Updated Baseline Data Generation Report

for

PROPOSED 3x800 MW COAL BASED

THERMAL POWER PLANT

Near Kamakhyanagar
DISTRICT DHENKANAL, ODISHA

(BASELINE ENVIRONMENTAL MONITORING : October - December, 2016)

MEC/11/S2/Q7BG/R/2296/R-0

JANUARY 2017

PROJECT PROPONENT

OTPC LIMITED
3rd Floor, Setu Bhawan,
OBCC Building, Nayapally,
Bhubaneshwar -751012

ENVIRONMENTAL CONSULTANT

MECON LIMITED
(A Govt. of India Enterprise)
Vivekananda Path
PO. Doranda
Dist – Ranchi, Jharkhand - 834002
CERTIFICATE NO: NABET/EIA/1417/SA 007

CONTENTS

List of Figure

List of Drawings

List of Tables

EXECUTIVE SUMMARY

SUMMARY REPORT

1.0 INTRODUCTION

Odisha Thermal Power Corporation Limited (OTPCL) proposes to set up a 3 x 800MW Thermal Power plant near Kamakhyanagar in Dhenkanal District of Orissa.

MOEFCC had issued TORs for preparation EIA report for the 2400 MW in the 64th meeting of the reconstituted EAC, held on Jan 7-8 2013 vide letter no. J-13012/43/2012 - IA. II (T) dated 05/03/2013.

Baseline environmental monitoring was conducted during Summer season (March-May), 2013. Environmental public hearing was conducted by Odisha State Pollution Control Board (OSPCB) on 05.08.2014 at 10:00 AM at Tumusingha R.I. Office Premises, Dhenkanal.

However, due to delay in allocation of coal block by Ministry of Coal, the project was delayed.

Since the validity of ToR was up to 04/03/2016, OTPCL approached MoEFCC for extension of ToR validity. In the 55th meeting of Expert Appraisal Committee (EAC) on Thermal Power & Coal Mining Projects, held on 5th& 6th May 2016, the ToR validity was extended for one year i.e. till 04.03.2017.

However, the Committee EAC recommended that fresh baseline data for one season (non-monsoon) should be collected and public notices should be published in leading local newspapers, Gram Panchayats, Website of PP etc. clearly summarizing the comparative baseline data along with the intimation that the public can send its comments if any to the PP and also MoEFCC within 15 days/one month respectively after publication of the public notice.
In view of the above, fresh baseline data generation was carried out during Post-monsoon season from October- December, 2016 by MECON Limited's Environmental Engineering Laboratory. Baseline data generated earlier i.e. Summer season, 2013 has been compared with the data generated during Post-monsoon season, 2016 and included in this report.

2.0 BASELINE DATA GENERATION/ESTABLISHMENT OF BASELINE FOR ENVIRONMENTAL COMPONENTS/COMPARISON OF PRESENT DATA WITH DATA GENERATED IN 2013

The data generation was carried out covering Micro-meteorology, Ambient Air Quality, Noise Levels, Water Quality, Soil and Ground water level measurements during the entire Post-monsoon season, (October to December), 2016.

In order to study the changes in ambient quality of the study area, samples have been collected from the same monitoring locations from where monitoring had been conducted earlier in 2013.

2.1 Micro-Meteorology

An automatic weather station was set up at Mohuli, Dhenkanal for three months during Post-monsoon season, 2016. During Summer Season, 2013 micro meteorological monitoring had been carried out at the same location.

During Post-monsoon season 2016 the predominant wind directions were W and WNW. During the entire monitoring period the predominant wind speeds were in the range of 1.6 – 7.4 Km/hr.

During summer season 2013 the predominant wind directions were ESE and SE. During the entire monitoring period the predominant wind speeds were in the range of 1.6 – 7.4 Km/hr.

Compared to summer season there was reversal in wind direction in post monsoon season 2016. Calm conditions are more during post monsoon compared to summer season. However occasional high winds 2- 3 m/s range observed more in post monsoon and also occasional rain fall during this period.

2.2 Ambient air quality

Post monsoon season monitoring was conducted at the same 8 Nos AAQ stations where summer monitoring had been conducted in 2013 to study the changes in ambient quality of the study area. 24 hourly samples were collected twice a week for 3 months continuously.

All the monitored values of PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, Pb, O_3 and Hg were below the National Ambient Air Quality Standards for "Residential rural and other areas". There is hardly any seasonal variation also not much change even after three years in the study area in respect to ambient air quality.

The summarised AAQ results are given in **Table-1 (A&B)**.

Table-1 : Summarised Results of AAQ Monitoring

A. Post-monsoon Season, 2016

Parameters		Results (µg/m³)							
		Mohuli	Kantajharia	Aluajharna	Mahulpal	Kankrajhara	Tulasipasi	Tumasinga	Kusumjodi
		A1	A2	A3	A4	A5	A6	A7	A8
PM10	Max.	90	92	93	95	90	91	91	94
	Min.	62	64	62	68	59	58	55	60
	Avg.	79	79	79	80	78	78	80	79
$PM_{2.5}$	Max.	56	57	53	55	54	54	56	55
	Min.	37	36	38	36	32	37	29	32
	Avg.	46	47	46	47	44	45	46	43
SO_2	Max.	12	11	11	13	10	11	11	12
	Min.	5	5	5	5	5	5	4	4
	Avg.	8	8	8	8	7	7	8	7
NO_X	Max.	36	35	32	39	34	30	33	37
	Min.	12	14	13	10	10	12	12	14
	Avg.	21	22	21	23	19	20	21	21
CO	Max.	1580	2234	1837	2198	1267	1464	1436	1496
	Min.	253	203	215	153	195	153	144	142
	Avg.	733	550	734	831	674	567	781	629
Pb	Max.	0.05171	0.05366	0.04887	0.06963	0.05928	0.05932	0.07721	0.05538
	Min.	0.02786	0.03592	0.03202	0.03841	0.02329	0.01910	0.04208	0.00736
	Avg.	0.03909	0.04324	0.04023	0.05479	0.04556	0.03370	0.05524	0.02807
Hg	Max.	0.00026	0.00036	0.00025	0.00027	0.00021	0.00016	0.00019	0.00014
	Min.	0.00013	0.00015	0.00011	0.00010	0.00010	0.00006	0.00012	0.00007
	Avg.	0.00018	0.00021	0.00019	0.00018	0.00015	0.00011	0.00014	0.00011
O_3	Max.	48	55	48	61	50	48	47	52
	Min.	31	27	32	34	30	29	32	28
	Avg.	39	40	39	41	39	38	39	40

B. Summer Season, 2013

Parameters		Results (µg/m³)							
		Mohuli	Kantajharia	Aluajharna	Mahulpal	Kankrajhara	Tulasipasi	Tumasinga	Kusumjodi
		A1	A2	A3	A4	A5	A6	A7	A8
PM10	Max.	95	94	92	93	94	92	94	95
	Min.	48	56	47	75	41	52	51	52
	Avg.	85	82	78	87	76	76	79	83
$PM_{2.5}$	Max.	60	51	56	51	51	51	51	55
	Min.	46	38	32	43	38	34	42	38
	Avg.	54	44	53	48	43	41	47	44
SO_2	Max.	13	11	13	13	13	7	10	13
	Min.	6	<4	5	4	5	<4	4	5
	Avg.	10	7	9	9	9	5	7	9
NO_X	Max.	23	20	21	28	21	18	18	21
	Min.	16	<10	13	15	12	<10	12	11
	Avg.	20	14	19	20	17	12	16	18
Hg	Max.	0.00052	0.00037	0.00036	0.00025	0.00045	0.00040	0.00028	0.00027
	Min.	0.00029	0.00027	0.00015	0.00005	0.00019	0.00031	0.00017	0.00014
	Avg.	0.00038	0.00032	0.00023	0.00014	0.00031	0.00035	0.00024	0.00019
O_3	Max.	102	71	59	82	87	76	86	99
	Min.	55	38	32	59	43	52	37	55
	Avg.	75	56	45	69	65	66	57	74

2.3 Noise

Measurement of noise level was carried out at 5 locations. All the noise monitoring stations were in residential areas. The average values of noise level at all the locations were found to be well within the norms during both day and night in both the seasons except at Mahuli and Mahulpal where average noise levels exceeded the norms marginally during day time which may be due to local activities .
No significant variation is observed in respect of ambient noise levels when compared with previous data

2.4 Water environment

Ground water Quality

Seven no. of Ground water samples were collected analysed for various parameters as per Drinking Water Specification IS: 10500 (2012).

Analysis results show that ground water quality parameters are meeting the prescribed norms of drinking water quality except for few parameters. When compared with earlier data it is observed that Iron is exceeding the norms at two places, Kankarajhara and Bijodihi during both the monitoring periods. Fluoride concentration at Kateni and Tulapasi exceeded the acceptable limits but were within the permissible limits during Summer, 2013; in other locations it was well below the acceptable limits. Ca is slightly high at Tumasinga in both the monitoring periods. In general all concentrations of all parameters during Post-monsoon season, 2016 were less in comparison to data analysed during Summer season, 2013 which may be due to dilution during monsoon.

Surface Water Quality

The Surface Water quality monitoring was carried out at three locations during both monitoring seasons and compared with CPCB surface water quality criteria. Analysis results show that surface water quality suitable for Outdoor bathing (organized) as well as Drinking water source after conventional treatment and after disinfection

However, to have a baseline data of the Surface water quality, samples were analysed for some other parameters as per IS: 10500. Iron levels exceeded the norms at all the three locations. High value of iron in post monsoon season may be due to rain wash out of the nearby surfaces.

No significant change is observed in surface water quality when compared earlier data analysed in 2013.

2.5 Soil

Soil samples were collected & analysed from four locations. Soil pH varies from 6.2 to 7.0 and 6.0 to 6.8 during post-monsoon, 2016 & summer, 2013 respectively, which is slightly acidic to neutral.

In the tested soil samples the electrical conductivity varies and from 124 μs/cm to 202 μs/cm and 141 μs/cm to 328 μs/cm in post-monsoon season, 2016 and summer season, 2013 respectively.

It was found that organic carbon content in the soil varied from 0.14% (low) to 1.11% (High). Nitrogen also varied from 147 kg/ha to 289 kg/ha which is in the range of low to medium. Available phosphorus varied from 11 kg/ha to 36 kg/ha i.e medium to high while available potassium is medium to high in post-monsoon season, 2016.

Micronutrients play a specific role in the growth and development of plants. In Post-monsoon season 2016, copper and zinc concentration level in all the samples were above the critical limits. Iron was above the limits in 3 out of 4 locations. In summer season, 2013 iron and zinc levels were below the critical limit in sample S1, S2 & S3 and above in S4. Copper concentration level in sample S1, S2 & S3 is in the range of critical limit. The critical limits of copper, zinc and iron are 0.20-0.66mg/kg, 0.50-0.65 mg/kg and 4.5-6.0 mg/kg respectively

2.6 Ground Water Regime

48 wells have been inventoried in the buffer zone and data like total depth, depth to water and their location were collected during the study. In each village minimum of two, maximum of five wells have been measured and measured levels were used to develop the groundwater contour map.

From the summer season data, it is evident that the water levels are almost in 3.1 to 13.0 m below ground level (BGL) and maintains static flow. However, in post-monsoon season, the water levels range from 1.2 m to 8 m BGL. On comparing data from both the season, it is evident that due to ground water recharging by monsoon season, the water level rises in all wells ranging from 1.2 m to 5 m depending upon the location.

2.7 Traffic Density Survey

Traffic density measurement were carried out during Post-Monsoon, 2016 on Dhenkanal –Kamakhyanagar road passing adjacent to eastern plant boundary near Mohuli. Traffic load during Post-Monsoon, 2016 has slightly increased in comparison to that of 2013.

MONITORING REPORT

1.0 INTRODUCTION

Odisha Thermal Power Corporation Limited (OTPCL) proposes to set up a 2400 MW (3 x 800 MW) coal based Super Critical Thermal Power plant at Kamakhyanagar Town in Dhenkanal District of Odisha. OTPCL is a joint venture of two State PSUs viz. Odisha Hydro Power Corporation Limited (OHPC) and Odisha Mining Corporation Limited (OMC).

