3.0 BASELINE ENVIRONMENTAL STATUS

3.1 Introduction

A regional background to the baseline data is being presented at the very onset, which will help in better appreciation of micro-level field data, generated on several environmental and ecological attributes of the study area. The base line status of the project environs is described section wise for better understanding of the broad-spectrum conditions. Field monitoring studies to evaluate the base line status of the project site were carried out during the months of 15th March 2010 to 31st May 2010, covering pre-monsoon season.

3.2 Land Use Studies

Studies on land use aspects of eco-system play important roles for identifying sensitive issues, if any, and taking appropriate actions for maintaining the ecological balance in the development of the region.

3.2.1 Landuse based on District Handbook

The objectives of land use studies are:

- To determine the present land use pattern;
- To analyze the impacts on land use due plant activities in the study area; and
- To give recommendations for optimizing the future land use pattern vis-a-vis growth of plant activities in the study area and its associated impacts.

3.2.1.1 Methodology

For the study of land use, literature review of various secondary sources such as District Census Handbooks, regional maps regarding topography, zoning settlement, industry, forest etc., were taken. The data was collected from various sources like District Census Handbook, Revenue records, state and central government offices and Survey of India (SOI) toposheets and also through primary field surveys.

3.2.1.2 Land use Based on Secondary Data

Based on the census report, 10-km radial distance around this Plant centre has been considered in the study. As the study area falls in Lalitpur district of Uttar Pradesh state. These areas were studied in detail to get the idea of land use pattern in the study area. The land use pattern of the study area is given in **Table-3.2.1** and in detail presented in **Annexure-V.**

TABLE-3.2.1
LAND USE PATTERN OF STUDY AREA

All values are given in the table (ha)

Sr. No.	Particulars of Land use	0-3 km	3-7 km	7-10 km	0-10km
1	Forest Land	153	234	269	657
2	Land under Cultivation				
	a) Irrigated Land	2381	6485	14974	23841
	b) Un irrigated Land	1603	1405	3601	6610

Sr. No.	Particulars of Land use	0-3 km	3-7 km	7-10 km	0-10km
3	Cultivable Waste Land	832	1863	5093	7789
4	Area not available for cultivation	302	1136	1947	3385
	Total Area	**5274**	**11124**	**25884**	**42283**

Source: District Primary Census Statistics of Lalitpur District U.P. - 2001

3.2.1.3 Forest Land

The forest is spreading over 657 ha works out to about 1.6 %of the total study area.

3.2.1.4 Land under Cultivation

Altogether 30451 ha cultivable land (irrigated and un- irrigated) was observed in the study area. The irrigated land admeasures to about 23841 ha in the study area which works out to be 56.3% of total study area. The un- irrigated land admeasures about 6610 ha and works out to about 15.6% of the total study area.

3.2.1.5 Cultivable Waste Land

Cultivable waste category of land includes the land which was cultivated sometime back and left vacant during the past 5 years in succession. These lands may either be fallows or covered with shrubs, which are not put to any use. The study area comprises of 7789 ha cultivable wastelands, which works out to about 18.4% of the study area. This percentage of land in this category indicates that almost all the cultivable lands are used for cultivation as well as various other purposes, while leaving a very less extent of land un-cultivated.

3.2.1.6 Land not available for Cultivation

All the lands not included in the above categories of land uses are considered in the category of land not available for cultivation. This category of land use mainly consists of the hilly and barren lands, human settlements, roads, water-bodies, etc. About 3385 ha area working out to about 8.0% of the total study area falls in this category.

3.2.2 Land Use Pattern based on Remote Sensing Data

Remote sensing satellite imageries were collected and interpreted for the 10-km radius study area for analyzing the land use pattern of the study area. Based on the satellite data land use/ land cover maps have been prepared.

3.2.2.1Land use/Land Cover Classification System

The present land use / land cover maps were prepared based on the classification system of National standards. For explanation for each of the land use category the details as given in **Table-3.2.2** were considered.

TABLE-3.2.2
LAND USE/LAND COVER CLASSIFICATION SYSTEM

Sr. No.	Level-1	Level-2
1	Built-up Land	Town/cities
		Villages
		Institution/Industry/Godown etc
		Plotted Area/Layout
2	Agriculture Land	Crop Land
		Plantations
		Fallow
3	Forest	Evergreen/Semi evergreen
		Deciduous
		Forest Plantation
4	Wastelands	Rocky/Stony Waste
		Land with /without scrubs
		Saline/sandy & Marshy/swampy
5	Water Bodies	River/Stream
		Lake/Reservoir/Tanks
6	Others	Orchard/Other Plantation
		Shifting cultivation
		Salt Pans, Snow covered/Glacial
		Barren/Vacant Land

- ***Data Requirements***

IRS-P6 Geo-Coded FCC of LISS-III was acquired for the mapping and interpretation. Besides, other collateral data as available in the form of maps, charts, census records, other reports and especially topographical survey of India maps are used. In addition to this, ground truth survey was also conducted to verify and confirm the ground features.

- ***Methodology***

The methodology adopted for preparation of land use/ land cover thematic map is monoscopic visual interpretation of geocoded scenes of IRS-P6 satellite LISS-III and field observations are taken. The various steps involved in the study are preparatory field work, field survey and post field work.

- ***Pre-field Interpretation of Satellite Data***

The False Color Composite (FCC) of IRS-P6 satellite data are used for pre-field interpretation work. Taking the help of topo-sheets, geology, geomorphology and by using the image elements the features are identified and delineated the boundaries roughly. Each feature is identified on image by their image elements like tone, texture, colour, shape, size, pattern and association. A tentative legend in terms of land cover and land use, physiography and erosion was formulated. The sample areas for field check are selected covering all the physiographic, land use/land cover feature cum image characteristics.

- ***Ground Truth Collection***

Both topo-sheets and imagery were taken for field verification and a transverse plan using existing road network was made to cover as many representative sample areas as possible to observe the broad land use features and to adjust the sample areas according to field conditions. Detailed field observations and investigations were carried out and noted the land use features on the imagery.

- ***Post Field Work***

The base maps of the study area were prepared, with the help of Survey of India Topo-sheet. Preliminary interpreted land use and the land cover features boundaries from IRS-P6 False Colour Composite were modified in light of field information and the final thematic details were transferred onto the base maps. The final interpreted and classified thematic map was catrographed. The cartographic map was colored with standard colour coding and detailed description of feature with standard symbols. All the classes noted and marked by the standard legend on the map.

- ***Final Output***

The final output would be the land use/land cover map, numerals were given different colour code for each category as shown in map. Area estimation of all features of Land use/Land cover categories was noted.

- ***Observations***

The following are the main interpreted land use/land cover classes of the study area and their respective areas are given in hectares in **Table-3.2.3.** The thematic map and land use pattern within 10-km radius based on IRS-P6 is shown in **Figure-3.2.1** and **3.2.2** respectively.

TABLE-3.2.3
LANDUSE BREAKUP

Sr. No	Type	% Area
1	Built up	1.65
2	Crop Land	46.13
3	Fallow land	41.18
4	Plantation	1.00
5	Road	1.54
6	Waste land	4.00
7	Water bodies	2.00

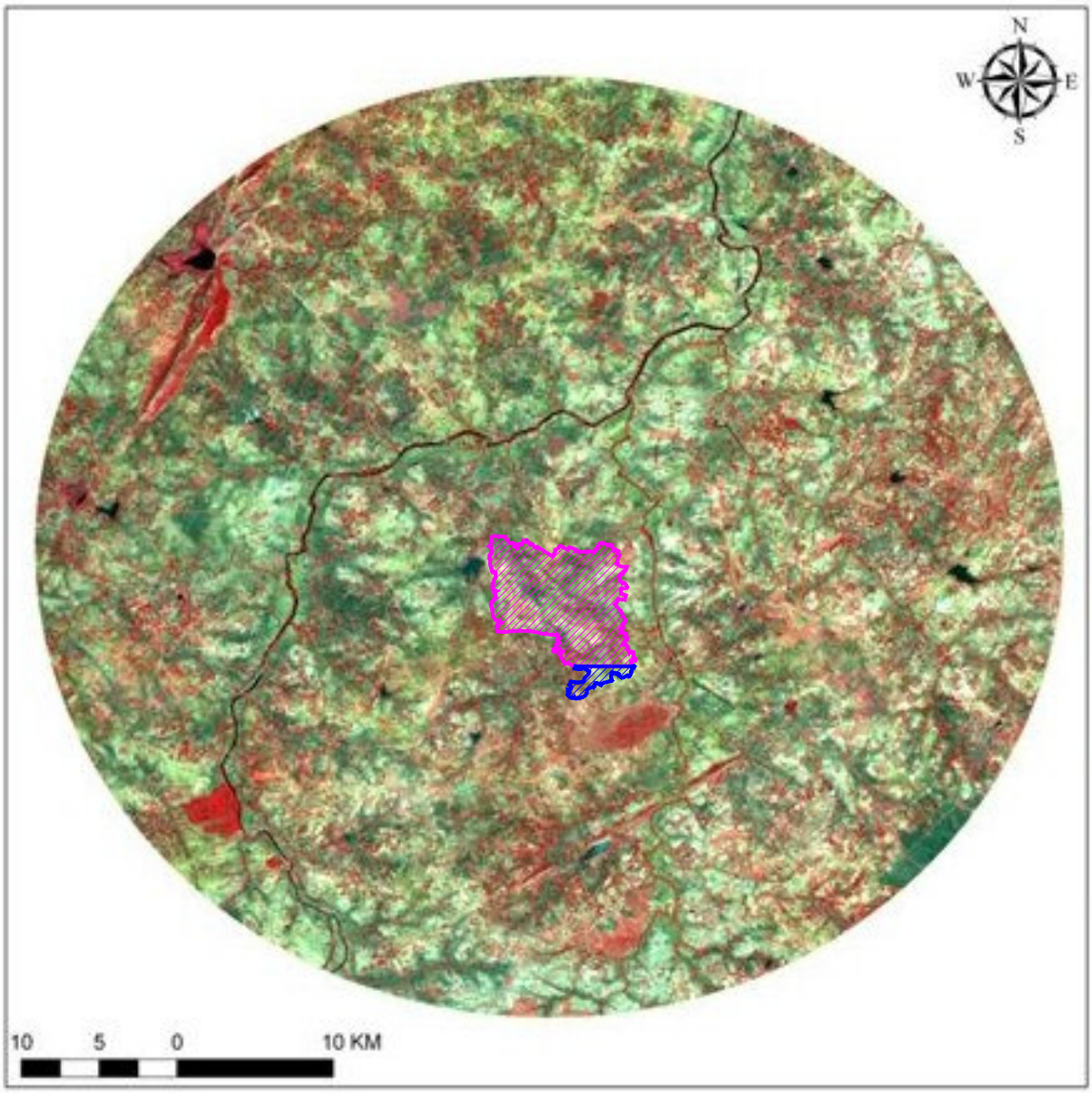

FIGURE-3.2.1
THEMATIC MAP OF STUDY AREA (LISS III)

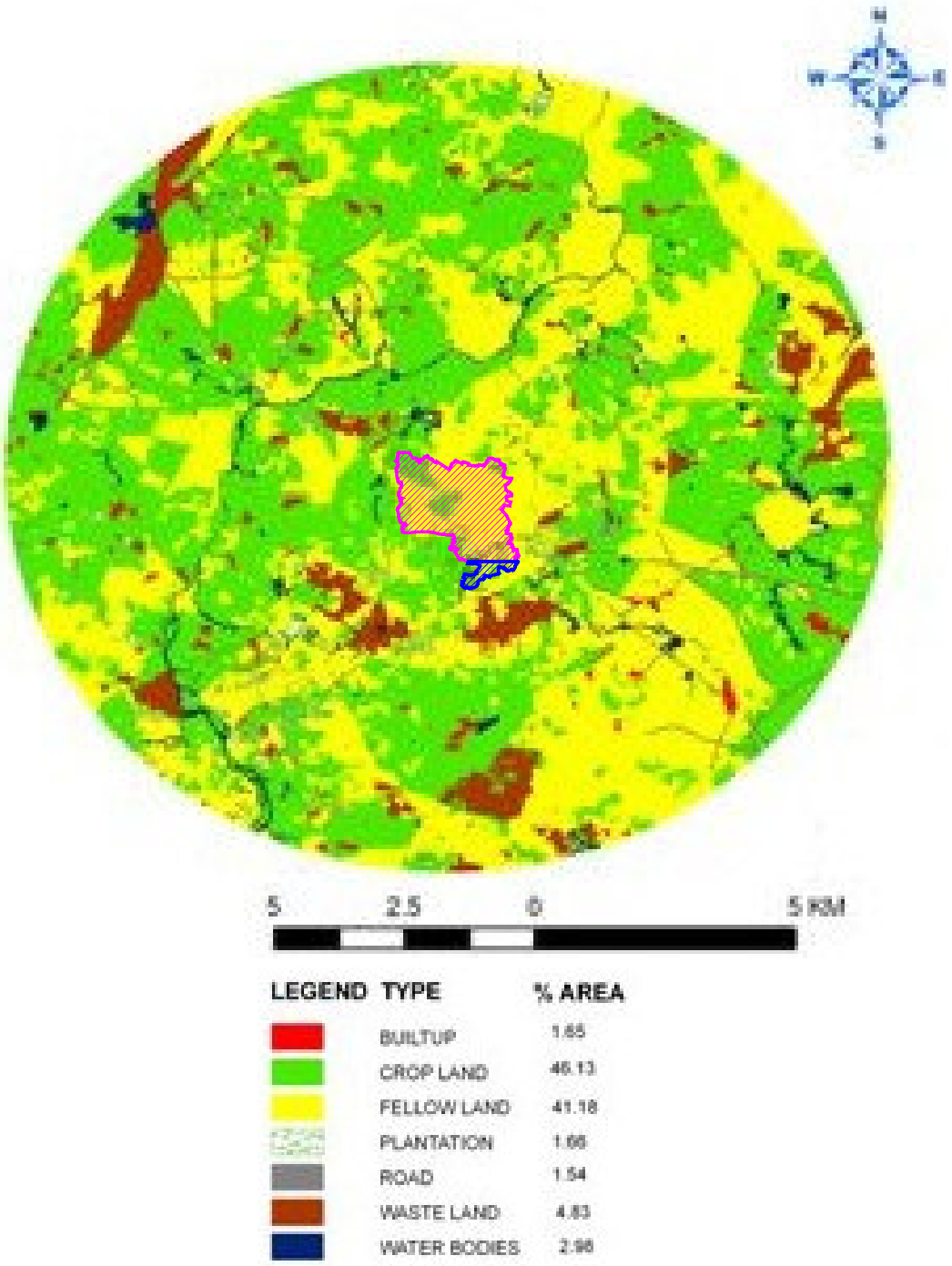

FIGURE-3.2.2
LAND USE PATTERN BASED ON SATELLITE DATA

3.3 Soil Characteristics

It is essential to determine the potential of soil in the area and identify the current impacts of urbanization and industrialization on soil quality and also predict impacts, which may arise due to the plant operations. Accordingly, a study of assessment of the baseline soil quality has been carried out.

