ACTION PLAN FOR INDUSTRIAL CLUSTER IN SEVERLY POLLUTED AREA

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

चेंबूर Chembur

Maharashtra Pollution Control Board

Kalptaru Point, Sion East, Mumbai - 400022

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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:

India has experienced rapid industrial growth in last few years. Maharashtra is one of the most industrialised states in the country. The state has identified industrial sectors like auto, engineering, chemical, electronics and textile as focus sectors. Industrial processes and activities consume materials and resources for manufacturing products generating emissions, effluents and solid wastes. Rise in growth in industrial activities is leading to manifold impacts to the environment. This environmental pollution is a wide reaching problem and if not controlled to certain tolerable levels, it is likely to influence the human health too. Long term exposure to the polluted air and water causes chronic health problems. 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.

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. 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. 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. For the study, Central Pollution Control Board (CPCB) has selected a total of 88 industrial areas or clusters in consultation with the Ministry of Environment & Forests Government of India. Out of these, 5 critically polluted industrial clusters namely Tarapur, Dombivali, Navi Mumbai, Aurangabad and Chandrapur, are identified and 3 severely polluted industrial clusters namely Pimpri-chinchwad, Nashik and Chembur from Maharashtra are added into this list.

Chembur is a suburb in eastern Mumbai, India. Chembur has pollution problems and was ranked 46th in a list of the most polluted industrial clusters in India. Effluents from oil refineries, fertilizer plants and reactors located in Chembur are also said to have polluted sea water in Thane Creek and affected marine life. The Deonar dumping ground in Deonar has caused health issues for the residents of Chembur. In 2008, around 40 residents of Chembur went on a hunger strike to protest against the frequent fires and smoke. Again in 2012, the residents complained to the Brihanmumbai Municipal Corporation on the smoke coming out of the dumping ground, which has been affecting asthma patients.

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 Chembur:

- The sampling was carried out in 4 days i.e. on 15th to & 19th June 2018 for Chembur region.
- A total of 6 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 7 Waste Water Samples, 4 Ground Water Samples and 3 VOC Samples from Ambient Air were collected and analyzed.

2.1 Stack Emission Parameters

<u>The Stack Emissions were analyzed with the following parameters:</u>

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.

2.3 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.
- BDL specifies that the result obtained is below deductable limit.

3.1 Stack Emission:

Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D.

Sr.	Name of Industry	Stack Identity	Table No.
1.	Tata Power Trombay thermal power station, Mahul	ESP	**I**
2.	RCF Mahul	Common Boiler Exhaust Chimney	**I**
3.	RCF Mahul	Furnes Scrubber	**I**
4.	BPCL Mahalgaon	-	**II**
5.	HPCL	CCR Hrsg 102 & 1001	**II**
6.	HPCL	CCR Hrsg=102 & 2001	**II**

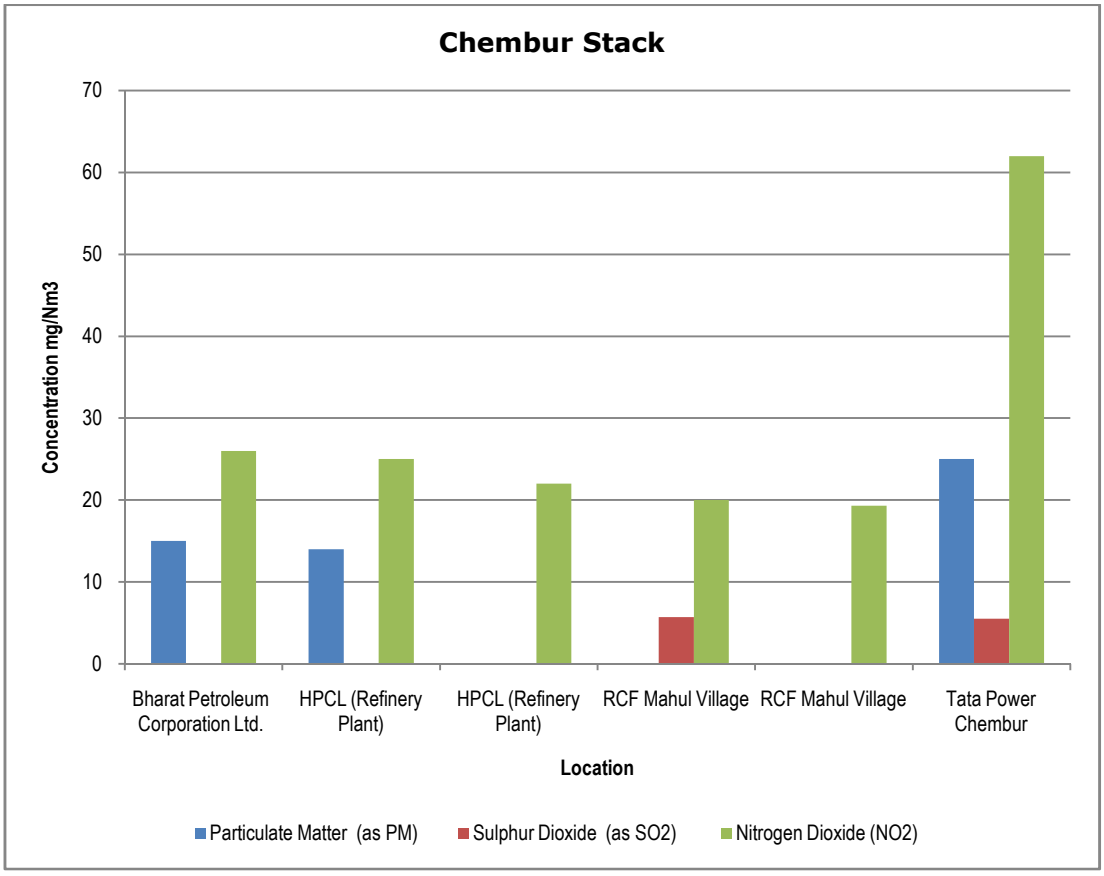
Table No. I

Name of Industry			**Tata Power Trombay thermal power station**	**RCF Mahul**	**RCF Mahul**
Date of Sampling			**16.06.18**	**15.06.18**	**15.06.18**
Sr.	**Parameter**	**Unit**	**Results**		
1.	Particulate Matter (as PM)	mg/Nm^3	15	14	BDL
	Std. Limit	**mg/Nm^3**	**100**	**100**	**100**
2.	Sulphur Dioxide (as SO_2)	mg/Nm^3	BDL	BDL	BDL
		kg/day	BDL	BDL	BDL
	Std. Limit	**mg/Nm^3**	**1700**	**1700**	**1700**
3.	Nitrogen Dioxide (NO_2)	mg/Nm^3	26	25	22
	Std. Limit	**mg/Nm^3**	**450**	**450**	**450**

Table No. II

Name of Industry			**BPCL Mahalgaon**	**HPCL**	**HPCL**
Date of Sampling			**18.06.18**	**18.06.18**	**18.06.18**
Sr.	**Parameter**	**Unit**	**Results**		
1.	Particulate Matter (as PM)	mg/Nm^3	BDL	NA	25
	Std. Limit	**mg/Nm^3**	**150**	**NA**	**100**
2.	Sulphur Dioxide (as SO_2)	mg/Nm^3	5.71	BDL	5.52
		kg/day	4	BDL	120
	Std. Limit	**mg/Nm^3**	**50**	**50**	**200**
3.	Nitrogen Dioxide (NO_2)	mg/Nm^3	20	19.3	62
	Std. Limit	**mg/Nm^3**	**400**	**400**	**300**

Graphs: Stack Monitoring for Chembur:



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**).

Sr.	Location	Location detail	Table No.
1.	Tata Power Trombay thermal power station	Near Colony	**I**
2.	RCF Mahul	Near Admin	**I**
3.	Indian Oil Regd. Office Indian oil G-Galiyavar, Jung marg	Near Office	**I**
4.	BPCL Mahalgaon	Near Admin	**II**
5.	HPCL Chembur, Jyoti Nagar	Near Admin	**II**
6.	HPCL Guest House	Near Office	**II**

Table No. I

Location				**Tata Power Trombay**	**RCF Mahul**	**Indian Oil Regd. Office**
Date of Sampling				**15.06.18**	**15.06.18**	**16.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	4.76	4.31	BDL
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	67.6	10.7	25.3
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	66	99	44
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	16	25	11
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	0.022	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**4**	1.24	1.4	1.75

