

ACTION PLAN FOR INDUSTRIAL CLUSTER IN CRITICALLY POLLUTED AREA

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

नवी मुंबई Navi Mumbai



Maharashtra Pollution Control Board

Kalptaru Point, Sion East, Mumbai - 400022

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

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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
PM₁₀	Particulate Matter (size less than 10 µm)
PM_{2.5}	Particulate Matter (size less than 2.5 µm)
SO₂	Sulphur Dioxide
STAP	Short Term Action Plan
WHO	World Health Organization

1. Introduction

Rapid modernization and industrialization worldwide has not only uprooted to the economic development, but has increased pollution of land, air and water. This has also destroyed our habitat and environment too. Pollutants discharged from the industries have widespread implications and one of the unpleasant effects on water bodies and air. Long term exposure to the polluted air and water causes chronic health problems, making the issue industrial pollution into severe one. So, scientists are exploring the quantum of pollution load as well as to devise 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.

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.

The present CEPI study is based on the Navi Mumbai industrial area of Maharashtra state. Navi Mumbai industrial estate was established in 1963 which is often known as TTC MIDC Estate. The Estate is located along the Thane Belapur Road towards Northern side of road and total area of the industrial estate is 27km². There are about 2200 industrial units of various category engaged in the manufacture of Chemicals, Dyes, Dye-intermediates, Bulk drugs, Pharmaceuticals, Textile auxiliaries, Pesticides, Petrochemicals, Textile processors, Engineering units etc. Navi Mumbai is a developing town and so many construction activities are going on. Hence, besides the industries, transport, loading, unloading and handling of agro products are other sources which are major contributors for pollution, especially air pollution.

2. Scope of Work

The Scope of Work consisted of the following:

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

- At each of the 5 CPAs and 3 SPAs, 24 hourly ambient air quality monitoring to be carried out.
- Representative samples for surface water quality, waste water quality and ground water quality to be collected from prominent surface and ground water bodies located in and around the clusters/areas.
- Submission of complete monitoring, sampling and analysis reports including the summary of the parameters exceeding the prescribed standards/norms for all the 5 CPAs and 3 SPAs.
- Submission of 3 copies of final report with photographs at prominent locations and the CD (soft copy) on completion of the project for every critically polluted and severely polluted area separately.

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

- The sampling was carried out in 6 days at various locations i.e. from 1st June to 06th June, 2017.
- In Navi Mumbai, a total of 7 Stack Monitoring Samples, 8 Ambient Air Quality Monitoring Samples, 5 Waste Water Samples and 6 Ground Water Samples were collected and analyzed.
- Health data of last 05 years (2011-2016) was collected from the hospitals nearby industrial clusters under study.

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 (SO₂)
2. Nitrogen Dioxide (NO₂)
3. Particulate Matter (PM₁₀)
4. Particulate Matter (PM_{2.5})
5. Ozone (O₃)
6. Lead (Pb)
7. Carbon Monoxide (CO)
8. Ammonia (NH₃)
9. Benzene (C₆H₆)
- 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. ($\text{NO}_2 + \text{NO}_3$)-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 ($\text{NH}_4 + \text{NH}_3$)-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 detection limit.

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

3.1 Stack Emission:

Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D. As VOCs concentration is not detected in the samples, hence it is not shown in the graphs.

Sr.	Name of Industry	Stack Identity	Table No.
1.	Amines & Plasticizer Ltd.	Boiler	Table No. I
2.	RPG Life Science Ltd.	Caustic Dilution	Table No. I
3.	Akash Fabrics Pvt. Ltd.	Boiler	Table No. I
4.	Aarcee Innovation Pvt. Ltd.	Coal Boiler	Table No. II
5.	Sovotex Textiles Pvt. Ltd.	Boiler (Thermopack)	Table No. II
6.	Sovotex Textiles Pvt. Ltd.	Boiler	Table No. II
7.	SI Group India Ltd.	HRG (Boiler)	Table No. II

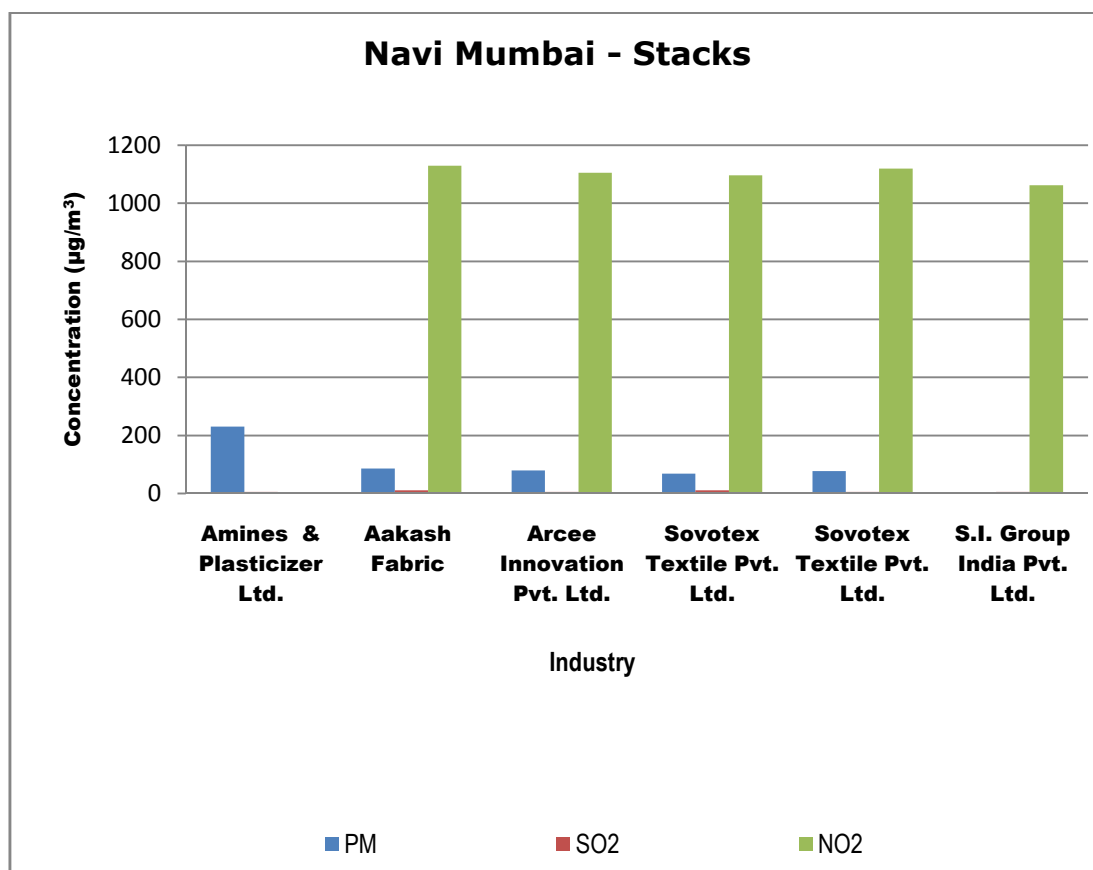
Table No. I

Name of Industry			Amines & Plasticizer Ltd.	RPG Life Science Ltd.	Akash Fabrics Pvt. Ltd.
Date of Sampling			01.6.17	01.06.17	06.06.17
Sr.	Parameters	Units	Results		
1.	Particulate Matter	mg/Nm ³	231	BDL	86
	Std. Limit	mg/Nm³	150	150	150
2.	Sulphur Dioxide (SO ₂)	mg/Nm ³	5.33	BDL	10.6
		kg/day	1.56	BDL	4.1
	Std. Limit	100mg/Nm³	100	148	100
3.	Nitrogen dioxide (NO ₂)	mg/Nm ³	BDL	BDL	1129
	Std. Limit	mg/Nm³	50	50	50
4.	Volatile Organic Compounds VOC				
i.	Methyl Isobutyl Ketone	-	ND	ND	ND
ii.	Benzene	-	ND	ND	0.23
iii.	Toulene	-	ND	ND	0.02
iv.	Xylene	-	ND	ND	ND
v.	Ethyl Benzene	-	ND	ND	ND
vi.	Ethyl Acetate	-	ND	ND	ND

Table No. II

Name of Industry			Aarcee Innovation Pvt. Ltd.	Savotex Textile Pvt. Ltd.	Savotex Textile Pvt. Ltd.	SI Group India Ltd.
Date of Sampling			06.06.17	05.06.17	06.06.17	06.06.17
Sr.	Parameters	Units	Results			
1.	Particulate Matter	mg/Nm ³	79	68	77	BDL
	Std. Limit	mg/Nm³	150	150	150	150
2.	Sulphur Dioxide (SO ₂)	mg/Nm ³	5.33	10.6	5.33	5.33
		kg/day	1.45	4.88	3.19	0.87
	Std. Limit	mg/Nm³	-	100	-	100
	Std. Limit	kg/day	-	-	-	-
3.	Nitrogen dioxide (NO ₂)	mg/Nm ³	1105	1096	1119	1062
	Std. Limit	mg/Nm³	50	50	50	50
4.	Volatile Organic Compounds VOC					
i.	Methyl Isobutyl Ketone	-	ND	ND	ND	ND
ii.	Benzene	-	0.18	ND	0.23	ND
iii.	Toulene	-	0.01	ND	0.02	ND
iv.	Xylene	-	ND	ND	ND	ND
v.	Ethyl Benzene	-	ND	ND	ND	ND
vi.	Ethyl Acetate	-	ND	ND	ND	ND

Graphs: Stack Monitoring for Navi Mumbai TTC MIDC:



3.2 Ambient AirQuality:

In order to arrive at conclusions, the Ambient Air Quality Monitoring Results are compared against National Ambient Air Quality Standards, 2009 (Annexure I).

Please note: Concentration of Benzene (C₆H₆), BaP and Arsenic (As) is observed Below Detection Limit (BDL), hence not included in graphs.

Sr.	Location	Location detail	Table No.
1.	Amines & Plasticizer Ltd.	Near Store	Table No. I
2.	Mahalaxmi Dyeing & printing Pvt. Ltd.	Near Store	Table No. I
3.	G.L. Construction 203, Honsare Village, TTC	Near Plant	Table No. I
4.	WMA TTC, P-128, Mhape, Navi Mumbai	Near D.G Set	Table No. I
5.	Ajwani Infrastructure Q-6, Mhape, TTC Industrial	Near Plant	Table No. II
6.	Croda Chemicals Pvt. Ltd. Plot No. 1/1, Part, TTC Industrial Area	Near Fire Station	Table No. II

Sr.	Location	Location detail	Table No.
7.	Aakash Fabric Plot no. A-63, Mahape, TTC	Near Gate	Table No. II
8.	Arcee Innovation Pvt. Ltd. TTC Area, Mahape	Near Gate	Table No. II

Table No. I:

Location				Amines & Plasticizer Ltd.	Mahalaxmi Dyeing & printing Pvt. Ltd.	G.L. Construction 203, Honsare Village, TTC	WMA TTC, P-128, Mahape, Navi Mumbai
Date of Sampling				02.06.17	04.06.17	03.06.17	03.06.17
Sr	Parameters	Unit	Std. Limit	Results			
1	Sulphur Dioxide (SO ₂)	µg/m ³	80	29.1	BDL	BDL	BDL
2	Nitrogen Dioxide (NO ₂)	µg/m ³	80	3.9	3.64	BDL	4.65
3	Particulate Matter (size less than 10 µm) or PM ₁₀	µg/m ³	100	136	142	197	210
4	Particulate Matter (size less than 2.5 µm) or PM _{2.5}	µg/m ³	60	32	36	50	49
5	Ozone (O ₃)	µg/m ³	180	50	BDL	23.3	BDL
6	Lead (Pb)	µg/m ³	1	0.021	0.020	BDL	BDL
7	Carbon Monoxide (CO)	mg/m ³	04	0.96	2.55	3.08	1.36
8	Ammonia (NH ₃)	µg/m ³	400	44.3	BDL	BDL	BDL
9	Benzene (C ₆ H ₆)	µg/m ³	5	BDL	BDL	BDL	BDL
10	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m ³	1	BDL	BDL	BDL	BDL

