

# Environmental Status Report 2022-2023



**Panvel Municipal Corporation**

*Submitted by*



**Indian Institute of Technology Bombay**  
**Powai, Mumbai- 40007**



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## Forward

I am glad and feel gratified to offer Panvel Municipal Corporation's Environmental Status Report for the years 2022-2023. The Environmental Status Report is the result of good improvements that make the city more environmentally friendly and sustainable. It is created with the use of data, information, beneficial suggestions, and policy prescriptions.

The Panvel Municipal Corporation makes every effort to collect and dispose of solid waste, maintain roads, manage drainage and sewerage systems, improve tree cover by planting plants every year, maintain chowk attractiveness, and plan the city to accommodate an ever-increasing population.

In the Panvel Municipal Corporation region, there are numerous industries that strive to maintain environmental balance while producing their products. Environmental protection and conservation have been a collective responsibility as well as an individual responsibility. The Environmental Status Report is the result of a thorough investigation by the Indian Institute of Technology, Bombay.

I am confident that the Environmental Status Report would assist Panvel Municipal Corporation in making the city clean, beautiful and healthy.

**Shree. Ganesh Nilkanth Rao Deshmukh**

Administrator & Municipal Commissioner  
Panvel Municipal Corporation



## Forward

The Environmental Status Report (ESR) is not just about the fulfillment of the need for a report; rather, it is a continuous process of measurement of environmental indicators and assessment of their condition. The results are not just compiled but are analyzed with deep study and discussion, on the basis of which the Vasai Virar City Municipal Corporation will take steps for the mitigation of identified environmental issues and strive towards better environmental management.

We consider this as one of our most important duties and it is for these reasons, we make intensive efforts to prepare this report annually. It is a matter of immense pride to be part of a team trying to develop the city in an eco-friendly manner. Through our combined efforts, we are striving to constantly improve the status of Vasai Virar City at all levels – social, environmental or economic.

Finally, I would also like to record my appreciation and thanks to all individuals and departments for their valuable inputs to this report.

**Dr. Prashant Rasal**  
Additional Commissioner  
Panvel Municipal Corporation



## Acknowledgement

The development of the "Environmental Status Report for Panvel Municipal Corporation" was a wonderful experience, which Indian Institute of Technology, Bombay (IIT Bombay) credits to Panvel Municipal Corporation (PMC) officials' cooperation and support.

To begin, IIT Bombay would like to thank Shri. Ganesh Nilkanth Rao Deshmukh, Administrator & Municipal Commissioner of PMC for their unwavering support and encouragement.

While formulating the ESR, IIT Bombay would like to express its gratitude to the City Engineer and all the officials of PMC, who assisted us during site visits and personal interactions to collate primary as well as secondary information.

The team also takes this opportunity to express gratitude to all the Executive Engineers of respective departments and their team members for their support and the Hon'ble committee members of PMC for their persistent cooperation.

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Finally, the authors express their gratitude to everyone who helped them compile this study.

**Panvel, December, 2022**



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## Abbreviation

|       |                                              |
|-------|----------------------------------------------|
| PMC   | Panvel Municipal Corporation                 |
| AAQ   | Ambient Air Quality                          |
| AAQMS | Ambient Air Quality Monitoring System        |
| AQI   | Air Quality Index                            |
| BDL   | Below Detectable Limit                       |
| BOD   | Biological Oxygen Demand                     |
| BPMC  | Bombay Provisional Municipal Corporation     |
| CAAQM | Continuous Ambient Air Monitoring Station    |
| CETP  | Common Effluent Treatment Plant              |
| CGWB  | Central Ground Water Board                   |
| CO    | Carbon Monoxide                              |
| COD   | Chemical Oxygen Demand                       |
| COPD  | Chronic Obstructive Pulmonary Disease        |
| CPCB  | Central Pollution Control Board              |
| CSR   | Corporate Social Responsibility              |
| dBA   | Weighted Decibels                            |
| DL    | Detectable Limit                             |
| DMP   | Disaster Management Plan                     |
| DO    | Dissolved Oxygen                             |
| DPR   | Detailed Project Report                      |
| DPSIR | Driving Force Pressure State Impact Response |
| EC    | Electrical Conductivity                      |
| ENE   | East- northeast                              |
| EPIP  | Export Promotion Industries Park             |
| ESR   | Environmental Status Report                  |



|         |                                                    |
|---------|----------------------------------------------------|
| GBD     | Global Burden of Disease                           |
| GC- FIS | Gas Chromatography- Flame Ionization Detection     |
| GC-FID  | Gas Chromatography- Flame Ionization Detector      |
| GIS     | Geographical Information System                    |
| GOM     | Government of Maharashtra                          |
| IMD     | India Meteorology Department                       |
| KLD     | Kilo- liters per Day                               |
| LPCD    | Liters per Capita per Day                          |
| LRI     | Lower Respiratory Tract Infection                  |
| LULC    | Land Use Land Cover                                |
| MCM     | Million Cubic Meters                               |
| MIDC    | Maharashtra Industrial Development Corporation     |
| MJP     | Maharashtra Jeevan Pradhikaran                     |
| MLD     | Mega liters per Day                                |
| MLD     | Million Liters Per Day                             |
| MMC     | Maharashtra Municipal Corporation                  |
| MMR     | Mumbai Metropolitan Region                         |
| MMRDA   | Mumbai Metropolitan Region Development Authority   |
| MoEF&CC | Ministry of Environment, Forest and Climate Change |
| MoHFW   | Ministry of Health and Family Welfare              |
| MPCB    | Maharashtra Pollution Control Board                |
| MPN     | Most Probable Ground                               |
| MSEB    | Maharashtra State Electricity Board                |
| MSL     | Mean Sea Level                                     |
| MSRDC   | Maharashtra State Road Development Corporation     |
| MSRTC   | Maharashtra State Road Transport Corporation       |
| MSW     | Municipal Solid Waste                              |



|                   |                                                                  |
|-------------------|------------------------------------------------------------------|
| MT                | Metric Tons                                                      |
| NAAQS             | National Ambient Air Quality Standards                           |
| NABL              | National Accreditation Board for Test & Calibration Laboratories |
| NAMP              | National Air Quality Monitoring Programme                        |
| NDMA              | National Disaster Management Authority                           |
| NE                | Northeast                                                        |
| NGO               | Non- Government Organization                                     |
| NNE               | North- northeast                                                 |
| NO <sub>x</sub>   | Oxides of Nitrogen                                               |
| NRW               | Non- Revenue Water                                               |
| NWMP              | National Water Monitoring Programme                              |
| ODF               | Open Defecation Free                                             |
| OECD              | Organization of Economic Co-corporation and Development          |
| PMC               | Panvel Municipal Corporation                                     |
| PM <sub>10</sub>  | Particulate Matter Below 10 micrometers Diameter                 |
| PM <sub>2.5</sub> | Particulate Matter Below 2.5 micrometers Diameter                |
| PPP               | Public Private Partnership                                       |
| PWD               | Public Works Department                                          |
| RDS               | Respirable Dust Sampler                                          |
| RSPM              | Respirable Suspended Particulate Matter                          |
| RTO               | Regional Transport Office                                        |
| SAR               | Sodium Absorption Rate                                           |
| SHG               | Self- Help Group                                                 |
| SMB               | Swachh Bharat Mission                                            |
| SO                | Sulphur Monoxide                                                 |
| SoE               | State of Environment Report                                      |
| SPM               | Suspended Particulate Matter                                     |



---

|       |                                                         |
|-------|---------------------------------------------------------|
| SSW   | South- southwest                                        |
| STP   | Sewage Treatment Plant                                  |
| SW    | Southwest                                               |
| SWD   | Social Welfare Department                               |
| TDS   | Total Dissolved Solids                                  |
| TSS   | Total Suspended Solids                                  |
| ULB   | Urban Local Bodies                                      |
| UNCED | United Nation Conference on Environment and Development |
| WHO   | World Health Organization                               |
| WIMCO | Western Indian Match Company                            |
| WQI   | Water Quality Index                                     |
| WQMS  | Water Quality Monitoring Station                        |
| WSW   | West- southwest                                         |
| WTP   | Water Treatment Plant                                   |



## Executive Summary

As per the Maharashtra Municipal Corporation (MMC) Act 1949, section 67(A), it is mandatory for all Urban Local Bodies (ULBs) of the state of Maharashtra to submit an annual Environmental Status Report (ESR) to General body on or before 31st July.

The 74<sup>th</sup> Amendment to the constitution has enlarged the roles and responsibilities of municipalities, specifically citing protection of the environment and promotion of ecological aspects. Preparation of Annual ESR is mandated in the state level legislation (the BPMC Act) following the 74<sup>th</sup> Constitutional Amendment Act and the 12<sup>th</sup> Schedule.

Environmental Reporting finds its roots in the Local Agenda 21 mandate that was passed in the Earth Summit of 1990 in Rio. Under this mandate, Urban Local Bodies (ULBs) required to undertake the preparation and publication of an annual State of Environment Report (SoE) or equivalent.

The ESR indicates the city's environmental concerns, growth factors and its impacts, provides information on the environmental infrastructure including water supply, sewage management, traffic & transportation, solid waste management, biodiversity, overall environmental pollution and degradation and possible mitigation measures required, information for investment and management decisions for the ULB (Urban Local Body), assessment of various natural resources, level of pollution & its direct or indirect impact on human beings and other life forms and annual budgeting and planning exercises etc.

As per the guidelines published in June 2009 by the Department of Environment, Government of Maharashtra, the ESR has to be developed as per the DPSIR (Driving Force Pressure State Impact Response) framework. This frame-work focuses on dynamic relationship between the human activities and its impact on physical and biological processes of the ecosystem.

The Environmental Status Report (ESR) 2022-23 aims to fulfill the objectives stated through the guidelines given by GOM regarding ESR study & the purpose of this study is;



- To highlight the condition of the biophysical environment of PMC
- To analyses of trends or changes in the environment as well as identify the causes of these changes of PMC
- To assess and interpret the implications and impacts of these trends
- To check adequacy of existing environmental infrastructure of PMC
- To set process for public participation
- To redevelop action plans of PMC
- To set targets, allocate responsibilities & institute monitoring and tracking mechanisms for making Panvel city environment friendly sustainable city.

To analyses the environmental health of Panvel area, the secondary data used from PMC, MJP, MPCB, CPCB, MIDC, MoHFW, MoEF&CC, NDMA, MSEB, Panvel Tehsil etc. and on field environmental survey was conducted for analyses the current environmental health of study area i.e. Panvel area. The purpose of on field survey was to know the environmental issues and efforts of PMC in mitigating the issues and also to understand the reasonable expectations of households in developing the city sustainable and environmentally friendly.

The Panvel city is divided into 30 wards for which elections are held every 5 years. The Panvel Municipal Corporation has population of 5,09,901 of which 2,71,303 are males while 2,38,598 are females as per report released by Census India 2011. In Panvel, Male literacy is around 80.38% while female literacy rate is 72.63%. Panvel Municipal Corporation has total administration over 40,478 houses to which it supplies basic amenities like water and sewerage. It is also authorized to build roads within Municipal Corporation limits and impose taxes on properties coming under its jurisdiction.

The increasing population due to high growth of mitigation, affordable housing, well-organized railway connectivity and enlargement of industrial activities are the main drives for pressure on environment as a public good in Panvel area. The ESR brings out the depletion of natural resources like water & biodiversity due to urbanization & industrialization. Also changes in land use & land cover reveal that there has been rapid urbanization in the city. Perhaps a large no of slums emerged in recent year that are



preliminary unplanned & hence the issue like low level of tree cover, high density population, at some area narrow roads at some location.

On the other hand, ESR analyses the status of Air quality, water quality & noise level was found within a healthy limit as provided by MPCB online monitoring data. The scientific analysis based on GIS & satellite images discovered the land use & land cover in the city & also enabled us to understand classification of land cover & percentage distribution of land use. Further, analyzing the status of & few changes in biodiversity helps us understand the impact of urbanization on the environment. The increment in tree cover could lead to better oxygen levels, heat stress, and less pollution in the city. The report also highlights the attempts made by PMC to increase tree cover through tree plantation programs since many years. Suggesting the use of sewage treatment plants to produce an effluent that can be reused in the city in a useful manner. Initiate segregation of solid waste, processing solid waste to generate unconventional sources of fuel & energy, banning the usage of plastic bags, strengthen dissemination of information to reduce the usage of plastic in general, to form an environment regulation body at PMC, to initiate to install environment monitoring station at PMC & to enhance the participation of NGOs including SHGs in conserving environment in the city. Also, suggesting more advance medical facilities for COVID- 19 like emergencies.

PMC recently received an award 'Three Star Garbage Free City' under Swachh Bharat Mission. These are evident for their sincere efforts in making the city clean, beautiful & environmentally friendly. The residents in Panvel appreciated the PMC for efforts relating to solid waste management, sewage system, sanitation, disaster management & services.



## 1 Background of ESR

ESR is one of the forms of State of Environment Reporting (SoE). This data is often analyzed to show trends of environmental pollution, impacts of growth and possible environmental action planning in the city. According to the municipal legislations, the Urban Local Bodies (ULBs) in Class I cities are required to publish an annual Environmental Status Report (ESR), which will indicate the status of environment management in the city and identify the areas where mitigation measures are required to be considered.

Environmental Reporting finds its roots in the Local Agenda 21 mandate that was passed at the Earth Summit of 1990 in Rio. Under this mandate, Urban Local Bodies (ULBs) are required to undertake the preparation and publication of an annual State of Environment Report (SoE) or equivalent.

The 74th amendment to the Indian constitution has enlarged the roles and responsibilities of municipalities, specifically citing protection of the environment and promotion of ecological aspects. Preparation of Annual ESR is mandated in the state level legislation (the BPMC Act) following the 74th Constitutional Amendment Act and the 12th Schedule. As per the guidelines published in June 2009 by the Department of Environment, Government of Maharashtra, the ESR has to be developed as per the DPSIR (Driving Force Pressure State Impact Response) framework. This frame-work focuses on dynamic relationship between the human activities and its impact on physical and biological processes of the ecosystem.

DPSIR framework assumes a chain of causal links starting with 'driving forces' (economic sectors, human activities) through 'pressures' (emissions, waste) to 'states' (physical, chemical and biological) and 'impacts' on ecosystems, human health and functions, eventually leading to political 'responses' (prioritization, target setting, indicators).

ESR also includes analysis of trends or changes in the environment, analysis of the causes of these changes, assessment and interpretation of the implications and impacts of these trends, and assessment of the actual and potential societal response to environmental problems. Today, ESR studies have emerged from being solely environment oriented to

encompassing, interfacing with economic and social elements. Hence, the ESR report has come to identify the key driving forces that influence environmental change and policies.

The study of ESR of PMC, 2022-23 aims to fulfil the objectives stated through the guidelines given by GOM regarding ESR study & the purpose of this study is;

- To highlight the condition of the biophysical environment of PMC,
- To analyses of trends or changes in the environment as well as identify the causes of these changes of PMC,
- To assess and interpret the implications and impacts of these trends,
- To check adequacy of existing environmental infrastructure of PMC.
- To set process for public participation,
- To redevelop action plans of PMC,
- To set targets, allocate responsibilities & institute monitoring and tracking mechanisms for making Panvel city environment friendly sustainable city.

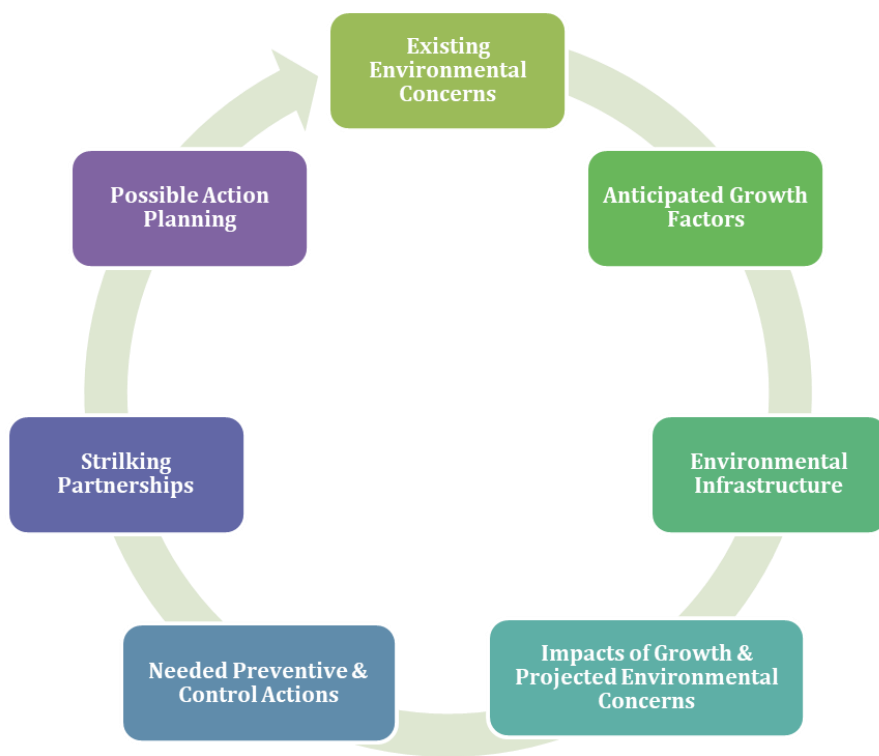


Figure 1.1: Process Guidance Framework for Public Participation



## 2 Panvel – City Profile

### 2.1 Background

Panvel City is known for being rich in nature, history, and culture. It is a fast-growing urban area close to Mumbai, surrounded by highways, shipping and industrial zones. Trading routes such as land and sea are the major reason for its prosperity. The routes were developed during the Mughal period and later developed by Portuguese, British and Marathas. Municipal Corporation is the governing body of the city of Panvel in Raigad district.

Panvel Municipal Corporation was formed on 25th August, 1852, as the first municipal corporation in the country. The initial notification for converting Panvel Municipal Council to Municipal Corporation came in the year 1991 but was never finalized. After rapid urbanization post-2000, Panvel Municipal Corporation was eventually upgraded to Municipal Corporation in 2016. Panvel Municipal Corporation is the first Municipal Corporation in Raigad district, 9th in the Mumbai Metropolitan Region and 27th in the state of Maharashtra. The Municipal Corporation includes 29 revenue villages of Panvel taluka, including Taloja, Kharghar, Kalamboli and Kamothe. It spreads over 110.06 km<sup>2</sup>, as per the 2011 census, it has a population of 5.09 lakh. It includes areas of gram panchayats, CIDCO, MIDC, MMRDA, Panvel Municipal Corporation and Raigad District Panchayat.

Panvel has been counted as one of the major cities in North Konkan for about seventy-eight hundred years. It is in the Raigad district of Maharashtra state and it is known as Konkan Convener situated at the headquarters of Pune-Mumbai. Panvel is also a taluka and it borders the Thane district. Panvel City, coordinates at 18°59'40"N and 73°06'50"E, is located 60 km away in the suburbs of Mumbai, the capital of the state of Maharashtra.

The corporation area comprises historic temples, mosques, churches, lakes, and the people living in the city. Water supply to Panvel city comes from the Dehrang dam owned by PMC. Also, in the present case, the development of Panvel city is taking place at a rapid pace and



CIDCO has developed New Panvel adjoining the old Panvel. Also, due to Konkan Railway passing through Panvel and the upcoming Navi Mumbai International Airport near Panvel City, Shivadi-Nhava Sea Link Bridge and SEZ projects, which are 25 to 30 km away from Panvel, are increasing the flow of citizens in this city. Table 2.1 gives brief information on Panvel city.

Table 2.1: Brief Information of Panvel City

| Sr. No | Index                           | Information                                                                                                                                                                                                                        |
|--------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | City                            | Panvel                                                                                                                                                                                                                             |
| 2      | Municipal Ground Coverage       | 110.06 sq. km.                                                                                                                                                                                                                     |
| 3      | Population (as per 2011 census) | 5.09 Lakhs                                                                                                                                                                                                                         |
| 4      | AMC Establishment               | 1 <sup>st</sup> October 2016                                                                                                                                                                                                       |
| 5      | Municipal Class                 | D                                                                                                                                                                                                                                  |
| 6      | Election Ward                   | 30                                                                                                                                                                                                                                 |
| 9      | River                           | Kasardi, Taloje & Kalundre river                                                                                                                                                                                                   |
| 10     | Nearby Dam                      | Dehrang dam                                                                                                                                                                                                                        |
| 11     | MSL                             | 28 m                                                                                                                                                                                                                               |
| 12     | Location                        | 18°59'40"N and 73°06'50"E                                                                                                                                                                                                          |
| 13     | National Highways No.35         | <ul style="list-style-type: none"><li>• Mumbai-Pune Expressway</li><li>• Sion-Panvel Expressway</li><li>• NH 4B, NH 66 start from here while NH 4 passes through Panvel</li></ul>                                                  |
| 14     | Railway                         | <ul style="list-style-type: none"><li>• Harbour line from Mumbai CSMT</li><li>• Central line from Diva / Karjat</li><li>• Western Freight Corridor from JNPT</li><li>• Konkan railway line from Mangalore meet at Panvel</li></ul> |
| 15     | Heritage                        | Beth El Synagogue                                                                                                                                                                                                                  |

Source: PMC Website

## 2.2 Location

Panvel with a jurisdiction of about 110.06 sq. km. is geographically located at 18°59'40"N Latitude and 73°06'50"E Longitude at about 28 meter above mean sea level. Panvel is well connected with all the nearest cities like Mumbai & Pune. Panvel falls in the Raigad district, which approximately 40 km from Mumbai by road. Panvel is also very close to Navi Mumbai and Thane. It scores supremely high on its road connectivity as it serves as a meeting point for multiple major highways. The Sion-Panvel Expressway is a 25 km long highway that connects Sion to Panvel via Navi Mumbai. Location of Panvel city is shown in Figure 2-1. The sanction plan of Panvel city as given in the PMC website is shown in Figure 2-2.

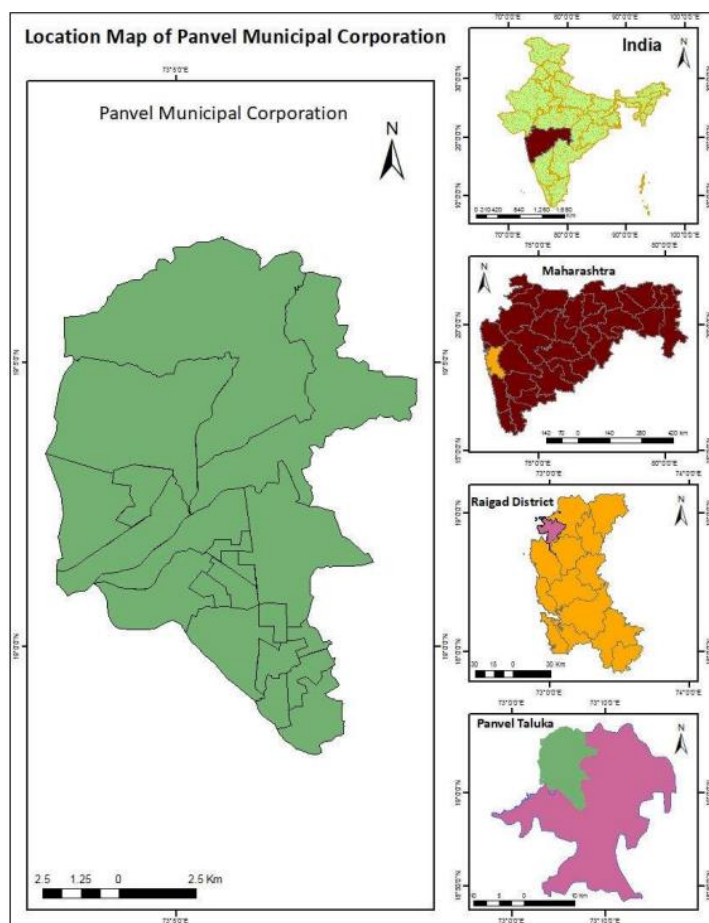


Figure 2.1: Location of Panvel City

Source: PMC Website

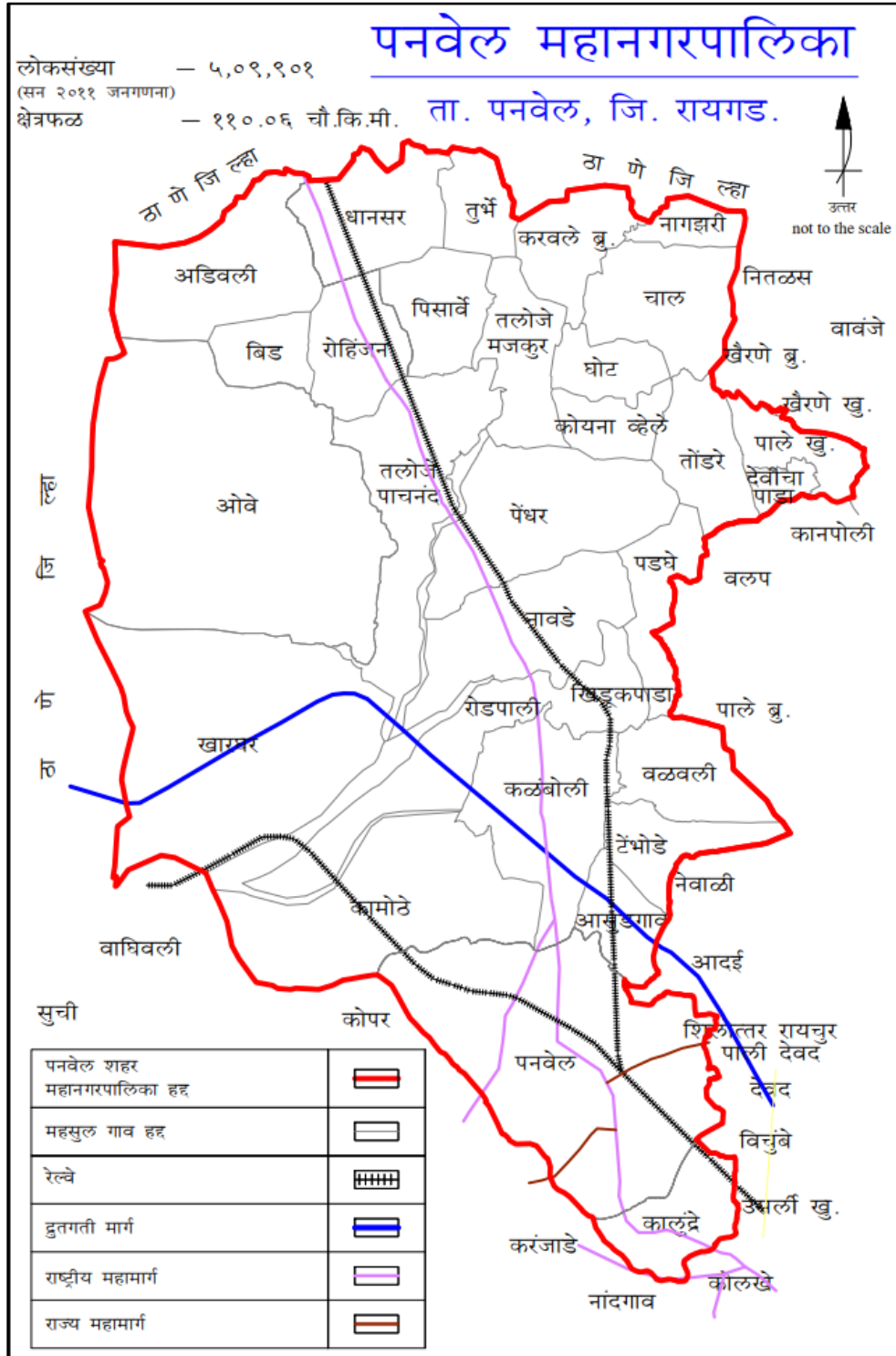


Figure 2.2: PMC Sanction Plan

Source: PMC Website

## 2.3 Connectivity Network

Panvel has emerged to be one of the fastest developing cities not only in Maharashtra but in the whole India as well. The fact that it is a neighboring city to Mumbai has led to an influx of people constantly migrating to it. These people see Panvel as the best option to not only beat the overcrowded, congested ways of Mumbai but also to tackle the paucity of land and skyrocketing rent that Mumbai is commonly infamous for. This is also one of the driving reasons why the real estate market in Panvel has boomed.

Panvel has been making quite the headlines for the upcoming Navi Mumbai International Airport, which is a Greenfield International Airport. Please refer Figure 2.3 for nearest airport connectivity of Panvel city. It will be the second international airport in the MMR. It will run alongside the Chhatrapati Shivaji Maharaj International Airport (CSIA) as one of India's first urban multi-airport systems.



Figure 2.3: Navi Mumbai Airport Connectivity

Source: <http://www.twenty22.in/2016/07/navi-mumbai-airport-connectivity.html>

**PANVEL**

**LEGEND**

- Major Road
- Other Road
- Railway
- Waterbody
- Hotel
- Hospital
- Cinema
- Religious Place
- Education
- Imp Landmark

Map not to Scale

Copyright © 2012 www.mapsofindia.com  
(Updated on 16th February 2012)

Source: <https://www.mapsofindia.com/maps/maharashtra/panvel.html>

Panvel rail connectivity, it has become an epicenter of sorts. Panvel Railway Station functions as one of the most crucial junctions on the Central Railway. While it comes under the Mumbai Division of Central Railway, a harbour line from Mumbai CSMT, a central line from Diva / Karjat, Western Dedicated Freight Corridor from JNPT and the line from Roha, all meet at Panvel. Apart from that, under the jurisdiction of CIDCO, various railway projects are underway and are coming up with great speed. The CST–Panvel fast corridor is a proposed elevated suburban rail corridor on the Harbour Line of the Mumbai Suburban Railway wherein air-conditioned EMUs (Electrical Multiple Units) will operate. Along with that, the Panvel-Karjat railway corridor is also under construction. The proposed project would lead to greater connectivity and accentuate development in the region by connecting the far extremes of the Raigad district. Please refer Figure 2.5 for rail connectivity of Panvel city.



Figure 2.5: Panvel Railway Connectivity Map

Source: <https://www.thehindu.com/news/cities/mumbai/mrvc-plans-to-bolster-vasai-panvel-corridor/article29892511.ece>

## 2.4 Climatic Conditions

The general climatic regime is fairly equitable since seasonal fluctuations of temperature are not significantly large. The moderating effects of the nearby sea and fairly high relative humidity in the atmosphere have restricted the variability. According to Department of Agriculture, Government of Maharashtra, the Maharashtra state is divided into 9 agro-climatic zones. Raigad Districts form part of the North Konkan Agro-climatic zone with the following climatic conditions:

### Temperature:

The mean daily maximum and minimum temperatures are 38°C and 16°C, respectively. Humidity is 98 % in monsoon and 60 % in winter.

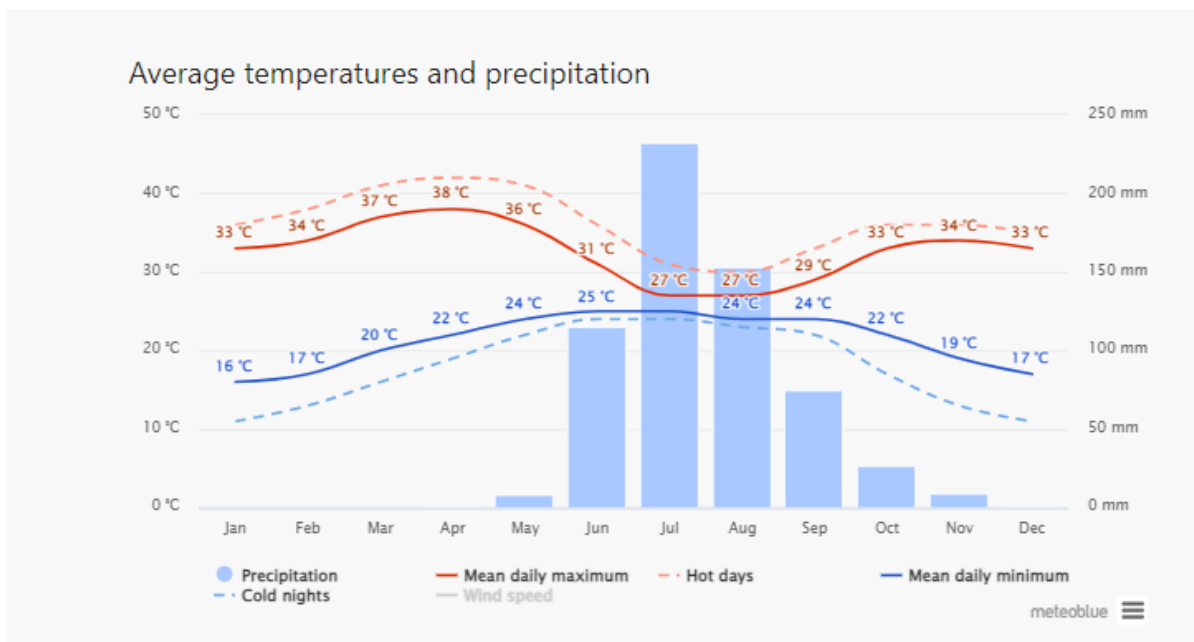


Figure 2.6: Panvel Average Temperature and Precipitation

(Source: [https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/panvel\\_india\\_1260434](https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/panvel_india_1260434))

## Rainfall:

The majority of the rainfall in the region is from the South-West monsoon between June and September. **The average annual rainfall is 2607 mm.** Maximum rainfall is received in the month of July.

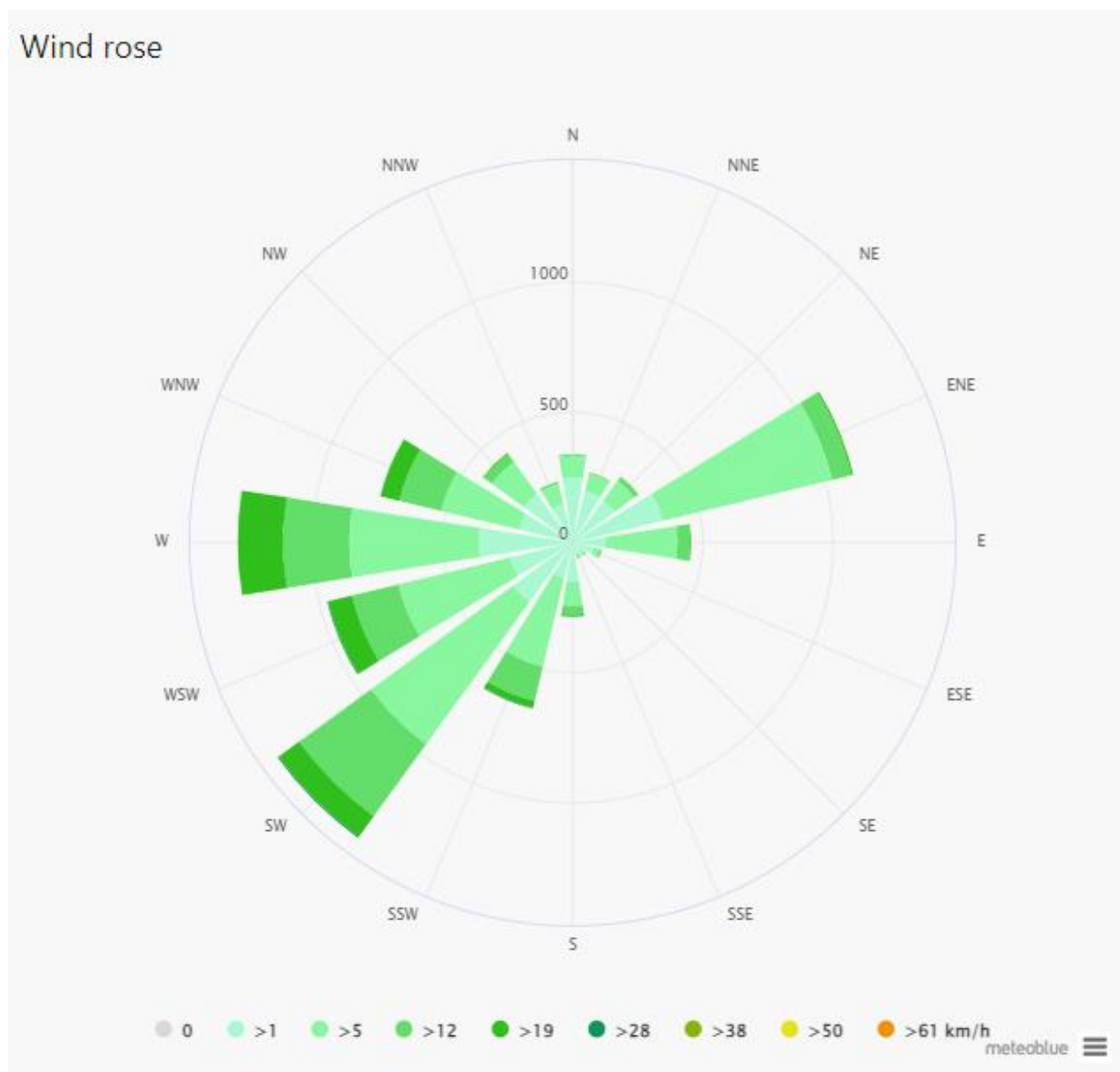


Figure 2.7: Annual Wind Rose for Panvel

(Source: [https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/panvel\\_india\\_1260434](https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/panvel_india_1260434))

Figure 2.7 shows the annual wind rose for Panvel. The wind rose indicates the wind-flow in hours per year in the particular direction. In Panvel, the wind blows with the speed of >1 km/h for around 275 hours in a year from the direction of SW to NE. Similarly, wind blows from West to East for around 350 hrs/year at the speed of > 1 km/hr and in the direction from WSW to ENE, with the speed of 1 km/hour for around 246 hours in a year.

### Land Use and Land Cover:

Panvel tehsil is in the Raigad district. The total Geographical area of the Panvel tehsil covers approximately 110.6 sq.km, which is in accordance with Figure 2.8.

