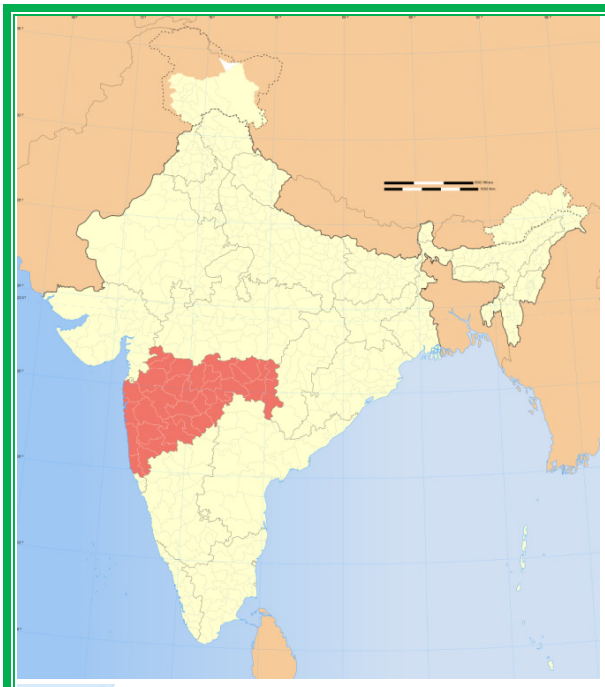
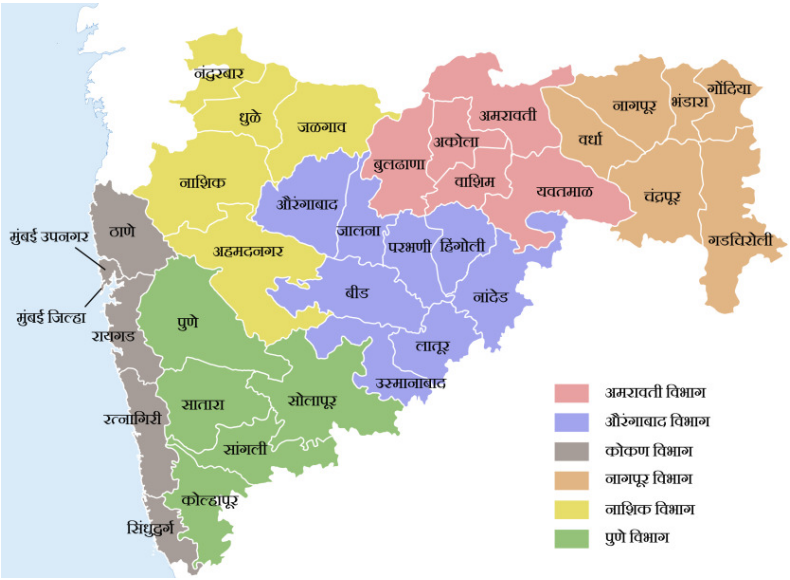
Action Plan for Industrial Cluster in Severely Polluted Areas

Monitoring, sampling, analysis of Stack, Ambient Air Quality, Surface Water, Ground Water, Waste Water



तारापुर Tarapur



MAHARASHTRA

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

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INDEX

Acknowledgement

We gratefully acknowledge **E. Ravendiran**, Member Secretary, Maharashtra Pollution Control Board, for entrusting this very important and prestigious project to us.

Our special thanks are to Regional and Sub Regional Officer of the concerned areas, for guidance during the sampling. The contribution of **Shri V. M Motghare** (Joint director APC) and Mr. Sameer Hundlekar (Field officer) is appreciated.

We would also like to extend our thanks to the concerned staff of Regional Hospitals, who has provided us the health data, which is the most important component of this revised concept of CEPI.

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
SPA	Severely 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
PM_{10}	Particulate Matter (size less than 10 µm)
$PM_{2.5}$	Particulate Matter (size less than 2.5 µm)
SO_2	Sulphur Dioxide
STAP	Short Term Action Plan
WHO	World Health Organization

1. Introduction:

Although industries contribute significantly to India's economic growth and development, the increase in pollution of land, water, air, noise and resulting degradation of environment that they have caused, cannot be overlooked. Industries are responsible for four types of pollution: a) Air b) water c) land d) noise. Rapid industrialization carries with it the seeds of environmental damage. Pollution of natural environment not only affects people but also have adverse impact on economic growth in the long run. Analysis of pollution load shows that there are few industries in the country which contribute to more than 90percent of the pollution. Hence, scientists are exploring the quantum of pollution load as well as to device certain strategies and technologies so that our sustainable development would not be jeopardized otherwise our long cherished dream of establishing eco-socialism on this watery planet could not come true.

Industrial pollution takes on many faces. It contaminates many sources of drinking water, releases unwanted toxins into the air and reduces the quality of soil all over the world. Every litre of waste water discharged by our industries pollute eight times the quantity of fresh water. The extent of pollution varies with the size of the industry, the nature of the industry, the type of products used and produced etc. In view of this, Central Pollution Control Board (CPCB) has evolved the concept of Comprehensive Environmental Pollution Index (CEPI) 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. Hence, revised concept came into existence, which is termed as Revised CEPI Version 2016.

The present report is also based on the revised CEPI version 2016. 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.

In this report, 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, Dombivli, 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 6 days at various locations i.e. from 30th January, to 04th February, 2019.
- In Tarapur, a total of 7 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 2 Volatile Organic Carbon samples 7 Waste Water Samples and 5 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 (PM_{10})
4. Particulate Matter ($PM_{2.5}$)
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 II**
2. Ambient Air Sampling and Analysis Methodology **- Annexure III**
3. Water/Wastewater Sampling and Analysis Methodology - **Annexure IV**

3. Results 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 detection limit.

Please Note: Industrial clusters observed with below detection limit parameters are NOT included into the graphs

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 (VOCs) could not be prepared as their concentration was found either very less or not detected.

Sr.	Name of Industry	Included in
1.	Mandhana Industrial Ltd. (Dyeing Unit- II)	Table No. I
2.	Siyaram Silk Mills Ltd.	Table No. I
3.	IVP Ltd.	Table No. I
4.	Sarex Overseas	Table No. II
5.	Lupin Ltd.	Table No. II
6.	Dicitex Furnishing	Table No. II

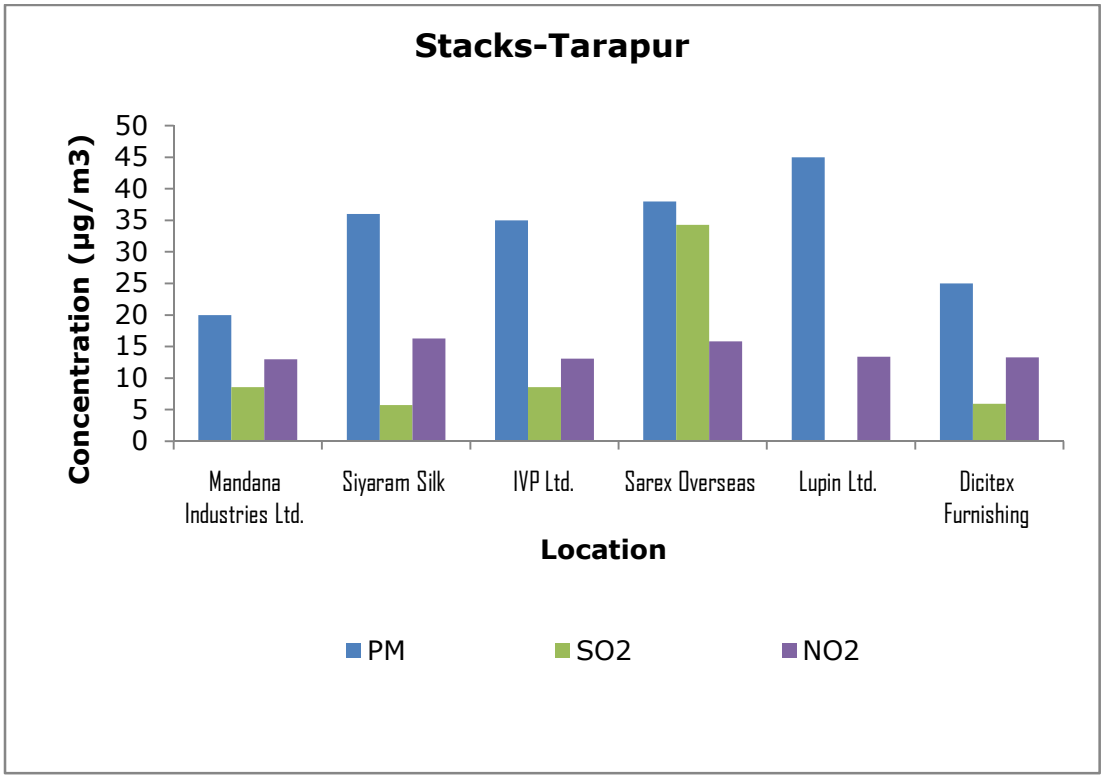
Table No. I:

Name of Industry			**Mandhana Industrial Ltd. (Dyeing Unit- II)**	**Siyaram Silk Mills Ltd.**	**IVP Ltd.**
Date of Sampling			**30.01.19**	**30.01.19**	**31.01.19**
Stack ID			Boiler	Boiler	Boiler
Sr.	**Parameters**	**Unit**	**Result**		
1	Particulate Matter	mg/Nm^3	20	36	35
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**
2	Sulphur Dioxide (SO_2)	mg/Nm^3	8.57	5.71	8.57
		kg/d	6.35	1.38	3.02
	Std. Limit	**mg/Nm^3**	**-**	**-**	**-**
3	Nitrogen Dioxide (NO_2)	mg/Nm^3	13	16.3	13.1

Table No. II:

Name of Industry			**Sarex Overseas**	**Lupin Ltd.**	**Dicitex Furnishing**
Date of Sampling			31.01.19	02.02.19	02.02.19
Stack ID			Boiler	Boiler	Boiler
Sr.	**Parameters**	**Unit**	**Result**		
1	Particulate Matter	mg/Nm^3	38	45	25
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**
2	Sulphur Dioxide (SO_2)	mg/Nm^3	34.3	<5	5.93
		kg/d	5.45	<0.02	6.13
	Std. Limit	**mg/Nm^3**	**-**	**-**	**-**
3	Nitrogen Dioxide (NO_2)	mg/Nm^3	15.8	13.4	13.3

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 V**).

Please Note: In Tarapur, all the parameters observed below detection limit in their concentrations are not shown in the graphs.

