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CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

FINAL REPORT

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Mumbai Metropolitan Region Development Authority

EA/EMP Report of JVLR Project under MUTP: *Mumbai*

June 2002

FILE COPY

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FINAL REPORT

Mumbai Metropolitan Region Development Authority

EA / EMP Report of JVLR Project under MUTP: *Mumbai*

June 2002

Reference I5674

For and on behalf of ERM	
Approved by:	*Subir Gupta*
Signed:	
Position:	*Managing Director*
Date:	*10 June 2002*

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CONTENTS

LIST OF ABBREVIATIONS

EXECUTIVE SUMMARY

1	INTRODUCTION	1
1.1	OVERVIEW OF MUMBAI URBAN TRANSPORT PROJECT (MUTP)	1
1.2	CHRONOLOGY OF VARIOUS STUDIES ON JVLR PROJECT	3
1.3	POLICY AND LEGAL FRAMEWORK	4
1.4	LAYOUT OF THE REPORT	6
2	JVLR PROJECT BACKGROUND AND PROPOSALS	8
2.1	PROJECT DESCRIPTION	8
2.2	EXISTING CROSS DRAINAGE STRUCTURES ALONG JVLR	11
2.3	RIGHT OF WAY ISSUES	12
2.4	IMPLEMENTATION PROGRAMME OF JVLR PROJECT	13
2.5	PROJECT PROPOSALS	13
2.6	ALTERNATIVE PROPOSALS ANALYSED IN PHASE I	18
2.7	OTHER PROJECTS BEING IMPLEMENTED IN THE SAME CORRIDOR OUTSIDE MUTP	24
2.8	ONGOING OTHER DEVELOPMENTAL PROJECTS ALONG JVLR	25
3	BASELINE ENVIRONMENT	26
3.1	LAND USE	26
3.2	TERRAIN & GEOLOGY	29
3.3	DRAINAGE SYSTEM IN THE PROJECT REGION	29
3.4	METEOROLOGY	30
3.5	TRAFFIC AND TRANSPORT	31
3.6	WATER ENVIRONMENT	34
3.7	SOIL	36
3.8	AMBIENT AIR QUALITY	37
3.9	AMBIENT NOISE LEVEL	39
3.10	ECOLOGY	41
3.11	PRESENCE OF NATURAL HABITATS	43
3.12	PRESENCE OF SENSITIVE RECEPTORS	50
3.13	PRESENCE OF PLACES OF WORSHIP	50
3.14	UTILITY/ FACILITY ALONG PROJECT CORRIDOR	51
3.15	CURRENT STATUS OF FLYOVER PROJECTS ALONG JVLR	53
4	IDENTIFIED ENVIRONMENTAL IMPACTS & RECOMMENDED MITIGATION MEASURES	60
4.1	LAND USE	60
4.2	TERRAIN & GEOLOGY	62
4.3	TRAFFIC AND TRANSPORT	66

4.4	WATER ENVIRONMENT	69
4.5	SOIL	70
4.6	AMBIENT AIR QUALITY	72
4.7	AMBIENT NOISE LEVEL	75
4.8	ECOLOGY	77
4.9	NATURAL HABITATS	79
4.10	PRESENCE OF SENSITIVE RECEPTORS	80
4.11	PLACES OF WORSHIP	81
4.12	UTILITY DIVERSION	85
4.13	OTHER CONSTRUCTION PHASE IMPACTS	86
4.14	IMPACT OF ONGOING OTHER DEVELOPMENT PROJECTS ALONG JVLR	87
5	ENVIRONMENTAL MANAGEMENT PLAN	89
5.1	ENVIRONMENTAL MANAGEMENT PLAN FOR PHASE I OF JVLR PROJECT	89
5.2	ENVIRONMENTAL MANAGEMENT PLAN FOR PHASE II OF JVLR PROJECT	128
6	PUBLIC INFORMATION AND CONSULTATION	153

LIST OF ABBREVIATIONS

AAQ	Ambient Air Quality
ANL	Ambient Noise Level
AQMS	Air Quality Monitoring Station
BEST	Bombay Electricity Supply and Transport Undertaking
BIS	Bureau of Indian Standards
BM Marg	Bindu Madhav Marg
BMC	Mumbai Municipal Corporation
BSES	Baseline Socio-economic Survey
CALINE	California Line Source Dispersion Model for Prediction of Air Pollutant Levels near Highways
CBO	Community Based Organisation
CD	Cross Drainage
CEMP	Community Environmental Management Plan
CES	Consulting Engineering Services
CO	Carbon monoxide
CPCB	Central Pollution Control Board
CRZ	Coastal Regulation Zone
CTV	Classified Trafic Volume
CZMP	Coastal Zone Management Plan
DP	Development Plan
DPR	Detailed Project Report
EA	Environmental Assessment
EC	Environmental Clearance
EEH	Eastern Express Highwat
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERM	Environmental Resources Management, India
FHWA	United States - Federal Highway Administration
GL	Ground level
GoI	Government of India
GoM	Government of Maharashtra
HCV	Heavy Commercial Vehicles
HTL	High Tide Line
IIM	Impact Identification Matrix
IIT	Indian Institute of Technology
IMD	India Meteorological Department
IMP	Independent Monitoring Panel
IRC	Indian Road Congress
JVLR	Jogeshwari-Vikhroli Link Road
Kms	Kilometres
L&T	Larson & Toubro
LBS Marg	Lal Bahadur Shastri Marg
LCV	Light Commercial Vehicles
LHS	Left Hand Side
LRT	Light Rail Transit
LTL	Low Tide line
M	Minor Impact
m	meter

Environmental Resources Management India (ERM) has been retained by Mumbai Metropolitan Region Development Authority (MMRDA) for carrying out Independent review and prepare an updated report on Environmental Assessment (EA) and Environmental Management Plan (EMP) for the proposed widening and improvement of Jogeshwari-Vikhroli Link Road (JVLR) prepared by Consulting Engineering Services (CES) in January 2002.

1.1 *OVERVIEW OF MUMBAI URBAN TRANSPORT PROJECT (MUTP)*

Mumbai, over the last few decades, has emerged as the financial and commercial capital of India. Greater Mumbai's population that was around 4 million in 1961 is now around 11.9 million in 2001. It has a unique distinction of satisfying 88 % of its peak period travel demand through public transport such as suburban trains and buses. Of the remaining 12% peak travel demand, taxis and private vehicles meet 7 % and 5 % of the demand respectively Although these proportions are estimated to remain more or less same until 2011 (with public transport sector falling marginally from 88% to 85 %), the number of public transport trips in the peak period will rise substantially given the continued rise in population. In terms of public transport, suburban rail services carry close to 6 million passengers per day. Bus services are provided by Brihan Mumbai Electric Supply and Transport Undertaking (BEST), with 3000 buses, and cater to 4.5 million journeys per day, of which approximately 60 % are connected with rail journeys.

The road network in Mumbai is predominantly radial along the peninsula and comprises three main corridors - Western, Eastern, and the Central in the Island City and two corridors in the suburbs. The number of registered vehicles in Greater Mumbai grew from 308,881 in 1981 to 628,488 in 1991and 859,734 in 1998. It is estimated that the number was 1,048,734 in 2001.

As a result of population growth and increase in private ownership of vehicles, public transport is under severe stress. For example, trains that have the rated capacity of 2600 passengers carry over 4500 passengers during peak hours. Buses too are overcrowded during peak period. Over-aged buses (500 out of a fleet of 3000) and increasing private vehicle ownership particularly of two and three wheeler vehicles with two stroke engines have given rise to increased traffic congestion and air and noise pollution.

In response to the emerging transport crisis, Mumbai Metropolitan Regional Development Authority (MMRDA) - the regional planning and coordinating agency- was mandated to prepare a transport sector development strategy. "Comprehensive Transport Strategy (CTS)" was prepared in 1994, providing a strategic framework for the transport sector of MMR. Three strategic alternatives were examined to meet the projected travel demand in MMR viz.

- Public Transport - PT;
- Public Transport with Demand Management in the Island City - PT+DM; and
- Road Investment - RI.

The strategic alternative of PT+DM is found to be the optimal strategy from a number of perspectives as outlined in the various environmental reports prepared by MMRDA.

The CTS clearly established the guiding principles that are still valid for transport sector today, namely that the investment priority must be accorded to public transport, particularly suburban railway; road investment should concentrate on improving east-west road links in the suburbs along with the Road Over Bridges (ROB) that replace the existing level crossings on the railways; and in the Island City where congestion is likely to be acute and there is inadequate space for expanding road network, demand management measures need to be adopted. The project components proposed for implementation under the Mumbai Urban Transport Project (MUTP) have been selected within the framework of this strategy.

Therefore on the basis of the framework developed under the CTS the following project components have been identified for implementation under MUTP:

Rail Transport Component

- Railway System - Capacity Optimization and Enhancement;
- Setting up new corridors along existing ones; and
- Purchase of rolling stock

Road Transport Component

- Road Transport - Traffic management (TM) and related measures, including area traffic control (traffic signal systems), bus priority and rail station area transport integration;
- Road Transport - Infrastructure, including roads and road over rail bridges, and
- Road Transport - Equipment (procurement of buses).

Resettlement and Rehabilitation

- Construction or purchase of about 20,000 permanent dwelling units;
- Construction of about 6000 transit dwelling units; and
- Land acquisition and R & R assistance

1.1.2 *Description of the Road Transport Component of MUTP*

The road component of MUTP seeks to strengthen the capacity of the MCGM for traffic management, policy and regulation, and support specific investments in traffic management, traffic signals, east-west connecting roads and rail grade separations.

The physical works under this component, which require review of environmental and social issues depending upon the nature and scope of work, include:

- Jogeshwari - Vikhroli Link Road (JVLR). This corridor includes two flyovers being constructed by Maharashtra State Road Development Corporation (MSRDC), which are not being financed through MUTP.
- Santa Cruz - Chembur Link Road (SCLR)
- Construction of 3 ROBs at Jogeshwari – South, Jogeshwari- North and at Vikhroli.
- Pedestrian sub-ways, footpaths and other pedestrian facilities.
- Station Area Traffic Improvement Schemes (SATIS).
- Bus Procurement.

Pedestrian Underpasses and other facilities and SATIS expected to have only very limited environmental issues during construction and bus procurement will have positive impact due to environment friendly buses.

1.2 *POLICY AND LEGAL FRAMEWORK*

Implementation of JVLR project will be taken up under the World Bank funded Mumbai Urban Transport Project (MUTP). In line with World Bank regulations, the project proposals and its implementation are to be in conformance to relevant World Bank Operational policies and guidelines Thus the World Bank Operational Policies (WB OP's) and directives (WB OD's) form an important policy framework for the JVLR project. The WB OP's and OD's, which are relevant to the project, include:

- Environmental Assessment (OP 4.01)
- Cultural property (OP 4 11)
- Involuntary Resettlement (OD 4.30)

Besides, the relevant country regulations and state government regulations also govern the implementation of project proposals, which include the following

Legislation related to Environment:

- Environmental (Protection) Act, 1986 and associated rules and notifications under the act
- Coastal Regulation Zone Notification, 1991
- The Maharashtra (Urban Areas) Preservation of Trees Act, 1975.

Legislation related to Resettlement and Rehabilitation:

- Land Acquisition Act 1894 (LA Act).
- Maharashtra Regional and Town Planning Act, 1966 (MR&TP Act).
- Development Control Regulations for Greater Mumbai 1991 (DCRs).
- The Maharashtra Co-operative Societies Act 1960.

1.3 *PROJECT OBJECTIVE*

Comprehensive transport plan for MMR prepared in 1994 recommended Jogeshwari – Vikhroli link road (JVLR) connecting Western Express Highway (WEH) and Eastern Express Highway (EEH) for improvement and widening. Based on the recommendations, the existing 2-lane wide JVLR is proposed for widening to 6-lane carriageway and improvement

The widening and improvement of JVLR has been since then taken up as a sub-project under the World Bank funded MUTP. The project proponent - MMRDA - has carried out various preparatory studies at different duration's on JVLR project and updated them to reflect the status as of now in 2002.

1.3.1 *Project Road Background*

The existing JVLR became operational in 1994. Prior to 1994, the link was available for traffic only in segments. The preparatory study reports divide JVLR into three sections for easy reference and understanding. The sections identified include:

Section I: The segment of JVLR which starts from WEH junction and ends at Saki Vihar road junction (near L&T Factory) has been referred as *Section I or Western section* of JVLR. The length of this section is 4.9 km.

Section II: The segment of JVLR which starts from Saki vihar road junction and ends at LBS marg junction (near Gandhi nagar square) has been referred as *Section II or Middle section* of JVLR. The length of middle section is 4.3 km.

Section III: The segment of JVLR, which starts from LBS marg junction (Gandhinagar square) and ends at EEH junction, has been referred as *Section III or Eastern section* of JVLR. The length of eastern section is 1.1 km.

1.4 *JVLR PROJECT PROPOSALS*

1.4.1 *Description of the Alignment*

Section I - WEH to Saki Vihar Road

The western section of the road passes through residential settlements, barren lands, hill section, and industrial area. Majas drainage channel (at Kms 0+900) and Mithi river (at Kms 3+800) are crossed in this section.

Section II - Saki Vihar Road to LBS Marg

The middle section passes through institutional areas, residential and commercial areas. Major surface water body - Powai lake - is located along the section

Section III - LBS Marg to EEH Junction.

Considerable part of eastern section is occupied by grasslands and slum settlements. Towards the last 100m, degraded and stunted mangrove vegetation falling under CRZ I area as per CRZ regulations is present

1.4.2 *Implementation Programme of JVLR Project*

The widening and improvement of JVLR corridor has been divided into two phases of implementation. During first phase, the widening and improvement of ***Section I*** and ***Section III*** will be taken up for construction and during second phase, ***Section II*** will be taken up for implementation.

1.4.3 *Right of Way Issues*

The Right of Way (RoW) issues as it stands today is as follows:

- The RoW in possession is 30m.
- Near high embankments and deep cuttings, the available RoW is 60m
- The DP provision for JVLR corridor is 45.7m. But the time frame for acquisition of the additional corridor as per DP is not known.
- DPR consultants have attempted to design the alignment within the available width and wherever not feasible retaining walls have been used to restrict the work within RoW.
- At locations where improvement in the alignment is proposed, acquisition of additional land beyond the available RoW has been proposed.
- At locations where service roads are proposed, the available RoW of 30m wide is inadequate The constructions of service roads at these sections have been proposed in phases to match with the programme of land acquisition as per DP provision.

1.4.4 *Recommended Scheme of Widening In Phase I*

As per the recommended scheme, JVLR is proposed to be widened to 3 + 3 divided carriageway. Following are the cross sectional details of the road after widening

Carriageway	2 x 11m	=	22m (2.5% slope)
Central median		=	1.2m (4% slope)
Shoulder / Footpath	2 x 2m	=	4m (4% slope)
Side slope		=	2 : 1

The total top width of the road will be 27.2m which is within the available RoW width of 30m.

Widening Scheme for Bridge Structures

The cross drainage structures/minor bridges located along JVLR are proposed to be widened to 4 + 4 divided carriageway configuration.

1.4.5 *Alternative Proposals Analysed in Phase I*

The project is to be implemented along an existing road and hence there is less scope for alternate proposals. However, few alternates were analysed and accordingly modified in the revised DPR. The alternative options considered include:

Modified SEEPZ Sub-way Proposal to a Grade Separator

The sub-way proposal of earlier DPR was revised and modified to grade separator. Reasons for modification include:

- Provision of sub-way for SEEPZ road below existing road leads to steep vertical gradient to accommodate the sub-way.
- Connection of SEEPZ sub-way road with the Aarey colony road was only possible through a system of service roads. These service roads need

retaining walls to contain the construction within available RoW and to avoid impact on social environment.

- Slum residential area on its northern edge and high-rise residences on its southern edge mark the physical attribute along JVLR at this junction Hence it is imperative to restrict construction within the available RoW.

Cut-section Proposed at Kms 2+100 to 3+200

In the revised DPR, vertical cut section has been proposed between Kms 2+100 to 3+200 for a length of about 700m. The depth of the cut section proposed at this chainage varies between 0 to 9m. The main objective is to reduce the existing gradient from 7% to 4.5%. In the earlier proposal, the existing vertical geometry was not altered to avoid severance of habitations located on either side of JVLR. However, in the revised DPR, the cut-section has been proposed along with Mahakali caves road bridge at Kms 2+460

Modified Junction Lay-out at Western Express Highway Junction

The layout of starting point of western section of JVLR has been reviewed in order to minimise the impact on social environment on the northern side of junction. It was found that scope for shifting the junction on south side existed which would result in reduced impact on social environment.

Modifications in the Vertical Alignment

The existing steep gradient (5 to 6.5%) in chainages Kms 0+250 to 0+400; 0+700 to 0+800; 0+850 to 0+950; 3+450 to 3+600; and 3+850 to 4+650 will be flattened for improved road geometry, safety and smooth vehicle movement.

Modifications in the Horizontal Alignment

The horizontal alignment has been reviewed in consonance with the changes effected in the vertical profile. Existing bridges and CD structures will be widened from both sides instead of one side widening proposed earlier to avoid land acquisition and displacement of inhabitants.

1.4.6 *Other Project Proposals in Phase I*

Other proposals found in the DPR on JVLR project include:

- The entire JVLR corridor has been proposed with a central median (divided carriageway)
- The existing bridge structures and new bridge proposed will have divided carriageway and footpaths on either side
- At-grade improvement works at the following junctions have been proposed:
  - Western express highway junction;
  - SEEPZ road junction;
  - Saki vihar road junction;
  - LBS marg junction,
  - Eastern express highway junction; and
  - 8 other minor junctions on JVLR and 2 minor junctions on the supporting road network.

- New vehicular bridge has been proposed at Kms 2+460 (Mahakali cave road bridge) to avoid severance of habitations.
- At some locations, the project objective has been achieved within the available RoW width to avoid/ reduce displacement of habitation by adopting retaining walls along the embankment sections.
- Detailed Storm water drainage analysis has been carried out to design road surface drainage, cross-sectional drainage, and hydraulic adequacy of existing bridges The detailed storm water drainage report - BRIMSTOWAD - prepared by BMC has been extensively used to form the basis for drainage design.
- The embankment sections have been proposed with slopes no steeper than 1V to 2H and where granular material is encountered the embankment slope would be no steeper than 1V to 1.5H to avoid rain and wind erosion.
- Traffic management and control systems have been proposed as per IRC 35 - 1997 and Traffic signs to be installed as per IRC 67 - 1997 and Motor Vehicle Act. The road delineators have been proposed as per IRC 79-1981.
- Metal beam crash barriers have been proposed on high embankment sections (height more than three metres) and concrete crash barriers on all bridge/ flyover structures.
- Landscaping and arboriculture has been proposed along JVLR as per IRC 56-1974 for embankment treatment.
- Compensatory plantation has been proposed as per IRC-SP-21, 1979 and IRC 66 - 1976.
- Turfing of slopes of high embankment to avoid rain and wind erosion has been recommended.

1.4.7 Proposed Construction Schedule for Phase I

The construction program has been envisaged to start by September 2002 and would be completed by October 2004. The Construction program designed for the JVLR project excludes any activity during heavy monsoon season.

1.4.8 Recommended Scheme of Widening In Phase II

The middle section of JVLR is already widened to six-lane configuration, barring 1-km length opposite IIT campus. DPR has not yet been prepared for Phase II of the project

1.4.9 Proposed Grade/Separators along JVLR outside MUTP

There are two flyover (grade separators) structures proposed along the alignment of JVLR viz., grade separators near L&T and LBS Marg. These two flyover projects are currently being implemented by MSRDC as separate packages out side MUTP.

1.4.10 Other Projects Being Implemented in the Same Corridor outside MUTP

The developmental works observed along JVLR include.

- Laying of Optical fibre communication (OFC) cables along the roadside.
- Construction of grade separators at two locations on JVLR i.e., at L&T-junction and another at LBS marg junction

- Widening work in progress in some portion of middle section of JVLR along its southern edge, near Panch kutir market area.

Besides,

- Jogeshwari - South ROB project which is proposed under MUTP would link JVLR to Swami Vivekanand (SV) road. SV road is major north-south link traversing along western coast of MMR.
- R&R site chosen opposite Kanjurmarg suburban rail station is currently being implemented under MUTP for the PAPs of railway projects
- The planned SEEPZ - Phase II extension which is presently under implementation near SEEPZ road junction.
- Vikhroli ROB and Jogeshwari - North ROB projects are also proposed under MUTP.

1.5 *BASELINE ENVIRONMENT*

In order to assess the baseline environmental status in the project area, a 300-m wide study corridor (150-m on either side of the project road) was identified and delineated at site. The baseline status of the JVLR project study corridor is presented in the following sub-sections.

1.5.1 *Land Use*

Section I - WEH to Saki Vihar Road

The land use pattern in this stretch of JVLR is predominantly residential, especially the stretch along the western end of the section. The middle segment of this section passes through open hilly area and Aarey Farm area. Besides residential land use, other major land uses observed along this section of JVLR are viz., industrial, commercial, and recreational.

Section II - Saki Vihar Road to LBS Marg

The land use pattern in this stretch of JVLR is predominantly institutional, residential and commercial. A major surface water body -Powai Lake - is located along the northern edge of JVLR

Section III - LBS Marg to EEH Junction.

In this stretch of JVLR, the land area is almost vacant except for the slums near central railway tracks. Degraded wasteland engulfs project road from either side for most part of its length. Towards the last 100m stretch, stunted mangroves vegetation is observed.

1.5.2 *Terrain & Geology*

Terrain of the project area is varying from slightly rolling (slope-6.5%) to almost level ground at various sections of JVLR. The geology of the region is typical of the western coast i.e. clayey soil underlain by basalt rock formations.

Drainage System in the Project Region

The JVLR section 1 drains through Oshiwara river and Mithi river systems Each system has its own network of tributaries and channels (nallahs) across JVLR. The Oshiwara river flows east into the sea and Mithi river flows south into Mahim creek. As for JVLR Section-3, the project road drains to Kannamwar Nagar Nallah

Status of Existing Roadside Drains

Inhabited stretches of JVLR have been provided with roadside drains For most part of the stretch, there are no roadside drains. Problems of water-logging and flooding is not reported in the area. Possible reason could be the rolling terrain and existence of good natural drainage systems.

1.5.3 *Traffic And Transport*

A classified traffic volume (CTV) survey was conducted during November 2001 and February 2002 at different locations on JVLR. The results is reported in the ***Table*** below.

Summary Results of CTV Survey

Daily traffic volume (bothways)	*SEEPZ junction**		*Western section#*	*Middle section**	*Eastern section#*
	SEEPZ road	*JVLR*			
2-wheelers	1772	5795	5490	14021	7898
3-wheelers	2279	7312	6675	19805	6141
Car/Jeep/Taxi	2317	8039	6471	21811	12346
Buses	257	1841	1991	4081	1472
Trucks/ Tempo	11220	3890	4301	8865	7057
Total 2-way traffic	7745	26877	24928	68583	34914

*Note * - Data from ERM India conducted CTV survey in February 2002, # - Data from CES conducted CTV survey in November 2001*

Accident Hazards and Safety

Statistical data on traffic accidents along JVLR could not be collected. The incessant traffic congestion and slow vehicle speeds fortunately reduces the possibilities for accidents. However, road accidents involving school children has been reported by the residents of the habitations located adjacent to Section 1 of JVLR

Based on the location of inhabited areas along JVLR, the accident hot spots could be the following.

- Inhabited stretch between Kms 0+000 to Kms 2+000
- Inhabited stretch near Kms 3+000
- Inhabited stretch near Kms 4+800
- Inhabited stretch between Kms 5+500 to Kms 9+300
- Hill section near Kamal Amrohi studios
- Hill section east of IIT campus

All major intersections and junctions are provided with traffic signals Police personnel manage the traffic for major part of the day.

1.5.4 *Water Environment*

Surface water bodies located close to the project road are listed below:

Part of JVLR	*Water body*	*Chainage*
Section I	Majas nallah	At Kms 0+901
Section I	Mithi/ Mahum river	At Kms 3+802
Section II	Powai lake	At Kms 5+900
Section III	Kannamwar nallah	At Kms 10+190

All the water bodies are mainly monsoon fed. Hence, except during monsoon months, the water bodies are used for sewage and other liquid waste transport and disposal. Powai Lake - larger in geographical spread and significance - is used for recreational purposes. Considerable portion of the lake is polluted and eutrophicated.

1.5.5 *Water Quality*

Water quality analysis was carried out on two surface water samples and two ground water samples (from open wells) collected from various water sources along JVLR. The quality assessment indicates that all parameters analysed are within the limits laid down in *IS 10500-1991 – Standards for Drinking water* and *Coastal water quality criteria SW-III for marine waters* with designated use of recreation (non-contact), industrial and aesthetics.

1.5.6 *Soil*

Soil in the area is alluvial type mixed with sand and falls under the semi-impervious to impervious category. Soil erodibility is moderate. Soil analysis indicates that at all locations it is sandy loam. Clay content is high above 50%. As for using it in highway construction, the soil falls under poor to fair category.

1.5.7 *Ambient Air Quality*

Baseline ambient air quality results are presented below.

Ambient Air Quality in November 2001 & February 2002*

Monitoring station	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	*Lead* ($\mu g/m^3$)	*CO* (mg/m^3)	*SPM* ($\mu g/m^3$)	*RPM* ($\mu g/m^3$)	*HC* (*ppm*)
[1]AQMS-1 (Fantasy Land)	50 4	35 5	ND	5 0[3]	383 6	181 3	ND
[1]AQMS-2 (L & T Junction)	41 3	36 8	ND	1 9[3]	272 8	123 8	ND
[1]AQMS-3 (Gandhi Nagar Police Station)	40 4	29 0	ND	0 57[3]	257 5	121 4	ND
[2]AQMS-4 (SEEPZ road junction)	3601	52 2	-	3 83[4]	521 5	336 8	BDL
[2]AQMS-5 (WEH junction)	40 7	55 8	-	4 28[4]	588 0	366 5	BDl
NAAQS/ Residential	80 0	80 0	1 0	4 0[5]	200 0	100 0	0 24[5]

*Note * - CES conducted the AAQ monitoring in November 2001 and ERM India in February 2002*

1 - CES commissioned monitoring stations, 2 - ERM India commissioned monitoring stations

3 – 24 hourly average values, 4 – 1 hourly average values, 5 – Reference MLEA report

All values are 24 hourly average values unless otherwise mentioned

The results indicate that SPM, CO and RPM values at all the stations monitored are more than the corresponding NAAQS for residential land use Since June 1996, SO_2 and NO_x are showing a increasing trend albeit gradually This can be attributed to the vehicular growth The same increasing trend is not observed in SPM and RPM levels. Pollutant levels for these two parameters show significant variation and the November 2001 levels are almost one-fifth of June 1996 levels One possible reason could be the seasonal variation in pollutant levels

1.5.8 *Ambient Noise Level*

Baseline ambient noise levels along various locations of JVLR is presented below.

Summary Results of ANL Monitoring, dB (A)

Noise levels	*NLMS-1 Fantasy land*	*NLMS-2 L&T*	*NLMS-3 LBS jn*	*NLMS-4 SEEPZ*	*NLMS-5 WEH*	*Noise stds* [1]
L_{eq} Day	80 1	83 2	86 0	80 4	84 8	55 0
L_{eq} Night	72 3	77 5	77 2	70 6	77 3	45 0

1 – Noise standards for residential land use

The ANL results show that traffic induced noise is exceeding the corresponding CPCB standards for residential land use significantly. The possible reasons for high traffic induced noise could be due to:

- High daily traffic volume observed along all sections of JVLR;
- Incessant traffic snarl and congestion at major intersections of JVLR, especially the middle section of JVLR; and
- Undulating and rolling terrain all along JVLR, which causes HCV to accelerate/decelerate very often generating, noise in the process

1.5.9 *Ecology*

Detailed ecological survey of the project study corridor was undertaken as part of the baseline assessment of the project area. Results of the survey are presented in the following sub-sections.

Western Section of JVLR

The trees of avenue plantation include *Acacia auriculiformis, Ailanthus exelsa, Albizzia lebbeck, Bombax ceiba, Cassia siamea, Ficus henglialensis, F. Religeosa, F. Glomerata, Pongamia pinnata, Terminalia catappa, Thespesia populea* etc.

During the ecological survey, the trees located within the 30m belt on both sides of existing road were identified and counted. A total number of 519 tress comprising of 35 species was identified as *'project affected'*.