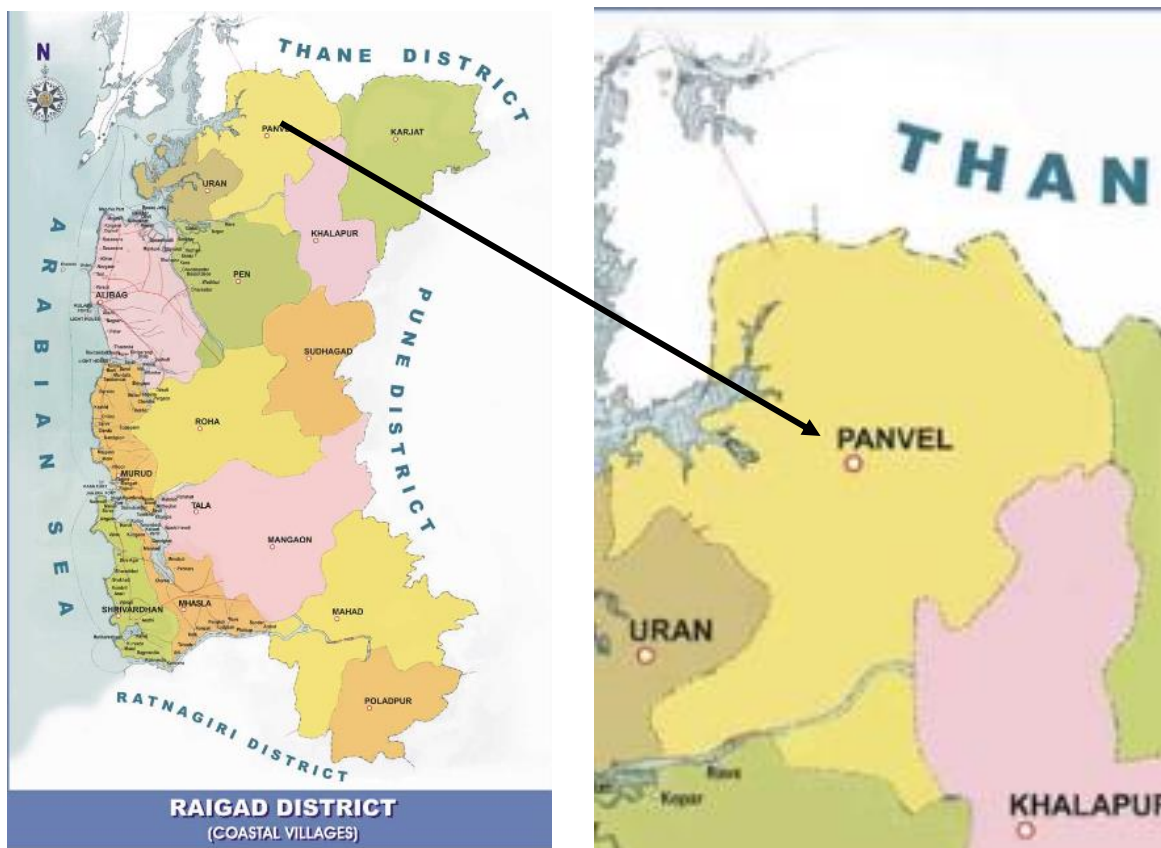


Figure 2.8: Raigad District Map and Panvel Tehsil

(Source: <https://www.mapsofindia.com/maps/maharashtra/districts/raigad.htm>)

Since the tehsil is in urban area the tree/green cover around the human settlements or build up area was also classified as green cover. Out of the total land cover area (110.06



m<sup>2</sup>), as shown in Figure 2.9, the total area under green cover class is 8.64 % (950 ha) which is followed by 61.42 % (6754 ha) as undeveloped area. This undeveloped area is classified as land which is barren and/or vacant, or under construction, etc. The agricultural area is 13.88 % (1527 ha) respectively.

Out of the total land use area (10995 ha), around 4241 ha is developed area while 6754 ha is an under developed area. Table 2.2 gives the division of land use and bifurcation of developed and under developed areas in Panvel city. Open area covers the highest percentage (around 21.03%) for undeveloped areas while for developed areas, transportation covers the highest percentage (10.49 %). Figures 2.9 and 2.10 show the bifurcation of developed and undeveloped areas graphically.

Table 2.2: Bifurcation of Developed Land Use

| Sr. No. | Developed Area            | Area (Ha)   | Percentage (%) |
|---------|---------------------------|-------------|----------------|
| 1       | Residential Area          | 1077        | 25             |
| 2       | Commercial Area           | 91          | 2              |
| 3       | Industrial Area           | 1010        | 24             |
| 4       | Public & Semi -Public Use | 249         | 6              |
| 5       | Public Utilities          | 162         | 4              |
| 6       | Transportation            | 1154        | 27             |
| 7       | Recreational              | 198         | 5              |
| 8       | Mixed Land                | 300         | 7              |
|         | <b>Total</b>              | <b>4241</b> | <b>100</b>     |

Source: City Development Department of PMC (2021-2022)

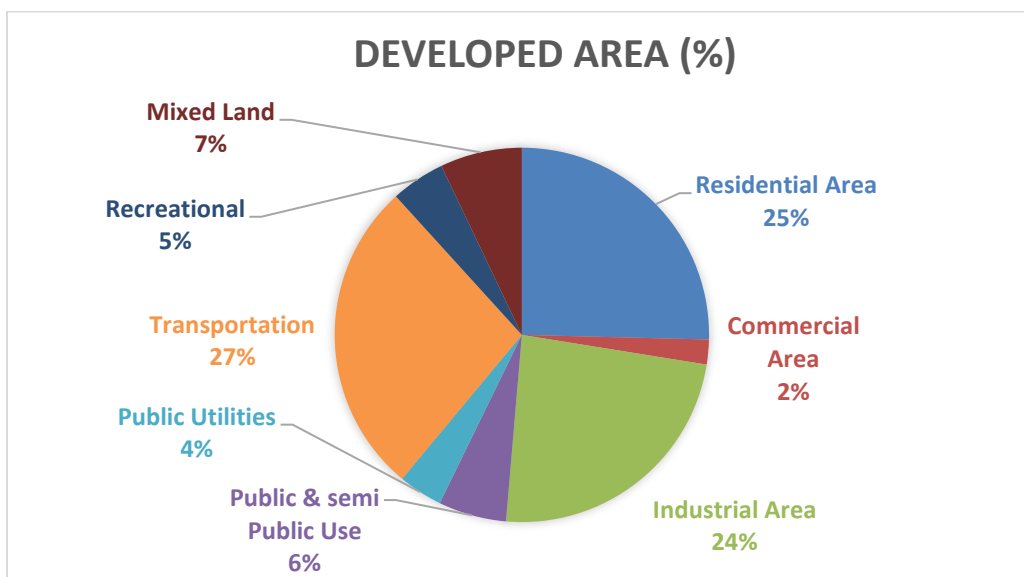


Figure 2.9: Bifurcation of Developed Land Use  
Table 2.3: Bifurcation of Undeveloped Land Use

| Sr. No. | Undeveloped Area   | Area (Ha)   | Percentage (%) |
|---------|--------------------|-------------|----------------|
| 1       | Green Cover        | 950         | 14             |
| 2       | Open Area          | 2315        | 34             |
| 3       | Defence            | 20          | 0.5            |
| 4       | Mining Area        | 100         | 1.5            |
| 5       | Rivers and Nallahs | 1842        | 27             |
| 6       | Agricultural area  | 1527        | 23             |
|         | <b>Total</b>       | <b>1527</b> |                |

Source: City Development Department of PMC (2021-2022)

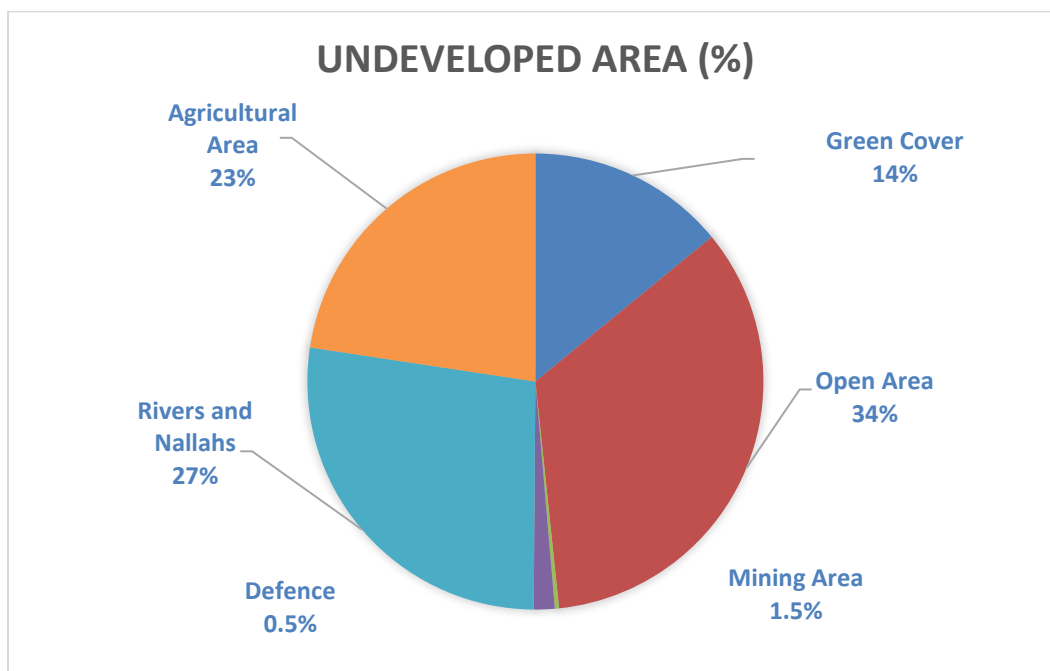


Figure 2.10: Bifurcation of Undeveloped Land Use

## 2.5 PMC Urban Infrastructure

PMC is comparatively less developed from the neighboring corporations. Though a slowly developing corporation, it is still a metropolitan city with all the facilities and infrastructure developing at speed. Table 2.3 gives the list of urban infrastructure facilities of PMC.

Table 2.4: Urban Infrastructure Facilities by PMC

| Sr. No. | Urbanization                                                                                                                                                                       | Planning & Design Authority        | Developed by | O/M            |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------|----------------|
| 1       | <b>Planning &amp; Development</b>                                                                                                                                                  | MMRDA,<br>Local Planning Authority |              |                |
| 2.      | <b>Infrastructure &amp; Services</b>                                                                                                                                               |                                    |              |                |
|         | <ul style="list-style-type: none"> <li>Water Supply service</li> <li>Sewerage service</li> <li>Sanitation service</li> </ul>                                                       | MJP                                | MJP          | PMC            |
|         | Storm water drainage system                                                                                                                                                        | PMC                                | PMC          | PMC            |
|         | <ul style="list-style-type: none"> <li>Municipal Solid Waste Management</li> <li>(Collection, Disposal &amp; Treatment)</li> </ul>                                                 | PMC                                | PMC          | PMC            |
|         | <ul style="list-style-type: none"> <li>Municipal roads &amp; flyovers</li> </ul>                                                                                                   | PMC & Town Planning                | PMC & PWD    | VVCMC          |
|         | <ul style="list-style-type: none"> <li>Street lights facility</li> <li>Fire Brigade</li> <li>Municipal Gardens</li> <li>Municipal Hospital</li> <li>Disaster management</li> </ul> | PMC                                | PMC          | PMC            |
| 3       | <b>Transportation &amp; Traffic</b>                                                                                                                                                |                                    |              |                |
|         | <ul style="list-style-type: none"> <li>Urban transport facilities</li> </ul>                                                                                                       | MSRTC & VVMT                       | MSRTC & VVMT | MSRTC          |
|         | <ul style="list-style-type: none"> <li>Registration &amp; regulations</li> </ul>                                                                                                   |                                    |              | RTO            |
|         | <ul style="list-style-type: none"> <li>Traffic Management</li> </ul>                                                                                                               |                                    |              | Traffic Police |
|         | <ul style="list-style-type: none"> <li>Indian Railways</li> <li>Mumbai Suburban Railway – Central Line</li> </ul>                                                                  | Indian Railways                    |              |                |
| 4       | Metro Service                                                                                                                                                                      | MMRDA                              |              |                |

Source: PMC Site



*PMC* : *Panvel Municipal Corporation*  
*PWD* : *Public Works Department*  
*MMRDA* : *Mumbai Metropolitan Region Development Authority*  
*MSRTC* : *Maharashtra State Road Transport Corporation*  
*RTO* : *Road Traffic Police*

**Water Supply:** Dehrang Dam is the main source of water in Panvel city. Total 16 MLD of water is abstracted from the Dehrang Dam to fulfil the water demand of Panvel Municipal Corporation area and nearby villages. During summers, the level of water reduces so, only 5-6 MLD Of water is available for abstraction. A part from that MJP, CIDCO and MIDC provides the water supply to remaining area to fulfil the overall water demand.

As per the draft water supply master plan report 2021, the domestic water demand is 265 MLD and non- domestic is 51.7 MLD. Hence, it indicates that the water demand is more than the water availability. The villages near by corporation area gets half of the water supply from Dehrang Dam & rest of the demand is fulfilled by borewells constructed by PMC. Considering the current and near future water demand the PMC need to make certain provision to meet the water demand.

Water may be treated differently in different communities depending on the quality of the source water that enters the treatment plant. The water that enters the treatment plant is most often either surface water or ground water. Surface water typically requires more treatment and filtration than ground water because lakes, rivers, and streams contain more sediment (sand, clay, silt, and other soil particles), germs, chemicals, and toxins than ground water. Public drinking water systems use different water treatment methods to provide safe drinking water for their communities. Public water systems often use a series of water treatment steps that include coagulation, flocculation, sedimentation, filtration, and disinfection. The coagulation is often the first step in water treatment. During coagulation, chemicals with a positive charge are added to the water. The positive charge neutralizes the negative charge of dirt and other dissolved particles in the water. When this occurs, the particles bind with the chemicals to form slightly larger particles. Common chemicals used in this step include specific types of salts, aluminum, or iron. Flocculation follows the coagulation step. Flocculation is the gentle mixing of the water to form larger,



heavier particles called flocs. Often, water treatment plants will add additional chemicals during this step to help the flocs form. Sedimentation is one of the steps water treatment plants use to separate out solids from the water. During sedimentation, flocs settle to the bottom of the water because they are heavier than water. Once the flocs have settled to the bottom of the water, the clear water on top is filtered to separate additional solids from the water. During filtration, the clear water passes through filters that have different pore sizes and are made of different materials (such as sand, gravel, and charcoal). These filters remove dissolved particles and germs, such as dust, chemicals, parasites, bacteria, and viruses. Activated carbon filters also remove any bad odors. Water treatment plants can use a process called ultrafiltration in addition to or instead of traditional filtration. During ultrafiltration, the water goes through a filter membrane with very small pores. This filter only lets through water and other small molecules (such as salts and tiny, charged molecules). After the water has been filtered, water treatment plants may add one or more chemical disinfectants (such as chlorine, chloramine, or chlorine dioxide) to kill any remaining parasites, bacteria, or viruses. To help keep water safe as it travels to homes and businesses, water treatment plants will make sure the water has low levels of the chemical disinfectant when it leaves the treatment plant. This remaining disinfectant kills germs living in the pipes between the water treatment plant and your tap. In addition to or instead of adding chlorine, chloramine, or chlorine dioxide, water treatment plants can also disinfect water using ultraviolet light. UV light and ozone work well to disinfect water in the treatment plant, but these disinfection methods do not continue killing germs as water travels through the pipes between the treatment plant and your tap.

Source : [https://www.cdc.gov/healthywater/drinking/public/water\\_treatment.html](https://www.cdc.gov/healthywater/drinking/public/water_treatment.html)

## 3 Driving Forces of Panvel City

### 3.1 DPSIR Framework

This framework was initially developed by the Organization for Economic Co-operation and Development (OECD), 1994 and has been used extensively by various national/international environmental agencies to relate effects of human activities on the state of environment. The DPSIR (Driving Forces, Pressure, State, Impact, Responses) model can be used as an analytical framework for assessing the environmental issues by examining inter-linkages between each of these elements (DPSIR).

It is a most effective form of conveying environmental status to the citizens and government authorities. This framework helps policy/decision makers in getting ground level/real time feedback about the impacts of various pressures on the states thereby helping prepare a forward action plan necessary for implementation of any future changes in policies useful for mitigating environmental issues.

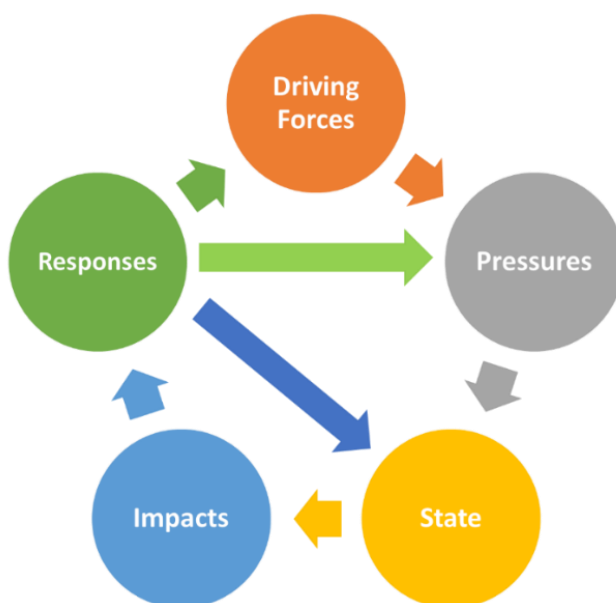


Figure 3.1: DPSIR Framework

**Driving Forces:** Socio-economic and socio-cultural forces driving human activities which increase or mitigate pressures on the environment



**Pressures:** Stresses that human activities place on the environment (e.g. Wastewater)

**State of the Environment (SoE):** The condition of the environment (e.g. Air or water quality assessment)

**Impacts:** Effects of environmental degradation (e.g. biodiversity loss, economic damage)

**Responses:** Responses by society to the environmental situation (e.g. Cleaner production, regulations)

The state of the environment is represented by the qualitative and quantitative indicators of environmental resources as well as the quality of services it offers. Environmental monitoring data for air and water quality, and the extent of land contamination are some typical quantitative indicators.

Environment is being degraded due to human intervention like shifting cultivation, over exploitation of forest resources, cattle grazing and changes in land use by converting forests to agricultural lands and dwelling sites. These activities have been continuing ever since man started cultivation and exploitation of natural resources for livelihood. The local urban bodies suffer from large human intervention in managing increasing demand for resources that generates pressure on environment and also attempt to conserve and protect the environment with its efforts in creating more environmental resources. Human intervention creates pressure on land and land cover in urban spaces. And hence it becomes necessary to understand the status of land use and resource extraction and evaluate its impact on environment.

### 3.2 Driving Forces of Panvel 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. 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 analyzed 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.

### **3.2.1 Population Growth**

The size of the population is one of the main factors that impact the environment by generating pressure on environmental resources available in a region. Natural resources like land and water are scarce and they are to be used efficiently and sustainably. These resources get exhausted as a large population makes use of them unsustainably. Hence there is some threshold level of population that can sustain the use of environmental resources. Thomas Malthus cited it as the Carrying Capacity of a region. An area's carrying capacity can be defined as the maximum number of people that the environment of that area can support through optimum utilization of the available resources (ILPWRM, 2012). Perhaps this carrying capacity is crossed in many regions globally, increasing the pressure on the environment and caused environmental degradation. Crutzen (2016) introduced the concept of Anthropocene Epoch which describes human influence on the environment. Hence one has to contextualize the population and its impact on the environment.

According to the ESR Report of 2021-2022, the total numbers of households residing in Panvel city are 3,43,618 which accounts total population of 5,09,901 of which 2,71,303 are male and 2,38,597 are female. The details are given in the following tables. The PMC is administratively divided into 30 wards.



Table 3.1: Ward-wise Classification of Concentration of Population in Panvel City

| Sr. No. | Size Class of Population | Wards                                                                 | Population density |
|---------|--------------------------|-----------------------------------------------------------------------|--------------------|
| 1       | Up to 5,000              | 20, 8, 25, 21, 27, 24, 30, 26, 23, 28, 18, 17, 16, 29, 14, 22, 15, 10 | Low                |
| 2       | 5,001-10,000             | 6, 9, 3, 19, 11, 5                                                    | Moderate           |
| 3       | 10,001-1,80,020          | 13, 2, 12, 7, 4, 1                                                    | High               |

Source: Election Department, PMC

Table 3.2: Ward- Wise Total and Percentage Population in Panvel City and Sex Ratio

| Ward No.                                 | Population | Percentage to Total Population | Ward No. | Population      | Percentage to Total Population |
|------------------------------------------|------------|--------------------------------|----------|-----------------|--------------------------------|
| 1                                        | 1,80,020   | 35.3                           | 16       | 2,757           | 0.5                            |
| 2                                        | 14,318     | 2.8                            | 17       | 2,389           | 0.5                            |
| 3                                        | 6,626      | 1.3                            | 18       | 2,250           | 0.4                            |
| 4                                        | 80,612     | 15.8                           | 19       | 8,858           | 1.7                            |
| 5                                        | 9,746      | 1.9                            | 20       | 118             | 0.0                            |
| 6                                        | 5,574      | 1.1                            | 21       | 771             | 0.2                            |
| 7                                        | 69,666     | 13.7                           | 22       | 4,020           | 0.8                            |
| 8                                        | 559        | 0.1                            | 23       | 1,881           | 0.4                            |
| 9                                        | 6,447      | 1.3                            | 24       | 1,179           | 0.2                            |
| 10                                       | 5,339      | 1.0                            | 25       | 673             | 0.1                            |
| 11                                       | 9,488      | 1.9                            | 26       | 1,403           | 0.3                            |
| 12                                       | 67,235     | 13.2                           | 27       | 883             | 0.2                            |
| 13                                       | 12,160     | 2.4                            | 28       | 2,026           | 0.4                            |
| 14                                       | 3,569      | 0.7                            | 29       | 3,341           | 0.7                            |
| 15                                       | 4,656      | 0.9                            | 30       | 1,337           | 0.3                            |
| <b>Total Population &amp; Percentage</b> |            |                                |          | <b>5,09,901</b> | <b>100</b>                     |
| <b>Sex Ratio (F:M)</b>                   |            |                                |          | <b>0.79</b>     |                                |

Source: Election Department, PMC

A relatively population density is observed in ward numbers 20, 8, 25, 21, 27, 24, 30, 26, 23, 28, 18, 17, 16, 29, 14, 22, 15, 10, with population up to 5,000. In contrast, a moderate level of concentration is observed in 6, 9, 3, 19, 11, 5 wards with a population above 5,001 to 10,000. There is a high concentration in 6 wards with a population size ranging between 10,001 and below 1,80,020. The population is not evenly distributed in the wards of PMC; and Panvel ward has the highest population density.



It has a total SC population of 37,923, and that of ST is 12,727. It is important to note that all the wards in the PMC have some population belonging to SC and ST as shown below in the Table 3.3.

Table 3.3: Ward-wise Proportion of SC and ST Population

| Ward No.     | SC Population | Percentage to Total SC Population | ST Population | Percentage to Total ST Population |
|--------------|---------------|-----------------------------------|---------------|-----------------------------------|
| 1            | 14,464        | 38.1                              | 4301          | 33.8                              |
| 2            | 567           | 1.5                               | 336           | 2.6                               |
| 3            | 372           | 1.0                               | 218           | 1.7                               |
| 4            | 5,750         | 15.2                              | 1,534         | 12.1                              |
| 5            | 284           | 0.7                               | 779           | 6.1                               |
| 6            | 291           | 0.8                               | 27            | 0.2                               |
| 7            | 9,036         | 23.8                              | 1,695         | 13.3                              |
| 8            | 16            | 0.0                               | 5             | 0.0                               |
| 9            | 443           | 1.2                               | 124           | 1.0                               |
| 10           | 185           | 0.5                               | 66            | 0.5                               |
| 11           | 163           | 0.4                               | 331           | 2.6                               |
| 12           | 2,777         | 7.3                               | 1,097         | 8.6                               |
| 13           | 874           | 2.3                               | 308           | 2.4                               |
| 14           | 105           | 0.3                               | 233           | 1.8                               |
| 15           | 292           | 0.8                               | 96            | 0.8                               |
| 16           | 145           | 0.4                               | 178           | 1.4                               |
| 17           | 102           | 0.3                               | 82            | 0.6                               |
| 18           | 168           | 0.4                               | 329           | 2.6                               |
| 19           | 683           | 1.8                               | 249           | 2.0                               |
| 20           | -             | -                                 | 16            | 0.1                               |
| 21           | 25            | 0.1                               | 35            | 0.3                               |
| 22           | 191           | 0.5                               | 30            | 0.2                               |
| 23           | 44            | 0.1                               | 2             | 0.0                               |
| 24           | 97            | 0.3                               | -             | -                                 |
| 25           | 14            | 0.0                               | 19            | 0.1                               |
| 26           | 17            | 0.0                               | -             | -                                 |
| 27           | 49            | 0.1                               | 359           | 2.8                               |
| 28           | 167           | 0.4                               | 87            | 0.7                               |
| 29           | 274           | 0.7                               | 185           | 1.5                               |
| 30           | 328           | 0.9                               | 6             | 0.0                               |
| <b>Total</b> | <b>37,923</b> | <b>100.0</b>                      | <b>12,727</b> | <b>100.0</b>                      |

Source: Election Department, PMC



### 3.2.2 Industrial Growth

The rapid growth of Panvel has made the city a prime region for commercial growth. The upcoming project of Navi Mumbai International Airport has made this city an attractive destination for new businesses and many industries are interested in initializing a new trade in this area. Panvel is surrounded by some major Maharashtra Industrial Development Corporation (MIDC) regions like Patalganga, Taloja, Nagothane, Roha, Khopoli, and Bhiwandi. Some of the Indian industries like Larsen & Toubro Limited, Reliance, Hindustan Organic Chemicals Ltd, ISRO's Propellant Complex., ONGC, IPCL providing ample job opportunities for population. Apart from industries, many more companies and manufacturers are based in Panvel. The Jawaharlal Nehru Port Trust (JNPT), also known as Nhava Sheva Port, which is the second largest container port in India also located nearby areas of Panvel. Panvel will also have a New Special Economic Zone (SEZ) in the near future, as declared by the government.

### 3.2.3 Religious Tourism

Panvel is an incredible tourist destination because of its pleasant weather, which keeps its visitor cool and comfortable all the time. It is the most crowded locality in Raigad District of Maharashtra. The place has developed into a good tourist destination while maintaining its natural rawness.

The city is situated on the banks of Panvel Creek, surrounded by the Matheran Hills. It is known for the forts in Raigad and Khopoli. The major historical attraction in Panvel taluka is Karnala Fort which is popular for trekking & bird watching. Panvel is also famous for the two prominent Ganesh temples in Maharashtra: Ballaleshwar, located in Pali, and Varadavinayak in Mhad village. Beth El Synagogue is a part of the Indian heritage & one of the tourist places in Panvel. The best time to visit Panvel is during winters as the city receives substantial rainfall during monsoons and scorching summers.

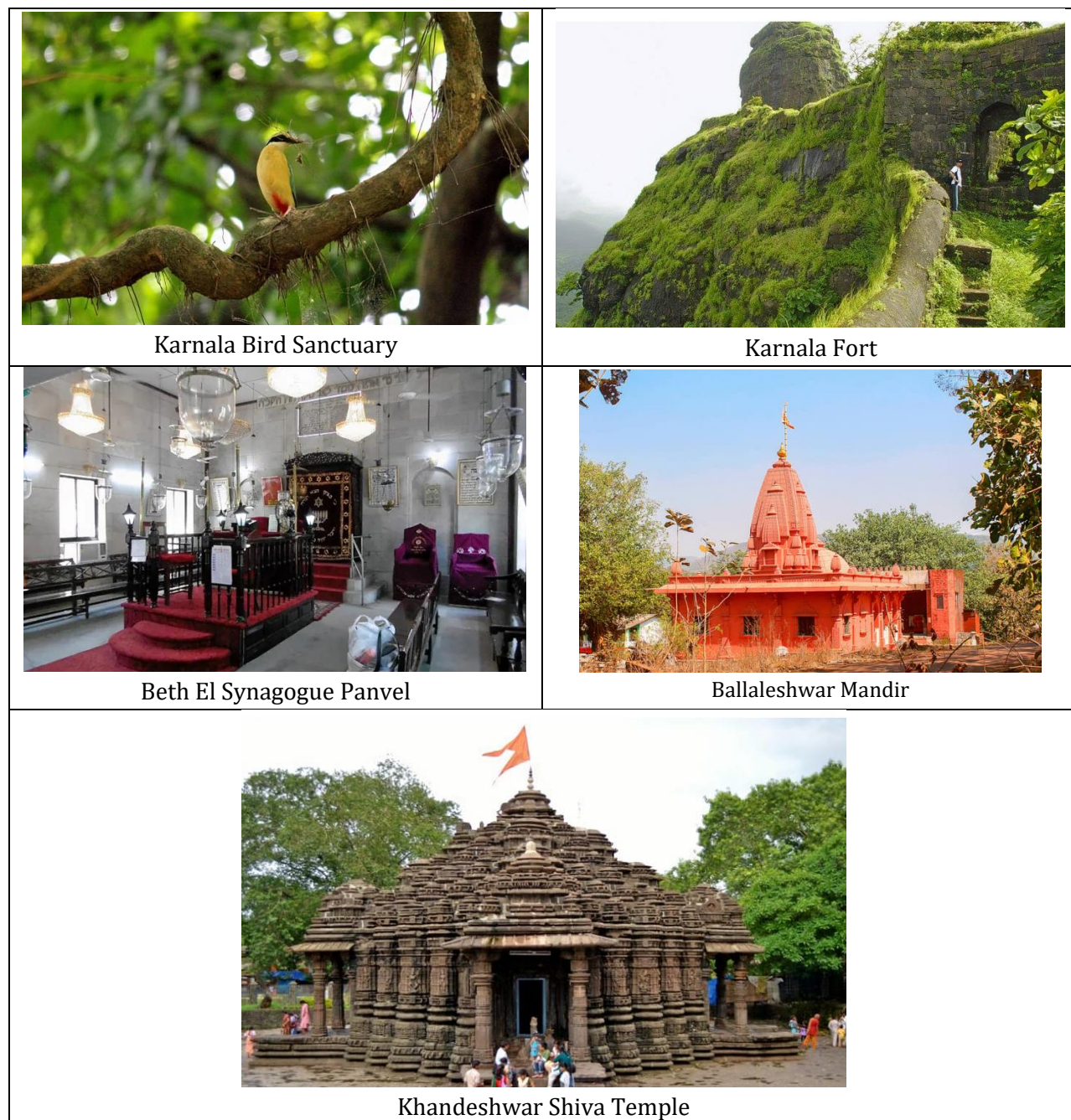


Figure 3.2: Tourist destinations in Panvel

### 3.2.4 Economic Development

If not managed properly, population and economic growth tend to affect the natural environment adversely. While the economic growth may positively impact measures such



as nutrition, health, and life expectancy, coupled with population growth, it also affects ecosystems. Unsustainable natural resource extraction, defunct waste management systems, and unregulated habitat settlements can significantly impact the mid-term sustainability of natural resources. Hence it is vital to assess the effects of economic activities on environment.

Panvel City is located 35 km away from Mumbai city, the state's and the nation's financial capital. It is also close to MIDC (Trance Thane Creek) TTC and has Taloja MIDC situated within its region. MIDC Taloja Industrial area is one of the reserved Chemical Industrial Areas developed by Maharashtra Industrial Development Corporation (MIDC). The Industrial area is situated adjacent to Navi-Mumbai and Panvel. It is one of the fully developed industrial areas having industries involved in various activities. The dominating industrial activities are Chemical, Food and Fish Processing, Dairy Products & Cold stores, and Engineering. Panvel is also close to Jawahar Nehru Port Trust (JNPT) which generates heavy traffic in and around the city. The city of Panvel has housed the human resources required for industrial and logistic purposes for these industrial zones. It is observed that Semi-Skilled & Unskilled human resources are readily available in the Taloja and Kalamboli parts of Panvel City. The Managerial and Senior managerial people travel from Panvel and Kharghar.



## 4 Air Environment

Earth's atmosphere is a layer of gases surrounding the planet. This mixture of gases that envelopes the earth is commonly known as air. The composition of pure air consists majorly of 78% nitrogen & 21% oxygen, while other gases like argon, carbon dioxide, methane and so on are present in trace amounts. Change in natural composition of air occurs due to addition of undesirable elements arising from anthropogenic activities like the combustion of fossil fuels. Emissions from power plants, industries, automobiles, construction activities and so on emit tonnes of air pollutants (any solid, liquid, or gaseous substance, including noise) into the atmosphere, which deteriorates the air quality and exposes citizens to great health risks.

Higher concentrations of air pollutants may be or tend to be injurious to human beings, other living creatures, plants, property, or environment. The Global Burden of Disease (GBD) stated about 4.2 million deaths due to exposure to PM<sub>2.5</sub> (Particulate Matter <2.5 microns) have occurred, thus ranking fifth for total deaths worldwide. In 2015, about 17.1% of deaths occur from ischemic heart disease, 14.2% from stroke, 16.5% from lung cancer, 24.7% from LRIs (Lower Respiratory tract Infections), and 27.1% from COPD (Chronic Obstructive Pulmonary Disease) were recorded due to exposure for Particulate Matter. As per the WHO (World Health Organization), almost 80% of urban population is exposed to air quality which fails to meet the WHO guidelines thus resulting in respiratory disease and other health problems.

In order to monitor the ambient air quality, CPCB (Central Pollution Control Board) at national level compares the status of ambient air quality parameters, which indicate the comparative status of various cities. In addition to this, at state level MPCB and at city level PMC also monitors the air quality parameters. This section discusses the status of the ambient air quality monitoring network and the ambient air quality recorded for various air pollutants and the processing comparisons.



## 4.1 Ambient Air Quality Monitoring Station

MPCB has established one Ambient Air Quality Monitoring Station (AAQMS) in Panvel. The monitoring station is non-continuous and it is under NAMP (National Air Quality Monitoring Program). The monitoring station is at Panvel Water Supply Behind State Transport (ST) Stand. The details of the monitoring station are given in Table 4.1.

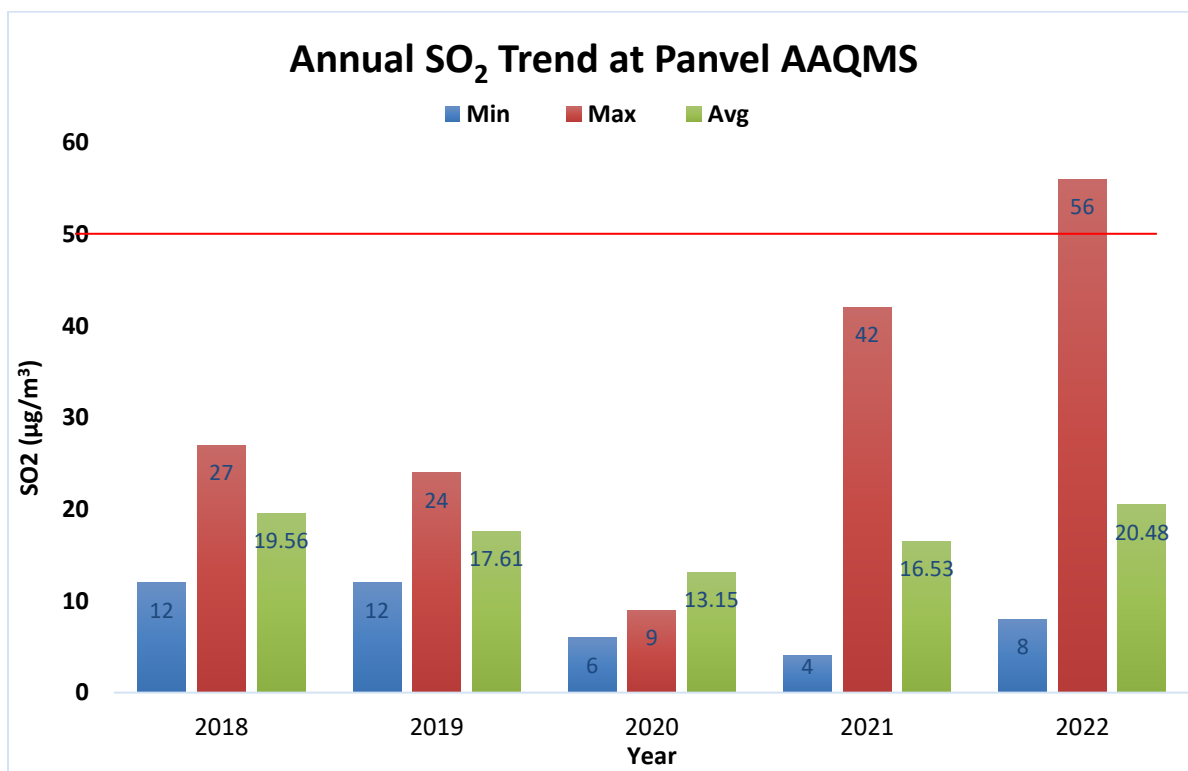
Table 4.1: Details of AAQMS at Panvel

|                             |                                               |
|-----------------------------|-----------------------------------------------|
| <b>City</b>                 | <b>Panvel</b>                                 |
| <b>Program</b>              | NAMP                                          |
| <b>Implementing Agency</b>  | MPCB                                          |
| <b>Location</b>             | Panvel Water Supply Behind ST Stand           |
| <b>MPCB Region</b>          | Panvel                                        |
| <b>Frequency</b>            | Two Days in a Week                            |
| <b>Parameters Monitored</b> | SO <sub>2</sub> , NO <sub>x</sub> , RSPM, SPM |

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

Sulfur dioxide is a highly toxic, colorless, nonflammable gas with a pungent odor. SO<sub>2</sub> belongs to sulfur oxides (SO<sub>x</sub>) group. Among the oxides, SO<sub>2</sub> is of major concern related to human health compared to other gases within the group. SO<sub>2</sub> is primarily emitted from anthropogenic sources like burning fossil fuels by power plants and other industrial facilities and fuel combustion in mobile sources such as locomotives, ships, and other equipment.

### Annual Trend in SO<sub>2</sub> Concentration



— Annual average standards for SO<sub>2</sub> (50 µg/m<sup>3</sup>)

Figure 4.1: Annual SO<sub>2</sub> Trend at Panvel AAQMS

Data Source: MPCB

It is observed that SO<sub>2</sub> concentration level was minimum during the year 2020. It can be due to the lockdown observed during the COVID- 19 pandemic and shutdown of industrial processes involving the burning of fossil fuels. As shown in Figure 4.1, annual measured SO<sub>2</sub> concentrations are well below the annual average standards for SO<sub>2</sub> (50 µg/m<sup>3</sup>) as per NAAQS set by CPCB. However, an increasing trend of SO<sub>2</sub> concentration from the year 2021 can be seen. As figure depicts, the vehicular pollution load was low in 2019-2020 due to the lockdown. There is a gradual increase thereafter as the normalcy in businesses return and an increase in pollution can be seen.