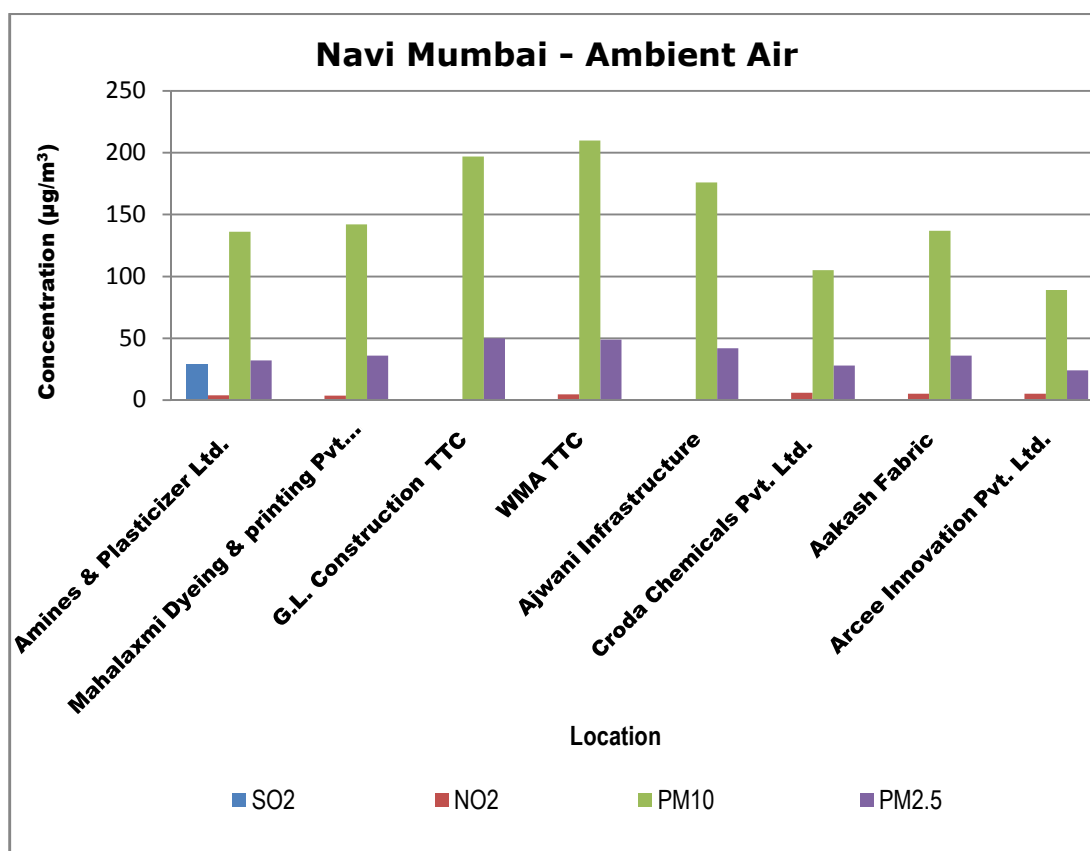
Location				Amines & Plasticizer Ltd.	Mahalaxmi Dyeing & printing Pvt. Ltd.	G.L. Construction 203, Honsare Village, TTC	WMA TTC, P-128, Mhape, Navi Mumbai
Date of Sampling				02.06.17	04.06.17	03.06.17	03.06.17
Sr	Parameters	Unit	Std. Limit	Results			
11	Arsenic (As)	ng/m ³	6	BDL	BDL	BDL	BDL
12	Nickel (Ni)	ng/m ³	20	3.05	BDL	3.03	BDL

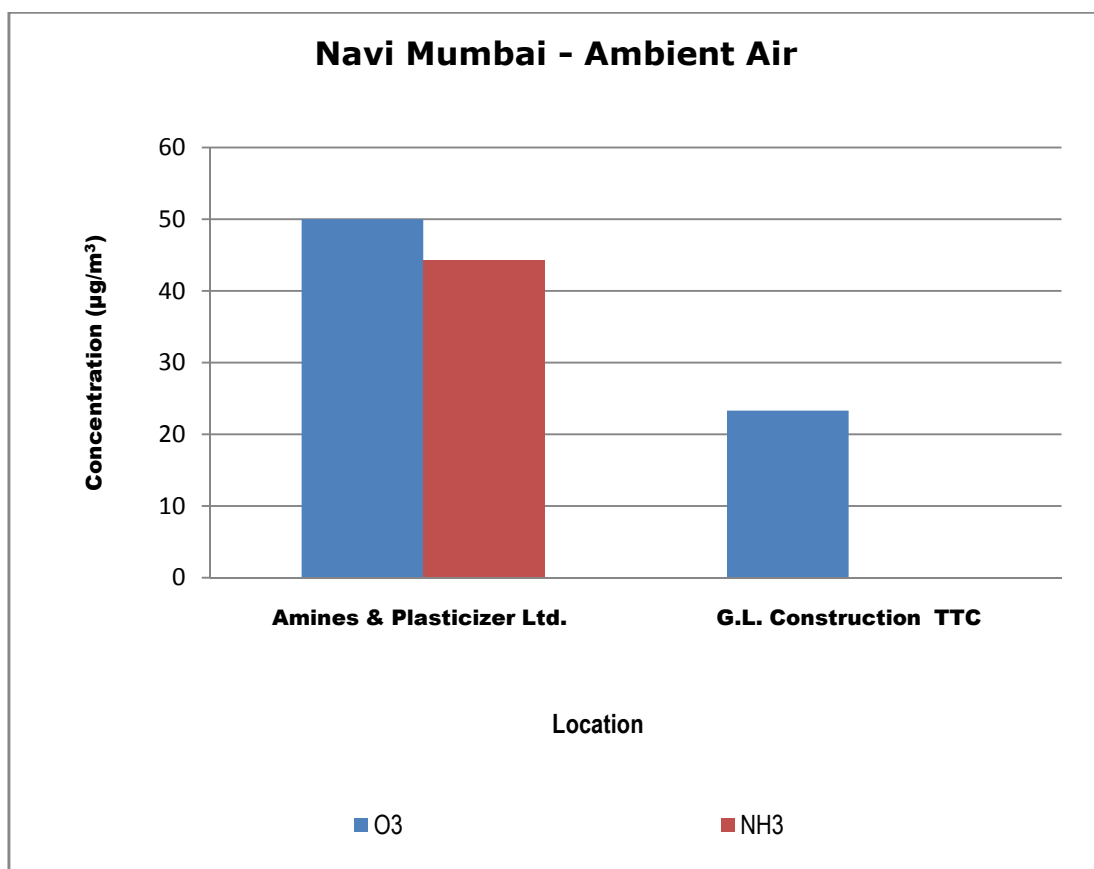
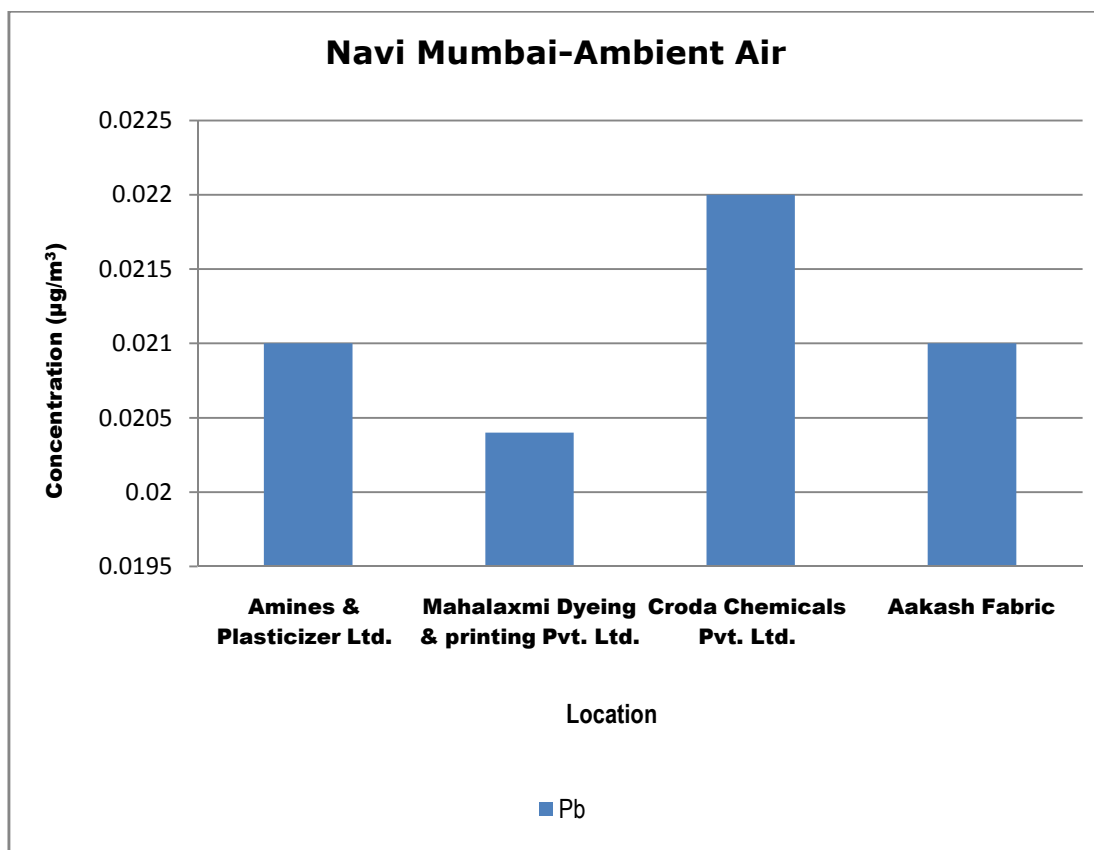
Table No. II

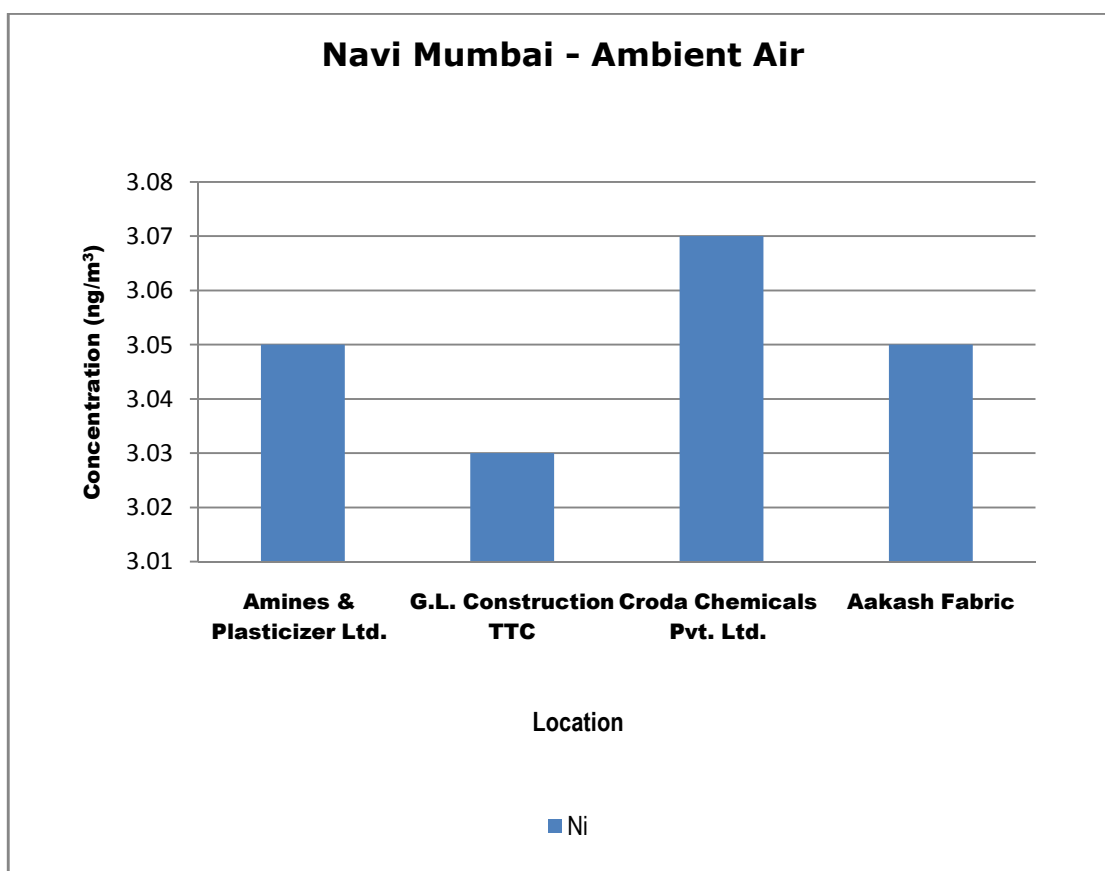
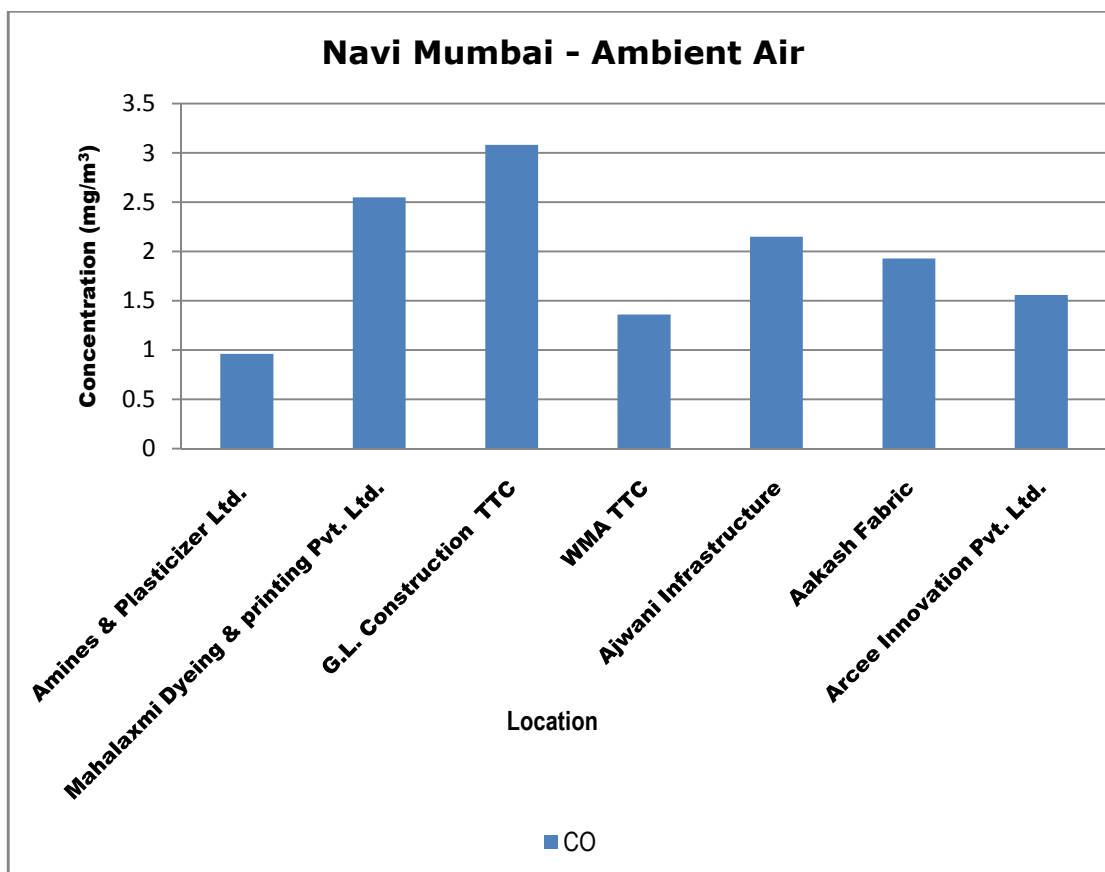
Location				Ajwani Infrastructure	Croda Chemicals Pvt. Ltd.	Aakash Fabric	Arcee Innovation Pvt. Ltd.
Date of Sampling				02.06.17	04.06.17	03.06.17	03.06.17
Sr	Parameters	Unit	Std. Limit	Results			
1	Sulphur Dioxide (SO ₂)	µg/m ³	80	BDL	BDL	BDL	BDL
2	Nitrogen Dioxide (NO ₂)	µg/m ³	80	BDL	5.87	5.08	5.26
3	Particulate Matter (size less than 10 µm) or PM ₁₀	µg/m ³	100	176	105	137	89
4	Particulate Matter (size less than 2.5 µm) or PM _{2.5}	µg/m ³	60	42	28	36	24
5	Ozone (O ₃)	µg/m ³	180	BDL	BDL	BDL	BDL
6	Lead (Pb)	µg/m ³	1	BDL	0.022	0.021	BDL
7	Carbon Monoxide (CO)	mg/m ³	04	2.15	BDL	1.93	1.56
8	Ammonia	µg/m ³	400	BDL	BDL	BDL	BDL

