



# NANDED WAGHALA CITY MUNICIPAL CORPORATION ENVIRONMENTAL STATUS REPORT

## 2014-15

# Environmental Status Report Nanded Waghala City 2014-15

Nanded Waghala City Municipal Corporation



Prepared by



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## ABBREVIATIONS

AAQMS-	Ambient Air Quality Monitoring Stations
AQI-	Air Quality Index
BIS-	Bureau of Indian Standards
BPMC	Bombay Provincial Municipal Corporation
CAAQMS	Continuous Ambient Air Quality Monitoring Station
CAGR	Compound Annual Growth Rate
CAGR	Compound Annual Growth Rate
CIDCO	City and Industrial Development Corporation
CNG	Compressed natural gas
CO	Carbon Monoxide
COPD	Chronic Obstructive Pulmonary Disease
DPR	Detailed Project Report
DPSIR	Driving Force-Pressure- State -Impact- Response
ESR	Environmental Status Report
GDDP	Gross District Domestic Product
GSDA-	Groundwater Surveys and Development Agency
HSD	High Speed Diesel
IIT	Indian Institute of Technology
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
LPG	Liquefied Petroleum Gas
MCM	Million Cubic Meter
MGM	Mahatma Gandhi Mission's College of Engineering and Technology
MIDC	Maharashtra Industrial Development Corporation
MJP	Maharashtra Jeevan Pradhikaran
MLD	Millions of Liters Per Day
MoEF	Ministry of Environment and Forests
MPCB	Maharashtra Pollution Control Board
MS	Motor Spirit
MSW	Municipal Solid Waste
MT	Metric Tones
NAMP	National Air Quality Monitoring Programme
NIEHS	National Institute of Environmental Health Sciences
NOx	Oxides of Nitrogen



NWCMC	Nanded Waghala City Municipal Corporation
NWMP	National Water Quality Monitoring Programme
PCNDDP	Per Capita Net District Domestic Product
PMC	Pune Municipal Corporation
PM	Particulate matter
PNG	Piped Natural Gas
RCC	Reinforced Cement Concrete
SAMP	State Air Quality Monitoring Programme
SGGS	Shri Guru Gobind Singh Institute of Engineering and Technology
SO <sub>x</sub>	Sulphur Dioxide
SRTMU	Swami Ramanand Teerth Marathwada University
STP	Sewage Treatment Plant
UHP	Urban Health Posts
ULB	Urban Local Bodies
VOC	Volatile Organic Compounds
WC	Water Closet
WHO	World Health Organization
WQI	Water Quality Index
WQMS	Water Quality Monitoring Station
WTP	Water Treatment Plant

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# Executive Summary

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Nanded city is one of the oldest and historic city in Marathwada region of Maharashtra and is regarded as the second most holy city after Amritsar due to the presence of Gurdwara Takhat Shri Hazur Sahib one of the five Takhas of Sikh community. The city of Nanded is spread across 63.44 sq.km and is divided in 4 administrative zones. As per census 2011, Nanded city has a population of 5,50,439, and registered a growth rate of 21.76% between 2001 and 2011.

Nanded city has two industrial zones, of which one lies at the outskirts of the city while one Industrial Estate within the city limits. Major industries are under Green category followed by orange and red category which has the least number of industries. The Nanded district has recorded an increase of about 13% in commercial activities over last five years. In terms of economic growth, the GDDP (Gross District Domestic Product) of Nanded has increased at a CAGR (Compound Annual Growth Rate) of 3.9% over past 5 years. As per census report 2011, people in Nanded city are engaged in tertiary sector which includes transportation trade, storage, communication and other services.

Increase in population coupled with industrial and commercial growth act as driving forces for growth of a city and exerts pressure on resources like Air, Water and Land in terms of its demand and pollution loads. Taking this into consideration the current report is prepared based on D-P-S-I-R (Drivers, Pressure, Status, Impact and Response) framework proposed by MPCB guidelines 2009. The following sections discuss the status and highlights of sections are elaborated further in this report.

## Water Resources

### Surface Water

Nanded city is blessed with the presence of Godavari River, second longest river in India and flows about 5 km in length along the Nanded city. Vishnupuri dam, situated near Asarjan village, has a storage capacity of about 80.79 million cubic meters and is the source of supplying water to the city. MPCB (Maharashtra Pollution Control Board) has installed two WQMS (Water Quality Monitoring Station under National Water Quality Monitoring Programme on Godavari river. On analyzing the data recorded at these stations, one may note that the WQI (Water Quality Index) of Godavari River for last 5 years is recorded under 'Good to Excellent' category at both the locations. (Table No. 1). Anthropogenic activities like washing of clothes, sanitation, religious offerings along the Ghats and banks of river Godavari in Nanded city is one of the major challenges which lead to water pollution.

In order to maintain cleanliness along the river front it is highly recommended to install sufficient Nirmalya bins and dustbins along all the ghats in the city. On the line of 'Har ki Paudi' in Haridwar, Nanded city may also plan to channelize and areas be demarcated for religious

activities while the remaining river front should be restricted from any religious activities. Weekly monitoring of the water quality along the various check points is highly recommended.

Given the current design of the ghats makes it convenient for waste water to be released in the river body. It is recommended that a dedicated space for washing of clothes be demarked and the platform be constructed in such a way that the slope of the same is in the opposite side to that of the river. The runoff from these platforms should be then let in the sewage connections which would then lead the waste water to the treatment plants. Direct access to the river for washing of the clothes must be restricted or banned.

**Table No. 1: WQI of Godavari river in Nanded city (2010-2015)**

Mar	86	82	78	NA	84	87	81	78	NA	84
Feb	77	79	78	81	85	73	86	80	80	80
Jan	77	84	81	86	NA	83	85	77	82	80
Dec	75	82	77	81	NA	79	80	81	79	73
Nov	NA	82	62	81	84	83	77	68	79	82
Oct	49	83	71	79	84	52	79	66	81	89
Sep	76	84	68	80	84	75	89	65	79	82
Aug	79	NA	80	78	84	84	79	78	81	81
Jul	NA	83	82	76	84	79	79	78	80	86
Jun	NA	78	74	85	85	37	60	67	85	86
May	NA	82	87	73	86	NA	69	86	75	85
Apr	NA	85	84	72	88	NA	58	84	78	88
Month	10-11	11-12	12-13	13-14	14-15	10-11	11-12	12-13	13-14	14-15
Station code	1210					1209				
Station name	Godavari River at Intake of pump house					Godavari River at Raher				

Legend

Good to Excellent	Medium to Good	Bad	Bad to Very bad
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## Ground water

There are 850 functional bore wells and 17 non-functional wells in NWCMC area. As per GSDA (Groundwater Surveys and Development Agency) there is no decline in groundwater levels during pre-monsoon as well as post-monsoon and have hence been categorized in the 'Safe' category. However, research studies conducted by various institutes have recorded decrease in groundwater quality which is attributed to high concentration of fluorides which have been recorded to be more than 2 times the standard limits.

Groundwater recharging pits, using ring wells are highly recommended for the city of Nanded to recharge the groundwater aquifers. NWCMC should undertake a survey to develop a detailed inventory of the number of bore wells within the city. As for the new installations, it is recommended that new bores should be approved by the corporation with appropriate

inventory. The applications should be linked to conditional approval, that all the bore wells should be augmented with a rain water recharging well structure.

### Water Supply

There are about 5 WTP (Water Treatment Plants) with a total capacity of 169 MLD which supply water to Nanded city. The current total load on these WTPs is about 90 MLD translating to a load efficiency of just over 53%. The raw water as well as the treated water is tested for the quality at the district public health laboratory at Nanded as well as at the laboratory established by water resources department, NWCMC. The water quality tests conducted for the treated water samples shows that all the water quality parameters are within the agreeable limits as compared to the BIS (Bureau of Indian Standards).

As of now NWCMC meters only 4.5 MLD, which is mere 5%, of the total supply of about 90MLD. About 85% of the water is un-metered and hence there is no proper accounting for the water supplied, and subsequently the water remains un-accounted. The NRW (Non-revenue water for Nanded city accounts to about 37% which is way beyond the service level benchmark of 20% set by Ministry of Urban Development, Government of India. It is strongly recommended that all the connections (domestic and non-domestic) for water supply within the NWCMC should be metered. This will help keep a tab on the water supply as well as the losses.

### Sewage Collection and treatment

The city has 2 operational STP's (Sewage Treatment Plants) with total capacity of 117 MLD, one each at Elichpur (30 MLD) and Bondar (87 MLD). The current load on these STP's is about 33 MLD indicating average operating efficiency of about 30%. About 35 MLD of sewage is released untreated into the Godavari River because of poor sewage network. As a response to this, the NWCMC has proposed new STP of 15 MLD at Sanghvi area of Nanded city and also submitted proposal under AMRUT (Atal Mission for Rejuvenation and Urban Transformation) for augmenting the sewer network.

Nanded city has 23 public toilets with mere 214 seats and has a deficit of more than 4100 seats. Given the fact that more than 39% of the population in Nanded lives in slums and slum areas cover more than 15% of the city area, it is highly recommended to install public toilets within the city. It shall also help cater to the tourist population and help reduce open defecation in the city. Mere 50%, of the total waste water generated from the Nanded city is collected and treated while the remaining 50% (about 30MLD) is released in the river without treatment. It is recommended that the sewerage infrastructure should be enhanced with utmost priority to cater to the requirements.

The treated water could be used for various secondary applications, by using dedicated tanker services, for various activities like Watering to road side plantations, Irrigation of lawns and gardens owned by NWCMC, Irrigation of farms and fields, Washing of roads to reduce road dust re-suspension, thus helping avoid air pollution, Water supply for construction activities and so on.

## Air and Noise Pollution

MPCB has established 3 non-continuous monitoring stations, namely at Ganeshnagar, Mutha Chowk and CIDCO Industrial Area, under NAMP (National Air Quality Monitoring Programme) in order to monitor and represent the air quality of Nanded city. These sites were established in January 2009 and the daily operation, analysis and maintenance of these sites is managed by Netaji Subashchandra Bose College, Nanded. Concentrations of SO<sub>2</sub> (Sulphur Dioxide), NO<sub>x</sub> (Oxides of Nitrogen) PM<sub>10</sub> (Particulate Matter) are monitored twice a week throughout the year.

As per air quality recorded at these sites it is noticed that Nanded city has recorded an increasing trend in NO<sub>x</sub> and PM<sub>10</sub> concentrations in past 5 years. Also SO<sub>x</sub> levels were noted to increase in 2014-15 as compared to last 4 years however they were recorded within the standards limit.

In the year 2014-15, the annual NO<sub>x</sub> concentrations at Nanded city ranged from 28µg/m<sup>3</sup> to 83µg/m<sup>3</sup>. The Industrial area CIDCO recorded the maximum annual NO<sub>x</sub> concentration twice the standard limit (40µg/m<sup>3</sup>). Similarly, PM<sub>10</sub> concentrations exceeded 1.5 to 3 times the CPCB standards (60µg/m<sup>3</sup>) in Nanded city. The maximum annual PM<sub>10</sub> concentrations was recorded at Industrial area CIDCO.

There is deterioration in terms of the AQI (Air Quality Index) of Nanded city. In the year 2014-15, the air quality in the Industrial area CIDCO and Mutha chowk were observed to be polluted whereas Ganeshnagar was recorded to be least affected. (Figure No. 1). The air quality in the Industrial area has been in between 'Moderate' and 'Poor' category for more than 50% of the observation days in the year 2014–15. This type of air quality is known to cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease.

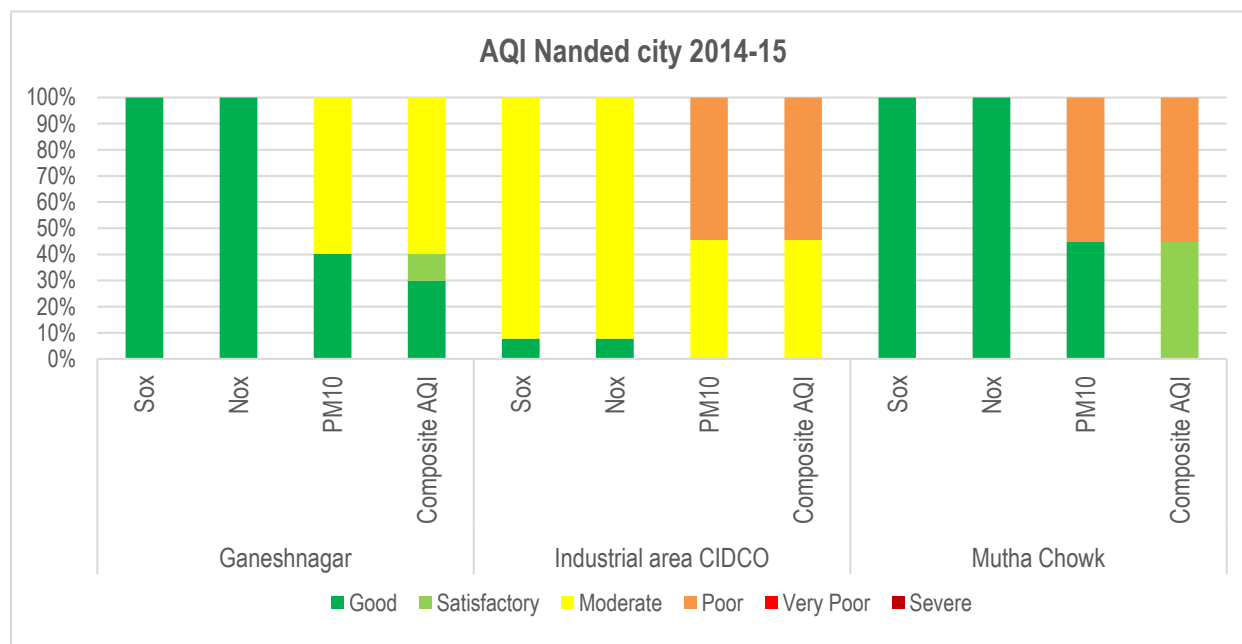


Figure No. 1: AQI of Nanded city 2014-15

Data Source: MPCB

More than 2 lakh new vehicles have been added to the on road vehicular fleet in Nanded in the past 5 years. In the year 2014-15 itself more than 43,000 new vehicles were registered out of these two wheelers had a share of more than 88%. The sale of Motor Spirit (Petrol) increased by 36% in last five years and in the reporting year about 18,869 KL was consumed within the city. This indicates that there is increase in vehicular density, traffic congestion as well as vehicular emissions leading to higher NO<sub>x</sub> and PM levels. Similarly firewood as source of cooking (32%), especially by the urban poor, also adds to the air pollution in Nanded city.

MPCB conducted noise monitoring during Diwali Festival at commercial (Vazirabad and Mondha) and residential (Ganeshnagar and Shivaji Nagar) zones. The average noise levels at these locations exceeded the permissible limits 65 dB (daytime standard) and 55 dB (night time standard) for commercial zone and 55dB (daytime standard) and 45 dB (night time standard) for residential zones. The decrease in trend of noise levels is observed over last 3 years however in 2014-15, the highest noise level about 1.3 times the standard was recorded at both Mondha area (85dB) as well as Vazirabad (84dB). The minimum noise level was recorded to be 71dB which is 1.6 times the day time standard at Shivaji Nagar.

To mitigate the air pollution for NO<sub>x</sub> and PM levels a few interventions and strategies for traffic management and transport sector has been recommended which include CNG retrofitting for Auto Rickshaws based on Pune Model and promoting CNG vehicles for public transport as well as private vehicles. Improvement of road quality and introduction of one way routes to regulate the traffic is highly recommended to help reduce the air pollution of the city.

As for the domestic sector the use of PNG (Piped Natural Gas) as an effective alternative for firewood and LPG for cooking purposes is recommended. Use of firewood as source of fuel, which accounts for about 32%, for cooking purposes can be replaced by smokeless chullas. Smokeless chullas reduces pollution load of CO, soot particles and Particulate Matter which result in acute respiratory infection disorders. Also these chullas are time and cost effective.

The control measures for air pollutants at construction sites should be integrated in the building codes and be implemented under the supervision of the corporation. This could be largely be incorporated from, GRIHA (Green Rating for Integrated Habitat Assessment), India's national green building rating system

- Use of wind fences to reduce the wind velocity. Use of vegetation cover around the storage pile can act as wind break.
- Utilize enclosure/coverings for storage piles like Tarpaulins, plastic, or other materials.
- Load and unload the building materials at downside of storage pile.
- When loading materials onto vehicles and conveyors, the drop heights should be kept to a minimum and enclosed whenever possible.
- Use of water sprays to suppress the dust production during construction activities.
- Enclosure /coverings for vehicles carrying construction materials.
- Proper exhaust system, use of catalytic converter and proper maintenance of vehicles can also minimize the air pollutants at construction sites



## Solid waste

It is estimated that about 240 MT (Metric Tonnes) per day of MSW (Municipal Solid Waste) generated in Nanded city. Out of the total generated, about of 230 MT MSW is collected daily in Nanded city through an effective system established by NWCMC. The remaining 10 MT of the waste remains unaccounted. Almost 3.5% (8 MT/day) out of the total waste is categorised as hazardous waste while about 0.32 MT of biomedical waste is generated per day in Nanded city. Waste from the city is collected with help of tractors, Refuse compactors, Nala cleaner machine, Bobcat machine and disposed at the Tupa dumping site situated around 2 km from the city.

NWCMC has provided about 113 closed type litterbins/containers for collection of MSW and has proposed to set up a waste processing plant for effective disposal of solid waste. Developing a scientific landfill over dumping ground and adopting waste to energy techniques is recommended to NWCMC for effective disposal of solid waste generated from the city.

## Health

Nanded city has good health facilities like private hospitals (333), Ayurvedic centers (22), Private Nursing Homes (48) and so on. In the year 2014–15 total 2382 number of cases for water borne diseases were recorded in Nanded city out of which 2319 cases of Gastroenteritis, 35 cases of Dengue and remaining 28 cases of Malaria were recorded. As for the cases of Tuberculosis (TB), around 545 cases and 28 deaths were recorded in the year 2014–15. Similarly, 92 cases and 2 deaths of respiratory disorders were recorded during the same duration.

Emphasis and awareness of TB is highly recommended for Nanded city. Awareness drives like TB literate ward should be undertaken. Public transport vehicles, may be targeted for advertisement campaigns. The efforts taken by NWCMC to curb Malaria and Dengue cases need to be highlighted and publicised. A proper documentation of the same must be maintained through a digital inventory.

Similarly, a process for recording data on number of cases of ARI (Acute Respiratory Infection), Asthama and so on recorded in Private hospitals must also be maintained.

## Nanded Waghala - City Profile

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Nanded Waghala city is the second largest urban city, after Aurangabad, in the Marathwada region of Maharashtra and is also the administrative headquarters of Nanded district. It is situated in eastern part of the Marathwada region located along the banks of Godavari River. The city is spread across 63.44 sq km and divided into 4 administrative zones, Zone A (Taroda-Sangvi), Zone B (Shivaji nagar-Ashoknagar), Zone C (Vazirabad-Itwara) and Zone D (CIDCO). As per JNNURM (Jawaharlal Nehru National Urban Renewal Mission) it has been recognised in the "C" category due to its cultural and historic significance.

As per census report<sup>1</sup>, Nanded- Waghala city has a total population of 5,50,439 constituting around 52% of males and 48% of females. The sex ratio of Nanded-Waghala city is around 928 females per 1000 males which is almost at par with the State average of 929.<sup>2</sup> The average literacy rate of Nanded-Waghala city is 74.8%; out of which male and female literacy is 78.59% and 70.76% respectively. Table No. 2, presents various basic details of the city.

**Table No. 2: Basic Details of the city**

Parameter	Attributes
Longitude	77°10' E
Latitude	18°30' N
Altitude from mean sea level	489 Metres
Total area	63.44 Sq. km
Population(Census 2001)	4,30,733
Population (Census 2011)	5,50,564
Average Annual rainfall (IMD)	950 mm
Average temperatures, Minimum and maximum (IMD)	20°C , 34°C respectively

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<sup>1</sup> Census of India 2011

<sup>2</sup> [http://www.dataforall.org/dashboard/censusinfoindia\\_pca/](http://www.dataforall.org/dashboard/censusinfoindia_pca/)

## History

Nanded city has a long history of over 7 centuries and is also birthplace of the saint poets like Vishnupant Sesa, Raguhunath Sesa and Vaman Pandit<sup>3</sup>. Nanded was ruled over by the Satavahanas, the Chalukyas, the Kakatiyas followed by the Yadavas. The name Nanded originated from "NANDI" the Vahan of Lord Shiva, who performed penance on the banks of river Godavari.<sup>4</sup> It is also believed that nine rishis known as Nand performed penance on the bank of the river Godavari and hence the name Nand tat<sup>5</sup>.

Until 1947, Nanded district along with the other four districts of the Marathwada region was a part of the Nizam's state while after the re organization of the states in 1956, Nanded was included in the Bombay state. Further in 1960, when the bifurcation of Bombay state into Maharashtra and Gujarat took place, Nanded along with other districts of Marathwada became the part of Maharashtra state<sup>6</sup>.

The Nanded city is endowed with the river Godavari and has several religious monuments. The Takhat Sachkhand Shri Hazur Abchalnagar Sahib Gurudwara (Sachkhand Gurudwara), one of the five Takhats of the Sikh religion is one of the most popular Guruwada in Nanded (Picture No. 1). It is believed that Shri. Guru Gobind Singh reached Nanded in July 1708. He camped on banks of Godavari river and would deliver sermons to his disciples. While on his death bed, Shri. Guru Gobind Singh, declared 'Guru Granth Shabib' as next guru of Sikhs and died on 7th October 1708. Maharaja Ranjit Singh, the founder of Sikh Empire, deeply loved and admired the teachings of Shri. Guru Gobind Singhji and hence to pay homage to the city where Guru Gobind Singhji died, Maharaja Ranjit Singhji built the Sachkhand Gurudwara between 1832 – 1837<sup>7</sup>.

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<sup>3</sup> <http://nanded.nic.in/htmldocs/index.html>

<sup>4</sup> <http://nanded.nic.in/htmldocs/index.html>

<sup>5</sup> [Groundwater Survey and Development Agency,Pune](http://www.gwdapune.org/)

<sup>6</sup> [http://nanded.nic.in/htmldocs/htmldocs/district\\_gazetter.html](http://nanded.nic.in/htmldocs/htmldocs/district_gazetter.html)

<sup>7</sup> <http://www.hazursahib.com/Informations/History.aspx>



**Picture No. 1: Takhat Sachkhand Shri Hazur Abchalnagar Sahib, Nanded**  
**Photo credit: TERI**

## Connectivity

Nanded is regionally linked by road to other urban areas by major highways namely, NH 222 Kalyan-Ahmednagar-Parbhani-Nanded-Nirmal, NH 204 Nagpur-Wardha-Nanded-Latur-Solapur-Sangli-Kolhapur-Ratnagiri and NH 161 Akola-Washim-Hingoli-Nanded-Degloor-Sangareddy, pass through the city. In terms of rail connectivity, Nanded is part of the South-Central Railway division and lies on the Mumbai-Secunderabad railway line. It is serviced by direct rail connectivity to Mumbai, Secunderabad and Amritsar.

Nanded city has a small airstrip, developed and maintained by MIDC (Maharashtra Industrial Development Corporation) that is capable of handling only small private aircrafts. While there is no commercial air traffic in the city airport (Picture No. 2); the runway is currently used for landing of private aircrafts and senior government dignitaries visiting to Nanded. Government of Maharashtra through MIDC is presently upgrading the existing infrastructure to facilitate regular commercial flights between Nanded and other important cities. The closest regular airports from the city are located at Aurangabad (250 km) and Hyderabad (280 km).



