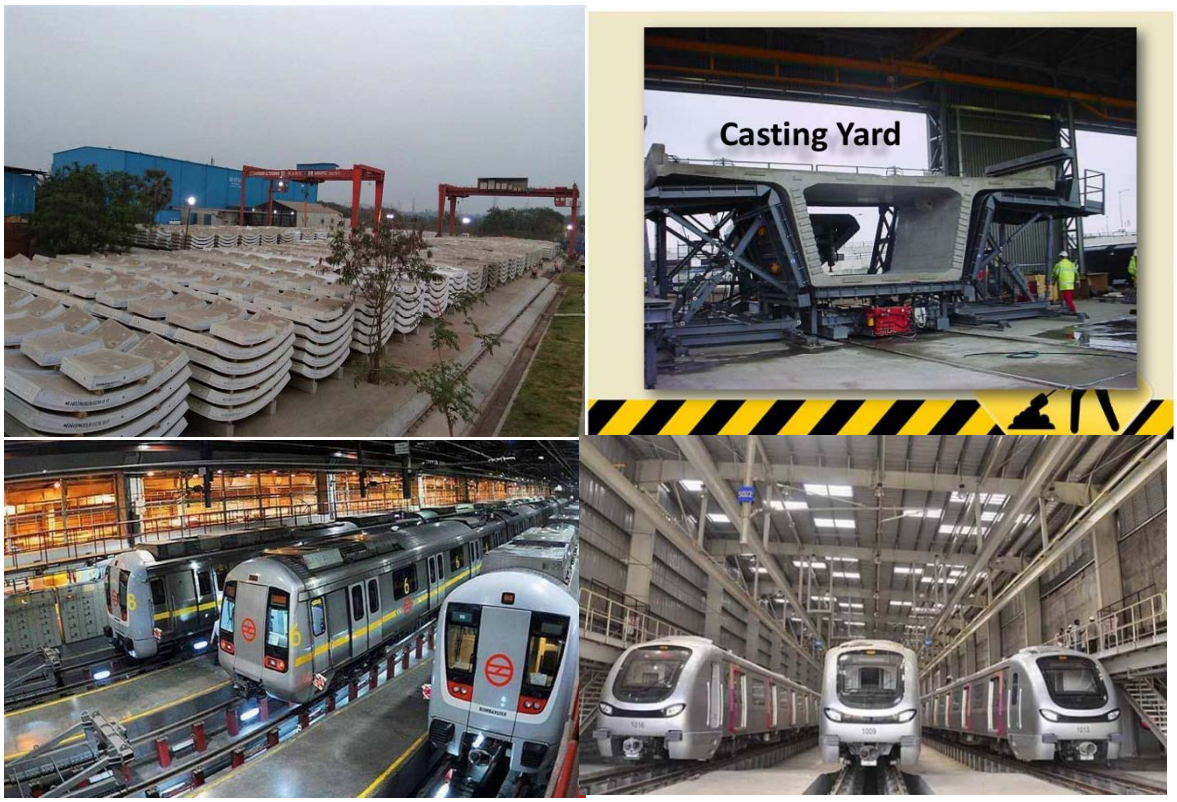
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

PROPOSED CONSTRUCTION OF 20 PIERS OF APPROACH ROAD AND METRO SPUR LINE TO MOGHARPADA CAR DEPOT AND CASTING YARD AT KAVESAR FOR METRO LINE – 4 PROJECT



PROJECT BY

MUMBAI METROPOLITAN REGION DVELOPMENT AUTHORITY

PREPARED BY

GLOBAL MANAGEMENT AND ENGINEERING CONSULTANTS INTERNATIONAL

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MAY 2019

INDEX

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAQ	Ambient Air Quality
AC	Air conditioner
AIBB	Asian Infrastructure Investment Bank
aMSL	above Mean Sea Level
BDL	Below Detectable Level
BEST	Brihanmumbai Electric Supply and Transport
BIS	Bureau of Indian Standard
BKC	Bandra Kurla Complex
BOD	Biological Oxygen Demand
C&D waste	Construction and Demolition Waste
CCTV	Closed Circuit Television
CGWA	Central Ground Water Authority
CMP	Comprehensive Mobility Plan
CNG	Compressed Natural Gas
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CR	Central Railway
CTE	Consent to Establish
CTO	Consent to Operate
cum/day	cubic meter per day
CZMP	Coastal Zone Management Plan
DFO	District Forest Officer
DG sets	Diesel Generated sets
DMP	Disaster Management Plan
DMRC	Delhi Metro Rail Corporation
DPR	Detailed Project Report
EIA	Environment Impact Assessment
EMP	Environmental Management Plan
EMP	Environmental Mitigation Plan
EPA	Environmental Protection Agency
ETP	Effluent Treatment Plant
FY	Financial Year
GBH	Birth at Breast Height
GoI	Government of India
GoM	Government of Maharashtra
IMD	Indian Meteorological Department
KLD	Kilo Liter per Day
Km	Kilometer

Km/hr	Kilometer per Hour
Leq	equivalent continuous sound pressure level in dB
Lmax	Maximum sound pressure level in dB
M	Meter
mbgl	meters below ground level
MCGM	Municipal Corporation of Greater Mumbai
MCGM	Municipal Corporation of Greater Mumbai
MMRC	Mumbai Metro Rail Corporation
MMRDA	Mumbai Metropolitan Region Development Authority
MoEF& CC	Ministry of Environment and Forestry& Climate Change
MRTS	Mass Rapid Transport System
MSPCB	Maharashtra State Pollution Control Board
MSW	Municipal Solid Waste
MUTP	Mumbai Urban Transport Project
MVA	Mega Volt Amp
NAAQS	National Ambient Air Quality Standard
NABL	National Accreditation Board for Testing and Calibration Laboratories
NGO	Non Governmental Organization
NGT	National Green Tribunal
NMMT	Navi Mumbai Municipal Transport
NTU	Nephelometric Turbidity Unit
OBC	Other Backward Section
OSHA	Occupational Safety & Health Administration
PAPs	Project Affected Peoples
PCE	Petrol Car Equivalent
PCR	Physical Cultural Resources
PHPDT	Peak Hour Peak Direction Traffic
PM	Particulate Matter
PPE	Personal Protective Equipment
PUC	Pollution Under Control
QC	Quality Control
RCC	Reinforced Concrete Cement
REA	Rapid Environmental Assessment
RF/PF	Reserve Forest/ Protected Forest
RO	Reverse Osmosis
ROW	Right of Way
RSES	Environment and Social Safeguard Division
RSS	Really Simple Syndication
RWH	Rain Water Harvesting
SEIAA	State Environmental Impact Assessment Authority
SGNP	Sanjay Gandhi National Park
SHE	Safety, Health and Environment

SPCB	State Pollution Control Board
SPS	Safeguard Policy Statement
SPM	Suspended Particulate Matter
STP	Sewage Treatment Plant
TMC	Thane Municipal Corporation
TMT	Thane Municipal Transport
TSS	Total Suspended Solids
WR	Western Railway

CHAPTER 1
INTRODUCTION

1.1 PROJECT BACKGROUND

With the widening gap between the available amenities and Infrastructure and the humongous requirement of such facilities for the ever increasing population, Transport Infrastructure Development has become the biggest challenge for the Mumbai Metropolitan Development Authority (MMRDA). Adoption of the land use policies proposed by MMRDA for the development of the region will arrest further deterioration of the urban environment and will facilitate a sustainable Development and growth. To tackle the problem of traffic congestion, MMRDA has proposed Mumbai Metro Line – 4 corridors which will save the time required by the commuters to travel from Mumbai city to Thane.

The metro corridor Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh is having total length of 34.98 km and will provide connectivity between Mumbai and thane cities. The project area also includes two car depots one at Vikhroli and other at Bhayanderpada in addition to viaduct and station area. Total 34 stations are to be constructed on this metro alignment. Entire corridor will be elevated.Metro 4 was initially planned from Wadala to Kasawadawali. The cost was pegged at Rs 14,549 crore. Later, MMRDA extended it to Gaimukh in Thane and to GPO on the southern side in Mumbai.

The alignment Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh lies between the $19^{o}01'33.95"$N, $72^{o}52'38.36"$E and $19^{o}17'06.42"$N, $72^{o}56'31.22"$E. Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh corridor of Mumbai Metro Project is proposed to start at Bhakti Park, wadala, F-North ward. The alignment then passes through LBS road, Eastern Express Highway and then through Ghodbunder raod and ends at Gaimukh. Government has accorded sanction to above metro project and declared the project as **"Public Project of Urgency and Vital Urban Transport Project".** MMRDA is the "Special Planning Authority" for Metro Line-4 project.

MMRDA has taken up expeditious implementation of 376 KM network of Metro corridors within upcoming 5 to 10 years in Mumbai region. Vide GR dated 25/11/2016 State Government has approved Metro Line-4 corridor (Wadala-Ghatkopar-Mulund-Thane-Kasarvadavali) (32.32 km). Vide GR dated 25/11/2016 State Government has approved

Metro Line-4 corridor (Wadala-Ghatkopar-Mulund-Thane-Kasarvadavali) (32.32 km). Vide GR dated 24/01/2019, State Government has also approved Metro Line-4A project (Kasarwadavali – Gaimukh) (2.66 km). Metro Line-4A project will reduce the traffic congestion in Thane- Ghodbandar road and surrounding area.

For such a wide network, MMRDA proposed

- Construction of 20 piers of approach road and Metro spur line to Mogharpada carshed depot at survey nos. 30 (pt), 27 (pt), 28 (pt) & 29(pt) of village Mogharpada. Total area for Metro Car Shed is proposed to be 27.50 ha. There is existing 40m wide road near to the proposed depot at a distance of approx. 200m. Connecting this road, 25m wide elevated approach road with Metro spur line is proposed which crosses the nala having width of 20 m affected in CRZ area. The piers are located in CRZ-II and not affected by mangroves/ 50m mangroves buffer zone as per approved CZMP
- Construction of casting yard at Survey No. 311,312,313, 314 & 267/15 of village Kavesar. Total area for casting yard is proposed to be 7.72 ha of which 6.31 ha area falls under CRZ II area.The said plot will be utilized temporarily for construction of pre-cast girders required for Metro projects. It is falling on landward side of an existing road.Casting yard will have following activities:
    - Site Office
    - RMC Plant & QC Lab
    - Reinforcement fabrication yard
    - Epoxy coating plant
    - Segment stacking yard
    - Other allied activities for functioning of casting yard.

1.2 NEED OF THE PROJECT

Transportation being the most vital element that effect normal life in Mumbai, any deficiency, in the infrastructure related to Transportation, seriously affects the productivity and economic growth of the city. Car-besotted and flyover-obsessed Mumbai needs an alternate transport system which will be greener, safer, faster and non-polluting-in other words people

friendly and environment friendly. As sufficient and timely investment was not made in the past on the development of an efficient alternate transport infrastructure, the presently available network of Suburban Railways and the Road Transport System been stretched to the crisis levels. In order to effectively augment the present Transport Systems MMRDA has conceived the idea of Metro Railway Network. According to MMRDA's estimates, the corridor, passing through Rafi Ahmed Kidwai Marg and PD'Mello Road, will cater to 7 lakh passengers a day, making it one of the busiest Metro.Once completed, Metro 4 will take away a huge load from the central local railway and will also connect Wadala with central suburbs and the island city. With the state government giving rights to MMRDA to develop Wadala as the next business district, this infrastructure would be a must.

1.2.1 GENERAL ADVANTAGES OF METRO RAILWAY SYSTEM:

i. Higher carrying capacity (50 seat+325 standing=375 per standard Coach) compared to road transport. (Equivalent to 7 lanes of bus traffic or 24 lanes of motor car traffic)
ii. Higher speed (maximum speed of 80km/hr irrespective of normal time or peak time compared to bus and other road traffic which literally snarls during peak time.)
iii. Smooth ride as it is not affected by other vehicles, pedestrians etc. (Travel in jam packed buses is very rough.)
iv. Safer compared to road transport in Mumbai where road accident rate is very high.
v. Occupies less land space as the Metro runs on elevated tracks which are supported on pillars; each pillar occupying a ground space of approximately 2M x 2M only.
vi. Elevated Metro Rail occupies only 2M width of the road space.
vii. No gaseous, liquid or solid pollution as the Metro railway is run on clean energy viz. electricity which does not emit any pollutant during the operation.
viii. Lower noise pollution compared to equivalent capacity of road transport. (By virtue of the state of the art technology applied for construction of the coaches and the track and by virtue of high elevation of the track (>7M) the noise nuisance caused by the Metro is far less compared to the road transport. (Noise levels of the modern Metro Rail Coaches and the track at the source is expected to be < 60 dB (A).
ix. Energy efficient (energy consumption per passenger km is only 20% of the energy consumed by the road based transport system).
x. Lower journey time (lower by 50-70% of the time taken by road traffic, depending on road conditions).

1.3 SCOPE OF EIA

The scope of the study includes detailed characterization of the status of the environment in an area of 10 km. radius of the proposed elevated road for major components, viz. air, noise, water, land, biological and socioeconomic and cultural environment, as per the Guidelines issued by Ministry of Environment and Forest, Government of India.

It is envisaged under the scope of EIA to;

- Assess the present status of air, noise, water, land, biological and socioeconomic components of the environment.
- Identify and quantify the impacts due to proposed elevated road on the environmental components during construction and operation phases.
- Evaluate the adequacy of existing and proposed environmental protection measures.
- Prepare Environmental Management Plan (EMP) outlining additional protection measures to be adopted for mitigation of adverse impacts.
- Delineate post-project environmental quality monitoring.

With the above scope and objective in mind, a multidisciplinary team was formulated comprising of experts in Air / Water / Noise Pollution, Socio-economic Studies, Ecological/Biological studies, Environmental Planning and Geologists/ Hydrologists.

1.3.1 STUDY AREA

To decide whether a proposed action is likely to cause significant adverse environmental effects, the concept of EIA is practiced. Before proceeding to establish baseline environmental status, it is important to know the boundary limits and framework, where data can be effectively utilized in impact assessment. The study area is considered upto 500m core zone and 10 km radial area.

1.4 APPROACHES AND METHODOLOGY

The methodology adopted for baseline data collection, identification and prediction of impacts for various environmental components are presented below:

1.4.1 Establishing Baseline Environmental Status

Baseline data describing the existing environmental status of the identified study area is determined using the procedures Prescribed by Guideline of MoEF. The study period is from March 2019 to May 2019

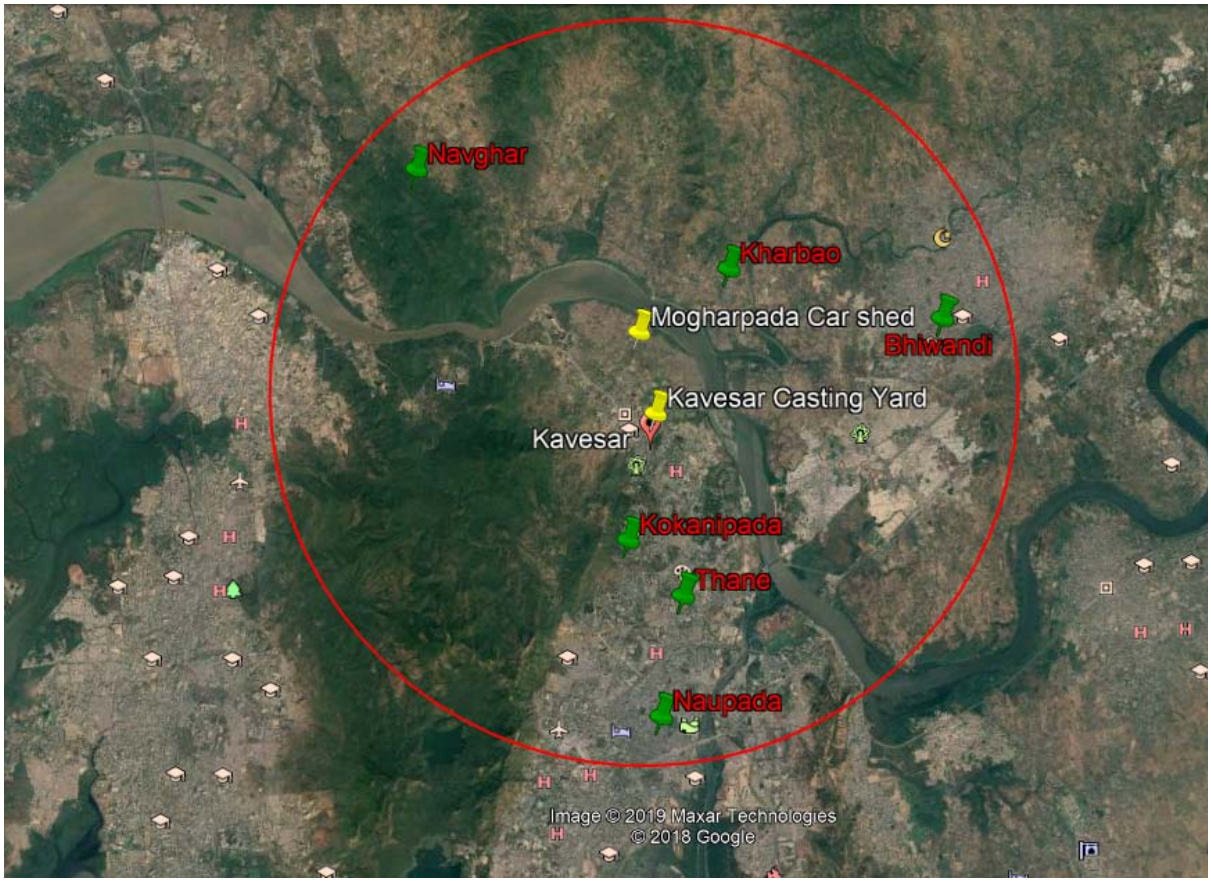

Fig: 1.1 Study area of proposed Car-shed Depot and Casting Yard for Metro Line -4

1.4.1 Physical Resources

a) Air Quality and Climate

Design of Ambient Air Quality Monitoring Network

The air quality status in the study area is assessed at predefined locations. The baselinestudies for air environment include identification of site and project specific air pollutantsprior to implementation of the project. The baseline status of the air environment is assessedthrough a systematic air quality monitoring program, which is planned based on the followingcriteria:

- Topography/ terrain of the study area
- Densely populated areas within the region

- Location of surrounding industries
- Representation of regional background
- Representation of valid cross-sectional distribution in downwind direction

Methodology for Ambient Air Quality Monitoring

Ambient Air Quality Monitoring (AAQM) was carried out at pre-identified locations.Maximum numbers of sampling locations were selected close to the proposed site and in thedownwind direction.

AAQM was carried out as per CPCB guidelines to determine a finer cross-sectionaldistribution of air pollution in an industrial developed region. The conventional parameterssuch as Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter(RSPM), Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NOx) were monitored on site, ateach of these sites.

An automatic weather monitoring station was also installed at project site, keeping thesensors exposed to the atmosphere and with minimum interference with the nearby structures.The micro-meteorological data like wind speed, wind direction, temperature and relativehumidity were collected using the weather station and cloud cover was recorded manually forthe study period.

b) Noise

Noise standards have been designated for different types of landuse, i.e. residential, commercial, industrial areas and silence zones, as per 'The Noise Pollution (Regulation and Control) Rules, 2000, Notified by Ministry of Environment and Forests, New Delhi, February 14, 2000'. The ambient noise standards and safe noise exposure limits are presented in Reportrespectively. Different standards have been stipulated during day time (6 am to 10 pm) and night time (10 pm to 6 am).

The residential, commercial, industrial areas and silence zones close to the project site and inthe study area have been identified. These locations have been chosen away from the majorroads and major noise sources so as to measure ambient noise levels. Equivalent noise levels(Leq) are measured twice a week during study period at each monitoring location during daytime and night time.

c) Water

Water quality was assessed with respect to faunal diversity and water quality at pre-defined locations. One sample was collected at the site location for establishing the baseline waterquality.

d) Topography and Soil

The city is characterized by flat terrain on the southern side whereas hilly region on northern side and submersible marsh land along the Thane Creek on the other side. The plain terrainforms a wide belt along the foot hills and away from Creek water, Ulhas river banks. Mumbaihas numerous creeks with close to 71 km^2 of creeks and mangroves along its coastline. Such asituation has also distracted the growth and placement of various activities. The Metro Line- 4runs centrally through the plains.

1.4.1.1 Ecological Resources

a) Terrestrial Ecology

The terrestrial flora and fauna is assessed through following parameters:

Flora

i) Species List

Such a list includes common and scientific names of plants found in the study area. This list is prepared based on visual observation during site visits and through review of site literature. Data available with various agencies is referred for identifying rare or endangered species in the region.

Fauna

Actual counts of the animals are made following the census technique. At each station a walk-through census is made. Line transects of 1 km selected for studying the faunaldiversity. Birds were recorded through birdcalls and direct sighting. Standard fieldidentification guides were used for identifying species.

b) Aquatic Ecology

Water samples were analyzed for estimating plankton counts viz. zooplankton and phytoplankton. Similarly, information about fisheries and coastal resources such as mangroves was collected from secondary sources.

1.4.1.2 Economic Development

a) Industries, Infrastructure Facilities and Transportation

The information on industries, infrastructure facilities such as power supply, water supply, telecommunication, sewerage, flood control etc. and transportation such as roads, harbours, railway, airports and navigation were collected from secondary sources and field visits.

1.4.2 Anticipated Environmental Impacts

The environmental impacts due to proposed project have been identified, predicted and evaluated.

In the present study the mathematical models that have been used for predictions include

- Assimilative capacity based approach to determine permissible air pollution load so as not to exceed ambient air quality standards stipulated by CPCB
- Wave divergence for stationary noise sources, Federal Highway Administration (FHWA) models for noise levels of vehicular sources
- For impact on water, land and biological components of environment, the predictions have been made based on available scientific knowledge and judgment.

1.4.3 Environmental Management Plan

Environmental Management Plan (EMP) is drawn after identifying, predicting and evaluating the significant impacts on each component of the environment with a view to maximizing the benefits from the project. Post-project Environmental Monitoring programme is also delineated in the report.

Table 1.1: GENERAL STRUCTURE OF ENVIRONMENT IMPACT ASSESSMENT REPORT

Chapter - 1	**Introduction**	This chapter provides purpose of the EIA report, background information of the project, stage of EIA report preparation, and scope, methodology and brief outline of EIA report.
Chapter - 2	**Description of the Project**	This chapter provides the following details: • Type of project • Need for the project • Project location • Project details including associated activities required for the project.
Chapter - 3	**Baseline Environmental Status**	This chapter presents the information on study area, information on existing environmental resources, findings of field studies undertaken to establish the baseline environmental status and has been organized into the following sub-sections: • Air Environment • Biological Environment • Noise Environment • Socio-economic Environment • Water Environment • Land Environment
Chapter - 4	**Environmental Impacts assessment**	This chapter details the identification, prediction and evaluation of impacts on each resource. The impacts of "the project" are predicted using available computer models during construction and operational phase. The significance of impacts is determined based on applicable environmental guidelines. It describes the overall impacts of the proposed project and identifies the areas of concern, which need mitigation measures.
Chapter - 5	**Environmental Monitoring Program**	Technical aspects of monitoring the effectiveness of mitigation measures (Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget

		and procurement schedules)
Chapter - 6	**Disaster Management plan**	This chapter includes Public Consultation; Risk Assessment, and Social Impact Assessment
Chapter - 7	**Project Benefits**	This chapter explains the improvements in the physical infrastructure and social infrastructure and employment potential.
Chapter - 8	**Environmental Management Plan (EMP)**	This chapter provides recommendations for Environmental Management Plan (EMP) including mitigation measure for minimizing the negative environmental impacts of the project. Environmental monitoring requirements for effective implementation of mitigation measures during construction as well as operation of the project have also been delineated along with required institutional arrangements for their implementation. Budgetary cost proposed for pollution mitigation and environmental management are also provided.
Chapter - 9	**Summary of Observations and Recommendations**	This Chapter summarizes the key issues and certain recommendations based on EIA study for successful implementation & execution of the proposed project.
Chapter - 10	**Disclosure of the Consultants Engaged**	This chapter explains the names of the consultants engaged with the brief resume and the nature of the consultancy engaged.

CHAPTER – 2
PROJECT DESCRIPTION

2.1 INTRODUCTION TO THE PROJECT

2.1.1 TRANSPORT SITUATION IN MUMBAI & THANE CITY

Transport plays a very important role in development of an economy. Transport is nothing but a means used to move people and commodities along with livestock from one place to the other. Transport is an integral part of infrastructure of any country, more so a developing economy. In a developing economy it is necessary that transport becomes developed as it helps people to look out for jobs within far and wide areas of city. Transport helps people and goods and services to be relocated from one place to the other. Transport also helps to safeguard the boundaries of a country from the neighboring countries. Transport has evolved over a period of time. Since Economic liberalization of India in 1991, transport has occupied a significant importance. Transport facilities available to people can be classified in to Public transport and Private transport.

Public transport systems in Mumbai include the Mumbai Suburban railway, Monorail, Metro, Brihanmumbai Electric Supply and Transport(BEST) buses, black-and-yellow meter taxis, auto rickshaws and ferries. Suburban railway and BEST bus services together accounted for about 88% of the passenger traffic in 2008. Auto rickshaws are allowed to operate only in the suburban areas of Mumbai, while taxis are allowed to operate throughout Mumbai, but generally operate in South Mumbai.

While in Thane city, the public transport include Thane Municipal Transport (TMT) buses, Thane-Nerul-Panvel local train, uto rickshaws, taxi. Taxis and rickshaws in Mumbai are required by law to run on compressed natural gas (CNG), and are a convenient, economical, and easily available means of transport.

2.1.1.1 Rail

The Mumbai Suburban Railway, popularly referred to as Locals forms the backbone of the city's transport system. It is operated by the Central Railway and Western Railway zones of the Indian Railways. Mumbai's suburban rail systems carried a total of 6.3 million passengers every day in 2007, which is more than half of the Indian Railways daily carrying capacity. Trains are overcrowded during peak hours, with nine-car trains of rated capacity 1,700 passengers, actually carrying around 4,500 passengers at peak hours. The Mumbai rail network is spread at an expanse of 319 route kilometres. 191 rakes (train-sets) of 9 car and 12 car composition are utilised to run a total of 2,226 train services in the city. Mumbai is the headquarters of two zones of the Indian

Railways:the Central Railway (CR) headquartered at ChhatrapatiShivaji Terminus(formerly Victoria Terminus), and the Western Railway (WR) headquartered at Churchgate. Mumbai is also well connected to most parts of India by the Indian Railways. Long-distance trains originate from ChhatrapatiShivaji Terminus,Dadar, LokmanyaTilak Terminus, Mumbai Central, Bandra Terminus, Andheri and Borivali.

The Mumbai Monorail and Mumbai Metro have been built and are being extended in phases to relieve overcrowding on the existing network. The Monorail opened in early February 2014. The first line of the Mumbai Metro opened in early June 2014.

2.1.1.2 Bus

Mumbai's bus services carried over 5.5 million passengers per day in 2008. Public buses run by BEST cover almost all parts of the metropolis, as well as parts of Navi Mumbai, Mira-Bhayandar and Thane. The BEST operates a total of 4,608 buses with CCTV cameras installed, ferrying 4.5 million passengers daily over 390 routes. Its fleet consists of single-decker, double-decker, vestibule, low-floor, disabled-friendly, air-conditioned and Euro III compliant diesel and compressed natural gas powered buses. BEST introduced air-conditioned buses in 1998. Maharashtra State Road Transport Corporation buses provide intercity transport connecting Mumbai with other towns and cities of Maharashtra and nearby states. The Navi Mumbai Municipal Transport (NMMT) and Thane Municipal Transport (TMT) also operate their buses in Mumbai, connecting various nodes of Navi Mumbai and Thane to parts of Mumbai. Buses are generally favoured for commuting short to medium distances, while train fares are more economical for longer distance commutes.

2.1.1.3 Water

Water transport in Mumbai consists of ferries, hovercrafts and catamarans. Services are provided by both government agencies as well as private partners Hovercraft services plied briefly in the late 1990s between the Gateway of India and CBD Belapur in Navi Mumbai. They were subsequently scrapped due to lack of adequate infrastructure.

2.1.1.4 Road

Mumbai is served by National Highway 3, National Highway 4, National Highway 8, National Highway 17 and National Highway 222 of India's National Highways system. The Mumbai-Pune Expressway was the first expressway built in India. The Eastern Freeway was opened in 2013. The Mumbai Nashik Expressway, Mumbai-Vadodara Expressway, are under construction. The Bandra-Worli Sea Link bridge, along with Mahim Causeway, links the island city to the

western suburbs. The three major road arteries of the city are the Eastern Express Highway from Sion to Thane, the SionPanvel Expressway from Sion to Panvel and the Western Express Highway from Bandra to Dahisar. Mumbai has approximately 1,900 km of roads. There are five tolled entry points to the city by road. Mumbai had about 721,000 private vehicles as of March 2014, 56,459 black and yellow taxis as of 2005, and 106,000 auto rickshaws, as of May 2013.

Thane is well connected to other regions by an extensive network of Railways and Roadways - including one national highway passing through Thane. As Thane is next to Mulund (which is the last station of Mumbai's Eastern Suburb), Airoli (which is the first station of Navi Mumbai's North-Western suburb), Bhiwandi the Junction to (2 Twin cities) of Kalyan- Dombivali& Vasai -Virar, and the Borivali Mumbai's Western Suburb & Mira Road/Bhayander through Ghodbunder Road, most parts of the city are easily accessible.

2.1.1.5 Air

The ChhatrapatiShivaji International Airport (formerly Sahar International Airport) is the main aviation hub in the city and the second busiest airport in India in terms of passenger traffic. It handled 36.6 million passengers and 694,300 tonnes of cargo during FY 2014–2015. An upgrade plan was initiated in 2006, targeted at increasing the capacity of the airport to handle up to 40 million passengers annually and the new terminal T2 was opened in February 2014.

The proposed Navi Mumbai International Airport to be built in the Kopra-Panvel area has been sanctioned by the Indian Government and will help relieve the increasing traffic burden on the existing airport.

The Juhu Aerodrome was India's first airport, and now hosts the Bombay Flying Club and a heliport operated by state-owned Pawan Hans.

2.1.1.6 Sea

Mumbai is served by two major ports, Mumbai Port Trust and Jawaharlal Nehru Port Trust, which lies just across the creek in Navi Mumbai. Mumbai Port has one of the best natural harbours in the world, and has extensive wet and dry dock accommodation facilities. Jawaharlal Nehru Port, commissioned on 26 May 1989, is the busiest and most modern major port in India. It handles 55–60% of the country's total containerized cargo. Ferries from Ferry Wharf in Mazagaon allow access to islands near the city. The city is also the headquarters of the Western Naval Command, and also an important base for the Indian Navy.

2.2 BACKGROUND OF THE PROJECT

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    - Reinforcement fabrication yard
    - Epoxy coating plant
    - Segment stacking yard
    - Other allied activities for functioning of casting yard.

Ministry of Environment, Forest and Climate Change (MoEF& CC), Government of India vide its letter dated 9th March, 2016 informed to MMRDA that Metro Rail project is not covered under EIA Notification, 2006. The project does not require an Environmental Clearance certificate from MoEF& CC. However, construction of building within Metro rail project for commercial purposes such as mall, offices or residential buildings etc. having built up area equal to or more than 20,000 m2 shall require prior Environmental Clearance from State Level Environmental Impact Assessment Authority (SEIAA).

Alignment of the Metro Line -4 has been affected by CRZ II at Bhakti Park, Wadala according to approved Coastal Zone Management Plan (CZMP) prepared as per Coastal Regulation Zone (CRZ) Notification 1991, for which authority has accorded sanction. As mangroves are present in the alignment and are partially affected, Forest Clearance from MoEF& CC has been accorded for same.

In order to effectively augment the present Transport Systems MMRDA has conceived the idea of Metro Railway Network.While meeting these essential services the project activity will generate temporary as well as permanent employment to the skilled and un-skilled workers at a large scale. This will improve the economy of the local population of this region.

2.3 NEED OF THE PROJECT

Transportation being the most vital element that effect normal life in Mumbai, any deficiency, in the infrastructure related to Transportation, seriously affects the productivity and economic growth of the city. Car-besotted and flyover-obsessed Mumbai needs an alternate transport system which will be greener, safer, faster and non-polluting-in other words people friendly and environment friendly. As sufficient and timely investment was not made in the past on the development of an efficient alternate transport infrastructure, the presently available network of Suburban Railways and the Road Transport System been stretched to the crisis levels. In order to effectively augment the present Transport Systems MMRDA has conceived the idea of Metro Railway Network. . According to MMRDA's estimates, the corridor, passing through Rafi Ahmed Kidwai Marg and PD'Mello Road, will cater to 7 lakh passengers a day, making it one of the busiest Metro.Once completed, Metro 4 will take away a huge load from the central local railway and will also connect Wadala with central suburbs and the island city. With the state government giving rights to MMRDA to develop Wadala as the next business district, this infrastructure would be a must.

2.3.1 GENERAL ADVANTAGES OF METRO RAILWAY SYSTEM:

i. Higher carrying capacity (50 seat+325 standing=375 per standard Coach) compared to road transport. (Equivalent to 7 lanes of bus traffic or 24 lanes of motor car traffic)
ii. Higher speed (maximum speed of 80km/hr irrespective of normal time or peak time compared to bus and other road traffic which literally snarls during peak time.)
iii. Smooth ride as it is not affected by other vehicles, pedestrians etc. (Travel in jam packed buses is very rough.)
iv. Safer compared to road transport in Mumbai where road accident rate is very high.
v. Occupies less land space as the Metro runs on elevated tracks which are supported on pillars; each pillar occupying a ground space of approximately 2M x 2M only.
vi. Elevated Metro Rail occupies only 2M width of the road space.
vii. No gaseous, liquid or solid pollution as the Metro railway is run on clean energy viz. electricity which does not emit any pollutant during the operation.

viii. Lower noise pollution compared to equivalent capacity of road transport. (By virtue of the state of the art technology applied for construction of the coaches and the track and by virtue of high elevation of the track (>7M) the noise nuisance caused by the Metro is far less compared to the road transport. (Noise levels of the modern Metro Rail Coaches and the track at the source is expected to be < 60 dB (A).

ix. Energy efficient (energy consumption per passenger km is only 20% of the energy consumed by the road based transport system).

x. Lower journey time (lower by 50-70% of the time taken by road traffic, depending on road conditions).

2.4 PROJECT LOCATION

The proposed Plan showing Metro Line- 4 alignment (Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh); Mogharpada Depot &Casting yard at Kavesar for Metro Line-4 project in figures below

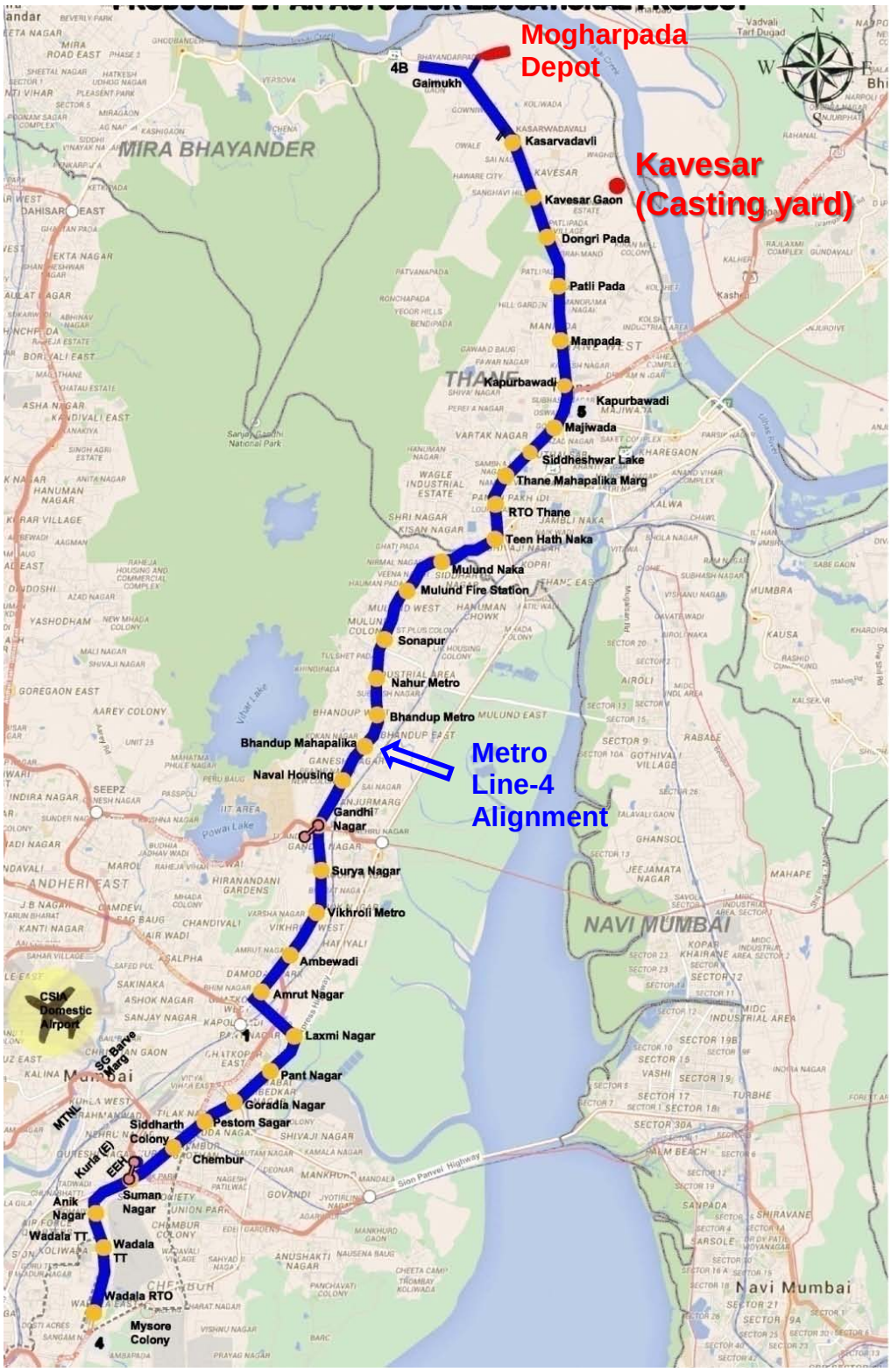


Fig 2.1: Project Location Map of Metro Line -4

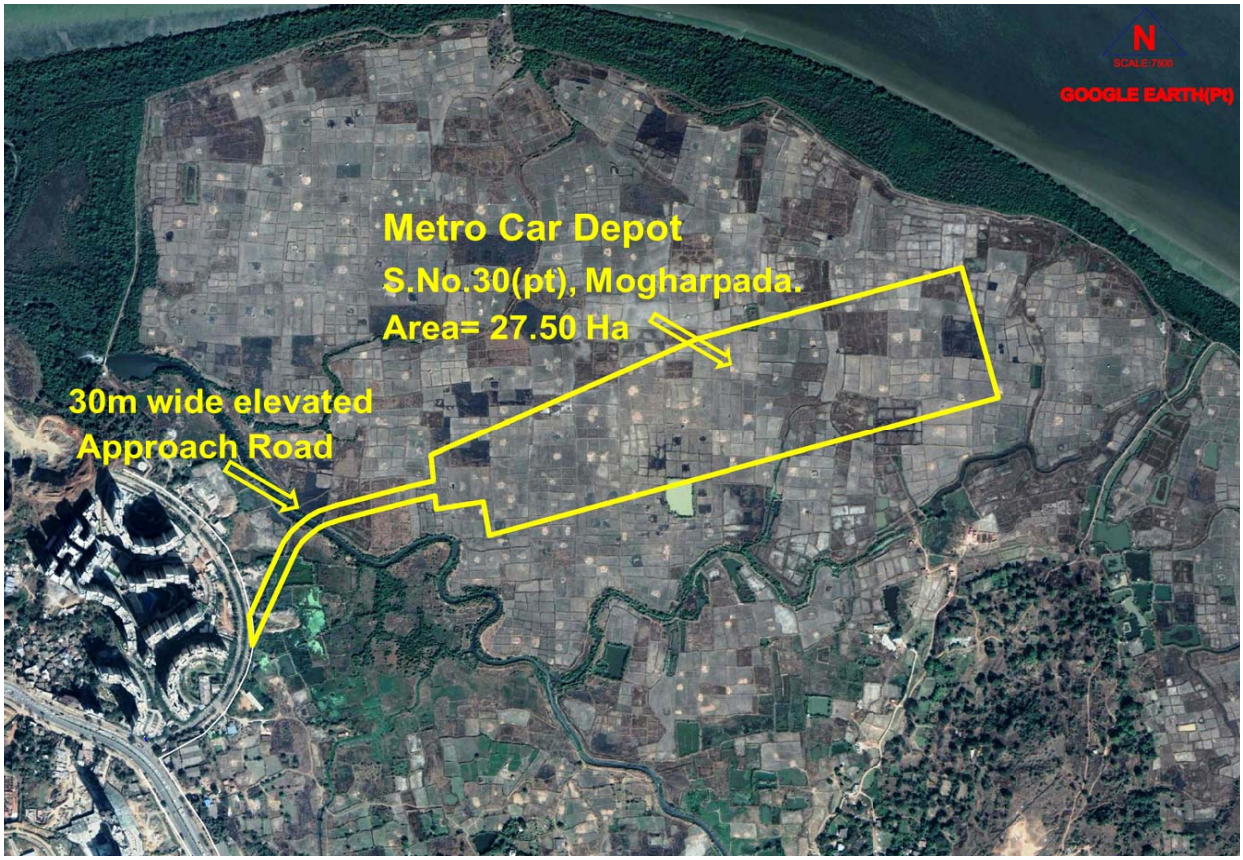


Fig 2.2 (a): Google image of Metro Car-Shed depot at Mogharpada

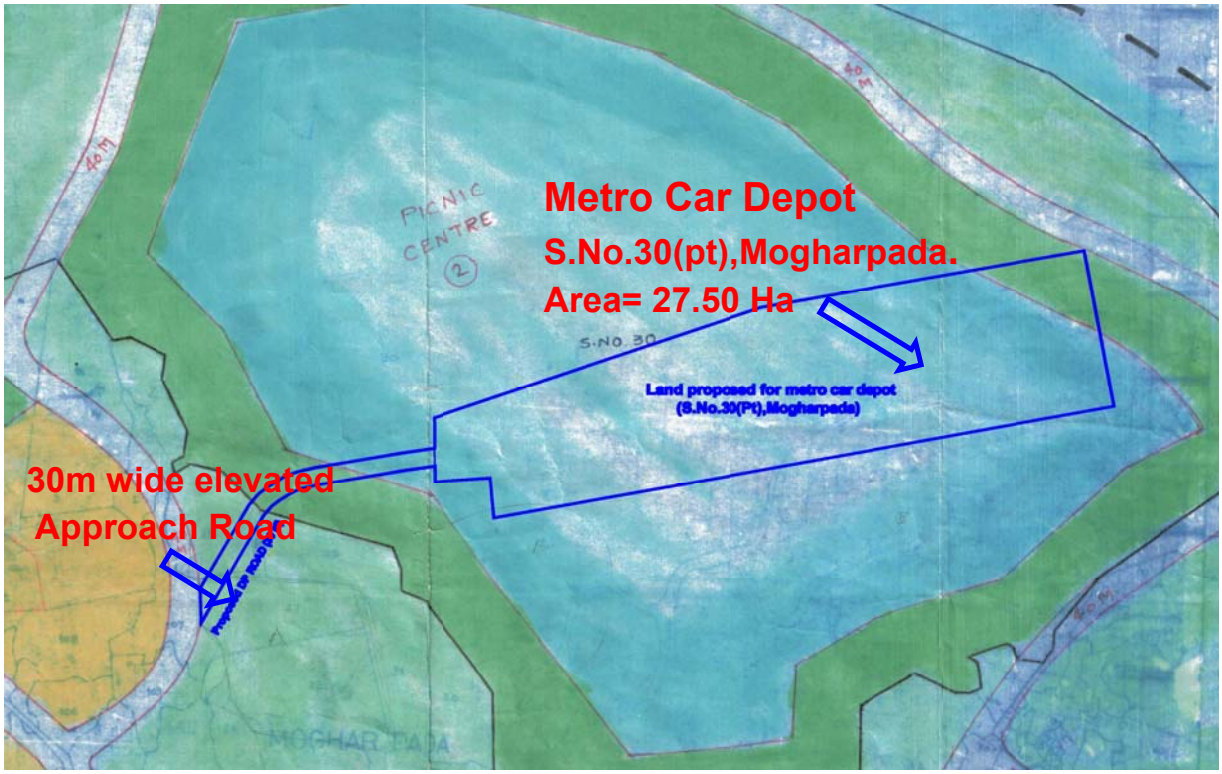


Fig 2.2 (b):Location Map of Metro Car-Shed depot at Mogharpada on TMC DP (Existing DP Reservation – Picnic Centre)

Fig 2.3 (a): Project Location Map of Casting Yard at Kavesar

Fig 2.3 (b): Google image of Casting yard at Kavesar

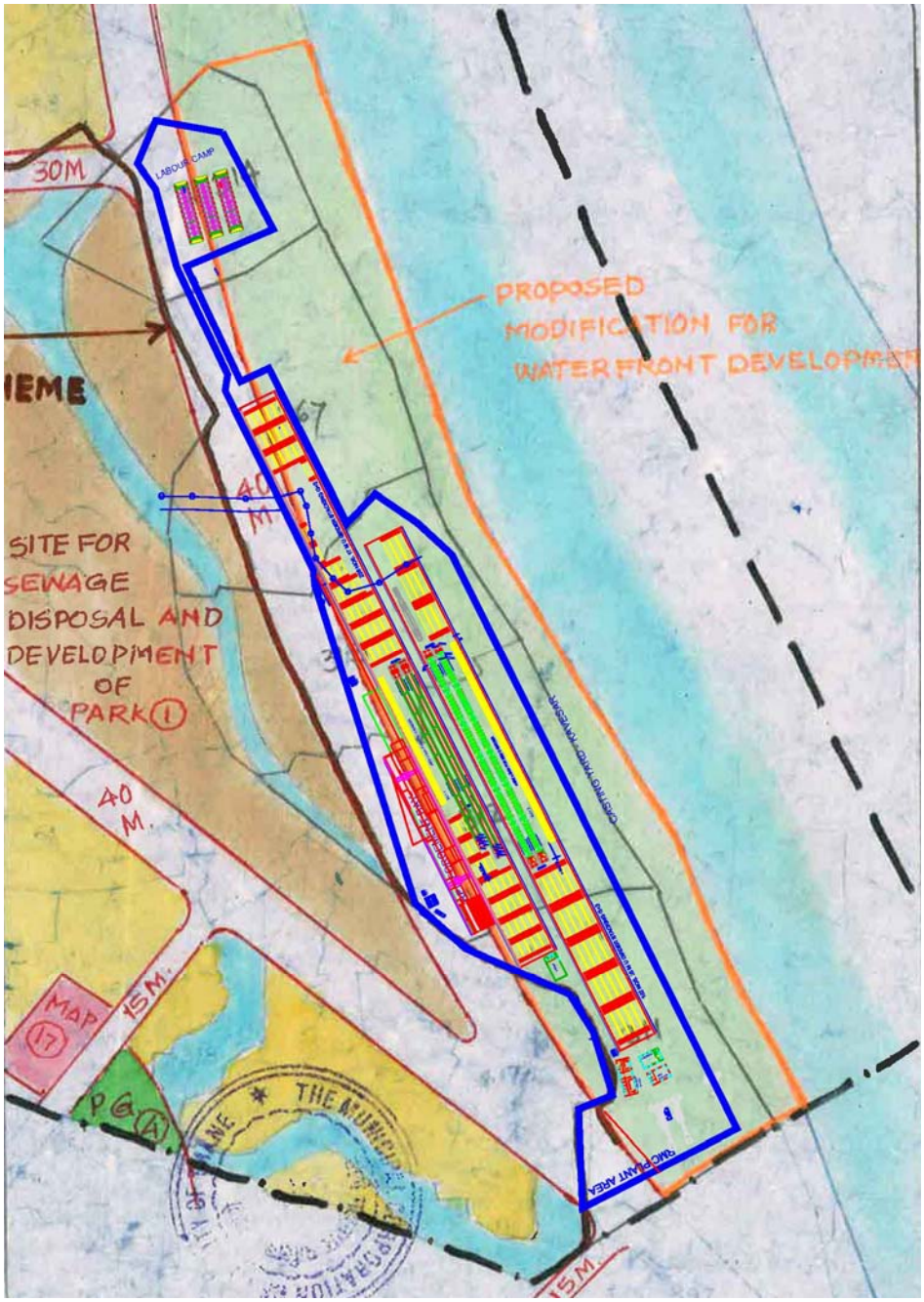


Fig 2.3 (c):Location of Casting yard at Kavesar on TMC DP (Reservation– Green zone (G-2) & 40m DP Road)

2.4.1 CRZ STATUS

The proposed car-shed depot and Casting Yard is planned on theMetro Line-4 from at village Mogharpada and Kavesar respectively. This project Falls under CRZ II as per CZMP of thane as shown in figures below. The total area affected under CRZ II area with construction of 20 no.s piers is 0.05 ha and with Casting Yard is 6.31 ha.