Location				Ajwani Infrastru cture	Croda Chemicals Pvt. Ltd.	Aakash Fabric	Arcee Innovatio n Pvt. Ltd.
Date of Sampling				02.06.17	04.06.17	03.06.17	03.06.17
Sr	Parameters	Unit	Std. Limit	Results			
	(NH ₃)						
9	Benzene (C ₆ H ₆)	µg/m ³	5	BDL	BDL	BDL	BDL
10	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m ³	1	BDL	BDL	BDL	BDL
11	Arsenic (As)	ng/m ³	6	BDL	BDL	BDL	BDL
12	Nickel (Ni)	ng/m ³	20	BDL	3.07	3.05	BDL

Graphs of Ambient Air Quality Monitoring for Navi Mumbai TTC MIDC:







3.3 Water/ Waste WaterQuality:

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.	S I Group India Pvt. Ltd.	ETP Outlet	Table No. I
2.	CETP Koperkharane MIDC, TTC	ETP Inlet	Table No. I
3.	CETP Koperkharane MIDC, TTC	ETP Outlet	Table No. I
4.	Modepro Pvt. Ltd.	Treated Water	Table No. II
5.	CETP (Replacement water) Koperkharane MIDC, TTC	CETP Outlet	Table No. II

Table No. I:

Location				S I Group India Pvt. Ltd.	CETP Inlet	CETP Outlet
Date of Sampling				02.06.17	04.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Result		
1.	Colour	Hazen		20	1000	20
2.	Smell	-		Agreeable	Agreeable	Agreeable
3.	pH	-	5.5 -9.0	7.94	3.54	4.83
4.	Oil & Grease	mg/L	10.0	BDL	13	1.4
5.	Suspended Solids	mg/L	100.0	21	103	180
6.	Dissolved Oxygen (%Saturation)	%		37	0	0
7.	Chemical Oxygen Demand	mg/L	250.0	50	3174	1389

Location				S I Group India Pvt. Ltd.	CETP Inlet	CETP Outlet
Date of Sampling				02.06.17	04.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Result		
8.	Biochemical Oxygen Demand (3 days,27°C)	mg/L	30.0	18	1030	447
9.	Electrical Conductivity (at 25 °C)	µmho/cm	-	11140	5760	4520
10.	Nitrite Nitrogen (as N)	mg/L	-	BDL	1.28	0.96
11.	Nitrate Nitrogen (as N)	mg/L	10.0	0.71	115	71.2
12.	(NO ₂ + NO ₃)-Nitrogen	mg/L	5.0	0.71	116	72.2
13.	Free Ammonia (as NH ₃ -N)	mg/L	5.0	BDL	BDL	BDL
14.	Total Residual Chlorine	mg/L	1.0	BDL	BDL	BDL
15.	Cyanide (as CN)	mg/L	0.2	BDL	BDL	BDL
16.	Fluoride (as F)	mg/L	2.0	0.52	0.38	0.1
17.	Sulphide (as S ²⁻)	mg/L	2.0	BDL	BDL	11.6
18.	Dissolved Phosphate (as P)	mg/L	5.0	BDL	0.8	0.63
19.	Sodium Absorption Ratio	-		2.4	7.07	0.56
20.	Total Coliforms	MPN index/ 100 mL	100.0	BDL	9.20 x 10 ⁵	540
21.	Faecal Coliforms	MPN index/ 100 mL	1000.0	BDL	BDL	BDL
22.	Total Phosphorous (as P)	mg/L	1.0	1.58	1.58	1.85

Location				S I Group India Pvt. Ltd.	CETP Inlet	CETP Outlet
Date of Sampling				02.06.17	04.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Result		
23.	Total Kjeldahl Nitrogen (as N)	mg/L	100.0	131	131	13.4
24.	Total Ammonia (NH ₄ +NH ₃)-Nitrogen	mg/L	5.0	73.1	73.1	12
25.	Phenols (as C ₆ H ₅ OH)	mg/L	3.0	BDL	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L	3.0	BDL	0.33	0.44
27.	Organo Chlorine Pesticides	µg/L	0.1			
i.	Alachlor	µg/L	2.0	BDL	BDL	BDL
ii.	Atrazine	µg/L	0.2	BDL	BDL	BDL
iii.	Aldrin	µg/L	0.1	BDL	BDL	BDL
iv.	Dieldrin	µg/L	2.0	BDL	BDL	BDL
v.	Alpha HCH	µg/L	0.01	BDL	BDL	BDL
vi.	Beta HCH	µg/L	2.0	BDL	BDL	BDL
vii.	Butachlor	µg/L	3.0	BDL	BDL	BDL
viii.	Delta HCH	µg/L	0.2	BDL	BDL	BDL
ix.	p,p DDT	µg/L	0.05	BDL	BDL	BDL
x	o,p DDT	µg/L	100.0	BDL	BDL	BDL
xi.	p,p DDE	µg/L	250.0	BDL	BDL	BDL
xii.	o,p DDE	µg/L	30.0	BDL	BDL	BDL
xiii.	p,p DDD	µg/L		BDL	BDL	BDL

Location				S I Group India Pvt. Ltd.	CETP Inlet	CETP Outlet
Date of Sampling				02.06.17	04.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Result		
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 (PAH)	µg/L	0.2	BDL	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	µg/L	2.0	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	5.0	BDL	BDL	BDL
31.	Nickel (as Ni)	mg/L	3.0	0.139	1.68	2.43
32.	Copper (as Cu)	mg/L	-	BDL	0.129	0.141
33.	Hexavalent Chromium (as Cr ⁶⁺)	mg/L	0.1	BDL	0.157	0.794
34.	Total Chromium (as Cr)	mg/L	2.0	BDL	0.154	0.242
35.	Total Arsenic (as As)	mg/L	0.2	BDL	0.014	0.017
36.	Lead (as Pb)	mg/L	0.1	BDL	BDL	0.048
37.	Cadmium (as Cd)	mg/L	2.0	BDL	0.002	0.003
38.	Mercury (as Hg)	mg/L	0.01	BDL	BDL	BDL
39.	Manganese (as Mn)	mg/L	2.0	0.118	0.49	0.713
40.	Iron (as Fe)	mg/L	3.0	0.295	14.3	22.3

Location				S I Group India Pvt. Ltd.	CETP Inlet	CETP Outlet
Date of Sampling				02.06.17	04.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Result		
41.	Vanadium (as V)	mg/L	0.2	BDL	BDL	BDL
42.	Selenium (as Se)	mg/L	0.05	BDL	BDL	BDL
43.	Boron (as B)	mg/L	-	BDL	BDL	0.583
44.	Bioassay Test on fish	% survival	90% survival after 96h in 100%effluent	100	0	0

Table II:

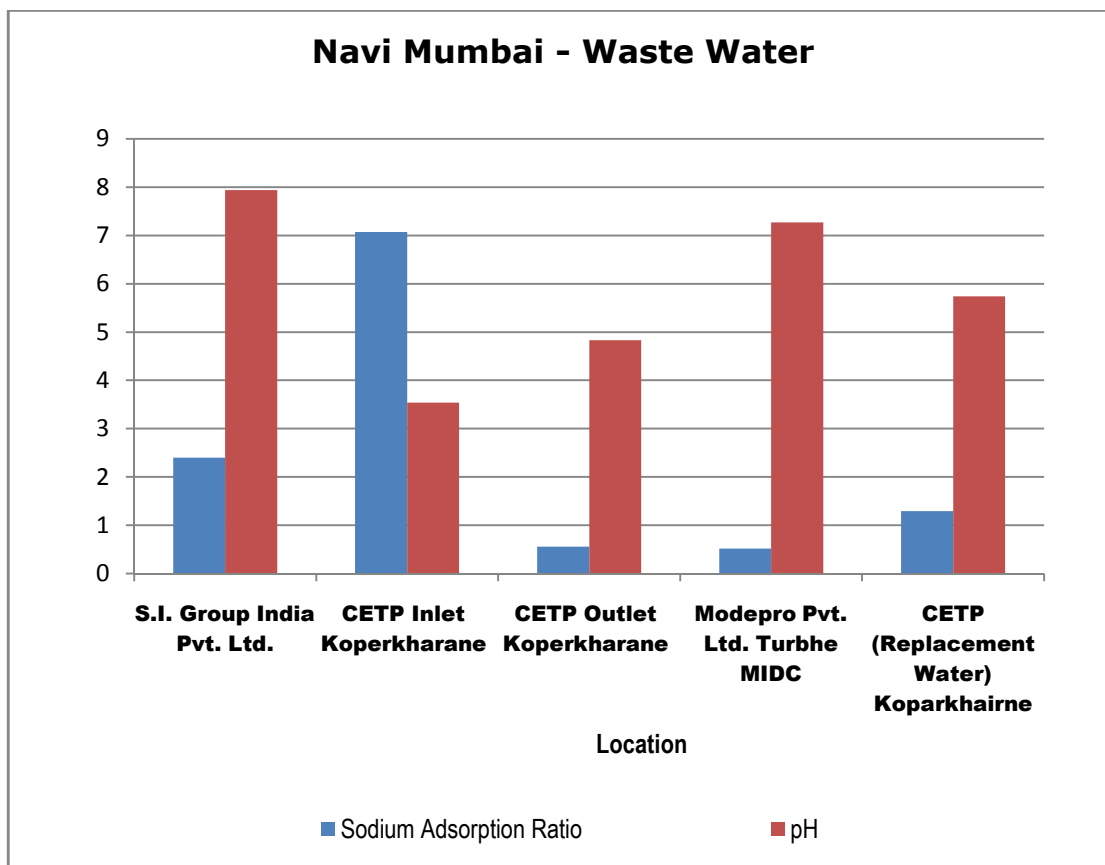
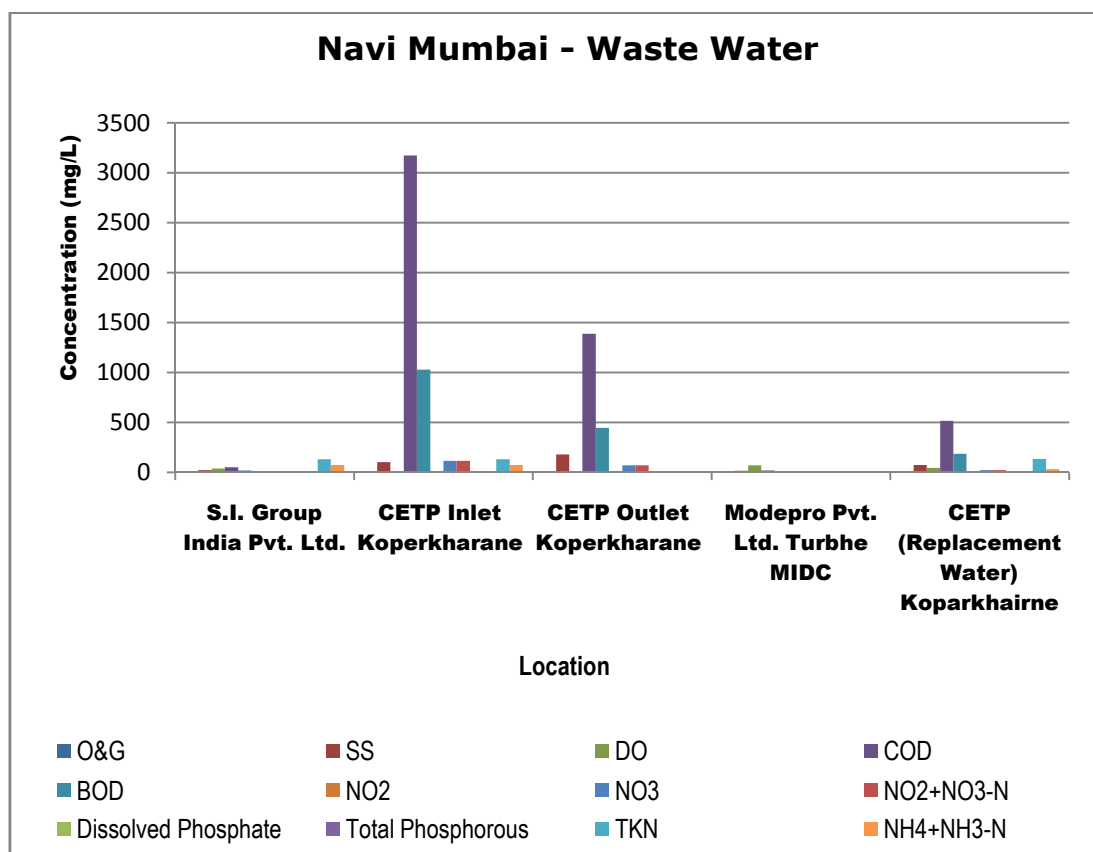
Location				Modepro Pvt. Ltd.	CETP (Replacement Water)
Date of Sampling				04.06.17	06.06.17
Sr.	Parameters	Unit	Std. Limit	Results	
1.	Colour	Hazen		1	10
2.	Smell	-		Agreeable	Agreeable
3.	pH	-	5.5 -9.0	7.27	5.74
4.	Oil & Grease	mg/L	10.0	BDL	BDL
5.	Suspended Solids	mg/L	100.0	16	75
6.	Dissolved Oxygen (%Saturation)	%		70	44
7.	Chemical Oxygen Demand	mg/L	250.0	20	516
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	30.0	7	185

