



# ANALYSIS AND ESTIMATION OF AIR AND NOISE QUALITY: A MODEL STUDY FORM THIMMAPALLY

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## ABSTRACT:

*Any anthropogenic activity is expected to cause some impact on the surrounding environment. The impacts may be adverse or beneficial. However, mankind as it is developed today cannot live without taking up these activities for food, security and other needs. Consequently, there is a need to harmonize developmental activities with the environmental concerns. It is desirable to ensure that the development options under consideration are sustainable. In order to achieve the above-mentioned goal, a baseline environmental study has been conducted within the study area and interpreted with the help of GIS tools. Present study is aimed at predicting the possible environmental impacts due to industrial operations and suggesting environmental safeguards to ensure environmentally sustainable development.*

**Keywords:** Collection of Baseline Data, Selection of Sampling Locations, Selection of Sampling Locations, Sensitive/Historical sites, Air Quality, Wind Patterns, Noise Environment

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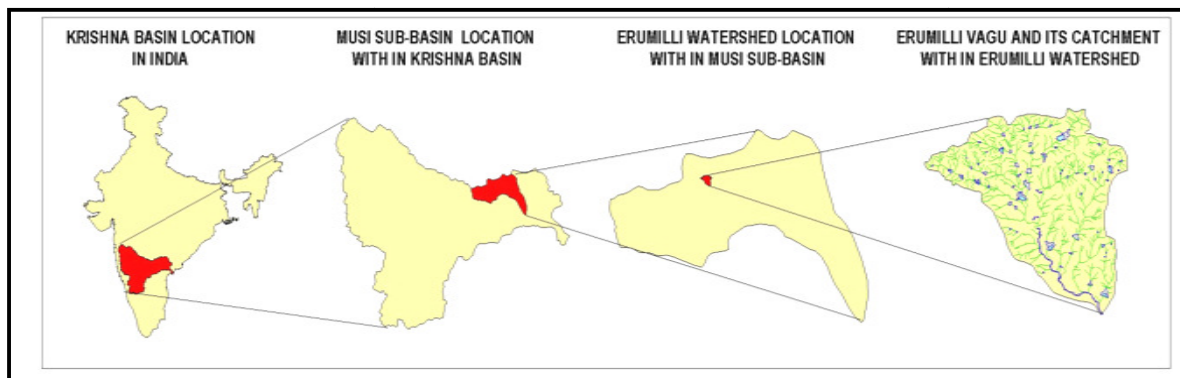
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## 1. INTRODUCTION

The environmental data collected are analysed to assess the status of the parameters due to the existing activities in the study and to evaluate the beneficial and adverse impacts of the proposed activities for siting of the industries. The Erimullivagu with an area of 108.30 sq. km has 97.0 sq. km part of Keesara Mandal, 7.60 sq.km forming part of Shamirpet Mandal and 3.70 sq.km forming a part of Ghatkesar Mandal (Handbook of Statistics, Ranga Reddy District; 2012-2013) consist of 21 habitations. During winter, winds are variable in direction and are light in force, being 8 to 9 Km/hr. During early summer the winds continue to be variable in direction in the mornings and in the afternoons, winds are mostly easterly to southeasterly. During May and the southwest monsoon season, winds are predominantly from westerly to northwesterly direction.

### 1.1 DESCRIPTION OF STUDY AREA

Keesara, an important town of study area is a place of great sanctity of Hinduism, enshrined with mythological glory of Lord Shiva belongs to medieval period and is renowned throughout the state. The study area lies in the North Eastern portion district of Ranga Reddy which is situated at the heart of Dakshinapatha of the Deccan Plateau of the Indian subcontinent an epitome of ancient Nizam culture and with latest edition of Information Technology. Both these ancient and modern cultures have to some extent contributed, directly or synergistically, for betterment of human life in this otherwise chronic drought-prone area. A long term planning strategy has been devised with the consequent study of the area under, 'Remote Sensing and Geographical Information System based Natural Resources Inventory and Management plan for Erimulli Vagu catchment, Musi River Basin, in order to make the study area survive as a viable, better inhabited and economically self-sustained entity. The term "development" assumed a new meaning after the Brundt land Report which called for a change in economic world order to reduce the destruction of environment and solve social problems. The term "sustainable development" has finally emerged as a code phrase to focus the need for harmonious development of land, water, vegetation and other natural resources of the area in such a way that the changes proposed to meet the needs of the development are brought about without diminishing the potential for meeting their future needs as well as those of the future generations. Systematic planning is indeed, prerequisite for the proper management and development of the land resources, which are highly stressed in the area as a result of frequent droughts causing water scarcity and overall poor life-style of the people. Sustainable development requires a holistic approach maximizing the crop yields after taking into account the precarious environment conditions



