

## 9. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

### 9.1 ENVIRONMENTAL BASELINE DATA

The main aim of the Environmental and Social Impact Assessment (ESIA) study is to ascertain the existing baseline conditions and to assess the impacts of all the factors as a result of the proposed New Sub-urban corridor on Virar-Vasai Road-Diva-Panvel section. The changes likely to occur in different components of the environment viz. Natural Physical Resources, Natural Ecological (or Biological) Resources, Human/Economic Development Resources (Human use values), Quality of life values (socio-economic), would be studied and assessed to a reasonable accuracy. The environment includes Water Quality, Air Quality, Soils, Noise, Ecology, Socio-economic issues, Archaeological /historical monuments etc.

The information presented in this section stems from various sources such as reports, field surveys and monitoring. Majority of data on soil, water quality, air and noise quality, flora and fauna were collected during field studies. This data have been further utilized to assess the incremental impact, if any, due to the project. The development/compilation of environmental baseline data is essential to assess the impact on environment due to the project.

The proposed new suburban corridor from Panvel to Virar is to run along the existing Panvel-Diva-Vasai line of Central Railway and then Vasai Road to Virar to Western Railway. The corridor is 69.50 km having 24 stations on Panvel-Virar section.

#### Land Environment

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 14 m above the mean sea level. Mumbai is located along western Arabian coast of India from 18° 53' north to 19° 16' north latitude and from 72° 00' East to 72° 59' East longitude. Parameters involved in land environment are, physiographic, land use, geology and soils, and seismicity. These are discussed in the following paragraphs.

#### Physiography

The physiographic feature of the Mumbai district is flat terrain flanked by north –south trending hill ranges. The hill ranges are almost parallel ridges in the eastern and western part of the area. The Powai – Kanheri hill ranges are the other hill extending in the eastern and central part running NNE – SSW. The maximum elevation of the area is 450 m above mean sea level (m amsl) at some of the peaks of hill ranges. Trombay island has



north – south running hills with maximum elevation of 300 m above mean sea level (m amsl). Malbar, Colaba, Worli and Pali hills are the isolated small ridges tending north – south in the western part of the district. The Powai – Kanheri hills form the largest hilly terrain in the central part of the Salsette island and are the feeder zone for the three lakes viz., Powai, Vihar and Tulsi. There are a number of creeks, dissecting the area. Among them, Thane is the longest creek. Other major creeks are Manori, Malad and Mahim which protrudes in the main land and give rise to mud flangs and swamps. The Mumbai area is drained by Mahim, Mithi, Dahisar and Polsar rivers. These small rivers near the coast, form small rivulets which inter mingle with each other resulting in swamps and mud flats in the low lying areas.

The entire Greater Bombay area is occupied by Deccan basalt flows and their acid and basic variants, poured out between the late Cretaceous and early Eocene times. The basaltic flows are horizontally bedded and are more or less uniform in character over wide areas. Certain extrusive and intrusive mafic types are associated with basalts and are found in the Bombay Islands and its vicinity<sup>1</sup>.

### Land Use

The alignment is passing through railway land already available along the existing Panvel-Virar section. The detail of land use pattern is given in **Table 9.1**.

**Table 9.1: Land use along the Alignment**

I.	Stations	Chainage	Landuse
1	Panval- New Panvel	0.000-1.466	Open land
2	New Panvel- Tembode	1.466-2.485	Open & residential land,
3	Tembode- Kalanboli	2.485-5.077	Open land
4	Kalanboli- Navade Road	5.077-7.435	Open & commercial land
5	Navade Road- Pindhar	7.435-8.850	Open & Marshy land
6	Pindhar- Taloje	8.850-10.782	Open land
7	Taloje – Nighu	10.782-14.876	Open, agricultural and barren land
8	Nighu- Narivali	14.876-16.733	Agricultural land
9	Narivali- Nilaje	16.733-19.360	Barren & open land
10	Nilaje- Nandavali	19.360-24.815	Residential & open land
11	Nandavali- Kopar	24.815-27.353	Residential & open land
12	Kopar- New Dombivli	27.353-28.650	Residential land
13	New Dombivli- Pimplas	28.650-32.315	Residential land
14	Pimplas- Bhiwandi Road	32.315-35.202	Open scrub, agriculture land
15	Bhiwandi Road- Kalwar	35.202-37.715	Open scrub
16	Kalwar- Dunge	37.715-40.507	Open scrub
17	Dunge- Kharbao	40.507-43.310	Agriculture land
18	Kharbao- Paye Gaon	43.310-47.305	Agriculture land
19	Paye Gaon- Juchandra	47.305-51.665	Agriculture land,salt pan
20	Juchandra- Vasai Road	51.665-57.280	Salt pan, Residential land
21	Vasai Road- Nalasopara	57.280-62.710	Residential land,Salt pan
22	Nalasopara-Virar	62.710-69.500	Residential land

<sup>1</sup> Maharashtra State gazetteers (<http://cultural.maharashtra.gov.in>)

## Soil Characteristics

The predominant soil cover in Mumbai city is sandy, whereas in the suburban district, the soil cover is alluvial and loamy. Two types of soils have been observed in the district viz., medium to deep black and reddish colored soil. Soil sampling was done to further establish the baseline characteristics and to assess the anticipated impacts due to proposed project. The project corridor passes along built up (commercial, residential and industrial) and open land areas. In order to ascertain the soil quality, a representative soil samples were collected from two locations namely (i) Navade and (ii) Bhiwandi were got analysed for the parameters as given in **Table 9.2**. The analysis of test result indicates that soil is slightly alkaline, non-saline in nature, have good fertility and texture is medium loam to sandy loam.

**Table 9.2: Physico-Chemical Characteristics of Soils**

S. I.	Parameters	Unit	Navade	Bhiwandi
1.	pH		7.64	7.89
2.	Conductivity	mS/cm	0.086	0.268
3.	Chloride	mg/100 gm	29.36	90.75
4.	Calcium as Ca	mg/100 gm	50.48	139.38
5.	Sodium	mg/100 gm	3.98	16.58
6.	Potassium	Kg/ha	130.52	792.03
7.	Organic matter	%	0.52	0.98
8.	Available Nitrogen as N	Kg/ha	221.26	351.18
9.	Available Phosphorus	Kg/ha	4.70	5.53
10.	Bicarbonates	mg/100 gm	76.73	211.86
11.	Orthophosphate	mg/kg	14.41	16.95
12.	Moisture Content	%	6.58	3.37
13.	Magnesium	ppm	173.35	236.39
14.	Texture			
	i) Sand	%	56.00	62.30
	ii) Silt	%	31.00	28.30
	iii) Clay	%	13.00	9.40

## Seismicity

Mumbai lies in the Bureau of Indian Standards (BIS) in Seismic Zone III, which means the city is at moderate risk. The last time Mumbai witnessed seismic activity was in 2005. Three consecutive tremors of 4-5 magnitude were witnessed. Mumbai lies over more than 10 seismic fault lines. Major fault lines lie along the Thane creek, Ulhas river, the Manori and Malad creeks and the lakes. To the west, a fault line stretches from Colaba to Vasai, touching Malabar hill. The seismic zoning map of India showing Mumbai region is given in the **Figure 9.1**.

### 9.1.1 Water Environment

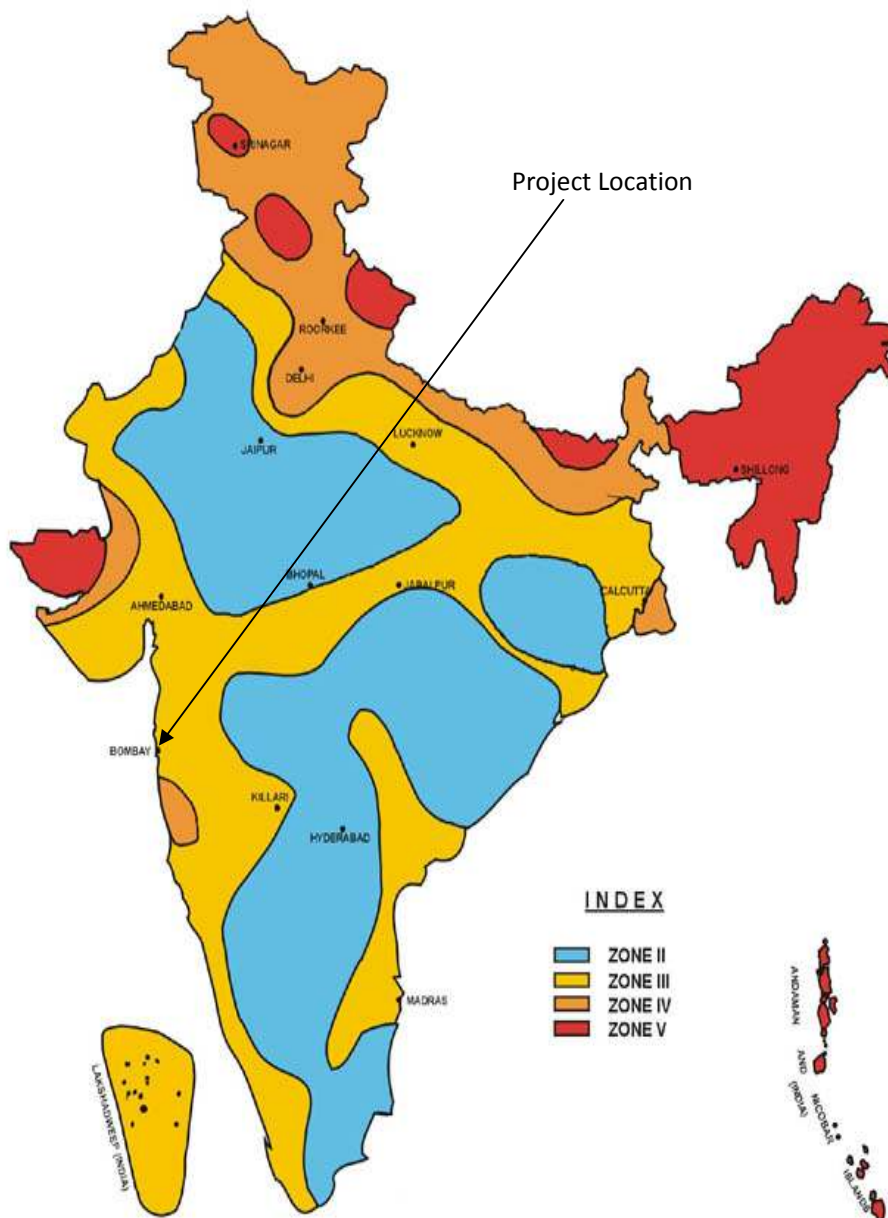
Water environment consists of water resources and its quality. Its study is important from the point of view to assess the sufficiency of water resources for the needs of the project in its various stages of the project cycle and also to assess

the impact of the project on water environment. Anticipated impacts of the proposed project on water environment have also been addressed.