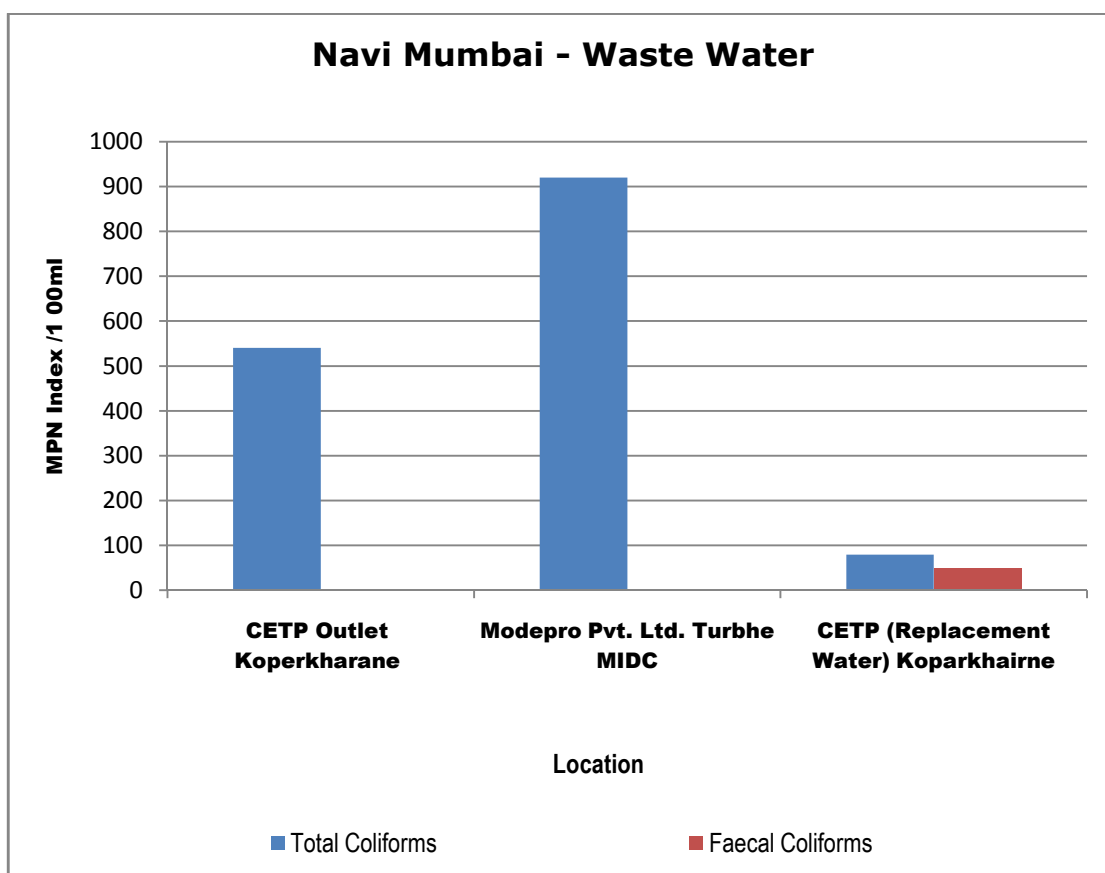
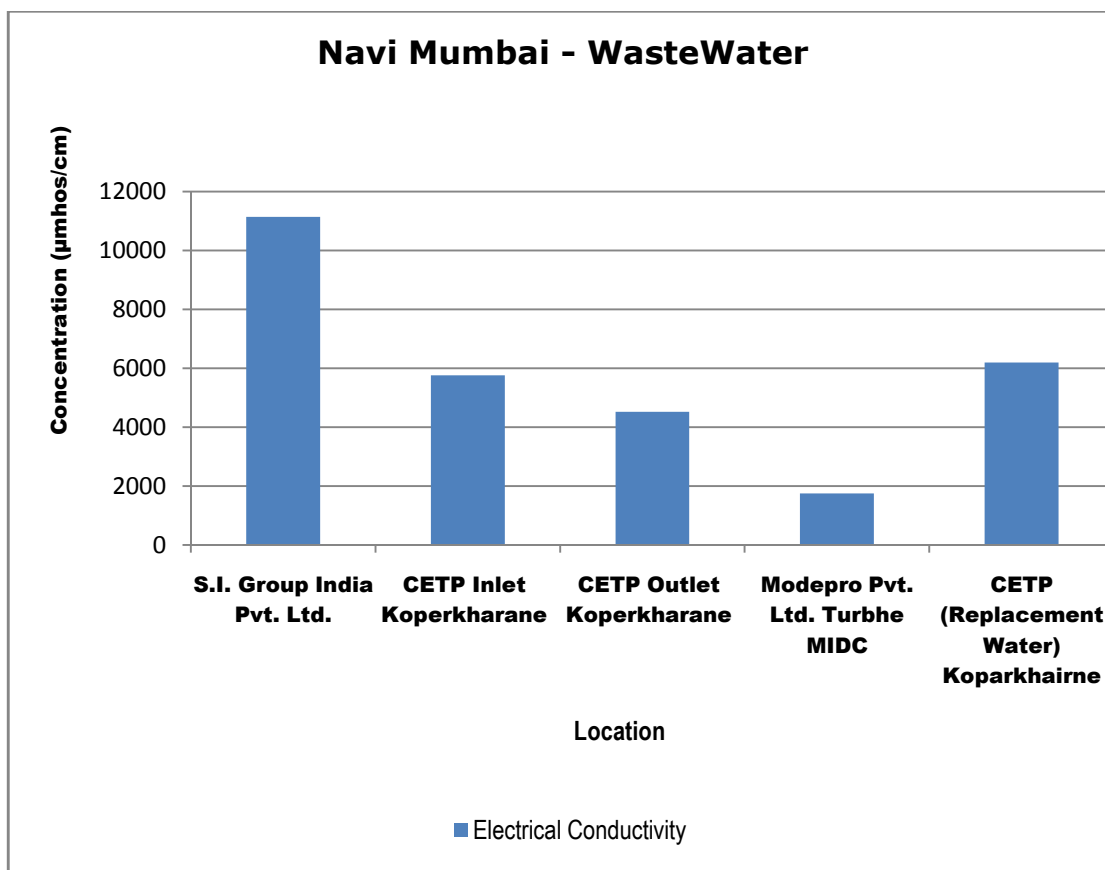
Location				Modepro Pvt. Ltd.	CETP (Replacement Water)
Date of Sampling				04.06.17	06.06.17
9.	Electrical Conductivity (at 25°C)	µmho/cm		1746	6200
10.	Nitrite Nitrogen (as N)	mg/L		0.03	0.1
11.	Nitrate Nitrogen (as N)	mg/L	10.0	9.02	24.3
12.	(NO ₂ + NO ₃)-Nitrogen	mg/L	5.0	9.05	24.4
13.	Free Ammonia (as NH ₃ -N)	mg/L	5.0	BDL	BDL
14.	Total Residual Chlorine	mg/L	1.0	BDL	0.12
15.	Cyanide (as CN)	mg/L	0.2	BDL	BDL
16.	Fluoride (as F)	mg/L	2.0	0.54	0.56
17.	Sulphide (as S ²⁻)	mg/L	2.0	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	5.0	0.27	BDL
19.	Sodium Absorption Ratio	-		0.52	1.29
20.	Total Coliforms	MPN index/100 mL	100.0	920	79
21.	Faecal Coliforms	MPN index 100 mL	1000.0	BDL	49
22.	Total Phosphorous (as P)	mg/L	1.0	0.97	BDL
23.	Total Kjeldahl Nitrogen (as N)	mg/L	100.0	8.62	135

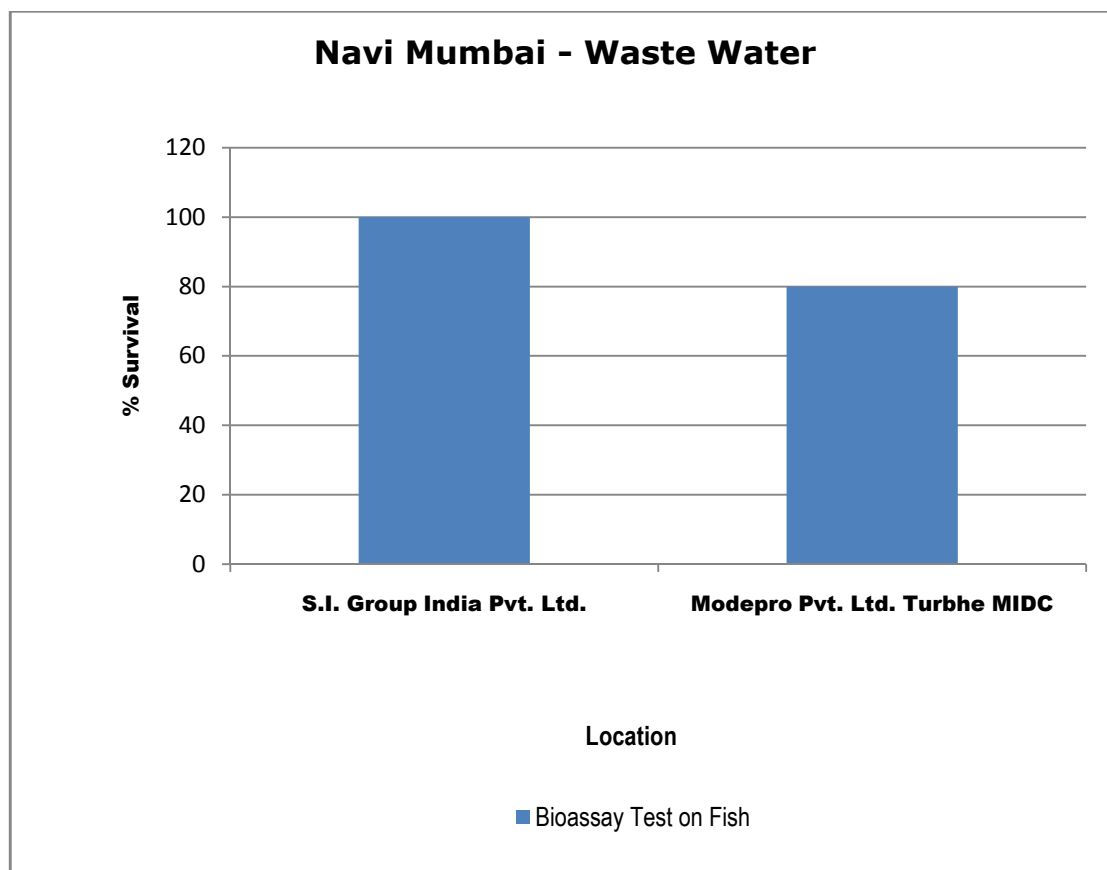
Location				Modepro Pvt. Ltd.	CETP (Replacement Water)
Date of Sampling				04.06.17	06.06.17
24.	Total Ammonia (NH ₄ +NH ₃)-Nitrogen	mg/L	5.0	4	31.7
25.	Phenols (as C ₆ H ₅ OH)	mg/L	3.0	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L	3.0	BDL	BDL
27.	Organo Chlorine Pesticides		0.1	-	-
i.	Alachlor	µg/L	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.	Butachlor	µg/L	3.0	BDL	BDL
viii.	Delta HCH	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
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

Location				Modepro Pvt. Ltd.	CETP (Replacement Water)
Date of Sampling				04.06.17	06.06.17
28.	Polynuclear aromatic hydrocarbons (PAH)	µg/L	0.2	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	µg/L	2.0	BDL	BDL
30.	Zinc (as Zn)	mg/L	5.0	BDL	BDL
31.	Nickel (as Ni)	mg/L	3.0	BDL	3.97
32.	Copper (as Cu)	mg/L		BDL	0.495
33.	Hexavalent Chromium (as Cr ⁶⁺)	mg/L	0.1	BDL	0.065
34.	Total Chromium (as Cr)	mg/L	2.0	BDL	0.14
35.	Total Arsenic (as As)	mg/L	0.2	BDL	0.035
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	BDL	BDL
40.	Iron (as Fe)	mg/L	3.0	1.29	1.16
41.	Vanadium (as V)	mg/L	0.2	0.146	3.84
42.	Selenium (as Se)	mg/L	0.05	BDL	BDL
43.	Boron (as B)	mg/L		BDL	BDL
44.	Bioassay Test on fish	% survival	90% survival after 96h in 100% effluent	BDL	0.27

Graphs of Waste Water Quality Monitoring for Navi Mumbai TTC MIDC:







3.4 Ground Water Analysis Results:

Sr.	Location	Source	Table No.
1.	TTC WMA Site	Borewell	Table No. I
2.	MSW Site	Borewell	Table No. I
3.	Vashi Creek	Creek water	Table No. I
4.	Alok NallaKoparkharaine	Borewell	Table No. II
5.	TTC Plot no. 142	Borewell	Table No. II
6.	Turbhe Village	Borewell	Table No. II

