Blade Throw

- Mandatory safety standards in turbine design, manufacturing, and installation as well as more frequent maintenance have made the occurrence of blade throw a rare phenomenon;
- Wind turbines can also be equipped with vibration sensors that can react to any imbalance in the rotor blades and automatically shut down the turbine if necessary, to avoid any chance of blade throw.

Shadow Flickering

With the possibility of shadow flickering on identified receptor locations, it can be mitigated by the following suggestions:

- Planting trees and ensure increase in dense vegetation coverage to screen the impacted receptor locations from sun;
- Installation of blinds such as curtains at the concerned window facing the turbines;
- It is recommended that MVIPL should ensure formulation of a complaint resolution procedure by Suzlon for the local community so that any issues or concerns associated with shadow flicker are reported to the site staff. Also, appropriate and timely action taken in case of receipt of such complaints need to be documented and maintained for records;
- The micro-siting guidelines recommended by National Institute of Wind Energy (NIWE), under the Ministry of New and Renewable Energy (MNRE), suggests wind farm developers to maintain a minimum distance of WTGs from sensitive receptors such as residential settlement/ house, highways, schools, religious structure[9], to ensure minimization of potential noise, shadow flicker and blade throw risks. Based on the formula, 143.5 m is the minimum distance between the project turbines (S-97, Suzlon make, HH of 90 m and RD of 97 m) and receptors. Therefore, Mytrah shall ensure the clearances as per the formula to adopt best Industry practices.

➢ *Impact Value*

Aspect	Scenario	Spread	Duration	Intensity	Overall
Land Use	Without Mitigation	Local	Long	Moderate	**Minor**
	With Mitigation	Local	short	Low	**Insignificant**
Visual Impacts	Without Mitigation	Local	Short	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**
Blade Throw	Without Mitigation	Local	Long	Low	**Insignificant**
	With Mitigation	Local	Long	Low	**Insignificant**
Shadow Flicker	Without Mitigation	Local	Short	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**
Communication Facilities	Without Mitigation	Local	short	Low	**Insignificant**
	Without Mitigation	Local	short	Low	**Insignificant**

6.5.4 Decommissioning Phase

At the end of a turbine's operating life, it can be refurbished for further use. If this is impractical, the turbine is disassembled and removed. The site could be re-powered with new wind turbine

[9] Minimum distance = Height of the turbine + ½ x rotor diameter + 5 m

technology; if not, it would be decommissioned and the land reclaimed. Because of their economic value, turbines are not abandoned. A well-maintained turbine often operates beyond 20 years, but when it reaches the end of its operating life, valuable parts and materials can be recovered.

➢ *Impacts*

- Issue of loss of job when the workers will be asked to leave after construction because wind farm project will not require more than 10 - 12 individual for operations phase;
- Improper disposal of construction waste and debris from deconstruction of campsites, 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 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;
- Reduction of worker will be done phase wise and corresponding to completion of each activity;
- The reduction in workers shall be done based only on the requirement of his/her skill set and not guided by any other factor;
- A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability;
- All waste generated from demobilisation shall be collected and disposed-off at the nearest municipal disposal site. 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; and
- Workers shall be briefed about the use and requirements of PPE.

➢ *Impact Value*

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

7. NOISE ENVIRONMENT

7.1 Introduction

This chapter presents a noise assessment of the project, based on the background noise monitoring at residential locations around the study area. Background noise measurements were undertaken at six (6) locations. About Eight (8) potential noise receptors were identified within 2000 m of the proposed project wind turbine locations. WindPRO noise model has been used to predict the noise levels from the wind turbines to the potential noise receptors.

7.2 Identified Noise Receptors

During the field survey, the study area was assessed to identify all noise receptors within 2000 m[10] of the proposed project turbine locations. In total eight (8) potential noise receptors were identified, consisting of built structures such as human settlements, temple and school. The geographical co-ordinates and their distance from nearest turbines of the receptors identified are presented in Table 7-1.

Table 7-1: Description of the identified Noise receptors

Receptor ID	Baseline Noise Monitoring Location ID	Geographical Coordinates	Description	WTGs within 2000 m from the Noise Receptor
PN1	NQ1	15° 2'31.86"N, 77°21'55.18"E	A Household in the Fields	PPD 32, PPD 33, PPD 43, PPD 44, PPD 45, PPD 46, PPD 47, PPD 55, PPD 56, PPD 57 and PPD 58
PN2	NQ2	15° 2'19.30"N, 77°20'27.20"E	A Household in the Fields	PPD 11, PPD 12, PPD 13, PPD 14, PPD 15, PPD 16, PPD 28, PPD 29, PPD 30, PPD 31, PPD 32, PPD 33 and PPD 34
PN3	NQ1	15° 1'36.77"N, 77°21'7.20"E	A Small Temple	PPD 11, PPD 12, PPD 13, PPD 31, PPD 32, PPD 33, PPD 34, PPD 35,
PN4	NQ1	15° 1'22.67"N, 77°22'51.88"E	Sai Temple	PPD 42, PPD 43, PPD 44, PPD 62
PN5	NQ3	15° 0'23.10"N, 77°17'47.00"E	A School	--
PN6	NQ4	15° 5'26.38"N, 77°22'24.53"E	Village	PPD 81, PPD 82
PN7	NQ5	15° 3'37.17"N, 77°24'13.39"E	Village	PPD 75, PPD 76, PPD 77, PPD 78, PPD 84, PPD 85
PN8	NQ6	14° 58'10.08"N, 77°23'34.11"E	Village	--

[10] IFC guidelines on Environmental, Health, and Safety Guidelines - Wind Energy dated 7th August 2015

7.3 Baseline Noise Levels

In order to evaluate the baseline noise levels in the study area, primary noise monitoring was carried out continuously for 24 hours at all the identified locations by M/s. Eco Services India Pvt Ltd, which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2005. The description of the monitoring locations is presented and shown in the Map below:

Table 7-2: Description of the Noise Monitoring Locations

Monitoring Location ID	Geographical Coordinates	Description
NQ1	15° 2'31.86"N, 77°21'55.18"E	Vajrakarur Village
NQ2	15° 2'19.30"N, 77°20'27.20"E	Pottipadu Village
NQ3	15° 0'23.10"N, 77°17'47.00"E	Chinna Hothur School
NQ4	15° 5'26.38"N, 77°22'24.53"E	Gulapalem Village
NQ5	15° 3'37.17"N, 77°24'13.39"E	Kamalpadu Village
NQ6	14° 58'10.08"N, 77°23'34.11"E	Tatrakallu Village

7.3.1 Methodology

Ambient Noise level was monitored continuously for 24 hours using Sound Level Meter of Baseline Technologies make of range 30-134 dB with least count of 0.1 dB and accuracy of ±0.1 dB. Sound pressure levels were recorded at every 10 minutes to calculate the L_{eq} (hourly) values. The relevant statistic measured was the LA90 (10min) (The A-weighted sound pressure level exceeded for 90 % of the 10 minute interval). The noise levels obtained were analysed to arrive at the equivalent continuous noise level (L_{eq}) for day and night time. The day and night time hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively.

7.3.2 Results and Observations

The results of the noise monitoring are presented in Table below:

Table 7-3: Results of Noise level monitoring

Monitoring Location ID	Leq Day (dB A)	Leq Night (dB A)
NQ1	48.1	35.0
NQ2	49.4	35.6
NQ3	53.2	40.0
NQ4	48.4	36.9
NQ5	49.0	38.2
NQ6	49.5	38.5
CPCB Norms	**55.00**	**45.00**

It was observed that the noise levels at the monitoring locations ranged from 48.1 dB (A) to 53.2 dB (A) during day time and 35.0 dB (A) to 40.0 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. Figure below illustrates the noise levels monitored at the sampling locations.

Figure 7-1: Noise Monitoring Sampling Locations

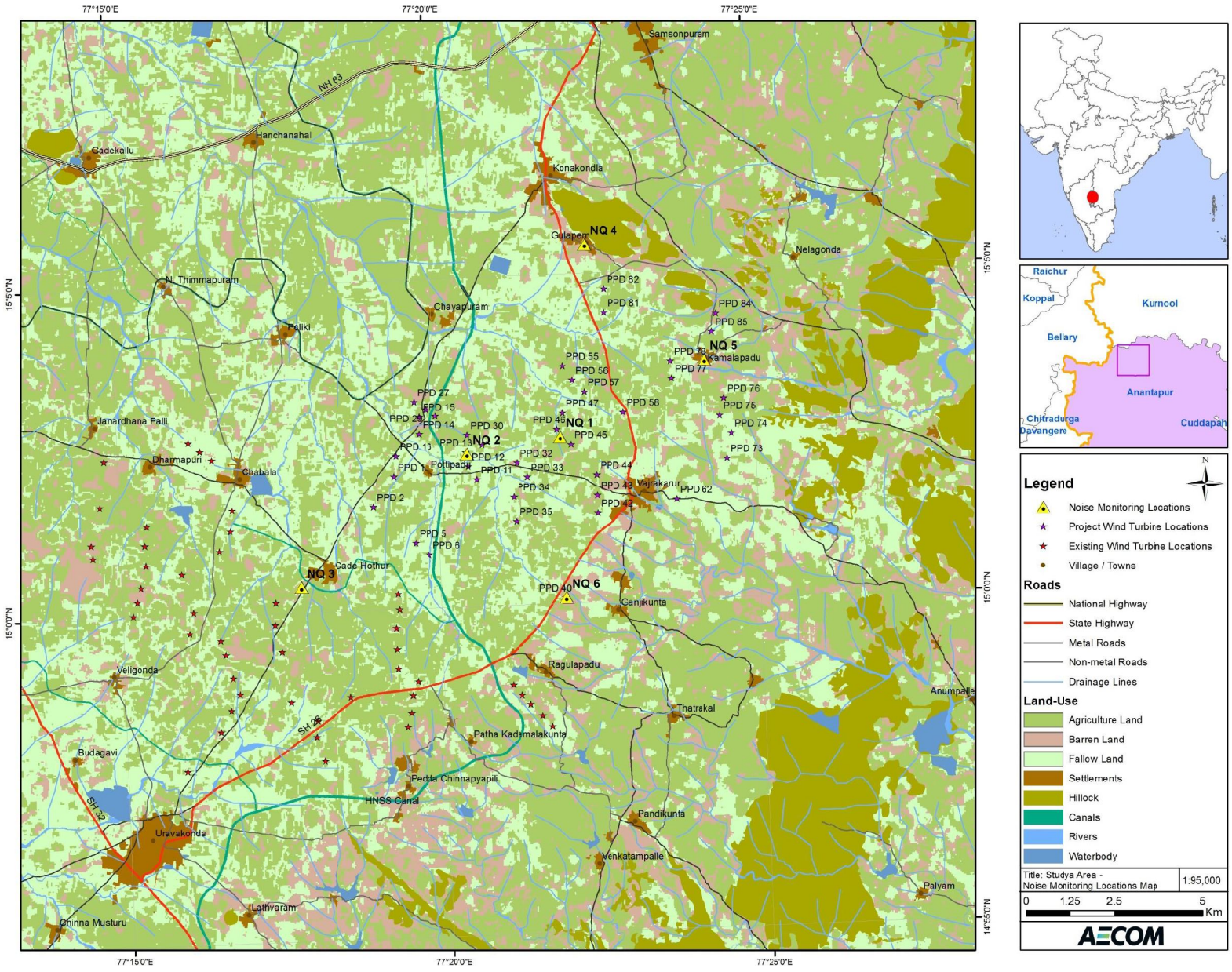
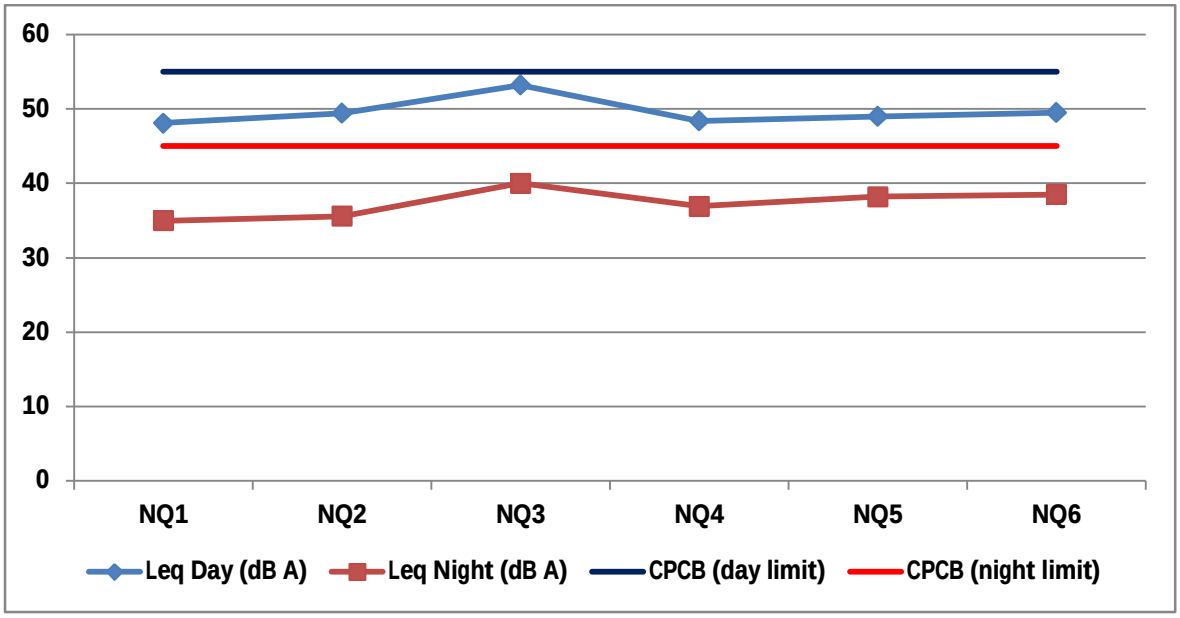


Figure 7-2: Monitored Noise Levels at sampling locations



7.4 Impact Assessment

7.4.1 Construction Phase

➢ *Impacts*

The construction activities which will lead to noise generation include the following:

- Site preparation and earthworks to gain access using bulldozers, trucks etc.;
- Foundation and construction using mobile equipment, cranes and concrete mixing;
- Heavy vehicle utilized to deliver construction materials and the turbine parts.
- Use of diesel generator sets may also lead to incremental noise however, that will be limited to a very short duration of 10 -15 days.

The exact methodology and the timing of construction cannot be predicted at this time; however the construction activities will be temporary in nature and will not last for more than 15-20 days for a particular turbine site. Also, the selected sites are located at a distance of approximately 1-2 km from villages and will not lead to disturbance.

➢ *Mitigation Measures*

- Construction activities shall be planned in consultation with local communities (if required);
- Adequate precautions and information will be provided prior to execution of blasting activity (if any);
- Construction equipment will be maintained in good working order and properly muffled;
- Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures;
- Provision of rubber paddings/noise isolators at equipment/machinery used for construction;

- Construction vehicles shall be well maintained and idling time will be minimized for vehicles when not in use;
- Site workers working near high noise equipment use personal protective equipment (PPEs) to minimize their exposure to high noise levels.

➢ *Impact Value*

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

7.4.2 Operation Phase

➢ *Impacts*

Noise from WTGs

The sources of noise generation from operating wind turbines[11] 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

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 7-3*** below illustrates the total sound power from components of a wind turbine.

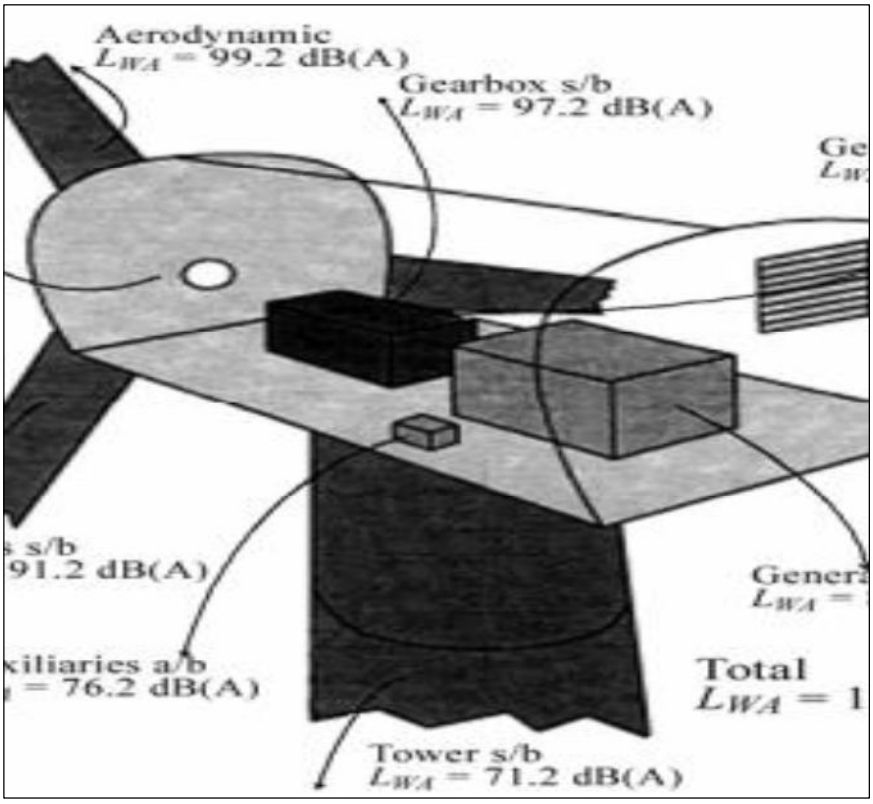
Aerodynamic Sounds

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.

[11] Source: Center for Energy Efficiency and Renewable Energy. (2002). RERL (Renewable Energy Research Laboratory). W*hite paper on Wind Turbine Noise Issues*. Retrieved from http://www.windcows.com/files/WindTurbineNoiseIssues.pdf

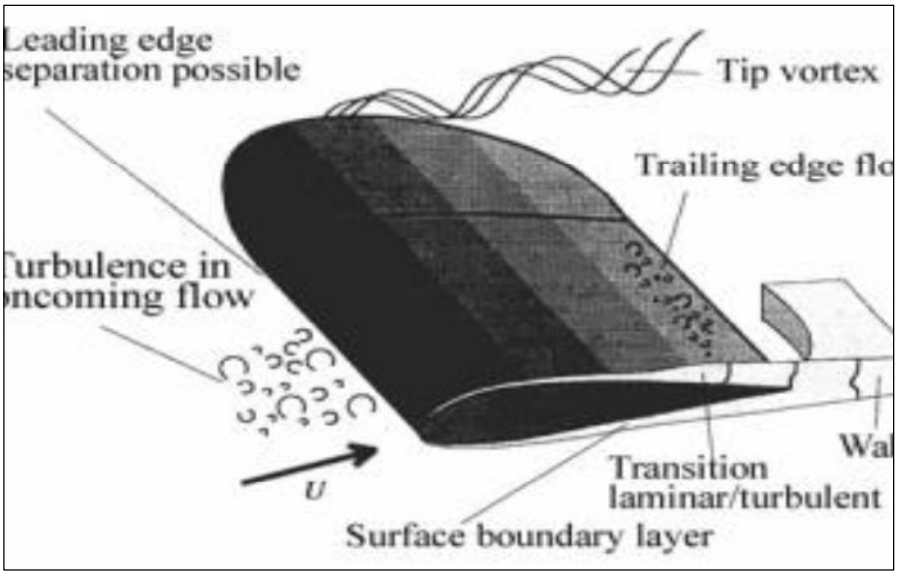
Figure 7-4 below shows the schematic representation of flow around a rotor blade.

Figure 7-3: Components and Total Sound Power Level of a Wind Turbine



Source: Center for Energy Efficiency and Renewable Energy. (2002).

Figure 7-4: Schematic of Flow around a Rotor Blade



Source: Center for Energy Efficiency and Renewable Energy. (2002).

The proposed project comprises of 50 WTGs of Suzlon make, S-97 model of 2.1 MW unit rated capacity with rotor diameter of 97 m and hub height of 90 m and Tubular tower. Noise impact due

to operation of the proposed project, was analysed using numerical calculations from EMD's WindPRO Software version 2.7 which is specifically designed for wind turbine noise. WindPRO contains pre-configured noise calculation models in order to calculate predicted noise levels at each of the selected noise receptor plus a ready built catalogue of wind turbines and noise emission data.

The ISO 9613-2 General noise calculation model was used which considers frequency dependant attenuation due to geometric divergence, atmospheric absorption, and ground effect. The model is valid for downwind propagation under a well-developed moderate ground based temperature inversion, which are conditions favourable to noise propagation from source to receiver.

The numerical results were then used to produce a noise map that visually indicates the extent of the incremental noise emissions from the site. The noise emissions were modelled for estimated wind speed from NIWE/MNRE notified wind monitoring station located near Vajrakarur site by i.e. 5.3 m/s at a hub height of 90 m. The direction of the wind is not taken into consideration as the wind could blow from any direction at the speeds that were modelled.

The results of the modelling exercise have been presented in below. Detailed Noise Modelling report has been attached as **Annexure II.**

Table 7-4: Resultant Noise Levels at Receptor Locations

Receptor	Description	Baseline dB(A)		Incremental dB(A)	Resultant dB(A)		Exceeding the Limits dB(A)	
		Day	Night		Day	Night	Day	Night
PN1	A household in the field - Vajrakarur Village	48.1	35.0	49.9	52.1	50.0	4.0	15.0
PN2	A hut in the field – Pottipadu Village	49.4	35.6	56.4	57.2	56.4	7.8	20.8
PN3	A small temple in the field - Vajrakarur Village	48.1	35.0	53.3	54.4	53.4	6.3	18.4
PN4	Sai Temple in Vajrakarur Village	48.1	35.0	41.3	48.9	42.2	0.8	7.2
PN5	Chinna Hothur Village School	53.2	40.0	27.9	53.2	40.3	0.0	0.3
PN6	Gulapalem School	48.4	36.9	36.0	48.6	39.5	0.2	2.6
PN7	Kamalpadu Village School	49.0	38.2	42.2	49.8	43.7	0.8	5.5
PN8	Tatrakarur Village School	49.5	38.5	23.6	49.5	38.6	0.0	0.1
CPCB Prescribed Limits		**55**	**45**	**--**	**55**	**45**	**--**	**--**

Note: *Figures in* ***bold*** *indicate resultant noise levels exceed the prescribed limits*

Inference

It is to be observed that the baseline noise levels in the area are within the prescribed CPCB standards both during the day and night at all the receptor locations.

The results from the modelling exercise indicate that the incremental noise due to operation of WTGs at receptor locations is in the range of 49.9 - 56.4 dB (A). The additional exposure to noise due to the operation of the wind turbines will be in the range of 4.0 – 7.8 dB (A) and 15.0 – 20.8 dB (A) during the day and night time respectively.

The estimated resultant noise levels are within the CPCB day time standard of 55 dB (A) at all the locations. Receptor location No. PN2 - a household in the field exceeds the CPCB's prescribed standards for both day and night time.

The estimated resultant noise levels are within the CPCB night time standard of 45 dB (A) at Five (5) out of Eight (8) identified receptor locations. Receptor location No. PN1 - a household in the fields and PN3 – a small temple, exceeds the CPCB's prescribed standards for night time.

