NATIONAL AMBIENT AIR QUALITY MONITORING
SERIES: NAAQMS//2009-10

NATIONAL AMBIENT AIR QUALITY STATUS 2008

CENTRAL POLLUTION CONTROL BOARD
MINISTRY OF ENVIRONMENT & FORESTS
Website: http://www.cpcb.nic.in/ e-mail: cpcb@nic.in

August 2009

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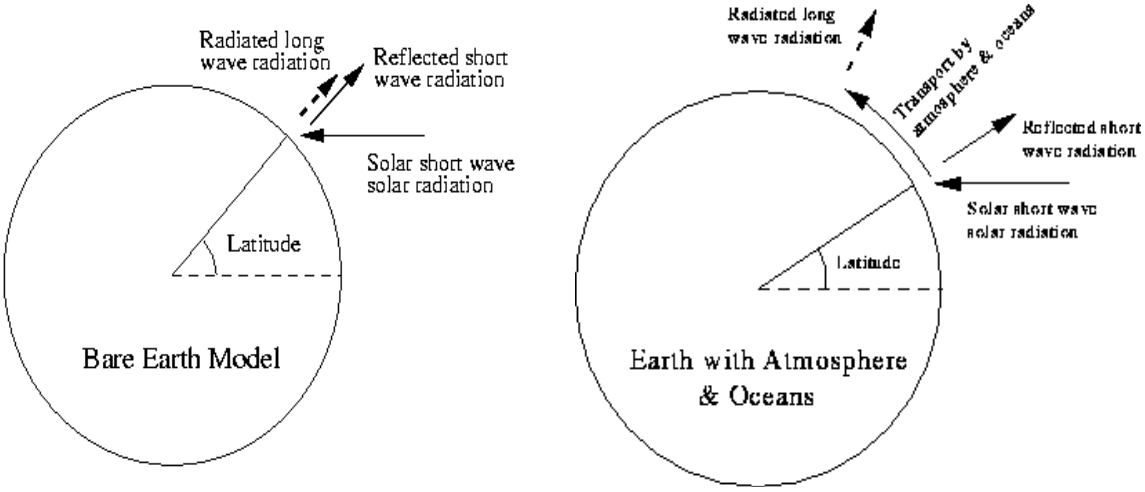

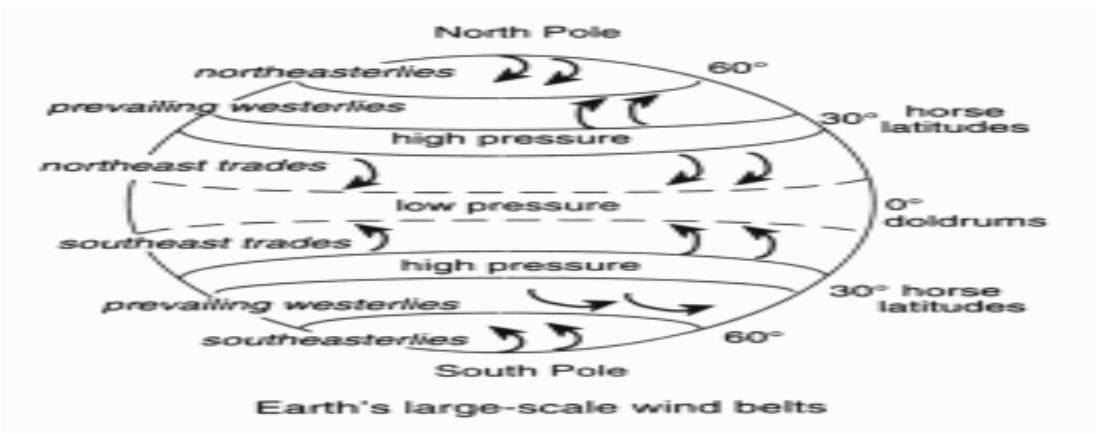

Earth's large-scale wind belts

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August 2009

FOREWORD

The Central Pollution Control Board (CPCB) in collaboration with the State Pollution Control Boards (SPCBs) has established the National Ambient Air Quality Monitoring (NAMP) Network, covering number of cities/towns of the country. The Network performed activities under the Air (Prevention and Control of Pollution) Act, 1981 to collect compile and disseminate information on air quality.

The ambient air quality is monitored collectively by CPCB, SPCBs, Pollution Control Committees (PCCs), and National Environmental Engineering Research Institute (NEERI). The data, thus generated, is transmitted to CPCB for scrutiny, analysis, compilation and its publication. The present Report contains ambient air quality data for the calendar year 2008 and trend analysis since 1995. Air pollution status of various pollutants is described in terms of Low, Moderate, High and Critical category, vis-a -vis the notified ambient air standards. The status are depicted in the form of tables and figures as well. The air quality trends in sixteen polluted cities identified by Apex Court, and four Mega Cities have been included along with the data on additional pollutants, such as ammonia, carbon monoxide, $PM_{2.5}$ etc.

The contributions made by my colleague Dr. Sanjeev Agrawal, Scientist `C' for compiling and collating the data. The guidance of Dr. D. D. Basu Senior Scientist & Shri J. S. Kamyotra, Member Secretary is highly appreciable. Efforts made by CPCB Head Office/ZO'sCPCB/SPCB's/PCC's and other collaborating agencies are acknowledged.

The co-operation of all the monitoring agencies is gratefully acknowledged in successfully achieving this major task. Hopefully, the report will be useful to all concerned.

(S. P. GAUTAM)

23rd September 2009

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CHAPTER-I
INTRODUCTION

Air pollutants are added in the atmosphere from variety of sources that change the composition of air and affect the biotic environment. The concentration of air pollutants depend not only on the quantities that are emitted from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emission. The pollution concentration vary spatially and temporarily causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. The sources of air pollutants include vehicles, industries, domestic and natural sources. The presence of air pollutants in the ambient air adversely affects the health of the population. In order to prevent and control air pollution, the Air (Prevention and Control of Pollution) Act was enacted in 1981. The responsibility has been further emphasized under Environment (Protection) Act, 1986. It is necessary to assess the present and anticipated air pollution through air quality survey/monitoring programs. Therefore, Central Pollution Control Board had started National Ambient Air Quality Monitoring (NAAQM) Network during 1984 - 85 at national level and gradually the number of stations has increased over the years. The programme was later renamed as National Air Quality Monitoring Programme (NAMP).

The ambient air quality monitoring network involves measurement of a number of air pollutants at different locations in the country. Air quality monitoring requires proper selection of pollutants, selection of locations, frequency and duration of sampling, sampling techniques, infrastructural facilities, man power and operation and maintenance. The areas selected for monitoring are based on high traffic density, industrial growth, human population and its distribution, emission source, public complaints, the land use pattern etc. Generally, the basis of a network design are the pollution source and the pollutants present. The criteria pollutants measured are Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO) etc.

The quality of the air that we breathe affects our health and quality of life. It can also have major impacts on the ecosystem. Measuring and understanding air pollution provides a sound scientific basis for its management and control. Historically, air pollution problem has typically been high levels of smoke and sulphur dioxide arising from the combustion of sulphur-containing fossil fuels such as coal for domestic and industrial purpose. However, now the major threat to clean urban air is posed by vehicular emission. A variety of pollutants are emitted by petrol and diesel-engine motor vehicles. These include carbon monoxide (CO), oxides of nitrogen (NOx), volatile organic compounds (VOCs) and particulates (PM_{10} and $PM_{2.5}$). The sources of particulate matter levels are vehicles, engine gensets, small scale industries, biomass incineration, boilers and emission from power plants, re-suspension of traffic dust, commercial and domestic use of fuels, etc. Fine particles contain microscopic

solids or liquid droplets that are very small and they can penetrate deep into the lungs and cause serious health problems. Generally, coarse particles are directly emitted and fine particles can be formed in the atmosphere. Photochemical reactions resulting from the action of sunlight on nitrogen dioxide (NO_2) and VOCs from vehicles leads to the formation of ozone. Ozone is a secondary long-range pollutant, which affects areas far from the original emission site.

The report presents results of ambient air quality monitoring carried out during the year 2008 at various monitoring stations under NAMP. Four criteria pollutants namely sulphur dioxide, nitrogen dioxide, respirable suspended particulate matter and suspended particulate matter have been monitored regularly at various monitoring locations. The air quality is described in terms of low, moderate, high and critical levels based on an exceedence factor. The pollutants that are exceeding the standards in many cities are suspended particulate matter and respirable suspended particulate matter. Results of additional pollutants such as benzene and carbon monoxide monitored in Delhi and ammonia in six cities have also been presented. The next few chapters present details of the National Air Quality Monitoring Programme and major findings during the year 2008. Also detailed are the initiatives taken for air pollution control.

I.I Air Pollutants

a) Sulphur dioxide (SO_2)

SO_2, is formed when fuel containing sulfur is burned. Sulfur is prevalent in raw materials such as crude oil, coal, and ore that contain common metals like aluminum, copper, zinc, lead etc. SO_2 reacts with other gases in the atmosphere to form sulphates that can cause harm to human health. Effects of SO_2 include respiratory illness, visibility impairment, acid rain and aesthetic damage. Sulfur oxides are emitted in significant quantities from thermal power plants, smelting process of sulfide ores to produce copper, lead and zinc and also from petroleum refining processes. The diesel driven vehicles are specific source of sulfur dioxide generated during combustion process. Sulfate particles, can be transported over long distances and deposited far from the sources. SO_2 can result in respiratory illness, particularly in children and the elderly, and it can also aggravate existing heart and lung diseases.

b) Oxides of Nitrogen (NO_x)

Oxides of nitrogen are a generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts. Nitrogen dioxide (NO_2) along with particulates is seen as a reddish brown layer over urban areas. Nitrogen oxides are formed when fuel is burned at high temperature. Sources of nitrogen oxides includes vehicles, industrial processes that burn fuel. Oxides of nitrogen react with Volatile Organic Compounds (VOCs) to form ground level ozone. They also react to form nitrates, acid aerosols. They also contribute to nutrient overload that deteriorates water quality. Nitrogen dioxide irritates the nose and throat, and it appears to increase susceptibility to respiratory infections.

c) Particulate Matter ($RSPM_{10}$ & $PM_{2.5}$)

Particulate matter is a mixture of many subclasses of pollutants that contain many different chemical species. The particle size is often described by aerodynamic diameter. Aerodynamic diameter depends on particle density and is defined as the diameter of a particle with the same settling velocity as spherical particle with unit density i.e. 1 g/cm^3 (USEPA, 1996). PM_{10} are the particles with upper size limited by a 50% cut at 10 μm aerodynamic diameter (USEPA, 1996). PM_{10} can be formed by physical processes of crushing, grinding and abrasion of surfaces. Mining and agricultural activities are some of the sources of large size particles.$PM_{2.5}$ are the particles with upper size limited by a 50% cut at 2.5 μm aerodynamic diameter (USEPA, 1996). Particulate matter is called primary if it is in the same form chemical form in which it is emitted into the atmosphere. The primary particulate matter includes wind blown dust such as road dust, fly ash, soot etc. Particulate matter is called secondary it is formed by chemical reactions in the atmosphere. Secondary particulate matter include sulphates, nitrates etc.

The size of particles is directly linked to their potential for causing health problems. Small particles less than 2.5 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease (USEPA, 2008). People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure (USEPA, 2008). Environmental effects of particulate matter include visibility reduction, aesthetic damage etc.

Composition of Particulate Matter

Atmospheric particles include combustion-generated particles, such as diesel soot or fly ash; photochemically produced particles, such as those found in urban haze; and soil-like particles from resuspended dust. The major constituents of RSPM are organic and elemental carbon, metals/elements like silicon, magnesium, iron, ions like sulphates, nitrates, ammonium etc. Understanding composition of particulate matter is most important to gain insight into the health effects caused and sources to be controlled. Composition of particulate matter varies from place to place and season depending upon sources present.

(i) Elemental Carbon

Elemental carbon (EC), also called ‘‘black carbon’’ or ‘‘graphitic carbon’’, has a chemical structure similar to impure graphite. Atmospheric elemental carbon is from primary anthropogenic sources and is not formed by reactions involving gaseous

hydrocarbon precursors in the atmosphere. EC plays an important role in atmospheric chemistry because of its adsorptive and catalytic properties, which can capture other pollutants to react on its surface.

(ii) Organic Carbon

Organic carbon (OC), a mixture of hydrocarbons and oxygenates, is formed by a variety of processes, including combustion and secondary organic aerosol (SOA) formation. Organic carbon may be emitted as primary particles directly from sources, but secondary organics can also be formed in the atmosphere from the low vapor pressure products of atmospheric chemical reactions. OC is a complex mixture of different organic compounds, containing polycyclic aromatic hydrocarbons and other components.

(iii) Elements/Metals

Calcium, aluminum, silicon, magnesium, and iron are some of the crustal material found predominately in the coarse particles. Most of the elements are emitted from coal, oil combustion, vehicles, and industrial processes. Other sources include crustral material from road dust, tyre wear, construction activities etc.

(iv) Ions

The common ions found in particulate matter are sodium, sulphates, nitrates, calcium, chloride, potassium. Potassium and nitrate may be found in both the small size and coarse particles. Potassium comes from soil in coarse particles and in small size particles it comes from wood burning. Nitrate in formed by reaction of gas phase nitric acid with gas-phase ammonia forming particulate ammonium nitrate.

d) Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless and poisonous gas. It is formed by incomplete combustion of carbon containing fuels. Major source of CO are vehicles. Incomplete combustion is most likely to occur at low air-to-fuel ratios in the engine. These conditions are common during vehicle starting when air supply is restricted and are not tuned properly, and at altitude, where thin air effectively reduces the amount of oxygen available for combustion. CO enters the bloodstream through lungs and forms carboxyhemoglobin which inhibits blood's oxygen carrying capacity to organs and tissues. Persons with heart disease are especially sensitive to carbon monoxide poisoning and may experience chest pain if they breathe the gas while exercising. Infants, elderly persons, and individuals with respiratory diseases are also particularly sensitive.

e) Ozone

Ozone is a secondary pollutants formed in the atmosphere by reaction between oxides of nitrogen and volatile organic compounds (VOCs) in the presence of sunlight. Vehicles, industrial emissions, gasoline vapours, chemical solvents emit

oxides of nitrogen and VOCs that form ozone. Peak O_3 levels occur typically during the warmer times of the year.

f) Ammonia

Ammonia is found in small quantities in the atmosphere, and is produced from the putrefaction of nitrogenous animal and vegetable matter. Ammonia occurs naturally and is produced by human activity. Ammonia and ammonium salts are also found in small quantities in rainwater. It is an important source of nitrogen which is needed by plants and animals. Ammonia gas can be dissolved in water and is called liquid ammonia or aqueous ammonia. Once exposed to open air, liquid ammonia quickly turns into a gas. Exposure to ammonia may occur by breathing or consuming food or water containing ammonia. No health effects have been found in humans exposed to typical environmental concentrations of ammonia. Exposure to high levels of ammonia in air may be irritating to skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high concentrations of ammonia.

g) Hazardous Air Pollutants

Hazardous air pollutants are also known as toxic air pollutants which may cause health effects such as reproductive effects, cancer etc. Toxic air pollutants include benzene, perchlorethlyene, methylene chloride, dioxin, asbestos, toluene, and metals such as cadmium, mercury, chromium, and lead compounds. Sources of benzene are gasoline and perchlorethlyene, is emitted from some dry cleaning facilities. Methylene chloride is used as a solvent and paint stripper by a number of industries. As per USEPA, 2007 (Source:http://www.epa.gov/ttn/atw/allabout.html) people exposed to toxic air pollutants at sufficient concentrations and durations may have an increased chance of experiencing serious health effects and these health effects can include damage to the immune system, as well as neurological, reproductive (e.g., reduced fertility), developmental, respiratory, cancer and other health problems. Also as per USEPA, 2007, in addition to exposure from breathing air toxics, some toxic air pollutants such as mercury can deposit onto soils or surface waters, where they are taken up by plants and ingested by animals and are eventually magnified up through the food chain.

I.II Air (Prevention and Control of Pollution) Act 1981

Government of India enacted the Air (Prevention and Control of Pollution) Act 1981 to arrest the deterioration in the air quality. The act prescribes various functions for the Central Pollution Control Board (CPCB) at the control level and State Pollution Control Boards at the state level. The main functions of the Central Pollution Control Board are as follows:

- To advise the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution.

- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the State Pollution Control Board.
- To carry out and sponsor investigations and research related to prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution; and
- To lay down standards for the quality of air.

The main functions of the State Pollution Control Boards are as follows:

- To plan a comprehensive programme for prevention, control and abatement of air pollution and to secure the execution thereof.
- To advise the State Government on any matter concerning prevention, control and abatement of air pollution.
- To collect and disseminate information related to air pollution.
- To collaborate with Central Pollution Control Board in programme related to prevention, control and abatement of air pollution; and
- To inspect air pollution control areas, assess quality of air and to take steps for prevention, control and abatement of air pollution in such areas.

I.III National Ambient Air Quality Standards (NAAQS)

The ambient air quality objectives/standards are pre-requisite for developing programme for effective management of ambient air quality and to reduce the damaging effects of air pollution. The objectives of air quality standards are:

- To indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property;
- To assist in establishing priorities for abatement and control of pollutant level;
- To provide uniform yardstick for assessing air quality at national level; and
- To indicate the need and extent of monitoring programme.

The Central Pollution Control Board had adopted first ambient air quality standards on November 11, 1982 as per section 16 (2) (h) of the Air (Prevention and Control of Pollution) Act, 1981. The air quality standards have been revised by the Central Pollution Control Board on April 11, 1994 and were notified in Gazette of India, Extra-ordinary Part-II Section 3, sub section (ii), dated May 20, 1994. The revised National Ambient Air Quality Standards are depicted in Annexure-I (Table A-1.1). The guidelines for declaring sensitive areas as recommended by peer/core group of CPCB are as follows:

Sensitive areas - sensitive area may include the following:

1) 10 kms all around the periphery of health resorts that are notified by State Pollution Control Boards in consultation with department of public health of the concerned state.

2) 10 kms all around the periphery of biosphere reserves, sanctuaries and national parks that are notified by Ministry of Environment and Forest or concerned states.

3) 5 kms all around the periphery of an archeological monument declared to be of national importance or otherwise that are notified by Archeological Survey of India (A.S.I.) in consultation with State Pollution Control Boards.

4) Areas which are delicate or sensitive to air pollution in terms of important agricultural/horticultural crops grown in that area and accordingly notified by State Pollution Control Boards in consultation with department of agriculture/horticulture of concerned state.

5) 5 kms around the periphery of centers of tourism and/or pilgrim due to their religious, historical, scenic or other attractions, that are notified by department of tourism of the concerned state in consultation with State Pollution Control Boards.

I.IV National Air Quality Monitoring Programme (N.A.M.P.)

Present status of NAMP: Central Pollution Control Board initiated National Ambient Air Quality Monitoring (NAAQM) programme in the year 1984 with 7 stations at Agra and Anpara. Subsequently the programme was renamed as National Air Quality Monitoring Programme (N.A.M.P.). NAAQS have been notified for seven parameters viz. SPM, RSPM, NO_2, SO_2, CO, NH_3 and Pb. Under National Air Quality Monitoring Programme (NAMP) presently ambient air quality is being monitored at 342 monitoring stations covering 128 cities/towns as on 31st March 2009 which was at 328 stations as on 31st March 2008. During 2008-09, 42 stations have been sanctioned additionally. Further, i) Parameters SPM, RSPM, SO_2 and NO_2 are being monitored at all the locations; ii) Three more parameters i.e. CO, Pb, and NH_3 are being monitored at selected locations in a few cities; iii) Other parameters i.e. O_3, Benzene, Trace heavy metals and PAHs are being monitored occasionally at selected locations for creating data base. During the year 2008-09, forty one new air quality stations were sanctioned in cities like Nalgonda,. Kakinada, Warangal, Nellore, Khamam Chitoor, Guntur, Vishakhapatnam, Tinsukhia, Lakhimpur, Nagaon, Nalbari, Bhirwari, Sangli, Roha, Rai Bareli, Gorakhpur, Kanpur, Bareily, Muradabad, Saharanpur, Unnao and Mathura covering three states.

Growth of Ambient Air Quality monitoring station under NAMP is depicted in Figure I.I and operating stations state wise/city wise under National Ambient Air Quality Monitoring Programme is given in Annexure-I (Table A-1.2).

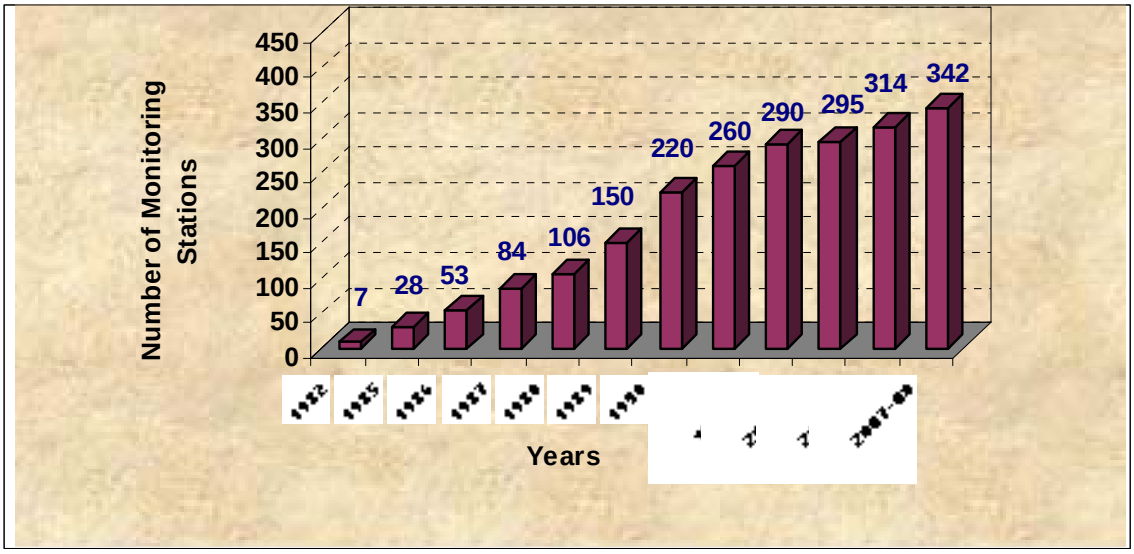

Fig. I.I: Growth of Ambient Air Quality operating stations under NAMP in India

I.IV.I Objectives

The objectives of the N.A.M.P. are as follows:

- To determine status and trends of ambient air quality;
- To ascertain whether the prescribed ambient air quality standards are violated,
- To Identify Non-attainment Cities
- To obtain the knowledge and understanding necessary for developing preventive and corrective measures;
- To understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind based movement, dry deposition, precipitation and chemical transformation of pollutants generated.

I.IV.II Monitoring Locations and Parameters monitored

Under N.A.M.P., four air pollutants *viz*., Sulphur Dioxide (SO_2), Oxides of Nitrogen as NO_2 and Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM_{10}), have been identified for regular monitoring at all the locations. Besides this, additional parameters such as Respirable Lead and other toxic trace metals, Hydrogen Sulphide (H_2S), Ammonia (NH_3) and Polycyclic Aromatic Hydrocarbons (PAHs) are also being monitored at selected locations.

The monitoring of meteorological parameters such as wind speed and direction, relative humidity and temperature was also integrated with the monitoring of air quality. The monitoring of pollutants is carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have 104 observations in a year.

The monitoring is being carried out by Central Pollution Control Board; State Pollution Control Boards: Pollution Control Committees; National Environmental Engineering Research Institute (NEERI), Nagpur. CPCB co-ordinates with the other agencies to ensure the uniformity, consistency of air quality data and provides technical and financial support to them for operating the monitoring station. N.A.M.P. is being operated through various monitoring agencies, large number of personnel and equipment are involved in the sampling, chemical analyses, data reporting etc. It increases the probability of variation and personnel biases reflecting in the data, hence it is pertinent to mention that these data be treated as indicative rather than absolute.

I.V Data Analysis and Limitations

The air quality data generated at the monitoring stations are transmitted to CPCB where these are checked, scrutinized, compiled, processed and analyzed statistically to get the information on the annual mean, standard deviation etc. of the pollutants. In the present report, results of SO_2, NO_2, RSPM and SPM, for the year 2008 are presented.
While presenting the air quality data in this report following conventions are followed:

i. Since the sampling for 24 hours in a day could not be fulfilled at all the locations due to reasons like power failure, rainfall etc, and the values monitored for 16 hours and more are considered as the representative values for assessing the ambient air quality for that day;
ii. In case no data is available in a particular month with respect to all the three parameters, the month has been excluded;
iii. In case, no data is reported for a particular station with respect to all the three parameters, during entire year, that station has been excluded; and
iv. The frequency of monitoring twice a week, 104 days in a year could not be met in some of the locations. In such cases, 50 days of monitoring in a year is considered adequate for the purpose of data analysis.

As NAMP is being operated through various monitoring agencies, a large number of personnel and equipments are involved in the sampling, chemical analyses, data reporting etc.. This increases the probability of personal biases reflecting in the data. Hence it is pertinent to mention that this document be referred keeping in view the above facts and the data be considered more as indicative rather than absolute. The data presented in this report is average over the entire year as available. In case, monthly average data is required then the same may be obtained by contacting CPCB.

I.VI Quality Assurance/Quality Control of Data and Management

Quality assurance and Quality control (QA/QC) is an essential part of any monitoring system. QA/QC is a programme of activities that ensures that measurements meet defined standards of quality, with a stated level of confidence. In order to ensure the quality of data the CPCB is carrying out various exercises as follows:

i) Calibration, Servicing and Repair of Instruments and Evaluation of Ambient Air Quality Monitoring Stations

CPCB is carrying out a project on calibration, servicing and repair of instruments/equipments and evaluation of ambient air quality monitoring stations under NAMP. Servicing and repair of respirable dust sampler and high volume sampler is carried out and they are also calibrated using top loading calibrator. The location of monitoring stations is evaluated as per CPCB guidelines so as to ensure quality of data.

ii) Training Program on Ambient Air Quality Monitoring

CPCB carries out training program on ambient air quality monitoring with an objective to improve quality of data generated under National Air Quality Monitoring Programme (NAMP). Training is provided to field and laboratory staff involved in NAMP. The training is provided on measurement methods of air pollutants i.e. sulphur dioxide (SO_2), nitrogen dioxide (NO_2), respirable suspended particulate matter (RSPM) and suspended particulate matter (SPM) etc.

iii) Guidelines for Ambient Air Quality Monitoring

CPCB has developed guidelines for carrying out ambient air quality monitoring. The Guidelines for Ambient Air Quality Monitoring include site selection criteria, quality assurance and quality control in air quality monitoring, type of pollutants to be monitored in a city, frequency and duration of monitoring, data reporting and compilation procedures and measurement methods of various air pollutants etc.

iv) Regular Inspection of Monitoring stations and monitoring laboratories are regularly inspected by CPCB officials to ensure proper and uniform methodology for sampling and analysis.

v) Review meetings of NAMP are regularly conducted with monitoring agencies to discuss various problems related to monitoring activities and sort out the remedial measures.

vi) Analytical quality control exercises using Ring Test Facility are regularly conducted to evaluate the performance of different laboratories.

vii) Additional Information includes the data of some State Air Quality Monitoring Stations (SAMP) have also been included in this report. These stations are in Amravati (Apurva Oil and Ind. Govt. College of Engineering, Rajkamal Square), Bhubaneshwar (IRC Village, Capital Police Station), Cuttack (R.O. Cuttack Office), Balasore (Sahadevkhunta), Amritsar (Nagina Soap Factory and A-1 Platters), Bhatinda (M/s Bhatinda Dts. Coop. Milk Producers Union Ltd.) Derrabasi (M/s Punjab Chemicals and Crop Protection Ltd and M/s Winsome Yarns Ltd.), Jodhpur (DIC Office, Shastri Nagar Police Thana and Office of Housing Board) and Allahabad (Bharat Yantra Nigam Ltd., and Square crossing).

CHAPTER-II
Air Quality Assessment & Major Findings

Air Quality Assessment & major findings of the ambient air quality monitoring carried out during the year 2008 are presented in this chapter. The air quality of different cities/towns has been compared with the respective NAAQS.

II.I Air Quality Assessment

The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard). The Exceedence Factor (EF) is calculated as follows:

$$\text{Exceedence Factor} = \frac{\text{Observed annual mean concentration of criteria pollutant}}{\text{Annual standard for the respective pollutant and area class}}$$

The four air quality categories are:

- Critical pollution (C) : when EF is more than 1.5;
- High pollution (H) : when the EF is between 1.0 - 1.5;
- Moderate pollution (M) : when the EF between 0.5 - 1.0; and
- Low pollution (L): when the EF is less than 0.5.

It is obvious from the above categorization, that the locations in either of the first two categories are actually violating the standards, although, with varying magnitude. Those, falling in the third category are meeting the standards as of now but likely to violate the standards in future if pollution continues to increase and is not controlled. However, the locations in Low pollution category have a rather pristine air quality and such areas are to be maintained at low pollution level by way of adopting preventive and control measures of air pollution. Adequate data for annual average concentration (with 50 and more day of monitoring) for SO_2 was received for 317 stations and adequate data for NO_2 was received for 316 stations. Adequate data for RSPM was received for 309 stations and adequate data for SPM was received for 297 monitoring stations. The detail of number of stations for which data was adequate or inadequate is given in Table II.I. Data of sixteen stations under State Ambient Air Quality Monitoring Programme (SAMP) were also included in analysis. The ambient air quality status with respect to annual mean concentration range for various parameters is given in Table II.II, ambient air quality status of various cities/towns in the country with respect to pollution levels (Low, Moderate, High and Critical) is presented in Table II.III

Table II.I Details of Monitoring Stations where Ambient Air Quality Monitoring was carried out during 2008

Area type	Number of monitoring stations							
	Adequate data				Inadequate data			
	SO_2	NO_2	RSPM	SPM	SO_2	NO_2	RSPM	SPM
Residential	191	191	187	181	12	12	16	13
Industrial	114	113	110	104	8	9	8	8
Sensitive	12	12	12	12	0	0	0	0
Total	**317**	**316**	**309**	**297**	**20**	**21**	**24**	**21**

Table II.II: Pollution Level Classification*

Pollution level*	Annual Mean Concentration Range (µg/m^3)				
	Industrial (I)			Residential (R)	
	SO_2 & NO_2	RSPM	SPM	SO_2, NO_2, & RSPM	SPM
Low (L)	0-40	0-60	0-180	0-30	0-70
Moderate (M)	41-80	61-120	181-360	31-60	71-140
High (H)	81-120	121-180	361-540	61-90	141-210
Critical (C)	>120	>180	>540	>90	>210

II.II Number of locations/monitoring stations with low, moderate, high and critical pollution levels

The analysis of four criteria pollutants with respect to National Ambient Air Quality Standards (NAAQS) during 2008 revealed that number of locations falling with respect to sulphur dioxide in low pollution levels category is 114, moderate category is 2 and there is no locations fall under high and critical levels in industrial area class if considered time weighted annual average concentrations. The 82 monitoring locations considering annual average concentrations of NO2 for industrial area class is falling in low category, 32 locations in moderate category, and only 2 locations in high levels whereas no critical category obtained. The number of monitoring locations considering annual average concentrations of RSPM for industrial area class fall in low category is 17, moderate category in 44 locations, high category in 31 locations and critical category in 24 locations of industrial area class of the country. The 35 locations considering annual average concentrations of SPM for industrial area class fall in low category, 49 numbers in moderate category, 23 numbers in high category whereas no critical category was found in industrial area class. The number of locations fall under four such category in industrial area class is depicted in Figure II.I. For residential area class 192 locations fall in low category with respect to Sulphur dioxide and 4 locations comes under moderate category whereas no high and critical levels were found. Locations with respect to NO2 falls under low category are 136, while 52 locations indicated moderate category and 8 locations indicated high pollution levels in residential areas whereas no critical levels obtained in residential areas. RSPM indicated only one location in low category, 30 locations in moderate category, 68 locations in high category and 98 locations in critical category of residential area class of the country. For residential area class detailing is depicted in Figure II.II

II.III Number of cities with low, moderate, high and critical pollution levels in the country

The analysis of four criteria pollutants with respect to National Ambient Air Quality Standards (NAAQS) during 2008 revealed that 80 cities falling with respect to Sulphur dioxide (SO_2) in low category and only one city fall under moderate category. Whereas no high and critical levels were found with respect to SO2 in industrial area class. Nitrogen dioxide pollution levels if considered time weighted annual average

concentrations indicated that low category in 65 cities and 15 cities fall under moderate category and only one city in high pollution levels of NO_2 in industrial areas. The RSPM in industrial area class indicated that 11 cities falls under low category, 34 cities in moderate category, 19 cities in high pollution levels category and 16 cities in critical category of industrial area class. The SPM showed 22 cities with low category, 38 cities with moderate category, 11 cities with high pollution level category and only one city indicated with critical category in industrial area class. The analysis for residential area class showed that 98 cities for Sulphur dioxide have low category and only 2 cities indicated only moderate category while no cities fall under high and critical category. The 76 locations considering time weighted annual average concentrations of NO_2 for residential area class, 22 cities fall under moderate category and only 2 cities showed high levels of pollution while no critical category was found. The RSPM in residential area class indicated that 2 cities in low category, 17 cities in moderate category, and 40 cities in high levels and 41cities in critical levels of RSPM pollution in residential area class. The suspended particulate matter (SPM) has indicated 3 cities in low category of pollution, 28 cities in moderate category, 32 cities in high level of pollution and 29 cities indicated critical levels of Suspended Particulate Matter (SPM) in residential area class. The number of cities with low, moderate, high and critical categories in industrial and residential area class are depicted in Figure II.III and II.IV respectively.