OTPCL had submitted Form-I to Ministry of Environment Forest and Climate Change, Govt. Of India (MoEFCC) to obtain TOR as per the guidelines laid down by MoEFCC for conducting environmental studies specified in Notification dated 14.09.06. Based on the information provided by OTPCL, MOEFCC had issued TORs for preparation EIA report for the 2400 MW in the 64th meeting of the reconstituted EAC, held on Jan 7-8 2013 vide letter no. J-13012/43/2012 - IA. II (T) dated 05/03/2013.

Based on TOR, baseline environmental monitoring was conducted during summer season (March-May), 2013 and the draft EIA/EMP report was prepared which was submitted for conducting Environmental Public Hearing (EPH). The EPH was conducted by Odisha State Pollution Control Board (OSPCB) on 05.08.2014 at 10:00 AM at Tumusingha R.I. Office Premises, Dhenkanal.

However, due to delay in allocation of coal block by Ministry of Coal, the project was delayed.

Since the validity of ToR was up to 04/03/2016, it was necessary to extend the validity of ToR for further one more year.

In view of the above, OTPCL approached MoEFCC for extension of ToR validity. In the 55th meeting of Expert Appraisal Committee (EAC) on Thermal Power & Coal Mining Projects, held on 5th& 6th May 2016, the ToR validity was extended for one year i.e. till 04.03.2017.

However, the Committee also noted that primary data used in the preparation of EIA/EMP report should not be more than 3 years old for submission of the final EIA/EMP report to the Ministry. Since the three years period of baseline data collected expires in May, 2016 the EAC recommended that fresh baseline data for one season (non-monsoon) shall be collected and the EIA/EMP report shall be accordingly updated.

Regarding fresh Public Hearing, the EAC opined that the same may not be required as the validity period of Public Hearing shall exist till the ToR validity of four years. However, the EAC recommended that public notices should be published in the leading local newspapers, Gram Panchayats, Website of PP etc. clearly summarizing the comparative baseline data along with the intimation that the public can send its comments if any to the PP and also MoEFCC within 15 days/one month respectively after publication of the public notice.

In view of the above, fresh baseline data generation was carried out during Post-monsoon season from October- December, 2016 by MECON Limited's Environmental Engineering Laboratory. Baseline data generated earlier 2013 has been compared with the present data generated and included in this report. The sampling period, frequency of sampling and methodology followed is given below:

The sampling period, frequency of sampling and methodology

Sr. No.	Environmental Component	Sampling Locations	Sampling Parameters	Total Sampling Period	Sampling Frequency	Methodology
1.	Meteorology	One location	Wind Speed, Wind Direction, Temperature, Relative Humidity Rainfall and Solar Radiation	3 months	Hourly	The meteorology parameters will be recorded using continuous recording meteorological instrument of Envirotech Instruments Pvt. Ltd., New Delhi (Model No. – WM271) for Wind Speed, Wind Direction, Temperature, Relative Humidity, Rainfall and Solar Radiation.
2.	Ambient Air Quality	8 locations	PM_{10}, $PM_{2.5}$, SO_2, NO_X, O_3, CO, Mercury	Two days per week for 12 weeks	24 hourly	Gravimetric method for PM_{10} and $PM_{2.5}$ particulates. Modified West & Gaeke method for SO_2 (IS-5182 part-II 1969) using Tetrachloromercurate. Jacob-Hochheiser method (IS-5182 part-IV 1975) for NO_X using Sodium Arsenate 0.01 N absorbing solution. NDIR Method for CO Gravimetric followed by AAS/ MPAES for Pb Buffered KI absorption Method for Ozone Cold vapour atomic absorption technique for Mercury
3.	Water Quality	83 Surface & 7 Nos Ground water locations	As per IS -10500:2012 for ground water & CPCB surface water quality criteria for surface water samples	Grab sampling	Once during study period	As per IS & APHA methods. Odour, taste, pH, conductivity & temperature were analysed at site and rest of parameters were properly preserved, transported and analysed at Environmental Engineering Laboratory, Ranchi.

4.	Noise	5 locations	Leq, dB(A)	24 hour	Once during study period	Integrated on hourly basis.
5.	Soil	4 locations	Physical and Chemical constituents, Suitability for agricultural growth	Mixed sample	Once during study period	Analysis was carried out as per IS 2720 Soil chemical analysis.

2.0 PROJECT SITE AND STUDY AREA

For the purpose of environmental study, the study area has been divided into two zones, namely, (i) Core zone - the proposed power plant site and (ii) Buffer zone, the 10 km radius area around the core zone periphery.

3.0 BASELINE DATA GENERATION/ESTABLISHMENT OF BASELINE FOR ENVIRONMENTAL COMPONENTS/COMPARISON OF PRESENT DATA WITH DATA GENERATED IN 2013.

Establishment of the baseline conditions of different environmental attributes in the study area has been carried out by conducting field monitoring for baseline data generation. The data generation was carried out covering Micr-meteorology, Ambient Air Quality, Noise Levels, Water Quality, Soil and Ground water level measurements during the entire Post-monsoon season, (October to December), 2016. The results have been compared with the data generated in 2013.

In order to study the changes in ambient quality of the study area, samples have been collected from the same monitoring locations from where monitoring had been conducted earlier in 2013.

3.1 Micro- Meteorology

To monitor site specific micro–meteorological data, an automatic weather station was set up at Mohuli, Dhenkanal.
The following meteorological attributes were monitored for three months during Post-monsoon season (October to December), 2016 on hourly basis:

- Wind speed
- Wind Direction
- Air Temperature
- Relative Humidity
- Rainfall
- Solar radiation

The summarised meteorological data collected during Post –monsoon season, 2016 are given in **Table 1.**

Table 1: Summarized Micro-meteorological data at Dhenkanal during Post-Monsoon season, 2016

Period	Wind Speed (km/hr)			Temperature (°C)			Relative Humidity (%)			Rain Fall (mm)
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	
Oct'16 – Dec'16	17.4	<1.6	1.1	35.3	12.0	23.6	96.6	3.2	49.7	51.5

The seasonal wind-rose for Post-Monsoon Season, 2016 is given in **Figs. 1a, 1b** and **1c**.

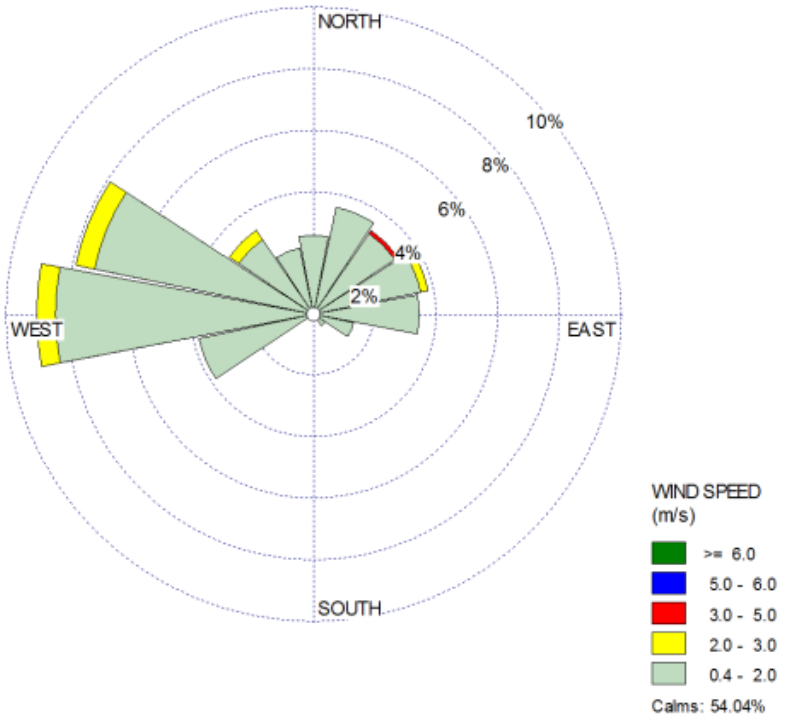


Fig 1a: Day Time Wind Rose at Dhenkanal During Post-Monsoon Season 2016

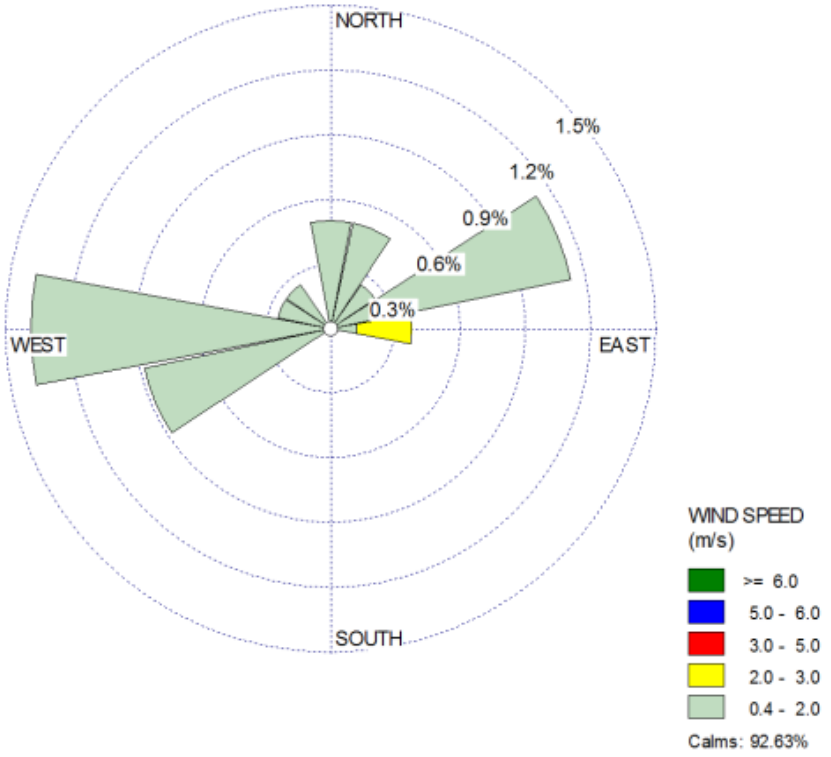


Fig 1b: Night Time Wind Rose at Dhenkanal During Post-Monsoon Season 2016

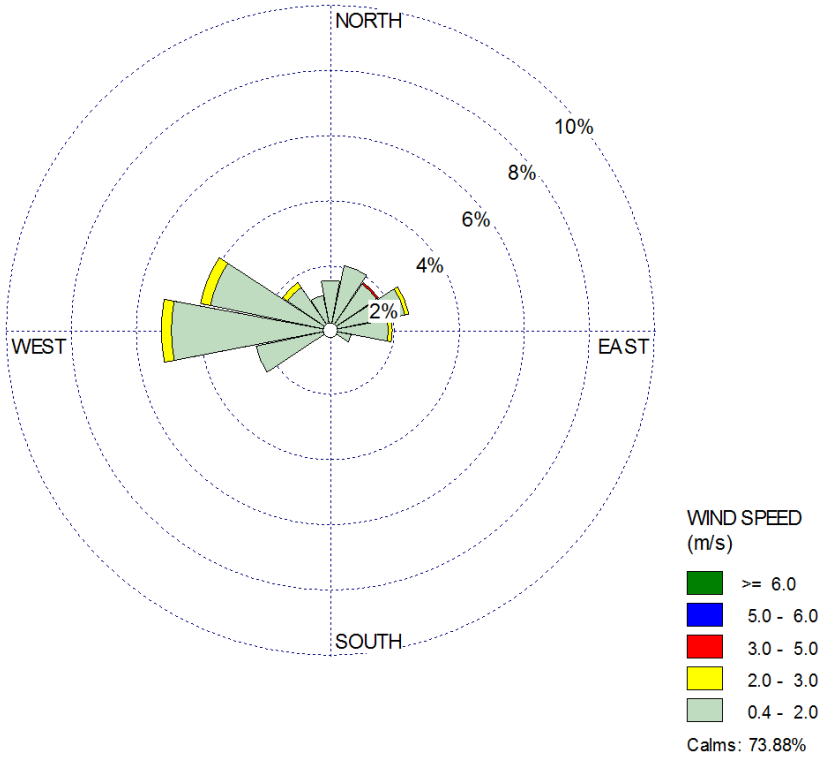


Fig 1c: Overall 24 hour Wind Rose at Dhenkanal During Post-Monsoon Season 2016

From the wind rose during Post-monsoon season 2016, it is observed that in general winds from W is pre-dominant followed by WNW. The trend is similar during both day and night time. However, winds are slightly distributed in North to East during day time. But calm conditions are more prevailed during night time. During the entire monitoring period the predominant wind speeds were in the range of 1.6 –7.4 Km/hr.