**Figure 1** Location of study area map

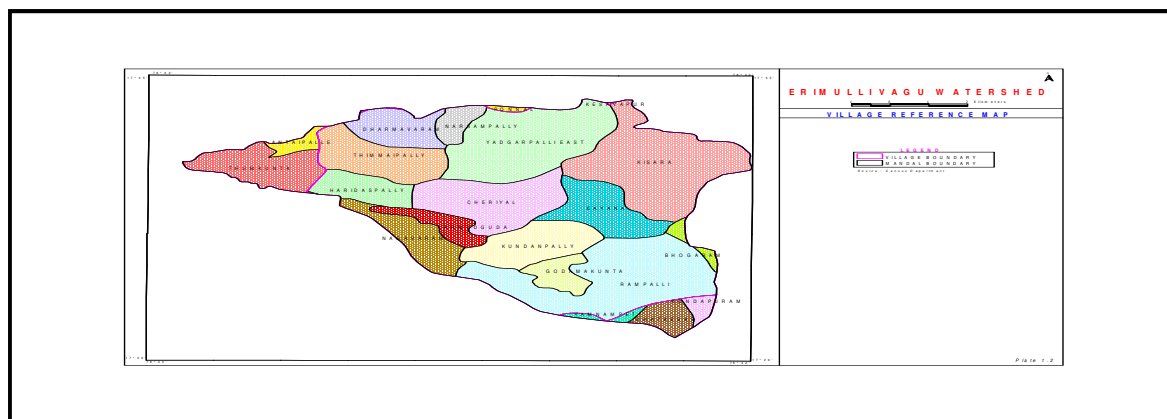


Figure 2 Village reference map

## 2. OBJECTIVES:

The main objectives of the study are:

- To assess the existing environmental status of air and noise within the study area.
- To identify the significant impacts due to the existing activities in the study area.
- To identify new industrial sites based on present environment scenario.

The baseline environment quality represents the background environmental scenario of various environmental components. Pollution in the area is mainly due to the local activities, vehicular movement and surrounding quarries and industrial activities. Various stone crushing activities exist in the northern sector of the study area, whereas the industrial zone lies near Ghatkesar in southern sector.

## 3. METHODOLOGY

### 3.1 Data collection:

Different data products required for the study include satellite data and SOI toposheets are collected. The satellite data of IRS-P6, LISS III, 2011 and 2016 years data was geometrically corrected and enhanced using SOI toposheets with scale 1:50000 and ERADAS software satellite imagery are printed in FCC. Collateral data collected from related organizations, comprises of air quality and demographic data.

### 3.2 Database creation

Satellite imageries are georeferenced using the ground control points with SOI toposheets as a reference and further merged to obtain a fused output in EASI/PACE Image processing software using the LISS III of 2011 and 2016 data of IRS P6. The study area is then delineated and subsetting from the fused data based on the latitude and longitude values and a final hard copy output is prepared for the generation of thematic maps using visual interpretation technique. The GIS digital database consists of thematic maps and Survey of India (SOI) toposheets and fused data of IRS – P6 PAN and IRS-ID LISS-III satellite imagery.

### 3.3 Spatial Database

Thematic maps like base map and drainage network maps are prepared from the SOI toposheets on 1:50,000 scale using Arc/Info GIS software to obtain a baseline data maps of the study area was prepared using visual interpretation technique from the fused satellite

imagery (IRS P6 + LISS III of 2011 and 2016) and SOI toposheets along with ground truth analysis. All the maps are scanned and digitized to generate a digital output.