TableNo.I:

Name of Industry				Vashi Creek	TTI WMA Site	MSW Site Navi Mumbai
Date of Sampling				02.06.17	02.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
1.	Colour	Hazen	5	1	1	2
2.	Smell	-	Agreeable	Agreeable	Agreeable	Agreeable
3.	pH	-	6.5-8.5	7.3	7.79	7.5
4.	Oil & Grease	mg/L	100	BDL	BDL	BDL
5.	Suspended Solids	mg/L	500	10	7	320
6.	Chemical Oxygen Demand	mg/L	10 (WHO, 1993)	200	10	60
7.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	6 (WHO, 1993)	71	3.1	38
8.	Electrical Conductivity (at 25 °C)	µmho/cm	750	1154	1371	44600
9.	Nitrite Nitrogen (as N)	mg/L		BDL	BDL	2.9
10.	Nitrate Nitrogen (as N)	mg/L	45	1.05	2.84	6.99
11.	(NO ₂ + NO ₃)-Nitrogen	mg/L	1.0	1.05	2.84	9.89
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	1.5	BDL	BDL	BDL
15.	Fluoride (as F)	mg/L	1	0.24	0.16	0.8

Name of Industry				Vashi Creek	TTI WMA Site	MSW Site Navi Mumbai
Date of Sampling				02.06.17	02.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
16.	Sulphide (as S ²⁻)	mg/L	0.05	BDL	BDL	BDL
17.	Dissolved Phosphate (as P)	mg/L		BDL	BDL	0.24
18.	Sodium Absorption Ratio	-		0.5	0.7	3.22
19.	Total Coliforms	MPN index/ 100 mL	ND	BDL	130	79
20.	Faecal Coliforms	MPN index/ 100 mL	ND	BDL	BDL	BDL
21.	Total Phosphorous (as P)	mg/L	0.5	BDL	BDL	0.68
22.	Total Kjeldahl Nitrogen (as N)	mg/L	0.001	0.56	1.01	2.46
23.	Total Ammonia (NH ₄ +NH ₃)-Nitrogen	mg/L	0.5	BDL	BDL	BDL
24.	Phenols (as C ₆ H ₅ OH)	mg/L	0.001	BDL	BDL	BDL
25.	Surface Active Agents (as MBAS)	mg/L	0.02	BDL	BDL	BDL
26.	Organo Chlorine Pesticides	µg/L	0.05			
i.	Alachlor	µg/L	20	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

Name of Industry				Vashi Creek	TTI WMA Site	MSW Site Navi Mumbai
Date of Sampling				02.06.17	02.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
vi.	Beta HCH	µg/L	0.04	BDL	BDL	BDL
vii.	Butachlor	µg/L	125	BDL	BDL	BDL
viii.	Delta HCH	µg/L	0.04	BDL	BDL	BDL
ix.	p,p DDT	µg/L	1	BDL	BDL	BDL
x	o,p DDT	µg/L	1	BDL	BDL	BDL
xi.	p,p DDE	µg/L	1	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	0.4	BDL	BDL	BDL
xvi.	Beta Endosulfan	µg/L	0.4	BDL	BDL	BDL
xvii.	Endosulfan Sulphate	µg/L	0.4	BDL	BDL	BDL
xviii.	Y HCH (Lindane)	µg/L	2.0	BDL	BDL	BDL
27.	Polynuclear aromatic hydrocarbons (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	BDL
32.	Hexavalent Chromium (as Cr ⁶⁺)	mg/L	1	BDL	BDL	BDL

Name of Industry				Vashi Creek	TTI WMA Site	MSW Site Navi Mumbai
Date of Sampling				02.06.17	02.06.17	04.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
33.	Total Chromium (as Cr)	mg/L	0.05	BDL	BDL	BDL
34.	Total Arsenic (as As)	mg/L	0.01	BDL	BDL	0.031
35.	Lead (as Pb)	mg/L	0.01	BDL	BDL	BDL
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	BDL
39.	Iron (as Fe)	mg/L	0.3	BDL	BDL	0.407
40.	Vanadium (as V)	mg/L		BDL	BDL	21.3
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		BDL	BDL	1.68

Table II:

Location				Alok Nalla	TTC Plot no. 142	Turbhe Village
Date of Sampling				06.06.17	06.06.17	06.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
1.	Colour	Hazen	5	10	1	1
2.	Smell	-	Agreeable	Agreeable	Agreeable	Agreeable
3.	pH	-	6.5-8.5	6.56	7.01	7.11
4.	Oil & Grease	mg/L	100	BDL	BDL	BDL

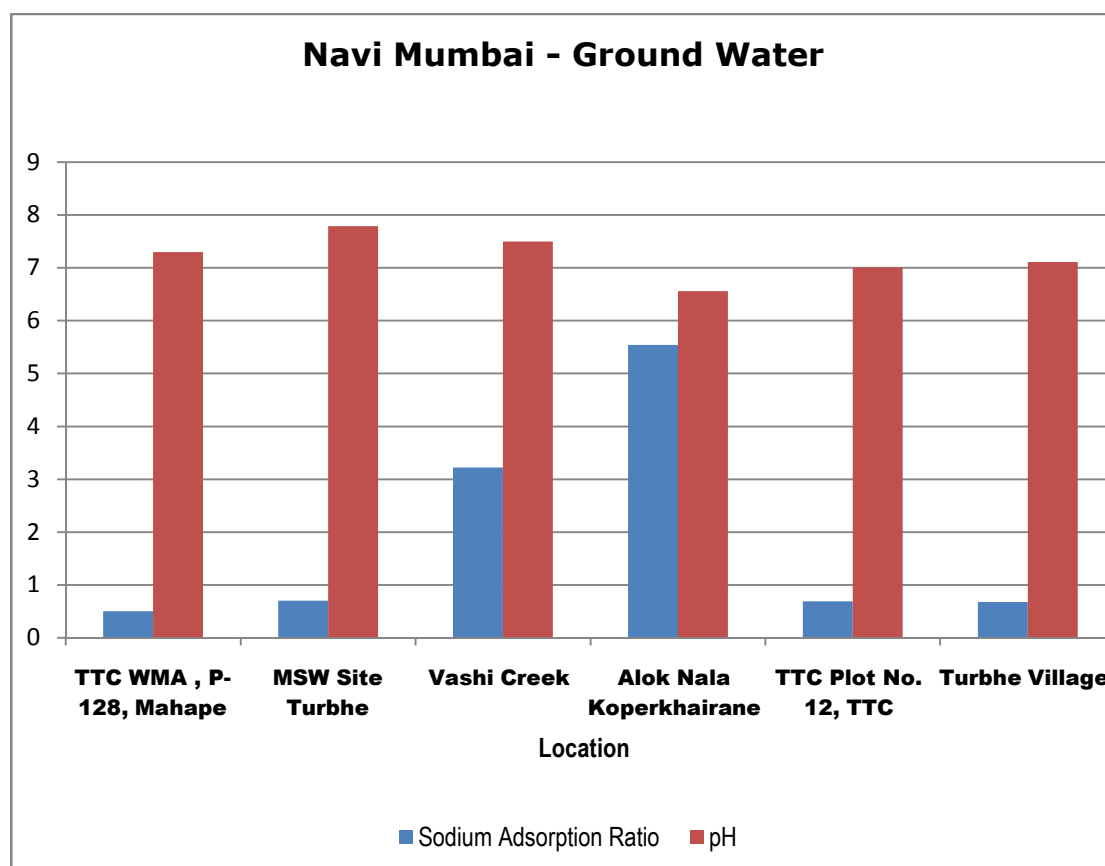
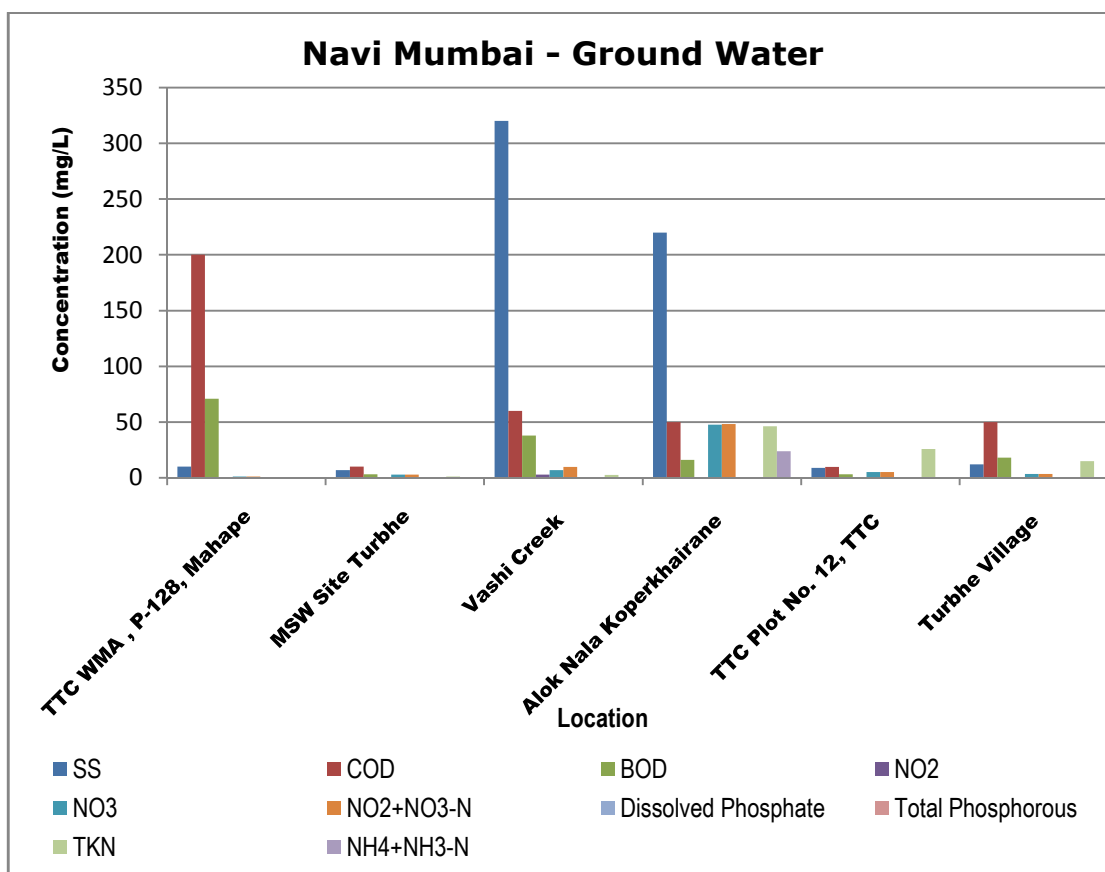
Location				Alok Nalla	TTC Plot no. 142	Turbhe Village
Date of Sampling				06.06.17	06.06.17	06.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
5.	Suspended Solids	mg/L	500	220	9	12
6.	Chemical Oxygen Demand	mg/L	10 (WHO, 1993)	50	9.9	50
7.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	6 (WHO, 1993)	16	3.1	18
8.	Electrical Conductivity (at 25 °C)	µmho/cm	750	3980	1021	999
9.	Nitrite Nitrogen (as N)	mg/L		0.41	BDL	BDL
10.	Nitrate Nitrogen (as N)	mg/L	45	47.8	5.3	3.57
11.	(NO ₂ + NO ₃)-Nitrogen	mg/L	1.0	48.2	5.31	3.58
12.	Free Ammonia (as NH ₃ -N)	mg/L	0.5	BDL	BDL	BDL
13.	Total Residual Chlorine	mg/L	0.2	BDL	0.1	0.08
14.	Cyanide(as CN)	mg/L	1.5	BDL	BDL	BDL
15.	Fluoride (as F)	mg/L	1	0.16	BDL	BDL
16.	Sulphide (as S ²⁻)	mg/L	0.05	10.4	BDL	BDL
17.	Dissolved Phosphate (as P)	mg/L		0.57	BDL	BDL
18.	Sodium Absorption Ratio	-		5.54	0.69	0.68