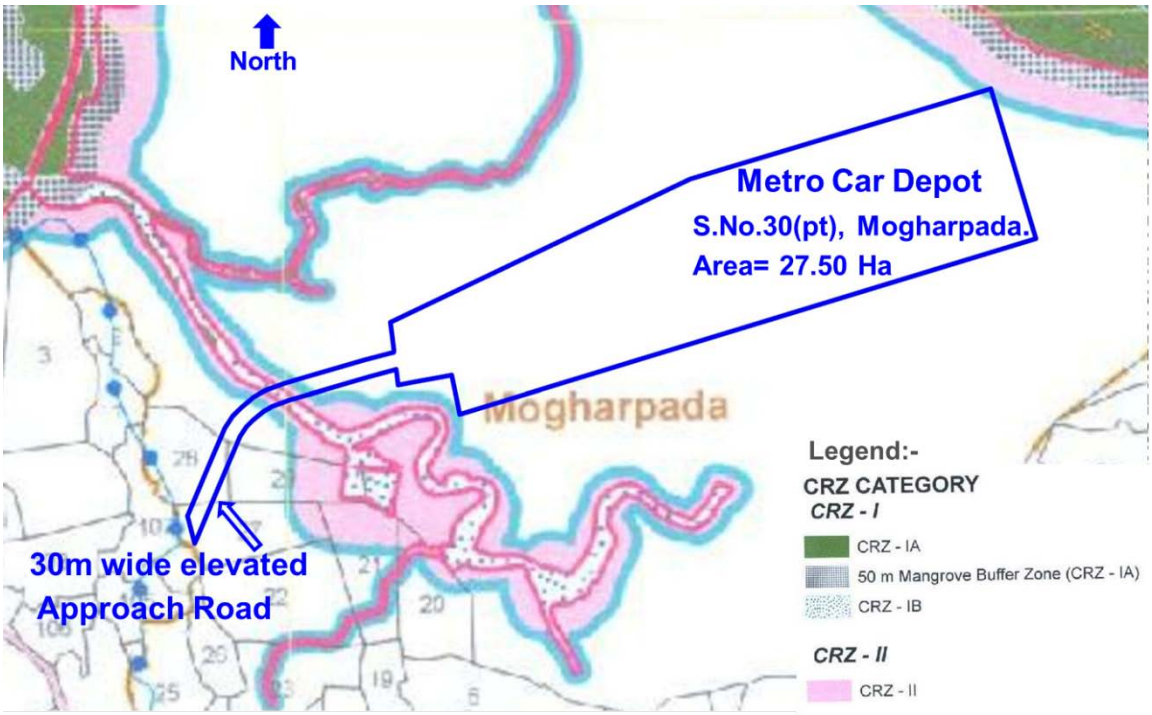


Fig 2.4 (a):Pier location on CZMP Map

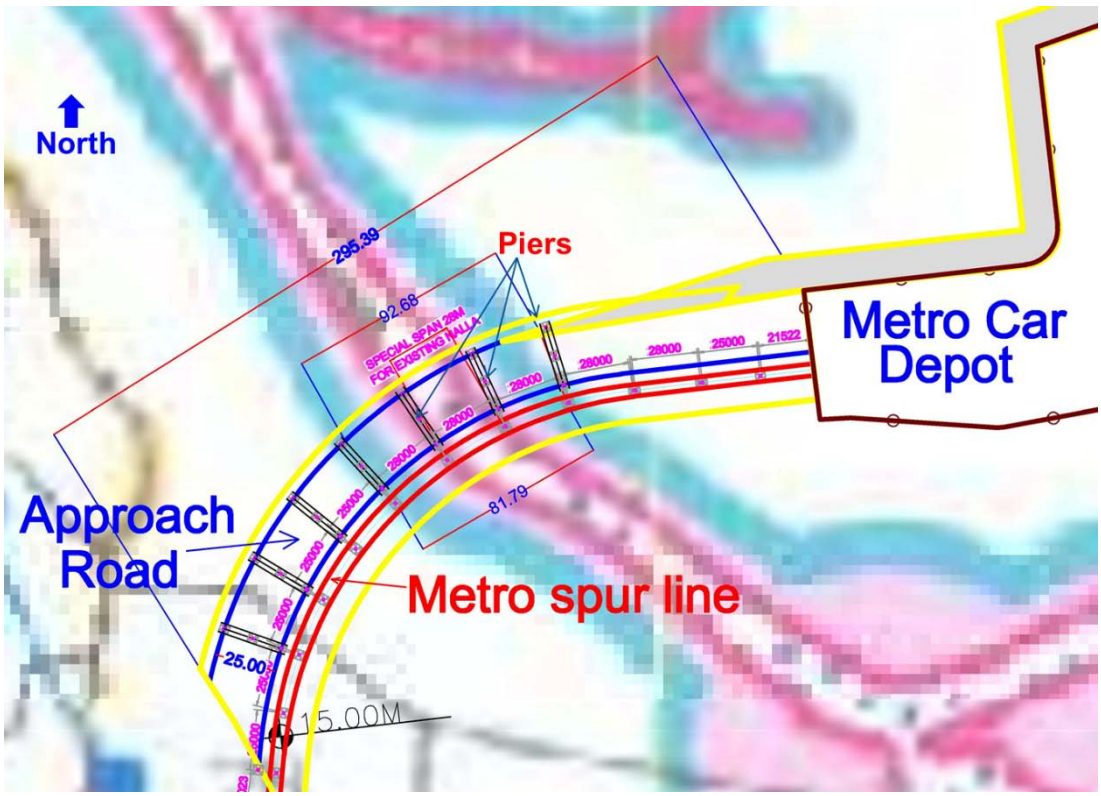


Fig 2.4 (b):Pier location on CZMP Map

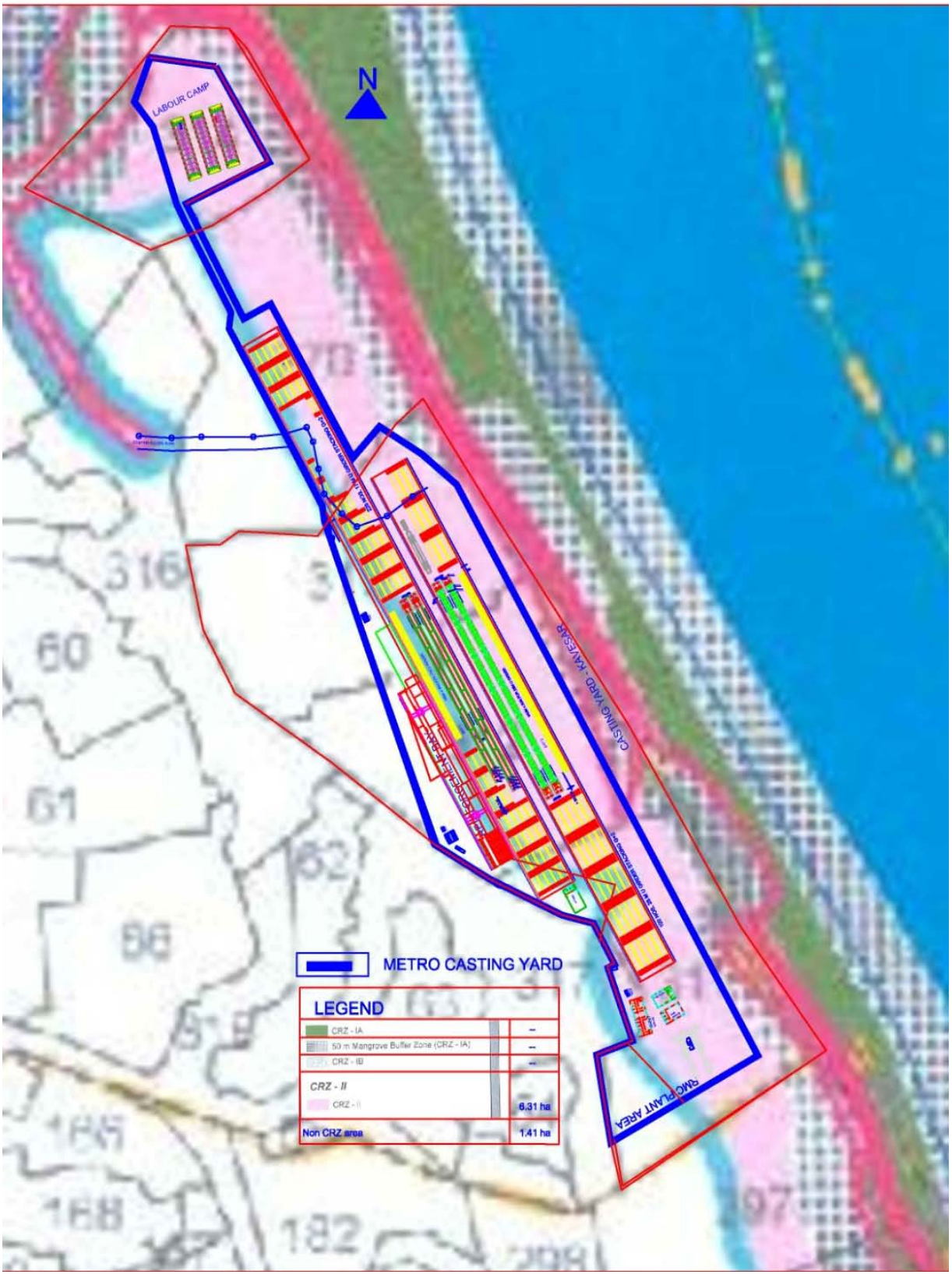


Fig 2.5:Location of Casting yard at Kavesar on approved CZMP

2.5 BRIEF DESCRIPTION OF METRO LINE- 4

2.5.1 METRO CORRIDOR

In view of increasing demand for mass transport, Maharashtra State Govt. and Mumbai Metropolitan Region Development Authority desired that the metro corridors shall be developed in the city.

One corridor has been proposed between Mumbai and Thane cities. The length of the alignment is about 34.98 km. Total 34 stations are to be constructed on this metro alignment. To meet the projected traffic demand, the possibility of running trains with composition of 6 Car trains/ 8 Car trains with different headway were examined. It was proposed to provide Box girders as superstructure for the viaduct

Initially, the Metro Line-4 corridor was proposed from Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali. The overall Capital Cost for the Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali Metro Corridor of Mumbai at March 2016 price level works out to **Rs. 9192 Crores** excluding applicable Taxes & Duties of **Rs. 1923 Crores.**Later on the Metro line-4 extended up to Gaimukh. The overall Capital Cost for the extension of Mumbai Metro Line-4 (Wadala -Ghatkopar - Mulund - Thane –Kasarvadavali) from Kasarwadavali to Gaimukh at June 2017 price level works out to **Rs.655 Crores** excluding applicable Taxes & Duties of **Rs. 131 crores**. The compensation for loss of land, fire control, information systems and contractor's obligations has been incorporated in project costs.

2.5.2 ROUTE ALIGNMENT

The alignment Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh lies between the $19^{o}01'33.95"N$, $72^{o}52'38.36"E$ and $19^{o}17'06.42"N$, $72^{o}56'31.22"E$. Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh corridor of Mumbai Metro Project is proposed to start at Bhakti Park, wadala, F-North ward. The alignment then passes through LBS road, Eastern Express Highway and then through Ghodbunderraod and ends at Gaimukh.

Total length of the corridor from dead end to dead end is 34.98 km. The entire corridor proposed is elevated. For the proposed alignment interchange facility will be provided at Kurla –East (Metro Line-2B), Gandhi Nagar Metro (Metro Line-6) & at Kapurbawadi (proposed TBK MRTS) **Fig. 2.6** shows the Route alignment of Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh corridor.

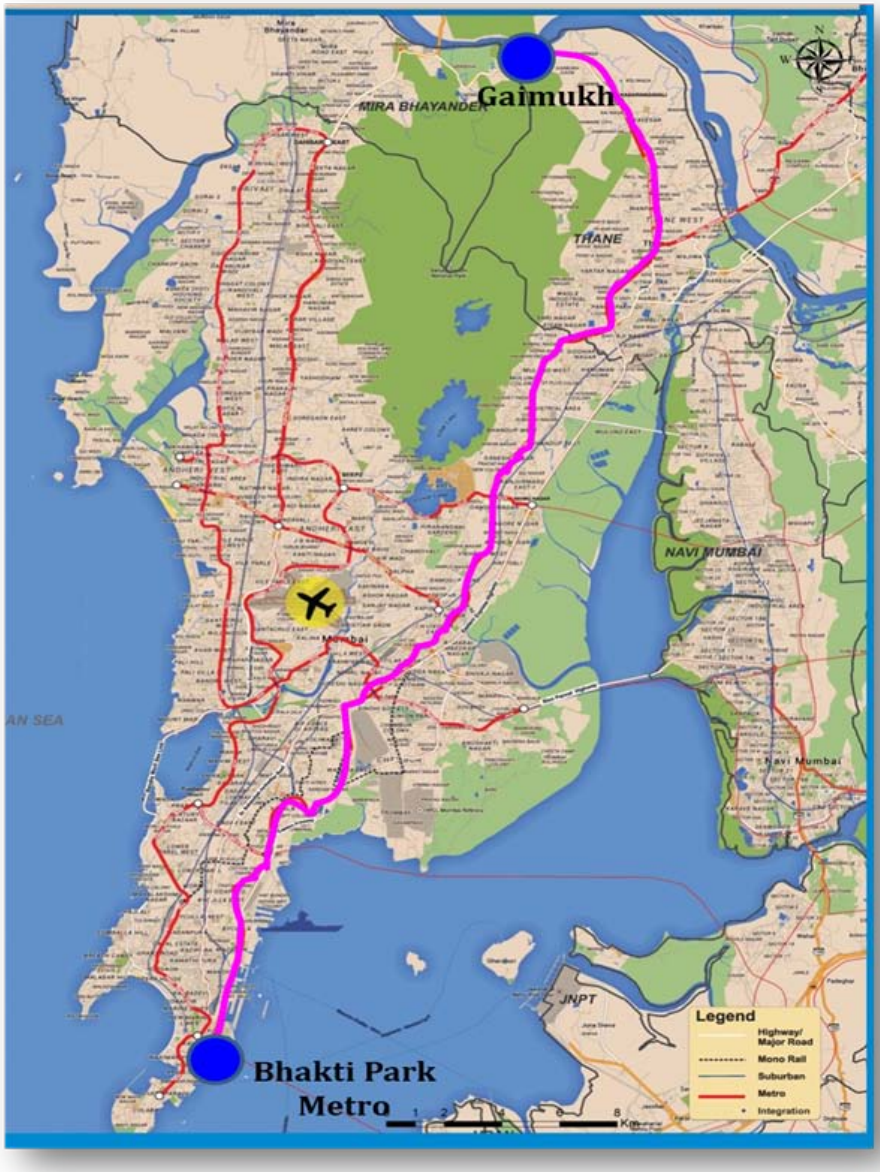


Fig. 2.6:Route Alignment of Wadala-Ghatlopar-Mulund-Thane-Kasarwadavali-Gaimukh Corridor

2.5.3 ROUTE LENGTH AND STATIONS

An elevated option has been adopted on the entire stretch of the proposed corridor of Metro Line- 4 i.e. Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh. Thirty Four stations have been proposed on the corridor. Efforts have been made to keep the inter station distance about a kilometer. Stations have been located so as to serve major passenger destinations and enable convenient integration with other modes of transport. All stations will be two level stations. All the operating and passenger facilities are proposed in the concourse on the lower level while platforms are on the upper

level of the stations. The details of stations have been elaborated in the **Table 2.1**shows an index map of the alignment and location of stations.

Table 2.1:Stations on Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali Metro Corridor

Sr. No	Station Name	Underground / Elevated	Sr. No	Station Name	Underground / Elevated
1	Bhakti Park,Wadala	Elevated	18	Shandrila	Elevated
2	Wadala TT	Elevated	19	Sonapur	Elevated
3	Anik Bus Depot	Elevated	20	Mulund Fire station	Elevated
4	Suman Nagar	Elevated	21	Mulundnaka	Elevated
5	Siddharth Colony	Elevated	22	Teen Hath Naka	Elevated
6	Amar Mahal	Elevated	23	RTO Thane	Elevated
7	Garodia Nagar	Elevated	24	Mahapalika Marg	Elevated
8	Pant Nagar	Elevated	25	Cadbury Junction	Elevated
9	Laxmi Nagar	Elevated	26	Majiwada	Elevated
10	Shreyas Cinema	Elevated	27	Kapurbawadi	Elevated
11	Godrej Colony	Elevated	28	Manpaada	Elevated
12	Vikhroli Metro	Elevated	29	Tikuji-ni-wadi	Elevated
13	Surya Nagar	Elevated	30	DongriPada	Elevated
14	Gandhi Nagar	Elevated	31	Vijay Garden	Elevated
15	Naval Housing	Elevated	32	Kasarwadavali	Elevated
16	BhandupMahapalika	Elevated	33	Gowniwada	Elevated
17	Bhandup Metro	Elevated	34	Gaimukh	Elevated

2.5.4 INTEGRATION OF AFC WITH OTHER LINES AND MODES OF TRANSPORT:

In Mumbai, different metro lines are being constructed and operated by different operators. In view of passenger convenience and operational efficiency, it is proposed that AFC for different metro lines should be integrated and smart card based fare products should be inter-operable. AFC system shall take into account revenue sharing mechanism among different operators based on journeys

performed at each system. The single ride tickets (tokens) may not be inter-operable and may be limited to each operators system.

The proposed AFC system shall provide interfaces to other operators such as Suburban Rail, Bus, Parking, Toll etc so that these systems may also be integrated with common smart card based fare products. This will facilitate the passengers as they need not carry different cards for different applications

2.5.5 BOARDING AND ALIGHTING

Traffic projection for different horizon years has been worked out in the DPR. However, the projections for the year 2031 have been summarized in **Table 2.2**.

Table 2.2: Boarding &Alighting Details For 2031

Alighting	Boarding	Vol. Gaimukh to Wadala	Station Name	Vol. Wadala to Gaimukh	Boarding	Alighting
11571	0	0	BHAKTI PARK METRO	3694	3694	0
4646	308	11571	WADALA TT	5861	2459	292
1034	207	15910	ANIK NAGAR BUS DEPOT	6281	575	155
2831	1413	16736	SUMAN NAGAR	7905	1943	319
4032	556	18154	SIDDHARTH COLONY	10981	3369	293
1622	521	21629	AMAR MAHAL JUNCTION	12708	2023	296
198	4491	22731	GARODIA NAGAR	12113	246	841
430	164	18439	PANT NAGAR	12306	337	143
881	547	18704	LAXMI NAGAR	12467	737	575
14120	5348	19038	SHREYES CINEMA	17599	7333	2202
2023	1178	27910	GODREJ COMPANY	16468	1053	2183
939	2181	28755	VIKHROLI METRO	15815	888	1542
522	981	27514	SURYA NAGAR	15452	494	856
4834	1457	27055	GANDHI NAGAR	17330	3173	1295
901	834	30432	NAVAL HOUSING	17975	800	155
284	959	30500	BHANDUP MAHAPALIKA	17777	227	425
1833	950	29825	BHANDUP METRO	18233	1217	761
822	7137	30708	SHANGRILA	17972	1883	2144

439	137	24394	SONAPUR	18120	361	213
755	1816	24697	MULUND FIRE STATION	18258	1083	945
507	400	23636	MULUND NAKA	18169	238	326
1151	2101	23743	TEEN HAATH NAKA (THANE)	18256	1695	1609
3330	2509	22793	RTO THANE	17168	2045	3133
1161	1251	23614	MAHAPALIKA MARG	16601	884	1451
1837	3122	23525	CADBURY JUNCTION	15922	1455	2134
944	2996	22240	MAJIWADA	14734	924	2113
506	2574	20189	KAPURBAWDI	12852	729	2612
10968	4067	18121	MANPADA	20415	9710	2147
1044	3205	25022	TIKUJI-NI-WADI	18800	869	2483
1457	4660	22861	DONGARI PADA	17793	966	1973
0	3077	19658	VIJAY GARDEN	15634	0	2159
753	6	16580	KASARWADAVALI	16328	695	0
1008	1509	17328	GOWNIWADA	15780	907	1455
0	16827	16827	GAIMUKH	0	0	15780
79386	79386	30708		20415	55012	55013
134398		**Peak Hour Ridership**			**134398**	
1343979		**Daily Ridership**			**1343979**	

2.5.6 METRO OPERATION PLAN:

2.5.6.1 Salient Features:

- Running of services for 19 hours of the day (5 AM to Midnight) with a station dwell time of 30 seconds,
- Make up time of 5-10% with 8-12% coasting.
- Scheduled speed for this corridor has been taken as 35 Kmph.

2.5.6.2 Metro Formation

To meet the above projected traffic demand, the possibility of running trains with composition of 6 Car trains with different headways have been examined.

Composition

- DMC : Driving Motor Car

- MC : Motor Car
- TC : Trailer Car
- 6-car train composition: DMC+TC+MC+ MC+TC+DMC

Capacity@6passengerspersquaremeter of standeearea

- DMC: 282 passengers (Sitting-42, Standing-240)
- MC: 298 passengers (Sitting-50, Standing-248)
- TC: 298 passengers (Sitting-50, Standing-248)
- 6 Car Train: 1756 Passengers (Sitting-284, Standing-1472)

2.6 DESCRIPTION OF THE PROJECT

2.6.1 MOGHARPADA CAR-SHED DEPOT

For such a wide network, MMRDA proposed construction of 20 piers of approach road and Metro spur line to Mogharpada card depot at survey nos. 30 (pt), 27 (pt), 28 (pt) & 29(pt) of village Mogharpada. Total area for Metro Car Shed is proposed to be 27.50 ha.

The approach road and Metro spur line is proposed to connect Metro Car Depot. The reservation of identified depot land is Picnic Center. Metro car depot is not affected by CRZ area. However, spur line and approach road is affected in CRZ-II area.

There is existing 40m wide road near to the proposed depot at a distance of approx. 200m. Connecting this road, 25m wide elevated approach road with Metro spur line is proposed which crosses the nala having width of 20 m affected in CRZ area.

The proposed number of Piers of approach road are 16 Nos. The area required for each pier is 25 sq.m, with total area required for 16 nos is 400 sq.m. (0.04 Ha.), each of length 93 m. The proposed number of Piers of metro spur line are 04 nos, with total area required as 100 sq.m. (0.01 Ha.), each of length 82 m. The piers are located in CRZ-II and not affected by mangroves/ 50m mangroves buffer zone as per approved CZMPunder Coastal regulation Zone (CRZ) Notification, 2011. No pier shall be constructed in CRZ-I-B area.

The Metro Car-Shed Depot layout superimposed on Google is shown in **fig 2.7** below;

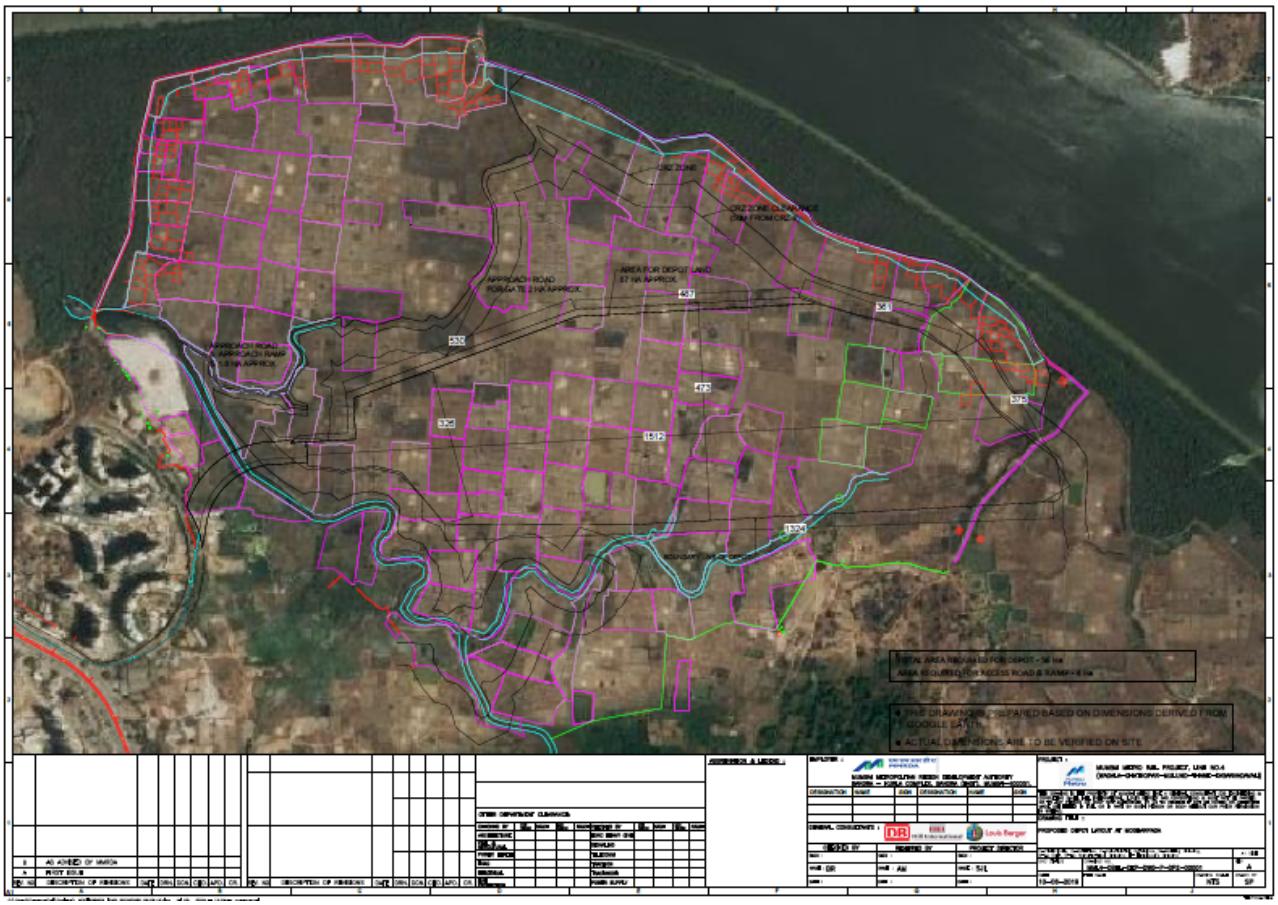


Fig. 2.7: Mogharpada Car-Shed Depot Layout Superimposed on Landmap with Google

2.6.1.1 Site Photos of Car- Shed Depot at Mogharpada

Fig 2.8: Site Photos of Proposed Car-Shed Depot at Mogharpada Village

2.6.2 CASTING YARD AT KAVESAR

A casting yard is a confined place where all the concrete structures like U GIRDER, I GIRDER, PIER CAP, etc. are to be casted /manufactured and shifted to their stack yard cured for the specific period and then shifting to the work site after they gain their required strength.Casting yard plays a most important role inPrecast Segmental Construction Project. For viaducts segmental pre-cast construction requires a casting yard.

MMRDA proposed construction of casting yard at Survey No. 311,312,313, 314 & 267/15 of village Kavesar to meet pre-cast requirements of metro line construction.

Total area for casting yard is proposed to be **7.72 ha** of which 6.31 ha area falls under CRZ II area. The said plot will be utilized temporarily for construction of pre-cast girders required for Metro projects. It is falling on landward side of an existing road.Casting yard will have following activities:

- Site Office
- RMC Plant & QC Lab
- Reinforcement fabrication yard
- Epoxy coating plant
- Segment stacking yard
- Other allied activities for functioning of casting yard.

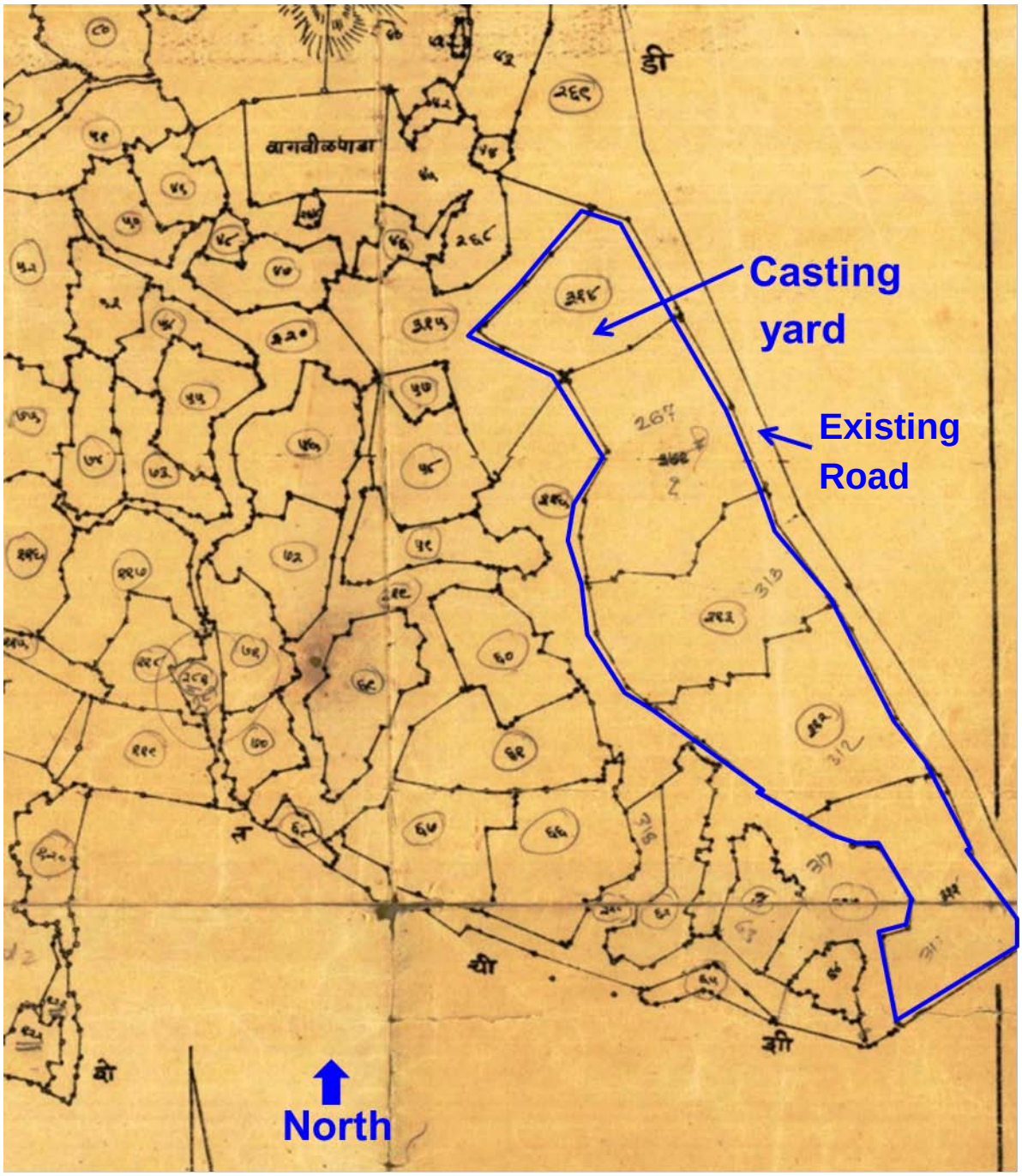


Fig 2.9: Location of Casting Yard at Kavesar on Village Map

2.6.1.2 Site Photos of Casting Yard at Kavesar

Fig 2.10: Site Photos of Proposed Casting Yard at Kavesar Village

2.7 SALIENT FEATURES OF THE PROJECT

The proposed project is to effectively augment the present Transport Systems, MMRDA has conceived the idea of Metro Railway Network. Once completed, Metro 4 will take away a huge load from the central local railway and will also connect Wadala with central suburbs and the island city. For such wide network to set-up, MMRDA has proposed construction of Metro Car-shed Depot and Casting Yard.

Name of Project: Proposed construction of 20 piers of approach road and metro spur line to Mogharpada car depot and casting yard at Kavesar for Metro Line – 4 project.

User Agency: "Mumbai Metropolitan Region Development Authority (MMRDA)".

Forest area diversion to be sought: None

2.7.1 PROJECT COST

The cost of this project will be around Rs. 225Crore

2.7.2 POTENTIAL PROJECT COMPONENTS

2.7.2.1 Water Requirement

The water requirement will be met with tanker water for construction purpose. Drinking water source will be met with potable drinking water supply. the Thane city receives water from Thane Municipal Corporation, MCGM, MIDC &ShahadTemghar water treatment plant (ESR-2013).

2.7.2.2 Infrastructure Facilities

The project area will have utility systems as mentioned above along with other important infrastructure facilities.

2.7.2.3 Water Quality

During the construction phase the water quality will be affected due to the construction activities. Suspended solids may accumulate on the water surface and thereby deplete dissolved oxygen content. The water quality may also be affected due to site specific pollution of water due to oil/grease from maintenance of construction equipments and heavy metal pollution due to entry of various metal pieces emanating from equipments/ chemical etc.

The impacts shall be mitigated by adoption of proper construction technology. Care shall be taken to avoid layer of suspended solids and spillage of oil and grease in the seawater during transportation as well as construction activities. Emission of fugitive particles shall be suppressed by sprinkling of water on the construction site.

No impact on the water quality is envisaged during the operational phase by adapting proper mitigation measures.

2.7.2.4 Biological / Ecological Environment

There is no mangrove destruction envisaged during construction of project. To maintain beautification, additional plantation shall be done. Trees found at project site are common species like Subabhul, Gulmohor, Peltoforum, Garden almond, Rain tree, Pipal, Neem, coconut, Saptaparni, mango etc.

2.7.2.5 Land Environment

Soil cover in the Mumbai city region is predominantly sandy due to its proximity to the sea. In the suburbs, the soil cover is largely alluvial and loamy. The underlying rock of the region is composed of black Deccan basalt flows, and their acidic and basic variants dating back to the late Cretaceous and early Eocene eras.

While the soils of thane district can be conveniently divides into three categories. The first type of soil, which is found in Dahanu, Palghar, Vasai and Thane tahsil, is fertile and useful for horticulture, Paddy cultivation and vegetables. Whereas, the second type which is found in Mokhada, Talasari and some parts of other tahsils on the Eastern slopes is useful for growing coares millets like Nagli and Varai. The third type of soil found in Bhiwandi, Kalyan and Shahapurtahsils is useful, particularly for Paddy cultivation.

Seismicity: Both Mumbai and Thane cities are located in zone III of seismic zoning map of India.

2.7.2.6 Socio-Economic Status

Socially and culturally Mumbai and Thane cities area are cosmopolitan in nature. According to the 2011 census, the population of Mumbai was 12,479,608. While Thane had population of 11,060,148 of which male and female were 5,865,078 and 5,195,070 respectively. Most of the people are working in service sector and industrial sector.

Socio-economic survey also did not reveal any anticipated adverse impact or unbearable load on infrastructure facilities available in the area. On the other hand these facilities are expected to increase with the launching of the project. Housing, transport, water and power supply, medical, education and other civil amenities are not adversely affected in future.

2.7.2.7Solid-Waste Management

The solid waste generated will consists of construction debris and it will be disposed off at authorized place. The construction debris will be transported via closed trucks to avoid fugitive dust emission, which will give rise higher SPM to the surrounding area.

2.7.2.8 Traffic Management

The proposed project will not affect the traffic management during construction phase.

CHAPTER 3
BASELINE ENVIRONMENTAL STUDY

3.1 SCOPE OF WORK

This section of the report gives description of the existing Environmental Studies within the project area, which constitutes the baseline for the study. Natural conditions are often critical when designing and constructing infrastructure works. The assessment of baseline studies of the appropriate environmental parameters, which may be affected by the project implementation, is a pre-requisite for any Environmental Impact Assessment (EIA) study.

Monitoring surveys of the study area (project area) has been carried out in one season. Field monitoring for meteorological conditions, ambient air quality, water quality, noise quality, etc. has been carried out in one season, which constitutes major portion of the baseline environmental studies. In addition to these important parameters, certain aspects like land use, socio-economic studies, geo-technical investigations etc. are covered during the study period. This information is based on secondary information sources and constitutes remaining part of the baseline environmental studies.

The impact on existing baseline of environmental parameter will be very restricted and of temporary in nature. These are further controlled and minimized by adopting various mitigative measures. Even during operational phase the impact on environmental settings will be negligible and will be controlled by adopting proper environment management plan (EMP). These aspects have been studied in depth with reference to the proposed project and baseline data has been presented in this chapter. These details have been given in the following sections.

EIA is often mandatory requirement for planning of infrastructure and marine structures. The EIA determines the environmental consequences of the project prior to construction, assessment of environmental impact due to construction, its impact on existing baseline environmental parameters and also importantly on land use and socio-economic parameters. The entire data has been collected through actual physical surveys and observations, literature surveys, interaction with locals, government agencies and departments. This chapter describes the baseline environment settings in the area and will throw light, its effect on day-to-day environment.

3.2 BASELINE ENVIRONMENTAL STATUS

In order to assess the existing environmental status in the project area, primary and secondary data on various environmental attributes viz. air quality, noise levels, water quality, soil, ecology, land use etc. have been collected and presented in the following paragraphs. The study period for preparation of EIA report is from March to May 2019

10 km radial area was surveyed in order to establish baseline environmental study. The various locations selected on the merits of environmental settings.

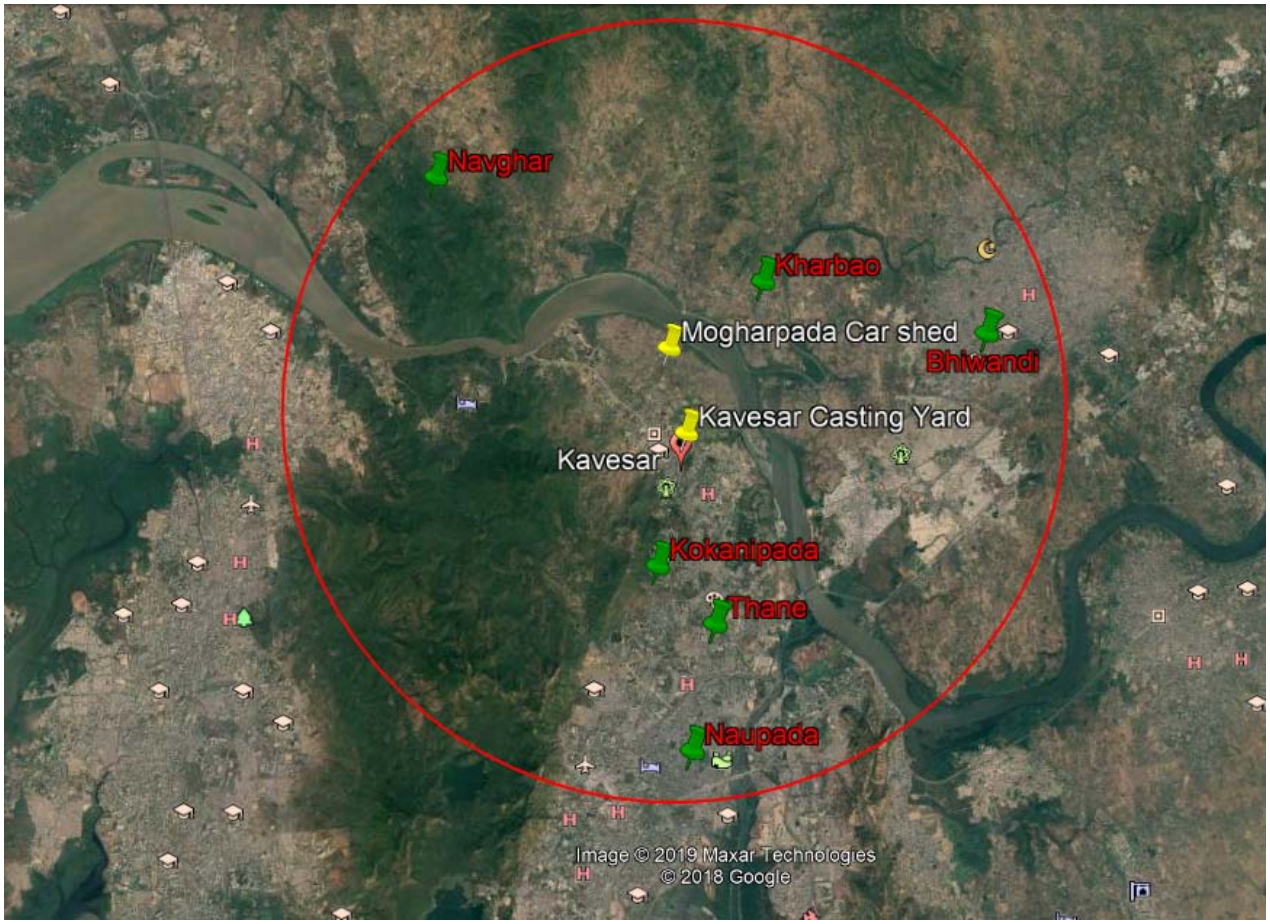


Fig 3.1: 10 km radial area from project site

3.2.1 Land Environment:

Geo-hydrological aspects of the area are studied on the basis of available survey of India Topo Sheets landsat imageries, field visits and other literature. During this study, emphasis was given on physiography (topography and drainage), lithology and hydrology of the area.

