Environmental Impact Assessment Report

SEPTEMBER 2017

Township Project in NAINA New City, at Vardoli, Panvel Taluka, Raigad Maharashtra

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Submitted to

Expert Appraisal Committee (Infra – 2),
Ministry of Environment & Forest and Climate Change
Indira Paryavaran Bhavan, New Delhi

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1. INTRODUCTION

1.1 Preamble

M/s Wadhwa Construction & Infrastructures Pvt. Ltd. has proposed a Township in Vardoli, Panvel taluka, in Raigad district of the State of Maharashtra. The Township will have clusters of housing and commercial businesses with associated infrastructure such as roads, schools, health care units, convenience shopping, water treatment plants, drainage and sewage facilities. To maintain the green ambience, it has been proposed provide large portion of the land as open green land for recreation purposes and healthy environment. The proposed project aims to integrate the development into a self-sufficient township with the needs to protect the environment as the main feature of developmental plan. It is located to the south-east of Navi Mumbai and the Panvel city at a distance of --- & -- kms respectively. The Site is within the new city 'NAINA' under planning and development by the City and Industrial Development Corporation (CIDCO) of Maharashtra. The Project area is within the land use zone of 'Predominantly Residential' use as per NAINA DP. Thus , the Site has potential to develop as it will also cater to reduce the urban pressures of the existing developments in Mumbai Metropolitan region.

1.2 Purpose of the Report

Environmental Impact assessment (EIA) is a process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of developmental proposals prior to major decisions being taken. EIA provides general information pertaining to purpose of the report, identification of project and project proponent. It also includes scope of study as well as regulatory scoping and organization of the report. The objective of this EIA is to foresee the potential environmental problems that would arise out of a proposed development and address them in the project's planning and implementation stage.

1.3 Identification of Project and Project Proponent

1.3.1 Project Proponent

M/s Wadhwa Construction & Infrastructure Pvt. Ltd is the Project Proponent of proposed township project. AECOM (India) has prepared the concept Master Plan and Infrastructure Plan of the project and Hiten Sethi & Associates Pvt. Ltd. Have done detail planning, architectural design and landscape design for the project. . Building Environment India Pvt. Ltd. has been appointed by the PP as an independent EIA consultant for carrying out environmental impact assessment studies for the proposed project.

1.3.2 Project Identification

The type of project is 'Township' which will be developed under Special / Integrated Township Policy of the State Government. . The State Government, under the Maharashtra Regional Town Planning Act, had on 10th March 2006, framed the special regulations for development of Special Township. These regulations were sanctioned under Section 20 of the Maharashtra Regional Town Planning Act (MRTP Act), 1966 and form part of the 14 regional plans in the State including that of Raigad district. The State Government has from time to time amended these regulations of Special / Integrated Townships.

The project area is within NAINA, the new 'Smart City' being developed by CIDCO near Navi Mumbai. The site is within proposed 'Predominantly Residential' land use of NAINA Development Plan. Uses permissible in 'Predominantly Residential' land use are residential, commercial, institutional / public / semi-public, transportation, green areas and utilities. Thus the proposed project is within the permissible use of the given land use.

1.4 Brief on the Project

1.4.1 Nature, Size, Strategic Location of the Project

Nature of Project : The Project has been notified by the Government of Maharashtra vide Gazette Notification no. TPS.1714/451/CR-70/15/UD-12, dated 02.12.2015 and provided 'Locational Clearance' for the township admeasuring 142 acres. The project was further granted Letter of Intent by SPA-NAINA (CIDCO), the Special Planning Authority of the area vide CIDCO/NAINA/PLNG/STP/BP-236/LOI/2016/4968, dated 25.11.2016 for an area of 137.73 acre (out of the 142 acres that were notified by GoM).

The township project is proposed under the State Governments township model which predominantly includes the following:

- Residential development (along with housing for EWS/LIG)
- Economic activities, including commercial, retail, office spaces, places of employment, markets etc.
- Health facilities
- Education facilities
- Open areas / parks / playgrounds &

- Utilities and service area

The allotment of land and built up area for each use is as per the approved Township Policy and is detailed further in Chapter 03.

Size and Location: The project is proposed over an area of 137.73 area. The site as an access from an exisiting road to the north. Further, the project area is under NAINA (Navi Mumbai International Airport Influence Notified Area) City. This is a new city to be development adjoin the present Navi Mumbai – Panvel corridor. CIDCO has been appointed as the Special Planning Authority (SPA) by the State Government in January 2014 and as required under MRTP Act 1966, it has prepared and published a Development Plan of the area under its jurisdiction. The proposed township project is in the residential zone of the published Development Plan of NAINA. As required under the said township policy and after Locational Clearance from the State Government, the project proponents had approached CIDCO (SPA-NAINA) for Letter of Intent (LOI) for developing the township. CIDCO has issued the LOI, for an area of 137.73 acres. In addition to the existing road (which is proposed to be widened to 24 mts in the DP), 02 DP Road of width 36 mts will provide increased accessibility to the project and also integrate the proposed developments with those of NAINA. The site is predominantly flat, with the south-eastern portion sloping upwards. The present location and the upcoming new city of NAINA, provide strategic linkages to the project that is estimated to house a population of 49000 persons (including floating population).

1.4.2 Key features of the proposed project site

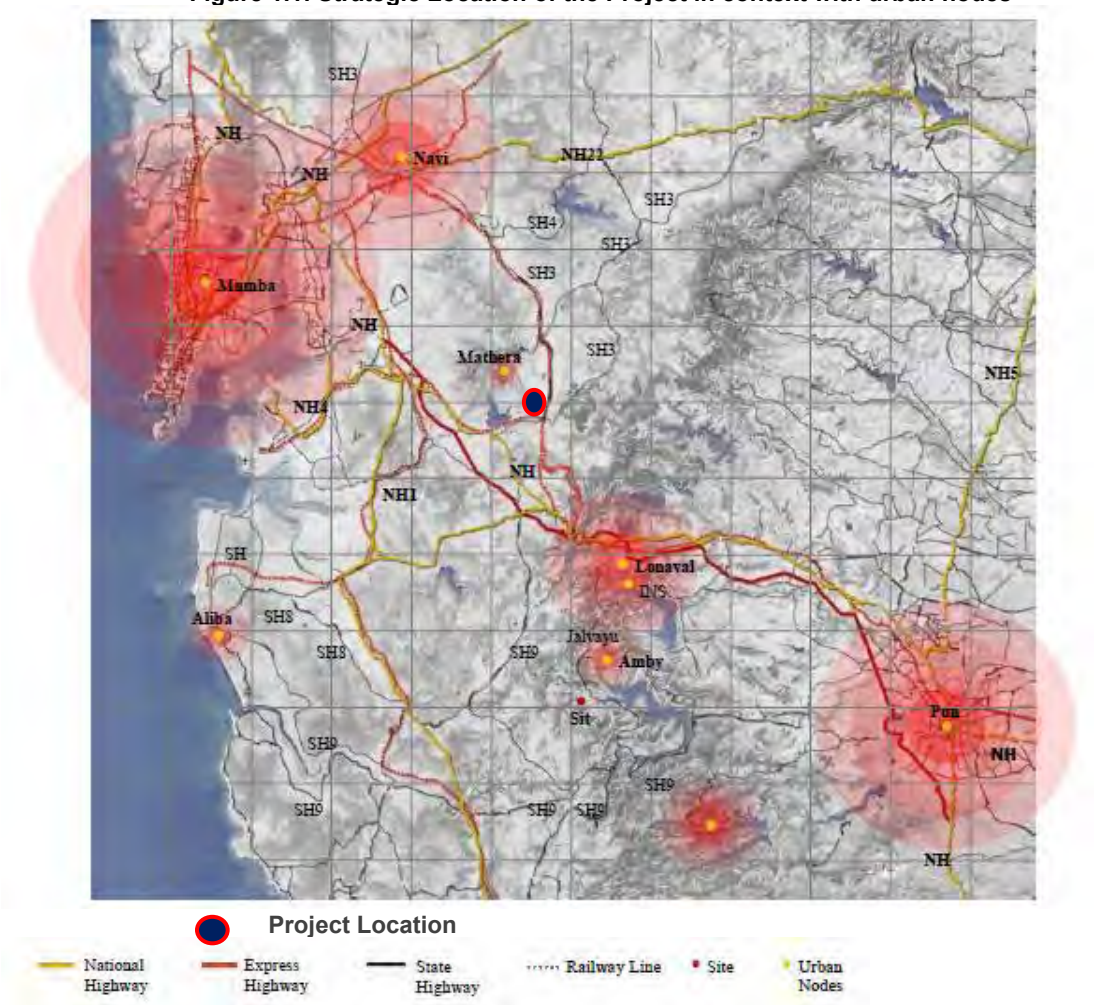
- Part of new 'Smart City' of NAINA
- Close proximity with two developed urban nodes i.e. Navi Mumbai and Panvel City .
- The Site area at present is unutilized and proposed to be developed for 'predominantly residential' use as per NAINA Development Plan. .
- Major portion of the Project site is relatively flat with hard strata (more details in Chapter 4.4.5 on Geology), making it suitable for the construction and development activities.

1.5 Importance of the Project to the Country, Region

Navi Mumbai is one of the largest planned townships in the Region. With a view to decongest Mumbai, development planning of Navi Mumbai started in 1971. The region started getting recognized as a destination for the middle-class population who were unable to afford houses within prime Mumbai or were not keen to move towards in the extended western suburbs of Mumbai i.e. Dahisar to Virar. In due course, because its good connectivity with Mumbai via road and rail, coupled with relatively affordable price points, it started attracting various classes of buyers.

The project site is around -- km from Navi Mumbai and -- kms from Panvel City . With such increasing urbanity in close vicinity, the development is likely to reach in and around the Site. The region is well-connected with Mumbai and Thane via road and rail network. . The NAINA City will further add to the connectivity of this region with its proposed Multi Modal Corridor (120 mts wide) connecting Mumbai with the new upcoming Airport. The present and future connectivity of the region makes the site an important location for township developments. The project is offering housing options for middle income groups and economic weaker section at reasonable prices in the region. This is expected to develop this project as an important residential destination near Navi Mumbai along with commercial, education and health facilities. The Project site location is shown in **Figure 1-1.**

Figure 1.1: Strategic Location of the Project in context with urban nodes



1.6 Scope of the EIA Study

1.6.1 Legal Requirement, Categorization of the Project and Chronology of application to SEAC-II (MMR), Maharashtra and EAC.

As per EIA Notification dated the 14th September 2006, all Projects and activities are broadly categorized in two basic categories - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural, manmade resources.

All projects or activities included as Category 'A' in the Schedule, including expansion and modernization of the existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests, Climate Change (MoEF & CC) on the recommendations of an Expert Appraisal Committee (EAC) to be constituted by the Central Government for the purposes of this notification.

All projects or activities included as Category 'B' in the Schedule, including expansion and modernization of existing Projects or activities as specified in sub paragraph (ii) of paragraph 2, or change in product mix as specified in sub paragraph (iii) of paragraph 2, but excluding those which fulfill the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) to be constituted as per this notification. In the absence of a duly constituted SEIAA or SEAC, a Category 'B' Project shall be treated as a Category 'A' Project.

Based on the then prevailing norms for EC, the Project Proponent applied to the SEIAA of Maharashtra for EC on 5th May 2015. As per then prevailing norms, the proposed project was designated as a project under project or activity 8 (b) as a "Township project" of category "B" of the Environmental Impact Assessment (EIA) Notification dated 14th September 2006.

The proposal submitted to SEIAA / SEAC-II (MMR) on 5th May 2015, had the following salient features:

(i) **Total land area** 638.97 Ac (including 126 acre area in Buffer Zone of Matheran Eco Sensitive Zone as notified by MoEF & CC's Notification, dated 04.02.2003).

(ii) **Total construction up area** 18,32,645.17 Sqm

(iii) **Approvals** : Township Notification (by State Government) in process. Developments proposed in buffer zone under consideration of Matheran Monitoring Committee and the District Collector.

This proposal OF 638.97 acres was submitted as the Project Proponent wanted to place the complete and integrated long term proposal for the developments before the Authority, so that a comprehensive evaluation of environmental impacts can be done. The objective of the Project Proponent was that, even though the project would be taken up in phases (of say 150 acres at a time), the environmental impact be studied as a whole for all the developments envisaged by them. Draft TOR for EIA was also proposed to the SEAC.

In July, 205 the project and draft TOR was present to the SEAC-II (MMR). The SEAC approved the TOR with additional (points / aspects to be covered) TOR on 23rd July 2015.

On 15 Feb 2016, the Project Proponent submitted Form 1, Form 1A and EIA Report to the SEAC.

In Oct 2016, the Project Proponent presented the proposal and EIA before the SEAC.

In this presentation, the SEAC was informed that the State Government has notified 142 acres of the originally proposed project area of 638.97 acres as Special Township Project vide Gazette Notification dated 12.12.2015.

The MOM of 19th and 20th October 2016, show that the SEAC decided to appraise only the 142 acres of land (with a construction area of 377058 sqm) notified for Special Township and asked the PP to approach the High Level Monitoring Committee (HLMC) of Matheran, set up under MoEF & CC's Notification of Feb. 2003, for proposals in the Buffer zone of Matheran Eco Sensitive Zone (MESZ).

The SEAC also asked for 16 compliances (including the above two, on 142 ac Township area and Buffer area)

As directed by the SEAC, the PP made necessary preparations for compliances.

In Nov 2016, City and Industrial Development Corporation (CIDCO) issued the Letter of Intent for the township project for 137.73 acres (out of the 142 acre land notified by the State Government for the township project). On 9th December 2016, MoEF & CC made amendments to the '(II) In the Schedule, for item 8' and substituted the following Schedule 8 in EIA Notification of 2006:

Schedule Item	Activity	Category with Threshold Limit		Conditions if Any
		A	B	
8		Building /Construction projects/Area Development projects and Townships		
8(a)	Building and Construction projects		≥20000 sq.mtrs and <1,50,000 sq.mtrs. of built-up area#	#(built up area for covered construction; in the case of facilities open to the sky, it will be the activity area)
8(b)	Townships and Area Development projects.		Covering an area ≥ 50 ha and or built up area ≥1,50,000 sq .m	++All projects under Item 8(b) shall be appraised as Category B1

***(Extract of :** MoEF & CC's EIA Notification S.O. 1533 (E) dated 14th September 2006)*

with :

(1)	(2)	(3)	(4)	(5)
"8		Building / Construction projects / Area Development projects and Townships		
8 (b)	Townships and Area Development projects	≥ 3,00,000 sq. mtrs of built up area or Covering an area ≥ 150 ha	≥1,50,000 sq. mtrs and < 3,00,000 sq. mtrs built up area or covering an area ≥ 50 ha and < 150 ha	Note.- General Condition shall not apply".

[F. No. 19-2/2013-IA-III (Pt.)]

***(Extract of :** MoEF & CC's Notification S.O. 3999 (E) dated 09th December 2016)*

Thus, under the above amendment of 9th Dec 2016, and as required under para 4(i) of EIA Notification 2006, the project was to be, now presented to EAC. The SEAC -II (MMR) also issued a letter (SEAC2016/CR/T.C.1) on 29th April 2017 to this effect.
The PP therefore applied to the EAC for further action on the EC for the said project. As per procedure laid, the PP submitted Form 1 and Form 1A and EIA Report.
MoEF & CC's representative, Mr Suresh also inspected the site on 08.07.2017 for verification of 'no construction / development work done prior to EC'. The verification report was submiited by the MoEF & CC representative on 31.07.2017.
The present township project was included in the 21ST meeting of EAC (Infra II).
).

The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of potential environmental impacts, both negative & positive, during the construction and operation phase of the proposed project and related activities taking place concomitantly.

1.6.2 Objectives and Scope of work

- To undertake an Environment Impact Assessment (EIA) study as per the approved Terms of Reference (ToR) from SEAC-II for Mumbai Metropolitan Region (MMR) during its 34th meeting on 29-23 July 2015 (Attached in Annexure I)
- Collection of information of the project
- To establish the baseline environmental and social scenario of the project surroundings
- To identify, predict and evaluate environmental and social impacts
- Recommend appropriate preventive and mitigation measures to eliminate or minimize pollution, environmental & social disturbances during the life-cycle of the project.
- Formulate an Environmental Management Plan (EMP) that they can be implemented, monitored and suitable corrective action can be taken in case of deviations
- Conduct a Risk Analysis Study and identify the major hazards
- Recommend measures to minimize hazard levels and develop a Disaster Management Plan (DMP)
- Final EIA Report Submission to SEAC-II, Maharashtra / EAC for Prior Environmental Clearance (EC)

1.7 Limitations

The Environmental Impact Assessment study is based on the primary baseline monitoring study undertaken during March 2015 to May 2015, available secondary information, and project information provided by the project proponent and public consultations undertaken with various stakeholders.
It is understood that the Proposed Township Project will be implemented in phases. The period of development is expected as horizontal 5 years from the start of the development of the project. The impact assessment is carried out based on the detailed master plan and proposed development as envisaged for the long term.
However, to the extent possible, the likely changes in technologies over the development period has been considered in the EIA report. Appropriate scientific factors and professional judgment has been used to arrive at an approximate quantity for all such components. The study is based on the understanding that all individual projects that will be developed in the Proposed Township Project will seek separate Environmental Clearance as per EIA Notification 2006 and subsequent amendments.

1.8 Structure of the EIA Report

The objective of the study is to identify the possible environmental impacts which can be anticipated as a result of the construction phase and operational phase of the proposed Project, and to suggest suitable measures to mitigate the expected adverse impacts on the environment.

Baseline data on flora, fauna and demography has been collected from site survey study and from available secondary sources from various Government as well as Non-Governmental agencies. A sampling network was designed for field studies to collect air, water, soil and noise quality data apart from collection of data pertaining to hydrology, meteorology, and land use, which were collected from secondary sources and on-site studies.

I. Executive Summary & Conclusion
II. Addressal of Terms Of Reference
III. EIA Report
Chapter 1 : Introduction
Chapter 2 : Project Description
Chapter 3 : Description of the Environment
Chapter 4 : Anticipated Environmental Impacts and Mitigation Measures **Chapter 5** : Analysis of Alternatives (Technology and Site)
Chapter 6 : Environmental Monitoring Programme
Chapter 7 : Additional Studies
Chapter 8 : Project Benefits
Chapter 9 : Emvironmental Cost Benefit Analysis
Chapter 10 : Environmental Management Plan
Chapter 11 : Disclosure of Consultants engaged

2 PROJECT DESCRIPTION

2.1 Introduction

The proposed Township project by M/s Wadhwa Construction and Infrastructure Pvt. Ltd is envisaged to be a sustainable township that consciously integrates environmental parameters in its planning and design to provide efficient and affordable housing and related services. Following are key parameters of planning:

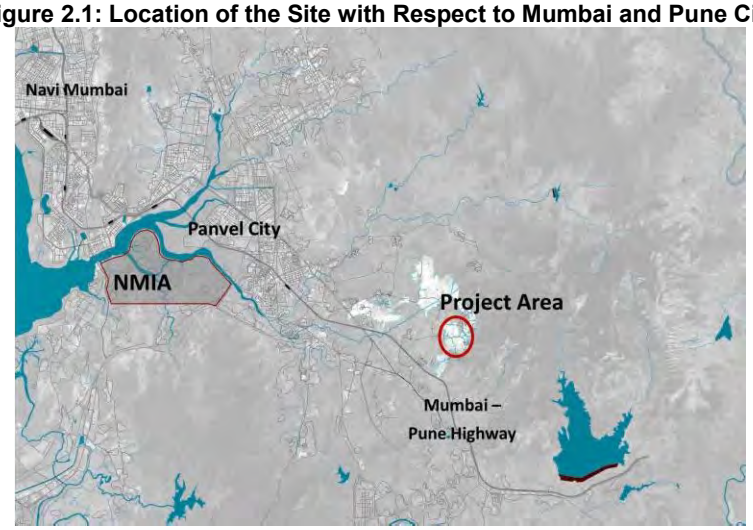
- Multi-use Planning (Residential, commercial, recreational)
- Community based planning
- Integration with environment
- Sustainable Development
- Network Efficiency & Regional Connectivity

Project planning is done for **137.73 acres**. The detail land use is given in sub-chapter on 'Master Plan' in this Chapter. This chapter presents the site appraisal, discusses the sensitivity of the site with respect to environment and provides the details of the project components planned for the proposed project.

2.2 Type of the Project

The Project is Township Project covering an area of 137.73acres at Vardoli, Taluka Panvel, District Raigad. The concept is to create a sustainable and ecological habitat by maintaining balance with ecosystem.

Figure 2.1: Location of the Site with Respect to Mumbai and Pune City

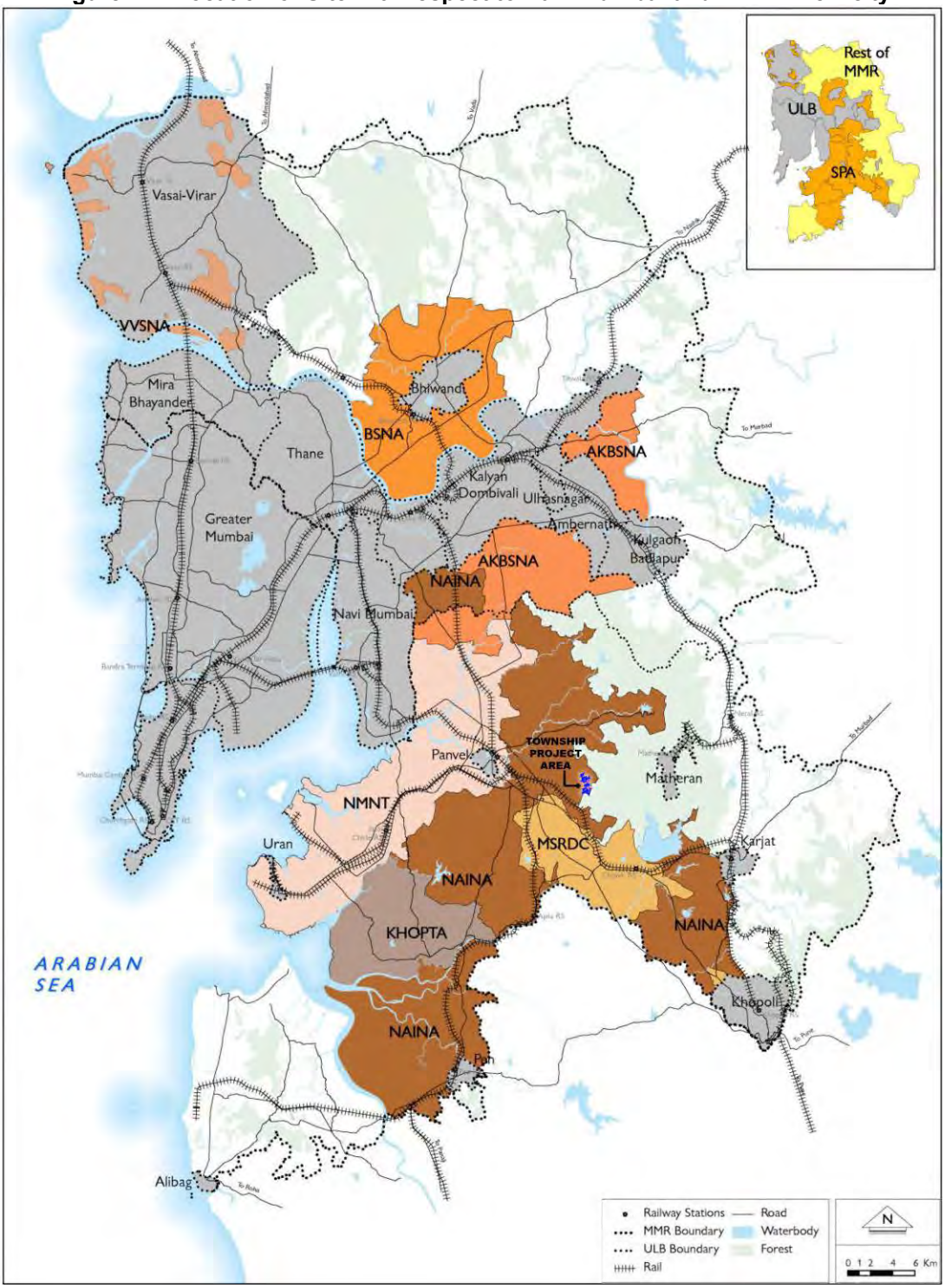


The project intends to develop residential, health care, education, institutional, public utilities, service stations, commercial, open and green areas. The project will also involve development of basic infrastructure such as roads, power supply, water supply, sewer and storm water network and waste management system.

2.3 Need of the Project

Navi Mumbai was planned and implemented, from 1970's, to reduce population pressure on Mumbai city. Today, Navi Mumbai has fully developed. It has become a hub for IT industry and the Taloja – Thane Belapur section house industrial units. Panvel is an old town, now grown into a independent node in itself with the development of New Panvel. The region now needs new avenues to grow. Further, with the new international airport coming up in Navi Mumbai, the region's future is dependent on orderly and organized growth. MoEF & CC, had during the EC for the new airport, directed the State Government to ensure that the area within 25 km of the new airport is planned properly so that the issues faced by the Mumbai airport (unorganized developments, slums etc.) are not faced again by the new airport. In response to this direction from MoEF & CC, the State Government notified the area within 25 kms of the new airport as NAINA and appointed CIDCO as the Special Planning Authority (under MRTP Act 1966) for this area. CIDCO is therefore developing this area and towards that, has prepared and published Development Plan of NAINA.

Figure 2.2: Location of Site with respect to Navi Mumbai and NAINA new city



The present township project is part of this NAINA 'New Smart City'. On a larger scale, the project will thus help in organized and planned development in the region and also provide comprehensive and integrated housing needs for the middle and lower income households of the Mumbai region. Being part of a upcoming new town, the project

also minimizes environmental impacts (as compared to a standalone green field project outside urban agglomerations) as utilities, services and transport facilities will be shared with a larger development.

2.4 Description of the Project Site

2.4.1 Site Location

This proposed development falls under the jurisdiction of Vardoli. Area within 5 Km radius from the boundary of the Project as the core zone has been considered for impact assessment and 5 km to 10 km radius from the boundary of the Project has been considered for EIA study i.e. area which can be affected by the proposed Township , as per the guidelines of Ministry of Environment & Forests, Climate Change, New Delhi. For ecological study and other studies, the area taken is 15 km radius from the boundary of the Project.

2.4.2 Site Connectivity

The site as an access from an exisiting road of ROW 18 mts, to the north. Further, the project area is under NAINA (Navi Mumbai International Airport Influence Notified Area) City. This is a new city to be development adjoin the present Navi Mumbai – Panvel corridor. CIDCO has been appointed as the Special Planning Authority (SPA) by the State Government in January 2014 and as required under MRTP Act 1966, it has prepared and published a Development Plan of the area under its jurisdiction. In addition to the existing road (which is proposed to be widened to 24 mts in the DP), 02 DP Road of width 36 mts will provide increased accessibility to the project and also integrate the proposed developments with those of NAINA. The nearest railway station (on the Panvel Karjat Rail line) is Mohope, which is about 2 kms from the site. The Panvel Karjat line is to be converted into suburban line (as provided in Indian Railway Budget 2016) and the Harbour line of Mumbai Suburban system shall be extended from Panvel to Karjat. This development planned for completion within the next 4 years, promises to substantially add to the transport network of the site.

2.4.3 Site Surroundings

The project site has access from a existing road of 18 mts ROW. This road is to the norther of the site and connects the site to NH4 (Old Mumbai Pune highway) to Shedung. Further north to the site is the Lonavli village. The site itself is part of revenue village Vardoli. The Vardoli gaothan area (residential) is entirely outside and to the west of the site. The Panvel Karjat rail line is to the south of the site and further south is the NH4. To the east of the site is the Matheran Eco Sensitive Zone (MESZ). The boundaries of the zone have been defined in MoEF & CC's Notification of Feb 2003. The said Notification defines the Core area and the buffer zone. Area outside the buffer zone is part of the NAINA new city. No part of the project area falls in the MESZ or its buffer zone area. The entire proposed project area is in the 'Predominantly Residential' zone of NAINA. To the south-west of the project area, at a distance of --- kms is the Karnala Sanctuary. In between the project area and Karnala Sanctuary, is the Mumbai-Pune Expressway, the Old Mumbai Pune highway, the Mumbai Goa National Highway, the Panvel Karjat rail line and all developments along these corridors.

Figure 2.3: Location of the Site with respect to Mumbai & Pune

Figure 2.4: Location of the Site with respect to Matheran ESZ, Karnala ESZ, Transport corridors and major existing & proposed developments.

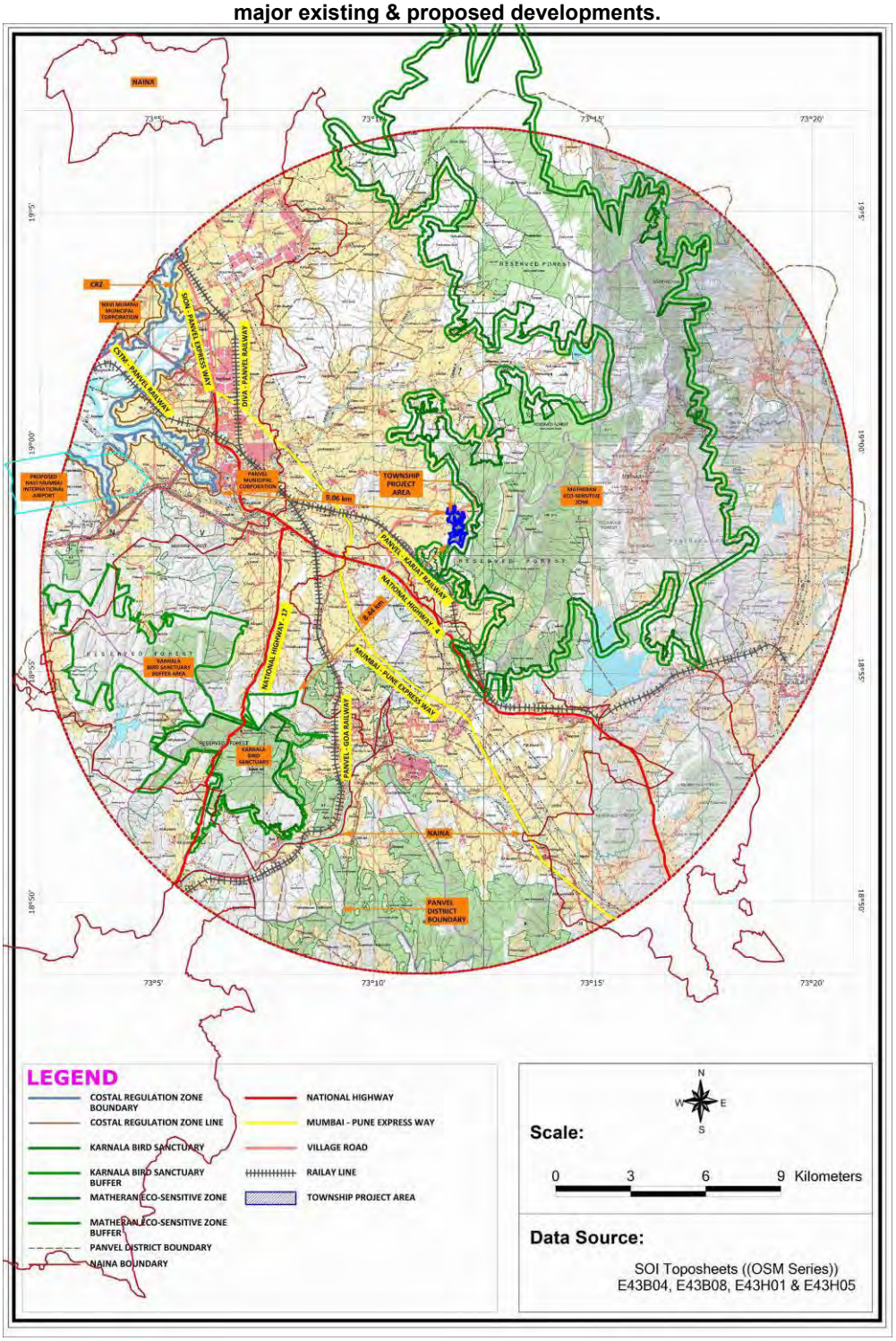


Table 2.1: Environmental Settings of the Project

Sr.	Particulars	Distance (Aerial) from the project site (kms)
1.	Latitude and Longitude	North: Latitude:18°58'33.84"N, Longitude:73°11'40.05"E South: Latitude:18°57'42.32"N, Longitude:73°11'57.22"E East: Latitude:18°58'00.49"N, Longitude:73°12'01.68"E West : Latitude:18°58'23.16"N, Longitude:73°11'30.14"E
2.	Nearest Highway	NH-4 at 3 kms from the southern boundary
3.	Nearest Suburban Rly Stn	Panvel Rly Stn at 8 km, Mohope Rly Stn at 1.38 km.
4.	Nearest Air Port	Mumbai airport at 50 km, Navi Mumbai Airport at 15 Km
5.	Nearest Town	Panvel at a distance of ~8 km
6.	Water bodies (River/ Lake)	Water stream passes through the site from east
7.	Defence Installations	None within 10 km radius of the project
8.	Seismic Zone	III

2.5 Project Overview

The proposed project is 'township' and has been planned as a mixed use development comprising of residential, commercial, health, education, transport and open space land uses. The following sections provide brief description of the project.

2.5.1 Development Concept

Rapid Urbanization is posing infrastructural challenges to governments & municipalities. As cities grow and expand their services, management and governance become increasingly complex. The Project is proposed to be an township providing infrastructure for academic institutions, students & faculty housing and support social & physical infrastructure. It is intended to have sustainable economic base and educational, institutional activities for technical & vocational skill development. The township project will have only main trunk infrastructure inclusive of the Main trunk road and the Arterial roads and allotted spaces for basic amenities, facilities and utilities. While for rest of the zones detailed planning with will have all the basic amenities, facilities and all infrastructure is proposed. The details are discussed further in the land use part of the report.

A smarter, efficient city that would encompass aspects of transportation, security, energy management, sustainability is the ideal option for decision makers and authorities. Special township concept will implement integrated communication network for data, voice, video and internet with uninterruptible power supply, high bandwidth, and redundancies. Utilities will be integrated through use of Smart Technologies and practices including smart meters, power system automation, traffic management system, Surveillance CCTV 's, Access control system along with smart amenities, smart environment, smart living, smart mobility etc.

Planning consideration is done by mapping movements from home to each amenity for different age groups, lead to wellness mapping that show health benefits for a given distribution of amenities. Co-location of educational institutions, medical facilities like college and health care units, commercial complex in the township makes academia and employment more efficient and effective.

Proposed township project will house higher education institutes including vocational training institutes and research institutes that impart education in various fields of learning, and provide the residential and recreational facilities for the students, faculty and staff. In addition to serving the training needs of students, the township also aims to encourage R&D, Nature school by setting up the necessary support systems to incubate environmental conservation education. These will typically be done through collaboration between universities and research institutes.

Table 2.2: Key Guiding Principals and Components of Concept Master Plan

Components	Approach
Transportation	• Main trunk arterial road with 4 lanes and service road including footpaths, signage, furniture, central verge • Typical C/S for Utility Crossing for 36m,, 18m, and 9m Wide Road • Intra Sectoral roads including the 18m ROW and 9m ROW Road including all footpaths, signages, furniture, central verge etc. • Traffic Signals & Street Lighting for above roads • Bridge over stream and Culverts along main trunk road
Site Grading, Storm Water Drainage and RWH	• Minimum site grading for main trunk road • Storm Water drains • RWH
Water Supply and Fire Fighting	• Bulk Flow Meters. • Fire Fighting System
Solid Waste Management	• Collection Bins required • Solid Waste collection and transfer equipment • Transfer Stations • Compost Plant
Power Supply	• 228 MVA Switchyard & Transmission lines • Solar system
Domestic Gas	• Provision for Domestic Gas receiving station • Provision for Domestic Gas distribution system including domestic gas distribution hub
Information and Communication Technology	• Fibre Optic Cables • Active network equipment including switches, routers etc. • Traffic Management System, Smart Metering as required for Water Supply and Power Supply
Miscellaneous	• Site Administrative Office and Boundary Wall / Fencing • Police and fire station • Surveillance office, security office

2.5.2 Planning Standards and Norms

To prepare a Master Plan and building plans for proposed township, the following are applicable:

1. Master Planning: Norms for townships as per Special / Integrated Township Policy of GoM, UDPFI Standards of MoUD & PA and Regional Plan / Development Plan DCR for aspects not covered in the previous two documents.
2. For Building design: Norms for townships as per Special / Integrated Township Policy of GoM, Standardized A, B, C Class Municipal Bye laws for Regional Plan and NAINA DCR.
3. For Infrastructure Planning: Norms for townships as per Special / Integrated Township Policy of GoM, UDPFI Standards of MoUD & PA and Regional Plan / Development Plan DCR and Standardized A, B, C Class Municipal Bye laws for Regional Plan.

In addition to the above, particular norms / rules / regulations of MoEF & CC, Airports Authority of India, Indian Railways etc. are applicable to individual technical aspects of design and planning.

2.5.3 Proposed Master Plan

The Master Plan has been prepared keeping the following points in view:

- Accepting the present water channel flowing through the project area as a natural feature and not changing / re-aligning / modifying it in any way. Additionally, planning the township on either side of the channel as self-sustaining parts. Hence the part - township to the north of the channel has is own residential, commercial, health, recreational, utility and education plots.
- Planning passive developments (greens, walkways etc.) along the water channel (i.e. land uses beyond the 'red line' of Water Resources Dept.), thereby leaving the water channel and the entire stretch on either side free of building developments.

- Having more than 30% of land area (excluding roads and plot level open spaces / marginal spaces) as open for play, recreation and leisure.
- Having 'no building development' on land having slope more than 1:5
- Creating water pond to house and take care of additional run-off that will occur due to change of land use from present to the proposed (even after providing for rain water harvesting at project level).
- Road alignments following natural contours.
- Integration of master planning with the Development Plan of NAINA
- Making provision for mass transits infrastructure (bus stations etc.) along 36 mts. wide road and pedestrian and cycle paths along all roads.

The proposed Master Plan and the Land use distribution for the project is attached below.

Figure 2.5: Proposed Land Use Plan for the Township

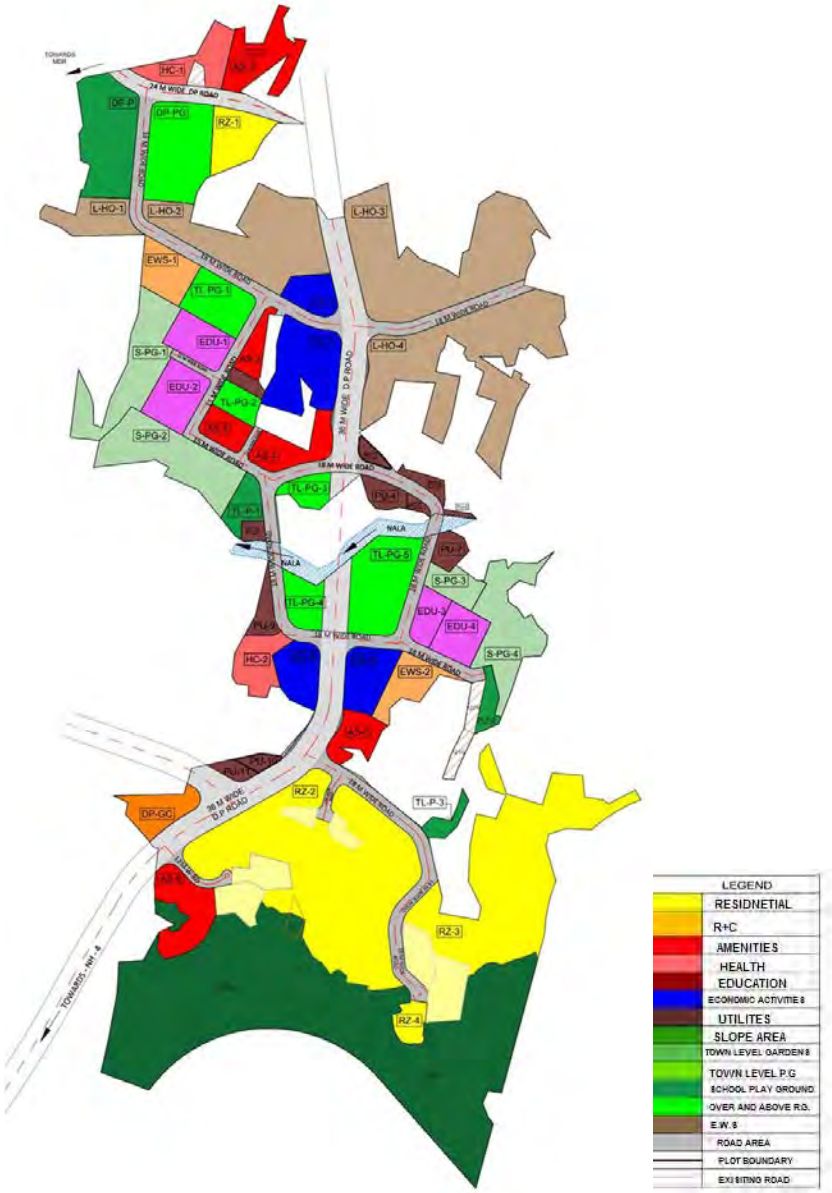


Table 2.3: Land use distribution of the Township

Sr.	Land use	Area (sqm)	Percentage
A	Project Area	557400.90	100.00%
B	Area Under Slopes	91778.60	
C	Net developable area	465622.30	
D	Land to be Surrendered to CIDCO (A X 15%)	83869	15.05%
E	Open Space (10% OF A)	56360.91	10.11%
E1	PARKS (1/3 x E)	18750.05	03.36%
E2	Playground (2/3 x E)	37610.86	06.75%
F	Amenities (5% OF A)	27932	05.01%
G	Growth Center	4555.08	00.82%
H	Schools with PG	57146.18	10.25%
H1	Schools	18098.75	03.25%
H2	School Playground	39047.43	07.01%
I	Health	10190.54	01.83%
J	Economic Activities	24186.57	04.34%
K	Roads	86634.85	15.54%
L	Utilities	13449.84	02.41%
M	Land for Residential Development +EWS	101297.32	18.17%
TOTAL		557400.9	100.00%

Table 2.4: Area statement: Township & Phase 1

Sr.	Description	Details
A	**TOWNSHIP AREA**	
1	Total plot Area (sqm)	557400
2	Net Plot Area (after DP etc.) (sqm)	465622
3	Permissible FSI	1 + 0.2 EWS
4	Permissible BUA (2 X 3) (sqm)	558746
5	Estimated Population	44344
11	Water Requirement in Cu M	8588
12	RWTP Capacity in Cu M	3258
12a	Phase 1 area (cum)	1454
12b	Phase 2 area (cum)	1804
13	Solid Waste TPD	16
14	Connected Load in KW	72299
15	Demand Load in KW	50963
16	Energy Saving in KW	21.46
17a	DG Set - Phase 1 area	1X320 KVA
17b	DG Set - Phase 2 area	1X380 KVA
18	Connectivity -	Existing road :18M ROW
B	**PHASE 1 AREA**	
1	Total area (sqm)	
2	Estimated Population	26444
3	Total BUA (including EWS) (sqm)	266043
3a	Residential (sqm)	204780
3b	Non-Residential (sqm)	62030
4	Non FSI Area (sqm)	81306
5	Total Construction Area (3+4) (sqm)	347349
6	Max Height of Buildings	75.4

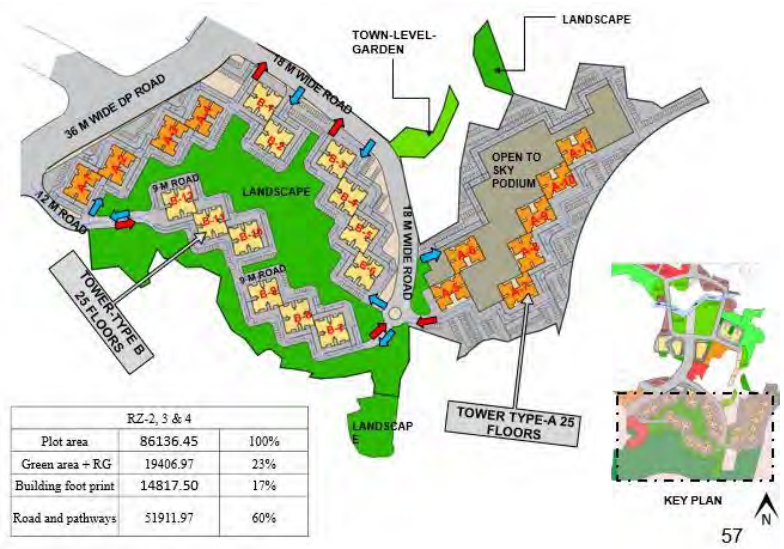
Project Phasing & Phase 1

As discussed, in the previous paragraph, the project has been planned so that the block to the north (of the water channel) and one to the south can be developed as self-sustaining neighbourhoods. The block to the South is planned to be taken up first i.e. in Phase 1. Therefore, the building and construction work planned in this phase is also included in the present EC application. The South Block included 03 residential plots, 01 plot for housing for Economically Weaker Section (LIG/EWS), a plot for school, health and 02 commercial plots. The details of developments on these plots and maps are provided thereafter.

Residential Buildings:

After a study of the demographic needs and trends, it was decided that the Unit Typologies shall be 1 RK, 1 BHK, 1.5 BHK and 2 BHK. These unit type shall now only provide housing options under affordable segment, but also be appropriate for the location and placing of the site. The 1 RK and 1 BHK units have been clubbed together in 'Type A' with respective Carpet Areas of 285 Sq. Ft and 375 Sq. Ft. 'Type A' also caters for the requirement of EWS housing as per norms. The bigger units of 1.5 BHK and 2 BHK Units have been clubbed together in 'Type B' buildings with respective Carpet Areas of 495Sq Ft and 570 Sq Ft. The Buildings are currently Stilt + 19 Floors but have a provision to be raised to Stilt + 25. The buildings have been arranged peripherally in such a way that they overlook a large central green space. The green space provides the necessary breather with high rise development all around. The buildings clusters are oriented keeping in mind, the predominant South-west and North-east winds flowing on site, in such a way that the natural breeze is not blocked. Individual buildings have been oriented diagonally to allow maximum units get access to direct sunlight for some time during the day. Even the smallest units have been designed to create a cross ventilation flowing through the apartment. Similarly, the lobbies too are cross ventilated and well lit, minimising need of artificial light and ventilation during day time. The plans provided below show the configurations at the floor level.

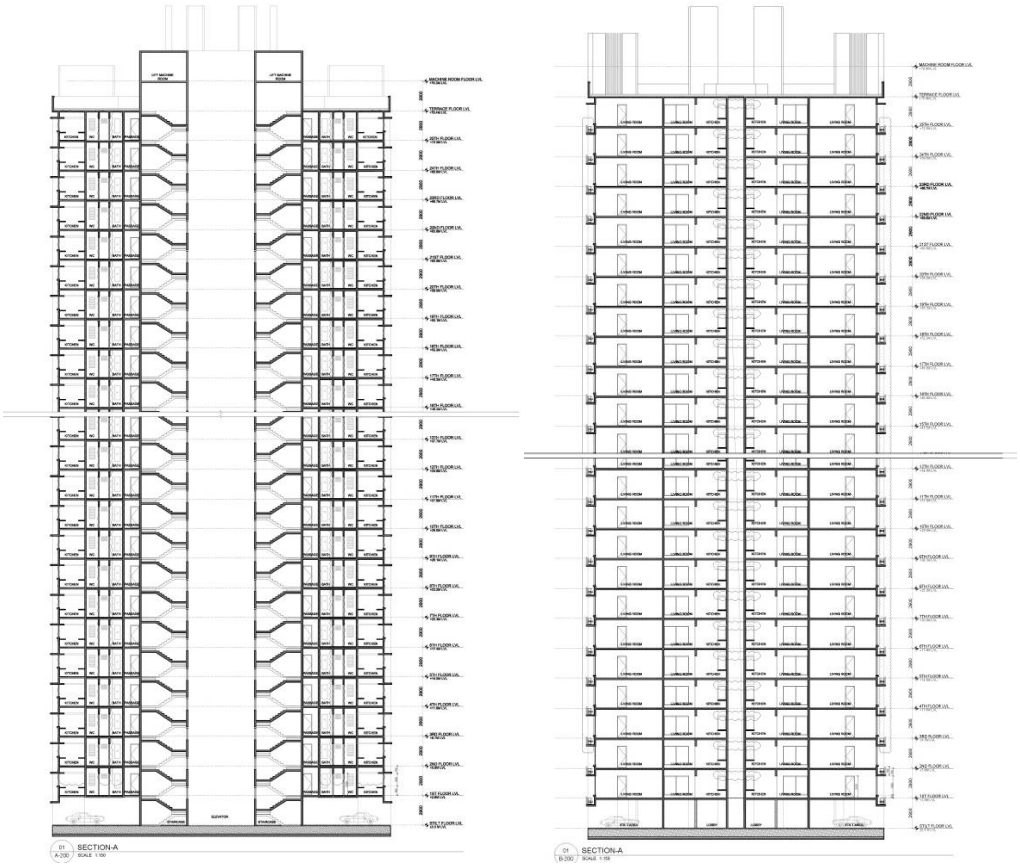
Figure 2.6: Plan of residential buildings on Plot RZ-2, 3 & 4



RZ-2, 3 & 4		
Plot area	86136.45	100%
Green area + RG	19406.97	23%
Building foot print	14817.50	17%
Road and pathways	51911.97	60%

Figure 2.7: Typical floor plans of residential buildings

Figure 2.8: Cross-section of residential buildings



Commercial Buildings

Commercial spaces have been designed to cater to requirement of Retail on Ground and Office spaces above, forming the much need population magnet of the township. The Office spaces are designed as Open Offices with minimum column obstruction allowing diversified planning from Single floor offices to smaller units possible within same grid as per Market requirement.

Located centrally on the 36 M DP Road, which forms the main artery of the town, they have an easy access from around the township. They also have proximity to the Town level Central Greens to provide relief to the office goers. The proximity of office space to well-designed houses will trigger the inflow of first wave of settlers. They are designed as Ground + 11-13 Floors. Floor to Floor Height of 3.6 M is provided to cater to additional services needs of modern office buildings. Though designed as centrally air conditioned, they are oriented in such a way to get prevalent SW winds across the building if required. The building periphery has glazing all around to bring in maximum natural light. The plan and section shown below explain the configuration of the commercial spaces.

Figure 2.9: Typical floor plan of Commercial Building - 1

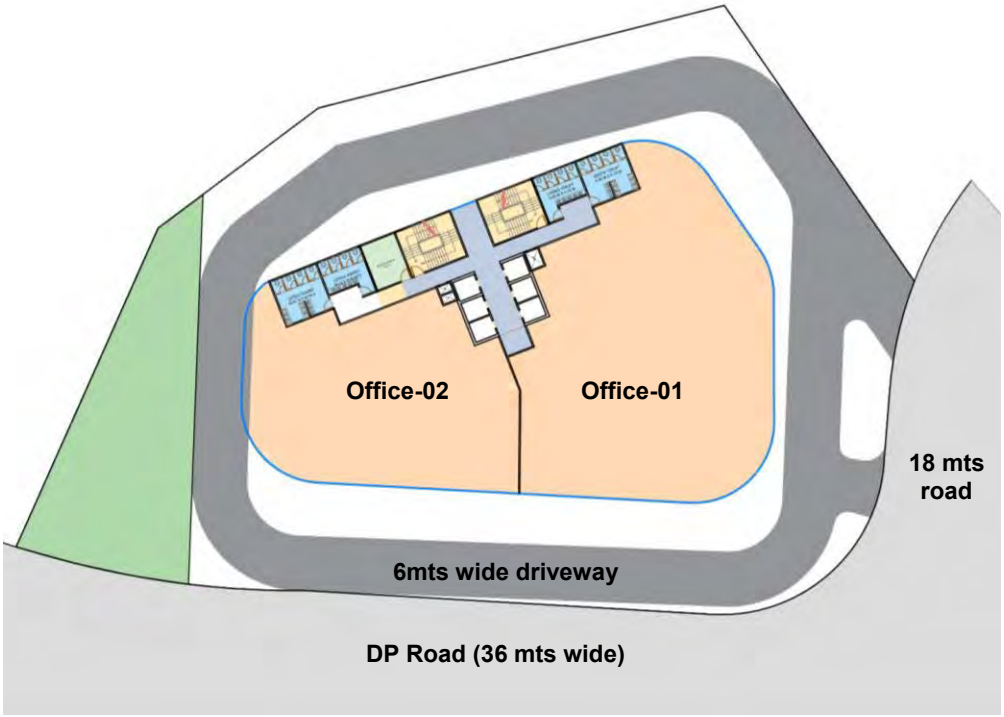


Figure 2.10: Typical floor plan of Commercial Building - 2

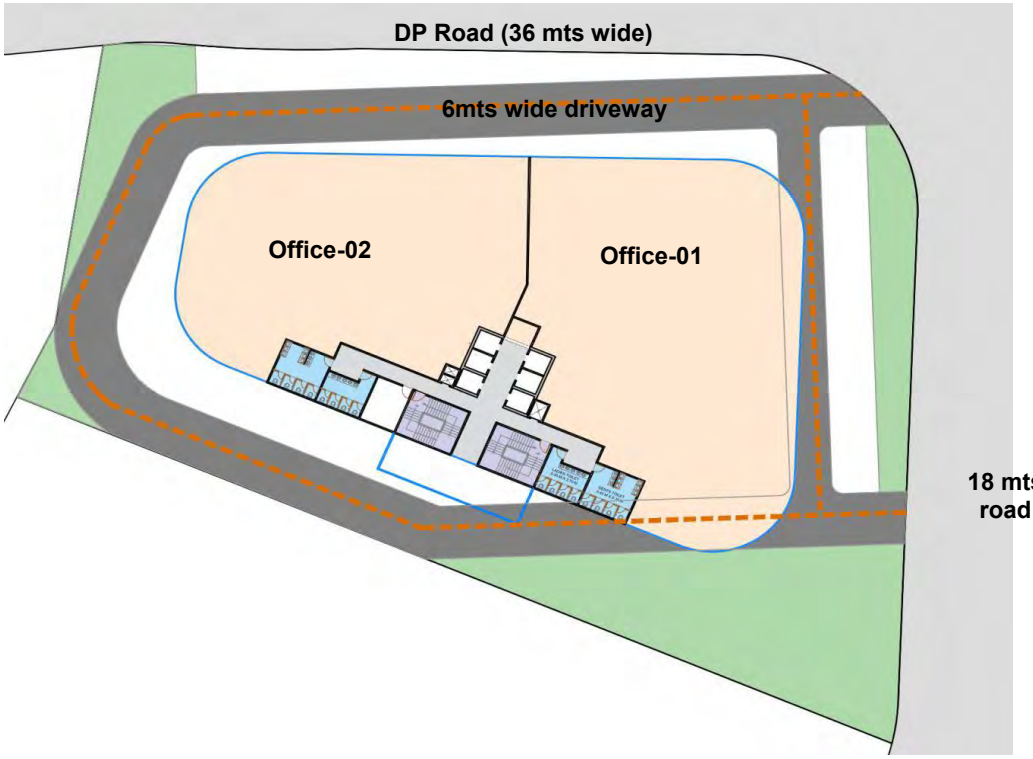
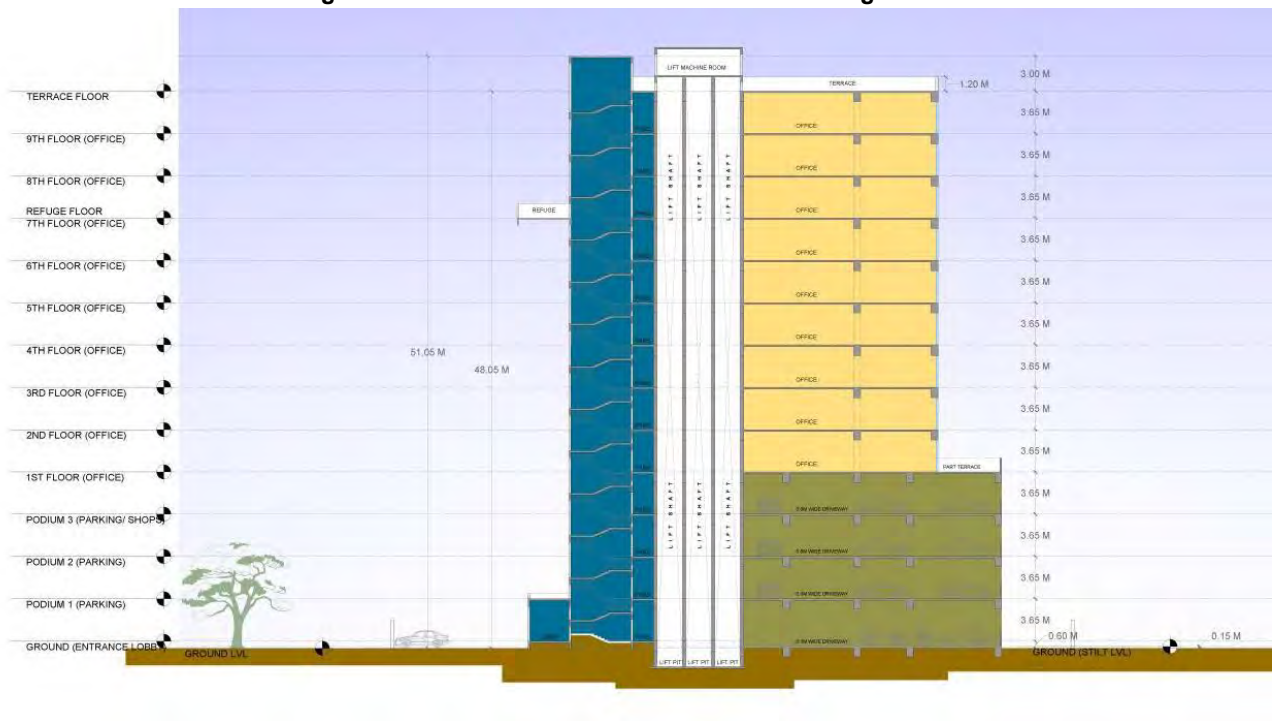


Figure 2.11: Cross-section of Commercial building

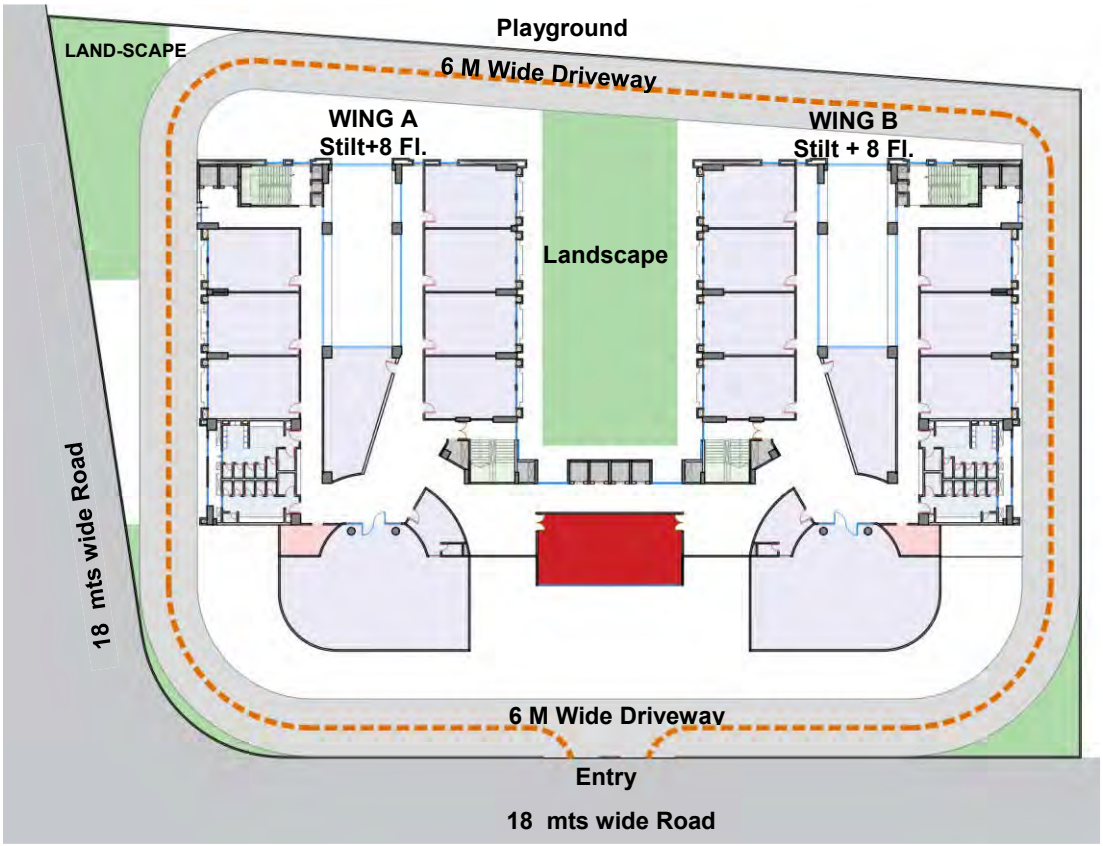


School Building

It is endeavoured that the residents of township have access to quality education, this is achieved by combining the requisite Primary and secondary schools into a single facility, so that the facilities like school playground can be maximised.

Located centrally, the school is designed to be within walking distance for most residents of the township. Apart from mandatory Playground it has easy access to the Town level Central Greens. Access to quality education is another magnet which helps early settlers to make the choice to shift to a new township. The school is designed as Ground + 8 Floor structure with all modern facilities like Multipurpose halls, Activity Rooms and Labs. Floor to Floor Height of 3.3 M is provided. It is oriented in such a way that prevalent SW winds flow across the building.

