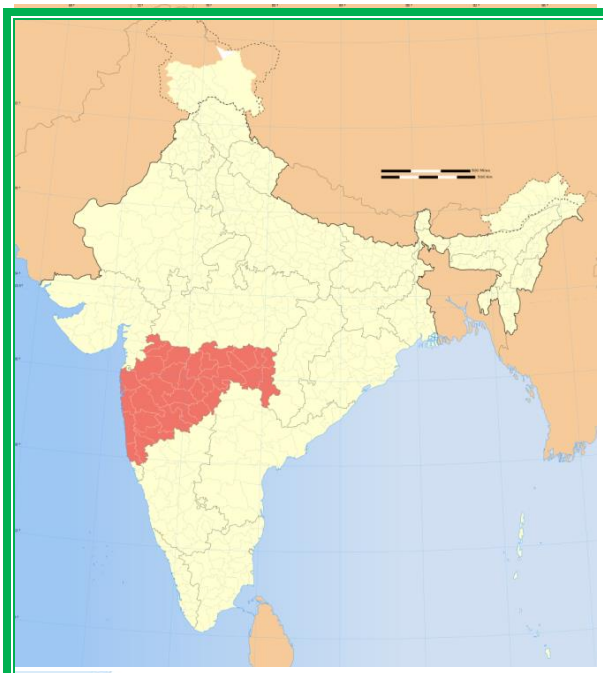
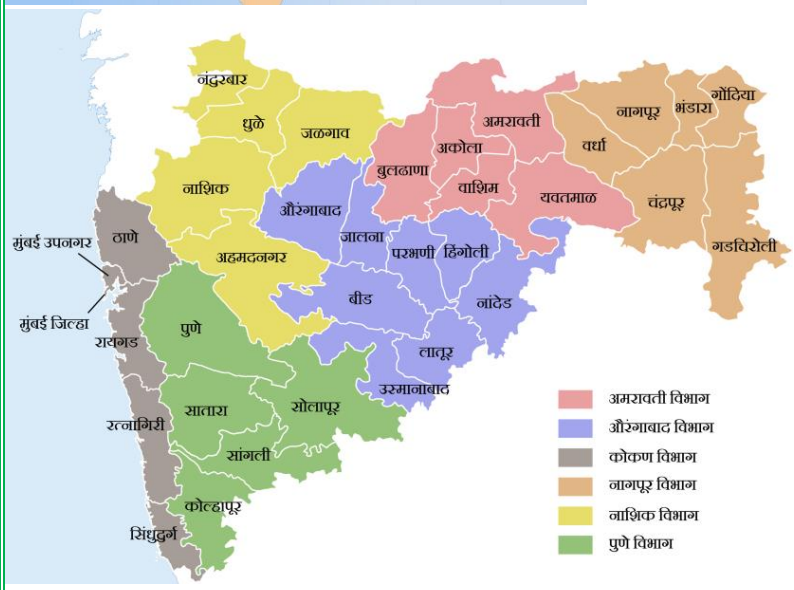
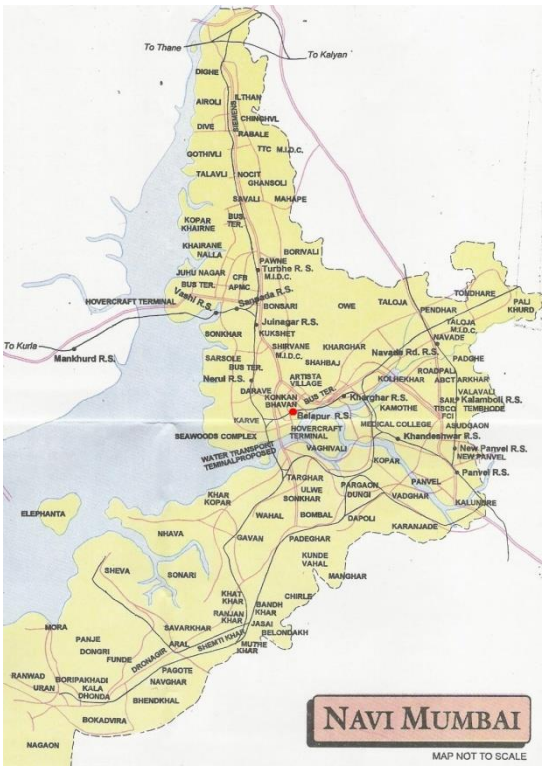


Action Plan for Industrial Cluster in Critically Polluted Areas

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

नवी मुंबई Navi Mumbai





MAHARASHTRA

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

February, 2019

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

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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
BDL	Not Detected
PAH	Poly Aromatic Hydrocarbons
PCB	Poly Chlorinated Biphenyls
PCT	Poly Chlorinated Terphenyls
PM_{10}	Particulate Matter (size less than 10 µm)
$PM_{2.5}$	Particulate Matter (size less than 2.5 µm)
SO_2	Sulphur Dioxide
STAP	Short Term Action Plan
WHO	World Health Organization

1. Introduction

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

Industrial pollution takes on many faces. It contaminates many sources of drinking water, releases unwanted toxins into the air and reduces the quality of soil all over the world. Every litre of waste water discharged by our industries pollute eight times the quantity of fresh water. The extent of pollution varies with the size of the industry, the nature of the industry, the type of products used and produced etc. In view of this, Central Pollution Control Board (CPCB) has evolved the concept of Comprehensive Environmental Pollution Index (CEPI) during 2009-10 as a tool for comprehensive environmental assessment of prominent industrial clusters and formulation of remedial Action Plans for the identified critically polluted areas. 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.

In this report, 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 27km^2. 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, 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 Navi Mumbai:

- The sampling was carried out in 5 days at various locations i.e. from 3rd January, to 9th January, 2019.
- In Navi Mumbai, a total of 6 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 5 Waste Water Samples and 3 Ground Water Samples were collected and analyzed.

2.1 Stack Emission Parameters

The Stack Emissions were analyzed with the following parameters:

1. Acid Mist
2. Ammonia
3. Carbon Monoxide
4. Chlorine
5. Fluoride(gaseous)
6. Fluoride (particulate)
7. Hydrogen Chloride
8. Hydrogen Sulphide

9. Oxides of Nitrogen
10. Oxygen
11. Polyaromatic Hydrocarbons (Particulate)
12. Suspended Particulate Matter
13. Sulphur Dioxide
14. Benzene
15. Toluene
16. Xylene
17. Volatile Organic Compounds (VOCs)

2.2 Ambient Air Quality Parameters

The Ambient Air Quality was analyzed with the following parameters:

1. Sulphur Dioxide (SO_2)
2. Nitrogen Dioxide (NO_2)
3. Particulate Matter (PM10)
4. Particulate Matter (PM2.5)
5. Ozone (O_3)
6. Lead (Pb)
7. Carbon Monoxide (CO)
8. Ammonia (NH_3)
9. Benzene (C_6H_6)
10. Benzo (a) Pyrene (BaP) (Particulate Phase Only)
11. Arsenic (As)
12. Nickel (Ni)

2.3 Water/Waste Water Parameters

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

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

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

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

i.Simple Parameters:

1. Sanitary Survey
2. General Appearance
3. Colour
4. Smell
5. Transparency
6. Ecological(Presence of animals like fish, insects) (Applicable to only surface water)

ii.Regular Monitoring Parameters:

7. pH
8. Oil & Grease
9. Suspended Solids
10. Dissolved Oxygen (% saturation) (Not applicable for Ground Waters)
11. Chemical Oxygen Demand
12. Biochemical Oxygen Demand
13. Electrical Conductivity
14. Nitrite-Nitrogen
15. Nitrate-Nitrogen
16. (NO_2 + NO_3)-Nitrogen
17. Free Ammonia
18. Total Residual Chlorine
19. Cyanide
20. Fluoride
21. Sulphide

22. Dissolved Phosphate
23. Sodium Absorption Ratio (SAR)
24. Total Coliforms (MPN/100 ml)
25. Faecal Coliforms (MPN/100 ml)

iii.Special Parameters:

26. Total Phosphorous
27. Total Kjeldahl Nitrogen(TKN)
28. Total Ammonia (NH_4 +NH_3)-Nitrogen
29. Phenols
30. Surface Active Agents
31. Organo Chlorine Pesticides
32. Polynuclear aromatic hydrocarbons (PAH)
33. Polychlorinated Biphenyls (PCB)and Polychlorinated Terphenyls (PCT)
34. Zinc
35. Nickel
36. Copper
37. Hexavalent Chromium
38. Chromium (Total)
39. Arsenic (Total)
40. Lead
41. Cadmium
42. Mercury
43. Manganese
44. Iron
45. Vanadium
46. Selenium
47. Boron

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

2.4 Methodology followed in Sampling and Analysis

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

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

3. Result of Analysis:

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

***Kindly note:**

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

Sr.	Name of Industry	Stack Identity	Table No.
1.	Amines & Plasticizer Ltd.	Boiler stack	Table No. I
2.	Akash Fabrics Pvt. Ltd.	Boiler	Table No. I
3.	Aarcee Innovation Pvt. Ltd.	Boiler	Table No. I
4.	SI Group India Ltd.	Boiler	Table No. II
5.	Life Science	Boiler	Table No. II
6.	Nocil limited	Boiler	Table No. II

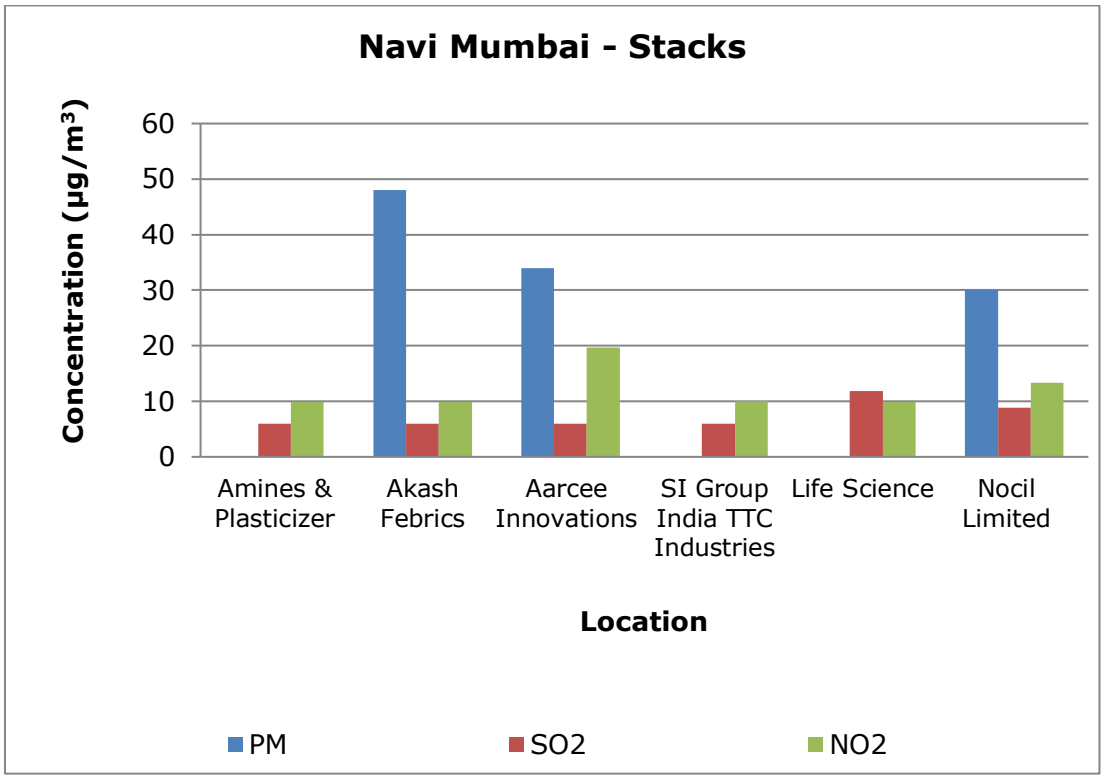
Table No. I

Name of Industry			**Amines & Plasticizer Ltd.**	**Akash Fabrics Pvt. Ltd.**	**Aarcee Innovation Pvt. Ltd.**
Date of Sampling			**05.01.2019**	**05.01.2019**	**07.01.2019**
Sr.	**Parameters**	**Units**	**Results**		
1.	Particulate Matter	mg/Nm^3	BDL	48	34
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**
2.	Sulphur Dioxide (SO_2)	mg/Nm^3	5.92	5.92	5.92
		kg/day	1.724	2.67	1.32
	Std. Limit	**mg/Nm^3**	**100**	**148**	**100**
3.	Nitrogen dioxide (NO_2)	mg/Nm^3	9.94	9.88	19.7
	Std. Limit	**mg/Nm^3**	**50**	**50**	**50**

Table No. II

Name of Industry			**SI Group India Ltd.**	**Life Science**	**Nocil limited**
Date of Sampling			**07.01.2019**	**07.01.19**	**07.01.19**
Sr.	**Parameters**	**Units**	**Results**		
1.	Particulate Matter	mg/Nm^3	BDL	BDL	30
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**
2.	Sulphur Dioxide (SO_2)	mg/Nm^3	5.92	11.8	8.88
		kg/day	6.37	3.56	4.01
	Std. Limit	**mg/Nm^3**	**100**	**148**	**100**
3.	Nitrogen dioxide (NO_2)	mg/Nm^3	9.95	9.94	13.3
	Std. Limit	**mg/Nm^3**	**50**	**50**	**50**

Graphs: Stack Monitoring for Navi Mumbai TTC MIDC:



3.2 Ambient Air Quality:

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

Please note: Concentration of Benzene (C_6H_6), BaP and Arsenic (As) is observed Below Detection Limit (BDL), hence not included in graphs.