Sr.	Locations	Location details	Table No.
1.	Mandhana Industrial Ltd. (Dyeing Unit- II)	Near ETP	Table No. I
2.	Siyaram Silk Mills Ltd.	Near ETP	Table No. I
3.	IVP Ltd.	Near Plant Area	Table No. I
4.	Sarex Overseas	Near Main Gate	Table No. I
5.	CETP	Near Plant Area	Table No. II
6.	Lupin Ltd.	Near Main Gate	Table No. II

Table No. I:

Location				**Mandhana Industrial Ltd. (Dyeing Unit- II)**	**Siyaram Silk Mills Ltd.**	**IVP Ltd.**
Date of Sampling				**30.01.19**	**30.01.19**	**31.01.19**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS, 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	5.64	5.8	5.36
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	9.35	8.21	8.45
3.	Particulate Matter (size <10 µm)or PM_{10}	$\mu g/m^3$	**100**	401	104	90
4.	Particulate Matter (size <2.5µm)or $PM_{2.5}$	$\mu g/m^3$	**60**	99	24	20

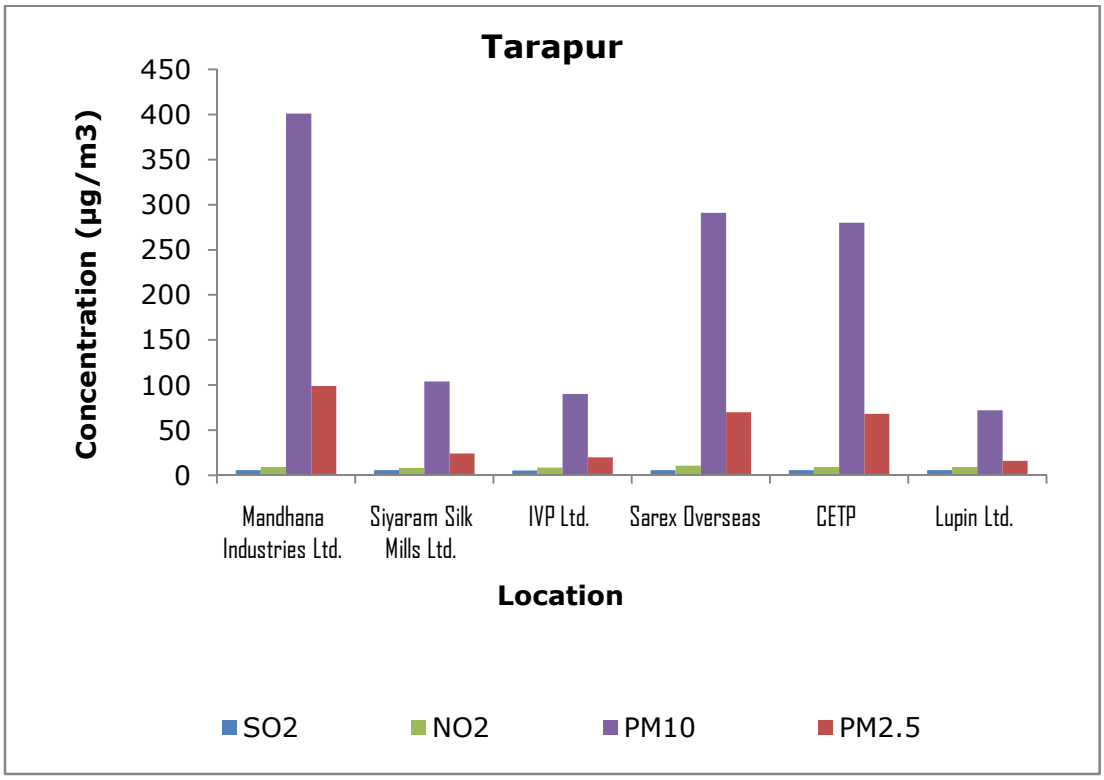
Location				**Mandhana Industrial Ltd. (Dyeing Unit- II)**	**Siyaram Silk Mills Ltd.**	**IVP Ltd.**
Date of Sampling				**30.01.19**	**30.01.19**	**31.01.19**
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**04**	1.71	5.04	1.74
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	BDL	BDL	BDL
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (as As)	ng/m^3	**6**	BDL	BDL	BDL
12.	Nickel (as Ni)	ng/m^3	**20**	BDL	BDL	BDL

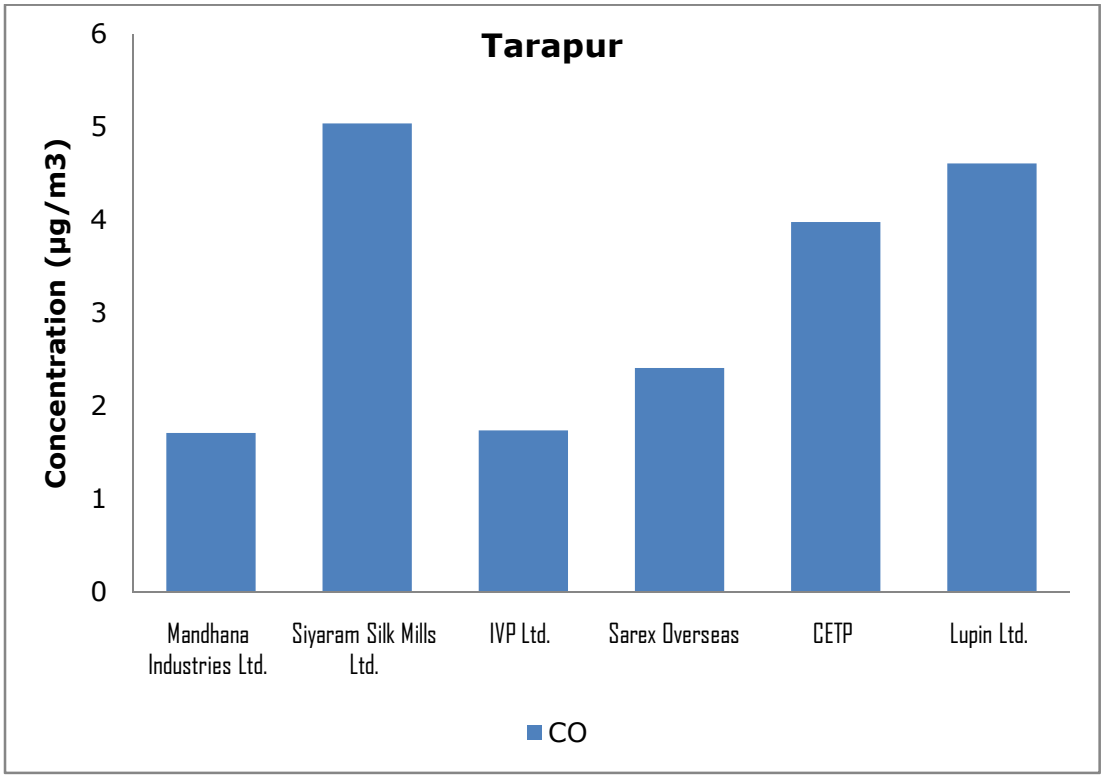
Table No. II:

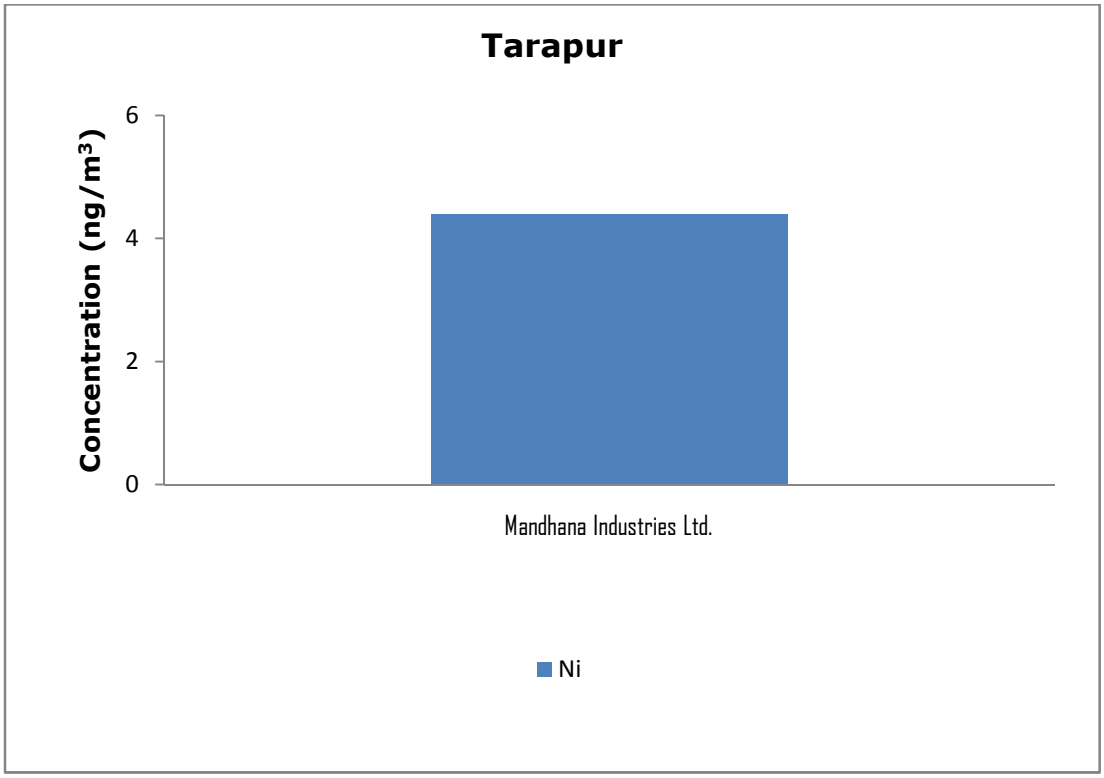
Location				**Sarex Oversea s**	**CETP**	**Lupin Ltd.**
Date of Sampling				**31.01.19**	**01.02.19**	**01.02.19**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS, 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	5.70	5.52	5.52
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	10.6	9.20	9.24
3.	Particulate Matter (size <10 µm)or PM_{10}	$\mu g/m^3$	**100**	291	280	72

Location				**Sarex Overseas**	**CETP**	**Lupin Ltd.**
Date of Sampling				**31.01.19**	**01.02.19**	**01.02.19**
4.	Particulate Matter (size <2.5µm)or $PM_{2.5}$	µg/m^3	**60**	70	68	16
5.	Ozone (O_3)	µg/m^3	**180**	BDL	BDL	BDL
6.	Lead (Pb)	µg/m^3	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**04**	2.41	3.98	4.61
8.	Ammonia (NH_3)	µg/m^3	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	µg/m^3	**5**	BDL	BDL	BDL
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (as As)	ng/m^3	**6**	BDL	BDL	BDL
12.	Nickel (as Ni)	ng/m^3	**20**	BDL	BDL	BDL

Graphs: Ambient Air Monitoring Results:







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 IX), CPCB Water Quality Criteria (Annexure VIII) and Drinking Water Specification, IS 10500:2012 (Annexure VII), Wastewater Analysis Results are compared with General Standards for Discharge of Environmental Pollutants Part A: Effluents, The Environment (Protection) Rules, 1986, Schedule VI.