**Water Resources**

Water supply to Mumbai district are from various sources viz. Tulsi Lake (18 MLD), Vihar (110 MLD), Tansa (477 MLD), Vaitarna (1070 MLD) and Bhatsa (1475 MLD). The Central Ground Water Board, Ministry of Water Resources, Government of India monitored ground water depth in May 2007 which is reported in subsequent section.

**Figure 9.1: Seismic Zoning Map of India**





0m bgl are observed in northern part of the area. Spatial variation in post-monsoon depth to water level in major part of the district range between 2 and 5 m bgl. Shallow water levels of < 2 m bgl are observed in small area in southern part, whereas water levels of 5 to 10 m bgl are observed in north central part of the district.

### Water Quality

In order to collect baseline data on the existing water quality, water samples were collected from 2 different locations along the alignment in the project study area and analyzed as per the procedure specified in standard methods for examination of water and wastewater published by American Public Health Association and the Bureau of Indian Standards (APHA/BIS). The results of the physio-chemical analysis are summarized in the **Table 9.3**.

The test results when compared with the prescribed limits of various parameters as per IS 10500:1991 indicated that sample collected from handpump at Navade has all the parameters within permissible limit while samples collected from Ulhas River are saline in nature having high total dissolved solid. The drinking standard specification of IS: 10500-1991 is presented in **Table 9.4** for comparison of results.

**Table 9.3: Chemical Analysis of Water Sample**

Sl. No.	Parameters	Navade (Handpump)	Ulhas River
1.	pH (at 25°C)	6.24	6.65
2.	Odor	Unobjectionable	Unobjectionable
3.	Taste	Agreeable	Salty
4.	Total Hardness as CaCO <sub>3</sub> (mg/l)	279.84	3604.00
5.	Calcium as Ca (mg/l)	42.48	212.42
6.	Alkalinity as CaCO <sub>3</sub> (mg/l)	200.14	184.51
7.	Chlorides as Cl (mg/l)	83.14	17996.19
8.	Residual Free Chlorine (mg/l)	<0.20	<0.20
9.	Cyanide as CN(mg/l)	<0.02	<0.02
10.	Magnesium as Mg (mg/l)	42.25	746.98
11.	Total Dissolved Solids (mg/l)	404.00	30118.00
12.	Sulphates as SO <sub>4</sub> (mg/l)	61.49	46.62
13.	Fluorides as F (mg/l)	1.12	0.89
14.	Nitrate as NO <sub>3</sub> (mg/l)	1.35	1.42
15.	Iron as Fe (mg/l)	0.45	0.53
16.	Boron (mg/l)	<0.50	<0.50
17.	Phenolic compounds (mg/l)	<0.001	<0.001
18.	Zinc as Zn (mg/l)	<0.10	<0.10
19.	Chromium as Cr (mg/l)	<0.01	<0.01
20.	Copper as Cu (mg/l)	<0.02	<0.02



Sl. No.	Parameters	Navade (Handpump)	Ulhas River
21.	Manganese as Mn (mg/l)	<0.10	<0.10
22.	Cadmium as Cd (mg/l)	<0.01	<0.01
23.	Lead as Pb (mg/l)	<0.05	<0.05
24.	Selenium as Se (mg/l)	<0.01	<0.01
25.	Arsenic as As(mg/l)	<0.05	<0.05
26.	Mercury as Hg (mg/l)	<0.02	<0.02
27.	Sodium as Na (mg/l)	34.00	9803.00
28.	Potassium as K (mg/l)	6.90	890.00
29.	Phosphate as PO <sub>4</sub> (mg/l)	0.14	2.50
30.	Total Suspended Solids (mg/l)	31.00	76.00
31.	BOD (mg/l)	3.75	19.50
32.	COD (mg/l)	9.80	63.73
33.	Oil & Grease (mg/l)	<0.4	1.00
34.	PAH (mg/l)	<0.01	<0.01
35.	Dissolved oxygen (mg/l)	5.26	5.26
36.	Nickel (mg/l)	<0.02	<0.02
37.	Pesticides (mg/l)	<0.01	<0.01
38.	Total Kjeldahl Nitrogen (mg/l)	2.93	5.27
39.	Total Coliform Count (MPN/100 ml)	42.00	1380.00
40.	Organic Phosphorus as P (mg/l)	<0.02	0.07

**Table: 9.4 Drinking Water – Specification IS 10500:1991**

S. No.	Substance or Characteristic	Requirement (Desirable Limit)	Permissible Limit in the absence of Alternate source
<b>Essential characteristics</b>			
1.	Colour, (Hazen units), Max	5	25
2.	Odour	Unobjectionable	--
3.	Taste	Agreeable	--
4.	Turbidity (NTU), Max	5	10
5.	pH Value	6.5 to 8.5	No Relaxation
6.	Total Hardness (as CaCo <sub>3</sub> ) mg/L, Max	300	600
7.	Iron (as Fe) mg/L, Max	0.3	1.0
8.	Chlorides (as Cl) mg/L, Max.	250	1000
9.	Residual, free chlorine, mg/L, Min	0.2	--



10.	Fluoride (as F) mg/L, Max	1.0	1.5
<b>Desirable Characteristics</b>			
11.	Dissolved solids mg/L, Max	500	2000
12.	Calcium (as Ca) mg/L, Max	75	200
13.	Magnesium (as mg) mg/L, Max	30	100
14.	Copper (as Cu) mg/L, Max	0.05	1.5
15.	Manganese (as Mn)mg/L, Max	0.10	0.3
16.	Sulfate (as SO <sub>4</sub> ) mg/L, Max	200	400
17.	Nitrate (as NO <sub>3</sub> ) mg/L, Max	45	No Relaxation
18.	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH) mg/L, Max	0.001	0.002
19.	Mercury (as Hg) mg/L, Max	0.001	No relaxation
20.	Cadmium (as Cd) mg/L, Max	0.01	No relaxation
21.	Selenium (as Se) mg/L,Max	0.01	No relaxation
22.	Arsenic (as As) mg/L, Max	0.01	No relaxation
23.	Cyanide (as CN) mg/L, Max	0.05	No relaxation
24.	Lead (as Pb) mg/L, Max	0.05	No relaxation
25.	Zinc (as Zn) mg/L, Max	5	15
26.	Anionic detergents (as MBAS) mg/L, Max	0.2	1.0
27.	Chromium (as Cr <sup>6+</sup> ) mg/L, Max	0.05	No relaxation
28.	Poly nuclear aromatic hydrocarbons (as PAH) g/L, Max	--	--
29.	Mineral Oil mg/L, Max	0.01	0.03
30.	Pesticides mg/L, Max	Absent	0.001
31.	Radioactive Materials		
	i. Alpha emitters Bq/L, Max	--	0.1
	ii. Beta emitters pci/L, Max	--	1.0
32.	Alkalinity mg/L, Max	200	600
33.	Aluminium (as Al) mg/L, Max	0.03	0.2
34.	Boron mg/L, Max	1	5

### 9.1.2 Meteorology and Air Environment

Meteorology is an important parameter for environmental impact assessment study. All air pollutants emitted by point and non-point sources are transported, dispersed or concentrated by meteorological and topographical conditions. The main parameters are: temperature, humidity, rainfall, winds and cloud cover. The meteorological data of Mumbai is collected from Regional Meteorological Centre (RMC), Colaba and Santacruz observatory of India Meteorological Department (IMD) for the year 2009 to year 2011. The meteorology and air environment of the area are discussed in subsequent sections.

#### Meteorology

The climate of Mumbai is characterized by an oppressive summer, dampness in the atmosphere nearly throughout the year, and heavy south-west monsoon rainfall. The cold season from December to February is followed by the summer season from March to June. The period from June to about the end of September constitutes the south-west monsoon season, and October and November form the post-monsoon season.

The monthly total rainfall at station Colaba and Santacruz is given in the **Table 9.5** & **Table 9.6** respectively. The relative humidity at Mumbai ranges between 44 % to 92 % and presented in **Table 9.7** to **Table 9.8**. The mean minimum temperature is 14.9°C and the mean maximum temperature is 35.4°C. Records of mean maximum and mean minimum temperatures are given in **Table 9.9** and **Table 9.10** respectively. The predominant wind direction is south/south-west in monsoon and north/north-east in winter.