3.2.2 Topography:

The city is characterized by high hills on one side and submersible marsh land along the Thane Creek, and Ulhas River bank on the other side. The plain terrain actually forms a wide belt along the foot-hills and away from creek water, Ulhas river banks. Such a situation has also distracted the growth and placement of various activities. The metro line runs centrally through the plains and windings along the foot of the hills.

3.2.3 Geography &Geology:

The total area of Mumbai is 437.71 km^2. Of this, the island city spans 67.71 km^2, while the suburban area spans 370 km^2, together accounting for 437.71 km^2 under the administration of (MCGM). (Project area falls in suburban).

Mumbai lies at the mouth of the Ulhas River on the western coast of India, in the coastal region known as the Konkan. It sits on Salsette Island (Sashti Island), which it partially shares with the Thane district. Mumbai is bounded by the Arabian Sea to the west. Many parts of the city lie just above sea level, with elevations ranging from 10 m to 15 ; the city has an average elevation of 14 m. Northern Mumbai (Salsette) is hilly, and the highest point in the city is 450 m at Salsette in the Powai–Kanheri ranges. The Sanjay Gandhi National Park (Borivali National Park) is located partly in the Mumbai suburban district, and partly in the Thane district, and it extends over an area of 103.09 km^2.

Geology of Mumbai is part of the geology of the Deccan traps that formed by the eruptions to rapidly cover a large part of the Indian Peninsula (at present extends over 500,000 sq. km). The volcanic eruptions around the Mumbai area occurred in shallow lagoon conditions and thus most of the lava flows. Due to sub-aqueous eruptions of the lava, the basalt was converted to spilite, as a result of the metasomatic changes. Some of the lava flows developed pillow structure and some became brecciated to form volcanic breccia. Such sub-aqueous volcanic breccia may be described as Hyaloclastic. There were intermediate and acid rocks formed as trachyte intrusive and rhyolie flows.

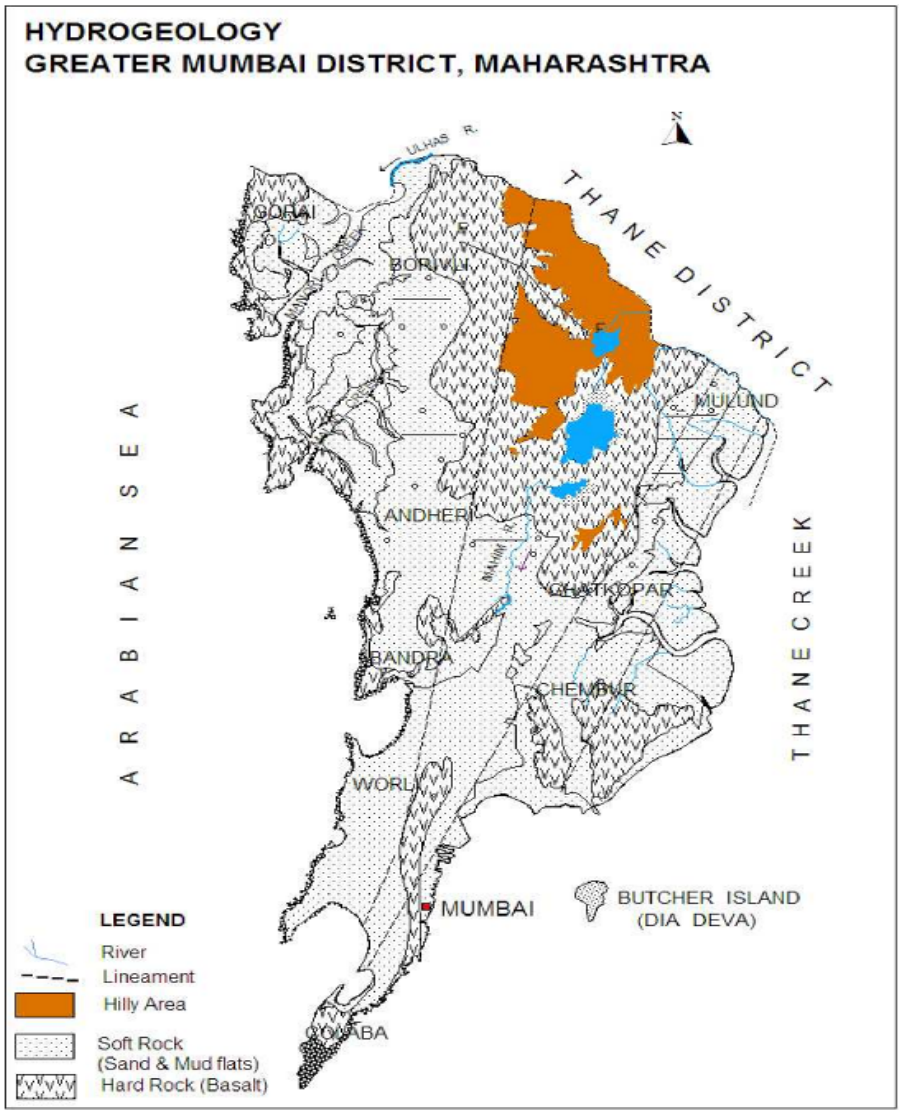
3.2.4 Hydrogeology:

The entire Mumbai district is underlain by basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow Alluvium formation of recent age also occurs as narrow stretch along the major river flowing in the area. Hydrogeological map of Mumbai is given in Fig. below.

3.4.2.1 Hard Rock Areas: Deccan Trap Basalt

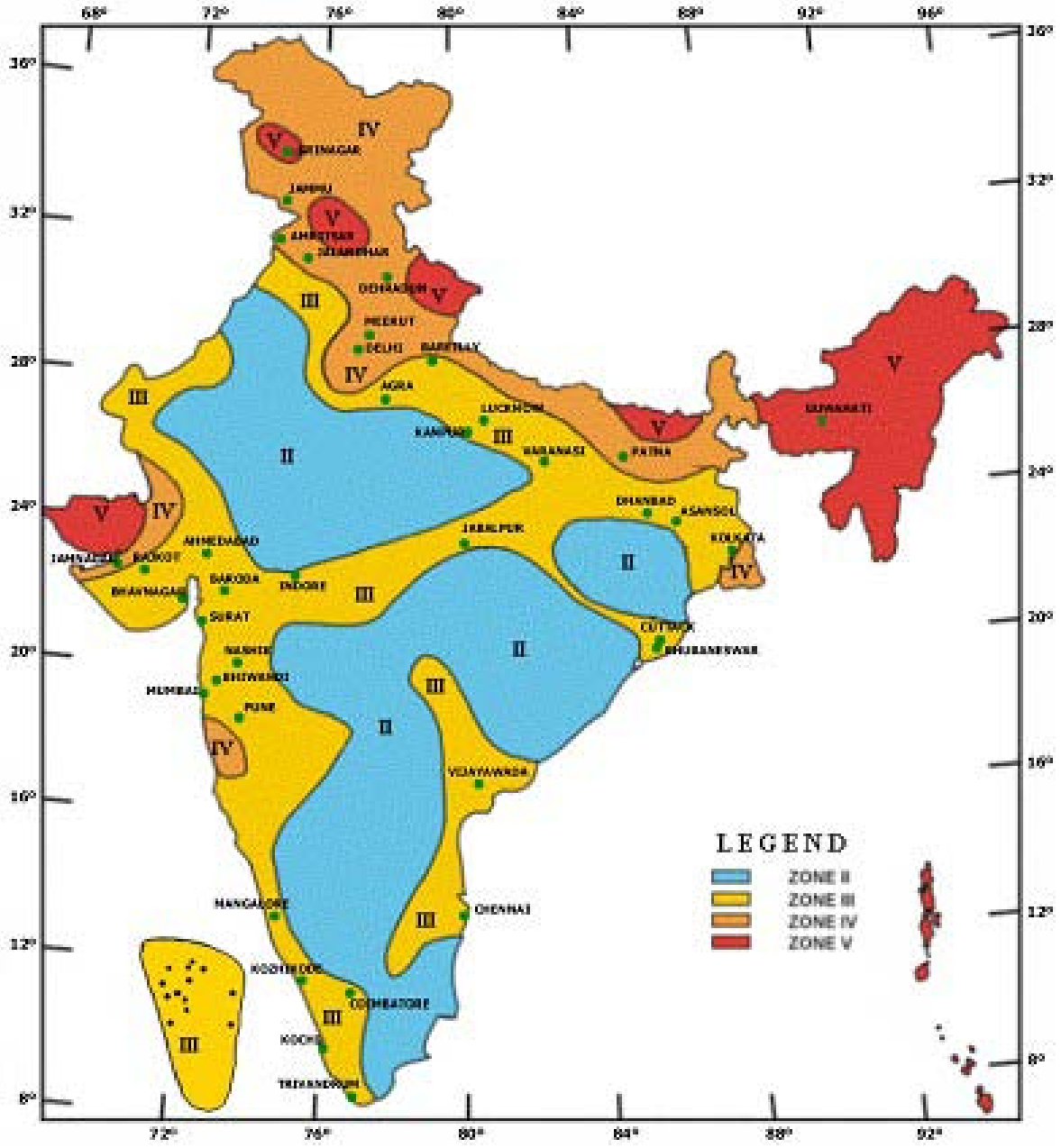
The 'Pahoehoe' flow in the district consists of highly vesicular bottom layer having closely spaced horizontal joints but the thickness is generally less. The vesicles are generally filled with secondary minerals and green earths. In such cases, they do not serve as aquifer. However, such vesicular zones are weathered in most part of the area, thus, making them moderately permeable. But if, vesicles are not filled, they act as highly permeable aquifers. The simple and compound "Pahoehoe" flow comprises a basal vesicular zone, middle relatively massive portion followed by a vesicular top. The vesicles of "Pahoehoe" flows are generally not interconnected and thus there is a variation in water holding capacity from the base to the top of the flow.

The occurrence and movement of groundwater is controlled by several factors such as topography, climate, geological features and hydro-geological properties of basalt. The occurrence of groundwater in the alluvium, colluvium and basalts in the study area.



3.2.5 Seismicity

The country has been classified into different zones indicating the intensity of damage or frequency of earthquake occurrences. Mumbai and Thane city lies on a seismically active zone owing to the presence of 23 fault lines in the vicinity. Both of these cities falls in zone III according to IS 1893: 2002 which means an earthquake up to magnitude 6.5 on Richer scale may be expected. Seismic Zoning Map and Micro-Zonation of India are given in Fig. below



Bureau of Indian Standards

Criteria for earthquake resistant design of structures
IS 1893: 2002

Mumbai, which lies along the west coast of India, is in the intra-plate stable continental region of Peninsular India (PI). Mumbai lie in seismic zone III. It is generally held that seismic activity is more at the intersections of the Dharwad, Aravali and Singhbhum proto-continents, which together constitute the PI. According to Chandra 1977, Mumbai is in the Panvel zone, which is seismically active. This zone strikes in the north–northwest direction along the west coast. Studies show that there are basically four fault zones surrounding Mumbai (Misra et.al. 2001). Subrahmanyan in 2001 has identified faults along Thane Creek, Panvel Creek and Dharmatar Creek in and around Mumbai as being active. The proposed project is away from the fault lines. The project site hasn't encountered any seismic activity since last decade but hazard management plan will be prepared for any emergency.

3.3 Soil Quality:

Soil samples were collected in and around the site to establish the baseline characteristics. Soil sample have been collected using auger from a depth of 60 cm from all the three locations. Soil sample collected from all locations were analyzed for physical and chemical characteristics. The site locations are given in Table 3.1(b)

Table 3.1 (a): Methodology of soil sample monitoring

Sampling Parameters	Analytical Equipment	Sensitivity/ Detection Limit	Methodology	Remarks
Moisture content	Electronic Balance	0.001 mg	IS: 2720 Part 2	Trial pit method for topsoil sample collection; disturbed samples
pH	pH meter	0.01 units	4500 H^+	
Colour	Visual comparison method	5 Pt/Co	IS 3025, part 4	
Conductivity	Conductivity meter	0.01 units	IS 3025, part 14	
Organic matter	Ferrous sulphate method	0.015 w/w	IS 2720, part 22	
Chlorides	Argentometric method	1 mg/l	IS 3025, part 32	
Calcium hardness	EDTA titrimetric method	50 mg/l	3500 Ca	5% Leachate to be made and analysed as per APHA, "Standard Methods" All method numbers are as per APHA "Standard Methods" (20th edition, 1998)
Sodium	Flame Photometer	100 µg/l	3500 Na B	
Potassium	Flame Photometer	100 µg/l	3500 K B	
Lead	Atomic Absorption Spectroscopy (AAS)	0.1 µg/l	3500 Pb B	
Total Chromium	AAS	10 µg/l	3500 Cr B & 3030D	
Copper	AAS	3 µg/l	3500 Cu B	
Zinc	AAS	20 µg/l	3500 Zn B	
Iron	AAS	10 µg/l	3500 Fe B	
Nickel	AAS	--	3500 Ni	
Sulphate	Turbidimetric method	1 mg/l	4500 SO42-	
Phosphate	Stannous Chloride method	0.1 mg/l	4500 P	
Calcium	EDTA titrimetric method	10 mg/l	3500 Ca	

Magnesium	AAS	--	3500 Mg	
Manganese	AAS	0.01 ppm	3500 Mn	
Cobalt	AAS	0.02 ppm	3500 Co	
Cadmium	AAS	0.01 ppm	3500 Cd	

TABLE 3.1(b): Sampling locations for soil quality monitoring

Location code	Sampling Location
S1	Mogharpada
S2	Kavesar

Soil Analysis Results

Analysis results for environmental parameters of the soil are given in below table.

Table 3.2: Soil analysis results

S. No	Parameters	S1	S2	Units
•	pH	7.31	6.01	--
•	Colour	Light Brown	Light Brown	--
•	Conductivity	0.09	0.09	µS/cm
•	Moisture Content	9.37	1.17	%
•	Organic Matter	0.18	0.31	%
•	Chlorides	115	92	mg/kg
•	Sulphates	140	125	mg/kg
•	Phosphates	3.73	2.4	mg/kg
•	Calcium Hardness	210	184	mg/kg
•	Calcium as Ca^{2+}	100	78	mg/kg
•	Magnesium as Mg^{+2}	7.29	6.76	mg/kg
•	Sodium	215	185	mg/kg
•	Potassium	5.1	6.4	mg/kg
•	Iron	116.76	114.2	mg/kg
•	Copper	4.76	0.136	mg/kg
•	Manganese	8.16	3.8	mg/kg
•	Chromium	1.77	0.096	mg/kg
•	Cobalt	3.66	4.1	mg/kg
•	Cadmium	0.028	0.031	mg/kg

S. No	Parameters	S1	S2	Units
•	Zinc	7.4	5.7	mg/kg
•	Lead	Below Detectable Limit	Below Detectable Limit	mg/kg

Results indicate that the soil is not polluted.

3.4 ReconnaissanceSurvey:

The Consultants made an in-depth study of the available land width (ROW) topographic maps, satellite imageries and air photographs of the project area and other available relevant information. Also arrange the required maps and the information needed from the potential sources. The detailed ground reconnaissance will be carried out immediately after the study of maps and other data. The primary tasks to be accomplished during the reconnaissance surveys include:

i.Topographical features of the area;

ii.Typical physical features along the existing alignment within and outside ROW

iii.Possible alignment alternatives, vis-a-vis, scheme for the construction of additional lanes parallel to the existing road.

iv.Realignment requirements including the provision of bypasses, grade separator / Flyovers and via-duct for pedestrian crossings with possible alignment alternatives.

v.Preliminary identification of improvement requirements including treatments and measures needed for the cross-roads.

vi. Traffic pattern and preliminary identification of traffic homogenous links.

vii. Sections through congested areas.

viii. Inventory of major aspects including land width, terrain, pavement type, carriageway type, bridges and structures (type, size and location), intersections (type, cross-road category, location) urban areas (location, extent), geologically sensitive areas, environmental features.

ix.Critical areas requiring detailed investigations; andrequirements for carrying out supplementary investigations.

xi. Soil (textural classifications) and drainage conditions

xii. Type and extent of existing utility services along the alignment (within ROW).

The data derived from the reconnaissance surveys will be utilized for planning and programming the detailed surveys and investigations. The data and information obtained from the reconnaissance surveys will be documented.

3.5 Ambient Air Quality Studies:

Baseline status of air environment within the study area was assessed through scientifically designed air monitoring network. Consideration for locating the air monitoring network included the following:

- Locations of receptors (viz. residential locations in/around project area.)
- To assess concentrations at/ near sensitive receptors (viz. schools/ College/)
- To assess hot-spot concentrations (viz. at high traffic concentration nodes and in commercial areas).
- To assess background concentration.

Season and Period of Monitoring

The ambient air monitoring was carried out in March to Mayof the year 2019.

Selected Sampling Locations

The locations for Ambient Air Quality Monitoring were decided based on the guidelines given in EIA manual from MoEF. For this EIA, the purpose is to ascertain the baseline pollutant concentrations in ambient air at residential areas & near road areas.Locations selected for ambient air quality monitoring are presented in below table.

Table 3.3: Ambient air qualitylocation&monitoringdetails

Station Code	AAQM Station	PM_{10}(24hr) ($\mu g/m^3$)	$PM_{2.5}$ (24 hr) ($\mu g/m^3$)	SO_2 (24hr) ($\mu g/m^3$)	NOx (24hr) ($\mu g/m^3$)	CO (1 hr) (mg/m^3)
		Average	Average	Average	Average	Average
AQ1	Mogharpada	91.67	54.17	20.83	21.73	<0.4
AQ2	Kavesar	75.00	35.00	20.83	21.63	<0.4
AQ3	Navghar	83.33	12.50	22.92	23.37	<0.4
AQ4	Kokanipada	70.83	50.00	19.79	21.83	<0.4
AQ5	Thane	94.10	58.33	18.75	19.86	<0.4
AQ6	Bhiwandi	79.92	54.17	21.88	22.62	<0.4

AQ7	Kharbao	54	21	16.32	20.34	<0.4
AQ8	Naupada	84.01	47.51	19.48	21.65	<0.4

Sampling Frequency

The frequency of monitoring was 24 hrs twice a week at each station spread over the season except for CO which was 1 hr twice a month.

Parameters Monitored and Methods Used

The parameters monitored were PM_{10} and $PM_{2.5}$, Sulphur Dioxide (SO_2), Nitrogen Oxides (NOx) and CO. The detailed monitoring methodology for ambient air is given in below table.

Table 3.4: Methodology of Ambient Air Monitoring

Sampling Parameters	Sampling Frequency	Sample collection		Sample Analysis		Methodology
		Sampling equipment	Sensitivity/ Detection Limit	Analytical Equipment	Sensitivity/ Detection Limit	
RSPM (PM_{10}, $PM_{2.5}$), SO_2, NOx and CO	24 hrs twice a week at each station	RSPM (PM_{10}), Respirable Dust Sampler	10 µg/m^3	RSPM(PM_{10}), Monopan Balance	0.0001 mg	Gravimetric (HVS) IS : 5182 (Part 23) : 2006 (through Cyclonic flow Technique)
		RSPM ($PM_{2.5}$), Fine Dust Sampler	2.5 µg/m^3	Monopan Balance	0.0001 g	Gravimetric Method – NAAQS Monitoring & Analysis Guidelines Volume 1 By CPCB
		SO_2: Rotameter for measurement of air flow	05 µg/m^3	SO_2: Spectrophotometer	-	IS : 5182 (Part 2) : 2001

Sampling Parameters	Sampling Frequency	Sample collection		Sample Analysis		Methodology
		Sampling equipment	Sensitivity/ Detection Limit	Analytical Equipment	Sensitivity/ Detection Limit	
		NO_x: Rotameter for measurement of air flow	05 µg/m^3	NO_x: Spectrophotometer	-	IS : 5182 (Part 6) : 2006
CO	1hrs twice a month at each station	Gas Bladder	--	NDIR Spectroscopy	< 0.05 ppm	IS : 5182 (Part 10) : 1999 Non Dispersive Infra Red (NDIR) Spectroscopy

Table 3.5: Permissible Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air		
		Industrial, Residential, Rural And Other Areas	Ecologically Sensitive Area (Notified by Central Govt.)	Methods of Measurement
Sulphur Dioxide (SO_2) ($\mu g/m^3$)	Annual *	50	20	- Improved West &Gaeke method
	24 hours**	80	80	- Ultraviolet Fluorescence
Nitrogen Dioxide (NO2) ($\mu g/m^3$)	Annual *	40	30	-Modified Jacob &Hochheiser method. (Na – Arsenite)
	24 hours**	80	80	Chemiluminescence
Particulate Matter (Size less than 10 μm) or PM10 $\mu g/m^3$	Annual *	60	60	- Gravimetric - TOEM
	24 hours**	100	100	- Beta Attenuation

Pollutant	Time Weighted Average	Concentration in Ambient Air		
		Industrial, Residential, Rural And Other Areas	Ecologically Sensitive Area (Notified by Central Govt.)	Methods of Measurement
Particulate Matter (Size less than 2.5 μm) or PM2.5 $\mu g/m^3$	Annual *	40	40	-Gravimetric -TOEM
	24 hours**	60	60	- Beta Attenuation
Carbon Monoxide (CO)(mg/m^3)	8 hours**	2	2	-Non dispersive infra red (NDIR) Spectroscopy
	1 hour	4	4	

Observation and Conclusion

The status of the ambient air quality in the study area was established by carrying out monitoring for air quality parameters like PM_{10}, SO_2, CO and NO_Xat 8 locations in the study area. The data presented is average for 24 hours.

Comparison of the above results with the value range indicators provided by CPCB indicates:

The average concentration of PM_{10} (24hr), PM $_{2.5}$ (24hr), SO_2, NOx and CO at all locations is observed to be within the specified limit of CPCB.

Calibration of RSPM

All RSPM samplers used for sampling purpose have been calibrated by its manufacturer Envirotech India Limited.

3.6 CLIMATES AND METEOROLOGY:

The climate of Mumbai is typically coastal, sultry and not very hot. The area receives average rainfall of 2500 mm to 3000 mm viz. in rainy season while the dry period is the summer and winter season.

3.6.1 Rainfall:

Being in the western coast, the rainfall is usually experienced from beginning of June to end of September with annual mean rainfall of 2500 mm. The average rainfall in the city over the past

decade has been calculated to be about 2442.8 mm. Most of the rainfall received is a result of southwest monsoon, though occasionally some rainfall has been reported in the winter months (from the north east monsoon) or in late summer (pre - monsoon showers).

3.6.2 Temperature:

It is observed that the mean maximum temperature varies from 35 °C to 40°C during the whole year. The temperature is maximum during the months of March to June. Due to humidity during this period, the weather condition is intolerable being more sultry. The weather is tolerable during the months of December to February with temperature ranging from 25°C to 35°C being minimum out of the year.

3.6.3 Humidity:

The range of variation in humidity is from 40% to 100%. The highest humidity is observed in the month of August. The overall humidity throughout the year in the city is on the higher side. The average humidity throughout the year is 44% and the maximum humidity experienced during the year in the monsoon months is about 98%.

3.6.4 Wind:

The wind direction is predominantly from west and northwest of the town for maximum period of the year. The mean wind velocity is about 11 km/hr. The maximum velocity varies from 15 to 19 km/hr during June to August.

The prevailing wind direction at site is shown through following wind roses prepared for each month throughout the year is as follows:

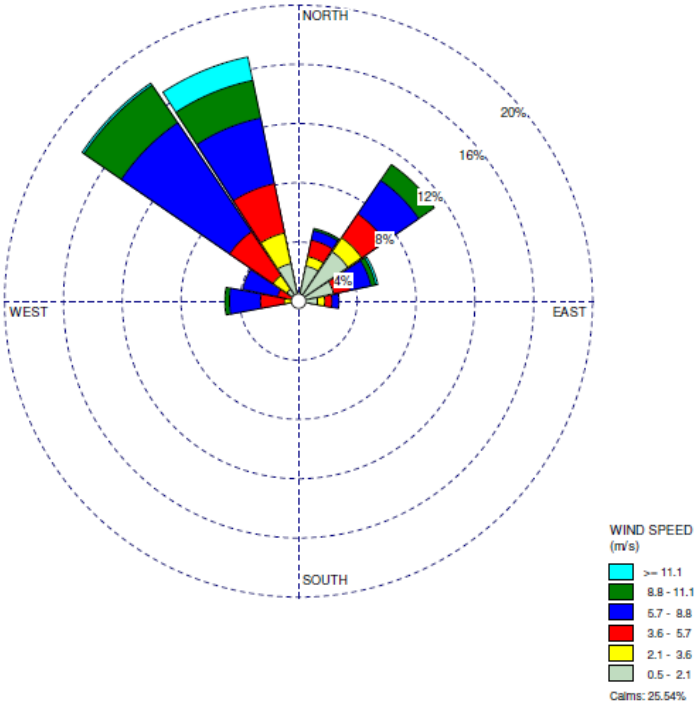


Fig. 3.2: Windrose diagram for Month: January 2018

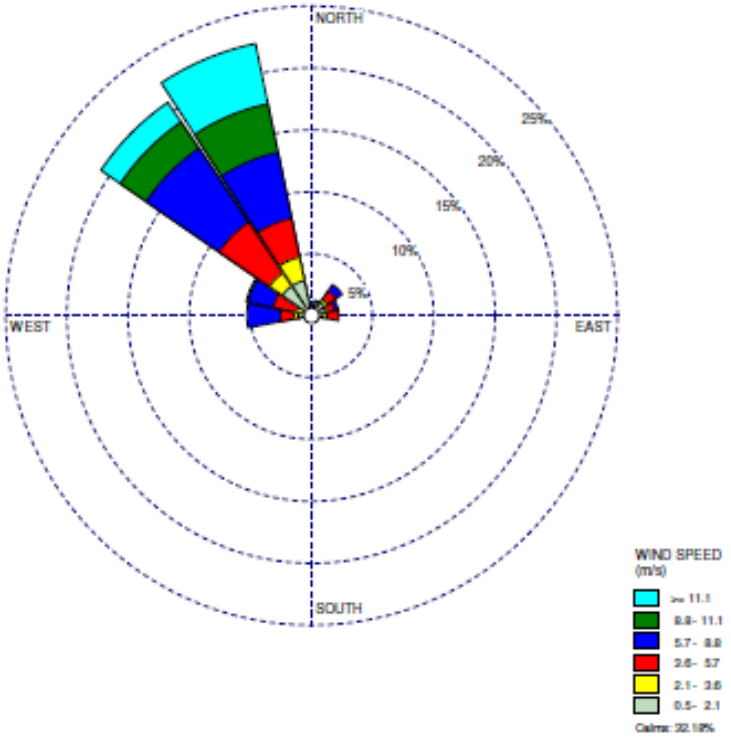


Fig. 3.3: Windrose diagram for Month: February 2018

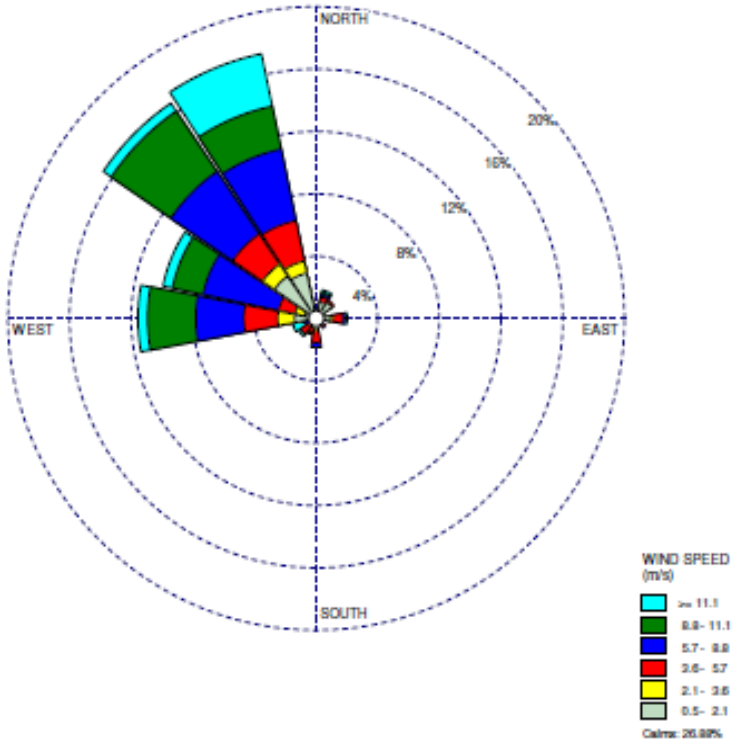


Fig. 3.4: Windrose diagram for Month: March 2018

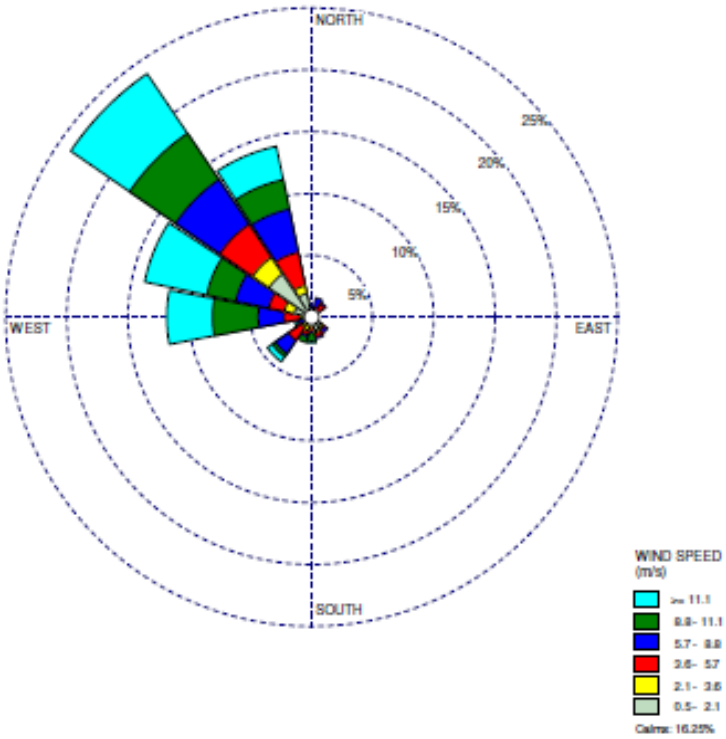


***Fig*. 3.5: Windrose diagram for Month: April 2018**

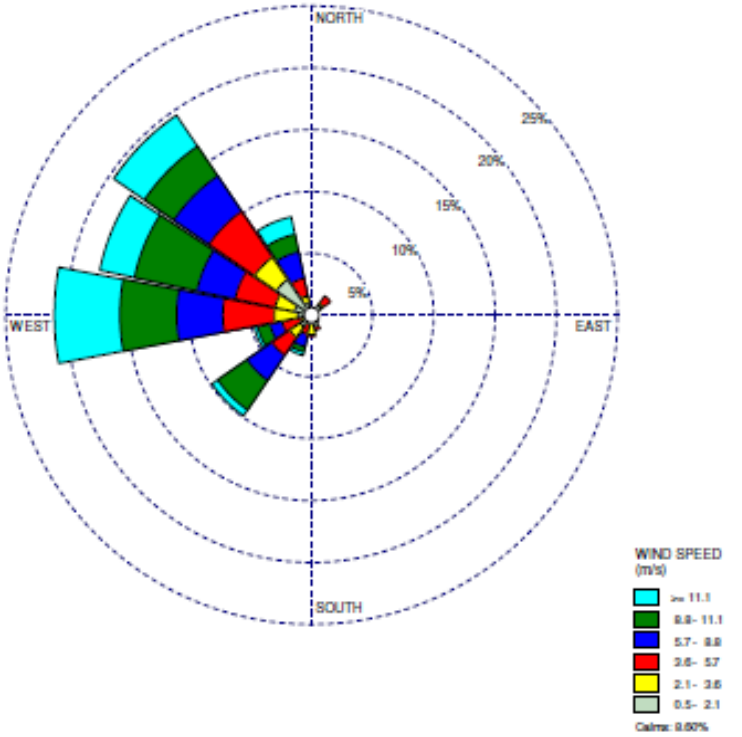


Fig. 3.6: Windrose diagram for Month: May 2018

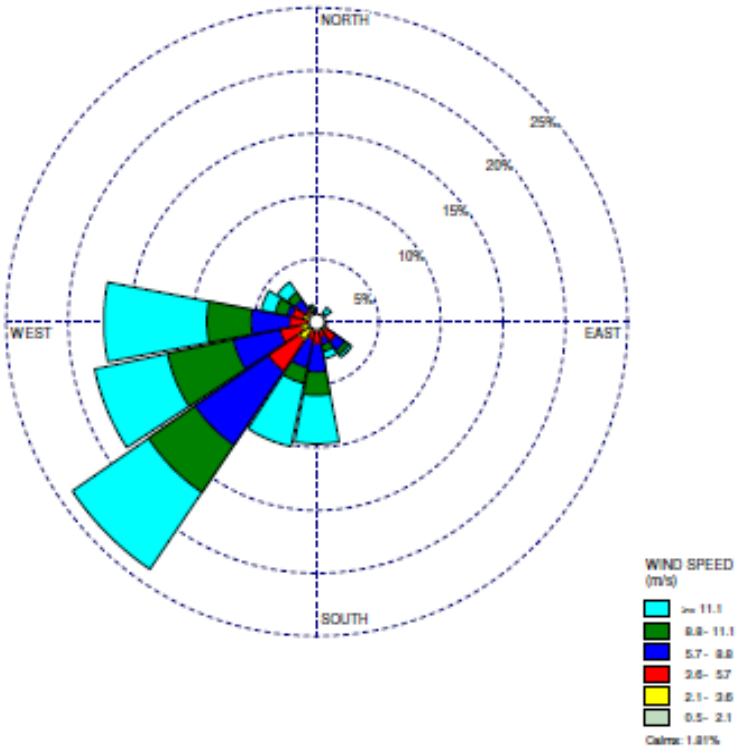


Fig. 3.7: Windrose diagram for Month: June 2018

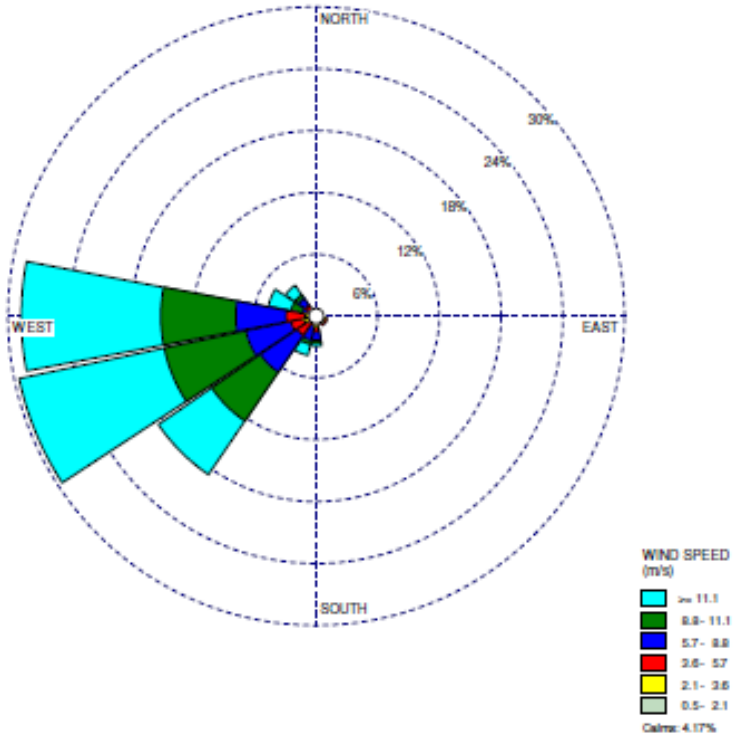


Fig. 3.8: Windrose diagram for Month: July 2018

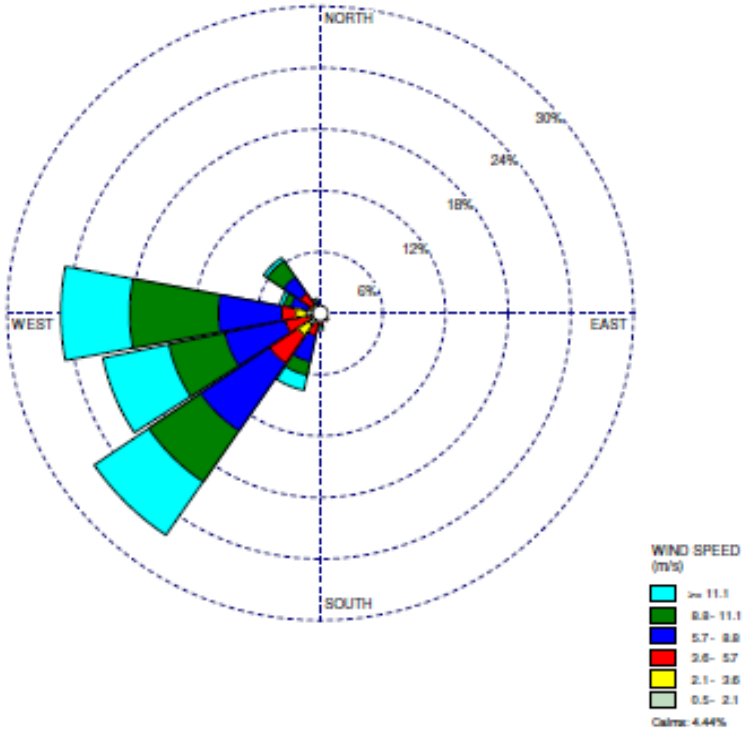


Fig. 3.9: Windrose diagram for Month: August 2018

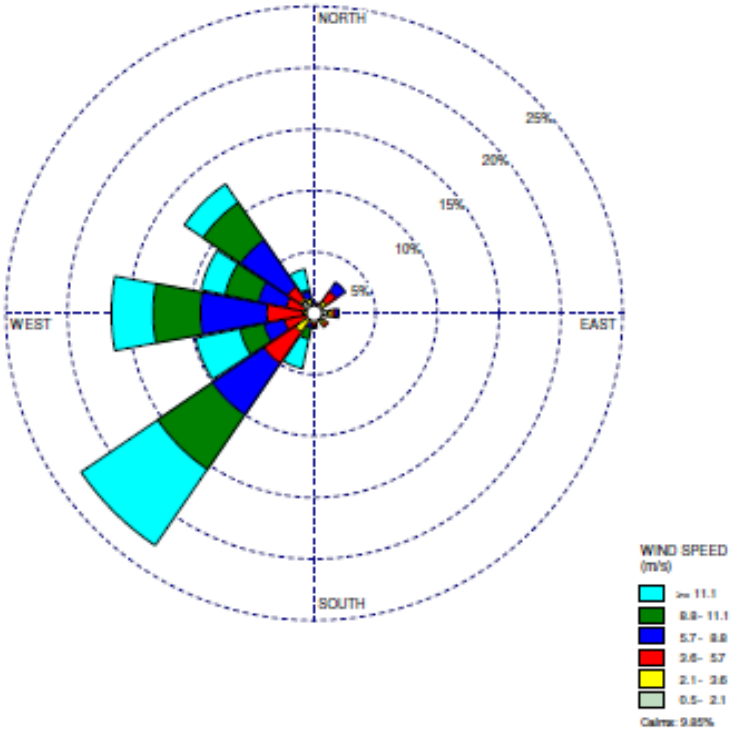


Fig. 3.10: Windrose diagram for Month: September 2018

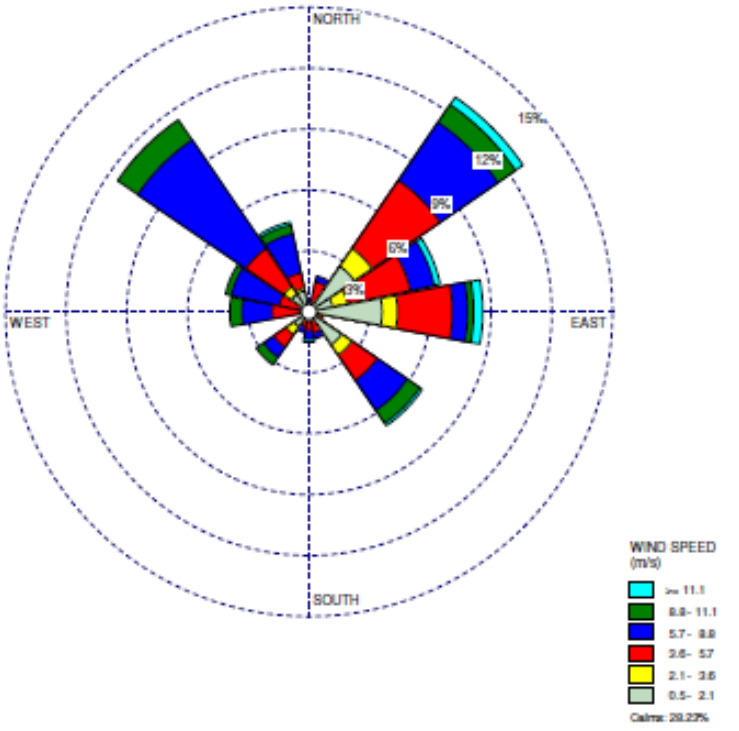


Fig. 3.11: Windrose diagram for Month: October 2018

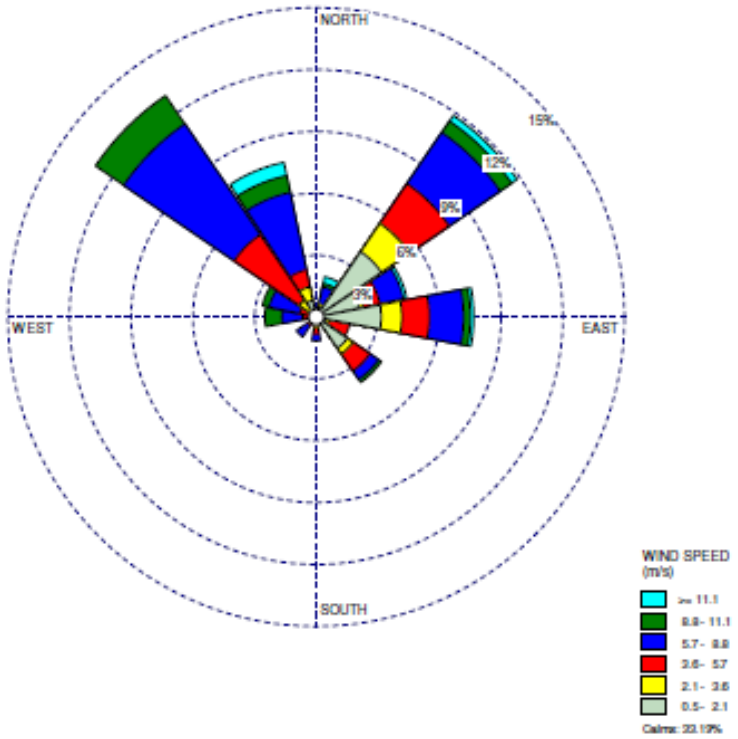


Fig. 3.12: Windrose diagram for Month: November 2018

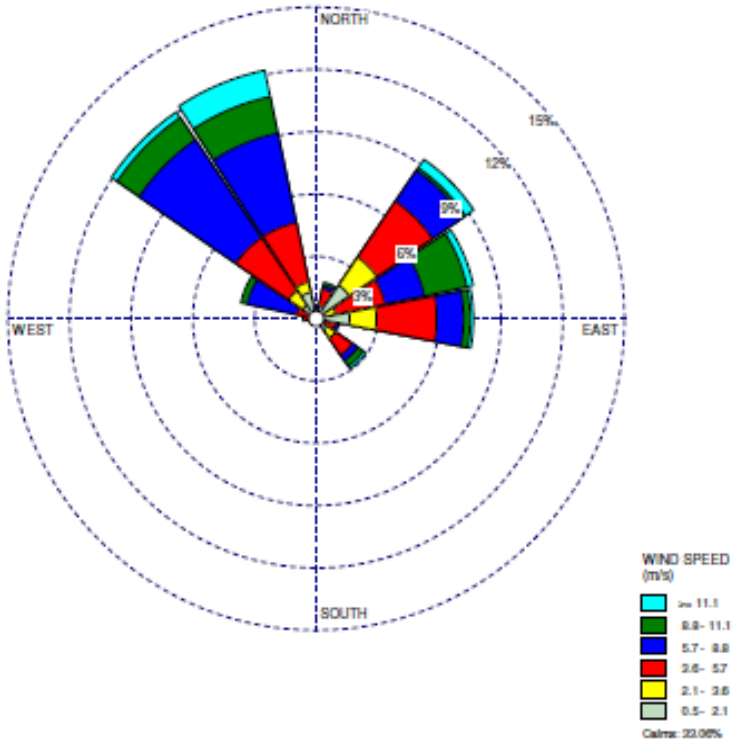


Fig. 3.13: Windrose diagram for Month: December 2018

3.7 NOISE LEVEL STUDIES:

As mentioned earlier the project area is near the busiest road. It experiences slightly higher noise levels during peak hrs. I.e. from day-time and in the evening period from 5 pm to 7 pm. Noise levels have been monitored at all the 8 locations and the results are presented in the **Table 3.7**

Noise levels are attributed to the vehicular traffic in the project area. There are no industrial activities, which will lead to higher noise levels. The heavy traffic during peak hours is due to the arterial location of the project site. The higher noise levels are observed only during congestion time.