3.3.1 Data Generation

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The physical, chemical and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil up to a depth of 90 cm.

The present study of the soil characteristics establishes the baseline characteristics and this will help future in identifying the incremental concentrations if any, due to the operation of the plant. The sampling locations have been identified with the following objectives:

- To determine the baseline soil characteristics of the study area;
- To determine the impact of industrialization on soil characteristics; and
- To determine the impact on soils more importantly from agricultural productivity point of view.

Eight locations within 10-km radius of the proposed plant boundary were selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and are homogenized. This is in line with IS: 2720 and Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America). The homogenized samples were analyzed for physical and chemical characteristics. The soil samples were collected during pre-monsoon season. The samples have been analyzed as per the established scientific methods for physico-chemical parameters. The heavy metals have been analyzed by using Atomic Absorption Spectrophotometer and Inductive Coupled Plasma Analyzer.

The methodology adopted for each parameter is described in **Table-3.3.1**.

TABLE-3.3.1
ANALYTICAL TECHNIQUES FOR SOIL ANALYSIS

Parameter	Method (ASTM Number)
Grain size distribution	Sieve analysis (D 422 – 63)
Textural classification	Chart developed by Public Roads Administration
Bulk density	Sand replacement, core cutter
Sodium absorption ratio	Flame colorimetric (D 1428-82)
pH	pH meter (D 1293-84)
Electrical conductivity	Conductivity meter (D 1125-82)
Nitrogen	Kjeldahl distillation (D 3590-84)
Phosphorus	Molybdenum blue, colorimetric (D 515-82)
Potassium	Flame photometric (D 1428-82)
Copper	AAS (D 1688-84)
Iron	AAS (D 1068-84)
Zinc	AAS (D 1691-84)
Boron	Surcumin, colorimetric (D 3082-79)
Chlorides	Argentometric (D 512-81 Rev 85)

The details of the sampling locations are given in **Table-3.3.2** and are depicted in **Figure-3.3.1**. The analysis results are presented in **Table-3.3.3.**

TABLE-3.3.2
DETAILS OF SOIL SAMPLING LOCATIONS

Code No	Location	Distance w.r.t Proposed Site (Km)	Direction w.r.t Proposed Site
S1	Proposed project site (near Mirchwara village)	--	--
S2	NE of project site	0.3	NE
S3	Udayapura village	2.0	E
S4	Bilata village	5.6	ESE
S5	Mirchwara RF near Mirchwara village	0.8	S
S6	Billa village	4.0	S
S7	Bhagnagar village	2.4	W
S8	Bamhouri shanna village	5.9	NW

Source: Vimta Labs Limited

Observations

The pH of the soil extracts varied from 7.5 to 8.2 indicating neutral to slightly alkaline. The electrical conductivity was observed to be in the range of 78 µS/cm to 225 µS/cm. The nitrogen values range between 53.3 kg/ha to 91.7 kg/ha. The nitrogen content in the study area falls in very less to less category. The phosphorus values range between 34 kg/ha to 85 kg/ha, indicating that the phosphorus content in the study area falls in medium to more than sufficient category. The potassium values range between 98.6 kg/ha to 210 kg/ha, which indicate that the soils have very to medium category. The chlorides were found to be in the range of 566.3 mg/kg to 921.4 mg/kg of soil.

TABLE-3.3.2 (A)
SOIL ANALYSIS RESULTS-PRE MONSOON SEASON

Sr. No	Parameter	UOM	S1	S2	S3	S4	S5	S6	S7	S8
1	pH (1:5 Aqueous extract))	-----	7.7	7.9	7.5	7.9	8.2	8.0	7.6	8.0
2	Conductivity (1:5 Aqueous extract))	µs/cm	108	125	78	154	225	110	105	180
3	Texture	-----	Silty clay	Silty clay	Silty clay	Silty clay	Clay	Sandy clay	Sandy clay	Sandy clay
4	Sand	%	19	48	50	51	25	27	55	58
5	Silt	%	40	14	10	10	25	22	16	14
6	Clay	%	41	38	40	39	50	51	29	28
7	Bulk density	g/cc	1.1	1.1	1	1	1	1.1	1.1	1
8	Exchangeable calcium as Ca	mg/kg	3895	3665	2298	4521	3980	4215	4780	3250
9	Exchangeable magnesium as Mg	mg/kg	266	315	254	267	241	559	210	436
10	Exchangeable sodium as Na	mg/kg	120	65	70	52	94	45	68	72
11	Available potassium as K	kg/ha	150.5	98.6	140	110	125	140	210	185
12	Available phosphorous as p	kg/ha	42.5	60.9	34	85	62	39	48	37
13	Available nitrogen as N	kg/ha	56	53.6	91.7	90	53.3	65.5	80.2	47.5
14	Organic matter	%	0.46	0.5	0.97	1.01	0.55	1.19	1.08	1.21
15	Organic carbon	%	0.26	0.29	0.56	0.59	0.32	0.69	0.52	0.48
16	Water soluble chlorides as Cl	mg/kg	566.3	921.4	566.8	637.2	706.6	637.3	778.9	566.5
17	Water soluble sulphate as SO_4	mg/kg	168.7	135.4	197.5	46.4	33.5	101.8	217.8	61.9
18	Sodium Absorption ratio	----	0.09	0.06	0.05	0.07	0.08	0.07	0.12	0.04
19	Aluminium	%	1.02	0.95	1.09	1	0.8	0.96	1.12	0.83
20	Total iron	%	0.98	1.22	0.86	1.03	1.13	1.07	0.86	1.06
21	Manganese	mg/kg	82	123	65	105	110	75	110	90
22	Boron	mg/kg	42	36.5	69	50	39	21	29	34
23	Zinc	mg/kg	70	75.6	55.9	92.4	68.7	50.7	68	63

TABLE-3.3.3
STANDARD SOIL CLASSIFICATION

Sr. No.	Soil Test	Classification
1	pH	<4.5 Extremely acidic 4.51- 5.00 Very strongly acidic 5.51-6.0 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (mmhos/cm) (1ppm = 640 ppm)	Upto 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops
3	Organic Carbon (%)	Upto 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/ha)	Upto 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (kg/ha)	Upto 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potassium (kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Hand Book of Agriculture, ICAR (Indian Council for Agricultural Research)

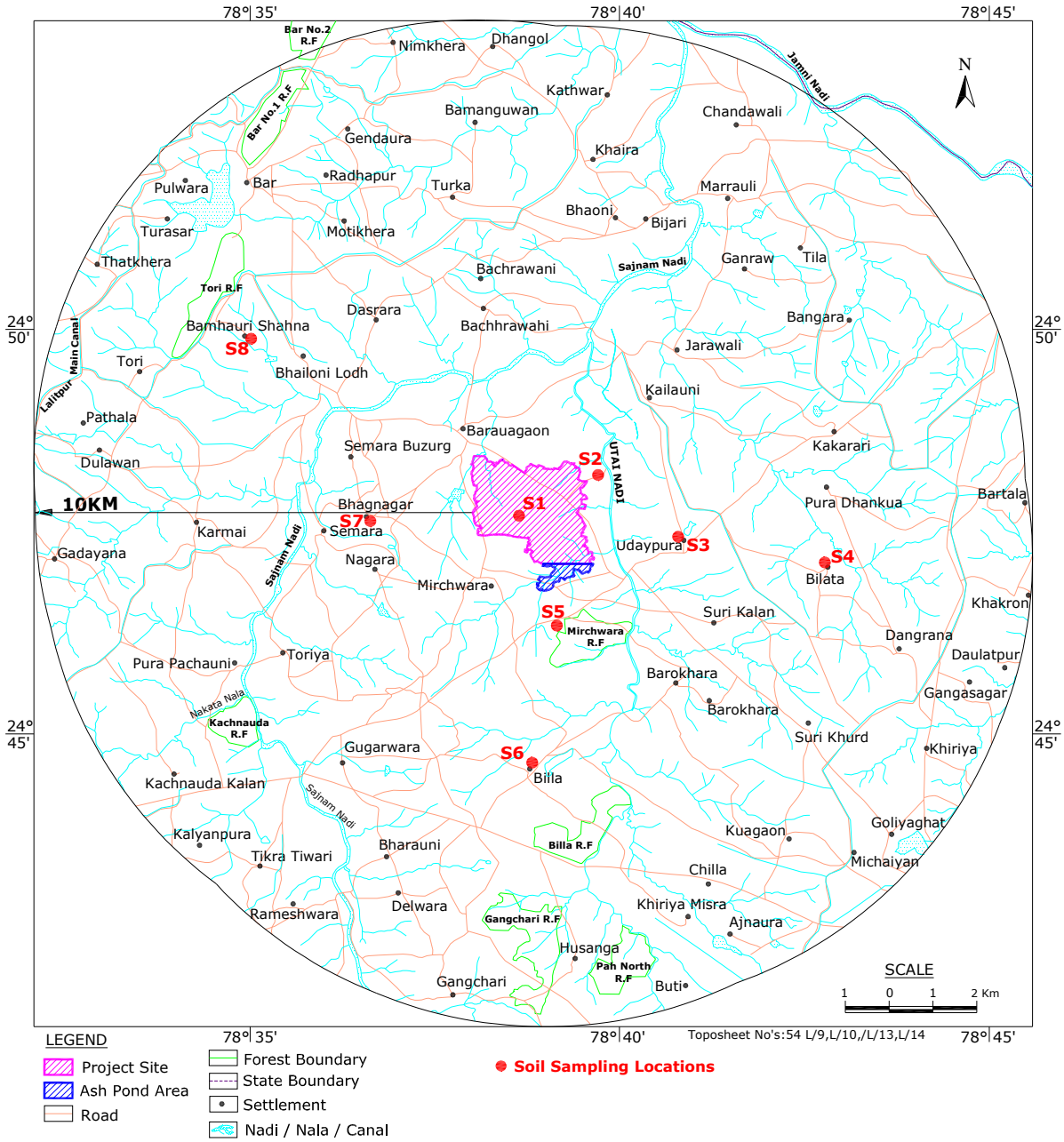

FIGURE-3.3.1
SOIL SAMPLING LOCATIONS

3.4 Climatology and Meteorology

The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information regarding proposed plant area and surrounding area for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region.

The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-Monsoon season : March to May
- Monsoon season : June to September
- Post-Monsoon season : October to November

3.4.1 Methodology

The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (IS : 8829) and India Meteorological Department (IMD). On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected every hour continuously from 15th March 2010 to 31st May 2010 representing pre-monsoon season.

3.4.1.1Methodology of Data Generation

The Central Monitoring Station (CMS) equipped with continuous monitoring equipment was installed on top of a residential building at a height of about 5.0 m above ground level to record wind speed, direction, relative humidity and temperature. The meteorological monitoring station was located in such a way that it is free from any obstructions and as per the guidelines specified under IS: 8829. Cloud cover was recorded by visual observation. Rainfall was monitored by rain gauge.

The continuous recording meteorological instrument of Dynalab, Pune (Model No.WDL1002) has been used for recording the met data. The sensitivity of the equipment is given in **Table-3.4.1**.

TABLE-3.4.1
SENSITIVITY OF METEOROLOGY MONITORING EQUIPMENT

Sr. No.	Sensor	Sensitivity
1	Wind Speed Sensor	± 0.02 m/s
2	Wind Direction Sensor	± 3 degrees
3	Temperature Sensor	± 0.2^{o}C

3.4.1.2 Sources of Information

India Meteorological Department has been monitoring surface observations at Tikamgarh which is about 17-km, ESE from project site. Pressure, temperature, relative humidity, rainfall, wind speed and direction are measured twice a day

viz., at 0830 and 1730 hr. The data for the above specified parameters has been collected for 10 years and processed. Data on cloud cover is compiled form the climatological tables for the IMD station at Tikamgarh.