The summarised meteorological data collected during summer season, 2013 are given in **Table 2.** The seasonal wind-rose for Summer Season, 2013, is given in **Figs. 2a, 2b** and **2c**.

Table 2: Summarized Micro-meteorological data at Dhenkanal during Summer Season, 2013

Period	Wind Speed (km/hr)			Temperature (°C)			Relative Humidity (%)			Rain Fall (mm)
	Max	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	
March'13 –May'13	8.6	<1.6	1.2	48.0	18.0	31.9	96.6	12.0	61.9	Nil

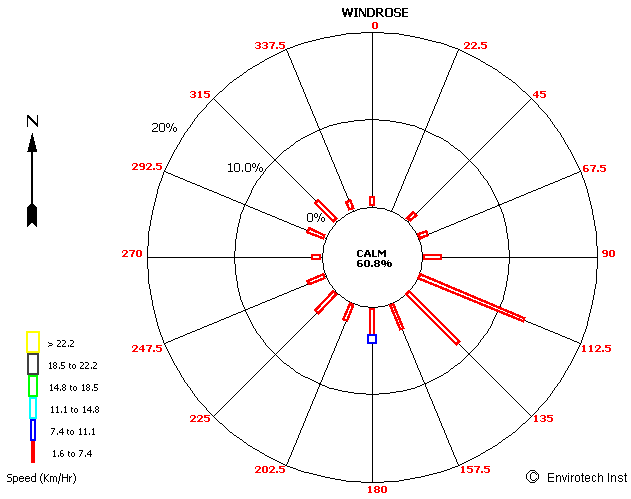


Fig 2a: Day Time Wind Rose at Dhenkanal During Summer Season 2013

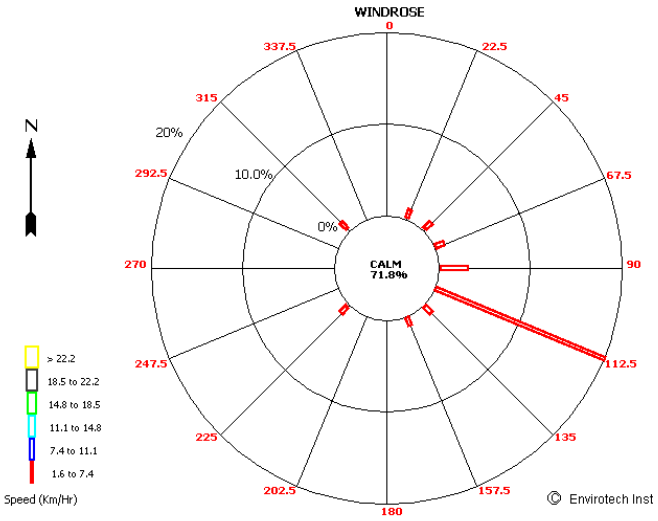


Fig 2b: Night Time Wind Rose at Dhenkanal During Summer Season 2013

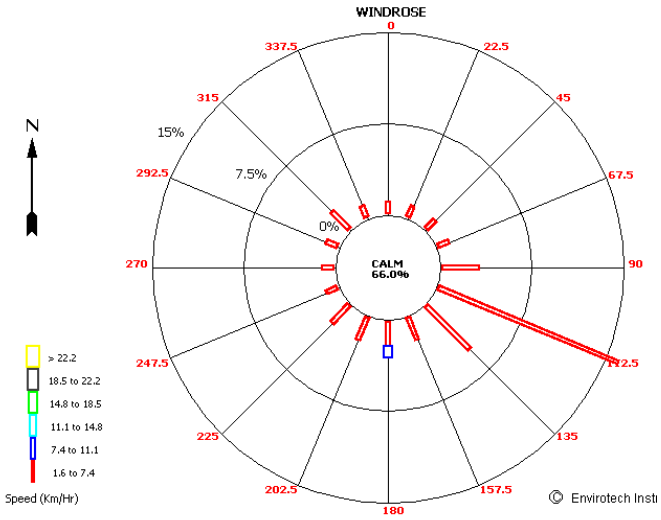


Fig 2c: Overall 24 hour Wind Rose at Dhenkanal During Summer Season 2013

It is observed from the wind rose during Summer Season, 2013 that in general winds from ESE is pre-dominant followed by SE. The trend is similar during both day and night time. However, winds are slightly distributed in East to North-West with occasional high winds from south during day time. But calm conditions are more prevailed during night time. During the entire monitoring period the predominant wind speeds were in the range of 1.6 – 7.4 Km/hr.

Since the present monitoring was conducted during post monsoon, compared to summer season there was reversal in wind direction in post monsoon season. Calm conditions are more during post monsoon compared to summer season. However, high winds 2- 3 m/s range observed more in post monsoon and occasional rain fall during this period.

3.2 Ambient air quality

To quantify the impact of the proposed Thermal Power Plant on the ambient air quality, it is necessary at first to evaluate the existing ambient air quality. The existing ambient air quality, in terms of Particulate Matter (PM10 &PM2.5), Sulfur-dioxide (SO_2), oxides of Nitrogen (NO_x), Carbon monoxide (CO), Lead (Pb), Ozone (O_3)and Mercury (Hg) have been measured through a planned field monitoring.

For selection of the monitoring stations, IMD data of Angul observatory was used to identify the probable locations. Station locations were decided by running screening model using wind direction & speed, atmospheric stability, stack details such as temperature, volume, exit velocity etc. of the proposed plant.

The approximate distance and direction of AAQ stations from the proposed site are given in **Table 2** and are marked in Drawing No. **MEC/10G0/11/S2/03.**

Post monsoon season monitoring was conducted at AAQ stations where earlier monitoring had been conducted to compare the seasonal variation.

Table 3: Location of AAQ Monitoring Stations

Station No.	Location	Approx. Distance & Direction from Project Site	Latitude-Longitude
A1	Mohuli	1.5 Km, E	**20°50'11", 85°30'51"**
A2	Kantajharia	8 Km, E	**20°49'57",85°36'15"**
A3	Aluajharna	2 Km, N	**20°50'56",85°31'19"**
A4	Mahulpal	6 Km, N	**20°55'38",85°32'48"**
A5	Kankrajhara	2 Km, W	**20°50'21",85°30'06"**
A6	Tulasipasi	7 Km, W	**20°48'32",85°27'28"**
A7	Tumasinga	7 Km, SW	**20°47'36",85°28'22"**
A8	Kusumjodi	2 Km, S	**20°49'14",85°31'33"**

The methodology for sampling and analysis is given in **Table 4.**

Table 4: Methodology of Sampling and Analysis for AAQ Monitoring

Parameter	Instrument/Apparatus Used	Methodology	Reference
PM_{10}	Respirable Dust Sampler	Gravimetric	MOEFCC G.S.R 826 (E) dtd. 16.11.09
$PM_{2.5}$	PM2.5Fine Dust Sampler	Gravimetric	MOEFCC G.S.R 826 (E) dtd. 16.11.09
SO_2	RDS with Impingerbox, Spectrophotometer etc.	Improved West & Gaeke Method	MOEFCC G.S.R 826 (E) dtd. 16.11.09
NO_x	RDS with Impinger box, Spectrophotometer etc.	Jacob &HochheiserModified (Na - Arsenite) Method	MOEFCC G.S.R 826 (E) dtd. 16.11.09
CO	CO Analyser	NDIR Method	MOEFCC G.S.R 826 (E) dtd. 16.11.09
Pb	AAS/MPAES	Gravimetric followed by AAS/ MPAES	MOEFCC G.S.R 826 (E) dtd. 16.11.09
O_3	RDS with Impinger box, Spectrophotometer etc.	Buffered KI absorption Method	MOEFCC G.S.R 826 (E) dtd. 16.11.09
Hg	Mercury analyser	Cold vapour atomic absorption technique	-

The summarised AAQ results are given in **Table 5**. The results have been compared with National Ambient Air Quality Standards (NAAQS) of Central Pollution Control Board (CPCB), which are presented in **Table 6.**

Table 5 : Summarised Results of AAQ Monitoring

A. Post-monsoon Season, 2016

Parameters		Results (µg/m³)							
		Mohuli	Kantajharia	Aluajharna	Mahulpal	Kankrajhara	Tulasipasi	Tumasinga	Kusumjodi
		A1	A2	A3	A4	A5	A6	A7	A8
PM10	Max.	90	92	93	95	90	91	91	94
	Min.	62	64	62	68	59	58	55	60
	Avg.	79	79	79	80	78	78	80	79
$PM_{2.5}$	Max.	56	57	53	55	54	54	56	55
	Min.	37	36	38	36	32	37	29	32
	Avg.	46	47	46	47	44	45	46	43
SO_2	Max.	12	11	11	13	10	11	11	12
	Min.	5	5	5	5	5	5	4	4
	Avg.	8	8	8	8	7	7	8	7
NO_X	Max.	36	35	32	39	34	30	33	37
	Min.	12	14	13	10	10	12	12	14
	Avg.	21	22	21	23	19	20	21	21
CO	Max.	1580	2234	1837	2198	1267	1464	1436	1496
	Min.	253	203	215	153	195	153	144	142
	Avg.	733	550	734	831	674	567	781	629
Pb	Max.	0.05171	0.05366	0.04887	0.06963	0.05928	0.05932	0.07721	0.05538
	Min.	0.02786	0.03592	0.03202	0.03841	0.02329	0.01910	0.04208	0.00736
	Avg.	0.03909	0.04324	0.04023	0.05479	0.04556	0.03370	0.05524	0.02807
Hg	Max.	0.00026	0.00036	0.00025	0.00027	0.00021	0.00016	0.00019	0.00014
	Min.	0.00013	0.00015	0.00011	0.00010	0.00010	0.00006	0.00012	0.00007
	Avg.	0.00018	0.00021	0.00019	0.00018	0.00015	0.00011	0.00014	0.00011
O_3	Max.	48	55	48	61	50	48	47	52
	Min.	31	27	32	34	30	29	32	28
	Avg.	39	40	39	41	39	38	39	40

B. Summer Season, 2013

Parameters		Results (µg/m³)							
		Mohuli	Kantajharia	Aluajharna	Mahulpal	Kankrajhara	Tulasipasi	Tumasinga	Kusumjodi
		A1	A2	A3	A4	A5	A6	A7	A8
PM10	Max.	95	94	92	93	94	92	94	95
	Min.	48	56	47	75	41	52	51	52
	Avg.	85	82	78	87	76	76	79	83
$PM_{2.5}$	Max.	60	51	56	51	51	51	51	55
	Min.	46	38	32	43	38	34	42	38
	Avg.	54	44	53	48	43	41	47	44
SO_2	Max.	13	11	13	13	13	7	10	13
	Min.	6	<4	5	4	5	<4	4	5
	Avg.	10	7	9	9	9	5	7	9
NO_X	Max.	23	20	21	28	21	18	18	21
	Min.	16	<10	13	15	12	<10	12	11
	Avg.	20	14	19	20	17	12	16	18
Hg	Max.	0.00052	0.00037	0.00036	0.00025	0.00045	0.00040	0.00028	0.00027
	Min.	0.00029	0.00027	0.00015	0.00005	0.00019	0.00031	0.00017	0.00014
	Avg.	0.00038	0.00032	0.00023	0.00014	0.00031	0.00035	0.00024	0.00019
O_3	Max.	102	71	59	82	87	76	86	99
	Min.	55	38	32	59	43	52	37	55
	Avg.	75	56	45	69	65	66	57	74

Table 6: NAAQS prescribed by CPCB (2009)

Parameters	Norms (All values in µg/m³)	
	Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Area (Notified by Central Government)
PM 10 (24 hrs. Avg.)	100	100
PM 2.5 (24hrs. Avg.)	60	60
SO_2 (24hrs. Avg.)	80	80
NO_X (24hr.Avg.)	80	80
O_3 (1 hr. Avg.)	180	180
CO (1 hr Avg.)	4000	4000
Pb (24 Avg.)	1	1
Note: 24/8 hourly values should be met 98% of the time in a year. However 2% of the time it may exceed but not on 2 consecutive days.		