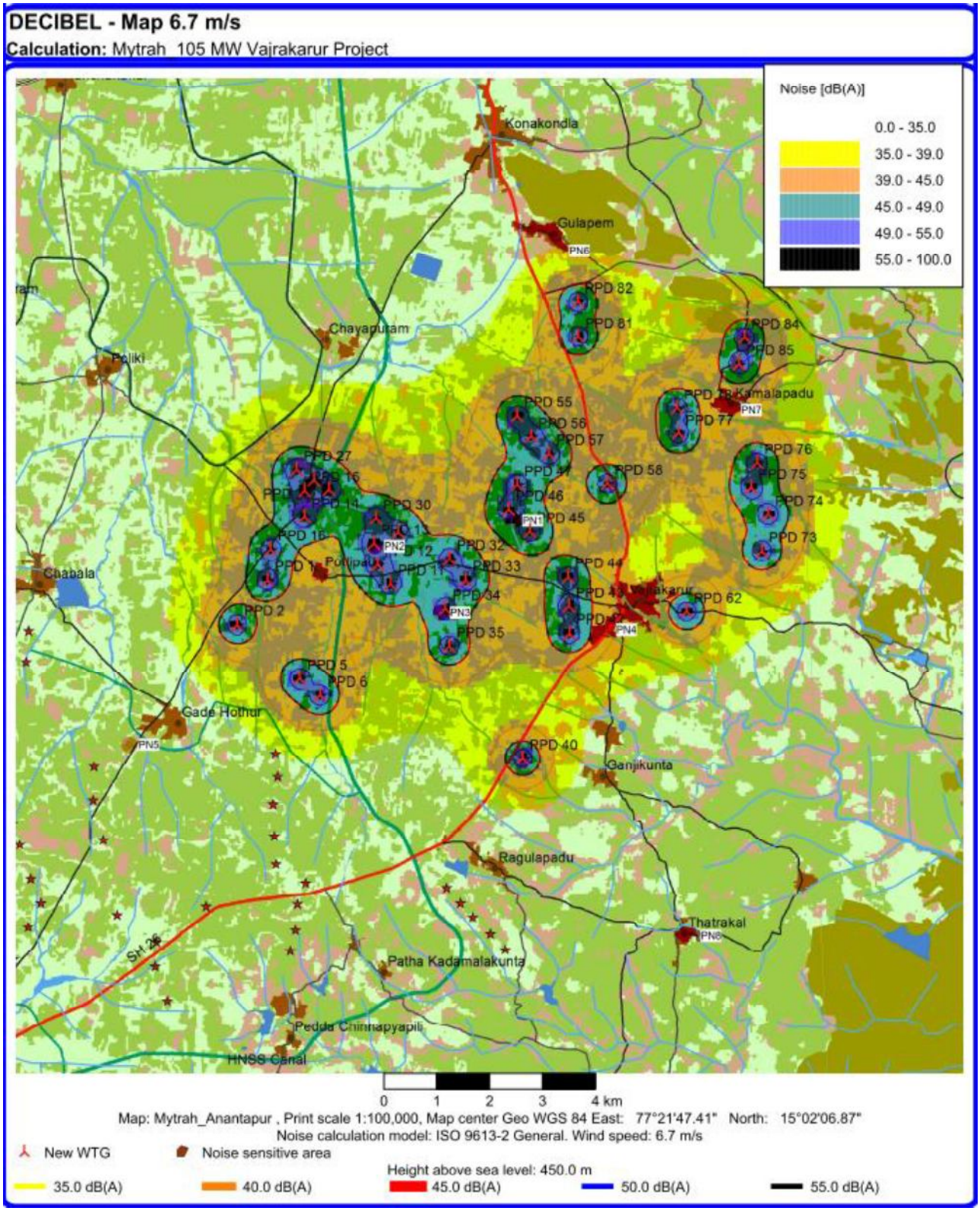
List of all the project turbines located within 2000 m from the identified noise receptors is detailed in the Table below:

Table 7-5: List of WTGs within 2000 m of receptor locations

S.No.	Receptor Location	WTG No.	Distance (m)
1.	PN1	PPD 32	1404
		PPD 33	1443
		PPD 43	1948
		PPD 44	1491
		PPD 45	382
		PPD 46	230
		PPD 47	679
		PPD 55	1998
		PPD 56	1636
		PPD 57	1440
		PPD 58	1917
2.	PN2	PPD 11	771
		PPD 12	354
		PPD 13	55
		PPD 14	1446
		PPD 15	1698
		PPD 16	1974
		PPD 28	1386
		PPD 29	1703
		PPD 30	534
		PPD 31	512
		PPD 32	1431
		PPD 33	1833
		PPD 34	1788
3.	PN3	PPD 11	1099
		PPD 12	1503
		PPD 13	1826
		PPD 31	1725
		PPD 32	1037
		PPD 33	780
		PPD 34	113
		PPD 35	644
4.	PN4	PPD 42	711
		PPD 43	838
		PPD 44	1240

S.No.	Receptor Location	WTG No.	Distance (m)
		PPD 62	1545
5.	PN5	--	--
6.	PN6	PPD 81	1651
		PPD 82	995
7.	PN7	PPD 75	1471
		PPD 76	1053
		PPD 77	847
		PPD 78	727
		PPD 84	1116
		PPD 85	601
8.	PN8	--	--

Figure 7-5: Noise Map



Noise from Transmission Lines

Once operational, 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. However, noise due to Corona Discharge is negligible for transmission lines up to 220 kV grade. It is highly unlikely that the corona discharge noise will exceed the normal background noise levels in the area and furthermore, such noises are restricted to certain weather conditions.

- *Mitigation Measures*

Based on the location and model output, the following mitigation measures are suggested to avoid any concerns of increased noise levels due to project turbines

- Increase in dense vegetation coverage around the receptor locations which shall act as noise barrier;
- Wind turbines shall be designed in accordance with the international acoustic design standards and maintained throughout the operational life so as to limit noise generation;
- The wind turbines shall be maintained in good running conditions throughout the operational life of the project through routine maintenance;
- Operation and Maintenance staff to be provided with personal protective equipment (PPEs) such as ear plugs and ear muffs when working close to turbine in operation;
- It is suggested that ground vegetation such as shrubs and bushes are cleared to the minimum extent possible during site clearance activities;
- Consult with the locals periodically to assess noise generation and set up a procedure to locate source of noise and steps taken to minimize them; and
- Implement a complaint resolution procedure to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved;
- Undertake ambient noise level monitoring from NABL/MoEFCC accredited laboratories on an annual basis in order to understand the increase in noise levels due to the project operation;
- The micro-siting guidelines recommended by National Institute of Wind Energy (NIWE), under the Ministry of New and Renewable Energy (MNRE), suggests wind farm developers to maintain a minimum distance of WTGs from sensitive receptors such as residential settlement/ house, highways, schools, religious structure[12], to ensure minimization of potential noise, shadow flicker and blade throw risks. Based on the formula, 143.5 m is the minimum distance between the project turbines (S-97, Suzlon make, HH of 90 m and RD of 97 m) and receptors. Therefore, Mytrah shall ensure the clearances as per the formula to adopt best Industry practices.

[12] Minimum distance = Height of the turbine + ½ x rotor diameter + 5 m

➢ *Impact Value*

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

8. ECOLOGICAL ENVIRONMENT

8.1 Introduction

This section provides a summary of the terrestrial ecology assessment undertaken for the project. It outlines the survey methodology used and describes the project area's existing ecological baseline conditions. This section also predicts the potential impacts of the proposed project on the ecology of the project area and suggests mitigation measures to ameliorate the predicted impacts.

8.2 Study Area

The study-area represents a large tract of land located on the Rayalaseema Plateau of western Andhra Pradesh. The overall terrain of the area is flat to gently undulating, broken only by a few small ridges, knolls and rocky outcrops. Most of the wind-turbine locations are distributed on the vast flat plains, while a few are located on the ridges and knolls. Small, highly seasonal streams form in the shallow catchments of the area, draining into either the Hagari River to its west or the Penner River to its east. The soils of the area are black or red, shallow, and mostly gravelly.

Most of the cultivable plain areas are covered by farmlands, many of them fallow, dotted with occasional small patches of thorn scrub. There are a few dispersed human habitations, mostly small villages, in the form of closely clustered homesteads. The Bellary – Guntakal – Tadpatri highway runs west-east to the north of the study-area, while the Bellary – Anantapur highway runs northwest-southeast to its southwest. In addition to these major roads, a few minor metalled roads run through the survey-area, besides a number of dirt roads and foot-trails. The aerial space around the study-area is interrupted mainly by power-lines and many existing wind-turbines.

Most of the WTGs that are part of the proposed project are distributed across the agricultural lands, with only a few located on the small knolls or hillocks. The area encompassed within an imaginary line joining the outermost wind-turbine locations, along with an area extending outward up to a distance of approximately 500 m from this line, was delineated as the "Study Area", and is hereinafter referred to as such.

8.3 Study Period

The terrestrial ecological survey was carried out from 24th to 27th August, 2015. The area was under the influence of southwest monsoon at the time. The weather was cloudy and humid, with few brief intervals of sunshine at the start of survey. Some intermittent rains were experienced during the second day and, from the third day onwards, the weather was pleasant through the rest of the study-period. The soil was well-drenched due to recent rains.

8.4 Methodology

A phased approach has been followed to carry out the present terrestrial ecological assessment. Successive phases of the assessment include (i) Reconnaissance survey (ii) Onsite data collection for determining ecological baseline setup (iii) Secondary data collection through desktop review of

available literature, and (iv) Identification, prediction and evaluation of impacts and possible mitigation.

8.4.1 Reconnaissance Survey

To get an overview of the overall ecological setting of the project area, a reconnaissance survey of the proposed 50 WTG locations and associated facilities, such as the proposed pooling substation, was carried out. Accessible turbine locations were covered using a vehicle, while inaccessible areas were covered on foot. The survey was focussed on evaluating existing land use and vegetation of the site and its surroundings. Based on this survey, nine sites were identified for quadrat studies within the project area, such that they represent the different habitats and associated land-use types observed in the .

8.4.2 Secondary Data Collection

An extensive desktop review of available published literature (books, websites, scientific papers, articles etc.) was conducted. The Forest Working Plans of the Forest Divisions falling in the project area were also referred to for secondary information. Additional information was sourced from the project proponent, governmental institutions and local residents of the survey-area. The secondary data was appropriately supplemented by a field survey for primary data collection.

8.4.3 Onsite Data Collection

Flora

Primary data on the flora of the study area was generated through quadrat-based quantitative surveys at nine (9) locations. At each location, a quadrat of approximately 20 m x 20 m was marked for recording the tree species as well as the number of individuals of each species, falling within the quadrat.

Similarly, a quadrat of approximately 5 m x 5 m for recording data on shrubs and quadrats of 1 m x 1 m for recording data on herbs were marked within the bigger quadrat.

The data recorded through the quadrat-studies was analysed to estimate the percentage frequency, abundance and density of each floristic species. Species richness was also calculated, separately for the woody and non-woody plants. The following formulae were used for calculating the percentage frequency, abundance and density, as applicable, of the species identified in the nine quadrats studied:

$$\%\ \text{Frequency of species A} = \frac{\text{Number of quadrats of occurrence of species A}}{\text{Total number of quadrats studied}} \text{x } 100$$

$$\text{Abundance of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Number of quadrats of occurrence of species A}}$$

$$\text{Density of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Total area studied}}$$

Due to time and resource constraints, and given the preliminary nature of this survey, the emphasis of the studies was kept limited to the higher flora.

Fauna

Primary data on the fauna of the study area was generated through both, direct evidence, in the form of visual sightings, and indirect evidence, such as calls, nests, burrows, droppings, scats, moults, tracks, etc. These were observed generally, in course of a brief walk-over of the site.

Following the walk-over, the site was scanned with standard bird-watching binoculars for approximately fifteen-minutes to record bird-species in particular.

The survey was conducted during most of the diurnal faunal activity-period, from mid-morning till early evening. Due to time and resource constraints, and given the preliminary nature of this survey, the emphasis of the studies was kept limited to the higher and diurnal fauna.

In view of the known vulnerability of certain faunal groups, mainly avifauna and bats, to wind-farm impacts, a special focus was maintained on these during the survey.

8.5 Ecological Diversity of the study area

8.5.1 Floristic Diversity of the study area

Forest Types

According to the Champion and Seth Classification of Indian Forests, the natural vegetation of the survey area represents the following forest-types:

- **Type 6A/C1 (Sub-group 6A - Southern Tropical Thorn Forest, Sub-division C1 – Southern Thorn Forest)**

These forests are seen in peninsular India, throughout the dry tract to the lee of the Western Ghats. They are met with on shallow dry soil, or deep but sandy soil. The ground is usually flat or in the form of low undulating hills and plateaux.

It is an open and low forest dominated by thorny species. The trees tend to be short with low-branching crowns that rarely meet to form a canopy. There is an ill-defined lower storey of large and small shrubs which tend to be spiny and show various xerophytic characters. A thin growth of grass appears during the moist season, but the ground remains largely bare through the rest of the year. Climbers are few, with most of the ones present also showing xerophytic adaptations.

Species associated with this type include:

Trees such as *Acacia catechu, Acacia leucophloea, Acacia nilotica, Aegle marmelos, Ailanthus excelsa, Albizzia spp., Azadirachta indica, Balanites aegyptica, Chloroxylon swietenia, Dichrostachys cinerea, Dolichandrone falcata, Ficus spp., Flacourtia indica, Grewia spp., Ixora arborea, Randia spp., Santalum album, Strychnos potatorum* and *Zizyphus spp*.;

Shrubs such as *Capparis decidua, Carissa spp., Cassia auriculata, Dodonaea viscosa, Euphorbialigularia, Lantana camara* and *Opuntia elatior*;

Grasses such as *Aristida* spp., and *Heteropogon contortus*; and;

Climbers such as *Ziziphus oenoplia*.

(Ecologically, such thorny woodlands and grasslands are considered to be the effect of excessive cutting and browsing and thus, not a true climatic formation. Protection of such an area is likely to lead to the regeneration of elements of a tropical dry deciduous forest.)

- **Type 6/DS2 (Group 6 – Southern Tropical Thorn Forest, Degradation Stage DS2 – Southern Euphorbia Scrub)**

This type of forest may represent either the ultimate stage in degradation of the previous forest type or extremely poor soil conditions. Though the *Acacias* and their associates continue to occur even in this stage, the trees are very stunted and take on a bush-like form. It is a very open form of forest in which the presence of fleshy Euphorbias is characteristic. Most of the soil is bare, with only a thin cover of wiry grasses.

Species associated with this type include:

Large shrubs such as *Calotropis gigantea, Capparis decidua, Euphorbia antiquorum* and *Euphorbia tirucalli*;
Small shrubs such as *Barleria buxifolia, Cassia auriculata, Dodonaea viscosa* and *Opuntia elatior*; and;
Grasses such as *Aristida spp*. and *Cymbopogon spp*.
Source: H. G. Champion & S. K. Seth, A Revised Survey of the Forest Types of India

Quadrat Data

Table 8-1 gives the details of the nine locations at which quadrat studies were carried out. :

Table 8-1: Details of the Quadrat Locations

Quadrat No.	Location	Elevation (m)	Nearest WTG location
1	15°00'05.00" N, 77°21'55.00"E	470	PPD – 40
2	15°03'25.50"N, 77°22'10.60"E	465	PPD – 56
3	15°03'36.90"N, 77°21'58.60"E	462	PPD – 55
4	15°01'54.44" N, 77°21'23.66"E	457	PPD – 33
5	15°02'20.81" N, 77°20'28.46"E	455	PPD – 13
6	15°01'45.70" N, 77°23'41.48"E	454	PPD – 63
7	15°02'08.09" N, 77°21'10.28"E	460	PPD – 32
8	15°02'52.31" N, 77°24'33.66"E	471	PPD – 76
9	15°02'30.00" N, 77°24'38.00"E	461	PPD – 74

Sources: Primary Survey

Figure 8-1: Map showing Ecological Survey Quadrat Locations

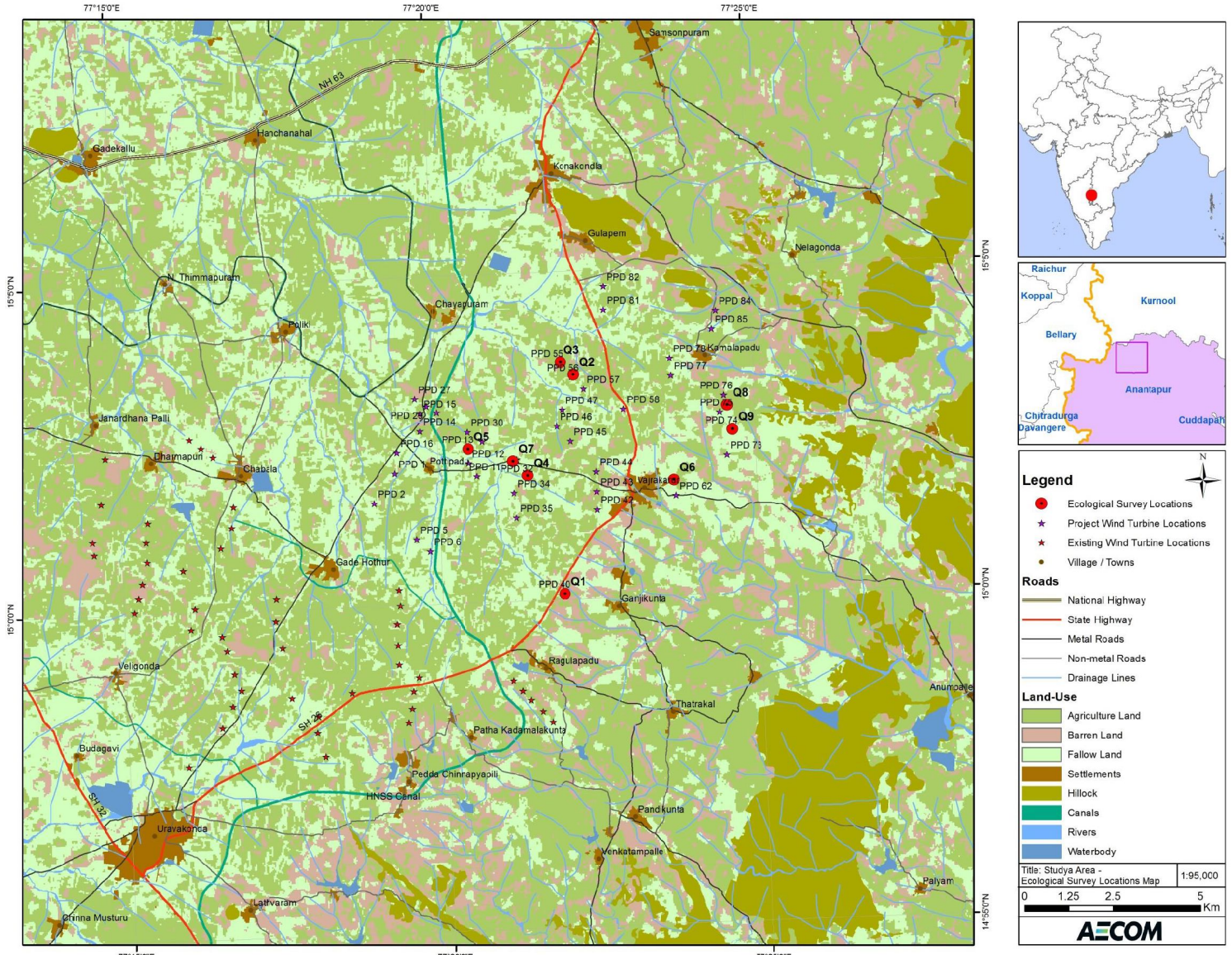


Table 8-2 presents the floristic data recorded during the quadrat-studies carried out at the nine aforementioned locations. The data on woody and non-woody flora is given in separate sections, along with percentage frequency, abundance and density of each species.

Table 8-2: Floristic Species recorded in the Study Area

Sr. No.	Species	Habit	% frequency	Abundance	Density/ Ha
		Woody Flora			
1	*Abutilon indicum*	Shrub	44.44	2.5	444.44
2	*Acacia nilotica*	Tree	11.11	2	5.56
3	*Azadirachta indica*	Tree	11.11	1	2.78
4	*Borassus flabellifer*	Tree	22.22	3.5	19.44
5	*Cadaba fruticosa*	Climber	11.11	1	44.44
6	*Calotropis procera*	Shrub	11.11	1	44.44
7	*Capparis sepiaria*	Tree	11.11	1	2.78
8	*Carissa carandas*	Shrub	11.11	1	44.44
9	*Catunaregam spinosa*	Shrub	11.11	1	44.44
10	*Croton bonplandianus*	Herb	44.44	2.25	10000.00
11	*Cryptostegia grandiflora*	Climber	11.11	1	44.44
12	*Dichrostachys cinerea*	Tree	11.11	2	5.56
13	*Euphorbia antiquorum*	Shrub	11.11	2	88.89
14	*Grewia tenax*	Shrub	11.11	2	88.89
15	*Jatropha gossypifolia*	Shrub	11.11	1	44.44
16	*Phoenix sylvestris*	Tree	11.11	2	5.56
17	*Prosopis cineraria*	Tree	11.11	2	5.56
18	*Prosopis juliflora*	Tree	33.33	3.3	27.78
19	*Securinega leucopyrus*	Shrub	11.11	2	88.89
20	*Senna auriculata*	Shrub	11.11	3	133.33
21	*Tamarindus indica*	Tree	11.11	1	2.78
22	*Tephrosia purpurea*	Herb	11.11	2	2222.22
23	*Ziziphus mauritiana*	Tree	11.11	1	2.78
		Non-Woody Flora			
1	*Agave sp.*	Shrub	11.11	6	266.67
2	*Aristolochia bracteolata*	Herb	11.11	2	2222.22
3	*Asparagus racemosus*	Climber	11.11	1	44.44
4	*Argemone mexicana*	Herb	11.11	1	1111.11
5	*Boerhavia diffusa*	Herb	11.11	1	1111.11
6	*Cleome viscosa*	Herb	11.11	2	2222.22
7	*Commelina sp.*	Herb	11.11	1	1111.11
8	*Cucumis myriocarpus*	Climber	11.11	1	44.44
9	*Cyanotis sp.*	Herb	11.11	1	1111.11
10	*Datura metel*	Herb	11.11	1	1111.11
11	*Euphorbia hirta*	Herb	11.11	1	1111.11
12	*Euphorbia ligularia*	Shrub	11.11	2	88.89
13	*Haplanthodes sp.*	Herb	11.11	1	1111.11
14	*Heliotropium europaeum*	Herb	11.11	1	1111.11
15	*Indigofera cordifolia*	Herb	11.11	1	1111.11
16	*Lagascea mollis*	Herb	11.11	1	1111.11
17	*Lepidagathis cristata*	Herb	11.11	1	1111.11
18	*Leucas aspera*	Herb	11.11	6	6666.67
19	*Ocimum sp.*	Shrub	11.11	2	88.89
20	*Parthenium hysterophorus*	Herb	33.33	4	13333.33
21	*Rivea hypocrateriformis*	Climber	11.11	1	44.44
22	*Solanaceae sp.*	Shrub	11.11	1	44.44
23	*Tribulus terrestris*	Herb	22.22	3.5	7777.78

Sr. No.	Species	Habit	% frequency	Abundance	Density/ Ha
24	*Trichodesma indicum*	Herb	11.11	1	1111.11
25	*Tridax procumbens*	Herb	11.11	4	4444.44
26	*Typha angustifolia*	Shrub	11.11	5	222.22
27	*Withania somnifera*	Shrub	22.22	1	88.89
28	*Xanthium indicum*	Herb	11.11	1	1111.11
29	Unidentified Species	Herb	11.11	1	1111.11

Sources: Primary Survey

Photo 8-1: Some Floristic Species of the Study Area

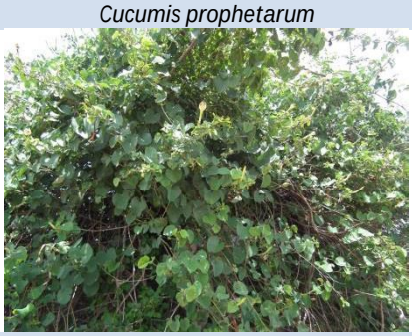
Abutilon indicum

Catunaregam spinosa

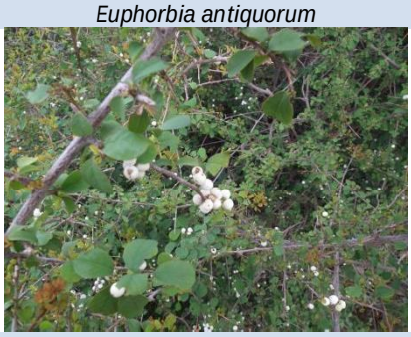
Cucumis prophetarum

Euphorbia antiquorum

Euphorbia ligularia



Rivea hypocrateriformis



Securinega leucopyrus

Croton bonplandianus

Withania somnifera

Ziziphus mauritiana

Boerhavia diffusa

Argemone mexicana

		
Cleome viscosa	*Haplanthodes sp.*	*Solanaceae sp.*
		
Datura innoxia	*Datura metel*	*Commelina sp.*
		
Leucas aspera	*Tribulus terrestris*	*Cryptostegia grandiflora*
		
Carissa carandas	*Tridax procumbens*	*Agave sp.*
		
Aristolochia bracteolata	*Heliotropium europaeum*	*Xanthium indicum*

		
Lagascea mollis	*Grewia tenax*	*Parthenium hysterophorus*
		
Trichodesma indicum	*Cyanotis sp.*	*Tephrosia purpurea*
		
Senna auriculata	*Lepidagathis cristata*	*Cadaba fruticosa*
		
Euphorbia sp.	*Typha angustifolia*	*Indigofera cordifolia*

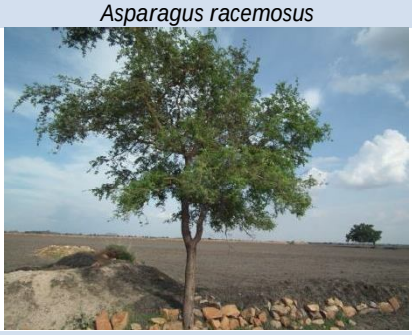

Calotropis procera

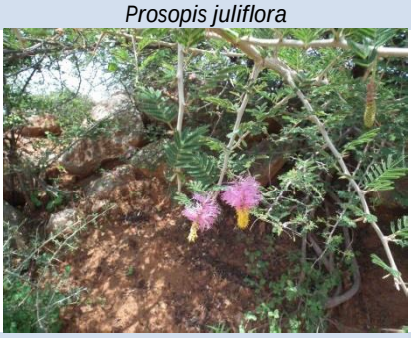

Capparis sepiaria


Asparagus racemosus


Prosopis juliflora


Borassus flabellifer


Prosopis cineraria


Dichrostachys cinerea


Tamarindus indica


Jatropha gossypifolia

Species Richness

The Species Richness of the woody flora of the project site is **23** and that of the non-woody flora is **29**.

8.5.2 Faunal diversity of the area

This section presents the faunal species reported from the study area and/or recorded during the field survey, along with their conservation status of each species as per the IUCN Red Data List and the Schedule under which the species is protected by the Wildlife (Protection) Act (1972) of India.

Avifauna

Table 8-3 lists the resident avifaunal species associated with the study area. (The migratory avifaunal species associated with the study area are listed later in this report, in Table 8-7.)