**Table 9.5: Total Monthly Rainfall At Station: Colaba**

Parameters	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly total rainfall (mm)	2009	0.000	0.000	Trace	0.000	002.3	265.9	771.3	204.5	519.1	158.3	120.2	Trace
	2010	Trace	Trace	000.0	000.3	000.0	947.4	1099.0	849.8	272.9	122.4	053.7	000.0
	2011	000.0	000.1	000.0	000.0	000.7	461.2	--	--	--	--	--	--

**Table 9.6: Monthly Total Rainfall at Station: Santacruz**

Parameters	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly total rainfall (mm)	2009	000.0	000.0	000.0	000.0	000.3	216.4	1142.2	290.3	322.2	223.3	77.5	Trace
	2010	000.0	Trace	000.0	000.7	000.0	712.1	1250.4	1036.5	328.9	064.0	047.2	000.0
	2011	000.0	000.0	000.0	000.0	Trace	661.7	--	--	--	--	--	--

**Table 9.7: Monthly Mean Relative Humidity at Station: Colaba**

Parameters	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly mean relative humidity	2009	81	86	79	79	79	85	93	91	92	86	85	84
	2010	80	85	88	83	84	92	96	96	90	85	86	78





at 08:30 hrs (%)	2011	80	85	81	83	77	92	--	--	--	--	--	--
Monthly mean relative humidity at 17:30 hrs (%)	2009	61	64	63	67	67	75	88	81	83	76	72	64
	2010	63	62	70	74	72	84	91	90	82	72	73	59
	2011	63	62	58	74	68	84	--	--	--	--	--	--

**Table 9.8: Monthly Mean Relative Humidity at Station: Santacruz**

Parameters	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly mean relative humidity at 08:30 hrs (%)	2009	78	77	73	70	69	74	88	84	87	79	77	75
	2010	65	76	79	69	71	83	91	90	86	84	79	77
	2011	77	77	72	77	71	78	--	--	--	--	--	--
Monthly mean relative humidity at 17:30 hrs (%)	2009	49	44	49	56	63	68	84	77	77	64	61	55
	2010	47	52	54	61	66	75	84	83	75	68	69	57
	2011	45	46	45	65	65	79	--	--	--	--	--	--

**Table 9.9: Monthly Mean Maximum and Minimum Temperature At Station: Colaba**

Parameters	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly mean maximum temperature (°c)	2009	32.0	30.7	32.6	34.2	34.7	33.8	29.5	31.2	31.1	32.7	32.8	32.2
	2010	32.0	30.4	32.1	34.3	35.3	32.4	29.9	29.9	31.7	33.0	33.3	30.9
	2011	30.7	31.2	33.6	33.2	34.2	31.8	--	--	--	--	--	--
Monthly mean minimum temperature (°c)	2009	19.4	19.5	22.5	24.6	26.7	27.7	25.6	26.2	25.8	24.6	23.8	22.3
	2010	21.3	21.8	24.2	26.5	28.5	26.6	25.3	25.6	25.9	25.9	24.9	20.6
	2011	18.6	20.8	23.4	25.3	27.6	26.7	--	--	--	--	--	--

**Table 9.10: Monthly Mean Maximum and Minimum Temperature At Station: Santacruz**

Parameters	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly mean maximum temperature (°c)	2009	32.9	32.6	34.3	35.4	33.9	33.6	29.8	31.1	31.2	33.3	32.9	32.1
	2010	32.5	31.6	33.6	34.6	34.7	33.0	30.3	29.8	31.5	33.0	33.6	30.8
	2011	31.6	32.1	35.3	33.2	33.5	32.0	--	--	--	--	--	--
Monthly mean minimum temperature (°c)	2009	17.9	18.1	21.8	25.1	27.3	27.8	25.4	26.1	25.4	23.1	22.1	19.2
	2010	18.8	19.0	22.2	24.8	27.8	26.1	24.9	25.1	25.2	24.7	23.4	17.4
	2011	14.9	17.2	20.1	23.8	26.8	26.2	--	--	--	--	--	--

**Air Quality**

Ambient Air Quality Monitoring (AAQM) has been carried out by setting up ambient air quality monitoring stations at six locations i.e. near Navade Railway Station, Nilaje Railway Station, Datiwali Railway Station, Bhiwandi Railway Station, Vasai road Railway Station and Virar Railway Station along the project alignment. The results so obtained are reported in Table 9.11. The result shows that PM10 level at Virar Railway station exceeds the specified limit established by CPCB. The revised National ambient air quality standards (NAAQS) laid down by Ministry of



Environment and Forest (MoEF) in 16th November 2009 has been given in Table 9.12 for comparison of results.

**Table 9.11: Air Quality at Project Site**

SI	Location	GPS Coordinate	Date of monitoring	PM2.5 (µg/m3)	PM10 (µg/m3)	NO2 (µg/m3)	SO2 (µg/m3)	CO (mg/m3)	HC (mg/m3)
1.	Nr. Navade Railway Station	19° 03' 07.3" N 072° 06' 14.6" E	24.06.12 to 25.06.12	33.48	79.9	17.72	9.06	<0.50	<0.50
2.	Nr. Nilaje Railway Station	19° 09' 15.6" N 073° 04' 49.9" E	25.06.12 to 26.06.12	30.29	62.13	17.01	7.66	<0.50	<0.50
3.	Nr. Dativali Railway Station	19° 11' 15.6" N 073° 03' 28.5" E	26.06.12 to 27.06.12	34.93	73.91	16.70	8.13	<0.50	<0.50
4.	Nr. Bhiwandi Railway Station	19° 16' 05.7" N 073° 02' 48.9" E	26.06.12 to 27.06.12	40.28	77.12	17.53	8.48	<0.50	<0.50
5.	Nr. Vasai Rd. Railway Station	19° 22' 53.9" N 072° 49' 85.3" E	27.06.12 to 28.06.12	23.62	54.97	16.53	7.47	<0.50	<0.50
6.	Nr. Virar Railway Station	19° 27' 21.3" N 072° 48' 41.8" E	27.06.12 to 28.06.12	47.95	125.02	19.01	9.51	<0.50	<0.50

**Table 9.12: National Ambient Air Quality Standards**

Pollutant	Time	Concentration	
		Industrial, Residential, Rural & other Area	Ecological Sensitive area
Sulphur Dioxide (SO <sub>2</sub> ) in µg/m <sup>3</sup>	Annual	50	80
	24 Hours	80	80
Oxides of Nitrogen (NO <sub>x</sub> ) in µg/m <sup>3</sup>	Annual	40	30
	24 Hours	80	80
Particulate Matter size less than 10µm in µg/m <sup>3</sup>	Annual	60	60
	24 Hours	100	100
Particulate Matter size less than 2.5µm in µg/m <sup>3</sup>	Annual	40	40
	24 Hours	60	60
Carbon Monoxide (CO) in mg/m <sup>3</sup>	8 Hours	02	02
	1 Hour	04	04
Ozone (O <sub>3</sub> ) in µg/m <sup>3</sup>	8 Hours	100	100
	1 Hour	180	180
Lead (Pb) µg/m <sup>3</sup>	Annual	0.50	0.50
	24 Hours	1.0	1.0
Ammonia µg/m <sup>3</sup>	Annual	100	100
	24 Hours	400	400
Benzene (C <sub>6</sub> H <sub>6</sub> ) µg/m <sup>3</sup>	Annual	05	05
Benzo (a) pyrene (BaP) Particulate phase only, ng/m <sup>3</sup>	Annual	01	01
Arsenic (As) ng/m <sup>3</sup>	Annual	06	06
Nickel (Ni) ng/m <sup>3</sup>	Annual	20	20

Source: CPCB guidelines

### Noise Environment

Noise levels were measured at six locations i.e. near Navade Railway Station, Nilaje Railway Station, Dativali Railway Station, Bhiwandi Railway Station, Vasai road Railway Station and Virar Railway Station along the project alignment by sound level meter. The noise levels measured are summarised in **Table 9.13**. The National Ambient Noise Quality Standards of CPCB is given in **Table 9.14** for

comparison. It is observed that the noise level at all locations exceeds the specified limit of 65 dBA (day) and 55 dBA (night) for commercial category due to large vehicular movement throughout the day.

**Table 9.13: Noise Levels along the Alignment Db (A)**

S. No.	Parameter	Monitoring Location						CPCB Limit
		Nr. Navade Railway Station	Nr. Nilaje Railway Station	Nr. Datiwali Railway Station	Nr. Bhiwandi Railway Station	Nr. Vasai Rd. Railway Station	Nr. Virar Railway Station	
1.	Lmin.	38.40	37.80	38.00	37.50	37.40	38.10	-
2.	Lmax.	93.40	80.70	90.20	98.70	87.10	85.10	-
3.	Ld	68.49	68.72	78.90	83.72	79.19	78.10	65
4.	Ln	57.14	56.85	67.57	56.19	66.96	69.76	55
5.	Ldn	66.74	66.97	77.15	81.96	77.43	76.36	-
6.	Leq.	64.71	64.76	75.13	74.55	75.11	75.32	-
7.	L10	70.41	69.53	81.31	83.20	80.40	82.62	-
8.	L50	64.30	65.20	72.55	70.10	76.45	73.95	-
9.	L90	42.04	45.87	47.47	46.40	44.98	48.09	-

**Table 9.14: National Ambient Noise Quality Standards**

Area Code	Category of Area	Limits in dB (A) Leq	
		Day time*	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence Zone**	50	40

Source: CPCB guidelines

### Location of Depot

The depot has been planned between proposed rail stations Kalwar to Dunge (Chainage 38,523 m to 39,850 m) covering an area of 34.80 ha. The land use of the area is partly barren and agriculture. The water body of 1023 sqm area exists within the proposed depot.

### 9.1.3 Ecological Environment

#### Flora & Fauna

Trees survey was carried out along the proposed alignment. During site visit, trees on left side of the proposed Panvel-Vasai Road section and right side of Vasai Road-Virar Section have been observed. Approximately 125 trees have been observed along the project alignment and it is expected that these trees are likely to be disturbed due to construction of proposed project. The type of species observed is Gulmohar, Peepal, Coconut, Palms, Neem etc. No rare or endangered species of trees have been noticed during field studies. An inventory of trees likely to be lost is presented in Table 9.15.