During Post-monsoon season, 2016 PM_{10} levels were 55 µg/m³ to 95 µg/m³ ; $PM_{2.5}$ levels were 29 µg/m³ to 56 µg/m³. For Summer, 2013 the corresponding values were 47 µg/m³ to 95 µg/m³ and 38 µg/m³ to 60 µg/m³ respectively, which are well within the prescribed norms of residential rural and other areas at all the stations. Values of $PM_{2.5}$, SO_2, NO_x, O_3, CO & Pb are also well within the norms for "Residential rural and other areas" in both the seasons. From the above table it is seen that there is no significant change in air quality observed even after three years in the study area.

3.3 Noise

In order to have an idea of the present background noise level of the project site, a detailed measurement of noise level was carried out at 5 locations (during summer season, 2013 and Post-Monsoon, 2016). Locations are shown in Drawing No. **MEC/10G0/11/S2/03**. Precision integrated sound level meter (type 2221 of Bruel & Kjaer of Denmark) was used. The measurements were carried out for 24 hours. Hourly readings of Leq.(A) were recorded for 15 minutes in each hour. The results of ambient noise monitoring are given in **Table 7**. The results have been compared with MoEFCC norms given in **Table 8**.

Table 7: Results of Noise Monitoring

A. Post Monsoon Season, 2016

Station No.	Location	Day (06.00-22.00 hr.)			Night (22.00-06.00 hr.)			Ldn
		Max.	Min.	Mean *	Max.	Min.	Mean *	
N-1	Mahuli	58.1	40.2	54.8	48.2	37.0	42.0	53.9
N-2	Aluajharna	57.8	41.0	54.2	48.6	36.5	42.2	53.6
N-3	Kusumjodi	52.2	40.1	44.0	47.1	35.2	40.9	47.9
N-4	Mahulpal	58.6	44.0	54.1	49.2	37.0	42.9	53.7
N-5	Kantajharia	48.3	39.1	45.3	45.6	35.2	40.2	47.8
All values in dB(A); ** Logarithmic Averages*.								

B. Summer Season,2013

Station No.	Location	Day (06.00-22.00 hr.)			Night (22.00-06.00 hr.)			Ldn
		Max.	Min.	Mean *	Max.	Min.	Mean *	
N-1	Mahuli	59.1	41.8	55.5	42.8	37.6	40.1	54.15
N-2	Aluajharna	58.2	41.8	54.2	41.3	36.9	39.2	52.91
N-3	Kusumjodi	51.7	39.9	44.1	40.6	35.1	38.2	46.11
N-4	Mahulpal	60.2	44.1	55.2	48.8	37.0	42.6	54.40
N-5	Kantajharia	48.7	39.5	45.0	44.3	35.1	39.5	47.26
All values in dB(A); ** Logarithmic Averages*.								

Table 8: Ambient Air Quality Norms in Respect of Noise

Type of Area	Day (0600-2200 hrs)	Night (2200-0600 hrs)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence zone	50	40
All values in dB (A)		

In post- monsoon season, 2016, the average values of noise levels at all the locations were found to be well within the norms during both day and night.

All the noise monitoring stations were in residential areas and the average values of noise level at all the locations were found to be well within the norms during both day and night period in summer season, 2013 except at Mahuli and Mahulpal where average noise levels exceeded the norms marginally during day time which may be due to local activities.

There is not much variation in ambient noise levels when compared with present data with the data recorded earlier.

3.4 Water environment

Water quality monitoring was carried out with the following objectives:

- To collect baseline data on existing water quality of Surface and Ground water
- To assess the raw water quality to be used by the proposed project

Selection of Sampling Locations

In order to study the existing water quality within the study area, samples of water were collected from the following ten (10) locations comprising of three surface water and seven ground water as given in **Table 9**. The locations are also marked in Drawing **No. MEC/10G0/11/S2/04**.

There are three surface water sources in the study area. Under the present proposal, water required for the plant will be drawn from River Brahmani. The other rivers / streams are Ramaila River and Indragit Nala both of which are tributaries of the Brahmani. Samples were collected from all these surface water sources.

In the study area the ground water flow is from north to south. The proposed ash pond is located in the south of the main plant area. In order to assess the existing ground water quality samples were collected from up-gradient of main plant and down-gradient of the ash pond and also east and west of the plant area.

Table 9: Location of Water Monitoring Stations

Sl. No.	Code No.	Location	Type
1	GW1	Kankrajhara	Ground Water
2	GW2	Bijodihi	Ground Water
3	GW3	Kusumjodi	Ground Water
4	GW4	Kateni	Ground Water
5	GW5	Tumasinga	Ground Water
6	GW6	Tulapasi	Ground Water
7	GW7	Kantajharia	Ground Water
8	SW1	Brahmani River	Surface Water
9	SW2	Ramiala River	Surface Water
10	SW3	IndrajitNala	Surface Water

Methodology

In order study the existing water quality within the study area, grab water samples were collected from ground water and surface water sources, as given in **Table 10.** Surface water samples were analysed for different parameters as required by CPCB surface water criteria and ground water samples were analysed for different parameters as per IS: 10500 (2012).

Results & Discussion of Ground Water Quality

Seven no. of Ground water samples were collected during both monitoring seasons and analysed for various parameters. Results of analysis are depicted in **Table 10** and have been compared with Drinking Water Specification IS: 10500 (2012).

Analysis results show that ground water quality parameters are meeting the prescribed norms of drinking water quality except for few parameters. When compared with earlier data it is observed that Iron is exceeding the norms at two

places, Kankarajhara and Bijodihi during both the monitoring periods. Fluoride concentration at Kateni and Tulapasi exceeded the acceptable limits but were within the permissible limits during Summer, 2013; in other locations it was well below the acceptable limits. Ca is slightly high at Tumasinga in both the monitoring periods.

In general all concentrations of all parameters during Post-monsoon season, 2016 were less in comparison to Summer, 2013 which may be because of present sampling done just after monsoon.

Table 10: Results of Ground Water Analysis

Sl. No.	Parameters	Norms*		Location			
		Requirement (Acceptable limits)	Permissible limits in the absence of alternate source	Kankrajhara	Bijodihi	Kankrajhara	Bijodihi
		Date of sampling		Summer season,2013		Post-monsoon,2016	
1	Colour, Hazen Units.	5	15	<5	<5	<5	<5
2	Odour	Agreeable	Agreeable	Unobjectionable	Unobjectionable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	1	5	<4	<4	<1	<1
5	pH value	6.5 to 8.5	No Relaxation	6.7	6.9	6.6	6.8
6	Total Hardness(as $CaCO_3$), mg/l, max	200	600	120	280	84	220
7	Iron (as Fe), mg/l, max.	0.3	No Relaxation	7.908	1.812	3.36	1.19
8	Chloride (as Cl),mg/l, max.	250	1000	16	103	13	94
9	Fluoride (as F), mg/l, max.	1	1.5	0.73	0.96	0.19	0.47
10	Total Dissolved Solids, mg/l, max.	500	2000	220	484	198	504
11	Calcium (as Ca), mg/l, max.	75	200	26	63	19	45
12	Magnesium (as Mg), mg/l, max.	30	100	14	30	9	26
13	Copper (as Cu), mg/l, max.	0.05	1.5	<0.025	<0.025	<0.01	<0.01
14	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.05	0.13	0.04	0.02
15	Sulphate (as SO_4), mg/l, max.	200	400	<4	24	<4	22
16	Nitrate (as NO_3), mg/l, max.	45	No Relaxation	<1	2	14	13
17	Phenolic compounds, mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001
18	Mercury,(as Hg), mg/l, max.	0.001	No relaxation	<0.0005	<0.0005	<0.0005	<0.0005
19	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.05	<0.05	<0.01	<0.01
20	Nickel (as Ni), mg/l, max.	0.02	No relaxation	ND	ND	<0.01	<0.01
21	Total Arsenic (as As), mg/l, max.	0.01	0.05	ND	ND	<0.03	<0.03
22	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
23	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.05	<0.05	<0.01	<0.01
24	Zinc (as Zn), mg/l, max.	5	15	0.599	0.019	0.078	0.026
25	Total Chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.05	<0.05	<0.01	<0.01
26	Total Alkalinity(as $CaCO_3$), mg/l	200	600	120	220	82	220
27	Aluminium (as Al), mg/l, Max	0.03	0.2	<0.02	<0.02	<0.01	<0.01
28	Boron (as B), mg/l, max.	0.5	1.0	<0.1	<0.1	<0.05	<0.05

*Detection limit in summer season'2013 & Post-monsoon season'2016 is different due to change of analytical equipment.

Table 10 : Results of Ground Water Analysis contd..

Sl. No.	Parameters	Norms*		Location			
		Requirement (Acceptable limits)	Permissible limits in the absence of alternate source	Kusumjodi	Kateni	Kusumjodi	Kateni
		Date of sampling		Summer season,2013		Post-monsoon,2016	
1	Colour, Hazen Units.	5	15	<5	<5	<5	<5
2	Odour	Agreeable	Agreeable	Unobjectionable	Unobjectionable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	1	5	<4	<4	<1	<1
5	pH value	6.5 to 8.5	No Relaxation	6.6	7.0	6.6	6.9
6	Total Hardness(as $CaCO_3$), mg/l, max	200	600	300	360	188	244
7	Iron (as Fe), mg/l, max.	0.3	No Relaxation	0.160	0.042	0.061	0.040
8	Chloride (as Cl),mg/l, max.	250	1000	111	113	80	67
9	Fluoride (as F), mg/l, max.	1	1.5	0.32	1.5	0.32	0.69
10	Total Dissolved Solids, mg/l, max.	500	2000	698	604	552	524
11	Calcium (as Ca), mg/l, max.	75	200	67	104	50	67
12	Magnesium (as Mg), mg/l, max.	30	100	32	24	17	18
13	Copper (as Cu), mg/l, max.	0.05	1.5	<0.025	<0.025	<0.01	<0.01
14	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.01	<0.01	<0.01	<0.01
15	Sulphate (as SO_4), mg/l, max.	200	400	39	39	26	28
16	Nitrate (as NO_3), mg/l, max.	45	No Relaxation	74	15	44	9
17	Phenolic compounds, mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001
18	Mercury,(as Hg), mg/l, max.	0.001	No relaxation	<0.0005	<0.0005	<0.0005	<0.0005
19	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.05	<0.05	<0.01	<0.01
20	Nickel (as Ni), mg/l, max.	0.02	No relaxation	ND	ND	<0.01	<0.01
21	Total Arsenic (as As), mg/l, max.	0.01	0.05	ND	ND	<0.03	<0.03
22	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
23	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.05	<0.05	<0.01	<0.01
24	Zinc (as Zn), mg/l, max.	5	15	<0.005	0.009	<0.01	<0.01
25	Total Chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.05	<0.05	<0.01	<0.01
26	Total Alkalinity(as $CaCO_3$), mg/l	200	600	252	268	186	240
27	Aluminium (as Al), mg/l, Max	0.03	0.2	<0.02	<0.02	<0.01	<0.01
28	Boron (as B), mg/l, max.	0.5	1.0	<0.1	<0.1	<0.05	<0.05

*Detection limit in summer season'2013 & Post-monsoon season'2016 is different due to change of analytical equipment.

Table 10: Results of Ground Water Analysis contd..