3.4.2 Presentation of Data

3.4.2.1 Meteorological Data Recorded at IMD, Tikamgarh

The data collected from IMD includes wind speed, wind direction, temperature, relative humidity, atmospheric pressure; rainfall and cloud cover over a period of 10 years from the year 1991 to 2000. The monthly maximum, minimum and average values are collected for all the parameters except wind speed and direction. All these parameters are recorded twice a day viz at 0830 and 1730 hours. The collected data is given in **Table-3.4.2**.

1] Temperature

The winter season starts from December and continues till the end of February. January is the coolest month with the mean daily maximum temperature at 26.8^{0}C and the mean daily minimum temperature at 7.0^{0}C. Both the night and day temperatures increase rapidly during the onset of the pre-monsoon season from March to May. During pre-monsoon the mean maximum temperature (May) was observed to be 41.8^{0}C with the mean minimum temperature at 13.6^{0}C. The mean maximum temperature in the monsoon season was observed to be 38.9^{0}C whereas the mean minimum temperature was observed to be 22.7^{0}C. By the end of September with the onset of south-west monsoon (October), the day temperatures increase slightly, with the mean maximum temperature at 33.2^{0}C and the mean minimum temperature at 11.7^{0}C. The monthly variations of temperature are presented in **Table-3.4.2.**

2] Relative Humidity

The air is generally very humid in the region especially during the monsoon when the average relative humidity at 8.30 hrs was observed to be 77% with a maximum and a minimum of 87 % and 58 % respectively. Similarly, at 17.30 hr., the average was observed to be 66% with the maximum and minimum values of 43% and 79% values respectively. In the pre-monsoon period, the average relative humidity at 8.30 hr. was 45.3 % with a maximum and minimum value of 55% and 35%. Likewise, the average relative humidity at 17.30 hr. was 25.3% with the maximum and minimum to be 22% and 31%. In the post-monsoon period, the average relative humidity at 8.30 hr. was 74.5% with the maximum and minimum to be 82% and 67%. Likewise, the average relative humidity at 17.30 hr. was 61.5% with the maximum and minimum to be 70% and 53%. During winter the average relative humidity at 8.30 hr. was 72.3% with the maximum and minimum to be 74% and 69%. Similarly, the average relative humidity at 17.30 hr. was 48.3% with a maximum and minimum of 55% and 39%. The monthly variations in the relative humidity are presented in **Table-3.4.2.**

TABLE-3.4.2
CLIMATOLOGICAL DATA GENERATED AT IMD STATION TIKAMGARH (1991-2000)

Month	Atmospheric Pressure (mb)		Temperature (^{0}c)		Relative Humidity (%)		Rainfall
	08.30	17.30	Max	Min	08.30	17.30	
January	977.5	974.8	24.3	7.0	74	51	21.5
February	976.1	973.0	26.8	9.1	69	39	20.8
March	973.6	970.3	33.2	13.6	55	31	6.6
April	969.5	965.7	39.1	20.0	36	22	3.0
May	965.6	961.9	41.8	25.1	35	23	4.8
June	962.2	958.8	38.9	26.9	58	43	115.4
July	961.4	958.7	32.5	24.5	83	72	321.0
August	962.6	960.1	30.9	23.8	87	79	387.3
September	967.1	964.6	32.3	22.7	82	70	131.4
October	972.8	969.8	33.2	17.8	67	53	16.7
November	976.4	973.6	29.8	11.7	64	49	22.0
December	978.3	975.6	25.5	7.4	74	55	6.6
Range	**958.7-978.3**		**7.0-41.8**		**22-87**		**1057.1**

Source: IMD, Tikamgarh

3] Atmospheric Pressure

During winter season the pressure observed was in the range of 973.0 to 978.3 mb, with the maximum pressure (978.3 mb) occurring in the month of December. During monsoon the pressure observed was in the range of 958.7 to 967.1 mb, with the maximum pressure 967.1 mb occurring during September month in the monsoon season. During post monsoon season the pressure observed was in the range of 969.8 to 976.4 mb, with the maximum pressure (976.4 mb) occurring in the month of October. During pre-monsoon the pressure observed was in the range of 961.9 to 973.6 mb, with the maximum pressure 973.6 mb occurring during March.

The pressure levels are found to be fairly consistent over the region. The monthly variations in the pressure levels are presented in **Table-3.4.2.**

4] Rainfall

The average annual rainfall based on the 10 year IMD data, was observed to be 1057.1 mm. The monsoon sets in the month of June and continues till September. The average rainfall observed during the monsoon season was 955.1 mm with maximum amount of rainfall (387.3 mm) occurring in the month of August and the minimum (131.4 mm) in the month of September respectively. The maximum numbers of rainy days occur in the month of August. Monthly variations in the rainfall for past 10 years are given in **Table-3.4.2.**

5] Cloud Cover

During the winter and the post-monsoon seasons it was observed that the skies are generally very clear. In the pre-monsoon season, generally light clouds were observed in the evenings, with clear mornings. During the monsoon season, both in the mornings and evenings, the skies were found to be clouded.

6] Wind Speed / Direction

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours. While during the afternoon hours the winds were stronger.The season wise discussion of the respective wind pattern is given as below:

The season wise discussion of the respective wind roses is given hereunder:

A) Wind Pattern during Pre-Monsoon Season

0830 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from west and south directions followed by south west direction **(Figure-3.4.1).**

Predominant winds from north direction were observed for 20% of the total time and in the south direction winds were observed for 18.3% of the total time. Whereas in south-west direction the winds were observed for 16.7% of the total time. In other directions, the percentage frequencies observed were N (13.3%), NW (7.7%), SE (6.6%), E (3.3%), NE (3.0%). The prevailing calm conditions are 11.1%.

1730 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from north, west directions followed by north-west direction (**Figure-3.4.1).**

Predominant winds from north direction were observed for 37% of the total time and in the west direction winds were observed for 16.3% of the total time. Whereas in north-west direction the winds were observed for 14.0% of the total time. In other directions, the percentage frequencies observed were SW (10.0%), S (8.7%), NE (5.7%), SE (2.3%), E (1.7%). The prevailing calm conditions are 4.3%.

B) Wind Pattern during Monsoon Season

0830 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from west direction and south-west direction followed by east direction **(Figure-3.4.1).**

Predominant winds from west direction were observed for 32.5% of the total time and in the south-west direction winds were observed for 25.5% of the total time. Whereas in north direction the winds were observed for 10.8% of the total time. In other directions, the percentage frequencies observed were S (7.0%), NE (5.0), E (4.0%), SE (3.8%). The prevailing calm conditions are 4.5%.

1730 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from west direction and south west direction followed by north direction **(Figure-3.4.1).**

Predominant winds from west direction were observed for 29.6% of the total time and in the west direction winds were observed for 22.8% of the total time. Whereas in north west direction the winds were observed for 9.5 % of the total time. In other directions, the percentage frequencies observed were N (15.3%), NE (5.0%), SE (3.5%), E (3.3%). The prevailing calm conditions are 4.5%.

C) Wind Pattern during Post-Monsoon Season

0830 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from south west direction and north direction followed by west **(Figure-3.4.2).**

Predominant winds from south direction were observed for 22.3% of the total time and in the south west direction winds were observed for 15.0 % of the total time. Whereas in north direction the winds were observed for 11.3% of the total time. In other directions, the percentage frequencies observed were W (10.3%), SE (7.3%), NW (3.7%), NE (2.7%), E (2.7%). The prevailing calm conditions are 24.7%.

1730 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from north direction and south direction followed by north-east direction **(Figure-3.4.2).**

Predominant winds from north direction were observed for 36% of the total time and in the south direction winds were observed for 10.3% of the total time. Whereas in north-east direction the winds were observed for 8.0 % of the total time. In other directions, the percentage frequencies observed were SW (7.7%), NW (7.3%), W (6.0%), E (4.0%), SE (3.0%), E (1.7%). The prevailing calm conditions are 17.7%.

D) Wind Pattern during Winter Season

0830 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from south direction and north direction followed by south-west direction **(Figure-3.4.2).**

Predominant winds from north direction were observed for 26.3% of the total time and in the north direction winds were observed for 12 % of the total time. Whereas in south west direction the winds were observed for 8.3% of the total time. In other directions, the percentage frequencies observed were SE (7.7%),

W (5.0%), NE (4.0%), E (3.7%), NW (2.3%). The prevailing calm conditions are 30.7%.

1730 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from north direction and south direction followed by north east direction **(Figure-3.4.2).**

Predominant winds from north direction were observed for 42.0% of the total time and in the south direction winds were observed for 9.0% of the total time. Whereas in north east direction the winds were observed for 8.0% of the total time. In other directions, the percentage frequencies observed were W (7.0%), NW (5.3%), SW (4.7%), E (3.3%), SE (3.0%). The prevailing calm conditions are 17.7%.

E) Annual Wind Pattern

0830 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from west direction and south-west direction followed by south direction **(Figure-3.4.3).**

Predominant winds from west direction were observed for 19.2% of the total time and in the south west direction winds were observed for 17.9% of the total time. Whereas in south direction the winds were observed for 16.8% of the total time. In other directions, the percentage frequencies observed were N (12.1%), SE (6.0%), NW (5.5%), NE (3.8%), E (3.5%). The prevailing calm conditions are 15.2%.

1730 Hours:

A review of the wind rose diagram shows that predominant winds are mostly from north direction and west direction followed by south-west direction **(Figure-3.4.3).**

Predominant winds from north direction were observed for 30.8% of the total time and in the west direction winds were observed for 16.8% of the total time. Whereas in south-west direction the winds were observed for 12.8% of the total time. In other directions, the percentage frequencies observed were NW (9.5%), S (8.3%), NE (6.4%), E (3.1%), SE (3.0%). The prevailing calm conditions are 9.3%.

3.4.2.2 Analysis of Meteorological Data Recorded at the proposed site:

1) <u>Temperature</u>

It was observed that the temperature ranged from 12.7^{o} C to 41.5^{o} C. The maximum temperature of 41.5^{o} C was recorded in the month of May with the minimum temperature recorded during the month of March at 12.7^{0}C.

2) Relative Humidity

During the period of observation the Relative Humidity ranging from 23 % to 53%. The maximum humidity (53%) was recorded in the month of March with the minimum occurring at 23 % in the month of April.

3) Rainfall

The intensity of rainfall observed during study period was 2.3 mm.

4) Cloud Cover

The skies in the month of May were generally clear with moderate clouds in the month of early June. Heavy clouds are characterized during the monsoon season, which gradually clears up by the post monsoon season. Moderate clouds are observed during the winter season.

5) Wind Speed and Direction

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours, while during the afternoon hours the winds were stronger.

The details are presented in **Table-3.4.3**.

3.4.3 Site specific Wind Rose Observations (Pre-monsoon Season)

Predominant winds were observed from North direction for 19.3 % of the total time. In the West direction winds were observed for 14.7% of the total time. Whereas for SW direction the winds were observed for 8.1% of the total time In other directions, the percentages frequencies were observed from NW (6.7%), SSW (6.7%), NNE (4.8%), WSW (3.9%), S (4.7%), E (5.5%), SE (3.0%), SSE (1.9%), NNW (3.8%), ENE (2.7%), NE (2.4%), ESE (1.5%) and calm conditions (7.5%).

Site specific wind rose representing pre-monsoon season is shown in **Figure-3.4.4**.

TABLE-3.4.3
MICRO-METEOROLOGICAL DATA

Period: 1st March 2010 to 31st May 2010

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Atmospheric Pressure (mb)	
	Max	Min	Max	Min	Total	Max	Min
March 2010	32.9	12.7	53	30	2.3	972.6	969.5
April 2010	39.2	19.6	35	23	--	967.4	963.4
May 2010	41.5	24.8	33	24	--	963.2	960.5
Range	**12.7-41.5**		**23-53**		**2.3**	**960.5-972.6**	

3.4.4 Comments

On comparison of site specific data generated for three months vis-à-vis the IMD data, slight variations were observed. The following observations are brought out.

- The maximum temperature recorded at the site during study period was around 41.5 ^{o}C whereas the value recorded at IMD was 41.8^{0}C. During the study period the highest relative humidity (53%) was recorded on-site compared with IMD data (55%).

- Slight variations were observed in case of wind speeds and directions. The variations may be due to the frequency, time of recording and the height of the station. The IMD data has been monitored twice a day, whereas the CMS data has been recorded at hourly frequency. The other reason may be the difference in the location of two stations.

The data generated at continuous monitoring station at project site when compared with the data recorded at IMD, it can be observed that the data generated at the site is broadly compatible with regional meteorology, except minor variations as described above.