**Table 9.15: Loss of Flora**

S.No	FROM	TO	NO. OF TREES
1	Panvel	At Station	04
	Panvel	New Panvel	00
2	New Panvel	At Station	00
	New Panvel	Tembode	00
3	Tembode	At Station	00
	Tembode	Kalamboli	00
4	Kalamboli	At Station	00
	Kalamboli	Navade Road	00
5	Navade Road	At Station	00
	Navade Road	Pindhar	00
6	Pindhar	At Station	00
	Pindhar	Taloje	00
7	Taloje	At Station	00
	Taloje	Nighu	00
8	Nighu	At Station	00
	Nighu	Narivali	00
9	Narivali	At Station	00
	Narivali	Nilaje	00
10	Nilaje	At Station	00
	Nilaje	Nandivali	00 (Ramp)
11	Nandivali	At Station	02 (Elev)
	Nandivali	Kopar	08
12	Kopar	At Station	00 (Elev)
	Kopar	New Dombivali	00
13	New Dombivali	At Station	00
	New Dombivali	Pimplas	02
14	Pimplas	At Station	00
	Pimplas	Bhiwandi Road	01
15	Bhiwandi Road	At Station	00
	Bhiwandi Road	Kalwar	00
16	Kalwar	At Station	00
	Kalwar	Dunge	00
17	Dunge	At Station	00
	Dunge	Kharbao	00
18	Kharbao	At Station	00
	Kharbao	Payegaon	02
19	Payegaon	At Station	00
	Payegaon	Kaman Road	00
20	Kaman Road	At Station	00
	Kaman Road	Juchandra	00
21	Juchandra	At Station	00
	Juchandra	Vasai Road	03
22	Vasai Road	At Station	11 (Ramp)
	Vasai Road	Nalasopara	03 (ramp)
23	Nalasopara	At Station	01 (Ramp)
	Nalasopara	Virar	01
24	Virar	At Station	00
25	At Depot	Kalwar to Dunge (34.80) ha	87
<b>TOTAL:</b>			<b>125</b>



### Mangroves

The mangrove forest in the District belong to the group “Littorai and swamp Forest”. The mangrove forest consists mostly of evergreen trees and shrubs belonging to several unrelated families and share similar habitat preferences and a similar physiognomy. In the area, lower salinity species of mangroves are *Rhizophora apiculata*, *Avicennia officinalis* and *Kandelia rheedii*.

During field visits it was observed that the proposed alignment passes through the mangrove stretch of 4825 sqm area. The proposed rail track corridor is passing parallel to the existing Central and Western Railway. There is no alternative to change the alignment to avoid the mangrove area. Three random quadrates of 10m X 10m were laid along the alignment to study the mangrove. During the survey, number of mangroves in each quadrate were counted and girth, height and cover of each individual was measured. The density of mangroves along the corridor is 4 numbers per 10 m<sup>2</sup>. The height and girth of the mangroves varies between 0.6 m – 1.5 m and 10 cm- 30 cm respectively. The details of mangrove area are given in the Table 9.16.

**Table 9.16: Details of Mangrove Area**

SI	Particulars	Chainage	Area (sqm)
1	Kharbao to Payegaon	45,900 m to 46,300 m	1170
2	Juchandra to Vasai Rd	59,400 m to 59,576 m	3655
<b>Total</b>			<b>4825</b>

The **Figure 9.2** shows the alignment passing through mangrove areas. The proposed alignment passing through mangrove area is shown in red colour and mangroves affected area in blue colour.

**Figure 9.2: Alignment passing through Mangrove Area**



**Kharbao station to Payegaon Station**



Juchandra station to Vasai station

The coastal stretches in India are protected by Coastal Regulation Zones Notification, 2011 under Environmental (Protection) Act, 1986. The clearance process for CRZ is explained in the subsequent paragraph.

**Procedure for CRZ clearance:** All projects attracting this notification and those activities not listed in the EIA notification, 2006 shall be considered for CRZ clearance as per the following procedure,

(i) The project proponents shall apply with the following documents seeking prior clearance under CRZ notification to the concerned State or the Union territory Coastal Zone Management Authority,-

- (a) Form-1 (Annexure-IV of the CRZ notification);
- (b) Rapid EIA Report including marine and terrestrial component except for construction projects listed under 4(c) and (d)
- (c) Comprehensive EIA with cumulative studies for projects in the stretches classified as low and medium eroding by MoEF based on scientific studies and in consultation with the State Governments and Union territory Administration;
- (d) Disaster Management Report, Risk Assessment Report and Management Plan;
- (e) CRZ map indicating HTL and LTL demarcated by one of the authorized agency (as indicated in para 2) in 1:4000 scale;



- (f) Project layout superimposed on the above map indicated at (e) above;
  - (g) The CRZ map normally covering 7km radius around the project site.
  - (h) The CRZ map indicating the CRZ-I, II, III and IV areas including other notified ecologically sensitive areas;
- (ii) No Objection Certificate from the concerned State Pollution Control Boards or Union territory Pollution Control Committees for the projects involving discharge of effluents, solid wastes, sewage and the like.;
- (iii) The concerned CZMA shall examine the above documents in accordance with the approved CZMP and in compliance with CRZ notification and make recommendations within a period of sixty days from date of receipt of complete application,-
- (a) MoEF or State Environmental Impact Assessment Authority (hereinafter referred to as the SEIAA) as the case may be for the project attracting EIA notification, 2006;
  - (b) MoEF for the projects not covered in the EIA notification, 2006 but attracting para 4(ii) of the CRZ notification;
- (iv) MoEF or SEIAA shall consider such projects for clearance based on the recommendations of the concerned CZMA within a period of sixty days.

#### **9.1.4 Social Impact Assessment**

Development of proposed Panvel-Virar Corridor involves acquisition of land for stations, running sections, TSS, Depot and for other facilities. Acquisition of this private land may cause social disruption and economic loss for the project affected families/people. While implementing the project, there is a need to take into account these disturbances and losses due to the project, their impact on socio-economic condition of the people and plan for their mitigation measures to minimise any negative impacts. The details of land acquisition, number of affected structures (legal and illegal) and affected families and socio-economic profile of affected families on the basis of sample survey is presented in this section.

##### **Scope of Land Acquisition**

In order to keep acquisition of private land to the minimum, the alignment has been so chosen that it remains mostly within Railway land. However, development of this rail corridor involves acquisition of land for entry, exit and for other facilities of station and running section. For different components of this corridor, a total 62.23 hac (54.63 hac Private land and 7.60 hac Government land) land will be required. About 34.80 hac of land would be acquired for depot at



Kalwar village between Bhiwandi and Kharbao station and this land is under private possession. The details of land requirement are presented in **Table 9.17**.

**Table 9.17: Land Requirement**

Description	Area (ha)			Total Area (ha)
	Running Section	Stations	Depot	
Government Land	5.25	2.34	0	7.60
Private Land	14.27	5.55	34.81	54.63
<b>Total</b>	<b>19.53</b>	<b>7.89</b>	<b>34.81</b>	<b>62.23</b>

### Impact on Structures

**Table 9.18** indicates impact of the proposed project on the different types of structures i.e. residential, commercial, residential cum commercial and other types. The total number of structures impacted in this corridor is 66 including 24 jhugies. Out of the total structures, 53 are residential, 09 are commercial and remaining 04 are such structures which includes public toilet, religious structures, school. About 16 residential structures will be affected adversely between Panvel and Nandivali.

**Table 9.18 Area Wise Impact on Structures**

S.I	Area	Chainage	Type of Structures			Total
			Residential	Commercial	Others	
1	Panvel-Tembode	1615.000-2485.739	11	0	1	12
2	Nilje-Nandivali	19944.041-224930.00	5	0	0	5
3	Nandivali-Kopar	25300.00-	9	0	0	9
4	Juchandra-Vasai Road	61970.333-62300.00	2	0	1	3
5	Vasai Road-Nalasopara	66700-66972	2	7	2	11
6	Nalasopara-Virar	67156-70009.907	24	2	0	26
<b>Total</b>			<b>53</b>	<b>9</b>	<b>4</b>	<b>66</b>

### Magnitude of Project Impact on the Structures

**Table 9.19** indicates the magnitude of project impact on the structures, which is categorized as partially and fully affected structures. Out of total 66 structures, 37 structures are fully affected and remaining 29 structures are partially affected. It is observed from the data that majority of structures will be affected fully between Nilje and Nandivali (04 structures) and between Panvel and Tembode





(12 structures). About 21 structures will be partially affected as the boundary walls of these structures are coming along the alignment.

**Table 9.19 Area Wise Partially/Fully Affected Structures**

S.No	Area	Chainage	Structures Affected		Total
			Partially	Fully	
1	Panvel-Tembode	1615.000-2485.739	0	12	12
2	Nilje-Nandivali	19944.041-224930.00	1	04	05
3	Nandivali-Kopar	25300.00-	3	6	9
4	Juchandra-Vasai Road	61970.333-62300.00	2	1	3
5	Vasai Road-Nalasopara	66700-66972	2	9	11
6	Nalasopara-Virar	67156-70009.907	21	5	26
<b>Total</b>			<b>29</b>	<b>37</b>	<b>66</b>

**Category of Structure Affected**

Table 9.20 shows that out of total titleholders, 42 are titleholders and remaining 24 are non-titleholders. It is found that about 05 legal structures are likely to be affected at station between Nilje and Nandivali whereas boundary wall of 21 legal structures are also likely to be affected at station between Nalasopara and Virar. Out of the total 24 illegal structures called non-titleholders, 11 are found between Panvel and Tembode, seven and five structures are found between Vasai Road and Nalasopara and between Nalasopara and Virar respectively.

**Table 9.20 Area Wise Category of Structures Affected**

S.No	Area	Chainage	Category of Structures		Total Structures
			Titleholders	Non-Titleholders	
1	Panvel-Tembode	1615.000-2485.739	1	11	12
2	Nilje-Nandivali	19944.041-224930.00	5	0	5
3	Nandivali-Kopar	25300.00-	9	0	9
4	Juchandra-Vasai Road	61970.333-62300.00	2	1	3
5	Vasai Road-Nalasopara	66700-66972	4	7	11
6	Nalasopara-Virar	67156-70009.907	21	5	26
<b>Total</b>			<b>42</b>	<b>24</b>	<b>66</b>



### Impact on PAFs/PAPs

It is evident from the **Table 9.21** that about 75 families consisting 366 persons will be affected due to the proposed rail project. Majority of families will be affected at station between Nilje and Nandivali and between Nandivali and Kopar. Exact number of displaced families will be found out during baseline socio-economic survey

**Table 9.21 Area Wise Impact on PAFs/PAPs**

S.No	Area	Chainage	Total PAFs*	Total PAPs*
1	Panvel-Tembode	1615.000-2485.739	11	54
2	Nilje-Nandivali	19944.041-224930.00	15	73
3	Nandivali-Kopar	25300.00-	21	102
4	Juchandra-Vasai Road	61970.333-62300.00	7	34
5	Vasai Road-Nalasopara	66700-66972	13	64
6	Nalasopara-Virar	67156-70009.907	8	39
<b>Total</b>			<b>75</b>	<b>366</b>

\*The above figure indicates approximate PAFs and PAPs(4.85 persons per family).

