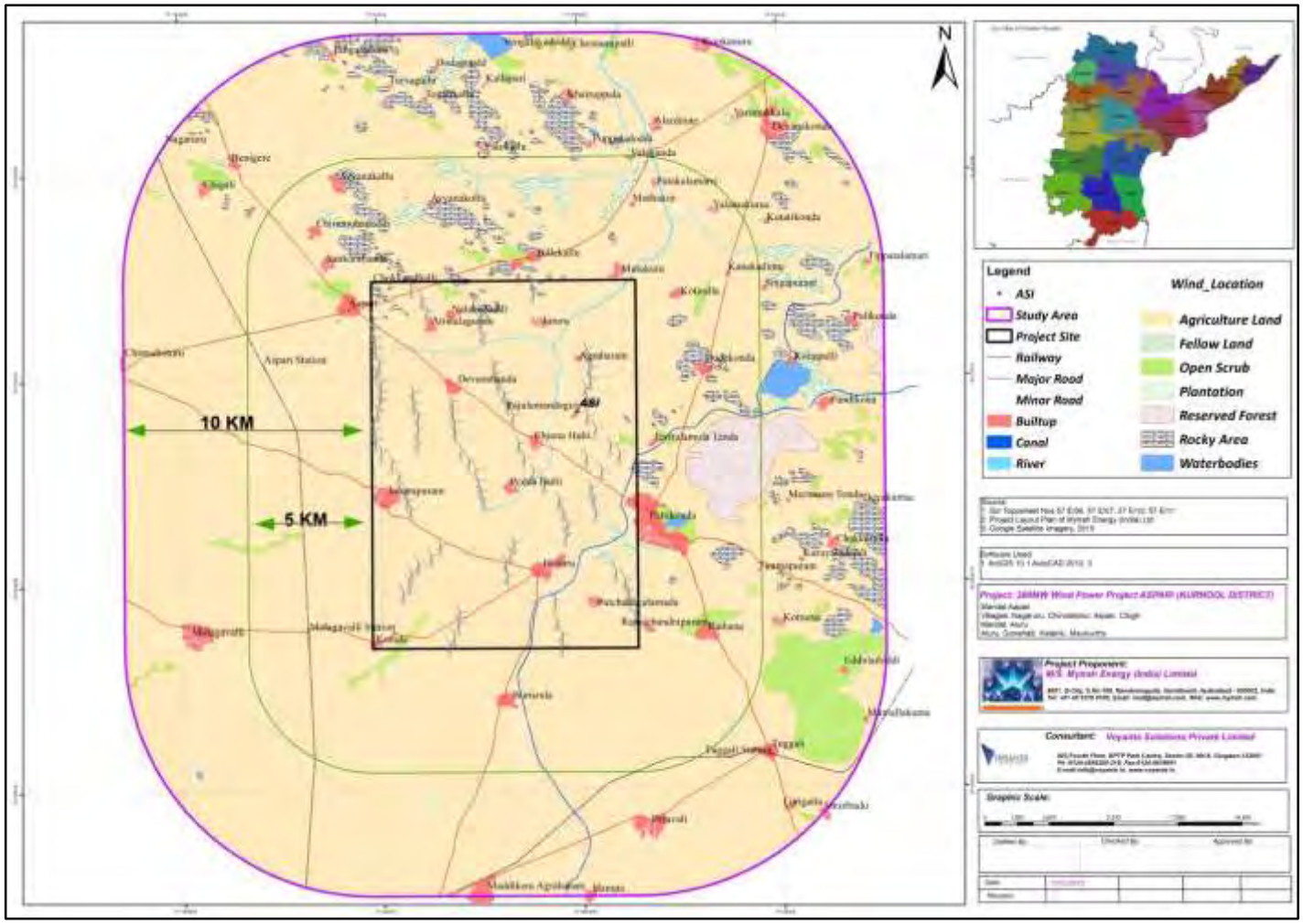

Figure 4:1: Boundary of the Project Influence Area

4.1.1 Topography

Topography of the area is undulating land. The core zone is mostly agricultural land but the buffer zone up to 10 km, there are rocky boulders. There is little hilly terrain in the buffer zone whose elevation is up to 480 MSL. There is a canal passing through the core zone as well as buffer zone which is called Handri Niwas Suzla Shrawanti Pathkam Canal which is also 250 mts away from WTG No ASP-76 (Ariel distance).

4.1.2 Land Use/ Land Cover

Detail study of the existing Land Use Land Cover (LULC) classification of the Study Area (10 km radius) has been studied in detail. The land use/ land cover map prepared using the methodology has been shown in **Figure 4.3.** The various land use and land cover classes delineated include plantation, water bodies, open scrub, agriculture land etc. The area of each class is compiled in **Table 4.1**

Table 4:1: Land Use/ Land Cover Distribution of the Study Area

S. No.	Category	Area in Hectare	% in area
1.	Plantation	67.3	0.1
2.	Water bodies	371.6	0.4
3.	Open Scrub	3193.4	3.2
4.	Agriculture Land	86456.9	87.9
5.	Rocky Area	3442.1	3.5
6.	Reserved Forest	1373.5	1.4
7.	Fellow Land	1312.0	1.3
8.	Buildup	1836.7	1.9
9.	Canal	44.7	0.0
10.	River	253.6	0.3
Total		**98351.82**	**100**

From the land use/ land cover map, the agriculture land covers 87.9% predominantly. Open scrub land and Rocky area covers 3.2% and 3.5% respectively. Reserved Forest, Fellow land and Build up area covers 1.4%, 1.3% and 1.9% respectively of the total area. River, water bodies and Plantation are hardly covering any area constituting of 0.3%, 0.4% and 0.1% respectively of the total study area.

Figure 4.2 shows the percentage distribution of land in the project influence area; and **Figure 4.3** shows the digitized topo map of the project influence area showing the geographical details of the project area. Project Influence Area for this wind farm is defined with the boundary connected through each WTG across the site connecting each WTG together.

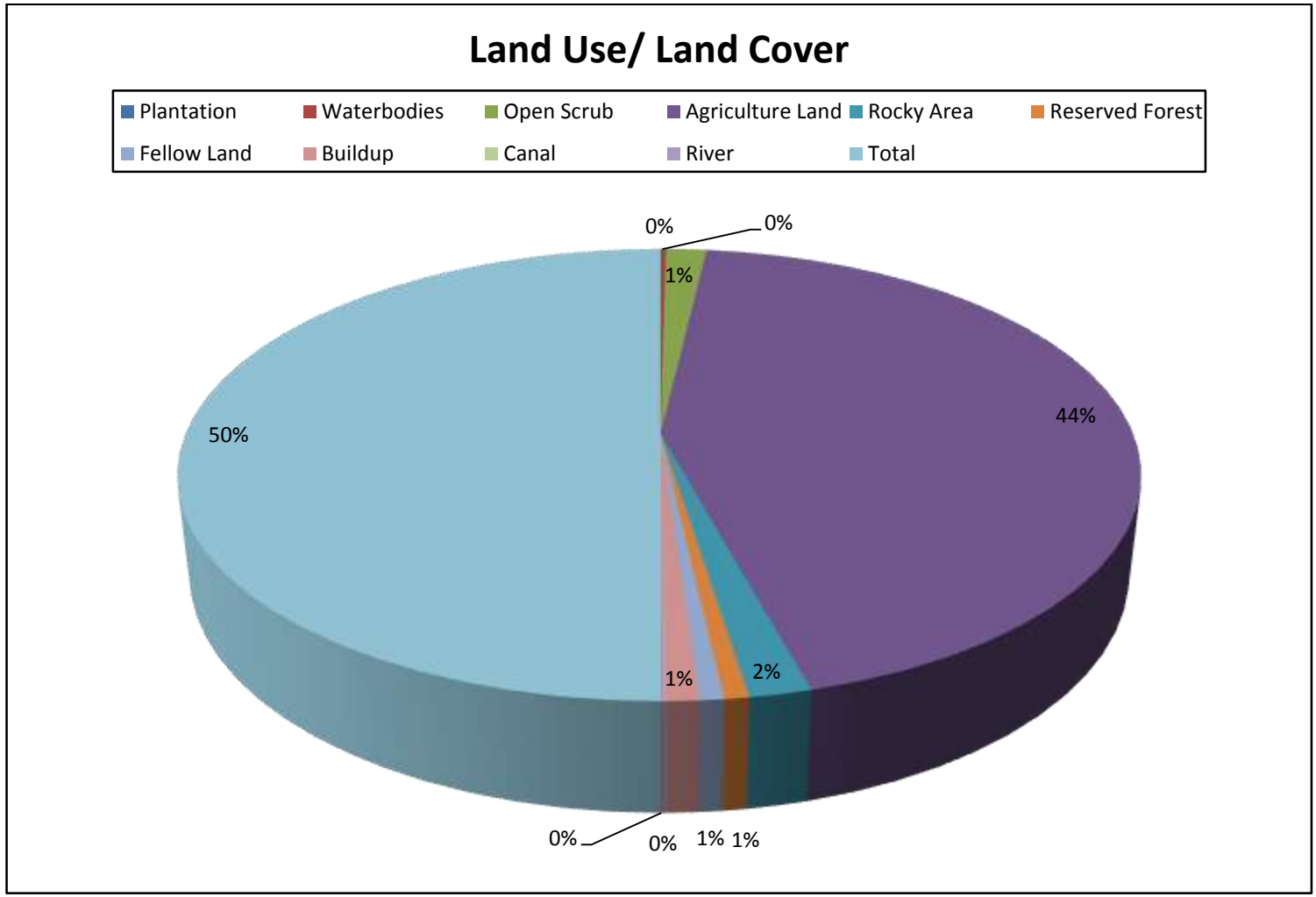

Figure 4:2: Percentage Land Use/ Land Cover propositions of the Project Influence Area

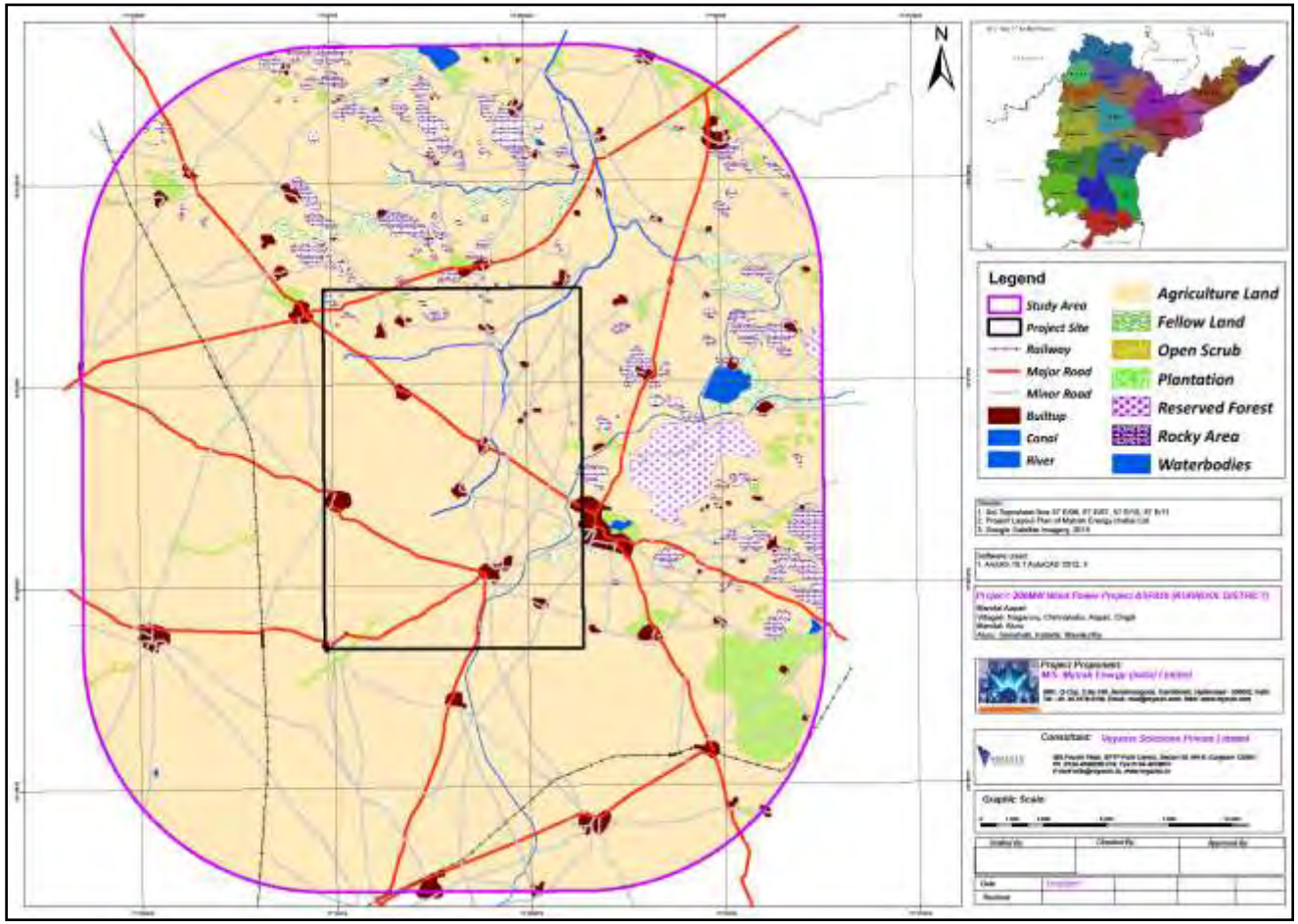

Figure 4:3: Land Use/ land Cover Map of the Project Influence Area

4.1.3 Drainage Pattern

The entire land of the district belongs to the larger drainage system of the Tungabhadra River. Drainage pattern in the Study area is from North-West direction to South-East. Handry River is flowing through the project area which is bifurcated at South-East of Juturu Village. There are small perennial tributaries from Handry River. It is a seasonal river and its only source of water is from Tungabhadra River. There is canal in southern part of the study area named Handri Niwas Suzla Shrawanti Pathkam Canal which gets its supply from Handry River.

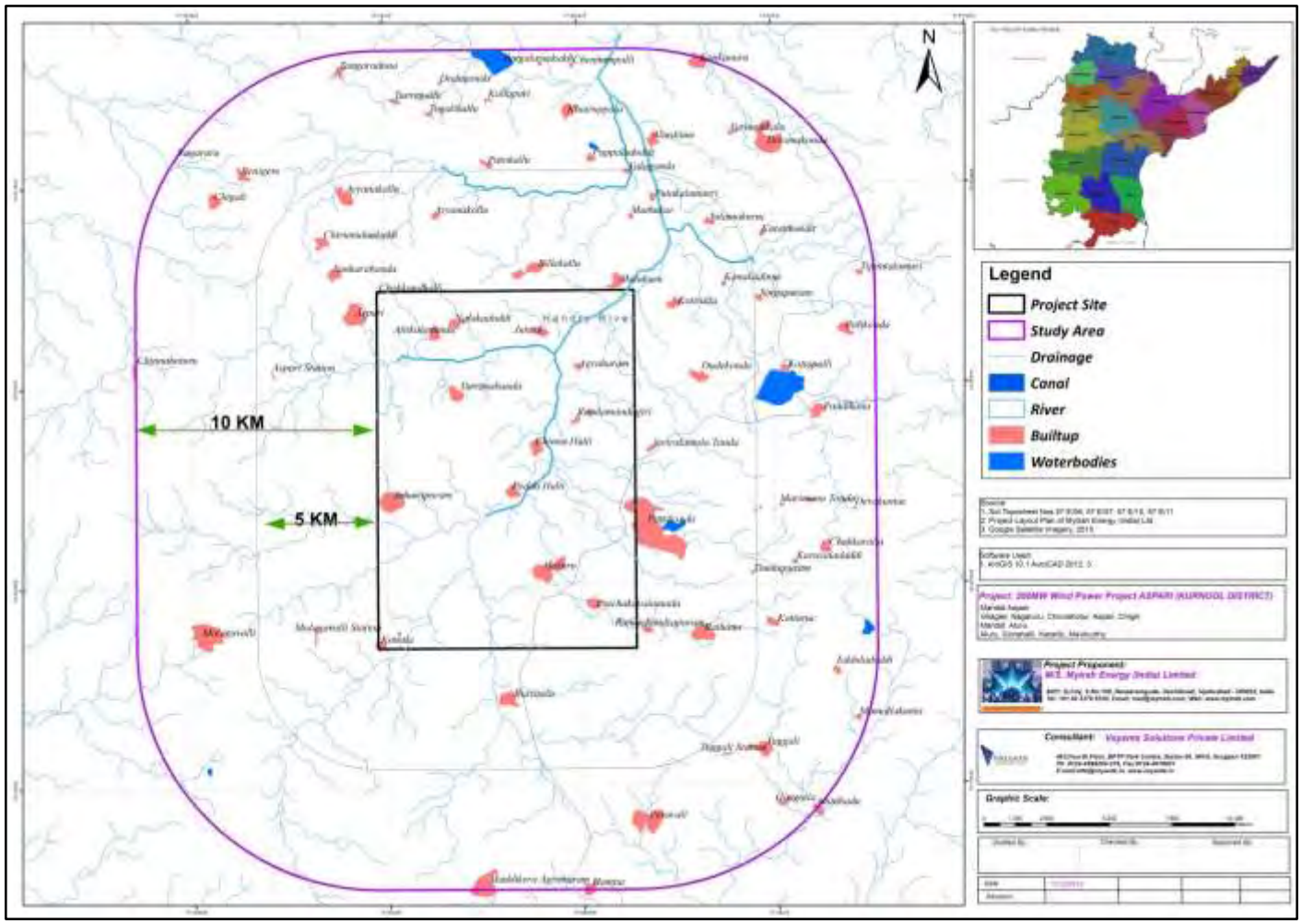

Figure 4:4: Drainage Pattern in the Study Area

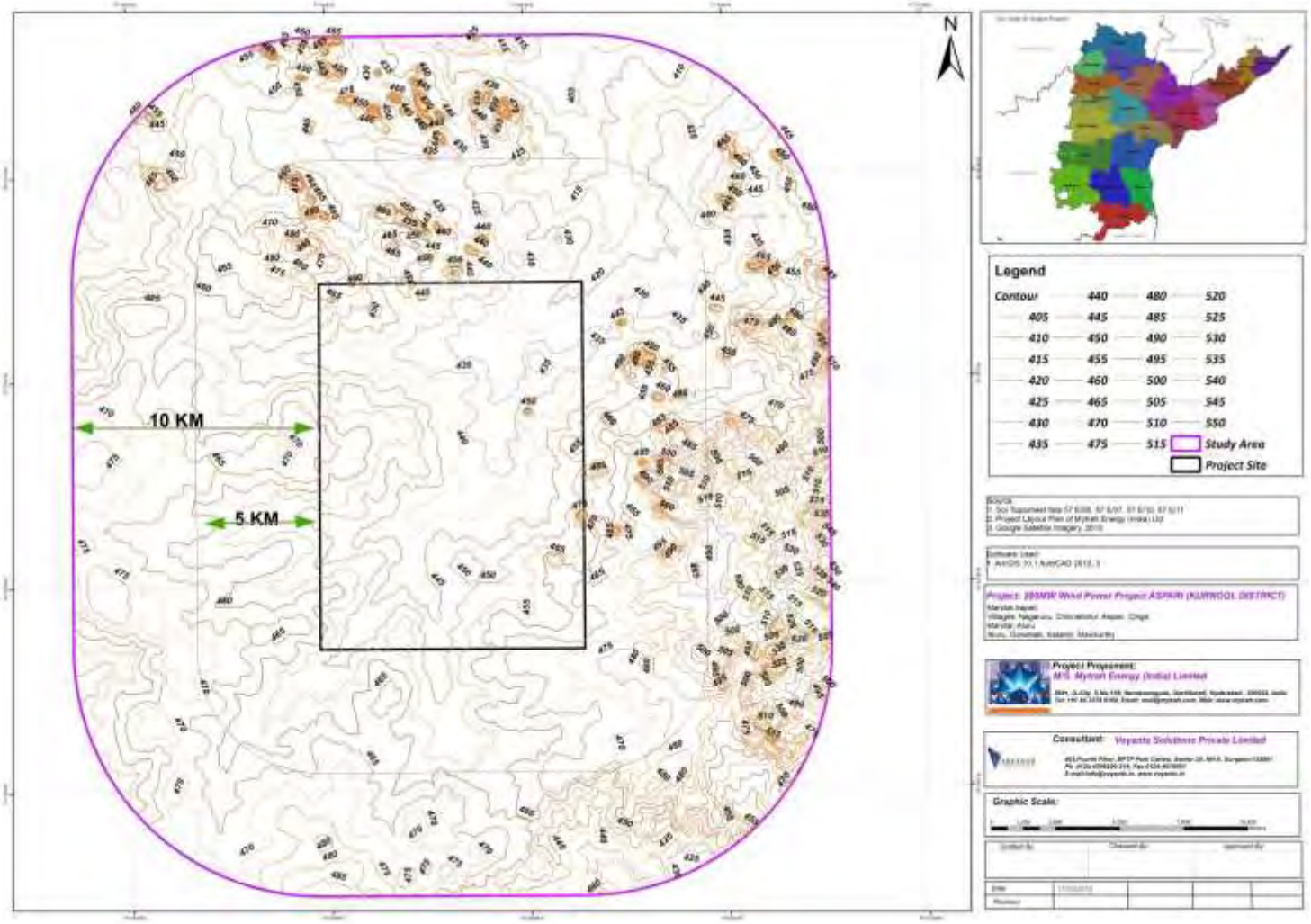

Figure 4:5: Contour Map of the Study Area

4.1.4 Geology

Kurnool district, in the southwestern part of Andhra Pradesh, covering an area of 17,658 sq. Km is situated between 14°55' and 16°07' N latitudes and 76°59'50" and 78°50' E longitudes. The district consists of two distinct physiographic provinces viz., the undulatory gneissic terrain with low denudational hills in the west and a sedimentary terrain with structural plateaus and homoclinical ridges and valleys in the east. The climate of this district may be described as semiarid with annual rainfall ranging from 40 to 60 cm and the daily temperature varying from 18° to 43° C. The Krishna River and its tributary Tungabhadra flow through the area in the north.

The Western part of Kurnool district exposes Archaean granitic gneisses, migmatites and granitoids which are grouped together as Peninsular Gneissic Complex (PGC). Amidst the gneissic terrain, narrow linear greenstone belts (Dharwar) of Gadwal and Jonnagiri occur. This consists of metavolcanics, biotite-chlorite schist, amphibolites, hornblende schist, banded ferruginous quartzite, agglomerate and ultramafics. The K-rich granites (equivalent to Close Pet Granite) of lower Proterozoic age, intruding PGC and schists are distributed in northern part of the district. The basic dykes and quartz veins are noticed in the western part of the district mainly along NW-SE and NE-SW trends. The Cuddapah Supergroup of rocks (Middle Proterozoic) unconformably resting over the crystallines, comprise of conglomerate, quartzite, shale limestone/dolomite and chert. Basic volcanic flows and sills are also present with in these sediments. The Kurnool Group (Upper Proterozoic) of sediments which lie unconformably over the Cuddapah Supergroup, occupy a large area in the east and are represented by quartzite, limestone and shale. The main structural features noticed in the area are folds and faults. The Cuddapah sediments show double plunging anticlines and synclines in the eastern part of the district. The ENE-WSW trending Gani-Kalva-Veldurti fault traverses the Archaean-Proterozoic crystallines and sediments.

4.1.5 Hydrogeology

Ground water occurs in all the geological formations in Kurnool district. Hydrogeological conditions in the district are presented in **Figure 4.6**.

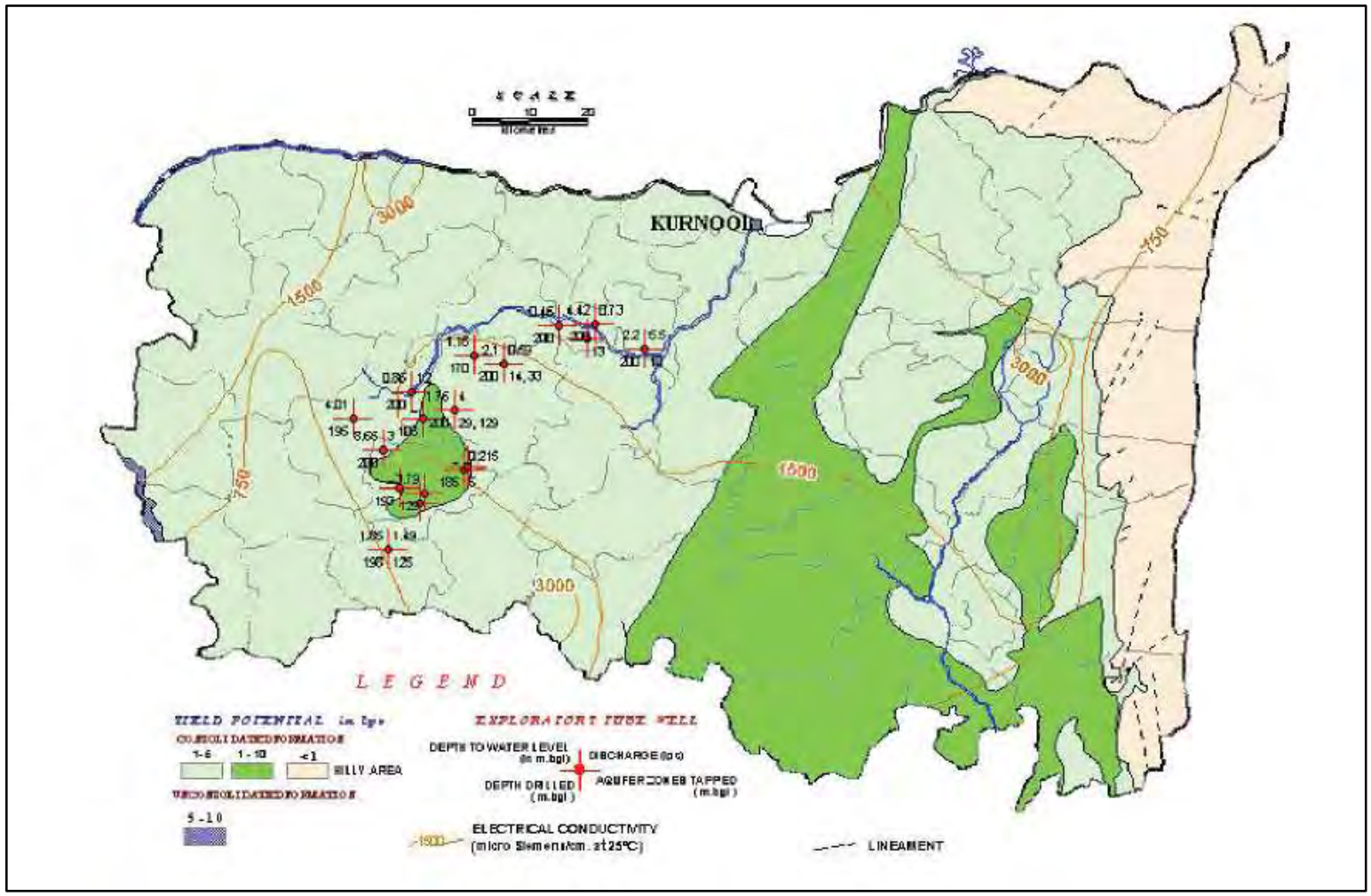

Figure 4:6: Hydrogeology of Kurnool District

Crystalline aquifers- The crystalline rocks develop secondary porosity through fracturing and subsequent weathering over ages and become water bearing. Movement of ground water is controlled by degree of inter-connection of secondary porosity and voids. The depth of weathered zone ranges from few centimeters to 18 m bgl. Ground water occurs under unconfined conditions in shallow weathered zones and under semi-confined conditions in joints, fissures and fractures. Occurrence of joints and fissures extends down to depth ranging from 20 to 100 m bgl. The shallow aquifers are developed through large diameter irrigation wells and domestic wells. The depth of irrigation wells ranges from 4 to 26m bgl. Irrigation wells sustain pumping of 2 to 4 hrs. per day during summer.

Consolidated Sedimentary Formation- Ground water occurs in the aquifers of Kurnool formations in Panyam Quartzites under unconfined and semi- confined conditions in weathered zone, sheared zones, joint planes and bedding contacts. The depth of dug wells varies from 7-13 m bgl, with extension bores down to a maximum depth of 15 m. The yield of wells ranges from 30 to 100 cu.m/day. In Koilkuntla limestone, ground water occurs under unconfined conditions in the top weathered zones and karstified horizons. Ground water occurs under unconfined condition in Nandyal shales down to a limited depth of 30 m bgl. The thickness alluvial aquifers varies from less <1 to 8.0 m and depth to water ranges between 1.0 and 5.3 m bgl.

Aquifer Parameters- Transmissivity of the aquifers in granitic gneisses in western part of the district in Vedavati River Basin ranging from 585 to 1370 sq.m/day and in Tungabhadra canal command area it is varying from 1 to 210 sq.m/day. The storativity is in the order of 2.76 x 10 - 2 to 1 x 10 –6. The specific capacity of wells varied from 5.92 to 49.78 lpm/m of draw down. Transmissivity values range from 67 and 1910 sq.m/day in Cuddapah and Kurnool formations.

4.1.6 Seismicity

Earthquakes in the recent past have occurred along and off the Andhra Pradesh coast and in regions in the Godavari river valley. Mild tremors have also hit the capital city of Hyderabad such as in September 2000. In the north, faults associated with the Godavari Graben show movement during the Holocene epoch. Another NW-SE trending active fault called the Kaddam Fault runs in a section of the northern Andhra Pradesh and continues in the same direction towards Bhusawalnin North Maharashtra.

According to the seismic hazard map of India, the state of Andhra Pradesh lies in Zone II and III.

The project site is falling in Zone II (as per IS 1893 (Part-I): 2002), **Figure 4.7** depicts the Seismic Zonation Map of India.

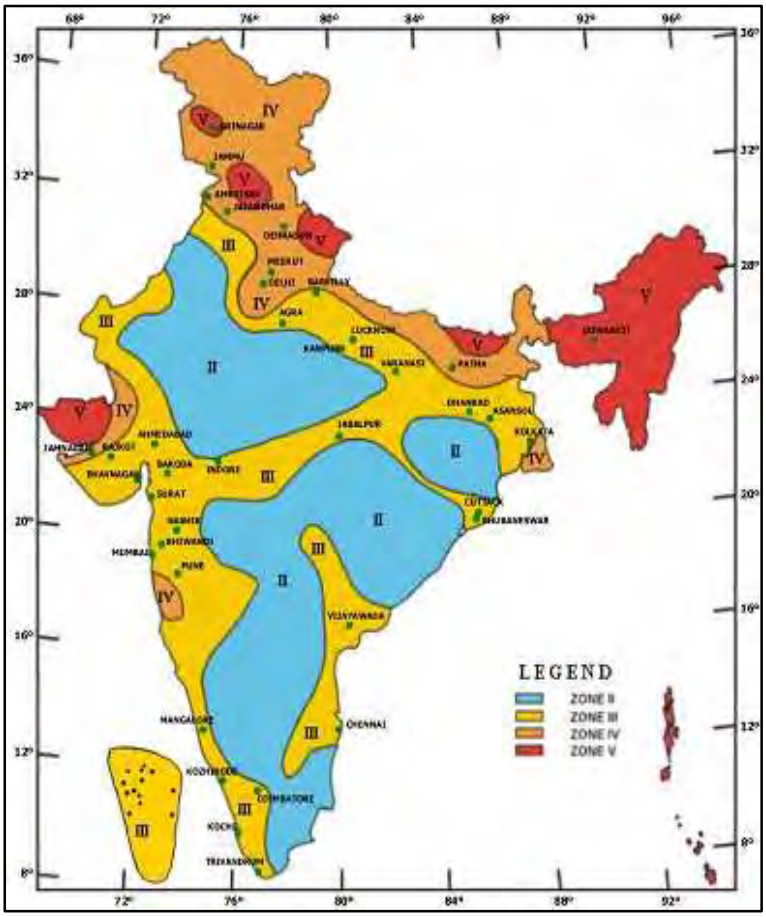

Figure 4:7: Seismic Zonation Map of India

4.1.7 Temperature and Humidity

The area lies in the tropical climate zone; hence it is hot in summer. Kurnool District summer highest day temperature is in between 30°C to 39.8°C. Average temperature of January is 27°C, February is 27°C, March is 21°C, April is 34°C and May is 35°C.

4.1.8 Meteorological Data

Historical Meteorological data for a period of 31 years (1951 – 1980) from Indian Meteorological Data (IMD) Kurnool was collected. Further, site specific meteorological data was also collected during the study period **20th November to 5th December 2015.**

Table 4:2: Meteorological Data (1951 – 1980)

Month	Station Level Pressure (hap)	Daily Mean		Relative Humidity %	Rainfall (mm)	Cloud Amount (Oktas)	Mean Wind Speed (Kmph)
		Max (°C)	Min (°C)				
Jan I	983.8	31.3	17.0	68	0.7	3.4	5.0
II	979.4			35		3.4	
Feb I	982.1	34.4	19.3	58	2.6	3.1	5.8
II	977.5			28		3.1	
Mar I	980.4	37.7	22.6	50	7.9	3.4	6.3
II	975.5			25		3.4	

Month	Station Level Pressure (hap)	Daily Mean		Relative Humidity %	Rainfall (mm)	Cloud Amount (Oktas)	Mean Wind Speed (Kmph)
		Max (°C)	Min (°C)				
Apr I	978.1	39.7	25.8	52	19.5	3.3	7.2
II	972.9			28		3.3	
May I	975.6	39.8	26.6	58	60.5	3.4	11.6
II	970.3			31		3.4	
June I	974.5	35.6	24.8	70	90.9	3.3	18.2
II	969.9			47		3.3	
July I	974.4	32.8	23.7	77	138.3	3.4	18.0
II	970.5			59		3.4	
Aug I	975.2	32.0	23.3	77	141.2	3.4	16.3
II	971.1			59		3.4	
Sep I	976.9	32.3	23.2	77	148.1	3.3	11.2
II	972.5			57		3.3	
Oct I	979.4	32.4	22.3	74	90.2	3.4	5.1
II	975.7			54		3.4	
Nov I	982.3	31.1	19.3	71	20.3	3.3	4.3
II	978.4			47		3.3	
Dec I	984.1	30.3	16.8	71	5.7	3.4	4.2
II	979.8			41		3.4	
Annual Total/ Mean I	978.9	34.1	22.1	67	725.9	3.37	9.4
Mean II	974.5			43		3.37	
Number of Years	30	30	30	30	30	30	28

To collect the micrometeorological conditions prevailing in the study area, a Micrometeorological Monitoring Station (MMS) was installed at top of the highest roof household in Peddahulti Village. The baseline meteorological data was collected as per IS: 8829 and IMD guidelines, from **20th November to 5th December 2015**. The hourly variations of the meteorological parameters recorded in the data logger for wind speed, wind direction, temperature, relative humidity and rainfall have been given in **Table 4.3**.

Table 4:3: Summary of IMD Climatological Sheet of Study Area

Date	Temperature (°C)	Relative Humidity (%)	Wind Direction (deg.)	Mean Wind Speed (kmph)	Rainfall (Inches)
	Average	Average	Average	Average	Average
20/11/2015	27.9	74.3	173.3	2.9	0.0
21/11/2015	26.9	71.4	195.4	3.4	0.0
22/11/2015	26.3	70.9	173.9	2.6	0.0

23/11/2015	25.6	70.1	154.5	4.3	0.0
24/11/2015	26.1	70.2	148.9	3.0	0.0
25/11/2015	25.9	71.0	102.9	3.0	0.0
26/11/2015	25.4	72.3	115.0	3.9	0.0
27/11/2015	26.4	72.5	120.8	2.5	0.0
28/11/2015	25.8	72.4	129.1	2.9	0.0
29/11/2015	26.7	71.3	170.1	4.2	0.0
30/12/2015	25.4	71.2	160.2	2.6	0.0
1/12/2015	25.4	70.6	142.5	3.5	0.0
2/12/2015	25.9	69.7	139.2	3.3	0.0
3/12/2015	26.7	70.2	170.2	2.9	0.0
4/12/2015	26.1	73.4	139.5	2.8	0.0
5/12/2015	25.4	73.4	179.8	4.3	0.0

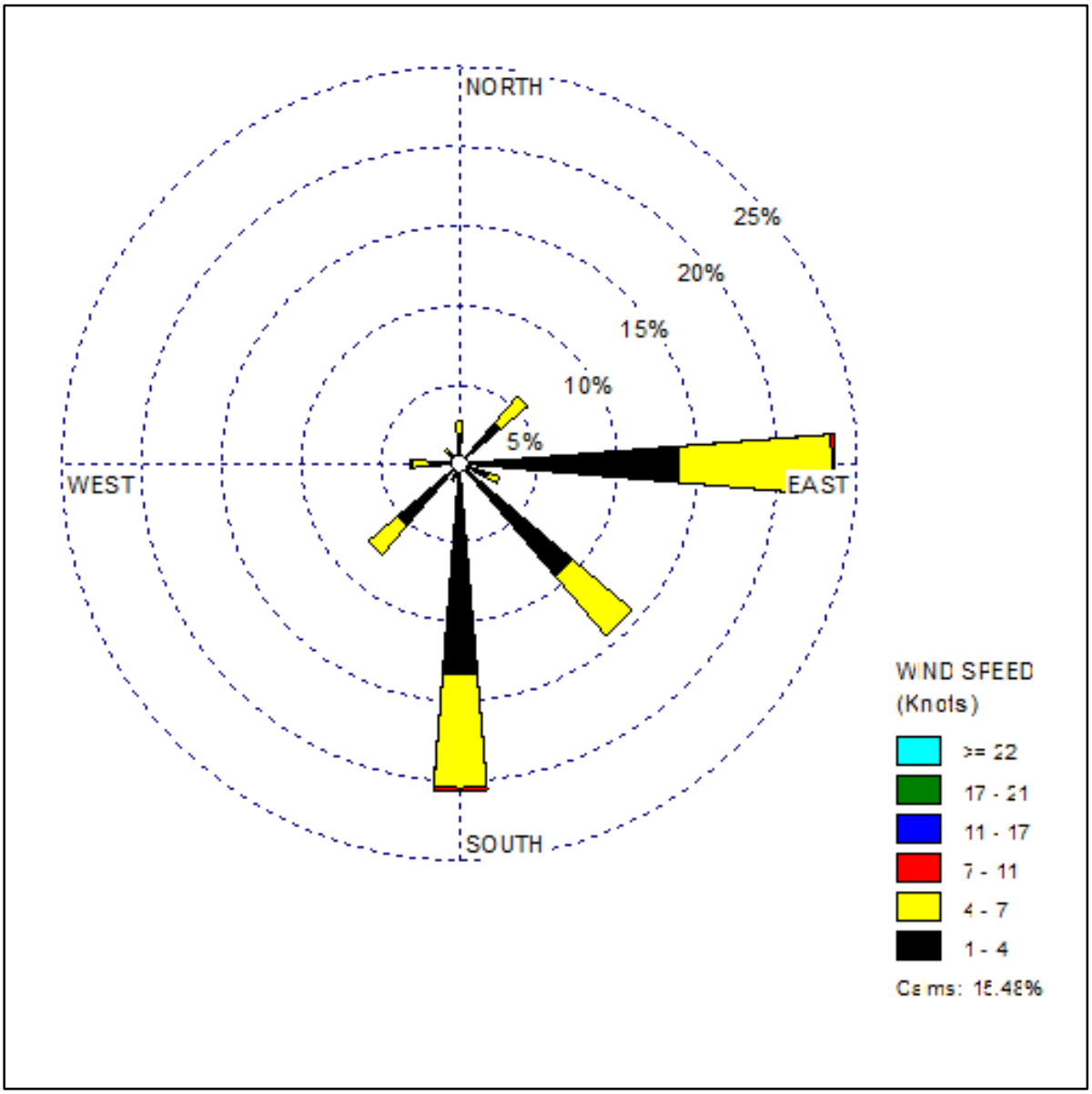

Figure 4:8: Wind Rose Diagram of the Study Area

It is observed for most of the time that the wind speed is varying between 1-7 knots. The predominant wind directions observed were from South (30%), East (40%) and South-East (15%). Calm conditions prevailed for 15% of the total time.

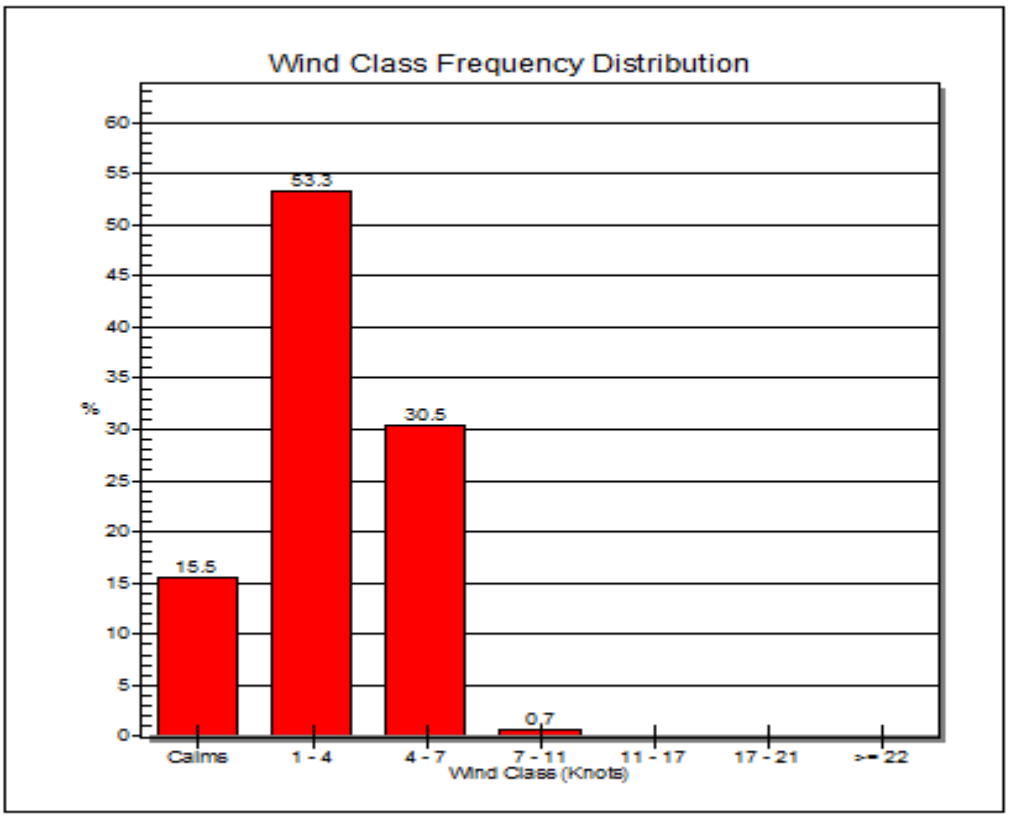

Figure 4:9: Wind Class Distribution (Frequency) of the Study Area

4.1.9 Rainfall

Kurnool receives rainfall only in the range of 670 mm annually and hence faces scarcity of water. The bulk of which is received through the Southwest monsoon 455 mm during the period from June to September. In all the villages, people mainly depend on Handri Niwas Suzla Shrawanti Pathkam Canal for drinking and domestic purposes and Government tap water in some. Also since rain-fed agriculture is the major occupation of the population, the scanty rainfall affects their economy as well.

The table below provides the rainfall received in the region during 1951 to 1980. This gives an account of rainfall deficiency existing in the region since a long time.