Monitoring Methodology of Noise Level

Methodology for monitoring of noise levels is given in below table.

Table 3.6:Monitoring Methodology of Noise

Env. Component	Sampling location	Sampling Parameter	Sampling Frequency	Sampling equipment
Ambient Noise levels	8 locations	Decibels – dB (A)	Hourly reading for 24 hours at each location	Noise Level Meter

Noise Level Results

Noise readings were taken at 8 different locations in 10km radius of project site. The results are presented in below table.

Table 3.7:Noise Level Readings

Station Code	Noise Monitoring Location	Equivalent Noise levels in Leq	
		Day	Night
N1	Mogharpada	67.09	58.30
N2	Kavesar	63.55	53.22
N3	Navghar	66.11	57.94
N4	Kokanipada	66.75	58.37
N5	Thane	65.59	55.60
N6	Bhiwandi	65.69	56.77
N7	Kharbao	61	52
N8	Naupada	72	63

Table 3.8:Permissible Noise Level (CPCB Standards)

Area	Category of Area	Permissible Limit	
		L_{eq} Day time	L_{eq} Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note - 1 Day time is reckoned in between 6.a m and 10 p.m.

Note - 2 Nighttime is reckoned in between 10 p.m. and 6 a.m.

3.7.1 Noise Monitoring result

Noise levels in Day time:

The noise level at the Kavesarduring day time was 63.55 dB, at Thane &Bhiwandi was 65.59 dB, at Navghar was 66.11 dB, at Mogharpada was 67.09 dB and at Kokanipada was 66.75dB. The minimum noise level during day time was observed at Kharbao(i.e61.00 dB) & the maximum noise level was observed atMogharpada(i.e67.09 dB) which is not within the standard range since the surveyed site passes through State highway 42 and busy Ghodbunder road. It is project site from where Metro line -4 passes and due to construction work, noise levels are high.

Noise levels in Night time:

The noise level at the Kavesarduring night time was 53.22 dB, at Thane was 55.60 dB, at Navghar was 57.94 dB, at Mogharpada was 58.30 dB, at Bhiwandi was 56.77 dB and at Kokanipada was 58.37dB. The minimum noise level during night time was observed at the Kharbao(i.e52 dB) & the maximum noise level was observed atKokanipada(i.e 58.37 dB) which is not within the standard range since the surveyed site passes through State highway 42 and busy Ghodbunder road.

3.8 Water Environment:

The portion of water that is available for consumption and other usage is relatively a small proportion of the quantity available in rivers, lakes and ground water. The crisis regarding water resources development and management thus arises because most of the water is not available for use and moreover, is characterized by its highly uneven spatial distribution. Accordingly, the

importance of water has been recognized and greater emphasis is being laid on its optimum use and overall effective management. The Environment Impact Assessment studies in the area of water resources are focused towards ensuring sustainable use of water.

The existing water resources, both surface and ground water with respective significance were identified within the study area (10 km radial distance) around project site. The representative sampling locations for surface water and ground water were selected to assess the existing (pre-project status) of water quality in the impact zone. Physico-chemical, nutrient, demand, and bacteriological parameters having relevance to public health and aesthetic significance were selected to assess the water quality status with special attention to project intake water source and the receiving body of the treated effluent keeping in view the discharge from the proposed project. The standard methods prescribed for surface and groundwater samplings as well as the analytical methods prescribed for individual parameters were followed in this study.

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3.8.1. Surface Water

The Surface water body adjacent to the project site is Ulhas River, Thane Creek.

The prevailing (pre-project) status of water quality has been assessed through identification of water resources and appropriate sampling locations for both surface and ground water in study area depending on topography. The water samples collected were analyzed for Physico-chemical, nutrient and demand parameters, bacteriological and biological characteristics and the respective results are given in Tables 3.12

3.8.2 Ground Water

Survey in the selected sample villages around the project site (within 10 km radius) revealed that most of the villages use hand pumps for drinking/domestic purposes. Ground water is reported to be encountered at a depth between 20-100 m. Total 1 samples were collected and analyzed to assess the baseline status of groundwater quality in the study area as shown in Table 3.11. The data on Physico-chemical nutrient and demand parameters, metals, bacteriological and biological characteristics of groundwater samples collected from various locations are given in Tables 3.12

Table 3.9 Water Quality Sampling Locations

Sr. No.	Sampling Location
	Surface water
1.	Thane Creek
	Ground water
2.	Kavesar

3.8.3 Baseline Status-Surface Water

The nearest water body located close to the project site is the Thane creek.However upcoming project will not affect these water bodies directly or indirectly.

TABLE 3.10: WATER ANALYSIS REPORT

Parameters	Surface water	Ground water	Units
	Physical Parameters		
Temperature	33	28.7	° C
	Chemical parameters		
Aluminum	<0.01	<0.005	Mg/l
Total Carbon	37.05	2.0	Mg/l
Boron	0.02	0.02	Mg/l
Silicon as SiO_2	8.60	43.2	%
Sodium absorption ratio	40.83	27	--
pH	7.80	7.4	--
Selenium as Se	<0.01	<0.004	Mg/l
Copper as Cu	<0.01	<0.002	Mg/l
Lead as Pb	<0.01	<0.005	Mg/l
Arsenic as As	<0.01	0.32	Mg/l
Conductivity	56800	2460.1	µS/cm
Free and saline Ammonia	<1	<1	Mg/l
Nitrite as NO_2	0.02	0.14	Mg/l
Oil & Grease	7	<0.5	Mg/l
Chromium as Cr	<0.01	<0.01	Mg/l
Colour	1	1	Hazen
Turbidity	150	2.58	NTU
Total Dissolved Solids (TDS)	45000	1620	Mg/l
Total Hardness as $CaCO_3$	5225	614	Mg/l
Sulphate as SO_4	1798	128	Mg/l
Fluoride as F	1.2	<0.10	Mg/l
Nitrate as NO_3	21.47	<0.005	Mg/l

Table 3.11: Surfacewaterqualitycriteriafordifferentuses (specifiedbyCPCB,1979andtheBureauofIndianStandards,1982)

S. No	Waterquality parameter	Characteristicofwaterbody				
		A*	B*	C*	D*	E *
1	Dissolved Oxygen (DO) mg/l	6	5	4	4	3
2	Biochemical Oxygen Demand	2	3	3	-	-
3	Total Coliform organisms ** MPN/100ml (max)	50 **	500	500	-	-
4	Total Dissolved Solids (TDS) mg/l (max)	500	-	1500	-	2100
5	Chlorides (as Cl-) mg/l (max)	250	-	600	-	600
6	Colour, Hazen units (max)	-	10	300	300	-
7	Sodium Absorption Ratio	-	-	-	-	20
8	Boron (as B), mg/l (max)	-	-	-	-	-
9	Sulphates (as SO4), mg/l (max)	400	-	400	-	1000
10	Nitrates (as NO3) mg/l (max)	20	-	50	-	-
11	Free Ammonia (as NH3) mg/l	-	-	-	1.2	-
12	Conductivity at 25oC micro mhos/cm	-	-	-	1000	2500
13	pH value	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.0-8.5
14	Arsenic (as As), mg/l (max)	0.05	0.2	0.2	-	-
15	Iron (as Fe), mg/l (max)	0.3	-	-	0.5	-
16	Fluoride (as F), mg/l (max)	1.5	1.5	1.5	-	-
17	Lead (as Pb), mg/l (max)	0.1	-	0.1	-	-

Note: ***Classesof wateruse:**

A Drinking water source without conventional treatment but after disinfection

B Outdoor bathing (organised)

C Drinking water source with conventional treatment followed by disinfection.

D Propagation of wild life, fisheries.

E Irrigation, industrial cooling, controlled waste disposal.

** Ifthecoliformisfoundtobemorethantheprescribedtolerancelimits,thecriteriafor coliformsshall be satisfiedif notmore than 20 percentof samplesshow more than the tolerance limitsspecifiedandnotmore than 5 percentof samplesshow valuesmore than 4 times the tolerance limits. There shouldbe novisible discharge of domestic andindustrial wasteintoclass“A”waters. Incase ofclasses“B”and“C”the dischargeshallbesoregulated/ treatedastoensure maintenance of the streamstandards.

3.9 ECOLOGICAL AND BIOLOGICAL ENVIRONMENT:

Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the abiotic components viz. Physical and chemical components of the environment.

Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important in Environmental Impact Assessment for safety of natural flora and fauna. Study of the impact of environmental stress on the biological community structure serves as an inexpensive and efficient early warning system, and it saves the system from a lively and an irreversible damage.

Biodiversity encompasses the variety and variability of life on Earth. It refers to the differences within and between all living organisms at their different levels of biological organization – genus, individuals, species and ecosystems. Biodiversity embraces all living organisms and their genetic diversity, a vast and complex array of ecosystems and habitats, as well as the processes that underpin and result from this diversity, such as photosynthesis, nutrient cycling or pollination.

Primary data was collected by conducting surveys at study area. Secondary data was also collected.

3.9.1 ACTIVITIES UNDERTAKEN DURING THE STUDY:

1. Flora survey
   - Identification of trees
   - Finding of Rare-Endangered-Threatened tree species
2. Fauna survey
   - Documentation of Avian, Reptilian, Insect, Amphibian, Mammal and other faunal diversity

- Observations by direct and indirect evidences (Direct evidence- Sighting and hearing, Indirect evidence- Pug marks, nests and other signs)
- Analysis of Scheduled species

3. Photo documentation

3.9.2Terrestrial Ecology

Proposed project is located near the western coast near Sanjay Gandhi national park area. The forests in the study area can be grouped under the following types:

- Tropical Southern moist teak bearing forests.
- Tropical Southern moist mixed deciduous forests.
- Western sub-tropical hill forests.
- Mangrove scrub forests.

Tropical Southern moist teak bearing Forests: Major part of the forests comprises of this type. Within this main type considerable local variations in composition and quality of crop are observed. These variations are due to the edaphic factor in some cases but in majority of them, the other factor like topography, biotic influences, and past treatment are responsible for such variations. This association is mostly found in the BhatanePalghar range on the foothills of the Western Ghats. The soil is shallow and poor in humus content. The Ain and Bonda are the most common species in these forests in the study area. The other species associated are Kakad, Shemat, Kuda and Takla but their proposition is not much. Undergrowth is sparse, while climbers are rare.

The Western Sub-Tropical Hill Forests: This type is found on the higher slopes of the Western Ghats on the Gambhirgad hills in Udhava. The area is exposed to strong winds with the result that the height growth of the trees is poor except in the valleys. It is a semi evergreen type of forest with many evergreen species in the over wood and with Underwood and under growth almost exclusively of evergreen species. The floristries are as under. Common species observed in the project area includes Mango (MangiferaIndica), Karanj (Ponganiapinnata), Kokam (Garciniaindica), Jambul (Syzygiumcumini), Shisham (Dalbergialatifolia), Asana (Brideliaretusa), Hirda (Terminaliachebula), Beheda (Terminaliabelerica), BherJambhuletc;

Five local types may be distinguished for the purposes of description of the forest and its management. The following forest types are observed in the study area.

- Teak forests
- Ain forests
- Mixed forests
- Babul Forests
- Casuarina Forests

The poorest quality of forests is found in forests situated adjacent or in proximity of villages and developing large townships. Forests in such areas have been subjected to great pressure by surrounding populations. Some hillocks which are very near to the townships have become barren lands and denuded of vegetation completely. Where the forests have been subjected to the heavy pressure of tahal lopping, non-teak species have disappeared. There is almost pure Teak in such areas but of very poor quality owing to the constant exposure of soil and lack of humus. In areas where grazing is heavy and such is the case of the entire accessible tract, natural regeneration and advance growth are absent.

Teak Forest: The forests having more than 20% of Teak in over wood are called as Teak forests. On deep, rich and well drained soil, most valuable species economically i.e. the teak occur and forms about 20 to 30 % of the crop. On poorer sites with shallow soils and particularly in areas which are subjected to frequent fires and severe damages due to hacking etc., the proportion of teak is more than 50 % but the growth is not so good. Almost pure teak forests are confined to Teak plantations, but most of them have been cut on account illegal tree felling. On better sites, the associates of teak are valuable timber species like Ain, KhairHed, Kalam, Bibla etc. are found. However, in poorer sites, associates are drier species like Dhavada, Kakad, Shemal etc.

Ain Forest: The forests having more than 50 % of Ain over wood are called as 'Ain forests'. In part of the areas, Ain accounts are more than 50 % of the crop. This forest type is very common in woodland or even in reserve forest where areas have been largely used for cultivation. This type occurs, on almost all malki land near woodlands and reserve forest. The occurrence of the species in cultivated area and encroachments indicates that the species has capability of surviving against the injuries or increased opressure, probably owing to its high coppicing power in the earlier stages and its suitability to the edaphic, climatic and other ecological or environmental conditions existing in this tract.

Mixed Forest: The forests with less than 20 % teak and none of the species being more than 50 % would be called as mixed forest. This type of the forest has low proportion of teak in the crop. It occurs in the areas which have not been subjected to adverse effects of biotic factors like fires, grazing, over grazing, hacking etc. This forest occurs in the more moist areas like nalla banks and shaded valleys.

Casuarina Forests: This forest type consists of the plantations of Casuarinaequisitifolia (Suru) along the sea coast in Palghar, Dahanu and Bordi Ranges of the Division. These are pure Suru plantations and have no Underwood or undergrowth, whereas, older plantations are very successful and have been harvested in the past. These forests are also important from aesthetic point of view as they form good shelterbelts on the coast.

Babul Forest: This type occurs in narrow strip along the Vaitarna River. Babul was raised artificially by sowing of seeds. The area is flat and has deep loamy soil. Almost pure crop of Babul was reported to be occurring as a result of regeneration efforts in the distant past. The crop is reported to have been regularly harvested. However, at present most of the areas under this forest type are blank and efforts for regeneration have not been made. The list of common reported floral species in the study area is given in Table 3.13.

TABLE 3.13: LIST OF COMMON PLANTS OCCURRING IN THE PROJECT AREA

Common Name	***Scientific Name***
Trees	
Ain	*Terminaliatomentosa*
Alu	*Meynalaxiflora*
Ashi	*Morindatinctoria*
Amba	*Mangiferiaindica*
Amati (Wavding)	*Embelicarobusta*
Apta	*Bauhinia racemosa*
Asana	*Brideliaretusa*
Arjunsadada	*Terminaliaarjuna*
Athroon (Kakar-Bhekal)	*Flacourtiaramontchi*
Avali	*Emblicaofficinalis*
Babul	*Acacia Arabica*

Common Name	***Scientific Name***
Bel	*Aeglemarmelos*
Bakula	*Mimusopselengi*
Bava (Bhava)	*Cassia fistula*
Beheda	*Terminaliabelerica*
Bhendi	*Thespesiapopulnea*
Bhokar (Shelute)	*Cordiadichotoma*
Bhutkesh (Lawsat)	*Mussaendafrondosa*
Bhitia (Alan or Bhutaksha)	*Elaeodendronglaucum*
Bibla	*Pterocarpusmarsupium*
Bondara	*Lagerstroemia parviflora*
Bor	*Ziziphus jujube*
Chambuli	*Bauhinia vahlii*
Chinch	*Tamarindusindica*
Dandoshi	*Dalbergialanceolaria*
Daiwas (Dahivel)	*Cordiamacleodii*
Datir	*Ficusheterophylla*
Dhaman	*Grewiatiliaefolia*
Dhavada	*Anogeissuslatifolia*
Gol	*Tremaorientalis*
Hed	*Adina cordifolia*
Hirda	*Terminaliachebula*
Humb	*Saccopetalumtomentosum*
Jambul	*Syzgiumcuminii*
Kalamb	*Stephegyneparvifolia*
Kadvai	*Hymenodicatyonexcelsum*
Katekumbhal	*Sideroxylontomentosum*
Kavath	*Limmoniaacidissima*
Khair	*Acacia catechu*
Khavas	*Sterculiacolorata*
Kinhai	*Albizziaprocera*
Kirmira	*Casearіatomentosa*

Common Name	***Scientific Name***
SHRUBS	
Adulsa	*Adhatodazeylanica*
Dhaiti	*Woodfordia floribunda*
Ghaneri	*Lantana camara*
Ghaypat	*Agave Americana*
Gultata	*Lantana alba*
Kanfuti	*Flemigiastrobiligera*
Kaladhotra	*Daturafastuosa*
Karvandi	*Carrissacarandas*
HERBS	
Anantmul (Upalasari)	*Hemidesmusindicus*
Bhigguli	*Indigoferaenneaphylla*
Burada	*Blumealacera*
Chikata	*Desmodiumpalchellum*
Dinda	*Leeamacrophylla*
Litchi (Van-bhendi)	*Urenalobata*
Papadi	*Pavettatomentosa*
Rankel	*Musa superb*
Ranhalad or sholi	*Curcuma aromatic*
Rankanda	*Scillaindica*
Sarpmukha	*Tephrosiapurpurea*
Sonki	*Senecio graham*
Tarota or Takala	*Cassia tora*
Vikharatalimkhana	*Hygrophilaamicularis*
CLIMBERS	
Alai/Alsi	*Dalbergiavolubilis*
Bhuikohala	*Impomoeadigitata*
Chilhari	*Caesalpiniasepiaria*
Gunj	*Abrusprecatorius*
Gulvel (Amarvel)	*Tinosporacordifolia*
Kanguni	*Celastruspaniculata*

Common Name	***Scientific Name***
Kantjaruel	*Capparissepiara*
Kuhili	*Mucunapruriens*
Phulsun	*Spatholobusroxburghii*
Sakalvel	*Ventilagomadraspatana*
Ukshi	*Calycopteris floribunda*
Valbiwala	*Milletiarecemosa*
Watvel	*Cocculusmacrocarpus*
Wagati	*Wagateaspicata*
Wag, Govinsi	*Cappariszeylanica*
BAMBOOS	
Bundhi or Cher	*Oxytenantheramonostigma*
Manvel	*Dendrocalamusstrictus*
Padhai or katas	*Bambusaarundianacea*
GRASSES	
Ber	*Ischaemumrugosum*
BhaleKusal	*Heteropogontriticus*
Bhongrut (Phuleraphul)	*Themedaquadrivalvis*
Bhuri	*Aristidapaniculata*
Boru	*Andropogon*
Chirika	*Eragrostistremula*
Dongarigavat	*Chrysopogonfulvu*
Ghanya	*Bothriochloapertusa*
Gondvel	*Andropogonpumilis*
Harali (Durva)	*Cynodondactylon*
Kunda	*Ischaemumpilosum*
Kothar	*Woodrowiadiandra*
Kusali	*Heteropogoncontortus*
Lavhala	*Mnesithealaevis*
Marvel	*Dichanthiumannulatum*
Pavnya	*Schimasulcatum*
Phool	*Themedatriandra*

Common Name	*Scientific Name*
Rosha	*Cymbopogonschoenanthus*
Sheda	*Schimanervosum*

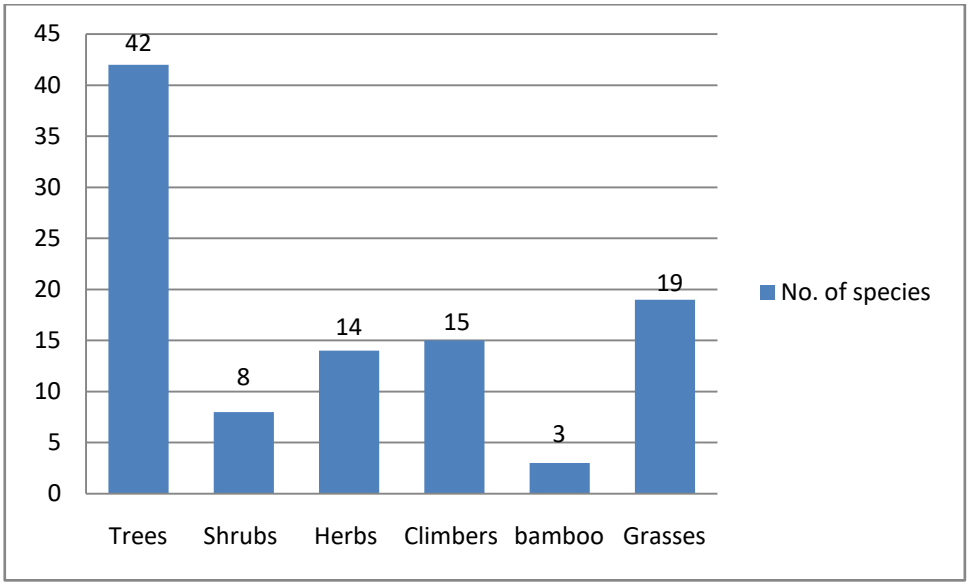


Fig 3.14:Flora found in project site

Fauna

Proposed project is located on the western coast near Sanjay Gandhi national park area, which forms part of the Thane Forest Division. The wild life population in the Thane Forest Division is dwindling due to increased biotic pressure on their habitat. The major wild life species reported in the project area are given in the Table 3.14.

TABLE 3.14: MAJOR WILD LIFE SPECIES OBSERVED IN THE PROJECT AREA

Sr. No	Common Name	Scientific Name
	MAMMALS	
1	Wild Boar	*Susscrofa*
2	Common Langur	*Presbytis entellus*
3	Barking Deer	*Muntiacusmuntjak*
4	Indian hare	*Lepusnigricollis*
5	Bonnet macaque	*Macacaradiata*
6	Rhesus Macaque	*Macacamulatta*

Sr. No	Common Name	Scientific Name
7	Flying fox (bat)	*Pteropus sp.*
8	Rat	*Bandicota sp.*
9	Indian field mouse	*Musbooduga*
10	Indian Palm civet	*Paradoxurushermaphroditus*
	REPTILES	
1	Common Garden Lizard	*Calotesversicolor*
2	Common Indian Monitor	*Varanusbengalensisis*
3	Common Wolf Snake	*Lycodonaulicus*
4	Common Red Snake	*Ptyasmucosus*
5	Common Indian Krait	*Bungaruscaeruleus*
6	Indian Cobra	*Najanaja*
7	Russell's Viper	*Daboiarussellia*
8	Jungle calotes	calotes *rouxii*
9	Fan throated lizards	Sitana sp.
10	Gecko	hemidactylusbrookii
11	Bark gecko	Hemiductylusleschenautus
12	Saw scaled viper	*Echiscarinatus*
13	Checkered keelback	*Xenochrophispiscato*
14	Keeled grass skink	*Eutropiscarinata*
15	Common trinket	*Coelognathus Helena helena*
16	Green keelback	*Macropisthodonplumbicolor*
17	Common vine snake	*Ahaeutullanasuta*
	AVIFAUNA	
1	Litle Grebe	*Tachybaptusrujicollis*
2	Little Cormorant	*Phalacrocoraxniger*
3	Purple Heron	*Ardeapurpurea*
4	Little Egret	*Egrettainrermedia,*
5	Pariah Kite	*Milvusniigrans*
6	Shikra	*Accipiter badius*
7	Grey Jungle Fowl	*GalIussonneratti*
8	White breasted Waterhen	*Atnaurornisphoenicurus*
9	Pheasant tailed Jacana	*Hydrophasianuschirurgus*
10	Red wattled Lapwing	*Vanellusindicus*

Sr. No	Common Name	Scientific Name
11	Common Greenshank	*Tringanebularia*
12	Blue Rock Pigeon	*Columba livia*
13	Indian Ring Dove	*Streptopeliadecaocto*
14	Spotted Dove	*Streptopeliachonensis*
15	Rose ringed Parakeet	*Psittaculakrameri*
16	Blossom headed Parakeet	*Psittaculacyanocephala*
17	Ashy prinia	*Priniasocialis*
18	Asian koel	*Eudynamysscolopaceus*
19	Barn owl	*Tyto alba*
20	Baya weaver	*Ploceusphilippinus*
21	Bramhini kite	*Haliasturindus*
22	Black Drongo	*Dicrurusmacrocercus*
23	Golden oriole	*Orioluskundoo*
24	Great Egret	*Ardea alba*
25	Green bee-eater	*Meropsorientalis*
26	Grey Heron	*Ardeacinerea*
27	Indian Cormorant	*Phalacrocoraxfuscicollis*
28	Indian peafawl	*Pavocristatus*
29	Jungle babbler	*Turdoidesstriata*
30	Large-billed Crow	*Corvusmacrorhynchos*
31	Pied bushchat	*Saxicolacaprata*
32	plain prinia	*Priniainornata*
33	Osprey	*Pandionhaliaetus*
34	Long-tailed shrike	*Laniusschach*
35	Pond heron	*Ardeolagrayii*
36	Little Ringed Plover	*Charadriusdubius*
37	Red-vented bulbul	*Pycnonotuscafer*
38	Red-whiskered bulbul	*Pycnonotusjocosus*
39	purple rumped sunbird	*Leptocomazeylonica*
40	Scaly-breasted Munia	*Lonchurapunctulata*
41	Small Blue Kingfisher	*Alcedoatthis*
42	Western reef egret	*Egrettagularis*
43	Whiskerd tern	*Chlidoniashybridus*
44	Indian roller	*Coraciasbenghalensis*

Sr. No	Common Name	Scientific Name
45	White rumpedmunia	*Lonchurastriata*
46	white throted fantail flycatcher	*Rhipiduraalbicollis*
47	White-cheeked barbet	*Psilopogonviridis*
48	White-throated kingfisher	*Halcyon smyrnensis*
49	Wire-tailed Swallow	*Hirundosmithii*
50	greater Coucal	*Centropussinensis*
	BUTTERFLY	
1	Blue tiger butterfly	*Tirumalalimniace*
2	Common crow butterfly	*Euploea core*
3	striped tiger butterfly	*Danausgenutia*
4	Glasy tiger butterfly	*Paranticaaglea*
5	Chocolate pansy butterfly	*Junoniaiphita*
6	Commander butterfly	*Moduzaprocris*
7	Common baron butterfly	*Euthaliaaconthea*
8	Common bushbrown butterfly	*Mycalesisperseus*
9	Common grass yelowbutterfly	*Euremahecabe*
10	Common jay butterfly	*Graphiumdoson*
11	Common Jezbell butterfly	*Delias eucharis*
12	Common Mormone butterfly	*Papiliopolytes*
13	Common palmfly butterfly	*Elymniashypermnestra*
14	Common pierot butterfly	*Castaliusrosimon*
15	Common rose butterfly	*Pachlioptaaristolochiae*
16	Common sailer butterfly	*Neptishylas*
17	Common silverline butterfly	*Spindasisvulcanus*
18	Crimson rose butterfly	*Pachliopta hector*
19	Great eggfly butterfly	*Hypolimnasbolina*
20	grey pansy butterfly	*Junoniaatlites*
21	Lime butterfly	*Papiliodemoleus*
22	Peacock pansy butterfly	*Junoniaalmana*
23	Pioneer butterfly	*Belenoisaurota*
24	Plain tiger butterfly	*Danauschrysippus*
25	psyche butterfly	*Leptosianina*
26	Red pierrot butterfly	*Talicadanyseus*
27	Southern rustic butterfly	*Cuphaerymanthis*
	OTHER INSECT	
1	Ground skimmer	*Diplacodestrivialis*
2	Pied Paddy Skimmer	*Neurothemistullia*
3	Green marsh hawk	*Orthetrumsabina*

Sr. No	Common Name	Scientific Name
4	Termites	*Termitoidaesps.*
5	Stag beetle	*Lucanus capreolus*
6	Praying mantis	*Mantis sps.*
7	Asiatic honey bee	*Apiscerana*
8	Grasshoppers	*Macrotonasp*
9	Giant honey bee	*Apisdorsata*
10	Blue dasher	*Brachydiplaxchalybea*
11	Crimson tailed marsh Hawk	*Orthetrumpruinosum*
12	Ground skimmer	*Diplacodestrivialis*
13	Rosy Skimmer	*Orthetrumluzonicum*
14	Globe Skimmer	*Pantalaflavescens*
15	Scarlet Skimmer	*Crocothemisservilia*
16	Catydid	*Microcentrumsp*
17	Bark mantis	*Gyromantis*
18	Asian Weaver ant	*Oecophylla sp.*
19	Carpenter ant	*Camponutus*
	SPIDERS	
1	Signature spider	*Argiopesp*
2	Common Funnel web spider	*Hippasasp*
3	Striped Lynx spider	*Oxyopessp*
4	Tent spider	*Cyrtophorasp*
5	Fishing spider	*Dolomedessp*

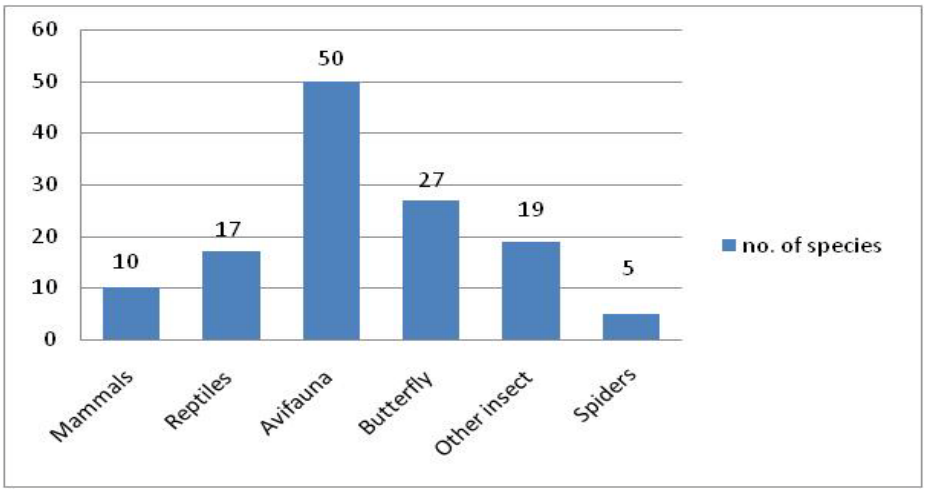


Fig 3.15Fauna found in project site

3.9.3Marine Ecology

Biological characteristics of a water body are very important, since they determine the productivity of the aquatic ecosystem. Primary productivity is the most important biological phenomenon in nature on which the entire diverse array of life depends either directly or indirectly. It involves trapping of the radiant energy of the sun and its transformation into high potential biochemical energy through the process of photosynthetic activities using inorganic materials of low potential energy. It also helps in measuring the ability of an area to support a biological population and sustain a level of growth and respiration. Fish production is dependent on zooplanktons, which in turn are dependent on the phytoplankton. As a part of the EIA study, a detailed marine ecological survey was conducted in the project area. The survey involved the collection and analysis of marine water and sediment samples for the biological parameters like zooplanktons, phytoplankton and benthic fauna of the project area.

Phytoplankton

Phytoplankton is the chlorophyll bearing microscopic organisms which produce organic carbon through photosynthesis. The density and abundance of phytoplankton can be used as an indicator of the primary productivity of an aquatic ecosystem. Phytoplankton is very sensitive to pollution and responds quickly to environmental changes. The abundance and density of phytoplankton depends on the level of nutrient and light penetration. The zooplanktons feed on phytoplankton and their survival is also directly dependent on the standing crop of the phytoplankton. Zooplankton in turn is fed by the larvae juveniles and fishes and other benthic organisms in aquatic ecosystems.

The dominant species observed during sampling were *Astermophalusspp, Chaetocerosdecipens, Cyclotella spp., Peridinium spp., Streptothecathamensi, and Thalassiosira spp.*

Zooplankton

Zooplanktons are microscopic free floating organisms which constitute an important link between primary producer and consumer of higher order in the aquatic food chain.

Therefore, the population dynamics of zooplanktons represent the physico-chemical and biological conditions of water.

The dominant species like *Copepod spp.*, *Lamellibranchs, Decapod larvae, and Polychaetes* were found in the sampling locations during the study period.

Benthos

Benthos is a collective term referred to the organisms lying in or associated with aquatic sediment comprising bacteria, plants and animals from almost all phyla. Benthic fauna have been found to play a significant role in the trophic network, as they utilise all forms of food material available in the sea-bed or estuarine base and form an important link in the transfer of energy. Another important aspect of the benthic studies is the effect of the pollution on the standing crop and productivity. Abiotic relationship of benthos especially with the sedimentological features has explained most of the fluctuations in benthic abundance. The macro-benthos and meio-benthos observed in the sediments at sampling location.

Fisheries

The prevailing fishery status of the region around project area was evaluated based on data collected from Department of Fisheries, Government of Maharashtra.

TABLE NO 3.15: MAJOR FISHES/OTHER SPECIES FOUND IN PROJECT SITE

S. No.	***Scientific Name of Species***	***Common name***
1.	*Terapontheraps*	largescaledterapon
2.	*Caridea sp.*	Shrimps
3.	*Coiliadussumeri*	Mandelli
5.	*Boleopthalmusboddaerti* .	Mud skipper .
6.	*Boleopthalmusdussumeri*	Mud skipper
7.	*Clariasgariepinus*	Cat fish, Shingada
8.	*Scatophagusargus*	Spotted scat
9.	*Trypauchen vagina*	burrowing goby
10.	*Scylla serrata*	Mud crab
11.	*Ucasp 1*	Fiddler crab

S. No.	*Scientific Name of Species*	*Common name*
12.	*Ucasp 2*	Fiddler crab
13	*Clibanariussp*	Hermit crab
14.	*Nassariussp*	gastropod
15.	*Nerita sp.*	Gastropod
16.	*Gafrarium sp.*	Bivalve
17.	*Crosostreamadresensis*	Oyster

3.9.4 Mangrove Vegetation

There are no Mangrovesalong the Project site. But Mangrove vegetation is good along existing Thane-Ghodbunder road. Dominant species observed during study is Avicennia marina and Avicenniaalba which are common mangrove species. Other species like Salvadorasps and Avicenniaofficinalis also found in small patches during study.

Mangroves are a group of trees and shrubs that live in the coastal intertidal zone. Mangrove forests only grow at tropical and subtropical latitudes near the equator because they cannot withstand freezing temperatures. Mudflats are very much important in initialization of establishment of mangroves. Mangrove trees have developed unique adaptations to the harsh conditions of coastal environments. They survive high amounts of salinity either by excreting salt through their leaves, or simply by safely keeping it within their tissues. Their root systems are shallow and partly exposed to the air, which allows them to breathe in an environment that's frequently flooded and low in oxygen. Mangrove swamps are unique ecological communities that link freshwater and oceanic ecosystems and host a rich diversity of animal species.

India -Mumbai coverage-species

About 7% of the world's mangroves are present in India. In India mangroves are present on West coast, East coast and AndmanNikobar islands. Mangroves in Mumbai are mostly seen along Mahim, Bandra, Versova, Sewri, Diva, Vikhroli, Thane creek, Malad, Vasai creek etc. Around 15 species are found to be present in coastal regions of Mumbai. Avicennia marina is the dominant mangrove species hat cover around 60% of mangrove cover of Mumbai. However, Mumbai has lost around 40% of its mangrove cover over past decade due to coastal land reclamation for various purposes. Increasing human population exerts pressure on mangrove ecosystem in coastal area creating need for reclamation.

Importance of mangroves

Their coverage of coastal shorelines and wetlands provide unique habitat to many species of birds, mammals, fishes and invertebrates. Mangroves act as buffer between the land and the sea. The roots of the mangrove help in slowing down the movement of tidal waters, causing sediments to settle out of the water and build up the muddy bottom. Mangroves contribute greatly in reducing coastal erosion. Besides their role in shoreline protection, mangroves constitute a valuable tool in the fight against climate change. When a tree grows, it stores carbon in its biomass, thus decreasing the amount of carbon dioxide in the atmosphere. Mangroves perform this carbon storage mechanism particularly well, as they can store up to five times more carbon than an equal area of rainforest. These efficient carbon sinks are becoming increasingly relevant in the light of worsening climate change. The trees intricate network of roots provides a shelter for many oceanic and freshwater species, and the forest is a food source for many types of organisms as well. Mangrove forests and estuaries are the breeding and nursery grounds for a number of marine organisms including the commercially important shrimp, crab and fish species. Hence, loss of mangroves not only affects us indirectly but there are direct economic repercussions through loss of fishing industry. Mangrove trees are also used for house building, furniture, transmission as well as telephone poles and certain household items. When these activities are managed appropriately it is possible to derive timber products from mangrove forests without significant environmental degradation, and while maintaining their value as a nursery and a source of food for commercial capture fisheries. In many coastal areas including Gulf of Kutch, mangroves are a substitute for fodder. Thus mangroves reduce pressures from the scarce pasturelands. Tannin is extracted from the bark of some mangrove species like Rhizophoramucronata, Bruguieragymnorrhiza and Ceriopstagal. Indian mangrove trees have 35% tannin in their bark, which is higher compared to other countries. Extracts from mangrove bark are used by Indian fishermen to dye their fishing net and enhance its durability.

Threats

Human-induced thermal, agrochemical, nutrient, heavy metal and oil-spill pollution also seriously impact this fragile ecosystem while deforestation and coastal development are one of its largest threats. Particularly development pressures caused by a growing population cause large amounts of mangrove destruction.

Conservation

Conservation efforts are being taken up by Government of India, however people's awareness and involvement in mangrove management is also crucial. Implementation of mangrove restoration and rehabilitation programmes, provision of incentives for mangroves plantation, enforcement of environmental laws, establishment of mangrove parks, promoting importance of mangrove ecosystem through nature camps, seminars, exhibitions and media etc are effective ways of conservation of mangrove.

Ecosensitive area

Sanjay Gandhi National Park earlier known as Borivali National Park is the nearest reserve area which is about 2.5 Km on western direction of the alignment. As per notification of Sanjay Gandhi national park Dated 5th Dec 2016 ESZ is spread to an extent of 100 m to 4 km from the boundary of SGNP. However, the proposed project does affect SGNP.

3.10. Photographs

Avicennia alba

Salvadorasps.

Avicenniaofficinalis

Avicennia marina

Peltophorum pterocarpum

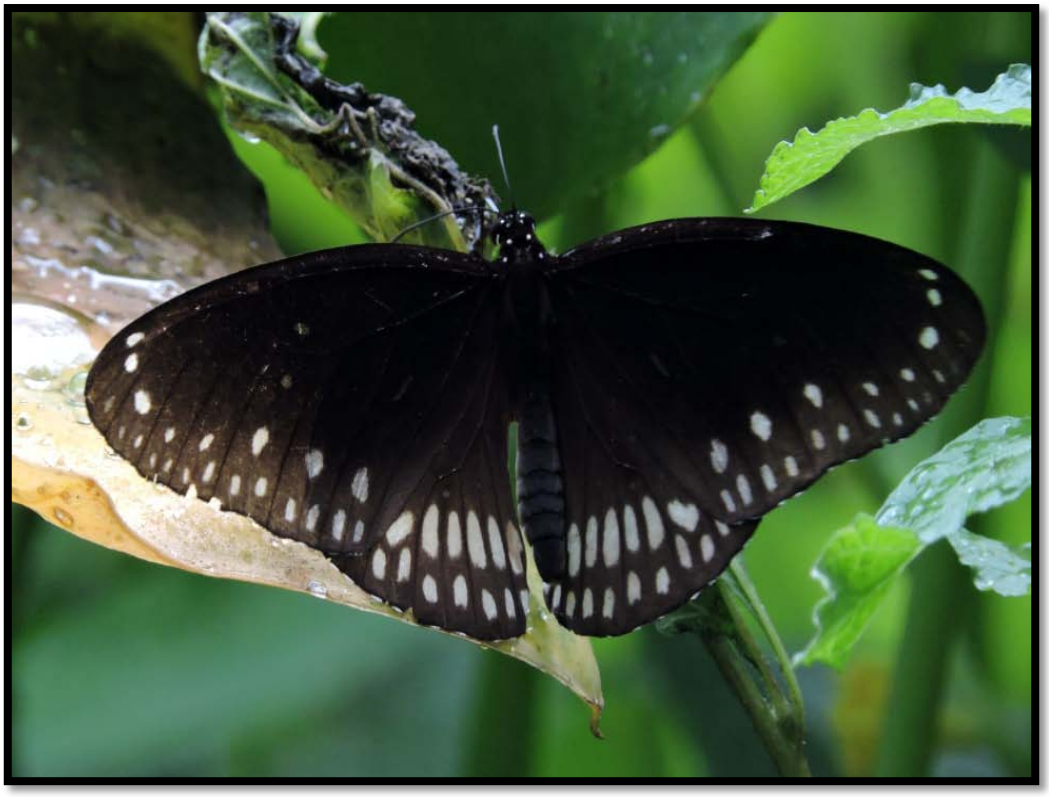
Lagerstroemia speciosa

Peacock pansy butterfly

Common caster butterfly, Female

Common Jezebel

Great EggFly



Common Crow

White Throated Kingfisher

Asian Koel

Grey Heron

CHAPTER 4
ENVIRONMENTAL IMPACT ASSESSMENT

4.1 INTRODUCTION

4.1.1 EIA Definitions

A process or set of activities designed to contribute pertinent environmental information to project or program decision-making. It is a process, which attempts to identify, predict and assess the likely consequences of proposed development activities. EIA is a planning aid concerned with identifying, predicting and assessing impacts arising from proposed activities such as policies, programs, plans and development projects which may affect the environment. EIA is a basic tool for the sound assessment of development proposals to determine the potential environmental, social and health effects of a proposed development.

Environment Impact Assessment (EIA) is becoming more and more common. Based on the "Law of Environment Protection" in India, environmental impact of every planned engineering project, including regulation works for navigation channels, should be carried. The local environmental protection bureau, where the project is located, will examine the potential impact on environment. The project will be approved, only when its environment impacts are acceptable. A thorough environmental impact assessment must incorporate an assessment of the economic impact of a project, the physical and chemical condition of the area, the flora and fauna and human reflections.

4.1.2 Purpose of Environment Impact Assessment

The projects, like any others, have impacts in the environment at a smaller degree. The magnitude of the impacts, of course, depends on the scale of the works. For this reason one should also realize that the extent of the investigation is not always the same. The points to be considered for EIA are given below. One should assess for every project, in the feasibility study, the scope and the size of EIA.

1 A complete Environment Impact Assessment study should describe the following items.

2 A description of the "as is" situation before the project starts in the area influenced by the project

3 A description of the proposed project and is influence on the environment after completion.

4 A description of the works and actions to be carried out to implement the project.

5 A description of the probable impact of all works and action described relating to:

The biological equilibrium, including;

The non-biological equilibrium, including

- Morphology
- Water quality
- Air quality
- Socio-economic factors
- Landscape
- Land use
- Visual intrusion
- Noise
- Employment
- Infrastructure
- Hazardous situations
- Recreational activities and
- Political

6 The possible beneficial environmental effects of the project.

7 The possible adverse environment effects of the project

8 An evaluation of the effects of various execution methods during the implementation period of the project

9 An evaluation of the effects during the period the project is commissioned

10 An evaluation of the effects of demolishing a structure during the period of construction

11 An evaluation of the (ir) reversibility of impacts

12 The range of primary, secondary and tertiary impacts (direct or indirect) of the project

13 A proposal for remedial actions to reduce the impacts of the project

4.1.3 Potential Environment Impacts of the project

The first step of an environmental impact assessment is to identify the potential effects of a project on environment. In this section, attempts will be made on outlining possible effects of the project on environment, together with mitigation measures.

4.2 ENVIRONMENT IMPACT ASSESSMENT AND MITIGATION MEASURES

4.2.1 Introduction

This chapter deals with the assessment of project impacts on environment. Mitigative measures are suggested to minimize the likely negative impacts. An Environmental Management Plan is also suggested along with an estimate of Environmental Costs as an input for evaluation the economic feasibility of the project.

The project will have impacts of varying magnitude on different environmental components. These impacts could be categorized as

1. Primary impacts, i.e. impacts which occur as a direct result of the project activities
2. Secondary and tertiary impacts, i.e. impacts that occur as a result of primary impacts.

Impacts could occur during the construction phase as well as during the Operational phase. Impacts during these phases are discussed separately in this chapter.