Sl. No.	Parameters	Norms*		Location			
		Requirement (Acceptable limits)	Permissible limits in the absence of alternate source	Tumasinga	Tulapasi	Tumasinga	Tulapasi
		Date of sampling		Summer season2013		Post-monsoon 2016	
1	Colour, Hazen Units.	5	15	<5	<5	<5	<5
2	Odour	Agreeable	Agreeable	Unobjectionable	Unobjectionable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	1	5	<4	<4	<1	<1
5	pH value	6.5 to 8.5	No Relaxation	7.4	7.4	7.1	7.2
6	Total Hardness(as $CaCO_3$), mg/l, max	200	600	824	356	512	240
7	Iron (as Fe), mg/l, max.	0.3	No Relaxation	0.042	0.121	0.05	0.09
8	Chloride (as Cl),mg/l, max.	250	1000	381	103	192	49
9	Fluoride (as F), mg/l, max.	1	1.5	0.64	1.25	0.55	0.99
10	Total Dissolved Solids, mg/l, max.	500	2000	1116	578	820	498
11	Calcium (as Ca), mg/l, max.	75	200	221	66	136	46
12	Magnesium (as Mg), mg/l, max.	30	100	66	47	42	30
13	Copper (as Cu), mg/l, max.	0.05	1.5	<0.025	<0.025	<0.01	<0.01
14	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.05	<0.05	0.08	0.08
15	Sulphate (as SO_4), mg/l, max.	200	400	77	44	54	24
16	Nitrate (as NO_3), mg/l, max.	45	No Relaxation	13	13	20	28
17	Phenolic compounds, mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001
18	Mercury,(as Hg), mg/l, max.	0.001	No relaxation	<0.0005	<0.0005	<0.0005	<0.0005
19	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.05	<0.05	<0.01	<0.01
20	Nickel (as Ni), mg/l, max.	0.02	No relaxation	ND	ND	<0.01	<0.01
21	Total Arsenic (as As), mg/l, max.	0.01	0.05	ND	ND	<0.03	<0.03
22	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
23	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.05	<0.05	<0.01	<0.01
24	Zinc (as Zn), mg/l, max.	5	15	<0.005	<0.005	0.02	0.07
25	Total Chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.05	<0.05	<0.01	<0.01
26	Total Alkalinity(as $CaCO_3$), mg/l	200	600	300	264	296	240
27	Aluminium (as Al), mg/l, Max	0.03	0.2	<0.02	<0.02	<0.01	<0.01
28	Boron (as B), mg/l, max.	0.5	1.0	<0.1	<0.1	<0.05	<0.05

*Detection limit in summer season'2013 & Post-monsoon season'2016 is different due to change of analytical equipment.

Table 10: Results of Ground Water Analysis contd..

Sl. No.	Parameters	Norms*		Location	
		Requirement (Acceptable limits)	Permissible limits in the absence of alternate source	Kantajharia	Kantajharia
		Date of sampling		Summer season2013	Post-monsoon,2016
1	Colour, Hazen Units.	5	15	<5	<5
2	Odour	Agreeable	Agreeable	Unobjectionable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	1	5	<4	<1
5	pH value	6.5 to 8.5	No Relaxation	6.6	6.6
6	Total Hardness(as $CaCO_3$), mg/l, max	200	600	232	156
7	Iron (as Fe), mg/l, max.	0.3	No Relaxation	<0.02	0.16
8	Chloride (as Cl),mg/l, max.	250	1000	63	30
9	Fluoride (as F), mg/l, max.	1	1.5	0.49	0.24
10	Total Dissolved Solids, mg/l, max.	500	2000	364	276
11	Calcium (as Ca), mg/l, max.	75	200	58	40
12	Magnesium (as Mg), mg/l, max.	30	100	21	14
13	Copper (as Cu), mg/l, max.	0.05	1.5	<0.025	<0.01
14	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.05	0.02
15	Sulphate (as SO_4), mg/l, max.	200	400	<4	<4
16	Nitrate (as NO_3), mg/l, max.	45	No Relaxation	11	7
17	Phenolic compounds, mg/l, max.	0.001	0.002	<0.001	<0.001
18	Mercury,(as Hg), mg/l, max.	0.001	No relaxation	<0.0005	<0.0005
19	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.05	<0.01
20	Nickel (as Ni), mg/l, max.	0.02	No relaxation	ND	<0.01
21	Total Arsenic (as As), mg/l, max.	0.01	0.05	ND	<0.03
22	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01
23	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.05	<0.01
24	Zinc (as Zn), mg/l, max.	5	15	0.115	0.051
25	Total Chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.05	<0.01
26	Total Alkalinity(as $CaCO_3$), mg/l	200	600	176	148
27	Aluminium (as Al), mg/l, Max	0.03	0.2	<0.02	<0.01
28	Boron (as B), mg/l, max.	0.5	1.0	<0.1	<0.05

*Detection limit in summer season'2013 & Post-monsoon season'2016 is different due to change of analytical equipment.

Results & Discussion of Surface Water Quality

The results of Surface Water quality monitoring are given in **Table 11** and compared with CPCB surface water quality criteria, as given in **Table 12**. Results show that surface water quality is conforming to Classes B and C both.(i.e, suitable for Outdoor bathing (organized) as well as Drinking water source after conventional treatment and after disinfection)

However, to have a baseline data of the Surface water quality, samples were analysed for some other parameters as per IS: 10500 iron levels exceeded the norms at all the three locations. High value of iron in post monsoon season may be due to rain wash out of the nearby surfaces. No significant change is observed in water quality when compared earlier data analysed in 2013.

Table 11: Surface Water Quality

Sl. No	Parameters	Brahmani River	Ramiala River	Indrajit Nala	Brahmani River	Ramiala River	Indrajit Nala
	Date of Sampling	Summer season,2013			Post-monsoon,2016		
1	Colour, Hazen units, Max.	<5	<5	<5	<5	<5	<5
2	Turbidity, NTU, Max.	<4	<4	<4	15	12	<1
3	pH Value	6.8	7.0	7.0	7.2	7.3	7.1
4	Dissolved Oxygen (as O_2), mg/l	6.4	6.2	6.0	6.3	6.2	6.4
5	BOD, 5 days at 20° C, mg/l	2	2	3	3	3	3
6	Total Hardness (as $CaCO_3$), mg/l, Max.	52	44	132	48	44	92
7	Iron (as Fe), mg/l, Max.	1.283	1.878	0.886	3.606	2.848	1.721
8	Chloride (as Cl), mg/l, Max.	14	12	24	10	8	14
9	Fluoride (as F) mg/L, Max.	0.33	0.23	0.67	0.15	0.19	0.4
10	Dissolved Solids mg/l, Max.	96	82	228	95	84	182
11	Calcium (as Ca), mg/l, Max.	10	10	30	10	10	26
12	Magnesium (as Mg), mg/L, Max.	7	5	14	6	5	7
13	Copper (as Cu), mg/l, Max.	<0.025	<0.025	<0.025	<0.01	<0.01	<0.01
14	Manganese (as Mn), mg/l, Max.	0.177	0.115	0.271	0.066	0.091	0.184
15	Sulphate (as SO_4), mg/l, Max.	6	<4	7	9	4	<4
16	Nitrate (as NO_3), mg/l, Max.	<1	<1	<1	6	4	3
17	Phenolic Compounds (as C_6H_5OH), mg/l Max.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
18	Mercury (as Hg), mg/l, Max.	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
19	Cyanide (as CN), mg/l, Max.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Lead (as Pb), mg/l, Max.	<0.05	<0.05	<0.05	<0.01	<0.01	<0.01
21	Zinc (as Zn), mg/l, Max.	<0.005	0.006	<0.005	0.027	0.017	0.034
22	Alkalinity (as $CaCO_3$) mg/l, Max.	48	44	128	42	42	96
23	Aluminium (as Al) mg/l, Max.	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01
24	Coliform organisms, MPN/100ml	340	270	400	480	330	400
25	Sodium Absorption Ratio	0.43	0.32	0.47	0.38	0.4	0.54
26	Free Ammonia (as N) mg/l	Nil	Nil	Nil	Nil	Nil	Nil
27	Electrical Conductivity, µmhos/cm	124	100	280	121	112	236
28	Boron, mg/l	<0.1	<0.1	<0.1	<0.05	<0.05	<0.05

Table 12: Central Pollution Control Board (CPCB) Surface Water Quality Criteria

SN	Parameters	Class A	Class B	Class C	Class D	Class E
1	pH	6.5–8.5	6.5–8.5	6.0-9.0	6.5–8.5	6.5–8.5
2	Dissolved oxygen (as O_2), mg/l, min	6	5	4	4	-
3	BOD, 5 days at 20° C, max	2	3	3	-	-
4	Total coli form organism, MPN/100 ml, max	50	500	5000	-	-
5	Free ammonia (as N), mg/l, max	-	-	-	1.2	-
6	Electrical conductivity, μmhos/cm, max	-	-	-	-	2250
7	Sodium absorption ratio, max.	-	-	-	-	26
8	Boron (as B), mg/l, max.	-	-	-	-	2

Class A: Drinking water source without conventional treatment but after disinfection
Class B: Outdoor bathing (organized)
Class C: Drinking water source after conventional treatment and after disinfection
Class D: Propagation of Wild life and Fisheries
Class E: Irrigation, Industrial Cooling, and Controlled Waste Disposal
Below E: Not meeting A, B, C, D & E criteria

3.5 Soil

In order to have an idea about the baseline soil quality in the study area, samples of topsoil were collected from the four locations once during the monitoring period. The soil samples were marked, brought to laboratory, air-dried and analysed for different physico-chemical characteristics.

Sl. No.	Sample Code	Location	Type of Land
1.	S1	Aluajharna	Agricultural
2.	S2	Ash pond area	Barren
3.	S3	Kateni	Agricultural
4.	S4	Tulsipasi	Forest

The above locations are marked Drawing No.**MEC/11/S2/10G0/04**.

Results& Discussion of Soil Analysis

The results of analysis are given in **Tables 13, 14, 15** and **16**.

Soil pH plays a very important role in the availability of nutrient and growth of plant. The composition of soil microbial community is also dependent on the soil pH. In the study area soil pH varies from 6.0 to 6.8 and from 6.2 to 7.0 in summer, 2013 & post-monsoon, 2016 respectively, which is slightly acidic to neutral.

Electrical conductivity (EC) is a measure of the concentration of soluble salts and ionic activity. Salt concentration is directly proportional to the osmotic pressure, which governs the power of osmosis in the soil-plant system. In the tested soil

samples the EC varies from 141 μs/cm to 328 μs/cm in summer season, 2013 and from 124 μs/cm to 202 μs/cm in post-monsoon season, 2016.

Table 13: Physico-chemical Properties of Soils

A. Post-monsoon Season, 2016

Characteristics	Results			
	S-1	S-2	S-3	S-4
Colour	Brownish	Reddish Brown	Light Brown	Dark Brown
Texture	Sandy Clay	Sandy Clay	Sandy Loam	Sandy Loam
Bulk Density	1.3	1.2	1.1	1.3
pH	6.2	6.7	6.2	7.0
Electrical Conductivity (μs/cm)	182	190	124	202

B. Summer Season, 2013

Characteristics	Results			
	S-1	S-2	S-3	S-4
Colour	Brown	Reddish Brown	Yellowish White	Blackish Brown
Texture	Sandy Clay	Sandy Clay	Sandy Loam	Loamy Sand
Bulk Density	1.5	1.6	1.4	1.3
pH	6.7	6.8	6.3	6.0
Electrical Conductivity (μs/cm)	160	141	142	328

The fertility status of the soil is indicated by its capacity to provide the primary nutrients i.e. Nitrogen, Phosphorus, Potassium (NPK) and Organic Matter content. The levels of NPK and organic carbon are presented in **Table-14 (A&B)**. It was found that organic carbon content in the soil varied from 0.14% (low) to 1.11% (High). Nitrogen also varied from 147 kg/ha to 289 kg/ha which is in the range of low to medium. Available phosphorus is varies from 11 kg/ha to 36 kg/ha medium to high while available potassium is medium to high in post-monsoon season, 2016.

