ACTION PLAN FOR INDUSTRIAL CLUSTER IN CRITICALLY POLLUTED AREA

Monitoring, Sampling, Analysis of Stack, Ambient Air Quality, Surface Water, Ground Water, Waste Water

तारापुर Tarapur

Maharashtra Pollution Control Board

Kalptaru Point, Sion East, Mumbai - 400022

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By undertaking this project and completing in schedule time, we consider ourselves very lucky since we have helped the mankind by giving the data on pollution load and further action by the Board, to bring down the pollution level.

We also thank our associates for working on this project for making the write up, making graphs and feeding the data on computer.

This acknowledgement will be incomplete if we do not thank our laboratory analysts and others who made this project a success by timely analysing the samples.

We also thank our sampling team members for conducting the sampling in this vast area.

Abbreviations:

APHA	American Public Health Association
BDL	Below Detection Limit
BOD	Biochemical Oxygen Demand
CEPI	Comprehensive Environmental Pollution Index
CETP	Common Effluent Treatment Plant
COD	Chemical Oxygen Demand
CPA	Critically Polluted Areas
DO	Dissolved Oxygen
ETP	Effluent Treatment Plant
MIBK	Methyl Isobutyl Ketone
MPCB	Maharashtra Pollution Control Board
NAAQS	National Ambient Air Quality Standards
NO_x	Oxides of Nitrogen
ND	Not Detected
PAH	Poly Aromatic Hydrocarbons
PCB	Poly Chlorinated Biphenyls
PCT	Poly Chlorinated Terphenyls
PM10	Particulate Matter (size less than 10 µm)
PM2.5	Particulate Matter (size less than 2.5 µm)
SO_2	Sulphur Dioxide
STAP	Short Term Action Plan
WHO	World Health Organization

1. Introduction:

Industrial pollution is the contamination of the environment by businesses, particularly plants and factories that dump waste products into the air and water. Industrial waste is one of the largest contributors to the global pollution problem endangering people and the environment. The Central Pollution Control Board (CPCB) has developed a Comprehensive Environmental Pollution Index (CEPI). The main objective of the study is to identify polluted industrial clusters or areas in order to take concerted action and to centrally monitor them at the national level to improve the current status of their environmental components such as air and water quality data, ecological damage, and visual environmental conditions.

The concept of Comprehensive Environmental Pollution Index (CEPI) was evolved by Central Pollution Control Board (CPCB) during 2009-10 as a tool for comprehensive environmental assessment of prominent industrial clusters and formulation of remedial Action Plans for the identified critically polluted areas. Later-on proposals were received from the SPCBs, State Governments, and Industrial Associations and concerned Stake-holders for revisiting the criteria of assessment under CEPI concept. After careful examination and consideration of the suggestions of concerned stake-holders, it was decided to prepare the revised concept of CEPI by eliminating the subjective factors but retaining the factors which can be measured precisely.

The results of the application of the Comprehensive Environmental Pollution Index (CEPI) to selected industrial clusters or areas are presented in this report. The main objective of the study is to identify polluted industrial clusters or areas in order to take concerted action and to centrally monitor them at the national level to improve the current status of their environmental components such as air and water quality data, ecological damage, and visual environmental conditions. A total of 88 industrial areas or clusters have been selected by the Central Pollution Control Board (CPCB) in consultation with the Ministry of Environment & Forests Government of India for the study. The index captures the various dimensions of environment including air, water and land. Comprehensive Environmental Pollution Index (CEPI), which is a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway and receptor have been developed.

The present CEPI study includes Tarapur industrial area of Maharashtra state. It is one of the best industrial area situated near Mumbai, Thane and adjacent to Gujarat state on Mumbai - Ahmedabad Express Highway. The industrial part of this place has a number of factories manufacturing dyes, paints and industrial / agricultural chemicals. Heavy metal factories manufacturing a wide variety of equipment are also based in this region. A few nationally prominent industrial establishments have their manufacturing plants in Tarapur. This city accommodates bulk drug manufacturing units, speciality chemical manufacturing units, steel plants and some textile plants. Government of Maharashtra has established Industrial Estate at Boisar, Tarapur in the year 1972. This estate is known as MIDC Tarapur. This is one of the largest chemical industrial estates in the State of Maharashtra.

2. Scope of Work

The Scope of Work consisted of the following:

Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water, and Ground Water Quality for identified five Critically Polluted areas (CPAs) in Maharashtra i.e. **Chandrapur, Dombivali, Aurangabad, Navi Mumbai,** and **Tarapur** and 3 Severely Polluted areas (SPAs) in Maharashtra i.e. **Chembur, Pimpri-Chinchwad and Nashik** as per standard methods.

- At each of the 5 CPAs and 3 SPAs, 24 hourly ambient air quality monitoring to be carried out.

- Representative samples for surface water quality, waste water quality and ground water quality to be collected from prominent surface and ground water bodies located in and around the clusters/areas.
- Submission of complete monitoring, sampling and analysis reports including the summary of the parameters exceeding the prescribed standards/norms for all the 5 CPAs and 3 SPAs.
- Submission of 3 copies of final report with photographs at prominent locations and the CD (soft copy) on completion of the project for every critically polluted and severely polluted area separately.

Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality for Tarapur:

- The sampling was carried out in 3 days at various locations i.e. from 21st February to 23rd February, 2017.
- In Tarapur, a total of 6 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 6 Waste Water Samples and 6 Ground Water Samples were collected and analyzed.

2.1 Stack Emission Parameters

The Stack Emissions were analyzed with the following parameters:

1) Acid Mist
2) Ammonia
3) Carbon Monoxide
4) Chlorine
5) Fluoride(gaseous)
6) Fluoride (particulate)
7) Hydrogen Chloride
8) Hydrogen Sulphide
9) Oxides of Nitrogen
10) Oxygen
11) Polyaromatic Hydrocarbons (Particulate)
12) Suspended Particulate Matter
13) Sulphur Dioxide
14) Benzene
15) Toluene

16) Xylene

17) Volatile Organic Compounds (VOCs)

2.2 Ambient Air Quality Parameters

The Ambient Air Quality was analyzed with the following parameters:

1) Sulphur Dioxide (SO_2)

2) Nitrogen Dioxide (NO_2)

3) Particulate Matter (PM10)

4) Particulate Matter (PM2.5)

5) Ozone (O_3)

6) Lead (Pb)

7) Carbon Monoxide (CO)

8) Ammonia (NH_3)

9) Benzene (C_6H_6)

10) Benzo (a) Pyrene (BaP) (Particulate Phase Only)

11) Arsenic (As)

12) Nickel (Ni)

2.3 Water/Waste Water Parameters

The Water/Waste Water was analyzed with the following parameters:

a. Prominent Surface Water bodies such as outfalls of CETPs, ETPs, treated effluent drainage, river, canal, ponds, lakes and other such water supply resources flowing through the area or flowing adjoining the CPA.

b. Ground Water Quality data of prominent ground water resources such as observation wells of Central Ground Water Board, drinking water wells, hand pumps, bore wells, hand pumps, bore wells and other such water supply resources located in the industrial cluster/area under consideration or in the peripheral areas.

Basic water quality parameters for surface water and ground water both are as follows:

i. Simple Parameters:

1) Sanitary Survey

2) General Appearance

3) Colour

4) Smell

5) Transparency

6) Ecological(Presence of animals like fish, insects) (Applicable to only surface water)

ii. Regular Monitoring Parameters:

7) pH

8) Oil & Grease

9) Suspended Solids

10) Dissolved Oxygen (% saturation) (Not applicable for ground waters)

11) Chemical Oxygen Demand

12) Biochemical Oxygen Demand

13) Electrical Conductivity

14) Nitrite-Nitrogen

15) Nitrate-Nitrogen

16) (NO_2 + NO_3)-Nitrogen

17) Free Ammonia

18) Total Residual Chlorine

19) Cyanide

20) Fluoride

21) Sulphide

22) Dissolved Phosphate

23) Sodium Absorption Ratio (SAR)

24) Total Coliforms (MPN/100 ml)

25) Faecal Coliforms (MPN/100 ml)

iii. Special Parameters:

26) Total Phosphorous

27) Total Kjeldahl Nitrogen(TKN)

28) Total Ammonia (NH_4 +NH_3)-Nitrogen

29) Phenols

30) Surface Active Agents

31) Organo Chlorine Pesticides

32) Polynuclear aromatic hydrocarbons (PAH)

33) Polychlorinated Biphenyls (PCB)and Polychlorinated Terphenyls (PCT)

34) Zinc

35) Nickel

36) Copper

37) Hexavalent Chromium

38) Chromium (Total)

39) Arsenic (Total)

40) Lead

41) Cadmium

42) Mercury

43) Manganese

44) Iron

45) Vanadium

46) Selenium

47) Boron

iv. Bioassay (Zebra Fish) Test: For specified samples only.

2.4 Methodology followed in Sampling and Analysis

Industries, places and locations that have been chosen for the sampling are representative of the city/area. Sampling has been done at the potential polluted areas so as to arrive at the CEPI. This will further help the authorities to monitor the areas in order to improve the current status of their environmental components such as air and water quality data, ecological damage and visual environmental conditions. Methodology for sampling, preservation and analysis have been done according to the references incorporated. Methodology of various types of parameters is presented under following annexure:

1. Stack Emission Sampling and Analysis Methodology – **Annexure I**
2. Ambient Air Sampling and Analysis Methodology **- Annexure II**
3. Water/Wastewater Sampling and Analysis Methodology - **Annexure III**

3. Result of Analysis

Results of Analysis are tabulated below for Stack Emission Monitoring, Ambient Air Quality Monitoring, Waste Water Analysis and Water Analysis. These are followed by their respective graphical representation.

***Kindly note:**

- NA specifies the sample is not analysed for the specific parameter.
- ND specifies that even though the sample was analysed for the parameter, it was not detected.
- BDL specifies that the result obtained is below deductable limit.

3.1 Stack Emission Monitoring:

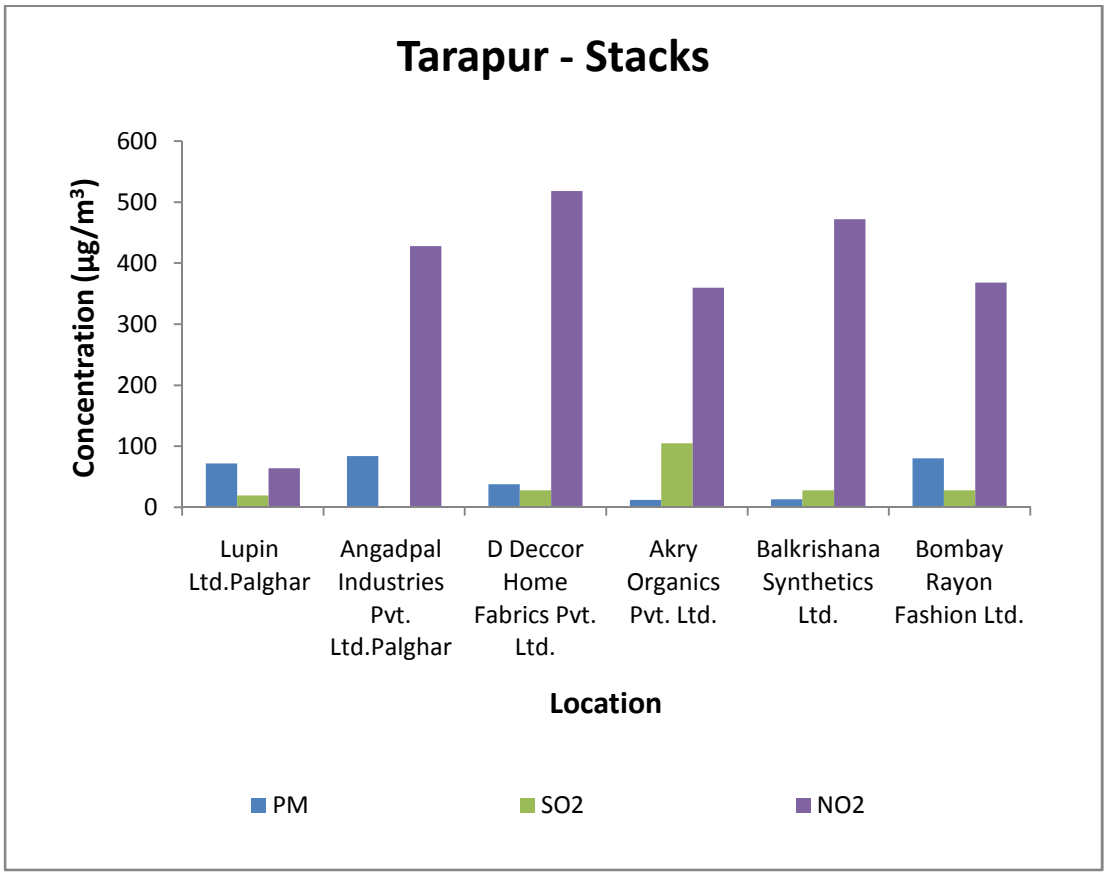
Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D. The limits are represented on the graphical representation. Graph of Volatile Organic carbon could not be prepared as their concentration was found below detection limits at both the locations.

Sr.	Name of Industry	Included in
1.	Lupin Ltd., Palghar	Table No. I
2.	Angadpal Industries Pvt. Ltd., palgghar	Table No. I
3.	D Decor home Fabrics Pvt. Ltd.	Table No. I
4.	Akry Organics Pvt. Ltd.	Table No. I
5.	Balkrishan Synthetics Ltd.	Table No. I
6.	Bombay Rayon Fashion Ltd.	Table No. I

Table No. I:

Name of Industry			**Lupin Ltd.**	**Angadpal Industries Pvt. Ltd.**	**D Decor home Fabrics Pvt. Ltd.**	**Akry Organics Pvt. Ltd.**	**Balkrishan Synthetics Ltd.**	**Bombay Rayon Fashion Ltd.**
Date of Sampling [XX/02/2017]			**21**	**21**	**22**	**22**	**22**	**23**
Stack ID			Boiler	Boiler	Boiler	Boiler	Boiler	Boiler
Sr.	**Parameters**	**Unit**	**Result**					
1	Particulate Matter	mg/Nm^3	72	84	38	12	13	80
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**	**150**	**150**	**150**
2	Sulphur Dioxide (SO_2)	mg/Nm^3	19.3	BDL	27.6	105	28	27.6
		kg/d	192	1.67	14	40	45.3	166
	Std. Limit	**mg/Nm^3**	**500**	**-**	**-**	**-**	**-**	**-**
3	Nitrogen Dioxide (NO_2)	mg/Nm^3	64.2	428	518	360	472	368

Graphs: Stack Monitoring Results:



3.2 Ambient Air Quality:

In order to arrive at conclusions, the Ambient Air Quality Monitoring Results are compared against National Ambient Air Quality Standards, 2009 (Annexure IV). The limits are represented on the graphical representation.