Sr.	Location	Location detail	Table No.
1.	Apar Industrial Ltd.	Near admin office	Table No. I
2.	Reliable IT Park, Airoli	Near main gate	Table No. I
3.	Asian Paints	Near main gate	Table No. I
4.	Lona IT Park	Near admin office	Table No. II
5.	Schlumberger Asia Services Ltd.	Near main gate	Table No. II
6.	Vashi STP Sector -18	Near office	Table No. II
7.	Apar Industrial Ltd.	Near admin office	Table No. III
8.	Vashi STP Sector -18	Near office	Table No. III

***The VOC result of ambient emission is provided in Table No. III**

Table No. I:

Location				**Apar Industrial Ltd.**	**Reliable IT Park, Airoli**	**Asian Paints**
Date of Sampling				**03.01.2019**	**03.01.2019**	**05.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	6.45	6.16	6.1
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	8.2	7.55	7.95
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	122	286	485
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	32	73	121
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**04**	4.19	3.5	7.53
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	7.45	5.79	1.32
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	BDL	1.59	0.609
12.	Nickel (Ni)	ng/m^3	**20**	BDL	BDL	10.9

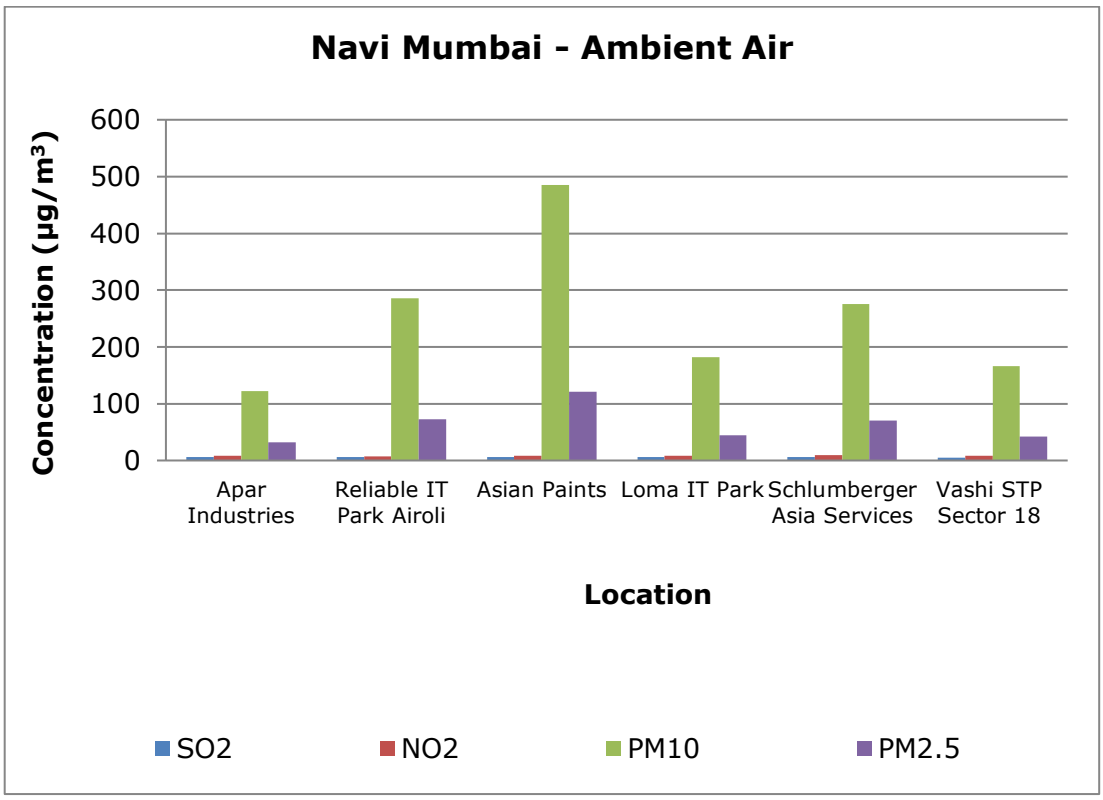
Table No. II:

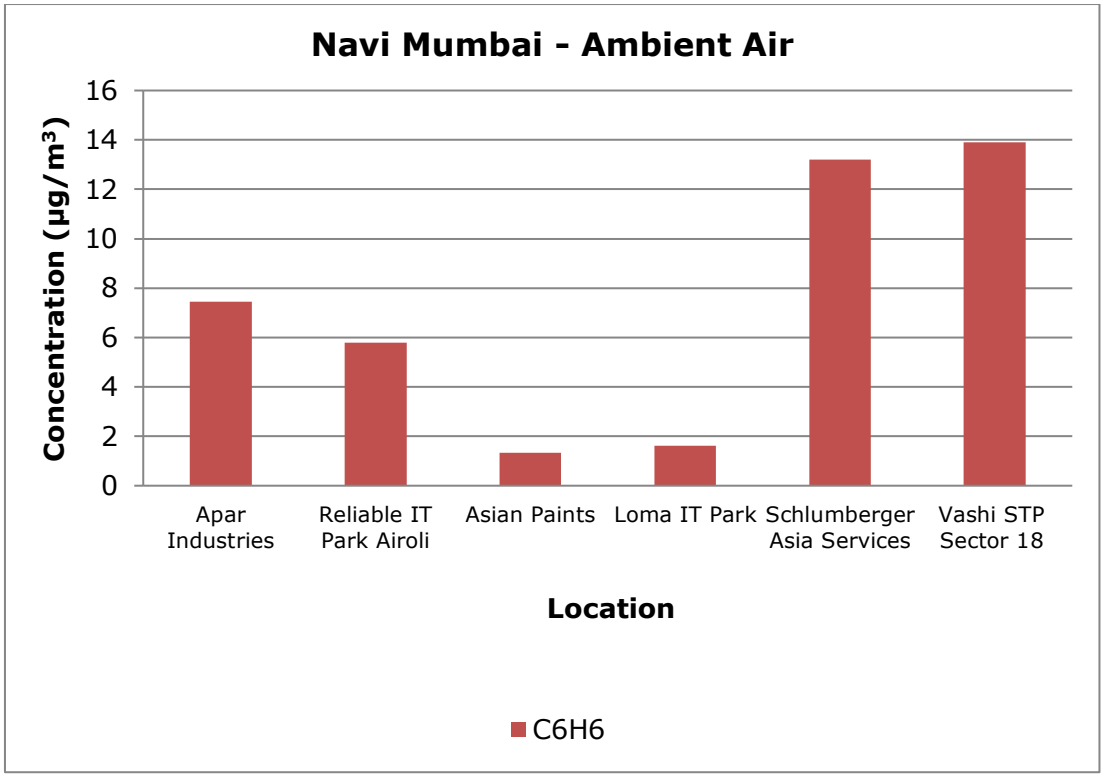
Location				**Lona IT Park**	**Schlumberger Asia Services Ltd.**	**Vashi STP Sector -18**
Date of Sampling				**04.01.2019**	**09.01.2019**	**09.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	6.51	6.54	5.41
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	8.7	9.73	7.96
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	182	275	166
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	44	70	42
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**04**	BDL	BDL	BDL
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	1.61	13.2	13.9
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**	BDL	8.24	13.9

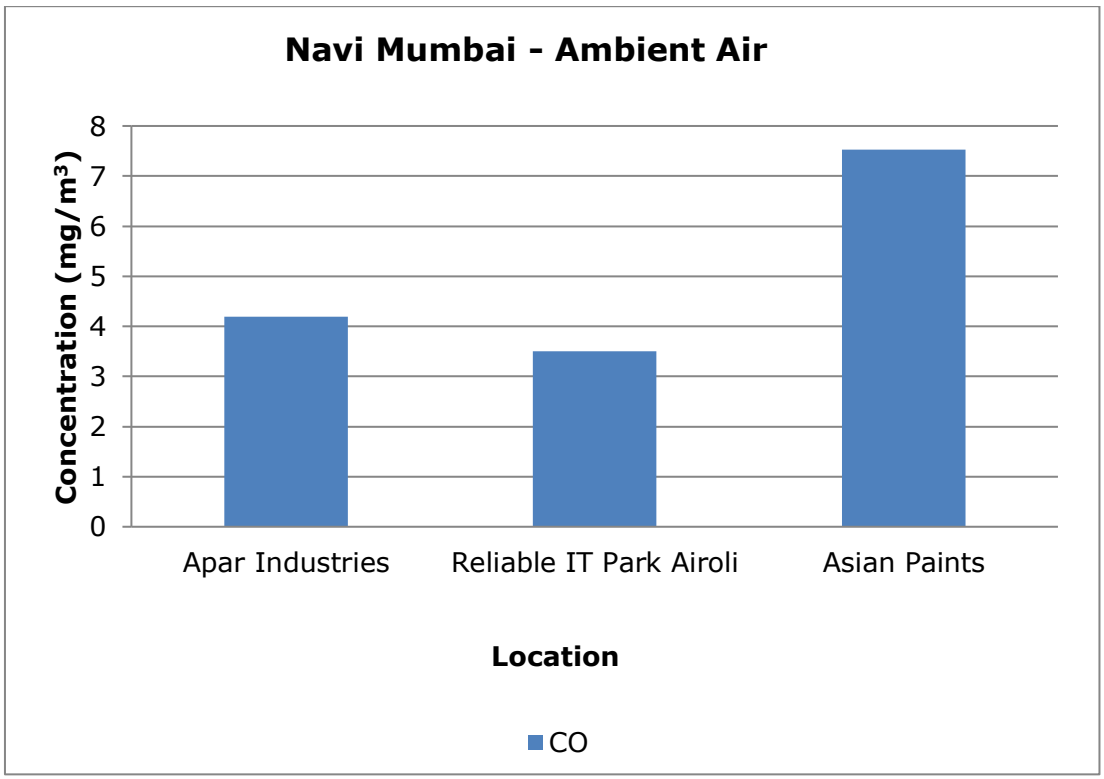
Table III:

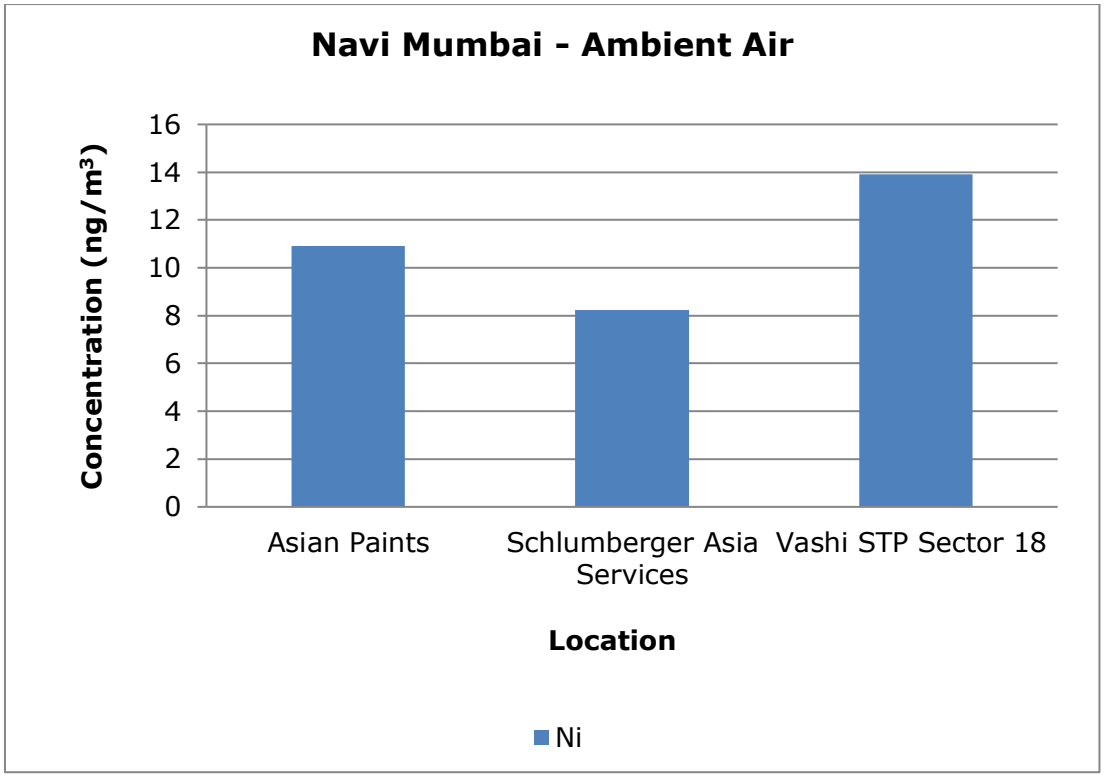
Location			**Apar Industries**	**Vashi STP**
Date of Sampling			**03.01.2019**	**09.01.2019**
Sr.	**Parameters**	**Unit**	**Results**	
	Volatile Organic Compounds (VOC)			
1.	Methyl Isobutyl Ketone	mg/Nm^3	ND	ND
2.	Benzene	mg/Nm^3	ND	ND
3.	Toulene	mg/Nm^3	ND	ND
4.	Xylene	mg/Nm^3	ND	ND
5.	Isopropyl Alcoho	mg/Nm^3	ND	ND
6.	Ethyl Acetate	mg/Nm^3	ND	ND

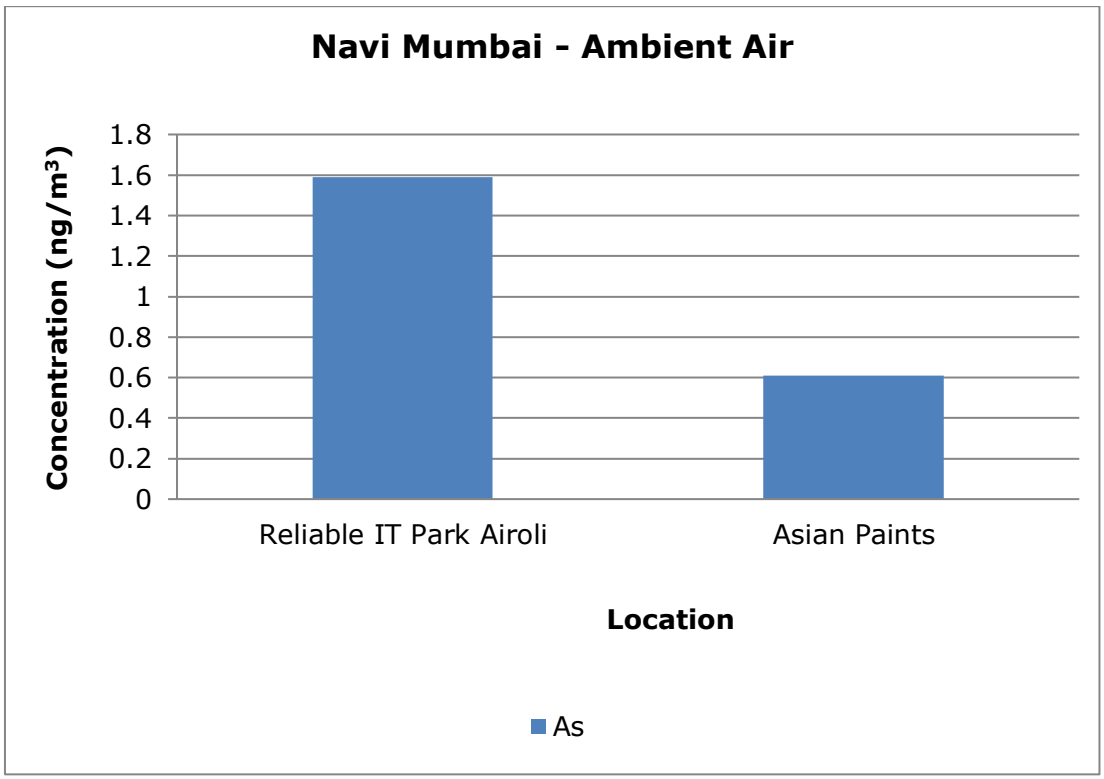
Graphs of Ambient Air Quality Monitoring for Navi Mumbai TTC MIDC:




Navi Mumbai - Ambient Air
Concentration (µg/m³)
16
14
12
10
8
6
4
2
0
Apar Industries
Reliable IT Park Airoli
Asian Paints
Loma IT Park
Schlumberger Asia Services
Vashi STP Sector 18
Location
C6H6


Navi Mumbai - Ambient Air
Concentration (mg/m³)
8
7
6
5
4
3
2
1
0
Apar Industries
Reliable IT Park Airoli
Asian Paints
Location
CO





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 IX), CPCB Water Quality Criteria

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

Sr.	Location	Source	Table No.
1.	Siemens Nalla	Surface water	Table No. I
2.	Alok Nalla	Surface water	Table No. I
3.	CBD Nalla	Surface water	Table No. I
4.	Juinagar Railway Station	Surface water	Table No. II
5.	Wonder Park	Surface water	Table No. II

Table I:

Location				**Siements Nalla**	**Alok Nalla**	**CBD Nalla**
Date of Sampling				**03.01.2019**	**03.01.2019**	**03.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		5	5	5
2.	Smell	-	**Agreeable**	Disagreeable	Disagreeable	Disagreeable
3.	pH	-	**5.5 -9.0**	6.73	7.02	7.03
4.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL
5.	Suspended Solids	mg/L	**100.0**	76	96	94
6.	Dissolved Oxygen (%Saturation)	%		0	0	6
7.	Chemical Oxygen Demand	mg/L	**250.0**	360	200	200
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	**30.0**	121	65	67
9.	Electrical Conductivity (at 25°C)	µmhos/ cm		556	1336	6010

Location				**Siements Nalla**	**Alok Nalla**	**CBD Nalla**
Date of Sampling				**03.01.2019**	**03.01.2019**	**03.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
10.	Nitrite Nitrogen (as NO_2)	mg/L		BDL	BDL	BDL
11.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	12.3	18.4	16.3
12.	(NO_2+ NO_3)-Nitrogen	mg/L		12.3	18.4	16.3
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**	1.08	1.7	1.37
17.	Sulphide (as S^{2-})	mg/L	**2.0**	3.01	1.01	4.23
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	0.6	0.16	1.6
19.	Sodium Absorption Ratio			0.70	0.55	0.36
20.	Total Coliforms	MPN index/ 100 mL	**100.0**	280	220	140
21.	Faecal Coliforms	MPN index/ 100 mL	**1000.0**	47	21	27
22.	Total Phosphate (as P)	mg/L		0.8	0.2	0.8
23.	Total Kjeldahl Nitrogen	mg/L	**100.0**	1.68	14.8	27.5
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**50**	2.3	2.3	2.3
25.	Phenols (as C_6H_5OH)	mg/L	**1.0**	BDL	BDL	BDL

Location				**Siements Nalla**	**Alok Nalla**	**CBD Nalla**
Date of Sampling				**03.01.2019**	**03.01.2019**	**03.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL	BDL
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.	Chlorpyriphos	µg/L	**3.0**	BDL	BDL	BDL
VIII.	Butachlor	µg/L		BDL	BDL	BDL
IX.	Delta HCH	µg/L	**0.2**	BDL	BDL	BDL
X.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
XI.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
XII.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL
XIII.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
XIV.	p,p DDD	µg/L		BDL	BDL	BDL
XV.	o,p DDD	µg/L		BDL	BDL	BDL
XVI.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
XVII.	Beta Endosulfan	µg/L		BDL	BDL	BDL
XVIII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL

Location				**Siements Nalla**	**Alok Nalla**	**CBD Nalla**
Date of Sampling				**03.01.2019**	**03.01.2019**	**03.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	BDL	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	0.123	1.25	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	BDL	0.029	BDL
32.	Copper (as Cu)	mg/L	**3.0**	0.04	BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	0.03	0.992	0.02
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	0.159	0.054	0.014
37.	Cadmium (as Cd)	mg/L	**2.0**	BDL	BDL	BDL
38.	Mercury (as Hg)	mg/L	**0.01**	BDL	BDL	BDL
39.	Manganese (as Mn)	mg/L	**2.0**	0.154	0.845	0.272
40.	Iron (as Fe)	mg/L	**3.0**	3.64	1.71	0.242
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	0.471	0.424

Location				**Siements Nalla**	**Alok Nalla**	**CBD Nalla**
Date of Sampling				**03.01.2019**	**03.01.2019**	**03.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
44.	Bioassay Test on fish	% survival	**90% survival of fish after 96 hours in 100% effluent**	80	90	90

Table II:

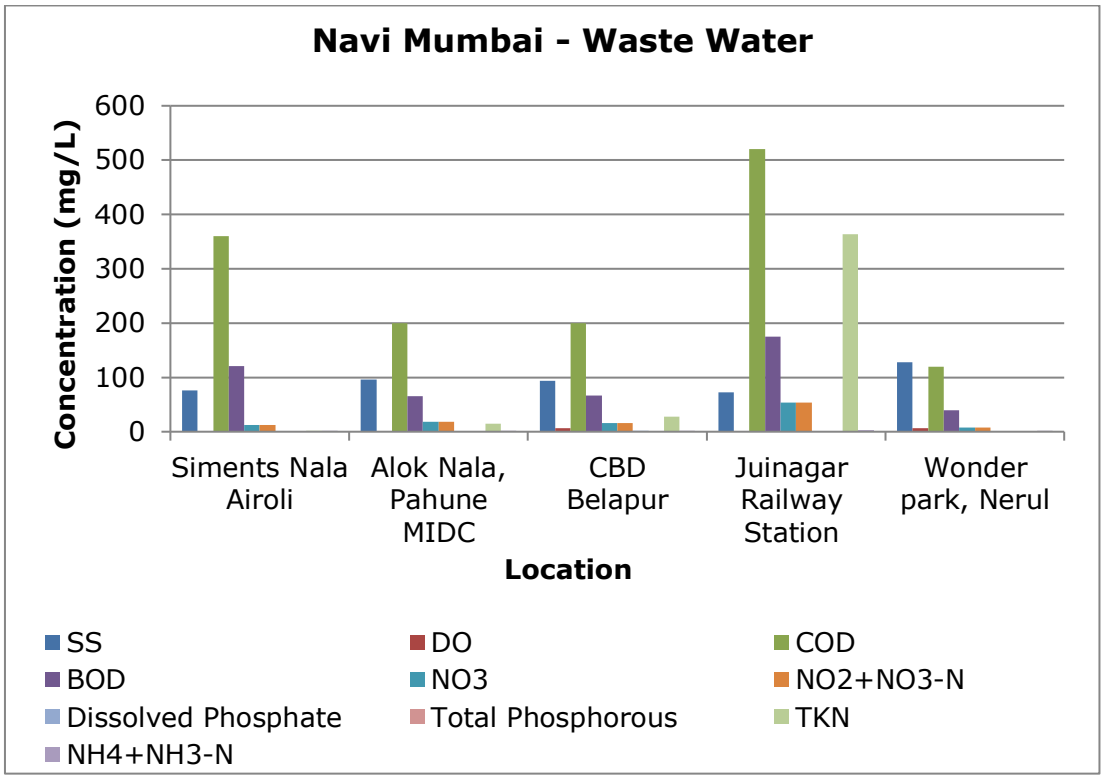
Location				**Juinagar Railway Station**	**Wonder Park**
Date of Sampling				**04.01.2019**	**04.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
1.	Colour	Hazen		7	1
2.	Smell	-	**Agreeable**	Disagreeable	Agreeable
3.	pH	-	**5.5 -9.0**	7.83	7.02
4.	Oil & Grease	mg/L	**10.0**	BDL	BDL
5.	Suspended Solids	mg/L	**100.0**	72	128
6.	Dissolved Oxygen (%Saturation)	%		0	6
7.	Chemical Oxygen Demand	mg/L	**250.0**	520	120
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	**30.0**	175	40
9.	Electrical Conductivity (at 25°C)	µmhos/cm		4050	671
10.	Nitrite Nitrogen (as NO_2)	mg/L		BDL	BDL