Figure 1.12: Plan of School Building



Healthcare Facility

It is endeavoured that the residents of township have access to Primary Healthcare facilities.

The Health Care Centre is located centrally so that in case of emergency it can be reached within minimum time from any point in the township. Still it is tucked away from the hustle bustle of main arterial roads and is overlooking the huge open spaces on the West of the township. It is designed as Ground + 5 Floor structure with all adequate necessary facilities like OPD, Check-up rooms, Labs and waiting areas for the patients. Floor to Floor Height of 3.3 M is provided.

Figure 2.13: Plan of Healthcare Facility

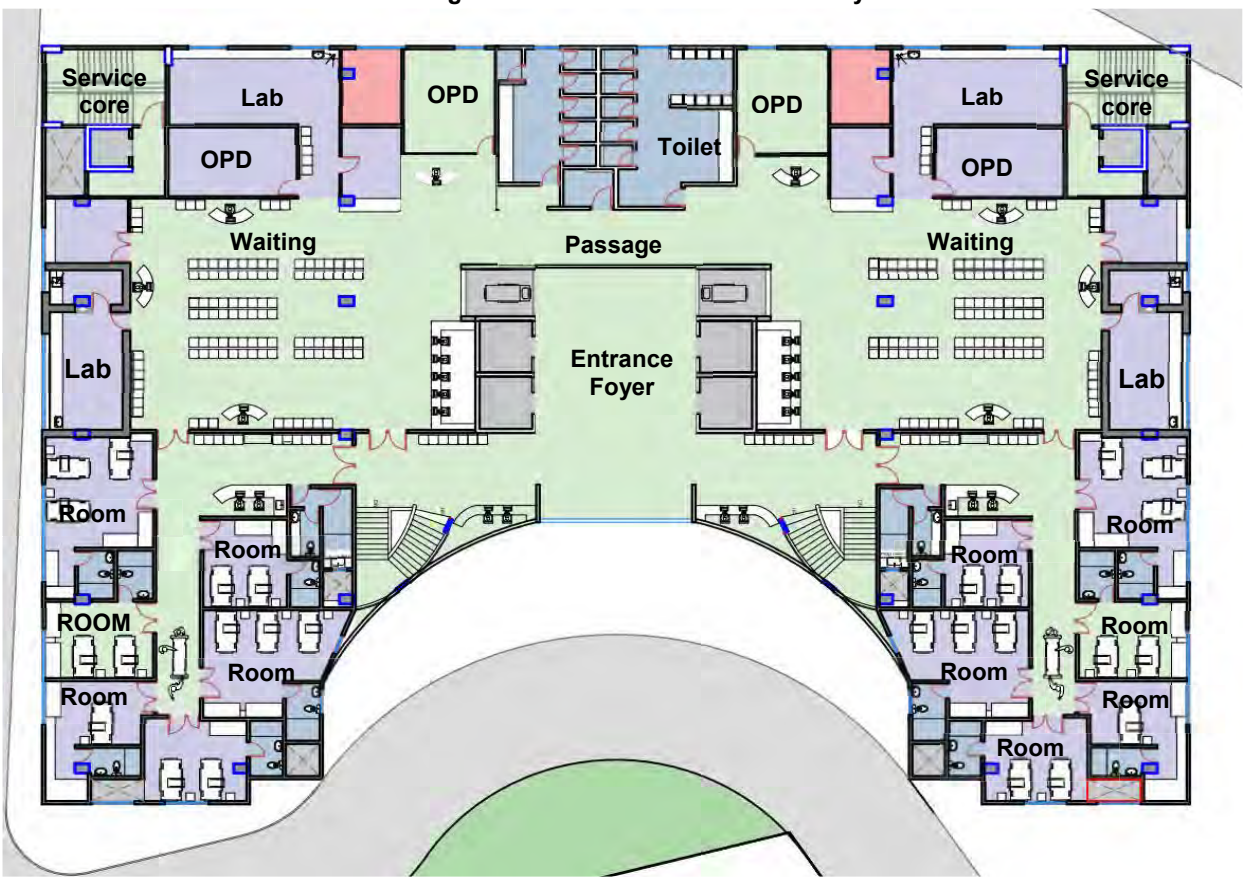


Table 2.5: Area statement for residential developments planned in South Block

Sr	Description	RZ2	RZ3	RZ4	EWS
1	Total plot Area	48170	35655	2310	4559
2	Permissible FSI	1 + 0.2 EWS	1 + 0.2 EWS	1 + 0.2 EWS	0.2 of base FSI
3	Total BUA including EWS	141808	62972	0	0
4	Non FSI Area	33324	12418	0	13463
5	Total Construction Area (3+4)	175132	75390	0	13463
6	Population	13080	7770	0	1400
7	Commercial Population	NA	NA	NA	NA
8a	Parking - Cars	2187	431	0	77
8b	Parking - 2W	199	39	0	7
9	Landscape Area	15740	14470	2310	1810
10	Ground Coverage	18.40%	10.60%	0.00%	12.00%
9	Max Height of Buildings	75.4	75.4	75.4	75.4

11	Water Requirement in Cu M	1831	1087	0	196
12	STP Capacity in Cu M	1645	977	0	176
13	Solid Waste TPD in Cu M	6.37	3.76	0.01	0.69
14	Connected Load in KW	11664	5148	50	994
15	Demand Load in KW	5912	3464	40	741
16	Energy Saving in KW	27.00%	29%	39%	29%
17	DG Set	2X750KVA	380KVA & 500KVA	NA	500KVA

Table 2.6: Area statement for non-residential developments planned in South Block

Sr	Description	School	Health	CZ3	CZ4
1	Total plot Area	7467	4767	4751	5474
2	Total BUA including EWS	23014	6238	16010	16001
3	Non FSI Area	4256	1652	7665	8528
4	Total Construction Area (3+4)	27270	7890	23675	24529
5	Population	3820	374	2189	2522
6	Parking - Cars	7	104	160	160
8a	Parking - Scooters	68	260	640	640
8b	Parking - Cycles	228	260	640	640
8c	Landscape Area	746	478	475	547
9	Ground Coverage	41%	33%	38%	43%
10	Max Height of Buildings	30	16.8	47.4	40.2
9	Water Requirement in Cu M	178	135	102	118
11	STP Capacity in Cu M	158	118	90	104
12	Solid Waste TPD in Cu M	1.04	0	0.43	0.45
13	Connected Load in KW	1669	600	2085	2365
14	Demand Load in KW	834	415	1312	1507
15	Energy Saving in KW	22%	23%	22%	21%
16	DG Set	1500KVA	750KVA	450KVA	450KVA

Development as per Seismic Activity:

The proposed project area falls in Zone-III, according to the Indian Standard Seismic Zoning Map. Suitable seismic coefficients in horizontal and vertical directions respectively, have been adopted while designing the structures.

Flood Area:

Due to the heavy rainfall in the rainy season in the region there may be possibility of the flooding in the natural stream passing through the site. The High Flood Level of this stream is 9 meters. Water bodies including underground water bodies in water scarce areas will be protected. The map of HFL ('red line' map) for the natural channel / stream has been obtained from Irrigation Department, Roha, Raigad. No building developments have been proposed in the red line area. Further, passive developments (greens, walkways etc) along the water channel (i.e. land uses beyond the 'red line' of Water Resources Dept.) have been planned, thereby leaving the water channel and the entire stretch on either side free of building developments.

2.5.4 Project Implementation Schedule

The phasing of the project would take place in two phases with a timeline of about 7 years. The phase wise development is explained as below;

Phase I:

This phase will have the basic infrastructure development. This will cover road works, utilities and developing green areas. As these infrastructure developments proceed, building works in the South Block (listed above) will be initiated. Thus this phase consist of infrastructure development in the township (i.e. 137.73 acres) and residential, commercial, educational and health developments in the South Block. activities will be

Phase II:

Phase II will cover building developments in the North Block. For these building projects, the PP shall separately approach the SEAC / EAC as required under MoEF & CC regulations.

2.6 Project Construction

2.6.1 Labour

As discussed in the earlier section, the construction for the project will be in two phases spanning over 7 years. It is estimated that 2-3 labor camps will be established for each phase with a capacity to accommodate a peak labour of 500 to 1000 workers at each campsite and an average labor of around 750 workers.

The construction phase will include hiring of local labor, but considering the magnitude of development, a temporary influx of population from outside areas is expected. The labor camps will be established and will be provided with water and power supply and sanitation facilities including toilet facilities along with septic tanks.

2.6.2 Construction Material

Alternate materials for construction will be used and will be sourced from local and nearby sources. Low cost and low embodied energy materials will be preferred for walls and roof construction structures. Some of the preferred materials of construction are:

Fal-G products (Fly ash, lime, and gypsum) – These are manufactured by binding fly ash, lime, and calcined gypsum (a by-product of phosphogypsum or natural gypsum). They can be used as a cementitious material for mortar/plasters and for masonry blocks of any desired strength.

Composite ferro-cement system – This is simple method of construction with ferro-cement, which is actually made of rich mortar reinforced with chicken and welded wire mesh. This type of construction reduces the wall thickness and thus increases the carpet area. Precast ferro-cement units in a trough shape are integrated with RCC columns. Ferro-cement units serve as a permanent skin unit and as a diagonal strut between columns.

Alternate Materials for roofing for construction will be used of lightweight synthetic aggregate- The example is Fly ash based aggregate, which is suitable for manufacture of brick, blocks, and is good substitute for clinker and natural aggregates. Pre-cast/aerated cellular concrete walling blocks and roofing slabs will be considered for construction materials.

2.6.3 Power Requirement

Power demand during initial period mainly will be for construction power which will be in the range of 5MVA. Electric supply during construction phase shall be provided from the nearest grid sub stations and with the help of D.G Sets. 4 Dg sets of 500 KVA capacity will be installed for construction work.

2.6.4 Water Requirements

The water requirement for the construction phase will include water for construction activities such as curing and formation of concrete mixtures and water for domestic consumption. Considering the number of workers required for the development during construction as per NBC norms, water demand for domestic consumption has been estimated to be about 250 KLD which may go up to 300 KLD at the peak construction period. Proponent will make adequate allocations for providing piped water supply to the labor colonies. For construction activities, tankers will be provided and adequate water allocations will be made by the nodal agency.

2.6.5 Wastewater Generation

The estimated quantity of sewage likely to be generated during each phase of construction is about 200 - 250 m^3/day. The labor camps will be provided with adequate number of soak pits and septic tanks for disposal of sewage. After completion of construction work, all the soak pit and septic tanks would be properly cleared and filled.

2.6.6 Solid Waste Generation

The waste generation during construction phase will include construction waste and residential waste from labor colonies. The construction waste will largely comprise of excavated earth and debris which can be used as a fill material for low lying areas and for construction of roads. The residential waste generated during the construction period from labor camps would be collected and transported to an interim transfer station where it will be treated (composting) by modular composter. Only residual waste will be handed over to local available facility for disposal. The construction activities will also entail generation of hazardous wastes such as waste oil. Proponent, through contractual obligations, will specify disposal of hazardous waste by the contractor to authorized recyclers/agencies.

2.7 Project Operation

2.7.1 Water Supply Infrastructure

Provision of safe, adequate water is a basic necessity for the healthy living of a community. In this section, demand of potable and non-potable water in the Proposed Project Area has been dealt with. On the basis of the total water demand, identification of the water source, requirement of treatment plant, transmission and distribution system, storage reservoirs and pumping station etc. have been estimated.

2.7.1.1 Water Supply Norms Prescribed By CPHEEO

The per capita water requirements for domestic and non-domestic uses as per norms prescribed by NBC 2005, Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, and Government of India is referred for the project.

2.7.1.2 Water Demand

Based on projected population total water demand is computed for both potable and non-potable purpose for various types of users such as residential, commercial, institutional areas.

2.7.1.3 Fire Demand

Fire demand is computed based on population in project area. A provision for fire demand in KLD is based on $100\sqrt{P}$ (where P is population in thousands), which is about 260 KLD. It is desirable that one third of the firefighting requirement form a part of service storage in 3 ESRs which has been estimated as 100 KL at STP zone. Fire demand of individual plot needs to be provided in the storage tanks of respective plot by the developer.

2.7.1.4 Other Demands

Recycled water will be utilized for flushing and gardening. Excess recycled water will be utilized to meet the other demands such as road washing, flushing of sewers, emergency firefighting, car washing etc.

2.7.1.5 Water Mass Balance Diagram

It is prepared considering potable and non-potable water demand for various usages considering losses in transmission and distribution system, treatment plant etc. The water mass balance diagram of the Township for the monsoon season is depicted in below.

Figure 2.14: Water Balance for the Township – Non-Monsoon Season

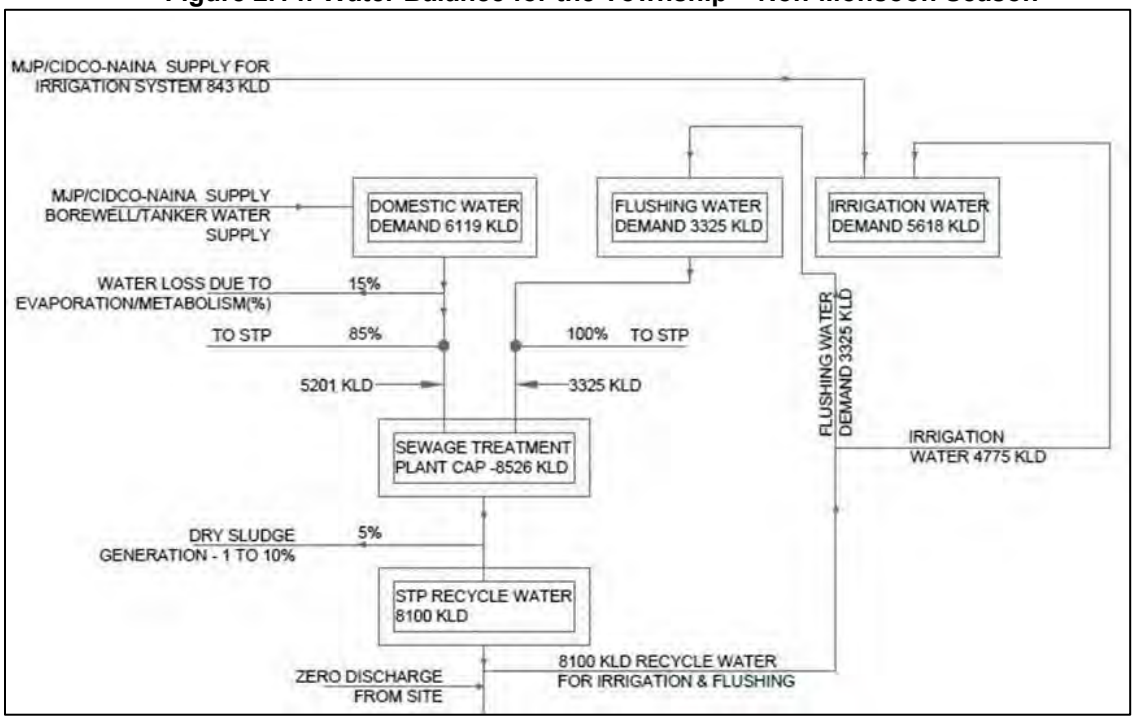


Figure 2.15: Water Balance for the Township –Monsoon Season

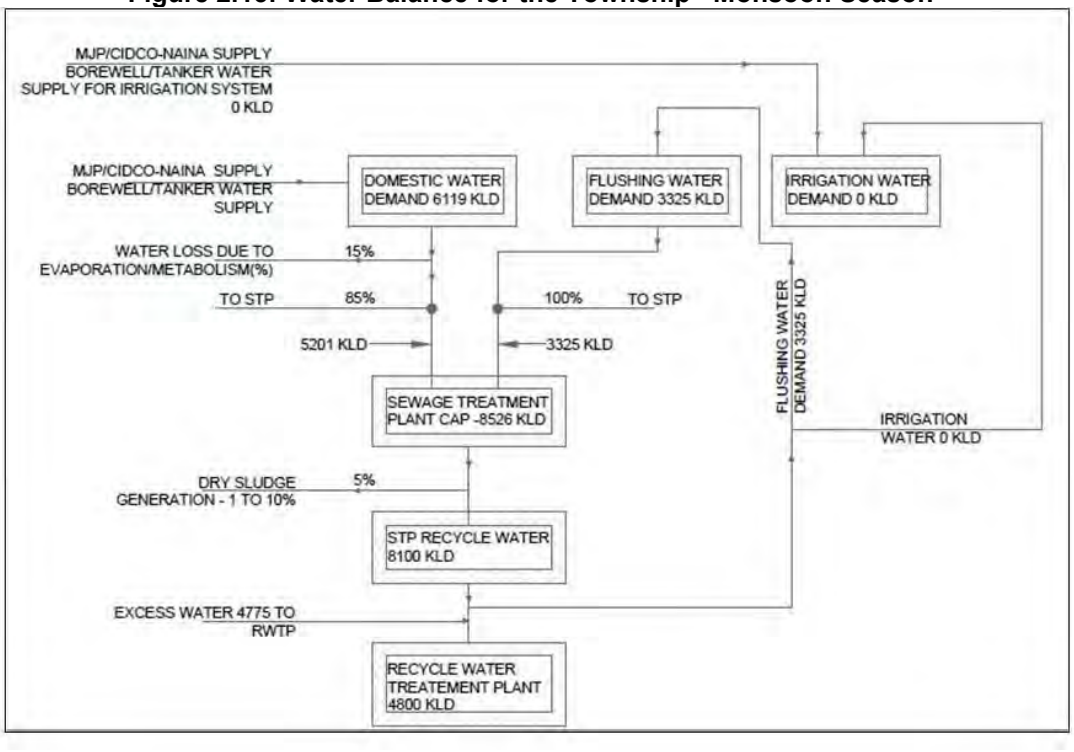


Table 2.6: Water Demand for the residential plots of Special Township

Domestic	1584	920	NIL	137	96	86	55	63
Flushing	792	460	NIL	68	75	45	44	50
Green area	126	116	NIL	14	6	4	4	4
total water	2502	1496	NIL	219	177	135	103	117
Total non-potable	918	576	NIL	82	81	49	48	54
Waste water	2138	1242	NIL	184	157	118	91	104
Sewage Treatment Plant capacity	2138	1242	NIL	185	158	118	90	104
Treated water	1925	1118	NIL	82	82	49	48	55

Figure 2.12: Water Mass Balance Diagram for RZ3 (Residential plot) – Non-Monsoon

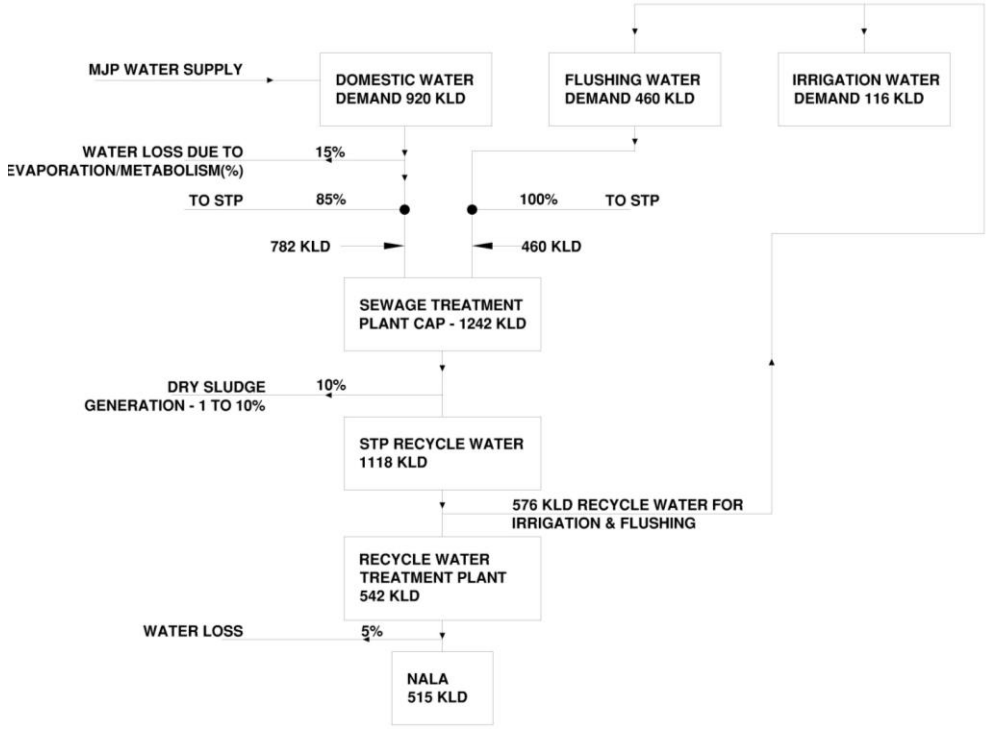


Figure 2.13: Water Mass Balance Diagram for RZ2 (Residential plot) – Monsoon

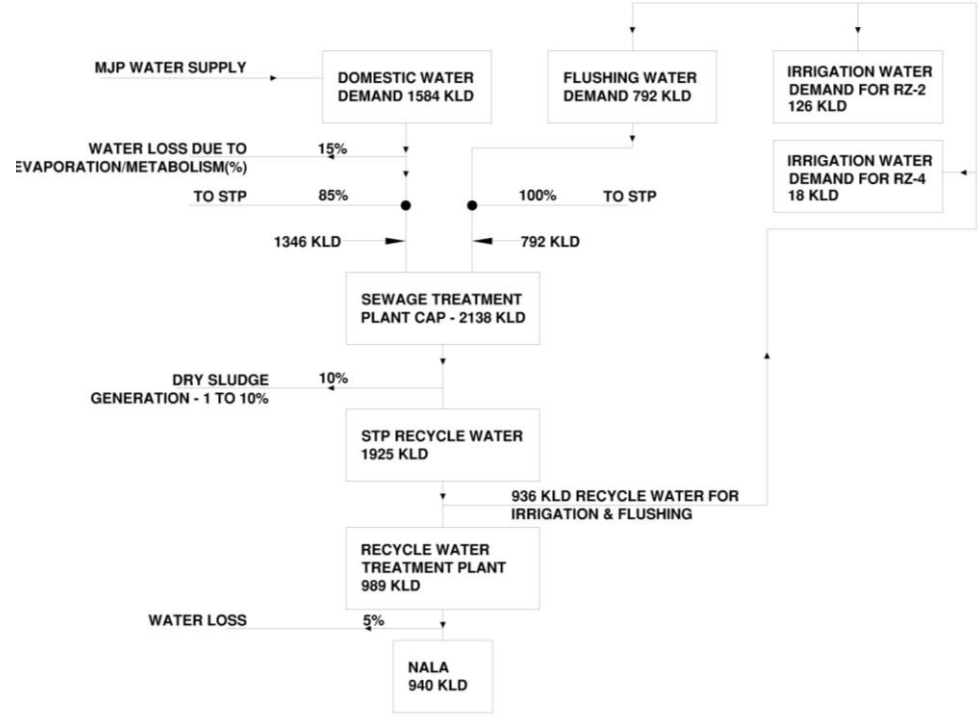


Figure 2.14: Water Mass Balance Diagram for RZ 2 (Residential plot) Non – Monsoon

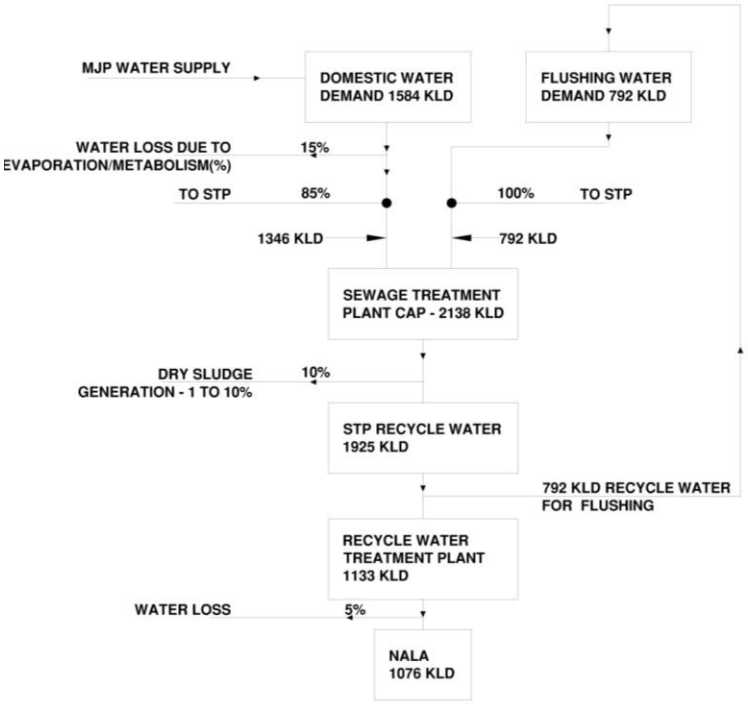
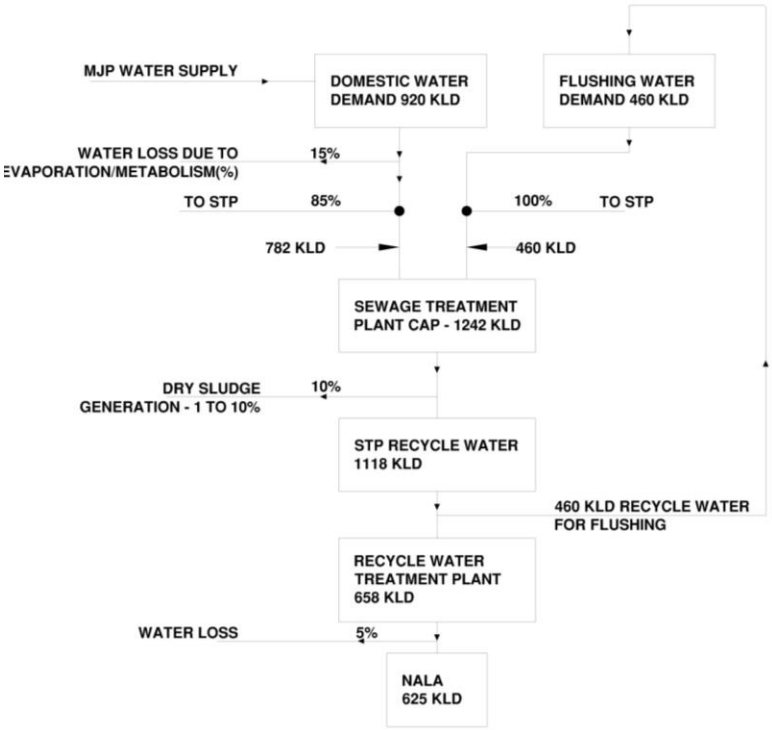


Figure 2.15: Water Mass Balance Diagram for RZ3 (Residential plot)



The water balance diagram for the Proposed Township has been prepared with zero discharge concepts. All wastewater generated from Residential, Commercial, Institutional and Health complex will be collected and treated appropriately and reused to meet the demand of flushing, landscape and other miscellaneous consumers so that the whole township is graded as Zero Discharge establishment. The total water demand for the project is expected to be 8.5 MLD and total net potable water demand is estimated to be around 6 MLD. The non-potable water demand will be met with by the tertiary treated water from four STP's proposed. This water is found to be adequate to meet the non- potable water requirements including the distribution losses in the network.

2.7.1.6 Planning of Water Supply System

The potable water demand will be sourced from CIDCO / MJP through the Nhava Sheva Sub-regional water supply scheme.

Process Concept for Water Treatment Plant:

- Domestic water from Local Authority supply / tankers will be brought into firefighting storage tank. Water from this tank shall be allowed to overflow into raw water storage tank. In case if the quantity of water supplied by Local Authority may not be consistent, WCIPL propose to mix water from all the possible sources in raw water tank.
- From Raw water tank, water will be fed to suitable water treatment plant by means of feed pumps and stored in the domestic / treated water tank. The treatment for raw water will consist of filtration through pressure sand filters, activated carbon filters, softening.

Equipment Details

Filtration

FRP Composite Vessel Filter

The filter shall be constructed of FRP material with inner shell of integrated polyethylene, polypropylene and other material as per manufacturer's standard. The inter distribution system and the underbed draw off system shall be of Hub & Lateral type of polypropylene material. The filter shall be provided with manhole cover, hand hole, flanged outlet for piping / valve connection and adequate tripod with skid self supporting structure for making the installation completed. The filter shall also be provided with vacuums breaking connection / accessories to avoid any collapse of internal lining. All filters shall be provided with lifting lugs. The filter bed depth shall be 1500 mm.

Face Piping

Each filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash complete with valves.

Accessories

Each filter shall be provided with following accessories :-

- Air release valve with connecting piping.
- 100 mm dia dial bourden type gunmetal pressure gauges with brass isolation ball valve and connection piping on inlet and outlet.
- Sampling valves (ball valves) on raw water inlet and filtered water outlet.
- Individual drain connection with brass full way ball valve for each filter.

The filter media shall comprise of gravel / silica of various grade in varying thickness. The cut-section of the filter along with filter media detail shall be subject to approval by the Consultant.

Test Kits (Optional)

One test kit will be provided with initial requirement of reagent:

a) PH meter (electronic)
b) Turbidity meter

Detail of equipment with technical literature shall be supplied with the tender.

Piping

The pipes and fittings in the domestic Water Treatment plant room shall be GI class `C' (heavy class) conforming to IS: 1239 (Part-I) for pipes and IS:1879 (Part 1 to 10) for malleable cast iron fittings.

Pumps

Pumps shall be vertical, centrifugal, multistage directly coupled to motor. Provision of pump with pump head & base of cast iron and other parts in SS 304 shall be made for pumps required in Hydropneumatic System, swimming pool and water fountain re-circulation system. Impeller shall be hydraulically balanced and keyed to shaft. Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer's instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall

be complete with flexible connections, valves, and pressure gauges. The pumps shall include cost of foundation channel complete.

Alum / Soda Ash Dozers

All dozers shall be of the electronic metering plunger type confirming to the requirements specified in the Bill of Quantities. They shall be complete with low level switch, low level alarm, tank and interconnecting piping.

UV Unit

UV unit shall be complete with reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lamp out alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV Dosage should be > 30,000 uW – Sec / sq.cm. The lamps should be selected based upon the flow requirement of respective unit.

Surflow Nozzles

Nozzles shall be constructed of unalterable UV resistant ABS plastic & shall be designed for low noise and smooth flow at desired rate. The nozzle shall be suitable for three adjustable set positions and shall be connected through ferrule / saddle connection to CILA pipe equidistant positioned on the swimming pool floor.

Suction Sweeper

Suction sweeper shall consist of centrifugal pump directly coupled through flexible coupling to 400/440 volts, 3 phase 50 cycles motor and both units mounted on a trolley complete with suitable starter, 30 meters (appx.) of cable terminating with a three pin plug with 600 mm wide suction sweeper head with wheels, spring loaded brush and towing rope, 20 meters length of internally armored hose with necessary coupling and floats. Contractor to submit the technical detail and catalogue of the suction sweeper model along with the bid for the review & approval of the Owner /Consultant.

Water Quality

The domestic water treatment basis of design is as per raw water analysis. PP / Contractor shall get the raw water analysis done at his own expense (in accordance to IS:10500 prior to submission of the water treatment scheme. The PP / contractor shall ensure domestic water of potable water standard after the treatment system. The acceptable standard of potable water shall be in accordance to SP:35 S & T : 1987 as per acceptable limits. The technical tolerances for water quality is tabulated below:

S.No.	Characteristic	Tolerance
i.	PH value	7.5 to 8.5
ii.	Total alkalinity (as CaCOs), mg/1, Max	50 to 500
iii.	Aluminium (as A1), mg/1, Max	0.1
iv.	Total residual chlorine, mg/1 a. At inlet, Max b. At outlet, Min	 0.5 0.2
v.	Oxygen absorbed in 4 hours at 27 deg.C mg/1, Max	1.0
vi.	Chloride (as CI), mg/1, Max	500
vii.	Iron, mg/1, Maxx	0.1
viii.	Heavy metals (as pb), mg / 1, Max	0.1
ix.	Colour, Hazen units, Max	10
x.	Turbidity, NTU, Max	10
xi.	Odour	Odourless
xii.	Taste	Palatable

UV Unit

UV unit shall be complete with reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lampout alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV Dosage should be > 30,000 uW – Sec / sq.cm. The lamps should be selected based upon the flow requirement of respective unit.

Chemical & Bacteriological / Microbiological Test Parameters of Raw Water

The above mentioned parameters shall be tested in accordance to IS : 10500 – 1991, Amendment No : 2-2003.
The Chemical and Physical Parameter (30 Parameter) shall be as follows :
Colour, Odour, Turbidity
Total Hardness, pH, Total Iron, Chloride, Dissolved Solids, Calcium, Magnesium, Copper, Hexavalent Chromium, Manganese, Sulphate, Nitrate, Fluoride, mercury, Cadmium, Selenium, Arsenic, Cyanide, Lead, Zinc, Aluminium, Boron, Phenolic Compounds, Detergents, Mineral Oil, Alkalinity, Silica.
Note : It is desired to also obtain probable composition of Total Solids if the TDS parameter exceeds 1000 ppm.
The bacteriological / Microbiological Test Parameter shall be as follows :-
MPN Coliform Organism, Cloiform Bacteria, E. Coli (Typical Faecal Organism).

The above tests shall be carried out by the PP / contractor prior to submitting the technical submittal of the water treatment plant equipment. PP / Contractor shall also submit the test report of raw water & treated water after the commissioning of the plant.

2.7.1.7 MJP Water Quality

Based on the MJP water quality, the water is of good quality as per required standards for its potable use. As per the water demand calculation, the total water demand for the project is expected to be 9.2 MLD and the gross potable water demand for the entire project development is estimated about 6 MLD. The MJP water quality is indicated below.

Table 2.9: MJP Water Characteristics

Parameters	Results	Standards
PH	7.8	6.5 – 8.5
Turbidity .NTU	2.0	2.5
Colour , PtCo	2	5
Odour, UO	U.O	U.O
Taste, U.O	U.O	U.O
Conductivity, ms	1.5	250
DO mg/l	7.4	7
BOD mg/l	1.4	20
COD mg/l	3	20
Residual Chlorine mg/l	0.1	<2.2
TS mg/l	28	500
TSS mg/l	12	250
TDS mg/l	16	20
Hardness as CaCO3 mg/l	42	200
Sulphate as SO4 mg/l	0.8	200
Chlorides as CL, mg/l	12	200
Calcium. Mg/l	22	200
Magnesium, mg/l	19	30
Iron, mg/l	ND	0.1
Manganese, mg/l	ND	0.05
Zinc mg/l	ND	5
Arsenic mg/l	ND	0.05
Lead mg/l	ND	0.05
Copper mg/l	ND	0.05
Phenol;, mg/l	ND	0.001
Fluoride, mg/l	ND	1
MPN Count per100 ml	ND	<10
Faecal Coli	ND	0

Note: BIS for drinking water quality IS 10500: 1991

2.7.2 Wastewater Infrastructure

The Moving Bed Bio Reactor (MBBR) system is an advanced high-rate wastewater treatment process utilizing free floating media which houses active biological cells. Essentially, MBBR system is a hybrid process where attached growth and suspended growth treatment processes functions simultaneously.

The most important part of the MBBR process is the specially designed floating media, which provides large surface area for bacterial growth. Hence these carrier elements (media) are in continuous movement, available surface area is constantly exposed to the wastewater, and hence uniform biological growth takes place over entire area of the media. 'Continuous Movement' of this carrier element is driven by air bubbles supplied inside the reactor by means on air diffusers. Given below are the treatment philosophy and parameters for a 85m3 per day sewage treatment plant.

The quality of raw effluent is considered as:

Sr.No.	Parameters	Range
1	Nature of waste	Sewage-Domestic
2	PH	5.0-8.0
3	BOD5(mg/l)	300
4	COD (mg/l)	400
5	Suspended Solids (mg/l)	250
6	Oil and Grease (mg/l)	20-50

The quality of treated water is considered as:

Sr.No.	Parameters	Range
1	BOD	< 20mg/l
2	COD (mg/l)	< 60mg/l
3	Oil and Grease (mg/l)	< 5mg/l
4	Suspended Solids (mg/l)	< 5mg/l
5	pH	No change

Treatment Technology:

The out-fall sewer main from the last manholes, (up to 85m3 per day) will be let into a screening chamber by gravity flow. Large solids particles shall be intercepted by a fine screen. The screen shall be manually cleaned with suitable rake arrangement at periodic intervals. The sewage after screening is collected in a collection sump for smoothing out peak flows. The provision of air shall be kept in this tank to break the solids in suspension and homogenize the sewage. The homogenized effluent is then pumped into the MBBR Reactor. The reactor is equipped with Floating media to prevail the attached growth of microorganism. The bio media shall be of sufficient quantity suitable for the strength of the waste. The media shall be placed in such a way to ensure easy maintenance or replacement of diffusers without disturbing the media. The air shall be provided through an air diffusion system to ensure equal distribution of air in the reactor. The overflow from the MBBR reactor is passed through a settler, and collected in Clarified Tank by gravity, from where it is pumped to a pressure sand filter, which is capable of removing finely divided colloidal particles. An activated carbon filter will remove all traces of color and odor, so that the effluent can be used for gardening. Filter backwash, and sludge filtrate, would be taken back into the collection sump. Sludge generated in the settler will be de-watered in a sludge filter press and bagged for removal. This sludge can be used as organic manure. Treated water is passed to softening system. After softening water can be used for flushing and gardening.

Excess treated effluent can be discharged into the sewer, since it meets PCB requirements. The comparison of the Sewage treatment technologies and subsequently the Sewage Treatment Plant process flow diagram is given below.

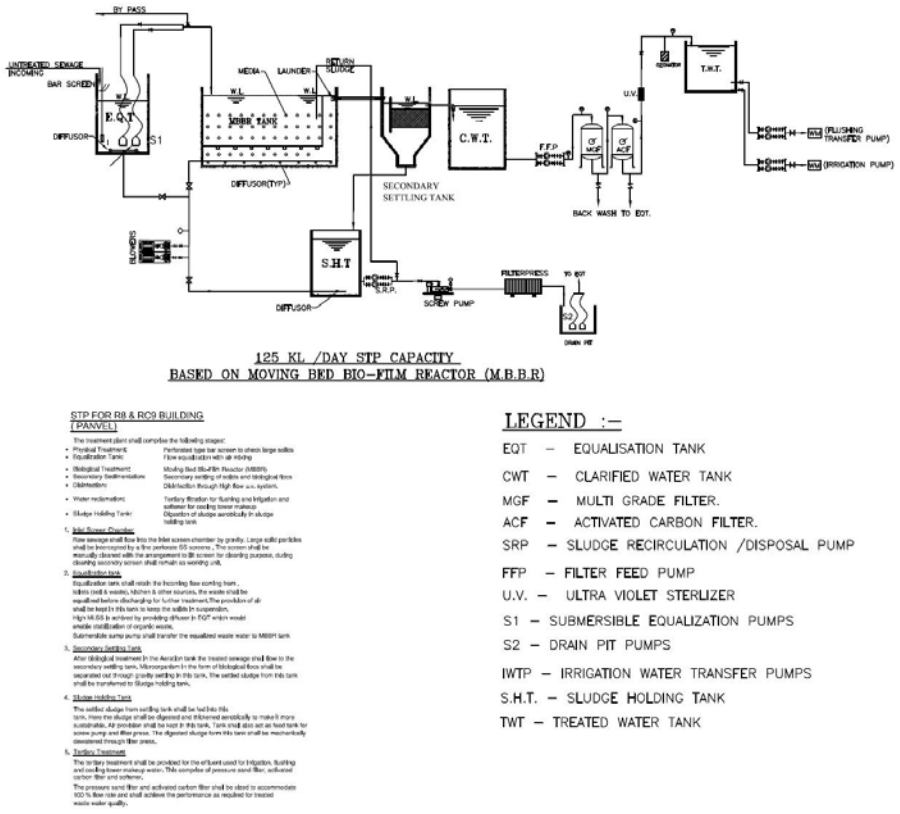
Table 2.10: Comparison of Sewage Treatment Plant technologies

Sr.	Description	Extended Aeration	SAFF/MBBR	FAB	Chemical Treatment Plants	MBR	SBR
1	Type of Treatment	Based on suspended growth of bacteria	Based on attached growth process	Based on attached growth process	Based on continuous batch process	Based on activated sludge process with ultrafiltration	Based on suspended growth process
2	Media used for treatment	No Media required	Utilizes plastic media floating in sewage	Utilizes plastic media fixed in position	Utilizes three non toxic, non hazardous chemical formulations	Utilizes membranes for treatment	No Media required
3	Final Clarifier required?	Yes	Yes	Yes	Yes	No	Yes

Sr.	Description	Extended Aeration	SAFF/MBBR	FAB	Chemical Treatment Plants	MBR	SBR
4	Tertiary Filter required?	Yes	Yes	Yes	Yes	No	Yes
5	MLSS (mg/l)	< 3000	No criterion	No criterion	No criterion as it works on physio chemical reactions such as precipitation, disinfection, flocculation & clarification	15,000 - 20,000	< 3000
6	M.L.S.S. monitoring	Required	Not Required	Not Required		Required	Required
7	Footprint area	Large	2-3 times smaller	2-3 times smaller	2-3 times smaller	3-5 times smaller	2-3 times smaller
8	Process Stability	Highly Sensitive to Sludge Bulking	Medium Sensitive to Sludge Bulking	Medium Sensitive to Sludge Bulking	Medium Sensitive to Sludge Bulking	Not Sensitive to upsets	Highly Sensitive to Sludge Bulking
9	Retention Time	20 - 24 hrs	6 - 8 hrs	6 - 8 hrs	6 - 8 hrs	4 - 6 hrs	More than 20 hrs
10	Sludge Recycling	Required	Not Required	Not Req.	Not Required	Not Required	Required
11	Power Consumption	High	Medium	Medium	High	High	High
12	Ease of Maintenance	Difficult	Easy	Easy	Easy	Easy	Complex
13	Ease of Operation	Difficult	Easy	Easy	Easy	Easy	Medium
14	Energy Cost	High	Medium	Medium	High	High	High
15	Modification / ext. existing STP	No	Yes	Yes	Yes	Yes	Yes
16	Use of Chemicals	High	Medium	Medium	Very High	Very Low	Medium
17	Continuous monitoring	Yes	Yes	Yes	Yes	No	Yes
18	Chlorination	Required	Required	Required	Required	Not Required	Required
19	Environmental Aspect of sewage treatment						
a)	Sludge Production	High	Low	Low	Low	Low	Medium
b)	Reduction of Coliform	Ineffective	Ineffective	Ineffective	Effective	Effective	Ineffective
c)	Use of Coagulants & Flocculants	High	Moderate	Moderate	Very High, since it is a chemical process plant	Not required	Not required
d)	Use of Chlorine	Req.as per sewage load	Req. as per sewage load	Req. as per sewage load	High	Not required	Req. as per sewage load

Sr.	Description	Extended Aeration	SAFF/MBBR	FAB	Chemical Treatment Plants	MBR	SBR
e)	Residual Chlorine Presence in treated water	Yes	Yes	Yes	Yes	No	Yes
f)	Quality of Treated Recycled water	Moderate	Good	Good	Good	Best. Potable water	Moderate
g)	Overall Cleanliness of the plant area	Bad	Moderate	Moderate	Moderate	Good	Moderate
20	Dependency on the vendor for routine operation	Moderate	Moderate	Moderate	Very High for the chemicals procurement	Moderate	Moderate

Figure 2.19: STP Process Flow Diagram



STP FOR R8 & RC9 BUILDING
(PANVEL)

LEGEND :-

EQT – EQUALISATION TANK
CWT – CLARIFIED WATER TANK
MGF – MULTI GRADE FILTER.
ACF – ACTIVATED CARBON FILTER.
SRP – SLUDGE RECIRCULATION /DISPOSAL PUMP
FFP – FILTER FEED PUMP
U.V. – ULTRA VIOLET STERLIZER
S1 – SUBMERSIBLE EQUALIZATION PUMPS
S2 – DRAIN PIT PUMPS
IWTP – IRRIGATION WATER TRANSFER PUMPS
S.H.T. – SLUDGE HOLDING TANK
TWT – TREATED WATER TANK

The characteristics of waste water before and after treatment are given in table 2.11 below :

Parameter	Raw Water Characteristics	Treated Water Characteristics	Discharge Norms (CPCB) (mg/l)	
	STP - Zone		Inland Surface water body	On land for irrigation
pH	5.5 - 9	7-8	5.5 to 9.0	5.5 to 9.0

Parameter	Raw Water Characteristics	Treated Water Characteristics	Discharge Norms (CPCB) (mg/l)	
	STP - Zone		Inland Surface water body	On land for irrigation
BOD5 @ 20°C, mg/L	300 - 350	<10	30	100
COD	450 - 550	<30	250	-
Total suspended solids, mg/L	500 - 600	<10	100	200
Oil and grease, mg/L	20	<1	1	1
Total kjeldahl Nitrogen (as N), mg/L	50	<1	100	-
Total Phosphorus, mg/L	5 - 7	<1	5	-
Fecal Coliform MPN/100 ml	10^7	14	-	-

- Occupation & construction of such large township taken very long time, treating sewage in individual cluster gives operational efficiency, since loads are estimated more precisely & plants are sized to realistic requirement. Partial load operations are in much care.
- Decentralized reduces coast of laying huge network of pipe & cost optimized is achievable.
- Decentralized waste water within cluster provides ease of planning since slopes are in control.
- Decentralized STP calls for lesser maintenance cost since pipe network is drastically reduces.
- Decentralized STP offers flexibility in planning for future development.
- Decentralized STP provides opportunity & optimize of each cluster stack holders to operate & maintain the STP, better handling & higher control.
- Decentralized STP provides ease of forward integration; output recycled water is utilized in distributed manner. For flushing & gardening secondary distribution for use of recycle water is optimized.
- Space optimization is achieved by using efficient negative spaces within cluster as cluster Sewage Treatment Plant required lesser space.
- Providing inbuilt upgradable module promotes flexibility of operation in case of failure of one of the module.
- We don't see any merits as such with centralized Sewage Treatment Plant in context of development excepting it provides large diversity means, optimization of capacity when entire township is occupied.

2.7.2.1 Recycling Wastewater Treatment Plant

Process Description

The treatment process shall comprise the following stages:

- Physical treatment: Coarse bar-screening
- Primary treatment: Auto coarse bar-screen
- Equalization tank: Flow equalisation with air mixing
- Flow measurement: Flow meter
- Biological treatment: Extended aeration with SBR
- Water reclamation: Tertiary filtration and sterilization
- Sludge disposal: Sludge chemical conditioning and dewatering

The layout of the recycling wastewater treatment plan is shown in **Annexure-6**

Performance Criteria of the Plant

Raw sewage will be brought into the Sewage Treatment Plant. The Contractor shall receive sewage from this point to the treatment plant for treatment process.

The treatment plant shall be designed to treat the following basic characteristic expected in the raw sewage.

Description

- Discharge period — 20 hrs / day
- Minimum Influent BOD5 concentration — 250-400 ppm
- Minimum Influent chemical oxygen demand — 600-800 ppm
- Minimum Influent suspended solids — 200-450 ppm
- Oil & Grease — 50 ppm

However, as a specialist in the field, contractor may envisize the raw sewage characteristic. Contractor to submit his confirmation on the treatment parameter considered as an Annexure. The plant shall be capable of treating effluent to the following standards:

Effluent from RWTP	APT
• Suspended solid	10 ppm
• BOD5 concentration	30 ppm
• COD concentration	< 30 ppm

Treated effluent shall be connected to a tertiary filtration / treatment and shall be treated for use for flushing, irrigation & cooling tower ac make-up purpose. The Contractor shall carefully consider the operation loading for the Sewage Treatment Plant.

Process Description: The Contractor shall design the Recycle Water Treatment Plant to receive continuous sewage inflow within the plantroom allocated on the site plan. The ease of maintenance and operation is of utmost importance in the design of Sewage Treatment Plant.

Inlet Screen Chamber: Raw sewage shall flow into the inlet screen chamber by gravity. Large solids particles shall be intercepted by an fine step screen. A manual screen shall be installed in parallel with the screw screen as a standby screen when the step screen is under maintenance.

Aeration Tank / SAFF Tank S.B.R: Sewage shall be retained in the S.B.R tank for Aeration, setting, Decanting Cycle subjected to biochemical oxidation by fine bubbles aeration.

U.V. Sterilizer with Monitoring Arrangement: Quartz based U.V. Sterilizer shall be designed to provide a UV Dose of 600 J/m2 at UVT of 65% and TSS less than 10 mg/L. System should deliver a 4 log reduction of total coliforms. The electrical control system should utilize high frequency electronic ballasts and provide efficiency of more than 90%. The reactor vessel shall utilize internal baffles to ensure turbulent and plug flow. The UV intensity monitoring system shall be designed in accordance with the German DVGW W294 standard. The sensor shall be of dry type and removable without system shutdown.

Effluent Tank: The effluent tank shall hold the treated effluent where it shall be periodically pumped through filters for terminal use.

Equipment

The following give the minimum requirements of the different components of the system. The figures indicated are for contractor's references. It shall be the Contractor's responsibility to select equipment for the plant proposed by them so that the capacities and performance of the Recycle Water Treatment Plant meet with the criteria set out in this specification.

All equipment and components of the system shall be of top quality construction and shall be corrosion resistant.

Coarse Screening Equipment

Bar screen shall be of 304 stainless steel constructions. Drip trays shall be provided for holding and drainage of the screenings. A manual by-pass screen of 30mm opening with stainless steel drip tray shall be provided. An isolation valve shall be provided to divert the flow to the by pass screen when the screen requires service.

Air Blowers

Air blowers shall be provided in duplicate / Triplicate, with one standby unit as specified in SOQ. Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with VFD controlled motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V-belt system or direct drive coupling. The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated. Motor speed shall be 1500 rpm. The size and performance of the air blower shall be so selected that it can provide a minimum air flow rate 0.5 l /sec / diffuser to 1l/sec/diffuser maximum, and to maintain a minimum of 2.0mg/□ dissolved oxygen in the aeration tanks in operation.

Air Diffusers for Aeration Reactor Tanks

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomic rubber membrane or composed of crystalline fused aluminum oxide with a suitable ceramic bonding material. Membrane endurance shall be more than 180,000 expansion/contraction cycles.

Diffuser shall be of self-cleaning, non-clog disc or dome-shaped type. Oxygen transfer efficiency shall not be less than 20% at 3.5m submergence in clear water. Alternatives may be offered for consideration. Diffuser hold down assemblies shall consist of a retainer bolt, a matching washer and gasket. Sealing gasket shall be composed of solid neoprene rubber and shall be conform to ASTM D-2000 and shall be suitable for withstanding the effects of wastewater high temperature up to 120□C. The Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

Equlization Tank

The equalization tank shall be designed to provide a minimum storage of 2 hours at peak flow while pumping. Three submersible pumps as per schedule shall be provided with level switch control and automatic cut-in of the

standby unit. An aeration system similar to the extended aeration tank shall be provided for mixing and aerating the sewage with dedicated air blower.

Sewage Pumps

Working and standby sewage pumps shall be provided. Each shall be of submersible type c/w guide base to facilitate case of removal, lift chain and automatic discharge connection. Pump casing and impeller shall be of cast iron material. Shaft shall be of stainless steel material. The BOQ identifies quote rate for alternate MOC.

Disinfection

High Flow U.V. Sterilizers shall be installed in the outlet side of filters before the treated water enters the treated water tank.

Tertiary Treatment

This tertiary treatment shall be provided for the effluent used for flushing, irrigation & cooling tower ac make-up system. The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria. Softeners shall be provided to reduce hardness to commercial zero for cooling tower makeup system. Details of the equipment layout proposal shall be submitted for review by the Project Manager with tender documents.

Electrical Control

The operation of the treatment process shall be fully automatic and PLC based. A completely assembled and prewired control panel with mimic diagram consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timbers, on-off-auto change-over switches and duty selectors for equipment.

Proper control sequence shall be designed according to system requirement and manufacturer standards,

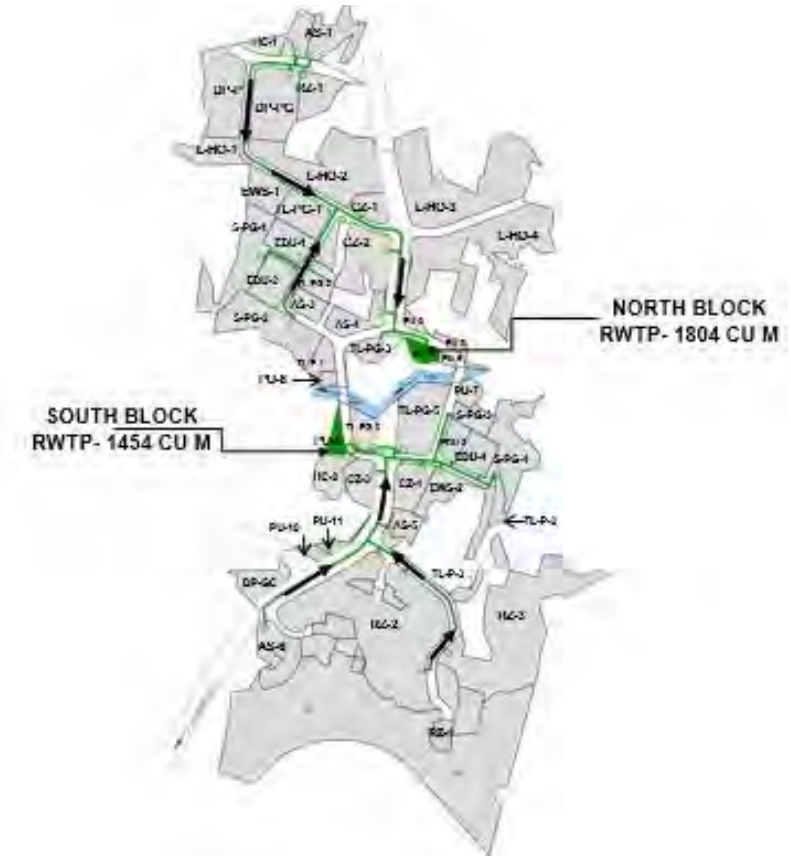
Piping Materials

SS304- Submerged air piping; MS epoxy coated- Air piping and pumped effluent riser (Non submerged) ; PVC piping - Pumped effluent (submerged) & tank overflow pipe line; PVC - Interconnecting pipe line after delivery header of pump / filter.

Valves

The Contractor shall supply and install all isolating valves and control valves as indicated on the drawings and as required for the proper and efficient operation and maintenance of the entire systems. All valves supplied shall be suitable for the working pressure and test pressure of the system as specified elsewhere in this specification. Regulating valves shall be of similar materials as that specified for cast iron gate valves. All regulating valves shall be lock shield type. All valves shall be full line size. Each valve shall have a purpose made reference number plate for label engraved or stamped indicating the manufacturer's catalogue number, pressure and temperature ratings. Valves shall be arranged so that clockwise rotation of the spindle will close the valve. Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows. All valves shall be packed with an approved packing and threads shall be coated with oil and graphite. Packings should be replaced when found deteriorated on site. Where possible locate all valves at convenient positions of operation from the floor with valve stems upright. Valves that are flanged shall have flanges to the table specified for the pipework. Plastic or metal plates (rust-less) shall be provided to indicate the open / close status as well as the use of each valve in the pump and tank rooms.

The treated wastewater will be distributed in individual zone by pumping and no ESR will be considered for the system. The pumping hours will be about 8 to 12 hrs. per day. For recycled water distribution HDPE pipes of P80 and PN6 class will be used. Recycled water will be delivered at the boundary of each parcel which needs to be stored with minimum half day storage for daily requirement for onward pumping and supply to users by the developer. By recycling treated wastewater fresh water requirement will be reduced by about 4 MLD which will help in conservation of precious water. The various layouts of the recycle WTP, substation and UG Tank are shown below:



	Township Area
	RWTP Location
→	Direction of flow

Figure 2.20: Recycle Water System, UG tank and substation Layout for the Township

2.7.3 Storm Water Management

The runoff calculations are given in table 2.12 below

POND SIZING CALCULATION							
Sr. No.		Area	Rainfall	Runoff Coefficient		Catchment Capacity	Unit
				Roof Area	Paved & Landscaped Area Avg runoff 0.6		
1	Pre Development Run-Off	711452	0.15	-	0.6	64031	Cumtr
2	Post Development Runoff	744251	0.15	0.9	0.6	67988	Cumtr
3	Incremental Runoff	-	-	-	-	3957	Cumtr
4	Area In Sqmtr	-	-	-	-	1583	Sqmtr
5	Pond (Dia In Mt)	44.9					Mtr Dia

The system shall be designed keeping in view the following:
(1) Natural Slope of the area.
(2) Layout of the different facilities in the complex.
(3) Levels of road and other services in the complex.

Approach to Planning

Storm water system shall employ combination of Open drains and pipe system at crossings laid along Ground slopes. Storm water system shall be designed for a Peak Rainfall intensity of 117mm/hr. In general, the rain water from terraces and other open areas shall be collected through rain water down-take pipes and connected through catch basins and the rain water from hard courts and parking area shall be collected directly by catch basins & connected to rain water percolation pits. Excess rain water shall flow to the peripheral storm water drain. Which shall be further connected with the main storm water line running parallel to the road. Main Storm water line shall be further connected with the existing nala.

Flood protection study

In Panvel, it rains mostly in the months from June to September. Intensity of Rainfall in Panvel, is 117mm/hr. However, the final levels of Site may undergo rising of the entire site and may create conditions which are flood prone. Thus, on a broad scale the flood prevention plan shall consist of following:

Water flows shall depend on final formation levels of the Plot. In order that during excess Rainfall water from adjoining properties does not infiltrate into our Plot, measure such as water barriers, holding ponds, Percolation tanks etc. shall be constructed.

All of these structures should preferably be placed along periphery of the Plot and more of them on the West side.

A catch drain is proposed on the southern and eastern boundary of the township area to the south of the seasonal nallah. This catch drain shall collect rain water flowing down from the southern and eastern part (outside the project area) and direct it into the seasonal nallah without taking it through the proposed township area. Thus the predominant natural drainage from southern and eastern part of the township remains unaffected by the township.

An estimated 4 m3/sec Surface runoffs is expected from the Plot, of which up to 25% could be successfully Percolated or Harvested. However, while estimating the Floods; consideration shall be given to water infiltration from adjoining areas.

A water body / pond is also proposed to the east of the township area. This pond's capacity has been designed such that the incremental runoff from the township area to the nallah is very less.

During Rainy Season:

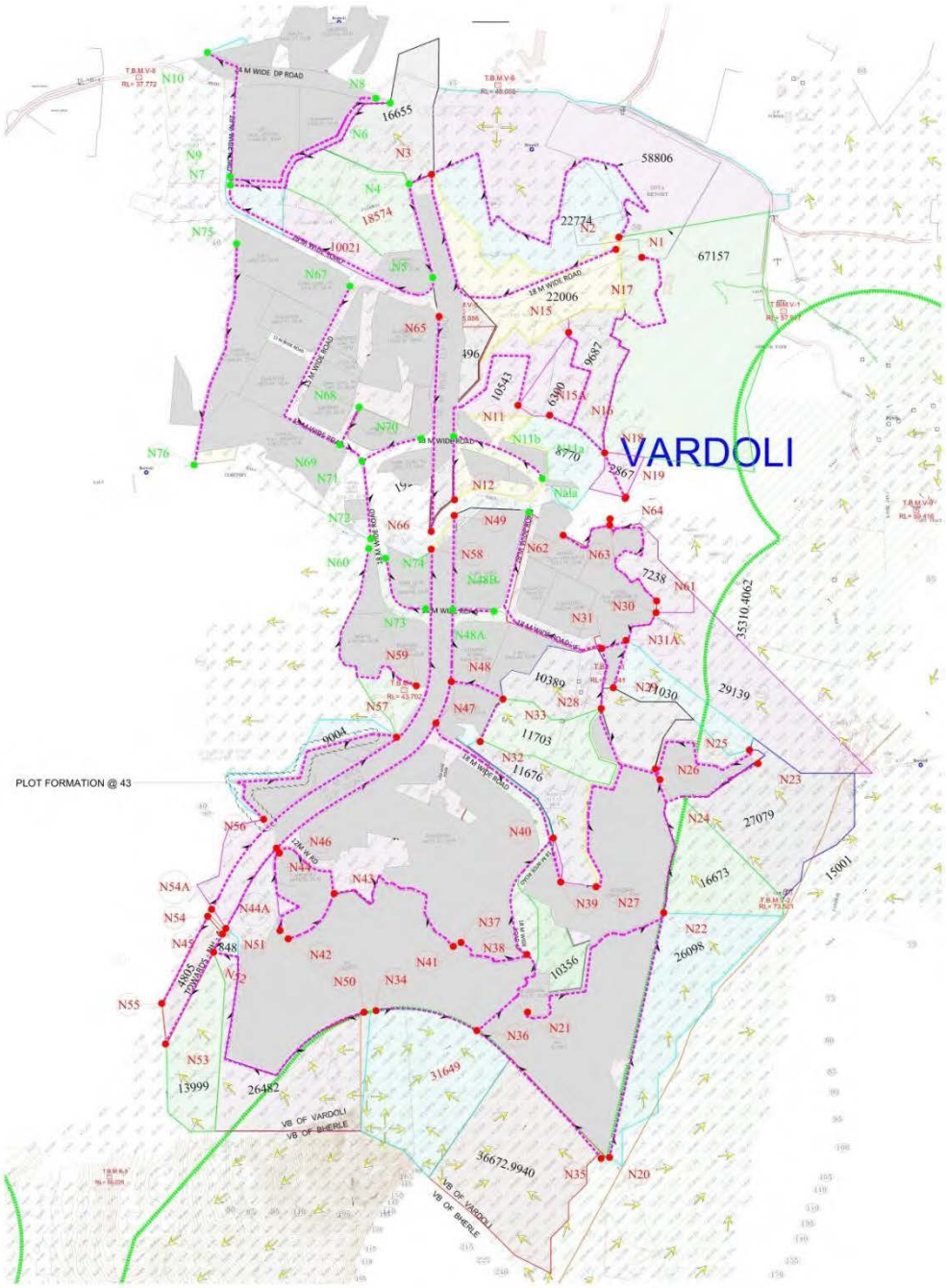
During intermittent rainfall, water shall be in excess quantity and thus an overflow from Retention basin/Holding ponds shall be connected to the External Storm water drainage system.