### Impact on Community Structures

**Table 9.22** indicates the impact of the proposed rail project on community structures. The project shall impact total 04 community structures. Out of the total four structures, 03 are identified as temples and one is school.

**Table 9.22 Area Wise Impact on Community Structures**

S.No	Area	Chainage	Community Structures			
			Temple	School/College	Toilet	Total
1	Panvel-Tembode	1615.000-2485.739	0	1	0	1
2	Nilje-Nandivali	19944.041-224930.00	0	0	0	0
3	Nandivali-Kopar	25300.00-	0	0	0	0
4	Juchandra-Vasai Road	61970.333-62300.00	1	0	0	1
5	Vasai Road-Nalasopara	66700-66972	2	0	0	2
6	Nalasopara-Virar	67156-70009.907	0	0	0	0
<b>Total</b>			<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### Demographic and Social Profile of the PAFs

Demographic & Social Profile: Demographic and social profile of project affected families and persons is presented in **Table 9.23**. Sex Ratio is very helpful indicator to know the participatory share of males and females in a region, which is also an important indicator for human development index. Among the surveyed population, it is observed that there are 279(54.1%) males and 237(45.9%) females.

The majority (41.9%) of family members belong to the age group of 36-60 years and 35.9 % belong to the age group to 15-35 years. Remaining 14.1% and 8.1% of family members belong to the age below 14 years and above 60 years respectively. The majority of the population are Hindus (81.5%) and remaining 18.5% are Muslims. A look at the data regarding the caste heritage reveals that the majority of the people (48.1%) come from OBC. But the second largest group of the people in project-affected areas belong to general caste (29.6%). It is observed that 26.8% persons have studied up to primary, 23% studied up to Secondary, 30.7% studied up to High School and 6.6% up to college. It is important to be noted that 12.9% of project affected people are illiterate.

**Table 9.23: Demographic and Social Profile of PAFS/PAPS**

S.No	Description	Frequency	Percentage (%)
<b>1.</b>	<b>Sex</b>		
1.1	Male	279	54.1
1.2	Female	237	45.9
<b>2.</b>	<b>Age Composition</b>		
2.1	0-14 yrs	73	14.1
2.2	15-35yrs	185	35.9
2.3	36-60yrs	216	41.9
2.4	>60	42	8.1
<b>3.</b>	<b>Religion</b>		
3.1	Hindu	22	81.5
3.2	Muslim	5	18.5
<b>4.</b>	<b>Social Group</b>		
4.1	SC	6	22.2
4.2	ST	0	0
4.3	OBC/BC	13	48.1
4.4	General	8	29.6
<b>5.</b>	<b>Education</b>		
5.1	Illiterate	59	12.9
5.2	Primary	122	26.8
5.3	Secondary	105	23.0
5.4	High School	140	30.7
5.5	College	30	6.6

### Economic Conditions of PAFs

Main occupation of the head of household is business (37%) followed by labour (29.6%), service(18.5%) and agriculture (14.8%). About 11.1% of families have their income less than Rs. 25,000/-, 7.4% of them have an income of Rs.25, 001-50,000/- per annum. About 29.6% of the families have an income range between Rs.50, 001 to 1, 00000 per annum. About 40.7% of the families have an income between Rs.1, 00,000 to 2, 00,000/- per annum and about 11.1% of them have an income more than Rs.2,00,000/ per annum. However, the average family income is Rs. 110648.53/- per annum. Economic condition of PAFs is given in **Table 9.24**.

**Table 9.24: Economic Condition of PAFs**

S.No.	Description	Frequency	Percentage (%)
<b>1.</b>	<b>Occupation</b>		
1.1	Agriculture	4	14.8
1.2	Labour	8	29.6
1.3	Business	10	37.0
1.4	Service	5	18.5
<b>2.</b>	<b>Family Income (Annual Rs.)</b>		
2.1	< 25,000	3	11.1
2.2	25,001-50,000	2	7.4
2.3	50,001-1,00000	8	29.6
2.4	1,00001-1,50000	5	18.5
2.5	1,50001-2,00000	6	22.2
2.6	>2,00000	3	11.1
2.7	Avg. Annual Income(Rs.)		1,10,648.53/-

### Family Pattern and its Size

The family particulars of PAFs are given in **Table 9.25**. Out of total Project Affected Families majority (74%) are nuclear, 19% are joint. Family size has been classified into four categories i.e., individual, small (2-4), medium (5-7) and large (7 & above). Majority of the families (47%) are small, 30.9% are medium and 14.5% families are large. Average size of family is four persons.

**Table 9.25: Family Particulars**

S.No.	Description	Frequency	Percentage (%)
<b>1</b>	<b>Type of Family</b>		
1.1	Joint	5	18.5
1.2	Nuclear	20	74.1
1.3	Individual	2	7.4



2	Size of Family		
2.1	Individual	2	74
2.2	Small (2-4)	6	22.2
2.3	Medium (5-6)	14	51.9
2.4	Large (7 & above)	5	18.5

## 9.2 POSITIVE ENVIRONMENTAL IMPACTS

Based on project particulars and existing environmental conditions, potentials positive and negative impacts have been identified that are likely to result from the proposed sub-urban rail corridor. The negative impacts are also analysed and presented. However, the positive impacts of the projects are given below:

### 9.2.1 Employment Opportunity

The proposed sub-urban rail project is likely to be completed in a period of five years. During construction local skilled and unskilled labourers will have an opportunity for employment directly or indirectly. Approximately 2000 persons are likely to work for construction of the project. In operation phase of the project about 45 persons per kilometre length of the corridor, i.e. (approx. 3,128 persons) will be employed for operation and maintenance of the proposed system. Thus, the project would provide substantial direct employment; besides, more people would be indirectly employed in allied activities and trades.

### 9.2.2 Benefits to Economy

The road and rail infrastructure development could not keep pace with the growing demand for last 4-5 decades due to the City's geographical constraint. Also, the development of Navi Mumbai picked up only after the Harbour line of Central Railway was extended from Mankhurd to Belapur in the year 1992 and thereafter to Panvel. The suburban railway line is now facing capacity constraints. Presently non-air conditioned EMU trains for practically 20 hours a day and are overcrowded during peak traffic hours on harbour line. There is no sub-urban trains on Panvel- Virar section. Hence, in order to improve the overall traffic and transportation scenario in Mumbai/ MMR and to cater to the future travel needs, MMRC and MMRDA have been introducing fast track on harbour line and sub-urban train service along main line from Panvel to Virar. This will facilitate people



to move quickly from CST to Panve and from Navi Mumbai area to Vasai Road-Virar area.

With the development of sub-urban corridor, it is likely that more people will be involved in trade, commerce and allied services due to better connectivity with the harbour line and western line making use of this suburban track rail corridor.

### 9.2.3 Reduction in the Vehicle Trip Kms on the Road

The reduction in vehicle trip Kms in the years 2021, 2031 and 2041 is indicated in **Table 9.26** after the introduction of sub-urban rail system. The basis of reduction of vehicle is shift of ridership from road vehicle to the proposed system. The reduction in number of vehicles gives benefits to economy by reduction in Vehicle Operating Cost (VOC), Fuel Consumption, Pollution Load, Accidents and Travel Time etc.

**Table 9.26: Reduction of vehicle trip Kms for the years 2021, 2031 and 2041 (avg. daily)**

Mode	No. of Vehicle Trip Kms Without Virar - Panvel Suburban Corridor		
	2021	2031	2041
Bus (Diesel)	146976	347025	621460
Bus (CNG)	250256	590880	1058162
Car (Petrol)	146976	347025	621460
Car (diesel)	250256	590880	1058162
Taxi (Petrol)	139031	328267	587867
Taxi (Diesel)	258201	609639	1091754
2 Wheeler (Petrol)	2261169	5872731	10517015
Auto (CNG)	190205	373271	668461
Auto (Diesel)	404184	793200	1420480
<b>Total</b>	<b>3778626</b>	<b>9218660</b>	<b>16508977</b>

### 9.2.4 Reduction in Air Pollution

Reduction in traffic on roads due to proposed sub-urban rail could lead to reduction in air pollution. Reduction in number of vehicles and the Emission factor of vehicles as per Euro-II norms taken and the reduction level of different pollutants like PM, NOx, HC, CO and CO2 for the years 2021, 2031 and 2041 is given in **Table 9.27**.

**Table 9.27: Reduction in Pollution Emission Due to Reduction of Vehicles (Tonnes/Year)**

Emission Reduction	Year		
	2021	2031	2041
Particulate Matter (PM)	94.42	219.70	393.44
Oxides of Nitrogen (NO <sub>x</sub> )	1128.99	2622.81	4696.98
Hydrocarbons (HC)	897.67	2205.38	3901.63
Carbon Monoxide (CO)	1469.18	3555.34	6366.98
Carbon Dioxide (CO <sub>2</sub> )	4766	11625	20687

### 9.2.5 Carbon-Di-Oxide Reduction

Carbon dioxide is one of the major greenhouse gases, which directly deplete the ozone layer. To reduce the overall greenhouse gas emissions International Emission Trading (IET) Mechanism has been followed under Kyoto Protocol. Under IET mechanism, countries can trade in the international carbon credit market. Countries with surplus credits can sell the same to countries with quantified emission limitation and reduction commitments under the Kyoto Protocol. Carbon credits are measured in units of certified emission reductions (CERs). Each CER is equivalent to one ton of carbon dioxide reduction. Therefore, 4766, 11625 and 20687 Carbon credits per year will be achieved through this project in the 2021, 2031 and 2041 respectively. In economic terms it will be valued as Rs. 28.77 lakh, Rs. 70.18 lakh and Rs. 124.88 lakh for year 2021, 2031 and 2041 respectively.