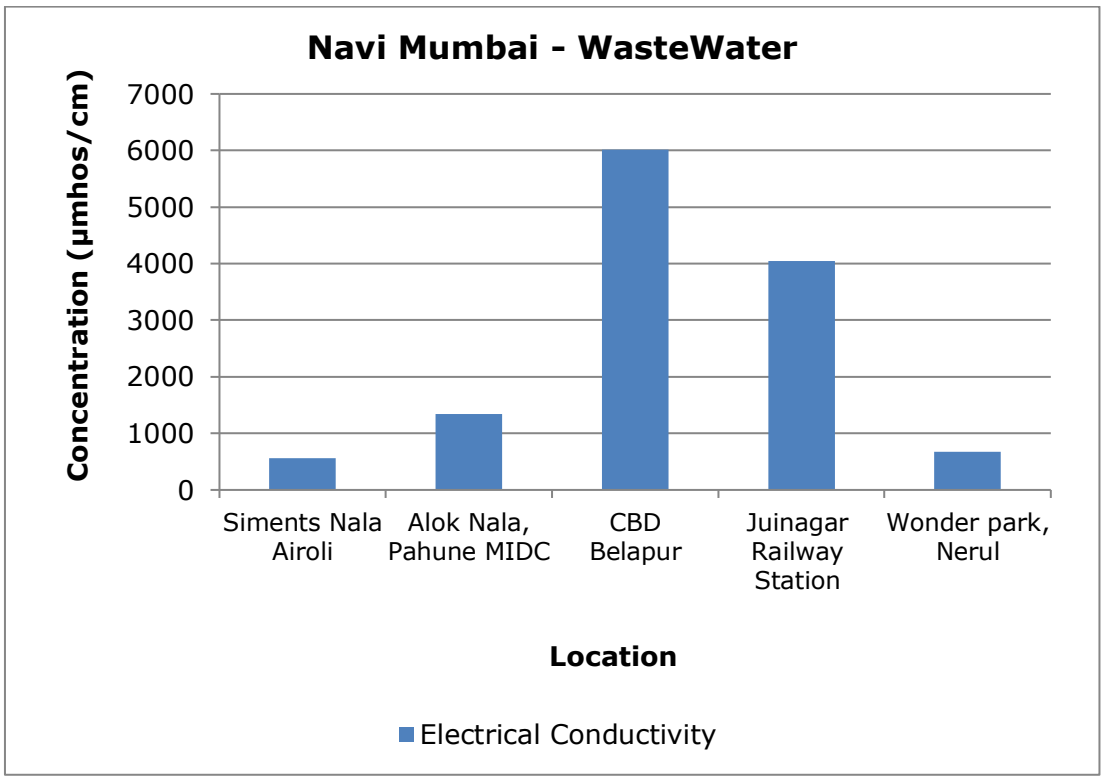
Location				**Juinagar Railway Station**	**Wonder Park**
Date of Sampling				**04.01.2019**	**04.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
11.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	54.2	7.17
12.	(NO_2+ NO_3)-Nitrogen	mg/L		54.2	7.17
13.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	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**	1.26	1.16
17.	Sulphide (as S^{2-})	mg/L	**2.0**	4	2.01
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	0.4	0.4
19.	Sodium Absorption Ratio			0.37	0.62
20.	Total Coliforms	MPN index/ 100 mL	**100.0**	170	23
21.	Faecal Coliforms	MPN index/ 100 mL	**1000.0**	27	13
22.	Total Phosphate (as P)	mg/L		0.6	0.8
23.	Total Kjeldahl Nitrogen	mg/L	**100.0**	364	0.89
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**50**	2.4	2.3
25.	Phenols (as C_6H_5OH)	mg/L	**1.0**	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL

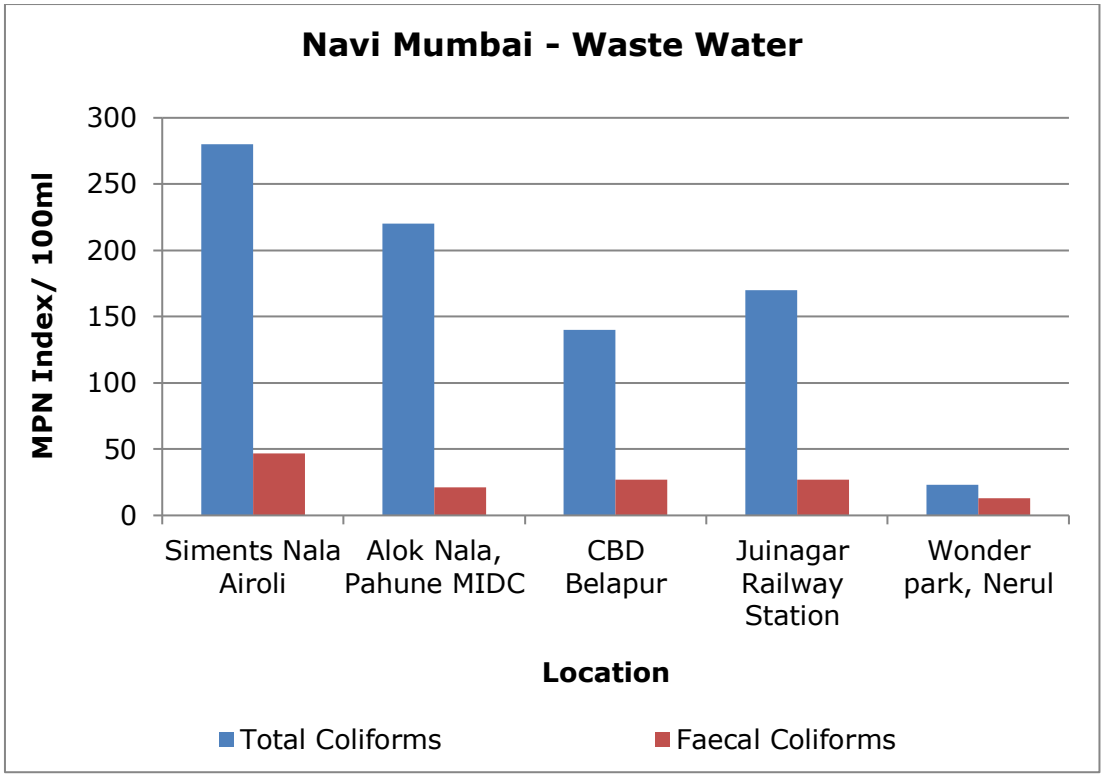
Location				**Juinagar Railway Station**	**Wonder Park**
Date of Sampling				**04.01.2019**	**04.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
27.	Organo Chlorine Pesticides				
I.	Alachlor	µg/L	**2.0**	BDL	BDL
II.	Atrazine	µg/L	**0.2**	BDL	BDL
III.	Aldrin	µg/L	**0.1**	BDL	BDL
IV.	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.	Chlorpyriphos	µg/L	**3.0**	BDL	BDL
VIII.	Butachlor	µg/L		BDL	BDL
IX.	Delta HCH	µg/L	**0.2**	BDL	BDL
X.	p,p DDT	µg/L	**0.05**	BDL	BDL
XI.	o,p DDT	µg/L	**100.0**	BDL	BDL
XII.	p,p DDE	µg/L	**250.0**	BDL	BDL
XIII.	o,p DDE	µg/L	**30.0**	BDL	BDL
XIV.	p,p DDD	µg/L		BDL	BDL
XV.	o,p DDD	µg/L		BDL	BDL
XVI.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL
XVII.	Beta Endosulfan	µg/L		BDL	BDL
XVIII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	BDL	BDL

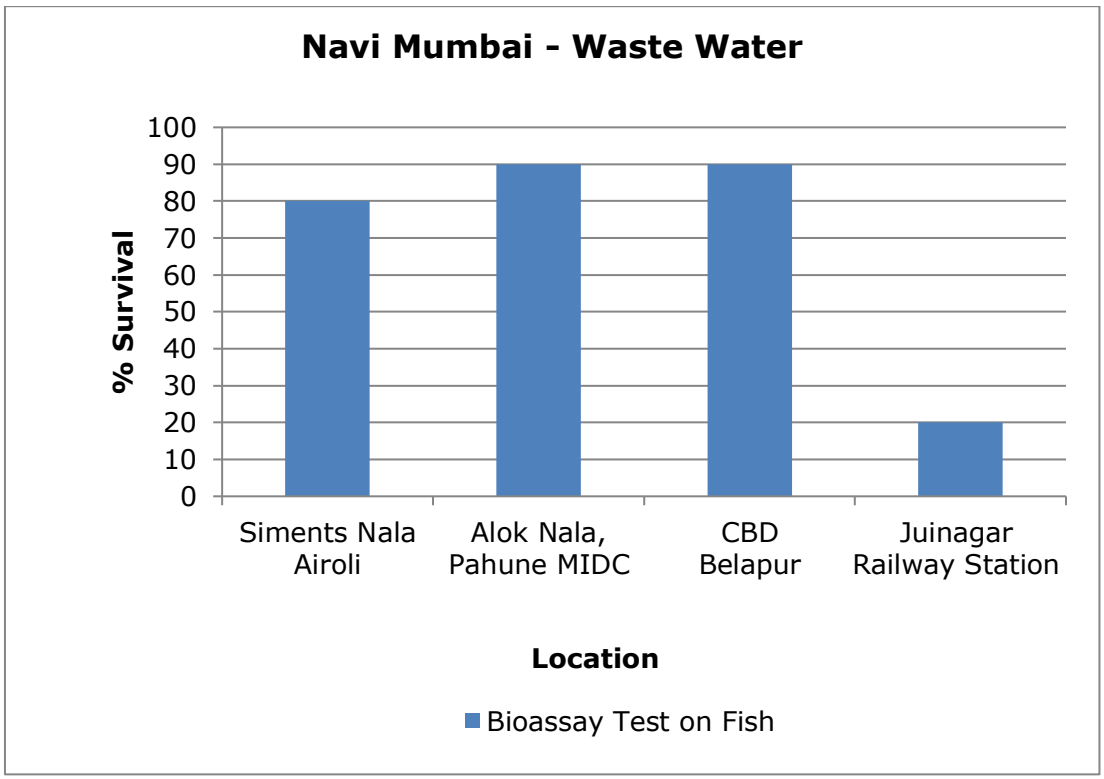
Location				**Juinagar Railway Station**	**Wonder Park**
Date of Sampling				**04.01.2019**	**04.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
29.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	0.812	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	0.026	BDL
32.	Copper (as Cu)	mg/L	**3.0**	0.692	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	0.109	0.020
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	BDL	0.009
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**	1.04	0.251
40.	Iron (as Fe)	mg/L	**3.0**	1.84	1.02
41.	Vanadium (as V)	mg/L	**0.2**	BDL	BDL
42.	Selenium (as Se)	mg/L	**0.05**	BDL	BDL
43.	Boron (as B)	mg/L		0.135	<0.1
44.	Bioassay Test on fish	% survival	**90% survival of fish after 96 hours in 100% effluent**	20	0