Table 8-3: Resident Avifauna associated with the Study Area

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	*Francolinus pictus*	Painted Francolin	LC	IV

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
2	*Francolinus pondicerianus*	Grey Francolin	LC	IV
3	*Coturnix chinensis*	King Quail	LC	IV
4	*Perdicula asiatica*	Jungle Bush Quail	LC	IV
5	*Perdicula argoondah*	Rock Bush Quail	LC	IV
6	*Galloperdix spadicea*	Red Spurfowl	LC	IV
7	*Galloperdix lunulata*	Painted Spurfowl	LC	IV
8	*Gallus sonneratii*	Grey Junglefowl	LC	II
9	*Pavo cristatus*	Indian Peafowl	LC	**I**
10	*Dendrocygna javanica*	Lesser Whistling- duck	LC	IV
11	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC	IV
12	*Anas poecilorhyncha*	Indian Spot-Billed Duck	LC	IV
13	*Tachybaptus ruficollis*	Little Grebe	LC	IV
14	*Mycteria leucocephala*	Painted Stork	NT	IV
15	*Ciconia episcopus*	Woolly-necked Stork	VU	IV
16	*Anastomus oscitans*	Asian Openbill	LC	IV
17	*Threskiornis melanocephalus*	Black-headed Ibis	NT	IV
18	*Pseudibis papillosa*	Red-naped Ibis	LC	IV
19	*Platalea leucorodia*	Eurasian Spoonbill	LC	**I**
20	*Butorides striata*	Striated Heron	LC	IV
21	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	IV
22	*Ardeola grayii*	Indian Pond Heron	LC	IV
23	*Ardea cinerea*	Grey Heron	LC	IV
24	*Ardea purpurea*	Purple Heron	LC	IV
25	*Egretta intermedia*	Intermediate Egret	LC	IV
26	*Bubulcus ibis*	Cattle Egret	LC	IV
27	*Casmerodius albus*	Great Egret	LC	IV
28	*Egretta garzetta*	Little Egret	LC	IV
29	*Microcarbo niger*	Little Cormorant	LC	IV
30	*Falco chicquera*	Red-necked Falcon	NT	I
31	*Falco jugger*	Laggar Falcon	NT	I
32	*Elanus caeruleus*	Black-winged Kite	LC	IV
33	*Milvus migrans*	Black Kite	LC	IV
34	*Haliastur indus*	Brahminy Kite	LC	IV
35	*Pernis ptilorhynchus*	Oriental Honey-buzzard	LC	IV
36	*Neophron percnopterus*	Egyptian Vulture	**EN**	IV
37	*Gyps bengalensis*	White-rumped Vulture	**CR**	I
38	*Gyps indicus*	Indian Vulture	**CR**	I
39	*Sarcogyps calvus*	Red-headed Vulture	**CR**	IV
40	*Circaetus gallicus*	Short-toed Snake Eagle	LC	IV
41	*Spilornis cheela*	Crested Serpent Eagle	LC	IV
42	*Accipiter badius*	Shikra	LC	IV
43	*Butastur teesa*	White-eyed Buzzard	LC	IV
44	*Aquila rapax*	Tawny Eagle	LC	IV
45	*Aquila fasciata*	Bonelli's Eagle	LC	IV
46	*Nisaetus cirrhatus*	Crested Hawk-eagle	LC	IV
47	*Ardeotis nigriceps*	Great Indian Bustard	CR	I
48	*Sypheotides indicus*	Lesser Florican	EN	I
49	*Turnix sylvaticus*	Small Buttonquail	LC	IV
50	*Amaurornis akool*	Brown Crake	LC	IV
51	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	IV
52	*Turnix suscitator*	Barred Buttonquail	LC	IV
53	*Fulica atra*	Eurasian Coot	LC	IV
54	*Gallinula chloropus*	Common Moorhen	LC	IV

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
55	*Porphyrio porphyrio*	Purple Swamphen	LC	IV
56	*Burhinus (oedicnemus) indicus*	Indian Thick-knee	LC	IV
57	*Esacus recurvirostris*	Great Thick-knee	NT	IV
58	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	IV
59	*Metopidius indicus*	Bronze-winged Jacana	LC	IV
60	*Vanellus malarbaricus*	Yellow-wattled Lapwing	LC	IV
61	*Vanellus indicus*	Red-wattled Lapwing	LC	IV
62	*Rostratula benghalensis*	Greater Painted-Snipe	LC	IV
63	*Charadrius dubius*	Little Ringed Plover	LC	IV
64	*Cursorius coromandelicus*	Indian Courser	LC	-
65	*Glareola lactea*	Small Pratincole	LC	-
66	*Sterna aurantia*	River Tern	NT	-
67	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	IV
68	*Pterocles indicus*	Painted Sandgrouse	LC	IV
69	*Columba livia*	Common Pigeon	LC	IV
70	*Ducula aenea*	Green Imperial Pigeon	LC	IV
71	*Streptopelia orientalis*	Oriental Turtle-Dove	LC	IV
72	*Streptopelia decaocto*	Eurasian Collared Dove	LC	IV
73	*Streptopelia tranquebarica*	Red Collared Dove	LC	IV
74	*Streptopelia chinensis*	Spotted Dove	LC	IV
75	*Streptopelia senegalensis*	Laughing Dove	LC	IV
76	*Treron phoenicopterus*	Yellow-footed Green Pigeon	LC	IV
77	*Psittacula krameri*	Rose-ringed Parakeet	LC	IV
78	*Psittacula eupatria*	Alexandrine Parakeet	NT	IV
79	*Psittacula cyanocephala*	Plum-headed Parakeet	LC	IV
80	*Hierococcyx varius*	Common Hawk-Cuckoo	LC	IV
81	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC	IV
82	*Eudynamys scolopaceus*	Asian Koel	LC	IV
83	*Taccocua leschenaultii*	Sirkeer Malkoha	LC	IV
84	*Rhopodytes viridirostris*	Blue-faced Malkoha	LC	IV
85	*Centropus parroti*	Southern Coucal	LC	IV
86	*Tyto alba*	Barn Owl	LC	IV
87	*Otus bakkamoena*	Indian Scops Owl	LC	IV
88	*Athene brama*	Spotted Owlet	LC	IV
89	*Glaucidium radiatum*	Jungle Owlet	LC	IV
90	*Bubo bubo*	Eurasian Eagle Owl	LC	IV
91	*Ketupa zeylonensis*	Brown Fish Owl	LC	IV
92	*Strix ocellata*	Mottled Wood Owl	LC	IV
93	*Caprimulgus affinis*	Savanna Nightjar	LC	IV
94	*Caprimulgus asiaticus*	Indian Nightjar	LC	IV
95	*Cypsiurus balasiensis*	Asian Palm Swift	LC	-
96	*Tachymarptis melba*	Alpine Swift	LC	-
97	*Hemiprocne coronata*	Crested Treeswift	LC	-
98	*Apus affinis*	Little Swift	LC	-
99	*Coracias benghalensis*	Indian Roller	LC	IV
100	*Upupa epops*	Common Hoopoe	LC	-
101	*Halcyon smyrnensis*	White-throated Kingfisher	LC	IV
102	*Alcedo atthis*	Common Kingfisher	LC	IV
103	*Ceryle rudis*	Pied Kingfisher	LC	IV
104	*Merops orientalis*	Green Bee-eater	LC	-
105	*Ocyceros birostris*	Indian Grey Hornbill	LC	-
106	*Megalaima haemacephala*	Coppersmith Barbet	LC	IV
107	*Megalaima zeylanica*	Brown-headed Barbet	LC	IV

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
108	*Dendrocopos nanus*	Brown-capped Pygmy Woodpecker	LC	IV
109	*Dendrocopos mahrattensis*	Yellow-crowned Woodpecker	LC	IV
110	*Dinopium benghalense*	Lesser Goldenback	LC	IV
111	*Tephrodornis pondicerianus*	Common Woodshrike	LC	-
112	*Artamus fuscus*	Ashy Woodswallow	LC	-
113	*Coracina macei*	Large Cuckooshrike	LC	IV
114	*Aegithina tiphia*	Common Iora	LC	IV
115	*Pericrocotus cinnamomeus*	Small Minivet	LC	-
116	*Lanius vittatus*	Bay-backed Shrike	LC	-
117	*Lanius meridionalis*	Southern Grey Shrike	LC	-
118	*Dicrurus macrocercus*	Black Drongo	LC	IV
119	*Dicrurus caerulescens*	White-bellied Drongo	LC	IV
120	*Oriolus xanthornus*	Black-hooded Oriole	LC	IV
121	*Rhipidura aureola*	White-browed Fantail	LC	-
122	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	LC	-
123	*Dendrocitta vagabunda*	Rufous Treepie	LC	IV
124	*Corvus (macrorhynchos) culminatus*	Indian Jungle Crow	NA	V
125	*Corvus splendens*	House Crow	LC	V
126	*Ptyonoprogne concolor*	Dusky Crag Martin	LC	-
127	*Hirundo fluvicola*	Streak-throated Swallow	LC	-
128	*Ammomanes phoenicura*	Rufous-tailed Lark	LC	IV
129	*Eremopterix griseus*	Ashy-crowned Sparrow Lark	LC	IV
130	*Galerida deva*	Sykes's Lark	LC	IV
131	*Alauda gulgula*	Oriental Sky Lark	LC	IV
132	*Pycnonotus cafer*	Red-vented Bulbul	LC	IV
133	*Pycnonotus luteolus*	White-browed Bulbul	LC	IV
134	*Prinia hodgsonii*	Grey-breasted Prinia	LC	-
135	*Prinia sylvatica*	Jungle Prinia	LC	-
136	*Prinia socialis*	Ashy Prinia	LC	-
137	*Prinia inornata*	Plain Prinia	LC	-
138	*Cisticola juncidis*	Zitting Cisticola	LC	-
139	*Orthotomus sutorius*	Common Tailorbird	LC	-
140	*Dumetia hyperythra*	Tawny-bellied Babbler	LC	IV
141	*Turdoides affinis*	Yellow-billed Babbler	LC	IV
142	*Turdoides malcolmi*	Large Grey Babbler	LC	IV
143	*Turdoides caudatus*	Common Babbler	LC	IV
144	*Turdoides striata*	Jungle Babbler	LC	IV
145	*Chrysomma sinense*	Yellow-eyed Babbler	LC	IV
146	*Zosterops palpebrosus*	Oriental White-eye	LC	IV
147	*Acridotheres tristis*	Common Myna	LC	IV
148	*Sturnia pagodarum*	Brahminy Starling	LC	IV
149	*Zoothera citrina*	Orange-headed Thrush	LC	-
150	*Saxicoloides fulicatus*	Indian Robin	LC	IV
151	*Copsychus saularis*	Oriental Magpie Robin	LC	IV
152	*Saxicola caprata*	Pied Bush Chat	LC	IV
153	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	-
154	*Chloropsis aurifrons*	Golden-fronted Leafbird	LC	-
155	*Dicaeum agile*	Thick-billed Flowerpecker	LC	IV
156	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	IV
157	*Cinnyris asiaticus*	Purple Sunbird	LC	IV
158	*Leptocoma zeylonica*	Purple-rumped Sunbird	LC	IV
159	*Passer domesticus*	House Sparrow	LC	-
160	*Gymnoris xanthocollis*	Chestnut-shouldered Petronia	LC	-

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
161	*Ploceus philippinus*	Baya Weaver	LC	IV
162	*Euodice malabarica*	Indian Silverbill	LC	IV
163	*Lonchura malacca*	Black-headed Munia	LC	IV
164	*Motacilla madaraspatensis*	White-browed Wagtail	LC	IV
165	*Anthus rufulus*	Paddyfield Pipit	LC	IV
166	*Rhinoptilus bitorquatus*	Jerdon's Courser	CR	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where - CR – Critically Endangered; LC – Least Concern; EN – Endangered; NA – Not Assessed; NT – Near Threatened; V – Vulnerable*
Sources: R. Grimmett, C. Inskipp & T. Inskipp, Birds of the Indian Subcontinent; Salim Ali, Book of Indian Birds; IUCN Red Data List

Photo 8-2: Some Residential Avifaunal Species of the Study Area

Vanellus indicus (Red-wattled Lapwing)

Streptopelia decaocto (Eurasian Collared Dove)

Stigmatopelia senegalensis (Laughing Dove)

Dicrurus macrocercus (Black drongo)

Eremopterix griseus (Ashy - crowned Sparrow Lark – Male)

Eremopterix griseus (Ashy - crowned Sparrow Lark - Female)

Sturnia pagodarum (Brahminy Starling)

Turdoides malcolmi (Large Grey Babbler)

Prinia inornata (Plain Prinia)

Mammals

Table 8-4: Mammals associated with the Study Area

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	*Macaca mulatta*	Rhesus Macaque	LC	II
2	*Macaca radiata*	Bonnet Macaque	LC	II
3	*Semnopithecus entellus*	Northern Plains Langur	LC	II
4	*Semnopithecus priam anchies*	Tufted Gray Langur	**NT**	II
5	*Panthera pardus*	Common Leopard	LC	**I**
6	*Melursus ursinus*	Sloth Bear	**V**	**I**
7	*Vulpes bengalensis*	Indian Fox	LC	II
8	*Hyaena hyaena*	Striped Hyena	LC	III
9	*Canis aureus*	Jackal	LC	II
10	*Muntacus muntjak*	Indian Muntjac	LC	III
11	*Rusa unicolor*	Sambar	**V**	III
12	*Axis axis*	Spotted Deer	LC	III
13	*Boselaphus tragocamelus*	Nilgai	LC	III
14	*Tetracerus quadricornis*	Four-horned Antelope	**V**	**I**
15	*Gazella benettii*	Indian Gazelle	LC	**I**
16	*Antilope cervicapra*	Blackbuck	**NT**	**I**
17	*Sus scrofa*	Wild Pig (Bore)	LC	III
18	*Canis lupus*	Grey Wolf	LC	**I**
19	*Felis chaus*	Jungle Cat	LC	II
20	*Prionailurus rubiginosus*	Rusty-spotted Cat	**V**	**I**
21	*Viverricula indica*	Small Indian Civet	LC	II
22	*Paradoxurus hermaphroditus*	Common Palm Civet	LC	II
23	*Herpestes smithii*	Grey Mongoose	LC	IV
24	*Herpestes edwardsii*	Grey Mongoose	LC	IV
25	*Mellivora capensis*	Honey Badger	LC	**I**
26	*Tetera indica*	Indian Gerbil	LC	-
27	*Manis crassicaudata*	Indian Pangolin	**EN**	**I**
28	*Lepus nigricollis*	Indian Hare	LC	IV
29	*Anathana ellioti*	Madras Tree Shrew	LC	-
30	*Suncus murinus*	House Shrew	LC	-
31	*Suncus etruscus*	Pygmy Shrew	LC	-
32	*Hystrix indica*	Indian Crested Porcupine	LC	IV
33	*Funambulus palmarum*	Three-striped Palm Squirrel	LC	-
34	*Bandicota indica*	Large Bandicoot-rat	LC	V
35	*Bandicota bengalensis*	Lesser Bandicoot-rat	LC	V
36	*Rattus rattus*	House Rat	LC	V
37	*Millardia meltada*	Soft-furred Field Rat	LC	V
38	*Madromys blanfordi*	White-tailed Wood Rat	LC	V
39	*Golunda ellioti*	Indian Bush Rat	LC	V
40	*Vandeleuria oleracea*	Asiatic Long-tailed Climbing Mouse	LC	V
41	*Mus musculus*	House Mouse	LC	V
42	*Mus booduga*	Little Indian Field Mouse	LC	V
43	*Mus phillipsi*	Wroughton's Mouse	LC	V
44	*Mus platythrix*	Spiny Field Mouse	LC	V
45	*Mus terricolor*	Pygmy Field Mouse	LC	V

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where - CR – Critically Endangered; LC – Least Concern; EN – Endangered; NA – Not Assessed; NT – Near Threatened; V – Vulnerable*
Sources: Forest Working Plan for the Forest of Anantapur District; Vivek Menon, A Field Guide to Indian Mammals (2003); IUCN Red Data List

Bats

Table 8-5: Species of bats associated with the Study Area

Sr.No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	*Pteropus giganteus*	Indian Flying Fox	LC	V
2	*Rousettus leschenaultia*	Fulvous Fruit Bat	LC	V
3	*Cynopterus sphinx*	Greater Short-nosed Fruit Bat	LC	V
4	*Taphozous nudiventris*	Naked-rumped Tomb Bat	LC	-
5	*Taphozous longimanus*	Long-winged Tomb Bat	LC	-
6	*Rhinolophus rouxii*	Rufous Horseshoe Bat	LC	-
7	*Rhinolophus lepidus*	Blyth's Horseshoe Bat	LC	-
8	*Rhinolophus pusillus*	Least Horseshoe Bat	LC	-
9	*Hipposideros speoris*	Schneider's Leaf-nosed Bat	LC	-
10	*Hipposideros fulvus*	Fulvous Leaf-nosed Bat	LC	-
11	*Hipposideros galeritus*	Cantor's Leaf-nosed Bat	LC	-
12	*Megaderma lyra*	Greater False Vampire	LC	-
13	*Rhinolophus beddomei*	Lesser Woolly Horseshoe Bat	LC	-
14	*Tadarida plicata*	Wrinkle-lipped Free-tailed Bat	LC	-
15	*Scotophilus heathii*	Asiatic Greater Yellow House Bat	LC	-
16	*Murina cyclotis*	Round-eared Tube-nosed Bat	LC	-
17	*Pipistrellus coromandra*	Indian Pipistrelle	LC	-
18	*Pipistrellus abramus*	Japanese Pipistrelle	LC	-
19	*Pipistrellus tenuis*	Indian Pygmy Bat	LC	-
20	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-
21	*Pipistrellus dormeri*	Dormer's Bat	LC	-
22	*Pipistrellus javanicus*	Javan Pipistrelle	LC	-
23	*Pipistrellus affinis*	Chocolate Pipistrelle	LC	-
24	*Hesperoptenus tickelli*	Tickell's Bat	LC	-
25	*Eonycteris spelaeaLesser*	Dawn Bat	LC	V
26	*Kerivoula picta*	Painted Bat	LC	-

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where - LC – Least Concern*
Sources: Vivek Menon, A Field Guide to Indian Mammals (2014); IUCN Red Data List

Photo 8-3: Some Mammalian Species of the Study Area

Pteropus giganteus (Indian Flying Fox)

Antilope cervicapra (Blackbuck)

Reptiles

Table 8-6: Reptiles associated with the Study Area

Sr.No.	Scientific Name	Common Name	IUCN Status	WPA Schedule
1	*Ramphotyphlops braminus*	Common Worm Snake	NA	IV
2	*Grypotyphlops acutus*	Beaked Worm Snake	LC	IV
3	*Python molurus*	Indian Rock Python	V	I
4	*Gongylophis conicus*	Common Sand Boa	NA	IV
5	*Eryx johnii*	Red Sand Boa	NA	IV
6	*Coelognathus helena helena*	Indian Trinket Snake	NA	IV
7	*Ptyas mucosa*	Indian Rat Snake	NA	II
8	*Argyrogena fasciolata*	Banded Racer	NA	IV
9	*Oligodon taeniolatus*	Streaked Kukri Snake	LC	IV
10	*Oligodon arnensis*	Banded Kukri Snake	NA	IV
11	*Dendrelaphis tristis*	Common Bronzeback Tree Snake	NA	IV
12	*Lycodon striatus*	Barred Wolf Snake	NA	IV
13	*Lycodon aulicus*	Common Wolf Snake	NA	IV
14	*Dryocalamus nympha*	-	NA	-
15	*Sibynophis subpunctatus*	Common Black-headed Snake	NA	IV
16	*Xenochrophis piscator*	Checkered Keelback Water Snake	NA	IV
17	*Amphiesma stolatum*	Buff-striped Keelback	NA	IV
18	*Macropisthodon plumbicolor*	-	NA	-
19	*Boiga trigonata*	Indian Gamma Snake	LC	IV
20	*Ahaetulla nasuta*	Common Vine Snake	NA	IV
21	*Bungarus caeruleus*	Indian Krait	NA	IV
22	*Naja naja*	Spectacled Cobra	NA	II
23	*Daboia russelli*	Eastern Russell's Viper	NA	II
24	*Echis carinatus*	Saw-scaled Viper	NA	IV
25	*Calotes versicolor*	Indian Garden Lizard	NA	-
26	*Psammophilus dorsalis*	South Indian Rock Agama	LC	-
27	*Sitana ponticeriana*	Fan-throated Lizard	LC	-
28	*Chamaeleo zeylanicus*	South Asian Chamaeleon	-	II
29	*Calodactylodes aureus*	Indian Golden Gecko	LC	I
30	*Geckoella nebulosa*	Clouded Ground Gecko	-	-
31	*Hemidactylus bowringii*	Bowring's Gecko	NA	-
32	*Hemidactylus frenatus*	Asian House Gecko	LC	-
33	*Hemidactylus leschenaultii*	Bark Gecko	NA	-
34	*Ophisops leschenaultii*	Leschenault's Lacerta	NA	-
35	*Eutropis carinata*	Keeled Indian Mabuya	LC	-
36	*Mabuya macularia*	Bronze Grass Skink	NA	-
37	*Varanus bengalensis*	Common Indian Monitor	LC	I
38	*Geochelone elegans*	Indian Star Tortoise	LC	IV

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where - LC – Least Concern; NA – Not Assessed; V – Vulnerable*

Sources: Indraneil Das, Snakes & other Reptiles of India; Romulus Whitaker & Ashok Captain, Snakes of India; IUCN Red Data List

8.6 Findings on Habitats

8.6.1 Natural Habitats

The study-area represents a tract of fairly degraded southern tropical dry deciduous forest and southern tropical thorn forest (thorny scrub and *Euphorbiaceae* scrubs), with their natural vegetation profile modified to varying extents from place to place. Forest areas are mostly confined to hilly and unproductive regions. Water is a scarce resource in the area and no major lakes/ponds or any other natural water body were observed in the study area during the course of survey.

8.6.2 Modified Habitats

Much of the study area is a modified habitat comprising agricultural lands and scattered villages.

The area is devoid of any natural water body. However, two anthropogenic water bodies, namely, the *Handri-Neeva Sujala Sravanthi* (HNSS) Water Canal, which traverses the study area, the *'Satya Sai Reservoir'*, a surface reservoir located at a distance of 2.8 km from WTG No. PPD 82, and the *Pottipadu Pond,* a village pond located at a distance of 500 m from PPD 01, were observed during the survey.

A large material yard is constructed within the study area, adjacent to SH-26, which connects Vajrakarur village to Uravakonda village.

Waste lands and cultivated fields supporting a large number of exotic weeds occupy most of the study area, together with human habitations and attendant infrastructure like roads and culverts.

8.6.3 Critical Habitats

The survey-area is likely to be containing habitats that are of significant importance to species of critical conservation-value. This section lists such species.

Migratory and/or Congregatory Species

The entire Indian subcontinent, including study-area, is situated within the limits of the Central Asian Flyway (CAF), one of the eight major flyways identified worldwide. The CAF connects a large swathe of the Palaearctic region with the Indian subcontinent and contains well-established routes along which a number of bird-species migrate annually.

Thus, the study-area is very likely to fall in the flight-path of the various winter, summer and passage visitor-birds migrating either to, or through, the region in which it is situated.

No congregatory avifaunal species has a recorded range that includes the study area.

Table 8-7 lists the migratory avifaunal species associated with the study area. It also gives the season of migration, the conservation status as per the IUCN Red Data List and the schedule under which the species is protected by the Wildlife (Protection) Act (1972) of India, for each species.