Picture No. 2: Nanded city airport

Source: <http://tourmet.com/wp-content/uploads/2013/12/Nanded-Airport.jpg>

## Biodiversity

Nanded city, still being a young and developing city has a lot natural areas in and around the city which harbours a variety of biodiversity. Around 151 species of birds are present in and around Nanded city which includes 86 sps of resident birds, 32 sps of resident migrant birds, 19 species of winter migrants, 10 sps of migrants, 2 sps of breeding migrants and 2 sps of passage migrants (Kulkarni, 2005)<sup>8</sup>. Chavan et al (2015) has reported 168 species of birds from the Godavari river basin in the Nanded district<sup>9</sup>. Study of ichthyofauna of Barul reservoir of Nanded district found 24 species of fish belonging to 11 families<sup>10</sup>. 7 species of algae were found from the Sahastrakund waterfall with dominance of class Chlorophyceae, Cyanophyceae and Zygnematophyceae<sup>11</sup>. Ethno botanical study by Routh and Mangulkar (2013) found 23 species of plants which are still being used for basic medicinal purpose. More biodiversity in and around Nanded city still needs to be explored.

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<sup>8</sup> Kulkarni, kanwate and Deshpande (2005). Birds in and around Nanded city, Maharashtra, ZOOS' Print Journal, 20(11), 2076- 2078.

<sup>9</sup> <http://www.ijcrar.com/vol-3-4/Shivaji%20P.%20Chavan,%20et%20al.pdf>

<sup>10</sup> <http://www.linknovate.com/publication/biodiversity-of-ichthyofauna-of-barul-reservoir-nanded-district-maharashtra-1307401/>

<sup>11</sup> Narwade et al (2014). Diversity of fresh water algae from the Sahastrakund waterfall, Nanded, Maharashtra; Indo American Journal of Pharmaceutical Research, ISSN NO: 2231-6876.

## Climate

The climatic conditions of the city are generally dry except during monsoon season that sets in the first week of June and lasts about 3 to 4 months, till the end of September. The average temperature of the city, as seen in Figure No. 2, lies in the range of 12°C (minimum) to 40°C (maximum). The highest temperature recorded in the district is about 46.6°C (May 7<sup>th</sup>, 1968) and minimum is 3.6°C (December 28<sup>th</sup> 1983). The Nanded district receives about 950mm rainfall throughout the year (Figure No. 3) out of which 93% of rainfall is received during the monsoon season from June to October. The heaviest rainfall recorded in 24 hours was about 252.6 mm on August 12<sup>th</sup> 1983.

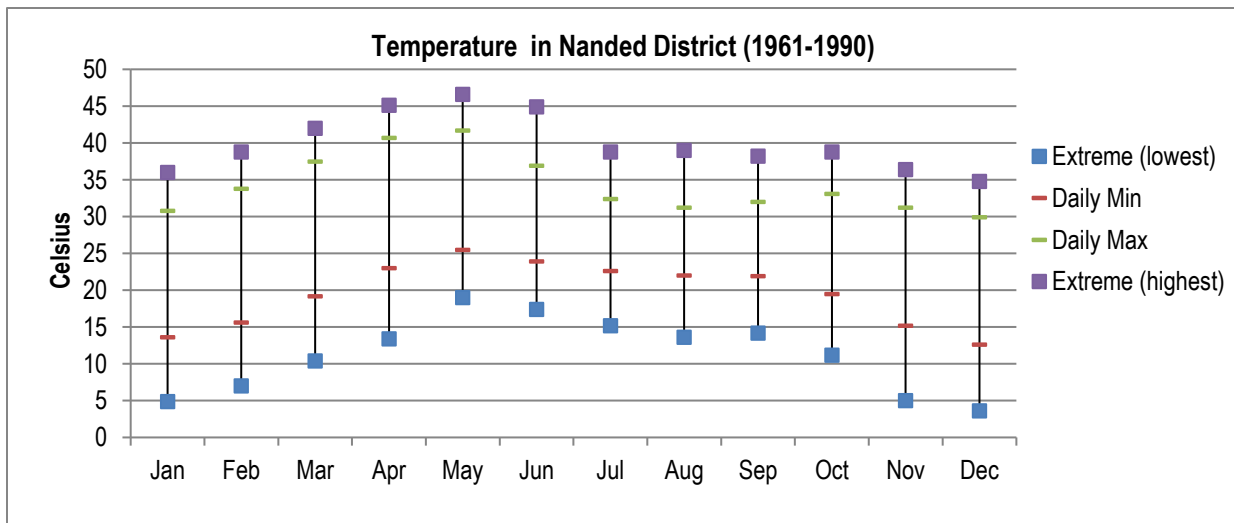


Figure No. 2: Temperature in Nanded district (1961-1990)

Source: IMD Pune, Climatology Normals (1961-1990)

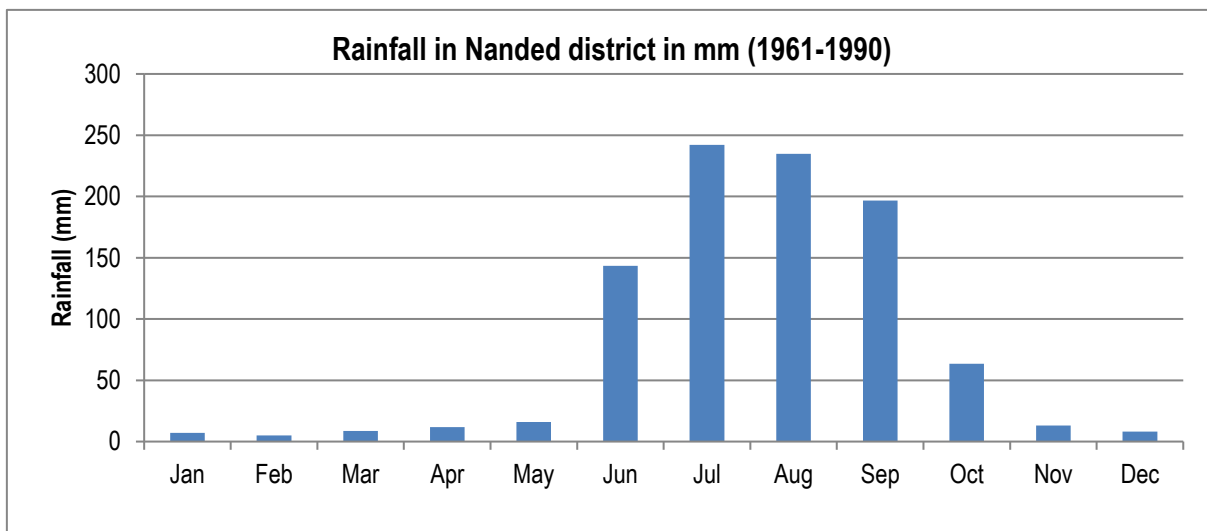


Figure No. 3: Rainfall in Nanded district in mm (1961-1990)

Source: IMD Pune, Climatology Normals (1961-1990)





## Driving Forces of Nanded City

Urbanization refers to growth in towns and cities. The process of urbanization is one of the most important dimensions of economic, social and physical change. Although it provides opportunities for job, better housing, education, knowledge, and technology and so on, it also exerts enormous stress on natural resources. As per the Census of India 2011, the population of country has increased by more than 22% (181 million) during the decade 2001-2011 which directly increases the demand for land, water as well as other natural resources, directly impacting their natural status. The growth of the industries, results in expansion of the business sector and economic growth of the city, which in turn attracts the inflow of population from other towns, villages thus setting a continuous and ever expanding cycle. Thus, population, industrial, economic and spatial growths act as primary driving forces in the growth of any city. Similarly, availability of resources like Air, Water, and Land act as key factors in the growth of cities and have been analysed in separate sections for their status, the—Pressures being exerted on them, the —Impact of various urban activities on these resources, and the —Response taken by the corporation to reduce the impacts.

### Population growth

The population of Nanded city, as per Census of India 2011 is 5,50,564 registering a decadal population growth rate of 21.76% which is higher than the state as well as national decadal average of 15.99% and 17.64%<sup>12</sup>. The trend of population during last 40 years has been depicted below in Figure No. 4. Surprisingly, it was seen that the population growth was higher in the period of year 1991 to 2001 (28.18%) as compared from year 2001 to 2011. The population number from the last five decades predicts the constant growth rate along a stagnant line. Assuming 4% annual growth rate in population, NWCMC is projected to have around 11 lakhs population by the year 2025<sup>13</sup>.

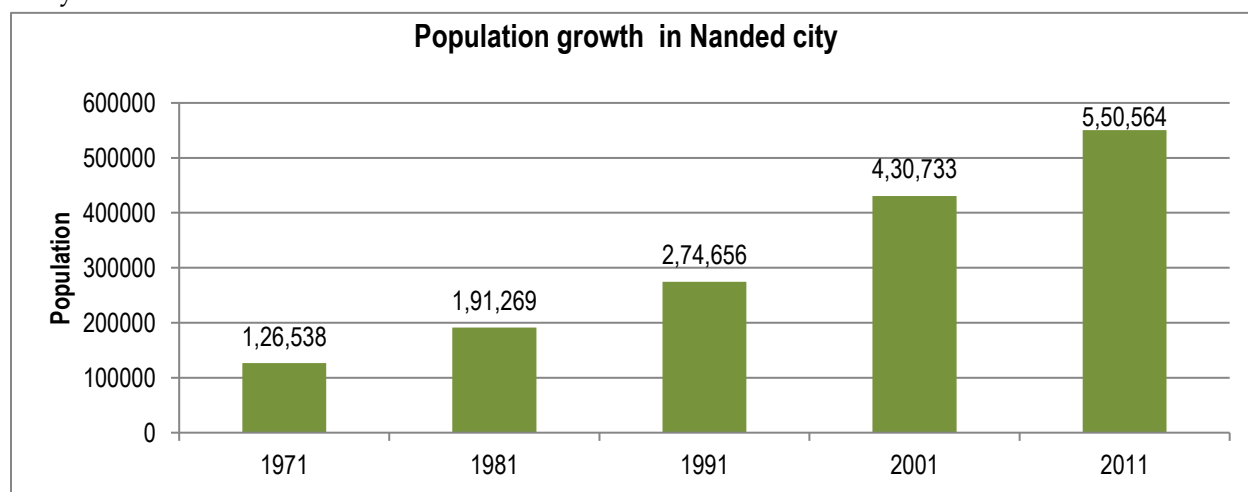


Figure No. 4: Population growth in Nanded city

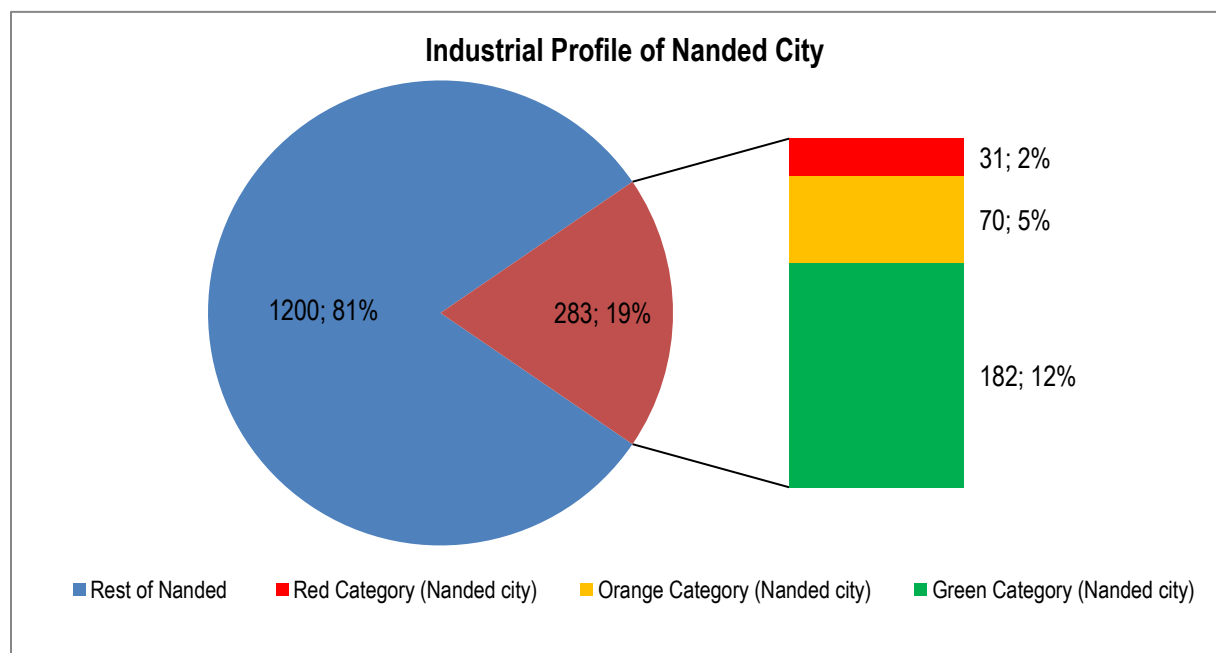
Source: Census of India

<sup>12</sup> [http://censusindia.gov.in/2011-prov-results/data\\_files/maharashtra/maha\\_at\\_aglance.pdf](http://censusindia.gov.in/2011-prov-results/data_files/maharashtra/maha_at_aglance.pdf)

<sup>13</sup> Nanded Waghala Municipal Corporation, [City Development Plan, 2006-25](#), Pg No.127

## Industrial and Commercial growth

Currently the city has two industrial zones –MIDC area and Nanded Industrial estate. The Industrial Estate is within the city whereas the MIDC zone lies at the outskirts of the city. The MIDC accounts for about 272 hec. area and Industrial Estate covers 55 hec. area<sup>14</sup>. At present there are 2 large scale, 4 Medium scale and 277 small scale industries engaged in the manufacturing activities. The industrial profile of Nanded city is given below in Figure No. 5. it is observed that Nanded district has major industries under Green category. 56% of green category, 23% orange category and 22% red category of industries are noted in Nanded district. Along with growth in industrial sector, the commercial activities of Nanded are also increasing gradually every year by 2-3%. The total commercial activities have increased by 13% in year 2014-15(67 properties) as compared in the year 2010-11 (33 properties) The Figure No. 6 represents the growth in commercial activities carried out in Nanded city.



**Figure No. 5: Industrial profile at Nanded**  
 Source: MPCB, Nanded

<sup>14</sup> [District industrial Center](#) ,D.I.C, Nanded (updated 2013)

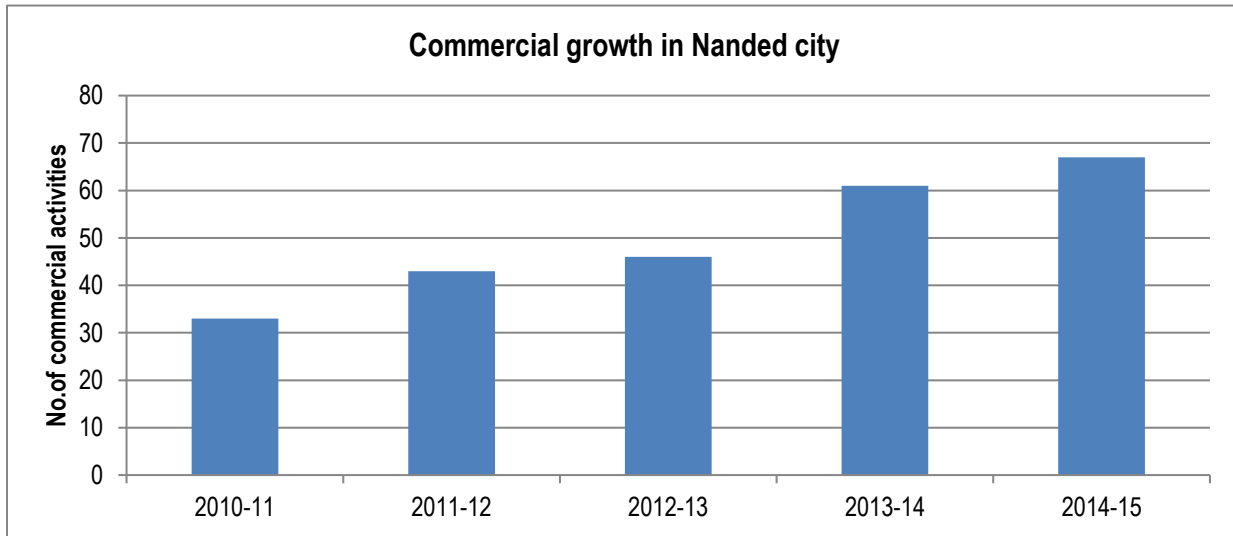


Figure No. 6: Commercial growth in Nanded city  
Source: District Center of Industries, Nanded<sup>15</sup>

## Economic development

The Nanded city shows significant economic growth over the last 5 years. The GDDP (Gross District Domestic Product) of Nanded at CAGR (Compound Annual Growth Rate) is 3.9% over past 5 years. In the year 2012-13, GDDP of Nanded recorded was 12,370 crores which is almost 1.2 times that of the year 2008-09 (10,223 crores). The economic growth of the region also influences the per capita economic growth of the population in Nanded district. In terms of PCNDDP (Per Capita Net District Domestic Product), the district shows 1.9 times increase with CAGR of 13%. The GDDP and PCNDDP of Nanded district is represented in Figure No. 7.

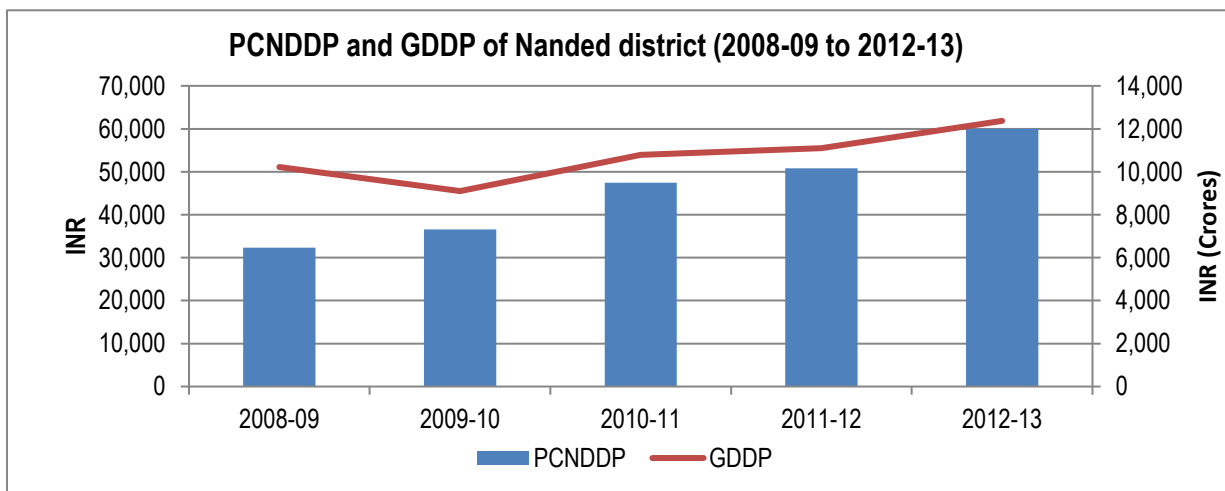


Figure No. 7: GDDP and PCNDDP of Nanded district from 2008-09 to 2012-13  
Source: Economic survey of Maharashtra 2010-11, 2011-12, 2012-13, 2013-14; GoM

<sup>15</sup> <http://www.nandeddic.in/list1.html>

While in the Nanded city, as per census 2011, about 30.47% population account as working population<sup>16</sup> and especially in the tertiary sector (trade, transportation, storage, communication and other services) professions (Figure No. 8). This could be attributed to new means of transportation and communication facilities, employment opportunities mainly in trade and commerce - catering to the local market and the rural hinterland followed by education, tourism, health and transportation services. Nanded is also considered as big regional trading hub for Banana, Custard Apple, Lime/Sweet Lime, Soya Bean and other agro based products. The share of tertiary professionals has increased from 59% to 65%, in 2011 as compared to 1981, while during the same time the share of persons in primary activities (agriculture and forestry) and secondary activities (Manufacturing, processing services and repairs) has reduced from 8% to 4% and 32% to 30% respectively. This decline in secondary sector maybe due to closure of Osmaan Shahi Textile Mills (Now known as Nanded Textile Mills Corporation), Cotton Research Center, Textile Corporation of Nanded and other manufacturing units<sup>17</sup>.