Table 14: Available Major Nutrients in Soil

A. Post-monsoon Season, 2016

Nutrients and Ratings	Results			
	S-1	S-2	S-3	S-4
Organic Carbon (%) and Rating	0.45 Low	0.14 Low	0.38 Low	1.11 High
Available Nitrogen (kg/ha) and Rating	147 Low	169 Low	154 Low	289 Medium
Available Phosphorus (kg/ha) and Rating	19 Medium	15 Medium	11 Medium	36 High
Available Potassium (kg/ha) and Rating	202 Medium	124 Medium	296 High	302 High
Rating based on : Available Nitrogen (Kg/Ha) <280 - Low; 280- 560 Medium; >560 - High Available Phosphorus (Kg/Ha) <10 - Low; 10 - 25 Medium; >25 - High Available Potassium (Kg/Ha) <120 - Low; 120 - 280 Medium; >280 - High Organic carbon (%) <0.50 - Low; 0.5 - 0.75 Medium; > 0.75 - High				

B. Summer Season, 2013

Nutrients and Ratings	Results			
	S-1	S-2	S-3	S-4
Organic Carbon (%) and Rating	0.45 Low	0.17 Low	0.30 Low	1.56 High
Available Nitrogen (kg/ha) and Rating	60 Low	182 Low	185 Low	477 Medium
Available Phosphorus (kg/ha) and Rating	43 High	23 Medium	9 Low	106 High
Available Potassium (kg/ha) and Rating	199 Medium	107 Low	135 Medium	228 Medium
Rating based on : Available Nitrogen (Kg/Ha) <280 - Low; 280- 560 Medium; >560 - High Available Phosphorus (Kg/Ha) <10 - Low; 10 - 25 Medium; >25 - High Available Potassium (Kg/Ha) <120 - Low; 120 - 280 Medium; >280 - High Organic carbon (%) <0.50 - Low; 0.5 - 0.75 Medium; > 0.75 - High				

The exchangeable cations in soil samples represent the nutrients available to the plant via adsorption on soil. Results of exchangeable cations are presented in **Table-15(A&B)**.

Table 15: Exchangeable Cations

A. Post-monsoon Season, 2016

Cations	Results			
	S-1	S-2	S-3	S-4
Calcium (meq/100 gm)	6.00 (59.34%)	4.20 (38.26%)	5.40 (53.10%)	7.2 (54.96%)
Magnesium (meq/100 gm)	2.4 (23.74%)	4.80 (43.72%)	3.60 (35.40%)	4.20 (32.06%)
Sodium (meq/100 gm)	1.19 (11.77%)	1.63 (14.83%)	0.88 (8.62%)	1.29 (9.88%)
Potassium (meq/100 gm)	0.52 (5.15%)	0.35 (3.19%)	0.29 (2.88%)	0.41 (3.11%)

B. Summer Season, 2013

Cations	Results			
	S-1	S-2	S-3	S-4
Calcium (meq/100 gm)	2.88 (57.17%)	2.16 (40.04%)	4.32 (63.24%)	9.36 (58.85%)
Magnesium (meq/100 gm)	1.44 (28.59%)	2.16 (40.04%)	2.16 (31.62%)	5.76 (36.22%)
Sodium (meq/100 gm)	0.38 (7.46%)	0.80 (14.85%)	0.18 (2.57%)	0.50 (3.15%)
Potassium (meq/100 gm)	0.73 (6.79%)	0.29 (5.07%)	0.41 (2.57%)	0.43 (1.78%)

Micronutrients play a specific role in the growth and development of plants. Most micronutrients, especially the transition metals Zn, Fe, Mn and Cu are constituents of many metal enzymes and they function in key metabolic events such as chlorophyll synthesis, photosynthesis, respiration, protein synthesis, nitrogen fixation, assimilation of nitrates and sulphate, etc. Soil micronutrient analysis can be employed as a diagnostic tool for predicting the possibility of deficiency of a nutrient and the profitability of its application. For this, it is essential to fix the critical limits. The critical limit of micronutrient in a soil is that content of extractable nutrient at or below which plantation practiced on it will produce a positive response to its application.

The critical limits of copper, zinc and iron are 0.20-0.66 mg/kg, 0.50-0.65 mg/kg and 4.5-6.0 mg/kg respectively. Results of available micronutrient in the tested soil samples are given in **Table 16**.

Table 16: Available Micro-nutrients

A. Post-monsoon Season, 2016

Micro Nutrient	Results (in mg/kg)			
	S-1	S-2	S-3	S-4
Iron	34.65	11.48	2.11	11.51
Copper	2.14	2.20	1.57	1.29
Zinc	2.45	6.30	7.27	2.99
Manganese	64.61	34.71	3.91	24.59

B. Summer Season, 2013

Micro Nutrient	Results (in mg/kg)			
	S-1	S-2	S-3	S-4
Iron	3.69	4.24	4.20	16.62
Copper	0.26	0.56	0.60	0.78
Zinc	0.40	0.39	0.27	0.29
Manganese	27.8	8.96	18.70	11.36

From the table above it can be seen that in summer season 2013 iron and zinc levels are below the critical limit in sample S1, S2 & S3 and above in S4. Copper concentration level in sample S1, S2 & S3 is in the range of critical limit.

In Post-monsoon season 2016 copper and zinc concentration level in all the samples were above the critical limits. Iron was above the limits at 3 locations out of 4.

3.6 Ground Water Regime

Core zone

Hydro geologically the area can be grouped under sedimentary cum metamorphosed rocky terrain overlain by sandy loamy soil, followed by shale and sandstone aquifers. In the core zone the top layer consist of clayey - sandy soil.

To understand the water table, attempts have been made to measure the available dug wells at core zone and buffer zone with the intension of establishing groundwater map for the study area.

About 48 wells have been inventoried in the buffer zone and data like total depth, depth to water and their location were collected during the study. In each village minimum of two, maximum of five wells have been measured and measured levels were used to develop the groundwater contour map.

From the summer season data measured in 2013, it is evident that the water levels are almost in 3.1 to 13.0 m **BGL** and maintains static flow. However, in post-monsoon season measured now, the water levels range from 1.2 m to 8 m. On comparing data from both the study periods, it is evident that due to ground water

recharging by monsoon season, the water level rises in all wells ranging from 1.2 m to 5 m depending upon the location.

The groundwater levels as measured in two different season viz. summer season of 2013 and Post-monsoon season of 2016 and water level fluctuations are shown in the **Table 17**. The cross-sectional water level fluctuations in the study area are also represented in **Fig 3(a) and 3(b).**

Table 17: Measured water levels and fluctuations from the surrounding villages

Sl. No.	Village	Summer Season'2013 (m)	Post-monsoon Season'2016 (m)	Fluctuation(m)	Dia (m)	Total Depth (m)
1.	Mahulpal	5.4	3.1	2.3	2.25	7.65
2.	Mahulpal	6.0	3.4	2.6	2.2	10
3.	Kusumjodi	6.3	3.6	2.7	1.35	10.3
4.	Kusumjodi	5.8	2.6	3.2	1.35	8.1
5.	Kusumjodi	5.8	2.8	3.0	1.35	9
6.	Kantajharia	7.7	4.3	3.4	2.5	11.25
7.	Kantajharia	5.3	4.1	1.2	1.35	8.5
8.	Dhobabahali	4.5	2.9	1.6	3.5	13.5
9.	Dhobabahali	4.2	2.2	2.0	2.2	13
10.	Dhobabahali	4.2	2.2	2.0	2.2	13.5
11.	Tumasinga	5.4	3.1	2.3	1.8	13
12.	Tumasinga	4.0	1.9	2.1	1.2	9
13.	Tumasinga	4.0	1.9	2.1	1.8	9
14.	Kankrajhara	5.6	4.3	1.3	3	6
15.	Aluajharana	8.4	2.5	5.9	3.1	10
16.	Aluajharana	13.5	5.9	7.6	1.8	16.4
17.	Salpada	8.5	4.7	3.8	1.6	9
18.	Salpada	8.2	4.2	4.0	1.6	9
19.	Mahuli	8.6	4.2	4.4	4.95	10.8
20.	Mahuli	8.1	3.9	4.2	2.9	9.9
21.	Mahuli	6.7	3.5	3.2	2.9	7.2
22.	Bijodihi	5.8	3.0	2.8	2	6.75
23.	Bijodihi	3.1	1.7	1.4	2.2	4
24.	Bijodihi	3.3	1.7	1.6	2.2	4.2
25.	Bijodihi	3.5	1.4	2.1	2.2	4.5
26.	Bijodihi	2.6	1.3	1.3	4	4.6
27.	Marichakhand	5.4	2.4	3.0	2.7	6.7
28.	Marichakhand	4.5	1.6	2.9	1.9	5.4
29.	Marichakhand	4.8	1.7	3.1	1.9	6.3
30.	Srimula	5.9	2.1	3.8	2	7.2
31.	Srimula	6.3	2.5	3.8	2	7.8
32.	Pulasahi	11.0	5.2	5.8	1.8	12.6
33.	Pulasahi	11.2	5.2	6.0	2.3	13.5
34.	Khatuahata	13.5	5.5	8.0	3.15	14
35.	Khatuahata	13.0	6.0	7.0	1.8	13.5
36.	Khatuahata	12.8	5.1	7.7	1.8	13.3
37.	Anlabereni	6.3	2.8	3.5	1.8	7.6
38.	Anlabereni	5.8	2.1	3.7	3.3	6.5

Sl. No.	Village	Summer Season'2013 (m)	Post-monsoon Season'2016 (m)	Fluctuation(m)	Dia (m)	Total Depth (m)
39.	Anlabereni	6.3	2.9	3.4	1.8	7.2
40.	Kotagara	5.3	2.2	3.1	2	6.2
41.	Kotagara	5.5	2.3	3.2	1.8	7.1
42.	Mahulguda	5.6	2.1	3.5	2.15	7.3
43.	Baruan	5.1	2.3	2.8	2.0	7.4
44.	Machhia	5.3	2.1	3.2	1.9	8.1
45	Painrusinghapur	5.2	1.9	3.3	1.8	7.3
46.	Bhagirathipur	6.0	2.5	3.5	1.5	9
47.	Kadua	3.5	1.6	1.9	1.5	5
48.	Galukotini	5.0	2.2	2.8	2.6	7.1

All values are in m. GL-Ground level

Fig 3a- Water Level Fluctuation in W-E cross section of Study Area.