Table 4:4: Rainfall (in mm) for Kurnool District

Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual Total or Mean II	No of years
0.7	2.6	7.9	19.5	60.5	90.9	138.3	141.2	148.1	90.2	20.3	5.7	725.9	30

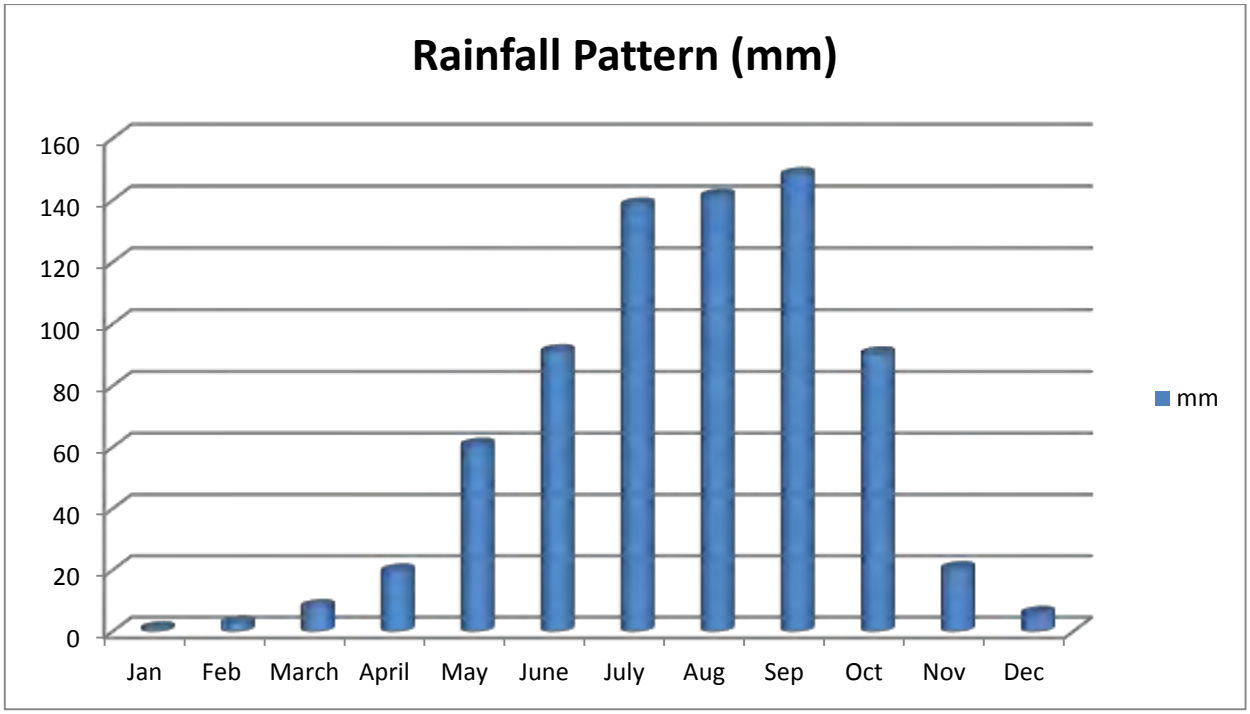

Figure 4:10: Rainfall Pattern: Kurnool District

The data provided in the table above shows that there are months when the percentage of departure of rainfall is to the tune of 80-100%.

4.2 AMBIENT AIR QUALITY

4.2.1 Baseline Monitoring

Air Quality monitoring of the project area is carried out by the laboratory division of Vision Laboratories India Pvt. Ltd., which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2005. The monitoring is based on the process manual ESIPL/SOP/C-AA/10. During the sampling process, concentrations of the following parameters in the environment are measured:

- Particulate Matter having size less than 2.5 um ($PM_{2.5}$)
- Particulate Matter having size more than 2.5 um and less than 10 um (PM_{10})
- Sulphur Dioxide (SO_2)
- Oxides of Nitrogen (NO_x)
- Carbon Monoxide (CO)

Air pollution due to combustion of fossil fuels in vehicles, domestic cooking and other industrial activities is reflected in the level of SO_2, NO_x and CO, whereas Particulate Matter concentration is indicative of the amount of dust and other fine particles in the air.

The locations chosen for sampling are part of four different villages, identified in the project area. Village Hosuru (AAQ-1) is the first sampling location and Pedda Hulthi Village (AAQ-2) is the second location Joharapuram and Agaraharan Villages are in the downwind direction. All these locations come under the category of residential zone and are chosen based on the direction of wind, habitation around etc. Four samples each are collected on four different days from the locations and

sampling is done for duration of 24 hours. The relative humidity of the locations on the days of sampling was in the range of 52-62% and the ambient temperature was approximately 30-31°C.

S.No	Village	Direction	Station
1.	Hosuru	Upwind	AAQ1
2.	Peddahulti	Centre	AAQ2
3.	Joharapuram	Downwind	AAQ3
4.	Agaraharan	Downwind	AAQ4

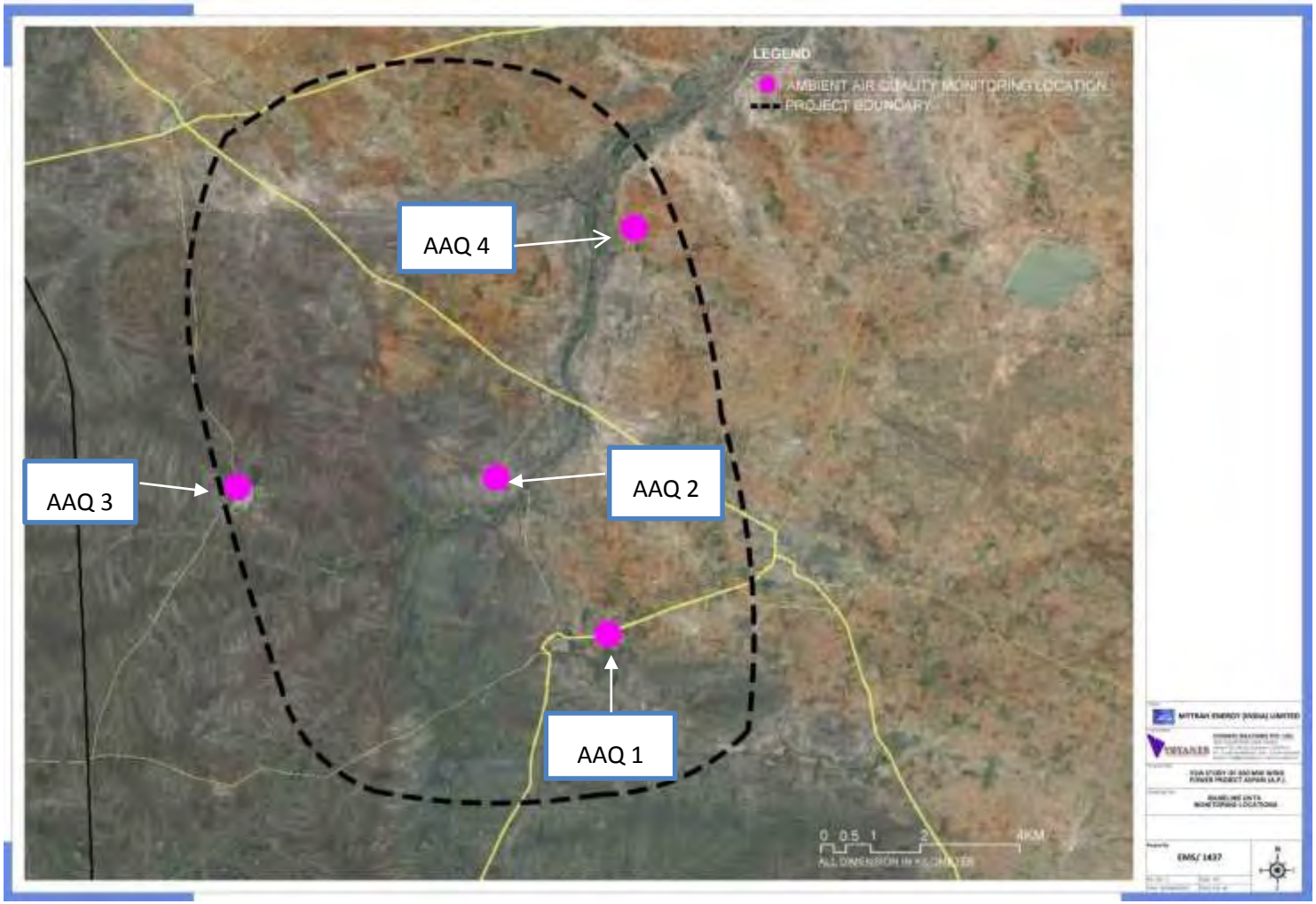

Figure 4:11: Location map showing Ambient Air Quality Monitoring Locations

Results:

The results of ambient air quality monitoring for Hosuru, Pedda Hulthi, Joharapuram and Agraharam villages with respect to five parameters – PM_{10}, $PM_{2.5}$, SO_2, NO_X and CO are provided below:

Table 4:5: Ambient Air Quality at AAQ1- Hosuru Village (in ug/m³)

Parameter	SO_2	NO_X	PM_{10}	$PM_{2.5}$	CO
Minimum	4.5	15.8	39.5	19.2	<1000.0
Maximum	5.5	17.7	45.7	23.9	<1000.0
Average	5.1	16.6	42.1	22.1	<1000.0
10 Percentile	4.7	15.9	39.8	20.2	-
20 Percentile	4.9	16.0	40.0	21.2	-
30 Percentile	5.1	16.0	40.2	22.2	-
50 Percentile	5.3	16.5	41.6	22.7	-
80 Percentile	5.4	17.2	44.0	23.2	-
98 Percentile	5.5	17.7	45.5	23.9	-
Arithmatic Mean	5.1	16.6	42.1	22.1	-
Geometric Mean	5.1	16.6	42.0	22.0	-
Standard Deviation	0.4	0.9	2.8	2.0	-
95 Percentile	5.5	17.6	45.3	23.8	-
NAAQS (24 hourly)	80	80	100	60	-

Table 4:6: Ambient Air Quality at AAQ2- Peddahulti Village (in ug/m³)

Parameter	SO_2	NO_X	PM_{10}	$PM_{2.5}$	CO
Minimum	6.0	17.2	38.5	19.5	<1000.0
Maximum	7.1	21.6	47.2	25.9	<1000.0
Average	6.6	19.4	43.5	22.5	<1000.0
10 Percentile	6.1	17.6	39.4	20.3	-
20 Percentile	6.2	17.9	40.3	21.0	-
30 Percentile	6.3	18.3	41.2	21.7	-
50 Percentile	6.7	19.3	44.0	22.2	-
80 Percentile	7.0	20.8	46.8	23.8	-
98 Percentile	7.1	21.5	47.2	25.7	-
Arithmatic Mean	6.6	19.4	43.5	22.5	-
Geometric Mean	6.6	19.3	43.3	22.4	-
Standard Deviation	0.5	1.9	4.2	2.6	-
95 Percentile	7.1	21.4	47.1	25.3	-
NAAQS (24 hourly)	80	80	100	60	-

Table 4:7: Ambient Air Quality at AAQ3- Joharapuram Village (in ug/m³)

Parameter	SO_2	NO_X	PM_{10}	$PM_{2.5}$	CO
Minimum	4.9	13.5	37.9	15.9	<1000.0
Maximum	5.3	16.3	42.9	21.9	<1000.0

Parameter	SO_2	NO_X	PM_{10}	$PM_{2.5}$	CO
Average	5.1	15.0	40.3	19.4	<1000.0
10 Percentile	5.0	13.8	38.1	17.1	-
20 Percentile	5.0	14.1	38.3	18.3	-
30 Percentile	5.1	14.4	38.6	19.4	-
50 Percentile	5.2	15.1	40.2	19.9	-
80 Percentile	5.2	15.9	42.2	20.7	-
98 Percentile	5.3	16.3	42.8	21.7	-
Arithmatic Mean	5.1	15.0	40.3	19.4	-
Geometric Mean	5.1	15.0	40.2	19.3	-
Standard Deviation	0.2	1.2	2.4	2.5	-
95 Percentile	5.3	16.2	42.7	21.6	-
NAAQS (24 hourly)	80	80	100	60	-

Table 4:8: Ambient Air Quality at AQ4- Agaraharn Village (in ug/m^3)

Parameter	SO_2	NO_X	PM_{10}	$PM_{2.5}$	CO
Minimum	4.9	14.9	36.5	17.7	<1000.0
Maximum	5.3	16.7	47.9	21.8	<1000.0
Average	5.1	15.7	41.4	19.9	<1000.0
10 Percentile	5.0	15.1	37.2	18.3	-
20 Percentile	5.0	15.2	37.9	18.9	-
30 Percentile	5.1	15.4	38.6	19.4	-
50 Percentile	5.2	15.6	40.6	20.0	-
80 Percentile	5.2	16.2	44.6	20.9	-
98 Percentile	5.3	16.7	47.6	21.7	-
Arithmatic Mean	5.1	15.7	41.4	19.9	-
Geometric Mean	5.1	15.7	41.2	19.8	-
Standard Deviation	0.2	0.8	5.0	1.7	-
95 Percentile	5.3	16.6	47.1	21.6	-
NAAQS (24 hourly)	80	80	100	60	-

The concentration of CO was found <1.0 mg/m^3 at all the places.

	
Hosuru Air Quality Monitoring	Agaraharam Air Quality Monitoring
	
Joharapuram Air Quality Monitoring	Peddahulti Air Quality Monitoring

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Inference

The concentrations of all the monitoring parameters (PM10, PM2.5, SO2, NOX and CO) were found to comply with the National Ambient Air Quality Standards (NAAQS). The air pollutant concentrations were well below the NAAQS. The maximum pollutant concentration was observed in the village Pedda Hulthi due to the urbanization setting in comparison to other nearby villages. The maximum PM_{10} concentrations was observed in Agraharan village to be 47.9 µg/m^3 whereas maxmum $PM_{2.5}$ concentrations (25.9 µg/m^3) was observed in Pedda Hulthi village; both of which are well below the respective NAAQS standard of 100 µg/m^3 and 60 µg/m^3. All the gaseous pollutants were also well below the NAAQS. Maximum concentration of SO_2 and NO_2 was observed as 7.1 µg/m^3 and 21.6 µg/m^3 concentration in comparison to NAAQS of 80 µg/m^3. CO concentration was observed to be below 1.0 mg/m^3 in all the locations in comparison to NAAQS of 2 mg/m^3. Hence, air quality in the project area was found to be complying with NAAQS.

4.3 SURFACE WATER QUALITY

For water quality testing, four water samples are collected from the villages mentioned below:

S. No.	Village	Station
1.	Hosuru	SW1
2.	Nalakadoddi	SW2
3.	Joharapuram	SW3
4.	Pattikonda	SW4

All the four samples are from surface water bodies are collected and are examined as per the standard methods specified by Bureau of Indian Standards (BIS). The quality of water is determined with respect to the standard values provided by the Central Pollution Control Board (CPCB).

All the four locations are chosen based on the availability of ponds or open water surfaces in the study area, Ponds or open water bodies were seasonal and perennial. It was observed that most of the open water bodies dried up.

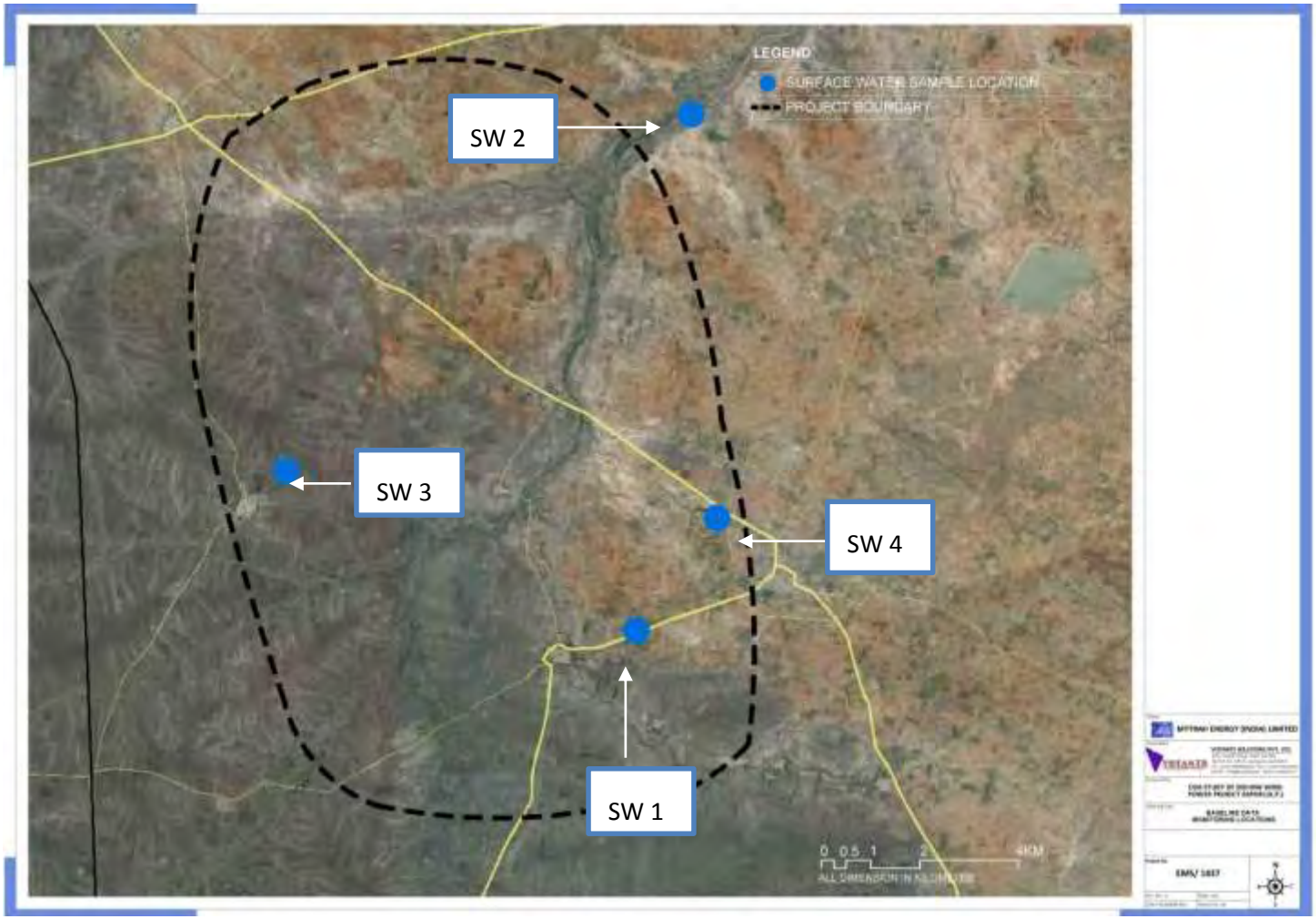


Figure 4:12: Location map showing Surface Water Sample Locations

Table below provides the result of water testing conducted by the NABL accredited Laboratory division of Vison Labs, Hyderabad on 20th November 2015.

Table 4:9: Surface Water Quality in the Study

S. No	Parameter	Units	IS:2296	SW 1	SW 2	SW 3	SW 4
			Class C Limits	Hosuru	Nalakaddi	Joharapuram	Pattikonda
				Water	Water	Water	Water
1	pH	-	6.5 – 8.5	8.39	8.11	8.34	8.54
2	Color	Hazen units	300	8	6	6	12
3	Conductivity	mS/cm	-	862	258	168	1216
4	Dissolved Oxygen	mg/l	4	4.2	4.6	4.9	4.6
5	BOD (3 days at 27°C)	mg/l	3	22	32	26	24
6	Total Dissolved Solids	mg/l	1500	548	160	106	778
7	Total Hardness	mg/l	-	220	90	40	250
8	Chloride as Cl	mg/l	600	105	25	25	150
9	Fluorides as F^-	mg/l	1.5	0.3	0.3	0.1	0.6
10	Sulphate as SO_4^{--}	mg/l	400	85.5	25.7	6.5	84.1
11	Alkalinity	mg/l	-	180	110	40	260
12	Nitrates as NO_3	mg/l	-	8.1	3.7	0.6	11.3
13	Cyanides as CN	mg/l	0.05	<0.001	<0.001	<0.001	<0.001
14	Calcium as Ca	mg/l	-	48	20	8	56
15	Magnesium as Mg	mg/l	-	24	9.6	4.8	26.4
16	Sodium as Na	mg/l	-	91.5	14.2	17.9	158.4
17	Potassium as K	mg/l	-	3.5	1.9	0.8	4.3
18	Iron as Fe	mg/l	50	0.26	0.22	0.22	0.28
19	Chromium as Cr	mg/l	0.05	0.006	<0.001	<0.001	0.008
20	Cadmium as Cd	mg/l	0.01	<0.001	<0.001	<0.001	<0.001
21	Lead as Pb	mg/l	0.1	<0.02	<0.02	<0.02	<0.02
22	Copper as Cu	mg/l	1.5	0.026	0.008	0.006	0.008
23	Arsenic as	mg/l	0.2	<0.001	<0.001	<0.001	<0.001
24	Selenium as Se	mg/l	0.05	<0.001	<0.001	<0.001	<0.001
25	Phenolics as C6H5Oh	mg/l	0.005	0.046	<0.001	<0.001	<0.001
26	Zinc as Zn	mg/l	5	0.18	0.038	0.029	0.068
27	Mercury as Hg	mg/l	-	<0.0002	<0.0002	<0.0002	<0.0002
28	Aluminum as Al	mg/l	-	<0.001	<0.001	<0.001	<0.001
29	Anionic detergents as MBAS	mg/l	0.12	0.56	0.068	0.064	0.038
30	Oil and grease	mg/l	0.3	0.8	0.6	0.3	0.6

S. No	Parameter	Units	IS:2296	SW 1	SW 2	SW 3	SW 4
			Class C Limits	Hosuru	Nalakadoddi	Joharapuram	Pattikonda
				Water	Water	Water	Water
31	Sodium Absorption Ratio	meq/l	-	2.68	0.65		4.4
32	Insecticides	mg/l	Absent	Absent	Absent	Absent	Absent
33	Coliform Organisms	MPN / 100 ml	Should not exceed 5000	3526	2980	3102	4260

Sample Collection date: 20.11.2015

Hosuru Canal Water Sample Collection

Joharapuram Surface Water Sample Collection

Nalakadoddi Surface Water Sampling

Pattikonda Surface Water Sampling

Inference

Surface Water samples were collected from four locations viz. Hosuru, Nalakadoddi, Joharapuram & Pattikonda Village and the water quality was compared for surface Water quality class "Class C" (IS:2296-1982) i.e. "Drinking water Source with Conventional Treatment followed by Disinfection"

Water samples from all the four locations – Hosuru, Nalakadoddi, Joharapuram and Pattikonda were found to comply with Claas C except Biodegradable Organic Pollution Load (i.e. BOD). Dissolved Oxygen (DO) concentration level in all the water bodies were found to be above minimum standard requirement of 4.0 mg/l. Highest dissolved solid concentration was observed to be 778 mg/l in comparison to permissible standard of 1500 mg/l. Surface water quality at all the locations were

found to comply with standards of “Drinking water source with conventional treatment followed by disinfection” except for BOD load.

4.4 GROUND WATER QUALITY

The ground water in the district is in general suitable for both domestic and irrigation purposes. The electrical conductivity ranges from 565 to 4343 micro Siemens/cm at 25 C. It is observed that EC values are more than 3000 micro Siemens/cm at 25 C in the western part of the district. Out of the 918 villages of the district, 72 villages are facing poor quality problem in ground water.

Half of the total irrigated area and most of the domestic needs of the district depend on ground water. There are about 53,375 ground water structures, which support the irrigation in the district. To meet the domestic water needs of the 918 villages, 12486 hand pumps and 580 seasonal bore wells and 1096-piped water supply schemes through bore wells schemes are constructed. The wells have 1-2 m of water column and sustain pumping by 5 HP motors for 2 to 5 hrs. in two spells, a day. The yield of wells varies from 40-150 cu.m/day during post-monsoon period. The fractured aquifers are tapped by bore wells of 100 to 159 m deep. In general, the discharge of bore wells varies from 1 to 18 cu.m/day for a drawdown of 4 to 10 m.

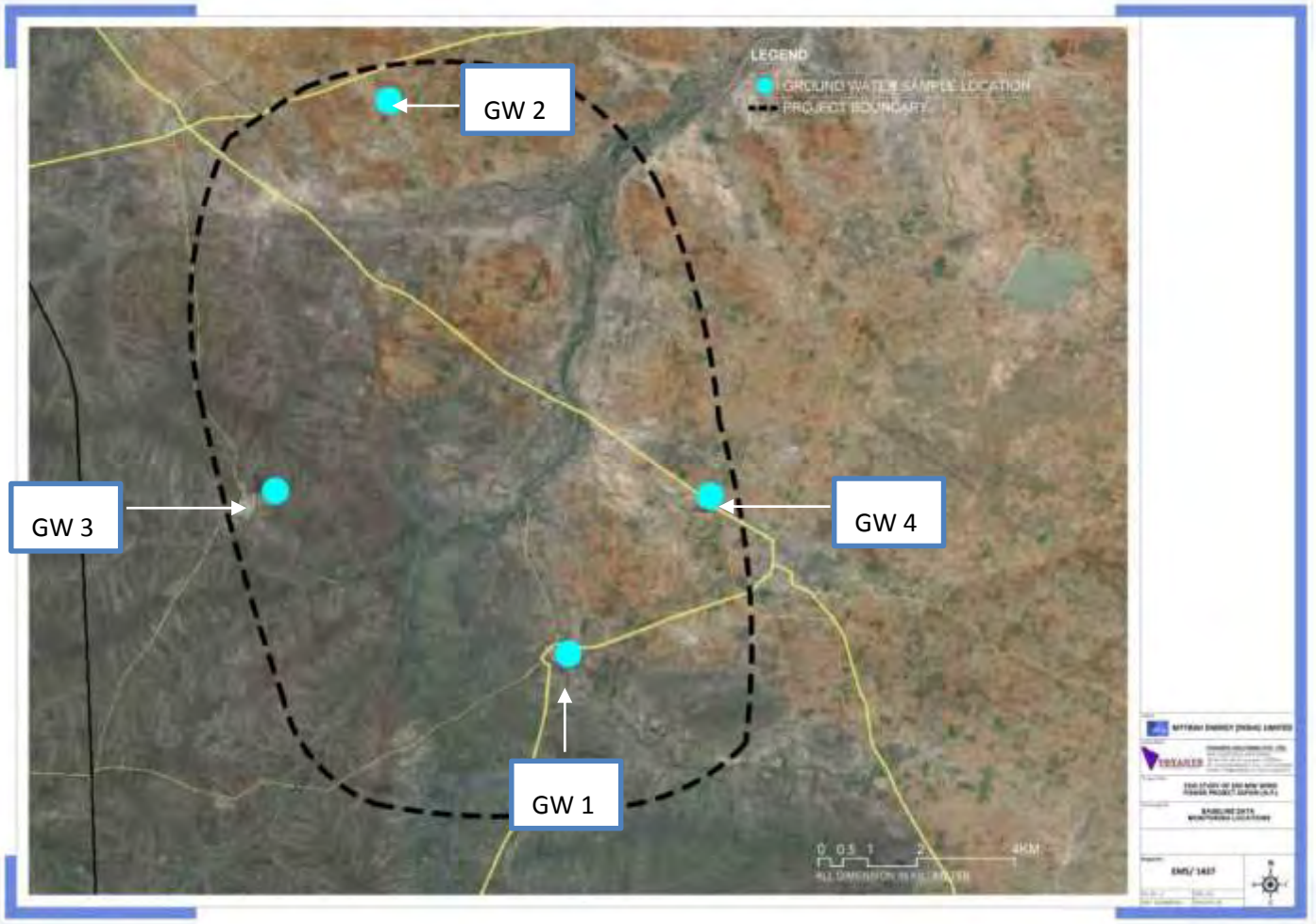


Figure 4:13: Location map showing Ground Water Sample Locations

For Ground Water quality testing, four water samples are collected from villages mentioned below:

S.No	Village	Station
1.	Hosuru	GW1
2.	Nalakadoddi	GW2
3.	Joharapuram	GW3
4.	Pattikonda	GW4

Table 4:10: Ground Water Quality in the Study

S. No	Parameter	Unit	Hosuru	Nalakadoddi	Pattikonda	IS 10500 : 2012
			GW 1	GW 2	GW 4	
1	pH	--	7.87	7.84	8.36	6.5-8.5
2	Turbidity	NTU	1.6	1.4	2	5-10
3	EC	µMho/cm	1462	642	2462	
4	TSS	mg/l	<01	<01	<01	
5	TDS	mg/l	944	408	1594	
6	Total Alkalinity as $CaCO_3$	mg/l	320	200	520	
7	Chlorides as Cl^-	mg/l	105	50.5	445.2	250-1000
8	Sulphates as SO_4^{-2}	mg/l	239.1	32.2	57.6	200-400
9	Nitrates as NO3	mg/l	8.2	10.8	14.9	45
10	Phosphates as PO_4	mg/l	0.04	0.02	0.08	
11	Total Hardness as $CaCO_3$	mg/l	160	200	420	200-600
12	Calcium as Ca	mg/l	48	44	88	75-200
13	Magnesium as Mg	mg/l	9.6	21.6	48	30-100
14	Sodium as Na	mg/l	257.1	50.1	365.7	
15	Potassium as K	mg/l	3.5	2.9	6.1	
16	Flourides as F^-	mg/l	1.1	0.5	1.9	1-1.5
17	Iron as Fe	mg/l	0.16	0.12	0.024	0.3-1
18	Phenolic Compounds	mg/l	<0.001	<0.001	0.006	0.001-0.002
19	Cyanide as CN^-	mg/l	<0.001	<0.001	<0.001	0.005
20	Residual Chlorine as Cl^-	mg/l	<0.001	<0.001	<0.001	0.2
21	Cadmium as Cd	mg/l	<0.001	<0.001	0.002	0.01
22	Total Chromium as Cr	mg/l	<0.001	<0.001	<0.001	0.05
23	Lead as Pb	mg/l	<0.02	<0.02	<0.02	0.05

S. No	Parameter	Unit	Hosuru	Nalakadoddi	Pattikonda	IS 10500 : 2012
			GW 1	GW 2	GW 4	
24	Zinc as Zn	mg/l	0.086	0.039	0.096	5-15
25	Manganese as Mn	mg/l	<0.001	<0.001	<0.001	30-100
26	Copper as Cu	mg/l	0.018	0.006	0.02	0.05-1.5
27	Nickel as Ni	mg/l	<0.001	<0.001	<0.001	3.0-5.0
28	Colour	Hazen	1	1	1	5.00
29	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable
30	Odor	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
31	Boron	mg/l	0.006	0.004	0.009	1.00
32	Anionic Detergents	mg/l	<0.001	<0.001	<0.001	0.20
33	Mineral Oil	mg/l	<0.001	<0.001	<0.001	0.01
34	Aluminium as Al	mg/l	<0.001	<0.001	<0.001	0.03
35	Mercury as Hg	mg/l	<0.0002	<0.0002	<0.0002	0.00
36	Pesticides	mg/l	Absent	Absent	Absent	Absent

Sample Collection date: 20.11.2015

Hosuru Ground Water Sample Collection

Joharapuram Ground Water Sample

Nalakadoddi Ground Water Sampling

Pattikonda Ground Water Sampling

Inference

Ground water samples were collected from four villages namely Hosurur, Nalkadoddi, Johrapuram and Pattikonda. The ground water samples were compared with drinking water quality standards (IS 10500: 2012). The ground water quality parameters from the Johrapuram village was not found to be fit as per drinking water quality standards and exceeds permissible limit standards for physical and general parameters. The dissolved solid concentration was found as high as 3306 mg/l in Johrapuram village due to high concentration of mineralogical parameters. The water sample from Johrapuram village was found to be hard water and hardness value was observed to be 1820 mg/l in comparison to standard limit of 600 mg/l. Concentration of chloride and hardness parameters from Pattikonda village was observed to above the limits of desirable standards through they were well within the permissible limit for all the other parameters except Phenolic compound which was found to be higher than permissible standards limit. The ground water quality from the villages namely Hosuru and Nalkadoddi were observed to be within the desirable standard limits of drinking water quality.

4.5 SOIL SAMPLE LOCATION

It is estimated that 61.4% of the total geographical area of Kurnool district is covered by Black Soils followed by 33.3% Red Soils and 5.3% others. Red and Black soils are predominantly present in the district.

The soils in the district are classified as clay, loamy and sandy soils. The black cotton soils are predominant in the mandals of Pattikonda, Nandyal, Allagadda, Koilkuntla, Nadikotkur and Adoni. In the eastern part of the district, red soil of a poor quality largely predominates. These soils although, generally poor in fertility, yield a very good crop with a minimum rainfall. Regar soils are predominant in the mandals of Kurnool and Pattikonda. The availability of alluvial soil is quite small and is confined to a few villages near the Banavasi and the Krishna.

Soil quality testing of the project locations are conducted by NABL accredited Laboratory division of Vision Labs. The procedure followed for testing is based on Guidelines by Indian Standards (IS 2720). The values obtained for each characteristic of soil such as pH, electrical conductivity etc. is compared with the prescribed standard values.

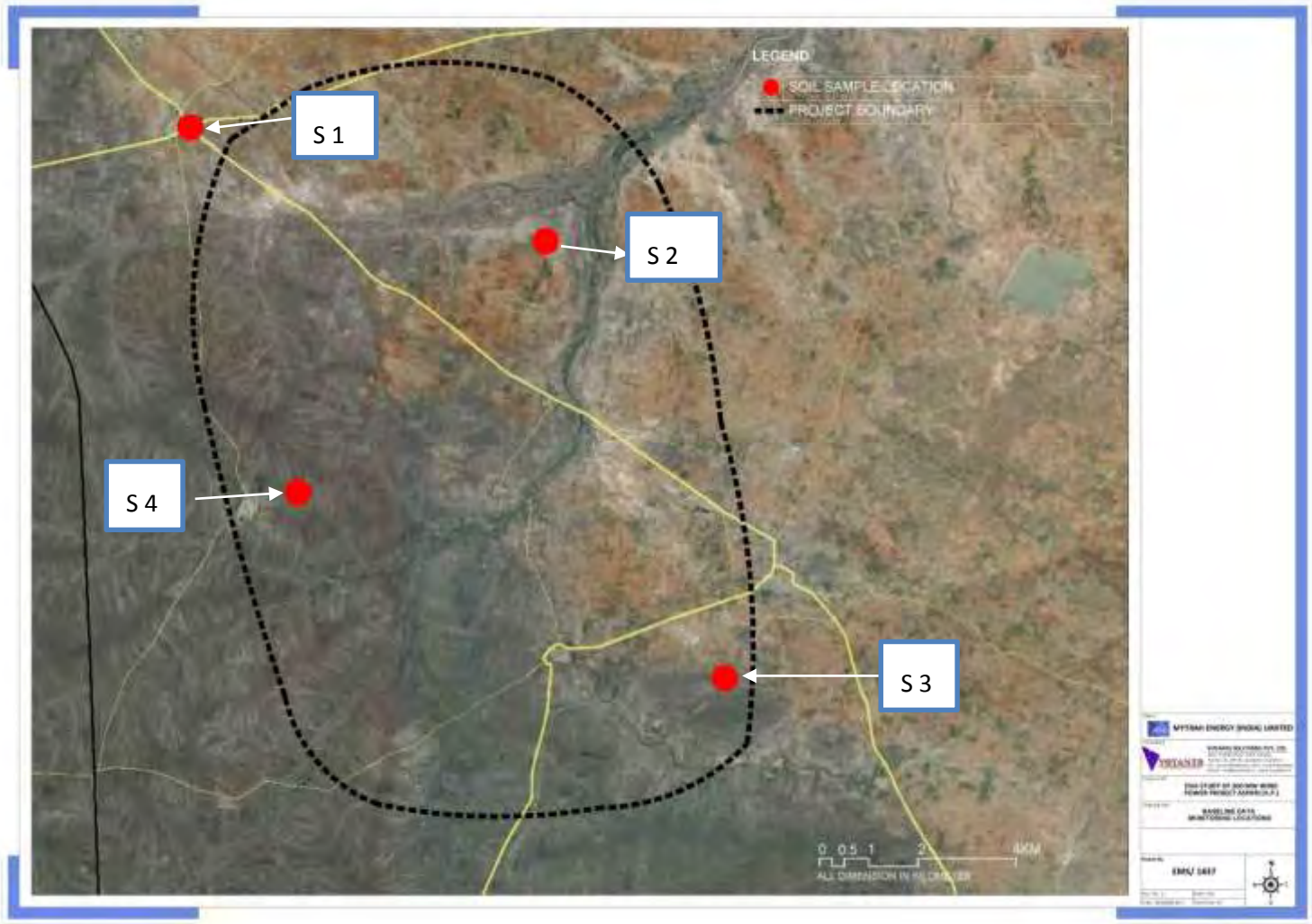


Figure 4:14: Location map showing Soil Sample Locations

Soil testing samples were collected from following villages:

S.No	Village	Station
1.	Aspari	S1
2.	Substation at Juturu Village	S2
3.	Joharapuram	S3
4.	Puchakayalamada	S4

Table 4:11: Soil Quality in the Study - 30 Centimetres

S. No.	PARAMETERES	UNIT	Aspari	Juturu (Substation)	Joharapuram	Puchakayalamada
			S 1	S 2	S 3	S 4
1	Texture	-	Silty Clay	Clay	Silty Clay	Clay
	Sand	%	20	25	11	23
	Silt	%	32	26	42	28
	Clay	%	48	49	47	49
2	pH (10% Slurry)	-	8.62	8.32	8.67	8.57
3	Conductivity	µmhos/cm	156	165	123	154
4	Moisture	%	4.3	4.5	4.2	5.2
5	Organic Matter	%	2.62	3.24	2.84	3.16
6	Bulk density	gram/cc	1.23	1.34	1.32	1.4
7	Porosity	% v/v	62	58	49	48
8	S.A.R	meq/kg	0.36	0.47	0.24	0.32
9	Infiltration capacity	mm/h	28.6	29.2	20.6	22.5
10	Carbonates	mg/kg	2.6	3.6	4.1	2.5
11	Sodium as Na	mg/kg	1	1.2	1	1.1
12	Potassium as K	%	4.6	5.2	6.8	5.6
13	Phosphorus as P	%	8.3	9.5	7.3	4.8
14	Chloride as Cl	mg/kg	1.6	1.2	1.3	1.3
15	Zinc as Zn	mg/kg	5.1	4.9	5.6	5.8
16	Copper as Cu.	mg/kg	0.08	0.09	0.11	0.16
17	Iron as Fe	mg/kg	0.16	0.19	0.22	0.18
18	Nitrogen as N	%	12.2	15.6	11.2	8.9
19	Sulphate as SO_4	mg/kg	1.3	1.1	0.9	1.1
20	Boron as B	mg/kg	0.26	0.24	0.32	0.25

Sample Collection date: 20.11.2015

Table 4:12: Soil Quality in the Study - 60 Centimetres

S. No.	PARAMETERES	UNIT	Aspari	Juturu (Substation)	Joharapuram	Puchakayalamada
			S 1	S 2	S 3	S 4
1	Texture	-	Silty Clay	Clay	Silty Clay	Clay
	Sand	%	16	21	9	20
	Silt	%	36	28	44	31
	Clay	%	48	51	47	49
2	pH (10% Slurry)	-	8.23	8.21	8.43	8.38
3	Conductivity	µmhos/cm	132	143	109	145
4	Moisture	%	6.9	5.8	5.4	6.3
5	Organic Matter	%	2.12	3.06	2.46	2.89
6	Bulk density	gram/cc	1.19	1.29	1.3	1.38
7	Porosity	% v/v	62	65	56	49
8	S.A.R	meq/kg	0.38	0.46	0.22	0.28
9	Infiltration capacity	mm/h	31.2	30.6	26.4	24.3
10	Carbonates	mg/kg	2.4	3.8	3.8	2.3
11	Sodium as Na	mg/kg	0.9	1.1	0.8	1.3
12	Potassium as K	%	4.2	4.9	6.5	5.4
13	Phosphorus as P	%	8.1	9.3	7.2	5.3
14	Chloride as Cl	mg/kg	1.4	1.1	1.2	1
15	Zinc as Zn	mg/kg	4.9	4.6	5.8	5.1
16	Copper as Cu.	mg/kg	0.11	0.08	0.14	0.14
17	Iron as Fe	mg/kg	0.14	0.16	0.2	0.14
18	Nitrogen as N	%	11.3	14.2	10.6	8.6
19	Sulphate as SO_4	mg/kg	1.1	1.1	0.9	1
20	Boron as B	mg/kg	0.24	0.22	0.3	0.24

Sample Collection date: 20.11.2015

Table 4:13: Soil Quality in the Study - 90 Centimeters

S. No.	PARAMETERES	UNIT	S 1 Aspari	S 2 Juturu (Substation)	S 3 Joharapuram	S 4 Puchakayalamada
			RESULTS	RESULTS	RESULTS	RESULTS
1	Texture	-	Silty Clay	Clay	Silty Clay	Clay
	Sand	%	16	21	10	22
	Silt	%	35	28	44	34
	Clay	%	49	51	46	44
2	pH (10% Slurry)	-	8.28	8.16	8.29	8.34

S. No.	PARAMETERES	UNIT	S 1 Aspari	S 2 Juturu (Substation)	S 3 Joharapuram	S 4 Puchakayalamada
			RESULTS	RESULTS	RESULTS	RESULTS
3	Conductivity	µmhos/cm	126	134	115	133
4	Moisture	%	10.2	8.6	7.3	8.9
5	Organic Matter	%	1.96	2.84	2.28	2.64
6	Bulk density	gram/cc	1.18	1.29	1.29	1.36
7	Porosity	% v/v	58	62	54	52
8	S.A.R	meq/kg	0.32	0.48	0.28	0.24
9	Infiltration capacity	mm/h	28.6	29.6	27.3	25.4
10	Carbonates	mg/kg	2.6	4.5	4	2.6
11	Sodium as Na	mg/kg	1.1	1	1.1	1.4
12	Potassium as K	%	2.6	2.9	5.6	4.9
13	Phosphorus as P	%	7.6	8.6	6.8	5
14	Chloride as Cl	mg/kg	1.2	1	1.1	0.9
15	Zinc as Zn	mg/kg	4.8	4.4	5.4	4.9
16	Copper as Cu.	mg/kg	0.08	0.06	0.14	0.12
17	Iron as Fe	mg/kg	0.09	0.14	0.18	0.18
18	Nitrogen as N	%	12.6	11.8	12.4	9.1
19	Sulphate as SO_4	mg/kg	0.9	0.8	1	0.9
20	Boron as B	mg/kg	0.19	0.25	0.28	0.2

Sample Collection date: 20.11.2015

Aspari Soil Sampling

Puchkalayamada Soil Sampling

	
Joharapuram Soil Sampling	Juturu Soil Sampling

Inference

Table above clearly points out that the texture of soil in Aspari and Joharapuram villages is Silty Clay. Whereas in substation at Juturu village and Puchakayalamada villages, soil texture is Clay. Presence of essential elements such as Sodium and Potassium are within Permissible Limits. Electrical Conductivity of the soil in Substation at Juturu, Puchakayalamada village and Aspari village is more than soil in Joharapuram Village. Heavy metals Zinc, Copper and Iron were observed in the soil samples analyzed at all locations.