Sr.	Locations	Included in
1.	Lupin Ltd., Palghar	Table No. I
2.	MIDC Office Bhoisar, Palghar	Table No. I
3.	Viraj profile, Palghar	Table No. I
4.	Govt. Hospital Bhoisar, Palghar	Table No. I
5.	Sarvali Village, Palghar	Table No. I
6.	Kolwade Village, Palghar	Table No. I

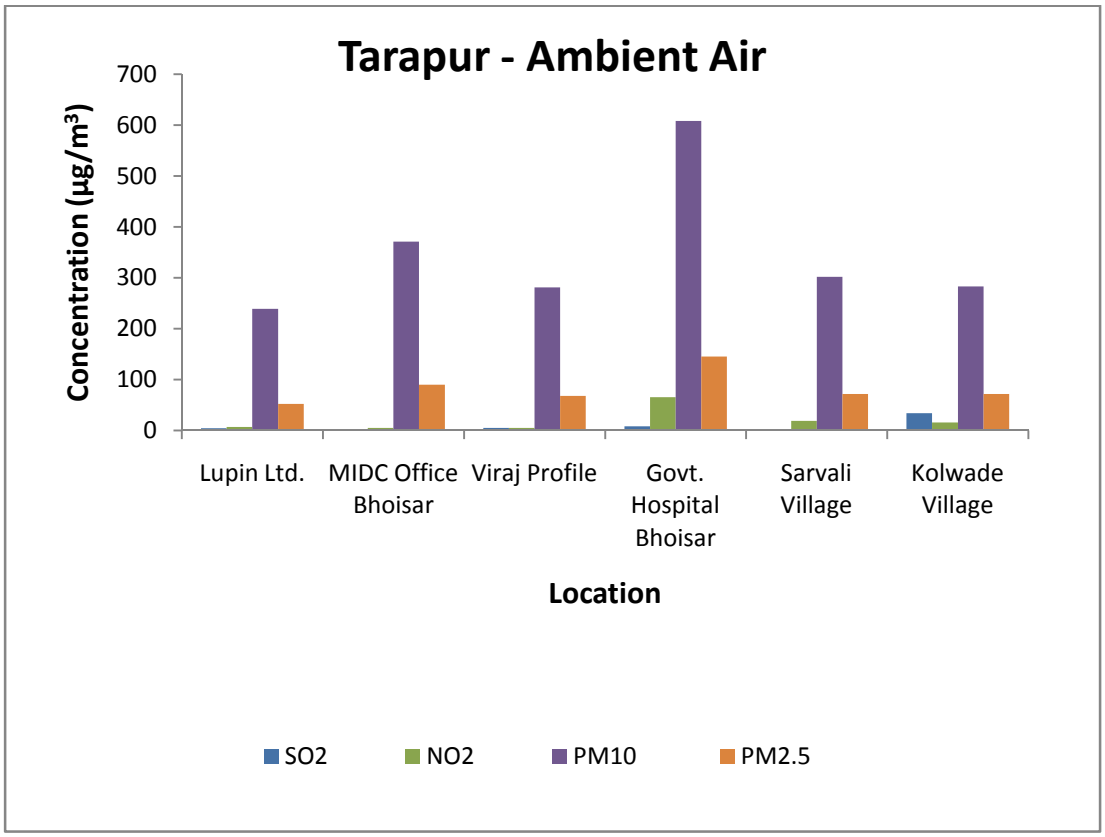
Table No. I:

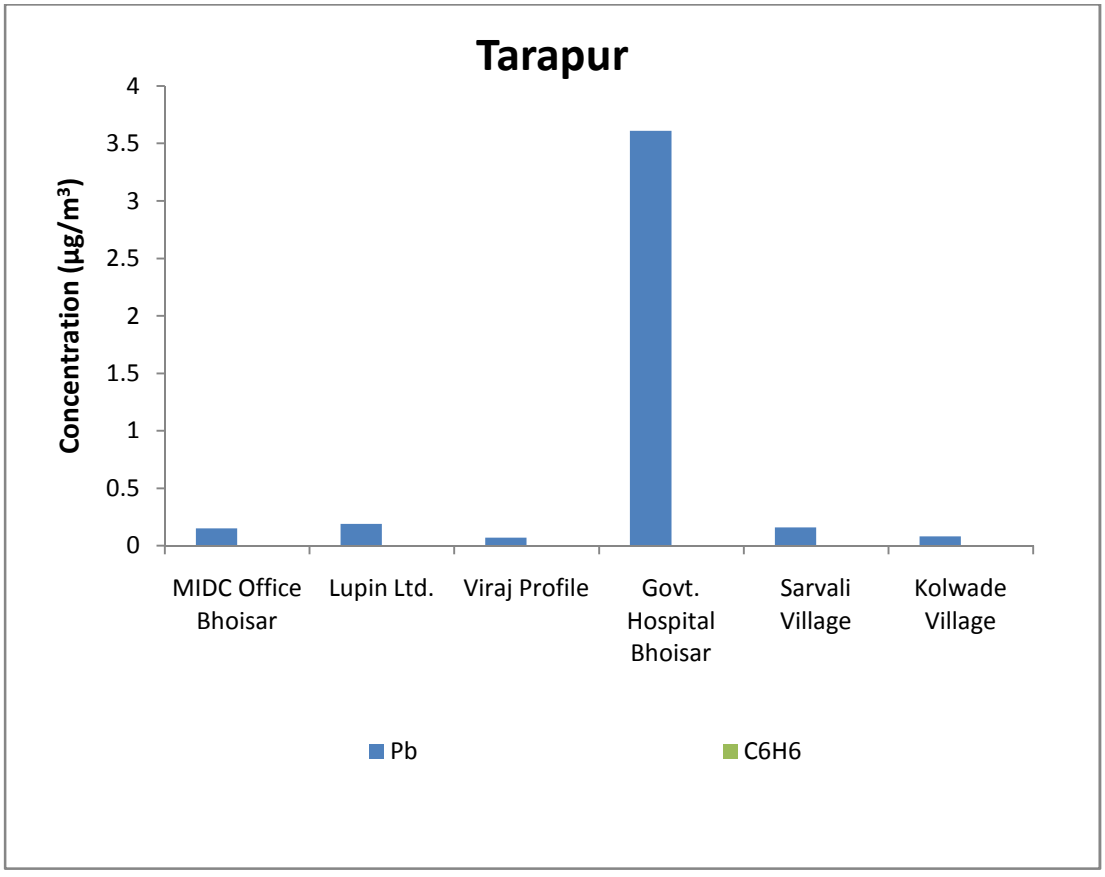
Location				**Lupin Ltd.**	**MIDC Office Bhoisar**	**Viraj profile**	**Govt. Hospital Bhoisar**	**Sarvali Village**	**Kolwade Village**
Date of Sampling [XX/02/2017]				**21**	**22**	**21**	**22**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS, 2009)**	**Results**					
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	4.41	BDL	5.07	8.44	BDL	34
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	7.16	4.81	5.09	65.6	19.1	16
3.	Particulate Matter (size <10 µm)or PM10	$\mu g/m^3$	**100**	239	371	281	608	302	283
4.	Particulate Matter (size <2.5µm)or PM2.5	$\mu g/m^3$	**60**	52	90	68	145	72	72
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL	44.3	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	0.15	0.19	0.07	3.61	0.16	0.08
7.	Carbon Monoxide (CO)	mg/m^3	**04**	1.18	1.39	2.45	-	-	-
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	61.8	43	BDL	71.3
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	BDL	BDL	BDL	BDL	BDL	BDL
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL	BDL	BDL	BDL
11.	Arsenic (as As)	ng/m^3	**6**	BDL	BDL	BDL	BDL	BDL	BDL
12.	Nickel (as Ni)	ng/m^3	**20**	15.5	13.7	18.8	19.5	19.4	20.0

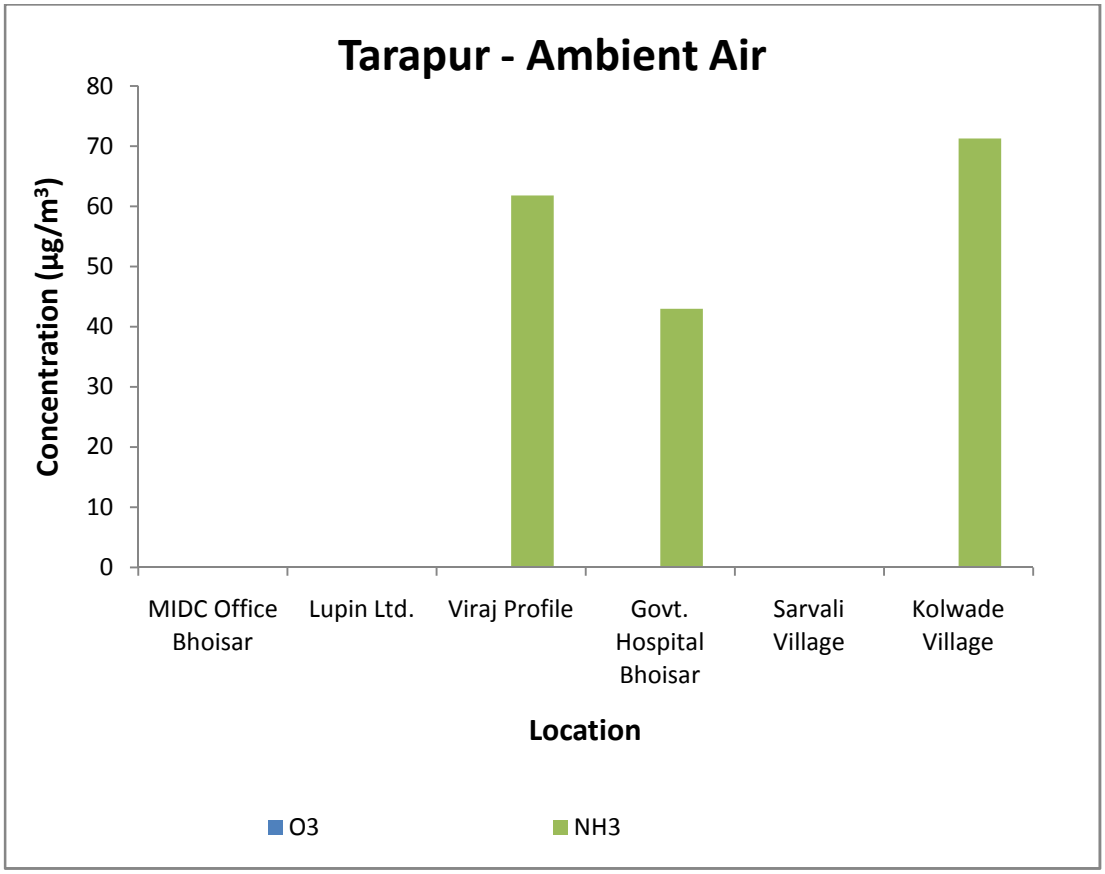
Location				**Lupin Ltd.**	**MIDC Office Bhoisar**	**Viraj profile**	**Govt. Hospital Bhoisar**	**Sarvali Village**	**Kolwade Village**
Date of Sampling [XX/02/2017]				**21**	**22**	**21**	**22**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS, 2009)**	**Results**					
	Volatile Organic Carbons (VOCs)								
i.	Methyl Isobutyl Ketone	mg/Nm_3	**20**	-	ND	-	-	-	ND
ii.	Benzene	mg/Nm_3	**100**	ND	0.31	ND	ND	ND	0.32
iii.	Toulene	mg/Nm_3	**100**	ND	2.39	ND	ND	ND	1.19
iv.	Xylene	mg/Nm_3	**100**	ND	ND	ND	ND	ND	ND
v.	Ethyl Benzene	mg/Nm_3	**100**	ND	ND	ND	ND	ND	ND
vi.	Ethyl Acetate	mg/Nm_3	**150**	ND	ND	ND	ND	ND	ND

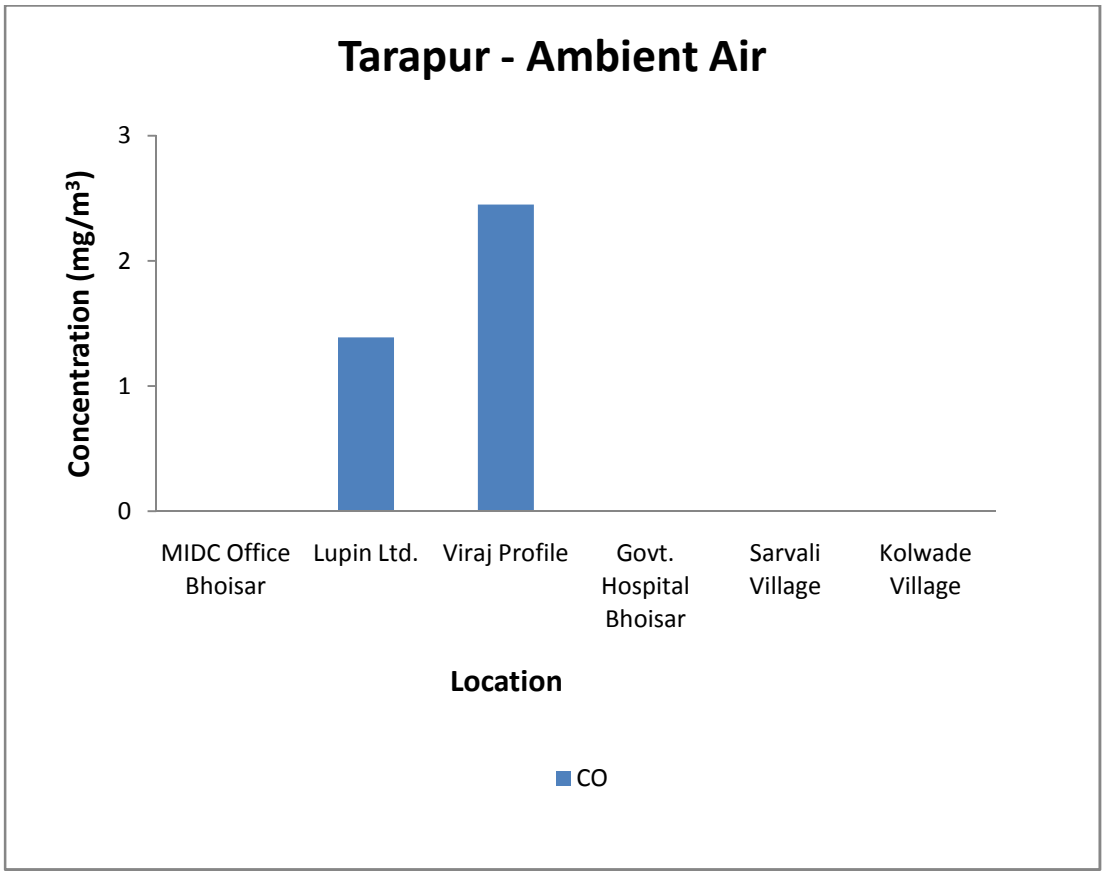
Note: All the result values of parameters namely NH_3, As and BaP are observed Below Detection Limit.