Middle Section of JVLR

Detailed ecological survey and identification & counting of *'affected'* trees were not carried out during the present survey, as the project proposals and preliminary construction drawings are not available at present.

Eastern Section of JVLR

The dominant avenue plantation in this region showed similar composition as that of western section of JVLR. During the ecological survey, it was found that no trees are located within the 30m belt on both sides of existing road

1.5.10 *Presence of Natural Habitats*

Along the eastern section of JVLR, mangrove swamps have been observed along the southern edge of the road. They have been significantly modified by human activity and hence the World Bank OP 4.04 does not apply to JVLR project On either side of existing 2-lane road, debris (mainly comprising of construction and top soil waste) has been dumped. The ecological assessment of this mangrove patch is presented below

Legal Status of Mangrove Area within Project Road RoW

PARTICULARS	*DESCRIPTION*
Ecological status	Degraded/stunted Mangroves
Status as per the Govt of India's Guidelines	RoW development exempted under CRZ regulations as a part of CZMP for Greater Mumbai by the MoEF of GoI
Mangrove area to be reclaimed on the Southern side of JVLR RoW	0 2 hectares
Location	South of JVLR near EEH junction.
Ecological status of the area on the Northern side of JVLR	Grasslands No presence of mangroves.

The mangrove vegetation in the region of study is a mixture of *Avicennia marina, Acanthus ilicifolius, Excoecaria agallocha, Sesuvium portulacastrum,* and *Aeluropus lagopoides* ***Table*** below provides details of distribution and current status of mangroves found within JVLR RoW.

Distribution and Current Status of Mangrove found within Project Road RoW

Names of species observed	*Avicennia marina, Excoecaria agallocha, Acanthus ilicifolius*
Average height of stand	1 5 - 3 5 m (majority of which is occupied by Avicennia marina - one of the widely occurring species of mangroves in and around Mumbai
Density	*Avicennia marina* (about 25 individuals per ha), *Excoecaria agallocha* (about 5 individuals per ha), *Acanthus ilicifolius* (this is an herbaceous plant and therefore non-significant in this area)

1.5.11 *Presence of Sensitive Receptors*

There are no sensitive receptors located along JVLR -Phase I stretch. Along middle section, sensitive receptors located just outside RoW include:

- Kendriya Vidyalaya (Central School) located within Indian Navy Housing Complex along northern edge of JVLR near LBS junction.
- Indian Institute of technology campus along northern edge of JVLR

1.5.12 *Presence of Places of Worship*

Phase I of JVLR Project

Archeological (prehistoric), paleontological, historical, and unique natural value sites are not found along Phase I stretch of JVLR. Few places of worship have been identified within the project RoW The details of which are provided below

Affected Religious Places along Phase I Stretch of JVLR

Name of the place/religious structure	*Location chainage, kms*	*Size of the structure, sq ft*	*Remarks*
1 Gajanan Maharaj Mandir	0+300	130	The temple will be affected fully A hall in front of the temple will not be affected strictly going by RoW
2 Hindu Temple	0+350	< 50	Fully affected
3 Buddha Vihar mandir	0+380	300	Temple fully affected A hall in front of the temple will not be affected strictly going by RoW
4 Place of worship	0+450	< 10	Private worship place Fully affected
5 Place of worship	0+480	< 10	Private worship place Fully affected
6 Ganpati Mandir	2+750	150	Temple will be fully affected
7 Hanuman mandir	2+800	130	Temple will be fully affected
8 Place of worship	3+800	< 10	Private place of worship Fully affected
9 Place of worship	4+800	< 10	Slum structure Fully affected
10 Hindu temple	9+300	< 30	Affected fully due to ROB widening as part of flyover construction at LBS junction

Phase II of JVLR Project

Along Phase II stretches since DPR proposals are not yet ready identification of affected religious places have not been done. The places of worship located close to the existing road edge were identified and their enumeration details are presented below.

Presence of Religious Places along Phase II Stretch of JVLR

Name of the place/religious structure	*# of structures along Section II*
Temples	2
Church	1
Mosques	0
Gurudwara (Place of worship of Sikhs)	1
Total	**4**

1.5.13 *Utility / Facility Relocation along Project Corridor*

Summary of utility services to be relocated during Phase I of JVLR is as below.

Utility service	*Section I*	*Section III*
Water supply line, metres	726	60
Telephone cables, metres	3,110	3,000
Underground electricity cables of BSES, metres	14,594	198
Underground electricity cables of MSEB, metres	3,214	2,804

1.5.14 *Current Status of Flyover projects along JVLR*

MSRDC is currently implementing two flyover (grade separators) projects along JVLR. The current status of the projects is under various stages of execution.

1.6 IDENTIFIED ENVIRONMENTAL IMPACTS

In order to identify various site-specific environmental issues, which might get impacted due to the implementation of proposed improvement and widening of JVLR, an Impact Identification Matrix (IIM) is prepared. Based on the IIM, various site-specific impacts identified are described in detail in the following sub-sections.

1.6.1 *Land Use*

During construction stage the available RoW will be cleared resulting in reclamation of residential land use. The impact on land use will be temporary in duration. During operation stage, induced impacts on land use pattern are anticipated to occur. As the JVLR will become a major link connecting EEH and WEH, it will lead to exploitation of vacant land area/ space available along the project corridor. The existing wastelands and coastal mangroves along eastern section might be reclaimed to improve its utility and increase the land value.

1.6.2 *Terrain & Geology*

Insignificant adverse impact is anticipated on the geological environment and physiography of the project corridor.

1.6.3 *Impact on Drainage Pattern*

Roadside drains have been proposed on either side of JVLR as well as regraded SEEPZ road. The new roadside drains will be connected to the existing storm drainage system/ drains in the area at appropriate locations.

Along Section 1 of JVLR

A review of the vertical alignment of the proposed JVLR reveals that the finished road level will be well above (5 to 28m above) the level of drainage systems available in the region. In light of this, no water stagnation problem is anticipated during operation phase of the project.

Along Section 3 of JVLR

The vertical profile designed for section 3 of JVLR is constantly sloping down to Kannamwar nallah with elevation difference of about 7m Hence drainage along project stretch will not be a problem.
During operation stage, the altered physiography may lead to soil erosion and may take long time for the drainage pattern to stabilise itself.

1.6.4 *Traffic And Transport*

During project initiation and construction phase, significant adverse impact on traffic and transport scenario is anticipated to occur for short-term duration. As per the local traffic management plan, for a length of about 3.95 kms the available carriageway width available for traffic movement during construction will be about 5.5m which is less than existing carriageway width of 9.0 m including the

unpaved shoulders. Thus there will be constricted space available for traffic movement.

During operation phase, the service roads proposed in phases will smoothen out the traffic movement reducing the conflict between local traffic movement and traffic passing through JVLR. This would also increase pedestrian safety.

Accident Hazards and safety

During construction phase, various construction activities will cause hindrance to the flow of existing traffic increasing the possibility for occurrence of accident hazards. Minor adverse impact is anticipated due to this reason.

During operation phase of the project, the vehicle cruising speed along JVLR will increase causing difficulties for pedestrians in crossing the 6-lane wide road Increased vehicle speed and volume will also increase the probability of accident hazards causing adverse impact. The adverse impact will be felt especially near inhabited areas of Section I and II of JVLR. The DPR has proposed pedestrian (zebra) crossings at the inhabited areas. These crossings should mitigate some of the adverse impacts anticipated on pedestrians' safety. The entire carriageway is proposed with central median, which will avoid head-on collision of vehicles

1.6.5 *Water Environment*

During construction phase, especially during monsoon season, increase in turbidity and suspended solids is expected to occur in all water bodies found along JVLR due to loose and disturbed soil layer erosion and rutting The impact will be insignificant. The construction program has taken this aspect into consideration and no activity has been proposed during the monsoon months. During operation phase of the project, minor to insignificant adverse impact is anticipated on the water quality of the surface water bodies located along JVLR

Hydrology

The existing bridge and cross-drainage structures along JVLR will also be widened to eight-lane divided carriageway configuration. Hydraulic adequacy of the widened structures have been checked. Adequate culverts, storm water drainage and road surface drainage channels have been provided in the design Hence possibility of water logging and increase in flood levels are not anticipated both during construction and operation phases of the project

1.6.6 *Soil*

Major impact on land environment due to the implementation of JVLR project will be because of the quantum of earthwork involved in the construction phase. The summary details of earthwork estimated are presented below.

- Total qty, of cut material = 1,61,785 cum
- Quantity of cut material proposed for reuse = 1,21,194 cum
- Remaining quantity of cut material for disposal = 40,591 cum
- Amount of borrow material required to be brought from borrow pits = 1,81,355 cum
- Total amount of material to be transported

in and out of project corridor = 2,21,946 cum

Nearly 75% of the cut material has been proposed for reuse in the project itself This is an appreciable aspect of the project proposal. The remaining 25% of cut material will be disposed near Aarey colony area located east of SEEPZ road The disposal site is presently a low-lying and barren land. The available width of RoW at this site is 60m and ownership of the land rests with the State government. Nearest surface body located at about 300m from the disposal site is Mithi river. The Mithi river is seasonal and carries sewage for most of the time in a year. However, good disposal practice should be adopted at this site to avoid any adverse impact on soil erosion and aesthetics related issues.

During operation phase of the project, minor adverse impact due to soil erosion is anticipated initially and after some years into operation phase, the impact may become insignificant.

1.6.7 *Ambient Air Quality*

Impact on AAQ during construction stage of both Phase I and II of JVLR project is anticipated. The adverse impact will be primarily due to transportation of construction debris, road construction activities, loading and unloading of construction materials, and plying of construction vehicles along unpaved shoulders.

During Operation phase of the project, in order to estimate the contribution of JVLR to the pollutant levels along its alignment an AAQ modelling analysis was carried out. For predicting ambient CO and NO_x levels, CALINE 3 - an air quality model for highways has been used and for predicting PM_{10} and Pb levels, a simple roll-back model was used.

CO levels

It is expected that with the project road widening, the CO levels are expected to lower down. The project, therefore, will have moderate impact on ambient air quality in terms of CO.

NO_x levels

The NOx levels are expected to remain below the standards only beyond 20 m from the edge of the road. The project, therefore, will have moderate impact on ambient air quality in terms of NOx.

SPM and PM10 levels

The modelling analysis results show that the predicted SPM and PM10 levels for the years 2004 and 2011 violate ambient air quality standards for residential areas posing significant impact on air quality.

1.6.8 *Ambient Noise Level*

During Construction phase of the project, the operation of construction machinery viz., earthmoving machinery's, loaders, backhoes, concrete mixer etc ,

and construction vehicles employed for transporting various construction material will lead to increase in ambient noise levels.

During Operation phase of the project, in order to estimate the JVLR traffic induced noise levels an ANL modelling analysis was carried out using Federal Highway Administration (FHWA) model. The prediction results indicate that the traffic induced day time noise level of 55 dB(A) is likely to occur at 200 m and beyond from the edge of the alignment while the night time traffic induced noise level of 45 dB(A) is likely to occur beyond 1000 m. The modelling results clearly reveal that day and night time noise levels are exceeding the prescribed standards.

1.6.9 *Ecology*

The widening of existing JVLR will require felling of about 519 trees during Phase I of JVLR project All the trees are indigenous species and do not fall under endangered variety Significant adverse impact is anticipated on the ecological environment of the project corridor due to felling of trees.

The compensatory plantation proposed in the DPR will mitigate the adverse impact on ecology to large extent in the long run. The DPR has proposed for compensatory plantation near Aarey colony area, where the available RoW is 60m wide and ownership of land rests with the State government. Approximate calculation reveals that about 0.6 ha of land area will be available for compensatory plantation in this area. This is far less than required for planting at least 519 trees. Hence besides Aarey colony area, other government-owned vacant area shall be identified for afforestation purpose. The Tree authority shall be consulted for identifying compensatory plantation area.

Compensatory plantation along either side of improved and widened JVLR is not possible for want of space. DPR has estimated and provided an amount of Rupees 4.7 millions for compensatory plantation and landscaping throughout Phase I stretches of JVLR. Thus with the compensatory plantation proposed, the short-term adverse impact on ecology will be largely mitigated in the long run and improve the aesthetical value of the area as well.

No impact on terrestrial fauna and aquatic fauna is anticipated. During operation stage, the vehicular traffic on JVLR will not have major impact on the ecological environment.

1.6.10 *Natural Habitats*

Baseline assessment indicates that local community has destroyed much of the mangroves and the land use has been changed to grass lands. On either side of existing 2-lane road, debris is being dumped. Hence the project road development and widening will not impact the existing mangroves swamps found well away from the project road RoW. The widening may reclaim 0 2 ha of land on the southern side of RoW.

It is notable here that MMRDA has mooted a separate project to develop a marine mangrove park between Kanjur village and Mulund with an objective to

rejuvenate and protect the existing mangroves in dilapidated form. The proposed park, which will be developed over an area of 150 hectares of land initially, will be spread to all 1000 hectares of salt pan land available in the region This would go a long way in mitigating any adverse impact the JVLR project might have on the existing mangroves.

1.6.11 *Presence of Sensitive Receptors*

No sensitive receptor will be located along section 1 of JVLR as the only kindergarten school located near Milind nagar will be cleared and relocated at the R&R site. Hence no impact is anticipated

During operation phase, induced impacts will be felt especially near IIT campus and Kendriya vidyalaya.

1.6.12 *Places of Worship*

RAP consultants have carried out *"project-affected-community'* consultation and based on that, an action plan has been outlined. Discussion findings and salient features of action plan are presented below.

- Out of nine identified places of worship, only four of them have an affected plinth area of more than 100 sq. ft size
- Consultations were carried out with concerned temple owners/ managing trustees in the major 4 temples. Shifting the temple to rear side of existing location was finalised. The temple committees have accepted responsibility for reconstruction of the temple.
- Project proponent needs to provide the relocation site and cost of reconstruction.
- In the new place identified for temple relocation, the households that will be affected due to shifting of temple will be included under the JVLR PAH's
- The other five places of worship were not significant ones and the issue of clearing them without relocating it anywhere was discussed during the community-level consultation process.

Consensus and agreement the local community had with R&R consultant indicates that no adverse impact or social repercussion is anticipated.

Places of Worship Relocation Issues in Phase II of JVLR

During Phase II of JVLR project, MMRDA is planning to follow the same approach that has been followed in all MUTP's including Phase I of JVLR, towards addressing the issue of relocation of places of worship.

1.6.13 *Utility Diversion*

During construction phase of the project, significant number of utility service equipments will be relocated. Significant adverse impact is anticipated while relocating water supply pipelines and underground electricity cables. The adverse impact will be significant on the western section of JVLR.

1.6.14 *Other Construction Phase Impacts*

Impacts due to Siting of Labour Camps

The DPR has not identified or suggested any location for siting construction camps. It would be contractor's responsibility to locate a site suitable for his work under the general conditions of contract and as per MRTH specifications for road and bridge works (MRTH specifications will form part of the contract). It would be contractor's responsibility to ensure that he complies local laws, if any, pertaining to construction camps siting and the area identified for siting construction camps are approved and authorised by competent authorities The PIA/ PMC will approve the area selected/ identified by the contractor.

Impacts due to Siting of Borrow and Quarry Material Areas

Significant adverse impact on geological resources is anticipated to occur at quarry sites and borrow areas identified for the project. The DPR consultant has identified three quarry sites viz., Dahisar, Vikhroli and Turbhe based on a detailed study report on quarry sites. Since as per the license conditions, the quarry sites will have an approved quarry site management and closure plan, the environmental issues pertaining to quarry site will be addressed and impacts, if any, will be mitigated.

Quarry and borrow areas identification will be the responsibility of the contractor as per his contractual conditions. There are no borrow areas identified along project road corridor and hence the impact due to borrows areas opening does not arise.

1.6.15 *Impact of Flyover projects along JVLR*

Two flyovers presently under construction stage and one flyover proposed near SEEPZ road junction along with JVLR widening proposal will have significant positive impact on the JVLR project.

1.7 *RECOMMENDED ENVIRONMENT MITIGATION MEASURES*

1.7.1 *Land Use*

During pre-construction and construction phase of the project, construction related activities shall be preferably restricted within project RoW. During operation phase of the project, the service roads, footpaths, shoulders, junctions/ intersections and on either side of high embankments shall be cleared off encroachments periodically.

1.7.2 *Terrain & Geology*

Insignificant adverse impact is anticipated on the geological environment and physiography of the project corridor.

Impact on drainage system

The new roadside drains shall be connected to the existing storm drainage system/ drains in the area at appropriate locations as per DPR proposal Contractor shall ensure that after construction is over or prior to monsoon season, the new drains and old drains existing along JVLR are maintained clean of construction debris.

1.7.3 *Traffic and Transport*

During pre-construction and construction phase of the project, traffic management scheme planned shall be adhered. PMC shall periodically review the plan with respect to site conditions.

The contractor shall take all necessary measures for the safety of traffic during demolition and site clearing activities. He shall provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the engineer for the information and protection of traffic.

Special consideration shall be given in the local traffic management to the safety of pedestrians. The temporary traffic arrangement within RoW, recommended in the DPR should be kept free of encroachments/ commercial activities.

PMC shall periodically inspect the temporary paved shoulders planned between Kms 0+000 to 2+200 and Kms 2+900 to 4+650 for potholes and depressed patches. Temporary repairing shall be carried out, if needed.

During operation phase of the project, traffic control measures including speed limits to be enforced strictly. Traffic volume and speed on JVLR shall be monitored and the benefits must be recorded to evaluate the effectiveness of the project

Accident Hazards and Safety

During construction phase, contractor shall ensure that the transport vehicles used to ferry materials and dispose debris does not create hazardous conditions for general traffic using the roadway

During operation phase, the entire JVLR corridor shall be monitored for any accidents. If any physical correction/ alteration in the geometry of the road is needed, the same shall be carried out.

1.7.4 *Water Environment*

During construction phase of the project, Siltation of soil into water bodies shall be prevented as far as possible by adapting soil erosion control measures as per MRTH guidelines. Construction work close to streams or water bodies shall be avoided during monsoon. Other mitigation measures to avoid siltation will include:

- Excavated soil should be disposed off properly so that it should not block the flow of water

- In areas susceptible to soil erosion, earthwork should be carried out before rainy season & temporary or permanent erosion protection work as may be feasible shall be provided
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into nearby surface water bodies or form mud puddles in the area.

During operation phase of the project the drains shall be maintained and cleaned periodically.

1.7.5 *Soil*

During construction phase, soil erosion control measures along embankment slopes are recommended The measures could be as per MRTH guidelines. Excess earth shall be disposed off in identified sites. Good disposal practice should be adopted at disposal site to avoid any adverse impact on soil erosion and aesthetics related issues. Debris disposal site shall be monitored for soil and ground water quality as per the monitoring plan recommended in the EMP.

During operation phase, road embankment & cut section stability should be checked for erosion and rutting. Any sign of instability should warrant adequate response immediately and well before succeeding monsoon season

1.7.6 *Ambient Air Quality*

The mitigation measures recommended during construction phase are:

- All vehicles delivering material to the site shall be covered to avoid material spillage.
- Construction site to be watered periodically to minimise fugitive dust
- The unpaved roads, if used by the contractor, shall be sprinkled with water at least once in a day to control the fugitive dust emissions.
- Contractor shall ensure that Concrete, Asphalt and Hot Mix plants are licensed and authorised for operation by concerned authorities and shall intimate the engineer-in-charge prior to procuring materials from them.
- Exhaust and noise emissions of construction equipment's shall adhere to emission norms as laid out by MoEF/ CPCB.

During operation, the competent authority shall enforce vehicular emission norms of the day.

1.7.7 *Ambient Noise Level*

The mitigation measures recommended during construction phase are:

- All construction equipment's shall be fitted with exhaust silencers. Damaged silencers to be promptly replaced by contractor.
- DG sets, if used, shall adhere to noise standards of MoEF.
- During blasting of hill section near Kamal Amrohi studios, noise levels shall adhere to local laws. Restricted blasting work hours and intermittent blasting could be few mitigation measures that can be adopted
- Operation hours for noise generating equipments such as pile driving, concrete and drilling etc. shall be pre-approved by PIA. The PIA depending on site-conditions may regulate and/ or restrict operation hours.

- Workers exposed to loud noise (As per Factory Act requirements) shall wear earplugs/earmuffs

During operation stage, there would be an increase in the ambient noise levels along the project road due to increased traffic The mitigation measures recommended during operation phase include:

- Noise will become a major problem if smooth flow in traffic is stopped due to congestion or bottleneck situation in the road. The traffic management unit of MCGM shall identify such locations causing hindrance to traffic flow and shall take adequate rectification measures.
- Near sensitive receptors "No Honking" zones shall be announced by placing adequate number of signboards along the road. Road section along IIT campus, Central school, and all residential areas shall be declared as "No honking zones".

1.7.8 *Ecology*

Trees falling within the alignment which are to be removed before commencement of construction shall be identified and approved by PIA Prior permission from MCGM/ Tree authorities shall be obtained.

During construction phase, compensatory plantation as provided in the DPR proposal shall be carried out in line with Tree authority regulations and guidelines. Tree authority shall be consulted for identifying compensatory plantation area.

During operation phase of the project, adequate care of the landscaping and compensatory plantation should be taken up so as to achieve tree authority's guideline survival rates.

1.7.9 *Natural Habitats*

During construction phase, all activities, construction vehicle movements and other miscellaneous activities must be restricted within project RoW Temporary disposal of demolition debris, felled trees or locating labour camps and stockyards beyond the project RoW must be avoided near the degraded mangrove patch observed near EEH.

1.7.10 *Presence of Sensitive Receptors*

Traffic congestion before IIT campus is frequent especially during peak hours. The DPR consultant shall prepare an exclusive traffic management scheme for the JVLR section before IIT campus.

1.7.11 *Places of Worship*

The nine cultural properties identified along Section I of JVLR shall be relocated/ cleared as per the community-level discussions and the action plan worked out with the local community/ owner of the structure.

1.7.12 *Utility Diversion*

In order to mitigate adverse impacts, all utilities, such as water supply lines, electrical installations, telephone lines etc. shall be shifted after prior approval of agencies. Utility relocation shall be carried out in shortest possible time to reduce inconvenience to public.

1.7.13 *Other Construction Phase Impacts*

Siting of Labour Camps

During construction phase, it would be Contractor's responsibility to locate a site suitable for his work under the general conditions of contract and as per MRTH specifications for road and bridge works (MRTH specifications will form part of the contract). It would be contractor's responsibility to ensure that he complies local laws, if any, pertaining to construction camps siting and the area identified for siting construction camps are approved and authorised by competent authorities. The PIA/ PMC will approve the area selected/ identified by the contractor.

Siting of Borrow and Quarry Material Areas

It would be contractor's responsibility to ensure that borrow and quarry areas that he has identified are approved and authorised to operate by competent authorities. The PIA/ PMC will approve the area selected/ identified by the contractor before he actually procures materials from them.

1.8 *Environmental Management Plan*

The EMP measures to be implemented during pre-construction, construction and operation stages have been delineated with assigned responsibilities on contractor, PMC and PIA. The EMP measures has been provided in Tables 5.1 through 5.3 for Phase I of JVLR and Tables 5.11 through 5.13 for Phase II of JVLR in the report. Other components of EMP is presented in the following sections.

1.8.1 *Environmental Monitoring Plan*

The plan includes recommended monitoring sites, parameters to be monitored, time and frequency of monitoring, and collection, analysis and reporting of monitoring data.

1.8.2 *Key Performance Indicators*

At the project level, to evaluate the effectiveness of EMP measures, certain performance indicators have been identified both for consstruction and operation phases. These indicators need to be analysed based on the project level monitoring data collected during construction and operation stages of the project.

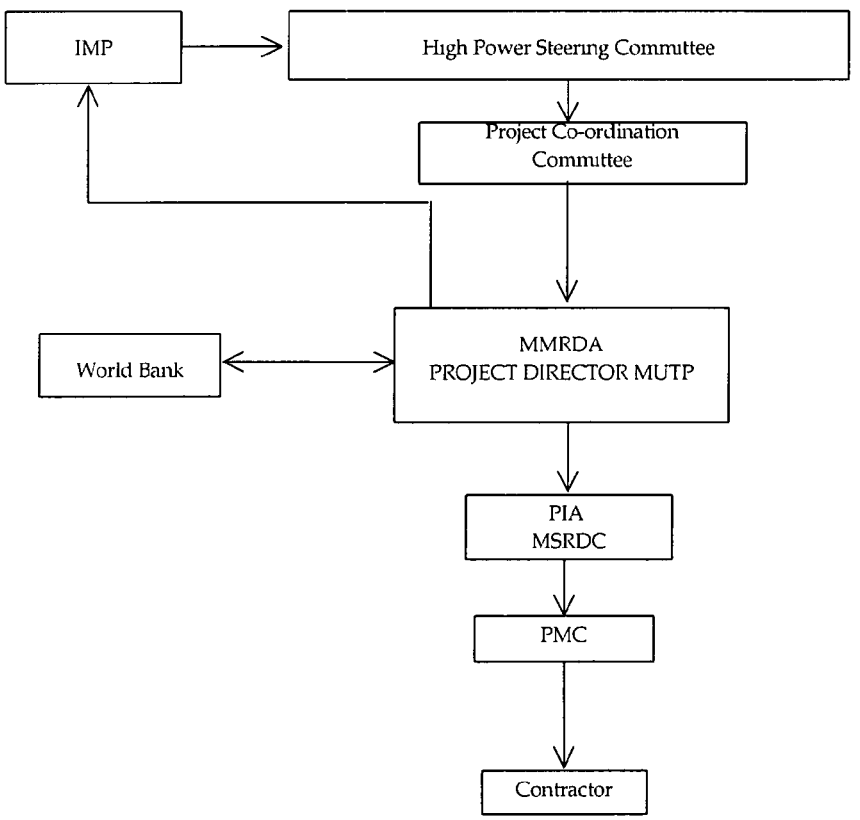
1.8.3 *EMP Reporting Arrangements*

The supervision and reporting process with respect to implementation status of mitigation measures during construction will initiate from the contractor at the lowest rung who will report to the Project Implementation Agency (PIA) through the Project Management consultant. Desired frequency of reporting process has been outlined.

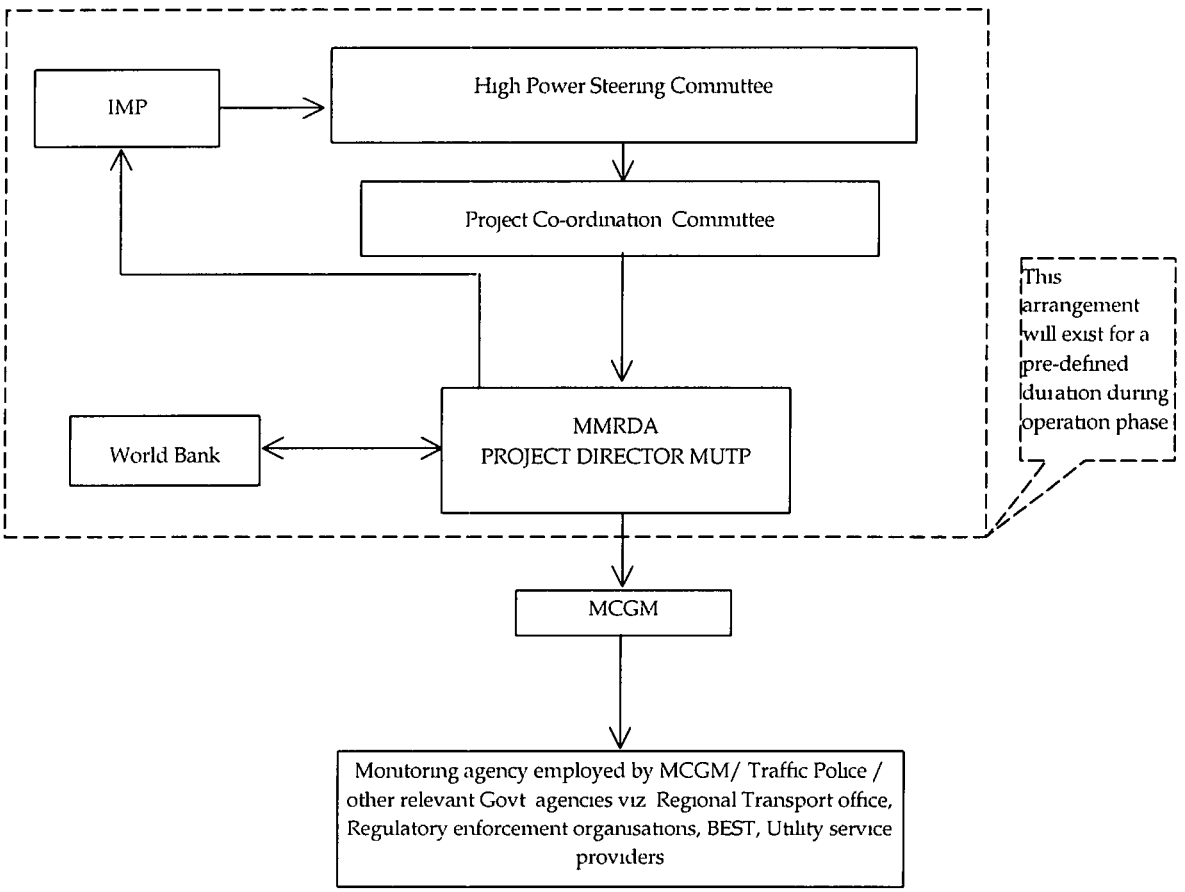
1.8.4 *Institutional Arrangement*

The co-ordination model proposed during construction and operation phases of sub-projects under MUTP is presented below

Institutional mechanism for implementation of EMP during Construction Phase of both Phase I and Phase II of JVLR project



Institutional mechanism for implementation of EMP during Operation Phase of both Phase I and Phase II of JVLR project



1.8.5 *Possible and Practical Measures for Environmental Enhancement*

Enhancement Measures along Section I of JVLR

Considering the various DPR proposals for the JVLR project, the possible enhancement measures are presented below.