During dry season:

During dry season, due to heat, it shall be necessary to make up for the evaporation losses. However, it is not advisable to make up using potable water as the quantity shall be quite huge. Thus it is proposed to use Recycled water from Sewage treatment plant with an additional degree of purification to ensure safety to Public health.

The schematic layouts of the storm water drainage are shown below:

Figure 2.21: Sheet flow details



	Township Area
•	Recharge Pits ????
- - - - -	Drain alignment

Figure 2.22: Storm Water drainage network and Recharge point location

	Township Area
•	Recharge Pits No.????
-----	Drain alignment

Figure 2.23: Storm water layout at Building Level

	Plot area
•	Recharge Pits No.????
------	Drain alignment

2.7.4 Rain Water Harvesting

The calculations for the rainwater harvesting pit for the entire plot are given below.

Table 2.13 : Roof top & Surface (Paved or Unpaved) water harvesting

Sr.	Description	Quantity	Unit
	Rooftop Run-off		
1	Plot Area	557400.90	sqmt
3	Total Terrace Area	75,052.30	sqmt
4	Total Rainwater generated from Terrace Area (35 mm rainfall/day)	2,495.49	cumt
5	Annual Rainwater Generated from the Terrace Area (2.5 mt rainfall)	1,78,249.21	cumt
	Surface Run-off		
6	Garden Area	1,87,898.53	sqmt
7	Paved / Road area	2,02,596.89	sqmt
8	Surface Run off from Garden Area	3,945.87	cumt
9	Surface Run off from Paved / Road Area	6,381.80	cumt

10	Total surface run off	10,327.67	cumt
11	Total Rooftop + surface run off	12,823.16	cumt
12	Annual rainwater generated from the Garden Area	1,40,923.90	cumt
13	Annual rainwater generated from the Paved / Road Area	4,55,842.99	cumt
14	Total Annual Rainwater Generated from Surface Area	5,96,766.89	cumt
15	Total Annual Rainwater Generated from the Surface Area and Terrace Area	7,75,016.10	cumt
16	Provide Recharge Pits	385	nos.
17	Size of Recharging Pit (3.0 Mt. x 3.0 Mt. x 3.0 Mt.)	385	nos.
18	Size of Grease cum Desilting chamber (2.0 Mt. x 0.9 Mt. x 2.0 Mt.)	385	nos.

Planning for Surface Runoff Rainwater Harvesting System;

1. Proposed each Recharging Pits with Grease cum Desilting Chamber. Each recharging pit will consist of borewell.
2. Surface runoff water will be diverted from SWD to rainwater harvesting unit. The surface rainwater will pass through grease cum desilting chamber and then transferred to recharging pit with borewell through gravitational force.
3. Proposed filtration of water through 'V' wire screens, which will be installed on the mouth of the borewell. First Flush Chamber will be provided to drain off first rainwater to storm water drain.

Note:

1 We may change to some extent harvesting criteria as per the soil condition to allow max. water to percolate. Variations in designs shall be permissible as per site conditions and design criteria.
2. Cost of implementation for Surface Units will be Rs.11.55 Crore (approx).
3. Annual Maintenance cost will be Rs.23 Lacs (approx).
4. RWH Unit Borewell depth 40 Mtr.

The total rainwater harvesting pits for the entire plot are given in table 2.14 below:

Total Rainwater generated per day from the Rooftop & Surface -	**22,867 Cu. Mt.**
Annually Rainwater harvested from Rooftop area + Surface area.	13,71,356 Cu. Mt.
Rain Water Harvesting Scheme: Surface RWH Unit:- Grease cum desilting chamber + recharging pit	385 Nos.

The plan and the section for the Rain water harvesting structure are given below.

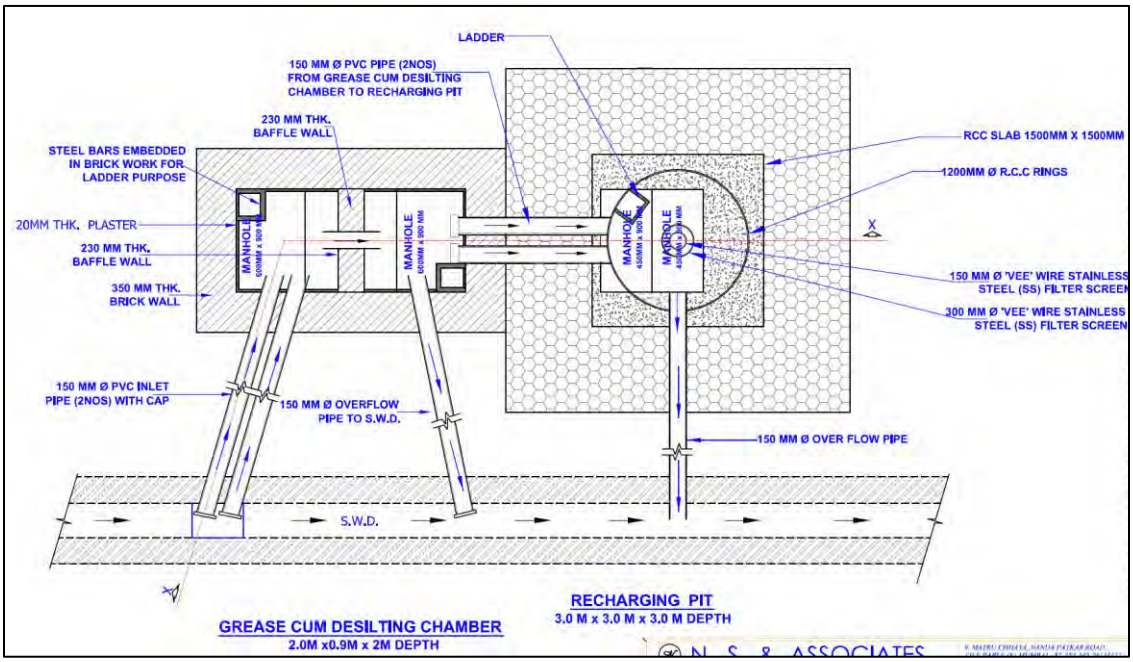


Figure 2.24: Plan for the rainwater harvesting structure

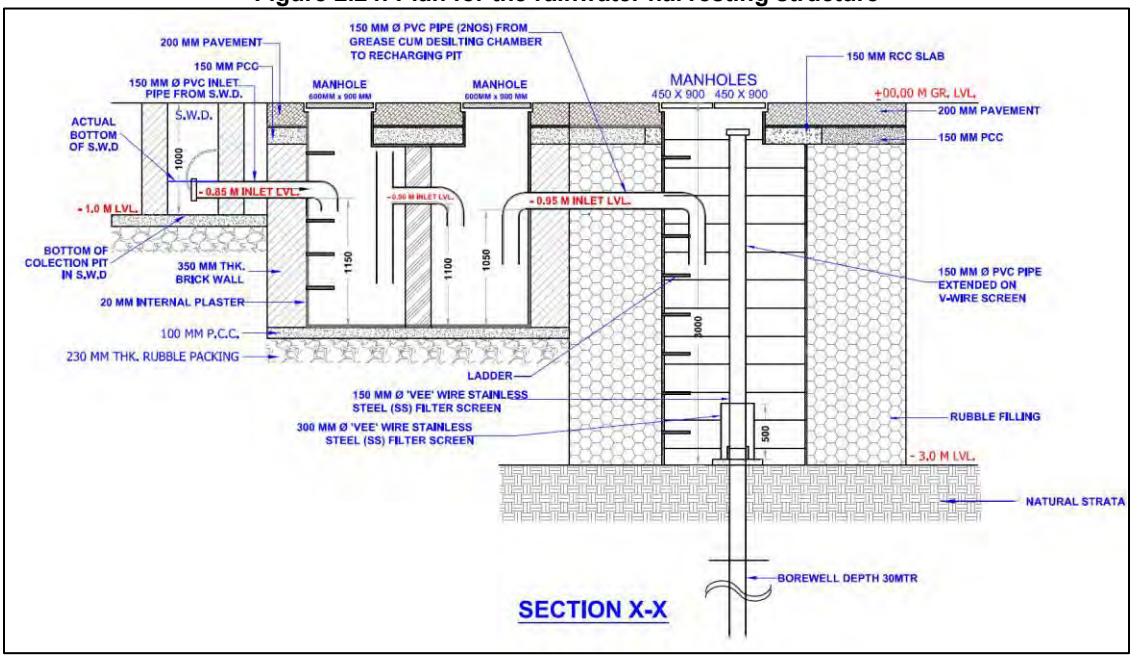


Figure 2.25: Section for the rainwater harvesting structure

2.8 Solid Waste Management

2.8.1 Solid Waste Generation

The solid waste generation in the township would be mainly from following sectors:

1. **Residential:** Waste generation from residential colonies of the students and faculties and other employees of the industries
2. **Commercial:** There would some commercial areas like shopping malls, Banks etc
3. **Institutional:** Waste would also be generated from educational institutions like schools and colleges
4. **Biomedical waste:** Biomedical waste would be generated from health care units / clinics.
5. **Street sweeping and garden waste:** Waste from street and road sweepings and garden waste

The solid waste generation for the proposed township is estimated based on CPHEEO manual for SWM and the report published by NEERI for metro cities in India. The basis for solid waste generation from different sectors is presented below:

Table 2.15: Basis of Solid Waste Generation from Different Sectors

S. N.	Source of waste	CPHEEO/ NEERI	Unit
1	Residential	0.5	Kgpcd
2	Commercial	0.2	Kgpcd
3	Institutional	0.2	Kgpcd
4	Roads	0.05	Kgpcd
5	Garden	0.0037	Kg/ sqm/ day
6	Health Clinic (MSW)	0.5	Kg/ bed/ day
7	Health Clinic (BMW)	1.25	Kg/ bed/ day
8	Sewage Treatment Plant sludge	300	Kg/ MLD

**Biomedical waste from Health Clinic will be handled per Biomedical Waste (Management and Handling) Rules, 1998.*

The debris management for the construction phase for the STP zone is given below:

Table 2.16: Debris management plan for the STP Zone

Materials	Waste generated (in buildings)		Handling Procedure
	Waste in tonnes	Waste in cu.mt.	
PCC Waste	274.35	391.93	Used for Site filling
Concrete Waste	4766.87	6809.82	Used for Site filling
Reinforcement steel scrap	960.23	1371.76	To be sold to vendors
Brick Debris	1817.58	2596.55	Used for Site filling
RCC	6412.99	9161.41	Used for Site filling
Tiles Waste	16529.73	23613.90	To be sold to vendors
Glass Waste	1749.00	2498.57	To be sold to vendors
Paint Cans	1371.76	1959.66	Will be taken by Contractor
Wood Waste	411.53	587.90	To be sold to vendors
Total	34294.05	48991.50	
Construction waste per year	4286 T per yr		
Construction waste per day	11.74T per day		

The solid waste assumption norms for the township residential is given below

Table 2.17: Solid waste management quantification assumptions

Components	Waste Generation Norms		Basis of Assumption
Residential	0.45	Kg/capita/day	Source: Manual for Municipal SWM
Garden area	0.003	kg/sq.m	Based on earlier studies
Sewage Treatment Plant Sludge	250	Kg / MLD of wastewater treated	Manual for Sewage treatment by CPHEEO

The solid waste quantification for the residential plots of Special township residential plots is given below

Table 2.1: Solid waste management quantification residential plots

Particulars	RZ-2	RZ-3	RZ-4	EWS-2
Population (no. of persons)	17600	10220		1520

Waste	7.92	4.599	0	0.684
Green Waste	0.05	0.04	0.01	0.01
Sewage Treatment Plant Sludge	0.53	0.31	0.00	0.05
Wet Waste	5.33	3.11	0.01	0.46
Dry Waste	3.17	1.84	0.00	0.27
Total Waste	**8.50**	**4.95**	**0.01**	**0.74**

CZ3						
Components	**Waste Generation Norms**		**Basis of Assumption**	**Unit**		**Total Waste Generated (TPD)**
Commercial	0.2	Kg/capita/day	Source: manual for Municipal Solid Waste Management	2189	Persons	7.92
Garden area	0.003	kg/sq.m	Based on earlier studies	475.86	Sq.m	0.05
STP Sludge	250	kg per MLD of wastewater treated	Manual for Sewerage and Sewage treatment by CPHEEO	0.09	Million Liters per Day	0.02
Total waste						**0.46**
Biodegradable waste						**0.20**
Non Biodegradable waste						**0.26**

CZ4						
Components	**Waste Generation Norms**		**Basis of Assumption**	**Unit**		**Total Waste Generated (TPD)**
Commercial	0.2	Kg/capita/day	Source: manual for Municipal Solid Waste Management	2522	Persons	7.92
Garden area	0.003	kg/sq.m	Based on earlier studies	547.44	Sq.m	0.05
STP Sludge	250	kg per MLD of wastewater treated	Manual for Sewerage and Sewage treatment by CPHEEO	0.10	Million Liters per Day	0.03
Total waste						**0.53**
Biodegradable waste						**0.23**
Non Biodegradable waste						**0.30**

The solid waste management including collection, storage, treatment and disposal is given below:

Table 2.2: Scheme for the solid waste management

Particulars	Description
Collection	Daily collection of waste take place from all the bins. • Daily sweeping and collection of waste from roads and other common facility area is carried out daily in the morning and evening. • For waste collection, covered vehicles is used. Separate collection for biodegradable and non-biodegradable wastes is ensured.
Storage	To minimize littering and odors, waste is stored in well-designed containers/bins which is located at strategic locations for biodegradable, Recyclable and Inert waste Blue (Inorganic) and green (Biodegradable) bags/bins, red for Hazardous and grey for E-waste are placed for segregation of waste. In the parking space, other open areas, green areas, commercial areas, amenities also dedicated bins are placed. Area for SWM: 50sq.m on each plot
Treatment & Disposal	Biodegradable waste -Biodegradable is treated in Organic waste converter. Non-biodegradable waste is handed over to authorized vendor Inert Waste: Will be disposed through Municipal Council. Recyclable:-sold to local recyclers Sewage Treatment Plant sludge will be used as organic manure.

Cost details	In Operation phase: Capital cost= 75 lakhs Maintenance cost = 24lakhs/yr.

The scheme of the source segregation is given below:

'Bin for Organic waste' (GREEN BIN)	**'Bin for Inorganic waste' (BLUE BIN)**
• Food waste (food, fruits, vegetables, meat/fish waste, eggshells etc.), • Horticulture waste, • Dippers, sanitary waste etc., • Discarded cloths etc. and • Wood material	• Papers, carbon papers, carboards, plastic waste, house sweeping, • CD's, cartridges, parts etc., • Glass, foils, discarded furniture etc., • Ceramics and • Rags, rubber, leather, ferrous, aluminum etc
'Bin for Haz waste' (RED BIN)	**'Bin for E- waste' (GREY BIN)**
• Aerosol, batteries, bleaches & draining agents, Oil waste & filters, solvents, insecticides, • Light bulbs, paints, lubricants, thinners etc., Pesticides & photography chemicals, • Styrofoam, thermometers, mercury containing products, injection needles etc., and • Discarded medicines and incontinence pads	**IT & Telecom equipment** • Centralised data processing • Computers, Printers, Copying • Electrical & electronics • User terminals. Fax, telex and mobiles • Answering machines **Consumer electrical and electronics** • Television & Refrigeration • Washing machines • Air conditioning and plants

The types of bins to be used for the various users is given below:

Sr	Bin types	Prototype
1	**Indoor bins :** These are placed within houses, shops, offices and have uniform shape that can be integrated with mechanized collection systems. These are wheel mounted and are compatible with loading arms of collection trucks. Colour code is as per segregation system. These will be in capacities of 90 lit and 120 lit.	
2	**Corridor bins :** These will be placed in public spaces such as courtyards, plazas and corridors. Waste from these bins will be transferred to common collection bins.	
3	**Road network and circulation bins :** These will be placed along the road side, footpaths and traverse locations to receive trash from road users.	 

Specification	90 lit	120 lit
Height (cm)	76.20	101.60
Width (cm)	38.10	38.10
Depth (cm)	38.10	38.10
Capacity (cm)	25.00	36.00
Wheel dia (cm)	15.25	15.25

4	**Secondary collection bins :** These are for common collection from institutional, commercial and open areas. These have a capacity to store waste for 2 days. These are also compatible with loading mechanism of collection vehicles. Bin sizes are 660 lit and 1100 lit.	

The following precautions will be taken for biomedical waste described as under:

- Care will be taken that no bio medical waste will get mixed into municipal waste.
- No biomedical waste shall be kept and store beyond period of 48hrs
- Biomedical waste will be handled as per BMW rule 1998 & Amendments thereof
- Hazardous waste generated during Operation phase, will be handed over to Mumbai Waste Management Limited (MWML), Taloja, Dist. Raigad belongs to Ramky Group.

DESCRIPTION OF BASELINE ENVIRONMENT

This chapter describes the existing environmental settings in the study area which has been considered as the delineated Project Region and an area of 15 km extending from the boundary of the Proposed Township. The understanding of the baseline environmental attributes is essential to identify any potential impacts and the potential change on the natural and socio-economic environments.

The baseline data generation included site visits, primary environmental monitoring, ecological surveys, social surveys and interviews, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department (IMD), Census of India etc. The baseline environmental status for the study area has been established through a comprehensive primary monitoring for three months extending from March 2015 to May 2015. The ecology and biodiversity survey was carried out in month of October 2015 for Prabal Machi and on site, within 5 km and 15 km from project boundary was carried out in the month of December 2015. The environmental monitoring for ambient air quality, water quality, soil quality, noise levels, meteorology and traffic survey of the study area extending 15 km beyond the site boundary was carried out by M/s Aavavira Biotech (P) Ltd as per the Terms of Reference (ToR) approved by the Maharashtra State Expert Appraisal Committee – II (SEAC - II) (provided as Annexure I).

3.1 Methodology

The baseline assessment is based on project site assessment and reconnaissance survey of the study area of 15 km radius around the boundary of the identified area. Baseline data is also supplemented by secondary information collected from various literatures, documents, report of previous surveys and also census data of the study area. Primary environmental baseline data was collected during March 2015 - May 2015.

Secondary data and information on various environment aspects like hydrogeology, hydrology, drainage pattern, ecology, meteorology and socio-economic aspects were collected from different institutions, government offices and literatures etc.

The baseline ambient air quality, water quality, soil quality, noise level and traffic density in the study area is based on the monitoring conducted. The baseline sampling and monitoring was done in compliance with applicable standards as prescribed by Central Pollution Control Board (CPCB).

The baseline study is structured in the following pattern:

- Climate and Rainfall
- Topography / Physiography;
- Hydrogeology and Drainage pattern;
- Geology;
- Meteorological condition;
- Ambient Air Quality;
- Ambient Noise Level;
- Surface and Ground water Quality;
- Soil Quality;
- Ecology;
- Land use; and
- Socio economic status

3.2 Climate & rainfall

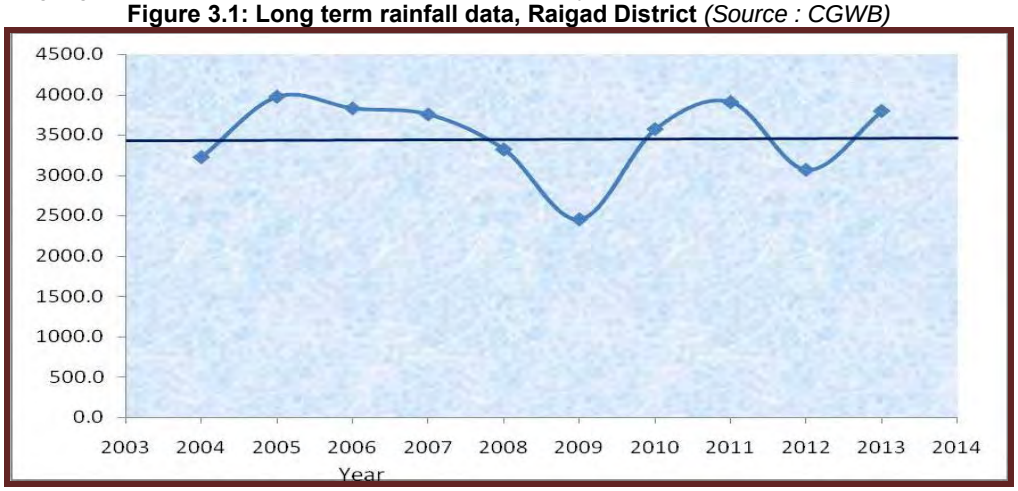
3.2.1 Climate

Raigad district experiences moist and humid climate. Alibaug and Bhira are the two places in the district having meteorological observatories. The climate of the district is typical of that on the west coast of India, with plentiful, regular and seasonal rainfall during the monsoon season. Being a coastal district, the diurnal and seasonal variations in temperature is not large. The year may be divided into four seasons; the summer season from March – May, the rainy season from June – September, the post- monsoon season October and November, and the winter season from December – February.

3.2.2 Rainfall

The south- west monsoon commences by about the first week of June and the rains continue till about the beginning of October. The average rainfall for the district is 3028.9 mm. The rainfall increases rapidly from the coast towards the Sahyadri on the eastern border of the district. Nearly 95 per cent of the annual rainfall is received during the south- west monsoon season. The rainfall is regular and the variations are from year to year. The following Figure shows the cumulative rainfall from last 10 years.

Figure 3.1: Long term rainfall data, Raigad District *(Source : CGWB)*



As shown above, the cumulative rainfall have experienced more than average rainfall in the tehsils of Karjat, Khalapur, Pen, Roha, Sudhagad, Mangaon, Tala, Mhasla and Poladpur. All these tehsils are lying in the Sahyadri Mountain. Rainfall increases from west to east

Table 3.1: Raigad District cumulative rainfall (in mm) (2000-2009)

Sr.	Tehsil	Rainfall(mm)	Sr.	Tehsil	Rainfall(mm)
1	Uran	2636	9	Sudhagad	3579
2	**Panvel**	**2951.4**	10	Mangaon	3702
3	Karjat	3213	11	Tala	3149.4
4	Khalapur	3250.6	12	Shrivardhan	2637.6
5	Pen	3433.7	13	Mhasla	3535.3
6	Alibag	2520.9	14	Mahad	2966
7	Murud	2904	15	Poladpur	3336.6
8	Roha	3899			

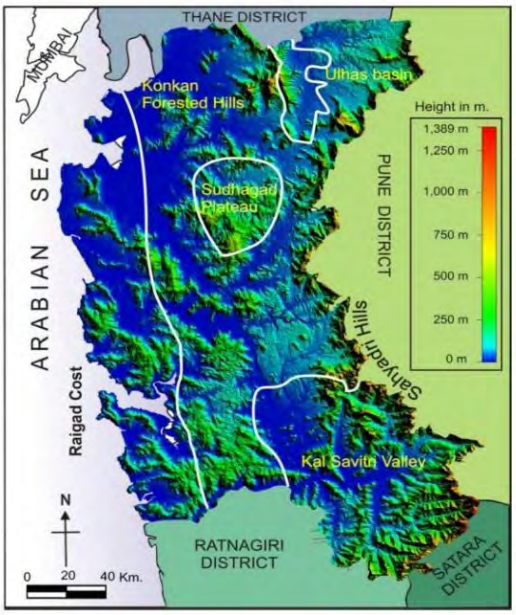
(Source: Raigad District Census Handbook, 2001)

3.3 Topography

Raigad district forms a part of Maharashtra littoral, the micro level divisions of coastal plain. It is slightly elongated in the north - south direction. Raigad has a long-indented coastline. The length of the coastline is about 240 kms, with several creeks and inlets, suggesting submergence confirmed by the submerged Khair forest in Thane creek and Mumbai harbor. Though the districts form an important part of the traditional —Konkan Plain", ruggedness and uneven topography form the governing theme in its physical features. The Sahyadri (Western Ghats) in the east send several transverse numbers of subsidiary hills westwards denying the plains of a uniform level and continuous character. Based on variation in local relief, the district can be classified into six

groups i.e. 1. Sahyadri Hills 2. Konkan Forested Hills 3. Sudhagad Plateau 4. Ulhas Basin 5. Kal- Savitri Valley 6. Raigad Coast.

Figure 3.2: Physiography of Raigad District



Soil: The soils of the district are formed from the Deccan trap which is the predominating rock formation of this district with small out-crops of laterite at a few places in the Poladpur taluka and in the Matheran hills. They ' are generally grouped as forest, varkas, rice, khar or salt, coastal alluvial and laterite soils. The study area is covered with a thin soil cover. The soil at moderately elevated portions is coarse grained and reddish to brownish red in colour showing less time for soil development and frequent washing during monsoon. However, the soil along the foot hill portions and along the lowermost portions is fine grained and black in color, derived from the hillock towards east and south by weathering and erosion, transported and deposited over the central low land by the agency of rainwater during monsoon. The soil thickness is very less, observed up to depth of 0.5 to 1 m. Hence, the weathering column also is shallow and many rock exposures are observed in the project area.

Figure 3.3: Soil cover & rock exposure in project area

3.4 Physiography and geology

3.4.1 Introduction

In order to understand the groundwater regime, to assess the probable impacts of the proposed activity on the groundwater, surface water and geology of this area and to design appropriate mitigative measures, rainwater harvesting scheme suitable for proposed project site for conservation of incident rainfall, systematic hydrogeological study was carried out in and around project area. This assignment was handled by Mr. S A Kothe of M/s Sujalam Consultants, Nagpur. Sujalam Consultants is approved by QCI NABET (Reaccreditation with Category A for Anacon Laboratories, Nagpur vide MoM of 11th Meeting of Accreditation Committee for Reaccreditation dt. 31st January 2014 as empaneled functional area expert for Hydrology and Groundwater and Geology).

3.4.2 Location & accessibility

The project area is located about 8kms in eastern direction from Panvel. The project site is well connected by all season road.

3.4.3 Physiography

The Township area occurs in a single patch which is occupies a topography that ranges from area with slope 1:5 to almost plain topography along lowly contours. The site is flanked on eastern side by the buffer area of MESZ. 2.5 kms to the east of the project boundary is a NS trending ridge, the topmost portion of this ridge rises to an elevation of 800 meters above mean sea level which descends to just 30 meters over a distance of 4 kilometers. The southern boundary portions of the project area occupy sloping land, whereas the rest part occupies gently sloping to flat land. The site in particular occupies an area which is located close to a natural water stream / divide. It has a higher elevation to the east and on descends down to an altitude of little over 20 m (AMSL) in central portion of the site. In addition, the site is intersected by three small streamlets that area seasonal in nature.

The study area is covered with a thin soil cover. The soil at moderately elevated portions is coarse grained and reddish to brownish red in colour showing less time for soil development and frequent washing during monsoon. The soil thickness is very less, observed up to depth of 0.5 to 1 m below ground level (bgl). Hence, the weathering column also is shallow and many rock exposures are observed in the project area (Plate).

Figure 3.4: Rock outcrop in project area

3.4.4 Drainage

The study area occupies a part of catchment of stream which is known as Uran Creek in its lower reaches. It is intersected by two seasonal; first order watercourses, which originate just outside the eastern boundary and flow East – West. These pour outs are ephemeral i.e. carry water only during showers; otherwise they are dry throughout the year. The overall drainage pattern of this region is dendritic, wherein the small drainage meets the larger one at an acute angle.

3.4.5 Geological study

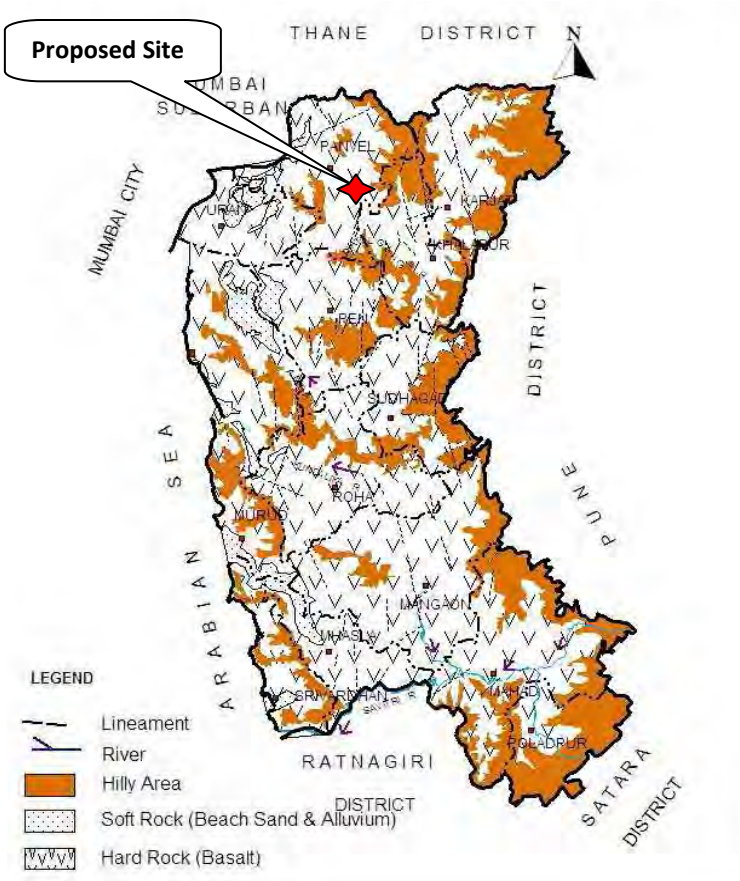
Deccan Trap Basalt of upper Cretaceous to lower Eocene period is the sole rock formation in this area. This rock occupies considerable portion of the Central India, covering significant portion in states of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Chhattisgarh and Karnataka. Nearly 82% of geographical area of Maharashtra state alone is made up of this rock (Refer Fig. 2). This rock is formed due to solidification of lava flows owing their origin to volcanic eruption. In the study area too, two layers of this rock, separated from each other by an intervening layer of soft, weathered rock and red soil are observed. The thickness of the individual layers is generally 12 mt. to 30 mt

Figure 3.5: Geological map of Maharashtra

3.5 Hydrological observations

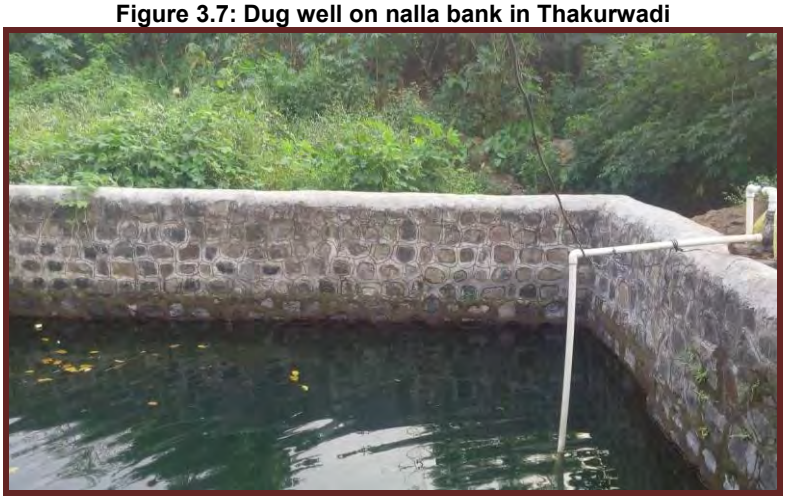
Groundwater Occurrence: The groundwater formation depends upon the topography as well as the subsurface geology The topography, as well as the subsurface rock both obstruct to the groundwater formation in the project area. The project area occupies a gently sloping, almost level land, and is comprised of Deccan trap basaltic rock. This rock has low porosity and permeability and hence, is found as —Ha" from groundwater occurrence point of view. These factors are found to play vital role in groundwater occurrence in the study area. The village Vardoli is famous for its groundwater scarcity. Most of the bore wells in Vardoli village have been found and reported by the residents as poor yielding, hardly providing drinking water. No bore well is found or reported to be used for agriculture in this village. The hydrogeological map sourced from District brochure of Raigad District (Published by CGWB) is shown below

Figure 3.6: Hydrological map of Raigad District



In the project area, the groundwater occurs both- under phreatic i.e. water table condition, providing water to open dug wells and confined condition tapped by means of bore wells. The water bearing structures are found to be located along low lying portions and adjacent to the surface water bodies in the form of streams or water tanks in this region (Plate below).

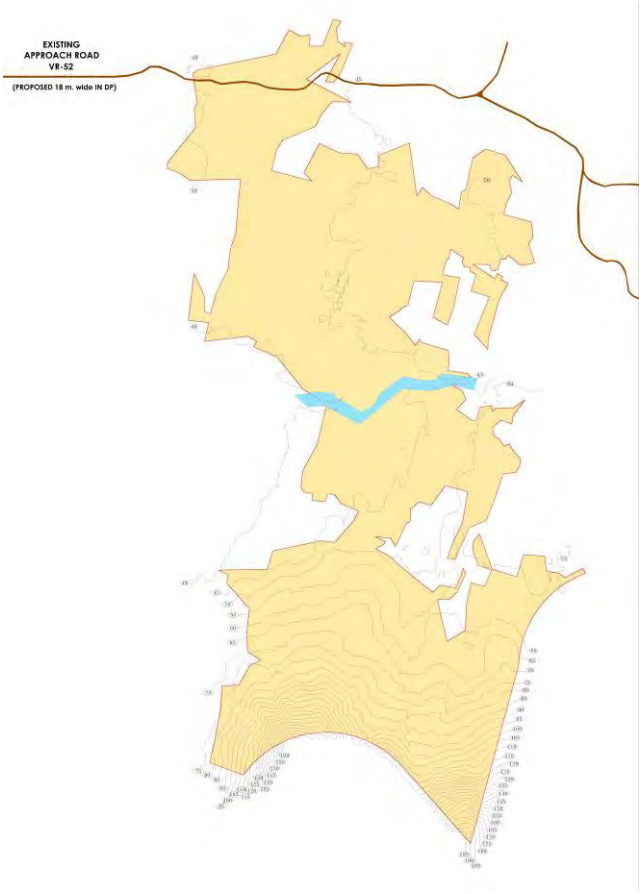
Figure 3.7: Dug well on nalla bank in Thakurwadi



Dug wells: The dug wells in adjacent area are found to be 8 to 10 m in depth bgl. They have been found to perform merely like storage tanks due to occurrence of hard rock and hence, poor inflows. The static water level (post monsoon) is found to be at 2 to 3mt depth below ground level, but the same rapidly goes down during dry season to and the dug wells go dry very soon. These structures are reported to deliver good water for drinking water purpose during winter.

Bore wells: The study and surrounding area hosts few bore wells. These are extensively used here. They are found to tap the semi confined and confined aquifer in this area. They are reported to be 100 to 120 m in depth bgl. Majority of bore wells are fitted with hand pump while few are installed with low capacity pumps as per requirement. It has been reported by the local residents that the bore wells have struck hard rock. Therefore, majority of the bore wells in this region are reported and found to deliver poor water i.e. 700 to 800 liter per hour. However, it is worth to mention here that there is no intensive use of groundwater in surrounding region.

Figure 3.8: Contour map showing natural drainage system of the site



3.6 Land use / cover mapping (within 15 kms radius)

Land use is primarily defined in terms of human activities but it can be inferred from the structure of physical components. Spatial patterns and relations (among land cover objects) must be taken in consideration to derive the land use. The field of Object-Based Image Analysis (OBIA) is mainly devoted to object-based classification of satellite image to obtain land cover maps and in fewer cases land use maps such object-based techniques could be further extended to identify more complex land use objects starting from the basic knowledge of land cover objects in the classified images. Complex structures (e.g., a nuclear plant or road network) can be identified as the result of the combination of different objects or of groups of objects.The land use representation starts from

the assessment of the land cover the observed physical cover of the Earth's surface. During the last few decades the land use concept has been defined in two different ways: the activities undertaken on a surface that induce land cover transformation (the management dimension); and the purpose underlying that transformation. Land use dynamics are a major determinant of land cover changes.

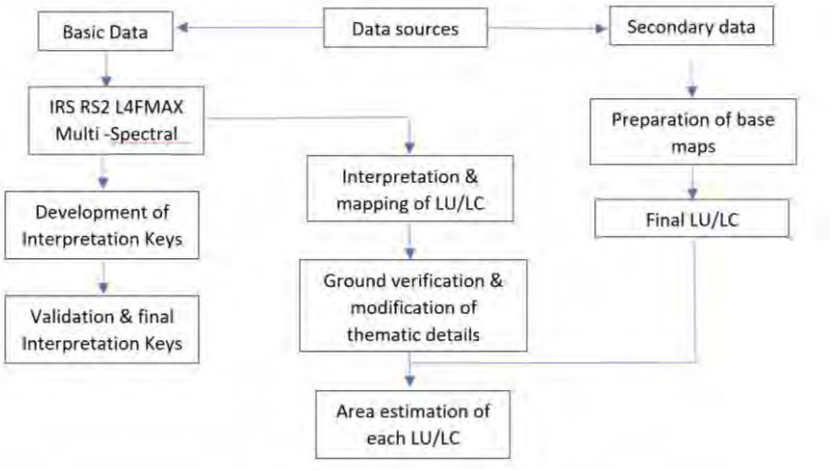
3.6.1 Scoping

- To establish the baseling information on Biophysical and socioeconomic condtions by applying remote sensing mapping techniques, supported by ground truth and ancillary data.
- To establish geo-information database based on the input from remote sensing as well as other ancillary data.
- To apply combination of RS & GIS techniques to arrive at land sustanibility classification to support the sustainable development planning.

3.6.2 Methodology

The land use/land cover map is prepared by adopting the interpretation techniques of the image in conjunction with collateral data such as topographical maps and census records. Image classification can be done by using visual interpretation techniques and digital classification using any of the image processing software. For the present study, ERDAS and ArcView Software's are used for pre-processing, rectification, enhancements and classifying the satellite data for preparation of land use land cover map and assessing land use land cover and land developmental activities. The imagery is interpreted initially based on the secondary data available and image characteristics. Thorough ground verification is done by BEIPL team to check each class of land use/land cover spread over the entire study area and final land use/land cover analysis is made after necessary corrections. Flowchart showing the methodology adopted is presented below.

Figure 3.9: Flowchart of simplified methodology



3.6.3 Data requirement

The data requirement for interpretation and analysis of land use and land cover of the study area is as below:

Basic Data

- Fused data of L4FMX
- Survey of India Toposheets, E43B04, E43B08, E43H01 & E43H05 (OSM Series), Scale: 1:50,000
- Local knowledge
- Area map on any scale to transfer details

- Reports and other secondary data of the study area.

Ground Data

- Ground data is very much essential to verify and to increase the accuracy of the interpreted classes and also to minimize the field work.

Data Analysis

- For analysis and interpretation of satellite data for land use and land cover mapping, the study has been divided into three parts:
- Preliminary Work
  - To lay down the criteria for land use classification to be adopted.
  - To fix the size of mapping units, which depends upon the scale.
  - Interpretation of different land use/cover classes.
  - Demarcation of unclassified areas.
  - Preparation of preliminary land use/cover map.
- Field Work
  - Type of ground data to be collected.
  - Selection of sample area for final classification.
  - Checking of unclassified areas demarcated.
  - Change in land use/cover areas wrongly identified and development of modified nomenclature.
  - General overall verification.
- Post-Field Work
  - Re-interpretation or correction of mismatch areas
  - Transfer of details on base map
  - Preparation of final land use/cover map

In order to finalize the land use/land cover map, the pre-field interpreted map details were revised on to the base map by additional field information, wherever necessary. Final drawings were then digitized in CAD/GIS (AutoCAD/ArcGIS) environment in order to prepare a digital database.

3.6.4 Baseline data

Satellite Data

IRS Resourcesat-2 L4FMX multispectral satellite data of 29th December 2014 was utilized for the present study and shown in **Figure 1**. The rectification of imagery was carried out on to bring the digital data on the earth coordinate system by means of ground control point (GCP) assignments from SOI toposheets.

Table 3.2: Details of Satellite data

Sr.No.	Satellite	Sensor	Scale	Path & Row	SOI Toposheet No	Date of Pass
1	IRS Resourcesat-2	L4FMX	1:50,000	94 & 59B	E43B04, E43B08, E43H01 & E43H05 (OSM Series)	29.12.2014

The spectral bands of IRS Resroucesat-2 data are furnished in Tables herewith.

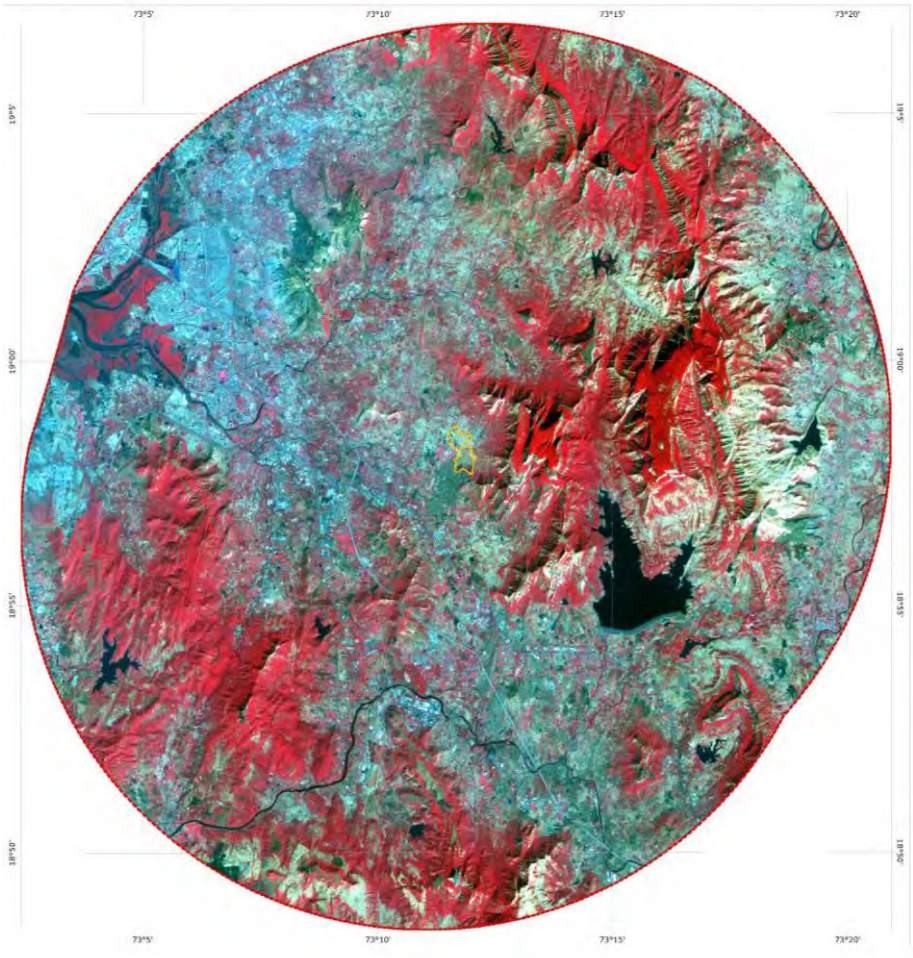
Table 3.3: Characteristics of IRS Resource-2 Data

Type Satellite	Multi Spectral Bands	Bandwidth/Wave length in microns	Spectral Resolution	Product type	Format/Scale
IRS Resourcesat-2	2,3,4	Band 2 : 0.52-0.59 Band 3 : 0.62-0.68 Band 4 : 0.76-0.86	5	Digital	Geocoded scale 1:50,000

Table 3.4: IRS Resourcesat-2 L4FMX, Satellite Spectral Bands and their principal applications

Band	Wave Length (Microns)	Applications
2	0.52-0.59	Soil/vegetation differentiations, coniferous/deciduous flora discrimination, vegetation vigour assessment, rock/soil boundary differentiation.
3	0.62-0.68	Strong chlorophyll absorption leading to discrimination of vegetation types mining area, mapping of settlements and transport network.
4	0.76-0.86	Delineation of surface water features, land forms / rock types, mining area, mapping of settlements and transport network.

Figure 3.10: IRS Resourcesat-2 L4FMX Image - 15 Sq. Km. study area



3.6.5 Collateral data & ground verification

Reports and maps have been prepared on the basis of satellite images, information map at 1:50,000 scale, field ground truth verification. Visually interpreted 15 Sq. Km radius study area of the satellite image and the interpreted features were checked on the ground during the field visit by BEIPL team. Local Officials of forest,

revenue and agriculture department were contacted for additional/secondary information. Modified field observations based on Land Use/Land Cover (LU/LC) legend was adopted for finalizing the LU/LC maps.

3.6.6 Interpretation of baseline data

Land Use/Land Cover Classification System
The purposes, for which land is being used commonly, are associated with different types of land cover such as built-up land, agriculture, forest, wasteland, water body and others. Following table shows the land use pattern of the study area.

Table 3.5: Level-II - Land Use/Land Cover statistics: 15 km Radius Area

Sr.No.	Land Use		Area (Hectares)	Area (%)
	Level-I	Level-II		
1.1	Built-up Land	Settlements	3612	4.22
1.2		Industry/Institutional Land	3278	3.83
1.3		New Development/Layout	14	0.02
1.4		Express Highway	157	0.18
2.1	Forest	Dense/Open Forest	17323	20.25
2.2		Degraded Scrub	4665	5.45
2.3		Forest Blanks	2372	2.77
3.1	Agricultural land	Plantation	217	0.25
3.2		Irrigated/Double Crop	1014	1.19
3.3		Other Agriculture Land	8979	10.50
3.4		Fallow Land	1071	1.25
4.1	Waste Land	Land with/without Scrub	36909	43.15
4.2		Rocky/Stony/Barren Land	649	0.76
4.3		Quarry/Mining Land	553	0.65
5.1	Water Body	Stream/River/Canal	1289	1.51
5.2		Reservoir/Tank/Pond	1753	2.05
5.3		Water Logged	127	0.15
6.1	Wetlands	Mudflats/Marshy Land	529	0.62
6.2		Mangroves	758	0.89
7	Others	Aquaculture Ponds	263	0.31
Total			85530	100.00

From the above table, it can be observed that nearly 45% of the study area consists of waste land, followed by forest area (28%) and agricultural land (13%) and others (14%). Nearly 43% of the waste land consists of land with or without scrubs, meaning that most of the study area has no or little vegetation and is also non-agricultural. Part of built up area is covered by either settlement or industry (4.22%) and institutional land ((3.83%). Dense or open forests constitute major part of the forest area, amounting to nearly 20.25% of the total project area. Water bodies amount to about 3.75% of the total project area. It is thus observed that no major agricultural land is being utilised for the Township proposal.
The accessibility of some of the transport facilities, health care units, fire & police station and airport is given below;

Table 3.5 a: Infrastructure facilities details near the site

Transport Facilities	**Distance**
Nearest railway station: Mohope Railway station:	1.3 km
Nearest Highway: National High way 4	within 3 km

Mumbai CST railway station	Within 56 km
Nearest Airport: Mumbai Chhatrapati Shivaji Terminus Airport	50 Kms
Mumbai Pune Express way	Within 4.2 km
Bus Depot: Vardoli bus depot	0.5 Kms.
Hospitals & Utilities	
Shreyas Hospita, MGM Hospital I & Arunodaya Hospital:	Within 13-14 Kms
Nearest Fire stations	12.5 Kms.
Panvel city Police Station	Within 14 Kms
Morbe Dam	App. 7 kms

Figure 3.11: Land use Map of the 15 Sq. Kms around Study Area

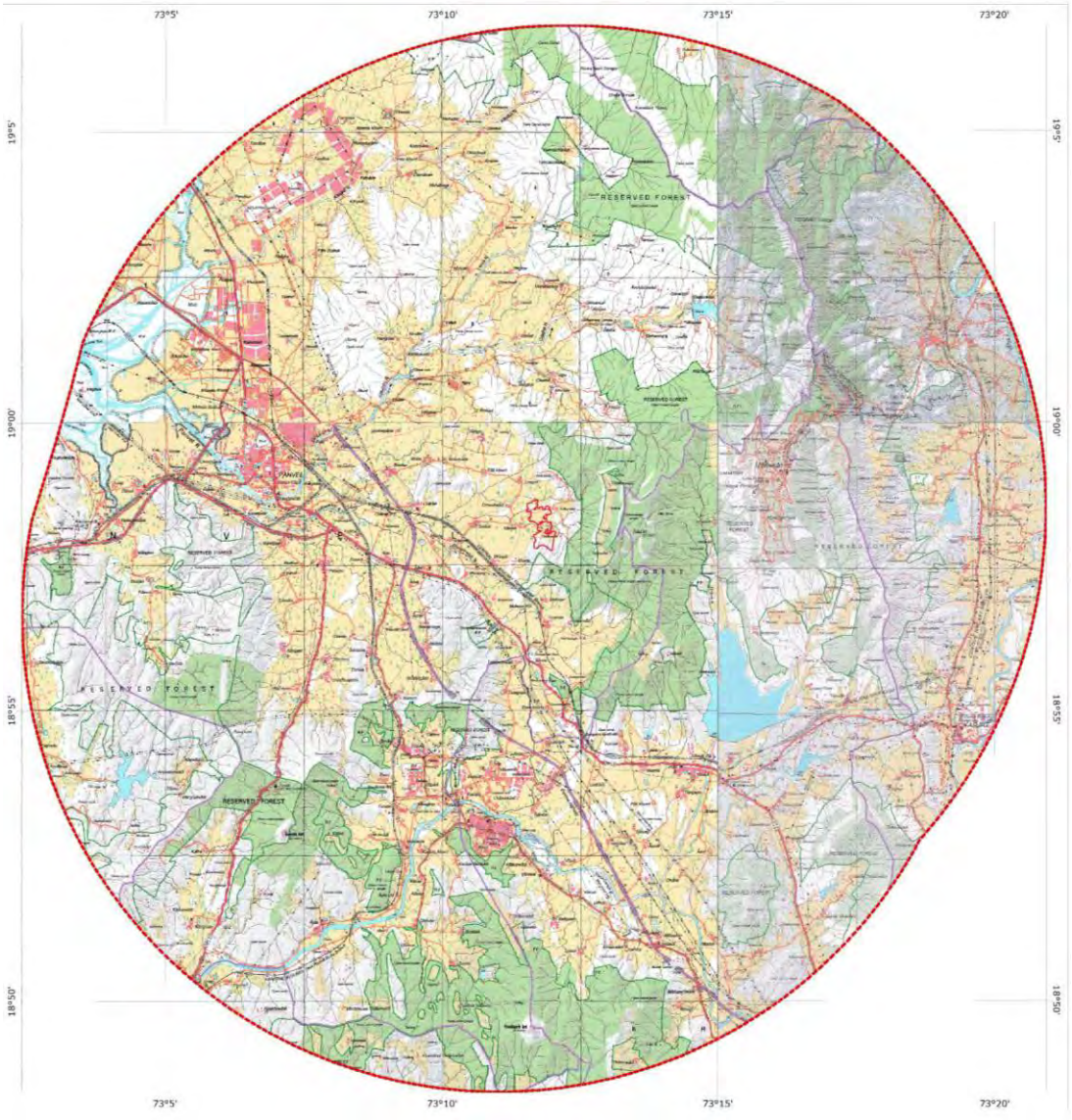
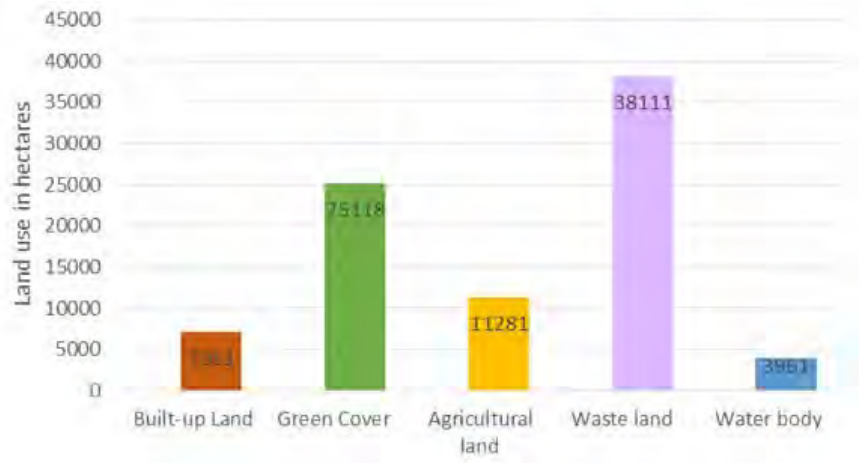


Figure 3.12: Land use distribution (15 Sq. Kms around Study Area)



3.7 Climate & micro-meteorology

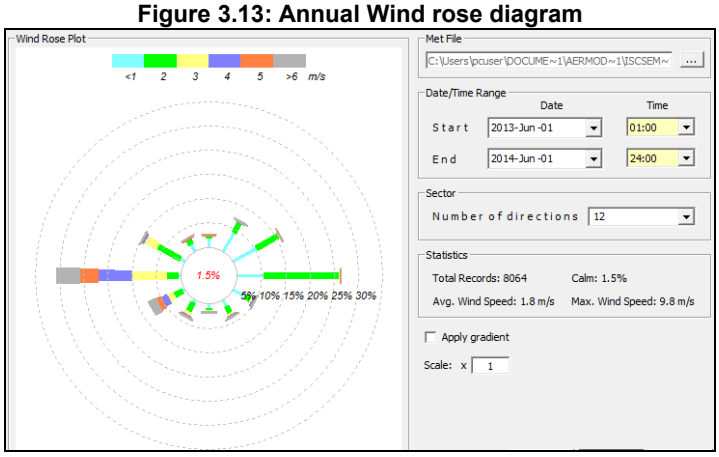
3.7.1 Climate

The metrological data for the project has been collected from IMD website in the form of met file from Envitrans solutions Pvt. Ltd. to identify the wind flow pattern along with other climate data. The region lies in hot and humid region. A calendar year may be divided into 3 seasons such as:

1. Winter (Cold Dry): November to February
2. Summer (Hot Dry): March to June, &
3. Monsoon (Wet): July to October

In cold season dry easterly winds prevail during most part of the day & cool north westerly winds prevail in the night. The onset of winters is marked in the month of November where slow drop of temperatures is experienced accompanied by few seasonal showers. From February onwards the humidity starts to increase along with rise in day temperatures. During the summer season the south westerly winds dominate the wind flow in the area. June marks the beginning of the monsoon period in Mumbai. The beginning of the month is characterized by a continuation of the summer with increased humidity. This period is marked by thunderstorms and often windy conditions as the monsoon establishes itself over the city. Rainfall activity intensifies as the month goes on, leading into wettest month, July marked by torrential rains and south westerly winds. The wind rose diagram for the whole year is as below:

Figure 3.13: Annual Wind rose diagram



3.7.2 Micro-meteorology

Based on the assessment of IMD data from the weather file procured from Envitrans Infosolutions Pvt. Ltd., a baseline profile of the temperature, relative humidity (RH), rainfall distribution, wind speed and wind direction of the region has been established, as discussed in this section.

Rainfall

The south west monsoon commences by about the first week of June and the rains continue till about the beginning of October. The average rainfall for the district is 3369.43mm. The rainfall increases rapidly from the coast towards the Sahyadri on the eastern border of the district. Nearly 95 % of the annual rainfall is received during the south- west monsoon season. The rainfall is regular and the variations are from year to year. The average rainfall of Khalapur taluka is given below.

Table 3.14: Annual Average Rainfall of Panvel Taluka(2001-2010)

Years	Rainfall (mm)
2001	4471.20
2002	3415.60
2003	2703.60
2004	2446.90
2005	3082.00
2006	3094.40
2007	4320.00
2008	3838.20
2009	3177.35
2010	3489.90
Average	**3369.43**

***Source**: Central Ground Water Board*

Temperature

Moderate temperatures are mainly observed here. Summers here begin from early March & lasts till early June. Summers are dry & hot. The temperature ranges from 20- 38^{0}C, though it varied as low as 18^{0}C to 40^{0}C during peak period. From November to January, is the winter season. Temperature at the winter peak drops to single digits but usually range around 9- 14^{0}C, but sometimes lowers up to 3^{0}C as depicted below, January to March are the months with moderate temperatures.

Table 3.15: Summary of Average Temperatures (2001 to 2012)

Months	Max.	Min.
Jan – March	30° C	9° C
April – June	37.1° C	23° C
July – September	22° C	15° C
October – December	28° C	13.1° C

The average temperature range of the district from secondary data of IMD and other such resources published ranged between 23.0 - 37.1^{0}C in summer whereas between 13.1- 28^{0}C in winter. The highest maximum average temperature was recorded in the month of May at 44.3^{0}C with January recording the lowest minimum temperature of 4.8^{0}C. The regional temperature profile reveals that the maximum and minimum temperature recorded was 38.6^{0}C and 17.9^{0}C respectively with the average temperature of 27.3^{0}C.

Humidity

The air is humid throughout the year. Relative humidity is on an average over 80 per cent during the south-west monsoon season. In the rest of the year the relative humidity is between 65 to 75 per cent.

Cloudiness

During the south-west monsoon season skies are heavily clouded to overcast. In the month of May and October the clouding is moderate. Clear or very lightly clouded skies are common in the rest of the year.

Winds

South West Monsoon winds are very strong and blow from west or south-west during monsoon season. During the period from October to December winds are generally moderate but sometimes strong in October and blow from directions between north-east and south-east. In the three months from January to March, the winds continue to be moderate and are predominantly from directions between north and east. In April while there is a slight strengthening of wind, the direction is variable. In May there is a further strengthening of winds and the

directions are between south-west and north-west. Wind rose diagrams for the months of March, April and May during which the monitoring for the project is carried out.