4.6 NOISE LEVEL MONITORING

Ambient noise was monitored at four locations in the study area. The locations identified were rural/residential/sensitive areas. The areas identified for monitoring with details are provided in **Table 4.14** below:

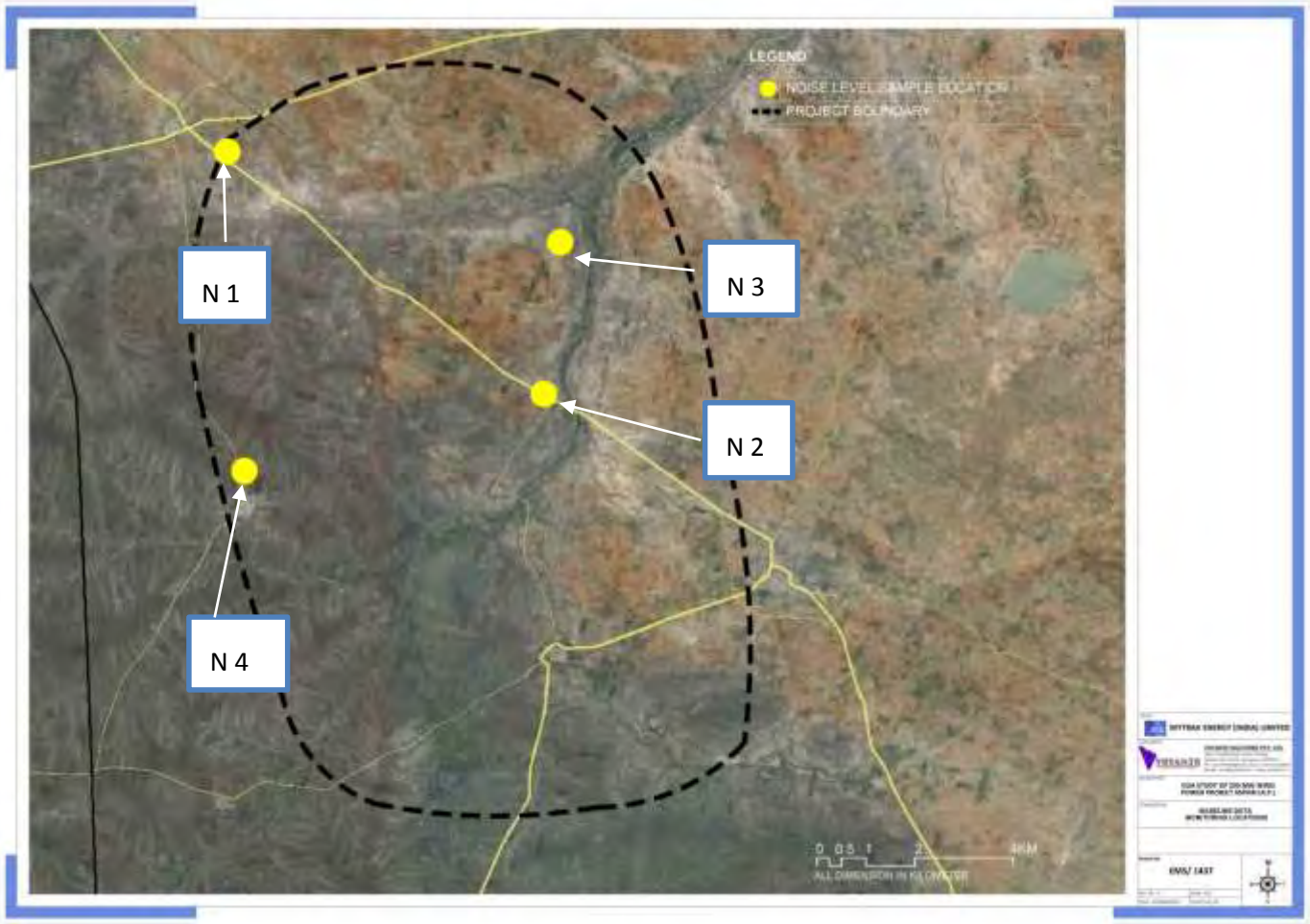


Figure 4:15: Location map showing Noise Level Sample Locations

Table 4:14: Noise Quality in the Study (in decibel)

S. NO	Location Name	Coordinates		Location Code
1	Aspari	$15^{028'}$34.36" N	$77^{0\ 23'}$23.91" E	N1
2	Chinnahulthi	15^{0}58'9.35" N	$77^{0\ 2}$7'52.01" E	N2
3	Juturu(substation)	$15^{0\ 27'}$17.17" N	$77^{0\ 27'}$32.44" E	N3
4	Joharapuram	$15^{0\ 24'}$35.95" N	$77^{0\ 24'}$1.51" E	N4

The observations of noise monitoring were calculated as Leq Day and Leq Night. The results are presented in the **Table 4.15.**

Table 4:15: Noise Sample

	Leq DAY	Leq NIGHT	Leq DAY NIGHT
N1-Aspiri	48.60	33.58	47.48
N2-Chinnahulthi	47.55	35.04	46.86
N3-Juturu(substation)	48.53	34.20	47.51
N4-Joharapuram	47.57	33.36	46.56

Aspari Noise Monitoring Location

ChinnaHultti Noise Monitoring location

Joharapuram Noise Sample Collection

Noise Monitoring at Sub-Station

The prescribed standard for equivalent noise levels at rural and residential areas are 55dB(A) for day time (0700 to 2200 hours) and 45 dB(A) for night time (2200 to 0700 hours) as described by IFC. The monitored noise levels were within the prescribed limits of the CPCB norms and the IFC guideline value with respect to noise at all locations. Both the standards /norms will be complied with i.e. IFC

and Law of Land (CPCB). MVTPL will also follow OHSAS norm of 8-hour exposure to 85 dB which is Occupational Noise Exposure. The noise levels are depicted in **Figure 4.16**

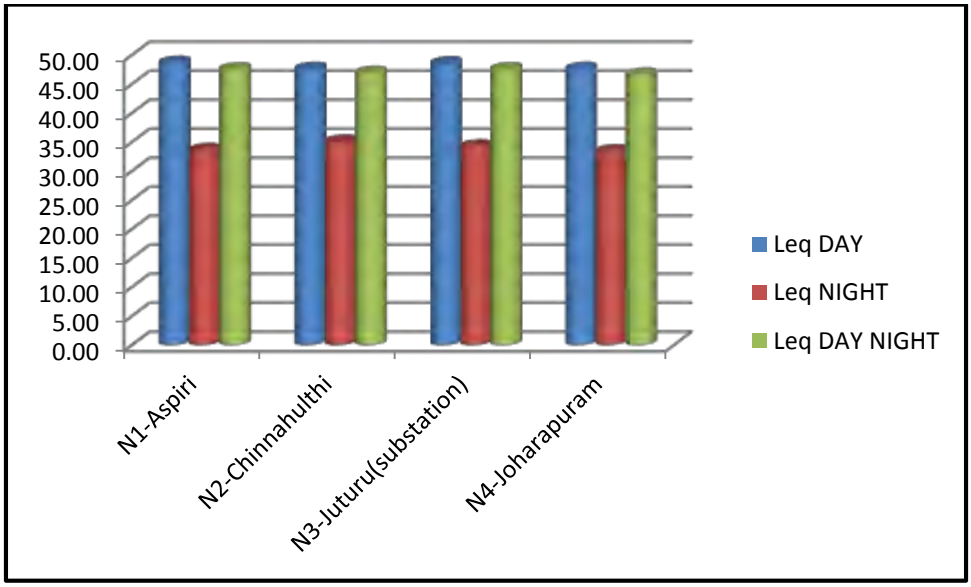


Figure 4:16: Observations of Noise Level in the Study Area

4.7 BIOLOGICAL ENVIRONMENT

The surveys for ecology and biodiversity assessment were conducted in and around the proposed wind farm site (Aspari village). In addition, a Long Term Bird & Bat Study has also been conducted separately by the consultant and enclosed as Annexure XII. The proposed area **(Photo-4.1**) lies in the Hindri river basin – a tributary of Tungabhadra River and located between 15° 20' 54" and 15° 29' 00" N latitude and 77° 23' 42" and 77° 29' 48" E longitude. The general topography of the area is gently undulating to flat. It is sloping towards northeast. It is marked with isolated agricultural farms and barren land. The main land use pattern is single crop agriculture. Out crop of rock boulders is a common feature of this area. The average elevation of land surface is observed to be 480 m above the MSL. The area is dominated by scrubby growth. These scrub growths are invaded by *Prosopis juliflora*. It has particularly occupied the open barren surface. The ecological studies were conducted to understand ecosystem structure at and around the proposed site.

Photo 4:1: The Proposed Site Showing Natural Land Use Pattern

Biogeographic setting:

According to revised forest types (Champion and Seth, 1968) the study area has been classified as Southern Tropical Thorn Forests (Group 6 subgroup 6A/C1/DS1/DS2). According to Rodgers & Panwar (1988) biogeographic classification the regions falls in what is known as Deccan biogeographic zone (6) and Deccan Plateau South (6A) biotic province. These areas are characterized by, dry thorn species and scrublands **(Photo 4.2**). The area is an important representative of dry scrubland in the region.

Criteria for Site Selection:

While selecting the areas for detailed studies on biodiversity and ecology following considerations were made

- Location of the proposed site.
- Different landscapes and land use patterns
    - Natural vegetation
    - Agro-ecosystems and surrounding areas
    - Water bodies – lakes, canals, ponds *etc*.
- Topography and Geology
- Guidelines from Ministry of Environment and Forest, Government of India

Based on the above parameters sampling sites were selected and sampling was carried out from different locations randomly.

Photo 4:2: The Scrub Forests around Proposed Site

Objectives of Ecological Studies:

The study was undertaken with a view to understand the status of ecosystem along the following line:

- Review of secondary literature available with Botanical and Zoological Survey of India, Forest department *etc*. for determining historical trends
- To assess nature and distribution of the vegetation in the area
- Determination of type of forests.
- Preparation of checklist of flora and fauna
- Listing of Trees, shrubs, climbers and herbs and other existing habit forms.
- To recognize the plant community
- To identify the rare and endangered species in the project area
- To determine ecologically sensitive areas like national parks or wildlife sanctuaries
- To assess the macrophytes along the water bodies.
- Generation of primary data to understand baseline ecological status of floral elements and sensitive habitats.
- Existing status of flora and fauna
- Enumeration of lower plants groups members (Pteridophytes, Bryophytes, Fungi, Algae) if any in the area.
- Disturbance due to human utilization and livestock.

Terrestrial Ecology:

Methods adopted for the study:

To achieve the above objectives, general floristic and ecological survey covering the entire area around the proposed site was carried out. The survey included:

- Reconnaissance Survey
- Generation of primary data to understand baseline ecological status of floral elements, sensitive habitats and rare species

- Importance and status of plants

Survey for Flora:

A survey was carried out to have an overview of the terrestrial ecosystem of the core area. The field visits were carried out during 24th to 28th November 2015. The area exhibits a land use pattern that mainly consists of agricultural land and highly degraded scrub patches.

Methodology for sampling and analysis:

The floristic studies were based on extensive exploration of the study area. The field surveys involve the preparation of an inventory of different species of plants including trees, shrubs, climbers and herbs in the plant community of the area. All plant species were identified correctly with the help of expert taxonomist and literature published by BSI. The observations were also made on the agricultural patterns, agricultural weeds and cultivated and introduced plant species. The documentation of the plant communities was done by random walk through the study area and visual observations.

The vegetation or the plant communities of the proposed area, was analyzed by taking the following precautions and considering the environmental variables while making the observations.

1. Disturbance due to human utilization and livestock.
2. General as well as specific photographs of the plants were taken.
3. Care was taken that every aspect should be covered during the field survey and no species shall be left unidentified from the study area.
4. Efforts were taken to observe wild plants, weeds, specimens from crop fields, wastelands, roadsides *etc*.
5. Rare, endangered, edible, poisonous, and economically important plants if any will be noted.

Observations and Results:

The topography and relief of the area was North-East direction. The study area best represents as arid or semi-arid region. The vegetation was very sparse consisting stunted thorny or prickly shrubs and herbs capable of drought resistance. Trees showed stunted growth and were very few and scattered. The vegetation can be described as scrubland or arid land and almost xerophytic in nature.

4.7.1 Floristic Analysis:

The plant species of a particular geographical area makes its flora. Floristic analysis is necessary for knowing the composition of plant species. The floristic survey was carried out in the proposed area. Overall 379 plant species have been recorded. The total number of genera were 264 and species 379 belonging to 77 families; indicating the floristic richness of the area. However, these species were very sparse in their distribution. The taxonomically most abundant genera (Table-1) were Cassia (11 species) and Euphorbia (10 species) followed by Cyperus (7 species), Acacia and Alysicarpus (6 species each), Abutilon and Hibiscus (5 species each). The taxa-wise most abundant families **(Table-4.14**) were Poaceae (33 species) and Fabaceae (26 species), followed by Asteraceae (25 species), Euphorbiaceae and Malvaceae (22 species each), and Caesalpiniaceae (20 species).

There was predominance of herbs (33%) and shrubs (28%) followed by trees (18%), and grasses (9%), whereas climbers represented 8% and sedges 5% ((**Figure 4.17**). Out of total species 86% were native (indigenous) and 14% exotic (**Figure 4.17**). The class dicotyledon represents highest number of species (82%), whereas class monocotyledon signifies 12 % species. Out of total species reported 81% were reported to be wild, and 19% as cultivated (**Figure 4.18**). The most common climbers were *Tylophora,*

Sarcostemma, Wattakaka volubilis, Pergularia daemia, Cocculus villosus, and *Rivea ornata*. The Pteridophytes were totally absent; and similarly the bryophytes and the fungi were not reported, as they are very much sensitive to humidity and moisture. The list includes the botanical name of species, habit, and family. The list is by actual siting of the core area and based on desk records.

Table 4:16: Taxa-wise most abundant genera.

Genus	Family	Number of Species
Cassis	Caesalpiniaceae	11
Euphorbia	Euphorbiaceae	10
Cyperus	Cyperaceae	7
Acacia	Mimosaceae	6
Alysicarpus	Fabaceae	6
Abutilon	Malvaceae	5
Hibiscus	Malvaceae	5
Ficus	Moraceae	4
Sida	Malvaceae	4
Ziziphus	Rhamnaceae	4

Table 4:17: Taxa-wise top ten families

Family	Number of species
Poaceae	33
Fabaceae	26
Asteraceae	25
Euphorbiaceae	22
Malvaceae	22
Caesalpiniaceae	20
Cyperaceae	19
Mimosaceae	16
Asclepiadaceae	14
Verbenaceae	12

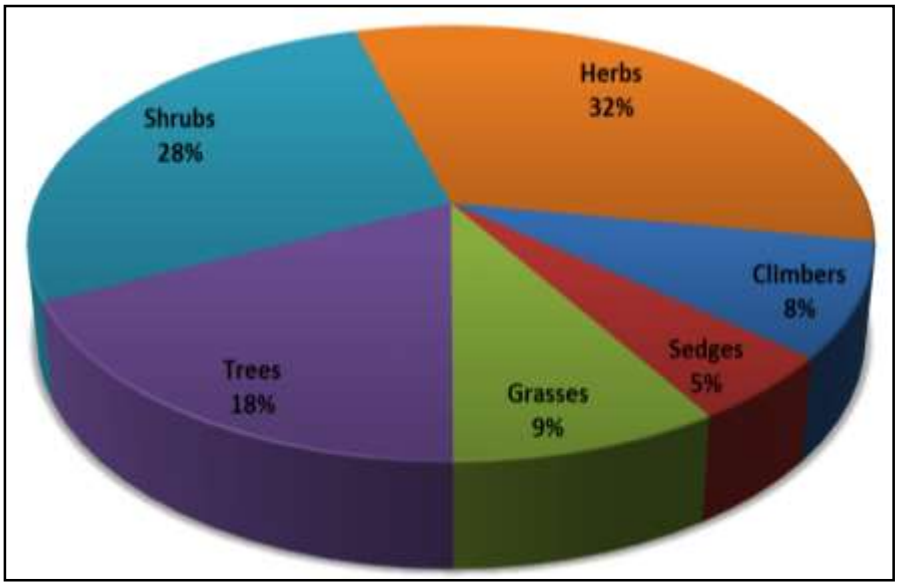


Figure 4:17: Distribution of habitat forms in the study area.

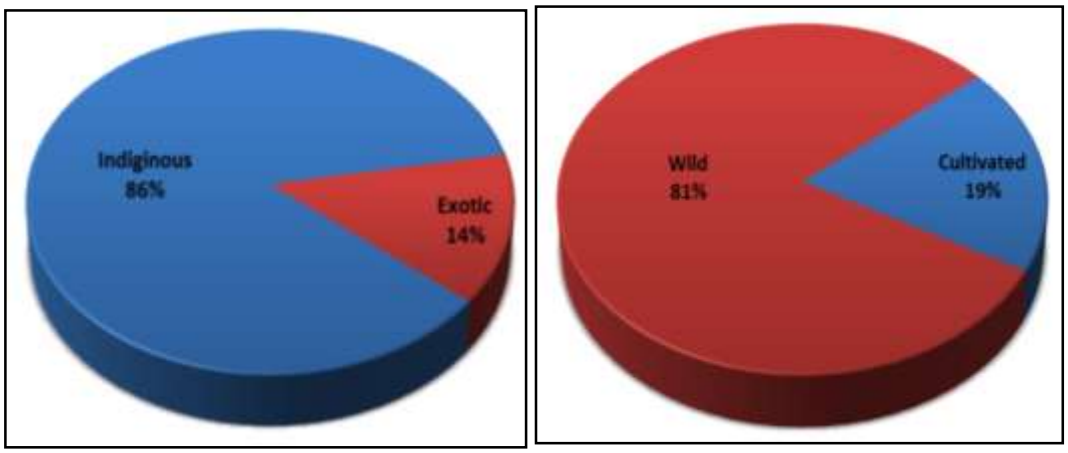


Figure 4:18: Distribution of native and exotic species; and wild verses cultivated species.

Herbaceous Flora of the Area:

The herbaceous vegetation was surveyed by random walk through the barren land, and single crop agriculture, and pasturelands. The abundant herb species includes Alysicarpus sp., Leucas sp., Euphorbia sp., Acalypha indica, Lepidagathis sp, Ageratum sp., Tephrosia sp., Cassia sp., Sida sp., Boerrhavia sp., Polygala sp., Amaranthus sp., Evolvulus sp., Parthenium sp., Tridax sp., etc. This herbaceous flora is enumerated in **Table 4.18** as below.

Table 4:18: Herbaceous flora of the area

Botanical Name	Family
Indoneesiella echioides	Acanthaceae
Lepidagathis cristata Willd.	Acanthaceae
Lepidagathis cuspidata Nees.	Acanthaceae
Peristrophe paniculata	Acanthaceae
Corbichonia decumbens	Aizoaceae

Botanical Name	Family
Achyranthes aspera Linn.	Amaranthaceae
Alternanthera pungens	Amaranthaceae
Alternanthera sessilis	Amaranthaceae
Amaranthus blitum	Amaranthaceae
Amaranthus spinosus Linn.	Amaranthaceae
Celosia argentea Linn.	Amaranthaceae
Digera arvensis	Amaranthaceae
Gomphrena serrata	Amaranthaceae
Acanthospermum hispidum	Asteraceae
Achmella uliginosa	Asteraceae
Ageratum conyzoides Linn.	Asteraceae
Amberboa ramose	Asteraceae
Bidens biternata	Asteraceae
Bidens pilosa Linn.	Asteraceae
Blainvillea acmella	Asteraceae
Echinops echinatus Roxb.	Asteraceae
Glossocardia bosvallea	Asteraceae
Lagasca mollis Cav.	Asteraceae
Launaea nudicaulis Hook.	Asteraceae
Parthenium hysterophorus L.	Asteraceae
Pulicaria wightiana C.B. Clarke	Asteraceae
Tricholepis radicans DC.	Asteraceae
Tridax procumbens Linn.	Asteraceae
Vernonia cinerea Less.	Asteraceae
Wedelia chinensis (Osbeck) Merr.	Asteraceae
Xanthium indicum	Asteraceae
Zornia gibbosa	Asteraceae
Heliotropium ovalifolium	Boraginaceae
Cassis tora Linn	Caesalpiniaceae
Cleome viscosa Linn.	Cleomaceae
Commelina benghalensis	Commelinaceae
Commelina diffusa	Commelinaceae
Cyanotis cristata	Commelinaceae
Cyanotis tuberosa	Commelinaceae
Tonningia axilaris	Commelinaceae
Convolvulus microphyllus	Convolvulaceae
Evolvulus alsinoides Linn.	Convolvulaceae
Acalypha capitate	Euphorbiaceae
Chrozophora plicata A. Juss.	Euphorbiaceae
Euphorbia geniculata Orteg.	Euphorbiaceae
Euphorbia hirta L.	Euphorbiaceae
Euphorbia microphylla	Euphorbiaceae

Botanical Name	Family
Phyllanthus fraternus	Euphorbiaceae
Alysicarpus bupleurifolius DC	Fabaceae
Alysicarpus longifolius	Fabaceae
Alysicarpus monilifer DC.	Fabaceae
Alysicarpus vaginalis	Fabaceae
Crotalaria medicaginea	Fabaceae
Desmodium triflorum DC.	Fabaceae
Indigofera cordifolia	Fabaceae
Indigofera linnaei	Fabaceae
Rhynchosia minima DC.	Fabaceae
Stylosanthes fruiticosa	Fabaceae
Stylosanthes hamata	Fabaceae
Tephrosia purpurea (L.) Pers.	Fabaceae
Leucas aspera Spreng.	Lamiaceae
Wolffia arrhizal	Lemnaceae
Decaschistia trilobata	Malvaceae
Hibiscus cannabinus	Malvaceae
Malvastrum coromandelianum	Malvaceae
Sida cordifolia Linn.	Malvaceae
Sida mysorensis	Malvaceae
Sida rhombifolia Linn.	Malvaceae
Urena tobata L.	Malvaceae
Martynia annua	Martyniaceae
Mollugo cerviana Seringe.	Molluginaceae
Mollugo pentaphylla Linn.	Molluginaceae
Boerhaavia diffusa Linn.	Nyctaginaceae
Ludwigia octovalvis (Jacq.) Raven	Onagraceae
Persicaria glabra	Polygonaceae
Portulaca oleracea Linn.	Portulacaceae
Portulaca quadrifida	Portulacaceae
Richardia scabra	Rubiaceae
Spermacoce stricta	Rubiaceae
Spermacoce verticillata	Rubiaceae
Striga lutea Lour.	Scrophulariaceae
Datura ferox	Solanaceae
Datura metal Linn.	Solanaceae
Physalis minima Linn.	Solanaceae
Phylla nodiflora	Verbenaceae
Hybanthus enneaspermus	Violaceae
Tribulus terrestris Linn.	Zygophyllaceae

Grasses and Sedges:

The grasses occupy important status in the herbaceous flora. The grasses were observed usually on the open places and in degraded forests, and wastelands. The grasses are useful as fodder and subsequent grazing and to check the exposure of soil. The most common grasses *were Aristida, Chloris, Digitaria, Dimeria, Dactyloctenium, Setaria, Cenchrus, and Cyperus* sp.

Sedges form a major component of most wetland vegetation units around the world and make an enormous contribution to nutrient cycling and habitat formation in these ecosystems. Sedges belong to family *Cyperaceae*. They form unique habitat for birds and other animals. We have reported few types of sedge during the field surveys. These grasses and sedges are listed below in **Table 4.19.**

Table 4:19: Grasses of the study area

Botanical Name	Form	Family
Alloteropsis cimicina	Grass	Poaceae
Aristida depressa Retz.	Grass	Poaceae
Aristida setacea Retz.	Grass	Poaceae
Arundinella ciliate	Grass	Poaceae
Arundinella leptochloa	Grass	Poaceae
Brachiaria distachya (Linn.) Stapf	Grass	Poaceae
Brachiaria miliiformis	Grass	Poaceae
Bulbostylis barbata	Sedge	Cyperaceae
Chloris barbata Sw.	Grass	Poaceae
Chrysopogon sp.	Grass	Poaceae
Cynodon dactylon (Linn.) Pers.	Grass	Poaceae
Cyperus castaneus	Sedge	Cyperaceae
Cyperus compressus Linn.	Sedge	Cyperaceae
Cyperus difformis	Sedge	Cyperaceae
Cyperus distans Linn.f.	Sedge	Cyperaceae
Cyperus halpan Linn.	Sedge	Cyperaceae
Cyperus iria	Sedge	Cyperaceae
Cyperus rotundus Linn.	Sedge	Cyperaceae
Dactyloctenium aegyptium	Grass	Poaceae
Digitaria ciliaris (Retz.) Koel.	Grass	Poaceae
Digitaria longiflora	Grass	Poaceae
Dimeria ornithopoda Trin.	Grass	Poaceae
Eleocharis dulcis	Sedge	Cyperaceae
Eleocharis geniculate	Sedge	Cyperaceae
Eleusine indica	Grass	Poaceae
Eragrostis tenella	Grass	Poaceae
Eragrostis unioloides	Grass	Poaceae
Eragrostis viscosa	Grass	Poaceae
Fimbristylis acumunata	Sedge	Cyperaceae
Fimbristylis dichotoma	Sedge	Cyperaceae
Fimbristylis miliacea	Sedge	Cyperaceae

Botanical Name	Form	Family
Heteropogon contortus	Grass	Poaceae
Isachne miliacea	Grass	Poaceae
Ischaemum indicum	Grass	Poaceae
Kyllinga brevifolia	Sedge	Cyperaceae
Lipocarpha chinensis	Sedge	Cyperaceae
Mariscus javanicus	Sedge	Cyperaceae
Paspalidium flavidum	Grass	Poaceae
Pycreus polystachyos	Sedge	Cyperaceae
Rhynchospora corymbosa	Sedge	Cyperaceae
Scirpus supinus	Sedge	Cyperaceae
Setaria barbata	Grass	Poaceae
Setaria pumila	Grass	Poaceae
Sorghum vulgare Pers.	Grass	Poaceae
Sporobolus indicus (Linn.) R.Br.	Grass	Poaceae
Themeda triandra	Grass	Poaceae

Weed Flora:

A large number of weeds grow in the agricultural fields. Especially the irrigated fields are having high number of weeds. The weed density may vary depending on the season. The typical weeds of the area recorded are *Tribulus terrestris*, *Celosia argentea*, *Polycarpea corymbosa*, *Boerhaavia diffusa*, *Alternanthera sp., Acalypha sp., Ageratum sp., Alysicarpus sp., Argemone mexicana, Euphorbia sp. etc.* All weeds are given in **Table 4.20** as follow.

Table 4:20: Weeds of the area

Botanical Name	Family
Acalypha indica Linn.	Euphorbiaceae
Achyranthes aspera Linn.	Amaranthaceae
Ageratum conyzoides Linn.	Asteraceae
Alternanthera triandra Lam.	Amaranthaceae
Alysicarpus pubescens Law	Fabaceae
Amaranthus spinosus Linn.	Amaranthaceae
Bidens pilosa Linn.	Asteraceae
Blumea lacera DC.	Asteraceae
Boerhaavia diffusa Linn.	Nyctaginaceae
Boerhaavia verticillata Poir.	Nyctaginaceae
Cassis tora Linn	Caesalpinaceae
Celosia argentea Linn.	Amaranthaceae
Chrozophora plicata A. Juss.	Euphorbiaceae
Cleome viscosa Linn.	Cleomaceae
Datura metal Linn.	Solanaceae
Desmodium triflorum DC.	Fabaceae
Echinops echinatus Roxb.	Asteraceae

Botanical Name	Family
Eclipta alba Haask.	Asteraceae
Euphorbia geniculata Orteg.	Euphorbiaceae
Euphorbia hirta L.	Euphorbiaceae
Evolvulus alsinoides Linn.	Convolvulaceae
Indigofera sp.	Fabaceae
Lagasca mollis Cav.	Asteraceae
Launaea nudicaulis Hook.	Asteraceae
Leucas aspera Spreng.	Lamiaceae
Ludwigia octovalvis (Jacq.) Raven	Onagraceae
Mollugo pentaphylla Linn.	Molluginaceae
Parthenium hysterophorus L.	Asteraceae
Physalis minima Linn.	Solanaceae
Polycarpea corymbosa	Caryophyllaceae
Polygala arvensis Willd.	Polygalaceae
Polygala erioptera DC.	Polygalaceae
Portulaca oleracea Linn.	Portulacaceae
Pulicaria wightiana C.B. Clarke	Asteraceae
Rhynchosia minima DC.	Fabaceae
Sida acuta Burm.	Malvaceae
Sida cordifolia Linn.	Malvaceae
Sida rhombifolia Linn.	Malvaceae
Solanum nigrum Linn.	Solanaceae
Solanum surattense Burm. f.	Solanaceae
Sonchus oleraceus Linn.	Asteraceae
Tephrosia purpurea (L.) Pers.	Fabaceae
Tribulus terrestris Linn.	Zygophyllaceae
Tricholepis radicans DC.	Asteraceae
Tridax procumbens Linn.	Asteraceae
Vernonia cinerea Less.	Asteraceae
Xanthium indicum	Asteraceae

The Exotic flora:

The local people cultivate many ornamentals, horticultural plants, important vegetables, trees, shrubs and climbers for aesthetic purpose. These represent fairly high number of exotic species. It has further enriched the flora. The forest department has introduced some species for plantation, which involves *Eucalyptus* sp. and *Casuarina equisetifolia*. Among the exotic flora most common species are *Delonix regia, Eucalyptus sp., Pithecolobium dulce, Polyalthia longifolia, Plumeria alba, Nerium odorum, Bougainvillea spectabilis, Canna indica, etc.* Some of the species are now naturalized in the area though they are exotic in nature. These include *Casuarina, Prosopis juliflora, and Leucaena etc.* The exotic species are listed below in **Table 4.21**.

Table 4:21: Exotic flora of the area

Botanical Name	Habit	Family
Bauhinia purpurea Linn.	Tree	Caesalpinaceae
Bauhinia variegata Linn.	Tree	Caesalpinaceae
Bougainvillaea spectabilis Willd.	Climber	Nyctaginaceae
Canna indica Linn.	Shrub	Cannaceae
Cassia siamea Lamk.	Tree	Caesalpinaceae
Casuarina equisetifolia Forst.	Tree	Casuarinaceae
Delonix regia (Bojer) Raf.	Tree	Caesalpinaceae
Duranta plumieri Jacq.	Shrub	Verbenaceae
Eucalyptus sp.	Tree	Myrtaceae
Euphorbia pulcherrima Willd.	Tree	Euphorbiaceae
Ipomoea carnea Jacq.	Shrub	Convolvulaceae
Jacaranda mimosaefolia D. Don	Tree	Bignoniaceae
Kigelia pinnata DC.	Tree	Bignoniaceae
Lantana camara Linn.	Shrub	Verbenaceae
Leucaena leucocephala (Lam.) de Wit.	Tree	Mimosaceae
Millingtonia hortensis Linn.	Tree	Bignoniaceae
Nerium indicum	Shrub	Apocynaceae
Peltophorum pterocarpum	Tree	Caesalpinaceae
Pithecolobium dulce Benth.	Tree	Mimosaceae
Pithecolobium saman Benth.	Tree	Mimosaceae
Plumeria acutifolia Poir.	Tree	Apocynaceae
Plumeria alba Linn.	Tree	Apocynaceae
Polyalthea longifolia (Sonnerat) Thw.	Tree	Annonaceae
Prosopis juliflora (Swartz) DC.	Shrub	Mimosaceae
Quisqualis indica Linn.	Climber	Combretaceae
Tagetes erecta Linn.	Herb	Asteraceae
Tecoma stans Juss.	Shrub	Bignoniaceae
Terminalia catappa Linn.	Tree	Combretaceae
Thespesia populnea Soland	Tree	Malvaceae
Thevetia neriifolia Juss.	Tree	Apocynaceae
Wedelia chinensis (Osbeck) Merr.	Herb	Asteraceae

Endangered Species:

There are no ecologically sensitive areas like national parks or wildlife sanctuaries, Tiger Reserves, Elephant Reserves, Turtle Nesting Ground and Core Zone Biosphere Reserve within the 10 km radius of proposed site. Though the area shows good diversity of flora, there were no reports of any species falling in endangered category as per the IUCN and BSI record.

Endemic Species:

The endemic species are those, which have restricted distribution to particular geographical area. This area was rich floristically; however, it does not show any local endemic species. Few species of plants which are endemic to India were reported from this area. It includes the species like- *Hardwickia binnata*, and *Dichrostachys cinerea.* Though these are endemic to India, are not under the threat.

Agriculture Pattern:

The main land-use around the proposed site was farming, mainly cultivated with crops like Ajwain (*Trachyspermum ammi*), Cotton (*Gossypium hirsutum*), Chana (*Cicer ariatinum*), Red gram (*Cajanus cajan*) and Groundnut (*Arachis hypogea*) as cash crops. The crops cultivated in this area are listed in **Table 4.22**. The other crops taken were Sunflower (*Helianthus annuus*), Bajara (*Pennisettum* sp.) and Jwari (*Sorghum vulgare*). The leafy vegetable crops are *Brassica oleracea* var *capitata*, *Spinacia oleracea*, *Coriandrum sativum,* and *Amaranthus sp.* The *Peucedanum graveolens* (Shepu) is found cultivated occasionally. The fruit vegetables are Tomato (*Lycopersicon esculenta*), Brinjal (*Solanum melongea*) and *Capsicum annum.*

The important fruit plants were *Cocos nucifera* (Coconut), *Areca catechu* (Areca nut), *Musa paradisica* (Banana), *Mangifera indica* (Mango), *Carica papaya* (Papita), and *Psidium guyava*. Occasionally, *Achrus sapota* was found grown nearby the houses. The wild fruit species are *Ziziphus mauritiana*, *Carissa spinarum* and *Cordia dichotoma*. The farms are interspersed with human habitation, villages and townships.

Table 4:22: Common crops of the area

Botanical Name	Common Name	Habit	Family
Abelmoschus esculentus	Ladies Finger	Herb	Malvaceae
Abelmoschus ficulneus	Wild Bhendi	Herb	Malvaceae
Arachis hypogaea L.	Ground nut	Herb	Fabaceae
Areca catechu L.	Areca nut	Tree	Arecaceae
Brassica juncea	Mustard	Herb	Brassicaceae
Brassica oleracea var. botrytis	Cauliflower	Herb	Brassicaceae
Brassica oleracea var. capitata	Cabbage	Herb	Brassicaceae
Cajanus cajan (L.) Millsp.	Red gram	Herb	Fabaceae
Capsicum annuum L.	Capsicum	Herb	Solanaceae
Carica papaya Linn.	Papaya	Shrub	Caricaceae
Cicer ariatinum	Cheak pea	Herb	Fabaceae
Coccinia indica Wight & Arn.	Ivy Gourd	Climber	Cucurbitaceae
Cocos nucifera Linn.	Coconut	Tree	Arecaceae
Colocasia antiquorum Schott.	Colocasia	Herb	Araceae
Coriandrum sativum Linn.	Coriander	Herb	Apiaceae
Cucurbita maxima Duch.	Pumpkin	Climber	Cucurbitaceae
Cyamopsis tetragonoloba	Cluster Bean	Herb	Fabaceae
Gossypium arboreum	Cotton	Shrub	Malvaceae

Botanical Name	Common Name	Habit	Family
Gossypium hirsutum	Cotton	Shrub	Malvaceae
Helianthus annuus L.	Sunflower	Herb	Asteraceae
Lablab purpureus	Indian Bean	Climber	Fabaceae
Luffa acutangula Roxb.	Ribbed gourd	Climber	Cucurbitaceae
Luffa aegyptiaca Mill.	Round gourd	Climber	Cucurbitaceae
Lycopersicum esculentum Mill.	Tomato	Herb	Solanaceae
Macrotyloma uniflorum	Horse gram	Climber	Fabaceae
Momordica charantia L.	Bitter gourd	Climber	Cucurbitaceae
Musa paradisiaca Linn.	Banana	Shrub	Musaceae
Oryza sativa L.	Rice	Grass	Poaceae
Pennisetum typhoideum Rich.	Bajra	Grass	Poaceae
Ricinus communis	Castor	Herb	Euphorbiaceae
Saccharum officinarum Linn.	Sugarcane	Grass	Poaceae
Sesamum indicum	Sesame	Herb	Pedaliaceae
Solanum melongena Linn.	Brinjal	Herb	Solanaceae
Sorghum vulgare Pers.	Sorgham	Grass	Poaceae
Trachyspermum ammi	Ajwain	Herb	Apiaceae
Trigonella foenum-graecum	Fenugreek	Herb	Fabaceae
Triticum aestivum Linn.	Wheat	Grass	Poaceae
Vigna aconitifolia	Moth Bean	Herb	Fabaceae
Vigna mungo	Black gram	Herb	Fabaceae
Vigna radiate	Green Gram	Herb	Fabaceae
Vigna trilobata	Wild Bean	Herb	Fabaceae
Vigna unguiculata	Cow Pea	Climber	Fabaceae
Withania somnifera	Ashwagandha	Herb	Solanaceae
Zea mays L.	Maize	Grass	Poaceae

Vegetation Structure:

The vegetation structure was confined to the species like – *Euphorbia antiquorum, Albizzia amara, Securinega leucopyrus, Carrisa spinarum, Azadirachta indica, Catunaregum spinarum, Dodonea viscosa, Cissus woodrowii, Dichrostachys cinera, Opuntia sp., Capparis sp.,* and *Acacia sp. etc.* At some places degradation as a result of the usual damage results in formation of close almost impermeable thorny thickets, 2-4 meters high. However, there were very open formation in which, fleshy *Euphorbia's* are the most important constituents.

The agricultural land also shows some sparse vegetation. The vegetation sampling was, therefore, carried out in agricultural land and scrublands as well. The open and waste places in and around the villages are invaded by *Prosopis juliflora* – an exotic and highly invasive forest weed. The hills have lost its natural topography due to exploration of granite. But, there is no quarrying near project area. It is still a virgin site. This is a common trend and local practice in the entire area.

The reserved forest at Pattikonda village represents plant communities such as *Rhus mysorensis-Dodonea viscosa-Ziziphus xylopyra*, *Carrisa spinarum-Gymnosporea montana-Holoptelia integrifolia*, and *Euphorbia antiquorum-Catunaregum spinarum-Dichrostachys cinera*. The other plant communities include *Ixora arborea-Grewia tenax-Cassia fistula*.

Out of hundreds species present in the forest, relatively few exert a major controlling influence by virtue of their size, structure, physiognomy and number. Overall structure of the vegetation of this area is scattered scrubland interspersed with grasslands. It is dominated by few tree species like *Acacia leucophloea*, *Azadirachta indica, Prosopis juliflora,* and to some extends *Cassia auriculata,* and *Ailanthus sp.* The shrub layer is represented by, *Capparis decidua, Carissa spinarum, Cassia montana, Catunaregum, Cadaba, Maytenus,* and *Ziziphus* sp. The climbers were few and sparse. The epiphytes were absent. This vegetation structure is the result of extreme local environmental factors.

Most commonly observed naturally occurring trees species were *Acacia leucophloea*, *Prosopis spicigera*, *Acacia nilotica*, and *Azadirachta indica*. These species were also found growing on agriculture bunds. *Prosopis juliflora* and *Lantana camara* were commonly found weeds or invasive species. The vegetation is characteristically dominated by *Prosopis juliflora, Cassia auriculata, Dodonea viscosa,* and *Securinega sp. Prosopis juliflora* is spreading naturally and forming a characteristic facies (appearance).

There were two reserved forests arround 10 km radius. The one was near village Pattikonda (Photo-4.3) at east and other near village Tuggali at southeast direction. These reserved forests were rich in a unique species composition. These species includes *Euphorbia antiquorum, Albizzia amara, Securinega leucopyrus, Carrisa spinarum, Azadirachta indica, Catunaregum spinarum, Dodonea viscosa, Cissus woodrowii, Dichrostachys cinera, Opuntia sp., Capparis sp.,* and *Acacia sp. , Rhus mysorensis, Dodonea viscosa, Ziziphus xylopyra*, *Carrisa spinarum, Gymnosporea montana,* and *Holoptelia integrifolia*.

The area is extremely open with a few scattered plants here and there. These arid forests were predominated by *Euphorbia*, *Acacia* and *Prosopis* species*. Cassia auriculata* and *Cassia montana*, were often the most conspicuous shrubs. Among the shrubs *Calotropis procera, Maytenus, Securinega, Opuntia* and *Dichrostachys* are frequently seen. The most characteristic grasses were *Aristida, Brachiara, Digitaria, Heteropogon, Sporobolus* sp. and *Dactyloctenium* sp.

Photo 4:3: Reserved forests near Pattikonda village

The community /ecosystem structure was fairly disturbed and showed no integrity. Because of the intense biotic pressure, mainly in the form of grazing, lopping and illicit removal of indigenous plant species, there is decrease in ecosystem resistance of forest, and as a result, the problem weed – *Prosopis juliflora* has invaded the forest and even agricultural area. It is very clear that the community was fairly disturbed and depicts a type of degraded scrubland (**Photo-4.3**).

4.7.2 Description of Fauna (Non-Domesticated)

Total Listing of Faunal Elements:

Faunal studies help to understand the wellbeing of a nature and functioning of ecosystems. It helps to monitor biological richness or heritage quality, habitat change and quantifying threatening species. The faunal components such as Arthropods, Molluscs, Pisces, Birds and Mammals are very sensitive to the change in the ecosystem, therefore are best used as indicators of the ecosystem function and considered crucial in the ecology and management of the aquatic and terrestrial ecosystems.

Animals and birds in the study area were documented using following means:

- Secondary sources and published literature
- By interviewing local people
- Actual sighting
- Indirect evidence (pallets, dung, droppings, scat, mould, marking on the trunks etc.)
- Nesting (birds, burrows for small mammals)

The records for the birds, mammals and other faunal groups were made at the same site where vegetation sampling was carried out. Most of the records of the mammalian and reptilian fauna are opportunistic, nonetheless very useful to understand habitat specificity and interrelationship between certain floral and faunal elements and also between certain geological and faunal features.

The list of species located and identified from various localities in the study area is given below.

Mammals:

The study area was a place of poor mammalian diversity. Wild boars were of common occurrence in this area. The area represents good habitat for this animal. At places, the damage caused by them to agriculture and plantations make them vulnerable to control. 27 species of mammals have been recorded during visit from the study area. The mammalian species recorded are listed in the following table 10 along with their schedule in which they are placed according to the Wildlife Act 1972 and IUCN status.

Table 4:23: Mammals of the study area

Common Name	Scientific *Name*	Schedule Category	IUCN Status
Madras Tree Shrew	Anathana ellioti	V	LC
Black buck	Antilope cervicapra	I	NT
Large Bandicoot Rat	Bandicota indica	V	LC
Asiatic Jackal	Canis aureus naria	II	LC
Indian Wolf	Canis lupas	I	LC
Short-nosed Fruit Bat	Cynopterus sphinx	V	LC
Cave Fruit Bat	Eonycteris spelaea	V	LC
Jungle cat	Felis chaus	II	LC
Indian Palm Squirrel	*Funambulus palmarum*	IV	LC
Indian Grey Mongoose	*Herpestes edwardsii*	II	LC
Small Indian Mongoose	*Herpestes javanicus auropunctatus*	V	LC
Common hare	Lepus nigricollis	IV	LC
Rhesus macaque	Macaca mulatta	II	LC
Bonnet monkey	Macaca radiata	II	LC
Indian False Vampire	Megaderma lyra	V	LC
Field Mouse	Mus booduga	V	LC
House mouse	Mus musculus	V	LC
Elliot's Brown Spiny Mouse	Mus saxicola	V	LC
Indian Hedgehog	Paraechinus micropus nudiventris	IV	LC
Indian Pipistrelle	Pipistrellus coromandra	V	LC
Indian flying fox	Pteropus giganteus	V	LC
House rat	Rattus	V	LC
Lesser Rat-tailed Bat	Rhinopoma hardwickei	V	LC
Langur	Semnopithecus entellus	II	LC
House Shrew	Suncus murinus	V	LC
Long-armed Sheath tailed Bat	Taphozous longimanus	V	LC
Indian Gerbil	Tatera indica cuvieri	V	LC

NT:- Near Threatened; LC:- Least Concerned

Source: *Actual sightings, interactions with local people, and Editor-Director, 2004. State Fauna Series 5: Fauna of Andhra Pradesh, Part-2 (Mammals and Marine & Estuarine Fishes), 1-311 (Published-Director, ZSI, Kolkata)*

Photo 4:4: Macaca mulatta, the mammal sighted during the field surveys.

Photo 4:5: Antilope cervicapra, the mammal sighted during the field surveys.

Reptiles:

The reptiles of arid zones exhibit remarkable diversity. The reptiles include turtles, lizards, amphibians, and snakes. The reptiles have a prominent role in the ecological balance and conservation of nature. Due to thoughtless destruction of natural habitats by man for his own uses, a large number of reptiles are threatened. Some of the amphibians and reptiles recorded during field visit are listed in the **Table 4.24** below.