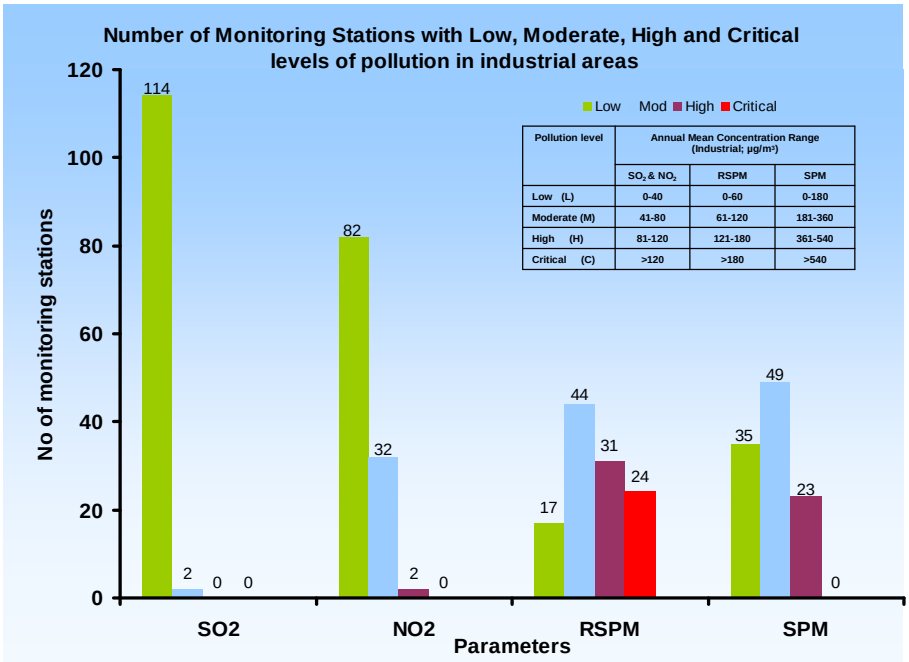

Fig. II.I : Number of locations with low, moderate, high and critical pollution levels in industrial areas

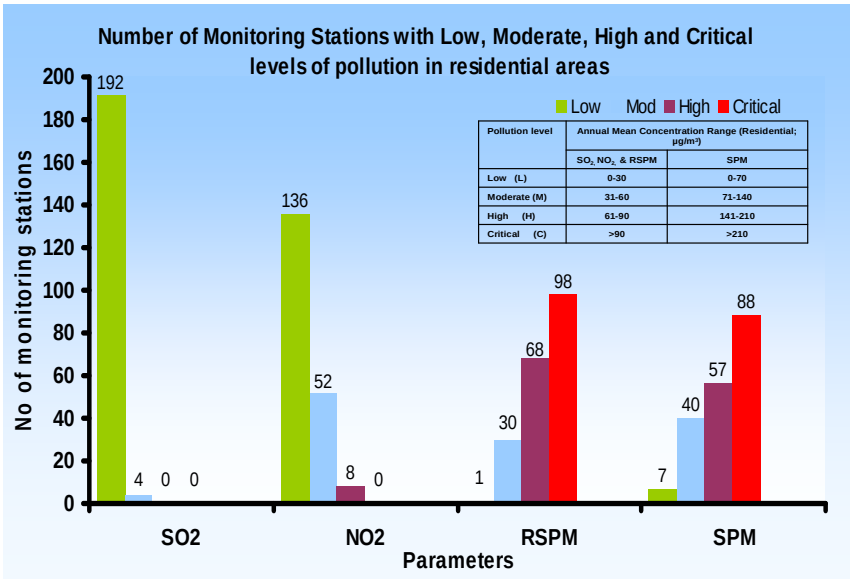

Fig. II.II: Number of locations with with low, moderate, high and critical pollution levels in residential areas

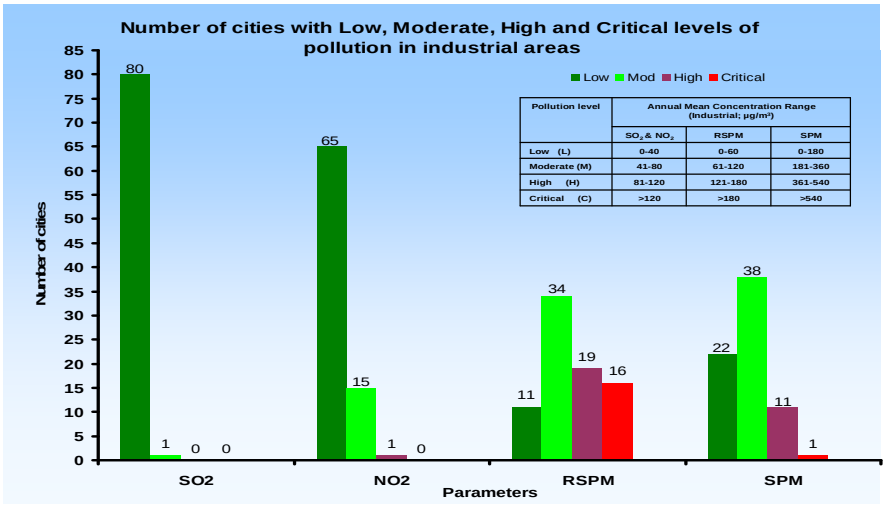

Fig. II.III: Number of Cities with low, moderate, high and critical pollution levels in industrial areas

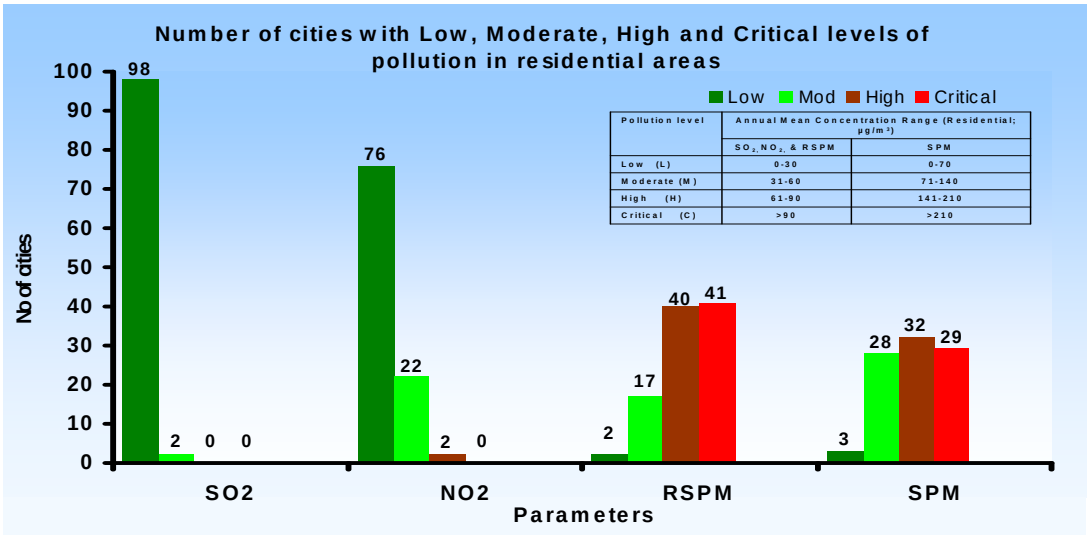

Fig. II.IV: Number of Cities with low, moderate, high and critical pollution levels in residential areas

Table II.III: City wise Ambient Air Quality for the year 2008 in terms of pollution level classification/categorization

(L: Low, M: Moderate, H: High, C: Critical)*

- **Pollution Level Classification**

STATE, UT / CITY	SO_2		NO_2		RSPM		SPM	
AREA CLASS	**I**	**R**	**I**	**R**	**I**	**R**	**I**	**R**
Andhra Pradesh								
Hyderabad	L	L	L	L	M	H	M	C
Visakhapatnam	L	L	L	M	M	H	L	H
Vijayawada	L	L	L	L	M	C	M	H
Ramagundum	-	L	-	L	-	H	-	C
Kurnool	-	L	-	L	-	H	-	H
Patencheru	-	L	-	L	-	C	-	C
Assam								
Guwahati	-	L	-	L	-	C	-	H
Bongaigaon	-	L	-	L	-	H	-	M
Tezpur	-	L	-	L	-	H	-	M
Dibrugarh	-	L	-	L	-	M	-	M
Sivasagar	-	L	-	L	-	H	-	M
Hailakandi	-	L	-	L	-	H	-	M
Bihar								
Patna	-	L	-	M	-	C	-	C
Chattisgarh								
Bhilai	L	L	L	L	H	H	M	H
Korba	-	L	-	L	-	C	-	C
Raipur	L	L	M	M	C	C	H	C
Chandigarh								
Chandigarh	L	L	L	L	H	H	M	M
Dadra & Nagar Haveli								

STATE, UT / CITY	SO_2		NO_2		RSPM		SPM	
AREA CLASS	**I**	**R**	**I**	**R**	**I**	**R**	**I**	**R**
Silvassa	L	L	L	L	M	H	M	H
Daman & Diu								
Daman	L	L	L	L	M	H	M	H
Delhi								
Delhi	L	L	M	M	C	C	H	H
Gujarat								
Ahmedabad	L	L	L	L	M	H	M	H
Ankleshwar	L	L	L	L	M	H	M	H
Jamnagar	-	L	-	L	-	C	-	H
Rajkot	L	L	L	L	M	H	M	H
Surat	L	L	L	L	M	H	M	H
Vadodara	L	L	M	L	M	M	M	H
Vapi	L	L	L	L	M	H	L	H
Goa								
Panjim	-	L	-	L	-	M	-	M
Vasco	L	-	L	-	L	-	L	-
Murmugao	L	-	L	-	L	-	L	-
Himachal Pradesh								
Damtal	-	L	-	L	-	M	-	M
Parwanoo	L	L	L	L	M	H	L	M
Paonta Sahib	L	L	L	L	H	C	M	H
Shimla	-	L	-	L	-	H	-	M
Baddi	L	-	L	-	H	-	M	-
Kala Amb	L	L	L	L	C	C	H	H
Haryana								
Faridabad	L	L	L	M	H	C	M	C
Jharkhand								
Dhanbad	-	L	-	M	-	C	-	H
Sindri	L	-	M	-	H	-	M	-
Jamshedpur	L	-	M	-	H	-	M	-
Ranchi	-	L	-	M	-	C	-	C
Karnataka								
Bangalore	L	L	M	M	M	H	M	H
Mysore	L	L	L	L	L	M	L	M
Hubli-Dharwad	L	L	L	L	M	C	M	C
Belgaum	L	-	L	-	L	-	L	-
Hassan	L	-	L	-	M	-	M	-
Mangalore	L	-	L	-	L	-	L	-
Kerala								
Kochi	L	L	L	L	M	M	L	M
Kottayam	L	L	L	L	L	M	L	L
Kozhikode	L	L	L	L	L	M	L	M
Thiruvananthapuram	L	L	L	L	M	M	L	L
Palakad	L	-	L	-	L	-	L	-
Maharashtra								
Mumbai	L	L	L	M	M	H	M	M
Chandrapur	L	L	M	M	H	H	M	M
Dombivali	L	-	M	-	M	-	-	-
Kolhapur	-	L	-	L	-	M	-	H
Nagpur	L	L	L	M	M	C	M	H
Nashik	L	L	L	L	M	H	L	H

STATE, UT / CITY	SO_2		NO_2		RSPM		SPM	
AREA CLASS	**I**	**R**	**I**	**R**	**I**	**R**	**I**	**R**
Pune	L	L	L	L	M	H	M	H
Solapur	L	L	L	M	M	H	M	C
Thane	L	L	L	L	L	M	L	M
Aurangabad	-	L	-	L	-	H	-	C
Navi Mumbai	L	L	M	M	H	C	M	C
Lote	L	L	L	L	M	H	L	H
Amravati	L	L	L	L	M	H	-	-
Madhya Pradesh								
Bhopal	-	L	-	L	-	C	-	C
Indore	L	L	L	L	C	C	M	H
Jabalpur	-	L	-	L	-	C	-	C
Nagda	L	L	L	L	M	C	L	M
Satna	L	L	L	L	C	C	H	H
Gwalior	-	L	-	L	-	C	-	C
Dewas	L	L	L	L	M	H	M	H
Ujjain	L	L	L	L	H	H	M	H
Meghalaya								
Shillong	-	L	-	L	-	M	-	L
Mizoram								
Aizwal	-	L	-	L	-	L	-	M
Nagaland								
Dimapur	-	L	-	L	-	H	-	M
Orissa								
Angul	L	L	L	L	H	H	M	H
Bhubaneshwar	-	L	-	L	-	H	-	H
Cuttack	-	L	-	L	-	H	-	C
Rourkela	-	L	-	L	-	C	-	H
Talcher	L	-	L	-	M	-	M	-
Rayagada	L	L	L	L	M	H	L	M
Sambalpur	-	L	-	L	-	M	-	M
Berhampur	-	L	-	L	-	H	-	H
Balasore	-	L	-	L	-	H		
Pondicherry								
Pondicherry	L	L	L	L	L	M	L	M
Punjab								
Gobindgarh	L	L	L	L	C	L	-	-
Jalandhar	L	L	L	L	H	C	-	-
Ludhiana	L	L	M	M	C	C	-	-
Naya Nangal	-	L	-	L	-	C	-	-
Amritsar	L	L	L	M	C	C	-	-
Khanna	L	L	M	M	C	C	-	-
Derabassi	L	-	L	-	C	-	-	-
Bhatinda	L	-	L	-	-	-	-	-
Rajasthan								
Alwar	L	L	L	M	H	C	H	C
Jaipur	L	L	L	M	H	C	M	C
Kota	L	L	L	L	H	C	M	C
Jodhpur	L	L	L	L	H	C	H	C
Tamil Nadu								
Chennai	L	L	L	L	M	M	L	M
Coimbatore	L	L	L	L	M	M	M	M
Madurai	L	L	L	L	L	M	L	M

STATE, UT / CITY	SO_2		NO_2		RSPM		SPM	
AREA CLASS	**I**	**R**	**I**	**R**	**I**	**R**	**I**	**R**
Salem	-	L	-	L	-	H	-	M
Tuticorin	L	M	L	L	H	H	M	M
Uttar Pradesh								
Anpara	L	-	L	-	C	-	C	-
Kanpur	L	L	L	L	C	C	H	C
Firozabad	L	L	L	L	C	C	H	C
Lucknow	L	L	L	M	C	C	H	C
Varanasi	-	L	-	L	-	C	-	C
Ghaziabad	L	-	L	-	C	-	H	-
Jhansi	-	L	-	L	-	C	-	C
Khurja	M	M	L	M	C	C	H	C
Meerut	-	L	-	M	-	C	-	C
West Bengal								
Asansol	L	-	M	-	H	-	M	-
Durgapur	L	L	M	M	H	H	M	M
Haldia	L	-	M	-	M	-	L	-
Howrah	L	L	H	H	M	C	M	C
Kolkata	L	L	M	H	M	C	M	C

II.IV Percent Violation of Criteria Pollutants

The percent locations violating national standards with respect to nitrogen dioxide (NO2), Respirable Particulate Matter (RSPM), and Suspended Particulate Matter (SPM) is depicted in Figure II.V. The percent locations violating with respect to NAAQS for NO2 in industrial area is 5% and in residential area is 14%. The percent locations violating with respect to NAAQS for RSPM in industrial area is 78% and in residential area is 87%. The percent locations violating with respect to NAAQS for SPM in industrial area is 43% and in residential area is 84%. The Sulphur dioxide (SO2) is not violating at any of the locations in the country. In sensitive areas the percentage violation indicated as 23%, 62%, 92% and 100% violation for SO2, NO2, RSPM and SPM respectively. Figure II.VI depicted combinedly violation with sentive area class with other classes. Number of monitoring stations violating NAAQS is presented in Table II.IV. 24 hourly average violation with respect to SO2 indicated very low numbers in residential area it shown 4 and in sensitive area 3 locations. Nitorgen Dioxide has indicated 31 locations violation in residnetial areas, 6 locations in industrial area and 9 location in sensitive area class. Out 342 location, 287 locations have indicated violations with respect to RSPM. 24 hoursly violation in resdentioanl class is 183, in industrial locations 93, and 11 locations for sensitive area class. SPM 24 hourly average at shown 175 locations in residential area and 48 location in industrial area class.

Table II.IV: Number of monitoring stations violating NAAQS
(Annual average and 24-hourly average)

Area Class	SO_2		NO_2		RSPM		SPM	
	24-Hourly	**Annual**	**24-Hourly**	**Annual**	**24-Hourly**	**Annual**	**24-Hourly**	**Annual**
Residential	4	-	31	8	183	166	175	145
Industrial	0	-	6	2	93	55	48	23
Sensitive	3	-	9	9	11	11	13	13
Total	**7**	**-**	**46**	**19**	**287**	**232**	**236**	**181**

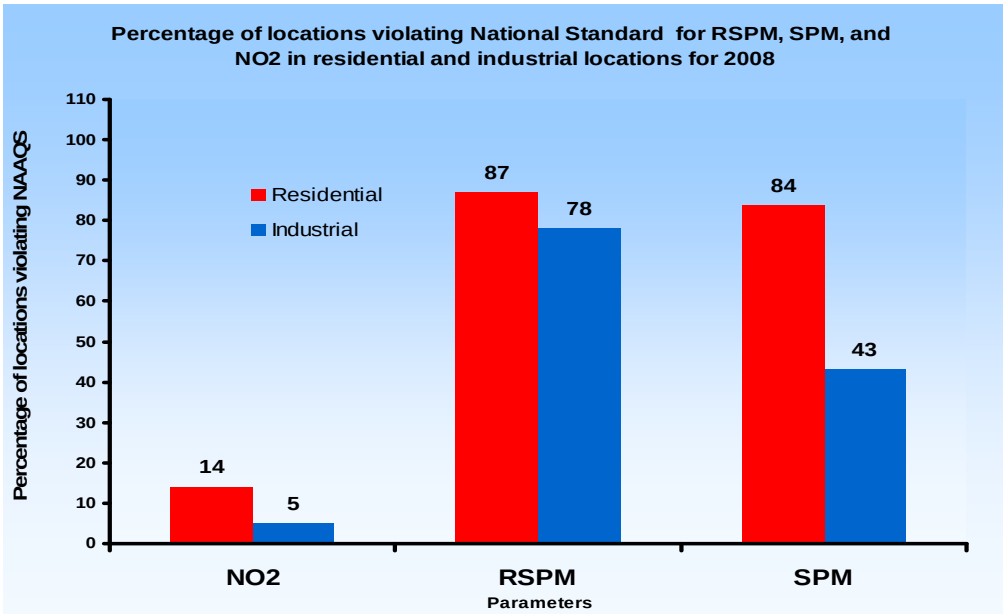

Fig. II.V: Percentage of locations violating National Ambient Air Quality Standards with respect to NO2, RSPM and SPM in residential and industrial areas

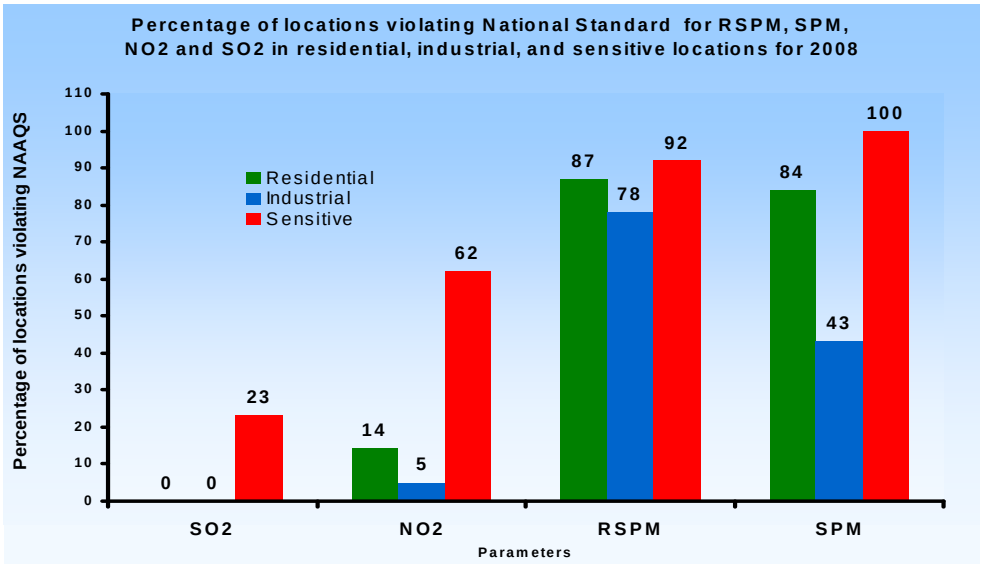

Fig. II.VI: Percentage of locations violating National Ambient Air Quality Standards with respect to SO2, NO2, RSPM and SPM in residential, industrial and sensitive areas

CHAPTER-II.I
Air Quality w.r.t. SULPHUR DIOXIDE (SO_2)

II.I.I General environmental concerns of Sulphur dioxide

SO_2 is formed when fuel containing sulfur is burned. Sulfur is prevalent in raw materials such as crude oil, coal, and ore that contain common metals like aluminum, copper, zinc, lead etc. Sulfur dioxides are emitted in significant quantities from thermal power plants, smelting process of sulfide ores to produce copper, lead and zinc and also from petroleum refining processes. The diesel driven vehicles are specific source of sulfur dioxide generated during combustion process. Sulfate particles, can be transported over long distances and deposited far from the sources. SO_2 in ambient air can also affect human health, particularly in those suffering from asthma and chronic lung diseases and exacerbates respiratory symptoms and impaired breathing in sensitive individuals. It also causes visibility impairment. It is considered more harmful when particulate and other pollution concentrations are high. SO2 also causes acid rain and aesthetic damage.

The summary of SO_2 levels in the country is detailed in this chapter. Summary is given in terms of number of monitoring stations in various ranges of annual average concentration and percentage violation. The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard). Air quality is described in terms of low, moderate, high and critical levels.

II.I.II Specific environmental concerns of Sulphur dioxide along with area type & annual average concentrations

Number of monitoring stations in residential and industrial areas in various ranges of annual average concentration is depicted in Figure II.I.I. National Ambient Air Quality Standard (NAAQS) (annual average) was not exceeded at any monitoring station in residential and industrial areas. SO_2 levels at 80% of the monitoring stations in industrial areas and 93% of the monitoring stations in residential areas were less than 20 $\mu g/m^3$. Table II.I.I and II.I.II shows top ten locations in terms of annual average concentration of sulphur dioxide in residential and industrial areas respectively. The highest concentration in residential area was observed at monitoring station located at Gram Panchayat, Ghugus Chandrapur, Maharashtra and highest concentration in industrial area was observed at monitoring station located at CGCRI, Khurja, Uttar Pradesh during 2008, although SO_2 levels at none of the monitoring stations exceeded the NAAQS (Annual average).

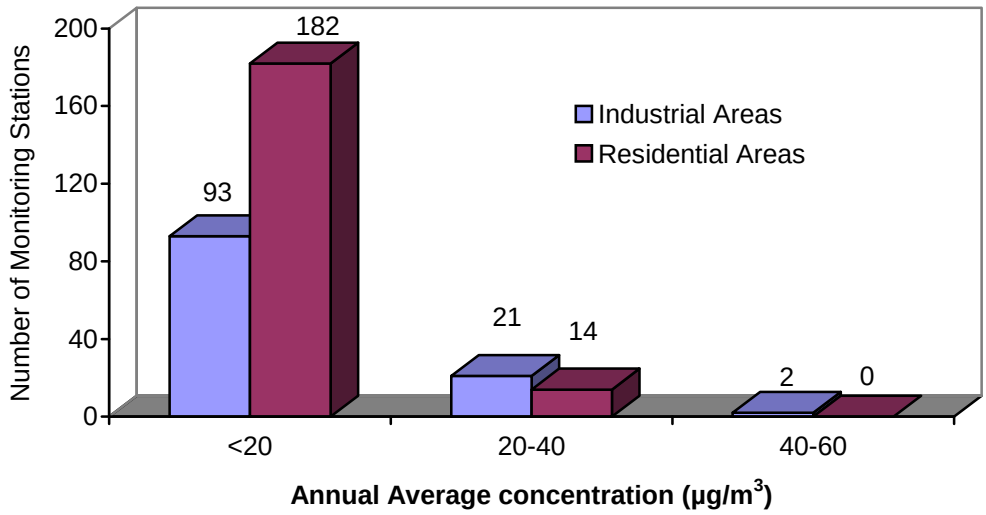

Fig II.I.I: Number of Monitoring Stations in various ranges of Annual Average Concentration of SO_2

Table II.I.I: Top ten locations with respect to Sulphur Dioxide during 2008 in residential areas.

Sl. No.	State	City	Location	Annual Average conc. (µg/m^3)
1	Maharashtra	Chandrapur	Gram Panchayat, Ghugus	40
2.	Uttar Pradesh	Khurja	Ahirpara	37
3.	Maharashtra	Nashik	NMC Building	33
4.	Tamil Nadu	Thoothukudi	Fisheries College	32
5.	Tamil Nadu	Thoothukudi	AVM Jewellery Bldg.	29
6	Maharashtra	Chandrapur	Nagar Parishad	27
7.	Uttaranchal	Dehradun	Clock Tower	27
8.	Maharashtra	Nashik	RTO Colony Tank	26
9.	Maharashtra	Lote	Chalke Wadi	25
10.	Maharashtra	Pune	Swargate	22

Table II.I.II: Top ten locations with respect to Sulphur Dioxide during 2008 in industrial areas.

S. No	State	City	Location	Annual Average conc. (µg/m^3)
1	Uttar Pradesh	Khurja	CGCRI	42
2.	Maharashtra	Greater Mumbai	Dombivalli MIDC	41
3.	Jharkhand	Jamshedpur	Bistupur Vehicle TC	38
4.	Maharashtra	Chandrapur	M.I.D.C.	37
5.	Jharkhand	Jamshedpur	Golmuri Vehical TC	36
6	Maharashtra	Greater Mumbai	Municipal Council	35
7.	Maharashtra	Tarapur	Police Chowki	31
8.	Maharashtra	Tarapur	Sports Stadium	31
9.	Maharashtra	Nashik	VIP Industrial Area	30
10.	Madhya Pradesh	Nagda	Chem. D. Labour Club	30

II.I.III Percentage Violation of NAAQS-24 Hourly Average

Number of monitoring stations in various ranges of percentage violation of NAAQS (24 hourly average) of SO_2 is depicted in Figure II.I.II. At all the monitoring stations in industrial areas and residential areas, the percentage violation of NAAQS (24 hourly average) was less than 2%.

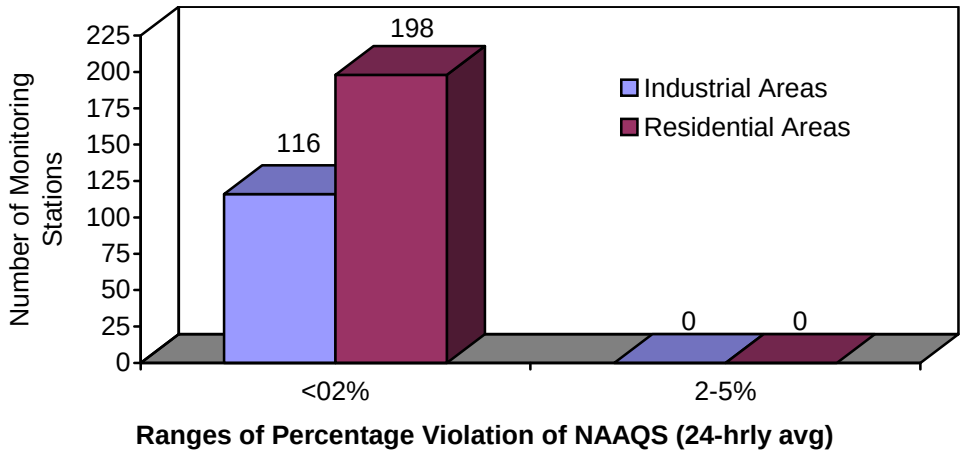

Figure II.I.II Number of Monitoring Stations in various ranges of Percentage Violation of NAAQS (24-hrly avg.) of SO_2

II.I.IV Air Quality with respect to SO_2 Pollution Levels-Low, Moderate, High & Critical

Number of monitoring stations with low and moderate levels of SO_2 is depicted in Figure II.I.III. SO_2 levels at all the monitoring stations in residential and industrial areas were low except at five monitoring stations in residential areas and three monitoring stations in industrial areas where moderate levels were observed. The NAAQS (Annual average) of SO_2 was not exceeded at any of the monitoring stations in residential and industrial areas during 2008.

The annual average concentration of SO_2 at various monitoring stations is given in Table II.I.III. The data given is annual average concentration and number of observations with 16 and more hours of monitoring a day. Also, described in the table is air quality in terms of low, moderate, high and critical. SO_2 levels at all the monitoring stations are within the prescribed NAAQS. Also, at almost all the stations low levels of SO_2 were observed.