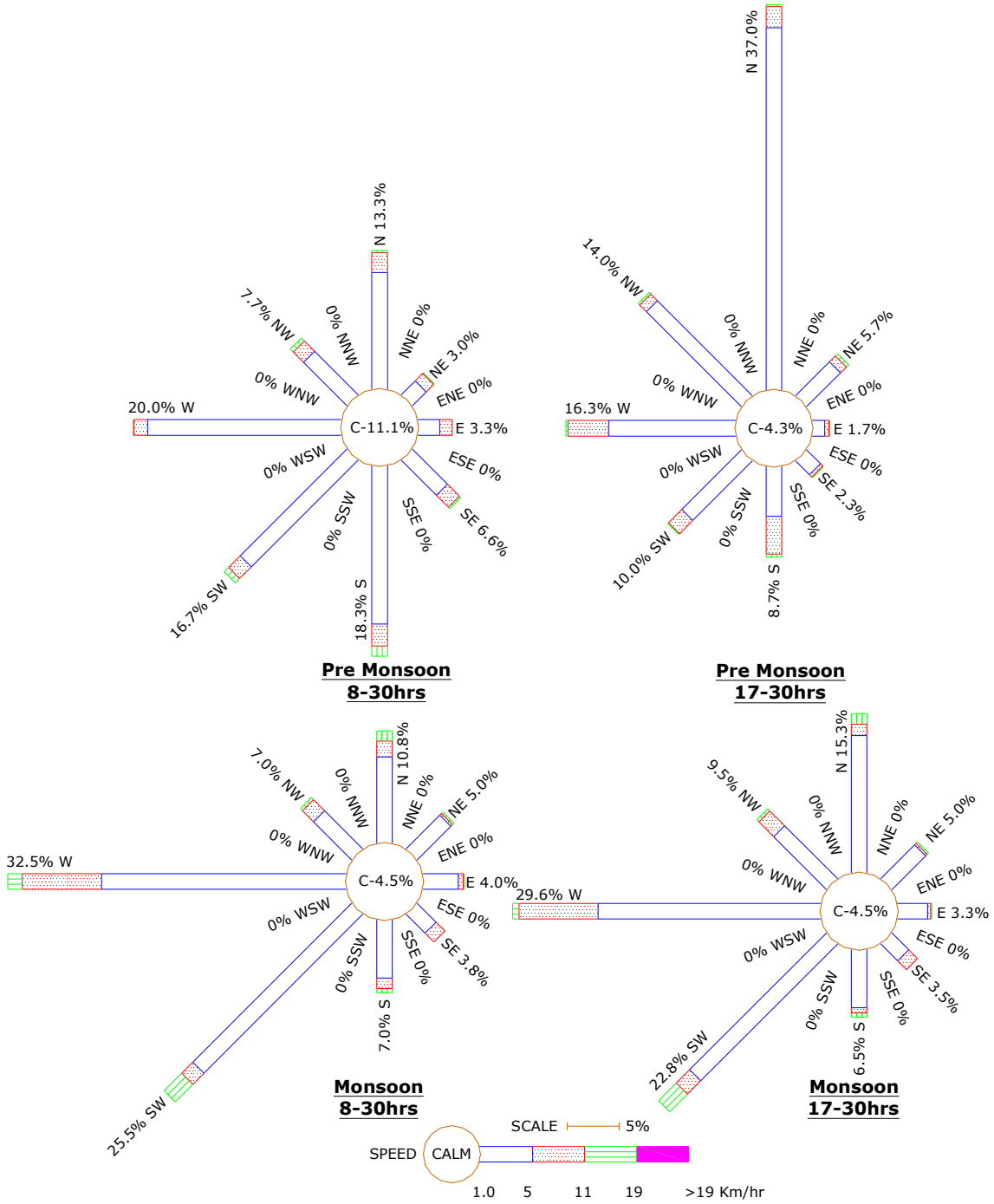

FIGURE-3.4.1
WIND ROSE-PRE-MONSOON & MONSOON (IMD- TIKAMGARH)

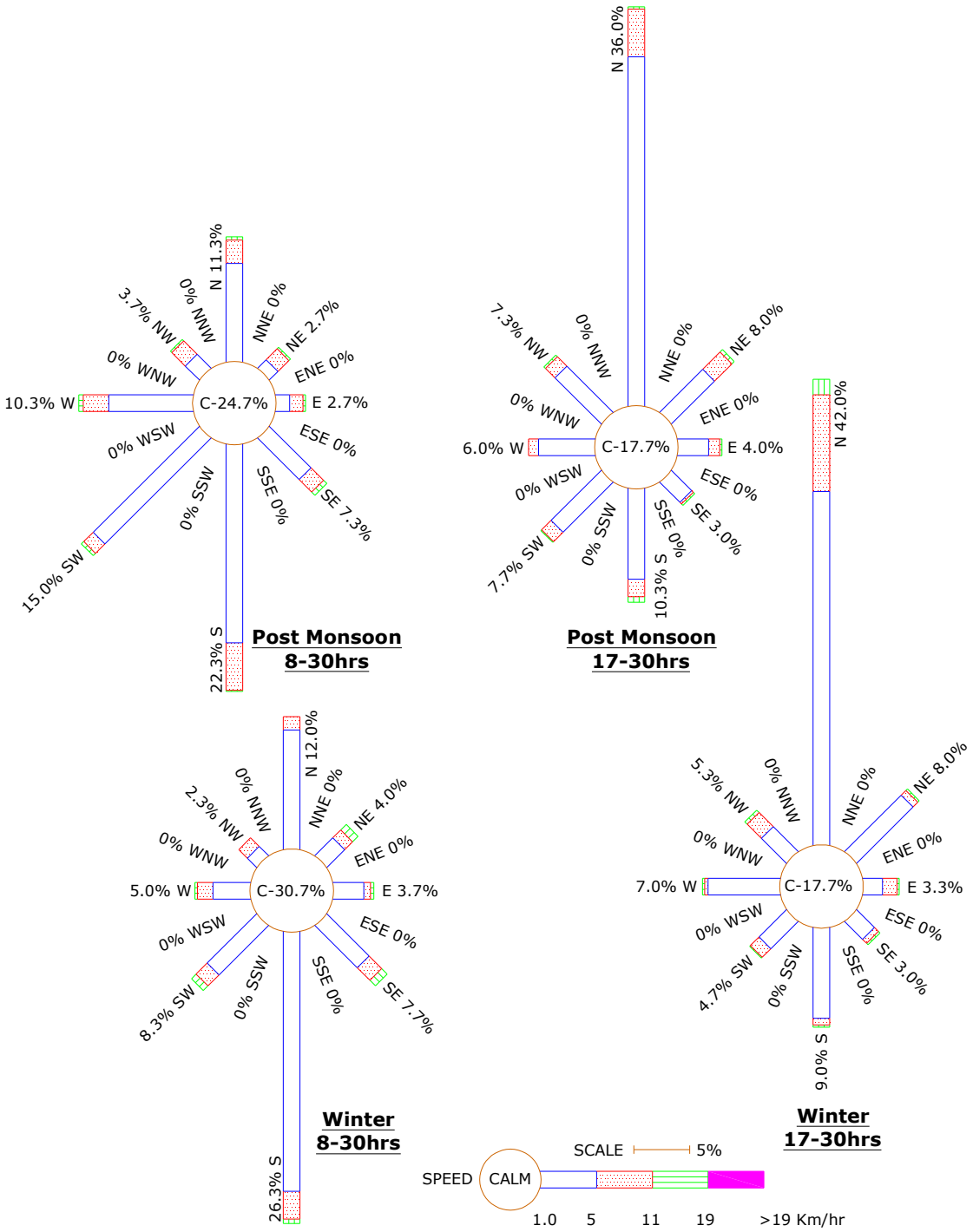

FIGURE-3.4.2
WIND ROSE-POST MONSOON & WINTER (IMD- TIKAMGARH)

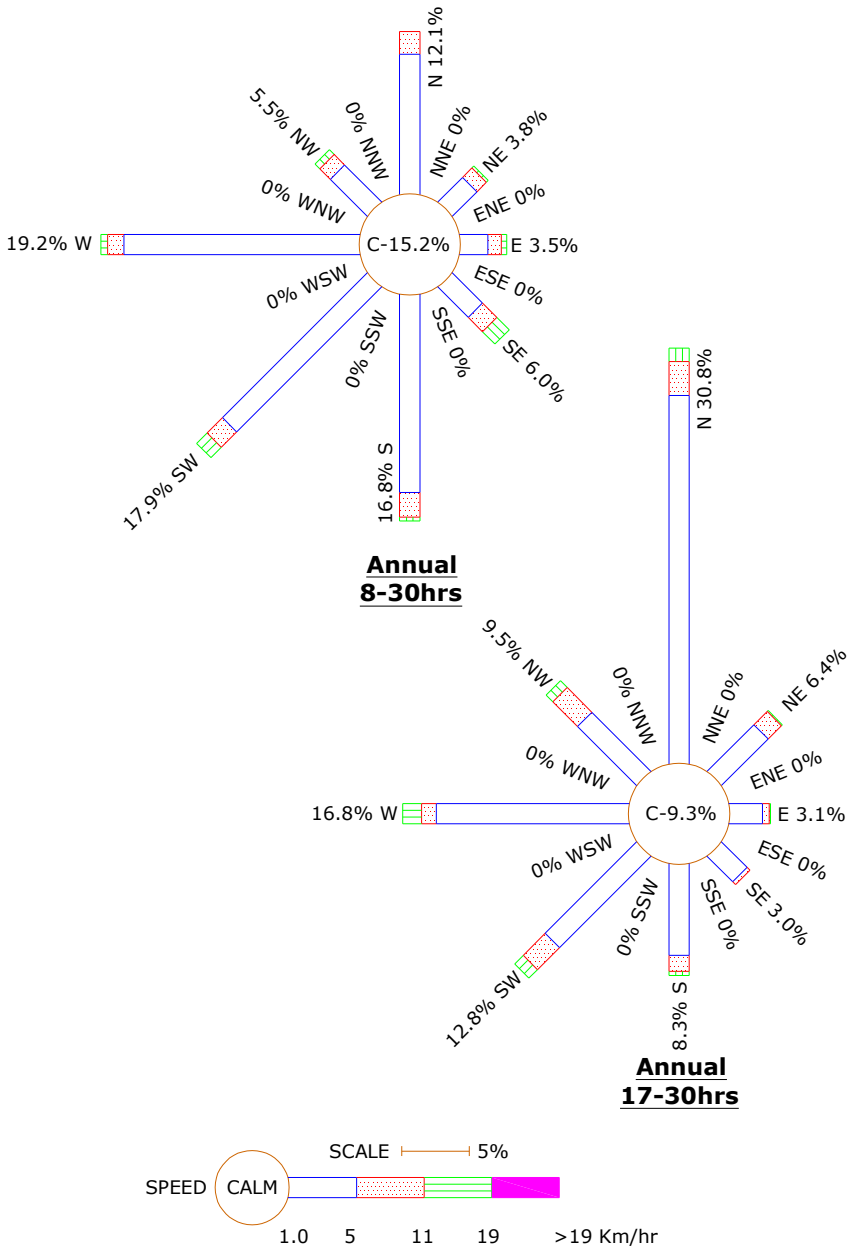

FIGURE-3.4.3
WIND ROSE-ANNUAL (IMD- TIKAMGARH)

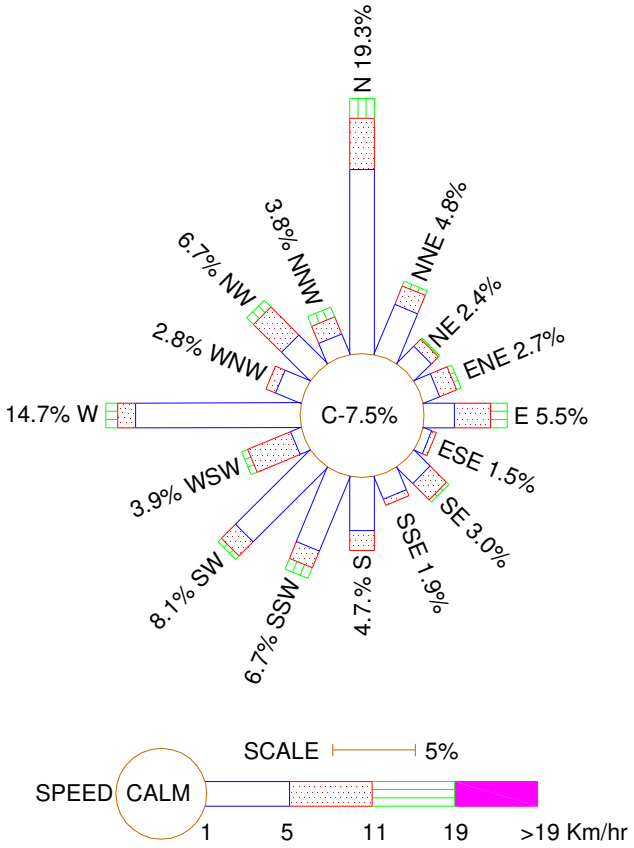

FIGURE-3.4.4
SITE SPECIFIC WIND ROSE (PRE-MONSOON SEASON)

3.5 Ambient Air Quality

The prime objective of the baseline air monitoring was to evaluate the existing air quality of the area. This will also be useful for assessing the conformity to standards of the ambient air quality during the operation of the proposed power plant.