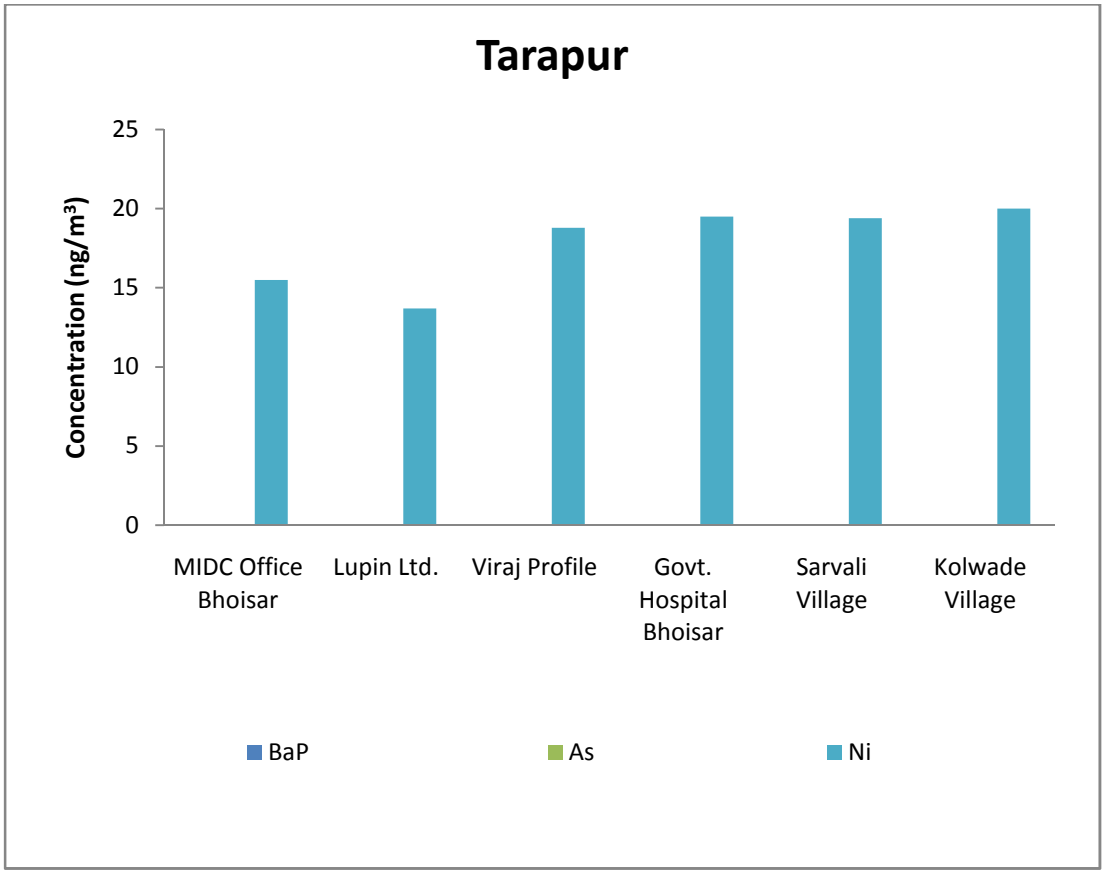
Graphs: Ambient Air Monitoring Results:

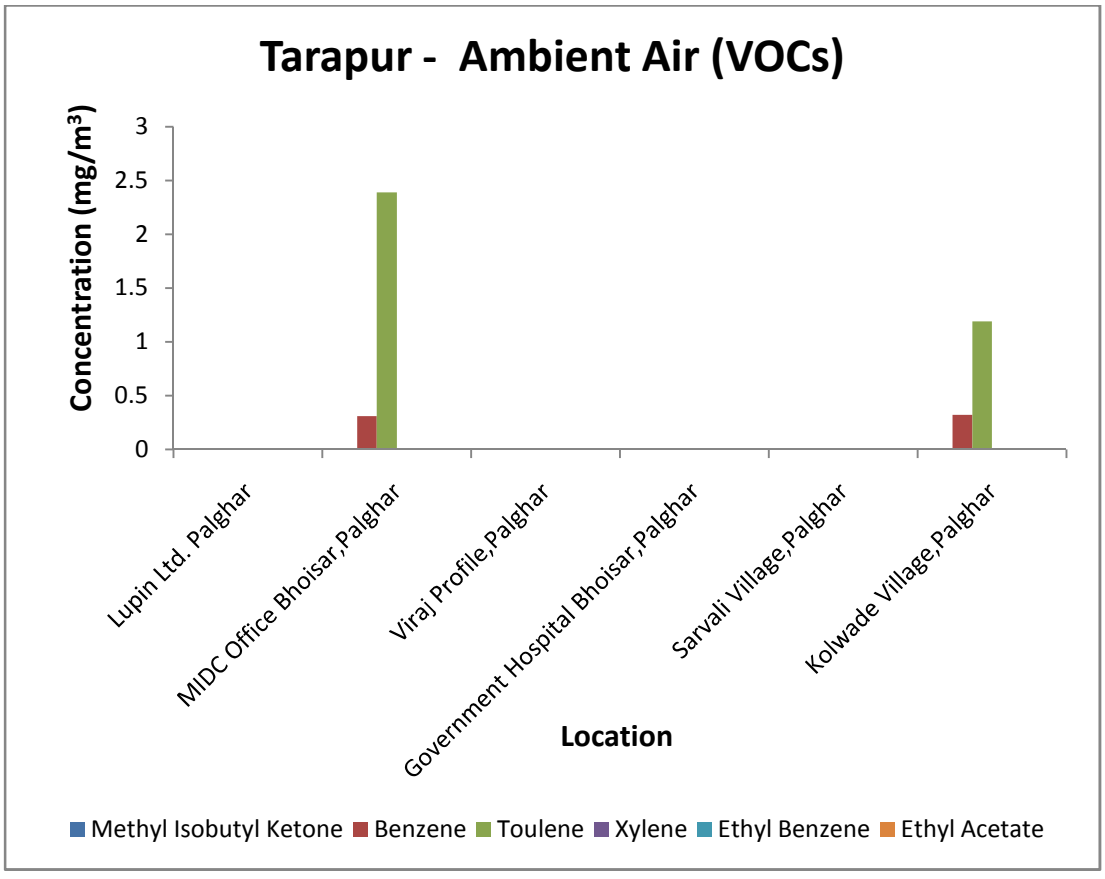





Tarapur - Ambient Air
Concentration (µg/m³)
80
70
60
50
40
30
20
10
0
MIDC Office Bhoisar
Lupin Ltd.
Viraj Profile
Govt. Hospital Bhoisar
Sarvali Village
Kolwade Village
Location
O3
NH3


Tarapur - Ambient Air
Concentration (mg/m³)
3
2
1
0
MIDC Office Bhoisar
Lupin Ltd.
Viraj Profile
Govt. Hospital Bhoisar
Sarvali Village
Kolwade Village
Location
CO


Tarapur
Concentration (ng/m³)
25
20
15
10
5
0
MIDC Office Bhoisar
Lupin Ltd.
Viraj Profile
Govt. Hospital Bhoisar
Sarvali Village
Kolwade Village
BaP
As
Ni


Tarapur - Ambient Air (VOCs)
Concentration (mg/m³)
3
2.5
2
1.5
1
0.5
0
Lupin Ltd. Palghar
MIDC Office Bhoisar,Palghar
Viraj Profile,Palghar
Government Hospital Bhoisar,Palghar
Sarvali Village,Palghar
Kolwade Village,Palghar
Location
Methyl Isobutyl Ketone
Benzene
Toulene
Xylene
Ethyl Benzene
Ethyl Acetate

3.3 Water/Waste Water:

Water analysis Results are compared against CPCB document on criteria for Comprehensive Environmental Assessment of Industrial Clusters-Water Quality Parameters Requirement and Classification (Annexure VIII), CPCB Water Quality Criteria (Annexure VII) and Drinking Water Specification, IS 10500:2012 (Annexure VI), Wastewater Analysis Results are compared with General Standards for Discharge of Environmental Pollutants Part A: Effluents, The Environment (Protection) Rules, 1986, Schedule VI (Annexure V)

3.3.1 Waste Water Analysis Results:

Sr.	Locations	Included in
1.	CETP	Table I
2.	Navapur Discharge	Table I
3.	Navapur Village	Table I
4.	Sarex Overseas	Table II
5.	D.Decor	Table II
6.	Lupin Ltd. Palghar	Table II

Table I:

Location				**CETP**	**Navapur Discharge**	**Navapur Village**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		50	500	1
2.	Smell	-		Disagreeable	Disagreeable	Disagreeable
3.	Transparency	m		0.8	0.6	0.8
4.	pH	-	**5.5 -9.0**	7.44	7.34	7.47
5.	Oil & Grease	mg/L	**10.0**	4	14	3
6.	Suspended Solids	mg/L	**100.0**	125	175	10

Location				**CETP**	**Navapur Discharge**	**Navapur Village**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
7.	Dissolved Oxygen (%Saturation)	%		0	0	0
8.	Chemical Oxygen Demand	mg/L	**250.0**	4000	6800	3600
9.	Biochemical Oxygen Demand (3 days,27°C)	mg/L	**30.0**	1260	2013	1134
10.	Electrical Conductivity (at 25°C)	µmhos/ cm		6610	15500	28600
11.	Nitrite Nitrogen (as N)	mg/L		0.8	2.5	0.91
12.	Nitrate Nitrogen (as N)	mg/L	**10.0**	0.88	BDL	BDL
13.	$(NO_2 + NO_3)$-Nitrogen	mg/L	**5.0**	1.68	2.5	0.91
14.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	0.27	0.2	0.26
15.	Total Residual Chlorine	mg/L	**1.0**	BDL	BDL	BDL
16.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L	**2.0**	0.78	1.2	0.7
18.	Sulphide (as S^{2-})	mg/L	**2.0**	2.0	2.0	1.0
19.	Dissolved Phosphate (as P)	mg/L	**5.0**	0.5	0.39	1.1
20.	Sodium Absorption Ratio	-		19.2	13.1	8.05
21.	Total Coliforms	MPN index/ 100 mL	**100.0**	BDL	BDL	BDL
22.	Faecal Coliforms	MPN index/ 100 mL	**1000.0**	BDL	BDL	BDL
23.	Total Phosphorous (as P)	mg/L	**1.0**	2.6	20	3.2

Location				**CETP**	**Navapur Discharge**	**Navapur Village**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
24.	Total Kjeldahl Nitrogen	mg/L	**100.0**	213	323	268
25.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	96.3	98.1	97.5
26.	Phenols (as C_6H_5OH)	mg/L	**3.0**	BDL	BDL	BDL
27.	Surface Active Agents (as MBAS)	mg/L	**3.0**	0.2	0.15	0.12
28.	Organo Chlorine Pesticides	µg/L	**0.1**			
i.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL
ii.	Atrazine	µg/L	**0.2**	BDL	BDL	BDL
iii.	Aldrin	µg/L	**0.1**	BDL	BDL	BDL
iv.	Dieldrin	µg/L	**2.0**	BDL	BDL	BDL
v.	Alpha HCH	µg/L	**0.01**	BDL	BDL	BDL
vi.	Beta HCH	µg/L	**2.0**	BDL	BDL	BDL
vii.	Butachlor	µg/L	**3.0**	BDL	BDL	BDL
viii.	Delta HCH	µg/L	**0.2**	BDL	BDL	BDL
ix.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
x.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
xi.	p,p DDE	µg/L	**250.0**	0.01	0.048	0.01
xii.	o,p DDE	µg/L	**30.0**	0.01	0.048	BDL
xiii.	p,p DDD	µg/L		BDL	BDL	BDL
xiv.	o,p DDD	µg/L		BDL	BDL	BDL

Location				**CETP**	**Navapur Discharge**	**Navapur Village**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
xv.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
xvi.	Beta Endosulfan	µg/L		BDL	BDL	BDL
xvii.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
viii.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
29.	Poly Aromatic hydrocarbons (as PAH)	µg/L	**0.2**	0.05	0.00052	0.03
30.	Polychlorinated Biphenyls (PCB)	µg/L	**2.0**	0.00007	0.00007	0.00007
31.	Zinc (as Zn)	mg/L	**5.0**	0.52	5.43	0.82
32.	Nickel (as Ni)	mg/L	**3.0**	0.07	0.13	0.06
33.	Copper (as Cu)	mg/L		0.2	1.18	0.37
34.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	0.02	BDL	BDL
35.	Total Chromium (as Cr)	mg/L	**2.0**	0.06	0.19	0.06
36.	Total Arsenic (as As)	mg/L	**0.2**	0.16	0.19	<0.005
37.	Lead (as Pb)	mg/L	**0.1**	0.03	0.03	0.02
38.	Cadmium (as Cd)	mg/L	**2.0**	BDL	0.004	BDL
39.	Mercury (as Hg)	mg/L	**0.01**	0.004	0.006	0.006
40.	Manganese (as Mn)	mg/L	**2.0**	0.26	0.52	0.3
41.	Iron (as Fe)	mg/L	**3.0**	2.74	2.88	2.28
42.	Vanadium (as V)	mg/L	**0.2**	0.02	0.06	0.03
43.	Selenium (as Se)	mg/L	**0.05**	0.05	0.02	0.06

Location				**CETP**	**Navapur Discharge**	**Navapur Village**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
44.	Boron (as B)	mg/L		0.54	0.54	1.63
45.	Bioassay Test on fish	% survival	**90% survival after 96h in 100%effluent**	0	0	0

Table II:

Location				**Sarex Overseas**	**D. Decor**	**Lupin Ltd.**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		3	4	1
2.	Smell	-		Disagreeable	Disagreeable	Disagreeable
3.	pH	-	5.5 -9.0	7.1	7.02	6.36
4.	Oil & Grease	mg/L	10.0	BDL	BDL	2.2
5.	Suspended Solids	mg/L	100.0	12	15	6
6.	Dissolved Oxygen (%Saturation)	%		80	50	5
7.	Chemical Oxygen Demand	mg/L	250.0	80	70	330
8.	Biochemical Oxygen Demand (3 days,27^{o}C)	mg/L	30.0	24.4	21.3	101
9.	Electrical Conductivity (at 25^{o}C)	µmhos/cm		252	1890	156.4
10.	Nitrite Nitrogen (as N)	mg/L		0.04	0.12	0.02

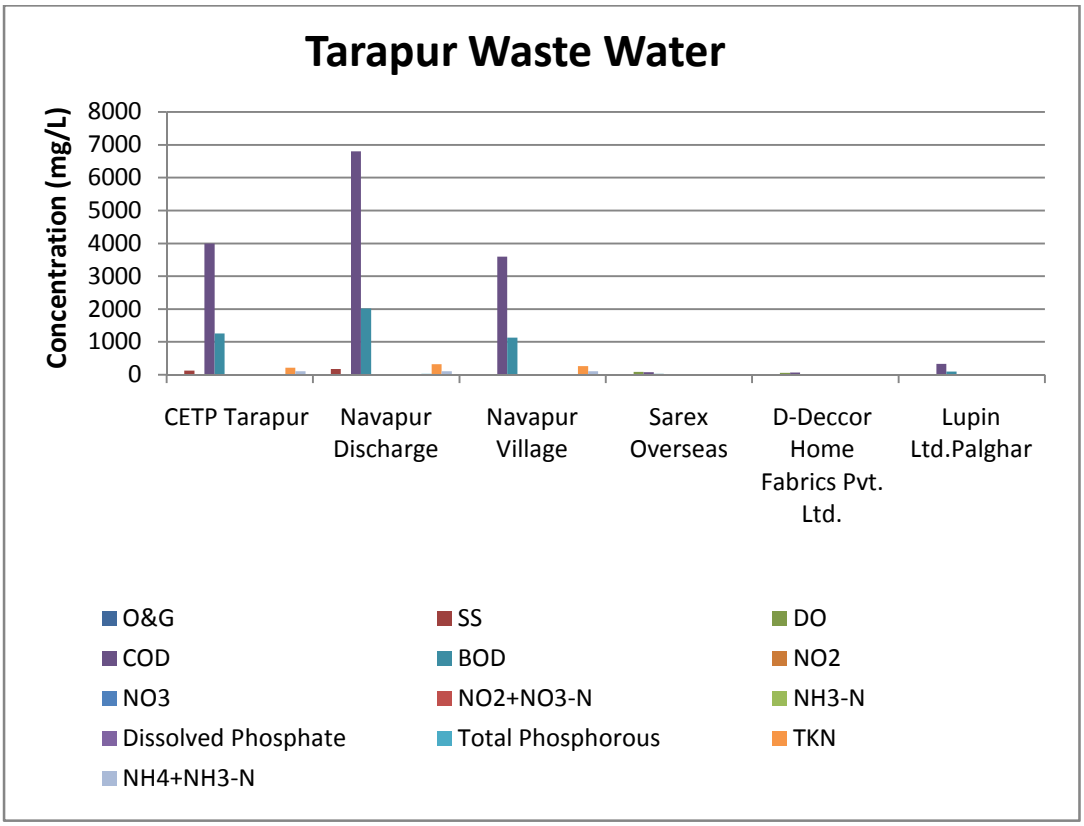
Location				**Sarex Overseas**	**D. Decor**	**Lupin Ltd.**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
11.	Nitrate Nitrogen (as N)	mg/L	10.0	3.32	9.11	1.14
12.	(NO_2 + NO_3)-Nitrogen	mg/L	5.0	3.36	9.23	1.16
13.	Free Ammonia (as NH_3-N)	mg/L	5.0	BDL	BDL	BDL
14.	Total Residual Chlorine	mg/L	1.0	BDL	BDL	BDL
15.	Cyanide (as CN)	mg/L	0.2	BDL	BDL	BDL
16.	Fluoride (as F)	mg/L	2.0	BDL	0.14	BDL
17.	Sulphide (as S^{2-})	mg/L	2.0	1.8	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	5.0	BDL	BDL	BDL
19.	Sodium Absorption Ratio	-		0.48	6.74	0.89
20.	Total Coliforms	MPN index/ 100 mL	100.0	BDL	BDL	BDL
21.	Faecal Coliforms	MPN index/ 100 mL	1000.0	BDL	BDL	BDL
22.	Total Phosphorous (as P)	mg/L	1.0	BDL	BDL	BDL
23.	Total Kjeldahl Nitrogen	mg/L	100.0	0.98	4.15	6.34
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	5.0	BDL	2.88	2.9
25.	Phenols (as C_6H_5OH)	mg/L	3.0	BDL	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L	3.0	BDL	BDL	BDL
27.	Organo Chlorine Pesticides	µg/L	0.1			