### 3.4 Attribute database

Fieldwork is conducted and ground water samples are collected from 19 predetermined locations based on the land use and drainage network maps in the study area. Care is taken in collecting the air samples for uniform distribution and density of sampling locations. The air samples were analyzed for ambient air quality. The air quality data thus obtained forms the attribute database for the present study (Table 1 & 2).

### 3.5 Integration of spatial and attribute database

The spatial and the attribute database generated are integrated for the generation of spatial distribution maps of selected air quality parameters namely Sulphur dioxide, oxides of nitrogen, suspended particulate material, respirable particulate material, lead, ammonia, carbon monoxide. The air quality data (attribute) is linked to the sampling location (spatial) in ARCGIS and maps

The baseline environmental quality represents the existing environmental status of various environmental components such as air, noise, water, land and socio-economic status of the identified study area.

The methodology adopted for the study is divided into the following phases:

- Identification of significant environmental parameters and assessing the existing status within the impact zone with respect of air, water, noise, soil and socio-economic components of environment.
- Assessment of impact on the ambient air quality taking into consideration the growing industrial scenario.
- Assessment of impact on water, land and socio-economic environment.
- Evaluation of suitability of the study area for further industrial development and thus preparing a Zone-Plan.

The methodology adopted for studying the various individual components of environment are described below.

### 3.6 Ambient Air Quality

The scenario of the existing ambient air quality in the study region has been assessed through a network of four ambient air quality stations during the study period. The monitoring network was so designed such that representative samples are obtained from the study area. These monitoring sites have been established keeping in view the available climatological norms of predominant wind direction and wind speed of this particular region. The following points were also taken into consideration in designing the network of sampling stations:

- Topography / terrain of the study area
- Populated areas within the study area
- Residential and sensitive areas within the study area.
- Magnitude of the surrounding industries and mines
- Representation of regional background levels
- Representation of cross sectional distribution in downward direction.

The existing Ambient Air Quality status (AAQ) has been monitored for Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO<sub>2</sub>), (NO<sub>x</sub>)

and Carbon monoxide (CO). SPM & RPM at each station have been monitored on 24 hourly basis and all the gaseous sampling has been done on 8 hourly basis. Pre-calibrated Respirable Dust Samplers have been used for monitoring of the existing AAQ status. Methodologies adopted for sampling and analysis were, as per the approved methods of Central Pollution Control Board (CPCB). Maximum, minimum, average and percentile values have been computed from the raw data collected at all individual sampling stations to represent the AAQ status of the study area.

### **3.7 Collection of Baseline Data**

To assess the existing industrial scenario in terms of environmental parameters, baseline environmental monitoring was carried out for winter season, covering the months of January 2016 to February 2016. The primary data was monitored for the identified parameters and supplemented by available secondary data. Data on existing Industries is also collected and mapped and is shown in Plate 1.

### **3.8 Selection of Sampling Locations**

For identifying the background air quality and also to represent the interference from various industrial and local activities, screening techniques have been used for identification of air quality stations in the study area. The following points were taken into consideration for designing the network of sampling stations:

- Predominant wind direction
- Topography
- Population density
- Terrain and sensitive areas
- Magnitude of the surrounding mines and industries

### **3.9 Sensitive/Historical sites**

The sensitive sites in the study area include Keesra, also known as Keesragutta, which is famous for its Ramalingeshwara temple. The place has archeological ruins of an old fort and some pillars bearing sculptures of Vighneshwar, Anjaneya and the incarnations of Mahavishnu. The scenario of the existing Ambient Air Quality (AAQ) in the study region has been assessed through a network of four ambient air quality stations. The monitoring network was so designed such that a representative data of the study area can be obtained. The existing AAQ status has been monitored for Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO<sub>2</sub>), (NO<sub>x</sub>), and Carbon monoxide (CO). SPM & RPM at each station have been monitored on 24 hourly basis and all the gaseous sampling has been done on 8 hourly basis. Pre-calibrated Respirable dust samplers have been used for monitoring of the existing AAQ status. Methodologies adopted for sampling and analysis were, as per the approved methods of Central Pollution Control Board (CPCB). Maximum, minimum, average and percentile values have been computed from the raw data collected at all individual sampling stations to represent the ambient air quality status of the study area.