Locality	Enhancement measures
Contiguous Residential areas	• Pedestrian crossings at select locations • Well-planned land use along service roads to avoid encroachment and squatters • Bus-bays along service roads • Planned space for taxi-scooters (3-wheeler) to park
Industrial area - SEEPZ and proposed SEEPZ extension	• Space for parking of heavy vehicles, buses, taxi-scooters and other vehicles along JVLR • Automobile service shops shall be allowed near the parking bay • Providing space for vehicle fuel refilling station (Petrol bunk) near the SEEPZ road junction
Commercial areas	• Space for parking personal vehicles shall be provided without obstructing traffic flow along JVLR

The enhancement measures recommended here have been adequately addressed in the DPR and budgeted. Hence enhancement measures recommended for

Section I of JVLR does not have any additional cost implications to the project cost.

Enhancement Measures along Section III of JVLR

Considering the various DPR proposals for the JVLR project, the possible enhancement measures are presented below.

Proposed Plan for Facilitating Mangrove Rejuvenation in the Region

Considering the marine Mangrove Park project mooted by MMRDA in the region, compensatory mangrove vegetation along JVLR project corridor may seem redundant. Instead, as an interim measure, about 0.4 ha of the area (0.2ha of adjoining land on either side of JVLR) shall be cleared off all debris and about 100m of the nallah on either side of JVLR be cleared off silt. This would facilitate, to some extent, the rejuvenation of mangroves and improving the aesthetics of the area.

Cost of facilitating Mangrove Rejuvenation Plan is provided in the following table.

No	Activity	Cost in Rupees
1.	Manipulation of land (will involve removal of entire debris from the clear felled area).	The cost of this activity may require approximately Rs 50,000 per ha
2.	Manipulation of channels (digging and de-silting channels for facilitating the tidal water in the areas of manipulation – which are in the upper intertidal region) near Kanjur Site	Rs. 200 per metre of channel
2.	As per the discussion in section 5.1 5, 0 4ha area shall be taken up for facilitating rejuvenation of mangroves. The cost of facilitating mangroves will be.	**Rs 60,000/-**

Enhancement Measures along Section II of JVLR

Locality	*Enhancement measures*
Residential areas	• Bus-bays along service roads • Planned space for taxi-scooters (3-wheeler) to park
Institutional	• DPR consultant shall carryout an exclusive traffic management study to avoid the bottleneck situation that exists opposite IIT campus The study shall analyse the feasibility of providing Road under pass opposite IIT main gate or reorganising entry/exit to IIT • Planned space for taxi-scooters (3-wheeler) to park • Bus-bays along service roads
Commercial	• Space for parking personal vehicles shall be provided without obstructing traffic flow along JVLR
Surface water body – Powai Lake	• The stretch between JVLR and Powai lake shall be converted to a park/garden with adequate seats/ benches

1.8.6 *Cost of Suggested Mitigation Measures for Phase I of JVLR project*

The EMP implementation will require financial commitments for the following:

- Budget for strengthening the capacity of the concerned organisations;

- Budget for implementing various mitigation measures proposed;
- Budget for undertaking enhancement measures proposed; and
- Budget for undertaking project-level environment monitoring.

These budgets have been estimated and provided in the table below.

Component of EMP	*Budgeted amount in Rupees*
Cost Estimates for Institutional Capacity Building	275,000
Cost Estimates for EMP Implementation	No additional cost
Cost estimate for implementing enhancement measures and project level monitoring – *During construction*	918,000
Cost estimate for project level monitoring – *During operation*	2,463,000
Grand Total	**3,656,000**

1.8.7 *Cost of Suggested Mitigation Measures for Phase II of JVLR project*

Component of EMP	*Budgeted amount in Rupees*
Cost Estimates for Institutional Capacity Building	No additional cost
Cost Estimates for EMP Implementation	No additional cost
Cost estimate for implementing enhancement measures and project level monitoring – *During construction*	1,366,000
Cost estimate for project level monitoring – *During operation*	73,000
Grand Total	**1,439,000**

1.9 PUBLIC INFORMATION AND CONSULTATION

Public consultation has been conducted at various stages of MUTP since the project was conceptualised in 1994. Complete details of the public-consulting processes are provided in the Consolidated Environmental Assessment on MUTP. The brief details are provided below.

Details of Public Consultation Process

Public Consultation	*Year*	*Suggestions/ Response in Brief*
Survey of Public Attitude[1]	1994 as part of CTS	Support for Public transport improvement schemes/ projects and road infrastructure
Public Consultation during EA of MUTP	June 1997	Approach and methodology adopted was fine-tuned as per the suggestions given during the process
Consultation during R&R	September 2001	As part of Baseline Socio-economic survey the NGO's explained the project details to the community affected
Consultation during Updated EA on MUTP	November 2000	Impact of ongoing developmental works were to be considered while designing the EMP for MUTP sub-projects Institutional arrangements were requested in more detail
Public Consultation during preparation of Consolidated EA	November 2001	A consultation process was exclusively conducted for the project-affected persons The
Public Consultation during preparation of Consolidated EA	November 2001	A consultation process was exclusively conducted for the general public The

From the various Public consultation processes, the major issues that has emerged include:

- Public concern over delay in implementing the MUTP
- Because of delay, many felt that planning MUTP on the basis of CTS carried out in 1994 may not be appropriate.
- Strong case was made for providing adequate facilities and safety to pedestrians from the burgeoning vehicular traffic
- Public concern about decreasing Public transport system' role in MMR
- Railway station area improvement schemes were desired for easy use
- EMPs prepared were appreciated in general. However, for effective implementation of EMP, dissemination of information was sought through electronic media and through NGO and CBO.

The details of action taken by MMRDA after the Public consultation process has been presented in Consolidated EA report on MUTP prepared by MMRDA.

Environmental Resources Management India (ERM) has been retained by Mumbai Metropolitan Region Development Authority (MMRDA) for carrying out Independent Review and update of the report on Environmental Assessment (EA) and Environmental Management Plan (EMP) of Jogeshwari-Vikhroli Link Road (JVLR) prepared by Consulting Engineering Services (CES) in January 2002 JVLR project has been proposed as a sub-project under the World Bank funded Mumbai Urban Transport Project (MUTP)

1.1 OVERVIEW OF MUMBAI URBAN TRANSPORT PROJECT (MUTP)

Mumbai, over the last few decades, has emerged as the financial and commercial capital of India. Greater Mumbai's population that was around 4 million in 1961 is now around 11.9 million in 2001. The urban growth has spread beyond the boundaries of Municipal Corporation of Greater Mumbai (MCGM) in the northern, north-eastern and eastern directions mainly along the suburban rail corridors to form Mumbai Metropolitan Region (MMR). Greater Mumbai has an area of 438 sq. km and a population of 11.9 million and the MMR has an area of 4354 sq km and a population of about 18 million By 2011, MMR is expected to have a population of 22 million. MMR generates about 5% of national GDP and contributes to over one third of India's tax revenues.

Mumbai has a unique distinction of satisfying 88 % of its peak period travel demand through public transport such as suburban trains and buses. Of the remaining 12% peak travel demand, taxis and private vehicles meet 7 % and 5 % of the demand respectively. Although these proportions are estimated to remain more or less same until 2011 (with public transport sector falling marginally from 88% to 85 %), the number of public transport trips in the peak period will rise substantially given the continued rise in population. In terms of public transport, suburban rail services carry close to 6 million passengers per day Bus services are provided by Brihan Mumbai Electric Supply and Transport Undertaking (BEST), with 3000 buses, and cater to 4.5 million journeys per day, of which approximately 60 % are connected with rail journeys. The rail network comprises Western Railway, Central Railway and Harbour Lines. On Western Railway, there are two corridors (*one corridor comprises a pair of lines*) between Churchgate and Borivali and one corridor beyond Borivali up to Virar. On Central Railway, there are two corridors between Chhatrapati Shivaji Terminal (CST) and Kalyan and on Harbor Line there is a single corridor from CST to Andheri with a branch to Kurla - Belapur. The road network in Mumbai is predominantly radial along the peninsula and comprises three main corridors - Western, Eastern, and the Central in the Island City and two corridors in the suburbs. The number of registered vehicles in Greater Mumbai grew from 308,881 in 1981 to 628,488 in 1991and 859,734 in 1998 It is estimated that the number was 1,048,734 in 2001.

As a result of population growth and increase in private ownership of vehicles, public transport is under severe stress For example, trains that have the rated capacity of 2600 passengers carry over 4500 passengers during peak hours Buses

too are overcrowded during peak period. Over-aged buses (500 out of a fleet of 3000) and increasing private vehicle ownership particularly of two and three wheeler vehicles with two stroke engines have given rise to increased traffic congestion and air and noise pollution Until now, solutions to Mumbai's acute transport problems have been hindered by the likely magnitude of displacement and resettlement of slum dwellers by the fragmentation of institutional responsibilities and the inadequacy of financial resources.

The transport challenges of Mumbai are compounded by the fact that over 50 % of Mumbai's population live in squatter settlements These settlements are most often located on publicly owned land and land reserved for public purposes in the master plans, including the land reserved for roads, road widening and along the rail tracks Managing the resettlement and rehabilitation of a large number of households and businesses, therefore, becomes a critical part of most transport projects

In response to the emerging transport crisis, Mumbai Metropolitan Regional Development Authority (MMRDA) - the regional planning and coordinating agency- was mandated to prepare a transport sector development strategy "Comprehensive Transport Strategy (CTS)" was prepared in 1994, providing a strategic framework for the transport sector of MMR Three strategic alternatives were examined to meet the projected travel demand in MMR viz.

- Public Transport - PT,
- Public Transport with Demand Management in the Island City - PT+DM; and
- Road Investment - RI.

The strategic alternative of PT+DM is found to be the optimal strategy from a number of perspectives as outlined in the various environmental reports prepared by MMRDA.

The CTS clearly established the guiding principles that are still valid for transport sector today, namely that the investment priority must be accorded to public transport, particularly suburban railway; road investment should concentrate on improving east-west road links in the suburbs along with the Road Over Bridges (ROB) that replace the existing level crossings on the railways; and in the Island City where congestion is likely to be acute and there is inadequate space for expanding road network, demand management measures need to be adopted. The project components proposed for implementation under the Mumbai Urban Transport Project (MUTP) have been selected within the framework of this strategy.

Therefore on the basis of the framework developed under the CTS the following project components have been identified for implementation under MUTP

Rail Transport Component

- Railway System - Capacity Optimization and Enhancement;
- Setting up new corridors along existing ones, and
- Purchase of rolling stock.

Road Transport Component

- Road Transport - Traffic management (TM) and related measures, including area traffic control (traffic signal systems), bus priority and rail station area transport integration,
- Road Transport - Infrastructure, including roads and road over rail bridges, and
- Road Transport - Equipment (procurement of buses)

Resettlement and Rehabilitation

- Construction or purchase of about 20,000 permanent dwelling units;
- Construction of about 6000 transit dwelling units; and
- Land acquisition and R & R assistance.

1.1.2 *Description of the Road Transport Component of MUTP*

The road component of MUTP seeks to strengthen the capacity of the MCGM for traffic management, policy and regulation, and support specific investments in traffic management, traffic signals, east-west connecting roads and rail grade separations. The project will also support the Brihan Mumbai Electric supply and Transport Undertaking (BEST) in improving its efficiency and capacity of service provision through institutional reforms and procurement of environment-friendly and user-friendly buses Through this component the project would help MMRDA improve the systems for developing strategies and policies for effective traffic/transport planning for MMR including their implementation through demand management and user pricing.

The physical works under this component, which require review of environmental and social issues depending upon the nature and scope of work, include:

- Jogeshwari - Vikhroli Link Road (JVLR). This corridor includes two flyovers being constructed by Maharashtra State Road Development Corporation (MSRDC), which are not being financed through MUTP.
- Santa Cruz - Chembur Link Road (SCLR).
- Construction of 3 ROBs at Jogeshwari – South, Jogeshwari- North and at Vikhroli.
- Pedestrian sub-ways, footpaths and other pedestrian facilities
- Station Area Traffic Improvement Schemes (SATIS).
- Bus Procurement.

Pedestrian Underpasses and other facilities and SATIS expected to have only very limited environmental issues during construction and bus procurement will have positive impact due to environment friendly buses

1.2 *CHRONOLOGY OF VARIOUS STUDIES ON JVLR PROJECT*

On the Jogeshwari-Vikhroli Link Road (JVLR) project identified under MUTP, a number of preparatory studies have been carried out by MMRDA.

MMRDA had appointed AIC Montgomery-Watson Consultants (India) Pvt Ltd to undertake preparation of the Environmental Assessment (EA) for the Mumbai Urban Transport Project (MUTP), in accordance with World Bank Operational Policy (then called Operational Directive 4 01) on Environmental Assessment. This EA process resulted in the preparation of Sectoral-Level Environmental Assessment (SLEA), Programmatic Level Environmental Assessment (PLEA), and Micro-Level Environmental Assessment (MLEA) The SLEA was a strategic assessment, while the PLEAs were prepared for small generic sub-projects like flyovers, Road Over Bridges (ROBs) and Road Under Bridges (RUBs). MLEAs were prepared for larger sub-projects like road widening and extensions

These studies were undertaken between 1996 and 1998 and resulted in several outputs including a synthesized final report As a part of this exercise the MLEA of Jogeshwari - Vikhroli Link Road (JVLR) was carried out The alignment of the subject project road – JVLR - is presented as ***Figure 1.1.***

As the MLEA and associated EMP of JVLR were prepared in 1998, MMRDA/MSRDC[1] appointed CES to prepare updated MLEA report (henceforth, this report is referred to as "*CES report*"). CES has prepared updated MLEA report taking into account the changes in baseline environmental conditions since 1998 and also the changes/ minor alterations in technical proposals of the project CE S conducted a baseline survey in November 2001 and submitted the draft updated EA/ EMP report to MMRDA in January 2002 for review/comments.

This report, is thus a result of an independent review and update of EA/EMP Report prepared by CES in January 2002. MMRDA has also prepared a Final Consolidated Environment Assessment (EA) Report on MUTP, 2002, based on the preparatory study reports on various sub-projects identified under MUTP The findings and recommendations of this report has been incorporated in the Final Consolidated EA Report on MUTP, 2002.

1.3 *POLICY AND LEGAL FRAMEWORK*

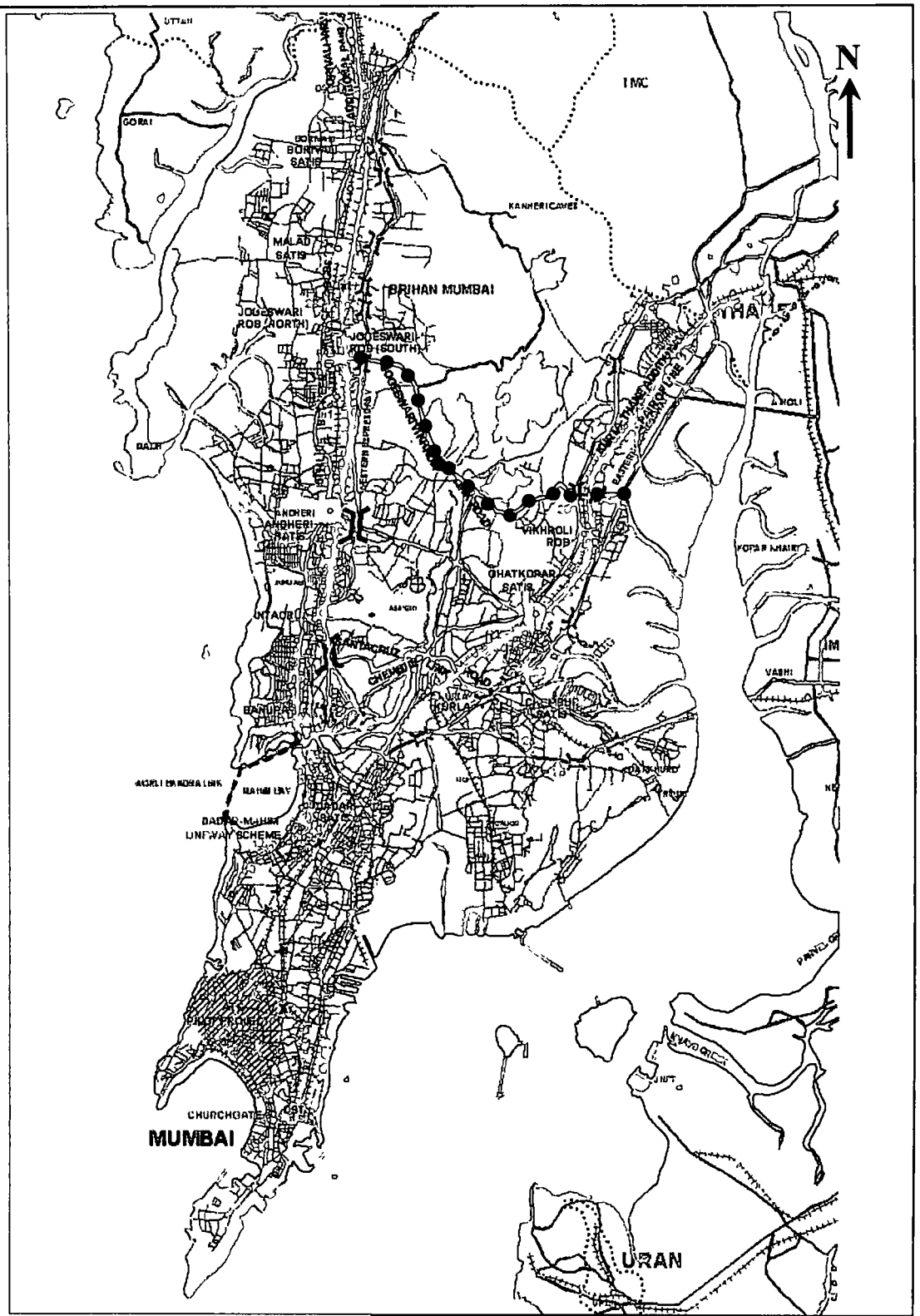
The project will be implemented under the applicable Indian legal framework and will also comply with the safeguard policies of the World Bank The present EMP report for JVLR project has been prepared in line with the Policy and Legal framework formulated for the MUTP by MMRDA. The Policy and Legal framework for the MUTP as outlined in the Consolidated EA report on MU TP, 2002 has been presented in ***Annex A***. The applicable legal and policy framework for JVLR Project is described below

1.3.1 *Applicable Indian Legal Requirements*

The applicable Indian legal framework is listed below:

Legislation related to Environment

(1) [1] Maharashtra State Road Development Corporation (MSRDC) is the identified Project Implementing Agency for the JVLR project



JVLR Project road

Source Consolidated EA report on MUTP Project, MMRDA, January 2002

ERM India Private Limited

Project : EA/ EMP report on JVLR project under MUTP

Client : Mumbai Metropolitan Region Development Authority

Title : Key map showing JVLR alignment

Figure : 1.1

ERM

- Environmental (Protection) Act, 1986 and associated rules and notifications under the act
- Coastal Regulation Zone Notification, 1991
- The Maharashtra (Urban Areas) Preservation of Trees Act, 1975

Legislation related to Resettlement and Rehabilitation:

- Land Acquisition Act 1894 (LA Act).
- Maharashtra Regional and Town Planning Act, 1966 (MR&TP Act)
- Development Control Regulations for Greater Mumbai 1991 (DCRs).
- The Maharashtra Co-operative Societies Act 1960.

For JVLR project only the following World bank policies are applicable and the details of these are further described in *Annex A*:

- Environmental Assessment (OP 4.01)
- Cultural property (OP 4 11)
- Involuntary Resettlement (OD 4 30)

1.4 *Layout Of The Report*

The remainder of the report is laid out as follows

Section 2 presents the subject JVLR project road background details viz., location, details of existing cross-drainage (CD) structures, widening and improvement proposals, alternate proposals analysed, other project proposals, envisaged construction program for implementation, and description of other ongoing developmental works along JVLR.

Section 3 presents baseline environmental status for various parameters and site-specific issues along the JVLR project corridor. This section also presents the status in 1996 as was reported in MLEA document and compares the same with current baseline status

Section 4 presents various identified impacts, which vary in magnitude, duration and nature, on various environmental parameters and site-specific issues both during project construction and operation phases and the recommended mitigation measures

Section 5 presents the recommended EMP, both for construction and operation phases of the project. This section also presents suitable environmental monitoring plan/ schedule for the key environmental impacts; key performance indicators during project implementation; recommended EMP reporting schedule and ready-to-use formats; design related changes, if any; measures for environmental enhancement of the area/site; and Institutional strengthening/ Capacity building required.

Section 6 presents the summary details of Public Consultation process carried out for the Mumbai Urban Transport Project.

The Annexe to this report include:

Annex A Policy and Legal framework identified for MUTP

Annex B Strip Plan maps of the JVLR project corridor

Annex C Drawings pertaining to various improvements and widening proposals of JVLR project.

Annex D Baseline monitoring report.

Annex E Ambient air quality modelling results

Annex F Ambient noise quality modelling results.

Annex G Reporting Format for EMP implementation status.

Annex H Environmental management measures for ongoing grade separator works along JVLR

2.1 PROJECT DESCRIPTION

In 1994, a Comprehensive transport plan was prepared by MMRDA to arrest and improve the deteriorating transport condition in the Mumbai Metropolitan Region. Under this study, several road components were selected for improvement. Jogeshwari - Vikhroli link road (JVLR) connecting Western Express Highway (WEH) and Eastern Express Highway (EEH) is one of the roads selected for improvement

The widening and improvement of JVLR has been since then taken up under the World Bank funded MUTP. The project proponent - MMRDA - has carried out various preparatory studies on JVLR project which include.

- Feasibility study and detailed project report, 1998
- Micro-level environmental assessment (MLEA), 1998
- Baseline socio-economic survey (BSES) of the project corridor, 1996
- Rehabilitation action plan (RAP) and Community environment management plan (CEMP), 1998
- Rehabilitation Implementation Plan (RIP), Draft report, January 2002

However, in view of the considerable passage of time, MMRDA and the project-implementing agency (MSRDC) reviewed and updated all the preparatory study reports. This Environmental Assessment and Environmental management plan report is thus an update of the MLEA report prepared by AIC Watson Consultants (AIC) in March 1998 and CES Report prepared in January 2002.

2.1.1 *Project Road Background*

Link roads connecting WEH and EEH are the major arterial roads of the Mumbai suburban road network. Both WEH and EEH run along north to south direction and are parallel in certain sections. The existing JVLR became operational in 1994. Prior to 1994, access was possible from Andheri - East through Marol area and up to Kamal Amrohi studio on the western side. On the eastern side, access was possible from LBS Marg (Gandhinagar square) and up to Indian Institute of Technology (IIT) campus. In mid 1980s, the section between IIT campus and Saki Vihar road was connected south of Powai Lake. The final two-lane wide link, connecting Kamal Amrohi studio and Saki Vihar Road, was constructed in 1994.

In the preparatory study reports, the entire project road starting from WEH and ending at EEH has been divided into three sections, possibly for easy reference and understanding. The sections identified include:

Section I: The segment of JVLR which starts from WEH junction and ends at Saki Vihar road junction (near L&T Factory) has been referred as *Section I* of JVLR. The length of this section is 4.9 km. This section being located on the western side is also referred as *Western section* of JVLR. Existing carriageway of the western section of JVLR is a two-lane road consisting of 7-m wide asphalted carriageway with 2.5m wide shoulders.

Section II: The segment of JVLR which starts from Saki vihar road junction and ends at LBS marg junction (near Gandhi nagar square) has been referred as *Section II* of JVLR. This section being located in the middle of entire JVLR is also referred as *Middle section* of JVLR The length of middle section is 4.3 km. Barring a length of about one kilometre, the entire middle section of JVLR has been widened by BMC to a cross-section width of six lanes. The existing 6-lane carriageway has no central median except for a stretch opposite IIT Powai. Out of six lanes, four central lanes have been constructed with flexible bituminous concrete and outermost lanes on either side have been asphalted.

Section III. The segment of JVLR, which starts from LBS marg junction (Gandhinagar square) and ends at EEH junction, has been referred as *Section III* of JVLR. This section being located on the eastern side is also referred as *Eastern section* of JVLR. The length of eastern section is 1.1 km - the shortest among the three sections. The present status of JVLR in this section is a two-lane carriageway constructed with bituminous concrete.

Out of three sections mentioned above, Section I & III are under the jurisdiction of PWD and Section II is under BMC. The total length of JVLR starting from WEH and ending at EEH is 10.3 Km. The alignment of existing JVLR with various sections identified is shown in ***Figure 2.1.***

2.1.2 *Description of the Alignment*

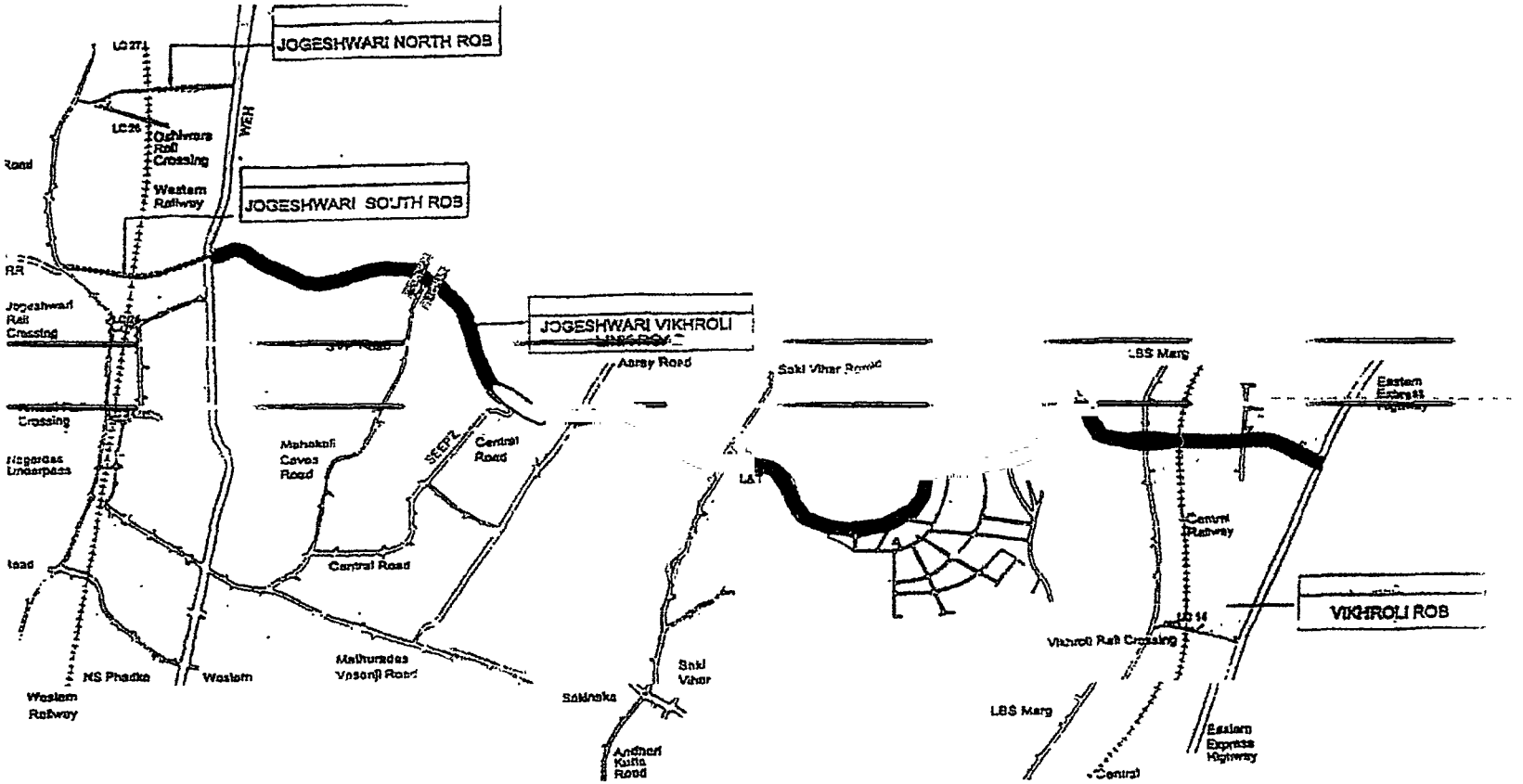
Various physical and environmental attributes located along the three sections of JVLR are presented in the following sub-sections.