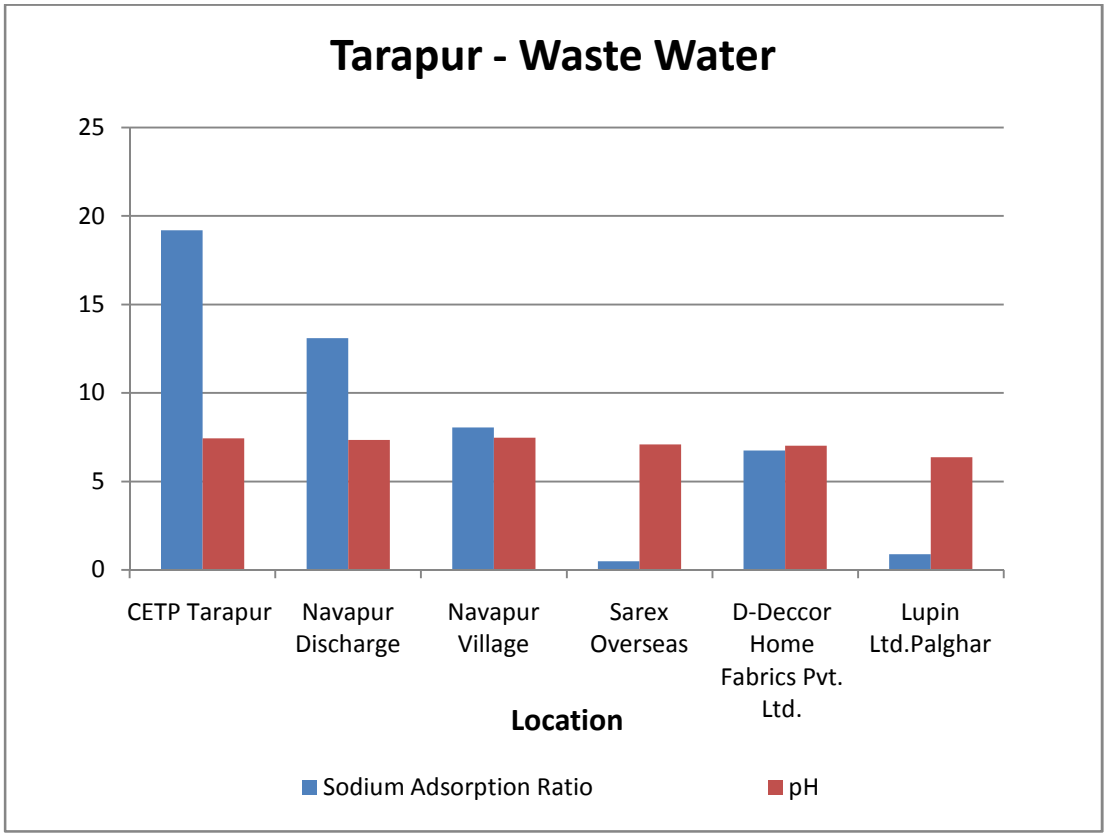
Location				**Sarex Overseas**	**D. Decor**	**Lupin Ltd.**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
i.	Alachlor	µg/L	2.0	BDL	BDL	BDL
ii.	Atrazine	µg/L	0.2	BDL	BDL	0.076
iii.	Aldrin	µg/L	0.1	BDL	BDL	BDL
iv.	Dieldrin	µg/L	2.0	BDL	BDL	BDL
v.	Alpha HCH	µg/L	0.01	0.01	0.013	0.013
vi.	Beta HCH	µg/L	2.0	BDL	BDL	BDL
vii.	Butachlor	µg/L	3.0	BDL	BDL	BDL
viii.	Delta HCH	µg/L	0.2	BDL	BDL	BDL
ix.	p,p DDT	µg/L	0.05	BDL	BDL	BDL
x.	o,p DDT	µg/L	100.0	BDL	BDL	BDL
xi.	p,p DDE	µg/L	250.0	0.01	BDL	0.01
xii.	o,p DDE	µg/L	30.0	0.01	BDL	0.01
xiii.	p,p DDD	µg/L		BDL	BDL	BDL
xiv.	o,p DDD	µg/L		BDL	BDL	BDL
xv.	Alpha Endosulfan	µg/L	10.0	BDL	BDL	BDL
xvi.	Beta Endosulfan	µg/L		BDL	BDL	BDL
xvii.	Endosulfan Sulphate	µg/L	5.0	BDL	BDL	BDL
viii.	Y HCH (Lindane)	µg/L	1.0	BDL	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	µg/L	0.2	0.00009	BDL	0.11

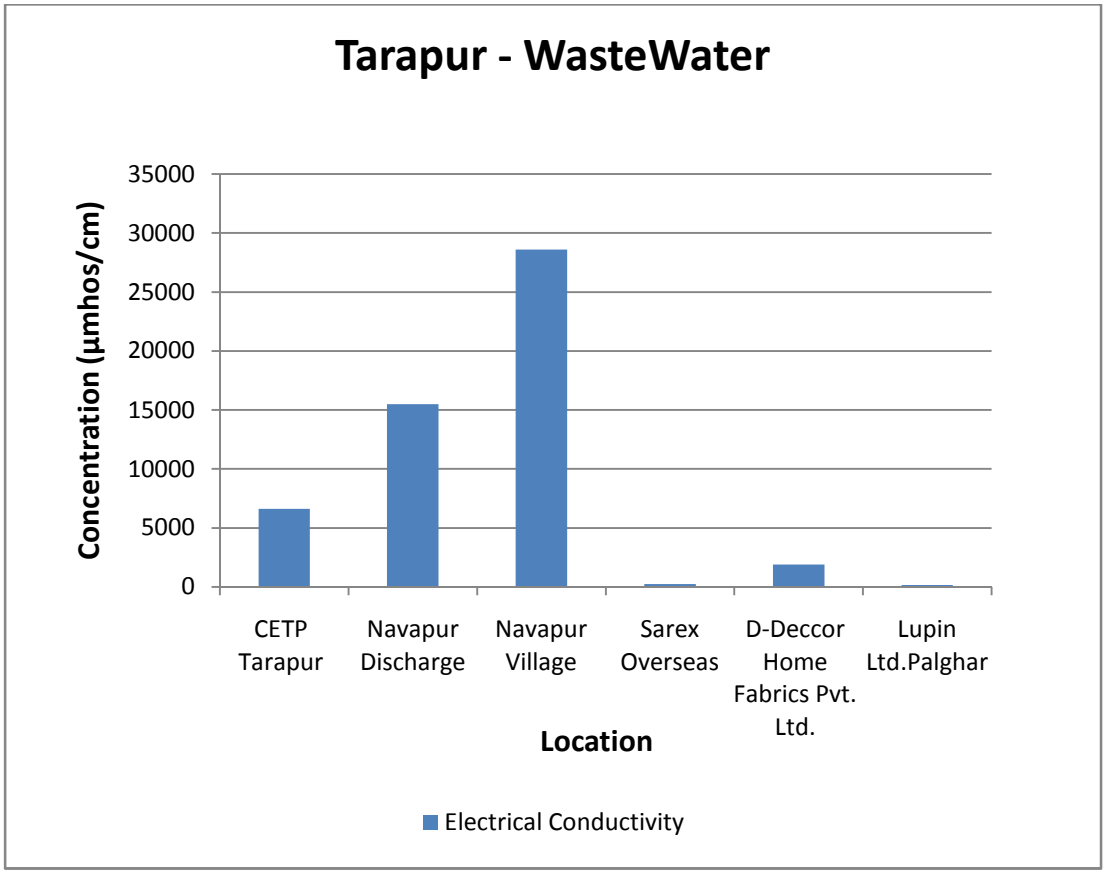
Location				**Sarex Overseas**	**D. Decor**	**Lupin Ltd.**
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
29.	Polychlorinated Biphenyls (PCB)	µg/L	2.0	0.00007	0.00007	0.00007
30.	Zinc (as Zn)	mg/L	5.0	BDL	0.1	BDL
31.	Nickel (as Ni)	mg/L	3.0	0.02	BDL	0.02
32.	Copper (as Cu)	mg/L		0.04	0.04	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	0.1	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	2.0	BDL	BDL	BDL
35.	Total Arsenic (as As)	mg/L	0.2	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	0.1	0.02	BDL	BDL
37.	Cadmium (as Cd)	mg/L	2.0	BDL	BDL	BDL
38.	Mercury (as Hg)	mg/L	0.01	0.004	0.009	0.02
39.	Manganese (as Mn)	mg/L	2.0	BDL	BDL	BDL
40.	Iron (as Fe)	mg/L	3.0	2.26	0.11	0.12
41.	Vanadium (as V)	mg/L	0.2	0.02	BDL	BDL
42.	Selenium (as Se)	mg/L	0.05	BDL	BDL	BDL
43.	Boron (as B)	mg/L		BDL	BDL	0.68
44.	Bioassay Test on fish	% survival	90% survival after 96h in 100%effluent	100	80	100

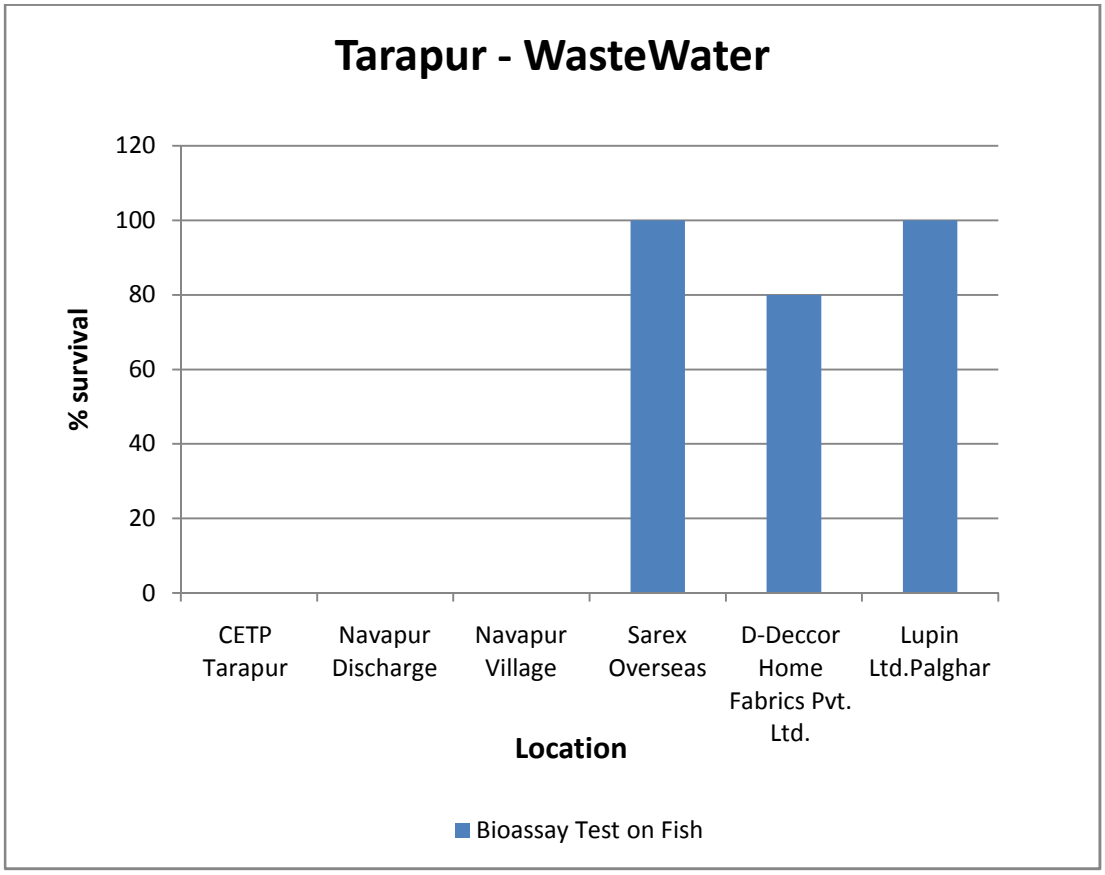
Graphs: Waste Water Monitoring Results:

Note : Total Coliforms and Total Faecal Coliforms in waste water samples are observed Below Detection Limit, hence they are not included into the charts below:






Tarapur - WasteWater
Concentration (µmhos/cm)
35000
30000
25000
20000
15000
10000
5000
0
CETP Tarapur
Navapur Discharge
Navapur Village
Sarex Overseas
D-Deccor Home Fabrics Pvt. Ltd.
Lupin Ltd.Palghar
Location
Electrical Conductivity


Tarapur - WasteWater
% survival
120
100
80
60
40
20
0
CETP Tarapur
Navapur Discharge
Navapur Village
Sarex Overseas
D-Deccor Home Fabrics Pvt. Ltd.
Lupin Ltd.Palghar
Location
Bioassay Test on Fish

3.3.2 Ground Water Analysis Results:

Sr. No.	Locations	Denotation	Included in
1.	Ankush Gharatwadi	A	Table I
2.	Dhodi Pooja Area	B	Table I
3.	Lala Vajpayee Area	C	Table I
4.	Chiku Wadi	D	Table II
5.	Kumbhavali Village	E	Table II
6.	Salvad Village	F	Table II

Table I:

Location				**Ankush Gharatwadi**	**Dhodi Pooja Area**	**Lala Vajpayee Area**
Type				Well Water	Bore Well	Well Water
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
3.	Colour	Hazen	**5**	1	1	1
	Odour		**Agreeable**	Agreeable	Agreeable	Agreeable
6.	pH	-	**6.5-8.5**	6.8	6.71	7.67
7.	Oil & Grease	mg/L	**100**	BDL	BDL	BDL
8.	Suspended Solids	mg/L	**500**	5	5	6
10.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	28	24	30
11.	Biochemical Oxygen Demand (3 days,27°C)	mg/L	**6 (WHO, 1993)**	8.51	7.32	9.43
12.	Electrical Conductivity (at 25°C)	µmhos/ cm	**750**	1531	499	2540

Location				**Ankush Gharatwadi**	**Dhodi Pooja Area**	**Lala Vajpayee Area**
Type				Well Water	Bore Well	Well Water
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
13.	Nitrite Nitrogen (as N)	mg/L		0.08	0.02	<0.01
14.	Nitrate Nitrogen (as N)	mg/L	**45**	8.82	1.71	7.64
15.	(NO_2 + NO_3)-Nitrogen	mg/L	**1.0**	8.9	1.73	7.64
16.	Free Ammonia (as NH_3-N)	mg/L	**0.5**	BDL	BDL	BDL
17.	Total Residual Chlorine	mg/L	**0.2**	BDL	BDL	BDL
18.	Cyanide (as CN)	mg/L		BDL	BDL	BDL
19.	Fluoride (as F)	mg/L	**1**	BDL	0.26	BDL
20.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL	BDL
21.	Dissolved Phosphate (as P)	mg/L		BDL	BDL	BDL
22.	Sodium Absorption Ratio			0.85	1.49	2.25
23.	Total Coliforms	MPN index/ 100 mL	**ND**	BDL	BDL	BDL
24.	Faecal Coliforms	MPN index/ 100 mL	**ND**	BDL	BDL	BDL
25.	Total Phosphorous (as P)	mg/L	**0.5**	0.14	BDL	BDL
26.	Total Kjeldahl Nitrogen	mg/L	**0.001**	0.92	1.04	1.15
27.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.5**	BDL	BDL	BDL
28.	Phenols (as C_6H_5OH)	mg/L	**0.001**	BDL	BDL	BDL