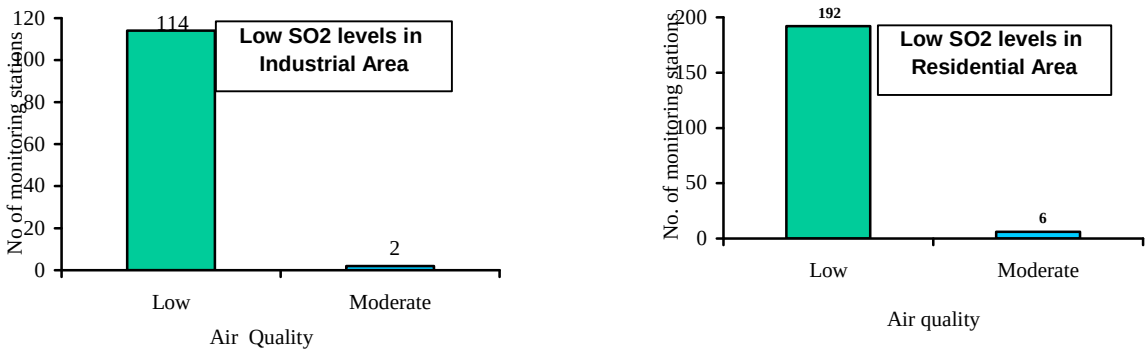

Figure II.I.III: SO_2 levels in different Area Type (Viz. Residential and Industrial)

Table II.I.III: Summary of SO_2 levels of Ambient Air Quality Stations under NAMP during 2008

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
Andhra Pradesh	Hyderabad	C.I.T.D. Balanagar	I	6	110	L	0
		Nacharam	I	BDL	92	L	0
		Uppal	I	6	108	L	0
		ABIDS Circle	R	6	89	L	0
		Charminar	R	6	107	L	1
		Jubilee Hills	R	5	108	L	0
		Paradise	R	6	108	L	0
		Tarnaka	R	4	96	L	0
		Zoo Park	S	5	107	L	0
	Kurnool	Mourya Inn	R	4	107	L	0
	Patencheru	Police Station	R	11	105	L	0
	Ramagundam	RTC Bus Depot	R	4	100	L	0
	Tirupati	Reg.Science Center	S	4	116	L	0
	Vijaywada	Autonagar	I	6	110	L	0
		Benz Circle	R	5	110	L	0
	Visakhapatnam	Industrial Estate	I	10	112	L	0
		Ganapuram Area	R	11	112	L	0
		Mndi	R	8	111	L	0
		Police Barracks	R	12	113	L	0
		Seethammadhara	R	10	112	L	0
		Naval Area/ ESI Hospital	S	11	112	M	4
Assam	Bongaigaon	Barpara Office Bldg	R	5	106	L	0
		Campus of Oil India	R	5	105	L	0
	Dibrugarh	Dibrugarh Off. Bldg	R	5	96	L	0
	Golaghat	Golaghat Off. Bldg.	R	4	43	L	0
	Guwahati	Fire Brigade Station	R	9	92	L	0
		ITI Building Gopinath Nagar	R	7	211	L	0
		Bamunimaidan Head Office	R	9	93	L	0
		Near Pragiyotish College	R	7	225	L	0
	Hailakandi	CISF Campus	R	6	61	L	0
	Sibsagar	Sibasagar Off. Bldg	R	5	57	L	0
	Tezpur	Tezpur Office Bldg	R	5	91	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
Bihar	Patna	Beltron Bhawan	R	6	61	L	0
		Gandhi Maidan T C	R	8	50	L	0
Chandigarh	Chandigarh	Industrial Area	I	BDL	153	L	0
		Kaimbwala Village	R	BDL	152	L	0
		Punjab Eng College	R	BDL	151	L	0
		Sector-17 C	R	BDL	154	L	0
		IMTECH, Sector-39	R	BDL	153	L	0
Chhattisgarh	Bhilai Nagar	M.P.L.U. Nigam	I	26	77	L	0
		Regional Office	R	6	76	L	0
		Visak Hostel	R	21	79	L	0
	Korba	I.T.I, Rampur	R	14	102	L	0
		HIG 21,22, MP Nagar (Extn)	R	13	109	L	0
		Pragati Nagar	R	13	89	L	0
	Raipur	Wool Worth I.Pvt.Ltd	I	17	60	L	0
		New HIG - 9, Hirapur	R	20	62	L	0
		Yatayat Thana	R	19	44	L	0
Dadra & Nagar Haveli	Silvasa	Khadoli Industrial Area	I	10	104	L	0
		Chetan Guest House	R	10	104	L	0
Daman & Diu	Daman	Kadaiya	I	10	104	L	0
		Airport Road	R	9	102	L	0
Delhi	Delhi	Mayapuri Indl. Area	I	13	96	L	0
		Shahdara	I	5	75	L	0
		Shahzada Bagh	I	6	68	L	0
		Janakpuri	R	5	77	L	0
		N.Y. School	R	5	79	L	0
		Nizamuddin	R	5	66	L	0
		Pitampura	R	5	69	L	0
		Siri Fort	R	5	75	L	0
		Town Hall	R	10	96	L	0
Goa	Mormugao	Mormugao Port Trust	I	BDL	101	L	0
	Panaji	Patto, Panaji	R	BDL	104	L	0
	Vasco	Electricity Deptt.	I	BDL	100	L	0
Gujarat	Ahmedabad	Naroda	I	13	104	L	0
		Shardaban Hospital	I	12	97	L	0
		Cadilla Bridge Narol	R	13	105	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Behrampura	R	12	104	L	0
		L.D. Eng. College	R	12	104	L	0
		R.C. High School	R	12	102	L	0
	Anklesvar	Rallies India Ltd	I	22	104	L	0
		Durga Traders	R	16	105	L	0
	Jamnagar	Fisheries Office	R	10	104	L	0
	Rajkot	Sardhara Indl.Corp.	I	11	104	L	0
		Regional Office	R	10	102	L	0
	Surat	Udhna	I	21	103	L	0
		Near A.I. Office	R	18	104	L	0
		S.V.R. Eng. College	R	14	103	L	0
	Vadodara	CETP	I	19	104	L	0
		Dandia Bazar	R	13	105	L	0
		GPCB Office	R	9	104	L	0
	Vapi	GEB	I	19	105	L	0
		Vapi Nagar Palika	R	14	106	L	0
Haryana	Hisar	Guru Jambeshwar Uni	R	7	44	L	0
		Urban Estate-II	R	8	43	L	0
	Yamunanagar	Ballarpur Industries	I	17	18	-	0
	Faridabad	Regional Office	R	13	90	L	0
		M/s Shivalik Global Ltd	I	13	64	L	0
Himachal Pradesh	Baddi	AHC	I	BDL	11	-	0
		Industry Department	I	BDL	143	L	0
		Housing Board	R	BDL	13	-	0
	Damtal	Old Road	R	BDL	66	L	0
		Regional Office	R	BDL	80	L	0
	Kala- Amb	Industrial Area	I	BDL	146	L	0
		Trilok Pur	R	BDL	155	L	0
	Nalagarh	M.C.	R	BDL	11	-	0
	Paonta Sahib	Gondpur Indl. Area	I	BDL	120	L	0
		Paonta Sahib	R	BDL	145	L	0
	Parwanoo	AC Office Bldg.	I	BDL	105	L	0
		Central Laboratory	R	BDL	112	L	0
	Shimla	Bus Stand	R	BDL	114	L	0
		Tekka Bench Ridge	S	BDL	130	L	0
Jharkhand	Dhanbad	Regional Office	R	19	91	L	0
	Jamshedpur	Bistupur Vehicle TC	I	38	92	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Golmuri Vehical TC	I	36	93	L	0
	Jharia	M.A.D.A.	I	19	43	-	0
	Ranchi	Albert Ekka Chowk	R	18	90	L	0
	Sindri	PDIL	I	18	82	L	0
Karnataka	Bangalore	Graphite India	I	16	78	L	0
		KHB Indl Area	I	15	120	L	0
		Peenya Indl. Area	I	15	92	L	0
		AMCO Batteries	R	15	102	L	0
		Yeshwanthpura	R	15	105	L	0
		Victoria Hospital	S	15	104	M	0
	Belgaum	Karnataka SPCB	I	BDL	100	L	0
	Gulbarga	Govt. Hospital	S	BDL	94	L	0
	Hassan	KSRTC Bus Stand	R	4	107	L	0
	Hubli-Dharwad	L. Industrial Area	I	BDL	80	L	0
		Rani C. Circle	R	BDL	95	L	0
	Mangalore	Baikampady Indl. Area	I	7	105	L	0
	Mysore	K.R. Circle	R	16	103	L	0
		Hebbal Industrial Area	I	15	95	L	0
Kerala	Kochi	Eloor	I	4	91	L	0
		Kalamassery	I	BDL	84	L	0
		Irumpanam	I	4	107	L	0
		Eloor II	I	4	94	L	0
		Ernakulum South	R	4	108	L	0
		FCI, OEN C. O. Bldg	R	5	62	L	0
		M.G. Road	R	5	101	L	0
	Kottayam	Vadavathoor	I	6	96	L	0
		Kottayam	R	6	97	L	0
	Kozhikode	Nallalam	I	BDL	108	L	0
		Kozhikode City	R	BDL	107	L	0
	Palakkad	SEPR Refractories India Ltd. Kanjikode	I	3	102	L	0
	Trivandrum	Hi Tech Chackai	I	18	100	L	0
		PRS Hospital	S	7	101	L	0
		Sasthamangalam	R	6	96	L	0
		SMV School	R	7	101	L	0
	Aurangabad (MS)	C.A.D.A. Office	R	9	95	L	0
		S.B.E.S. College	R	9	94	L	0
		Bibi-Ka-Maqbara	S	7	90	L	0
	Amravati						
		Apurva Oil and	I	10	94	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
Maharashtra		Ind.					
		Govt. Coll. of Engg.	R	7	99	L	0
		Rajkamal Square	R	12	95	L	0
	Chandrapur	M.I.D.C.	I	37	83	L	0
		Nagar Parishad	R	27	87	L	0
		SRO, Bapat Nagar	R	38	86	M	0
	Greater Mumbai	Dombivalli MIDC	I	41	50	M	0
		Municipal Council	I	35	51	L	0
	Kolhapur	Mahadwar Road	R	11	103	L	0
		Ruikar Trust Dabhlkar Corner	R	16	101	L	0
		Shivaji University	R	8	66	L	0
	Lote	MIDC WTP	I	25	52	L	0
		Chalke Wadi	R	25	52	L	0
	Mumbai	Parel	I	7	98	L	0
		Kalbadevi	R	11	93	L	0
		Worli	R	8	99	L	0
	Nagpur	Hingna Road	I	9	96	L	0
		MIDC Office	I	10	89	L	0
		Govt. Poly. College	R	9	79	L	0
		Institution of Eng.	R	9	93	L	0
		Maskasath	R	7	89	L	0
		NEERI Lab	R	6	94	L	0
	Nashik	VIP Industrial Area	I	30	100	L	0
		NMC Building	R	33	105	M	0
		RTO Colony Tank	R	26	96	L	0
	Navi Mumbai	MIDC Taloja	I	25	96	L	0
		MPCB Central Lab	I	22	84	L	0
		Airoli	R	15	104	L	0
		MESB Power Station	R	12	101	L	0
		Nerul	R	19	112	L	1
		Panvel Water Works	R	15	100	L	1
	Pune	Bhosari	I	23	99	L	0
		Nalstop	R	21	103	L	0
		Swargate	R	22	100	L	0
	Solapur	WIT Campus	I	17	105	L	0
		Voronoko Primary School	R	18	104	L	0
	Tarapur						
		MIDC Office	I	29	34	-	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Compound					
		Police Chowki	I	31	35	-	0
		Sports Stadium	I	31	36	-	0
	Thane	Balkum/Kolshet	I	14	94	L	0
		Kopri	R	11	101	L	0
		Naupada	R	11	99	L	0
	Amravati	Govt. college	R	7	99	L	0
		Apurva oil & industries	I	10	94		0
		Rajkamal	R	12	95	L	0
Manipur	Imphal	Secretariat Building	R	BDL	20	-	0
Meghalaya	Shillong	Boards Office	R	BDL	87	L	0
		MUDA Complex , Police Bazar	R	BDL	36	-	0
Mizoram	Aizawl	Bawngkawn	R	BDL	102	L	0
		Khatla	R	BDL	104	L	0
		Laipuitlang	R	BDL	103	L	0
Madhya Pradesh	Bhopal	Govindpura	I	7	42	-	0
		Arera Colony	R	BDL	54	L	0
		Hamidia Road	R	9	46	L	0
		T.T.Nagar	R	5	50	L	0
	Dewas	EID Perry (I) Ltd.	I	20	94	L	0
		Vikas Nagar	R	15	87	L	0
	Gwalior	Dindayal Nagar	R	8	81	L	0
		Maharaj Bada	R	9	24	-	0
	Indore	Polo Ground	I	12	87	L	0
		Kothari Market	R	12	85	L	0
		Scheme No. 78	R	6	93	L	0
	Jabalpur	Vijay Nagar	R	BDL	91	L	0
	Nagda	Chem. D. Labour Club	I	30	72	L	0
		Grasim Guest House No.2	R	18	86	L	0
		Grasim Kalyan Kendra	R	22	83	L	0
	Sagar	Pt. Deendayal Nagar	R	3	98	L	0
	Satna	Sub-Divisional Off.	I	4	70	L	0
		Regional Office	R	BDL	68	L	0
	Ujjain	District Office	I	15	97	L	0
		Regional Office	R	7	81	L	0
		Mahakal Temple	S	12	74	M	0
Nagaland	Dimapur	Bank Colony	R	BDL	99	L	0
		Dhobinala	R	BDL	99	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
Orissa	Angul	Industrial Estate	I	6	95	L	0
		NALCO Township	R	8	58	L	0
	Berhampur	Regional Office	R	BDL	104	L	0
	Bhubaneshwar	OSPCB Bldg	R	BDL	108	L	0
		Capital Police Stn.	R	BDL	101	L	0
		IRC Village	R	BDL	101	L	0
	Cuttack	Roof of Traffic Tower Cuttack	R	BDL	104	L	0
		R.O. Cuttack	R	BDL	86	L	0
	Rayagada	Jaykaypur	I	BDL	103	L	0
		Regional Office	R	BDL	107	L	0
	Rourkela	IDL Police Out-post	R	6	105	L	0
		Regional Office	R	5	104	L	0
	Sambalpur	PHD Ofice, Sambalpur	R	3	110	L	0
	Talcher	Coal Field Area	I	14	94	L	0
		T.T.P.S Colony	I	10	96	L	0
Punjab	Gobindgarh	Raj Steel	I	11	132	L	0
		Rolling Mills	R	11	131	L	0
	Jalandhar	Focal Point	I	14	70	L	0
		M/s Gee Kay International	I	13	72	L	0
		MC Tube Well No.27	R	13	51	L	0
		Regional Office	R	10	78	L	0
	Amritsar	Nagina Soap Factory	I	15	79	L	0
		A-1 Platters	R	15	57	L	0
	Bathinda	Bathinda Milk Plant	I	8	88	L	0
	Dera Bassi	M/s Punjab Chemicals Ltd.	I	8	131	L	0
		Winsome Yarns Ltd	I	8	129	L	0
	Khanna	Markfed Vanaspati	I	10	123	L	0
		A S School	R	9	127	L	0
	Ludhiana	Milk Plant	I	9	130	L	0
		Rita Sewing Machines	I	11	119	L	0
		Vishwakarma Chowk	R	9	128	L	0
		PPCB Office Bldg.	R	10	112	L	0
	Naya Nangal	NFL Guest House	R	8	108	L	0
		Punjab Alkalies	R	8	114	L	0
Pondicherry	Pondicherry	PIPDIC	I	6	62	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Chamber of Commerce	R	3	84	L	0
		DSTC Office	R	5	68	L	0
Rajasthan	Alwar	Vitage Distillers Ltd.	I	8	98	L	0
		RIICO Pump House	I	8	102	L	0
		Regional Office	R	8	103	L	0
	Jaipur	MIA	I	6	106	L	0
		VKIA	I	7	108	L	0
		Ajmeri Gate	R	6	99	L	0
		Chandpole	R	7	105	L	0
		RSPCB Office	R	5	123	L	0
		Vidyadhar Nagar	R	6	108	L	0
	Jodhpur	Basni Indl. Area	I	7	91	L	0
		DIC Office, Industrial Estate	I	7	104	L	0
		M M Police Thane	R	6	99	L	0
		Sojati Gate	R	7	97	L	0
		Housing Board	R	5	103	L	0
		Shastri Nagar	R	7	90	L	0
	Kota	Regional Office	I	10	105	L	0
		Municipal C. Bldg	R	9	104	L	0
		KVK Bhorkhara	R	8	101	L	0
	Udaipur	Regional Office, MIA	I	8	103	L	0
		Ambamata	R	6	104	L	0
		Town Hall	R	6	105	L	0
Tamil Nadu	Chennai	Manali	I	14	91	L	0
		Kathivakkam	I	13	90	L	0
		M C Thiruvottiyur	I	5	71	L	0
		Thiruvottiyur	I	13	113	L	0
		Madras Med. College	R	6	80	L	0
		NEERI CSIR Campus	R	6	93	L	0
	Coimbatore	SIDCO Office	I	7	91	L	0
		Dist. Coll. Office	R	6	92	L	0
		Ponniyarajapuram	R	5	89	L	0
	Madurai	Fenners (I) Ltd.	I	11	92	L	0
		Highway Bldg.	R	9	87	L	0
		Kunnathur Chatram	R	10	96	L	0
	Salem	Sowdeswari College	R	8	128	L	0
	Thoothukudi	Raja Agencies	I	28	89	L	0
		AVM Jewellery	R	29	95	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Bldg.					
		Fisheries College	R	32	93	M	1
Uttar Pradesh	Agra	Nunhai	I	10	69	L	0
		Regional Office	R	9	106	L	0
		DIC, Nunhai	S	4	97	L	0
		Itmad-ud-daulah	S	5	108	L	1
		Rambagh	S	4	105	L	0
		Taj Mahal	S	5	230	L	3
	Anpara	Anpara Colony	I	18	97	L	0
		Renusagar Colony	I	19	100	L	0
	Allahabad	Bharat Yantra Nigam	R	6	99	L	0
		Square Crossing	R	10	101	L	0
	Firozabad	CDGI	I	25	95	L	0
		Raza Ka Tal	R	22	88	L	0
		Tilak Nagar	R	20	93	L	0
	Ghaziabad	Atlas Cycles Ltd	I	22	68	L	0
		Bulandshahar R.I.A.	I	19	55	L	0
	Jhansi	Jail Chauraha	R	9	103	L	0
		Veeranga Nagar	R	8	100	L	0
	Kanpur	Fazal Ganj	I	7	80	L	0
		Jajmau	I	7	94	L	0
		Sharda nagar	R	7	80	L	0
		Deputy Ka Parao	R	7	94	L	0
		Kidwai nagar	R	7	90	L	0
	Khurja	CGCRI	I	42	57	M	0
		Ahirpara	R	37	55	M	0
	Lucknow	Talkatora	I	9	96	L	0
		Aminabad	R	8	92	L	0
		Aliganj	R	8	94	L	0
		Kapoor Hotel	R	8	100	L	0
		Mahanagar	R	8	87	L	0
	Meerut	Begum Bridge	R	11	56	L	0
		Thana Railway Road	R	9	66	L	0
	Noida	GEE-PEE	I	11	94	L	0
		R.O, UPPB	R	11	95	L	0
	Varanasi	Regional Office	R	16	66	L	0
		Sigra	R	16	82	L	0
Uttaranchal	Dehradun	Raipur Road	I	20	13	-	0
		Clock Tower	R	27	39	-	0
West Bengal	Asansol	Asansol M.C.	I	9	104	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
	Durgapur (WB)	Dew India Ltd	I	11	104	L	0
		Kwality Hotel	I	9	104	L	0
		PCBL Club	R	5	104	L	0
	Haldia	Super Market	I	9	104	L	0
		WBIIDC	I	10	104	L	0
	Howrah	Bandhaghat	I	15	104	L	0
		Howrah MC	I	8	104	L	0
		Bator	R	6	104	L	0
		Naskarpara	R	12	104	L	0
	Kolkata	Behala Chowrasta	I	8	78	L	0
		Cossipore Police Stn	I	12	97	L	0
		Dunlop Bridge	I	6	78	L	0
		Baishnabghata	R	5	76	L	0
		Kasba	R	9	96	L	0
		Lal Bazar	R	10	96	L	0
		Minto Park	R	6	79	L	0
		Moulali	R	7	76	L	0
		Salt Lake	R	6	78	L	0

Note:
R – Residential and other areas, I – Industrial area, S – Sensitive Areas, Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for n $\geq$ 50 days), % violation – percentage violation of NAAQS (24 hourly average) BDL = Below Detection Limit (Concentration less than 4 $\mu g/m^3$ for SO_2).

CHAPTER- II.II
Air Quality w.r.t. NITROGEN DIOXIDE (NO_2)

II.II.I General environmental concerns of nitrogen dioxide

Oxides of nitrogen are a generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts. Nitrogen oxides are formed during combustion processes at high temperatures from the oxidation of nitrogen in air. The major types of oxides of nitrogen are nitric oxide (NO) and nitrogen dioxide (NO_2). They are collectively known as NOx. Nitrogen dioxide (NO_2) along with particulates is seen as a reddish brown layer over urban areas. Sources of nitrogen oxides includes vehicles, industrial processes that burn fuel. Oxides of nitrogen react with Volatile Organic Compounds (VOCs) to form ground level ozone. They also react to form nitrates, acid aerosols. Almost all NO_x is emitted as NO, which is rapidly oxidized to more toxic NO_2. They also contribute to nutrient overload that deteriorates water quality. Oxides of nitrogen are immunotoxic and increase the susceptibility to respiratory tract infection such as influenza. Continued or frequent exposures to high concentrations of NOx in breathing air may cause irritation of the lungs and consequent acute respiratory illness. In addition, NO_x is a potent and selective vasodilator in pulmonary arterial hypertension.

II.II.II Specific environmental concerns of Nitrogen dioxide along with area type & annual average concentrations

The summary of NO_2 levels in the country is detailed in this chapter. Summary is given in terms of number of monitoring stations in various ranges of annual average concentration and percentage violation. The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard. Air quality is described in terms of low, moderate, high and critical levels.

Number of monitoring stations in residential and industrial areas in various ranges of annual average concentration is depicted in Figure II.II.I. NO_2 levels at nine monitoring stations exceeded the National Ambient Air Quality Standard (NAAQS) (annual average) in residential areas and NO_2 level at two monitoring stations in industrial areas exceeded NAAQS (Annual average). The nine monitoring stations in residential areas are located at Town Hall, N.Y. School, Delhi, Moulali, Minto Park, Lal Bazar, Salt lake in Kolkata, West Bengal, Bator and Nasakpara in Howrah, West Bengal and one location at SRO Bapat Nagar in Chandrapur, Maharashtra and one location at PCBL Club, Durgapur West Bengal. Two monitoring stations in industrial areas where NAAQS (Annual average) was exceeded are located at Bandhaghat, Howrah and Dew India Ltd., Durgapur, West Bengal. NO_2 levels at remaining monitoring stations were less than the NAAQS (Annual Average) during 2008. NO_2 levels at 71% of the monitoring stations in industrial areas and 81% of the monitoring stations in residential areas were less than 40 $\mu g/m^3$. Table II.II.I and Table II.II.II show top

ten locations in terms of annual average concentration of nitrogen dioxide in residential and industrial areas respectively. The highest concentration in residential area was observed at monitoring station located at Town Hall, Delhi and highest concentration in industrial area was observed at monitoring station located at Bandhaghat, Howrah during 2008.

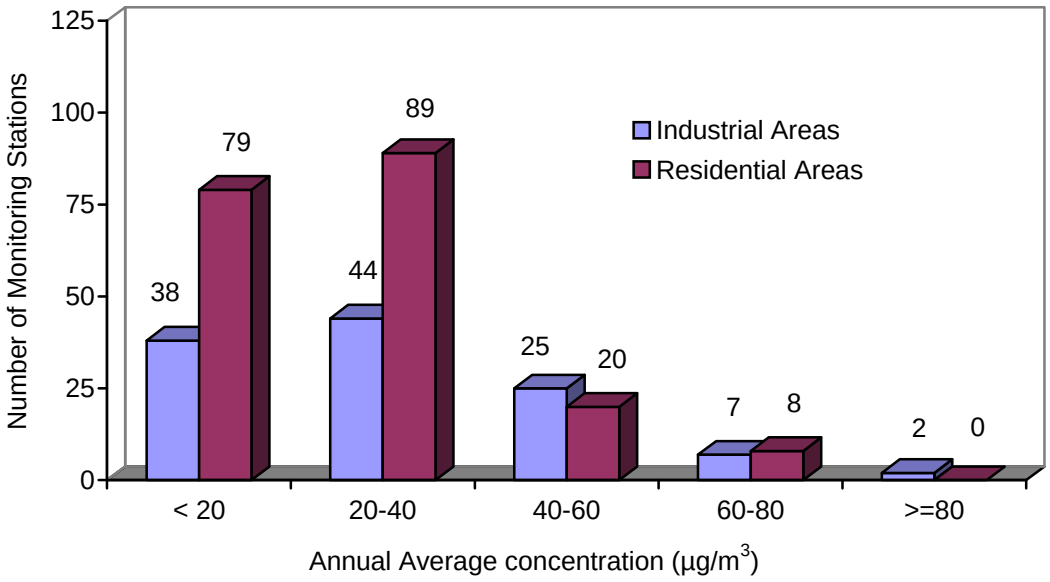

Fig. II.II.I: Number of Monitoring Stations in various ranges of Annual Average Concentration of NO_2

Table II.II.I: Top ten locations with respect to Nitrogen Dioxide during 2008 in residential areas.

Sl. No.	State	City	Location detail	Annual Average conc. (µg/m3)
1.	Delhi	Delhi	Town Hall	77*
2.	West Bengal	Kolkata	Moulali	76*
3.	West Bengal	Howrah	Naskarpara	73*
4.	Delhi	Delhi	N.Y. School	69*
5.	West Bengal	Kolkata	Lal Bazar	69*
6.	West Bengal	Kolkata	Minto Park	68*
7.	West Bengal	Kolkata	Salt Lake	64*
8.	West Bengal	Howrah	Bator	61*
9.	Maharashtra	Chandrapur	SRO, Bapat Nagar	60*
10.	West Bengal	Durgapur (WB)	PCBL Club	59

* - Locations where annual mean concentration of NO_2 exceeded the NAAQS of 60 µg/m^3 for Residential areas.

Table II.II.II: Top ten locations wrt Nitrogen Dioxide during 2008 in industrial areas

Sl. No.	State	City	Location	Annual Average conc. (µg/m^3)
1.	West Bengal	Howrah	Bandhaghat	91*
2.	West Bengal	Durgapur (WB)	Dew India Ltd	82*
3.	West Bengal	Kolkata	Behala Chowrasta	75
4.	Delhi	Delhi	Mayapuri Indl. Area	75
5.	West Bengal	Durgapur (WB)	Kwality Hotel	74
6.	West Bengal	Asansol	Asansol M.C.	74
7.	West Bengal	Howrah	Howrah MC	74
8.	West Bengal	Kolkata	Cossipore Police Stn	65
9.	West Bengal	Kolkata	Dunlop Bridge	63
10	Delhi	Delhi	Shahdara	58

* - Locations where annual mean concentration of NO_2 exceeded the NAAQS of 80 µg/m^3 for Industrial areas.

II.II.III Percentage Violation of NAAQS (24 Hourly Average)

Number of monitoring stations in various ranges of percentage violation of NAAQS (24 hourly average) of NO_2 is depicted in Figure II.II.II. In industrial areas, the percentage violation of NAAQS (24 hourly Avg.) was equal to or more than 2% at five monitoring stations. In residential areas, the percentage violation of NAAQS (24 hourly Avg.) was equal to more than 2% at twenty five monitoring stations.

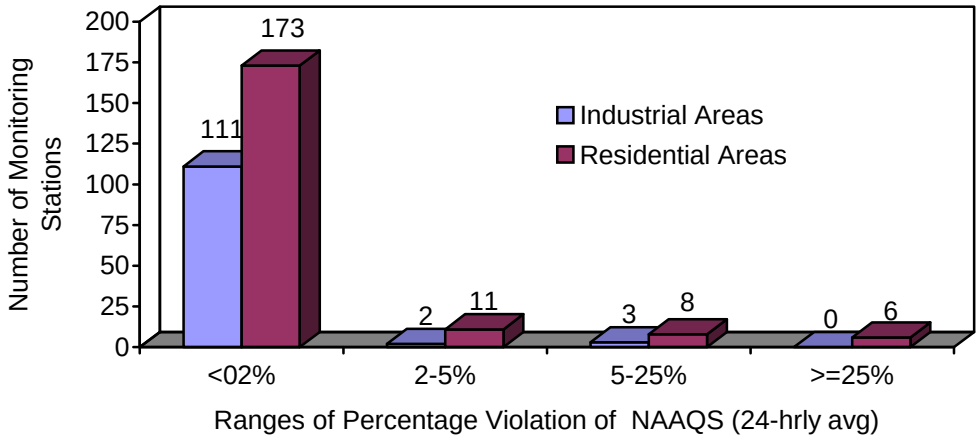

Figure II.II.II Number of Monitoring Stations in various ranges of Percentage Violation (various ranges) of NAAQS (24-hrly avg.) of NO_2

II.II.IV Air Quality with respect to NO_2 Pollution Levels-Low, Moderate, High & Critical

Number of monitoring stations with low, moderate and high levels of NO_2 is depicted in Figure II.II.III. NO_2 levels at 72 % of the monitoring stations in industrial areas and 70% of the monitoring stations in residential areas were low. High levels of NO_2 were observed at Town Hall, Sarojini Nagar, Delhi, Moulali, Minto Park, LalBazar, Salt Lake in Kolkata, Nasakpara and Bator in Haora and SRO Bapat Nagar, Chandrapur, Maharashtra. High levels of NO_2 were also observed at two monitoring station in industrial areas located at Bandhaghat, Howrah and Dew India Ltd., Durgapur, West Bengal.

The annual average concentration of NO_2 at various monitoring stations is given in Table II.II.III. The data given in table is annual average concentration and number of observations with 16 and more hours of monitoring a day. Also, described in the table is air quality in terms of low, moderate, high and critical. NO_2 levels at most of the monitoring stations were within the prescribed NAAQS. Also, at most of the monitoring stations low levels were observed.

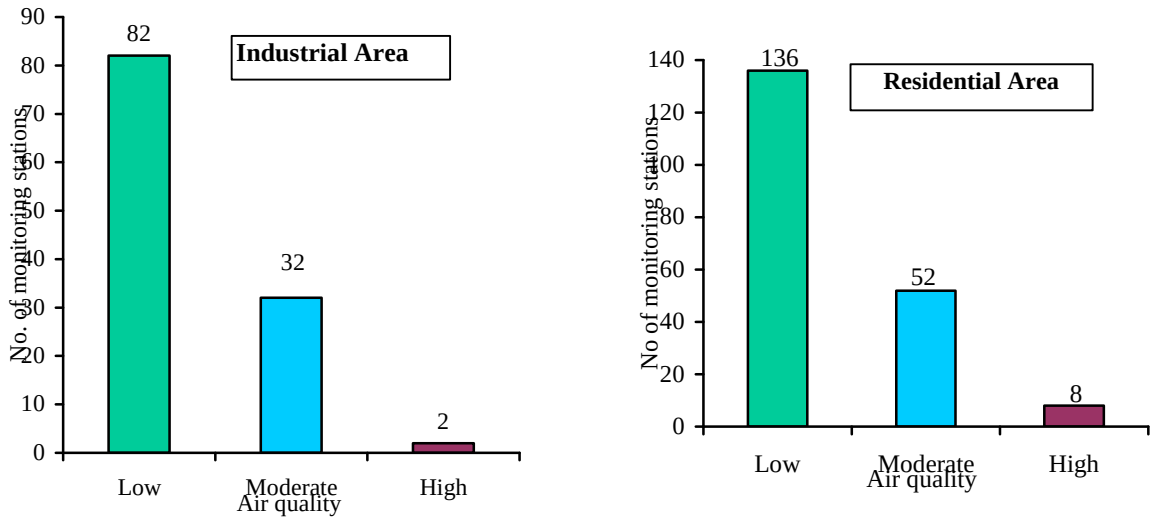

Figure II.II.III: Number of Monitoring Stations with Low, Moderate, High and Critical levels of Nitrogen Dioxide.

Table II.II.III: Summary of NO_2 levels of Ambient Air Quality Stations under NAMP during 2008

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
Andhra Pradesh	Hyderabad	C.I.T.D. Balanagar	I	33	110	L	0
		Nacharam	I	17	92	L	0
		Uppal	I	32	108	L	0
		ABIDS Circle	R	31	89	M	7
		Charminar	R	34	107	M	2
		Jubilee Hills	R	16	108	L	0
		Paradise	R	34	108	M	1
		Tarnaka	R	22	96	L	3
		Zoo Park	S	17	107	H	0
	Kurnool	Mourya Inn	R	11	106	L	0
	Patencheru	Police Station	R	24	105	L	0
	Ramagundam	RTC Bus Depot	R	18	100	L	0
	Tirupati	Reg.Science Center	S	9	116	M	0
	Vijaywada	Autonagar	I	30	110	L	0
		Benz Circle	R	26	110	L	0
	Visakhapatnam	Industrial Estate	I	28	112	L	0
		Ganapuram Area	R	33	112	M	0
		Mndi	R	27	111	L	1
		Police Barracks	R	32	113	M	0
		Seethammadhara	R	31	112	M	2
		Naval Area/ ESI Hospital	S	28	112	C	57
Assam	Bongaigaon	Barpara Office Bldg	R	11	106	L	0
		Campus of Oil India	R	10	105	L	0
	Dibrugarh	Dibrugarh Off. Bldg	R	11	96	L	0
	Golaghat	Golaghat Off. Bldg.	R	11	43	L	0
	Guwahati	Fire Brigade Station	R	18	92	L	0
		Gopinath Nagar	R	14	211	L	0
		Head Office	R	19	93	L	0
		Near Pragiyotish College	R	15	225	L	0
	Hailakandi	CISF Campus	R	13	61	L	0
	Sibsagar	Sibasagar Off. Bldg	R	12	57	L	0
	Tezpur	Tezpur Office Bldg	R	11	91	L	0
Bihar	Patna	Beltron Bhawan	R	28	60	L	0
		Gandhi Maidan T C	R	51	50	M	4
Chandigarh	Chandigarh	Industrial Area	I	20	153	L	0
		Kaimbwala Village	R	12	152	L	0
		Punjab Eng College	R	14	151	L	0
		Sector-17 C	R	16	154	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Sector-39	R	13	153	L	0
Chhattisgarh	Bhilai Nagar	M.P.L.U. Nigam	I	32	77	L	0
		Regional Office	R	16	76	L	0
		Visak Hostel	R	26	79	L	0
	Korba	I.T.I, Rampur	R	22	102	L	0
		HIG 21,22, MP Nagar (Extn)	R	21	109	L	0
		Pragati Nagar	R	21	89	L	0
	Raipur	Wool Worth I.Pvt.Ltd	I	42	60	M	0
		New HIG - 9, Hirapur	R	44	62	M	0
		Yatayat Thana	R	44	44	M	0
Dadra & Nagar Haveli	Silvasa	Khadoli Industrial Area	I	17	104	L	0
		Chetan Guest House	R	17	104	L	0
Daman & Diu	Daman	Kadaiya	I	18	104	L	0
		Airport Road	R	16	102	L	0
Delhi	Delhi	Mayapuri Indl. Area	I	75	96	M	3
		Shahdara	I	58	75	M	0
		Shahzada Bagh	I	49	69	M	0
		Janakpuri	R	53	77	M	0
		N.Y. School	R	69	79	H	34
		Nizamuddin	R	42	66	M	0
		Pritampura	R	38	69	M	4
		Siri Fort	R	49	75	M	0
		Town Hall	R	77	96	H	48
Goa	Mormugao	Mormugao Port Trust	I	9	101	L	0
	Panaji	Patto, Panaji	R	13	104	L	0
	Vasco	Electricity Deptt.	I	14	100	L	0
Gujarat	Ahmedabad	Naroda	I	22	104	L	0
		Shardaban Hospital	I	19	97	L	0
		Cadilla Bridge Narol	R	21	105	L	0
		Behrampura	R	20	104	L	0
		L.D. Eng. College	R	18	104	L	0
		R.C. High School	R	20	102	L	0
	Anklesvar	Rallies India Ltd	I	28	104	L	0
		Durga Traders	R	24	105	L	0
	Jamnagar	Fisheries Office	R	27	104	L	0
	Rajkot	Sardhara Indl.Corp.	I	15	104	L	0
		Regional Office	R	13	102	L	0
	Surat	Udhna	I	27	103	L	0
		Near A.I. Office	R	25	104	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		S.V.R. Eng. College	R	21	103	L	0
	Vadodara	CETP	I	43	104	M	0
		Dandia Bazar	R	28	105	L	0
		GPCB Office	R	14	104	L	0
	Vapi	GEB	I	25	105	L	0
		Vapi Nagar Palika	R	22	106	L	0
Haryana	Hisar	Guru Jambeshwar Uni	R	BDL	44	L	0
		Urban Estate-II	R	BDL	43	L	0
	Yamunanagar	Ballarpur Industries	I	33	18	-	0
	Faridabad	Regional Office	R	25	90	L	0
		M/s Shivalik Global Ltd	I	24	64	L	0
Himachal Pradesh	Baddi	AHC	I	BDL	11	-	0
		Industry Department	I	12	143	L	0
		Housing Board	R	9	13	-	0
	Damtal	Old Road	R	19	79	L	0
		Regional Office	R	16	101	L	0
	Kala- Amb	Industrial Area	I	14	146	L	0
		Trilok Pur	R	12	155	L	0
	Nalagarh	M.C.	R	BDL	11	-	0
	Paonta Sahib	Gondpur Indl. Area	I	14	120	L	0
		Paonta Sahib	R	12	145	L	0
	Parwanoo	AC Office Bldg.	I	10	105	L	0
		Central Laboratory	R	9	112	L	0
	Shimla	Bus Stand	R	10	114	L	0
		Tekka Bench Ridge	S	BDL	129	L	0
Jharkhand	Dhanbad	Regional Office	R	44	91	M	0
	Jamshedpur	Bistupur Vehicle TC	I	51	92	M	0
		Golmuri Vehical TC	I	50	93	M	0
	Jharia	M.A.D.A.	I	45	43	-	0
	Ranchi	Albert Ekka Chowk	R	33	90	M	0
	Sindri	BIT	I	42	82	M	0
Karnataka	Bangalore	Graphite India	I	42	78	M	0
		KHB Indl Area	I	40	120	L	0
		Peenya Indl. Area	I	41	92	M	0
		AMCO Batteries	R	40	102	M	0
		Yeshwanthpura	R	41	105	M	0
		Victoria Hospital	S	41	104	C	100
	Belgaum	Karnataka SPCB	I	14	100	L	0
	Gulbarga	Govt. Hospital	S	14	94	M	0
	Hassan	KSRTC Bus Stand	R	20	107	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
	Hubli-Dharwad	L. Industrial Area	I	12	80	L	0
		Rani C. Circle	R	12	95	L	0
	Mangalore	Baikampady Indl. Area	I	BDL	105	L	0
	Mysore	K.R. Circle	R	21	103	L	0
		Hebbal Industrial Area	I	BDL	95	L	0
Kerala	Kochi	Eloor	I	BDL	91	L	0
		Kalamassery	I	BDL	84	L	0
		Irumpanam	I	11	107	L	0
		Eloor II	I	12	94	L	0
		Ernakulum South	R	20	108	L	0
		FCI, OEN C. O. Bldg	R	14	62	L	0
		M.G. Road	R	18	101	L	0
	Kottayam	Vadavathoor	I	15	96	L	0
		Kottayam	R	22	97	L	0
	Kozhikode	Nallalam	I	BDL	108	L	0
		Kozhikode City	R	9	107	L	0
	Palakkad	SEPR Refractories India Ltd. Kanjikode	I	BDL	102	L	0
	Trivandrum	Hi Tech Chackai	I	19	100	L	0
		PRS Hospital	S	28	101	C	20
		Sasthamangalam	R	26	96	L	0
		SMV School	R	30	101	L	0
Maharashtra	Aurangabad (MS)	C.A.D.A. Office	R	21	95	L	0
		S.B.E.S. College	R	21	94	L	0
		Bibi-Ka-Maqbara	S	17	90	L	7
	Amravati	Apurva Oil and Ind.	I	13	94	L	0
		Govt. Coll. of Engg.	R	9	99	L	0
		Rajkamal Square	R	16	95	L	0
	Chandrapur	M.I.D.C.	I	58	83	M	0
		Nagar Parishad	R	47	87	M	0
		SRO, Bapat Nagar	R	60	86	M	2
	Greater Mumbai	Dombivalli MIDC	I	57	50	M	0
		Municipal Council	I	55	51	M	0
	Kolhapur	Mahadwar Road	R	18	103	L	0
		Ruikar Trust Dabhlkar Corner	R	30	101	L	0
		Shivaji University	R	12	66	L	0
	Lote	MIDC WTP	I	26	52	L	0
		Chalke Wadi	R	27	52	L	0
	Mumbai	Parel	I	35	98	L	0
		Kalbadevi	R	45	93	M	16