Section I – WEH to Saki Vihar Road

The western section of the road starts from east of Jay coach Factory near WEH junction. From WEH, the road passes through series of adjacent residential areas namely, Majeswadi, Pratap Nagar, Anand Nagar, Green fields Society, Durga Nagar and Sariput Nagar. Towards the western end of this section, a commercial recreation park called Fantasy Land is located, on the northern side of JVLR. Towards east of Fantasy land, JVLR aligns along Kamal Amrohi Studios, State Government-owned Nursery, private-owned Matoshri Park, SEEPZ Industrial area, BSES Office and L&T factory. Between BSES and Larsen & Toubro (L&T) factory, JVLR crosses over Aarey Farm area, Mithi River, and BMC Water Pipelines. Towards the end of this section, JVLR aligns through Milind Nagar and Tungawa hutments and meets Saki-Vihar Road opposite L&T Gate No 5. The major physical attributes found along Section I have been presented in the strip plan maps provided in ***Annex B***

Section II – Saki Vihar Road to LBS Marg

The western end of middle section starts with a staggered intersection, located within a distance of about 100-m, along Saki Vihar road. The section starting



JVLR alignment – Section I (Western section) Implementation under Phase I

JVLR alignment – Section II (Middle section) Implementation under Phase II

JVLR alignment – Section III (Eastern section) Implementation under Phase I

Proposed Vehicle Bridge

Proposed grade separator

Grade separators under implementation outside MUTP

ERM India Private Limited

Project	**Improvement and widening of JVLR under MUTP**
Client	**Mumbai Metropolitan Region Development Authority**
Title	**Jogeshwari – Vikhroli Road Alignment map**
Figure	**2.1**

ERM

from this staggered intersection is known as *Aadi Shankaracharya Marg*, which is aligned along south bank of Powai Lake. Aadi Shankaracharya Marg further traverses through north of Hiranandani gardens, between south of IIT campus and north of Panch Kutir market area. Inside the Panch Kutir market area, along the southern edge of JVLR two Hindu temples are located. Immediately after IIT campus, JVLR runs close to Holy Trinity Church, Gurudwara (a place of worship for the followers of Sikh religion) and Kendriya Vidyalaya (Central School located within Indian Navy residential complex). After crossing IIT campus, the section further runs down over a steep hill to meet LBS marg at Gandhinagar square near Kanjurmarg. The major physical attributes found along Section II have been presented in the strip plan maps provided in ***Annex B***

Section III – LBS Marg to EEH Junction

The eastern section of JVLR starts from LBS Marg junction. Immediately after this major 4-way intersection, JVLR crosses over Central railway line at about 100-metre distance. There is an existing 2-lane ROB on the JVLR at this location. The ROB is located in between Kanjurmarg and Vikhroli suburban rail stations, which are located on the north and south of ROB respectively Immediately after the ROB, on the eastern side of it and on either side of its embankment a sprawling slum area is located. The Tagore Nagar slums located on the southern side of JVLR and ROB is large in its spread and is well established The area located on the northern side of ROB embankment and east of Kanjurmarg suburban rail station, has been identified as *Relocation and Rehabilitation* site for the Project affected persons (PAP) of various railway projects, that are currently being implemented under MUTP The land area on either side of JVLR and between ROB and EEH is essentially marshy with wild grass outgrowth to large extent. Kannamwar nallah and many other man-made drainage channels carry considerable amount of sewage and criss-cross the marshy land area. The Tagore nagar slums and rehabilitation site are essentially marshy land reclaimed sites. The major physical attributes found along Section III have been presented in the strip plan maps provided in ***Annex B.***

2.2 *EXISTING CROSS DRAINAGE STRUCTURES ALONG JVLR*

Currently there are five bridge structures located along western section and two bridge structures located along eastern section of JVLR. Middle section has no bridge structures. The details of the existing bridge structures have been presented in ***Table 2.1***.

Table 2.1 ***Details of existing bridges along JVLR***

#	Bridges	Location chainage, Kms	Total length, mts
1	Majas Nallah	0+901	15
2	Aarey Road	3+310	14
3	Mahim/ Mithi river	3+802	30
4	Pipeline Bridge #1	4+032	45 2
5	Pipeline Bridge #2	4+407	31 43
6	ROB over Central railway line	9+300	69

#	Bridges	Location chainage, Kms	Total length, mts
7	Kannamwar Nallah	10+190	12 2

Note *-Project chainage starts from WEH (Kms 0+000) and ends at EEH (Kms 10+300)
Source Table 1 1 from CES Report, January 2002

2.3 *RIGHT OF WAY ISSUES*

The scheme for widening and upgrading the JVLR was initially presented in the Detailed Project Report (DPR) prepared in the year 1998. Then, the consultants proposed upgradation and widening of JVLR within the available Right of Way (RoW) width of 30-m without recommending geometrical improvement of JVLR sections. The main concern then was to minimise additional land acquisition and hence widening was proposed within available RoW.

However, in the development plans (DP) prepared by MCGM and PWD, DP provision of 45.7 m RoW for JVLR has been provided. MSRDC - the implementing agency appointed for executing the JVLR project - wished to go for geometrical improvements as well by utilising the 45.7-m RoW planned Hence the same Consultants revised the DPR, in December 2001 with an objective to.

- Improve the vertical and horizontal geometry of JVLR at various locations to bring the geometry as per MRTH/ IRC specifications; and
- Widen the existing 2-lane carriageway to 6-lane carriageway with central median.

The RoW available for construction and additional land corridor proposed are key issues which determines the implementation of JVLR project. The Right of Way (RoW) issues as it stands today is as follows:

- The RoW in possession is 30m.
- Near high embankments and deep cuttings, the available RoW is 60m
- The DP provision for JVLR corridor is 45.7m. But the time frame for acquisition of the additional corridor as per DP is not known.
- DPR consultants have asserted that where the proposed alignment does not deviate much from the existing road alignment, it possible to contain the widening works within the available RoW of 30m. At some locations, where the proposed alignment has deviated from present road alignment, retaining walls have been proposed to contain the widening works within the available RoW of 30m
- At locations where improvement in the vertical and horizontal alignment is proposed, additional land beyond the available RoW of 30m has been proposed for acquisition.
- At locations where service roads are proposed, the available RoW of 30m wide is inadequate. Hence, the constructions of service roads at these sections have been proposed in phases to match with the programme of land acquisition as per DP provision.

2.4 IMPLEMENTATION PROGRAMME OF JVLR PROJECT

The widening and improvement of JVLR corridor has been divided into two phases of implementation In the first phase of implementation, the widening and improvement of ***Section I*** and ***Section III*** will be taken up for construction. During second phase of JVLR project, the widening and improvement of ***Section II*** will be taken up for implementation. Tentatively the Phase I of JVLR project is scheduled to start by September 2002 and to be completed by start of 2004. The Phase II of JVLR project is scheduled to start one year later of Phase I implementation. The design consultant has prepared a revised DPR for the Phase I of JVLR project.

As for Phase II of JVLR project, as pointed out in *section 2.1 1*, barring one kilometre length opposite IIT campus, rest of the muddle section is 6-laned with central median. Hence, in all probability the remaining one kilometre length will be taken up for 6-laning during Phase -II of JVLR project. As of now, no detailed project report has been prepared for Phase II of JVLR. It is understood that MMRDA and Project implementing authorities (PIA) will set in motion the process of preparing DPR for Phase II of JVLR in due course of time. Thus after completion of both Phase I and Phase II, the entire JVLR would have been 6-laned with central median.

2.5 PROJECT PROPOSALS

2.5.1 *Recommended Scheme of Widening In Phase I*

As per the recommended scheme, JVLR is proposed to be widened to 3 + 3 divided carriageway. Following are the cross sectional details of the road after widening.

Carriageway	-	2 x 11m	=	22m (2.5% slope)
Central median			=	1.2m (4% slope)
Shoulder / Footpath	-	2 x 2m	=	4m (4% slope)
Side slope			=	2 : 1

The total top width of the road will be 27.2m. The available RoW width is 30m except near high embankments where available RoW is 60m. Typical cross-sectional drawings of the proposed carriageway are presented in ***Annex C.***

Service roads have been proposed in phased manner at various locations along JVLR Within the available RoW width of 30-m, only 6-lane carriageway, which will require a width of about 27.2m, can be accommodated. Since as per development plans of MCGM and PWD, a proposal for additional land corridor acquisition is in the pipeline to increase the RoW width to 45.7m, the construction of service roads have been proposed after the acquisition is completed.

For the proposed widening and improvement of of JVLR, DPR has recommended the pavement as below:

i)	Granular Sub base	-	500 mm thick
ii)	Wet mix Macadam (WMM)	-	0.95 m
iii)	Dry lean concrete (base)	-	150 mm
iv)	Pavement Quality concrete (PQC)	-	330 mm

The section-wise widening proposals in the DPR are presented in the following sub-sections. The proposals pertain to the Phase I of JVLR project.

Section I - WEH to Saki Vihar Road

The existing two-lane asphalted carriageway for a length of 4.9-km has been proposed to be widened to six-lane divided carriageway configuration with central median during the Phase I of JVLR. Concrete pavement has been proposed for the six-lane widened carriageway. A grade separator has been proposed at SEEPZ road junction.

Section III - LBS Marg to EEH Junction.

The existing two-lane rigid concrete pavement for a length of 1.1-km would be widened to 2 x 3-lane divided carriageway with central median during the Phase I of JVLR project. Flexible pavement has been proposed for this section of carriageway.

Widening Scheme for Bridge Structures

The cross drainage structures/minor bridges located along JVLR are proposed to be widened to 4 + 4 divided carriageway configuration. The details of widening scheme proposed for existing bridge structures is presented in *Table* 2.2

Table 2.2 ***Details of Widening Scheme Proposed for Existing Bridges on JVLR***

#	Bridges	Existing structural system	Widening scheme proposed
1	Majas Nallah	Solid deck slab resisting on PCC piers Open foundations	Widening proposed equally on both sides
2	Aarey Road	Solid slab resting on abutments in C R Masonry Open foundations	Widening proposed on both sides
3	Mahim/ Mithi river	Tee beam slab bridge; PCC piers & abutments Open foundations	Widening proposed on both sides
4	Pipeline Bridge #1	Tee beam slab bridge; beams supported on individual piers Gravity type abutments Open foundations	Widening proposed on both sides.
5	Pipeline Bridge #2	Tee beam slab bridge; beams supported on individual piers Gravity type abutments Open foundations	Widening proposed on both sides
6	ROB over Central railway	Prest Conc Beam with riding deck slab RCC piers with common pier cap, gravity type abutment Pile foundation	Widening proposed on both sides
7	Kannamwar Nallah	Solid slab resting on PCC piers & abutments. Open foundations.	Widening proposed on both sides.

Note. Existing 'T' beam superstructure is proposed to be replaced with RCC Deck Slab Additional piers are proposed to be provided between the abutment and intermediate pier
Source CES Report, January 2002

Besides the existing bridge structures, one new vehicular bridge has been proposed in the revised DPR (refer *Figure 2.1*). The new vehicular bridge has been proposed near Mahakali caves road junction (kms 2+460) opposite Kamal Amrohi studio and State Government owned Nursery.

At Kms 2+460, vertical geometry of the existing road steeply slopes down on either side i e , eastern and western side. Especially on the eastern side, the vertical gradient is about 6 to 7%. Since many heavy commercial vehicles breakdown while negotiating the steep upward slope, DPR has proposed a major horizontal and vertical alignment alteration. From Kms 2+100 to 3+200, a vertical cut section has been proposed to bring the vertical gradient down to about 4.5%. The depth of vertical cut section proposed varies between 0 to 9-m. From Kms 2+400 to 3+200, horizontal alignment alteration has also been proposed.

The open cut section proposed from Kms 2+100 to 3+200, will severe connectivity between Mahakali caves road on the southern side of JVLR and areas on the northern side of JVLR. To avoid severance of habitations, Kamal Amrohi Studio and Nursery near Mahakali caves road, a new vehicular bridge has been proposed, which will connect Mahakali Caves road to north service road proposed along northern edge of JVLR. The cross-sectional details of new Mahakali cave road bridge at Kms 2+460 is presented in ***Annex C***

Flyover at SEEPZ Road Junction

A flyover has been proposed near SEEPZ road junction where SEEPZ road forms a T- shaped junction with JVLR. The SEEPZ flyover has been mooted in the in the revised DPR on JVLR-project prepared by CES. This flyover project has been proposed as part of the Phase I of JVLR project. The flyover proposal is still under design stage.

The SEEPZ flyover is aligned along JVLR in East-west orientation, crossing over the T-junction with SEEPZ road. Unlike the other two flyovers (presently being implemented outside MUTP and discussed in detail under *Section 2.7*) proposed along JVLR, this flyover would carry unidirectional traffic moving along Vikhroli to Jogeshwari direction. The length of the proposed flyover is 440m. A 12-m wide deck slab consisting of a 2-lane carriageway has been proposed.

Just after the T-junction with SEEPZ road, on the western side, the vertical alignment of JVLR climbs steeply up. Because of this natural slope available, the western section of the proposed flyover would be shorter than the eastern section.

The SEEPZ road will be lifted and regraded to the existing road level at the junction Service ramps have been proposed on both side of the regraded SEEPZ road to facilitate movement from/to JVLR. Reinforced earth retaining walls have been proposed to support the embankment on either side of SEEPZ road The cross-sectional detail of SEEPZ flyover is presented in ***Annex C***.

Local Traffic Management Plan during Construction

As per the Construction program outlined in the DPR on Phase I of JVLR project, the sequence of work and local traffic management plan envisages three stages of

construction along various stretches of JVLR. The road construction, bridge structures and retaining walls will be constructed in a mutually exclusive manner. That is they will be constructed independently at different stretches of JVLR. The local traffic management plan and sequence of activity for JVLR is as below.

Stage - I Roads

- Clear working limits
- Carry-out utility diversion works
- Carry-out storm drainage works
- Carry-out ground improvement works
- Local traffic management. Construct 2m wide temporary paved shoulder on northern edge of JVLR between Kms 0+000 to 2+200 and 2+900 to Km 4+650. Construct 5.5.m north and south diversion roads on either side of rock-cut portion at Kms 2+200 to 2+900. This portion of rock-cut diversion road will later be used as ground level service roads.
- Maintain traffic on existing southern carriageway of JVLR and new paved shoulder on northern side.
- Remove debris
- Construct the new concrete pavement and shoulder of southern side carriageway to the full width.

Stage 2:

The traffic to be diverted along constructed new southern carriageway and start constructing new northern side carriageway.

Stage 3:

The full width of 6-laned road will be put to use and construction and installation of road furniture will be completed

Similarly for bridges and flyover, the new structures are being planned to be constructed on one side initially and later the other side carriageway without affecting the old structure and traffic.

The local traffic management plan along Section III of JVLR will be along similar lines. There are no major CD structures and grade separators along Section III of JVLR hence managing local traffic will not be a major problem.

Other Project Proposals in Phase I

The revised DPR on JVLR project has many other proposals, recommendations for implementation along with the widening scheme. The salient proposals found in the revised DPR are presented below:

- The entire JVLR corridor has been proposed with a central median (divided carriageway)

- The existing bridge structures and new bridge proposed will have divided carriageway and footpaths on either side
- At-grade improvement works at the following junctions have been proposed·

  - Western express highway junction;
  - SEEPZ road junction;
  - Saki vihar road junction;
  - LBS marg junction,
  - Eastern express highway junction; and
  - 8 other minor junctions on JVLR and 2 minor junctions on the supporting road network.
- New vehicular bridge has been proposed at Kms 2+460 (Mahakali cave road bridge) to avoid severance of habitations, Kamal Amrohi Studio, and Government owned Nursery.
- Junction improvement scheme near Western express highway has been shifted to southern side to reduce displacement of habitation and commercial structures.
- The existing steep gradient of about 5 to 6.5% at Kms 0+250 to 0+400; 0+700 to 0+800; 0+850 to 0+950; 3+450 to 3+600; 3+850 to 4+650; and 2+100 to 3+200 has been proposed to be flattened to about 4.5% to bring the geometry as per MRTH/ IRC specifications.
- Horizontal alignment geometry modification has been proposed near existing/ proposed bridge structures and at Kms 2+400 to 3+200 to bring the geometry as per MRTH/ IRC specifications.
- At some locations, the project objective has been achieved within the available RoW width to avoid/ reduce displacement of habitation by adopting retaining walls along the embankment sections.
- Detailed Storm water drainage analysis has been carried out to design road surface drainage, cross-sectional drainage, and hydraulic adequacy of existing bridges. The detailed storm water drainage report - BRIMSTOWAD - prepared by BMC has been extensively used to form the basis for drainage design
- The embankment sections have been proposed with slopes no steeper than 1V to 2H and where granular material is encountered the embankment slope would be no steeper than 1V to 1.5H to avoid rain and wind erosion
- Traffic management and control systems have been proposed as per IRC 35 - 1997 and Traffic signs to be installed as per IRC 67 - 1997 and Motor Vehicle Act. The road delineators have been proposed as per IRC 79-1981.
- Metal beam crash barriers have been proposed on high embankment sections (height more than three metres) and concrete crash barriers on all bridge/ flyover structures.
- Landscaping and arboriculture has been proposed along JVLR as per IRC 56-1974 for embankment treatment.
- Compensatory plantation has been proposed as per IRC-SP-21, 1979 and IRC 66 - 1976.
- Turfing of slopes of high embankment to avoid rain and wind erosion has been recommended.

Proposed Construction Schedule for Phase I

The entire construction program has been designed by identifying all the tasks that are to be undertaken to achieve the project objective. The construction program has been envisaged to start by September 2002 and would be completed by October 2004. The Construction program designed for the JVLR project

excludes any activity during heavy monsoon season Thus there will be minimum construction activity during the months of June to September 2003 and during the months of June to August 2004. The construction program worked out for the JVLR project, as extracted from the DPR, is presented in *Annex C.*

2.5.2 *Recommended Scheme of Widening In Phase II*

The middle section of JVLR, as mentioned elsewhere, is under the jurisdiction of MCGM. The MCGM (formerly known as BMC) has already undertaken widening to six-lane configuration. Barring 1-km length of the total 4.3-km long stretch of this section, the six-lane rigid pavement is already in place.

However, after the completion of Phase I i.e. after 2004, the existing considerably 6-laned Section II of JVLR will be taken up for widening and improvement. At this juncture, though DPR has not yet been prepared EMP has been recommended in this report with a premise that during Phase II of JVLR, the 6-lane widening (in the 1-km stretch where it is yet to be done) and improvement would be carried out. **If additional widening or improvement is recommended later by the DPR consultants, then EA and EMP for Phase – II of JVLR project may have to be revised accordingly.**

2.6 *ALTERNATIVE PROPOSALS ANALYSED IN PHASE I*

The project is to be implemented along an existing road and hence there is less scope for alternate proposals being considered and analysed in design stage. Alternate proposals pertaining to major change in horizontal alignment of the existing JVLR is ruled out as the road traverses through urban setting. Changing the horizontal alignment in a major way would mean significant adverse impact on social environment.

The alternative options considered in the design stage are presented in the following sub-sections.

2.6.1 *Modified SEEPZ Sub-way Proposal to a Grade Separator*

In the DPR prepared in 1998, a sub-way was proposed near SEEPZ road junction The sub-way was meant for SEEPZ road traffic to access JVLR. In the revised DPR, however, the consultants have modified the proposal to a grade separator at this junction (discussed in *Section 2.5.1*). The reasons cited for modifying the proposal include the following

- Provision of sub-way for SEEPZ road below existing road leads to steep vertical gradient to accommodate the sub-way.
- Connection of SEEPZ sub-way road with the Aarey colony road was only possible through a system of service roads. These service roads need retaining walls to contain the construction within available RoW and to avoid impact on social environment. The earlier layout plan with SEEPZ sub-way is presented as ***Figure 2.2.***
- Slum residential area on its northern edge and high-rise residences on its southern edge mark the physical attribute along JVLR at this junction. Hence it is imperative to restrict construction within the available RoW.

With a grade separator, the construction activities can be restricted within available RoW. Access between JVLR and SEEPZ road and vice-versa becomes easier under the fly-over structure. Service ramps have also been proposed along both sides of regraded SEEPZ road to facilitate movement from/to JVLR. The gradient along JVLR can be maintained as per the IRC standards. The revised Grade separator layout plan is presented as *Figure 2.3.*

2.6.2 *Cut-section Proposed at Kms 2+100 to 3+200*

In the revised DPR, vertical cut section has been proposed between Kms 2+100 to 3+200 for a length of about 700m. The depth of the cut section proposed at this chainage varies between 0 to 9m.

In the earlier proposal, the existing vertical geometry was not altered to avoid severance of habitations located on either side of JVLR.

However, in the revised DPR, the cut-section has been proposed along with Mahakali caves road bridge at Kms 2+460. Salient features of the modified proposal include:

- Mahakali caves road bridge will avoid severance of habitations on either side of JVLR as it would connect both north and south service roads proposed at ground level.
- Heavily loaded 2-axle and multi-axle trucks carrying industrial and commercial goods found the existing steep gradient difficult to negotiate. Breakdown of heavy vehicles was reported often in this section. Other problems included increased vehicle operating costs, wear and tear of vehicles, incessant traffic congestion due to breakdown of vehicles. With the revised proposal the existing steep gradient (7%) will be cut down to about 4 5% enabling smooth movement of traffic.
- A vehicular bridge and a zebra crossing that are proposed in this section would increase pedestrian's safety.

2.6.3 *Modified Junction Lay-out at Western Express Highway Junction*

The layout of starting point of western section of JVLR has been reviewed in order to minimise the impact on social environment on the northern side of junction. After examining the layout plan prepared, ground verification was carried out to identify the social impacts at the site. It was found that scope for shifting the junction on south side existed which would result in reduced impact on social environment The earlier and modified plan of the junction is presented as *Figures 2.4 and 2.5* respectively.

2.6.4 *Modifications in the Vertical Alignment*

In the earlier DPR, vertical and horizontal alignment changes were not attempted in order to avoid impacts on social environment. However, upon reviewing the earlier designed vertical profile, it is found that there is a scope to improve the vertical profile by flattening the existing steep gradients (5 to 6.5%) in chainages Kms 0+250 to 0+400; 0+700 to 0+800; 0+850 to 0+950; 3+450 to 3+600; and 3+850 to 4+650 in addition to the open cut proposed at Kms 2+100 to 3+200. The profile

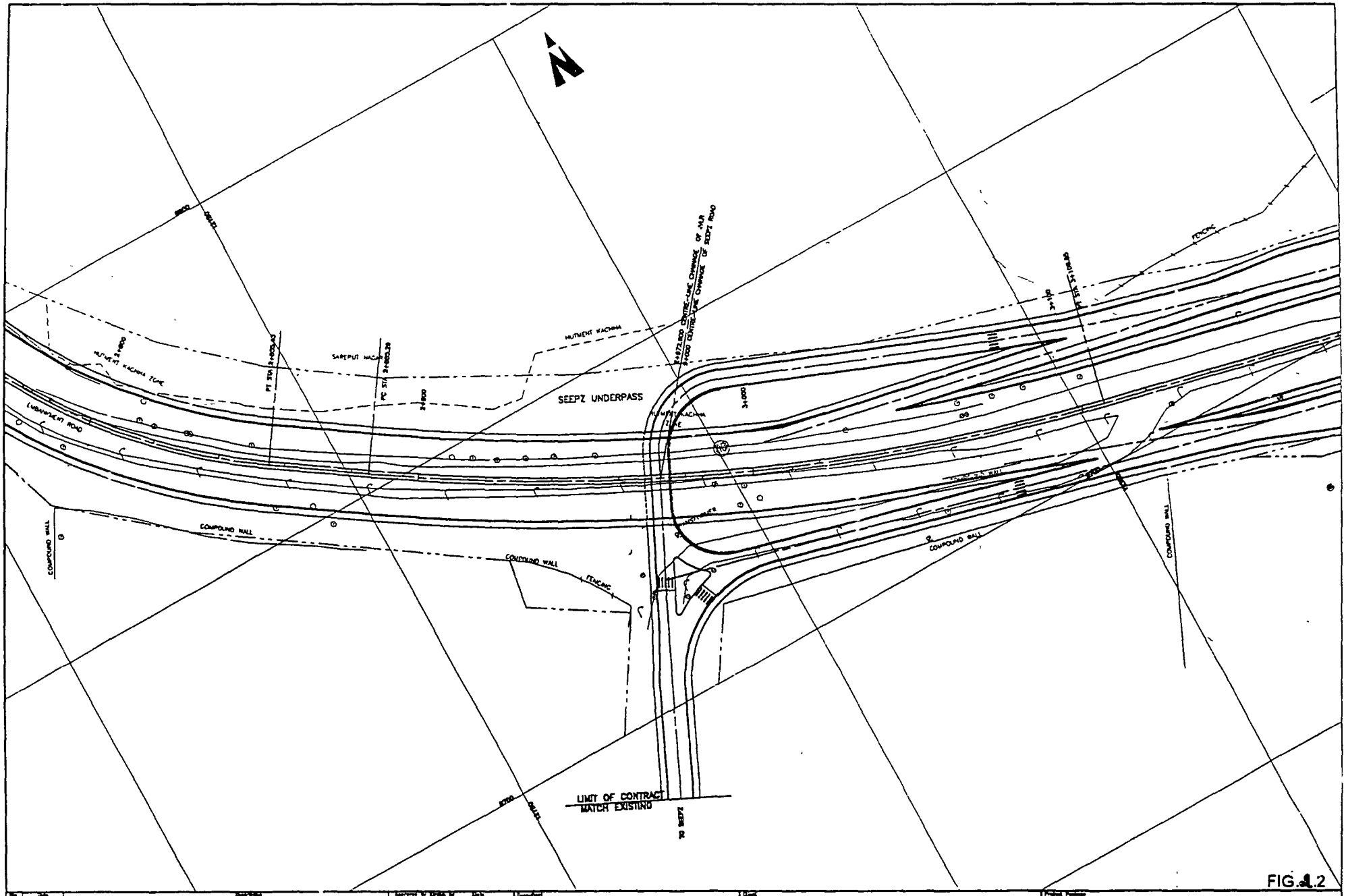


FIG. 1.2

Drawn by	Date	Consultant: WILBUR SMITH ASSOCIATES, INC.	Client: MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY	Project Package: PACKAGE 2- JOGESHWARI/VIKHROLI LINK ROAD
Checked by	Date	In association with: MVA ASIA LTD.	Project: MUMBAI URBAN TRANSPORT PROJECT II (MUTP II) - PHASE 2	Drawing Title: JVLR-SECTION1 SEEPZ JUNCTION
Approved by	Date	CONSULTING ENGINEERING SERVICES (INDIA) LTD.	PACKAGE 2 - JOGESHWARI/VIKHROLI LINK ROAD	
		TRANSPORT AND PLANNING GROUP	PACKAGE 3 - ROAD OVER BAG, BRIDGES (SOB'S) AT VIKHROLI, JOGESHWARI SOUTH, JOGESHWARI NORTH	
			PACKAGE 4 - PARKING DEMONSTRATION PLAN	Drawing No. JVLR1 /HW/JN0002 Scale 1:2000