The ambient air quality was monitored at eight locations in and around the project site. The results of ambient air quality are presented in **Annexure-VI.**

3.5.1 Methodology adopted for Air Quality Survey

➢ ***Selection of Sampling Locations***

The baseline status of the air quality in the study area has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance program has been based on the following considerations:

- Meteorological conditions on synoptic scale;
- The methodology for conducting the baseline environmental survey and selection of sampling locations considered the guidelines given in the EIA manual of the MoEF;
- Topography of the study area;
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

Ambient Air Quality Monitoring (AAQM) stations were set up at eight locations with due consideration to the above mentioned points. **Table-3.5.1** gives the details of environmental setting around each monitoring station and their distances with reference to the proposed power plant. The AAQM locations are depicted in **Figure–3.5.1.**

TABLE-3.5.1
DETAILS OF AMBIENT AIR QUALITY MONITORING LOCATIONS

Location Code	Location	Distance (km)	Direction	Environment Setting
AAQ1	Proposed project site (near Mirchwara village)	--	--	
AAQ2	NE of project site	0.3	NE	Cross wind
AAQ3	Udayapura village	2.0	E	Down wind
AAQ4	Bilata village	5.3	ESE	Down wind
AAQ5	Mirchwara RF near Mirchwara village	0.8	S	Cross wind
AAQ6	Billa village	4.0	S	Down wind
AAQ7	Bhagnagar village	1.9	W	Up wind
AAQ8	Bamhouri shanna village	6.0	NW	Cross wind

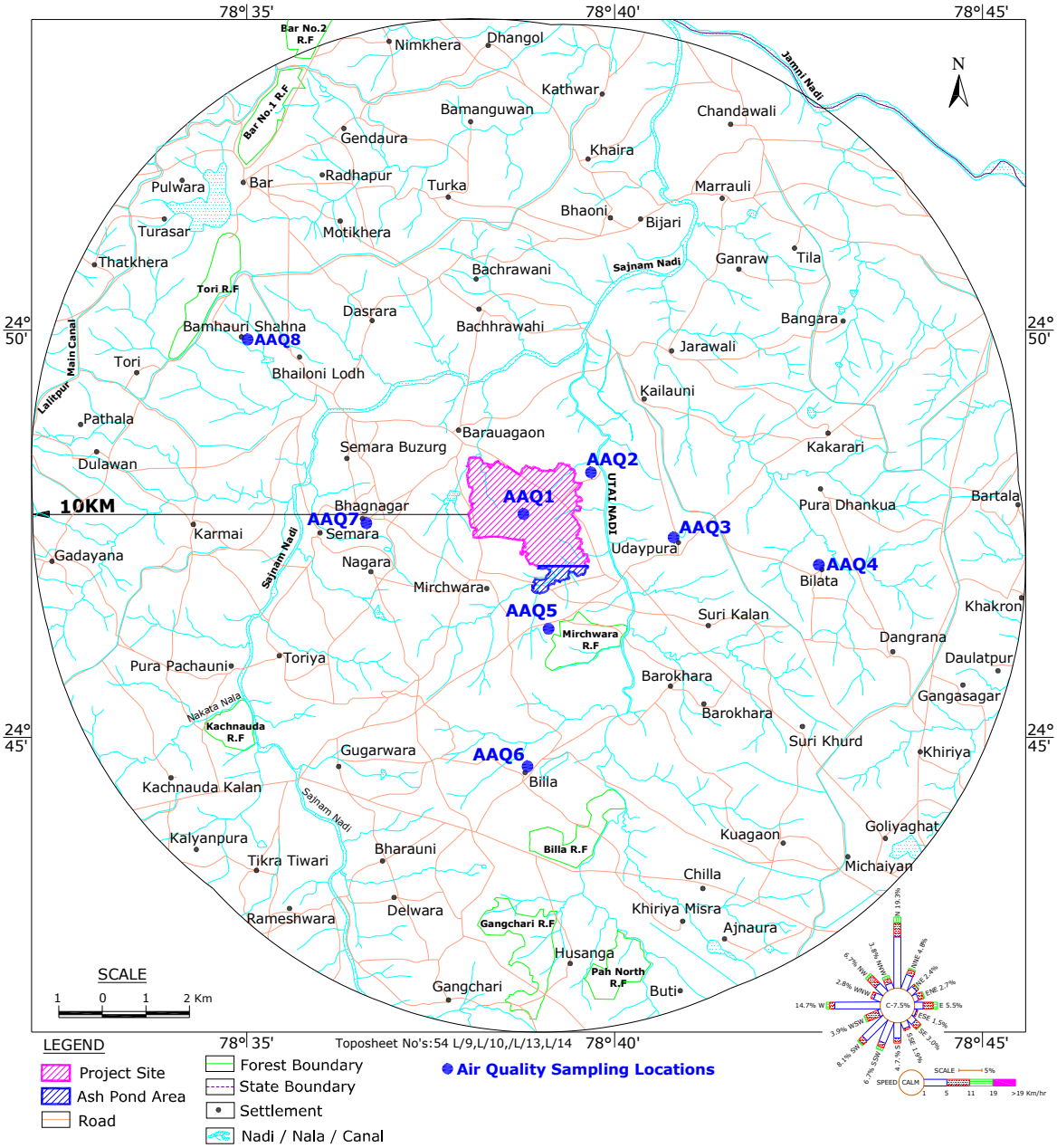

FIGURE-3.5.1
AMBIENT AIR QUALITY SAMPLING LOCATIONS

3.5.2 Frequency and Parameters for Sampling

The following frequency has been adopted for sampling:

Ambient air quality monitoring has been carried out with a frequency of two days per week at ten locations during study period. The ambient air quality parameters along with their frequency of sampling are given in **Table-3.5.2**.

TABLE-3.5.2
MONITORED PARAMETERS AND FREQUENCY OF SAMPLING

Parameters	Sampling Frequency
PM_{10}	24 hourly sample twice a week for one season
PM2.5	24 hourly sample twice a week for one season
Sulphur dioxide (SO_2)	24 hourly samples twice a week for one season
Oxides of Nitrogen (NO_X)	24 hourly samples twice a week for one season
Carbon monoxide (CO)	Three 8 hourly samples in a day; twice a week for one season
Ozone (O_3)	8 hourly samples twice a week for one season
Mercury (Hg)	24 hourly samples twice a week for one season

3.5.3 Instruments used for Sampling

Respirable dust samplers (RDS) have been used for monitoring of PM_{10} and $PM_{2.5}$ and gaseous pollutants like SO_2, NOx, Mercury, Ozone and CO.

3.5.4 Sampling and Analytical Techniques

TSPM and RPM have been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 Part-II, 1969) has been adopted for estimation of SO_2. Jacobs-Hochheiser method (IS-5182 Part-IV, 1975) has been adopted for the estimation of NOx. The techniques used for ambient air quality monitoring and its minimum detectable levels are given in **Table-3.5.3**.

TABLE-3.5.3
TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Sr. No.	Parameter	Technique	Technical Protocol	Minimum Detectable Limit ($\mu g/m^3$)
1	Total Suspended Particulate Matter	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	5.0
2	Respirable Particulate Matter	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	4.0
3	Sulphur Dioxide	Modified West and Gaeke	IS-5182 (Part-II)	4.0
4	Nitrogen Oxide	Jacob & Hochheiser	IS-5182 (Part-VI)	4.0
5	Carbon monoxide	FID technique (Gas chromatography)	IS-5182(Part-X)	12.5
6	Ozone (O_3)	Spectrophotometer	ASTM-D-5011-92	1.0
7	Mercury (Hg)	The recovered samples are digested, and appropriate fractions are analyzed for Hg by cold vapor atomic absorption spectroscopy (CVAAS).	USEPA method IO-2.1/ IS-5182 (P-1)/USEPA IO 3.4	0.1

Source: Vimta Labs Limited and Bureau of Indian standards

TABLE- 3.5.4 (A)
SUMMARY OF AMBIENT AIR QUALITY RESULTS (PRE MONSOON SEASON)

Code	Location	PM_{10}				$PM_{2.5}$				SO_2			
		Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Project site	31.4	35.3	35.4	39.4	13.3	18.6	15.6	18.5	5.1	6.3	5.5	6.3
AAQ2	NE -project site	33.7	43.8	38.2	43.0	16.8	20.7	18.6	20.7	5.2	6.5	5.8	6.5
AAQ3	Udayapura	31.1	42.8	35.3	42.2	18.0	20.6	19.5	20.6	5.5	7.7	6.4	7.6
AAQ4	Bilata village	32.5	40.8	36.0	40.4	14.2	19.8	17.0	19.5	5.4	7.9	6.9	7.8
AAQ5	Mirchwara RF	32.1	39.9	34.4	38.9	15.5	19.3	17.5	19.2	6.2	7.8	7.1	7.8
AAQ6	Billa village	29.7	36.2	32.5	36.2	16.1	19.9	18.2	19.9	5.4	7.6	6.5	7.6
AAQ7	Bhagnagar	35.2	49.5	40.8	49.2	15.8	19.1	17.0	19.0	5.6	8.1	6.8	7.9
AAQ8	Bamhourishanna	36.2	46.7	39.7	45.4	16.7	19.7	18.2	19.7	5.2	7.4	6.1	7.3
		29.7-49.5				**13.3-20.7**				**5.1-8.1**			

All values are expressed in $\mu g/m^3$ Source: Vimta Labs Limited

TABLE- 3.5.4 (B)
SUMMARY OF AMBIENT AIR QUALITY RESULTS (PRE MONSOON SEASON)

Code	Location/ Village	NOx				CO			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Project site	6.2	8.2	7.1	8.2	106	156	130	156
AAQ2	NE -project site	5.8	7.8	7.0	7.8	118	155	135	154
AAQ3	Udayapura	6.3	7.9	7.3	7.9	104	148	116	135
AAQ4	Bilata village	6.7	8.8	7.7	8.6	123	153	137	153
AAQ5	Mirchwara RF	6.9	8.4	7.8	8.4	107	161	128	150
AAQ6	Billa village	5.8	8.9	7.1	8.5	105	165	130	161
AAQ7	Bhagnagar	6.5	8.2	7.3	8.1	109	162	134	159
AAQ8	Bamhourishanna	5.6	7.7	6.6	7.7	104	156	124	145
	Range	**5.6-8.9**				**104-165**			

All values are expressed in $\mu g/m^3$

TABLE-3.5.4 (C)
SUMMARY OF AMBIENT AIR QUALITY RESULTS (PRE MONSOON SEASON)

Code	Location/ Village	Ozone				Mercury			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Project site	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ2	NE -project site	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ3	Udayapura	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ4	Bilata village	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ5	Mirchwara RF	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ6	Billa village	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ7	Bhagnagar	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
AAQ8	Bamhourishanna	<1.0	<1.0	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1
	Range	**< 1.0**				**<0.1**			

3.5.5 Presentation of Results

The analysis results for the study period are presented in detail in **Annexure-VI.** Various statistical parameters like 98th percentile, average, maximum and minimum values have been computed from the observed raw data for all the AAQ monitoring stations.

The summary of these results for all the locations is presented in **Table-3.5.4 (A), Table-3.5.4 (B) and Table-3.5.4(C).** These are compared with the standards prescribed by Central Pollution Control Board (CPCB) for rural and residential zone.

3.5.6 Observations of the results

The observations based on a perusal of the results for pre monsoon season are summarized below:

PM_{10}: The maximum value of 49.5 μg/m^3 was observed at AAQ7 and minimum value of 29.7 μg/m^3 was observed at AAQ6.

$PM_{2.5}$: The maximum value of 20.7 μg/m^3 was observed at AAQ2 and minimum value of 13.3 μg/m^3 was observed at AAQ1.

SO_2: The maximum value of 8.1 μg/m^3 was observed at AAQ7 and minimum value of 5.1 μg/m^3 was observed at AAQ1.

NO_X: The maximum value of 8.9 μg/m^3 was observed at AAQ6 and minimum value of 5.6 μg/m^3 was observed at AAQ8.

CO: The CO concentrations in the region are observed to be well under the limits of 2000 μg/m^3 applicable for residential areas as specified by CPCB standards.

Ozone: Ozone values in all location are observed to be below detectable limit (1.0 μg/m^3).

Mercury: Mercury values in all the locations are aobserved to be below detectable limit (1.0 μg/m^3)

3.6 Water Quality

Selected water quality parameters of ground water and surface water resources within 10-km radius of the study area have been studied for assessing the hydrological environment to evaluate anticipated impact of the coal based power plant. Understanding the water quality is essential in the preparation of Environmental Impact statement. It also assists to identify critical issues in a view to suggest appropriate mitigation measures for implementation to curb the deterioration of various hydrological sources in the vicinity of the project site.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict the likely impacts on water quality due to the project and related activities.

3.6.1 Methodology

Reconnaissance survey was undertaken and monitoring locations were finalized based on:

- Drainage pattern;
- Location of residential areas representing different activities/likely impact areas; and
- Likely areas, which can represent baseline conditions.

Three surface water and ***seven*** ground water sources covering 10-km radial distance were examined for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and other activities on surface and ground water. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA).

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1 ml HNO_3. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like Dissolved Oxygen (DO) and pH were analyzed

The methodology for sample collection and preservation techniques was followed as per the Standard Operating Procedures (SOP) mentioned in **Annexure-VII.**

3.6.2 Water Sampling Locations

Three surface water and *seven* ground water samples were collected as grab samples and were analyzed for various parameters. The analyzed results were compared with the standards for drinking water as per IS: 2296 and 10500. The water sampling locations are listed below in **Table-3.6.1** and are shown in **Figure-3.6.1**.