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Worli	R	38	99	M	5
	Nagpur	Hingna Road	I	36	96	L	1
		MIDC Office	I	32	91	L	0
		Govt. Poly. College	R	29	79	L	0
		Institution of Eng.	R	31	93	M	0
		Maskasath	R	34	89	M	2
		NEERI Lab	R	33	94	M	4
	Nashik	VIP Industrial Area	I	26	100	L	0
		NMC Building	R	28	105	L	0
		RTO Colony Tank	R	22	96	L	0
	Navi Mumbai	MIDC Taloja	I	45	96	M	0
		MPCB Central Lab	I	42	84	M	0
		Airoli	R	28	105	L	0
		MESB Power Station	R	40	101	M	0
		Nerul	R	38	112	M	4
		Panvel Water Works	R	42	100	M	5
	Pune	Bhosari	I	35	99	L	0
		Nalstop	R	37	103	M	0
		Swargate	R	39	100	M	0
	Solapur	WIT Campus	I	34	105	L	0
		Voronoko Primary School	R	36	104	M	0
	Tarapur	MIDC Office Compound	I	54	34	-	0
		Police Chowki	I	54	35	-	0
		Sports Stadium	I	51	37	-	0
	Thane	Balkum/Kolshet	I	18	94	L	0
		Kopri	R	16	101	L	0
		Naupada	R	14	99	L	0
	Amravati	Govt. college	R	9	99	L	0
		Apurva oil & industries	I	13	94		0
		Rajkamal	R	16	95	L	0
Manipur	Imphal	Secretariat Building	R	19	20	-	0
Meghalaya	Shillong	Boards Office	R	BDL	87	L	0
		MUDA Complex , Police Bazar	R	25	36	-	0
Mizoram	Aizawl	Bawngkawn	R	BDL	102	L	0
		Khatla	R	BDL	104	L	0
		Laipuitlang	R	BDL	103	L	0
Madhya Pradesh	Bhopal	Govindpura	I	17	42	-	0
		Arera Colony	R	34	54	M	0
		Hamidia Road	R	20	46	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		T.T.Nagar	R	11	50	L	0
	Dewas	EID Perry (I) Ltd.	I	27	94	L	0
		Vikas Nagar	R	22	87	L	0
	Gwalior	Dindayal Nagar	R	18	81	L	0
		Maharaj Bada	R	14	24	-	0
	Indore	Polo Ground	I	22	87	L	0
		Kothari Market	R	22	85	L	0
		Telephone Nagar	R	12	93	L	0
	Jabalpur	Vijay Nagar	R	25	91	L	0
	Nagda	Chem. D. Labour Club	I	18	72	L	0
		Grasim Guest House No.2	R	25	86	L	0
		Grasim Kalyan Kendra	R	32	83	M	0
	Sagar	Pt. Deendayal Nagar	R	17	98	L	0
	Satna	Sub-Divisional Off.	I	BDL	70	L	0
		Regional Office	R	BDL	68	L	0
	Ujjain	District Office	I	16	97	L	0
		Regional Office	R	9	81	L	0
		Mahakal Temple	S	12	74	M	0
Nagaland	Dimapur	Bank Colony	R	14	99	L	0
		Dhobinala	R	14	99	L	0
Orissa	Angul	Industrial Estate	I	22	95	L	0
		NALCO Township	R	18	58	L	0
	Berhampur	Regional Office	R	13	104	L	0
	Bhubaneshwar	OSPCB Bldg	R	18	108	L	0
		Capital Police Stn.	R	21	101	L	0
		IRC Village	R	18	101	L	0
	Cuttack	Roof of Traffic Tower Cuttack	R	23	104	L	0
		R.O. Cuttack	R	16	86	L	0
	Rayagada	Jaykaypur	I	19	103	L	0
		Regional Office	R	20	107	L	0
	Rourkela	IDL Police Out-post	R	10	105	L	0
		Regional Office	R	11	104	L	0
	Sambalpur	PHD Ofice, Sambalpur	R	14	110	L	0
	Talcher	Coal Field Area	I	24	94	L	0
		T.T.P.S Colony	I	19	96	L	0
Punjab	Gobindgarh	Raj Steel	I	26	133	L	0
		United Rolling Mills	R	26	131	L	0
	Jalandhar	Focal Point	I	32	70	L	0
		Punjab Maltex	I	32	72	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		MC Tube Well No.27	R	30	51	L	0
		Regional Office	R	26	78	L	0
	Amritsar	Nagina Soap Factory	I	34	79	L	0
		A-1 Platters	R	36	57	L	2
	Bathinda	Bathinda Milk Plant	I	20	88	L	0
	Dera Bassi	M/s Punjab Chemicals Ltd.	I	22	132	L	0
		Winsome Yarns Ltd	I	22	130	L	0
	Khanna	Markfed Vanaspati	I	40	123	L	0
		A S School	R	37	127	M	0
	Ludhiana	Milk Plant	I	36	130	L	0
		Rita Sewing Machines	I	45	119	M	0
		Vishwakarma Chowk	R	37	128	M	0
		PPCB Office Bldg.	R	41	112	M	0
	Naya Nangal	NFL Guest House	R	22	109	L	0
		Punjab Alkalies	R	20	114	L	0
Pondicherry	Pondicherry	PIPDIC	I	13	62	L	0
		Chamber of Commerce	R	9	84	L	0
		DSTC Office	R	12	68	L	0
Rajasthan	Alwar	Vitage Distillers Ltd.	I	31	98	L	0
		RIICO Pump House	I	30	102	L	0
		Regional Office	R	31	103	M	0
	Jaipur	MIA	I	32	106	L	0
		VKIA	I	41	107	M	0
		Ajmeri Gate	R	37	99	M	0
		Chandpole	R	41	105	M	0
		RSPCB Office	R	26	123	L	0
		Vidyadhar Nagar	R	31	108	M	0
	Jodhpur	Basni Indl. Area	I	24	91	L	0
		DIC Office, Industrial Estate	I	24	104	L	0
		M M Police Thane	R	22	99	L	0
		Sojati Gate	R	25	97	L	0
		Housing Board	R	21	103	L	0
		Shastri Nagar	R	25	90	L	0
	Kota	Regional Office	I	28	105	L	0
		Municipal C. Bldg	R	25	105	L	0
		KVK Bhorkhara	R	23	102	L	0
	Udaipur	Regional Office, MIA	I	36	103	L	0
		Ambamata	R	24	104	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
		Town Hall	R	26	105	L	0
Tamil Nadu	Chennai	Manali	I	21	91	L	0
		Kathivakkam	I	20	90	L	0
		M C Thiruvottiyur	I	BDL	71	L	0
		Thiruvottiyur	I	19	113	L	0
		Madras Med. College	R	9	80	L	0
		NEERI CSIR Campus	R	8	93	L	0
	Coimbatore	SIDCO Office	I	34	91	L	0
		Dist. Coll. Office	R	29	92	L	0
		Ponniyarajapuram	R	27	89	L	0
	Madurai	Fenners (I) Ltd.	I	24	92	L	0
		Highway Bldg.	R	22	87	L	0
		Kunnathur Chatram	R	24	96	L	0
	Salem	Sowdeswari College	R	25	129	L	0
	Thoothukudi	Raja Agencies	I	20	89	L	0
		AVM Jewellery Bldg.	R	17	95	L	1
		Fisheries College	R	18	93	L	2
Uttar Pradesh	Agra	Nunhai	I	10	69	L	0
		Regional Office	R	10	106	L	0
		DIC, Nunhai	S	41	97	C	76
		Itmad-ud-daulah	S	30	108	C	53
		Rambagh	S	26	105	C	31
		Taj Mahal	S	20	231	H	22
	Anpara	Anpara Colony	I	29	97	L	0
		Renusagar Colony	I	29	100	L	0
	Allahabad	Bharat Yantra Nigam	R	27	99	L	0
		Square Crossing	R	47	101	M	13
	Firozabad	CDGI	I	36	95	L	0
		Raza Ka Tal	R	32	88	M	0
		Tilak Nagar	R	29	93	L	0
	Ghaziabad	Atlas Cycles Ltd	I	16	59	L	0
	Ghaziabad	Bulandshahar R.I.A.	I	15	47	-	0
	Jhansi	Jail Chauraha	R	28	103	L	0
		Veeranga Nagar	R	27	100	L	0
	Kanpur	Fazal Ganj	I	26	80	L	0
		Jajmau	I	23	94	L	0
		Sharda nagar	R	23	80	L	0
		Deputy Ka Parao	R	23	94	L	0
		Kidwai nagar	R	23	90	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 hourly average)
	Khurja	CGCRI	I	35	57	L	0
		Ahirpara	R	30	55	L	0
	Lucknow	Talkatora	I	37	96	L	0
		Aminabad	R	36	91	M	0
		Aliganj	R	36	94	M	0
		Kapoor Hotel	R	35	100	M	0
		Mahanagar	R	35	87	M	0
	Meerut	Begum Bridge	R	44	56	M	0
		Thana Railway Road	R	39	66	M	0
	Noida	GEE-PEE	I	42	94	M	0
		R.O, UPPB	R	43	95	M	0
	Varanasi	Regional Office	R	18	66	L	0
		Sigra	R	19	82	L	0
Uttaranchal	Dehradun	Raipur Road	I	21	13	-	0
		Clock Tower	R	28	39	-	0
West Bengal	Asansol	Asansol M.C.	I	74	104	M	0
	Durgapur (WB)	Dew India Ltd	I	82	104	H	4
		Kwality Hotel	I	74	104	M	0
		PCBL Club	R	59	104	M	23
	Haldia	Super Market	I	48	104	M	0
		WBIIDC	I	52	104	M	0
	Howrah	Bandhaghat	I	92	104	H	0
		Howrah MC	I	82	104	H	14
		Bator	R	61	104	H	19
		Naskarpara	R	73	104	H	37
	Kolkata	Behala Chowrasta	I	75	78	M	9
		Cossipore Police Stn	I	65	96	M	13
		Dunlop Bridge	I	63	78	M	0
		Baishnabghata	R	48	76	M	4
		Kasba	R	47	96	M	22
		Lal Bazar	R	69	96	H	47
		Minto Park	R	68	79	H	29
		Moulali	R	77	76	H	38
		Salt Lake	R	64	78	H	21

Note:
R – Residential and other areas, I – Industrial area, S – Sensitive Areas, Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for n $\geq$ 50 days), % violation – percentage violation of NAAQS (24 hourly average) BDL = Below Detection Limit (Concentration less than 4 $\mu g/m^3$ for SO_2).

CHAPTER -II.III
Air Quality w. r. t. RESPIRABLE SUSPENDED PARTICULATE MATTER (RSPM or PM_{10})

II.III.I General environmental concerns of Respirable Particulate Matter

Particulate matter is called primary if it is in the same chemical term in which it is emitted into the atmosphere. The primary particulate matter includes wind blown dust such as road dust, fly ash, soot etc. Particulate matter is called secondary if it is formed by chemical reactions in the atmosphere. Secondary particulate matter include sulphates, nitrates etc. Particulate matter is a mixture of many subclasses of pollutants that contain many different chemical species. The particle size is described by aerodynamic diameter. Aerodynamic diameter depends on particle density and is defined as the diameter of a particle with the same settling velocity as spherical particle with unit density i.e. 1 g/cm^3. PM_{10} are the particles with upper size limited by a 50% cut at 10 μm aerodynamic diameter. They consist of particles with a diameter up to 10 µm. PM_{10} can be formed by physical processes of crushing, grinding and abrasion of surfaces. Mining and agricultural activities are some of the sources of large size particles.

The size of particles is directly linked to their potential for causing health problems. Small particles less than 2.5 micrometers in diameter pose the greatest problems, because they can get deep into the lungs, and some may even get into the bloodstream. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. Environmental effects of particulate matter include visibility reduction, aesthetic damage etc. Exposure to high doses of UFP can cause severe pulmonary inflammation and hemorrhage, high degree of alveolar and interstitial edema, disruption of epithelial and endothelial cell layers and even death.

II.III.II Specific environmental concerns of the Respirable Suspended Particulate Matter (RSPM) along with area type & annual average concentrations

The summary of Respirable Suspended Particulate Matter (PM_{10}/RSPM) levels in the country is detailed in this chapter. Summary is given in terms of number of monitoring stations in various ranges of annual average concentration and percentage violation. The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard. The four categories are low, moderate, high and critical levels.

Number of monitoring stations in industrial and residential areas in various ranges of annual average concentration is depicted in Figure II.III and Figure II.III.II respectively. RSPM levels were equal to or exceeded National Ambient Air Quality Standard (NAAQS) (annual average) at 55 monitoring stations in industrial areas and 166 monitoring stations in residential areas. Table II.III.I and Table II.III.II show top ten locations in terms of annual average concentration of RSPM in residential and industrial areas respectively. The highest concentration in residential area was observed at monitoring station located at Town Hall, Delhi and highest concentration in industrial area was observed at monitoring station located at Rita Sewing Maschines, Ludhiana, Punjab.

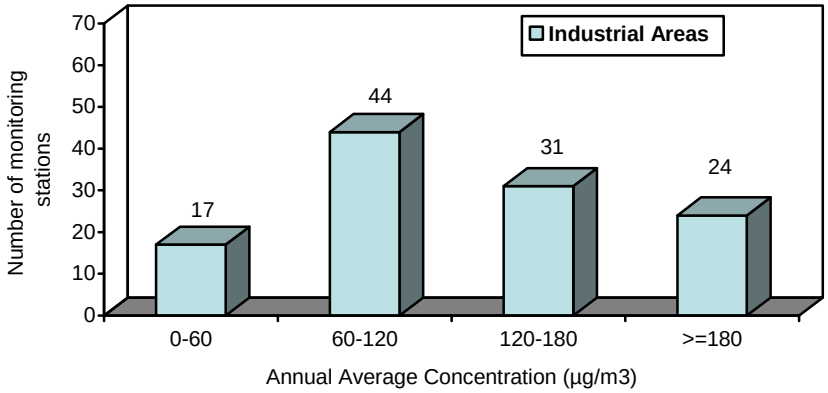

Fig. II.III.I: Number of Monitoring Stations (Industrial Area) in various Ranges of Annual Average Concentration of RSPM

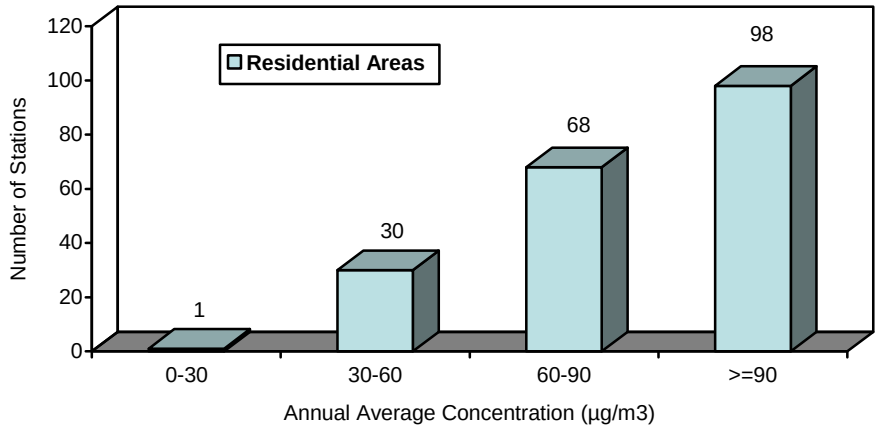

Fig. II.III.II: Number of Monitoring Stations (Residential Area) in various Ranges of Annual Average Concentration of RSPM

Table II.III.I: Top ten locations with respect to RSPM during 2008 in residential areas

Sl. No.	State	City	Location	Annual Average conc. (µg/m^3)
1.	Delhi	Delhi	Town Hall	278
2.	Punjab	Ludhiana	PPCB Office Bldg.	263
3.	Punjab	Khanna	A S School	239
4.	Punjab	Ludhiana	Bharat Nagar Chowk	238
5.	Delhi	Delhi	Janakpuri	219
6.	Madhya Pradesh	Indore	Kothari Market	217
7.	Uttar Pradesh	Khurja	Ahirpara	217
8.	Punjab	Gobindgarh	United Rolling Mills	216
9.	Uttar Pradesh	Firozabad	Raza Ka Tal	215
10	Uttar Pradesh	Kanpur	Deputy Ka Parao	215

* - Locations where annual mean concentration of RSPM exceeded the NAAQS of 60 µg/m^3 for Residential areas.

Table II.III.II: Top ten locations with respect to RSPM during 2008 in industrial areas

Sl. No.	State	CIty	Location	Annual Average conc. (µg/m^3)
1.	Punjab	Ludhiana	Rita Sewing Machines	351
2.	Madhya Pradesh	Satna	Sub-Divisional Off.	265
3.	Delhi	Delhi	Mayapuri Indl. Area	263
4.	Uttar Pradesh	Ghaziabad	Bulandshahar R.I.A.	257
5.	Punjab	Khanna	Markfed Vanaspati	255
6.	Uttar Pradesh	Khurja	CGCRI	245
7.	Madhya Pradesh	Indore	M.P. Laghu Udyog	240
8.	Uttar Pradesh	Firozabad	CDGI	239
9.	Rajasthan	Jaipur	VKIA	238
10	Himachal Pradesh	Kala Amb	Industrial Area	234

* - Locations where annual mean concentration of RSPM exceeded the NAAQS of 120 µg/m^3 for Industrial areas.

II.III.IV Percentage Violation of NAAQS-24 Hourly Average

Number of monitoring stations in various ranges of percentage violation of NAAQS (24 hourly average) of RSPM is depicted in Figure II.III.III. The percentage violation of NAAQS (24 hourly Avg.) was less than 2% at 28 monitoring stations in industrial areas and 38 monitoring stations in residential

areas. At all the remaining stations, the percentage violation of NAAQS (24 hourly avg.) was 2% or more.

II.III.V Air Quality with respect to Respirable Particulate Matter Pollution Levels-Low, Moderate, High & Critical

Number of monitoring stations with low, moderate, high and critical levels of RSPM is depicted in Figure II.III.IV. RSPM levels at 50 % of the monitoring stations in residential areas and 20% of the monitoring stations in industrial areas were critical.

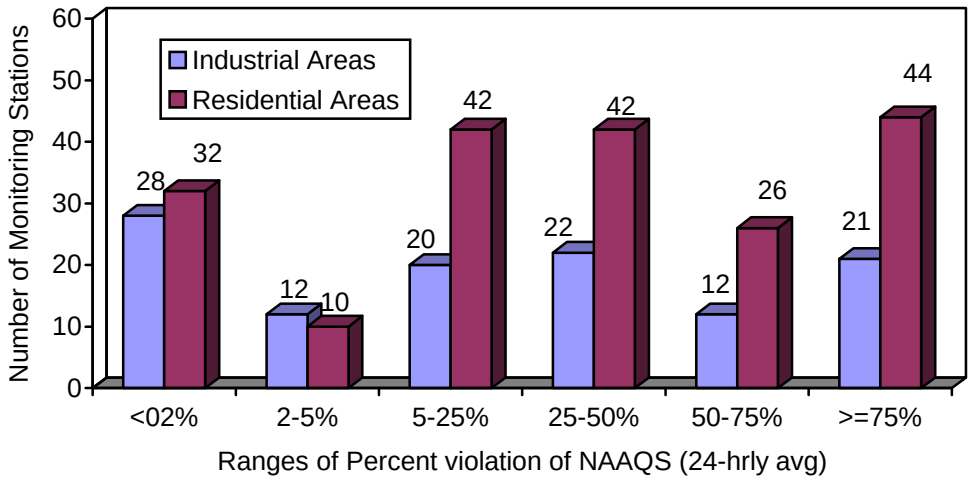

Figure II.III.III: Number of Monitoring Stations in various ranges of Percentage Violation of NAAQS (24-hrly avg.) of RSPM

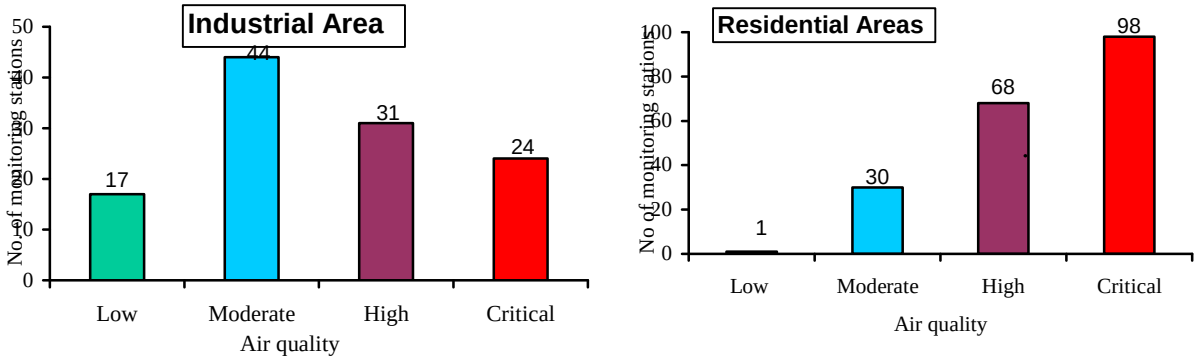

Figure II.III.IV: Number of Monitoring Stations with Low, Moderate, High and Critical levels of RSPM

The annual average concentration of RSPM at various monitoring stations is given in Table II.III.III. The data given is annual average concentration and number of observations with 16 and more hours of monitoring a day. Also, described in the table is air quality in terms of low, moderate, high and critical. RSPM levels at many monitoring stations violated the prescribed NAAQS.

Table II.III.III: Summary of RSPM levels of Ambient Air Quality Stations under NAMP during 2008

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
Andhra Pradesh	Hyderabad	C.I.T.D. Balanagar	I	106	110	M	63
		Nacharam	I	54	93	L	0
		Uppal	I	108	108	M	4
		ABIDS Circle	R	81	93	H	26
		Charminar	R	119	107	C	79
		Jubilee Hills	R	58	108	M	3
		Paradise	R	114	108	C	70
		Tarnaka	R	64	98	H	10
		Zoo Park	S	58	107	H	3
	Kurnool	Mourya Inn	R	71	106	H	5
	Patencheru	Police Station	R	97	105	C	45
	Ramagundam	RTC Bus Depot	R	87	101	H	33
	Tirupati	Reg.Science Center	S	34	116	M	0
	Vijaywada	Autonagar	I	101	110	M	2
		Benz Circle	R	91	110	C	36
	Visakhapatnam	Industrial Estate	I	69	112	M	0
		Ganapuram Area	R	96	112	C	7
		Mndi	R	78	111	H	23
		Police Barracks	R	93	113	C	19
		Seethammadhara	R	79	112	H	15
		Naval Area/ ESI Hospital	S	68	112	H	30
Assam	Bongaigaon	Barpara Office Bldg	R	56	106	M	9
		Campus of Oil India	R	76	105	H	33
	Dibrugarh	Dibrugarh Off. Bldg	R	56	96	M	8
	Golaghat	Golaghat Off. Bldg.	R	71	43	-	16
	Guwahati	Fire Brigade Station	R	141	92	C	82
		Gopinath Nagar	R	103	211	C	43
		Head Office	R	152	93	C	82
		Near Pragiyotish College	R	96	225	C	43
	Hailakandi	CISF Campus	R	66	61	H	13
	Sibsagar	Sibasagar Off. Bldg	R	81	57	H	32
	Tezpur	Tezpur Off.Bldg	R	76	91	H	27

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
Bihar	Patna	Beltron Bhawan	R	94	72	C	36
		Gandhi Maidan T C	R	146	64	C	80
Chandigarh	Chandigarh	Industrial Area	I	123	153	H	31
		Kaimbwala Village	R	91	152	C	38
		Punjab Eng College	R	88	151	H	32
		Sector-17 C	R	80	154	H	23
		Sector-39	R	95	153	C	41
Chhattisgarh	Bhilai Nagar	M.P.L.U. Nigam	I	157	78	H	74
		Regional Office	R	79	76	H	0
		Visak Hostel	R	90	79	H	9
	Korba	I.T.I, Rampur	R	113	102	C	75
		HIG 21,22, MP Nagar (Extn)	R	107	108	C	66
		Pragati Nagar	R	102	89	C	54
	Raipur	Wool Worth I.Pvt.Ltd	I	212	65	C	92
		New HIG - 9, Hirapur	R	181	51	C	98
		Yatayat Thana	R	182	46	-	100
Dadra & Nagar Haveli	Silvasa	Khadoli Industrial Area	I	109	104	M	1
		Chetan Guest House	R	78	104	H	3
Daman & Diu	Daman	Kadaiya	I	105	104	M	0
		Airport Road	R	87	102	H	25
Delhi	Delhi	Mayapuri Indl. Area	I	263	96	C	78
		Shahdara	I	210	73	C	66
		Shahzada Bagh	I	203	72	C	53
		Janakpuri	R	219	75	C	89
		N.Y. School	R	180	79	C	67
		Nizamuddin	R	200	44	-	68
		Pritampura	R	159	75	C	79
		Siri Fort	R	215	74	C	91
		Town Hall	R	278	96	C	92
Goa	Mormugao	Mormugao Port Trust	I	54	101	L	2
	Panaji	Patto, Panaji	R	57	104	M	1
	Vasco	Electricity Deptt.	I	50	101	L	1
Gujarat	Ahmedabad	Naroda	I	129	104	H	21
		Shardaban Hospital	I	80	98	M	0
		Cadilla Bridge Narol	R	84	105	H	0
		Behrampura	R	83	104	H	4

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
		L.D. Eng. College	R	73	104	H	2
		R.C. High School	R	81	103	H	1
	Anklesvar	Rallies India Ltd	I	108	105	M	0
		Durga Traders	R	77	105	H	0
	Jamnagar	Fisheries Office	R	95	104	C	36
	Rajkot	Sardhara Indl.Corp.	I	120	104	M	5
		Regional Office	R	89	102	H	1
	Surat	Udhna	I	100	103	M	0
		Near A.I. Office	R	86	104	H	7
		S.V.R. Eng. College	R	75	103	H	0
	Vadodara	CETP	I	119	104	M	0
		Dandia Bazar	R	68	105	H	6
		GPCB Office	R	45	104	M	0
	Vapi	GEB	I	84	105	M	0
		Vapi Nagar Palika	R	73	106	H	4
Haryana	Hisar	Guru Jambeshwar Uni	R	79	44	-	2
		Urban Estate-II	R	145	43	-	65
	Yamunanagar	Ballarpur Industries	I	375	18	-	94
	Faridabad	Regional Office	R	139	90	C	100
		M/s Shivalik Global Ltd	I	160	64	H	42
Himachal Pradesh	Baddi	AHC	I	56	11	-	0
		Industry Department	I	152	171	H	45
		Housing Board	R	88	13	-	30
	Damtal	Old Road	R	73	80	H	9
		Regional Office	R	57	101	M	0
	Nahan	Industrial Area	I	234	155	C	88
		Trilok Pur	R	92	157	C	45
	Nalagarh	M.C.	R	53	11	-	9
	Paonta Sahib	Gondpur Indl. Area	I	172	122	H	66
		Paonta Sahib	R	92	139	C	6
	Parwanoo	AC Office Bldg.	I	95	105	M	10
		Central Laboratory	R	64	125	H	6
	Shimla	Bus Stand	R	61	107	H	4
		Tekka Bench Ridge	S	47	135	M	10
Jammu & Kashmir	Jammu	M.A.M. Station	R	72	42	-	14

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
Jharkhand	Dhanbad	Regional Office	R	131	92	C	67
	Jamshedpur	Bistupur Vehicle TC	I	172	92	H	98
		Golmuri Vehical TC	I	171	93	H	100
	Jharia	M.A.D.A.	I	200	44	-	73
	Ranchi	Albert Ekka Chowk	R	173	92	C	83
	Sindri	BIT	I	136	86	H	41
Karnataka	Bangalore	Graphite India	I	161	78	H	45
		KHB Indl Area	I	71	120	M	2
		Peenya Indl. Area	I	123	92	H	36
		AMCO Batteries	R	76	102	H	20
		Yeshwanthpura	R	104	105	C	39
		Victoria Hospital	S	66	104	H	31
	Belgaum	Karnataka SPCB	I	33	100	L	0
	Gulbarga	Govt. Hospital	S	71	94	H	38
	Hassan	KSRTC Bus Stand	R	50	107	M	0
	Hubli-Dharwad	L. Industrial Area	I	100	80	M	14
		Rani C. Circle	R	107	95	C	42
	Mangalore	Baikampady Indl. Area	I	60	105	L	0
	Mysore	K.R. Circle	R	50	103	M	0
		Hebbal Industrial Area	I	48	97	L	0
Kerala	Kochi	Eloor	I	45	91	L	2
		Kalamassery	I	49	84	L	0
		Irumpanam	I	41	107	L	0
		Eloor II	I	50	94	L	3
		Ernakulum South	R	44	108	M	1
		FCI, OEN C. O. Bldg	R	38	62	M	0
		M.G. Road	R	36	101	M	0
	Kottayam	Vadavathoor	I	35	96	L	0
		Kottayam	R	57	97	M	0
	Kozhikode	Nallalam	I	25	108	L	0
		Kozhikode City	R	42	106	M	0
	Palakkad	SEPR Refractories India Ltd. Kanjikode	I	30	102	L	2
	Trivandrum	Hi Tech Chackai	I	86	100	M	0
		PRS Hospital	S	65	101	H	9
		Sasthamangalam	R	50	96	M	0

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
		SMV School	R	66	101	H	2
Maharashtra	Aurangabad (MS)	C.A.D.A. Office	R	73	93	H	16
		S.B.E.S. College	R	89	92	H	40
		Bibi-Ka-Maqbara	S	62	90	H	32
	Amravati	Apurva Oil and Ind.	I	64	94	H	0
		Govt. Coll. of Engg.	R	38	99	M	0
		Rajkamal Square	R	97	95	C	42
	Chandrapur	M.I.D.C.	I	157	83	H	45
		Nagar Parishad	R	161	88	C	84
		SRO, Bapat Nagar	R	193	87	C	89
	Greater Mumbai	Dombivalli MIDC	I	104	50	M	20
		Municipal Council	I	99	50	M	10
	Kolhapur	Mahadwar Road	R	86	103	H	33
		Ruikar Trust Dabhlkar Corner	R	102	101	C	59
		Shivaji University	R	65	78	H	12
	Lote	MIDC WTP	I	68	52	M	0
		Chalke Wadi	R	83	52	H	33
	Mumbai	Parel	I	117	99	M	31
		Kalbadevi	R	130	94	C	52
		Worli	R	133	99	C	72
	Nagpur	Hingna Road	I	157	97	H	53
		MIDC Office	I	136	93	H	28
		Govt. Poly. College	R	119	79	C	59
		Institution of Eng.	R	124	94	C	64
		Maskasath	R	80	78	H	33
		NEERI Lab	R	67	94	H	23
	Nashik	VIP Industrial Area	I	79	100	M	3
		NMC Building	R	88	105	H	36
		RTO Colony Tank	R	71	96	H	24
	Navi Mumbai	MIDC Taloja	I	192	101	C	58
		MPCB Central Lab	I	130	84	H	29
		Airoli	R	88	106	H	31
		MESB Power Station	R	117	102	C	50
		Nerul	R	102	112	C	47
		Panvel Water	R	158	100	C	68