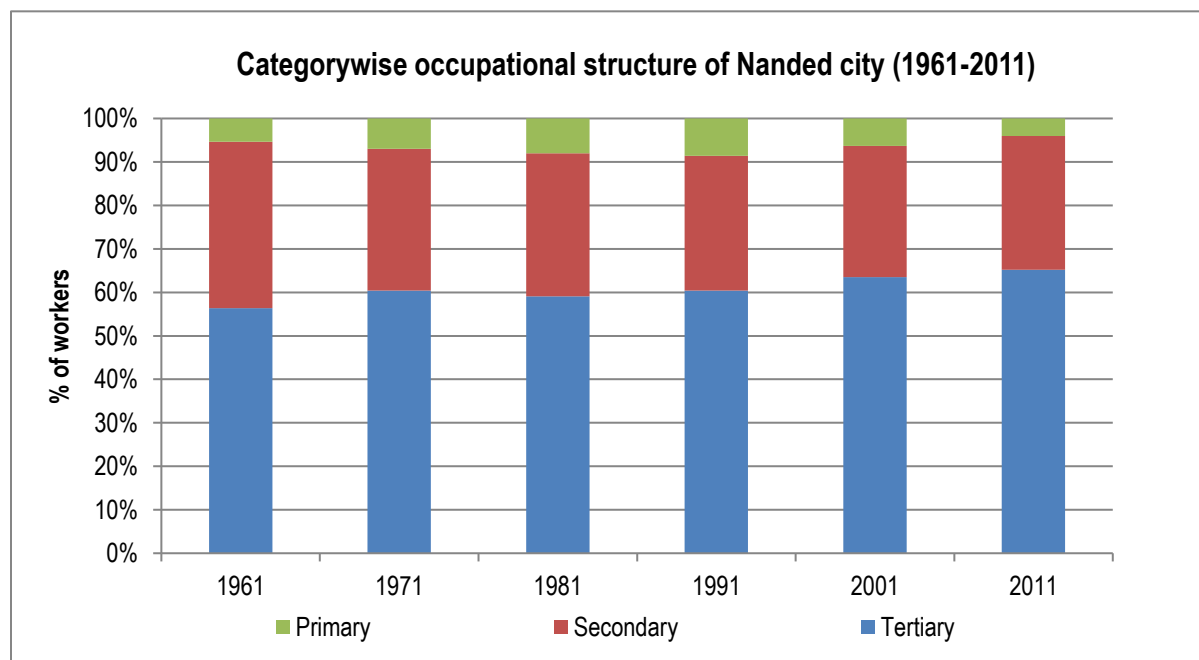


Figure No. 8: Category wise occupational structure of Nanded city (1961-2011)

Source: M.U. Deshmukh, 2015<sup>18</sup>

<sup>16</sup> M. U. Deshmukh, P.A. Khadke, [Study of Occupational Pattern in Nanded city june-july 2015](#), Vol 2/10, Pg no.2623

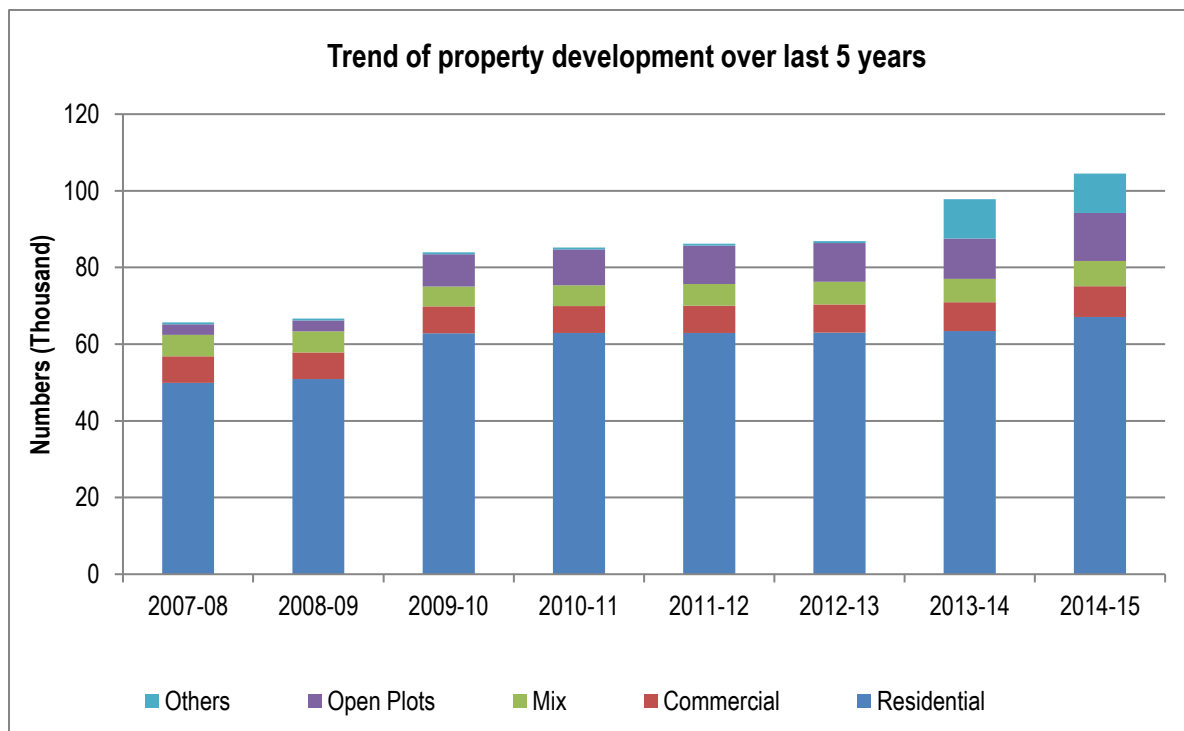
<sup>17</sup> Dr. P. B. Kadam, Dr. S.B. Rathod, [Study of Occupational Structure in Nanded city](#), Pg no.196,2013

<sup>18</sup> M.U.Deshmukh,P.A.Khadke, [Study of Occupational Pattern in Nanded city june-july 2015](#), Vol 2/10, Pg no.2623

## Spatial growth

The Nanded city has expanded over the years, not only in terms of population or activities but also in terms of its spatial coverage. Many villages/towns were added to the corporation limits, since its inception. The Census of India 2011 records 27% of urban population in Nanded district, out of which 19% of urban population resides in Nanded- waghala City. The city displays an increase in population by 21% in year 2011(5, 50,564) as compared to 2001(4, 30,733). This rapid increase results in use of land/space to accommodate the population.

The number of properties in Nanded has increased by 59% as compared to year 2007-08. For the year 2014-15, the residential properties mark the highest recording of 64% while the least is observed to be in 'Mix' areas (Residential and commercial ) recording 6% out of the total 104,497 properties. From Figure No. 9, the increase in open plot areas has increased by 5 times as compared to 2007-08. This may be due to addition of new areas demarcated by the corporation in the city. Similarly, the increasing trend in 'Other' category is almost 20 times as compared to year 2007-08 .The sector wise property in Nanded in shown in Figure No. 9



**Figure No. 9: Trend of property development over last 5 years**

**Source: Town Planning, NWCMC**

*Note: Mix includes commercial and residential category; others includes religious/educational property and mobile towers*



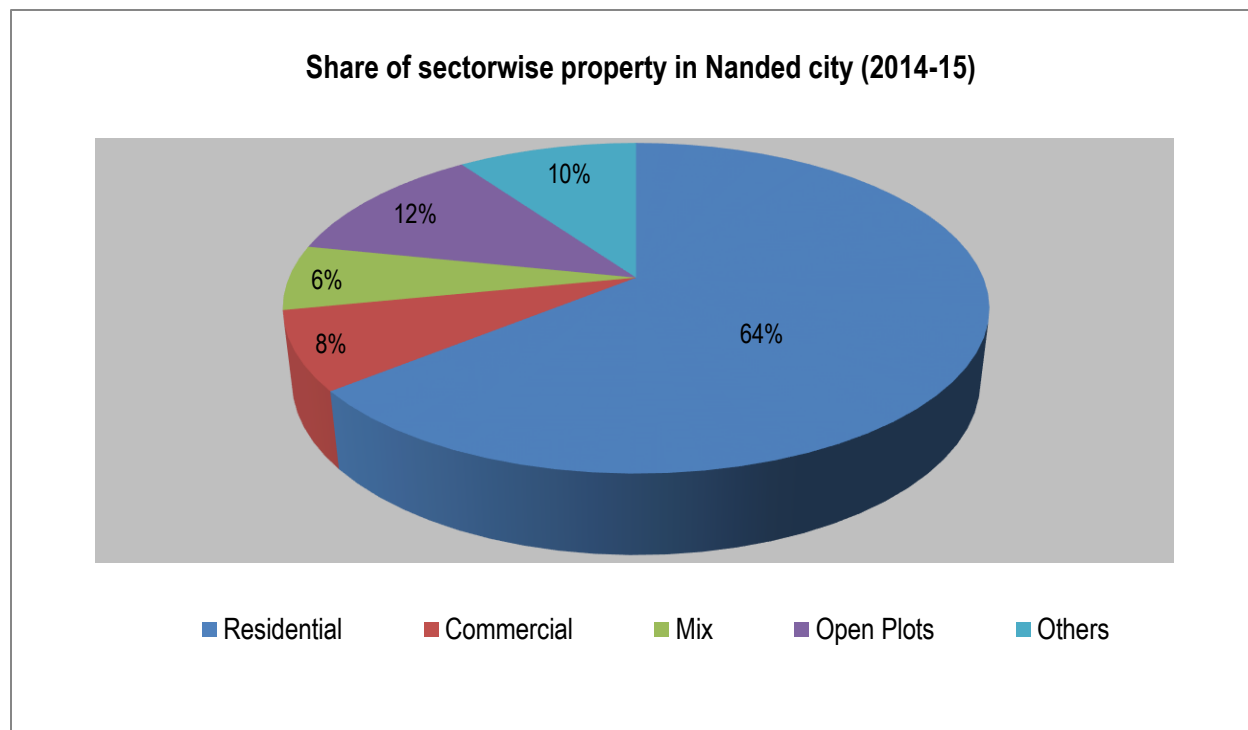


Figure No. 10: Share of sector wise property in Nanded city -2014-15  
 Source: Town Planning Department, NWCMC

## Religious Tourism

The city has conferred the status as “Holy City” by government of Maharashtra on housing the Guru Granth Sahib and last resting place of Shri Guru Gobind Singhji. Nanded is a well-known Sikh pilgrimage centre; as the famous Sikh Gurdwara Takhat Shri Hazur Sahib is present in the city. Along with famous Gurudwara the city also complements seven other Gurudwaras present in the city. Over 1.5 million tourists, mainly Sikhs, from all over the world visit Nanded every year during Holi, Baisakhi, Dussera, Diwali and Parlok Gaman of Guru<sup>19</sup>.

The other religious places include - Masjid of Biloli (330 year old), Renuka Mata Temple (Mahur), Khandobha Temple (Malegaon), Kaleshwar Temple, Kandhar Dargah and Aundha Nagnath Temple. The city also has Vishnupuri Dam, Unkeshwar hot springs, Sahastrakund waterfall and Nanded Fort as tourist spots. A beautiful Siddeshwar Temple known for Chalukyan era architecture in Hottal of Degloor Taluka is also tourist attraction<sup>20,21</sup>.

It is estimated that around 3 million pilgrims visit to this city every year due to its religious significance.

<sup>19</sup> [Nanded city development plan 2006-25](#), 2006, Pg No. 25

<sup>20</sup> <http://nanded.nic.in/htmldocs/htmldocs/tourism.html>

<sup>21</sup> <http://www.nandedonline.in/city-guide/dams-waterfalls-and-parks-in-nanded>

## Educational institutes

Nanded is famous for its educational facilities and is often referred to as the 'Educational Hub' of Marathawada and attracts a lot of students from the neighbouring districts. The Nanded University commonly known as SRTMU (Swami Ramanand Teerth Marathwada University) is situated in Nanded and has about 131 colleges affiliated colleges. There are 3 Engineering Institutions namely Shri Guru Gobind Singh Institute of Engineering and Technology (SGGS), an autonomous college; Mahatma Gandhi Mission's College of Engineering and Technology (MGM), Matoshri Prathistan's Engineering College along with a Dr. Shankarrao Chavan Government Medical College and the Government Ayurvedic College. The list and trend of Government institutes in Nanded is presented below in Table No. 3.

**Table No. 3: List of Educational Institutes in Nanded**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Anganwadi	130	130	130	257	257	269
Primary	210	199	164	236	242	254
Secondary	65	87	74	95	100	107
College	28	28	28	28	28	28
D.Ed Colleges	10	10	10	10	10	10
B.Ed. Colleges	9	9	8	9	9	9
Law Colleges	2	2	3	3	3	3
Medical Colleges	2	2	2	2	2	2
I.T.I.	2	2	2	2	2	2
Engineering Colleges	1	1	1	1	1	1
<b>Total</b>	<b>459</b>	<b>470</b>	<b>422</b>	<b>643</b>	<b>654</b>	<b>685</b>

Source: Education Department, NWCMC



# Water Resources

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Water is the basis of life forms and is the element which is the key to the existence of life on this very planet. Although, about 71% of the earth is covered with water it predominately (97%) is salt water and not fit for human consumption. Mere 3% of the total water available on earth is freshwater and that too is majorly locked in form of ice-caps, glaciers or ground water leaving mere 0.3% of the freshwater accessible to humans<sup>22</sup>. Given the increasing demand of water for domestic, agricultural and industrial applications and the limited accessible sources of water, it is undoubtedly one of the most precious resource we need to conserve and use judiciously. The following section presents the status of surface and ground water in Nanded city.

## Surface Water

### Godavari River

Godavari River is the second longest river in India after the Ganges and originates from Trimbakeshwar (Western Ghats) at Nashik in Maharashtra. The total length of the river is estimated to be about 1,465 kilometres (910 miles), and it first flows eastwards across the Deccan plateau then turns southeast, entering the west Godavari district and east Godavari district of Andhra Pradesh, until it splits into two watercourses that widens into a large river delta and eventually flows into the Bay of Bengal. The drainage areas of the Godavari basin in Maharashtra accounts to 48.65%, (1, 52,199 Sq.km), which is largest than any of the states through which it flows. The salient features of the basin have been elaborated in Table No. 4 Nanded city is blessed with the presence of Godavari River (Picture No. 3) and flows about 5 km in length along the Nanded city. Before entering the city's jurisdiction, the river travels almost 500 km from the source. There are three major dams, (Gangapur, Jayakwadi & Majalgaon) on the Godavari river before it reaches Nanded city.

**Table No. 4: Salient Features of Godavari Basin**

Features	Details
Basin extent	Longitude: 73° 24' to 83° 4' E Latitude : 16° 19' to 22° 34' N
Catchment Area (Sq.km.)	3,12,812
Average Water Resource Potential (MCM)	1,10,540
Utilizable Surface Water Resource(MCM)	76,300
Live Storage Capacity of Completed Projects (MCM)	35,434
Live Storage Capacity of Projects Under Construction (MCM)	8,228
Total Live Storage Capacity of Projects (MCM)	43,662

**Data source: Water Resources Information System of India**

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<sup>22</sup> [http://water.epa.gov/learn/kids/drinkingwater/water\\_trivia\\_facts.cfm](http://water.epa.gov/learn/kids/drinkingwater/water_trivia_facts.cfm)



**Picture No. 3: Godavari River flowing through the city of Nanded**  
**Photo credit: TERI**

### Vishnupuri Dam

Nanded city receives its daily water supply from Vishnupuri dam situated near Asarjan village on the river. The command area of the dam is distributed in Nanded, Kandhar & Loha taluka of Nanded district. The dam has a live storage of about 80.79 million cubic meters, out of which 43.95 million cubic meters storage is reserved for drinking purpose for Nanded city and 10.26 million cubic meters storage is reserved for industrial applications. The barrage (Picture No. 4) has 18 vertical gates<sup>23</sup>. While the specifications of the dam have been tabulated in Table No. 5.

**Table No. 5: Specification of Vishnupuri dam**

Specifications	Attributes
Type of Dam	Earth
Distance from city (NWCMC) jurisdiction	8 km
Height above lowest foundation (m)	13
Length of dam (m)	321
Gross storage capacity	8,355
Effective storage capacity (thousand cubic meters)	8,196
Designed spillway capacity (m <sup>3</sup> /sec)	33,220
Design purpose	Irrigation

**Source: Central Water Commission, Government of India<sup>24</sup>**

<sup>23</sup> <http://nanded.nic.in/htmldocs/htmldocs/Vishnupuri-Dam.html#>

<sup>24</sup> <http://www.cwc.nic.in/main/downloads/National%20Register%20of%20Large%20Dams%202009.pdf>



**Picture No. 4: Vishnupuri Dam constructed on Godavari River in Nanded**

**Photo credits: TERI**

Under the NWMP (National Water Quality Monitoring Programme), the MPCB (Maharashtra Pollution Control Board) has installed two WQMS (Water Quality Monitoring Station), one at Vishnupuri dam and other one being at Raheer (Taluka Nayagaon) representing upstream and downstream locations respectively for Nanded city. The water quality is monitored at both these locations with a monthly frequency and are tested at the Aurangabad laboratory of MPCB for more than 19 parameters.

The water quality index (WQI), determined by MPCB, indicated that the water samples collected upstream as well as downstream are in 'Good to Excellent' category (Table No. 6) consistently for the past 5 years, indicating that the water samples were observed to be well within the standard limits and the water is not polluted as per chemical tests.

The water supply and sanitation department of NWCMC also monitors the water quality of the water received from the dam at the water treatment plants operated by NWCMC. The quality of water is tested at the district health laboratory at Nanded for raw water samples received at the water treatment plants. Monthly samples are sent to the laboratory and the annual average water quality is presented in Table No. 9 and discussed below in the subsection Water Treatment Plants.

**Table No. 6: Trend of the WQI for water samples monitored at NWMP sites in Nanded city**

Mar	86	87	82	81	78	78	NA	NA	84	84
Feb	77	73	79	86	78	80	81	80	85	80
Jan	77	83	84	85	81	77	86	82	NA	80
Dec	75	79	82	80	77	81	81	79	NA	73
Nov	NA	83	82	77	62	68	81	79	84	82
Oct	49	52	83	79	71	66	79	81	84	89
Sep	76	75	84	89	68	65	80	79	84	82
Aug	79	84	NA	79	80	78	78	81	84	81
Jul	NA	79	83	79	82	78	76	80	84	86
Jun	NA	37	78	60	74	67	85	85	85	86
May	NA	NA	82	69	87	86	73	75	86	85
Apr	NA	NA	85	58	84	84	72	78	88	88
Station	1210	1209	1210	1209	1210	1209	1210	1209	1210	1209
Year	10-11		11-12		12-13		13-14		14-15	

**Legend**

Good to Excellent	Medium to Good	Bad	Bad to Very Bad	No Data
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Data source: MPCB<sup>25</sup>

<sup>25</sup> MPCB 2014, [Water Quality Status of Maharashtra 2012-13](#), Water Quality Index for WQMS in Godavari Basin (1 of 2):Sub-basin-Godavari Middle and Manjra, pg 42



## Groundwater

Groundwater is the water found underground in the cracks and spaces in soil, sand and rock<sup>26</sup> and is one of the most dependable source of water which is commonly extracted through dugwells, borewells and tubewells. Citizens of Nanded Waghala city depends on ground water for some of its activities, irrespective of the established systematic water supply. Altogether, there are 17 non-functional wells and 850 functional bore wells in NWCMC area which are being used. The groundwater quality and groundwater retention capacity of a particular area largely depends on the geology of the area. The geology of the Nanded district has been discussed below.

### Geology and hydrogeology of the area<sup>27</sup>

The Nanded district is featured mainly by three main rock units (Archeans, Deccan Traps and Alluvium). Deccan traps occupy more than two-thirds of the district and overlie the granites. Extensive outcrops of granite are found in south eastern parts of district while smaller outcrops are noticed in the north-east side near Kinwat area.

The total ground water recharge table for Nanded district was recorded to be 1,41,577.24 ham (2011-12) out of which the net annual availability is 1,34,461.31 ham while the rest groundwater is lost due to natural discharges. The total area of Nanded taluka (40,680 hectare) is divided as ground water recharge worthy area into Command and Non command area. The water levels of the city, provided below in Table No. 7, reflects that there is no decline in the pre-monsoon and post-monsoon in terms of ground water level and hence GSDA (Groundwater Surveys and Development Agency) has declared that the groundwater level belongs in the 'Safe' category.

**Table No. 7: Ground water level of Nanded (2011- 12)**

Sr. No	Area	Command/ Non command	Rainfall (mm)	Average Pre monsoon water level (mbgl)	Average Post monsoon water level (mbgl)	Average fluctuation (m)
1	Nanded	Command	753.30	8.47	3.76	4.70
2	Nanded	Non command	722.85	8.98	3.78	5.20

**Source: Groundwater Surveys and Development Agency, GoM & Central Ground Water Board, Central Region, Nagpur, GoI (2014).**

<sup>26</sup> <http://www.groundwater.org/get-informed/basics/groundwater.html>

<sup>27</sup> <https://gsda.maharashtra.gov.in/nanded.html>

## Qualitative status of groundwater

Groundwater quality in Nanded district as well as the city has been recorded to be deteriorated (Wadve and Arjun, 2010)<sup>28</sup> in studies conducted by various institutes. Fluoride and Nitrate<sup>29</sup> contamination in groundwater samples has been a chronic issue for the district of Nanded.

Fluoride concentrations are found to be high in ground water rendering it unsuitable for drinking, the reason being the Precambrian basement rocks and Proterozoic sediments present in the district<sup>30</sup>. Fluoride concentrations were found (1.4 to 2.4 mg/l) in Dharmabad area, Nanded district which were almost twice with respect to its permissible limit of 1.2 mg/l (Hussain et al, 2011)<sup>31</sup>.

Studies by Chitanand et al. (2008) have found concentrations of Faecal and Total coliforms above the permissible limit in ground water due to the impact of increasing urbanisation<sup>32</sup>.

High concentration of total solids, electrical conductivity, hardness, TA (Total Alkalinity), Ca (Calcium), Mg (Magnesium), chlorides, Fe (Iron), bacteria were found in ground water near solid waste landfill site at Valmikinagar (Sheikh et al, 2012)<sup>33</sup>.

Chlorides were found to be above the permissible limits in the drinking water of the city as per Sayyed and Bhosale (2011)<sup>34</sup>. Madhnure and Tambe (2012) have found pollution in ground water in the vicinity of MIDC Industrial complex due to lead, cadmium, manganese; also dissolved solids, total hardness, Calcium, Magnesium, Chlorine and Sulphates are above the desirable limit making the ground water unfit for human consumption<sup>35</sup>.

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<sup>28</sup> Wavde P, Arjun B (2010). Groundwater quality assessment at Malegaon region of Nanded in Maharashtra (India), J Environ Sci Eng, 52(1):57-60.

<sup>29</sup> CPCB 2007, Status Of Groundwater Quality In India -Part – I, Groundwater Quality Series: Gwqs/ 09/2006-2007, Table 43: Statewise Details of Contamination of Ground Water in Some Areas of the Districts Due to Various Contaminant, Pg 132

<sup>30</sup> Groundwater Surveys and Development Agency & Central Ground Water Board, Central Region, Nagpur (2014). Report on the dynamic ground water resources of Maharashtra (2011-2012), Government of Maharashtra, Government of India.

<sup>31</sup> Hussain et al (2011). Fluoride ion concentration of ground water from Dharmabad, District Nanded, Maharashtra, International Journal of Plant, Animal and Environmental Sciences, Volume-1, Issue-3.

<sup>32</sup> Chitanand, Gyananath and Lade (2008). Bacterial assessment of ground water: A case study of Nanded city, Journal of Environmental Biology, 29(3) 315-318.

<sup>33</sup> Shaikh P. R., Bhosle A. B., Yannawar V. B (2012). The impact of landfill on soil and groundwater quality of the Nanded city, Maharashtra Researcher; 4 (7):56-63.

<sup>34</sup> Sayyed and Bhosale (2011). Analysis of Chloride, Sodium and Potassium in Groundwater Samples of Nanded City in Mahabharata, India, European Journal of Experimental Biology, 1 (1).

<sup>35</sup> Madhnure and Tambe (2012). Assessment of groundwater pollution in the vicinity of MIDC industrial complex, Nanded district, Maharashtra, India, Memoir, Indian society of applied geochemists, pp. 265 – 278.

## Water Resource Management

### Water Supply

#### Water Treatment Plants

NWCMC supplies water to the city of Nanded from the Vishnupuri dam. There are about 5 water treatment plants (Table No. 8) with a total capacity of about 169 MLD. The Kabra nagar treatment plant is the largest of all and has a capacity of about 95 MLD, out of which a 60MLD plant was installed in 1997 while it was augmented with about 35 MLD in the year 2009 under the JNNURM (Jawaharlal Nehru National Urban Renewal Mission) funding.

The total existing load on the WTP's is about 90 MLD indicating that the plants run at an average efficiency of about 53.25% (Table No. 8). The CIDCO Nanded WTP is the most efficient (66.67%) WTP while the Dankin WTP, the oldest, operates at mere 44.44% efficiency. The latest constructed WTPS, at Asadvan and the new WTP at Kabra nagar operate at 57.14% efficiency each.

The raw water as well as the treated water is tested for the quality at the district public health laboratory, Nanded as well as at the laboratory established by water resources department, NWCMC. Samples are sent to the district public health laboratory with a monthly frequency, while the department's laboratory tests daily samples. The average quality of raw water for various parameters is been presented in Table No. 9. The water quality tests conducted for the treated water samples reveal that all the parameters are well within the agreeable limits as compared to the BIS (Bureau of Indian Standards) specifications.