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






Navi Mumbai - Waste Water
MPN Index/ 100ml
300
250
200
150
100
50
0
Siments Nala Airoli
Alok Nala, Pahune MIDC
CBD Belapur
Juinagar Railway Station
Wonder park, Nerul
Location
Total Coliforms
Faecal Coliforms


Navi Mumbai - Waste Water
% Survival
100
90
80
70
60
50
40
30
20
10
0
Siments Nala Airoli
Alok Nala, Pahune MIDC
CBD Belapur
Juinagar Railway Station
Location
Bioassay Test on Fish

3.4 Ground Water Analysis Results:

Sr.	Location	Source	Table No.
1.	MSW,TTC Area	Borewell	Table No. I
2.	TTC WMA Site	Borewell	Table No. I
3.	TTC Plot no. 142	Borewell	Table No. I

Table No. I:

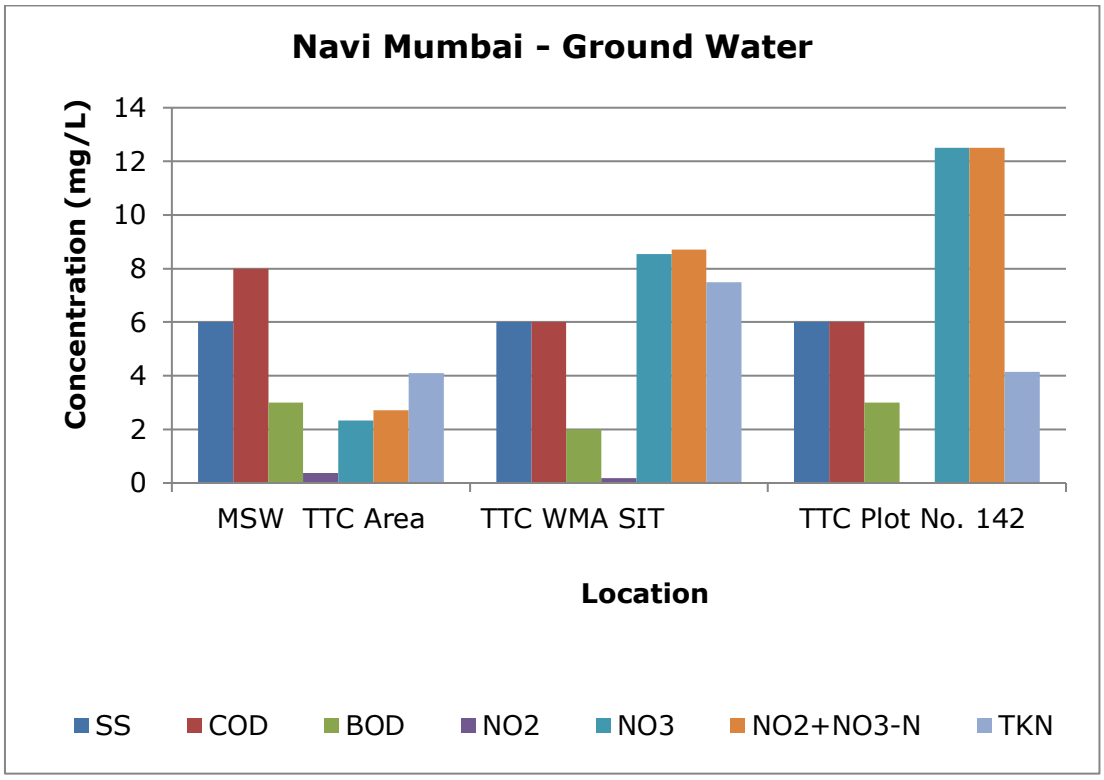
Location				**MSW TTC Area**	**TTC WMA Site**	**TTC Plot No- 142**
Date of Sampling				**08.01.2019**	**08.01.2019**	**08.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen	**5**	1	1	1
2.	Smell	-	**Agreeable**	Agreeable	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	7.11	8.13	7.08
4.	Oil & Grease	mg/L		BDL	BDL	BDL
5.	Suspended Solids	mg/L	**100**	6	6	6
6.	Dissolved Oxygen (%Saturation)	%		95	80	5.8
7.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	8	6	6
8.	Biochemical Oxygen Demand (3 days, 27° C)	mg/L	**6 (WHO, 1993)**	3	2	3
9.	Electrical Conductivity (at 25° C)	µmho/cm		609	756	699
10.	Nitrite Nitrogen (as NO_2)	mg/L		0.38	0.17	BDL

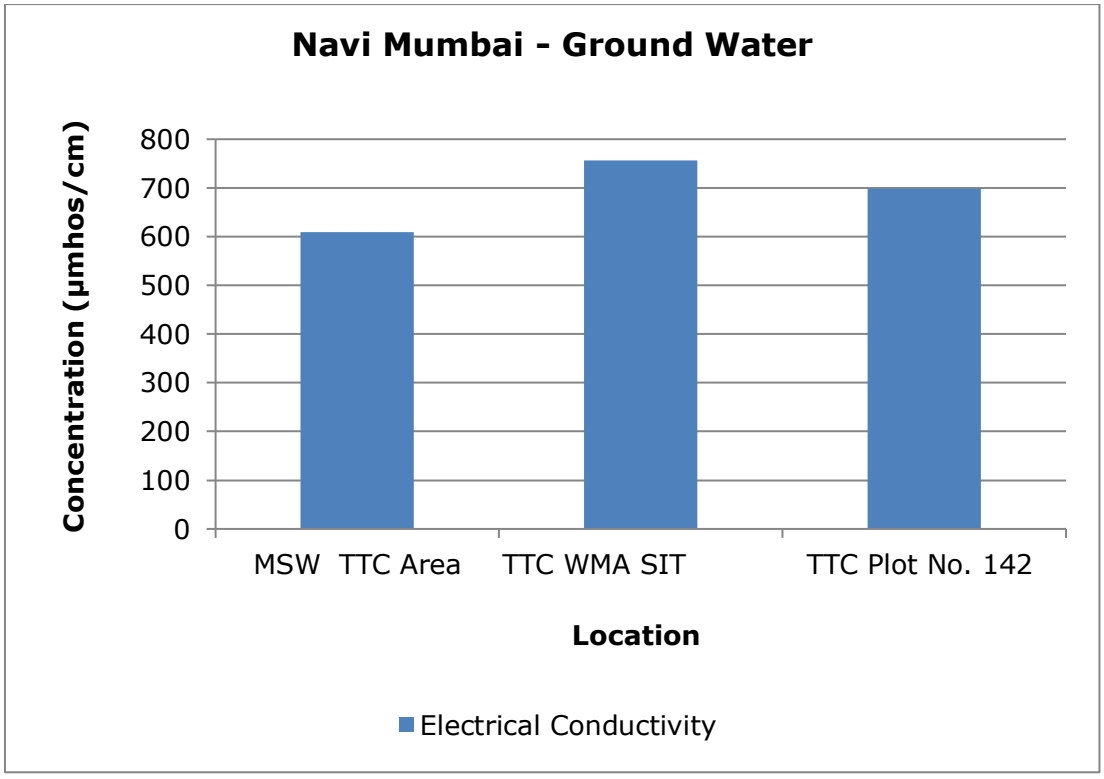
Location				**MSW TTC Area**	**TTC WMA Site**	**TTC Plot No- 142**
Date of Sampling				**08.01.2019**	**08.01.2019**	**08.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
11.	Nitrate Nitrogen (as NO_3)	mg/L	**45**	2.34	8.54	12.5
12.	(NO_2 + NO_3)-Nitrogen	mg/L		2.72	8.71	12.5
13.	Free Ammonia (as NH_3-N)	mg/L	**0.5**	BDL	BDL	BDL
14.	Total Residual Chlorine	mg/L	**0.2**	BDL	BDL	BDL
15.	Cyanide (as CN)	mg/L	**0.05**	BDL	BDL	BDL
16.	Fluoride (as F)	mg/L	**1.0**	0.3	BDL	0.1
17.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L		BDL	BDL	BDL
19.	Sodium Absorption Ratio	mg/L		0.51	0.38	0.33
20.	Total Coliforms	MPN index/ 100 ml		170	24	21
21.	Faecal Coliforms	MPN index/ 100 ml		14	7.8	4.5
22.	Total Phosphorous (as P)	mg/L		BDL	BDL	BDL
23.	Total Kjeldahl Nitrogen	mg/L		4.1	7.50	4.14
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.5**	BDL	BDL	BDL
25.	Phenols (as C_6H_5OH)	mg/L	**0.001**	BDL	BDL	BDL

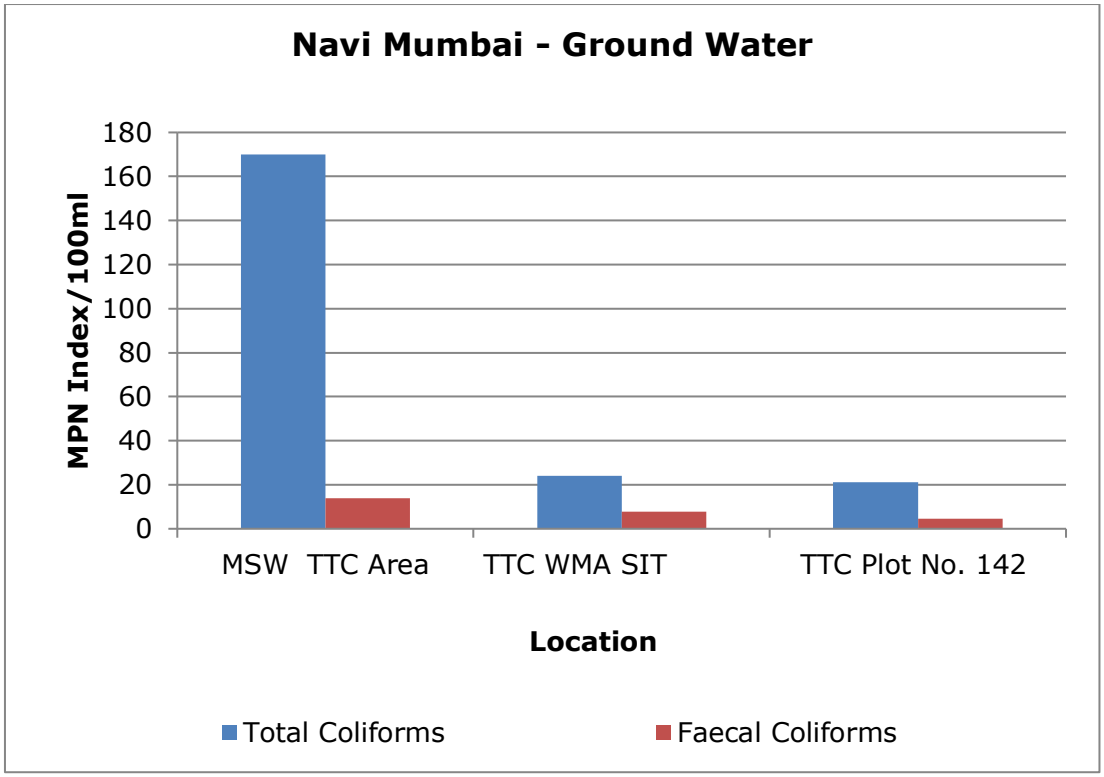
Location				**MSW TTC Area**	**TTC WMA Site**	**TTC Plot No- 142**
Date of Sampling				**08.01.2019**	**08.01.2019**	**08.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL	BDL
27.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**20.0**	BDL	BDL	BDL
II.	Atrazine	µg/L	**2.0**	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.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
VIII.	Chlorpyriphos	µg/L	**30.0**	BDL	BDL	BDL
IX.	Butachlor	µg/L	**125.0**	BDL	BDL	BDL
X.	p,p DDT	µg/L	**1.0**	BDL	BDL	BDL
XI.	o,p DDT	µg/L	**1.0**	BDL	BDL	BDL
XII.	p,p DDE	µg/L	**1.0**	BDL	BDL	BDL
XIII.	o,p DDE	µg/L	**1.0**	BDL	BDL	BDL
XIV.	p,p DDD	µg/L	**1.0**	BDL	BDL	BDL
XV.	o,p DDD	µg/L	**1.0**	BDL	BDL	BDL
XVI.	Alpha Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
XVII.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
XVIII.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**2.0**	BDL	BDL	BDL