## 9.3 NEGATIVE ENVIRONMENTAL IMPACTS

Based on project particulars and existing environmental conditions, potential negative impacts likely to result from the proposed development have been identified. Negative impacts have been listed under the following headings:

- Impacts due to project location
- Impacts due to construction works, and
- Impacts due to project operation.

### 9.3.1 Impacts Due To Project Location

#### Change of Land use

Development of proposed Panvel-Virar rail corridor will require 68.91 hac of land. Out of the total requirement of land, 60.92(88.41%) hac of land is government and 7.99 (11.59%) hac is under private possession.

**Table 9.28: Acquisition of Land**

S.No.	Land Requirement	Area (in ha.)	Percentage (%)
1	Govt. Land	7.99	11.59
2	Private land	60.92	88.41
	<b>Total</b>	<b>68.91</b>	<b>100.00</b>

### Displacement of People

About 106 families constitute 516 persons are likely to be affected due to the acquisition of land. Exact number of displaced families will be found out during baseline socio-economic survey.

### Loss of Trees

Approximately 125 trees have been observed along the project alignment & at Depot and it is expected that these trees are likely to be affected due to construction of proposed project.

With removal of these trees the process of CO<sub>2</sub> absorption, O<sub>2</sub> production and the income from forest products will get affected and the losses are reported below.

S.No.	Description	Quantity
1.	Total no. of Trees	: 125
2.	Increase in CO <sub>2</sub> @ 21.8 Kg/year/ tree	: 2725 kg
3.	Decrease in Oxygen production @ 49 Kg/year/tree	: 6125 kg

Total loss of carbon credit is 2.72 per year due to cutting of 125 trees. About 6125 kg of oxygen production will get reduced because of tree loss.

### Loss of Mangroves

The most part of the proposed alignment is at grade and hence construction activities at mangrove affected area will disturb the mangroves. About 4825 sqm mangrove areas are likely to be affected due to construction of proposed rail track corridor.

### Loss of Historical and Cultural Monuments

The proposed Panvel Virar New Sub-urban Rail Track is proposed along the existing Virar-Vasai-Diva-Panvel line within the Right of Way. Depot is proposed





on open land between Kalwar and Dunge station. Hence, no loss of Historical and Cultural Monuments is anticipated.

### **Impacts on Water Bodies**

The proposed alignment is passing through Ulhas River, Mutali River and 20 numbers of nalas. The construction of pillars/abatement/culvert on river and nalas may cause temporary impact. However, during construction specific precautions would be taken by disposing the excavated earth/debris immediately generated during construction to have minimal impact of the construction activities.

### **Utility/Drainage problems**

The alignment will cross drains / nalas large number of sub-surface, surface and overhead utility services, viz. sewer, water mains, storm water drains, telephone cables, electric pipes, etc. These utilities services are essential and have to be maintained in working order during different stages of construction by temporary/permanent diversions or by supporting in position. Since these affect construction and project implementation time schedule/ costs for which necessary planning/ action needs to be initiated in advance.

## **9.3.2 Impacts Due to Project Construction**

### **Soil Erosion and Soil Pollution**

Though the project may not have significant impact on soil erosion, however, minor impact on soil erosion due to runoff from unprotected excavated areas may result in soil erosion, especially when erodibility of soil is high. Mitigation measures include careful planning, timing of cut-and-fill operations and re-vegetation. Problems could arise from dumping of construction soils (concrete, bricks), waste materials (from contractor's camp) etc. causing surface and ground water pollution. Hence, it is proposed to have Ready Mix Concrete (RMC) directly from batching plant for use at site. Batching plants should be located away from the site preferably, away from the human settlements.

### **Health Risk at Construction Site**

Health risks during construction activity include disease hazards to workers due to lack of sanitary facilities like safe disposal of human waste and garbage clearance and disposal facility. In order to avoid such a situation, proper mitigation measures should be incorporated, which should include proper water supply, sanitation, drainage, healthcare and human waste disposal facilities in labour



camps. In addition reduced contaminated water spillage and adoption of disease control measures should be adopted to reduce the health risks.

### **Impact on Water Quality**

Construction activities may have impact on water bodies due to disposal of waste. The waste could be due to the spillage of construction materials, dumping of used water from the stone crusher, oils and greases, and labour camp. But the quantities of such spills are very negligible. Care, however, needs to be taken to provide adequate sanitary facilities and drainage in the temporary colonies of the construction workers. Provision of adequate washing and toilet facilities with septic tanks and appropriate refuse collection and disposal system should be made obligatory. Contamination of ground water can take place, if the dump containing above substances gets leached and percolate into the ground water table. This is not the case with the present project, as the activity does not involve usage of any harmful ingredients. Moreover, activities are of short duration. Hence, in overall, the impact on either ground or surface water quality is anticipated to be minimum due to the present project.

### **Air Pollution**

The dust will be produced due to excavation, loading and unloading and transportation of construction materials, vehicular and construction equipment emission and emission from the DG sets etc,. Construction work of the New sub-urban rail track will have more impact on the air quality at station and at depot locations as compared to running section. In the previous section, the existing conditions of air quality along the alignment are described. The monitoring results of pollutants such as PM 2.5, PM10, NO<sub>2</sub>, SO<sub>2</sub>, CO and HC are within the permissible limit of the national standards (NAAQS, CPCB), however, the dust concentrations monitored near Virar Railway station is 1.25 times higher than the standard value. Hence, dust could be the problem at these locations when the project is under construction. Impacts associated with pollutant emissions during construction are expected to be of short term, thus resulting in a low impact on long-term air quality and visibility. The management plan for reduction of construction stage impact is given in subsequent section. During operation phase of the project there will be no impacts on air quality of the region.

### **Noise Pollution**

The major sources of noise pollution during construction are movement of vehicles for transportation of construction material and the construction machinery/equipment at the construction site. As seen in **Table 9.29**, construction activities are expected to produce noise levels in the range of 104 - 109 dB (A) at source which decreases with increase in distance.

**Table 9.29: Forecasted Noise Levels**

Sl	Particulars	Noise Levels in dB (A) without Noise Controls	
		At Source	At 50 feet
1	1.5 cum capacity Excavator / Loader	109	85
2	8.33 cum capacity rear end dumper	108	84
3	Crawler Dozer	109	85
4	Heavy Duty jack Hammer	109	85
5	Compressor	104	80
6	Crane	107	83
7	Generator	105	81
8	Rock Drill	122	98

Data taken from "construction equipment noise levels and ranges report" of Federal Highway Administration.

Exposure to noise may lead to complete hearing loss, tension, fatigue, fast pulse/respiration rates, dizziness & loss of balance, anger, irritation & in extreme case nervousness. Careful planning of machinery operation and scheduling of operations can however reduce the noise levels. Construction of noise barriers, such as temporary walls between noisy activities and receivers reduces noise by up to 15 dB(A). Vegetation cover also reduces the noise level. The overall noise during construction will be for short-term and can be mitigated as mentioned in Management Plan.

### Impact due to Labour Camp

About 2000 persons are likely to work during peak construction activity. The skilled workers will be associated with specialized work while the local workers will be employed for other associated work like earthwork and concreting. About 700 skilled workers will stay at each labour camp having three labour camps at appropriate and suitable locations. Considering that 80% of labourers are married, in 80% of married families both husband and wife will be working and taking average family size as 3, total workforce in the labour camps will be about 1100. The water requirement at camp will be 77 KLD, waste water generation 61.6 KLD & Municipal solid waste generation 385 Kg per day.

### 9.3.3 Impacts Due to Project Operation

#### Noise

The main source of noise will be from running of trains. Noise radiated from train operations and track structures generally constitute the major noise sources. The maximum noise level will be during application of break near platform. The average noise level will be around  $85 \pm 1.0$  dB (A). Wayside Noise Level at 15 m from track Centre Line and at 25 km/h will be  $71.5 \pm 2.0^2$ .

<sup>2</sup> A study conducted by National Physical Laboratory for Delhi Metro.



### **Accidental Hazards**

In view of the hazards potential involved due to failure of system and accident the on-site and off- site emergency measures need to be formulated and shall be implemented by the construction agency during construction and by railway authority during operational phases.

### **Water Supply**

The IS 1172: 1993 (Reaffirmed 1998) code of basic requirements for Water Supply, Drainage and Sanitation has recommended 25-litres/day, water supply to persons working at railway stations without bathing facilities. Water requirement at all stations has various components, viz. Personal use of Staff, Fire demand, Make up water for air conditioning and ventilation, and wastage. The water demand at all stations would be about 85.5 Kilo litres per day. Twenty four (13 existing and 11 New) have been proposed along the new sub-urban corridor from Panvel to Virar. The water requirement for passenger at 13 existing station will be met from the existing linked interchanged stations. The eleven new stations will meet their water requirement from Municipal Corporation. Platform washing requirement has been worked out at the rate of 2-lit per sq.m.

### **Railway Station Refuse**

An additional station refuse will be generated about 342 kg/day from the operating staff.

### **Visual Impacts**

The construction of proposed suburban rail track corridor will bring about a change in visual look through which it will operate. An architecturally well-designed structure, which could be aesthetically pleasing and able to reduce impact due to visual disfiguration, may be incorporated in present corridor.

#### **9.3.4 Impact Due to Depot**

The depot has been planned between proposed rail stations Kalwar to Dunge. The area of depot is about 34.80 hectares. The depot will have following facilities:

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

These facilities could generate water and noise issues. The area will be levelled through cut and fill method within the depot. Problems anticipated at depot sites are:



### **Water Supply**

Water supply will be required for different purposes in the depot. The water requirement for train washing purpose will be 500 litres/car/day. About 66.5 KLD of fresh water will be required at Depot for different uses. Other water requirement for horticulture, flushing urinals/closet will be met from recycled water. The water after conventional treatment can be processed through Reverse Osmosis (RO) technology for specific use such as washing of equipment/ trains. This will reduce the fresh water requirement.

### **Effluent Treatment**

About 53.2 KLD of waste is to be generated at depot, which will be treated at 100 KLD effluent treatment plant. The treated waste water will be tested for Inland Water Discharge Standard before release in to water body, if required. The part of the water will be recycled to use at depot horticulture purpose.