Table 4:24: Reptiles and amphibians of the study area

Common Name	Scientific Name	Schedule Category
Amphibians		
Common Indian Toad	*Bufo melanostictus*	V
Skittering Frog	*Euphlyctis cyanophlyctis*	V
Indian Bull Frog	*Hoplobatrachus tigerinus*	V
Common frog	Rana tigrina	*IV*
Reptiles		
Krait	*Bungarus coeruleus*	IV
Garden lizard	*Calotes versicolor*	V
Saw-scaled viper	*Echis carinatus*	IV
Pond Tortoise	*Geomyda trijuga*	IV
Wall lizard	*Hemidactylus brooki*	V
Oriental garden lizard	*Calotes versicolor*	
Forest Lizard	*Calote rouxi*	

Common Name	Scientific Name	Schedule Category
Cobra	*Naja*	II
Wolf snake	*Oligodon venustus*	IV
Rat snake	*Ptyas mucosus*	II
Common Skink	*Mabuya carinata*	
Russell's viper	*Vipera russeli*	II
Checkered Keelback	*Xernochrophis piscator*	II
Indian Chameleon	*Chamaeleon zeylanicus*	

Bird Fauna:

Birds are important to human welfare in various ways including seed dispersal agents. Despite the human activities, the study sites have fairly good avifaunal diversity. The field survey resulted in documentation of about 79 bird species, which are listed in the following **Table 4.25.**

Table 4:25: Birds listed from the study sites

Common Name	Scientific Name	Schedule Category	IUCN Category
Bar-headed goose	*Anser indicus*		
Black drongo	*Dicrurus macrocercus*	IV	
Black headed Ibis	*Threskiornis melanocephalus*		NT
Black kite	*Milvus migrants*	IV	
Black shouldered kite	*Elanus caeruleus*	IV	
Black winged stilt	*Himantopus*	IV	
Brown fish owl	*Bubo zeylonesis*	IV	
Common babbler	*Turdoides candatus*	IV	
Common gray quail	*Coturnix*	IV	
Common hawk	*Cuculus varius*	V	
Common quail	*Coturnix*	IV	
Common sand piper	*Actitis hypoleucos*	IV	
Common sandpiper	*Actitis hypoleucos*		
Common snipe	*Gallinago*	IV	
Common swallow	*Hirundo rustica*		
Coots	*Fulica atra*	IV	
Crow pheasant	*Centropus cinensis*	IV	
Darter	*Anhinga melanogaster*		NT
Demoiselle crane	*Anthropoides virgo*	IV	
Golden headed woodpecker	*Dinopium benghalense*	IV	
Green bee eater	*Merops orientalis*		
Grey Heron	*Ardea cinerea*		
Grey necked Bunting	*Emberiza buchanani*	IV	
Grey wagtail	*Motacilla caspica*		
Hoopoe	*Upupa epops*		
House crow	*Corvus spledens*	V	
House sparrow	*Passer domesticus*		

Common Name	Scientific Name	Schedule Category	IUCN Category
Indian great horned owl	*Bubo owl*	IV	
Indian myna	*Acrodontherus tristis*	IV	
Indian night jar	*Caprimulgus asiaticus*	IV	
Indian pipits	*Anthus novaeseelan-diae*	IV	
Indian robin	*Saxicoloides fulicatus*		
Indian Roller	*Caracias benghalensis*	IV	
Indian Silver bill	*Euodice malabarica*		
Indian small sky lark	*Alaunda gulgula*	IV	
Intermediate Egret	*Ardea intermedia*		
Jungle crow	*Corvus macrorhynchus*	V	
Koel	*Eudynamys scolopacea*	V	
Large Indian parakeet	*Psiltacula eupatria*	IV	
Laughing dove	*Spilopelia senegalensis*		
Little cormorant	*Phalacrocorax niger*	IV	
Little egret	*Egretta garzetta*	IV	
Magpie robin	*Copsychus saularis*		
Palm swift	*Cypsiarus parvus*		
Pariah kite	*Milvus migrans*		
Pied king fisher	*Ceryle rudius*	IV	
Pond heron	*Ardeola grayii*		
Purple moor hen	*Porphyrio*		
Purple sunbird	*Nectarinia asiatica*	IV	
Rain quail	*Coturnix coromandelica*	IV	
Red headed bunting	*Emberiza melanocephala*	IV	
Red munia	*Estrilda amandave*	IV	
Red start	*Phoenicurus ochrurus*	IV	
Red vented bulbul	*Picnonotus cater*	IV	
Red wattled lapwing	*Vanellus indicus*		
Ring dove	*Streptopelia decaocto*	IV	
River tern	*Sterna aurantia*		NT
Rock Dove	*Columba livia*	IV	
Rose ringed parakeet	*Psiltacula krameri*	IV	
Rosy Starling	*Pastor roseus*		
Ruddy shelduck	*Tadorna ferruginea*	IV	
Screech owl	*Tyto alba*	IV	
Shikra	*Accipitar badius*		
Small blue king fisher	*Alcedo atthis*	IV	
Small minivet	*Pericrocotus cinnanomus*	IV	
Spot billed Duck	*Anas poecilorhyncha*		
Spotted dove	*Streptopela chinensis*	IV	

Common Name	Scientific Name	Schedule Category	IUCN Category
Spotted sand piper	*Tringa glareola*	IV	
Tailor bird	*Orthotonus sutorias*		
Tawny Eagle	*Aquila rapax*		
Weaver bird	*Ploceus phillippinus*	IV	
White breasted water hen	*Amaurornis phoenicurus*		
White eyed Buzzard	*Butastur teesa*		
White throat lesser	*Sylvia curuca*	IV	
White throated munia	*Lonchuro malabarica*	IV	
White Wagtail	*Motacilla alba*		
White-browed wagtail	*Motacilla maderaspatensis*		
Yellow wagtail	*Motacilla flava*	IV	
Yellow wattle lapwing	*Vanellus malabaricus*		

Source: *Director, 2008. Fauna of Andhra Pradesh, Siale Fauna Series, S(Part-8)-A yes: 1-68 (Published-Director" ZSI, Kolkata)*

Conclusion:

The plant life in an area seems to be fairly disturbed and do not show any integrity. The major conclusions are as follows.

1. There were no ecologically sensitive areas like national parks or wildlife sanctuaries, Tiger Reserves, Elephant Reserves, Turtle Nesting Ground and Core Zone Biosphere Reserve within the 10 km radius of proposed site; however, there are two reserved forests near the villages Patti Konda and Tuggali. These reserved forests show scrub vegetation.
2. According to revised forest types (Champion and Seth, 1968) the forests type was Southern Tropical Thorn Forests (Group 6 subgroup $6A/C_1/DS_1/DS_2$). According to Rodgers & Panwar (1988) biogeographic classification the regions falls in what is known as Deccan biogeographic zone (6) and Deccan Plateau South (6A) biotic province.
3. The survey also illustrates that there are no rare plant species on the proposed site.
4. Major factors responsible for disturbance are anthropogenic activities.
5. The most common plant species were *Euphorbia antiquorum, Securinega leucopyrus, Carrisa spinarum, Azadirachta indica, Catunaregum spinarum, Dodonea viscosa, Cissus woodrowii, Dichrostachys cinera, Opuntia sp., Capparis sp.,* and *Acacia sp., Rhus mysorensis, Ziziphus xylopyra*, *Gymnosporea montana,* and *Holoptelia integrifolia*.
6. Total numbers of plant species recorded were 379 including herbs (33%) and shrubs (28%) followed by trees (18%) and grasses (9%); whereas climbers represented 8% and sedges 5%.
7. The forests are significantly disturbed.
8. Birds represent dominant group among the faunal composition.
9. Among mammals Rhesus macaque and Indian Palm Squirrel and among reptiles Garden Lizard and Common Skink were most common.

4.8 SOCIO-ECONOMIC BASELINE

This section provides an understanding of the administrative setup of the district, the demographic profile of the villages in the project area, the social groups present, the land use pattern in the area, the livelihood profile of the community, the common property resources, the social and physical infrastructure available in terms of the education and health infrastructure, the water supply for irrigation and drinking purposes, sanitation facilities and connectivity. The purpose of this section is to allow for an increased understanding of the key issues identified as well as identify areas of intervention in future scenarios.

4.8.1 Methodology

The key objective of the socio-economic study is to assess possible impact of the project on socio-economic life of the people in the neighborhood of the project.

A mixture of both quantitative and qualitative approach has been adopted in the current socio-economic study. The study has been conducted based on primary and secondary data. While primary data has been collected through a stratified sampling method of selected households located in the nearby village, the secondary data has been collected from the administrative records of the Government of Andhra Pradesh, Census of India 2011, district hand book and state and district portal.

The details regarding population composition, number of literates, workers, etc. have been collected from secondary sources and analyzed. Data on amenities available in the study area have been collected from secondary sources like District Annual Statistical Handbook, http://www.kurnool.ap.gov.in/, Census of India 2011, and analyzed.

Two stage sampling design has been adopted to select the sampling units. The first stage units are census villages in the rural areas and towns/cities in urban areas. The ultimate stage units are households in the selected villages and towns/cities. Stratified Sampling Method has been adopted to select the sampling units. Estimation of various parameters has been made based on sample data and bottom top approach has been adopted.

On the basis of a preliminary reconnaissance survey, questionnaire was developed to make it suitable to fulfill the objectives of the study. The questionnaires contained both open ended and close ended questions.

The data collected during the above survey was analyzed to evaluate the prevailing socio-economic profile of the area. Based on that, impacts due to project operation on the community have been assessed and recommendations for improvement have been made. The impact from the wind power project will be very minimal and will be limited to maximum within 5 km radius.

4.8.2 Baseline of the Study Area

State Profile: Andhra Pradesh

Andhra Pradesh is one of India's Southern states and is situated on the southeastern coast of the country. Also known as the Rice Bowl of India, because of being one of the highest producers of rice in the state. The population of Andhra Pradesh as per Census 2011, before the formation of Telangana as a separate state was 84,580,777 of which male and female are 42,442,146 and 42,138,631 respectively. In 2001, total population was 76,210,007 in which males were 38,527,413

while females were 37,682,594. The total population growth in this decade was 10.98 percent while in previous decade it was 13.86 percent. The population of Andhra Pradesh forms 6.99 percent of India in 2011. In 2001, the figure was 7.41 percent. The state covered an area of 275,045 sq. km before formation of Telangana. But now, the state is spread across 160,205 sq. km and has a population of 49,378,776. Following **Table** depicts details about the districts of the state:

Table 4:26: List of Districts in Andhra Pradesh

S No.	District	Population (Census 2011)	Sex Ratio (per 1000)	Average Literacy
1	Anantapur	4,081,148	977	63.57%
2	Chittoor	4,174,064	997	71.53%
3	East Godavari	5,154,296	1006	70.99%
4	Guntur	4,887,813	1003	67.4%
5	Krishna	4,517,398	992	73.74%
6	Kurnool	4,053,463	988	59.97%
7	Prakasam	3,397,448	981	63.08%
8	Sri Potti Sriramulu Nellore	2,963,557	985	68.9%
9	Srikakulam	2,703,114	1015	61.74%
10	Visakhapatnam	4,290,589	1006	66.91%
11	Vizianagaram	2,344,474	1019	58.89%
12	West Godavari	3,936,966	1004	74.63%
13	YSR (Kadapa)	2,882,469	985	67.3%

Source: Census of India, 2011

Poverty Level: National and State

National Level: As per Press Note on Poverty 2011-12, Planning Commission Government of India (2013) the percentage of persons below the Poverty Line in 2011-12 has been estimated as 25.7% in rural areas, 13.7% in urban areas and 21.9% for the country as a whole. The respective ratios for the rural and urban areas were 41.8% and 25.7% and 37.2% for the country as a whole in 2004-05. It was 50.1% in rural areas, 31.8% in urban areas and 45.3% for the country as a whole in 1993-94. In 2011-12, India had 270 million persons below the Tendulkar Poverty Line as compared to 407 million in 2004-05, that is a reduction of 137 million persons over the seven-year period.

State Level: Like-wise the percentage of persons below the Poverty Line in Andhra Pradesh State in 2011-12 has been estimated as 10.96% in rural areas, 5.81% in urban areas and 9.20% for the whole state and it was 61.80 lakhs of person were below poverty line in Rural area and 16.98 lakhs of person in Urban area and 78.78 lakhs in whole state of Andhra Pradesh in the same year. Monthly per capita expenditure (MPCE) of the state in rural area is INR 1563.21 and in Urban area is INR 2559.30.

District Profile: Kurnool

Kurnool District in the state of Andhra Pradesh, India, is located in the west-central part of the state and is bounded by Mahabubnagar district of Telangana in the north, Raichur district of Karnataka in the northwest, Bellary district of Karnataka in the west, Ananthapur district in the south, YSR Kadapa district in the South East and Prakasham district in the east. The city of Kurnool is the headquarters of the district. It has a population of 4,053,463 of which 28.35% were urban as of Census Survey of India, 2011. It occupies 10th and 2nd place in terms of area in Largest Districts of

India and Andhra Pradesh respectively, accounting for 17,658 square kilometers (6,818 sq mi) and 53rd place in terms of Population in India. Telugu is the official as well as the most widely spoken language in Kurnool. Languages such as Kannada and Urdu are spoken by a tiny minority of the population in Kurnool.

Kurnool District has 3 Revenue Divisions viz., Kurnool, Nandyal and Adoni, 54 *Mandals* and 53 *Panchyat Samitis* (Block) under these revenue divisions. It also has a Municipal Corporation of Kurnool and 4 Municipalities namely, Nandyal, Adoni, Yemmiganur and Dhone. There are 899 gram panchayats that include 7 notified and 862 non-notified, alongside 920 revenue villages and 615 hamlets.

Poverty Level of District Kurnool:

As per district Civil Supplies Department report (www.kurnool.ap.gov.in), details of BPL cardholder family of Kurnool District as well as Aluru, Aspari and Pattikonda *Mandal* has been represented in the **Table 4.27** and compared with total population of Census 2011.

Table 4:27: Mandal/taluka wise BPL Cardholder Family

S. N0.	Name of Mandal	No. of BPL Card Holders Family	Total Population (Census 2011)	Percentage with Respect to total Population (Census 2011)
1	Kurnool District	1038399	4053463	25.62
2	Aluru	12943	55834	23.18
3	Aspari	16743	65088	25.72
4	PattiKonda	15186	68962	22.02

Source:http://kurnool.ap.gov.in/departmentView.apo?mode=getDepartment&departmentFlag=CAF&subDepartmentFlag=CAF

Project Influence Area

The Aspari wind farm site is located approximately 70 km to the Southwest of Kurnool District Headquarter and 60 km to the Northeast of Bellary District Headquarter. The nearest towns are Guntakal and Adoni. The proposed project is covering 11 Census villages of Aluru and Pattikonda Taluka of Adoni division, District Kurnool (Andhra Pradesh). The study area for this proposed project has been considered 5 km peripheral from the project boundary. Further, to achieve an informative result the total area has been segregated into two different zones. Which is: -

i. Zone -1 : Core Zone
ii. Zone -2 : 5 km. radius from Core Zone

On the basis of available census data, 2011 different aspects of socio economic condition of all villages in these two different zones have been analyzed which is presented in **Table 4.28.**

4.8.3 Demographic Profile of the Study Area

Table 4:28: Demographic Profile of the Study Area

S. No.	Name of Villages	HH	Population			Literates				Main Workers			Marginal Workers			Non Workers	
			Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F
Zone I (Core Zone)																	
1.	Aspari	1410	7263	3624	3639	3598	2173	1425	3358	1722	1636	633	269	364	3272	1633	1639
2.	Chinna Hulthi	383	1707	860	847	868	552	316	1012	509	503	70	38	32	625	313	312
3.	Chokkanahalli	54	251	123	128	85	48	37	145	74	71	0	0	0	106	49	57
4.	Devanabanda	456	2052	1033	1019	965	599	366	1183	619	564	11	4	7	858	410	448
5.	Hosur	1462	7114	3598	3516	3452	2105	1347	3121	1821	1300	682	185	497	3311	1592	1719
6.	Joharapuram	907	4501	2291	2210	2307	1461	846	1881	1251	630	251	85	166	2369	955	1414
7.	Jutur	701	3471	1747	1724	1382	857	525	1769	883	886	429	230	199	1273	634	639
8.	Nalakadoddi	906	4219	2164	2055	1480	1021	459	1455	867	588	1158	505	653	1606	792	814
9.	Pattikonda	6138	29342	14428	14914	17106	9480	7626	10563	7277	3286	1419	553	866	17360	6598	10762
10.	Pedda Hulthi	367	1839	913	926	831	525	306	699	383	316	371	171	200	769	359	410
11.	Putchakayalamada	444	2137	1091	1046	1028	656	372	945	501	444	308	159	149	884	431	453
Total		**13228**	**63896**	**31872**	**32024**	**33102**	**19477**	**13625**	**26131**	**15907**	**10224**	**5332**	**2199**	**3133**	**32433**	**13766**	**18667**
Zone II (Buffer Zone 5 km. Radius)																	
12.	Billekallu	810	4319	2169	2150	1542	999	543	2473	1271	1202	123	57	66	1723	841	882
13.	Chiramandoddi	308	1487	779	708	628	419	209	940	465	475	9	5	4	538	309	229
14.	Dudekonda	1174	5826	2977	2849	2060	1313	747	2894	1593	1301	545	205	340	2387	1179	1208
15.	Molagavalli	1644	9475	4865	4610	4609	2833	1776	5150	2792	2358	445	167	278	3880	1906	1974
16.	Muthkur	819	4124	2134	1990	1685	1140	545	2605	1350	1255	111	47	64	1408	737	671
17.	Ramachandrapuram	392	1272	606	666	693	388	305	669	392	277	122	6	116	481	208	273

S. No.	Name of Villages	HH	Population			Literates				Main Workers			Marginal Workers			Non Workers	
			Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F
18.	Ratana	961	4739	2441	2298	2499	1509	990	1927	1157	770	831	332	499	1981	952	1029
19.	Sankarabanda	288	1485	744	741	706	440	266	853	448	405	4	3	1	628	293	335
Total		**6396**	**32727**	**16715**	**16012**	**14422**	**9041**	**5381**	**17511**	**9468**	**8043**	**2190**	**822**	**1368**	**13026**	**6425**	**6601**
Total		**19624**	**96623**	**48587**	**48036**	**47524**	**28518**	**19006**	**43642**	**25375**	**18267**	**7522**	**3021**	**4501**	**45459**	**20191**	**25268**

Source: Census of India, 2011

4.8.4 Data Collection & Survey

There are 19 villages within the study area of core zone and buffer zone as explained above. Consultation and socio-economic survey was mainly conducted in 11 census villages of core zone located close proximity and approachable distance from the site in order to assess the impact of the upcoming wind power project in district Kurnool, Andhra Pradesh. However, the secondary baseline data collection as per Census 2011 was collected from Census of India for all the villages within the study area as per the zones as described in **Section 4.8.2** and **Table** above.

4.8.5 Concept & Definition of Terms Used

a) **QoL**: The Quality of Life (QoL) refers to degree to which a person enjoys the important possibilities of his/her life. The 'Possibilities' result from the opportunities and limitations, each person has in his/her life and reflect the interaction of personal and environmental factors. Enjoyment has two components: the experience of satisfaction and the possession or achievement of some characteristic.

b) **Household**: A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one member households, two member households or multi-member households.

c) **Sex Ratio:** Sex ratio is the ratio of females to males in a given population. It is expressed as 'number of females per 1000 males'.

d) **Literates:** All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

e) **Literacy Rate:** Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

f) **Labor Force:** The labor force is the number of people employed and unemployed in a geographical entity. The size of the labor force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labor force of a country consists of everyone of working age (commencing from 14 years and below retirement (around 65 years) that are participating workers, that is people actively employed or seeking employment. People not counted under labor force are students, retired persons, stay at home people, people in prisons, permanently disabled persons and discouraged workers.

g) **Work:** Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time or full time or unpaid work in a farm, family

enterprise or in any other economic activity.

h) **Worker:** All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation of land or milk production even solely for domestic consumption are also treated as workers.

i) **Main Workers**: Those workers who had worked for the major part of the reference period (i.e. 6 months or more in the case of a year) are termed as Main Workers.

j) **Marginal Workers:** Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers**.**

k) **Work Participation rate (WPR)**: The work participation rate is the ratio between the labor force and the overall size of their cohort (national population of the same age range). In the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

l) **Below Poverty Line (BPL) family:** As per Press Information Bureau, Govt. of India, 2011-12, Poverty Line Estimation for rural areas (as per Tendulkar Committee Report) is at INR 816 per capita per month and INR 1,000 per capita per month in urban areas. Thus, for a family of five, the all India poverty line in terms of consumption expenditure would amount to about INR 4,080 per month in rural areas and INR 5,000 per month in urban areas.

Further, as per information from the site of District Supply Office, Kurnool the eligibility criteria of the BPL card holder family income should not be more than INR 60,000/- per annum in Rural Areas and INR 75,000/- per annum in Urban Areas.

m) **Pacca House**: A pucca house is one, which has walls and roof made of the following material: (i) *Wall material:* Burnt bricks, stones (packed with lime or cement), cement concrete, timber, ekra etc. (ii) *Roof Material:* Tiles, GCI (Galvanised Corrugated Iron) sheets, asbestos cement sheet, RBC, (Reinforced Brick Concrete), RCC (Reinforced Cement Concrete) and timber etc.

n) **Kutcha House:** The walls and/or roof of which are made of material other than those mentioned above, such as unburnt bricks, bamboos, mud, grass, reeds, thatch, loosely packed stones, etc. are treated as kutcha house.

o) **Semi-pucca House:** A house that has fixed walls made up of pucca material but roof is made up of the material other than those used for pucca house.

4.8.6 Baseline Data of the Study Area

In the table below an attempt has been made to provide salient features of socio-economic features of the study area:

Table 4:29: Demography, Literacy and Occupational details of people living in Study Area

S. No.	Description	Number	% to total
1	**Total Population - Gender wise**	**96,623**	**100**
	Male	48,587	50.29
	Female	48,036	49.71

S. No.	Description	Number	% to total
	Sex ratio (No. of females per 1000 males)	989	
2	**Total Population (0-6 years) - Gender wise**	**11,687**	**12.10**
	Male	6,132	52.47
	Female	5,555	47.53
	Sex ratio (No. of females per 1000 males)	906	-
3	**Total Population (Sector Wise)**	**96,623**	**100**
	Rural	**96,623**	**100**
	Urban	0	0
4	**Total no. of households**	**19,624**	-
	Average House hold size	5	-
	Lowest Household size (Village: Krishnapuram)	3.24	-
	Highest Household size (Village: Kelaginakanive)	5.76	-
5	**Total SC & ST Population**	**17,743**	**18.36**
	Total Population (SC)	**15,605**	**16.15**
	Total Population (ST)	**2,138**	**2.21**
6	**Total Literates – Gender wise**	**47,524**	**55.95**
	Male Literacy (with respect to the male population)	28,518	67.17
	Female Literacy (with respect to the female population)	19,006	44.74
	Literacy gap between male and female	-	22.43
7	**Total Literates – Sector wise**	**47,524**	**--**
	Rural (Number and % to total literates)	**47,524**	100
	Urban (Number and % to total literates)	0	0
9	**Total Workers & Work Participation Rate**	**51,164**	**52.95**
	Male (Number and % with respect to the male population)	28,396	58.44
	Female (Number and % with respect to the female population)	22,768	47.40
	Gender gap in workforce (in percentage)	-	11.05
10	**Total Main Workers & percentage to total worker**	**43,642**	**85.30**
	Male (Number and % with respect to the male working population)	**25,375**	**89.36**
	Female (Number and % with respect to the female working population)	**18,267**	**80.23**
a)	Main Worker as Cultivator (Number and Percentage)	13,051	29.90
b)	Main Worker as Agricultural Labour (Number and Percentage)	21,354	48.30
c)	Main Worker as Household Industry Worker (Number and Percentage)	628	1.44
d)	Main Worker as Other workers (Number and Percentage)	8,609	19.73
11	**Total Marginal Workers & percentage to total worker**	**7,522**	**14.70**
	Male (Number and % with respect to the male working population)	**3,021**	**10.64**
	Female (Number and % with respect to the female working population)	**4,501**	**19.77**
a)	Marginal Worker as Cultivator (Number and Percentage)	422	5.61
b)	Marginal Worker as Agricultural Labour (Number and Percentage)	5,562	73.94
c)	Marginal Worker as Household Industry Worker (Number and Percentage)	151	2.01
d)	Marginal Worker as Other workers (Number and Percentage)	1,387	18.44

S. No.	Description	Number	% to total
12	**Number and Percentage of Marginal Worker (3-6 Months)**	**6,924**	**92.05**
13	**Number and Percentage of Marginal Worker (0-3 Months)**	**598**	**7.95**

4.8.7 Demographic Composition

Population:

According to Census of India 2011, the total population of the study area is **96,623** in which 50.29% are males and 49.71% are females. An average gender ratio of the study area is approx. 989 females per 1000 males, which is much better than national average of 933 females per 1000 males. Total study area comes under rural settlement. Approx. 12.10% of the total population belongs to 0-6 age group. The sex ratio of this age group is 903 female children per 1000 male children, which is much below than average sex ratio of the study area. The break-up of population data for the study area zone-wise is given in **Table 4.25.**

Households and Household Size:

The entire population of the study area has been grouped into 19,624 households and the average size of household is approx. 5 persons/ household.

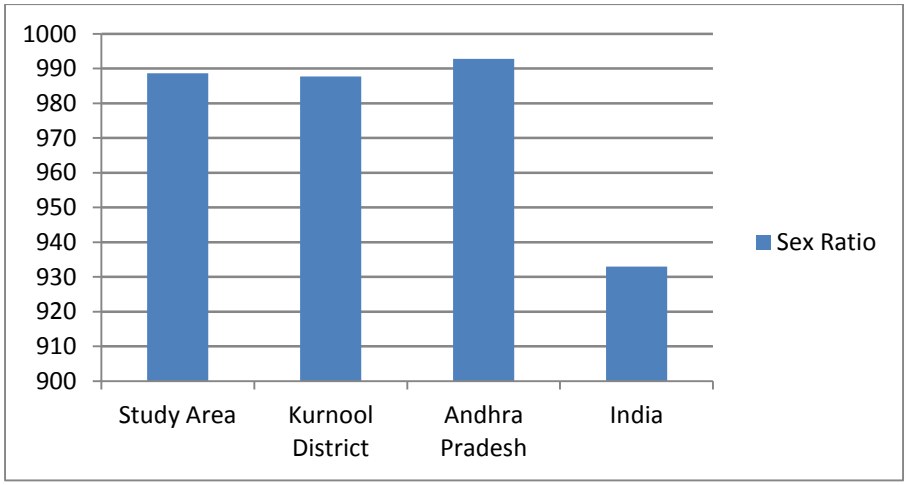
During site visit it was observed and noted that most of the houses of the study area are semi-pucca and approximately 20% are kachcha houses. Nearly every respondent reported that they were living in their own houses. The area of the house structure was varying from 300-700 square metres. Approx. 35% households have toilet facility but 95% people of the study area defecate outside due to lack of water.

Table 4:30: Zone-wise Break up of Population in Study Area

S. No.	Core/ Buffer Zone	House-holds	House hold Size	Population				Population (06 years)			
				Total	M	F	Gender Ratio	Total	M	F	Gender Ratio
1	Core	13228	4.83	63896	31872	32024	1004.77	7592	3953	3639	920.57
2	Buffer	6396	5.12	32727	16715	16012	958	4095	2179	1916	879.30
Total		**19624**	**4.92**	**96623**	**48587**	**48036**	**988.67**	**11687**	**6132**	**5555**	**906**

Source: *Census of India, 2011*

Gender Ratio of the study area with district, state and national average is compared and is shown in **Figure 4.19:**



Source: Census of India, 2011

Figure 4:19: The Gender ratio in the study area as compared with district, state and national level

Social Stratification:

With reference to the **Table 4.31**, approx. 18.36% of the total population of the study area belongs to Schedule Caste and Schedule Tribes. Among the total population, Scheduled Caste constitutes of 16.15% and 2.21% belongs to Schedule Tribe community. In Core zone, approx. 14.46% people belongs to SC and 2.28% belongs to ST category. *Reddy, Rao, Vaishya, Chaudhari, Setty, Rao, Lingabaleja* etc. are comes under general category (O.C.); *Kurma, Valamiki, Boya, Pinjari, Dudekula, Yadaya, Kurva, Kumbari, Golla, Dukula, Chakali, Mangala, Wadde, Uppare* etc. comes under Backward Caste (B.C.); *Madiga, Mala, Harizana, Dasari* etc. comes under Schedule Caste (SC) and Yerukala, *Nayak* comes under Scheduled Tribes of social group in the study area. As per primary survey, standard of life of people of the study area is below average. Though the composition of the people of higher caste (approx 10% as per our site visit observation) is very low but they are dominating to the whole society. Approx 70% people come under Backward Caste (B.C.).

The population composition of SC is 14.46% and ST is 2.28% in the villages of core zone and they come under vulnerable groups of family. Their livelihood depends on agriculture and agricultural labour. Presence of SC population in village Pedda Hulti (33.50%) and Devanabanda (27.49%) indicate that at leat 1/3 of population of these villages are economicaly weak and socially backward. None of the SC/ST family is directly affected due land procurement process. During construction period, they will be given employment opportunity and in MVTPL's CSR activity skill development training will be provided to them on the basis of their hobbies and employment opportunity in the region.

The break up distribution of scheduled caste and scheduled tribe population in the project area is shown in **Table 4.31**.

Table 4:31: Zone-wise Distribution of SC and ST Population in Study Area

S. No.	Village	Schedule Caste Population				Schedule Tribe Population			
		Total	M	F	Percentage	Total	M	F	Percentage
Core Zone									
1.	Aspari	1285	636	649	17.69	24	14	10	0.33
2.	Chinna Hulthi	240	129	111	14.06	29	16	13	1.70
3.	Chokkanahalli	0	0	0	0	0	0	0	0
4.	Devanabanda	564	294	270	27.49	9	5	4	0.44
5.	Hosur	1297	669	628	18.23	22	10	12	0.31
6.	Joharapuram	558	300	258	12.40	0	0	0	0
7.	Jutur	582	290	292	16.77	0	0	0	0
8.	Nalakadoddi	366	189	177	8.68	6	2	4	0.14
9.	Pattikonda	3387	1463	1924	11.54	1360	678	682	4.63
10.	Pedda Hulthi	616	298	318	33.50	8	4	4	0.44
11.	Putchakayala mada	346	187	159	16.19	0	0	0	0
Sub-Total		**9241**	**4455**	**4786**	**14.46**	**1458**	**729**	**729**	**2.28**
Buffer Zone									
2	**Sub-Total**	**6364**	**3306**	**3058**	**19.45**	**680**	**367**	**313**	**2.08**
Total		**15605**	**7761**	**7844**	**16.15**	**2138**	**1096**	**1042**	**2.21**

Source: Census of India, 2011

Poverty Line in Core Zone Villages of the Study Area: Table below reflects details of BPL Cardholders family's which has been collected from respective village Panchyat office during site visit. In village Joharapuram 31.53% person are below poverty line which is highest and in village Nalkadoddi 12.30% person below poverty line which is lowest with respect to the total population of the village.

Table 4:32: BPL Cardholder Family

Name of the village	BPL Cardholder Family	Percentage with Respect to Population of village (Census 2011)
Aspari and Chokkanahalli	1960	26.08
Chinna Hulthi	454	26.60
Devanabanda	506	24.65
Hosur	1724	24.23
Joharapuram	1419	31.53
Jutur	459	13.22
Nalakadoddi	519	12.30
Pattikonda	5489	18.71
Pedda Hulthi	419	22.78
Putchakayalamada	527	24.66
Total	**13476**	**22.28**

Source: Respective Village Panchyat Office (Collected during site visit)

Literacy and Literacy Rate:

The average literacy rate of the study area is 55.95% (47524) in which male's literacy is 67.17% with respect to the male population as against 44.74**%** for females with respect to the female population, creating a gender gap of 22.43%. Though the state govt. has facilitated every village with at least Govt. Primary Schools, Upper Primary Schools and *Anganwadi* Centers but the quality of education in the study area is very poor. As per our observation and consultation with villagers, it was found out that most of the villagers above 50 years of age are literate but they do not have any educational certificates. In core zone, 90% of literate females are educated only up to primary level and only 8-10% of the females are educated up to secondary levels. Dropout rates especially for girl child are very high in these villages and also in the study area. This is mostly because of poor economic conditions of the study area and less independence of women. Hence, instead of attending schools, these small girls/boys help their parents in household works, or in daily paid labor jobs. Few villagers left their houses with their family members for more than 4 to 6 month every year in search of jobs in nearby villages, towns and cities, therefore schooling education of children are affected. The break up distribution of literate population in the project area is shown in **Table 4.33.**

Table 4:33: Zone-wise Distribution of Literacy in the Study area

S. No.	Zone	Number of Literates			Literacy Rate			
		Total	M	F	Total	M	F	Gender Gap
1	**Core**	33102	19477	13625	58.79	69.763	48.00	21.76
2	**Buffer**	14422	9041	5381	50.37	62.20	38.17	24.02
Total		**47524**	**28518**	**19006**	**55.95**	**67.17**	**44.74**	**22.43**

Source: Census of India, 2011

The literacy rate of the project area has been compared with the literacy rate of district, state and national level which shows that literacy rate of the study area is below than the literacy rate of the district, state and national level. This figure reflects that a little more than the half of the total population of the study area are literate. Literate people can bargain better and put interest of the community during project planning land procurement stage. Literate people can get employment opportunity during project construction and operation phase as per their skill and qualification. They can assess positive and negative impact of the project and give their suggestions during project planning and construction phase better than others. Details of comparison are given in **Figure 4.20.**

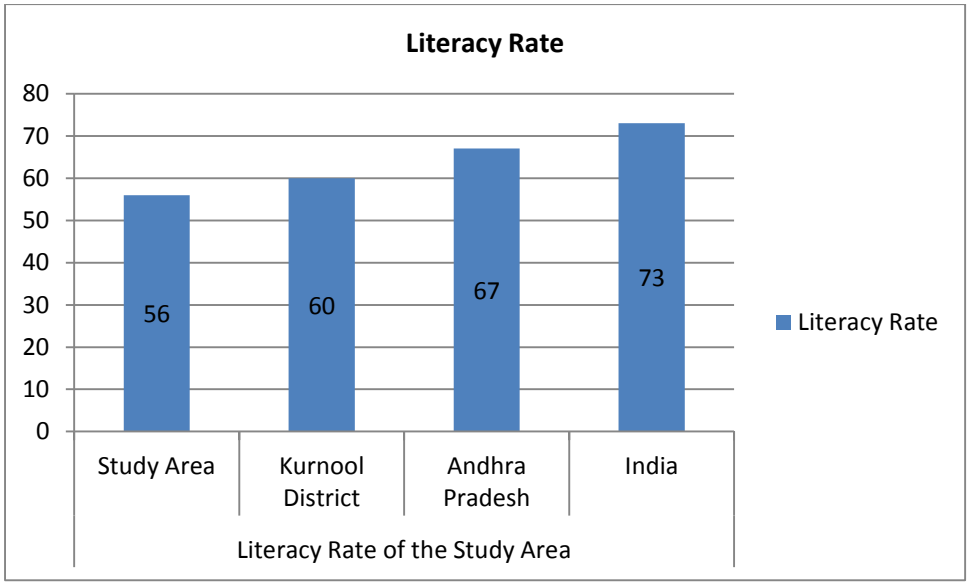


Figure 4:20: The Literacy Rate in the study area when compared with district, state and national level

Workers and Work Participation Rate:

The total number of workers in the study area is 51164 and the WPR is 52.95% in which male are 58.44% with respect to the male population and females are 47.40% with respect to female population. Among the total workers 85.30% are main workers and the remaining 14.70% are marginal workers. The percentage of male in the main workers is 89.36% with respect to male working population, while it is only 10.64% in the case of marginal workers. On the other hand, the percentage share of female in the main workers is 80.36% with respect to female working population; it is 19.77% in the case of marginal workers. As per the table below, it appears that most of the people (male & female) are engaged in main workers while in overall male workers dominate to female workers because less opportunity of work, unawareness of women rights, lack of education, lack of skill development opportunity and male dominating tradition to female workers.

Table 4:34: Work Participation Rate of the Study area

S. No.	Category	Total	M	F
1.	Total Worker	52.95%	58.44%	47.40%
2.	Non-worker	47.05%	41.56%	52.60%
Total		**100%**	**100%**	**100%**
1.	Main Worker	85.30%	89.36%	80.36%
2.	Marginal Worker	14.70%	10.64%	19.77%
Total		**100%**	**100%**	**100%**

Source: Census of India, 2011

Categorization of Main Workers on the basis of Occupation:

Following tables reflects that 48.93% of main worker are involved as agricultural labourers followed by cultivators 29.90%, other workers 19.72% and only 1.44% are involved in household industry.

Table 4:35: Categorization of Main Workers on the basis of Occupation

S. No.	Zone	Types of Main Workers							
		Cultivators		Agricultural Laborers		Household Industrial Workers		Other Workers	
		Nos.	Percentage	Nos.	Percentage	Nos.	Percentage	Nos.	Percentage
1	Core	5589	21.39	12857	49.20	490	1.88	7195	27.53
2	Buffer	7462	42.61	8497	48.52	138	0.79	1414	8.07
	Total	**13051**	**29.90**	**21354**	**48.93**	**628**	**1.44**	**8609**	**19.72**

Source: Census of India, 2011

Categorization of Marginal Workers on the basis of Occupation:

Following tables reflects that 73.94% of marginal worker are involved as agricultural labourers followed by other workers 18.44%, cultivators 5.61% and only 2.01% are involved in household industry.

Table 4:36: Categorization of Marginal Workers on the basis of Occupation

S. No.	Zone	Types of Marginal Workers							
		Cultivators		Agricultural Laborers		Household Industrial Workers		Other Workers	
		Nos.	Percentage	Nos.	Percentage	Nos.	Percentage	Nos.	Percentage
1.	Core	265	4.97	3948	74.04	124	2.33	995	18.66
2.	Buffer	157	7.17	1614	73.70	27	1.23	392	17.90
Total		**422**	**5.61**	**5562**	**73.94**	**151**	**2.01**	**1387**	**18.44**

Source: Census of India, 2011

Considering the work culture of the study area, it appears that most of the workers in both the category main and marginal are engaged in agricultural labourers. In the study area most of the Workers are either main/marginal agricultural labourers or cultivators or other workers. The daily paid laborers work in the nearby villages, towns or cities as agricultural labours, industry, iron ore mine or earn their livelihood by working as laborers in various construction sites/building etc.

Culture and Religion:

The field survey has revealed that majority of the persons living in the villages are Hindus with approx 10 % of population in the study area are Muslim and Christian. Most part of the study area has been occupied by Hindus and they play a vital role in making cultural and religious activities. Out of total population in the study area, approx 80% population are general and Backward Caste category, 20% are SC and ST. Men of the study area generally wear Lungi and kamiz/shirt, pant and shirt and women wear saries and suits. Yugadi, Dashahara, Deepawali, Sankranti, Vinayak Festival, Muharram, Eid ul Fiter, Chrismasday are the main festivals celebrated by the people of the study area. They worship Lord Shiva, Anjaney, Rama, Durga and Shiva etc.

There is an old temple of Lord Shiva, protected by ASI, which is near to the Wind Turbine ASP – 122 (650 m. West) of the Project area. Here are few inscriptions of Great Ashoka.

House Types:

Houses in the study area are generally semi-pacca. There are pacca and temporary types of structures have also been observed. The houses are generally made by bricks and stones. Although 35% households have facility of toilet and state government is also providing financial donation in making toilets in rural area but approximately 95% of people defecate outside due to lack of water and unawareness. Tap water supplied by village panchayat with government assistance and hand pumps are the main source of drinking water and other domestic use. Ground water level of the study area is approximately 400 to 500 feet and it was reported that there is fluoride in ground water. But as per the sample taken, only in the village Nalkadiddi, there is fluoride in ground water. As reported, villagers of Agraharam are forced to leave their houses in the month of summer due to scarcity of water for drinking and other domestic use. Villagers of Joharapuram are forced to drink rain water stored in village pond due to hardness in ground water. State government has planned to install water purifier plant in every village but it has not reached every village of the study area yet.

Occupation and Economy:

The main occupation of the study area is agriculture and more than 75% people depend on agriculture or as agricultural labourers. Main crops grown in the region are cotton, ground nut, onion, makka, corn etc. which depends on rain water. Few people are engaged in their paternal profession like barber, carpentry etc. There are very few opportunity of livelihood except agriculture and agricultural labours. Average land holding size of the study area is 3 to 30 acre per family. The average income of the family of the study area is INR 5,000 to 10,000 per month while the income of BPL family is < INR 5,000 per month and most part of the income is spent on food. There is requirement of skill development training so that local villagers may get more option to earn their livelihood.

Infrastructure Facilities

Roads:

The study area of the proposed wind power project is well connected with state highway and inter village road which are in good in good condition. The internal roads of the villages which link one village to another are also pucca and semi-pucca.

Education:

Considering the educational facilities in the study area, Govt. Primary School, Upper Primary School and *Anganwadi* is available in every village of core zone. Govt. Senior Secondary School is available in Aspari and Pattikonda villages. Government Degree Colleges are available in Pattikonda and Adoni. In every school and college there is facility of toilets for girls and boys separately but it is observed that it is not in a good condition. Although local panchayat provides water supply through pipeline connection but they are not good for drinking as there is a contamination of fluoride. In spite of government infrastructure facility and support (facility of mid-day meal, free books distribution and two pairs of uniform to every student) for education, the literacy rate is very poor in

the study area. Although, there is support for girl child education, but it is only up to junior level. Very few people are able to provide higher education to their girl child.

Health:

As per Rural Health Statistics 2015[1], there are 576 sub-centers, 83 PHC, 18 CHC, 1 Sub divisional Hospital and 1 District Hospital is running in Kurnool District. In core zone of the study area there are two governments Primary Health Center is working properly, one is in Aspari village and another is in Pattikondda village. Government Community Health center is available in Adoni town which is 25 km. from the project site. In this hospital all the facility with advance technology is available. There are so many Private Hospitals are also working with better facility. There is no any epidemic or chronic disease have been reported in the study area during consultation with local villagers except general fever, cough, cold and bone related pains due to contamination of fluoride in ground water.

Drinking Water Facility:

As reported during consultation, there is acute shortage of water in the villages of the study area and ground water level is 400 to 500 feet. Every village, there is water tank constructed. Water is supplied for drinking and other domestic use to each house via pipe line with the assistance of government and village panchayat. Fluoride in ground water has been reported by the people of the villages. Though, the state government is facilitating villages with water purifier plant but it has not reached in every village and villages such as Joharapuram and Agraharam are badly affected by water scarcity and fluoride.

Communication:

The villages in the study area are well connected via mobile, telephone and internet. Government post office is also available in most of the village panchayat of the study area. Means of communications such as internet, telephone and television has made a vital role in changing the conservative thoughts of the people of the study area and brought awareness for development in every dimension of life.

Electricity Facility:

The study area is good in terms of electricity supply. Generally, 20 to 22 hours' electricity is available in most of the villages of the study area. Proposed 200 MW Wind power project may reduce demand-supply gap of the state. Thus in future, power cut will be reduced. They utilize power in establishing household industry, irrigation etc. The implementation of the proposed wind power plant project will throw opportunities to local people for both direct and indirect employment. The project will provide impetus to industrialization of the area. Further, the occupational pattern of the people in the area will change making more people engaged in industries and business. With this, occupational shifting of people from tertiary sector to industry, trade and business will get going. Thus proposed project will improve socio-economic status of the study area.