Location				**Ankush Gharatwadi**	**Dhodi Pooja Area**	**Lala Vajpayee Area**
Type				Well Water	Bore Well	Well Water
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
29.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL	BDL
30.	Organo Chlorine Pesticides	µg/L	**0.05**			
i.	Alachlor	µg/L		BDL	BDL	BDL
ii.	Atrazine	µg/L	**2**	0.33	0.47	0.083
iii.	Aldrin	µg/L	**0.03**	0.035	0.036	BDL
iv.	Dieldrin	µg/L	**0.03**	0.063	0.063	BDL
v	Alpha HCH	µg/L	**0.01**	0.13	0.16	0.03
vi.	Beta HCH	µg/L	**0.04**	0.61	0.8	0.15
vii.	Butachlor	µg/L	**125**	0.056	0.066	BDL
viii.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
ix.	p,p DDT	µg/L	**1**	BDL	BDL	BDL
x.	o,p DDT	µg/L	**1**	BDL	BDL	BDL
xi.	p,p DDE	µg/L	**1**	0.065	0.066	0.02
xii.	o,p DDE	µg/L	**1**	0.065	0.066	0.02
xiii.	p,p DDD	µg/L	**1**	0.079	0.077	0.018
xiv.	o,p DDD	µg/L	**1**	0.079	0.077	0.018
xv.	Alpha Endosulfan	µg/L	**0.4**	0.031	0.033	BDL
xvi.	Beta Endosulfan	µg/L	**0.4**	0.13	0.12	BDL
xvii.	EndosulfanSulphate	µg/L	**0.4**	BDL	BDL	BDL

Location				**Ankush Gharatwadi**	**Dhodi Pooja Area**	**Lala Vajpayee Area**
Type				Well Water	Bore Well	Well Water
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
xviii.	Y HCH (Lindane)	µg/L	**2.0**	0.12	BDL	BDL
31.	Polynuclear aromatic hydrocarbons (as PAH)	µg/L	**0.0001**	0.0001	0.0002	0.0002
32.	Polychlorinated Biphenyls (PCB)	µg/L	**0.0005**	0.00007	0.00007	0.00007
33.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL	BDL
34.	Nickel (as Ni)	mg/L	**0.02**	BDL	BDL	BDL
35.	Copper (as Cu)	mg/L	**0.05**	BDL	BDL	BDL
36.	Hexavalent Chromium (as Cr^{6+})	mg/L	**1**	BDL	BDL	BDL
37.	Total Chromium (as Cr)	mg/L	**0.05**	BDL	BDL	BDL
38.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL	BDL
39.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL	BDL
40.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL	BDL
41.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL	BDL
42.	Manganese (as Mn)	mg/L	**0.1**	0.05	0.07	BDL
43.	Iron (as Fe)	mg/L	**0.3**	BDL	BDL	BDL
44.	Vanadium (as V)	mg/L		0.03	0.04	0.05
45.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL	BDL
46.	Boron (as B)	mg/L		BDL	BDL	0.14
47.	Bioassay Test on fish	% survival		100	100	100

Table II

Location				**Chiku Wadi**	**Kumbhavali Village**	**Salvad Village**
Type				Bore Well	Bore Well	Bore Well
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameter**		**Std. Limit**	**Results**		
1.	Colour	Hazen	**5**	1	1	1
2.	Odour		**Agreeable**	Agreeable	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	6.74	7.64	7
4.	Oil & Grease	mg/L	**100**	BDL	BDL	BDL
5.	Suspended Solids	mg/L	**500**	5	5	6
6.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	31	24	27
7.	Biochemical Oxygen Demand (3 days,27°C)	mg/L	**6 (WHO, 1993)**	9.44	7.32	8.23
8.	Electrical Conductivity (at 25°C)	µmhos/ cm	**1000**	3230	444	987
9.	Nitrite Nitrogen (as N)	mg/L		0.05	BDL	BDL
10.	Nitrate Nitrogen (as N)	mg/L	**45**	6.21	2.33	4
11.	$(NO_2 + NO_3)$-Nitrogen	mg/L	**1.0**	6.26	2.33	4
12.	Free Ammonia (as NH_3-N)	mg/L	**0.5**	BDL	BDL	BDL
13.	Total Residual Chlorine	mg/L	**0.2**	BDL	BDL	BDL
14.	Cyanide (as CN)	mg/L		BDL	BDL	BDL
15.	Fluoride (as F)	mg/L	**1**	0.34	0.42	0.44
16.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL	BDL
17.	Dissolved Phosphate (as P)	mg/L		BDL	BDL	BDL

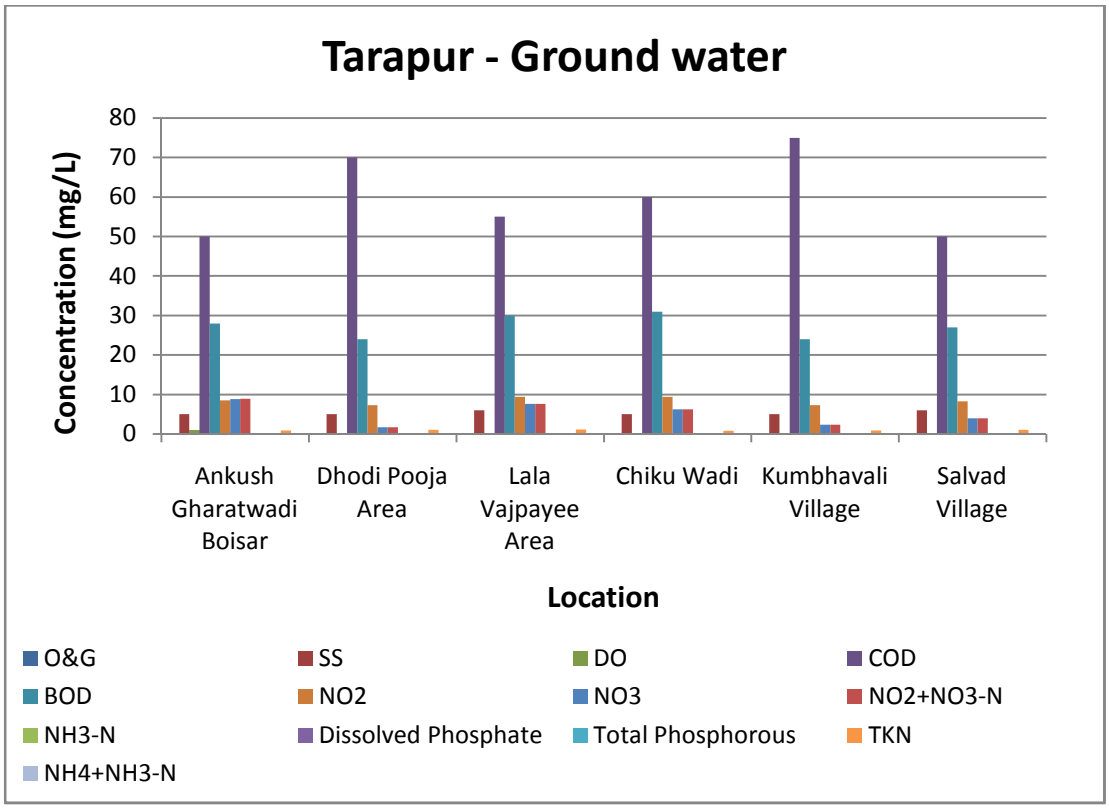
Location				**Chiku Wadi**	**Kumbhavali Village**	**Salvad Village**
Type				Bore Well	Bore Well	Bore Well
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameter**		**Std. Limit**	**Results**		
18.	Sodium Absorption Ratio			0.64	1.21	1.08
19.	Total Coliforms	MPN index/ 100 mL	**ND**	BDL	BDL	BDL
20.	Faecal Coliforms	MPN index/ 100 mL	**ND**	BDL	BDL	BDL
21.	Total Phosphorous (as P)	mg/L	**0.5**	BDL	BDL	BDL
22.	Total Kjeldahl Nitrogen	mg/L	**0.001**	0.81	0.92	1.04
23.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.5**	BDL	BDL	BDL
24.	Phenols (as C_6H_5OH)	mg/L	**0.001**	BDL	BDL	BDL
25.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL	BDL
26.	Organo Chlorine Pesticides	µg/L	**0.05**			
i.	Alachlor	µg/L		BDL	BDL	BDL
ii.	Atrazine	µg/L	**2**	0.046	0.058	0.025
iii.	Aldrin	µg/L	**0.03**	BDL	BDL	BDL
iv.	Dieldrin	µg/L	**0.03**	BDL	BDL	BDL
v	Alpha HCH	µg/L	**0.01**	0.02	0.017	BDL
vi.	Beta HCH	µg/L	**0.04**	0.094	0.081	0.064
vii.	Butachlor	µg/L	**125**	BDL	BDL	BDL

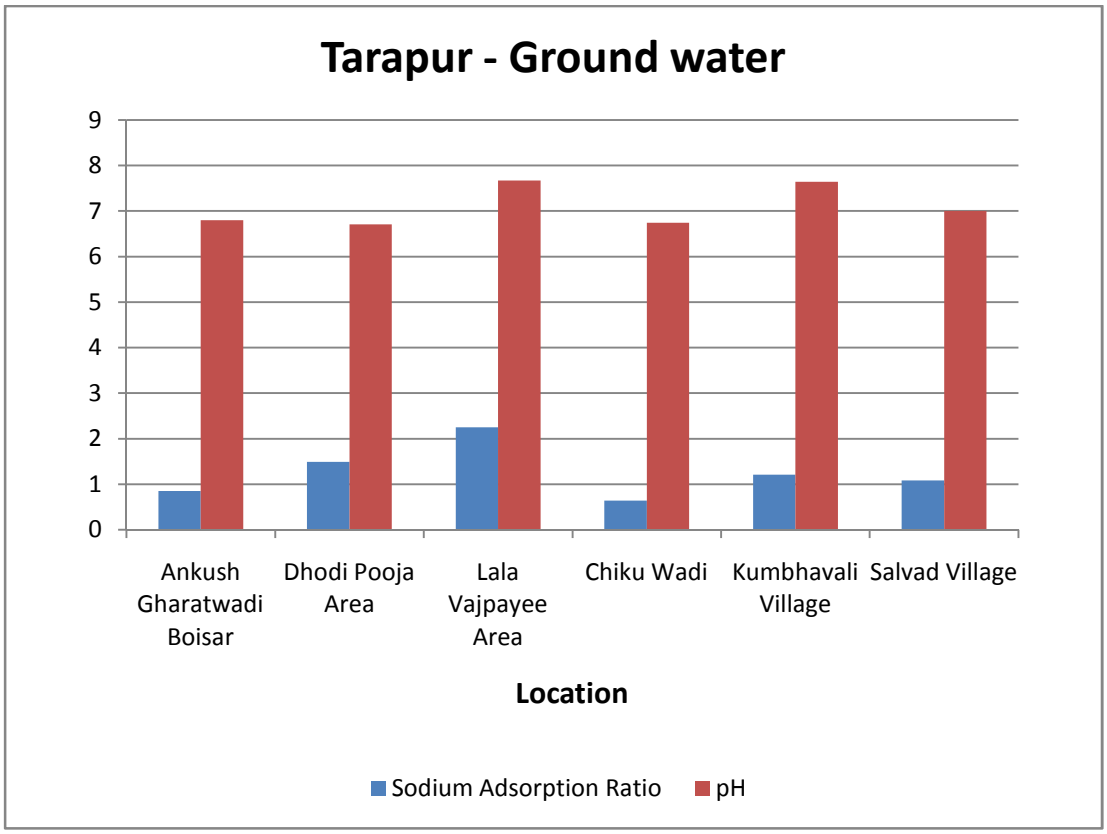
Location				**Chiku Wadi**	**Kumbhavali Village**	**Salvad Village**
Type				Bore Well	Bore Well	Bore Well
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameter**		**Std. Limit**	**Results**		
viii.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
ix.	p,p DDT	µg/L	**1**	BDL	BDL	BDL
x.	o,p DDT	µg/L	**1**	BDL	BDL	BDL
xi.	p,p DDE	µg/L	**1**	0.016	0.019	0.015
xii.	o,p DDE	µg/L	**1**	0.016	0.019	0.015
xiii.	p,p DDD	µg/L	**1**	0.015	0.016	0.013
xiv.	o,p DDD	µg/L	**1**	0.015	0.016	0.013
xv.	Alpha Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
xvi.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
xvii.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL	BDL
xviii.	Y HCH (Lindane)	µg/L	**2.0**	BDL	BDL	BDL
31.	Polynuclear aromatic hydrocarbons (as PAH)	µg/L	**0.0001**	0.0003	0.0002	0.0008
32.	Polychlorinated Biphenyls (PCB)	µg/L	**0.0005**	0.00007	0.00007	0.00007
33.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL	BDL
34.	Nickel (as Ni)	mg/L	**0.02**	BDL	BDL	0.03
35.	Copper (as Cu)	mg/L	**0.05**	BDL	BDL	BDL
36.	Hexavalent Chromium (as Cr^{6+})	mg/L	**1**	BDL	BDL	BDL
37.	Total Chromium (as Cr)	mg/L	**0.05**	BDL	BDL	BDL

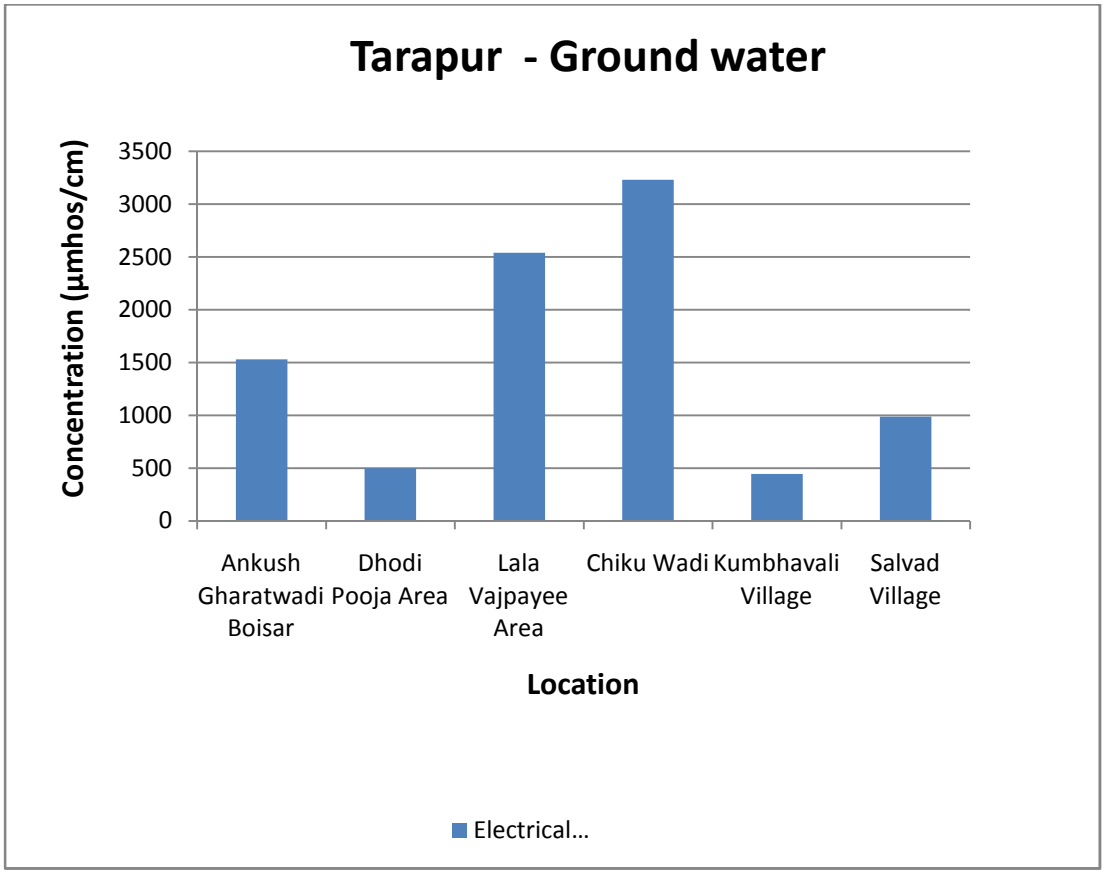
Location				**Chiku Wadi**	**Kumbhavali Village**	**Salvad Village**
Type				Bore Well	Bore Well	Bore Well
Date of Sampling [XX/02/2017]				**23**	**23**	**23**
Sr.	**Parameter**		**Std. Limit**	**Results**		
38.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL	BDL
39.	Lead (as Pb)	mg/L	**0.01**	0.03	BDL	BDL
40.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL	BDL
41.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL	BDL
42.	Manganese (as Mn)	mg/L	**0.1**	1.09	BDL	BDL
43.	Iron (as Fe)	mg/L	**0.3**	BDL	BDL	BDL
44.	Vanadium (as V)	mg/L		0.03	0.03	0.03
45.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL	0.008
46.	Boron (as B)	mg/L	**1.0-5.0**	5.06	BDL	BDL
47.	Bioassay Test on fish	% survival		100	100	100