### **3.10 AAQ Data Interpretation**

The magnitude and significance of the environmental pollution caused by industries and stone quarries depend on the type of industry and concentration of quarrying activity. The air borne particulate matter is the main air pollutant, contributed by quarrying and vehicular movement, whereas SO<sub>2</sub> and NO<sub>x</sub> are contributed by industrial and vehicular emissions.

### 3.11 Air Quality

This map is prepared based on the secondary data of ambient air quality from the available sources. The air quality map provides information about the status of ambient air quality. The ambient air quality is depicted as high, medium and low quality zones by describing the quantitative data in normative terms (CPCB, 1996). 'High' air quality indicates that the level of concentration of pollutants in the ambient air is very well within standards and as such there is no air pollution problem. 'Medium' air quality indicates that the level of concentration of pollutants in the ambient air does not exceed the required standards but is very close to the standards. 'Low' air quality indicates that the level of concentration of pollutants exceeds the permissible limits prescribed and hence is polluted.

The steps involved in the preparation of Air Quality map are:

- Establishment of AAQ stations at Ghatkesar, Keesra, Bandlaguda and Yadgarpalli and data was collected at each monitoring station with details of RSPM, TSPM, NOX and Sox.
- These monitoring stations were located on the map based on Latitude and Longitude provided. The data was categorized for Max and Average values for all the parameters and mapping was done taking Max values into consideration.

The parameters considered are:

- Total Suspended Particulate Matter (TSPM),
- Residual Suspended Particulate Matter (RSPM),
- Nitrate (Nox) and Sulphates(SO<sub>2</sub>)
- Less than 50% of Permissible Limit is categorized as Low
- 50% - 100% of Permissible Limit is categorized as Medium
- 100% of Permissible Limit is categorized as High

### 3.12 Noise Environment

The noise level variation can be temporal, spectral and spatial. The residential noise level is that level below which the ambient noise does not seem to dropdown during the given interval of time and is generally characterised by unidentified sources. Ambient noise level is characterised by significant variations above a base or a residential noise level. The maximum impact of noise is felt on urban areas, which is mostly due to the commercial activities and vehicular movement during peak hours of the day. Measured noise levels displayed as a function of time provides a useful scheme for describing the acoustical climate of a community. Noise levels recorded at each station with a time interval of about 30 minutes are computed for equivalent noise levels. Equivalent noise level is a single number descriptor for describing time varying noise levels. The equivalent noise level is defined as mathematically

$$10\text{Log}1/T \Sigma (10^{L_n/10})$$

Where, L = sound pressure level a function of time dB (A) &

T = Time interval of observations

Noise levels during the night time generally drop, therefore to compute Equivalent noise levels for the night time, noise levels are increased by 10 dB (A) as the night time high noise levels are judged more annoying compared to the day time. Noise levels at a particular station are represented as Day-Night equivalent (L<sub>dn</sub>). Day-Night equivalent is the single number index designed to rate environmental noise on daily/24 hourly basis. Mathematically L<sub>dn</sub> is given by

$$L_{dn} = 10 \log \{ 1/24 (15 \times 10^{(L_d/10)} + 9 \times 10^{(L_n+10)/10}) \}$$

Where,

$L_d$  = A weighed equivalent for day time period (6 am to 9 pm)

$L_n$  = A weighed equivalent for night time period (9 pm to 6 am)

Noise monitoring has been carried out at four locations to identify the impact due to the existing sources on the surroundings in the study area. Noise levels were recorded at an interval of 30 minutes during the day and night times to compute the day equivalent, night equivalent and day-night equivalent level. The following table gives the summary of the same.