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
		Works					
	Pune	Bhosari	I	112	101	M	29
		Nalstop	R	98	103	C	47
		Swargate	R	99	100	C	52
	Solapur	WIT Campus	I	78	105	M	2
		Voronoko Primary School	R	79	104	H	17
	Tarapur	MIDC Office Compound	I	67	34	-	0
		Police Chowki	I	92	35	-	11
		Sports Stadium	I	73	37	-	0
	Thane	Balkum/Kolshet	I	59	94	L	0
		Kopri	R	57	101	M	0
		Naupada	R	57	99	M	0
		Apurva oil & industries	I	64	94	M	0
		Govt. college	R	38	99	M	0
		Rajkamal	R	97	95	C	42
Manipur	Imphal	Secretariat Building	R	84	20	-	35
Meghalaya	Shillong	Boards Office	R	57	87	M	0
		MUDA Complex , Police Bazar	R	89	36	-	22
Mizoram	Aizawl	Bawngkawn	R	44	102	M	0
		Khatla	R	39	104	M	0
		Laipuitlang	R	28	103	L	0
Madhya Pradesh	Bhopal	Govindpura	I	91	48	-	17
		Arera Colony	R	129	54	C	89
		Hamidia Road	R	124	55	-	45
		T.T.Nagar	R	62	64	H	14
	Dewas	EID Perry (I) Ltd.	I	96	99	M	10
		Vikas Nagar	R	72	93	H	20
	Gwalior	Dindayal Nagar	R	133	74	C	66
		Maharaj Bada	R	192	24	-	96
	Indore	Polo Ground	I	240	87	C	99
		Kothari Market	R	217	86	C	99
		Telephone Nagar	R	131	93	C	86
	Jabalpur	Vijay Nagar	R	136	91	C	95
	Nagda	Chem. D. Labour Club	I	113	74	M	3
		Grasim Guest House No.2	R	92	87	C	13
		Grasim Kalyan Kendra	R	97	84	C	27
	Sagar	Pt. Deendayal Nagar	R	115	3	-	100

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
	Satna	Sub-Divisional Off.	I	265	70	C	99
		Regional Office	R	115	68	C	63
	Singrauli	Jayant Township	R	78	24	-	0
		N.T.P.C., Vidyanagar	R	66	30	-	0
		Waidhan	R	49	23	-	0
	Ujjain	District Office	I	154	98	H	63
		Regional Office	R	70	85	H	21
		Mahakal Temple	S	82	75	H	51
Nagaland	Dimapur	Bank Colony	R	69	99	H	15
		Dhobinala	R	74	99	H	20
Orissa	Angul	Industrial Estate	I	127	95	H	34
		NALCO Township	R	89	58	H	24
	Berhampur	Regional Office	R	64	104	H	6
	Bhubaneshwar	OSPCB Bldg	R	80	108	H	14
		Capital Police Stn.	R	94	101	C	40
		IRC Village	R	83	101	H	22
	Cuttack	Roof of Traffic Tower Cuttack	R	87	104	H	32
		R.O. Cuttack	R	75	86	H	28
	Rayagada	Jaykaypur	I	63	103	M	0
		Regional Office	R	65	107	H	1
	Rourkela	IDL Police Out-post	R	104	105	C	61
		Regional Office	R	99	104	C	50
	Sambalpur	PHD Ofice, Sambalpur	R	50	110	M	0
	Talcher	Coal Field Area	I	99	94	M	16
		T.T.P.S Colony	I	90	96	M	4
Punjab	Gobindgarh	Raj Steel	I	215	132	C	98
		United Rolling Mills	R	216	130	C	100
	Jalandhar	Focal Point	I	161	71	H	66
		Punjab Maltex	I	160	72	H	79
		MC Tube Well No.27	R	158	51	C	100
		Regional Office	R	121	78	C	88
	Khanna	Markfed Vanaspati	I	255	123	C	98
		A S School	R	239	127	C	100
	Ludhiana	Milk Plant	I	231	130	C	95
		Rita Sewing Machines	I	351	119	C	100
		Vishwakarma Chowk	R	238	128	C	100

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
		PPCB Office Bldg.	R	263	112	C	100
	Naya Nangal	NFL Guest House	R	207	1	-	100
		Punjab Alkalies	R	103	114	C	49
Pondicherry	Pondicherry	PIPDIC	I	54	62	L	0
		Chamber of Commerce	R	45	85	M	1
Rajasthan	Alwar	Vitage Distillers Ltd.	I	151	98	H	40
		RIICO Pump House	I	120	102	M	23
		Regional Office	R	162	105	C	72
	Jaipur	MIA	I	75	106	M	6
		VKIA	I	238	108	C	75
		Ajmeri Gate	R	107	103	C	49
		Chandpole	R	143	106	C	76
		RSPCB Office	R	82	124	H	29
		Vidyadhar Nagar	R	119	108	C	45
	Jodhpur	Basni Indl. Area	I	172	91	H	55
		DIC Office, Industrial Estate	I	116	104	M	26
		M M Police Thane	R	172	99	C	93
		Sojati Gate	R	184	97	C	95
		Housing Board	R	108	103	C	55
		Shastri Nagar	R	137	90	C	68
	Kota	Regional Office	I	125	105	H	34
		Municipal C. Bldg	R	125	105	C	63
		KVK Bhorkhara	R	126	103	C	59
	Udaipur	Regional Office, MIA	I	110	102	M	26
		Ambamata	R	79	104	H	22
		Town Hall	R	75	105	H	22
Tamil Nadu	Chennai	Manali	I	78	91	M	3
		Kathivakkam	I	68	91	M	1
		M C Thiruvottiyur	I	56	71	L	0
		Thiruvottiyur	I	77	114	M	8
		Madras Med. College	R	48	81	M	2
		NEERI CSIR Campus	R	48	93	M	3
	Coimbatore	SIDCO Office	I	116	93	M	15
		Dist. Coll. Office	R	57	95	M	8
		Ponniyarajapuram	R	53	90	M	8

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
	Madurai	Fenners (I) Ltd.	I	43	94	L	0
		Highway Bldg.	R	38	90	M	0
		Kunnathur Chatram	R	44	97	M	0
	Salem	Sowdeswari College	R	78	133	H	0
	Thoothukudi	Raja Agencies	I	132	92	H	34
		AVM Jewellery Bldg.	R	87	98	H	35
		Fisheries College	R	68	94	H	14
Uttar Pradesh	Agra	Nunhai	I	201	83	C	72
		Regional Office	R	185	99	C	96
		DIC, Nunhai	S	246	98	C	90
		Itmad-ud-daulah	S	198	108	C	79
		Rambagh	S	195	102	C	87
		Taj Mahal	S	165	231	C	70
	Anpara	Anpara Colony	I	122	98	H	7
		Renusagar Colony	I	125	100	H	32
	Allahabad	Bharat Yantra Nigam	R	137	99	C	60
		Square Crossing	R	225	101	C	85
	Firozabad	CDGI	I	244	95	C	79
		Raza Ka Tal	R	222	88	C	76
		Tilak Nagar	R	201	93	C	72
	Ghaziabad	Atlas Cycles Ltd	I	215	68	C	93
	Ghaziabad	Bulandshahar R.I.A.	I	257	56	C	98
	Jhansi	Jail Chauraha	R	147	103	C	97
		Veeranga Nagar	R	113	100	C	43
	Kanpur	Fazal Ganj	I	225	81	C	100
		Jajmau	I	210	96	C	100
		Sharda nagar	R	210	83	C	100
		Deputy Ka Parao	R	215	94	C	100
		Kidwai nagar	R	201	90	C	100
	Khurja	CGCRI	I	245	57	C	100
		Ahirpara	R	217	55	C	100
	Lucknow	Talkatora	I	205	96	C	92
		Aminabad	R	192	93	C	100
		Aliganj	R	186	94	C	100
		Kapoor Hotel	R	183	100	C	100
		Mahanagar	R	183	87	C	100
	Meerut	Begum Bridge	R	118	56	C	98
		Thana Railway Road	R	111	66	C	97

State	City	Station	Type	Annual Average	No. of days(n)	Air Quality	% Violation (24 hourly average)
	Noida	GEE-PEE	I	142	94	H	34
		R.O, UPPB	R	154	95	C	97
	Varanasi	Regional Office	R	101	68	C	27
		Sigra	R	111	83	C	55
Uttaranchal	Dehradun	Raipur Road	I	93	2	-	0
		Clock Tower	R	126	34	-	82
West Bengal	Asansol	Asansol M.C.	I	135	104	H	37
	Durgapur (WB)	Dew India Ltd	I	173	104	H	33
		Kwality Hotel	I	136	104	H	36
		PCBL Club	R	89	104	H	38
	Haldia	Super Market	I	62	104	M	5
		WBIIDC	I	61	104	M	6
	Howrah	Bandhaghat	I	102	104	M	22
		Howrah MC	I	114	104	H	32
		Bator	R	97	104	C	36
		Naskarpara	R	95	104	C	36
	Kolkata	Behala Chowrasta	I	89	78	M	13
		Cossipore Police Stn	I	182	97	C	41
		Dunlop Bridge	I	76	78	M	15
		Baishnabghata	R	58	76	M	20
		Kasba	R	149	96	C	52
		Lal Bazar	R	145	97	C	51
		Minto Park	R	60	79	M	20
		Moulali	R	89	76	H	26
		Salt Lake	R	75	78	H	22

Note:
R – Residential and other areas, I – Industrial area, S – Sensitive Areas, Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for n $\geq$ 50 days), % violation – percentage violation of NAAQS (24 hourly average)

CHAPTER-II.IV Air Quality with respect to SUSPENDED PARTICULATE MATTER (SPM)

II.IV.I General environmental concerns of Suspended Particulate Matter

The high SPM levels lead to greater prevalence of health effects depicting sub-clinical effects, impaired pulmonary function, respiratory symptoms, medication use, excess doctor room visit, asthma and bronchitis. The majority of the symptoms are reversible because of better health facilities and greater awareness about diseases. The wide spread criticality of SPM problem in the country is due to the synergistic effect of natural factors like presence of extensively large arid and semi arid region in north west region, loss of moisture from top soil strata, distribution of sea salts with sea winds, natural formation of sulfate and nitrates during secondary reactions. The anthropogenic factors responsible for high SPM are extensive urbanization and construction activities, vehicular population increase, frequent use of captive power generation unit/domestic generation, extensive use of fossil fuel and biomass (wood, leaves etc.) as well as particulate contribution from biological debris.

The summary of Suspended Particulate Matter (SPM) levels in the country are detailed in this chapter. Summary is given in terms of number of monitoring stations in various ranges of annual average concentration and percentage violation. The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard. The four categories are low, moderate, high and critical levels.

II.IV.II Specific environmental concerns of the Suspended Particulate Matter (SPM) along with area type & annual average concentrations

Number of monitoring stations in industrial and residential areas in various ranges of annual average concentration of SPM is depicted in Figure II.IV.I and Figure II.IV.II respectively. National Ambient Air Quality Standard (NAAQS) (annual average) was equal to or exceeded at 23 monitoring stations in industrial areas and 145 monitoring stations in residential areas.

Table II.IV.I and Table II.IV.II show top ten locations in terms of annual average concentration of SPM in residential and industrial areas respectively. The highest concentration in residential area was observed at monitoring station located at Begum Bridge Meerut, Uttar Pradesh and highest concentration in industrial area was observed at monitoring station located at Mayapuri Industrial Area, Delhi.

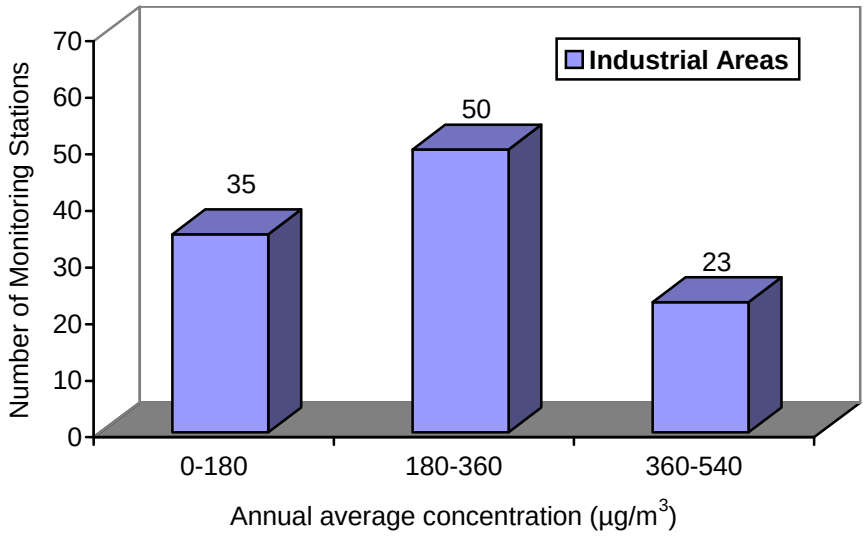

Fig II.IV.I: Number of Monitoring Stations (Industrial Areas) in Various Ranges of Annual Average Concentration of SPM

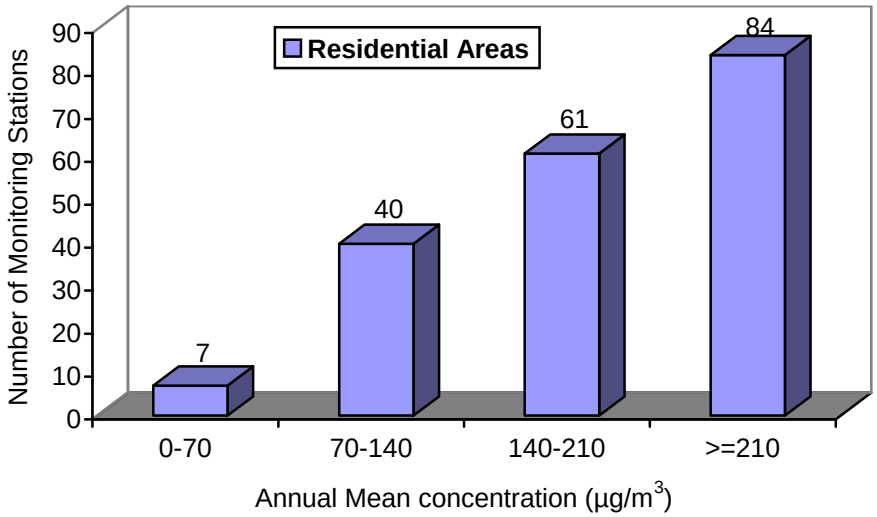

Fig. II.IV.II: Number of Monitoring Stations (Residential Areas) in Various Ranges of Annual Average Concentration of SPM

Table II.IV.I: Top ten locations with respect to SPM during 2008 in residential areas

S. No.	State	City	Location	Annual Average conc. (µg/m^3)
1.	Uttar Pradesh	Meerut	Begum Bridge	709
2.	Uttar Pradesh	Meerut	Thana Railway Road	515
3.	Delhi	Delhi	Town Hall	508
4.	Uttar Pradesh	Kanpur	Deputy Ka Parao	483
5.	Uttar Pradesh	Khurja	Ahirpara	472
6.	Uttar Pradesh	Kanpur	Dabauli	470
7.	Uttar Pradesh	Firozabad	Raza Ka Tal	464
8.	Uttar Pradesh	Kanpur	Kidwai nagar	464
9.	Uttar Pradesh	Noida	R.O, UPPB	449
10.	Rajasthan	Jodhpur	Sojati Gate	437

* - Locations where annual mean concentration of SPM exceeded the NAAQS of 140 µg/m^3 for Residential areas.

Table II.IV.II: Top ten locations with respect to SPM during 2008 in industrial areas

S. No.	State	City	Location	Annual Average conc. (µg/m^3)
1.	Delhi	Delhi	Mayapuri Indl. Area	**529**
2.	Uttar Pradesh	Firozabad	CDGI	515
3.	Uttar Pradesh	Kanpur	Fazal Ganj	496
4.	Uttar Pradesh	Khurja	CGCRI	493
5.	Uttar Pradesh	Kanpur	Jajmau	471
6.	Delhi	Delhi	Shahzada Bagh	460
7.	Delhi	Delhi	Shahdara	459
8.	Uttar Pradesh	Ghaziabad	Bulandshahar R.I.A.	456
9	Haryana	Yamunanagar	Ballarpur Industries	430
10	Uttar Pradesh	Lucknow	Talkatora	429

* - Locations where annual mean concentration of SPM exceeded the NAAQS of 360 µg/m^3 for Industrial areas

II.IV.III Percentage Violation of NAAQS -24 Hourly Average

Number of monitoring stations in various ranges of percentage violation of NAAQS (24 hourly average) of SPM is depicted in Figure II.IV.III. The percentage violation of NAAQS (24 hourly Avg.) was less than 2% at 65 monitoring stations in industrial areas and 38 monitoring stations in residential areas. At all other stations, the percentage violation of NAAQS (24 hourly avg.) was 2% or more.

II.IV.IV Air Quality with respect to Suspended Particulate Matter Pollution Levels-Low, Moderate, High & Critical

Number of monitoring stations with low, moderate, high and critical levels of SPM is depicted in Figure II.IV.IV. SPM levels at 46 % of the monitoring stations in residential areas were critical.

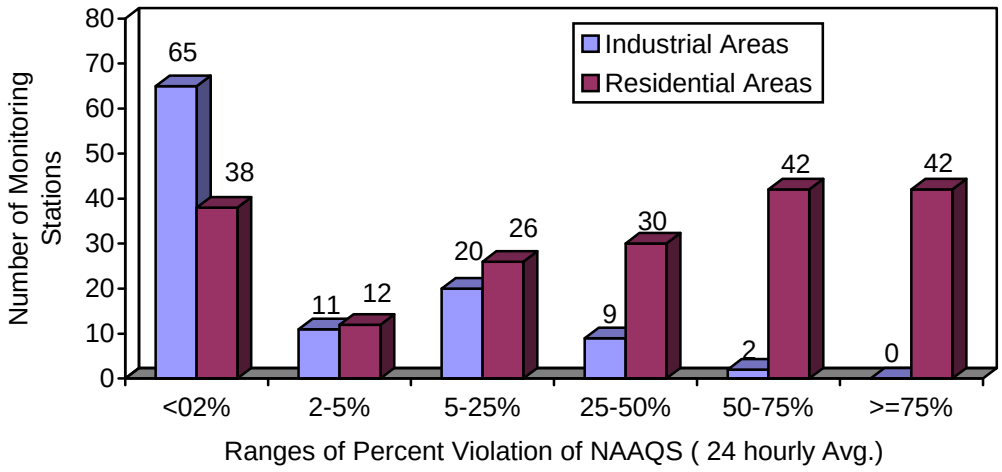

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Fig. II.IV.III: Number of Monitoring Stations in various ranges of Percentage Violation of NAAQS (24-hrly avg.) of SPM

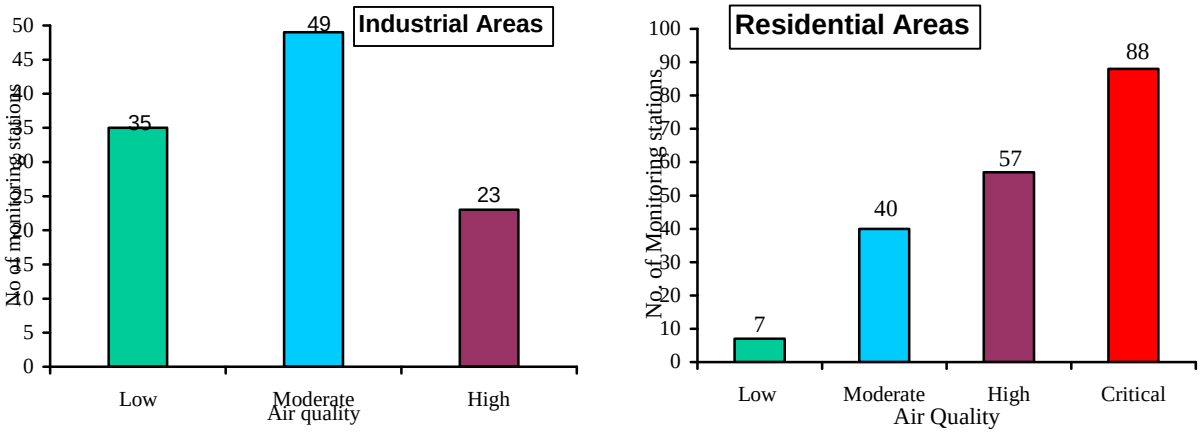

Figure II.IV.IV: Number of Monitoring Stations with Low, Moderate, High and Critical levels of SPM

The annual average concentration of SPM at various monitoring stations is given in Table II.IV.III. The data given is annual average concentration and number of observations with 16 and more hours of monitoring a day. Also, described in the table is air quality in terms of low, moderate, high and critical. SPM levels at many monitoring stations violated the prescribed NAAQS.

SPM levels exceed the prescribed NAAQS in many cities especially in residential areas. Northern cities like Jodhpur, Meerut, Delhi, Kanpur, Khurja, Lucknow, and Varanasi experiences dust storms and hazy conditions during summer months. These dust storms build up particulate matter in ambient air resulting in high SPM levels. The reasons for high Suspended Particulate Matter levels may be natural dust, re-suspension of dust, vehicles, commercial and domestic use of fuel vehicular traffic Diesel/Kerosene gensets, small scale industries, biomass incineration, boilers and emission from power plants, re-suspension of traffic dust, commercial and domestic use of fuels.

Table II.IV.III: Summary of SPM levels of Ambient Air Quality Stations under NAMP during 2008

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
Andhra Pradesh	Hyderabad	C.I.T.D. Balanagar	I	306	110	M	0
		Nacharam	I	104	93	L	0
		Uppal	I	302	108	M	0
		ABIDS Circle	R	192	93	H	42
		Charminar	R	325	106	C	97
		Jubilee Hills	R	155	108	H	12
		Paradise	R	315	108	C	99
		Tarnaka	R	164	98	H	26
		Zoo Park	S	160	107	C	11
	Kurnool	Mourya Inn	R	171	106	H	12
	Patencheru	Police Station	R	246	105	C	58
	Ramagundam	RTC Bus Depot	R	264	101	C	63
	Tirupati	Reg.Science Center	S	109	116	C	63
	Vijaywada	Autonagar	I	238	110	M	0
		Benz Circle	R	201	110	H	58
	Visakhapatnam	Industrial Estate	I	143	112	L	0
		Ganapuram Area	R	223	112	C	1
		Mndi	R	159	111	H	26
		Police Barracks	R	226	113	C	63
		Seethammadhara	R	179	112	H	30
		Naval Area/ ESI Hospital	S	142	112	C	87
Assam	Bongaigaon	Barpara Office Bldg	R	91	106	M	4
		Campus of Oil India	R	113	105	M	8
	Dibrugarh	Dibrugarh Off. Bldg	R	92	96	M	1
	Golaghat	Golaghat Off. Bldg.	R	108	43	-	0
	Guwahati	Fire Brigade Station	R	211	92	C	57
		Gopinath Nagar	R	163	211	H	27
		Head Office	R	233	93	C	67
		Near Pragiyotish College	R	151	225	H	19
	Hailakandi	CISF Campus	R	104	61	M	3
	Sibsagar	Sibasagar Off. Bldg	R	119	57	M	4
	Tezpur	Tezpur Office Bldg	R	131	91	M	21
Bihar	Patna	Beltron Bhawan	R	225	75	C	61
		Gandhi Maidan T	R	390	64	C	95

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
		C					
Chandigarh	Chandigarh	Industrial Area	I	257	153	M	0
		Kaimbwala Village	R	187	152	H	40
		Punjab Eng College	R	181	151	H	33
		Sector-17 C	R	168	154	H	34
		Sector-39	R	196	153	H	42
Chhattisgarh	Bhilai Nagar	M.P.L.U. Nigam	I	264	78	M	0
		Regional Office	R	163	76	H	0
		Visak Hostel	R	179	79	H	6
	Korba	I.T.I, Rampur	R	236	102	C	84
		HIG 21,22, MP Nagar (Extn)	R	226	108	C	72
		Pragati Nagar	R	213	89	C	63
	Raipur	Wool Worth I.Pvt.Ltd	I	385	65	H	12
		New HIG - 9, Hirapur	R	381	67	C	98
		Yatayat Thana	R	337	46	-	100
Dadra & Nagar Haveli	Silvasa	Khadoli Industrial Area	I	228	104	M	0
		Chetan Guest House	R	154	104	H	2
Daman & Diu	Daman	Kadaiya	I	244	104	M	0
		Airport Road	R	178	102	H	22
Delhi	Delhi	Mayapuri Indl. Area	I	529	96	H	54
		Shahdara	I	459	75	H	35
		Shahzada Bagh	I	460	68	H	32
		Janakpuri	R	408	77	C	91
		N.Y. School	R	355	79	C	77
		Nizamuddin	R	406	65	C	92
		Pritampura	R	371	69	C	94
		Siri Fort	R	398	73	C	91
		Town Hall	R	508	96	C	95
Goa	Mormugao	Mormugao Port Trust	I	98	101	L	0
	Panaji	Patto, Panaji	R	103	104	M	0
	Vasco	Electricity Deptt.	I	108	101	L	0
Gujarat	Ahmedabad	Naroda	I	339	104	M	0
		Shardaban Hospital	I	203	98	M	0
		Cadilla Bridge Narol	R	207	105	H	0
		Behrampura	R	194	104	H	37
		L.D. Eng. College	R	177	104	H	12
		R.C. High School	R	198	103	H	40

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
	Anklesvar	Rallies India Ltd	I	214	105	M	0
		Durga Traders	R	154	105	H	0
	Jamnagar	Fisheries Office	R	175	104	H	6
	Rajkot	Sardhara Indl.Corp.	I	218	104	M	0
		Regional Office	R	164	102	H	6
	Surat	Udhna	I	198	103	M	0
		Near A.I. Office	R	171	104	H	0
		S.V.R. Eng. College	R	150	103	H	0
	Vadodara	CETP	I	276	104	M	0
		Dandia Bazar	R	153	105	H	14
		GPCB Office	R	101	104	M	0
	Vapi	GEB	I	167	105	L	0
		Vapi Nagar Palika	R	148	106	H	4
Haryana	Hisar	Guru Jambeshwar Uni	R	163	44	-	0
		Urban Estate-II	R	233	43	-	60
	Yamunanagar	Ballarpur Industries	I	430	13	-	23
	Faridabad	Regional Office	R	312	90	C	100
		M/s Shivalik Global Ltd	I	345	64	M	0
Himachal Pradesh	Baddi	AHC	I	177	10	-	0
		Industry Department	I	334	160	M	9
		Housing Board	R	216	10	-	29
	Damtal	Old Road	R	143	80	H	9
		Regional Office	R	107	101	M	0
	Kala- Amb	Industrial Area	I	427	155	H	28
		Trilok Pur	R	171	157	H	34
	Nalagarh	M.C.	R	164	11	-	27
	Paonta Sahib	Gondpur Indl. Area	I	286	124	M	2
		Paonta Sahib	R	180	147	H	0
	Parwanoo	AC Office Bldg.	I	172	105	L	0
		Central Laboratory	R	132	125	M	10
	Shimla	Bus Stand	R	115	120	M	2
		Tekka Bench Ridge	S	88	136	C	34
Jammu & Kashmir	Jammu	M.A.M. Station	R	162	42	-	21
Jharkhand	Dhanbad	Regional Office	R	190	92	H	35
	Jamshedpur	Bistupur Vehicle TC	I	272	92	M	0
		Golmuri Vehical TC	I	293	82	M	0
	Jharia	M.A.D.A.	I	279	44	-	5

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
	Ranchi	Albert Ekka Chowk	R	324	91	C	13
	Sindri	BIT	I	198	86	M	0
Karnataka	Bangalore	Graphite India	I	408	78	H	31
		KHB Indl Area	I	205	120	M	1
		Peenya Indl. Area	I	324	92	M	8
		AMCO Batteries	R	208	102	H	44
		Yeshwanthpura	R	288	105	C	69
		Victoria Hospital	S	204	104	C	100
	Belgaum	Karnataka SPCB	I	72	100	L	0
	Gulbarga	Govt. Hospital	S	210	94	C	99
	Hassan	KSRTC Bus Stand	R	123	107	M	0
	Hubli-Dharwad	L. Industrial Area	I	210	80	M	0
		Rani C. Circle	R	223	95	C	51
	Mangalore	Baikampady Indl. Area	I	118	105	L	0
	Mysore	K.R. Circle	R	97	103	M	0
		Hebbal Industrial Area	I	94	97	L	0
Kerala	Kochi	Eloor	I	105	91	L	0
		Kalamassery	I	101	84	L	0
		Irumpanam	I	62	107	L	0
		Eloor II	I	77	94	L	0
		Ernakulum South	R	88	108	M	0
		FCI, OEN C. O. Bldg	R	58	62	L	0
		M.G. Road	R	67	101	L	1
	Kottayam	Vadavathoor	I	39	96	L	0
		Kottayam	R	61	97	L	0
	Kozhikode	Nallalam	I	76	108	L	0
		Kozhikode City	R	83	106	M	0
	Palakkad	SEPR Refractories India Ltd. Kanjikode	I	137	102	L	4
	Trivandrum	Hi Tech Chackai	I	97	100	L	0
		PRS Hospital	S	75	101	H	2
		Sasthamangalam	R	58.9	96	L	0
		SMV School	R	76	101	M	1
Maharashtra	Aurangabad (MS)	C.A.D.A. Office	R	214	93	C	60
		S.B.E.S. College	R	316	92	C	82
		Bibi-Ka-Maqbara	S	176	90	C	84
	Chandrapur	M.I.D.C.	I	215	83	M	2
		Nagar Parishad	R	233	88	C	56

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
		SRO, Bapat Nagar	R	264	87	C	64
	Kolhapur	Mahadwar Road	R	193	103	H	51
		Ruikar Trust Dabhlkar Corner	R	251	101	C	71
		Shivaji University	R	142	78	H	12
	Lote	MIDC WTP	I	127	52	L	0
		Chalke Wadi	R	155	52	H	27
	Mumbai	Parel	I	272	96	M	4
		Kalbadevi	R	251	94	C	57
		Worli	R	256	99	C	70
	Nagpur	Hingna Road	I	256	93	M	1
		MIDC Office	I	185	93	M	2
		Govt. Poly. College	R	155	79	H	19
		Institution of Eng.	R	166	94	H	30
		Maskasath	R	228	78	C	62
		NEERI Lab	R	165	94	H	33
	Nashik	VIP Industrial Area	I	153	100	L	0
		NMC Building	R	176	105	H	40
		RTO Colony Tank	R	135	96	M	17
	Navi Mumbai	MIDC Taloja	I	421	101	H	32
		MPCB Central Lab	I	285	84	M	11
		Airoli	R	216	106	C	52
		MESB Power Station	R	266	102	C	60
		Nerul	R	252	112	C	54
		Panvel Water Works	R	421	100	C	67
	Pune	Bhosari	I	286	101	M	3
		Nalstop	R	253	103	C	66
		Swargate	R	257	100	C	63
	Solapur	WIT Campus	I	245	105	M	0
		Voronoko Primary School	R	245	104	C	88
	Tarapur	MIDC Office Compound	I	101	36	-	0
		Police Chowki	I	129	35	-	0
		Sports Stadium	I	104	37	-	0
	Thane	Balkum/Kolshet	I	135	78	L	0
		Kopri	R	127	78	M	1
		Naupada	R	126	81	M	0
Manipur	Imphal	Secretariat Building	R	238	20	-	60
Meghalaya	Shillong	Boards Office	R	63	87	L	0

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
		MUDA Complex , Police Bazar	R	119	36	-	0
Mizoram	Aizawl	Bawngkawn	R	95	102	M	0
		Khatla	R	87	104	M	0
		Laipuitlang	R	59	103	L	0
Madhya Pradesh	Bhopal	Govindpura	I	205	47	-	0
		Arera Colony	R	356	54	C	98
		Hamidia Road	R	308	53	-	83
		T.T.Nagar	R	120	63	M	11
	Dewas	EID Perry (I) Ltd.	I	218	99	M	5
		Vikas Nagar	R	187	93	H	26
	Gwalior	Dindayal Nagar	R	234	79	C	62
		Maharaj Bada	R	306	26	-	88
	Indore	Polo Ground	I	357	87	M	1
		Kothari Market	R	325	86	C	99
		Telephone Nagar	R	203	93	H	61
	Jabalpur	Vijay Nagar	R	297	91	C	100
	Nagda	Chem. D. Labour Club	I	158	74	L	0
		Grasim Guest House No.2	R	132	87	M	1
		Grasim Kalyan Kendra	R	141	84	H	2
	Sagar	Pt. Deendayal Nagar	R	232	99	C	68
	Satna	Sub-Divisional Off.	I	410	70	H	10
		Regional Office	R	166	68	H	17
	Singrauli	Jayant Township	R	386	24	-	100
		N.T.P.C., Vidyanagar	R	326	30	-	100
		Waidhan	R	227	23	-	96
	Ujjain	District Office	I	317	98	M	0
		Regional Office	R	151	85	H	25
		Mahakal Temple	S	174	75	C	81
Nagaland	Dimapur	Bank Colony	R	122	99	M	2
		Dhobinala	R	131	99	M	6
Orissa	Angul	Industrial Estate	I	282	95	M	2
		NALCO Township	R	172	58	H	23
	Berhampur	Regional Office	R	154	104	H	23
	Bhubaneshwar	OSPCB Bldg	R	158	108	H	13
		Capital Police Stn.	R	166	101	H	21
		IRC Village	R	157	101	H	18
	Cuttack	Roof of Traffic Tower Cuttack	R	281	104	C	71
		R.O. Cuttack	R	167	86	H	29