Table 8-7: Migratory Avifauna associated with the Study Area

Sr.No.	Scientific Name	Common Name	Migratory Status	IUCN Status*	WPA Schedule
1	*Conturnix conturnix*	Common Quail	Winter	LC	IV
2	*Conturnix coromandelica*	Rain Quail	Winter	LC	IV
3	*Anser indicus*	Bar-headed Goose	Winter	LC	IV
4	*Tadorna ferruginea*	Ruddy Shelduck	Winter	LC	IV
5	*Anas strepera*	Gadwall	Winter	LC	IV
6	*Anas clypeata*	Northern Shoveler	Winter	LC	IV
7	*Anas acuta*	Northern Pintail	Winter	LC	IV
8	*Anas querquedula*	Garganey	Winter	LC	IV
9	*Anas crecca*	Common Teal	Winter	LC	IV
10	*Aythya ferina*	Common Pochard	Winter	LC	IV
11	*Aythya fuligula*	Tufted Duck	Winter	LC	IV
12	*Ciconia ciconia*	White Stork	Winter	LC	IV
13	*Phoenicopterus roseus*	Greater Flamingo	Winter	LC	IV
14	*Plegadis falcinellus*	Glossy Ibis	Winter	LC	IV
15	*Anhinga melanogaster*	Darter	Winter	NT	IV
16	*Phalacrocorax fuscicollis*	Indian Cormorant	Winter	LC	IV
17	*Phalacrocorax carbo*	Great Cormorant	Winter	LC	IV
18	*Falco tinnunculus*	Common Kestrel	Winter	LC	IV
19	*Falco peregrinus*	Peregrine Falcon	Winter	LC	IV
20	*Pandion haliaetus*	Osprey	Winter	LC	I
21	*Circus aeruginosus*	Eurasian Marsh Harrier	Winter	LC	IV
22	*Circus macrourus*	Pallid Harrier	Winter	NT	IV
23	*Circus pygargus*	Montagu's Harrier	Winter	LC	IV
24	*Hieraaetus pennatus*	Booted Eagle	Winter	LC	IV
25	*Porzana pusilla*	Baillon's Crake	Winter	LC	IV
26	*Turnix tanki*	Yellow-legged Buttonquail	Winter	LC	IV
27	*Himantopus himantopus*	Black-winged Stilt	Winter	LC	IV
28	*Philomachus pugnax*	Ruff	Winter	LC	-
29	*Gallinago gallinago*	Common Snipe	Winter	LC	IV
30	*Gallinago stenura*	Pin-tailed Snipe	Winter	LC	IV
31	*Limosa limosa*	Black-tailed Godwit	Winter	NT	IV
32	*Numenius arquata*	Eurasian Curlew	Winter	NT	IV
33	*Tringa erythropus*	Spotted Redshank	Winter	LC	IV
34	*Tringa tetanus*	Common Redshank	Winter	LC	IV
35	*Tringa stagnatilis*	Marsh Sandpiper	Winter	LC	IV
36	*Tringa nebularia*	Common Greenshank	Winter	LC	IV
37	*Tringa glareola*	Wood Sandpiper	Winter	LC	IV
38	*Tringa ochropus*	Green Sandpiper	Winter	LC	IV
39	*Actitis hypoleucos*	Common Sandpiper	Winter	LC	IV
40	*Calidris temminckii*	Temminck's Stint	Winter	LC	IV
41	*Calidris minuta*	Little Stint	Winter	LC	IV
42	*Chlidonias hybrida*	Whiskered Tern	Winter	LC	-
43	*Clamator jacobinus*	Jacobin Cuckoo	Summer	LC	IV
44	*Asio flammeus*	Short-eared Owl	Winter	LC	IV
45	*Merops philippinus*	Blue-tailed Bee-eater	Passage	LC	-
46	*Jynx torquilla*	Eurasian Wryneck	Winter	LC	IV
47	*Pitta brachyura*	Indian Pitta	Winter	LC	-
48	*Coracina melanoptera*	Black-headed Cuckooshrike	Passage	LC	IV
49	*Lanius cristatus*	Brown Shrike	Winter	LC	-
50	*Lanius schach*	Long-tailed Shrike	Winter	LC	-
51	*Dicrurus leucophaeus*	Ashy Drongo	Winter	LC	IV

Sr.No.	Scientific Name	Common Name	Migratory Status	IUCN Status*	WPA Schedule
52	*Oriolus kundoo*	Indian Golden Oriole	Winter	LC	IV
53	*Terpsiphone paradisi*	Asian Paradise-Flycatcher	Winter	LC	IV
54	*Cecropis daurica*	Red-rumped Swallow	Winter	LC	-
55	*Hirundo rustica*	Barn Swallow	Winter	LC	-
56	*Acrocephalus dumetorum*	Blyth's Reed-Warbler	Winter	LC	-
57	*Iduna rama*	Sykes's Warbler	Winter	LC	-
58	*Iduna caligata*	Booted Warbler	Winter	LC	
59	*Phylloscopus humei*	Hume's Leaf Warbler	Winter	LC	-
60	*Phylloscopus trochiloides*	Greenish Warbler	Passage	LC	-
61	*Phylloscopus (trochiloides) nitidus*	Green Warbler	Passage	LC	-
62	*Sylvia curruca*	Lesser Whitethroat	Winter	LC	-
63	*Sylvia althaea*	Hume's Whitethroat	Winter	LC	-
64	*Sturnia malabarica*	Chestnut-tailed Starling	Winter	LC	IV
65	*Luscinia svecica*	Bluethroat	Winter	LC	IV
66	*Phoenicurus ochruros*	Black Redstart	Winter	LC	IV
67	*Saxicola torquatus*	Common Stonechat	Winter	LC	IV
68	*Monticola solitarius*	Blue Rock Thrush	Winter	LC	IV
69	*Muscicapa dauurica*	Asian Brown Flycatcher	Summer	LC	IV
70	*Ficedula superciliaris*	Ultramarine Flycatcher	Winter	LC	IV
71	*Cyornis tickelliae*	Tickell's Blue Flycatcher	Winter	LC	IV
72	*Motacilla flava*	Yellow Wagtail	Winter	LC	-
73	*Motacilla cinerea*	Grey Wagtail	Winter	LC	-
74	*Motacilla alba*	White Wagtail	Winter	LC	-
75	*Anthus godlewskii*	Blyth's Pipit	Winter	LC	IV
76	*Anthus trivialis*	Tree Pipit	Winter	LC	IV

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where - LC – Least Concern; NT – Near Threatened*

Sources: R. Grimmett, C. Inskipp & T. Inskipp, Birds of the Indian Subcontinent; Salim Ali, Book of Indian Birds; IUCN Red Data List

Critically Endangered or Endangered Species

Table 8-8 lists the species associated with the study-area which are designated as either 'Critically endangered' or 'endangered' as per the IUCN Red Data List. The Schedule under which the species is protected under the Wildlife (Protection) Act (1972) of India is also given.

Mammals

Table 8-8: Critically Endangered/Endangered Mammals associated with the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	*Manis crassicaudata*	Indian Pangolin	EN	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where - EN – Endangered*

Sources: Vivek Menon, A Field Guide to Indian Mammals; IUCN Red List

Avifauna

Table 8-9: Critically Endangered/Endangered Birds associated with the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	*Neophron percnopterus*	Egyptian Vulture	EN	IV
2	*Gyps bengalensis*	White-rumped Vulture	CR	I
3	*Gyps indicus*	Indian Vulture	CR	I
4	*Sarcogyps calvus*	Red-headed Vulture	CR	I
5	*Ardeotis nigriceps*	Great Indian Bustard	CR	I
6	*Sypheotides indicus*	Lesser Florican	EN	I
7	*Rhinoptilus bitorquatus*	Jerdon's Courser	CR	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where - CR – Critically Endangered; EN – Endangered*

Sources: R. Grimmett, C. Inskipp & T. Inskipp, Birds of the Indian Subcontinent; Salim Ali, Book of Indian Birds; IUCN Red Data List

Endemic/Restricted Range Species

Table 8-10 lists the species that are endemic to, or have restricted ranges that include, the study-area.

Table 8-10: Endemic / Restricted Range Species associated with the Study Area

Sr. No.	Scientific Name	Common Name	Range
Birds			
1	*Perdicula argoondah*	Rock Bush Quail	Central & Western India
2	*Galloperdix spadicea*	Red Spurfowl	Peninsular India
3	*Galloperdix lunulata*	Painted Spurfowl	Peninsular India
4	*Rhinoptilus bitorquatus*	Jerdon's Courser	Andhra Pradesh
5	*Strix ocellata*	Mottled Wood Owl	Peninsular India
6	*Pycnonotus xantholaemus*	Yellow-throated Bulbul	South Indian hills
Mammals			
1	*Semnopithecus priam anchies*	Tufted Gray Langur	Kurnool and Anantapur districts of Andhra Pradesh& Tumkur district of Karnataka
2	*Pipistrellus abramus*	Japanese Pipistrelle	Andhra Pradesh, Arunachal Pradesh, Meghalaya and Uttar Pradesh
Reptiles			
1	*Calodactylodes aureus*	Indian Golden Gecko	Rocky outcrops of Telangana, Andhra Pradesh & Tamil Nadu
2	*Geckoella nebulosa*	Clouded Ground Gecko	Hills of India's east coast & Deccan Plateau of Telangana & Andhra Pradesh

Sources: *Vivek Menon, A Field Guide to Indian Mammals; R. Grimmett, C. Inskipp & T. Inskipp, Birds of the Indian Subcontinent; Salim Ali, Book of Indian Birds; Indraneil Das, Snakes & other Reptiles of India; Romulus Whitaker & Ashok Captain, Snakes of India*

Alien/Invasive Species

Table 8-11 lists the invasive alien/non-native plant species recorded in the study area.

Table 8-11: Invasive Alien/Non-native Species associated with the Study Area

Sr. No.	Species	Habit	Vernacular Name
1	*Prosopis juliflora*	Tree	Jammi
2	*Parthenium hysterophorus*	Herb	Chatak Chandani

8.7 Designated Areas

The Marutla Reserve Forest, located approximately 20 km from Study area is the nearest protected area from the study area. The Jogimatti Reserve forest in Chitradurga, Karnataka, located approximately 142 km from the study area is the nearest Important Bird Area (IBA). The Veerapuram Bird Sanctuary in village Veerapuram of Anantapur District, an important breeding place of Painted Stork (*Mycteria leucocephala)*, and located nearly 135 km from the study area, is the nearest Bird Sanctuary. Therefore, no area of ecological sensitive importance such as legally protected forest, reserve forest, national park etc., is located within or in the vicinity of the study area.

8.8 Ecosystem Services

8.8.1 Crops

The natural flows of the survey-area carry nutrients from the relatively higher lands and slopes to the lowest-lying plains which are cultivated by the local residents. Table 8-13 lists some of the seasonal crops grown in the study-area.

Table 8-12: Crops associated with the Study Area

Sr.No.	Species	Common Name	Type of Crop
1	*Arachis hypogea*	Groundnut	Nut, Oil-seed
2	*Gossypium herbaceum*	Cotton	Fibre
3	*Ricinus communis*	Castor	Oil-seed
4	*Helianthus annuus*	Sunflower	Oil-seed
5	*Lycopersicum esculentum*	Tomato	Vegetable
6	*Capsicum frutescens*	Chili	Spice

Photo 8-4: Some Crops of the Study Area

Ricinus communis (Castor crop)

Helianthus annuus (Sun flower crop)

Gossypium herbaceum (Cotton crop)

Arachis hypogea (Groundnut crop)

8.8.2 Fodder

The pasturelands and fallow fields of the survey-area support plants that serve as fodder for the domestic cattle (including buffaloes, cows and plough and draught oxen), sheep and goats of the area. Crop residue is also an important source of fodder for this livestock.

8.8.3 Fuel / Timber wood

Trees and shrubs growing in the survey-area are lopped and fallen twigs gathered by the local community for use as fuel. The dung of domestic animals, fed almost entirely by fodder-plants extracted from the local pasturelands and crop-residue from the local farms, represents a secondary form of biomass used as fuel by the community. *Acacia nilotica* recorded from the study-area is a major timber tree-species to the local community.

8.8.4 Temple

There exists a temple, dedicated to Sai baba, in Vajrakarur Village, which, being a place of worship, also serves as a meeting place for the local community.

8.9 Conclusion

The proposed project-area contains a mosaic of natural and modified habitats which is supporting a variety of flora and fauna, and providing various ecosystem-services to the local communities.

The remnant patches of natural vegetation in the area are providing habitats to a fairly good diversity of wild fauna.These patchy natural habitats are also likely to be acting as wildlife corridors which connect the faunal populations inhabiting the region. The proposed project-area also contains critical habitats, in the form of potential roosting, foraging and nesting sites of some globally threatened, a few endemic and many migratory species.

The project installations and activities are likely to cause a moderate loss, degradation or fragmentation of these habitats and services through alteration or obstruction of natural ecological flows and the removal of natural vegetation.

Such ecological impacts can be brought down to a minimal level by preservation or restoration of the natural topography and drainage of the affected areas, as also, by replacement of lost vegetation

and enhancement of existing vegetation through an ecologically sensitive, native species-based plantation programme.

The wind-turbines that are part of the project have the potential to impact those avifaunal species of the project-area that are known to be particularly vulnerable to risk of death or bodily damage from collision (as in the case of raptor birds and migratory waterfowl) or interaction (as in the case of bats) with the turbines.

While individuals of all such species are subject to risk of death or bodily damage from collision with the turbines, it is only the globally threatened species among them that face a significant risk at a species level, in view of their already decimated or fast-reducing numbers. Such risk can be minimized by following the standard collision-avoidance measures internationally recommended for windfarms.

There is no Legally Protected Area, Important Bird Area or Ramsar Site within a 10 km radius of the project-area, the closest such areas being approximately 20-140 km away.

The potential impacts of the proposed project on the ecology of the area and the corresponding mitigative measures are described in detail in the following section of this report.

8.10 Impact Assessment

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

8.10.1 Construction Phase

- *Impacts*

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 death or degradation in the quality of life of the organisms' dependant 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 fibre 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.

The entire Indian subcontinent, including study-area, is situated within the limits of the Central Asian Flyway (CAF), one of the eight major flyways identified worldwide. The CAF connects a large swathe of the Palaearctic region with the Indian subcontinent and contains well-established routes along which a number of bird-species migrate annually.

Thus, the study-area is very likely to fall in the flight-path of the various winter, summer and passage visitor-birds migrating either to, or through, the region in which it is situated.

- *Mitigation Measures*

The following mitigation measures shall be adopted:

- 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 construction activity.
- Cutting or lopping of trees shall be avoided. Mature trees and standing dead trees shall not be cut or lopped under any circumstances.
- 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 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 at the earliest and emphasis should be given on increasing the green-cover 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 (The species of trees, shrubs, herbs and climbers listed under the Section Forest-Types of this report may be used for this purpose). No exotic or non-native species should be planted in the area.

➢ *Impact Value*

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

8.10.2 Operation Phase

➢ *Impacts*

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.

Bird species associated with the study-area include members of groups considered especially vulnerable to collision-risk from wind turbines, namely raptors and migratory waterfowl. Some of the species concerned are designated as globally threatened or near-threatened by the IUCN.

Although no known major migratory flyway coincides with the study area, the area is likely to fall in the path of the various birds, including waterfowl, migrating 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:

- 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;
- Visibility enhancement objects such as marker balls, bird deterrents, or diverters shall also be installed along the transmission line to avoid avian collision;
- Native vegetation must be planted or allowed to grow around the wind-turbines, such that their canopy screens potential prey on the ground from raptors flying overhead;
- It is to be ensure that there is no formation of heaps of rocks or earthen mounds around the installed WTGs;
- Appropriate storm-water management measure shall be implemented to avoid creating ponds which can attract birds and bats for feeding or nesting in the windfarm area;
- It is recommended that a long-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 bird-species utilizing the wind-turbine envelope around the year, and, assessment of the significance of such risk to the concerned bird-populations.

➢ *Impact Value*

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

9. OCCUPATIONAL HEALTH & SAFETY ENVIRONMENT

9.1 Introduction

Occupational health and safety (OHS) refers to ensuing safety, health and welfare of people engaged in workplace. IFC Performance Standard 2 (Labour and Working Conditions) highlights the need for safe and healthy work environment taking into account inherent risks in its particular sector and specific classes of hazards with respect to a project, including physical, chemical, biological and radiological hazards, and specific threats to women. The PS emphasises the necessity to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards.

This Section discusses the possible occupational hazards associated with the construction and operation phases of the proposed project and suggests appropriate mitigation measures that should be taken in order to prevent and/or minimize the impact of such hazards. The risks have been identified for the construction, operation and maintenance, and decommissioning phases of the project.

9.2 Impact Assessment

8.2.1 Pre-construction Phase

This phase does not entail any OHS risks. However, while finalising the construction and O&M contractors for the proposed project, MVIPL shall scrutinise the contractor's Environmental, Health and Safety (EHS) policies if any and past performance track record on earlier projects.

8.2.2 Construction Phase

The construction phase comprises of the following activities:

- Clearing of vegetation;
- Construction of access roads;
- Construction of site access tracks with field gates and temporary fencing (where required);
- Excavation of foundations;
- Construction of wind turbine foundations;
- Substation construction and grid connection installation;
- Excavation of trenches and laying the power and instrumentation cables;
- Erection of Wind Turbine Generators (WTGs)

➢ *Impacts*

The occupational risks associated with the aforementioned activities have been classified as:

Working at height

This generally involves workers engaged in activities at height ≥ 2 m e.g., assembly of wind tower components, setting up transmission towers etc. The workers engaged in such activities can fall or slip from the scaffolding or ladders which may result in minor injuries such as muscle sprain or major ones such as ligament tear, fractures, haemorrhage depending on the height at which they are working.

Hot work

This kind of work includes primarily welding activities such as fixing turbine components etc.

Eye injuries:

- Retina damage due to flash or sparks emanating from the welding arc.
- *Photokeratitis*: It is caused due to prolonged exposure of insufficiently protected eyes to ultraviolet (UV) radiation and intense visible light from welding arcs. Photokeratitis is akin to sunburn of the cornea and conjunctiva, and is not usually noticed until several hours after exposure.

Burns: Exposure to infrared and UV radiation produced by the electric arc and other flame cutting equipment may heat the skin surface and the tissues immediately below the surface. It can result in thermal burns in some situations.

Respiratory Diseases: These can occur due to inhalation of obnoxious gases viz. acetylene, phosgene, carbon monoxide, ozone and nitrogen oxides (NO, NO_2) formed in the welding arc. Besides this, metals (such as zinc, cadmium, beryllium, iron oxide, mercury, lead) emissions in the form fine Respirable particulates is also entailed in welding activities. Depending on exposure, inhalation of these substances can cause acute or chronic problems such as bronchitis, asthma, emphysema, cancer. These can also affect the central nervous system, brain, kidney, liver on long-term exposure.

Electrical work

Electrical operations such as laying down transmission lines, connecting the power lines to grid substations etc. come under this type of work. Such activities pose the risk of occupational hazards like:

- ***Electrical shocks***: Such incidents can occur when the fixing equipment used by the workers come in contact with an electricity source which is not properly insulated such as live power lines, cables, switches etc. In some cases, it may lead to electrocution of the worker(s) involved in such works.
- ***Electrical burns****:* They occur when the skin comes in contact with live power lines etc. The severity of the burn depends on voltage, current, time of contact etc. The burns can be classified as low voltage, high voltage, flash, flame, arc and oral burns depending on the factors.
- ***Fire and/or explosion hazard****:* These can occur due to short-circuiting of power lines etc. The injuries can range from burns to death of the workers involved in the work.

Crane Operation

Crane operation will be involved in erection of WTG components. It entails OHS risks such as accidents due to crane failure owing to excessive loads. Such events can lead to severe injuries and death of workers.

Ergonomic injuries

These injuries also known as Musculoskeletal Disorders (MSD) can occur due to awkward or sustained postures, forceful exertion or strain, exposure to vibration and sudden shocks during equipment or material loading and unloading processes. Improper ergonomics can affect the muscles, nerves, tendons, ligaments, joints, cartilage and spinal discs. The possible injuries include muscle strains, sprain, ligament tear, fracture, paralysis and slip disc.

Respiratory diseases

Construction activities e.g., blasting, excavation, concrete mixing, cutting involve significant amount of particulate emissions in the form of dust, silica, fibres etc. as well as gaseous emissions such as fumes, smoke, acetylene etc. Hence, construction activities entail the risk of acute or chronic health hazards such as bronchitis, asthma, silicosis, asbestosis, cancer etc. to workers who are constantly exposed to such emissions.

Hearing damage

Workers involved in activities like blasting, metal cutting are exposed to sudden as well as continuous loud noise in excess of 80 dB(A). Consequently, they are at the risk of hearing impairment, ear damage, and irreversible hearing loss if proper protective measures are not taken.

Other Occupational Hazards

These include the following:

- ***Road accidents*** can occur during material/equipment transportation due to vehicle movement on uneven terrains, overturning due to carriage of loads in excess of safe limits, over-speeding etc. Such incidents can lead to physical injuries to drivers, death etc.;

- ***Trip and fall hazards:*** They occur when workers trip over/fall when debris etc. lies in the walkway/passages. The injuries are similar to those discussed under working at height; and

- Workers at times are not accustomed to use of Personal Protection Equipment (PPE) such as safety helmets or hard hats, safety shoes, harness etc. Their negligence may result in accident/hazard such as head injuries, haemorrhage, fracture etc.;

➢ *Mitigation Measures*

Thus, occupational health and safety (OHS) risks entailed in various construction activities necessitate the requirement of adequate mitigation measures that shall be implemented by MVIPL and construction contractor engaged for construction work.

Working at height

- Effective work permit system for working at height shall be ensured;
- All workers engaged in such work shall be provided with adequate Personal Protective Equipment (PPE) such as safety helmets, belts, safety shoes;
- Fall protection measures such as guardrails, body belts, harness etc. shall be provided to arrest slip or fall and avoid/minimise injury to workers;
- All work at height shall be conducted during daytime in presence of sufficient sunlight; and
- Workers shall be trained in usage of PPEs;
- Such activities shall be carried out under strict vigilance and supervision of competent certified personnel/site EHS manager.

Hot work

- Effective work permit system for hot work shall be ensured;
- Provision of following PPEs shall be ensured by Suzlon:
  - Shock proof rubber gloves;
  - Protective clothing;
  - Gas masks;
  - Safety shoes; and
  - Eye protective gear – welding masks with filter and cover plates, goggles.
- Usage of PPEs shall be mandated and workers shall be trained in usage of PPEs;
- It shall be ensured that all cables and wires are doubly insulated and adequate number of lugs are provided with the power supply;
- Proper ground shall be provided with power supply;
- Provision of Earth Leakage Circuit Breaker (ELCB) and Residual Current Circuit Breaker (RCCB) shall be ensured with power supply wherever possible as per design of protection system; and
- Welding operation shall be conducted in presence of supervision of competent personnel/site EHS manager.

Electrical Work

- Effective work permit system for electrical work shall be ensured;
- Provision of PPEs such as shock proof gloves, safety shoes shall be ensured to the workers;
- Circuit breakers shall be provided in power supply for equipment to prevent excessive flow of current and hazards due to possible short-circuiting;
- All cables and wires shall be properly insulated; and
- All electrical work shall be conducted in supervision of site EHS manager/electrical engineer.

Crane Operation

- All lifting operation shall be carried out by a competent person certified in conducting such work. The contractor shall ensure that no person is engaged in driving or operating lifting appliances unless he is sufficiently trained, competent and reliable, possesses the knowledge of inherent risks involved in the operation and is medically examined periodically;

- All lifting appliances shall be thoroughly examined by a competent person, prior to engagement with the project;
- 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.
- Safety measures pertaining to crane operation have been outlined in the ***Crane Safety Plan.***

Ergonomic injuries

It shall be ensured that all lifting operations are carried out under supervision of competent person. Proper work posture shall be ensured and no person shall be allowed to carry excessive loads.

Respiratory diseases

It shall be ensured that dust control measures such as water sprinkling and provision of masks to workers are implemented. Workers shall be apprised about entailed about potential risks and mitigation measures.

Hearing damage

Earmuffs and earplugs shall be provided to workers for limiting exposure to noise within specified limits.

Other Occupational Hazards

- Speed limits shall be put into place for project vehicles within project premises. Signage indicating the same shall be put up along the access roads;
- Even access roads of sufficient width shall be provided for vehicle movement; and
- Movement of vehicles shall be restricted to the identified routes and only trained drivers shall be employed.

In addition to the aforementioned mitigation measures, the following measures shall be ensured to be implemented by Suzlon:

- An OHS training programme shall be undertaken to apprise the workers about the entailed risks and mitigation measures. It shall be ensured that senior management and onsite Suzlon staff and contractors are a part of this programme;
- Periodic inspection of PPEs shall be conducted to ensure that they are in proper condition. A record/register shall be maintained for the same;
- Usage of PPEs shall be mandated;
- Adequate number of firefighting equipment viz. sand buckets, water drums and extinguishers shall be provided at strategic locations throughout the project premises;
- Mock fire drills shall be conducted on a half-yearly basis. Such activities shall be conducted under supervision of MVIPL senior management and onsite Suzlon staff;

- Adequate number of First aid boxes shall be provided. An ambulance shall be made available at the premises round the clock;
- An accident monitoring and reporting record shall be maintained to keep a track of the accident/incidents. It shall have entries of the name of injured person, kind of injury, treatment provided, compensation provided if any. The objective shall be to minimize such occurrences in the future and attain zero accidents; and
- Emergency contact numbers shall be provided at strategic locations throughout the site and workers shall be apprised about the same.

➢ *Impact Value*

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

8.2.3 Operation Phase

➢ *Impacts*

The health and safety aspects to be considered during operation and maintenance phase of the proposed project include:

Working at height

The maintenance activities such as turbine service and repair will involve working at height (≥2m). The operation and maintenance activities will be carried out by the O&M contractor. The possible occupational hazards associated with such activities are same as those discussed earlier under working at height in construction phase.

Electrical/Fire Hazards

Turbine maintenance activities like motor/wire repairing will involve electrical work. The workers involved in such activities are susceptible to risks viz., electrical shocks, electrical burns, and fire and/or explosion hazards. The risks have been discussed elaborately in the earlier section.

➢ *Mitigation Measures*

- Instructions and procedures shall be provided 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;
- All workers shall be acquainted made thorough with operation and maintenance manuals of model of installed WTG;
- Work permit system shall be implemented for working at height (typically when working over 2m) and for hot jobs;
- The use of safety belt and need for safety net as required shall be ensured;
- All work at height shall be undertaken during daytime with sufficient sunlight;
- Integrity of structures shall be checked prior to undertaking work;

- Fixtures shall be installed on tower components to facilitate the use of fall protection systems;
- Only those workers who are 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. Work at height shall be conducted under supervision of site EHS manager;
- Wind turbines shall be equipped with a grounding system; Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components;
- The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire;
- Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and
- An accident reporting and monitoring record shall be maintained.

➢ *Impact Value*

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

8.2.4 *Decommissioning Phase*

➢ *Impacts*

This phase includes de-erection of WTGs, transmission lines etc. These activities involve the following potential impacts:

- Working at height;
- Crane operations
- Electrical work; and
- Transportation of WTG components.

➢ *Mitigation Measures*

The mitigation measures will be same as those discussed in earlier sections. It shall also be ensured that construction debris is cleaned up and disposed in a proper manner. Otherwise, it may lead to vehicle accidents during transportation of turbine components.

➢ *Impact Value*

Aspect	Scenario	Spread	Duration	Intensity	Overall
Occupational Health and Safety	Without Mitigation	Medium	Short	Moderate	**Moderate**
	With Mitigation	Medium	Short	Low	**Minor**

10. AIR, WATER & SOIL ENVIRONMENT

10.1 Introduction

The quality of air, water and soil in a region effectively gives a perspective of the quality of environment of that region. Hence to quantify the impact of project on the environment and to analyse the temporal variations as the project progresses, an existing baseline condition within and associated with the project area is to be established prior to the beginning of project activities. This section provides a detailed account of the baseline conditions in the project area with respect to air, water and soil quality. It also discusses about the potential impacts that might arise during the construction and operation phases of the project, along with suggestions for mitigation or reduction of the same.