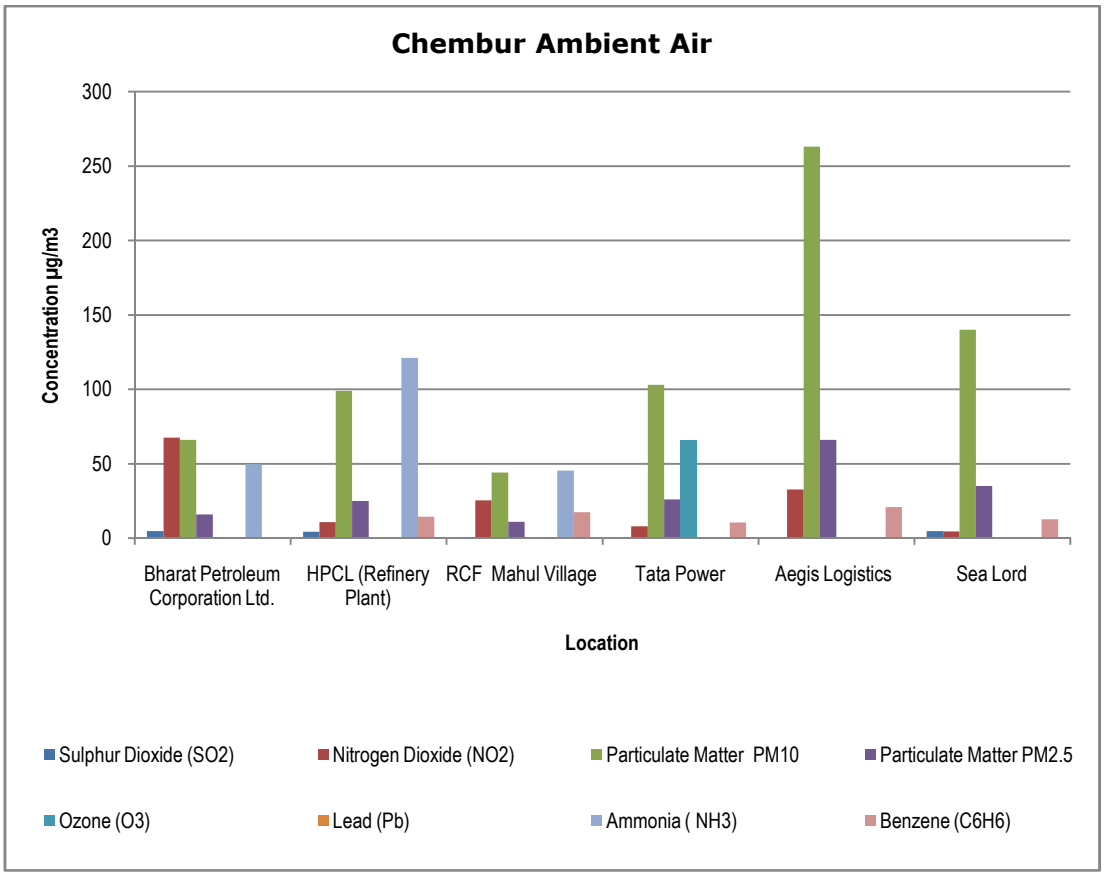
Location				**Tata Power Trombay**	**RCF Mahul**	**Indian Oil Regd. Office**
Date of Sampling				**15.06.18**	**15.06.18**	**16.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	49.6	121	45.3
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	BDL	14.4	17.5
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	BDL	BDL	BDL
12.	Nickel (Ni)	ng/m^3	**20**	4.02	17.7	10.5

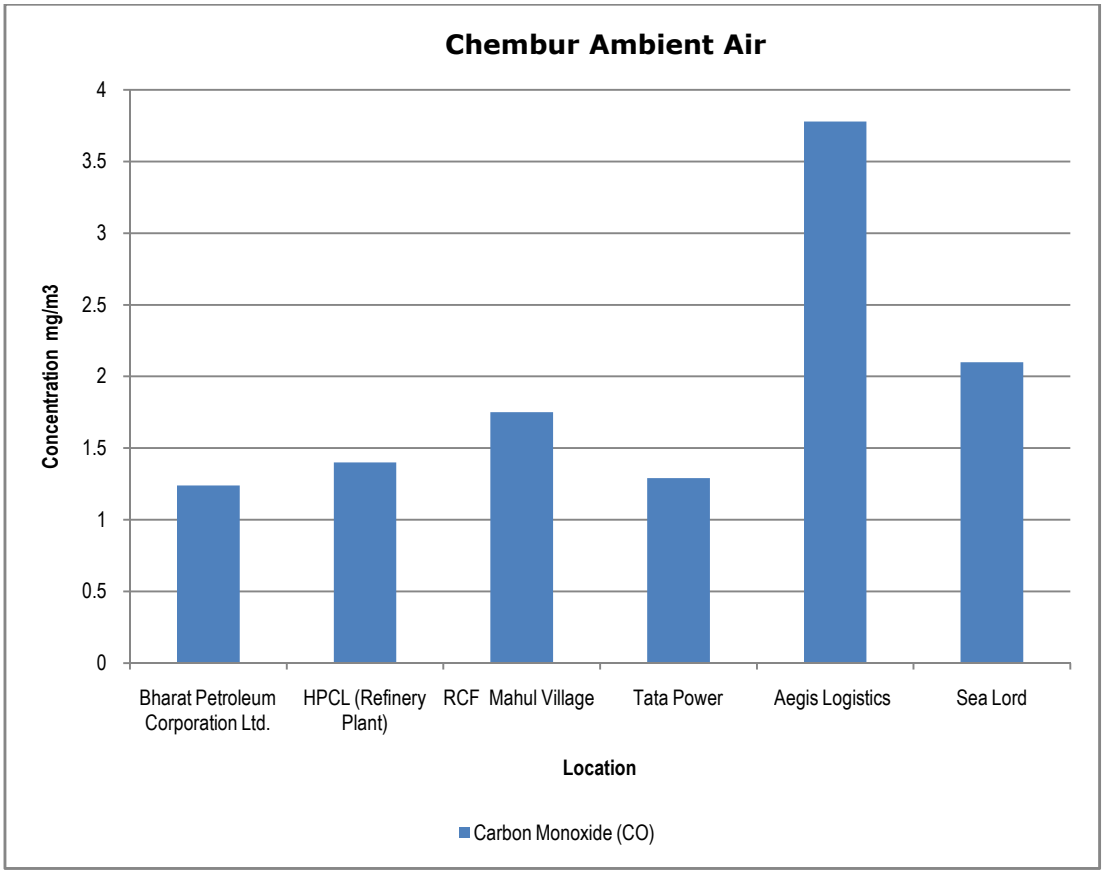
Table No. II

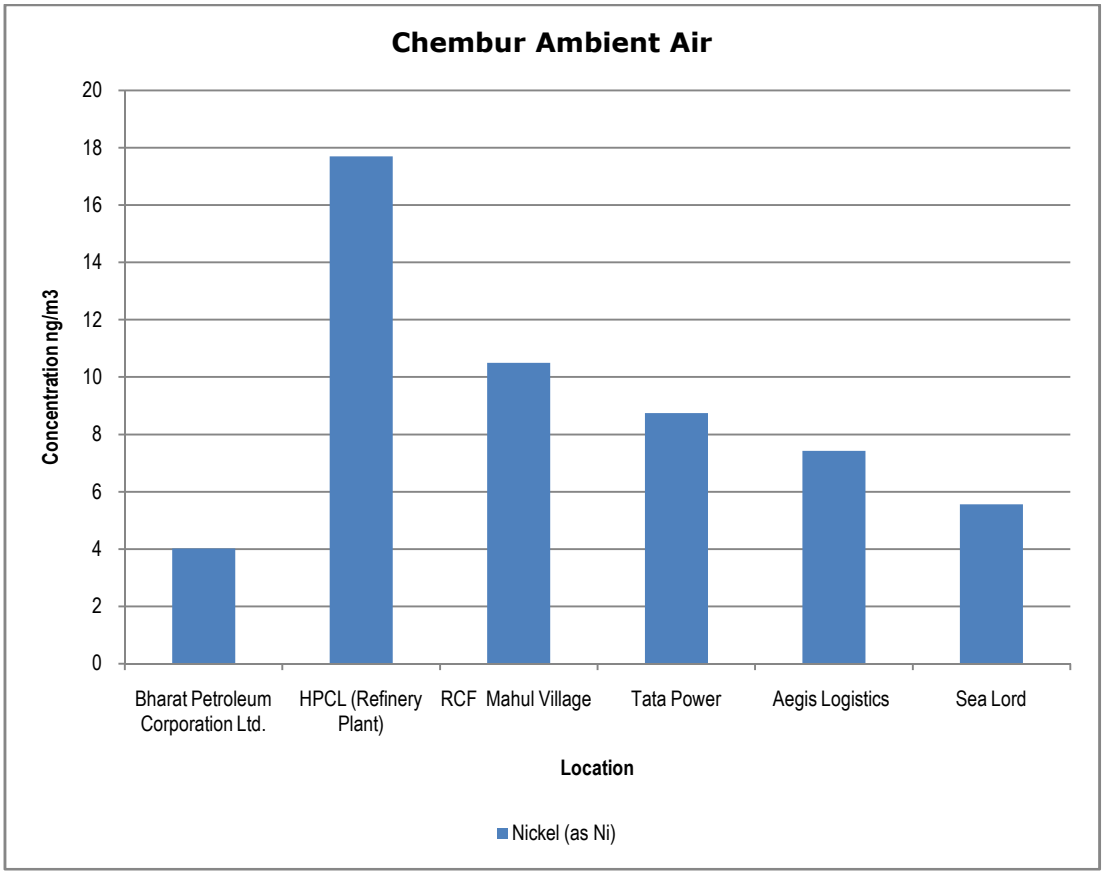
Location				**BPCL Mahalgaon**	**HPCL Chembur**	**HPCL Guest House**
Date of Sampling				**18.06.18**	**18.06.18**	**18.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	BDL	BDL	4.7
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	8.03	32.7	4.43
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	103	263	140
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	26	66	35
5.	Ozone (O_3)	$\mu g/m^3$	**180**	65.6	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	0.04