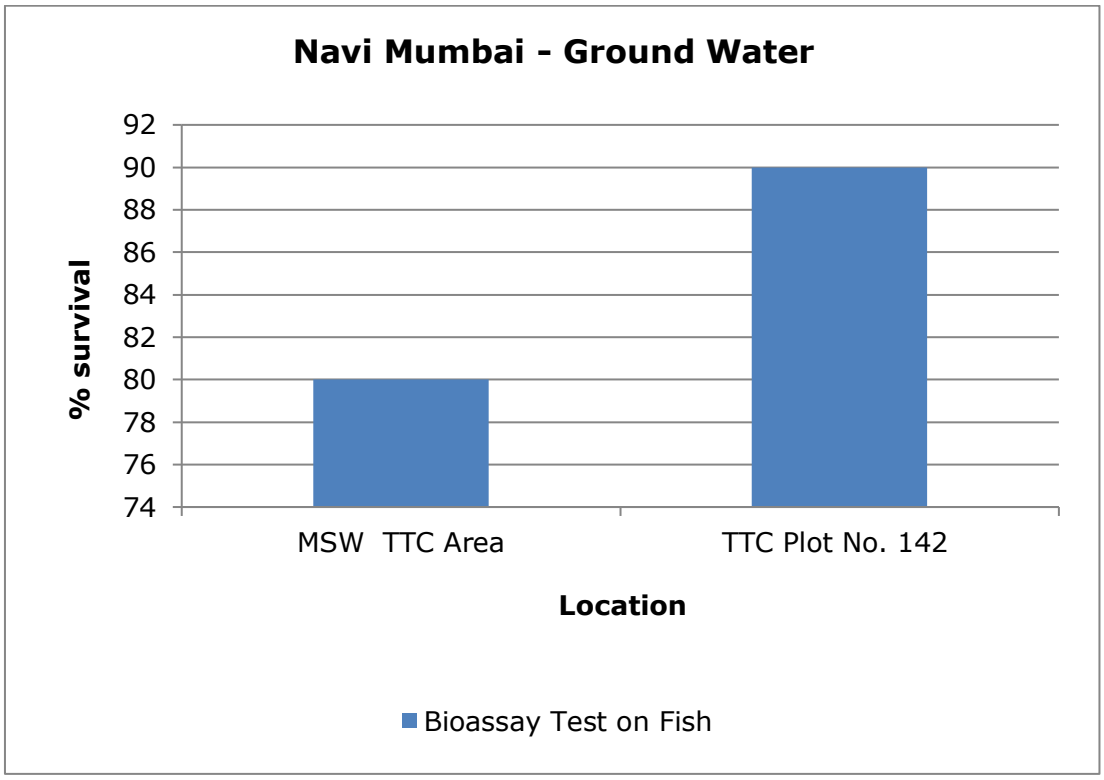
Location				**MSW TTC Area**	**TTC WMA Site**	**TTC Plot No- 142**
Date of Sampling				**08.01.2019**	**08.01.2019**	**08.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.0001**	0.0004	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0005**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	BDL	0.056	0.075
31.	Nickel (as Ni)	mg/L	**0.02**	BDL	0.023	0.044
32.	Copper (as Cu)	mg/L	**0.05**	BDL	0.065	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L		BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**0.05**	BDL	0.080	0.154
35.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL	BDL
37.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL	BDL
38.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL	BDL
39.	Manganese (as Mn)	mg/L	**0.1**	BDL	0.548	0.393
40.	Iron (as Fe)	mg/L	**0.3**	BDL	0.552	0.460
41.	Vanadium (as V)	mg/L		BDL	BDL	BDL
42.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL	BDL
43.	Boron (as B)	mg/L	**0.5**	BDL	BDL	BDL
44.	Bioassay Test on fish	% survival		80	0	90

Graphs of Ground Water Quality Monitoring for Navi Mumbai:






Navi Mumbai - Ground Water
MPN Index/100ml
180
160
140
120
100
80
60
40
20
0
MSW TTC Area
TTC WMA SIT
TTC Plot No. 142
Location
Total Coliforms
Faecal Coliforms


Navi Mumbai - Ground Water
% survival
92
90
88
86
84
82
80
78
76
74
MSW TTC Area
TTC Plot No. 142
Location
Bioassay Test on Fish

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.

1. Particulate matter was observed in the range of Below Detection Limit (BDL i.e. <10 mg/Nm^3) to 48 mg/Nm^3. It is observed below detection limit at 3 locations namely: Amines & Plasticizer, SI Group India TTC Industries and Life Science Pawane.
2. Sulphur dioxide concentration is observed maximum at Life Science Pawane (11.8 mg/Nm^3). Nitrogen dioxide is observed in the range of 9.88 to 19.7 mg/Nm^3.

All three parameters are observed below their standard limits, which signify that stack emissions are under control and not polluting the environment.

4.2 Ambient Air Quality Monitoring:

In the present study, six ambient air quality monitoring stations were selected for sampling. They are (i) Asian Paints (ii) Schlumberger Asia Services Ltd. (iii) Vashi STP Sector -18 (iv) Airoli IT Park (v) Lona IT Park (vi) Apar Industrial 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**: It is observed minimum at Vashi STP (5.41 µg/m^3) and maximum at Schlumberger Asia Services Ltd. (6.54 µg/m^3), these values are quiet lower than the standard limit of NAAQS i.e. 80 µg/m^3.
2. **Nitrogen dioxide:** It is observed minimum at Airoli IT Park (7.55 µg/m^3) and maximum at Schlumberger Asia Services Ltd. (9.73 µg/m^3). These values of nitrogen dioxide are also observed below the standard limit of 80 µg/m^3 at all the locations.
3. **Particulate Matter (PM_{10})**: PM_{10} is considered as one of the major causes of ambient air pollution. At all the sampled locations, all 6 samples are found to exceed the standard limit of 100µg/m^3. It is observed minimum at Apar Industries (122 µg/m^3) and maximum at Asian Paints (485µg/m^3).
4. **Particulate Matter ($PM_{2.5}$)**: Like PM_{10} it is also categorized as a probable carcinogen. However, its concentrations at 3 locations are observed below the standard limit of 60 µg/m^3. It is found in the range of 32 to 121 µg/m^3.
5. **Ozone (O_3)**: Concentration of ozone in all the samples is observed lower (below 19 µg/m^3) than its standard limit
6. **Lead (Pb)**: Concentration of Lead is also observed below standard limit in all the samples i.e. <0.02 µg/m^3
7. **Carbon monoxide (CO)**: It is observed below standard limit at all the locations i.e. in the range of BDL to 7.53 mg/m^3
8. **Ammonia (NH_3):** Concentration of ammonia is also observed very much lower than its standard limit (400 µg/m^3). It is observed below 40 µg/m^3.
9. **Benzene (C_6H_6):** Benzene is a known carcinogen, hence it is unsafe when exceeds the limit. Except 2 locations Lona IT Park (1.61 µg/m^3) and Asian Paints (1.32 µg/m^3), all other samples are observed with excess benzene as compared to its standard limit of 5 µg/m^3.

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/m^3 at all the locations, which is quite lower value than its standard limit of 1 ng/m^3.
11. **Arsenic:** Concentration of Arsenic at all the studied locations is found below the standard 6 ng/m^3.
12. **Nickel:** Concentration of Nickel is also observed below the standard limit (20 ng/m^3), 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 five industries - (i) Wonder Park (ii) Juinagar Railway Station (iii) Siements Nalla Airvali (iv) Alok Nalla Vashi (v) CBD Nallah

1. **Colour** (Hazen Units): Colour units are found below the acceptable standard.
2. **Odour**: odour of all the samples is found disagreeable, except sample of Wonder park, which is found agreeable.
3. **pH**: it is observed in between 6.73 and 7.83 which is well within the range.
4. **Suspended Solids**: Suspended solids of treated outlet water of all locations appeared to be clean, as suspended solids is observed below 100 mg/L.
5. **Chemical Oxygen Demand**: It is observed in the range of 120 to 520 mg/L, which is quiet below the standard limit (250 mg/L).
6. **Biochemical Oxygen Demand**: BOD samples also show the opposite trend as compared to COD samples. All the samples are observed to higher than the standard limit (30 mg/L). It is observed in the range of 65 to 175 mg/L
7. **Total Ammonia**: All the samples are found in the range of 2.3 to 2.4 mg/L. Hence, very less than the standard limit of 5 mg/L.
8. **Total Kjeldahl Nitrogen**: It is observed in the range of 0.89 to 27.5 mg/L at 4 locations. However, at Juinagar Railway Station (364 mg/L), it is observed higher than the standard limit (100 mg/L).
9. **Fish Bioassay**: It is observed in the range of 0 to 90% of fish survival.
10. **Heavy metals**: All the heavy metals are found below the standard limits in all the samples.
11. Other parameters like Free Ammonia, Total Residual Chlorine, Cyanide, Fluoride, Dissolved Phosphate, Phenolic compounds also meet the criteria as prescribed by CPCB.

4.4 Ground water Quality Monitoring:

Six samples were collected from 3 different locations namely: (i) MSW TTC Area (ii) TTC WMA (iii) TTC Plot no. 142 MIDC. Parameters which are not included in ISO 10500:2012 are compared with WHO standards like BOD (6 mg/L) and COD (10 mg/ L).

1. **Colour** (Hazen Units): Colour units are below the acceptable standard.
2. **Odour**: odour of all the samples is found agreeable.
3. **Chemical Oxygen Demand:** All samples are found below the permissible standard limit of 10 mg/L i.e. in the range of 6 to 8 mg/L.
4. **Biological Oxygen Demand:** BOD samples also follow the similar trend as COD. All samples are found below the permissible standard limit of 6 mg/L i.e. in the range of 2 to 3 mg/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 (45 mg/l), in the range of 2.34 to 12.5 mg/L.
3. **Residual Free Chlorine**: Values are below the acceptable standard.
4. **Total Ammonia**: All readings are found within the acceptable standard.
5. **Fluoride:** Values are below the acceptable standards, in the range of BDL at TTC WMA to 0.3 mg/L at MSW TTC area.
6. **Sulphide:** All the readings of sulphide are observed below 0.025 mg/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 below the standard limit i.e. in the range of 4.1 to 7.5 mg/L.
9. **Fish Bioassay**: Zero percent fish survival was detected in the water sample of WMA TTC after 96 h followed by MSW TTC (80%) and then TTC plot no. 142 (90%)
10. ***Boron:** Values are below the acceptable standards.

    (*CPCB Water Quality criteria for Irrigation, Industrial Cooling & Controlled Waste disposal).
11. **Surface Active Agents:** It exceeds the standard of drinking water.
12. **Metals:** All the metals are observed within the acceptable limits of drinking water standards.
13. **PAH & PCB** is also found 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.