10.2 Air Environment

10.2.1 Baseline Monitoring

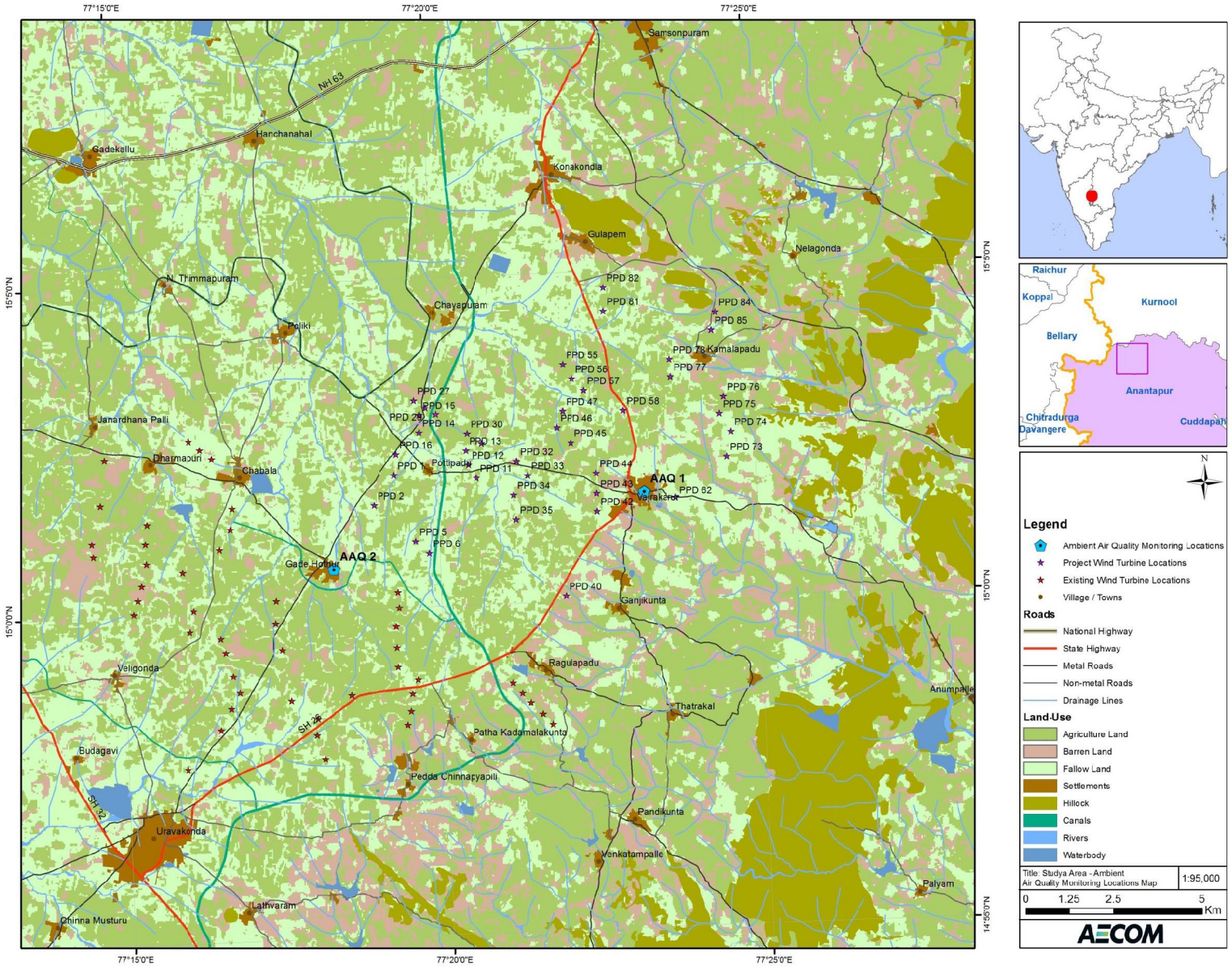
Air Quality monitoring of the project area is carried out by the laboratory division of Eco Services India Pvt Ltd, which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2005. The monitoring is based on the process detailed in IS-5182, the Indian Standard for Ambient Air Quality parameters and the Manufacturer 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 µm ($PM_{2.5}$)
- Particulate Matter having size more than 2.5 µm and less than 10 µm (PM_{10})
- Sulphur Dioxide (SO_2)
- Oxides of Nitrogen (NOx)

Air pollution due to combustion of fossil fuels in vehicles, domestic cooking and other industrial activities is reflected in the level of SO_2 and NOx, 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 two different villages, identified in the project area. The Pooling Sub Station of Suzlon at Gadehothur village (AAQ-1) is the first sampling location and Vajrakarur village (AAQ-2) is the second location. Both 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 both 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^{o}C.

Figure 10-1: Ambient Air Quality Monitoring Locations



Results

The results of ambient air quality monitoring for Gadehothur and Vajrakarur villages with respect to four parameters – PM_{10}, $PM_{2.5}$, SO_2 and NOx are provided below:

Table 10-1: Ambient Air Quality of project area

S.No	Day of sampling	Parameters	NAAQS *	Location	
				Gadehothur (µg/m^3)	Vajrakarur (µg/m^3)
1.	08-09-2015	PM_{10}	100	40.3	60.8
2.	10-09-2015			42.6	58.6
3.	14-09-2015			38.9	52.6
4.	17-09-2015			39.6	54.6
5.	08-09-2015	$PM_{2.5}$	60	13.2	15.8
6.	10-09-2015			13.7	14.3
7.	14-09-2015			11.6	12.4
8.	17-09-2015			12.4	14.6
9.	08-09-2015	SO_2	80	5.6	6.2
10.	10-09-2015			6.2	6.7
11.	14-09-2015			5.2	6.3
12.	17-09-2015			5.4	6.9
13.	08-09-2015	NOx	80	12.9	14.8
14.	10-09-2015			11.7	13.1
15.	14-09-2015			10.6	12.1
16.	17-09-2015			9.8	13.8

Source: Environmental Baseline monitoring Report – Eco Services India Pvt Ltd

**NAAQS - National Ambient Air Quality Standards by CPCB, 2009*

The comparative analysis of concentrations of each parameter in both the regions and with respect to NAAQS is provided in figures 10-1 to 10-4 below:

Figure 10-2: Observed PM_{10} levels at the air quality monitoring locations

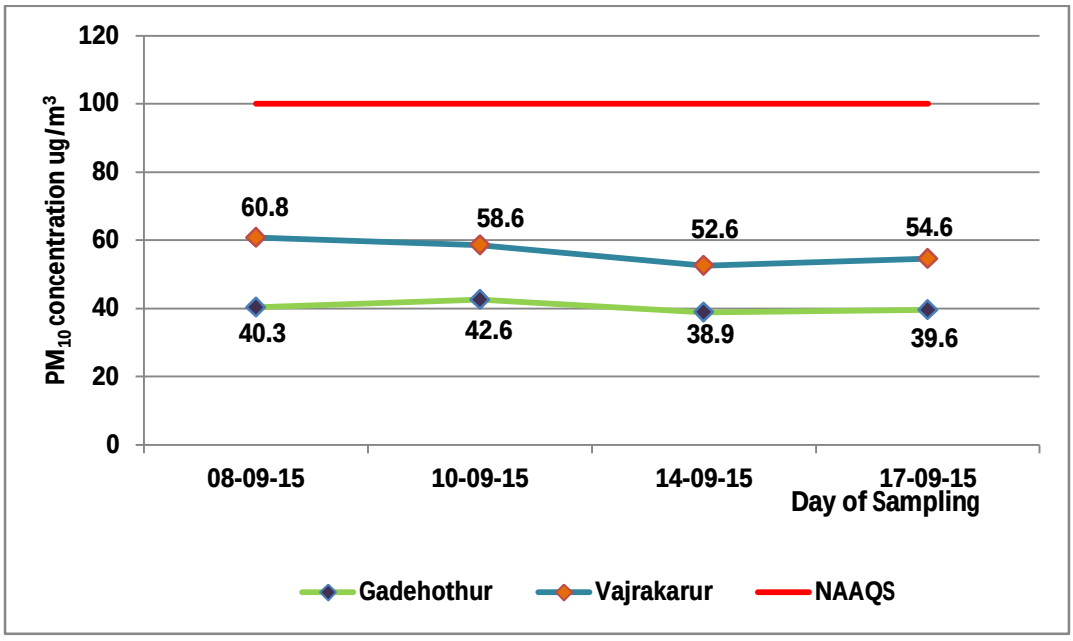


Figure 10-3: Observed $PM_{2.5}$ levels at the air quality monitoring locations

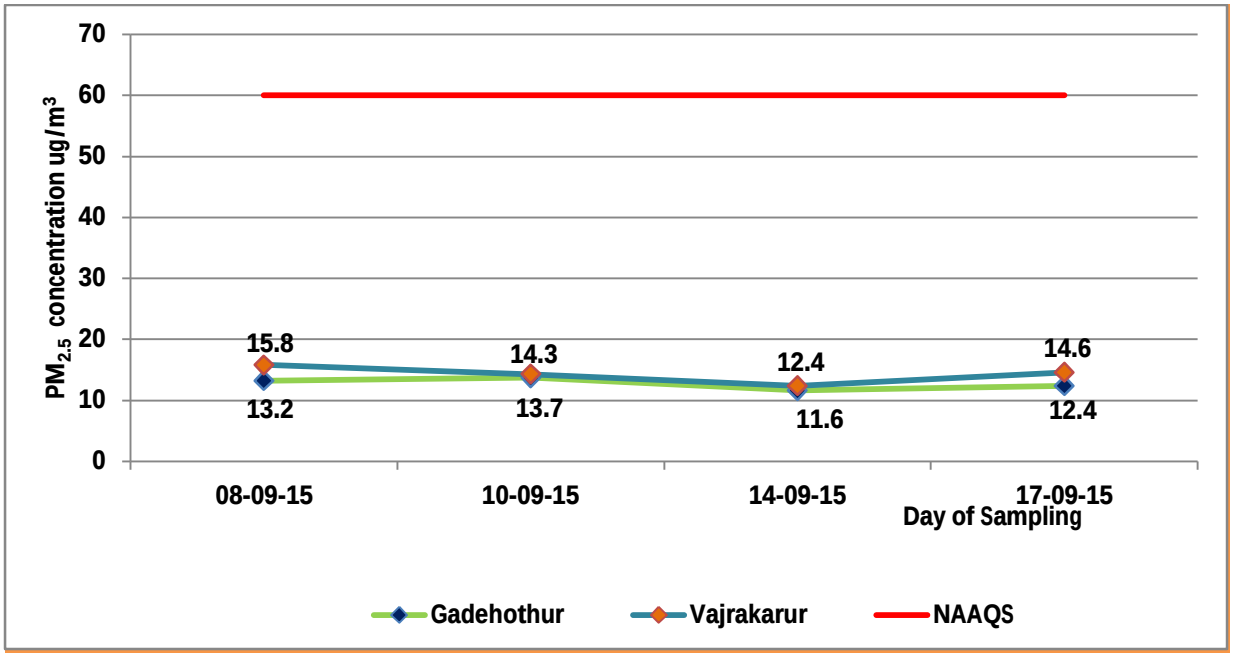


Figure 10-4: Observed SO_2 levels at the air quality monitoring locations

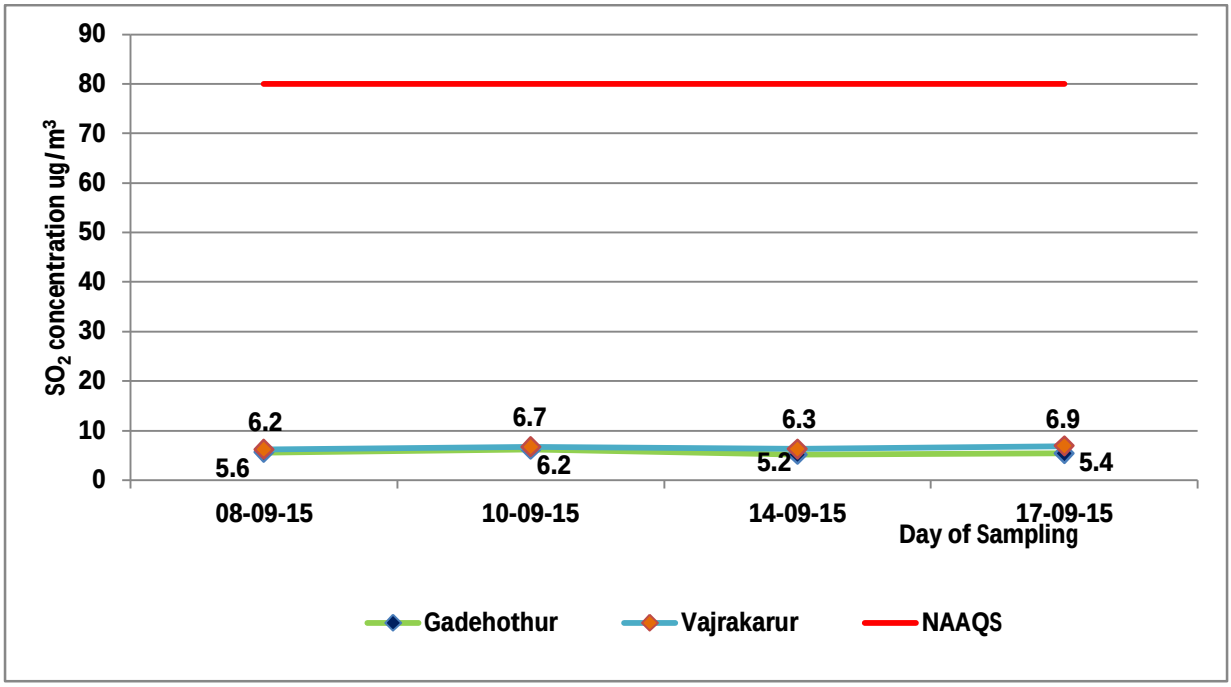
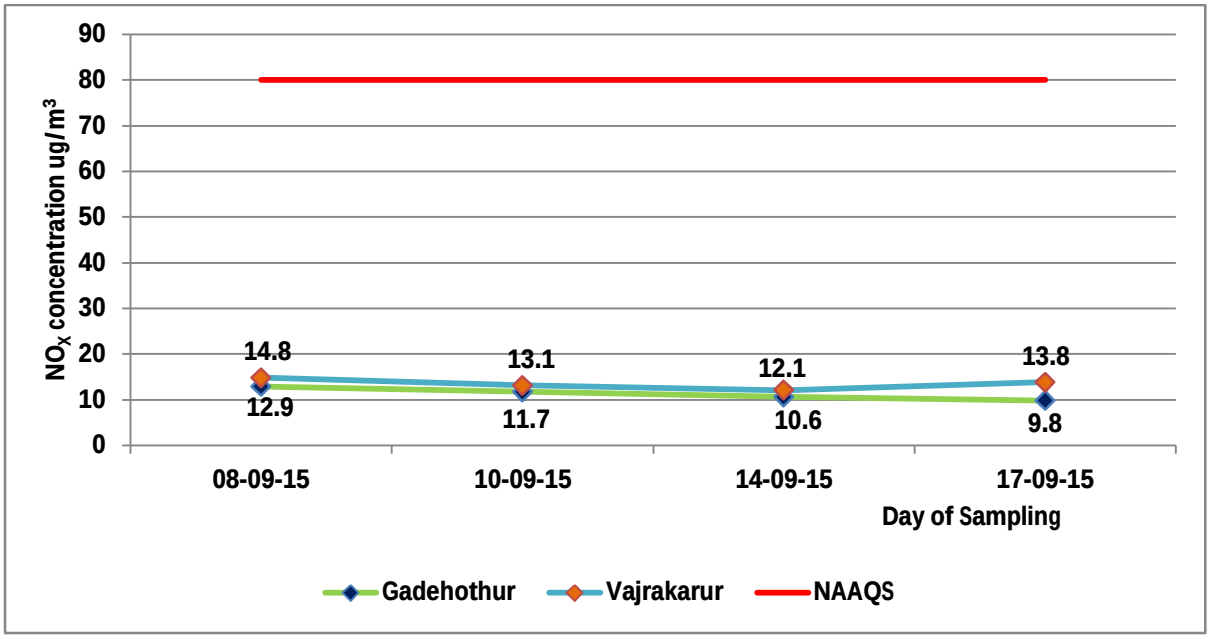


Figure 10-5: Observed NO_X levels at the air quality monitoring locations



Inference

It can be observed from Figure 10-1 to Figure 10-4 that the concentration of all the monitoring parameters (PM10, PM2.5, SO2 and NOx) in the two regions – Gadehothur and Vajrakarur, is substantially below the National Ambient Air Quality Standards (NAAQS) prescribed by Central Pollution Control Board. It was noted that even though the concentrations of these pollutants fall under the prescribed limits for both the villages, Vajrakarur has a higher concentration of all pollutants. This variation in concentration between the two villages is the highest for PM10, and it can be due to the urbanisation 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.

10.2.2 Impact Assessment – Construction Phase

- *Impacts*

During the construction phase of project, there will be direct and indirect activities which will negatively impact the environment and deteriorate the quality of air. Following are some such activities:

- Earthwork which generates dust to the highest degree
- Emissions from road traffic – While transporting filling materials and the like to the project site there are chances of dust formation, considering the small size of cement particles, sand etc., and windy nature of the region. Primary pollutant like particulate matter is also generated from re-suspended dust from roads.

- Exhaust fumes from Heavy Good Vehicles (HGV) containing primary pollutants like Sulphur dioxide and from machineries used for lifting and erection of turbine parts, diesel generators etc. Incomplete combustion of fossil fuels or oil spillage from poorly maintained vehicles, will also release pollutants

➢ *Mitigation Measures*

- To avoid spillage during transit, fine-grained and loose construction materials should be covered;
- Storage area of construction materials has to be in an area which is least wind-prone;
- Vehicles are to maintained properly by conducting regular checks to minimise the emission of pollutants from exhausts and obtaining Pollution Under Control certificate from pollution control board on a periodic basis;
- Idling time of vehicles should be minimised to the extent possible, to reduce burning of fossil fuel;
- Daily inspection of construction site to check the effectiveness of the above mentioned activities.

➢ *Impact Value*

Aspect	Scenario	Spread	Duration	Intensity	Overall
Air Quality	Without mitigation	Medium	Short	Low	**Minor**
	With mitigation	Medium	Short	Low	**Insignificant**

The construction work of a windfarm is only for a short duration of time and temporary. Hence, adhering to the above mentioned mitigation measures, the impact of project on air quality during construction phase will not substantial.

10.2.3 Impact Assessment - Operation Phase

➢ *Impacts*

The baseline air quality will not vary to a considerable extend as the operation of wind turbines doesn't involve any significant air polluting activities. Except for the minor emissions such as carbon monoxide and nitrogen oxides released from Diesel Generators during preventive maintenance period which are not likely to exceed air quality standards, there are no direct emissions from the wind turbines. Hence the overall impact on air quality during operation phase is minor.

10.3 Water Environment

10.3.1 Baseline Monitoring

The project area lies in a rain shadow region which does not benefit from either of the monsoons in an arid agro-ecological zone. In spite of being the largest district in Andhra Pradesh, Anantapur receives rainfall only in the range of 550-565 mm annually and hence faces scarcity of water. In all the villages, people mainly depend on Sathya Sai water supply 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.

Table 10-2: Rainfall in Anantapur district (Seasonal and as on 02-10-2015)

	Actual (mm)	Normal (mm)	Departure (%)	
(As on 02-10-2015)	1.4	5.8	-75%	**Scanty**
Season	3.1	12.8	-76%	**Scanty**

Source: Meteorological Centre, Hyderabad

The table below provides the rainfall received in the region during 2012 and 2013. This gives an account of rainfall deficiency existing in the region since a long time.

Table 10-3: Rainfall (mm) in Anantapur district (2012 and 2013)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2012	0.6	1.0	5.1	74	28.3	16	82.4	113.4	80.2	72.6	59.4	3.0
%Dep	**-80**	-70	-16	292	-50	-71	28	52	-38	-37	68	-74
2013	0.0	7.4	0.6	18.4	33	49.5	36.3	38.4	226.8	85.6	5.5	0.2
%Dep	**-100**	124	**-90**	-3	-42	-10	-44	-48	76	-26	**-84**	**-98**

Source: India Meteorological Department

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%.

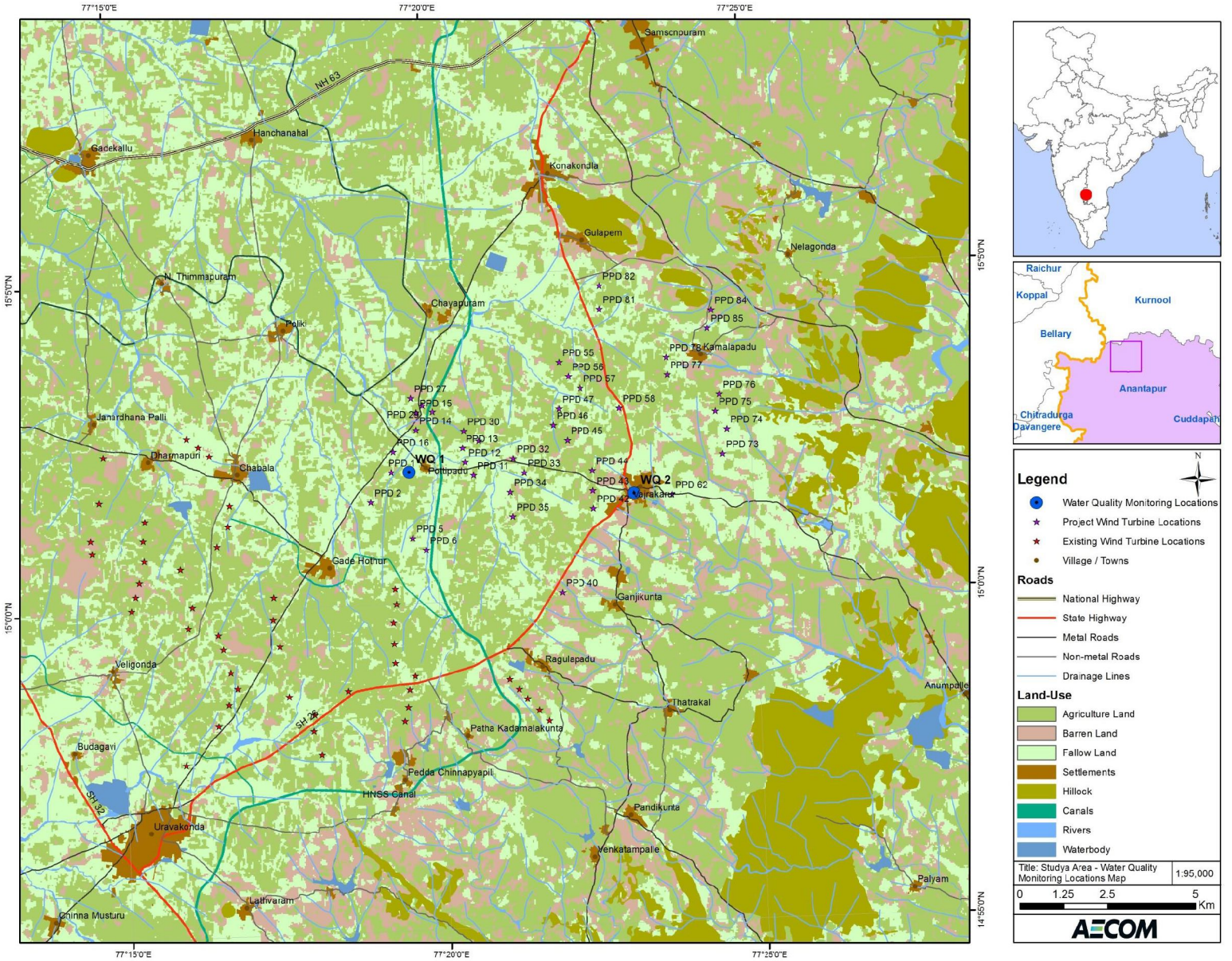
The ground water report for Anantapur prepared by Central Ground Water Board (CGWB) states that the district is chronically drought affected. Since the district has been considered a drought prone area, water conservation activities are carried out by District Watershed Management Agency (DWMA) as well as some non-governmental organisations like Rural Development Trust who has built 3053 water bodies in Anantapur. Out of the 65 mandals, 15 mandals fall in over exploited areas where the ground water development is more than 100% and hence, future development plans for ground water utilization is dim.

Even though the groundwater in the district is suitable for both irrigation and domestic purposes as per the assessment of CGWB, fluoride concentration in many locations is more than the permissible limit; and a total of 993 Fluoride affected villages exist in the district. Fluorosis is an endemic disease prevalent in 17 states of India and Andhra Pradesh is one among those where more than 70% of the districts are affected. Presence of high level of Fluoride, a reactive non-metallic element, in the blood serum and urine samples of people in Anantapur has been mentioned in many health survey reports. A study conducted by national Centre for Biotechnology Information in Anantapur district reveals that more than 43% of the inhabitants are affected by dental fluorosis and 0.4% by skeletal fluorosis.