Figure 3.14: Wind rose diagram for March 2015

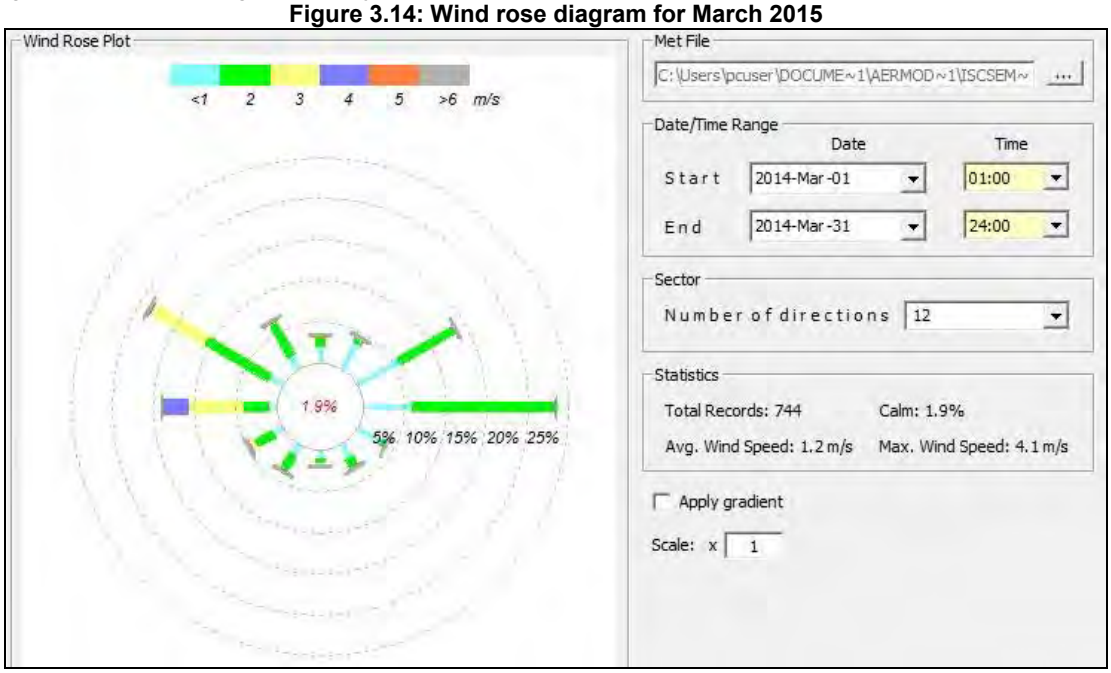


Figure 3.15: Wind rose diagram for April 2015

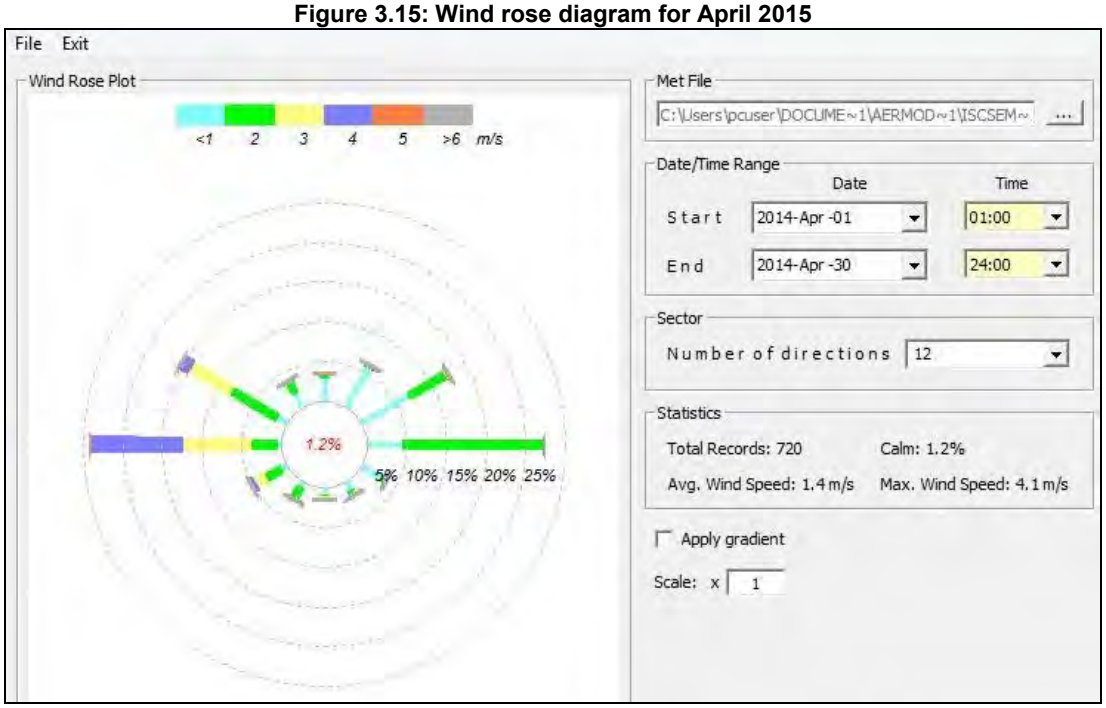
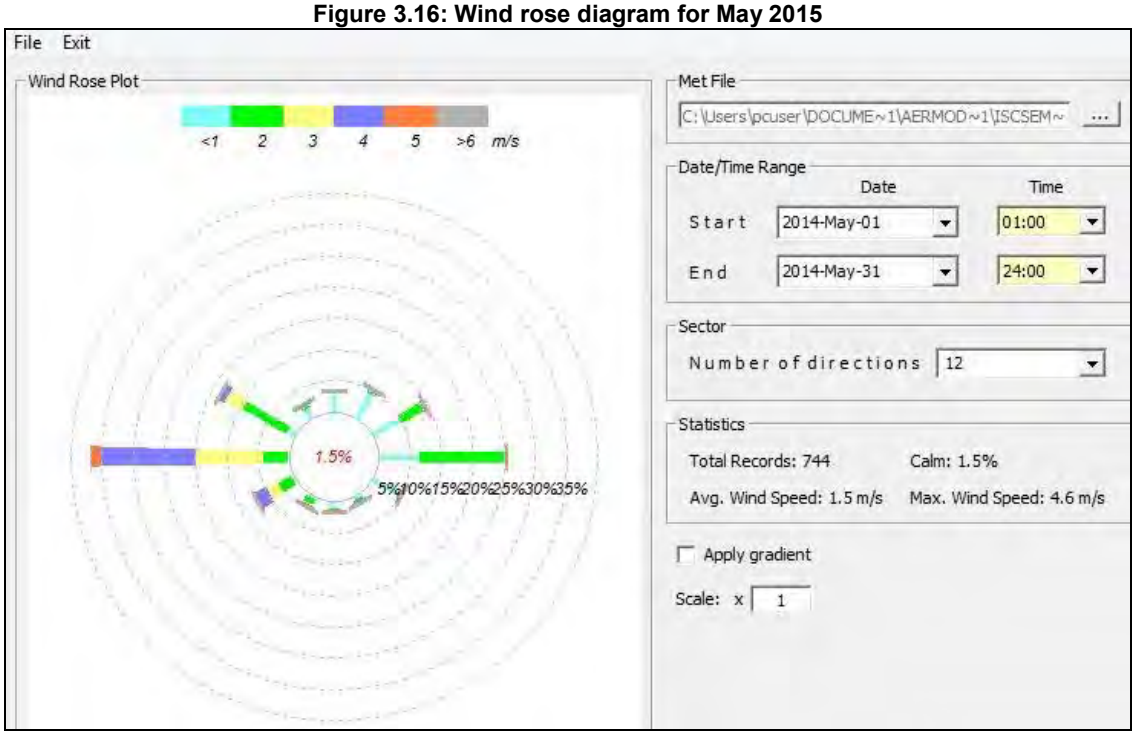


Figure 3.16: Wind rose diagram for May 2015



3.7.3 Baseline air environment

Ambient air quality is influenced by a complex mix of sources which vary diurnally as well as seasonally in urban areas due to variety of forms and extent of contribution. Major expected sources in and around the project especially in the core zone of developed portion is the existing habitation of the project. Most of the contributions are mainly anticipated to be geologic dust under the influence of wind speed with limited agricultural dust. Considering the overall objective and baseline environmental setting of the study area, ambient air sampling locations were finalized on the basis of the local wind flow pattern and topography of the project. It was found to be very essential to evaluate the air quality monitoring locations as per the standard criteria of sampling set up by International agency as well as Indian standards. Below Table represents the environmental attributes considered for formulating environmental baseline along with the source of data whereas Table 3.17 depicts frequency and monitoring methodology for various environmental attributes. Table 3.18 delineates these criteria for setting up of air quality monitoring stations and has been evaluated for its accuracy in determining the representative air quality in different parts of the Special Township.

Table 3.16: Environmental Attributes

Attribute	Parameter	Source of Data
Ambient Air Quality	PM_{10}, SO_2, and NOx, PM2.5, CO	Ambient air quality monitoring at nine locations

Table 3.17: Environmental Attributes: Frequency and Monitoring Method

Attributes	Sampling		Method	Remarks
	Network	Frequency		
Air Environment				

Respirable Suspended Particulate Matter (PM_{10})	Requisite locations in the project influence area	24 hourly during Pre-monsoon	Gravimetric (High-Volume with Cyclone)	As per CPCB standards for NAAQM, 2009
$PM_{2.5}$			Ambient Air Fine Dust Sampler	
Oxides of Sulphur (SO_2)			EPA Modified West & Gaeke method	

The sampling has been carried out once during from the month of March 2015 to May 2015. The locations along with their positional data is depicted below.

Figure 3.17: Air monitoring locations on the Google Earth encircling 5km radius

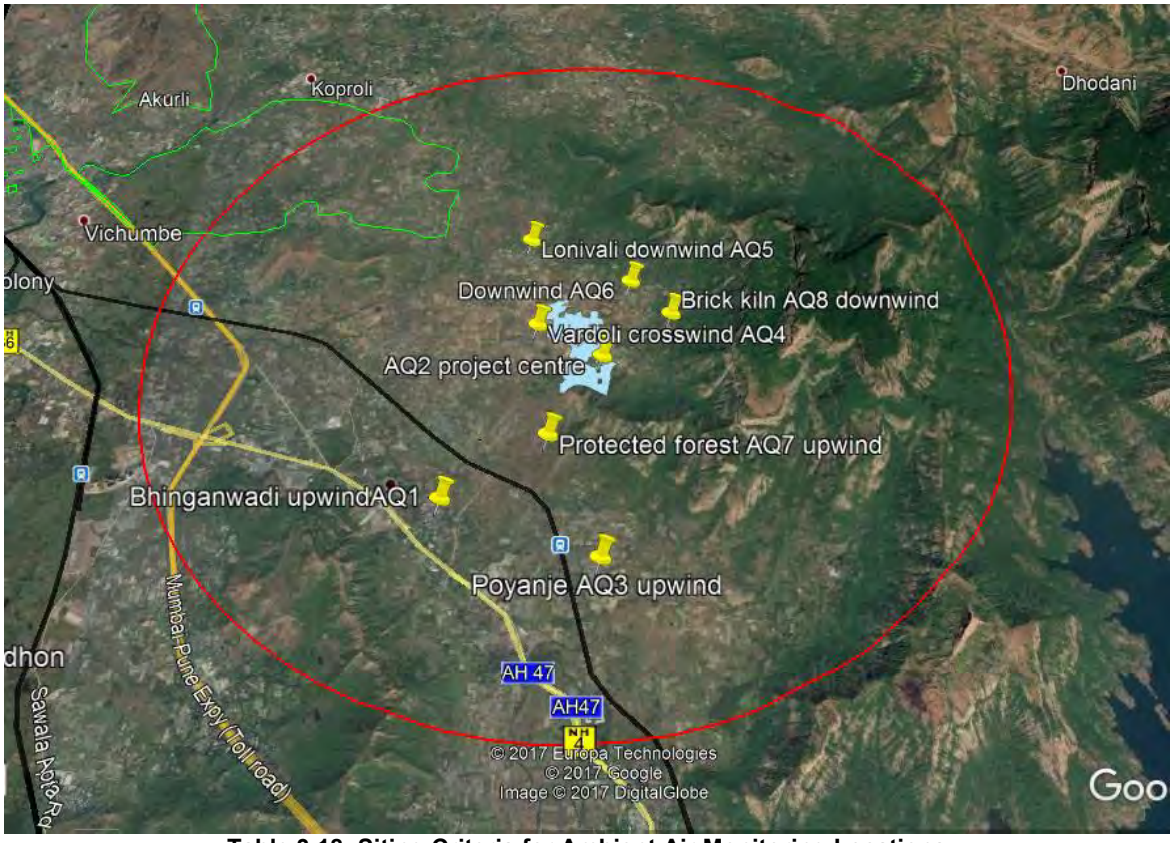


Table 3.18: Siting Criteria for Ambient Air Monitoring Locations

Criteria	IS Siting Requirement	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQ9
Vertical placement	2 – 15 mtr	5mts	5mts	5mts	5mts	5mts	5mts	5mts	5mts	5mts
Spacing from the tree	≥ 10 mtr	15mts	15mts	15mts	+10mts	15mts	15mts	15mts	15mts	15mts
Obstacle Distance	2x Ht. difference	> 2x	> 2x	> 2x	more	> 2x	> 2x	> 2x	more	> 2x
Unrestrict	≥ 270^0;	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ed Air Flow	no obstruction									
Distance to road	> 5 mtr	+10mts	+10mts	+10mts	+5mts	+15mts	+5mts	+15mts	20mts	20mts
Paving	Paved	Unpaved	Unpaved	Unpaved	Unpaved	Unpaved	Unpaved	Unpaved	Unpaved	Unpaved
Category	---	North Side within Project plot	Centre of the project plot	South side of the Project plot near NH -4	Cross wind towards West near Bhingar Village	Cross wind towards north West near Vardoli Village	Cross wind towards East near Mohape Village	Cross wind towards East near Mohape Village	Upwind near some farmers dwellings	Downwind near Khanavale Village
Location	---	Lat - 18°58'27.92"N Long - 73°11'59.02"E	Lat - 18°57'35.58"N Long - 73°11'34.34"E	Lat - 18°56'33.81"N Long - 73°10'59.64"E	Lat - 18°57'31.15"N Long - 73°10'56.94"E	Lat - 18°58'14.11"N Long - 73°11'23.24"E	Lat - 18°57'20.63"N Long - 73°12'12.10"E	Lat - 18°56'36.02"N Long - 73°11'25.25"E	Lat - 18°59'3.56"N Long - 73°11'59.58"E	Lat - 18°56'10.96"N Long - 73°10'55.92"E
Above MSL	---	52m	42mt	28mt	24mt	38mt	232mt	29mt	33mt	29mt

Since there are no extreme influential sources other than few DG sets (operation once in a while only) and cooking in the houses by using wood and cow dung cakes as raw fuel, along with minimal vehicular traffic as on date inside the project. There was presumed to be no source influence at any of the sampling locations making it much more representative. Land-use had been used as the primary site selection criteria followed by conventional parameters that influence ambient air as depicted above. 8 locations have been selected with a view to accommodate residential zones which envisages the upcoming development within the project. All of these locations had minimal influence of traffic being inside the project premises wherein only vehicles plying on roads are those of the property owners and a few limited ones used by villagers. The only heavy duty vehicles known to ply with the premises are State Transport Buses travelling from Navi Mumbai to this region which is approximately 80 in number throughout the day. All the locations were typically observed for ease of sampling with electricity connections and security. A detailed chain of custody for sampling and analysis was followed.

Ambient Air Quality

The prime objective of collecting baseline air quality data is to assess the prevailing / existing ambient air quality in the project influence area. 24 hourly ambient air quality monitoring was carried for three consecutive months during the month of March'14 to May'14. The details of eight air quality locations i.e. North Side within Project plot, Centre of the project plot, South side of the Project , Cross wind towards West near Bhingar Village, Cross wind towards north West near Vardoli Village, Cross wind towards East near Mohope Village, Towards South near Tata Motors, Upwind near some farmers dwellings, Downwind near Khanavale Village along with results are presented in --------.

Conventionally, one season data as expected to be assessed for ambient air quality usually covers one season i.e. about 3 to 4 months, following 2 consecutive days a week forming a total of about 60 samples at each site.

Figure 3.18: Representative photo of High Volume Sampler

In all 1260 samples were collected throughout the three months of monitoring including all site data. High Volume Sampler for PM10 & Ambient Air Fine dust Sampler for PM2.5 from MoEF approved laboratory – Aavanira Biotech Pvt. Ltd. duly calibrated as enclosed in Annexure 2. Oxides of Sulphur and Nitrogen were sampled with High Volume Sampler. Daily data for a period of 3 months was collated from each of the sites thereby making sure to include representativeness of sites in discussion. Fine criteria pollutants were monitored i.e. PM10, PM2.5, Sulphur dioxide (SO2), Nitrogen oxides (NOx). Respective results are tabulated below.

Table 3.19: Summary of SO_2, NOx, PM_{10} & $PM_{2.5}$ results

	SO_2				NOx			
Code	Min	Max	Av.	98th %tile	Min	Max	Av.	98th %tile
AQ1	10.1	22.8	18.8	22.3	34.3	51.6	42.6	50.2
AQ2	10.3	25.6	19.4	24.4	35.2	46.8	39.5	45.6
AQ3	18.2	23.0	20.3	22.7	35.1	43.2	39.1	42.6
AQ4	6.5	11.6	8.8	10.9	12.6	23.3	18.0	22.2
AQ5	6.5	11.6	8.8	10.9	12.6	23.3	18.0	22.2
AQ6	6.5	10.4	8.8	10.4	12.2	20.4	17.4	20.3
AQ7	19.1	22.4	20.4	22.2	36.4	42.0	39.3	41.9
AQ8	6.7	10.1	8.5	10.0	13.2	20.3	17.4	20.2
AQ9	7.3	11.4	8.8	10.8	12.6	23.3	18.1	22.4
	PM_{10}				$PM_{2.5}$			
Code	Min	Max	Av.	98th %tile	Min	Max	Av.	98th %tile
AQ1	71.3	88.8	78.4	87.6	42.4	56.7	48.0	55.9
AQ2	71.3	87.3	77.6	86.0	38.4	50.3	44.1	50.3
AQ3	62.1	78.2	70.5	77.0	31.5	39.6	35.6	38.9
AQ4	35.1	43.2	38.7	42.7	15.8	20.7	17.8	20.5
AQ5	35.1	43.2	38.7	42.7	15.8	20.7	17.8	20.5
AQ6	36.0	43.4	38.7	43.1	16.8	21.3	19.0	21.0
AQ7	58.7	72.5	67.7	72.5	29.8	38.1	34.3	38.0

AQ8	34.9	40.2	38.0	40.0	15.8	20.3	18.2	20.3
AQ9	35.1	41.5	38.5	41.1	17.1	20.9	18.8	20.6

Note: All figures in µg/m^3

Table 3.20: Summary of CO results

Location code	CO			
	Min	Max	Average	98th %tile
AQ1	0.7	1.1	0.8	1.1
AQ2	0.6	1.2	0.8	1.1
AQ3	0.4	0.9	0.7	0.9
AQ4	0.1	0.1	0.1	0.1
AQ5	0.1	0.1	0.1	0.1
AQ6	0.1	0.1	0.1	0.1
AQ7	0.4	0.8	0.6	0.8
AQ8	0.1	0.1	0.1	0.1
AQ9	0.1	0.1	0.1	0.1

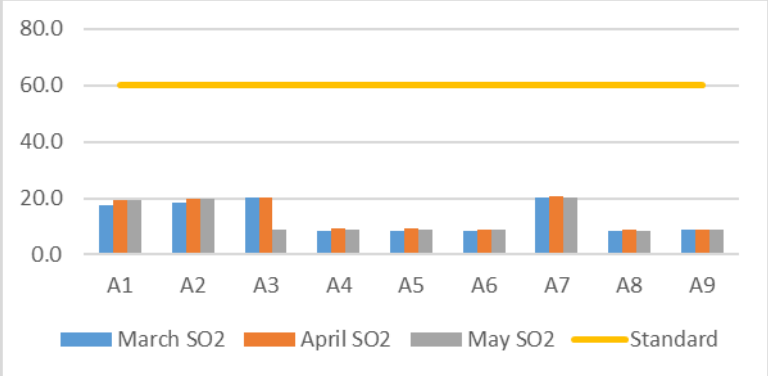
Note: All values in mg/m^3

Inferences

Sulphur Dioxide (SO_2)

The average concentrations of SO_2 were found to well within the prescribed CPCB limit of 80 µg/ m3. The concentrations of Sulphur dioxide in the region are observed to be in the range of 6.5 to 25.6 µg/ m3. The maximum values of SO_2 were recorded at center of the project site (AQ-2). The average values ranged from 8.5 µg/ m3 to 20.4 µg/m3 and 98 percentile values varied from 10 µg/ m3 to 24.4 µg/m3. The graphical representation of observations is presented below.

Figure 3.19: Graphical representation of maximum values of SO_2

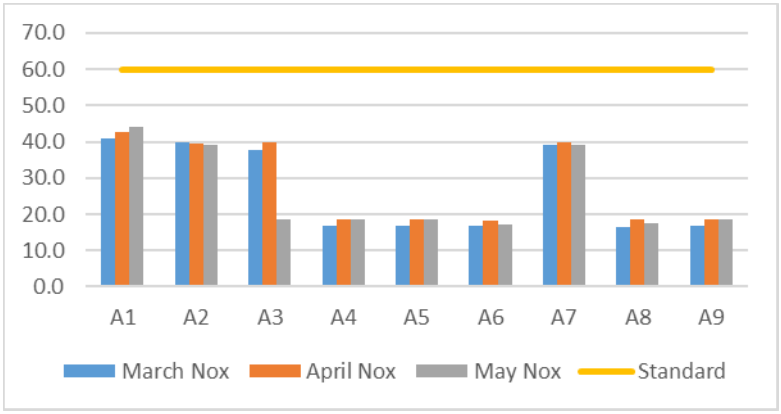


CPCB limit : 60 µg/m^3

Oxides of Nitrogen

The minimum NOx concentration was observed to be 12.2 µg/ m3 at crosswind towards East near Mohape village (AQ6). The maximum NOx concentration observed is 51.6 µg/ m3 at north side within the project site (AQ-1). The 98 percentile values measured were in the range of 20.2 µg/ m3 and 50.2 µg/ m3. The average values ranged from 17.4 µg/ m3 to 42.6 µg/ m3. The NOx concentrations were within the prescribed norms of 80 µg/m3 as per NAAQS guidelines. The observations of NOx are presented graphically below.

Figure 3.20: Graphical representation of maximum values of NOx

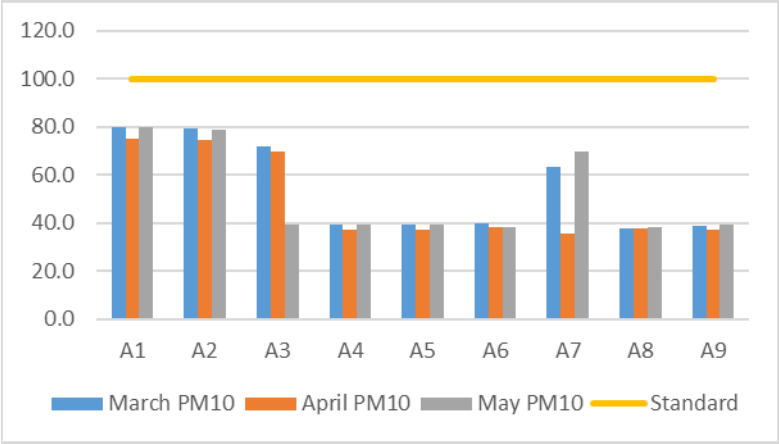


CPCB limit : 60 µg/m^3

Particulate Matter – PM_{10}

The average PM_{10} concentration recorded at all the sampling locations are well below the prescribed CPCB limits of 100µg/m3. The minimum value recorded was 34.9 µg/m3 at upwind near farmer dwellings (AQ8). The maximum value recorded was 88.8 µg/m3 at northern side of the project site (AQ-1). The 98 percentile values ranged from 40.0 µg/m3 to 87.6 µg/m3.. The average values varied from 38.0 µg/m3 to 78.4 µg/m3. The graphical representation is provided below.

Figure 3.21: Graphical representation of the maximum values of PM_{10}

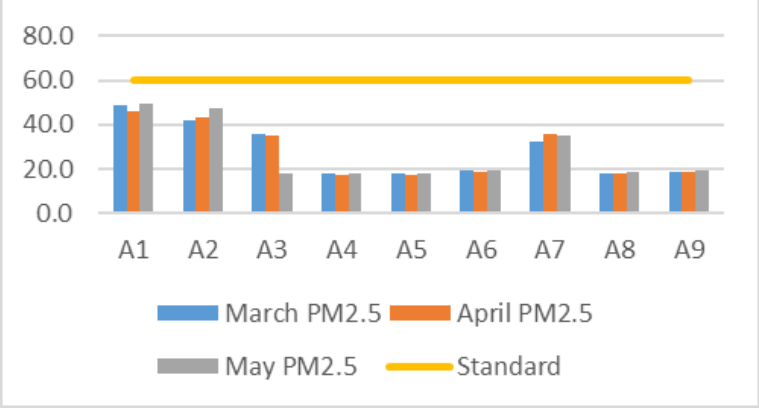


CPCB Limit – 100 µg/m^3

Particulate Matter – $PM_{2.5}$

The average $PM_{2.5}$ concentration recorded at all the sampling locations are well below the prescribed CPCB limits of 60µg/m3. The minimum value recorded was 15.8 µg/m3 at crosswind towards west near Bhingar village (AQ4). The maximum value recorded was 56.7 µg/m3 at northern side within the project site. (AQ-1). The 98 percentile values ranged from 20.3 µg/m3 to 55.9 µg/m3. The average values varied from 17.8 µg/m3 to 48.0 µg/m3. The graphical representation is provided below.

Figure 3.22: Graphical representation of maximum values of $PM_{2.5}$

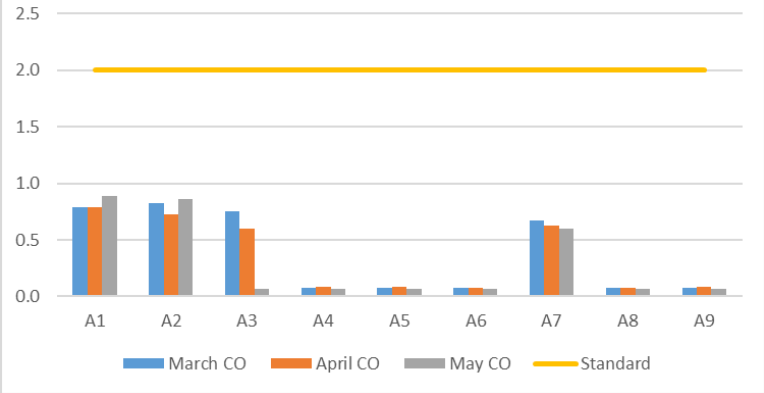


CPCB Limit – 60 µg/m^3

Carbon monoxide

The minimum value recorded was 0.1 mg/m^3 at crosswind towards North West near Vardoli village (AQ5). The maximum value recorded was 1.2 mg/m^3 at centre of the project site (AQ2). The 98 percentile values ranged from 0.1 mg/m^3 to 1.1 mg/m^3 .The average values varied from 0.1 mg/m^3 to 0.8 mg/m^3.

Figure 3.23: Graphical representation of maximum values of CO



Conclusion: All the parameters except CO are within the limits as prescribed by NAAQS 2009.

3.7.4 Ground water depth

The depth to water levels in the district ranges between 10-15 mbgl.

3.7.5 Surface & groundwater quality monitoring

The water quality assessment was done to understand the baseline ground water quality of the study area. The groundwater sample was collected from the project site and surface water from site. The details of ground water and surface water sampling locations are presented below.

Table 3.21: Details of Ground Water Sampling Locations

S .No.	Sampling Location	Code	Justification for Location of Sample
1.	Open Well - north side of project	GW1	Representing groundwater quality at the Project Site.
2.	Open Well - north side of project	GW2	--do--
3.	Bore Well - north side of project	GW3	--do--
4.	Bore Well - north side of project	GW4	--do--
5.	Open Well - West of the project	GW5	--do--
6.	Open Well - East of project	GW6	--do--
7.	Bore Well in Mohope Village	GW7	--do--
8.	Bore Well in Bhingarwadi Village	GW8	--do--

Table 3.22: Details of surface water sampling locations

S .No.	Sampling Location	Code	Justification for Location of Sample
1.	Morbe Dam	SW - 1	Intake point for water supply

Figure 3.24: Ground water sampling locations

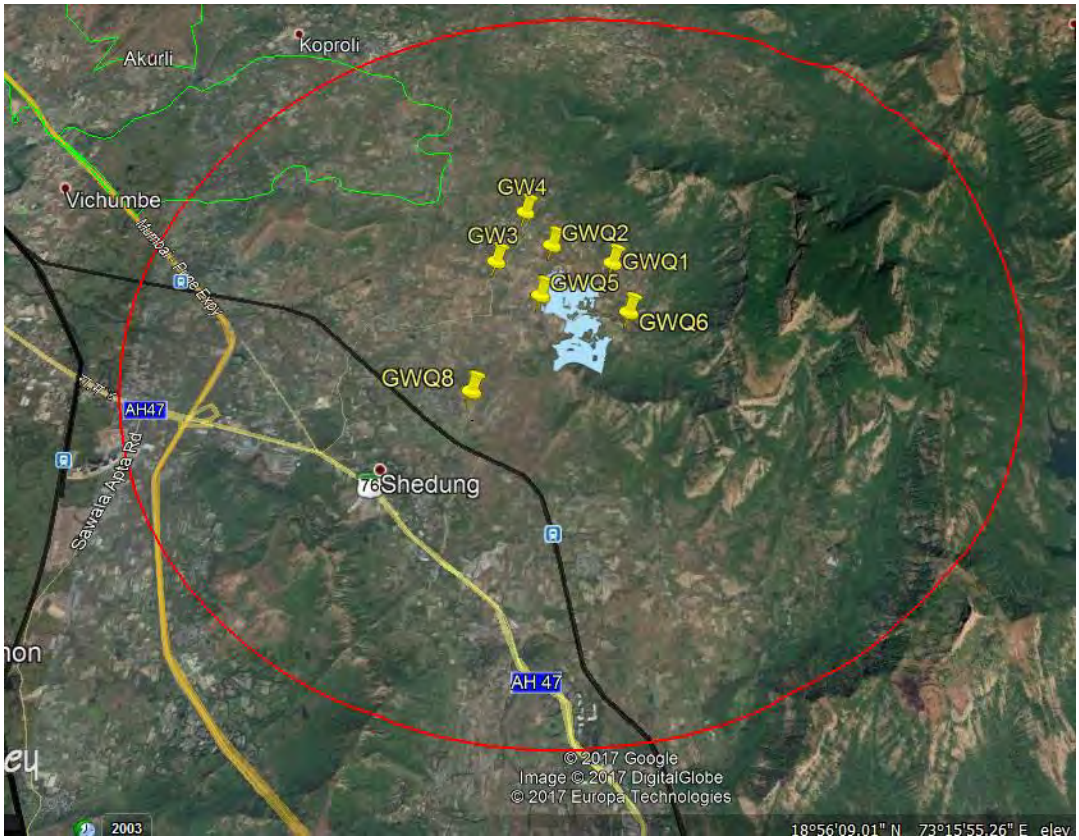


Figure 3.25: Surface water sampling locations

Ground water quality results
Ground Water quality sampling results are given below.

Table 3.23: Ground water quality characteristics at onsite
(GWQ – 1 TO 8, MAY 27TH TO JUNE 20TH 2015)

No	Parameter	Units	Standard Method	(GWQ 1)	(GWQ 2)	(GWQ 3)	(GWQ 4)	(GWQ 5)	(GWQ 6)	(GWQ 7)	(GWQ8)	Limits as per IS 10500
Physical Parameters												
1	Turbidity	NTU	IS: 3025 Part-10 (R.A : 2002)	3.70	1.0	0.50	1.20	0.50	1.70	0.80	0.50	<1
2	TDS	mg/lit	IS: 3025 Part-16 (R.A : 2006)	365.0	172.0	205.0	112.0	312.0	335.0	71.0	65.0	<500
Chemical Parameters												
1	pH	--	IS: 3025 Part-11 (R.A : 2002)	6.13	6.38	5.82	6.55	5.90	6.27	6.29	6.32	6.5-8.5
2	Total Hardness as $CaCO_3$	mg/lit	IS: 3025 Part-21 (2009)	264.71	147.06	71.90	78.43	192.81	232.03	44.12	34.31	<200
3	Total Alkalinity as $CaCO_3$	mg/lit	IS: 3025 Part-23 (R.A : 2003)	200.0	136.84	13.16	115.79	147.37	157.89	147.37	157.89	<200
4	Chloride as Cl	mg/lit	IS: 3025 Part-32 (R.A : 2003)	61.96	8.37	66.56	7.54	75.35	72.84	15.07	16.75	<250
5	Sulphate as SO_4	mg/lit	APHA :22nd edition - (4500- SO_4^{2-} E)	22.72	6.20	53.98	3.94	28.67	16.18	8.13	7.71	<200
6	Fluoride as F*	mg/lit	APHA :22nd edition - (4500-F^- F)	0.25	0.28	1.20	0.03	0.56	0.60	0.08	0.72	<1.0
7	Residual chlorine *	mg/lit	APHA :22nd edition - (4500-Cl B)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	>0.2
8	Nitrate as NO_3	mg/lit	APHA :22nd edition - (4500- NO_3^{2-} B)	0.87	0.01	<0.10	<0.10	0.08	0.65	0.03	0.16	<45
Elemental Testing												
1	Calcium as Ca	mg/lit	IS: 3025 Part-02 (2004)	45.28	20.69	20.83	20.83	31.40	40.69	6.89	5.59	<75
2	Magnesium as Mg	mg/lit	IS: 3025 Part-02 (2004)	20.20	8.25	1.41	2.02	18.02	17.67	1.60	1.64	<30
3	Iron as Fe	mg/lit	IS: 3025 Part-02 (2004)	0.03	0.05	0.04	0.15	0.04	0.10	0.75	0.28	<0.3
4	Copper as Cu	mg/lit	IS: 3025 Part-02 (2004)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
5	Cadmium as Cd*	mg/lit	IS: 3025 Part-02 (2004)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003
6	Chromium as Cr	mg/lit	IS: 3025 Part-02 (2004)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
7	Lead as Pb*	mg/lit	IS: 3025 Part-02 (2004)	0.01	<0.01	<0.01	0.01	0.01	0.05	<0.01	<0.01	<0.01
8	Selenium as Se*	mg/lit	IS: 3025 Part-02 (2004)	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
9	Manganese	mg/lit	IS: 3025 Part-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1

No	Parameter	Units	Standard Method	(GWQ 1)	(GWQ 2)	(GWQ 3)	(GWQ 4)	(GWQ 5)	(GWQ 6)	(GWQ 7)	(GWQ8)	Limits as per IS 10500
	as Mn		02 (2004)									
10	Zinc as Zn	mg/lit	IS: 3025 Part-02 (2004)	0.03	<0.01	<0.01	0.14	<0.01	0.01	0.66	0.03	<5.0
	Microbiological Parameters											
1	Total Coliform	MPN/100ml	IS: 1622 (R.A : 1996)	500	04	30	<2	170	280	30	08	Absent
2	Fecal Coliform	MPN/100ml	IS: 1622 (R.A : 1996)	24	04	30	<2	27	22	<2	<2	Absent

No	Parameter	Units	Standard Method		(GWQ 1)	(GWQ 2)	(GWQ 3)	(GWQ 4)	(GWQ 5)	(GWQ 6)	(GWQ 7)	(GWQ8)	Limits as per IS 10500
	Physical Parameters												
1	Turbidity	NTU	IS: 3025 Part-10 (R.A : 2002)		3.70	1.0	0.50	1.20	0.50	1.70	0.80	0.50	<1
2	TDS	mg/lit	IS: 3025 Part-16 (R.A : 2006)		365.0	172.0	205.0	112.0	312.0	335.0	71.0	65.0	<500
	Chemical Parameters												
1	pH	--	IS: 3025 Part-11 (R.A : 2002)		6.13	6.38	5.82	6.55	5.90	6.27	6.29	6.32	6.5-8.5
2	Total Hardness as $CaCO_3$	mg/lit	IS: 3025 Part-21 (2009)		264.71	147.06	71.90	78.43	192.81	232.03	44.12	34.31	<200
3	Total Alkalinity as $CaCO_3$	mg/lit	IS: 3025 Part-23 (R.A : 2003)		200.0	136.84	13.16	115.79	147.37	157.89	147.37	157.89	<200
4	Chloride as Cl	mg/lit	IS: 3025 Part-32 (R.A : 2003)		61.96	8.37	66.56	7.54	75.35	72.84	15.07	16.75	<250
5	Sulphate as SO_4	mg/lit	APHA :22nd edition - (4500- SO_4^{2-} E)		22.72	6.20	53.98	3.94	28.67	16.18	8.13	7.71	<200
6	Fluoride as F*	mg/lit	APHA :22nd edition - (4500-F^- F)		0.25	0.28	1.20	0.03	0.56	0.60	0.08	0.72	<1.0
7	Residual chlorine *	mg/lit	APHA :22nd edition - (4500-Cl B)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	>0.2
8	Nitrate as NO_3	mg/lit	APHA :22nd edition - (4500- NO_3^{2-} B)		0.87	0.01	<0.10	<0.10	0.08	0.65	0.03	0.16	<45
	Elemental Testing												
1	Calcium as Ca	mg/lit	IS: 3025 Part-02 (2004)		45.28	20.69	20.83	20.83	31.40	40.69	6.89	5.59	<75
2	Magnesium as Mg	mg/lit	IS: 3025 Part-02 (2004)		20.20	8.25	1.41	2.02	18.02	17.67	1.60	1.64	<30
3	Iron as Fe	mg/lit	IS: 3025 Part-		0.03	0.05	0.04	0.15	0.04	0.10	0.75	0.28	

No	Parameter	Units	Standard Method		(GWQ 1)	(GWQ 2)	(GWQ 3)	(GWQ 4)	(GWQ 5)	(GWQ 6)	(GWQ 7)	(GWQ8)	Limits as per IS 10500
			02 (2004)										<0.3
4	Copper as Cu	mg/lit	IS: 3025 Part-02 (2004)		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
5	Cadmium as Cd*	mg/lit	IS: 3025 Part-02 (2004)		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003
6	Chromium as Cr	mg/lit	IS: 3025 Part-02 (2004)		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
7	Lead as Pb*	mg/lit	IS: 3025 Part-02 (2004)		0.01	<0.01	<0.01	0.01	0.01	0.05	<0.01	<0.01	<0.01
8	Selenium as Se*	mg/lit	IS: 3025 Part-02 (2004)		<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
9	Manganese as Mn	mg/lit	IS: 3025 Part-02 (2004)		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
10	Zinc as Zn	mg/lit	IS: 3025 Part-02 (2004)		0.03	<0.01	<0.01	0.14	<0.01	0.01	0.66	0.03	<5.0
	Microbiological Parameters												
1	Total Coliform	MPN/100ml	IS: 1622 (R.A : 1996)		500	04	30	<2	170	280	30	08	Absent
2	Fecal Coliform	MPN/100ml	IS: 1622 (R.A : 1996)		24	04	30	<2	27	22	<2	<2	Absent

Note : For E.coli and Coliform <2 can be considered as Absent
*The tests marked with an * are not accredited by NABL*

Surface Water Quality Results
Surface water quality sampling results are given below.

Table2.34: Surface water quality Characteristics at onsite
(SWQ -1, MAY 27TH TO JUNE 20TH 2015)

Sr. No.	Parameter	Results	Units	Limits- IS 2296 Class C (Cl.3.3)	Standard Method
	Physical Parameter				
1	Turbidity	0.80	NTU	NS	IS: 3025 Part-10 (R.A : 2002)
2	TDS	51.0	mg/lit	<1500	IS: 3025 Part-16 (R.A : 2006)
	Chemical Parameter				
1	pH	6.30	--	6.5-8.5	IS: 3025 Part-11 (R.A : 2002)
2	Hardness: $CaCO_3$	35.95	mg/lit	NS	IS: 3025 Part-21 (2009)
3	Alkalinity: $CaCO_3$	33.68	mg/lit	NS	IS: 3025 Part-23 (R.A : 2003)
4	Chloride as Cl	5.02	mg/lit	<600	IS: 3025 Part-32 (R.A : 2003)
5	Sulphate as SO_4	2.68	mg/lit	<400	APHA :22nd edition -(4500- SO_4^{2-} E)
6	Fluoride as F*	0.35	mg/lit	<1.5	APHA :22nd edition -(4500-F^- F)
7	Residual Chlorine chlorine *	<1.0	mg/lit	NS	APHA :22nd edition -(4500-Cl B)
8	Nitrate as NO_3	<0.10	mg/lit	<50	APHA :22nd edition -(4500- NO_3^{2-} B)
	Elemental Testing				
1	Calcium as Ca	5.12	mg/lit	NS	IS: 3025 Part-02 (2004)
2	Magnesium as Mg	1.96	mg/lit	NS	IS: 3025 Part-02 (2004)

3	Iron as Fe	0.13	mg/lit	<50	IS: 3025 Part-02 (2004)
4	Copper as Cu	<0.01	mg/lit	<1.5	IS: 3025 Part-02 (2004)
5	Cadmium as Cd*	<0.01	mg/lit	<0.01	IS: 3025 Part-02 (2004)
6	Chromium as Cr	<0.01	mg/lit	<0.05	IS: 3025 Part-02 (2004)
7	Lead as Pb*	0.01	mg/lit	<0.1	IS: 3025 Part-02 (2004)
8	Selenium as Se*	<0.01	mg/lit	<0.05	IS: 3025 Part-02 (2004)
9	Manganese as Mn	<0.01	mg/lit	NS	IS: 3025 Part-02 (2004)
10	Zinc as Zn	<0.01	mg/lit	<15	IS: 3025 Part-02 (2004)
		Microbiological Parameter			
1	Total Coliform	1600	MPN/100ml	5000	IS: 1622 (R.A : 1996)
2	Fecal Coliform	51	MPN/100ml	NS	IS: 1622 (R.A : 1996)

Ground Water Quality

All physico chemical parameters as per IS: 3025 Part-10 (R.A : 2002), IS: 3025 Part-16 (R.A : 2006), IS: 3025 Part-11 (R.A : 2002), IS: 3025 Part-21 (2009), IS: 3025 Part-23 (R.A : 2003), IS: 3025 Part-32 (R.A : 2003), APHA :22ndedition -(4500- SO42- E), IS: 3025 Part-02 (2004), IS: 1622 (R.A : 1996) are within the permissible limit for all ground waters. The physico chemical parameters are within the permissible limit when compared with IS 10500 except certain parameters such as Total Hardness, Turbidity and Iron at some locations.

Surface Water Quality

The surface water samples were analyzed against the designated best use classification of IS: 3025 Part-10 (R.A : 2002), IS: 3025 Part-16 (R.A : 2006), IS: 3025 Part-11 (R.A : 2002), IS: 3025 Part-21 (2009), IS: 3025 Part-23 (R.A : 2003, IS: 3025 Part-32 (R.A : 2003), APHA :22ndedition -(4500- SO42- E), IS: 3025 Part-02 (2004) and IS: 1622 (R.A : 1996). All physico chemical parameters are within permissible limit as per IS : 2296. pH of all surface water ranges from 7.49 to 8.6. BOD found in the range of 2.4 to 3.4 mg/l. Microbiological parameters – total coliform to be 1600 MPN/100 ml. The parameters like pH& BOD of all surface waters are within limit as per EPA 1986 Schedule II. The water quality assessment infers that water is potable after conventional treatment and disinfection. This surface water body can be classified as class ‗C' as per CPCB rules titled ―Use Based Classification of surface waters in India" i.e, Drinking water source after conventional treatment and disinfection.

3.7.6 Ambient noise quality

Introduction

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound, which is composed of many frequency components of various loudness distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the scale which is measured in dB(A). This is more suitable for audible range of 20 to 20,000Hz and weighs the components according to the response of a human ear. The impact of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent or continuous in nature.)
- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance.
- The location of the noise source, with respect to noise sensitive land use, which determines the loudness and period of exposure.

The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance; depending on loudness of noise levels. The main objective of noise monitoring in the study area is to establish the baseline noise levels, and assess the impact of the likely noise expected due to construction and operation of various industries in the proposed Special Township.

Noise survey has been conducted in the study area covering two zones viz., Residential, and Commercial .The noise monitoring has been undertaken for 24 hrs. at each location.

Methodology

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. The monitoring has been conducted at 8 locations in the study area. Noise levels were recorded continuously over 24 hour's periods. The details of the locations are provided and shown below.

Table 3.24: Details of Noise Quality stations

Location code	Location name	Distance (km)	Direction
N1	Upwind near some farmers dwellings	0.15	--
N2	North Side within Project plot	0.03	North
N3	North-West (Vardoli Village)	0.20	North West
N4	Within project site	---	---
N5	Towards East (Mohope Village)	0.2	East
N6	South side of the Project plot	0.1	South
N7	Cross wind towards West near Bhingar	0.2	West
N8	Khanavale Village	0.2	South

Figure 3.27: Noise locations marked on Google Earth Map

Method and Parameters for Monitoring

Noise levels were measured using an Integrating Sound Level Meter manufactured by Rion (model no. NL – 20). The sound level meter measures continuous equivalent noise level (Leq). Noise measurements were undertaken

at all location for 24 hours. The day noise level has been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all ambient locations.

Parameters Measured during Monitoring

Equivalent sound Pressure Level (Leq): The Leq is the equivalent continuous sound level which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because sound from noise source often fluctuates widely during a given period of time.

The instrument internally performs the statistics of frequency distribution for the set time period (in this case one-hour) and hourly Leq are obtained at each location. These hourly Leq is added logarithmically to obtain 24 hours Leq as well as Lday and Lnight levels.

Lday is defined as the equivalent noise level measured over a period of time during day (10 am to 6 pm). The Leq value measured for each individual hour and then averaged for 10 am to 6 pm and is known as Lday.

Lnight is defined as the equivalent noise level measured over a period during night (10 pm to 6 am). The Leq value measured for each individual hour and then averaged for 10 pm to 6 am and is known as Lnight.

Further the noise rating developed by EPA for specification of community noise from all sources is the day night sound level, Ldn. It is similar to a 24 hour equivalent sound level except that during the night period, which extends from 10.00 p.m. to 6.00 a.m. A 10 Dba weighing penalty is added to the account for the fact that noise at night when people are trying to sleep is judged more annoying than the same noise during the day time.

Results and discussion

The equivalent noise levels viz. Leq (24hrly) and L_{dn} at ambient noise locations for summer season are presented below.

Table 3.26: Results of Noise Monitoring

Sr.	Location & Distance	Leq dB(A) Measured
N1	150m Upwind near Farmers dwellings	52.0 dB
N2	30m towards North side	51.7 dB
N3	200m towards North-West (Vardoli Village)	52.5 dB
N4	Within project site	52.9 dB
N5	200m Towards East (Mohape Village)	52.6 dB
N6	100m Towards South	52.3 dB
N7	200m Towards West (Bhingar Village)	52.1 dB
N8	200m Downwind (Khanavale Village)	51.6 dB

Table 3.26: Table showing L_{dn} values for noise monitoring locations

Noise Monitoring Locations	L_{dn}(dbA)
Upwind near some farmers dwellings (N1) 150MTS	49
North Side within Project plot (N2) 30MTS	48
Cross wind towards north West near Vardoli Village (N3) 200MTS	49
Centre of the project plot (N4) Within the project	50
Cross wind towards East near Mohape Village (N5) 200MTS	49
South side of the Project plot near NH -4 (N6) 100MTS	49
Cross wind towards West near Bhingar Village (N7) 200MTS	49
Downwind near Khanavale Village(N8) 200MTS	49

Observations

The 24 hourly L_{eq} as evidenced from the Table varies from 51.6 dB(A) (Khanavale village) to a maximum of 52.9 dB(A) (Within project site)

The Ldn varies as evidenced from the Table varies from 48 dB(A) (North side within project site to a maximum of 50 dB(A) (Centre of the project plot).

3.7.7 Traffic & transportation

3.1.1.1 Scope

GMD Consultants have been commissioned by WCIPL to provide a Traffic Impact Study for this project.
The scope of this study is listed below:

- **Traffic Surveys**: To conduct traffic surveys of area project site in order to capture base traffic:
  - Assess current traffic pattern on access road – neighboring road network
  - Capture traffic emanating from new developments and from adjacent properties
- **Traffic Circulation**: To review traffic circulation plan (cars, 2W, fire tender)
- **Impact Analysis**: Analyze the forecast project traffic in conjunction with base traffic. Conduct an Impact Analysis of project traffic as well as study impacts and suggest mitigation measures.
- **Swept Path Analysis**: Conduct analysis at critical locations of project entry/exit to ensure safe and efficient turning maneuvers.
- **Traffic Control**: Address the provision of road signages, markings and traffic calming measures. Also provide a traffic management plan to address issues of traffic control and safe dispersal.

3.1.1.2 Standards and assumptions

Codes and Manuals

Design standards are generally followed bottom-up or part to whole. Local bylaws are given highest priority to meet the requirements set by local development control agency. Other standards, although explicitly not mentioned by local development control agency, are referred from national or international design manuals that are accepted and widely referred by other professionals in the industry.
Following Codes and Manuals have been referred in this study:

- Codes by Indian Road Congress
- A Policy on Geometric Design of Highways and Streets' by American Association of State Highway and Transportation Officials (AASHTO)
- Trip Generation and Parking Generation handbooks by Institute of Transportation Engineers (ITE)
- Guidelines for Preparation of Traffic Impact Assessment Reports by LTA, Singapore
- Design recommendations for multi-storey and underground car parks 3rd Edition, IStruct, UK.

Design Parameters

The basic design parameters considered for the study has been illustrated below:

1) The social status as well as economic well-being of the residents plays an important role in determining the parking demand for any residential project.
2) The visitors will expect a safe and efficient circulation with good levels of service, i.e. minimum waiting time at security check, proper traffic control at entry / exits, minimum congestion delays and pleasing aesthetics.
3) A design vehicle is a vehicle whose dimensions and operational characteristics are used to establish layout geometry. Toyota Innova (Big Car) and Maruti Swift (Small Car) and Volvo 400 (Fire Tender) were chosen as the design vehicles.
4) The speed of the vehicle is restricted within the premises as below
   a. On the straight sections - 15 kmph
   b. On turns and bends - 10 kmph
   c. On ramps - 10 kmph
5) The maximum number of traffic a road can carry is referred to as its Capacity or design Service Volume. The service volumes considered for the project is given below.

Table 3.28: Roadway Capacities as per IRC 106: 1990

Type of Roadway	Road Capacity*	Category
4 Lane 2 way divided	5143	(Arterial)
2 Lane 2 way	1714	(Sub-Arterial)

4 Lane 2 way divided	4143	(Sub-Arterial)

*Indian Road Congress 106: 1990 Urban Road Capacity

6) Level of Service (LOS) can be defined as a letter designation that describes a range of operating characteristics on a given facility. Six Levels of Service are defined for capacity analysis. They are given letter designations from A to F, with LOS ‗A' representing best level of operational standards and LOS ‗F' the worst.

Table 3.29: Description of LOS based on V/C Ratio

Level of Service (LOS)	Volume/Capacity Ratio (V/C)	Level of Comfort	Nature of flow
A	<0.30	Highest	Free Flow
B	0.30 – 0.50		Reasonably free flow
C	0.50 – 0.70		Stable flow
D	**0.70 – 0.90**	**Threshold**	**Approaching unstable flow**
E	1.00		Unstable flow
F	>1.00	Lowest	Forced flow

Maximum waiting time preferred is **60 seconds**.

Entry / Exit Lane Capacities

The following capacities as recommended by UK – Institute of Structural Engineers have been adopted. These have been validated at a few Indian locations.

Entry/Exit Lane Capacities for Car Parks

Sr No	Type of Entry	Capacity (veh/hour/lane)
1	Free-flow access into internal distributor road/ structure (no parking spaces immediately after access, i.e. ramp distributing to several levels of car park)	800
2	Free-flow access	580
3	Lifting-arm barrier without ticket issue	550
4	Lifting-arm barrier with automatic ticket issue (push button)	360
5	Lifting-arm barrier with access card (slot-based)	235
6	Lifting-arm barrier with transponder (no slot – RFID etc.)	380

Sr No	Type of Exit	Capacity (veh/hour/ln)
1	Ticket on entry and payment at a manned exit	240
2	Lifting-arm barrier without ticket issue	550
3	Ticket on entry and variable payment to a machine linked to the exit barrier	270
4	Ticket on entry and operation of the exit barrier by a prepaid ticket or token	600
5	Free-flow exit	Analysis based on specific road layout (i.e.yield etc.)

Rates based on: „Design recommendations for multistory and underground car parks, Institute of Structural Engineers, 3rd Edition, June 2002" and „HBS 2001, FGSV Verlag, January 2002"

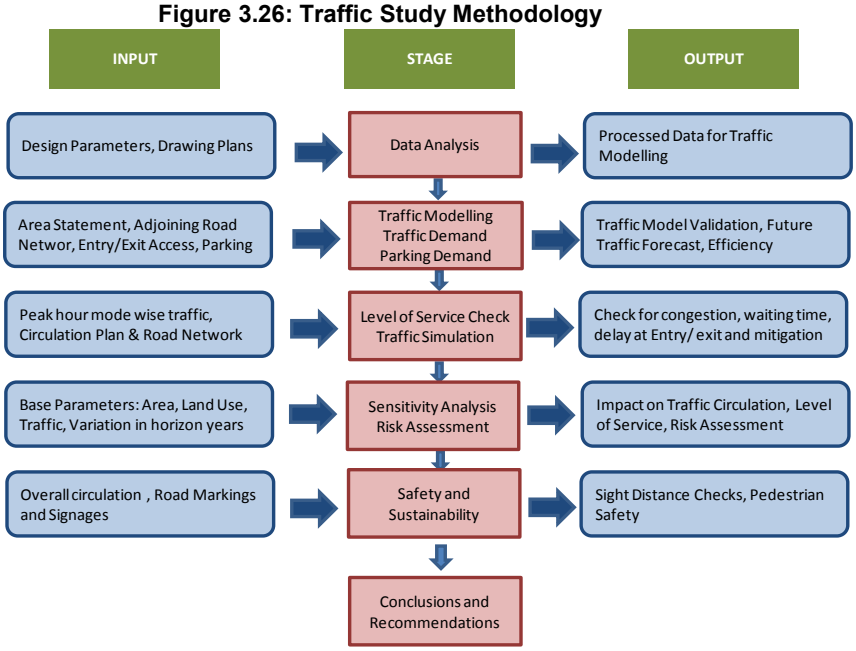
As per international practices it is preferred to restrict the queue length to around **18m i.e. 3 vehicles**. This is also linked with space availability at site for queuing.

3.1.1.3 Traffic survey methodology

Traffic Study Methodology

The methodology adopted for traffic analysis for this project is represented in the form of a flowchart as shown below.

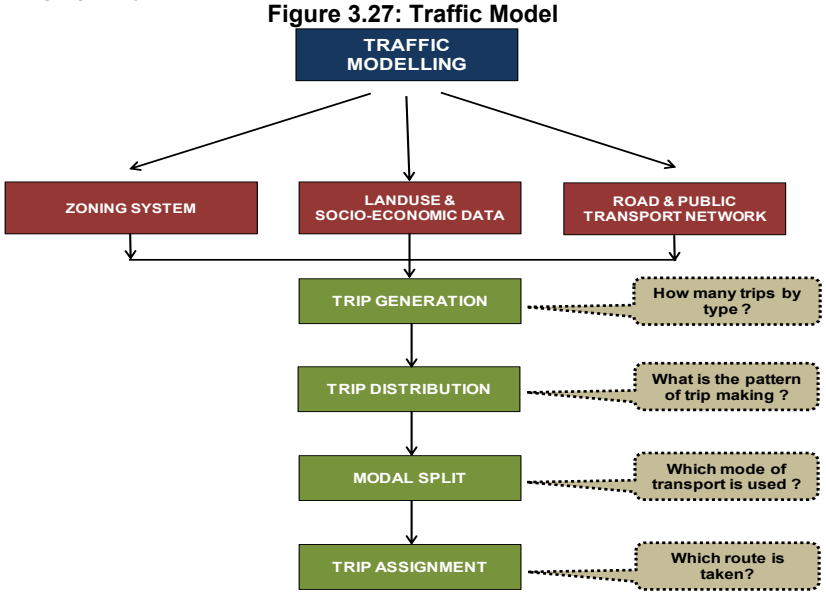
Figure 3.26: Traffic Study Methodology



3.1.1.4 Traffic model

Traffic modeling is the process of analyzing the pattern in which an area's transport network would be used by traffic given the distribution and characteristics of the area's population, employment and other land uses. The output of traffic analysis is forecast of vehicles using each road segment within the study area. Traffic forecast is best achieved by transportation modeling. The conventional transportation modeling is a four stage process. The most widespread form of model utilized is gravity model and the same is utilized for this project. The broad outline of this four stage gravity model is illustrated below.

Figure 3.27: Traffic Model

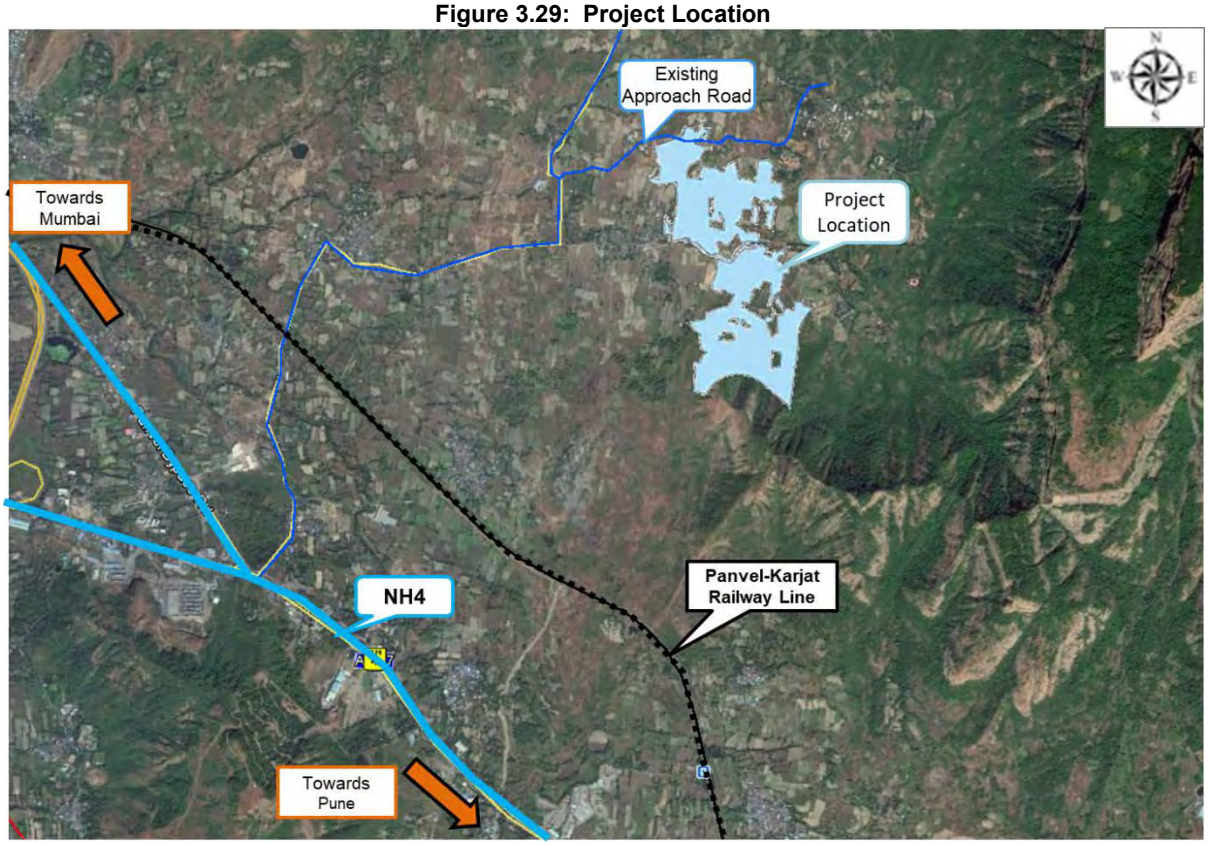


3.1.1.5 Surrounding road network

The project location is surrounded by a planned road network. The project has direct access to existing 18.0m wide Road with connects to NH4. Following pictures depict the surrounding road network.

Figure 3.28: National Highway 4

Figure 3.29: Project Location



The site is well connected to major urban centers around Mumbai via road and rail. It is connected to all basic services like hospital, police station, fire station, post office and others

3.1.1.6 Traffic surveys

Traffic surveys are necessary to gather base data information about existing traffic and travel pattern on surrounding roads. Road network within 5km radius from the project location is considered for traffic study. Traffic surveys were carried out on 19th May, 2017 (Friday) and 20th May, 2017 (Saturday) at National Highway 4 (NH4) and existing 18.0m wide Road.

3.1.1.7 Base traffic

Traffic survey was conducted for 24 hours to understand the hourly traffic variation for the roads. The observed peak hour volume for National Highway 4 (NH4) and 18.0m wide Road has been illustrated below. Also modal split along with directional distribution of traffic for each road has been illustrated in the figures below.

Table 3.30: Hourly Traffic Volume on National Highway 4

Time Period	2W	3W	Cars	Buses	Lcv	2 Axle	3 Axle/ Multi Axle	Total Vehicles	Total PCU
8 to 9	648	139	672	60	169	168	218	2075	2775
9 to 10	720	155	747	67	188	187	242	2305	3083
10 to 11	660	142	684	61	172	171	222	2113	2826
11 to 12	636	137	659	59	166	165	214	2036	2723
12 to 13	600	129	622	56	157	156	202	1921	2569
13 to 14	576	124	597	54	150	150	194	1844	2466
14 to 15	540	116	560	50	141	140	182	1729	2312
15 to 16	624	134	647	58	163	162	210	1998	2672
16 to 17	612	131	635	57	160	159	206	1960	2621
17 to 18	624	134	647	58	163	162	210	1998	2672
18 to 19	636	137	659	59	166	165	214	2036	2723
19 to 20	648	139	672	60	169	168	218	2075	2775
20 to 21	672	144	697	62	176	174	226	2152	2878
21 to 22	714	153	740	66	187	185	240	2286	3057
22 to 23	504	108	523	47	132	131	170	1614	2158
23 to 24	480	103	498	45	125	125	162	1537	2055
24 to 1	420	90	435	39	110	109	141	1345	1798
1 to 2	300	64	311	28	78	78	101	961	1285
2 to 3	180	39	187	17	47	47	61	576	771
3 to 4	108	23	112	10	28	28	36	346	462
4 to 5	96	21	100	9	25	25	32	307	411
5 to 6	264	57	274	25	69	69	89	845	1130
6 to 7	360	77	373	33	94	93	121	1153	1542
7 to 8	480	103	498	45	125	125	162	1537	2055
Total	12102	2599	12548	1125	3161	3142	4073	38750	51821

Figure 3.30: Hourly Traffic Distribution for National Highway

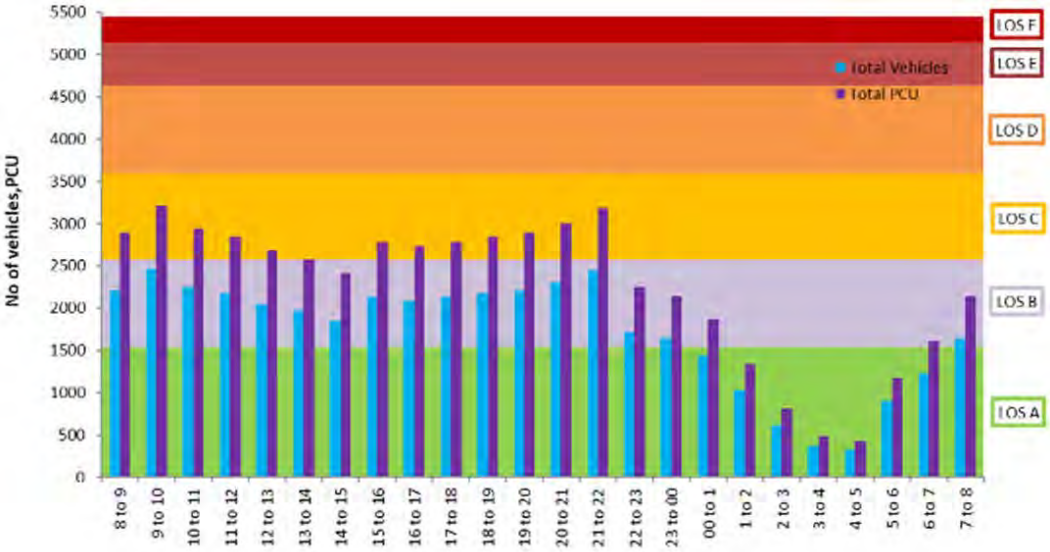


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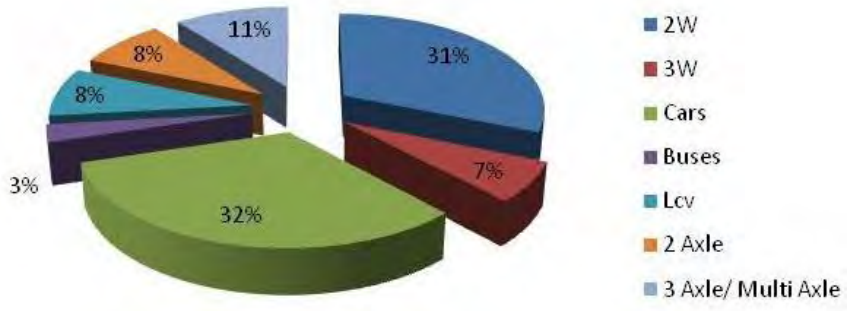
Figure 3.31: Modal Split (vehicles) for National Highway 4



Based on preliminary analysis it was observed that:

- Peak morning traffic was observed between 9 & 10am and peak evening traffic was observed between 6 to 7pm.
- The vehicular traffic predominantly consists of car and two wheelers.