[1] https://nrhm-mis.nic.in/Pages/RHS2015

4.8.8 Observations and Need Based Assessment

On the basis of interpretation made above, primary survey (interaction with stakeholders, FGD, community consultation, consultation with government official and discussion with influential person of the study area) and secondary sources, the major outcomes specify the following need based gaps in the study area:

- Gender Ratio of the study area is approximately 988 per thousand males whether as it is 905 in children below 6 years old;
- Total literacy rate of the study area is approximately 56% whether as male literacy is 67% and female literacy rate is 45% approx. which is much lower. There are approximately 22.43% of literacy gap between male and female;
- State Govt. provides facility of text book, one pairs of uniform, mid-day meal and scholarship to all the students studying in Govt. Primary and Upper Primary Schools;
- Work Participation Rate of the study area is 53.45% in which males are 58% and females are 47%. There are 11% of gender gap between male and female;
- Livelihood of the most of the people of the study area are agriculture and agricultural labour. Few people are still adopted traditional profession of their ancestors;
- Women have limited opportunity of employment and economically they depend on their male counterparts.
- There are no other opportunity of employment and livelihood in the study area. Youth and literate people generally migrate for work and job in developing cities like Kurnool, Bellary Hyderabad, Bangaluru, Mumbai etc.;
- Scarcity of drinking water is a major issue of the study area. Main source of drinking water is piped supply tap water through village panchayat, hand pump and pond. People of Joharapuram has been observed taking water from open pond for drinking and other domestic purposes. Ground water level of the study area is at approximately 400 to 500 feet. There is also contamination of fluoride in ground water;
- Population of Scheduled Tribes in the study area is 2.21% and Scheduled Caste is 16.15% as per census 2011. SC and ST are not directly affected due to proposed project and its land procurement process.
- There are two primary health centers (PHC) available in village Aspari and Pattikonda. In Adoni, approx. 25 km. from village Aspari, there is community health center (CHC) with ambulance and other medical facility;
- There are no chronic or epidemic disease reported in the study area;
- There is no proper drainage system in the villages of the study area. Open drainage system has been observed during site visit;
- Facility of purified drinking water are not available in the public places like school, hospital, panchayat bhawan etc.

5 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This chapter describes various positive and negative environmental and social impacts identified and assessed for the construction and operation phases of the wind power project. These impacts have been identified through review of available project information; discussions with the local community; representatives of the project proponents and other sector specific professionals.

The chapter identifies and assesses the range of potential impacts and extent of their severity on environment, ecology, socio-economic resources, demographics, livelihoods, as well as access and infrastructure issues. Mitigation measures for the identified impacts are also presented in this section.

5.1 IMPACT APPRAISAL CRITERIA

The Criterion which has been employed to appraise impacts on various social and environmental components is as presented as **Table 5.1** below:

Table 5:1: Impact Appraisal Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: refers to area of direct influence from the impact of a particular project activity.	Insignificant/ Local spread	Impact is restricted within the foot prints of the Project boundary. For transmission line it will be within the right of way	Except for ecology (which is defined as loss of vegetation only at site) or within the base of pylon and under the conductors
	Medium Spread	Impact is spread from up to 2 km from the boundary of the Project. Within 500m on either side of transmission line	Except for ecology (which is defined as loss of vegetation at site including large trees with limited disturbance to adjoining flora & fauna)
	High Spread	Impact is spread up to 2 km to 5 km from footprint boundary of the Project Beyond 500m on either side of transmission line	Except for ecology (which is defined as loss of vegetation at site and/or damage to adjoining flora and fauna).
Duration: based on duration of impact and the time taken by an environmental component to recover back to current state	Insignificant/ Short Duration	When impact is likely to be restricted for duration of less than 1 year;	The anticipated recovery of the effected environmental component within 2 years
	Medium Duration	When impact extends up to 3 years	With an anticipated recovery of the effected environmental component within 6 years
	Long Duration	When impact extends	With anticipated

Criteria	Sub-Classification	Defining Limit	Remarks
		beyond 3 years	recovery of prevailing condition to happen within 6 years or beyond or upon completion of the project life
Intensity: defines the magnitude of Impact	Insignificant intensity	When resulting in changes in the environmental baseline conditions is up to 10%	However, it shall be reconsidered where the baseline values are already high.
	Low intensity	When resulting in changes in the baseline conditions up to 20%	For ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	When resulting in changes in the baseline conditions for up to 30%	For ecology, it refers to changes that are expected to be recoverable
	High intensity	When change resulting in the baseline conditions beyond 30%	While for ecology, high intensity refers to changes that result in serious destruction to species destruction to species, productivity or their habitat
Nature: refers to whether the effect is considered beneficial or adverse	Beneficial		Useful to Environment and Community
	Adverse		Harmful to Environment and Community.

A significance assessment matrix was developed to assess the impacts based on the appraisal criteria developed above, which is as given in **Table 5.2** below:

Table 5:2: **Impact Significance Criteria**

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

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

The Impacts for the proposed project are covered under the following subsections:

- Construction Phase
- Operational phase
- Decommissioning Phase

5.2 IMPACTS DURING CONSTRUCTION PHASE

Based on activities involved, an impact interaction matrix for construction phase was prepared for the project. The impact identification matrix is presented in **Table 5.3** below:

Table 5:3: Impact Identification Matrix for Construction Phase

S. No.	Main Activities	Environmental and Social Components									
		Land	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Ambient Noise Quality	Water Quality	Traffic/ Transport	Social/ Livelihood	Occupational Health and Safety
1	Site Preparation										
	Procurement of Land	■	■							■	
	Site Clearing Grading	■	■			■					
	Vegetation clearance		■								
	Staging area	■				■					
2	Labour Engagement										
	Employment of workers								■	■	■
	Water requirement			■							
	Power requirement				■						
	Waste handling and disposal					■					
	Sewage disposal					■		■			
3	Material Handling and Storage										
	Transportation and Unloading of construction material								■		■
	Transportation of Turbine components								■		■
	Storage and Handling of turbine components	■									■
	Storage and Handling of construction material, explosives, hazardous materials,			■	■						■

	etc.										
4	Construction activities										
	Preparation/Mixing of construction material										
	Supply of water, power, sanitation etc.										
	Operation of construction machinery, foundation, pads, access road, offices etc.,										
	Handling and Disposal of construction wastes										
	Construction of new access roads and widening of existing roads										
5	De-mobilisation of Construction Equipment										
	Dismantling of temporary support construction structures/ equipment's										
	Removal of construction machinery										
	Transportation of Construction/Dismantled wastes										

The construction activity will comprise of following activities which will impact the environment and social aspects, as described in sections below:

- Procurement of land
- Site Clearing
- Labour Engagement
- Material Handling and Storage
- Concrete work, Erection and Installation Activities (construction of roads, erection of turbines, setting up of transmission lines etc.)
- Construction Demobilization

5.2.1 Procurement of Land

Impacts

Land procurement for wind turbines will be minor adverse impact as the land procured is one crop rain-fed agricultural with mix of fallow land and it does not attract any physical and economical displacement. The land is currently used for cultivation though the area has scarcity of water. Water availability during summer time is really less. Water table goes down up to 130 m during summer time. Hardness is found in the quality of water, which affects the vegetation and soil to an extent.

Some land is used for grazing of animals but that is also restricted to some areas only as the terrain is difficult for animals to approach. Construction activities will scare away animals and will also restrict their movement across terrain for grazing.

The compensation paid for land will benefit the affected families economically, as they will be able to acquire better land (agricultural land) in adjoining areas for investment and Tax saving purposes, or utilize it in suitable income generating business. The land was procured after prior consultation and finalization of rates at a village level informal meeting which was verified during site visit by village sarpanch and local community.

Mitigation Measures

The procurement of private land through MVTPL is under process and it was observed during the stakeholder consultation that the compensation paid for the land was acceptable to affected families and it was better than the circle rate and market rate of the study area. Further it was verified with the govt. circle rate and sample of purchased land document (**Annexure VII**) shared by MVTPL. However, the project proponent shall ensure:

- Grazing areas are left accessible for cattle and other animals after the construction activities are completed; except identified footprint areas and other utilities having potential risk.
- Details of transmission line and access road shall be shared with the affected families and the community.
- . Proposed project will promote industrialization in the study area, improve demand-supply gap of electricity, improve rates of land, brings employment opportunity and community development through CSR activity.
- All remaining land procurement shall involve counseling through MEIL/MVTPL of the affected families on beneficial investment and optimum utilization of compensation amount.

Impact Value

The impact on environment and social components from land procurement will have a localised impact with medium duration and a low intensity after mitigation measures are employed.

Table 5:4: Impact Value – Land Procurement

Aspect	Scenario	Spread	Duration	Intensity	Overall
Site Preparation	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Local	Short	Low	Minor

5.2.2 Site Clearing

Wind farm projects require relatively less clearing of vegetation as compared to conventional power projects. Clearing of site will be required for the following activities.

- Access to site;
- Storage of construction material;
- Clearing for staging;
- Movement of machinery;
- Radius of 20m around each tower;
- Intra-farm underground cables;
- Pooling substation; and
- Area for maintenance office

Impacts

The site clearing activities such as removal of vegetation, grading, leveling and related activities will majorly impact the ecology and soil resources and quality at site. The following impacts are envisaged due to site clearing:

Soil Quality

- The activities associated with site clearing will result in removal of vegetation, if any and lead to loose soil at site. The area being a high wind zone will result in generation of dust.
- Movement of heavy vehicles can enhance compaction of soil; as well disturb the original stability along the terrain, this can further add to soil erosion.
- Disturbance of ground surface can also result in increased loss of soil with surface run offs leading to nutrient loss.
- Preparation of access roads, staging areas, holding areas etc. will require excavation and filling of sand /gravel etc. for preparing a stable base.
- There will be requirement for removal trees, if any for crane staging area, intervening areas, overhead clearance for suspended turbine components.

Ecology

Removal of vegetation may result in loss of habitat for small mammals and birds. However, the ecological survey carried out at site established that the site does not support any significant ground vegetation. Also the clearance of vegetation shall be carried out along radius of 20 m around each wind turbine site and the entire area procured for each wind turbine may not be cleared. The locations identified for the wind turbine generators does not comprise of any trees in the immediate vicinity. The project may however involve removal of few trees for crane staging area, intervening areas, overhead clearance for suspended turbine components. The impact on ecological environment is assessed to be minor for the project.

Impact Assessment Flora and Fauna

The potential impacts during the construction and operation phase of the project are outlined in the following section.

A. CONSTRUCTION PHASE

Impact:

The construction activities for the project will involve clearing of land at the turbine-sites and along access-roads. This will directly cause the loss of microhabitats and overall habitat-area, as well as, fragmentation of habitats. The microhabitats and habitats involved are likely to be providing feeding grounds, breeding areas and/or roosting sites to resident faunal species. Thus, the construction-related site-clearance activities may potentially lead to degradation in the quality of life of the organisms' dependent on the project area.

Apart from this, the affected area is also likely to be supporting species that serve the food, medicinal, fodder, fuel, and fiber and timber needs of the local community. The construction-related site-clearance activities may potentially destroy or damage such living natural resources. Most of the locations identified for the wind turbine generators are patches of farmland. Hence, the vegetation required to be cleared is mainly composed of herbs associated with fallow fields and does not comprise any tree species. However, the project may involve removal of a few trees to clear land for crane staging areas and access-roads or to gain overhead clearance for suspended turbine components.

Mitigation Measures

The following mitigation measures shall be adopted:

- No bird carcass spotted at site. In the study area, hardly 5-10 birds (only common birds) come and go; hence no collision is envisaged. It will be a rare of the rarest event for accidents to happen. Nesting is not sighted in the transmission line/ cables.
- The site clearance for tower erection, access road and ancillary facilities shall be restricted to the necessary footprint area around WTGs.
- No vegetation shall be removed from land which are not directly required for any project construction activity.
- Cutting or lopping of trees shall be avoided. Mature trees shall not be cut or lopped except finding no alternatives.
- The crane staging area, intervening areas, overhead clearance for suspended turbine components shall be planned.
- Every effort must be taken to avoid and contain environmental pollution in any form. Solid or liquid waste (if any) generated by the project, or by project-related activities, should not be allowed to contaminate soil, ground-water or surface water-bodies.
- Areas around the turbine shall be rehabilitated as per the applicability at the earliest and emphasis should be given on increasing the green-cover with suitable plant species in and around the project-site to ameliorate project induced disturbances and enhance the ecological value of the area. Project proponent should use only native species for plantations.

Impact Value

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

B. OPERATION PHASE

Impact:

The impact of wind turbines on wildlife during operational phase, most notably on birds and bats, has been deaths from collisions with wind turbines and due to changes in air pressure caused by the spinning turbines, as well as from habitat disruption. The potential impacts of wind projects during operational phase may include the following:

- Collision of birds with rotating blades or static elements of turbines, leading to death or bodily damage;
- Barotrauma, internal haemorrhaging induced in bats flying through the low-pressure zone around an operational turbine, leading to disruption of natural life-processes and eventual death;
- Barrage effect, inducing migrating bird-flocks to change their natural flight route, thereby increasing the energy-expense entailed; and
- Shooing effect, inducing some birds to maintain a distance from wind turbines, thereby modifying their natural behaviour and access to resources.

Although no known major migratory flyway coincides with the study area, the area is likely to fall in the path of the various birds, moving through/into the region in which the study-area is located.

Mitigation Measures

The following measures have been considered in the project design. A few additional mitigation measures have also been recommended:

- No bird carcass at site was found. In the study area, hardly 5-10 birds (only common birds) came and go and hence no collision was expected. Accidental can happen anywhere, but very rare.
- Continuous Bird and Bat Monitoring is already happening at site.
- No nesting was expected at transmission cables as there are not many birds found in the area.
- The layout provides adequate spaces between each turbine for movement of birds which would reduce the potential for accidental collision;
- Daytime visual markers shall be provided on any guy wires used to support towers to enhance visibility of the wires to birds;
- Suitable visibility enhancement objects shall also be installed along the transmission line to avoid avian collision;
- Native vegetation with suitable species must be planted or allowed to grow around the wind-turbines;
- It is to be ensure that there is no formation of heaps of rocks or earthen mounds around the installed WTGs for a long time;
- Appropriate storm-water management measure shall be implemented after due feasibility to avoid creating ponds which can attract birds and bats for feeding or nesting in the wind farm area;
- Though there is no declared migratory path at study area, but it is recommended that a short-term programme, designed to monitor avifaunal activity with reference to wind-turbines, be instituted at the project-site. The main purpose of such a monitoring programme should be to generate the base-line data required for prediction of collision-risk for the local

bird-species utilizing the wind-turbine envelope around the year, and, assessment of the significance of such risk to the concerned bird-populations.

- Long term Bird/Bat Study is already being carried out at site that has been enclosed as Annexure XII. In any significance, appropriate mitigating measurements will be taken as a good practice in the host country.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ecology	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

Mitigation Measures for site setting -

The following mitigation measures will be employed during site clearance:

Soil Quality

- Any existing tracks and access route shall be made use of wherever possible. Access road shall be planned to cause minimal disturbance to the terrain topography.
- Existing surface drainage pattern shall be retained to the extent possible.
- Localized sprinkling of water at applicable areas and when required shall be undertaken.
- Movement of vehicles shall be restricted to planned roads to avoid unwanted disturbance to soil.
- Excavated material will be stock piled and used for backfilling of foundations, trenches or other activities.
- Depending on the orientation of the towers, staging area shall be planned to enable erection of more than one tower from one staging area.

Ecology

- The site clearance for tower erection, access road and ancillary facilities will be restricted to the necessary footprint area.
- Vegetation shall not be removed from areas falling in land not required for any construction activity.
- The crane staging area, intervening areas, overhead clearance for suspended turbine components shall be planned in such a way that minimum tree felling is required.
- Disturbed areas shall be re-vegetated with suitable plant species.

Impact Value

The impact on environment and social components from site preparation will have a localised impact with medium duration and a low intensity after mitigation measures are employed.

Table 5:5: Impact Value – Site Clearance

Aspect	Scenario	Spread	Duration	Intensity	Overall
Site Clearance	Without Mitigation	Medium	Medium	Moderate	Moderate
	With Mitigation	Local	Medium	Low	Minor

5.2.3 Labour Engagement

The construction stage will require 75 during normal functions while during peak construction activities will require 175 workers. An additional labour of 100 workers will be required for erection of transmission line. Skilled workers will be hired from outside while unskilled workers will be hired locally by GE/Suzlon.

Impacts

Engagement of workers can result in the following potential impacts:

- The increased expectation for local recruitment and greater involvement by the locals can cause rift and differences between the local community and the workers already engaged.
- Recruitment of staff lacking skill sets required for operation of construction machinery, use of construction tools etc. under pressure from community can lead to delay in project activities.
- There is a positive impact of labour engagement to the small shops and traders in the region as there will be an increase in sale of daily-use products for the workers and drivers bringing material to the site.
- Impact on women from influx of migrant workers, safety and opportunity for Employment

Mitigation Measures

- Community expectations for employment and other local benefits need to be addressed and managed by the project proponent. Adequate representation for local labour shall be decided by contractor as well as the MVTPL management and conveyed to the community.
- MVTPL shall identify employment opportunities based on skill set and education requirement for people whose land plots have been impacted. Employment opportunities shall consider vulnerable section of the society (if any) such as economically weaker class, families with small land holding etc. based on their skill set.
- MVTPL's EHS requirement will be incorporated by the contractor as per the applicability. MVTPL through the contractor agreement shall ensure that the construction contractor commits and adheres to social obligations including community relations, handling complaints and grievances, adherence to labour laws and commitments etc. The contractor shall provide adequate training on social behavior and community interaction to the workers engaged by them. The contractor shall undertake medical test of the workers engaged for the project for a sufficient time period to ensure his/her health status.
- MVTPL to ensure that the construction site shall have sanitation, drinking water and waste disposal facilities. Portable toilet /other arrangement with septic tank soak pits will be provided at site to facilitate the sewage generated.
- There will a limited number of local migrant workers (from within the country) engaged for the project; these workers and their contractors will be adequately briefed about how to respect local customs and women.

Impact Value

The impact on environment and social components from labour engagement will have a localised impact with short duration and a low intensity after mitigation measures are employed.

Table 5:6: Impact Value – Labour Engagement

Aspect	Scenario	Spread	Duration	Intensity	Overall
Labour Engagement	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

5.2.4 Material Handling and Storage

Material handling and storage will include transportation of turbine components, transmission tower structure, conductors, transformers, switch yard components, construction material etc. The impacts identified from this activity are:

Impacts

Transportation and Traffic

The construction activities will require transportation of construction material and turbine components to the site. Ground transportation and traffic impacts associated with wind energy projects typically include impacts on the transportation system itself (e.g., the physical properties of the road system) and impacts on traffic that uses the transportation system. Such impacts arise almost entirely during the construction period.

- Transportation of heavy and large components of turbines can cause damage to the road infrastructure, culverts, bridges, drainage structure, poles, signboards etc.
- Heavy and large components of wind accessories may be damaged due to improper infrastructure; on which it is being transported.
- Movement of oversize structures will be slow and shall lead to blockade of traffic and congestions at crossing and turns.
- Protrusions and edges of components being transported can lead to damage of roadside structures and can lead to accidents.
- Break down of vehicles and unplanned halt along the road can lead to traffic blockade and discomfort to community.
- Transportation of construction material in open trucks / tippers can lead to dust generation along the route.

Health and Safety

Storage and handling of various wind farm components and construction material will require specific emphasis on health and safety. Inadequate planning and implementation can lead to the following issues:

- Physical injury during loading and unloading of turbine components
- Accident and injury from crane failure during handling of wind turbines
- Trip and fall hazards due to improper storage and placing of components
- Accident and injury due to vehicle collision/slip along terrain etc.
- Potential risk for cattle and livestock moving around the project road

Community and Social

Community and social impact from material handling and storage will include:

- Traffic congestion along the village/minor roads due to movement of heavy vehicles and other construction related vehicles
- Disturbance from traffic movement during night time on minor roads
- Potential for accidents to livestock and people
- Damage to village roads and related structures
- Stacking of transmission line components in field and private lands along the ROW
- Parking of vehicles in open fields and other non-project locations
- Movement of vehicle along transmission line through land not designated as ROW

Soil and Water

Environmental concerns from material handling and storage will include:

- Dispersal of construction material due to wind, leading to contamination of soil in the areas in proximity of the proposed wind farm and along the transmission line
- Run off from construction material which can flow along the slopes and contaminate the water bodies downstream.
- Oil spills from construction machinery and vehicles during refueling at construction site can contaminate the soil

- Oil leaks from vehicles and machinery operating at site also cause contamination to Soil.

Mitigation Measures

The transportation trips will be limited suitably for pickup trucks, construction supervisor's/campsite workers. Movement of heavy vehicles will be slow and require continuous monitoring by dedicated person for suitable movement from source to destination.

The mitigation measures to be considered during material transport and handling for construction shall include:

Transportation and Traffic

There are existing operational wind farms in the area, which suggests that there are existing roads capable of handling the size and load of wind turbine and its components. However, MVTPL shall undertake a detailed analysis to assess the feasibility of transportation of turbine and associated components. This includes identifying the origin of the components and the most efficient route to the location of the site. The analysis will also review the general conditions of the road, width, horizontal curvature, vertical curves, intersection geometry, drainage structures, height restrictions, load restrictions of existing bridges and culverts, and any locally significant features.

The mitigation of the transportation routes will vary from minor modifications to the existing roadway to partial reconstruction, depending on the specific situation. Wherever possible, rerouting of construction traffic to wider, less-restrictive road will be preferred. A transportation plan shall be developed based on the route finalised prior to commencement of transportation of heavy machinery.

Where road widths are insufficient, either temporary widening of the road with gravel or full depth widening of the pavement structure will be undertaken. All construction and modification activities will be undertaken after prior approval / permission from local administration.

Pilot vehicles will be provided with trucks carrying large components to manage traffic and assist the movement without any damage or accident to structures along the road. All vehicles engaged for transportation will be verified for fitness. Any incidence of breakdown will be attended immediately to ensure smooth flow of vehicle along the road.

The traffic movement planned is kept significantly away from most of the villages. No movement is proposed on village roads. The drivers will be asked to maintain a minimum speed limit in the area to avoid accidents to people and livestock.

Health and Safety

Loading-Unloading Activities:

Operation of loading –unloading equipment shall be undertaken under the guidance/supervision of trained professional. All lifting appliances shall be thoroughly examined by a competent person, prior to engagement with the project. Unloading equipment, lifting appliances will be certified by competent statutory authority before use.

The contractor shall ensure that no person is engaged in driving or operating lifting appliance unless he is sufficiently competent and reliable, possess the knowledge of risks involved in the operation and is medically examined periodically. As per Section 23 of the Factories Act, 1948, as amended, young persons (below 18 years of age) must not be allowed to work at any dangerous machine (including cranes) unless they have been fully instructed about the dangers arising pertaining to the machine and the precautions to be observed, and have received sufficient training in work at the machine, or are under adequate supervision by a person who has a thorough knowledge and experience of the machine.

The contractor shall ensure that machinery is equipped with a legible, durable load chart that shows the manufacturer's recommended load configurations and maximum load weights. The chart must be securely attached to the cab and easily visible to operators when they are seated at the control station.

Storage of turbine components and associated facilities:

Storage of turbine components will be made in an identified location at site. Storage area will be provided with proper lighting and space for access of lifting equipments.

All material will be arranged in a systematic manner with proper labeling and without any protrusion or extension onto the access corridor. The construction material for transmission tower will be kept at site and carried to individual towers as per requirement.

Community and Social

The village Panchayat/local administration will be consulted prior to moving of large components. Information about transportation will be conveyed in advance.

Any concerns regarding damage to roads and associated structures (if any) will be addressed prior to use of village roads. Widening of shoulders and development of new roads will be discussed with the competent authority and undertaken only after all concerns and compensations (if applicable) are addressed.

Movement of vehicles will be restricted to non-congestion hours i.e. apart from 09:00 to 11:00 and 04:00 to 06:00 on the identified routes. In case of transmission lines all vehicles will use the ROW. No vehicle will be parked on any other land other than the designated parking at site. While moving on village roads, all vehicles including smaller vehicles will follow a speed limit of 30km/hr. Only trained and experienced drivers will be engaged for the project. The drivers will be briefed about the specific precautions and social commitments to be considered while driving on village roads.

Soil and Water

All construction material will be stored at site in suitable manner to avoid dispersal with wind. All vehicles carrying construction material will be covered while travelling on public roads.

The drainage pattern of the area shall not be disturbed during construction to the extent possible. Culverts or water conveyances shall be provided for all permanent and temporary roads to be constructed for the project. Run off control measures such temporary bounding around storage of construction material, silt traps etc. shall be employed.

Impact Value

The impact on environment and social components from material handling and storage will have localised impact with medium duration and a low intensity after mitigation measures are employed

Table 5:7: Impact Value –Material Handling and Storage

Aspect	Scenario	Spread	Duration	Intensity	Overall
Material handling and Storage	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

5.2.5 Concrete Work, Erection and Installation Activities

Construction activities will spread over duration of one year, the peak activity will be executed over a period of 6 to 8 months. The main construction activities will be:

- Construction of access roads
- Construction of foundation of tower

- Construction of transformer pad
- Erection of tower and Installation of turbine components
- Laying of transmission lines
- Construction of pooling substation and switchyard
- Erection of transmission pylons and stringing of conductors

Impacts

The impacts identified from construction activities will comprise of the following:

- Excavation activities and earthworks during construction might result in chance find of cultural and historical artifacts of heritage value.
- Road construction work will involve operation of hot mix plants and activities that generate noise and air pollution.
- Mixing of construction material and setting up of batching unit will generate dust, which will be carried downwind to villages and habitation.
- Blasting activities (if any) for foundation will generate noise and vibration; although small in nature it will scare birds and grazing cattle around the site. Noise will also be generated from operation of construction machinery.
- Construction activities can cause contamination of soil and water resources through oil spill from storage of fuel at site. Fuel will be stored at site for operation of machinery. It is estimated that about 2KL of diesel will be stored at site for operation of construction machinery. Contamination can also result from leaks and drips from machinery and vehicles at site.
- Working at heights may be required during construction activities, including the assembly of wind tower components, transmission towers etc. Working at heights is associated with hazards of fall and slip and can lead to fatal injuries. Uses of wielding and electrical operation are also prone to fire and electric hazards.
- Random disposal of excavated soil and construction debris can lead to contamination of soil in the area along with potential for sediment to flow into nearby water bodies. Improper disposal of package material, boxes, plastics, ropes etc. can lead to littering in the area.
- Hazardous wastes such as waste oil etc. can cause contamination of soil and water bodies if adequate precautions for management and handling are not undertaken.
- Stringing for transmission lines can lead to damage to agricultural crop, especially prior to harvest season. Stringing across roads can lead to traffic congestion tower crossing areas. Stinging activities close to habitations can lead to noise and disturbance to the local community.

Mitigation Measures

The mitigation measures during masonry, erection and installation shall include the following:

- A procedure for reporting chance find shall be developed by MVTPL. MVTPL is ISO certified and as a part of the system MVTPL has developed desired SOP for activities at asset level which will be aligned in the upcoming ESMS. In case of any chance find MVTPL and its contractors will:
- Halt all work in progress at the site
- Ensure that the area is cordoned off
- Ensure that the District administration and nearest office of archaeological survey is informed as per the applicability
- Facilitate the inspection by relevant authorities
- Restart the work only after receiving go ahead from the relevant authority
- Generation of dust during from batching plant and excavation activities will be controlled through sprinkling of water as and when required. Batching unit shall be located away from

the edges of plateau and away from habitations. Loose soil will be kept in suitable way to prevent dust generation.

- All blasting activities (if required) will be controlled. The intensity will be small to generate any significant noise and vibration. Adequate precautions and information will be provided prior to execution of any blasting activity. Portions of site will be restricted temporarily during construction to avoid movement of grazing animals and local people.
- Stone aggregates shall be sourced only from licensed existing quarries
- Hot mix plants shall be at least 500 m away from human settlements and preferably located on leeward side of most dominant wind direction. All permit conditions shall be implemented /complied as per the applicability and nature of work.
- Appropriate traffic diversion schemes shall be implemented during construction of road is under progress and all works shall be planned and swiftly completed to avoid inconvenience to road users.
- Storage of oil will be undertaken in suitable manner. Fuel storage will be located at a significant distance from electrical works and panel. Re-fueling of machinery at site will be undertaken with proper care.
- Vehicles and machinery will be maintained and repaired immediately for leaks. Drip pan will be provided to vehicles with leaks to prevent contamination of soil.
- Hazardous waste (if any) generated from machinery and equipments will be stored at site in a secure location. The same will be disposed as per Standard Practice, stipulated by host country.
- Work permit system shall be implemented for working at height (typically when working over 2 m above) and for hot jobs. Prior to undertaking work, integrity of structures shall be inspected. Only workers trained in climbing techniques and use off all protection measures; inspection, maintenance, and replacement of fall protection equipment shall be engaged for work at height.
- Construction debris and excavated material will be used for filling up of low lying areas and for foundation works of pooling station and maintenance room. All packaging material will be collected at the storing area and sold to vendors.
- Appropriate fall-protection system will be provided as per the requirement, along with compatible with the tower components. Safety belts will be mandatory and shall be monitored for wear and tear on regular basis. While operating power tools at height, workers will be provided with a second (backup) safety strap. All workers will be trained about use of Personal Protection Equipment, which will be mandatory to be worn at site during construction. Hard hat areas will be marked and informed to all workers.
- Stringing activities will have limited impact on agriculture as the land use is mostly fallow and barren. Agricultural land will be avoided wherever alternate site options will be available. Stringing activity will be preferred after considering harvest period and will be scheduled to keep loss of crop if any to minimum. Prior information and adequate signs will be provided at all locations of transmission pylons falling near road crossings and habitations.

Impact Value

The impact on environment and social components from concrete work, erection and installation activities will have a localised impact with short duration and a low intensity after mitigation measures are employed.

Table 5:8: Impact Value – Concrete Work, Erection and Installation Activities

Aspect	Scenario	Spread	Duration	Intensity	Overall
Concrete Work, Erection and Installation Activities	Without Mitigation	Local	Short	Moderate	Moderate
	With Mitigation	Local	Short	Low	Minor

5.2.6 Construction Demobilisation

Construction demobilisation will require removal of machinery, workers, campsite and other temporary structures.

Impacts

The key issues associated with demobilisation are:

- Loss of job will be an issue when the workers will be asked to leave after construction because wind farm project will not require more than 8-10 individual for operations phase.
- Improper disposal of construction waste and debris from deconstruction of storage area, etc. will lead to contamination of soil and discontent of community.
- Deconstruction activity will lead to generation of dust which can be carried downwind to habitations
- Deconstruction activities are associated with health and safety issues such as structural collapse, trip and fall, electrical hazard etc.

Mitigation Measures

The mitigation measures for demobilisation shall include:

- The contractor shall inform the workers and local community about the duration of work. The workers shall be clearly informed about the expected schedule and completion of each activity.
- A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability. And MVTPL has already adopted this mechanism in their HR policy in the total life cycle of any project.
- All waste generated from demobilisation shall be collected and disposed off at the nearest municipal disposal site or suitable area, identified by competent authority. Structures that can be reused will be carried back by the contractors or sold to vendors.
- All necessary Personal Protection Equipment (PPE) shall be used by the workers during demobilisation.
- Workers will be briefed about the use and requirements of PPE.

Impact Value

The impact value due to construction demobilization will be minor after mitigation measures are implemented.

Table 5:9: Impact Value – Construction Demobilization

Aspect	Scenario	Spread	Duration	Intensity	Overall
Demobilization	Without Mitigation	Local	Short	Moderate	Moderate
	With Mitigation	Local	Short	Low	Insignificant

5.2.7 Noise Generation

During the construction phase, noise will be generated preliminary during the day time (07:00 to 22:00 hours). Noise will be generated from moving vehicles as well as construction equipment including the DG sets utilized for power. As a control measure it will be ensured that noise emission from the vehicles and equipment shall not exceed 85 dB(A) which is as per Environment (Protection) Amendment Rules, 2002 for noise limits for vehicles applicable at manufacturing stage for passenger and commercial vehicles with gross vehicle weight above 12000 kg as specified in central Motor

Vehicles Rule 1989). DG 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.

Table 5:10: Typical sound level from various types of construction vehicles and equipment

S. No	Type of Vehicle	Description	Typical Sound Power Level (dB
1.	Passenger Vehicle	Passenger Vehicle	85
2.	Trucks	10 ton capacity	83
3.	Cranes	Overhead and mobile	75
4.	Mobile Construction Vehicles	Compactor / Rollers	75
5.	Mobile Construction Vehicles	Front loaders	75
6.	Stationary construction equipment	Concrete Mixer	75
7.	Compressor	Air compressor	75
8.	Compressor	Vibratory compactor	75

Source: Environment (Protection) Amendment Rules, 2002 and Schedule-VI of Environment (Protection) Rules, 1986

It is to be noted that ambient noise levels depend on various factors such as the exact number of vehicles/equipment being used at the construction site, number of hours of operation, etc. Due to unavailability of such information, the cumulative noise levels from simultaneous use of construction vehicles and equipment is difficult to ascertain. However, the construction activities will be temporary in nature and will not last for more than 15-20 days for a particular turbine site. Regular noise monitoring is also being proposed to have a check on noise level during construction phase.

5.3 IMPACTS DURING OPERATION PHASE

The major activity of wind farm operation will be power generation. Power generation from wind farm project has minimal environmental and social concerns as compared to any other source of power generation. However, several other impacts are associated with wind power operations. The major issues of concern during operation of turbines are as provided below:

- Visual impacts due to wind turbines
- Impacts due to noise generation from turbines and transmission lines
- Impacts due to shadow flicker
- Ecological impacts
- Impacts on water resources
- Impacts due to generation of hazardous waste
- Health and safety impacts
- Community and social impacts
- Impacts due to electromagnetic interference of transmission lines
- Cultural and archaeological impacts
- Impacts on communication signals

Based on the activities involved, an impact interaction matrix for operation phase was prepared for of the project. The impact identification matrix is presented in **Table** below.

Table 5:11: Impact Identification Matrix for Operation Phase

S. No.	Environmental and Social Components	Main Activities		
		Power Generation	Maintenance of turbines	Corporate Social Activities
	Visual/ Aesthetics			

S. No.	Environmental and Social Components	Main Activities		
		Power Generation	Maintenance of turbines	Corporate Social Activities
	Ecology	■		
	Water Resources		■	
	Noise	■	■	
	Cultural/ Archaeological		■	■
	Health and Safety	■	■	
	Hazardous waste		■	
	Shadow Flicker	■		
	Community/ Social			■
	Communication facilities	■	■	

The above impacts associated with operation phase of the proposed project and the mitigation measures are provided in the following sub sections.

5.3.1 Visual Intrusion

Visual resources refer to all objects (man-made and natural, moving and stationary) and features (e.g. landforms and water bodies) that are visible on a landscape. They contribute to the scenic and visual appeal of the landscape. An adverse visual impact is defined as anon welcome visual intrusion that diminishes the visual quality of an existing landscape. Changes that can be perceived as visual intrusions generally result from the introduction of visual contrast to the existing scene, based on differences in form, line, color, and/or texture.

Visual and aesthetic impacts are among the most commonly expressed concerns about the development of wind energy projects. Determination of what constitutes an adverse visual impact is highly subjective because it depends on the values, beliefs, and experiences of individual viewers. Opinions about the aesthetic qualities of wind energy facilities can vary greatly among different segments of the population and from one location to another. Visual contrast with the existing landscape is often unavoidable because of the size and typical location of wind farms. Nevertheless, there are some measures that can be incorporated into the design of the project facilities to limit the degree of visual contrast and reduce the prospect that the contrast would be widely perceived as an adverse visual effect, or at least reduce the degree of the effect.

Impacts

The project will have the following impacts related to visual intrusion:

- Wind energy development projects would be clearly visible because of the height and large size of turbine components.
- Shadow flicker is the most significant impact related to visual intrusion.
- All above ground ancillary structures would potentially produce visual contrasts due to their design and result in glare due to reflectivity of their surfaces.

Mitigation Measures

It is critical to recognize that wind turbines cannot be adjusted to meet visual criteria alone. The turbines must be located in the areas with appropriate wind resources in order for the project to be viable.

A visual assessment of the proposed site with respect to the identified tower locations was undertaken. It was also observed that visibility of tower from villages in close proximity will be

limited. It is therefore assessed that the visual intrusion will be limited and more based on individual perception.

The wind turbine towers and blades will be as per Standard Practice white in order to avoid any differing contrast to the landscape and thereby minimize visual discomfort. An anti-reflective paint coating will also be applied to the turbine towers and blades to mitigate the possible impacts of light reflection/blade glint.

Impact Value

The visual impacts on environment and social components due to operation of the wind turbines will be localised with short duration and low intensity after mitigation measures are employed. Hence the overall significance of the impact with mitigation measures will be insignificant.

Table 5:12: Impact Value – Visual Intrusion

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual Intrusion	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

5.3.2 Bird and Bat Study

A long term bird and bat survey was undertaken to study the potential impact of wind turbines on bat and avifauna population of the proposed project site area. The total area required for the project is approximately 494 acres. The proposed project is spread over 12 revenue villages of Aluru and Pattikonda Taluka. The land identified for the proposed project site is primarily undulating and mix of single cropped agricultural and barren land. The core zone is mostly single crop land but the buffer zone up to 10 km is predominantly agricultural land interspersed with isolated patches of sparse vegetation and without crop of rocky boulders. The major observations of the present survey are:

i. 24 bats species and 164 bird species are recorded in the whole Kurnool district as per the publically available data. As per the IUCN Criteria the entire mentioned bat species fall under the criteria of Least Concern whereas 5 bird species belong to “Critically Endangered” and 3 species belong to “Endangered” category.
ii. In the project site 88 bird species and 4 bat species were recorded. However, none of them belong to “Critically Endangered” or “Endangered” category of IUCN Red list.
iii. There are no major migratory paths observed during the site study and found as per the available secondary data
iv. Out of 88 bird and bat species 36 species including 26 migratory species were found to be species of concern as per national and different international regulations.

The anticipated impact to the bat and avifauna population due to the project was found to be general in nature common with wind mill projects like mortality due to collision with turbine rotor or accidental body touch with high tension transmission line or in general disturbance in the site due to construction and operation of the project.

The proposed project does not expect to threaten the long term viability/function of any of bat and bird species found in the area. However, mitigation measures are suggested to minimize the project impact on bat and avifauna. The project as per the closure of ESIA falls into the Category B in reference to the ADB environmental and social safeguard policy (2009). The project is expected to be beneficial in improving the power scenario of the area.

The detail study report is enclosed as **Annexure XII**

5.3.3 Noise Generation

During the field survey, receptor consisting primarily of built structures and settlements such as a small house in the field, temple and villages were identified. Primary Noise monitoring was carried out for continuous 24 hours at 4 locations by a NABL Accredited Laboratory to evaluate the baseline noise levels at the project site.

It was observed that the noise levels at the monitoring locations ranged from 47.55 dB (A) to 48.06 dB (A) during day time and 33.36 dB (A) to 35.04 dB (A) during night time. The baseline noise levels in the area are thus within the prescribed CPCB standards of 55 dB (A) and 45 B (A) during the day and night time respectively at all locations.

Sources of Wind Turbine Noise

The sources of noise generation from operating wind turbines can be divided into two categories: mechanical sounds, from the interaction of turbine components, and aerodynamic sounds, produced by the flow of air over the blades.

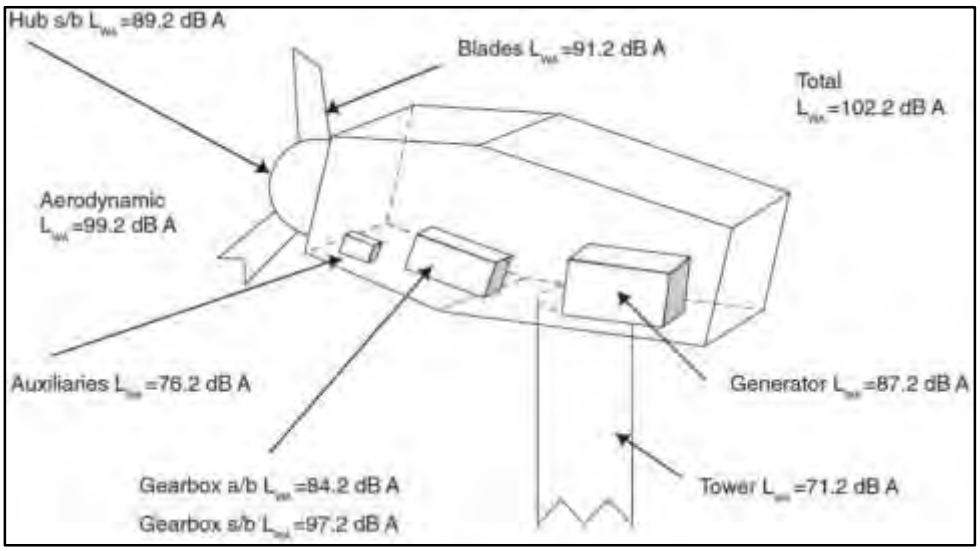
Mechanical Sounds

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; and
- Auxiliary Equipment

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 type of aerodynamic noise may include low frequency, impulsive low frequency, total and continuous broadband. In addition, the amount of noise may rise with increasing rotation speed of the turbine blades, therefore turbine design which allow lower rotational speeds in higher winds will limit the amount of noise generated.

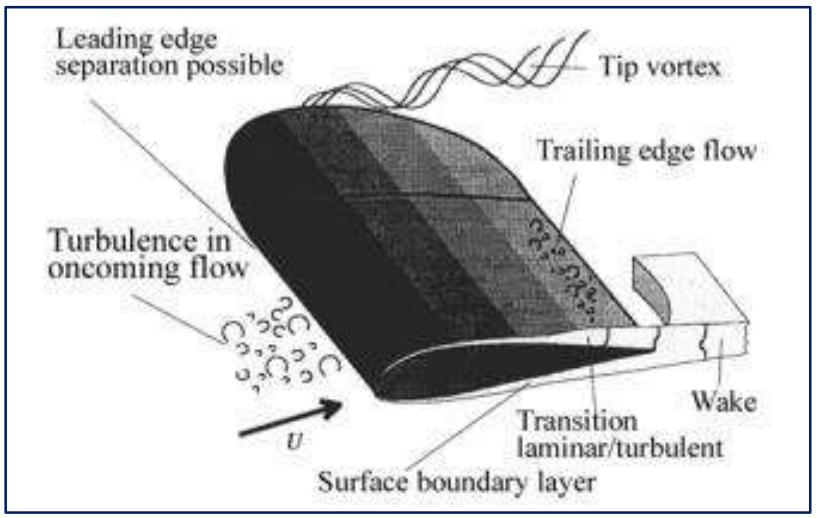
Mechanical noise may be generated by machinery in the nacelle of the wind turbines. The project envisages installation of 30 x 1.7 MW (GE-1.7), 44 x 2.3 MW (GE-2.3), 23 x 2.1 MW (S-111 Suzlon) Wind Turbine Generators (WTG). Since the emitted sound is associated with the rotation of mechanical and electrical equipment, it tends to be tonal (i.e., of a common frequency), although it may have a broadband component. Figure below illustrates the total sound power from components of a wind turbine.



Source: Centre for Energy Efficiency and Renewable Energy

Aerodynamic Sounds

Aerodynamic noise originates from the flow of air around the blades. It increases with the rotor speed and can be classified into three groups namely; Low Frequency, Inflow Turbulence and Air Foil Self Sounds. Low frequency sound is generated when the rotating blade encounters localized flow deficiencies such as wind speed changes, flow around the turbines etc. Inflow Turbulence depends on the amount of atmospheric turbulence which tends to result in local pressure fluctuations around the blade. And finally, Air Foil Self Sounds includes the sound generated by the air flow right along the surface of the air foil with broadband characteristics. Figure below shows the schematic representation of flow around a rotor blade.