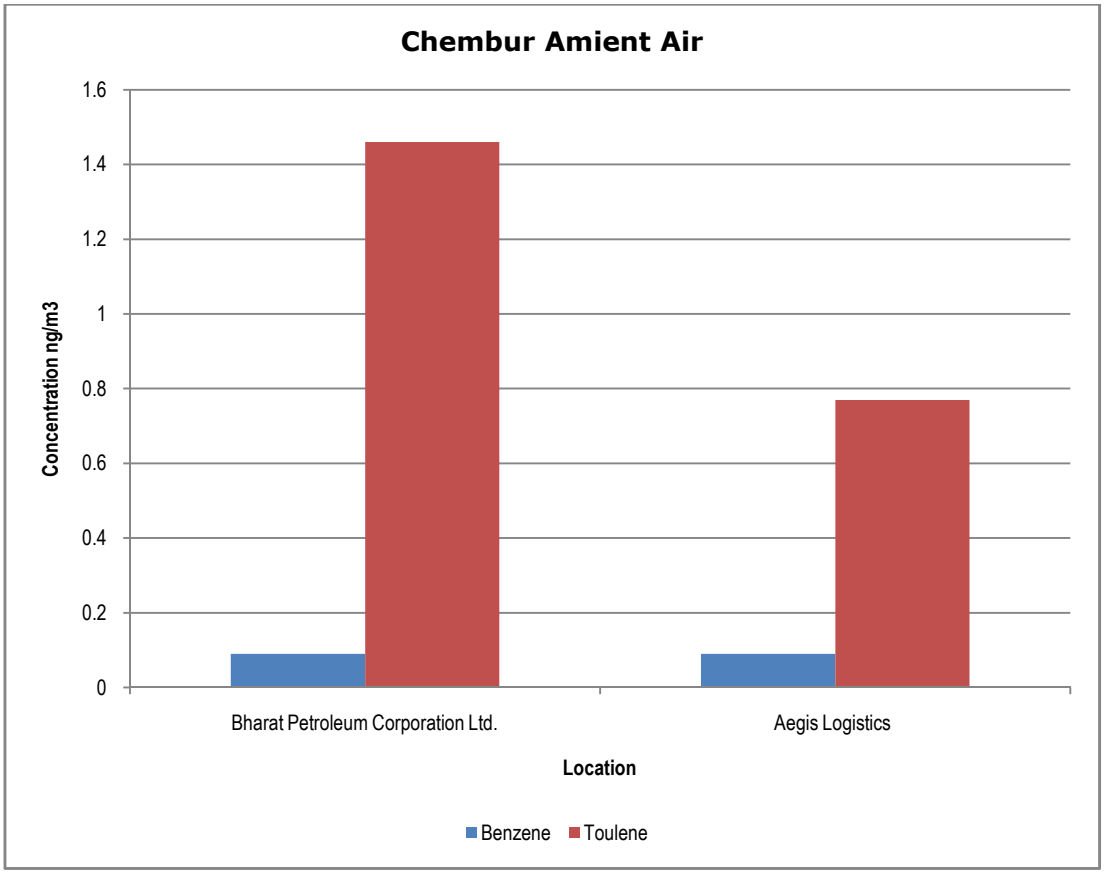
Location				BPCL Mahalgaon	HPCL Chembur	HPCL Guest House
Date of Sampling				**18.06.18**	**18.06.18**	**18.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
7.	Carbon Monoxide (CO)	mg/m^3	**4**	1.29	3.78	2.1
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	10.6	20.8	12.7
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	BDL	BDL	BDL
12.	Nickel (Ni)	ng/m^3	**20**	8.74	7.43	5.56

Graphs: Ambient Air Quality Monitoring for Chembur:




Chembur Ambient Air
Concentration mg/m3
4
3.5
3
2.5
2
1.5
1
0.5
0
Bharat Petroleum Corporation Ltd.
HPCL (Refinery Plant)
RCF Mahul Village
Tata Power
Aegis Logistics
Sea Lord
Location
Carbon Monoxide (CO)


Chembur Ambient Air
Concentration ng/m3
20
18
16
14
12
10
8
6
4
2
0
Bharat Petroleum Corporation Ltd.
HPCL (Refinery Plant)
RCF Mahul Village
Tata Power
Aegis Logistics
Sea Lord
Location
Nickel (as Ni)



3.3 Water/ Waste Water Quality:

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

Sr.	Location	Source	Table No.
1.	BPCL Mahal gaon, Outside Nala	Surface Water	**I**
2.	HPCL	Surface Water	**I**
3.	Free Way (Mysore Colony Metro Station), Nalla	Surface Water	**I**
4.	Mazgaon Dock Chembur, Mahul Gaon (Material Gate) Nalla	Surface Water	**II**
5.	RCF Near Shivaji Chowk Nalla	Surface Water	**II**
6.	BPCL Mahal gaon, Outside Nala	Surface Water	**II**
7.	HPCL	Surface Water	**III**

Table No. I

Location				**BPCL Mahal gaon, Outside Nala**	**HPCL**	**Free Way**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		200	200	1
2.	Smell	-		Disagreeable	Disagreeable	Agreeable
3.	pH	-	**5.5 -9.0**	6.91	6.51	6.89
4.	Oil & Grease	mg/L	**10.0**	1.2	BDL	1.4
5.	Suspended Solids	mg/L	**100.0**	20	8	10
6.	Dissolved Oxygen (% Saturation)	%		0	90	0
7.	Chemical Oxygen Demand	mg/L	**250.0**	239	20	239
8.	Biochemical Oxygen Demand (3 days,27^{o} C)	mg/L	**30.0**	73	6.86	73
9.	Electrical Conductivity (at 25^{o} C)	µmho/cm		741	2780	2600
10.	Nitrite Nitrogen (as NO_2)	mg/L		0.163	0.06	0.043
11.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	32	36	44.1
12.	(NO_2 + NO_3)-Nitrogen	mg/L	**5.0**	32.2	36.1	44.1
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

Location				**BPCL Mahal gaon, Outside Nala**	**HPCL**	**Free Way**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
15.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
16.	Fluoride (as F)	mg/L	**2.0**	BDL	BDL	BDL
17.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	BDL	BDL	0.39
19.	Sodium Absorption Ratio	mg/L		2.19	2.23	2.08
20.	Total Coliforms	MPN index/ 100 ml	**100.0**	14	BDL	7.8
21.	Faecal Coliforms	MPN index/ 100 ml	**1000.0**	BDL	BDL	BDL
22.	Total Phosphorous (as P)	mg/L	**1.0**	BDL	0.144	0.78
23.	Total Kjeldahl Nitrogen (as TKN)	mg/L	**100.0**	194	1.15	27.5
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	141	0.2	5.71
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

Location				**BPCL Mahal gaon, Outside Nala**	**HPCL**	**Free Way**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
27.	Organo Chlorine Pesticides					
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	Delta HCH	µg/L	**3.0**	BDL	BDL	BDL
VIII	Butachlor	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**	BDL	BDL	BDL
XII	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
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
XVIII	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	0.003	0.02	0.01

Location				**BPCL Mahal gaon, Outside Nala**	**HPCL**	**Free Way**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
29.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	0.21	BDL	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	0.013	BDL	BDL
32.	Copper (as Cu)	mg/L		BDL	BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	0.11	BDL	BDL
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	0.022	0.012	BDL
37.	Cadmium (as Cd)	mg/L	**2.0**	BDL	BDL	BDL
38.	Mercury (as Hg)	mg/L	**0.01**	0.002	BDL	0.002
39.	Manganese (as Mn)	mg/L	**2.0**	0.07	0.048	BDL
40.	Iron (as Fe)	mg/L	**3.0**	0.48	BDL	BDL
41.	Vanadium (as V)	mg/L	**0.2**	BDL	BDL	0.08
42.	Selenium (as Se)	mg/L	**0.05**	0.014	0.007	BDL
43.	Boron (as B)	mg/L		BDL	0.17	BDL

Location				**BPCL Mahal gaon, Outside Nala**	**HPCL**	**Free Way**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
44.	Bioassay Test on fish	% survival	**90% survival after 96h in 100%effluent**	100	100	100

Table No. II

Location				**Mazgaon Dock Chembur, Mahul Gaon**	**RCF Near Shivaji Chowk Nalla**
Date of Sampling				**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
1.	Colour	Hazen		1	1
2.	Smell	-		Agreeable	Agreeable
3.	pH	-	**5.5 -9.0**	7.07	7.12
4.	Oil & Grease	mg/L	**10.0**	1	1.2
5.	Suspended Solids	mg/L	**100.0**	8	9
6.	Dissolved Oxygen (% Saturation)	%		70	35
7.	Chemical Oxygen Demand	mg/L	**250.0**	129	179
8.	Biochemical Oxygen Demand (3 days,27^{o} C)	mg/L	**30.0**	39	61
9.	Electrical Conductivity (at 25^{o} C)	µmho/cm		1304	4600

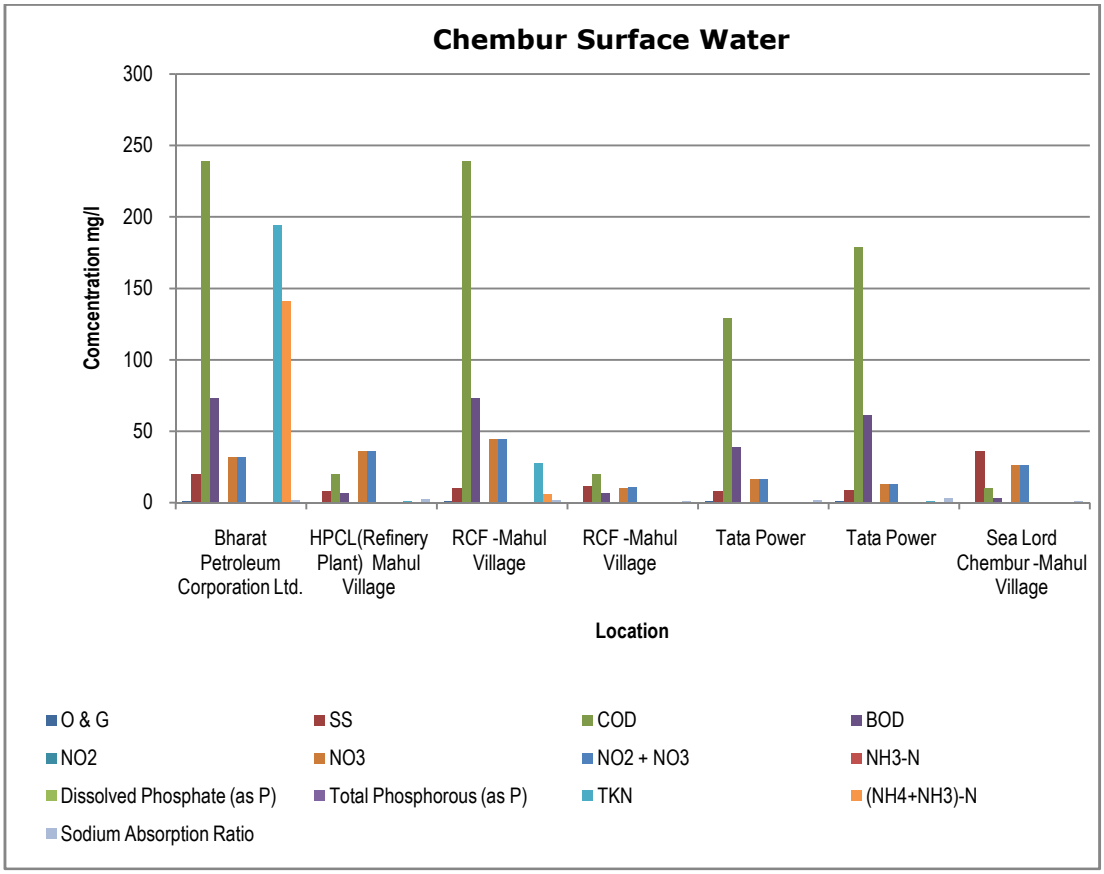
Location				**Mazgaon Dock Chembur, Mahul Gaon**	**RCF Near Shivaji Chowk Nalla**
Date of Sampling				**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
10.	Nitrite Nitrogen (as NO_2)	mg/L		0.02	0.02
11.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	16.6	13.1
12.	(NO_2 + NO_3)-Nitrogen	mg/L	**5.0**	16.6	13.1
13.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	BDL	BDL
14.	Total Residual Chlorine	mg/L	**1.0**	BDL	BDL
15.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL
16.	Fluoride (as F)	mg/L	**2.0**	BDL	BDL
17.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	0.19	0.126
19.	Sodium Absorption Ratio	mg/L		2.05	3.46
20.	Total Coliforms	MPN index/ 100 ml	**100.0**	49	7.8
21.	Faecal Coliforms	MPN index/ 100 ml	**1000.0**	BDL	BDL
22.	Total Phosphorous (as P)	mg/L	**1.0**	0.49	0.258
23.	Total Kjeldahl Nitrogen (as TKN)	mg/L	**100.0**	0.69	1.15