Table 3.31: Hourly Traffic Volume on existing 18.0m wide Road

Time Period	2W	3W	Cars	Buses	Lcv	2 Axle	3 Axle/ Multi Axle	Total Vehicles	Total PCU
8 to 9	33	14	30	4	6	4	3	94	91
9 to 10	41	17	37	5	7	5	4	116	113
10 to 11	38	16	34	5	7	5	4	109	104
11 to 12	33	14	30	4	6	4	3	94	91
12 to 13	30	13	27	4	5	4	3	86	81
13 to 14	29	12	26	4	5	4	3	83	80
14 to 15	31	13	28	4	6	4	3	89	86
15 to 16	33	14	30	4	6	4	3	94	91
16 to 17	35	15	32	4	6	4	3	99	96
17 to 18	39	16	35	5	7	5	4	111	105
18 to 19	43	18	39	5	8	5	4	122	118
19 to 20	40	17	36	5	7	5	4	114	110
20 to 21	35	15	31	4	6	4	3	98	95
21 to 22	31	13	28	4	6	4	3	89	85
22 to 23	25	11	22	3	5	3	3	72	68
23 to 24	19	8	17	3	4	3	2	56	51
24 to 1	17	7	15	2	3	2	2	48	46
1 to 2	15	7	14	2	3	2	2	45	41
2 to 3	13	6	11	2	3	2	2	39	34
3 to 4	11	5	10	2	2	2	1	33	28
4 to 5	8	4	7	1	2	1	1	24	22
5 to 6	9	4	8	1	2	1	1	26	25
6 to 7	16	7	15	2	3	2	2	47	44
7 to 8	25	11	22	3	5	3	3	72	68
Total	649	277	584	82	120	82	66	1860	1773

Figure 3.32: Hourly Traffic Distribution for existing 18.0m wide Road

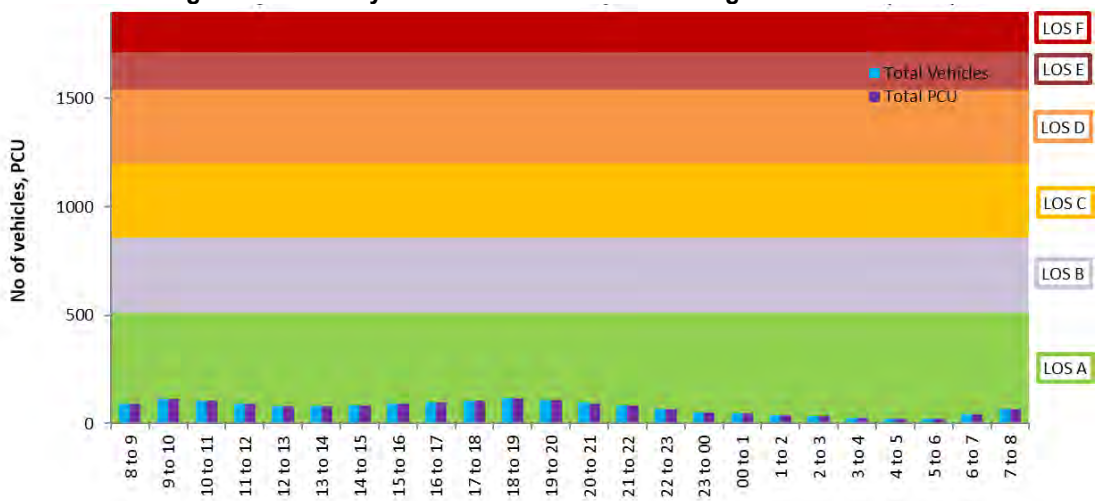
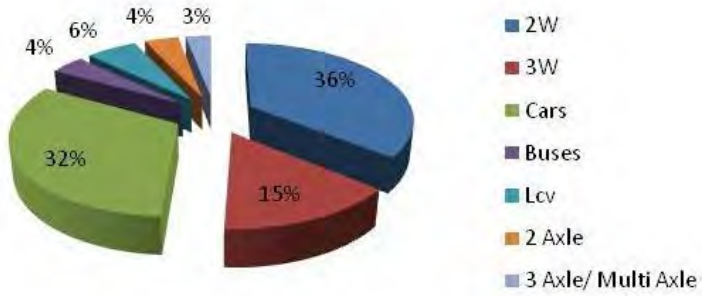


Figure3.33: Modal Split (vehicles) for Proposed 18.0m wide Road



Based on preliminary analysis it was observed that:

- Peak morning traffic was observed between 9 and 10 AM and peak evening traffic was observed between 6 to 7 PM.
- The vehicular traffic predominantly consists of car and two wheelers.

3.1.1.8 Project connectivity and access

Project entry/exit from access road widths with in the project & their cross sections is illustrated below. Provision of access points to drop off /pickup have been planned to facilitate efficient circulation and dispersal of traffic. These access points shall provide entry / exit facility to parking and drop off locations and are strategically located and designed in such a way that it not only adds efficacy to circulation and accessibility but also helps in safety, security and traffic management.

Figure 3.34: STP Road Network

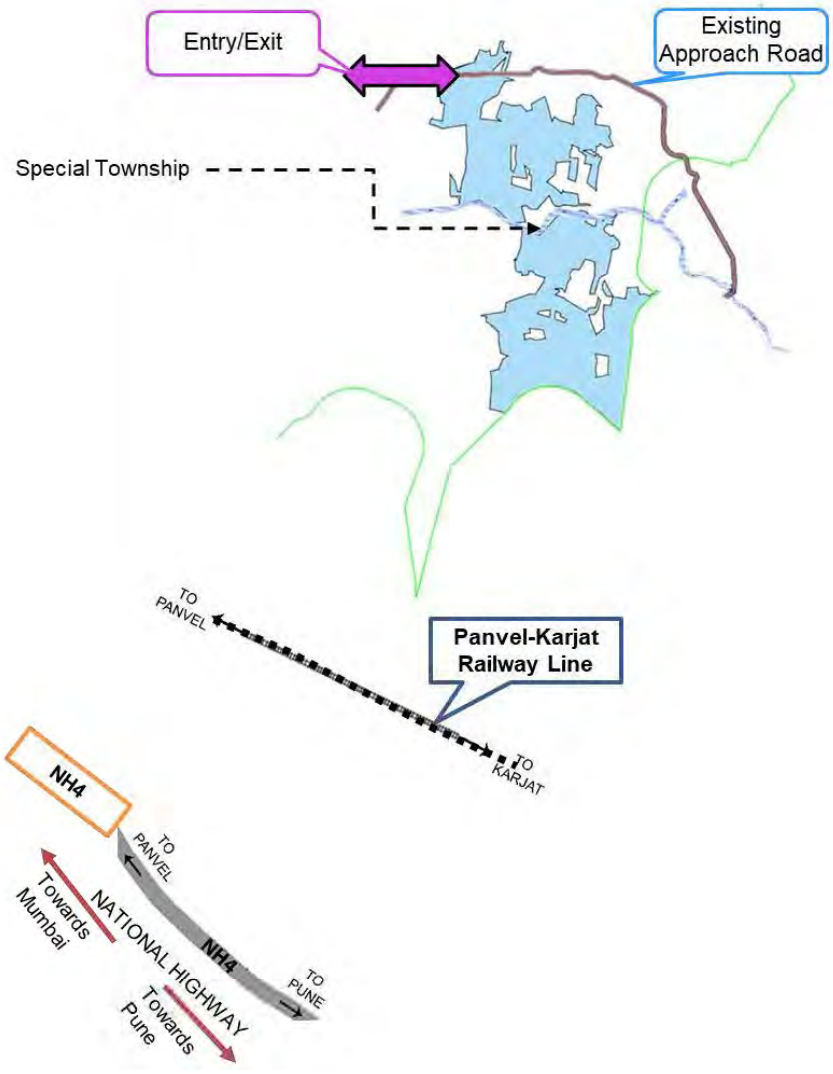


Figure 3.35: STP Road Network

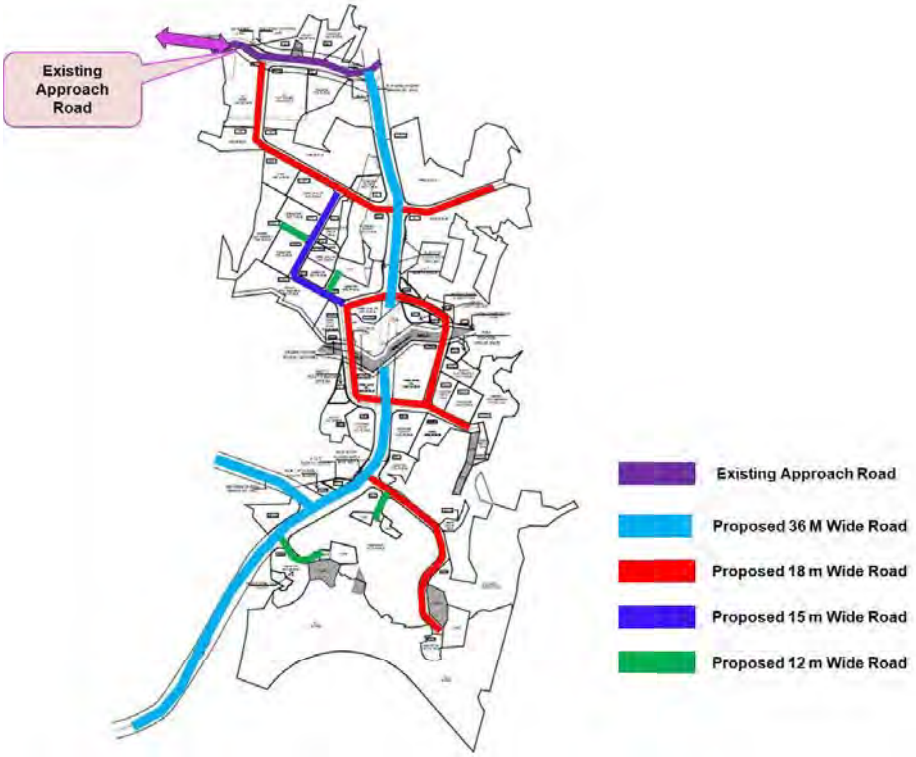
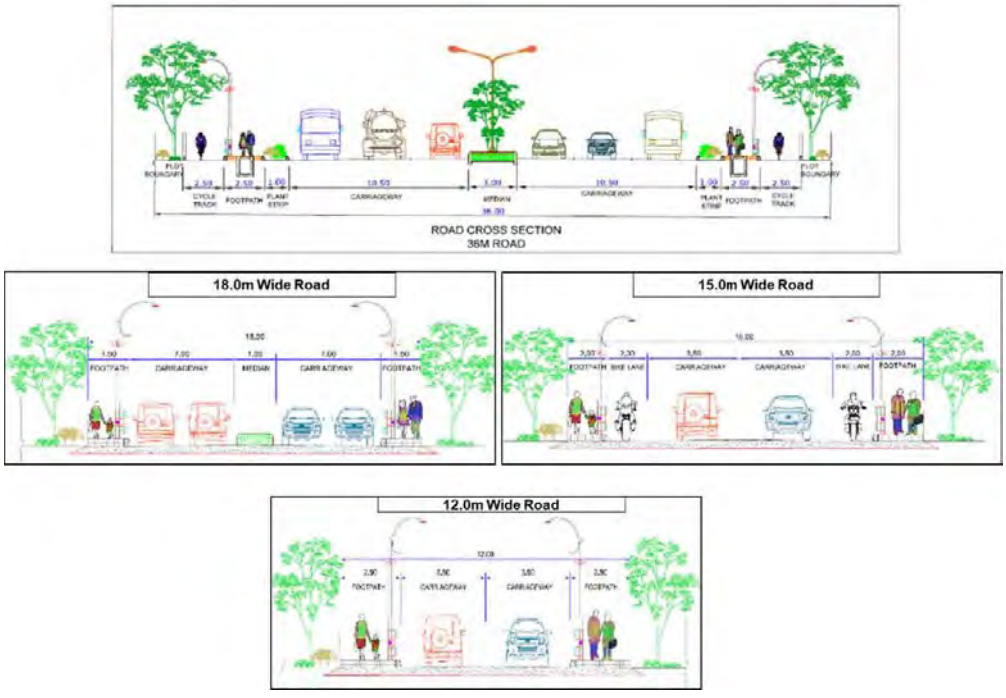


Figure 3.36: Proposed Road Cross Sections



3.1.1.9 Area statement

Unit Statement

BUA for different land uses is as given below for North and south Block

AREA STATEMENT- SOUTH BLOCK	
Description	**BUA in Sq.mt**
Residential with EWS	216125
Commercial Zone	32011
Health Care	6238
Education	23014

AREA STATEMENT- NORTH BLOCK	
Description	**BUA in Sq.mt**
Residential with EWS	39953.39
Commercial	53587.34
Health Care	5321.18
Education	25625

3.1.1.10 Parking statement

All the parking required for the project is being accommodated within the project premises. The parking statement is given below.

Table 3.32: Parking Statement (South Block)

Description	No of Car Parking's	No of Two Wheeler Parking's
RZ-2	2187	199
RZ-3	431	39
EWS-2	77	7
School	7	68
Hospital	104	260
CZ-3	160	640
CZ-4	160	640
Total	**3126**	**1854**

3.1.1.11 Traffic analysis: Forecast & Assignment

Traffic forecasting is the process of estimating the total number of trips generated and attracted by each land-use.

Traffic forecasting is done using trip generation rates which are developed to estimate the number of trips generated from specific household and/or land use. For the purpose of this study, ITE trip generation manual were referred for arriving at basic trip generation rates and these rates were further modified suitably to represent Indian conditions. The no of trips include visitors, services and other trips attracted by residential, educational and commercial land use.

The project is expected to be commissioned by the year 2030. This would generate additional trips during day and peak hours. The trips generated by the project are given in table below:

Table 3.33: Trip Generation

Description	AM Peak Hour		PM Peak Hour		Total Trip AM Peak Hour	Total Trip PM Peak Hour
	Trip in	Trip out	Trip in	Trip out		
Residential	141	562	548	295	703	844
School	351	62	99	232	413	331
Hospital	334	84	42	376	418	418
Economical Zone	24	13	22	33	37	55

A traffic growth of 5% is considered per year for the surrounding network. Based on this, the traffic has been forecasted and has been summarized below.

Table 3.34: Base Traffic Analysis

Road Name	Description	Peak Traffic Volume in 2017 (PCU/hr) (A)	Design Traffic Capacity as per IRC 106:1990 (PCU/hr)	V/C Ratio* (Peak volume /capacity)	LOS*
NH4	4 Lane 2 Way (divided) (Arterial)	3187	5143	0.62	C
Existing Approach Road	2Lane 2 Way (Sub- Arterial)	105	1714	0.06	A

This project being of residential land use, once commissioned will be generating predominantly outgoing and incoming traffic during morning and evening peak hours respectively. There will be various modes of vehicles contributing to the traffic.

Traffic Assignment

Trip distribution essentially describes that how the generated / attracted traffic arrives and departs from the project development site and in which direction. An overall trip distribution was developed for the site after a review of the existing travel patterns in the area. The volume of traffic generated / attracted will have a defined pattern of distribution both for entry and exit. Locations of the residential zones, major roadways and highways that will serve the development have been considered to arrive at trip distribution.

The project site is surrounded by a well planned road network. Existing neighboring roads will carry traffic from and towards the site. The impact of the project traffic would be predominantly on NH4 and 18m wide road. Following has been assumed for assignment of trips on existing road network.

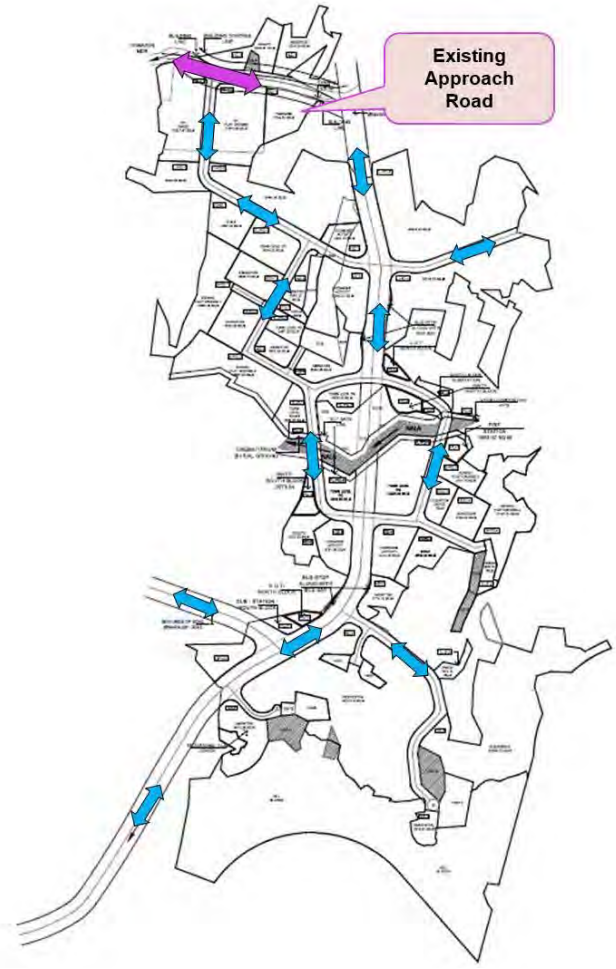
Table3.35: Trip Assignment on Existing Road Network

Road Name	Project Impact (%)
NH4	100
Existing 18m wide road	100

3.1.1.12 Traffic analysis: Vehicular circulation

The project consists of residential, commercial, Health and education blocks. Multiple access points for vehicles have been provided to ensure smooth vehicle movement. Circulation of traffic with in the project access roads has been illustrated in **Error! Reference source not found.**.

Figure 3.37: Traffic Circulation - STP



3.1.1.13 Traffic analysis: Traffic impact analysis

The traffic on NH4 and existing 18m wide road was analyzed to assess its traffic impact on the existing roads. Future traffic on adjoining roads shall comprise of following two major components:

- Base Road Traffic (forecasted to year 2020 and 2025)
- Project Traffic (2020 and 2025)

The road traffic has been forecasted for year 2020 and 2025. This total traffic on the road is compared with its capacity. This V/C ratio of peak traffic volume and capacity is used as an index to determine level of congestion on link which is likely to occur when projected traffic is operative on link. Pedestrian traffic is assumed to use footpaths and not affect the road capacity. The summary of results for future traffic link flow conditions at different access roads is shown below.

Table 3.35: Traffic Capacity Analysis of Access Roads – 2020

Road Name	Peak Traffic Volume in 2020 (PCU/hr)(A)	Project Traffic (PCU/hr) (B)	Total Traffic in 2020 (A + B)	Design Traffic Capacity as per IRC 106:1990 (PCU/hr)	V/C Ratio (Peak volume /capacity)	LOS
NH4	3665	123	3788	5143	0.74	D
Existing Approach Road	226	123	349	1714	0.20	A

Table 3.36: Traffic Capacity Analysis of Access Roads – 2025

Road Name	Peak Traffic Volume in 2025 (PCU/hr)(A)	Project Traffic (PCU/hr) (B)	Total Traffic in 2025 (A + B)	Design Traffic Capacity as per IRC 106:1990 (PCU/hr)	V/C Ratio (Peak volume /capacity)	LOS
NH4	4461	615	5076	7714	0.66	C
Existing Approach Road	300	615	915	4143	0.22	A

The above results indicated that there are no concerns on account of project traffic and the traffic will continue to run as usual even after commissioning of project in year 2020. Pedestrian traffic is high in this region.
Under present configuration the roads will operate at V/C ratio of maximum 0.74 and 0.66 for the year 2020 & 2025 respectively during the peak hour after completion of the development, which indicates the traffic will continue to run smoothly.

3.1.1.14 Swept path analysis

It is the analysis of the path of the design vehicle undertaking a movement and/or a turning maneuver. At a basic level this includes calculating the thread of each wheel during the turn and also calculating the maneuvering space needed by the vehicle body (front & rear overhang).
Objectives
The objectives of performing swept path analysis are as follows:

- To check that the plan layout can accommodate the movement of the design vehicle expected by the development.
- To provide solutions to possible geometric congestions on the site.
- To provide information of the proposed layout and see if it serves the purpose, especially at turns where head room for vehicle maneuvers is limited.
- To provide to local authority and developers precise information and the swept path analysis of vehicles overlaid on the proposed site layout to demonstrate that the vehicles can maneuver safely and efficiently within the site layout.

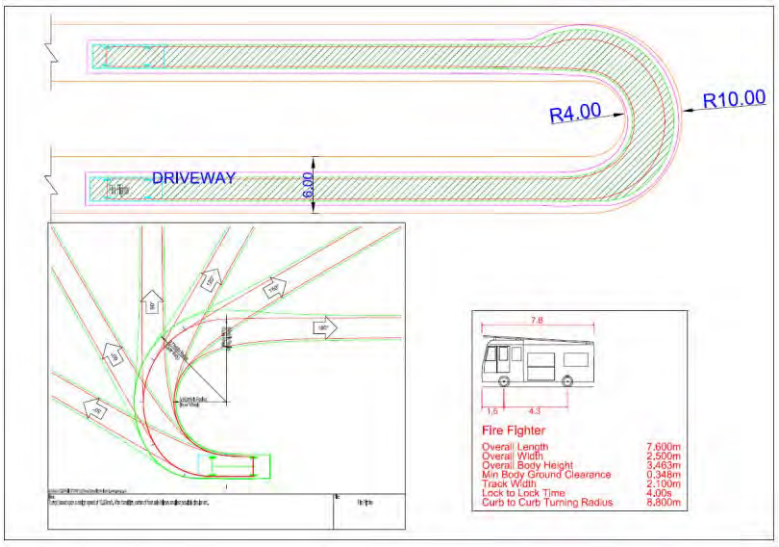
3.1.1.15 Design vehicle

A design vehicle is a vehicle whose dimensions and operational characteristics are used to establish layout geometry. From an optimum design perspective it is beneficial to select the design vehicle which is near to 85% percentile, i.e. 85% of vehicles will have smaller dimensions. This helps in optimizing the space requirements. The design vehicles selected for this particular project are as follows:

- Fire Tender

Detailed design and dimensions of design vehicle has been illustrated below.

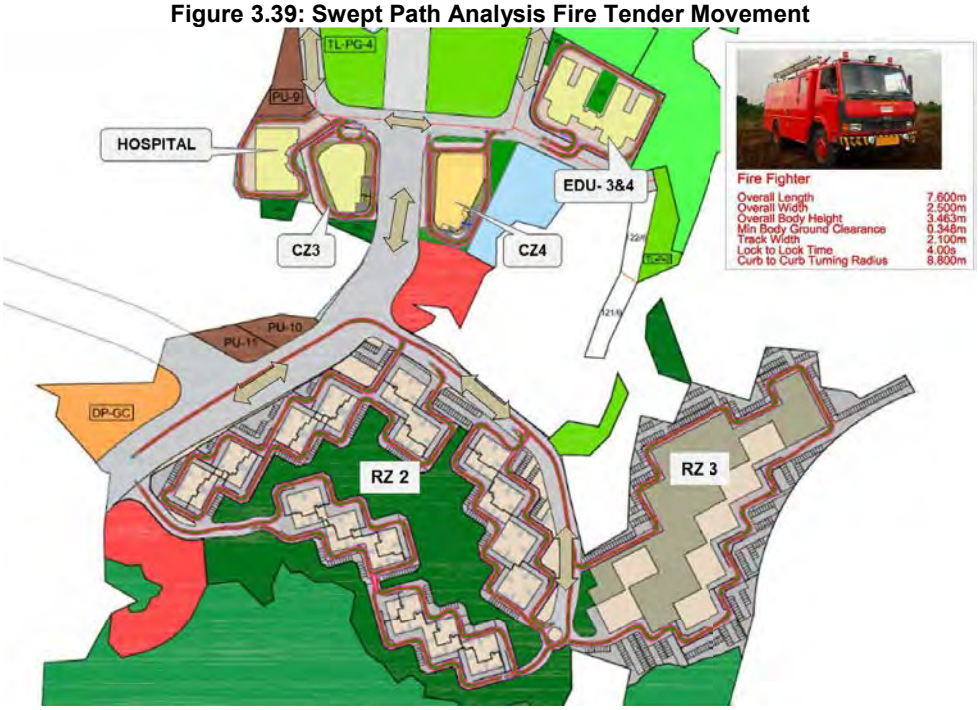
Figure 3.38: Dimensions of Fire Tender



3.1.1.16 Layout plan

Entry/Exit points hold the key to a well efficient circulation plan. A well-defined Entry/Exit area eases out traffic movement and reduces unnecessary congestion. Circulation path for Fire Tender travelling through layout is analyzed.

Figure 3.39: Swept Path Analysis Fire Tender Movement



3.1.1.17 Traffic management: Traffic calming

The improvements to maintain the required level of service can be implemented by adopting traffic management measures for efficient traffic operations. Traffic Management Plan (TMP) indicates traffic routes and the measures for traffic regulation. It indicates the roads for use of certain classes of traffic, the location of traffic control i.e. signage and markings and the directions in which traffic should move. These are necessary for safe and efficient movement of vehicles and pedestrians.

3.1.1.18 Traffic management: Traffic control measures

A Traffic Management plan indicating traffic circulation, traffic calming and traffic control is indicated below.Traffic calming is intended to slow and control motor-vehicle traffic in order to improve safety for pedestrians and bicyclists. Traffic calming measures are of various types like speed tables, curb extension, chicane etc. These are mitigation measures to ensure safety.
Following are the proposed specific improvements for each street

Traffic Control Measures

The internal roads are undivided to maintain flexibility of traffic lanes. Minimum 6m wide roadway width has been provided for the movement of vehicles. Recommended design speed on the internal road is 15kmph and on the turns, is 10kmph. Speed tables will be provided near the entrance/exit point to control traffic and regulate speed of vehicles. An illustrative picture is also shown herewith. Additionally, the following shall be required to maintain traffic flow at required level of service.

- Road Markings and Signages: Proper road markings (edge, median, arrows, turning, Kerb) and signages (direction, turning, speed, and pedestrian crossings) will be installed and maintained on all roads in the vicinity of project premises.
- On-street parking will be prohibited on all external and internal streets.
- Pick and drop at designated places only.
- Preferably no U-Turn on roadway
- Traffic calming measures – speed tables, signage

Apart from internal signage – it will be requested to provide necessary signage and traffic control measures, on neighboring roads, – such as Speed limit, Left hand curve, pedestrian crossing etc.

Table 3.37: Traffic Control Measures

Sr. No	Description	Signage
1	**Speed Limit**	
2	**Silence Zone**	
3	**Pedestrian Crossing**	
4	**Left Hand Curve**	

Figure 3.40: Illustration of a Speed Hump

Figure 3.41: Pavement Markings

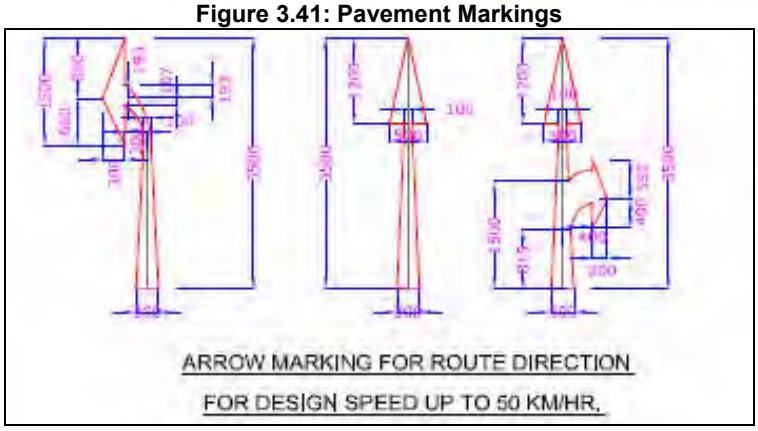


Figure 3.42: Traffic Management Plan - Layout

3.1.1.19 Conclusions & recommendations

The traffic impact analysis was conducted and the results were discussed in earlier section. The conclusions and recommendations are summarized below:

1) The project traffic has been forecasted for year 2020 and 2025 this has been superimposed along with existing projected traffic to arrive at future traffic for year 2020, and 2025.
2) The forecast traffic on the roads adjoining the project namely NH4 and 18m wide Road will operate at acceptable level of service in 2025 hence will not require mitigation measures.
3) Swept Path analysis yielded that road geometry was adequate for vehicle turning maneuvers.
4) A Traffic Management Plan in terms of traffic calming measures and traffic control measures has been devised and proposed to maintain adequate level of service and safety of vehicles and pedestrian.

3.7.8 Soil environment

Soil is the end product of the influence of the climate such as temperature, precipitation, slope, organisms, parent materials and time. Soil is composed of particles of broken rock which have been altered by physical, chemical and biological processes that include weathering with associated erosion. The soils of the district are formed from the Deccan trap. The project site is slightly undulating & open land, Private Forest at some places as per toposheet and there are limited places where any agricultural activities are prevalent. The study region has many areas where green vegetation can be seen indicating that for trees and shrubs, the soil quality is good. Shallow to Medium Deep soil is identified in study region. This soil is composed of various disintegrated rocks of the overlying trap formation, with a varying proportion of calcareous substances. It is reddish, light brown in colour. Rice is a major crop commonly observed in study area followed by Pulses, oil seeds and vegetables

Soil Types and Quality

As part of baseline study conducted, soil samples were collected from six locations from the project site and surrounding area in the month of May 2015 and analysed for the physical and chemical parameters in order to determine productivity of soil. The details of the soil sampling locations are described are shown below.

Table 4.39: Details of Soil Sampling Locations

Sr. No.	Sampling Location	Station Code	Direction w.r.t Project Site	Site Co-ordinates	Landuse
1	Project plot	SQ-1	North Side within Project plot	18°58'27.83"N 73°12'0.90"E	Open Land
2	Project plot	SQ-2	Centre of the project plot	18°57'43.49"N 73°11'38.72"E	Open Land
3	Project plot	SQ-3	South side of the Project plot	18°57'5.42"N 73°11'12.59"E	Open Land
4	Mohape Village	SQ-4	South East	18°57'1.67"N 73°12'0.94"E	Private Forest Land
5	Vardoli Village	SQ-5	West	18°58'13.42"N 73°11'22.79"E	Agriculture Land
6	Bhingar Village	SQ-6	South West	18°57'31.82"N 73°10'45.26"E	Agriculture Land

Soil sampling locations were chosen based on a reconnaissance survey of the area and prevailing activities within the 10 km study area. Samples were collected by hand sampling augurs from surface region. All the soil samples were taken at depth of 30 cm (sub surface) from the upper surface. Samples were homogenised before testing. The samples were packed in dependable, waterproof containers and analysed as per APHA, C.A. Black (Soil Chemical Analysis) and IS: 2720 (Physical Parameters). The sampled soil quality results are presented below and are described in the further subsections.

Figure 3.43: Soil Sampling Locations

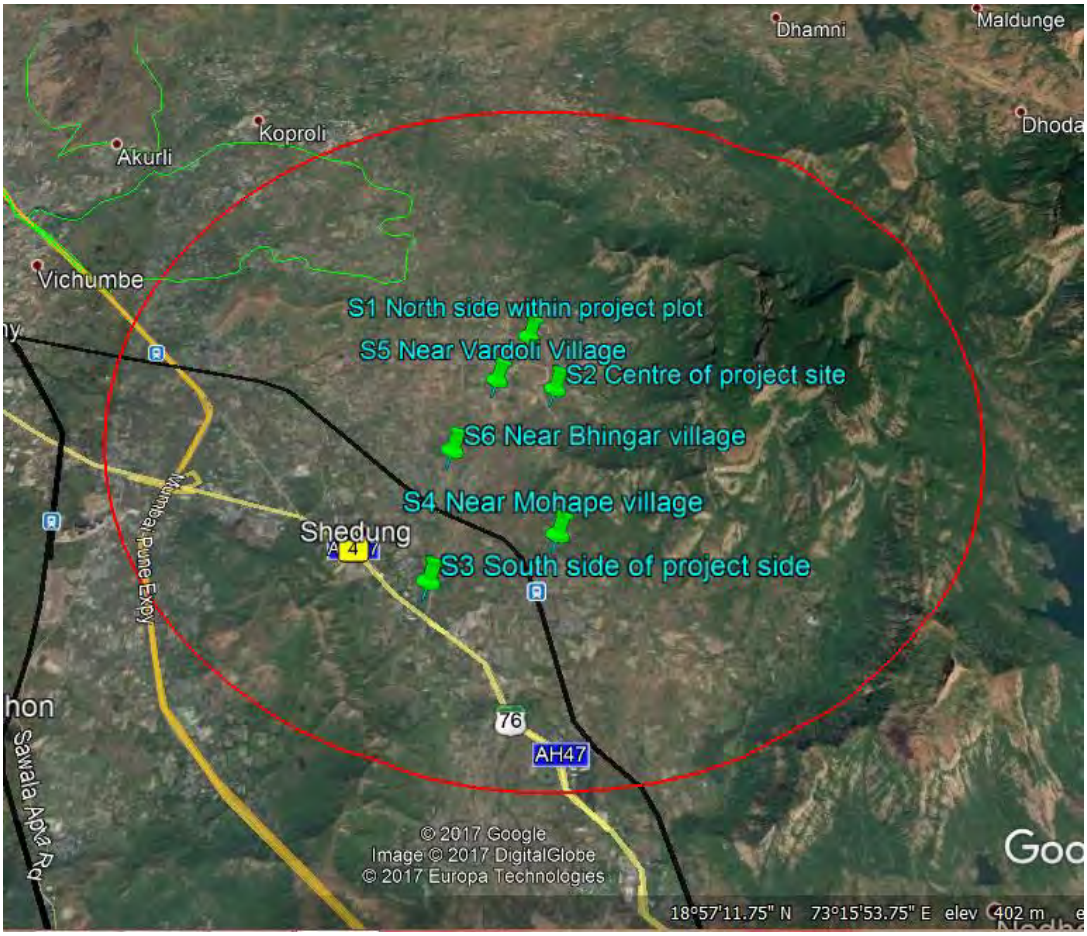


Figure 3.40: Soil Quality in & around the site

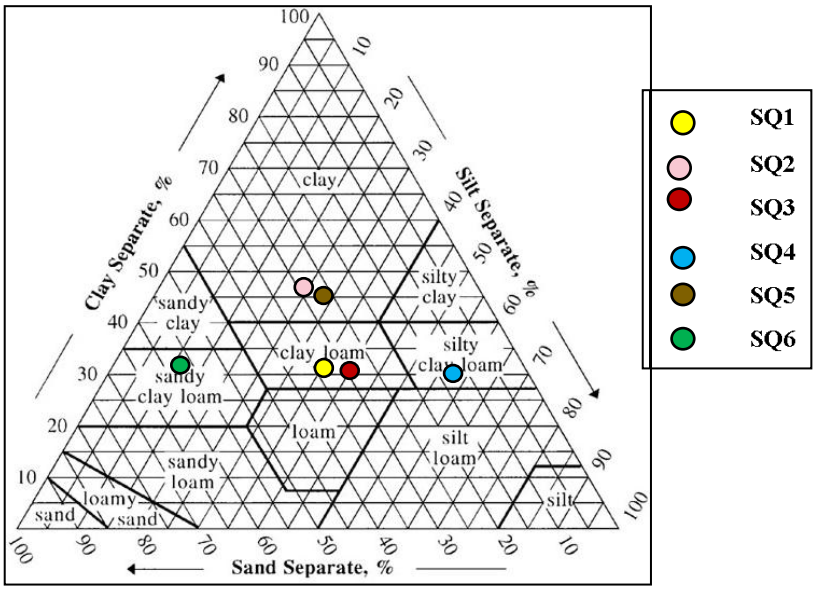
Sr	Parameters	Unit	Project (SQ-1)	Project (SQ-2)	Project (SQ-3)	Mohape (SQ-4)	Vardoli (SQ-5)	Bhingar (SQ-6)
1	Soil Texture	-	Clay Loam	Clay	Clay Loam	Silty Clay Loam	Clay	Sandy Clay Loam
2	pH (at 25^{O}c)		7.45	7.89	7.24	6.57	6.98	7.13
3	E. Conductivity	µs/cm	18.98	80.10	93.60	879.0	174.50	180.0
4	Organic Matter	%	0.88	3.36	0.53	3.36	1.42	1.42
5	Total Nitrogen	mg/kg	420.0	350.0	1610.0	490.0	630.0	1820.0
6	Sodium Absorption Ratio	-	0.83	0.62	0.70	3.47	6.89	54.31
7	Salinity	%	0.002	0.005	0.005	0.04	0.009	0.009
8	Water holding	%	45.0	55.0	45.0	60.0	70.0	60.0

	Capacity							
9	Potassium (as K)	mg/kg	46.62	105.70	87.05	162.50	82.07	94.83
10	Phosphorous (as P)	mg/kg	402.0	1378.0	134.90	555.70	589.20	192.80
11	Sodium (as Na)	mg/kg	62.24	45.30	64.13	373.70	663.10	4724.0
12	Calcium (as Ca)	mg/kg	510.30	300.50	840.40	1277.0	1441.0	1104.0
13	Magnesium (as Mg)	mg/kg	807.50	882.17	1168.0	1531.0	972.0	1494.0
14	Iron (as Fe)	mg/kg	3618.0	4709.0	4982.0	5678.0	5858.0	6941.0
15	Copper (as Cu)	mg/kg	37.07	93.85	45.72	62.15	61.02	56.84
16	Manganese (as Mn)	mg/kg	132.90	112.0	473.10	116.30	200.90	437.0
17	Zinc (as Zn)	mg/kg	17.51	22.50	18.11	25.63	20.21	26.48
18	Nickel (as Ni)	mg/kg	35.36	34.10	33.08	35.29	27.77	35.65

Soil Quality in the Study Area
Soil Texture Classification

The soil texture for all the locations was observed to be Loam, Clay loam, Silty Clay Loam and Sandy Clay Loam. The soil texture classification for the six soil samples is depicted below.

Figure 3.44: Soil texture classification



The pH of the samples SQ-4 and SQ-5 collected was in the range of 6.57 to 6.98 i.e. slightly acidic and pH of the samples SQ-1, SQ-2, SQ-3 & SQ-6 was in the range of 7.13 to 7.89 i.e. moderately alkaline as per the ranges and classification of pH given by Department of Agriculture. (Source: Method Manual, Soil Testing in India, 2011). It is a very important property of soil as it determines the availability of nutrients, microbial activity and physical condition of soil.

Electrical conductivity (EC) expresses ion contents of solution which determine the current carrying capacity thus giving a clear idea of the soluble salts present in the soil. The Collected Soil samples was highly alkaline.

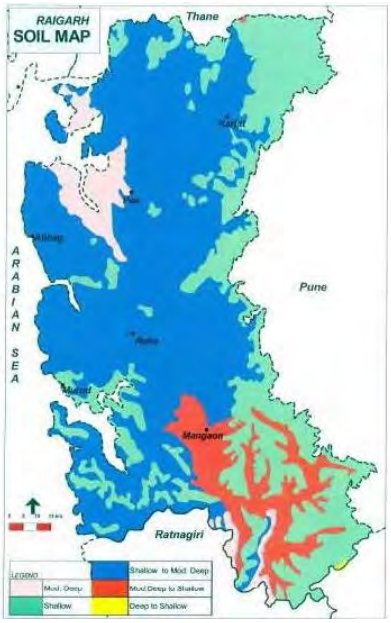
Electrical Conductivity value ranges from 18.98 µs/cm to 879.0 µs/cm. Water holding capacity as the amount of water held in the soil. Soil structure influences the extent of pore space in the soil, water holding capacity, aeration, root movement and the nutrient availability. The better and more stable soil aggregates are considered as a desirable soil property with regard to plant growth. Water holding capacity of Collected Soil samples ranges from 45 to 70 %. The important cations present in soil are calcium and magnesium. It is observed that both calcium and magnesium concentrations are in the range of 300.50 to 1441.0 mg/kg and 807.50 to 1531.0 mg/kg respectively whereas sodium and potassium are in the range of 45.30 to 4724.0 mg/kg and 46.62 to 162.50 mg/kg respectively.

The concentration of micronutrient in the soil was observed in the ranges of 3618.0 to 6941.0 mg/kg for iron, 112.0 to 473.10 mg/kg for manganese, 17.51 to 26.48 mg/kg for zinc, 37.07 to 93.85 mg/kg for copper and 27.77 to 35.65 mg/kg for nickel. Thus it was observed that the soils from the study area are enriched in micronutrients like Zn, Mn, Cu, Fe although they show varying range. Organic matter present in soil influences its physical and chemical properties of soil. Soil OM is important to a wide variety of soil chemical, physical, and biological properties. As soil OM increases, so does CEC, soil total N content, and other soil properties such as water holding capacity and microbiological activity. Organic matter, total nitrogen and phosphorous are found to be in the range of 0.53 to 3.36 %, 350.0 to 1820.0 mg/kg and 134.90 to 1378.0 mg/kg respectively presented. The soils of location SQ-2 and SQ-4 are having high range of organic matter content and total nitrogen content in the soil. Also having high range of Phosphorus and Potassium content thus shows good fertility level and fulfil the minimum nutrient requirement for plant.

Soil Type in the Study Area

Based on Soil map of Raigad district (Source - NBSS & LUP, Nagpur), soil of the study area is classified as shallow to moderate deep.

Figure 3.45: Soil Map of the area *(Source : NBSS & LUP, Nagpur)*



Interpretation

The construction activities, if not planned properly, may result in digging and excavations in the project area that can make the land susceptible to erosion during rainy season. The top soil removed will be reused for proposed landscaping purpose. The project would involve compaction of soil due to construction activities and landscaping towards the later part which would reduce the chance of subsidence.

The photographs of soil from tree plantation within the Plot and agricultural fields in surrounding area are shown below.

Figure 3.46: Photographs of soil from tree plantation within the Plot and agricultural fields around surrounding area

3.8 Ecology & bio-diversity

3.8.1 Introduction

In view of the need of EIA & for conservation of environmental quality and biodiversity, study of biological environment is one of the most important aspects for Environmental Impact Assessment. 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 them but also with the abiotic components viz. physical and chemical components of the environment. Generally, biological communities are the indicators of climatic and edaphic factors. The biological environment includes mainly terrestrial ecosystem and aquatic ecosystem.

The animal and plant communities exist in their natural habitats in a well-organized manner. Their natural setting can be disturbed by any externally induced anthropological activities or by naturally induced calamities or disaster. So, once this setting is disturbed it becomes practically impossible or takes a longer time to come to its original state. Plants and animals are more susceptible to environmental stress. A change in the composition of biotic communities under stress is reflected by a change in the distribution pattern, density, diversity, frequency, dominance and abundance of natural species of flora and fauna existing in the ecosystem. These changes over a span of time can be quantified and related to the existing environmental factors. The sensitivity of animal and plant species to the changes occurring in their existing ecosystem can, therefore, be used for monitoring Environmental Impact Assessment studies of any project. The documentation of flora and fauna at any project site acts as a primary tool to assess the prevailing habitat at any location. The study of the life forms along with meteorological conditions at core. The main report for the ecology and biodiversity is presented in the EIA report while the calculations related to the flora and fauna are presented in Annexure-IV.

3.8.2 Study area

As per guidelines of MoEF for Environmental Impact Assessment, pertaining to Townships , total study area is restricted up to 15.0 km radius from the project site, of which primary data need to be collected from the area up to 5.0 km radius and remaining area, up to 10.0 km, will be represented by secondary data. The data up to 5.0 km radius were generated with reference to topography, land use, vegetation pattern, animals etc. All observations were undertaken in July 2015 at select sampling locations viz., site area, core area. The climatic conditions in the study area are severe with hot climate and moderate rainfall. Terrestrial vegetation primarily consists of trees and shrubs.

Figure 3.47: Map of Study Area for Ecological Study Project Site

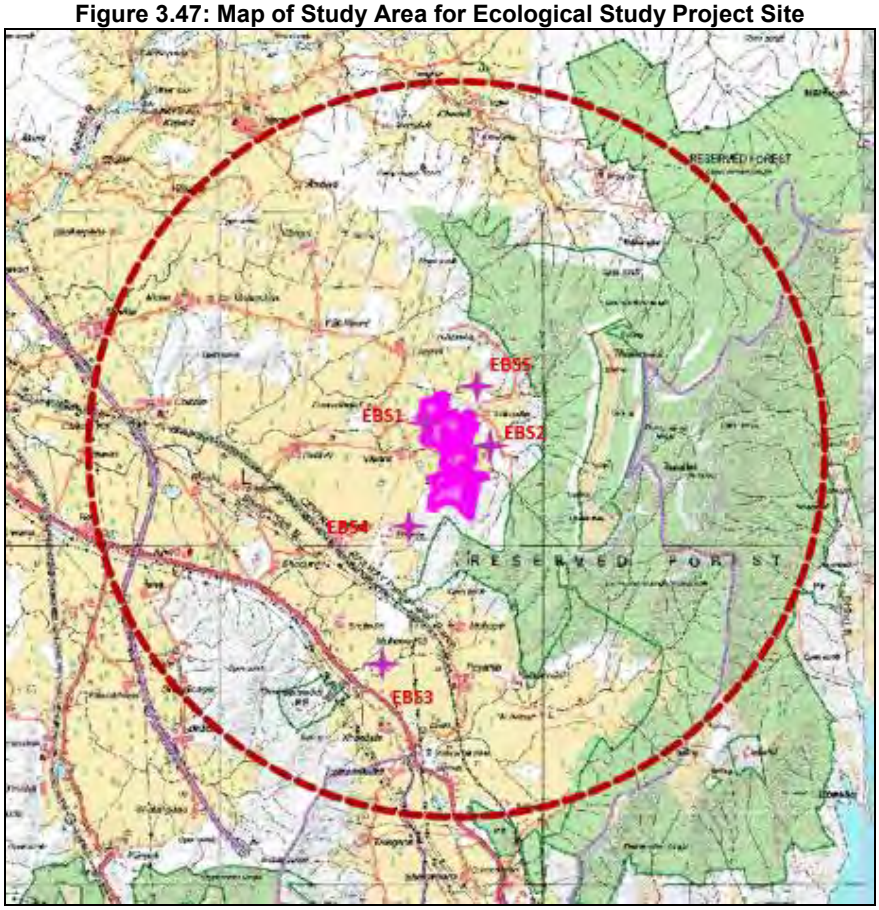


Figure 3.48: Map of Study Area for Ecological Study upto 5 kms from project boundary

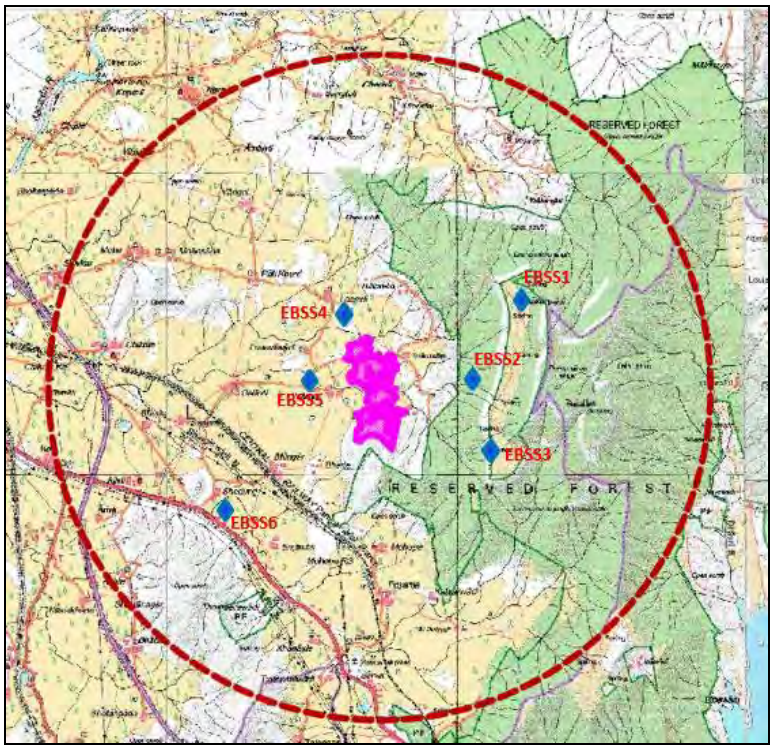
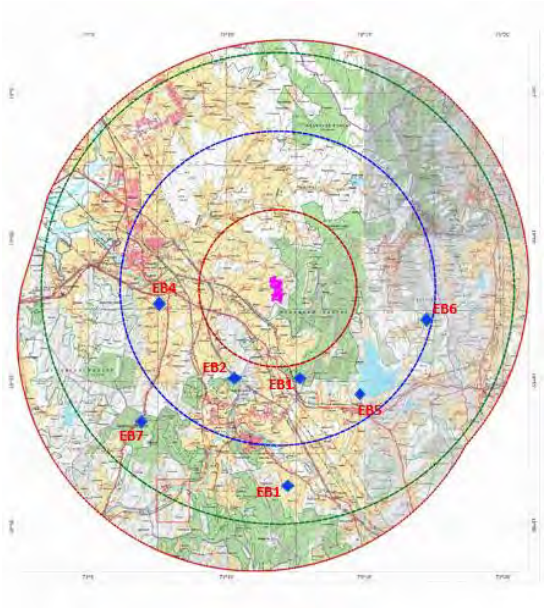


Figure 3.49: Map of Study Area for Ecological Study upto 15 kms from project boundary



3.8.3 Scope of the study

Keeping the foremost ecological aspects of urban areas in mind a study was undertaken in following objectives:

- Identification and designation of ecological significance of life forms in the area under study.
- To document trees that may be affected by the proposed development and the mitigation proposed.

The study covered following aspects:

Floral survey

- Identification of Tree, shrub, herb, climber and grass species and enumeration of significant tree, shrub, herb, climber and grass species
- Plantation plans giving thrust on endemic and regional species.
- Documentation of Rare, Endangered, Threatened flora

Faunal survey

- Documentation of Avian, Reptilian, Insect, Amphibian, Mammal and other major faunal diversity
- Identification and documentation of significant fauna based on indirect evidence- Pug marks, nests and other signs)

Approach of the Study

To assess the ecological issues and document flora and fauna associated with the project following tasks were undertaken:

- Understanding the Ecological Impotence of project surrounding before visiting site
- Site survey on Google Earth for 15.0 km radius from project
- Preliminary visit on the site
- Desk Study
- Site Survey by subsequent visits

The sampling stations that have been sampled are discussed as following:

- The site can be considered as a mixed vegetation moist deciduous and semi-evergreen ecosystem which slopes westwards which can be demarcated as distinct layers. Three quadrant sample plots were sited within each of the layers. The sample plots were randomly located on the open lowland.
- A quadrant of 10.0 x 10.0 m^2 and 5.0 m^2 area as sample plot for the tree cover and ground cover sampling respectively.
- For avian survey, survey time was 15 min. per location both in morning & the evening at each place.

Table 3.41: Description of tentative sampling locations

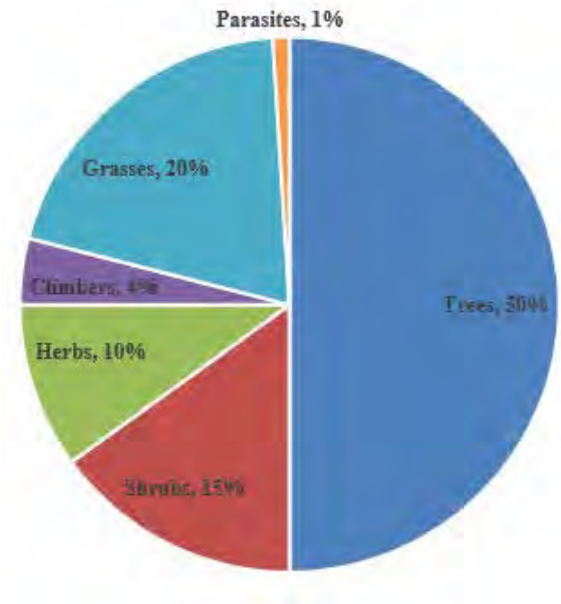
S. No.	Sampling Location	Code	Direction from Centre of Project Site
A.	**In Project Site**		
1.	Near Vardoli Village	EBS1	NW
2.	Near Farm House	EBS2	NE
3.	Near Vinganwadi Village	EBS3	S
4.	Near Bherle Village	EBS4	S
5.	On eastern boundary	EBS5	E
B.	**Project Boundary upto 5.00 Km**		
1.	Near PrabalmachiVillage	EBSS1	NNE
2.	On Prabalmachi	EBSS2	E
3.	Hill Slope of Prabalmachi	EBSS3	E
4.	Near Lonivali Village	EBSS4	NNW
5.	Near Vardoli Village Bus Stop	EBSS5	W
6.	Near Aayush Resort, Shedung	EBSS6	SSW
	Project Boundary upto 15.00 Km		
1.	Near Bhokarpada Village	EB1	SSE
2.	Near Bhatan Pada	EB2	SSW
3.	Near Vadgaon Village	EB3	S
4.	Near Nandgaon Village	EB4	W

5.	Vil Near Morbe Dam	EB5	SSE
6.	Near Sagachiwadi Village	EB6	SE
7.	Karnala Bird Sanctuary	EB7	S

Floral Diversity of the Core Zone:
The core area is mostly flat terrain divided into three layers:
The uppermost layer is in sync with the vegetation continuation from Prabal Machi, but mostly sparse.
The middle layer consists of cultivated lands with some houses, which are mostly —Kaccha" structures.
The lowest layer is partly cultivated. There are a large grass patches which is covered with mostly invasive species of grass during the monsoon period. The land is mostly devoid of vegetation during dry months

A field survey was undertaken to enumerate the trees in the proposed site and general types of vegetation in proposed site. 5 areas (EBS 1, EBS 2, EBS 3, EBS 4 & EBS 5) were selected for physical survey of plant species. As the proposed site is highly contoured so we have considered the sampling location at different level. Sampling Station 1 & 3 (EBS 1 & 3) at ground level, Sampling location 2 (EBS 2), Sampling Location 4 (EBS 4) & Sampling location 5 (EBS 5) at different slope level within the project site. We have considered quadrant of 10 x 10 m^2 for field survey.

Figure 3.50: Habitat-wise distribution of flora inside core zone



The core zone showed a mixed type of vegetation. The flora mainly consisted of grasses, shrubs, herbs and tree in the core zone. The dominant trees are *Bombax ceiba* followed by *Mangifera indica, Terminalia sp., Cordia dichotoma, Wrightia tinctoria, Moringa pterigosperma, Ziziphus rugosa, Syzygium cumini* etc.
Total number of 56 species of trees were encountered during the survey Sampling Station 1 (EBS 1), Sampling Station 2 (EBS 2), Sampling Station 3 (EBS 3), Sampling Station 4 (EBS 4) & Sampling Station 5 (EBS 5) within the project site respectively.
The Shannon-Wiener Index (log) of above mentioned sites (EBS 1-5) is 3.23, 2.73, 3.38, 3.20 & 3.76 respectively. As the values ranges between 2.70-3.70, it indicates high diversity of plant species in these areas. The maximum diversity of plants was observed in and around EBS 5 due to the proximity of Prabal Machi.
The Simpson Index of above mentioned sites (EBS 1-5) is 0.04, 0.02, 0.02, 0.03 & 0.02 respectively. The dominant species in this site was *Tectona grandis* followed by *Terminalia sp, Butea Monosperma, Mangifera indica.* In EBS 1 dominant species was *Mangifera indica* followed by *Cordia dichotoma, Ziziphus mauritiana,*

Butea Monosperma. Near EBS 2 dominant species *Wrightia tinctoria* followed by *Mangifera indica.* In EBS 3 dominant species was *Mangifera indica* followed by *Psidium guajava.* Near EBS 4 dominant species *Sterculia urens* followed by *Butea Monosperma & Mangifera indica.*

The study shows the core zone comprises of mixed type of vegetation of species (*Tectona grandis, Terminalia sp, Cordia dichotoma, Wrightia tinctoria* etc.) as well as cultivated species (*Mangifera indica, Psidium guajava etc.).*

Total number of 12 species of shrubs were encountered during the survey Sampling Station 1 (EBS 1), Sampling Station 2 (EBS 2), Sampling Station 3 (EBS 3), Sampling Station 4 (EBS 4) & Sampling Station 5 (EBS 5) within the project site respectively.

The Shannon-Wiener Index (log) of above mentioned sites (EBS 1-5) is 1.9, 1.5, 1.6, 1.9 & 2.3 respectively. As the values ranges between 1.5-2.3, it indicates high diversity of shrub species in these areas. The dominant species in this site was *Holarrhena antidysenterica* followed by *Carrissa carandas*. In EBS 1&2 dominant species was *Eupatorium sp.* followed by *Abelmoschus moschatus*. Near EBS 3 dominant species E*clipta prostrata* .followed by *Eupatorium sp.* Near EBS 4 dominant species *Holarrhena antidysenterica* followed by *Cida acuta* & *Eupatorium sp.*

Figure 3.51: Select green patches (EBS 1-5) of trees within the project site

Figure 3.52: Representation of Diversity Indices of Trees , Shrubs & Herbs Species In Core Zone

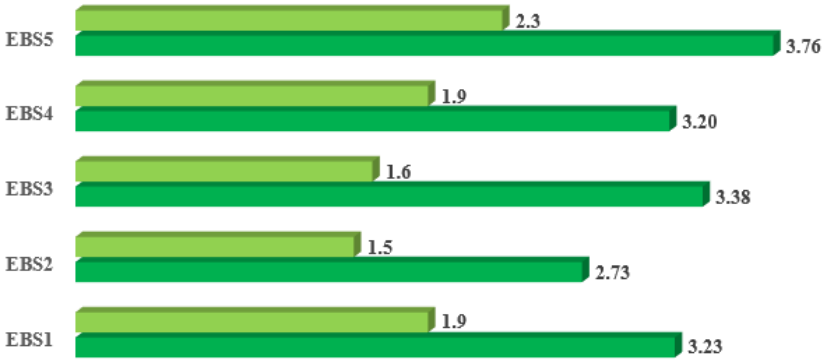


Figure 3.52: Graphical Representation of Distribution of Trees Species In Core Zone

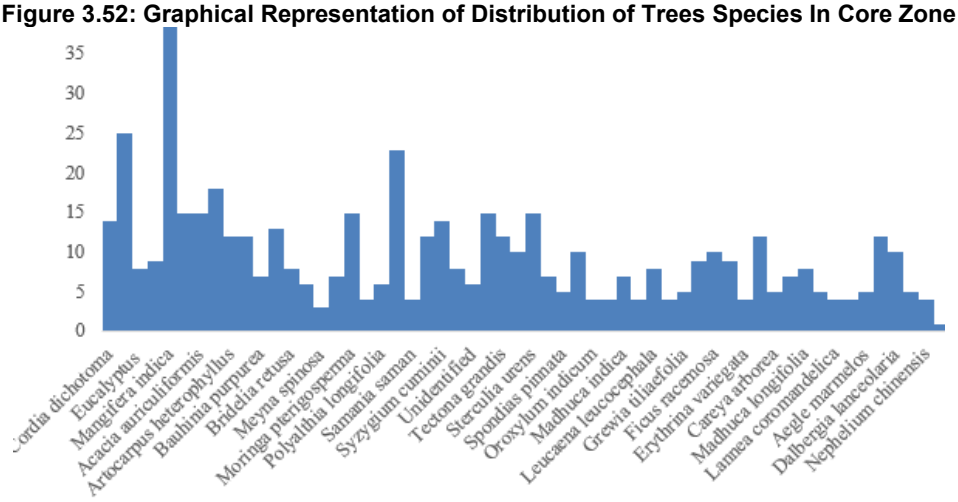
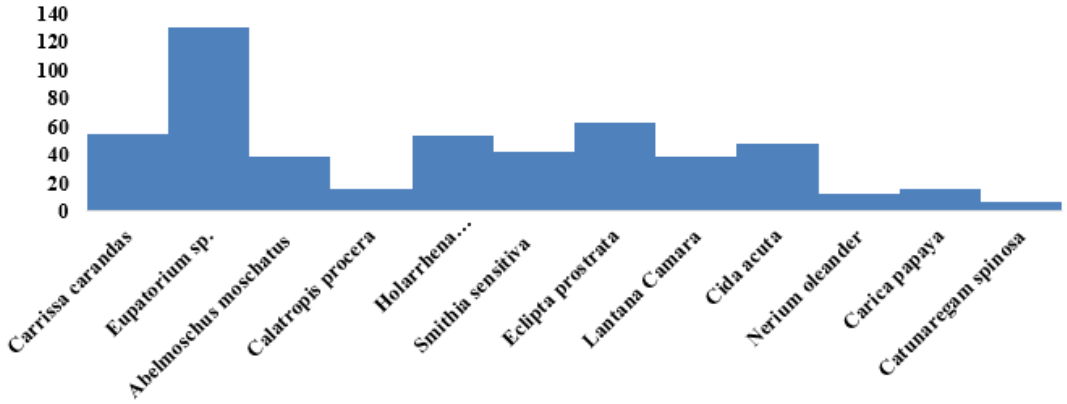


Figure 3.53: Graphical Representation of Distribution of Shrubs & Herbs Species In Core Zone



Amphibian Diversity:
The only amphibian seen was the common toad, *Bufo bufo.*
Insect Diversity:
The arthropod varieties included 15 butterflies and 8 types of spiders.
Summary of faunal observations

- Number of Bird species observed: 63
- Number of reptile and amphibian species observed: 4
- Number of Butterfly species observed: 15
- Mammal species observed: 7
- Number of spider species observed: 8

Discussion and Conclusion
The floral and faunal species encountered during the study were enlisted and compared with the IUCN Red List and the protected species list as per the Indian Wildlife Protection Act Schedule. None of the species observed in the core zone were found to be endangered, threatened or vulnerable. Hence the impact on species diversity will be minimal due to direct loss. However necessary mitigation measures should be taken to minimize the indirect

impact of the project on the local ecosystem. The indirect impact may be due to the contaminated water produced during the project activities or due to the particulate matter emitted during the project activities.
The green belt to be developed on the project boundary should emphasize on plantation of native species.
The landscaping planning should be undertaken in phases as the project proceeds with utmost importance on native species in association with existing flora and fauna.
The site boundary should be in guidelines so as to avoid conflict with wild, domesticated and stray animals.