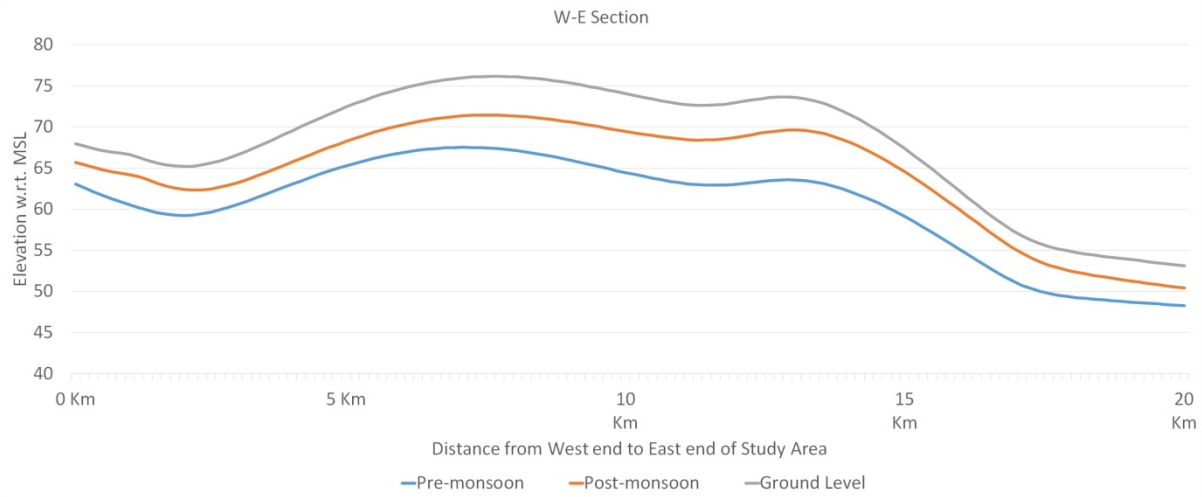
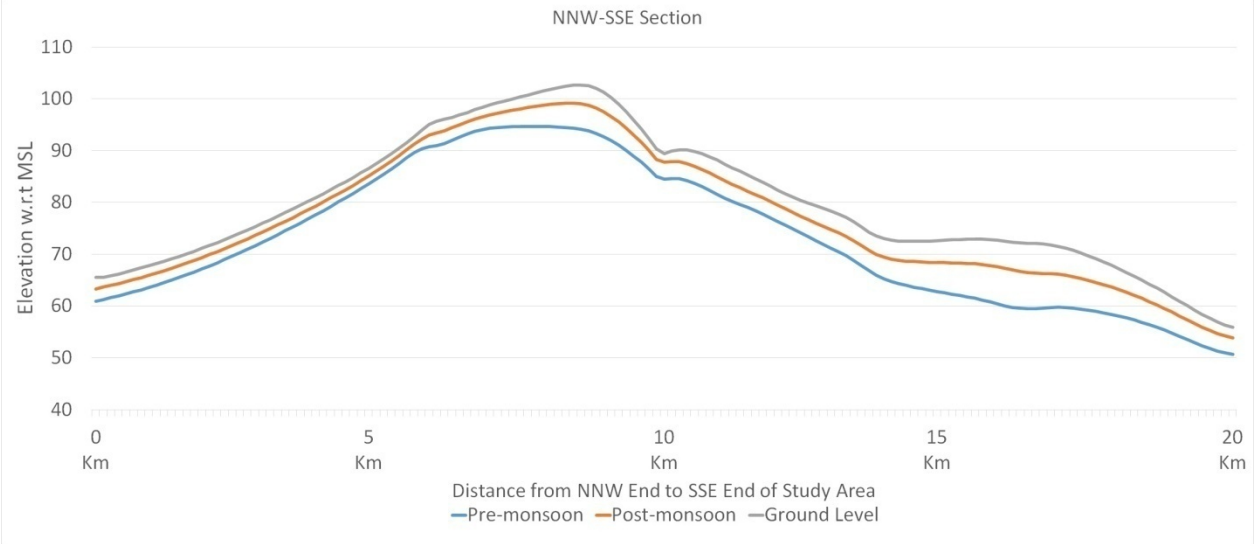


Fig 3b- Water Level Fluctuation in NNW-SSE cross section of Study Area.



3.7 Traffic Density Survey

To assess the present traffic load on Dhenkanal –Kamakhyanagar road passing adjacent to eastern plant boundary, traffic density survey was conducted at Mohuli during Post-Monsoon, 2016 and summer season, 2013. Outcome of the studies are shown in **Table 18 (A&B)**.

Traffic load has slightly increased now in comparison to earlier data surveyed in 2013.

Table 18(A): Traffic Density Survey during Post-Monsoon, 2016

TIME	Towards Kamakhyanagar			Towards Dhenkanal		
	Heavy Vehicles	LMV	Two Wheelers	Heavy Vehicles	LMV	Two Wheelers
06.00-07.00Hrs	17	48	40	25	41	43
07.00-08.00Hrs	28	30	45	33	29	53
08.00-09.00Hrs	18	28	40	16	37	47
09.00-10.00Hrs	17	41	48	25	28	52
10.00-11.00Hrs	13	20	30	07	27	32
11.00-12.00Hrs	19	28	41	31	26	25
12.00-13.00Hrs	20	37	56	18	25	47
13.00-14.00Hrs	17	38	50	23	30	52
14.00-15.00Hrs	28	17	37	21	19	35
15.00-16.00Hrs	36	25	41	25	37	24
16.00-17.00Hrs	17	31	36	18	34	37
17.00-18.00Hrs	23	57	28	20	37	25
18.00-19.00Hrs	18	38	31	13	52	29
19.00-20.00Hrs	28	29	25	25	22	30
20.00-21.00Hrs	13	24	17	18	28	20
21.00-22.00Hrs	25	15	15	28	17	11
22.00-23.00Hrs	10	08	05	13	13	07
23.00-24.00Hrs	17	13	07	12	18	03
24.00-01.00Hrs	08	14	-	11	17	-
01.00-02.00Hrs	08	16	-	14	13	-
02.00-03.00Hrs	16	15	-	13	17	-
03.00-04.00Hrs	12	30	03	18	32	06
04.00-05.00Hrs	15	38	13	13	37	20
05.00-06.00Hrs	11	40	41	08	48	37

Table 18(B): Traffic Density Survey during summer season, 2013

TIME	Towards Kamakhyanagar			Towards Dhenkanal		
	Heavy Vehicles	LMV	Two Wheelers	Heavy Vehicles	LMV	Two Wheelers
06.00-07.00Hrs	15	15	27	6	25	22
07.00-08.00Hrs	10	37	37	9	35	33
08.00-09.00Hrs	8	27	31	7	18	37
09.00-10.00Hrs	9	23	40	7	31	31
10.00-11.00Hrs	12	35	21	13	17	25
11.00-12.00Hrs	6	18	32	4	21	29
12.00-13.00Hrs	10	27	33	15	13	35
13.00-14.00Hrs	11	18	41	7	14	15
14.00-15.00Hrs	8	12	18	10	17	21
15.00-16.00Hrs	6	10	21	11	16	32
16.00-17.00Hrs	9	21	42	8	28	43
17.00-18.00Hrs	11	37	48	3	31	51
18.00-19.00Hrs	17	33	31	7	25	33
19.00-20.00Hrs	7	27	25	5	19	37
20.00-21.00Hrs	3	21	28	13	28	31
21.00-22.00Hrs	11	10	15	11	25	11
22.00-23.00Hrs	8	11	10	14	13	5
23.00-24.00Hrs	13	12	7	15	8	6
24.00-01.00Hrs	7	8	-	6	7	-
01.00-02.00Hrs	3	14	-	4	5	-
02.00-03.00Hrs	5	7	-	8	9	-
03.00-04.00Hrs	8	15	-	9	17	-
04.00-05.00Hrs	14	27	15	11	24	17
05.00-06.00Hrs	11	33	33	7	38	38

Fig: 4a Heavy Vehicle movement (HVM) towards Kamakhyanagar during Post Monsoon (PM) 2016 and Summer 2013

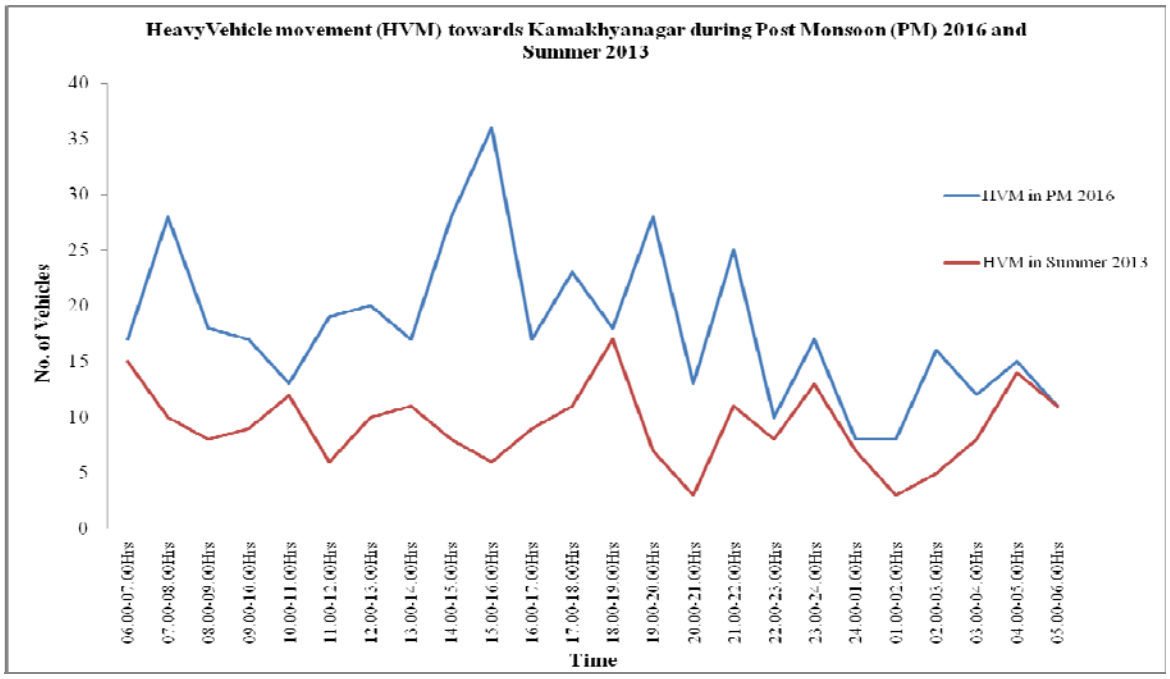
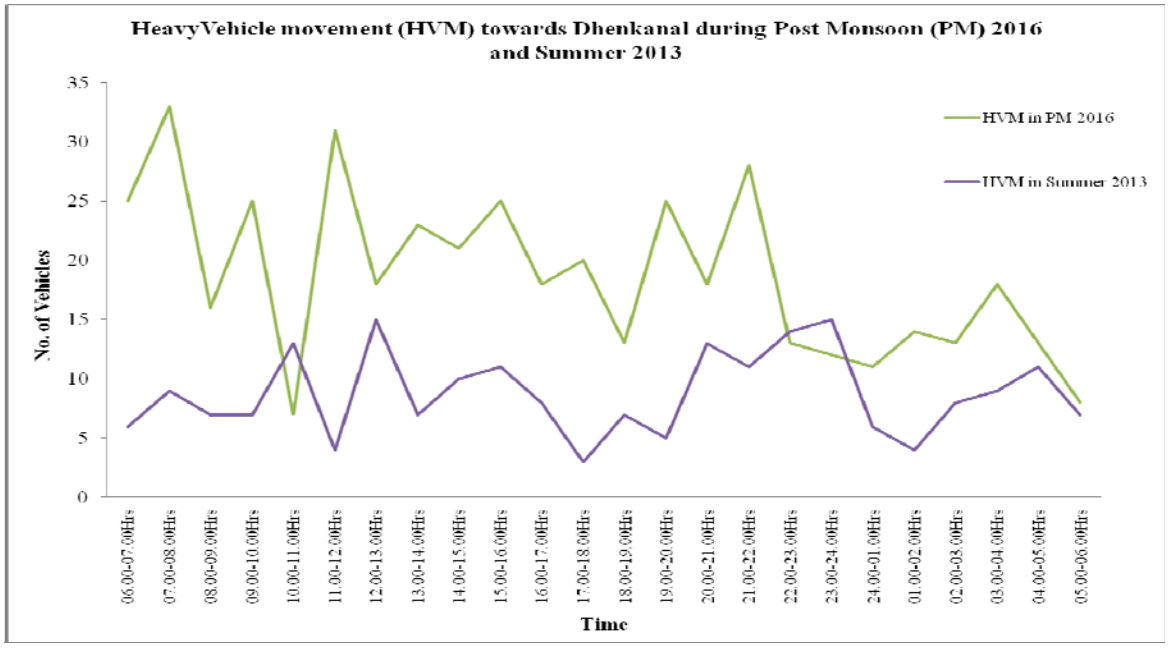


Fig: 4b Heavy Vehicle movement (HVM) towards Dhenkanal during Post Monsoon (PM) 2016 and Summer 2013