TABLE-3.6.1
DETAILS OF WATER SAMPLING LOCATIONS

Location Code	Locations	Source	Distance (km)	Direction
Ground Water				
GW1	Plant site (near Mirchwara village)	Dug well	--	--
GW2	Mirchwara Village	Hand pump	1.2	SW
GW3	Barauagoan	Hand pump	0.6	NW
GW4	Billa Village	Hand pump	4.0	S
GW5	Toriya Village	Hand pump	5.2	WSW
GW6	Bhagnagar Village	Hand pump	2.4	W
GW7	Udayapura Village	Hand pump	2.0	E
Surface Water				
SW1	Sajnam river (U/S) near Chandwali village	Fresh water	7.2	NNE
SW2	Sajnam river (D/S) near Semara village	Fresh water	3.8	W
SW3	Utai river near Udaypura village	Fresh water	0.6	E

3.6.3 Presentation of Results

Three surface water samples and seven ground water samples have been considered around the power plant within the periphery of 10 km taking in to account the various uses. The results of ground water samples are presented in **Table-3.6.2(A) & (B).** The results of surface water samples are presented in **Table-3.6.3**.

3.6.4 Observations

3.6.4.1 ***Ground Water Quality***

The results of analysis indicate that the pH ranges in between 6.7 to 7.2, which is well within specified standard of 6.5 to 8.5. The hardness was observed to be ranging from 215 mg/l to 578 mg/l. Chlorides were found to be in the range of 20 mg/l to 209 mg/l. Sulphates were found to be in the range of 4.5 mg/l to 42.1 mg/l. The Total Dissolved Solids concentrations (TDS) were found to be ranging in between 229 mg/l to 946 mg/l. Heavy metals are in very low concentration and are well within the prescribed limits.

3.6.4.2 Surface Water Quality

The results of analysis indicate that the pH ranges in between 8.0 to 8.2. The Total Dissolved Solids concentrations (TDS) were found to be ranging in between 206 mg/l to 273 mg/l. The Chlorides and Sulphates were found to be in the range of 21.0 mg/l to 30.0 mg/l and 0.8 mg/l to 1.4 mg/l respectively. It is observed that Chlorides and Sulphates are well within the permissible limits. Heavy metals in very low concentration and are well within the prescribed limits.

It is evident from the above values that all the parameters are found to comply with the requirements of IS: 2296 specification of surface water. The surface water quality does not indicate any industrial contamination.

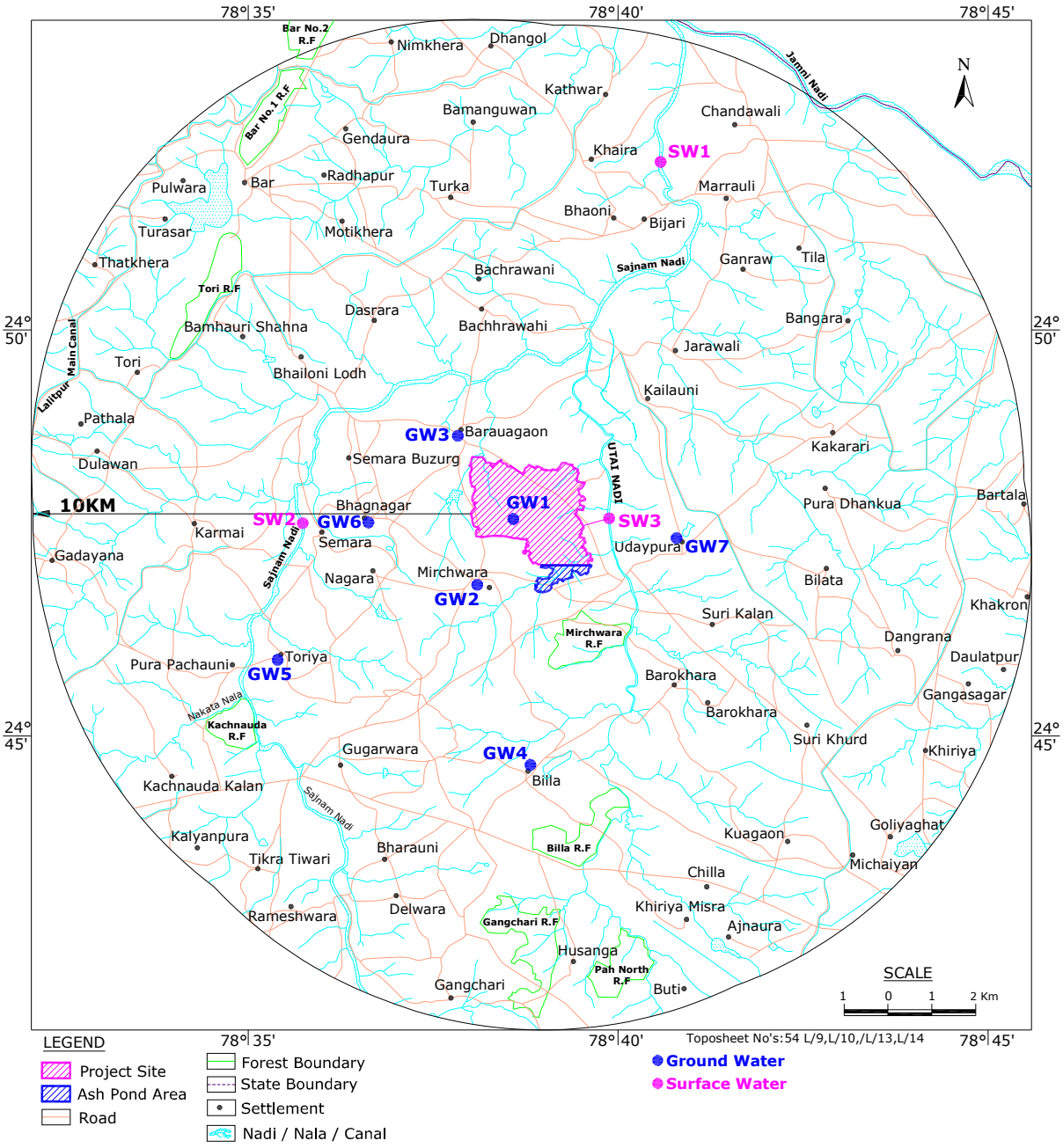

FIGURE-3.6.1
WATER SAMPLING LOCATIONS

TABLE-3.6.2 (A)
GROUND WATER QUALITY-PRE MONSOON SEASON

Sr. No	Parameters	Unit	IS:10500 limits	GW1	GW2	GW3	GW4
1	pH	-	6.5-8.5 (NR)	7.2	7.1	7.1	6.7
2	Color	Hazen	5 (25)	<1.0	<1.0	2.0	2.0
3	Odour	-	UO	UO	UO	UO	UO
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity	(NTU)	5 (10)	1	1	2	2
6	Total Hardness	mg/l	300 (600)	215	300	230	358
7	Conductivity	μδ/cm	$	472	725	611	788
8	Total Dissolved Solids	mg/l	500 (2000)	342	582	468	612
9	Chlorides as Cl^-	mg/l	250 (1000)	20.0	62.4	50.0	85.0
10	Residual Free Chlorine	mg/l	0.2 Min. (-)	<0.1	<0.1	<0.1	<0.1
11	Fluoride as F	mg/l	1.0 (1.5)	0.7	0.9	0.7	0.4
12	Calcium as Ca	mg/l	75 (200)	70	100	78	130
13	Magnesium as Mg	mg/l	30 (100)	9.7	12.2	8.5	8.0
14	Sulphates as SO_4^-	mg/l	200 (400)	4.5	22.6	10.3	15.9
15	Nitrates as NO_3	mg/l	45 (NR)	23.7	38.6	26.1	60.6
16	Phenolics as C_6H_5OH	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001
17	Cyanide as CN	mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02
18	Alkalinity as $CaCO_3$	mg/l	200 (600)	185	240	210	200
19	Boron	mg/l	1 (5)	0.05	0.02	0.09	0.05
20	Sodium as Na	mg/l	$	14.5	29.0	38.5	10.0
21	Potassium as K	mg/l	$	1.0	5.2	8.7	11.0
22	Iron as Fe	mg/l	0.3 (1.0)	0.08	0.12	0.23	0.16
23	Copper as Cu	mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	<0.01
24	Manganese as Mn	mg/l	0.1 (0.3)	<0.01	<0.01	<0.01	<0.01
25	Aluminum as Al	mg/l	0.03 (0.2)	<0.01	<0.01	<0.01	<0.01
26	Chromium as Cr^{+6}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05
27	Cadmium as Cd	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01
28	Selenum as Se	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01
29	Arsenic as As	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01
30	Lead as Pb	mg/l	0.05 (NR)	<0.01	<0.01	<0.01	<0.01
31	Zinc as Zn	mg/l	5 (15)	<0.01	<0.01	0.02	0.01
32	Mercury as Hg	mg/l	0.001 (NR)				
33	Anionic Detergents as MBAS	mg/l	0.2 (1.0)	<0.01	<0.01	<0.01	<0.01
34	Poly Nuclear Aromatic Hydrocarbons (PAH)	mg/l	$	Nil	Nil	Nil	Nil
35	Mineral Oil	mg/l	0.01 (0.03)	<0.01	<0.01	<0.01	<0.01
36	Pesticides	mg/l	Absent(0.001)	Absent	Absent	Absent	Absent
37	E.Coli	-	Absent (-)	Absent	Absent	Absent	Absent
38	Total Coliforms	MPN/ 100 ml	10 (-)	Absent	Absent	Absent	Absent

TABLE-3.6.2 (B)
GROUND WATER QUALITY-PRE MONSOON SEASON

Sr. No	Parameters	Unit	IS:10500 limits	GW5	GW6	GW7
1	pH	-	6.5-8.5 (NR)	7.0	6.9	7.0
2	Color	Hazen	5 (25)	2.0	<1.0	<1.0
3	Odour	-	UO	UO	UO	UO
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity	(NTU)	5 (10)	3	1	1
6	Total Hardness	mg/l	300 (600)	302	578	240
7	Conductivity	μδ/cm	$	686	1445	688
8	Total Dissolved Solids	mg/l	500 (2000)	428	946	425
9	Chlorides as Cl^-	mg/l	250 (1000)	75.0	209.2	55.0
10	Residual Free Chlorine	mg/l	0.2 Min. (-)	<0.1	<0.1	<0.1
11	Fluoride as F	mg/l	1.0 (1.5)	0.6	0.5	1.0
12	Calcium as Ca	mg/l	75 (200)	95	165	90
13	Magnesium as Mg	mg/l	30 (100)	15.8	40.2	3.6
14	Sulphates as SO_4^-	mg/l	200 (400)	16.1	42.1	14.7
15	Nitrates as NO_3	mg/l	45 (NR)	46.1	59.1	40.8
16	Phenolics as C_6H_5OH	mg/l	0.001(0.002)	<0.001	<0.001	<0.001
17	Cyanide as CN	mg/l	0.05 (NR)	<0.02	<0.02	<0.02
18	Alkalinity as $CaCO_3$	mg/l	200 (600)	205	360	230
19	Boron	mg/l	1 (5)	0.12	0.05	0.15
20	Sodium as Na	mg/l	$	20.4	65.0	50.1
21	Potassium as K	mg/l	$	10.0	15.5	2.5
22	Iron as Fe	mg/l	0.3 (1.0)	0.02	0.08	0.11
23	Copper as Cu	mg/l	0.05 (1.5)	<0.01	<0.01	<0.01
24	Manganese as Mn	mg/l	0.1 (0.3)	<0.01	<0.01	<0.01
25	Aluminum as Al	mg/l	0.03 (0.2)	<0.01	<0.01	<0.01
26	Chromium as Cr^{+6}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05
27	Cadmium as Cd	mg/l	0.01 (NR)	<0.01	<0.01	<0.01
28	Selenium as Se	mg/l	0.01 (NR)	<0.01	<0.01	<0.01
29	Arsenic as As	mg/l	0.01 (NR)	<0.01	<0.01	<0.01
30	Lead as Pb	mg/l	0.05 (NR)	<0.01	<0.01	<0.01
31	Zinc as Zn	mg/l	5 (15)	0.02	<0.01	<0.01
32	Mercury as Hg	mg/l	0.001 (NR)	<0.001	<0.001	<0.001
33	Anionic Detergents as MBAS	mg/l	0.2 (1.0)	<0.01	<0.01	<0.01
34	Poly Nuclear Aromatic Hydrocarbons (PAH)	mg/l	$	Nil	Nil	Nil
35	Mineral Oil	mg/l	0.01 (0.03)	<0.01	<0.01	<0.01
36	Pesticides	mg/l	Absent(0.001)	Absent	Absent	Absent
37	E.Coli	-	Absent (-)	Absent	Absent	Absent
38	Total Coliforms	MPN/ 100 ml	10 (-)	Absent	Absent	Absent