**Table 1** List of Existing Industries

Industry Name	Address	Products	Category	Scale	Latitude (Dd)	LONGITUDE (DD)
Hindustan Lever Ltd	Ghatkesar	Instant Tea/Coffee; Coffee Processing	Orange	Ssi	17.452	78.678
Sri Lakshmi Metal Industries	Sy.No.400, Keesara	Stone Crusher	Orange	Medium	17.541	78.673
Shree Kankaria Construction & Industries	Sy.No.816 & 134, Ankireddypally (V), Keesara (M)	Construction Material	Orange	Ssi	17.542	78.674
Sree Venkataramana Construction Materials (P) Ltd	Sy.No.185/4, 185/5, Ankireddypally (V), Keesara (M)	Construction Material	Orange	Ssi	17.547	78.689
Sai Baba Metal Industry	Sy.No. 70, Dharmaram, Keesara (M)	Stone Crushers	Orange	Ssi	17.550	78.607
Kesava Stone Crushers	Sy.No.12, Timmaipally (V), Keesara (M)	Stone Crushers	Orange	Ssi	17.545	78.600
Sri Balaji Metal Industries	Timmaipally (V), Keesara (M)	Stone Crushers	Orange	Ssi	17.541	78.605
Kasinath Metals PvtLtd	Sy.No.185/2a, Ankireddypally (V), Keesara (M)	Stone Crushing	Orange	Ssi	17.546	78.685
Robo Silicon Pvt Ltd	Sy.No.426, Ankireddypalli (V), Keesara (M)	Fine Aggregate Coarse Aggregate	Orange	Medium	17.549	78.672
Ganesh Stone Crusher	Sy.No.497/A, Anikireddypally (V), Keesara (M)	Crushed Stone Metal Stone Dust	Orange	Ssi	17.552	78.680
Ssp Polymer Industries Ltd	Ssp Polymer Industries Ltd Ghatkesar	Wires, Pipes, Extruded Shapes From Metal	Others	Ssi	17.463	78.681
Arm Ltd	Bandlaguda	Galvanising Of Ms Structure	Red	Ssi	17.500	78.617
Standard Chemical Corporation	Plot No.11, Rampalli Road,Nagaram	Ammonium Nitrate	Red	Ssi	17.492	78.612
Ganga Bhavani Rice Mill	Keesara	Rice	Others	Ssi	17.529	78.670
Vijaya Industries	Keesara	Rice	Others	Ssi	17.527	78.662
Annapoorna Bmrm	Rampally	Rice	Others	Ssi	17.460	78.648

**Table 2** Ambient Air Quality Standards (National)

Sl. No.	Parameter	Residential, Rural & other Areas			Sensitive Areas			Industrial Areas		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
1	Sulphur Dioxide SO <sub>2</sub>	0 – 30	30 – 60	60	0 – 7.5	7.5 – 15	15	0 – 40	40 – 80	80
2	Oxides of Nitrogen as NO <sub>2</sub>	0 – 30	30 – 60	60	0 – 7.5	7.5 – 15	15	0 – 40	40 – 80	80
3	Suspended Particulate Matter (SPM)	0 – 70	70 – 140	140	0 – 35	35 – 70	70	0 – 180	180 – 360	360
4	Respirable Particulate Matter (RPM)	0 – 30	30 – 60	60	0 – 25	25 – 50	50	0 – 60	60 – 120	120
5	Lead (Pb)	0 – 0.375	0.375 – 0.75	0.75	0 – 0.125	0.125 – 0.50	0.5	0 – 0.5	0.5 – 1	1
6	Ammonia	0 – 0.05	0.05 – 1	0.1	0 – 0.05	0.05 – 0.1	0.1	0 – 0.05	0.05 – 1	0.1
7	Carbon Monoxide (CO)	0 – 1	1 – 2	2	0 – 0.5	0.5 – 1.0	1	0 – 2.5	2.5 – 5	5