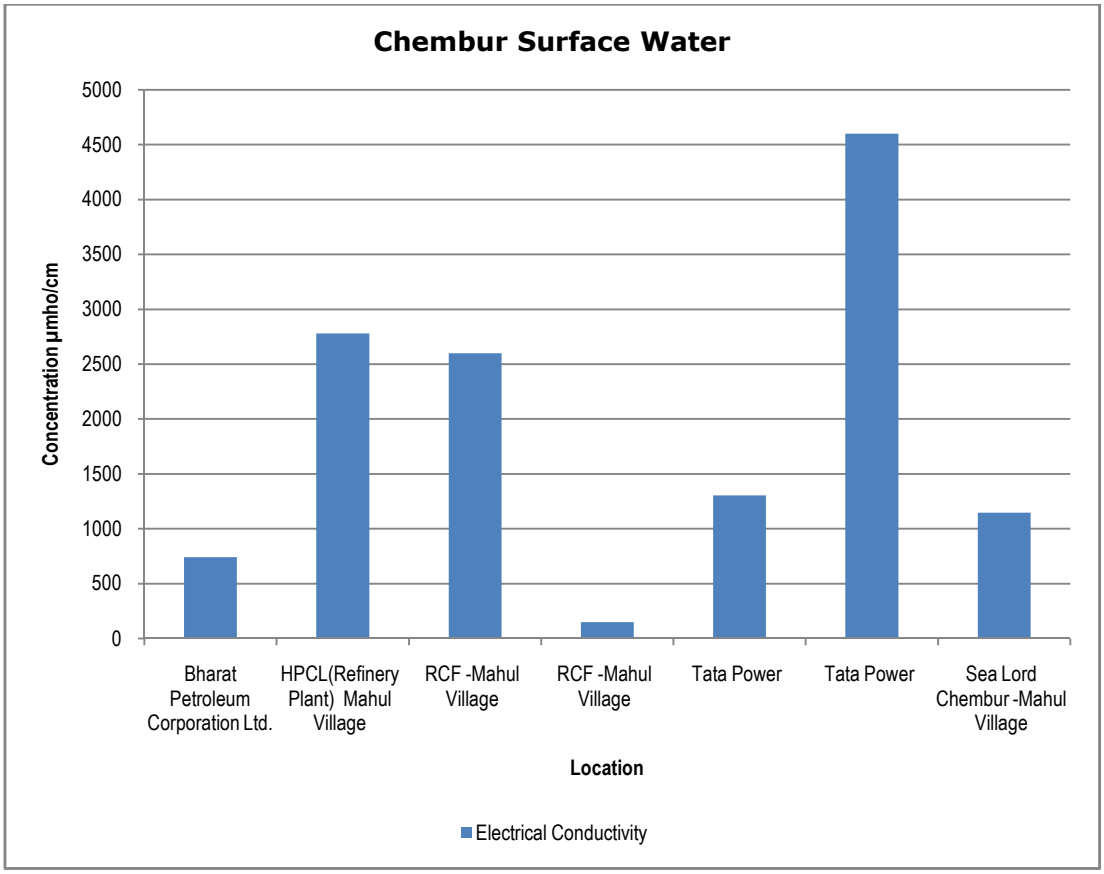
Location				**Mazgaon Dock Chembur, Mahul Gaon**	**RCF Near Shivaji Chowk Nalla**
Date of Sampling				**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	BDL	BDL
25.	Phenols (as C_6H_5OH)	mg/L	**3.0**	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L	**3.0**	BDL	BDL
27.	Organo Chlorine Pesticides				
I.	Alachlor	µg/L	**2.0**	BDL	BDL
II.	Atrazine	µg/L	**0.2**	BDL	BDL
III.	Aldrin	µg/L	**0.1**	BDL	BDL
IV.	Dieldrin	µg/L	**2.0**	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL
VI.	Beta HCH	µg/L	**2.0**	BDL	BDL
VII.	Delta HCH	µg/L	**3.0**	BDL	BDL
VIII.	Butachlor	µg/L	**0.2**	BDL	BDL
IX.	p,p DDT	µg/L	**0.05**	BDL	BDL
X.	o,p DDT	µg/L	**100.0**	BDL	BDL
XI.	p,p DDE	µg/L	**250.0**	BDL	BDL
XII.	o,p DDE	µg/L	**30.0**	BDL	BDL
XIII.	p,p DDD	µg/L		BDL	BDL
XIV.	o,p DDD	µg/L		BDL	BDL
XV.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL

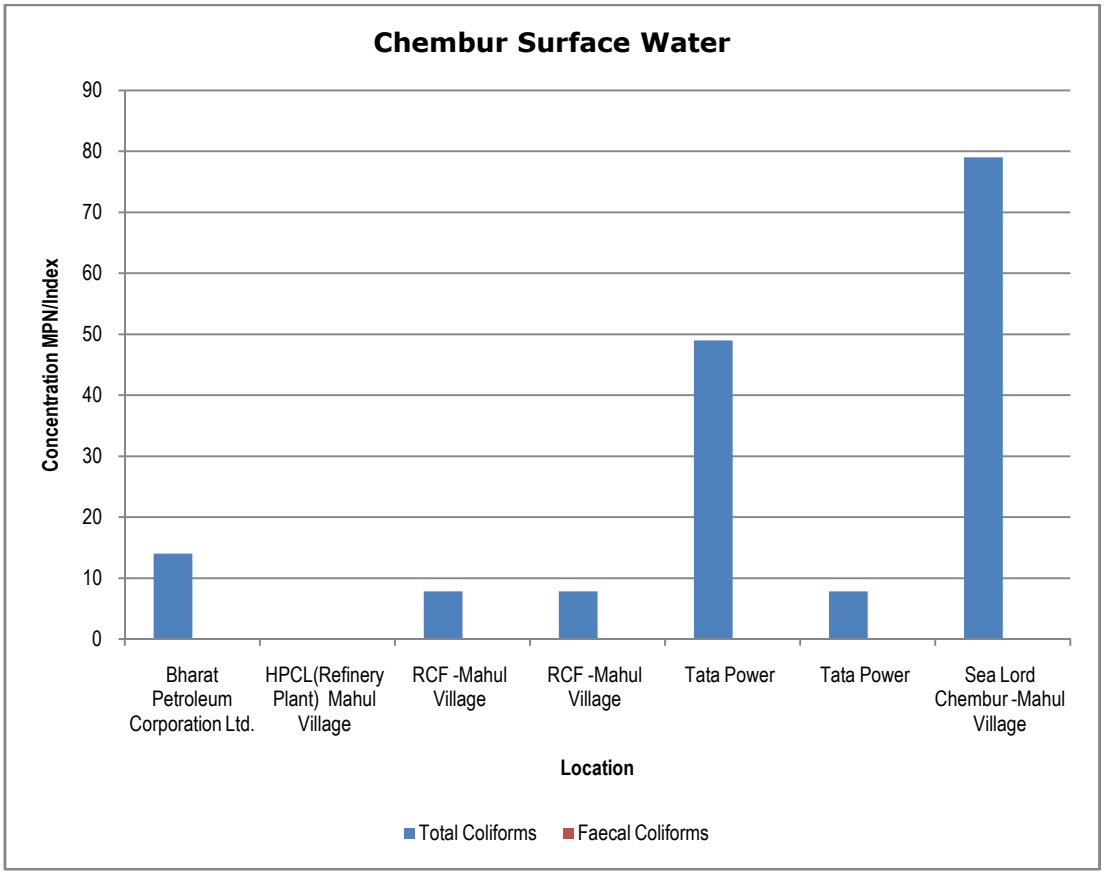
Location				**Mazgaon Dock Chembur, Mahul Gaon**	**RCF Near Shivaji Chowk Nalla**
Date of Sampling				**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
XVI.	Beta Endosulfan	µg/L		BDL	BDL
XVII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL
XVIII.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	0.002	0.01
29.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	BDL	BDL
32.	Copper (as Cu)	mg/L		BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	BDL	BDL
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	BDL	BDL
37.	Cadmium (as Cd)	mg/L	**2.0**	BDL	BDL
38.	Mercury (as Hg)	mg/L	**0.01**	BDL	BDL
39.	Manganese (as Mn)	mg/L	**2.0**	0.092	BDL
40.	Iron (as Fe)	mg/L	**3.0**	0.084	0.068