Schematic of Flow around a Rotor Blade

GE -2.3 MW

Normal Operation Calculated Apparent Sound Power level and octave Band Spectra

Apparent sound power level LWA, k is initially calculated as a function of hub height wind speed Vhh, corresponding wind speeds v 10m at 10m height above the ground level have been evaluated assuming a logarithmic wind profile. In the case a surface roughness of zoref =0.05 m has been used, which is representative of average terrain conditions

$$v_{10m} = v_{HH} \frac{\ln\left(10m / z_{0ref}\right)}{\ln\left(hub\ height / z_{0ref}\right)}$$

Calculated apparent sound power levels LwAk and associated octave –band spectra are given in table below. Values are provided as mean levels as a function of V10m for normal operation (NO) over cut-in to cut-out wind speed range. Uncertainties for octave sound power.

Normal Operation –A Weighted Octave Spectra (DB)												
Hub Height Wind speed		4	5	6	7	8	9	10	11	12	13	14-cut out
Standard wind speed at 10m for a hub height of 80m (m/s)		2.9	3.6	4.3	5.0	5.7	6.5	7.2	7.9	8.6	9.3	10.1-cut out
Standard wind speed at 10m for a hub height of 94 m (m/s)		2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8 –Cut out
Frequency	16	52.5	52.6	53.8	57.1	60.1	62.6	64.8	65.0	65.1	65.1	65.1
	31.5	67.4	67.1	68.3	71.3	74.2	76.7	78.7	78.9	79.0	79.0	79.0
	63	77.7	77.4	78.9	81.8	84.5	86.9	88.7	88.8	88.9	89.0	89.0
	125	84.2	84.4	87.1	90.1	92.5	93.5	95.1	95.0	95.0	95.1	95.2
	250	88.5	89.2	92.2	95.7	98.5	98.6	99.9	99.6	99.6	99.6	99.7
	500	90.2	90.9	93.3	96.9	100.1	101.3	102.9	102.9	102.8	102.8	102.8
	1000	88.9	89.8	91.7	94.9	98.0	100.2	102.1	102.3	102.4	102.5	102.5
	2000	84.2	85.9	88.1	91.0	93.6	95.7	97.7	97.8	97.8	97.6	97.3
	4000	73.0	77.0	80.8	83.8	86.3	87.5	89.2	89.0	88.4	87.4	87.1
	8000	55.1	58.8	62.2	66.3	69.1	68.2	68.4	68.1	67.5	66.8	66.4
Total Sound Power Level in dB(A)		95.0	95.8	98.2	101.6	104.5	105.8	107.5	107.5	107.5	107.5	107.5

Note: Normal Operation Calculated apparent sound power level, 2.2-116 as a function of 10 m speed (zref=0.05 m) the octave band spectra are for information only.

At 10 m wind speeds lower than 5 m/s the sound power levels decreases and may get so low that wind turbine acoustics become indistinguishable from background noise. For a conservative calculation data at 5 m/s may be used.

For 10 m wind speeds above 10 m/s the wind turbine has reached rated power and blade pitch regulation acts in a way that tends to decrease noise levels. For a conservative calculation data at 10m/s may be used.

The highest normal operation calculated apparent sound power level for 2.3 -116 is Lwak =107.5 Db.

Uncertainty Levels

Apparent sound power levels in table -1 are calculated mean levels. Uncertainty levels associated with measurements are described in IEC/TS 61400-14.

Per IEC/TS 61400-14, Lwad is the maximum apparent sound power level for 95% confidence level resulting from n measurements performed according to IEC 61400-11 standard: Lwad =LwA+K where LwA is the mean apparent sound power level from IEC 61400 -11 testing reports and K =1.645σt.

Testing standard deviation values σT, σR and σP for measured apparent sound power level are described by IEC/TS 61400-14 where σT is the total standard deviation, σP is the standard deviation for product variation and σR is the standard deviation for test reproductively.

Assuming σR<0.8 dB and σP < 0.8 dB as typical values leads to a calculated K < 2dBfor 95% confidence level.

GE 1.7-103-50Hz and 60 Hz

This section summarizes the acoustic emission characteristics of 1.7-103 wind turbine for normal operation. Apparent sound power levels LWA,k are initially calculated as a function of hub height wind speed vHH. Corresponding wind speeds v10m at 10 m height above ground level have been evaluated assuming a logarithmic wind profile. In this case a surface roughness of z0ref = 0.05 m has been used, which is representative of average terrain conditions.

$$v_{10m} = v_{HH} \frac{\ln\left(10m / z_{0ref}\right)}{\ln\left(hub\ height / z_{0ref}\right)}$$

Calculated apparent sound power levels L_{wak} and associated octave –band spectra are given in the following table. Value are provided as mean levels as a function of v10m for normal operation (NO) over cut-in-to cut –out wind speed range. Uncertainties for octave sound power levels are generally higher than for total sound power levels.

1.7-103 –Normal Operation									
Standard wind speed at 10 m (m3/s)		5	5.5	6	6.5	7	8	9	10-cutout
Hub height wind speed at 80 m (m/s)		7.0	7.7	8.4	9.1	9.7	11.1	12.5	14-Cutout
Frequency	32	73.9	75.9	77.8	79.5	80.6	80.7	80.6	80.4
	63	83.4	85.5	87.5	89.3	90.5	90.5	90.5	90.3
	125	88.7	90.9	92.9	94.7	95.5	95.7	95.7	95.6
	250	92.7	95.0	97.1	99.0	98.1	97.7	97.7	97.6
	500	94.9	97.6	100.0	102.2	101.5	100.3	100.3	100.3
	1000	93.8	96.2	98.5	100.8	101.7	102.4	102.6	102.7
	2000	92.5	94.5	96.4	98.1	98.9	99.6	99.6	99.4
	4000	86.7	89.2	91.3	93.2	92.8	91.4	90.5	89.9
	8000	68.8	72.1	74.9	77.1	75.2	74.1	73.3	72.6
	16000	31.2	33.4	35.4	37.6	37.9	35.9	35.6	35.9
Total apparent sound power level Lwa,k (dB)		100.3	102.6	104.9	106.9	107.0	107.0	107.0	107.0

Note: Normal operation calculated apparent sound power level L1.7-103 with 80 m hub height as function of 10 m wind speed Zref =0.05 m), the octave band spectra are for information only.

At 10 m wind speeds lower than 5 m/s the sound power levels decreases and may get so low that wind turbine acoustics become indistinguishable from background noise. For a conservative calculation data at 5 m/s may be used.

For 10 m wind speeds above 10 m/s the wind turbine has reached rated power and blade pitch regulation acts in a way that tends to decrease noise levels. For a conservative calculation data at 10 m/s may be used.

The highest normal operation calculated apparent sound power level for the 1.7 -103 is Lwak =107.0 dB.

For Suzlon 2.1MW
Turbine Model: S111DFIG-2100Kw
Operational Mode: Normal Operation
Air density: 1.225 Kg/m3
Turbulence Intensity: 16%
Blade Condition: Clean, no ice, no defects
Equipment: Tonality reduction kit (TRK)

Measurement Standard:

All values are given according to IEC 61400-11 wind turbine generator systems-part11: acoustic noise measurement techniques.

Sound Power level

The reference sound power level LWA, ref 10 for the S111 DFIG 2100Kw turbine shall not exceed 105 dB(A) in total.

LWA, ref is the sound power level referenced to a wind speed measured in hub height, excluding uncertainty U [accord IEC 61400-11]: LWA=LWA, ref+U

Table 5:13: Declaration of Octaves (Input Data)

hh wind	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz	LWA[Db(A)]
4.0	77.1	81.5	85.0	90.1	92.5	92.4	84.6	89.7	98.0
5.0	77.3	82.5	86.3	90.8	93.9	92.3	84.6	79.7	98.0
6.0	78.1	84.2	88.4	92.6	95.8	93.9	89.6	79.3	100.0
7.0	79.6	87.3	91.6	95.5	98.0	95.8	93.1	81.1	102.5
8.0	81.2	89.7	94.2	97.8	99.6	97.2	94.9	82.8	104.4
9.0	81.0	90.6	94.8	98.7	100.1	97.0	95.9	84.4	105.0
10.0	79.5	87.2	91.0	96.7	98.3	95.4	93.2	85.3	102.8
11.0	79.7	86.7	89.1	94.3	96.8	95.2	90.7	85.4	101.4
12.0	80.3	86.7	88.6	92.9	96.0	95.4	90.7	85.6	100.9
13.0	80.3	86.6	88.4	92.2	95.7	95.5	90.8	85.8	100.7
14.0	80.3	86.6	88.4	92.0	95.6	95.5	91.0	86.4	100.7
15.0	80.3	86.7	88.4	92.1	95.6	95.5	91.1	86.6	100.7

The herewith specified sound level is valid under the following conditions –

- The maximum noise of 105.0 dB(A) is to be regarded as the maximum noise for all wind speeds, octaves and hub heights.
- The values up to 105.0 dB(A) may vary regarding relation to wind speeds, octaves or hub heights but will not change in total.
- Declaration of sound level bases on a model using values from measurements according to IEC 61400-11 Ed 2.1 Wind turbine generator systems –part 11: acoustic noise measurement techniques.
- Absence of Tonality is declared for turbines equipped with TRK only.
- The wind turbine sound shall be measured without being influenced by surrounding tonality sources.
- The rotor blades have to be according to the nominal blade design conditions.
- The wind turbine is operating in its specified range
- The specified electrical power is taken at the low voltage side of the transformer
- The site turbulence intensity values at each wind speed are according to the normal turbulence intensity by considering the whole rotor area.
- All noise measurements shall be taken from downwind direction.

Noise Impact Modeling

Scenario Considered

The impact on nearby receptor was assessed to present the worst case scenario considering following assumptions.

- Source is operating at highest noise i.e. 107.5 dB(A) as discussed above sections
- No absorption of noise by the surface in between
- No absorption of noise by medium of transportation,
- No barrier is between receptor and source

The impact from wind turbine at receptor were assessed considering hemispherical propagation of sound wave presented by the following equation-

$L_R = L_S + DI - 20 \log(r) - A_e - 8$

Where,

L_R: Sound pressure level at a receptor located at radial 'r', dB (A)

L_S: Sound pressure level at the source, dB (A)

DI: Directivity index of the source (for hemispherical radiation DI = 3dB (A)

r: Radial distance of the receptor from the source, m

A_e: represents excess attenuation of sound caused by the environmental conditions such as:

- o Absorption in Air
- o Effect of rain, snow and fog
- o Reflections and refractions at barriers and buildings
- o Effect of the terrain, grass, shrubs, trees etc.
- o Effect of wind and temperature gradient

The absorption of the sound is generally a complex phenomenon. In general, for homogeneous loss free atmosphere Ae = 0.

Modeling Outcome

To assess the worst case scenario, maximum incremental Nosie level at individual receptor was superimposed on maximum existing noise level i.e. 48.06 dB(A). The average increment noise level in the project vicinity would be in the tune of 2.59 dB(A).

The result of the assessment presents that the expected noise level will be well within the prescribed limit by CPCB residential standards. The receptor is almost equi-distance from turbines ASP-53 & ASP-54 and likely to expose to the noise generated from both the turbines. Receptor locations are presented in **Table 3.1** and Receptor map is presented in **Annexure III**. Noise modeling input data has also been enclosed as **Annexute XIV**. The noise increment map in respect to the turbines and receptors as graphed based on the modeling exercise is given as **Figure 5.1.**

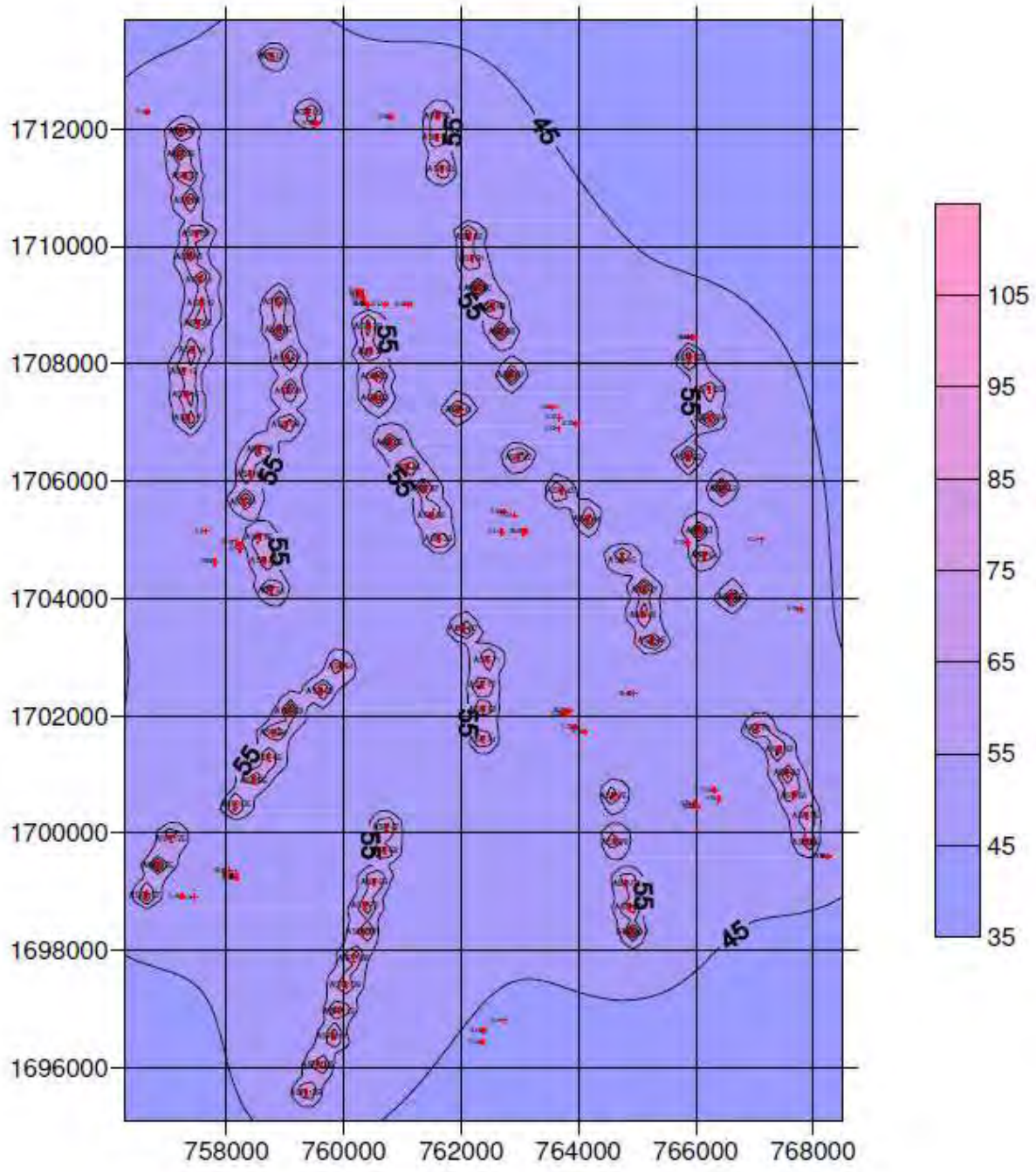


Figure 5:1: Noise Increment Map

Mitigation Measures:

While planning, micro-siting activity of the wind turbines has considered a minimum setback distance to all residential habitation in order to avoid sensitive noise receptors and wind turbines are designed in accordance with the international acoustic design standards to keep noise levels under check. In addition to above, the following mitigation measures shall be considered to further limit its impacts.

- Proper siting of wind power projects to avoid locations in close proximity to sensitive noise receptors
- Adherence to national or international acoustic design standards for wind turbines
- Plantation of vegetation around the Grid substation;
- The wind turbines shall be maintained in good running conditions throughout the operational life of the project through routine maintenance.

Grievance redress mechanism will be implemented to assure that any complaints from the community regarding operational noise are investigated and resolved promptly and adequately.

The minimum distance between a receptor and wind-turbine is approximately 250m. Therefore, there is sufficient space to develop noise barrier in terms of tree plantation between turbine and receptor if noise level found exceeding the prescribed standards during post project monitoring. Also it is worth to mention that there is very much possibility of noise level below this value due fluctuation in the wind speed at various time, presence of vegetation and other form of noise barrier between receptor and source, etc. Regular noise monitoring is proposed.

Mechanical noise will be controlled as there are in built shutdown system in Latest technology in case the noise level increased in WTG. To control Aerodynamic noise latest design of the wind turbine which will be installed at project site are focused on reducing noise without affecting the power generated by the wind turbine. The noise reduction was found to be about 1-1.5 dB A for the G58 with a Reynolds number of 1.6x106 and 2-3 dB(A) for the GE94 with a Reynolds number of 3x106 for acoustically optimized airfoils in “silent rotors by acoustic optimization” (SIROCCO) project. Regular noise monitoring would be the part of post project monitoring plan to have a continuous check on noise increment values.

Impact due to transmission of Power

Noise from energised overhead lines can be produced by a phenomenon known as ‘Corona Discharge’ (a limited electrical breakdown of the air). Conductors are designed and constructed to minimise corona effects, although, under certain conditions this can be audible as a ‘hissing’ sound, sometimes accompanied by a low frequency hum.

Electromagnetic noise due to WTG operations can interfere with telecommunications services as the wind turbines create physical obstructions that distort the communication signals. Communications systems that may be affected due to this include off-air TV broadcast signals and mobile telephone services.

Table 5:14: Impact Value – Noise Generation

Aspect	Scenario	Spread	Duration	Intensity	Overall
Noise Generation	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

5.3.4 Shadow Flicker

Shadow flicker is the term used to describe the effect caused by the shadows cast by moving wind turbine blades when the sun is visible. Shadow flicker occurs when the shadow cast by the moving blades of a wind turbine passes through a window or a door. The effect of the shadow moving around with the blade makes it seem as if a shadow is flickering with each blade passing by (large wind turbines have three blades, so three times per rotation) - comparable to someone turning on and off the light in rapid succession. This can result in alternating changes in light intensity perceived by viewers. Since wind turbines are usually located relatively far from potential shadow receptors.

There is anecdotal evidence inter nationally 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.

Shadows will be cast on specific days of the year and will move from one point to another relatively quickly. And certain areas are more susceptible to shadow effects at certain times of the day. Areas to the west of the wind turbine would experience these effects as the sun rises. Areas to the north would experience the effects during the day. Areas to the east would experience these as the sun sets. The shadows cast by the wind turbine blades will be narrow, be of low intensity and move rapidly at the receptor. The closer a receptor is to the wind turbine, the more intense the shadows, as a greater proportion of the sun is blocked by the rotating wind turbine blades.

For India we do not have any specific standard however we have guideline published by CSE related to shadow flickering. The same has been followed while assessing the Impact for the Project.

Shadow flickering does not have any international standard so far. Also lack of country wise regulations or specific guidance with respect to shadow flicker. In most of the European countries i.e Germany and Provinces, Spain, Italy, France, UK/England, Scotland, Portugal, Denmark, Netherlands, Sweden, Ireland and western Australia have wind policies and Recommendation which is also presented in **Annexure XI**.

All the identified project turbine locations are in general away from the main villages with human settlements. However, few locations were identified to be located close to temporary household or crop storage area, temple and a school. These can be considered as receptors of shadow flickering from project turbines. During the site survey, thirty-three (33) receptors identified within 1km of the project turbines were identified as potential shadow receptors. The details of the shadow receptors are provided in **Annexure IV; Receptor map is being included as Annexure -III**.

Wind Farm software is used to calculate detailed shadow flicker map across an area of interest with site-specific locations using shadow receptors. We have performed Shadow flicker modelling using EMD's Wind Farm Software version for all WTGs. The project envisages installation of 30 x 1.7 MW (GE-1.7), 44 x 2.3 MW (GE-2.3), 23 x 2.1 MW (S-111 Suzlon) Wind Turbine Generators (WTG).

Impacts

- Distance to wind turbine location - within 10 rotor diameters of site or 900 meters
- Areas most likely to be effected by shadow effects related to position of sun in the sky – locations to the east, west, and north of wind turbine
- Current use of facility (residence, classroom, overnight lodging)
- Areas of cultural and historical significance

- Line of site to wind turbine from windows at site.

During sunset, the shadow source will be at a lower elevation than the wind turbines and will not have an impact.

Shadow flicker at each shadow receptor location is calculated every minute of every day throughout the entire year. Shadow receptors can be configured to represent an omni-directional window of a specific size (greenhouse mode) or a window facing a single direction of a specific size (single direction mode). The shadow receptors used in this analysis were configured as single direction-mode receptors representing a 1.5-meter-wide by 1.5-meter-high window.

The inputs for the Wind farm shadow flicker model include the following:

- The geographic locations and characteristics of the proposed WTGs;
- The locations of identified shadow receptors;
- Turbine Model Specifications; and
- Topography was assumed to be flat as a theoretical worst case scenario.

The Wind farm software calculates the position of the sun throughout the day in accordance to the curvature of the earth, the time of year and the project site's position. The software calculates the occurrences of shadow flicker at each of the identified receptor. Analysis was conducted to represent a theoretical worst case scenario, with the following conditions:

- The sun is shining all day, from sunrise to sunset with clear skies;
- There are no obstructing features such as trees and vegetation; and
- The wind turbines are always operating i.e. there is continuous wind of sufficient speed and no maintenance or down time.

The results of the modelling exercise have been presented in **Annexure IV.**

So as per the analysis WTG number ASP-22,23 & 54 are responsible for shadow flickering effect on receptor 6,7 & 11 respectively.

Receptor 6 is getting shadow flickering from ASP-22 for which the annual shadow flickering is 96 hours and 81 days for which the limit is exceeded.

Receptor 7 is getting shadow flickering from ASP-23 for which the annual shadow flickering is 86 hours and 92 no of days for which limit is exceeded.

Receptor 11 is getting shadow flickering from ASP-22 for 69.20 hours and 73 number of days for which the limit is exceeded.

For receptor -6 and 7 shadow flickering is prominent is winter season i.e. December and January while for receptor 11 it is more prominent in the month April, July and august. As discussed earlier, no national, state, county, or local standards exist for frequency or duration of shadow flicker from wind turbines. However, international regulations, studies, and guidelines from Europe and Australia have suggested 30 hours of shadow flicker per year and 30 minutes of shadow flicker per day as the threshold of significant impact, or the point at which shadow flicker is commonly perceived as an annoyance. Accordingly, the above threshold parameters were used in this analysis to evaluate potential shadow flicker impacts on the farm houses present in near vicinity of the WTG locations.

Turbine number ASP-54 is causing flicker. There are 76 number of days with flickers and 69 number of days for which limit is exceeded. Worse day for ASP-54 was 13/12/2016.

Shadow hours per year for the most of the receptors are within the threshold limits i.e. 30 hours per year. However, shadow flicker effect generated by Turbines ASP-22, ASP-23 and ASP-54 found crossing the suggested level of 30 hours of shadow flicker per year at receptor (residential location) no. 6, 7, 11 and 22 as shown in the receptor map in **Annexure III**. Detail and Distance of receptors from WTG is presented in **Table 3.1**. Thus impact of the proposed project due to shadow flickering effect is insignificant for all the WTGs except ASP-22, 23 & 54. Since the site is under pre-construction phase so during site visit, ESIA team has done the consultation and communicated to the concerned people and conveyed them about the impact due to shadow flickering of the wind turbine but they have not shown any concern about it. The shadow flicker effect created by above list turbines on receptor no. 6, 7, 11 and 22 are described in **Table** below.

Table 5:15: Shadow Flicker Effect Intensity

Receptor ID	Receptor name	Annual shadow flicker [hh:mm]	Number of days with flicker	Number of days for which the limit is exceeded	Worst day	Minutes on worst day	Turbines causing flicker
6	Residence	96:00	123	81	18-06-2016	70	17(ASP-22), 18(ASP-23)
7	Residence	86:00	106	92	11-01-2016	60	18(ASP-23)
11	Residence	69:20	93	73	23-04-2016	60	17(ASP-22)
22	Single structure	75:30	76	69	13-12-2016	80	63(ASP-54)

In India at present there is no standard in case of non- forest land diversion for Wind power projects. However as per Ministry of Environment and Forests (MoEF&CC) guidelines, a minimum distance of 300 m is recommended between windmill and highway or village habitation.

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.

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 to other obstructions that intervene between receptors and turbine during times when effect 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 purpose of assessment, it has been assumed that all worst –case circumstances apply.

Table 5:16: Impact Significance of Shadow Flickering –

Impact	Shadow flickering during the operation phase
Impact Nature	Negative
Impact Type	Direct
Impact Duration	Long term
Impact Extent	Local
Impact scale	Within 350 m from the WTGs on the receptors located in the SE-NE and SW-NW orientation from the WTGs
Frequency	During sunny days
Impact Magnitude	Medium
Vulnerability of social Receptors	No major settlement is within 350 m from the WTGs. However scattered hutments are located within the impact zone.
Impact Significance	Considering the overall impact magnitude and vulnerability of social receptors, the impact significance is assessed as minor

Table 5:17: Impact Value – Shadow Flicker

Aspect	Scenario	Spread	Duration	Intensity	Overall
Shadow Flicker	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

Mitigation Measures

A control system would be employed' as part of the wider turbine control systems to calculate, in real time, whether shadow flicker may affect a property, based on pre-programmed co-ordinates for the properties and wind turbines, and the intensity of sunlight, as measured by a device attached to a turbine tower. When the control system calculates that the sunlight is bright enough to cast a shadow, and that a turbine shadow falls on a property, it automatically shuts the turbine down, re-starting it when the shadow has moved away from the property. In the highly unlikely event that shadow flicker is experienced at properties other than those identified in this assessment, these would be investigated by Lancaster University or an independent third party, and if a complaint is found to be justified additional control measures of the types identified above will be implemented. A programme of monitoring will also ensure the effectiveness of the proposed mitigation and allow for it to be adapted to allow for any inaccuracies in the calculation.

The orientation of Turbines no. ASP-22, ASP-23 and ASP-54 (receptors 6,7 & 11 respectively as shown in the receptor map in **Annexure III** will be revised in such a manner that overall shadow flicker impact remains within suggested threshold standard of 30 hours of shadow flicker per year and 30 minutes of shadow flicker per day (IFC Environmental, Health, and Safety Guidelines for Wind Energy). However, optimise use of the turbine will also be kept in mind while revising the orientation of above three turbines. Probability of open space / window on other side of the residential property and vegetative shield shall also be checked, so that, overall psychological impact of the shadow flicker may get reduced.

5.3.5 Ecology

Impacts

The following ecological impacts are envisaged due to the operation of the project:

- Fatalities of birds and bats (if any), due to possibility of collisions with wind turbines blades, meteorological towers, and transmission lines; electrocution from transmission lines;
- Barrage effect for migrating birds, causing a change of flight route;
- Habitat loss for small mammals and birds due to setting up of turbines and associated facilities;
- Hunting and Poaching of mammals and avi-fauna (Particularly Schedule I fauna) by the labours or project employees;
- Some birds keep distance to wind turbines resulting in habitat alteration;
- Increased risk of fires at the site due to failure of machinery or transmission line.

The principal risk to birds believed to be posed by turbines, is the potential to be killed as a result of collision with moving rotors. The probability of a bird being hit, when making a transit through a rotor, depends on the size of the bird (both length and wingspan), breadth and pitch of the turbine blades, the rotation speed of the turbine, and the flight speed of the bird.

Mitigation Measures

In the proposed project site no "Critically Endangered" or "Endangered" bird & bat species were recorded. Moreover, the proposed site does not form part of any critical habitat, IUCN protected area, Important Bird Area and Ramsar Wetland Site. The anticipated impact identified due to the project are general in nature common with wind mill projects like mortality due to collision with turbine rotor or accidental body touch with high tension transmission line or in general disturbance in the site due to construction and operation of the project. Two schedule I fauna namely Black buck and Indian Wolf were reported in study area. Proposed conservation plan for the mentioned species has been highlighted below. The following measures shall be adopted in order to minimize any impacts on the ecology and biodiversity of the area:

In case injured birds / bird hit is observed, the site staff shall:

- Marking overhead cables and transmission poles using defectors and avoiding use of areas of high bird concentrations, especially for species vulnerable to collision.
- Where possible, installing transmission cables underground in accordance with existing best practice guidelines for underground cable installation. Otherwise if possible, install overhead cables with proper insulation to avoid bat and bird electrocution through body touch. Install bird defectors on overhead transmission cables at selected points wherever possible.
- The illumination within the project area should be bare minimum and be within the acceptable limits, particularly during night hours. This will help in undisturbed activities of nocturnal species like rodents, bats and owls.
- Some bird reflectors can be fitted at relevant places to divert low-medium and medium-high flying bird species during day time.
- Feasibility of fixing of bird defector on the turbine to avoid perching of birds near blades can be worked out, specially raptor species which prefer to perch at higher points.
- Four veterinary hospital located in Joharapuram, Devenabanda, Pattikonda and Hosuru are identified for handling of any bird / bat injury.
- Identify the bird species and maintain documented record of the bird hit.
- Staff will be trained to handle the hurt/hit bird and take it to nearest Vatenary hospital.
- Doors of WTGs will be closed all the time to ensure safety from monkeys.
- Conservation of Antelope, present in the area, will be planned as per the feasibility.

Two schedule I fauna namely Black buck and Indian Wolf were reported in study area. Awareness development among the project labours / employees to conserve / protect the ecosystem of the area would be taken care by the EHS cell of the project. In addition, specific conservation measures as proposed for conservation of Schedule I fauna are described below.

Black buck (Antelope cervicapra)

Habitats and Range

Blackbucks generally live on open plains and open woodlands in herds of five to 50 animals with one dominant male. They are very fast and can match a speed of 60-80 kmph. They are primarily grazers and avoid forested areas. They require water every day and may move long distances in search of water and forage in summer.

MVTPL has consulted with forest department Kurnool through the letter, enclosed as Annexure XIII. However, they suggested that the proposed project site does not falls under forest area.

Conservation Measures

- Ban on removal of bushes, creepers and closed canopy and thick undergrowths near tall grassland areas where these animals are found as they prefer uses closed canopy and thick undergrowth for resting and nursing young ones, but may use open or scrub forest for foraging purpose
- Development of some fruit trees or flower plants with seeds and pods near the areas of its habitat. Also some soft stemed shrubs or creepers or climber and small trees with thick leaves should be developed as they also prefer leaflets of shrubs, trees and creepers. - augment its habitats;
- Fire protection - will save fodder from burning, also their breeding and littering sites.

Indian Wolf (Canis lupas)

Habitats and Range

Although, wolves live in forests but are more common in bare and open regions. They generally live in holes, caves and cavities in the rocks and even lying up in fields or patches of scrub and thorn forest. They are diurnal or nocturnal in general. They feed on hare, Chinkara, foxes and even cattle. Actually it eats any animal, which it can capture easily, such as rodents. Sometimes they become man-eaters or child lifters, when driven by hunger. They are generally seen in pairs.

MVTPL has consulted with forest department Kurnool through the letter, enclosed as Annexure XIII. However, they suggested that the proposed project site does not falls under forest area.

Conservation Measures

- Howling surveys may be done for determining summer home sites for wolves and pup production. So that wolf zones in terms of food value can be improved.
- Protection against poaching- through patrolling parties.
- Fire protection- will save vegetation as cover and small prey base for this species.
- Adequate habitat to support a viable population should exist in the zone(s) where the species is afforded the most protection. Tree cutting will be probhited in this zone.

Consultation with Forest dept. has been made for implementation of above mitigation measures which is enclosed as Annexure XIII.

Impact Value

The impacts on ecology of the project area will be major with long duration and moderate intensity after mitigation measures are employed.

Table 5:18: Impact Value – Ecology

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ecology	Without Mitigation	Local	Long	High	Major
	With Mitigation	Local	Long	Moderate	Moderate

5.3.6 Water Resources

Impacts

The most significant use of water during wind project operation is cleaning of wind turbine rotor blades. It is estimated that about 2m^3 of water will be required for cleaning of each turbine to avoid deformation the shape of air foil and degradation of performance as part of the annual maintenance schedule. Maximum 45 liters per day of potable/ domestic water is also consumed for limited staffs at wind operation site.

Mitigation Measures

Water required for cleaning will be sourced from authorised tankers suppliers. The use of water will be minimal as cleaning/ domestic of all turbines will not be undertaken simultaneously. Bottle package water is used for drinking purpose.

Impact Value

The impact value on water resources will be insignificant with mitigation measures. The impacts will be localised with short duration and low intensity.

Table 5:19: Impact Value – Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

5.3.7 Hazardous Waste

Impacts

Hazardous waste generated from operation and maintenance of wind farms is limited to small quantities of waste oil from use of lubricant oil and transformer oil. The waste requires adequate disposal measures as per the requirements of Hazardous Waste Management Handling and Transboundary Movement Rule 2008. Improper disposal of hazardous waste can lead to contamination of soil and ground water, which could result in indirect impacts to humans, flora and fauna.

Mitigation Measures

The following mitigation measures will be employed for hazardous waste generation:

- Waste oil generated shall be stored in a secure location.
- Waste oil will only be sold as per the directive of statutory authority.
- Transformer oil shall be returned to the manufacturers as per the agreement of purchase.

Impact Value

The impacts due to hazardous waste generation will be localised with low intensity. The impact value will be minor with implementation of adequate mitigation measures.

Table 5:20: Impact Value – Hazardous Waste

Aspect	Scenario	Spread	Duration	Intensity	Overall

Hazardous Waste	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

5.3.8 Health and Safety

Impacts

Mitigation Measures

Working at height for cleaning and maintenance of turbines will require adherence to precautions and safety measures as provided:

- GE/ Suzlon shall provide instructions and procedures to all the workers involved in service repair of wind turbines, which will consider wind speeds and other external conditions in such a manner that service, maintenance and repair work on the wind turbine can be performed safely.
- Ensure use of safety belt and need for safety net as required
- All work at height to be undertaken during daytime with sufficient sunlight except emergency (with proper illumination arrangement)
- Work permit system shall be implemented for working at height (typically when working over 2 m above) and for hot or welding jobs.
- Prior to undertaking work, integrity of structures shall be inspected.
- Fixtures shall be installed on tower components to facilitate the use of fall protection systems;
- Only workers trained in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment shall be engaged for work at height.
- Workers handling electricity and related components will be provided with shock resistant gloves, shoes and other protective gears. Adequate training regarding health and safety will be provided to the workers.
- The switch yard building will be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire.
- Safety incidents will be recorded and monitored. The objective shall be to gradually reduce and attain zero incidences.

The following safety measures shall be adopted to minimise the risk of electrical/fire hazards:

- Wind turbines shall be equipped with an earthing system;
- Access to areas containing exposed electrical equipment (such as transformers) shall be fenced and locked. Warning signs shall be posted at hazardous locations;
- Firefighting equipments such as fire extinguishers and sand buckets shall be provided at appropriate locations;
- Workers involved in electric operations shall be provided with Protective Equipment such as rubber gloves etc;
- Employees involved in electrical works shall be trained in and familiar with the safety related work practices, safety procedures, and other safety requirements that pertain to their respective job assignments.
- First aid box/ arrangement to be ensured.

Impact Value

Emergency Contact number should be displayed at identified areas.

The impact value of health and safety related aspects during operation will be minor with implementation of adequate mitigation measures.

Table 5:21: Impact Value – Health and Safety

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

5.3.9 Cultural /Archaeological

Impacts

There are no assessed impacts for cultural or archaeological aspect for this project.

Mitigation Measures

- The siting and location of towers has taken into consideration the proximity to temple and access to the temple.
- MVTPL shall incorporate development of temple and access routes as part of their corporate social responsibility to meet the expectation of community.
- All electrical facilities and transformer will be adequately fenced to avoid any electrical hazards during festival seasons.
- Noise levels at the temple are expected to be within the day time noise guideline, however night time levels may exceed. There are no visitors during night hours, except during festival season and therefore the impact will be minor.

Impact Value

The cultural impacts during operation will be minor with implementation of adequate mitigation measures.

Table 5:22: Impact Value – Cultural/archaeological

Aspect	Scenario	Spread	Duration	Intensity	Overall
Cultural	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

5.3.10 Community/ Social Issues

The impacts on the community and the social fabric of the surrounding region will include the following:

- Impacts due to noise and shadow flicker
- Impacts due to electromagnetic fields;
- Restriction of use of project area for grazing activities;
- Impact on community functions in the area.

The issue of noise and show flicker has already been discussed in the above section. The other community issues are presented below.

Impacts due to Electromagnetic Fields

Electromagnetic Fields (EMF) emanate from any wire carrying electricity. Members of the general public are routinely exposed to these fields in their everyday lives. Possible effects associated with the electric and magnetic fields from transmission lines (or similar electrical sources) fall into two categories:

- short-term effects that can be perceived and may represent a nuisance
- possible long-term health effects.

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

Mitigation Measures

The lists of exposure limits for general public/occupational exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection(ICNIRP) is as given in **Table 5.23** and **Table 5.24.**

Table 5:23: **ICNIRP exposure limits for general public exposure**

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	5000	100
60 Hz	4150	83

Source: ICNIRP (1998): "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Table 5:24: ICNIRP exposure limits for occupational exposure

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	5000	100
60 Hz	4150	83

There are no specific standards or guidance on EMF in India however the Indian Electricity Act and Rules clearly stipulate the minimum clearances required for setting up of transmission lines and substations. Hence the ICNIRP standards and guidelines have been considered and will be complied with. For the general public (up to 24 hours a day) an exposure level of 1,000 mG or100 µT is suggested. The EMF generated by the proposed 220KV substation unit and transmission lines will be lesser than the suggested value.

The recommendations applicable to the management of EMF exposures (as per IFC) as given below will be followed by the project:

- Application of engineering techniques will be considered to reduce the EMF produced by the transmission lines, substation or transformers. Examples of these techniques include:
- Shielding with specific metal alloys as per standard practice
- Increasing height of transmission towers as a standard practice
- Modifications to size, spacing, and configuration of conductors (if required)
- The 33 kV transmission lines and 220 kV transmission lines are proposed to be located considering construction safety.

Impacts on Grazing Activities and Community Functions

The proposed site comprises of grazing land which is used by the local villagers during the post monsoon season. There is a no loss of grazing land as the wind turbines are at sufficient distance from each other. The temple on the Rajulamandigiri plateau hosts rituals and functions few times a year during major festivals when people from the local villages and surrounding areas visit the

temple. However, the wind farm project will not restrict access to the temple since the turbines will be located at sufficient distance from the temple.

Mitigation Measures

MVTPL will allow normal movement of goats and sheep in most part of the site, except footprint areas and other associated establishment considering potential risk. MVTPL shall ensure that all transformers are fenced and cables insulated to avoid any electrical hazards. Access to turbine tower ladders shall be restricted. All community functions associated with the temple will be allowed to function as existing. MVTPL will also try and be a part of such celebrations through their CSR activities.

Impact Value

The impact on community/social issues is expected to be of local spread, long duration and low intensity with mitigation measures and the overall impact is assessed to be minor.

Table 5:25: Impact Value – Community/Social Issues

Aspect	Scenario	Spread	Duration	Intensity	Overall
Community/ Social Issues	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

5.3.11 Communications

Impacts

Wind projects may impact communications signals in two ways. Wind turbines and their associated transmission lines can generate electromagnetic noise, which can interfere with telecommunications services, or, more commonly, wind turbines create physical obstructions that distort communications signals. The types of communications systems that may be affected include off-air TV broadcast signals, and mobile telephone services.

Off-air stations are television broadcasters that transmit signals that can be received from terrestrially located broadcast facilities on a television receiver. Off-air television signals are subject to distortion by the reflections from the turbine blades and by the attenuation of the signal passing through the wind turbines. The reflections may cause multipath distortion and ghosting. Blade motion may cause the contrast and brightness of the signal to vary.

Mitigation Measures

The area was surveyed for presence of mobile transmission tower in the immediate vicinity. It was observed that there are no mobile towers within about 1.5-2.0 km of the proposed site. Thus the potential for any such interference is minimized.

These effects on off air television apply to analogue modulated television signals and do not affect digital signals in the same way. Almost all of the television operators including the national broadcast makes use of digital signals and hence will have little impact due to windfarm.

Impact Value

The operation of the wind farm will have localised impacts of low intensity on the communication signals in the area.

Table 5:26: Impact Value – Communications

Aspect	Scenario	Spread	Duration	Intensity	Overall
Communication Signals	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

Note: Hence no mitigation measures are suggested.

5.4 DECOMMISSIONING PHASE

Decommissioning activities depend on the proposed subsequent use of the site, but they typically consist of removal of infrastructure (e.g. turbines, substations, roads) and reclamation of the project site, which may include re-vegetation wherever required.

MVTPL shall prepare a detailed decommissioning plan at least one year prior to the commencement of decommissioning. Removal of turbines and associated facilities shall ensure the following:

- Inform the relevant stakeholders about decommissioning plan and proposed subsequent actions;
- Removal of all structures including foundations to the extent possible;
- Removal of all waste collected at site, including the demolition debris;
- Noise and dust emissions to be kept low during the decommissioning;
- Roads and culvert to be retained after consultation with the community;
- Heavy vehicle movement to be planned and informed to the community;

5.5 CUMULATIVE IMPACTS

The potential cumulative impacts identified for the project and their mitigations are provided in the following sub sections.

Socio-economics

Impact on Land

Approximately 494 acres of land has been estimated for the proposed wind farm out of which approximately 276 acres of land has been procured and rest is under process. The Land identified for the proposed project site is primarily undulating and mix of single cropped agricultural and barren land, devoid of any physical / archeological infrastructure and do not involve any economical/residential displacement. The land is being procured under willing seller and willing buyer basis and compensation paid best of the market value in respect to circle rate, defined by government. Thus the impact on land is minor.

Migrant Workers

Although the proposed project will not engage significant migrant labour, other upcoming projects in the vicinity might result in the influx of migrant population. This will support the local economy in terms of sale of consumable items, food items, accommodation etc. However, the influx of large number of outsiders can potentially lead to cultural conflicts.

Most of the civil works being small in nature will be handled by the local contractors from Kurnool or nearby regions. This would ensure that the workers are largely from within Andhra Pradesh. Only

skilled workers for erection of turbines and operation cranes will be sourced from outside states and their numbers will be relatively less.

The local contractors and labours will be engaged during construction to avoid migration of labour from far off places. This will not have any stress on the local and moreover provide job opportunities to the local population.

Impact on Infrastructure

The road connectivity in the area is good therefore transportation of turbine components will not lead to any disturbances to the habitations. There will be no disturbance to habitations as the turbines are erected on isolated plateaus.

Impact on air quality, water quality and soil characteristics

During operation of the project no fuel of any kind will be burnt. Therefore, the impact on air quality is not considered. There is no wastewater generation from the wind turbine. The domestic wastewater may be generated from office of the O&M team. Septic tanks with soak pits will be provided to treat sewage during operation phase. There is no significant solid waste generation during operation phase. Therefore, the impact on soil is not envisaged.

Noise

The noise from existing surroundings has been captured in the baseline recorded for the project; the resulted predicted noise with proposed project is with the acceptable limits.

It was observed that the noise levels at the monitoring locations ranged from 47.55 dB (A) to 48.06 dB (A) during day time and 33.36 dB (A) to 35.04 dB (A) during night time. The baseline noise levels in the area are thus within the prescribed CPCB standards of 55 dB (A) and 45 B (A) during the day and night time respectively at all locations and also IFC Standard of 55 dB (A) and 45 B (A) during the day and night time respectively for Residential areas. Both the standards are being complied with i.e. IFC and the law of the host country. MVTPL will also follow OHSAS norm for 8-hour exposure i.e. Occupational Noise Exposure.

It is to be noted that ambient noise levels depend on various factors such as the exact number of vehicles/equipment being used at the construction site, number of hours of operation, etc. Due to unavailability of such information, the cumulative noise levels from simultaneous use of construction vehicles and equipment is difficult to ascertain. However, the construction activities will be temporary in nature and will not last for more than 15-20 days for a particular turbine site.

The resultant noise levels will increase marginally with the operation of WTGs for daytime and will be within the prescribed limits.

The impact from wind turbine at receptor is assessed considering hemispherical propagation of sound wave and the results of the assessment present that Noise level at the receptor would be in a tune of 52dB(A), which is well within the prescribed standard of 55 dB(A) at residential location. Also it is worth to mention that there is very much possibility of noise level below this value due fluctuation in the wind speed at various time, presence of vegetation and other form of noise barrier between receptor and source, etc.