#### 4. RESULTS AND DISCUSSION

1. The maximum SPM concentration of 74  $\mu\text{g}/\text{m}^3$  was observed at Keesara - AAQ station, which is located in close proximity to the quarrying operations. The maximum RPM concentration of 40  $\mu\text{g}/\text{m}^3$  was also observed at Keesara - AAQ station, due to the quarrying operations in vicinity. Maximum SO<sub>2</sub> concentration of 8.9  $\mu\text{g}/\text{m}^3$  was found at the AAQ station located in Ghatkesar industrial zone. Following the similar trend, the maximum NO<sub>x</sub> concentration of 11.2  $\mu\text{g}/\text{m}^3$  was also found at the same AAQ station.
2. Areas within 2 km of Keesara, Malkaram and Rampalli villages are found low in air quality. This is attributed to the quarries. Similar low air quality pocket is noticed around Ghatkesar due to vehicular pollution and IDA. The remaining area has medium air quality. High air quality zone is demarcated south of Lalanguda.
3. Noise levels were recorded at an interval of 30 minutes during the day and night times to compute the day equivalent, night equivalent and day-night equivalent level. The main noise levels are due to the vehicular movement and quarries
4. The Environmental sensitivity of the study area is represented by 7.14 %, area comprising of degraded forest, 2.29 % of area occupied by water bodies, 2.43% area covered by hills, 2.49% with double crop area, 4.04 % of area with plantations, built-up land covering 1.50 % of area and industries occupying 0.04 %.
5. Major part of the study area is low dispersion sensitive while area covered with isolated hills /hillocks forms high dispersion sensitive zone.
6. Due to the presence of forest and low air quality the majority of the area is high aerial sensitive. A small pocket of medium aerial sensitivity and low aerial sensitivity is observed on the eastern side of Cherial and Lalanguda villages.
7. The study indicated that medium air and low water polluting industries can be setup towards East of Cherial, South-west of Keesara and High air and low water polluting industries towards North of Ghatkesar.



8. Table 3 gives the summary of ambient air quality observed in the study area. The observations made at Keesara - AAQ station indicated maximum SPM concentration of  $74 \mu\text{g}/\text{m}^3$  and  $40 \mu\text{g}/\text{m}^3$  of RPM concentration due to quarries. The Ghatkesar AAQ station recorded maximum  $\text{SO}_2$  concentration of  $8.9 \mu\text{g}/\text{m}^3$  and maximum  $\text{NO}_x$  concentration of  $11.2 \mu\text{g}/\text{m}^3$  shows the impact of existing IDA. Areas within 2 km of Keesara, Malkaram and Rampalli villages are found low in air quality. This is attributed to the quarries. Similar low air quality pocket is noticed around Ghatkesar due to vehicular pollution and IDA. The remaining area has medium air quality. High air quality zone is demarcated south of Lalanguda.

**Table 3** Summary of Ambient Air Quality

CODE	MG/M <sup>3</sup>		
	Maximum	Minimum	Average
<b>Suspended Particulate Matter (SPM)</b>			
A-1	70	52	61
A-2	74	53	65
A-3	68	45	59
A-4	71	56	67
<b>Respirable Particulate Matter (RPM)</b>			
A-1	36	27	30
A-2	40	29	34
A-3	35	24	29
A-4	38	28	33
<b>Sulphur dioxide (SO<sub>2</sub>)</b>			
A-1	8.9	5.7	7.2
A-2	7.2	4.5	5.6
A-3	8.3	6.3	7.3
A-4	7.6	5.2	6.5
<b>Oxides of Nitrogen (NO<sub>x</sub>)</b>			
A-1	11.2	6.9	9.4
A-2	10.8	6.4	8.9
A-3	9.6	6.5	8.4
A-4	9.8	6.8	8.2
A-1	: Ghatkesar	A-2	: Keesara
A-3	: Bandlaguda	A-4	: Yadagiripalli

## 9. Wind Patterns

### *Wind Pattern during 00:00 – 08:00 hours*

The predominant wind directions during this period were from the NW (47.18%), NNW (27.83%) and WNW (12.50%) accounting to about 87.51 % of the time with calm winds of less than 1.7 km/h for 0.01 % of the time. The average wind speed during this period ranged between 6 and 10 km/h.

**Wind pattern during 08:00 – 16:00 hours**

The predominant wind directions during this period were from NNW (29.39%), NW (26.16%), and WNW (11.83%) accounting to about 67.38% of the total time. Average wind speed during this period ranged between 8 and 12 km/h. The winds were under calm condition for 0.03% of the time.