TABLE-3.6.3
SURFACE WATER QUALITY-PRE MONSOON SEASON

Sr. No	Parameters	Unit	IS: 2296 Class 'C' Limits	SW1	SW2	SW3
1	pH	-	6.5 – 8.5	8.0	8.2	9.1
2	Color	Hazen	300			
3	Taste	-	--	U.O	U.O	U.O
4	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
5	Temperature	°C	--	21.2	21.3	19.8
6	Turbidity	NTU	--	3	2	6
7	Conductivity	µδ/cm	$	370	326	423
8	Residual Chlorine as Cl_2	mg/l	$	<0.1	<0.1	<0.1
9	Total Dissolved Solids	mg/l	1500	229	206	273
10	Dissolved Oxygen	mg/l	4	6.2	6.0	6.1
11	B.O.D (3days at 27^0c)	mg/l	3	<3	<3	3
12	COD	mg/l	$	10	10	15
13	Total Hardness as $CaCO_3$	mg/l	$	112	114	94
14	Total Alkalinity as $CaCO_3$	mg/l	$	145	120	155
15	Calcium as Ca^{2+}	mg/l	$	35	32	15.8
16	Magnesium as Mg^{2+}	mg/l	$	10.2	7.1	17.0
17	Chlorides as Cl	mg/l	600	21.0	30.0	60.0
18	Sulfates as SO_4^2	mg/l	400	1.1	1.4	0.8
19	Fluorides as F	mg/l	1.5	0.8	0.8	1.0
20	Nitrates as NO_3	mg/l	$	0.7	0.5	1.4
21	Total Phosphorus	mg/l	$	0.1	0.2	0.1
22	Sodium	mg/l	$	20.0	25.5	54.5
23	Potassium	mg/l	$	1.5	1.9	6.7
24	Phenols as C_6H_5OH	mg/l	0.005	<0.001	<0.001	<0.001
25	Cyanides as CN-	mg/l	0.05	<0.02	<0.02	<0.02
26	Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01
27	Cadmium as Cd	mg/l	0.01	<0.01	<0.01	<0.01
28	Copper as Cu	mg/l	1.5	<0.01	<0.01	<0.01
29	Lead as Pb	mg/l	0.1	<0.01	<0.01	<0.01
30	Iron as Fe	mg/l	50	0.15	0.3	0.1
31	Hexavalent Chromium as Cr^{6+}	mg/l	0.05	<0.05	<0.05	<0.05
32	Mercury as Hg	mg/l	$	<0.001	<0.001	<0.001
33	Selenium as Se	mg/l	0.05	<0.01	<0.01	<0.01
34	Zinc as Zn	mg/l	15	<0.01	<0.01	<0.01
35	Aluminum as Al	Mg/l	$	<0.01	<0.01	<0.01
36	Anionic Detergents as MBAS	mg/l	1	<0.01	<0.01	<0.01
37	Boron as B	mg/l	$	0.09	0.11	0.19
38	Polynuclear Aromatic Hydrocarbons (PAH)	mg/l	0.2	Absent	Absent	Absent
39	Mineral Oil	mg/l	0.01	<0.01	<0.01	<0.01
40	Sodium Absorption Ratio (SAR)	-	-	0.77	1.06	2.27
41	E.Coli	-	--	Absent	Absent	Absent
42	Total Coliforms	MPN/ 100 ml	5000	Absent	Absent	Absent

$- Indicates no limits have been specified; UO: Un Objectionable

3.7 Noise Level Survey

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound, which is composed of many frequency components of various types of loudness levels distributed over the audible frequency range. The most common and universally accepted scale is the A weighted scale, which is measured in dB (A). This is more suitable for audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of human ear. The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise.

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise expected to be generated during the project operations around the project site.

3.7.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise at different noise generating sources has been identified based on the residential, industrial and commercial activities in the area. The noise monitoring has been conducted for determination of noise levels at eight locations in the study area. The noise levels at each location were recorded for 24-hrs. The environment setting of each noise monitoring location is given in **Table-3.7.1** and shown in **Figure-3.7.1**.

TABLE-3.7.1
DETAILS OF NOISE MONITORING LOCATIONS

Location Code	Locations	Distance w.r.t Project Site (Km)	Direction w.r.t Project Site	Remarks
N1	Proposed project site (near Mirchwara village)	--	--	Industrial area
N2	NE of project site	0.3	NE	Residential area
N3	Udayapura village	2.0	E	Residential area
N4	Bilata village	5.3	E	Residential area
N5	Mirchwara RF near Mirchwara village	0.8	S	Sensitive area
N6	Billa village	4.0	S	Residential area
N7	Bhagnagar village	2.4	W	Residential area
N8	Bamhouri shanna village	5.9	NW	Residential area

Source: Vimta Labs Limited

3.7.2 Method of Monitoring

Sound Pressure Levels (SPL) measurements were recorded at eight locations. The readings were taken for every hour for 24-hrs. The day noise levels have been monitored during 7 am to 10 pm and night noise levels during 10 pm to 7 am at all the locations covered in the study area.

During each hour parameters like L10, L50, L90 and Leq were directly computed by the instrument based on the sound pressure levels.

3.7.3 Presentation of Results

The statistical analysis is done for measured noise levels at eight locations in the study area. The parameters are analyzed for L_{day}, L_{night}, and L_{dn}. The statistical analysis results are given in **Table-3.7.2.**

TABLE-3.7.2
AMBIENT NOISE LEVELS IN THE STUDY AREA [dB (A)]

Location Code	Location	L10	L50	L90	Leq	Lday	Lnight	Ldn
N1	Proposed project site	46.2	42.7	38.9	43.6	44.4	40.7	47.9
N2	NE of project site	44.5	40.0	36.6	41.0	43.0	38.1	45.6
N3	Uadayapura village	48.5	44.6	40.9	45.6	46.4	42.8	49.9
N4	Bilata village	49.3	45.5	41.7	46.5	47.7	43.8	51.0
N5	Mirchwara RF near Mirchwara village	43.4	39.2	35.3	40.3	41.3	36.9	44.3
N6	Billa village	50.3	46.5	42.7	47.5	49.1	44.8	52.1
N7	Bhagnagar village	47.5	42.7	39.1	43.9	46.0	40.2	48.1
N8	Bamhouri shanna village	46.2	42.3	38.4	43.3	44.2	39.6	47.0

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

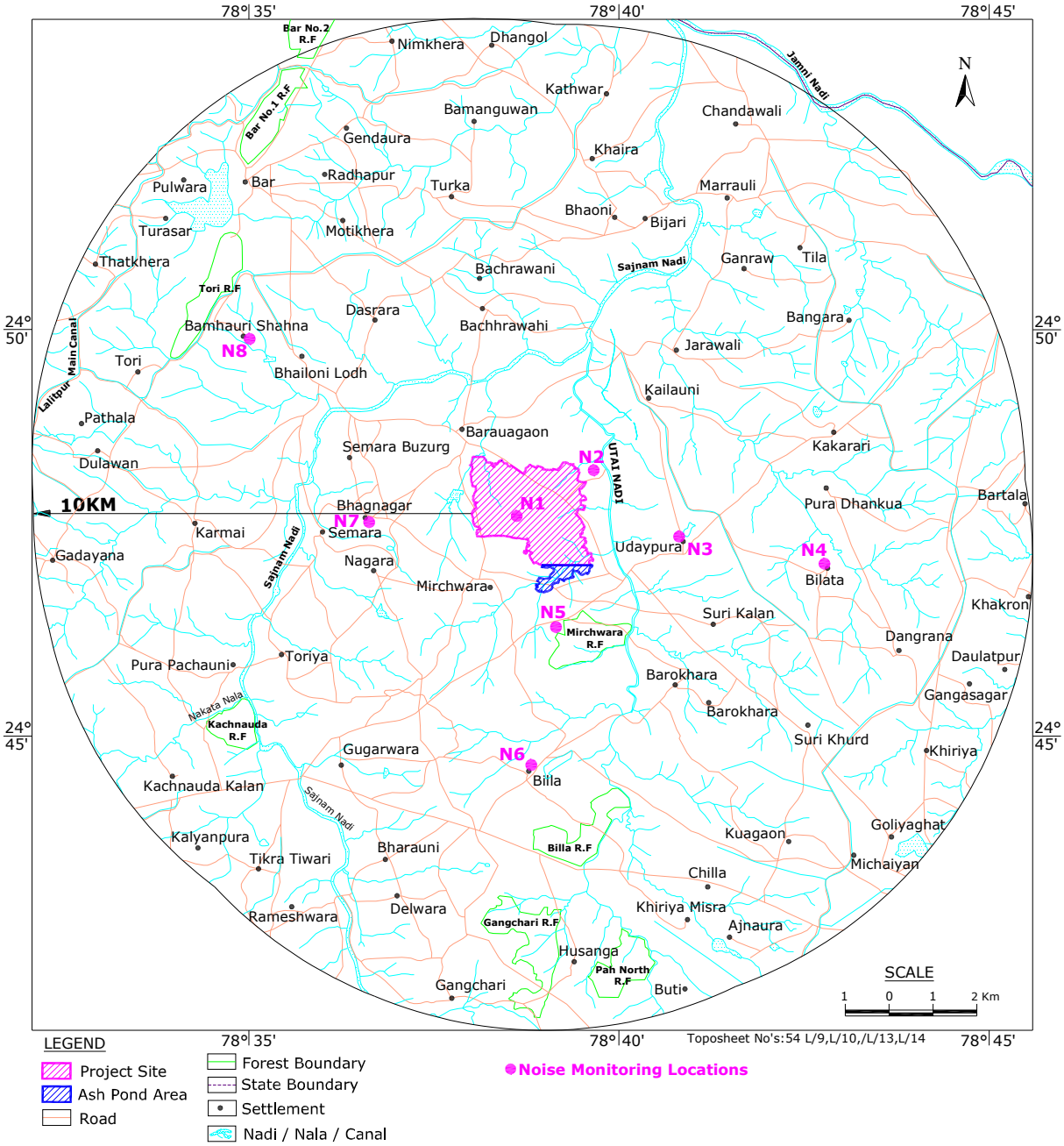

FIGURE-3.7.1
NOISE MONITORING LOCATIONS

3.7.4 Observation of Results

a) Day time Noise Levels (L_{day})

Residential Zone: The daytime (L_{day}) noise levels are observed to be in the range of 44.2 – 49.1 dB (A). The maximum noise level of 49.1 dB (A) was observed at Billa village (N6) and the minimum noise level of 44.2 dB (A) was observed at Bamhouri shanna village (N8).

Industrial Zone: The daytime (L_{day}) noise levels are observed to be in the range of 44.4 dB (A).

Sensitive Zone: The daytime (L_{day}) noise levels are observed to be in the range of 41.3 dB (A).

It is observed that the day time noise levels are in broadly in accordance to the prescribed limit of 55 dB (A) for rural / residential areas and 75 dB (A) for industrial zones.

b) Night time Noise Levels (L_{night})

Residential Zone: The nighttime (L_{night}) noise levels are observed to be in the range of 39.6–44.8 dB (A). The maximum noise level of 44.8 dB (A) was observed at Billa village (N6) and the minimum noise level of 39.6 dB (A) was observed at Bamhouri shanna village (N3).

Industrial Zone: The nighttime (L_{night}) noise levels are observed to be in the range of 40.7 dB (A).

Sensitive Zone: The nighttime (L_{night})) noise levels are observed to be in the range of 36.9 dB (A).

It is observed that the nighttime (L_{night}) noise levels are in broadly in accordance to the prescribed limit of 45 dB (A) for rural / residential areas and 70 dB (A) for industrial zones.

3.8 Ecology

3.8.1 Introduction

An ecological survey of the study area was conducted particularly with reference to listing of species and assessment of the existing baseline ecological (Terrestrial and Aquatic ecosystem) conditions.

3.8.2 Objectives of Ecological Studies

The present study was undertaken with the following objectives:

- To assess the nature and distribution of vegetation in and around the proposed project site
- To assess the distribution of animal life spectra;

- To understand the productivity of the water bodies;
- To ascertain migratory routes of fauna and possibility of breeding grounds.

3.8.3 Methodology Adopted for the Survey

To achieve the above objectives a detailed study of the area was undertaken in 10-km radius area as proposed project site as centre. The different methods adopted were as follows:

- Compilation of secondary data with respect to the study area from published literature and Government agencies;
- Generation of primary data by undertaking systematic ecological studies in the area; and
- Gathering data for ethnobiology.

The present report gives the review of published secondary data and the results of field sampling conducted during pre monsoon season-2010.

3.8.4 Forest Blocks in Study Area

The records of forest department and survey of India maps reveal that there are 17 forest blocks within 10-km radius of the proposed project site and details are presented in **Table-3.8.1.**

TABLE-3.8.1
DETAILS OF FOREST IN STUDY AREA

Sr. No.	Name of the Forest Block	Distance from Project Site (km)	Direction from Project Site
1	Tori RF	6.7	NW
2	Bar No.1 RF	9.0	NW
3	Bar No.2 RF	10.7	NNW
4	Maoten RF	12.7	N
5	Bara Pahar RF	14.1	NNE
6	Baroda Gang RF	12.7	NW
7	Baroda PF	13.7	E
8	Maughat PF	12.0	E
9	Banhaur Kharait RF	10.9	NNW
10	Nayakhara PF	11.8	E
11	Ramnagar PF	12.0	ESE
12	Mirchwara RF	0.4	SE
13	Billa RF	4.2	S
14	Gangchari RF	6.3	S
15	Pah north RF	7.3	S
16	Kachnauda RF	6.0	WSW
17	Pah East RF	9.9	SSW

- ***National Park/Sanctuary***

As per Ministry of Environment Notifications and local Forest Notifications reveal that no Wildlife sanctuaries, National parks/biospheres in 15- km radius from plant boundary.