Sr.	Locations	Location detail	Included in
1.	CETP inlet	ETP Outlet	Table I
2.	CETP outlet	ETP Outlet	Table I
3.	Siyaram Silk	ETP Inlet	Table I
4.	Resonance Specialities	ETP Outlet	Table II
5.	Aarti Drugs	ETP Outlet	Table II
6.	Aarti Industries	ETP Outlet	Table II
7.	Calex Chemicals Ltd.	ETP Outlet	Table II

Table I:

Location				**CETP Inlet**	**CETP Outlet**	**Siyaram Silk Mill**
Date of Sampling				04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**		
1.	Colour	Hazen		400	350	1
2.	Smell	-		Disagreeable	Disagreeable	Disagreeable
3.	pH	-	**5.5 -9.0**	6.29	7.01	8.22
4.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL
5.	Suspended Solids	mg/L	**100.0**	73	91	63
6.	Dissolved Oxygen (% Saturation)	%		130	120	120
7.	Chemical Oxygen Demand	mg/L	**250.0**	4400	2400	80
8.	Biochemical Oxygen Demand (3 days,27^{o} C)	mg/L	**30.0**	1470	799	26
9.	Electrical Conductivity (at 25^{o} C)	µmhos/cm		12570	6400	2450
10.	Nitrite Nitrogen (as N)	mg/L		1.12	0.82	0.08
11.	Nitrate Nitrogen (as N)	mg/L	**100**	11	4.93	14.3
12.	(NO_2 + NO_3)-Nitrogen	mg/L	**5.0**	12.1	5.75	14.4
13.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	0.11	0.50	BDL
14.	Total Residual Chlorine	mg/L	**1.0**	BDL	BDL	BDL

Location				**CETP Inlet**	**CETP Outlet**	**Siyaram Silk Mill**
Date of Sampling				04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**		
15.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
16.	Fluoride (as F)	mg/L	**2.0**	47.5	70	0.46
17.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	4.32	BDL
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	3.42	0.59	1.10
19.	Sodium Absorption Ratio	-		47.8	29.4	30
20.	Total Coliforms	MPN index/100 mL	**100.0**	BDL	23	BDL
21.	Faecal Coliforms	MPN index/100 mL	**1000.0**	BDL	7.8	BDL
22.	Total Phosphorous (as P)	mg/L	**1.0**	7.27	0.88	1.30
23.	Total Kjeldahl Nitrogen	mg/L	**100.0**	1140	627	5.26
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	68	60.8	1.6
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**			
i.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL

Location				**CETP Inlet**	**CETP Outlet**	**Siyaram Silk Mill**
Date of Sampling				04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**		
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.	Chlorpyrifos			BDL	BDL	BDL
ix.	Delta HCH	µg/L	**0.2**	BDL	BDL	BDL
x.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
xi.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
xii.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL
xiii.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
xiv.	p,p DDD	µg/L		BDL	BDL	BDL
xv.	o,p DDD	µg/L		BDL	BDL	BDL
xvi.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
xvii.	Beta Endosulfan	µg/L		BDL	BDL	BDL
xviii.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
xix.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
28.	Poly Aromatic hydrocarbons (as PAH)	µg/L	**0.2**	0.01	0.045	BDL

Location				**CETP Inlet**	**CETP Outlet**	**Siyaram Silk Mill**
Date of Sampling				04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**		
29.	Polychlorinated Biphenyls (PCB)	µg/L	**2.0**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	3.38	2.04	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	0.123	0.107	BDL
32.	Copper (as Cu)	mg/L		11	0.859	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	0.643	0.632	0.027
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	0.035	0.080	BDL
37.	Cadmium (as Cd)	mg/L	**2.0**	0.006	0.007	BDL
38.	Mercury (as Hg)	mg/L	**0.01**	BDL	BDL	BDL
39.	Manganese (as Mn)	mg/L	**2.0**	0.548	0.715	0.041
40.	Iron (as Fe)	mg/L	**3.0**	26.4	23.5	0.733
41.	Vanadium (as V)	mg/L	**0.2**	0.055	0.033	BDL
42.	Selenium (as Se)	mg/L	**0.05**	0.579	BDL	BDL
43.	Boron (as B)	mg/L		0.588	0.905	0.112

Location				**CETP Inlet**	**CETP Outlet**	**Siyaram Silk Mill**
Date of Sampling				04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**		
44.	Bioassay Test on fish	% survival	**90% survival after 96h in 100% effluent**	0	0	0

Table II:

Location				**Resonance Specialities Ltd.**	**Aarti Drugs**	**Aarti Industries**	**Calex Chemicals Ltd.**
Date of Sampling				04.02.19	04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**			
1.	Colour	Hazen		1	1	1	1
2.	Smell	-		Agreeable	Disagreeable	Disagreeable	Disagreeable
3.	Transparency	m					
4.	pH	-	**5.5 - 9.0**	8.04	5.73	7	7.15
5.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL	BDL
6.	Suspended Solids	mg/L	**100.0**	9	70	23	10
7.	Dissolved Oxygen (% Saturation)	%		142	98	122	125

Location				**Resonance Specialities Ltd.**	**Aarti Drugs**	**Aarti Industries**	**Calex Chemicals Ltd.**
Date of Sampling				04.02.19	04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**			
8.	Chemical Oxygen Demand	mg/L	**250.0**	30	50	10	20
9.	Biochemical Oxygen Demand (3 days,27^{o} C)	mg/L	**30.0**	11	16	3.3	7
10.	Electrical Conductivity (at 25 ^{o} C)	µmhos/cm		186.5	11600	79.4	557
11.	Nitrite Nitrogen (as N)	mg/L		BDL	1.12	BDL	BDL
12.	Nitrate Nitrogen (as N)	mg/L	**100**	0.61	55.8	0.27	1.42
13.	(NO_2 + NO_3)-Nitrogen	mg/L	**5.0**	0.61	56.9	0.27	1.42
14.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	BDL	BDL	BDL	BDL
15.	Total Residual Chlorine	mg/L	**1.0**	BDL	BDL	BDL	BDL
16.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L	**2.0**	0.73	0.64	0.90	0.38
18.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	BDL	BDL	BDL
19.	Dissolved Phosphate (as P)	mg/L	**5.0**	BDL	3.31	BDL	BDL

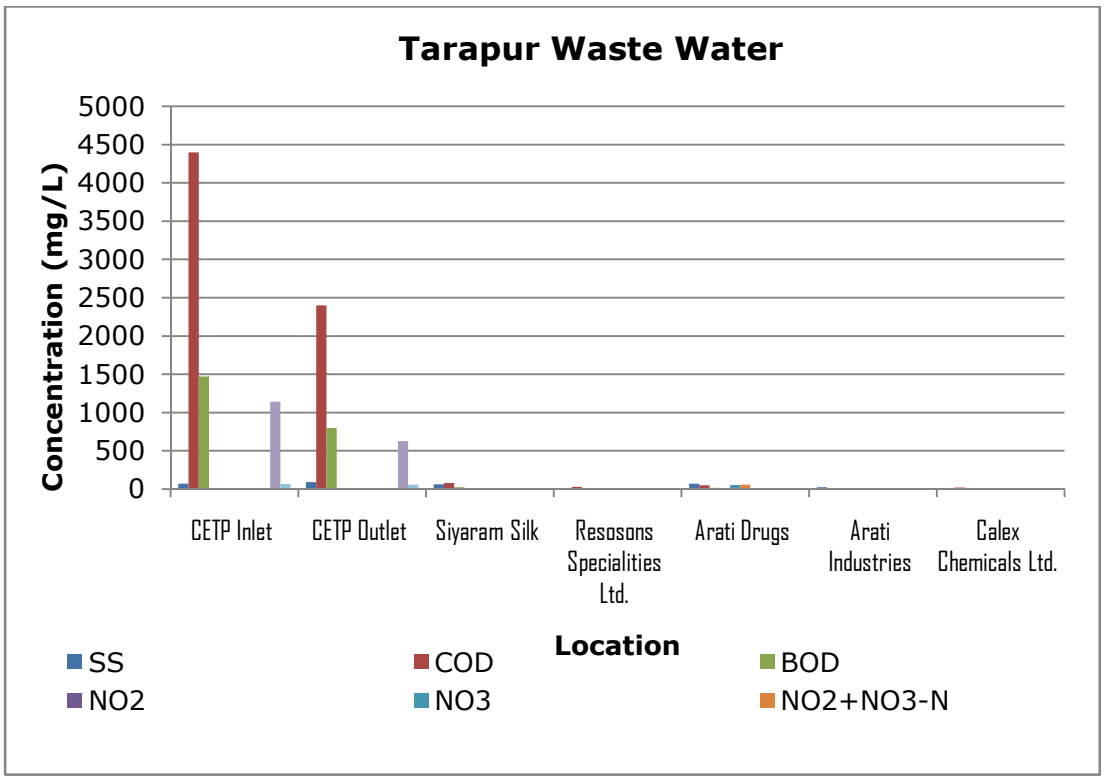
Location				**Resonance Specialities Ltd.**	**Aarti Drugs**	**Aarti Industries**	**Calex Chemicals Ltd.**
Date of Sampling				04.02.19	04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**			
20.	Sodium Absorption Ratio	-		0.48	83.7	0.39	4.43
21.	Total Coliforms	MPN index/100 mL	**100.0**	7.8	7.8	23	23
22.	Faecal Coliforms	MPN index/100 mL	**1000.0**	BDL	BDL	23	13
23.	Total Phosphorous (as P)	mg/L	**1.0**	BDL	5.69	BDL	0.29
24.	Total Kjeldahl Nitrogen	mg/L	**100.0**	3.36	1.8	0.56	5.61
25.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	BDL	0.42	BDL	BDL
26.	Phenols (as C_6H_5OH)	mg/L	**3.0**	BDL	BDL	BDL	BDL
27.	Surface Active Agents (as MBAS)	mg/L	**3.0**	BDL	BDL	BDL	BDL
28.	Organo Chlorine Pesticides	µg/L	**0.1**				
i.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL	BDL
ii.	Atrazine	µg/L	**0.2**	BDL	BDL	BDL	BDL
iii.	Aldrin	µg/L	**0.1**	BDL	BDL	BDL	BDL

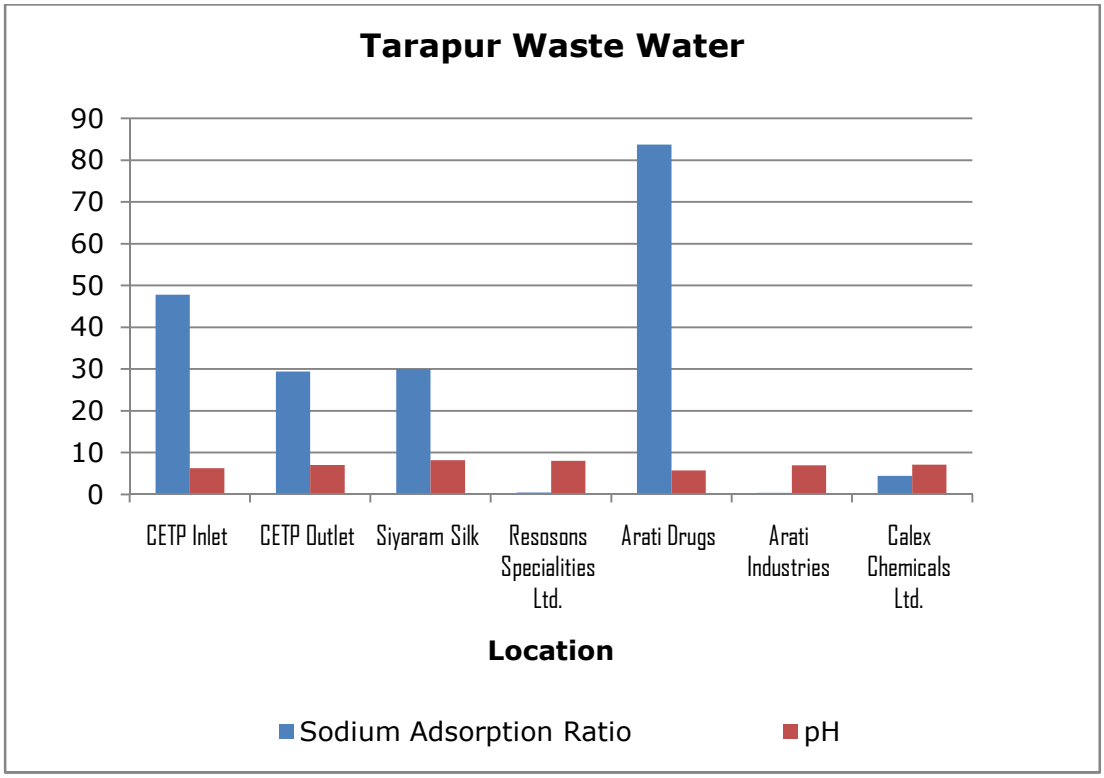
Location				**Resonance Specialities Ltd.**	**Aarti Drugs**	**Aarti Industries**	**Calex Chemicals Ltd.**
Date of Sampling				04.02.19	04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**			
iv.	Dieldrin	µg/L	**2.0**	BDL	BDL	BDL	BDL
v.	Alpha HCH	µg/L	**0.01**	BDL	BDL	BDL	BDL
vi.	Beta HCH	µg/L	**2.0**	BDL	BDL	BDL	BDL
vii.	Butachlor	µg/L	**3.0**	BDL	BDL	BDL	BDL
viii.	Chlorpyrifos			BDL	BDL	BDL	BDL
ix.	Delta HCH	µg/L	**0.2**	BDL	BDL	BDL	BDL
x.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL	BDL
xi.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL	BDL
xii.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL	BDL
xiii.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL	BDL
xiv.	p,p DDD	µg/L		BDL	BDL	BDL	BDL
xv.	o,p DDD	µg/L		BDL	BDL	BDL	BDL
xvi.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL	BDL
xvii.	Beta Endosulfan	µg/L		BDL	BDL	BDL	BDL
xviii.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL	BDL
xix.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL	BDL
29.	Poly Aromatic hydrocarbons (as PAH)	µg/L	**0.2**	0.012	0.011	BDL	0.003