**Table No. 8: Details of the water treatment plants supplying water to NWCMC jurisdiction**

Sr No	Water Treatment Plant	Year of Commissioning	Capacity (MLD)	Current Load (MLD)	Efficiency (%)
1	Dankin (New Pump House)	1985	27	12	44.44
2	CIDCO Nanded	1992	12	8	66.67
3	Kabara nagar	1997	60	30	50.00
4	Asadvan	2009	35	20	57.14
5	New Kabara nagar	2009	35	20	57.14
	<b>Total</b>		<b>169</b>	<b>90</b>	<b>53.25</b>

Data source: Water Resources Department, NWCMC



Picture No. 5: View of the Kabra nagar water treatment plant at Nanded

Table No. 9: Average Water quality for raw water received at the WTPs

Parameters	CIDCO Nanded	Asadvan	New Pump House	Kabara nagar
Physical Appearance	Clear	Turbid	Turbid	Clear
Odour	Odourless	Odourless	Odourless	Odourless
Turbidity	16.29	10.81	13.03	7.22
pH	7.56	7.65	7.59	7.62
Chlorides	42.58	41.58	41.00	40.75
Nitrates	1.52	1.94	2.09	1.77
Total Hardness	147.67	159.00	163.83	157.00
Alkalinity	141.17	137.67	135.17	134.17
Iron	0.07	0.06	0.07	0.08
Fluoride	0.41	0.35	0.51	0.53
TDS	285.92	270.67	284.50	283.92

Data source: District public health laboratory, Nanded

Table No. 10: Average Water Quality for treated water at the WTP's against the BIS<sup>36</sup> standards

Parameters	CIDCO Nanded	Asadvan	New Pump House	Kabara nagar	New Kabra Nagar	BIS Specification Normal Values	
						Agreeable Limits	Permissible Limits
Physical Appearance	Clear	Clear	Clear	Clear	Clear		
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Agreeable	Agreeable
Turbidity	1.56	1.77	1.60	3.75	3.11	1.0	5.0
pH	7.48	70.63	7.48	7.49	7.49	6.5-8.5	No relaxation
Chlorides	42.83	44.00	40.83	42.58	42.25	250	1000
Nitrates	1.99	1.46	3.27	2.36	1.67	45	No relaxation
Total Hardness	152.50	160.83	153.67	148.50	150.00	200	600
Alkalinity	134.33	127.33	129.83	130.83	131.50	200	600
Iron	0.03	0.12	0.04	0.03	0.02	0.3	No relaxation
Fluoride	0.43	0.42	0.48	0.49	0.47	1.0	1.5
TDS	290.25	270.83	276.25	281.08	282.58	500	2000

Data source: District public health laboratory, Nanded

<sup>36</sup> BIS 2012, IS 10500:2012, [Indian Standard Drinking Water — Specification \( Second Revision\)](#), Table 1 Organoleptic and Physical Parameter, Pg 1-2

## Distribution Network

NWCMC has a total distribution network of about 800 km and the water is supplied through gravity and no additional booster pumps have been installed. Of the total water supplied to the city, 90 MLD, about mere 5 MLD is metered supply while the remaining 85 MLD water is unmetered. NWCMC currently supplies water for about one hour/day and during peak summer season, the supply gets hindered and NWCMC supplies water every alternate day. NWCMC supplies about 80 MLD to domestic consumers and about 10 MLD to commercial consumers.

There are 39 ESR's (Elevated Storage Reservoirs) in Nanded city which have a total storage capacity of about 65.44 Million Litres. Zone B (Shivajinagar- Ashok Nagar) has about 14 ESR's, the maximum across all zones of the city with a potential of about 27 ML, while Zone A (Taroda-Sanghvi) has mere 5 ESR's with a capacity of about 5.25ML. The average per capita ESR storage in Nanded city is about 119 liters with the least (87 liters) in Zone C (Itwara-Vazirabad) and the maximum (209 Liters) in the Zone D (CIDCO).

**Table No. 11: Zone wise capacities of the Elevated Storage Reservoirs in Nanded city**

Zone	Population	Number of Tanks	Capacity (Million Liters)	Average capacity per capita (Liters)
Taroda-Sanghvi	53147	5	5.25	99
Shivajinagar- Ashok Nagar	211465	14	26.95	127
Itwara-Vazirabad	216918	12	18.79	87
CIDCO	69034	8	14.45	209
<b>Total</b>	<b>550564</b>	<b>39</b>	<b>65.44</b>	<b>119</b>

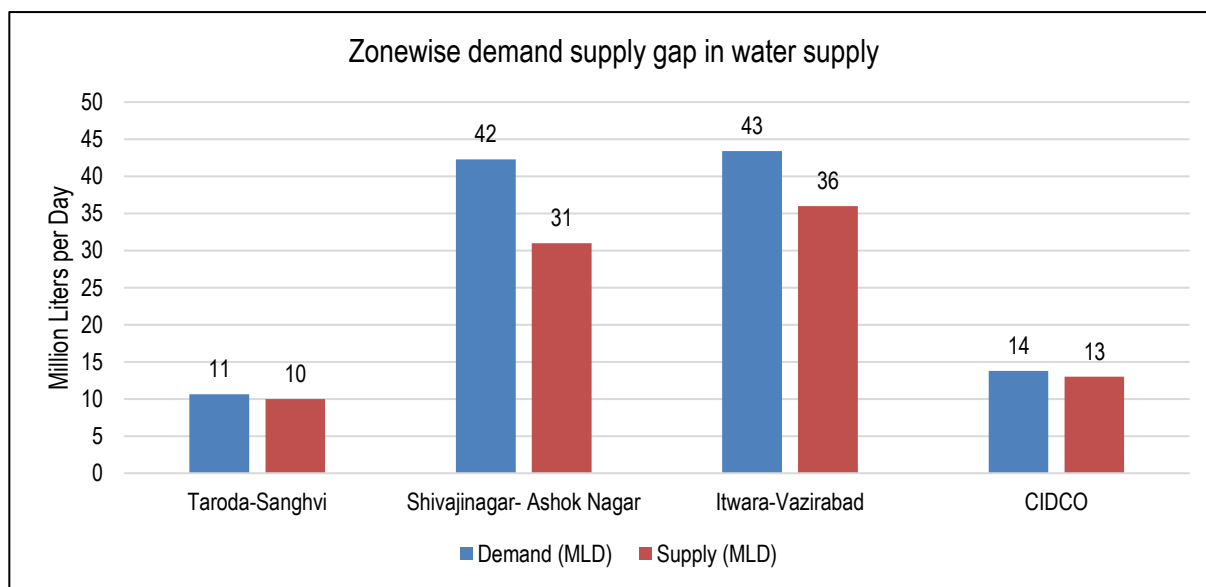
Data Source: Water Supply Department, NWCMC

## Demand-Supply Gap

Based on the population of Nanded City it is estimated that the existing demand of water in the city is about 110 MLD (Table No. 12), however the present supply to the city based on its capacity and the existing infrastructure is about 90 MLD indicating a deficit of about 20 MLD. Zone B (Shivajinagar-Ashok Nagar) of NWCMC has a deficit of about 11MLD followed by zone C (Itwara-Vazirabad) which has a deficit of about 7 MLD. Zone A (Taroda- Sanghvi) and D (CIDCO) have sufficient water supply and as compared to the other parts have water deficit of about 1MLD in both these zones. Figure No. 11 presents the graphical representation of the zone wise demand supply gap for water in Nanded city.

**Table No. 12: Zone wise demand supply gap in water supply as on October 2015**

Zone	Area	Population	Demand		Supply (MLD)	Deficit (MLD)
			(Liters)	(MLD)		
A	Taroda-Sanghvi	53,147	10,629,400	11	10	1
B	Shivajinagar- Ashok Nagar	2,11,465	42,293,000	42	31	11
C	Itwara-Vazirabad	2,16,918	43,383,600	43	36	7
D	CIDCO	69,034	13,806,800	14	13	1
	<b>Total</b>	<b>5,50,564</b>	<b>110,112,800</b>	<b>110</b>	<b>90</b>	<b>20</b>



**Figure No. 11: Zone wise demand supply gap in water supply as on October 2015**

Data source: Water Supply department, NWCMC and calculations from BIS<sup>37</sup> standard

Note: Figures in the table have been rounded off to the closest integer and hence the total may not match

<sup>37</sup> BIS, 2011: [Draft Indian Standard Code of Basic Requirements for Water Supply, Drainage and Sanitation](#), Water Supply Requirements, Pg - 5

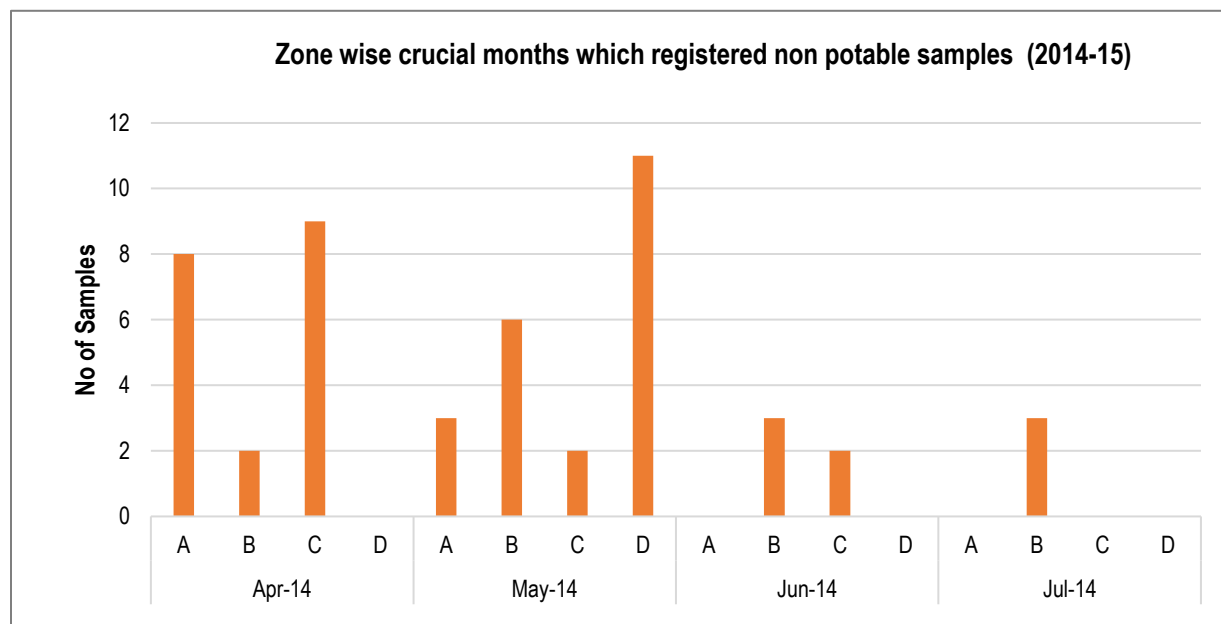


## Water Quality at Tap end

Out of the total 2008 samples analysed by the NWCMC for potability, in the year 2014-15, mere 49 samples (2.44%) were detected as non-potable. In the peak summer month of May 2014, all the zones of Nanded city recorded non-potable samples. Zone B (Shivaji nagar-Ashok nagar) recorded non-potables samples in four months of April-July. While Zone A (Taroda-Sanghvi) recorded more than 6.5% or the samples as non-potable in the April and May months, followed by about 3.4% of non-potable samples detected in zone D (CIDCO) in the month of May (Table No. 13).

**Table No. 13: Zone wise percentage of non-potable samples detected in 2014-15**

Zone	Area	Population	Total Samples	Potable Samples	Non-potable Samples	% Non-Potability
A	Taroda-Sanghvi	53,147	169	158	11	6.51
B	Shivajinagar-Ashok Nagar	2,11,465	764	750	14	1.83
C	Itwara-Vazirabad	2,16,918	756	743	13	1.72
D	CIDCO	69,034	319	308	11	3.45
<b>Total</b>		<b>5,50,564</b>	<b>2008</b>	<b>1959</b>	<b>49</b>	<b>2.44</b>



**Figure No. 12: Zone wise crucial months which registered non potable samples (2014-15)**

Data Source: Water Supply department, NWCMC

## Sewerage and Sanitation

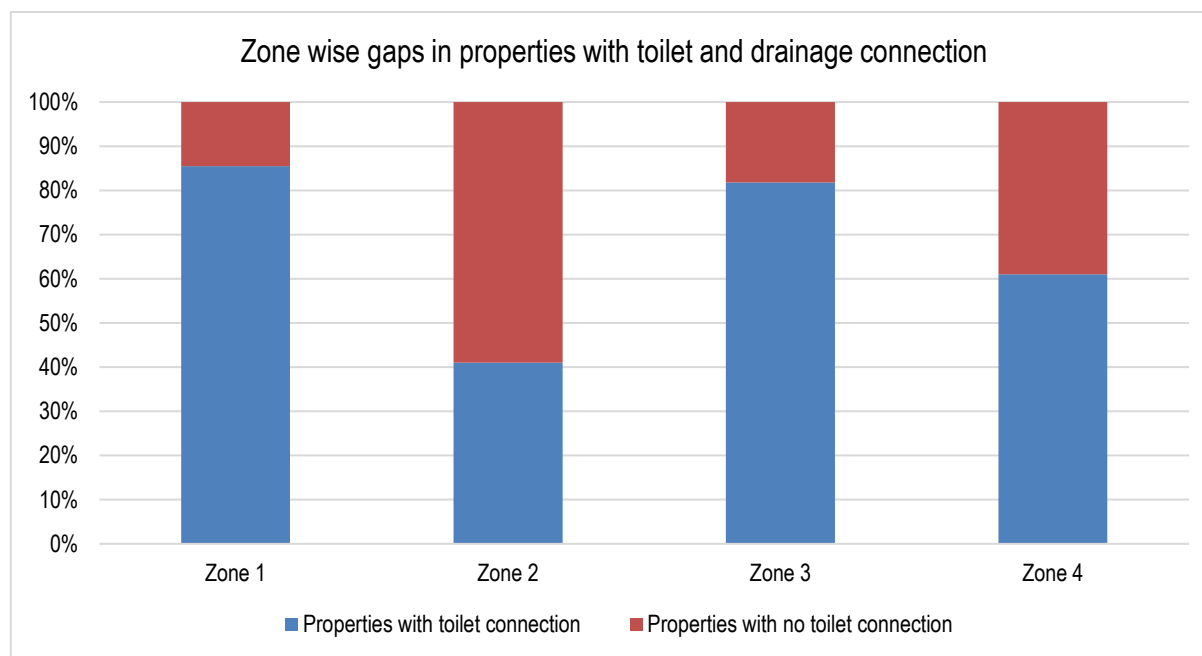
### Sewage Generation and Network

Based on the water supply to the city about 68 MLD of sewage is generated within Nanded city. It is estimated that the sewage generation in Nanded increases by about 10% per year<sup>38</sup>. Sewage generated by the domestic sector accounts to about 90% of the total sewage generation while the rest 10% is attributed to be generated from the commercial sector.

Nanded has an underground sewerage system that was designed and developed by MJP (Maharashtra Jeevan Pradhikaran) in 1969-71. The sewerage system was thereafter handed over to the then Nanded Municipal Council in 1974 for operation and maintenance. The sewerage system was designed for a peak load of 10 MLD. The total length of existing sewer lines in Nanded city is about 430 km comprising about 25 km of main sewers and about 410 km of laterals.

### Drainage Connectivity

It is estimated that more than 22,000 households in Nanded city do not have toilet and drainage connection. Zone 1 and 3 have a good coverage, more than 80% of in terms of toilets and drainage connections. Zone 2 and zone 4 are of concern since they do not have coverage of about 40% and 60% respectively. Figure No. 13 depicts the gaps in the properties with toilet and drainage connectivity.



**Figure No. 13: Zone wise gaps in properties with toilet and drainage connection**

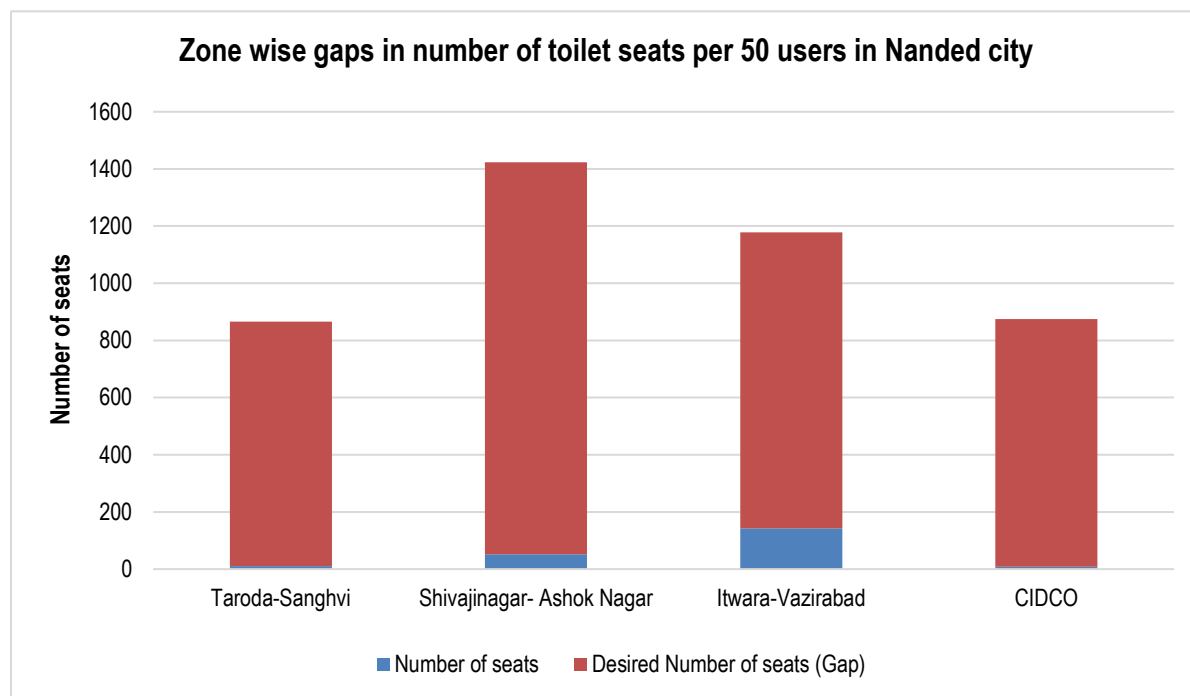
Data source: City Sanitation Plan NWCMC 2011<sup>39</sup>

<sup>38</sup> As per personal discussion with officials from Water Supply and Sewerage Department of NWCMC

<sup>39</sup> NWCMC, 2011; *Nanded-Waghala City Sanitation Plan*, Volume- 1 The Report, 6.3 Existing Sewerage System, Pg – 73-74

## Public Toilets

There are about 23 public toilets in Nanded city which have about 214 seats. However, these are far less than the minimum required number of seats to cater to the existing users (Figure No. 14). As per calculations it is estimated that a minimum number of 4300 seats are required in the city. Upon assuming that the households in the slum lacks toilet facility within their premises, it is estimated that about 2.17 lakh slum population lacks appropriate toilet facilities, thus leading to open defecation. All the zones in Nanded city lack public toilet infrastructure and this issue merits immediate attention.



**Figure No. 14: Zone wise gaps in number of toilet seats per 50 users in Nanded city**  
 Data source: City Sanitation Plan<sup>40</sup> NWCMC and Sanitation department NWCMC

<sup>40</sup> NWCMC, 2011; *Nanded-Waghala City Sanitation Plan*, Volume- 1 The Report, 6.1 NWCMC Prabhags, Zones & Wards: General Description, Pg 54-60

## Sewage Treatment Plants

Out of the total sewage generated of 68 MLD, NWCMC treats about 33 MLD (48%), of sewage. NWCMC has 2 operational sewage treatment plants, one at Elichpur and Bondar each (Table No. 14). The plants average operating efficiency is of 26.67% and 28.74% respectively. A modified mechanized Sewage treatment plant of 15 MLD is proposed and under construction at Sanghvi area of Nanded city.

**Table No. 14: Details of the Sewage Treatment Facilities in Nanded city**

Sr No	Sewage Treatment Plant	Year of Commissioning	Capacity (MLD)	Current Load (MLD)	Efficiency (%)
1	Mechanized STP at Elichpur	2011	30	08	26.67
2	Conventional Lagoon at Bondar	2012	87	25	28.74
	<b>Total</b>		<b>117</b>	<b>33</b>	<b>28.21</b>
3	STP at Sanghavi	Under Construction	15	-NA-	

Data source: Water Supply and Sewerage, NWCMC



**Picture No. 6: The aerated Lagoon at Bondar STP – Nanded City**

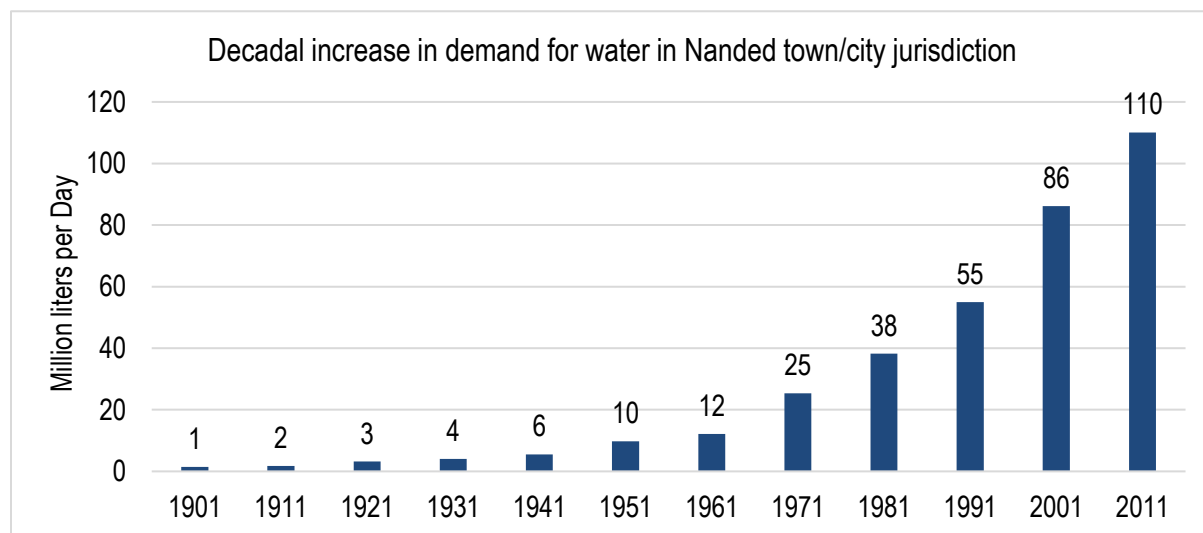
Photo Source: TERI

## Pressure on water resources

### Water Supply infrastructure

#### Increase in demand for water

It is notable that as the population of the city of Nanded has increased the demand for water supply has also increased proportionally. On an average the demand for water in every decade has increased almost 1.5 times. While in the recent 20 years, i.e between 1991 and 2011 the demand for water has doubled from 55 MLD to 110 MLD. Owing to influx of migratory population, in terms of pilgrims, students, government employees, who do not get accounted as local population, the water demand is expected to be much higher. The current estimates are based on census population and hence the demand for water could be higher, thus exerting pressure on water supply infrastructure as well as the resource itself. As of March 2014, it is estimated that the population of about 15,000 is not served with water supply within NWCMC.



**Figure No. 15: Decadal increase in demand for water in Nanded town/city jurisdiction**  
**Source: Calculations for estimating demand for water based on population (BIS standard)<sup>41</sup>**

#### Non-revenue water

As per estimates from the water supply and sewerage department, NWCMC, the non-revenue water accounts for about 37%. This could be minimised by regulating the control of water supply, installing meters for all connections and addressing the pipe breaks as well as leakages as early as possible. This not only leads to loss of water as a resource but also leads to indirect losses for energy and treatment inputs which are consumed during the pumping and treatment of raw water.