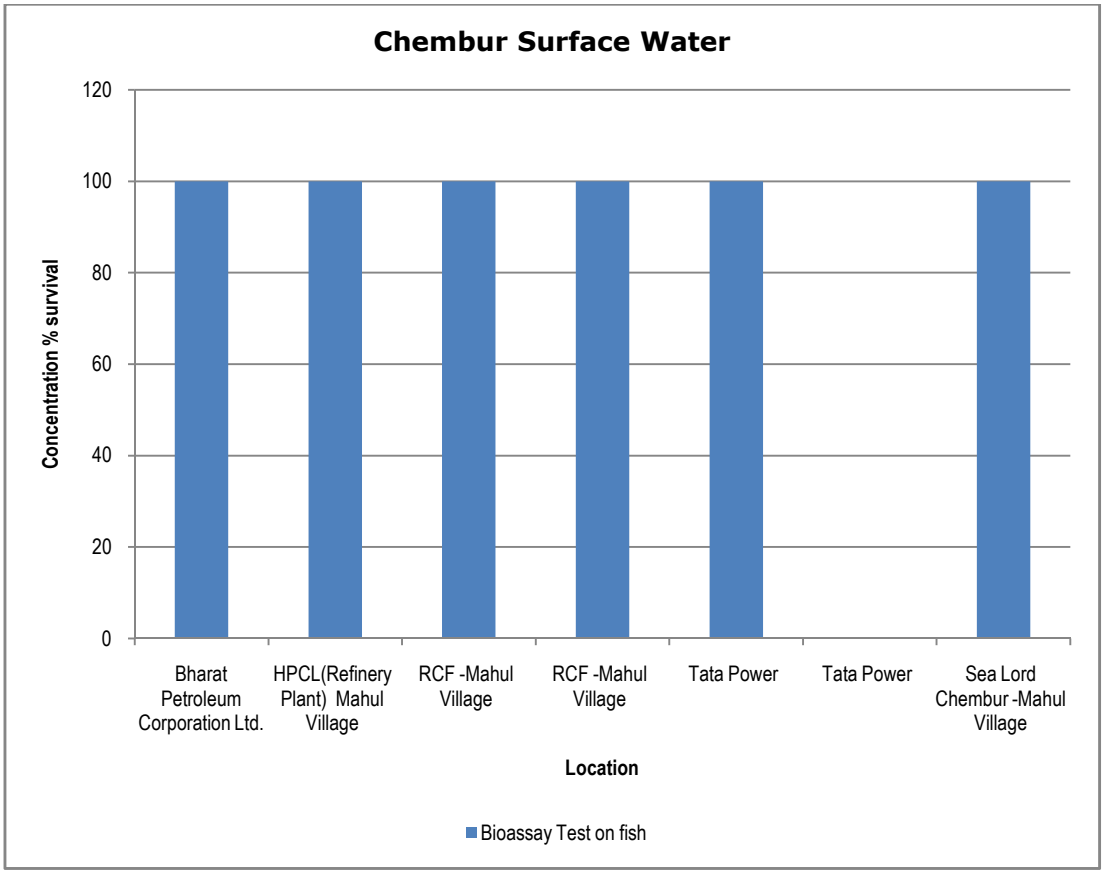
Location				**Mazgaon Dock Chembur, Mahul Gaon**	**RCF Near Shivaji Chowk Nalla**
Date of Sampling				**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
41.	Vanadium (as V)	mg/L	**0.2**	BDL	0.019
42.	Selenium (as Se)	mg/L	**0.05**	BDL	BDL
43.	Boron (as B)	mg/L		BDL	0.11
44.	Bioassay Test on fish	% survival	**90% survival after 96h in 100%effluent**	100	0

Graphs: Surface Water Quality Monitoring for Chembur:




Chembur Surface Water
Concentration µmho/cm
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Bharat Petroleum Corporation Ltd.
HPCL(Refinery Plant) Mahul Village
RCF -Mahul Village
RCF -Mahul Village
Tata Power
Tata Power
Sea Lord Chembur -Mahul Village
Location
Electrical Conductivity


Chembur Surface Water
Concentration MPN/Index
90
80
70
60
50
40
30
20
10
0
Bharat Petroleum Corporation Ltd.
HPCL(Refinery Plant) Mahul Village
RCF -Mahul Village
RCF -Mahul Village
Tata Power
Tata Power
Sea Lord Chembur -Mahul Village
Location
Total Coliforms
Faecal Coliforms



3.4 Ground Water Quality:

Sr.	Location	Source	Table No.
1.	HPCL Chembur, Jyoti Nagar, New admin Building	Ground Water	**I**
2.	HPCL Guest House	Ground Water	**I**
3.	Sealord Mahul Gaon	Ground Water	**I**
4.	RCF Near Shivaji Chowk Statu	Ground Water	**II**

Table No. I

Location				**HPCL Chembur**	**HPCL Guest House**	**Sealord Mahul Gaon**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		1	1	1

Location				**HPCL Chembur**	**HPCL Guest House**	**Sealord Mahul Gaon**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
2.	Smell	-	**Agreeable**	Agreeable	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	7.2	7.06	6.43
4.	Oil & Grease	mg/L		BDL	BDL	BDL
5.	Suspended Solids	mg/L	**100**	6	10	7
6.	Dissolved Oxygen (%Saturation)	%		80	75	40
7.	Chemical Oxygen Demand	mg/L	**500**	13	8	16
8.	Biochemical Oxygen Demand (3 days,27^{o}C)	mg/L	**10 (WHO, 1993)**	3.96	2.43	4.88
9.	Electrical Conductivity (at 25^{o}C)	µmho/cm	**6 (WHO, 1993)**	2730	863	3060
10.	Nitrite Nitrogen (as NO_2)	mg/L	**0.3 (WHO, 1993)**	0.01	BDL	0.045
11.	Nitrate Nitrogen (as NO_3)	mg/L		2.11	BDL	17.4
12.	(NO_2 + NO_3)-Nitrogen	mg/L	**45**	2.12	BDL	17.4
13.	Free Ammonia (as NH_3-N)	mg/L	**1.0**	BDL	BDL	BDL
14.	Total Residual Chlorine	mg/L	**0.5**	BDL	BDL	BDL
15.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
16.	Fluoride (as F)	mg/L		BDL	BDL	0.26

Location				**HPCL Chembur**	**HPCL Guest House**	**Sealord Mahul Gaon**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
17.	Sulphide (as S^{2-})	mg/L	**1**	BDL	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	**0.05**	BDL	BDL	0.266
19.	Sodium Absorption Ratio	mg/L		0.84	1.23	1.59
20.	Total Coliforms	MPN index/ 100 ml		7.8	BDL	79
21.	Faecal Coliforms	MPN index/ 100 ml	**ND**	BDL	BDL	BDL
22.	Total Phosphorous (as P)	mg/L	**ND**	BDL	BDL	0.576
23.	Total Kjeldahl Nitrogen	mg/L	**0.5**	1.03	1.27	1.38
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.001**	BDL	BDL	BDL
25.	Phenols (as C_6H_5OH)	mg/L	**0.5**	BDL	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L	**0.001**	BDL	BDL	BDL
27.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**0.05**	BDL	BDL	BDL
II.	Atrazine	µg/L	**20**	BDL	BDL	BDL
III.	Aldrin	µg/L	**2**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**0.03**	BDL	BDL	BDL

Location				**HPCL Chembur**	**HPCL Guest House**	**Sealord Mahul Gaon**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
V.	Alpha HCH	µg/L	**0.03**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**0.01**	BDL	BDL	BDL
VII.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
VIII.	Butachlor	µg/L	**125**	BDL	BDL	BDL
IX.	p,p DDT	µg/L	**0.04**	BDL	BDL	BDL
X.	o,p DDT	µg/L	**1**	BDL	BDL	BDL
XI.	p,p DDE	µg/L	**1**	BDL	BDL	BDL
XII.	o,p DDE	µg/L	**1**	BDL	BDL	BDL
XIII.	p,p DDD	µg/L	**1**	BDL	BDL	BDL
XIV.	o,p DDD	µg/L	**1**	BDL	BDL	BDL
XV.	Alpha Endosulfan	µg/L	**1**	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	**0.4**	BDL	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**2.0**	BDL	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0001**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**0.0005**	BDL	BDL	BDL
31.	Nickel (as Ni)	mg/L	**5.0**	BDL	BDL	BDL
32.	Copper (as Cu)	mg/L	**0.02**	BDL	BDL	BDL

Location				**HPCL Chembur**	**HPCL Guest House**	**Sealord Mahul Gaon**
Date of Sampling				**19.06.18**	**19.06.18**	**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
33.	Hexavalent Chromium (as Cr6+)	mg/L	**0.05**	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**1**	BDL	BDL	BDL
35.	Total Arsenic (as As)	mg/L	**0.05**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL	BDL
37.	Cadmium (as Cd)	mg/L	**0.01**	BDL	BDL	BDL
38.	Mercury (as Hg)	mg/L	**0.003**	BDL	BDL	BDL
39.	Manganese (as Mn)	mg/L	**0.001**	0.09	BDL	0.03
40.	Iron (as Fe)	mg/L	**0.1**	BDL	BDL	0.08
41.	Vanadium (as V)	mg/L	**0.3**	BDL	0.04	0.02
42.	Selenium (as Se)	mg/L		BDL	BDL	BDL
43.	Boron (as B)	mg/L	**0.01**	BDL	BDL	0.27
44.	Bioassay Test on fish	% survival		100	80	100