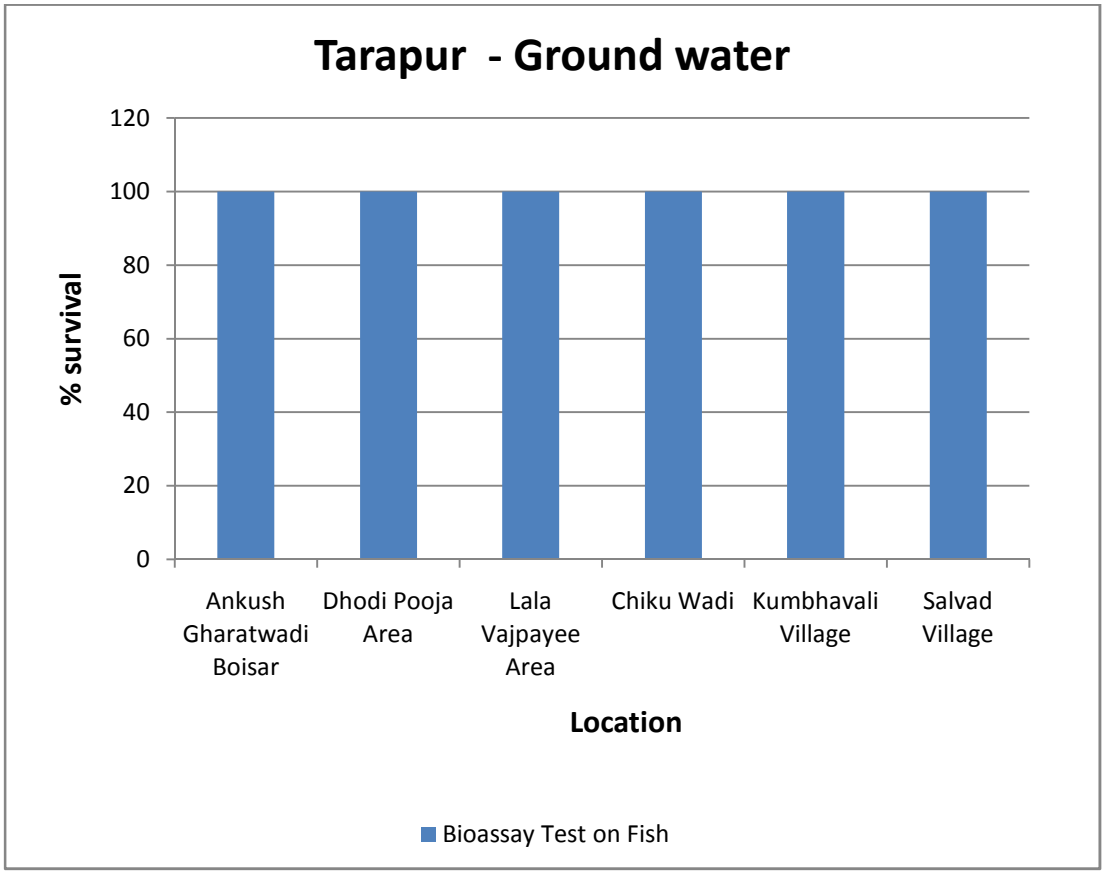
Graphs: Ground Water Monitoring Results:

Note : Total Coliforms and Total Faecal Coliforms in waste water samples are observed Below Detection Limit, hence they are not included into the charts below:






Tarapur - Ground water
Concentration (µmhos/cm)
3500
3000
2500
2000
1500
1000
500
0
Ankush Gharatwadi Boisar
Dhodi Pooja Area
Lala Vajpayee Area
Chiku Wadi
Kumbhavali Village
Salvad Village
Location
Electrical...


Tarapur - Ground water
% survival
120
100
80
60
40
20
0
Ankush Gharatwadi Boisar
Dhodi Pooja Area
Lala Vajpayee Area
Chiku Wadi
Kumbhavali Village
Salvad Village
Location
Bioassay Test on Fish

4 Summary of the Results

Based on the study done, the results are summarised and concluded as follows:

4.1 Stack Emission Monitoring:

In Tarapur, six different stacks were monitored at Bombay Rayon fashion Ltd., D. Decor, Akry Organics, Balkrishana Synthetics, Angatpal Industries and Lupin Ltd. Results show that particulate matter as well as sulphur dioxide, both are below the standard limits. All the values of Particulate matter is observed below standard limit. It is ranged from 12 to 84 mg/Nm^3 and sulphur dioxide in the range of <5 to 105mg/Nm^3. However, the nitrogen dioxide is observed is observed with minimum concentration 64.2 mg/Nm^3 at Lupin Ltd. and maximum at D Decor Ltd. (518 mg/Nm^3)

4.2 Ambient Air Monitoring:

At Tarapur, ambient air quality was monitored at six locations namely: MIDC Office Bhoisar, Lupin Ltd., Viraj Profile, Government Hospital, Sarvali Village and Kolwade Village. At all these places 12 parameters of ambient air quality standards were monitored along with Volatile Organic Compounds.

1) **Suphur dioxide (SO_2):** All the results for SO_2 are observed lower than the standard limit of 80 µg/m^3.It is observed below the detection limit (<4 µg/m^3) at MIDC Office and Sarvali Village locations. Maximum concentration 8.44 µg/m^3 is observed at Government Hospital.

2) **Nitrogen Dioxide (NO_x):** It varies between 4.81µg/m^3 and 65.6µg/m^3 at MIDC Office and Government Hospital Bhoisar respectively, which is also below the standard 80µg/m^3.

3) **Particulate Matter (PM_{10}):** It is found most critical parameter as all the readings of PM_{10} exceed the standard limit of 100µg/m^3. Minimum of 239 µg/m^3 is obtained at Lupin Ltd. and maximum of 608µg/m^3 at Government Hospital, Bhoisar.

4) **Particulate Matter ($PM_{2.5}$):** Concentration of $PM_{2.5}$ also shows almost same pattern as PM_{10}. Its value at all the stations except one (Lupin Ltd. with 52 µg/m^3) also exceed the standard limit of 60 µg/m^3. It is observed in the range of 52 to 145µg/m^3.

5) **Ozone (O_3):** All values of O_3 recorded below the detection limit except at Government Hospital, where it is observed as 44.3 µg/m^3.

6) **Lead (Pb):** Lead is categorised as known human carcinogen by CPCB. In our results, **c**oncentration of Lead is found below the standard limit ranging from 0.07 to 0.19µg/m^3 at all the locations, except at Government Hospital (3.61 µg/m^3), where sample is found to exceed the standard (1.0µg/m^3)

7) **Carbon Monoxide (CO):** Values of Carbon Monoxide are also observed below standard limit at all the studied locations. It is observed 1.18 mg/m^3 at MIDC Office Bhoisar, 1.39µg/m^3 at Lupin Ltd. and 2.45µg/m^3 at Viraj Profile. Samples for rest of the three locations are not received.

8) **Ammonia (NH_3):** Out of all, three locations are found to have ammonia concentration below the detection limit and other three are observed with a range of 43 to 71.3 µg/m^3.

9) **Benzene:** Benzene falls under group C category, which includes known carcinogens. Study shows that all the locations has <1 µg/m^3 benzene concentration i.e. below the standard limit (5µg/m^3).

10) **Benzo (a) Pyrene (BaP):** All values recorded below the detection limit.

11) **Arsenic:** Arsenic values are also observed well below the detection limit.

12) **Nickel:** All the values are observed below the standard limit of 20ng/m^3 in the range of 13.7 to 20.0ng/m^3.

4.3 Waste Water Quality:

Six samples of ETP outlet and inlet were collected from different industries namely (i) CETP outlet (ii) Navapur Discharge, CETP Inlet (iii) Navapur Village (iv) Sarex Overseas (iv) D Decor Home Fabrics Pvt. Ltd. (v) Lupin Ltd.

1) **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 6.36 to 7.47.

2) **Oil and Grease:** All values within the acceptable range.

3) **Suspended Solids:** Except CETP outlet (125mg/L) and CETP inlet (175mg/L), remaining four samples of different locations are found within the acceptable limits.

4) **Chemical Oxygen Demand:** Chemical Oxygen Demand is found above the standards of 250mg/L at four locations ranging from 330 to 6800mg/L. However, at Sarex Overseas (80mg/L) and D Decor Ltd. (70mg/L) samples are observed within the standard limit.

5) **Biochemical Oxygen Demand:** Biochemical Oxygen demand also exhibits the same picture as COD. This is recorded highest (2013mg/L) at CETP inlet and minimum at D Decor (21.3mg/L).

6) **Total Kjeldahl nitrogen:** CETP outlet (213mg/L), CETP inlet (323mg/L) and Navapur village CETP outlet (268mg/L), all three exhibit value of TKN beyond standard limit (100mg/L).

7) **Total Ammonia:** All values of total ammonia exhibit below standard limit in the range of <0.1 to 98.1 mg/L.

8) **Metals:** All metals like Iron, Arsenic, Nickel, Copper, Hexavalent Chromium (Cr^{6+}) are observed either below detection limit or below their standard limits.

9) **Fish Bioassay:** Fish bioassay exhibits 0-100% survival. CETP outlet, CETP inlet and Navapur village, these 3 water samples has NIL (0%) survival.

Following parameters meet the criteria as prescribed by CPCB.

1) **Total Residual Chlorine**
2) **Cyanide**
3) **Fluoride**
4) **Sulphide**
5) **Dissolved Phosphate**
6) **Total Ammonical Nitrogen**
7) **Phenolic compounds**

4.4 Ground Water Quality:

Six Borewell samples were collected from different locations namely: (i) Ankush Gharatwadi (ii) Dhodi Pooja Area (3) Lala Vajpayee (iv) Chiku Wadi (v) Kumbhavali Village (vi) Salvad Village

1) **Colour** (Hazen Units): Colour units are below the acceptable standard.

2) **Odour** of the sample is agreeable.

3) **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 6.71 to 7.67.

4) **Chemical Oxygen Demand:** All the samples were detected above standard limits of 10mg/L set by WHO. It is ranged from 24 to 31mg/L.

5) **Biological Oxygen Demand:** BOD samples also followed the similar pattern as COD samples. All the samples are detected above the standard limit of 6mg/L (WHO, 1993). It is ranged from 7.32 to 9.44mg/L.

Following are the parameters which are compared with 10500:2012 Drinking water specifications.

1) **Nitrite**: Values of Nitrite are at below detection level.

2) **Nitrate:** Nitrate value ranged between 1.71 mg/L and 8.82mg/L. Nitrate concentrations are below the acceptable standards of IS 10500:2012.

3) **Residual Free Chlorine**: Values are below the acceptable standards.

4) **Total Ammonia**: is within the acceptable range.

5) **Cyanide:** Concentration of cyanide in all the bore well water is very much below the standard.

6) **Fluoride:** All the values are observed below standard limit. It is ranged from <0.05 to 0.44mg/L.

7) **Sulphide:** Analytical values are below the detection limits and below the standards.

8) **Sodium Absorption Ratio:** These values fit within range of water quality criteria of CPCB.

9) **Electrical Conductivity:** As per the water quality criteria of CPCB, water samples exceed the limit of electrical conductivity at Ankush Gharatwadi, Lala Vajpayee, Chiku Wadi and Salvad Village

10) **Boron:** Chikkuwadi bore well water exceeds the limit showing the concentration of 1.09mg/L.

11) **Metals:** Metals like Copper, Total Chromium, Lead, Arsenic, Cadmium and Mercury are well within the acceptable limits of drinking water standards.

12) **PAH & PCB** are also below the acceptable limits.

5 CEPI Score:

Comprehensive Environmental Pollution Index (CEPI) is intended to act as early warning tool which helps in categorization of industrial clusters/areas in terms of priority of needing attention.

Based on Sub-index Score (score of individual environmental component like air, water etc.):

- **Score more than 63:** A Critical Level of Pollution in the respective level of environmental component
- **Score between 51-63:** Severe to critical level of pollution with reference to respective environmental component

Cut-off Score

- **Score 50:** Severely Polluted Industrial Clusters/areas
- **Score 60:** Critically Polluted Industrial Clusters/areas

Based on Aggregated CEPI Score **(**score includes sub-index score of all individual environmental components together):

- **Aggregated CEPI score >70:**Critically polluted areas
- **Aggregated CEPI score between 60-70 :** Severely polluted areas

Below given Table shows aggregated CEPI of present report in comparison with the CEPI Score 2013 and CPCB report (2009).

1. CEPI score by CPCB in 2009

2. CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)

3. CEPI score MPCB 2016 this report (considering all parameters)

4. CEPI score MPCB 2017, this report (considering all parameters)

The result shows that CEPI score of present report is 67.67. This is higher than the CEPI score of 2016 studies (65.51), but lower than the CEPI score 2013 (85.01).

The higher CEPI score in the present study as compared to the 2016 score is may be due to the time period when sampling was done. In 2016, sampling was carried out in monsoon season (July month) and this time it was done in post monsoon (February month). It is proved that in monsoon season, pollutants load gets decreased in air as well as in water bodies due to dilution and in post monsoon season, it again gets increased or comes to normal. This has resulted in lower CEPI score in 2016 and again increase in 2017 score.

However, it should also be noticed over here that MPCB's efforts through the formulation of action plans decreased the overall concentration of pollutants in all aspects i.e. air, land and water in Tarapur area in past three years. This has also resulted in decreased score of CEPI now.

Comparison of CEPI scores of 2013 and 2017 reports:

Results show that present CEPI score (74.58) of Tarapur city considering all revised standards and parameters has decreased a lot if compared with the CEPI Score of 2013 (85.01) report. This clearly indicates the successful application of STAP and LTAP of MPCB which resulted in a cleaner environment of Tarapur city in past three years.

Detailed results of Air, Water and Land are given below:

Air:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Present Report 2017	2	5	10	6	3	3	12	3	3	5	14	10	**46**
CEPI Score 2016	4	5	20	6	3	3	12	3	3	5	14	10	**56**
CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)	6	5	30	8	3	3	14	3	5	5	20	10	**74**
CPCB Report 2009	5.75	5.0	28.75	2.0	3	3	8	3	3	5	14	10	**60.75**

Water:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Present Report 2017	1	5	5	8	3	3	14	5	5	0	25	15	**59**
CEPI Score 2016	1	5	5	8	0	3	11	3	5	0	15	15	**46**
CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)	4	5	20	8	0	3	11	3	3.75	0	11.25	15	**57.25**
CPCB Report 2009	3	5	15	8	0	3	11	3	5	0	15	15	**56**

Land:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Present Report 2017	1	5	5	8	0	3	11	3	5	0	15	15	**46**
CEPI Score 2016	1	5	5	6	3	3	12	5	3	0	15	15	**47**
CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)	4	5	20	8	3	3	14	5	5	0	25	15	**74**
CPCB Report 2009	3	5	15	7.75	3	3	13.75	5	1.5	0	7.5	15	**51.25**

Aggregated CEPI:

	Air index	Water Index	Land Index	CEPI
Present Report 2017	46	59	46	**67.67**
CEPI Score 2016	56	46	47	**65.51**
CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)	74	57.25	74	**85.01**
CPCB Report 2009	60.75	51.25	56	**72.01**

6 Conclusions

Present study shows the characteristics and status of environmental pollution caused by different industrial clusters of Tarapur city. It shows that the concentration of pollutants in air, ground water and surface water is lowered down as compared to past studies, as most of the results are observed below their standards with an exception of one or two parameters. Among all the sampling locations, Alok Nalla is found the most critical location in view of pollution in all the environmental components i.e. Air, Water and Land.