4.2.2 Significant Environmental Impacts and Mitigative Measures

In view of the above study, we will sub divide the key environmental factors into 3 groups:-

In respect of existing status

In respect of construction phase and

In respect of operation phase

The type and magnitude of the impacts are entirely site specific. In order to logically analyse situation on a probable scale, following standards have been devised for the project under consideration to quantify the impact:

0 = No impact

1 = Negligible

2 = Mild

3 = Moderate

4 = Significant

5 = Severe

Utility of the above noted qualitative scale is that it can be used as a method to approximately indicate varying order of caution while dealing with road projects at different stretches of the project.

4.2.3 Checklist of Impacts

The impact evaluation determines whether a project development alternative is in compliance with existing standards and regulations. It uses acceptable procedures and attempts to develop a numeric value for total environmental impact. A transformation of the review of multiple environmental objectives into a single value or a ranking or projects is the final step in impact assessment. There are about hundred methods for carrying out impact assessment, which can be grouped into the following categories:

- Ad-hoc method,
- Checklist,
- Matrix,
- Network,
- Overlays,
- Environmental Index and
- Cost Benefit analysis.

Each of the methods is subjective in nature and none of these is applicable in every case. Out of these 7 methods listed above, checklist method has been used and presented. Checklist is a list of environmental parameters or impact indicators which encourages the environmentalist to consider and identify the potential impacts.

A typical checklist identifying anticipated environmental impacts is shown in Table 4.1.

TABLE 4.1: CHECKLIST OF IMPACTS

Sr. No.	Parameter	Negative Impact	No Impact	Positive Impact
A.	**Impacts due to Project Location**			
i.	Displacement of People		*	
ii.	Change of Land use and Ecology	*		
iii.	Loss of Cultural and Religious Structures		*	
iv.	Socio-economic Impacts		*	
v.	Loss of Trees		*	
vi.	Drainage & Utilities Problems		*	
B.	**Impact due to Project Design**			
i.	Platforms - Inlets and Outlets		*	
ii.	Ventilation and Lighting		*	
iii.	Station Refuse	*		
iv.	Risk due to Earthquakes		*	
C.	**Impact due to Project Construction**			
i.	Loss of trees		*	
ii.	Soil Erosion & health risk at construction site	*		
iii.	Traffic Diversions		*	
iv.	Risk to Existing Buildings		*	
v.	Excavated soil and muck disposal	*		
vi.	Air pollution due to dust emission	*		
vii.	Increased Water Demand	*		
viii.	Supply of Construction Material	*		
ix.	Generation of Construction and Demolition Waste	*		
x.	Batching Plant and Casting Yard		*	
xi.	Air & Noise	*		
xii.	Loss of historical & cultural monument		*	
xiii.	Impact of labour camp	*		
D.	**Impact due to Project Operation**			
i.	Oil spillage at depot	*		
ii.	Noise pollution at stations and depot	*		
iii.	Water supply and sanitation	*		
iv.	Solid waste generation at stations and depot	*		
v.	Generation of Hazardous waste at Depot	*		

Sr. No.	Parameter	Negative Impact	No Impact	Positive Impact
vi.	Pedestrian Issues		*	
vii.	Visual Impacts		*	
viii.	Station Illumination		*	
ix.	Employment Opportunities			*
x.	Enhancement of Economy			*
xi.	Mobility			*
xii.	Safety and reduced accidents			*
xiii.	Traffic Congestion Reduction			*
xiv.	Reduced fuel Consumption			*
xv.	Reduction in Buses/ Auto rickshaws/Taxis			*
xvi.	Reduced Air Pollution			*
xvii.	Carbon dioxide Reduction			*
xviii.	Improvement of Quality of Life			*

Each of the negative impacts on the environment requires consideration of mitigative measures. Some of these measures require judicious application of road engineering design and construction methodology while others require special techniques. An attempt has been made to indicate the required mitigative measures for each type of identified negative impact.

4.2.4 Matrix Procedure for Impact Assessment and Quantification

The interactive matrix presented in Fig 4.1 gives a brief but full-fledged quantification of environmental impact on the project alignment

Positive effect : **P** Negative effect : **N1** Nil to Negligible Moderate **N3** Major	Public interest	1- Public Health	2- Ecology	3- Fisheries/ Water Bodies	4- Nature conservation	5- Tourism and recreation	6- Cultural values/Socio-Eco values	7- Environmental Parameters	8- Employment Generation
PROJECT ACTIVITIES									
DURING CONSTRUCTION:									
Construction activities at Site	**N2**	**N2**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**P**
Rearrangement of Land use	**N2**	**N2**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	--
Open-site for construction material	**N2**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	--
Transport of construction material	**N2**	**N2**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**P**
DURING OPERATION (Direct/ Indirect)									
Movements of Raw Materials	**N2**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**P**
Spills	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	**N1**	--
WASTES DURING CONSTRUCTION									
Air	**N2**	**N2**	**N1**	**N1**	**N1**	**N1**	**N1**	**N2**	--
Water	**N1**	**N1**	**N2**	**N1**	**N1**	**N1**	**N1**	**N2**	--
Solid Waste	**N1**	**N1**	**N2**	**N1**	**N1**	**N1**	**N1**	**N2**	--
Noise	**N2**	**N1**	**N2**	**N1**	**N1**	**N1**	**N1**	**N2**	--
RELATED DEVELOPMENTS									
Population growth	--	**N1**	**N1**	--	--	**P**	**P**	**N1**	--
Employment	P	P	--	--	**N1**	**P**	**P**	--	--
Industrial development (Ancillary)	--	--	--	--	--	--	--	--	--
Trade /commerce	--	--	--	--	--	--	--	--	--

Fig 4.1: Matrix Procedure for Impact Assessment and Quantification

This approach is important for carrying out Environmental Impact Assessment (EIA) as it gives conceptual framework for the assessment of the environmental impact. From the above Matrix is we can see that there are going to positive as well as few negative impacts due to the project. The scale of these impacts for the said project is as **N3**<**N2**<**P**<**N1**whichindicates that the project will have a Nil to Negligible effect on the surrounding environment. The project is envisaged to have some positive impacts with reference to population growth and employment.

Each of the negative impacts on the environment requires consideration of mitigate measures. Some of these measures require judicious application of engineering design and construction methodology while others require special techniques. An attempt has been made to indicate the required mitigate measures for each type of identified negative impact.

4.3 NEGATIVE ENVIRONMENTAL IMPACTS

Negative impacts likely to result from the proposed development have been listed under the following headings:

- Impacts due to Project Location;
- Impacts due to Project Design;
- Impacts due to Construction; and
- Impacts due to Project Operation.

For each of these headings, potential impacts and mitigating measures have been studied.

4.3.1 Impacts from the project Location

The possible impacts due to project location have been examined for the proposed development. All the identified impacts and accepted mitigative proposed measures should form a part of the project. During this phase, those impacts, which are likely to take place due to the layout of the project are:

- Change of Land use;
- Loss of bio-mass or bio-diversity
- Utility/Drainage Problems,
- Socio-economic impacts;
- Impact on Historical and Cultural Monuments;
- Risk due Earthquake

4.3.1.1 Land Use

The landuse pattern, which will undergo some changes, will not be further altered during operational phase. The landuse covered under green belt / agri land will be maintained during operational phase. The aesthetic look of the said landuse will be enhanced by green belt and other signage with proper architectural plans.

The required land (permanent & temporary) for the construction of the proposed project is both government as well as private land which shall be allotted by Mumbai Metropolitan Regional Development Authority (MMRDA). Private land (if any) will be acquired as per the provisions of The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013 (Act 30 of 2013) and Resettlement and Rehabilitation Policy for Mumbai Urban Transport Project (MUTP) notified in March 1997 and amended in December 2000.

4.3.1.2 Loss of trees

Trees are assets in purification of urban air, which by utilizing CO_2 from atmosphere, release oxygen into the air.The average consumption of oxygen for a person is about 182 kg/ year. It means these trees will meet the requirement of about 1,217 people round the year. Trees help carbon sequestration acting as a carbon sink.

The Casting yard and Piers of approach road and spur line to car-shed depot are in urban/ city area and will not pass through any forests. Hence no loss to forest is anticipated due to the project. Also, there is no tree cuttingduring construction phase.

Any trees that will be affected during the project activities will be re-planted at suitable sites. The project location has a good quantity of green cover in the surrounding areas. However if any further plantation is to undertaken, it will be done by planting local trees.

4.3.1.3 Issues related to Utility/ Drainage

The Casting Yard is on urban area with nocanals/ drains/ nalas, surface and utility services, viz. sewer, water mains, storm water drains, telephone cables, overhead electrical transmission lines, electric pipes, roads, traffic signals etc. passing through. So, there is no impact with proposed construction of casting yard.

The piers of approach road also do not cross any canals/ drains/ nalas, surface and utility services, viz. sewer, water mains, storm water drains, telephone cables, overhead electrical transmission lines, electric pipes, roads, traffic signals etc. The proposed Metro spur line crosses nalla having width of 20 m. During construction there is no diversion of this nalla envisaged. So, there is no impact

During construction phase there will not be many issues that would be encountered for the utility system/infrastructure facilities already existing within the alignment. If any, these utility services are essential and have to be maintained in working order during different stages of construction by temporary / permanent diversions or by supporting in position.

4.3.1.4 Socio-Economic Impact

The project at any stage does not envisage rehabilitation or resettlement of local/ labor population.

4.3.1.5 Impact on Historical places

There is no historical monument having any archaeological value in the vicinity of the proposed alignment. Thus on this aspect there would be no impact.

4.3.1.6 Risk Due to Earthquake

The project area lies in Zone III of Bureau of Indian Standards (BIS) Seismic Zoning Map (Chapter-3). Seismic factor proposed by India Meteorological Department (IMD) for the purpose of design of Civil Engineering structures shall be incorporated suitably while designing the structures.

4.3.2PROJECT DESIGN RELATED IMPACTS

Considered impacts, due to project designs are:

4.3.2.1 Engineering Design

Best engineering practices will be adopted to design the piers for car-shed depot and casting yard in order to minimize the effect on environment and for better and faster development of the metro line. All the required drawings, etc. will be prepared using latest software and will be easily available at any given time.

4.3.2.2 Project Scheduling

The schedule for the various project activities will be strictly in line with the MoEFCC guidelines. Any delays/changes in the timeline will be informed in well advance.

4.3.2.3 Through post construction by providing facilities to other Government Departments and agencies to watch, monitor, enforce environment standards.

All the environmental laws will be strictly implemented and followed during construction and operation phase of the project. All the environmental parameters will be monitored at regular intervals and the reports will be readily available.

4.3.3 IMPACTS DUE TO PROJECT CONSTRUCTION

Although environmental hazards related to construction works are mostly of temporary nature. Appropriate measures would be included in the work plan and budgeted for. The most likely negative impacts related to the construction works are:

- Top Soil erosion, pollution and health risk at construction site,
- Traffic diversion
- Risk to existing building,
- Excavated soil disposal problems,
- Dust Generation,
- Increased water demand,
- Impact due to Supply of Construction Material,
- Disposal of Construction and Demolition Waste,
- Impacts due to batching plant and casting yard,
- Noise Pollution
- Loss of Historical and Cultural Monuments
- Demolition of any structures (not envisaged)

4.3.3.1 Soil Erosion Impact

Every care has to be taken to avoid damage to the top soil. It has to be preserved and utilized. Problems could arise from dumping of construction spoils (Concrete, bricks) waste materials (from contractor camps) etc causing surface and ground water pollution. However, it is proposed to have mix concrete directly from batching plant for use at site.

4.3.3.2Traffic Coordination issues

During construction period, partial traffic diversions on road will be required. Traffic would not get affected on the Highway but on service roads. Advance traffic updates/ information on communication systems will be an advantage to users of affected roads.

4.3.3.3 Risk to Existing Building

The proposed project does not pose any serious risk to existing buildings since there is safe distance between buildings andproject

4.3.3.4Excavated Soil Disposal

The proposed project is on plain area and thus the excavation would be limited to piers and their piling.

The soil would be used for refilling at station site. If there would be some residual soil, it would be utilized by MMRDA for internal use for refilling Depot sites and, if surplus, it would be disposed off at designated locations as per Mumbai Authority directions.

4.3.3.5Air pollution due to Dust Emission

During construction phase incremental air quality levels (Suspended Particulate Matter) will be observed as per the routine experience during any such construction activity.

Transportation of earth and establishment of the material will involve use of heavy machinery like compactors, rollers, water tankers, and dumpers. This activity is machinery intensive resulting in dust generation. However, this activity will be only short-term. Protective measures shall be undertaken during construction phase. Movement of trucks and other heavy equipments at construction site would generate dust during construction phase. With the development of the activity the major issues related with ambient air quality will be the construction activity including access roads, movements of construction vehicles and whereas post-construction activity will have movement of vehicular traffic. All the measure will be taken to avoid any deviations in the existing air quality by adopting scientific methods, which includes mandatory

EURO II certification to construction vehicles, dust entrapment, water sprinkling, etc. Emission from above sources will have temporary but not significant impact on air quality.

Deterioration in ambient air quality during construction stage is expected to occur due to the transportation of material required for construction, various construction activities, vehicular emissions etc. But it will be kept below existing background levels.

Various mitigative methods will be adopted for vehicular emissions, fugitive dust by adopting various techniques. The air quality may be slightly affected but not significantly, by the movement of vehicles at both the sides of the project.

The following measures will be taken to mitigate the dust entrainment and fugitive emissions from the various sources:

- Asphalt and hot-mix plants will not be located in the habitation areas
- Trucks carrying soil, sand or stone will be covered with traps to avoid spilling and blowing by wind from quarry to the site of construction
- Sprinkling water will control fugitive dust entrainment.
- Regular maintenance of machinery and equipment will be carried out.
- Mostly, pre-cast materials will be used for construction of bridge across river
- The pre-cast blocks will be transported to the construction sites by large trucks.
- Latest construction equipment and technologies will be used with arrangements for dust and noise control.
- Regular maintenance of equipment will be ensured.
- Construction materials required at the construction yard will be obtained from the authorised borrow areas and quarry sites and will be transported in covered trucks.

4.3.3.6Water Demand

The water demand will increase during construction phase for meeting out drinking and domestic water requirement of workers.

Sufficient water for construction purpose would be made available by MCGM as it is responsible for water supply in Mumbai. Water requirement for construction of Metro will be met through the public supply. It is suggestedto use treated STP water for the purpose of Construction. Proper

care shall be taken while drawing water from public facilities to avoid any negative impact on the residents living in the vicinity of project whose water demand is, in any case, met by Municipal Corporation of Greater Mumbai supplied water.

4.3.3.7 Supply of Construction Material

Quarry operations are independently regulated activities and outside the purview of the project proponent. It is nonetheless, appropriate to give consideration to the environmental implications in selection of quarry sources since poorly run operations create dust problems, contribute noise pollution, ignore safety of their employees, or cause the loss of natural resources. So, the construction material shall be sourced only from legalized and approved quarries.

4.3.3.8Construction and Demolition Waste Impacts (Debris)

Construction and demolition (C&D) debris is defined as that part of the solid waste stream that results from land clearing and excavation, and the construction, demolition, remodeling and repair of structures, roads and utilities. C&D waste includes concrete, stones and dirt generated during excavation (sometimes collectively referred to as "fill material" or rubble). C& D Waste may be generated from Pile caps, residual cement bags, residual steel scrap, excess construction material stacked at site etc. It is a waste stream that is separate and distinct from residential and commercial waste, commonly called municipal solid waste (msw).

4.3.3.9 Casting Yard Impacts

There would be significant movement of men, material and machinery in casting yard. Huge quantity of Cement, aggregates and other construction materials would be used in casting yard. There would be generation of dust, noise, flue gases and other contaminants from the working of heavy machinery for handling and transporting the construction materials. Proper mitigation measures will be adopted to minimize environmental impact like,

- The Contractor shall submit make arrangements to control dust pollution through provision of windscreens, sprinklers, and dust encapsulation.

- In Casting Yard Areas within the Site where there is a regular movement of vehicles, hard surface is provided that is kept clear of loose surface material so that dust emission due to vehicular movement can be reduced.
- Dust collector is used at to reduce fugitive cement dust generation and air pollution.
- Water sprinkling on aggregate at site, water is sprinkled on aggregate so as to avoid the generation of dust and particulate matter.
- The casting yard will be barricaded and made as a compulsory PPE zone
- The drainages (temporary/permanent) shall be periodically maintained to remove the debris/rubble etc. so that the blockage of drainage will be cleared out and flow of wastewater will be proper to the outlet to avoid the stagnation of water in the surrounding area.
- Time office, canteen, drinking water, toilet and rest place will be suitably located for the easy access to workers. All the facilities will be properly cleaned and maintained during the entire period of operation.
- Manual handling of cement will be avoided to a larger extent. Whenever it is absolutely necessary the workmen will be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.
- Access roads and internal circulation roads will be well laid and maintained properly at all time.
- The all equipments/instruments utilized in the casting yard will be fully acoustic enclosure and the D.G. sets will be fully covered and not to be used any open generator. In case the generator more than 1 year from the manufactured date, then, the D.G. sets must undergo the monitoring in line with the noise emission/air emission.
- The waste generated in different types like recyclable / biodegradable / hazardous / biomedical etc. shall be segregated at source for the effective waste management system.
- The general housekeeping and environmental sanitation to be adopted by all means throughout project tenure for the aesthetic point of view.

4.3.3.10 Noise Levels

The noise pollution will be generated by construction activities, mainly due to digging, piling etc. and also due to the construction equipments if they are not in maintained condition. Also during such activities if existing vehicular traffic is not properly diverted then congestion and then continuous honking habits will also lead to incremental noise levels which are of indirect nature. This will also pave way for vehicular air pollution which is also to be minimized effectively.

Noise due to operation of construction equipments

The major sources of noise during construction phase are due to operation of various construction equipments. The noise levels generated by various construction equipments are given in **Table 4.2.**

TABLE 4.2: AVERAGE NOISE LEVELS GENERATED BY THE OPERATION OF VARIOUS CONSTRUCTION EQUIPMENTS

Equipment	Noise level (dB(A))
Floating pontoon with mixer machine and crane	70
Winch machine	80
Transit mixer	75
Dumpers	75
Generators	85
Batching plant	90
Dredger	85
Booster pumps	85

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that equipment required during construction phase is operating at a common point. Likewise, to predict the worst case scenario, attenuation due to various factors too has not been considered during noise modeling.

It is a known fact that there is a reduction in noise level as the sound wave passes through a barrier. Walls of various houses or other structure will attenuate at least 30 dB (A) of noise. In addition there is noise attenuation due to the following factors.

- Air absorption

- Rain
- Atmospheric in-homogeneities
- Vegetal cover

Thus, no increases in noise levels are anticipated as a result of various activities, during the project construction phase due to the following:

- Assumption that all equipment are operating from a common point leads to over-estimation of increase in noise level
- Attenuation of 30 dB(A) of noise by wall of any structure
- Noise attenuation due to various factors.

Noise due to increased vehicular movement

During construction phase, there will be significant increase in vehicular movement for transportation of construction material. At present, there is no vehicular movement near the barrage site. During construction phase, the increase in vehicular movement is expected to increase up to a maximum of 5 to 6 trucks/hour.

TABLE 4.3: INCREASE IN NOISE LEVELS DUE TO INCREASED VEHICULAR MOVEMENT

Distance (m)	Ambient noise level dB (A)	Increase in noise level due to increased vehicular movement dB (A)	Noise levels due to increased vehicular movement dB (A)	Increase in ambient noise level due to increased vehicular movement dB (A)
10	36	72	72	60
20	36	67	67	55
50	36	61	61	49
100	36	57	57	45
200	36	52	52	40
500	36	46	47	35
1000	36	42	44	31

As mentioned earlier, there will be significant attenuation due to various factors, e.g. absorption by construction material, air absorption, atmospheric inhomogeneties, and vegetal cover. Thus, no significant impact on this account is anticipated.

Noise generated due to drilling

The noise levels monitored at a 10 m distance from the source and operator's cabin is given in the **Table 4.4.**

TABLE 4.4: NOISE GENERATED DUE TO DRILLING

Equipment	Noise level at source dB (A)
Standing idle (inside cabin)	70-72
Standing idle (10 m radius)	72-74
On load (inside cabin)	78-80
On load (10 m radius)	82-84

The noise levels during various construction activities have been compared to various standards prescribed by Occupational Safety and Health Administration (OSHA), which are being implemented in our country through rules framed under Factories Act. For 8 hour duration, equivalent noise level exposure should be less than 90 dB (A).

Impacts of noise on labour

The effect of high noise levels on the operating personnel has to be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90 dB(A) affects the hearing acuity of the workers/operators and hence, should be avoided. To prevent these effects, it has been recommended by Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons is limited (**Table 4.5**).

TABLE 4.5: MAXIMUM EXPOSURE PERIODS SPECIFIED BY OSHA

Maximum equivalent continuous Noise level dB(A)	Unprotected exposure period per day for 8 hrs/day and 5 days/week
90	8
95	4
100	2
105	1
110	½
115	¼
120	No exposure permitted at or above this level

4.3.3.11 Loss of Historical and Cultural Monuments

No historical/ cultural monuments will be lost as a result of the proposed development.

4.3.3.12Impacts due to Labour Camps

Health risks include disease hazards due to lack of sanitation facilities in labour camps (water supply and human waste disposal) and insect vector disease hazards of local workers and disease hazards to the local population.

Mitigation measures should include proper water supply, sanitation, drainage, health care and human waste disposal facilities. In addition to these, efforts need to be made to avoid water spills, adopt disease control measures and employment of local labour. Problems could arise due to difference in customs of workers from outside and local residents. These risks could be reduced by providing adequate facilities in worker's camps, raising awareness amongst workers and by employment of preferably local labour.

4.3.4 IMPACTS DUE TO PROJECT OPERATION

Along with many positive impacts, the project may cause the following negative impacts during operation of the project due to the increase in the number of passengers and trains at the stations:

- Noise Pollution,
- Water Pollution,
- Air Pollution
- Solid waste generation,
- Aesthetics

4.3.4.1 Noise Pollution

Operation phase is extremely important from two important environmental issues viz. noise levels and vibration levels. There is no noise pollution envisaged during operational phase.

4.3.4.2 Water Pollution

The proposed project does not involve any water body and hence there is no water pollution envisaged during operational phase.

4.3.4.3Air Pollution

The proposed construction of piers after completion does not involve any air emissions and hence there is no air pollution envisaged during operational phase.

The proposed Casting Yard may involve air pollutants emission during operational phase. Though, air quality may not be further deteriorated after development of this project. By proper monitoring periodically ambient air quality at selected sites shall be maintained.

4.3.4.4 Solid Waste Generation

The collection and removal of refuse from stations in a sanitary manner is of great importance. There is no solid waste generation envisaged during operational phase.

4.3.4.5 Aesthetics

The introduction of Metro spur line implies a change in streets. An architecturally well designed elevated section can be pleasing to the eyes of beholders. Recent metro projects have attempted to incorporate this objective in their designs. Since a low profile would cause the least intrusion, the basic elevated section has been optimised at this stage itself.

4.3.5 IMPACTS DUE TO DEPOT

One CarshedDepot is proposed at Mogharpada. The depot will have following facilities:

- Washing Lines,
- Operation and Maintenance Lines,
- Workshop, and
- Offices.

These facilities will could generate water and noise issues. The depot area may have to be filled up. Problems anticipated at depot sites are:

- Water supply,
- Oil Pollution,
- Cutting of trees
- Sanitation,
- Effluent Pollution,
- Noise Pollution,
- Loss of livelihood,
- Impact due to filling of area, and

- Surface drainage.

4.3.5.1 Water Requirement

Water supply will be required for different purposes in the depot. The water requirement for drinking will be 500 litre per day and 1,00,000litre per day for other requirements (Departments and Contractors office), which shall be met by MCGM Drinking water supply.

4.3.5.2 Oil spills

Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance Depot cum workshop for maintenance of rolling stock, is very common. The spilled oil should be trapped in oil and grease trap. The collected oil would be disposed off to authorised collectors, so as to avoid any underground/ surface water contamination.

4.3.5.3 Noise Pollution

The main source of noise from depot is the operation of workshop. The roughness of the contact surfaces of rail and wheels and train speed are the factors which influence the magnitude of rail - wheel noise.

The vibration of concrete structures also radiates noise. Due to less activity, no impact on the ambient noise is anticipated.

4.3.5.4 Solid Waste

At per available data, it is estimated that about 2 Ton per month of solid waste will be generated from the Depot site which will be taken by the cleaning contractor weekly and disposed to the Municipal waste disposal sites.

Sludge of the order of 250 kg/year is expected to be generated from the ETP/STP that will be stored in leak proof containers and disposed off as per State Pollution Control Board site.

Oil and grease of the order of 2652 litres/ year will be produced from the Depot which will be disposed off through approved re-cyclers.

About 2.5 ton/month of iron turning of the PWL for the wheel profiling will be generated from the Depot.

4.4 POSITIVEENVIRONMENTAL IMPACTS

Based on project particulars and existing environmental conditions, potential impacts that are likely to result from the proposed project development have been identified and wherever possible these have been quantified. This part deals with the positive impacts of the project. The introduction of the metro will also yield benefits from non-tangible parameters such as saving due to equivalent reduction in road construction and maintenance, vehicle operating costs, less atmospheric air pollution and socio-economic benefits of travel time, better accessibility, better comfort and quality of life. However, all benefits cannot be evaluated in financial terms due to non-availability of universally accepted norms. The parameters such as economic growth, improvement in quality of life, reduction in public health problems due to reduction in pollution, etc. have not been quantified.

Some of the potential positive impacts expected from the project are:

- Improved Aesthetics
- Opportunities for locals for better employment
- Enhancement of economy
- Mobility, Safety and reduced accidents;
- Traffic Congestion Reduction;
- Reduced Fuel Consumption;
- Reduced air Pollution;
- Carbon Credits;
- Improvement of Quality of Life

4.4.1 Improved Aesthetics

The introduction of metro implies a change in streets through which it will operate. An architecturally well designed elevated section can be pleasing to the eyes of beholders. Recent metro projects have attempted to incorporate this objective in their designs. Since a low profile would cause the least intrusion, the basic elevated section has been optimised at this stage itself.

4.4.2 Increased Employment Opportunities

The project is likely to be completed in a period of about 1 year. During this period manpower will be needed to take part in various activities. Thus the project would provide substantial direct employment. Besides, more people would be indirectly employed in allied activities and trades.

4.4.3 Enhancement of Economy

The proposed transport facility of MMRDA will facilitate sub-urban population to move quickly from Mumbai to Thane city. With the development of Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh corridor, it is likely that more people will be involved in trade, commerce and allied services. MMRDA will, however, make it convenient for more people to move in the present suburban areas.

4.4.4 Mobility Safety and Reduced Accidents

The metro network increases the mobility of people at faster rate. The proposed corridor will provide more people connectivity to other parts of the city. Metro journey is safe and result and reduced accidents on roads.

4.4.5 Traffic Congestion Reduction

To meet the forecast transport demand in the year 2026, it is estimated that the number of buses will have to be more. During this period personalised vehicles may also grow. Together, they will compound the existing problems of congestion and delay. The proposed development will reduce journey time and hence congestion and delay.

4.4.6 Reduced Fuel Consumption

On implementation of the project, it is estimated that both petrol and diesel consumption will get reduced. The saving will be due to two factors namely Reduction in vehicles and decongestion on roads.

4.4.7 Reduced Air Pollution

Based on available data and assumptions, an attempt has been made to model the air quality scenario for future using Asian Development Bank's "Transport Emissions Model". On the basis of above referred assumptions, daily reduction of pollutants would be as given in Table 4.6.

TABLE 4.6:DAILY REDUCTION OF POLLUTANTS

Sr.	Pollutant	Daily reduction (in kg)
1	CO	8993.946
2	CO_2	421770.57
3	NOx	1184.261
4	VOC	1077.404
5	Particulates	21.156
6	SO_2	52.07

4.4.8 Carbon Credits

Due to savings in fuel and reduction in air pollution etc. carbon credit would be generated during operation of the metro rail similar to the experience with Delhi Metro Rail Corporation Ltd. Each Carbon Credit represents one ton of CO_2 either removed from atmosphere or saved from being emitted. Details have been attached as follows:

- **Carbon Credit and Green House Gases (Climate Change Scenario In India):**

Delhi and Mumbai are among India's largest metropolises and are also growing very fast. Delhi had a population of approximately nine million in 1991, which has since grown to approximately 18 million and is expected to grow further to 22 million by 2021(Government of Delhi 2010). Mumbai, over the same period, has grown from approximately 12 million to 20 million. On the other hand, the distinct topographical situations of Delhi and Mumbai present differences in the way climate change is perceived in the two cities. Mumbai, being a coastal city, has certain specific concerns such as the effects of sea-level rise. The rainfall pattern of the city, when seen in conjunction with its island terrain, suggests that soil erosion, landslides and flooding are likely to intensify. By contrast, Delhi, a land-locked city, is confronted by issues such as heat-island effect, dwindling water resources, waste generation and growing demands for more energy through fuels and electricity. Being an exploratory exercise, this study chose to cast its net wide, even if a bit thinly, attempting to understand the salience of climate change through diverse voices, namely, government officials, experts, scholars, activists, non-governmental organizations (NGO), journalists, green consultants and, in Mumbai, the especially vulnerable community of fisher folk.

In the urban Indian context, the climate change conundrum gets further complicated by relative priorities around mitigation and adaptation, the former geared towards reducing the emission of

GHGs while the latter is largely about increasing the resilience against the impacts of climate change. The initial simplicity of the meanings of these two terms also extends to their interrelation. Adaptation can only remain meaningful if mitigation is worked upon robustly. Beyond this broad understanding about their meanings and relation to each other, both the terms acquire much more complexities. According to UN-Habitat (2011) mitigation is the implementation of policies to reduce greenhouse gas emissions (through reducing resource inputs and emissions per unit of output) and to enhance carbon sinks.

To date, responses have been concentrated in five sectors:

- Urban Built Environment and Design, e.g. land-use planning, regeneration, increased density to reduce mobility demand, and promote walking and cycling;
- The Built Environment, e.g. energy efficient materials and design, retrofitting, energy demand reduction;
- Transport, e.g. mass transportation, energy/fuel efficient electric cars;
- Urban Infrastructure, e.g. renewable and low carbon energy supplies, waste recycling;
- Carbon Sequestration, e.g. tree planting, carbon capture and storage. Adaptation, initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects, is described in the following key sectors:
- Infrastructure and Settlements, e.g. drainage, storm surge barriers, wetland protection;
- Water Management, e.g. storage and conservation due to expected shortage of clean water;
- Transport, e.g. improved design and safety standards;
- Energy, e.g. infrastructure strengthening, source diversification.

❖ **Kyoto Protocol**

International concern about the climate change has led to the kyoto protocol, negotiated in 1997 and came into force on 16th February, 2005. It contains legally binding emission targets for developed countries to limit or reduce greenhouse gas emission. It is an international agreement to curtail emission of green house gases (GHGs) which is responsible for global warming. Green house gas in atmosphere absorbs and emits radiations within the thermal infrared range. The 6 greenhouse gases are responsible: Carbon-di-Oxide (CO2), Methan (CH4), Nitrous Oxide (N2O), Hydrofluoro Carbons (HFCs), Per Fluoro Carbons (PFCs) and SulphurHexa fluoride

(SF6). The objective of the protocol was the stabilization of GHG concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Carbon market is the brain child of the Kyoto protocol for controlling GHG emissions. The protocol agreed 'caps' or quotas on the maximum amount of GHG for developed and developing countries. The protocol makes it mandatory for the commercial entities emitting above the permitted limit of Carbon dioxide to cut down their emissions to prescribed levels or they should buy carbon credits certificates which can be transacted in the market, or alternatively pay a charge for the emissions, which is referred to as carbon tax.

❖ **The Global Warming Potential (GWP)**

The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. It is a measure of how much energy the emissions of one ton of a gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide. The larger the GWP, the more that a given gas warms the Earth compared to carbon dioxide over that time period. The time period usually used for GWPs is 100 years. Carbon dioxide (CO_2), by definition, has a GWP of 1 regardless of the time period used, because it is the gas being used as the reference. Methane (CH_4) is estimated to have a GWP of 28-36 over 100 years. Nitrous Oxide (N_2O) has a GWP 265 times that of CO2 for a 100-year timescale. Chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), hydro chlorofluorocarbons (HCFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) are sometimes called high-GWP gases because, for a given amount of mass, they trap substantially more heat than CO_2. GWP for GHG reduced during operation of Metro are given below.

GHG	**Reduced Amount (Kg)**	**Reduced GWP**
CO_2	421770.57	421770.57
NO_x	1184.26	313828.9

4.4.9 Improvement of Quality of Life

Development of Metro rail in the city would lead to overall improvement of quality of life of local populace by virtue of availability of better transport facility at competitive rates, better road safety, reduced pollution, improved general health etc.

CHAPTER - 5
ENVIRONMENTAL MONITORING PROGRAMME

5.1 THE NEED

Monitoring is an essential component for sustainability of any developmental Project. It is an integral part of any environmental assessment process. Any Development project introduces complex inter-relationships in the project area between people, various natural resources, biota and the many developing Forces. Thus, a new environment is created. It is very difficult to predict with complete certainty the exact post-project environmental scenario; hence, monitoring of critical parameters is essential in the post-project phase.

Monitoring of environmental indicators signal potential problems and facilitate timely prompt implementation of effective remedial measures. It will also allow for validation of the assumptions and assessments made in the present study. Monitoring becomes essential to ensure that the mitigation measures planned for environmental protection function effectively during the entire period of projects Operation. The data so generated also serves as a data bank for prediction of post-project scenarios in similar projects.

Environmental monitoring during the construction phase shall comprise checking:

- Appropriate permits, certificates, authorizations and
- Compliance with the EMP and governmental regulations

This can be ensured through use of checklists for:

- Site Establishment.
- Monthly Audit.
- Site Closure.
- Environmental Management Plan implementation monitoring during the construction phase.

Monitoring Checklists are given below:

PROJECT START-UP CHECKLISTS

ENVIRONMENTAL ASPECTS	YES/NO	COMMENTS
Personnel on site are environmental aware of various issues of interest		
Telephone numbers of emergency services are available on site		
Solid waste management system has been established at both construction site and labor camp		
Wastewater management system has been establish at both construction site and labor camp		
Necessary firefighting equipment is available and in good working order.		

Weekly Checklists

ENVIRONMENTAL ASPECTS	YES/NO	COMMENTS
Construction camp is neat and tidy and the laborers facilities are of the acceptable standard.		
Waste collection and removal system is being monitored.		
Sufficient firefighting equipment is available at the construction site and is in good working order.		
All construction vehicles are in good working order and have a valid PUC certificates.		
Dust control measures (wherever necessary) are in place and are in working efficiently.		

Noise control measures (wherever necessary) are in place and are effective in controlling erosion.		
Erosion control measures (wherever necessary) are in place and effective in controlling erosion.		

Monthly Checklists:

ENVIRONMENTAL ASPECTS	YES/NO	COMMENTS
Environmental Management is reviewed in the monthly review project review meeting at site.		
All new personnel on site are imparted training on Environmental Awareness.		
Construction activities are undertaken according to the approved method statements.		
Fuel flammable material storage areas comply with general fire safety requirements.		
Public complaints have been recorded and dealt with the satisfactory manner.		

Site Closure Checklist:

ENVIRONMENTAL ASPECTS	YES/NO	COMMENTS
Contractor has cleared everything not forming the part of the permanent works.		
Re-vegetation has been satisfactorily completed.		
All areas disturbed during		

construction have been brought back to the near original condition in accordance with the conditions.		

5.2 AREAS OF CONCERN

From the monitoring point of view, the important parameters are resettlement and rehabilitation of project-affected persons, marine water quality, ambient air quality, noise, etc. An attempt is made to establish early warning system, which indicates the stress on the environment, suggested monitoring parameters and programmers are described in the subsequent sections.

5.3 WATER QUALITY

The chemical characteristics of the water quality should be monitored as well as the biological, parameters. Both surface and bottom water should be sampled and analyzed. The parameters to be monitored are as follows:

Water Quality

Physico-Chemical Parameters	Inorganic Parameters	Biological Parameters
Colour	Chlorides	Total Coliform MPN/100 ml
Turbidity	Fluorides	
pH value	Phosphate as PO4	
Suspended Solids	Sulphate as SO4	
Dissolved Solids	Nitrate as NO3	
	Total Hardness	
	Calcium as Ca	
	Magnesium as Mg^{-}	
	Manganese as Mn^{-2}	

5.4 SOIL QUALITY

The soil sample is collected in and around the site to establish the baseline characteristics of the study area. Soil sample is collected using the auger from the depth of 60 cm from the project site.

Soil sample collected from the project site is analyzed for the physical and chemical characteristics and is reported.

5.5 AMBIENT AIR QUALITY

Construction Phase

Ambient air quality monitoring is recommended to be monitored at 8stations close to the construction sites. The monitoring can be conducted for one season. Monitoring can be conducted twice a week for 4 consecutive weeks. The parameters to be monitored are PM_{10}, $PM_{2.5}$, $S0_2$ and $NO_{x.}$

Operation phase

Micrometeorology

An essential part of air quality monitoring would be to establish a small automatic Meteorological observation station to record daily continuous synoptic data. Arrangements for recording temperature, humidity, visibility, wind direction and speed, cloud cover, rainfall and meteorological phenomena like storms would be required to be established at the terminal site. The ambient air quality monitoring will have to be conducted at 6 locations; Air quality could be monitored for one season. High volume samplers can be used for this purpose. The frequency of monitoring shall be twice a week for 24 hours for four consecutive weeks. The parameters to be monitored are PM_{10}, $PM_{2.5}$, SO2 and NOx. The ambient air quality monitoring during project Operation phase can be carried out by project staff. Sufficient provision has been earmarked for purchase of monitoring of: Ambient air quality and micro- meteorological instruments and equipments

5.6 NOISE

Personnel involved in the work areas, where high noise levels are likely to be observed during project construction and operation phases. For such in-plant personnel, audiometric examination should be arranged at least once per year

The project staff arid a noise meter can be purchased will carry out the noise level monitoring during construction and operation phases.

Neighborhood (up to radius of 1 km)

It is recommended that during project operation phase, monitoring of sensitive areas like schools and Medicare centers be conducted within a distance of 1 km radius of the site to ascertain noise levels at receptors.

5.7 BIOLOGICAL ENVIRONMENT

The ecological survey was carried out to establish the baseline ecological conditions of the region. The list of flora and fauna found in the study area is to be given.

Sites of greenbelt development should be monitored once in every month during Project operation phase to study the growth of various species and to identify the needs if any, such; as for irrigation, fertilizer dosing, pesticides, etc. Project staff can conduct monitoring.

5.8 SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME

The summary of Environmental Monitoring Programme for implementation during Project construction and operation phases is given in Tables-5.1

TABLE 5.1

THE SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME FOR IMPLEMENTATION DURING PROJECT CONSTRUCTION AND OPERATION PHASE

Sr. No.	Aspects	Parameters to be monitored	Frequency of monitoring	Location
1.	Water			
	Physical Parameters	Colour, Turbidity, pH value, Suspended Solids, Dissolved Solids.	Once in three months	3 to 4sites
	Inorganic Parameters	Chloride, Fluoride, Phosphate, Sulphates, Nitrates, Total Hardness, Calcium, Magnesium, Total Iron, Dissolved Iron, Manganese	Once a year	3 to 4sites
	Biological	Total Coliform	Once in a year	3 to 4 sites

	parameters	MPN/100 ml.		
2.	Ambient air quality	SPM, RPM, SO_2&$NO_{x,}$ CO	Summer, post monsoon & winter seasons Twice a week for four consecutive weeks per season	Close to major construction sites
3.	Ambient Noise Quality.	Equivalent noise Levels	During peak construction activities	Construction sites
4.	Greenbelt Development	Rate of Survival and Growth Of Various Species	Once per Month	Various plankton sites

CHAPTER 6

DISASTER MANAGEMENT PLAN

6.1 DISASTER MANAGEMENT PLAN

Disasters are Events usually characterized by negative given impact and exceptional demands for intervention are inevitable. Impact can be substantially reduced the by adequate response, early warning and disaster responses. Disaster Management encompasses out aspects of planning for and responding to disasters and risks including hazard analysis vulnerability reduction (preparedness) prevention, mitigation, response, recovery and rehabilitation. Contingency planning relates to events, which major may not occur and potential responses put in place to prevent or respond to an emergency situation. It applies to management of both risks and consequences of disasters.

Mitigation is action to reduce the consequences of disasters while it may not be possible to prevent disasters, the effects can be modified or a reduced if appropriate steps are taken. Responses can be divided early and late phases. Early responses are rescuing a relief whereas later responses are Rehabilitation and Reconstruction. The first people respond to any disaster are communities/ institution themselves. There resourcefulness is the key to disaster mitigation.

Thus there is inter- connection between Disaster Management and sustainable development while good Disaster planning minimizes interruption to development, poor responses can divert scares resources, increase dependency and actually increase vulnerability to further disasters.

6.1.1 Disaster Management

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. The first step is to identify the causes which develop/ pose unexpected danger to the structural integrity of pier construction. The potential causes are excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These need to be looked into with care.

- Establishment of permanent Disaster Management line function assign to a senior post
- Create a **"Disaster Unit"** with full time responsibilities for Disaster Planning and management, which would include: -

- Develop and maintain a written and regularly updated Disaster Plan
- Set up and run of Disaster operation room and team that can be activated at short notice
- Establishes a central administrative data facility and functional communication network.
- Liaise and network with key officials, other departments, NGO's and with Disaster structures at all levels of Government.
- Plan / Health welfare scenario for likely or predictable Disasters.
- Train and evaluate for Disaster readiness and advocate for prevention especially reduction in vulnerability and risks.

6.1.2 Preparedness for Disaster Management

Being a technologically complex system with a new set of staff, intensive mock drills for the staff concerned is very essential to train them to become fully conversant with the actions required to be taken up while handling emergencies. They will be trained in appropriate communication skills while addressing passengers during incident management to assure them about their wellbeing seeking their cooperation. Since learning can only be perfected by 'doing' the following Mock Drills:

i. Fire Drill
ii. Drill for use of rescue & relief
iii. Hot line telephone communication with state disaster management authority.

6.1.3 Need for Disaster Management Measures

Disaster brings about sudden and immense misery to humanity and disruptions to normal human life in established social and economic patterns. It has the potential to cause large scale human suffering. There is a need to provide efficient disaster management plan to tackle above mentioned emergency situations at metro system.

The main objectives of Disaster Management Measures are as follows:

i. Save life and alleviate the sufferings.
ii. Provide help to stranded people and arrange their prompt evacuation.
iii. Instil a sense of security amongst all concerned by providing accurate information.
iv. Protect project property.
v. Expedite restoration of operations as early as possible.

vi. Lay down the actions required to be taken by staff in the event of a disaster in order to ensure prompt handling of crisis situation in a coordinated manner.

vii. To ensure that all officials who are responsible to deal with the situation are thoroughly conversant with their duties and responsibilities in advance. It is important that these officials and workers are adequately trained in anticipation to avoid any kind of confusion and chaos at the time of the actual situation and to enable them to discharge their responsibilities with alertness and promptness.

6.1.4 Identification and Assessment of Hazards

This stage is very crucial to both on-site as well as off-site emergency planning and requires works management systematically to identify what emergencies could arise in their plant. These would range from small events, which can be dealt with by works personnel without Outside help to the largest event for which it is practical to have a plan.

The assessment of possible incidents should produce a report indicating:

- The worst events considered;
- The route to those worst events;
- The time scale to lesser events along the way;
- The size of lesser events if their development is halted;
- The relative likelihood of events;
- The consequences of such events

6.1.5Planning During Conceptual Stage

Proper planning of a DMP at the conceptual stage, although this is also responsibility of individual industry, helps in enhancing the safety of the equipment and worker. This eventually helps to minimize the loss of life and property, which are the direct consequences of accidents. In order to achieve this, following things need to be taken into account

- Risk associated with the proposed facility
- Safety measures
- Siting of facility
- Layout of the facility

- Emergency preparedness and
- Compliance with the regulatory requirements
- Centralized control room
- LAN connecting to all safety concerns

6.1.6 Emergency planning and response procedures

Emergency rarely occurs. Therefore, activities during emergencies require coordination of higher order than for planned activities, carried out according to fixed time schedule or on a routine day-to-day basis. To effectively coordinate emergency response activities, an organizational approach to planning is required. The important areas of emergency planning are Organization, Responsibilities, Procedures, Communication and Transport, Resource Requirements and Control Centre. Developer level emergency plan requires additional planning over and above those considered under above plans, which should be properly integrated to ensure better coordination.

The emergency planning includes anticipatory action for emergency, maintenance and streamlining of emergency preparedness and ability for sudden mobilization of all forces to meet any calamity.

6.1.7 Serious Incidents Requiring Disaster Management Measures

Metro specific disasters can be classified into two broad categories e.g.: Man-made and Natural.