Table No. II

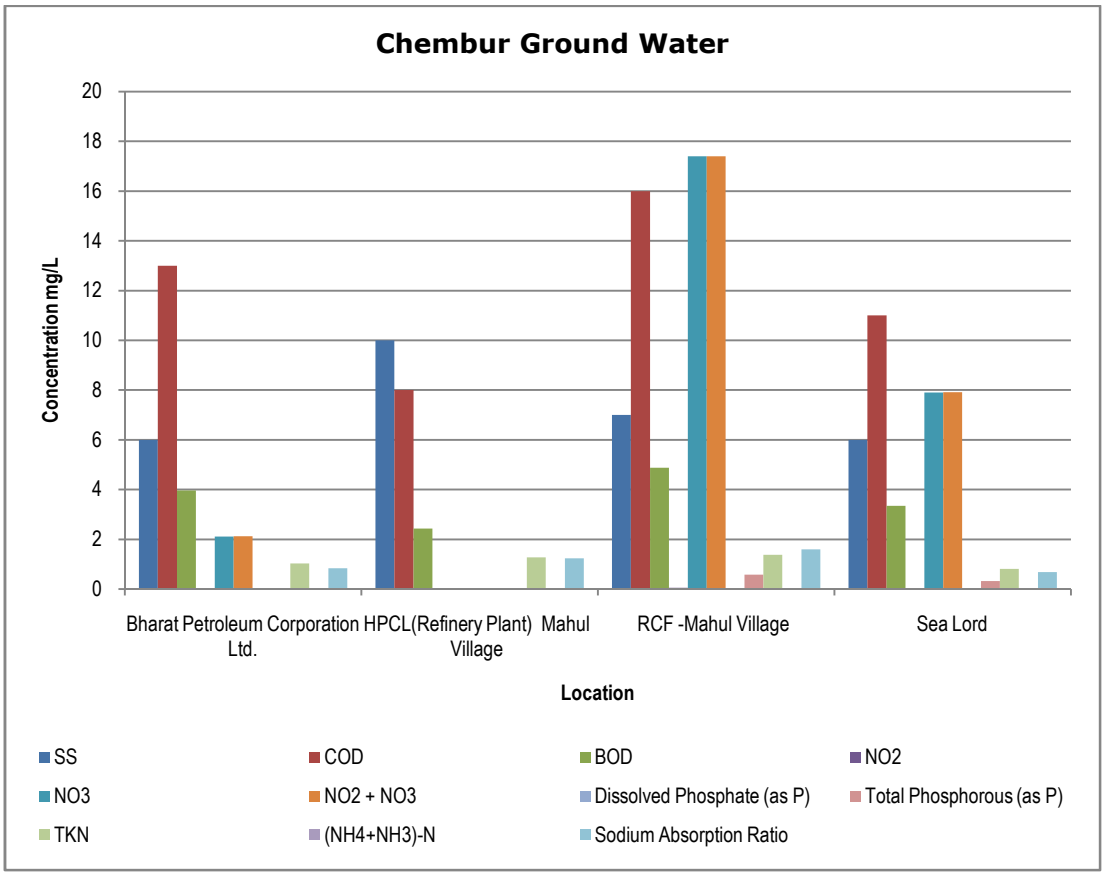
Location				**RCF Near Shivaji Chowk Statue**
Date of Sampling				**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**
1.	Colour	Hazen		1
2.	Smell	-	**Agreeable**	Agreeable
3.	pH	-	**6.5-8.5**	7.2
4.	Oil & Grease	mg/L		BDL
5.	Suspended Solids	mg/L	**100**	6
6.	Dissolved Oxygen (%Saturation)	%		80
7.	Chemical Oxygen Demand	mg/L	**500**	13
8.	Biochemical Oxygen Demand (3 days,27^{o}C)	mg/L	**10 (WHO, 1993)**	3.96
9.	Electrical Conductivity (at 25^{o}C)	µmho/cm	**6 (WHO, 1993)**	2730
10.	Nitrite Nitrogen (as NO_2)	mg/L	**0.3 (WHO, 1993)**	0.01
11.	Nitrate Nitrogen (as NO_3)	mg/L		2.11
12.	(NO_2 + NO_3)-Nitrogen	mg/L	**45**	2.12
13.	Free Ammonia (as NH_3-N)	mg/L	**1.0**	BDL
14.	Total Residual Chlorine	mg/L	**0.5**	BDL
15.	Cyanide (as CN)	mg/L	**0.2**	BDL
16.	Fluoride (as F)	mg/L		BDL
17.	Sulphide (as S^{2-})	mg/L	**1**	BDL

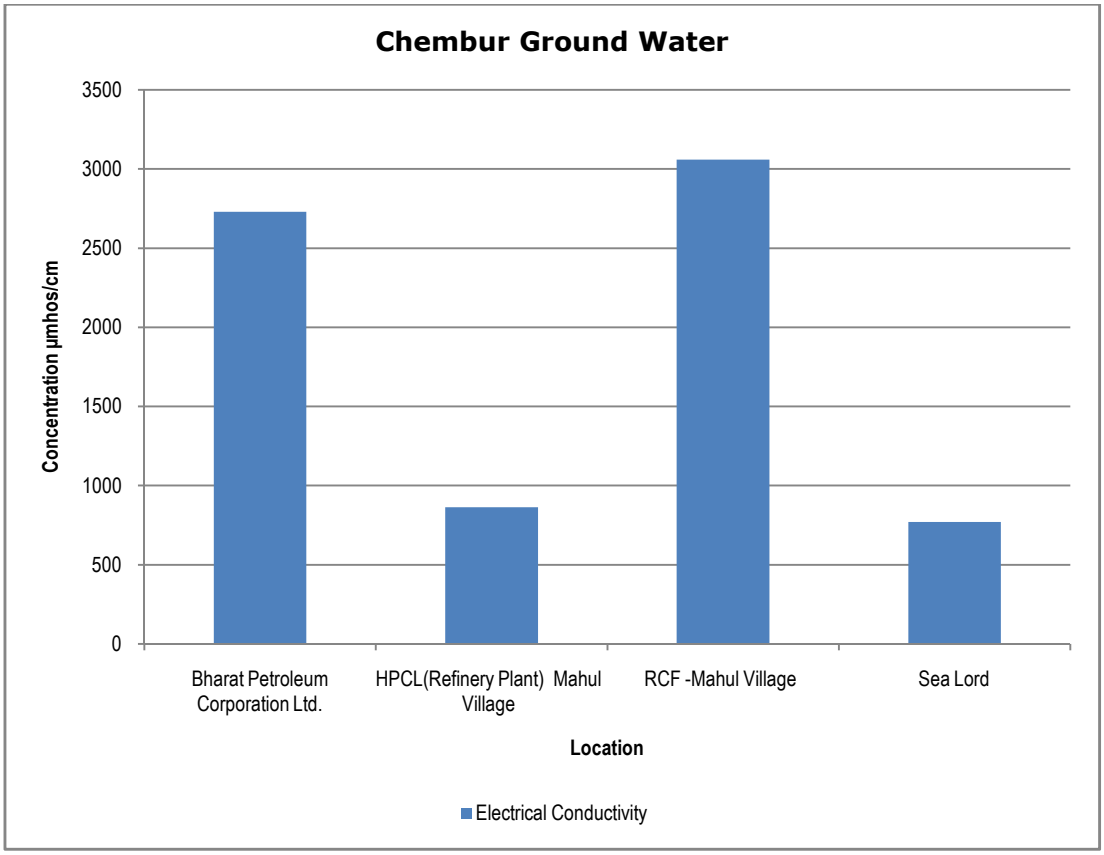
Location				**RCF Near Shivaji Chowk Statue**
Date of Sampling				**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**
18.	Dissolved Phosphate (as P)	mg/L	**0.05**	BDL
19.	Sodium Absorption Ratio	mg/L		0.84
20.	Total Coliforms	MPN index/ 100 ml		7.8
21.	Faecal Coliforms	MPN index/ 100 ml	**ND**	BDL
22.	Total Phosphorous (as P)	mg/L	**ND**	BDL
23.	Total Kjeldahl Nitrogen	mg/L	**0.5**	1.03
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.001**	BDL
25.	Phenols (as C_6H_5OH)	mg/L	**0.5**	BDL
26.	Surface Active Agents (as MBAS)	mg/L	**0.001**	BDL
27.	Organo Chlorine Pesticides			
I.	Alachlor	µg/L	**0.05**	BDL
II.	Atrazine	µg/L	**20**	BDL
III.	Aldrin	µg/L	**2**	BDL
IV.	Dieldrin	µg/L	**0.03**	BDL
V.	Alpha HCH	µg/L	**0.03**	BDL
VI.	Beta HCH	µg/L	**0.01**	BDL
VII.	Delta HCH	µg/L	**0.04**	BDL
VIII.	Butachlor	µg/L	**125**	BDL
IX.	p,p DDT	µg/L	**0.04**	BDL
X.	o,p DDT	µg/L	**1**	BDL