Parameters of air sampling are observed within the standard limit except PM_{10} and $PM_{2.5}$ as compared to their standards at almost all the sampling locations. Also, O_3 is also observed higher than the standard limit at Government Hospital Area.

Among waste water samples, BOD and COD of CETP Inlet and CETP outlet samples are found beyond standard limit. Kjeldahl nitrogen is also observed higher in these samples.

All the ground water samples are found within the limits except BOD and COD of all the water samples, which are observed above standard limits.

Moreover, the lower value (67.67) of Comprehensive Environmental Pollution Index (CEPI) in the present study as compared to past few years study also reveals the fact that the environmental pollution in this city is substantially decreased over the period of times. To achieve this target, improvement in conventional practice and procedures adopted by the industries coupled with initiatives taken by Maharashtra Pollution Control Board played a major role. Although, a decrease in environmental pollution is observed, but still there is lot of scope to improve the environmental quality of the city, for which continuous efforts, strategies, planning and actions are required.

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Air Index	2	5	10	6	3	3	12	3	3	5	14	10	**46**
Water Index	1	5	5	8	3	3	14	5	5	0	25	15	**59**
Land Index	1	5	5	8	0	3	11	3	5	0	15	15	**46**
Aggregated CEPI													**67.67**

7 Efforts Taken For the Abatement and Control of Pollution

The regional office of Maharashtra pollution control board has taken various initiatives in reducing the CEPI Score of 85.01 of 2013 to 67.67 of 2017. Below mentioned are some of the efforts:

a) Expansion of TEPS-CETP from existing 25 MLD to 37 MLD

b) Due to various measures taken by the industries solvent recovery improved. And following industries has taken measures

- M/s. Arti Drugs Ltd, Plot No. N-198, MIDC Tarapur, Tal.Palghar. This industry has developed new technology for the recovery of ammonium sulphate 2000 Mt/month by unit operation like evaporation, crystallization. Earlier the same was treated in their ETP.
- M/s Camlin Fine Chemicals. Ltd., Plot No. D, MIDC Tarapur has segregated of high COD stream.

- M/s. Arti Industries Ltd., Plot No E-50, has installed zero discharge plant such as incineration high COD.
- M/s Lupin Limited Plt No. T-142 MIDC, Tarapur has provided Anaerobic Digestor for segregated effluents.

c) Board has informed CHWTSDF to increase the frequency of collecting of HW and its transportation.
d) MIDC is carrying out massive tree plantation program on empty/ reserved plots, and on boundary of MIDC. 4500 nos of trees have been distributed by MIDC to TIMA.
e) Replacement of RCC drainage by HDPE within MIDC area.
f) Five nos of industries has started and recycling 50 % of their treated effluent i.e 1604.5 CMD • 7 No. of Textile industries has provided zero discharge system and recycling about 2434 CMD

8. Photographs

Arky Organics- Stack

Lupin Ltd. – Stack

Balkrishna Synthetics – Stack

Bombay Rayon –Stack

D Decor Pvt. Ltd. – Stack

Kolade Village – Ambient Air Monitoring

Sarvali Village – Ambient Air Monitoring

CETP Inlet

CETP Outlet

D Decor Pvt. Ltd.- ETP Outlet

Government Hospital, Boisar-Ambient Air Monitoring

Ankush Gharatwadi – Groundwater Sampling

Chiku Wadi – Ground Water Sampling

DhodiPooja – Ground Water Sampling

Kumbavali Village – Groundwater Sampling

Lala Vajpayee Area – Groundwater Sampling

Salvad Village – Ground Water Sampling

Lupin Ltd. – Ambient Air Monitoring

Lupin Ltd. – Water Sampling

MIDC Office – Ambient Air Monitoring

Navapur Discharge

Navapur Discharge

Sarex Overseas ETP Outlet

Viraj Profile- Ambient Air Monitoring

Sarvali Village- Ambient air Monitoring

9. References

1. Criteria for Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/4/2009-10
2. Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/5/2009-10
3. Action Plan for Industrial Cluster:Chandrapur,November 2010,MPCB
4. Action Plan for Industrial Cluster:Dombivali,November 2010,MPCB
5. Action Plan for Industrial Cluster:Aurangabad,November 2010,MPCB
6. Action Plan for Industrial Cluster:NaviMumbai,November 2010,MPCB
7. Action Plan for Industrial Cluster:Tarapur,November 2010,MPCB
8. Standard Methods for the Examination of Water and Waste Water, American Public Health Association, 22nd Edition, 2012.
9. IS 3025 (various parts)
10. www.mpcb.gov.in
11. www.cpcb.gov.in

10. Annexures

Annexure I : Stack Emission Sampling and Analysis Methodology

Sr.	Parameters	Method References	Techniques	Detection Limit
1.	Acid Mist (as Sulphuric Acid)	US EPA Method no.m-8	Barium thorine titration Method	0.6 mg/Nm^3
2.	Ammonia	IS 11255 (Part 6):1999, Reaffirmed 2003	Titration/Nessler Reagent / Spectrophotometric Method	1 mg/Nm^3
3.	Carbon Monoxide	USEPA Method 10B	GC-FID Method	0.2 mg/Nm^3
4.	Chlorine	US EPA Method 26 for sampling	Titrimetric	0.001 mg/Nm^3
5.	Fluoride (Gaseous)	US EPA Method 13 A	SPADNS Zirconium Lake Spectrophotometric Method	0.025 mg/Nm^3
6.	Fluoride (Particulate)	US EPA Method 13 A	SPADNS Zirconium Lake Spectrophotometric Method	0.005 mg/Nm^3
7.	Hydrogen Chloride	US EPA Method 26 for sampling	Titrimetric	0.25 mg/Nm^3
8.	Hydrogen Sulphide	IS 11255 (Part 4):1985	Titrimetric	1 mg/Nm^3
9.	Oxides of Nitrogen	IS 11255 (Part 7): 2005	PDSA Colorimetric Method	10 mg/Nm^3
10.	Oxygen	IS 13270 : 1992	ORSAT Apparatus	1 %
11.	Poly Aromatic Hydrocarbons (Particulate)	IS 5182 (Part 12) : 2004, Reaffirmed 2009 CPCB Guidelines, May 2011, Page No.39	GC-FID Method	0.25 mg/Nm^3
12.	Suspended Particulate Matter	IS 11255 (Part 1):1985, Reaffirmed 2003	Gravimetric Method	10 mg/Nm^3
13.	Sulphur Dioxide	IS 11255 (Part	Titrimetric IPA	5.0mg/Nm^3

Sr.	Parameters	Method References	Techniques	Detection Limit
		2): 1985, Reaffirmed 2003	thorine Method	0.02kg/day
14.	BTX (Benzene, Toluene, Xylene)	NIOSH (NMAM) 1501	Adsorption and Desorption followed by GC-FID analysis	0.001 mg/Nm^3
15.	VOC (Volatile Organic Compounds)	NIOSH (NMAM) 1501 for sampling	Adsorption and Desorption followed by GC-FID or GC/MS analysis	-
i	Methyl Isobutyl Ketone	-	-	0.001 mg/Nm^3
ii	Benzene	-	-	0.001 mg/Nm^3
iii	Toluene	-	-	0.001 mg/Nm^3
iv	Xylene	-	-	0.001 mg/Nm^3
v	Ethyl Benzene	-	-	0.001 mg/Nm^3
vi	Ethyl Acetate	-	-	0.001 mg/Nm^3

Annexure II: Ambient Air Sampling and Analysis Methodology

Sr.	Parameters	Method References	Techniques	Detection Limit
1.	Sulphur Dioxide (SO_2)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.1	Improved West &Gaeke Method	4 µg/m^3
2.	Nitrogen Dioxide (NO_2)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.7	Modified Jacob &Hochheiser Method	3 µg/m^3
3.	Particulate Matter (size less than 10 µm) or PM_{10}	CPCB Guidelines for the Measurement of Ambient Air Pollutants,Volume I, May 2011, Page No.11	Gravimetric Method	2 µg/m^3
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 15	Gravimetric Method	0.4 µg/m^3
5.	Ozone (O_3)	APHA, Method No. 820, Page no. 836	Chemical Method	19.6 µg/m^3
6.	Lead (Pb)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.02 µg/m^3
7.	Carbon Monoxide (CO)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume II, May 2011, Page No. 16	Non Dispersive Infra Red (NDIR) spectroscopy	0.05 mg/m^3
8.	Ammonia (NH_3)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 35	Indophenol Blue Method	4.0µg/m^3
9.	Benzene (C_6H_6)	IS 5182 (Part 11):2006	Adsorption and Desorption followed by GC-FID analysis	1.0 µg/m^3

Sr.	Parameters	Method References	Techniques	Detection Limit
10.	Benzo (a) Pyrene (BaP) – particulate phase only,	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 39	Solvent extraction followed by GC-FID analysis	0.2 ng/m^3
11.	Arsenic (As)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.3ng/m^3
12.	Nickel (Ni)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	3.0ng/m^3

Annexure III: Water/Wastewater Sampling and Analysis Methodology

Sr.	Parameters	Methods References	Techniques	Detection Limit
1.	Sampling Procedure for Chemical Parameters	IS 3025 (Part 1): 1987, Reaffirmed 1998, Amds.1& APHA, 22nd Ed., 2012, 1060 B, 1-39	-	-
2.	Sampling Procedure for Microbiological Parameters	APHA, 22nd Ed., 2012,1060 B, 1-39, 9040, 9-17, and 9060B, 9-35	-	-
3.	Temperature	APHA, 22nd Ed., 2012, 2550-B, 2-69	By Thermometer	-
4.	Colour	APHA, 22nd Ed., 2012 , 2120-B, 2-26	Visible Comparison Method	1 Hazen Unit
5.	Odour	IS 3025 (Part 5): 1983, Reaffirmed 2006	Qualitative Method	-
6.	pH	APHA, 22nd Ed., 2012, 4500-H^+- B, 4-92	By pH Meter	1
7.	Oil & Grease	APHA, 22nd Ed., 2012, 5520-B, 5-40	Liquid -liquid Partition-Gravimetric Method	1.0 mg/L
8.	Suspended Solids	IS 3025(Part 17): 1984, Reaffirmed 2006,Amds.1	Filtration /Gravimetric Method	5.0 mg/L
9.	Dissolved Oxygen	IS 3025(Part 38): 1989, Reaffirmed 2009	Iodometric Method-Azide modification	0.05 mg/L
10.	Chemical Oxygen Demand	APHA,22nd Ed., 2012 , 5220-B, 5-17	Open Reflux Method	5.0 mg/L
11.	Biochemical Oxygen Demand	IS 3025(Part 44): 1993,Reaffirmed 2009,Amds.1	Iodometric Method	5.0 mg/L
12.	Electrical Conductivity	APHA, 22nd Ed., 2012, 2510- B, 2-54	By Conductivity Meter	0.1 µmho/cm
13.	Nitrite-Nitrogen	APHA, 22nd Ed., 2012, 4500-NO_2-B, 4-120	Colorimetric Method	0.006 mg/L
14.	Nitrate-Nitrogen	APHA,22nd Ed.,2012	UV Spectrophotome	0.2 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
		,4500-NO_3,B-4-122	ter Screening Method	
15.	(NO_2 + NO_3)-Nitrogen	APHA, 22nd Ed., 2012, 4500-NO_2-B, 4-120 APHA,22nd Ed.,2012,4500-NO_3,B-4-122	Colorimetric Method UV Spectrophotometer Screening Method	0.2 mg/L
16.	Free Ammonia	APHA, 22nd Ed., 2012 , 4500 NH_3, F, 4 -115	Colorimetric Method	0.006 mg/L
17.	Total Residual Chlorine	IS 3025 (Part 26) :1986 , Reaffirmed 2009, Ed. 2.1(2004-02)	Iodometric Method	0.1 mg/L
18.	Cyanide (CN)	APHA, 22nd Ed., 2012 ,4500-CN, C & E, 4-41 & 4-43	Colorimetric Method	0.001 mg/L
19.	Fluoride (F)	APHA, 22nd Ed., 2012, 4500-F^-, D, 4-87	SPADNS Method	0.05 mg/L
20.	Sulphide (S^{2-})	APHA, 22nd Ed., 2012, 4500 –S^2 , C-4-175, F-4-178	IodometricMethod	0.08 mg/L
21.	Dissolved Phosphate (P)	APHA,22nd Ed., 2012 , 4500 P,E, 4-155	Ascorbic Acid Method	0.03 mg/L
22.	Sodium Absorption Ratio	IS11624 :1986, Reaffirmed 2006	By Calculation	0.3
23.	Total Phosphorous (P)	APHA,22nd Ed., 2012 , 4500 P,E, 4-155	Ascorbic Acid Method	0.03 mg/L
24.	Total Kjeldahl Nitrogen	APHA, 22nd Ed., 2012, 4500 NH_3, B & C, 4 -110, 4-112	Titrimetric Method	0.1 mg/L
25.	Total Ammonia (NH_4 +NH_3)-Nitrogen	APHA,22d Ed., 2012 , 4500 NH_3, F, 4 -115	Colorimetric Method	0.001 mg/L
26.	Phenols (C_6H_5OH)	APHA,22nd Ed., 2012 , 5530- B & C, 5-44 & 5-47	Chloroform Extraction Method	0.001 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
27.	Surface Active Agents	APHA,22nd Ed., 2012 , 5540-B & C,5-50	Methylene Blue Extraction Method	0.1 mg/L
28.	Organo Chlorine Pesticides	APHA, 22nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
29.	Polynuclear aromatic hydrocarbons (PAH)	APHA, 22nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
30.	Polychlorinated Biphenyls (PCB)	APHA, 22nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
31.	Zinc (Zn)	IS 3025(Part 2): 2004	ICP Method	0.1 mg/L
32.	Nickel (Ni)	IS 3025(Part 2): 2004	ICP Method	0.05 mg/L
33.	Copper (Cu)	IS 3025(Part 2): 2004	ICP Method	0.03 mg/L
34.	Hexavalent Chromium (Cr^{6+})	APHA, 22ndEd., 2012,3500-Cr,B,3-69	Colorimetric Method	0.02 mg/L
35.	Total Chromium (Cr)	IS 3025(Part 2): 2004	ICP Method	0.02 mg/L
36.	Total Arsenic (As)	IS 3025(Part 2): 2004	ICP Method	0.005 mg/L
37.	Lead (Pb)	IS 3025(Part 2): 2004	ICP Method	0.008 mg/L
38.	Cadmium (Cd)	IS 3025(Part 2): 2004	ICP Method	0.002 mg/L
39.	Mercury (Hg)	IS 3025(Part 2): 2004	ICP Method	0.0008 mg/L
40.	Manganese (Mn)	IS 3025(Part 2): 2004	ICP Method	0.02 mg/L
41.	Iron (Fe)	IS 3025(Part 2): 2004	ICP Method	0.06 mg/L
42.	Vanadium (V)	IS 3025(Part 2): 2004	ICP Method	0.05 mg/L
43.	Selenium (Se)	IS 3025(Part 2): 2004	ICP Method	0.005 mg/L
44.	Boron (B)	IS 3025(Part 2): 2004	ICP Method	0.1 mg/L
45.	Total Coliforms	APHA, 22nd Ed., 2012,9221-B, 9-66	Multiple tube fermentation technique	1.1 MPN/100ml

Sr.	Parameters	Methods References	Techniques	Detection Limit
			(MPN/100ml)	
46.	Faecal Coliforms	APHA, 22nd Ed., 2012,9221-E, 9-74	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
47.	Bioassay (Zebra Fish) Test	IS 6582, 1971, Reaffirmed 1987	Static Technique	-

Annexure IV: National Ambient Air Quality Standards, 2009

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National Ambient Air Quality Standards: Central Pollution Control Board

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevntion and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in suppression of the Notification No(s). S.O.384(E), dated 11th April, 1994 and S.O.935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards **with immediate effect**, namely:

Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas (Notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2) µg/m³	Annual *	50	20	– Improved West and Gaeke – Ultraviolet fluorescence
		24 hours **	80	80	
2	Nitrogen Dioxide (NO_2) µg/m³	Annual *	40	30	– Modified Jacob & Hochheiser (Na-Arsenite) – Chemilminescence
		24 hours **	80	80	
3	Particulate Matter (size less than 10 µm) or PM_{10} µg/m³	Annual *	60	60	– Gravimetric – TOEM – Beta attenuation
		24 hours **	100	100	
4	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m³	Annual *	40	40	– Gravimetric – TOEM – Beta attenuation
		24 hours **	60	60	
5	Ozone (O_3) µg/m³	8 hours **	100	100	– UV photometric – Chemiluminescence – Chemical Method
		1 hour **	180	180	
6	Lead (Pb) µg/m³	Annual *	0.50	0.50	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper – EDXRF using Teflon filter
		24 hours **	1.0	1.0	
7	Carbon Monoxide (CO) mg/m³	8 hours **	02	02	– Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour **	04	04	
8	Ammonia (NH_3) µg/m³	Annual *	100	100	– Chemiluminescence – Indophenol blue method
		24 hours **	400	400	
9	Benzene (C_6H_6) µg/m³	Annual *	05	05	– Gas Chromatography based continuous analyzer – Adsorption and Desorption followed by GC analysis
10	Benzo (a) Pyrene (BaP) – particulate phase only, ng/m³	Annual *	01	01	– Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As) ng/m³	Annual *	06	06	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper.
12	Nickel (Ni) ng/m³	Annual *	20	20	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper.