The cumulative noise impact of the other turbines on the proposed project is marginal and will be within the acceptable norms of ambient noise.

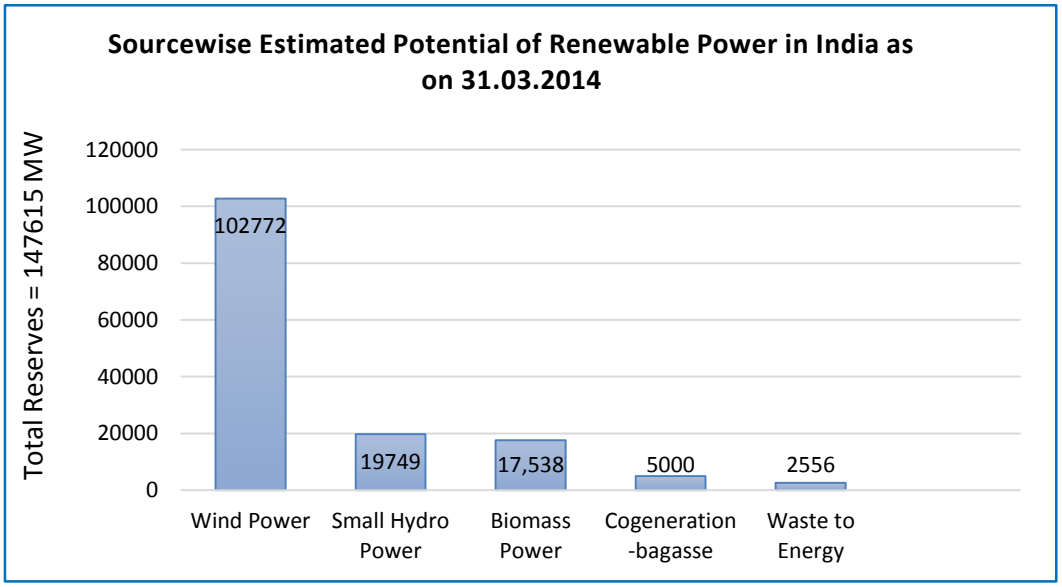
6 ANALYSIS OF ALTERNATIVES

6.1 INTRODUCTION

Analysis of alternatives involves a thorough study of the possible future conditions in the project study area in response to a set of alternatives without the project or status quo condition. Development of Wind Power in the project area will not only be based on green energy and resources but also have the potential of not having emission issues as compared with power plants based on conventional energy. The other added benefits from such project are that it will add values to the local as well as national grid.

As of 2012, India had an installed renewable energy capacity about 24.9 GW. During the eleventh five-year plan, nearly 55,000 MW of new generation capacity was created, yet there continued to be an overall energy deficit of 8.7 per cent and peak shortage of 9.0 per cent. Therefore, resources currently allocated to energy supply are not sufficient for narrowing the gap between energy needs and energy availability. The total potential for renewable power generation in the country as on March 31, 2014 is estimated at 147615 MW (Refer **Figure 1.1**). This includes wind power potential of 102772 MW (69.6%), SHP (small-hydro power) potential of 19749 MW (13.38%), Biomass power potential of 17,538 MW (11.88%), bagasse-based cogeneration in sugar mills 5000 MW (3.39%) and 2556 MW (1.73) from Waste to Energy.

Figure 6:1: Plan wise Growth of Installed Generating Capacity in India



Source: Energy Statistics, 2015

Alternative methods of power generation and comparison with the following one is discussed in this chapter.

6.2 ALTERNATIVE METHODS OF POWER GENERATION

Harnessing wind energy is an eco-friendly process, inexhaustible and processes a minimal environmental footprint. There are neither fuel requirements nor large quantities of water for

operation of the plant. **Table 6.1** elaborates upon the advantages and disadvantages of various power generation systems.

Greenhouse gas Emission: As per the estimation of International Atomic Energy (IAEA) the grams of carbon equivalent (including CO_2, CH_4, N_2O etc.) per kilowatt-hour of electricity (g Ceq/kWh) for Wind energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy. **Table 6.2** highlights the advantages and disadvantages along with Greenhouse Gas (GHG) emission that each technology possesses.

Considering various factor such as wind resources potential in the project districts; favorable environmental and social settings, low GHG emission in the project life cycle, land availability, governmental assistance, and local community's acceptance of solar energy project over the last decade in the region, wind energy based power generation is the most alternative in the state of Andhra Pradesh.

Table 6:1: Advantage and Disadvantage of Conventional Technology

Mode	Disadvantage	Advantage
Thermal Power Plant	• High fossil fuel consumption • Large quantities of water requirement for cooling • High volume of emission from operation • Accumulation of fly ash (in case of coal powered installations) • GHG emission estimated as 228 gCeq/kWh	• Large scale production potential • Moderate gestation period • Relative inexpensive • Wider distribution potential
Nuclear Power	• Availability of fuel and power source • Hazard associated with radioactive material • High cost of project • Long gestation period • Risk of fallout and melt down scenarios and its impacts on the local populace and environment.	• Capable of producing huge amounts of energy with little or no carbon
Wind Power	• Overall land requirement is large but impact on land is partial • Site specific (associated to wind pattern) • Expensive installation	• Pollution level are insignificant • Inexpensive power generation • Inexhaustible source • GHG emission as low as 2.5 gCeq/kWh for the production from source.
Solar Power	• Large land requirement • Site specific to solar installation • Concrete foundation on large area	• Pollution level are insignificant • Inexpensive power generation

Mode	Disadvantage	Advantage
		• Inexhaustible source • GHG emission as low as 8.2 gCeq/kWh for the production chain.

Source: International Atomic Energy Agency (IAEA)

Table 6:2: CO_2 Equivalent Emissions for full Energy Chain

Technology	Maximum Value	Minimum Value
Coal	1290	860
Oil	890	689
Gas	1234	460
Hydro	410	16
Nuclear	30	9
Wind	75	11
Solar PV	279	30
Biomass	116	37

Source: IAEA Bulletin

6.3 ALTERNATE TECHNOLOGY

The wind turbine manufacturer for this project is Suzlon Energy (S-111, 2.1 MW) and GE (GE-1.7 MW-103 and GE-2.3 MW-116). Suzlon Energy was established in 1995, a multinational organization, delivering technologically advanced and profitable wind energy solutions for all types of wind regimes, environmental conditions and terrain, both on-shore and off-shore and has installed more than 25 GW across 6 countries. The S111 is a technologically advanced product of the S88 and S97 2.1 MW family. This product has been specifically designed for Suzlon's next generation 2.1 MW turbine and is engineered to deliver a 20% increase in AEP (Annual Energy Production) at the same hub height compared to Suzlon's S97 wind turbine model. The S111 is built on the proven reliability of the S88 and S95/97 2.1MW family that currently has over 3100 turbines installed in fifteen different countries with over 68,000,000 operating hours. The blade is designed to harness the optimal available wind resources and deliver higher energy productivity, which in turn ensures higher ROI to customers. Suzlon turbines have been setting industry benchmarks across the entire technology value chain by meeting new standards.

GE Power & Water's Renewable Energy business has invested more than 2 billion dollars in next generation wind turbines since entering in the industry in 2002. Whether at the turbine, plant, or grid level, GE continues to focus on providing more value for their customers. Through the use of advanced analytics, GE's Renewable Energy business is redefining the future of wind power, delivering on proven performance, availability and reliability.

GE's 1.7-103 wind turbine is a three-blade, upwind, horizontal axis wind turbine with a rotor diameter of 103 meters. The turbine rotor and nacelle are mounted on top of a tubular steel tower, providing a hub height of 80 meters. The turbine uses active yaw control to keep the rotor pointed into the wind. The turbine is designed to operate at a variable speed and has an active blade pitch control (designed to regulate turbine rotor speed), and a doubly-fed induction type generator along with power electronic converter system.

GE's 2.3MW, 116m rotor wind turbine offers a 27% increase in swept area when compared to the 1.7-103 turbine, resulting in a 26% increase in Annual Energy Production (AEP) at 7.5 m/s (at a 2.3 rating). This increase in blade swept area allows greater energy capture and improved project economics for wind developers. GE's proprietary 56.9-meter blade is designed specifically for the 2.3MW rating of this platform, enabling longer length, lower loads and improved performance.

6.4 WATER REQUIREMENT

The interdependency between water and energy, sometimes called the water-energy nexus, is growing in importance as demand for both water and energy increases. Energy is required for water treatment and supply, while virtually all processes for energy production require significant amount of water. Many areas are already under water and energy constraints and yet water and energy are both indispensable for modern economics. Moreover, the population is expected to grow, which will boost the water and energy demand substantially in the coming years.

Solar and Wind Power Projects have been known to almost insignificant water requirement in comparison to nuclear and coal based power projects. Wind farms require small amount of water, used to clean wind turbine rotor blades in arid climates (where rainfall does not keep the blade clean).

According to American Wind Energy Association (AWEA), water consumption (technology gallons/MWh) is as follows; Nuclear- 620; Coal- 490; Oil- 430; Wind- 1; Solar- 30.

6.5 ALTERNATIVE LOCATION FOR THE PROJECT

The location of any wind based power generating project is finalized based on several factors which allow the project to operate in a technically and economically viable manner. Some of these factors include:

- Availability of optimum wind speed, which is the primary requirement for a wind power project;
- The distance between the transmission line route and project area should be less, for easy transportation of energy;
- The site is better than others from the sense of avoiding bird migratory routes;
- No substantial negative impact on environment or socio-economic conditions of the region; and
- Ability to build the project on a site fulfilling national and state compliances.

Andhra Pradesh Wind Power policy states that the wind power potential in the combined state of Andhra Pradesh as estimated by the National Institute of Wind Energy (NIWE), is around 14,497 MW at 80 m above ground level. It also mentions that a region like Kurnool is one of the ear-marked zones because of its high wind power potential. The region is dry as it faces scarcity of rainfall, wind is the only resource available, and farming is the main occupation of people in the region.

Andhra Pradesh is one of the States in India having windy locations, identified for wind power generation. Reportedly there are no ecologically sensitive areas found around the region. Also, there was neither a requirement to relocate the native people nor any destruction of flora-fauna occurred as part of the project. And the site was selected in such a way that it does not fall in bird migratory route.

The local community of Aspari has a positive approach towards upcoming wind energy projects in the region. Proposed project will give boost to local population. Monetary gains, education, health,

sanitation, water conservation, plantation and improvement in general environment will lead to positive growth. Apart from these factors, the villagers are of the expectation that such projects will elevate the standard of economy and provide them jobs like that of a security guard.

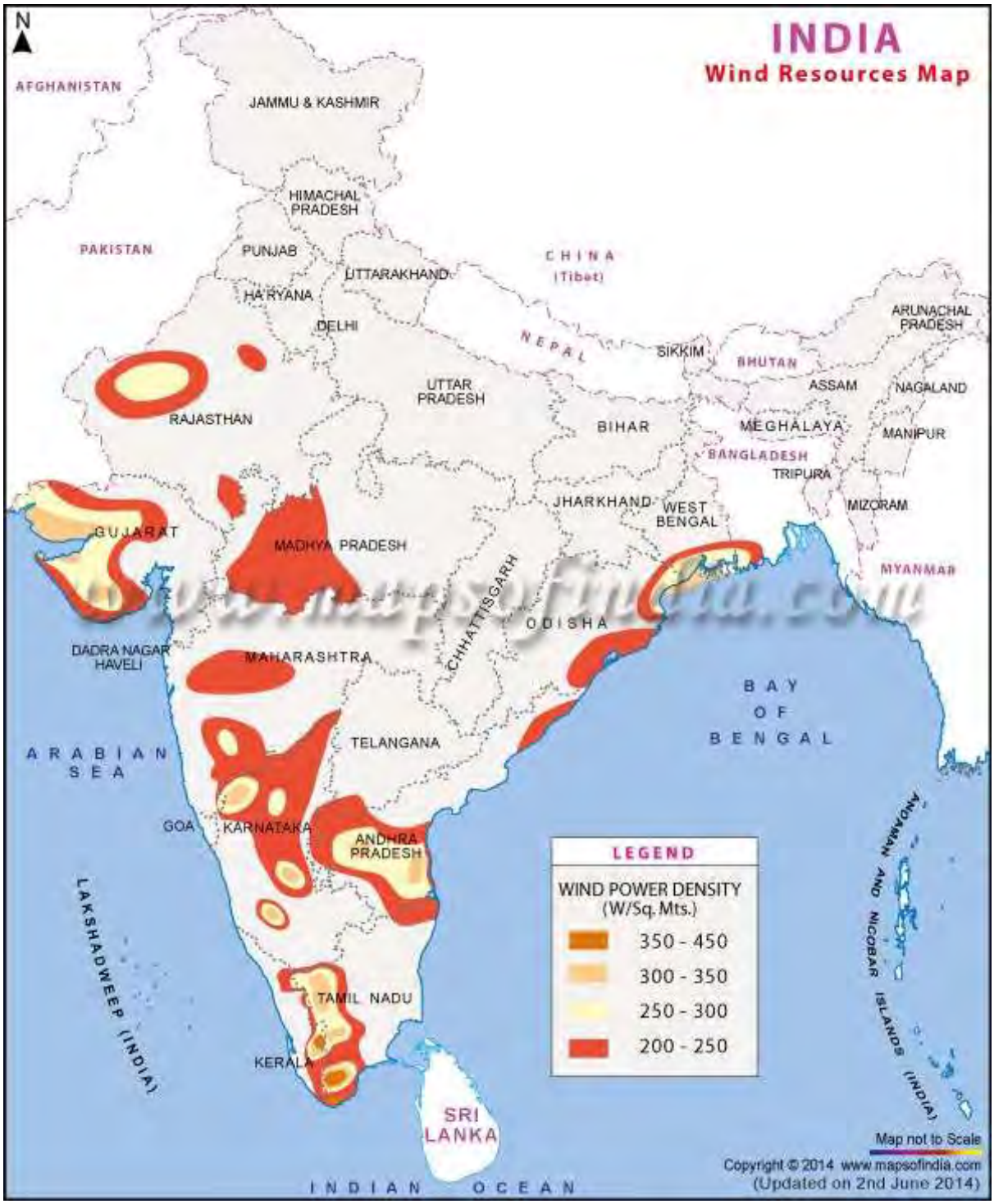


Figure 6:2: Wind Resource Map

Source: Data on estimation of Installable Wind Power Resource and Density in India, National Institute of Wind Energy

6.6 GREEN HOUSE GAS (GHG)EMISSION

Harnessing wing energy is an eco-friendly process. As per the estimations of International Atomic Energy Agency (IAEA), the gram of Carbon –eq per Kilowatt-hour of electricity for wind project are low when compared with other conventional / non-conventional sources of energy. The GHG emission of 2.5gCeq/kwh for the production chain of wind farm is estimated against the thermal GHG emission of 228 gCeq/kwh (source: International Atomic Energy Agency). Viewing the favorable environmental impacts, considerable low GHG emission as well as significant threat (nationally/ internationally) of global warming, Wind Energy based power generation is the most appropriate alternatives.

6.7 ALTERNATE ROUTE FOR TRANSMISSION LINES

Even though the construction of transmission line has very less impact on environment and socio-cultural resources, this can be reduced by careful selection of route. The Transmission lines carry electricity from Wind Turbine Generators to a 33/220 KV MVTPL Substation at Juturu village in Pattikonda *Taluk* and from these to the 220/11 kV Grid Substation at Nansuralla sub-station. The multiple components that are interlinked with the selection of route for transmission lines include landowners' concerns, habitats of endangered species, airports, military bases, rivers or any other topographical or cultural features that could pose conflict. A careful multifarious approach is being taken to reach a consensus on the routes that will do least damage and contain costs.

The following factors are generally considered while selecting the route for transmission line:

- The line should not infringe with any area of natural resources, forest lands etc.;
- Any route which has the presence of a monument of cultural or historical importance, community structures is exempted;
- If selection of an area involves extensive removal of vegetation, that is averted otherwise proper planning with approval of competent authority will be ensured.
- No environmentally sensitive sites are to be damaged during the process of installing transmission lines and access roads
- Right of way/access roads to the substation will be shared with appropriate stakeholders;
- The proposed route should not affect any public utility service such as schools, playgrounds, etc.; and
- There should not be threat to the survival of any community especially Tribal population, while selecting the route.

The client has met the owners of the land in person and has reached a consensus on selection of route for transmission lines, before acquiring land from them, and has paid a satisfactory compensation. Many of the routes are through barren land where no cultivation is happening, having least impact on environment, cultivable lands and vegetation. No habitations, community structures, or residential areas are damaged.

Hence, after taking all the above factors into consideration, the shortest possible route which is economical from the point of view of construction and maintenance and which creates the least environmental and social footprint has to be chosen.

6.8 CONCLUSION

As mentioned in the sections above, the project will be environment friendly with minimal greenhouse gas emission, most feasible and choice of power generation in the state, has many advantages like elevating the standard of rural economies, increasing the power supply of the energy deficit state of Andhra Pradesh in an environmentally friendly manner. Hence, the project with all the chosen options – site, mode of power generation, route of transmission line etc., is the appropriate alternative and is beneficial for the region.

7 INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

7.1 INTRODUCTION

Public consultation and participation has been viewed as a continuous two ways process involving, promoting of public understanding of the processes and mechanisms through which developmental problems and needs are investigated and solved. The public consultation, as an integral part of environmental and social assessment process throughout the project preparation stage not only to minimizes the risks and unwanted hurdle against the project implementation but also abridges the gap between the community and the project formulators, which leads to successful and timely completion of the project and making the project people friendly.

Therefore, keeping in mind the above objective public consultation with the people of different section of the society, i.e., local administrative officials, some related social agencies, business groups, community representatives, village heads, Panchayat members, respectable and influential persons and project affected persons of the project area were made. Moreover, potential vulnerable people were also consulted with the aim to make people aware and minimize adverse impacts of the proposed project. The option of alternative design was also discussed to achieve accelerate the implementation of proposed wind farm project with people's involvement.

7.2 OBJECTIVES

The main objective of the consultation process is to minimize negative impacts of the project and to maximize benefits from the project to the local population and affected family. The objectives of public interaction of this project are:

- Promote public awareness and improve understanding of the local people about the proposed wind power project;
- Assessment of possible requirement of improvements;
- Solicit the views of affected communities / individuals on environmental and social problems;
- Improve environmental and social soundness;
- To settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation.

7.3 CONSULTATION LEVEL AND STAGES

As part of the project, the consultations are considered at following stages:

Table 7:1: Public Consultation Level and Stages

Levels	Stages of Consultation	Public Consultation Organizer	Stages	Target Group
Project Proponent level and Village/Community Level	1	Developer/ Client	During Project Planning and Land Procurement Stage	Local community, land aggregator, village president/*sarpanch*, village administrative officer and land seller
Project Pre-construction Stage by ESIA Team	2	ESIA Team	During Pre-construction stage	Project Affected Persons/ Village Panchayat/ Influential Person of the Society/ Local Community Government Officials/

7.4 CONSULTATION DURING THE PROJECT PLANNING STAGE

The ADB Safeguard Policy requires the project proponent to undertake consultation with affected land losers and other concerned stakeholders and facilitate their informed participation in the project. The primary objective of the consultation process shall be to ensure that the views and concerns of the stakeholders are considered by the project proponent at an early stage of the project. All issues and concerns raised by the stakeholders shall be addressed in a timely and appropriate manner by the project proponent. Based on the consultation process, a grievance redress mechanism for the community shall be established to receive and facilitate the community concerns and grievances regarding the project.

It was informed and verified by village *sarpanch,* and local community at the time of site visit that community/village *Panchyat* around the vicinity of the project site has been informally informed about the proposed project by MVTPL during project preparation and planning stage. The community is aware of the Site Office premises and the concerned person to contact and is free to get in touch whenever required. Following points had been discussed in the consultations:

- The present scenario of electricity and demand and supply gap;
- State Government's initiations to encourage Renewable projects;
- Basic concepts of wind power project and its benefit;
- Details about tentative location of wind farm and general details about wind farm;
- Need for land, mode of willing buyer-willing seller concept, general idea of compensation under this;
- Scope of employment was discussed with villagers in construction phase and O & M phase;
- Suggestions and recommendations of villagers/ stakeholders were pleaded and welcomed.

7.5 CONSULTATION DURING THE PROJECT PRE-CONSTRUCTION STAGE BY ESIA TEAM

A public consultation programme and focused group discussion were conducted at 10 different locations within the core zone of the study by ESIA team. The locations of such consultation are strategically chosen coming the easy proximity of the villagers. The details of consultation location, dates of consultation are shown in **Table 7.2**.

Table 7:2: Details of Public Consultation

S. No	Location of Consultation	Community being Consulted	Dates of Consultation	Target Group
1	Govt. Primary School, Pedda Hulti	Villagers of Pedda Hulti and Pattikonda	Date: 21.11.2015 Time 10.00 A.M. to 11.30 A.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village.
2.	Near Shiva Temple, Hosuru	Villagers of Hosuru, Putchakayalamada and Burujula.	Date: 21.11.2015 Time 11.30 P.M. to 02.30 P.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village.
3.	Near Hanuman Temple, Chinna Hulti	Villagers of Chinna Hulti	Date: 21.11.2015 Time 03.45 P.M. to 04.30 P.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village
4.	Near Anganwadi Center, Juturu	Villagers of Juturu	Date: 21.11.2015 Time 05.30 P.M. to	Project Affected Family, Village Panchayat Members and

S. No	Location of Consultation	Community being Consulted	Dates of Consultation	Target Group
			06.30 P.M.	Respectable and Influential Person of the village
5.	Govt. Upper Primary School, Joharapuram	Villagers of Joharapuram	Date: 22.11.2015 Time 09.00 A.M. to 10.30 A.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village
6.	Village Panchayat, Aspari	Villagers of Aspari	Date: 22.11.2015 Time 11.30 A.M. to 12.30 P.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village
7.	Lord Ram Temple, Near Govt. Upper Primary School, Nalka Doddi	Villagers of Nalka Doddi and Chokkanahalli	Date: 23.11.2015 Time 10.30 A.M. to 11.30 A.M.	Project Affected Family, Village Panchayat Members, School Teachers and Respectable and Influential Person of the village
8.	Near Village Panchayat, Devanabanda	Villagers of Devanabanda	Date: 23.11.2015 Time 02.30 P.M. to 03.30 P.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village
9.	Near Temple and Govt. Upper Primary School, Attikalgundu	Villagers of Attikalgundu	Date: 24.11.2015 Time 10.30 A.M. to 12.00 P.M.	Project Affected Family, Village Panchayat Members, School Teachers and Respectable and Influential Person of the village
10.	Temple in village Rajulamandgiri	Villagers of Rajulamandgiri	Date: 24.11.2015 Time 02.30 P.M. to 03.30 P.M.	Project Affected Family, Village Panchayat Members and Respectable and Influential Person of the village

7.6 CONSULTATION PROCESS

The findings are based mainly on the participatory methods of focus group discussions, key informant interviews, natural interviews. These methods are well established and have been widely used in environmental and sustainability research. The method goes beyond the superficial and gives depth and intensity to the discussion and incorporates the local point of view within a short period.

The process of stakeholder consultation included:

- Identification of the relevant stakeholders including all those individuals, groups and organizations potentially affected by or interested in the project;
- Imparting information about the project and its potential impacts on their lives in local and simple language;
- During the consultation process the project plan was clearly explained;
- Recording of their concerns and aspirations through survey and discussions;
- Responding to their queries in a neutral manner.

In the primary research a list of open-ended questionnaire is used in both the focus group discussions and the individual interviews. A three-person survey team carried out the discussions and the interviews. The list of persons involved in the public consultation is limited to those who were willing to allow their name to be added in the document.

Focus group discussions were held with the randomly selected villagers and land owners. These groups encompass a wide age range, as well as both genders, and people from the entire communal spectrum. The FGD included people who had given their land for the proposed project.

Natural group discussions were also conducted, where ever possible. Natural group discussions are interviews conducted with 'naturally 'occurring groups. The method has the advantage of being interviewed at a time and place of their convenience, and is suitable from the point of view of the interviewee. The result is honest and open discussion in a more relaxed and informal manner.

The aspects covered questions and broad responses obtained during the social survey, consultation, discussion and interviews are as provided below:

7.7 ISSUES/ CONCERNS RAISED/ ADDRESSED DURING CONSULTATION

7.7.1 Awareness about the Project

All the respondents were aware with the proposed project and they were informed by the land aggregators about the project. They were not sure about the access roads planned for the project to move up and expected it to be kept away from the habitations. Access road is in planning stage. The individuals interviewed informed about the consultations undertaken by the land aggregator and confirmed that discussions were undertaken in all the above villages. The respondents were aware about the process of wind turbines to be erected.

7.7.2 Occupation and Livelihood

The main occupation of the study area is agriculture and livestock rearing (Sheep/goat) and more than 75% people depend on agriculture or as agricultural labourers. Main crops grown in the region are cotton, ground nut, onion, makka, corn etc. which depends on rain water. Average land holding size of the study area is 3 to 30 acre per family. The average income of the study area is INR. 3,000 to INR. 10,000 per month and most part of the income is spent on food.

There are very few avenues for job and non-agricultural works are far and few, most of the men migrate to the nearby towns/city as Adoni, Kurnool, Tirupati, Hyderabad, Bellari and Bangalore for better job opportunities.

7.7.3 Health

There is no any epidemic or chronic disease have been reported in the study area during consultation with local villagers except general fever, cough, cold and bone related pains due to contamination of fluoride in ground water. People of the study area are well aware with HIV/AIDS/STP.

7.7.4 Education

In spite of government infrastructure facility and support (facility of mid-day meal, free books distribution and two pairs of uniform to every student) for education, the literacy rate is very poor in the study area. Although, there is support for girl child education, but it is only up to junior level. Very few people are able to provide higher education to their girl child.

7.7.5 Use of the Land Being Procured

The community has reported that the terrain is difficult for agricultural purposes as there is no source of irrigation and it depends on rain water. The community is willing to sell their unfertile and

barren land and buy more land in the vicinity/neighbourhood which is more productive and better than the land they sold. There are no other use of the land and benefits from the area being considered for the project.

7.7.6 Rates offered for the Project

The land owners agreed with the fact that rate being offered by the land aggregators is better than what they would have received if there was no project. There is no family rendered landless by procurement of land as all of the land owners have more land besides it. The villagers intend to use the compensation for procurement of more livestock and land.

7.7.7 Cultural Issues

There is a small temple protected by Archeological Survey of India in the village Rajulamandgiri. It is approximately 650m West from WTG ASP-122. In addition to it, there are many temples, mosques and churches have been observed in between the settlement area of villages of core and buffer zone of the study area. Access to these religious places will not be impacted due to these WTGs.

7.7.8 Migrant Labours

The community would prefer engagement of local youth for the construction work and as security guards after the project is commissioned. They were however aware that few of the skilled workers will come from outside and were comfortable to work with them. Proposed project will check migration of local labours during construction period.

7.8 STAKEHOLDERS IDENTIFICATION

A stakeholder is any group or individual who may affect or be affected by a specific project. They should be prioritized by identifying direct (those who have a direct interest or influence on the project) and indirect stakeholders whose interest is indirect. Stakeholders may also be internal within the Project or external to the Project. Stakeholder identification is useful to prioritize, analyze and assess stakeholder issues while creating management systems and strategies to address specific concerns. The stakeholders identified and summary of consultation with the stakeholders is provided in **Table 7.3.**

Table 7:3: Stakeholder Analysis

S. No.	Stakeholder Category	Relevant Stakeholders	Concerns & Expectations	Addressal of Issues/ Concerns by MVTPL
1.	**Local Community**	**Land owners** Affected persons whose land has entered into sales agreement with MVTPL or already acquired or being (purchased) for the project	Concerns and expectation raised during consultations were: ➢ The land owners expected adequate compensation for affected land; ➢ Expectation of employment opportunities from the project; ➢ Land required for transmission line and access roads to be disclosed; ➢ Access to grazing area on the plateau shall not be completely blocked; ➢ Villagers expressed concerns about scarcity of drinking water. They were however aware of the fact that rainfall in the area is not affected by presence of wind farms; ➢ They wanted engagement of more local people specially those who sold their land for the project as there are security issues with outsiders; ➢ The people expressed concerns over movement of heavy traffic, as they fear safety of children and livestock which roam around freely in the area.	MVTPL has paid adequate compensation for the private land procured based on direct negotiations with land owners and willing to sell and willing to purchase basis, reportedly at higher rates than the prevalent market price. MVTPL will identify employment opportunities based on skill set requirement through GE/Suzlon. However, in O & M phase, there is a limited scope in wind Project. Approximately 494 acres of land will be required for proposed project. MVTPL shall allow normal movement of domestic animal in most part of the site except foot print area and other areas facilities having potential risk. As per MEIL's CSR Policy, MVTPL shall propose community developmental programme on need based and with consultation to stakeholders. For construction activities, skilled labour will come from outside whether as unskilled labour will be hired locally as per their skill set through GE/Suzlon. All workers will be adequately briefed about the code of conduct to be maintained and to respect local customs and people. A transportation and traffic management plan has been proposed to enable more efficient management of construction traffic associated

S. No.	Stakeholder Category	Relevant Stakeholders	Concerns & Expectations	Addressal of Issues/ Concerns by MVTPL
				with the proposed project. MVTPL shall implement all components of the plan during construction phase of the project in order to address the concerns raised by the people of the community.
2.	**Local Institutions**	**Village *Panchayat*** The Village Panchayat is the lowest level of the three tiers Panchayati Raj Institutions (PRI). In the project area, it consists of more than one revenue village. The village Panchayat generally has control over the local resources and the Panchayat works on the general agenda of local area and community development. It understands the local needs/issues and can also act as a good ally for conflict	The Gram Panchayat was observed to be supportive of the project. They felt that the land being sought for the project was not serving good because of the topography and lack of irrigation and sufficient rainfall. ➢ They wanted greater engagement of local community and employment opportunities to local people. ➢ Village *Panchayat* expect local benefits like enhancement the local infrastructure, targeted social investment programme through CSR initiatives. ➢ The Village *Panchayat* hinted at the following activities: ○ *Measures to improve the water availability of the area; and* ○ *Contribute towards developmental activities of the village.*	MVTPL will identify employment opportunities based on skill set requirement for people through GE/Suzlon. It is proposed that during construction phase unskilled labour will be hired locally whether as skilled workers will be brought in from outside. The CSR initiatives proposed by the Village *Panchayat* and suggestions made during the need based assessment study will be further explored. As per MEIL's CSR Policy, MVTPL shall propose community developmental programme on need based and with consultation to stakeholders as per **Annexure II.**

S. No.	Stakeholder Category	Relevant Stakeholders	Concerns & Expectations	Addressal of Issues/ Concerns by MVTPL
		resolution at the community level. The Panchayat also has the powers to decide on affairs relating to the village, address concerns and grievance and decide upon issues of land diversion and change in land use.		
3.	**Govt. Institutions**	**Regulatory authorities** *State Labour department* is the agency for implementation of labour standards and the state labour policy. *Revenue department* will be interested in compliance of affected revenue land by project.	The main concerns of the State Labour Policy would be ensuring compliance to labour and working condition standards and implementation. Revenue department will approve diversion of revenue land affected by project. The requisite application with respect to the same has been forwarded to the administration. Andhra Pradesh Transmission Corporation (A.P. Transco) to finalize the location of common substation so that the final alignment of the transmission line could be finalized. Teachers of the government schools expressed their positive response. They enlisted their	MVTPL will comply with all regulatory requirements and obtain all requisite consents. MVTPL will explore the opportunity in school under CSR activity.

S. No.	Stakeholder Category	Relevant Stakeholders	Concerns & Expectations	Addressal of Issues/ Concerns by MVTPL
		Andhra Pradesh Transmission Company (A.P. Transco) will receive the power generated for further transmission to Grid. Government School falling within the villages of core zone	requirements as purifier drinking water facility, toilets and scholarships to student to encourage them.	
4.	**Local NGOs and Civil Societies**	**NGOs** In project area no NGO/civil society has been noticed in function for development programme in concerned communities.	Social organizations observed in the area were not directly associated with any of the project related functions.	---
5.	**Site Developer/ Land Aggregator**	The site developer agency i.e. MVTPL has the role to initiate land purchase through negotiation and mutual concern	The process of deciding the rate of land shall be transparent and well informed to the concerned community. A set of community engagement has been undertaken at the affected villages. The site developer should organize public consultations with affected land owners and Panchayats to	The land has been procured on the basis of willing seller and willing buyer and the rate of land was based on negotiations with individual land owners for the turbines as well as associated facilities.

S. No.	Stakeholder Category	Relevant Stakeholders	Concerns & Expectations	Addressal of Issues/ Concerns by MVTPL
		with affected community.	redress their grievances regarding compensation prior to mutation of land. The site developer shall also engage with community for negotiation of land required for access roads and transmission lines after identification of alignment.	
6.	**Site Occupier and Project Developer**	MVTPL will be responsible for all the project activities undertaken directly or through the sub-contractors.	MVTPL shall engage with the community prior to mobilisation of construction workers and material. MVTPL shall engage with the Panchayats and explore potential for CSR initiatives as per its CSR Policy	MVTPL will explore the opportunities directly or through the GE/Suzlon as per the applicability.

Thus on the basis of above consultation/ group discussion with local community/ villagers/ village president/ village panchayat members/ influential person of the region/ government officials and various stake holders, we may conclude that proposed project will prove beneficial not only to local region but also up to state and national level for a long term. There is a big support of local community in favour of the project. They are seeing their development through proposed project.

8 GRIEVANCE REDRESS MECHANISM

8.1 INTRODUCTION

This Grievance Redressal Framework (GRM) has been developed by MVTPL for managing grievances related to environmental and social performance arising from its operations in solar and wind power projects. This document describes the types of grievances, grievance redressal process and mechanism informal and formal channels for handling grievances arising from the various stakeholders of MVTPL.

This GRM shall serve as one of the component of MVTPL's Environmental and Social Management System (ESMS) for managing social performance of its projects as well as providing more accountability to its stakeholders. The GRM is based on four (4) guiding principles of the company which include:

- Transparency
- Fairness
- Respect
- Accountability

8.2 KEY DEFINITIONS

Some of the key terms and their definitions as applicable for this framework are described in the following **Table 8**:1**.**

Table 8:1: Definitions of key terms used in this document

Term	Definition
Affected Party	Stakeholders who are affected by the company or operation, both positively and negatively. Within this it is possible to distinguish between those that are directly affected and indirectly affected by the company or operation.
Communication	Dialogue between MVTPL and the affected stakeholder. Communication is exchanging (giving and receiving) information. Communication enables MVTPL to convey the aspects, risks and opportunities of their operations, and to receive information from a range of stakeholder's concerns, questions and suggestions shared in response.
Consultation	Consultation is not the same as communication although both are two-way processes. Consultation is purposeful and deliberately seeks input from stakeholders in order to shape relations and the development of programs. The aim is to ensure mutual understanding and for all parties to be able to manage decisions that have a potential to affect all concerned.
Grievance	A concern, complaint or feeling of resentment raised by any stakeholder either affected or interested in company operations. Both concerns and complaints can result from either real or perceived impacts of a company's operations.
Incident	An event or chain of events which caused or could have caused injury, illness, loss of assets or potential or actual damage to relationships or reputation.

Term	Definition
Operation(s)	A location or activity that is operated by MVTPL or one of its contractors on behalf of MVTPL. Locations could include solar or wind power project sites or offices including corporate or regional head offices.
Records of communication / consultation	Records of communication / consultation may include key e-mails, letters, newsletters, memorandums, complaints, opportunities for improvement, records of distribution/attendance, records of formal and informal meetings and records of commitments.
Stakeholder	Persons or groups that are directly or indirectly affected by a project as well as those that may have interests in a project and/or the ability to influence its outcome, either positively or negatively. This can refer to shareholders, lenders, employees, communities (including farmers, landless, women groups, youth groups, etc. industry, governments and interested third parties.
Worker	Worker is defined as any man or woman working on any project site owned, or developed by MVTPL or any of its EPC contractors.

8.3 TYPES OF GRIEVANCES

If any internal or external stakeholder believes that the company's business practices or activities are having an adverse impact on their quality of life, livelihood or environment, which they want the project team/management to address, such a concern can be classified as a complaint or grievances. From the purpose of classifying the various kinds of grievances that can arise, they are mostly categorized under four (4) headings:

- Internal Grievances
  - Employee Grievance (Separate procedure in place as part of the Human Resources (HR). These include the employees hired specifically for the site.
- External Grievances
  - Contractor and labour related grievances;
  - Community grievances including those on land and resettlement issues, project activities, CSR intervention, employee-community conflicts, and other project related issues

Detailed description of the various external and internal grievances along with the various issues covered under these heads is mentioned subsequently.

8.3.1 Internal Grievances- Employees Grievance

The likely grievances of direct employees of MVTPL may include but not limited to:

- Complaints pertaining to amount of wage, salary, other remuneration or benefits, as per company's centralized HR Policy
- Timely disbursement of remuneration;
- Working condition, health and safety of the employees;
- Unethical behavior between senior and subordinate employees;
- Discrimination on the basis of caste, creed, language, religion etc.;
- Gender discrimination; and
- Workplace harassment

8.3.2 External Grievances

External grievances are those grievances received from the external stakeholders such as labour and workforce, contractors, communities, local administrative setup, community groups/NGOs, and media groups.

Contractors and Labour Related Grievance

The workers include the local and interstate migrant workers are likely to have the grievance related to the following issues:

- Risk to health and safety of the laborers or workers hired by the Contractors;
- Working condition of the laborers;
- Wage discrimination among the laborers;
- Timing of the payments;
- Adequate facilities in the labour camps (during construction stages) including water supply and sanitation;
- PF, ESIC, Workmen's compensation, adequate health facility related issues;
- Unjustified deduction from the wages;
- Minimum wage rates for the laborers;
- Extended working hours;
- Prevention and protection of child labour from hazardous work condition;
- Issue of forced labour;
- Gender discrimination.

8.3.3 Community Grievance

The surrounding community of the project is considered as important stakeholder by the Project. The possible grievances of the community could be:

Land and compensation related issues

- Damage to, crops, infrastructure;
- Eligibility issues and payment of compensation;
- Improper/ inadequate valuation of the compensation;
- Compensation and employment entitlement against losses;
- Delay in the payment of the compensation;
- Livelihood restoration issues and associated benefits;
- Adverse impacts on community, common property resources (CPR);

Community development, employment and other issues

- Risks to community, health & safety (e.g. traffic);
- Accidents (e.g. involving livestock);
- Unethical Behavior by MVTPL personnel or its sub-contractors;
- Noise/dust/air emissions or any other impact on environment caused by project or sub-contractors;
- Demand for development interventions in the community;
- Issues owing to behavior of the security personnel and general attitude of the local community;

- Issues related to cultural conflicts or opportunity conflict owing to presence of migrant workers in the community or in the nearby areas;
- Any attempts to conceal the above

8.4 REDRESSAL PROCESS

8.4.1 Redressal Process for Internal/Employee Grievances

MVTPL as part of its Human Resources system has developed grievance addressing policy that covers registration and addressal of internal grievances raised by the employees. The grievance policy is intended as the tool by which a member of staff may formally have a grievance, regarding any condition of their employment, which he/ she wants to be heard by the management of the Company. The aggrieved employee has the right to representation by a professional organization, a staff association or a colleague/ friend.

The following stages outline the existing grievance redressal process established by MVTPL for its employees:

Stage 1: First level of grievance addressal

- An employee having a grievance should raise the matter with his manager as soon as possible either verbally or in writing.
- If the matter itself concerns the employee's line manager or program manager, then the grievance should be escalated to the superior.
- If the manager/superior is unable to resolve the matter at that time, then a formal written grievance form should be submitted. The manager should then respond within 32 working days (i.e. the manager's normal working days) to the grievance within an unless an extended period of time is agreed upon by both parties. The response will give a full written explanation of the mangers decision and who to appeal to if it remains unresolved.

Stage 2: Second level of grievance addressal

- In most instances the Company would expect the mangers' decision to be final and for the matter to come to a close. However, in some circumstances the employee may remain aggrieved and can appeal against the decision of the manager concerned.
- The appeal, to the manager next in line, must be made within ten working days of the original response to the employee grievance. The appeal must be in writing and contain the original formal Grievance form. This manager will attempt to resolve the grievance. A formal response and full explanation will be given in writing, as will the name of the person to whom they can appeal if still aggrieved, within 7 days.
- Where the 'next in line' manager at this stage is the Director Department Head with responsibility for the employee's function, then the grievance should immediately progress to stage 3.

Stage 3: Third level of grievance addressal

- If the employee remains aggrieved there will be a final level of appeal to the Director responsible for the employee's function. This appeal must be made in writing enclosing a copy of the original Formal Grievance form, to the Senior Manager within ten working days of receipt of the Stage 2 response. This Director will arrange and hear the appeal with another

management representative and respond formally with a full explanation within 20 working days.

- Where a grievance is raised against a Senior Manager then the grievance will be heard by the Chief Executive.
- There is no further right of appeal. Where however both parties agree that there would be some merit in referring the matter to a third party for advice, conciliation or arbitration, arrangements will then be made to find a mutually acceptable third party.

8.4.2 Redressal Process for External Grievances

Stage 1: Publicizing Grievance Management Procedures

For any project, MVTPL is required to ensure suitable public disclosure of its grievance handling and redressal process to its external stakeholders such as the community or the local administration. The company will establish a grievance cell at the plant site. The grievance cell shall comprise of the plant manager and other relevant personnel and disclosure of such a cell has to be made at suitable location in the plant premises so that any member of the community can easily access such information. The information is required to include information on registering and redressal process grievances.

Looking at the scale of the project and the duration of the construction stage wherein maximum numbers of contract workers, migrant workers or workers from the local community are supposed to be working at the site for a duration ranging from 6 months to nine months tentatively, the Grievance Redressal Mechanism for the community can simultaneously be used for the workers. The process of disclosure of information and the GRM process itself will be disclosed to the workers. Should the contractors have their own GRM, MVTPL will ensure that it is functioning effectively and even review the grievance records. However, if the contractors lack GRM in the first place, MVTPL will ensure that the workers are linked to their GRM process.

For the grievance mechanism to be in line with the cultural and socio- economic characteristics, based on its understanding of the ground situation in the project area, the company will strive to provide the following information to the stakeholders (primarily community) from time to time, at least some of the following:

- Project-level mechanisms capable of delivering outputs against grievances and benefits complainants can receive from using the company grievance mechanism, as opposed to other resolution mechanisms;
- Information on who can raise complaints (affected communities);
- Where, when, and how community members can file complaints;
- Company personnel responsible for receiving and responding to complaints, and
- Type of response complainants can expect from the company, including timing of response;

The existence of GRM needs to be continuously reminded on a regular basis during project implementation. Person from the company's grievance cell such as onsite personal for handling and managing grievances, CSR officers, or individuals working in analogous positions, shall be responsible for publicizing the procedure through appropriate methods.

Step 2: Receiving and Keeping Track of Grievances

This receipt and tracking of grievances primarily involves the following stages:

- Collecting and recording grievances as they come in;
- Registering them in a central place; and
- Tracking them throughout the processing cycle to reflect their status and important details.

Grievance Receipt and Recording

Staff from the grievance cell charged with collection of grievances (e.g., grievance officer at the project office location, community liaison, or field staff authorized to take grievances) writes down complaints at group or individual meetings, during field visits, or at designated locations. These grievances are to include:

- Complaints received through third parties such as community persons, contractors, contract workers, etc.;
- Complaints received by project staff directly involved in handling grievances;
- Complaints received through staff or employees that have direct contact with communities (if authorized);

Tracking of grievances can be undertaken through a grievance log method. Keeping good records helps to track cases, respond to grievances in a timely manner, check the status of complaints and track progress, measure effectiveness, and report on results.