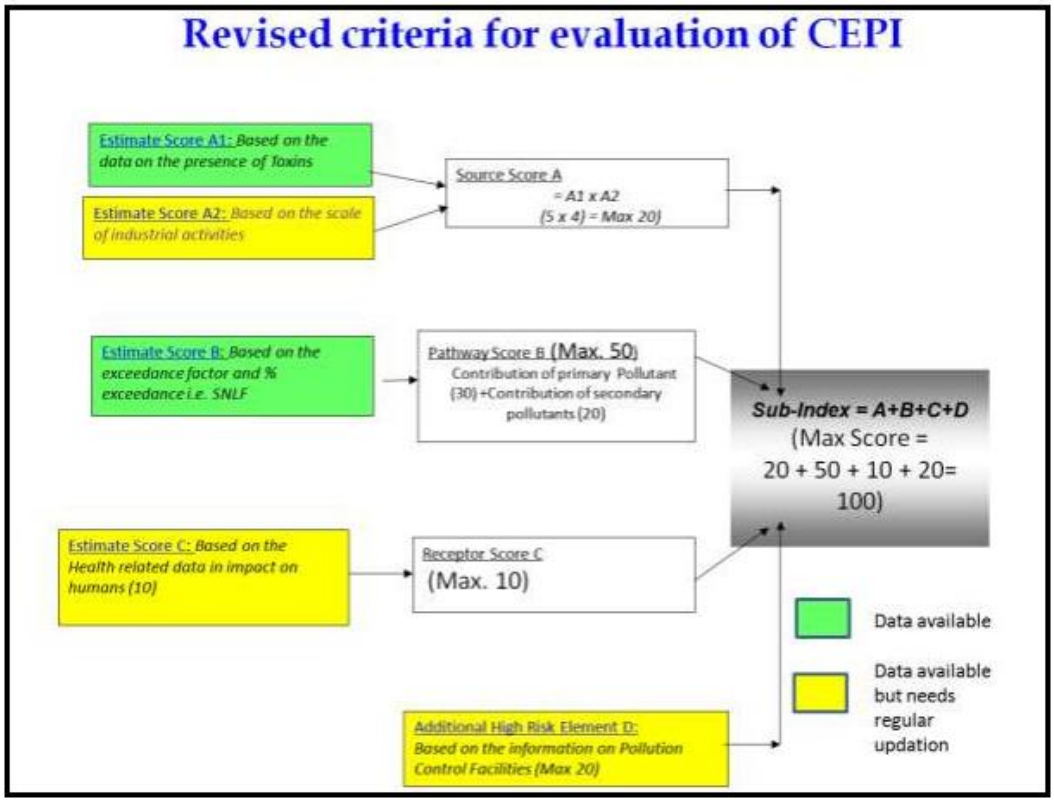
III. Health component was also retained in the revised concept in line with the suggestions of Secretary, MoEFCC during the meeting held in MoEF.

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.

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



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

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

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

Cut-off Score

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

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

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

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

Subsequently NAAQS 2009 came in force. List of parameters to be considered increased and expanded including more critical and hazardous pollutants like benzene, BaP, Metals, etc. existing in the environment. There was revision of standards (limiting values) as well. In this present report of 2016 prepared by MPCB, CEPI is calculated considering all these revised standards' limiting values, list of parameters and complete scope of monitoring.

5.1 Comparison of CEPI scores:

The result shows that CEPI score of present report is 44.39. The present study is the compilation of post monsoon season, which also regulates the score value. This time locations under study were different from past studies. Hence, comparative results cannot be illustrated and discussed. But the overall CEPI is observed as 44.39 in Navi Mumbai city, which falls below the category of severely polluted areas, according to the revised CEPI guidelines. Hence, it can be concluded that the industries are following environmental rules and regulations laid by MoEF and MPCB to control the pollution and to keep the environment clean and green.

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

Air

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2019	2.5	4	10				20				0	10	**40**
CEPI score June 2018	2.5	4	10				20				0	10	**40**
CEPI score February 2018	2	4	8				20				10	10	**48**
CEPI score June 2017	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 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
CEPI score February 2019	1.75	4	7				20.5				0	5	**32.5**
CEPI score June 2018	1.75	4	7				10				0	5	**22**
CEPI score February 2018	2.25	4	9				29.75				10	5	**53.75**

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score June 2017	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 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
CEPI score February 2019	1.75	4	7				10.5				0	5	**22.5**
CEPI score June 2018	1.75	4	7	-	-	-	1.5	-	-	-	0	5	**13.5**
CEPI score February 2018	2.5	4	10				31.25				10	5	**56.25**
CEPI score June 2017	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 2016	1	5	5	8	0	0	8	5	5	5	30	5	**48**

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
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
CEPI score February 2019	40	32.5	22.5	**44.39**
CEPI score June 2018	40	22	13.5	**41.78**
CEPI score February 2018	48	53.75	56.25	**67.54**
CEPI score June 2017	52	49	49	**63.52**
CEPI score February 2017	51	48	36	**59.46**
CEPI Score 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.

At elevated levels, all the pollutants have adverse effects on human and environment. Health data collected from the nearby hospitals of the sampling locations shows cases related to respiratory problems mainly. Parameters of air sampling are observed within the standard limit except PM_{10} and $PM_{2.5}$ at certain locations as compared to their standards. Benzene concentration is also detected in ambient air. Although the concentrations are observed lower than the permissible limits at most of the locations, but due to its carcinogenic nature, it should always be a point of concern. Among surface water samples, parameters like BOD of most of the samples are found below standard limit, however, COD is observed above the standard limits at most of the studied locations. Similarly, in ground water samples also, all the parameters are observed much below the permissible limits.

This time the studied locations were different from past studies. Hence, direct comparison of increase and decrease in pollution cannot be illustrated. However, the overall present Comprehensive Environmental Pollution Index (CEPI) is calculated as 44.39 in the present study of Navi Mumbai city. The score itself 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	2.5	4	10	20	0	10	40
Water Index	1.75	4	7	10.5	0	5	22.5
Land Index	1.75	4	7	20.5	0	5	32.5
						Aggregated CEPI	**44.39**

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 44.39 of 2019. Below mentioned are some of the efforts:

- About 17 industries have started using Natural Gas as fuel (PNG) since last 4 years. Gas Pipeline works started from 2011.
- Due to Change in Fuel Pattern the SO_2 Reduction: 576.70 T/A.
- All major polluting industries having their own full fledge 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.
- 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.
- All Large /Medium/ small scale industries has installed dust collectors and scrubbing systems as Air Pollution Control Devices.
- All the bulk mfg. units (12 nos) are being proposed to install VOC analyser including alarm system.
- About 57 major polluting industries are closed, namely – NOCIL Petrochemicals, Reliance Silicons, Standard Alkali (Chemical Division), Corromandal Fertilizers, Jaysynth Dyechem, Unique Chemicals, Cabbot India etc.
- 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. Photographs

Schlumberger Asia Ltd.
Airoli IT Park

Apar Industries

Vashi STP

CBD Nala

Juinagar Nala

Siemens Nala

TTC Plot no. 142

TTC WMA Mahape

9. References

1) Criteria for Comprehensive Environmental Assessment of Industrial Clusters, December 2009, CPCB, EIAS/4/2009-10
2) Comprehensive Environmental Assessment of Industrial Clusters, December 2009, CPCB, EIAS/5/2009-10
3) Action Plan for Industrial Cluster: Navi Mumbai, November 2010, MPCB
4) Final Document on Revised CEPI Version – 2016, CPCB No.B-29012/ ESS(CPA)/ 2015-16
5) Standard Methods for the Examination of Water and Waste Water, American Public Health Association, 22nd Edition, 2012.
6) IS 3025 (various parts)
7) www.mpcb.gov.in
8) www.cpcb.gov.in

10. Annexure

Annexure I Health related data in impact on humans

C: Receptor

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

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

Attached below health data collected for the region

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

1. **Name of the Polluted Industrial Area (PIA): Navi Mumbai**
2. **Name of the major health centre/ organization: Dr. R. N. Patil's Suraj Hospital**
3. **Name and designation of the contact person:**
4. **Address: Near Sadhu Vaswani International School, Sun Palm View Bldg, Opp. Palm Beach Marg Plot No. 1 & 1A, Sector 15, Sanpada, Navi Mumbai**
5. **Year of Establishment:**

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases					
1.	**Asthma**	2	3	2	-	-
2.	**Acute Respiratory Infection**	12	25	7	-	-
3.	**Bronchitis**	3	2	4	-	-
4.	**Cancer**	0	0	0	-	-
	Water Borne Diseases					
5.	**Gastroenteritis**	46	31	20	-	-
6.	**Diarrhea**	3	2	0	-	-
7.	**Renal diseases**	34	30	25	-	-
8.	**Cancer**	4	7	0	-	-

Dr. R. N. Patil's SURAJ HOSPITAL

Signature of the Hospital Head/ Superintend

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

1. **Name of the Polluted Industrial Area (PIA): Navi Mumbai**
2. **Name of the major health centre/ organization: ESIC**
3. **Name and designation of the contact person: Medical superintend**
4. **Address: Sector 29C, Gothivali Village, Sector 30, Rabale, Navi Mumbai**
5. **Year of Establishment:**

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases					
1.	**Asthma**	27	75	144	142	102
2.	**Acute Respiratory Infection**	39	43	107	43	42
3.	**Bronchitis**	10	17	4	13	5
4.	**Cancer**	8	6	4	12	8
	Water Borne Diseases					
5.	**Gastroenteritis**	29	7	11	7	1
6.	**Diarrhea**	8	3	2	3	2
7.	**Renal diseases**	28	38	41	22	3
8.	**Cancer**	0	0	0	0	0

Signature of the Hospital Head/ Superintend

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

6. **Name of the Polluted Industrial Area (PIA): Navi Mumbai**
7. **Name of the major health centre/ organization: Mahatma Gandhi Mission Hospital**
8. **Name and designation of the contact person: Medical superintend**
9. **Address: Sector C.B.D Belapur, Navi Mumbai**
10. **Year of Establishment:**

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases					
1.	**Asthma**	17	6	17	4	2
2.	**Acute Respiratory Infection**	22	44	41	-	-
3.	**Bronchitis**	41	32	92	70	28
4.	**Cancer**	-	-	-	-	-
	Water Borne Diseases					
5.	**Gastroenteritis**	34	77	26	-	-
6.	**Diarrhea**	8	5	5	3	-
7.	**Renal diseases**	0	0	0	0	0
8.	**Cancer**	0	0	0	0	0

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

Signature of the Hospital Head/ Superintend

Annexure II: Stack Emission Sampling and Analysis Methodology

Sr.	Parameters	Method References	Techniques	Detection Limit
1.	Acid Mist (as Sulphuric Acid)	US EPA Method no.m-8	Barium thorine titration Method	0.6 mg/Nm^3
2.	Ammonia	IS 11255 (Part 6):1999, Reaffirmed 2003	Titration/ Nessler Reagent/ Spectrophotometric Method	1 mg/Nm^3
3.	Carbon Monoxide	USEPA Method 10B	GC-FID Method	0.2 mg/Nm^3
4.	Chlorine	US EPA Method 26 for sampling	Titrimetric	0.001 mg/Nm^3
5.	Fluoride (Gaseous)	US EPA Method 13 A	SPADNS Zirconium Lake Spectrophotometric Method	0.025 mg/Nm^3
6.	Fluoride (Particulate)	US EPA Method 13 A	SPADNS Zirconium Lake Spectrophotometric Method	0.005 mg/Nm^3
7.	Hydrogen Chloride	US EPA Method 26 for sampling	Titrimetric	0.25 mg/Nm^3
8.	Hydrogen Sulphide	IS 11255 (Part 4):1985	Titrimetric	1 mg/Nm^3
9.	Oxides of Nitrogen	IS 11255 (Part 7): 2005	PDSA Colorimetric Method	10 mg/Nm^3
10.	Oxygen	IS 13270 : 1992	ORSAT Apparatus	1 %
11.	Poly Aromatic Hydrocarbons (Particulate)	IS 5182 (Part 12) : 2004, Reaffirmed 2009 CPCB Guidelines, May 2011, Page No.39	GC-FID Method	0.25 mg/Nm^3
12.	Suspended Particulate Matter	IS 11255 (Part 1):1985, Reaffirmed 2003	Gravimetric Method	10 mg/Nm^3
13.	Sulphur Dioxide	IS 11255 (Part 2): 1985, Reaffirmed 2003	Titrimetric IPA thorine Method	5.0 mg/Nm^3 0.02 kg/day