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

1) Pond water from Pottipadu village
2) Tap water from Sri Sathya sai water supply scheme in Vajrakarur village

Figure 10-6: Water Quality Monitoring Locations



Both the samples are from surface water bodies and are examined as per the standard methods specified by American Public Health Association (APHA 22nd edition) and Bureau of Indian Standards (BIS). The Sathya Sai water supply is part of a project launched by Sathya Sai Central Trust, in collaboration with L&T and the Government of Andhra Pradesh.

Photo 10-1: Villagers collecting water from Sathya Sai water tap

Source: Picture taken during site visit

The quality of water is determined with respect to the standard values provided by the Central Pollution Control Board (CPCB), which also has the classification of water into five classes – A, B, C, D and E - as mentioned in the Table below:

Table 10-4: Water Quality Criteria

Designated best use	Class of water	Major 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 at 20°C) shall be 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism (MPN/100ml) shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen : 5mg/l or more • Biochemical Oxygen Demand (5 days 20°C) shall be 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism (MPN/100ml) shall be 5000 or less

Designated best use	Class of water	Major Criteria
		• pH between 6 to 9 • Dissolved Oxygen : 4mg/l or more • Biochemical Oxygen Demand (5 days 20°C) 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen : 4mg/l or more • Free Ammonia (as N) : 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below E	• Not meeting A,B,C,D, and E criteria

Source: Central Pollution Control Board

Results

Table 10-6 provides the result of water quality testing conducted by the NABL accredited Laboratory division of Eco Services India Pvt Ltd, on 9th of September 2015.

Table 10-5: Result of water quality testing

S.No	Parameters	IS 10500:2012 AL (PL)	Unit	Test Result	
				Pond water – Pottipadu	Sathya Sai tap water - Vajrakarur
1	Colour	5 (15)	Hazen	BDL (DL:5.0)	BDL (DL:5.0)
2	Turbidity	1 (5)	NTU	4.8	1.5
3	Temperature	-	^{o}C	25.4	25.5
4	pH	6.5 – 8.5	@ 25 ^{o}C	8.01	7.26
5	Electrical Conductivity	200 (600)	µmhos/cm	239	936
6	Total Dissolved Solids	500 (2000)	mg/l	143	592
7	Total Suspended Solids	-	mg/l	6.0	BDL (DL:2.0)
8	Total Hardness as $CaCO_3$	200 (600)	mg/l	60	488
9	Calcium	75 (200)	mg/l	14	115
10	Magnesium	30 (100)	mg/l	6	49
11	Chloride	250 (1000)	mg/l	36	40
12	Sulphate	200 (400)	mg/l	59	144
13	Iron	0.3	mg/l	1.6	BDL (DL:0.1)
14	Dissolved Oxygen		mg/l	5.9	6.2
15	Oil and Grease	-	mg/l	BDL (DL: 2.0)	BDL (DL:2.0)
16	Fluoride	1.0 (1.5)	mg/l	BDL (DL: 0.1)	1.2
17	Chromium	.05 (No relaxation)	mg/l	BDL (DL: 0.03)	BDL (DL:0.03)

S.No	Parameters	IS 10500:2012 AL (PL)	Unit	Test Result	
				Pond water – Pottipadu	Sathya Sai tap water - Vajrakarur
18	Copper	0.05 (1.5)	mg/l	BDL (DL: 0.03)	BDL (DL:0.03)
19	Manganese	0.1 (0.3)	mg/l	BDL (DL: 0.01)	BDL (DL:0.01)
20	Chemical Oxygen Demand	-	mg/l	BDL (DL: 4.0)	BDL (DL:4.0)
21	Bio Chemical Oxygen Demand	-	mg/l	BDL (DL: 2.0)	BDL (DL:2.0)
22	Nitrate	45 (No relaxation)	mg/l	BDL (DL: 0.5)	BDL (DL:0.5)
23	Alkalinity	200 (600)	mg/l	54	44
24	Phosphate	-	mg/l	BDL (DL: 0.1.0)	0.3
25	Salinity	-	g/l	0.1	0.43
26	Zinc	5 (15)	mg/l	6.2	2.2
27	Mercury	0.001 (No relaxation)	mg/l	BDL (DL: 0.0005)	BDL (DL: 0.0005)
28	Arsenic	0.01 (0.05)	mg/l	BDL (DL: 0.005)	BDL (DL: 0.005)
29	Lead	0.01 (No relaxation)	mg/l	BDL (DL: 0.005)	BDL (DL: 0.005)
30	Barium	0.7 (No relaxation)	mg/l	84	206
31	Cadmium	0.003 (No relaxation)	mg/l	BDL (DL: 0.005)	BDL (DL: 0.005)
32	Total Coliform	Shall not be detectable in any 100 ml sample	MPN/100 ml	170	<2
33	Faecal Coliform		MPN/100 ml	90	<2

(Source: Environmental Baseline monitoring ReporT – Eco Services India Pvt Ltd)

(BDL: Below Detection level; DL: Detection Level; AL: Acceptable Limit; PL: Permissible Limit)

Bureau of Indian Standards (BIS) recommends that the acceptable limit (AL) is to be implemented. Values in excess of those under acceptable render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under permissible limits (PL) in the absence of alternate source, above which the sources will have to be rejected

Value above Acceptable Limit (AL) but below Permissible Limit (PL)

Value above Permissible Limit (PL)

Inference

a) Faecal and Total coliform

Table 10-6: Presence of Faecal and Total coliform

IS 10500:2012 (Drinking water standards)	Water Quality criteria - CPCB	Pond water – Pottipadu	Sathya Sai tap water -Vajrakarur

IS 10500:2012 (Drinking water standards)	Water Quality criteria - CPCB	Pond water – Pottipadu	Sathya Sai tap water -Vajrakarur
Shall not be detectable in any 100 ml sample	Water for outdoor bathing (Class B) has maximum limit of 500 MPN/100ml	Within permissible limit of CPCB standards if the water is used for domestic purposes and not drinking.	As confirmed by the villagers of Vajrakarur, the Sathya Sai tap water is used for drinking as well. Hence, the presence of faecal and total coliform detected, even though <2 MPN/100 ml is above the permissible limit of IS 10500:2012

b) Barium and Iron

The amount of Barium in both the locations is exceeds the maximum level prescribed in IS 10500:2012 standards. Also, the concentration of Iron exceeds the permissible limit in the pond water of Pottipadu.

c) Above Acceptable Limit but below Permissible limit

In Sathya Sai tap water collected from Vajrakarur, the following parameters have crossed the acceptable limit but are within the permissible limits prescribed by Indian Standards for drinking water:

- Electrical Conductivity
- Total Dissolved Solids
- Total hardness
- **Flouride**
- Calcium
- Magnesium

Similarly, the level of zinc in pond water of Pottipadu has crossed the acceptable limit but falls below the permissible limit.

10.3.2 Impact Assessment – Construction Phase

➢ *Impacts*

- Since cement is highly alkaline when mixed with concrete, any accidental spill during transfer or site runoff contaminated with cement may lead to changes in pH of downstream surface water.
- Spillage of fuels, waste oil or lubricants from vehicles and machinery or runoff from disturbed soils may cause sediment load in underground water during the construction of drainage channels, or excavation for foundation
- Water from temporary toilets constructed for construction workers, if not properly channelized or stagnated can lead to contamination of underground water.

Considering the negligible quantities of wastewater to be generated during the construction phase, the impact on surface water due to the construction activity is expected to be insignificant.

➢ *Mitigation Measures*

- Portable toilets with septic tanks and soak pits should be provided
- If there is any leakage, drip pans should be provided in those vehicles
- Storage area for oil, cement and other construction materials should be paved and impervious with secondary containment for fuel storage tanks

➢ *Impact Value*

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Quality	Without mitigation	Medium	Short	Moderate	**Minor**
	With mitigation	Medium	Short	Low	**Insignificant**

10.3.3 Impact Assessment - Operation Phase

➢ *Impacts*

- Turbine blades are cleaned during Operation and Maintenance phase; an activity that uses a good amount of water which is approximately 2 m^3 per turbine. Waste water generated after cleaning might stagnate;
- During operation phase, few personnel like engineers and security guards will be deployed at site. Waste water from the toilets, floor cleaning and similar domestic works, if not channelized, collected and removed properly will lead to pollution of ground water.

➢ *Mitigation Measures*

- Adequate septic tanks and soak pits should be provided at site
- Septic tanks should be maintained properly and cleaned at regular intervals
- Since Anantapur is a water scarce and drought prone region, it is advisable to get water for domestic usage through authorised water tankers ; and
- The drinking water requirement for the site personnel shall be met through packaged drinking water.

➢ *Impact Value*

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

10.4 Soil Environment

10.4.1 Baseline Monitoring

It is estimated that 63% of the total geographical area of Anantapur district is covered by sandy loam followed by 14% rocky land and 19% clay. A study conducted by National Bureau of Soil Survey and Land Use Planning suggests that Anantapur not only suffers from aridity but also has soil constraints like shallow rooting depth, calcareousness etc. Since a large area of the district has coarse soil, it is highly prone to wind and water erosion and has poor water and nutrient retention qualities. The soil temperature regime is Iso-hyperthermic with a mean annual temperature of 22^{o}C or more and a difference between mean summer and mean winter temperatures of less than 5^{o}C at 50 cm below the surface. The soil moisture regime is Ustic as per the criteria given in Soil Taxonomy.

Red and black soils are predominantly present in the district. About 88% of soil has poor organic carbon and nitrogen content, 75% has medium to high phosphorus content and 94% has medium to high Potassium content. The project area in Vajrakarur has brown well drained loamy soils occurring on undulating pediments.

Soil quality testing of the project location is conducted by NABL accredited Laboratory division of Eco Services India Pvt Ltd., for which samples were collected from Suzlon's Pooling Sub-station at Gadehothur village and from Vajrakarur village. The procedure followed for testing is based on Guidelines by Food and Agriculture Organisation (FAO), United Nations and 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.

Results

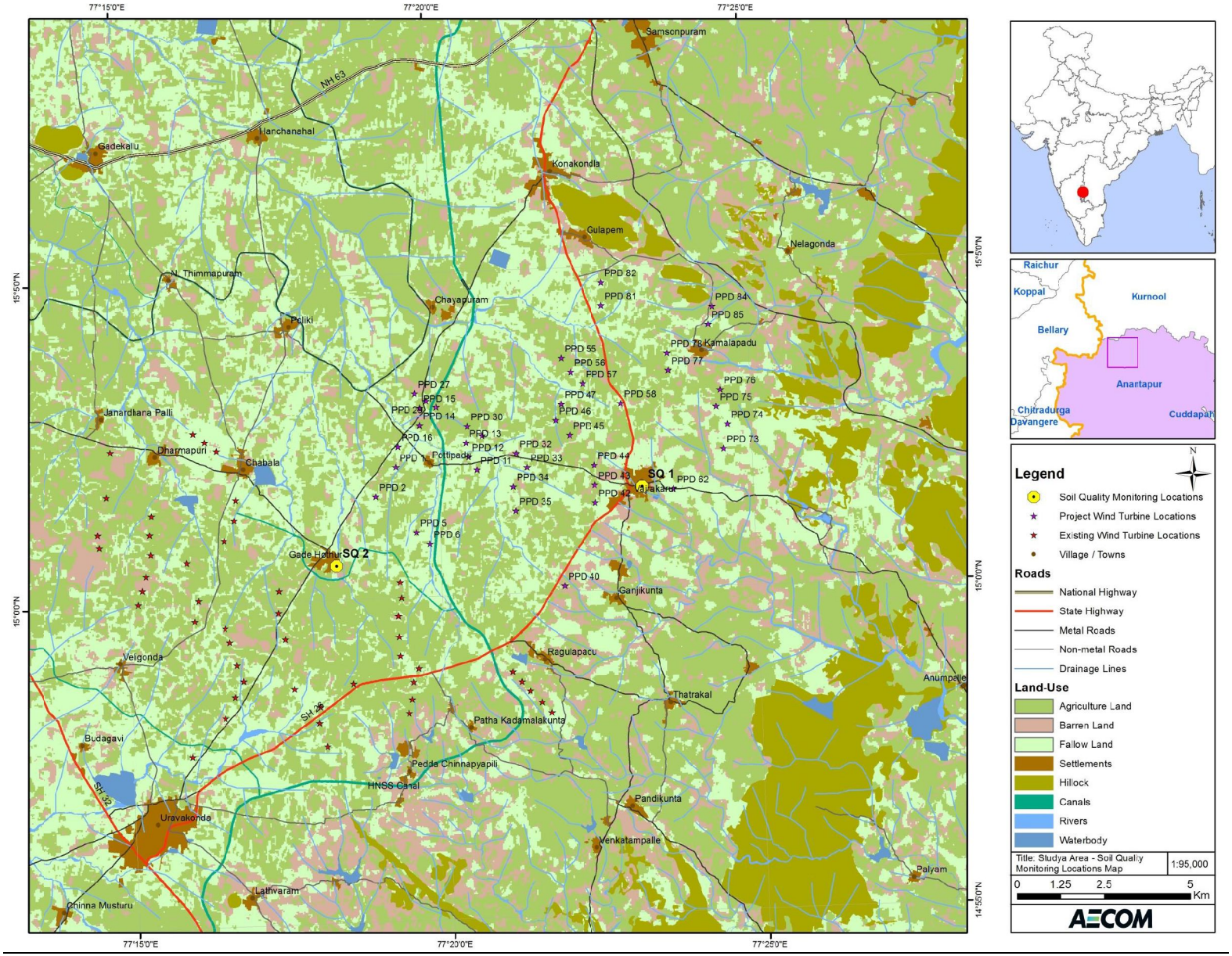
Table 10-7: Results of Soil Quality Testing

S.No	Test Parameters	Method	Results	
			Vajrakarur	Suzlon's PSS - Gadehothur
1.	pH @ 25 ^{o}C	IS 2720 Part 26: (Reaff: 2011)	7.85	7.2
2.	Electrical Conductivity @ 25 ^{o}C in µmhos/cm	IS 14767:2000 (Reaff: 2010)	2049	768
3.	Particle Size Distribution in %	IS 2720 - Part 4		
	a) 10 mm	IS 2720 - Part 4	Nil	Nil
	b) 4.75 mm	IS 2720 - Part 4	0.4	1.2
	c) 2 mm	IS 2720 - Part 4	4.6	6.8
	d) 425 micron	IS 2720 - Part 4	54.8	58.2
	e) 75 micron	IS 2720 - Part 4	40.2	33.8
4.	Phosphorus as P in µg/g	FAO, United Nations Rome, 2007	98.3	6.6
5.	Sodium as Na (soluble) in meq/100 g	FAO, United Nations Rome, 2007	1.12	BDL (DL: 0.05)
6.	Potassium as K (Soluble) in meq/100 g	FAO, United Nations Rome, 2007	0.14	BDL (DL: 0.05)
7.	Total Nitrogen as N in %	FAO, United Nations Rome, 2007	0.18	0.46
8.	Cation exchange capacity in meg/l	FAO, United Nations Rome, 2007	12.7	0.33
9.	Texture	FAO, United Nations Rome, 2007		
	a) Percent clay	FAO, United Nations Rome, 2007	54	59
	b) Percent silt	FAO, United Nations Rome, 2007	38	28

	c) Percent sand	FAO, United Nations Rome, 2007	8	13
10.	Permeability in %	FAO, United Nations Rome, 2007	24	36
11.	Porosity in %	FAO, United Nations Rome, 2007	16	10

Source: Soil Quality testing report, Eco Services India Pvt Ltd;
BDL – Below Detection Level; DL: Detection Limit)

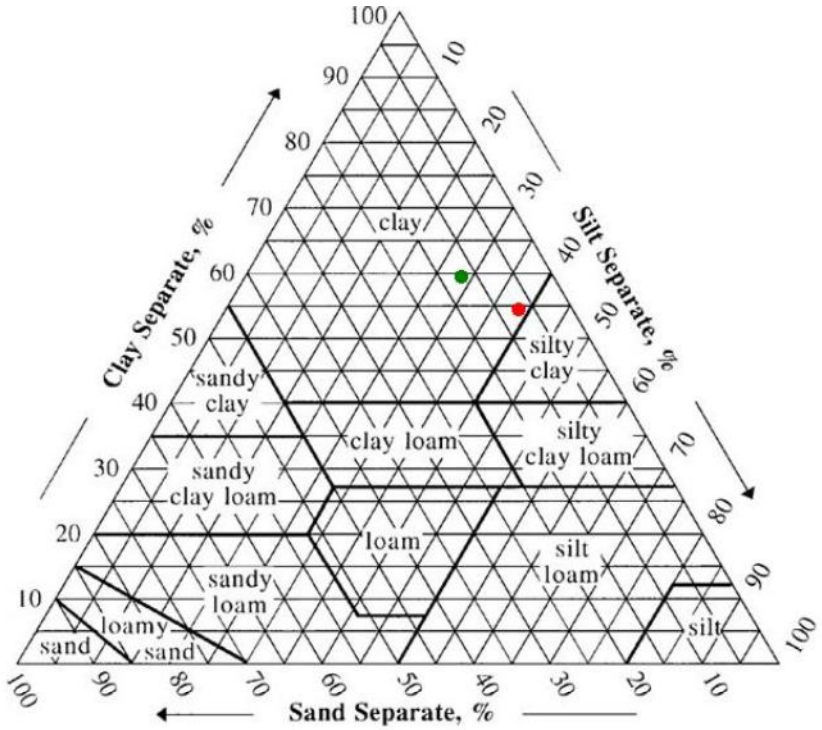
Figure 10-7: Soil Quality Monitoring Locations



Inference

Table 10-10 clearly points that the texture of soil in both the villages is silty clay. Presence of essential elements such as Sodium and Potassium are Below Detection Level (BDL). More than 50% of the particles in both the sites are in the range of 425 micron size and more than 30% is of 75 microns. Electrical conductivity of the soil in Vajrakarur is more than 2.5 times that of Gadehothur, and Phosphorous content in Gadehothur as compared to Vajrakarur is also less.

Figure 10-8: Soil Texture Triangle



Soil Texture

- Vajrakarur
- Gadehothur

Source: Soil Texture Calculator; website of National Resources Conservation Service, US Dept of agriculture

10.4.2 Impact Assessment – Construction Phase

➢ *Impacts*

During construction phase, following are the prevalent negative impacts on land/soil:

- Considerable disturbance to soil and nearby superficial geology due to activities such as excavations for foundations, construction of access roads and drainage, etc;
- Removal of existing vegetation for construction will decrease the rigidity of soil and make it loose and open to erosion. Since the region is windy, scouring of exposed soil might happen due to high velocity of wind;
- Top soils and sub soils will be extracted during excavation which will lead to loose soil generation and its subsequent dispersal by wind. Excavation can disturb the original topography of the area and consequently lead to soil erosion;

- Direct and indirect impact on the landscape of the region such as modification of initial appearance of the site, abandoning of certain parts of the site by its users due to installation of wind turbines;
- Construction debris, excavated soils or solid waste generated when workers are on site, if dumped in nearby fields will affect the quality of soil;
- Random disposal of excavated soil and construction debris in nearby fields and private land; and
- Soil contamination due to oil leaks/spillage from machinery and vehicles.

➢ *Mitigation Measures*

- Demarcate an area which is less wind-prone for storage of construction materials and should use tarpaulin sheets to avoid dispersal or kept in an enclosed space;
- Limit construction activities to months having moderate climate conditions when there is no heavy wind or rainfall, to avoid top soil removal;
- To minimise runoff, channels and drains are to be fully established and bedded as quickly as possible;
- While transporting, construction materials such as sand, cement and other such fine-grained materials should be covered;
- Construction debris and excavated material can be used for filling low-lying areas;
- Paved spaces should be constructed for handling machineries or vehicles, while refuelling etc. if there is a spillage, that portion of the soil is to be cut out and stored separately to be disposed with the hazardous waste
- Re-vegetate the area surrounding turbine locations as early as possible, to reduce the negative effect on soil; and
- All construction material shall be stored in a designated/demarcated storage area within the site and covered with tarpaulin sheet to avoid dispersal with wind.

➢ *Impact Value*

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without mitigation	Medium	Short	Moderate	**Minor**
	With mitigation	Medium	Short	Low	**Insignificant**

10.4.3 Impact Assessment - Operation Phase

➢ *Impacts*

During the operation phase, 50 turbines of 2.1 MW each are functioning at the same time. Hazardous waste such as waste/used oil and lubricants will be generated especially during maintenance works due to the presence of mechanical parts in wind turbine generators and usage of diesel generators. Improper storage, handling and disposal of these hazardous wastes can lead to contamination of soil or groundwater.

➢ *Mitigation Measures*

- Hazardous waste such as waste/used oil has to be stored in a defined space and should be accessible only to authorised personnel;
- The storage space should be an impervious paved surface and should have a secondary containment area and spill control toolkit;
- Quantity of hazardous waste handled should be clearly documented as per Hazardous Waste Management rules and documents should be updated regularly; and
- Hazardous waste should be sold to an authorised vendor from Andhra Pradesh Pollution Control Board (APPCB) on a periodic basis, documents of which should be maintained as per requirements under the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008.

➢ *Impact Value*

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without mitigation	Local	Long	Moderate	**Minor**
	With mitigation	Local	Long	Low	**Insignificant**

11. ENVIRONMENT & SOCIAL MANAGEMENT PLAN

11.1 Introduction

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

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

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

MVIPL is committed to ensure compliance to all the commitments towards Environment, Social, Health and Safety Standards while executing all the project related activities for the 105 MW Vajrakarur Wind Power Project. This ESMP is applicable to all the employees of Suzlon and the other sub-contractors if any, engaged during the project lifetime. MVIPL shall ensure that Suzlon, the O&M contractor of this project shall follow the mitigation measures and ESMP.

Social Environment Health and Safety Management System (SEHSMS)

The 105 MW wind power project is being developed by Mytrah Vayu Indravati Pvt. Ltd (MVIPL) which a 100% is owned subsidiary of MEIL. The existing corporate Social Environment Health and Safety Management System (SEHSMS) Manual of MEIL requires the company to develop project specific organizational structure in order to evaluate and manage social, environmental, health and safety issues during all stages of their project activities. The SEHSMS shall be applicable to all subsidiaries of MEIL. The corporate SEHSMS will guide the implementation at the project level compliance to the standards as committed by MEIL as a corporate entity. The Environment and Social Management Plan (ESMP) prepared here will be implemented through the proposed organizational framework. The assigned personnel shall be responsible for the EHS&S performance, implementation and communication for the project. Design, manufacture, operations and maintenance services of Suzlon have been certified as ***ISO 9001:2008*** by Det Norske Veritas-GL.

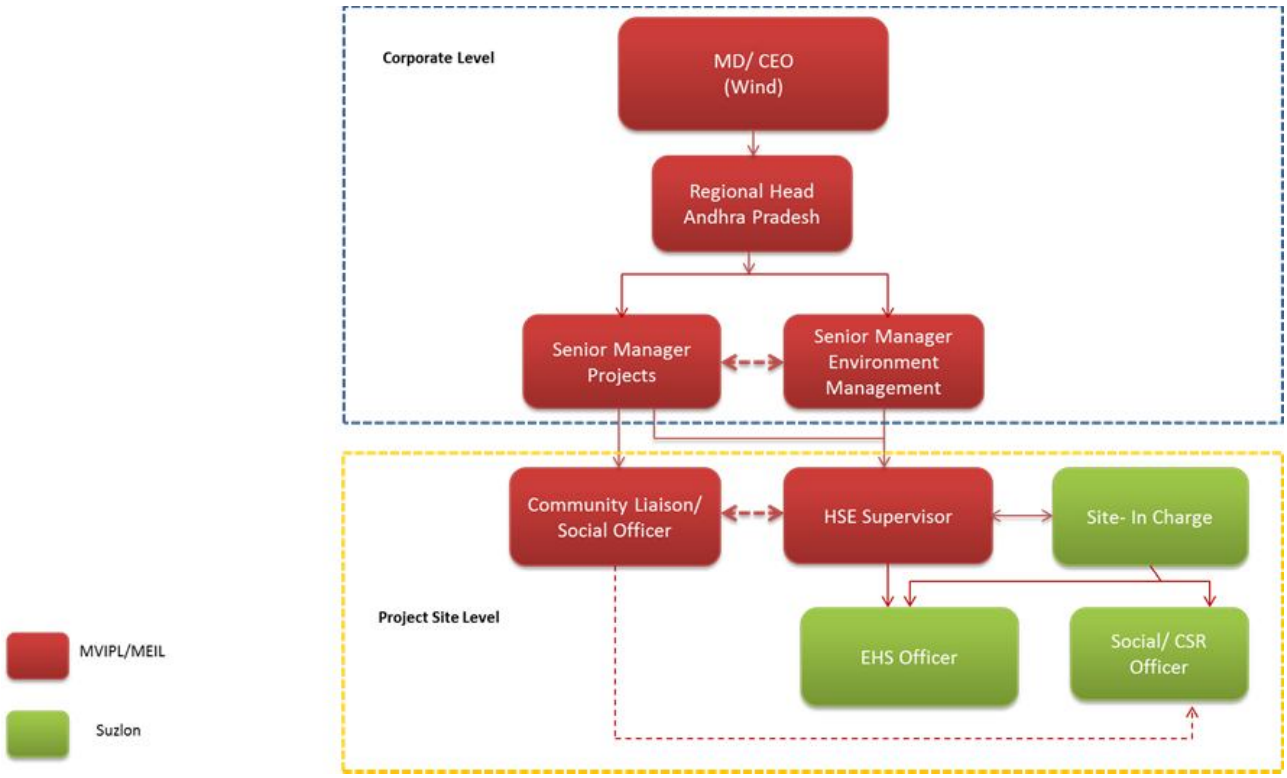
11.2 Organisational Structure

The overall management and coordination of the project will be managed through Chief Operating Officer (Wind) who will be supported by the Head of various departments like Business development, projects, asset management, finance & accounts and human resource. The Head – Projects will overview, monitor and control the activities of Site Manager and the EHS supervisor at the site. The contractors will be controlled by the Project Manager during operation phase.