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
	Rayagada	Jaykaypur	I	112	103	L	0
		Regional Office	R	121	107	M	1
	Rourkela	IDL Police Out-post	R	215	105	C	76
		Regional Office	R	188	104	H	27
	Sambalpur	PHD Ofice, Sambalpur	R	130	110	M	0
	Talcher	Coal Field Area	I	234	94	M	0
		T.T.P.S Colony	I	189	96	M	0
Punjab	Amritsar	Nagina Soap Factory	I	409	78	C	1
		A-1 Platters	R	467	54	H	100
	Bathinda	Bathinda Milk Plant	I	209	88	M	0
	Dera Bassi	M/s Punjab Chemicals Ltd.	I	213	130	M	0
	Naya Nangal	Winsome Yarns Ltd	I	210	120	M	0
		NFL Guest House	R	203	108	H	58
Pondicherry	Pondicherry	PIPDIC	I	82	62	L	0
		Chamber of Commerce	R	69	85	L	1
		DSTC Office	R	125	68	M	9
Rajasthan	Alwar	Vitage Distillers Ltd.	I	269	98	M	2
		RIICO Pump House	I	214	102	M	0
		Regional Office	R	307	105	C	80
	Jaipur	MIA	I	198	106	M	4
		VKIA	I	427	108	H	32
		Ajmeri Gate	R	285	102	C	77
		Chandpole	R	373	105	C	95
		RSPCB Office	R	202	124	H	44
		Vidyadhar Nagar	R	269	108	C	66
	Jodhpur	Basni Indl. Area	I	415	90	H	18
		DIC Office, Industrial Estate	I	354	104	M	11
		M M Police Thane	R	425	99	C	97
		Sojati Gate	R	437	97	C	98
		Housing Board	R	330	103	C	86
		Shastri Nagar	R	395	90	C	96
	Kota	Regional Office	I	273	105	M	5
		Municipal C. Bldg	R	253	105	C	65
		KVK Bhorkhara	R	253	103	C	62
	Udaipur	Regional Office, MIA	I	357	102	M	16
		Ambamata	R	250	104	C	73

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
		Town Hall	R	243	105	C	73
Tamil Nadu	Chennai	Manali	I	174	91	L	0
		Kathivakkam	I	175	91	L	2
		M C Thiruvottiyur	I	127	71	L	0
		Thiruvottiyur	I	173	114	L	0
		Madras Med. College	R	108	81	M	0
		NEERI CSIR Campus	R	94	93	M	2
	Coimbatore	SIDCO Office	I	221	93	M	0
		Dist. Coll. Office	R	96	95	M	0
		Ponniyarajapuram	R	89	90	M	2
	Madurai	Fenners (I) Ltd.	I	89	94	L	0
		Highway Bldg.	R	82	90	M	0
		Kunnathur Chatram	R	92	97	M	0
	Salem	Sowdeswari College	R	122	132	M	2
	Thoothukudi	Raja Agencies	I	231	92	M	11
		AVM Jewellery Bldg.	R	144	98	H	0
		Fisheries College	R	106	94	M	4
Uttar Pradesh	Agra	Nunhai	I	396	84	H	11
		Regional Office	R	356	108	C	95
		DIC, Nunhai	S	565	97	C	98
		Itmad-ud-daulah	S	444	102	C	98
		Rambagh	S	427	105	C	98
		Taj Mahal	S	305	230	C	84
	Anpara	Anpara Colony	I	259	98	M	0
		Renusagar Colony	I	243	100	M	0
	Allahabad	Bharat Yantra Nigam	R	292	99	C	70
		Square Crossing	R	646	101	C	94
	Firozabad	CDGI	I	519	95	H	67
		Raza Ka Tal	R	473	88	C	83
		Tilak Nagar	R	423	93	C	81
	Ghaziabad	Atlas Cycles Ltd	I	411	67	H	1
		Bulandshahar R.I.A.	I	456	55	H	24
	Jhansi	Jail Chauraha	R	292	103	C	73
		Veeranga Nagar	R	239	100	C	60
	Kanpur	Fazal Ganj	I	496	81	H	49
		Jajmau	I	471	96	H	30
		Sharda nagar	R	470	83	C	100
		Deputy Ka Parao	R	483	94	C	100

State	City	Station	Type	Annual Average	No. of days (n)	Air Quality	% Violation (24 Hourly average)
		Kidwai nagar	R	464	90	C	100
	Khurja	CGCRI	I	493	57	H	0
		Ahirpara	R	472	55	C	100
	Lucknow	Talkatora	I	429	96	H	8
		Aminabad	R	402	93	C	100
		Aliganj	R	389	94	C	100
		Kapoor Hotel	R	388	100	C	100
		Mahanagar	R	386	87	C	100
	Meerut	Begum Bridge	R	709	56	C	100
		Thana Railway Road	R	513	66	C	100
	Noida	GEE-PEE	I	424	94	H	5
		R.O, UPPB	R	449	95	C	100
	Varanasi	Regional Office	R	295	68	C	45
		Sigra	R	351	83	C	65
Uttaranchal	Dehradun	Raipur Road	I	190	13	-	0
		Clock Tower	R	294	39	-	92
West Bengal	Asansol	Asansol M.C.	I	296	104	M	14
	Durgapur (WB)	Dew India Ltd	I	374	104	H	28
		Kwality Hotel	I	299	104	M	15
		PCBL Club	R	203	104	H	41
	Haldia	Super Market	I	129	104	L	0
		WBIIDC	I	135	104	L	0
	Howrah	Bandhaghat	I	234	104	M	0
		Howrah MC	I	250	104	M	7
		Bator	R	204	104	H	41
		Naskarpara	R	204	104	H	42
	Kolkata	Behala Chowrasta	I	205	78	M	4
		Cossipore Police Station	I	374	97	H	23
		Dunlop Bridge	I	177	78	L	0
		Baishnabghata	R	132	76	M	20
		Kasba	R	308	87	C	64
		Lal Bazar	R	322	97	C	69
		Minto Park	R	143	79	H	22
		Moulali	R	189	76	H	30
		Salt Lake	R	172	78	H	26

Note: R – Residential and other areas, I – Industrial area, S – Sensitive Areas, Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for n $\geq$ 50 days), % violation – percentage violation of NAAQS (24 hourly average).

CHAPTER- II.V
ADDITIONAL AIR POLLUTANTS

This chapter provides data of additional pollutants monitored in the country. Additional pollutants monitored are ***Ammonia, carbon monoxide, fine particulate matter with size less than 2.5 micrometer ($PM_{2.5}$), Hydrogen sulphide (H_2S) and Ozone***. Ammonia and Hydrogen Sulphide is measured in six major cities namely Hyderabad, Delhi, Mumbai, Nagpur, Chennai and Kolkata and $PM_{2.5}$, Carbon Monoxide and Ozone is regularly measured in Delhi.

II.V.I General Environmental concerns of additional parameters:

Particulate Matter-$PM_{2.5}$

Particulate Matter with a diameter up to 2.5 µm is known to be $PM_{2.5}$. Airborne particles smaller than 2.5 µm ($PM_{2.5}$) are usually called fine particles. These particles may penetrate deep inside the airways and are more strongly linked to adverse health effects (USEPA, 1996). Fine particles are composed mainly of carbonaceous materials (organic and elemental), inorganic compounds (sulfate, nitrate, and ammonium), and trace metal compounds (iron, aluminium, nickel, copper, zinc, and lead). There are potentially thousands of different compounds existing on fine particles that may exert harmful biological effects. On any day or location, the PM mass concentration may be similar, yet the composition may vary greatly enough to differentially impact human health. The relationship between PM_{10} or $PM_{2.5}$ exposure and acute health effects is linear at concentrations below 100 $\mu g/m^3$. A modest rise in PM_{10} or $PM_{2.5}$ level has been shown to be associated with small changes in cardiac function. Exposure to the fine particles induces oxidative stress in Human body.

Carbon monoxide (CO)

Carbon monoxide (CO) is a toxic gas emitted into the atmosphere as a result of combustion processes. CO is also formed by the oxidation of hydrocarbons and other organic compounds. CO is produced almost entirely (90%) from road traffic in European cities. It remains in the atmosphere for approximately one month before being oxidized to CO_2. The largest contributors of CO are petrol-fuelled vehicles. CO binds strongly to hemoglobin in red blood corpuscles resulting in the production of carboxy-hemoglobin (COHb). This impairs the transport of oxygen within the blood and can result in adverse effect on tissues with high oxygen needs such as the cardiovascular and nervous systems. High concentration (>1000 ppm) for prolonged hours (>8 hr) can give rise to hypoxia. A study has shown that chronic exposures to CO may cause adverse birth outcomes such as reduced birth weight and intrauterine growth retardation.

Volatile organic compounds (VOCs)

VOCs consist of various classes of carbon-containing chemicals that are gases at room temperature. They are released into the environment from petrol and diesel, especially the former, by evaporation or as combustion products. Some VOCs (e.g. benzene) are

human carcinogens while others are either respiratory tract irritants or neurotoxic (e.g. toluene, xylene).

Benzene, a VOC, is a minor constituent of petrol. It is produced from combustion and evaporation of both petrol and diesel, especially the former. Combustion of petrol is the largest source (70% of total emissions) of benzene in air. Airborne benzene is primarily absorbed through the respiratory tract and then transported by blood to critical target organs. Therefore, it is possible that cumulative exposure to benzene could lead to systemic changes. Benzene has been found very harmful for human health for its hematotoxic, neurotoxic, leukemogenic and carcinogenic effects and because of this a sustained worldwide effort is on to reduce benzene exposure as far as possible.

II.V.II. Specific Environmental concerns of Ammonia Levels in some Indian cities

Ammonia levels measured in six major cities namely Delhi, Mumbai, Chennai, Kolkata, Nagpur and Hyderabad by National Environmental Engineering Research Institute (NEERI) under National Air Quality Monitoring Programme (NAMP) of CPCB are detailed below.

Annual average concentration of ammonia has been compared with the NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard). The four categories are low, moderate, high and critical as explained in earlier chapters. Low levels were observed in Nagpur, Chennai and Kolkata. Moderate levels were observed in Delhi and residential areas of Hyderabad. There was no violation of NAAQS (annual average and 24 hourly averages) at all the monitored locations. The air quality with respect to ammonia levels is given in Table II.V.I. Annual average concentration of ammonia at 18 monitoring stations in 6 cities are given in Table II.V.II

Table II.V.I: Ambient Air Quality with respect to Ammonia in India during 2008

Pollution level	**Annual Mean Concentration Range (µg/m^3)**	
Low (L)	0-50	
Moderate (M)	50-100	
High (H)	100-150	
Critical (C)	> 150	
STATE, UT / CITY	**Ammonia**	
AREA CLASS	**Industrial Areas**	**Residential Areas**
Andhra Pradesh		
Hyderabad	L	M
Delhi		
Delhi	M	M
Maharashtra		
Mumbai	M	L
Nagpur	L	L
Tamil Nadu		
Chennai	L	L
West Bengal		
Kolkata	L	L

Table II.V.II: Summary of Ammonia Levels during 2008

Sl. No.	STATE/UT	CITY	LOCATION	Type of Area	Average ($\mu g/m^3$)	No. of days (n)	% Violation wrt NAAQS (24 hourly avg.)	Air Quality
1	Andhra Pradesh	Hyderabad	Nacharam	I	38	96	0	L
			Tarnaka	R	48	95	0	L
			ABIDS Circle	R	58	94	0	M
2	Delhi	Delhi	Mayapuri Ind. Area	I	76	95	0	M
			Sarojini Nagar	R	74	78	0	M
			Town Hall	R	76	96	0	M
3	Maharashtra	Mumbai	Parel	I	53	97	0	M
			Worli	R	40	96	0	L
			Kalbadevi	R	49	93	0	L
		Nagpur	Hingna Road	I	36	95	0	L
			Maskasath	R	32	77	0	L
			NEERI Lab., Nehru Marg	R	31	92	0	L
4	Tamil Nadu	Chennai	Thiruvottiyur Municipal Office	I	24	85	0	L
			Madras Medical College	R	14	81	0	L
			NEERI CSIR Campus	R	14	88	0	L
5	West Bengal	Kolkata	Cossipore	I	7	96	0	L
			Lal Bazaar	R	7	95	0	L
			Kasba	R	8	94	0	L

Note: R – Residential and other areas, I – Industrial area, Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for n $\geq$ 50 days), % violation with respect to NAAQS (24 hourly avg.) – Percentage violation wrt NAAQS (24 hourly average)

II.V.III Carbon Monoxide

a) CO levels at BSZ Marg (ITO)

Carbon monoxide is monitored at Bahadur Shah Zafar (BSZ) Marg, New Delhi using Non-Dispersive Infrared Spectrometry (NDIR) method. Monthly average and annual average concentration of CO is given in Table II.V.III. The annual average concentration of CO was 2249 $\mu g/m^3$ during 2008 and monthly average concentration varied from

1528 µg/m^3 to 3312 µg/m^3. High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi.

Table II.V.III: Concentration of Carbon Monoxide (CO) at BSZ Marg New Delhi during 2008

Months of 2008	CO Concentration (µg/m^3)
January	2242
February	2404
March	2229
April	1528
May	2144
June	2226
July	1931
August	1556
September	1836
October	2784
November	3312
December	2799
Annual Average	**2249**

b) CO levels at Siri Fort, Delhi

Carbon monoxide is monitored at Siri Fort, New Delhi using Non-Dispersive Infrared Spectrometry (NDIR) method. Monthly average and annual average concentration of CO is given in Table II.V.IV. The annual average concentration of CO was 1198 µg/m^3 during 2008 and the monthly average concentration varied from 787 µg/m^3 to 2134 µg/m^3. High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi.

Table II.V.IV: Concentration of Carbon Monoxide (CO) at Siri Fort, New Delhi during 2008

Months of 2008	CO Concentration (µg/m^3)
January	1505
February	1213
March	1248
April	1067
May	865
June	787
July	821
August	996
September	932
October	1336
November	2134
December	1471
Average	**1198**

c) CO levels at Delhi College of Engineering (DCE), Bawana, Delhi

Carbon monoxide is monitored at Delhi College of Engineering (DCE), Bawana, Delhi using Non-Dispersive Infrared Spectrometry (NDIR) method. Monthly average and annual average concentration of CO is given in Table II.V.V. The annual average concentration of CO was 1005 µg/m^3 during 2008. The monthly average concentration varied from 746 µg/m^3 to 1759 µg/m^3.

Table II.V.V: Concentration of Carbon Monoxide (CO) at DCE, Bawana, Delhi during 2008

Months of 2008	CO Concentration (µg/m^3)
January	809
February	905
March	814
April	789
May	991
June	904
July	879
August	746
September	761
October	1115
November	1593
December	1759
Average	**1005**

II.V.IV. Ozone levels

a) Ozone level at BSZ Marg (ITO)

Ozone was measured at BSZ Marg(ITO) using continuous analysers. Monthly average and annual average concentration of Ozone are given in Table II.V.VI. The annual average concentration of Ozone was 40 µg/m^3 during 2008. The monthly average concentration of ozone varied from 22 µg/m^3 to 61 µg/m^3.

Table II.V.VI: Concentration of Ozone at BSZ Marg (ITO), New Delhi during 2008

Months of 2008	Ozone Concentration (µg/m^3)
January	22
February	29
March	43
April	43
May	34
June	48
July	47
August	58
September	61
October	40
November	33
December	26
Average	**40**

Higher ozone concentrations are observed, in general, in Summer months as it is formed by photochemical reactions of NOx and VOCs. Ozone concentrations tend to peak in early to mid afternoon in areas where there is strong photochemical activity.

b) Ozone levels at Siri Fort, Delhi

Ozone was measured at Siri Fort using continuous analysers. Monthly average and annual average concentration of Ozone are given in Table II.V.VII. The annual average concentration of Ozone was 31µg/m^3 during 2008. The monthly average concentration of ozone varied between14 µg/m^3 to 48 µg/m^3.

Table II.V.VII: Concentration of Ozone at Siri Fort, New Delhi during 2008.

Months of 2008	Ozone Concentration (µg/m^3)
January	14
February	17
March	20
April	22
May	35
June	48
July	37
August	46
September	37
October	44
November	34
December	18
Average	31

Higher ozone concentrations are observed, in general, in summer months as it is formed by photochemical reactions of NOx and VOCs. Ozone concentrations tend to peak in early to mid afternoon in areas where there is strong photochemical activity.

c) Ozone levels Delhi College of Engineering (DCE), Bawana

Ozone was measured at Delhi College of Engineering (DCE) using continuous analysers. Monthly average and annual average concentration of Ozone are given in Table II.V.VIII. The annual average concentration of Ozone was 45 µg/m^3 during 2008. The monthly average concentration of ozone varied from 17 µg/m^3 to 72 µg/m^3.

Table II.V.VIII: Concentration of Ozone at DCE, Bawana, Delhi during 2008

Months of 2008	Ozone Concentration (µg/m^3)
January	NA
February	NA
March	72
April	68
May	63

June	52
July	59
August	19
September	17
October	33
November	35
December	27
Average	45

NA – Data not available/not adequate

Higher ozone concentrations are observed, in general, in summer months as it is formed by photochemical reactions of NOx and VOCs. Ozone concentrations tend to peak in early to mid afternoon in areas where there is strong photochemical activity.

II.V.V Particulate matter with size less than 2.5 μm ($PM_{2.5}$)

Particulate matter with size less than 2.5 micrometer ($PM_{2.5}$) was measured at BSZ Marg (ITO), New Delhi using continuous analyzers. Monthly average and annual average concentration of $PM_{2.5}$ are given in Table II.V.IX. The annual average concentration of $PM_{2.5}$ was 137 μg/m^3 during 2008. The monthly average concentration of $PM_{2.5}$ varied between 49 μg/m^3 to 230 μg/m^3. Higher $PM_{2.5}$ levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matter is washed out due to wet deposition.

Table II.V.IX: Concentration of $PM_{2.5}$ at BSZ Marg (ITO), Delhi during 2008

Months of 2008	**$PM_{2.5}$ Concentration (μg/m^3)**
January	152
February	178
March	134
April	80
May	63
June	49
July	NA
August	NA
September	NA
October	159
November	230
December	191
Average	137

NA – Data not available/not adequate

CHAPTER-III
AIR QUALITY TRENDS

Air quality trends are depicted in this chapter. Trends are plotted for annual average concentrations. Trends are depicted for sulphur dioxide, nitrogen dioxide, respirable suspended particulate matter for sixteen cities as well as Mega cities (Four Major Urban Centers) of the country and carbon monoxide emissions for the capital city Delhi.

III.I. Air Quality of Sixteen cities (Urban Centers): Trends in Annual Average Concentrations

Central Pollution Control Board has also identified various non- attainment cities all over the country on the basis of national ambient air quality data under NAMP. Central Pollution has been coordinating with the concerned state governments of the sixteen critically polluted cities identified by the Hon'ble Supreme Court of India as well as non-attainment cities identified by itself for the preparation of action plan for the control of air pollution in all these cities. Further CPCB is also reviewing and monitoring the implementation of the action plans prepared for these critically polluted as well as non- attainment cities. ***A list of sixteen cities as identified by the Supreme Court of India is given in Table III.I.***

Table III.I: List of 16 cities identified by the Hon'ble Supreme Court of India

Sl. No.	List of 16 cities identified by the Hon'ble Supreme Court of India
1	**Cities to be reviewed by Ministry of Environment & Forests (MOEF) (7 cities)** Agra, Jharia, Varanasi, Faridabad, Patna, Jodhpur and Pune.
2	**Cities to be reviewed by Environmental Protection (Prevention & Control) Control Authority (EPCA) (7 cities)** Ahmedabad, Kanpur, Sholapur, Lucknow, Bangalore, Chennai and Hyderabad
3	**Cities being reviewed by the respective Hon High Courts of the cities (2 cities)** Mumbai and Kolkata

So far State Governments of the all the sixteen critically polluted cities as identified by the Hon'ble Supreme Court of India have submitted their action plan for controlling air Pollution from all the major sources including industrial, vehicular & domestic sources. The major actions those have been proposed for almost all the cities are:

- **Industrial Pollution**
  - Shifting of Industries from non- confirming zones.
  - Switching over to clean technologies.
  - Using clean fuels.
  - Installation of Pollution control Devices.
  - Development of green belt, etc.
- **Vehicular Pollution**
  - Implementation of the emission norms as well as fuel quality in accordance with the road map proposed by the Auto Fuel Policy.

- Switching over to clean alternate fuels like CNG, LPG & Bio-fuels.
- Augmentation in Public Transport system
- Better traffic management
- Implementation of fiscal measures, etc

➢ **Domestic Pollution**

- Ban on open burning of garbage, biomass, etc.
- Augmentation on supply of LPG as cooking fuel, etc.

Central Pollution Control Board along with EPCA has been regularly reviewing action plan submitted by State Pollution Control Boards, further it is also monitoring the timely implementation of the action plan. The trend analysis including annual average concentrations of SO_2, NO_2, and RSPM in seventeen cities are described below.

(a) SO_2

Trend in annual average concentration of SO_2 in residential areas of Delhi, Mumbai, Chennai and Kolkata is depicted in Figure III.I. Trend in annual average concentration of SO_2 in residential areas of Hyderabad, Bangalore, Ahmedabad and Lucknow is depicted in Figure III.II. Trend in annual average concentration of SO_2 in Jodhpur, Agra, Faridabad and Solapur is depicted in Figure III.III. Trend in annual average concentration of SO_2 in Kanpur, Pune, Jharia, Patna and Varanasi is depicted in Figure III.IV. SO_2 levels are within the prescribed National Ambient Air Quality Standards in residential areas. A decreasing trend was observed in residential areas of Delhi, Lucknow and Pune. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as CNG in Delhi etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality. Also there has been a change in domestic fuel used from coal to LPG which may have contributed to reduction in ambient levels of SO_2.

(b) NO_2

Trend in annual average concentration of NO_2 in residential areas of Delhi, Mumbai, Chennai and Kolkata is depicted in Figure III.V. Trend in annual average concentration of NO_2 in residential areas of Hyderabad, Bangalore, Ahmedabad and Lucknow is depicted in Figure III.VI. Trend in annual average concentration of NO_2 in Jodhpur, Agra, Faridabad and Solapur is depicted in Figure III.VII. Trend in annual average concentration of NO_2 in Kanpur, Pune, Jharia, Patna and Varanasi is depicted in Figure III.VIII. NO_2 levels were within the prescribed NAAQS in residential areas. No definite trend has been observed in ambient nitrogen dioxide levels. In some cities ambient NO_2 levels are decreasing whereas in some cities the trend is fluctuating. Although various interventions have taken place to mitigate ambient NO_2 levels but at the same time number of vehicles has increased exponentially. The vehicles are one of the major sources of NO_2. Measures taken to mitigate ambient NO_2 levels are introduction of improved vehicular technology in the form of Bharat Stage-III vehicles, banning of old vehicles in some cities, improved traffic management etc.

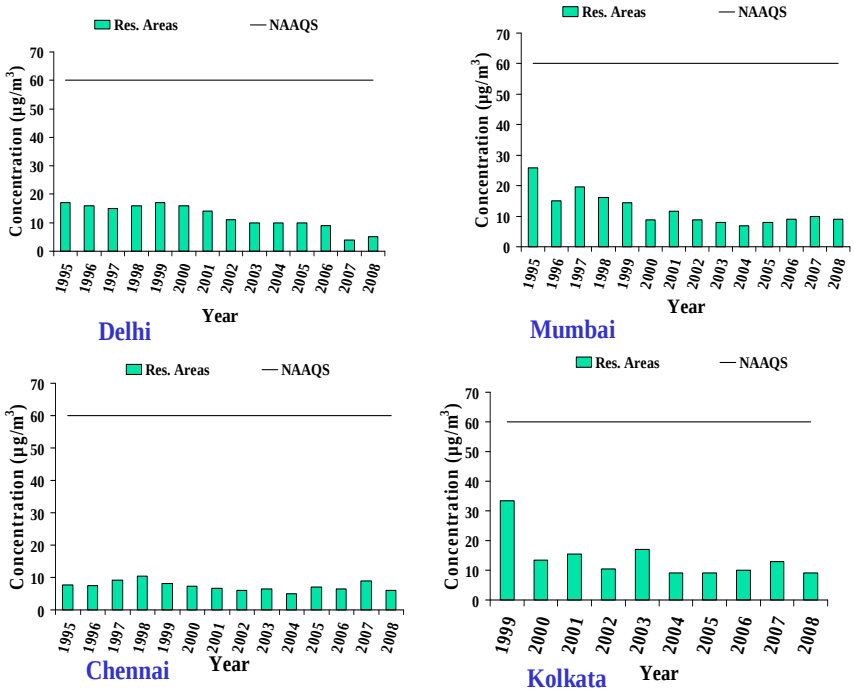

Fig: III.I. Trends in Annual Average Concentration of SO_2 in residential areas of Delhi, Mumbai, Chennai and Kolkata.

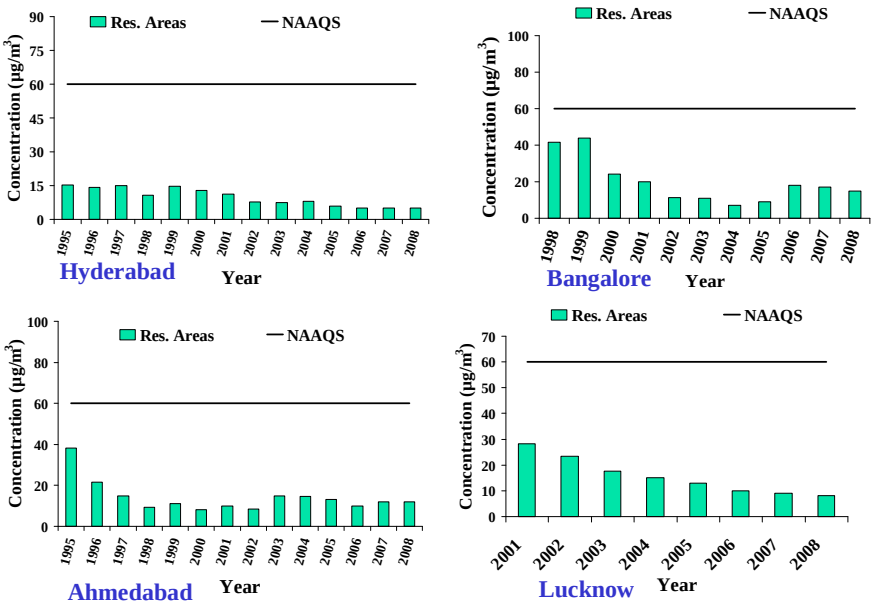

Fig. III.II: Trends in Annual Average Concentration of SO_2 in residential areas of Hyderabad, Bangalore, Ahmedabad and Lucknow.

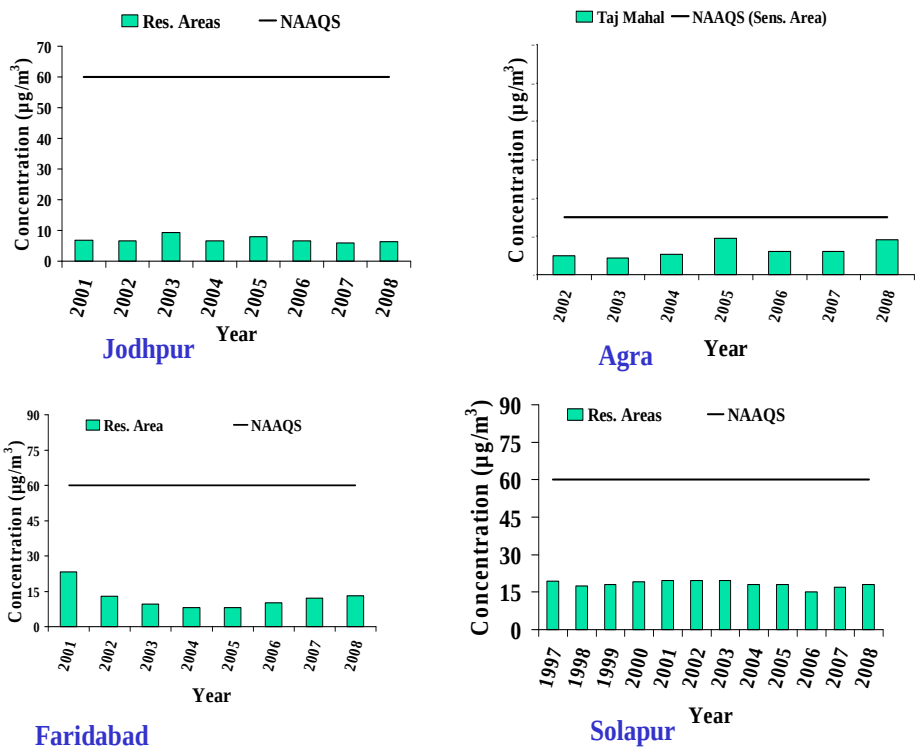

Fig III.III: Trends in Annual Average Concentration of SO_2 in Jodhpur, Agra, Faridabad and Solapur.