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2 % of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

SANT PRASAD GAUTAM, Chairman, Central Pollution Control Board [ADVT-III/4/184/09/Exty.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India. Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October,1998.

µg/m³: micro-gram/m³ i.e. 10^{-6}gm/m³ ng/m³ : nano-gram/m³ i.e 10^{-9}gm/m³

Annexure V: General Standards for Discharge of Environmental Pollutants, Part A: Effluents (The Environment (Protection) Rules, 1986, Schedule VI)

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
1.	Colour and Odour	See Note 1	--	See Note I	See Note 1
2.	Suspended solids, mg/L, Max.	100	600	200	a. For process waste water - 100 b. For cooling water effluent- 10 percent above total suspended mailer of influent cooling water.
3.	Particle size of suspended solids	Shall pass 850 micron IS Sieve			a. Floatable solids, Max 3 mm b. Settleable solids Max 850 microns
4.	Dissolved solids (Inorganic), mg/L, Max.	2100	2100	2100	--
5.	pH value	5.5 -9.0	5.5 -9.0	5.5 -9.0	5.5-9.0
6.	Temperature °C, Max	Shall not exceed 40 in any section of the stream within 15 mts. Downstream from the effluent outlet	45 at the point of discharge	--	45 at the point of discharge
7.	Oil and Grease, mg/L, Max	10	20	10	20

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
8.,	Total Residual chlorine, mg/L, Max	1.0	--	--	1.0
9.	Ammonical Nitrogen (as N), mg/L, Max	50	50	--	50
10.	Total Kjeldahl Nitrogen (as N), mg/L, Max.	100	--	--	100
11.	Free Ammonia (as NH_3), mg/L, Max	5.0	--	--	5.0
12.	Biochemical oxygen demand (5 days, at 20° c) mg/L, Max	30	350	100	100
13.	Chemical oxygen demand, mg/L, Max	250	--	--	250
14.	Arsenic (as As), mg/l, Max	0.2	0.2	0.2	0.2
15.	Mercury (as Hg). Mg/L, Max	0.01	0.01	--	0.01
16.	Lead (as Pb), mg/L, Max	0.1	1.0	-	1.0
17.	Cadmium (as Cd), mg/L,	2.0	1.0	--	2.0
18.	Hexavalent Chromium (as Cr^{+6}) mg/L, Max	.1	2.0	--	1.0
19.	Total Chromium (as Cr), mg/L, Max	2.0	2.0	--	2.0

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
20.	Copper (as Cu), mg/L, Max.	3.0	3.0	--	3.0
21.	Zinc (as Zn), mg/L, Max.	5.0	15	0--	15
22	Selenium (as Se), mg/l, Max.	0.05	0.05	--	0.05
23	Nickel (as Ni), mg/l, Max.	3.0	3.0	--	5.0
24	Boron (as B), mg/l, Max.	2.0	2.0	2.0	--
25.	Percent Sodium, Max.	--	60	60	--
26.	Residual Sodium carbonate, mg/l, Max.	--	--	5.0	--
27.	Cyanide (as Cn), mg/L, Max.	0.2	2.0	0.2	0.2
28.	Chloride (as Cl), mg/L, Max.	1000	1000	600	--
29.	Fluoride (as F), mg/IL, Max.	2.0	15	--	15
30.	Dissolved Phosphate (as P), mg/L, Max.	5.0	--	--	--
31.	Sulphate (as SO_4), mg/L, Max.	1000	1000	1000	--
32.	Sulphide (as S), mg/L, Max.	2.0	--	--	5.0
33.	Pesticides	Absent	Absent	Absent	Absent

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
34.	Phenolic compounds (as C_6H_5OH), mg/L, Max.	1.0	5.0	--	5.0
35.	Radioactive materials:				
	a. Alpha emitters MC/ml., Max.	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	b. Beta emitters µc/ml., Max	10^{-6}	10^{-6}	10^{-7}	10^{-6}

Annexure VI: Drinking Water Specification-IS 10500:2012

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1	**Organoleptic and Physical Parameters**			
1.	Colour	Hazen units	Max 5	Max 15
2.	Odour	-	Agreeable	Agreeable
3.	pH value	-	6.5-8.5	No relaxation
4.	Taste	-	Agreeable	Agreeable
5.	Turbidity	NTU	Max 1	Max 5
6.	Total dissolved solids	mg/L	Max 500	Max 2000
Table 2	**General parameters concerning substances undesirable in excessive amounts**			
7.	Aluminium (as Al)	mg/L	Max 0.03	Max 0.2
8.	Ammonia (as total ammonia- N)	mg/L	Max 0.5	No relaxation
9.	Anionic detergents (as MBAS)	mg/L	Max 0.2	Max 1.0
10.	Barium (as Ba)	mg/L	Max 0.7	No relaxation
11.	Boron (as B)	mg/L	Max 0.5	Max 1.0
12.	Calcium (as Ca)	mg/L	Max 75	Max 200
13.	Chloramines (as $C1_2$)	mg/L	Max 4.0	No relaxation
14.	Chlorides (as Cl)	mg/L	Max 250	Max 1000
15.	Copper (as Cu)	mg/L	Max 0.05	Max 1.5
16.	Fluoride (as F)	mg/L	Max 1.0	Max 1.5

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
17.	Free residual chlorine	mg/L	Min 0.2	Min 1
18.	Iron (as Fe)	mg/L	Max 0.3	No relaxation
19.	Magnesium (as Mg)	mg/L	Max 30	Max100
20.	Manganese (as Mn)	mg/L	Max 0.1	Max 0.3
21.	Mineral Oil	mg/L	Max 0.5	No relaxation
22.	Nitrate (as NO_3)	mg/L	Max 45	No relaxation
23.	Phenolic compounds (as C_6H_5OH)	mg/L	Max 0.001	Max 0.002
24.	Selenium (as Se)	mg/L	Max 0.01	No relaxation
25.	Silver (as Ag)	mg/L	Max 0.1	No relaxation
26.	Sulphate (as SO_4)	mg/L	Max 200	Max 400
27.	Sulphide (as H_2S)	mg/L	Max 0.05	No relaxation
28.	Total Alkalinity as calcium carbonate	mg/L	Max 200	Max600
29.	Total hardness (as $CaCO_3$)	mg/L	Max 200	Max 600
30.	Zinc (as Zn)	mg/L	Max 5	Max15
Table 3	**Parameters Concerning Toxic Substances**			
31.	Cadmium (asCd)	mg/L	Max 0.003	No relaxation
32.	Cyanide (asCN)	mg/L	Max 0.05	No relaxation
33.	Lead (as Pb)	mg/L	Max 0.01	No relaxation
34.	Mercury (asHg)	mg/L	Max 0.001	No relaxation
35.	Molybdenum (as Mo)	mg/L	Max 0.07	No relaxation
36.	Nickel (as Ni)	mg/L	Max 0.02	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
37.	Pesticides	mg/L	See Table 5	No relaxation
38.	Polychlorinatedbiphenyls	mg/L	Max 0.0005	No relaxation
39.	Poly nuclear aromatic Hydrocarbons (as PAH)	mg/L	Max 0.0001	No relaxation
40.	Total Arsenic(as As)	mg/L	Max 0.01	Max0.05
41.	Total Chromium (as Cr)	mg/L	Max 0.05	No relaxation
42.	Trihalomethanes			
a)	Bromoform	mg/L	Max 0.1	No relaxation
b)	DibromochloroMethane	mg/L	Max 0.1	No relaxation
c)	Bromodichloromethane	mg/L	Max 0.06	No relaxation
d)	Chloroform	mg/L	Max 0.2	No relaxation
Table 4	**Parameters Concerning Radioactive Substances**			
43.	Radioactive Materials			
a)	Alpha emitters	Bq/L	Max 0.1	No relaxation
b)	Beta emitters	Bq/L	Max 1.0	No relaxation
Table 5	**Pesticide Residues Limits and Test Method**			
i)	Alachor	µg/L	20	No relaxation
ii)	Atrazine	µg/L	2	No relaxation
iii)	Aldrin/ Dieldrin	µg/L	0.03	No relaxation
iv)	Alpha HCH	µg/L	0.01	No relaxation
v)	Beta HCH	µg/L	0.04	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
vi)	Butachlor	µg/L	125	No relaxation
vii)	Chlorpyriphos	µg/L	30	No relaxation
viii)	Delta HCH	µg/L	0.04	No relaxation
ix)	2,4- Dichlorophenoxyacetic acid	µg/L	30	No relaxation
x)	DDT (o,p&p,p — Isomers of DDT, DDE and DDD)	µg/L	1	No relaxation
xi)	Endosulfan (α,β & sulphate)	µg/L	0.4	No relaxation
xii)	Ethion	µg/L	3	No relaxation
xiii)	Gamma - HCH (Lindane)	µg/L	2	No relaxation
xiv)	Isoproturon	µg/L	9	No relaxation
xv)	Malathion	µg/L	190	No relaxation
xvi)	Methyl parathion	µg/L	0.3	No relaxation
xvii)	Monocrotophos	µg/L	1	No relaxation
xviii)	Phorate	µg/L	2	No relaxation
Table 6	**Bacteriological Quality of Drinking Water**			
44.	E.coli or thermotolerant coliform bacteria	/100	Not detectable	-
45.	Total coliform bacteria	/100 mL	Not detectable	-
	Virological Requirements			
46.	MS2 phage	/1 L	Absent	-
	Biological Requirements			

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
47.	Cryptosporidium	/10 L	Absent	-
48.	Giardia	/10 L	Absent	-
49.	Microscopic organisms such as algae,zooplanktons,flagellates,parasites and toxin producing organisms		Free from microscopic organisms	-

Annexure VII: CPCB Water Quality Criteria:

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	➢ Total coliformorganisms (MPN*/100 ml) shall be 50 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/l or more, and ➢ Biochemical Oxygen Demand 2 mg/l or less
Outdoor bathing (organized)	B	➢ Total coliform organisms (MPN/100 ml) shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5 mg/l or more, and ➢ Biochemical Oxygen Demand 3 mg/l or less
Drinking water source with conventional treatment	C	➢ Total coliform organisms (MPN/100ml) shall be 5000 or less ➢ pH between 6 and 9 ➢ Dissolved Oxygen 4 mg/l or more, and ➢ Biochemical Oxygen Demand 3 mg/L or less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/l or more, and ➢ Free ammonia (as N) 1.2 mg/L or less
Irrigation, industrial cooling, and controlled disposal	E	➢ pH between 6.0 and 8.5 ➢ Electrical conductivity less than 2250 micro mhos/cm, ➢ Sodium Absorption Ratio less than 26, ➢ and Boron less than 2 mg/l.

	Below E	➢ Not Meeting A, B, C, D & E Criteria

Annexure VIII: Water Quality Parameters Requirements and Classification

Water quality parameters are classified into three categories, given in Table (i), (ii) and (iii) (Source: CPCB, 2002, "Water Quality Criteria and Goals", Monitoring of Indian National aquatic Resources Series: MINARS/17/2001-2002).

Table: Basic Water Quality Requirement and Classification (Surface Water + Ground Water)

i) Simple Parameters:

Sr.	Parameters	Requirement for Waters of Class		
		A-Excellent	**B-Desirable**	**C-Acceptable**
(i)	Sanitary Survey	Very Clean neighborhood and catchment	Reasonably clean neighborhood	Generally clean neighborhood
(ii)	General Appearance	No floating matter	No floating matter	No floating matter
(iii)	Colour	Absolutely Colourless	Almost colourless, very light shade if any	No colour of anthropogenic origin
(iv)	Smell	Odourless	Almost odourless	No unpleasant odour
(v)	Transparency	>1.0 depth	>0.5 to 0.1m depth	>0.2 to 0.5 m depth
(vi)	Ecological* (Presence of Animals)	Fish & Insects	Fish & Insects	Fish & Insects

* Applicable to only surface water

ii) Regular Monitoring Parameters:

Sr.	Parameters	Requirement for Waters of Class		
		A Excellent	**B-Desirable**	**C-Acceptable**
(i)	pH	7.0 to 8.5	6.5 to 9.0	6.5 to 9.0
(ii)	DO (% Saturation)	90-110	80-120	60-140
(iii)	BOD, mg/l	Below 2	Below 5	Below 8
(iv)	EC, µmhos/cm	<1000	<2250	<4000
(v)	(NO_2+NO_3)-Nitrogen, mg/l	<5	<10	<15
(vi)	Suspended solid,	<25	<50	<100

	mg/l			
(vii)	Feacal Coliform, MPN/ 100 ml	<20 per 100 ml	<200 per 100 ml	<2000 per 100 ml
(viii)	Bio-assay (Zebra Fish)	No death in 5 days	No death in 3 days	No death in 2 days

Note:

1. Dissolved Oxygen (DO) not applicable for ground waters.
2. Dissolved Oxygen in eutrophicated waters should include measurement for diurnal variation.
3. Suspended solid limit is applicable only during non-monsoon period.
4. Faecal Coliform values should meet for 90% times.
5. Static Bio-Assay method may be adopted.

iii) Specific Parameters: (Only in case of need/apprehensions)

Sr.	**Parameters**	**Requirement for Waters of Class**		
		A- Excellent	**B-Desirable**	**C-Acceptable**
(i)	Total Phosphorous	<0.1 mg/l	< 0.2 mg/l	< 0.3 mg/l
(ii)	T.K.N	< 1.0 mg/l	<2.0 mg/l	<3.0 mg/l
(iii)	Total Ammonia (NH4 + NH3)-Nitrogen	< 0.5 mg/l	< 1.0 mg/l	< 1.5 mg/l
(iv)	Phenols	< 2µg/l	< 5µg/l	<10 µg/l
(v)	Surface Active Agents	<20 µg/l	<100µg/l	< 200µg/l
(vi)	Organo Chlorine Pesticides	< 0.05µg/l	< 0.1µg/l	< 0.2µg/l
(vii)	PAH	< 0.05µg/l	<0.1 µg/l	<0.2 µg/l
(viii)	PCB and PCT	< 0.01µg/l	< 0.01µg/l	< 0.02µg/l
(ix)	Zinc	< 100µg/l	< 200µg/l	<300 µg/l
(x)	Nickel	< 50µg/l	< 100µg/l	< 200µg/l
(xi)	Copper	< 20µg/l	< 50µg/l	<100µg/l
(xii)	Chromium (Total)	< 20µg/l	< 50µg/l	< 100µg/l
(xiii)	Arsenic (Total)	< 20µg/l	<50 µg/l	<100 µg/l

(xiv)	Lead	< 20µg/l	< 50µg/l	< 100µg/l
(xv)	Cadmium	< 1.0µg/l	<2.5 µg/l	< 5.0µg/l
(xvi)	Mercury	< 0.2µg/l	< 0.5µg/l	< 1.0µg/l