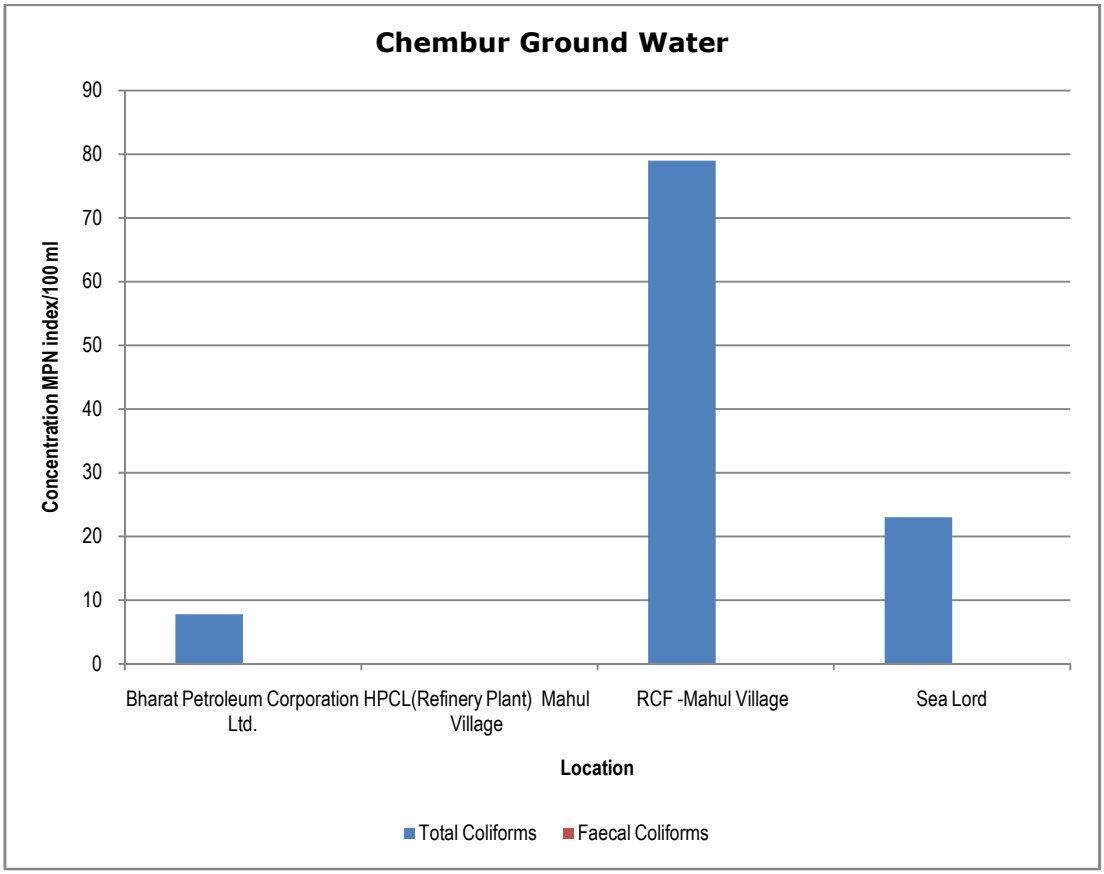
Location				**RCF Near Shivaji Chowk Statue**
Date of Sampling				**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**
XI.	p,p DDE	µg/L	**1**	BDL
XII.	o,p DDE	µg/L	**1**	BDL
XIII.	p,p DDD	µg/L	**1**	BDL
XIV.	o,p DDD	µg/L	**1**	BDL
XV.	Alpha Endosulfan	µg/L	**1**	BDL
XVI.	Beta Endosulfan	µg/L	**0.4**	BDL
XVII.	Endosulfan Sulphate	µg/L	**0.4**	BDL
XVIII.	Y HCH (Lindane)	µg/L	**0.4**	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**2.0**	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0001**	BDL
30.	Zinc (as Zn)	mg/L	**0.0005**	BDL
31.	Nickel (as Ni)	mg/L	**5.0**	BDL
32.	Copper (as Cu)	mg/L	**0.02**	BDL
33.	Hexavalent Chromium (as Cr6+)	mg/L	**0.05**	BDL
34.	Total Chromium (as Cr)	mg/L	**1**	BDL
35.	Total Arsenic (as As)	mg/L	**0.05**	BDL
36.	Lead (as Pb)	mg/L	**0.01**	BDL
37.	Cadmium (as Cd)	mg/L	**0.01**	BDL
38.	Mercury (as Hg)	mg/L	**0.003**	BDL

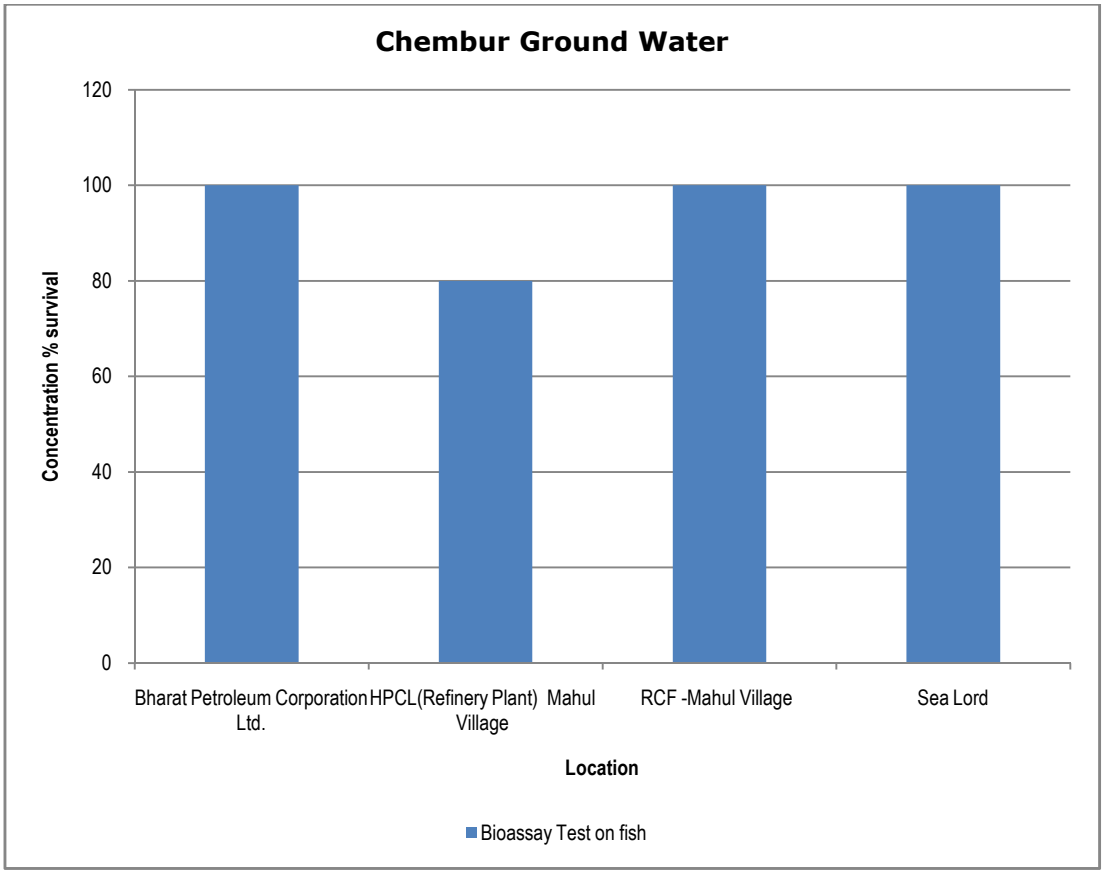
Location				**RCF Near Shivaji Chowk Statue**
Date of Sampling				**19.06.18**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**
39.	Manganese (as Mn)	mg/L	**0.001**	0.09
40.	Iron (as Fe)	mg/L	**0.1**	BDL
41.	Vanadium (as V)	mg/L	**0.3**	BDL
42.	Selenium (as Se)	mg/L		BDL
43.	Boron (as B)	mg/L	**0.01**	BDL
44.	Bioassay Test on fish	% survival		100

Graphs: Ground Water Quality Monitoring for Chembur:




Chembur Ground Water
3500
3000
2500
2000
1500
1000
500
0
Concentration µmhos/cm
Bharat Petroleum Corporation Ltd.
HPCL(Refinery Plant) Mahul Village
RCF -Mahul Village
Sea Lord
Location
Electrical Conductivity


Chembur Ground Water
90
80
70
60
50
40
30
20
10
0
Concentration MPN index/100 ml
Bharat Petroleum Corporation Ltd.
HPCL(Refinery Plant) Mahul Village
RCF -Mahul Village
Sea Lord
Location
Total Coliforms
Faecal Coliforms



4. Summary and Conclusion

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

4.1 Stack Emission Monitoring:

Six industries from Chembur were selected for Stack emission monitoring.

1. **Particulate matter (PM):** Out the 6 stacks; Particulate matter was collected only from 5 stacks. All the results obtained are within the standard emission for the specified industry.

2. **Sulphur dioxide (SO_2):** 4 stacks out of the 6 stacks, was below the detectable limit and 2 stack results is within the limits.

3. **Nitrogen dioxide (NO_2):** NO_2 was sampled from 6 stacks. The higher concentration of NO2 was observed at Tata Power with 62 mg/Nm^3.

4.2 Ambient Air Quality Monitoring:

Six ambient air samples were collected from Chembur region. The parameters monitored were studied as per the NAAQ standards. The variations of each parameter within the area under study are discussed below:

1. **Sulphur dioxide (SO_2):** All the locations are observed with very low concentrations of SO_2, with 3 stacks out of the 6 showed results below the detection limit. The highest level of SO_2 was observed at Bharat Petroleum Corporation Ltd. with 4.76 µg/m^3 which is very much lower than the standard limit of NAAQS i.e. 80 µg/m^3.

2. **Nitrogen dioxide (NO_2):** Values of nitrogen dioxide are also observed below the standard limit of 80 µg/m^3 at all the 6 locations. The highest level of NO_2 was observed at Bharat Petroleum Corporation Ltd. with a result of 67.6 µg/m^3.

3. **Particulate Matter (PM_{10}):** 3 sampled locations in Chembur region showed higher level of PM_{10} concentration than the standard limit of NAAQS. The level of PM_{10} was higher at Tata Power, Aegis Logistics and Sea Lord with 103 µg/m^3, 263 µg/m^3 and 140 µg/m^3 respectively.

4. **Particulate Matter ($PM_{2.5}$):** $PM_{2.5}$ concentration was higher the limit of NAAQS at HPCL (Refinery Plant) with 66 µg/m^3. All other 5 location monitored was well within the standard limit.

5. **Ozone (O_3):** Ozone was found to be below detectable limit in all location except at Tata Power with a concentration of 65.6 µg/m^3.

6. **Lead (Pb):** Two location out of 6 location monitored was detected with concentration of lead and was well within the NAAQS standard.

7. **Carbon Monoxide (CO):** Concentration of carbon monoxide has been found to well within the limits in all 6 locations monitored with the highest concentration at Tata Power with 3.78 mg/m^3.

8. **Ammonia (NH_3):** Ammonia was below the detectable limit in 3 locations out of the 6 locations monitored. The level of NH_3 was well within the limits.

9. **Benzene (C_6H_6):** Out of 6 locations monitored, one location showed below the detectable limit and 5 locations was having benzene concentration higher than 5 µg/m^3 which is the standard limit as per NAAQS.

10. **Benzo(a)pyrene (BaP):** BaP was below detectable limit in all 6 locations monitored.

11. **Arsenic (As):** As was also below detectable limit in all 6 locations monitored.

12. **Nickel (Ni):** Concentration of Nickel was well within the permissible limit of 20ng/m^3 at 6 locations monitored. The highest level of Nickel was observed at HPCL (Refinery Plant) with 17.7 ng/m^3.