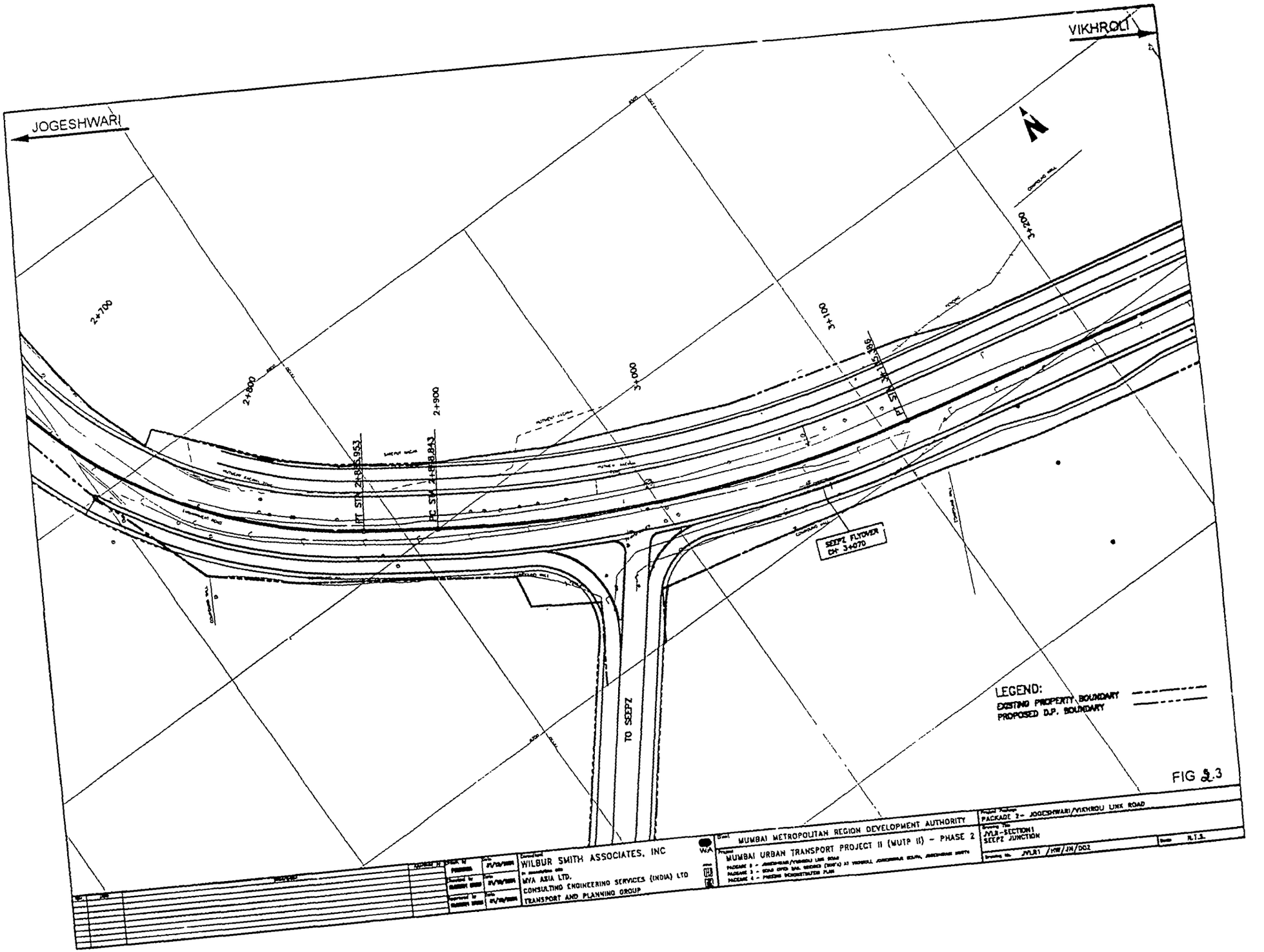

JOGESHWARI
VIKHROLI
2+700
2+800
2+900
3+000
3+100
3+200
SEEPZ FLYOVER
CH: 3+070
TO SEEPZ
LEGEND:
EXISTING PROPERTY BOUNDARY
PROPOSED D.P. BOUNDARY
MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY
MUMBAI URBAN TRANSPORT PROJECT II (MUTP II) – PHASE 2
WILBUR SMITH ASSOCIATES, INC
MVA ASIA LTD.
CONSULTING ENGINEERING SERVICES (INDIA) LTD
TRANSPORT AND PLANNING GROUP
PACKAGE 2:- JOGESHWARI/VIKHROLI LINK ROAD
JVLR-SECTION1
SEEPZ JUNCTION
JVLR1 /KW/JN/002
N.T.S.

FIG 2.3

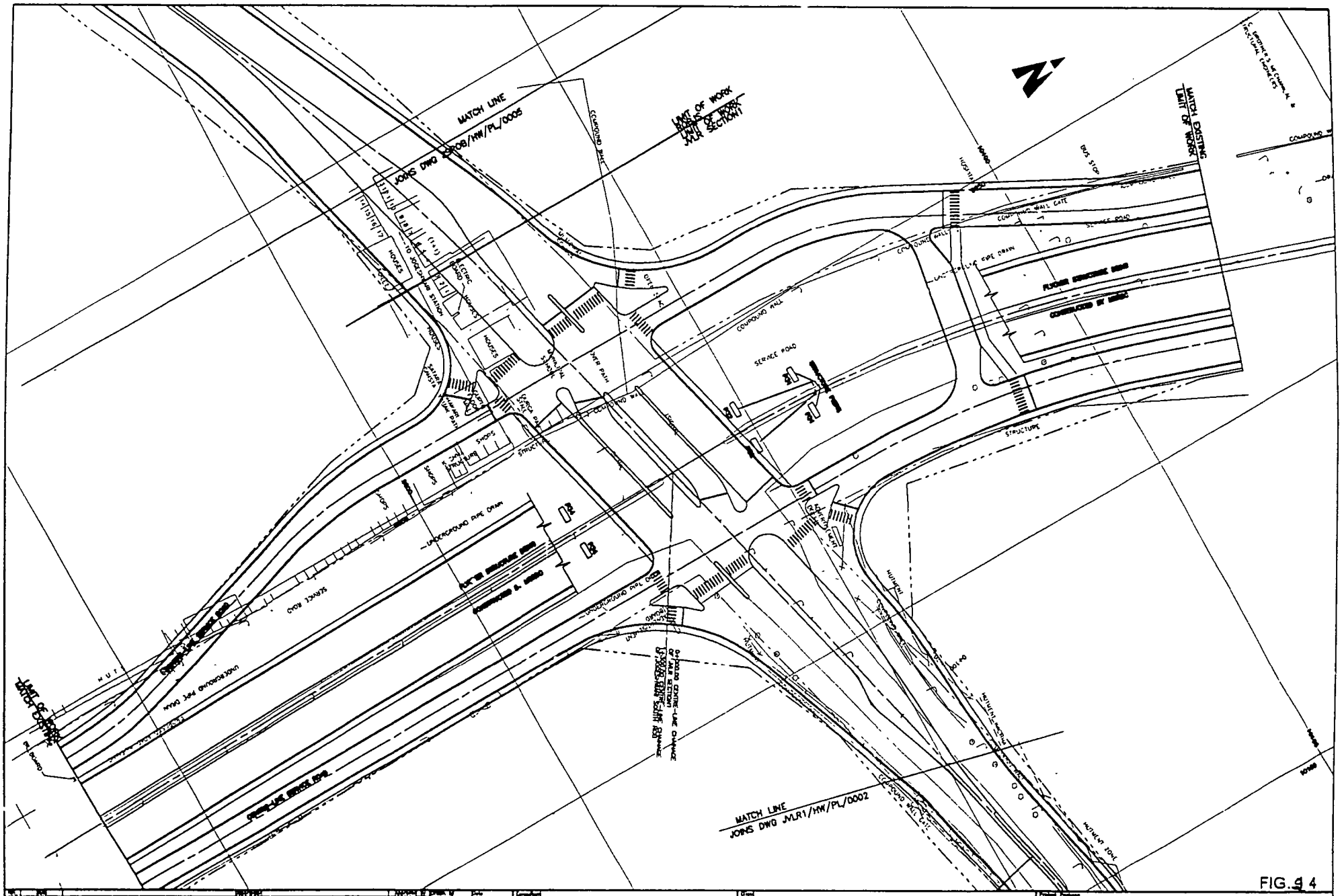
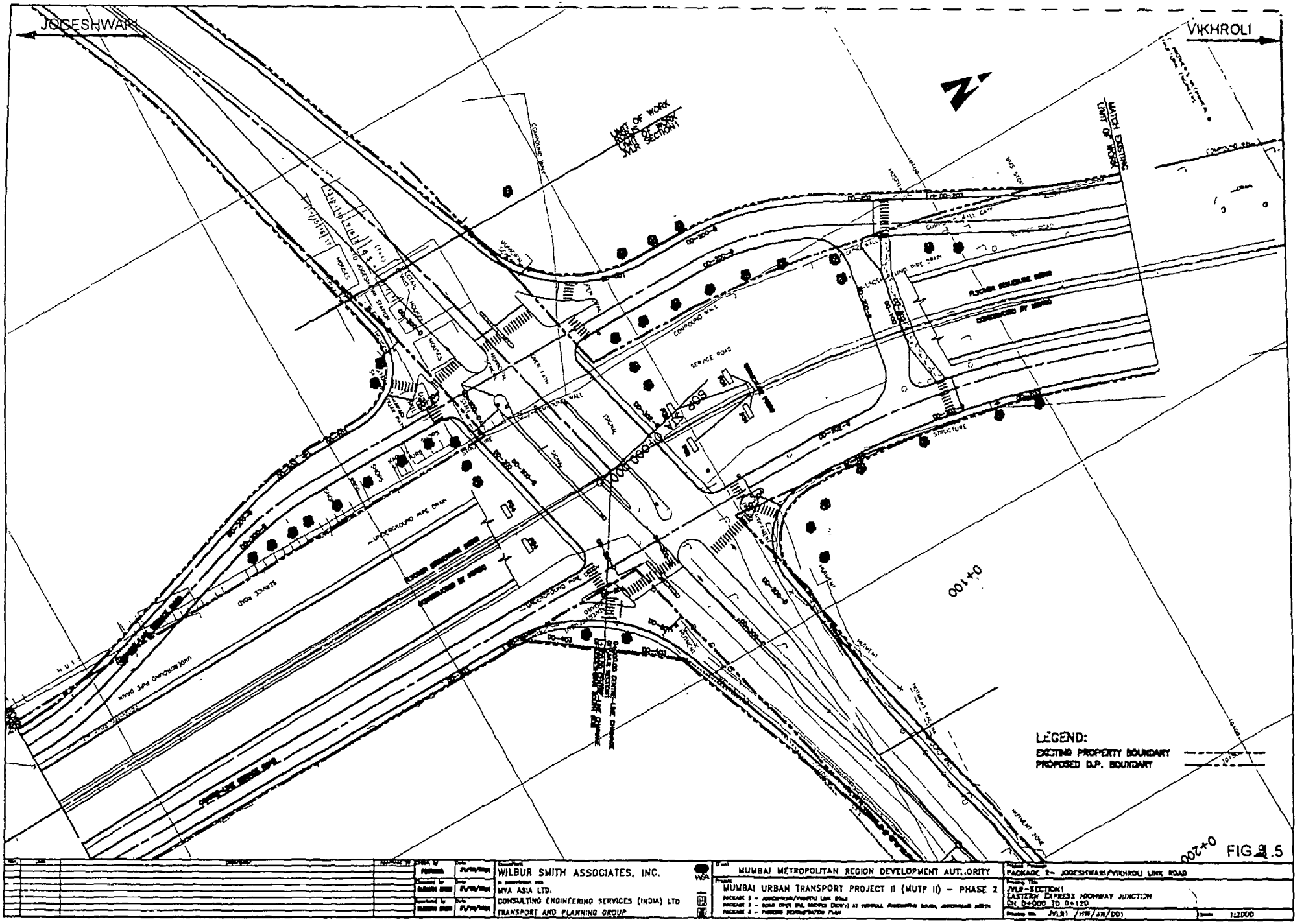


FIG. 4

Consultant: WILBUR SMITH ASSOCIATES, INC.	Client: MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY	Project Package: PACKAGE 2 – JOGESHWARI/VIKHROLI LINK ROAD	
In association with: MVA ASIA LTD.	Project: MUMBAI URBAN TRANSPORT PROJECT II (MUTP II) – PHASE 2	Drawing Title: JVLR-SECTION1 EASTERN EXPRESS HIGHWAY JUNCTION CH D+000 TO D+120	
CONSULTING ENGINEERING SERVICES (INDIA) LTD	PACKAGE 1 – JOGESHWARI/VIKHROLI LINK ROAD		
TRANSPORT AND PLANNING GROUP	PACKAGE 2 – ROAD OVER RAIL BRIDGES (ROB's) AT VIKHROLI, JOGESHWARI SOUTH, JOGESHWARI NORTH		
	PACKAGE 3 – PARKING DEMONSTRATION PLAN	Drawing No. JVLR1 /HW/JN0001	Scale 1:2000


JOGESHWARI
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LEGEND:
EXCITING PROPERTY BOUNDARY
PROPOSED D.P. BOUNDARY
WILBUR SMITH ASSOCIATES, INC.
MVA ASIA LTD.
CONSULTING ENGINEERING SERVICES (INDIA) LTD
TRANSPORT AND PLANNING GROUP
MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY
MUMBAI URBAN TRANSPORT PROJECT II (MUTP II) – PHASE 2
PACKAGE 2 – JOGESHWARI/VIKHROLI LINK ROAD
JVLR-SECTION1
EASTERN EXPRESS HIGHWAY JUNCTION
CH. 0+000 TO 0+120
JVLR1 /HW/JN/001
1:2000

FIG 3.5

alteration suggested will not have an impact on social environment while improving the traffic movement across JVLR.

2.6.5 *Modifications in the Horizontal Alignment*

The horizontal alignment has been reviewed in consonance with the changes effected in the vertical profile at the sections mentioned in *section 2.6.4* In the earlier proposal, the existing road alignment was shifted to one side where there are existing bridges to accommodate new 3-lane bridge structure. During the review it is noted that available width of RoW is symmetrical about the centre line of existing road.

In the revised DPR, the bridge structures have been proposed for carrying 8-lane traffic (2 lane existing and 6 new lanes proposed). The existing bridge structures are widened equally/ symmetrically on either side of centre line of the road The total width of each structure would be 35.2m consisting of 14.5m carriageway on either side of median and 2.0m wide footpath. The revised proposal fully utilises the larger RoW width available near the bridges and embankment sections of JVLR and addresses the issue of future widening of JVLR to 8-lane road during which bridges will not have to be widened.

2.7 *OTHER PROJECTS BEING IMPLEMENTED IN THE SAME CORRIDOR OUTSIDE MUTP*

There are two flyover (grade separators) structures proposed along the alignment of JVLR viz., grade separators near L&T and LBS Marg. These two flyover projects are currently being implemented by MSRDC as separate packages out side MUTP. The flyover at SEEPZ road junction has been proposed as part of Phase I of JVLR project. The details of the flyovers outside MUTP is presented in the following sub-sections.

Grade Separator at Saki Vihar Road Junction

The alignment of L&T flyover at the end of Section I crosses Saki-Vihar Road and passes through Larsen & Toubro campus. In order to improvise traffic flow at Saki Vihar road junction, construction of grade separator is undertaken instead of a conventional signalized crossing.

The ground here rises from R L 17.50 at the junction with Saki-Vihar Road to R.L. 22.00 at the junction with Powai Road. A 200m long flyover is proposed consisting of one span of 40m and 8 spans of 20 m. The spans over Saki-Vihar Road is proposed to be 40 m considering possible future expansion and to avoid pier just in front of entrance gate of L&T. The possible conversion of this span into standard spans of 20m will be studied in detailed engineering. Ground being at lower elevation on Jogeshwari side, approaches are provided with retaining walls, while on Powai side these are provided on embankment. A minimum vertical clearance of 5.5m is provided over Saki Vihar Road while 4.5m is provided inside L&T campus for free movement of vehicles.

The flyover provides for 6 lanes divided carriageway with an overall width of 24.2m No footpaths are proposed on flyover as these are provided on other roads at-grade The construction of flyover is expected to be completed within year 2002

Flyover at LBS Marg Junction

The alignment of JVLR crosses LBS road at the end of section II. Due to heavy traffic on the JVLR as well as on LBS road and to avoid traffic congestion, a grade separator has been proposed and is currently under construction phase. Length of the flyover is 780 m with 15 piers & 2 abutments. Each span is 16.4m long except an obligatory span, which is 40m in length. Length of approaches on Powai & EEH side is 180m and 146m respectively. At present the status of construction is just about 50% complete. The construction of flyover is expected to be completed within year 2002.

2.8 ONGOING OTHER DEVELOPMENTAL PROJECTS ALONG JVLR

During baseline assessment some ongoing developmental works were observed which would have an impact on the proposed JVLR project of varying significance. The developmental works observed along JVLR include:

- Laying of Optical fibre communication (OFC) cables almost all along JVLR on one side or either side of the existing 2-lane road.
- Construction of grade separators at two locations on JVLR i.e., at L&T-junction and another at LBS marg junction *(this has been discussed in detail in Sections 2.7)*.
- Widening work in progress in some portion of middle section of JVLR along its southern edge, near Panch kutir market area.

Besides, other projects, which are at various stages of implementation, will have an impact on the JVLR in future. The other developmental projects, which are being implemented in the project region, include:

- Jogeshwari - South ROB project which is being implemented under the ongoing MUTP would link JVLR to SV Road. SV road is major north-south link traversing along western coast of MMR.
- R&R site chosen opposite Kanjurmarg suburban rail station is currently being implemented under MUTP for the PAPs of railway projects.
- The planned SEEPZ - Phase II extension which is presently under implementation near SEEPZ road junction.
- Vikhroli ROB and Jogeshwari - North ROB projects which are also to be implemented under MUTP will have impact to some extent on JVLR as they are located on the secondary road network of JVLR.

In order to assess the baseline environmental status in the project area, a 300-m wide study corridor (150-m on either side of the project road) was identified and delineated at site. The study corridor width of 300-m was decided after a careful review of the methodology adopted in the MLEA report on JVLR project prepared in 1998 and reconnaissance site visit

The Government of India policy guideline for conducting EA for highway projects specifies that a study corridor width of 7-km should be considered during baseline and impact assessment. However, as discussed under *section 1.3.1*, JVLR project cannot be classified under a highway project, as it is an arterial road located within MMR Hence, the guideline may not be relevant for a project proposal consisting of improving and widening the existing road, located in an urbanised setting. In view of this, considering the width of immediate impacted area and impact dissipation distance, a 300-m width corridor was identified for baseline assessment. The baseline status of the JVLR project study corridor is presented in the following sub-sections.

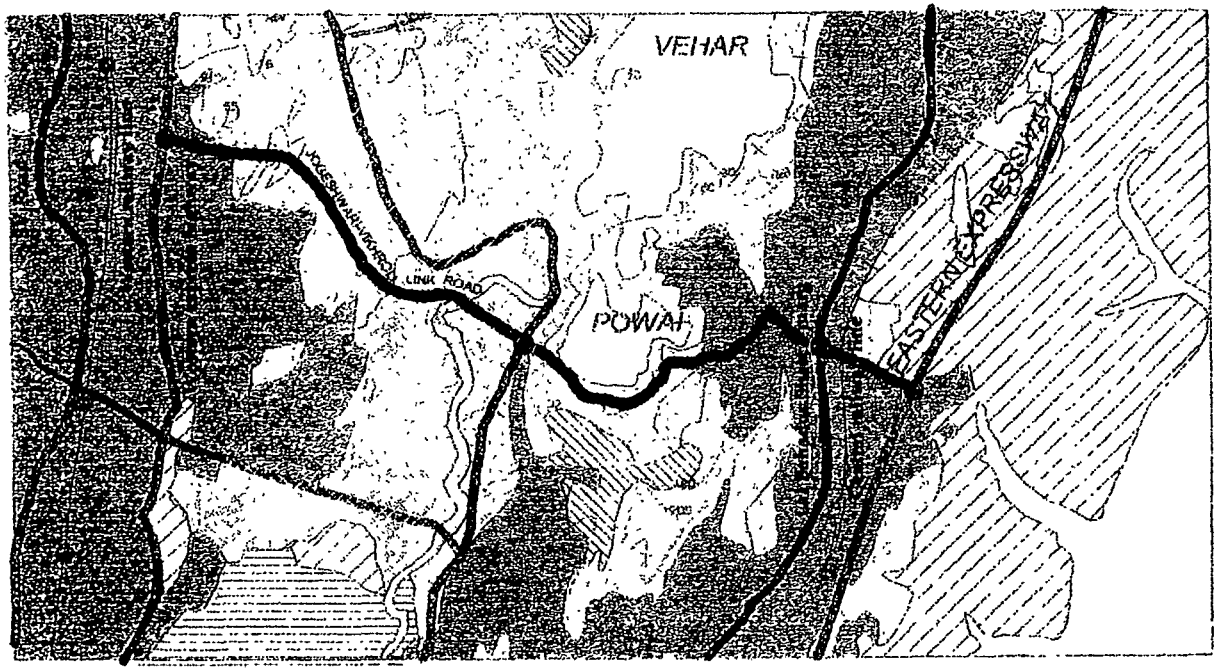
3.1 LAND USE

The corridor of land adjacent to JVLR on either side is being put to extensive and varied use. As the link is developing into a major network connecting EEH and WEH, the land use pattern along the project corridor has undergone a rapid change since it was opened to traffic in 1994. Open and barren wasteland space available in the western and middle sections of JVLR and the marshy land area in the eastern section of JVLR is being converted to residential, commercial and industrial land use pattern albeit gradually. The land use pattern observed in the study corridor is described in the following sub-sections. The regional land use pattern map of the project region is presented in ***Figure 3.1***.

3.1.1 *Section I - WEH to Saki Vihar Road*

The land use pattern in this stretch of JVLR is predominantly residential, especially the stretch along the western end of the section. Residential areas viz., Majaswadi, Pratapnagar, Anand Nagar, Green Field Society, Durga Nagar and Sariput Nagar are located along the western end of Section I of JVLR. The middle segment of this section passes through open hilly area and Aarey Farm area. Milind Nagar slums and Tungawa hutments on either side mark the eastern segment of the section.

Besides residential land use, other major land uses observed along this section of JVLR are viz , industrial, commercial, and recreational. Major Industrial area viz., Santacruz Electronics and Export Promotion Zone (SEEPZ) is located along the project road at Kms 3+070. L&T factory located at the eastern end of Section I is one major industry located along the project road. Towards the east of existing SEEPZ area, an extension (Phase II of SEEPZ) of the industrial promotion zone is currently being planned and under implementation.



N

PUBLIC/SEMI PUBLIC		PLANTATION		COASTAL WET LAND		RAIL	
INDUSTRY		DENSE FOREST		WATER BODY		RAILWAY STATION	
AIRPORT / HARBOUR		SPARSE FOREST		HILL CONTOUR			
BEACHES / GROVES		SCRUB LAND		MAJOR ROAD			
AGRICULTURE		ROCKY OUTCROP		OTHER ROAD			

Alignment of Section I of JVLR

Alignment of Section II of JVLR

Alignment of Section III of JVLR

Source: PLEA report of Vikhroli ROB, March 1998

ERM India Private Limited

Project	**Widening and Improvement of JVLR**
Client	**Mumbai Metropolitan Region Development Authority**
Title	Land use pattern of the project region
Figure	**3.1**

ERM

The major physical attributes observed along the project road have been depicted in the Strip Plan maps presented in *Annex B.*

3.1.2 *Section II - Saki Vihar Road to LBS Marg*

The land use pattern in this stretch of JVLR is predominantly institutional, residential and commercial. Other major land use pattern observed is industrial land use along the western and eastern end of this stretch of JVLR. A major surface water body -Powai Lake - is located along the northern edge of JVLR. The significance and sprawl of the lake can be gauged from the fact that JVLR traverses along the southern bank of Powai Lake for a length of about one kilometre. Major Institutions viz., Indian Institute of Technology (IIT), Maritime Training Institute, Shipping Corporation of India, Indian Register of Shipping, and private sector consulting firm SGS India Limited are located along JVLR in this section.

A major residential township - locally known as Hiranandani Gardens - is also located on the southern edge of JVLR, opposite Powai Lake Besides Hiranandani Gardens, Income Tax Officers Residential colony, Coast Guard Officers Residential complex, Indian Navy Civilian Residential colony and a host of other private residential apartments dot the landscape along JVLR. Near the eastern end of this section and towards the southern edge of JVLR, considerable sprawl of slums is also located behind the marble polishing and retail selling units. These slums are located in an unplanned and haphazard manner along the hilly stretches and hill tops. Solid waste generated from these slum residences is regularly dumped along the down slope of the hills causing immense blemish to otherwise aesthetically nice area.

The land value along this stretch of JVLR is constantly increasing and is considered to be one among highly valued locations in the metropolis of Mumbai. The major physical attributes observed along the project road have been depicted in the Strip Plan maps presented in *Annex B.*

3.1.3 *Section III - LBS Marg to EEH Junction.*

In this stretch of JVLR, the land area is almost vacant except for the slums near central railway tracks. The marshy and highly degraded wasteland engulfs project road from either side for most part of its length. A narrow industrial land use corridor located between LBS Marg and Central railway line and running parallel to them is also observed Major industrial facilities belonging to Hindustan Lever Limited, Sprite Industries and Cadilla Pharmaceuticals are located within this corridor.

It is notable that part of marshy and wasteland site opposite Kanjurmarg suburban rail station has been identified and chosen for resettling some of the Project affected families (PAFs) affected due to the ongoing railway projects that are being implemented under the World Bank funded MUTP. Implementation of the subject project of this report - JVLR project - is also proposed for implementation under MUTP. With the implementation of various R&R and CEMP measures proposed and recommended for this resettlement site, the land use pattern along northern edge of JVLR stretch will have be altered. The major

physical attributes observed along the project road have been depicted in the Strip Plan maps presented in *Annex B*

3.2 *TERRAIN & GEOLOGY*

The western section of JVLR passes through a slightly rolling terrain encountering a few steep slopes (max, slope being 6.5%) In the middle section, the terrain is slightly rolling, but the road alignment passes over almost level ground from L&T factory to IIT campus. Beyond IIT campus, the alignment runs down over a steep hill further to meet LBS Road. The eastern section passes through almost flat terrain except for the elevated embankment of the ROB over central railway tracks

The geology of the region is typical of the western coast i.e. clayey soil underlain by basalt rock formations.

3.3 *DRAINAGE SYSTEM IN THE PROJECT REGION*

The JVLR section 1 drains through Oshiwara river and Mithi river systems. Each system has its own network of tributaries and channels (nallahs) across JVLR. The complete network of drainage system is as follows:

- Oshiwara river
  - Via WEH drain system - At Kms 0+000
  - Via Majas Nallah - At Kms 0+900
- Mithi river
  - Directly into Mithi river - At Kms 3+800
  - Via drainage channel at pipeline bridge #2 - At Kms 4+030
  - Via Saki Vihar road drainage system - At Kms 4+900

The Oshiwara river flows east into the sea and Mithi river flows south into Mahim creek.

As for Section -2 of JVLR, the existing road drains to the following systems:

- Powai lake - a major surface water body between Kms 5+000 to 6+200
- Mithi river
  - Via Saki vihar road drainage system - At kms 4+900
- Kannamwar nagar nallah
  - Via LBS marg drainage system - At kms 9+300

As for JVLR Section-3, the project road drains to the following existing systems:

- Kannamwar Nagar Nallah
  - Directly to Kannamwar nagar nallah - Kms 10+190
  - Via LBS marg drainage system - Kms 9+300

3.3.1 *Status of Existing Roadside Drains*

Along section 1 of JVLR, existing 2-lane carriageway has been provided with open roadside drains along the stretches that pass through habitations. Roadside drains are found on one side or either side of the road between Pratap nagar

(Kms 0+000) to Poonam nagar road junction (Kms 2+000). Between Kms 2+000 to 4+900 i.e end of section 1 of JVLR no roadside drains are found. Throughout the section 1 of JVLR, no localised flooding has been reported except during incessant rains lasting for more than a week at a stretch. There are no low-lying areas along JVLR that are not connected to drainage system.

Along section 2, roadside drains have been provided on either side near IIT campus and one side near the stretches opposite Hiranandani gardens. The down side of the hill section does not have roadside drains.