<sup>41</sup> BIS, 2011: [Draft Indian Standard Code of Basic Requirements for Water Supply, Drainage and Sanitation](#), Water Supply Requirements, Pg - 5



## Lack of appropriate sewage network

### Poor condition of Sewerage Infrastructure

The sewerage network is over 35<sup>42</sup> years old and is in a very poor condition. The foundation of the pipeline is highly dilapidated, resulting in cracks in the RCC sewer mains. Due to the predominantly black cotton soil and ageing of the components of the system, the chambers and the manholes have also developed cracks. Hence, the sewage discharged into the system does not flow as per design. Most of the sewerage and storm water intermingle and ultimately untreated sewage mixed with sludge and storm water is discharged into Godavari River.

### Release of untreated sewage in river water

The current load at the STP's is only about 33 MLD of waste water (black and grey) while the rest of the water, i.e about 35 MLD, is released untreated into the river Godavari. The release points at Nagina ghat is depicted below in Picture No. 7.

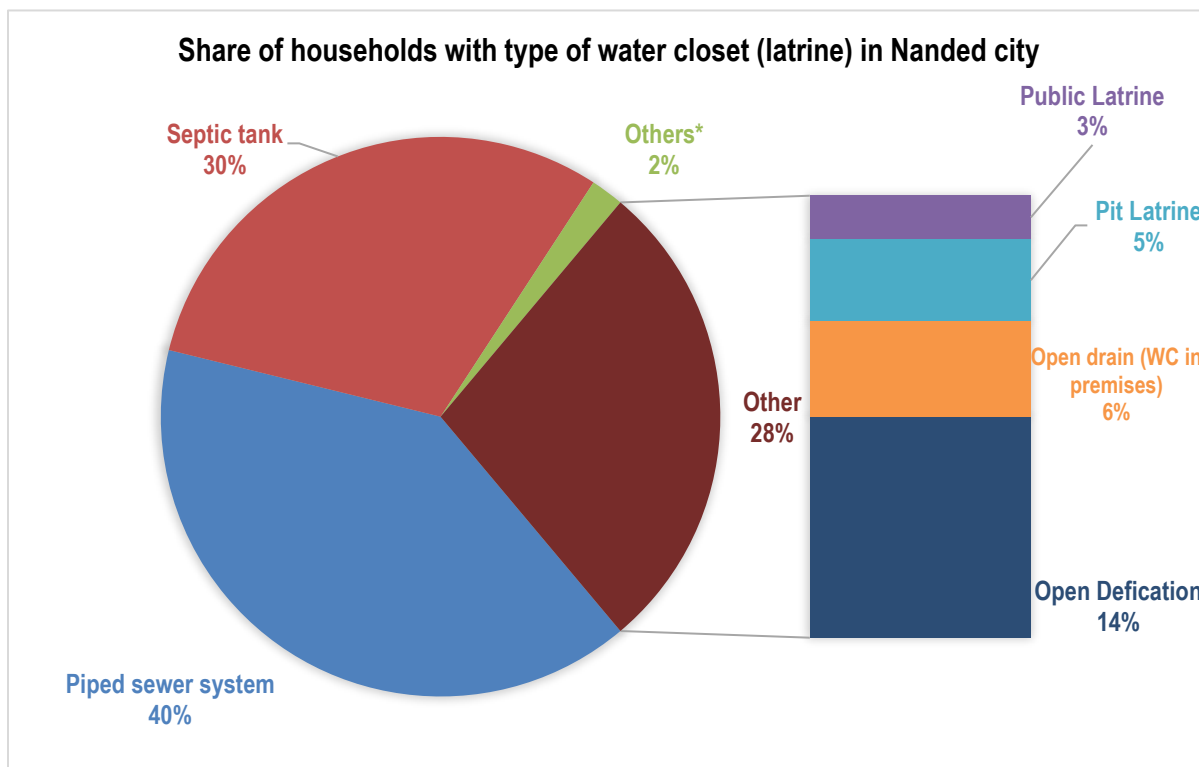


**Picture No. 7: Release of domestic waste water in river Godavari**  
Photo credit: TERI

<sup>42</sup> NWCMC, 2011; *Nanded-Waghala City Sanitation Plan*, Volume- 1 The Report, 6.3 Existing Sewerage System, Pg - 72

### Lack of Connectivity to Sewer Lines

As per census report 2011 there are about 1,06,912 households in Nanded urban area and out of these, as seen in Figure No. 16, mere 40% (42,705) have piped sewer connections while 30% (32,474) have septic tank. About 30% of the households and public toilets do not have sewer connectivity or septic tank facility. 14% (14,800) households account for open defecation while 6% (6,452) of the households have a WC in the premises but the flush is led to an open drain system.



**Figure No. 16: Share of households with type of water closet (latrine) in Nanded city**  
 Data Source: Census of India 2011<sup>43</sup>

<sup>43</sup> Census 2011, *District Census Handbook-Nanded, Village And Town Wise, Primary Census Abstract (PCA)*, Series 28 Part XII B, Table No 5 Number and Percentage of Households by type of Latrine facility, 2011, Pg 370-371



## Anthropogenic activities

The water bodies in Nanded city are vulnerable to various pressures from anthropogenic activities. As seen in Picture No. 8, dumping of waste along the banks of the river body at Vishnupuri dam, using the river water for sanitation, washing of clothes and accessing the river body for religious offerings and last rites are very commonly observed sights along the Ghats, banks of river Godavari in Nanded city. These anthropogenic activities leave a lot of chemicals in terms of phosphates, detergents, oil, and religious offerings in the river water, thus polluting the water bodies.



Picture No. 8: Anthropogenic influences on the banks of Godavari river  
Photo credit: TERI

## Impact on Water Resources

### Eutrophication

Eutrophication arises from the oversupply of nutrients, usually phosphates and nitrogens<sup>44</sup>, which induces explosive growth of plants and algae thereby creating the state of hypoxia (low levels of oxygen). The source of this excess phosphate is detergents, industrial/domestic run-off, and fertilizers<sup>45</sup>. Anthropogenic activities accelerate the rate at the nutrients which enter the water ecosystem. Runoff from agriculture and development, pollution from septic systems and sewers, sewage sludge spreading, and other human-related activities increase the flow of both inorganic nutrients and organic substances into the aquatic ecosystem. Phosphorus is often regarded as the main cause in cases of eutrophication in lakes and river bodies subjected to "point source" pollution from sewage pipes.

The river body in Nanded city has started developing eutrophication as well as growth of *Eichhornia crassipes* (Picture No. 9). The increase in Eutrophication levels (Growth of Phytoplankton and Algae) can lead to more severe secondary impacts such as:

- Low dissolved oxygen levels and formation of hypoxic or "dead" zones (oxygen-depleted waters), which in turn can lead to ecosystem collapse.
- Loss of subaquatic vegetation as excessive growth of phytoplankton, micro & macro algae reduce light penetration.
- Change in species composition and biomass of the benthic (bottom-dwelling) aquatic community, eventually leading to reduced species diversity.
- A shift in phytoplankton species composition, creating favourable conditions for the development of nuisance, toxic, or otherwise harmful algal blooms.



Picture No. 9: Growth of water hyacinth (left) and Lemna minor (right) in Godavari river

Photo credit: TERI

<sup>44</sup> [http://www.unep.or.jp/ietc/publications/short\\_series/lakereservoirs-3/3.asp](http://www.unep.or.jp/ietc/publications/short_series/lakereservoirs-3/3.asp)

<sup>45</sup> <http://www.wri.org/our-work/project/eutrophication-and-hypoxia/sources-eutrophication>



## Response by NWCMC

### Enhancement of Sewage network and processing

NWCMC has already submitted a proposal to state as well as central Government to seek funds under various schemes to enhance the existing sewage network and collection efficiency of the sewage generated in Nanded city. A proposal of about INR 413 crores has been submitted under the AMRUT (Atal Mission for Rejuvenation and Urban Transformation), launched by Government of India. It is expected that by March 2017, there would be almost 100% sewer connections, collection and treatment in Nanded city.

There is an under construction STP (Sewage Treatment Plant), of about 15 MLD, based on modified mechanised technology in the Sanghvi area. It is proposed that the waste water from A zone shall be connected to this STP.

### Sweeping and cleaning along ghats

NWCMC has made provisions of a few dust bins at the Vishnupuri dam to avoid random disposal of waste. The corporation also undertakes regular cleaning along the banks and the ghats along Godavari River. The solid waste dumped along the ghats is manually collected and transported using tractor trolley to the dumping site.



Picture No. 10: Provision of dust bins and Regular MSW collection along the ghats

Photo credit: TERI

### Artificial Ponds for idol immersion

In the year 2015, NWCMC constructed an artificial pond named '*Paryavaran Snehi Shri Ganesh Murti Visarjaan Talav*' and encouraged the citizens to immerse the Ganesh idols in this ponds and avoid immersing the idols directly in the river body. Around 25 thousand idols were immersed this year.

This helped not only in reducing the pollution levels in the river, but also help avoid release of about 1 million cubic meters of water, which would have otherwise been released in the river from the dam to have a flushing action. This quantum of water can now meet the requirements of Nanded city for about 2 months.



Picture No. 11: The artificial pond constructed by NWCMC for Ganesh idol immersion  
Photo credit: NWCMC

## Air Quality

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Air is a mixture of gases and has a composition of 78% nitrogen, 21% oxygen, and less than 1% of argon, carbon dioxide, and other gases. However the Anthropogenic activities like combustion of fossil fuels, mining and construction activities, emissions from industries like power plant, plastic and paint manufacturing, oil and petroleum refineries, vehicular emissions alter this composition since they lead to change in the natural composition of air. Addition of pollutants in form of any solid, liquid or gaseous substance in atmosphere in such concentration that trend to be injurious to human beings or other living creatures or plants or property or environment results in air pollution<sup>46</sup>.

Pollutants are classified into Primary and Secondary pollutants. Primary pollutants are substances that are directly emitted into atmosphere from the source, for example carbon dioxide (CO<sub>2</sub>) from fossil fuels, whereas secondary pollutants are formed in atmosphere through chemical reaction such as formation of ozone in photochemical smog. Prolonged exposure to high air pollution levels is known to cause various health impacts like bronchitis, asthma, lung disorders and even brain damage. Air pollution also affects the environment; and is known to cause acid rains which damage the vegetation, forests, water bodies and so on thus affecting the ecosystem.

WHO (World Health Organization) in its Ambient Air Pollution Database Report has cited that air quality in most cities worldwide fail to meet WHO guidelines for safe levels, thus resulting in increasing number of respiratory diseases and other health problems. In April 2014, WHO issued new information estimating that outdoor air pollution was responsible for the deaths of around 3.7 million people under the age of 60 in 2012<sup>47</sup>.

Ambient air quality monitoring network is designed to get spatial and temporal variation of ambient air concentrations for a wide range of pollutants. To have a continuous vigilance of the air quality in the different parts of the state MPCB has installed various AAQMS (Ambient Air Quality Monitoring Stations) in various regions of the state. In the year 2014-15, there are 72 active AAQMS in Maharashtra under NAMP (65), SAMP (4) and 3 CAAQMS. The stations monitors sulphur dioxide (SO<sub>x</sub>), oxides of nitrogen (NO<sub>x</sub>), Particulate matter (PM) as major pollutants and CO, Ozone, Hydrocarbons in case of continuous monitoring stations.

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<sup>46</sup> [The Air \(Prevention Control of Pollution\) Act, 1981](#) (No 14 of 1981)

<sup>47</sup> <http://www.who.int/mediacentre/news/releases/2014/air-quality/en/>

## Status

### Monitoring Network

In order to monitor the air quality of Nanded city, MPCB has established 3 non-continuous monitoring stations under NAMP (National Air Quality Monitoring Programme). Netaji Subashchandra Bose College, has been appointed by MPCB as the implementing agency to monitor the air quality of Nanded city at three locations (Table No. 15) who monitor three parameters SO<sub>x</sub>, NO<sub>x</sub> and RSPM.

**Table No. 15: Air Quality Monitoring stations in Nanded city**

Category	Station code	Station Name	Site Address	Year of Establishment	Days of Monitoring
Residential	703	Ganesh Nagar	Ganesh Nagar, Near Shriram Mandir, Nanded	2009	Monday, Tuesday
Commercial	704	Mutha Chowk	Lahoti Complex, Near Shivaji Statue, Vajirabad	2009	Friday, Saturday
Industrial	705	Industrial Area CIDCO	MIDC Office, CIDCO	2009	Wednesday, Thursday



**Ganesh Nagar (Residential)**



**Mutha Chowk (Commercial)**



**CIDCO (Industrial)**

**Picture No. 12 : Air monitoring sites in Nanded city.**

Source: TERI

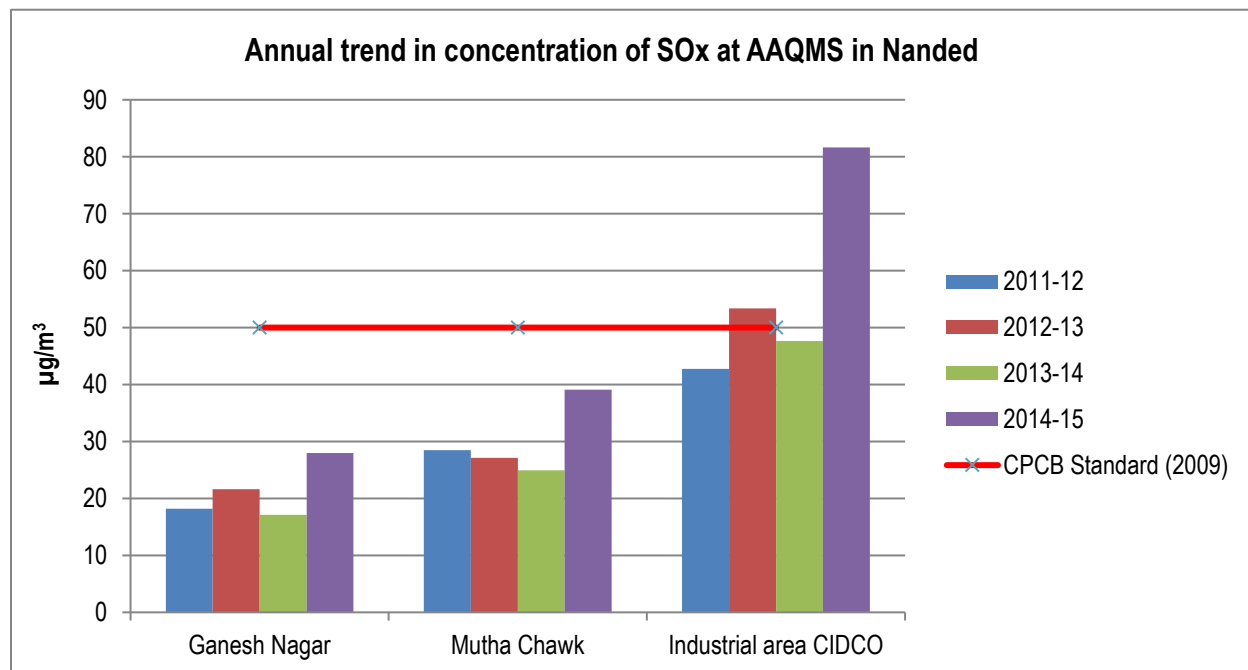


## Sulphur Dioxide (SO<sub>2</sub>)

Sulphur Dioxide (SO<sub>2</sub>), a colourless gas with a pungent, irritating odour and taste belongs to the family of reactive oxides of sulphur. The natural source for SO<sub>2</sub> emissions are volcanoes while the manmade emission sources include industrial and vehicular emissions. Being polar in nature, it readily dissolves in water to give acidic solution which oxidizes to sulphuric acid and is transported by wind currents over hundreds of miles, and deposited as acid rain. Acid rain causes acidification of water bodies, corrosion to metals structures and skin diseases.

### Annual Trend

In terms of SO<sub>x</sub> concentrations, Nanded city is quite clean and the annual average concentrations have been well within the standard (50µg/m<sup>3</sup>). However, there has been an increase in the annual average SO<sub>x</sub> concentrations in the year 2014-15 at all the AAQMS sites as compared to the past five years. In the year 2014-15 the AAQMS representing the industrial area recorded an annual SO<sub>x</sub> concentration of about 82µg/m<sup>3</sup>, which is almost 1.6 times higher than the annual standard limit. Since all the AAQMS recorded increase in SO<sub>x</sub> concentrations one may conclude that even if the SO<sub>x</sub> levels are within the standards they may increase in the near future if appropriate measures are not taken.



**Figure No. 17: Annual trend in concentration of SO<sub>x</sub> at AAQMS in Nanded**  
Source: MPCB, Nanded



### Monthly Trend for year 2014-15

Contradictory to the normal trend of high pollution levels in the winter season, one may note from Figure No. 18 that the AAQMS in Nanded city have recorded relatively high SO<sub>x</sub> concentrations in the summer season (April to June) as compared to other months. The AAQMS representing Industrial area of CIDCO recorded the highest concentration of SO<sub>x</sub> (86µg/m<sup>3</sup>) almost 1.7 times higher the standard limit 50µg/m<sup>3</sup> and consistently exceeded the annual standards. Even the minimum monthly average at this location was recorded to be 79µg/m<sup>3</sup> which is 1.6 times the standard limits. The AAQMS at Mutha-chowk and Ganeshnagar recorded maximum monthly SO<sub>x</sub> concentration of 50µg/m<sup>3</sup> and 37µg/m<sup>3</sup> respectively in the May month, which was the highest at those AAQMS as compared to other months. But the SO<sub>x</sub> levels in commercial and residential areas represented by the AAQMS respectively recorded SO<sub>x</sub> concentrations well within the standards.

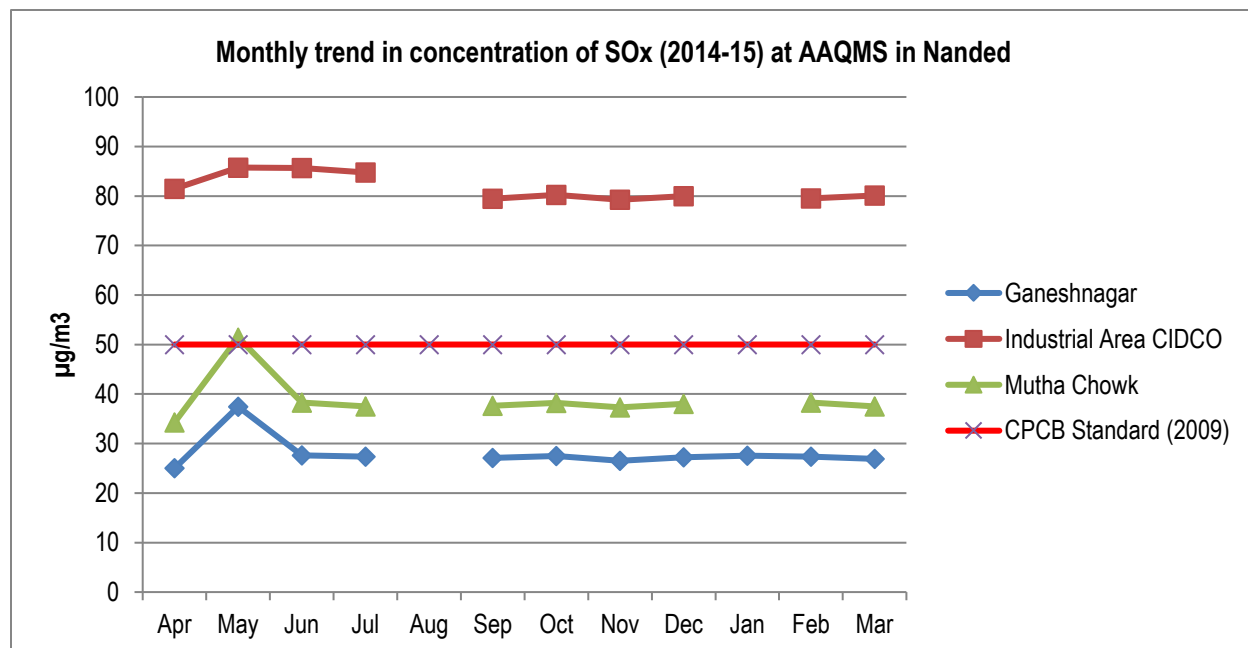


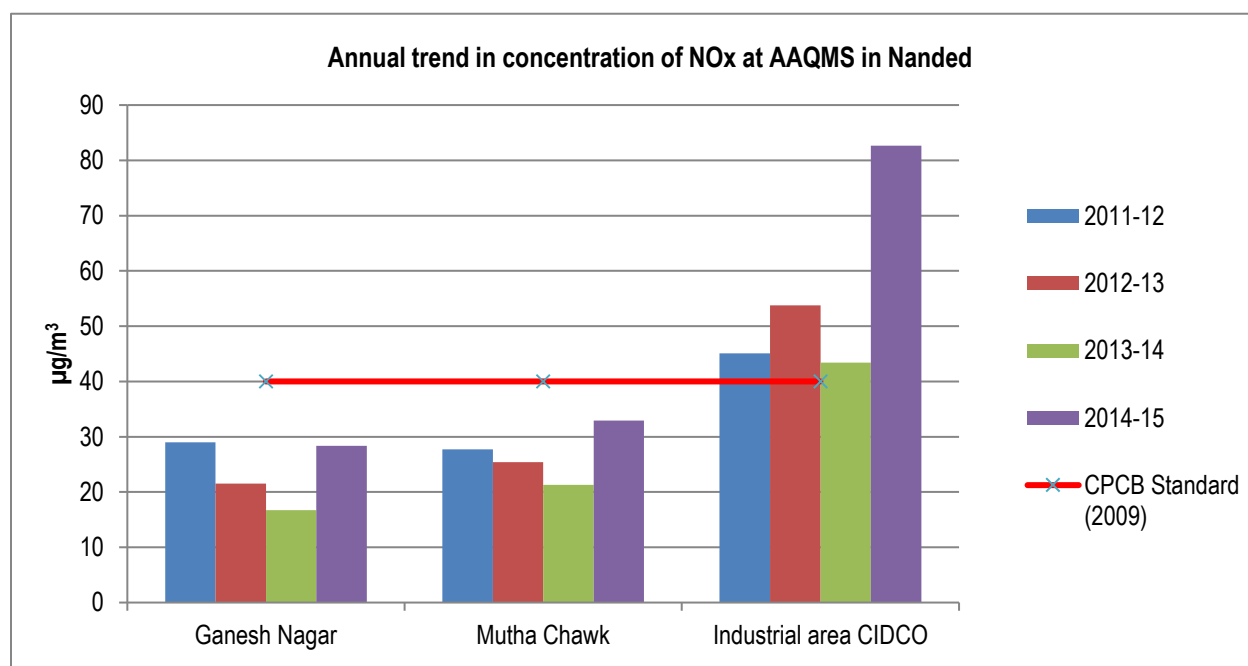
Figure No. 18: Monthly trend in concentration of SO<sub>x</sub> (2014-15) at AAQMS in Nanded  
 Source: MPCB, Nanded

## Oxides of Nitrogen

Nitrogen dioxide is a reddish-brown gas with a pungent, irritating odour. Nitrogen oxide react with the unburned hydrocarbons to form photochemical smog which causes damage to plants and is also detrimental to human health. These compounds play an important role in the atmospheric reactions that create ozone (O<sub>3</sub>) and acid rain. Nitrogen dioxide is known to irritate the lungs and increase susceptibility to respiratory infections.