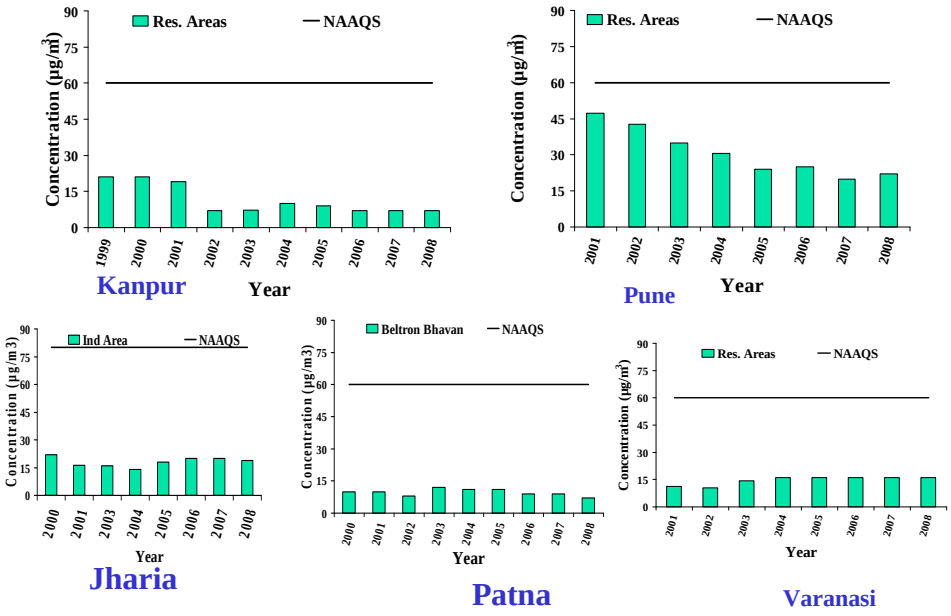

Fig. III.IV: Trends in Annual Average Concentration of SO_2 in Kanpur, Pune, Jharia, Patna and Varanasi

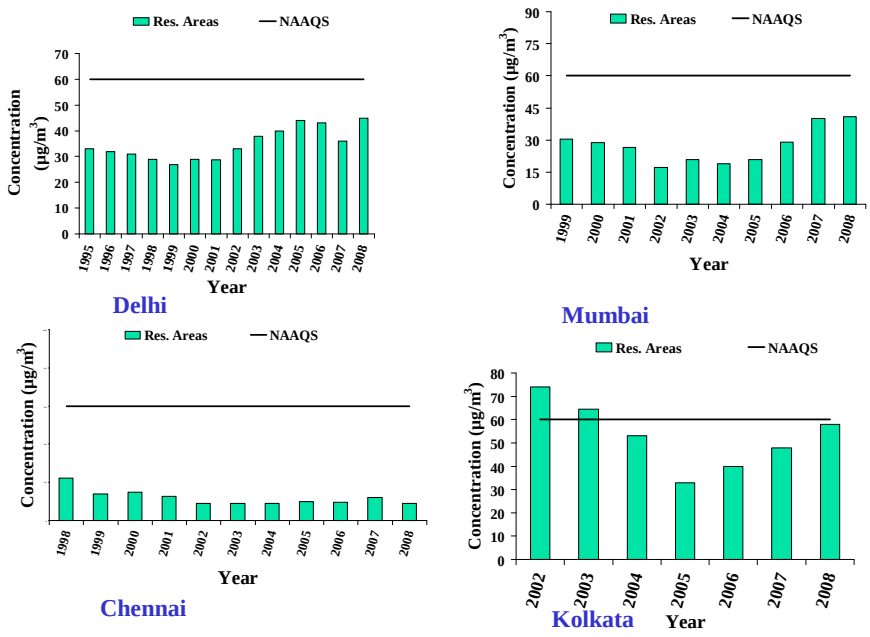

Fig. III.V: Trends in Annual Average Concentration of NO_2 in residential areas of Delhi, Mumbai, Chennai and Kolkata

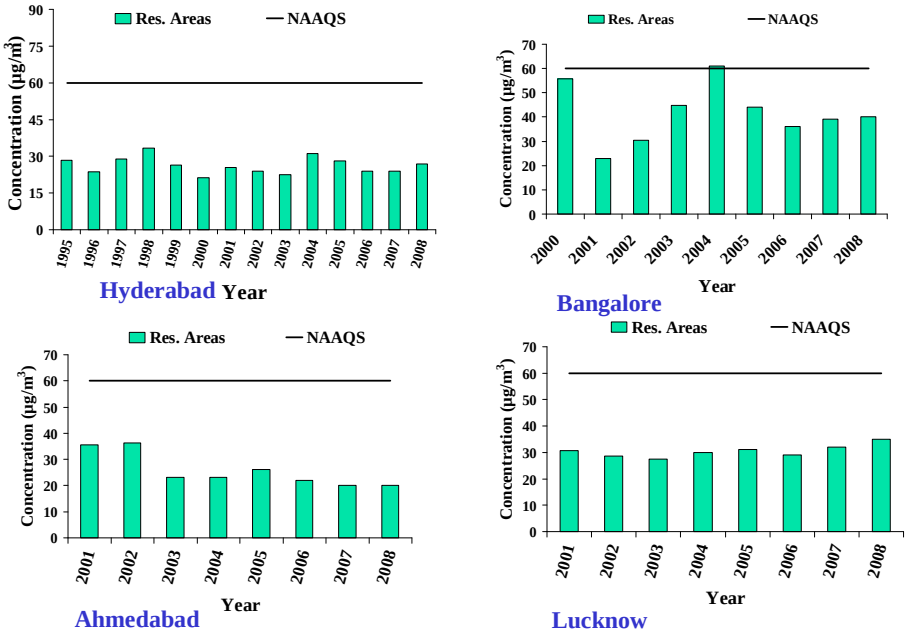

Fig. III.VI: Trends in Annual Average Concentration of NO_2 in residential areas of Hyderabad, Bangalore, Ahmedabad and Lucknow

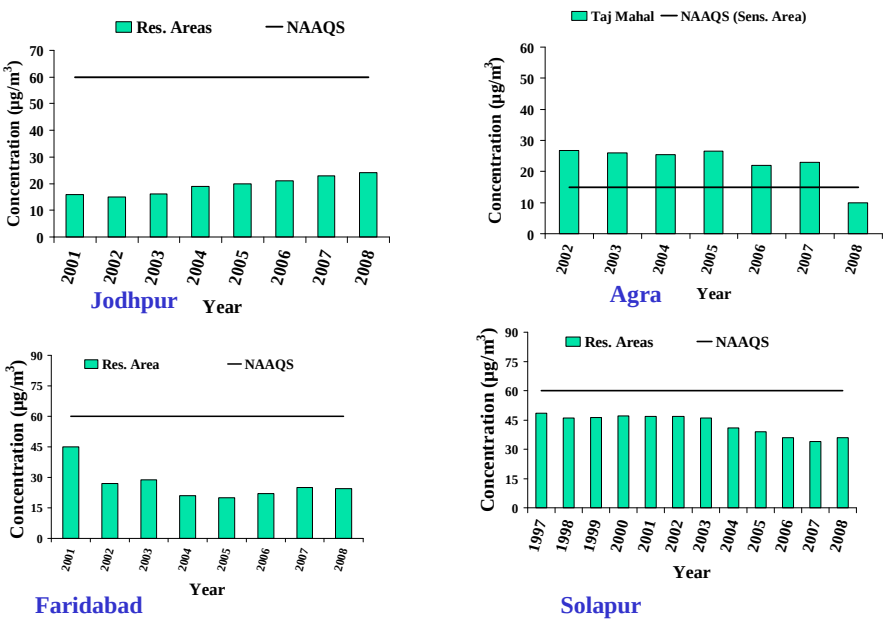

Fig. III.VII: Trends in Annual Average Concentration of NO_2 in Jodhpur, Agra, Faridabad and Solapur

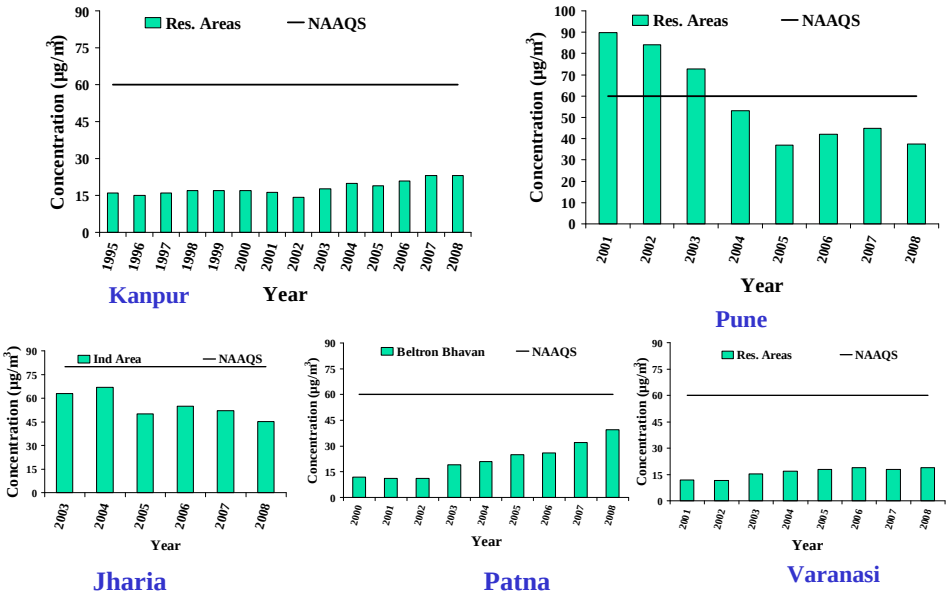

Fig. III.VIII: Trends in Annual Average Concentration of NO_2 in Kanpur, Pune, Jharia, Patna and Varanasi

c) RSPM

Trend in annual average concentration of RSPM in residential areas of Delhi, Mumbai, Chennai and Kolkata is depicted in Figure III.IX. Trend in annual average concentration of RSPM in residential areas of Hyderabad, Bangalore, Ahmedabad and Lucknow is depicted in Figure III.X. Trend in annual average concentration of RSPM in Jodhpur, Agra, Faridabad and Solapur is depicted in Figure III.XI. Trend in annual average concentration of RSPM in Kanpur, Pune, Jharia, Patna and Varanasi is depicted in Figure III.XII. RSPM levels exceed the prescribed NAAQS in most of the cities. No definite trend has been observed in ambient Respirable Suspended Particulate Matter. In some cities ambient RSPM levels are decreasing whereas in some cities the trend is fluctuating. Although various interventions have taken place to mitigate ambient RSPM levels but at the same time number of vehicles has increased exponentially. The vehicles are one of the major sources of RSPM. Measures taken to mitigate ambient RSPM levels are implementation of stricter vehicle emission norms and commensurate fuel quality, use of cleaner fuels, banning of diesel driven vehicles in some cities etc. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, re-suspension of traffic dust, commercial and domestic use of fuels, etc.

d) Carbon monoxide (CO)

Trend in annual average concentration of Carbon monoxide (CO) in Delhi is depicted in Figure III.XIII. High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi. Despite an increase in number of vehicles, CO levels have reduced during last few years. The decrease may be attributed to measures such as conversion of three wheelers of CNG in Delhi.

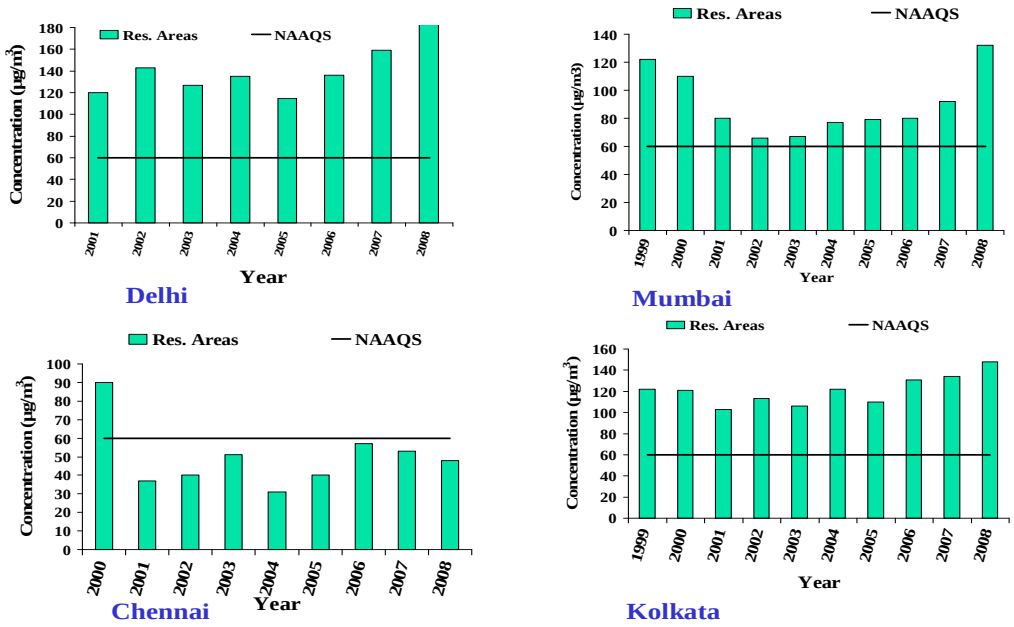

Fig. III.IX: Trends in Annual Average Concentration of RSPM in residential areas of Delhi, Mumbai, Chennai and Kolkata

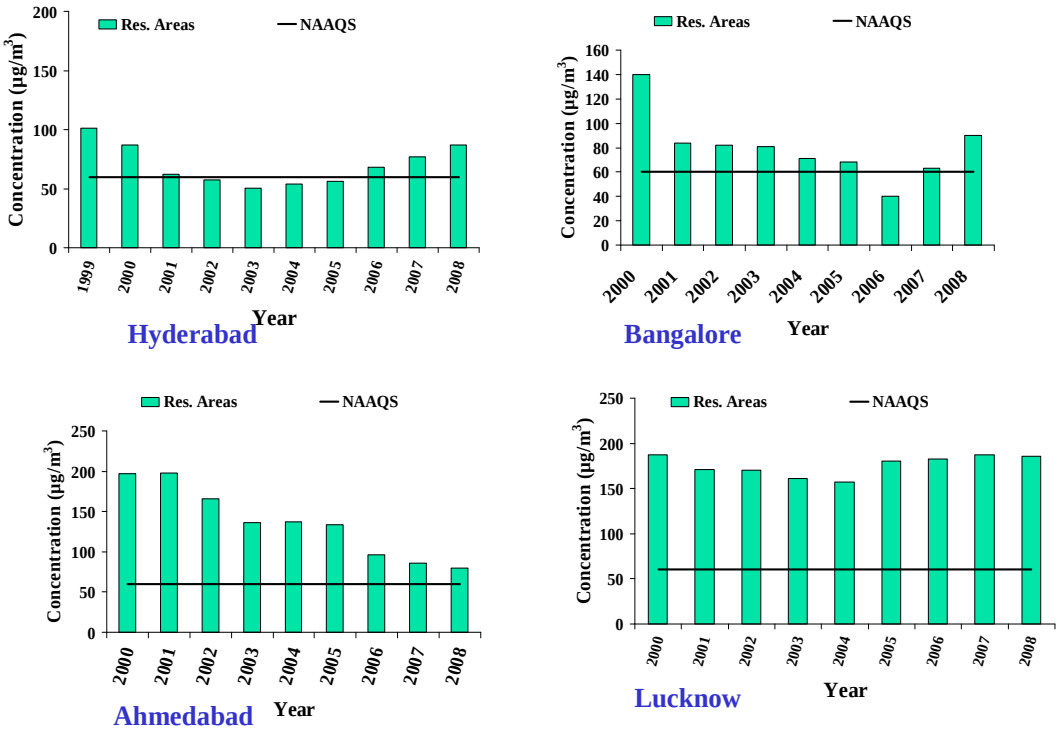

Fig. III.X: Trends in Annual Average Concentration of RSPM in residential areas of Hyderabad, Bangalore, Ahmedabad and Lucknow.

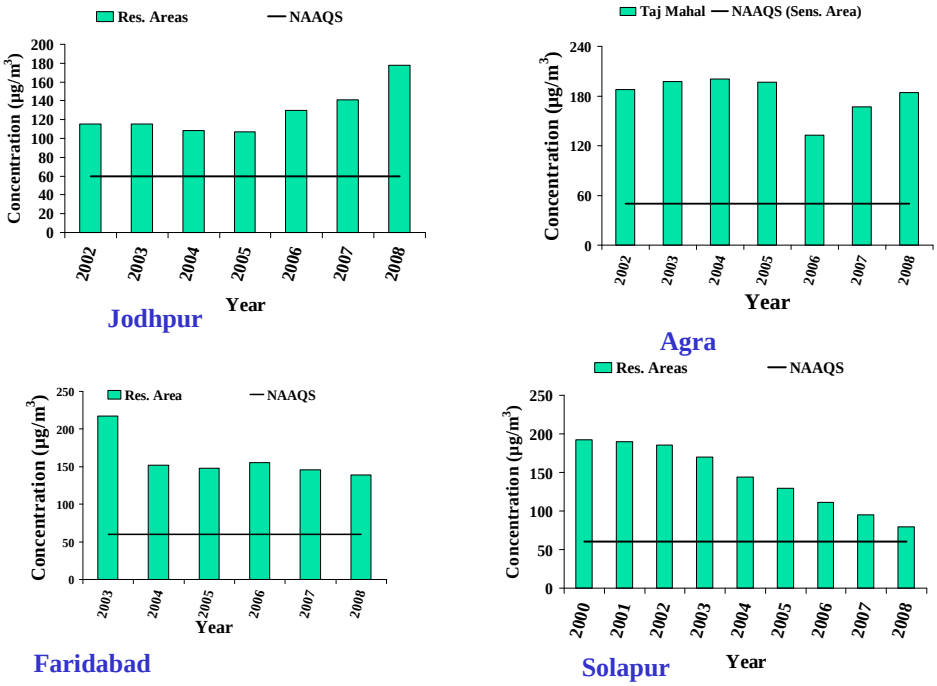

Fig. III.XI: Trends in Annual Average Concentration of RSPM in residential areas of Jodhpur, Agra, Faridabad and Solapur.

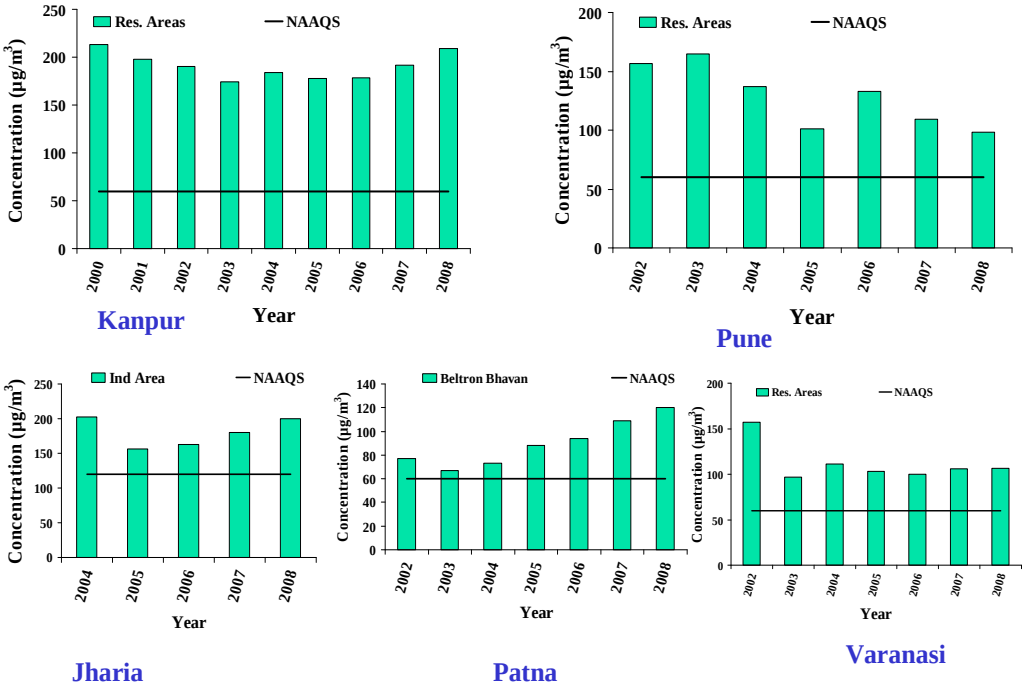

Fig. III.XII: Trends in Annual Average Concentration of RSPM in Kanpur, Pune, Jharia, Patna and Varanasi.

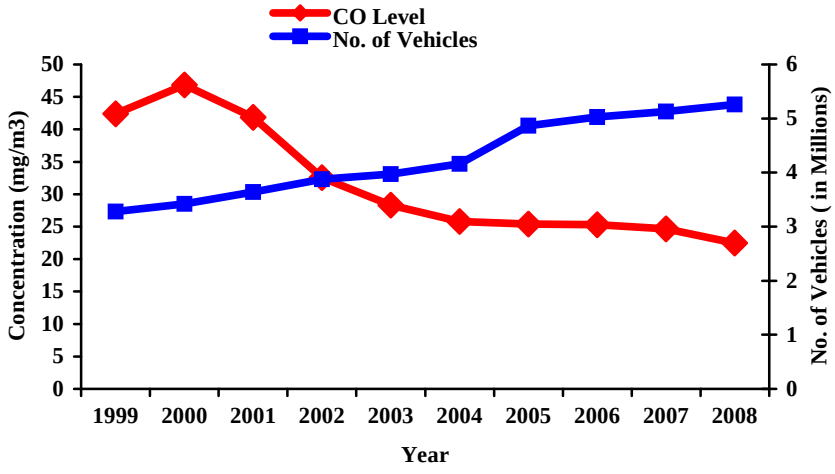

Figure III.XIII: Trend in Carbon Monoxide (CO) levels BSZ Marg (ITO), New Delhi

III.II Air Quality of Indian Mega Cities (Major Urban Centers)

a) Air Quality in Delhi Metropolitan City

Ambient air quality trend for annual average concentration with respect to three criteria pollutants such as SO2, NO2 and RSPM for BSZ Marg, a major traffic intersection in (ITO), Delhi is depicted in Fig. III.XIV. The 10 years trend revealed that SO_2 indicated slightly decreasing trend while NO_2 had shown decreasing trend after 2003 and RSPM had shown decreasing trend after 2005. Although there is no standard for traffic intersections but Nitrogen dioxide has shown above the national standard since 2003 to 2005, but in 2006 onwards it had shown within the national standard, if considered commercial or industrial areas as 80 µg/m^3. The respirable particulate matter had shown increasing trend during 2001 to 2002 but fluctuating during 2003 to 2005 and shown stable trend during 2006 to 2008 due to several interventions at source level taken by the Government.

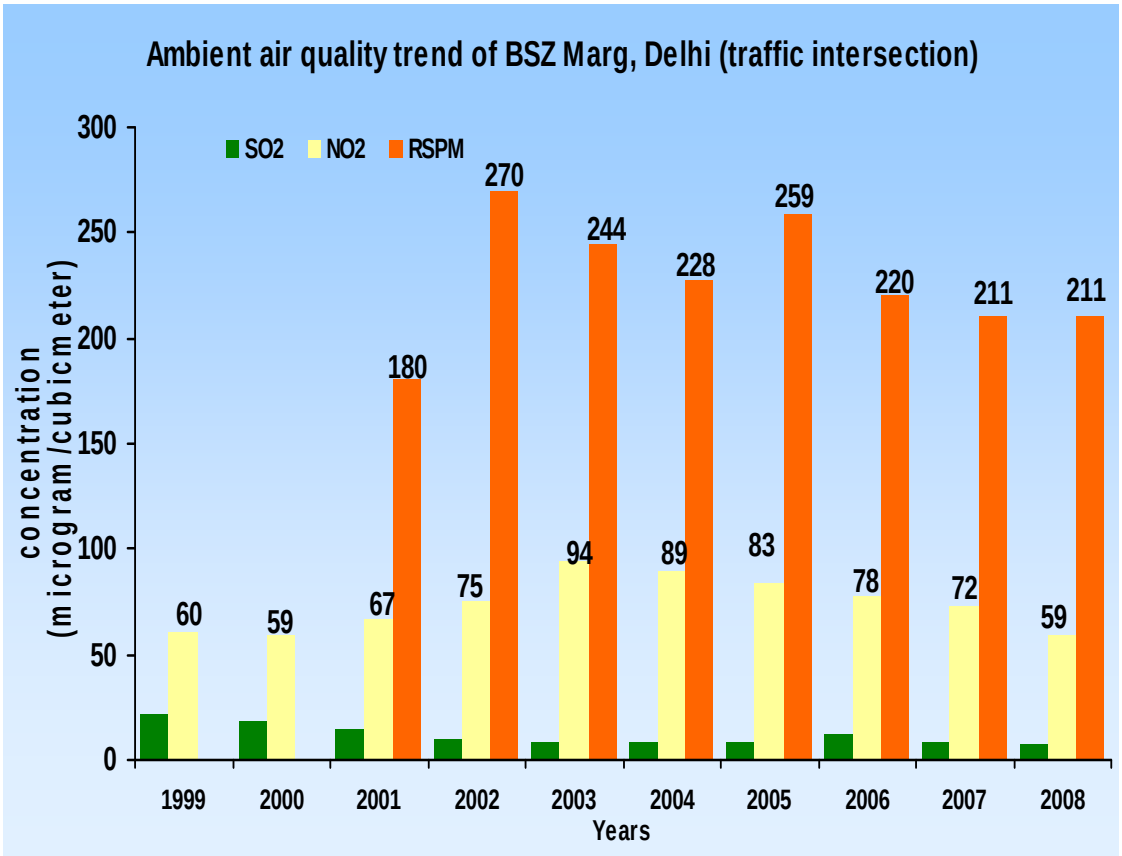

Figure III.XIV: Trends in SO2, NO2 and RSPM levels at BSZ Marg (ITO), New Delhi.

b) Trends in Annual Average Concentrations for four Mega Cities (Combined Ambient Air Quality Status of criteria pollutants)

Five years trend for four mega cities of India:

Figure III.XV depicts the five year trend of three criteria pollutants in residential areas of four mega cities. It is revealed from the figure that Chennai had shown all three criteria pollutants within the national standards. Other three cities such as Mumbai, Kolkata, and Delhi had shown SO2 and NO2 Annual concentration are well within the National Ambient Air Quality Standards (NAAQS) while RSPM indicated increasing trend in all five consecutive years.

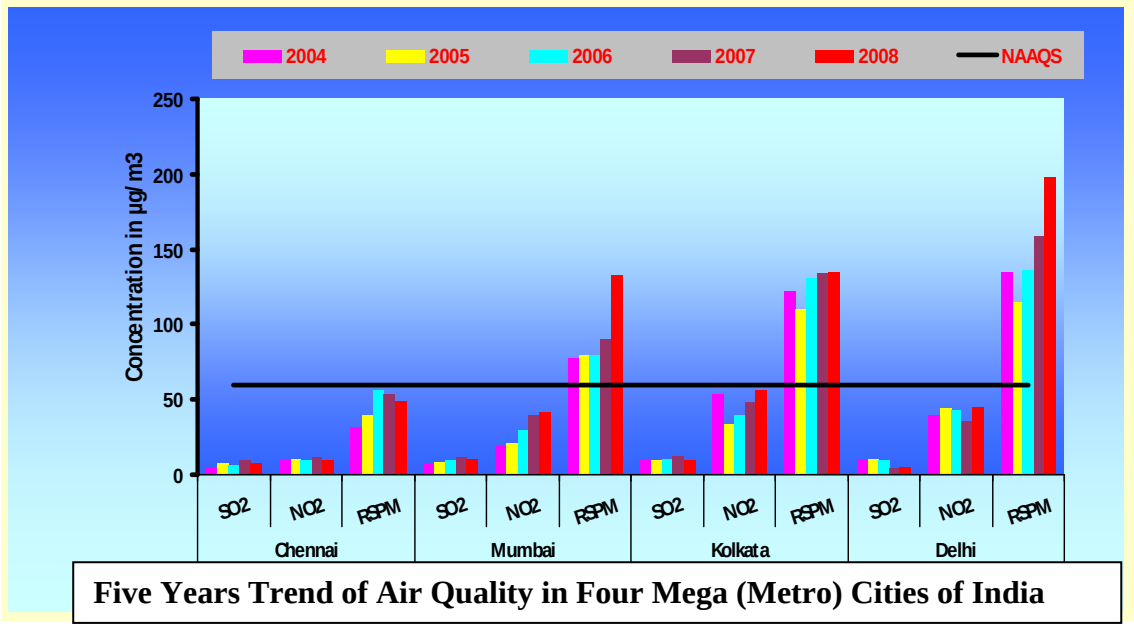

Fig.III.XV: Five Years Trend of Air Quality (Residential areas-annual average concentrations) in Four Mega (Metro) Cities of India

c) Three years trend of Air Quality in Metropolitan cities

Metro-cities are those cities having population more than one million & above. As per 2001 census there are 35 metro cities in India. The metropolitan cities along with area and population are presented in Annexure II- Table B-1.1. In this report air quality with respect to SO2, NO2 and RSPM has been presented for selected locations of each metro city. Annual average concentration for residential area class for three consecutive years is given in Annexure II- Table B-1.2.

III.III Air Quality Status – State Wise/City wise

Ambient air quality has been compiled state wise irrespective of locations/sites with average concentrations of air pollutants. Air quality with respect to SO2, NO2 and RSPM has been presented for the year 2008 is given in Annexure II- Table B-1.3.

III.IV. Percentage of Cities with Low, Moderate, High and Critical Levels

Trend in percentage of cities (Res. Areas) with low, moderate, high and critical levels of SO_2, NO_2, RSPM and SPM is depicted in Figure III.XVI. Percentage of cities with low levels of SO_2 have decreased over the years thus indicating that SO_2 pollution have reduced over the years. NO2 levels showed no change in low and moderate category but in high pollution level category (61-90 µgm/m^3) it had shown decrease from 4% to 3%. However no critical pollution levels observed during 2008, if considered National Annual Average concentration. The percentage of locations/cities in respect of RSPM showed slight decrease of critical levels and moderate levels but increase of high levels. SPM concentrations have indicated increase in high levels but decrease in critical levels.

III.V. National Mean Concentration

National mean concentration with 90^{th} percentile and 10^{th} percentile for SO_2, NO_2, RSPM and SPM is depicted in Figure III.XVII. National mean SO_2 concentration has decreased over the years indicating that there has been a decline in SO_2 levels. National mean NO_2 and RSPM concentration has remained stable over the years despite increase in sources like vehicles. The reason for this may be various intervention measures that have taken place such as improvement in vehicle technology and other vehicular pollution control measures like alternate fuel etc. National mean SPM concentration has been fluctuating over the years.

CPCB publishes annual average concentration of SO_2, NO_2, RSPM and SPM in annual status reports. Average of annual average concentrations is calculated considering all the ambient air quality monitoring stations under NAMP. As well as 90^{th} percentile and 10^{th} percentile of annual average concentrations is calculated considering all the ambient air quality monitoring stations under NAMP. Trend in average of annual average, 90^{th} percentile and 10^{th} percentile is depicted in figure III.XVII SO2, NO2, RSPM and SPM. National mean SO_2 concentration has decreased over the years indicating that there has been a decline in SO_2 levels. National mean NO_2 and RSPM concentration remain stable over the years despite increase in sources like vehicles. The reason for this may be various intervention measures that have taken place such as improvement in vehicle technology and other vehicular pollution control measures like alternate fuel etc. National mean SPM concentration has been fluctuating over the years and no definite trend has been observed as sources of SPM are natural dust, re-suspension of dust etc.

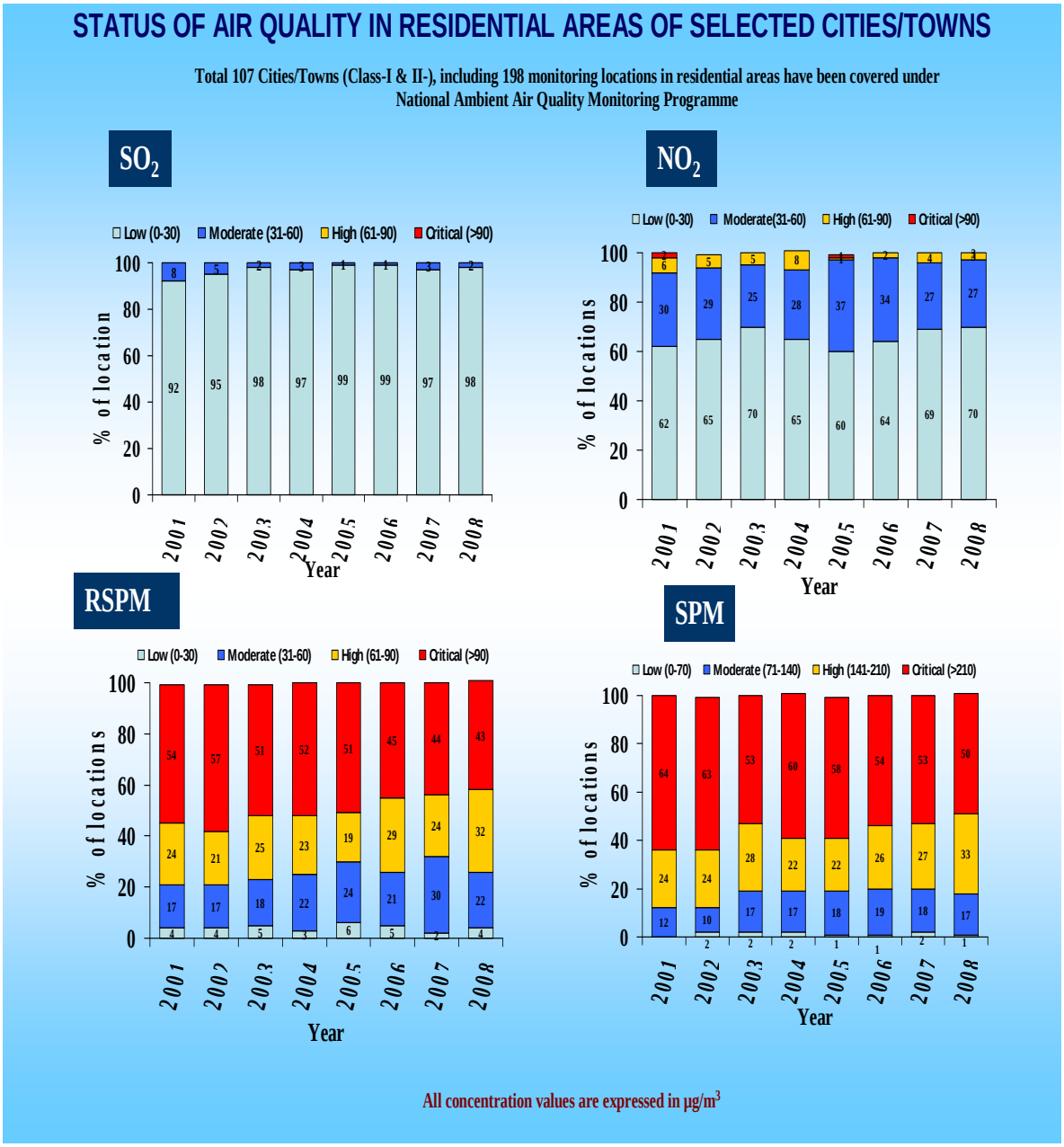

Fig. III.XVI: Pollution levels of different locations of cities fall under different categories of Air Quality in India

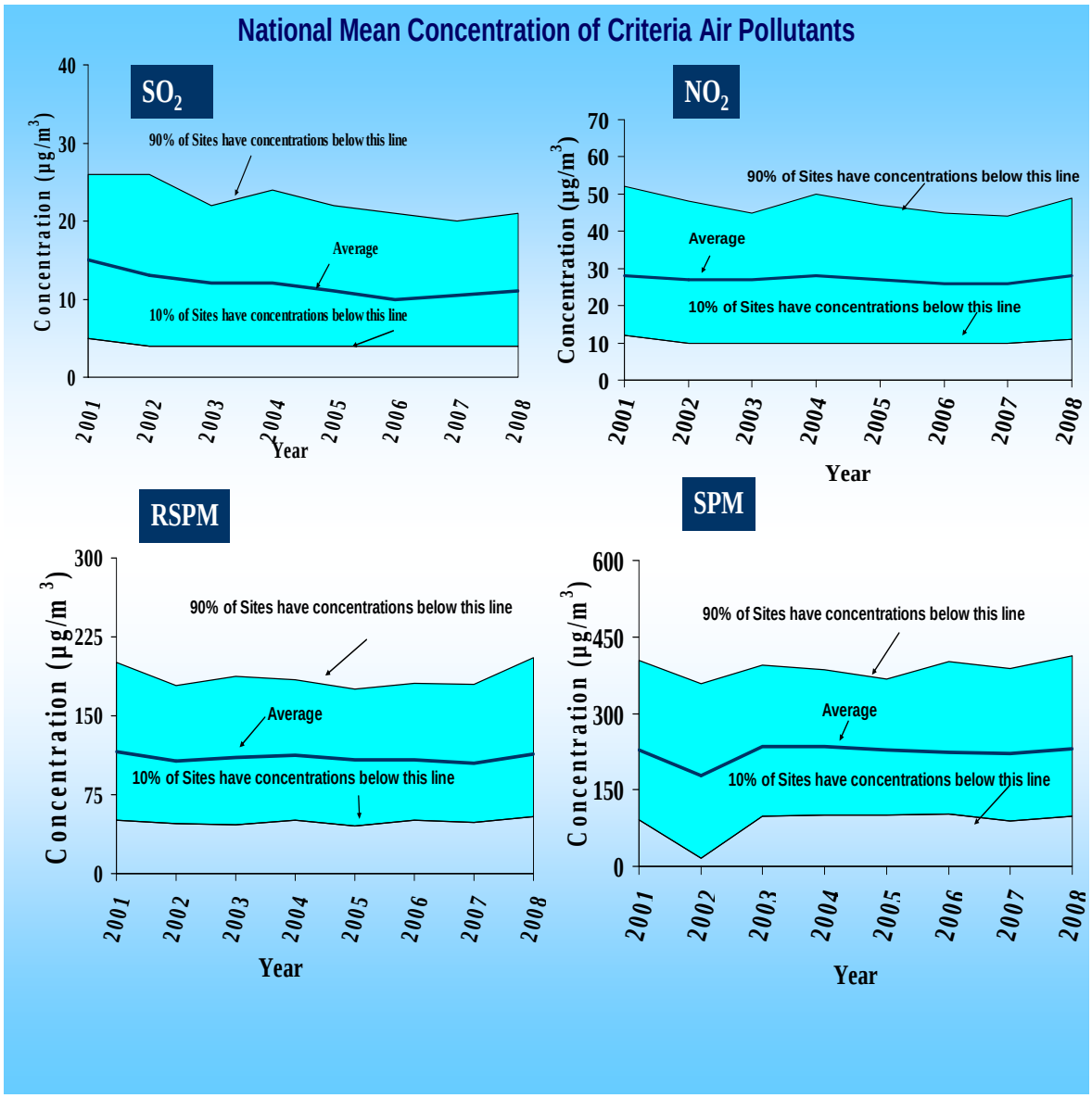

Fig. III.XVII: National Mean Concentrations of different sites (locations) fall under 10 percentile and 90 percentile area in the area plot graph of criteria pollutants in India

CHAPTER-IV
INITIATIVES FOR CONTROL OF AIR POLLUTION

Various measures have been taken to control air pollution from vehicles, industries and other sources. The steps taken to control air pollution from vehicles and industries are as follows:

IV.I Measures taken to Reduce Vehicular Pollution

i) Vehicular Emission Norms

a) During 1990-91 India for the first time notified mass emission norms for the vehicles at the manufacturing stage as well as for in-use vehicles. These norms were notified under EPA, motor vehicles rules & Air Act.

b) The emission norms introduced in 1996 have been important in controlling vehicular pollution because of stringency of emission norms along with fuel quality in 1996. For the first time crankcase emission norms and evaporative emission norms were introduced.

c) From April 1995 passenger cars were allowed to register only if they are fitted with a catalytic converter in four metros-Delhi, Mumbai, Kolkata & Chennai. Emission norms for such vehicles were notified under motor vehicles rules during January 1998. These norms were stricter by 50 percent compared to 1996 norms.

d) The testing method for passenger car norms were changed from hot start to cold start, which is also a stringent measure, compared to the earlier one.

e) More stringent norms were introduced for the year 2000. These norms were notified under Motor Vehicle Rules during 1997. Automobile manufacturers have to undergo major modification to meet these norms.

f) As per Hon'ble Supreme Court's directions only private vehicles conforming to at least EURO-I norms are being registered in NCR from June 1999 and from April 2000 only private vehicles conforming to Euro-II equivalent i.e. Bharat Stage-II norms were registered. In Mumbai Euro-II norms for private vehicles (4 wheelers) was applicable from 2001. In Kolkata, India-2000 norms (Euro-I) have been made applicable from November 1999.

g) From 1st October 1999, emission norms for agricultural tractors were introduced throughout the country. Bharat Stage-II and Bharat Stage-III emission norms for tractors have been scheduled to be implemented from 2003 and 2005 respectively.

h) The Bharat Stage-II norms for new 4-wheeler private non-commercial vehicle were introduced in Mumbai from January 2001, Kolkata and Chennai from July 2001 to 24th October, 2001.

i) Only those taxies are being registered in Delhi, which are meeting Bharat Stage-II norms.

j) Bharat Stage-II norms for Diesel 4 wheeler transport vehicles were introduced in NCT from 24th October, 2001, in Greater Mumbai, Kolkata & Chennai from 31.10.2001

k) The expert committee on Auto Oil, Policy was constituted during September 2001. The interim report of the committee was submitted to Govt. on 1.1.2000. Recommending Bharat Stage-III emission norms for all category of 4-wheelers in 7 mega cities from 2005 and rest of the country by 2010. Final report of the committee has been submitted in September 2002 which includes road map for control of vehicular pollution up to 2010.

l) Final report of the Inter-Ministerial Task Force constituted by MO & P&NG at the instance of the Committee of Secretaries to evolve a long term policy for vehicular emission and auto fuel policy has been submitted which recommended introduction of Bharat Stage-II norms for 4-wheelers and next stage emission norms for 2/3 wheelers throughout the country from 2005 and introduction of Bharat stage-III norms for four wheelers in 7-mega cities from 2005.

ii) Fuel Quality Specifications

For the first time diesel and gasoline fuel quality with respect to environment related parameters has been notified under EPA during April 1996. Gasoline lead phase out programme is given in Table IV.I.