A. **Man Made Disaster**

i. Terrorist attack
ii. Bomb threat/ Bomb blast
iii. Hostage Situations
iv. Release of Chemical or biological gas in trains, stations or tunnels
v. Fire in depot and yard, underground/ elevated infrastructures, power stations etc.

B. **Natural Disaster**

i. Earthquakes- Mumbai has been located in Seismic zone III and can expect an earthquake of up to 6.5 magnitude on Richter scale. According to this, Mumbai lies in Zone III and would suffer moderate tremors in case of a quake.

ii. Floods- There is possibilities and incidences of flooding in Mumbai region happened during monsoon season due to heavy rains.

6.1.8 Provisions at Metro Stations/Other Installations

To prevent the emergency situation effectively, an effective system will be provided which will include Fire Detection and Suppression System, Smoke Management, Environmental Control System (ECS), Lighting System, Station Power Supply System, DG Sets & UPS, Seepage system, Water Supply and Drainage System, Sewage System, Station Area Lights and other facilities which may be deemed necessary.

The above said provisions are suggestive and an exhaustive set of facilities will be provided based on site conditions, location and other internal and external factors. The details of these activities will be taken up at project implementation stage.

The following recommendations under a series of headings:

1. Preventive Action

Once the likelihood of a disaster is suspected, action will be initiated to prevent a failure. Engineers responsible for preventive action shall identify sources of repair equipments, materials, labour and expertise for use during emergency.

2. Reporting Procedures

The level at which a situation will be termed a disaster shall be specified. This will include the stage at which the surveillance requirements should be increased both in frequency and details.

The Engineer-in-Chief will notify the officer for the following information:

- Exit points for the public,
- Safety areas in the tunnel/overhead rail, and
- Nearest medical facility

3. Communication System

An efficient communication system is absolutely essential for the success of any disaster management plan. This will be worked out in consultation with local authorities. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas will be clearly identified and provided with temporary and fool proof communication system.

There are four communication systems in the operation building;

1. **Voice:** The voice communication system will consist of telephone service from the Local Exchange Carrier (LEC) for the use of operation personnel and emergency telephone communication between motorist on the road and operation personnel.
2. **Data:**Data communications will be through a local area network (LAN) that has the ability to connect the various computer systems in the control room and the rest of the operation center together.
3. **Video:** Video communication will be through TV network which will broadcast the necessary action required in case of emergency.
4. **Radio:** Radio communication will be through radio frequency network which will broadcast the necessary action required in case of emergency.

4. **Emergency Action Committee**

To ensure coordinates action, an Emergency Action Committee will be constituted. The representative from MMRDA may be the Chairman of this Committee. The committee will comprise of:

- Station Manager concerned,
- Police Officer of the area,
- Representative of transport department,
- Home Guard representative,
- Fire Brigade representative,
- Health Department representative,
- Department of Information and Publicity, and
- Non-Governmental Organization of the area

Emergency Action Committee will prepare the evacuation plan and procedures for implementation based on local needs and facilities available. The plan will include:

- Demarcation of the areas to be evacuated with priorities,
- Safe route to be used, adequacy of transport for evacuation, and traffic control,
- Safe area and shelters,
- Security of property left behind in the evacuated areas,
- Functions and responsibilities of various members of evacuation teams, and
- Setting up of joint control room

All personnel involved in the Emergency Action Plan will be thoroughly familiar with all the elements of the plan and their responsibilities. They will be trained through drills for the Emergency Action Plan. The staff at the site will be trained for problem detection, evaluation and emergency remedial measures. Individual responsibility to handle the segments in emergency plan will be allotted.

Success of an emergency plan depends on public participation, their response to warning notifications and timely action. Public shall be educated on the hazards and key role in disaster mitigation by helping in the planned evacuation and rescue operations.

It is essential to communicate by whom and how a declared emergency will be terminated. There should be proper notification to the public on de-alert signals regarding termination of the emergency. The notification shall be clear so that the evacuees know precisely what to do when re-entering or approaching the affected areas.

6.2 EMERGENCY MEASURES

The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape etc. The aim of Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event of accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities. These are discussed in following sections.

1. Ventilation system

Depot will be provided with proper ventilation system. The windows will be opened together with the help of a remote device. This is proposed to ensure that if any kind of smoke or polluted air gathers inside the Depot, it can quickly be removed.

2. Fire Protection

The building materials will be of appropriate fire resistance standard. The fire resistance period will be at least 2 hours for surface or over head structures. Wood shall not be used for any purpose, excluding artificial wood products, which are flame resistant. The materials which have zero surface burning characteristics will be used. The electrical systems will be provided with automatic circuit breakers activated by the rise of current as well as activated by over current. The design of depot and yard will include provision for the following:

1. Fire prevention measures,
2. Safety and Security Systems

Fire Prevention and Safety Measures

Fire prevention measures will be designed and implemented to minimize the risk of outbreak of fire by appropriate choice, location and installation of various materials and equipment. In stations planning, potential sources of fire can be reduced by:

i. Fire Prevention

- Use of non-combustible or smoke retardant materials where possible,
- Rolling stock will be provided with fire retarding materials, low smoke zero halogen type electric cable will also provided,
- Provision of layout which permits ease of maintenance for equipment and cleaning of the premises,
- Provision of special storage spaces for combustible materials such as paint and oil,
- Prohibition of smoking in fire prone areas,

ii. Safety

- Automatic sprinkler/detection system will be provided if floor area exceeds 750sq. m
- One wet riser-cum-down comer per 1000 sq. m floor area with static underground storage tank, overhead tanks and pumps of suitable capacity with hydrants, first-aid reel, etc. will be provided
- Portable fire non-aqueous extinguishers of Carbon Dioxide, chemical dry powder etc. will be provided at suitable places.
- Automatic smokes venting facilities will be provided.
- The travel distance for fire escape shall not exceed 20 m where escape is available in more than one direction; the distance could be upto 40 m.

Safety & Security Systems:

The system will be designed and installed for safe transportation of people& premises safety.

Requirements:

- The system shall protect vulnerable premises from fire.
- The system shall be able to detect the unauthorized entry and exit at nominated places.
- The system shall include

1. Fire alarm system.
2. Fire Hydrant and Sprinkler System.
3. Fire Extinguishers.

A. FireAlarmSystem:

The Fire Alarm System is a fully integrated, Fire Detection & Alarm System. It includes alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, power supplies, and wiring. Its installation is restricted to designated areas at the following locations:

1. At Depot, in depot controller room.
2. Evacuation routes.
3. Equipment room.
4. Store room.
5. Any other place required.

B. Fire Hydrant System:

The entire pipeline shall be kept pressurized with water. When any of the hydrant valve opens, the pressure in the pipeline reduces drastically. Jockey pump set shall normally keep the complete system pressurized, and enables it to cope up with the system demand, which results in further fall in pressure. The fall in pressure is sensed by the designated pressure switch, which automatically starts the main fire pump set.

Depending upon the type and sensitivity of the risk, diesel-engine power pump set should be installed having 100% standby capacity.

Fire Hydrant System comprises of the following:

- Sufficiently large water reservoir
- Fire pump sets (Main and Standby)
- Jockey pump set
- Hydrant valves
- Fire fighting hoses
- Branch pipe with nozzles

Hydrant System is proposed to be installed at following Places

- Restricted area of Depot.

C. Fire Brigade Connector:

Approved fire brigade connection, shall consist of 4 nos. of 63 mm instantaneous inlets, in a glass fronted wall box, at a suitable position on the street at convenient location to make inlets accessible. The size of the wall box shall be adequate to allow hose to connect to the inlets, after breaking glass cover if need be.

Sprinkler System: is proposed to be installed at following places

- Equipment room.
- Store room.

D. Fire Extinguishers:

Fire extinguishers form a first aid action against small and incipient fire before it develops into a major hazard. These extinguishers shall be installed in the entire public, as well as service areas where the security is necessary. These appliances should be distributed, over the entire area, so that its users do not have to travel more than 15 m to reach the appliance. These appliances can be mounted or hanged on the wall at desired location.

E. Access for Fireman

A secondary access to the station, not used by passengers for evacuation, will be available to fireman should the need arise. The entry point will be easily accessible from the road. Access will be available to all levels of the station. The minimum width of the stairs is 1.0 m and maximum height will not exceed 25 cm.

6.3 VARIOUS SCENARIOS OF RISKS AND DISASTER IN THE PROJECT

6.3.1 SCENARIO 1: Evacuation of People

Communication system plays an important role, which will be available on the depot and Yard. Early response such as rescue and relief by the rescue team by means of life savings boat shall be expected to commence immediately. These rescued passengers shall be brought on the creek and given first Aid by paramedics and to avoid further consequences they will be taken nearby hospital.

6.3.2 SCENARIO 2: Accidents

The major risk involved in this type of Disaster fatal or high degree of injury. Early response will be in terms of well equipped ambulance with paramedical team reaching on the site. This will help in rescue of passengers from the accident site and will be taken to the nearest

hospital. If need so arises the patient can be taken to one of the major and super specialty hospital in the area.

6.3.3 SCENARIO 3: Spillage and Leakages of Oil

This Disaster can occur during a leak or spillages of oil or fuel carrying tankers met with an accident. The major risk involved in this includes danger of skidding of other vehicles due to spillages. The early response in this case will be stoppage of vehicular movement immediately by using communication system and towing the damaged vehicle in order to make traffic easier. The clean- up procedure is of immense importance in order to avoid further hazards and consequences.

Figure 6.1: DMP FOR MEDICAL SAFETY SCENARIO

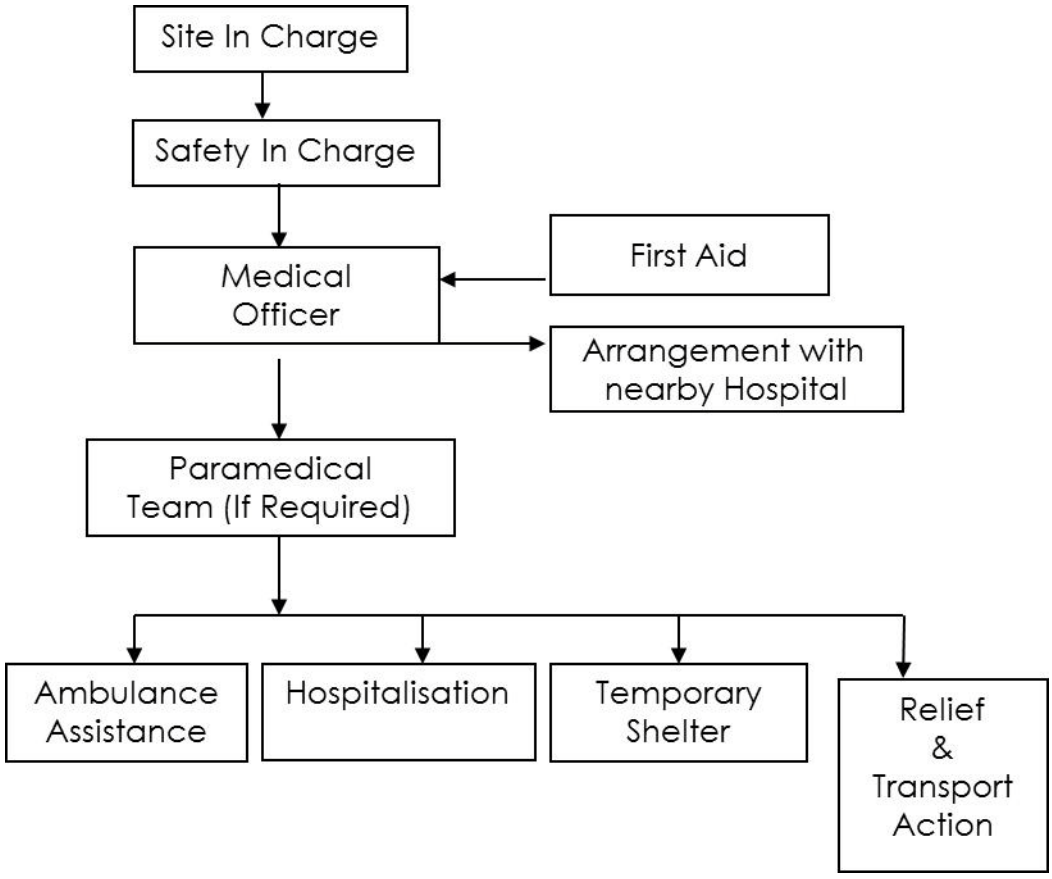
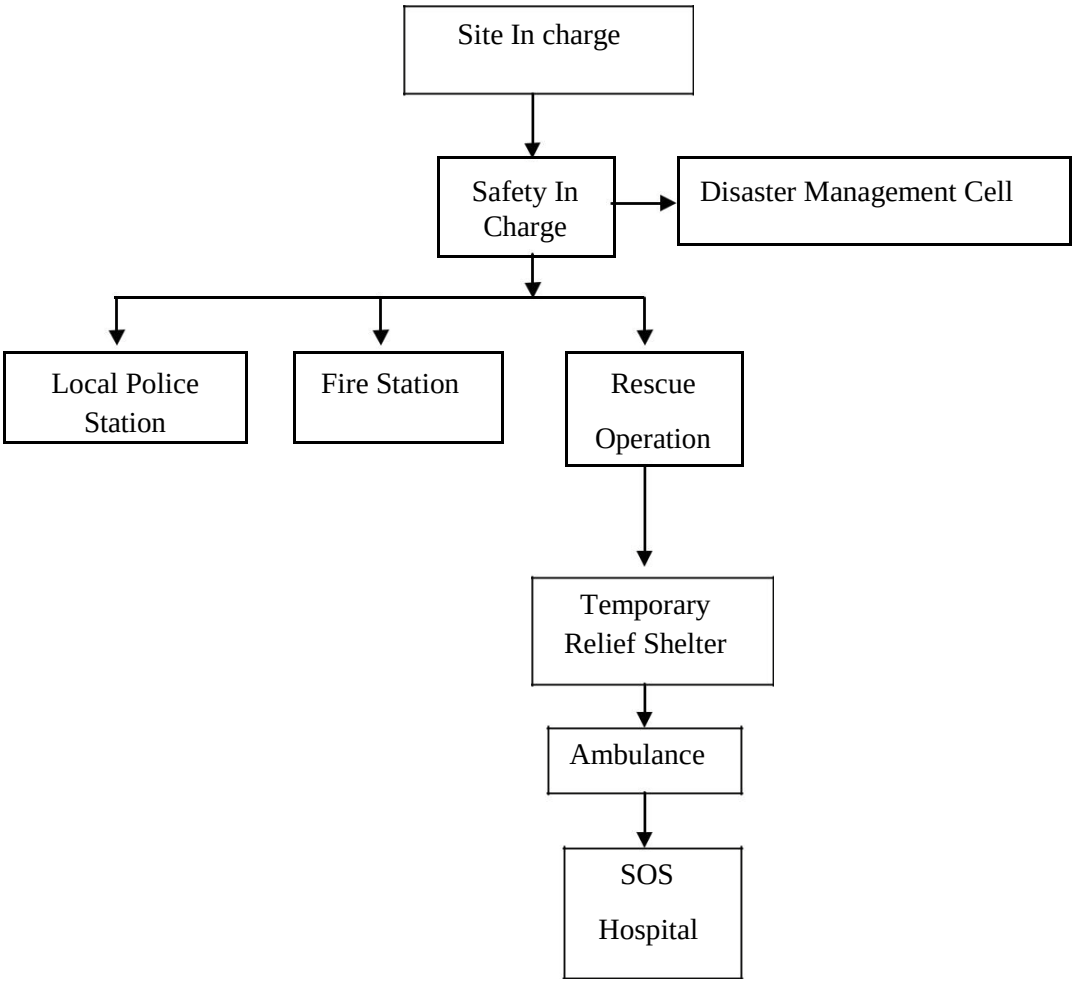


Figure 6.2: SCENARIO: ACCIDENT



CHAPTER 7
PROJECT BENEFITS

7.1 INTRODUCTION

Transport plays a very important role in development of an economy. Transport is nothing but a means used to move people and commodities along with livestock from one place to the other. Transport is an integral part of infrastructure of any country, more so a developing economy. In a developing economy it is necessary that transport becomes developed as it helps people to look out for jobs within far and wide areas of city. Transport helps people and goods and services to be relocated from one place to the other. Transport also helps to safeguard the boundaries of a country from the neighboring countries. Transport has evolved over a period of time. Since Economic liberalization of India in 1991, transport has occupied a significant importance. Transport facilities available to people can be classified in to Public transport and Private transport.

Public transport systems in Mumbai include the Mumbai Suburban railway, Monorail, Metro, Brihanmumbai Electric Supply and Transport (BEST) buses, black-and-yellow meter taxis, auto rickshaws and ferries. Suburban railway and BEST bus services together accounted for about 88% of the passenger traffic in 2008. Auto rickshaws are allowed to operate only in the suburban areas of Mumbai, while taxis are allowed to operate throughout Mumbai, but generally operate in South Mumbai.

While in Thane city, the public transport include Thane Municipal Transport (TMT) buses, Thane-Nerul-Panvel local train, uto rickshaws, taxi. Taxis and rickshaws in Mumbai are required by law to run on compressed natural gas (CNG), and are a convenient, economical, and easily available means of transport.

7.2 BACKGROUND OF THE PROJECT

With the widening gap between the available amenities and Infrastructure and the humongous requirement of such facilities for the ever increasing population, Transport Infrastructure Development has become the biggest challenge for the Mumbai Metropolitan Development Authority (MMRDA). Adoption of the land use policies proposed by MMRDA for the development of the region will arrest further deterioration of the urban environment and will

facilitate a sustainable Development and growth. To tackle the problem of traffic congestion, MMRDA has proposed Mumbai Metro Line – 4 corridors which will save the time required by the commuters to travel from Mumbai city to Thane.

The metro corridor Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh is having total length of 34.98 km and will provide connectivity between Mumbai and thane cities. The project area also includes two car depots one at Vikhroli and other at Bhayanderpada in addition to viaduct and station area. Total 34 stations are to be constructed on this metro alignment. Entire corridor will be elevated. Metro 4 was initially planned from Wadala to Kasawadawali. The cost was pegged at Rs 14,549 crore. Later, MMRDA extended it to Gaimukh in Thane and to GPO on the southern side in Mumbai.

The alignment Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh lies between the $19^{o}01'33.95"$N, $72^{o}52'38.36"$E and $19^{o}17'06.42"$N, $72^{o}56'31.22"$E. Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh corridor of Mumbai Metro Project is proposed to start at Bhakti Park, wadala, F-North ward. The alignment then passes through LBS road, Eastern Express Highway and then through Ghodbunder raod and ends at Gaimukh. Government has accorded sanction to above metro project and declared the project as **"Public Project of Urgency and Vital Urban Transport Project".** MMRDA is the "Special Planning Authority" for Metro Line-4 project.

MMRDA has taken up expeditious implementation of 376 KM network of Metro corridors within upcoming 5 to 10 years in Mumbai region. Vide GR dated 25/11/2016 State Government has approved Metro Line-4 corridor (Wadala-Ghatkopar-Mulund-Thane-Kasarvadavali) (32.32 km). Vide GR dated 25/11/2016 State Government has approved Metro Line-4 corridor (Wadala-Ghatkopar-Mulund-Thane-Kasarvadavali) (32.32 km). Vide GR dated 24/01/2019, State Government has also approved Metro Line-4A project (Kasarwadavali – Gaimukh) (2.66 km). Metro Line-4A project will reduce the traffic congestion in Thane- Ghodbandar road and surrounding area.

For such a wide network, MMRDA proposed

- Construction of 20 piers of approach road and Metro spur line to Mogharpada carshed depot at survey nos. 30 (pt), 27 (pt), 28 (pt) & 29(pt) of village Mogharpada. Total area for Metro Car Shed is proposed to be 27.50 ha. There is existing 40m wide road near to the proposed depot at a distance of approx. 200m. Connecting this road, 25m wide elevated approach road with Metro spur line is proposed which crosses the nala having

width of 20 m affected in CRZ area. The piers are located in CRZ-II and not affected by mangroves/ 50m mangroves buffer zone as per approved CZMP

- Construction of casting yard at Survey No. 311, 312, 313, 314 & 267/15 of village Kavesar. Total area for casting yard is proposed to be 7.72 ha of which 6.31 ha area falls under CRZ II area. The said plot will be utilized temporarily for construction of pre-cast girders required for Metro projects. It is falling on landward side of an existing road. Casting yard will have following activities:

    - Site Office
    - RMC Plant & QC Lab
    - Reinforcement fabrication yard
    - Epoxy coating plant
    - Segment stacking yard
    - Other allied activities for functioning of casting yard.

7.3 NEED OF PROJECT:

Transportation being the most vital element that effect normal life in Mumbai, any deficiency, in the infrastructure related to Transportation, seriously affects the productivity and economic growth of the city. Car-besotted and flyover-obsessed Mumbai needs an alternate transport system which will be greener, safer, faster and non-polluting-in other words people friendly and environment friendly. As sufficient and timely investment was not made in the past on the development of an efficient alternate transport infrastructure, the presently available network of Suburban Railways and the Road Transport System been stretched to the crisis levels. In order to effectively augment the present Transport Systems MMRDA has conceived the idea of Metro Railway Network. According to MMRDA's estimates, the corridor, passing through Rafi Ahmed Kidwai Marg and PD'Mello Road, will cater to 7 lakh passengers a day, making it one of the busiest Metro. Once completed, Metro 4 will take away a huge load from the central local railway and will also connect Wadala with central suburbs and the island city. With the state government giving rights to MMRDA to develop Wadala as the next business district, this infrastructure would be a must.

7.4 BENEFITS OF METRO RAILWAY SYSTEM

The benefits of the project can be divided into tangible & intangible benefits. The tangible benefits are technical benefits while intangible benefits include the environmental & economic benefits.

7.4.1 Technical Benefits:

i. Higher carrying capacity (50 seat + 325 standing = 375 per standard Coach) compared to road transport. (Equivalent to 7 lanes of bus traffic or 24 lanes of motor car traffic)
ii. Higher speed (maximum speed of 80km/hr irrespective of normal time or peak time compared to bus and other road traffic which literally snarls during peak time.)
iii. Smooth ride as it is not affected by other vehicles, pedestrians etc. (Travel in jam packed buses is very rough.)
iv. Safer compared to road transport in Mumbai where road accident rate is very high.
v. Occupies less land space as the Metro runs on elevated tracks which are supported on pillars; each pillar occupying a ground space of approximately 2M x 2M only.
vi. Elevated Metro Rail occupies only 2M width of the road space.
vii. No gaseous, liquid or solid pollution as the Metro railway is run on clean energy viz. electricity which does not emit any pollutant during the operation.
viii. Lower noise pollution compared to equivalent capacity of road transport. (By virtue of the state of the art technology applied for construction of the coaches and the track and by virtue of high elevation of the track (>7M) the noise nuisance caused by the Metro is far less compared to the road transport. (Noise levels of the modern Metro Rail Coaches and the track at the source is expected to be < 60 dB (A).
ix. Energy efficient (energy consumption per passenger km is only 20% of the energy consumed by the road based transport system).
x. Lower journey time (lower by 50-70% of the time taken by road traffic, depending on road conditions).

7.4.2 Environmental Benefits:

- Environmental benefits cannot be measured by a tool directly but can be subjectively visualized. Provision of metro lines along any busy corridor would help to reduce congestion on the road.

- Similarly on this section, seamless traffic movement could be achieved for all the vehicles.
- This would help to reduce the consumption of fuel due to lesser interruptions and optimum travel speed.
- Also, due to reduced congestion, noise pollution as well as air pollution in the surrounding areas can be diminished.

7.4.3 Economic Benefits:

- The improved speed of traveling will create substantial savings in fuel consumption.
- Fuel savings are significant for individual as well as the country as a whole.
- The improved access towards high traffic areas will also appreciate use of adjoining plots and economic activities will increase.

CHAPTER 8
ENVIRONMENTAL MANAGEMENT PLAN

8.1 INTRODUCTION

Impact assessment helps in identifying potentially damaging aspects of a proposed project. Based on the findings of the impact assessment, Environment Management Plan is devised to minimize adverse impacts and enumerated various steps to be taken for improvement of the environment.

However due to no major adverse impact on the Air, Water, Land, Biological Environment due to the project, the Environment Management Plan shall not be very complicated and only regular Monitoring of ambient air quality, water quality, noise level monitoring and soil quality monitoring shall be carried out as per the requirements.

All persons working near the noise generation equipments shall use Personal Protective Equipment such as earplugs muffs and closely monitored for implementation. All workers should be made aware of adverse effect high noise levels through training program; this will ensure proper implementation of mitigation majors.

Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. A project may have identified proper mitigation measures but without a management plan to execute it, the desired results may not be obtained. The present chapter on Environment Management Plan envisages proper implementation of mitigation measures to reduce the adverse impacts arising out of the project activities.

The following issues have been addressed in this EMP:

1. Mitigation measures for abatement of the undesirable impacts caused during construction and operation stages
2. Details of management plans
3. Institutional set up for implementation of the EMP

Post project environmental monitoring programme to be undertaken after commissioning of the project

4. Expenditures for environmental protection measures.

The EMP is proactive in nature and should be upgraded if new facilities or modification of existing facilities, with environmental concerns, come up at a larger stage.

EMP included four major elements:

1. Commitment and policy: the project will strive to provide and implement the Environmental Management Plan that incorporates all issues related to air, land and water
2. Planning: this includes identification of environmental impacts, legal requirements, and setting environmental objectives. The various potential impacts are discussed under chapter 4
3. Implementation: this comprises of resources available to the developers, accountability of contractors, training of operational staff associated with environmental control facilities and documentation of measures to be taken.
4. Measurement and Evaluation: this includes monitoring, corrective actions, and record keeping.

The EMP's that will be put into place consist of those during construction and operating stages of the project and includes the following elements:

1. Hazardous and Solid Waste Management
2. Air Pollution Control and Management
3. Noise Control and Management
4. Plantation, Landscaping and Land Management
5. Occupational, Safety and Health Issues
6. Environmental Monitoring

7. Emergency Response Plans for Emergency Scenarios

8. Environmental Management System

8.2 SUMMARY OF CRITICAL IMPACTS/ ISSUES

The major impacts due to different project activities and their mitigation measures have been identified in Chapter-4. These measures together constitute part of Environmental Management Plan (EMP). Environmental study carried out by the consultants has highlighted the following critical features of the project **(Table-8.1)**.

Table- 8.1 Critical Impacts / Issues

Sr. No	Issues	Description
1.	Ambient Air Quality	During construction air and noise pollution may increase and would require mitigation.
2.	Ambient Noise Level	In the operation stage air quality and noise levels are generally expected to improve. However, measures would be taken to contain pollution due to increased vehicular traffic near the project area.
3.	Ecology	No Mangrove shall be affected. No tree cutting envisaged Marine ecology shall be impacted due to construction activities but shall soon be restored.
4.	Water Quality	During construction all the care will be taken to avoid Contamination of any water bodies.
5.	Land Use Pattern	Land use pattern will remain same after project Completion.

In the Environmental Management Plan (EMP), impact mitigation and monitoring requirements are specified and the institutional arrangements for implementation of the project identified. The EMP also includes the cost of implementing mitigation and monitoring requirements.

8.3 IDENTIFICATION OF IMPLEMENTING AUTHORITY

The responsibility for the implementation of the EMP will be with the Promoter and Contractor (P & C). An environmental management cell (EMC) will be established by the P & C for implementing the mitigative measures. To mobilize the appropriate expertise to design diverse type of mitigation measures. The P & C need to be collaborating with order institutions in the public and private sector viz. State forest Department, State Public Health Engineering Department, State Traffic Department, and State Police Department etc. The EMC will ensure timely implementation of various mitigative measures at different stages of the project i.e. during construction and operation stage and the completion of the project within scheduled time frame.

In addition, an Environmental Officer will be appointed by project authorities for management of the project with the objective of reviewing and assessing the progress made by the concession company in implementing the suggested mitigative measures

8.4 IMPLEMENTATION OF RECOMMENDED MITIGATION MEASURES

Different activities to be addressed in the management plan have been considered and discussed in detail in **Table no 8.1.** This table presents an inventory of tasks to be performed for environmental management.

The mitigation measure for the impact is made a part of proposed activities. The major instruments of environmental management will be monitoring performance of the construction by the EMC. The conditions, which must fulfilled documents, are suggested below:

1. All necessary measures and precautions will be cited so that the execution of the works and all associated operations on site or off- site are carried out in conformity with statutory and regulatory environmental requirements.

2. Necessary measures and precautions to avoid nuisance or disturbance arising from the execution of the works will be included, preferably at the source itself.

3. Wastes such as spoil or debris or silt from the sites will be immediately removed and the affected areas will be restored to their original state.

8.5 MONITORING PLAN

The regular components of monitoring and its frequency have been identified in **Table 8.3.**

The air and noise quality monitoring will be performed at the same locations where baseline monitoring was carried out.

Environment Management Cell (EMC) Constituted by the P & C will be the prime agency for monitoring all activities. Project promoters will supervise all activities and accordingly advise the P & C to improve on areas where any shortcomings are observed. The EMC will provide all the monitoring results to project promoters who will keep a record of all information and suggest suitable measures to be adopted by the Contractor if any aspect is found to be diverting from the anticipated values/ standards.

8.6 ENVIRONMENTAL TRAINING

The Environment Management Cell (EMC), in addition to implementing and monitoring different environmental attributes, will also be actively involved in imparting training and raising environmental awareness of Construction Engineers/ Contractors and other staff members/ workers so as to enable them take the environmental aspects into consideration as and when required. In the long run, the EMC can impart additional and specialized training in environmental management of the road and building construction system.

8.7 BUDGETS FOR ENVIRONMENTAL MANAGEMENT PLAN

The mitigative measures suggested in the preceding chapters forms costs related to measures incorporated into engineering design; project scheduling, site planning and preparation of tender documents. The cost on this account will be covered with the construction budget and should not be seen as items of cost for implementing Environmental Management Plan. The estimated environmental cost considered here includes:

a) During Construction phase

1. Dust suppression
2. Noise monitoring to check noise pollution for sensitive receptors like school if any.
3. Solid waste management due to construction activity.
4. Economic compensation to tree construction debris

b) During Operation phase

1. Air pollution monitoring
2. Noise monitoring
3. Water quality monitoring

The environmental cost is consists of monetary value of the mitigative measures adopted to minimize the negative impact of project on environment. Environmental cost is divided into two categories, i.e. capital cost and operation and maintenance cost. Capital cost is the cost of all the structural measures proposed for environmental protection during construction phase while the operation an maintenance cost include the cost of monitoring air, noise, soil and water and maintaining the structural measures over project life.

Table 8.2 Reporting of The Major- Parameters And Responsible Organization

Environmental Impact	Mitigation Measures Taken or To Be Taken	Time Frame	Implementing Organization		Responsible Organization
			Implement	Supervision	
	A. DESIGN PHASE				
Cultural Heritage	No Cultural Heritage in the area	---	---		---
Flood	Elevated alignment shall be well designed	During Design	Detailed Design Consultant	General Consultant	MMRDA
Inadequate design provision for safety against seismological hazard	Make sure that design provides for safety of structures against worst combination of forces in the probability of an earthquake likely to occur in seismic zone-III.	DPR and detailed design stage	Detailed Design Consultant	General Consultant	MMRDA
	PRE –CONSTRUCTION STAGE				
Water requirement	The requirement of water for construction purpose etc shall be planned and shall be arranged from available and authorized sources in order to avoid digging of Tube wells.	Pre construction stage	Contractor	General Consultant	MMRDA/EMP implementing agency
Disposal of final treated effluent from treatment plant	Options for final disposal shall be studied and the suitable disposal route shall be decided carefully to minimize the impact on receiving bodies. As far as possible zero discharge rules may be adopted.	During design stage / and pre construction of treatment plant	Contractor	General Consultant	MMRDA/EMP implementing agency
Casting Yard	These facilities to be located away from habitation. Consent to Establish and Consent to Operate to be taken from MPCB and to comply with all stipulations.	During Pre-construction Stage	Contractor	General Consultant	MMRDA/EMP implementing agency

	B. CONSTRUCTION PHASE				
Environmental Management and Monitoring	This will include institutional requirements, training, environmental management and monitoring	During and after construction	Contractor	General Consultant	MMRDA/EMP implementing agency
Dust	Water should be sprayed during construction phase, wherever it is required to avoid dust. Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.	During construction	Contractor	General Consultant	MMRDA/EMP implementing agency
Air Pollution	Vehicles and machinery are to be regularly maintained so that emissions conform to National and State AAQ Standards. No vehicle without valid PUC certificate would be allowed at Construction Sites.	Beginning with and continuing throughout construction period	Contractor	General Consultant	MMRDA/EMP implementing agency
Equipment Selection maintenance and operation	Construction plants and equipment will meet acceptable standards for emissions and will be maintained and operated in a manner that ensures that relevant air, noise, and discharge regulations are met.	During construction	Contractor	General Consultant	MMRDA/EMP implementing agency
Noise	Noise standard at processing sites, will be strictly enforced as per GOI noise standards. Workers in vicinity of strong noise will wear earplugs and their working time should be limited as a safety measure. At construction sites within 150m of sensitive receptors construction will be stopped from 22:00 to 06:00. Machinery to be provided noise barriers	Beginning and through construction	Contractor	General Consultant	MMRDA/EMP implementing agency

	(Stone walls and plantation) for silence zones including schools and hospitals.				
Vibration	The vibration level limits at work sites adjacent to the alignment shall conform to the permitted values of peak velocity as given in guidelines, if any.	Beginning and through construction	Contractor	General Consultant	MMRDA/EMP implementing agency
	• **WATER**				
Contamination from Wastes	All justifiable measures will be taken to prevent the wastewater produced in construction from entering directly into any rivers, drainage and irrigation system	Throughout construction period	Contractor	General Consultant	MMRDA/EMP implementing agency
Wastage of water	Measures shall be taken to avoid misuse of water. Construction agency shall be instructed accordingly to follow strict procedures while using the water for construction and drinking purpose.	Beginning with and continuing throughout construction	Contractor	General Consultant	MMRDA/EMP implementing agency
Sewerage disposal during construction at Service Centers	If any water source is present in alignment a minimum distance of any sewage or toilet facility should be 200 meters from it.	Throughout construction period	Contractor	General Consultant	MMRDA/EMP implementing agency
Sanitation and Waste Disposal in Construction Camps	Sufficient measures will be taken in the construction camps, i.e. provision of garbage tank and sanitation facilities. Waste in septic tanks will be cleared periodically. Drinking water will meet Indian National Standards. Garbage will be collected in a tank and	Before and during building of construction camps	Contractor	General Consultant	MMRDA/EMP implementing agency

	disposed off daily. Special attention shall be paid to the sanitary condition of camps. Camps will be located at a minimum distance of 200 m from water sources.				
	• **SOIL**				
Quarrying	Quarrying will be carried out at approved and licensed quarries only. All environmental mitigation measures shall be enforced at Quarry site also.	During construction	Contractor	General Consultant	MMRDA/EMP implementing agency
	• **FLORA AND FAUNA**				
Loss of trees and Avenue Plantation	No tree cutting envisaged	--	--	--	--
	• **SOCIAL**				
Traffic jams and congestion	If there are traffic jams during construction, measures should be taken to relieve the congestion with the co-ordination of transportation and traffic police department	During construction	Contractor	General Consultant	MMRDA/ Traffic department
Safety with vehicles, people and livestock and signage	• Safety education and fines. • Allow for adequate traffic flow around construction areas • Provide adequate signage, barriers and flag persons for safety precautions. • Communicate to the public through radio, TV & newspaper announcements	During construction	Contractor	General Consultant	MMRDA/ Traffic department

	regarding the scope and timeframe of projects, as well as certain construction activities causing disruptions or access restrictions				
	C. OPERATION PHASE				
Noise and Vibration	Suitable measures should be adopted wherever necessary. The public shall be educated about the regulations of noise and vibration pollution and its implications.	After completion of construction	MMRDA/EMP implementing agency	General Consultant	MMRDA/EMP implementing agency
	• **WATER**				
Maintenance of Storm Water Drainage System	The urban drainage systems will be periodically checked and cleared so as to ensure adequate storm water flow.	Beginning and end of monsoon	MMRDA/EMP implementing agency	General Consultant	MMRDA/EMP implementing agency
	• **SOLID WASTE**				
Solid Waste Management	Solid waste generated during operation phase will be disposed off through authorized organization.	During and after construction. Throughout the operation.	MMRDA/EMP implementing agency	General Consultant	MMRDA/EMP implementing agency

8.8 ENVIRONMENTAL MONITORING PLAN

The purpose of the monitoring programme is to ensure that the envisaged purpose of the project is achieved and results in desired benefits. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. The broad objectives are:

1. To evaluate the performance of mitigation measures proposed in the EMP
2. To evaluate the adequacy of Environmental Impact Assessment
3. To suggest improvements in management plan, if required
4. To enhance environmental quality
5. To satisfy the legal and community obligation.

8.9 PERFORMANCE INDICATORS

The physical, biological and social components identified to be particularly significant in affecting the environment at critical locations have been suggested as Performance Indicators and are listed below:

1. Air quality with respect to $PM_{2.5,}PM_{10}$, NO_x, SO_2 and CO
2. Noise levels around sensitive locations
3. Plantation success/survival rate
4. Restoration of borrow pits
5. Occupational health monitoring
6. Accident frequency

Table 8.3 Environmental Monitoring Plan

			Monitoring				Institutional responsibility	
			Standard	**Location (Chainage)**	**Frequency**	**Duration**	**Implementation**	**Supervision**
Air	Construction Stage	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, Pb	Air (Prevention and Control of Pollution) Rules, CPCB, 1994	All locations where baseline monitoring has been carried out.	During entire civil construction stage	24 hours Twice a month	Contractor	MMRDA
	Operation Stage	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, Pb	Air (Prevention and Control of Pollution) Rules, CPCB, 1994	All locations where baseline monitoring has been carried out.	Twice a week for 2 weeks in each location in every season (except monsoons)	24 hours Twice a month	BOT Operator	MMRDA
Noise	Construction Stage	Noise levels on dB (A) scale	Noise Standard by CPCB	All locations where baseline monitoring has been carried out.	During entire civil construction stage or even later	24hours Once a week	Contractor	MMRDA
	Operation Stage	Noise levels on dB (A) scale	Noise Standard by CPCB	All locations where baseline monitoring has been carried out.	Reading to be taken in one location once in a season.	Continuous 24 hours	BOT Operator	MMRDA
Soil	Construction Stage	Monitoring of Pb, oil and grease	Threshold for each contaminant set by IRIS database of USEPA until national standards are promulgated		Once in a season for 3 seasons	-	Contractor	MMRDA, through an approved monitoring agency

	Operation Stage	Monitoring of Pb, oil and grease	Threshold for each contaminant set by IRIS database of USEPA until national standards are promulgated	At an accident/spill location involving bulk transport carrying hazardous material 50 m from road centre line	Once in a season for 3 seasons (except monsoons)	-	BOT Operator	MMRDA, through an approved monitoring agency
Water	Construction Stage	Surface, Groundwater quality (IS 10500:1991)	Water standards by CPCB	All locations where baseline monitoring has been carried out.	During entire civil construction stage or even later	Once a month	Contractor	MMRDA
	Operation Stage	Surface, Groundwater quality (IS 10500:1991)	Water standards by CPCB	All locations where baseline monitoring has been carried out.	During entire civil construction stage or even later	Once a month	BOT Operator	MMRDA
Green Belt	Construction Stage	Monitoring of transplanted and newly planted trees.	-	Location selected for transplantation and newly plantation of trees.	During the construction phase	-	Contractor in consultation with Forest Department	MMRDA
	Operation Stage	Maintenance of plantation (Greenbelt)	-	Location selected for transplantation and newly plantation of trees.	Every year for 3 years	-	BOT Operator	MMRDA

The monitoring data will be compared with baseline data regularly. Mitigation measures will be implemented in case of increase in any pollution level which is likely to be negligible in this project. Continuous modeling will generate a data which can be further evaluated by respective software. Noise modeling can be conducted by taking extent of noise traveled into consideration. Further this data can be analyzed in the software like Breezsoft, DhwaniPro, soundPLAN etc. studies of Vibration will be done by transducer probe containing accelerometer. Further that data can be analyzed in software like ABRAVIBE and SpectraPLUS. GHG emission can be measured by calculating Green house gases emitted by all possible sources and then convert all obtained values in CO equivalent which will give total emissions. Measurement of the gases emitted will be assessed during the air quality monitoring.

8.10BUDGETS FOR ENVIRONMENTAL MANAGEMENT PLAN

The environmental cost is consisting of monetary value of the mitigative measures adopted to minimize the negative impact if any of project on environment. Environmental cost is divided into two categories, i.e. capital cost and operation and maintenance cost. Capital cost is the cost of all the investment measures proposed for environmental protection during construction phase while the operation and maintenance cost include the cost of running and operating of these measures such as monitoring air, noise and water and maintaining the investment measures over project life.

Table 8.4: Environment monitoring cost during Construction Phase.

Parameter	Stations	Tests	Cost (INR) (Per month)
Air	8	1. Wind speed(m/sec) 2. Wind direction 3. Relative humidity 4. PM10 5. PM2.5 6. SO_2 7. NO_x 8. NH_3	1,60,000/-
Water	4	1. pH, 2. Temperature, 3. Total dissolved solids, 4. turbidity, 5. Total hardness, 6. total alkalinity, 7. chloride, 8. Sulphate, 9. Nitrate as N, 10. fluoride, 11. sodium, 12. potassium, 13. total phosphorus, 14. BOD, COD, DO 15. Heavy metals (Cd, Zn, Ni, Cr) 16. Total coliforms, faecal coliforms	25,000/-

Noise	8	Ambient noise levels- dB(A) Leq Day Leq Night	20,000/-
	Total cost		**2,05,000.00 per month**

Table 8.5: Environment monitoring cost During Operations Phase.

Parameter	**Stations**	**Tests**	**Cost (INR) (Per month)**
Air	6	1. Wind speed(m/sec) 2. Wind direction 3. Relative humidity 4. PM10 5. PM2.5 6. SO_2 7. NO_x 8. NH_3	1,20,000/-
Water	4	1. pH, 2. Temperature, 3. Total dissolved solids, 4. turbidity, 5. Total hardness, 6. total alkalinity, 7. chloride, 8. Sulphate, 9. Nitrate as N, 10. fluoride, 11. sodium, 12. potassium, 13. total phosphorus, 14. BOD, COD, DO 15. Heavy metals (Cd, Zn, Ni, Cr) 16. Total coliforms, faecal coliforms	25,000/-
Noise	6	Ambient noise levels- dB(A) Leq Day Leq Night	12,000/-
	Total cost		**1,57,000.00 per month**

Table 8.6: Environmental Management Cost

CONSTRUCTION PHASE		
SR. No	**ITEMS**	**COST (INR) DURING CONSTRUCTION PER YEAR**
1	AIR ENVIRONMENT	12,80,000
2	WATER ENVIRONMENT	7,20,000
3	NOISE ENVIRONMENT	1,28,000
4	MOBILE STP	20,00,000
	TOTAL EMP COST	**41,28,000.00**

OPERATION PHASE		
SR. No	**ITEMS**	**COST (INR) DURING OPERATION PER YEAR**
1	AIR ENVIRONMENT	9,60,000
2	WATER ENVIRONMENT	7,20,000
3	NOISE ENVIRONMENT	1,28,000
4	DMP – (Maintenance Cost)	5,00,000
	TOTAL EMP COST	**23,08,000**

Operation and maintenance of mobile STP may cost around Rs. 40,000/- per month during construction phase.

CHAPTER 9
EXECUTIVE SUMMARY

9.1 PROJECT NAME

PROPOSED CONSTRUCTION OF 20 PIERS OF APPROACH ROAD AND METRO SPUR LINE TO MOGHARPADA CAR DEPOT AND CASTING YARD AT KAVESAR FOR METRO LINE – 4 PROJECT.

9.2 PROJECT DESCRIPTION

With the widening gap between the available amenities and Infrastructure and the humongous requirement of such facilities for the ever increasing population, Transport Infrastructure Development has become the biggest challenge for the Mumbai Metropolitan Development Authority (MMRDA). Adoption of the land use policies proposed by MMRDA for the development of the region will arrest further deterioration of the urban environment and will facilitate a sustainable Development and growth. To tackle the problem of traffic congestion, MMRDA has proposed Mumbai Metro Line – 4 corridors which will save the time required by the commuters to travel from Mumbai city to Thane. It will also reduce the air pollution and provide safe and comfortable journey to the commuters.

The metro corridor Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh is having total length of 34.98 km and will provide connectivity between Mumbai and thane cities. The project area also includes two car depots one at Vikhroli and other at Bhayanderpada in addition to viaduct and station area. Total 34 stations are to be constructed on this metro alignment. Entire corridor will be elevated. Metro 4 was initially planned from Wadala to Kasawadawali. The cost was pegged at Rs 14,549 crore. Later, MMRDA extended it to Gaimukh in Thane and to GPO on the southern side in Mumbai.