Along section 3, roadside drains have not been provided along existing 2-lane carriageway. Throughout the section 3 of JVLR, no localised flooding has been reported except during incessant rains lasting for more than a week at a stretch. There are no low-lying areas along JVLR that are not connected to drainage system.

3.4 METEOROLOGY

In order to assess the baseline status with respect to meteorology and climate issues, secondary data from Santacruz meteorology observatory of Indian Meteorology Department (IMD) was collected. This observatory located at about three kilometres from the project road is the nearest observatory maintained by IMD. Based on the data collected from the IMD observatory at Santacruz, a discussion on the meteorological environment of the project area is presented below.

3.4.1 *Seasons*

The study area experiences tropical savana climate. The moderating effects of the nearby sea and the fairly high amount of relative humidity in the atmosphere have restricted the variability.

The four seasons that are normally observed in the area are as follows:

Winter	:	Dec - Feb
Pre-monsoon (summer)	:	March - May
Monsoon	:	June - September
Post-monsoon	:	Oct - Nov.

3.4.2 *Temperature*

Seasonal variations in temperature follow closely the course of the Sun The month of January is invariably the coldest and May the warmest month. With the onset of monsoon in early June, there is a reversal of temperature curve and the temperature during the period of monsoon remains very uniform at about 27°C. During post-monsoon season, the temperature slightly increases above 27°C, but gradually falls by the start of January. On an average, the temperature during summer months varies from 27° C to 35° C, while in winter it ranges from 17° C to 19° C. Highest temperature recorded in the region is 40.6°C.

3.4.3 *Relative Humidity*

The Relative Humidity ranges between 63% to 80% in the monsoon period. Between November to January i.e. during winter months, the relative humidity varies from 57% to 72%. The relative humidity generally is higher than 60% throughout the year.

3.4.4 *Rainfall*

Monsoon generally sets in around the second week of June and continues till late September. July and August are the wettest month all over the region. There is hardly a day without rain during these two months. Towards the later part of the season, as the frequency of rain decreases, the project area experiences oppressive hot weather associated with high relative humidity. It receives rainfall during southwest monsoon season. The average rainfall received ranges from 1850 mm to 2000 mm in a year.

3.4.5 *Wind Direction and Speed*

The predominant direction of wind during the month of October to May is from North-East in the morning hours and North-West during the evening hours. However, during the monsoon month's i. e June to September, the wind is predominantly from southwest quarter, both during morning and evening hours The maximum wind speeds have been observed for most of the time during the year from North-West quarter, especially during south-west monsoon period. During other seasons, wind speed is generally moderate.

3.5 *TRAFFIC AND TRANSPORT*

In order to assess the traffic volume across the existing JVLR, a Classified traffic volume (CTV) survey was carried out at two locations - one along western section and other along eastern section of JVLR during November 2001 During February 2002, CTV survey was conducted at two more locations viz., SEEPZ road junction and LBS marg junction. The detailed CTV results are presented in *Annex D*. The summary results of CTV survey is reported in ***Table 3.1***

Table 3.1 *Summary Results of CTV Survey*

Daily traffic volume (bothways)	*SEEPZ junction**		*Western section#*	*Middle section**	*Eastern section#*
	SEEPZ road	*JVLR*			
2-wheelers	1772	5795	5490	14021	7898
3-wheelers	2279	7312	6675	19805	6141
Car/Jeep/Taxi	2317	8039	6471	21811	12346
Buses	257	1841	1991	4081	1472
Trucks/ Tempo	11220	3890	4301	8865	7057
Total 2-way traffic	**7745**	**26877**	**24928**	**68583**	**34914**

*Note * - Data from ERM India conducted CTV survey in February 2002, # - Data from CES conducted CTV survey in November 2001*

The vehicles passing through the JVLR were classified into Heavy commercial vehicles (Trucks/ tempo), light commercial and personal vehicles (Car/ jeep/ taxi), Buses, 2-wheelers, and 3-wheelers. The CTV survey was carried out for one day at the above-said locations.

CTV survey results show that the middle section of JVLR carries more traffic when compared to other two sections of JVLR. JVLR is used by all modes of vehicular traffic considerably. Daily traffic volume of 2-wheelers, 3-wheelers and light 4-wheelers is considerably high over the other modes of vehicles

The SEEPZ road traffic was also counted during the CTV survey carried out in February 2002 as a flyover is being proposed at this T-shaped junction. In order to justify the flyover proposal at this junction, a CTV survey was carried out. The CTV results at this junction indicate that a daily traffic volume of bout 7745 vehicles is plying on this road. The light commercial and personal vehicles along with 3-wheelers comprise more than 50% of the daily traffic volume on this road. This could be due to movement of industrial workers/ employees Besides, the SEEPZ road links the JVLR with other major east to west link known as Kurla - Andheri road located south of JVLR. Kurla - Andheri road also carries heavy traffic with many major intersections along the way. To avoid traffic overcrowding and congestion on this road, a portion of traffic volume destined towards northern suburban region diverts to JVLR through SEEPZ road. The implementation of JVLR project will have an induced impact of attracting more such diverted traffic from Kurla - Andheri road.

The MLEA study on JVLR project carried out in March 1998 has predicted daily traffic volume for the years 2001 and 2011. The predicted traffic volume at various sections of JVLR is presented below in *Table 3.2*

Table 3.2 *Traffic Projections on JVLR for the Years 2001 & 2011*

Daily traffic volume (bothways)	*Western section*		*Middle section*		*Eastern section*	
	2001	*2011*	*2001*	*2011*	*2001*	*2011*
2-wheelers	4435	9143	7914	16312	5068	10445
3-wheelers	8196	16892	20644	42549	4377	9020
Car/Jeep/Taxi	6672	13751	16171	33330	21284	43867
Buses	742	1530	3249	6696	580	1196
Trucks/ Tempo	7647	15759	17455	35976	880	1813
Total 2-way traffic	**27692**	**57075**	**67386***	**138885***	**32189**	**66342**

*Source MLEA of JVLR, March, 1998, * - Total includes cycles and hand carts*

A comparative analysis was carried out between the predicted traffic volume figures and observed figures in the year 2001 with an objective to assess the accuracy of the traffic prediction. Results of the analysis are presented in *Table 3.3*.

Table 3.3 Comparison of Predicted and Observed Traffic Volume on JVLR for the Year 2001

Daily traffic volume (bothways)	*Western section*		*Middle section*		*Eastern section*	
	Observed	*Predicted*	*Observed*	*Predicted*	*Observed*	*Predicted*
2-wheelers	5490	4435	14021	7914	7898	5068
3-wheelers	6675	8196	19805	20644	6141	4377
Car/Jeep/Taxi	6471	6672	21811	16171	12346	21284
Buses	1991	742	4081	3249	1472	580
Trucks/ Tempo	4301	7647	8865	17455	7057	880
Total 2-way traffic	**24928**	**27692**	**68583**	**67386***	**34914**	**32189**
Difference in the values, %	**9.98%** less the predicted value		**1.78%** more the predicted value		**8.47%** more the predicted value	

*Source MLEA of JVLR, March, 1998, * - Total includes cycles and hand carts*

The prediction seems to be more accurate for the middle section of JVLR than other two sections even though predictions are fairly accurate in all sections. In the middle section of JVLR, the daily traffic volume of 2-wheelers observed is almost double the predicted value while it is exactly the opposite in the case of heavy commercial vehicles (Trucks/tempo). However, the predictions had assumed that by 2001 the JVLR project would have been completed, which is not the case. Hence, the volume of heavy commercial vehicles may increase once the project comes into operation stage considering the importance of JVLR link in MMR.

3.5.1 *Accident Hazards and Safety*

Statistical data on traffic accidents along JVLR could not be collected. However, during Baseline Socio-economic survey (BSES) conducted in February 1996, as part of preparing the final RAP and CEMP report, road accidents involving school children has been reported by the residents of the habitations located adjacent to Section 1 of JVLR. They have cited the absence of pedestrian crossing in the existing JVLR as the major reason for the reported accidents

In other inhabited sections, no such accident hazards have been reported in the RAP report. The rolling terrain and constricted width available for traffic movement is a constraint for cruising at higher speeds. Moreover, nearly 30,000 to 60,000 vehicles travel through the 2-lane JVLR in a day. Due to this traffic snarls and congestion occurs frequently. As a blessing in disguise incessant traffic congestion and slow vehicle speeds fortunately avoids the possibilities for accidents

Based on the location of inhabited areas along JVLR, the accident-prone zones could be the following:

- Inhabited stretch between Kms 0+000 to Kms 2+000
- Inhabited stretch near Kms 3+000
- Inhabited stretch near Kms 4+800
- Inhabited stretch between Kms 5+500 to Kms 9+300
- Hill section near Kamal Amrohi studios

- Hill section east of IIT campus

All major intersections and junctions are provided with traffic signals. The traffic movement is enforced with the traffic police manning all these junctions for major part of the day Because of these reasons traffic intersections/ junctions along JVLR are mostly free of major accidents.

3.6 WATER ENVIRONMENT

3.6.1 *Presence of Surface Water Bodies*

Due to undulating and slightly rolling terrain in the project study area, natural depressions has formed few surface water bodies viz., a monsoon fed river, natural drainage channels and a major surface water body along JVLR sections. The surface water bodies, which lie close to the project road, are as below:

Part of JVLR	*Water body*	*Chainage*
Section I	Majas nallah	At Kms 0+901
Section I	Mithi/ Mahim river	At Kms 3+802
Section II	Powai lake	At Kms 5+900
Section III	Kannamwai nallah	At Kms 10+190

All the water bodies are mainly monsoon fed. Hence, except during monsoon months, the water bodies are used for sewage and other liquid waste transport and disposal. Except for draining the project area during monsoon months and carrying sewage, these water bodies do not serve any other purpose to the habitations living nearby. Due to disposal of sewage disposal they are in a much dilapidated and abused state. Powai Lake can be an exclusion from other water bodies found in the area. Powai Lake - larger in geographical spread and significance - is used for recreational purposes. However, sewage generated from nearby residential areas and IIT campus is said to be dumped into this lake without adequate treatment. Hence, considerable portion of the lake is already much polluted and eutrophicated.

3.6.2 *Water Quality*

To assess the quality of both surface as well as ground water available in the project area, two surface water samples and two ground water samples (from open wells) were collected and analysed as per Indian Standards for drinking water specifications IS 10500 -1991. Samples were collected from the same locations that are referred in the MLEA study report on JVLR, submitted in 1998 The same locations were selected in order to compare, assess and record the change in water quality of the project area.

The sampling locations selected in November 2001 for the water quality assessment are presented in ***Table 3.4.***

Table 3.4 *Water Quality Assessment Locations*

Part of JVLR	Location	Source of sample	Utility of the source	Sample Id
Section I	Near Majas Depot	Open well	Activities except drinking	WQ-1
Section I	Mithi river	Surface water	Sewage transport and drainage	WQ-2
Section II	Near IIT campus	Open well	Activities except drinking	WQ-3
Section III	Powai lake	Surface water	Recreational Purposes	WQ-4

The results of the water quality assessment carried out in November 2001 is presented in the *Table 3.5*

Table 3.5 *Water Quality Monitoring Results*

Parameter	Unit	WQ-1	WQ-2	WQ-3	WQ-4	IS 10500 standards	Coastal SW-III stds.#
pH	-	7.21	7.19	7.25	7.63	6.5 - 8.5	6.5 - 8.5
Turbidity	NTU	Nil	Nil	Nil	2.2	5	30
Total hardness (as $CaCO_3$)	Mg/l	286	114	238	154.0	300	-
Total Alkalinity	Mg/l	325	150	250	285.0		-
Chloride (as Cl)	Mg/l	13	8.5	26	35	250	-
Calcium (as Ca)	Mg/l	60	25	60	54.0	75	-
Sulphate (as SO_4)	Mg/l	186	90	52	Nil	200	-
Magnesium (as Mg)	Mg/l	33	12.5	21	32.0	30	-
Potassium (as K)	Mg/l	Nil	Nil	Nil	6.0		-
Sodium (as Na)	Mg/l	Nil	10.8	Nil	12.0		-
Iron (as Fe)	Mg/l	Nil	Nil	Nil	Nil	0.3	0.5
Lead (as Pb)	Mg/l	Nil	Nil	Nil	N.D	0.05	-
Total Coliform	MPN/ 100 ml	ND	300	ND	180		500
Oil & Grease	Mg/l	Nil	2.2	Nil	Nil		No visible oil slick
Dissolved Oxygen	Mg/l	2.5	4.0	2.7	7.2		3.0 or 40% saturation value

Parameter	Unit	WQ-1	WQ-2	WQ-3	WQ-4	IS 10500 standards	Coastal SW-III stds.#
BOD	Mg/l	23	92	150	420		-

N D Not Detectable,

 # - Coastal water quality standards with designated use of recreation (non-contact) and aesthetics

Source CES study conducted in November 2001

As per the water quality assessment observations at site, the surface water sources are not tapped for drinking water purpose. However, the quality assessment indicates that all parameters analysed are within the limits laid down in *IS 10500-1991 – Standards for Drinking water* and *Coastal water quality criteria SW-III for marine waters* with designated use of recreation (non-contact), industrial and aesthetics. The total hardness and alkalinity values have been reported to be higher in the ground water samples than the surface water samples. Presence of chlorides, calcium, sulphates, and magnesium has been reported in all samples analysed albeit the levels are within the corresponding standards.

Powai lake, is presently being used for recreational (non-contact) purpose. Efforts to desilt and stop sewage disposal into the lake were taken in the past. Much more effort in this direction is planned to be undertaken in future The water quality assessment indicates that there is significant organic content as noted by the high BOD value. Notably, the dissolved oxygen (DO) content is high almost at the saturation limit. The high DO content could be attributed to the eutrophicated state of the lake. The organic content needs to be brought down considerably by adopting various measures viz., stopping sewage flow into the lake without adequate treatment; complete desilting of settled sludge; and clearing the dense mat of algal bloom

3.7 SOIL

Soil in the area is alluvial type mixed with sand and falls under the semi-impervious to impervious category. Soil erodibility is moderate. As per the soil classification for highway pavement construction use, the soil falls under poor to fair category for base course construction. However, it is fairly suitable for forming homogeneous embankment. Soil samples were collected at same regions as specified in the MLEA study report on JVLR project. The soil samples were analysed for various physical and chemical parameters. The results are shown in ***Table 3.6***

As per textural classification, soil at all locations are Sandy loam. Clay content is high above 50%. The typical characteristics of the clayey soil include.

- less prone to erosion;
- high water holding water capacity;
- less permeability; and
- gradual consolidation of disturbed soil.

These characteristics of a typical clayey soil located in the project region will help mitigate some of the adverse impacts due to project implementation.

Lead quantity at all three monitoring stations were found below detectable limits. Moisture content of the soil at WEH, Kamal Amrohi studio and EEH was found

to be 22.41%, 3.27% and 7.5% respectively Organic matter at WEH Kamal Amroli Studio and EEH were found to be 14 3%, 14.5% and 33%, which shows organic contamination of soil along the existing road. Notably, organic matter is found to be higher near EEH among the 3 samples collected for analysis. This indicates degradation and decomposition of vegetative matter and sewage solids. The soil quality assessment results concur with the inference based on visual observations and assessment. The organic matter may leach down the soil layer to reach the ground water (GW) resource due to persistent sewage disposal - to which the present marshy land area near EEH is being subjected - and will contaminate the GW resource.

Table 3.6 *Soil Quality Monitoring Results*

Parameters	Near WEH	Near Kamal Amrohi Studio	Near EEH
Textural Classification			
Sand, % w/w	4 0	3 0	-
Silt, % w/w	9 0	32	-
Clay, % w/w	87	65	-
pH	7 54	7 59	7 69
Electrical Conductivity, µ-mho/ cm	1 14	0 86	1 0
Sodium as Na, % by mass	0 0018	0 0044	0 0063
Potassium as K, % by mass	0 00023	0 00010	0 0029
Calcium as Ca, % by mass	0 0076	0 060	0 884
Magnesium as Mg, % by mass	0 0031	0 0038	0 0043
Total Alkalinity as CaCo3	215	295	330
Chloride as Cl	0.086	0 21	0,84
Organic Matter, %	14.3	14.5	33 0
Nitrogen, %	1 24	0 044	0 58
Lead, ppm	ND	ND	ND
Moisture Content, % by mass	22 41	3 27	7 05

Source CES study conducted in November 2001

3.8 AMBIENT AIR QUALITY

In order to assess the baseline Ambient Air Quality (AAQ) in the project area, an AAQ monitoring was carried out at five locations. Out of the five locations, CES has conducted AAQ monitoring at three locations during the baseline assessment study conducted by them in November 2001. ERM India, which conducted the independent review of CES study report, recommended that AAQ monitoring be conducted at two more locations and commissioned AAQ monitoring at the two additional locations in February 2002.

The monitoring was carried out for four non-consecutive days. During each day, monitoring was carried out for 24 hours. Working days in a week were consciously selected for carrying out the AAQ monitoring. The details of AAQ monitoring stations, methodology adopted and a discussion on the AAQ monitoring results are presented in the following sub-sections.

3.8.1 *Methodology for Ambient Air Quality Monitoring*

The methodology, code of practice, and the equipments/ instruments used for analysis during Ambient Air Monitoring has been presented in *Table 3.7* The

additional monitoring at two locations viz., SEEPZ road junction and WEH junction, commissioned by ERM India was carried out by Netel Chromatographs, Thane, Mumbai – a MoEF certified laboratory

Table 3.7 *Methodology*

Parameter	Code of Practice	Sampler	Equipment	Methodology
SPM	IS 5182 (Part 5)	HVS	Balance Oven Dessicator	Gravimetric
RPM		HVS with cyclone separator	Balance	Gravimetric
SO_2	IS 5182 (Part 2)	HVS	Colorimeter	Colorimetric
NO_x	IS 5182 (Part 6))	HVS	Colorimeter	Colorimetric
CO	IS 5182 (Part 10)	Bladder & Aspirator	Gas Chromatograph	Flame Ionization Detector

3.8.2 *Ambient Air Quality Monitoring Stations (AQMS)*

AAQ monitoring was carried out at five locations along the JVLR project corridor The details of the AQMS commissioned by both CES and ERM India is presented in the ***Table 3.8***

Table 3.8 *Ambient Air Quality Monitoring Stations*

Sl. No.	Station	Chainage	Dist. From C/L	Ht from GL	Landuse
1 *	AQMS-1 (Fantasy Land)	0 140 km	20 m	5 m	Residential
2 *	AQMS-2 (L & T Junction)	4 9 km	15 m	7 m	Residential/Industrial
3 *	AQMS-3 (Gandhi Nagar Police Station)	9.9 km	25 m	5 m	Commercial/ Industrial
4#	AQMS-4 (SEEPZ road junction)	3+070	10m	2m	Industrial
5#	AQMS-5 (WEH junction)	0+100	5m	2 5m	Residential

*Note * - CES commissioned monitoring stations, # - ERM India commissioned monitoring stations*

3.8.3 *AAQ Monitoring Results & Discussion*

The parameters monitored include Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), and Hydrocarbon (non-methane). The AAQ monitoring data is presented in ***Annex D***. Summary results of AAQ monitoring are presented in ***Table 3.9***.

Table 3.9 *Ambient Air Quality in November 2001 & February 2002**

Monitoring station	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	Lead ($\mu g/m^3$)	CO (mg/m^3)	SPM ($\mu g/m^3$)	RPM ($\mu g/m^3$)	HC (ppm)
AQMS-1 [1]	50.4	35 5	ND	5 0[3]	383.6	181 3	ND
AQMS-2 [1]	41 3	36 8	ND	1 9[3]	272 8	123 8	ND
AQMS-3 [1]	40 4	29 0	ND	0 57[3]	257 5	121 4	ND

Monitoring station	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	Lead ($\mu g/m^3$)	CO (mg/m^3)	SPM ($\mu g/m^3$)	RPM ($\mu g/m^3$)	HC (ppm)
AQMS-4 [2]	3601	52 2	-	3 83[1]	521 5	336 8	BDL
AQMS-5 [2]	40 7	55 8	-	4 28[1]	588 0	366 5	BDl
NAAQS/ Residential	80 0	80 0	1 0	4 0[4]	200 0	100 0	0 24[5]

Note [1] - CES conducted the AAQ monitoring in November 2001 and ERM India in February 2002
1 - CES commissioned monitoring stations, 2 - ERM India commissioned monitoring stations
3 – 24 hourly average values, 4 – 1 hourly average values, 5 – Reference MLEA report
All values are 24 hourly average values unless otherwise mentioned

The results indicate that SPM, CO and RPM values at all the stations monitored are more than the corresponding NAAQS for residential land use.

Table 3.10 Comparison of AAQ in June 1996[1] and November 2001[1]

Station	SPM ($\mu g/m^3$)		RPM ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)		Nox ($\mu g/m^3$)	
	June'96	Nov '01	June'96	Nov '01	June'96	Nov '01	June'96	Nov '01
AQMS-1	724 5	267 1	155 1	130 4	38 4	40 1	41 4	42 5
AQMS-2	916 4	275 0	222 1	130 5	28 2	37 4	35 7	38 1
AQMS-3	1099 4	407 5	248 9	198 7	31 7	47 0	34 0	35 0

Note AAQ data from AQMS-4 and 5 are not compared since June 1996 AAQ data is not available
1 – MLEA assessment was carried out in June 1996 and present assessment was carried out in November 2001

The comparative analysis to assess the changes in baseline socio-economic environment since June 1996, indicates that SO_2 and NO_x are showing a increasing trend albeit gradually. This can be attributed to the vehicular growth, which was much along the MLEA predicted lines. However the same increasing trend is not observed for SPM and RPM Pollutant levels for these two parameters show significant variation and the November 2001 levels are almost one-fifth of June 1996 levels. The MLEA report has not reported in detail the reasons for such high values in June 1996. Hence, it would be difficult to derive conclusions based on these results. One possible reason could be the seasonal variation in pollutant levels, as the AAQ assessment for MLEA study was carried out just before monsoon season (June) and the present AAQ monitoring was carried out during post-monsoon season (November) Nevertheless, mitigation measures are required for arresting the upward trend in gaseous and particulate pollutant levels along JVLR as a long-term measure.

3.9 AMBIENT NOISE LEVEL

In reference to the discussion in *section 3.1*, the land use pattern and presence of various physical attributes indicate that ambient noise levels will be an important parameter during the implementation of JVLR project. In order to assess the baseline Ambient Noise levels (ANL) in the project area, ANL monitoring was carried out at five different locations along JVLR project corridor. The locations were selected to represent various landuse categories with respect to which ANL standards of MoEF/ CPCB have been recommended. The ANL monitoring was carried out for one whole day. Working days in a week were consciously selected for carrying out the ANL monitoring.

3.9.1 *ANL Monitoring Station*

Monitoring stations were selected considering the land use pattern, traffic intersection and diversion. Details of the ANL monitoring station is presented in *Table 3.11.*

Table 3.11 Ambient Noise Quality Monitoring Stations

Sl. No	Station	Chainage	Dist. from road edge	Ht from GL	Landuse	Remarks
1	NLMS-1 (Fantasy Land)	0 140	3 m	1 2 m	Residential	Major residential area
2	NLMS-2 (L & T Junction)	4+900	2 m	1 2 m	Residential / Industrial	Major Industrial area
3	NLMS-3 (Gandhi Nagar Police Station)	9+900	2 m	1 2 m	Sensitive/ Industrial	The only two sensitive receptors found along JVLR viz Central school and IIT are located nearby
4	NLMS-4 (SEEPZ road junction)	3+070	2 m	1 2 m	Industrial	Major Industrial area
5	NLMS-5 (WEH junction)	0+000	3 m	1 2 m	Residential	Major residential and road intersection

3.9.2 *Methodology*

The noise levels were observed using Nutron SL 4001 handheld noise level meter as per IS 3029-1980. The instantaneous noise levels were observed at every 6-minute interval manually. Based on the 6-minute interval instantaneous noise levels the hourly equivalent noise levels were computed.

3.9.3 *Results and Discussion*

The ANL monitoring data is presented in ***Annex D.*** Summary result of ANL monitoring is presented in ***Table 3.12.***

Table 3.12 Summary Results of ANL Monitoring, dB (A)

Noise levels	NLMS-1	NLMS-2	NLMS-3	NLMS-4	NLMS-5	Noise stds [1]
L_{eq} Day	80 1	83 2	86 0	80 4	84 8	55 0
L_{eq} Night	72 3	77 5	77 2	70 6	77 3	45 0

1 – Noise standards for residential land use

The ANL results show that traffic induced noise is exceeding the corresponding CPCB standards for residential land use significantly. The important factor to be noted here is the location of ANL monitoring The present NLMS were located very close to the project road - at a distance of about 2m from the edge of the road. As the noise level dissipates with distance location of NLMS with respect to JVLR is an important criteria to be considered. The possible reasons for high traffic induced noise could be due to:

- High daily traffic volume observed along all sections of JVLR;
- Incessant traffic snarl and congestion at major intersections of JVLR, especially the middle section of JVLR, and
- Undulating and rolling terrain all along JVLR, which causes HCV to accelerate/decelerate very often generating, noise in the process.

3.9.4 *Change in ANL since MLEA Study conducted in 1996*

When compared to noise levels observed in 1996, both Leq (day) and Leq (night) shows appreciable increase in noise levels ***(Refer Table 3.13)*** However noise levels at all the locations are above the CPCB standards for ambient noise levels in a residential land use.

Table 3.13 ***Change in ANL since MLEA Study conducted in 1996***

Noise levels, dB(A)	NLMS-1		NLMS-2		NLMS-3		Noise stds
	June'96	Feb' 02	June'96	Feb' 02	June'96	Feb' 02	
L_{eq} Day	77 7	80 1	84 1	83 2	79 8	86 0	55 0
L_{eq} Night	70 0	72 3	74 3	77 5	75 5	77 2	45 0

Note Data from NLMS-4 and 5 are not compared since 1996 ANL are not available

The reason for increasing trend in ANL could be attributed to the factors mentioned in *section 3 8 3* The construction of flyovers/ grade separators cannot be contributing to traffic induced noise levels. The reason being the construction work on LBS Marg flyover near NLMS-3 is temporarily stopped and there was no activity during ANL monitoring. At L&T-junction (near NLMS-2) the construction of flyover is taking place for the segment within the L&T factory area and hence cannot be a primary source of ANL in the area

3.10 *ECOLOGY*

Vegetation along inhabited areas is mainly comprised of avenue plantation raised by Municipal Corporation. As the road is not passing through either forest or ecologically sensitive areas like national park or sanctuary hence there are no records of any wildlife, endangered or rare animal species within the project area Detailed ecological survey of the project study corridor was undertaken as part of the baseline assessment of the project area. Results of the survey are presented in the following sub-sections.

3.10.1 *Western Section of JVLR*

This part of the road passes through small villages, industrial establishments, and institutional and residential areas. The trees of avenue plantation include *Acacia auriculiformis, Ailanthus exelsa, Albizzia lebbeck, Bombax ceiba, Cassia siamea, Ficus benghalensis, F Religeosa, F. Glomerata, Pongamia pinnata, Terminalia catappa, Thespesia populea* etc.