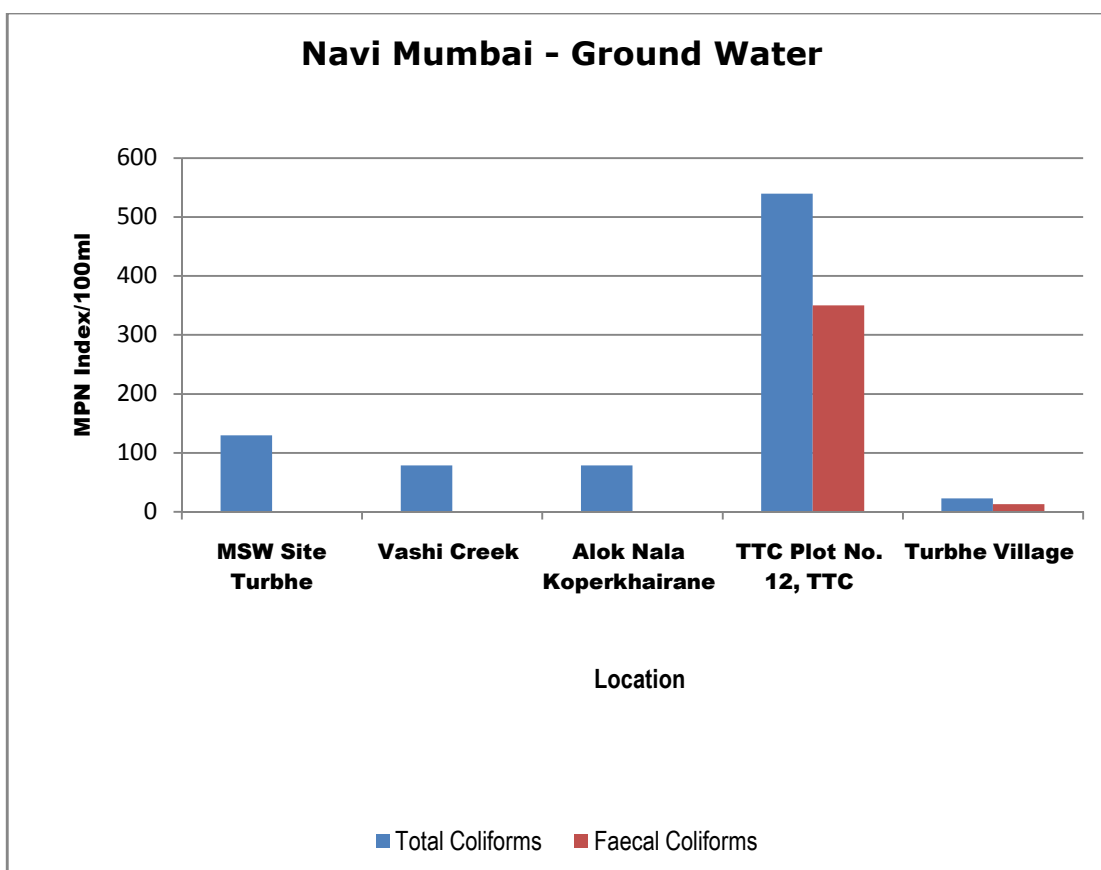
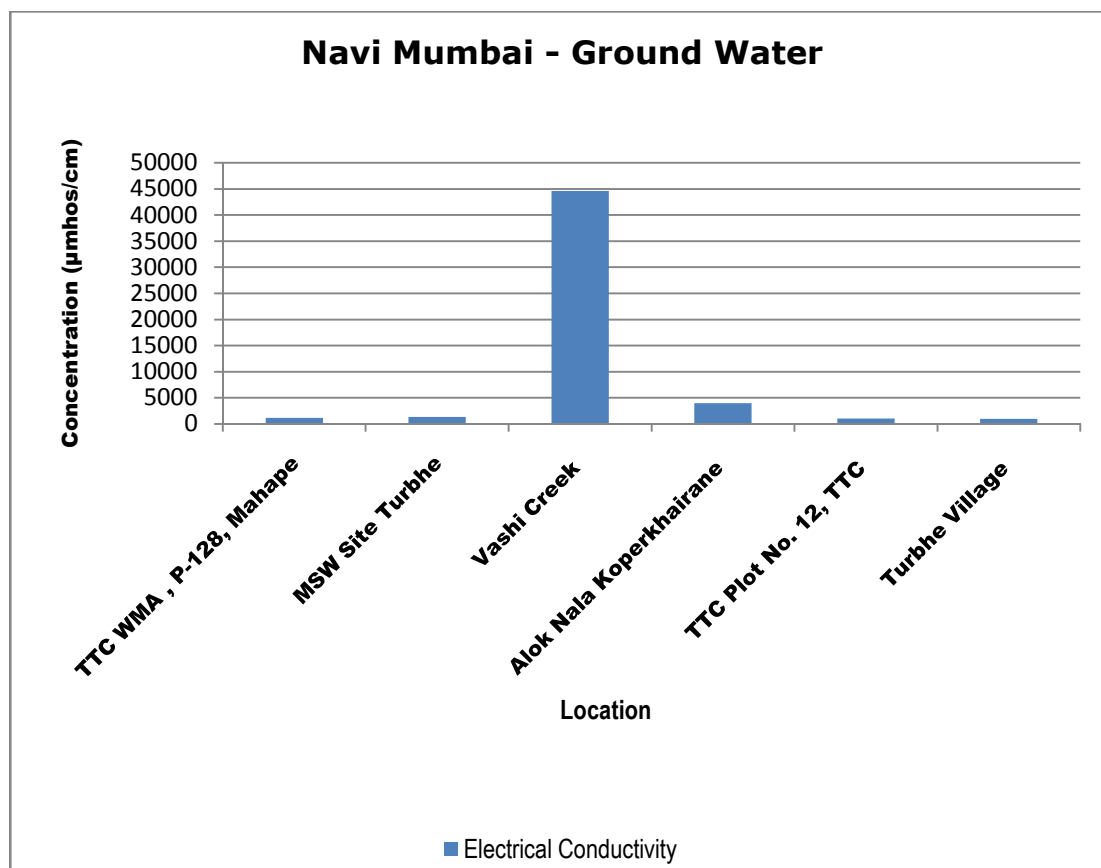
Location				Alok Nalla	TTC Plot no. 142	Turbhe Village
Date of Sampling				06.06.17	06.06.17	06.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
19.	Total Coliforms	MPN index/ 100 mL	ND	79	540	23
20.	Faecal Coliforms	MPN index/ 100 mL	ND	BDL	350	13
21.	Total Phosphorous (as P)	mg/L	0.5	0.68	BDL	BDL
22.	Total Kjeldahl Nitrogen (as N)	mg/L	0.001	46.2	25.8	14.9
23.	Total Ammonia (NH ₄ +NH ₃)-Nitrogen	mg/L	0.5	23.8	0.53	BDL
24.	Phenols (as C ₆ H ₅ OH)	mg/L	0.001	BDL	BDL	BDL
25.	Surface Active Agents (as MBAS)	mg/L	0.02	0.29	BDL	0.68
26.	Organo Chlorine Pesticides		0.05			
i.	Alachlor	µg/L	20	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.	Butachlor	µg/L	125	BDL	BDL	BDL
viii.	Delta HCH	µg/L	0.04	BDL	BDL	BDL
ix.	p,p DDT	µg/L	1	BDL	BDL	BDL

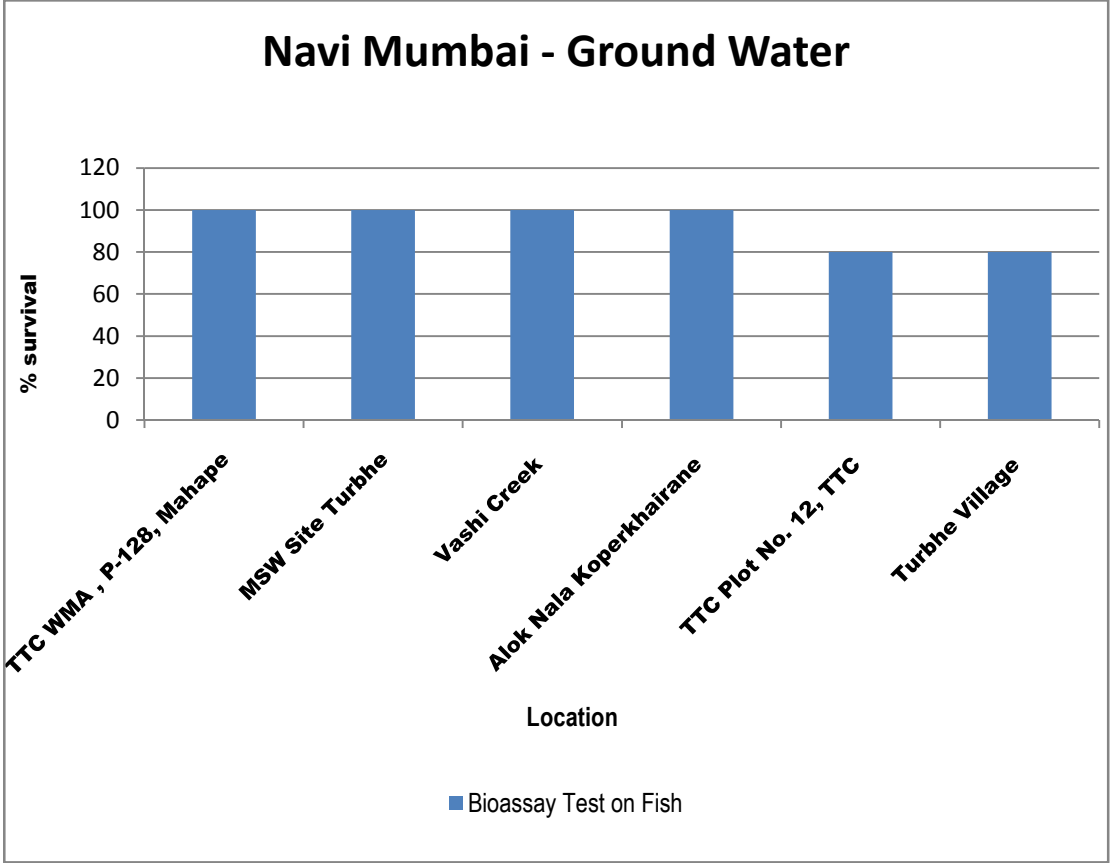
Location				Alok Nalla	TTC Plot no. 142	Turbhe Village
Date of Sampling				06.06.17	06.06.17	06.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
x	o,p DDT	µg/L	1	BDL	BDL	BDL
xi.	p,p DDE	µg/L	1	BDL	BDL	BDL
xii.	o,p DDE	µg/L	1	BDL	BDL	BDL
xiii.	p,p DDD	µg/L	1	BDL	BDL	BDL
xiv.	o,p DDD	µg/L	1	BDL	BDL	BDL
xv.	Alpha Endosulfan	µg/L	0.4	BDL	BDL	BDL
xvi.	Beta Endosulfan	µg/L	0.4	BDL	BDL	BDL
xvii.	Endosulfan Sulphate	µg/L	0.4	BDL	BDL	BDL
xviii.	Y HCH (Lindane)	µg/L	2.0	BDL	BDL	BDL
27.	Polynuclear aromatic hydrocarbons (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	0.565	BDL	BDL
31.	Copper (as Cu)	mg/L	0.05	0.022	BDL	BDL
32.	Hexavalent Chromium (as Cr ⁶⁺)	mg/L	1	0.07	BDL	BDL
33.	Total Chromium (as Cr)	mg/L	0.05	BDL	BDL	BDL
34.	Total Arsenic (as As)	mg/L	0.01	0.119	BDL	BDL
35.	Lead (as Pb)	mg/L	0.01	BDL	BDL	BDL

Location				Alok Nalla	TTC Plot no. 142	Turbhe Village
Date of Sampling				06.06.17	06.06.17	06.06.17
Sr.	Parameters	Unit	Std. Limit	Results		
36.	Cadmium (as Cd)	mg/L	0.003	0.122	BDL	BDL
37.	Mercury (as Hg)	mg/L	0.001	BDL	BDL	BDL
38.	Manganese (as Mn)	mg/L	0.1	BDL	BDL	BDL
39.	Iron (as Fe)	mg/L	0.3	1.02	BDL	BDL
40.	Vanadium (as V)	mg/L		7.27	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		1.13	BDL	0.175

Graphs of Ground Water Quality Monitoring for Navi Mumbai:







4. Summary and Conclusions

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

4.1 Stack Emission Monitoring:

Seven different industries were selected for Stack monitoring. All the three parameters detected and analyzed in the samples are observed below the standard limits.

Particulate matter was observed in the range of below $10\text{mg}/\text{Nm}^3$ to $231\text{mg}/\text{Nm}^3$. Minimum is observed in S I Group India Pvt. Ltd. and maximum at Amines & Plasticizers Ltd.

Sulphur dioxide values were observed in the range of 5.33 to $10.6\text{mg}/\text{Nm}^3$. It is observed minimum at RPG Life Science Ltd. and Maximum at Amines & Plasticizer Ltd. Nitrogen dioxide was observed comparatively in the higher range of 1062 to $1119\text{mg}/\text{Nm}^3$.

4.2 Ambient Air Quality Monitoring:

In the present study, five Ambient Air Quality monitoring stations were selected for sampling. They are (i) Amines & plasticizers Ltd. (ii) Mahalaxmi Dying & Printing Pvt. Ltd. (iii) G.L. Construction Pvt. Ltd. (iv) TTC WMA (v) Ajwani Infra TTC Area (vi) Croda Chemicals Pvt. Ltd. (vii) Akash Fabrics Pvt. Ltd. (viii) Arcee Innovation Pvt. Ltd.

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:** All the locations except one i.e. Amines & Plasticizers Ltd. ($29.1\mu\text{g}/\text{m}^3$) are observed with very low concentrations of SO_2 (BDL), which is quite lower than the standard limit of NAAQS i.e. $80\mu\text{g}/\text{m}^3$.
2. **Nitrogen dioxide:** Values of nitrogen dioxide are also observed below the standard limit of $80\mu\text{g}/\text{m}^3$ at all the locations. It is detected in the range of BDL to $5.87\mu\text{g}/\text{m}^3$.
3. **Particulate Matter (PM_{10}):** PM_{10} is considered as one of the major causes of ambient air pollution. Out of all the sampled locations, 7 are exceeding the standard limit of $100\mu\text{g}/\text{m}^3$. However, only one industrial sample i.e. of Arcee Innovations Pvt. Ltd. ($89\mu\text{g}/\text{m}^3$) it is found below standard.
4. **Particulate Matter ($\text{PM}_{2.5}$):** Like PM_{10} it is also categorized as a probable carcinogen. However, unlike PM_{10} , its concentration is observed below standard limit in all the collected samples. It is found in the range of 24 to $50\mu\text{g}/\text{m}^3$.
5. **Ozone (O_3):** Concentration of ozone in all the samples is observed lower than its standard limit. Except at Amines & Plasticizers Ltd. ($50.0\mu\text{g}/\text{m}^3$) and G.L. Construction Pvt. Ltd. ($23.3\mu\text{g}/\text{m}^3$), concentration of Ozone is observed below $19\mu\text{g}/\text{m}^3$.
6. **Carbon Monoxide (CO):** Concentration of carbon monoxide has also been found below the standard limit ($2.0\mu\text{g}/\text{m}^3$) at all the sampling locations i.e. in the range of BDL to $3.08\mu\text{g}/\text{m}^3$.
7. **Lead (Pb):** Likewise, Carbon Monoxide, concentration of Lead is also observed below standard limit in all the samples i.e. in the range of BDL to $0.022\mu\text{g}/\text{m}^3$.