3.8.5 Floristic Composition- Primary Survey

Details of terrestrial ecological locations are presented in **Table-3.8.2** and shown in **Figure-3.8.1.**

TABLE-3.8.2
DETAILS OF TERRESTRIAL ECOLOGICAL LOCATIONS

Station Code	Name of the Station	Distance from nearest Project Area	Direction w.r.t. Project Area	Environmental Setting
TE1	Proposed Project site	-	-	Industrial
TE2	North Project Site	0.3	NE	Industrial
TE3	Udayapura village	2.0	E	Rural/Residential
TE4	Bilata village	5.3	ESE	Rural/Residential
TE5	Mirchwara RF near Mirchwara village	0.8	S	Rural/Residential
TE6	Billa village	4.0	S	Rural/Residential
TE7	Bhagnagar village	2.4	W	Industrial Area
TE8	Bamhouri shanna village	5.9	NW	Rural/Residential

Floristic Richness

During field survey, maximum 219 number of plant species (except algae, fungi and bryophytes) were recorded from the study area. The list of plant species recorded in the study area is given in Table-1 of **Annexure-VIII**. Authenticated document from the Forest Department is enclosed.

Life form spectrum is a reflection of plant community. A plant community is governed by several factors like climatic, edaphic, topographic and biotic. Even local variations in environment affect components of plant community.

In the study area, maximum numbers of species are therophytes, followed by phanerophytes. These classes are followed by hemicryptophytes and geophytes. Hydrophytes were found in very few numbers.

Presence of large number of phanerophytes (shrubs and trees) and therophytes (annuals or herbaceous vegetation) indicates semiarid to tropical vegetation structure.

Hemicryptophytes (predominantly grasses and sedges) were found to be significant in the area. These indicate fertile and wet soil in upper layer of soil profile.

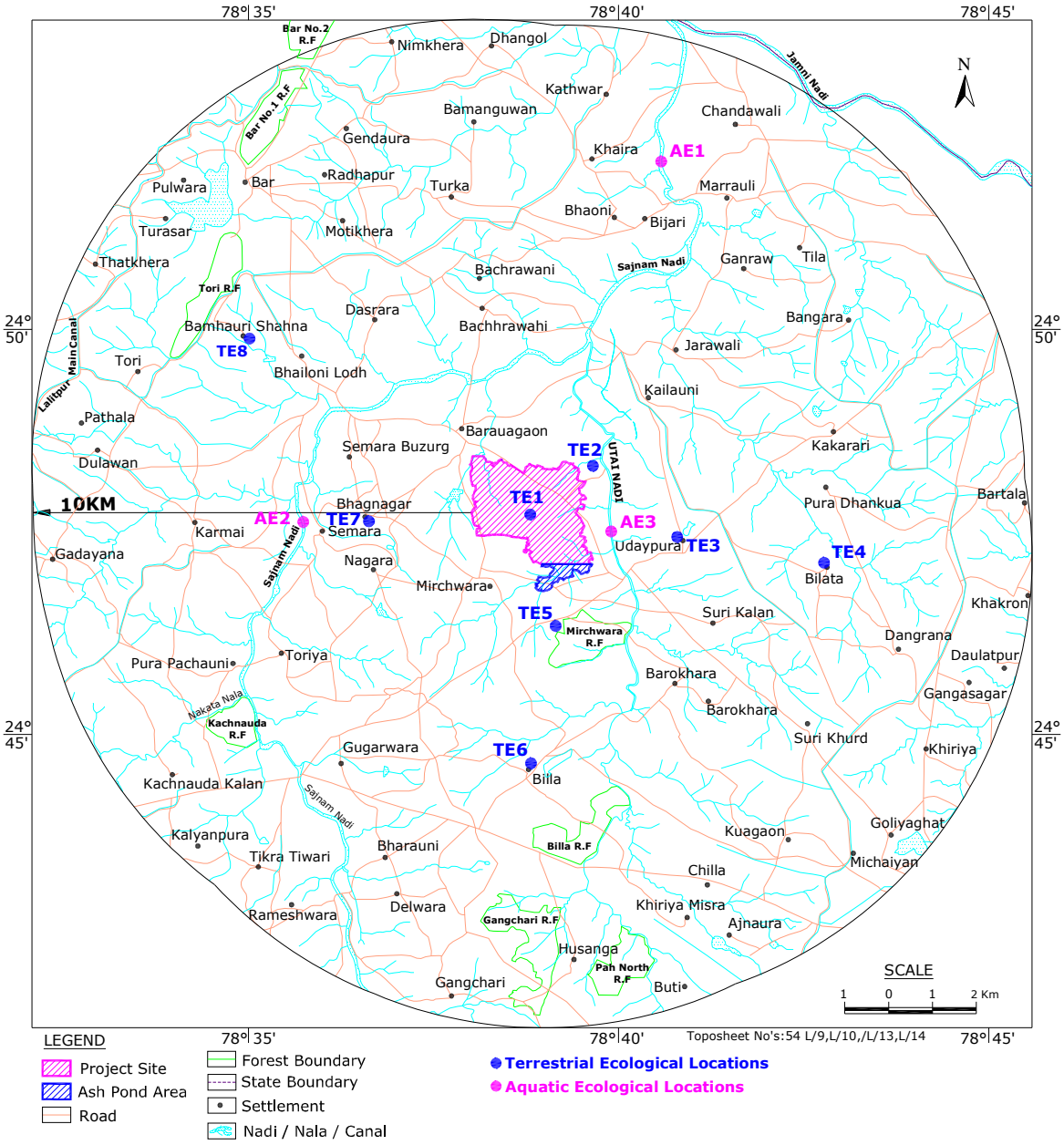

FIGURE-3.8.1
ECOLOGICAL SAMPLING LOCATIONS

3.8.6 Endangered Plants

Floristic studies were conducted during pre monsoon season in 2010 to know the presence of any endangered/threatened/endemic plant species in plant area and surrounding 15-km radius. The study area did not record the presence of any critically threatened species. The records of Botanical Survey of India and Forest department also did not indicate presence of any endangered and or vulnerable species in this area.

3.8.7 Fauna-Primary Survey

The observed and recorded wild animal species in 10-km radius and their conservation status as per Wildlife (Protection) Act, 1972, 45 birds species, 3 species of reptiles, 5 species butterflies, 2 species of Amphibians and 10 species of mammals are recorded, out of which 3 species belong to Schedule-II animals and rest belongs to Schedule-III and IV and V of Wildlife (Protection) Act, 1972.

The list of fauna recorded in the study area is given in Table-2 of **Annexure-VIII**.

3.8.8 Aquatic Ecosystems

3.8.8.1Introduction

Aquatic ecological studies were conducted to assess the biological resources in study area. Three sampling locations were identified for sampling. Samples were collected during the post-monsoon season. Details of the locations are given in **Table-3.8.3**.

TABLE-3.8.3
DETAILS OF AQUATIC ECOLOGICAL LOCATIONS

Code	Location	Distance w.r.t. Project Area (km)	Direction w.r.t. Project Area	Source Type
AE1	Sangam river (U/S) near Chandawali village	7.2	NNE	River
AE2	Sangam river (D/S) near Semara village	3.8	W	River
AE3	Utai Nadi near Udaypura village	0.6	E	River

The list of plankton recorded in fresh water bodies in study during study period is given in Table-3 of **Annexure-VIII.**

3.9 Demography and Socio-Economics

In this section, the prevailing socio-economic aspects of people in the study area around the proposed plant boundary, which would form the basis for making planning efforts for the socio-economic development of people in the study area, have been described.

3.9.1 Methodology Adopted for the Study

The methodology adopted for the study mainly includes review of published secondary data, the study is fowling in Mahroni, Talbehat and Lalitpur Tehsils of Lalitpur district in Uttar pradesh state such as the District Census Statistics of 2001, Lalitpur district of Uttar Pradesh state for the parameters of demography, occupational structure of people within the study area of 10 km radial distance from the periphery of the proposed project site.

The village wise demographic data as per 2001 Census is presented in **Annexure-IX**. The salient features of the demographic and socio-economic aspects are described in the following sections.

3.9.2 Demographic Aspects

3.9.2.1 Distribution of Population

As per 2001 census the study area consists of 85247 persons inhabited in the study area of 10 km radial distance from the periphery of the proposed plant. The distribution of population in the study area is given in **Table-3.9.1**.

TABLE-3.9.1
DISTRIBUTION OF POPULATION IN THE STUDY AREA

Sr. No	Particulars	0-3 km	3-7 km	7-10 km	0 – 10 km
1	No. of Households	1190	3278	9649	14117
2	Male Population	3901	10368	31063	45332
3	Female Population	3326	9138	27451	39915
4	Total Population	7227	19506	58514	85247
5	% of Males to Total Population	53.98	53.15	53.09	53.18
6	% of Females to Total Population	46.02	46.85	46.91	46.82
7	Average Household Size	6.07	5.95	6.06	6.04
8	Sex Ratio	852.6	881.4	883.7	880.5
9	Density of Population/Km^2	137	175	226	201

Source: District Primary Census Statistics of Lalitpur District U.P. - 2001

The males and females constitute about 53.18% and 46.82% in the study area respectively.

3.9.2.2 Average Household Size

The study area had an average family size of 6.04 persons per household in 2001. This is moderate family size and is in comparison with the other parts of the district.

3.9.2.3 Population Density

The density of population of the study area works out to about 201 persons perkm$^{2.}$

3.9.2.4 Sex Ratio

The configuration of male and female indicates that the males constitute to about 53.18% and 46.82% females to of the total population. The sex ratio i.e. the number of females per 1000 males indirectly reveals certain sociological aspects in relation with female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 880 females per 1000 males.

3.9.3 Social Structure

None of Scheduled Tribe Castes (ST) In the study area population and 22.84% Scheduled Castes (SC) indicating that about 22.84% of the population in the study area belongs to socially weaker sections. The distribution of population in the study area by social structure is shown in **Table-3.9.2**.

TABLE-3.9.2
DISTRIBUTION OF POPULATION BY SOCIAL STRUCTURE

Sr. No.	Particulars	0-3 km	3-7 km	7-10 km	0 – 10 km
1	Scheduled Castes	1339	4826	13306	19471
2	% to total population	18.53	24.74	22.74	22.84
3	Scheduled Tribes	0	0	0	0
4	% to total population	0	0	0	0
5	Total SC and ST	1339	4826	13306	19471
6	% to total population	18.53	24.74	22.74	22.84
7	Other castes	5888	14680	45208	65776
8	% to total population	81.47	75.26	77.26	77.16
9	**Total Population**	**7227**	**19506**	**58514**	**85247**

Source: District Primary Census Statistics of Lalitpur District U.P. - 2001

3.9.4 Literacy Levels

The analysis of the literacy levels in the study area reveals an average literacy rate of 34.50% as per 2001 census data. The distribution of literates and literacy rates in the study area is given in **Table-3.9.3.**

The male literacy i.e. the percentage of literate males to the total literates of the study area works out to be 24.69% The female literacy rate, which is an important indicator for social change, is observed to be 9.81 % in the study area. This indicates that there is a considerable need for sociological development in the region.

TABLE-3.9.3
DISTRIBUTION OF LITERATE AND LITERACY RATES

Sr. No	Particulars	0-3 km	3-7 km	7-10 km	0-10 km
1	Total Literates	2696	6531	20182	29409
2	Average literacy (%)	37.30	33.48	34.49	34.50
3	Male Literates	1899	4742	14405	21046
4	Male Literacy (%)	26.28	24.31	24.62	24.69
5	Total Male	3901	10368	31063	45332
6	% Male Literates to total Literates	70.44	72.61	71.38	71.56
7	Female Literates	797	1789	5777	8363
8	Total Female	3326	9138	27451	39915
9	Female Literacy (%)	11.03	9.17	9.87	9.81
10	% Female Literates to Total Literates	29.56	27.39	28.62	28.44
11	**Total Population**	**7227**	**19506**	**58514**	**85247**

Source: District Primary Census Statistics of Lalitpur District U.P. – 2001

3.9.5 Occupational Structure

The occupational structure of residents in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 4 categories of workers defined by the Census Department consisting of cultivators, agricultural laborers, those engaged in manufacturing, processing and repairs in household industry; and others including those engaged in household industry, construction, trade and commerce, transport and communication and all other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As per 2001 census records altogether the main workers works out to be 31.90% of the total population. The marginal workers and non-workers constitute to 16.61% and 51.50% of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The occupational structure of the study area is given in **Table-3.9.4.**

TABLE-3.9.4
OCCUPATIONAL STRUCTURE

Sr. No	Occupation	0-3 km	3-7 km	7-10 km	0-10 km
1	Total Main Workers	2500	6844	17848	27192
2	Percentage to Total Population (%)	34.59	35.09	30.50	31.90
3	Marginal Workers	985	3403	9769	14157
4	Percentage to Total Population (%)	13.63	17.45	16.70	16.61
5	Non-Workers	3742	9259	30897	43898
6	Percentage to Total Population (%)	51.78	47.47	52.80	51.50
Total Population		**7227**	**19506**	**58514**	**85247**

Source: District Primary Census Statistics of Lalitpur District U.P. – 2001