During the ecological survey, the trees located within the 30m belt on both sides of existing road were identified and counted, as they will be uprooted during project implementation. A total number of 35 species belonging to 32 genera & 16 families were identified during the survey. About 519 trees have been identifed as '*project affected*' vegetation during the present survey. The trees

identified are found distributed all along the western section of JVLR Significant number of trees affected was found at the section between hill section and Mithi river. The list of trees [> 10 cm diameter at breast height (DBH)] recorded within the 30 m belt on both sides is given in *Table 3.14.*

Table 3.14 List of Plants Recorded within RoW along JVLR

S.#	Scientific Name	Common Name	Family	# of trees
1	*Acacia auriculiformis*	Australian Acacia	Mimosaceae	8
2	*Albizzia lebbeck*	Shirish	Mimosaceae	62
3	*Alstonia scholaris*	Datvin	Apocynaceae	6
4	*Artocarpus integrifolia*	Jackfruit	Ulmaceae	3
5	*Borassus flabelliferus*	Taad	Palmaceae	21
6	*Bombax ceiba*	Silk cotton	Malvaceae	3
7	*Cassia siamea*	Balwa	Caesalpinaeae	21
8	*Casuarina equisatefolia*	Suru	Casnarinaceae	23
9	*Cocos nucifera*	Coconut	Palmaceae	23
10	*Cordia dichotoma*	Bhokar	Beragmaceae	3
11	*Delonix regia*	Gulmohar	Caesalpinaceae	27
12	*Erythrina orientalis*	Coral tree, pangera	Fabaceae	15
13	*Eucalyptus sp*	Nilgiri	Myrtaceae	9
14	*Ficus benghalensis*	Wao	Moraceae	25
15	*Ficus religiosa*	Umbar	Moraceae	35
16	*Ficus glomerata*	Pipal	Moraceaw	2
17	*Gliricidia sepium*	Undirmari	Fabaceae	5
18	*Holoptelia integrifolia*	Padi	Ulmaceae	2
19	*Leucaena leucophloea*	Subabhul	Mimosaceae	31
20	*Mangifera indica*	Mango	Anacardiaceae	22
21	*Manikara zapota*	Rayon	Sapotaceae	6
22	*Moringa oleifera*	Sheiga	Moringaceae	8
23	*Peltophorum fgerrugineum*	Copper-pod Tree	Caesalpinaceae	5
24	*Phoenix sylvestris*	Shindi	Palmaceae	1
25	*Pithecellabium dulce*	Vilayati Chinch	Mimisaceae	14
26	*Plumeria rubra*	Champa	Apocynaceae	5
27	*Polyalthia longifolia*	Asupal	Anonaceae	8
28	*Pongamia pinnata*	Karanj	Fabaceae	29
29	*Samanea saman*	Raintree	Mimosaceae	5
30	*Spathadea companulata*	-	Binanaiaceae	2
31	*Syzygium cummuni*	Jamun	Myrtaceae	10
32	*Tamarinds indica*	Chinch	Caesalpinaceae	8
33	*Tectona grandis*	Teak	Verbenaceae	6
34	*Terminalia catappa*	Jangli Badam	Combretaceae	32

S #	Scientific Name	Common Name	Family	# of trees
35	*Thespesia populnea*	Bhendi	Malvaveae	34
	Total			519

Source CES field survey conducted during Nov 2001

3.10.2 *Middle Section of JVLR*

The middle section of JVLR traverses through well-developed residential and institutional area. Along the southern bank of Powai Lake a green patch comprising of trees, shrubs and dense grass is observed. Between IIT and LBS road, the hilly roadside are cut to rock level and are devoid of any planned or unplanned vegetation growth. Detailed ecological survey and identification & counting of *'affected'* trees were not carried out during the present survey, as the project proposals and preliminary construction drawings are not available at present.

3.10.3 *Eastern Section of JVLR*

The dominant avenue plantation in this region showed similar composition as that of western section of JVLR. Other species found along eastern section of JVLR include *Casuarina equisetifolia, Cocos nucifera, Borrasus flabuliferrus, Eucalyptus sp , Mangifera indica, Leucaena locophloea, Moringa oleifera* However, during the ecological survey, it was found that no trees are located within the 30m belt on both sides of existing road

The last 100 m stretch of JVLR on the eastern section at Kms 10+200 traverses through degraded marshy land area. More discussion specifically on this marshy land is presented in ***Section 3.11***

3.11 *PRESENCE OF NATURAL HABITATS*

As per WB OP 4.04, a natural habitat is defined as habitats that are land and water areas where (i) the ecosystems' biological communities are formed largely by native plant and animal species, and (ii) human activity has not essentially modified the area's primary ecological function. Important natural habitats may occur, among other environments, in mangrove swamps and coastal marshes Along the eastern section of JVLR, while such a mangrove swamps have been observed along the southern edge of the road, they have been significantly modified by human activity and hence the World Bank OP 4.04 does not apply to JVLR project. The ecological assessment of this mangrove patch is presented in the following discussion.

3.11.1 *Baseline Assessment of Mangroves within the Project Road RoW*

Mangroves can be defined as *"a tree, shrub, palm, ground fern or a grass exceeding half a metre in height and growing above the mean sea level in the intertidal zone of marine coastal environments or estuaries margins of the world's tropical and sub-tropical coastal regions is called mangrove"*

Legal Status of Area within Project Road RoW

PARTICULARS	*DESCRIPTION*
Ecological status	Degraded/stunted Mangroves
Status as per the Govt of India's Guidelines	RoW development exempted under CRZ regulations as a part of CZMP for Greater Mumbai by the MoEF of GoI
Mangrove area to be reclaimed on the Southern side of JVLR RoW	0 2 hectares
Location	South of Jogeshwari-Vikhroli Link Road's (JVLR) interception to the Eastern Express Highway near Kannamwar Nagar Nallah
Ecological status of the area on the Northern side of JVLR	Grasslands No presence of mangroves
Status of mangrove vegetation on the proposed ROW in Southern side of JVLR	Degraded/stunted Mangroves

Since water situation and tidal forces operate at different intensities in different parts of an intertidal zone, the species of mangroves prospering in these areas also are different. If one considers the Thane creek region as one contiguous habitat, the successional pattern of zonation from sea-side (creek side), towards land ***Avicennia - Sonneratia - Aegiceras - Acanthus - Aeluropus.*** The mangrove vegetation in the region of study is a mixture of *Avicennia marina, Acanthus ilicifolius, Excoecaria agallocha, Sesuvium portulacastrum,* and *Aeluropus lagopoides* ***Table 3.15*** provides details of distribution and current status of mangroves found within JVLR RoW

Table 3.15 Distribution and Current Status of Mangrove found within Project Road RoW

Names of species observed	*Avicennia marina, Excoecaria agallocha, Acanthus ilicifolius*
Average height of stand	1 5 - 3 5 m (majority of which is occupied by Avicennia marina - one of the widely occurring species of mangroves in and around Mumbai
Density	*Avicennia marina* (about 25 individuals per ha), *Excoecaria agallocha* (about 5 individuals per ha), *Acanthus ilicifolius* (this is an herbaceous plant and therefore non-significant in this area)

It is to be noted here that mangroves are found along southern side of JVLR RoW On the northern side, the local community has converted the mangrove vegetation to grasslands. Hence no mangrove swamps were observed on the northern side of JVLR RoW, during the baseline survey. ***A photo documentation of the mangrove area is appended at the end of this section.***

JVLR is presently a two lane road at this stretch and is proposed to be widened to. 6 lanes. The alignment of JVLR has been approved by the MoEF as a part of CZMP of Greater Mumbai under CRZ regulations. On either side of existing 2-lane road, debris (mainly comprising of construction and soil waste) has been dumped along the eastern stretch of JVLR. The widening may reclaim 0.2 ha of land on the southern side of RoW.

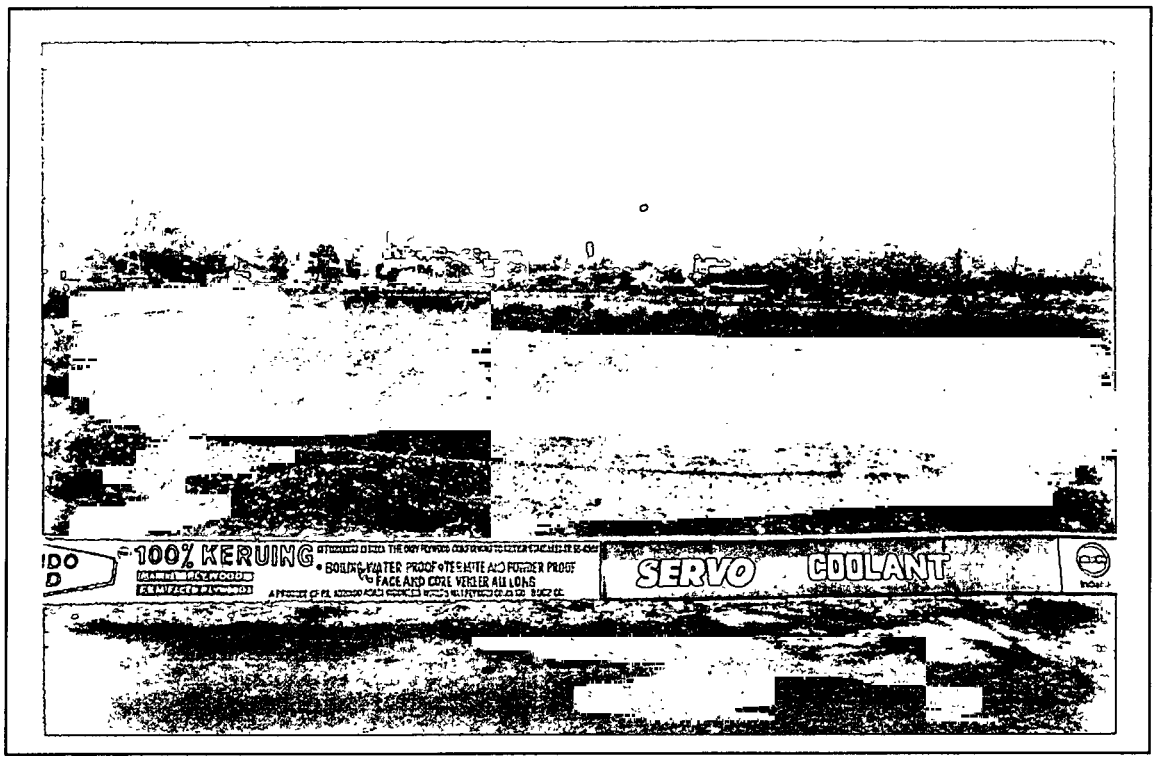


Photo 1: View of Mangrove swamps located well away from JVLR edge

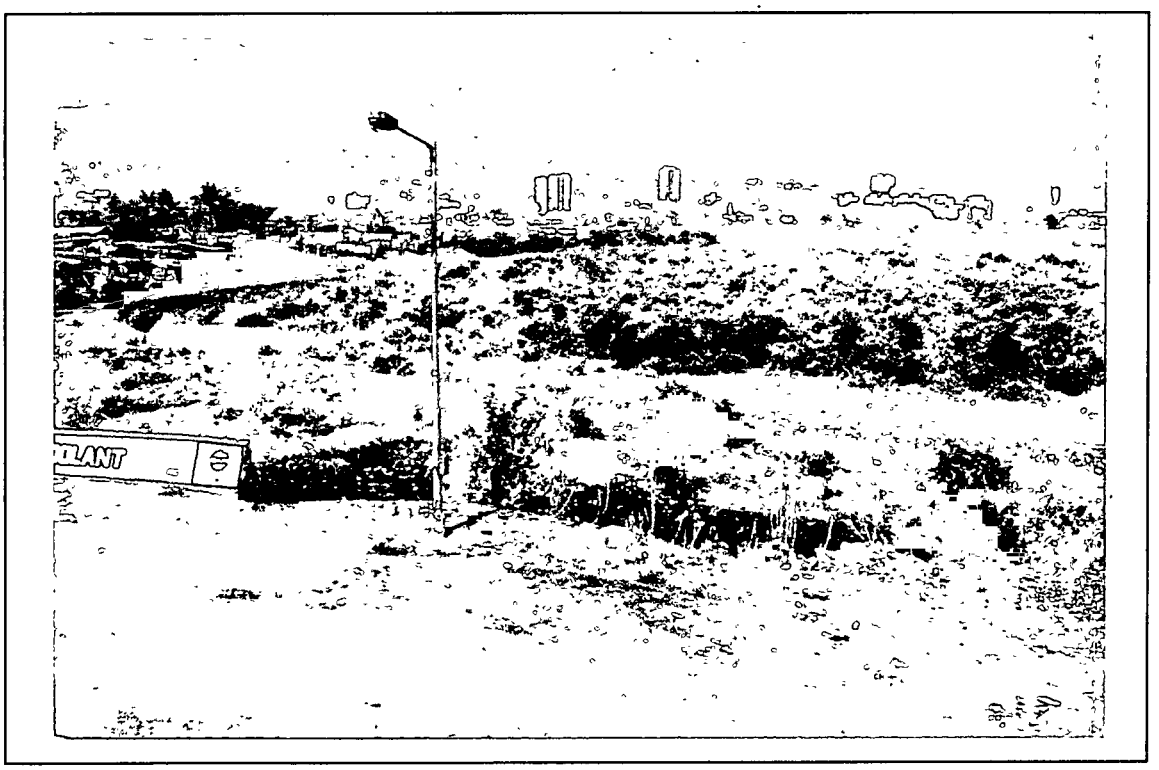


Photo 2: Another view of Mangrove swamps located well away from JVLR edge

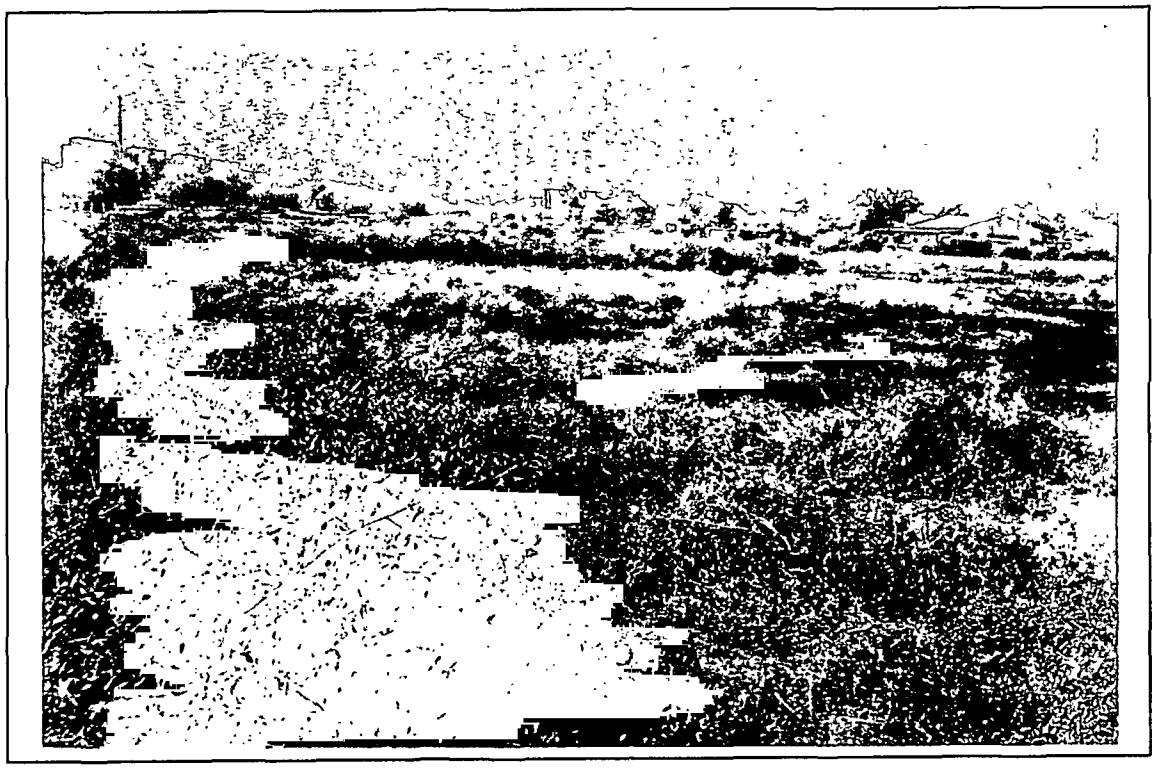


Photo 3: Mangrove swamps being destroyed by local community for converting the landuse

Photo 4: View of converted mangrove swamps.

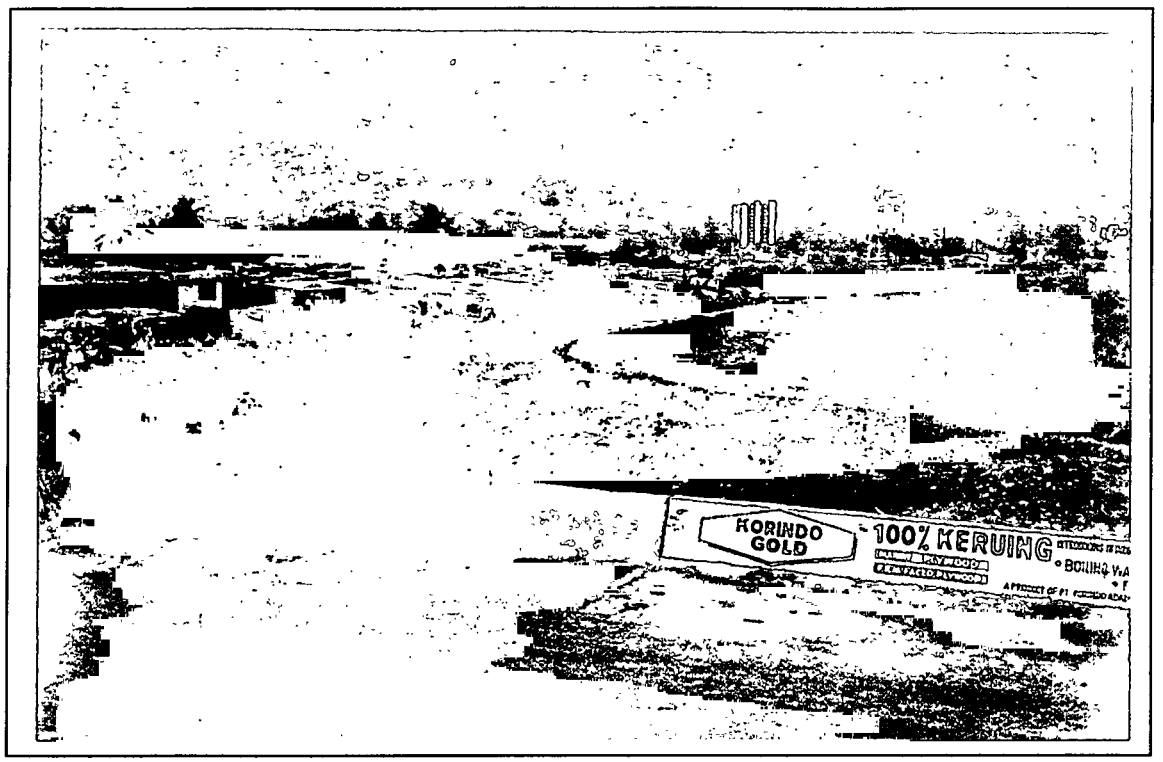


Photo 5: Kannamwar Nallah (Natural drain) carrying sewage criss-cross the mangroves area

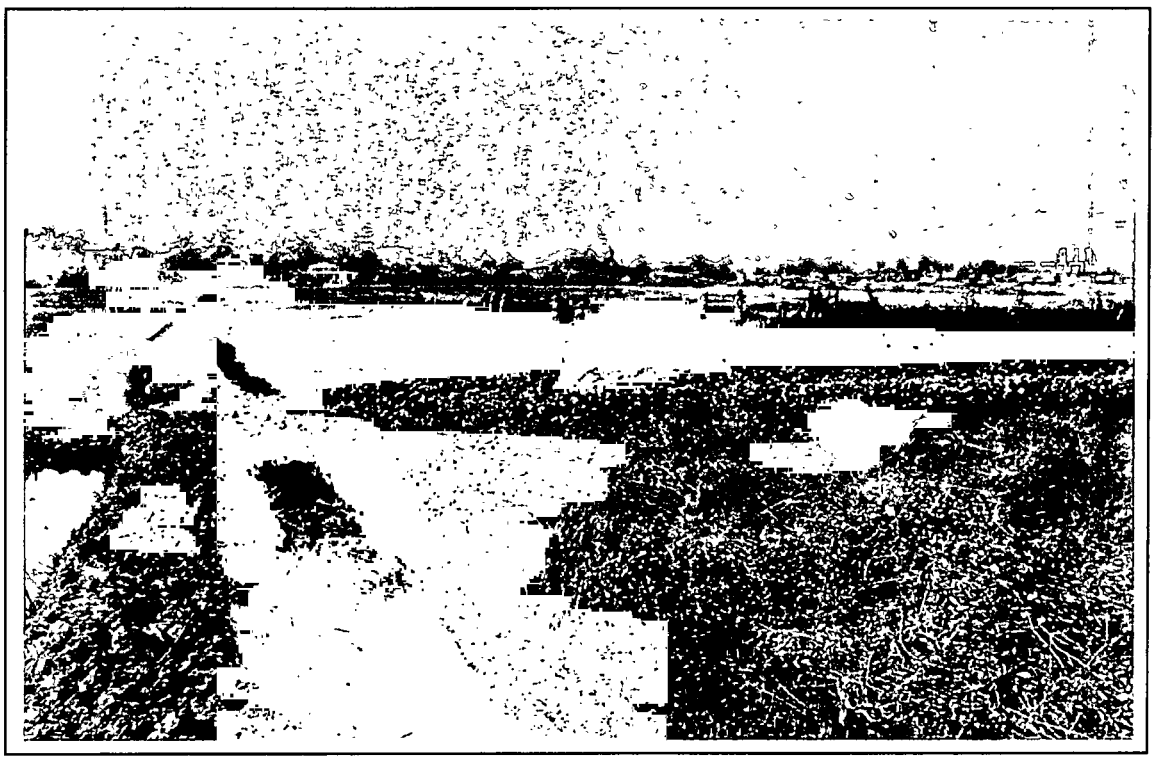


Photo 6: Another view of converted Mangrove swamp lands.

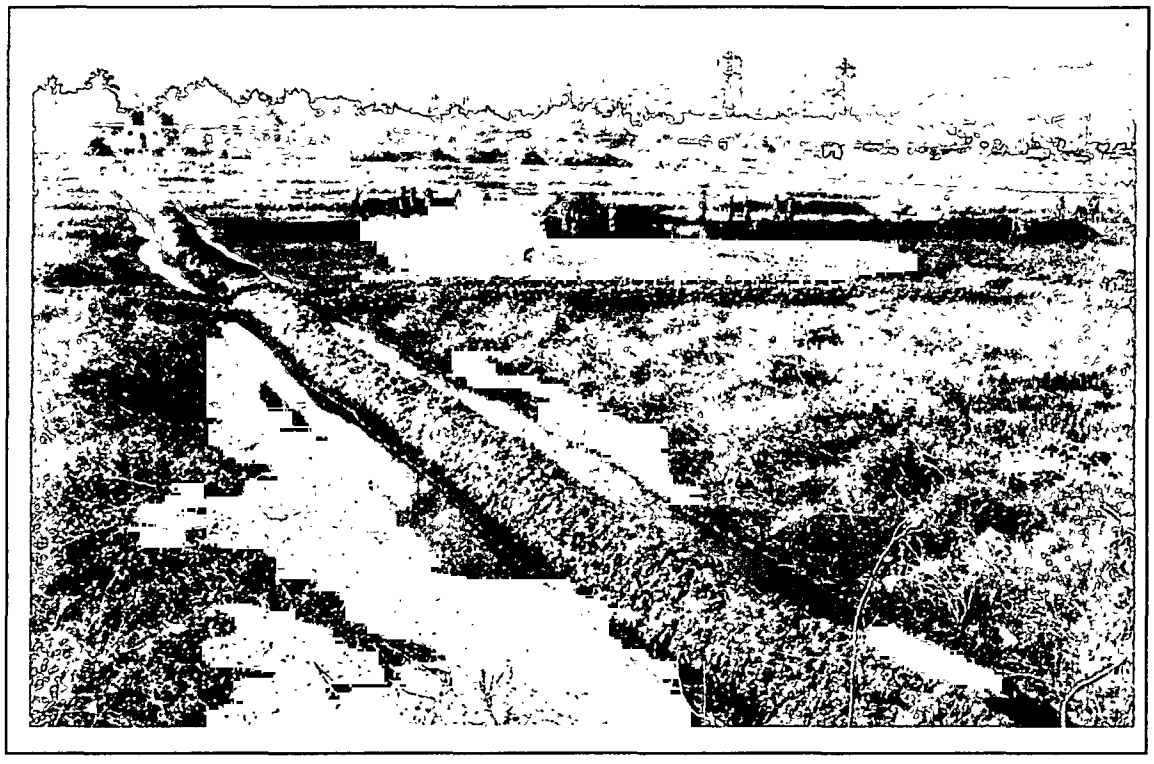


Photo 7: Converted Mangrove swamps to a full-fledged farming land with sewage irrigation

Photo 8:Mangroves being burnt to clear the swamps

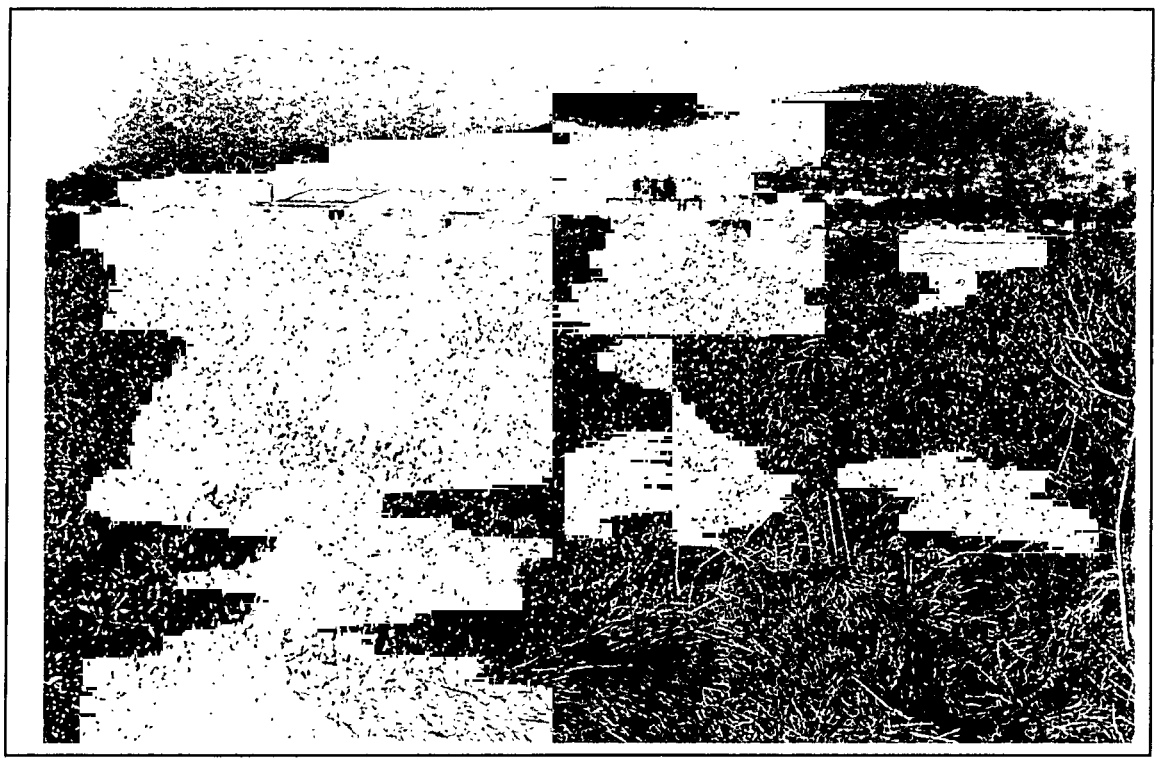


Photo 9: View of Mangrove swamps located well away from JVLR edge

3.12 PRESENCE OF SENSITIVE RECEPTORS

3.12.1 *Phase I of JVLR Project*

The presence of Schools, Educational Institutions, Hospitals and other institutions within the project corridor were identified as sensitive receptor.

The Final RAP and CEMP report on Phase I of JVLR project has identified a pre-KG school located within the Milind Nagar slums as a structure that would be affected due to the implementation of JVLR project. The KG school (locally known as *Balwadi*) is a slum structure of size not more than 100 sq.ft. The PAPs are being provided with amenities/ facilities at the R&R site more than they have lost to JVLR project. There are no other receptors located within the proposed alignment of JVLR

3.12.2 *Phase II of JVLR Project*

Along the Phase II stretches since DPR proposals are not yet ready identification of affected receptors have not been done However, during the preparation of this report, the receptors located close to the existing road edge were identified The identified receptors include:

- A Kendriya Vidyalaya (Central School) located within Indian Navy Civilian Housing Complex
- Indian Institute of technology campus along northern edge of JVLR

Both this receptors are located outside the RoW of JVLR.