### **Oil Pollution**

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

### **Noise Pollution**

The main source of noise from depot is during operation of workshop. The roughness of the contact surfaces of rail, wheel and train speed is the factors, which influence the magnitude of rail - wheel noise. The vibration of concrete structures also radiates noise. No impact on the ambient noise is anticipated due to mild activities.

### **Surface Drainage**

Due to the filling of the low-lying area for the construction of depots, the surface drainage pattern will change. Suitable drainage measures will be adopted to drain off the area suitably in the nearby water body.

### **Solid Waste**

At per available data, it is estimated that about 1.8 Ton per month of solid waste will be generated from the Depot.

### Vegetation at Depot

The 87 number of trees exists at the depot area. The various units of the depot should be designed and fixed in such a way to protect the vegetation existing in the depot area.

## 9.4 ENVIRONMENTAL MANAGEMENT PLAN

Based on environmental baseline conditions, planned project activities and its impacts assessed, the set of measures to be taken during implementation and operation to avoid or offset adverse environmental impacts or to reduce them to acceptable levels, together with the action which needs to be taken to implement them are enumerated in this section.

### 9.4.1 Compensation for Loss of Trees

It is expected that 125 trees are likely to be lost due to construction of proposed project. It is presumed that Government land will be provided for afforestation; hence no land cost will be involved. Land for plantation of trees will be identified by the project proponent in consultation with Forest Department of State Government. Thus, the total cost of compensatory afforestation and fencing works out to **Rs. 37.50 Lakhs**. The Tree Authority of Mumbai is responsible to give the permission for tree cutting in the project area under Maharashtra (Urban Areas) Protection and Preservation of Trees Act 1975, as modified up to 3rd Nov 2006. According to the Tree Authority an application with site map should be submitted to authority for inspection and permission for cutting of tree. The Maharashtra Felling of Trees (Regulation) Act, 1964 has recommended native plant species<sup>3</sup> for afforestation. The native plant species recommended for afforestation includes gulmohar, neem, Pilkhan, Ashoka, Jamun, Desi Badam etc. The botanical names of the species to be planted are indicated in the **Table 9.30**.

**Table 9.30: Scientific Names of Tree for Plantation**

SI	Local Name	Botanical Name
1	Gulmohar	<i>Delonix regia</i>
2	Neem	<i>Azadirachta indica</i>
3	Ashoka	<i>Saraca asoca</i>
4	Jamun	<i>Syzygium cumini</i>
5	Desi Badam	<i>Terminalia catappa</i>
6	Coconut Tree	<i>Cocos nucifera</i>
7	Jackfruit	<i>Artocarpus integra</i>
8	Karanj	<i>Pongamia pinnata</i>
9	Rubber Tree	<i>Ficus elastic</i>
10	Sheesham	<i>Dalbergia sissoo</i>

<sup>3</sup> The Maharashtra felling of trees (Regulation) Act, 1964



**Compensation for loss of Mangroves:** About 4825 sq.m area of mangroves is likely to be affected due to proposed construction of suburban rail track corridor. According to the general practice of mangroves afforestation, five times number of mangroves needs to be planted for each one cut. Hence, mangroves plantation will have to be carried out on 24,125 sq.m of area. Therefore the cost for mangroves management plan is kept as **Rs.58 lakh**. Mangroves should be planted by using natural seedling or nursery seedling. Care should be taken not to disturb the adjacent mangrove area in any case by any activity or person engaged in construction activity.

### **Water Supply and Waste water Treatment Facility for Workers Camps**

It is estimated that about 77 KLD water will be required daily for the camps, which will be taken from borewell/Municipal Water Supply. Borewell water will be chlorinated for use as drinking water. About 80% of the water supply will be generated as sewage/waste water, which needs to be treated before disposal or may be connected to nearby sewerage network.

As per the Contract Labour (Regulation & Abolition) Act, 1970, there shall be at least one latrine for every 25 male. The sewage from the community water closet would be treated through septic tank and disposed off through soak pits. The drinking water facilities and sewage disposal sites should be located away from each other. A provision of Rs. 17.55 Lakh would be made for these facilities as reported in Table 9.31.

**Table 9.31: Cost of Water Supply and Sanitation Facilities**

SI	Description	Rate (Rs/Unit)	Numbers	Cost (Lakhs)
1	Water Treatment & Supply Facilities	2,00,000	3	6,00,000
2	Community water closet	30,000	30	9,00,000
3	Septic Tank & Soak pit including connection	85,000	3	2,55,000
<b>Total</b>				<b>17,55,000</b>

### **Solid Waste Management**

It is estimated that about 385 Kg per day municipal solid waste will be generated from the labour camp. The collection, conveyance and disposal facilities shall be made available by providing 20 litres capacity bin with handle and cover for 8 workers. In addition, one community bins would be provided for effective collection of the waste. The disposal of the waste will be at municipal corporation landfill site. The cost of these facilities including maintenance for 5 years works out to be about **Rs. 37.60 Lakh**.



### Air Pollution Control Measures

During the construction period, the impact on air quality will be mainly due to increase in Suspended Particulate Matter (SPM) along haul roads and emission from vehicles and construction machinery. Though an air quality during construction shows insignificant impact, nevertheless certain mitigation measures which shall be adopted to reduce the air pollution are presented below:

- The Contractor shall take all necessary precautions to minimise fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste.
- The Contractor shall use construction equipment to minimise or control of air pollution.
- Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India or the State Government from any transport during handling of materials, construction or storage activity.
- The DG sets to be installed to provide power backup will adhere to the emission standards.
- The Contractor shall use cover for materials of dust generating like debris and soil being transported from construction sites.
- All trucks carrying loose material should be covered and loaded with sufficient free-board to avoid spills through the tailboard or sideboards.
- Contractor shall install barriers around the open construction sites before commencing the work.
- The temporary dumping areas shall be maintained by the Contractor at all times until excavate is re-utilised for backfilling wherever necessary or as directed by Employer.
- The Contractor shall place material in a manner that will minimize dust production. Material shall be wetted each day, to minimize dust production.
- The Contractor shall sprinkle water at construction sites to suppress dust,
- The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt.

### 9.4.2 Noise Control

There may be an increase in noise level in ambient environment due to construction and operation of this rail corridor. The increase in levels is marginal; hence, local population will not be adversely affected. However the exposure of workers to high noise levels needs to be minimized. This can be achieved by job rotation, automation, protective devices, noise barriers, and soundproof compartments, control rooms etc. Earplug/ muffs, or other hearing protective wear will be provided to those working very close to the noise generating





machinery. Special acoustic enclosures should be provided for individual noise generating equipments, wherever possible.

Pile driving operation can produce high noise levels which could be reduced by using a suitable sound absorbent. Safety precautions as stipulated in IS: 5121 (1969) 'Safety Code for Piling and other Deep Foundation' need to be adopted.

Noise level from loading and unloading of construction materials can be reduced by usage of various types of cranes and placing materials on sand or sandy bag beds. Sound barriers are usually effective along route having fast traffic. The reduction in noise level increases with height of barrier.

### 9.4.3 Traffic Diversion/ Management

Traffic is most likely to be affected during construction of suburban rail track corridor project. Hence Traffic Diversion Plans are required in order to look for options and remedial measures so as to mitigate any traffic congestion situations arising out due to acquisition of road space during construction. Any reduction of road space during construction results in constrained traffic flow. In order to retain satisfactory levels of traffic flow during the construction period; traffic management and engineering measures need to be taken. They can be road widening exercises, traffic segregation, one-way movements, traffic diversions on influence area roads, acquisition of service lanes, etc. Only temporary diversion plans will be required during construction of the suburban rail track corridor. At the onset, all encroachments from ROW for stations and entry/exit will have to be removed. Traffic Management Guidelines should be adopted by contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen at construction sites.

- All construction workers should be provided with high visibility jackets with reflective tapes.
- Warn the road user clearly and sufficiently in advance.
- Provide safe and clearly marked lanes for guiding road users.
- Provide safe and clearly marked buffer and work zones
- The primary traffic control devices used in work zones shall include signs, delineators, barricades, cones, pylons, pavement markings and flashing lights.

### 9.4.4 Soil Erosion Control

Soil Erosion will take place due to the construction of proposed suburban rail track during construction of the project. The surface facilities and related transport will cause soil erosion. Prior to the start of the construction, the Contractor shall submit his schedules to the MRVC for carrying out temporary and permanent erosion/sedimentation control works as are applicable for the items of



clearing and grubbing, roadway and drainage excavation, embankment/sub-grade construction, pavement courses and shoulders. He shall also submit his proposed method of erosion/sedimentation control and his plan for disposal of waste materials. Visual monitoring will be carried out during construction which includes photographic records and site description data. The visual inspection should be conducted on quarterly basis by the contractor in presence and consultation with PMC. Monitoring may be undertaken by staff with good observational skills, the ability to reliably record and report site conditions. Work shall not be started until the erosion/sedimentation control schedules and methods of operations for the applicable construction have been approved by the MRVC.

The surface area of erodible earth material exposed by clearing and grubbing, excavation shall be limited to the extent practicable. The Contractor may be directed to provide immediate control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage to adjacent properties, or cause contamination of nearby streams or other watercourses. Such work may involve the construction of temporary berms, dykes, sediment basins, slope drains and use of temporary mulches, fabrics, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation.

Temporary erosion is sometimes caused due to the Contractor's negligence, carelessness or failure to install permanent controls. Sedimentation and pollution control measures then become necessary as a part of the work as scheduled or ordered by the MRVC, and these shall be carried out at the Contractor's own expenses. Temporary erosion, sedimentation and pollution control work, which is not attributed to the Contractor's negligence, carelessness or failure to install permanent controls, will be performed as ordered by the MRVC.

#### **9.4.5 Sanitation Management Plan at Stations**

The public health facilities, such as water supply, sanitation and toilets are much needed at the stations. Water should be treated before use up to WHO drinking water standards or as per IS 10500-1991 standards. The collection and safe disposal of human wastes are among the most important problems of environmental health. The safe sewage disposal systems would be provided.