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

Annexure III: Ambient Air Sampling and Analysis Methodology

Sr.	Parameters	Method References	Techniques	Detection Limit
1.	Sulphur Dioxide (SO_2)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.1	Improved West & Gaeke Method	4 µg/m^3
2.	Nitrogen Dioxide (NO_2)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.7	Modified Jacob & Hochheiser Method	3 µg/m^3
3.	Particulate Matter (size less than 10 µm) or PM_{10}	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.11	Gravimetric Method	2 µg/m^3
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 15	Gravimetric Method	0.4 µg/m^3
5.	Ozone (O_3)	APHA, Method No. 820, Page no. 836	Chemical Method	19.6 µg/m^3
6.	Lead (Pb)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.02 µg/m^3
7.	Carbon Monoxide (CO)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume II, May 2011, Page No. 16	Non Dispersive Infra Red (NDIR) spectroscopy	0.05 mg/m^3
8.	Ammonia (NH_3)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 35	Indophenol Blue Method	4.0 µg/m^3
9.	Benzene (C_6H_6)	IS 5182 (Part 11):2006	Adsorption and Desorption followed by GC-FID analysis	1.0 µg/m^3
10.	Benzo (a) Pyrene (BaP) – particulate phase only,	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 39	Solvent extraction followed by GC-FID analysis	0.2 ng/m^3

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

Annexure IV: Water/Wastewater Sampling and Analysis Methodology

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

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

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

Sr.	Parameters	Methods References	Techniques	Detection Limit
43.	Selenium (Se)	IS 3025 (Part 2): 2004	ICP Method	0.005 mg/L
44.	Boron (B)	IS 3025 (Part 2): 2004	ICP Method	0.1 mg/L
45.	Total Coliforms	APHA, 22nd Ed., 2012, 9221-B, 9-66	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
46.	Faecal Coliforms	APHA, 22nd Ed., 2012, 9221-E, 9-74	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
47.	Bioassay (Zebra Fish) Test	IS 6582, 1971, Reaffirmed 1987	Static Technique	-

Annexure V: National Ambient Air Quality Standards, 2009

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National Ambient Air Quality Standards: Central Pollution Control Board

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

Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas (Notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2) µg/m^3	Annual *	50	20	– Improved West and Gaeke – Ultraviolet fluorescence
		24 hours **	80	80	
2	Nitrogen Dioxide (NO_2) µg/m^3	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/m^3	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/m^3	Annual *	40	40	– Gravimetric – TOEM – Beta attenuation
		24 hours **	60	60	
5	Ozone (O_3) µg/m^3	8 hours **	100	100	– UV photometric – Chemiluminescence – Chemical Method
		1 hour **	180	180	
6	Lead (Pb) µg/m^3	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/m^3	8 hours **	02	02	– Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour **	04	04	
8	Ammonia (NH_3) µg/m^3	Annual *	100	100	– Chemiluminescence – Indophenol blue method
		24 hours **	400	400	
9	Benzene (C_6H_6) µg/m^3	Annual *	05	05	– Gas Chromatography based continuous analyzer – Adsorption and Desorption followed by GC analysis
10	Benzo (a) Pyrene (BaP) – particulate phase only, ng/m^3	Annual *	01	01	– Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As) ng/m^3	Annual *	06	06	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper.
12	Nickel (Ni) ng/m^3	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/m^3: micro-gram/m^3 i.e. 10^{-6}gm/m^3 ng/m^3 : nano-gram/m^3 i.e. 10^{-9}gm/m^3

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

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

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

Sr.	Parameter	Standards			
		Inland surface Water	Public Sewers	Land for Irrigation	Marine Coastal Areas
20.	Copper (as Cu), mg/L, Max.	3.0	3.0	--	3.0
21.	Zinc (as Zn), mg/L, Max.	5.0	15	0--	15
22	Selenium (as Se), mg/L, Max.	0.05	0.05	--	0.05
23	Nickel (as Ni), mg/L, Max.	3.0	3.0	--	5.0
24	Boron (as B), mg/L, Max.	2.0	2.0	2.0	--
25.	Percent Sodium, Max.	--	60	60	--
26.	Residual Sodium carbonate, mg/L, Max.	--	--	5.0	--
27.	Cyanide (as Cn), mg/L, Max.	0.2	2.0	0.2	0.2
28.	Chloride (as Cl), mg/L, Max.	1000	1000	600	--
29.	Fluoride (as F), mg/L, Max.	2.0	15	--	15
30.	Dissolved Phosphate (as P), mg/L, Max.	5.0	--	--	--
31.	Sulphate (as SO_4), mg/L, Max.	1000	1000	1000	--
32.	Sulphide (as S), mg/L, Max.	2.0	--	--	5.0
33.	Pesticides	Absent	Absent	Absent	Absent
34.	Phenolic compounds (as C_6H_5OH), mg/L, Max.	1.0	5.0	--	5.0

Sr.	Parameter	Standards			
		Inland surface Water	Public Sewers	Land for Irrigation	Marine Coastal Areas
35.	Radioactive materials:				
	a. Alpha emitters MC/ml., Max.	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	b. Beta emitters µc/ml., Max	10^{-6}	10^{-6}	10^{-7}	10^{-6}

Annexure VII: Drinking Water Specification-IS 10500:2012

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1	Organoleptic and Physical Parameters			
1.	Colour	Hazen units	Max 5	Max 15
2.	Odour	-	Agreeable	Agreeable
3.	pH value	-	6.5-8.5	No relaxation
4.	Taste	-	Agreeable	Agreeable
5.	Turbidity	NTU	Max 1	Max 5
6.	Total dissolved solids	mg/L	Max 500	Max 2000
Table 2	General parameters concerning substances undesirable in excessive amounts			
7.	Aluminium (as Al)	mg/L	Max 0.03	Max 0.2
8.	Ammonia (as total ammonia- N)	mg/L	Max 0.5	No relaxation
9.	Anionic detergents (as MBAS)	mg/L	Max 0.2	Max 1.0
10.	Barium (as Ba)	mg/L	Max 0.7	No relaxation
11.	Boron (as B)	mg/L	Max 0.5	Max 1.0
12.	Calcium (as Ca)	mg/L	Max 75	Max 200
13.	Chloramines (as $C1_2$)	mg/L	Max 4.0	No relaxation
14.	Chlorides (as Cl)	mg/L	Max 250	Max 1000
15.	Copper (as Cu)	mg/L	Max 0.05	Max 1.5
16.	Fluoride (as F)	mg/L	Max 1.0	Max 1.5
17.	Free residual chlorine	mg/L	Min 0.2	Min 1
18.	Iron (as Fe)	mg/L	Max 0.3	No relaxation
19.	Magnesium (as Mg)	mg/L	Max 30	Max100

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
20.	Manganese (as Mn)	mg/L	Max 0.1	Max 0.3
21.	Mineral Oil	mg/L	Max 0.5	No relaxation
22.	Nitrate (as NO_3)	mg/L	Max 45	No relaxation
23.	Phenolic compounds (as C_6H_5OH)	mg/L	Max 0.001	Max 0.002
24.	Selenium (as Se)	mg/L	Max 0.01	No relaxation
25.	Silver (as Ag)	mg/L	Max 0.1	No relaxation
26.	Sulphate (as SO_4)	mg/L	Max 200	Max 400
27.	Sulphide (as H_2S)	mg/L	Max 0.05	No relaxation
28.	Total Alkalinity as calcium carbonate	mg/L	Max 200	Max600
29.	Total hardness (as $CaCO_3$)	mg/L	Max 200	Max 600
30.	Zinc (as Zn)	mg/L	Max 5	Max15
Table 3	Parameters Concerning Toxic Substances			
31.	Cadmium (as Cd)	mg/L	Max 0.003	No relaxation
32.	Cyanide (as CN)	mg/L	Max 0.05	No relaxation
33.	Lead (as Pb)	mg/L	Max 0.01	No relaxation
34.	Mercury (as Hg)	mg/L	Max 0.001	No relaxation
35.	Molybdenum (as Mo)	mg/L	Max 0.07	No relaxation
36.	Nickel (as Ni)	mg/L	Max 0.02	No relaxation
37.	Pesticides	mg/L	See Table 5	No relaxation
38.	Polychlorinatedbiphenyls	mg/L	Max 0.0005	No relaxation
39.	Poly nuclear aromatic Hydrocarbons (as PAH)	mg/L	Max 0.0001	No relaxation
40.	Total Arsenic(as As)	mg/L	Max 0.01	Max0.05
41.	Total Chromium (as Cr)	mg/L	Max 0.05	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
42.	Trihalomethanes			
a)	Bromoform	mg/L	Max 0.1	No relaxation
b)	DibromochloroMethane	mg/L	Max 0.1	No relaxation
c)	Bromodichloromethane	mg/L	Max 0.06	No relaxation
d)	Chloroform	mg/L	Max 0.2	No relaxation
Table 4	Parameters Concerning Radioactive Substances			
43.	Radioactive Materials			
a)	Alpha emitters	Bq/L	Max 0.1	No relaxation
b)	Beta emitters	Bq/L	Max 1.0	No relaxation
Table 5	Pesticide Residues Limits and Test Method			
i)	Alachor	µg/L	20	No relaxation
ii)	Atrazine	µg/L	2	No relaxation
iii)	Aldrin/ Dieldrin	µg/L	0.03	No relaxation
iv)	Alpha HCH	µg/L	0.01	No relaxation
v)	Beta HCH	µg/L	0.04	No relaxation
vi)	Butachlor	µg/L	125	No relaxation
vii)	Chlorpyriphos	µg/L	30	No relaxation
viii)	Delta HCH	µg/L	0.04	No relaxation
ix)	2,4- Dichlorophenoxyacetic acid	µg/L	30	No relaxation
x)	DDT (o,p&p,p — Isomers of DDT, DDE and DDD)	µg/L	1	No relaxation
xi)	Endosulfan (α,β & sulphate)	µg/L	0.4	No relaxation
xii)	Ethion	µg/L	3	No relaxation
xiii)	Gamma - HCH (Lindane)	µg/L	2	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
xiv)	Isoproturon	µg/L	9	No relaxation
xv)	Malathion	µg/L	190	No relaxation
xvi)	Methyl parathion	µg/L	0.3	No relaxation
xvii)	Monocrotophos	µg/L	1	No relaxation
xviii)	Phorate	µg/L	2	No relaxation
Table 6	Bacteriological Quality of Drinking Water			
44.	E.coli or thermotolerant coliform bacteria	/100	Not detectable	-
45.	Total coliform bacteria	/100 mL	Not detectable	-
	Virological Requirements			
46.	MS2 phage	/1 L	Absent	-
	Biological Requirements			
47.	Cryptosporidium	/10 L	Absent	-
48.	Giardia	/10 L	Absent	-
49.	Microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin producing organisms		Free from microscopic organisms	-

Annexure VIII: CPCB Water Quality Criteria:

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	➢ Total coliform organisms (MPN*/100 ml) shall be 50 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/L or more, and ➢ Biochemical Oxygen Demand 2 mg/L or less
Outdoor bathing (organized)	B	➢ Total coliform organisms (MPN/100 ml) shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5 mg/L or more, and ➢ Biochemical Oxygen Demand 3 mg/L or less
Drinking water source with conventional treatment	C	➢ Total coliform organisms (MPN/100ml) shall be 5000 or less ➢ pH between 6 and 9 ➢ Dissolved Oxygen 4 mg/L or more, and ➢ Biochemical Oxygen Demand 3 mg/L or less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/L or more, and ➢ Free ammonia (as N) 1.2 mg/L or less
Irrigation, industrial cooling, and controlled disposal	E	➢ pH between 6.0 and 8.5 ➢ Electrical conductivity less than 2250 micro mhos/cm, ➢ Sodium Absorption Ratio less than 26, ➢ and Boron less than 2 mg/l.
	Below E	➢ Not Meeting A, B, C, D & E Criteria

Annexure IX: Water Quality Parameters Requirements and Classification

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

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

i) Simple Parameters:

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

* Applicable to only surface water

ii) Regular Monitoring Parameters:

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

Sr.	Parameters	Requirement for Waters of Class		
		A Excellent	B-Desirable	C-Acceptable
(vii)	Fecal Coliform, MPN/ 100 ml	<20 per 100 ml	<200 per 100 ml	<2000 per 100 ml
(viii)	Bio-assay (Zebra Fish)	No death in 5 days	No death in 3 days	No death in 2 days

Note:

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

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

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

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