### Annual Trend

From Figure No. 19, it is notable that the NO<sub>x</sub> concentrations in Nanded were recorded to be higher as compared to the past 5 years. The Industrial CIDCO recorded the maximum annual concentration of NO<sub>x</sub> 83µg/m<sup>3</sup>, which violated the annual NO<sub>x</sub> standards (40µg/m<sup>3</sup>) by more than 2 times. This AAQMS has recorded NO<sub>x</sub> concentrations higher than the annual standards consistently for the past 4 years. The Ganeshnagar and Mutha Chowk AAQMS recorded annual NO<sub>x</sub> concentrations of 28µg/m<sup>3</sup> and 33µg/m<sup>3</sup> respectively which were well below the annual standards in the year 2014-15.



**Figure No. 19: Annual trend in concentration of NO<sub>x</sub> at AAQMS in Nanded**

Source: MPCB, Nanded

### Monthly trend for the year 2014-15

As for the monthly trend (Figure No. 20) the highest NO<sub>x</sub> concentrations were also recorded in the summer (April to June) months and subsequently a declining trend was observed during the monsoon as well as the winter months. The concentration of NO<sub>x</sub> in Industrial area of CIDCO was recorded to exceed the annual standard limit (40µg/m<sup>3</sup>) all throughout the year (2014-15) while the AAQMS at Ganeshnagar and Mutha chowk recorded their maximum NO<sub>x</sub> concentration of about 40µg/m<sup>3</sup>, borderline category, in the month of May while in the other months the NO<sub>x</sub> concentrations were well below the standards.

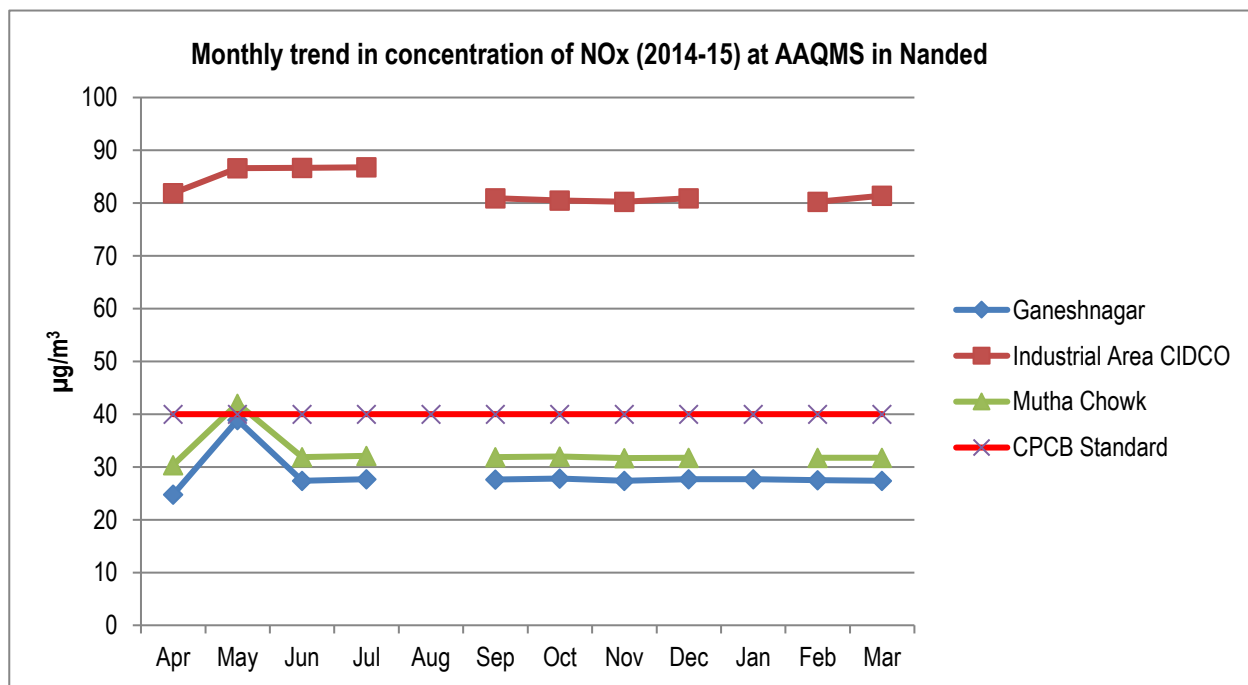


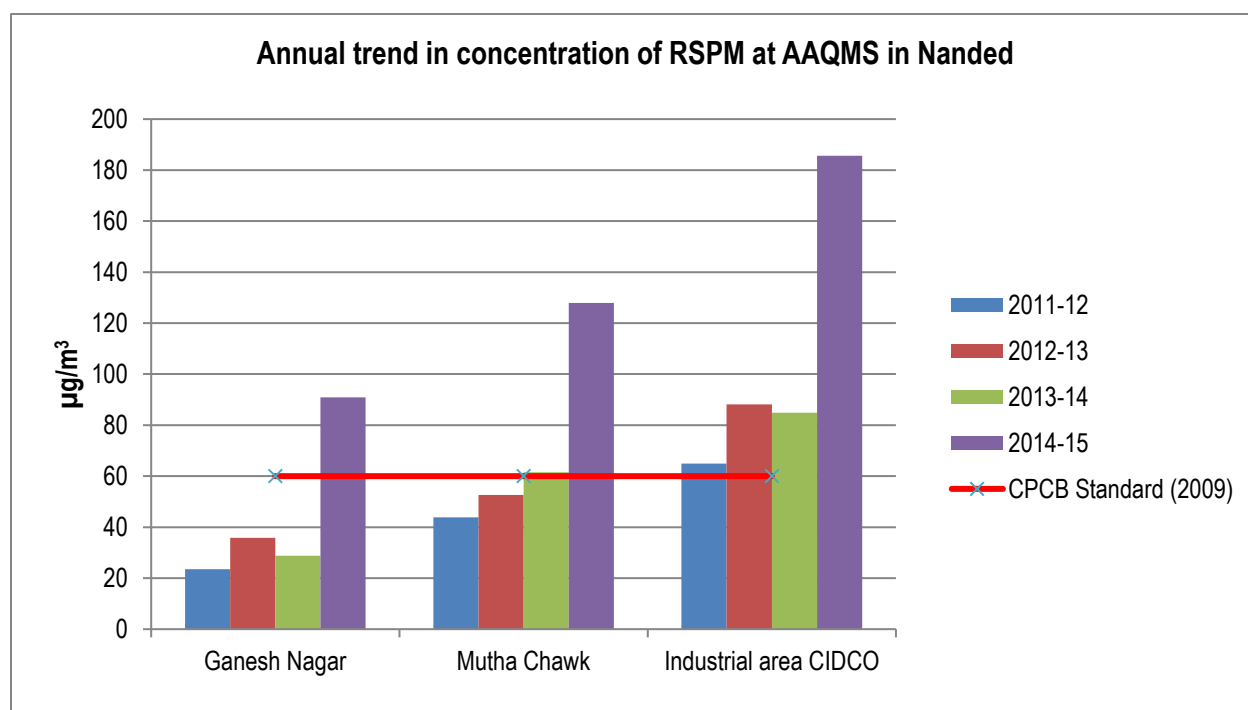
Figure No. 20: Monthly trend in concentration of NO<sub>x</sub> (2014-15) at AAQMS in Nanded  
 Source: MPCB, Nanded

## Particulate Matter

Particulate matter (PM) generally includes particles ranging between 10-2.5  $\mu\text{m}$  in size. PM include various pollutants like dust, fly ash, soot, smoke, aerosols, fumes, mists and condensing vapours, which may arise from various anthropogenic activities. Inhalation of Particulate Matter can result in respiratory related disorders leading to aggravated asthma, acute respiratory symptoms including aggravated coughing, difficult or painful breathing, chronic bronchitis and decreased lung function.

### Annual Trend

As for the PM concentrations recorded in the Nanded city, there has been an increasing trend in PM concentrations (Figure No. 21). In the year 2014-15 all the AAQMS representing the Nanded city violated the annual RSPM standards. The Industrial areas recorded average RSPM concentrations of  $186\mu\text{g}/\text{m}^3$  which is more than 3 times the standard ( $60\mu\text{g}/\text{m}^3$ ) set by CPCB. The AAQMS at Mutha chowk ( $128\mu\text{g}/\text{m}^3$ ) and Ganeshnagar ( $91\mu\text{g}/\text{m}^3$ ) also recorded high RSPM concentrations 1.5 to 2 times the standard. The industrial area of CIDCO has consistently violated the standard for the past 4 years.



**Figure No. 21: Annual trend in concentration of RSPM at AAQMS in Nanded**  
Data Source: MPCB, Nanded

### Monthly trend for the year 2014-15

As seen in Figure No. 22, the industrial CIDCO area and Mutha chowk recorded high RSPM concentrations throughout the year. The Industrial CIDCO recorded monthly maximum RSPM concentration of  $225\mu\text{g}/\text{m}^3$  in December month, almost 3.8 times the annual standard ( $60\mu\text{g}/\text{m}^3$ ). The Mutha chowk recorded RSPM concentration 2.8 times ( $173\mu\text{g}/\text{m}^3$ ) the annual standard in month of October. The Ganeshnagar recorded increase in RSPM concentrations in the winter months and recorded the maximum concentration of  $122\mu\text{g}/\text{m}^3$  in the months of September and October.

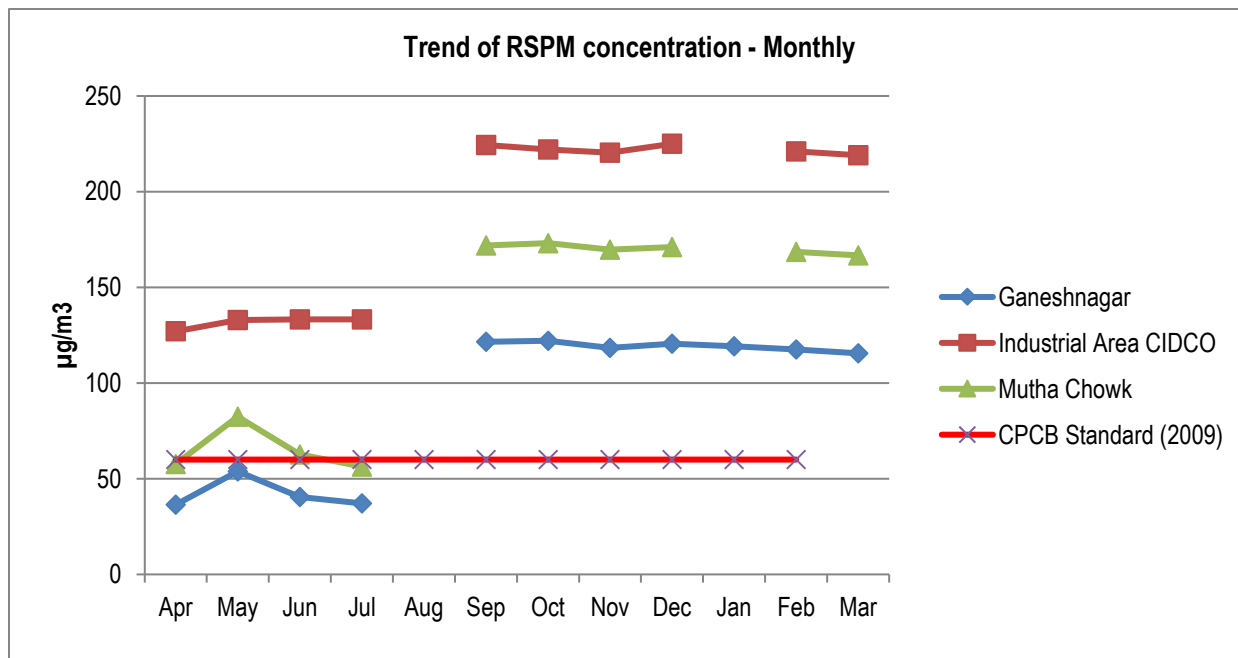


Figure No. 22: Monthly trend in concentration of RSPM (2014-15) at AAQMS in Nanded  
Data source: MPCB, Nanded

## Air Quality Index (AQI)

The Air quality Index (AQI) is a tool which determines the overall status of air quality in the region. The AQI for Nanded has been calculated based on the calculation of AQI developed, by CPCB in consultation with IIT (Indian Institute of Technology) Kanpur in the year 2014<sup>48</sup> and the same has been used in the report titled 'Air Quality Status of Maharashtra 2014-15' published by MPCB<sup>49</sup>.

From Figure No. 23, it is observed that there is deterioration in the air quality of Nanded city over last 5 years. Vehicular emissions and congestion are expected to be the prime cause of this deterioration. In the year 2014-15, the air quality in CIDCO area and Mutha chowk were observed to be polluted whereas Ganeshnagar was recorded to be least affected. More than 55% of the observations recorded at MIDC CIDCO and Mutha Chowk areas recorded air of 'Poor' quality (201-300) whereas the remaining 45% was observed to have AQI of 'Moderate' (101-200) in case of CIDCO area and 'Satisfactory' (50-100) of Mutha Chowk respectively.

The air quality in the residential area (Ganeshnagar) has deteriorated since last year (2013-14) as in the year 2014-15 more than 60% of the monitoring days were recorded with 'Moderate' (101-200), vis-a-vis 'Good' and 'Satisfactory' categories recorded last year. The increase in urbanisation and construction activities has resulted in decrease in air quality in residential zone of Ganeshnagar.

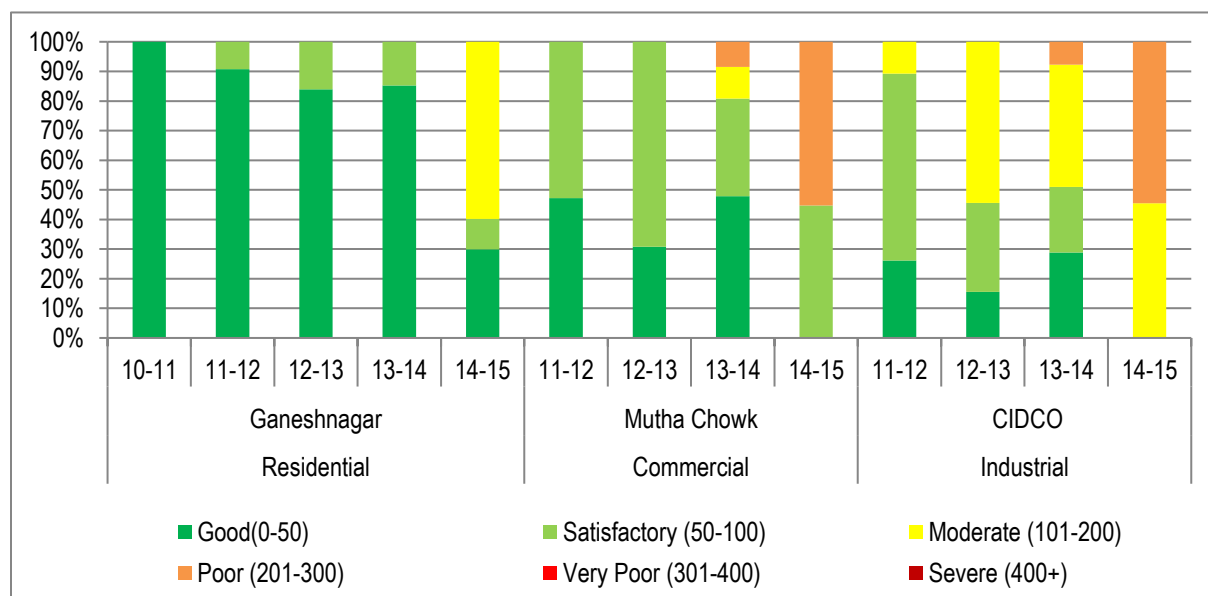


Figure No. 23: Air Quality Index of Nanded city

Data source: MPCB

<sup>48</sup> CPCB, [National Air Quality Index](#), 2014

<sup>49</sup> MPCB 2015, [Air Quality Status of Maharashtra 2014-15](#), National Air Quality Index, pg-43

### Noise levels during Diwali festival

Figure No. 24, represents noise levels at various locations- Vazirabad, Mondha, Ganesh nagar and Shivaji Nagar, representing commercial and residential areas monitored by MPCB during Diwali festival. It was observed that the noise levels at all locations exceeded the permissible limits 65 dB (daytime standard) and 55 dB (night time standard) for commercial zone and 55dB (daytime standard) and 45 dB (night time standard) for residential zone as prescribed by CPCB. The decrease in trend of noise levels is observed over last 3 years in both commercial and residential zones. The commercial zone of Vazirabad shows decrease in noise level by 21% in 2014-15 (84 dB) as compared 2012-13 (106 dB). The Ganeshnagar area recorded decrease in noise level by 2% in the year 2013-14 (91d B) as compared to previous year 2012-13 (93 d B).

In the year 2014-15, the commercial areas recorded the highest noise level at both Mondha area (85dB) as well as Vazirabad (84dB) which is almost 1.3 times the standard limit. Even the minimum noise levels recorded (66dB) in these locations violated the day time standards. The Shivajinagar residential area also recorded average noise level of 85dB, almost 1.3 times the standard limits. The minimum noise levels recorded in this area (71dB) which is 16 dB more than the day time standard.

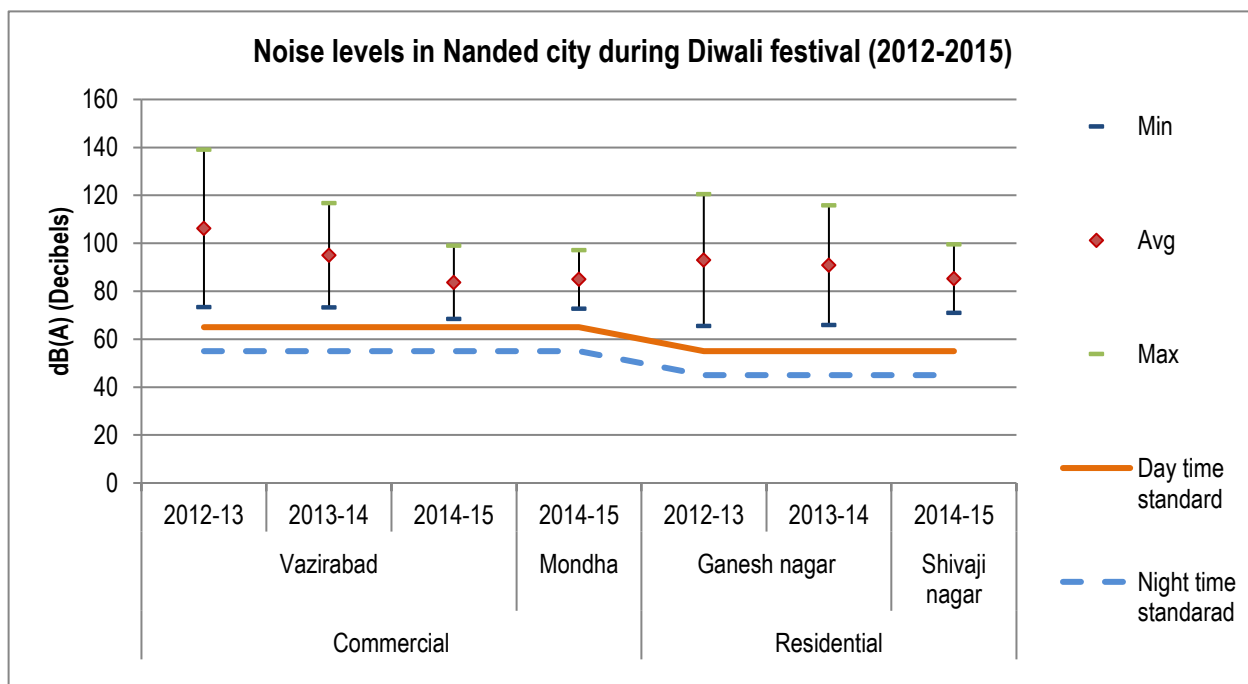


Figure No. 24: Noise monitoring during Diwali festivals (2012-13 to 2014-15)  
Source: MPCB, Nanded



## Pressure

Nanded Waghala City recorded a decadal increase of 28% population between 2001 and 2011. This rapid increase in urban population results in resource demands, anthropogenic activities, industrial development, high demands for transportation, and other infrastructure thereby exerting pressures on natural resources. Combustion of fossil fuels like coal, firewood, petrol, diesel and so on to meet the energy demand for cooking, electricity, vehicular movement are considered as major source for air pollution. Transport sector contributes about 70% of environmental pollution contributing CO as a major pollutant followed by hydrocarbons<sup>50</sup>. Other pollutants include oxides of nitrogen, sulphur dioxide, particulates, and photochemical toxics. The CO<sub>2</sub> emissions in India on roads are predicted to reach 1212 million tons in 2035<sup>51</sup>. Vehicular emissions like CO, PM and NO<sub>x</sub> results in respiratory and pulmonary disorders, leukaemia, affects cardiovascular and nervous system and can also be carcinogenic.

## Vehicular Growth

Vehicular growth leads to increased consumption of petroleum products thus increasing the emissions leading to air pollution. There has been tremendous increase in the number of vehicles in Nanded city in the past few years, leading to traffic congestion and increased emissions. As seen in Figure No. 25 more than 40 thousand new vehicles get registered every year in Nanded city and more than 88% of these are two wheelers. It is estimated that every day, in the year 2014-15, almost 147 two wheelers got added to the fleet of vehicles in Nanded city.

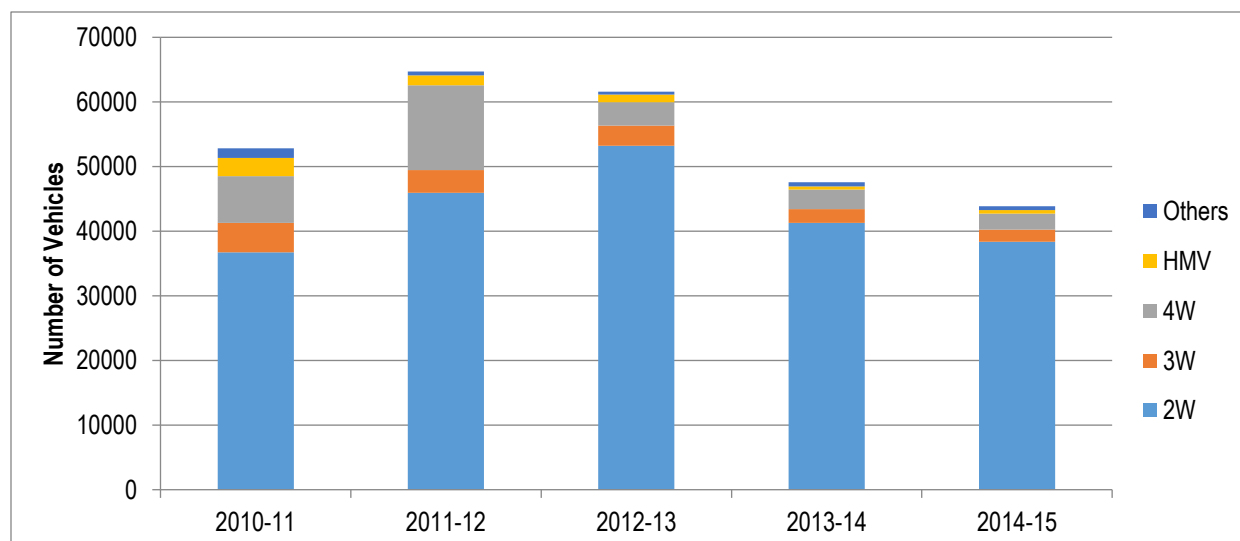


Figure No. 25: Number of vehicles on road in Nanded city

Data source RTO, Nanded

Note: Others include vehicles like ST wagons, Stage carriages, Mini Bus, Pot Service Vehicles, Multi Articulated and Tractors

<sup>50</sup> R.K.Shrivastava, [Air pollution due to road transportation in India: Review on assessment and reduction technologies](#), Pg No.69

<sup>51</sup> CPCB, [Status of vehicular pollution control programme in India](#), March 2010, Pg No.11

## Fuel consumption

### Transport sector

MS (Motor Spirit) and HSD (High Speed Diesel) commonly known as petrol and diesel respectively are the commonly used fuels for transport in Nanded city. Increase in vehicular growth directly increases the demand for fuel consumption. Figure No. 26 depicts the trend of fuel consumption in transport sector. The sale of petroleum products has increased with a Compound annual growth rate (CAGR) of almost 4% in the last 5 years. The highest fuel (MS and HSD) consumption in the last 5 years was recorded in the year 2012-13 of 44,518 kilolitres whereas in 2014-15 the consumption of HSD and MS accounted to about 41,708 Kiloliters.