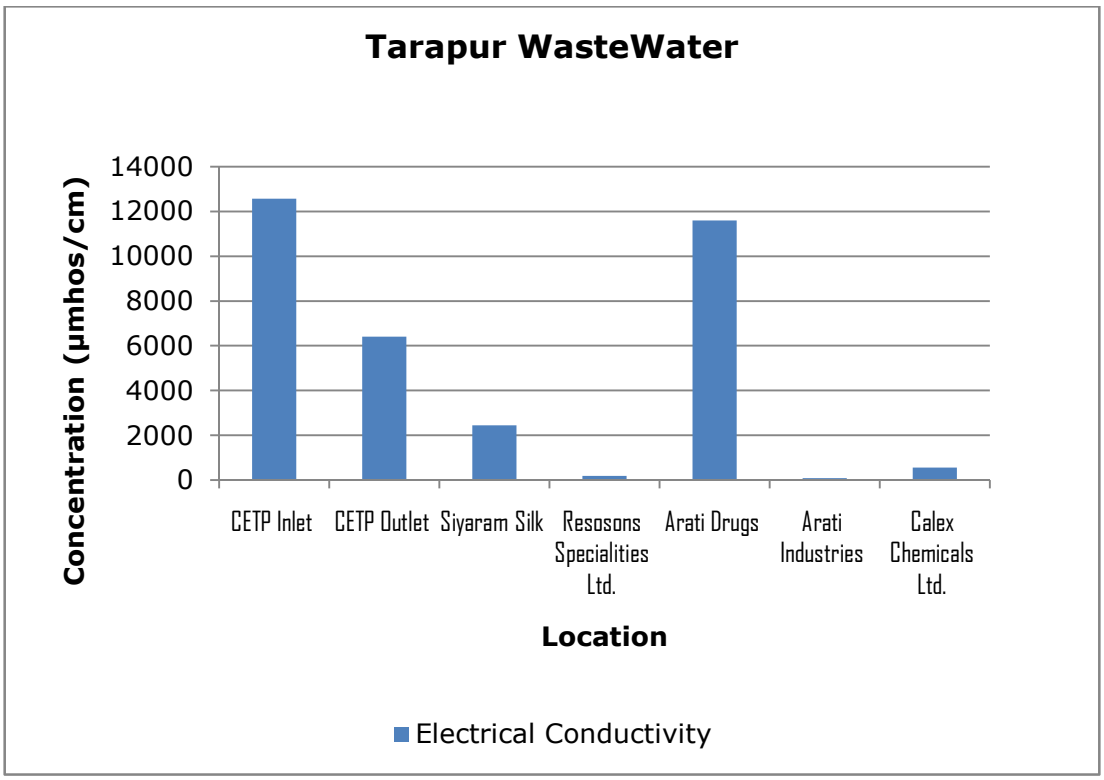
Location				**Resonance Specialities Ltd.**	**Aarti Drugs**	**Aarti Industries**	**Calex Chemicals Ltd.**
Date of Sampling				04.02.19	04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**			
30.	Polychlorinated Biphenyls (PCB)	µg/L	**2.0**	BDL	BDL	BDL	BDL
31.	Zinc (as Zn)	mg/L	**5.0**	BDL	0.741	BDL	BDL
32.	Nickel (as Ni)	mg/L	**3.0**	BDL	0.042	BDL	BDL
33.	Copper (as Cu)	mg/L		BDL	BDL	BDL	BDL
34.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL	BDL
35.	Total Chromium (as Cr)	mg/L	**2.0**	BDL	BDL	BDL	BDL
36.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL	BDL
37.	Lead (as Pb)	mg/L	**0.1**	BDL	BDL	BDL	BDL
38.	Cadmium (as Cd)	mg/L	**2.0**	BDL	BDL	BDL	0.016
39.	Mercury (as Hg)	mg/L	**0.01**	BDL	BDL	BDL	BDL
40.	Manganese (as Mn)	mg/L	**2.0**	BDL	0.269	BDL	BDL
41.	Iron (as Fe)	mg/L	**3.0**	0.193	5.28	0.366	0.234
42.	Vanadium (as V)	mg/L	**0.2**	BDL	BDL	BDL	BDL
43.	Selenium (as Se)	mg/L	**0.05**	BDL	BDL	BDL	BDL

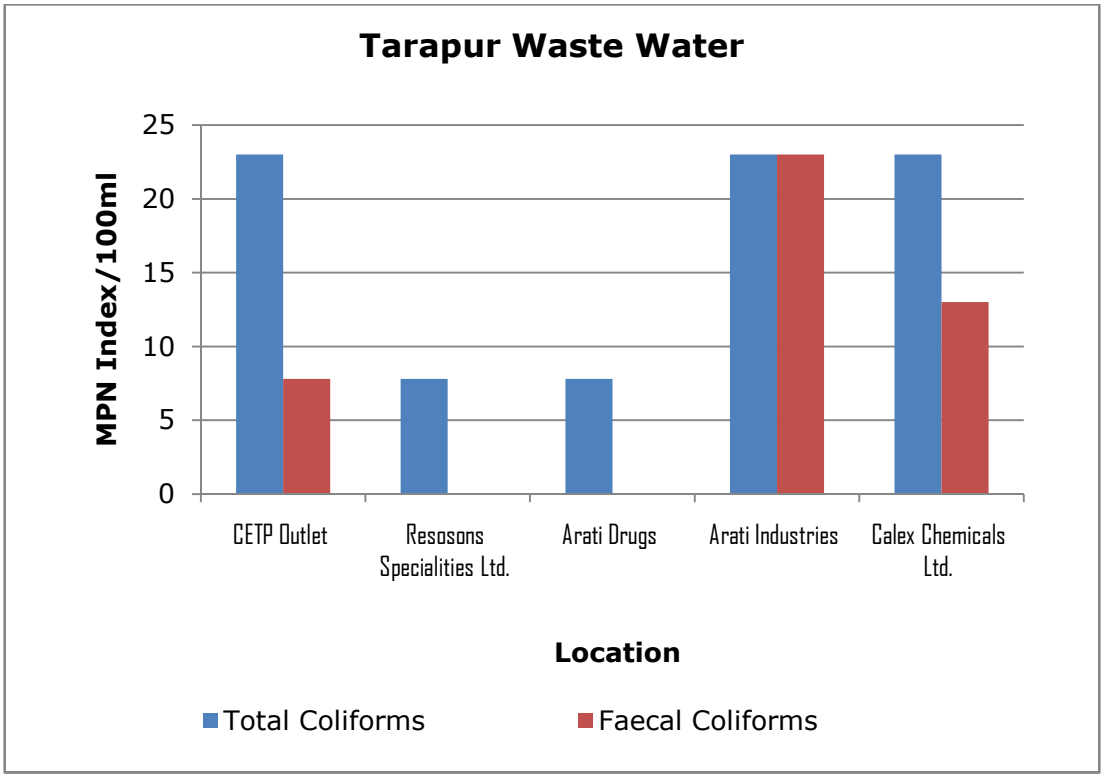
Location				Resonance Specialities Ltd.	Aarti Drugs	Aarti Industries	Calex Chemicals Ltd.
Date of Sampling				04.02.19	04.02.19	04.02.19	04.02.19
Sr.	**Parameters**		**Std. Limit**	**Results**			
44.	Boron (as B)	mg/L		BDL	BDL	BDL	BDL
45.	Bioassay Test on fish	% survival	**90% survival after 96h in 100% effluent**	100	0	100	100

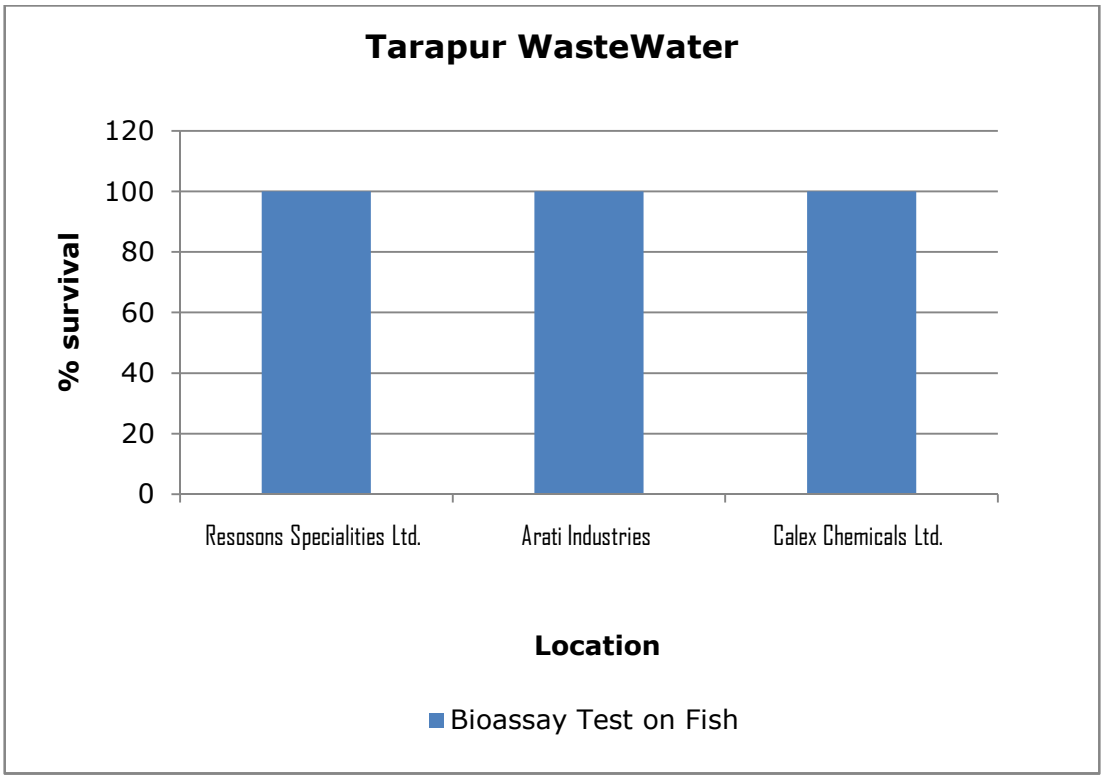
Graphs: Waste Water Monitoring




Tarapur Waste Water
90
80
70
60
50
40
30
20
10
0
CETP Inlet
CETP Outlet
Siyaram Silk
Resosons Specialities Ltd.
Arati Drugs
Arati Industries
Calex Chemicals Ltd.
Location
Sodium Adsorption Ratio
pH