### Monthly Trend in SO<sub>2</sub> Concentration for the Year 2022

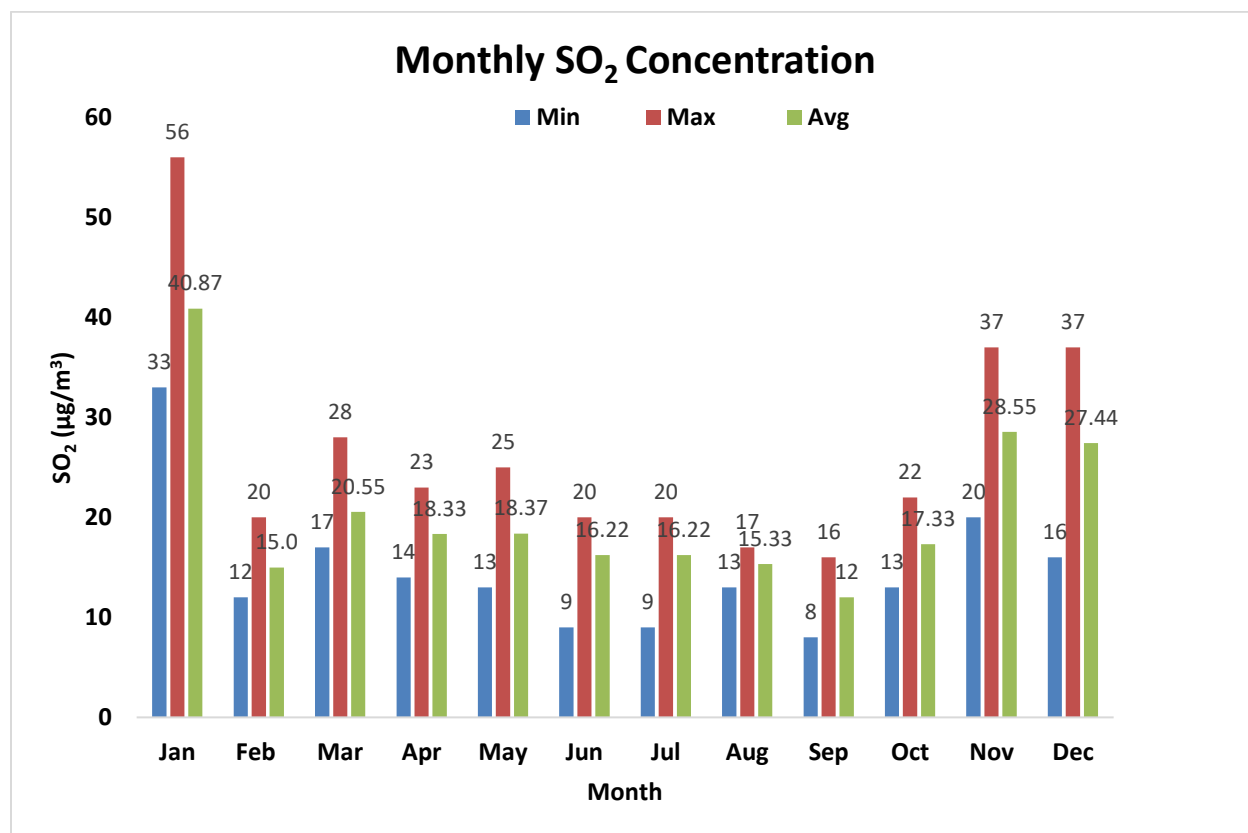


Figure 4.2: Monthly SO<sub>2</sub> Trend at Panvel AAQMS in 2022

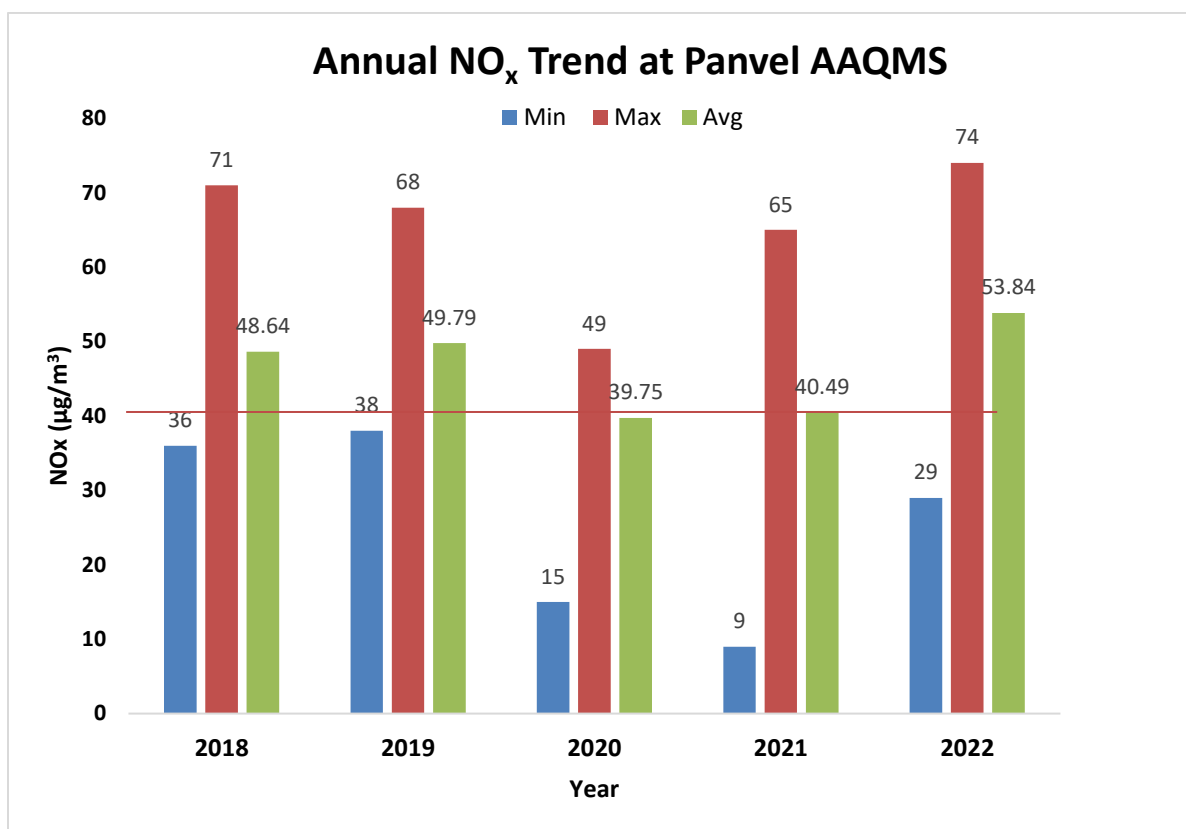
Data Source: MPCB

It can be seen from Figure 4.2 that the minimum and maximum concentration of SO<sub>2</sub> has remained below 40 µg/m<sup>3</sup> throughout the year, except in the month of January, the maximum concentration has increased up to 56 µg/m<sup>3</sup>.

#### 4.1.2 Nitrogen Oxides (NO<sub>x</sub>)

NO<sub>x</sub> represents seven compounds (N<sub>2</sub>O, NO, N<sub>2</sub>O<sub>2</sub>, N<sub>2</sub>O<sub>3</sub>, NO<sub>2</sub>, N<sub>2</sub>O<sub>4</sub> and N<sub>2</sub>O<sub>5</sub>). Among the NO<sub>x</sub> family, NO<sub>2</sub> has adverse effects on human health since it causes lung disorders and contributes to the formation of secondary pollutants such as ozone and acid rain.

### Annual Trend in NO<sub>x</sub> Concentration



— Annual average standards for NO<sub>x</sub> (40 µg/m<sup>3</sup>)

Figure 4.3: Annual NO<sub>x</sub> Trend at Panvel AAQMS

Data Source: MPCB

As seen in Figure 4.3, it can be noted that NO<sub>x</sub> concentration level was minimum during the year 2020 as there were restrictions on the use of vehicles because of nationwide lockdown (COVID-19 Pandemic). NO<sub>x</sub> is majorly emitted from combustion of fuel from automobiles and mobile sources (50%), electric power plants (20%) and other domestic usage (30%) (EPA 456/F-99-006R, November 1999). Annual measured NO<sub>x</sub> concentrations for the years 2018 to 2022 exceed the annual average standards for NO<sub>x</sub> (40 µg/m<sup>3</sup>) as per

NAAQS set by CPCB. The highest average concentration of  $\text{NO}_x$  was reported in 2022 ( $53.84 \mu\text{g}/\text{m}^3$ ) and the lowest was reported in 2020 ( $39.75 \mu\text{g}/\text{m}^3$ ).

### *Monthly Trend in $\text{NO}_x$ Concentration for the Year 2022*

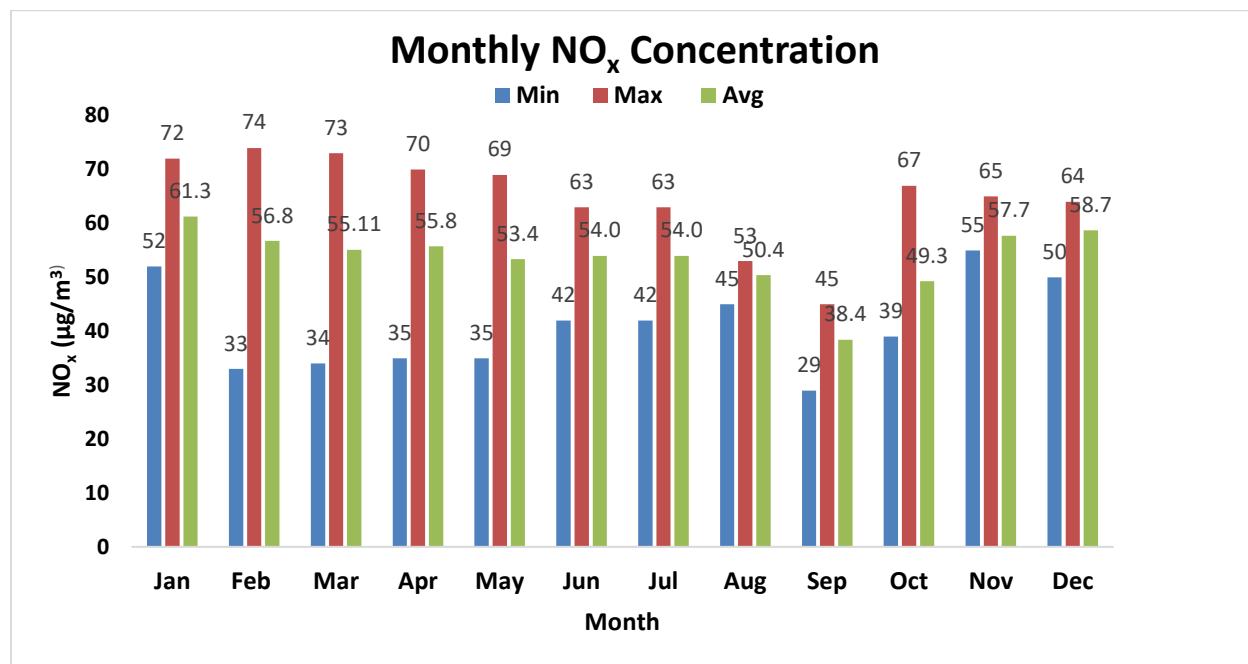


Figure 4.4: Monthly  $\text{NO}_x$  Trend at Panvel AAQMS in 2022

Data Source: MPCB

It can be seen from Figure 4.4 that the minimum & maximum monthly concentrations of  $\text{NO}_x$  were 29 &  $74 \mu\text{g}/\text{m}^3$ , reported in September and February, respectively.

### **4.1.3 Respirable Suspended Particulate Matter (RSPM)**

RSPM (Respirable Suspended Particulate Matter) refers to particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers. They are produced from combustion processes, vehicles, and industrial sources. Particulate matter is a complex mixture of extremely small particles and liquid droplets made up of several components, including acids (such as nitrates and sulfates), organic chemicals, metals and soil or dust particles. Particles that are 10 micrometers in diameter or smaller can pass through the

throat and nose and enter the lungs, commonly referred to as RSPM. Once inhaled, these particles can affect the heart and lungs and cause serious health effects

### *Annual Trend in RSPM Concentration*

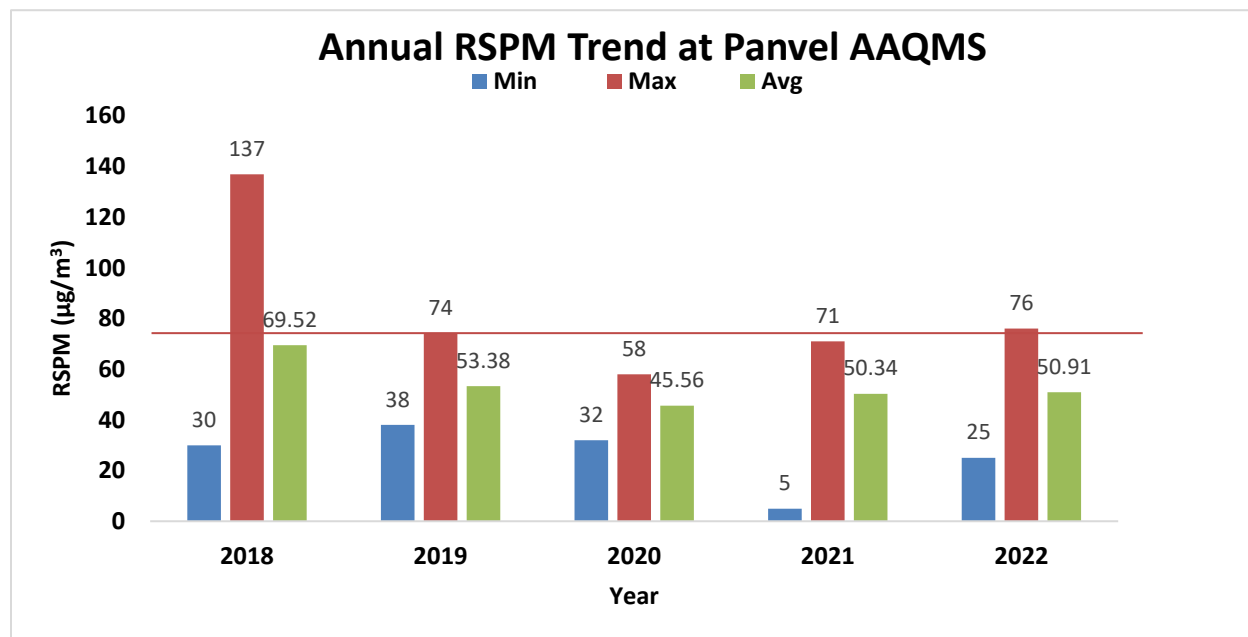


Figure 4.5: Annual RSPM Trend at Panvel AAQMS

Data Source: MPCB

It was observed that RSPM average concentration level was minimum during the year 2020 because of restrictions on use of private & public vehicles as well as industrial operations except for biomedical production. The projected emissions observed due to operations & vehicles were used as emergency services. It can be seen from Figure 4.5 that the average annual RSPM is lower than the CPCB prescribed annual standard of  $60\mu\text{g}/\text{m}^3$  for all the years except 2018. For the year 2018, the annual average concentration can be seen as higher than the CPCB standard. The maximum RSPM concentration is seen in 2018 ( $137\mu\text{g}/\text{m}^3$ ), and the minimum RSPM concentration was reported in 2021 ( $5\mu\text{g}/\text{m}^3$ ).

### Monthly Trend in RSPM Concentration for the Year 2022

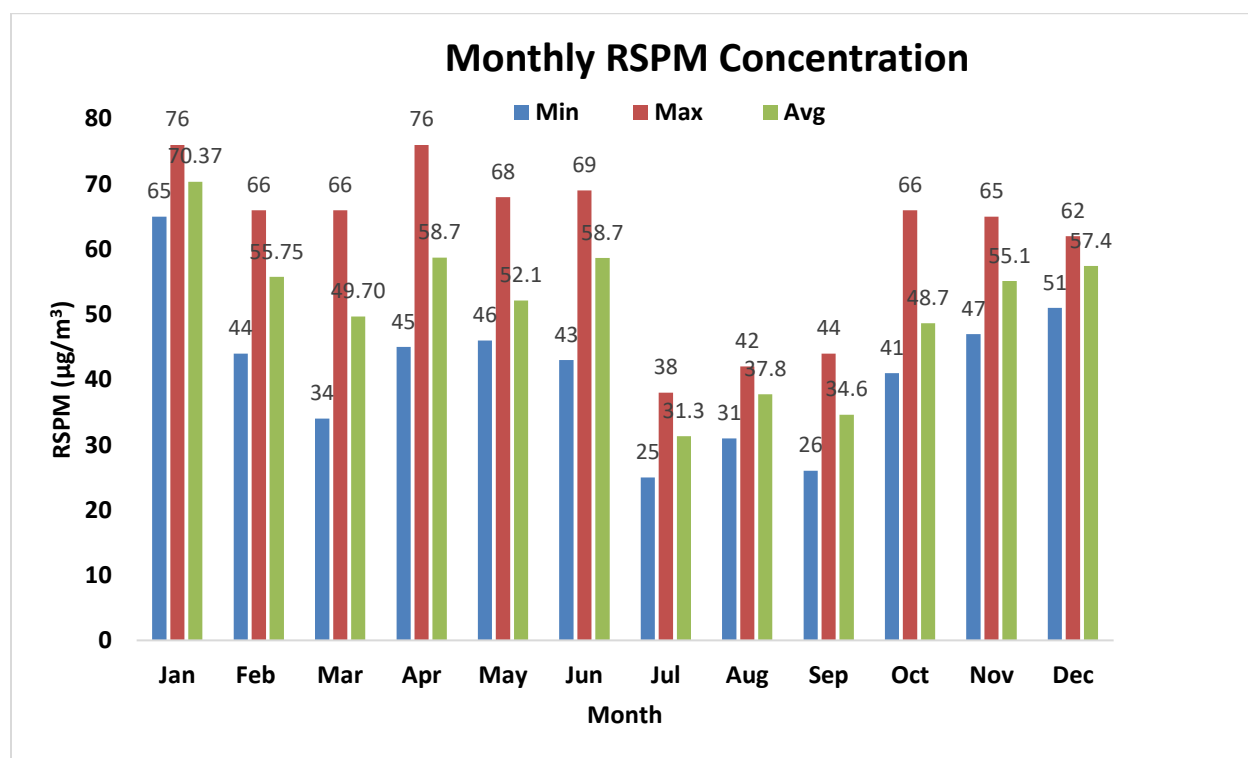


Figure 4.6: Monthly RSPM Trend at Panvel AAQMS in 2022

Data Source: MPCB

As seen in Figure 4-6, the minimum, maximum and average monthly concentration of RSPM is within a CPCB standards. The maximum concentration of RSPM was 76 µg/m³ in the month of January & April. The average concentration of RSPM was highest in the month of January while it was lowest in the month of July. The minimum yearly concentration of RSPM was 25 µg/m³ in the month of July. This can be due to the monsoon season.

#### 4.1.4 Suspended Particulate Matter (SPM)

SPM (Suspended Particulate Matter) is usually defined as comprising particles less than 10  $\mu\text{m}$  in diameter suspended in the atmospheric environment. In particular, air particulates less than 2  $\mu\text{m}$  in diameter, which mainly originate from such sources as incinerators, boilers and automobiles, may reach deeply into human lungs during respiration and thus cause respiratory diseases. SPM can be also produced by photochemical reactions of gaseous substances in the atmosphere.

##### *Annual Trend in SPM Concentration*

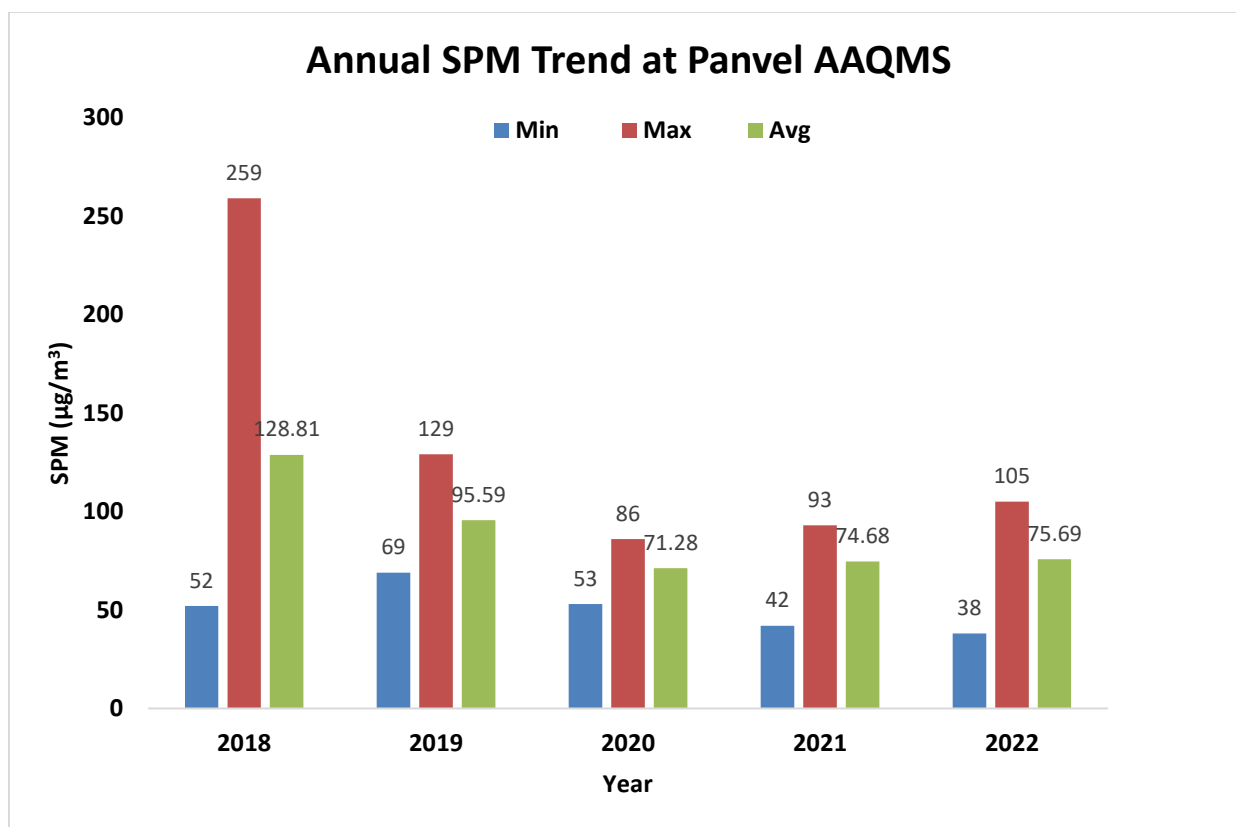


Figure 4.7: Annual SPM Trend at Panvel AAQMS

Source: MPCB

It was observed that the annual SPM average concentration is more than the CPCB prescribed annual standard of 60  $\mu\text{g}/\text{m}^3$  in all the years. The maximum concentration of



SPM was seen in the year 2018 ( $259\mu\text{g}/\text{m}^3$ ), while the minimum concentration was seen in the year 2022 ( $38\mu\text{g}/\text{m}^3$ ).

### Monthly Trend in SPM Concentration for the Year 2022

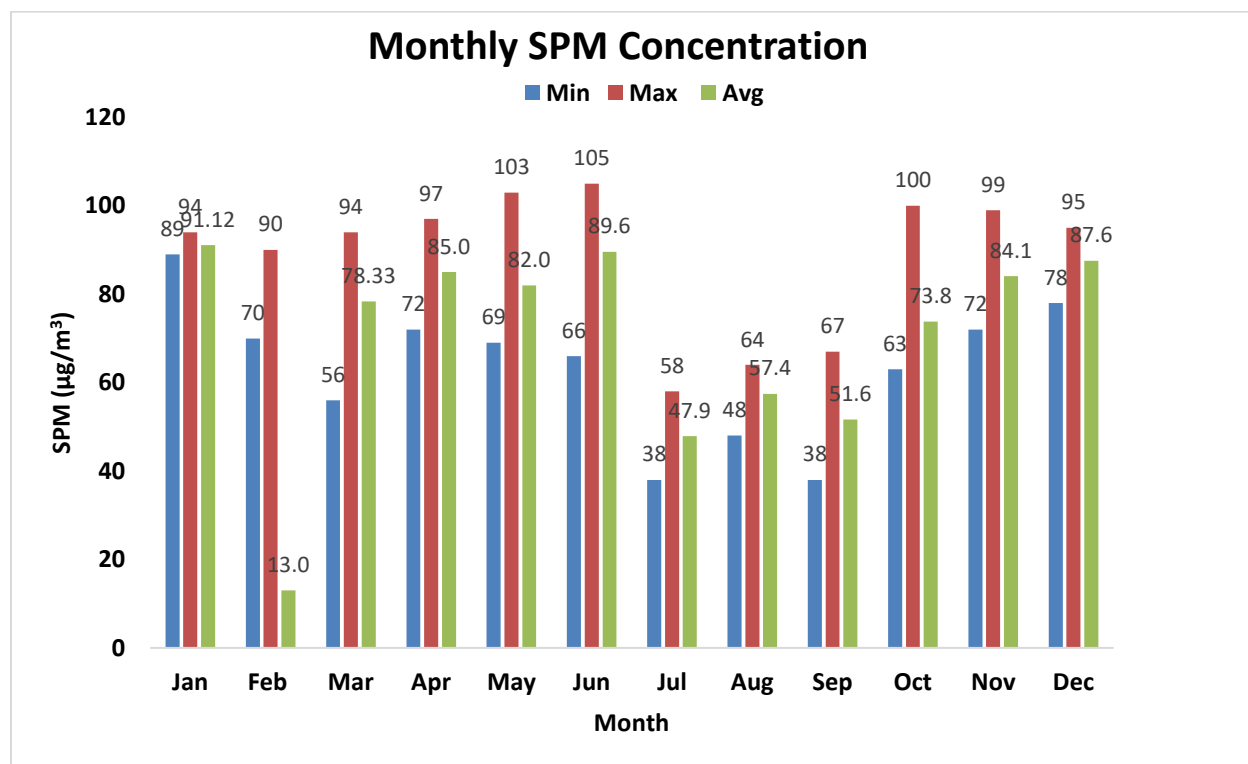


Figure 4.8: Monthly SPM Trend at Panvel AAQMS in 2022

Source: MPCB

The monthly highest SPM concentration was seen in the month of June ( $105 \mu\text{g}/\text{m}^3$ ) while the lowest concentration can be seen in the month of July & September ( $38 \mu\text{g}/\text{m}^3$ ).

### Air Quality Index

Air Quality Index (AQI) is the most convenient way to convey the information on outdoor air quality which could be easily understood by general public. AQI transforms complex air quality data of various pollutants into a single index value. AQI is calculated using the AQ sub index and the health breakpoints, which are evolved for eight pollutants ( $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$ ,  $\text{NO}_2$ ,  $\text{SO}_2$ ,  $\text{CO}$ ,  $\text{O}_3$ ,  $\text{NH}_3$ , and  $\text{Pb}$ ) for which short-term (up to 24-hours) are prescribed by NAAQS. Based on the measured ambient concentrations of a pollutant, sub-index is calculated, which is a linear function of concentration. The worst sub-index determines the



overall AQI. The sub-indices for individual pollutants at a monitoring location are calculated using its 24-hourly average concentration value (8-hourly in case of CO and O<sub>3</sub>) and health breakpoint concentration range.<sup>1</sup> AQI are within a range of 0 to 500 and is categorized into 'Good', 'Satisfactory', 'Moderate', 'Poor', 'Very Poor' or 'Severe' based on the concentration of various pollutants and their health impacts at various concentrations. Higher value of AQI indicates high level of pollution. Figure 4.9 shows the AQI classification.

Table 4.2: AQI Classification

| AQI     | Quality Classification                                                                 | Remarks      | Colour Code |
|---------|----------------------------------------------------------------------------------------|--------------|-------------|
| 0-50    | Minimal Impact                                                                         | Good         | Green       |
| 51-100  | Minor breathing discomfort to sensitive people                                         | Satisfactory | Light Green |
| 101-200 | Breathing discomfort to the people with lung, heart disease, children and older adults | Moderate     | Yellow      |
| 201-300 | Breathing discomfort to people on prolonged exposure                                   | Poor         | Orange      |
| 301-400 | Respiratory illness to the people on prolonged exposure                                | Very Poor    | Red         |
| > 401   | Respiratory effects even on healthy people                                             | Severe       | Dark Red    |

Source: MPCB

AQI for Panvel was collected from MPCB website for the years 2018-2022. AQI was calculated for each year. As seen in Figure 4.9, it can be noted that for the year 2019, 2020, 2021, 2022 the AQI index was good and satisfactory. It can be due to the COVID-19 induced lockdown there were restrictions on the use of vehicles and operations in industries. AQI might cause minor breathing discomfort to the sensitive people. For the years 2018-2022, there can be seen a trend of decreasing AQI. The highest good days was seen in the year of 2020 (35 days) while the lowest good days was seen in the year of 2019 (4 days). The percentage of 'Satisfactory' AQI was 80.6 in 2018, while it was 95.3%, 53.3%, 77.3% and 89.4 in 2019, 2020, 2021 and 2022, respectively. 'Moderate' AQI was 11.7% in 2018, respectively.

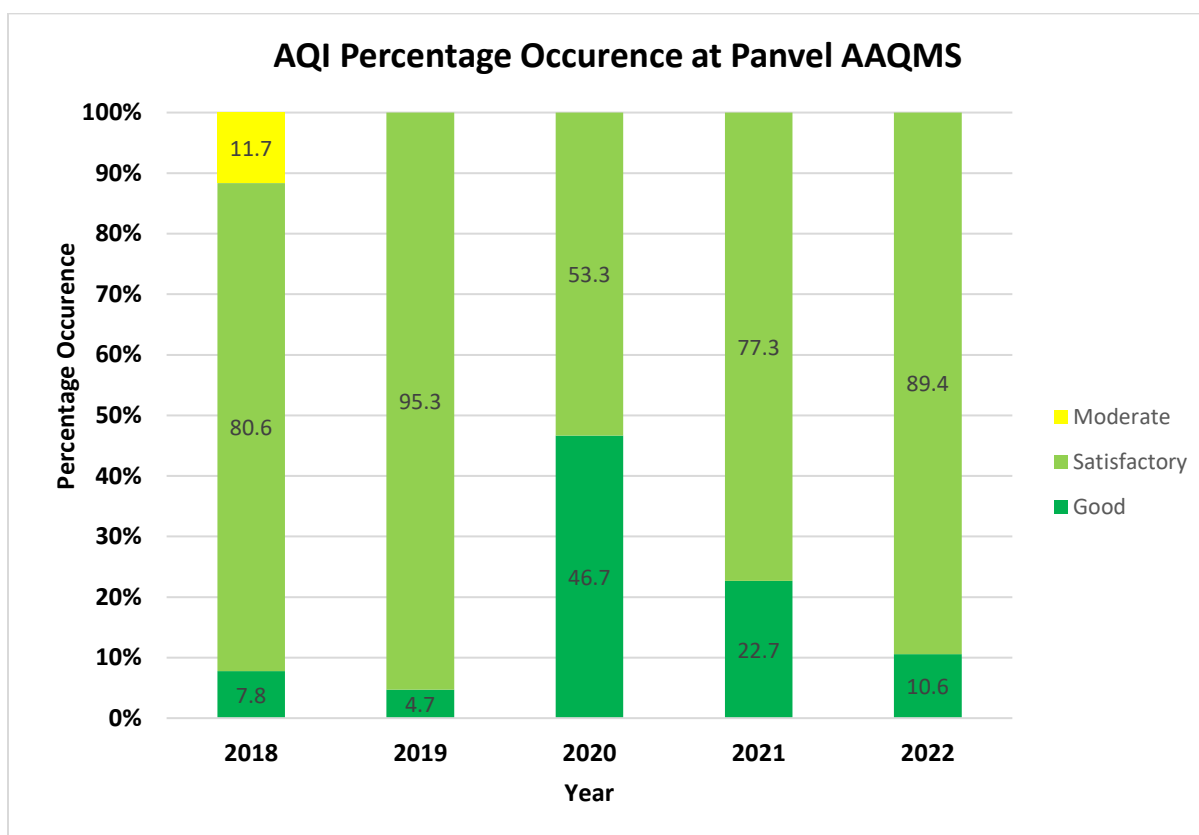


Figure 4.9: Annual AQI Percentage Occurrence at Panvel AAQMS

Source: MPCB



## 5 Noise Environment

Noise pollution is caused by an unwanted sound that is produced by various natural or man-made sources such as oceans, construction, industries, transportation etc. Noise pollution is one of the major environmental pollutants that are encountered in daily life and has a direct effect on human performance. Noise pollution is regarded as a public nuisance under Sections 268, 290 & 291 of the Indian Penal Code. There are several other legislations relating to noise pollution such as The Factories Act, 1948 (under which 'noise induced hearing loss' is notified as a disease); Motor Vehicles Act, 1988 (which specifies rules for horns and silencers); Law of Torts (civil suits can be filed for claiming damages); The Air (Prevention and Control of Pollution) Act, 1981 (ambient noise standards have been given), The Environment (Protection) Act, 1986; Noise Pollution (Regulation and Control) Rules, 2000 and regulations in respect of Loudspeakers/Public Address System.

Noise pollution is generally defined as regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms. Further, there are standards and guidelines for ambient noise quality, automobiles, domestic appliances and construction equipment, generator sets and firecrackers as notified under the Environment (Protection) Act, 1986. According to the World Health Organization, sound levels less than 70 dBA are not damaging to living organisms, regardless of how long or consistent the exposure is. Exposure for more than 8 hours to constant noise beyond 85 dBA may be hazardous. If you work for 8 hours daily in close proximity to a busy road or highway, you are very likely exposed to traffic noise pollution around 85dBA. CPCB Limits for Ambient Noise is given in the table 5.1.

Table 5.1: CPCB Limits for Ambient Noise

| Area Code | Category of Area | Limit in dB (A), Leq |            |
|-----------|------------------|----------------------|------------|
|           |                  | Day Time             | Night Time |
| A         | Industrial Area  | 75                   | 70         |
| B         | Commercial Area  | 65                   | 55         |
| C         | Residential Area | 55                   | 45         |
| D         | Silent Zone      | 50                   | 40         |



- Day time shall mean from 6:00 a.m. to 10:00 p.m.
- Night time shall mean from 10:00 p.m. to 6:00 a.m.
- Silence Zone is an area comprising not less than 100 m around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
- Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.
- dB (A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.
- A “decibel” is a unit in which noise is measured.
- “A”, in dB (A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.
- Leq is the energy mean of the noise level over a specified period.

This type of pollution is so omnipresent in today’s society that we often fail to even notice it anymore:

- Street traffic sounds from cars, buses, pedestrians, ambulances etc.
- Construction sounds like drilling or other heavy machinery in operation.
- Airports, with constant elevated sounds from air traffic, i.e. planes taking off or landing.
- Workplace sounds, often common in open-space offices.
- Constant loud music in or near commercial venues.
- Industrial sounds like fans, generators, compressor, mills etc.
- Strain stations traffic.
- Household sounds, from the television set to music playing on the stereo or computer, vacuum cleaners, fans and coolers, washing machines, dishwashers, lawnmowers etc.
- Events involving fireworks, firecrackers, loudspeakers etc.



- Conflicts generate noise pollution through explosions, gunfire etc. The dysfunctions, in this case, are likely caused by the conflict and insecurity and less by the noise pollution in itself, although that compounds stress levels too.

### **Consequences of Noise Pollution:**

Whether we realize we are subjected to it or not, noise pollution can be hazardous to our health in various ways.

- Hypertension is, in this case, a direct result of noise pollution caused elevated blood levels for a longer period of time.
- Hearing loss can be directly caused by noise pollution, whether listening to loud music in your headphones or being exposed to loud drilling noises at work, heavy air or land traffic or separate incidents in which noise levels reach dangerous intervals, such as around 140 dB for adult or 120 dB for children.
- Sleep disturbances are usually caused by constant air or land traffic at night, and they are a serious condition in that they can affect everyday performance and lead to serious diseases.
- Child development. Children appear to be more sensitive to noise pollution and a number of noise-pollution-related diseases and dysfunctions are known to affect children, from hearing impairment to psychological and physical effects. Also, children who regularly use music players at high volumes are at risk of developing hearing dysfunctions. Various cardiovascular dysfunctions, Elevated blood pressure caused by noise pollution, especially during the night, can lead to various cardiovascular diseases.
- Dementia isn't necessarily caused by noise pollution, but its onset can be favored or compounded by noise pollution.
- Psychological dysfunctions and noise annoyance. Noise annoyance is, in fact, a recognized name for an emotional reaction that can have an immediate impact. Land animals are also affected by noise pollution in the form of traffic, firecrackers etc., and birds are especially affected by the increased air traffic.



## 6 Water Environment

Earth is termed as 'Blue Planet' because 71% of the earth's surface is covered with water. The earth has an abundance of water yet majority of water (97.5%) is saline water. Out of the remaining 2.5% of fresh water, around two thirds of it is in frozen form in ice caps and glaciers. Only about 0.3% of freshwater is available for human use majority of which comes from rivers. Water is one of the vital renewable resources on earth. Lakes, rivers, streams groundwater are important fresh water sources. The majority of freshwater is actually found underground as soil moisture and in aquifers.

### 6.1 Surface Water

Surface water is any natural water that has not penetrated under the surface of the ground underneath. Rivers, lakes, oceans and wetlands are commonly known surface water bodies. The surface water body in Panvel City is Taloje & Kasrdi River. A major source of water supply in Panvel City is Dehrang Dam which is across Gadeshwar Lake. The other sources of water at Panvel are from MIDC, CIDCO and Patalganga MJP institutes. Table 6.1 gives the PMC water profile and Figure 6.1 shows the distribution of water supply in Panvel City.