Figure No. 26 shows that the sale for Motor spirit (MS) has increased whereas decline curve is observed in the consumption of High Speed Diesel (HSD) over past 5 years. The use of MS has increased by 36% in last five years. The use of HSD showed increase in trend by 28% in the year 2012-13 as compared to 2010-11 however in 2014-15 the consumption of HSD dipped by 19% as compared to 2012-13.

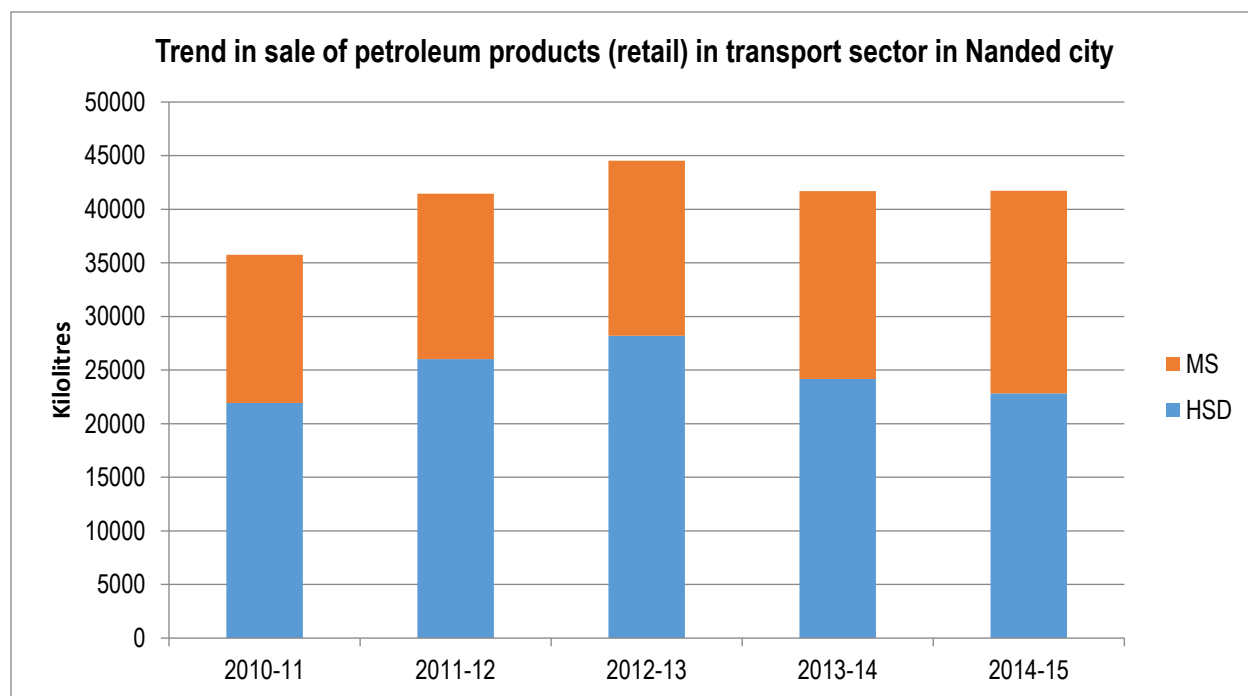
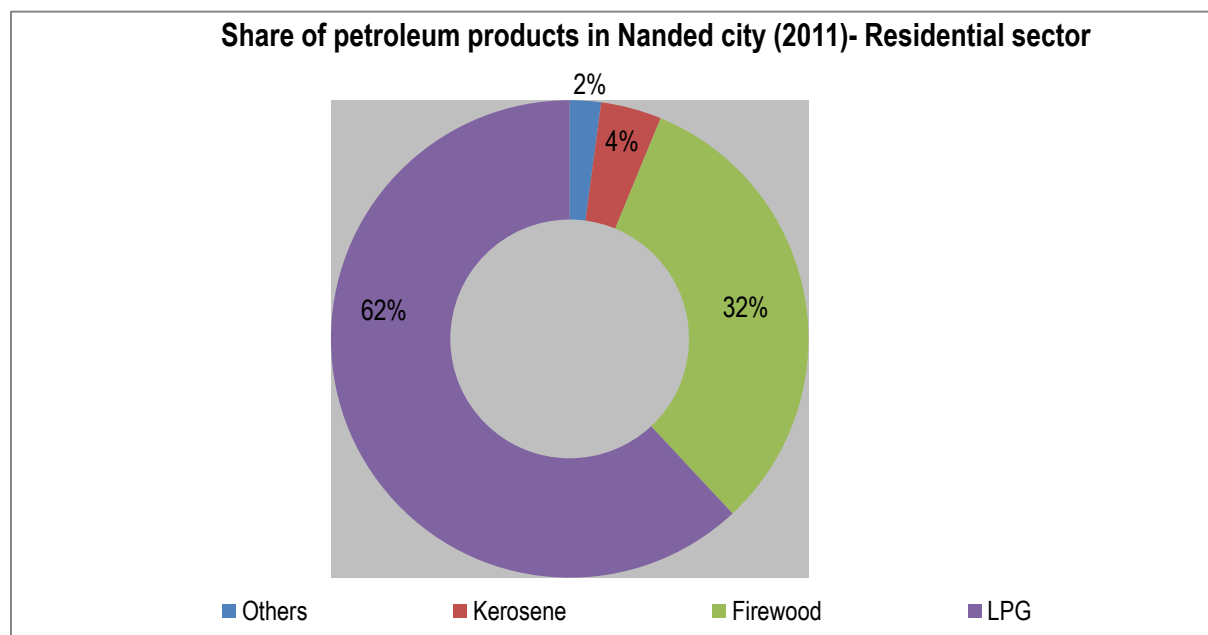


Figure No. 26: Trend in sale of petroleum products (retail) in transport sector in Nanded city  
Data source: IOCL, BPCL & HPCL

## Domestic Fuel usage



**Figure No. 27 Share of petroleum products in Nanded city (2011) –Residential sector**

**Data source: Census of India 2011**

*Note: Others include fuels like electricity, biogas, cow-dung cake, crop residue, coal, lights, charcoal and any other*

It is notable from Figure No. 27 that LPG (Liquefied Petroleum Gas) and Firewood are main sources of fuel for cooking. LPG accounts for 62% of total fuel used followed by firewood by 32%. Apart from these two; kerosene (4%) is also used for cooking purposes. Other sources of fuels include crop residue, coal, electricity, biogas and cow dung cake.

Burning firewood as source of fuel for cooking can produce high levels of indoor air pollution with emission of carbon monoxide, hydrocarbons and particulate matter that penetrate deep into the lungs<sup>52</sup>. It is estimated that about 4 million people die prematurely from illness due to indoor air pollution caused by burning of solid fuels. Exposure to household air pollution almost doubles the risk for pneumonia in children. It is estimated that there are 12% deaths due to pneumonia, 34% from stroke, 26% from heart disease, 6% from lung cancer and 22% from chronic obstructive pulmonary disease (COPD).<sup>53</sup>

<sup>52</sup> International Energy Agency, [Energy for cooking in developing countries](#), Pg No. 425

<sup>53</sup> World Health Organization, [Household air pollution and health](#), 2014

## Industrial activities

Most of the industries established are agro based such as sugar mills, dal mills, oil mills and so on. The production of cash crop like cotton has led to the establishment of a spinning and weaving mill at Nanded. Ginning and pressing is, another important processing industry serving the cotton growing area of the district.<sup>54</sup> The Industrial profile for Nanded district is represented in Figure No. 28.

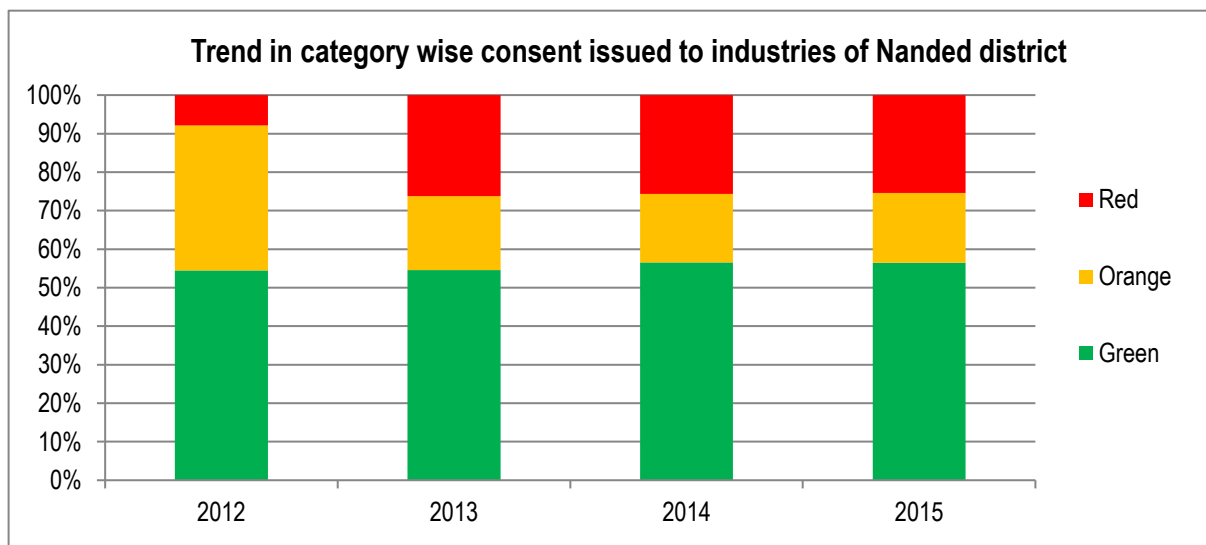


Figure No. 28: Trend in category wise share of industries of Nanded district

Source: MPCB, Nanded

From Figure No. 28, it is observed that the Nanded district comprises of 56% of green category, 23% orange category and 22% red category of industries. An increase of more than 3% in the consents issued has been recorded in the last four years. While the consents for red category industries increased by 15%.

Nanded city accounts for 19% of the industries out of the total industries in Nanded district. (Figure No. 29). Nanded city has two industrial zones namely Nanded MIDC area and Industrial Estate Nanded. The MIDC zone in Nanded city has 225 small scale industries with one large scale industries namely M/s. Kohinoor feeds and fats (Solvent) while the Industrial area has small scale industries.

The Industrial Profile for Nanded city is represented in Figure No. 30. Nanded city majorly comprises of industries under green category (64%) followed by orange category (25%) and red category (11%).

<sup>54</sup> <http://www.nandedonline.in/city-guide/business-and-economy-of-nanded>

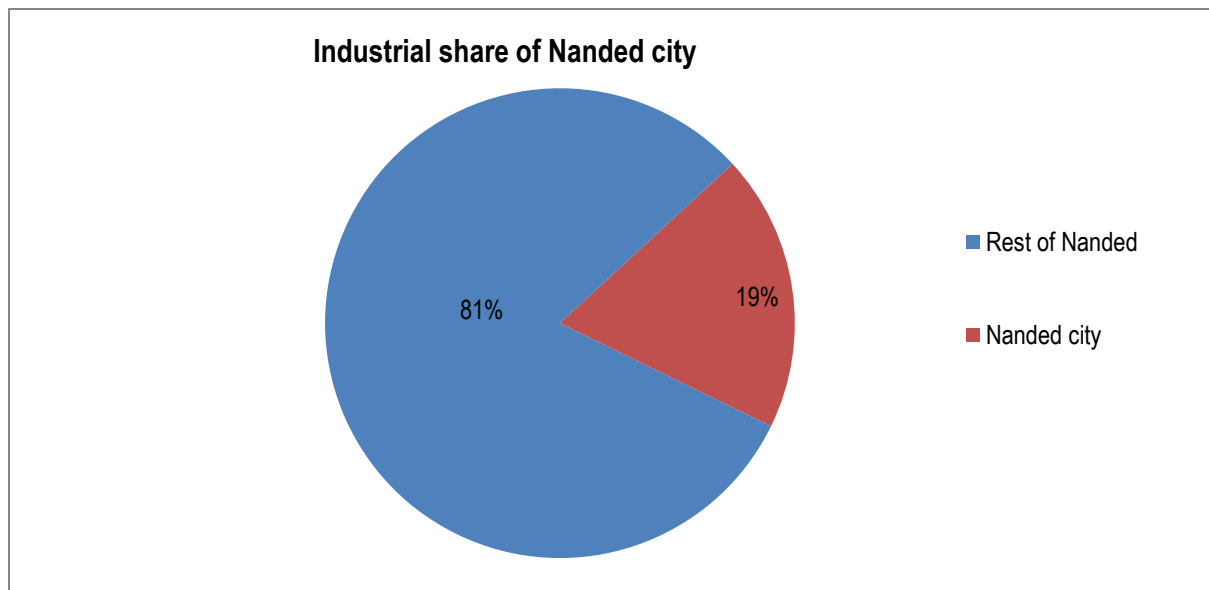


Figure No. 29: Industrial share of Nanded city  
Source: MPCB, Nanded

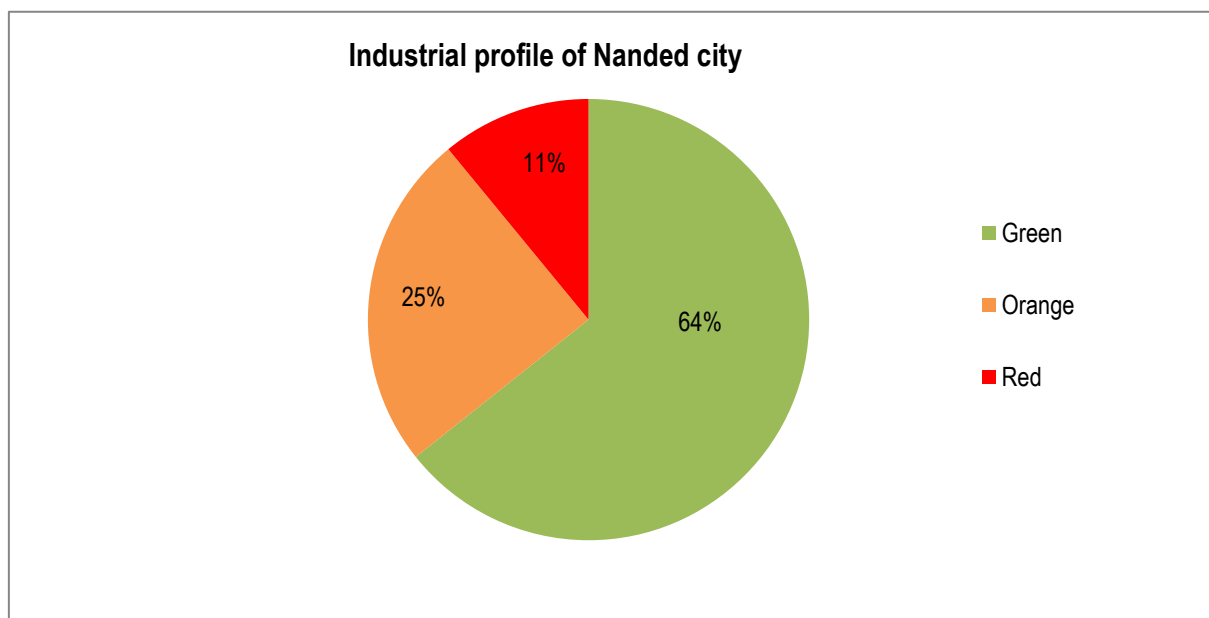


Figure No. 30: Industrial Profile of Nanded city  
Source: MPCB, Nanded

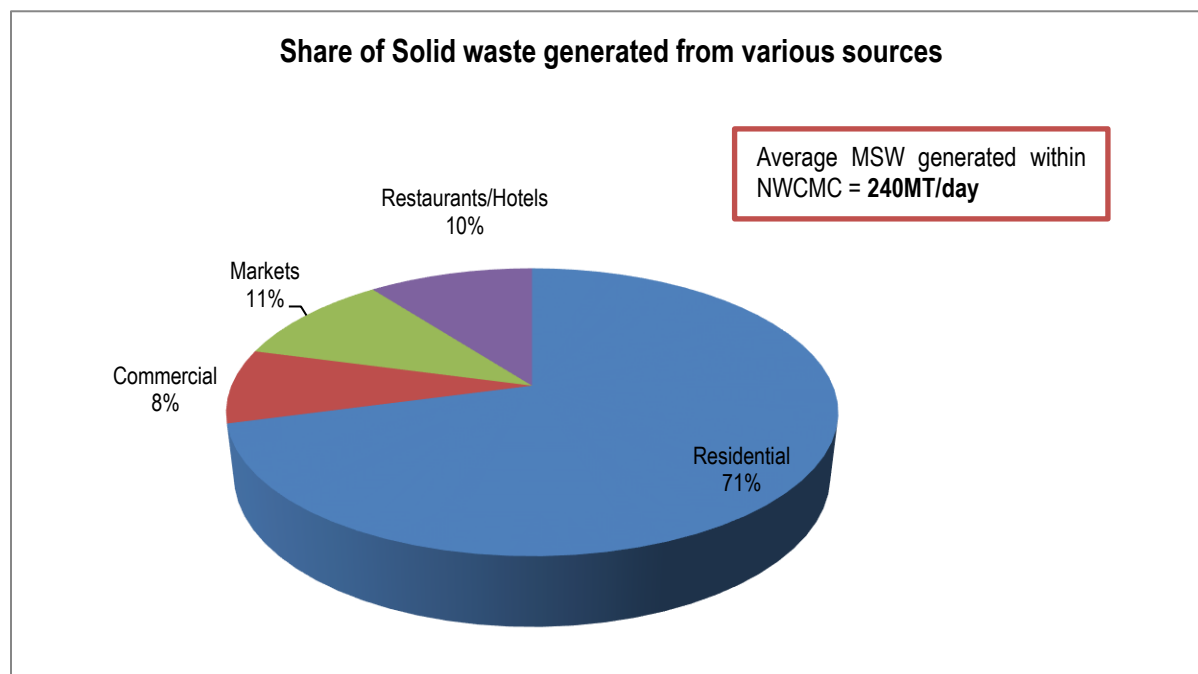
# Solid Waste Management

Ministry of Environment and Forests (MoEF) has defined MSW as commercial and residential wastes generated in a municipal or notified area in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes<sup>55</sup>. As per the guidelines of Honourable Supreme Court on March 1999 and Municipal Solid Waste (Management & Handling) Rules September 2000, the solid waste management system has been organized for effective management and disposal. MSW (Municipal solid Waste) management includes the collection, transportation, and responsible disposal of waste generated in the city. Solid waste generated in Nanded city is collected from all 6 wards of NWCMC.

## Source and Composition

A total of 240 Metric Tonnes (MT) waste is generated daily out of which only 230 MT is collected. The rest 10 MT of the waste remains unaccounted. The main source of solid waste is from the residential area comprising mainly of household waste with a share up to 71% followed by commercial areas, markets and restaurants (Figure No. 31). As seen in Figure No. 32 the waste mainly consists of biodegradable (65%) waste from the residential areas followed by inert, ash & debris; plastic and so on. Almost 3.5% out of the total waste belongs to hazardous waste.

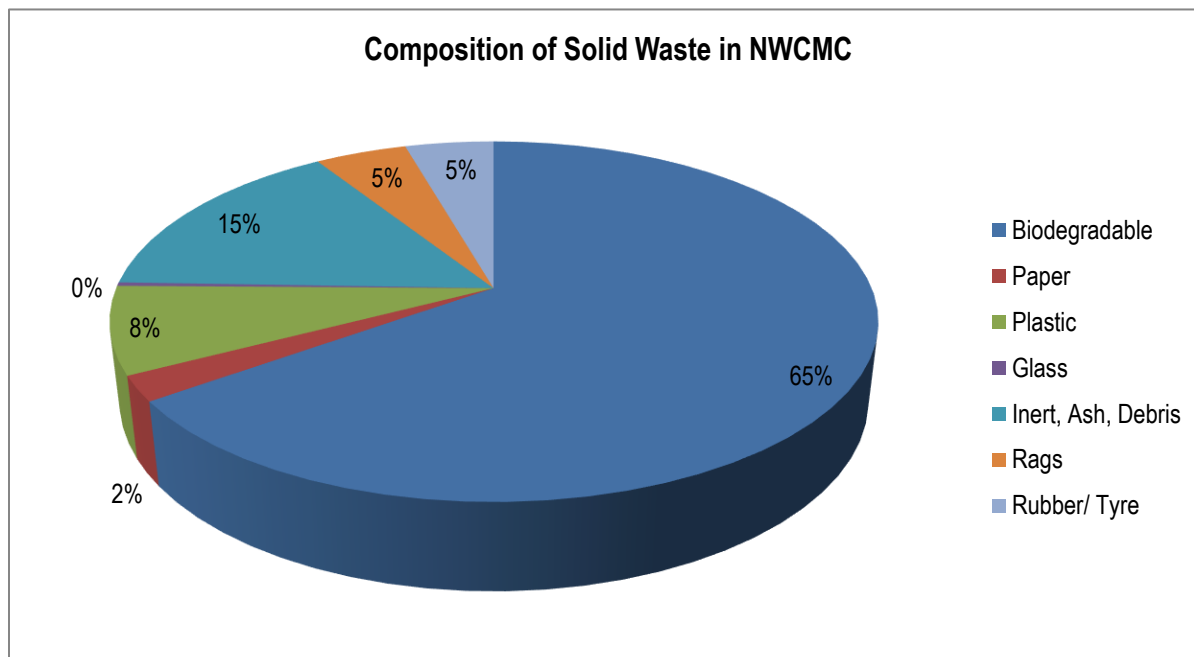
Figure No. 31: Total percent waste generated from various sources in NWCMC



Source: Solid Waste Management Department, NWCMC

<sup>55</sup> <http://www.moef.nic.in/legis/hsm/mswmhr.html>





**Figure No. 32: Composition of solid waste in NWCMC**  
**Source: Solid Waste Management Depart, NWCMC**

## Bio medical Waste

The city also generates considerable amount of biomedical waste due to presence of hospitals and various other health facilities in the city. The average biomedical waste generated (government hospitals) is around 0.3 to 0.325 MT/ day. Biomedical waste is collected from various hospitals and dispensaries by private contractors and is disposed of at disposal plant present at Tupa village. The private hospitals and dispensaries generate bio-medical waste of about 0.188 MT/ day out of which 0.182 MT/ day of waste is disposed of by private contractor M/s. Superb Hygiene Disposal, and is supervised by MPCB.