The project does not attract any significant adverse social impacts or risks as indicated in the previous sections. The project footprint area is limited to its immediate vicinity and a particular range of stakeholders. It is proposed that MVIPL appoints a qualified EHS supervisor for supervising the environment, health and safety issues at the project site. The EHS Supervisor shall work in coordination with the HSE Staff of Suzlon and report to the Regional EHS Manager of MEIL. Also, major control of the project in various phases viz., land procurement, site development, obtaining statutory approvals, stakeholder engagement, compensation, CSR activities and hiring sub-contractors remains with turnkey contractor, who is Suzlon for the proposed project. Hence, a Community Liaison Officer needs to be appointed by MVIPL at project level, who will work in coordination with the Community/CSR Officer of Suzlon for managing the social (including workers and neighbouring community) issues.

The organizational structure for both site level and corporate level has been presented in figure below.

Figure 11-1: Organisation Structure



11.3 Roles and Responsibilities

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

Project Manager

The Project Manager is responsible for overall management of the project and ESMP implementation. The following tasks will fall within his/her responsibilities:

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

HSE Supervisor

The HSE supervisor will have the following responsibilities and will report to Project Manager and Regional EHS Head:

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

Community Liaison/ Social Officer

The community liaison officer will have the following responsibilities:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Undertaking community development initiatives in the project villages in coordination with Suzlon;

- Keep record of all the CSR activities being undertaken for the project;
- Keep the Regional EHS Manager informed on the progress of CSR activities undertaken at project site;
- Conduct periodic (formal and informal) meetings with local community for understanding their grievances and outcomes of the CSR activities;
- Inform the local community about the Grievance Redressal Mechanism and ensure effective implementation;
- Manage all grievances of the project and record the actions taken.

EHS Officer-Suzlon

The contractor(s) EHS officer shall be responsible for implementation of this EMP and any other environmental requirements that may be identified by the Project Manager during the course of the contract. The contractor(s) EHS officer shall have received basic EHS training either as part of the contract or previously. In addition to any other responsibilities, the general duties of the contractor's EHS officer shall be:

- Ensuring that all personnel (including sub-contractors) are duly informed of the requirements contained in this EMP, and the associated responsibilities and implications of this EMP;
- Ensuring that all records needed to demonstrate compliance with the EMP requirements are obtained, filed and readily available for inspection by the Project Manager or the Proponent;
- Consulting with the Client's HSE Officer regarding interpretation of the EMP and any other aspects of the contract that may impact significantly on the environment;
- Ensuring that all personnel demonstrate respect and care for the environment in which they are operating;
- He will responsible for imparting of tool-box training and other health and safety trainings required during different phases of the project;

Social Officer- Suzlon

- Undertaking community development initiatives in the project influenced villages;
- Planning, implementing and recording all the CSR activities being undertaken for the project;
- Managing all grievances of the project and recording the actions taken.
- Acting as a point of contact for local residents and community members;
- The contractor should develop a code of conduct to guide the employees on how to behave with the community to avoid conflicts;
- Develop a Grievance Redressal Mechanism in lines with Informing the local community about the Grievance Redressal Mechanism and ensuring effective implementation; and
- Conducting periodic meetings with local community for understanding their grievances and outcomes of the CSR activities;

11.4 Monitoring and Audit

The ESMP will have to be monitored on a regular basis in order to ensure effective implementation. The EHS team of MEIL/MVIPL, along with Suzlon, will undertake inspection and monitoring of the

environmental and social impacts of construction and operation phase activities in order to ensure the effectiveness of suggested mitigation measures.

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

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

11.5 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. The following records shall be maintained at site:

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

11.6 Required Training

The training and competence of personnel working remotely and the readiness of all necessary safety equipment in the location is needed to be assessed. Hence, MEIL/MVIPL shall ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMS and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Suzlon is responsible for ensuring that their workers are provided HSE training as stipulated. In addition to formal training, the contractor

should undertake tool-box talks. A training register should be kept on site for all training conducted onsite.

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

A basic occupational training program and specialty courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.

Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin.

Table 11-1: Training Requirements for the Proposed Project

Topic	Training Content	Targeted Audience
General Project Awareness	• Benefits of the Project • Type of land required for the project • Possible employment Opportunities	Local Communities
Environmental and Social Management training	• Purpose of action plan for the project activities; • Requirements of the specific Action Plans • Understanding of the sensitive environmental and social features within and surrounding the project areas; and • Understanding of the potential risks from the project activities;	Site Level Officers of Suzlon and MEIL/MVIPL and Contract Workers
Occupational Health & Safety Training	• The importance of conforming with all HSE policies; • The HSE impacts of the proposed activities; • HSE benefits of improved personal performance; • Worker roles and responsibilities in achieving conformance with the client's HSE policy, procedures and this EMP including associated procedures and emergency preparedness and response requirements; • Mitigation measures required to be implemented when carrying out their work activities. • Use of PPE; • Job Safety analysis • First aid trainings and awareness regarding medicines; • Fire drills and usage of fire extinguishers at the time of emergency; • Maintaining accident and incident investigation reports	Site Level Officers of Suzlon and MEIL/MVIPL and Contract Workers First Aiders and Fire Fighters

11.7 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 shall be adopted by MEIL/ MVIPL and imposed as conditions of contract of the sub-contractor(s) employed for respective phases of the proposed wind 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.

11.8 Management Plans and Procedures

11.8.1 Traffic Management Plan

The framework management plan for traffic and road safety will need to cover the following aspects that are detailed subsequently:

- Management of access and approach roads;
- Training of vehicle operators;
- Vehicle Management and maintenance;
- Community liaison safety;
- Key mitigation measures;

The project WTG locations are well connected by roads which are further connected through arterial roads to the National Highway-63, which connects Ankola in Rajasthan with Gooty, in Andhra Pradesh and locally called as Bellary-Nellore Road. The other roads near to site are:

- Village Road connecting Guntakal village and Uravakonda village;
- Vajrakarur Village road which connects Konakondla village to Vajrakarur village;

All the WTGs will be transported via NH-63 and the aforementioned internal village roads to the Suzlon yard site which is situated at Vajrakarur village and subsequently to the WTG locations. The village roads in the project area are surfaced, two lane undivided carriage roads.

Potential Impacts

The traffic density on the roads in the proposed Project area is low. However, with the commencement of the construction activities for the Project, the traffic movement will increase due to transportation of turbine components and site personnel. A yard site is stablished in Vajrakarur

village. The turbine components such as blades, tower nacelle will be brought to the yard site and will then be sent to the individual turbine locations as per the requirement.

On an average, about 7-8 trucks/trailers will be required to bring the components of one turbine. Considering that at a particular instant of time, construction works for 10 turbines will be carried out simultaneously, a maximum of 70-80 trucks/trailers will ply on these roads. This kind of traffic movement may disturb the local people/ livestock population in the area and also poses increased risks of road accidents. The possible impacts associated with road traffic movement during the construction phase of the project include the following:

- increase in traffic movement on the road network linked to the project leading to traffic congestion and delays;
- short term closure of existing transport routes during proposed construction/widening of access roads thereby causing disruption and delays in traffic;
- increase in traffic related noise and emissions;
- damage to existing roads due to heavy vehicular/ equipment movement; and
- increased probability of road accidents which may result in injury, fatalities or environmental damage

Purpose and Objective of the Traffic Management Plan

The Traffic Management Plan (herein after referred as TMP) sets out a framework for managing the movement of construction traffic to minimise the effects of traffic travelling to and from the site during the construction period of the wind farm. All contractors shall be informed about this document and shall be required to conform to restrictions, mitigations and obligations contained herein. The key objectives of the TMP are to:

- Utilise the existing roadways in an efficient manner;
- Minimise traffic congestion and consequent delays;
- Ensure safety of employees, contractors, local users including general public;
- Ensure timely completion of the proposed construction/widening of access roads; and
- Minimise disturbance to the social environment.

Applicability of TMP

This plan shall be taken in action by MEIL/ MVIL and Suzlon, all sub-contractors or any other third parties associated with the construction phase of the project. The plan shall be reviewed by MEIL/MVIPL as the construction phase progresses and modified if necessary.

Preliminary Assessment

MVIPL shall carry out a preliminary assessment of the proposed access routes which will be used to deliver the wind turbine components and other construction equipment/materials to the proposed project sites. It should include:

- Potential of the existing road infrastructure along the identified route to accommodate the transportation of components and construction equipments/materials;

- Improvements that may be required along the identified route to enable the safe passage of load deliveries and plans to reduce the delay and disruption caused to network traffic flows during the installation of the wind turbines; and
- Forecast traffic flow for construction phase.

Overall traffic management is to be monitored on a daily basis to evenly spread traffic flow during a day so as to avoid congestion and minimize chances of road accidents. All the contractors will be required to comply with statutory vehicle and speed limits with respect to width, height, loading etc.

Management of access and approach roads

On the basis of the assessment undertaken, the existing infrastructure available for the project will be reviewed and adequate measures will be taken.

- Signage shall be erected to identify site access routes and to inform motorists that local roads will be accommodating construction traffic;
- Signage warning for the site access junction locations and an advisory speed restriction of 30 kmph will be suggested;
- Widening and strengthening of the carriageway shall be undertaken where necessary, to accommodate the turbine delivery vehicle wheel tracks;
- When practicable, construction traffic movements (equipment and materials) shall be scheduled to avoid the peak traffic periods at the beginning and end of each day and other sensitive periods, in order to minimise any potential disturbance to local traffic.
- Appropriate speed limits for various motor vehicles and construction equipments shall be determined as part of the traffic management based on type of roads available;
- Alternative access routes for the transport of project construction equipments and wind turbine parts to project site shall be identified.

Traffic Management Planning

Traffic planning and management can efficiently mitigate the impacts associated with the project related road traffic. The efficient management and planning of transport will require the implementation of following measures:

- Impose and enforce speed limits on all haulage vehicles operating on haul routes;
- Establishment of safe sight distances including within construction areas;
- The movement of heavy, wide or slow-moving loads shall be planned at times when traffic volume on the roads concerned is least;
- Signage shall be put up around the construction areas to facilitate traffic movement;
- Roads along the identified route shall be kept clear of construction debris in order to facilitate smooth traffic movement;
- Regular inspection of access roads' conditions and whenever, necessary, repair of construction traffic related damages shall be done;
- Appropriate supervision shall be provided to control flow of traffic when machinery needs to cross roads;

- Information will be provided to local authorities relating to the construction period, including abnormal load traffic movement schedules;
- Training and testing of heavy equipment operators and drivers, including vision tests. Records of all such trainings shall be maintained;
- Maintaining records of all accidents involving project vehicles and implementing a traffic complaint and corrective action procedure;
- All diversions shall be constructed to the specifications of the applicable road authority and will be maintained in good drivable conditions until the completion of the re-instatement work;
- Most construction equipment and vehicles would be brought to the wind farm site at the beginning of the construction process during construction mobilization and would remain on site throughout the duration of the construction activities for which they were needed; and
- The project traffic or any project activity shall not obstruct the access to neighbouring properties;

Parking Facilities

MVIPL/MEIL along with the EPC contractor(s) shall implement the following measures for efficient parking of project vehicles.

- A detailed plan for signage around the construction areas shall be prepared and implemented in order to
    - Facilitate traffic movement;
    - Indicate location of parking facilities;
    - Provide directions to various components of the works; and
    - Provide safety advice and warnings.

  All signs shall be posted in both English and the local language (Telgu).

- Dedicated parking area shall be provided around the project site for parking the private vehicles owned by construction personnel and other onsite staff; and
- Temporary concrete paved areas will be provided for parking of vehicles and overhaul provisions will be made for any accidental spill of oil or fuel during parking or whenever the vehicle is idling.

Vehicle Management and Maintenance

In order to minimise the accident rates and the overall transport fuel consumption, it shall be ensured that the vehicle fleet working is maintained according to the manufacturers' specifications. This shall include the compliance of all vehicles with all safety related specifications (such as the fitting of the correct tyres, with adequate reserves of tread, safe for movement in snow areas, inflated to manufacturer recommended levels), as well as mechanically maintaining vehicles to manufacturer specifications so as to minimise fuel consumption as well ensure safety on road.

Suzlon shall ensure the following in respect to vehicle maintenance, noise and emission standards:

- All vehicles shall be maintained so that their noise and air emissions do not cause nuisance to workers or local people, It shall be ensured that their mufflers or silencers are in proper working condition;

- An up to date database of all vehicles and construction equipments deployed across various project component locations will be maintained. The database will contain details about the periodical maintenance, schedule of maintenance, vehicular emission and noise emission testing done as per Indian regulatory requirements, copy of PUC certificates etc.;
- New vehicles/equipment purchased 'as new' after contract award shall comply with emission standards in force on the purchase date;
- Older vehicles/equipment not purchased 'as new' after contract award shall be maintained so that noise and air emissions levels are no greater than when the vehicle/ equipment was new.
- Avoidance of passage through and near settled areas during night time hours;
- Oil and fuel leaks must be addressed within 24 hrs of observation or reporting on any vehicle or construction equipment;
- Vehicle maintenance and management parameters will form a critical component of key performance indictor for the contractor responsible to maintain their vehicles;
- All heavy vehicles like cranes, battery operated trolleys etc. will be provided with reversing siren.

Roles and Responsibilities

The effectiveness of TMP depends on how well it's implemented by the management and adhered to by the employees. The roles and responsibilities specific to the plan have been described below. Both, MVIPL and Suzlon need to take up the roles and responsibilities as defined for effective implementation of the plan.

MVIPL's and SUZLON's Responsibilities

- Communicate the contents and requirements of TMP to all the associated personnel and contractors managing transport operations and fleet;
- Secure from the project contractors and maintain an updated list containing details of transport vehicle fleet and its corresponding environmental regulatory compliance details with respect to emission and noise;
- Conduct workforce training programmes and ensure that all personnel are aware of their responsibilities;
- Coordinate internally with contractors to minimize traffic generation;
- Implement appropriate inspection and monitoring programme;
- Determine corrective action for non-compliance and identify opportunities for continuous improvement;
- Obtain and update the necessary on-road and off-road permits from concerned regulatory authorities; and
- Ensure a proper record keeping and reporting system.

11.8.2 Crane Safety plan

A crane is a type of machine, generally equipped with a hoist, wire ropes or chains, and sheaves, that can be used both to lift and lower materials and to move them horizontally. It's mainly used for lifting heavy things and transporting them to other places. In the proposed wind farm project cranes will be used during the erection and commissioning phase of the WTG's and for installing the turbine components while erecting the towers.

During crane operation in windy conditions and especially during lifting loads, the influence of the wind must certainly be observed. Before starting work the crane operator must determine the expected maximum wind speed at the site.

Cranes are designed and tested for lifting heavy loads to great height. Hence, they involve a risk of catastrophic accidents if safe operating practices are not adhered to. The possible consequences of a crane failure include:

- Loss of life;
- Short/Long term disruption in the project;
- Payment of insurance and compensation costs by the project proponent/crane manufacturer; and
- Litigation costs (if any)

The Crane safety measures/guidelines that must be implemented with respect to this project have been described in the following section.

Table 11-2: Crane Safety Plan

S. No.	Safety Aspect	Precautions/Safety Measures to be taken
1.	Equipment Requirements	• It shall be ensured that every crane 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 crane and easily visible to operators when they are seated at the control station. • The crane shall be equipped with an automatic safe load indicator and every crane shall be clearly marked for its safe working load. • Crane operator cabin shall be provided with suitable seat, foot rest and protection from vibration. • The cabin shall have adequate ventilation and be equipped with a suitable fire extinguisher.
2.	Operator Training and Certification	• The crane operators must be physically fit and thoroughly trained and competent enough to operate the specific type of crane. • The operators must possess certificates indicating their competence or they shall be trained/tested for the operation of the specific crane used in the project prior to commencement of construction.
3.	Wind/Weather Considerations	• It shall be ensured that recommendations pertaining to wind (speed, direction) as mentioned in component/crane manufacturer's chart is strictly adhered to. • Wind speeds at the time of operation shall be determined using a boom tip anemometer. • A lightning safety plan shall also be in place.
4.	Communication	• It shall be ensured that qualified, designated people are assigned the responsibilities required to safely and properly signal the crane to components into place. • Proper methods/ tools (e.g. hand signals, radio) shall be used for signalling purposes.

S. No.	Safety Aspect	Precautions/Safety Measures to be taken
5.	Ground Pressures and Travel Routes	• The bearing capacity of the ground shall be determined prior to lifting of heavy loads. • During all major component lifts, crane mats shall be placed on top of the crane pad to minimise the damages to be incurred.
6.	Crane Travel Limits	• All cranes shall have a published chart indicating the operating guidelines for moving the crane. • Considerations for the maximum percent grade, side slope and boom position shall be accounted for when planning the roadways and especially when moving the crane. • All overhead obstacles shall be discussed prior to marking the safe travel route for the cranes.
7.	Lift Area Control	• A safe zone for all non-essential personnel shall be established once the crane is ready to make a lift. • Essential personnel operations shall be planned and supervised so that no one is working under the boom or lifting component.
8.	Lift Plans	• Lift plans shall be provided for each major component lift to the crane operator prior to performing the work. • Operator shall keep the lift plans on hand to ensure that each lift falls within the plans made. • Lift plans shall have basic information such as crane configuration, component weights, rigging requirements and weights, crane capacities, crane pad requirements etc.
9.	Required PPEs	• No harness and lanyard is required on the tower portion of the crane, within the operators cab or on the counterbalance jib; however, a hardhat must be worn when at any location on the crane (except in the operators cab).

MVIPL/ Suzlon Responsibility

MVIPL and Suzlon have the following responsibilities with respect to crane safety:

- Implement all the safety measures as mentioned in the crane safety plan.
- Supervise the crane operations to ensure that the safety measures are strictly adhered to.
- Conduct periodic inspection of the cranes employed in the project

During inspection, HSE officer of MVIPL/Suzlon must check that:

- All the cranes deployed in the project have a valid *Certificate of Fitness* as prescribed under Section 56 of The Central Motor Vehicles Rules, 1989.
- The certificates of fitness are as per the format prescribed under Form 38 of the aforementioned rules.
- The crane has been provided with a Load Safety Certificate.
- The equipments/components of the deployed cranes are in good condition and not subjected to loads greater than the limits mentioned in the load chart.
- The safety measures mentioned in the plan are strictly adhered to.

Crane Driver's Responsibility

There are a number of basic protocols to be enacted as control measures: -

- Maintaining full concentration at all times, not being distracted;;
- Driving to suit the road & weather conditions;
- Speed limit will be the third aspect if the first two are considered carefully;
- Not using mobile phones whilst driving; and
- Ensuring crane is in good working order & reporting faults.

11.8.3 Stakeholder Management Plan

MVIPL should commit to the following principles for effective and long term engagement:

- Providing information in advance of consultation activities and decision making;
- Providing meaningful information in a format and language that is readily understood and tailored to the needs of the target stakeholder group(s);
- Conducting information disclosure and consultations for disseminating relevant information related to the proposed project;
- Establishing two way dialogue between both sides to provide opportunity to exchange views and information;
- Establishing clear and simple mechanisms for responding to concerns, suggestions, and grievances; and
- Incorporating, where appropriate and feasible, feedback into project or program design, and reporting back to stakeholders.

Stakeholder Identification

The stakeholders for the project 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 need to be identified based on potential impact from all related facilities associated with the project including associated facilities, transmission routes etc. The characteristics that have been taken into consideration while mapping the stakeholder constitutes the following:

- Stakeholders who will be affected by the potential environmental and social impact;
- Stakeholders who oppose or support the project changes, if any;
- Department of government which are relevant to the project; and
- Stage of the project development is which stakeholder to be engaged.

The following stakeholders have been identified for the proposed wind farm.

S. No.	Types of Stakeholders	Description	Groups + Individuals
1	Direct Internal Stakeholders	Direct internal stakeholders comprise the parent company or the project proponent and the employees of the company that are directly controlled by the parent company.	• All Employees of MVIPL and MEIL
2	Direct External Stakeholders	Direct external stakeholders comprise the project affected people, local communities, third party contractors, supply chain and financial intermediary who are directly affected by the project activities but are not directly controlled by the project proponent.	• Land Owners of private land and their families • The EPC Contractor (Suzlon) • The lending Agency • Sub- Contractors hired by Suzlon • Contracted Workers
3	Indirect External Stakeholders	Indirect external stakeholders comprise of those stakeholders who fall within the external group such as those involved in institutions or agencies concerned with managing the resource or those who depend at least partially on the business generated by the resource.	• Local Population residing in the 7 identified Project Villages • Local Government Authorities (Sarpanch of the village) • Andhra Pradesh Pollution Control Board (APPCB) • New & Renewable Energy Department Corporation of AP limited (NREDCAP) • National Institute of Wind Energy (NIWE) • Local Media

Stakeholder Analysis

Stakeholder analysis supports project developers in their assessment of the project environment and their negotiating position, and it can help them to make decisions regarding stakeholder involvement. After identification of relevant stakeholders, they are analysed in terms of their importance during the project life cycle and has been categorized into stakeholders who need to engage regularly, important players and stakeholders of low significance. The stakeholders have been analysed in table below.

S. No	Categorization of Stakeholders based on Significance	Stakeholders relevant to the project
1.	Important Players	• MEIL and MVIPL • The lending Agency • EPC Contractor (Suzlon)
2.	Stakeholders need to engage regularly	• Land owners of private land and their families • Local Population residing in the Project Villages (seven) • Local Government Authorities (Gram Panchayat) • Contracted Workers • Sub- Contractors hired by Suzlon
3.	Stakeholders with low significance	• Andhra Pradesh Pollution Control Board (APPCB)

S. No	Categorization of Stakeholders based on Significance	Stakeholders relevant to the project
		• New & Renewable Energy Department Corporation of AP limited (NREDCAP) • Local Media

Process of Information Disclosure

Disclosure of relevant project information helps communities and other stakeholders to understand the risks, impacts and opportunities of the project. MVIPL/ Suzlon should ensure that local community has access to relevant information regarding the project which can be in form of documented Environmental and Social Assessments and Action Plans (i.e., Environment and Social Management Plan, Stakeholder Engagement Plan etc.). The key information that should be disseminated to the community is:

- The duration of proposed project activities;
- Any risks and potential impacts on such communities and relevant mitigation measures;
- The envisaged stakeholder engagement process; and
- The grievance mechanism.

Methods of Communication

Communication of information pertaining to the project and its disclosure depends upon type of stakeholder identified.

Direct Stakeholders

MVIPL should document the procedures for determining and awarding compensation which

- Identifies all affected people;
- provides an inventory of affected assets;
- Describes the methods applied for valuing land and other affected assets at full replacement cost;
- Indicates the rates of compensation to be paid;

MVIPL should summarize this information for public disclosure to ensure that affected people understand the land acquisition procedures and know what to expect at the various stages of the transaction (e.g., when an offer will be made to them, how long they will have to respond, grievance mechanism). MVIPL should provide the affected households and communities the opportunity to participate in the negotiations based on the established procedures.

At the stage of construction, communication with citizens will be primarily focused at collection and examination of grievances which may be submitted due to nuisance of construction works or increased traffic. At the operational stage of the proposed project the company will maintain routine provision of information about wind farm performance to local citizens.

Indirect Stakeholders

Internal stakeholders (with focus on direct and indirect workers) will be informed using the existing communication channels and following the rules of internal communication. The routine

communication channels comprise: meetings, e-mails, trainings, flow of information through the management chain. The disclosure of information can also be undertaken through to external stakeholders (non-governmental organization, neighbouring communities) will take place in response to direct queries, complaints or objections received. Electronic versions of documents such as ESIA report; Environment, Health & Safety and Social Policy; Environment Management Plan; Social Management Plan will be made available at the company's website.

The tools and techniques that can be adopted are given in the following:

- Public/ General Meetings: This tool can be utilized to disclose information on a large scale involving the stakeholders on regular basis. A schedule of the meeting can be circulated well in advance and discussions can involve feedback session from the stakeholders. Once the meeting concludes, minutes of the same should be kept as a record with the site office and a copy given to the village head, where meeting is conducted.
- Focus Group Discussion (FGDs): conducting of FGDs is important for a particular group of stakeholder on issues related to the project activities. It can be used to understand the needs, perceptions, concerns of the group.
- Participatory Workshop: Participatory workshops are meetings which enable local people to analyse, share and enhance their knowledge to plan, manage and evaluate development taken place through leaflets, posters and visual presentations.
- Participatory Rural Appraisal (PRA) Techniques: PRA techniques are usually adopted to emphasize local knowledge by enabling local people to make their own appraisal about the activities to be undertaken for the development of wind farm.

Stakeholder Engagement

Stakeholder engagement is an on-going process which is to commence at the earliest stage of project planning and continue throughout the life of the project cycle. The process should be free of manipulation, interference and to be conducted on the basis of timely, relevant, understandable and accessible information.

Stakeholder engagements during the pre-construction, construction and operations phases of the project are determined both by various activity schedules that the project demands and the commitments defined within the specific requirements including the following:

- Considering the commitments to continuous reporting to the stakeholders throughout the life of the project;
- The need for local community based engagement and dissemination of information about the project; and
- Identifying the need to keep the community ready and engaged on the project

Initiation of Stakeholder Engagement

AECOM undertook a site visit in August 2015 and held consultation exercise with the local population around the project. As of that date, the project was observed to be in a construction phase where land owners have been approached for land procurement required for WTG locations and access roads. Till that date, the stakeholder engagement was managed by the land team from

Suzlon in an informal manner and the discussions were limited to land owners who have given their land for the project.