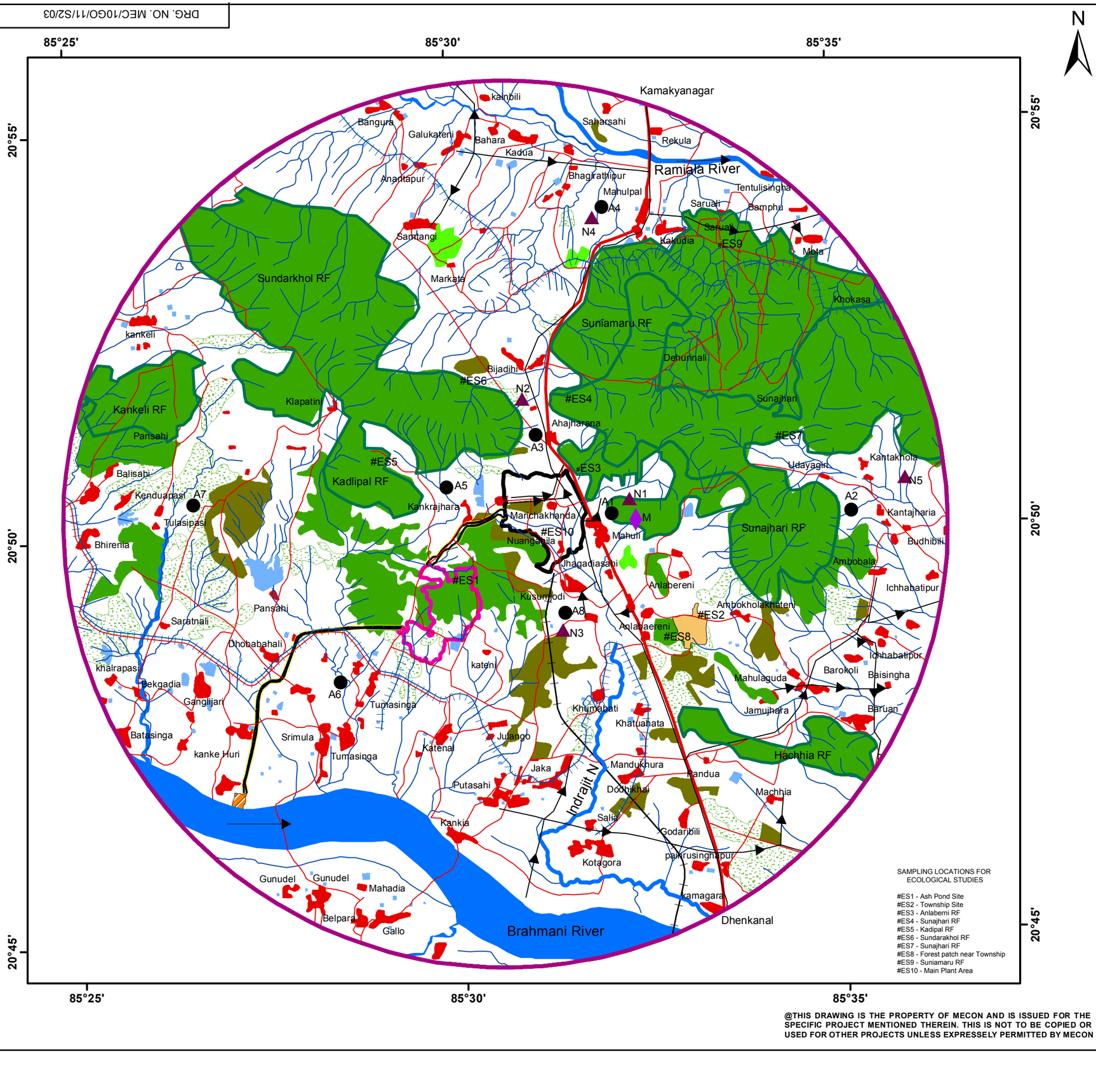


Conclusion:

- Earlier monitoring was conducted in summer season in 2013. The present monitoring was conducted in post monsoon 2016. In general for all environmental attributes except slight seasonal variations no significant variations are observed in ambient environmental quality
- No industrial development in the study area for the last three years
- There is no significant change in ambient air quality in the study area observed when compared with the present data with data generated earlier in 2013 in the study area
- No significant change in concentrations of parameters in both surface and ground waters observed. Dilution observed during post monsoon season
- Ground water table having season fluctuation. Water level rises in all wells ranging from 1.2 m to 5 m depending upon the location.

DRAWINGS

DRG. NO. MEC/10GO/11/S2/03



SAMPLING LOCATIONS FOR ECOLOGICAL STUDIES

#ES1 - Ash Pond Site
#ES2 - Township Site
#ES3 - Anlaberni RF
#ES4 - Sunajhari RF
#ES5 - Kadipal RF
#ES6 - Sundarakhol RF
#ES7 - Sunajhari RF
#ES8 - Forest patch near Township
#ES9 - Suniamaru RF
#ES10 - Main Plant Area

AMBIENT AIR QUALITY MONITORING STATIONS

A1	Mohuli	A5	Kankrajhara
A2	Kantajharia / Udayagiri	A6	Tulsaipasi
A3	Alujharana	A7	Tumasinga
A4	Mahulpal	A8	Kusumjodi

AMBIENT NOISE MONITORING STATIONS

N1	Mohuli	N4	Mahulpal
N2	Alujharana	N5	Kankrajhara
N3	Kusumjodi		

METROLOGICAL MONITORING STATIONS

M Mohuli

REFERENCE

- Stream Seasonal
- Canal
- Nala
- Powerline
- Other Road
- State Highway
- Proposed Railway
- Pipe Line
- Settlement
- River
- Pond
- Forest
- Dense Scrub
- Open Scrub
- Planatation
- Plant
- Ash Dump
- Intake Pond
- OPTCL

Topo Sheet Index

63 P/6 | 63 P/10
63 P/7 | 63 P/11

Buffer Zone

0 2.5 5 10 Km

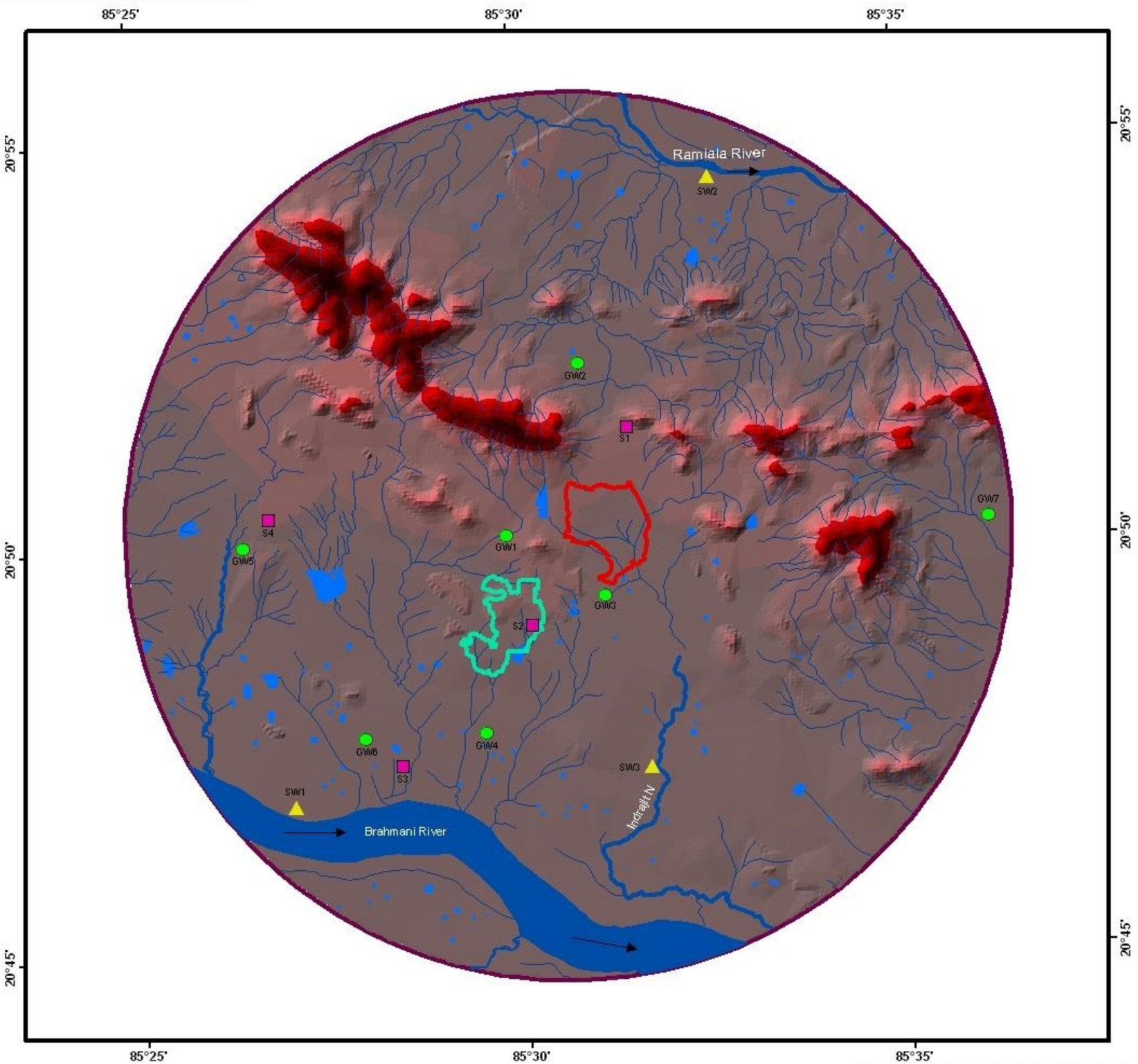
OPTCL

PROJECT PROPONET
ODISHA THERMAL POWER CORPORATION LIMITED

EIA CONSULTANT
मेकॉन लिमिटेड MECON LIMITED

SECTION	ENV. ENGG.		EIA / EMP FOR 3*800 MW COAL FIRED TPP AT ANNUPURNA KHAMAR TALUK KAMAKHYANAGAR. DIST- DHENKANAL, ODISHA
LOCATION	RANCHI		
DESIGNED	PB		
DRAWN	AABSyS		PHYSIOGRAPHY IN STUDY AREA
CHECKED & VERIFIED	MKM		
APPROVED	SIG.	SCALE : As Shown Above	REV
	DATE	DRG. NO. MEC/10GO/11/S2/03	0

DRG. NO. MEC/G249M1/S2/04



N

SURFACE WATER SAMPLING LOCATIONS

SW1	Intake Point (Brahmani River)
SW2	Ramila River
SW3	Indrajit Nadi

GROUND WATER SAMPLE LOCATIONS

GW1	Kankrajhara	GW5	Tumasinga
GW2	Bijodihi	GW6	Tulapasi
GW3	Kusumjodi	GW7	Kantajharia
GW4	Kateni		

SOIL SAMPLING LOCATIONS

S1	Aluajhama	S3	Kateni
S2	Proposed Ash Pond Area	S4	Tulsaipasi

REFERENCE

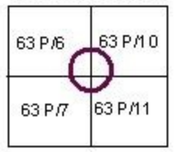
Water Bodies

- Streams
- Pond
- River
- Lease Area
- Ash Pond

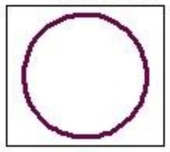
Elevation Range in m

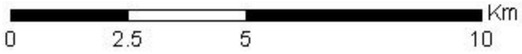
- >480
- 430-480
- 380-430
- 330-380
- 280-330
- 190-230
- 140-190
- 90-140
- <90

Topo Sheet Index



Buffer Zone





OPPC

PROJECT PROPONET
ODISHA THERMAL POWER CORPORATION LIMITED

EIA CONSULTANT
मेकॉन लिमिटेड MECON LIMITED

SECTION	ENV ENGG.	EIA / EMP FOR 3*800 MW COAL FIRED TPP AT ANNUPURNA KHAMAR TALUK KAMAKHYANAGAR. DIST- DHENKANAL, ODISHA
LOCATION	RANCHI	
DESIGNED	PB	
DRAWN	AAE/pt	DRAINAGE IN STUDY AREA
CHECKED & VERIFIED	MEM	
APPROVED	SIG.	SCALE : As Shown Above / REV
	DATE	DRG. NO. MEC/10GO/11/S2/04 / 0