Tarapur WasteWater
Concentration (µmhos/cm)
14000
12000
10000
8000
6000
4000
2000
0
CETP Inlet
CETP Outlet
Siyaram Silk
Resosons Specialities Ltd.
Arati Drugs
Arati Industries
Calex Chemicals Ltd.
Location
Electrical Conductivity


Tarapur Waste Water
MPN Index/100ml
25
20
15
10
5
0
CETP Outlet
Resosons Specialities Ltd.
Arati Drugs
Arati Industries
Calex Chemicals Ltd.
Location
Total Coliforms
Faecal Coliforms


Tarapur WasteWater
% survival
120
100
80
60
40
20
0
Resosons Specialities Ltd.
Arati Industries
Calex Chemicals Ltd.
Location
Bioassay Test on Fish

3.4 Ground Water Analysis Results:

Sr. No.	Locations	Included in
1.	Ankush Gharatwadi	Table I
2.	Dhodi Pooja Area	Table I
3.	Lala Vajpayee Area	Table I
4.	Chiku Wadi	Table II
5.	Kumbhavali Village	Table II
6.	Salvad Village	Table II

Table I

Location				**Dhodi Pooja Area**	**Lala Vajpayee Area**	**Salvad Village**
Type				Borewell	Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**	**04.02.19**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen	**5**	1	1	1
2.	Odour		**Agreeable**	Agreeable	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	7.54	7.75	7.75
4.	Oil & Grease	mg/L	**100**	BDL	BDL	BDL
5.	Suspended Solids	mg/L	**500**	14	14	10
6.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	37	32	13
7.	Biochemical Oxygen Demand (3 days, 27^{o} C)	mg/L	**6 (WHO, 1993)**	12	11	BDL

Location				**Dhodi Pooja Area**	**Lala Vajpayee Area**	**Salvad Village**
Type				Borewell	Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**	**04.02.19**
8.	Electrical Conductivity (at 25° C)	µmhos/cm	**750**	523	1298	2330
9.	Nitrite Nitrogen (as N)	mg/L		BDL	BDL	BDL
10.	Nitrate Nitrogen (as N)	mg/L	**45**	6.49	4.90	9.29
11.	$(NO_2 + NO_3)$-Nitrogen	mg/L	**1.0**	6.49	4.90	9.29
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**	1.25	1.27	1.18
16.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL	BDL
17.	Dissolved Phosphate (as P)	mg/L		BDL	BDL	BDL
18.	Sodium Absorption Ratio			1.33	BDL	4.18
19.	Total Coliforms	MPN index/100 mL	**ND**	79	63	11
20.	Faecal Coliforms	MPN index/100 mL	**ND**	23	26	BDL
21.	Total Phosphorous (as P)	mg/L	**0.5**	BDL	BDL	BDL

Location				**Dhodi Pooja Area**	**Lala Vajpayee Area**	**Salvad Village**
Type				Borewell	Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**	**04.02.19**
22.	Total Kjeldahl Nitrogen	mg/L	**0.001**	0.39	0.90	1.34
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	**0.05**	BDL	BDL	BDL
26.	Organo Chlorine Pesticides	µg/L				
i.	Alachlor	µg/L		BDL	BDL	BDL
ii.	Atrazine	µg/L	**2**	BDL	BDL	BDL
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**	BDL	BDL	BDL
vi.	Beta HCH	µg/L	**0.04**	BDL	BDL	BDL
vii.	Chlorpryriphos	µg/L		BDL	BDL	BDL
viii.	Butachlor	µg/L	**125**	BDL	BDL	BDL
ix.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
x.	p,p DDT	µg/L	**1**	BDL	BDL	BDL
xi.	o,p DDT	µg/L	**1**	BDL	BDL	BDL
xii.	p,p DDE	µg/L	**1**	BDL	BDL	BDL

Location				**Dhodi Pooja Area**	**Lala Vajpayee Area**	**Salvad Village**
Type				Borewell	Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**	**04.02.19**
xiii.	o,p DDE	µg/L	**1**	BDL	BDL	BDL
xiv.	p,p DDD	µg/L	**1**	BDL	BDL	BDL
xv.	o,p DDD	µg/L	**1**	BDL	BDL	BDL
xvi.	Alpha Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
xvii.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
xviii.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL	BDL
xix.	Y HCH (Lindane)	µg/L	**2.0**	BDL	BDL	BDL
27.	Polynuclear aromatic hydrocarbons (as PAH)	µg/L	**0.0001**	BDL	BDL	BDL
28.	Polychlorinated Biphenyls (PCB)	µg/L	**0.0005**	BDL	BDL	BDL
29.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL	BDL
30.	Nickel (as Ni)	mg/L	**0.02**	BDL	BDL	BDL
31.	Copper (as Cu)	mg/L	**0.05**	BDL	BDL	0.152
32.	Hexavalent Chromium (as Cr^{6+})	mg/L	**1**	BDL	BDL	BDL
33.	Total Chromium (as Cr)	mg/L	**0.05**	BDL	BDL	BDL
34.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL	BDL
35.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL	BDL

Location				**Dhodi Pooja Area**	**Lala Vajpayee Area**	**Salvad Village**
Type				Borewell	Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**	**04.02.19**
36.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL	BDL
37.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL	BDL
38.	Manganese (as Mn)	mg/L	**0.1**	BDL	BDL	0.129
39.	Iron (as Fe)	mg/L	**0.3**	0.138	0.137	0.082
40.	Vanadium (as V)	mg/L		BDL	BDL	BDL
41.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL	BDL
42.	Boron (as B)	mg/L		BDL	BDL	BDL
43.	Bioassay Test on fish	% survival		0	0	100

Table II

Location				**Ankush Gharat wali**	**Chiku Wadi**
Type				Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**
Sr.	**Parameter**	**Std. Limit**	**Results**		
1.	Colour	Hazen	**5**	1	1
2.	Odour		**Agreeable**	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	8.03	6.91
4.	Oil & Grease	mg/L	**100**	BDL	BDL
5.	Suspended Solids	mg/L	**500**	12	18

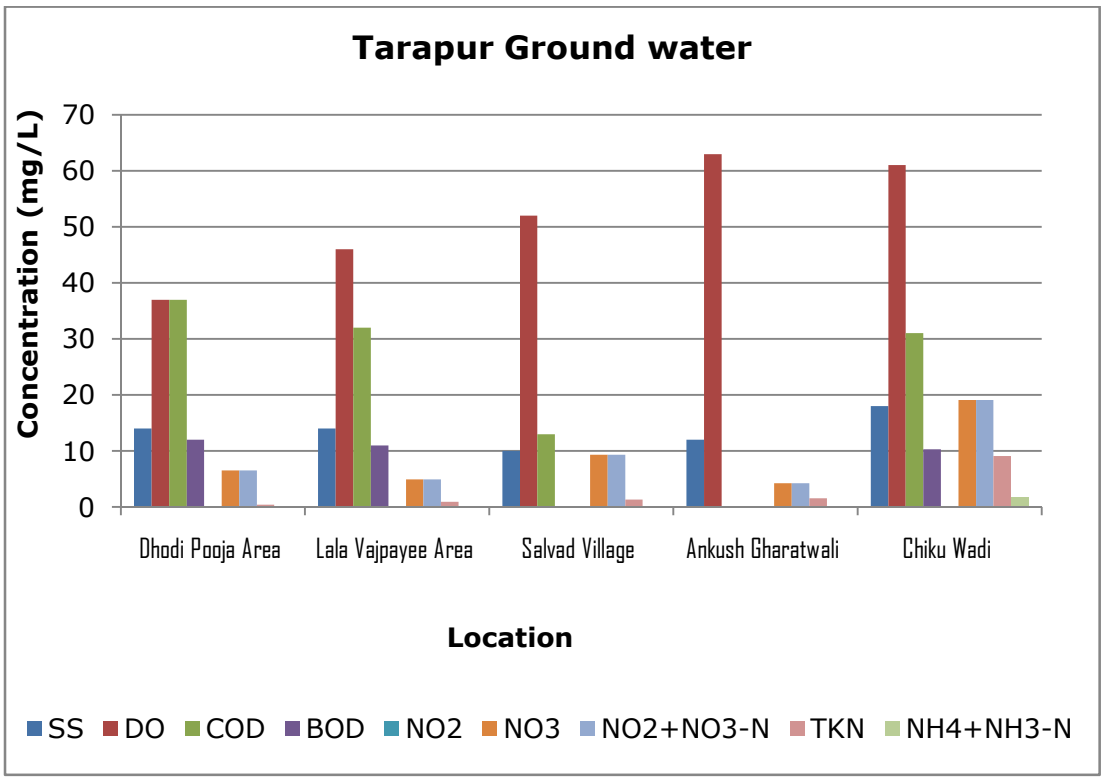
Location				**Ankush Gharat wali**	**Chiku Wadi**
Type				Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**
6.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	BDL	31
7.	Biochemical Oxygen Demand (3 days, 27^{o} C)	mg/L	**6 (WHO, 1993)**	BDL	10.3
8.	Electrical Conductivity (at 25^{o} C)	µmhos/cm	**1000**	745	5570
9.	Nitrite Nitrogen (as N)	mg/L		BDL	BDL
10.	Nitrate Nitrogen (as N)	mg/L	**45**	4.22	19.1
11.	(NO_2 + NO_3)-Nitrogen	mg/L	**1.0**	4.22	19.1
12.	Free Ammonia (as NH_3-N)	mg/L	**0.5**	BDL	BDL
13.	Total Residual Chlorine	mg/L	**0.2**	BDL	BDL
14.	Cyanide (as CN)	mg/L		BDL	BDL
15.	Fluoride (as F)	mg/L	**1**	0.63	0.75
16.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL
17.	Dissolved Phosphate (as P)	mg/L		BDL	BDL
18.	Sodium Absorption Ratio			0.58	1.34
19.	Total Coliforms	MPN index/100 mL	**ND**	43	70
20.	Faecal Coliforms	MPN index/100 mL	**ND**	BDL	17