The alignment Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh lies between the $19^{o}01'33.95"N$, $72^{o}52'38.36"E$ and $19^{o}17'06.42"N$, $72^{o}56'31.22"E$. Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh corridor of Mumbai Metro Project is proposed to start at Bhakti Park, wadala, F-North ward. The alignment then passes through LBS road, Eastern Express Highway and then through Ghodbunder raod and ends at Gaimukh. Government has accorded sanction to above metro project and declared the project as **"Public Project of Urgency and Vital Urban Transport Project".** MMRDA is the "**Special Planning Authority**" for Metro Line-4 project.

MMRDA has taken up expeditious implementation of 376 KM network of Metro corridors within upcoming 5 to 10 years in Mumbai region. Vide GR dated 25/11/2016 State Government has approved

Metro Line-4 corridor (Wadala-Ghatkopar-Mulund-Thane-Kasarvadavali) (32.32 km). Vide GR dated 25/11/2016 State Government has approved Metro Line-4 corridor (Wadala-Ghatkopar-Mulund-Thane-Kasarvadavali) (32.32 km). Vide GR dated 24/01/2019, State Government has also approved Metro Line-4A project (Kasarwadavali – Gaimukh) (2.66 km). Metro Line-4A project will reduce the traffic congestion in Thane- Ghodbandar road and surrounding area.

For such a wide network, MMRDA proposed construction of;

- 20 piers of approach road and Metro spur line to Mogharpada card depot at survey nos. 30 (pt), 27 (pt), 28 (pt) & 29(pt) of village Mogharpada. Total area for Metro Car Shed is proposed to be 27.50 ha. There is existing 40m wide road near to the proposed depot at a distance of approx. 200m. Connecting this road, 25m wide elevated approach road with Metro spur line is proposed which crosses the nala having width of 20 m affected in CRZ area. The piers are located in CRZ-II and not affected by mangroves/ 50m mangroves buffer zone as per approved CZMP

- Casting yard at Survey No. 311, 312, 313, 314 & 267/15 of village Kavesar. Total area for casting yard is proposed to be 7.72 ha of which 6.31 ha area falls under CRZ II area. The said plot will be utilized temporarily for construction of pre-cast girders required for Metro projects. It is falling on landward side of an existing road. Casting yard will have following activities:
  - Site Office
  - RMC Plant & QC Lab
  - Reinforcement fabrication yard
  - Epoxy coating plant
  - Segment stacking yard
  - Other allied activities for functioning of casting yard.

9.3 NEED OF THE PROJECT

Transportation being the most vital element that effect normal life in Mumbai, any deficiency, in the infrastructure related to Transportation, seriously affects the productivity and economic growth of the city. Car-besotted and flyover-obsessed Mumbai needs an alternate transport system which will be greener, safer, faster and non-polluting-in other words people friendly and environment friendly. As sufficient and timely investment was not made in the past on the development of an efficient alternate transport

infrastructure, the presently available network of Suburban Railways and the Road Transport System been stretched to the crisis levels. In order to effectively augment the present Transport Systems MMRDA has conceived the idea of Metro Railway Network. . According to MMRDA's estimates, the corridor, passing through Rafi Ahmed Kidwai Marg and PD'Mello Road, will cater to 7 lakh passengers a day, making it one of the busiest Metro. Once completed, Metro 4 will take away a huge load from the central local railway and will also connect Wadala with central suburbs and the island city. With the state government giving rights to MMRDA to develop Wadala as the next business district, this infrastructure would be a must.

9.4 ABOUT THE PROJECT

9.4.1 Project Location

The proposed Plan showing Metro Line- 4 alignment (Wadala-Ghatkopar-Mulund-Thane-Kasarwadavali-Gaimukh); Mogharpada Depot & Casting yard at Kavesar for Metro Line-4 project in figures below

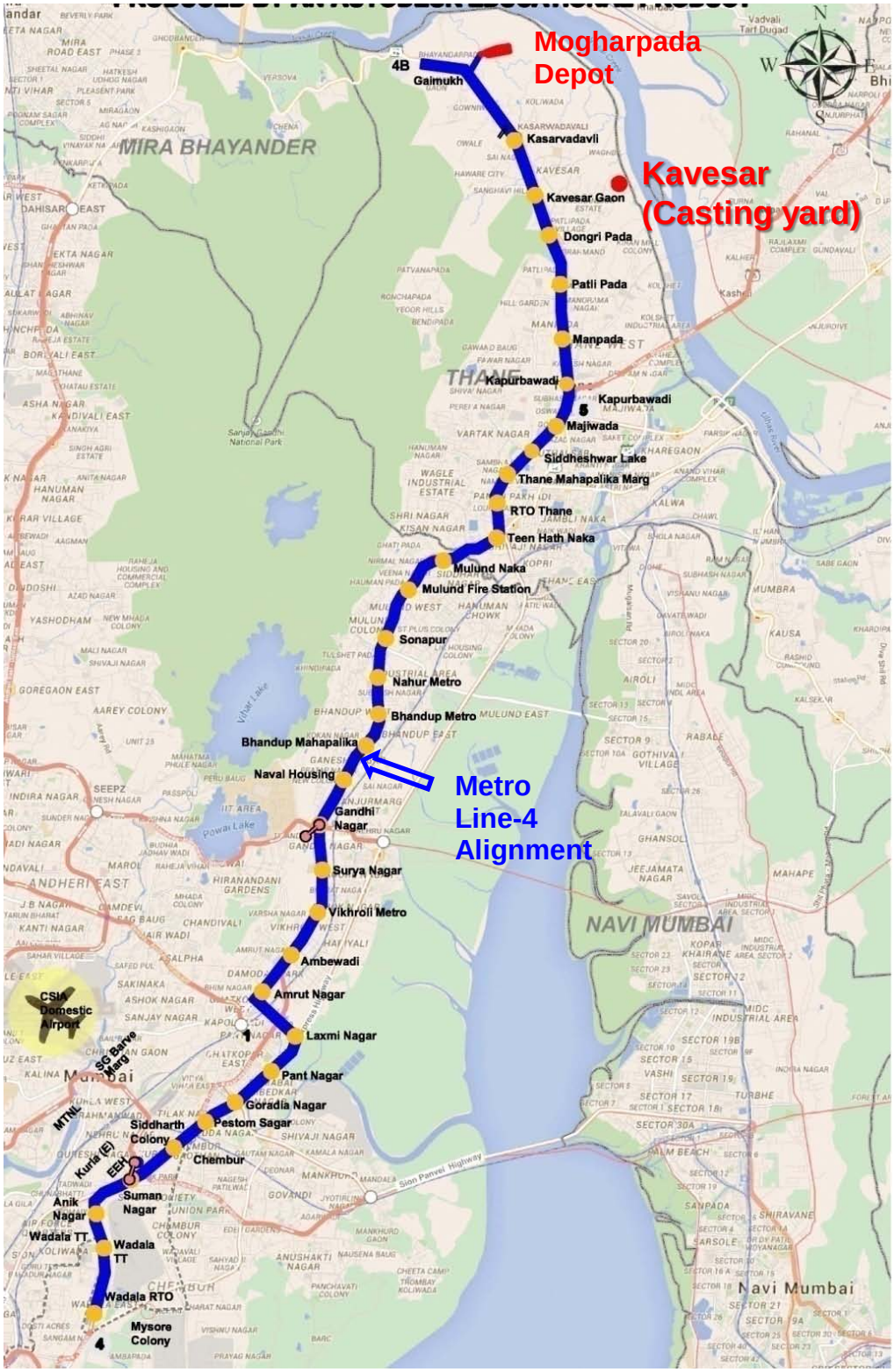


Figure 9.1 (a): Proposed Project Location

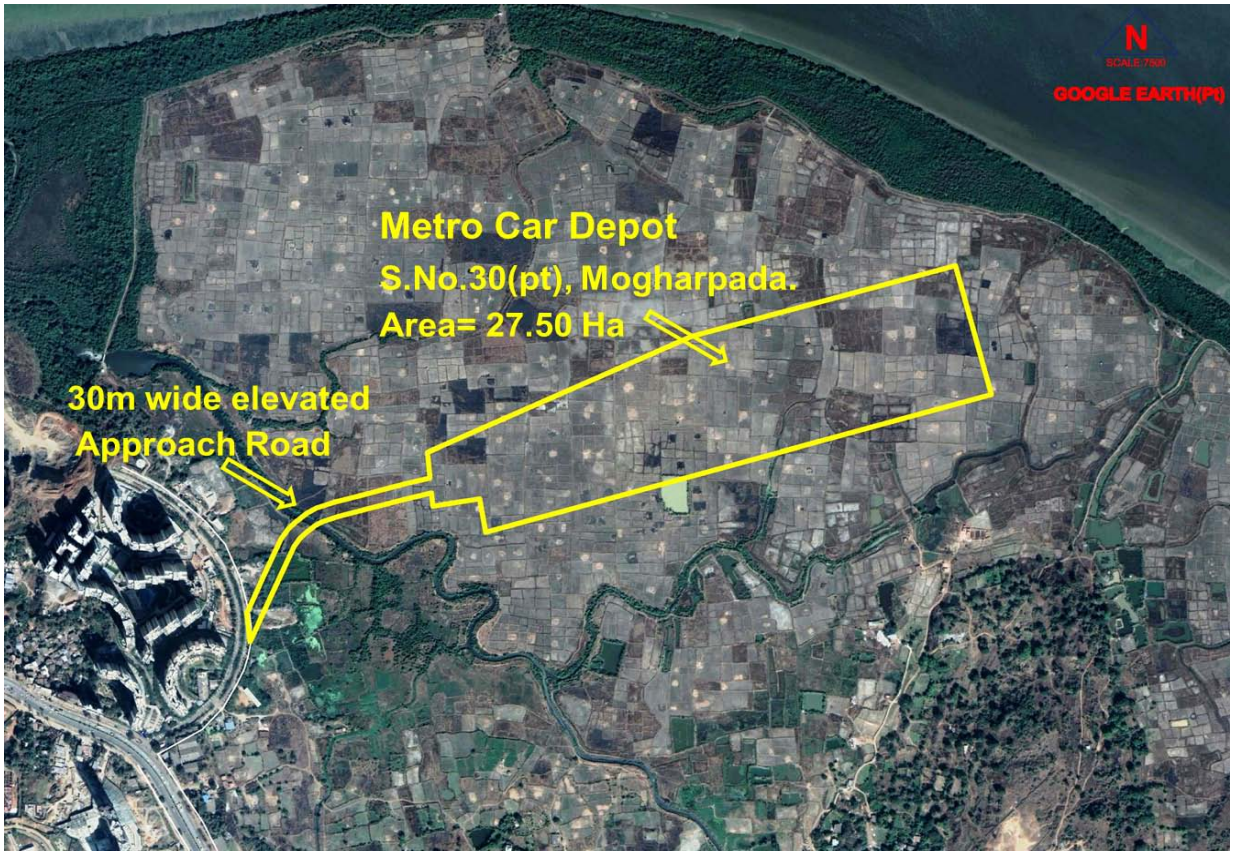


Fig 9.1 (b): Google image of Metro Car-Shed depot at Mogharpada

Fig 9.1 (c): Project Location Map of Casting Yard at Kavesar

9.4.2 CRZ Status: The proposed project falls under CRZ II

The proposed car-shed depot and Casting Yard is planned on the Metro Line-4 from at village Mogharpada and Kavesar respectively. This project Falls under CRZ II as per CZMP of thane as shown in figures below. The total area affected under CRZ II area with construction of 20 no.s piers is 0.05 ha and with Casting Yard is 6.31 ha.

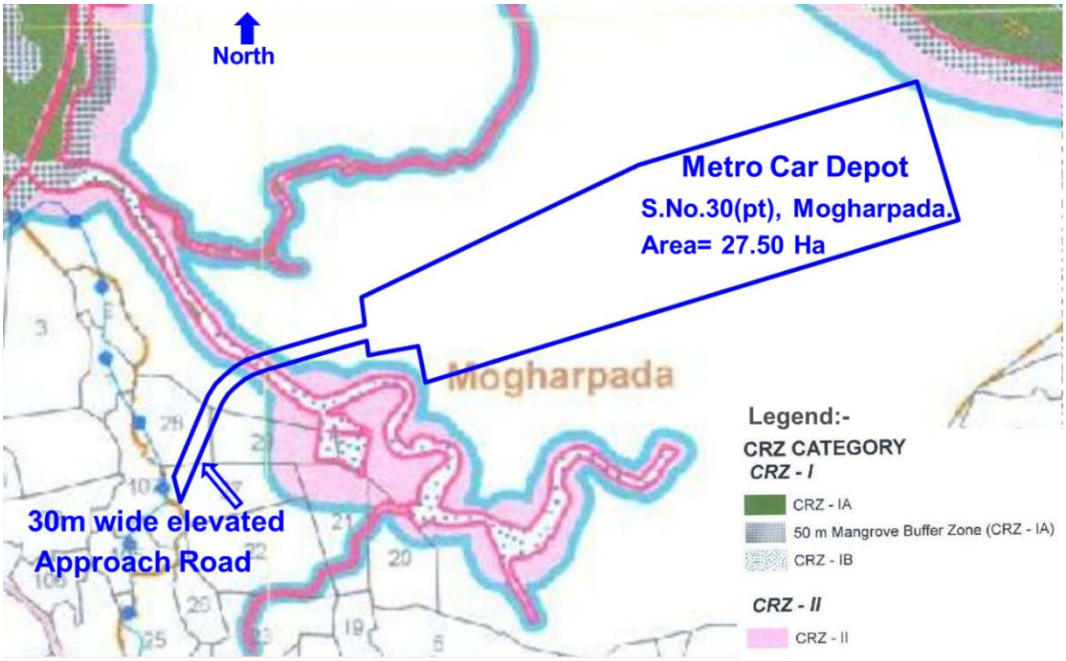


Fig 9.2 (a): Pier location on CZMP Map

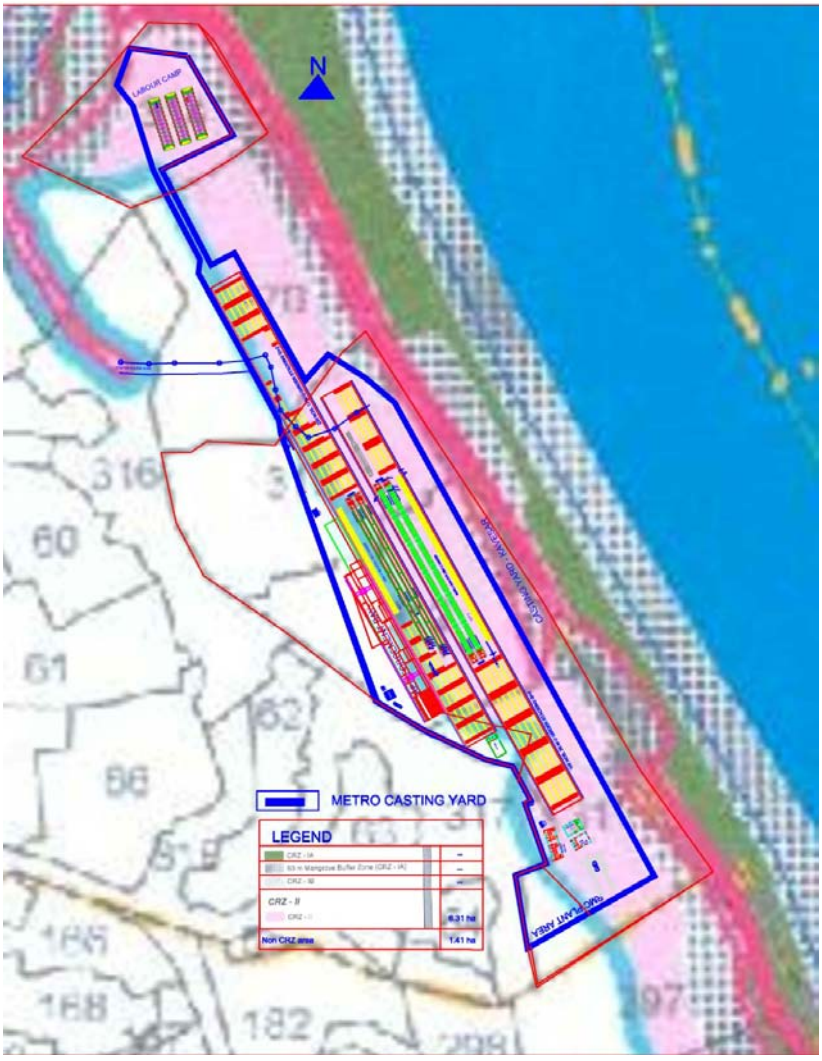


Fig 9.2 (b): Location of Casting yard at Kavesar on approved CZMP

9.5 PROJECT DESCRIPTION

9.5.1 MOGHARPADA CAR-SHED DEPOT

MMRDA proposed construction of 20 piers of approach road and Metro spur line to Mogharpada card depot at survey nos. 30 (pt), 27 (pt), 28 (pt) & 29(pt) of village Mogharpada. Total area for Metro Car Shed is proposed to be 27.50 ha.

The approach road and Metro spur line is proposed to connect Metro Car Depot. The reservation of identified depot land is Picnic Center. Metro car depot is not affected by CRZ area. However, spur line and approach road is affected in CRZ-II area.

There is existing 40m wide road near to the proposed depot at a distance of approx. 200m. Connecting this road, 25m wide elevated approach road with Metro spur line is proposed which crosses the nala having width of 20 m affected in CRZ area.

The proposed number of Piers of approach road are 16 Nos. The area required for each pier is 25 sq.m, with total area required for 16 nos is 400 sq.m. (0.04 Ha.), each of length 93 m. The proposed number of Piers of metro spur line are 04 nos, with total area required as 100 sq.m. (0.01 Ha.), each of length 82 m. The piers are located in CRZ-II and not affected by mangroves/ 50m mangroves buffer zone as per approved CZMP under Coastal regulation Zone (CRZ) Notification, 2011. No pier shall be constructed in CRZ-I-B area.

Fig. 9.3: Mogharpada Car-Shed Depot Layout Superimposed on Landmap with Google

9.5.2 CASTING YARD AT KAVESAR

A casting yard is a confined place where all the concrete structures like U GIRDER, I GIRDER, PIER CAP, etc. are to be casted /manufactured and shifted to their stack yard cured for the specific period and then shifting to the work site after they gain their required strength. Casting yard plays a most important role in Precast Segmental Construction Project. For viaducts segmental pre-cast construction requires a casting yard.

MMRDA proposed construction of casting yard at Survey No. 311, 312, 313, 314 & 267/15 of village Kavesar to meet pre-cast requirements of metro line construction.

Total area for casting yard is proposed to be 7.72 ha of which 6.31 ha area falls under CRZ II area. The said plot will be utilized temporarily for construction of pre-cast girders required for Metro projects. It is falling on landward side of an existing road. Casting yard will have following activities:

- Site Office
- RMC Plant & QC Lab
- Reinforcement fabrication yard
- Epoxy coating plant
- Segment stacking yard
- Other allied activities for functioning of casting yard.

9.6 DESCRIPTION OF THE ENVIRONMENT

In order to assess the existing environmental status in the project area, primary and secondary data on various environmental attributes viz. air quality; noise levels, water quality, soil, ecology, land use etc. have been collected.

9.6.1 Establishing Baseline Environmental Status

Baseline data describing the existing environmental status of the identified study area is determined using the procedures Prescribed by Guideline of MoEF. The study period is from March 2019 to May 2019.

9.6.2 Soil Quality

TABLE 9.1 (a): Sampling locations for soil quality monitoring

Location code	Sampling Location
S1	Mogharpada
S2	Kavesar

Soil Analysis Results

Analysis results for environmental parameters of the soil are given in below table.

Table 9.1 (b): Soil analysis results

Parameters	S1	S2	Units
pH	7.31	6.01	--
Colour	Light Brown	Light Brown	--
Conductivity	0.09	0.09	µS/cm
Moisture Content	9.37	1.17	%
Organic Matter	0.18	0.31	%
Chlorides	115	92	mg/kg
Sulphates	140	125	mg/kg
Phosphates	3.73	2.4	mg/kg
Calcium Hardness	210	184	mg/kg
Calcium as Ca^{2+}	100	78	mg/kg
Magnesium as Mg^{+2}	7.29	6.76	mg/kg
Sodium	215	185	mg/kg
Potassium	5.1	6.4	mg/kg
Iron	116.76	114.2	mg/kg
Copper	4.76	0.136	mg/kg
Manganese	8.16	3.8	mg/kg
Chromium	1.77	0.096	mg/kg

Parameters	S1	S2	Units
Cobalt	3.66	4.1	mg/kg
Cadmium	0.028	0.031	mg/kg
Zinc	7.4	5.7	mg/kg
Lead	Below Detectable Limit	Below Detectable Limit	mg/kg

Results indicate that the soil is not polluted.

9.6.3 Air Quality

The baseline Ambient Air Quality data of the region has been obtained. Air quality monitoring was carried out at 08 locations along the proposed project area.

Table 9.2: Ambient air quality location & monitoring details

Station Code	AAQM Station	PM_{10} (24hr) ($\mu g/m^3$)	$PM_{2.5}$ (24 hr) ($\mu g/m^3$)	SO_2 (24hr) ($\mu g/m^3$)	NOx (24hr) ($\mu g/m^3$)	CO (1 hr) (mg/m^3)
		Average	Average	Average	Average	Average
AQ1	Mogharpada	91.67	54.17	20.83	21.73	<0.4
AQ2	Kavesar	75.00	35.00	20.83	21.63	<0.4
AQ3	Navghar	83.33	12.50	22.92	23.37	<0.4
AQ4	Kokanipada	70.83	50.00	19.79	21.83	<0.4
AQ5	Thane	94.10	58.33	18.75	19.86	<0.4
AQ6	Bhiwandi	79.92	54.17	21.88	22.62	<0.4
AQ7	Kharbao	54	21	16.32	20.34	<0.4
AQ8	Naupada	84.01	47.51	19.48	21.65	<0.4

The average concentration of PM_{10} (24hr), $PM_{2.5}$ (24hr), SO_2, NOx and CO at all locations is observed to be within the specified limit of CPCB.

9.6.4 Water Quality

The main drinking water source in the study area is provided by MCGM.The existing water resources, both surface and ground water with respective significance were identified within the study area (10 km radial distance) around project site.

Table 9.3 (a): Water Quality Sampling Locations

Sr. No.	Sampling Location
	Surface water
1.	Thane Creek
	Ground water
2.	Kavesar

Table 9.3 (b): WATER ANALYSIS REPORT

Parameters	Surface water	Ground water	Units
	Physical Parameters		
Temperature	33	28.7	° C
	Chemical parameters		
Aluminum	<0.01	<0.005	Mg/l
Total Carbon	37.05	2.0	Mg/l
Boron	0.02	0.02	Mg/l
Silicon as SiO_2	8.60	43.2	%
Sodium absorption ratio	40.83	27	--
pH	7.80	7.4	--
Selenium as Se	<0.01	<0.004	Mg/l
Copper as Cu	<0.01	<0.002	Mg/l
Lead as Pb	<0.01	<0.005	Mg/l
Arsenic as As	<0.01	0.32	Mg/l
Conductivity	56800	2460.1	µS/cm
Free and saline Ammonia	<1	<1	Mg/l
Nitrite as NO_2	0.02	0.14	Mg/l
Oil & Grease	7	<0.5	Mg/l
Chromium as Cr	<0.01	<0.01	Mg/l
Colour	1	1	Hazen
Turbidity	150	2.58	NTU
Total Dissolved Solids (TDS)	45000	1620	Mg/l
Total Hardness as $CaCO_3$	5225	614	Mg/l
Sulphate as SO_4	1798	128	Mg/l
Fluoride as F	1.2	<0.10	Mg/l
Nitrate as NO_3	21.47	<0.005	Mg/l

9.6.5 Noise Quality

Noise levels are attributed to the vehicular traffic in the project area. There are no industrial activities, which will lead to higher noise levels.Noise readings were taken at 8 different locations in 10km radius of project site. The results are presented in below table.

Table 9.4: Noise Level Readings

Station Code	Noise Monitoring Location	Equivalent Noise levels in Leq	
		Day	Night
N1	Mogharpada	67.09	58.30
N2	Kavesar	63.55	53.22
N3	Navghar	66.11	57.94
N4	Kokanipada	66.75	58.37
N5	Thane	65.59	55.60
N6	Bhiwandi	65.69	56.77
N7	Kharbao	61	52
N8	Naupada	72	63

9.6.6 Ecology & Bio-Diversity

The Primary data was collected by conducting surveys at study area. Secondary data was also collected.Proposed project is located near the western coast near Sanjay Gandhi national park area. But there is no mangrove destruction or tree cutting envisaged during project development. Hence, there will be hardly any damage caused to bio-diversity.

9.7 ENVIRONMENT MANAGEMENT PLAN

Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. A project may have identified proper mitigation measures but without a management plan to execute it, the desired results may not be obtained.

In the Environmental Management Plan (EMP), impact mitigation and monitoring requirements are specified and the institutional arrangements for implementation of the project identified. The EMP also includes the cost of implementing mitigation and monitoring requirements.

Table 9.5 MITIGATION MEASURES

Environmental Impact	**Mitigation Measures Taken or To Be Taken**
DESIGN PHASE	
Cultural Heritage	No Cultural Heritage in the area
Flood	Elevated alignment shall be well designed
Inadequate design provision for safety against seismological hazard	Make sure that design provides for safety of structures against worst combination of forces in the probability of an earthquake likely to occur in seismic zone-III.
PRE –CONSTRUCTION STAGE	
Water requirement	The requirement of water for construction purpose etc shall be planned and shall be arranged from available and authorized sources in order to avoid digging of Tube wells.
Disposal of final treated effluent from treatment plant	Options for final disposal shall be studied and the suitable disposal route shall be decided carefully to minimize the impact on receiving bodies. As far as possible zero discharge rules may be adopted.
Casting Yard	These facilities to be located away from habitation. Consent to Establish and Consent to Operate to be taken from MPCB and to comply with all stipulations.
CONSTRUCTION PHASE	
Environmental Management and Monitoring	This will include institutional requirements, training, environmental management and monitoring
Dust	Water should be sprayed during construction phase, wherever it is required to avoid dust. Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.
Air Pollution	Vehicles and machinery are to be regularly maintained so that emissions conform to National and State AAQ Standards. No vehicle without valid PUC certificate would be allowed at Construction Sites.
Equipment Selection maintenance and operation	Construction plants and equipment will meet acceptable standards for emissions and will be maintained and operated in a manner that ensures that relevant air, noise, and discharge regulations are met.
Noise	Noise standard at processing sites, will be strictly enforced as per GOI noise standards. Workers in vicinity of strong noise will wear earplugs and their working time should be limited as a safety measure. At construction sites within 150m of sensitive receptors construction will be stopped from 22:00 to 06:00. Machinery to be provided noise barriers (Stone walls and plantation) for silence zones including schools and hospitals.
• **WATER**	
Contamination from Wastes	All justifiable measures will be taken to prevent the wastewater produced in construction from entering directly into any rivers, drainage and irrigation system
Wastage of water	Measures shall be taken to avoid misuse of water. Construction agency shall be instructed accordingly to follow strict procedures while using the water for construction and drinking purpose.
Sewerage disposal during construction at Service	If any water source is present in alignment a minimum distance of any sewage or toilet facility should be 200 meters from it.

Centers	
Sanitation and Waste Disposal in Construction Camps	Sufficient measures will be taken in the construction camps, i.e. provision of garbage tank and sanitation facilities. Waste in septic tanks will be cleared periodically. Drinking water will meet Indian National Standards. Garbage will be collected in a tank and disposed off daily. Special attention shall be paid to the sanitary condition of camps. Camps will be located at a minimum distance of 200 m from water sources.
• **SOIL**	
Quarrying	Quarrying will be carried out at approved and licensed quarries only. All environmental mitigation measures shall be enforced at Quarry site also.
• **FLORA AND FAUNA**	
Loss of trees and Avenue Plantation	No tree cutting envisaged
• **SOCIAL**	
Traffic jams and congestion	If there are traffic jams during construction, measures should be taken to relieve the congestion with the co-ordination of transportation and traffic police department
Safety with vehicles, people and livestock and signage	• Safety education and fines. • Allow for adequate traffic flow around construction areas • Provide adequate signage, barriers and flag persons for safety precautions. • Communicate to the public through radio, TV & newspaper announcements regarding the scope and timeframe of projects, as well as certain construction activities causing disruptions or access restrictions
OPERATION PHASE	
Noise and Vibration	Suitable measures should be adopted wherever necessary. The public shall be educated about the regulations of noise and vibration pollution and its implications.
• **WATER**	
Maintenance of Storm Water Drainage System	The urban drainage systems will be periodically checked and cleared so as to ensure adequate storm water flow.
• **SOLID WASTE**	
Solid Waste Management	Solid waste generated during operation phase will be disposed off through authorized organization.

9.8PROJECT BENEFITS

The benefits of the project can be divided into tangible & intangible benefits. The tangible benefits are technical benefits while intangible benefits include the environmental & economic benefits.

Technical Benefits:

i. Higher carrying capacity (50 seat + 325 standing = 375 per standard Coach) compared to road transport. (Equivalent to 7 lanes of bus traffic or 24 lanes of motor car traffic)
ii. Higher speed (maximum speed of 80km/hr irrespective of normal time or peak time compared to bus and other road traffic which literally snarls during peak time.)
iii. Smooth ride as it is not affected by other vehicles, pedestrians etc. (Travel in jam packed buses is very rough.)
iv. Safer compared to road transport in Mumbai where road accident rate is very high.
v. Occupies less land space as the Metro runs on elevated tracks which are supported on pillars; each pillar occupying a ground space of approximately 2M x 2M only.
vi. Elevated Metro Rail occupies only 2M width of the road space.
vii. No gaseous, liquid or solid pollution as the Metro railway is run on clean energy viz. electricity which does not emit any pollutant during the operation.
viii. Lower noise pollution compared to equivalent capacity of road transport. (By virtue of the state of the art technology applied for construction of the coaches and the track and by virtue of high elevation of the track (>7M) the noise nuisance caused by the Metro is far less compared to the road transport. (Noise levels of the modern Metro Rail Coaches and the track at the source is expected to be < 60 dB (A).
ix. Energy efficient (energy consumption per passenger km is only 20% of the energy consumed by the road based transport system).
x. Lower journey time (lower by 50-70% of the time taken by road traffic, depending on road conditions).

Environmental Benefits:

- Environmental benefits cannot be measured by a tool directly but can be subjectively visualized. Provision of metro lines along any busy corridor would help to reduce congestion on the road.
- Similarly on this section, seamless traffic movement could be achieved for all the vehicles.

- This would help to reduce the consumption of fuel due to lesser interruptions and optimum travel speed.
- Also, due to reduced congestion, noise pollution as well as air pollution in the surrounding areas can be diminished.

Economic Benefits:

- The improved speed of traveling will create substantial savings in fuel consumption.
- Fuel savings are significant for individual as well as the country as a whole.
- The improved access towards high traffic areas will also appreciate use of adjoining plots and economic activities will increase.

- Reduced pollution, vehicle maintenance, fuel saving due to better quality of roads.

9.9PROJECT COST

The estimated cost of the project is 225 Cr.

9.10DISASTER MANAGEMENT PLAN

Disaster Management Plan (DMP), safety measures and action plan have been prepared. It is also included to make ground preparation for natural calamity, which is most unlikely event in the present surrounding of the site.

9.11 ENVIRONMENTAL MANAGEMENTCOST

The environmental cost is consisting of monetary value of the mitigative measures adopted to minimize the negative impact if any of project on environment. Environmental cost is divided into two categories, i.e. capital cost and operation and maintenance cost. Capital cost is the cost of all the investment measures proposed for environmental protection during construction phase while the operation and maintenance cost include the cost of running and operating of these measures such as monitoring air, noise and water and maintaining the investment measures over project life.

Table 9.6: Environmental Management Cost

CONSTRUCTION PHASE		
SR. No	**ITEMS**	**COST (INR) DURING CONSTRUCTION PER YEAR**
1	AIR ENVIRONMENT	12,80,000
2	WATER ENVIRONMENT	7,20,000
3	NOISE ENVIRONMENT	1,28,000
4	MOBILE STP	20,00,000
	TOTAL EMP COST	**41,28,000.00**

OPERATION PHASE		
SR. No	**ITEMS**	**COST (INR) DURING OPERATION PER YEAR**
1	AIR ENVIRONMENT	9,60,000
2	WATER ENVIRONMENT	7,20,000
3	NOISE ENVIRONMENT	1,28,000
4	DMP – (Maintenance Cost)	5,00,000
	TOTAL EMP COST	**23,08,000**

Operation and maintenance of mobile STP may cost around Rs. 40,000/- per month during construction phase.

CHAPTER – 10
CONSULTANTS ENGAGED

"MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY (MMRDA)" for carrying out the above mention study have entrusted "Global Management and Engineering Consultant International (GMEC)".

We are an ISO 9001:2008 certified, multi-disciplinary engineering, design and Consultancy Company, a respected specialty company, actively partnering with our customers to provide innovative and sustainable technical and management solutions that help creating sustainable and long term solutions for our customers and society.

GMEC experts all focused first and foremost on providing tangible customers value and service that offers non-compromised, quality engineering work following the latest developments in technology and applying the most appropriate and beneficial solutions to Clients, Society and Environment.

GMEC was formed with a vision to become a market leader in the industry. The focus of the company is to become a total service provider to Civil, Environmental, Mechanical, Industrial Engineering , Construction & Project Management.

From consulting, designing to implementation and management, we take care of all aspects of business network, to keep business up and running with close to zero downtime. We partner with our customers by combining our expert domain knowledge, outstanding technical capabilities and right consulting which enables them to execute their business in the most optimal way.

Our experienced and certified engineers provide service and support for the latest platforms and technologies, to make the most of your existing investment. Using best practices, methods and customer-centric approach that are tuned to finding solutions that meet specific business needs, we can help your organization turn powerful technology into superior results and competitive advantage.

We are one of the leading environmental and environmentally related infrastructure project consultants and completed no. of prestigious projects in the country. It includes Rs. 6,000 Crore project of Sewri- Nhava Sheva sea link i.e. Mumbai Trans Harbour Link project, Rs. 500 Crore of Inland Passenger Water Transport (IPWT) project. We have been also associated with major industrial houses in India, which includes ELDER PHARMA, DUPHAR GROUP, RUNWAL GROUP (ARIANE PHARMA), VINATI ORGANICS, ETC. along with FINOLEX group, CABOT India, NITCO group, ISPAT group, INDIAN OIL CORPORATION LTD., SAHARA group, etc.

We have been also associated with various commercial development projects and companies. This includes RUNWAL GROUP, MATOSHREE REALTORS, FRAVASHI GROUP, SOLITUDE, PWD DEPT., etc. This project consultancy includes designing and commissioning of Sewage Recycling plants, Green Belt development, storm water design, etc.

We have our **Lead Office** in Mumbai at:
102, HIREN INDUSTRIAL ESTATE,
MOGUL LANE, MAHIM
MUMBAI - 400 016.
MAHARASHTRA.

To cater the needs of Industrial Corporate Houses in remaining part of the state, we have offices at **Pune** and **Aurangabad**. We also have presence in the state of Goa and have office at Ponda. We also have our liasoning offices with our staff at Solapur, Kolhapur, Satara and Nagpur.
We have full-fledged office consisting of total of 5 Nos. of Computers operated by engineers themselves along with all the infrastructure facilities. The computers are loaded with different types of programs to cater various requirements.

The technical team is led by **Dr. U. S. Kulkarni** and is assisted by 5 nos. of Engineers. There are 3 nos. of field teams for carrying out various Surveys, Monitoring Programs, Operation and Maintenance. We also have resident engineers who are responsible for their regions. In all **GMEC International** is fully self-sufficient, technically competent and therefore can handle any project irrespective of its size and capacity.

A.2. ABOUT OUR ENGINEERING/ARCHITECT OFFICES:

We have facility to carry out Detailed Designing, Structural Designing and Fabrication Drawings at our above offices.

A.3. ABOUT OUR LABORATORY:

This is our heart of the Consultancy Services as we carry out various feasibility and treatability studies before designing a particular project. The laboratory is fully sophisticated and computerized and moreover it is FDA approved laboratory. One can carry out any no. of chemical, physico-chemical analysis of water and wastewater using various analytical instruments. Such a facility of water, wastewater, air monitoring and noise measurements is also available in Pune.

CURRICULUM VITAE

OF

DR. UMESH S. KULKARNI

(M.Sc., Ph. D.)

Dr. Umesh S. Kulkarni

Profession	**Expert: Environment, Ecology, Health & Socio- Economic.**
Date of birth	**12-03-1964**
Years with the firm	**28 YEARS**
Nationality	**INDIAN**
Membership of professional societies	Associate Member - FICCI American Solid Waste Association (ASWA) Indian Water Works Association (IWWA) Water Environment Federation (WEF) Indian Institute of Environment Sciences (IIES) International Eco – Tourism Society (IETS) Associate member – Indo Brazilian Society Member - Maharashtra Economic Development Corporation (MEDC)
Key qualifications	
Education	
(year)	**Ph.D.** (Treatment of Industrial Wastewater Chemical Engineering)
	Dept. of Chemical Technology (UDCT), University of Mumbai.
	M. Sc. (Physical Chemistry)
	University of Mumbai
	B. SC. (Chemistry)
	University of Mumbai

Language

	Read	Write	Speak
English	Yes	Yes	Yes
Hindi	Yes	Yes	Yes
Marathi	Yes	Yes	Yes

APPOINTED AS AN TECHNICAL MEMBER ON **MAHARASHTRA POLLUTION CONTROL BOARD (MPCB)**

RECENTLY APPOINTED BY **UDD, GOVT OF MAHARASHTRA** AS AN EXPERT MEMBER - ENVIRONMENT ON THE **TECHNICAL COMMITTEE FOR HIGH RISE CLEARANCES** FOR THE **ULHASNAGAR MUNICIPAL CORPORATION - JULY 2015**

RECENTLY APPOINTED AS AN EXPERT MEMBER - ENVIRONMENT BY **UDD, GOVT OF MAHARASHTRA** FOR REVISED **DEVELOPMENT PLAN (DP)** FOR THE **ULHASNAGAR MUNICIPAL CORPORATION 2014-15**

APPOINTED AS AN EXPERT MEMBER - ENVIRONMENT AT **NATIONAL Hydro - Electric Power Corporation (NHPC)** by **Ministry of Power, New Delhi**

NOMINATED AS AN FOUNDER MEMBER - ENVIRONMENT IN THE COMMITTEE WHICH FORMULATED BIO-MEDICAL RULES by **Ministry of Environment and Forests, New Delhi**

RECENTLY APPOINTED AS VICE PRESIDENT OF THE INDO-BRAZIL CHAMBER OF COMMERCE

APPOINTED AS ENVIRONMENTAL CONSULTANT FOR MUMBAI COASTAL ROAD PROJECT BY MCGM

COMPLETED CRZ AND ENVIRONMENTALCLEARANCES FOR MORE THAN 50 MAJOR INFRASTRUCTURE PROJECTS FOR THE STATE OF MAHARASHTRA

PROFESSIONAL EXPERTISE:

1. Environmental Infrastructure Projects
2. Public Health and Bio-Medical Waste Sciences
3. Environment & Ecological Sciences
4. Hazardous Waste Management / Municipal Waste Management
5. Eco – Tourism
6. Development of Large Industrial Areas pertaining to Environmental Aspects.
7. Environment Impact Assessment (EIA)
8. ISO 14001
9. Water Audit and Water Conservation
10. Lake Ecology and Restoration

PROFESSIONAL ACHIEVEMENTS :

a. Appointed as Expert member on Steering Committee of **FICCI**, Western Region

b. Appointed as Expert Member on Advisory Committee of **National Hydroelectric Power Corporation (NHPC)** on the Environmental Aspects, Ministry of Power,

c. Nominated as Expert Member on Committee Formulation of Bio-Medical Rules – 1998 by **Ministry of Environment and Forest, New Delhi, (MoEF)**

d. Appointed as Technical Board Member of ***Maharashtra Pollution Control Board*** **(MPCB),** Government of Maharashtra.

e. Nominated as an Expert member of Indian Institute of Rural Development (IIRD - Joint Venture with Govt. of Rajasthan, WHO, UNDP etc.)

f. Member – Industrial and Environment

Committee of Indian Merchant's Chambers (IMC).
g. Nominated as Expert Member on
Environment Committee of Maharashtra
Economic Development Corporation (MEDC)

ASSOCIATED CORPORATES: 1. **Director** – Ashok Alco-Chem Ltd.

2. **Director** – Ashok Alco Bio-Chem Ltd.

3. **Director** – Vivid Chemicals Ltd.

4. **CEO** – International Infrastructure Projects and Labs. (IIPL)

RECENT PUBLICATIONS.....

- Three Environmental Impact Assessment Research papers have been accepted to be published in WIT Press Journal of Sustainable development and planning at **Wessex University of Technology, United Kingdom in May, 2012, 2014 AND 2013**
- No. of research papers have been published in India and Foreign Journals including **Indian Journal of Environment, American Chemical Society, Journal of Public Health** etc
- Also delivered and presented no of research papers in person at various **International Conferences at USA and Singapore**
- Recently presented research paper at **5TH European Conference on Environment and Ecology at Prague, Czech Republic, in Oct.-2001**
- Attended no. of **Conferences and Exhibitions at USA, UK, France, Singapore in the past**

PATENTS.....

- Involved in application of an Indian Patent for **"Separation and Recovery of micro level Lignin from Bagasse (Pulp Effluents)"**
- Recently selected as qualified for **Government of Maharashtra for carrying out Water and Energy audits as per World Bank standards**

DR UMESH KULKARNI HAS COMPLETED SEVERAL IMPORTANT INFRASTRUCTURE & CONSTRUCTION PROJECTS UNDER ENVIRONMENTAL AND CRZ CLEARANCES FOR THE STATE OF MAHARASHTRA & PAN INDIA. IT INCLUDES MMRDA, MSRDC, CIDCO, PWD, NHAI AND SO ON.

List Of Important INFRASTRUCTURE PROJECTS IN THE STATE OF MAHARASHTRA - Consultancy Projects for obtaining Clearance:

1. CRZ & EC clearance for proposed Ropeway from Sewri to Elephanta Island by Mumbai Port Trust.
2. Environmental Clearance Ropeway project at Kalyan Haji Malang Gad by PWD, Maharashtra
3. Environmental Clearance Ropeway project at Saptashringi Mandir at Vani,Nashik
4. CRZ Clearance Ropeway project between Janki Chhati to Yamunotri, Uttarkashi
5. Environmental Clearance including EIA for 1st ever Special Economic Zone in India – Navi Mumbai SEZ on 1250 Ha area.
6. Environmental Clearance including EIA for Pharmaceutical SEZ at Kalamboli on 350 acre of area for NMSEZ Pvt. Ltd.
7. Environmental Clearance including EIA for Engineering SEZ at Kalamboli on 170 acre of area for NMSEZ Pvt. Ltd.
8. Environmental Clearance including EIA for 2000 MW Gas based Power Project for NMSEZ Pvt. Ltd.
9. Environmental Clearance amendment for SEZ project of JNPT.

10. FOREST CLEARANCE

11. Municipal Corporation Of Greater Mumbai

12. The Proposed Construction of Priority Sewer Tunnel(PSTI & II) at Village- Malwani, District Mumbai Suburban
13. Proposed Construction of 847 MLD waste water facility (WwTF)Sewage Treatment Plant at Village Malwani Malad (W) Mumbai
14. Proposed Water Pipe Line (3.5 Km) Carring Secondary Treated Sewage from Ghatkopar Pumping Station to Wastage to Energy (WtE) Plant at Village- Deonar & Vikhroli
15. Proposed Construction of Tunnel underneath Sanjay Gandhi national Park along Goregoan Mulund Link Road Project at Village - Aarey, Gundgoan, Vihar & Nahur District Mumbai Suburban
16. Construction of Mumbai Sewage Disposal Project Priority Work Stage- II Components Bhandup & Ghatkopar WwTF Project

17. Maharashtra State Road Development Corporation

18. Proposed of Construction of Vesova- Bandra Sea Link Project, at Villages- Versova, Juhu, bandra (Dande) District -Mumbai Suburban

19. Mumbai Metropolitan Region Development Authority

20. Proposed Construction of Mutimodal Corridor from Navghar to Chirner Project
21. Proposed Construction of Charkop and Mankhurd Metro Car Shed

22. Jawaharlal Nehru Port Trust

23. Proposed Construction of Port Based Special Economic Zone (SEZ) Phase-I at JNPT

24. Public Works Department

25. Proposed Construction of Sion Panvel Special State Highway Project

26. City Industrial Development Corporation of Maharashtra

27. Proposed Construction of Uran Bypass Road Project at Boripakhadi & Kharkalaghoda Taluka Uran District – Raigad
28. Proposed Construction of Development of Golf course at Kharghr, Navi Mumbai

29. Thane Municipal Corporation Project Through, J Kumar Infra Projects Limited

30. New Creek Bridge between Thane Municipal Limit at Village Kalwa & Rabodi District Thane in the State of Maharashtra

31. **CRZ CLEARANCE PROJECT**
32. **Mumbai Mangrove Conservation Unit**
33. CRZ Clearance for proposed construction of boundary wall on landward side of Mangroves at 10 locations
34. CRZ Clearance for proposed construction of boundary wall on landward side of Mangroves at 9 locations
35. CRZ Clearance for proposed construction of boundary wall on landward side of Mangroves at 2 locations
36. CRZ Clearance for proposed construction of boundary wall on landward side of Mangroves at Colaba.
37. CRZ Clearance for proposed construction of boundary wall on landward side of Mangroves at Sarsole

38. Harbour Engineer Department

39. CRZ clearance from MCZMA for proposed construction of Anti sea Erosion bund, Approach Road at Versova in Mumbai Suburban (from Sagar Kutir to Hindu Smashanbhumi)
40. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion bund behind Raigad collector bunglow to D.S.P Bunglow at Alibaug, Dist. –Raigad.
41. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Pomedi, Tal and Dist-Ratnagiri.
42. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Anjarla, Tal- Dapoli, Dist-Ratnagiri.
43. CRZ clearance from MCZMA for proposed construction of Protection wall at Varvade, Dist-Ratnagiri.
44. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Karde, Tal- Dapoli, Dist-Ratnagiri.
45. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Someshwar, Tal- Ratnagiri, Dist-Ratnagiri ASE - Padale Ratnagiri.
46. CRZ clearance from MCZMA for proposed construction of Protection Wall with Anti Sea Erosion Bund at Juve Chavanwadi, Tal- Ratnagiri, Dist-Ratnagiri.
47. CRZ clearance from MCZMA for proposed construction of Retaining wall near to creek at Khed, Tal- Khed, Dist-Ratnagiri.

48. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Uttambar, Tal- Dapoli, Dist-Ratnagiri.
49. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Navabagh Ubhadanda (Creek Side).Tal-Vengurla. Dist- Sindhudurg.
50. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Buns at Newale Fort to Bhogave, Tal-Vengurla,Dist –Sindhudurg.
51. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Bhogave Last Stop to Donetar, Tal- Vengurla, Dist – Sindhudhrg.
52. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Wayangani Poydiwadi, Tal- Vengurla, Dist- Sindhudurg.
53. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund At-Hadi Bundar, Tal-Malvan,Dist-Sindhudurg.
54. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund At-Sarjekot Near Suvarnakada, Tal-Malvan,Dist-Sindhudurg.
55. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund At-Shree Krishna Temple to Moreshwar Temple, Dandi. Tal-Malvan,Dist-Sindhudurg.
56. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at-Talashil Sea Side, Tal- Malvan,Dist Sindhudurg.
57. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Ambolgad Godivane Raghobawadi Stambh, Tal- Rajapur, Dist-Ratnagiri.
58. CRZ clearance from MCZMA for proposed construction of Protection Wall At Vilye Kondwade, Tal- Rajapur, Dist-Ratnagiri.
59. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Kalbadevi, Tal. and Dist-Ratnagiri.
60. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Kasop, Tal. and Dist-Ratnagiri.
61. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund at Mandvi Jetty from parking area to Existing ASE Bund, Tal. and Dist-Ratnagiri.
62. CRZ clearance from MCZMA for proposed construction of Anti Sea Erosion Bund Using Tetrapod at Murguwada Pandharamad Shri Dattatray patil's house to Shri Satish Sawant house, Tal. and Dist. Ratnagiri.

63. Public Works Department

64. CRZ clearance from MCZMA for Construction of Servant Quarter at CS. No. 215, G. B. Chief Justice House at N. D. Road, Mumbai

65. **City and Industrial Development Corporation**
66. Construction of State Guest House-cum-Emporium at Plot No 2-B, Sector 30 A, Vashi, Navi Mumbai (Nagaland House)
67. CRZ clearance from MCZMA for proposed Coastal Road From Aamra Marg to JNPT at Ulwe Node.
68. CRZ clearance from MCZMA for proposed project of construction of various bridges on Ulwe river diversion channel for Navi Mumbai International Airport, Navi Mumbai.
69. CRZ clearance from MCZMA for proposed Construction of 11m Wide by Pass Road from Hotel Anandi to Uran City.

70. **Municipal Corporation of Greater Mumbai**
71. CRZ Clearance for Scientific processing of MSW in 52.45 ha area which is in CRZ III area other than CRZ-I at Kanjur MSW processing site in Mumbai.
72. CRZ Clearance for Proposed Integrated Solid Waste Management Plant at Kanjur, Mumbai.
73. CRZ clearance for Pipeline (3.5km) carrying secondary treated sewage from Ghatkopar Pumping Station to main processing plant, open car park for 50 cars, Effluent pond (20x11.25m), Effluent Treatment Plant (20x22.5m), Leachate Treatment plant(20x11.25m), Areas for future expansion(1.01ha) and security booth 2 nos.(6.3x6.3m) at Deonar Solid Waste Management Facility

74. Mumbai Port Trust

75. CRZ clearance for proposed "Deepening and Widening of Approach Channel to Second Chemical Berth at Pir Pau in Mumbai".
76. CRZ clearance for Proposed Development of Multipurpose Jetty at Girgaon Chowpatty, Mumbai
77. CRZ clearance for Proposed Ecological & Cultural Park at Sewree, Mumbai.
78. CRZ clearance for Construction of two offshore container berths and development of container terminal on BOT basis in Mumbai Harbour.
79. CRZ clearance for proposed Development of Marina at MbPT, Mumbai.
80. Amendment in CRZ clearance/ recommendations for construction 5th Oil Berth at Jawahar Dweep in Mumbai Harbour.

81. Jawaharlal Nehru Port Trust

82. CRZ Clearance for proposed Vadhavan Port
83. CRZ clearance for balance work Construction of 4th container terminal and marine container terminal
84. CRZ Clearance Construction of Coastal Berth and approach bridges

85. Maharashtra State Road Development Corporation Ltd.

86. CRZ Clearance from MCZMA, SEAC-I & SEIAA For Thane Creek Bridge III
87. CRZ clearance for proposed Versova Bandra Sea Link is proposed to be constructed as a faster link between Versova and Bandra in the suburbs of Mumbai.
88. CRZ Clearance for Proposed Elevated Road on Thane-Ghodbundar Road from Chainage 0/000 to 4/500 (Ghodbundar to Gaimukh).

89. Maharashtra Maritime Board

90. CRZ Clearance for Maintenance Dredging in Satpati Creek/Dudh River

91. ENVIRONMENTAL CLEARANCE

92. Mumbai Port Trust

93. Environmental Clearance for Construction of two offshore container berths and development of container terminal on BOT basis in Mumbai Harbour
94. Environmental Clearance for proposed "Deepening and Widening of Approach Channel to Second Chemical Berth at Pir Pau in Mumbai"

95. Jawaharlal Nehru Port Trust

96. Amendment in the EC of Construction of 4th container terminal and marine container

terminal

97. Environmental Clearance for balance work Construction of 4th container terminal and marine container terminal
98. Environmental Clearance for the proposed Deepening and Widening of Existing Mumbai Harbour Channel and JN Port Channel (Phase II)
99. Environmental Clearance for proposed Vadhavan Port
100. Environmental Clearance for Construction of Coastal Berth and approach bridges
101. Environmental Clearance for development of Port based Special Economic Zone (SEZ) at Jawaharlal Nehru Port Trust (JNPT) Area (Phase I)

102. Maharashtra State Road Development Corporation Ltd.

103. Environmental Clearance for Nagpur Mumbai Expressway Package 2 from Pulgaon to Sindkhed Raja
104. Environmental clearance for proposed Versova Bandra Sea Link is proposed to be constructed as a faster link between Versova and Bandra in the suburbs of Mumbai
105. Extension of Environmental clearance for proposed Versova Bandra Sea Link is proposed to be constructed as a faster link between Versova and Bandra in the suburbs of Mumbai

106. Municipal Corporation of Greater Mumbai

107. Environmental clearance for proposed Goregaon-Mulund Link Road District Mumbai, Maharashtra
108. Environmental Clearance for Scientific processing of MSW in 52.45 ha area which is in CRZ III area other than CRZ-I at Kanjur MSW processing site in Mumbai
109. Environmental clearance for Proposed Integrated Solid Waste Management Plant at Kanjur, Mumbai
110. Environmental clearance proposed Deodar Waste to Energy Project at Deonar Dumping Ground, Mumbai

111. Other Infra projects

112. CRZ clearance from MCZMA and MoEF, New Delhi for Proposed Western Corridor of DFCC (Phase 2) from JNPT to Borigaon (The. Talasari) for Indian Railways, GoI.
113. CRZ and Environmental Clearance for Chh. Shivaji Maharaj Statue in the Arabian Sea for PWD, Govt of Maharashtra
114. Preparing EIA of ADB format for the proposed Metro line 2A and 7 proposed by MMRDA Obtaining CRZ clearance for Mumbai Coastal road- south part proposed by MCGM, Mumbai
115. Environmental Clearance including EIA for MSRDC for their Mumbai Trans Harbor Link project (MTHL).
116. Environmental Clearance including EIA for MSRDC for their Versova- Bandra Sea Link Project.
117. Coastal Road for extension of National Highway 4-B at Dronagiri, for CIDCO, Maharashtra state – consist of coastal road, fly over bridges, etc
118. Environmental Clearance including EIA for National Highway Authority of India (NHAI) for their 100 km. Pune -Solapur project.
119. Coastal Road from Palm Beach Road to Airoli for NMMC.
120. Environmental Clearance including EIA for MSRDC for their Peddar Road via Duct

Katraj By-pass road for NHAI.

121. Zarap – Patradevi state highway for Public Works Dept., Ratnagiri, Maharashtra, 21 km stretch with 2 river crossing bridges.
122. Thane-Bhiwandi-Vadpa Special State Highway for Public Works Dept., Thane, Maharashtra – consist of 10km road and 3 nos. of bridges across Thane creek.
123. Four laning to Jalna Deulgaon Raja Berala SH-176 in km. 148/00 to 76/00 with construction of Deulgaon Raja Bypass length 5.41 km. by G.O.M. Public Works Department, Buldhana
124. Four laning from Berala fata Chikhali Amdapur Khamgaon to N.H.6, Length 67.00 Km by G.O.M. Public Works Department, Buldhana
125. Construction of Coastal Road for Dighi Port connecting to NH-17 by IL&FS Transportation Networks Limited.
126. Proposed construction of two lane approach road for existing Mankule Bridge situated across Kharnai Creek in Mankule & Dherand Village by Office of the Executive Engineer Alibag Public Works Division
127. Environmental Clearance including EIA for National Highway Authority of India (NHAI) for their project at Ahmedabad.
128. Four-laning and strengthening of Dharbhanga to Jhanjharpur section of National Highway- 57, in the state of Bihar (km 70/000 to km 110/000) by National Highways Authority of India (NHAI)
129. Environment/CRZ Clearance for construction of various bridges for Ulwe rive Diversion Channel for Navi Mumbai International Airport by CIDCO
130. Development of Vadhavan Port at Vadhavan, Dahanu by JNPT and MMB.
131. Environment/CRZ Clearance for construction of Coastal Berth at JNPT
132. CRZ clearance for proposed shipyard project of Pipavav Shipyard, Taluka Rajula, District Amreli for Pipavav Shipyard Limited.
133. CRZ and EC for “Multipurpose Terminal Facility” At Chanje Village, Karanja Creek, Raigad For M/S. Karanja Terminal & Logistics Private Limited
134. Environment Clearance for proposed Marina facilities at the north of Zuari River Kargwal constructions Pvt Ltd
135. CRZ and EC for Proposed Developemnet of Lavgan Port for M/s.Lavgan Dockyard Pvt. Ltd.
136. Environment Clearance, CTE for proposed Jaigad Dockyard by Chowgule Steamships Ltd
137. Environment Clearance for Construction of Coast Gurad Station on plot 18/1, mouje-Agardanda, Murud-Janjira, Raigad by The Commander, ICGS
138. Environment Clearance for Upgradation and expansion of existing ship repair and ship building facility for Konkan Barge Builders Pvt. Ltd.,
139. Environment Clearance for Construction of Jetty/s and Stacking Yard at Balekeri Port, M/S. Coastal services,
140. CRZ and EC for Proposed development of Jaigad Port- (Now M/s Angre Port Pvt Ltd) for M/s Jaigad Port Infrastructure Pvt. Limited
141. Environment Clearance for proposed expansion of Captive Jetty from 331.5 m to 1800 m by ISPAT industries Ltd
142. Environment Clearance for Proposed Captive Marine Terminal at Mithpaur by Tata Chemicals Ltd
143. Development of Mangrove Park at Manori by MMRDA

144. Preparation of EIA and obtaining CRZ clearance for deepening and widening of existing JN Port & Mumbai Port channel
145. Obtaining Environment clearance from SEAC for expansion of existing facilities of Amri Chemical Ltd., Aurangabad
146. Obtaining Environment clearance from SEAC for expansion of existing facilities of Finkem Chemical Ltd., Aurangabad
147. Environment & CRZ Clearance for Development of Waste to Energy Project at Deonar Dumping Ground, Mumbai
148. Environmental Clearance including EIA for RITES and GOI for 7 Air Stripes in the state of Maharashtra
149. EIA & Public Hearing for Inland Passenger Water Transport Project on West Coast of Mumbai, for MSRDC.
150. Environmental Clearance including EIA for Dighi Port.
151. First Hazardous Waste Inventarisation Project was carried out in association with Dept. of Environment and Forests, Govt. of India and Central Pollution Control Board.
152. Appointed as an Advisor - Environment of 1st ever Floatel (Floating Hotel in Sea) near Mumbai.
153. Carrying out Feasibility study for Safe Disposal of Medical Waste for Jaipur City.
154. Appointed as Consultant to Indian Institute of Rural Development (IRD), which is a conglomerate of World Bank, UNICEF, etc. and other central government departments and authorities.
155. Carrying out feasibility study report for Lake Restoration and Beautification of 15 lakes in Thane Municipal Area.
156. Carrying out Environment Management Plan for Pravara Sahakari Sakhar Karkhana Ltd., PARAVARANAGAR.
157. Consultancy services to Coca-Cola India Ltd.
158. Awarded work to compile Environment Status Report for Pimpri-Chinchwad Municipal Corporation.
159. Preparation of Environmental Management Plan for proposed Sports City Complex at vill. Kalapur, Goa, for P.W.D., Govt. of Goa.
160. Preparation of Comprehensive Environmental Survey Status Report on solid waste, air pollution, sewerage and other related issues for Nalasopara Municipal, Council, and Dist. Thane.
161. Preparation of Comprehensive Environmental Survey Status Report on solid waste, air pollution, sewerage and other related issues for Virar Municipal, Council, Dist. Thane
162. Study of Pilot Plant for solid waste disposal for the city of Ponda, Goa.
163. Consultancy for carrying out Detailed Master Plan for Storm Water Drainage and Sewerage and Solid Waste System at Mhapusa, Ponda and Panjim cities, Goa.
164. Carrying out Total Survey including Plane Table, L-Sections and Cross Sections for Thane Municipal Corp. under Integrated Road Development Program, Phase-5.
165. Comprehensive Environment Audit including Water Audit etc. for Pimpri - Chinchwad Municipal Corp. Pune.
166. Comprehensive Environment Audit including Water Audit etc.
167. For Nallasopara Municipal Council.
168. For Navaghar Manikpur Municipal Council.
169. For Virar Municipal Council.
170. For Pimpri - Chinchwad Municipal Corp. Pune.

171. Preparation of detailed feasibility report for proposed construction of Sports City at village Kalapur, Govt. of Goa. This work is entrusted by MSRDC on behalf of Govt. of Goa. This work includes detailed Storm Water Drainage and Sewerage system in the village site for construction of Sports City, detailed Topographical Survey and Geotechnical Investigations and Environment Impact Assessment.
172. Preparation of Comprehensive Environmental Survey Status Report on solid waste, air pollution, sewerage and other related issues for M/s. HINDUSTAN MAX-GB (India) Ltd., Pimpri, and Pune.
173. Preparation of Comprehensive Environmental Survey Status Report on solid waste, air pollution, sewerage and other related issues for M/s. GODREJ INDUSTRIES LTD, Valia, and Gujarat.
174. Environmental Clearance including EIA for Orchid Chemicals & Pharmaceuticals Ltd. for their project, at Alatur, Chennai.
175. Comprehensive Environment & Ecology studies for obtaining Environmental Clearance including EIA for Celestial Properties Ltd. For Their Hill Station project at Tal. Mulshi, Dist. Pune.
176. Environment/CRZ Clearance for construction of anti-sea erosion bund/seawall at various locations by Harbour Engineer Department, PWD like Mumbai, Raigad, Ratnagiri, and Sindhudhrg

List Of Important BUILDING AND CONSTRUCTION PROJECTS IN THE STATE OF MAHARASHTRA - Consultancy Projects:

177. Redevelopment of Existing Mill For M/s. Prakash Cotton Mills at C.S. No. 1C/434 of Lower Parel (Division) Situated at Shankar Rao Naram Path (Gowalia Chawl Lane), Lower Parel, Mumbai by M.H. & A.D. Board. Mumbai
178. Redevelopment of existing transit camp under Mass Housing Scheme of E.W.S.& HIG/MIG/LIG type tenements at land bearing S. No. 177, 179(P),180&181,C.T.S.No.: 1654(P), 1659,1660, 1661, 1662,1663/B(P), 1664/A, 1665/A ,1666, at Shailendra Nagar, Dahisar, Mumbai by M.H. & A.D. Board. Mumbai
179. Composite H.S.G. Scheme On Land Bearing S.No.58/1 (P), 58/2 (P), 58/3 (P), Sr. No 59/A3 (P), 60/3 (P), 63/1 (P), Sr. No 63/2 &Sr. No 63/3 At Shrirampur, District-Ahmednagar, Maharashtra by M.H. & A.D. Board. Mumbai
180. Extension to an Existing Scheme on S. No. 70/A-1, 70/A-2, 70/A-3 & 70/B, At- Netaji Nagar, Wanowari, Pune-1 by Pune Housing & Area Development Board (MHADA)
181. Group Housing Scheme by Maharashtra Housing and Area Development Authority at GAT Nos. 44(Pt.) , 49(Pt.), 129(Pt.) , 130/1/A (Pt.), 130/1/B, 130/2,130/3(Pt.) & 130/4(Pt.) Mahalunge , Tal:Khed ,Pune-1 by Pune Housing & Area Development Board (MHADA)
182. Redevelopment of Existing Transit Camp With Transit & EWS Type Tenements at C.S. No 2/292, 378,379,380, & 419 of Matunga Division At Antop Hill Wadala, Mumbai Maharashtra by M.H. & A.D. Board. Mumbai
183. Redevelopment Of Existing Mill For M/s Century Textile And Industries Ltd. At C. S. No. 5/794 (PT.) Of Lower Parel (Div.) & F.P. No. 1080 Of TPS IV Of Mahim (Div.), Mumbai by M.H. & A.D. Board. Mumbai

184. MHADA Housing Development Project for MIG scheme on Plot Bearing S. No.309 At Village Pathardi, Nashik by M.H. & A.D. Board. Mumbai
185. MHADA Housing Development Project for EWS, MIG & LIG Scheme On Plot Bearing S.No.609 At Adgaon Shiwar, Nashik by M.H. & A.D. Board. Mumbai
186. Redevelopment the existing Transit Camp with Transit & MIG type tenements at Gaikwad Nagar, Malwani, Mumbai by M.H. & A.D. Board. Mumbai
187. Redevelopment at CTS No. 145, at Gavanpada, Village Mulund (E), Mumbai -81 by M.H. & A.D. Board. Mumbai
188. Redevelopment of Transit Camp with Transit, EWS & MIG types tenements at S.No. 113 (PT), C.T.S. No. 356 A of Hariyali–E-Village, Kannamwar nagar Vikhroli (East), Mumbai. Town/Tehsil: Vikhroli District: Mumbai by M.H. & A.D. Board. Mumbai
189. Development of building for Economically Weaker Sections and MIG type tenements at land bearing C.T.S No 1C/1/1 (Part) Shimpavali of Village Kandivali at Charkop, Mumbai by M.H. & A.D. Board Mumbai
190. Redevelopment Of Existing Mill For M/s. Shreeniwas Cotton Mill Of Property Bearing C.S. No.2/443 Lower Parel (Division) Situated At Shankarrao Naram Path Marg, G/South Ward, Mumbai by M.H. & A.D. Board Mumbai
191. Redevelopment Of Existing Transit Camp Under Mass Housing Scheme Of Transit LIG/ MIG/ HIG Type T/S On Land Bearing C.S. No.4 (Part) Salt Pan Division In F/N Ward. At – Sion, Mumbai by M.H. & A.D. Board Mumbai
192. Redevelopment of transit tenements for providing alternate temporary accommodation for residents of old dilapidated buildings in Island city of Mumbai and High Income Group tenements under Mass Housing Scheme at Gorai Road, Borivali (West), Mumbai (Gorai I) by M.H. & A.D. Board Mumbai
193. Redevelopment of Transit Tenements by constructing Transit & HIG tenement at C.T.S. No. 240, S.No. 23/1, 23, 25 (pt), 26, 27, 29, 31, 131, 134, 137 (A), 137 (B) & 197 at Gorai road (part –II), Borivali (W), Mumbai (Gorai II) by M.H. & A.D. Board Mumbai.
194. Redevelopment existing Transit Camp with Transit, LIG & MIG type tenements at New Magathane, Borivali (E) Maharashtra by M.H. & A.D. Board Mumbai.
195. Redevelopment of existing transit camp under mass housing scheme of Transit/LIG-1/MIG-1 Type T/S on land bearing C. T. S. No. 194-A/9/1,5,8,9 at Pant Nagar, Ghatkopar, Mumbai for M. H. & A. D. Board
196. Redevelopment of Existing Transit Camp with HIG type tenements on CTS No. 7643 at Bharat Nagar, Bandra (East) for M. H. & A. D. Board Mumbai.
197. Redevelopment Of Rehab Units Under Mass Housing Scheme On Land Bearing C.S.No.- 2/501(PART), Sub Plot No.1,2 & 3 At Sector -V, Dharavi, Mumbai For Dharavi Redevelopment Project/S.R.A for M. H. & A. D. Board Mumbai.
198. Development of the MIG/LIG/EWS type tenements with training centre in village Kopari at Powai, Mumbai, Maharashtra for M. H. & A. D. Board Mumbai.
199. Development of Transit Camp & LIG Type Tenements at C.T.S No. 6/1 (part) at Turbhe Mandale Village, Mankhurd, Mumbai, Maharashtra for M. H. & A. D. Board Mumbai.
200. EWS Mass Housing Scheme at S.No. 13 Bhandarli,Tal-Thane for Kokan Housing and Area Development Board (MHADA).
201. EWS Mass Housing Scheme Survey .no.80, 81 Bhandarli, Tal-Thane, Maharashtra for Kokan Housing and Area Development Board (MHADA).

202. EWS Mass Housing Scheme at S. No. 157/1, Gotheghar, Tal-Thane, Maharashtra for Kokan Housing and Area Development Board (MHADA).
203. EWS Mass housing Scheme S. No. 86,95, 133 Shirdhon, Taluka Kalyan for Kokan Housing and Area Development Board (MHADA).
204. Development of EWS Mass Housing Scheme at S.No. 162, Khoni, Kalyan for Kokan Housing and Area Development Board (MHADA).
205. Establishing Temporary Casting Yard for Housing projects undertaking by M.H.A.D.A. & Govt. of Maharashtra, aided by central Govt.s JNNURM project planning at CTS. No. 6/1 9P), Village – Mandale & CTS. 10(P) Village – Turbhe , Off Sion –Panvel Highway, Mankhurd, Mumbai for M.H.A.D.A
206. Redevelopment Of Existing Transit Camp Under Mass Housing Scheme Of Transit T/S On Land Bearing C.S No.651 (P), Plot No. 97 C (Pt). At Cuff Parade,Colaba, Mumbai. (Phase I and Phase II) for M. H. & A. D. Board Mumbai.
207. Redevelopment of Existing Transit Camp with MIG, EWS Type Tenements; At C. S. No. 1506, Fisherman Colony, Mahim Creek for M. H. & A. D. Board Mumbai.
208. Construction Of Residential Quarters For Mumbai Policemen at Land Bearing NO. 78, 79,79A, 80 & 80A, C.S. NO. 801, 802, 802A, 803 & 803A, At Worli (Plot –I) for M. H. & A. D. Board Mumbai.
209. Construction Of Residential Quarters For Mumbai Policemen at Land Bearing NO. 94 & 93A, C.S. No. 818 & 817 A, At Worli (Plot –II) for M. H. & A. D. Board Mumbai.
210. Construction of Residential Quarters for Mumbai Policemen at plot no. 940, C.S.No. 1 / 179 F.P No. 9 at Wadibunder, Mumbai for M. H. & A. D. Board Mumbai.
211. Mass Housing scheme (UL-I & UL-II) in Sector 19a, Ulwe, Navi Mumbai for M/s. CIDCO Ltd.
212. Mass housing scheme of KH I, KH II, KH III & KH IV type in sector 16 & 17 for M/s. CIDCO Ltd.
213. NRI residential development Navi Mumbai, CIDCO
214. CIDCO Exhibition Center Vashi
215. Residential Building "Shiv Parvati C.H.S.L" on Plot No. B, RSC-54, MHADA Layout, C.T.S. No.1C/1 (part) of Village, Kandivali (West), Mumbai for Shiv Parvati C.H.S.Ltd.
216. Development “67 SHILL” on Plot Bearing S. No. 67, H.No.1 at Village SHILL, Thane for M/s. Riddhi Siddhi Skyline Builders and Developers LLP.
217. Slum Rehabilitation Scheme on plot bearing C.T.S. No. 65(pt), 66, 66/1 to 51 of village Andheri at Andheri (West) Mumbai-400 058. For “Ashyana (Andheri –West) S.R.A CHS. Ltd by M/s. Millionaire Reality.
218. Residential Scheme “Pristine Developers” On S. No. 167, At Wakad, Dist. Pune by M/s Pristine Properties
219. Cosmos Horizon “Residential Cum Commercial Project” at Survey No. 192/2A (P), 192/2(B), 193/2B(P), 3B(P), at Pokhran Road - 2, Village Majiwade, Thane (West), Dist. Thane, Maharashtra by M/s. Concorde Developers.
220. SRA Project “Terrapolis Atrius” on Plot bearing C.T.S No. 509, 510, 510/1to 8 Village Nahur, Motinagar, L.B.S. Road, Mulund (W), and Mumbai by M/s. Terrapolis Asset PL.
221. Residential Redevelopment Project “Tarachand Compound” on Plot Bearing C.S. No 362 of Mazgaon Division At Junction Of D.N. Singh Road & Hathi Baug Lane Off Sheth Motisha Lane in E Ward, Mumbai, Maharashtra M/s Hemali Investment & Finance Pvt. Ltd.

222. Residential Complex “Seema Residency” at Survey Nos. 46(Pt.), 47(Pt.), 49(Pt.), 51(Pt.), 52(Pt.), 53(Pt.) at, Village - Varap, Taluka - Kalyan, District – Thane by M/s Atlanta Landmark
223. Residential Complex at Plot Bearing S. No. 189/1/1(P), 190(P), 192/1(P) At village Majiwade, Thane (W) by M/s. Ravi Realtors
224. Residential cum commercial project "Sudama Regency" on plot bearing S. No. 156, H. No. 1/B, 1/C, 1/D – 2 & 3 and S. No. 164 on Shil Phata – Diva Station Road, Village Dawle, Thane (W) by M/s. Shree Siddhivinayak Enterprises.
225. Residential Development “JMJ ATLANTIS” at Plot No. S. 28/4, 28/5, 28/6, 28/7, 28/8, 28/9, 28/10, 28/11, 28/12 at Kondhwa, Pune by M/s JMJ Infrastructure Pvt. Ltd.
226. Slum Rehabilitation Development “STAR LIVING” SRA C.H.S.L.at CTS No. 7 (Pt), 8(Pt), 30, & 31 of Village Naupada, Gokhale Road, Thane (West) by M/s. Theme Developers Pvt. Ltd.
227. Cosmos Classique” On Plot Bearing S.No.120 II.NO.3, S.NO.140 H.NO. 6, S.NO.140 H. NO.7, S.NO.141 H.NO.5, S.NO.141H.NO.6A, S.NO.141H.NO.6B, S.NO.140 H.NO.9. S.NO.140 H.NO.11, At Village- Kolshet, Taluka & Dist-thane, Maharashtra by M/s. Concorde Builders
228. Residential Project at Survey No.1004, Near Mico Circle, Nashik by M/s. Pancharatna Buildcon Pvt. Ltd.
229. Redevelopment of property bearing C.S. No. 1255, 1256, 1257, 1258,1260, 1261, 1262, 1263, 1264, 1265, 1308, 1309, 1310 & 1311 of Byculla, Div., situated at Shaikh Burhan Kamruddin Street , Temkar Street E-Ward , Mumbai, Maharashtra M/s. Mohd. Husain Jalaluddin Nirban.
230. Redevelopment of Property situated at F. P. No. 482 of TPS IV Mahim Division, Bhavani Shankar Road, known as Padhyewadi, in G/N Ward, Dadar by M/s. Karwa and Kewal Kiran Realtors (AOP)
231. SRA scheme on plot nos.286 to 294, 294A of Seweree Wadala Scheme No.57 (N) Mumbai for Sanyukt Ekjut SRA CHS by M/s. Grace Erectors.
232. Residential Cum Commercial Complex “ Hill Spring” at S. Nos. 185/2, 3, 4, 186, 187 of village Kavesar, Ghodbunder Road, Thane by M/s Velocity.
233. Residential Complex “Greeshma Residency” at plot bearing C.T.S. No. 188(Pt), Plot – B, A1, At Village Naupada, Thane by M/s. Shree Saptashree Builders & Developers P L
234. S. R. scheme under clause 3.11 read with clause 3.5 & 3.19 of Appendix IV of DCR 33(10) on land bearing CTS Nos. 16A (pt), 16A/3 to 13 of village Malad at Appa pada, Malad-E, Mumbai by M/s. Neelkanth Ghanwat & Others.
235. Development on Plot Bearing S. NO. 155/1/B, 155/4/1/B, 156/2, 157/1/B, 157/2, 162/1, At - Village Khidkali, Thane by M/s. Concorde Realty.
236. Development of building for welfare center & office building on plot bearing CTS No. 1-C/3A (PT) Survey No.41/1A (PT) of village Oshiwara, Jogeshwari (W) by M/s. Sonata Realty Pvt. Ltd.
237. Residential Project “VISION HEIGHTS” At C.T.S. No. 68/A/1 & 68/A/2 (Old C.T.S. No. 68-A, 68-A/1 to 23, 69, 69 1 to 47 of Village Bandivali, Jogeshwari (West), Mumbai by M/s.Vision Developers.
238. Building on amalgamated plot bearing C.S. NO. 1492, 1/1492, 2/1492, 3/1492 and 4/1492, building known as ‘B’, ‘G’ ‘K’, ‘L’ ‘C’, ‘AEM’, ‘F & H’ Block situated at the

Junction of Mata Ramabai Ambedkar & D. N. Road, 'A' Ward, Fort – Division by M/s. Beauty Lifestyles & Homes Pvt. Ltd.

239. Slum Rehabilitation Scheme at C.T.S. No. 444 (pt) Of Village Malwani, Marve Road, Malad (W), Mumbai – 95, Maharashtra. For TAKSHASHILA (MALAD) SRA C.H.S. (PROP)" by M/s Sai Construction Company
240. Redevelopment of Jai Maharashtra Nagar CHS Federation Ltd. at S. Nos. 50, [51-41], 52 & 54 of village Magathane, CTS No. 183(pt), 191(pt) & 197(pt) at MHADA Lay-out, Borivali (East) by M/s. Jai Maharashtra Nagar Development Pvt. Ltd.
241. Living Heritage Centre at Survey No.25, Kharghar, Navi-Mumbai by Surabhi Foundation for Research & Cultural Exchange (Surabhi FORCE).
242. Slum Rehabilitation project (Ramjinandan CHS) at C.T.S. no. 151 (pt) to 154 (pt), 160 to 169, 170 to 173, 278 (pt), 279 (pt) at village Borla, Govandi, M/E Ward by M/s. Rameshwar Corporation.
243. Residential Building at Village Ambivali at C.T.S No 844/22,822/26,844/31 & 844/32 of Village Ambivali at Shah Industrial Estate, Andheri (W) by M/s. Gammon India Ltd.
244. Slum Rehabilitation Scheme (Malwani Mahakali Nagar (SRA) Co-op HSG. Society) at C.T.S No. 2841 (pt) of village Malvani at Malad (W) by M/s. Grace Estate Development Corporation.
245. Slum Rehabilitation Scheme at C.T.S. no. 1178-A, 1178-B, 1179-A, 1179-A/5A, 1179-A/8A, 1179-A/9, 1179-A/11A, 1179-A/12 to 1179-A/137, 1179-A/143 to 167 & 1179-B, 1179-B/1 to 4, 1179-B/5B, 1179-B/6, 1179-B/7, 1179-B/8B, 1179-B/10, 1179-B/11B & non slum plot bearing C.T.S No. 1179-A/138 to 142 of village Dahisar, Taluka Borivali at R.T. Road, Krishna colony, Opp. Rajashree Talkies, Dahisar (East) by M/s. Thacker Construction
246. Residential Building Project at CTS No. 5/10/1 to 5/10/6 of village Borla, Taluka, Kurla, 'M' –Ward, Chembur, Mumbai by Kutchi Sarvodaya Nagar Trust
247. Rental Housing Project at Survey No. 45/4, 45/8B, 45/9, 45/18(PT), 45/11 (PT) at village –Shiloter Raichur and Survey No. 173/0 at Village Aakurli Tal Panvel District Raigad by M/s. Vinay S. Agarwal Developers.
248. Samriddhi Residential Tower (A&B) and Commercial & Star Hotel Building Project by M/s. Sunshine Housing Pvt. Ltd.
249. Education Institute at SF-6, CTS. No. 4207(pt), At B.K.C, Mumbai by Taleem Research Foundation.
250. Residential Project at Plot Survey Number 218, 219, 221, 222, 223, 224 (part) 293, 294 (part) of Bhukum village by M/s. Sigma Realty
251. CRZ clearance for Office Building At Nepean Sea Road by MSRDC.
252. Environmental Clearance for Rental Housing Project by MMRDA.
253. Residential Building On Plot Bearing C.T.S No. 284 Of Village Bhandup, Mumbai by M/s. Marathon Realty Pvt. Ltd.
254. Housing Scheme at Survey Nos. - 67, 70/1, 71, 72, 73, 74/1, 74/8, 77/1, 77/2P, 78/2, 78/3, Village Chikloli, Ambernath (E) by M/s. Sai Ashray Developers Pvt. Ltd.
255. Residential Development on plot bearing CTS No. 1651, 1653 & 1654 of Bandra-C Village, Situated at Ambedkar Road, Bandra, Mumbai Shree Ahuja Properties Pvt Ltd.
256. Redevelopment Of Existing Building No. 1 To 7, Known As Saptarshi Co-op Hsg. Society Ltd on Plot Bearing CTS No. 475(pt) at Swadeshi Mill Compound, Chunabhatti – Sion, Mumbai by M/s. S. B. Developers

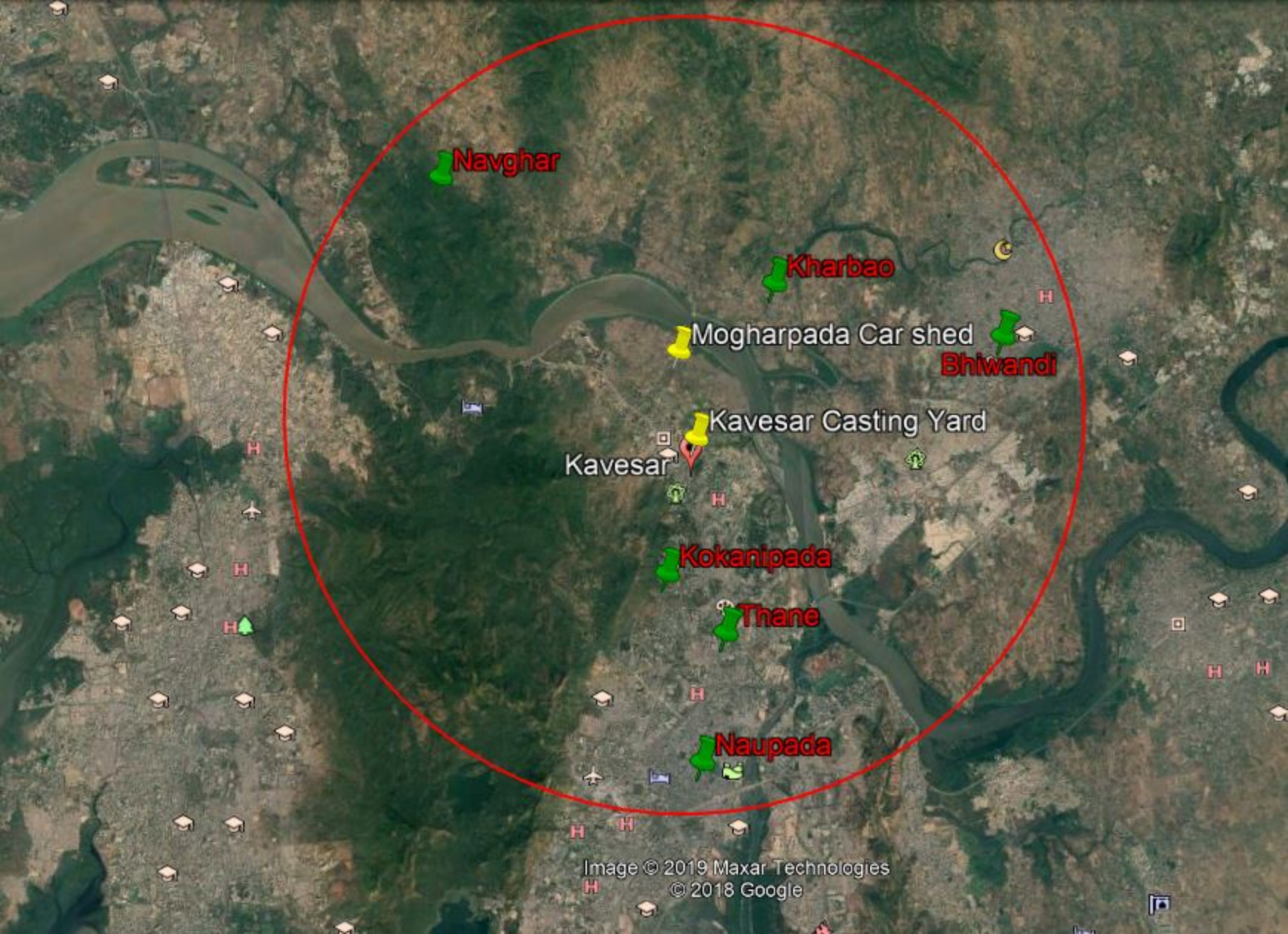
257. Head Quarters and Training Center for Mumbai Police by Maharashtra State Police Housing & Welfare Corporation Ltd.
258. Redevelopment of Police Staff Quarters on Plot Bearing C.T.S. No. 258/A, Aarey Village (SRPF) at Goregaon (East), Mumbai by Maharashtra State Police Housing & Welfare Corporation Ltd.
259. Proposed Construction of 672 Residential Quarters For S.P. Satara, at C.S. No. 92 and 197 (286 Old), Peth Malhar (Superintendent Of Police Head Quarters) Satara, Dist. Satara by Maharashtra State Police Housing & Welfare Corporation Ltd.
260. Police staff quarters residence on plot bearing CTS no. 4,4/1,4/2, 4/3 of village Marol at Andheri (E), Mumbai by Maharashtra State Police Housing & Welfare Corporation Ltd.
261. Construction of 280 quarters including all infrastructural amenities for C.P. Nagpur at Takli, Nagpur by Maharashtra State Police Housing & Welfare Corporation Ltd.
262. S. R. Scheme on plot bearing C.T.S No.1 (Pt), of Village Deonar, Bhujbalwadi/ Bhimwadi, Situated at Ghatkopar Mankhurd Link Road/Govandi Station Road, Govandi, Mumbai by M/s. Fat Cat Infrastructure Pvt. Ltd.
263. Anandam World City Project at Model Mill Ganesh Peth, Nagpur by M/s.Goldbricks Infrastructure Pvt. Ltd.

List Of Important TOWNSHIP AND AREA DEVELOPMENT PROJECT IN THE STATE OF MAHARASHTRA - Consultancy Projects:

264. Expansion project for construction of residential cum commercial complex at plot bearing C.S. No.1798, 1841, 16/1840 of Byculla Division, Byculla (West), Mumbai by M/s. Swayam Realtors & Traders LLP.
265. LIG. MIG AND HIG type buildings at S. no 116/1 to 5 at Mauza, Waddhamna, Nagpur for NH & AD, Board. Nagpur.
266. Construction of Residential Apartment Scheme at Plot No. 1 to 6, CTS No. 101, 154, 155 & 159, Sheet No. 227 & 233, Subhash Road, Nagpur, Maharashtra for NH & AD, Board. Nagpur.
267. Development Of Existing Textile Mill (Bombay Dyeing) At C.S. No. 223 (Pt), 1/983 (Pt) Of Dadar, Naigaon Division, Wadala, Mumbai for M.H. & A.D. Board. Mumbai
268. Expansion of Residential Cum Convenience Shopping Project On the Land Of MHADA At S. No. 376 (Pt), 392 (Pt) At Virar/Bolinj, Tal. & Dist, Palghar by Konkan Housing & Area Development Board, Mumbai (MHADA).
269. MIG & HIG Mass Housing scheme at sector 36, Kharghar (Phase I) by M/s. CIDCO Ltd.
270. EWS/ LIG Mass Housing scheme at sector 36, Kharghar (Phase II) by M/s. CIDCO Ltd.
271. Seawoods (NRI Complex) project at Nerul, CIDCO
272. Residential Development on plot bearing C.T.S. No. 491A/6 and 491A/5 of Nahur village, Mulund, Mumbai, Maharashtra by PRL Developers Pvt. Ltd.
273. Development "NEST'" at S. no. 274, 414, 415, 416, 417, 418, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 450,451, 452, 453, 454, 455 & other, Village Bhugaon, Tal Mulshi, Dist Pune by M/s. Enerrgia Skyi Developers.
274. Residential cum Commercial Project "ANMOL NAYANTARA CITY- 1" at Survey No. 785/1+2+3/3/3, 785+2+3/6, 785/1+2+3/1, 778/1/C, 778/2 B (P), 785/1+2+3/9, 785/(P) ,

Tidke Colony, Near Durwankur Lawn, Near Mico Circle, Nashik, Maharashtra by Bafna Realtors Pvt. Limited.

275. Residential Cum Commercial Group Housing Scheme.'' Suyojit Viridian Vallis,'' on land bearing survey no. 145/1,145/3,149/1,149/2,151,152,155/2(Pt), of village Makhmalabad, Nashik by M/s. Sun Infrastructure Pvt. Ltd.
276. International tech park SEZ for International Tech Park (MADC)
277. EC for the re-development project by Patel group and company developers and infrastructure.
278. Development of Ambey Valley by Sahara India Pvt. Ltd.
279. Development on 500 acres of land by The solitude Pvt. Ltd.
280. Township Project (Annanya Resort & Residences) at Alibaug by Annanya Resorts and Residences Pvt. Ltd.
281. Residential and commercial project at Mouze Jat Tarodi, 211 Medical Squares, Rambagh, District Nagpur by TRIF real estate and development Pvt. Ltd.
282. CRZ clearance for expansion project of Rising city by Rare Townships Pvt. Ltd.
283. Commercial Complex on plot bearing CTS No. 110-A, 110-B and 110-C of Village Kurla-II situated at junction of Kale and LBS Marg, Kurla (W), Mumbai by PRL Agastya Private Limited.
284. Knowledge City (Vill. Lavale, Pune) by Oxford Properties Group
285. Malabar Hill (Hinjewadi, Pune) by Riddhi-Siddhi Nahar Group
286. Eiffel City (Vill. Lavale, Pune) by Riddhi-Siddhi Nahar Group
287. Residential Township & Commercial Pride Purple (Pune) by PRIDE Group
288. Residential Township & Commercial Neelkanth Rice Lands Pvt. Ltd. (Panvel) by Neelkanth Group.
289. Cornell Infrastructure Pvt. Ltd. (Thane) by Marathon Group
290. Residential Township & Educational, Commercial development by Lonavalley Township Pvt. Ltd. (Lonavala)
291. IT – Park Development. (Mumbai) by Reliance Energy Ltd.


Navghar
Kharbao
Mogharpada Car shed
Bhiwandi
Kavesar Casting Yard
Kavesar
Kokanipada
Thane
Naupada
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