In order to ensure the efficient implementation of the proposed ESMP and communication with identified stakeholders including local villagers from the project villages, the process shall be formalised through a designated social representative as defined in the proposed organisational structure of the Project.

The two important elements of stakeholder engagement will be disclosure of information and consultations. This implies that as a first step, the findings of the ESIA, especially the ESMP shall be disclosed to the community. Further, the community should be regularly updated about the implementation of the ESMP and all other relevant information pertaining to the project. The stakeholders shall also be made aware of the available job opportunities from time to time.

MVIPL shall undertake stakeholder consultation and disclosure meeting after finalizing alignment of transmission line and access pathway routes. All stakeholders will be informed about the proposed alignment of the transmission line and access road along with details of ROW required. However, compensations and other negotiations shall be undertaken at individual basis. The stakeholder meeting shall be undertaken at location(s) convenient to the stakeholders along the route of transmission line or access road.

A Corporate Social Responsibility (CSR) plan is required to be formulated after consultation with the local villagers and village panchayats. Based on the need assessment undertaken by AECOM, the following activities are recommended to be a part of the CSR plan that may be developed by MVIPL/ Suzlon.

- Development of roads and their upkeep which will be utilised during installation and maintenance activities of WECs, subsequently and benefit locals as well;
- Creation of alternate employment opportunities;
- Availability of portable drinking water utilizing RO plant in the project villages;
- Establishing of vocational training centres for women offering courses like stitching, knitting etc., which can benefit them to generate income and become self-sustainable.

The proposed way-forward for community engagement is provided in the table below. This comprises of further steps to be taken for engagement of relevant stakeholders that are planned throughout the project lifetime.

Stakeholder Engagement Process
Land Purchase (transmission lines)
• MVIPL and Suzlon shall engage in direct communication with the land contributor families before signing land sales/ lease deeds; • The land contributors shall be made aware of the compensation. • Formal stakeholder disclosure meeting (s) to be undertaken to disclose the alignment and land requirement for transmission lines; • All concerns of the stakeholders to be recorded and responded.
Pre- Mobilisation
• Consultation with village panchayats about movement of heavy vehicles; • Information on route and timing of vehicle movement to be provided to village administrations;

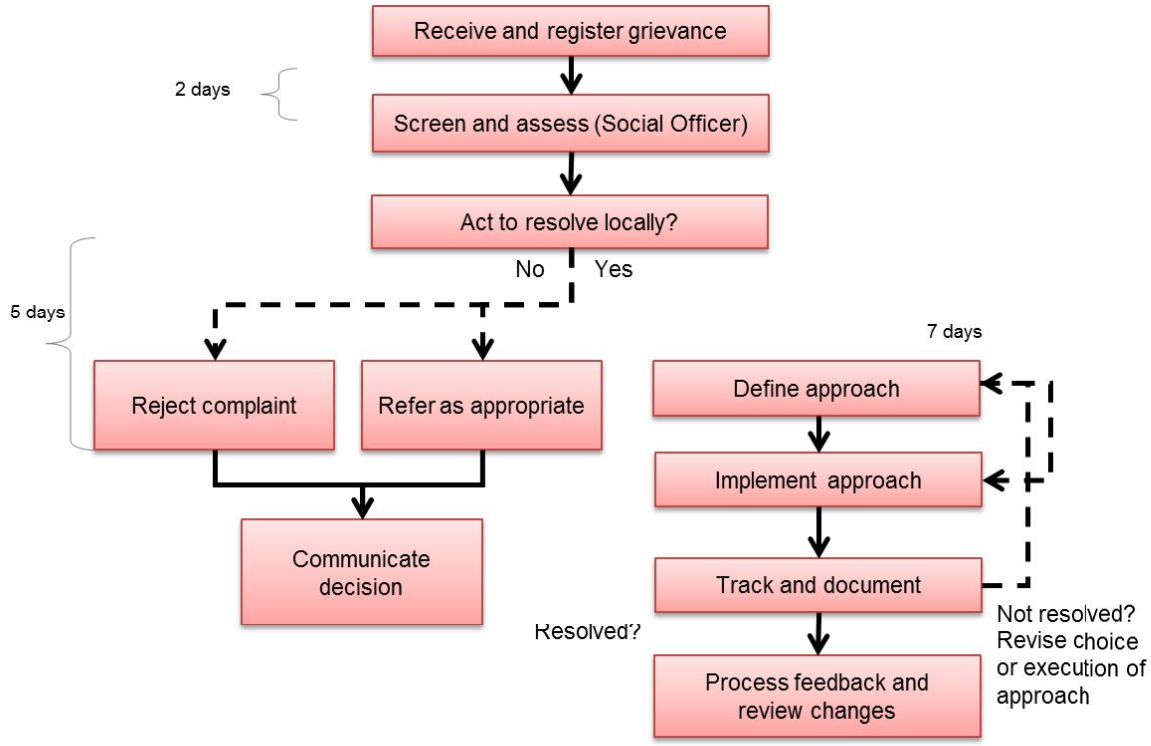
Stakeholder Engagement Process
• All villages will be informed about the commencement of construction work and available job opportunities.
Construction
• Recruit local villagers for work; • Set up a grievance redress mechanism and inform the community about the procedure; • Discuss the management plan with the community and incorporate the comments.
Operation
• Engage in community welfare programs; • Engage with community to prepare a CSR plan; • Contribute towards the welfare of village places of worship, infrastructure facilities such as schools, hospitals and water reservoirs etc ; • Hiring locals with appropriate skills for security guard job role, vehicle drivers, canteen facilities etc. • Record and address grievances of the community.
De-commissioning
• Decommissioning plan to be informed to the stakeholders at least four months prior; • Inform community about movement of vehicles and labour requirement; • Engage local labour in demobilization; • Record and address grievance of the community.

11.8.4 Grievance Redress Mechanism

MVIPL should establish a Grievance Redressal Mechanism that is managed by a representative appointed by the organization, who would be responsible for recording, directing and redressing grievances of stakeholders. The Grievance Redressal procedure will also outline the process and steps to be taken and the time limit within which the issue would need to be resolved to the satisfaction of the complainant. The project will endeavour to get all complaints recorded and addressed in a uniform and consistent manner. For disputes that cannot be internally resolved, the project will set up an independent mechanism with representation from community, Panchayats and locally respected citizens of the area to sort these conflicts. If it has a legal implication the district administration will be approached.

A Grievance Redress Committee shall be set up which shall include members from MVIPL, Suzlon and Local village panchayat. The Committee will convene meetings on monthly basis and take steps to redress the grievance. A flow chart illustrating the grievance handling procedure is proposed below figure.

Figure 11-2: Flowchart showing the grievance handling procedure



Grievances can be lodged directly (verbally) or in written format in a complaints register to be kept at the project office. The notices to be published informing the public of construction works, it should also give details of what to do if there is a problem or concern. The grievance/complaint register shall record the following:

- Date when the grievance was recorded;
- Name of the person with the grievance/complaint;
- Information on proposed corrective action communicated to complainant; and
- The date the grievance was closed out.

As shown in the flowchart all grievances shall be treated as confidential and without prejudice. They shall be acknowledged within five-six days and responded to within two weeks or more quickly in cases where there is specific urgency (7 days).

MVIPL/ Suzlon shall take care of the following:

- All relevant stakeholders and onsite workers should be aware of whom to approach for reporting a grievance and the support and sources of advice that are available to them. All staff of both the Suzlon and MVIPL must be familiar with grievance procedure and respective timelines;
- Stakeholders notifies the company via the Social Officer or Site In charge directly on the concerns and issues relating to the project activities;
- Any labour with concerns pertaining to onsite work such as sanitation, terms of employment, wages paid etc. may register their complaint in writing to the nominated persons at site;

- Secured Grievance boxes shall be placed at specific public place within the community and the site offices;
- If the stakeholder wishes to remain anonymous, he/she can write down the grievances and drop it in the available complaint boxes;
- In case of verbal complaints, labour or any other stakeholder will approach Social Officer or Site in Charge of contractor, who will enter the grievance in the grievance register; and
- Once a complaint has been received it shall be recorded in the complaints log register or data system.

The grievances redress mechanism (GRM) shall be documented in English and Telugu and copies shall be kept at the project site office and corporate office. The GRM is also to be displayed at notice board at the project site office and training on the GRM shall also be provided during induction.

MVIPL to ensure that the contractor would keep the workers informed about the grievance mechanism at the time of recruitment and make it easily accessible to them. All the relevant contact numbers to be made available to them. The mechanism to address concerns promptly, using an understandable and transparent process and provide timely feedback to the concerned Stakeholders.

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
Construction Phase					
1.	**Land procurement; and Site Preparation**	• Row for Transmission lines • Loss of ground vegetation	• Details of associated facilities, i.e. transmission line and access road shall be discussed with the locals from project villages and the local community; • It shall be ensured that the Land owners is provided with complete information about the project, including relevant details such as the lifespan of the project, its associated risks, impacts and benefits prior to sale agreements with them; • All sale/ lease deeds shall be in the local language (Telugu) and the land contributors shall not asked to provide on signatures on deeds in other languages such as English. • Re-vegetation shall be undertaken by MVIPL once the site preparation activities are over; • It shall be ensured that native vegetation species shall be planted; and • It shall be ensured that excavated areas shall be guarded properly which can otherwise lead to accidents. Suzlon shall also demarcate certain areas for grazing in order to prohibit animals straying into turbine locations and transformer yards during project operation. • Minimize presence of ancillary structures on the site by minimizing site infrastructure.	Monitor the land procurement process and compensation paid on monthly basis. Maintain a record of all sale deeds executed. Monitor excavated areas which are needed to be cordoned off. Monitor the site preparation activities on weekly basis and document the progress.	Project Manager of MVIPL/ Social Officer of MVIPL/ Social(CSR) Officer of Suzlon
2.	**Traffic Disturbance**	Dust Emissions; Disturbance from traffic movement; Increased probability of road accidents	• Project transportation through community areas shall be avoided to the extent possible; • The routes for transport of construction material for road development shall be finalized conducting a survey of the existing road conditions; • The transportation of WTG components shall be avoided during peak traffic flow phases as identified during traffic volume survey; • Routes shall be planned along wider and less-restrictive	Monitor Vehicles PUC certificates and Training Records of Drivers Engaged on quarterly basis Monitor implementation of traffic management plan on monthly basis.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			roads. Where road widths are insufficient, either temporary widening of the road with gravel or full depth widening of the pavement structure will be undertaken; • Widening of shoulders and development of new roads will be discussed with the community and undertaken only after all concerns are addressed; • All vehicles engaged for transportation shall be verified for fitness and valid Pollution Under Control (PUC) certificates issued by registered authorities; • Any incidence of breakdown shall be attended immediately to ensure smooth flow of vehicle along the road. Movement of vehicle shall be restricted to the identified routes and only trained drivers shall be employed; • High noise generating construction activities shall not be carried out during night time; and • All public utilities like power transmission cables, telephone cables, water/sewerage lines, drains, tube wells etc. falling within road land width shall be inventoried, and arrange for relocation /shifting to adjacent areas in consultation with the respective agencies/authorities and community. • MVIPL will ensure implementation of the ***Traffic Management Plan*** for minimizing community disturbance due to WTG components and material transportation.	Document any incident or near miss	
3.	**Labour Engagement**	Conflict among workers Use of community facilities	• Community expectations for employment and other local benefits need to be addressed and managed by the project proponent. • Regular updates on opportunities and skill requirements shall be provided to the community; • Assess the exact number of workers to be required at each stage in the construction period and notify the community about number of labourers and skills required; • The construction workers shall be instructed about their	Legal Register maintained by the Construction Contractor -Record of wages given to Labours - Age of Workers to be maintained to ensure no engagement of child labour. Details of any awareness programmes conducted for	Project Manager of MVIPL/ Social Officer of MVIPL/ Social(CSR) Officer of Suzlon

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			behaviour and interaction with the local community or other workers; • To the extent possible sourcing of construction labour (masons etc.) shall be done from local region; • Ensure local contracting and vendor opportunities as far as possible; • Avoid using any community infrastructure facilities like water bodies, electricity etc. • MVIPL shall ensure that the construction contractors engaged commit and adhere to social obligations including community relations, handling complaints and grievances, adherence to labour laws and international commitments etc.; • The contractor shall provide adequate training on social behaviour and community interaction to the workers engaged by them; • Health camps and awareness programs shall be conducted at regular intervals. Participation of local community members in such programs shall be ensured; • The water usage shall be monitored and controlled to minimise the wastewater generation; and • MVIPL shall ensure that no child labour, forced labour and non-discrimination, payment of wages, etc. are compiled to by the contractors;	workers.	
4.	**Noise Levels**	Increased noise levels due to operation of heavy vehicles; Use of diesel generator sets may also lead to incremental noise	• Construction activities shall be planned in consultation with local communities (if required); • Adequate precautions and information will be provided prior to execution of blasting activity (if any); • Construction equipment will be maintained in good working order and properly muffled; • Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example	Undertake ambient noise level monitoring at one of the construction locations when construction work is ongoing on quarterly basis. Monitor the usage of PPE on monthly basis.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			with silencers, acoustic louvers and enclosures; • Provision of rubber paddings/noise isolators at equipment/machinery used for construction; • Construction vehicles shall be well maintained and idling time will be minimized for vehicles when not in use; • Site workers working near high noise equipment use personal protective equipment (PPEs) to minimize their exposure to high noise levels.	Monitor the working of construction equipment which should be restricted to day time only.	
5.	**Ecology**	• The construction activities may lead to loss of vegetation resulting in displacement of wildlife species. • Disturbance to local livestock population	• 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 construction activity. • Cutting or lopping of trees shall be avoided. Mature trees and standing dead trees shall not be cut or lopped under any circumstances. • The crane staging area, intervening areas, overhead clearance for suspended turbine components shall be planned. • Solid or liquid waste 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 at the earliest and emphasis should be given on increasing the green-cover in and around the project-site to ameliorate project-induced disturbances and enhance the ecological value of the area.	Monitor the implementation of Crane Safety plan and document the adherence to the plan. The entire workforce shall be sensitized (by the construction contractor) to possible adverse ecological impacts during the construction phase by conducting awareness programs.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge
6.	**Occupational Health and Safety**	• Material handling and storage • Possible injuries associated with working at height	• All workers engaged in such work shall be provided with adequate Personal Protective Equipment (PPE) such as safety helmets, belts, safety shoes; • Effective work permit system for working at height shall be ensured;	**Weekly** Undertake weekly tool box training.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
		(≥ 2m) • Electrical work injuries (eye injuries, shocks, burns, fires/explosion) Other occupational hazards	• Provision of Earth Leakage Circuit Breaker (ELCB) and Residual Current Circuit Breaker (RCCB) shall be ensured with power supply wherever possible as per design of protection system; • All lifting operation shall be carried out by a competent person certified in conducting such work. The contractor shall ensure that no person is engaged in driving or operating lifting appliances unless he is sufficiently trained, competent and reliable, possesses the knowledge of inherent risks involved in the operation and is medically examined periodically; • Loading and unloading operation of equipment shall be done under the supervision of a trained professional. • All work at height to be undertaken during daytime with sufficient sunlight. • The labour engaged for working at height shall be trained for temporary fall protection devices and use of personal fall arrest systems shall be ensured. • Fire extinguishing equipment shall be provided in adequate number on site to handle any possible fire outbreaks.	Records of PPE usage on monthly basis. Records of Work Permit issues to the workers. Details of First Aid provided to the workers Training of the workers regarding health and safety procedures, PPE usage, working at heights, regulatory provisions at least once in 6 months.	
7.	**Ambient Air Quality**	• Dust generation and subsequent dispersal by wind during site preparation activities; • Pollutant (SOx, Nox, PM) discharge into surrounding air from exhaust emission of	• To avoid spillage during transit, fine-grained and loose construction materials should be covered; • Storage area of construction materials has to be in an area which is least wind-prone; • Vehicles are to maintained properly by conducting regular checks to minimise the emission of pollutants from exhausts and obtaining Pollution Under Control certificate from pollution control board on a periodic basis; • Idling time of vehicles should be minimised to the extent possible, to reduce burning of fossil fuel; • Daily inspection of construction site to check the effectiveness of the above mentioned activities.	**Quarterly** Undertake ambient air quality monitoring at one of the construction locations when construction work is ongoing. Monitor the pollution levels at the nearest sensitive receptor or 50m whichever is nearer on the downwind side	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
		construction vehicles.			
8.	**Water Quality**	• Possibility of contaminated runoff from the site entering the nearby water bodies. • Domestic water runoff from the portable toilets into neighboring water bodies can lead to degradation of water quality.	• Portable toilets with septic tanks and soak pits should be provided • If there is any leakage, drip pans should be provided in those vehicles • Storage area for oil, cement and other construction materials should be paved and impervious with secondary containment for fuel storage tanks	Verification is to be undertaken that water sourcing is from a legally compliant source and is to be recorded. Records of water consumption to be maintained on monthly basis	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge
9.	**Soil Quality**	• Excavation can disturb the original topography of the area which can further lead to soil erosion; • Soil contamination due to dispersion of construction material and Oil leaks/spillages from vehicles and machinery operating at site.	• Demarcate an area which is less wind-prone for storage of construction materials and should use tarpaulin sheets to avoid dispersal or kept in an enclosed space; • Limit construction activities to months having moderate climate conditions when there is no heavy wind or rainfall, to avoid top soil removal to the extent possible; • To minimize runoff, channels and drains are to be fully established and bedded as quickly as possible; • While transporting, construction materials such as sand, cement and other such fine-grained materials should be covered; • Construction debris and excavated material can be used for filling low-lying areas; • Paved spaces should be constructed for handling machineries or vehicles, while refuelling etc. if there is a spillage, that portion of the soil is to be cut out and stored separately to be disposed with the hazardous waste;	Inspect area which are re-vegetated and maintain records on monthly basis. Inspection of storage of areas where construction material is stored. Details of any oil spill , if happens on monthly basis Undertake training on soil contamination and pollution aspects at least once in a year to Projects team, Vehicle fleet operators and Sub Contractor staff.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			• Re-vegetate the area surrounding turbine locations as early as possible, to reduce the negative effect on soil.		
Operation Phase					
1.	**Ecology**	• Collision of birds/bats with wind turbines and meteorological towers • Birds/bats collision and electrocution from transmission lines	• 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; • Visibility enhancement objects such as marker balls, bird deterrents, or diverters shall also be installed along the transmission line to avoid avian collision; • Native vegetation must be planted or allowed to grow around the wind-turbines, such that their canopy screens potential prey on the ground from raptors flying overhead; • It is to be ensure that there is no formation of heaps of rocks or earthen mounds around the installed WTGs; • Appropriate storm-water management measure shall be implemented to avoid creating ponds which can attract birds and bats for feeding or nesting in the windfarm area; • It is recommended that a long-term programme, designed to monitor avifaunal activity with reference to wind-turbines, be instituted at the project-site.	Periodic Bird/Bat carcass survey to be undertaken during operation phase	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge
2.	**Noise Levels**	• Noise resulting from Wind turbines • Noise from the transmission lines	• Increase in dense vegetation coverage around the said receptor point location which shall act as noise barrier; • Wind turbines shall be designed in accordance with the international acoustic design standards and maintained throughout the operational life so as to limit noise generation; • The wind turbines shall be maintained in good running conditions throughout the operational life of the project through routine maintenance;	Ambient noise levels at all nearby villages to be monitored once every six months. O&M records of WTGS are to be maintained.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			• Operation and Maintenance staff to be provided with personal protective equipment (PPEs) such as ear plugs and ear muffs when working close to turbine in operation; • It is suggested that ground vegetation such as shrubs and bushes are cleared to the minimum extent possible during site clearance activities; • Consult with the locals periodically to assess noise generation and set up a procedure to locate source of noise and steps taken to minimize them; and • Implement a complaint resolution procedure to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved; • Undertake ambient noise level monitoring from NABL/MoEFCC accredited laboratories on an annual basis in order to understand the increase in noise levels due to the project operation; • The micro-siting guidelines recommended by National Institute of Wind Energy (NIWE), under the Ministry of New and Renewable Energy (MNRE), suggests wind farm developers to maintain a minimum distance of WTGs from sensitive receptors such as residential settlement/ house, highways, schools, religious structure, to ensure minimization of potential noise, shadow flicker and blade throw risks. Based on the formula, 143.5 m is the minimum distance between the project turbines (S-97, Suzlon make, HH of 90 m and RD of 97 m) and receptors. Therefore, Mytrah shall ensure the clearances as per the formula to adopt best Industry practices.		

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
3.	**Hazardous Waste and Soil Quality**	• Waste oil will be generated from the turbine gear box • Improper disposal and handling of waste oil can lead to soil and ground water contamination	• Hazardous waste such as waste/used oil has to be stored in a defined space and should be accessible only to authorised personnel • The storage space should be an impervious paved surface and should have a secondary containment area and spill control toolkit • Quantity of hazardous waste handled should be clearly documented as per Hazardous Waste Management rules and documents should be updated regularly • Hazardous waste should be sold to an authorised vendor on a periodic basis, documents of which should be maintained.	• Site engineers and maintenance staff need to be aware and trained about the procedure for proper storage and disposal waste oil and how to act in case of accidental oil spillage. • Ground water sample and soil sample testing needs to be undertaken at the waste oil handling and storage location once in every three years.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge
4.	**Water Resource and Quality**	• Water required for toilet flushing is being sourced from the bore well at project site near the pooling substation	• Adequate septic tanks and soak pits should be provided at site • Septic tanks should be maintained properly and cleaned at regular intervals • It is advisable to get water for domestic usage through authorised water tankers • Since water in the region has high fluoride content, it is recommended to find an alternate source of drinking water for the personnel on site.	• Ground water sample testing at the project site location once in every 6 months.	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge
5.	**Occupational health & safety**	• Working at height during maintenance • Electrical hazards • Structural collapse due to natural hazards	• Only trained workers should be allowed to work at heights. • Workers handling electricity and related components will be provided with shock resistant gloves, shoes and other protective gears. • Implementation of work-permit system for working at height, electric and hot jobs. • Personal protective equipment to be provided for all personnel during maintenance work.	• All safety related incidents will be recorded and monitored, in order to ultimately achieve "zero incidences" level. • Adequate training to be provided to the workers regarding health and	HSE Supervisor of MVIPL/ EHS Officer of Suzlon, Site- In Charge

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			• The switchyard building will be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire. • Health and safety training is given on regular basis to all the employees	safety procedures. • Workers to be trained for use of Personal Protection Equipment and its importance.	
6.	**Community/ Social Issues**	• Alteration of Land Use • Visual Aesthetics • Shadow Flicker • Hindrance to communication facility	• MVIPL to apply and obtain change of land use from Agricultural land and Non-Agricultural (NA) for industrial purpose; and • The layout for access roads and transmission lines shall be developed considering the minimum land requirement as needed. • The vane tips of the wind turbine shall be painted with Orange colour strips to avoid bird hits; • Maintaining uniform size and design of turbines by having same direction of rotation, type of turbine and height on a wind farm or adjoining wind farm; • Layout or adjustment should be such that turbine blades rotate in the same direction; • Ensuring absence of any auxiliary structures except the required ones such as access roads and transformer yards which accompany the turbines; and • The micro-siting guidelines recommended by National Institute of Wind Energy (NIWE), under the Ministry of New and Renewable Energy (MNRE), suggests wind farm developers to maintain a minimum distance of WTGs from sensitive receptors such as residential settlement/ house, highways, schools, religious structure, to ensure minimization of potential noise, shadow flicker and blade throw risks. Based on the formula, 143.5 m is the minimum distance between the project turbines (S-97, Suzlon make, HH of 90 m and RD of 97 m) and receptors. Therefore, Mytrah shall ensure the clearances as per the formula to	• Periodic checking of turbine areas to ensure that fencing and electric cables are in good condition. • Any community development activities will be guided and implemented in accordance with the CSR policy of Suzlon	Project Manager of MVIPL/ Social Officer of MVIPL/ Social(CSR) Officer of Suzlon

S.No.	Aspects	Potential Impacts	Suggested Mitigation/ Management Measures	Monitoring / Training Requirement	Management Responsibility
			adopt best Industry practices. • Planting trees and ensure increase in dense vegetation coverage to screen the impacted receptor locations from sun; • Installation of blinds such as curtains at the concerned window facing the turbines; • It is recommended that MVIPL should ensure formulation of a complaint resolution procedure by Suzlon for the local community so that any issues or concerns associated with shadow flicker are reported to the site staff. Also, appropriate and timely action taken in case of receipt of such complaints need to be documented and maintained for records.		

12. CONCLUSION & CATEGORISATION

The ESIA has assessed the overall impacts on Environmental and Social components as a result of construction and operation of proposed ***105 MW Vajrakarur wind power project*** for MVIPL. 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. 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.

The proposed Environmental and Social Management Plan describes implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. Based on the ESIA study conducted and as per ***IFCs categorisation 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.

Also, 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.

The rationale for categorisation 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 or displacement;
- There are no indigenous communities in the project area;
- The additional exposure to noise is estimated to be in the range of 4.0 – 7.8 dB (A) and 15.0 – 20.8 dB (A) during the day and night time respectively due to the operation of the wind turbines. The estimated resultant noise exceeds the standard at three (3) locations which can be mitigated by implementation of suitable measures as suggested;
- None of the project turbines are located within the vicinity of the reserve forest and does not involve any forest land. Therefore, ensuring minimal impact on ecology during the construction and operation phase of the project.