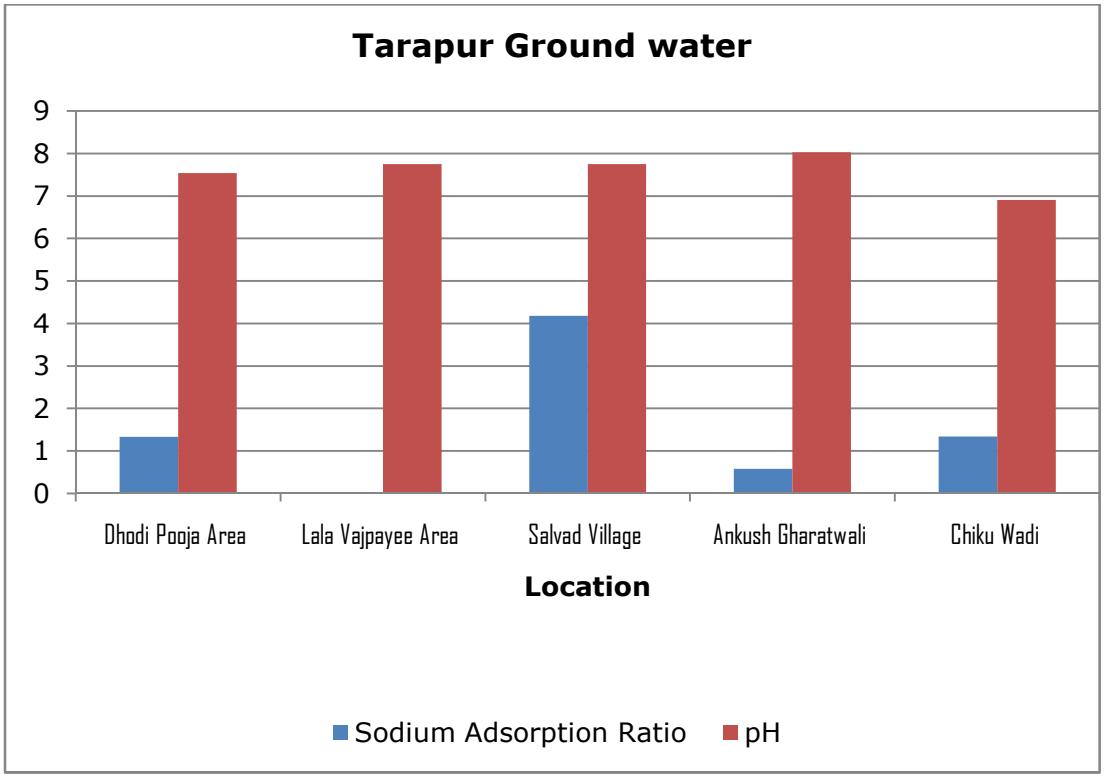
Location				**Ankush Gharatwali**	**Chiku Wadi**
Type				Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**
21.	Total Phosphorous (as P)	mg/L	**0.5**	BDL	BDL
22.	Total Kjeldahl Nitrogen	mg/L	**0.001**	1.57	9.1
23.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.5**	BDL	1.7
24.	Phenols (as C_6H_5OH)	mg/L	**0.001**	BDL	BDL
25.	Surface Active Agents (as MBAS)	mg/L	**0.05**	BDL	BDL
26.	Organo Chlorine Pesticides	µg/L			
i.	Alachlor	µg/L		BDL	BDL
ii.	Atrazine	µg/L	**2**	BDL	BDL
iii.	Aldrin	µg/L	**0.03**	BDL	BDL
iv.	Dieldrin	µg/L	**0.03**	BDL	BDL
v	Alpha HCH	µg/L	**0.01**	BDL	BDL
vi.	Beta HCH	µg/L	**0.04**	BDL	BDL
vii.	Chlorpryriphos	µg/L	**0.04**	BDL	BDL
viii	Butachlor	µg/L		BDL	BDL
viii.	Delta HCH	µg/L	**125**	BDL	BDL
ix.	p,p DDT	µg/L	**1**	BDL	BDL
x.	o,p DDT	µg/L	**1**	BDL	BDL
xi.	p,p DDE	µg/L	**1**	BDL	BDL

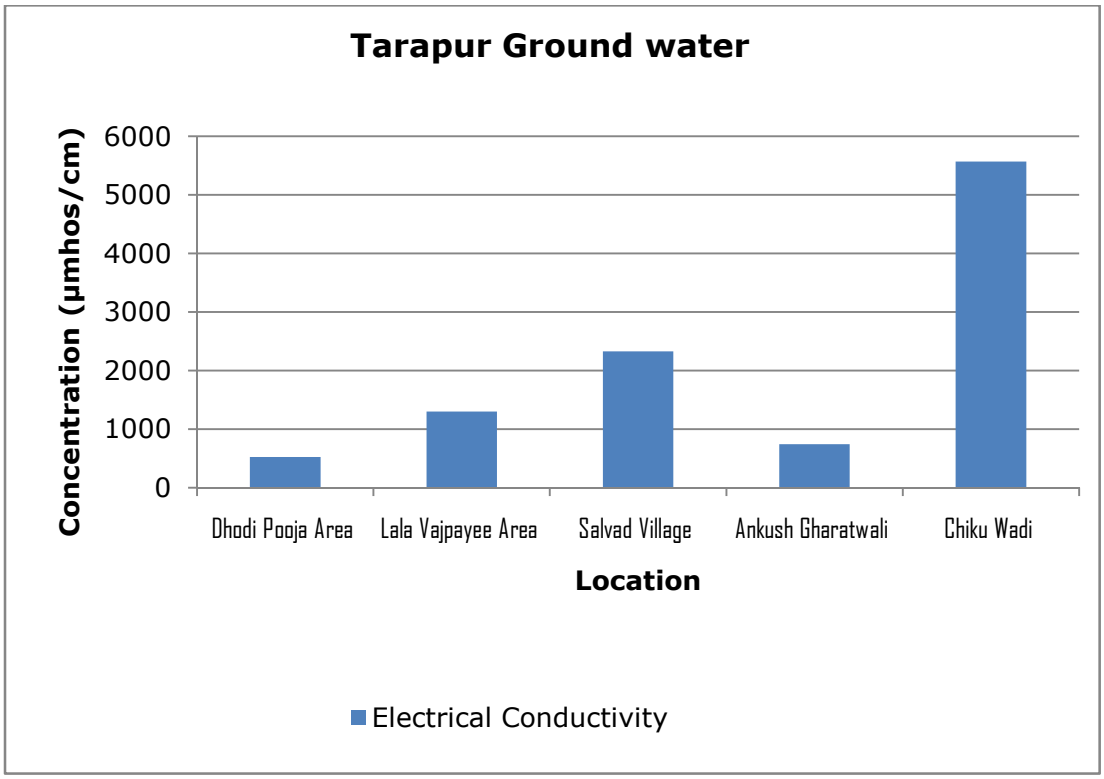
Location				**Ankush Gharatwali**	**Chiku Wadi**
Type				Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**
xii.	o,p DDE	µg/L	**1**	BDL	BDL
xiii.	p,p DDD	µg/L	**1**	BDL	BDL
xiv.	o,p DDD	µg/L	**1**	BDL	BDL
xv.	Alpha Endosulfan	µg/L	**0.4**	BDL	BDL
xvi.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL
xvii.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL
xviii.	Y HCH (Lindane)	µg/L	**2.0**	BDL	BDL
31.	Polynuclear aromatic hydrocarbons (as PAH)	µg/L	**0.0001**	BDL	BDL
32.	Polychlorinated Biphenyls (PCB)	µg/L	**0.0005**	BDL	BDL
33.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL
34.	Nickel (as Ni)	mg/L	**0.02**	BDL	0.022
35.	Copper (as Cu)	mg/L	**0.05**	BDL	7.39
36.	Hexavalent Chromium (as Cr^{6+})	mg/L	**1**	BDL	BDL
37.	Total Chromium (as Cr)	mg/L	**0.05**	0.022	0.022
38.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL
39.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL
40.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL

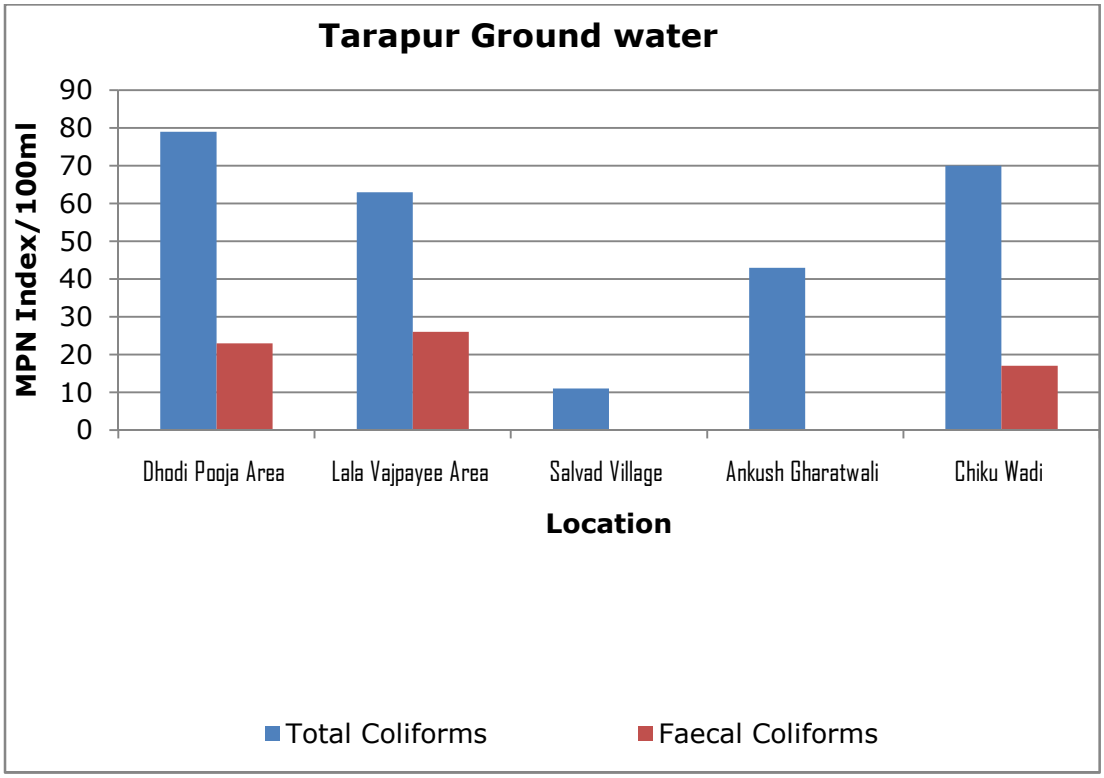
Location				**Ankush Gharat wali**	**Chiku Wadi**
Type				Borewell	Borewell
Date of Sampling				**04.02.19**	**04.02.19**
41.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL
42.	Manganese (as Mn)	mg/L	**0.1**	3.69	3.75
43.	Iron (as Fe)	mg/L	**0.3**	0.091	0.091
44.	Vanadium (as V)	mg/L		BDL	BDL
45.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL
46.	Boron (as B)	mg/L	**1.0-5.0**	BDL	BDL
47.	Bioassay Test on fish	% survival		100	0