8. **Ammonia (NH₃):** Concentration of ammonia is also observed very much lower than its standard limit (400 µg/m³). Except at Amines & Plasticizers Ltd. (44.3 µg/m³), concentration of all other samples is observed below 40 µg/m³.
9. **Benzene (C₆H₆):** Benzene is a known carcinogen; hence it is unsafe when exceeds the limit. Fortunately, all the samples under study are observed with less than 1 µg/m³ concentration of Benzene, which is quite lower value than its standard limit of 5 µg/m³.
10. **Benzo(a)pyrene:** BaP is also considered as a critical pollutant hence lethal if exceeds the limits. The study shows that the concentration of BaP is below 0.2 ng/m³ at all locations, which is quite lower value than its standard limit of 1 ng/m³.
11. **Arsenic:** Concentration of Arsenic at all the studied locations is found below the standard 6 ng/m³.
12. **Nickel:** Concentration of Nickel is also observed below the standard limit (20 ng/m³), at all the studied locations of Navi Mumbai.

4.3 Waste water Quality Monitoring:

To understand the quality of treated effluent, samples were collected from following industries - (i) S I Group India Pvt. Ltd. (ii) CETP Inlet (iii) CETP Outlet (iv) Modepro Pvt. Ltd. TTC MIDC (v) CETP outlet (replacement water).

1. **Colour** (Hazen Units): Colour units are found below the acceptable standard except inlet CETP water sample.
2. **Odour:** odour of all the samples is found agreeable.
3. **pH:** it is observed in between 3.54 and 7.94 which is well within the range.
4. **Suspended Solids:** Except outlet (180 mg/L) and inlet (103 mg/L) water sample of CETP, suspended solids of treated outlet water of all the other five locations appeared to be clean, as suspended solids is observed below 100 mg/L.
5. **Chemical Oxygen Demand:** Out of all, CETP outlet (1389 mg/L), inlet (3174 mg/L) and replacement water (516 mg/L) are observed to exceed standard limit (250 mg/L). However, other two samples are observed as 20 and 50 mg/L.
6. **Biochemical Oxygen Demand:** BOD samples also show the same trend as COD samples. Out of all, CETP outlet (447 mg/L), inlet (1030 mg/L) and replacement water (185 mg/L) are observed to exceed standard limit (30 mg/L). However, other two samples are observed as 7 and 18 mg/L.
7. **Sulphide:** Except at CETP Inlet Koperkhairne (11.6 mg/L), concentration of sulphide at all the other locations is found below 0.025 mg/L, which is below the standard limit of sulphide 2.0 mg/L.
8. **Total Ammonia:** Except Modepro Pvt. Ltd. (4.0 mg/L), all the other water samples are found to exceed the standard limit of 5 mg/L in the range of 12 to 73.1 mg/L.
9. **Total Kjeldahl Nitrogen:** Except Modepro Pvt. Ltd. (8.62 mg/L) and CETP outlet (13.4 mg/L), all the other water samples are found to exceed the standard limit of 100 mg/L.

10. **Fish Bioassay:** In case of waters of S I Group India Pvt. Ltd., 100% of fish survival is observed at the end of 96h. however, in case of Modepro Pvt. Ltd sample. exhibits 80% of fish survival. All other water samples failed in bioassay test as zero fish survival is noticed at the end of 96 h in these.
11. **Heavy metals:** All the heavy metals are found below the standard limits in all the samples except iron, which is observed in higher concentration than the standard limit at CETP inlet (14.3mg/L), outlet (22.3mg/L) and replacement water samples (3.84mg/L).

Following parameters meet the criteria as prescribed by CPCB.

12. Free Ammonia
13. Total Residual Chlorine
14. Cyanide
15. Fluoride
16. Dissolved Phosphate
17. Phenolic compounds

4.4 Ground water Quality Monitoring:

1. Fiveborewell samples were collected from different locations namely: (i) TTC WMA Site (ii) MSW Site (iii) Vashi Creek(iv) Alok Nala, Koparkhairane(v) TTC Plot no. 142 MIDC, Navi Mumbai (vi) Turbhe Village. Parameters which are not included in ISO 10500:2012 are compared with WHO standards like BOD (6mg/L) and COD (10mg/L).
2. **Colour** (Hazen Units):Colour units are below the acceptable standard, except water sample of Alok nalla.
3. **Odour:** odour of all the samples is found agreeable.
4. **Chemical Oxygen Demand:**Out of all the samples, 4 samples are detected above standard limit of WHO. These are TTC WMA Site (200mg/L), Vashi Creek (60mg/L), Alok NalaKoparkhairane (50mg/L) andTurbhe Village (50mg/L).
5. **Biological Oxygen Demand:** BOD samples also follow the similar trend ad COD. Out of all, 4 samples are detected above standard limit of WHO. These are TTC WMA Site (71mg/L), Vashi Creek (38mg/L), Alok NalaKoparkhairane (16mg/L) and Turbhe Village (18mg/L).

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

1. **Nitrite:** Values of Nitrite are observed below detection level.
2. **Nitrate:**Results of Nitrate are also observed below standard limit (45mg/l), except Alok Nalla (47.8mg/L). Rest all are observed in the range of 1.05 to 6.99mg/L.
3. **Residual Free Chlorine:** Values are below the acceptable standards.
4. **Total Ammonia:** All readings are found within the acceptable range.

5. **Fluoride:** Values are below the acceptable standards, below detection limit.
6. **Sulphide:** All the readings of sulphide are observed below 0.025mg/L, except Alok Nala sample (10.05mg/L).
7. **Sodium Absorption Ratio:** These values fit within range of water quality criteria of CPCB.
8. **Total Kjeldahl nitrogen:** All the water samples are observed above the standard limit in the range of 0.56 to 46.2mg/L.
9. **Fish Bioassay:** In case of water samples of TTC Plot no. 142 MIDC and Turbhe Village of Navi Mumbai 80% of fish survival is observed at the end of 96h. However, rest all are observed with 100% fish survival at the end of 96h.
10. ***Boron:** Values are below the acceptable standards.
11. (*CPCB Water Quality criteria for Irrigation, Industrial Cooling & Controlled Waste disposal).
12. **Surface Active Agents:** It exceeds the standard of drinking water.
13. **Metals:** All the metals except manganese and iron at Vashi Creek and Alok Nala locations are observed within the acceptable limits of drinking water standards.
14. **PAH & PCB** are also below the acceptable limits.

5. CEPI Score

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

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.

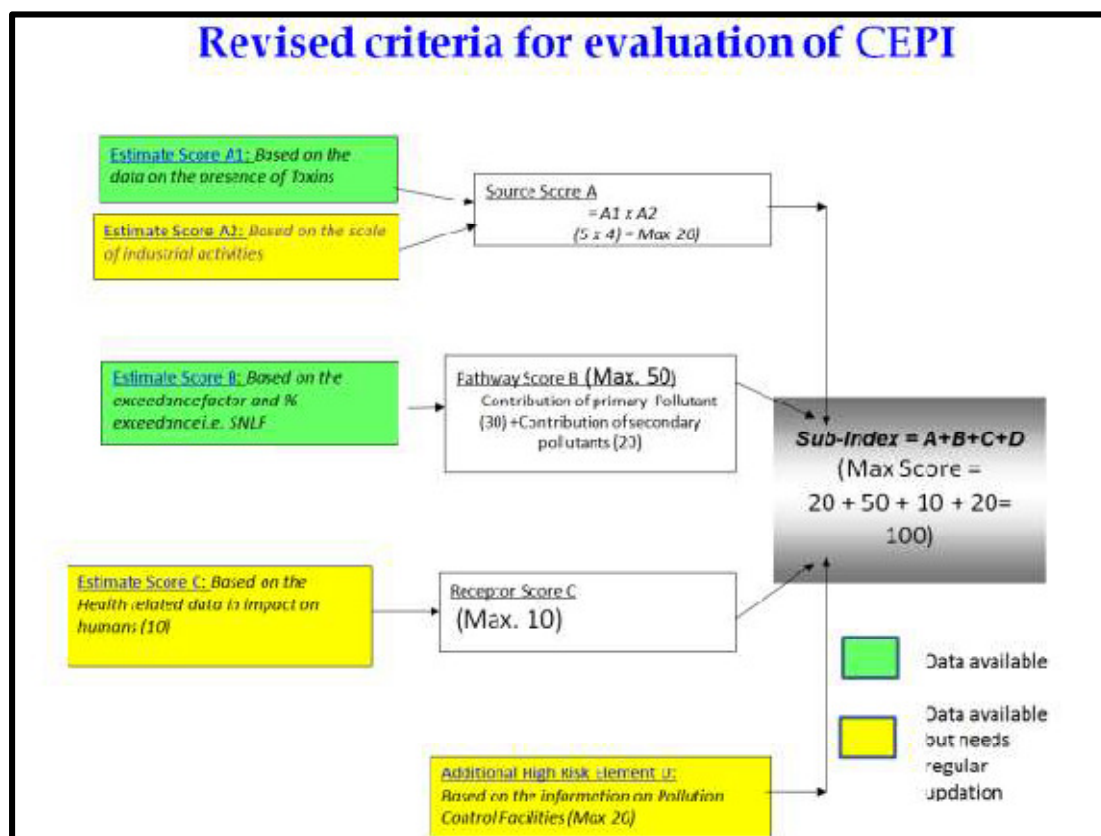
To overcome the subjectivity, revised concept is proposed by eliminating the subjective factors as described in the previous section, but retaining the factors which can be measured precisely.

- 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.
4. 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.

The result shows that CEPI score of present report is 63.52. The present study is the compilation of pre-monsoon season, which also affects the score value. It should be noticed here that MPCB's efforts through the formulation of action plans decreased the overall concentration of pollutants in all aspects i.e. air, land and water in Navi Mumbai area in past three years. This has also resulted in decreased score of CEPI now.

5.1 Comparison of CEPI scores:

Results show that present CEPI score (63.52) of Navi Mumbai considering all revised standards and parameters has decreased by almost 14 points if compared with the CEPI Score of 2013 (77.39) report. This clearly indicates the successful application of STAP and LTAP of MPCB which resulted in a cleaner environment of Navi Mumbai in past three years.

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

Air

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Present Report CEPI Score June, 2017 (Revised CEPI 2016)	2.75	4	11	-	-	-	31	-	-	-	0	10	52
CEPI Score February, 2017	3	5	15	6	3	3	12	3	3	5	14	10	51
CEPI score, August, 2016	3	5	15	6	0	0	6	3	1.5	0	4.5	10	35.5
CEPI score 2013	6	5	30	8	0	0	8	3	5	0	15	10	63
CPCB Report 2009	6	5	30	6	0	0	6	3	5	0	15	10	61

Water:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Present Report CEPI Score June, 2017 (Revised CEPI 2016)	3.5	4	14	-	-	-	20	-	-	-	10	5	49
CEPI Score February, 2017	1	5	5	8	0	0	8	5	5	5	30	5	48
CEPI score, August, 2016	1	5	5	8	0	0	8	5	5	5	30	5	48
CEPI score 2013	4	5	20	8	0	0	8	5	4.8	5	28.6	5	61.8
CPCB Report 2009	3	5	15	8	3	3	14	5	3	5	20	10	59

Land:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
Present Report CEPI Score June, 2017 (Revised CEPI 2016)	3.5	4	14	-	-	-	20	-	-	-	10	5	49
CEPI Score February, 2017	1	5	5	6	0	0	6	5	3	5	20	5	36
CEPI score, August, 2016	1	5	5	8	0	0	8	5	5	5	30	5	48
CEPI score 2013	4	5	20	8	0	0	8	5	5	5	30	5	63
CPCB Report 2009	3	5	15	6	15	3	10	5.5	3	5	20	10	55.5

Aggregated CEPI:

	Air Index	Water Index	Land Index	CEPI
Present Report CEPI Score June, 2017 (Revised CEPI 2016)	52	49	49	63.52
CEPI Score February, 2017	51	48	36	59.46
CEPI score, August, 2016	30.5	48	48	56.86
CEPI score 2013	63	61.75	63	77.39
CPCB Report 2009	61	59	55.5	73.77

6. Conclusions

The Present study has been done according to the revised CEPI Version 2016. This is an attempt to check the characteristics and status of environment among the different industrial clusters of Navi Mumbai 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.

Among all the sampling locations, Government Hospital is found the most critical location in view of pollution in all the environmental components i.e. Air, Water and Land. Parameters of air sampling are observed within the standard limit except PM_{10} as compared to their standards at 7 locations out of total 8 sampling locations. Among waste water samples, BOD of CETP Inlet, CETP outlet and CETP replacement water samples are found beyond standard limit. Few samples of suspended solids and sulphides also exceed their standard limits in the samples. Similarly, in ground water samples BOD and COD of four samples are observed higher than the permissible limits. Among all the samples, water of Alok Nalla is observed severely polluted.