## Collection

About 61.44 (sq. km) of area is covered for the collection of solid waste. The total number of households covered for collection is around 91,809 out of which 70,542 are covered through door to door collection (bell ringing) while the rest of the waste for 21,267 households collected through common facilities like litterbins and containers. A total of 113 closed type litterbins/containers are provided throughout the city and waste from the litterbins is collected on a daily basis. Vehicles such as 25 tractors, 80 Ape, 07 Refuse compactors, 01 Nala cleaner machine (Hopper type) and 01 Bobcat machine are further used for the collection of solid waste for the bins and containers.

## Sweeping

Almost 51.76 Km road, excluding the footpaths, are swept in the city. A total of 688 sweepers are employed to sweep the roads on a daily basis.

## Processing and Disposal

Waste collected from the city is transported on a daily basis to waste dumping site at MIDC-Tupa. The dumping site is present 2 Km away from the municipal limits, to avoid nuisances, and is spread across a total of 9.89 hectare area. Around 230 MT of solid waste is dumped daily at the dumping site. Staff of 473 people has been employed for waste collection and disposal at dumping site. The dumping site has a life expectancy of around 30 years i.e. till 2044.

## Response

NWCMC has proposed to set up a waste processing plant in the coming years for effective disposal of solid waste of the city.

# Health

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## Environment and Health

The interaction between the environment and human health are highly complex and difficult to assess. The best-known health impacts are related to ambient air pollution, poor water quality and insufficient sanitation.

WHO (World Health Organization) has estimated that 24% of the global burden of disease, healthy life years lost, and 23% of all deaths (premature mortality) were due to modifiable environmental factors (for example, pollution, occupational risks, land use practices and lack of sanitation)<sup>56</sup>. As per a research by WHO, environmental factors are responsible for spreading more than 80% of the diseases. Globally, nearly one quarter of all deaths and of the total disease burden can be attributed to the environment<sup>57</sup>. Diseases with the largest absolute burden from environmental exposure included diarrhoea, lower respiratory infections, Dengue and Malaria.

The status of health of residents is one of the most crucial indicators of the environmental status of a city. But in addition to good environmental conditions, a city also needs to have good healthcare facilities. The following section presents the status of various diseases recorded in NWCMC in the year 2014-15 and the actions taken in the sensitive wards/ UHPs (Urban Health Posts) in NWCMC area.

Nanded has diverse health care services and facilities including clinics, hospitals, super speciality hospitals, private and government dispensaries and so on. Given below is the list of current health care facilities of Nanded is provided in Table No. 16.

**Table No. 16: Health care facilities in NWCMC**

Sr. No	Health care facilities	2014-15
1	No. of Private Hospitals	333
2	Ayurvedic Clinics	22
3	Homeopathy Clinics	28
4	Bachelor of Dental Surgery	78
5	Pediatricians	26
6	Gynecologists	123
7	NWCMC Hospitals	4
8	Private Nursing Homes	48

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<sup>56</sup> [http://www.who.int/quantifying\\_ehimpacts/publications/preventingdisease.pdf?ua=1](http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf?ua=1)

<sup>57</sup> [http://www.who.int/quantifying\\_ehimpacts/publications/preventingdisease/en/](http://www.who.int/quantifying_ehimpacts/publications/preventingdisease/en/)

## Water Borne Diseases

Water borne diseases are caused by pathogenic microorganisms, which are directly transmitted when contaminated water is consumed. Gastroenteritis, diarrhoea, hepatitis and typhoid are some of the commonly occurring water borne diseases in Nanded. The status and occurrence of the diseases is presented below in Table No. 17.

**Table No. 17: Cases of water borne diseases**

Sr. No	Name of disease	No. of cases	No. of deaths
1	Cholera	0	0
2	Gastroenteritis	2319	0
3	Malaria	Jan to Dec 2014= 19 Jan to Oct 2015= 09	0
4	Dengue	Jan to Dec 2014= 34 Jan to Oct 2015= 01	0
5	Diarrhoea/ Dysentery	-	-

## Air Borne Disease

Air pollution is playing a significant role in deteriorating the health quality of the urban dwellers as they are more prone towards its ill effects. According to the NIEHS (National Institute of Environmental Health Sciences<sup>58</sup>) long-term exposure to air pollutants increases a person's risk to acquire respiratory illnesses. NIEHS notes that children and the elderly are especially vulnerable to the detrimental health effects of ozone, fine particulate matter (PM) and other airborne toxicants. The cases of respiratory disorders like Asthma, COPD (Chronic Obstructive Pulmonary Disorder) such as chronic bronchitis and emphysema and lung cancer are increasing day by day due to air pollution. As per WHO, 80% of outdoor air pollution-related premature deaths were due to ischaemic heart disease and strokes, while 14% of deaths were due to chronic obstructive pulmonary disease or acute lower respiratory infections; and 6% of deaths were due to lung cancer<sup>59</sup>. Hence it is necessary to keep a check on diseases like bronchitis and asthma. The status and occurrence of diseases is given below in Table No. 18.

<sup>58</sup> <http://www.niehs.nih.gov/>

<sup>59</sup> <http://www.who.int/mediacentre/factsheets/fs313/en/>

**Table No. 18: Cases of air borne diseases**

<b>Sr. No</b>	<b>Name of disease</b>	<b>No. of cases</b>	<b>No. of deaths</b>
1	Tuberculosis	545	28
2	Bronchitis	112	0
3	Respiratory infections	92	02
4	Others	-	-



# Recommendations

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## Water Supply and Sewerage

### Metering of water supply

As of now NWCMC meters only 4.5 MLD, which is mere 5%, of the total supply of about 90MLD. About 85% of the water is un-metered and hence there is no proper accounting for the water supplied, and subsequently the water remains un-accounted. It is strongly recommended that all the connections (domestic and non-domestic) for water supply within the NWCMC should be metered. This will help keep a tab on the water supply as well as the losses.

### Constructing Public Toilets

Nanded city has mere 23 public toilets with mere 214 seats and has a deficit of more than 4100 seats. Given the fact there are a lot of slums and urban poor in the city, it is highly recommended to install public toilets within the city. It shall also help cater to the tourist population in the city and help reduce open defecation in the city.

### Enhancing the collection and processing of sewage

Mere 50%, of the total waste water generated from the Nanded city is collected and treated while the remaining 50% (about 30MLD) is released in the river without treatment. It is recommended that the sewerage infrastructure should be enhanced with utmost priority to cater to the requirements.

### Reuse of treated water

The treated water could be used for various secondary applications, by using dedicated tanker services, for the following activities.

1. Watering to road side plantations
2. Irrigation of lawns and gardens owned by NWCMC
3. Irrigation of farms and fields
4. Washing of roads to reduce road dust re-suspension, thus helping avoid air pollution
5. Water supply for construction activities

## River front management

### Strategically designed Dhobi Ghats

Given the current design of the ghats makes it convenient for waste water to be released in the river body. It is recommended that a dedicated space for washing of clothes be demarked and the platform be constructed in such a way that the slope of the same is in the opposite side to that of the river. The runoff from these platforms should be then let in the sewage connections which



would then lead the waste water to the treatment plants. Direct access to the river for washing of the clothes must be restricted or banned.

### Installation of Nirmalaya bins

A lot of religious activities take place along the banks of the Vishnupuri dam as well as the river water front in the city. The devotees offer a lot of nirmalya and release it in the water body. Dedicated Nirmalya bins could be installed along the river front, and ghats and be decanted regularly by the corporation. This could be further be processed using vermi compost technology to make useful compost for the plantations in the gardens of NWCMC and road site plantations.

### Installation of dustbins

Solid waste, plastic bags, bottles, styrofoam, wrappers, cloth and so on, are being dumped along the river. It is recommended to install dustbins along the banks of the river and on the ghat for appropriate disposal of the solid waste. NWCMC has installed a few dustbins, but given the footfall of visitors more number of dustbins is desired.

### Channelizing of water for religious access

The river water should be channelized and an areas be demarcated for religious activities while the remaining river front should be restricted from any religious activities. This shall help in restricting the access and the thus caused pollution and also help in easy management for clean-up activities.

## Groundwater Management

### Groundwater recharging be made compulsory with borewell connections

It is essential that the ground water tables gets recharged so that the ground water could be used during critical months. Groundwater recharging pits, using ring wells are highly recommended for the city of Nanded to recharge the groundwater aquifers. Constructing a recharging pits should be made compulsory for all the borewell connections issued by NWCMC. This shall help ensure long term sustainability for using and depending on Groundwater.

To promote this concept NWCMC can offer some rebate on property tax to the properties which have a groundwater recharging pit (rainwater harvesting structure). Also NWCMC could initially subsidize 20% charges for construction of rain water recharging pits to promote the concept further and ensure its implementation.

### Policy framework for installing Bore wells

NWCMC should undertake a survey to develop a detailed inventory of the number of bore wells within the city. As for the new installations, it is recommended that new bores should be approved by the corporation with appropriate inventory. The applications should be linked to conditional approval, that all the bore wells should be augmented with a rain water recharging well structure.

## Monitoring infrastructure and analysis

As per recommended in the Section 66 of Maharashtra Municipal Corporation Act 1949, NWCMC should establish an environmental laboratory to conduct water quality monitoring of the water samples from the following:

- Weekly monitoring of Godavari River
  - At two locations, one each at upstream and downstream of Nanded city
  - At all the ghats along the city
  - At all the Nallah release points along Godavari and Asna river
  - Nallah water sampling of all the 12 nallahs
- Weekly monitoring and quality analysis of the Leachate generate data the dumping site as well as at the proposed land fill site.

## Air Pollution

### Mitigation Measures

#### Transport sector

- ***CNG retrofitting for Auto Rickshaws based on Pune Model***

The Pune city opted for CNG, a cleaner fuel as compared to petrol and diesel, in the past three years making it mandatory for auto rickshaws to install CNG kits. As per the Regional Transport Office (RTO) of Pune, out of the 45,000 auto rickshaws in the city, 22,950 got the kits fitted till 2013. The Pune Municipal Corporation (PMC) has been providing a subsidy to drivers for the kits. These CNG rickshaws have different fare structure with green color code on hood for the passengers to identify the CNG operated rickshaw. This action has resulted in reduction of air pollution in the region.

- ***CNG based public transport vehicles***

The change in fuel type in public vehicles (buses, taxis, rickshaws) from conventional fuels like petrol, diesel to CNG can result in reduction of nitrous oxide by 40%, hydrocarbons by 90%, CO by 80% which are harmful to human health<sup>60</sup>. The noise level of CNG engine is also low as compared to diesel engine.

- ***Promotion of CNG based private vehicles***

The use of CNG as type of transport fuel should be promoted in private sector in order to control the air pollution from automobiles. The Pune Municipal Corporation accounts 13,961 privately owned cars on CNG as per on January 2014<sup>61</sup>.

<sup>60</sup> Sandhya Wakdikar, [Compressed natural gas: A problem or a solution?](#), 2002

<sup>61</sup> <http://timesofindia.indiatimes.com/city/pune/More-private-cars-switching-to-CNG/articleshow/31757229.cms>

- **Traffic Management**

Improvement of road quality and introduction of one way routes to regulate the traffic is highly recommended to help reduce the air pollution of the city.

### Domestic and commercial sector

- Use of PNG as effective alternative for firewood and LPG for cooking purposes.
- Enhance production and use of Biogas/Bio-methanation as source of fuel for cooking.
- Use of firewood as source of fuel for cooking purposes can be replaced by smokeless chulaas. Smokeless chulaas reduces pollution load of CO, soot particles and Particulate Matter which result in acute respiratory infection disorders. Also these chullas are time and cost effective.

### Construction activities

The control measures for air pollutants at construction sites should be integrated in the building codes and be implemented under the supervision of the corporation.<sup>62</sup>

- Use of wind fences to reduce the wind velocity. Use of vegetation cover around the storage pile can acts as wind break.
- Utilize enclosure/coverings for storage piles like Tarpaulins, plastic, or other materials.
- Load and unload the building materials at downside of storage pile.
- When loading materials onto vehicles and conveyors, the drop heights should be kept to a minimum and enclosed whenever possible.
- Use of water sprays to supress the dust production during construction activities.
- Enclosure /coverings for vehicles carrying construction materials.
- Proper exhaust system, use of catalytic converter and proper maintainace of vehicles can also minimize the air pollutants at construction sites

## Monitoring of Air Quality

### Monitoring network

The 'Guidelines for National Ambient Air Quality Monitoring 2003' issued by CPCB gives a calculation to determine the minimum number of monitoring stations required in an area, based on population of the region. Since Nanded city has a population of 5,50,564 it is estimated that the city should have total 7 AAQMS in the city. There are three monitoring stations-Ganesh nagar (Residential), Mutha Chowk (Commercial) and CIDCO Area (Industrial) in Nanded established by MPCB. It is highly recommended to establish 4 additional stations as per these guidelines in order to have appropriate observations for the air quality of the city. It is suggested to have one additional station each representing residential and commercial areas.

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<sup>62</sup> Environment Canada, [Best practices for reduction of emissions from construction and demolition sites](#),2005

In addition the city should also have CAAQMS (Continuous Ambient Air Quality Monitoring Station) in order to record the real time data on air quality in the city.

### Additional parameters

The Nanded city has recorded tremendous growth in vehicles (Figure No. 25), which adds various air pollutants. Apart from SO<sub>x</sub> and NO<sub>x</sub> emissions the transport sector contributes about 70% of environmental pollution contributing CO as a major pollutant.<sup>63</sup> While, tropospheric ozone formation occurs when NO<sub>x</sub>, CO and VOC (Volatile Organic Compounds), react in the atmosphere in the presence of sunlight. This (tropospheric ozone) pollution can result in pulmonary diseases such as lung cancer, irritation of eyes, asthma, respiratory and cardiac disorders. Apart from this, Photochemical smog can also result in road accidents

Hence, apart from monitoring the general parameters like SO<sub>x</sub>, NO<sub>x</sub>, PM additional parameters like CO, Ozone and Benzene should be monitored. Depending on the construction sites, Volatile organic carbons (VOCs) can also be monitored as additional parameters as indicator for air pollution.

### Research studies

#### Emission Inventory and Source Apportionment

Emission inventories determine the significant sources of air pollutants, emission trends over period of time and estimate air quality thus necessary for projections and regulatory actions for future. Information on vehicle sources of various categories (2 wheeler, 3 wheelers, cars, Taxi and so on), different area sources, Emission load from industries and vehicles should be maintained. Source Apportionment identifies the quantification of pollution levels from receptor sites. A study to document the emission inventory of the city is highly recommended.

#### Baseline research on Indoor air quality

NWMC should also undertake a study to monitor the indoor air quality of various places within the city. About 32% of population in the city uses firewood as source of fuel for cooking which results in indoor air pollution as elaborated in Figure No. 26.

### Data Management

- Data for Air quality, Noise and water to be maintained and published in collaboration with MPCB on the municipal corporation website at regular intervals. Similarly the corporation should also record and maintain the data for sale of fuels from different oil companies/agencies.
- An inventory of various constructional activities in the city in regards to date, location, agency, quality and quantity of raw materials utilised should be maintained by NWMC. The initiatives taken by the construction agency to reduce the air pollution/dispersion of particles should be submitted in a specific format to NWCMC.

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<sup>63</sup> R.K.Shrivastava, [Air pollution due to road transportation in India; Review on assessment and reduction technologies](#), Pg No.69

- NWMC should also document the record of Acute Respiratory Infections, asthma problems and other respiratory disorder annually from Private hospitals and dispensaries.

## **Solid Waste Management**

NWCMC should undertake several measures in order to increase the efficiency of solid waste management system. Some recommendation are mentioned below:

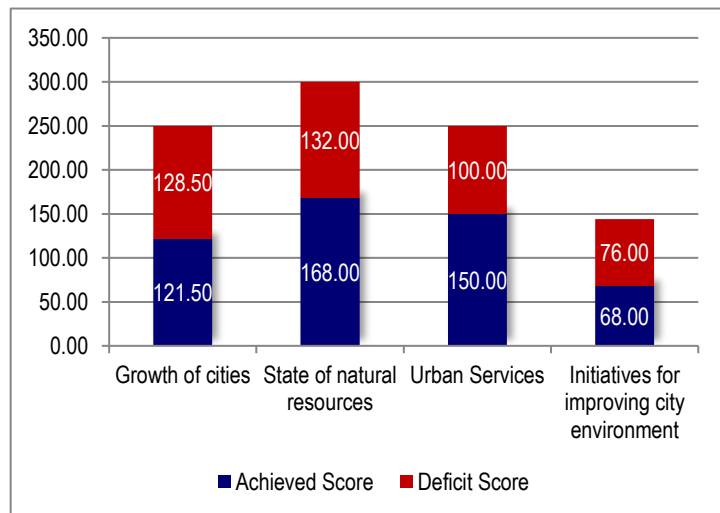
- Initially the corporation should understand the nature of solid waste of the city and develop a DPR with a long term vision to mitigate the issues pertaining to solid waste management.
- Develop a scientific landfill site over a dumping site in order to treat the solid waste.
- Adopt a more sustainable method for effective collection of waste from households.
- Incorporate waste to energy techniques for effective disposal of solid waste such as Bio methanation plant, Biomass gasifier, pyrolysis technique and so on.
- Replication of successful case studies from other corporations.
- Delegations from NWCMC should have a site visit to study the 'State of Art' solid waste management system at Navi Mumbai.

## Environmental Performance Index

For evaluating the environmental reporting and performance of cities, MPCB in 2009 developed methodology called Indicator Framework Approach. Indicator framework has been developed with four levels of indicators- The data variables which are translated to preliminary indicators under various thematic groups. The preliminary indicators of same theme add to give thematic indicators. These Thematic indicators are then added up to give final Environmental Performance Index (EPI). Thus, EPI is method of quantifying and ranking the environmental performance of a city. These indices can be used to determine a baseline value and then a trend could be developed for the following years to track the development and address the gaps specifically. The EPI has been calculated based on the model developed by MPCB using MS<sup>TM</sup> Excel software. A definite score has been allotted to the 65 data variables depending upon the benchmarks set according to the national, state or the defined average as per international standards. For example, the population growth is one of the key indicators of the environment and if it exceeds the limits, it exerts pressure and adversely impacts the environment and, hence, the score given would be less in such a situation. Vice-a-versa, a pro-environment initiative is given better score. Hence, better the EPI score better is the state of environment of that city.

The EPI score for Nanded city was determined to be 507.50 out of 944 in the year 2014-15 as compared to Pune<sup>64</sup> (EPI - 708) & Navi Mumbai (EPI - 663). Initiatives in terms of conserving the natural resources, and taking pro-environment initiatives is highly desired by the corporation in order to improve the EPI score by NWMC.

Environmental Score		507.50
Thematic Indicators	Maximum	Achieved
Growth of cities	250	121.50
State of natural resources	300	168.00
Urban Services	250	150.00
Initiatives for improving city environment	144	68.00



<sup>64</sup> [http://www.punecorporation.org/sites/default/files/reports\\_dpr/ESR\\_Report\\_2015-2016.pdf](http://www.punecorporation.org/sites/default/files/reports_dpr/ESR_Report_2015-2016.pdf)

Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score	
Growth of cities	Demographic growth (% 2001)	Population growth rate	%	Census	27.8	4	
		% of slum population to total population	%	Census	39.45	2	
	Economic growth	Work participation ratio	%	Census	260	10	
		% of people below poverty line.	%	Statistical Handbooks	4.09	10	
		% of budget spent on Environmental Infrastructure		ULB Budget	5.68	2	
	Industrial growth	% of polluting industries to total industries	%	MPCB Regional Offices	36	6	
	Spatial growth (Decadal)	Population density	Persons/sq Km	Census	8678	2	
		% of slum area to city area	%	Census	15	2	
	State of Natural resources	Landuse	% of green area to the total city area	%	Town planning department	0.7	2
			Green area per 1000 persons	Ha/person	Town planning department	0.08	2
Air		Ambient air quality	Score		B	8	



Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score
	Noise	Noise levels		MPCB Regional Offices	C	6
	Water	Water quality			B	8
	Energy	Per capita energy consumption	Kwh/ Annum	Maharashtra Energy Development Agency	614.54202	2
		Share of renewable energy in total energy consumed	%		0.01	2
		Number of hours for load shedding	hours		0	10
	Human	Crude death rate	%	Census	19.5	2
		Infant mortality rate	%	Census	12.30	10
Urban services	Water Supply	Net LPCD supplied	lpcd	Water supply department	163.46	10
		% of households connected by service connection	%		72.5	8
		Unaccounted for water	%		37	2
		Duration of water supply	hours		1	4
		Staff per 1000 connections	Persons		4.31	2

Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score
	Sewerage Sanitation	% of population catered to by underground sewer network	%	Sewerage Department	90	10
		% area covered with collection to total city area	%		90.00	10
		Staff per 1000 connections	Persons		0.2	2
	Solid Waste Mgmt	Total SW generated per capita	gm	Solid Waste Management Department	454.18	4
		Life of landfill site	Years		0	0
		% of waste disposed into landfill site to total waste generated	%		92	10
		% of waste collected to total waste generated	%		92	10
		% biomedical waste treated to total BM waste	%		100	10
	Transport	Road area as % of city area	%	Town Planning Department	3.56	2

Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score
		% of population travelling by public transport	%	Regional Transport Authority	15.0	2
Initiatives for improving city environment	Environmental awareness and education	Are the training programmes for school teachers on Environmental education adequate?	Score		M	4
		To what extent are awareness programs on environment launched during festivals or other times of the year?			M	4
		To what extent exhibitions / street plays etc organized to spread environmental awareness?			L	2
		To what extent does the city/town have any local Television channel running programs, advertisements related to environment sponsored by the respective ULB?			A	0
		To what extent do the local newspapers include a section on environment sponsored by the ULB?			A	0

Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score
	Waste Management	To what extent has the segregation of dry and wet waste substantially reduced the volume of waste disposed to the landfill?			A	0
		To what extent is waste management decentralized to NGO / CBO?			H	6
		To what extent is the activity of recycling of waste by ragpickers formalized by the ULB?			M	4
		To what extent is management of demolition and construction waste addressed in the policy and regulations of the ULB?			L	2
		To what extent is the city/town responding to PPP efforts in managing hazardous waste, plastic, electronic waste and waste oil?			M	4
	Slum Improvement	To what extent are the regularised slum areas formally provided with sanitation and sewerage facilities?			VH	8

Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score
		To what extent do the residents of slums have access to public health centres and regular health checkups?			H	6
		To what extent are adult education programs run by the ULB in slum areas?			L	2
		To what extent is the solid waste in slum areas managed by the ULB?			H	6
		To what extent does the ULB have regulations on use of fuel like banning firewood and providing alternate fuel?			L	2
	Traffic	To what extent are paths dedicated to bicycle or pedestrian movement?			H	6
		To what extent are steps taken to prevent adulteration of fuel?			L	2
		To what extent are clean fuels like CNG used?			A	0
	Water	To what extent does the ULB have regulations/ schemes encouraging Rain Water Harvesting?			L	2

Thematic Indicators	Primary indicators	Data variables	Unit	Source	Value	Score
		To what extent do building codes have regulations for using water saving fittings and fixtures?			M	4
		To what extent has the ULB taken measures to identify leaks and reduce water losses?			M	4
		To what extent does the ULB check whether the water quality is satisfactory at the consumers end?			H	6