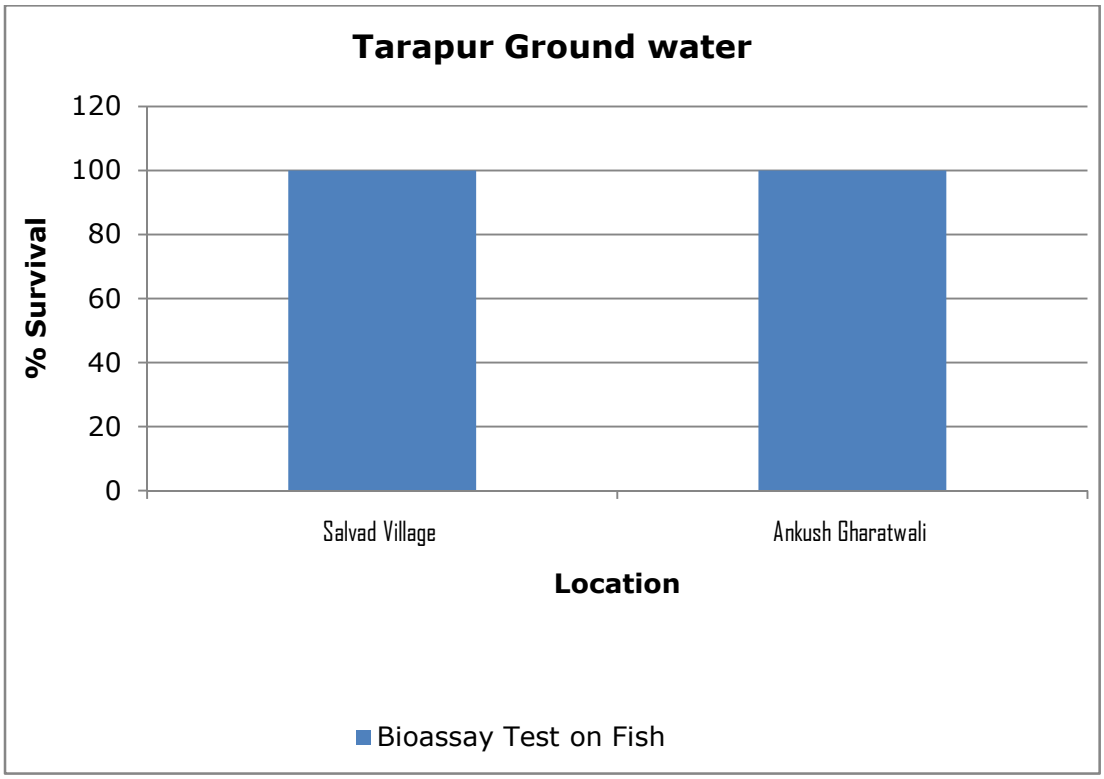
Graphs: Ground Water Monitoring Results:




Tarapur Ground water
9
8
7
6
5
4
3
2
1
0
Dhodi Pooja Area
Lala Vajpayee Area
Salvad Village
Ankush Gharatwali
Chiku Wadi
Location
Sodium Adsorption Ratio
pH


Tarapur Ground water
Concentration (µmhos/cm)
6000
5000
4000
3000
2000
1000
0
Dhodi Pooja Area
Lala Vajpayee Area
Salvad Village
Ankush Gharatwali
Chiku Wadi
Location
Electrical Conductivity


Tarapur Ground water
MPN Index/100ml
90
80
70
60
50
40
30
20
10
0
Dhodi Pooja Area
Lala Vajpayee Area
Salvad Village
Ankush Gharatwali
Chiku Wadi
Location
Total Coliforms
Faecal Coliforms


Tarapur Ground water
% Survival
120
100
80
60
40
20
0
Salvad Village
Ankush Gharatwali
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 Mandana Industries Ltd., Siyaram Silk, IVP Ltd., Sarex Overseas, Lupin Ltd. and Dicitex Furnishing. Results show that concentration of all the parameters, particulate matter, nitrogen dioxide and sulphur dioxide, are below the standard limits. Particulate matter is observed in the range of 25 to 45 mg/Nm^3 and sulphur dioxide in the range of Below Detection Limit (BDL i.e.<5) to 34.3 mg/Nm^3. However, the nitrogen dioxide is observed is observed with the range of 13.1 mg/Nm^3 – 16.3mg/Nm^3.

4.2 Ambient Air Monitoring:

At Tarapur, ambient air quality was monitored at six locations namely: Mandana Industries Ltd., Siyaram Silk, IVP Ltd., Sarex Overseas, CETP and Lupin Ltd. At all these places 12 parameters of ambient air quality standards were monitored.

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 in the range of 5.36 to 5.80 µg/m^3.
2. **Nitrogen Dioxide (NO_x):** All the results for SO_2 are observed lower than the standard limit of 80 µg/m^3. It is observed in the range of 8.21 to 10.6 µg/m^3.
3. **Particulate Matter (PM_{10}):** It is the most critical parameter as its higher concentration in the air affects ecosystem health a lot. However, 50% of all the locations are observed with above the standard limit of 100 µg/m^3 of PM10. Minimum of 72µg/m^3 is observed at Lupin Ltd. and maximum of 401 µg/m^3 at Mandhana Industries Ltd.
4. **Particulate Matter ($PM_{2.5}$):** Concentration of $PM_{2.5}$ also followed the similar trend as PM_{10} is observed. It is observed in the range of 16 to 99 µg/m^3.
5. **Ozone (O_3):** All values of O_3 recorded below the detection limit i.e.19.8µg/m^3.
6. **Lead (Pb):** Lead is categorised as known human carcinogen by CPCB. In our results, concentration of Lead is found below the standard limit.
7. **Carbon Monoxide (CO):** Values of Carbon Monoxide are also observed below standard limit at all the studied locations. It is observed minimum of 1.71 mg/m^3 at Mandhana Industries Ltd. and maximum (5.04mg/m^3) at Siyaram Silks.
8. **Ammonia (NH_3):** All values of O_3 recorded below the detection limit.
9. **Benzene:** Benzene falls under group C category, which includes known carcinogens. All values are recorded below the standard limit of 5µg/m^3.
10. **Benzo (a) Pyrene (BaP):** All values recorded below the detection limit i.e. <0.2ng/m^3.
11. **Arsenic:** Arsenic values are also observed well below the detection limit i.e. BDL.
12. **Nickel:** All the values are observed below the standard limit of 20 ng/m^3.

4.3 Waste Water Quality:

Seven samples of ETP outlet and inlet were collected from different industries in Tarapur region. The quality of waste water was determined by determining various parameters as per standards and corresponding results are discussed below:

1. **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 5.73 to 8.22.
2. **Oil and Grease:** All values within the acceptable range.

3. **Suspended Solids:** All the samples of different locations are found within the acceptable limits.
4. **Chemical Oxygen Demand:** Chemical Oxygen Demand is found above the standards of 250 mg/L in two water samples namely CETP inlet (4400 mg/L) and CETP Outlet (2400 mg/L).
5. **Biochemical Oxygen Demand:** Biochemical Oxygen demand also exhibits the same picture as COD. This is recorded highest (1470 mg/L) at CETP inlet and minimum at CETP Outlet (799 mg/L).
6. **Total Kjeldahl Nitrogen:** It is also observed beyond permissible limit at two locations namely CETP inlet (1140 mg/L) and CETP Outlet (627 mg/L).
7. **Total Ammonia:** Out of all values of minimum is observed as BDL at three locations and maximum is observed as 68 mg/L at CETP Inlet.
8. **Metals:** All metals like Arsenic, Nickel, Copper, Hexavalent Chromium (Cr^{6+}) are observed either below detection limit or below their standard limits. However water sample of CETP Inlet is observed with above permissible limits of metals also.
9. **Fish Bioassay:** Fish bioassay exhibits 0-100% survival.
10. Parameters like Total Residual Chlorine, Cyanide, Fluoride, Sulphide, Dissolved Phosphate, Total Ammonical Nitrogen and Phenolic compounds, also meet the criteria as prescribed by CPCB.

4.4 Ground Water Quality:

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

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 6.91 to 8.03.
4. **Chemical Oxygen Demand:** Except Ankush Ghratwadi water sample (<5mg/L), all other samples were detected above the standard limit of 10 mg/L set by WHO. It is ranged from <5 to 37 mg/L.
5. **Biological Oxygen Demand:** Except Ankush Ghratwadi and Salvad village water samples, all other samples were detected above the standard limit of 6 mg/L set by WHO. It is ranged from <1 to 12 mg/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 4.22mg/L and 19.1mg/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**: observed within the acceptable range.
5. **Cyanide:** Concentration of cyanide in all the bore well water is very much below the standard.
6. **Fluoride:** out of five, three samples are observed above standard limit. It is observed in the range of 0.63 to 1.27 mg/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.
10. **Metals:** Metals like Copper, Total Chromium, Lead, Arsenic, Cadmium and Mercury are well within the acceptable limits of drinking water standards.
11. **PAH & PCB** are also below the acceptable limits.
12. **Fish Bioassay:** Fish bioassay exhibits 0-100% survival

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.

CPCB had evolved certain methodology to calculate CEPI, in which a score has been fixed for different environmental components based on the level of pollution. The scoring system involves an algorithm that takes into account the basic selection criteria. This approach is based on the basic hazard assessment logic that can be summarized as below.

Hazard = pollutant source, pathways, and receptor

CPCB has calculated CEPI for the identified critically polluted industrial clusters. It is calculated separately for air, water, and land. The basic framework and scoring system of the CEPI – based on three factors namely pollutant, pathway, and receptor – has been described further under this section.

To overcome the subjectivity, revised concept is proposed by eliminating the subjective factors as described in the previous section but retaining the factors which can be measured precisely.

I. Revised concept is prepared by eliminating the debatable factors but retaining the factors which can be measured precisely.

II. It is decided to develop the Comprehensive Environmental Pollution Index (CEPI) retaining the existing algorithm of Source, Pathway and Receptor.

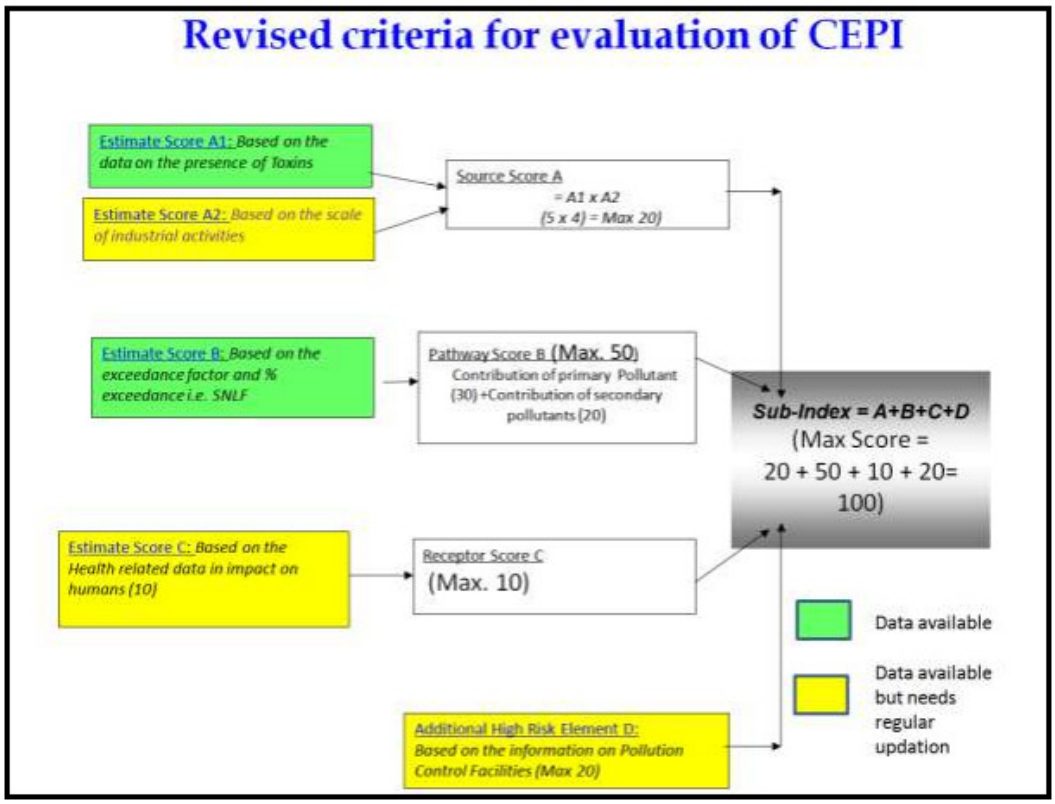
III. Health component was also retained in the revised concept in line with the suggestions of Secretary, MoEFCC during the meeting held in MoEF.