Table IV.I: Gasoline Lead Phase Out Programme

Phase	Date of Introduction	Lead Content	Areas Covered
Phase-I	June 1994	Low lead (0.15 g/l)	Delhi, Mumbai, Kolkata, Chennai
Phase-II	1.4.1995	Unleaded (0.013 g/l)+ low leaded	Delhi, Mumbai, Kolkata, Chennai
Phase-III	1.1.1997	Low leaded	Entire country
Phase-IV	1.9.1998	Only unleaded	NCT
Phase-V	31.12.1998	Unleaded+Low leaded	Capitals of states & Uts
Phase-VI	1.9.1998	Unleaded	NCR
Phase-VII	1.2.2000	Unleaded	Entire Country

Diesel sulphur reduction programme is given in Table IV.II. Gasoline benzene reduction programme is given in Table IV.III.

Table IV.II: Diesel Sulphur Reduction Programme.

Phase	Date of Introduction	Sulphur Content	Areas Covered
Phase-I	April 1996	0.50%	Four metros & Taj
Phase-II	August 1997	0.25%	Delhi & Taj
Phase-III	April 1998	0.25%	Metro Cities
Phase-IV	January 2000	0.25%	Entire Country

Phase-V	April 2000	0.05%	NCR-private vehicles
	January 2000	0.05%	Mumbai-all vehicles
	March 2001	0.05%	NCT-all vehicles
	June 2001	0.05%	NCR-all vehicles
	July 2001	0.05%	Chennai & Kolkata
Phase-VI	October 2001	0.05%	All retail outlets of four metros
Phase-VII	2003	0.05%	Ahemadabad, Surat, Agra, Pune & Kanpur
Phase-VIII	2005	0.05%	Entire country
Phase-IX	2005	0.035%	10 metro cities & Agra
Phase-X	2010	0.035%	Entire country
Phase-XI	2010	0.005%	10 metro cities

Table IV.III: Gasoline Benzene Reduction Programme.

Date of Introduction	Benzene Content	Areas Covered
Before 1996	No specification	Entire Country
April 1996	5% benzene	Entire Country
April 2000	3% benzene	Metro Cities
November 2000	1% benzene	NCT & Mumbai
2005	1% benzene	All Metro cities

iii) Better traffic management in Delhi

- Restriction has been imposed on goods vehicles during day time from August 1999 in Delhi .
- Left lane has been made exclusive to buses and other HMV in Delhi.
- Time clocks have been installed in important red lights to enable the drivers to switch off their vehicles depending on the time left in the time clocks.
- Construction of more fly-overs and subways and closing of T-Junctions for better traffic flow.
- Regular information about traffic flow through radio FM bands for avoiding congested roads.

iv) Improvement of the Public transport System in Delhi

- Various steps taken for the improvement of the public transport system in Delhi are as follows:
- Number of buses has been increased to discourage use of individual vehicles by allowing private sectors for operation.
- Metro Rail Project for Various stretches in Delhi has been completed successfully and work is in progress to connect various zones of Delhi.

v) Reduction of emissions by the use of lubricants

- Specifications of 2T oil for two stroke engine with respect to smoke have been notified under EPA during September 1998 for implementation from 1.4.1999 throughout the country.
- Pre-mix 2T oil dispenser has been installed at all petrol filling stations in Delhi so that excessive oil is not being used by the vehicle owners. Sale of loose 2T oil has been banned from December 1998 in Delhi & Kolkata.

vi) Mass awareness regarding vehicular pollution control

- Messages/articles related to vehicular emissions are disseminated through newsletters, pamphlets, newspapers, magazines, Television, Radio, Internet, Workshops and Summer Exhibitions.
- Display of ambient air quality data through display system near ITO, Newspapers, daily news& Internet.
- NGOs working on vehicular pollution control are being encouraged for mass awareness campaigns.

vii) Alternate fuelled vehicles

- CNG vehicles introduced in Mumbai & Delhi. At present more than 80,000 CNG vehicles(19000 cars, 49810 Autos, 4935 RTVs & 8874 Buses) are plying in Delhi and about 23,000 in Mumbai. All city buses converted to CNG mode in Delhi .
- There are more than 111 CNG filling stations installed in Delhi with average consumption of674 tonnes per day of CNG.
- Emission norms for CNG & LPG driven vehicles has been notified.
- Petrol vehicles are running on ethanol blended (5%) petrol in states of Maharastra, AndhraPradesh, Goa, Gujarat, Haryana, Karnataka, Tamil Nadu Uttar Pradesh, Daman & Diu andUnion Territories of Dadar & Nagar Hawali, Chandigarh and Pondicherry .
- Work is in progress to run diesel vehicles on bio-diesel.

viii) Control of pollution from in-use vehicles:

- Idling emission norms notified for in-use vehicles. Pollution Under Control (PUC) certificate areissued for adherence to idling emission norms every 6/3 months. Number of computerizedPUC centers in Delhi is around 353.
- More than15 year old commercial vehicles are phased out from Delhi since 1998.
- New in- use vehicles norms proposed

ix) Recommendations of the final report of the Expert Committee on "Auto Fuel Policy"

- Bharat Stage-II norms for new vehicles except two & three wheelers, which are in place in thefour mega cities of Delhi, Mumbai, Kolkata & Chennai to be extended to Hyderabad, Bangalore, Ahemadabad, Kanpur, Pune, Surat & Agra by 2003 and entire country by 2005.
- Euro-III equivalent emission norms for all new vehicles except 2 & 3 wheelers to be applicable in 11 cities from 1 st April 2005 and extended throughout the country by 2010.
- Euro -IV equivalent emission norms for all new vehicles except 2 & 3 wheelers to be applicablein 11 cities by April 2010.
- Bharat Stage-II Emission norms for 2&3 wheelers to be applied through out the country byApril 2005 and Bharat Stage-III by 2008/2010.
- To meet Bharat Stage-II, Euro-III and Euro-IV equivalent emission norms, matching quality of petrol & diesel should be simultaneously made available.

IV.II. Measures Taken for Controlling Air Pollution from Industries

The measures taken for controlling air pollution from industries are as follows:

(a) Emission standards have been notified under the Environment (Protection) Act, 1986 to check pollution.
(b) Industries have been directed to install necessary pollution control equipment in a time bound manner and legal action has been initiated against the defaulting units.
(c) 24 critically polluted areas have been identified. Action Plan have been formulated for restoration of environmental quality in these areas.
(d) Environmental guidelines have evolved for siting of industries.
(e) Environmental clearance is made compulsory for 29 categories of development projects involving public hearing/ NGO participation as an important component of Environmental Impact Assessment process.
(f) Environmental audit in the form of environmental statement has been made mandatory for all polluting industries.
(g) Preparation of zoning Atlas for siting of industries based on environmental considerations in various districts of the country has been taken up.
(h) Power plants (coal based) located beyond 1000 kms from the pit-head are required to use low ash content coal (not exceeding 34%) with effect from 1.6.2002. Power plants located in the sensitive areas are also required to use low ash coal irrespective of their distance from the pit head.

IV.III. Action Plan for the control of air pollution in sixteen cities identified by the Hon'ble Supreme Court of India

With the objective of controlling these rapidly burgeoning air pollution problems in our country, the Hon'ble Supreme Court of India, in the matter of CWP No. 13029 of 1995, passed the orders on 05.04.2001, regarding formulation and implementation of action plans for control of pollution in selected cities. The Hon'ble Court stressed the need for such initiatives relating to vehicular pollution in Delhi and directed that action plan for pollution control in the cities/ towns, which do not meet the ambient air quality standards, should be prepared.

On August 14, 2003, the Hon'ble Supreme Court passed the following direction: *"CPCB's report shows that the Respirable Particulate Matter (in short "RSPM") levels in Ahmedabad, Kanpur, Sholapur, Lucknow, Bangalore, Chennai, Hyderabad, Mumbai and Kolkata are alarming."*

"Issue notices to the States of Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh, Karnataka and Tamil Nadu. In the Meantime, we direct that the Union of India and the respective States shall draw a plan for lowering the rate of RSPM level in the aforesaid cities. After the plan is drawn, the same would be placed before EPCA. This may be done within a period of two months. We are excluding Mumbai and Kolkata where the respective High Courts are stated to be monitoring the RSPM levels in those cities. EPCA after examining the matter shall submit a report to this Court within a period of four weeks thereafter."

Further Central Pollution Control Board has also identified various non-attainment cities all over the country on the basis of national ambient air quality data under NAMP. Central Pollution has been coordinating with the concerned

state governments of the sixteen critically polluted cities identified by the Hon'ble Supreme Court of India as well as non-attainment cities identified by itself for the preparation of action plan for the control of air pollution in all these cities. Further CPCB is also reviewing and monitoring the implementation of the action plans prepared for these critically polluted as well as non- attainment cities. So far State Governments of the all the sixteen critically polluted cities as identified by the Hon'ble Supreme Court of India have submitted their action plan for controlling air Pollution from all the major sources including industrial, vehicular & domestic sources. The major actions those have been proposed for almost all the cities are:

- **Industrial Pollution**
  - Shifting of Industries from non- confirming zones.
  - Switching over to clean technologies.
  - Using clean fuels.
  - Installation of Pollution control Devices.
  - Development of green belt, etc.
- **Vehicular Pollution**
  - Implementation of the emission norms as well as fuel quality in accordance with the road map proposed by the Auto Fuel Policy.
  - Switching over to clean alternate fuels like CNG, LPG & Bio-fuels.
  - Augmentation in Public Transport system
  - Better traffic management
  - Implementation of fiscal measures, etc
- **Domestic Pollution**
  - Ban on open burning of garbage, biomass, etc.
  - Augmentation on supply of LPG as cooking fuel , etc.

Central Pollution Control Board along with EPCA has been regularly reviewing action plan submitted by State Pollution Control Boards, further it is also monitoring the timely implementation of the action plan.

Chapter-V
Conclusions

Percent Violation of National Standard- Country analysis

In conclusion, it is found that no violation of NAAQS (Annual average) of SO_2 at any monitoring station in residential and industrial areas. The numbers of stations/locations violating annual standards and 24-hourly NAAQS during the year 2008 have been summarized. It is quite evident that the NAAQS of RSPM and SPM are violated at most of the monitoring stations. NAAQS (Annual average) of SPM has violated at 84% of the monitoring stations in residential areas and 43% of the monitoring stations in industrial areas. NAAQS (Annual average) of RSPM has violated at 87% of the monitoring stations in residential areas and 78% of the monitoring stations in industrial areas. NAAQS (Annual average) of NO_2 has violated at 14% monitoring stations in industrial areas and 5% monitoring locations in residential areas.

NAAQS (24 hourly average) of NO_2 has violated at 31 monitoring stations established in residential area class while RSPM and SPM indicated 183 and 175 locations/Stations respectively. NAAQS (24 hourly average) industrial area class with respect to NO2, RSPM and SPM indicated as 6, 93 and 48 locations respectively. Sensitive area class indicated with respect to NO2, SO2, RSPM and SPM violated in 3, 9, 11 and 13 locations respectively. In sensitive areas the percentage violation indicated as 23%, 62%, 92% and 100% violation for SO2, NO2, RSPM and SPM respectively.

Violation of NAAQS in Metropolitan cities/Sixteen cities

The ambient air quality in residential of metropolitan cities revealed that out of 35 cities, 29 cities exceeding the NAAQS of RSPM for annual average concentration while NO2 had shown above the NAAQS of NO2 for average concentration in Asansol, while rest are within the annual standard. SO2 has not violated in any of the metropolitan city in 2008. The increasing trend of RSPM in most of the Metropolitan cities observed. About 60% cities have indicated increasing trend while 40% had shown either slightly decreasing trend or stable in all the three successive years (2006 to 2008). With regard to sixteen cities trend analysis, comparing with previous year, the RSPM concentration had shown increasing trend in Delhi, Mumbai, Kolkata, Banglore, Jodhpur, Agra, Kanpur, Jharia and Patna.

Chapter-VI
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ANNEXURE -I- Table A1.1 NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Pollutant	Time Weighted Average	Concentration in Ambient Air			Method of Measurement
		Industrial Area	Residential, Rural and other Areas	Sensitive Area	
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	1. Improved West and Gaeke Method 2. Ultraviolet Fluorescence
	24 Hours Average**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Oxides of Nitrogen as NO_2	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	1. Jacob & Hochheiser modified ($NaOH$-$NaAsO_2$) Method 2. Gas Phase Chemiluminescence
	24 Hours Average**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3	High Volume Sampling (Average flow rate not less than 1.1m^3/minute)
	24 Hours Average**	500 µg/m^3	200 µg/m^3	100 µg/m^3	
Respirable Particulate Matter (Size less than 10µm) (RPM)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3	Respirable Particulate Matter Sampler
	24 Hours Average**	150 µg/m^3	100 µg/m^3	75 µg/m^3	
Lead (Pb)	Annual Average*	1.0 µg/m^3	0.75 µg/m^3	0.50 µg/m^3	AAS Method after sampling using EPM 2000 or equivalent filter paper
	24 Hour Average**	1.5 µg/m^3	1.0 µg/m^3	0.75 µg/m^3	
Carbon Monoxide (CO)	8 Hours Average**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3	Non dispersive Infrared Spectroscopy
	1 Hour Average	10.0mg/m^3	4.0 mg/m^3	2.0 mg/m^3	
Ammonia (NH_3)	Annual Average*	0.1 mg/m^3			-
	24 Hour Average**	0.4 mg/m^3			

* Annual Arithmetic mean of minimum 104 measurements in a year twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

NOTE

1. National Ambient Air Quality Standard : The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
3. The State Government / State Board shall notify the sensitive and other areas in the respective states within a period of six months from the date of notification of National Ambient Air Quality Standards

Annexure I-Table A-1.2
Table: Operating Stations under National Air Quality Monitoring Programme (NAMP) by December 2008, India

Sl. No.	State/Union Territory	City	Operating Monitoring Station
1	Andhra Pradesh	Hyderabad	9
		Visakhapatnam	6
		Tirupati	1
		Vijayawada	2
		Kurnool	1
		Ramagundum	1
		Patencheru	1
2	Assam	Bongaigaon	3
		Gawahati	4
		Tezpur	1
		Sibasagar	1
		Dibrugarh	1
		Golaghat	1
		Hailakandi	1
		Daranga	1
3	Bihar	Patna	2
4	Chandigarh	Chandigarh	5
5	Chattisgarh	Korba	3
		Bhilai	3
		Raipur	3
6	Delhi	Delhi	11
7	Daman & Diu	Daman	2
8	Dadra Nagar Haveli	Silvasa	2
9	Goa	Ponda	1
		Vasco	1
		Marmagao	1
10	Gujarat	Ahmedabad	6
		Ankaleshwar	2
		Jamnagar	1
		Rajkot	2
		Surat	3
		Vadodara	4
		Vapi	2
11	Haryana	Faridabad	2
		Hissar	2
		Yamuna Nagar	1
12	Himachal Pradesh	Damtal	2
		Parwanoo	2
		Poanta Sahib	2
		Shimla	2
		Kala Amb	2
		Baddi-Barotiwala	3
		Nalagarh	1
13	Jammu& Kashmir	Jammu	3
14	Jharkand	Dhanbad	1
		Jharia	1
		Sindri	1
		Jamshedpur	2

Sl. No.	State/Union Territory	City	Operating Monitoring Station
		Ranchi	1
15	Karnataka	Bangalore	6
		Dharwar, Hubli	2
		Mangalore	1
		Hassan	1
		Mysore	2
		Gulbarga	1
		Belgaum	1
16	Kerala	Kozhikode	2
		Kottayam	2
		Cochin	7
		Thiruvanantapuram	4
		Palakkad	1
17	Madhya Pradesh	Bhopal	4
		Indore	3
		Jabalpur	1
		Nagda	3
		Gwalior	2
		Sagar	2
		Satna	2
		Singrauli	3
		Ujjain	3
		Dewas	3
18	Maharashtra	Aurangabad	3
		Lote	2
		Tarapur	3
		Kolhapur	3
		Mumbai	3
		Ambernath	2
		Chandrapur	3
		Nagpur	6
		Nasik	3
		Solapur	2
		Pune	3
		Thane	3
	Maharashtra	Navi Mumbai (incl TTC Ind. Area, Taloja Ind Area)	6
19	Meghalaya	Shillong	2
20	Mizoram	Aizwal	3
21	Manipur	Imphal	1
22	Nagaland	Dimapur	2
23	Orissa	Rayagada	2
		Rourkela	2
		Talcher	2
		Angul	2
		Bhubaneshwar	1
		Cuttack	1
		Sambalpur	1
		Berhampur	1
24	Punjab	Gobindgarh	3
		Jalandhar	4
		Ludhiana	4
		Naya Nangal	2
		Khanna	2
25	Pondicherry	Pondicherry	3

Sl. No.	State/Union Territory	City	Operating Monitoring Station
26	Rajasthan	Alwar	3
		Jaipur	6
		Jodhpur	3
		Kota	3
		Udaipur	3
27	Sikkim	Gangtok	2
28	Tamilnadu	Chennai	6
		Tuticorin	3
		Coimbatore	3
		Madurai	3
		Salem	1
29	Uttar Pradesh	Agra	5
		Anpara	2
		Firozabad	3
		Gajroula	2
		Ghaziabad	2
		Kanpur	6
		Lucknow	5
		Noida	2
		Varanasi	2
		Jhansi	2
		Khurja	2
		Meerut	2
30	Uttaranchal	Dehradun	2
31	West Bengal	Kolkata	10
		Durgapur	3
		Haldia	3
		Howrah	4
		Asansol	1
Total	**31**	**131**	**346**

Total Cities: 131, Total States- 26, Total UT's- 5.

Note: The list includes 3 stations of NEERI in Delhi, Mumbai, Kolkata, Nagpur, Hyderbad and Chennai each and stations maintained by Universities i.e. WIT Solapur (2 stations), KTHM Nashik (3 stations), VNIT Nagpur (3 stations), Thane Municipal Corporation (3 stations). Stations maintained by CPCB and its zonal offices have also been included in NAMP. These stations are BSZ Marg, Delhi, Delhi College of Engineering, Delhi, Arera Colony, Bhopal, J.D. park, Kolkata, Subhanpura, Vadodara and Vikas Nagar, Kanpur.

ANNEXURE II-TABLE B-1.1

Table: PROFILE OF METROPOLITAN CITIES OF INDIA

CITIES	AREA (sq. km)	POPULATION IN THOUSAND
Greater Mumbai	437.71	16,368,084
Kolkata	187	13,216,546
Delhi	862.18	12,791,458
Chennai	170	6,424,624
Bangalore	125.9	5,686,844
Hyderabad	172.68	5,533,640
Ahemadabad	190.94	4,519,278
Pune	198.00	3,755,525
Surat	111.16	2,811,466
Kanpur	NA	2,690,486
Jaipur	200.4	2,324,319
Lucknow	310.1	2,266,933
Nagpur	217.17	2,122,965
Patna	99.45	1,707,429
Indore	130.17	1,639,044
Vadodara	108.26	1,492,398
Bhopal	284.9	1,454,830
Coimbatore	314.84	1,446,034
Ludhiana	134.67	1,395,053
Kochi	39.58	1,355,406
Vishakhapatnam	78.33	1,329,472
Agra	NA	1,321,410
Varanasi	83.6	1,211,749
Madurai	115.48	1,194,665
Meerut	NA	1,167,399
Nashik	NA	1,152,048
Jabalpur	NA	1,117,200
Jamshedpur	NA	1,101,804
Asansol	NA	1,090,171
Dhanbad	NA	1,064,357
Faridabad	NA	1,054,981
Allahabad	NA	1,049,579
Amritsar	NA	1,011,327
Vijayawada	NA	1,011,152
Rajkot	NA	1,002,160

Area: 1991and Population figures 2001 Census.

Annexure II-Table B- 1.2

Ambient Air Quality in Metro Cities (Annual Averages of Residential Areas)

City Name	2006			2007			2008		
	SO_2	NO_2	RSPM	SO_2	NO_2	RSPM	SO_2	NO_2	RSPM
Agra	6	22	133	6	23	167	5	20	165
Ahmedabad	10	22	96	12	20	86	12	20	80
Allahabad	-	-	-	20*	40*	159*	8	35	128
Amritsar	12	31	-	14	33	-	15	36	-
Asansol	5	54	132	7	57	112	9	74	135
Bangalore	18	36	48	17	39	63	15	40	90
Bhopal	5	13	59	11	19	84	7	15	93
Chennai	7	10	57	9	9	37	6	9	48
Coimbatore	11	34	42	7	27	45	5	28	55
Dhanbad	19	52	109	20	52	107	19	44	131
Delhi	9	43	136	4	36	159	5	45	198
Faridabad	10	22	155	12	25	146	13	25	139
Hyderabad	5	27	81	5	24	77	6	27	87
Jaipur	4	32	118	5	29	98	6	34	112
Jabalpur	BDL	22	82	BDL	24	107	BDL	25	136
Jamshedpur	38	51	128	38	52	166	37	51	172
Indore	6	13	109	8	16	108	9	17	174
Kanpur	7	21	180	7	24	193	7	23	209
Kochi	BDL	BDL	53	BDL	16	46	5	19	40
Kolkata	7	53	100	8	58	99	9	58	148
Lucknow	10	29	188	9	32	187	8	35	186
Ludhiana	16	39	282	10	36	201	10	39	251
Madurai	10	27	36	9	21	43	10	23	41
Meerut	-	-	-	11	44	120	10	42	115
Mumbai	9	29	86	11	40	92	9	42	132
Nagpur	7	24	70	7	25	99	8	32	98
Nashik	34	28	69	43	35	45	30	25	80
Patna	10	41	113	10	50	123	7	39	120
Pune	25	42	133	20	45	109	22	38	99
Rajkot	11	14	61	12	17	76	10	13	89
Surat	22	29	121	17	26	87	16	23	81
Vadodara	14	23	114	10	19	83	11	21	57
Varanasi	16	19	100	16	19	114	16	19	106
Vijayawada	5	32	81	6	36	85	5	26	91
Visakhapatnam	11	32	99	9	31	95	10	31	87

All concentrations in Microgramme per Cubic Metre) Source: Data as reported by CPCB/SPCBs/PCCs/NEERI. Note:- '-' Data not available/inadequate. BDL – Below Detection Limit (i.e. less than 4 micrograms per cubicmeter for SO_2 and less than 9 micrograms per cubicmeter for NO_2). Data of Agra is of Taj Mahal (sensitive area) and data of Jamshedpur and Asansol is of Industrial Area. Data as reported in monthly summary sheet\Environmental Data Bank available as on date. Data for 2008 is average of data available as on date. National Ambient Air Quality Standard for Residential Areas (Annual average) for SO_2,NO_2 and RSPM = 60 microgramme per cubic metre.

Annexure-II Table B1.3

State Wise Level of SO2, NO2 and RSPM in Industrial Areas under National Ambient Air Quality Monitoring Programme (NAMP) during 2008

Name of the State	SO_2 (µg/m^3) (Annual)	NO_2(µg/m^3) (Annual)	RSPM (µg/m^3) (Annual)
	Avg.	Avg.	Avg.
Andhra Pradesh	6	27	87
Chandigarh	2	20	123
Chhattisgarh	17	42	212
Delhi	8	61	225
Goa	3	11	52
Gujarat	16	26	127
Haryana	15	28	267
Himachal Pradesh	2	12	134
Jharkhand	28	47	170
Karnataka	10	25	85
Kerala	6	11	45
Maharashtra	24	41	108
Madhya Pradesh	15	18	160
Orissa	8	21	95
Punjab	11	35	229
Pondicherry	6	13	54
Rajasthan	8	31	135
Tamil Nadu	13	21	81
Uttar Pradesh	17	27	197
Uttaranchal	20	21	93
West Bengal	10	73	119

Note: Data available as on date 15.04.09

Table B-1.3 contd../-

Annexure II- Table B- 1.3

State wise Level of SO_2, NO_2 and RSPM in Residential Areas under National Ambient Air Quality Monitoring Programme (NAMP) during 2008

Sl No	Name of the State	SO_2 µg/m^3 (Annual)	NO_2 µg/m^3 (Annual)	RSPM µg/m^3 (Annual)
		Avg.	Avg.	Avg.
1	Andhra Pradesh	8	26	85
2	Assam	6	13	89
3	Bihar	7	39	120
4	Chandigarh	2	14	89
5	Chattisgarh	16	28	126
6	Delhi	5	55	209
7	Goa	2	13	57
8	Gujarat	12	18	83
9	Haryana	9	13	121
10	Himachal Pradesh	2	12	71
11	Jharkand	19	38	152
12	Karnataka	10.5	27	77
13	Kerala	5	20	48
14	Madhya Pradesh	9	19	110
15	Maharashtra	16	31	101
16	Meghalaya	2	34	73
17	Mizoram	2	15	37
18	Manipur	3	19	84
19	Nagaland	2	14	72
20	Orissa	4	16	80
21	Punjab	10	30	193
22	Pondicherry	4	10	45
23	Rajasthan	7	28	122
24	Tamilnadu	12	20	58
25	Uttar Pradesh	12	30	170
26	Uttaranchal	27	28	126
27	West Bengal	9	66	101

Note: Data available as on date 15.04.09

Appendix- I

Methods of Measurement

a) Sulphur Dioxide (SO_2)

Sulphur dioxide content in the ambient air is measured by the modified West and Gaeke method. Sulphur dioxide in ambient air is absorbed in a solution of 0.04M sodium tetrachloromercurate at an average flow rate of 1 liter per minute (LPM), resulting in the formation of dischlorosulphitomercurate complex. The main interference is due to the oxides of nitrogen, ozone and trace metals. Interference from oxides of nitrogen can be prevented by adding sulphamic acid, which acts as a reducing agent and converts some of the oxygenated nitrogen species to nitrogen gas. Interference from ozone can be eliminated by aging the sample prior to analysis. Interference from trace metals can be prevented by adding EDTA (disodium salt) to the unexposed absorbing solution. For analysis, the exposed sample is treated with sulphamic acid, formaldehyde and acid bleached pararosaniline containing hydrochloric acid. Pararosaniline, formaldehyde and bisulfite anion react to form violet red coloured pararosaniline methyl sulphonic acid. The intensity of the colour is measured on a spectrophotometrer at 560 nm wavelength. The detection range of the SO_2 concentration is 4 – 1050 $\mu g/m^3$.

b) Nitrogen dioxide (NO_2)

In the method the NO_2 from ambient air is absorbed in a solution of sodium hydroxide and sodium arsenite. Sulphur dioxide is the major interfering compound. The interference of sulphur dioxide is eliminated by converting it to sulphuric acid by addition of hydrogen peroxide. The absorbed nitrogen dioxide is then reacted with sulphanilamide in the presence of phosphoric acid at a pH of less than 2 and then coupling it with N-(1Nepthyl) ethylenediamine dihydrochloride. The absorbance of the highly coloured azo dye is measured on spectrophotometer at a wavelength of 540 nm. The detection range of the NO_2 concentration is 9 – 750 $\mu g/m^3$.

c) Suspended Particulate Matter (SPM)

SPM are particulate/aerosol having diameter less than 100μm that tend to remain suspended in the atmosphere for a long period of time. Sea salt, soil dust, volcanic particles and smoke from forest fires are the natural sources of total suspended particulates. Fossil fuel burning and industrial processes are the anthropogenic sources of suspended particulate matter. Monitoring of SPM is carried out for 24 hours with 8-hourly sampling. SPM is measured gravimetrically with GFA/EPM 2000 filter paper using high volume sampler.

For measurement of SPM, ambient air is drawn into a covered housing of HVS through a 20.3 x 25.4 cm (8 x 10") Whatman GF/A or EPM pre weighed glass fiber filter paper at a flow rate of 1.1 to 1.5 cubic meters per minute. The main housing should be rectangular (29 cm x 36 cm) and must be provided

with a gable roof having 45^{o} to the horizontal so that the filter is protected from precipitation and particles less than 100 µm size are only collected on the filter surface. Particles within the size range of 100 to 0.1 µm are ordinarily collected on glass fiber filter.

The mass concentration of SPM in the ambient air, expressed in micrograms per cubic meter is calculated by measuring the mass of collected particulate and the volume of air drawn.

d) Respirable Suspended Particulate Matter (RSPM/ PM_{10})

PM_{10} are the particulate matter having aerodynamic diameter less than 10 µm and it is fraction of the particulate matter suspended in air and it represents the fraction that is considered to enter the respiratory system. Sources of PM_{10} include road dust, emission from petrol and diesel exhaust, construction and fireplaces. PM_{10} may also be formed from other pollutants (acid rain, NO_x, SO_x, organics) and from incomplete combustion of any fuel. Monitoring of RSPM is carried out for 24 hours with 8-hourly sampling. RSPM is measured gravimetrically with GFA/EPM 2000 filter paper using respirable dust sampler.