Moreover, the present CEPI score (63.52) 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	2.75	4	11	31	0	10	52
Water Index	3.5	4	14	20	10	5	49
Land Index	3.5	4	14	20	10	5	49
Aggregated CEPI							63.52

7. Efforts taken for the reduction in pollution:

The regional office of Maharashtra pollution control board has taken various initiatives in reducing the CEPI Score of 77.39 of 2013 to 63.52 of 2017. Below mentioned are some of the efforts:

- a) About 17 industries have started using Natural Gas as fuel (PNG) since last 4 years. Gas Pipeline works started from 2011.
- b) Due to Change in Fuel Pattern the SO₂ Reduction: 576.70 T/A.
- c) All major polluting industries having their own full fledged ETP in their premises for treatment of effluent generated during activities. And then treated effluent is sent to CETP for further treatment and disposal in the Creek.
- d) The treated effluent of the industries is discharged into Common Effluent Treatment Plant (CETP) for further treatment and disposal and then discharged into TTC creek through closed pipeline at the point recommended by National Institute of Oceanography (NIO) nearly 3 km inside Vashi creek.
- e) All Large /Medium/ small scale industries has installed dust collectors and scrubbing systems as Air Pollution Control Devices.
- f) All the bulk mfg. units (12 nos) are being proposed to install VOC analyser including alarm system.
- g) About 57 major polluting industries are closed, namely – NOCIL Petrochemicals, Reliance Silicons, Standard Alkali (Chemical Division), Corromandal Fertilizers, JaysynthDyechem, Unique Chemicals, Cabbot India etc.
- h) Implementation of CEPI Action Plan by improvement of Environmental Pollution Control System has resulted in Reduction of Pollution Load. This has resulted in low pollution levels & hence improvement in CEPI status. Use of CNG for industrial and transportation already started

8. References

- 1) Criteria for Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/4/2009-10
- 2) Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/5/2009-10
- 3) Action Plan for Industrial Cluster:Chandrapur,November 2010,MPCB
- 4) Action Plan for Industrial Cluster:Dombivali,November 2010,MPCB
- 5) Action Plan for Industrial Cluster:Aurangabad,November 2010,MPCB
- 6) Action Plan for Industrial Cluster:NaviMumbai,November 2010,MPCB
- 7) Action Plan for Industrial Cluster: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

9. 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

MAHARASHTRA POLLUTION CONTROL BOARD
Sub Regional Office Tarapur-II

Tel : (02525) 273314
email:srotarapur2@mpcb.gov.in



M.I.D.C. Office Compound,
Tarapur, Post-TAPS, Boisar(w).

Tal- Palghar, Dist-Thane -401504

MPCB/SROTR-II/TB-

Date:- 23/06/2017

*Sailela Hospital
Tarapur, Boisar*

Sub:- Health related data collection for CEPI REV.

Ref:- Request from representative of Ashwamedh Engineers & Consultant C.S.I.

Sir,

Board has the contrasted the work for project on Monitoring Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality in critically polluted areas in Maharashtra including Tarapur for Pre-Monsoon season. Vide letter dtd.29.05.2017, further vide mail from JD Air Section dtd.07.06.2017 has asked to collect the Health related data for CEPI revision to Ashwamedh Engineers, accordingly you are requested to give the data in prescribed format for Health related data in respect of discuses for the year 2012, 2013, 2014, 2015, 2016 & 2017 at earliest.

Further as per a direction from CPCB vide letter dtd.26.04.2016 they have mentioned revised CEPI score calculation where is the weight age for Health related study is 10, Hence as per the said directions information is required at the earliest.

(Dr. R.A. Rajput)

Sub-Regional officer, Tarapur-II

9766029991

*Sailela Hospital
Tarapur, Boisar*

[illegible]

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office - Navi Mumbai

Phone : 022-2757 27 40

Fax : 022-2757 1586

Visit us at :- <http://mpcb.gov.in>

e-mail : ronavimumbai@mpcb.gov.in



Raigad Bhavan, 7th Floor,
Sector-11,
C.B.D. Belapur
Navi Mumbai 400 614

No. MPCB/RONM/2017/170621FTS-0008

Date: 21/06/2017

To,

1. NMMC General Hospital, Vashi
2. E.S.I.S Hospital, Vashi ✓
3. MGM Hospital, Belapur ✓

Sub:- Health related data collection for CEPI REV.

Ref:- Request from representative of Ashwamedh
Engineers & Consultant C.S.I.

Sir,

Board has the contrasted the work for project on Monitoring Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality in critically polluted areas in Maharashtra including Navi Mumbai for Pre-Monsoon season Vide letter dtd. 29.05.2017, further vide mail from JD Air Section dtd. 07.06.2017 has asked to collect the Health related data for CEPI revision to Ashwamedh Engineers, accordingly you are requested to give the data in prescribed format for Health related data in respect of discuses for the year 2012, 2013, 2014, 2015, 2016 & 2017 at earliest.

Further as per a direction from CPCB vide letter dtd. 26.04.2016 they have mentioned revised CEPI score calculation where the weight age for Health is related study is 10. In this regard you are requested to give information as per the said directions at the earliest.

(Dr. A. N. Harshwardhan)
Regional Officer, Navi Mumbai

TB

E.S.I.S. Hospital

Alane
MEDICAL SUPERINTENDENT
E.S.I.S. HOSPITAL, VASTI,
Navi Mumbai-400703

2012	93	10	2	-	20	1	-	1	2	4
2013	86	6	1	-	23	2	-	1	1	2
2014	102	5	1	-	42	1	-	2	Nil	3
2015	142	13	6	-	43	7	-	3	-	22
2016	144	4	4	-	107	11	-	2	-	41
2017	75	17	12	-	43	7	-	3	-	38
2012	3	5		2		3	7	5		
2013	1	16					5	1		
2014	2	28					1			
2015	4	70					4	3		
2016	17	92		2	44	26		5		
June 2017	6	32		1	41	77		5		

Mahatma Gandhi Mission Hospital

CBD, BELAPUR

Dr. V. J. Mahadi
Dr. V. J. MAHADIK
MEDICAL SUPERINTENDENT
M.G.M. Hospital & Research Centre
CBD Belapur, Navi Mumbai.

Navi Mumbai

Name of Hospital	Year	Diseases caused by Air pollution					Diseases caused by Water pollution				
		Asthma	Bronchitis	Pulmonary cancer	Mesothelioma (lung cancer)	Acute respiratory infections <i>Apr to Mar</i> <i>0-5 yrs.</i>	Gastroenteritis	Typhoid	Diarrhea	Liver damage and even cancer (due to presence of chlorinated solvents in the polluted water)	Kidney damage (because of various harmful chemicals present in the polluted water)
NMMC GENERAL HOSPITAL	2012						259	179	17		
	2013						173	122	03		
	2014					408	152	85	30		
	2015					601	217	46	22		
	2016					388	351	54	65		
	2017					1006 922	35	19	01		

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 thiorine 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 thiorine Method	5.0mg/Nm ³

Sr.	Parameters	Method References	Techniques	Detection Limit
				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 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	4.0µg/m ³
9.	Benzene (C ₆ H 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 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, 22 nd Ed., 2012, 1060 B, 1-39	-	-
2.	Sampling Procedure for Microbiological Parameters	APHA, 22 nd Ed., 2012, 1060 B, 1-39, 9040, 9-17, and 9060B, 9-35	-	-
3.	Temperature	APHA, 22 nd Ed., 2012, 2550-B, 2-69	By Thermometer	-
4.	Colour	APHA, 22 nd 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, 22 nd Ed., 2012, 4500-H ⁺ -B, 4-92	By pH Meter	1
7.	Oil & Grease	APHA, 22 nd 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, 22 nd 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

Sr.	Parameters	Methods References	Techniques	Detection Limit
12.	Electrical Conductivity	APHA, 22 nd Ed., 2012, 2510- B, 2-54	By Conductivity Meter	0.1 μ mho/cm
13.	Nitrite-Nitrogen	APHA, 22 nd Ed., 2012, 4500-NO ₂ -B, 4-120	Colorimetric Method	0.006 mg/L
14.	Nitrate-Nitrogen	APHA, 22 nd Ed., 2012, 4500-NO ₃ , B-4-122	UV Spectrophotometer Screening Method	0.2 mg/L
15.	(NO ₂ + NO ₃)-Nitrogen	APHA, 22 nd Ed., 2012, 4500-NO ₂ -B, 4-120 APHA, 22 nd Ed., 2012, 4500-NO ₃ , B-4-122	Colorimetric Method V Spectrophotometer Screening Method	0.2 mg/L
16.	Free Ammonia	APHA, 22 nd 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, 22 nd Ed., 2012, 4500-CN, C & E, 4-41 & 4-43	Colorimetric Method	0.001 mg/L
19.	Fluoride (F)	APHA, 22 nd Ed., 2012, 4500-F ⁻ , D, 4-87	SPADNS Method	0.05 mg/L
20.	Sulphide (S ²⁻)	APHA, 22 nd Ed., 2012, 4500 -S ²⁻ , C-4-175, F-4-178	Iodometric Method	0.08 mg/L
21.	Dissolved Phosphate (P)	APHA, 22 nd Ed., 2012, 4500 P, E, 4-155	Ascorbic Acid Method	0.03 mg/L
22.	Sodium Absorption Ratio	IS 11624 :1986, Reaffirmed 2006	By Calculation	0.3
23.	Total Phosphorous (P)	APHA, 22 nd Ed., 2012, 4500 P, E, 4-155	Ascorbic Acid Method	0.03 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
24.	Total Kjeldahl Nitrogen	APHA, 22 nd 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,22 ^d Ed., 2012 , 4500 NH ₃ , F, 4 -115	Colorimetric Method	0.001 mg/L
26.	Phenols (C ₆ H ₅ OH)	APHA,22 nd Ed., 2012 ,5530- B & C, 5-44 & 5-47	Chloroform Extraction Method	0.001 mg/L
27.	Surface Active Agents	APHA,22 nd Ed., 2012 ,5540-B & C,5-50	Methylene Blue Extraction Method	0.1 mg/L
28.	Organo Chlorine Pesticides	APHA, 22 nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
29.	Polynuclear aromatic hydrocarbons (PAH)	APHA, 22 nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
30.	Polychlorinated Biphenyls (PCB)	APHA, 22 nd 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, 22 nd Ed., 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

Sr.	Parameters	Methods References	Techniques	Detection Limit
39.	Mercury (Hg)	IS 3025(Part 2): 2004	ICP Method	0.0008 mg/L
40.	Manganese (Mn)	IS 3025(Part 2): 2004	ICP Method	0.02 mg/L
41.	Iron (Fe)	IS 3025(Part 2): 2004	ICP Method	0.06 mg/L
42.	Vanadium (V)	IS 3025(Part 2): 2004	ICP Method	0.05 mg/L
43.	Selenium (Se)	IS 3025(Part 2): 2004	ICP Method	0.005 mg/L
44.	Boron (B)	IS 3025(Part 2): 2004	ICP Method	0.1 mg/L
45.	Total Coliforms	APHA, 22 nd Ed., 2012,9221-B, 9- 66	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
46.	Faecal Coliforms	APHA, 22 nd 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 (Prevention 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) – Chemiluminescence
		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 ₆ H 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/Ext.]

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. 10⁻⁶gm/m³

ng/m³: nano gram/m³ i.e. 10⁻⁹gm/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 matter 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/IL, Max.	2.0	15	--	15
30.	Dissolved Phosphate (as P), mg/L, Max.	5.0	--	--	--
31.	Sulphate (as SO ₄), mg/L, Max.	1000	1000	1000	--
32.	Sulphide (as S), mg/L, Max.	2.0	--	--	5.0
33.	Pesticides	Absent	Absent	Absent	Absent
34.	Phenolic compounds (as C ₆ H ₅ OH), 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 $\mu\text{C/ml.}$, 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 Cl 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 ₆ H ₅ OH)	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 ₂ S)	mg/L	Max 0.05	No relaxation
28.	Total Alkalinity as calcium carbonate	mg/L	Max 200	Max600
29.	Total hardness (as CaCO ₃)	mg/L	Max 200	Max 600
30.	Zinc (as Zn)	mg/L	Max 5	Max15
Table 3	Parameters Concerning Toxic Substances			
31.	Cadmium (asCd)	mg/L	Max 0.003	No relaxation
32.	Cyanide (asCN)	mg/L	Max 0.05	No relaxation
33.	Lead (as Pb)	mg/L	Max 0.01	No relaxation
34.	Mercury (asHg)	mg/L	Max 0.001	No relaxation
35.	Molybdenum (as Mo)	mg/L	Max 0.07	No relaxation
36.	Nickel (as Ni)	mg/L	Max 0.02	No relaxation
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 VIII: CPCB Water Quality Criteria:

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	<ul style="list-style-type: none"> ➤ 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	<ul style="list-style-type: none"> ➤ 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	<ul style="list-style-type: none"> ➤ 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	<ul style="list-style-type: none"> ➤ 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, cooling, and industrial controlled disposal	E	<ul style="list-style-type: none"> ➤ 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	<ul style="list-style-type: none"> ➤ 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, μ mhos/cm	<1000	<2250	<4000

(v)	(NO ₂ +NO ₃)-Nitrogen, mg/l	<5	<10	<15
(vi)	Suspended solid, mg/l	<25	<50	<100
(vii)	Faecal 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 (NH ₄ + NH ₃)-Nitrogen	< 0.5 mg/l	< 1.0 mg/l	< 1.5 mg/l
(iv)	Phenols	< 2µg/l	< 5µg/l	<10 µg/l
(v)	Surface Active Agents	<20 µg/l	<100µg/l	< 200µg/l
(vi)	Organo Chlorine Pesticides	< 0.05µg/l	< 0.1µg/l	< 0.2µg/l
(vii)	PAH	< 0.05µg/l	<0.1 µg/l	<0.2 µg/l
(viii)	PCB and PCT	< 0.01µg/l	< 0.01µg/l	< 0.02µg/l
(ix)	Zinc	< 100µg/l	< 200µg/l	<300 µg/l

(x)	Nickel	< 50µg/l	< 100µg/l	< 200µg/l
(xi)	Copper	< 20µg/l	< 50µg/l	<100µg/l
(xii)	Chromium (Total)	< 20µg/l	< 50µg/l	< 100µg/l
(xiii)	Arsenic (Total)	< 20µg/l	<50 µg/l	<100 µg/l
(xiv)	Lead	< 20µg/l	< 50µg/l	< 100µg/l
(xv)	Cadmium	< 1.0µg/l	<2.5 µg/l	< 5.0µg/l
(xvi)	Mercury	< 0.2µg/l	< 0.5µg/l	< 1.0µg/l