**Wind pattern during 16:00 – 24:00 hours**

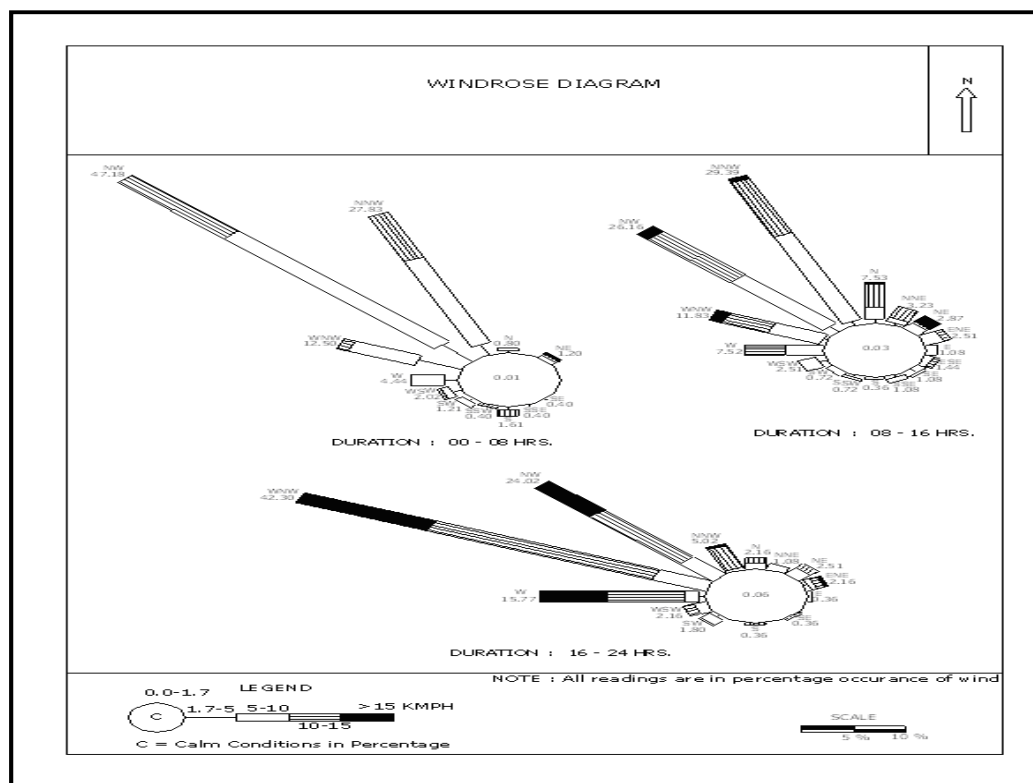
The predominant wind directions during this period were from WNW (42.30%), NW (24.02%) and W (15.77%) accounting to about 82.09% of the total time. Average wind speed during this period ranged between 8 and 14 km/h. the winds were under calm condition for 0.06% of the time.

**Wind pattern during 00:00 – 24:00 hours**

The predominant wind directions during the season were from NW (32.39%), WNW (23.12%), NNW (20.02%) and W (9.14%), accounting to 84.67 % of the time with calm winds of less than 1.7 km/h for 0.06 % of the time. The average wind speed during this period varied between 8 and 12 km/h.

**Table 4** Summary of the Wind Pattern

Season	Duration (Hours)	Predominant Wind Direction	Average Wind Speed (km/h)
Post monsoon	00:00 – 08:00	NW, NNW & WNW	6-10
	08:00 – 16:00	NNW, NW & WNW	8-12
	16:00 – 24:00	WNW, NW & W	8-14
	00:00 – 24:00	NW, WNW, NNW & W	8-12



**Table 5** Summary of Noise Levels

CODE	STATION	NOISE LEVEL dB(A)		
		Day-Equivalent	Night-Equivalent	Day-Night Equivalent
N-1	Ghatkesar	53.9	44.1	54.0
N-2	Keesara	50.5	44.6	52.5
N-3	Bandlaguda	53.4	47.2	55.2
N-4	Yadagiripalli	54.1	39.8	52.9

The ambient noise standards are given in table 6

**Table 6** Ambient Noise Standards

Area Code	Category of Area	Noise Levels in db (A) Leq	
		Day Time *	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45

Note:

Day Time is from 6 am to 9 pm

All the results that are recorded are founded to be well within the permissible limits.

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