Table 6.1: PMC Water Profile

|                               |                                             |
|-------------------------------|---------------------------------------------|
| <b>Water Availability</b>     | 238.7 MLD                                   |
| <b>Source of Water Supply</b> | Dehrang Dam, MIDC, CIDCO and Patalganga MJP |
| <b>Water Requirement</b>      | 316.7 MLD                                   |
| <b>Water Coverage</b>         | 95%                                         |
| <b>Net Supply Per Person</b>  | 110 LPCD                                    |

Source: Water Supply Department, PMC

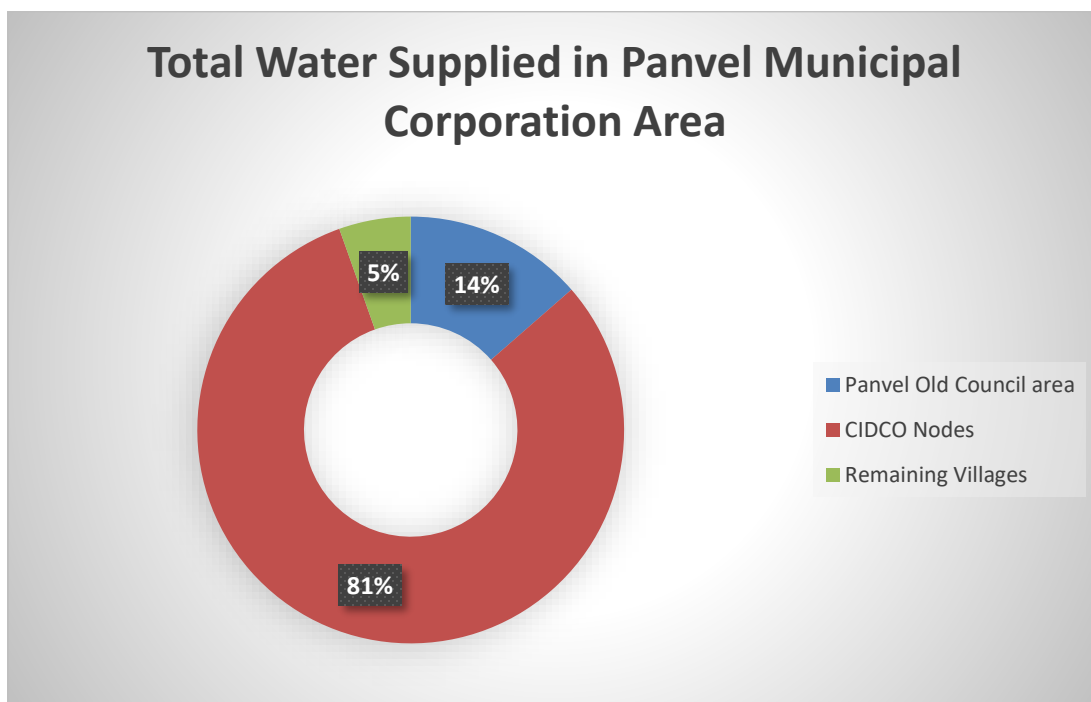


Figure 6.1: Total Water Supplied in Panvel Municipal Corporation Area

#### 6.1.1 Dehrang Dam, Gadeshwar Lake

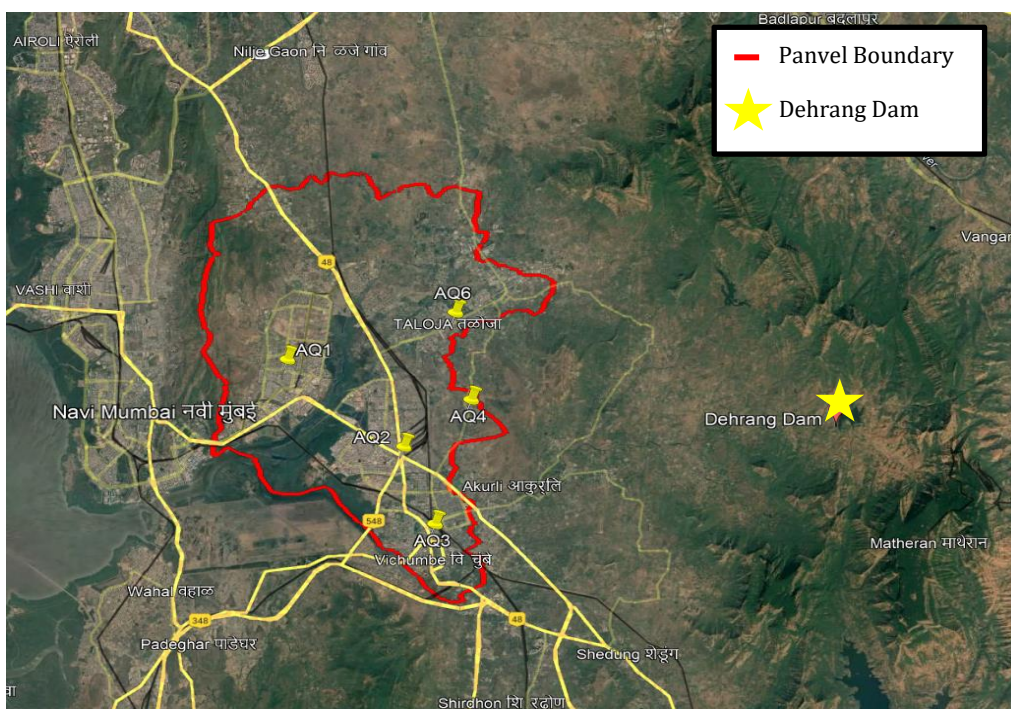


Figure 6.2: Location of Dehrang Dam



Figure 6.3: Gadeshwar Lake, Panvel

Under the ownership of PMC, Deharanga Dam was constructed in the year 1964 and is spread over 277 acres of land. The Dehrang Dam has been Panvel Municipal Corporations (PMC) main source of water supply for the around 1.45 lakhs population of old Panvel region, comprising three villages, namely old Khanda, Takka & Podi gaathan area. For remaining population, PMC needs to buy more water from Maharashtra Jeevan Pradhikaran (MJP), Maharashtra Industrial Development Corporation (MIDC) and Navi Mumbai Municipal Corporation (NMMP).

There are a total of four water distribution systems in PMC through which PMC manages the water supply. The first water supply is from Panvel ST stand pumping to Panvel Corporation area. Another from Maharashtra Jeevan Pradhikaran (MJP) to Kalamboli & New Panvel. Next from Bhokarpada (WTP) to Kamothe. In Kharghar & Taloja water being supplied from CIDCO. The Panvel Municipal Corporation has total 40,478 tap connections in its region. Out of which 34,286 are residential & 5,988 are industrial connection. The PMC area (including Municipal Area and 29 villages) recorded an 8 MLD water deficit. The water sources are not thoroughly connected therefore water cannot transfer to other sources during any water availability crisis.



Figure 6.4: Dehrang Dam, Panvel

### 6.1.2 Surface Water Quality

Currently, surface water sources are facing a lot of pressure due to anthropogenic activities. Surface water sources are the major receivers of solid waste, industrial effluent and domestic sewage. This causes water pollution and degrades the quality of surface water. It is very detrimental to the aquatic ecosystem and overall components of the ecosystem. The industrial residues are likely to get bio accumulated in the aquatic organisms which are in turn consumed by the humans. This will have a very harmful effect on humans as well. It is very important to continuously track the level of pollutants in water bodies. Therefore, MPCB has installed water quality monitoring stations (WQMS) across the Maharashtra state to monitor the overall water quality of a particular surface water resource. Water quality is monitored per month across all the stations.

MPCB, under **NWMP - National Water Quality Monitoring Programme** has set up Water Monitoring Stations around Panvel City: at Kopra Bridge (Panvel Creek sample).



Table 6.2: Details of the Monitoring Station – Kopra Bridge (Panvel Creek sample)

| Water Quality Monitored at: Kopra Bridge (Panvel Creek sample) |             |                |                 |
|----------------------------------------------------------------|-------------|----------------|-----------------|
| Name of the Program                                            | NWMP        | Type of Sample | Surface         |
| Station Code                                                   | 2803        | Frequency      | Monthly (Trend) |
| Regional Office                                                | Navi Mumbai | Regional Lab   | -               |

Table 6.3: Annual Average Water Quality Monitoring Data of Panvel Creek at Kopra Bridge

| Year |      | pH   | DO<br>(mg/l) | BOD<br>(mg/l) | COD<br>(mg/l) | Nitrate<br>(mg/l) | Fecal<br>Coliform |
|------|------|------|--------------|---------------|---------------|-------------------|-------------------|
| 2018 | Min. | 6.4  | 3            | 3             | 20.0          | 0.1               | 17                |
|      | Max. | 8.2  | 6.9          | 18            | 224           | 7.9               | 170               |
|      | Avg. | 7.17 | 5.18         | 7.71          | 65.33         | 3.38              | 74.5              |
| 2019 | Min. | 6.5  | 4.5          | 4             | 12            | 0.1               | 21                |
|      | Max. | 8.7  | 7            | 11            | 120           | 2.8               | 94                |
|      | Avg. | 7.18 | 5.88         | 5.92          | 41.67         | 1.33              | 40.92             |
| 2020 | Min. | 6.8  | 4            | 3.2           | 16            | 0.1               | 13                |
|      | Max. | 7.5  | 7            | 10            | 128           | 2                 | 110               |
|      | Avg. | 7.21 | 6.03         | 4.98          | 37.67         | 1.03              | 47.5              |
| 2021 | Min. | 6.5  | 4.6          | 3.4           | 12            | 0.3(BDL)          | 4.5               |
|      | Max. | 7.9  | 7.4          | 8             | 80            | 9.2               | 140               |
|      | Avg. | 7.2  | 5.99         | 5.55          | 35            | 2.6               | 52.21             |
| 2022 | Min. | 7.1  | 3.8          | 4             | 12            | 0.3(BDL)          | 22                |
|      | Max. | 7.8  | 6.9          | 12            | 184           | 20.2              | 94                |
|      | Avg. | 7.36 | 5.4          | 7.44          | 68.89         | 3.89              | 54.11             |

Source: MPCB

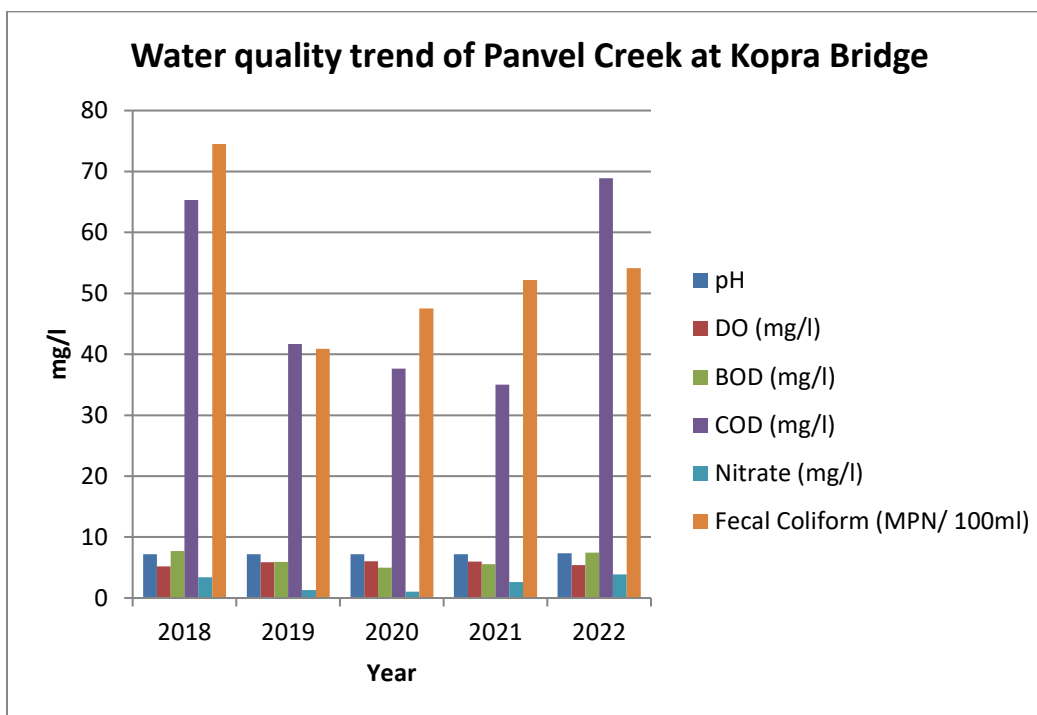


Figure 6.5: Water quality trend of Panvel Creek at Kopra Bridge

Annual water quality Trend of Panvel Creek at Kopra Bridge has been depicted in Figure 6.5. it is observed that cod and fecal coliform values go high due to domestic effluent discharge from the nearby area.

### Water Quality Index

The water quality index (WQI) provides a single number that expresses the overall water quality, at a certain location and time, based on several water quality parameters. The objective of WQI is to turn complex water quality data into information that is understandable and usable by the public.

Table 6.4: Water Quality Index

| WQI         | Quality Classification | Remarks          | Colour Code |
|-------------|------------------------|------------------|-------------|
| 63-100      | Good to Excellent      | Non-Polluted     | Green       |
| 50-63       | Medium to Good         | Non-Polluted     | Yellow      |
| 38-50       | Bad                    | Polluted         | Orange      |
| 38 and less | Bad to very Bad        | Heavily Polluted | Red         |



Table 6.5: Trend of the WQI for Panvel Creek Water Samples (At Kopra Bridge)

| Station Code | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 2803         | 2018 |     |     |     |     |     |     |     |     |     |     |     |     |
| 2803         | 2019 |     |     |     |     |     |     |     |     |     |     |     |     |
| 2803         | 2020 |     |     |     |     |     |     |     |     |     |     |     |     |
| 2803         | 2021 |     |     |     |     |     |     |     |     |     |     |     |     |
| 2803         | 2022 |     |     |     |     |     |     |     |     |     | NA  | NA  | NA  |

Data Source: MPCB

\*For the year 2022, data is available only till the month of September. NA: Not Available

As seen from Table 6.5, the WQI of the locations have been equal to or more than 63 (non-polluted) throughout the year from 2018-2022.

## 6.2 Water Resource Management

Panvel Municipal Corporation has water supply from Maharashtra Jeevan Pradhikaran (MJP), MIDC and Panvel Municipal Corporation in Panvel City. With the inception of Panvel Municipal Corporation, 29 villages from Raigad Zilla Parishad and CIDCO developed areas were transferred to Panvel Municipal Corporation. In these areas, independent water supply systems are available. The total water supplied in Panvel old Corporation area is around 30 MLD & in CIDCO nodes, it is around 179 MLD. In remaining villages, MIDC supplies around 9 MLD water and CIDCO supplies around 3 MLD of water. As per water supply department of PMC the total water supply across Panvel City is 238.7 MLD which after treatment goes to the Water Distribution System as depicted in table 6.6. Overall, the system has a net approximate water loss of around 20%.

Table 6.6: Water Distribution at PMC

|                                 |           |
|---------------------------------|-----------|
| Water Distribution from Source  | 238.7 MLD |
| Water Received after Treatment  | 238.7 MLD |
| Actual Distribution of Water    | 191 MLD   |
| Per capita/day? supply of water | 110 L     |
| Overall Water Loss              | 20%       |

Source: Water Supply Dept., Panvel

### Details about Water Treatment Plants

- Water Treatment Facility (WTF) near Panvel ST Stand supplies water to Panvel Corporation area.
- Maharashtra Jeevan Pradhikarn's has Water Purification Centers at Badlapur and treated water being is supplied to Kalamboli & New Panvel area.
- In Kharghar & Taloja water is supplied by CIDCO.

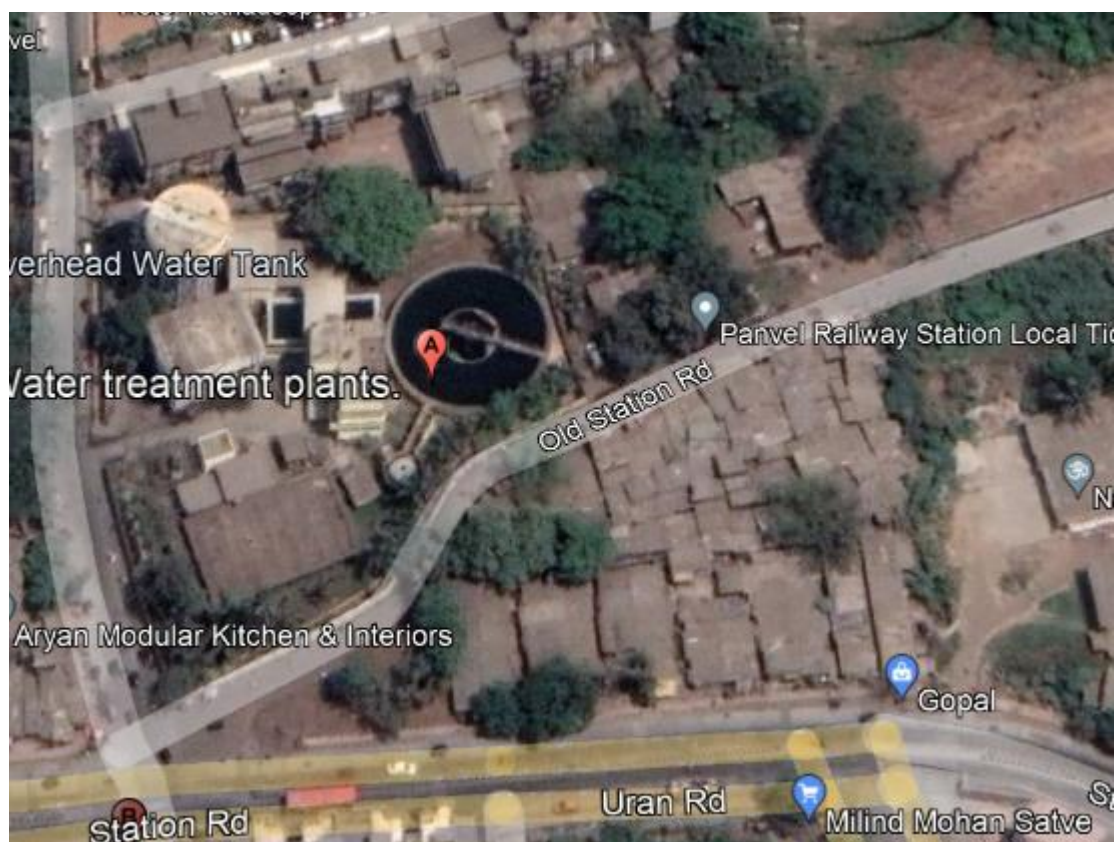


Figure 6.6: Panvel ST Stand WTP (18°59'24.59"N, 73° 7'4.63"E)

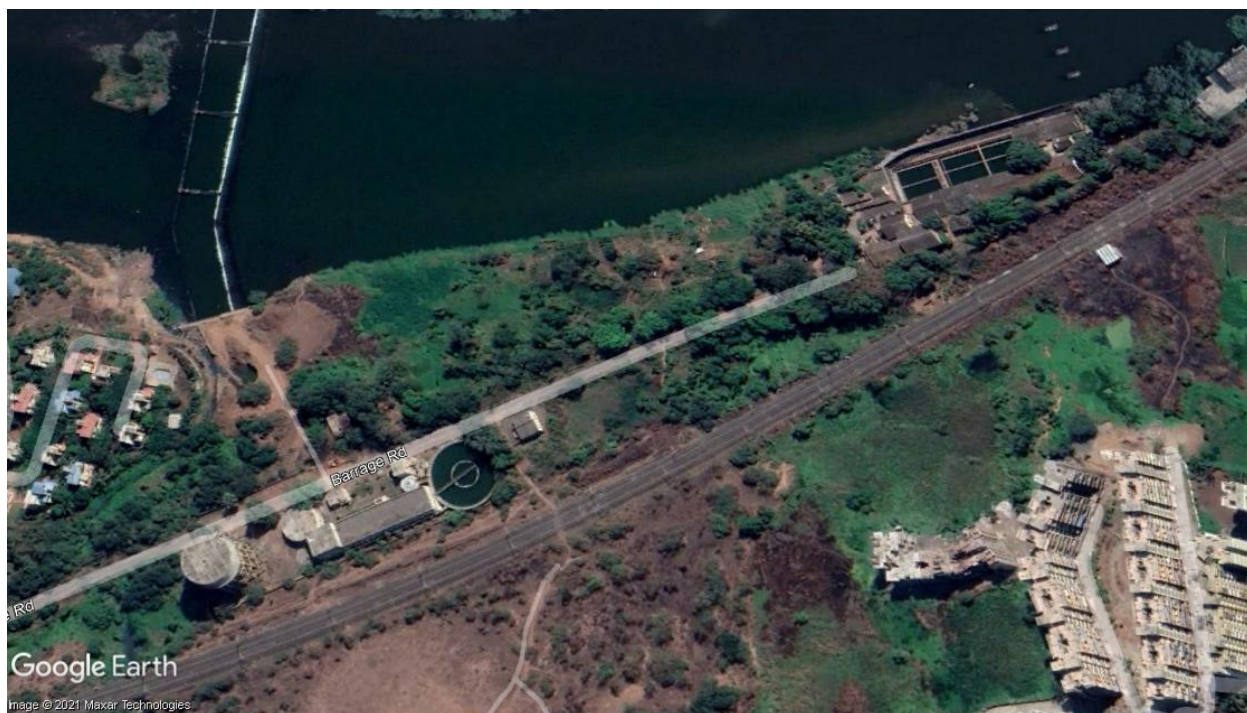


Figure 6.7: Badlapur Barrage Dam WTP ( $19^{\circ}08'53.81''\text{N}$ ,  $73^{\circ}15'09.89''\text{E}$ )

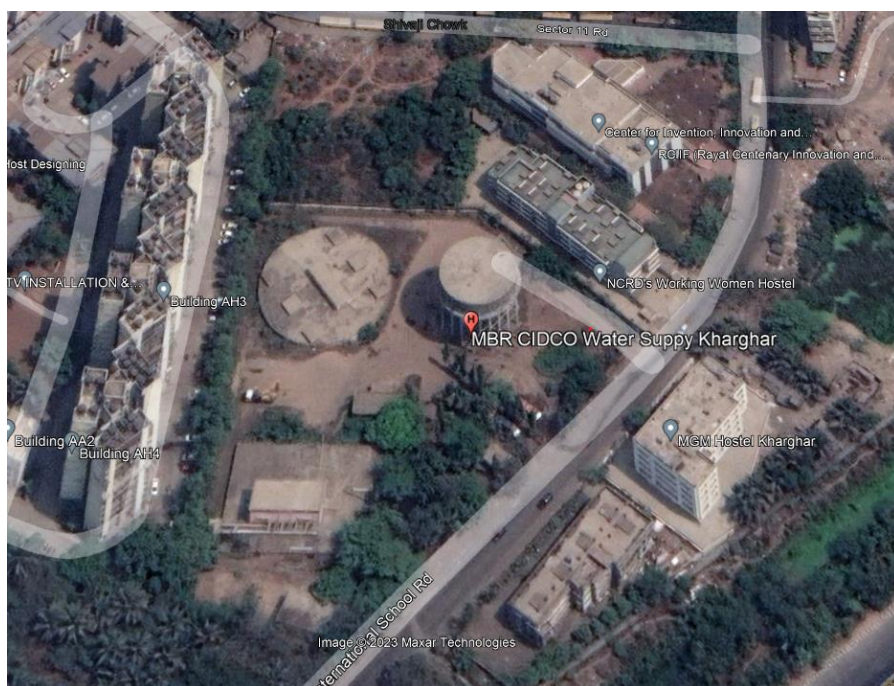


Figure 6.8: CIDCO Water Supply, Kharghar ( $19^{\circ}2'12.32''\text{N}$ ,  $73^{\circ}4'13.51''\text{E}$ )

Table 6.7: Per Capita Supply of Water

| Details                                  | Period   | Mode of supply | Total water supply | PCPD  |
|------------------------------------------|----------|----------------|--------------------|-------|
| Existing Water Supply                    | 4 hours  | Metering       | 210 MLD            | 110 L |
| Minimum Water requirements as per norms. | 24 hours | Metering       | Not Applicable     | 135L  |

Source: Water supply department of Panvel

Table 6.8: Water Supply by Type

| Type                    | Numbers | Percentage (%) |
|-------------------------|---------|----------------|
| <b>Total no. of Tap</b> | 40478   |                |
| Residential Connection  | 34286   | 85%            |
| Industrial Connection   | 5988    | 15%            |
| Hand Pump               | -       | -              |
| Tube Well               | -       | -              |
| Well                    | -       | -              |

Source: Water supply department

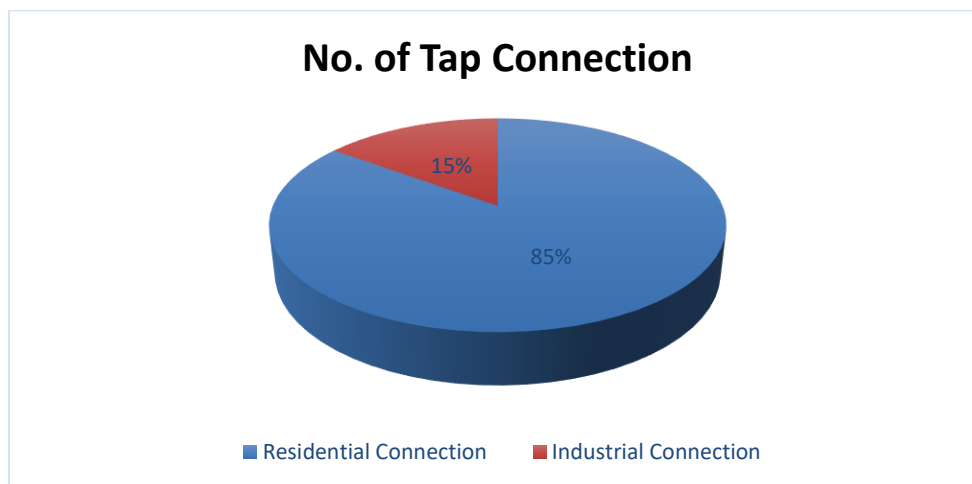


Figure 6.9: Tap Connections in Panvel



## 6.3 Ground Water

Due to well-planned and established chain of water supply, the dependence of the PMC region on ground water table for its daily activities is high compared to other regions in Raigad district. According to the block wise ground water assessment conducted by Central Ground Water Board (CGWB) in 2017, the ground water in Panvel Taluka has been deemed 'safe'. Table 6.9 gives the details of ground water resources of Panvel Taluka.

Table 6.9: Ground Water Resources of Panvel Taluka (As on March 2009)

|                                                                                  |                |
|----------------------------------------------------------------------------------|----------------|
| Net annual Ground Water Availability (ham)                                       | <b>5098.74</b> |
| Existing Gross Ground Water Draft for Irrigation (ham)                           | 824.84         |
| Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (ham) | 359.42         |
| Existing Gross Ground Water Draft for All Uses (ham)                             | 1184.26        |
| Provision for Domestic and Industrial Requirement Supply to 2025 (ham)           | 718.83         |
| Net Ground Water Availability for Future Irrigation Development (ham)            | 3555.03        |
| Stage of Ground Water Development (%)                                            | 22.23          |
| Category                                                                         | SAFE           |

Source: Central Ground information, Raigad District, CGWB Report)



Figure 6.10: Pre-Monsoon Depth of Water Level in Thane District, May 2011

(Source: Ground Water Information, Raigad District, CGWB Report)

**Post-Monsoon Depth to Water Level-Nov-2011**

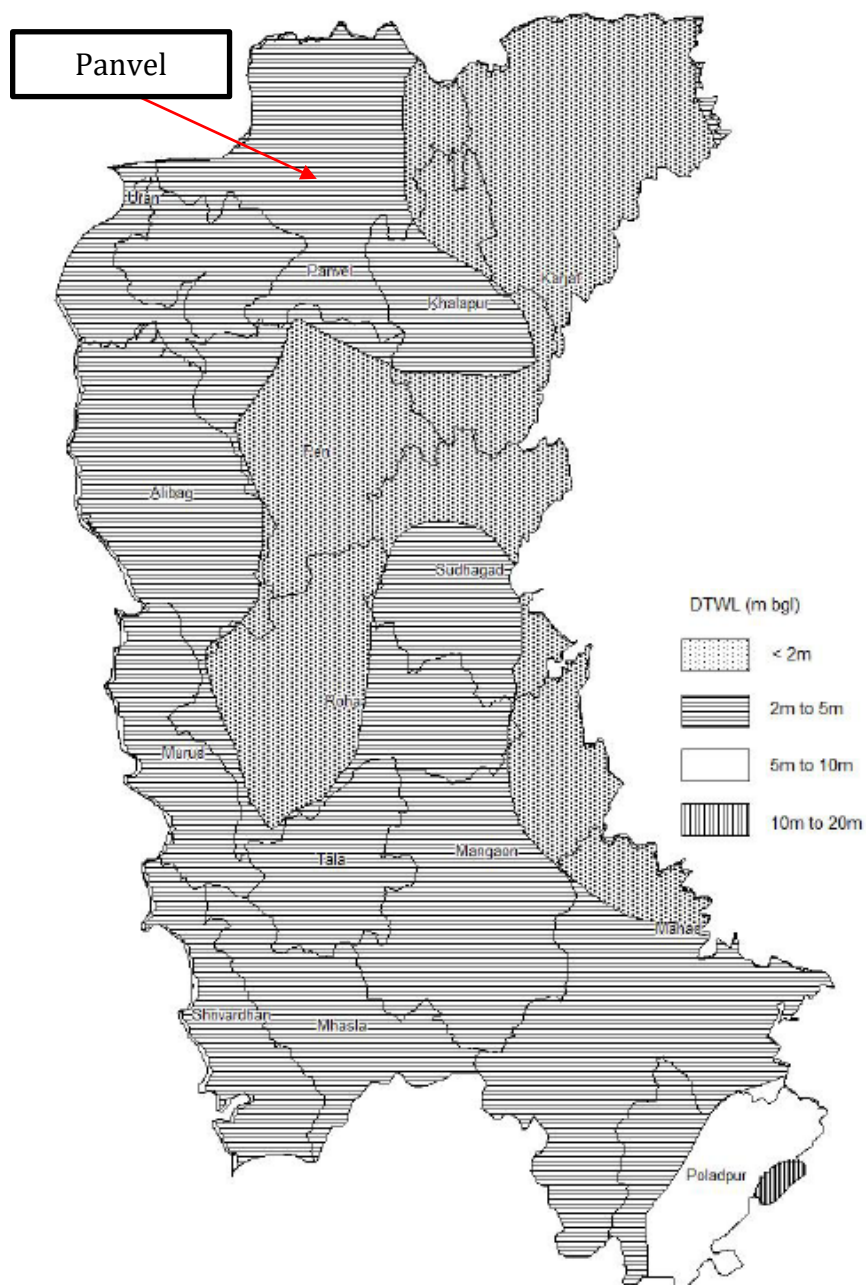


Figure 6.11: Post-Monsoon Depth of Water Level in Thane District, November 2011

(Source: Ground Water Information, Raigad District, CGWB Report)



We can see from Figure 6.10 that the pre-monsoon depth of water level, the eastern part of Panvel Taluka has water table in the range of 2m to 5m below ground level while the water table at the western part is in the range of 5m to 10m below ground level. For the post monsoon depth of water level is in the range of 2 to 5 m below ground level, as seen in Figure 6.11.

## 6.4 Sewage Treatment

Sewerage systems are networks for collecting wastewater, conveying it via pipes, conduits, and ancillary works from its origin to treatment before discharge back into the environment (Read, 1997). There are two types of sewage residual generated in urban areas, including industrial sewage and residential sewage. The Panvel City consists of the areas earlier governed by CIDCO, Raigad Zilla Parishad, MIDC and Panvel Municipal Corporation and hence different levels of development of sewerage systems exist in the city. The PMC has its sewage treatment plant (STP) at Bandar Road with a capacity of 14 MLD. The remaining 6 STP Plants are in CIDCO boundary and all the individual, public and common toilets are connected through sewerage pipeline to these STPs. One STP Plant at Kamothe with the capacity of 85 million liters per day (MLD) and another 2 STP's at Kharghar with the capacity of 70 MLD & 25 MLD, respectively. Taloja MIDC has a Common Effluent Treatment Plant (CETP) named Taloja CETP Cooperative Society Ltd located in Taloja, which is of 32 MLD capacity. Taloja CETP Co-operative Society Ltd. has a cluster of 1036 Member Industries. The Remaining STPs are located in Kalamboli and Kalundre and their capacities are 50 MLD & 2 MLD, respectively. Sewage Treatment Plants and their capacities are given in table 6.10.

Table 6.10: Sewage Treatment Plant and capacities

| Sr. No. | Sewage Treatment Plant and Location | Capacity (MLD) |
|---------|-------------------------------------|----------------|
| 1       | STP at Bandar Road                  | 14 MLD         |
| 2       | Kamothe                             | 85 MLD         |
| 3       | STP at Kharghar 1                   | 70 MLD         |
| 4       | STP at Kharghar 2                   | 25 MLD         |
| 5       | Taloja CEPT                         | 32 MLD         |
| 6       | Kalamboli                           | 50 MLD         |
| 7       | Kalundre                            | 2 MLD          |

Source: Drainage Department, PMC



Figure 6.12: Kamothe STP (19° 0'48.62"N 73° 5'13.02"E), Capacity – 85 MLD

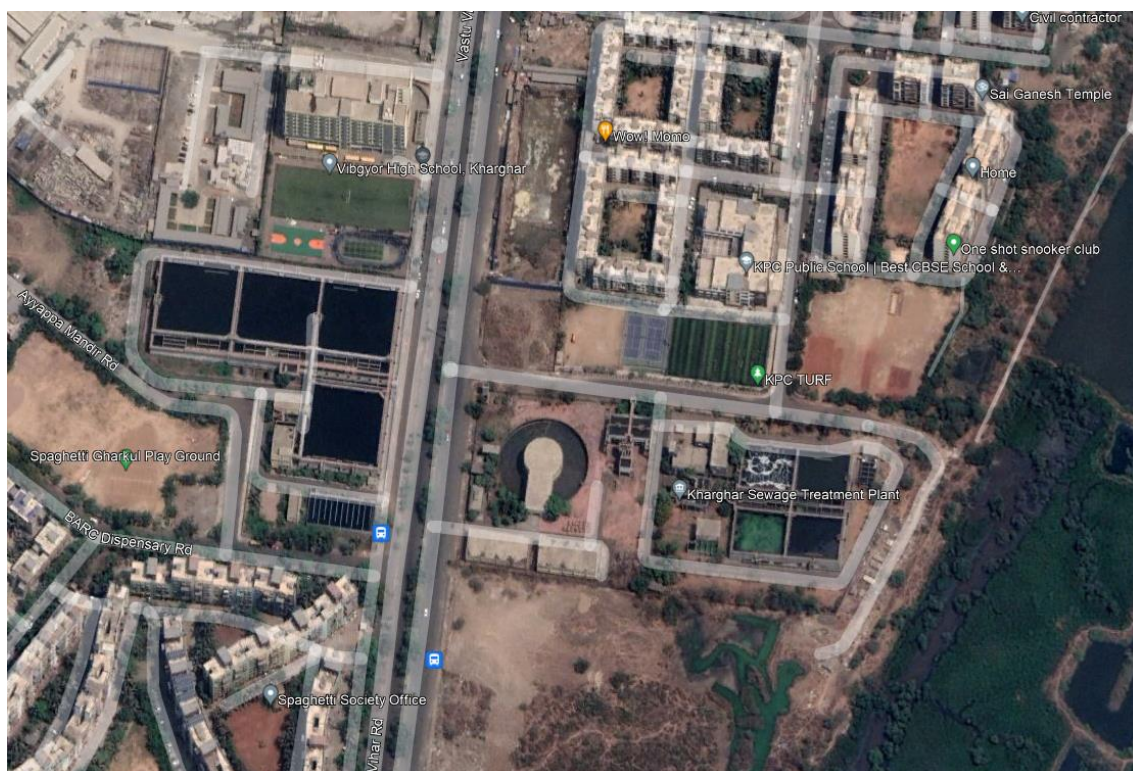


Figure 6.13: Kharghar STP (19° 2'31.38"N 73° 4'49.38"E), Capacity – 70 MLD

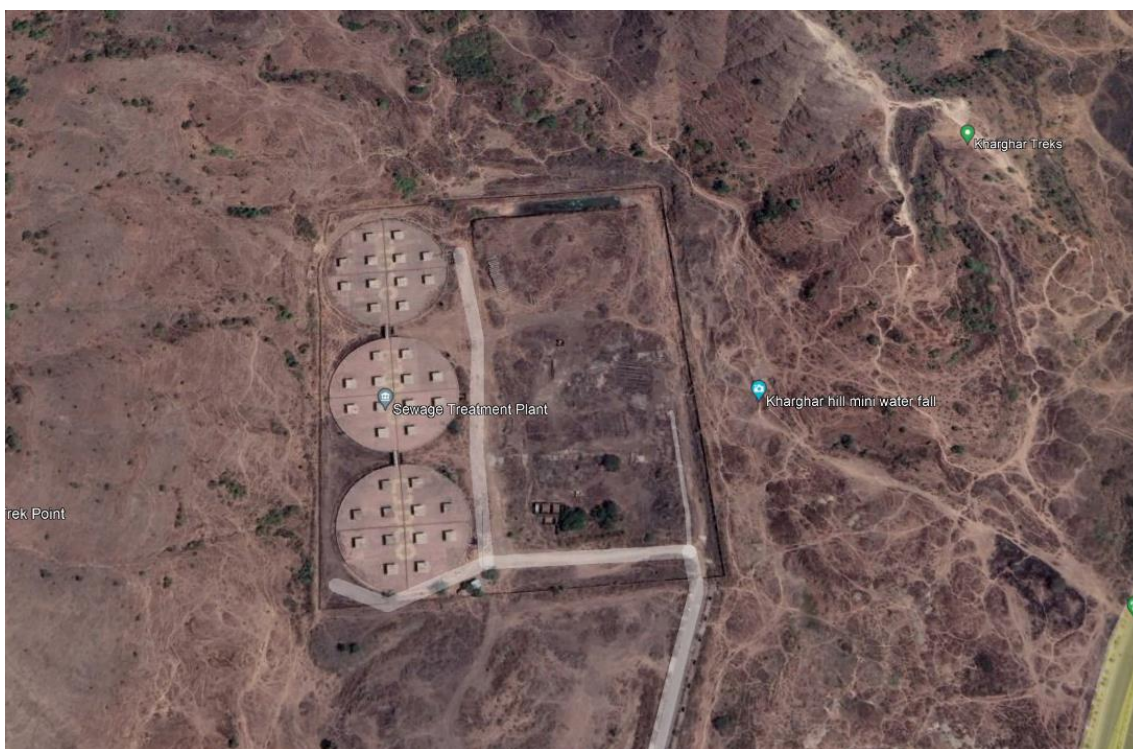


Figure 6.14: Kharghar STP (19° 4'16.10"N 73° 3'50.74"E), Capacity – 25 MLD



Figure 6.15: Kalamboli STP ( $19^{\circ} 2'6.59''\text{N } 73^{\circ} 5'52.45''\text{E}$ ), Capacity – 50 MLD



Figure 6.16: Taloja STP ( $19^{\circ} 4'21.72''\text{N } 73^{\circ} 5'33.21''\text{E}$ ), Capacity – 32 MLD

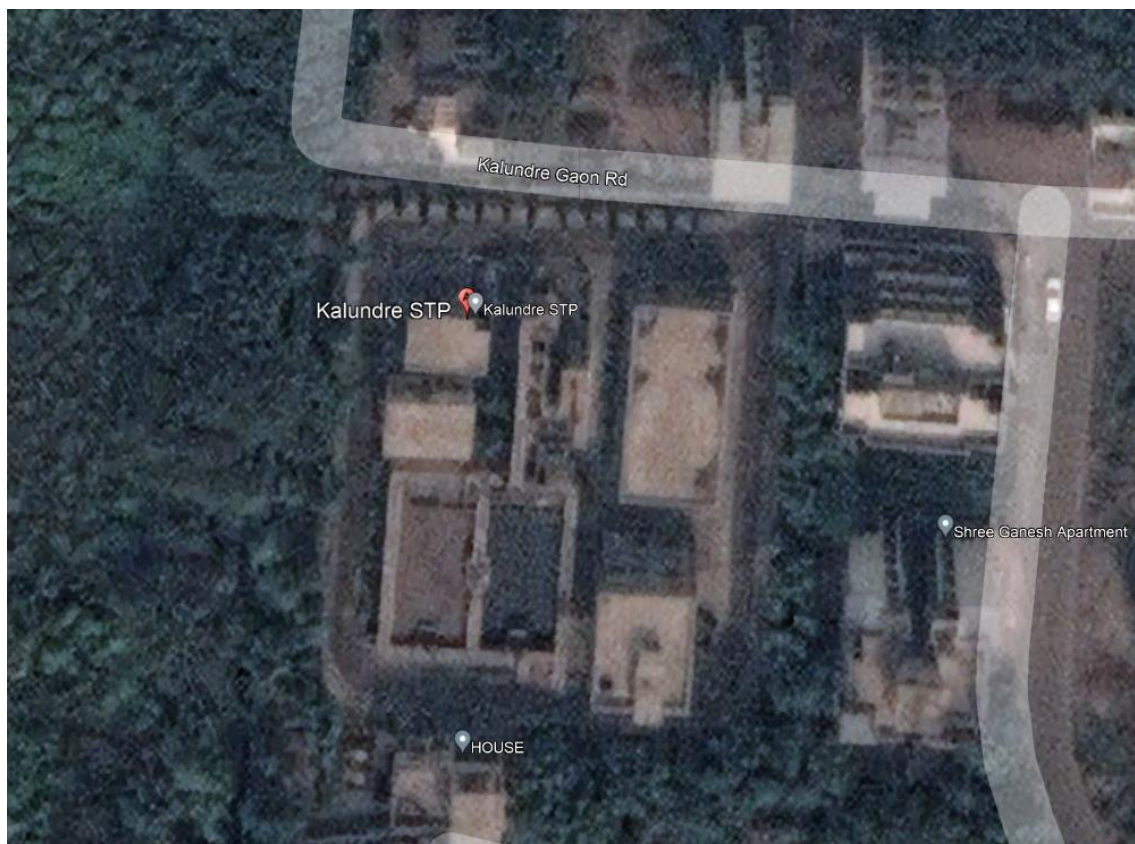


Figure 6.17: Kalundre STP (18°58'40.02"N 73° 7'32.12"E), Capacity – 2 MLD

Source: [www.mapsofindia.com](http://www.mapsofindia.com)

The effluent generated by the industries is collected through gravity lines in two Collection Sumps, one near Ghot Village and the other at CETP. From the Collection Sump near Ghot village, effluent is pumped to the Collection Sumps at CETP. The Equalization Tank is used to dampen the variations in the quality and flow rate. To keep the effluent suspended solids away from settling and ensure proper mixing Floating Aerators have been installed in old plants and diffused coarse aeration is there in the expansion plant. The pH correction is carried out with lime if required.