3.8.4 Wildlife, habitats & anthropological factors

According to the local people interviewed during the survey most of the wildlife that was present in the area over thirty years ago has gradually decreased over the period of 3 decades. Population pressure is also a contributing factor as the area around the vegetated patch and the project site is fairly well populated.

Forest Type of Study area
The forest types in the region can be classified as Scrub; Mixed Deciduous forests; and Evergreen forests. Locally available wild valuable genetic resources can be used for new crop species development.
There are some private forest areas in the South East of the site.

http://www.mahaforest.nic.in/district_detail.php?dist_id=118
http://www.mahaforest.nic.in/internal.php?id=29

Sanctuary
Karnala Bird Sanctuary
Karnala Bird Sanctuary, in Uran Tahsil of Raigad District, falls under 15.00 km radius of the study area. Our EB team surveyed the location. Findings were already represented in the Annexure. Total area of the sanctuary is 12.154 sqkm with 6.562 sqkm of Reserve forest, 5.547 sqkm of acquired forest and 0.045 sqkm of private land.
Geographic co-ordinates:
Longitudes: 7305'N to 7308'N
Latitudes: 18052'E to 18054'E
The place along the Mumbai Goa NH 17, the road passes through sanctuary is about 1.5 km. It is 65 km away from Mumbai and 12 km from Panvel, 17 km from Pen and around 100 km from Pune.. In spite of being a small pocket it holds a rich diversity of wood land vegetation & wood land bird species. It also forms a catchment area of Patalganga River. The Sanctuary is a green oasis surrounded by industrial areas of Panvel, Khopoli & Patalganga. Hilly terrain consists of nallas on eastern and western slopes which drains in Patalganga River. Mean max.temp.: 34.25^{O}C while Mean min.temp.: 24.82^{O} C while average annual rainfall is 2404.45mm. Prior to 31st March, 1994 the area of this sanctuary was under administrative control of Alibag Forest Division. Henceforth, the area is transferred to Wild Life Division, Thane. Area 4.27 Sq.Km. of reserve forest was earlier declared as Karnala Fort sanctuary in the year 1968 under —Bombay Wild Animal And Wild Bird Act,1951". In 1986, as per the provision of Wild life Protection Act,1972 of Section 18, the area 12.11 Sq.Km. was notified for Karnala Bird Sanctuary.In 2003, an area of 12.109Sq.km. of reserve and acquired forest including earlier declared area was notified as Karnala Bird Sanctuary under sec. 26(a) of Wild Life Protection Act,1972. In 2003, subsequently a private cultivation area 0.045Sq.Km. Added by declaration as Karnala Bird Sanctuary. Thus, today the total area of the sanctuary is 12.154Sq.Km. The total length of external boundary is 29.56 km. The sanctuary area is divided in compartments hence the internal boundary is16.50 km. At the bottom of the funnel hill of the fort there are 12 water storage dug out tanks in impermeable basalt rock that retain stagnated rain water all around the year. 23 cement water dishes kept at strategic places to provide water to animals and birds. On 17th June 2015, MoEF & CC vide its Notification No S.O. 1658(E) defined the ESZ around the Karnala Wildlife Santcuary. This ESZ is spread over an area of 30.57 sq kms, with an extent varying from 0 mts to 8 kilometers from the boundary of the Karnala Wildlife Scantuary. This ESZ is at a distance of ------ from the project site. Further the project site and the Karnala WS and ESZ have the Mumbai-Pune Expressway, Mumbai Goa National Highway the old Mumbai Pune Highway, the Panvel Karjat Rail Line and all developments along these corridors in between them.
Flora
3B/C1b – Southern Teak Bearing Forest

2B/C2 – Southern Moist Mixed Deciduous
4E/RS1 – Tropical reparine Fringe Forest

The Sanctuary area is covered with mixed forest. In Southern teak bearing forest, the teak dominance seen in Karnala Sanctuary.

With teak, top canopy consists of Ain, Amba, Behada, Hed, Kusum, Sawar, Dhavada, middle canopy Alu, Bahawa, Dhaman, Dikamali, Asana, Apta, Palas, Lokhnadi, Kuda. herbs, shrubs and grasses like atrun, Karvand, Kusali and Marvel. The moist mixed deciduous forest is similar with Southern Teak bearing Forest except that percentage of Kinjal, Nana, amba and Behda are more than Teak. The density of the forest is between 0.6 to 0.8. The Riparian Fringing Forest occur along the nala bank consists of top canopy with Umbar,Jambhul, Karanj Amba. Middle canopy with Alu, Bahava,Dhaman, Dikemali, Lokhandi, Palas,Kumbhi. In 1980, Botonical Survey of India Pune carried out the survey of this area and find out about 642 species.

Fauna

The topographical features and ecological conditions are favourable for boarding large variety of birds and small animals like wild pig, barking deer, porcupine, mongoose, jungle cat, monitor lizard, squirrels, hyena and monkey.

As many as 132 bird spp. have been listed in the sanctuary. Of these 92 spp. are resident and 40 spp. are migratory. Globally threatened and endemic birds like Long Billed Vultures, Malbar Gray Hornbill, Small Sun Bird and Shahin Falcon birds spp. are found in Karnala Bird Sanctuary. Around 11 spp. of reptiles are found in sanctuary area like Cobra, Krait, Viper, Python, Rat snake etc.

(Source: http://www.thanewildlife.org/Sanctuaries/karnala-wildlife-sanctuary)

Matheran eco Sensitive Zone:

Matheran, the smallest hill station in the Northern Western Ghats of Maharashtra is about 7.2sq.km in area. The word Matheran means ‗forest' (ran) on the ‗head' (mathe). It is located between Mumbai-Pune urban belt and situated at a distance of about 64 km South-East of Mumbai (Karjat Taluka, District Raigad) and 81 km from Alibaug, the district headquarters. Another metropolis, Pune lies at a distance of about 125 km in South-East diection. Matheran ESA encompasses 214.73 sq. Km of land in and around it and 200 meters buffer zone covering about 89 villages. More than 60 % of the area of Matheran comes under ‗reserved forest' category. The details of various zones and their areal expansion are given below.

Table 3.42: Distribution of Matheran Eco-Sensitive-Area

Zone	Area in Sq.Km
Forest Zone	205.58
Green Zone-1	1.91
Green Zone-2	1.88
Quarry Zone	0.02
Urbanization Zone	5.34
Total	**214.73**

Geographically Matheran plateau lies between 18° 55‘N Latitude and 73° 51‘E Longitude and it is to the west of main range of Western Ghats. Bio-geographically, the region is important on account of being an outlier of the main Western Ghats mountain chain and in effect sheltering a pocket of evergreen forest isolated in geological past. Surrounded by hill and dale topography Matheran presents a dynamic landscape. The deep ravines around it are covered by dense forests and the top of hill is a large plateau. Its general height above m.s.l. is 759m and the highest point on it is at 803.45m. The laterite, which forms the upper strata of the plateau, appears as a purplish red rock variegated with different colours. Fragmented laterite cap is found in addition to the thick laterite clay deposits. The major threat today Matheran is facing are the landslides due to heavy rainfall and the weathered rock pattern itself.

It is very rich on accounts of biodiversity as it supports evergreen forest of Memecylon Syzigium-*Actinodaphne type (Puri et al., 1983). Various tree species commonly seen on the plateau are Olea dioica, Mangifera indica, Eugenia jambolana, Ficus glomerata, Heterophragma roxburghii, Bridelia retusa and Memecylon umbellatum. Predominant tree species on the slopes are Terminalia tomentosa, Lagerstroemia parviflora, Adina cordifolia, Garuga pinnata, Dillenia pentagyna, Pongamia glabra, Schleichera trijuga and Bombax malabarica. It is also a*

home to endangered endemic mammal species such as Ratufa indica elphinstonii (Giant squirrel), which is Scheduled-I species.
The Matheran Eco Sensitive Zone was notified by the MoEF & CC vide a Notification in Feb 2003. The boundaries of the zone have been defined in this Notification of Feb 2003. The said Notification defines the Zone and the buffer zone. The buffer zone is the 200 mts land along the boundary of MESZ. The project is entirely outside this Buffer zone. The Area outside the buffer zone is part of the NAINA new city. The entire proposed project area is in the ‗Predominantly Residential' zone of NAINA.

3.9 Socio-economic environment

This section discusses the baseline scenario of the socio-economic environment in the study area and anticipated impacts of the proposed project on the socio-economic environment. The issues under focus are demographic pattern, economic activities, education and literacy profile, etc. The assessment attempts to predict and evaluate the future impacts of project upon people, their physical and psychological health and well-being, their economic status, cultural heritage, lifestyle and other value system.

General Overview of Project Location
The proposed project will be built on purchased lands in Vardoli in Taluka Panvel, District Raigad of Maharashtra State.

Raigarh District
Raigad is bound by Mumbai Harbor to the northwest, Thane District to the north, Pune District to the east, Ratnagiri district to the south, and the Arabian Sea to the west. It includes the large natural harbor of Pen-Mandwa, which is immediately south of Mumbai harbor, and forming a single landform with it. The northern part of the district is included in the planned metropolis of Navi Mumbai, and its port, the Jawaharlal Nehru Port.The district includes prosperous towns/cities of Panvel, Alibag, Mangaon, Roha, Pen, Khopoli, Kharghar, Taloja, Khalapur, Uran, Patalganga, Rasayani, Nagothana, Poladpur, Alibag, Karjat and Mahad. The largest city both in area and population is Panvel.

Panvel Taluka
Panvel Taluka is the most populated taluka in Raigad District. It lies approximately 40 kilometers east of Greater Mumbai in the Mumbai Metropolitan Region. It lies adjacent to the Navi Mumbai International Airport forming its eastern boundary. Panvel City in Panvel District is a part of MMR (Mumbai Metropolitan Region). Panvel Taluka is industrially prosperous as it has some major Maharashtra Industrial Development Corporation (MIDC) managed regions like Patalganga, Taloja, Nagothane, Roha, Khopoli, Bhiwandi. Some of the Indian industry majors like Larsen & Toubro Limited, Reliance, Hindustan Organic Chemicals Ltd., ONGC, IPCL are based around Panvel providing mass employment. The JNPT port is also located near Panvel. New SEZ declared by government are coming around Panvel. Panvel is an important junction point as many major highways meet and pass through the city. The Mumbai-Pune Expressway, Sion-Panvel Expressway, NH 4B and NH 66 start from here while NH 4 passes through Panvel.

Scope of the study
As per the EIA notification 2006, socio-economic impact has been carried out on villages and urban centres lying within the 15 km radius of the project area. For this assessment, the study area has been divided into following:

- Villages close to the project : 4 villages
- Villages within the 15 km radius of the project area: 151 villages & 9 Urban Centers.
- Urban areas within study area

3.9.1 Methodology

The methodology adopted is as under:

- Socio-Economic baseline data was collected through primary survey as well as secondary sources.
- Primary survey involved visiting project site, discussion with the local population including project affected, local elected representatives such as panchayats and local administrative units of government.

- Secondary data collection involved collecting existing Census data, published documents on various aspects such as land use, demography, literacy, employment, social structure of society, and socio cultural aspects from different institutions, government offices, literature etc. and discussions with the concerned departments/agencies.

3.9.2 Baseline socio-economic data

This section presents the comparative statement of baseline socio-economic data area within 15 kms of radius .

Table 3.43: Comparative data of population, Sex ration and Literacy rate.

Name	Total Pop.	Total Male Pop.	Total Female Pop.	Literates	Male Literates
Maharashtra	112374333	58243056	54131277	81554290	45257584
Raigad	2634200	1344345	1289855	1939994	1059692
Panvel	750236	397228	353008	575681	319292
Closeby Villages	2729	1367	1362	1771	999
Total Rural area within 15 kms of radius	428538	225683	202855	297663	170155
Urban areas	541011	286439	254572	433602	236727

Name	Female Literates	%	Male literacy rate	Female Literacy rate	Sex Ratio	Child Sex Ratio
Maharashtra	36296706	72.57	77.70	67.05	929	894
Raigad	880302	73.65	78.83	68.25	959	935
Panvel	256389	76.73	80.38	72.63	863	919
Closeby Villages	772	64.88	73.08	56.68	996	1109
Total Rural area within 15 kms of radius	127508	69.13	75.40	62.86	898	939
Urban areas	196875	79.99	82.64	77.34	889	910

Socio–economic profile of the study area

The names of the villages within the project study area and their categorization are given in the **Table-4.44** below

Category	Name of village	Type of area	Name of Tehsil/block	Name of district
Villages cloase to project	Vardoli.	Rural	Panvel	Raigarh
Villages within 15 km of the project area	Turade, Jatade, Panshil, Talegaon, Bhokarpada, Pali Bk, Poyanje, Mohope, Kaliwali, Savane, Chawane, Jambhivali, Kasap, Ladiwali, Karade Kh., Karade Bk, Morbe, Hatnoli, Tupgaon, Pali Kh., Sarang, Tembhari,	Rural	Panvel	Raigarh

	Vayal, Kambe, ambharli, Parade, Vat, Kaire, Borivali, Washivali, Vanivali, Kopari, Asroti, Jambhivali Tarf Boreti, Kandroli Tarf,ankhal Warad, Lohop, Wadgaon, Talavali, Isambe, Ambivali T.Wankhal, Majgaon, Poud, Akulwadi, Gulsunde, Lodhivali, Barwai, Palaspe,Kolkhe, Shedung, Loniwadi, Wardoli, Nadhal, houk, Manivali,Borgaon Bk., Borgaon Kh., Sarang, Tembhari, Asare, Dharni, Nigdoli, Vinegaon, Vavandal, Sondewadi, Vadvihir, Hatnoli, Haliwali, Kirawali Deulwadi, Wanjale, Sawargaon, Bamnoli, Umroli, Ashane, ,Koshane, Asal, Bhutiwali, Pali T. Waredi, Bekare, Wadawali Tarf Waredi, Chinchawali, Diksal, Garpoli, Borle, Mamdapur, Kondiwale, Damat, Bhadwal, Bedisgaon, Karambeli, Wangani, Mahodar, Vavanje, Shiravali, Pale Bk., Kherane Kh., Devichapada, Kanpoli, Chindharan, Mahalungi, Ambe tarf taloje, Khairwadi, Koyana Velhe, Pale Kh., Mahodar, Kalamboli Tarf Waredi, Panvel, Ritghar, Dundre, Dhamani, Maldunge, Dhodani, Deharang, Gadhe, Ambe tarf waje, Shivansai, Umroli, Usarli Bk., Vakadi, Harigram, koproli, Chipale, Bonshet, Vihighar, Nere, Ambivali, Sangatoli, Waje, Cheravali, Wajapur, Nevali, Adai, Akurli, Kondale, Vichumbe, Dapoli, Ajivali, Shedung,Chirvat, Shirdhon, Nanoshi, Chinchavan, Savale, Karnala, Tighar, Maldunge, Dundre, Dhamani, Tamsai, Belvali, Bedisgaon			
Urban areas within the study area	Ambivali T. Tungartan (CT), Ambivali T. Tungartan (CT) WARD NO.-0001,Mohpada Alias Wasambe (CT), Mohpada Alias Wasambe (CT) WARD NO.-0001, Rees (CT), Rees (CT) WARD NO.-0001, Panvel, Neral (CT) WARD NO.-0001, Neral (CT)	Urban	Panvel	Raigarh

Demographic details of the study area

The demographic details of the study area are given below:

Table 3.45: Comparative demographic details of the study area

Level	Name		Total Population	Scheduled Caste Persons	Scheduled Tribe Population	Other Total Population
State	Maharashtra	Total	112374333 (100)	13275898 (11.8)	5315025 (9.4)	88588222 (78.8)
		Rural	61556074 (100)	7494819 (12.2)	4540456 (14.6)	45055178 (73.2)
		Urban	50818259 (100)	5781079 (11.4)	774569 (3.0)	43533044 (85.7)
District	Raigad	Total	2634200 (100)	134952 (5.1)	153657 (11.6)	2194123 (83.3)
		Rural	1664005 (100)	64338	135959 (16.3)	1328899

				(3.9)		(79.9)
		Urban	970195 (100)	70614 (7.3)	17698 (3.5)	865224 (89.2)
Taluka	Panvel	Total	750236 (100)	49799 (6.6)	24575 (6.4)	652275 (86.9)
		Rural	252477 (100)	11843 (4.7)	18381 (14.4)	204355 (80.9)
		Urban	497759 (100)	37956 (7.6)	6194 (2.4)	447920 (90.0)
Project	Study Area	Rural	3641 (100)	31 (0.9)	1458 (40.0)	2152 (59.1)

As per census 2011, out of the total population in Raigad district, about 63.2% comprise of rural population whereas in Panvel Taluka the total rural population is only about 33.65%.

Social Groups

Raigad District shows SC population of about 5% of total district population which is lesser than SC population of Maharashtra State. On contrary, Raigad District show higher ST population percentage of about 11.6% of total District population. A similar higher percent of ST population is noticed in Panvel Sub-district but the study area of the affected villages shows highest percentage of ST population (40%). Thus, as per census 2011, the vulnerable group of ST is higher in Raigad district, Panvel Sub district and study area.

Table 3.46: SC & ST population

Level	Name		Total sex ratio	SC-Sex Ratio	ST Sex ratio
State	Maharashtra	Total	929.4	894.21	961.64
		Rural	951.74	890.39	959.4
		Urban	903.02	899.45	964.55
District	Raigad	Total	959.47	935.29	985.17
		Rural	988.07	948.94	1011.51
		Urban	912.28	912.69	961.77
Taluka	Panvel	Total	888.68	919.18	935.07
		Rural	895.05	934.21	914.48
		Urban	885.47	911.13	941.58
Project	Study Area	Total	973	823.5	1019.4

From the above table we observe that overall sex ratio in Raigad district is higher than Maharashtra State. There are about 959 females for every 1000 males in Raigad District, 988 females for every 1000 males in rural areas. It is to be noted that sex ratio amongst the ST rural population in Raigad District is 1011 females for every 1000 males. The sex ratio in the study area is higher among its district and sub-district figures.

Literacy and Sex Ratio

According to 2011 census, sex ratio in the total study area including the affected villages, other rural villages and the urban areas ranged from 889 to 996. Sex ratio in affected villages is higher as compared to the sex ratio of Maharashtra which is 929. While sex ratio of all the other regions is well below the state average. Total literacy rate of the villages is 64.88 % which is below the state literacy rate of 72%.

It is important to note that, literacy rate for male and female in the villages is 73% and 56% respectively. The female literacy rate on an average is 65%, the male literacy rate is 77%. Male population show higher literacy rate as compared to female population, this can also be compared with the sex ratio. The details are presented below.

Table 3.47: Literacy Rate

Level	Name		Male Literacy Rate	Female Literacy Rate

State	Maharashtra	Total	55.49	44.51
		Rural	56.39	43.61
		Urban	54.57	45.43
District	Raigad	Total	54.62	45.38
		Rural	55.01	44.99
		Urban	54.05	45.95
Taluka	Panvel	Total	55.46	44.54
		Rural	57.3	42.7
		Urban	54.65	45.35
Project	Study Area	Total	37.32	29.33

From the above table , we see higher literacy rates in Panvel sub-district among the rural male population. Female literacy rate, overall are lower than male literacy rates. Also, literacy rates amongst both male & female population are on the lower side as compared to its sub-district and district figures.

Main workers and marginal workers

We observe higher percentages of marginal workers in the study area as compared to its state, district and taluka statistics.

Construction of projects that boost development shall give a big platform to diversify the employment opportunities of the affected villagers. The closeby villages that have high vulnerable groups shall gain benefits of the proposed project.

Table 3.48: Workforce Participation Chart

Level	Name		Main Workers	Marginal Workers
State	Maharashtra	Total	88.5	12.9
		Rural	86.5	15.6
		Urban	91.9	8.8
District	Raigad	Total	80.0	24.9
		Rural	75.5	32.5
		Urban	89.2	12.2
Taluka	Panvel	Total	87.2	14.6
		Rural	82.3	21.5
		Urban	89.8	11.4
Project	Study Area	Total	72.87	27.13

Baseline socio-economic data based on primary survey

According to the Census 2011 data, in the study area total population are 1026980 living in 238278 households. The closeby villages has a population of 787 HH with 3641 persons that is about 0.35% of the study area population.

Table 3.49: No of households and total population – Study Area

Project Study Area	No. of HH	Total Population
Villages closeby	787 (0.33)	3641 (0.35)
Villages within the study area	97408 (40.88)	439076 (42.75)
Urban areas within the study area	140083 (58.79)	584263 (56.89)
Total Study Area	238278 (100)	1026980 (100)

For purpose of detailed assessment and analysis, our detailed study area covers only the affected village- Vardoli.

Detailed Study Area- Closeby Villages

The closeby village (Vardoli) has a population of 1161 persons living in 172 Households. We shall now understand the general profile of the detailed study area through parameters such as- demography, educational & health facilities, socio-cultural groups.

Demography

Population

As per Census 2011, Village Vardoli has the highest population amongst the closeby village with 21.9% of total households being affected.

Table 3.50: Demography of the closeby villages

	No. of HH	Total population	Male Population	Female Population	0-6 age
Bherle	172 (21.9)	736 (20.2)	354(19.2)	382(21.3)	125(24.2)
Vardoli	243 (30.9)	1161(31.9)	584(31.7)	577(32.1)	166(32.2)
Bhingarwadi	169 (21.5)	832 (22.9)	429(23.3)	403(22.4)	97(18.8)
Khanavale	203 (25.8)	912 (25.0)	478(25.9)	434(24.2)	128(24.8)
Total	787 (100)	3641(100)	1845(100)	1796(100)	516(100)

Gender Composition:

If we see the gender composition across the four villages, we can observe that both the genders are almost equally distributed in all the four villages.

Table 3.51: Gender composition of the study area

	Total population	Male Population	Female Population
Wardoli	1161	584 (50.3)	577 (49.7)

*Source: Census 2011; *Figures in bracket indicate percentages*

Social Groups

Amongst the closeby villages, we observe least population of Scheduled Caste and higher population amongst Scheduled tribes and Other backwards Classes.. Village Bherle has the highest population of Schedule tribes, while other villages show lesser Scheduled Tribal Population. The relative percentage of Schedule caste population is low in all the four affected villages ranging from 0 to 1.3 % of its total village population.

Table 3.51 a: Social Groups in the study area

Village	SC Population	ST Population	Other Population	Total population
Bherle	0 (0.0)	731 (99.3)	5 (0.7)	736 (100)
Wardoli	15 (1.3)	391 (33.7)	755 (65.0)	1161 (100)
Bhingarwadi	8 (1.0)	20 (2.4)	804 (96.6)	832 (100)
Khanavale	8 (0.9)	316 (34.6)	588 (64.5)	912 (100)
Total	31 (0.9)	1458 (40.0)	2152 (59.1)	3641 (100)

*Source: Census 2011; *Figures in bracket indicate percentages*

Amongst the vulnerable group of Scheduled tribes, we see a relatively higher female population in Village Bherle and Bhingarwadi.

Table 3.52: Social Group composition in the study area

Village	Scheduled Caste	Scheduled Tribe	Others

	Male	Female	Total	Sex ratio	Male	Female	Total	Sex ratio	Male	Female	Total	Sex ratio
Bherle	0	0	0	0.0	350	381	731	1088.6	4	1	5	250.0
Wardoli	8	7	15	875.0	205	186	391	907.3	371	384	755	1035.0
Bhingarwadi	5	3	8	600.0	7	13	20	1857.1	417	387	804	928.1
Khanavale	4	4	8	1000.0	160	156	316	975.0	314	274	588	872.6
Total	17	14	31	823.5	722	736	1458	1019.4	1106	1046	2152	945.8

Literacy rates

The average literacy rate amongst the affected four villages is 66.66%. Village Bhingarwadi has the highest literacy rate and Village Bherle has the lowest.

Table 3.53: Literacy rate within the study area

	Male Literate Population	Female Literate Population	Total Literate population	Total Population
	a	b	c	d
Bherle	209 (28.40)	156 (21.20)	365 (49.59)	736 (100)
Wardoli	423 (36.43)	367 (31.61)	790 (68.04)	1161 (100)
Bhingarwadi	367 (44.11)	294 (35.34)	661 (79.45)	832 (100)
Khanavale	360 (39.47)	251 (27.52)	611 (67.00)	912 (100)
Total	1359 (37.32)	1068 (29.33)	2427 (66.66)	3641 (100)

Occupation

As per census definitions, the working and non-working population enumeration was based on concepts of in agriculture and allied traditional cottage industries.

We can infer that the highest population working in agriculture and allied industries is in Village Bherle (44.97%) and the lowest in Village Bhingarwadi (29.33%). It is observed that more than 50 % of population fall in non-working category.

Table 3.54: Occupation within nearby villages

	Non-Working Population	Working Population	Total Population
	a	b	a+b
Bherle	405 (55.03)	331(44.97)	736
Wardoli	693(59.69)	468(40.31)	1161
Bhingarwadi	588(70.67)	244(29.33)	832
Khanavale	591(64.80)	321(35.20)	912
Total	2277(62.54)	1364(37.46)	3641

The reasons for this varied work force participation may be multiple like non-availability of fertile agricultural land, shift from agricultural to manufacturing or service –oriented sectors, large or small-scale business like ownership of poultries, shops, providing services as a construction contractor, and supply of machinery. As per the primary survey conducted, Village Bhingarwadi shows relatively a larger percentage of population shifting from

agricultural sector to the above mentioned services. An awareness about the development of peri-urban areas has been spread amongst these people and are trying to follow the current trend in occupation suitable towards per-urban development.

Amongst the villages that still practice or are dependent on agricultural and allied activities, the following table, highlights the bifurcation of working population as main workers and marginal workers. As per the table, more than 60% of working population are main workers; with Village Bhingarwadi with the highest participation of 79.92%. Village Bherle and Khanavle have higher percentage of population as marginal workers. These high numbers indicate that thispopulation is at high risks due to vulnerability of their occupation.

Table 3.55: Main workers and marginal workers

Villages	Main Workers	Marginal Workers	Total Working Population
	a	b	a+b
Bherle	228(68.88)	103(31.12)	331(100)
Wardoli	377(80.55)	91(19.45)	468(100)
Bhingarwadi	195(79.92)	49(20.08)	244(100)
Khanavale	194(60.43)	127(39.57)	321(100)
Total	994(72.87)	370(27.13)	136(100)

As per the Table, we observe a high percentage as other workers followed by agricultural labourers as main workers. This may be indicating that villagers are shifting from agricultural activities to other activities that aid development of these rural areas.

Amongst the marginal workers, we do not see a particular trend in all the closeby villages, Village Bherle and Wardoli have higher percentages of working population as agricultural workers whereas Village Bhingarwadi has high cultivators and Village Khanavle show high percent of other workers. We observe that three out of four villages have a major population still working in agricultural sector. One of the reasons maybe lack of secondary occupation available to them.

Table 3.56: Working population within the affected villages

Working population within affected villages					
Main Workers					
	Cultivators	Agricultural Labourers	Household Workers	Other Workers	Total Main Workers
	a	b	c	d	a+b+c+d
Bherle	0 (0.0)	98(42.98)	1(0.44)	129(56.58)	228(100)
Wardoli	67 (17.77)	92(24.40)	2(0.53)	216(57.29)	377(100)
Bhingarwadi	45(23.08)	3(1.54)	8(4.10)	139(71.28)	195(100)
Khanavale	33(17.01)	7(3.61)	0(0.0)	154(79.38)	194(100)
Total	145(14.59)	200(20.12)	11(1.11)	638(64.19)	994(100)
Marginal Workers					
	Cultivators	Agricultural Labourers	Household Workers	Other Workers	Total MarginalWorkers
	w	x	y	z	w+x+y+z
Bherle	1(0.97)	72(69.90)	0(0.0)	30(29.13)	103(100)
Wardoli	1(1.10)	70(76.92)	0(0.0)	20(21.98)	91(100)
Bhingarwadi	31(63.27)	2(4.08)	1(2.04)	15(30.61)	49(100)

Khanavale	4(3.15)	16(12.60)	0(0.0)	107(84.25)	127(100)
Total	37(10.0)	160(43.24)	1(0.27)	172(46.49)	370(100)

Socio –Economic Survey

Objective

The objective of conducting socio economic survey was to obtain the detailed prevailing socio-economic condition of the villagers affected by the project. The survey also captures the awareness, opinion and reaction of the villagers about the proposed project.

Methodology

In the present study, primary data was collected from a sample of 23 villagers residing in the closeby villages (detailed study area) through a well-structured and pre-tested questionnaire. In the survey, issues related to livelihood, basic amenities and post project scenario etc. were discussed with the villagers of the study area.

Table 3.57: Sample size for socio economic survey

Sr. No.	Village	Percentage of Total households	No of Sampled households
1	Bherle	172 (21.9)	6
2	Vardoli	243 (30.9)	8
3	Bhingarwadi	169 (21.5)	5
4	Khanavale	203 (25.8)	2
Total		**211 (100)**	**21**

The interviews conducted through structured questionnaires have derived quantitative data, but has also extended discussion with sample respondents in order to supplement the structured findings of the questionnaires with qualitative information as well. Hence, the data collection exercise has been quantitative as well as qualitative in nature.

During interview, there was simultaneous translation of the questionnaires from English into spoken Marathi for the sample respondents—who gave all responses and remarks in Marathi, which was then translated and recorded into written English on the individual questionnaires. All of the data collected in the field and recorded on the questionnaires was gone over collectively by the social expert. All of the quantifiable data was then transposed into a spreadsheet format, with additional comments and remarks recorded during individual interviews.

Details of the survey

None of the sample respondents was below 30 years showing the maturity of the respondents in giving quality information concerning their stay in the area. Table below depicts the age structure of the respondents.

Table 3.58: Age Structure of Respondents

Age Groups	Frequency	Percentage
20-30	4	19.04
30-40	8	38.08
40-50	6	28.57
50-60	3	14.31
Total	**21**	**100**

Source: Primary Survey

Most of the respondents were male and only about 10% of the respondents were females. A major reason for less participation of females was their non-availability due to their household or agricultural activites.

Family Size

The average household size was found to be 4-5 members. Majority of the sample respondents have been living in the village since birth. New-age ideas of nuclearisation of families has led to formation of smaller family units. These new smaller family units are either nuclear or extended; many of them share the same house premise.

Table 3.59: Family size in the affected villages

Village Name	Sample size	Family Size			
		NA	2	3 to 5	6 to 9
Bherle	6	0	0	2	4
Wardoli	8	0	1	6	1
Bhingarwadi	5	0	0	3	2
Khanavale	2	0	0	2	0
Total	21	0	1	13	7

Source: Primary Survey

Education:

It can be observed that nearly 39 % of the respondents had education upto Secondary School. Many respondents left education mid-way to earn wages. Also, nearly 10 % of the respondents have studied upto Higher Secondary School. There are mid-day meal schemes fully functioning in all schools of the affected villages. Mid-day meal scheme has been very effective in increasing education levels and health of the children in the villages

Table 3.60: Literacy details in the affected villages

Village name	Literacy Details					
	Illiterate	Primary (class 5)	Secondary (6 - 10)	Higher (graduate)	Technical	Vocational
Bherle	11	4	15	1	0	0
Wardoli	2	3	9	2	0	0
Bhingarwadi	3	4	11	5	2	0
Khanavale	2	0	4	2	0	0
Total	18	11	39	10	2	0

A general opinion of the villagers found out during our primary survey was that the villagers cannot afford the cost of education at higher levels. These costs include uniforms, books, transportation and opportunity cost of the wage received as a labourer. Also, girl education is not prominent as a general perception of the villagers is that all females get married at a young age to become homemakers and hence education may become needless.

Economic Structure

Basic Amenities:

In Village Wardoli, 50 % respondents live in Semi-pucca house where roofs are made from Asbestos or are laid with Mangalore tiles.In village Bherle, nearly, 75% of respondents live in Semi-pucca house where roofs are laid with Mangalore tiles , 20% have roofs with straw-thatch and rest have RCC roofs. All respondents in Village Bhingarwadi live in pucca houses with compound walls made out of Reinforced Concrete Cement and bricks. In village Khanavle, 100 % respondents live in Semi-pucca house where roofs are made from Asbestos.

Educational facilities include a primary school in Village Bhingarwadi, Village Bherle, Secondary school in Village Bhingarwadi, Anganwadis in all the affected villages. For higher Secondary school, students have to travel to nearby Village Ajiwale.

Health care facilities are meagre in all the affected villages. Primary health centre is available only in Village Bhingarwadi. Lack of healthcare facilities and availability of doctors in emergency situations is a serious concern.

The respondents that fall in BPL category avail of the food scheme provided by the government. These families avail monthly supply of 25 kg of rice, 5 kg of wheat,2 kg of sugar and 1 lit of cooking oil for food consumption.

Perceptions & Opinions regarding Redevelopment

Questions were asked to respondents to seek their opinions and perceptions regarding the proposed project. Opinions are important vehicle through which one could understand the existing mental attitude of people in general and groups, and community in particular.

All the respondents were aware of the proposed project. This reflects that the project proponent has carried out regular consultation with the villagers. Nearly 90% of the respondents were made aware of the project by the project proponent and the rest were made aware by other villagers. Regular consultation with the community can

help create awareness about the proposed project. It also brings about greater transparency likely to result in greater acceptance of the proposed project and people taking informed decisions.
The respondents who have sold their land to the project proponent have utilized the proceeds to mainly upgrade their homes. Few respondents have invested in business.
These villagers are aware of the pressures of peri-urban development and its impacts on their village. A gradual transition of main occupation from agricultural activities to manufacturing and service-oriented is one of the indicators. The villagers seek employment opportunities in industries near Panvel and other urban areas. Nearly 70% of the respondents would prefer some form of employment in or nearby their villages. The respondents who are head of their households and who secondary school drop-outs would like employment as security guards, helpers, gardeners. Few respondents have shown interest in seeking employment as building contractors or building machinery contractors.
All respondents mention lack of basic infrastructure especially drinking water, sanitation and health services. Lack of proper provision of drinking water, adequate drainage infrastructure cause health problems in the villages. Self-help groups amongst the women folk in villages are effective in spreading awareness about proposed project. Few women have informally shown willingness to work post project construction.
All the respondents are aware that their children need higher education facilities to seek employment in developed area. They hope that the proposed project shall provide educational facilities for future generation.
The school teachers hope that the project shall improve the school infrastructure and aid mid-day meal schemes. Many respondents have shown willingness to be trained in vocations like electrician, automobile mechanic, carpenter, gardener etc.
The respondents have opined that after the proposed project there would be positive impacts such as increased employment opportunities, increased opportunities for business. Very few respondents perceive the project to cause negative impacts.

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

This chapter describes various social and environmental impacts identified and assessed for the construction and operation phases of the proposed Township Project. These impacts have been identified through available project documents; discussions with the local community; the project proponents and BEIPL's previous project experience in handling assignments of a similar nature. This section identifies and assesses the range of potential impacts and extent of their severity on environment, ecology, socio-economic resources, demographics, livelihoods, as well as access and infrastructure issues. Mitigation measures for the identified impacts are also suggested with a management plan for the proposed mitigation measures. Use of energy is considered as an impact. To reduce energy consumption all the building area ensured to follow **Energy Conservation Building Code** along with use of solar energy.

4.1 Pollution sources

Pollutants generated during both the construction and operation phase of the Township project would be solid, liquid and gaseous in nature. The generation of pollution could be continuous, periodic or accidental. Sources of pollutants and their characteristics during the construction and operational phase are given below.

Table 4.1: Pollutant Sources And Characteristics

S.N.	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
Construction Phase				
1.	Ground working and leveling	Air emissions – PM_{10}, $PM_{2.5}$, CO, NO_x, and SO_2	Dust from construction activities and excavation. Particulates, NOx, SOx and CO from vehicle exhaust	Temporary during construction phase only- bulk of the emissions are expected from ground working and leveling activities.
		Earth / solid waste	Solid waste from construction activity and excavation.	Temporary.
		Noise	Noise generated from construction equipment and machinery	Temporary during initial construction phase.
2.	Labour Camps	Sewage	Sewage generated from temporary labour camps on site	Temporary – during the initial construction phase
		Solid Waste	Solid Waste generated from temporary labour camps on site	Temporary – during the initial construction phase
Operation Phase				
1.	Vehicular movement	Air emissions and noise	All exhaust emissions like vehicles, DG etc	Continuous / Periodic
2.	Diesel power generators	Air emissions	SO_2, PM_{10}, $PM_{2.5}$, CO from fuel burning	Occasional
		Noise	Noise due to running of equipment	Occasional
		Hazardous waste	Used Oil Generation	Periodic, during oil changes
3.	Restaurants	Sewage	Wastewater – BOD, Suspended solids, pathogens	Continuous
		Domestic Solid waste	Bio-degradable & non-biodegradable wastes	Continuous
4.	Commercial Areas	Sewage	Domestic wastewater – BOD, S.S, Pathogens	Continuous
		Domestic Solid Wastes	Bio-degradable and non-biodegradable wastes	Continuous
5.	Raw water treatment	Wastewater	Backwash water discharge	Continuous
		Solid waste	Sludge from coagulation process	Continuous

S.N.	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
6.	Sewage treatment Plant	Solid waste	Organic and inorganic sludge	Continuous
		Treated water	Treated sewage used for horticulture	Continuous
7.	Diesel Storage	Solid waste	Settled sludge during tank cleaning	Occasional
		Oil	Oil spillage – Accidental large spills due to pipe rupture Oil Spillage - Small quantities due to small pipe leaks	Accidental / Only due to poor housekeeping
8.	Maintenance / housekeeping	Wastewater	Floor washing	Continuous
		Solid waste	Used equipment parts and garden wastes	Continuous
9.	Air conditioners	Air emission	Ozone Depleting Substance release	Continuous
10.	Vehicle Parking Area	Oil Spills	Minor oil leaks in parking lot	Continuous – small quantities
11.	Storm water drains	Wastewater	Contamination discharge from site – Mainly suspended solids	During rainy season

4.2 Project activities

Following key project activities that are summarized in below table from an impact identification perspective under three distinguishable phases.

Table 4.2: Summary of Key Project Activities

Planning Phase	Construction Phase	Operation Phase
• Regulatory authority approval • Initiate Civil engineering surveys: - Topographical surveys - Geotechnical investigations - Environmental quality monitoring • Surveys and consultations • Project planning phase activities - Infra design (drinking water; wastewater; storm water, rainwater harvesting ,waste management; Transport; Street lights; and others • Environmental Clearance (EC) EAC and Consent to Establish MPCB	• Pre-construction and mobilization phase activities: - Setting up site office, labour camps, onsite concrete batching plant, material testing laboratory, material storage and scrap yards and transport of materials/scraps • Infrastructural: - Drinking water supply; - Waste water conveyance, treatment, reuse and disposal - Storm water drainage; - Rainwater harvesting systems; - Solid waste collection, storage, treatment and disposal systems; - Landscaping and garden; - Roads and road furniture • Construction buildings - Foundation excavation and construction - Superstructure construction - Electrical / Plumbing works - Carpentry & tiling works • Community and Social facilities	- Liability period O&M activities an responsibilities of M/s Wadhwa Construction & Infrastructures Pvt. Ltd (WCIPL) - Building repair and maintenance - Plumbing repairs - Housekeeping - Electrical repairs - Lift O&M - Carpentry related repairs - Associated infrastructure utility/facility O&M - Community infrastructure utility/facility O&M

4.3 Impact evaluation

4.3.1 Impact Criteria and ranking

All project environmental activities/aspects were comprehensively identified for the proposed project construction and operational phase. The level of impact that may result from each of the activity-component interactions are assessed based on subjective criteria in this chapter. Based on standard environmental assessment methodologies, three key elements are considered for this analysis.

Severity of Impact: the degree of damage that may be caused to the environmental components concerned. This will be decided by the standards available for the parameter. To decide severity a scale is essential. This scale is assumed to be percentage value of the parameter with respect to the existing standard. The 0 reading would be considered as 0 % and the standards valued will be considered as 100%. For example SOx standard is 80 mircogram/ m^3. In this case if a project depicts baseline or prediction value as 80 microgram/ m^3 then the value in terms of scale is considered as 100%. If a project depicts baseline or predicted value as 72 mircogram/ m^3 then the value is 90%. Based on this scale three levels of severity are considered which are defined below.

Severity 1 (Low)	The baseline and / or predicted value is less than 90%
Severity 2 (Moderate)	The baseline and / or predicted value is between 90% -110%
Severity 3 (High)	The baseline and / or predicted value is more than 110%

Extent of Impact: the geographical spread of the impact around project location and corridors of activities. Extent of the project impact is based on the impacts extent beyond the project boundary. As per the model TOR for Building and Construction Manual by MoEF (2010) the primary impact zone is 500m from the project boundary. Based on this data the scale of extent of impact is defined as below.

Extent 1 (Low)	Extent of the impact is within the project boundary.
Extent 2 (Moderate)	Extent of impact is within 500m. from the project boundary.
Extent 3 (High)	Extent of impact is beyond 500m from the project boundary.

Duration of Impact: the time for which the impact lasts taking into account the project lifecycle. The duration impact for construction has to be bifurcated in to Construction and Operation Phase especially. For Construction Phase the following criteria are used to decide intensity of the duration.

Cont. Duration 1 (Low)	Impacts those are instantaneous. (e.g. Noise)
Cont. Duration 2 (Moderate)	Impacts those last during the entire construction phase.
Cont. Duration 3 (High)	Impacts those last after the construction phase.

Any impact that is going to happen because of the operation of the project will continue throughout the life of the project. Hence these impacts are categorized based on their likely occurrence or frequency. These are defined in the following manner.

Ope. Duration 1 (Low)	Rare (e.g. D. G. set operation)
Ope. Duration 2 (Moderate)	Periodic
Ope. Duration 3 (High)	Regular (e.g. traffic generated by the project occupants)

A positive or beneficial impact that may result from this project is not ranked and is depicted in the form of ++.

4.3.2 Impact significance

The significance of the impact is adjudged based on a multiplicative factor of the three element rankings mentioned above. The Table below assigns impact significance in the scale of Low-Medium-High and will be used for delineation of preventive actions, if any, and management plans for mitigation of the impacts.

The impact significance is determined taking into account the measures which are factored at the design and planning phase of the project. Legal issues are taken into account in the criteria sets, wherever appropriate, to aid WCIPL in effort to comply with all relevant legislations. Additionally, the results of quantitative impact prediction exercise, wherever undertaken, are also fed into the process.

Table 4.3: Criteria based significance of impact

Severity of Impact (A)	Extent of Impact (B)	Duration of Impact (C)	Impact Significance (A X B X C)	
1	1	1	1	LOW
1	1	2	2	
1	2	1	2	
2	1	1	2	
2	1	2	4	
1	2	2	4	
3	1	2	6	MEDIUM
1	3	2	6	
2	2	2	8	
3	2	2	12	
2	3	2	12	
2	2	3	12	
3	3	2	18	HIGH
3	2	3	18	
2	3	3	18	
3	3	3	27	
- Impact is Beneficial -			++	POSITIVE

To assist in determining and presenting the significance of an impact, an impact evaluation matrix was developed. The significance of the impact is depicted using colour codes for easy understanding. In the case that an environmental component might be impacted by more than one project activity the higher impact significance ranking is taken as the significance ranking for the subject receptor. Impacts that are determined to have high significance ranking of ">12" are considered to be significant and hence require examination in terms of preventive actions and/or required additional mitigation to reduce the level of the potential impact.

4.4 Impact on ambient air quality and mitigation measures

Township projects do not contribute much to degradation of ambient air quality (AAQ) levels during its project life cycle. Maximum air emissions are expected to happen during construction phase of the project. Baseline data and assessment indicates that the predominant wind direction at the site is, North West. Residential receptors are located on the south-eastern side at a distance around 600 m and any fugitive dust generation could potentially affect these sensitive receptors. Baseline ambient air quality measurement undertaken as part of EIA study during March 2015 to May 2015 indicates that air quality levels were well within the commercial zone limits prescribed by current NAAQS standards published in 2009. Respirable suspended particulate matter (PM_{10}) was in the range of 34.9µg/m^3 to 88.8µg/m^3. $PM_{2.5}$ was in the range of 15.8µg/m^3 to 56.7µg/m^3 . SO_2 and NOx were in the range of 6.5µg/m^3 to 25.6µg/m^3 and 20.2µg/m^3 to 50.2 µg/m^3 respectively. Major sources of air pollution near the site vicinity during operational phase would be medium traffic movement through 18 mts wide road to the north of the site and the proposed DP roads and occasional operations of DG sets.
During planning phase, it is necessary to include AAQ as a factor while siting sewage treatment plants, Solid waste segregation centres and Composting yards. The Sewage Treatment Plant is located as per the topography of the site which is the most important factor considering the pumping cost of sewage. To curb odor best management practices will be used.

During construction phase which is critical as far as ambient air quality is concerned, following are the key sources of air emissions:

- Use of fire wood for cooking and burning of garbage in labour camp sites; Indoor air quality issues due to cooking inside shelters in labour camp sites;
- Fugitive dust generation at/due to: vehicular movement on unpaved surfaces; at material handling yards; construction operations such as excavation, loading and unloading of excavated earth material;
- Gaseous emissions from heavy construction equipment, machinery, RMC trucks and vehicular fleet.

Majority of the workers are from around the village and Khopoli town who need not reside on the site. Those few who will stay on the site will be provided with cooking gas. During construction phase, project plans to use minimum number of vehicle fleet as there is no space to move around or park inside the construction areas. Construction machinery and equipment will also be deployed in minimum numbers as construction activity will be taken up in phases. Gaseous emissions from construction equipment and machinery will not significantly alter the AAQ environment in the region.
During operational phase, foul smell emanating from STP, Solid waste segregation centers, composting yards could be potential sources for local air quality deterioration. However, measures would be taken to reduce odor pollution by maintaining green buffer around the Township. Summary of Anticipated Impacts on AAQ are given below.

Table 4.4: Anticipated Impacts on AAQ

Impacts to consider during Planning Phase	Impacts during Construction Phase	Impacts Operational Phase
Locating STP, Solid waste segregation centers, Composting yards	Fugitive dust along access roads, construction sites	Foul smell from STP, Solid waste segregation centres, composting yards
	Gaseous emission from vehicles, machinery and equipment that use fossil fuel	Indoor air quality issues in individual residential units
	Indoor air quality, garbage burning and fire wood use are critical AAQ issues	

4.4.1 Predicted Air Emissions from the Site

For the purpose of air dispersion modeling traffic and DG set emissions are considered for both construction and operatione phases on the proposed site.

Construction Phase Impacts

The emission types and the quantification of emissions for the project are shown in the Table 4..5 below

Source Type	Particulars	Determinants of Emissions	Emission Factors	Emission Factors	Emissions kg/Day	Emissions gm/s/sqmt for area sources and gm/s for point sources
DG Set (point source)	4 DG sets above 500KVA capacity	Maximum 24 hours of operation/week	PM_{10} - 0.0009kg/Hp/Hr	0.0005kg /kw-hr	0.002	0.000163399
			SO_2 - 0.00125 kg/Hp/Hr	0.0048kg /kw-hr	0.0192	0.000222222
			NOx - 0.01888 kg/Hp/Hr	0.007kg/ kw-hr	0.028	0.000324074
			CO - 0.00406kg/Hp/Hr	0.003kg/ kw-hr	0.012	0.000138889
Stationary Construction Equipments (spread into area sources)	20JCB FOR 8HRS	@150Hp	PM_{10} - 0.00032kg/Hp		28.16	1.84E-06
		@250Hp	SO_2 - 0.036kg/Hp		3168.04	0.00020705
	10 Poclain - Fugitive FR 8HRS		NOx - 0.00585kg/Hp		514.81	3.36E-05
			CO - 0.0025kg/Hp		220	1.44E-05
Material Carrying	100 trucks @ 50 trips	25,000kms/ day	PM_{10} - 1.24gm/km		31	4.30E-06
			SO_2 - 25.4gm/km		635	8.82E-05

vehicles(Line source)	each of 5kms		NOx - 0.49gm/km CO - 0.30gm/km		12.25 7.5	1.70E-06 1.04E-06
Transit vehicles	10 buses @ 50kms/day each	500km/day for buses	PM_{10} - 1.24gm/km (15yr) SO_2 - 2.5gm/km (15yr) NOx - 13.84gm/km (15yr) CO - 19.3gm/km (15yr)		0.62 1.25 6.92 9.65	8.61E-08 1.74E-07 9.61E-07 1.34E-06
	20 - 4 wheelers @ 50km each	4000kms of 4 wheelers @30% petrol & 70% diesel vehicles	Petrol g/km PM_{10} - 0.0195 NOx - 0.645 CO - 4.825	Diesel g/km PM_{10} - 0.06 NOx - 0.49 CO - 0.30	6.63	9.21E-07
Construction emissions	Area source – Fugitive	Approx. 135 acres/9 months	0.11T/Acre Month (ARB)		355.31	1.67E-05
Hot Mix Plant	Area source / Fugitive Included	300MT/Day	PM_{10} - 2.25kg/T (AP42) SO_2 - 0.044kg/T NOx - 0.06kg/T CO - 0.2kg/T		607.5 13.2 18 60	1.32E-05 2.88E-07 3.92E-07 1.31E-06
Stone crushers	Area source / Fugitive Included	400MT/day 400MT/day 75MT/day 200T/Hr	0.000167kg/T (ARB)		0.94	2.05E-08
Resuspended Dust	Area/Line Source – Fugitive Nature	VKT and silt loadings	PM_{10} – 0.9165gm/VKT (AP-42 Modified with local SL values)		27.04	5.89E-07

Significance of Impact

Using the scale mentioned in section 4.2.2 the significance of the impact is as mentioned below.

Severity of Impact	1	Extent of Impact	2	Duration of Impact	2
Impact Significance = 4 i.e. Low					

Emission from Material and Debris Stockpile

Fugitive emission from site preparatory activities viz. cut and fill operation and material stockpiles movement may lead to an increase in $PM_{10}$and $PM_{2.5}$ level in ambient air above the NAAQS specified for particulate matter. The generation and dispersion of fugitive dust from material and debris stockpiles will depend upon the prevailing wind conditions and is likely to get aggravated during months (April to June) recording normal average wind speed.

The debris are not likely to be taken away from the site as the site is heavily contoured and most of the construction debris generated will be used in filling and leveling. None of the village structures are located near the blacktop of the road and does not show ribbon development along the road. Thus, fugitive dust emission in carrying debris will be very less. The material carrying may have impact throughout the road length and construction period.

Significance of Impact

Severity of Impact	2	Extent of Impact	3	Duration of Impact	2
Impact Significance = 12 i.e. Medium					

The maximum impact on AAQ levels will occur during construction phase of the project life cycle and is anticipated to be minor adverse. Else, during operational phase, depending upon the location of STP and AAQ levels will not be impacted significantly by the project.

Mitigation Measures

To mitigate the impact of PM_{10}& $PM_{2.5}$ as discussed earlier during the construction phase of the proposed project, the following measures are recommended for implementation:

- A dust control plan;
- Use of Ready Mix Concrete, and
- Procedural changes to construction activities.

Dust Control Plan

Table 4.6 provides a dust control plan, specific to construction activities.

Table 4.6: Dust Control Plan

Fugitive Dust Source Category	Dust Control Actions	Cost Distribution
Earth-moving	**1a.** For any earth moving which is more than 30m from all property lines, conduit watering as necessary to prevent visible dust emissions from exceeding 100m in length in any direction.	1a. Associated pumping costs.
Disturbed surface areas (except completed grading areas)	**2a.** Apply dust suppression in a sufficient quantity5 liters/Sq.mt.two times in a day i.e. during entry of trucks to maintain a stabilized surface; **2b**. Areas, which cannot be stabilized, as evidenced by wind driven dust, must have an application of water at least twice per day for at least 80 percent of the unstabilized area .	2b. Associated pumping costs.
Disturbed surface areas (completed grading areas)	**2c**. Apply water to at least 80 percent of all inactive accessible disturbed surface areas on a daily basis when there is evidence of wind driven fugitive dust.	2c. Associated pumping costs.
Inactive disturbed surface areas	**3a**. Apply dust suppressants in 5 liters/Sq.mt. two times in a day to maintain a stabilized surface; OR **3b.** Utilize any combination of control actions 2c, 2d, or 3a such that, in total, they apply to all inactive disturbed surface areas.	3b. n/a
Unpaved roads	**4a**. Water all roads used for any vehicular traffic at least twice per day of active operations; approximately 91 KLD of water requirement for dust suppression at rate of 5 liters/sq.mt is OR **4b**. Water all roads used for any vehicular traffic once daily and restrict vehicle speed to 15 kmph.	4a. Associated pumping costs. 4b. Associated sprinkling costs
Open storage piles	**5a**. Apply water to at least 80 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust; OR	5a. Associated pumping costs. 5b. Enclosure costs

Fugitive Dust Source Category	Dust Control Actions	Cost Distribution
	5b. Install a three-sided enclosure with walls with no more than 50 percent porosity that extends, at a minimum, to the top of the pile.	
Track-out control	**6a**. Downwash of trucks (especially tyres) prior to departure from site.	6a. Associated pumping costs.

The most cost-effective dust suppressant is water, recycled water from existing Sewage Treatment Plant is available on the construction site. Water can be applied using water trucks, handheld sprays and automatic sprinkler systems. Furthermore, incoming loads could be covered to avoid loss of material in transport, especially if material is transported off-site.

Procedural Changes to Construction Activities

Material Production - The transport of materials such as concrete and asphalt to construction sites generate significant amounts of road dust, especially for sites that are relatively far from material manufacturers. Setting up temporary portable concrete plants and/or asphalt plants at construction sites can eliminate haulage of materials.
Idling Time Reduction - Construction equipment is commonly left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Existing idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention from the operators.
Improved Maintenance - Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors will be asked to provide maintenance records for their fleet as part of the contract bid and at regular intervals throughout the life of the contract. A monetary incentive/disincentive provision will be established to encourage contractors to comply with regular maintenance requirements.
Reduction of On-site Construction Time - Rapid on-site construction would reduce the duration of traffic interference and therefore, reduce emissions from traffic delay. Off-site fabrication of structural components can also enhance the quality of work, as the production takes place in controlled settings and external factors such as weather and traffic do not interfere.

Operation Phase Impacts on Ambient Air Quality

During operation phase the major source of pollution shall be the vehicular movement along with DG set emissions and re suspended dust. The emission inventory is as shown below.

Table 4.7: Table showing the emission inventory during operation phase

Source Type	Particulars	Determinants of Emissions	Emission Factors	Emissions kg/Day	Emissions kg/Day
DG Set	7 DG sets above 100KVA capacity	Maximum 24 hrs of ops/week	PM_{10} - 0.0009kg/Hp/Hr	946.24	946.24
			SO_2 - 0.00125 kg/Hp/Hr	1,314.23	1,314.23
			NOx - 0.01888 kg/Hp/Hr	19,765.96	19,765.96
			CO - 0.00406kg/Hp/Hr	4,268.61	4,268.61
Vehicles (2025)	Proposed 1925 + 3691 cumulative growth from DP Road & access road	VKT of 5700351/day	PM_{10} - Table 4.9	16,971.46	16,971.46
			NOx - Table 4.10	3,19,694.85	3,19,694.85
			CO - Table 4.11	13,00,057.78	13,00,057.78
Re-suspended Dust (2025)	Proposed 1925 + 3691 cumulative growth from DP Road and existing access road	VKT of 6,22,094/day	PM_{10} – 0.9165gm/VKT (AP-42 Modified with local SL values) based on ADT classes	53,393.00	53,393.00

Results and Discussion:

The emission output of the sources considered for both construction and operation sources are shown accompanying table. The impact areas considered during the simulation are the Monitoring locations for which the

baseline data has been collected for SOx, NOx, PM10 and CO. The latitudinal and longitudinal placement of the monitoring locations are given as below.

Table 4.8: Table showing location of the receptors to identify the GLC for present and future scenarios

 **AQ-1 (**South west of Projec; Lat - 18°58'27.92"N, Long - 73°11'59.02"E)	 **AQ-3 (**South of project; Lat. - 18°56'33.81"N; Long. - 73°10'59.64"E)
 **AQ-2 (**Within project; Lat.- 18°57'35.58"N; Long.- 73°11'34.34"E)	 **AQ – 4 (**Lat - 18°57'31.15"N; Long - 73°10'56.94"E Cross wind West Bhingar)
 **AQ – 5 (**Lat - 18°58'14.11"N; Long - 73°11'23.24"E, Cross wind towards north West of Vardoli)	 **AQ -6 (**Lat - 18°57'20.63"N; Long - 73°12'12.10"E, Cross wind towards South East near Mohope)

AQ-7 (Lat - 18°56'36.02"N; Long - 73°11'25.25"E, Towards South west of the project)

AQ-8 (Lat - 18°59'3.56"N; Long - 73°11'59.58"E, Upwind near some farmers dwellings)

AQ-9 (Lat - 18°56'10.96"N; Long - 73°10'55.92"E, Near Khanavale Village)

Meteorology, rainfall, temperature, humidity, cloudiness and winds (including Windrose diagrams for March, April and May 2014) have been discussed in Chapter 3 at (3.7)

Impact Assessment

The results of the air modeling simulation is shown in Tables herewith. The NAAQS standards for PM10, NOx, CO and SOx, are 60.0µg/m3, 80.0µg/m3, 2000.0µg/m3, and 80.0µg/m3 respectively for 24 hours. The modeling results in tables below can be assessed as below:

In Year 2016

PM10:- The PM10 levels for the project during 2016 are the highest for Bhinganwadi village which is 81.95µg/m3, and lowest for village at the point A8 which is 39.75µg/m3. The higher levels of PM10 at A1 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are being exceeded

NOx:- The NOx levels for the year 2016 are maximum at receptor A1 which are 44.2 µg/m3. The annual emission benchmark as per NAAQS is 40 µg/m3. The lowest levels of NOx emissions over the annual period is 18.47 µg/m3 which are at Receptor 8.
CO: - The 8 hourly CO levels as per NAAQS standards is 2000µg/m3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 896.46 µg/m3 while the lowest is at 82.93 which is at Khanawale Village
SOx:- The annual emission levels of SOx as per NAAQS is 50µg/m3. The Maximum level detected is 79.54 µg/m3 which is at the project site while the minimum level is at Khanawale village which is 9.28 µg/m3.

In Year 2025
PM10:- The PM10 levels for the project during 2016 are the highest for Bhinganwadi village which is 81.95µg/m3, and lowest for village at the point A8 which is 39.75µg/m3. The higher levels of PM10 at A1 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are being exceeded
NOx:-The NOx levels for the year 2016 are maximum at receptor A1 which are 44.2 µg/m3. The annual emission benchmark as per NAAQS is 40 µg/m3. The lowest levels of NOx emissions over the annual period is 18.47 µg/m3 which are at Receptor 8.
CO: - The 8 hourly CO levels as per NAAQS standards is 2000µg/m3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 896.46 µg/m3 while the lowest is at 82.93 which is at Khanawale Village.
SOx:-The annual emission levels of SOx as per NAAQS is 50µg/m3. The Maximum level detected is 79.54 µg/m3 which is at the project site while the minimum level is at Khanawale village which is 9.28 µg/m3.

In Year 2035
PM10:- The PM10 levels for the project during 2016 are the highest for Bhinganwadi village which is 81.95µg/m3, and lowest for village at the point A8 which is 39.75µg/m3. The higher levels of PM10 at A1 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are being exceeded
NOx:- The NOx levels for the year 2016 are maximum at receptor A1 which are 44.2 µg/m3. The annual emission benchmark as per NAAQS is 40 µg/m3. The lowest levels of NOx emissions over the annual period is 18.47 µg/m3 which are at Receptor 8.
CO: - The 8 hourly CO levels as per NAAQS standards is 2000µg/m3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 896.46 µg/m3 while the lowest is at 82.93 which is at Khanawale Village.
SOx:-The annual emission levels of SOx as per NAAQS is 50µg/m3. The Maximum level detected is 79.54 µg/m3 which is at the project site while the minimum level is at Khanawale village which is 9.28 µg/m3.

In Year 2040
PM10:- The PM10 levels for the project during 2016 are the highest for Bhinganwadi village which is 81.95µg/m3, and lowest for village at the point A8 which is 39.75µg/m3. The higher levels of PM10 at A1 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are being exceeded
NOx:-The NOx levels for the year 2016 are maximum at receptor A1 which are 44.2 µg/m3. The annual emission benchmark as per NAAQS is 40 µg/m3. The lowest levels of NOx emissions over the annual period is 18.47 µg/m3 which are at Receptor 8.
CO: - The 8 hourly CO levels as per NAAQS standards is 2000µg/m3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 896.46 µg/m3 while the lowest is at 82.93 which is at Khanawale Village.
SOx:-The annual emission levels of SOx as per NAAQS is 50µg/m3. The Maximum level detected is 79.54 µg/m3 which is at the project site while the minimum level is at Khanawale village which is 9.28 µg/m3.