Outlines of revised CEPI 2016 criteria

The outlines of the revised CEPI criteria are as follows:

1. It is proposed to develop the Comprehensive Environmental Pollution Index (CEPI) based on Sources of pollution, real time observed values of the pollutants in the ambient air, surface water and ground water in & around the industrial cluster and health related statistics.
2. For assessment of the environmental quality of the area i.e. CEPI score, the concept of SNLF i.e. a surrogate number which represents the level of exposure (a function of percentage sample Exceedance & Exceedance Factor) shall be used.
3. Health component to be evaluated based on the health data available from major hospitals in the area was also retained in the revised concept.

The evaluation criterion of the revised CEPI version 2016 is described in the flowchart given below:



Here, health data collected for Receptor Score C is included in Annexure I

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

Since the inception of the programme, MPCB has also formulated Action Plans to mitigate the environmental pollution problems for each of the 8 Critically Polluted Areas (CPAs) in Maharashtra. Based on available information, parameters selected and monitored in continuation with this, CEPI has been calculated and Short-Term Action Plan (STAP) as well as Long Term Action Plan (LTAP) was prepared in 2010.

Subsequently NAAQS 2009 came in force. List of parameters to be considered increased and expanded including more critical and hazardous pollutants like benzene, BaP, Metals,

etc. existing in the environment. There was revision of standards (limiting values) as well. In this present report of 2016 prepared by MPCB, CEPI is calculated considering all these revised standards' limiting values, list of parameters and complete scope of monitoring.

5.1 Comparison of CEPI scores:

The result shows that CEPI score of present report is 53.60. The present study is the compilation of post monsoon season, which also regulates the score value. This time locations under study were different from past studies. Hence, comparative results cannot be illustrated and discussed. But the overall CEPI is observed as 53.60 in Tarapur city, which falls below the category of severely polluted areas, according to the revised CEPI guidelines. Hence, it can be concluded that the industries are following environmental rules and regulations laid by MoEF and MPCB to control the pollution and to keep the environment clean and green.

Detailed and Aggregated CEPI score of present report is being compared with the previous years studies in the tables given below:

Air:

	A1	**A2**	**A**	**B1**	**B2**	**B3**	**B**	**C1**	**C2**	**C3**	**C**	**D**	**CEPI**
CEPI score Feb 2019	2	4	8				16.75				0	10	**34.75**
CEPI score June 2018	2	4	8				8				0	10	**26**
CEPI score February 2018	2.75	4	11				11.5				0	10	**32.5**
CEPI score June 2017	2.5	4	10	-	-	-	0	-	-	-	0	10	**20**
CEPI score February 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	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
CEPI score Feb 2019	2.5	4	10				20				0	15	45
CEPI score June 2018	2.5	4.	10				14.25				0	15	**39.25**
CEPI score February 2018	2.5	4	14				13.5				0	15	**38.5**
CEPI score June 2017	3.5	4	14	-	-	-	20	-	-	-	0	15	**49**
CEPI score February 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	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
CEPI score Feb 2019	2.5	4	10				20				0	15	**45**
CEPI score June 2018	2.5	4	10				20				0	15	**45**
CEPI score February 2018	2.5	4	10				20				0	15	**45**
CEPI score June 2017	3.5	4	14	-	-	-	17.25	-	-	-	0	15	**46.25**

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 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	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
CEPI score February 2019	34.75	45	45	**53.60**
CEPI score June 2018	26	39.25	45	**50.61**
CEPI score February 2018	32.5	38.5	45	**51.88**
CEPI score June 2017	20	49	46.25	**53.72**
CEPI score February 2017	46	59	46	**67.67**
CEPI Score 2016	56	46	47	**65.51**
CEPI score 2013	74	57.25	74	**85.01**
CPCB Report 2009	60.75	51.25	56	**72.01**

6 Conclusions

This is an attempt to check the characteristics and status of environment among the different industrial clusters of Tarapur city. Revised CEPI version 2016 includes 2 major modifications in terms of evaluation of data: (1) It includes Contribution of primary as well as secondary pollutants under Factor B (Max Value 50) and (2) Exhaustive collection of health data of people residing in the vicinity of industrial clusters under study, Factor C (Max Value 10). This has changed the entire criteria of calculating CEPI as compared to the previous CEPI version and hence affected the overall CEPI score also. 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.

Parameters of air sampling are observed within the standard limit all the sampling locations. Among waste water samples, BOD and COD of CETP Inlet, CETP outlet samples are found beyond standard limit. All the ground water samples are found within the limits except BOD and COD of few the water samples, which are observed above standard limits at one location.

Moreover, the lower value (53.60) 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. Overall CEPI figures are comprised in the table below:

	A1	A2	A	B	C	D	CEPI
Air Index	2	4	8	16.75	0	10	**34.75**
Water Index	2.5	4	10	20	0	15	**45**
Land Index	2.5	4	10	20	0	15	**45**
						Aggregated CEPI	**53.60**

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 67.67 of June to 53.60. 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. Aarti 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

g) 7 No. of Textile industries has provided zero discharge system and recycling about 2434 CMD

8 Photographs

Mandhana Industries

Lupin Ltd.

Sarex Overseas

Siyaram Silk Mills

IVP Ltd.

CETP

CETP Inlet

CETP Outlet

Resonance Specialities

Siyaram Silk Mills

Chikuwadi borewell

Dhodi Pooja borewell

Salvad Village borewell

Lalla vajpayee Well water

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: Dombivli, November 2010, MPCB
5. Action Plan for Industrial Cluster: Aurangabad, November 2010, MPCB
6. Action Plan for Industrial Cluster: Navi Mumbai, November 2010, MPCB
7. Action Plan for Industrial Cluster: Navi Mumbai, 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 Health related data in impact on humans

C: Receptor

Component C **(Impact on Human Health)** **10**	
Main - 10	
% increase in cases	**Marks**
<5%	**0**
5-10%	**5**
>10%	**10**

- % increase is evaluated based on the total no. of cases recorded during two consecutive years.
- For Air Environment, total no. of cases related to Asthma, Bronchitis, Cancer, Acute respiratory infections etc. are to be considered.
- For surface water/ ground water Environment, cases related to Gastroenteritis, Diarrhoea, renal (kidney) malfunction, cancer etc are to be considered.
- For the above evaluation, the previous 5 years records of 3-5 major hospitals of the area shall be considered.

Attached below health data collected for the region

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

1. **Name of the Polluted Industrial Area (PIA):** Tarapur
2. **Name of the major health centre/ organization:** Thunga Hospital
3. **Name and designation of the contact person:**
4. **Address:** AM-32,Tarapur M.I.D.C., Boisar, Maharashtra 401506
5. **Year of Establishment:**

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases					
1.	**Asthma**	21	53			
2.	**Acute Respiratory Infection**	58	184			
3.	**Bronchitis**	26	43			
4.	**Cancer**	2	6			
	Water Borne Diseases					
5.	**Gastroenteritis**	50	101			
6.	**Diarrhea**	154	133			
7.	**Renal diseases**	0	0			
8.	**Cancer**	0	0			

Signature of the Hospital Head/ Superintend

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

6. **Name of the Polluted Industrial Area (PIA):**
7. **Name of the major health centre/ organization:** TAPS Hospital
8. **Name and designation of the contact person:**
9. **Address:** Tarapur Rd, Boisar, Maharashtra 401504
10. **Year of Establishment:**

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases					
1.	**Asthma**	27	59			
2.	**Acute Respiratory Infection**	95	75			
3.	**Bronchitis**	5				
4.	**Cancer**					
	Water Borne Diseases					
5.	**Gastroenteritis**	39	73			
6.	**Diarrhea**	41	37			
7.	**Renal diseases**					
8.	**Cancer**					

Signature of the Hospital Head/ Superintend

Annexure II: 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 2): 1985, Reaffirmed 2003	Titrimetric IPA thorine Method	5.0 mg/Nm^3 0.02 kg/day

Sr.	Parameters	Method References	Techniques	Detection Limit
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 III: 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	4.0 µg/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
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

Sr.	Parameters	Method References	Techniques	Detection Limit
11.	Arsenic (As)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.3 ng/m^3
12.	Nickel (Ni)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	3.0 ng/m^3

Annexure IV: 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

Sr.	Parameters	Methods References	Techniques	Detection Limit
14.	Nitrate-Nitrogen	APHA,22nd Ed., 2012, 4500-NO_3, B-4-122	UV Spectrophotometer Screening Method	0.2 mg/L
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 V 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	Iodometric Method	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, 22nd 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

Sr.	Parameters	Methods References	Techniques	Detection Limit
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 (MPN/100ml)	1.1 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 V: 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 VI: 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

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
7.	Oil and Grease mg/L, Max	10	20	10	20
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/L, 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
34.	Phenolic compounds (as C_6H_5OH), mg/L, Max.	1.0	5.0	--	5.0

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
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 VII: 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
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

Sr.	**Characteristic**	**Unit**	**Requirement (Acceptable Limit)**	**Permissible Limit in the Absence of Alternate Source**
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 (as Cd)	mg/L	Max 0.003	No relaxation
32.	Cyanide (as CN)	mg/L	Max 0.05	No relaxation
33.	Lead (as Pb)	mg/L	Max 0.01	No relaxation
34.	Mercury (as Hg)	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
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

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
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
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

Sr.	**Characteristic**	**Unit**	**Requirement (Acceptable Limit)**	**Permissible Limit in the Absence of Alternate Source**
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			
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 VIII: CPCB Water Quality Criteria:

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	➢ Total coliform organisms (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 IX: 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, mg/l	<25	<50	<100

Sr.	Parameters	Requirement for Waters of Class		
		A Excellent	B-Desirable	C-Acceptable
(vii)	Fecal 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	<2 µg/l	<5 µg/l	<10 µg/l
(v)	Surface Active Agents	<20 µg/l	<100 µg/l	<200 µg/l
(vi)	Organo Chlorine Pesticides	<0.05 µg/l	<0.1 µg/l	<0.2 µg/l
(vii)	PAH	<0.05 µg/l	<0.1 µg/l	<0.2 µg/l
(viii)	PCB and PCT	<0.01 µg/l	<0.01 µg/l	<0.02 µg/l
(ix)	Zinc	<100 µg/l	<200 µg/l	<300 µg/l
(x)	Nickel	<50 µg/l	<100 µg/l	<200 µg/l
(xi)	Copper	<20 µg/l	<50 µg/l	<100 µg/l

Sr.	Parameters	Requirement for Waters of Class		
		A- Excellent	B-Desirable	C-Acceptable
(xii)	Chromium (Total)	<20 µg/l	<50 µg/l	<100 µg/l
(xiii)	Arsenic (Total)	<20 µg/l	<50 µg/l	<100 µg/l
(xiv)	Lead	<20 µg/l	<50 µg/l	<100 µg/l
(xv)	Cadmium	<1.0 µg/l	<2.5 µg/l	<5.0 µg/l
(xvi)	Mercury	<0.2 µg/l	<0.5 µg/l	<1.0 µg/l