The effluent is pumped to a flash mixer wherein Polyaluminum Chloride (PAC) is dosed with rapid mixing and led to Clariflocculator to flocculate and settle suspended solids and remove a certain portion of suspended organic matter. The Suspended Solids settle down in Primary Clariflocculator, leaving the clear supernatant overflow from the weir top and it



is the primary treated effluent which goes to the Aeration Tank for secondary biological treatment. The settled sludge is scrapped with a scrapper mechanism and pumped to the sludge sump, further thickened in a thickener and dewatered with Centrifuge Decanter. The centrate water of the Centrifuge Decanter is taken to Equalization Tank for further treatment. In Aeration Tank, only sludge remains, which is a heterogenic microbial culture. Diffused Aeration System supplies the oxygen required for micro-organism. The bacteria consume the organic matters present in the effluent as their food source and produce Carbon Dioxide and water as by-products. The overflow of the Aeration Tank flows to the Secondary Clarifier where Mixed Liquor Suspended Solids (MLSS), which is a form of biomass only, settle down, leaving clear supernatant at the top, which is treated water. The treated water is discharged in the Waghivali Creek by pumping through High Density Polyethylene (HDPE) closed pipeline. The settled sludge is partially recycled back to Aeration Tank to maintain the MLSS concentration in it and partially wasted in the sludge sump. The MLSS is dewatered and dried along with the sludge which is generated in the primary treatment. The dried sludge is sent to Mumbai Waste Management Ltd. for further disposal by secured landfilling as per the consent conditions.

Though the waste residual from industries is treated by CETP, it is observed that many industries in Taloja discharge residual water in Kasadi River. It is also observed that severe pollutants are discharged at Waghivali Creek by CEPT that are hazardous for residents' health and biodiversity in the region. The sludge is also a matter of grave concern; the lead and many chemical components in sludge generate harmful effects on the ecosystem, including vegetation, aqua system and wildlife in the vicinity.

## 7 Soil Environment

Soil may be defined as a thin layer of earth's crust which serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to, and influenced by genetic and environmental factors – parent material, climate, organisms and topography all acting over a period of time. They serve in varying degree as a reservoir of nutrients and water for crops, provide mechanical anchorage and favorable tilt. The components of soil are mineral material, organic matter, water and air, the proportion of which vary and which together form a system for plants growth; hence the need to study the soils in perspective.

A study of the soil profile is important from a crop husbandry point of view, since it reveals the surface and the sub- surface characteristic and qualities, namely, depth, texture, structure, drainage conditions and soil moisture relationship which directly affect the plant growth. A study of soil profile supplemented by physical, chemical and biological properties of the soil will give full picture of soil fertility and productivity. Physical properties of the soil include water holding capacity, aeration, plasticity, texture, structure, density and color etc. Chemical properties refer to the mineralogical composition and the content of the type of minerals such as Kaolinite, illite and montmorillonite, base saturation, humus and organic matter content. The biological property refers to a content of extent and types of microbes in the soil, which include bacteria, fungi, worms, and insects. Soil formation in Maharashtra mainly depends on the organic components, original rock, climate, the slope of the land and time. According to the climates in different regions and types of rocks, different classifications of soils are formed. A long time is required for the formation of mature soil, as it is a very slow process.

Some dominant groups of Indian soil, classified according to soil taxonomy and chemical property:

- 1) Res Soil: They are wide inn their spread. The red color is due to diffusion of iron in the soil.



- 2) Lateritic Soil: Are composed of mixture of hydrated oxides of aluminium and iron with small amounts of fertility.
- 3) Black Soil: Contains a high proportion of Calcium and Magnesium Carbonates and have a high degree of fertility.
- 4) Alluvial Soil: This is the largest and agriculturally most important group of soils.
- 5) Desert Soil: Occurs mostly in dry areas and important content is quartz.
- 6) Forest and Hill Soils high in organic matter.

Source: <https://www.gktoday.in/types-of-soils-in-india/>

In Konkan zone, mostly Laterite and acidic coarse, shallow soil is found and in western ghat zone light, laterite and reddish brown soil is found. Most of the rivers flowing in Konkan are small and flow with great speed. Therefore, the silt brought by them accumulates at the mouth of the rivers. These soils are found along the mouths of rivers on the west coast, eg, the Panvel-Uran coast, Dharamtar Bay etc.

To study the soil quality, Soil samples were collected from all the four wards of Panvel. The activities around the sample sites are taken into consideration to learn the sources of pollution or the factors governing the physico-chemical properties of the soil samples. Soil sampling results are tabulated and attached in [Annexure IV \(Page 142\)](#). The analytical results indicates that the soil texture is sandy and pH of the soil is ranged between 6.43- 8.56. "Strongly alkaline" soil was observed at residential area. In other locations, it varied from "Slightly acidic" to "Moderately alkaline". As specially in industrial area it is found slightly acidic due to use of toxic chemical in industrial processes. The values for Nitrogen at all locations varied between 147-206 kg ha<sup>-1</sup>. This indicates that the Nitrogen is 'Low' as per the classification at all locations. Sandy soils may lose Nitrogen through leaching, while heavy, poorly drained soils may lose Nitrogen through denitrification. Without enough nitrogen in the plant, the plant cannot grow taller, or produce enough food (usually yellow). The concentration of Phosphate was estimated to be between 19-28 kg ha<sup>-1</sup>. The highest concentration can be observed at location SQ2, while the lowest concentration can be observed at location SQ1 during the monitoring period. Here it is observed that Phosphate concentration observed 'Medium' as per chemical classification of soil quality. The concentration of Potassium was found to be ranging between 869-1290 kg ha<sup>-1</sup>. Here it is



observed that Potassium concentration observed 'Very High' as per chemical classification of soil quality. A severe excess of potassium in the soil will cause the clay particles to disperse and clog needed pore space so that water will tend to stand on top instead of infiltrating the soil. Plants need significant amounts of nitrogen, phosphorus, and potassium to grow and thrive. Well-fed plants are healthier and more productive. For the optimal growth of crops, sufficient amounts of nutrients should be available in the root zone of the crops. Those nutrients can be partly supplied by the soil and should be partly added with organic manures and fertilizers. Soils will contain different amounts of available nutrients, depending of the parent material (e.g. sand, clay, peat), and differences in the management history such as preceding crops, management of crop residues and use of manure and fertilizers in the past. Also, differences in climatic conditions may alter the available nutrients. For that reason, it is of importance for farmers to know the NPK content of their soil, so that they know how much N, P and/or K they should add with organic or mineral fertilizers, to optimize crop growth, production and yield.



## 8 Biodiversity

Biodiversity is the variety of life on Earth, it includes all organisms, species, and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems. Biodiversity is a variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystem. Biodiversity forms the foundation of the vast array of ecosystem services that critically contributed to human well-being. Biodiversity is important in human managed as well as natural ecosystem.

Our planet's essential goods and services depend on the variety and variability of genes, species, populations and ecosystems. Biological resources feed and clothe us and provide housing, medicines and spiritual nourishment. The natural ecosystems of forests, savannah, pastures and rangelands, deserts, tundra's, rivers, lakes and seas contain most of the Earth's biodiversity. The decline in biodiversity is largely the result of human activities and represents a serious threat to human development. The loss of biological diversity may reduce the resilience of ecosystems to climatic variations and air pollution damage. Atmospheric change can have an important impact on forests, biodiversity, and freshwater and marine ecosystem, as well as on economic activities, such as agriculture (UNCED, 1992).

All of the Earth's species work together to survive and maintain their ecosystems. However, much of the Earth's biodiversity is in jeopardy due to human consumption and other activities that disturb and even destroy ecosystems. Pollution, climate change, and population growth are all threats to biodiversity. These threats have caused an unprecedented rise in the rate of species extinction. Some scientists estimate that half of all species on Earth will be wiped out within the next century. Conservation efforts are necessary to preserve biodiversity and protect endangered species and their habitats.

Urbanization is often cited as a major reason for loss of native biodiversity and its replacement with non-native vegetation across the world (McKinney, 2002; Sanderson *et*



*al.*, 2002). While urbanization does have an intense effect on native biodiversity and dramatic transformation of biophysical processes, there is also a growing recognition that urban areas are heterogeneous with variations and transitions in the synthesis of social, political, economic, biophysical processes at different scales (Cadenasso, Pickett, & Schwarz, 2007). Urban ecosystems serve as key sites where scholars across disciplines find common ground to explicitly integrate the dynamics of social-ecological and political processes (Francis, Lorimer, & Raco, 2011).

### **Measures of Biodiversity**

In spite of many tools and data sources, biodiversity remains difficult to quantify precisely. But precise answers are seldom needed to effectively understand where biodiversity is, how it is changing over space and time, the drivers responsible for such change, the consequences for ecosystem services and well-being, and the response options available. Ideally, to assess the conditions and trends of biodiversity either globally or sub- globally, it is necessary to measure the abundance of all organisms over space and time, using taxonomy (such as the number of species), functional traits (for example, the ecological type such as nitrogen- fixing plants like legumes versus non- nitrogen fixing plants), and the interaction among species that affect their dynamic and function (predation, parasitism, competition, and facilitation such as pollination, for instance, and how strongly such interactions affect ecosystems).even more important would be to estimate biodiversity turnover, not just point estimates in space or time.

Currently, it is not possible to do this with much accuracy because the data are lacking. Even for the taxonomic component of biodiversity, where information is the best, considerable uncertainty remains about the true extent and changes in taxonomic diversity (Hassan, Scholes, and Ash, 2005).there are many measures of biodiversity; species richness(the number of species in a given area) represents a single but important metric that is valuable as the common currency of the diversity of life but it must be integrated with other metrics to fully capture biodiversity (Hassan, Scholes and Ash, 2005).



Panvel is a locality of the Konkan Division of Raigad District in the state of Maharashtra. The region is situated on the banks of the Gadhi River (Kalundre river) with coordinates 18°59'40"N 73°06'50"E and MSL 28 m. it is comes in between the biogeographical zone of Western Ghats and Malabar Coastal region. The place is by far the largest and most popular city in the Raigad district. It is the node of Navi Mumbai as it in the center. The whole area of Panvel comprises a small patch offorest, open grass, scrub, agriculture and plantations, freshwater wetlands, urban parks, gardens, or avenues. The adjoining river opens into a creek known as Panvel Creek. Panvel soil is rich in minerals, but the human-dominated localities in Panvel range from rural agro landscapes to core urban zones. In addition to this, the area has substantial numbers of estuarine habitats that harbour many mangrove species. Environmentalists and some local citizens pointed out that the Gadhi river is in a sorry state due to sewage pipes getting dumped in the river. Local citizens of Panvel have urged the authorities to clean the river, but the situation of the river is the same and has been closed for solving traffic congestion space.

### **Suggestion**

Environmental protection is an integral component of sustainable development. The environment is threatened in all its biotic and abiotic components: animals, plants, microbes and ecosystems comprising biological diversity; water, soil and air, which from the physical components of habitats and ecosystems; and all the interactions between the components of biodiversity and their sustaining habitats and ecosystem. With the continued increase in chemicals usage, energy and non- renewable resources by an expanding global population, associated environmental damage caused by over consumption, the quantities of waste generated, and the degree of unsustainable land use appear likely to continue growing (UNCED, 1992).

The need for a diverse genetic pool of plant, animal and microbial germ plasma for sustainable development is well established. Biotechnology is one of many tools that can play an important role in supporting the rehabilitation of degraded ecosystems and landscapes (UNCED, 1992).

As per newsband news release on 31 Jan, 2023, Panvel will soon have around ten new parks with different themes. One of them is the bio-diversity park in Panvel sector-5, the work of which is likely to get completed within three months. Since there are no zoos or animal related parks in the city, this would be the first garden with information on various local animals and birds of Raigad- Panvel region. Another news is release by Hindustan time on 24 May, 2023 on reforestation at Taloja Hill forest. A barren patch of Taloja Hill is now brimming with greenery and wildlife thanks to a three-year reforestation drive by local NGOs with the help of the State Forest Department's Alibaug unit and the local community.

A survey for biodiversity was carries out in 2016, where thousands of different tree types were found along with animals and birds which are common in Panvel and Raigad District.

|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|   |   |
| <p><b>Common Indian Toad</b></p>                                                    | <p><b>Common Tree Frog</b></p>                                                       |
|  |  |
| <p><b>Fungoid Frog</b></p>                                                          | <p><b>Bush Frog sps.</b></p>                                                         |

|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|    |    |
| <p><b>Northern cricket frog</b></p>                                                 | <p><b>Common Skittering Frog</b></p>                                                 |
|   |   |
| <p><b>Indian Spectacled Cobra</b></p>                                               | <p><b>Common Tree Frog</b></p>                                                       |
|  |  |
| <p><b>Saw-scaled Viper</b></p>                                                      | <p><b>Common Krait</b></p>                                                           |

|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|    |    |
| <b>Gram Blue</b>                                                                    | <b>Tiny Grass Blue</b>                                                               |
|    |    |
| <b>Common Iora</b>                                                                  | <b>Wood Sandpiper</b>                                                                |
|   |  |
| <b>Crested Serpent Eagle</b>                                                        | <b>White-throated Fantail</b>                                                        |
|  |  |
| <b>White-eyed Buzzar</b>                                                            | <b>Rufous Woodpecker</b>                                                             |

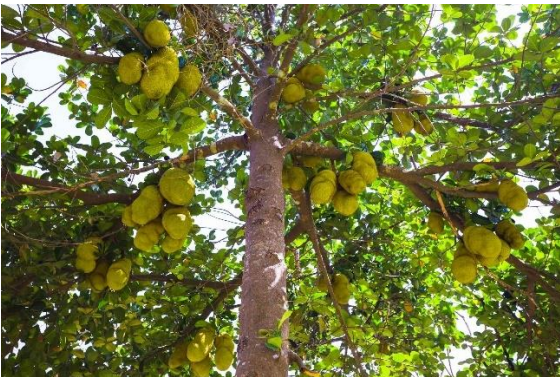
|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|    |    |
| <p><b>Gram Blue</b></p>                                                             | <p><b>Khair</b></p>                                                                  |
|   |   |
| <p><b>Babul</b></p>                                                                 | <p><b>Adulsa</b></p>                                                                 |
|  |  |
| <p><b>Kaju Tree</b></p>                                                             | <p><b>Jackfruit Trees</b></p>                                                        |

Figure 8.1: Common Species of Flora & Fauna Found in Panvel



## Tree Cover

Urban tree ecosystem provides a range of social and ecological services, but due to the heterogeneity of these canopies, their spatial extent is difficult to quantify and monitor. Traditional pre-pixel classification methods have been used to map urban canopies; however, such techniques are not generally appropriate for assessing these highly variable landscapes. Landsat imagery has historically been used for pre-pixel driven land use/land cover (LULC) classifications, but the spatial resolution limits our ability to map small urban features. In such cases, hyper spatial resolution imagery, such as aerial or satellite imagery with a resolution of one meter or below is preferred. Analysis and classification of remote sensing imagery, along with geographic information system (GIS) analysis and modeling provide the most efficient method for assessment. The detailed survey of biodiversity reveals that there has been a decrease in tree cover and trees are cut due to construction activities by private builders in the city.

The state of biodiversity is very well rich in Panvel city. As the temperature of the city is moderate and facilitates a better living environment for animals, birds and plants along with human beings. There might be changed is the biodiversity count in the past few years due to changing climatic conditions and natural calamities. Up to 2607 mm of precipitation was observed the month of July 2022. This did not impact the water supply system and the residents in Panvel could get enough water across the year. Various species of birds and butterflies are observed as there are various plants and trees. Also, various reptile species can be seen in the city.

India is one of the recognized mega-diverse countries of the world, harboring nearly 7-8% of the recorded species of the world, and representing 4 of the 34 globally identified biodiversity hotspots (Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sundaland). India is also a vast repository of traditional knowledge associated with biological resources. So far, over 91,200 species of animals and 45,500 species of plants have been documented in the ten biogeographic regions of the country. Inventories of floral and faunal diversities are being progressively updated with



several new discoveries through the conduct of continuous surveys and exploration. Along with species richness, India also possesses high rates of endemism. In terms of endemic vertebrate groups, India's global ranking is tenth in birds, with 69 species; fifth in reptiles with 156 species; and seventh in amphibians with 110 species. Endemic-rich Indian fauna is manifested most prominently in Amphibian (61.2%) and Reptilian (47%). India is also recognized as one of the eight Vavilovian centers of origin and diversity of crop plants, having more than 300 wild ancestors and close relatives of cultivated plants, which are still evolving under natural conditions.

The main threats to biodiversity include habitat fragmentation, degradation and loss; over-exploitation of resources; shrinking genetic diversity; invasive alien species; declining forest resource base; climate change and desertification; impact of development projects; impact of pollution. Against the backdrop of the varying socio-cultural milieu and often conflicting demands of various stakeholders, there is an urgent need for augmenting and accelerating the efforts for the conservation and sustainable use of biodiversity, and for the fair and equitable sharing of benefits arising from the utilization of genetic resources.

Human activities are disturbing both structure and functions of ecosystem and altering biodiversity. Such disturbances reduce the abundance of some organisms, causing an increase in the population of other organisms, modifying the interaction among organisms, and altering the interactions between the organisms and their physical and chemical environments. Patterns of infectious diseases are sensitive to these disturbances.



## 9 Solid Waste Management

Municipal solid waste (MSW) is defined as waste collected by the municipality or disposed of at the municipal waste disposal site and includes residential, institutional, commercial, municipal, and construction and demolition waste. MSW management includes the collection, transportation, and responsible disposal of waste generated in the city.

Solid waste generation is a continuously growing problem at all levels including local levels. Solid wastes are those organic and inorganic waste materials produced by various activities of the society, which have lost their value to the first user. Improper disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels. Urban society rejects and generates solid material regularly due to rapid increase in production and consumption. The problem in India is more acute as its economic growth and urbanization have been very rapid in recent times. This necessitates management of solid waste at generation, storage, collection, transfer and transport, processing and disposal stages in an environmentally sound manner in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and environmental considerations. Thus, solid waste management includes all administrative, financial, legal, planning, and engineering functions.

**The daily average solid waste generated and collected by PMC in 2022 was about 330.5 tons per day (TPD), translating to 559 grams of solid waste per capita.** The main source of solid waste is primarily from the residential areas and commercial areas falling within the PMC area. The other sources of solid waste in PMC area are domestic waste and vegetable market waste. Total waste generation in PMC is mentioned in Table 9.1.



Table 9.1: Category wise Quantity of Waste Generated in PMC

| Waste Generating Source                             | MT/ day      | Percentage (%) |
|-----------------------------------------------------|--------------|----------------|
| Households                                          | 278.28       | 84.2           |
| Street Sweeping                                     | 0.76         | 0.2            |
| Hotels and Restaurant                               | 43.06        | 13.0           |
| Markets (Vegetable Markets, Mandi, etc.)            | 4.45         | 1.3            |
| Commercial Establishments (e.g. Institutions, etc.) | 3.95         | 1.2            |
| Total Waste Generated in Panvel town                | 330.5        | -              |
| <b>Total Waste Generated</b>                        | <b>330.5</b> | <b>-</b>       |

Source: SWM Department, Panvel 2022

Door to Door Collection: PMC has implemented a mechanism to collect solid waste effectively. PMC has 100% door to door collection facility. Mechanical Road Sweeping: PMC has 100% manual sweeping process for sweeping.

#### A. Segregated Waste Transport

Almost 100% of waste is being transported through segregated waste transport system. There are 58 Ghanta Gaadis that collect and transport the solid waste. These bell vehicles go door to door to collect solid waste. There are 25 Compactors for the transport of solid waste to the processing facility at Taloja. All the vehicles are monitored with the help of GPS technology.

#### B. Segregation, Treatment and Disposal

The processing of solid waste is also an important task in solid waste management. Total 330.5 TPD waste is processed in CIDCO Solid Waste Management Plant, Taloja. Segregated organic waste is processed at a materials recovery facility (MRF), a place where solid wastes are delivered to be separated, processed, and stored for later use as raw materials for remanufacturing and reprocessing refuse-derived fuel (RDF) is produced. The organic waste is also processed from which compost manure is produced and is sold as a brand 'Bhumiputra'. The Panvel Municipal Corporation has its landfill site at which old solid waste is processed. Hazardous waste and Bio-Medical waste is transported to Mumbai



West Management Company, run By RAMK at Taloja and the company process it with the help of an incineration facility and then a secure landfill is carried out.

The residents and students in schools and colleges are trained to segregate organic and inorganic waste and process organic waste to compost fertilizer. The PMC also has installed 50 Compost Fertilizer Trunks (Khat Kundi) at various residential locations in Panvel City, which are maintained and monitored by private contractors.

Panvel Municipal Corporation, Panvel 171 TPD waste is processed in these Compost Fertilizer Trunks and the produced fertilizer is used from plants in the area. In addition, 780 litter beans have organic and inorganic compartments installed in residential and commercial areas in the city, which are maintained and monitored by private contractors. Other physical Components of waste and their quantities are mention in table 9.2.

Table 9.2: Physical Components of Waste from PMC

| Sr. No. | Components                               | Generated        | Collected        | Processed       |
|---------|------------------------------------------|------------------|------------------|-----------------|
| 1       | Plastic, Plastic bags, Tetra Packs, etc. | 33.25 TPD        | 33.25 TPD        | -               |
| 2       | Biomedical waste                         | 3.66 TPD         | -                | -               |
| 3       | E-waste                                  | 0.90 TPD         |                  |                 |
| 4       | C & D waste                              | 23 Ton/<br>Month | 23 Ton/<br>Month | 23<br>Ton/Month |
| 5       | Food Waste                               | 43.06 TPD        | -                | -               |

Source: SWM Department Panvel Municipal Corporation 2022

## Biomedical Waste

Medical care is crucial for human health but the waste associated with medical facilities causes a direct impact on community, workers associated with healthcare industries and on overall environment as it may be infectious, toxic, pointed, sharp, and un-hygienic and so on. Hence it is crucial to scientifically manage and dispose biomedical waste to reduce its direct impact on the environment as well as on humans.



According to Biomedical Waste Management Rules, 2016, it is mandatory to follow notified rules for all persons who generate, collect, receive, store, transport, treat, dispose or handle biomedical waste in any form including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological labs, blood banks, research and educational institutions, health camps, vaccination camps, forensic labs, blood donation camps, first aid rooms of schools.

## 10 Primary Monitoring

Primary environmental monitoring was carried out in the areas inside Panvel city in the month of December 2022. Monitoring for water quality and soil quality was done by Mahatma Phule Krishi Vidyapeeth, College of Agriculture (Soil Analysis Laboratory) & ambient air quality, and ambient noise level monitoring were done by Horizon Lab. The number of sampling locations for primary monitoring are given in Table 10.1. The results of the primary monitoring are described in the following sub-sections.

Table 10.1: Number of Sampling Locations for Primary Monitoring

| Particulars           | No. of Sampling Locations |
|-----------------------|---------------------------|
| Ambient Air Quality   | 4                         |
| Ground Water Quality  | 5                         |
| Surface Water Quality | 8                         |
| Ambient Noise Levels  | 4                         |
| Soil Quality          | 4                         |

### 10.1 Ambient Air Quality

Ambient air quality was monitored at 4 locations inside Panvel city to assess the ambient air quality status of the area and also to check its conformity with the ambient air quality standards specified by Central Pollution Control Board (CPCB).

The monitoring locations were selected based on the data analysis of the past years and topography of the study area and the location of potential sensitive receptors such as habitations. The factors considered while selecting of the monitoring locations include:

- Topography of the study area
- Representative nature of the sample
- Accessibility
- Location of the receptors
- Availability of power

Particulate Matter – size less than  $2.5 \mu\text{g}/\text{m}^3$  ( $\text{PM}_{2.5}$ ), Particulate Matter -- size less than  $2.5 \mu\text{g}/\text{m}^3$  ( $\text{PM}_{10}$ ), Nitrogen Oxides ( $\text{NO}_x$ ), Sulphur Dioxide ( $\text{SO}_2$ ), and Carbon Monoxide ( $\text{CO}$ ) were monitored at 4 locations. Monitoring was done on 23<sup>rd</sup> December 2022. Monitoring locations for ambient air quality were selected based on the guidelines given in Environmental Impact Assessment manual from the Ministry of Environment, Forest and Climate Change (MoEF&CC). The purpose is to ascertain the baseline pollutant concentrations in ambient air in and around the study area. Ambient air quality monitoring locations are shown in Figure 10.1. The details of the monitoring stations are given in Table 10.2. The sampling methodology and protocol are given in Table 10.3. The monitoring results are given in Table 10.4.

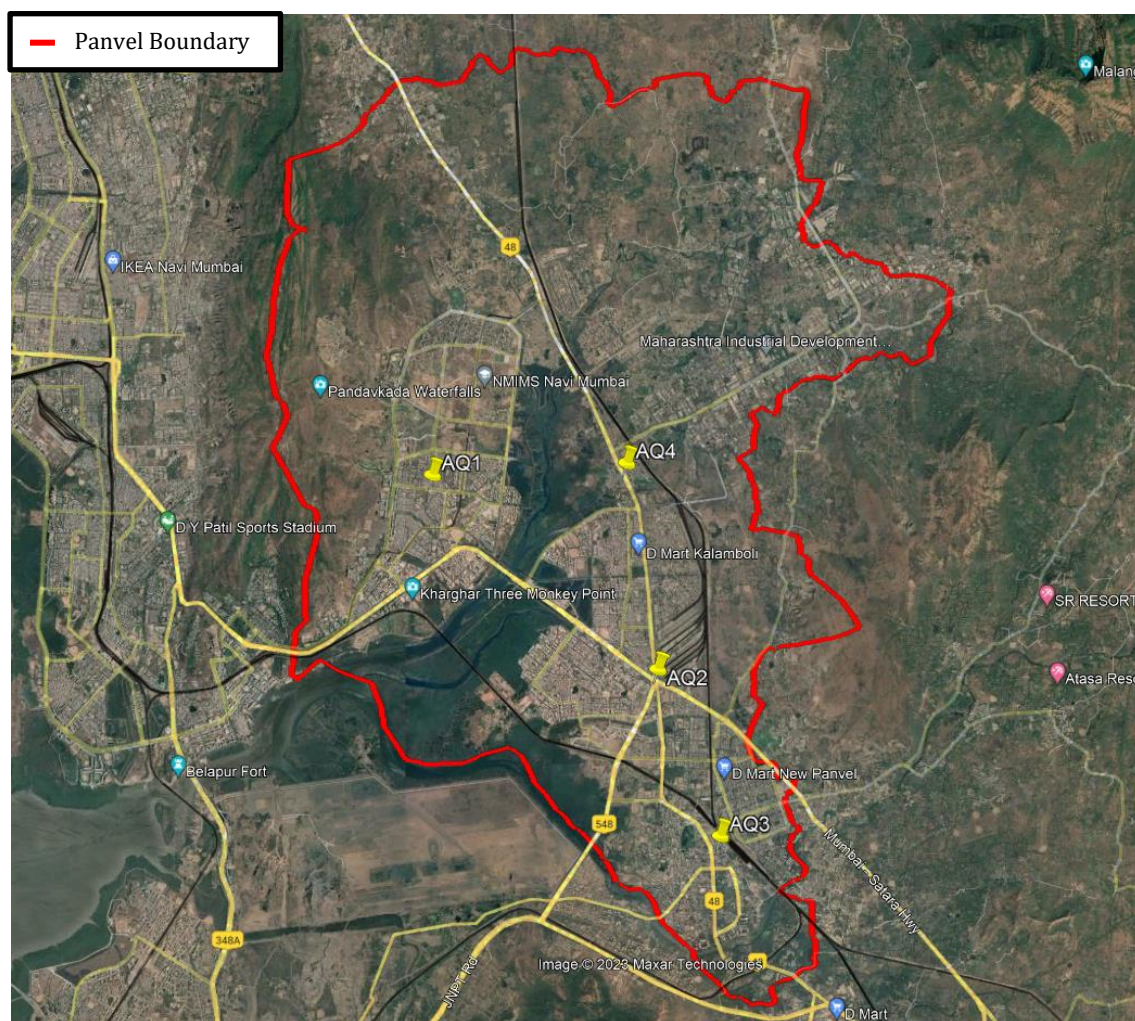


Figure 10.1: Ambient Air Quality Monitoring Locations



Table 10.2: Ambient Air Quality Monitoring Locations and Parameters

| Code | Site Location        | Location Coordinates           | Landmark         | Parameters                                                                       |
|------|----------------------|--------------------------------|------------------|----------------------------------------------------------------------------------|
| AQ1  | Shilp Chowk          | 19°2'50.23"N<br>73° 4'11.65"E  | Residential Area | PM <sub>10</sub> , PM <sub>2.5</sub> ,<br>SO <sub>2</sub> , NO <sub>x</sub> , CO |
| AQ2  | Kalamboli Circle     | 19° 1'3.56"N<br>73° 6'22.49"E  | Industrial Area  |                                                                                  |
| AQ3  | Panvel Bus Depot     | 18°59'31.95"N<br>73° 6'58.74"E | Commercial Area  |                                                                                  |
| AQ4  | Navade Gram Panchyat | 19° 2'56.77"N<br>73° 6'4.42"E  | Industrial Area  |                                                                                  |

Table 10.3: Sampling Methodology and Protocol

| Sampling Parameters | Standard referred | Sample Collection       | Sample Analysis      | Methodology                  |
|---------------------|-------------------|-------------------------|----------------------|------------------------------|
|                     |                   | Sampling Equipment      | Analytical Equipment |                              |
| PM <sub>10</sub>    | IS 5182-Part 23   | Respirable Dust Sampler | Electronic Balance   | Gravimetric Method           |
| PM <sub>2.5</sub>   | -                 | Fine Dust Sampler       |                      |                              |
| SO <sub>2</sub>     | IS 5182-Part 2    | RDS with impinger       | Spectrophotometer    | Improved West & Gaeke Method |
| NO <sub>x</sub>     | IS 5182-Part 2    |                         |                      | Na Arsenite Method           |
| CO                  | IS 5182-Part 10   | Tadler Bag              | GC-FID               | Chromatography               |

Source: Standard Practices

\*Particulate Matter (PM<sub>10</sub> & PM<sub>2.5</sub>), SO<sub>2</sub> & NO<sub>x</sub> were sampled for 24 hrs. CO was sampled for 1 hr.



Figure 10.2: Ambient Air Monitoring at Panvel Bus Depot

Table 10.4: Ambient Air Quality Monitoring Results (Pre- Monsoon)

| Code         | Parameters<br>Locations | SO <sub>2</sub><br>(µg/m <sup>3</sup> )<br>24<br>Hourly | NO <sub>2</sub><br>(µg/m <sup>3</sup> )<br>24<br>Hourly | PM <sub>10</sub><br>(µg/m <sup>3</sup> )<br>24<br>Hourly | PM <sub>2.5</sub><br>(µg/m <sup>3</sup> )<br>24<br>Hourly | CO<br>(mg/m <sup>3</sup> )<br>8 Hourly |
|--------------|-------------------------|---------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|----------------------------------------|
| AQ1          | Shilp Chowk             | 15.34                                                   | 19.45                                                   | 169.85                                                   | 81.23                                                     | 1.89                                   |
| AQ2          | Kalamboli Circle        | 12.10                                                   | 22.13                                                   | 183.19                                                   | 96.45                                                     | 1.61                                   |
| AQ3          | Panvel Bus<br>Depot     | 15.10                                                   | 16.98                                                   | 170.58                                                   | 86.31                                                     | 1.40                                   |
| AQ4          | Navade Gram<br>Panchyat | 12.10                                                   | 13.19                                                   | 150.37                                                   | 75.13                                                     | 1.20                                   |
| <b>NAAQS</b> |                         | <b>80</b>                                               | <b>80</b>                                               | <b>100</b>                                               | <b>60</b>                                                 | <b>2</b>                               |

### Inference:

As seen in Table 10.4, the SO<sub>2</sub>, NO<sub>2</sub> and CO concentrations are below the NAAQS in all the areas. However, the concentrations of PM<sub>10</sub> & PM<sub>2.5</sub> are above the NAAQS at all the monitoring locations. Generally, PM<sub>10</sub> & PM<sub>2.5</sub> concentration increases mainly due to by traffic, industrial activities, domestic fuel burning, as well as from unspecific sources of human origin. In the post-monsoon scenario, the pollution load is usually low as rain depends on particles floating in the air, its falls with them to the ground reducing the concentration of pollutants.

The maximum PM<sub>10</sub> & PM<sub>2.5</sub> concentrations are seen at Kalamboli Circle, 183.19 µg/m<sup>3</sup> & 96.45 µg/m<sup>3</sup>, respectively. As the name suggests, the location is a circle with vehicles coming from all the directions which explains the increased concentration. Also, the major transport route, Mumbai - Satara Highway, Kalamboli Flyover Bridge, MIDC area with cement industries are in the proximity of Kalamboli circle that adds up to increased pollution in the said area.

Table 10.5: Ambient Air Quality Monitoring Results (Post-Monsoon)

| Code         | Parameters<br>Locations | SO <sub>2</sub><br>(µg/m <sup>3</sup> )<br>24 Hourly | NO <sub>2</sub><br>(µg/m <sup>3</sup> )<br>24 Hourly | PM <sub>10</sub><br>(µg/m <sup>3</sup> )<br>24 Hourly | PM <sub>2.5</sub><br>(µg/m <sup>3</sup> )<br>24 Hourly | CO<br>(mg/m <sup>3</sup> )<br>8 Hourly |
|--------------|-------------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|----------------------------------------|
|              |                         |                                                      |                                                      |                                                       |                                                        |                                        |
| AQ1          | Shilp Chowk             | 0.003                                                | 0.02                                                 | 79.4                                                  | 69.32                                                  | 1.40                                   |
| AQ2          | Kalamboli Circle        | 0.003                                                | 0.01                                                 | 56.8                                                  | 50.0                                                   | 1.0                                    |
| AQ3          | Panvel Bus Depot        | 0.003                                                | 0.012                                                | 66.9                                                  | 58.7                                                   | 1.0                                    |
| AQ4          | Navade Gram Panchyat    | 0.003                                                | 0.016                                                | 61.4                                                  | 54.3                                                   | 0.8                                    |
| <b>NAAQS</b> |                         | <b>80</b>                                            | <b>80</b>                                            | <b>100</b>                                            | <b>60</b>                                              | <b>2</b>                               |

### Inference:

As seen in Table 10.5, the SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and CO concentrations are below the NAAQS in all the areas. The highest PM<sub>2.5</sub> concentration is observed at Shilp Chowk which

is  $69.32 \mu\text{g}/\text{m}^3$ . This place is in the center of a roundabout connecting sector 12, 21, 19 and 20 and it is a major conjugation point in Kharghar city.

## 10.2 Ambient Noise Environment

Baseline noise levels were monitored at the same locations where the ambient air quality monitoring was done, using a spot noise measurement device. Noise level measurement locations were identified for assessment of existing sound level status, keeping in view the land use pattern, residential areas, schools, bus stands etc. The noise monitoring locations are shown in Figure 10.6. The day and night time hours as prescribed by CPCB are from 06:00 AM to 10:00 PM and 10:00 PM to 06:00 AM, respectively, CPCB noise limits for day and night time are given in Table 10.6. The results of ambient noise level monitoring for day time and night time are given in Table 10.8.

Table 10.6: CPCB Limits for Ambient Noise

| Area Code | Category of Area | Limit in dB (A), $L_{eq}$ |            |
|-----------|------------------|---------------------------|------------|
|           |                  | Day Time                  | Night Time |
| A         | Industrial Area  | 75                        | 70         |
| B         | Commercial Area  | 65                        | 55         |
| C         | Residential Area | 55                        | 45         |
| D         | Silent Zone      | 50                        | 40         |

- Day time shall mean from 6:00 a.m. to 10:00 p.m.
- Night time shall mean from 10:00 p.m. to 6:00 a.m.
- Silence Zone is an area comprising not less than 100 m around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
- Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.
- dB (A)  $L_{eq}$  denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.
- A “decibel” is a unit in which noise is measured.



- “A”, in dB (A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.
- Leq is the energy mean of the noise level over a specified period.

The noise monitoring location details are given in below Table 10.7.