Table 4.9: PM10 emissions for 2016 to 2040

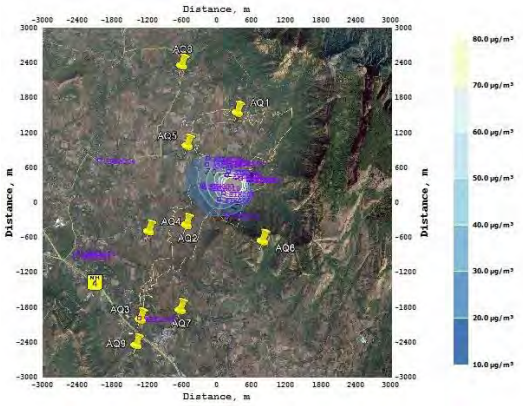
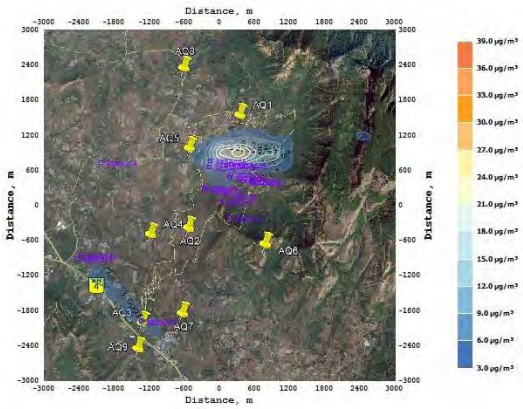
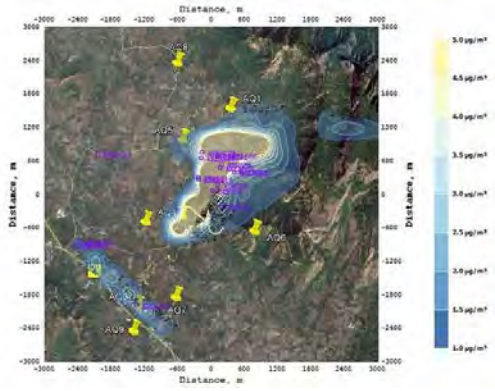
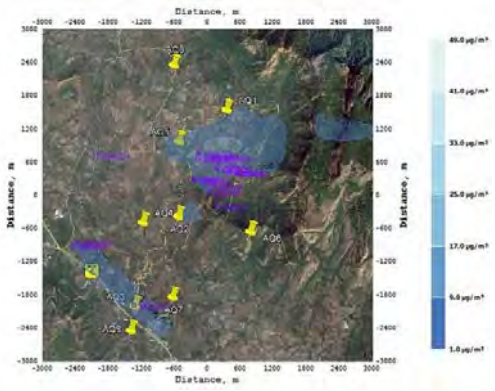
2016	2025
	
2035	**2040**
	

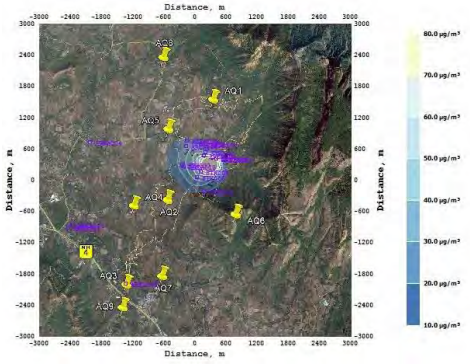
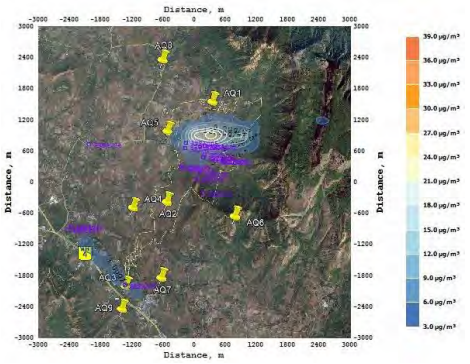
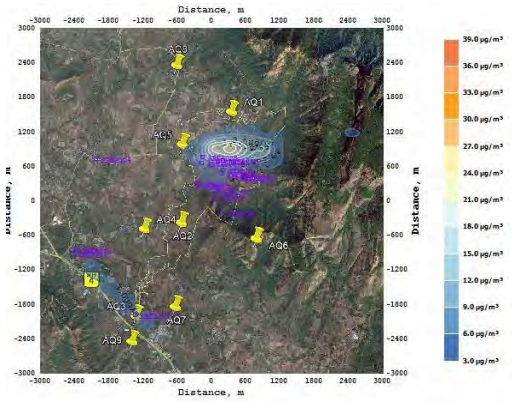
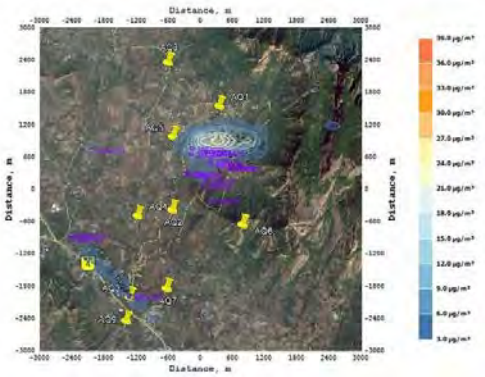
Table 4.10: NOX for 2016 to 2040	
2016	**2025**
	
2035	**2040**
	

Table 4.11: CO for 2016 to 2040

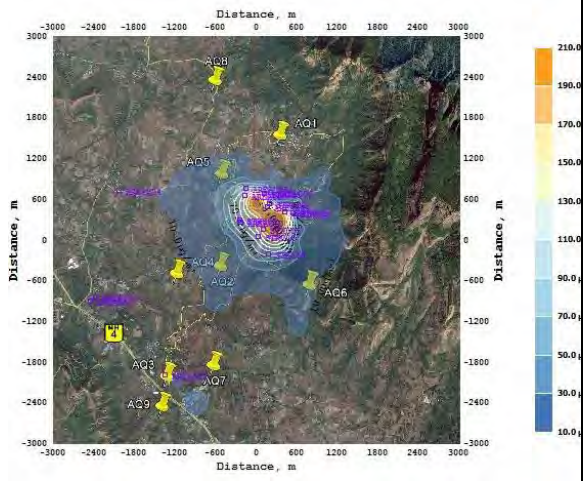
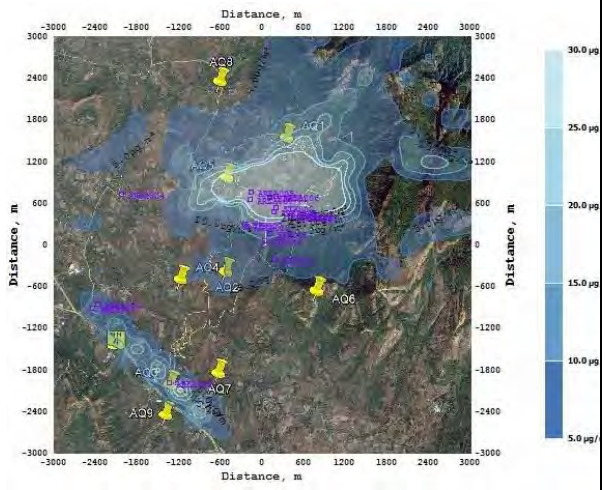
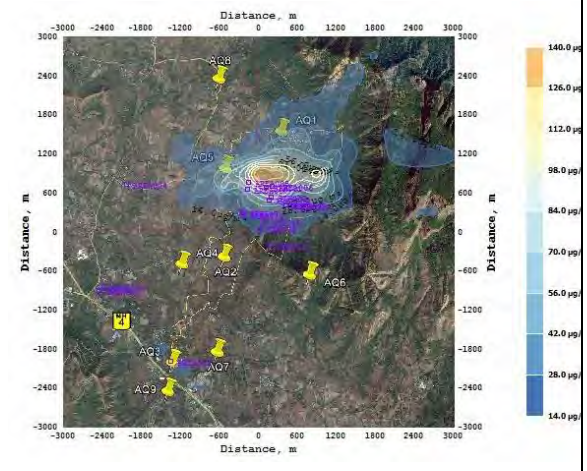
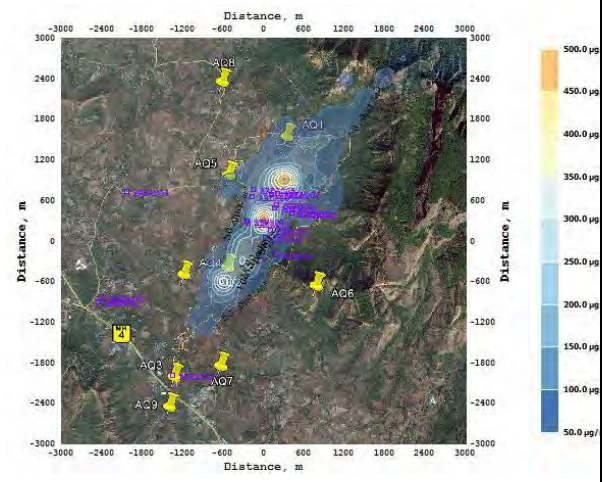
2016	2025
	
2035	**2040**
	

Table 4.8: Emission Results as per air modelling

	2016				2025			2035				2040	
R	PM10 µg/m^3	NOx µg/m^3	CO µg/m^3	SOx µg/m^3	PM10 µg/m^3	NOx µg/m^3	CO µg/m^3	PM10 µg/m^3	NOx µg/m^3	CO µg/m^3	PM10 µg/m^3	NOx µg/m^3	CO µg/m^3
1	81.95	44.2	896.46	27.72	80.06	47.27	918.5	81.74	47.28	983.22	81.79	47.32	933.76
2	89.93	43.11	873.82	79.54	79.7	41.04	864.7	84.29	41.24	1100.43	80.03	41.45	868.79
3	75.81	40.49	753.51	20.79	73.63	42.59	759.55	73.67	42.59	778.89	73.64	42.6	757.43
4	44.06	19.85	86.51	16.65	39.73	19.09	84.92	40.11	19.11	107.89	39.82	19.14	87.68
5	59.66	23.85	116.06	19.96	39.78	20.76	116.31	40.92	20.78	137.66	40.83	20.97	136.14
6	46.49	19.09	94.39	15.44	39.92	18.58	83.33	40.41	18.59	103.08	40.01	18.62	85.29
7	71.69	39.98	684.08	21.33	70.12	40.36	682.08	70.16	40.36	698.12	70.13	40.37	682.51
8	39.75	18.47	84.13	10.02	38.13	18.63	84.65	38.27	18.63	94.76	38.24	18.65	87.2
9	42.04	19.27	82.93	9.28	39.52	18.94	82.34	39.53	18.94	84.7	39.52	18.95	81.91

R= Receptor

In Year 2016

1) **PM10:-** The PM10 levels for the project during 2016 are the highest for Bhingar village which is 81.95µg/m3, and lowest for village at the point R8 which is 39.75µg/m3. The higher levels of PM10 at R1 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are not being exceeded
2) **NOx**:-The NOx levels for the year 2016 are maximum at receptor R1 which are 44.2 µg/m3. The 24 hourly emission benchmark as per NAAQS is 80µg/m3. The lowest levels of NOx emissions over the 24 hourly period is 18.47 µg/m3 which are at Receptor 8.
3) **CO: -** The 8 hourly CO levels as per NAAQS standards is 2000µg/m^3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 896.46 µg/m3 while the lowest is at 82.93 which is at Khanawale Village
4) **SOx:-**The 24 hourly emission levels of SOx as per NAAQS is 50µg/m^3. The Maximum level detected is 79.54 µg/m^3 which is at the project site while the minimum level is at Khanawale village which is 9.28 µg/m^3.

In Year 2025

1)PM10:- The PM10 levels for the project during 2016 are the highest for Bhingar village which is 80.06µg/m3, and lowest for village at the point R8 which is crosswind having a value of 38.13µg/m3. The higher levels of PM10 at R1 is because the high levels of fugitive dust generated during the construction phase. Even though the emission levels are below the standards as prescribed by NAAQS which is 100 µg/m3, to reduce the high levels of fugitive dust emissions, dust suppression measures would be employed such as Wheel washing, water sprinkling etc.

2)NOx:-The NOx levels for the year 2016 are maximum at receptor R1 which are 47.27 µg/m3. The annual emission benchmark as per NAAQS is 40 µg/m3. The lowest levels of NOx emissions over the annual period is 18.58 µg/m3 which are at R6 which is towards the east near Mohope village.

3) **CO: -** The 8 hourly CO levels as per NAAQS standards is 2000µg/m^3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 918.5 µg/m3 while the lowest is at 82.34 µg/m3 which is at Khanawale Village.
4) **SOx :-** As the project is envisaged to be in operation phase during period of 2025, and the source of emissions would be just the DG sets. The operation of DG sets solely depends on the power outages within the project. Considering the present power generation situation in the country and the fact that a new Smart City of NAINA would be alteast largely developed by then, DG sets on the site have not been considered as source of emission during operation phase of the project.

In Year 2035

1) **PM10:-** The PM10 levels for the project during 2016 are the highest for R2 which is 84.29µg/m3, and lowest for village at the point R8 which is 38.27µg/m3. The higher levels of PM10 at R2 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are being exceeded
2) **NOx**:-The NOx levels for the year 2016 are maximum at receptor A1 which are 44.2 µg/m3. The annual emission benchmark as per NAAQS is 40 µg/m3. The lowest levels of NOx emissions over the annual period is 18.47 µg/m3 which are at Receptor 8.

3) **CO: -** The 8 hourly CO levels as per NAAQS standards is 2000µg/m^3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 896.46 µg/m3 while the lowest is at 82.93 which is at Khanawale Village.

In Year 2040

1) **PM10:-** The PM10 levels for the project during 2016 are the highest for Bhinganwadi village(A1) which is 81.79µg/m3, and lowest for village at the point R8 which is 38.24µg/m3. The higher levels of PM10 at A1 is because the high levels of fugitive dust generated during the construction phase. It should be noticed that the NAAQS levels are not being exceeded
2) **NOx**:-The NOx levels for the year 2016 are maximum at receptor R1 which are 47.32µg/m3. The 24 hourly emission benchmark as per NAAQS is 80 µg/m3. The lowest levels of NOx emissions over the 24 hourly period is 18.62 µg/m3 which are at R6.
3) **CO: -** The 8 hourly CO levels as per NAAQS standards is 2000µg/m^3 which is not surpassed at any of the receptor locations. The maximum CO levels are at receptor R1 which are 933.76 µg/m3 while the lowest is at 18.62µg/m3 which is at Mohape Village.

4.5 Impact on water resources & quality and mitigation measures

Potential impacts on water environment by the Township development are primarily related to water consumption and disposal of wastewater. This section provides assessment of:
-Water requirement for the proposed project
-Quantity and characteristic of wastewater generated from the proposed group housing.
-Surface water Runoff

5.5.1 Construction Phase Impacts

The hydrogeological study in and around the Township area highlight the following probable impacts due the proposed project. The effects and their respective remedies are discussed below:

- The project shall involve some cut and fill activity, which will involve top soil removal.
- The construction of of roads shall involve some cutting and filling.
- There may be surface and groundwater contamination due to vehicular traffic in the site.
- The development of the plot will result in changes which thereby result in increased surface run off.
- The proposed activity shall draw lot of people. The influx of people will result in sewage discharge to contaminate surface and groundwater.

Slope Stabilization

The soils of the district are formed from the Deccan trap. The study area is covered with a thin soil cover. The soil at moderately elevated portions is coarse grained and reddish to brownish red in colour showing less time for soil development and frequent washing during monsoon. The soil thickness is very less, observed up to depth of 0.5 to 1 m below ground level (bgl). Hence, the weathering column also is shallow and many rock exposures are observed in the project area.

Construction & Development of site

Development of the proposed site could lead to stockpiling and excavation activity on site, thereby causing erosion of base soil. The runoff from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season.

Significance of Impact

Severity of Impact	1	Extent of Impact	1	Duration of Impact	2
Impact Significance = 2 i.e. Low					

Construction of Roads & Parking Areas

The impact from the road construction depends on both the construction practices and the type of material used. Construction waste of electrical installation, DG sets, painting and flooring is likely to create significant impact. This type of waste would be stock piled and disposed properly.

Significance of Impact

Severity of Impact	1	Extent of Impact	3	Duration of Impact	2

Impact Significance = 6 i.e. Medium

Labor Facilties
During construction phase, wastewater shall be generated from labour colony. Wastewater generated would contain high concentration of BOD, nitrate and E. Coli. Significant water quality impact will occur, if the sewage is disposed without any prior treatment. The management strives to employ local population from nearby villages to the maximum extent possible; hence impact from labour colony is not anticipated to be high. The site already has facility of sewer line and working Sewage Treatment Plant which would be used by the construction labours.
Significance of Impact

Severity of Impact	1	Extent of Impact	1	Duration of Impact	2
Impact Significance = 2 i.e. Low					

Mitigation Measures
To prevent degradation and maintain the quality of the water source, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water into any water body. Following management measures are suggested to protect the water quality during the construction phase.

- Avoid excavation during monsoon season
- Check dams shall be provided to prevent construction runoff from the site to the surrounding water bodies;
- Any area with loose debris within the site shall be planted;
- To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area should be kept effectively impervious. Any wash off from the oil/grease handling area shall be drained through impervious drains. Clarifiers or oil/water separators shall be constructed and effluent should be treated appropriately before releasing it;
- Construction activities generate disturbed soil, concrete fines, fertilizer, oils and other wastes. On-site collection and settling of storm water, prohibition of equipment wash downs, and prevention of soil loss and toxic releases from the construction site are necessary to minimize water pollution;
- All stacking and loading areas should be provided with proper garland drains equipped with baffles to prevent run off from the site to enter any water body.
- The contractor will take all precautions to minimize the wastage of water in the construction process.

5.5.2 Operation Phase Impacts
Discharge of surface run-off
The rainwater harvesting will be at the Township project in the form of Surface Water reservoir created by arresting the runoff. Recharge pits will be provided.

Water Demand
Water demand during the operational phases is estimated on the basis of various activities proposed as per project master plan and associated consumption pattern. Details of the water requirement and sources are given in Chapter 3, under Water Requirements.

Water Balance
Water balance for the site has been calculated from the water requirement for the site and the reclaimed wastewater that would be used on site. Water Balance for Monsoon and Non-monsoon season are depicted below. Wastewater reclaimed after treatment would be used for on-site flushing, makeup water for HVAC. There will be zero discharged of treated water from Sewage Treatment Plant as all the treated water will be utilized onsite. The Water balance chart are given and discussed in Chapter 3, under Water Requirements .. RWTP has been proposed to
It is observed that the water consumption for landscaping will be reduced after specific period. As the saplings will grow into trees and trees will require less quantity of water as compared to saplings. But it is assumed that green area like lawn will require water till the project exists.

Mitigation Measures

Sustainable surface water extraction plan be evolved considering the water demand of the project in its operation phase. Water conservation and development measures need to be taken including all possible potential for reuse and recycling of water. These could be in the form of the following:
-Rainwater Harvesting and water source development
-Minimizing water consumption
-Promoting reuse of water after treatment and development of closed loop systems for different water streams.

Minimizing Water Consumption
Water consumption will be minimized by combination of water saving devices and other domestic water conservation measures. Furthermore, to ensure ongoing water conservation, an awareness programme will be introduced for the residents. Following section discusses the specific measures, which shall be implemented:

Impact on Water Quality
The wastewater generation during construction and operation phase is described below:

Construction Phase Impacts
As mentioned earlier wastewater stream generated by construction labour would be negligible.

Mitigation Measures for construction phase
Operation Phase Impacts
During this phase, 100% of the water supplied for flushing and 85% for domestic use would be discharged as waste water. (Source: Manual on sewerage & sewage treatment, GoI).
Mitigation Measures

Table4.9: Expected Wastewater Characteristics And Pollution Load

S.N.	Parameter	Per Capita Contributing/day	Concentration in wastewater mg/l
1	pH		7.15-7.65
2	Total Solids	200	500-800
3	Oil & Grease	15	107.8
4	Suspended solids	100	150-250
5	Biochemical Oxygen Demand (BOD_3 days @ 27^0 C)	50	200-250
6	Chemical Oxygen Demand	100	250-350
7	Phosphates	1	8.5
7	Nitrates	Absent	1-3
8	Alkalinity	20-30	125-200

Source: Manual on Sewerage and Sewage Treatment, Govt. of India

The reuse / recycle of water are vital for the sustainability of any developmental activity. The project proponent, being an enlightened group also desires to maximize the reuse / recycle of this natural resource. The project will use Sewage Treatment Plant of MBBR and MBBR technology and will ensure the minimum desired quality of wastewater which given below.

Table 4.10: Discharge Norms for Wastewater

Parameters	Expected waste water Characteristics (mg/l)	Discharge Norms (CPCB) (mg/l)		Reclaimed Water Quality
		Inland Surface water body	On land for irrigation	
pH	7.15-7.65	5.5 to 9.0	5.5 to 9.0	6 to 8.5
Biochemical Oxygen Demand (BOD_3 at 27°C) mg/l	200-250	30	100	< 20

Parameters	Expected waste water Characteristics (mg/l)	Discharge Norms (CPCB) (mg/l)		Reclaimed Water Quality
		Inland Surface water body	On land for irrigation	
Chemical Oxygen Demand (COD) mg/l	250-350	250	-	< 60
Suspended Solids	150-250	100	200	<10
Total Kjeldal Nitrogen as N	1-3	100	-	Below 10
Total Phosphates as P	8.5	5	-	Below 0.2
Oil and Grease	107.8	1	1	< 2
Pathogens and nematode cysts		-	-	Absent
Odour		-	-	Odour less

Source: Manual on Sewerage and Sewage Treatment, Govt. of India

➢ **Promoting Reuse of Water after Treatment and Development of Closed Loop Systems**

To promote reuse and development of closed loop system for water, segregation of two schemes namely (i) Wastewater Treatment scheme; and (ii) Storm Water Management scheme have been suggested.

➢ **Wastewater Treatment Scheme**

Sanitation infrastructure shall comprise of following:

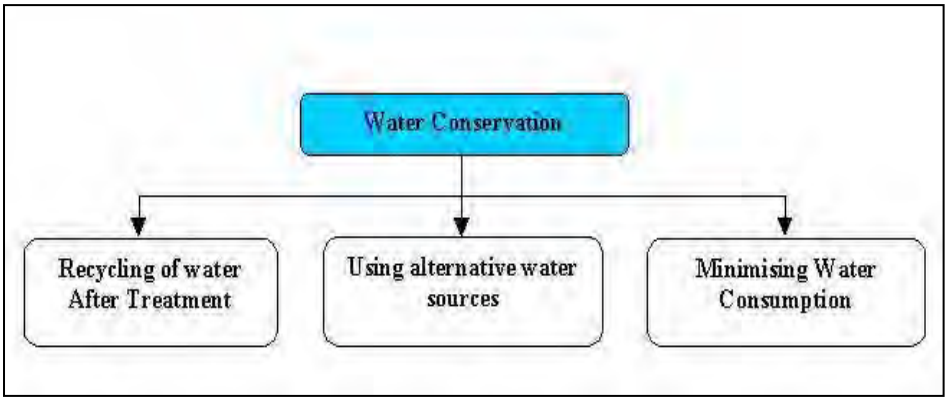
- Wastewater collection and conveyance system
- Wastewater treatment and disposal arrangement

Wastewater collection and conveyance system shall be an underground drainage network that will be designed to collect wastewater from each and every point and convey it to one point for treatment.

Proposed development will have sewage treatment plants based on MBR Technology for treatment of the waste water generated from the different activities proposed. Treated effluent will be used for flushing, landscaping and car washing.

Water Conservation and Development

The water conservation plan consists of a combination of three major steps depicted below:



Water Conservation Plan

Water conservation shall be practiced to the extent possible by use of reclaimed water for non potable application like gardening and flushing.

➢ **Water Quality and Drainage**

- The Contractor shall adopt good construction management practices that will reduce the risks of accidental discharge of pollutants into natural drainage or contamination of groundwater. Such practices incorporated in this the CMP.
- Oils will be handled and stored on designated spaces and concrete surfaces such as the truck stand so that no oil will be disposed to surface water or foul drains.
- Drainage during the construction phase will use the permanent drainage system where possible.
- The Contractor is required to give consideration to minimization of water use during the construction phase.
- Garland drains/dykes shall be constructed all around site in order to prevent dispersion on rainwater in all directions.
- Ponding will be carried out on slabs so as to reduce water for curing.
- When ponding is not feasible, gunny bags will be placed on slabs to aid as moisture retainers thereby reducing water demand.
- Rainwater collected in sedimentation pits and in other strategic areas will be reused for construction purposes.
- Admixtures like fly ash will be used in the concrete, which reduces drying shrinkage and permeability and lowers heat of hydration, which help conserve moisture.
- The Contractor shall follow the Environment Management Plan

4.6 Impact on topography and mitigation measures

The principal land transformation may occur on account of the proposed construction of the facilities through cut and fill earthworks. The cut and fill works normally change the natural topography of the land which may possibly result in disruption of the natural drainage of the land and the immediate surrounding vicinity. The impact will not be very significant as it is localized and temporarily restricted to construction phase.

Siginificance of Impact

Severity of Impact	1	Extent of Impact	1	Duration of Impact	2
Impact Significance = 2 i.e. Low					

Mitigation:

In the proposed plan it has been proposed to minimize the topographical changes through design interventions, construction techniques, vegetation, arboriculture and landscape planning during and post construction period.

Impact during the construction Phase

During construction phase of the project, typical impacts associated with twonship projects include the following:

- Abandoned sites and facilities that are created during construction phase (such as site office, labour camps, onsite concrete batching plant, material storage and scrap yards, onsite material testing laboratory, transit tenements etc.) could lead to misuse and encroachment;
- Ancillary sites and facilities that inadvertently develop around construction sites and facilities stays put during post construction phase leading to an adverse impact on land use.
- Water stream is flowing through the site and the drainage pattern will not get altered. The water stream will be retained and maintained. Further very limited developments have been planned along the water stream as explained in ‘Development Concept’ in Chapter 3.
- The labour facilties will be constructed on the flat terrain near residential areas

However, considering the project setting, construction phase proposals and the site management plans, none of the possible adverse impacts listed above is anticipated. All the sites and facilities that are created during construction phase (such as site office, labour camps, onsite concrete batching plant, material storage and scrap yards, onsite material testing laboratory, etc.) will be located within the proposed development area and reused.

Significance of Impact

Severity of Impact	1	Extent of Impact	1	Duration of Impact	2
Impact Significance = 2 i.e. Low					

During project operational phase, the level of repair and maintenance sustained through project life cycle will determine the sustenance of positive change in land use and land value.

Social Impact of Land use change

Land prices will raise as a result of the development of the project, which will lead to better standard of living of people living in nearby villages. Development of infrastructure such as road network, schools, health care units etc. will be beneficial to people living in nearby villages as well. Farmers from the nearby villages will get higher value for their products. Overall having a positive impact on the social and economic life of people of nearby villages.

Connectivity of the nearby villages will also improve in the medium term. In the long term, development of NAINA City will add to the infrastructure and connectivity of the nearby villages.

Significance of Impact

Severity of Impact	1	Extent of Impact	2	Duration of Impact	2
Impact Significance = 4 i.e. Low					

4.7 Impact on soil resources and mitigation measures

Construction Phase

During construction phase activities such as excavation will take place. This may lead to soil erosion causing loss of top productive layer of the soil. However, such impacts will be primarily confined to the project site during initial construction period. Also, waste generated from construction activity includes construction debris; waste from the Labour camp, etc. This may lead to soil contamination causing loss of top productive layer of the soil. To avoid the impacts on the land appropriate measures should be adopted for storage and disposal of solid waste

Significance of Impact

Severity of Impact	1	Extent of Impact	2	Duration of Impact	2
Impact Significance = 4 i.e. Low					

Mitigation Measures

- The area of proposed Township project is little undulating on south eastern side. Rest of the project plot is almost flat thus minimum cutting, filling and levelling work is expected.
- All the excavated materials shall be used on the site itself. No external material is envisaged for any filling purpose.
- Excavated topsoil will be used for green-belt development.
- Construction debris is bulky and heavy and re-utilized on site for Road making, Plinth filling purpose.
- Waste generated from labour shall be collected and composted on site.
- The non-compostable and non-recyclable portion of the waste shall be collected and handed over to Authorized Vendor.

Soil Erosion Control Measures

- Major activities pertaining to site grading and excavation for foundation and backfilling will be avoided during monsoons and shall be planned for dry season;
- Surface runoff from the construction site and exposed areas will be diverted using dykes, drainage swales or ditches. The method of choice will depend on the size of the drainage area and the steepness of the slope;
- Retention wall or bund shall be provided around the storage areas for excavated soil and other construction material to check the flow of sediments with storm water in case of rain;
- Excavated soil shall be used/transported at the earliest for filling low lying areas at the site for raising of level as planned;
- Proper routing and adequate capacity of the storm water run-offs drains with catch pits shall be provided at all construction sites;
- Completed earthworks will be sealed and/ or re-vegetated as soon as reasonably practicable with the help of landscape expert;

- The excavated soil material shall be stacked in earmarked areas. It is advised to be dumped properly and stabilized with grass and trees or utilized for greenbelt development to avoid its washing due to rains;
- Moreover, the washed soil will also be arrested by creating garland drains, leading to settling pond/s to allow its settling and avoid its mixing with surface water and result in their silting.

Soil Compaction

- The movement and parking of heavy machinery and other vehicles shall be restricted to identified area to limit the possibility of compaction;
- Restoration of area used for parking of heavy machinery and other storage shall be undertaken immediately after completion of each project activity

Prevention of Contamination

- Storage facilities will be designed within paved surface, provided with covered shed and adequate containment facility at the construction site to prevent contamination of soil due to accidental spills of lubricating oil, fuel oil, paints, thinner, varnishes, chemicals etc.;
- Storage of machine oil, used oil and grease will be provided with adequate secondary containment to avoid any soil contamination;
- Adequate hazardous waste collection and storage facilities shall be provided in a designated place away from storm water drains or watercourses with proper access control and proper labeling;
- All the hazardous waste containers will be properly labeled with the waste being stored and the date of generation;
- The hazardous waste shall not be stored for more than 90 days at the site and will be sold to authorized recyclers;
- An inventory of the hazardous waste generated and sold to recyclers shall be maintained by the contractors;
- A portable spill containment and cleanup equipment will be available at site and training in the equipment deployment will be imparted to the contractors;
- Covered garbage bins shall be provided for the construction camps and will be collected and transferred to the existing/proposed waste management facilities;
- The construction waste shall be used as a fill material for the low lying areas and for construction of roads;
- Empty containers, which may contain some toxic substances such as paints, solvents, adhesives and sealants shall be returned to the manufacturers or disposed appropriately as the case may be;
- Waste generated will be segregated into biodegradable and non-biodegradable contents. All biodegradable wastes from kitchen to be collected for secondary use such as animal feed or for vermi-compost. Other biodegradable wastes to be collected and disposed of in humus pits generated onsite for subsequent use as manure;
- Construction wastes from site such as metal cuttings debris, plastic packing material, wooden logs etc. will be segregated and kept in specially identified waste bins. All metal scrap will be sold while concrete waste/debris and other inert materials that cannot be recycled to be crushed and reused for level raising onsite or in road/pavement development within the site;
- Hazardous wastes including used oil, waste oil and residue containing oil or other hazardous substances will be stored at a designated place at all construction sites for disposal through authorized vendors approved by the Madhya Pradesh State Pollution Control Board;
- Paintbrushes and equipment for water and oil based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soils, watercourses, or drainage systems;
- Segregation of potentially hazardous waste from non-hazardous construction site debris;
- The contractor shall educate the workers and subcontractors about hazardous waste storage and disposal procedures;
- The septic tanks shall be abandoned and filled with earth after the labour camps are evacuated on completion of works.

Operation Phase

The operational phase of the project will generate garbage as solid waste. Land contamination mainly occurs due to lack of proper storage and disposal of solid waste. The solid waste will be mainly domestic in nature and will not contain any hazardous waste. To avoid the impacts on the land appropriate measures should be adopted for storage and disposal of solid waste. The impact will be localized within the project premises and not very significant.

Significance of Impact

Severity of Impact	1	Extent of Impact	2	Duration of Impact	2
Impact Significance = 4 i.e. Low					

Mitigation Measures

There will be no discharge of waste water onto land as it is zero discharge unit and providing sewage treatment plant to treat the sewage generated from the project.

The solid wastes shall be segregated according to their properties, packed, transported and stored in a separate impervious storage area demarcated for them. They will then be disposed or recycled through the authorized agency approved by the State Pollution Control Board.

Also since the proposed project is to be located within the NAINA City all the construction activities will be limited for the project area only. Therefore, no additional impact on the soil quality is expected due to construction activities within the proposed project site and nearby area.

4.8 Impact on ambient noise quality and mitigation measures

4.8.1 Construction Phase

The cumulative predicted sound pressure levels due to equipment present during construction phase are tabulated below.

Table 4.13 Error! No text of specified style in document.**: Predicted sound pressure levels at noise monitoring stations during construction phase**

Long Duration Noise Sources

S.No.	Noise Generating areas	Noise level at source (dBA)		Anticipated Noise level (dBA)				
				N2 : Towards North	N6 : Towards South	N1 : Upwind	N8 : Khanavale Village	N7 : Bhingar Village
		(at 1 meter dist)	Distance from project site (m)	30	100	150	200	200
1	Excavator-Loader /JCB/ Breaker/Construction Activity	90		60.5	50.0	46.5	44.0	44.0
2	Concrete Mixers	95		65.5	55.0	51.5	49.0	49.0
3	Compressors	95		65.5	55.0	51.5	49.0	49.0
	Cumulative Noise Levels			69.1	58.6	55.1	52.6	52.6
	Attenuation due to Green Belt and accoustic enclosure			20.0	20.0	20.0	20.0	20.0
	Existing Noise Levels (day-time)			51.7	52.3	52.0	51.6	52.1
	Cumulative Noise Levels (DAY)			**53.6**	**52.5**	**52.1**	**51.7**	**52.1**

The following machinery would be used for this project during the Construction phase of the plant. The majority if the sources of noise are the construction equipment, the machinery going to be present at the site and during the operational phase DG Sets will be used as emergency power back in the event of power outage.

- Batching Plant – 100 dB
- Tower Cranes - < 75 dB
- Passenger hoists - < 75 dB
- De-watering Pumps – 85~90 dB
- DG Sets – Multiple Nos. - 85 dB
- Concrete Mixer – 90 dB
- Concrete Pump – 90~95 dB
- Earth Moving – Front Loader/Bull Dozer/Roller/Truck/Paver etc. – 85~95 dB
- Compressors – 95~100 dB

DG Sets:-There are total Multiple DG Sets going to be present at the project site. These are the permanent sources of noise which are going to be present during the operational phase as well. The Noise level generated by each of the DG Set is going to be approximately 85dB(A). The DG sets are not going to be continuously running. They will run only when there would be a power outage. The DG Sets have to have the

Acoustical Canopies as per the CPCB Norms to reduce their Noise level to less than 75dBA. Although the actual noise levels are observed at approx. 85dBA, it would not be a major disturbance to the noise environment as they will be placed at different locations.

Compressors: Air compressors, be it Screw Compressors or Reciprocating Compressors, generate noise levels above 100dB even if they are electric driven or engine driven. Engine Driven compressors are bound to make even more noise due to the diesel engine. Compressors with pre-installed Acoustical Canopy should be chosen so that the noise generated at the source itself is lesser than 85dB.

1. **Batching Plant :** The batching plant contains several different sources, the collective noise level of which may rise to 100dB. Following are the several different sources present in a batching plant.
   Truck and front end loader engine noise
   - Hydraulic pumps
   - Conveyor belts
   - Air valves
   - Filters
   - Alarms
   - Compressors
   - Swinging, scrapping and loading devices

Significance of Impact

Severity of Impact	1	Extent of Impact	3	Duration of Impact	2
Impact Significance = 6 i.e. Medium					

Mitigation measures during construction phase

- The contractor should carefully choose the above equipment in order to meet with the CPCB Norms.
- Hydraulic pumps and compressors should be covered with Acoustical Enclosures with 20 dB Transmission Loss Rating in order to reduce the noise.
- Valves should be covered with Removable Acoustical Blankets.
- The contractor should choose controlled operating hours for noisy activities such as delivery, loading unloading etc.

Noise Levels were measured at the following locations for the Baseline data :

Sr.	Location & Distance	Leq (dB) Measured
N1	150m Upwind nr Farmers dwellings	52.0 dB
N2	30m towards North side	51.7 dB
N3	200m towards North-West (Vardoli Village)	52.5 dB
N4	Within project site	52.9 dB
N5	200m Towards South East (Mohape Village)	52.6 dB
N6	100m Towards South	52.3 dB
N7	200m Towards West (Bhingar Village)	52.1 dB
N8	200m Downwind (Khanavale Village)	51.6 dB

Noise modelling for construction phase

From the noise modeling predictive analysis, it can be noted that at N2 which is at 30 meters from the project site, increase of approximately 2dB in predicted. At 100 meters from the project boundary, approximately 0.3dB of time averaged increase is predicted. At 150 meters from the project boundary, approximately 0. 2dB of increase is predicted and beyond 200 meters from the project site, no increase is predicted due to the construction activity at the project site.

This increase of 0.3~2dB is negligible considering that, the human ear can detect an increase in SPL only when the increase is more than 0.5Db. Hence the 0.2dB increase predicted at 100 meters distance from the project site is negligible.

Mitigation : Sound-Reflective Corrugated Roof-Sheets are recommended to be installed surrounding the construction activity. These Reflective noise barriers provide a Transmission Loss Rating of 3~5dB which should take care of this predicted increase.
The Noise Modeling Study was conducted considering the major sources of noise only and assuming their Sound Pressure Levels at maximum possible levels, i.e. for considering the worst-case scenario. Hence, for the Noise modeling study, the SPL of Excavators/Earth moving machinery was assumed at its peak of 95dB, the cumulative noise level of Batching Plant at 100dB and other Tower Crane, Material hoist etc. with their collective Noise Level assumed at 90dB, which is usually lesser than 85dB for most machines when measured individually, but since many machines would be running together, the collective SPL increases because of the logarithmic addition of SPL of multiple sources.

This analysis is done assuming that the Noise level of the mentioned sources is going to be 85 dB at the Boundary of the project site, where as in actual, the machinery will be installed well within the boundary of the Plot, and other sound sources e.g. Ventilation system etc. are going to be installed inside the constructed building, because of which there will additional attenuation and hence the SPL measured at the boundary of the project because of the machinery involved in this project is going to be much lower than what is considered in this report. This Analysis is done for the absolute worst case scenario for the Noise Environment.

4.8.2 Operational Phase:

The cumulative predicted sound pressure levels due to equipment present during operation phase are tabulated below.

Table 4.13: Predicted sound pressure levels at noise monitoring stations during operational phase

Operational Phase

S.No.	Noise Generating areas	Noise level at source (dBA)		Anticipated Noise level (dBA)				
				N2 : Towards North	N6 : Towards South	N1 : Upwind	N8 : Khanavale Village	N7 : Bhingar Village
		(at 1 meter dist)	Distance from project site (m)	30	100	150	200	200
1	STP (Pumps,Blowers)	100		70.5	60.0	56.5	54.0	54.0
2	DG Sets (Multiple)	90		60.5	50.0	46.5	44.0	44.0
3	Vehicular Movement	90		60.5	50.0	46.5	44.0	44.0
	Cumulative Noise Levels			71.2	60.8	57.3	54.8	54.8
	Attenuation due to Green Belt and accoustic enclosure			20.0	20.0	20.0	20.0	20.0
	Existing Noise Levels (day-time)			51.7	52.3	52.0	51.6	52.1
	Cumulative Noise Levels (DAY)			**54.5**	**52.6**	**52.1**	**51.7**	**52.2**

Impacts during operational phase
During operational phase, the only sources going to be present at the project site are the DG Sets, the Sewage treatment plant which would have multiple Blowers, Pumps etc., the combined noise of which is assumed at 100dB, and the vehicular movement, the noise contribution of which is minimal.

During the operational phase, increase of approximately 2.8dB is observed at 30 meters from the project boundary, especially on the side where Sewage Treatment Plant is located. At 100 meters, approximately 0.3dB increase is predicted, and beyond 200 meters, 0.1dB or no increase is predicted.

However, although the increase appears to be of 0.3~2.8dB at distances of 100 meters or so, at closer distances, such as in the buildings right next to the Sewage Treatment Plant, higher noise levels may be observed which may trouble the residents. Therefore, Acoustical Enclosures with 30dB Transmission Loss Ratings are recommended for the Blowers of the Sewage Treatment Plant.

Contribution due to vehicular movement is likely to be even less than 80dB, and it would be significant only during morning and evening peak hours, hence no mitigations are required for this source of noise.

Significance of Impact

Severity of Impact	**1**	**Extent of Impact**	**3**	**Duration of Impact**	**2**

Impact Significance = 6 i.e. Low

4.9 Ground vibrations due to railway passing

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, the magnitude of vibration is expressed in terms of Peak Particle Velocity (PPV) and millimetres per second (mm/s). Guidance relevant to acceptable vibration at the foundation of buildings is contained within BS 7385 (1993): Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration. This states that that there should typically be no cosmetic damage if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines relate to relatively modern buildings and are normally be reduced to 50% or less for more critical buildings. Critical buildings include premises with machinery that is highly sensitive to vibration or historic buildings that may be in poor repair, including residential properties. The German standard DIN4150 provides limits below which it is very unlikely that there will be any cosmetic damage to buildings. For structures that are of great intrinsic value and are particularly sensitive to vibration, transient vibration should not exceed 3mm/s at low frequencies. Allowable levels increase to 8mm/s at 50Hz and 10mm/s at 100Hz and above. In Ireland, the National Roads Authority (NRA) have issued **Guidelines for the Treatment of Noise and Vibration in National Road Schemes and have indicated** typically deemed acceptable vibration levels in order to minimise the risk of building damage during road construction as shown below.

Table 4.14: Allowable Vibration velocity

Allowable Vibration Velocity (Peak Particle Velocity) at the closest part of the building / project site		
Less than 10 Hz	10 to 50 Hz	More than 100 Hz
8 mm/sec	12.5 mm/sec	20 mm/sec
Above are the maximum allowable values of PPV to avoid any damage to the structures.		

A special study was conducted to measure the Peak Particle Velocity of Vibration measured at the ground when the train passes from the Railway Track, measured at various distances.The results are tabulated below.

Table 4.15: Peak Particle velocity due to railway passing, at project site:

Sr.No	Distance from the Railway Track (meters)	Peak Particle Velocity (No Train Passing) mm/Sec	Peak Particle Velocity (When Train Passing) mm/sec
1	15	0.07	0.14
2	25	0.07	0.13
3	50	0.05	0.10
4	60	0.07	0.10
5	100	0.05	0.06

Conclusion

From the above results, we can see that Ground Vibrations Peak Particle Velocity, measured at various distances are measured up to 0.15 mm/ sec, where as the maximum allowable PPV for buildings is 8mm/sec. Therefore, we can conclude that the PPV measured due to ground vibrations when the railway passes from near the project site, is well within the allowable limits. No structural damage or even human irritation will cause with these measured values of PPV.

Significance of Impact

Severity of Impact	**1**	**Extent of Impact**	**2**	**Duration of Impact**	**2**
Impact Significance = 4 i.e. Low					

Conclusions drawn from Noise modeling during operation phase

1. Maximum increase in Sound Pressure level would be of approximately 0.3~2dB for distances up to 100 meters from the project site during the construction phase. During the operational phase, at 150 meters distance, approximately 0.2dB of increase is predicted. Beyond 200 meters, 0.1dB or no increase is predicted.
2. Approximately 3dB of increase was predicted in the Noise monitoring locations within 30 meters distance from the project boundary., which will be taken care of, by installing an Acoustical Enclosure for the STP Blower. At 200 meters distance, increase of 0. 1dB is predicted. This is a very negligible increase as the minimum increase noticeable by a human ear is 0.5dB.
3. Beyond a distance of 200 meters from the project site, there will not be any increase in the Sound Pressure Levels.
4. Mitigations Measures as tabulated below should be implemented for avoiding any potential impact on the Noise Environment

Sr.	Machinery	Predicted SPL at 1 mt. distance	Mitigations Required
1.	JCB / Other earth moving machinery/Back Hoe/Front end Loader /Bull Dozer/Scrapper/Grader/Truck etc.	85~90 dB	This project site has only a few JCB/other earth moving Machines during the construction phase. The sound pressure level of a JCB measured at 1 meter distance can be up to 85 dB. This is an unavoidable source of noise which cannot be attenuated by any means. However, this source has been already considered In the Noise Modeling study, and its impact will not make any significant difference on the Noise Environment. For the people working in the near field of these equipment, 85 dBA is a perfectly safe noise level for continuous noise dose of up to 8 hours.
2.	DG Sets (Multiple Nos.)	<85 dB	Diesel Generator Sets are supposed to have Sound Pressure Levels of lesser than 75 dBA when measured at 1 meter distance. However, these DG sets are not going to be kept close to one another. The DG Set of 2000 KVA Capacity are recommended with a minimum Transmission Loss Rating of 30 dBA. For DG Sets of capacity lower than 1000 KVA, the canopy that comes with the DG set itself is sufficient to bring down the SPL within allowable limits.
3.	Batching Plant (1 No.)	100 dB	Batching plant consists of multiple number of different sources of noise as already listed in this report. Mitigations : 1. The contractor should carefully choose the above equipment in order to meet with the CPCB Norms. 2. Hydraulic pumps and compressors should be covered with Acoustical Enclosures with 20 dB Transmission Loss Rating in order to reduce the noise. 3. Valves should be covered with Removable Acoustical Blankets. 4. The contractor should choose controlled operating hours for noisy activities such as delivery, loading unloading etc.

4.	Tower Crain / Material Hoist	<80 dB	The lifting mechanism of the Tower Crane or the builders hoist usually have very low noise levels of less than 75 dBA. However they are usually powered by Diesel Engines in order to make them portable, and hence the noise of the diesel engine itself can exceed 90 dBA. Therefore following mitigations should be implemented : 1. Acoustical Canopy for the Diesel Engine running the portable hoists/cranes to be installed with TL Rating of 30 dB.
5.	Pumps (Multiple) Mono block pump Submersible pump Multistage pump Concrete Pump	90~95 dB	The noise level due to the pump may go up to 95 dB for larger pumps. In case of such high noise levels, it is important to reduce the noise levels to below 80 dBA. For this Acoustical Enclosures with 20 dB Transmission loss Ratings are recommended. For smaller sized pumps, the SPL of the pump may be below 80 dB without any enclosure itself. In this case, there is no additional mitigation required for the Pump.
6.	Compressor	100~105 dB	Engine or Electrical Driven Compressors generate SPL of 100~105 dB. Acoustical Enclosure with 30 dB Transmission Loss Rating is recommended for the Compressor to be used for this project.
7.	Additional Mitigations / Cares to take	N/A	Sound Reflective barriers to be installed at the boundary of the project site. All people working in the vicinity of the Equipment/Machinery with Sound Pressure Levels higher than 95 dB should wear protective ear plugs to avoid permanent hearing damage.

4.10 Impact on socio-economic environment and mitigation measures

The establishment of the proposed development is likely to generate a range of permanent and temporary social impacts. These impacts will also be both positive and negative in nature. The positive impacts include increase in employment opportunities, improvement in infrastructure facility in general and in areas surrounding project area in particular, business opportunities for the local people, increase in real estate value in surrounding area etc. The negative impacts of the project are changes in land-use & loss of trees. The entire range of impacts can be broadly categorized as:

- Direct impacts on the prevailing natural and social systems;
- Indirect impacts that may be secondary impacts, derived from the existing natural and social systems; and

All impacts have been identified through consultation with the Project proponent, with government officials, elected representatives at village and consultation with various stakeholders including the people living in villages affected by the project.

The actual impacts are documented from the examination of available data, socio-economic survey and feedback received from the stakeholder consultations.

The pre-construction and construction phase impacts on socio-economic conditions of the Project area are discussed in the following sub-sections.

- **Land Related Impact**

Impact of Loss of Land

The land required for project has been mostly bought from families in the nearby villages. Land is a major asset of villagers; loss of land can have a negative impact on livelihoods of most villagers. However, in this case land has been bought on a 'willing seller – willing buyer' basis from the open market. In fact land has been bought at prices much higher than the 'ready recknor' prices published by the Revenue Dept. Further, only 20% land acquired is used for agriculture while the remaining 80% is a barren land. Thus, the impact financial impact has been minimal is not positive.

Land use planning

The proposed development will comprise of residential, commercial & amenities / utility buildings. The proposed land use pattern will be under 'Predominantly Residential' as per the Development Plan of NAINA.

Impact on Livelihood

Land was purchased on willing buyer - willing seller basis & is in title & control/possession of the Group. No rehabilitation and resettlement is expected. There is also suggestion that the families of nearby villages , depending on their experience and skill / education, should be given preference in employment opportunities that will arise because of the project.

Significance of Impact CHECK THIS SCALE OF IMPACT. I THINK THIS SHOULD BE 'LOW'

Severity of Impact	2	Extent of Impact	1	Duration of Impact	3
Impact Significance = 6 i.e. Medium ??????					

Mitigation Measures

This impact is expected to be moderate and with the implementation of the following mitigation measures, the potential impact of loss of livelihood will be further minimised.

- Temporarily allowing land owners to use the land for cultivation till the project activity starts;
- Provide necessary skill improvement training to affected people to make them employable in project operation phase

Impact on utilities

During the construction phase, utilities such as power line, water supply, telephone etc will not be affected, as the PP has planned to get entirely new infrastructure for construction phase and not depend on the present infrastructure. Hence, the significance of impact would be negligible.

Significance of Impact

Severity of Impact	1	Extent of Impact	1	Duration of Impact	1
Impact Significance = 1 i.e. Low					

Mitigation Measures

This impact is expected to be minor and with the implementation of the following mitigation measures, the potential disruption to existing utilities will be further minimised:

- Coordination with respective concerned department for new utility and relocation of existing ones;
- Establishing replaced utilities prior to disconnecting or discontinuing the existing one;
- Providing intimation to the people in advance about any disruption to services.

Impact on Livelihood Opportunities

Job Opportunities

The proposed project will create new jobs in skilled, semi-skilled, unskilled, managerial and technical level. This along with other project related requirements like security, housekeeping, gardening etc. will create a constant requirement for labor, for the entire operation phase of the project life. In addition, the the project will create number of job opportunities & also other proposed facilities such as commercial, recreational, health care unit, education etc. It is also envisaged that many jobs will be created outside the project boundary by various ancillary units catering to the construction and development needs of the project. Further, the benefits of project will trickle down to remaining local communities if adequate measures are taken in a planned way.

Significance of Impact

Severity of Impact	Extent of Impact	Duration of Impact
Impact is beneficial ++		

Mitigation

The project would spur the employment opportunity at local and regional level. In order to benefit the local population from the implementation of the project the following measures should be adopted:

- Dissemination of information to the local youths about various types of jobs opportunities likely to be generated by the project;
- Under CSR program companies should identify local youths and train them under the skill development program, so that they can be job ready. For Example, ICIC bank under its CSR gives skill development training to underprivileged youth along with job opportunities.

Infrastructure / Institutional Development

With the development of project activities, the locals expressed that infrastructural development in their villages such as access roads, water supply, and sanitation facilities should be upgraded. In addition, the schools and collage facilities should be provided so that the education will be available in the village.

Due to this project development there will be sufficient commercial support such as food, clothing in nearby villages.

Benefits of Community Development Activities

Once the proposed project is established, the continued sustenance of community relations will require the project proponents to engage in community development initiatives as per needs and priorities. The project authority through CSR program can identify areas of engagement with communities for social development. The initiatives of the project can be from livelihood restoration, income generation, education and provision of health facilities, which can further improve the quality of life of the community in the vicinity.

Development of Public Utilities & Resources

Another key impact that the project will bring about in the betterment of the public is the increase in utilities and resources. Presently, the villages are dependent on nearest urban centres (Panvel) for facilities like higher education, medical, recreation etc. Improved facilities in project will significantly benefit the local community in terms of access to public utilities and in supporting overall social development. However, the actual benefits to local population will accrued if the following mitigation measures are proposed.

Mitigation

Allowing access to local villagers to various facilities developed in the project, especially to schools, health care units and markets.

Provision of some preference or rebate to people especially from project affected villages in admission to schools, health care units etc.

Better value for Local Products

Development of project will create a market in itself for local products such as vegetables, dairy, poultry etc. Presently nearest urban centre is the primary market for the villagers and mostly sales their product through middleman. With the development of residential and market in the project will give the villagers to sale their product directly to the consumers at a market rate, thus making more profit. The project may also encourage the villagers to take up cultivation of vegetables seriously and diversify to meet the growing demand from the project residents.

Impact on Women

Enhanced facilities such as schools, health, recreation in vicinity has direct linkages to the improvement in women's social- economic condition. This is especially true for the women living in surrounding villages of project area. Furthermore, local educated women will have opportunity to work in the manufacturing units and other facilities are will be established in the project. Additionally, there would be opportunity to work as domestic help in the residence colony in the project. The project will surely enhance the situation of women.

Significance of Impact

Severity of Impact	Extent of Impact	Duration of Impact
Impact is beneficial ++		

Impact on poor section of society

With the implementation of the project, poorer section of society living around the project area would be benefited from access to employment, education, medical and other utilities. This section of the population would also have access to market and many other unskilled job for the entire operation period of the project.**Increase in Real Estate Value**

The value of land around project has already increased significantly with the announcement of the project and buying of land. It is expected that the value of real estate will further enhance once the implementation of project starts and will continue for some time before stabilizing in operation life of the project. Villagers around the project site will reap the benefit of enhanced value of the land by liquidating or becoming joint project owners by becoming development partners. The project will also bring in many workers of different categories who will be looking for accommodation outside the project boundary. Local people will have continuous source of earning by letting out their house for accommodation to these families.

Other Social Impacts and Risks (Across the Project Life Cycle)

Risk of Community Expectations

The project may give rise to the expectations of villages living around the project site. If not meet with their expectation, it is possible that conflicting situation will arise and disturb the peaceful social atmosphere. This will have to be managed maturely by having constant dialogue with all stakeholders.

4.11 Impact on hydrogeology and mitigation measures

The hydrogeological study in and around the proposed Township project highlights the following probable impacts due the proposed activity. The probable impacts and their respective mitigative measures are also discussed below:

Adverse effect on Geology of area:

Remedy: The area occupies a Deccan Trap basaltic rock. It occupies a predominantly flat area which shows a negligible drop of 2.5 meters over 250 to 300 m distance (i.e.1 in 100 to 120). The study area occupies a hard, stable rock section. As such the proposed activity is not going to change the characteristics of this rock and thus alter the geology of this area.

Top soil removal due to cut and fill activity during site development.

Remedy:

a) The project area wears a thin layer of soil, immediately underlain with hard basaltic rock. Hence, the proposed activity is not envisaged to involve noticeable soil removal. Still, the excavated top soil is advised to be dumped with due care and advised to be stabilized with grass, to be utilized for land scaping, greenbelt development to avoid its washing due to rains.

b) Moreover, the washed soil (if any) is also advised to be arrested by creating garland drains around the oil dumps, which will lead to settling pond/s to allow soil settling and avoid its mixing with surface water.

Flooding during monsoon:

Remedy:

The site is situated has a seasonal water stream passing through. The stream originates just outside of eastern portion of the site and flow in east – west direction. Hence it is advised that no developments are proposed within the flood lines of this stream The roads and the road side drains within the site are advised to be given the slope in accordance with the surface topography and finished ground level. The existing surface water drainage is also advised to be maintained to avoid flooding of surrounding area.

Surface and groundwater contamination due to increased vehicular traffic in and around the proposed township site.

Remedy:

The site is made up of hydrogeologically “Hard” basaltic rock. The site and adjacent area is devoid of any noticeable large surface water stream. Hence, it is not susceptible to Surface water contamination but the existing surface water stream course are advised to be maintained in the proposed project to avoid disturbing of stabilized surface water regime. This basaltic rock in this area also has poor groundwater potential. Still, the site is advised to be provided with oil and grease traps to separate mixing of oil and grease from vehicles with surface or groundwater to avoid contamination.

The development of the plot as township will result in change in land use which thereby result in increased surface run off.
Remedy:
A) The proposed activity shall occupy almost 137 acres of land. It is going to develop residential units. Therefore, the current land use in the form of waste land / agriculture land shall undergo radical change. However, the agriculture in this neighbourhood is principally rain-fed, single crop agriculture which is poorly developed for want of water. Furthermore, the proposed site is within the new city of NAINA. Hence, there is insignificant agriculture in this area. Still, the change in land use is advised to be countered with green belt development within and around the project area.
B) The development of the plot shall result in increase in covered area thereby to boost surface run off; but it is also advised to be countered with rainwater harvesting within the project premises and surrounding area. The same is covered under 'Rain Water Harvesting' in Chapter.2.

4.12 Impact on ecology, biodiversity and mitigation measures

Description	Anticipated Impact	Probable Source	Mitigation Measures
During Construction Phase:			
	Loss of vegetation associated with site clearance, road construction, lay-down and assembly area etc.	Construction activities for land preparation and site development	The areas going to be cleared should be clearly demarcated
			Unless & until absolute requirement no vegetation clearing will be taking place
			Topsoil removed during construction will be replaced or reused as soon as possible as this will help the natural recovery of local vegetation from the seed contained in the soil.
			New tree plantation will be done as per landscaping plan using native flora to enhance the overall ecology of the area
	Impact on due to site clearance, blasting, and road construction and lay-down areas, and increased human activity.		Speed limit of the vehicle to be restricted at site at maximum speed of 20 km/hr to avoid or reduce running over of fauna especially, reptiles.
			Harvesting, hunting of animals and setting fire in the vegetated areas to be strictly prohibited

ANALYSIS OF ALTERNATIVES

5.1 Use of environment friendly materials

Eco friendly building materials and construction technology will be used for the Project.
a. Use of Ferro Cement: Reducing material use by use of ferro cement where ever possible. These are energy efficient and also help reduce the dead load of a building.
b. Use of Fly Ash Bricks: Emphasis would be given on using eco friendly materials like fly ash bricks in this project. There are lot of advantages which fly ash brick and fly ash lime brick enjoys over conventional bricks and are enlisted below:

- Cost less to produce – at least 10% less than concrete bricks and 20% less than clay bricks.
- Save construction cost – Due to the uniform shape and size of the fly ash brick, it saves labor in laying bricks by about 15%.
- Use less energy – Much energy is consumed in heating clay bricks in kilns. By using fly ash bricks instead of clay bricks, much energy is saved in brick manufacturing.
- Reduce air pollution – Much fossil fuel is used in heating clay bricks in kilns. Burning such fuel generates air pollution and greenhouse gas (CO2), contributing to global warming. By manufacturing fly ash bricks (at room temperature) instead of clay bricks (at over 2,000 oF), emission of air pollutants and greenhouse gas is avoided at brick plants, which helps to reduce air pollution and global warming.
- Cleans indoor air – Recent research has shown that by using fly ash bricks indoors, the bricks adsorb mercury from the indoor air, causing the indoor air to be cleaner than the outdoor air.

c. Use of low VOC emissions such as cement and use of materials that prevent leaching
d. Material that are exceptionally durable, or require low maintenance e.g. PVC pipes will be used.

5.2 Building materials

Use of alternative technologies for each component of the buildings envelope, superstructure, finishes and road and surrounding areas will follow National Building Code 2009 (NB Code 2009). Some of these are given below:

- Brick and block products with waste and recycled contents such as fly ash (waste from coal burning plants), blast furnaces lag, sewages ludge, waste wood fiber etc.
- Fly ash based light weight aerated concrete blocks will be used for walls.
- Perforated bricks will be used for wall structures.
- Brick panel with joists, Fillers lab roofing, brick funicular shell roofing, RCC channel units, micro-concretero of ingtiles are some of the alternative techniques for roofing.

Some of the alternate materials for construction are:-

- Use of precast thin lintels, use of ferrocement-sun shade cum lintel etc.
- Use of renewable timber for door sand windows
- Use of steel manufactures from recycled content
- Aluminum from verified recycled content
- Saw dust based door sand window frames
- Ferrocement shutters, PVC doors and windows, Ricehusk boards, Natural fiber-reinforce polymer composited door panels
- Bamboo based products, bamboo strips boards.
- Alternatives for finishes include Flyash, Ceramictiles, Terrazzo floors.

Some of the alternate methods for erosion control on slopes:-

- Temporary silt fences to catch any runoff from the construction of the project to the natural drain
- Stabilization of Steep Slopes with Plants and Erosion Control Structures
- Use of geotextiles for the purpose of soil erosion conservation during construction and operation phase on slopes

5.3 Direct & indirect environmental impact

- Integrity of site and vegetation during construction will be preserved,
- Use of integrated pest management, herbal based pesticides will be used for pest control,

- Use of native plants for landscaping, List of plants has been identified in and reported in Chapter 3 and 4 of Ecology and Biodiversity Report,
- Minimization of disturbance to the watershed, and natural drainage, development of water body for rainwater harvesting and using for the project activity.
- Identification of the daylighting avalilability withi the occupied building areas. 3D modelling and sunpath analysis of the residential areas within the project is carried out to identify the areas lacking natural day light. Refer Annexure II for sunpath analysis.

5.4 Recourse conservation and recycling

- Use of recyclable products and those with recycled material content
- Reuse of building components, equipment, and furnishings
- Minimization of construction waste and demolition debris through reuse and recycling
- Easy access to recycling facilities for building occupants,
- Minimization of sanitary waste through reuse of graywater
- Use of rain water for irrigation and project water demand,
- Water conservation in building operations by using water-saving devices,
- Use of best waste water treatment methods

5.5 Indoor environmental quality

- Volatile organic compound content of building materials will minimize due to use of water based paints,
- Minimization of opportunity for microbial growth by using herbal based pesticides and fungicides,
- Adequate fresh air supply due to building design approach.
- Provision of appropriate window sizes helps improve the day lighting availability

5.6 Community issues to be kept in view

- Access to site,
- Preservation of ecology and biodiversity of the area,
- Local incentives, policies, regulations that promote green design under CSR activities will be implemented,
- Construction waste will be reused within site.
- Regional availability of environmental products and expertise will be used to maximum extent.