A sample tracking format at minimum should contain and maintain the following grievance related details:

- Grievance Date
- Village/ work Site
- Areas
- Complainant
- Details of the issue (Categorization can be done)
- Hearing officer
- Issue Related to concerned Dept.
- Present Status
- Remarks (Open, Closed, and Pending Status)
- Total time taken to close the grievance

Relevant personnel from respective departments such as Labour, land, HR and CSR will track the resolution status, coordinate it with the division(s) responsible for corrective actions, and maintain a record of progress (for example- open, pending or closed).

It is likely that not many people from each of the departments will be available at the site all the time. It is therefore important that the responsibility will be assigned to one of the Grievance coordinators (any dedicated site person for registering grievances) who will be responsible for tracking, either directly addressing the grievances or rerouting to the respective departments (such as HR/EHS/Land) and closing the grievances.

Designated grievance coordinators from the grievance cell of respective sites will presents to the ESMS committee an aggregated monthly report on the status of complaints; the frequency may vary once the construction stage is over. The coordinator may also do a case to case grievance status reporting in case of critical grievances or grievances that may require immediate attention of the ESMS committee.

A few key considerations that are required to be kept during handling and management of grievances are as follows:

- All incoming grievances are to be acknowledged as soon as possible.
- A formal confirmation with a complaint number (assigned to each of the grievance), or other identifier, and a timeline for response to assure the complainant that MVTPL is responding properly.
- If a complaint is received in person, a good practice is to acknowledge it on the spot.
- If a more complex investigation is required, the complainant shall receive an update explaining the actions required to resolve the complaint, and the likely timeline.
- The company will explain up front what claims clearly are outside the scope of the mechanism and what alternative avenues communities can use to address these potential issues. This communication can be made upfront as part of the disclosure to the community.

Step 3: Reviewing and Investigating Grievances

The personal from the grievance cell responsible for grievance handling will organize the process to validate the complaint's legitimacy and arrange for investigation of details. To begin this process, the nature of the grievance shall be established to determine the measures needed for review and investigation. All grievances shall undergo some degree of review and investigation, depending on the type of grievance and clarity of circumstances:

- Minor, straightforward issues may only need screening before proceeding to the next step (resolution options and response). Review of minor issues, especially those related to a complainant's request for information, can generally be handled easily by providing information on the spot, or referring the person to community liaison personnel.
- Less clear, more problematic, or repetitive issues, or group complaints may need a more detailed review prior to action. Staff involved in handling grievances may need to seek advice internally, and in some cases turn to outside parties to help in the validation process, especially in cases of damage claims.
- Complex issues with multiple parties may need investigation can be organized internally, or the company may designate third-party experts to investigate when impartiality is important or when complex technical matters are involved. If an extensive investigation is found to be necessary, it shall be initiated swiftly before circumstances change or the conflict escalates further.

Labour-Related Grievances

After categorization of the grievances once it reaches the project, the labour related grievances shall be directly managed or handled by the HR representative at the site/ designated supervisor or further escalated to the Human Resources (HR) at the corporate level which is ideally placed to redress issues related to the grievances.

Complaints clearly not related to the Project

It is sometimes difficult to determine which issues are related to the project and which are not. If in doubt, employees designated to receive grievances will accept the complaint and assess its legitimacy.

Complaints Constituting Criminal Activity and Violence

In these cases, complainants shall be referred to the formal justice system. The Grievance cell at the MVTPL shall also record the same; however, in terms of action must refer it to the concerned administration for suitable legal and criminal action.

Commercial Disputes

Commercial matters will be stipulated for in contractual agreements and issues shall be resolved through a variety of commercial dispute resolution mechanisms or civil courts, as per contracts.

Issues related to Governmental Policy and Government Institutions

Issues or grievances related to governmental policy or institutions shall be captured through the MVTPL GRM system, then the grievances may be passed along to authorities and let the communities know how to follow up and even facilitate the process of follow up for the communities. It is also essential that MVTPL communicates clearly to the communities about the role, responsibilities, and limitations of a company grievance mechanism and the limitations of the same in handling grievances such as these.

Step 4: Developing Resolution Options and Preparing a Response

Rationale for Grievance Closure

- The requirements/need specified in the form of grievance by the aggrieved have been effectively addressed to the satisfaction of the complainant e.g. - demands for employment opportunities have been met by MVTPL;
- Grievance to be duly addressed and closed by MVTPL.

Process of the Grievance Redressal

- The person having grievance will come on the scheduled time and lodge the complaint at the designated place (plant office or corporate desk)
- He/ She will be heard by the concerned officer.
- The grievance will be processed and concerned person will be informed through a written communication/ Phone in case of urgency within seven days.
- On hearing from the grievance officer they have to come for further processing to the grievance redressal center if required.

Step 5: Monitoring, Reporting, and Evaluating a Grievance Mechanism

Monitoring and reporting can be tools for measuring the effectiveness of the grievance mechanism and the efficient use of resources, and for determining broad trends and recurring problems so they can be resolved proactively before they become points of contention. Monitoring helps identify common or recurrent claims that may require structural solutions or a policy change, and it enables the company to capture any lessons learned in addressing grievances. Periodic review of internal and external grievances has to be carried out at the ESMS committee meetings.

Monitoring Indicators

Grievance records will provide the background information for regular monitoring, both informal and formal. Depending on the extent of project impacts and the volume of grievances, monitoring measures will vary. Some of the monitoring indicators identified that can be a part of the monitoring

mechanism may include:

- Tracking the number of grievances received and resolved;
- Apart from reviewing each grievance and analyzing effectiveness and efficiency, using complaints to analyze systemic deficiencies.
- Recognize patterns in the grievances the company receives, and how they are being resolved.
- Communities preference to any of the several channels to submit grievances;
- Whether there is particular sub group in the community raising complaints (for example, women, elderly);
- Whether there is a trend in particular groups particular kind of complaints relating to operations or accessibility or any specific issues;
- Average time taken for resolution of grievances falling under particular category;
- Effectiveness of different solutions in addressing various category of grievances;
- Whether there are matters significantly affecting company policy or requiring legal review;
- Issues of cultural appropriateness and transparency;
- Whether the existing system meets requirements established by the company as well as the expectations of all stakeholders.

Step 6: Reporting and Recording

Based on all grievances received, registered, documented and tracked through database regular reports shall be prepared for reporting to the senior management. This shall assist in tracking overall trends and patterns in concerns allowing emerging issues to be flagged and understood at an early stage. The statistics on grievance handling and redress are to be included in action plans and annual reporting. Monitoring and reporting also create a base level of information that can be used by the company to report back to communities.

8.5 DISCLOSURE OF THIS GRM

The disclosure for GRM will be done with the community, employees and various stakeholders. The disclosure will be done through website and other potential opportunity of communication with display at prominent places at the gate of the site and other working areas at the site. t can also be done especially to the external stakeholder at the various stages of project screening and impact assessment studies at the project level and to be continued during the operations stage.

8.6 MANPOWER: ROLES AND RESPONSIBILITIES

8.6.1 Corporate Level

At the corporate level, handling of grievances is required to be directly handled by the HR department under the responsibility of the designated officer, and the various HR personnel available for resolution of internal grievances.

8.6.2 Project Level

A grievance cell is to be formed during the initial inception phase of the project. The grievance coordinator (Mr. Swaran Kumar K - 09515113452) will be responsible for effective implementation of GRM and coordinating day to day functions. Periodic meetings and reviews of the Grievance cell are carried out by them.

The grievance cell would be reporting back to the head HR department and supported by other

heads from other functional areas such as Land, CSR, EHS etc. as per requirement. The mandate of this cell would be managed as part of the ESMS committee.

8.7 FINANCIAL

MVTPL will ensure a budget allocation to deal with grievance tracking and handling.

8.8 TRAINING

Training shall be provided in the company's policy and practices for both employee and other external stakeholder grievance mechanisms, relevant to their exposure and responsibilities for managers, all other employees, contractors and visitors, which shall include as a minimum:

- Expected behaviors and accepted practices when interacting with employees and stakeholders in order to avoid a grievance in the first instance;
- Routes available for employees to lodge a grievance;
- Routes available for employees and other external stakeholders to lodge a grievance;
- Roles and responsibilities for handling and resolving grievances (including key internal and external stakeholder contacts), and;
- Recording and tracking procedures.

9 ENVIRONMENTAL MANAGEMENT PLAN

The ADB Environmental Safeguards requires the project proponent to prepare an environmental management plan which addresses the identified potential impacts and risks. An effective environmental management system is a dynamic, continuous process initiated by management and involving communication between the project proponent, the workers, and the local communities directly affected by the project. The EMP includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

MVTPL is committed to execute all construction and operation related activities for the proposed wind power project as per the best established environmental, health and safety (**Annexure I,** MEIL' EHS Policy) standards and also it will be aligned with upcoming ESMS to be implemented at asset level. Mitigation measures are proposed for impacts which are identified and quantified. Some residual impact will however persist after the all mitigation measures are employed, the Environmental and Social Management Plan intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during construction and operational phase.

9.1 REGULATORY AGENCIES

The authorities/agencies to be coordinated for ESMP implementation include the following:

- District Administration of Kurnool District;
- Land Revenue Department;
- Andhra Pradesh State Pollution Control Board;
- State Electricity Board;
- Central Electricity Authority;
- Factory Inspectorate;

9.2 ENVIRONMENT & SOCIAL MANAGEMENT SYSTEM (ESMS)

An Environment & Social Management System (ESMS) is already available (MEIL) to assist MVTPL in developing a comprehensive mechanism at the asset level to lay down a rationalized procedure for assessing and managing social, environmental, health and safety issues at all stages of their activities. The corporate MEIL ESMS will guide the implementation at the project level compliance to the standards as committed by MVTPL. The Environment and Social Management Plan (ESMP) provided in the subsequent sections will be operationalized within the framework of the management system. ESMS will be aligned to IFC Performance Standards and ADB Safeguard Policies 2009.

9.2.1 Organisation, Roles and Responsibilities

The proposed organizational structure to implement the ESMP during the construction phase is as proposed:

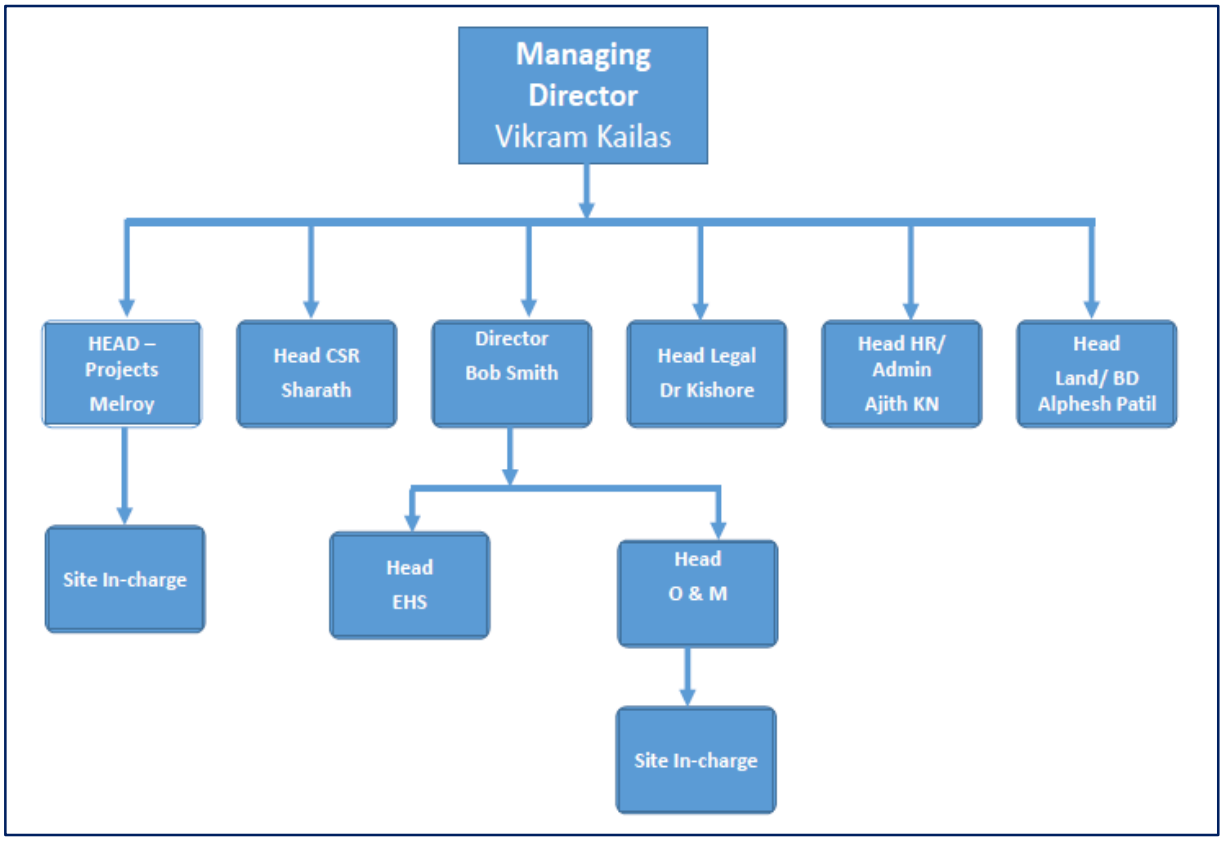


Figure 9:1: Construction Phase Organizational Structure for ESMS Implementation

The usual activities of the EHS manager and his team will be as following:

- Ensuring availability resources and appropriate institutional arrangements for implementation of ESMP;
- Compliance of legislative requirements and ADB safeguards;
- Carryout audits, and inspection of all the project activities through site engineer;
- Preparation of necessary documents and record keeping system through site engineer;
- Review and updating of ESMP for effective its implementation.

9.2.2 Contractors Management

Prior to assigning any contract, MVTPL will pre-qualify each contractor according to commercial, technical, quality assurance and its past performance on EHS standards so as to satisfy MVTPL 's requirements.

MVTPL will ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMP and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Special emphasis will be placed on traffic management and operation of cranes.

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.

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

- Purpose of action plan for the project activities;
- Requirements of the specific Action Plans;
- Understanding of the sensitive environmental and social features within and surrounding the project areas; and
- Aware of the potential risks from the project activities;

A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.

Training should be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards. Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their coworkers.

Through appropriate contract specifications and monitoring, the employer should ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

As part of the ADB Social Protection Requirements and IFC Performance Standard-2 requirements, MVTPL has initiated the revision of its HR Policy. The updated HR policy is reported to include:

- MVTPL's position on child labour, forced labour, as well as commitment to favorable/safe working conditions;
- Applicability of the policy to indirect employees like contractors, contracted laborers or other stakeholders in the supply chain;
- Provide details of recruitment, induction, leave, termination, insurance, medical facility, training and incentives;
- Define leave policy;
- Provide measures against discrimination on basis of caste, religion or sex;
- Provide details of health benefits and insurance coverage;
- Provide for measures against sexual harassment;
- Provide for measures taken to ensure —Occupational Health and Safety is ensured for all employees on site;
- Provide for employee forums as an alternative to collective bargaining or registration with a trade union.

Although all employee related matters would be documented and monitored at the corporate level, given the limited footprint and operations of the wind power plant, management of labour and employee relations can be one of the responsibilities of the plant manager who can be assisted by the on-site field supervisor in charge of implementing the social management systems on site. It is suggested that the revised human resource systems shall be applicable to the proposed project. However, the HR management systems framework would need to take the following into account:

- Awareness of the requirements under the ADB Social Protection Requirements and IFC Performance Standards 2 on Labour and Working Conditions, particularly with respect to training of contractors and occupational health and safety provisions;
- Providing all employees and labour with an access to an alternative collective bargaining or grievance redressal forum;

- Ensuring that all contractors and sub-contractors for whom MVTPL is the —principle employer are compliant for all applicable provisions of the Indian Labour Laws, particularly with regards to child labour, working houses, minimum wages, overtime etc. during the construction and operations phase;

9.2.3 ESMP Review and Amendments

The ESMP provided with this report is an environment management tool which needs to be reviewed periodically to address changes in the organisation, process or regulatory requirements.

9.2.4 Inspection, Monitoring & Audit

In order to implement the ESMP, the on-site team will develop a time-bund and action oriented Environmental and Social Action Plan to implement the mitigation measures provided for each of the identified environmental and social impacts. This ESMP will have Tobe monitored on a regular basis, quarterly or half-yearly and all outcomes would need to be audited in accordance with existing EHS commitments as per **Annexure I**.

The monitoring process will cover all stakeholders including contractors, labourers, suppliers and the local community impacted by the project activities and associated facilities. Inspection and monitoring of the environmental and social impacts of construction and operation phase activities will increase the effectiveness of suggested mitigations. Through the process of inspection, audit, and monitoring MVTPL will ensure that all the contractors comply with the requirements of conditions for all applicable permits including suggested action plans. The inspections and audits will be done by MVTPL 's trained team and external agencies/experts. The entire process of inspections and audits will be documented. The inspection and audit findings will be implemented by the contractors in their respective areas.

9.2.5 Reporting and Review

MVTPL will develop and implement a programme of reporting through all stages of the project - construction and commissioning, operation and decommissioning. Contractors will be required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting will be done in form of environmental, health, safety and social check list, incident record register, environmental, health, safety and social performance reports (quarterly basis).

9.2.6 External Reporting and Communication

All complaints and enquiries are to be appropriately dealt with and records be maintained in Complaint/Enquiry Register by EHS Officers or other delegated staff. MVTPL shall also submit annual monitoring reports to ADB on the progress of implementation of the ESMP. MVTPL shall undertake annual inspections in order to verify compliance with the ESMP and progress towards the expected outcomes. Necessary corrective actions shall be identified based on the verifications and a corrective action plan shall be formulated. MVTPL shall ensure effective implementation of these corrective actions and submit periodic monitoring reports to ADB. MVTPL shall also provide ADB with an annual report on its compliance with ADB's social protection requirements.

9.2.7 Internal Reporting and Communication

Inspection and audit observations along with their improvement program are to be regularly reported to the senior management for their consideration. The same are also to be communicated

within the staff working on the project. To maintain open communication between the staff and management on EHS&S issues the following shall be used:

- Team Briefings,
- On-site work group meetings;
- Work Specific Instructions; and
- Meeting with stakeholders.

9.2.8 Documentation and Record Keeping

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to identified personnel in form of the following:

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

9.2.9 Proposed Environment and Social Management Plan

An Environment and Social Management Plan has been developed following the delineation of impacts and mitigation measures. These measures will be adopted by the project proponent and imposed as conditions of contract of the sub-contractor employed for respective phases of the power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule. The ESMP includes the following:

- Mitigations suggested for adverse environmental and social impacts and associated risks;
- Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations;
- Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations;
- Monitoring arrangements for effective implementation of suggested mitigations for the proposed project; and
- Reporting requirement to the regulatory agencies and funding institutes

Table 9:1: Environment and Social Management Plan for Construction Phase

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
Soil				
• Erosion and compaction • Contamination	• Disturbed area to be suitably re-vegetated with selected plant species at the earliest • Localized sprinkling of water in applicable affected areas at areas where vegetation is removed shall be undertaken for the entire duration of construction. • Use of existing track for transport of man and material to the extent possible • Loose soil to be protected from wind and runoff by covering/ watering/ other means of covering • All construction material to be kept within the footprint of the area acquired. • Taken care of loose construction material to avoid being carried into adjoining area by wind. • Painting of panels, switchyard structures to be undertaken after covering the land beneath with a sheet of impervious material as per the requirement. • Re-fueling of machinery at site to be undertaken over paved/ suitable surface.	• MVTPL representative to make observations as and when on storage and handling of soil and construction material. • Workers to be trained on handling and storage of fuel and hazardous waste by contractor. • Workers handling painting activity to be briefed about the need to prevent contamination. • Drivers to be instructed about use of dedicated tracks within the site.	• To be mentioned in the contract with the construction contractor. • Site supervisor/ Engineer to make observations and convey it to the contractors/ Project Head. • Deputed EHS/ site engineer of will monitor the implementation of the same and report to MVTPL on monthly basis.	• Soil excavation cost will be INR 3,00,000 per WTG and backfilling cost will be INR 70,000. *Before commissioning of project*

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
	• In case of any accidental spill the soil to be cut and stored securely for disposal with hazardous waste			
Waste Disposal				
• Accumulation of construction waste • Run off into rainwater channels • Unhygienic condition for labours • Hazardous waste from machinery, generators etc. (lube oil, hydraulic oil, waste oil etc)	• Suitable access road shall be planned to cause minimal disturbance to the terrain topography. • Existing surface drainage pattern to be retained to the extent possible, otherwise proper engineering measure to be taken. • Construction waste to be properly stored and disposed off suitably. • Other wastes like wood packaging material, metal, jute, etc. will be sold to scrap dealers/ buyers. • Random stocking of raw material, storage of debris, piling of loose soil etc to be strictly controlled. • Portable toilets/ suitable arrangements with septic tank-soak pit arrangement to be provided for workers • Hazardous waste (if any) will be taken care as per host's country's legislation stored at a secure location and only be sold to APPCB authorized vendors. • Housekeeping of the area to be maintained on regular basis.	• Workers to be instructed to maintain neat, clean & hygiene at the use of facilities. • Contractors will be briefed about the need for proper storage and disposal of construction waste • MVTPL will brief the specific needs as per Host Country's requirement for further execution, as and when required.	• Site Engineer • To be mentioned in the contract with the construction contractor • Site Engineer to make observations and convey it to the contractors. • Monthly report of EHS supervisor to include the compliance and observations if any.	• To be incorporated as part of project budget, no additional cost is envisaged. *During Construction phase*

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
Water Resource and Quality				
• Run off into rainwater channels • Loss of soil • Change in micro level drainage pattern • Wastage of water	• Water for construction and consumption to be arranged by the suitable local contractors through authorised tanker water suppliers. • Adequate arrangement for storm water management in identified area during construction period to be made to avoid sediment run off from the site. • Storm water flow during monsoons to be directed to the existing suitable channels. • Optimal utilization of water to be ensured throughout the construction phase • Leaks and losses to be checked frequently to ensure optimum uses. • Proper storage and supply facilities to be arranged before undertaking construction activities. • Portable toilet/ suitable arrangement with septic tank soak pits will be provided at site to facilitate the sewage generated.	• Monthly consumption of water to be recorded. • Workers to be instructed about optimal use of water • Storm water arrangements will be made after feasibility and will be monitored for clogging as and when required, if any. • Water quality monitoring at project site is done during construction phase.	• Site Engineer • To be mentioned in the contract with the construction contractor • Site Engineer to make observations and convey it to the contractors • Monthly report of Site Engineer/ EHS site engineer to be sent to EHS head	• Water quality monitoring cost– INR 12,000 per sample • Performance parameters – Suspended Solids (SS), Total dissolved solids (TDS), oil, grease, Biological Oxygen Demand (BOD), Total coliforms, Faecal coliforms *Winter Season*
Ecology				
• Clearing of vegetation • Cutting of	• Suitable re-vegetation with selected species at disturbed areas to be undertaken.	• Construction contractor to instruct and inform workers about need to	• Site supervisor/ Engineer • To be mentioned	*Tree cutting is not envisaged during development of the project site since the area is*

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
trees • Disturbance to avifauna, small mammals	• Construction zone to be identified as fenced suitably • Tree cutting to be limited to those directly affecting the wind turbine • Workforce to be instructed to avoid any other activity likely to affect the local flora & fauna.	refrain from activities that may adversely affect the ecology •	in the contract with the construction contractor. • Site Engineer/ Head project will be giving vegetation clearance to any contractor.	*devoid of vegetation.*
Traffic and Transport				
• Movement of heavy vehicles leading to congestion and accidents • Improper parking of vehicles used by workers and for movement of material can lead to discomfort to other users. • Damage to road and related structure from	• Vehicle movement and parking within the project premises shall be managed properly to avoid accidents • Routes for use by construction traffic to be planned to minimize impact on adjoining activities. • Dedicated path within the site for exclusive entry and exit of the construction vehicles to be provided. • Regular maintenance of vehicles to be taken up. • Where road widths are insufficient, either temporary widening of the road with gravel or full depth widening of the pavement structure to be undertaken as part of project execution planning. • All construction and modification activities to be undertaken after prior	• Contractor (GE and Suzlon) shall undertake a detailed analysis of transportation feasibility prior to transportation of turbine and associated components • Necessary training to the driver of construction vehicles for speed restrictions and to crew members on do's and don'ts during construction vehicles movements. • Drivers to be assessed for their knowledge on traffic rules before engagement. • During the construction phase number of vehicles	• Site supervisor/ Engineer. • To be mentioned in the contract with the construction contractor	• Regular maintenance of vehicle and up keep of roads shall be included in O&M budget *For all construction related activities during construction and operation phases.*

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
heavy vehicles • Risk to livestock and cattle	approval / permission from local administration as per the applicability. • Local administration and village Panchayat to be informed in advance about the movement of heavy and oversized components of turbines, if required. • Pilot vehicles to be provided with trucks carrying large components to manage traffic and assist the movement without any damage or accident to structures along the road. • Speed of all project vehicles to be restricted to 30km/hr on village roads. • Appropriate traffic diversion schemes shall be implemented when bitumen paving is under progress and all works shall be planned and swiftly completed to avoid inconvenience to road users • Transportation to be undertaken along identified paths. • High noise generating activities to be restricted to day time (07:00 to 22:00 hours) with proper mitigation measures.	as well as any incidents and accidents need to be reported and their outcomes monitored. • MEIL's On site emergency preparedness plan has been enclosed as Annexure VI. The plan has been extracted from ISO document and should be read as uncontrolled.		
Atmospheric Emissions				
• Fugitive dust • Emissions from diesel	• Dust generating activities to be avoided/ minimized (when not avoidable)	• Ambient air quality monitoring within the project area shall be	• Site supervisor/ Engineer • To be	• Water tankers would cost INR 1200-1600 per tanker (15,000-20,000 liters)

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
engines/ vehicles	• During high wind speeds, appropriate steps to be taken for loose construction material at construction site. • Equipments/ machinery to be properly maintained to minimise smoke in the exhaust emissions. • Machinery to be turned off when not in use. • Housekeeping of the area to be maintained • The impact of emissions from vehicles bringing construction material to be minimised by proper upkeep of maintenance of vehicles, sprinkling of water on unpaved roads (when required) at the construction site and planned movement of such vehicles. • Vehicle speed to be restricted to 30km/hour at site to minimize potential for dust generation in the surroundings • Trucks /dumpers to be covered by tarpaulin sheets during off site transportation of friable construction materials and spoil •	undertaken at least once during the construction period.	incorporated in the contract with contractor	• Ambient air quality monitoring –INR 7000 per location once in project construction phase (except rainy season). • Performance parameters – PM_{10},$PM_{2.5}$, SO_X, NO_X and CO *Throughout construction phase*
Noise and Vibration				
• Disturbance to habitations	• Only well maintained equipment (proper working conditions within	• Noise monitoring at site and surrounding villages to	• Site Engineer • Construction	• Cost of Noise monitoring shall be INR 5000 per location once

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
• Disturbance to fauna • Occupational Hazard	Indian noise standards) will be operated on site. • DG sets shall be used for emergency power/ backup (if any). • Provision of rubber paddings/noise isolators at equipment/machinery used for construction • Construction vehicles to be well maintained (Pollution Under Control Certificate- PUC is a Certification Mark issued to certify that motor vehicles in India meet emission and pollution control norms) and minimise idling time for vehicles when not in use. • Loud, sudden noise emissions to be avoided wherever possible. • Information about blasting activities (if any) to be provided as per standard practice. • Site workers working near high noise equipment use personal protective devices to minimise their exposure to high noise levels.	be undertaken once in project construction phase and annually in operation phase. • Arrangements/facilities for noise reduction to be monitored as and when required • Schedule of activities to be discussed and finalised between site manager and the contractor • 24 hourly continuous monitoring to be undertaken at every village in proximity twice in a year. • Values of Leq Day, Leq Night to be determined.	Contractor • Third party monitoring agency to be engaged for Noise Monitoring • External training on use of PPE.	in project construction. • Performance parameter –Leq-day, Leq night, Leq average <u>*Throughout construction phase*</u>
Cultural				
• Existing temples near site • Shadow Flicker • Cultural	• Access to the existing temple to be retained as existing while working on turbines close to the temple. • Turbines to be located in suitably safe distance from temple. WTG is located 600 mts away from ASI site, which is a	• Workers to be briefed about need for cooperation and harmony with the community • Workers to respect the sanctity of the temple.	• Construction Contractor	•

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
differences amongst workers	safe distance for any obstruction to be caused by the respective WTG. • To the extent possible sourcing of construction labour to be done from local region by contractor for unskill activities			
Health and Safety				
• Working at height • Operation of heavy machinery • Accidents leading to injuries fatalities • Occupational health hazards	• All the required safety measures based on the individual's job profile to be provided (as per working guidelines, use of personal protective equipments.) for construction workers through the contractors. • Ensure effective work permit system for hot work, electrical work, working at height, working in confined space etc. • Ensure personal protective equipment for all personnel present at site are made available. • Arrangement for fire control measures • Display of Emergency phone numbers at site. • Ensure good house-keeping at the construction site to avoid slips and falls. • Lifting /Dropping/ lowering of construction material or tool to be restricted and undertaken only under strict supervision, if required.	• Proper training of the workers regarding health and safety procedures • Workers to be trained through sub-contractors regarding use of Personal protection equipment and its importance. • Operation of Cranes to follow a Crane Safety Plan. • MEIL's On site emergency preparedness plan has been enclosed as Annexure VI. The plan has been extracted from ISO document and should be read as uncontrolled.	• Site Manager/ Engineer • Safety Officer of contractor to be ensured for each activity. • To form part of the contractor's contract.	• Training of workers will be mostly given by internal resources. *Throughout Construction phase*

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
Social				
• Access to Common Property Resources • Access to grazing lands; • Village approach road to the site; • Land Requirement	• The project will engage with the affected community (if any) to understand the stakeholders on the common property resources whose access would be impacted. • Grazing of livestock in the footprint of wind farms along with any sensitive area will only be restricted. In general, the project does not fall under grazing land. • The project will upgrade the existing roads before use. • These roads will be handed back to the community as an improved/ better quality infrastructure. • Migrant labour to briefed on code of conduct to be maintained • Approximately 493.75 acres of land will be required for the proposed project including WTGs, pooling sub-station, transmission line etc. Land procurement is under process. The Land identified for the project, is open, single cropped agricultural and barren land; is being procured under willing seller and willing buyer basis and best of the market value with respect to circle rate, defined by government of Andhra Pradesh. The	• The site personnel will ensure that during the construction phase there is no misuse of community facilities	• MVTPL to ensure the workers are trained to ensure harmony with community through contractors. • On-site personnel and contractors to be aligned with the requirements of social responsibility • After completion of land procurement for WTGs, transmission line, pooling sub-station etc., MEIL/MVTPL will summarise it in table showing Plot Number/Survey Number, Circle rate, Rate paid with evidence that MEIL/MVTPL	-

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
	land which is not identified yet, MEIL/MVTPL will follow proper procedure during procurement process.		paid at or above market rate.	
• Job Expectations • Expectations for other local benefits	• The project will communicate and discuss with the community in a transparent manner. • Consultation with women/women's groups will also be held during construction and operation phases to listen to their issues and concerns regarding labour, health and safety etc. as well as to solicit their ideas on various community initiatives.	• MVTPL shall hold regular consultations with appropriate stakeholders. • All concerns must be addressed through systematic process.	• MVTPL • GE/ Suzlon	-
• Local Employment	• Assess the exact number of workers to be required at each stage through contractor/ own resource in the construction period. • Ensure priority is given to local people for short term/long term employment opportunities, based on required skill and education level.	• Explore possibilities of training and capacity building to enable the community to be able to secure the available jobs and contracts, as per the applicability and requirement of the business. • MVTPL to explore possibility to engage women in appropriate work as per the applicability.	• MVTPL to assess potential for engagement of local community and for women.	-
• Demands for materials.	• Ensure local contracting and vendor opportunities aligned with the scope		• MVTPL /Contractor	

Impact Identified	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate and Timeline
	and demand as far as possible			

Table 9:2: Environment and Social Management Plan for Operation Phase

Issue	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate
Aesthetics and Visual Impact				
• Visual intrusion	• Towers to be painted as per Standard Industry practice only.		• Head – Project	*Prior to commencement of operation*
Waste Disposal				
• Used oil • Transformer oil	• Used oil to be securely stored and sold only to APPCB approved vendors as and when required. • Transformer oil to be replaced and returned by the supplier of transformers	• O&M staff to be briefed and trained about the need for proper storage and disposal waste oil	• Head – O & M Operations • Manager • Deputed EHS Engineer of O & M	-
Ecology				
• Bird Kill • Avian collision	• The turbine layout provides adequate spaces between each turbine for movement of birds which would reduce the potential for accidental collision. The site is devoid of any migratory bird route. • Standard practice on turbine blades shall be considered to enhance visibility. • Marking overhead cables and transmission poles using defectors and	• It is suggested to have monitoring of bird and bats for a year of project operations. • Train the security staff on handling injured birds / bat and injured birds should be taken to nearest Vatenary hospital located in	• MVTPL to engage an expert to periodically assess bat and bird status. The expert shall also train the staff at site to address the incidents of bird hit / injury.	• Quarterly Monitoring cost through external expert (INR 600,000 -800,000 per year)

Issue	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate
	avoiding use of areas of high bird concentrations, especially for species vulnerable to collision. • Where possible, installing transmission cables underground in accordance with existing best practice guidelines for underground cable installation. Otherwise if possible, install overhead cables with proper insulation to avoid bat and bird electrocution through body touch. Install bird defectors on overhead transmission cables at selected points wherever possible. • The illumination within the project area should be bare minimum and be within the acceptable limits, particularly during night hours. This will help in undisturbed activities of nocturnal species like rodents, bats and owls. • Some bird reflectors can be fitted at relevant places to divert low-medium and medium-high flying bird species during day time. • Feasibility of fixing of bird defector on the turbine to avoid perching of birds near blades can be worked out, specially raptor species which prefer to perch at higher points.	Joharapuram, Devenabanda, Pattikonda and Hosuru .		
• Habitat Destruction of Black-buck and	• Ban on removal of bushes, tree, shrubs	• Recording of man animal conflict, if any	• MVTPL shall periodically review	***Note:*** *During consultation with Forest department Kurnool, they*

Issue	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate
Indian Wolves • Man Animal Conflict	in nearby forest areas • Awareness development among the project labours / employees to conserve / protect the ecosystem • Fire protection measures to avoid any fire due to project	• Recording of fire incidence • Awareness development among the project labours / employees to conserve / protect the ecosystem	the accident • Communication with forest dept. officials has already been made. But the Forest Dept. suggested that there is no chance of animal conflict with WTG.	*suggested that the proposed project does not falls under forest area.*
Noise				
• Turbine noise • Corona Discharge	• Maintenance and repair of turbines will be undertaken on annual basis/ as and when required. • Transmission line to have Conductors designed to minimise corona effects • Implement a complaint resolution procedure to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved. • Optimisation of turbine speed. In high wind, blade speed is controlled as per the desired criteria to avoid blade throw. • Provision of Noise barrier in terms of green belt near to receptor, if noise level found crossing the standards during operation phase monitoring	• Turbines certified as per IEC to be engaged • Monitor noise at all nearby village once a year during operation phase. Monitoring during construction phase is also done,	• Head – O & M • Deputed EHS Engineer of O & M • Site Manager in consultation with deputed EHS officer.	• Monitoring cost INR 7,000 per year • Performance parameters-Leq-day, Leq-night and Leq average
Water Resource and Quality				

Issue	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate
• Water requirement for cleaning	• Tanker water will be used.	• Water consumption to be recorded and assessed on monthly basis for wastage	• Deputed EHS Engineer of O & M • Plant Manager	-
Health and Safety				
• Working at Height • Use of Cranes • Electrical hazards • Accidents leading to injury/fatality	• Work permit system shall be implemented of reworking at height. • Personal protective equipment to be provided for all personnel during maintenance work • Crane safety plan to be followed • Workers handling electricity and related components to be provided with shock resistant gloves, shoes and other protective gears. • Adequate training regarding health and safety to be provided to the workers. • The switchyard building to be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire.	• Proper training of the workers regarding health and safety procedures • Workers to be trained for use of Personal Protection Equipment and its importance. • Engineer/ Supervisor/ Worker (as per the applicability) shall be trained- Wind Safety Specific Training. • MEIL's On site emergency preparedness plan has been enclosed as Annexure VI. The plan has been extracted from ISO document and should be read as uncontrolled.	• Site Manager • Head - O&M	• Internal resources • External resources for wind specific safety training (INR 4,00,000 to 6,00,000)
Social				

Issue	Suggested Mitigation	Monitoring/ Training	Management Responsibility	Cost Estimate
• Impacts on Local Economy	• The project shall try and involve local enterprises for procurement of material wherever possible.	-	• Procurement team • Head – O & M	-
• Shadow Flicker	• All turbines located along the edges close to habitation to have a suitable set off of to negate the spread of any distinct shadow at the village. • Shadow flicker is anticipated by WTG No. ASP-22, ASP-23 and ASP-54. Above turbine will be proposed in such a manner that overall shadow flicker impact remains within suggested threshold standard of 30 hours of shadow flicker per year and 30 minutes of shadow flicker per day. However, optimise use of the turbine will also be kept in mind while revising the orientation of above three turbines. Probability of open space / window on other side of the residential property and vegetative shield shall also be checked, so that, overall psychological impact of the shadow flicker may get reduced.	• Fall of shadow from all turbines to be observed and vegetative shield to be opted if required.	• Head – O & M	-
• Upgrades to Local Infrastructure • Grazing land	• Collaborate with local government/ Non-government for any community development programs to share their sources and cut cost; • Grazing area to be retained with fencing limited to transformer areas	• Any community development activity will be guided and implemented in accordance with group CSR Policy.	• Head - CSR • O & M – Head	

9.2.10 Feedback Mechanism

The key indicators from various monitoring will be helpful in refining the mitigation measures suggested and also for introduction of new measures as required. The key indicators on the status of project during the various stages of the project are:

Construction

Grievance redressal shall be the key indicator to assess community concerns, concerns of women and behavioural issues of workers. The EHS supervisor will assess the basic behaviour of workers at site towards local community, women and other workers. The inputs from EHS supervisor will determine the need for extent and frequency of briefing and training on local customs, respect for women and code of conduct to be imparted to the workers. The liaison officer will continuously interact with the community and land aggregators to address the key concerns.

Incident reporting mechanism shall be a key indicator for the Health and Safety aspects of the site. The safety Officer shall either directly or through EHS supervisor verify the capability of the contractors / sub-contractors to implement the EHS requirement. The need for training and scope for improvement shall be charted internally and implemented. MVTPL shall focus on incident reduction and follow up measures.

Internal and External Audits of the site shall be carried out on periodic basis. Internal Audit can be on monthly basis while external audit shall be undertaken after the construction work is fully initiated. The Audit reports and the corrective actions submitted shall be implemented in a time bound manner by MVTPL under the guidance of the corporate EHS head.

Debris removal and re-vegetation of site: Restoration of site post construction is a key indicator for the lenders and MVTPL to assess the commitment to environment. Removal of debris and re-vegetation at each site shall be undertaken in a time bound manner for each turbine and the access roads.

Operation:

Grievance Redressal will remain a key indicator for community concerns and to understand the effectiveness of CSR programs planned/implemented. It will also provide an assessment of behaviour of security staff with the local community, especially women.

Noise Monitoring: The noise predicted from the turbines is within limit; however, the cumulative noise may change with advent of more turbines or other activities in future. Also with ageing of turbines the noise levels may increase. The Noise monitoring proposed every 12th month through an independent agency will ensure a feedback on the same.

Bat Monitoring: Presence of bat colony in the area has been observed noted, for which a monitoring plan is proposed. The documentation of information pertaining to bat will enable MVTPL to understand the extent of bat kill and respond accordingly.

Need Assessment Study: The Social Officer along with the team will undertake a need assessment study for all the project villages and the output of the assessment will be utilised to plan and Implement the CSR Program. The Assessment shall be carried out every two years. Need Assessment will be conducted during construction phase as part of ESIA study. It will be vetted in the O&M stage for further improvement, if any.

10 CONCLUSION AND RECOMMENDATION

The ESIA has assessed the overall impacts on Environmental and Social components as a result of construction and operation of proposed 200 MW Wind Power Project at Aspari (Andhra Pradesh). The impacts due to the project is minimal, site specific and has reversible impacts on the micro environment of the project site owing to the construction activities, noise generation from the project turbines and shadow flickering effect which can be readily addressed through mitigation measures. The proposed Environmental and Social Management Plan describes implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. Mitigation measures for potential impacts on physical, social and biological aspects of the environment have been specified through:

- Adequate arrangements for construction safety, stakeholder engagement and grievance redress mechanism;
- Stringent adherence to Health and Safety requirements; and
- Obtaining requisite permits for the proposed project.

Based on the ESIA study conducted as per ADB's Environment Categorization of Projects the proposed wind power project can be classified as a **Category B** for Environment as the project will have adverse environmental impacts that are less in number, generally site specific and readily addressed through mitigation measures. In addition, the project is also classified as Category C for Involuntary Resettlement and Indigenous People as no involuntary resettlement and indigenous people are anticipated to be affected by the project activities. And as per IFCs categorization of projects the proposed project can be categorized as Category B, which specifies that the project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and readily addressed through mitigation measures.

The rationale for categorization being:

- Overall the project being a wind power project is a green project and does not have significant adverse impacts associated with the construction or operation activities;
- The land required for the project is taken on "*willing seller-willing buyer"* basis and individual negotiation with the land owners and the project does not involve any physical/economic displacement;
- There are no indigenous communities being affected in the project area;
- The project does not involve diversion of any forest land. Therefore, ensuring minimal impact on ecology during the construction and operation phase of the project.

On the basis of our long term bird & bat study, proposed project does not expect to threaten the long term viability/function of any of bat and bird species found in the area. No species of the area belongs to "Critically Endangered", or "Endangered" category of IUCN Red list category. There is no record of major migratory path as per publicly available secondary data. The impact identified to the bat and avifauna population due to the project was found to be general in nature common with wind mill projects like mortality due to collision with turbine rotor or accidental body touch with high tension transmission line or in general disturbance in the site due to construction and operation of the project. Though there are chances of collision mortality and electrocution which is commonly associated with wind power project, but with the above survey and evidences we may infer that they

may not cause any substantial change in abundance and/or reduction in distribution of a bird and bat population. Bat and birds will not emerge out in high wind velocity and will prefer to remain in roost at such time. So possibility of collision with wind mill blades will be rare here at Aspari Site. Even if it occurs, it will not be fatal but may be injurious.

No migratory bat species have been recorded from the study area. However, Indian Fruit bat travels everyday a long distance in search of food and returns back to day-time roost. Since the memory and vision of Indian Flying Fox is very good, its foraging area is fairly large and some of the location sites near Aspari village where a day-time roost have been located may come under its foraging area. However, they are high fliers and can fly above turbine heights mostly in line formations during evening, night and early morning hours. When wind mills will be in operation, these bats will sense the obstructions in their route with the help of excellent night vision and memory. They are vocal and communicate with other members with vocal sounds and body postures and positioning. They will change the route and select a safer path in the foraging area.

As far as insectivorous bat species are concerned none of them are high fliers and they fly at lower to medium heights. They will sense obstructions in their routes with the help of very well developed ultra bio-sonar and eco-location systems. In addition, they possess very good vision. Therefore, in these cases also possibility of collision with wind mill blades will be rare. Even if it occurs, it will not be fatal but may be injurious.

Finally, the developmental activities with respect to wind mill project under study will not be detrimental to the survival of these species. However proper and eco-friendly care is essential with bare minimum disturbance to the habitat during construction and operational phases. It can minimize threats, if any, to the local bat and bird populations. Attempts to be made not to bring in changes in study area habitats which may attract at latter stage, birds and bats for foraging, nesting and resting purposes. However, proper vigilance needs to be ensured to monitor any changes in bird and bat population, if any in latter stage. If any hazard is observed to any of bat and bird species a detailed species oriented study to be undertaken and the mitigation measures should ensure proper restoration and rehabilitation for the area.