The water demand for operational staff at all stations would be about 85.5 Kilo litres per day. The water requirement for passenger will be met from the existing linked interchanged stations for stations proposed at existing rail station. The water requirement at Depot will be 66.5 KLD. This shall be provided from municipal/ground water source.

An additional refuse, generated will be about 342 kg/day from the operating staff. The maintenance of adequate sanitary facilities for temporarily storing refuse on the premises is considered a responsibility of the MRVC project authorities. The storage containers for this purpose need to be designed. However it is suggested



that the capacity of these containers should not exceed 50 litres and these should be equipped with side handles to facilitate handling. To avoid odour and the accumulation of fly-supporting materials, garbage containers should be washed at frequent intervals. This should be collected and transported to local municipal bins for onward disposal to disposal site by municipality. Waste generated during and after construction will be disposed in accordance with relevant National and State laws and Regulations.

#### 9.4.6 Occupational health hazards and control

It is necessary to provide safe and clean working environment for the control/prevention of health hazards. Care shall be taken to provide good working conditions during operation of proposed suburban rail corridor. Provision of conditions in contract and good construction practices will take care of any occupational health hazard issues and provide environmentally safe work areas. However, a provision of **Rs. 100.00 Lakh** have been proposed for health related issues and its control for this project.

#### 9.4.7 Training Programmes

The training programmes need to be conducted by the experts, for MRVC officers. These programmes could be extended for the local population for their active participation in the project implementation. Apart from training, such programme should include guidelines for safety, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc. The **Rs. 12.50 Lakh** has been kept for the National Training programme.

International training programme for 25 numbers of MRVC officers are proposed to acquire the latest know how about the construction, operation and maintenance of rail. The estimated cost for International training for which estimated cost will be **Rs.87.50 Lakh**. The overall cost involved for National and International training programmes will be **Rs. 100 Lakh**.

#### 9.4.8 Environmental Enhancement Measures

In addition to mitigation measures adopted for negative impacts during construction and operation of the project, some of the measures for improvement of environment have been undertaken as described below:

- Landscaping & beautification
- Solar energy
- Environmental awareness programmes
- Utility facilities to unprivileged people

The cost for environmental enhancement measures has been kept as **Rs. 50 Lakh** (Lump sum).



#### 9.4.9 Social Management Plan

The proposed rail project requires land. The acquisition of land for the project shall displace people from their home, livelihood base and business base. The project will involve acquisition of 68.91 ha of which only 60.92 ha is under private acquisition. The SIA study which is based on the principle that the population affected by the project will be assisted to improve their living standards. Applicable laws on land acquisition and resettlement for the proposed rail project are mainly Railways (Amendment) Act, 2008 and National Rehabilitation and Resettlement Policy, 2007. Chapter IVA, Section 200 of RAA, 2008 states that provision of NRRP, 2007 for the project affected families, notified by the Government of India in the Ministry of Rural Development vide number F.26011/4/2007-LRD dated 31st October, 2007 shall apply with regard to land acquisition by Central Government under this Act. Therefore, the cost for resettlement action plan has been prepared as per NRRP, 2007. The cost for private land and structures has been presented in DPR. R&R cost will cover rehabilitation grant for loss of livelihood, assistance for construction of shops, transitional allowance, shifting allowance, assistance for house construction for affected BPL families, financial assistance to vulnerable families and training assistance.

#### 9.4.10 Management Plan for Depot

##### Water supply

About 66.5 KLD of water will be required for operation and functioning of depot. This could be either collected from Municipal Corporation. If in any case, water is not available from BMC, bore well water will be taken out for its treatment through Reverse Osmosis system before their use in various purposes and for drinking water. This will cost of about **Rs.50 Lakh**.

##### Oil Pollution Control

The oil tends to form scum in sedimentation chambers, clog fine screens, interfere with filtration and reduce the efficiency of treatment plants. Hence oil and grease removal tank has to be installed at initial stage of effluent treatments. Such tanks usually employ compressed air to coagulate the oil and grease and cause it to rise promptly to the surface. Compressed air may be applied through porous plates located in bottom of the tank. The tank may be designed for a detention period of 5 to 15 minutes. This accumulated oil and grease will be disposed off through approved re-cyclers.

##### Sewage/Effluent Pollution Control

About 53.2 KLD of sewage/effluent is likely to be generated at depot. The sewage



could be treated up to the level so that it could be used for horticulture purpose in the campus. The estimated cost of sewage/effluent treatment plant is about **Rs.60 Lakh**. This has to be treated as per the requirement of regulatory pollution control agency of the state (MPCB).

### **Solid Waste Disposal**

About 1.8 Ton per month of solid waste will be generated from the Depot which will be taken by the cleaning contractor weekly and disposed to the Mumbai Municipal Corporation waste disposal sites in accordance with relevant National and State laws and regulations. The cost required for the efficient management of solid waste at Depot will be **Rs. 8.00 Lakh** for three year.

### **Surface Drainage**

The Storm water of the depot will be collected through the drain. Rain water harvesting pits are provided at different locations in the drains and for surplus storm water, the drainage system is connected to a nearby disposal site. The drainage costs have been included in project cost.

### **Green belt development**

The greenbelt development / plantation in the depot area not only functions as landscape features resulting in harmonizing and amalgamating the physical features with surrounding environment but also acts as pollution sink / noise barrier. In addition to augmenting present vegetation, it will also check soil erosion, make the ecosystem more diversified and functionally more stable, make the climate more conducive and restore balance. It is recommended to have a provision of **Rs 40 Lakh** in the cost estimate for the green belt development. Treated sewage and effluent in the best combination should be used for green belt development.

### **Recycling of treated waste water**

Waste water generated at depot is proposed to be collected at ETP for treatment and recycled for horticulture work of the depot. About 50.54 KLD of treated waste water will be available for horticulture. The rest of treated water will be released to the nearby water body.

## **9.5 ENVIRONMENTAL MONITORING PLAN**

**Environmental Monitoring:** The environmental monitoring will be required for the construction and operational phases. The parameters need to be monitored are: Water Quality, Air quality and Noise levels etc. The parameters shall be monitored one year



before the construction, during the construction phase and also for at least three years after the completion of the project (total 9 years).

#### 9.5.1 Water Quality

The parameters for monitoring would be: pH, Dissolved Oxygen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids, Chlorides, Nitrates, Sulphates, Total Nitrogen, Total Phosphates, oils and grease etc. The main monitoring stations could be about ten locations (Including Depot & Labour Camps). The cost for water quality analysis works out to be **Rs. 38.34 lakh**.

#### 9.5.2 Soil Quality

The parameters for monitoring would be: pH, Sodium, Potassium, Chloride, Nitrogen, Phosphorous, Organic Matter, Heavy Metals, Oil and Grease. The main monitoring stations could be about ten locations (Including Depot & Labour camp). The cost for soil quality analysis works out to be **Rs. 28.08 lakh**.

#### 9.5.3 Air & Noise Quality Monitoring

The parameters for air quality monitoring would be: PM2.5, PM10, SO<sub>2</sub>, NO<sub>x</sub>, CO, HC. The monitoring locations will be about eight (Including Depot & Labour camp). The place of monitoring will be decided by the engineer In-Charge on sensitivity of the location. The cost for Air & Noise monitoring works out to be **Rs. 54.15 lakh** and **Rs. 23.04 Lakh** respectively.

#### 9.5.4 Environmental Management Cell

MRVC shall establish an Environment Division at the initial stage of the project itself. The division should be staffed with an Environmental Engineer/Officer and a Technical Assistant (environment background). The task of the division would be to supervise and coordinate studies, environmental monitoring and implementation of environmental mitigation measures, and it should report directly to Project Director of the project authority. The Cost of such an establishment has been estimated as **Rs. 188.21 lakh**.

#### 9.5.5 Cost Estimate

The cost for environment and resettlement and rehabilitation is given in **Table 9.32 & 9.33** respectively. The total cost for environmental and social management plan is **Rs 1134.39 Lakh**.

**Table 9.32: Cost for Environmental Management**

SI	ITEM	Amount RS. (in lakh)
<b>Environmental Cost</b>		
1	Tree Plantation	37.50
2	Water Supply & Sanitation	17.55
3	Solid Waste	37.60
4	Occupational Health Hazards	100.00
5	Environment Cell	188.21
6	Training Programs (national & International)	100.00
7	Environmental Enhancement Measures	50.00
8	Mangroves Management Plan	58.00
9	Management Plan for Depot	158.00
10	Environmental Monitoring	143.61
	Misc (10%)	82.25
<b>Total</b>		<b>972.72</b>

**Table 9.33: Cost for R&R**

S.No	Description	Quantity	Rate (Rs.)	Amount (Rs. In Lakh)
<b>A</b>	Compensation for loss of private land and structures has been presented in DPR.			
<b>B</b>	Rehabilitation Grant for loss of livelihood <sup>1</sup>	9	Rs.127/- for 750 days	8.57
<b>C</b>	Assistance for construction of shop <sup>2</sup>	9	25,000	2.25
<b>D</b>	Transitional Allowance <sup>3</sup>	66	Rs.127/- for 300 days	25.15
<b>E</b>	Shifting Allowance	66	10,000	6.60
<b>F</b>	Assistance for house construction <sup>4</sup> for affected BPL families	18	Rs.700/- p/sq.ft for 270 sq.ft	34.02
<b>G</b>	Financial Assistance to Vulnerable People (BPL/ SC/ ST/ WHH/ Old Age people)	36	Rs.127/-for 300 days	13.72
<b>H</b>	Training Assistance	51	4000/-	2.04
<b>J</b>	Sub Total (B+C+D+E+F+G+H)			92.35
<b>K</b>	Add 20% towards institutional arrangements			18.47
<b>L</b>	<b>Total</b>			<b>110.82</b>
	Add Contingency@ 10%			11.08
	<b>Grand Total</b>			<b>121.90</b>

1. Consider titleholders and non-titleholders.
2. Consider only for Non-titleholders.
3. Consider both for titleholders and non-titleholders.
4. Consider only for BPL