5.7 Energy conservation

The project consists of mixed use development like Residential Units (Major Part), Health Care units, Educational Institute, Commercial Buildings, Public Amenities, etc. The total connected load of the project is around 69,581 kW. The maximum demand is 46,487 kW. The energy conservation plan is reported in **Chapter 4**.
It is proposed to use following renewable source of energy.

- Solar Energy @ 350 KW Capacity.
- To install solar panels on the roof of residential units as well as other commercial and public amenity buildings wherever it is feasible.
- To install solar based street lights.

Other Energy Conservation Measures

- To use LED Lamps in place of high pressure discharge lamps for the street lights.
- To use time based circuits for street light to switch off part of the lights during night hours.
- To use dimmer to reduce the illumination level to reduce the energy consumption.
- To use automation for all the mechanical plants like STP, WTP, Transmission Lines, Solid Waste Management plants etc.
- To use star rated high efficiency motors for all the plants.
- Ensure all buildings are ECBC compliant

Awareness Programme

To bring a strict discipline in the end user, an awareness programme will be conducted to educate all type of end users to use.

- LED Lights wherever possible.
- To use dimmers and automation for all the lights.
- To use thermal insulation for building envelope to reduce the heat input.
- To use geothermal technique for HVAC System.
- To use solar energy for the HVAC System.
- To activate lights, A/C or any other equipment on occupancy basis.

Solid Waste Management for energy conservation

- We propose to recycle waste materials in to new products by sending the recyclable material to recycling plant.
- We propose to decompose the organic waste and to produce either useful manure .

Goal to Achieve via Ten Points by Conservation

1. To produce energy with renewable source of energy like solar, wind, geothermal or hydro and reduce carbon foot print.
2. To use efficient, environment friendly light source like LED in place of fluorescent, Incandescent.
3. Automation of the street lights.
4. Automation of all mechanical plants and also to use star rated motors & pumps.
5. To use thermal protected building material to reduce HVAC Load.
6. To use geothermal cooling for HVAC System.
7. To run awareness educational programmme to all end users.
8. To process the organic waste to produce manure
9. To send all recycle waste for process.
10. To overall reduce energy consumption and actively take part in energy conservation programme.

ENVIRONMENTAL MONITORING PROGRAMME

Monitoring is one of the most important components of a management system. An environmental monitoring plan provides feedback about the difference between actual environmental scenario and the impacts of the project on the environment. The purpose of environmental monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse effects can be detected and timely action can be taken.

6.1 Objectives of EMP

The key issues associated with the life cycle of a project are the monitoring of environmental parameters. Three types of environmental monitoring are associated with the project, which project period to determine existing conditions ranges of variation and process of change. Effects/impact monitoring involves measurements of environmental variable during construction and operation phase of the project to assess the impact that may have been caused by the project. Finally, compliance monitoring takes the form of periodic sampling and continuous measurements of level of pollutant emissions in the air, waste discharge on land or water, level of noise to ensure that standards are met. The basic objective of the environment monitoring program is:

- To ensure implementation of mitigation measures during project implementation;
- To provide feedback to the decision makers about the effectiveness of their actions;
- To determine the project's actual environmental impacts so that modifications can be made to the mitigation measures;
- To identify the needs for enforcement action before irreversible environmental damage occurs;
- To provide scientific information about the response of an ecosystem to a given set of human activities and mitigation measures.

6.2 Suggested EMP

The environmental monitoring plan for the proposed project has been developed in view of the institutional, scientific and fiscal issues pertaining to the project. For developing the monitoring plan, appropriate Value Ecosystem Components (VEC's) which are likely to be affected have been identified. For each component, suitable measurable environmental indicators which are appropriate to the impact mechanism and scale of disturbance and have a low natural variability, broad applicability and an existing data series have been defined. The monitoring plan has been designed for the construction and the operation phase of the project and the details of the plan have been presented in **Table 6-1**.

Sr. No.	Type	Locations	Parameters	Period and Frequency	Institutional Responsibility	
					Implementation	
Construction Phase						
1	Ambient Air Quality	8 locations as selected during baseline study	PM10, $PM_{2.5}$, SO_2, NO_2, CO, HC, VOC's	24-hr (8hr for CO) Av. samples / quarter	Contractor through MoEF approved agency	WICPL
2	Ground Water	3 locations as selected during baseline study	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	-do-	WICPL

Sr. No.	Type	Locations	Parameters	Period and Frequency	Institutional Responsibility	
					Implementation	
3	Surface Water	3 locations as selected during baseline study	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	Contractor through MoEF approved agency	WICPL
4	Noise	8 locations as selected during baseline study	24hrly Day and Night time Leq levels	Quarterly	-do-	WICPL
5	Soil	6 locations as selected during baseline study	Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal, Alkalinity, Acidity	Quarterly	-do-	WICPL
Operation Phase						
1	Ambient Air Quality	4 locations as selected after consultation with MPCB	PM10, $PM_{2.5}$, SO_2, NO_2, CO, HC, VOC's	24-hr (8hr for CO) Av. samples / quarter	WICPL through MoEF approved agency	WICPL
2	Ground Water	3 locations as selected after consultation with MPCB	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	-do-	WICPL
3	Surface Water	3 locations as selected after consultation with MPCB	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	-do-	WICPL
4	Noise	4 locations in site and in the surrounding areas @ MPCB	24hrly Day and Night time Leq levels	Quarterly	-do-	WICPL
5	Soil	6 locations as selected after consultation with MPCB	Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal, Alkalinity, Acidity	Quarterly	-do-	WICPL
6	Treated potable water quality	Water Treatment Plant	Parameters for horticulture use - BOD, pH, S.S, Coliforms	Half Monthly	-do-	WICPL
7	Treated Sewage Water Quality	All SEWAGE TREATMENT PLANTs (3 no.)	Parameters for horticulture use - BOD, pH, S.S, Coliforms	Half Monthly	-do-	WICPL
8	Treated Effluent Quality	ETP	As per IS 10500 – potable water standards	Half Monthly	-do-	WICPL

6.3 Data analysis

The monitored data will be analyzed and compared with the baseline levels as established in the EIA study and the regulatory standards specified by different government agencies. The standards against which the different environment components will be compared are as per **Table 6-2**.

Table 6.2: Applicable Standards for Different Environmental Components

Sr. No.	Component	Applicable Standards
1	Ambient Air Quality	National Ambient Air Quality standards, CPCB
2	Noise Quality	Ambient Air Quality Standards with Respect to Noise, CPCB
3	Surface water quality	IS:2296: Class 'C' Water, CPCB
4	Ground water quality	IS: 10500 Standards, BIS
5	Soil Quality	--
6	Treated sewage water quality	IS 2490(1974) – Discharge into surface water, IS 3306(1974) – Discharge on land, IS 3307(1974)- Discharge for agricultural use
7	Effluent	Minimum National Standards (MINAS) for industries by CPCB

6.4 Reporting schedule

The monitoring results of the different environmental components will be analyzed and compiled every six months during the construction and the operation phase.

The report will be assessed through competent environmental agencies to analyze and ascertain the reasons for any high pollutant level. The development possibly responsible for this high pollutant level will be identified by the proponent. The environmental management plan corresponding to that development or activity will be checked for its efficacy.

6.5 Emergency procedures & corrective measures

Corrective measures will be adopted if the review of the monitoring report reveals that the environmental management plan is inadequate or has not been implemented properly. A detailed review will be carried out by the interdisciplinary team of experts of the Environment Management Cell (**Figure 7-15**) for assessing the gaps between the EMP and its implementation. A corrective action plan will be worked out for the environmental component and a rigorous follow up of that plan will be adopted.

6.6 Detail budgetary provisions

A MoEF accredited laboratory will be sub contracted for the monitoring work. The cost estimates for the proposed monitoring plan are as detailed in Table 6-3.

Table 6.3 Error! No text of specified style in document.**: Cost Estimates for Environmental Monitoring**

S.N	Parameter	Sampling Frequency	No. of Samples per annum	Cost per Sample (INR)	Total Annual Cost (INR)
A. Construction Phase					

1	Ambient air quality	Twice per quarter	24	15000	3,60,000
2	Noise quality	Twice per quarter	24	4000	96,000
3	Ground water	Twice per quarter	12	10000	1,20,000
4	Surface water	Twice per quarter	12	10000	1,20,000
5	Soil quality	Twice per quarter	6	6000	24,000
				Total Cost	7,20,000
B. Operation Phase					
1	Ambient Air Quality	Twice per quarter	6	10000	60,000
2	Noise	Twice per quarter	6	4000	24,000
3	Ground Water	Twice per quarter	2	10000	20,000
4	Surface Water	Twice per quarter	4	6000	24,000
5	Soil	Twice per quarter	18	10000	1,80,000
6	Treated potable water quality	Six times per quarter	54	6000	3,24,000
7	Treated Sewage Water Quality	Six times per quarter	6	10000	60,000
8	Treated Effluent Quality	Twice per quarter	6	4000	24,000
				Total Cost	6,32,000
				Total Cost (A+B)	13,52,000

ADDITIONAL STUDIES

7.1 Corporate social responsibility (CSR)

7.2 Introduction

The Ministry of Corporate Affairs, GoI, vide its Notification dated 27th February' 2014 (G.S.R, 129(E)) has provided guidelines for CSR programmes, expenditure and reporting structure. The present report has taken these guidelines and further adds to the intent of the MoCA's CSR Policy 20 I4.
Further as per Ministry of Environment & Forests Circular No.J- 1 10 1 3 / 25 / 2014-IA.I dated the 11th August, 2014 'the Companies (Corporate Social Responsibility Policy) Rules, 2014 comes into effect only in case of companies having operating projects and making net profit'.
Notwithstanding the above, WCIPL has already started CSR activities in the surrounding reas/villages and has also chalked out a CSR plan for future.
In this report, the details of CSR Activities are provided under the following head:

A. Present condition of 3 settlements in the vicinity the project area.
B. Outline of WCIPL's CSR policy :
   Projects and programmes presently been undertaken
   Projects and programmes proposed to be under taken
C. Composition of CSR Committee
D. Average Net Profit of the Company (last 3 yrs.)
E. Present and Proposed CSR Expenditure
F. Details of CSR spent

7.3 Study of nearby settlements

Taratep Thakurwadi

The location has a local school and has about 40 homes. All the homes are brick constructed and have mud tiles on the roof but in certain cases, well-constructed homes are observed too. The arrangements of the homes are congested and very less space is available to move in between. The primary source of fuel for cooking is wood (as it appears to be freely available from the forests behind) and huge stocks of wood seems to be kept stored at every home. The water source for the village is a well which has limited water resources and is re-filled everyday with the help of 1 or 2 tankers. The water is then pumped to local tanks from where it is used by the people. There is a proposal from the Zilla Parishad to bring piped, treated water to this settlement. The water is consumed directly from the source, without any proper treatment. Also in certain cases, due to unavailability of electricity (load shedding) village use buckets to draw water from the well. The approach road to the village area is poorly constructed and also has few SOLAR lamps along the street. The number of lamps available is very less in comparison to what is needed. Some lamps are functional in the area.

Typical dwelling unit	Lanes between dwellings in Taratep Thakurwadi

Drinking water well 1

Drinking water well 2

Vardoli Village

The village is relatively well developed and has well maintained homes. Quite a number of vehicles are observed in certain homes.

The village has functional LPG cylinders for cooking fuel, however some homes were observed to store wood to be used for cooking.

The village has a well which is again refilled using tankers and has a motor attached to the edge for drawing water. Villagers use the water from the resource. Also was it observed that the village homes has have personal pumps at their homes to fill the overhead tanks of 2/3 storied homes. Also some homes have air conditioners to their homes.

Village Vardoli

Dwelling units are relatively well constructed and maintained

Lanes between dwellings

ESR at Vardoli

Interiors of a school

Roads in Vardoli

Haltep Thakurwadi

There are approximately 45 houses in this settlement. While previous generations of the resident families worked in agricultural field, the present day work force of this settlement is involved in construction, warehousing and allied activities in the area.

There is water scarcity in this settlement. The local Zilla Parishad had planned piped water supply to this settlement from the overhead resorvior of Village Vardoli. However the work has not been completed and the residents depend on the wells nearby and water tankers during dry season.

Water tank at Haltep Thakurwadi

School at Haltep Thakurwadi

7.4 Outline of WCIPL's CSR policy

The Company believes that the proposed project should influence the surrounding environment in a positive manner and should leading to improvement in the quality of life of the future residents of the township as well as those residing nearby. Projects and programmes presently been undertaken:

- Jobs & Involvement of locals in Nursery Development
- WCIPL had developed a Nursery spread over an area of about 15 acres in Village Vardoli. The objective of this Nursery is to grow and nourish plants gor project plantation. All works related to Nursery such as :
- Setting up Nursery
- Plant Propagation
- Nursery Maintenance
- Plantation

Have been done by involving only local residents from the 3 adjoining settlements.

General CSR works

Distribution of School Bags at the start of Academic calendar

School bags and stationery was distributed in June 2016 in the 3 adjoinging settlements. Distribution was done to all school children and local residents and School Teachers were involved in the distribution work.

Dritribution of School bags & Stationary, May 2016

Involvement of Village elders in CSR Activities

Constructing Water Pipeline For Helthep Thakurwadi

The residents of Thakurwadi faced a perennial problem of drinking water availability. The residents had to depend on ground water / wells or water tankers throughout the year. The Zilla Parishad had proposed a water pipeline from Vardoli Village overhead resiorvior to the settlement. However, this work could not be completed and the pipeline was left incomplete.

Water tanker at Thakurwadi

Women getting water from nearby well

On 12 March 2016, Saturday during the interaction with WCIPL team, the residents of Thakurwadi highlighted this problem. WCIPL therefore, with the consent of Gram Panchayat and local elders, decided to complete the water supply system work.
This work involved :
Laying 75 mm GI Water supply line (500 mts)
Repairing Pump and pump room at Thakurwadi
Repairs of water tank at Thakurwadi
WCIPL allotted the civil works to M/s.Wandekar & Co. at its expense (Rs.5,16,577/-).

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>ESR at Vardoli Village</td><td>Dysfunctional Pumps at Thakurwadi</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Repair of Pumps in Thakurwadi</td><td>Laying of new water pipeline at Thakurwadi</td></tr>
</table>

Construction of Rcc Road In Bhingarwadi:-
The Bhingarwadi Village lies to the south of the project area. Though it is not directly adjoining to the project, it is nearby and the residents of this Village requested WCIPL to assist in making an ‘all season’ access road for the village.
Considering the condition of the access road, WCIPL got a RCC road constructed for the villagers. This road was completed and handed over to the Village in May 2016.

Laying of RCC Road at Bhingarwadi Village

New RCC Road at Bhingarwadi

7.5 CSR works undertaken till date

Table 7.1 : CSR activities undetaken

Sr.No.	Particulars of CSR Activity	Village/Settlement	Work status	Amt spent
1	Construction of RCC Road	Bhingarwadi	Completed	30,00,000/-
2	Constructing water Pipelines for Helthep	Thakurwadi	Completed	4,77,000/-
3	Jobs & Involvement of locals in Nursery Development	Vardoli	In Progress	26,80,000/-
4	Employment of locals in project work	Vardoli, Bherle, Bhingarwadi & Thakurwadi	In Progress	25,00,000/-
5	Distribution of School Bags and stationary at the start of Academic calendar	Vardoli, Bherle, Bhingarwadi & Thakurwadi	completed	1,00,000/-

7.6 CSR activities planned

Training and skilling young residents

It is estimated the the Project works would require approx.1000 Masons, 715 Plumbers, 1100 carpenters, 700 Electicians,800 security personnel & 1000 maintenance personnel.

While plumbing, carpentry works would involve jobs it the project completion stage, this itself would be spread over about 10 years period. The security and maintenance personnel jobs would be required even after completion of the project and hence would always be long term jobs.

These jobs typically require 10 years formal education and a training/skilling period. We have found that while the local residents have formal education as required for these jobs, they lack the skill development training.

It is therefore proposed that WCIPL would identify such local residents of the right age and provide / arrange to provide skill development in the above fields. Possible avenues are tie-ups with ITI's / local similar Institutions. On an average, the plan is to provide such skills to about 15 youngsters / year.

Village upgradation programme:

It is envisaged that upgradation works shall include:

- Access road works
- Drinking water works
- Solar lighting
- Public hygiene
- General awareness programme
- Alignment of all above works with Swach Bharat programme
- Plantation drives: Along Major District Roads and village roads connecting the village / settlements.

Urban Agriculture :

The residents in the adjoining villages have significant experience in horticulture, agriculture and related field. Local species of food plants, their needs, upkeep etc is an 'embedded knowledge' with the residents. WCIPL would like to make use of this knowledge that has been passed from generations to generation while taking up Urban Agriculture projects.

Risk Assessment and Disaster Management Plan

The risk and disaster management plan has been enclosed as **Annexure 4**

PROJECT BENEFITS

8.1 Introduction

The township project is part of a new 'Smart City' NAINA, being developed by CIDCO (as part of MoEF & CC's EC conditions for the proposed Navi Mumbai International Airport project). The land parcel is about 7 kilometers from the said prosed International Airport, Navi Mumbai. As part of the development plans, Wadhwa Infrastructure and Construction Pvt Ltd (WICPL) will construct verticals like residential, schools, health and commercial facilities. Spread over an area in excess of 137.73 acres near Panvel, the project will be an integrated housing development and will house around about 49000 residents and is expected to generate direct employment and indirect employment.

Major features:

- 30% + area for green spaces, playgrounds etc. Education and health facilities within the township
- Employment centers within the township
- Conservation of natural features (water stream etc)
- Housing for economically weaker sections
- Convenient shopping

8.2 General benefits

The general benefits of the project are as under:

- The project will trigger developments in new city NAINA and thereby fulfil CIDCO / State Government and MoEF & CC's vision to have planned developments in NAINA and shall also assist out-migration from overcrowded centers in long run.
- As no R & R is envisaged, the project will bring about several economic benefits to local people & integrate locals seamlessly
- The project envisages employment potential and economic prosperity to local population of the surrounding villages as well as help create opportunities for entrepreneurship leading to multiple associates activities
- Physical infrastructure is a key towards better quality of life. It plays a vital role in current lifestyles for individuals, businesses & organizations. It includes utility services, overhead & underground facilities, telecommunication facilities & roads. The proposed project would provide housing, transportation & communication facilities, as also recreational & business opportunities
- Apart from the general benefits above following are some of the direct & indirect benefits due to the development of this project

8.3 Direct benefits

8.3.1 Enhanced connectivity

Road Construction leading to increased connectivity for the project and nearby areas

8.3.2 Transport facility

Establishment of the project will lead to increased bus / public transport to the area in addition to creating new bus stations, fire station, police station etc. (within the township)

8.3.3 Medical facility

New health facilities and linkages with ambulance services, establishing medical camps etc.

8.3.4 Drinking water arrangement

Bringing assured drinking water network to this interior area, with consummate infrastructure of treatment, storage etc. will help the surrounding area too. Dependence of the surrounding area on ground water / bore wells shall decrease over a period of time

8.3.5 Employment generation

Employment generation during the construction as well as operational phase is the biggest positive side of the project. The project will provide positive impact on the economic development of the region in terms employment opportunities.

In the post occupancy stage, Wadhwa Construction and Infrastructure Pvt Ltd. shall encourage opportunities of employment within the township to reduce long distance travel. To ensure this, mixed use development as proposed with offices, institutional areas, recreational & cultural areas, retail spaces as well as health care units within the township shall require skilled as well as unskilled staff and preferably to be catered by locals. The expected employment opportunities to be 23% of total resident / service population of 1.5 Lakhs in Panvel township by 2025

8.3.6 Entertainment & leisure

8.4 Indirect benefits

The proposed township has not only directly benefited the villagers but also has attempted to indirectly add significantly to the convenience and welfare of the villagers as well as the visitors. It is to be particularly noted that these indirect benefits cannot be quantitatively measured and stated but, these indirect benefits have qualitatively improved the standard of life of the most concerned person including resident and casual visitors. Some of those which have indirectly added values to life of people are as under:

- Tar Road to the township
- Electricity line from MSEDCL to the township switch yard & subsequently to nearby villages
- Many employees & workers of the township will be staying on rental basis in the nearby villages. This will indirectly help the income of the villagers.
- Business opportunities to the villagers by awarding building material supply contract/s, labor provision contract/s, supply of milk, horticulture, etc.
- Business opportunities to the needy villagers by allocating shops at staff residential areas, labor facilities and construction sites within and surrounding the township.
- Economic help to those senior citizens who are under poverty and have no alternate income generating support

8.4.1 Improvement in socio-economic status

Improve access to economic resources (equal employment opportunities during construction phase, skills development and assistance to form self-help groups and undertake self-employment activities);
Improved urban infrastructure (improved living conditions and welfare facilities).

8.4.2 Improvement in physical infrastructure

The project will have substantial open spaces around. There will neither be any inundation nor any erosion. The substantial green area will decrease the run-off
Roof rain harvesting –Run off due to paved areas will be collected through well design storm water network and will be used for artificial recharge of aquifers.
Construction management plan will be strictly followed. Construction material storage will be on identified places. Proper waste management system will be followed.

ENVIRONMENTAL MANAGEMENT PLAN

9.1 Introduction

Environmental Management Plan (EMP) deals with the implementation procedure of the guidelines and measures recommended to avoid, minimize and mitigate environmental impacts of the project. The issues likely to develop at various stages of the project could be addressed by preparing a compatible EMP and its effective implementation. Also provision of Environment Management Cell (EMC) to regular monitoring of environmental aspects.

9.2 EMP

The EMP is a plan of action for mitigation / management / avoidance of the negative impacts of the project and enhancement of the project corridor. For each measure to be taken, its location, timeframe, cost, implementation and overseeing / supervision responsibilities are listed. Environmental Management Action Plan which explains the environmental issues and the avoidance / mitigation / minimization or enhancement measures adopted and/or to be adopted during different phases of the project i.e Design / Pre-Construction Phase, Construction Phase & Operational Phase

9.3 Objectives of EMP

The objectives of the EMP at various stages of the project planning and implementation are as follows:

Design / Preconstruction stage:

- To develop a design that incorporates environmental safeguards; and
- To provide mitigation measures to all expected environmental degradation.

Construction stage

- To prevent and reduce the negative impacts of the project by implementing mitigation measures
- To ensure that the provisions of the EMP are followed and implemented by implementation arrangements.

Operation stage:

- To prevent deterioration of environment components of air, water, soil, noise, biological etc.

The EMS also suggests an overall framework under which the EMP is executed.

Implementation Arrangements:

The responsibility for the implementation and supervision of EMP will be taken care by the Environment Management Cell (EMC).

9.4 Environmental Management Cell (EMC)

WCIPL Ltd will establish Environmental Management Cell which is headed by Project Manager in construction phase. A separate environment management cell comprising experienced and qualified personnel reporting to the HSE in charge for performance and monitoring of environmental equipment / measures needs to be setup. Thorough implementation of the environmental management plan at various stages of the project implementation as delineated will be ensured with respect to EMS including regular environmental audit for the total construction. The EMC comprises of staff having adequate experience in field such as construction site supervision, product/equipment procurement and environmental management.

Table 9.1: EMC and Responsibilities In Construction Phase

During Construction Phase		
Designation	**Qualification**	**Proposed responsibility**
Project Manager	B. E. (7+ Yr experience)/MBA	Project manager will head the EMC & will be overall responsible for effectively implementing the EMP. He/she will manage the entire operation, staffing, budgeting and quality check for the EMP.
Site Manager	B. E. (Five year experience)	Material waste minimization, labour camp sanitation, Noise, oil grease & vibration nuisance control, accident prevention.

Procurement Assistant	BSC /B com (3+ years – Procurement in projects.)	The procurement assistant will ensure that all the special material, equipments and consultants required for the EMP are procured in advance. He/she will also ensure that the relevant clauses area added in the other tenders and contracts that form part of the EMP.	
Environmental Manager	M. Sc. / M. Tech. (Environmental Science) Two year experience in Environmental Monitoring and reporting.	Air and Noise	Field observation, Laboratory tests, interpretation & reporting. Monitoring PUC control, Noise & odour mitigation measures
		Water	Water budget, O&M of water supply & Monitoring functioning of waste water treatment plan, Rain water harvesting system, WTP/Disinfection and filtration unit.
		Solid waste	Monitoring, collection, segregation, treatment, disposal of MSW, E waste, Hazardous waste during construction and operation phase in accordance with the requirements of applicable rules.
		Compliance Reporting	Six monthly post EC compliance and State Pollution Control Board consents
Assistant	B.sc /B. com	Secondary responsibility for environment management and decision making for all environmental issues & ensure environmental monitoring as per appropriate procedures.	

Figure 9.1: Organisation Setup of EMC in Construction Stage

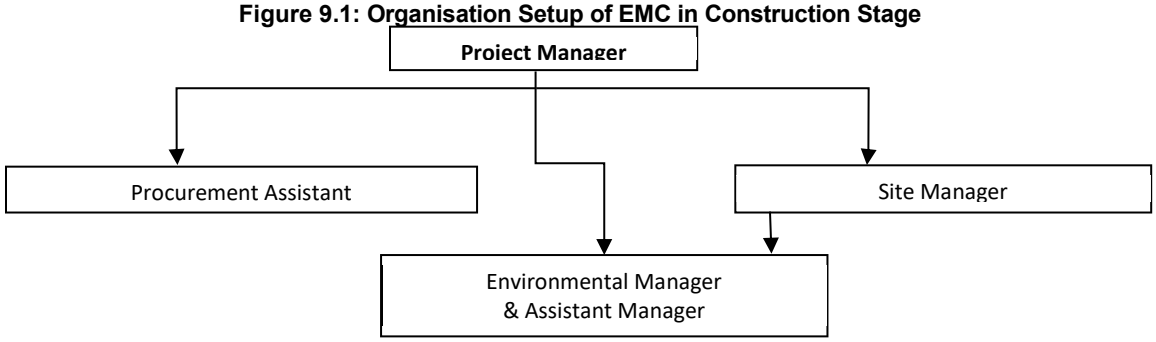
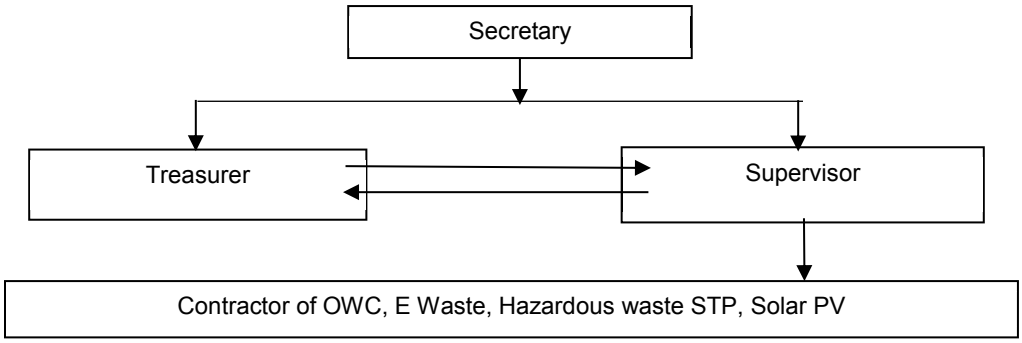


Figure 9.2: Organisation Setup of EMC in Operation Stage



Responsibilities of EMC

The generalized responsibilities of the EMC will be as follows:

Conducting Environmental monitoring of the surrounding area through MoEF approved agency.

- Carrying out the Environmental Management Plan.
- Organizing meetings of the Environmental Management Committee and reporting to the committee.

- Ensuring that prescribed environmental standards are maintained.
- Ensure that all different types of statutory returns / compliance report to be submitted to relevant regulatory bodies.
- Commissioning of pollution control equipment/ measures
- Specification and regulation of maintenance schedules for pollution control equipment.
- Developing the green area
- Ensuring water use is minimized.
- Carrying out Environmental Audit during construction and operation phase.

9.5 Reporting systems

Reporting system provides the necessary feedback for project management to ensure quality of the works and that the program is on schedule. The rationale for a reporting system shall be based on accountability to ensure that the measures proposed as part of the Environmental Management Plan which gets implemented in the project. Standard formats are prepared for the maintaining the standard procedure of environment regulations, which will be take care by EMC.

9.6 Training

WCIPL will entrust the proposed implementation of project needs integrating the social and environmental issues in its construction & operation phase. To achieve this goal, the EMC of WCIPL, need to give training to workers/Engineers during construction phase and working staff during operation phase for environment management and the effective implementation of the environmental issues. The training programme should equip the members of the EMC to implement and supervise the EMP and expose to environmental and social issue as associated with the project. EMC can then be given the responsibility of active dissemination of the culture of environmental/social consciousness and ethics within the rest of the staff. Once the staff have received training and have gained experience through the implementation of the EMP, they should be ready to resume leadership role. The training to be undertaken need to be of relevance to the specific context, focusing on the following issues:

- Environmental Regulations applicable on the Project
- International, National and State level regulatory framework
- Environment Monitoring Proposed in the Project
- EMP proposed in the Project
- Reporting and Auditing Systems proposed in the Project
- Awareness regarding water usage, water conservation
- Awareness regarding energy usage, energy conservation
- Harnessing water resources, including rain water harvesting
- Solid waste generation, its processing, awareness to reduce waste
- Safety measures use during operation phase

Besides the trainings, there are various logistic supports including various items that need to be procured for the effective and efficient functioning of EMC, these, include but not limited to, the following equipment

- Noise monitoring through noise meter
- Weather station
- Digital Camera
- Computing facilities to allow the documentation unit to be self-sufficient etc.
- A well-stocked library with books and manuals related to environmental impacts & safety issues.

9.7 Environmental monitoring

The environmental monitoring programme provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect.

- Monitoring of facilities at construction camps
- Monitoring of air, noise, soil and water parameters including silt load
- Monitoring of survival rate of trees
- Monitoring of cleaning of drains and water bodies
- Monitoring of pollution control devices

9.8 Site specific EMP

The EMP presents the project specific management on –

- Air Environment
- Water Environment
- Noise Environment
- Soil/Land Environment
- Biological Environment
- Management of Solid wastes
- Management of Organic Waste Converter
- Management of sewage generated
- Management of Energy Conservation
- Management of Safety measures
- Environmental management strategies

9.8.1 Air

Construction Phase:
During construction phase, sources of air pollution will be construction activity, excavation, vehicular movements, loading/unloading of trucks/dumpers, DG set and Heavy machineries like cranes, concrete mini mixer.
Impacts on Air Environment:

- Air quality may be affected, level of particulate matter will increased
- Dust may affect the workers
- Dust may affect the nearby vegetation

Mitigation measures:

- Water sprinkling on site for dust separation.
- Use of covering sheets shall be done for trucks carrying construction material to prevent air borne dust.
- All material storages adequately shall be covered to avoid dust / particulate emissions.
- Use of ready mix concrete instead of using onsite batching plant for concrete.
- Proper maintenance of DG sets
- Regular maintenance of machineries & vehicles used during construction phase.

Operation Phase:
During operation phase, DG sets, vehicular movement are the sources of air pollution. In operation phase, DG set is proposed & movements of Cars, two wheelers, will be takes place.
Impacts on Air Environment:

- Particulate matters level will increase
- Dust level may be increased due to vehicles movements
- Air quality also infected

Mitigation measures:

- DG sets installed as per the MPCB standards
- DG sets will be use only during electricity failure
- Regular servicing & monitoring of DG sets will be done
- Checking PUC will be mandatory for vehicles
- Parking space proposed for3535cars & 321 two wheelers
- Sufficient internal road width & turning radius will be provided for smooth vehicular movement.
- Regular monitoring of Air quality

9.8.2 Noise

Construction Phase

During construction phase, sources of noise pollution will be due to operation of machineries; Earthmoving Machinery, Mini Hoist Crane, Hoist Crane, Concrete mini mixer, Weigh batcher etc. as well as transportation vehicles.

Impact on Noise Environment:

- Increasing noise level will affect workers on site & nearby personals
- Noise will cause nuisance to the nearby area
- Increasing noise level will affect faunal elements of nearby areas

Mitigation Measures:

- Low noise generating (90 dB (A)) equipment's will be use.
- High noise generating construction activities should be carried out only during daytime.
- For vehicles horn blowing is prohibited.
- Regular maintenance of machineries, vehicles & equipment's used during construction phase
- Workers working near high noise construction machinery would be supplied with ear muffs/ear plugs.
- Hydraulic pumps and compressors should be covered with Acoustical Enclosures with 20 dB Transmission Loss Rating in order to reduce the noise.
- Valves should be covered with Removable Acoustical Blankets.
- The contractor should choose controlled operating hours for noisy activities such as delivery, loading unloading etc.

Operation Phase

During operation phase, sources of noise pollution will be noise generated from DG sets, Pumps, vehicular movement etc.

Impact on Noise Environment:

- Noise will cause nuisance to the nearby area
- Users/ employee will suffer from noise pollution

Mitigation measures:

- Low noise generating DG sets will be installed as per the MPCB standards
- Acoustics enclosures will be used to reduce noise pollution
- Provide adequate parking arrangement, which would help in reducing noise levels due to vehicular movement in the parking area.
- Internal road width (7.5m and 6m) help to smooth traffic movement

9.8.3 Water

Construction phase:

During construction phase, sources of water pollution will be excess ground water drawn, contamination of ground water by leaking of diesel, oil, paint, solvents & sewage from labour facilities.

Impacts on Water Environment:

- Additional pressure on local water resources due to water requirement for construction work

- Sediment run off from construction area
- Disposal of sewage from labours facilities

Mitigation measures:

- Water for construction phase will be sourced from Borewell.
- 100 local non-residential labours will be employed at site for whom separate tank of 25 KLD will be provided for domestic water facility.
- 100 local residential labours will be employed at site during peak hours for whom separate tank of 18KLD will be provided for domestic purpose.
- Optimal water conservation measures at Construction site along with adequate awareness programmers to be organized for the workers.
- Mobile toilets will be provided @1 toilet for 10 workers & agreement will be made with authorized agency for maintenance, collection and disposal of sewage generated from labour activities
- Regular removal of debris from construction site to be practiced.
- Oil and grease traps before discharge.

Operation Phase:

Impacts on Water Environment:

- Increase load on fresh water sources
- Unplanned disposal of domestic waste water generated
- Inadequate management of storm water
- Spills, leaks from storage areas

Mitigation measures:

- Dual plumbing system will be adopted for reuse and recycle of water
- The waste water generated from the project will be treated in Sewage Treatment Plant . Wastewater produced on site will be treated in Sewage Treatment Plant at individual plot levels and then will be sent to Recycled Water treatment plant of capacity 890 KLD on MBBR/MBR/SBRtechnology. The treated water coming from Sewage Treatment Plant will be reused for irrigation purpose and flushing purpose.
- Provision of rain water harvesting through RWH tanks.
- Well-designed storm water drainage will be provided within project site to carry generated storm water

9.8.4 Soil / land

Construction Phase:

During construction phase, excavation, transportation, accidentally spillage of paints, oil and diesel will impact on soil/land environment.

Impact on Soil/Land Environment:

- Deteriorate the soil characteristics
- Soil contamination

Mitigation measures:

- Proper and separate storage provide for construction material
- Carefully handling of paints, oil
- Excavated material (debris) used in levelling, internal road making
- Hazardous waste will be handled and disposed of in accordance with the requirements of hazardous waste management rules 2016.
- Waste oil generated from DG sets will be handled over to authorized recyclers approved by MPCB
- Movement and parking of heavy machinery and vehicles will be restricted to identified area
- Excavation to be undertaken during dry season.
- Proper routing and adequate capacity of the storm water run-offs drains will be provided.
- Separate colour coded bins for biodegradable and non-biodegradable waste will be provided on site
- The solid wastes generation due to workers dwelling on the site will be segregated and will dispose off through authorized vendor.

Operation Phase:
During operation phase, soil will be contaminated through solid waste, E-waste
Impacts on Soil /Land Environment:

- Soil contamination through solid waste dumping

Mitigation measures:

- Separate colour coded bins for biodegradable and non-biodegradable waste will be provided on site
- Waste oil generated from DG sets will be handled over to authorized recyclers approved by MPCB

9.8.5 Biological

No any adverse impact will be identified on biological environment except land cleaning.
Construction phase:
Green area development/landscape plan will be implemented during construction phase, will be started during construction phase.
Operation Phase:

- Native, Fruit bearing trees, Shrubs will be selected for the plantation purpose as in table 9.3

Sr.	Common name	Scientific name	No.s proposed
1	Morinda/Noni	*Morinda citrifolia*	100
2	Mauha	*Madhuca indica*	100
3	Chinaberry tree	*Melia azadirach*	100
4	Ainasadada	*Holoptela integrifolia*	120
5	Dhaman	*Grewia tiliaefolia*	120
6	Kaushi	*Firmiana colorata*	155
7	Umber	*Ficus racemosa*	120
8	Vad	*Ficus benghalensis*	130
9	Pangara	*Erythrina variegata*	140
10	Kumbh	*Careya arborea*	140
11	Tad	*Borassus flabellifer*	21
12	Moha	*Madhuca longifolia*	115
13	Beheda	*Terminalia bellirica*	120
14	Bel	*Aegle marmelos*	140
15	Dandus	*Dalbergia lanceolaria*	145
16	Avla	*Emblica officinalis*	145
17	Red Sandalwood	*Adenanthara pavonina*	10
18	Maharukh	*Ailanthus excelsa*	22
19	Phudgus	*Alseodaphnae semicarpifolia*	23
20	Saptaparni	*Alstonia scholaris*	189
21	Dhau	*Anogeissus acuminata*	138
22	Kadamb	*Anthocephalus chinensis*	174
23	Kapok	*Ceiba pentandra*	185
24	Sukanu	*Cerbera manghas*	33
25	Shisham	*Dalbergia sissoo*	61
26	lahan karmal	*Dillenia pentagyna*	85
27	Indian Boxwood	*Gardenia latifolia*	84
28	Small Flowered Ixora	*Ixora parviflora*	87
29	Thorel's Crape myrtle	*Lagerstroemia thorellii*	118
30		*Magnolia pterocarpa*	15

31	Indian Cork Tree	*Millingtonia hortensis*	89
32	Copper pod	*Peltophorum pterocarpum*	154
33	Putrajiva	*Putranjiva roxburghii*	148
34	Sita Ashok	*Saraca asoca*	127
35		*Sesbania grandiflora*	90
36	Jangali badam	*Sterculia foetida*	4
			3747

9.8.6 Solid waste

Construction Phase:

During construction phase waste would be generated mainly due to excavation in form of debris and soil. Recyclable waste i.e. steel, iron, cement bags, plastics containers, boxes will be sent to authorize recycler. Hazardous waste regenerated during construction phase, will be handed over to Mumbai Waste Management Limited (MWML), Taloja, Dist. Raigad. Solid waste generated from labour facility will be disposed to local municipal authority.

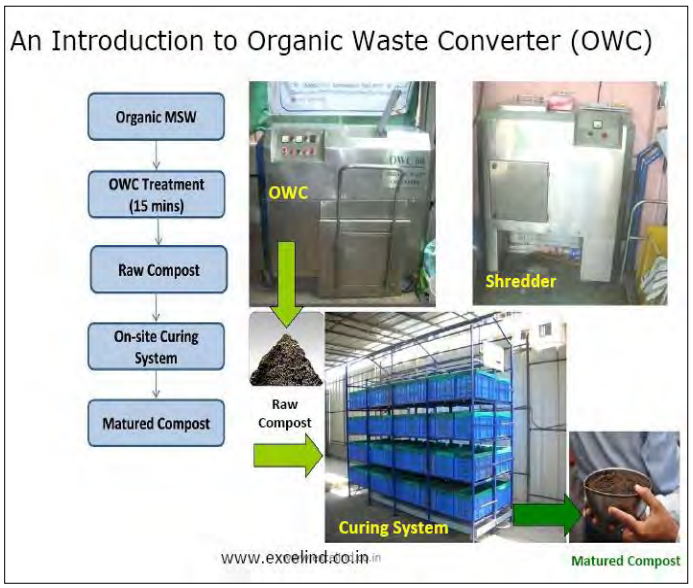
Operation Phase:

During operation phase; Solid waste, E-waste will be generated. Expected users of the proposed project is 49000persons. Generated solid waste will be segregated in to dry (Non-Biodegradable) & wet (Biodegradable). Dry waste will be collected & disposed by Authorised recyclers; whereas wet waste will be treated on site in Organic Waste Converter (OWC130), & treated material used as manure for landscape purpose. Total generated E-waste will be collected & disposed by authorized E waste vendor. Provision of temporary storage (50 sq.m) of E-waste will be done on site.

Organic Waste Converter (OWC):

- Total Biodegradable waste-8.92TPD+0.78TPD
- Non-Biodegradable waste -5.28TPD+1.02 TPD

Total waste:14.20 TPD+1.80TPD (Residential and Commercial plots)
Total: 16TPD



Total Area Required for Waste Management Processing for the Project (Waste storage area+ Shredder area+ OWC machine area +Saw storage area + Racks+ Compost storage +Dr waste storage and segregation)= 150sq.m

OWC-300	
Machinery & Equip.	Specifications
Composting Machine OWC-300. (1600 KG Per Day)	a)Power Connection : 8 HP (Main Motor & Chopper Motor) b) Brim Capacity: 130 Lit. c) Waste Batch size: 50 Kg. d) Batch Duration: 15 min. e) MOC: All contact parts of SS-304. f) Trolley: One No. of SS-304. g) Mobility arrangement: Suitable mobility arrangement for the equipment for movement on the plain flooring.
Double Curing System	Capacity: 1600 Kg of Organic Waste per day. •100 Nos. of HDPE crates of size 54x36x26 cm, laminated with aerating net. •One number of four shelf folding storage rack of size 365x120x255 cm. •4 Nos. of Leachate collection tray of G.I. of size 150x55x7 cm. •Double Fogger: Moisture control fogging system consisting of 140 foggers, Disc Filter, Ball Valve, 1 No of Laxmi Make Pump, Time Control unit for spray and frequency control, One number of pressure gauge, and other accessories like piping, valves etc.
Shredder	Shredder is required if garden waste like plant pruning's is to be converted into organic manure as also will take care of meat bones. Drive geared motor and mounted on fabricated frame for easy working. Note: The cutters are made of C.S duly carburized and hardened. The two shafts holding the cutters operate at differential speeds i.e. 100 R.P.M and 70 R.P.M to facilitate self-cleaning. Body Cover SS 304 and Mobility Arrangement.

Machinery and Equipment	Amt (INR)
Composting Machine OWC-300	18,50,000
Double Curing System	4,47,000
Shredder	1,95,000
Sanitreat	Rs. 130 per kg
Bionoculam	Rs. 130 per kg
Labour charges	Rs.96000 (Rs. 8000 per month per labour)
Annual maintenance	Rs.60000
Saw dust	Rs 2,19,000

9.8.7 Safety Measures Proposed

Following safety measures proposed during Construction & operation phase of the project:

Construction Phase	Operational Phase
• Majority work in day time	• All electrical wiring of buildings are in concealed.

• Adequate drinking water facility through water tanker • First aid facility on site • Mobile toilets for workers • Water sprinkling on ground to reduce dust emission • Guarding all parts of dangerous machinery • Provide protecting equipment's to workers (Ex.- Helmets, Ear Plugs, Hand cloves) • Proper maintenance of vehicles & other instruments • Maintaining hoists, lifting machinery chain, ropes are in good condition. • Walking surfaces at height are of sound construction & with safety rails • Fire protective equipment's like sand buckets & extinguishers will be installed	• Fire service inlet with hydrant valve outlet provided at ground level of buildings • ISI marked Portable fire extinguishers in each buildings at parking, lift room, Transformer room & main switch board • Automatic sprinkler for the basement • Dewatering pumps at the basement • Manual call point & siron system • Provision of court yard hydrant system • Provision of Refuge areas as per norms • DG sets provided as immediate back up in case of power failure • All Fire equipment's are with ISI mark • Provision of OHT • Provision of UGT for the project

9.9 Budgetary allocation

9.9.1 Cost of EMP during construction phase

Sr.	Component	Impacts Identified	Suggested Mitigation Measures	Resp.	Estimate
1	Ambient Air Quality	Emissions from equip. & vehicles	Per day 2 tanker will be used for water sprinkling for dust suppression	Site Manager	Water For Dust Suppression: 4.00 Lakh
		Improper handling and storage of construction material	DG sets will be provided with adequate acoustic enclosure for emergency power back up		Air Monitoring: 80,000
		Fugitive dust emissions	Transportation of raw materials required for construction will be carried out during non peak hours		
		Emissions from onsite operation of diesel generators	Parking of delivery trucks or other equipment will not be permitted on public road during unloading or when not in active use		
			During Construction ready mix concrete in enclosed container shall be used.		
			Raw material carrying vehicles with valid PUC will be allowed at site per day.		
			Periodic Maintenance of construction equipment		
			Screens on the periphery of the site		
			Covering Dusty load on vehicles by impervious sheet		
			Regular Air Monitoring for CO,SO2, NOx, PM10, PM2.5		

2	Water Resources and Quality	Additional pressure on local water resources due to water requirement for construction work	Water for construction phase will be sourced from borewell.	Site Manager	Water Monitoring: 80,000.00
		Sediment run off from construction area	150 local non residential labours will be employed at site for whom separate tank of 10 KLD will be provided for domestic water facility.		Sintex tank :50,000
		Disposal of sewage from labours facilities	80 local residential labours will be employed at site during peak hours for whom separate tank of 15 KLD will be provided for domestic purpose.		
			Optimal water conservation measures at Construction site along with adequate awareness programmers to be organized for the workers.		
			Mobile toilets (23no.s) will be provided @1 toilet for 10 workers.		
			Agreement will be made with authorized agency for maintenance, collection and disposal of sewage generated from labour activities		
			Regular removal of debris from construction site to be practiced.		
			Oil and grease traps before discharge.		
			Silt traps and bunds will be set-up around construction sites.		
			Recharge pits have been provided for rainwater harvesting		
3	Land Environment	Soil Erosion and compaction	Top soil will be separated from subsoil, debris and stones & will be stockpiled in designated areas, covered or stabilized with temporary seeding for erosion prevention and s hall be reapplied to site during plantation of the proposed green area	Site Manager	Soil monitoring: 80,000
			Excavation to be undertaken during dry season.		Waste bins:15,000
			Proper routing and adequate capacity of the storm water run-offs drains will be provided.		Top soil Conservatio n :3lakhs
			Separate colour coded bins for biodegradable and non biodegradable waste will be provided on site		

			The solid wastes generation due to workers dwelling on the site will be segregated and will dispose off through authorized vendor.		
			Movement and parking of heavy machinery and vehicles will be restricted to identified area.		
			All storage facilities will be designed with paved surface, provided with covered shed and adequate containment facility at the construction.		
			Hazardous waste will be handled and disposed of in accordance with the requirements of hazardous waste management rules 2008.		
			Waste oil generated from DG sets will be handled over to authorized recyclers approved by MPCB		
			Construction waste treatment technology		
4	Landscape and Topography	Localized flooding and related health issues due to decreased infiltration	No extra soil will brought into the site from outside the project boundary for the construction activity.	Site Manager	Slope preservation :323 lakhs
		Change in existing land use	Stockpiled top soil would be covered with plastic sheet and through garland drain to prevent any loss because of rain or wind erosion. In operation phase this soil would be used for landscaping purpose.		
		Change in drainage pattern	Green area will be developed to improve the landscape.		
5	Traffic and transport	Increased traffic volume	Providing dedicated path within the site for entry and exit of the construction vehicles	Site Manager	Included in Project Cost
		Disruption of traffic and increased cases of road related hazards	Dedicated parking area will be provided for project vehicles.		
			Detailed plan for signage around the construction areas will be prepared to facilitate traffic movement.		

6	Ambient Noise Quality	Noise due to Construction activities (such as excavation, grading, erecting equipment, piling, etc)	Adequate planning to avoid high noise activities will be undertaken.	Site Manager	Monitoring cost of Noise levels: 20,000
		Noise due to operation of heavy equipment and machinery	Acoustic enclosures, noise barriers will be provided in areas of high noise generating sources.		Provision of ear muffs 0.85 Lacs
			Rubber padding will be provided for vibration control		7040/- per running meter (4m ht)
			Movement of vehicles during night time will be limited.		
			Construction workers to use ear muffs in areas with potential for high noise generation.		
			Sound-Reflective Corrugated Roof-Sheets are recommended to be installed surrounding the construction activity.		
7	Ambient Noise Quality	Movement of vehicles	Provision of proper parking arrangement, traffic arrangement plan of smooth flow of vehicles helps to abate noise pollution due to vehicular traffic	Site Manager	
			Regular maintenance of vehicles and repair of equipment.		
			Restriction on use of equipment generating high noise during night time.		
			Working hours and construction activities to be aligned and works will be prohibited during night hours.		
8	Employment and Local Economy	Increased employment opportunities	Project to utilize the facilities available from the local market to support the local economy to the extent possible.	Site Manager	
		Contracting opportunities for local	Wherever possible, labour from local community will be employed for construction activity and maintenance activites.		
			Periodical health check-up facility will be organized by project authority for local people (construction labour)		

			Certain infrastructure facilities will be provided to the workers on the site such labour facility, mobile toilets and sanitation facilities so as to minimize the load on the existing infrastructure facilities		
9	Ecology	Increased turbidity and siltation	Raw materials and debris will be stored away from run off areas. Standard noise levels will be maintained during construction activities.	Site Manager	
10	Sanitation, Safety and Health facility	Domestic solid waste generation	Personal protective equipments will be provided to all labours and its use will be made mandatory .	Site Manager	Health Check-up: (Quarterly)1.05 lakh
		Indoor air quality	Existing buildings will be used by labours for residence in peak period		Personal protective equipments: 85 000
		Waste water generation	6 sets of first aid kits will be provided on site		Creches for children:10,000
		Health and hygiene issue	Health check up of labours will be done twice year		Medicines, detols and preliminary check up equipment/ materials:10,000
		Location of labour facility	Doctor's visit will be organized once in month for routine inspection		Site sanitation 62,500 (@ 12,500 for 5 toilets)
			Safety and warning signages will be provided on strategic locations covering entire project site (at distance of 1 m).		Emergency/ Exigencies: 30,000 (Ambulance hire basis+doctors+Hospitilization)
			Training and awareness programme for labours will be organized after every six months		Educational and Safety Awareness Program:10,000 (Audio-visual)
			Creches for Children		
11	Environmental Consultancy		Monitoring of Environmental parameters as per Consent	Environmental	Included in project cost

		Environment Management	Submission of concerned documents to the authorities as per mentioned in EC and Consent	Consultant	
12	EM Cell				6.00 Lakhs
13	DMP Cost				284.93 lakhs (incldingOM)
14	KZym-Tec soil stabilization technology				400 Lakhs
15	**Total Cost**				**1027.93 Lakhs**

9.9.2 Cost of EMP during operation phase

Sr.	Component	Impacts Identified	Suggested Mitigation Measures	Resp.	Estimated Cost (INR)
1	**Ambient Air Quality**	Emission from power backup/ DG sets Emissions from increase in traffic volume	Regular PUC checkup for all users Each DG sets at plot level with acoustic enclosure for emergency power back up Ambient air monitoring as per local norms / 6 month Sufficient stack Ht. for DG set & periodic maintenance, Use of low sulphur diesel for DG sets.	Supervisor	Cost of Air Monitoring 1.6 Lakhs/Year
2	**Ambient Noise Quality**	Increase in noise levels in residential areas Movement of vehicles	Each DG sets at plot level with acoustic enclosure will be provided for emergency power back up Ambient noise monitoring as per local norms / 6 month. Regular maintenance of vehicles, sufficient parking space, Provision of signage's for easy circulation of traffic. About 187186.94 sq.m is total green area for Special township which is 33.5% of plot area at blanket level. 36579.52 sq.m is total green area which is 32.32% at plot level. There are 352 existing trees in Special Township project, 42 trees will be cut /transplanted. 6432 no.s of trees are proposed to be planted at blanket level.3747 no. of trees are proposed to be planted at Plot level	Supervisor	Cost of Air Monitoring 1.6 Lakhs/Year
3	**Water Resources and Quality**	Increase load on fresh water sources Unplanned disposal of domestic waste water generated Inadequate management of storm water Spills, leaks from storage areas	Dual plumbing system will be adopted for reuse and recycle of water Sewage Treatment Plant of suitable capacity will be provided at plot level. Suitable nos. of rain water harvesting pit 385 no.s will be provided at plot level Well designed storm water drainage will be provided within project site to carry generated storm water Treated sewage generated from the project site will be used for landscaping, car washing, flushing. Excess treated sewage will be transferred to recycle water treatment plant.	Supervisor	Water Quality monitoring: 1.6 Lakhs/Year STP : Capital Cost:68Lakh O & M Cost: 10Lakh/annum RWH along with WTP Capital Cost: 20Lakh O & M Cost: 0.7 Lk/annum

Sr.	Component	Impacts Identified	Suggested Mitigation Measures	Resp.	Estimated Cost (INR)
4	**Solid Waste Disposal**	Inadequate collection and treatment of domestic waste Unhygienic conditions, odour problem Contamination of soil and groundwater Improper disposal of sludge	Hazardous waste management will be handled in compliance with Hazardous Waste (Management, Handling and Tran boundary Movement) Rules, 1989 and subsequent amendments. Biodegradable waste will be treated through OWC while non biodegradable waste will be handed over to Panvel Municipal Corporation. A total sludge will be generated from the sewage treatment plants of all the residential plots and commercial plots will be de-watered using filter press, dried and used for gardening purpose. E-waste (0.9 TPY) will be handled as per E waste Management rules 2016.	Supervisor	Cost of solid waste processing area: 288Lakh O & M Cost: 48 Lacs per annum
1.	**Energy Conservation**	All buildings will be Energy Conservation Building Code complient. Installation & Maintenance of energy conservation equipment		Maintenance In charge	ECBC compliance & Solar Panel, solar water heaters 595Lakhs, O & M Cost 9.5 lacs./annum
5	**Ecology**	Impact on flora and fauna of the adjoining green areas	187186.94 sq.m is total green area for Special township which is 33.5% of plot area at blanket level. 36579.52 sq.m is total green area which is 32.32% at plot level. There are 352 existing trees in Special Township project, 42 trees will be cut /transplanted. 6432 no.s of trees are proposed to be planted at blanket level.3747 no. of trees are proposed to be planted at Plot level.	Supervisor	Soil Monitoring Cost: 1.6 Lakhs/Year, Capital Cost of Landscaped area: 302Lacs / annum, Maintenance of Slope preservation:16 lakhs
6	**Traffic Management**	Increased traffic volume Disruption of traffic and increased cases of road related hazards	As per Regional Plan DCR : 3538cars ,Scooters : 326 no.s parking will be provided Separate entry and exit point with 6 m & 9 m (turning radius) wide internal road will be provided for easy traffic management	Supervisor	--
7	**Energy Conservation**	Installation & Maintenance of energy conservation equipment		Maintenance In charge	Solar Panel and solar water heaters 95Lakhs O & M Cost 9.5 lacs./annum.
8	**Disaster Management Plan Implementation**	Earthquake Flood Cyclone Terror Attack Fire Power Failure	Maintenance of Systems & Equipment Regular training Effective fire evacuation plan will be designed and displayed in common entrance lobby Fire extinguishers on each floor and first-aid kits in common areas will be provided	Maintenance charge	Capital Cost: 794 Lakh O & M Cost: 45.3 Lacs per annum

Sr.	Component	Impacts Identified	Suggested Mitigation Measures	Resp.	Estimated Cost (INR)
			Emergency preparedness plan and disaster management plan will be prepared and communicated with all residents Mock drilling for combating any emergency situation will be conducted once in six months Meeting with facility management team will be organized every month to audit smooth functioning of all building services		
9		•	Environmental Management Cell		2.5 lacs
Total Capital Cost: 2076.4 lakh and OM cost:123 lacs/yr					

Annexures

Annexure 1

Format for **CONSTRUCTION CAMP/LABOR COLONY**

Sl.	Item	Unit	Details	Remarks if any
1	**Details of Workforce**			
a.	Total No. of Labours	Nos.		
b.	Total No. of Male Workers	Nos.		
c.	Total No of Female Workers.	Nos.		
d.	No. of Children in labour facility	Nos.		
2	**Details of Dwelling Units**			
b.	Minimum Size of Dwelling	M x m		
c.	No. of opening per dwelling	Nos.		
d.	Water requirement	Nos.		
e.	No. of mobile toilets	Nos		
f.	No. of Cans use for water storage	Nos		
g.	Fencing around facility	Y/N		
h.	Maintain ace of all toilets	Y/N		
3	**Details of facilities provided**			
a.	Details of First Aid Facility	Yes/No		
b.	Availability of Dav Care center.	Yes/No		
c.	Availability of dust bins	Yes/No		
d.	Medical camps/medical check-up	Yes/No		
e.	Safety equipment's	Yes/No		

Remarks:

Prepared & Checked By
Signature
Name

Approved By
Signature
Name

Annexure 2

DETAILS OF CONSTRUCTION ACTIVITY

Sr.	Item	Unit/No.s	Details (Model, Capacity)	Last Servicing	Next Servicing
1.	Details of Machineries				
a.	Earthmovers				

b.	Cranes				
c.	Ready Mix				
d.	Trucks/Dumpers				
e.	Tractors				

Sr.	Item	Unit/No.s	Details (Capacity)	Remark
2.	No. of Tanker used			
3.	No. of Trees planation			
4.	Survival rate of trees			
5.	**Raw material**			
a.	Steel			
b.	Cement			
c.	Paint			
d.	Hardware			
e.	Hand Tool			
f.	Safety Equipments			

Remarks:

Prepared & Checked By
Signature
Name

Approved By
Signature
Name

Annexure 3
EXCAVATION DETAILS

Sr.	Item	Quantity	Remark
1.	Excavation		
a.	Excavated Material		
c.	Debris		
2.	Landfilling		

Remarks:

Prepared & Checked By
Signature
Name

Approved By
Signature
Name

Annexure 4
CHECKLIST FOR ENVIRONMENT INSPECTION

Sr.	ESMP Measures
1	Provision of a personnel accountable for implementation of ESMP / Safety Measures with Contractor
2	Consent to Establish from Maharashtra Pollution Control Board
3	Consent to Operate from Maharashtra Pollution Control Board
4	Compliance of MPCB Conditions
5	Whether compliance reported through monthly Progress report
6	PUC taken for all Construction Vehicles
7	PUC checking for all vehicles in Operation Phase

9	Monitoring report
10	Submission of Six monthly compliance to MPCB, Environment Dept., MoEF-Bhopal
11	Submission of Water Cess
12	Submission of Environment Statements
13	Solid waste management
14	E-waste management
16	Checking of energy meters of all pollution control devices

Remarks:

Prepared & Checked By
Signature
Name

Approved By
Signature
Name

Annexure 5
WASTE MANAGEMENT

Sl. N.	Characteristics of Waste	Type of Waste	Total Quantity generated (cum/l)	Reused/ Recycled, If any (Quantity in cum/l)	Final Quantity of waste generated (cum/l)	Disposed Quantity (cum/l)	Disposal Practices	Remarks

Remarks:

Prepared & Checked By
Signature
Name

Approved By
Signature
Name

Annexure 6
ENVIRONMENT MONITORING

Sr. No.	Locations	Duration Of Monitoring	Standard	Results	Remarks
AIR QUALITY			PM10, $PM_{2.5}$, Sulphur Dioxide (SO_2), Oxides Of Nitrogen (NO_2) Carbon Monoxide (CO)	RSPM,SO2,Nox,CO	
WATER QUALITY			Ph, Turbidity, Temperature, TSS, TDS, Magnesium Hardness, Total Alkanity, Sulphate, Nitrate, Fluoride, Sodium, Potassium, Total Nitrogen, Total Phosphorus, DO, BOD,COD, Salinity, Fluoride, Chloride And MPN (No. Of Coli Forms / 100ml), Heavy Metals	Ph, Turbidity, TDS, Total Hardness, Calcium, Magnesium, Total Alkalinity, Chlorides, Sulphates, Chlorides, Nitrates, Flourides, Residual Chlorine, Copper, Iron, Cadmium, Lead, Zinc, Chromium, Manganese, Selenium, Sodium, Potassium,	

				Salinity, Total Nitrogen, Total Phosphorus, DO, BOD, COD, Total Coliforms.	
SOIL QUALITY			Ph, Texture, Organic Matter, Heavy Metals And Trace Metal, Alkalinity, Acidity, Electrical Conductivity, Permeability, Water Holding Capacity, Porosity	Ph, Texture, Organic Matter, Heavy Metals And Trace Metal, Alkalinity, Acidity, Electrical Conductivity, Permeability, Water Holding Capacity, Porosity	
NOISE QUALITY			L Day Equivalent L Night Equivalent L Equivalent	L Day Equivalent L Night Equivalent L Equivalent	

Remarks:

Prepared & Checked By
Signature
Name

Approved By
Signature
Name

BUILDING ENVIRONMENT INDIA PVT LTD

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Report	**Environmental Impact Assessment and Environmental Management Plan Report**				
Project Details					
Name of the Report	**Wadhwa Construction and Infrastructures Pvt. Ltd.** EIA / EMP Report for Township Project at Vardoli, Panvel Taluka, Raigad District, Maharashtra				
Client	**Wadhwa Construction and Infrastructures Pvt. Ltd.**				
Prepared by	**Building Environment India Pvt Ltd.**				
Project Number **xxxxx**	**Report No** **xxxx**	**Version** **001**	**Released Date** **10.09.2017**		
Contact Details					
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NABET Accreditation NO. – 69th MOM, 7 February 2012					
EC Application Reference Document	**TOR Issued:**				
Issue Order					
Date **10.09.2017**	**Building Environment India Pvt Ltd.**			**WCIPL**	
	Originated by		**Checked and Approved by**	**Checked and Approved by**	
	Name	**Signature**	**Name**	**Signature**	**Name**	**Signature**
	P Kulkarni	--signed--	H Kolatkar	--signed--	G Deshmukh	--signed--

Disclaimer

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