Table 10.7: Ambient Noise Monitoring Locations

| Code | Site Location        | Location Coordinates        | Landmark         |
|------|----------------------|-----------------------------|------------------|
| NQ1  | Shilp Chowk          | 19°2'50.23"N 73° 4'11.65"E  | Residential Area |
| NQ2  | Kalamboli Circle     | 19° 1'3.56"N 73° 6'22.49"E  | Industrial Area  |
| NQ3  | Panvel Bus Depot     | 18°59'31.95"N 73° 6'58.74"E | Commercial Area  |
| NQ4  | Navade Gram Panchyat | 19° 2'56.77"N 73° 6'4.42"E  | Industrial Area  |

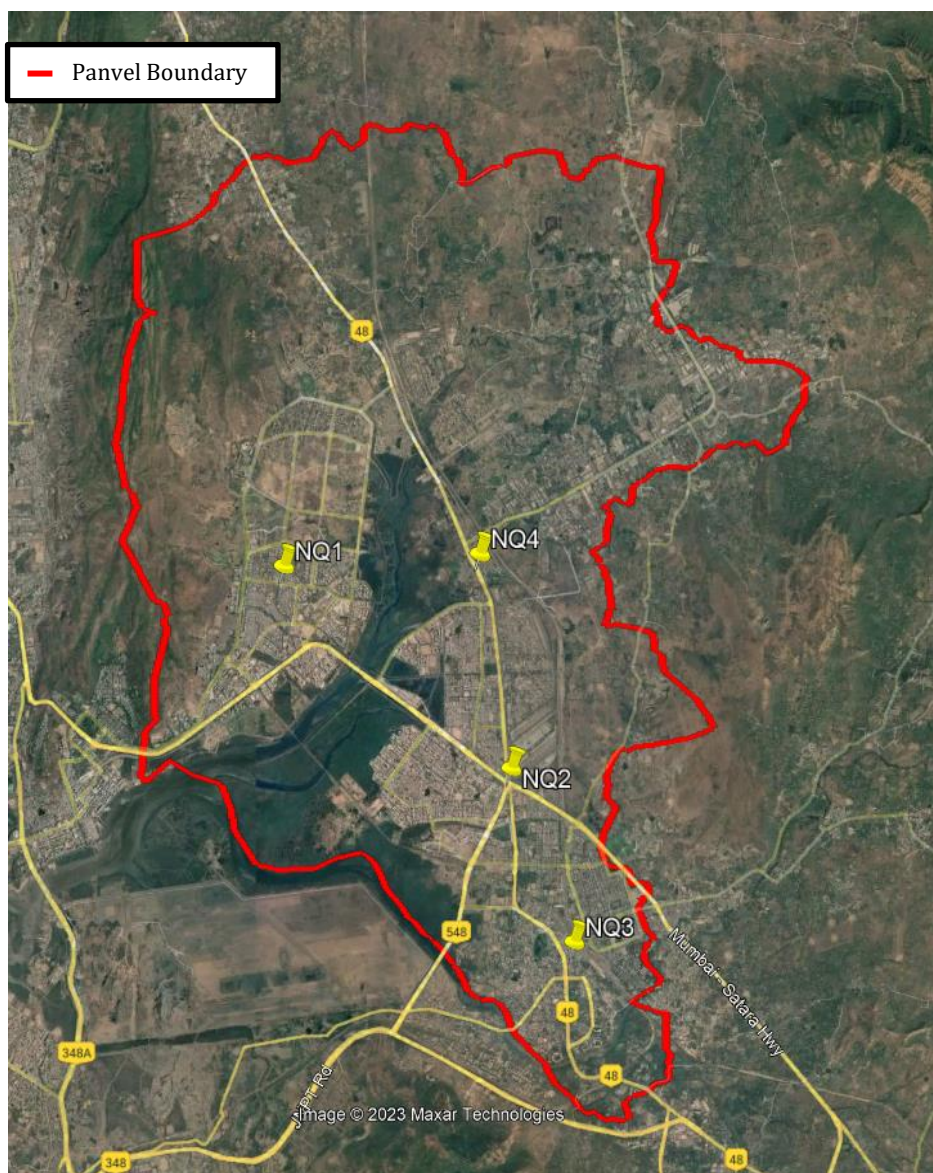


Figure 10.3: Ambient Noise Monitoring Locations

Table 10.8: Results for Noise Level Monitoring (Pre-Monsoon)

| Code | Parameters<br>Locations | Zone        | Minimum<br>Leq, dB(A) | Maximum<br>Leq, dB(A) | Average Leq,<br>dB(A) |
|------|-------------------------|-------------|-----------------------|-----------------------|-----------------------|
| NQ1  | Shilp Chowk             | Residential | 60.5                  | 89.8                  | 71.14                 |
| NQ2  | Kalamboli Circle        | Industrial  | 66                    | 87.1                  | 75.60                 |
| NQ3  | Panvel Bus Depot        | Commercial  | 73.5                  | 87.3                  | 78.70                 |
| NQ4  | Navade Gram Panchyat    | Industrial  | 92.9                  | 97.2                  | 94.48                 |

Table 10.9: Results for Noise Level Monitoring (Post-Monsoon)

| Code | Parameters<br>Locations | Zone        | Minimum<br>Leq, dB(A) | Maximum<br>Leq, dB(A) | Average Leq,<br>dB(A) |
|------|-------------------------|-------------|-----------------------|-----------------------|-----------------------|
| NQ1  | Shilp Chowk             | Residential | 58.5                  | 96.1                  | 70.73                 |
| NQ2  | Kalamboli Circle        | Industrial  | 66                    | 93.5                  | 75.47                 |
| NQ3  | Panvel Bus Depot        | Commercial  | 73.5                  | 92.6                  | 78.70                 |
| NQ4  | Navade Gram Panchyat    | Industrial  | 84.4                  | 97.2                  | 95.05                 |

**Inference:**

As seen in Tables 10.8 & 10.9, the noise level in commercial, residential and industrial areas are above the CPCB limits, which are mention in table 10.6. The Average noise level is highest in Navade gram panchayat area (95.05 dB (A)). It can be due to its proximity to the railway station and the highway. The average noise level is the lowest at the Shilp Chowk (70.73 dB (A)).

### 10.3 Water Quality

The water quality of the area was assessed for physio-chemical and bacteriological analysis of ground and surface water samples. Five groundwater and Eight surface water samples were collected from Panvel city for analysis of the existing water quality in the area. For surface water, samples were collected from the rivers in the city and groundwater samples were collected from bore wells and hand pumps. The surface water samples were rated according to the CPCB Water Quality Criteria against A, B, C, D and E class of water based on the parameters identified in the criteria. The parameters of the ground water samples were compared with the drinking water quality standards specified in IS 10500: 2012.

The details of the CETP, ground water and surface water quality locations and parameters are given in Table 10.10. The sample collection locations of surface water and ground water are shown in Figure 10.4.



Table 10.10: Surface & Ground Water Sample Collection Locations and Parameters

| Code | Site Location                  | Location Coordinates           | Area        | Parameters                                                                                                                                                                                                     |
|------|--------------------------------|--------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SW1  | Shree Shiv Samarth             | 19°2'36.25"N<br>73° 4'24.29"E  | Kharghar    | pH, Turbidity,<br>Total Coliform,<br>Free Ammonia,<br>TDS, Nitrate, Total<br>hardness as CaCO <sub>3</sub> ,<br>Total alkalinity as<br>CaCO <sub>3</sub> ,<br>COD, BOD, DO, TSS,<br>Sodium Absorption<br>Ratio |
| SW2  | Shiv Temple Pond               | 19° 1'0.34"N<br>73° 5'37.24"E  | Kamothe     |                                                                                                                                                                                                                |
| SW3  | Roadpali                       | 19° 2'25.75"N<br>73° 5'54.51"E | Kalamboli   |                                                                                                                                                                                                                |
| SW4  | Dewale Lake                    | 18°59'21.75"N<br>73° 6'27.51"E | New Panvel  |                                                                                                                                                                                                                |
| SW5  | Taloje River                   | 19° 4'56.61"N<br>73° 6'1.72"E  | Up Stream   |                                                                                                                                                                                                                |
| SW6  | Taloje River                   | 19° 4'2.91"N<br>73° 5'36.68"E  | Down Stream |                                                                                                                                                                                                                |
| SW7  | Kasrdi River                   | 19° 2'51.25"N<br>73° 6'33.92"E | Up Stream   |                                                                                                                                                                                                                |
| SW8  | Kasrdi River                   | 19° 2'48.56"N<br>73° 6'13.00"E | Down Stream |                                                                                                                                                                                                                |
| GW1  | Kharghar Gram Panchayat        | 19° 2'42.51"N<br>73° 4'14.87"E | Kharghar    | pH, Turbidity, TDS,<br>Arsenic, Total<br>hardness as CaCO <sub>3</sub> ,<br>Total alkalinity as<br>CaCO <sub>3</sub> , DO, Chloride,<br>TSS, Fluoride, Mercury,<br>Lead                                        |
| GW2  | Kamothe gram panchyat office   | 19° 0'59.40"N<br>73° 5'25.34"E | Kamothe     |                                                                                                                                                                                                                |
| GW3  | Kalamboli gram panchyat office | 19° 1'20.72"N<br>73° 6'10.73"E | Kalamboli   |                                                                                                                                                                                                                |
| GW4  | Panvel panchyat samiti         | 18°59'18.67"N<br>73° 6'51.85"E | panvel      |                                                                                                                                                                                                                |
| GW5  | Taloje MIDC                    | 19° 3'40.58"N<br>73° 7'2.89"E  | Taloja MIDC |                                                                                                                                                                                                                |

### 10.3.1 Surface Water Analysis

Surface & Ground water samples were collected from all four wards of Panvel Municipal Corporation and also from major rivers around the city. The parameters of the surface water samples were compared against the designated best use classification of CPCB as given in Table 10.11.

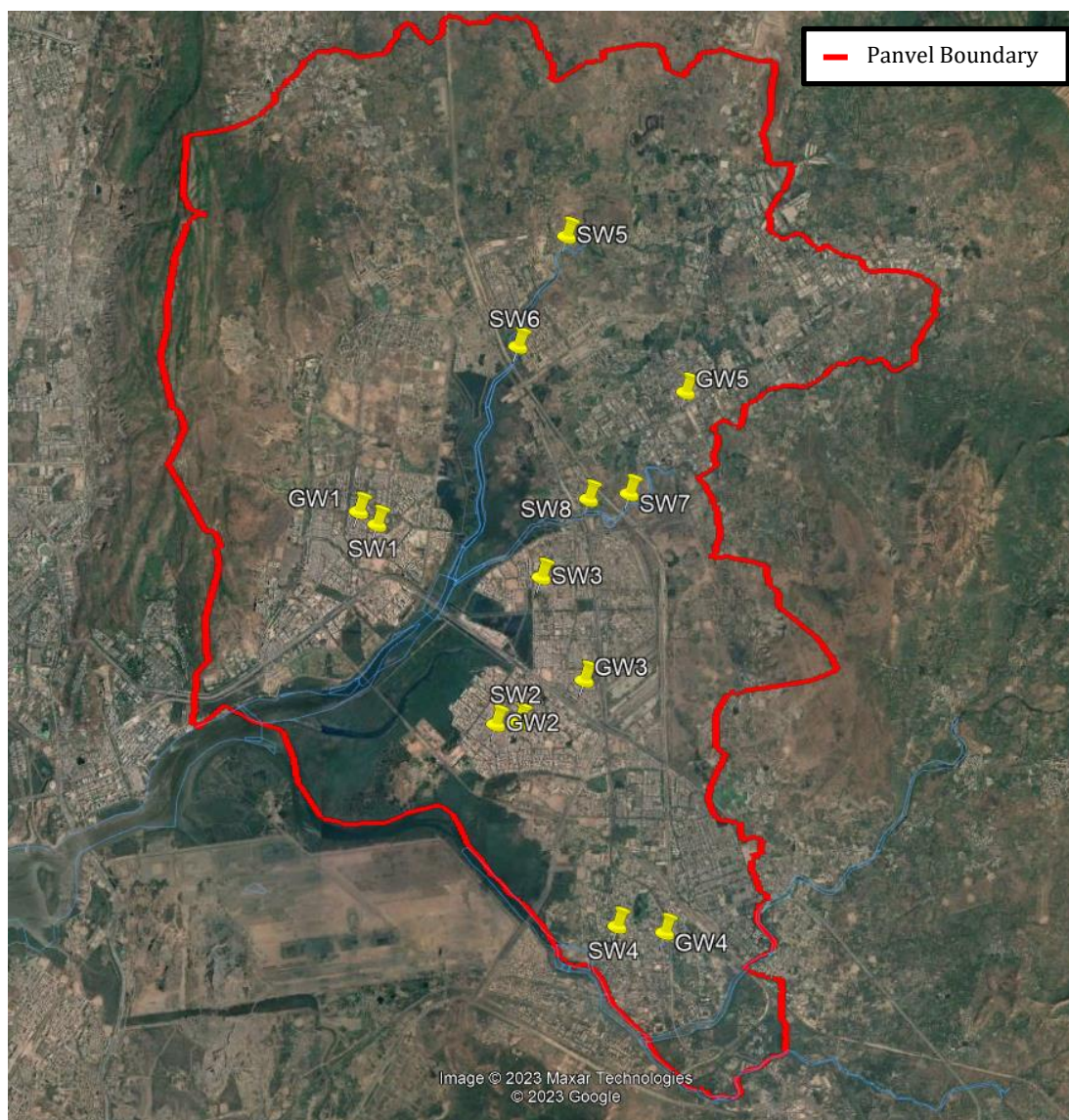


Figure 10.4: Ground Water and Surface Water Monitoring Locations



Table 10.11: Water Quality Standards by CPCB for Best Designated Usage

| Designated- Best-Use                                                        | Class of Water | Criteria                                                 |
|-----------------------------------------------------------------------------|----------------|----------------------------------------------------------|
| Drinking Water Source Without Conventional Treatment but After Disinfection | A              | Total Coliforms Organism MPN/100 ml shall be 50 or less. |
|                                                                             |                | pH between 6.5 – 8.5                                     |
|                                                                             |                | Dissolved Oxygen: 6 mg/l or more                         |
|                                                                             |                | Biochemical Oxygen Demand 5 Days 20 °C: 2 mg/l or less   |
| Outdoor Bathing (Organized)                                                 | B              | Total Coliforms Organism MPN/100 ml shall be 500 or less |
|                                                                             |                | pH between 6.5 and 8.5                                   |
|                                                                             |                | Dissolved Oxygen: 5 mg/l or more                         |
|                                                                             |                | Biochemical Oxygen Demand 5 Days 20 °C: 3 mg/l or less   |
| Drinking Water Source After Conventional Treatment and Disinfection         | C              | Total Coliforms Organism MPN/100 ml shall be 500 or less |
|                                                                             |                | pH between 6.5 and 9                                     |
|                                                                             |                | Dissolved Oxygen: 4 mg/l or more                         |
|                                                                             |                | Biochemical Oxygen Demand 5 Days 20 °C: 3 mg/l or less   |
| Propagation of Wildlife and Fisheries                                       | D              | pH between 6.5 and 8.5                                   |
|                                                                             |                | Dissolved Oxygen: 4 mg/l or more                         |
|                                                                             |                | Free Ammonia (as N): 1.2 mg/l or less                    |
| Irrigation, Industrial Cooling, Controlled Water Disposal                   | E              | pH between 6.5 and 8.5                                   |
|                                                                             |                | Electrical Conductivity at 25°C micro mhos/cm: Max 2250  |
|                                                                             |                | Sodium Absorption Ration: Max. 26                        |
|                                                                             |                | Boron: Max. 2 mg/l                                       |
|                                                                             |                | Free Ammonia (as N): 1.2 mg/l or less                    |
|                                                                             |                | Chlorides: 600 mg/l                                      |
|                                                                             |                | Sulphates: 1000 mg/l                                     |
| -                                                                           | Below-E        | Not Meeting A, B, C, D & E Criteria                      |



Figure 10.5: Surface Water Sample Collection from Kalamboli Visarjan Talav

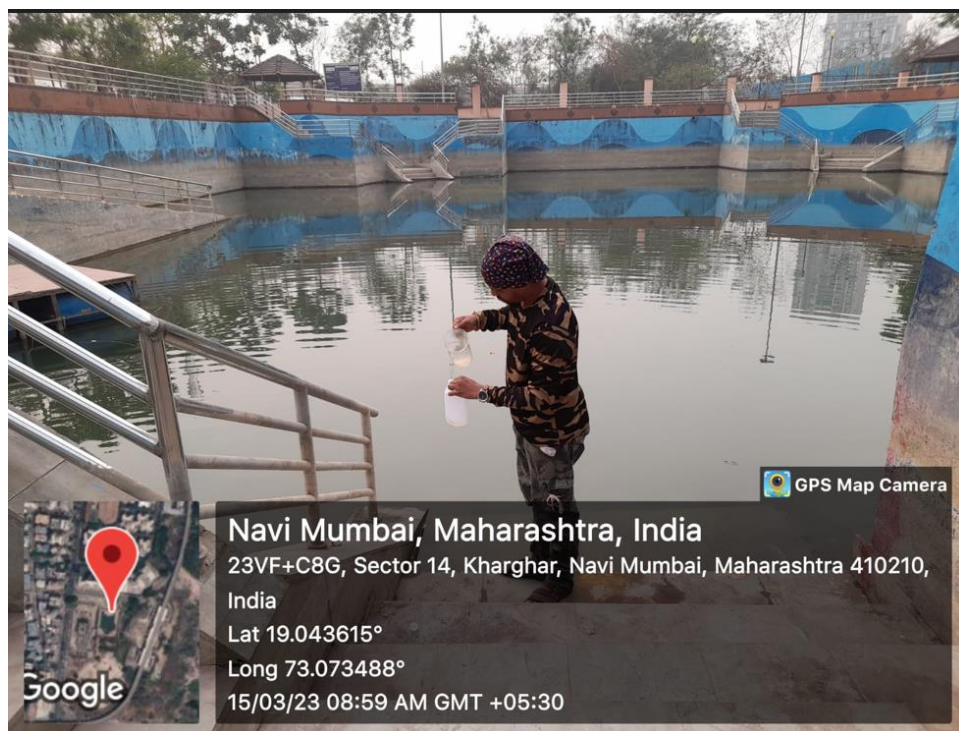


Figure 10.6: Surface Water Collection from Shree Shiv Samartha Talav, Kharghar



Table 10.12: Results of Surface Water Samples Analysis (Pre-Monsoon)

| Sr. No. | Parameter                             | Normal Range | Units  | (SW1)     | (SW2)     | (SW3)     | (SW4)     |
|---------|---------------------------------------|--------------|--------|-----------|-----------|-----------|-----------|
| 1.      | pH                                    | 6.0-8.5      |        | 7.5       | 7.19      | 7.28      | 7.4       |
| 2.      | Electrical Conductivity               | < 2250.0     | mS/cm  | 2490      | 1284      | 2260      | 471       |
| 3.      | Taste                                 | NS           | ---    | Agreeable | Agreeable | Agreeable | Agreeable |
| 4.      | Colour                                | NS           | Hazen  | 1.1       | 0.9       | 1.4       | 0.6       |
| 5.      | Odour                                 | NS           | ---    | Agreeable | Agreeable | Agreeable | Agreeable |
| 6.      | Turbidity                             | NS           | NTU    | 1         | 1         | 1.2       | 0.55      |
| 7.      | TSS                                   | NS           | mg/L   | 34        | 28        | 39        | 23        |
| 8.      | TDS                                   | < 2100.0     | mg/L   | 2266      | 1042      | 2015      | 402       |
| 9.      | COD                                   | NS           | mg/L   | 38.4      | 89.6      | 83.2      | 38.4      |
| 10.     | BOD@ 27°C for 3 days                  | NS           | mg/L   | 11.5      | 29.1      | 27.6      | 12.8      |
| 11.     | DO                                    | NS           | mg/L   | 3.6       | 3         | 3.2       | 3.9       |
| 12.     | Total Hardness as CaCO <sub>3</sub>   | NS           | mg/L   | 1860      | 608       | 1450      | 148       |
| 13.     | Total Alkalinity as CaCO <sub>3</sub> | NS           | mg/L   | 86        | 80        | 68        | 72        |
| 14.     | Free Ammonia as N                     | NS           | mg/L   | NIL       | NIL       | NIL       | NIL       |
| 15.     | Nitrates as NO <sub>3</sub>           | NS           | mg/L   | 3.45      | 2.9       | 2.85      | 2.75      |
| 16.     | SAR                                   | < 26.0       | ---    | 12.4      | 10.4      | 11.6      | 10.1      |
| 17.     | Total Coliform                        | NS           | CFU/ml | 34        | 28        | 27        | 24        |

NS: Not Specified



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| Sr. No. | Parameter                             | Normal Range | Units  | (SW5)     | (SW6)     | (SW7)     | (SW8)        |
|---------|---------------------------------------|--------------|--------|-----------|-----------|-----------|--------------|
| 1.      | pH                                    | 6.0-8.5      |        | 7.03      | 7.21      | 7.33      | 6.51         |
| 2.      | Electrical Conductivity               | < 2250.0     | mS/cm  | 3320      | 4722      | 4260      | 6892         |
| 3.      | Taste                                 | NS           | ---    | Agreeable | Agreeable | Agreeable | Agreeable    |
| 4.      | Colour                                | NS           | Hazen  | 1.8       | 2.25      | 2.2       | 4.3          |
| 5.      | Odour                                 | NS           | ---    | Agreeable | Agreeable | Agreeable | Disagreeable |
| 6.      | Turbidity                             | NS           | NTU    | 1.65      | 2.1       | 1.9       | 3.5          |
| 7.      | TSS                                   | NS           | mg/L   | 46        | 56        | 48        | 69           |
| 8.      | TDS                                   | < 2100.0     | mg/L   | 3012      | 4256      | 3950      | 6322         |
| 9.      | COD                                   | NS           | mg/L   | 70.4      | 83.2      | 96        | 627.2        |
| 10.     | BOD@ 27°C for 3 days                  | NS           | mg/L   | 26.5      | 33.2      | 37.5      | 298.6        |
| 11.     | DO                                    | NS           | mg/L   | 2.9       | 2.1       | 2.5       | 0.8          |
| 12.     | Total Hardness as CaCO <sub>3</sub>   | NS           | mg/ L  | 990       | 640       | 760       | 600          |
| 13.     | Total Alkalinity as CaCO <sub>3</sub> | NS           | mg/L   | 66        | 74        | 70        | 62           |
| 14.     | Free Ammonia as N                     | NS           | mg/L   | NIL       | NIL       | 2.45      | 3.12         |
| 15.     | Nitrates as NO <sub>3</sub>           | NS           | mg/L   | 2.45      | 4.12      | 3.9       | 5.25         |
| 16.     | SAR                                   | < 26.0       | ---    | 12.5      | 14.1      | 13.4      | 16.2         |
| 17.     | Total Coliform                        | NS           | CFU/ml | 42        | 50        | 42        | 62           |

NS: Not Specified



Table 10.13: Results of Surface Water Samples Analysis (Post-Monsoon)

| Sr. No. | Parameter                             | Normal Range | Units                  | (SW1)  | (SW2)  | (SW3)  | (SW4)  |
|---------|---------------------------------------|--------------|------------------------|--------|--------|--------|--------|
| 1.      | pH                                    | 6.5 -7.5     |                        | 7.69   | 7.69   | 7.63   | 7.82   |
| 2.      | Electrical Conductivity               | 0 - 0.75     | dSm <sup>-1</sup>      | 1.56   | 0.87   | 1.42   | 0.35   |
| 3.      | Carbonates                            |              | meq.lit. <sup>-1</sup> | 1.60   | 4.00   | 1.60   | 0.30   |
| 4.      | Bicarbonates                          |              | meq.lit. <sup>-1</sup> | 1.60   | 2.40   | 2.40   | 3.60   |
| 5.      | Chlorides                             | 0 - 5.00     | meq.lit. <sup>-1</sup> | 1.20   | 4.40   | 4.00   | 4.00   |
| 6.      | Sulphates                             | 0 - 4.00     | meq.lit. <sup>-1</sup> | 21.48  | 1.00   | 12.62  | 1.55   |
| 7.      | Calcium                               |              | meq.lit. <sup>-1</sup> | 20.40  | 4.60   | 12.40  | 2.60   |
| 8.      | Magnesium                             |              | meq.lit. <sup>-1</sup> | 3.20   | 4.60   | 4.60   | 1.60   |
| 9.      | Sodium                                |              | meq.lit. <sup>-1</sup> | 1.83   | 2.10   | 3.03   | 1.68   |
| 10.     | Potassium                             |              | meq.lit. <sup>-1</sup> | 0.45   | 0.50   | 0.59   | 0.47   |
| 11.     | Mg: Ca ratio                          | 0 - 1.50     |                        | 0.16   | 1.00   | 0.37   | 0.62   |
| 12.     | SAR                                   | <10          |                        | 0.53   | 0.69   | 1.04   | 1.16   |
| 13.     | Residual sodium carbonate (RSC)       | <1.25        |                        | 0.00   | 0.00   | 0.00   | 0.00   |
| 14.     | Total Dissolved Salts (TDS)           | < 460        | mg lit. <sup>-1</sup>  | 998.40 | 556.80 | 908.80 | 224.00 |
| 15.     | Total hardness as CaCO <sub>3</sub>   |              | mg lit. <sup>-1</sup>  | 2360   | 920    | 1700   | 420    |
| 16.     | Total alkalinity as CaCO <sub>3</sub> |              | mg lit. <sup>-1</sup>  | 320    | 640    | 400    | 390    |
| 17.     | BOD                                   | < 30         | mg lit. <sup>-1</sup>  | 11.41  | 9.09   | 10.54  | 8.04   |
| 18.     | COD                                   | < 200        | mg lit. <sup>-1</sup>  | 46.18  | 36.00  | 42.08  | 32.16  |
| 19.     | Nickel (Ni)                           | < 3          | mg lit. <sup>-1</sup>  | traces | traces | 0.02   | traces |
| 20.     | Chromium (Cr)                         | 6.5 -7.5     | mg lit. <sup>-1</sup>  | 0.17   | 0.15   | 0.15   | 0.12   |



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| Sr. No. | Parameter                             | Normal Range | Units                  | (SW5)  | (SW6)  | (SW7)  | (SW8)   |
|---------|---------------------------------------|--------------|------------------------|--------|--------|--------|---------|
| 1.      | pH                                    | 6.5 -7.5     |                        | 8.1 1  | 8.13   | 7.62   | 7.33    |
| 2.      | Electrical Conductivity               | 0 - 0.75     | dSm <sup>-1</sup>      | 0.36   | 0.37   | 0.68   | 4.10    |
| 3.      | Carbonates                            |              | meq.lit. <sup>-1</sup> | 0.40   | 0.30   | 0.40   | 0.30    |
| 4.      | Bicarbonates                          |              | meq.lit. <sup>-1</sup> | 4.00   | 2.80   | 5.20   | 5.20    |
| 5.      | Chlorides                             | 0 - 5.00     | meq.lit. <sup>-1</sup> | 4.00   | 4.40   | 4.40   | 4.00    |
| 6.      | Sulphates                             | 0 - 4.00     | meq.lit. <sup>-1</sup> | 1.32   | 2.00   | 0.83   | 50.38   |
| 7.      | Calcium                               |              | meq.lit. <sup>-1</sup> | 5.20   | 2.40   | 3.60   | 8.20    |
| 8.      | Magnesium                             |              | meq.lit. <sup>-1</sup> | 5.60   | 2.00   | 2.60   | 4.60    |
| 9.      | Sodium                                |              | meq.lit. <sup>-1</sup> | 1.01   | 1.04   | 4.04   | 47.08   |
| 10.     | Potassium                             |              | meq.lit. <sup>-1</sup> | 0.07   | 0.06   | 0.39   | 3.02    |
| 11.     | Mg: Ca ratio                          | 0 - 1.50     |                        | 1.08   | 0.83   | 0.78   | 0.56    |
| 12.     | SAR                                   | <10          |                        | 0.44   | 0.70   | 2.26   | 18.61   |
| 13.     | Residual sodium carbonate (RSC)       | <1.25        |                        | 0.00   | 0.00   | 0.00   | 0.00    |
| 14.     | TDS                                   | <460         | mg lit. <sup>-1</sup>  | 230.40 | 236.80 | 435.20 | 2624.00 |
| 15.     | Total hardness as CaCO <sub>3</sub>   |              | mg lit. <sup>-1</sup>  | 1080   | 440    | 640    | 1280    |
| 16.     | Total alkalinity as CaCO <sub>3</sub> |              | mg lit. <sup>-1</sup>  | 440    | 310    | 560    | 550     |
| 17.     | BOD                                   | < 30         | mg lit. <sup>-1</sup>  | 6.50   | 7.23   | 8.04   | 16.71   |
| 18.     | COD                                   | < 200        | mg lit. <sup>-1</sup>  | 26.01  | 28.92  | 32.16  | 66.84   |
| 19.     | Nickel (Ni)                           | < 3          | mg lit. <sup>-1</sup>  | traces | traces | traces | traces  |
| 20.     | Chromium (Cr)                         | 6.5 -7.5     | mg lit. <sup>-1</sup>  | 0.13   | 0.11   | 0.12   | 0.13    |

### Inference:

The summary of inferences of the analysis of surface water samples results is as follows:

- pH of the Surface water samples was observed to be in the range of 7.33 – 8.13.
- The Chemical Oxygen Demand (COD) value was found to be in the range of 26.01 mg/l to 66.84 mg/l. The Highest level of COD (66.84 mg/l) was seen in sample SW8 (Kasrdi River is downstream of Navade bridge). All values obtained were within the desirable limit for COD as prescribed by CPCB.

- The maximum concentrations of Biochemical Oxygen Demand (BOD) were observed at SW8 (16.71 mg/l), whereas the minimum concentration was observed at SW5 (6.50 mg/l); but all the values are within the permissible limits.
- Total Hardness was observed to be ranging between 420 to 2360mg/l. The highest value of hardness was recorded at Shree Shiv Samarth Talav, Kharghar & minimum value was recorded at SW4; which is a sample collected in Dewale Lake in the study area.
- The concentrations of Total Dissolved Solids were in the range of 224 mg/l to 2624 mg/l. The maximum concentration of Total Dissolved Solids (TDS) was observed at SW1, SW2, SW3 & SW8, whereas the minimum TDS concentration was observed at SW4, SW5, SW6 & SW7. Since the locations are wide-ranging from rivers & lakes, a large variation is observed in the concentration of Total Dissolved Solids.

### 10.3.2 Ground Water Analysis

The ground water samples were analyzed for parameters as specified in IS: 10500 (2012) standards, "Drinking Water- Specifications" and analyzed as per methods specified in IS: 3025, "Methods of sampling and test (physical and chemical) for water and wastewater". The results of the analysis are presented in Table 10.13 & 10.14. The summary of results is presented in the following sub section.



Figure 10.7: Ground Water sampling from Kamothe Gaon, Kamothe



Figure 10.8: Ground Water sampling from Kharghar Gaon, Kharghar



Table 10.14: Results of Ground Water Samples Analysis (Pre-Monsoon)

| Sr. No | Parameters                            | Units | Limits as per IS10500:2018 | (GW1)        | (GW2)        | (GW3)     | (GW4)     | (GW5)     |
|--------|---------------------------------------|-------|----------------------------|--------------|--------------|-----------|-----------|-----------|
| 1      | pH                                    | ---   | 6.5-8.5                    | 7.23         | 6.88         | 6.86      | 7.18      | 7.15      |
| 2      | Electrical Conductivity               | mS/cm | Not Specified              | 0.67         | 0.79         | 0.10      | 0.57      | 0.155     |
| 3      | Total Hardness as CaCO <sub>3</sub>   | mg/L  | < 200.00                   | 214          | 202          | 36        | 180       | 62        |
| 4      | TDS                                   | mg/L  | < 500.00                   | 544          | 656          | 88        | 494       | 130       |
| 5      | TSS                                   |       | Not Specified              | 16           | 24           | 12        | 20        | 14        |
| 6      | Chlorides as Cl                       | mg/L  | < 250.00                   | <b>51.35</b> | <b>61.40</b> | 5.05      | 39.25     | 14.10     |
| 7      | Total Alkalinity as CaCO <sub>3</sub> | mg/L  | < 200.00                   | <b>48</b>    | <b>52</b>    | 42        | 58        | 60        |
| 8      | DO                                    | mg/L  | Not Specified              | 5.30         | 5            | 6.60      | 5.10      | 6.40      |
| 9      | Arsenic as As                         | mg/L  | < 0.01                     | BDL< 0.01    | BDL< 0.01    | BDL< 0.01 | BDL< 0.01 | BDL< 0.01 |
| 10     | Fluoride as F                         | Mg/L  | < 1.00                     | 0.17         | 0.195        | 0.023     | 0.09      | NIL       |
| 11     | Mercury as Hg                         | mg/L  | < 0.001                    | BDL< 0.01    | BDL< 0.01    | BDL< 0.01 | BDL< 0.01 | BDL< 0.01 |
| 12     | Lead as Pb                            | mg/L  | < 0.01                     | BDL< 0.01    | BDL< 0.01    | BDL< 0.01 | BDL< 0.01 | BDL< 0.01 |

\*BDL: Below Detectable Limit, DL: Detectable Limit

Table 10.15: Results of Ground Water Samples Analysis (Post-Monsoon)

| Sr. No | Parameters                            | Units | LIMITS AS PER IS10500:2018 | (GW1)  | (GW2)  | (GW3)  | (GW4)  | (GW5)  |
|--------|---------------------------------------|-------|----------------------------|--------|--------|--------|--------|--------|
| 1      | pH                                    | -     | 6.5-8.5                    | 8.01   | 7.96   | 8.08   | 8.02   | 8.49   |
| 2      | Electrical Conductivity               | mS/cm | Not Specified              | 0.18   | 0.10   | 0.37   | 0.16   | 0.95   |
| 3      | Total Hardness                        | mg/L  | < 200.00                   | 240    | 300    | 480    | 380    | 940    |
| 4      | TDS                                   | mg/L  | < 500.00                   | 115    | 64     | 236    | 102    | 608    |
| 5      | Chloride as Cl                        | mg/L  | < 250.00                   | 4      | 2.80   | 3.60   | 2.80   | 5.60   |
| 6      | Total Alkalinity as CaCO <sub>3</sub> | mg/L  | < 200.00                   | 160    | 200    | 520    | 360    | 1200   |
| 7      | Chromium as Cr                        | mg/L  | 6.5 -7.5                   | 0.12   | 0.12   | 0.12   | 0.11   | 0.12   |
| 8      | Nickel                                | mg/L  | 3                          | traces | traces | traces | traces | traces |

### Inference:

- The above results indicate that the pH of all the ground water samples was observed to be in the range of 6.86-8.49.
- Total Dissolved Solids in the samples were in the range of 64 – 656 mg /l.
- Total Hardness was found to vary between 360-940 mg/l.
- Chloride was detected in the range of 2.80 to 61.40 mg/l.
- Heavy metal concentrations in all the samples were found to be well within the limits.

## 10.4 Soil Sample Analysis

Four soil sample were collected three from Commercial, Residential area and One from Industrial area.

Table 10.16: Soil Sample Locations

| Code | Site Location        | Location Coordinates           | Landmark         | Parameters                                                                                     |
|------|----------------------|--------------------------------|------------------|------------------------------------------------------------------------------------------------|
| SQ1  | Shilp Chowk          | 19°2'50.23"N<br>73° 4'11.65"E  | Residential Area | pH, Texture, Total Organic Matter, Sodium Adsorption Ratio (SAR), Water holding Capacity, NPK. |
| SQ2  | Kalamboli Circle     | 19° 1'3.56"N<br>73° 6'22.49"E  | Industrial Area  |                                                                                                |
| SQ3  | Panvel Bus Depot     | 18°59'31.95"N<br>73° 6'58.74"E | Commercial Area  |                                                                                                |
| SQ4  | Navade Gram Panchyat | 19° 2'56.77"N<br>73° 6'4.42"E  | Industrial Area  |                                                                                                |

Table 10.17: Soil Sample Analysis Results (Pre-Monsoon)

| Location & Code<br>Parameter |       | Normal Range | SQ1        | SQ2        | SQ3        | SQ4        |
|------------------------------|-------|--------------|------------|------------|------------|------------|
| pH                           | ---   | 6.5-7.5      | 7.08       | 6.52       | 7.16       | 6.76       |
| Texture                      | ---   | -            | Sandy loam | Sandy loam | Sandy Silt | Sandy Clay |
| Sand                         | %     | -            | 54         | 58         | 50         | 46         |
| Slit                         | %     | -            | 16         | 14         | 20         | 20         |
| Clay                         | %     | -            | 30         | 28         | 30         | 34         |
| EC                           | mS/cm | < 2          | 0.227      | 0.91       | 0.19       | 0.53       |
| Total Organic Matter         | %     | -            | 0.63       | 0.48       | 0.66       | 0.59       |
| SAR                          | ---   | < 10         | 11.12      | 8.9        | 13.2       | 10.5       |
| Water holding Capacity       | %     | -            | 52.1       | 46.2       | 51.45      | 49.1       |

Table 10.18: Soil Sample Analysis Results (Post-Monsoon)

| Location & Code<br>Parameter | Unit                   | Normal<br>Range | SQ1          | SQ2                | SQ3       | SQ4       |
|------------------------------|------------------------|-----------------|--------------|--------------------|-----------|-----------|
| pH                           | -                      | 6.5-7.5         | 8.56         | 6.43               | 7.40      | 8.33      |
| EC                           | mS/cm                  | < 2             | 0.31         | 0.10               | 0.26      | 0.13      |
| WHC                          | %                      | -               | 36.05        | 55.92              | 39.45     | 40.25     |
| Organic carbon               | -                      | 0.4-0.6         | 0.32         | 1.67               | 0.63      | 0.39      |
| SAR                          | -                      | < 10            | 4.61         | 0.75               | 4.01      | 0.98      |
| Available N                  | (kg ha <sup>-1</sup> ) | 281-420         | 147          | 206                | 177       | 160       |
| Available P                  | (kg ha <sup>-1</sup> ) | 15-21           | 19           | 28                 | 21        | 21        |
| Available K                  | (kg ha <sup>-1</sup> ) | 151-200         | 869          | 921                | 1104      | 1290      |
| Texture                      | -                      | -               | Silt<br>Loam | Silty Clay<br>Loam | Silt Loam | Silt Loam |

#### Inference:

- pH of the soil in the study area ranged between 6.43- 8.56. The “Strongly alkaline” soil was observed at first location (SQ1). In other locations, it varied from "Slightly acidic” to “Moderately alkaline”.
- The values for Nitrogen at all locations varied between 147-206 kg ha<sup>-1</sup>. This indicates as the Nitrogen is ‘Low’ as per the classification at all locations.
- The concentration of Phosphate was estimated to be between 19-28 kg ha<sup>-1</sup>. The highest concentration can be observed at location SQ2, while the lowest concentration can be observed at location SQ1 during the monitoring period. Here it is observed that Phosphate concentration observed ‘Medium’ as per chemical classification of soil quality.
- The concentration of Potassium was found to be ranging between 869-1290 kg ha<sup>-1</sup>. Here it is observed that Potassium concentration observed ‘Very High’ as per chemical classification of soil quality.
- The large variation is observed in the values due to their use or application and also due to the variation in the use of fertilizers.



Figure 10.9: Soil Sample sampling from Taloja



## 11 Conclusion and Recommendation

Panvel city surrounded by industrial area, therefore it is likely to be affected by pollution. This would imply a need to have a framework for the environmental management.

The AQI of Panvel was good as there were restriction implied due to the COVID- 19 situation. But as the restrictions are lifted, industries have started working again, also human activities have increased and so do the transport. The ambient air sampling is done for all four wards of PMC & its result indicates exceeding values of PM<sub>10</sub> and PM<sub>2.5</sub> for all locations. The reason for the high values of PM<sub>10</sub> & PM<sub>2.5</sub> are major transport route i.e., Mumbai -Satara Highway, Kalamboli Flyover Bridge is passing by the same route. Also, these areas are beside the various cement industries Air Pollution is also contributed by Urban Transport significantly. It is observed that the maximum population use of individual vehicle for transportation. To reduce vehicular pollution, subsidized low-cost local public transport system, as BEST reduced tariffs significantly recently to attract more people towards the mode of public transport, be made available to the residents in the city. The use of CNG kit-fitted vehicles can also help to curb air pollution. CNG is an effective alternative fuel option to tackle pollution. The use of zero-emission vehicles such as electric cars, electric scooters/bikes, and EV commercial vehicles can significantly reduce carbon emissions. It should start its own subsidized low-cost Municipal Transport System which should largely have Electric Buses to boost the reduction in vehicular pollution and also install sources of renewable energy to reduce CO<sub>2</sub> emission at electricity generation. Carpooling is another effective way to reduce pollution and is cost-effective as well. As Panvel is an industrial hub, the vegetation in the city is seen to be less. By increasing the vegetation of the city i.e., besides the roads can reduce PM<sub>10</sub> levels to a considerable rate.