4.3 Waste Water Quality Monitoring:

To understand the quality of treated effluent, samples were collected from 7 industries of Chembur. Considering the general parameters of all the industries mentioned, following are the conclusions:

1. **Colour:** Colour units are found high with more than 100 Hazen unit in 3 water sample collected.

2. **Odour**: odour of 3 samples is found disagreeable at 7 water samples collected.

3. **pH**: it is observed in between 6.5 and 7.4 which is well within the range.

4. **Suspended Solids**: Suspended solids of all 7 water sample is well within the limits and ranged in between 8 mg/L to 36 mg/l.

5. **Chemical Oxygen Demand**: All samples collected, were well within the limit required as per standard. The highest COD was observed at Bharat Petroleum Corporation Ltd. and RCF -Mahul Village with 239 mg/L concentration.

6. **Biochemical Oxygen Demand**: 3 out of the 7 samples collected was exceeding the limit required as per standard of BOD. The highest BOD was observed at Bharat Petroleum Corporation Ltd. and RCF -Mahul Village with 73 mg/L concentration.

7. **Sulphide**: 7 samples collected were found to have below detectable limit.

8. **Total Ammoia**: 2 water samples collected had high concentration of Ammonia ranging in between 5.71 mg/L to 141 mg/L.

9. **Total Kjeldahl Nitrogen**: Out of 6 water samples collected, only one sample had high concentration of TKN with a concentration of 194 mg/L.

10. **Fish Bioassay**: 100% Survival was attained in 6 water samples collected for Bioassay test and in 1 water samples, no fishes survived at all.

11. **Heavy metals**: All the heavy metals are found below the standard limits in all the samples.

4.3 Ground Water Quality Monitoring:

Four ground water samples were collected from Chembur region.

1) **Colour** (Hazen Units): Colour units are below the acceptable standard of all water samples collected.

2) **Odour**: odour of all the samples is found agreeable.

3) **Chemical Oxygen Demand:** The COD of all 4 samples was found in the range between 8 mg/L to 16 mg/L.

4) **Biological Oxygen Demand:** BOD of all 4 samples was found in the range between 2.43 mg/L to 4.88 mg/L.

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

1) **Nitrite**: Values of Nitrite at all location was well within the standard.

2) **Nitrate:** Results of Nitrate are also observed below standard limit (45mg/l).

3) **Residual Free Chlorine**: Values are below the detectable limit in all 4 samples collected.

4) **Total Ammonia**: Values are below the detectable limit in all samples collected.

5) **Fluoride:** Values are below the acceptable standards, below <0.05mg/L.

6) **Sulphide:** All the readings of sulphide are below detectable limit in all 4 samples collected.

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

8) **Total Kjeldahl nitrogen:** All 4 water sample collected exceeded the standard limit of TKN and ranged in between 0.81 mg/L to 1.38 mg/L concentration.

9) **Fish Bioassay**: HPCL(Refinery Plant) Mahul Village borewell water sample 80% survival was observed. Remaining all location 100% survival was observed.

10) ***Boron:** Values are below the acceptable standards.

(* CPCB Water Quality criteria for Irrigation, Industrial Cooling & Controlled Waste disposal).

11) **Surface Active Agents:** All 4 samples showed below detectable limit.

12) **Metals:** All the metals except manganese at few locations are observed within the acceptable limits of drinking water standards.

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

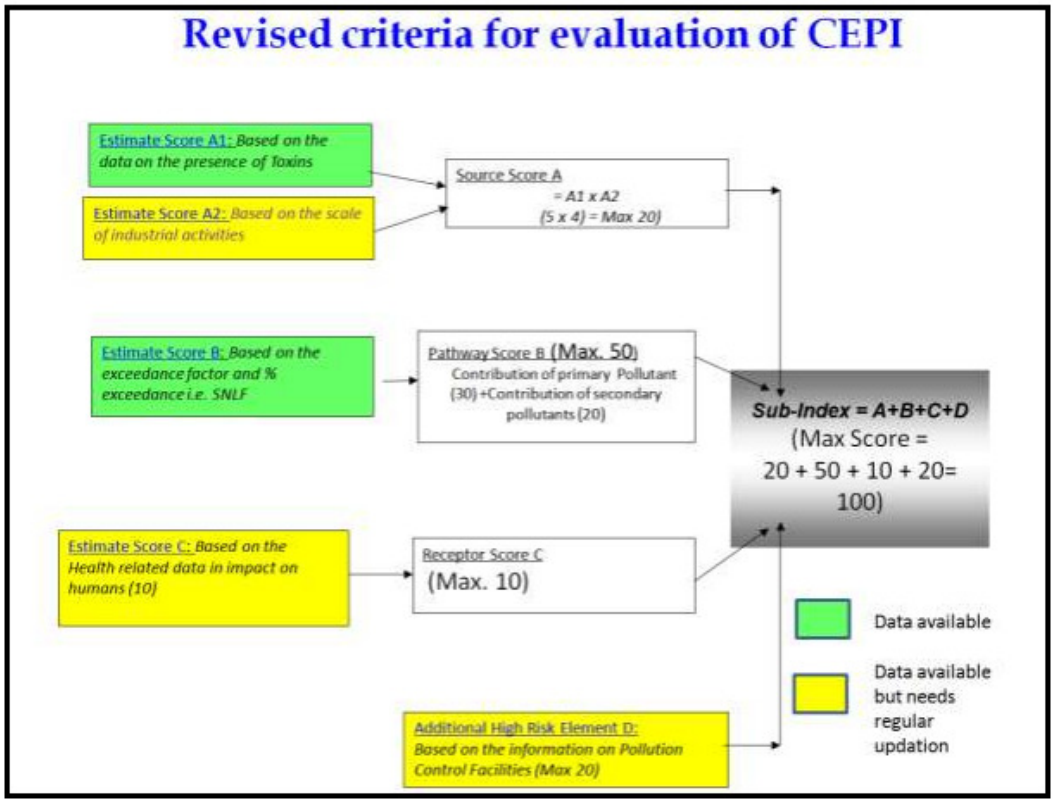
The outlines of the revised CEPI criteria are as follows:

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 June 2018 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:

Below given Table shows aggregated CEPI of present report in comparison with:

1. CEPI score by CPCB in 2009
2. CEPI score MPCB February 2017
3. CEPI score MPCB June 2017
4. CEPI score MPCB February 2018

Results show that present CEPI score (45.07) of Chembur considering all revised standards is lesser tan the CPCB CEPI Score of February 2018 (44.1) report.

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

Air

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score June 2018	4.1	2.84	11.6	-	-	-	9.8	-	-	-	5	10	**36**
CEPI score February 2018	3	4.4	13.2	-	-	-	10.6	-	-	-	5	10	**38.8**
CEPI score June 2017	3	3.3	9.9	-	-	-	9	-	-	-	5	10	**33.9**
CEPI score February 2017	3	5	15	5	0	0	5	5	5	0	25	10	**55**
CPCB Report 2009	5.75	5	28.75	6	0	0	6	5	3	0	15	10	**59.75**

Water:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score June 2018	2.4	4.2	10.08	-	-	-	14.8	-	-	-	5	10	**39.88**
CEPI score February 2018	2	2.6	5.2	-	-	-	7.1	-	-	-	10	10	**32.3**
CEPI score June 2017	2.6	4.1	10.6	-	-	-	8	-	-	-	10	10	**38.66**
CEPI score February 2017	2	3.8	7.6	5	0	3	8	5	3	0	15	10	**40.6**
CPCB Report 2009	3	5	15	7.75	1.5	1.5	10.75	5	2	5	15	10	**50.75**

Land:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score June 2018	2.5	1.7	4.25	-	-	-	11	-	-	-	5	10	**30.25**
CEPI score February 2018	2.3	1.4	3.22	-	-	-	8.5	-	-	-	10	10	**31.72**
CEPI score June 2017	3.8	3.1	6.2	-	-	-	9	-	-	-	10	10	**40.78**
CEPI score February 2017	3	4.3	12.9	5	3	3	11	4	2	3	11	10	**44.9**
CPCB Report 2009	3	5	15	3	1.5	1.5	6	5	2	5	15	10	**46.00**

Aggregated CEPI:

	Air Index	Water Index	Land Index	CEPI
CEPI score June 2018	36	39.88	30.25	**44.1**
CEPI score February 2018	38.8	32.3	31.72	**45.07**
CEPI score June 2017	33.9	38.66	34.2	**44.3**
CEPI score February 2017	55	40.6	44.9	**63.2**
CPCB Report 2009	59.75	50.75	46.00	**69.19**

6. 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: Chembur, 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: 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

7. Annexure

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

Sr.	Parameters	Method References	Techniques	Detection Limit
13.	Sulphur Dioxide	IS 11255 (Part 2): 1985, Reaffirmed 2003	Titrimetric IPA thorine Method	5.0mg/Nm^3
				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
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	0.3ng/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

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	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
27.	Surface Active	APHA,22nd Ed., 2012	Methylene Blue	0.1 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
	Agents	, 5540-B & C,5-50	Extraction Method	
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

Sr.	Parameters	Methods References	Techniques	Detection Limit
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 Test (Zebra Fish)	IS 6582, 1971, Reaffirmed 1987	Static Technique	-

Annexure IV: National Ambient Air Quality Standards, 2009

The Gazette of India

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NEW DELHI, WEDNESDAY, NOBEMBER 18, 2009 No. B-29016/20/90/PCI-I

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

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

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

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
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
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
17.	Free residual chlorine	mg/L	Min 0.2	Min 1

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

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

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
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			
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 coliform organisms (MPN*/100 ml) shall be 50 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/Lor more, and ➢ Biochemical Oxygen Demand 2 mg/Lor 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/Lor more, and ➢ Biochemical Oxygen Demand 3 mg/Lor 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/Lor more, and ➢ Biochemical Oxygen Demand 3 mg/Lor less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/Lor more, and ➢ Free ammonia (as N) 1.2 mg/Lor 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, 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	< 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

Sr.	Parameters	Requirement for Waters of Class		
		A- Excellent	B-Desirable	C-Acceptable
(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