Data on noise level was collected by using noise level meter covering the entire cities main areas such as Industrial Area, Commercial Area, Residential Area and Silent Zone. The data was collected continuously for 24hrs. Noise levels are seen to be exceeding in the Residential area, Commercial area and industrial zone. As there is increase in the



population and the restrictions are lifted, human activities have increased causing a rise in the noise level. The Average noise level is highest at Navade gram panchayat area. It can be due to its proximity to the railway station and the highway. As the Kalamboli circle is near highway road and Kalamboli MIDC road is also connected to the circle, so that the noise levels are exceeding due to passing of vehicles and material transportation practices where goes on day and night. The Commercial area is nearby Panvel ST stand which causes heightened noise levels. Effective traffic control measures near residential and commercial area can be implemented. Encourage citizens to use public transport rather than drive their own car to cut down on traffic and noise pollution. Conduct awareness and education programmes on the consequences of noise pollution. Plant trees. Trees have been established to be effective in reducing noise levels within urban settings, around major highways, and even at the places we stay. In addition to that, trees have various aesthetic advantages and improve air quality.

Panvel is well connected to a water source. Water quality is equally important to sustain the environment. At present 238 MLD water is available per day remaining 80 MLD of water need to make available from other water sources. There are four main sources such as a Dehrang Dam, MIDC, CIDCO and Patalganga MJP through which PMC can manage the water supply. Now also the water demand is more than the supply, some villages are not getting enough amount of water for daily use to overcome this problem PMC construct borewell in village to full feel the water demand. Considering the water demand in near future the PMC need to make certain provision to meet the future water demand. The Kondhane Dam project it's an great initiative by the CIDCO to fulfil the additional CIDCO's drinking water demand in the balance areas like CIDCO nodes and Navi Mumbai International Airport (i.e. Kharghar, Kamothe, Kalamboli, Taloja, Karanjade, Kalundre, Dronagari, Ulwe, Pushpak etc), CIDCO subsequently requested to the Govt. of Maharashtra to allocate the Kondhane Dam Project in Karjat Taluka of Dist. Raigad to CIDCO for drinking water source. As per the request of CIDCO, Water Resource Department, Govt. of Maharashtra handed over Kondhane dam project as a drinking water project. The provision regarding the same is allowed under the general meeting of MPC on September 5,



2019(Kondhane dam brief project report presented by CIDCO). The most important concern is the pollution of water bodies Kasadi and Taloja rivers in PMC areas. MPCB does not monitor the water quality of any of the rivers because water from these water bodies is not used for drinking purpose. But pollution in water bodies has multiple effects on ecosystem and biodiversity in the areas and hence we recommend that PMC insist MPCB to carry out water quality monitoring in all rivers in the PMC area. Strict action on the discharge of industrial effluent in the water body must be taken. The capacity of CETP should be increased so that more effluent can be treated. All the water bodies such as rivers, lakes and ponds must be cleaned regularly with the help of required equipment.

PMC carries out Solid Waste Management with the help of Mumbai Waste Management Ltd., located at Taloja, MIDC. Area under Panvel Municipal Corporation Generates approx. 450 TDP MSW. Out of Which approx. 56 % is wet waste, approx. 40 % is Dry waste (Based on daily weighting report at MSW Plant), approx. 1 % is Domestic Hazardous waste and approx. 3 % Sanitary Waste. Since January 2021, PMC is practicing 100 % Processing on wet waste and 100 % Processing on dry waste. Domestic Hazardous waste and Sanitary Hazardous waste are been processed 100 % by Mumbai Waste Management, RAMKY Group at location. The work of MSW processing plant is awarded to CIDCO Management. The operator of the site also charged tipping fee of around Rs.736/- Ton for functioning of the plant. The permission for new housing construction or housing projects must not be issued in notified MIDC area and also nearby villages of the SWM site in Taloja.

All the gardens in the city are cleaned and maintained from time to time. The tree cover in gardens be increased and plants that include flowers and aesthetics in gardens are very important aspects that relax the stress of residents. The ornamental plantation can be done to cover the unused, empty open areas of public gardens in the city. Panvel municipal corporation planted 17,445 trees at MGM Dental college extension building sector 19,20, TATA Hospital Corner to Sec.35,Kharghar, Taloja phase-II,Sec.25 to Koyanavelle village and Panvel mumbra Road to Dhansar village under Majhi Vasundhara Abhiyan programme 1.0 and 2.0, out of which 14,763 trees survived as per report.



Cleanliness and Beautification of Roads are equally important in making City sustainable. Roadside gardening on open and unused areas will enhance the look of the roads. That reduces the stress of the commuters and residents passing by the roads.



## Annexure I

### Lists of Flora and Fauna

#### List of Amphibians

| Sr. No. | Common Name            | Scientific Name            |
|---------|------------------------|----------------------------|
| 1       | Common Indian Toad     | Duttaphrynus melanostictus |
| 2       | Common Tree Frog       | Polypedates maculatus      |
| 3       | Fungoid Frog           | Hydrophylax bahuvistara    |
| 4       | Bush frog sps.         | Raorchestes sps.           |
| 5       | Indian Bullfrog        | Hoplobatrachus tigerinus   |
| 6       | Cricket frog           | Minervarya sps.            |
| 7       | Common Skittering Frog | Euphlyctis cyanophlyctis   |

Source: [www.indiabiodiversity.org](http://www.indiabiodiversity.org)

#### List of Snakes

| Sr. No. | Common Name             | Scientific Name       |
|---------|-------------------------|-----------------------|
| 1       | Indian Spectacled Cobra | Naja naja             |
| 2       | Russell's Viper         | Daboia russelii       |
| 3       | Saw-scaled Viper        | Echis crinatus        |
| 4       | Common Krait            | Bungarus caeruleus    |
| 5       | Checkered Keelback      | Xenochrophis piscator |
| 6       | Buff-striped Keelback   | Amphiesma stolatum    |
| 7       | Rat Snake               | Ptyas mucosa          |
| 8       | Common Wolf Snake       | Lycodon aulicus       |
| 9       | Travancore Wolf Snake   | Lycodon travancoricus |
| 10      | Common Vine Snake       | Ahaetulla nasuta      |
| 11      | Common Cat Snake        | Boiga trigonata       |
| 12      | Indian Rock Python      | Python molurus        |
| 13      | Common Sand Boa         | Eryx conicus          |
| 14      | Red Sand Boa            | Eryx jhonii           |
| 15      | Montane Trinket         | Coelognathus helena   |

Source: [www.indiabiodiversity.org](http://www.indiabiodiversity.org)



## List of Butterflies

| Sr. No. | Common Names         | Scientific Name       |
|---------|----------------------|-----------------------|
| 1       | Gram Blue            | Euchrysops cnejus     |
| 2       | Tiny Grass Blue      | Zizula hylax          |
| 3       | Grass Jewel          | Chilades trochylus    |
| 4       | Red Pierrot          | Talica nyseus         |
| 5       | Common Cerulean      | Jamides celeno        |
| 6       | Forget-me-not        | Catochrysops Strabo   |
| 7       | Dark Grass Blue      | Zizeeria karsandra    |
| 8       | Common Lineblue      | Prosotas nora         |
| 9       | Tailless Lineblue    | Prosotas dubiosa      |
| 10      | Pointed Ciliate Blue | Anthene lycaenina     |
| 11      | Slate Flash          | Rapala manea          |
| 12      | Common Silverline    | Spindasis vulcanus    |
| 13      | Peacock Royal        | Tajuria cippus        |
| 14      | Apefly               | Spalgis epus          |
| 15      | Common Small Flat    | Sarangesa dasahara    |
| 16      | Grass Demon          | Udaspes folus         |
| 17      | Rice Swift           | Borbo cinnara         |
| 18      | Blank Swift          | Caltoris kumara       |
| 19      | Spotted Small Flat   | Sarangesa purendra    |
| 20      | Brown Awl            | Badamia exclamationis |
| 21      | Common Baron         | Euthalia aconthea     |
| 22      | Gaudy Baron          | Euthalia lubentina    |
| 23      | Baronet              | Symphaedra nais       |
| 24      | Common Crow          | Euploea core          |
| 25      | Plain Tiger          | Danaus chrysippus     |
| 26      | Striped Tiger        | Danaus chrysippus     |
| 27      | Blue Tiger           | Tirumala limniace     |
| 28      | Glassy Tiger         | Parantica aglea       |
| 29      | Great Eggfly         | Hypolimnas bolina     |
| 30      | Danid Eggfly         | Hypolimnas misippus   |
| 31      | Blue Oakleaf         | Kallima horsfieldi    |
| 32      | Common Eveningbrown  | Kallima horsfieldi    |
| 33      | Common Bushbrown     | Mycalesis perseus     |
| 34      | Chocolate Pansy      | Junonia iphita        |
| 35      | Peacock Pasy         | Junonia almanac       |
| 36      | Blue Pansy           | Junonia orithya       |
| 37      | Commander            | Moduza Procris        |
| 38      | Tawny Rajah          | Charaxes Bernardus    |
| 39      | Black Rajah          | Charaxes solon        |



|    |                     |                          |
|----|---------------------|--------------------------|
| 40 | Common Nawab        | Polyura athamas          |
| 41 | Common Sailor       | Neptis hylas             |
| 42 | Short-banded Sailor | Neptis hylas             |
| 43 | Tawny Coster        | Acraea terpsicore        |
| 44 | Common Leopard      | Phalanta phalantha       |
| 45 | Lemon Pansy         | Junonia lemonias         |
| 46 | Common Jezebel      | Delias eucharis          |
| 47 | Indian Wanderer     | Pareronia hippie         |
| 48 | Common Mormon       | Papilio polytes          |
| 49 | Blue Mormon         | Papilio polymnestor      |
| 50 | Common Rose         | Pachliopta aristolochiae |

Source: [www.indiabiodiversity.org](http://www.indiabiodiversity.org)

### List of Birds

| Sr. No. | Common Names              | Scientific Name             |
|---------|---------------------------|-----------------------------|
| 1       | Purple Heron              | Ardea purpurea              |
| 2       | Little Grebe              | Tachybaptus ruficollis      |
| 3       | Little Cormorant          | Phalacrocorax niger         |
| 4       | Eastern Cattle Egret      | Bubulcus coromandus         |
| 5       | Intermediate Egret        | Egretta intermedia          |
| 6       | Great Egret               | Egretta alba                |
| 7       | Little Egret              | Egretta garzetta            |
| 8       | Grey Heron                | Ardea cinerea               |
| 9       | Indian Pond Heron         | Ardeola grayii              |
| 10      | Western Reef Egret        | Egretta gularis             |
| 11      | Black-crowned Night-heron | Nycticorax nycticorax       |
| 12      | Striated Heron            | Butorides striatus          |
| 13      | Black Bittern             | Dupetor flavicollis         |
| 14      | Chestnut Bittern          | Ixobrychus cinnamomeus      |
| 15      | Painted Stork             | Mycteria leucocephala       |
| 16      | Asian Openbill            | Anastomus oscitans          |
| 17      | Woolly-necked Stork       | Ciconia episcopus           |
| 18      | Oriental White Ibis       | Threskiornis melanocephalus |
| 19      | Eurasian Spoonbill        | Platalea leucorodia         |
| 20      | Glossy Ibis               | Plegadis falcinellus        |
| 21      | Indian Black Ibis         | Pseudibis papillosa         |
| 22      | Ruddy Shelduck            | Tadorna ferruginea          |
| 23      | Northern Pintail          | Anas acuta                  |
| 24      | Greylag Goose             | Anser anser                 |
| 25      | Common Teal               | Anas crecca                 |
| 26      | Spot-billed Duck          | Anas poecilorhyncha         |



|    |                        |                        |
|----|------------------------|------------------------|
| 27 | Garganey               | Anas querquedula       |
| 28 | Gadwall                | Anas Strepera          |
| 29 | Eurasian Wigeon        | Anas Penelope          |
| 30 | Northern Shoveller     | Anas clypeata          |
| 31 | Comb Duck              | Sarkidiornis melanotos |
| 32 | Lesser Whistling duck  | Lesser Whistling duck  |
| 33 | Black-shouldered Kite  | Elanus caeruleus       |
| 34 | Black Kite             | Milvus migrans         |
| 35 | Brahminy Kite          | Haliastur indus        |
| 36 | Black-eared Kite       | Milvus milvus lineatus |
| 37 | Shikra                 | Accipiter badius       |
| 38 | White-eyed Buzzard     | Butastur teesa         |
| 39 | Oriental Honeybuzzard  | Pernis ptylorhynchus   |
| 40 | Common Buzzard         | Buteo buteo            |
| 41 | Montagu's Harrier      | Circus pygargus        |
| 42 | Palid Harrier          | Circus macrourus       |
| 43 | Western Marsh Harrier  | Circus aeruginosus     |
| 44 | Crested Serpent eagle  | Spilornis cheela       |
| 45 | Short-toed Snake eagle | Circaetus gallicus     |
| 46 | Booted Eagle           | Hieraaetus pennatus    |
| 47 | Black Eagle            | Ictinaetus malayensis  |
| 48 | Greater Spotted Eagle  | Aquila clanga          |
| 49 | Indian Spotted Eagle   | Aquila pomarina        |
| 50 | Common Kestrel         | Falco tinnunculus      |

Source: [www.indiabiodiversity.org](http://www.indiabiodiversity.org)

## List of Trees found in Panvel

| Sr. No. | Common Names         | Scientific Name       |
|---------|----------------------|-----------------------|
| 1       | Gunj                 | Abrus precatorius     |
| 2       | Australian acacia    | Acacia auriculiformis |
| 3       | Khair                | Acacia catechu        |
| 4       | Babul                | Acacia nilotica       |
| 5       | Cat Tail             | Acalypha hispida      |
| 6       | Harit-manjari        | Acalypha indica       |
| 7       | Agada                | Achyranthes aspera    |
| 8       | Ratan Gunj           | Adenanthera pavonina  |
| 9       | Adulsa               | Adhatoda vasica       |
| 10      | Gorakh Chinch/Baobab | Adonsonia digitate    |
| 11      | Bael                 | Aegle marmelos        |
| 12      | Goat Weed            | Ageratum conyzoides   |



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|    |                           |                          |
|----|---------------------------|--------------------------|
| 13 | Shirish                   | Albizia lebbeck          |
| 14 | Saptaparni /Devil Tree    | Alstonia scholaris       |
| 15 | Kaju                      | Anacardium occidentale   |
| 16 | Sitaphal                  | Annona squamosa          |
| 17 | Supari                    | Areca catechu            |
| 18 | Jackfruit                 | Artocarpus heterophylla  |
| 19 | Shatavari                 | Asparagus racemose       |
| 20 | Bilimbi                   | Averrhoa bilimbi         |
| 21 | Kadu Neem                 | Azadirachta indica       |
| 22 | Bamboo                    | Bambusa arundinaceae     |
| 23 | Butterfly Flower          | Bauhinia monandra        |
| 24 | Apta                      | Bauhinia racemose        |
| 25 | Bogainvillea              | Bogainvillea spectabilis |
| 26 | Kante Savar               | Bombax ceiba             |
| 27 | Tad                       | Borassia flabellifer     |
| 28 | Palash                    | Butea monosperma         |
| 29 | Bottle Brush              | Callistemon lanceolatus  |
| 30 | Rui                       | Calotropis gigantea      |
| 31 | Indian Shot               | Canna indica             |
| 32 | Karvand                   | Carissa carandas         |
| 33 | Fish Tail Palm            | Caryota urens            |
| 34 | Candle Cassia             | Cassia alata             |
| 35 | Amaltas                   | Cassia fistula           |
| 36 | Takla                     | Cassia tora              |
| 37 | Sadaphuli                 | Catharanthus roseus      |
| 38 | White Silk Cotton, Kapok  | Ceiba pentandra          |
| 39 | Brahmi                    | Centella asiatica        |
| 40 | Tendli                    | Coccinia grandis         |
| 41 | Coconut                   | Cocos nucifera           |
| 42 | Pan Ova                   | Coleus aromaticus        |
| 43 | Bhokar                    | Cordia dichotoma         |
| 44 | Kailaspati                | Couroupita guianensis    |
| 45 | Khulkhula                 | Crotalaria retusa        |
| 46 | Kali Musali               | Curculigo orchoides      |
| 47 | Amarvel/Dodder            | Cuscuta reflexa          |
| 48 | Umbrella Plant            | Cyperus alternifolius    |
| 49 | Shisham / Indian rosewood | Dalbergia sissoo         |
| 50 | Datura                    | Datura innoxia           |
| 51 | Gulmohar Delonix regia    | Gulmohar Delonix regia   |
| 52 | Shend vel Dioscoria       | Shend vel Dioscoria      |
| 53 | Draceana Draceana sp.     | Draceana Draceana sp.    |
| 54 | Maka / Bhingaraj          | Eclipta prostrata        |



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|    |                                 |                                       |
|----|---------------------------------|---------------------------------------|
| 55 | Pangara /Indian Coral Tree      | Erythrina variegata /Erythrina indica |
| 56 | Christamas Plant                | Euphorbia pulcherrima                 |
| 57 | Wad, Banyan                     | Ficus bengalensis                     |
| 58 | Pukar                           | Ficus Benjamin                        |
| 59 | India rubber Tree               | Ficus elastica                        |
| 60 | Kala Umbar                      | Ficus hispida                         |
| 61 | Gular                           | Ficus racemose                        |
| 62 | Peepal                          | Ficus religiosa                       |
| 63 | Undirmar                        | Gliricidia sepium                     |
| 64 | Kal-lavi                        | Gloriosa superba                      |
| 65 | Dhaman                          | Grevia tiliaefolia                    |
| 66 | Fire bush                       | Hamelia patens                        |
| 67 | Sontakka                        | Hedychium coronarium                  |
| 68 | Anantmol                        | Hemidesmus indicus                    |
| 69 | Jaswand                         | Hibiscus rosasinensis                 |
| 70 | Chilbil/Vavla                   | Holoptelea integrifolia               |
| 71 | Beach Spider Lily               | Hymenocallis littoralis               |
| 72 | Adulsa / Vasaka                 | Justicia adhatoda                     |
| 73 | Sausage Tree                    | Kigelia Africana                      |
| 74 | Jarul                           | Lagerstroemia speciose                |
| 75 | Common Lantana                  | Lantana camara                        |
| 76 | Heena/Mehndi                    | Lawsonia inermis                      |
| 77 | Subabhul                        | Leucaena leucocephala                 |
| 78 | Kavath                          | Limonia acidissima                    |
| 79 | Pan Lavang                      | Ludwigia octovalvis                   |
| 80 | Mahua                           | Madhuca indica                        |
| 81 | Chikoo                          | Manikara zapota                       |
| 82 | Pudina                          | Mentha viridis                        |
| 83 | Karanj                          | Millettia pinnata /Pongamia pinnata   |
| 84 | Bakul                           | Mimoseps elengi                       |
| 85 | Kadamb                          | Mitragyna parviflora                  |
| 86 | Noni                            | Morinda citrifolia                    |
| 87 | Mulberry                        | Morus alba                            |
| 89 | Khaj Khujali                    | Khaj Khujali                          |
| 90 | Kaddipatta                      | Murraya koeni                         |
| 91 | Mussaenda                       | Mussaenda erythrophylla               |
| 92 | Kanher                          | Nerium indicum                        |
| 93 | Parijat                         | Nyctanthes arbortristis               |
| 94 | Tulsi                           | Ocimum sanctum                        |
| 95 | Kevda                           | Pandanus odorattismus                 |
| 96 | Copper pod, Rusty shield bearer | Peltophorum pterocarpum               |
| 97 | Avala                           | Phyllanthus embelica                  |



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|     |               |                          |
|-----|---------------|--------------------------|
| 98  | Rai Avla      | Phyllanthus acidus       |
| 99  | Jungli jalebi | Pithacellobium dulce     |
| 100 | Champa tree   | Plumera rubra            |
| 101 | Bitti         | Bitti Cascabela thevetia |
| 102 | Amba          | Mangifera Indica         |
| 103 | Bor           | Ziziphus mauritiana      |
| 104 | Tamda Kuda    | Writia tomentosa         |
| 105 | Nirgudi       | Vitex negundo            |
| 106 | Bhendi        | Thespesia populnea       |

Source:

[www.indiabiodiversity.or](http://www.indiabiodiversity.or)



## Annexure II

### Past Initiatives by PMC

| Sr.No | Department                                    | Work Type                       | Year | Project Name                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|-----------------------------------------------|---------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Project Departments (Maji Vasundhara Abhiyan) | Climate Change Champions Panvel | 2023 | First Innovation - The Panvel City Municipal Corporation (PCMC) under Majhi Vasundhara initiative has launched mobile Application name can be Climate Change Champions Panvel.                                                                                                                                                                                                                       |
| 2     | Garden Department                             | Tree Plantation                 | 2023 | Create newly green area under Majhi Vasundhara Abhiyan 3.0.                                                                                                                                                                                                                                                                                                                                          |
| 3     | Project Departments (Maji Vasundhara Abhiyan) | Asian Bird Census               | 2023 | Second Innovation - The Panvel City Municipal Corporation (PCMC) under Majhi Vasundhara initiative has launched the Asian Bird Census.                                                                                                                                                                                                                                                               |
| 4     | Garden Department                             | Tree Plantation                 | 2022 | Trees planted during Majhi Vasundhara Abhiyan 1.0 and 2.0.<br>1.MGM Dental college extension building sector 19,20<br>2.TATA Hospital Corner to Sec.35,Kharghar<br>3.Taloja phase-II,Sec.25 to Koyanavelle village<br>4.Panvel mumbra Road to Dhansar village<br>5.Idgah Maidan<br>6.Palekhurd<br>Total 17,445 trees planted under these programme out of which 14,763 trees survived as per report. |
| 5     | Project department                            | Awareness Programs              | 2022 | Renewable energy Awareness program at koleshwar mandir school.                                                                                                                                                                                                                                                                                                                                       |
|       | Electrical Department                         | solar System                    | 2022 | Installation of rooftop solar systems.                                                                                                                                                                                                                                                                                                                                                               |
|       |                                               |                                 |      |                                                                                                                                                                                                                                                                                                                                                                                                      |



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| Sr.No | Department                                    | Work Type                                               | Year | Project Name                                                                                                                                                                                                                                                                  |
|-------|-----------------------------------------------|---------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | Project Department                            |                                                         | 2022 | Places where Maji Vasundhara Abhiyan promotion has been done.                                                                                                                                                                                                                 |
| 6     | Electrical Department                         | Installed EV Charging points                            | 2022 | Panvel Municipal Corporation Installed EV Charging points at following location to promote the EV vehicles :<br>1.Tata Power Charging Station<br>2.Ather Grid Charging Station<br>3.Electric Vehicle Charging Station<br>4.Kazam Charging Station<br>5.GoEgo Charging Station |
| 7     | Project Departments                           | Information, Education & Communication (IEC) Activities | 2022 | Awareness on Segregation of Waste                                                                                                                                                                                                                                             |
|       |                                               |                                                         |      | Awareness on Segregation of Waste & Plastic Ban                                                                                                                                                                                                                               |
|       |                                               |                                                         |      | Awareness on no single use plastic                                                                                                                                                                                                                                            |
|       |                                               |                                                         |      | Zero Waste Event                                                                                                                                                                                                                                                              |
| 8     | Project Departments (Maji Vasundhara Abhiyan) | Awareness Programs                                      | 2022 | Awareness activities conducted at Public Place/Private Institution/Educational Institution/Other for proper segregation of E-waste.                                                                                                                                           |
| 9     |                                               |                                                         | 2022 | Awareness initiatives for banning for firecracker at Public Places/Private Institutes/Educational Institute/Local Community/Others.                                                                                                                                           |
| 10    | Environmental Department                      | Plastic ban                                             | 2022 | Walk For Cleanliness, organized by Panvel Municipal Corporation in collaboration with ITM College of Health Sciences to promote cause of Say No to #singleuseplastic.                                                                                                         |
| 11    | Electrical Department                         |                                                         | 2022 | Installation of LED streetlights at road side of village.                                                                                                                                                                                                                     |



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| Sr.No | Department                        | Work Type                   | Year | Project Name                                                                                                                                                                        |
|-------|-----------------------------------|-----------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12    | Public Work Department            |                             | 2022 | Panvel municipal corporation creates artificial immersion spots for Visarjan to reduce the water pollution during festivals.                                                        |
| 13    | Solid waste management Department | Awareness activity          | 2022 | Awareness activity for the promotion of eco-friendly immersion                                                                                                                      |
| 14    | Public Work Department            |                             | 2022 | Well Rejuvenation initiative for urban and rural areas.                                                                                                                             |
| 25    | Water Department                  | Rainwater Harvesting        | 2022 | Installation of Rooftop Rainwater Harvesting system in public building.6788 cubic meters of rain water harvested during Majhi Vasundhara Abhiyan 2.0 & Majhi Vasundhara Abhiyan 3.0 |
| 16    | Public Work Department            | Water Resource Conservation | 2022 | Water Resource Conservation and Rejuvenation program arrange for all the major lake in the city.                                                                                    |
| 17    |                                   | Beautification              | 2021 | Beautification and development of vadale lake in panvel municipal corporation area.                                                                                                 |
| 18    | Solid waste management Department | Dumpsite Remediation        |      | Remediation of all identified dumpsites.                                                                                                                                            |
| 19    |                                   | Dry waste processing plant  |      | Installed Dry waste processing plant (Out of total Dry waste collected)                                                                                                             |
| 20    | Public Work Department            | Cycle Tract                 | 2020 | The Bicycle facility is initiated in the Kharghar area and has been very successful; it will be expanded soon in other areas in the city.                                           |
| 21    |                                   | Beautification              |      | Lake Beautification Under Majhi Vasundhara Abhiyan 3.0)                                                                                                                             |
| 22    |                                   | Beautification              |      | Well Beautification Under Majhi Vasundhara Abhiyan 3.0)                                                                                                                             |

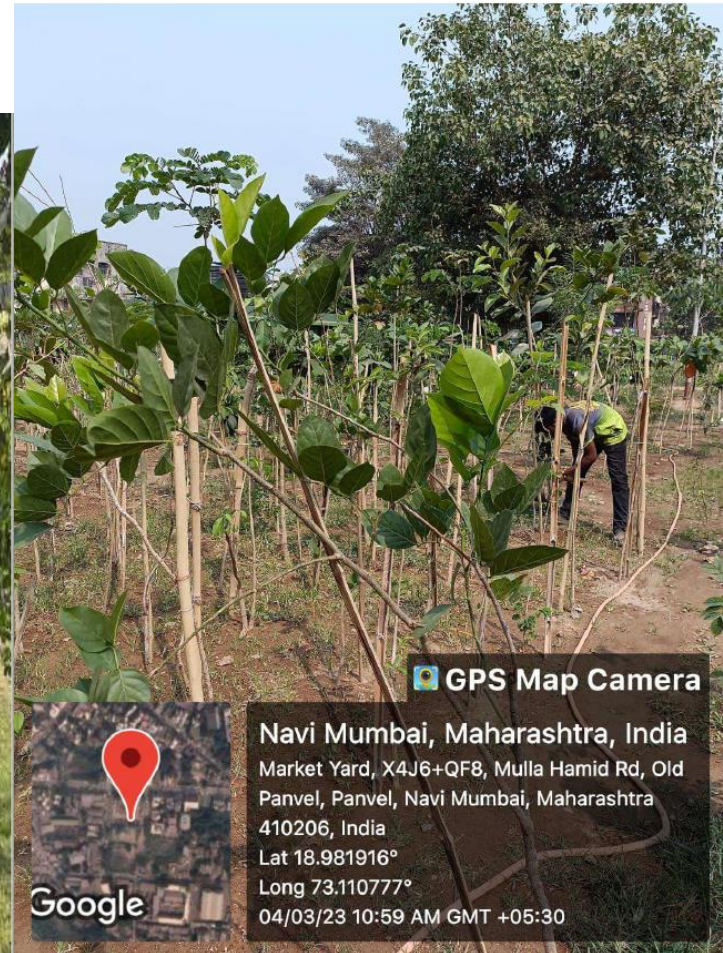


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| Sr.No | Department                                             | Work Type           | Year | Project Name                                                                                                  |
|-------|--------------------------------------------------------|---------------------|------|---------------------------------------------------------------------------------------------------------------|
| 23    | Project<br>Departments (Maji<br>Vasundhara<br>Abhiyan) | Miyawaki plantation | 2016 | Miyawaki plantation done at urban naka, panvel and sai<br>nagar old panvel under Maji Vasundhara Abhiyan 3.0. |

Source: PMC Website



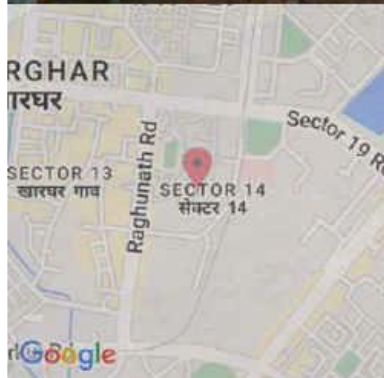
Miyawaki plantation done at Urban Naka, Panvel and Sai Nagar old panvel under Maji Vasundhara Abhiyan 3.0(2016).



Awareness Programs under Swachh Bharat Mission



Awareness on Segregation of Waste



BLOCK-C, RAGHUNATH VIHAR ARMY, ब्लॉक J, केसर सिम्फनी, सेक्टर 14, खारघर, नवी मुंबई, महाराष्ट्र 410210, India

|           | Decimal   | DMS        |
|-----------|-----------|------------|
| Latitude  | 19.04483  | 19°2'41" N |
| Longitude | 73.074098 | 73°4'26" E |

2022-12-10(Sat) 10:44(am)

Zero Waste Event



Awareness on Dry waste collection and processing



Trees plantation done at MGM Dental college extension building sector 19,20 under Majhi Vasundhara Abhiyan 1.0 and 2.0.



Bicycle facility is initiated in the Kharghar area



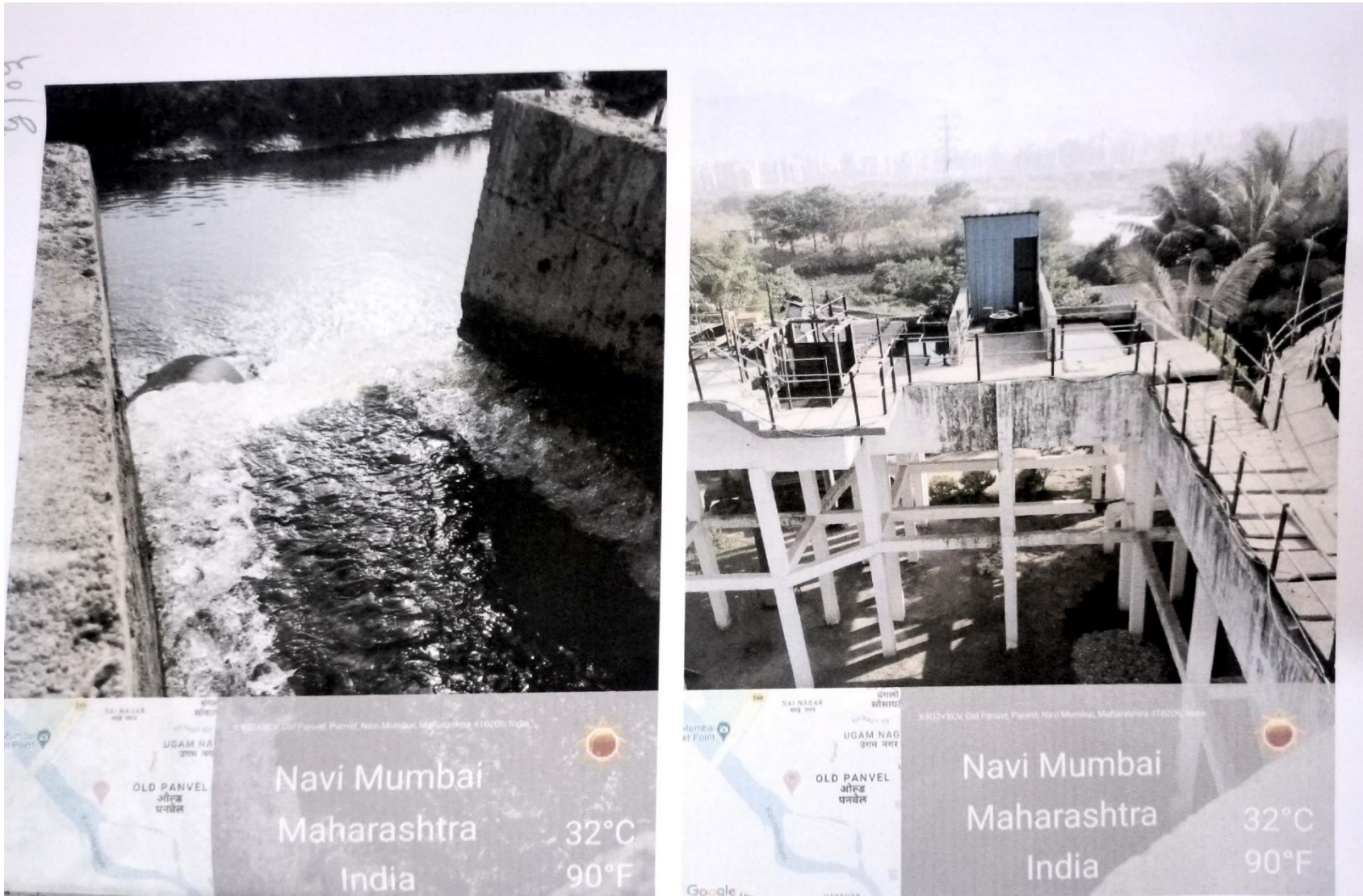
Panvel Municipal Corporation Installed EV Charging points



Beautification and development of Vadale lake in Panvel municipal corporation area.



Installation of Rooftop Rainwater Harvesting system in public building



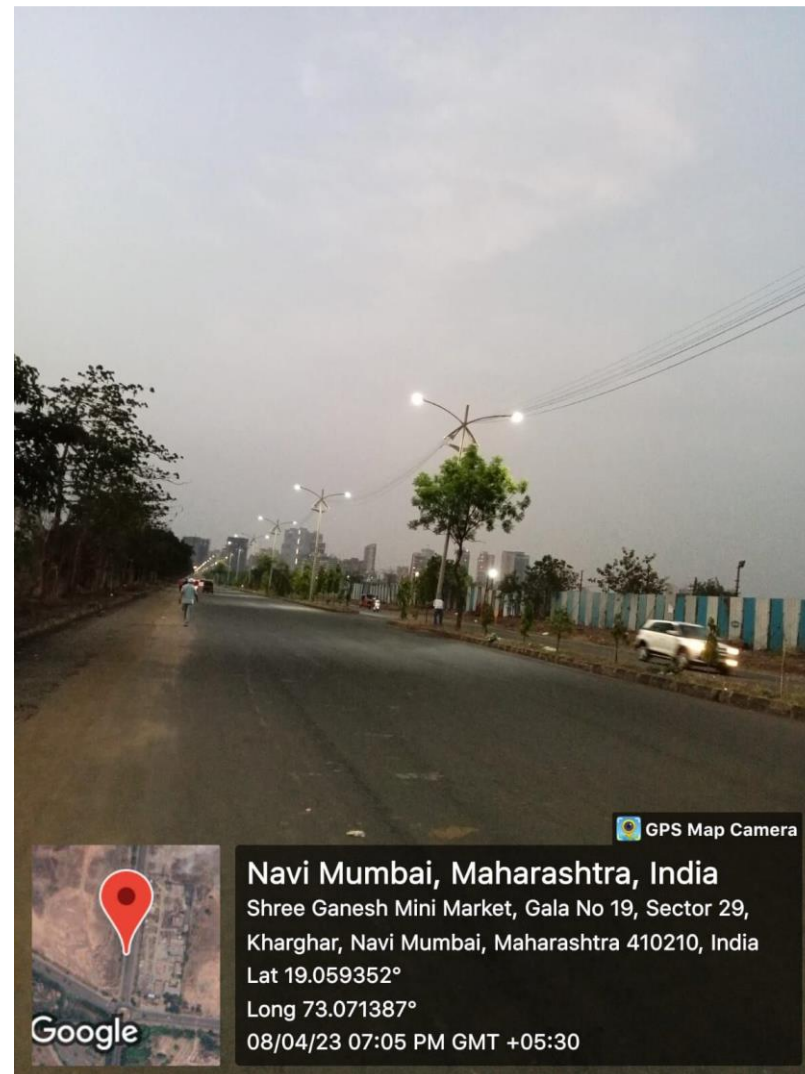
STP installation near old panvel area



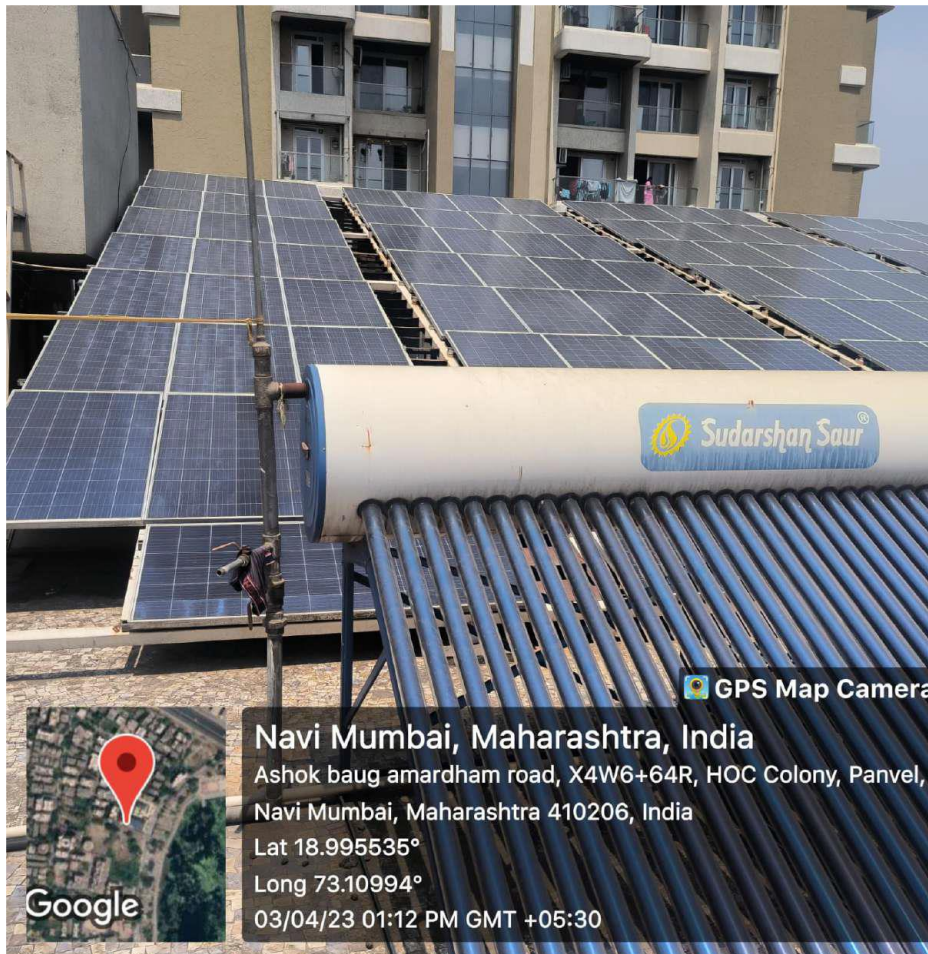
Panvel municipal corporation creates artificial immersion spots for Visarjan to reduce the water pollution during festivals.



Renewable energy awareness program at Koleshwar mandir school.



Installation of LED streetlights at road side of village



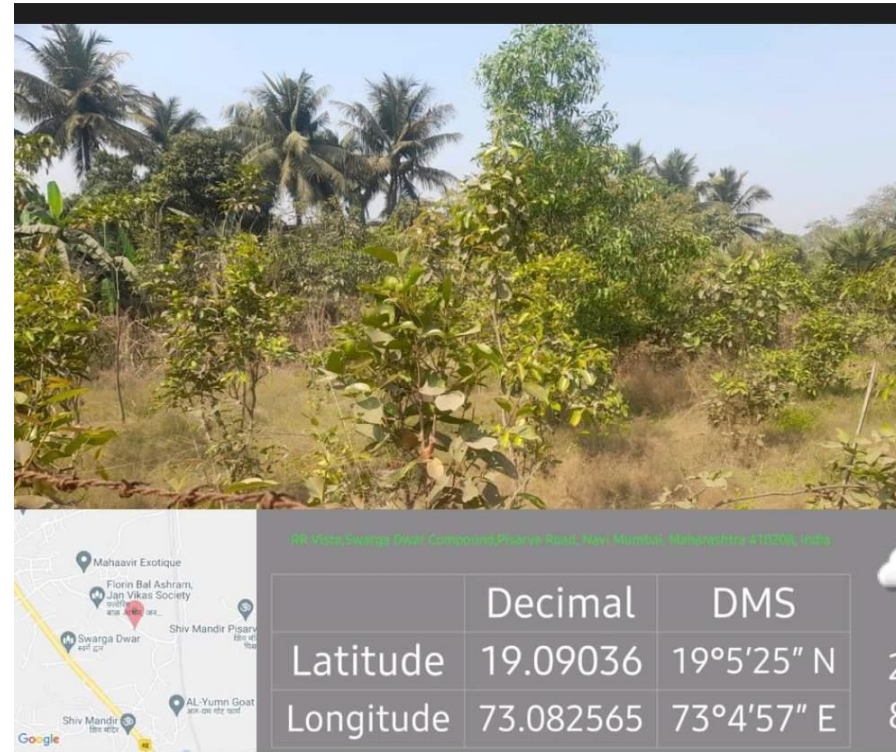
Installation of rooftop solar systems



Second Innovation - The Panvel City Municipal Corporation (PCMC) under Majhi Vasundhara initiative has launched the Asian Bird Census.



Places where maji vasunhara abhiyan promotion has been done



No of trees survive under maji Vasundhara abhiyan



## Annexure III

### List of Schools

| School List in Panvel |                                                                             |                    |
|-----------------------|-----------------------------------------------------------------------------|--------------------|
| Sr. No                | School Name                                                                 | Centre Name        |
| 1                     | Ramsheth Thakur Public School                                               | Kharghar Sector 19 |
| 2                     | R. Z. P School Kharghar                                                     | Kharghar Sector 13 |
| 3                     | KPC Public School                                                           | Kharghar Sector 16 |
| 4                     | Bal Bharati Public School                                                   | Kharghar Sector 4  |
| 5                     | Vishwajyot High School & Preschool                                          | Kharghar Sector 20 |
| 6                     | Siddharth Multipurpose Residential High School                              | Kharghar Sector 19 |
| 7                     | Ali Public School                                                           | Kharghar Sector 30 |
| 8                     | K.P.C. English High School                                                  | Kharghar Sector 13 |
| 9                     | Apeejay School                                                              | Kharghar Sector 21 |
| 10                    | Navi Mumbai Mahanagar Palika School - 2                                     | Kharghar Sector 14 |
| 11                    | Bonny School                                                                | Kharghar Sector 12 |
| 12                    | RZP School                                                                  | Kharghar Sector 10 |
| 13                    | Z P school                                                                  | Kharghar Sector 13 |
| 14                    | Harmony School                                                              | Kharghar Sector 36 |
| 15                    | Ryan International School                                                   | Kharghar Sector 11 |
| 16                    | Convent of Jesus & Mary High School & Junior College & International School | Kharghar Sector 6  |
| 17                    | New English School                                                          | Kharghar           |



| School List in Panvel |                                            |                     |
|-----------------------|--------------------------------------------|---------------------|
| Sr. No                | School Name                                | Centre Name         |
|                       |                                            | Sector 13           |
| 18                    | VIBGYOR High School                        | Kharghar Sector 15  |
| 19                    | DAV International School                   | Kharghar Sector 15  |
| 20                    | SBOA Public School                         | Kharghar Sector 5   |
| 21                    | Greenfingers Global School                 | Kharghar Sector 12  |
| 22                    | JIE Schools Mumbai                         | Kharghar Sector 18  |
| 23                    | R. Z. P. School                            | Kharghar Sector 33  |
| 24                    | Murbi Village Marathi School               | Kharghar Sector 19  |
| 25                    | Namdev Bua Khutarikar school               | Kharghar Sector 4   |
| 26                    | Sudhagad Edu. School                       | Kharghar Sector 10  |
| 27                    | Mothers Pride school                       | Kharghar Sector 19  |
| 28                    | M.E.S Public School                        | Kalamboli Sector 14 |
| 29                    | Vedant Public School                       | Kalamboli Sector 2  |
| 30                    | Jilha Parishad School                      | Roadpali            |
| 31                    | New Sudhagad Education Societys HighSchool | Kalamboli Sector 1E |
| 32                    | RZP School                                 | Kalamboli Sector 1E |
| 33                    | Madhyamik Vidyalay                         | Kalamboli Sector 1E |
| 34                    | Raigad Zilla Parishad Prathmik School      | Kalamboli Sector 1E |
| 35                    | Balaji International school                | Roadpali            |
| 36                    | St. Joseph's High School                   | Kalamboli Sector 5  |
| 37                    | Re English school                          | Kalamboli Sector 6E |



| School List in Panvel |                                               |                        |
|-----------------------|-----------------------------------------------|------------------------|
| Sr. No                | School Name                                   | Centre Name            |
| 38                    | Old Sudhagad School                           | Kalamboli Sector 3E    |
| 39                    | New Mumbai English School                     | Kalamboli Sector 10    |
| 40                    | Prarthamik shala                              | Kudupada               |
| 41                    | St. Joseph's High School                      | Kalamboli Sector 4     |
| 42                    | M.E.S. Dyanmandir School                      | Roadpali               |
| 43                    | The Oxford International School               | Kalamboli Sector 5     |
| 44                    | Carmel Convent High School                    | Kalamboli Sector 8     |
| 45                    | Loknete Ramsheth Thakur Public School         | Kamothe Sector 6       |
| 46                    | Z.P.School                                    | Kamothe Sector 14      |
| 47                    | SGT International School                      | Naupada                |
| 48                    | Mnr school of excellence                      | Kamothe Sector 6       |
| 49                    | St. Agrasen High School                       | Kamothe Sector 34      |
| 50                    | Rising Sun High School                        | Kamothe Sector 12      |
| 51                    | Jilha parishad Prarthamik shala               | Kamothe Gaon Sector 14 |
| 52                    | Mansarovar Vidhyalay                          | Kamothe Sector 34      |
| 53                    | Loknete Ramshet Thakur English Medium School  | Kamothe Sector 6       |
| 54                    | Marathi School                                | Kamothe Gaon           |
| 55                    | Bright Vision English High School             | Kamothe Sector 10      |
| 56                    | Shankarrao Chavan Vidya English Medium School | Kamothe Sector 20      |
| 57                    | Marvel School                                 | Kamothe Sector 31      |



| School List in Panvel |                                     |                  |
|-----------------------|-------------------------------------|------------------|
| Sr. No                | School Name                         | Centre Name      |
| 58                    | DAV Public School                   | Kamothe Sector 9 |
| 59                    | Shantiniketan Public School         | Kamothe Sector 2 |
| 60                    | Mumbai Public School & Daycare      | New Panvel       |
| 61                    | New Horizon Public School           | Panvel           |
| 62                    | Kids Garden National Public Schools | New Panvel East  |
| 63                    | St. Joseph's High School            | New Panvel East  |
| 64                    | Panvel Nagar Parishad Kanya School  | Old Panvel       |
| 65                    | Panvel Muncipal school no 5         | New Panvel East  |



## List of Hospitals

| Name of Hospital                                | Location               |
|-------------------------------------------------|------------------------|
| Ymt Hospital                                    | Kharghar<br>Sector 4   |
| Niramaya Hospital                               | Kharghar<br>Sector 4   |
| Ashwini Hospital                                | Kharghar<br>Sector 7   |
| VAMC Hospital                                   | Kharghar<br>Sector 12  |
| Mangaldeep multispeciality hospital             | Kharghar<br>Sector 12  |
| Sanjeevan Hospital                              | Kharghar<br>Sector 12  |
| Shree Hospital                                  | Kharghar<br>Sector 12  |
| Om Navjeevan Hospital                           | Kharghar<br>Sector 21  |
| Airla Hospital                                  | Kharghar<br>Sector 20  |
| Khar ghar medical centre                        | Kharghar<br>Sector 20  |
| Urban Health Center (A Government Organization) | Kharghar<br>Sector 15  |
| BARC Kharghar Dispensary                        | Kharghar<br>Sector 15  |
| Medicover Hospitals                             | Kharghar<br>Sector 10  |
| Dr Alat Hospital                                | Kalamboli              |
| Mangaldeep Hospital                             | Kalamboli<br>Sector 3E |
| Meera General And piles Hospital                | Kalamboli<br>Sector 3E |
| Mahatma Gandhi Mission Hospital                 | Kalamboli<br>Sector 4E |
| Dr. Singh's City Hospital                       | Kalamboli<br>Sector 4  |
| Amar Hospital                                   | Kalamboli<br>Sector 10 |
| NPS Hospital kalamboli                          | Kalamboli              |



| Name of Hospital                      | Location               |
|---------------------------------------|------------------------|
|                                       | Sector 10              |
| Mathadi hospital kalamboli            | Kalamboli              |
| Suasth Hospital                       | Kalamboli<br>Sector 20 |
| Shree siddhivinayak hospital          | Kalamboli<br>Sector 15 |
| Aasha Hospital                        | Kalamboli              |
| PFA hospital                          | Kalamboli              |
| VAMC Hospital                         | Kalamboli              |
| Jeewandeep Hospital                   | Kalamboli              |
| Samata Hospital                       | Kalamboli<br>Sector 1  |
| B&J Superspeciality Hospital          | Kamothe                |
| MITR Hospital                         | Kamothe<br>Sector 35   |
| Om Sai Hospital                       | Kamothe                |
| Prathmik arogya Kendra                | Kamothe<br>Sector 1    |
| Shree Sangam Multispeciality Hospital | Kamothe<br>Sector 8    |
| METROCARE HOSPITAL and ICU            | Kamothe<br>Sector 8    |
| Galaxy Hospital                       | Kamothe<br>Sector 8    |
| healthgs Hospitals                    | Kamothe<br>Sector 12   |
| ZP Hospital                           | Kamothe<br>Sector 12   |
| Criticare Hospital                    | Kamothe<br>Sector 12   |
| healthgs Hospitals                    | Kamothe<br>Sector 12   |
| Aadi Hospital                         | Kamothe<br>Sector 12   |
| Matoshree Multispeciality Hospital    | Kamothe<br>Sector 20   |



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| Name of Hospital                                      | Location             |
|-------------------------------------------------------|----------------------|
| Jeevan Jyot Hospital                                  | Kamothe<br>Sector 21 |
| Yashoda maternity and general hospital                | Kamothe<br>Sector 21 |
| Noble Care Hospital                                   | Kamothe<br>Sector 21 |
| ONGC Hospital                                         | Panvel               |
| Panvel Hospital                                       | Panvel               |
| Rural Hospital Panvel                                 | Old Panvel           |
| Gandhi Super Speciality Hospital                      | Panvel               |
| Government hospital                                   | Panvel               |
| Gune Hospital                                         | Old Panvel           |
| Mhatre Accident Hospital                              | Old Panvel           |
| New Govt Hospital Behind Dargah Panel Mahanagarpalika | Old Panvel           |
| Panvel Rural Hospital                                 | Old Panvel           |
| Panvel B.M.C Hospital                                 | Old Panvel           |



## Annexure IV

### Water & Soil Monitoring Results



सत्यमेव जयते  
महाराष्ट्र शासन

**MAHATMA PHULE KRISHI VIDYAPEETH,  
Division of Soil Science and Agril. Chemistry  
COLLEGE OF AGRICULTURE, PUNE- 411 005**



Address for correspondence: E mail: - [professorsoilscience@yahoo.com](mailto:professorsoilscience@yahoo.com) Ph. No. (020) 25537033, Extn. (514, 355)

No.ACP/SSAC/Water analysis report/ 718 /2022

Date: 08 DEC 2022

To,

M/s. Sustainable Approach for Green Environment  
205, 2<sup>nd</sup> Floor, Bhawani Industrial Estate,  
Hare Krishna road, Oppo. Main Gate of IIT Bombay  
Powai, Mumbai- 400076

**Subject:** Analytical report of Water and Soil Samples.....

**Ref:** Application for analysis dated on 2.11.2022.

Sir,

With reference to above subject the analytical report of your water and Soil samples given by you in laboratory on 2<sup>nd</sup> November 2022 is attached herewith.

This is for your information and further needful please.

Thanking you.

Your's faithfully

**Encl.:** Water and soil sample reports

Professor

Division of Soil Science and Agril. Chemistry,  
College of Agriculture, Pune



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Panvel Municipal Corporation



| Sr. No.       | Parameter                                       | Normal Range | Lab No.395 (SQ1 Khargar) | Rating            | Lab No.396 (SQ2 Kamothe) | Rating          | Lab No.397 (Kalamboli MIDC road) | Rating          | Method used and reference                                  |
|---------------|-------------------------------------------------|--------------|--------------------------|-------------------|--------------------------|-----------------|----------------------------------|-----------------|------------------------------------------------------------|
| 1.            | pH (1: 2.5)                                     | 6.5-7.5      | 8.56                     | Strongly alkaline | 7.19                     | Neutral         | 6.43                             | Slightly acidic | Potentiometric Jackson (1973)                              |
| 2.            | Electrical Conductivity (dSm <sup>-1</sup> )    | < 2          | 0.31                     | Normal            | 0.14                     | Normal          | 0.10                             | Normal          | Conductometric Jackson (1973)                              |
| 3.            | Organic Carbon (%)                              | 0.4-0.6      | 0.32                     | Low               | 0.59                     | Medium          | 1.67                             | Very High       | Wet Oxidation Nelson and Sommers (1982)                    |
| 4.            | Available Nitrogen (N) (kg ha <sup>-1</sup> )   | 281-420      | 147                      | Low               | 156                      | Low             | 206                              | Low             | Alkaline permanganate Subbiah and Asija (1956)             |
| 5.            | Available Phosphorus (P) (kg ha <sup>-1</sup> ) | 15-21        | 19                       | Medium            | 22                       | Moderately high | 28                               | Moderately high | 0.5M NaHCO <sub>3</sub> (pH-8.5) Watanabe and Olsen (1965) |
| 6.            | Available Potassium (K) (kg ha <sup>-1</sup> )  | 151-200      | 869                      | Very High         | 1069                     | Very high       | 921                              | Very high       | Neutral Normal Ammonium Acetate , Jackson (1973)           |
| 7.            | Water Holding Capacity (WHC) (%)                | ----         | 36.05                    | ---               | 46.86                    | ---             | 55.92                            | ---             | Keen's Box Richards (1954)                                 |
| 8.            | Sand (%)                                        | ----         | 28.09                    |                   | 32.42                    |                 | 17.93                            |                 | International Pipette method Piper (1966)                  |
| 9.            | Silt (%)                                        | ---          | 61.26                    |                   | 58.96                    |                 | 51.81                            |                 |                                                            |
| 10.           | Clay (%)                                        | ---          | 9.46                     |                   | 6.64                     |                 | 28.42                            |                 |                                                            |
| 11.           | Textural Class                                  | ---          | Silt Loam                |                   | Silt Loam                |                 | Silty Clay Loam                  |                 |                                                            |
| Soluble Salts |                                                 |              |                          |                   |                          |                 |                                  |                 |                                                            |
| 12.           | Calcium (meq lit <sup>-1</sup> )                | ---          | 4.00                     | ---               | 4.00                     | ---             | 3.40                             | ---             | Versenate Titration Page (1989)                            |
| 13.           | Magnesium (meq lit <sup>-1</sup> )              | ---          | 1.20                     | ---               | 2.20                     | ---             | 0.40                             | ---             |                                                            |
| 14.           | Sodium (meq lit <sup>-1</sup> )                 | ---          | 7.43                     | ---               | 6.22                     | ---             | 1.04                             | ---             | Flame Photometry Page (1989)                               |
| 15.           | Sodium Adsorption Ratio (SAR)                   | < 10         | 4.61                     | Excellent         | 4.29                     | Excellent       | 0.75                             | Excellent       | ----                                                       |

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| Sr. No.       | Parameter                                       | Normal Range | Lab No.398 (Panvel green zone) | Rating          | Lab No.399 (Taloje MIDC) | Rating              | Lab No.400 (Karavale-near by vihan cakes) | Rating          | Method used                                                |
|---------------|-------------------------------------------------|--------------|--------------------------------|-----------------|--------------------------|---------------------|-------------------------------------------|-----------------|------------------------------------------------------------|
| 1.            | pH (1: 2.5)                                     | 6.5-7.5      | 7.40                           | Mildly alkaline | 8.33                     | Moderately alkaline | 6.36                                      | Slightly acidic | Potentiometric Jackson (1973)                              |
| 2.            | Electrical Conductivity (dSm <sup>-1</sup> )    | < 2          | 0.26                           | Normal          | 0.13                     | Normal              | 0.55                                      | Normal          | Conductometric Jackson (1973)                              |
| 3.            | Organic Carbon (%)                              | 0.4-0.6      | 0.63                           | Moderately High | 0.39                     | Low                 | 1.13                                      | Very High       | Wet Oxidation Nelson and Sommers (1982)                    |
| 4.            | Available Nitrogen (N) (kg ha <sup>-1</sup> )   | 281-420      | 177                            | Low             | 160                      | Low                 | 189                                       | Low             | Alkaline permanganate Subbiah and Asija (1956)             |
| 5.            | Available Phosphorus (P) (kg ha <sup>-1</sup> ) | 15-21        | 21                             | Medium          | 21                       | Medium              | 26                                        | Moderately High | 0.5M NaHCO <sub>3</sub> (pH-8.5) Watanabe and Olsen (1965) |
| 6.            | Available Potassium (K) (kg ha <sup>-1</sup> )  | 151-200      | 1104                           | Very High       | 627                      | Very High           | 1290                                      | Very High       | Neutral Normal Ammonium Acetate , Jackson (1973)           |
| 7.            | Water Holding Capacity (WHC) (%)                | ----         | 39.45                          | ---             | 40.25                    | ---                 | 51.20                                     | ---             | Keen's Box Richards (1954)                                 |
| 8.            | Sand (%)                                        | ----         | 26.94                          |                 | 31.73                    |                     | 13.24                                     |                 | International Pipette method Piper (1966)                  |
| 9.            | Silt (%)                                        | ---          | 62.68                          |                 | 59.23                    |                     | 53.09                                     |                 |                                                            |
| 10.           | Clay (%)                                        | ---          | 8.38                           |                 | 7.14                     |                     | 32.12                                     |                 |                                                            |
| 11.           | Textural Class                                  | ---          | Silt Loam                      |                 | Silt Loam                |                     | Silty Clay Loam                           |                 |                                                            |
| Soluble Salts |                                                 |              |                                |                 |                          |                     |                                           |                 |                                                            |
| 12.           | Calcium (meq lit <sup>-1</sup> )                | ---          | 4.40                           | ---             | 2.80                     | ---                 | 4.20                                      | ---             | Versenate Titration Page (1989)                            |
| 13.           | Magnesium (meq lit <sup>-1</sup> )              | ---          | 0.60                           | ---             | 2.40                     | ---                 | 2.00                                      | ---             |                                                            |
| 14.           | Sodium (meq lit <sup>-1</sup> )                 | ---          | 6.34                           | ---             | 1.58                     | ---                 | 6.68                                      | ---             | Flame Photometry Page (1989)                               |
| 15.           | Sodium Adsorption Ratio (SAR)                   | < 10         | 4.01                           | Excellent       | 0.98                     | Excellent           | 3.80                                      | Excellent       | ----                                                       |

**Note :** This report will not valid for any legal matter.

*Professor*  
Soil Science and Agril Chemistry  
College of Agriculture Pune-5



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**Analytical report of Water Samples**

| Sr. No. | Parameter                                                      | Normal Range   | Lab No. 401 (SW1) | Lab No. 402 (SW2) | Lab No. 403 (SW3) | Lab No. 404 (SW4) | Lab No. 405 (SW5) | Lab No. 406 (SW6) | Method used and Reference                                           |
|---------|----------------------------------------------------------------|----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------------------------------------------------------|
| 1.      | pH                                                             | 6.5 - 7.5      | 7.69              | 7.87              | 7.69              | 7.38              | 7.63              | 7.88              | Potentiometric Jackson (1973)                                       |
| 2.      | Electrical Conductivity (dSm <sup>-1</sup> )                   | 0 - 0.75       | 1.56              | 0.28              | 0.87              | 0.83              | 1.42              | 0.86              | Conductometric Jackson (1973)                                       |
| 3.      | Carbonates (meq.lit. <sup>-1</sup> )                           | --             | 1.60              | Absent            | 4.00              | 4.00              | 1.60              | 4.00              | Titrimetric method<br>Richard (1954)                                |
| 4.      | Bicarbonates (meq.lit. <sup>-1</sup> )                         | --             | 1.60              | 4.40              | 2.40              | 5.20              | 2.40              | 2.80              |                                                                     |
| 5.      | Chlorides (meq.lit. <sup>-1</sup> )                            | 0 - 5.00       | 1.20              | 4.00              | 4.40              | 4.40              | 4.00              | 8.40              | Mohr's titration Richard (1954)                                     |
| 6.      | Sulphates (meq.lit. <sup>-1</sup> )                            | 0 - 4.00       | 21.48             | 3.48              | 1.00              | 1.05              | 12.62             | 1.09              | Turbidimetric Richard (1954)                                        |
| 7.      | Calcium (meq.lit. <sup>-1</sup> )                              | --             | 20.40             | 2.20              | 4.60              | 3.20              | 12.40             | 2.20              | Versenate Titration<br>Richard (1954)                               |
| 8.      | Magnesium (meq.lit. <sup>-1</sup> )                            | --             | 3.20              | 1.00              | 4.60              | 2.40              | 4.60              | 1.80              |                                                                     |
| 9.      | Sodium (meq.lit. <sup>-1</sup> )                               | --             | 1.83              | 1.17              | 2.10              | 6.32              | 3.03              | 9.19              | Flame Photometry<br>Richard (1954)                                  |
| 10.     | Potassium (meq lit. <sup>-1</sup> )                            | --             | 0.45              | 0.55              | 0.50              | 0.63              | 0.59              | 0.92              |                                                                     |
| 11.     | Mg : Ca ratio                                                  | 0 - 1.50       | 0.16              | 0.45              | 1.00              | 0.75              | 0.37              | 0.82              | ---                                                                 |
| 12.     | Sodium adsorption ratio (SAR)                                  | Less than 10   | 0.53              | 0.93              | 0.69              | 3.78              | 1.04              | 6.52              | USSLS (1954)                                                        |
| 13.     | Residual sodium carbonate (RSC)                                | Less than 1.25 | 0.00              | 1.20              | 0.00              | 3.60              | 0.00              | 2.80              | Eaton (1950)                                                        |
| 14.     | Total Dissolved Salts (TDS) (mg lit. <sup>-1</sup> )           | < 460          | 998.40            | 179.20            | 556.80            | 531.20            | 908.80            | 550.40            | Richard (1954)                                                      |
| 15.     | Total hardness as CaCO <sub>3</sub> (mg lit. <sup>-1</sup> )   | ---            | 2360              | 320               | 920               | 560               | 1700              | 396               | APHA (2005)                                                         |
| 16.     | Total alkalinity as CaCO <sub>3</sub> (mg lit. <sup>-1</sup> ) | ---            | 320               | 440               | 640               | 920               | 400               | 680               | APHA (2005)                                                         |
| 17.     | BOD (mg lit. <sup>-1</sup> )                                   | < 30           | 11.41             | 4.98              | 9.09              | 7.75              | 10.54             | 9.57              | Titrimetric method<br>APHA (2005)                                   |
| 18.     | COD (mg lit. <sup>-1</sup> )                                   | < 200          | 46.18             | 23.00             | 36.00             | 31.00             | 42.08             | 38.06             | Open reflux method<br>APHA (2005)                                   |
| 19.     | Nickel (Ni) (mg lit. <sup>-1</sup> )                           | < 3            | traces            | traces            | traces            | traces            | 0.02              | traces            | Atomic Absorption<br>Spectrophotometer Lindsey<br>and Norvel (1978) |
| 20.     | Cromium (Cr) (mg lit. <sup>-1</sup> )                          | 6.5 - 7.5      | 0.17              | 0.16              | 0.15              | 0.14              | 0.15              | 0.13              |                                                                     |

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| Sr. No. | Parameter                                                      | Normal Range | Lab No. 407 (SW8) | Lab No. 408 (SW9) | Lab No. 409 (SW10) | Lab No. 410 (SW11) | Lab No. 411 (SW12) | Lab No. 412 (SW13) | Method used and Reference                      |
|---------|----------------------------------------------------------------|--------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|------------------------------------------------|
| 1.      | pH                                                             | 6.5 - 7.5    | 7.81              | 7.82              | 7.73               | 8.01               | 8.18               | 8.11               | Potentiometric Jackson (1973)                  |
| 2.      | Electrical Conductivity (dS m <sup>-1</sup> )                  | 0 - 0.75     | 0.60              | 0.35              | 0.34               | 0.41               | 0.21               | 0.36               | Conductometric Jackson (1973)                  |
| 3.      | Carbonates (meq.lit. <sup>-1</sup> )                           | --           | 0.20              | 0.30              | 0.30               | 0.20               | 0.20               | 0.40               | Titrimetric method                             |
| 4.      | Bicarbonates (meq.lit. <sup>-1</sup> )                         | --           | 3.20              | 3.60              | 3.20               | 4.00               | 2.80               | 4.00               | Richard (1954)                                 |
| 5.      | Chlorides (meq.lit. <sup>-1</sup> )                            | 0 - 5.00     | 3.60              | 4.00              | 4.40               | 4.80               | 2.80               | 4.00               | Mohr's titration Richard (1954)                |
| 6.      | Sulphates (meq.lit. <sup>-1</sup> )                            | 0 - 4.00     | 0.55              | 1.55              | 1.87               | 2.35               | 0.76               | 1.32               | Turbidimetric Richard (1954)                   |
| 7.      | Calcium (meq.lit. <sup>-1</sup> )                              | --           | 3.60              | 2.60              | 2.40               | 2.80               | 2.20               | 5.20               | Versenate Titration                            |
| 8.      | Magnesium (meq.lit. <sup>-1</sup> )                            | --           | 3.00              | 1.60              | 1.40               | 2.40               | 1.40               | 5.60               | Richard (1954)                                 |
| 9.      | Sodium (meq.lit. <sup>-1</sup> )                               | --           | 1.19              | 1.68              | 1.54               | 1.35               | 1.02               | 1.01               | Flame Photometry                               |
| 10.     | Potassium (meq.lit. <sup>-1</sup> )                            | --           | 0.24              | 0.47              | 0.69               | 0.10               | 0.42               | 0.07               | Richard (1954)                                 |
| 11.     | Mg : Ca ratio                                                  | 0 - 1.50     | 0.83              | 0.62              | 0.58               | 0.86               | 0.64               | 1.08               | ---                                            |
| 12.     | Sodium adsorption ratio (SAR)                                  | < 10         | 0.65              | 1.16              | 1.12               | 0.84               | 0.76               | 0.44               | USSLS (1954)                                   |
| 13.     | Residual sodium carbonate (RSC)                                | < 1.25       | 0.00              | 0.00              | 0.00               | 0.00               | 0.00               | 0.00               | Eaton (1950)                                   |
| 14.     | Total Dissolved Salts (TDS) (mg lit. <sup>-1</sup> )           | < 460        | 384.00            | 224.00            | 217.60             | 262.40             | 134.40             | 230.40             | Richard (1954)                                 |
| 15.     | Total hardness as CaCO <sub>3</sub> (mg lit. <sup>-1</sup> )   | --           | 660               | 420               | 380                | 520                | 360                | 1080               | APHA (2005)                                    |
| 16.     | Total alkalinity as CaCO <sub>3</sub> (mg lit. <sup>-1</sup> ) | --           | 340               | 390               | 350                | 420                | 300                | 440                | APHA (2005)                                    |
| 17.     | BOD (mg lit. <sup>-1</sup> )                                   | < 30         | 8.72              | 8.04              | 7.12               | 6.63               | 6.17               | 6.50               | Titrimetric method<br>APHA (2005)              |
| 18.     | COD (mg lit. <sup>-1</sup> )                                   | < 200        | 34.88             | 32.16             | 28.46              | 26.52              | 24.68              | 26.01              | Open reflux method<br>APHA (2005)              |
| 19.     | Nickel (Ni) (mg lit. <sup>-1</sup> )                           | < 3          | traces            | traces            | traces             | traces             | traces             | traces             | Atomic Absorption                              |
| 20.     | Cromium (Cr) (mg lit. <sup>-1</sup> )                          | 6.5 - 7.5    | 0.13              | 0.12              | 0.12               | 0.12               | 0.13               | 0.13               | Spectrophotometer Lindsey<br>and Norvel (1978) |

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| Sr. No. | Parameter                                                      | Normal Range | Lab No. 413 (SW14) | Lab No. 414 (SW15) | Lab No. 415 (SW16) | Lab No. 416 (GW1) | Lab No. 417 (GW2) | Lab No. 418 (GW3) | Method used and Reference                                           |
|---------|----------------------------------------------------------------|--------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|---------------------------------------------------------------------|
| 1.      | pH                                                             | 6.5 - 7.5    | 8.13               | 7.62               | 7.33               | 8.01              | 8.07              | 7.96              | Potentiometric Jackson (1973)                                       |
| 2.      | Electrical Conductivity (dSm <sup>-1</sup> )                   | 0 - 0.75     | 0.37               | 0.68               | 4.10               | 0.18              | 0.13              | 0.10              | Conductometric Jackson (1973)                                       |
| 3.      | Carbonates (meq.lit. <sup>-1</sup> )                           | --           | 0.30               | 0.40               | 0.30               | Absent            | Absent            | Absent            | Titrimetric method<br>Richard (1954)                                |
| 4.      | Bicarbonates (meq.lit. <sup>-1</sup> )                         | --           | 2.80               | 5.20               | 5.20               | 1.60              | 2.80              | 2.00              |                                                                     |
| 5.      | Chlorides (meq.lit. <sup>-1</sup> )                            | 0 - 5.00     | 4.40               | 4.40               | 4.00               | 4.00              | 3.60              | 2.80              | Mohr's titration Richard (1954)                                     |
| 6.      | Sulphates (meq.lit. <sup>-1</sup> )                            | 0 - 4.00     | 2.00               | 0.83               | 50.38              | 2.92              | 2.60              | 1.45              | Turbidimetric Richard (1954)                                        |
| 7.      | Calcium (meq.lit. <sup>-1</sup> )                              | --           | 2.40               | 3.60               | 8.20               | 1.60              | 2.20              | 2.60              | Versenate Titration<br>Richard (1954)                               |
| 8.      | Magnesium (meq.lit. <sup>-1</sup> )                            | --           | 2.00               | 2.80               | 4.60               | 0.80              | 1.20              | 0.40              |                                                                     |
| 9.      | Sodium (meq.lit. <sup>-1</sup> )                               | --           | 1.04               | 4.04               | 47.08              | 0.24              | 0.34              | 0.31              | Flame Photometry<br>Richard (1954)                                  |
| 10.     | Potassium (meq lit. <sup>-1</sup> )                            | --           | 0.06               | 0.39               | 3.02               | 0.04              | 0.06              | 0.04              |                                                                     |
| 11.     | Mg : Ca ratio                                                  | 0 - 1.50     | 0.83               | 0.78               | 0.56               | 0.50              | 0.55              | 0.25              | ---                                                                 |
| 12.     | Sodium adsorption ratio (SAR)                                  | < 10         | 0.70               | 2.26               | 18.61              | 0.22              | 0.26              | 0.25              | USSLS (1954)                                                        |
| 13.     | Residual sodium carbonate (RSC)                                | < 1.25       | 0.00               | 0.00               | 0.00               | 0.00              | 0.00              | 0.00              | Eaton (1950)                                                        |
| 14.     | Total Dissolved Salts (TDS) (mg lit. <sup>-1</sup> )           | < 460        | 236.80             | 435.20             | 2624.00            | 115.20            | 83.20             | 64.00             | Richard (1954)                                                      |
| 15.     | Total hardness as CaCO <sub>3</sub> (mg lit. <sup>-1</sup> )   | ---          | 440                | 640                | 1280               | 240               | 340               | 300               | APHA (2005)                                                         |
| 16.     | Total alkalinity as CaCO <sub>3</sub> (mg lit. <sup>-1</sup> ) | ---          | 310                | 560                | 550                | 160               | 280               | 200               | APHA (2005)                                                         |
| 17.     | BOD (mg lit. <sup>-1</sup> )                                   | < 30         | 7.23               | 8.04               | 16.71              | 5.32              | 3.17              | 2.46              | Titrimetric method<br>APHA (2005)                                   |
| 18.     | COD (mg lit. <sup>-1</sup> )                                   | < 200        | 28.92              | 32.16              | 66.84              | 21.28             | 12.68             | 9.83              | Open reflux method<br>APHA (2005)                                   |
| 19.     | Nickel (Ni) (mg lit. <sup>-1</sup> )                           | < 3          | traces             | traces             | traces             | traces            | traces            | traces            | Atomic Absorption<br>Spectrophotometer Lindsey<br>and Norvel (1978) |
| 20.     | Cromium (Cr) (mg lit. <sup>-1</sup> )                          | 6.5 - 7.5    | 0.11               | 0.12               | 0.13               | 0.12              | 0.11              | 0.12              |                                                                     |

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| Sr. No. | Parameter                                                    | Normal Range | Lab No. 419 (GW4) | Lab No. 420 (GW5) | Lab No. 421 (GW6) | Lab No. 422 (GW7) | Lab No. 423 (GW8) | Lab No. 424 (GW9) | Method used and Reference                   |
|---------|--------------------------------------------------------------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------------------------------|
| 1.      | pH                                                           | 6.5 - 7.5    | 7.68              | 8.03              | 8.08              | 8.02              | 8.49              | 8.14              | Potentiometric Richard (1954)               |
| 2.      | Electrical Conductivity ( $\text{dSm}^{-1}$ )                | 0 - 0.75     | 0.96              | 0.99              | 0.37              | 0.16              | 0.95              | 0.42              | Conductometric Richard (1954)               |
| 3.      | Carbonates ( $\text{meq.lit}^{-1}$ )                         | --           | 2.40              | 3.20              | 2.40              | 1.60              | 5.60              | 2.40              | Titrimetric method                          |
| 4.      | Bicarbonates ( $\text{meq.lit}^{-1}$ )                       | --           | 5.60              | 6.40              | 2.80              | 2.00              | 6.40              | 3.20              | Richard (1954)                              |
| 5.      | Chlorides ( $\text{meq.lit}^{-1}$ )                          | 0 - 5.00     | 8.40              | 5.60              | 3.60              | 2.80              | 5.60              | 2.80              | Mohr's titration Richard (1954)             |
| 6.      | Sulphates ( $\text{meq.lit}^{-1}$ )                          | 0 - 4.00     | 0.95              | 3.00              | 2.18              | 2.03              | 1.81              | 1.25              | Turbidimetric Richard (1954)                |
| 7.      | Calcium ( $\text{meq.lit}^{-1}$ )                            | --           | 3.20              | 3.80              | 2.20              | 2.40              | 4.80              | 3.40              | Versenate Titration                         |
| 8.      | Magnesium ( $\text{meq.lit}^{-1}$ )                          | --           | 2.60              | 3.20              | 2.60              | 1.40              | 4.60              | 2.00              | Richard (1954)                              |
| 9.      | Sodium ( $\text{meq.lit}^{-1}$ )                             | --           | 11.48             | 10.06             | 1.58              | 0.51              | 6.33              | 1.72              | Flame Photometry                            |
| 10.     | Potassium ( $\text{meq.lit}^{-1}$ )                          | --           | 0.07              | 1.14              | 0.24              | 0.06              | 0.06              | 0.03              | Richard (1954)                              |
| 11.     | Mg : Ca ratio                                                | 0 - 1.50     | 0.81              | 0.84              | 1.18              | 0.58              | 0.96              | 0.59              | ---                                         |
| 12.     | Sodium adsorption ratio (SAR)                                | < 10         | 6.75              | 5.38              | 1.02              | 0.37              | 2.92              | 1.05              | USSLS (1954)                                |
| 13.     | Residual sodium carbonate (RSC)                              | < 1.25       | 2.20              | 2.60              | 0.40              | 0.00              | 2.60              | 0.20              | Eaton (1950)                                |
| 14.     | Total Dissolved Salts (TDS) ( $\text{mg.lit}^{-1}$ )         | < 460        | 614.40            | 633.60            | 236.80            | 102.40            | 608.00            | 268.80            | Richard (1954)                              |
| 15.     | Total hardness as $\text{CaCO}_3$ ( $\text{mg.lit}^{-1}$ )   | ---          | 580               | 700               | 480               | 380               | 940               | 540               | APHA (2005)                                 |
| 16.     | Total alkalinity as $\text{CaCO}_3$ ( $\text{mg.lit}^{-1}$ ) | ---          | 800               | 960               | 520               | 360               | 1200              | 560               | APHA (2005)                                 |
| 17.     | BOD ( $\text{mg.lit}^{-1}$ )                                 | < 30         | 4.08              | 6.12              | 3.98              | 3.07              | 4.69              | 5.93              | Titrimetric method<br>APHA (2005)           |
| 18.     | COD ( $\text{mg.lit}^{-1}$ )                                 | < 200        | 16.00             | 24.08             | 16.28             | 12.68             | 18.26             | 23.88             | Open reflux method<br>APHA (2005)           |
| 19.     | Nickel (Ni) ( $\text{mg.lit}^{-1}$ )                         | < 3          | traces            | traces            | traces            | traces            | traces            | traces            | Atomic Absorption                           |
| 20.     | Cromium (Cr) ( $\text{mg.lit}^{-1}$ )                        | 6.5 - 7.5    | 0.12              | 0.11              | 0.12              | 0.11              | 0.12              | 0.11              | Spectrophotometer Lindsey and Norvel (1978) |

**Note :** This report will not valid for any legal matter.

  
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