3.13 PRESENCE OF PLACES OF WORSHIP

As per the United Nations term "cultural property" includes sites having archeological (prehistoric), paleontological, historical, religious, and unique natural values. Cultural property, therefore, encompasses both remains left by previous human inhabitants (for example, middens, shrines, and battlegrounds) and unique natural environmental features such as canyons and waterfalls. The rapid loss of cultural property in many countries is irreversible and often unnecessary. *(Reference WB OP 4 11)*

3.13.1 *Phase I of JVLR Project*

Archeological (prehistoric), paleontological, historical, and unique natural value sites are not found along Phase I stretch of JVLR. Few places of worship have been identified within the project RoW that will be cleared during construction phase of the project Enumeration details of places of worship that will be relocated/cleared is presented in ***Table 3.16***

Table 3.16 ***Relocation of Religious/ Worshipping Places along Phase I Stretch of JVLR***

Name of the place/religious structure	# of structures along Section I	# of structures along Section III
Temples	9	1
Total	9	1

1 – 8 #s as per RAP report, February, 1996 and 1 has been recently identified with the modification in the DPR proposal near SEEPZ road

The significance of the religious/worshipping places identified can be better understood from the size of each structure to be relocated. The size details of each identified structure is presented in *Table 3.17*

Table 3.17 Structural Details of Religious Places along Phase I Stretch of JVLR

Name of the place/religious structure	Location chainage, kms	Size of the structure, sq.ft	Remarks
1 Gajanan Maharaj Mandir	0+300	130	The temple will be affected fully A hall in front of the temple will not be affected strictly going by RoW
2 Hindu Temple	0+350	< 50	Fully affected
3 Buddha Vihar mandir	0+380	300	Temple fully affected A hall in front of the temple will not be affected strictly going by RoW
4 Place of worship	0+450	< 10	Private worship place Fully affected
5 Place of worship	0+480	< 10	Private worship place Fully affected
6 Ganpati Mandir	2+750	150	Temple will be fully affected
7 Hanuman mandir	2+800	130	Temple will be fully affected
8 Place of worship	3+800	< 10	Private place of worship Fully affected
9 Place of worship	4+800	< 10	Slum structure Fully affected
10 Hindu temple	9+300	< 30	Affected fully due to ROB widening as part of flyover construction at LBS junction

3.13.2 *Phase II of JVLR Project*

Along the Phase II stretches since DPR proposals are not yet ready identification of affected religious places have not been done. However, during the preparation of this report, the places of worship located close to the existing road edge were identified and their enumeration details are presented in *Table 3.18.*

Table 3.18 Presence of Religious Places along Phase II Stretch of JVLR

Name of the place/religious structure	# of structures along Section II
Temples	2
Church	1
Mosques	0
Gurudwara (Place of worship of Sikhs)	1
Total	**4**

3.14 *UTILITY/FACILITY ALONG PROJECT CORRIDOR*

3.14.1 *Utility Services to be shifted in Phase I Stretches*

The inhabited areas have access to the following public utilities/ facilities:

- Underground telephone cables
- Underground water supply lines
- Underground power supply cables
- Underground sewerage system
- Street light poles and underground cables

Electric transmission/utility belonging to MSEB

- Street lighting underground cables, 1636 m length; Mithi river bridge to Saki vihar road
- 11 kV underground cables, 1578 m length, Mithi river bridge to Saki vihar road

Utility Services in Eastern Section of JVLR

Water supply lines

- 230 mm dia Main, 60 m length from LBS Marg to Kanjurmarg bridge

Telephone utility

- 12-way duct, no working cables, relocation at 2 # of bridge sites. Length of duct is 80 m. Additionally 2 new manholes are also required.
- 2 # of PIJF cables, 1380 m length from LBS marg to EEH 2x 2000 pairs
- 3 # of PIJF cables, each 760 m length from LBS marg to DP road. 1x800 pairs and 2 x 2000 pairs
- 2 # of PIJF cables, 780 m length from LBS marg to DP road 2x 1200 pairs

Electric transmission/utility belonging to BSES

- 11 kV underground cables, 198 m length

Electric transmission/utility belonging to MSEB

- Street lighting underground cables, 2260 m length
- 11 kV underground cables, 144 m length

3.14.2 *Utility Services to be shifted in Phase II Stretches*

Along Phase II stretches since DPR proposals are not yet ready data on affected utility services is not available at present. However, Phase II project stretch has access to the following facilities/ services:

- Underground telephone cables
- Underground water supply lines
- Underground power supply cables
- Underground sewerage system
- Street light poles and underground cables
- Storm water surface drains
- Bus stopping stations
- Auto-rickshaw stand

3.15 *CURRENT STATUS OF FLYOVER PROJECTS ALONG JVLR*

MSRDC is currently implementing two flyover (grade separators) projects along JVLR The current status of the projects is under various stages of execution. In order to ascertain the environmental status at these flyover sites, a rapid audit was conducted. The main objective of the rapid audit was.

- to observe/ assess various site-specific issues at the construction site;
- to report the status of the project at site; and

- to observe/ assess various mitigation measures that are being implemented/ unimplemented at site

The findings of rapid audit conducted at these flyover sites have been presented in *Table 3.19*.

Table 3.19 Findings of Rapid Audit carried out at Flyover sites on JVLR

Environmental Issues	*LBS Marg Junction Flyover*	*Saki Vihar Road Junction Flyover*
Status at site	Flyover is currently under construction stage. The flyover construction is at present stopped since November 2001.At present, the northern side carriageway construction is almost complete except the abutments. The southern side carriageway has been just started and only 2 piers out of total 15 has been completed.	Flyover is currently under construction stage At present only the eastern section of the flyover i e the portion which runs through the L&T Factory area is under construction. Currently flyover deck slab construction is being carried out at this section. The work on the western section of the flyover, which runs along the Slum area located on either side of existing 2-lane JVLR carriageway has not yet started Even the pre-construction activities viz PRoW clearing and R&R are yet to be started.
Local Traffic management	Adequate traffic management measures have been implemented at site. Since pier construction of northern side carriageway is over, traffic moving along Jogeshwari - Vikhroli direction is being allowed through the construction area. However, few large concrete blocks left haphazardly along the road can be removed to the side, so that free movement of traffic is enhanced at this heavily congested junction.	Construction activity is currently taking place inside the L&T Factory area and hence there is no disturbance to traffic moving along Saki vihar road and JVLR Opposite the Office of Indian Register of Shipping located behind L&T factory and on the eastern side, barricaded enclosure have been provided for a length of about 100m to the construction side. Barricades have been provided on the Powai lake side as well.
Pedestrian safety	Service ramps on either side of existing ROB at the eastern end of flyover is partially complete Pedestrians and railway commuters from Kanjurmarg railway station	Since construction activity is currently taking place inside the L&T Factory, pedestrians have not faced any problem due to the activities at site. However, when the work on

Environmental Issues	*LBS Marg Junction Flyover*	*Saki Vihar Road Junction Flyover*
	have started using the unpaved service ramps. Since all the construction equipments have been removed from the site, there are no obstructions to the movement of pedestrians However, early resumption of construction and completion of the project would be beneficial to the pedestrians.	western section of the flyover starts, adequate temporary pathways will have to be provided for safe and easy movement of pedestrians across this junction.
Ecology	The flyover is being constructed along an existing junction There is no adverse impact observed on this issue at the site.	Presently site has been cleared and construction work has proceeded till deck slab construction stage inside the L&T Factory area However, few trees located along the alignment of the flyover inside the L&T factory might have been removed. On the western side, ecological impact is quite negligible
Socio-economic scenario	There has been no additional acquisition of land as the construction of flyover is taking place within the available RoW of JVLR. However, the ROB widening being implemented under the same contract will result in displacement of slum residents of Tagore nagar area. Presently site clearance work is in progress.	Slum area located along and on either side of JVLR opposite L&T Gate #3 will have to be relocated and resettled once the construction of western section of flyover starts. In any case, the slum areas will have to be removed during the widening of JVLR. Hence R&R issues will be addressed during implementation of JVLR project
Utility relocation/ diversion	Since the construction has started quite a few months back, utility diversion seems to have been completed As of now, no utility diversion work is in progress at site	Construction at present is progressing within L&T factory area. Outside the factory area, no utility diversion work has taken place It seems that utility diversion work at this site may be taken up along with that of western section of JVLR

Environmental Issues	*LBS Marg Junction Flyover*	*Saki Vihar Road Junction Flyover*
Land use	No major impact on land use has been observed at the site as the construction activity was limited to within existing RoW. Residential land use along a stretch near the Tagore nagar slum areas will be reclaimed for ROB widening and embankment construction.	Major adverse impact on the Slum dwellers located opposite L&T gate #3 is anticipated. However, with the implementation of R&R measures, the adverse impact on the residential land use can be largely mitigated. In the long term the removal of slums will enhance the aesthetics of the area.
Physiography	Physiography of the area has not been affected with the implementation of flyover project, as there is no large-scale earth moving and refilling except for abutment portions.	Physiography of the area has not been affected with the implementation of flyover project, as there is no large-scale earth moving and refilling except for abutment portions
Drainage	No major impact on drainage has been observed. However, roadside drains have been constructed along the service ramps. The drains are quite deep (depth of about 3-4m) and has been left uncovered. Since there are no hand rails provided along the ramps at present, serious accidents might occur to the pedestrians using the ramps during night-time. The drains have not been cleaned for construction debris	Physiography of the area indicates that the area drains into Powai lake located along northern edge of JVLR and at the end of eastern section of flyover. Hence adequate drainage system needs to be provided at this site The earthwork carried out should be well stabilised as there will be high erosion of disturbed/ altered soil.
Water environment	No impact on this issue is observed as there are no water bodies located nearby	Major impact on the water quality of Powai lake is anticipated. Stacking of topsoil has been carried out properly within a secluded enclosure which has been adequately barricaded upto a height of about 1.6m. However, minor amount of topsoil disposal was observed along the banks of Powai lake at one location, which

Environmental Issues	*LBS Marg Junction Flyover*	*Saki Vihar Road Junction Flyover*
		should be avoided in future.
Fugituve dust emission	Since the construction activity has stopped now, the measures taken to control fugitive dust emission could not be observed. The storage yards have been located at the BM Thackeray marg -JVLR junction on the eastern side.	The construction activity has proceeded till deck slab construction stage and hence all dust-emitting activities have been completed. However, the storage yards have been located a little away from the site at about 250m on the western side along JVLR.
Hot mix / Asphalt plants/ Concrete batching plants	In-situ plants were not located within the project site.	In-situ plants were not observed during the audit.
Ambient Noise levels	Construction activity has stopped since November 2001. Hence the noise generation from Construction activity could not be ascertained.	The deck slab construction activity is in progress within the L&T factory area. Noise impact has been minor at this site. The vehicular movement along JVLR and Saki vihar road contributes much to the prevalent noise levels in the area.
Debris/ Top soil disposal/ Construction waste disposal	At the site, except for the huge concrete blocks, there are no stacks of construction waste/debris left within the PRoW Some amount of topsoil debris was found stacked inside the defunct HLL factory on the eastern side of LBS marg.	The topsoil stacks have been adequately barricaded within a 1.6m high enclosure. However, minor amount of topsoil disposal was observed along the banks of Powai lake at one location, which should be avoided in future.
Presence of Sensitive	A Kendriya Vidyalaya (KV) located within the Naval Civilian Housing Colony on the northern side of JVLR	No sensitive receptor is found near the Flyover site. Hence no major impact I anticipated on this issue

Environmental Issues	*LBS Marg Junction Flyover*	*Saki Vihar Road Junction Flyover*
receptors	and western side of LBS marg is the only sensitive receptor found near the flyover site. During operation stage, the KV may bear the brunt of deteriorating AAQ and ANL.	
Location of Construction material storage yards	The storage yards have been located at the BM Thackeray marg -JVLR junction on the eastern side. The site selected is closer to the flyover site and also does not obstruct traffic movement along the eastern section of JVLR.	The storage yards have been located at about 250m from the junction towards the western side along JVLR. The site selected is closer to the flyover site and also does not obstruct traffic movement along the western section of JVLR.
Location of Labour camps	Labour camps were not observed within the flyover site or in the areas nearby	Labour camps were not observed within the flyover site or in the areas nearby.

4 IDENTIFIED ENVIRONMENTAL IMPACTS & RECOMMENDED MITIGATION MEASURES

In order to identify various site-specific environmental issues, which might get impacted due to the implementation of proposed improvement and widening of JVLR, an Impact Identification Matrix (IIM) is prepared.

In the IIM, all site-specific issues, perceivable environmental issues and social issues are listed in a row. Various construction activities expected during the implementation of JVLR project are listed in a column.

The resultant impact of carrying out various activities listed in the column against various perceived environmental issues are assessed and noted. The impact identification and assessment over a particular site-specific issue is carried out based on baseline environmental status for that particular issue and Consultants experience in similar projects. The IIM prepared for JVLR project has been presented as ***Table 4.1***. Based on the IIM, various site-specific impacts identified are described in detail in the following sub-sections.

4.1 LAND USE

A discussion on Impact on land use pattern is presented below for each section of JVLR for better understanding.

Section I:
Impact on land use pattern is expected to be significant more during operation phase than during construction phase. During construction stage the available/ existing RoW will be cleared for widening the carriageway and implementing various other project proposals. Even clearing the site within the existing RoW will displace about 4956 PAP's belonging to 1068 PAH's in the western and eastern section of JVLR Since adequate RAP and CEMP measures have been planned for the PAPs, the adverse impact will be largely temporary in duration as some of the residential land use (even though in an encroached land area) will be reclaimed for road construction.

During operation stage, induced impacts on land use pattern are anticipated to occur. As the JVLR will become a major link connecting EEH and WEH, the land values are bound to go up in short duration. This will lead to exploitation of vacant land area/ space available along the western section of the project corridor. Specifically, the induced impacts during operation phase might include·

- Proliferation of slum dwellings along either side of JVLR
- Increased commercial activities and the road side land use will be altered to commercial land use
- Encroachment of scant wooded area

Section II

Impact on land use pattern during construction of Phase I of JVLR will be practically none. However, during Phase II implementation, the residential and commercial land use activity near Panch Kutir market area might be impacted adversely as they are located very close to the project road. The RAP and CEMP studies planned for the Phase II of JVLR project will address the R&R issues adequately and mitigate the impact to large extent. Hence the adverse impact will be of short duration.

However, during operation stage, induced impacts on land use pattern are anticipated to occur. The induced impact will along similar lines as has been described for Section I of JVLR.

Section III:

The adverse impact on land use pattern during construction phase will be insignificant, as most of the area is occupied by marshy and highly degraded wastelands. A narrow corridor of the residential land use pattern near the southern edge of JVLR immediately after existing ROB will be affected due to the embankment proposed for widening the existing 2-lane ROB. The relocation of slum dwellers of the affected corridor is presently being carried out and the corridor is being cleared of slum structures.

However, during operation stage, induced impacts on land use pattern are anticipated to occur. The existing wastelands and coastal mangroves might be reclaimed to improve its utility and increase the land value. The wasteland area opposite Kanjurmarg rail-station has already been earmarked for relocating some of the PAP's of ongoing railway projects, which are being taken up under MUTP. The CEMP measures proposed for this relocation & rehabilitation site will trigger the induced impacts anticipated to occur in this stretch of JVLR.

Mitigation measures

During pre-construction and construction phase of the project, construction related activities shall be preferably restricted within project RoW.

During operation phase of the project, the service roads, footpaths, shoulders, junctions/ intersections and on either side of high embankments shall not be allowed to be encroached once again with residential and commercial squatter settlements.

4.2 TERRAIN & GEOLOGY

Insignificant adverse impact is anticipated on the geological environment of the project corridor during construction phase of the project and no impact is anticipated during operation phase of the project.

Significant adverse impact on geological resources is anticipated to occur at quarry sites and borrow areas identified for the project. The DPR consultant has

identified three quarry sites viz., Dahisar, Vikhroli and Turbhe based on a detailed study report on quarry sites located within MMR prepared by Kirloskar Consultants. The three sites identified are licensed by the competent authorities for operation. In all probability, Dahisar quarry site will be selected during implementation of the project, as the site is said to contain adequate amount of quarry and borrow material (about 74, 93, 800 cum). Dahisar is located along Western express highway and 15 kms north of project road. The quarry site's proximity to Western express highway will have an advantage in transporting quarry material to project site. Since as per the license conditions, the quarry sites will have an approved quarry site management and closure plan, the environmental issues pertaining to quarry site will be addressed and impacts, if any, will be mitigated.

The physiographic feature of the project corridor will be altered at select few locations viz., at Kms 0+250 to 0+400; Kms 0+700 to 0+800; Kms 0+850 to 0+950; Kms 3+450 to 3+600; Kms 3+850 to 4+650; and Kms 2+100 to 3+200. At these locations the existing steep gradient (of about 5 to 6.5%) will be flattened to standard MRTH/ IRC specifications for vertical alignment of highways. The impact of alterations on the drainage pattern is discussed in the following section.

4.2.1 *Impact on Drainage Pattern*

Roadside drains have been proposed on either side of JVLR as well as regraded SEEPZ road. The new roadside drains will be connected to the existing storm drainage system/ drains in the area at appropriate locations.

DPR consultants have carried out detailed storm water drainage analysis to design road surface drainage, cross-sectional drainage, and to check hydraulic adequacy of existing bridges. The design of storm water drainage system has been carried out based on the guidelines given by IRC SP - 42. The important parameters in the design of storm drainage system are the design rainfall intensity and estimation of runoff. The project area is located within the MMR. For MMR, MCGM has carried out a detailed study on storm water drainage system under the World Bank assistance. This study report - BRIMSTOWAD - has been referred to arrive at the design co-efficients and rainfall intensity.

The values considered during storm drainage system design for JVLR project is reproduced below:

Design rainfall intensity	: 50mm per hour
Co-efficient of runoff	: 1
Roughness co-efficient	: 0.017 for masonry open drains and 0.013 for pipe drains

Concrete rectangular and trapezoidal drains have been proposed along the road for the road surface drainage system.

Along Section 1 of JVLR

As per the DPR proposals, near the SEEPZ road junction, major vertical alignment alterations will be carried out during construction phase. Besides, along the following locations vertical alignment has been proposed as per IRC specifications:

- Kms 3+450 to 3+600;
- Kms 3+850 to 4+650; and
- Kms 2+100 to 3+200.

A review of the vertical alignment of the proposed JVLR reveals that the project road traverses through many high and low points. The relative levels of the high and low points on proposed JVLR vertical alignment is presented below.

Designed Vertical profile along Section 1 of JVLR

Location chainage, Kms	Relative levels, mts	Nearest drainage system
0+000	16	WEH drains
0+350	30	WEH drains and Majas nallah
0+550	24	Majas nallah
0+750	28	Majas nallah
Majas Nallah	~28	-
0+950	24	Majas nallah
1+750	34	Majas nallah
2+050	44	Majas nallah
2+550	56	Majas nallah
3+350	31	Mithi river
3+650	24	Mithi river
Mithi river	~24	-
4+100	29	Mithi river
4+500	28	Pipeline bridge #2
4+650	27	Saki vihar road drains

The vertical profile indicates that after construction, the finished road level will be well above the level of drainage systems available in the region. The level difference available between the highest point on the proposed road and nearest drainage system varies between 5 m to 28m. No stretch of the proposed JVLR will be below the level of drainage system. In light of this, no water stagnation problem is anticipated during operation phase of the project.

There is one critical stretch between Kms 0+350 and Kms 0+750. Designed vertical profile indicates that at Kms 0+550 the road level will slope down by 4 to 6m thus creating minor depression along the stretch. Though drains have been provided along both sides of the road, the depth of the drain will be cause of concern, as this stretch is located in densely populated area. It is recommended that this stretch of drains be covered.

Along Section 3 of JVLR

A review of the vertical alignment of the proposed section 3 of JVLR reveals that the project road gently slopes down towards Kannamwar nagar nallah The relative levels of the high and low points on proposed JVLR vertical alignment is presented below.

Designed Vertical profile along Section 3 of JVLR

Location chainage, Kms	*Relative levels, mts*	*Nearest drainage system*
9+200	21	Kannamwar nallah via LBS marg drains
9+360	17	Kannamwar nallah
9+580	11.5	Kannamwar nallah
10+160	4	Kannamwar nallah
Kannamwar nallah	~4	-
10+280	5.2	Kannamwar nallah

The vertical profile designed for section 3 of JVLR is constantly sloping down to Kannamwar nallah Hence drainage along project stretch will not be a problem

During operation stage, the altered physiography may lead to soil erosion and may take long time for the drainage pattern to stabilise itself. Hence minor, adverse impact on the drainage pattern is anticipated due to alterations in the physiography.

Mitigation measures

During construction phase, DPR has recommended that the opening up of new borrow pits shall be in accordance with the IRC 10-1961 specifications. Top soil (upto 150 mm) to be preserved and reused as the resurfacing material for the berms, slopes and central verge of the road where plantation / grasses will be developed

Significant impact on geological resources is anticipated to occur at quarry sites and borrow areas PIA shall ask the contractors to ensure that sand, aggregates and other quarry material be sourced from licensed quarries

The physiographic feature of the project corridor will be altered at select few locations where existing steep gradient of about 5 to 6.5% will be flattened to standard MRTH/ IRC specifications for vertical alignment of highways. At these select few locations, cut section and embankment portion shall be stabilised to avoid soil erosion and rutting

Impact on drainage system

Storm water drains have been proposed on either side of JVLR as well as on regraded SEEPZ road. The new roadside drains will be connected to the existing storm drainage system/ drains in the area at appropriate locations as per DPR proposal. Contractor shall ensure that after construction is over or prior to

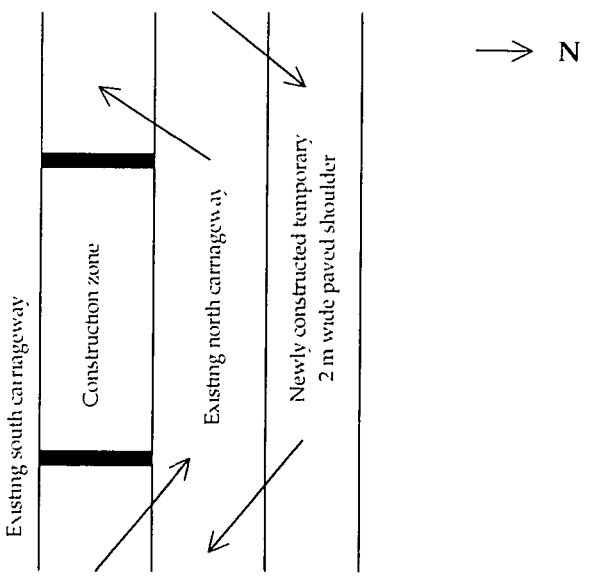
monsoon season, the new drains and old drains existing along JVLR are maintained clean of construction debris

4.3 *TRAFFIC AND TRANSPORT*

During project initiation phase, significant adverse impact on traffic and transport scenario is anticipated to occur for short-term duration. The impact would be felt adversely especially on the western section of JVLR where more area has to be cleared for the project. As per the construction program, this activity will be carried out in about 4 months time. To mitigate this adverse impact, site clearance activities must be carried out swiftly and in well-planned manner

During construction phase, significant adverse impact for temporary duration is anticipated. As per the construction program, the construction of entire JVLR corridor might take about 24 months time to complete. The local traffic management plan presented in *Section 2.5 1* envisages three stages of construction along various stretches of JVLR. The road construction, bridge structures and retaining walls will be constructed in a mutually exclusive manner. That is they will be constructed independently at different stretches of JVLR. The local traffic management plan outlined by DPR is illustrated in ***Figure 4.1.***

Figure 4.1 *Local Traffic management Plan during Phase I of JVLR project*



As per the plan, for a length of about 3.95 kms the available carriageway width available for traffic movement during construction will be about 5.5m The existing carriageway width available for traffic is about 9.0 m including the unpaved shoulders. Thus there will be constricted space available for traffic movement Though the whole length of 3.95 kms won't be taken up for implementation at a time, adverse impact is anticipated during construction

stage This calls for adequate temporary mitigation measures during construction stage of the project.

During operation phase, the service roads proposed in phases will smoothen out the traffic movement reducing the conflict between local traffic movement and traffic passing through JVLR. This would also increase pedestrian safety The footpaths proposed in the JVLR project should be maintained free of hawkers and encroachers.

4.3.1 *Accident Hazards and safety*

During construction phase, various construction activities will cause hindrance to the flow of existing traffic increasing the possibility for occurrence of accident hazards. Minor adverse impact is anticipated due to this reason. The local traffic management plan discussed in *section 4 3* needs to take into account this issue of safety to pedestrians and local inhabitants.

During operation phase of the project, the vehicle cruising speed along JVLR will considerably increase. Increased vehicular speed will cause difficulties for pedestrians in crossing the 6-lane wide road Increased vehicle speed and volume will also increase the probability of accident hazards causing adverse impact. The adverse impact will be felt especially near inhabited areas of Section I and II of JVLR. The DPR has proposed pedestrian (zebra) crossings at the following locations:

- At Kms 0+000 near WEH junction
- Kms 0+371 near Pratap nagar inhabited area
- Kms 0+700 near inhabited area of western section
- Kms 0+984 near inhabited area of western section
- Kms 1+310 near inhabited area of western section
- Kms 1+747 near inhabited area of western section
- Kms 2+550 near proposed Mahakali cave road bridge
- Kms 3+550 near SEEPZ area
- Near Saki vihar road junction
- Near Adi Shankaracharya marg junction
- Near LBS marg junction

These crossings should mitigate some of the adverse impacts anticipated on pedestrians' safety.

The entire carriageway is proposed with central median, which will avoid head-on collision of vehicles considerably. This will be a significant positive impact of implementing the project. It is to be noted here that DPR on JVLR emphasise on providing traffic management and control systems as per IRC 35 - 1997 and traffic signs as per IRC 67 - 1997 and Motor Vehicle Act. The road delineators have been proposed as per IRC 79-1981. These proposals will help mitigate some of the adverse impacts discussed above.

Mitigation measures

During site clearance activity, the building demolition and debris removal must be carried out swiftly and in well-planned manner. Possibly debris removal can be carried out during non-peak hours and with deployment of more vehicles for the purpose

During pre-construction and construction phase of the project, adequate traffic management scheme has been planned in the DPR in integration with construction program envisaged, which shall be adhered PMC shall periodically review the plan with respect to site conditions

The contractor shall take all necessary measures for the safety of traffic during demolition and site clearing activities. He shall provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the engineer for the information and protection of traffic

Special consideration shall be given in the local traffic management to the safety of pedestrians The temporary traffic arrangement within RoW, recommended in the DPR should be kept free of encroachments/ commercial activities.

As per the traffic management plan, for a length of about 3.95 kms the available carriageway width will be about 5.5m. This might aggravate the congestion and fugitive dust emission problems besides vehicular emissions and noise. It would be advisable to discourage or regulate traffic using JVLR during construction phase. Some of the measures, which PIA/ PMC can think of implementing during construction phase, include:

- HCV's, LCV's and 4-wheelers can be banned entry to the active-construction section during daylight hours and can be advised to take secondary road networks available in the area;
- Placing adequate number of notice boards at crucial points viz EEH junction, LBS junction, Saki vihar road junction, SEEPZ road junction, and WEH junction The notice boards shall inform the road users of construction work in progress and advise them to take alternative routes, if possible, to avoid congestion and delay.

This approach would reduce the traffic volume on JVLR, which would help to manage the traffic across construction section. This is feasible at site, as there are 5 entry/ exit points to JVLR viz , EEH junction, LBS marg junction, Saki vihar road junction, SEEPZ road junction, and WEH junction.

PMC shall periodically inspect the temporary paved shoulders planned between Kms 0+000 to 2+200 and Kms 2+900 to 4+650 for potholes and depressed patches Temporary repairing shall be carried out, if needed.

During operation phase of the project, traffic control measures including speed limits to be enforced strictly. Traffic volume and speed on JVLR shall be

monitored and the benefits must be recorded to evaluate the effectiveness of the project

Accident Hazards and Safety

During construction phase, the following mitigation measures are recommended for implementation

- Contractor shall ensure that the transport vehicles used to ferry materials and dispose debris does not create hazardous conditions for general traffic using the roadway
- The construction site should be barricaded at all time in a day with adequate marking, flags, reflectors etc., for the safety of general traffic movement and pedestrians.

During operation phase, the entire JVLR corridor shall be monitored for any accidents Project road management agency shall maintain a database based on data collected from traffic police They shall analyse the database and rectify if any physical correction/ alteration in the geometry of the road is needed.
As per DPR, the following measures are being planned for implementation along JVLR

- Emergency communication system
- Mobile communication system
- Variable message sign system
- Meteorological data system
- Lighting system.

Traffic management unit of MCGM shall keep these systems in effective operational condition. The effectiveness of these systems shall also be documented periodically to learn from the experience and apply to other road networks in MMR in future.

4.4 WATER ENVIRONMENT

4.4.1 *Water quality*

As discussed in *Section 3.6*, there are quite a few water bodies located along the project corridor. The baseline water quality levels in these water bodies indicate that all monitored parameters are well within the prescribed limits for Coastal Water criteria. However all of the water bodies are used for sewage and other liquid waste dumping and transport.

During construction phase, water quality of Powai lake might get deteriorated due to increase in turbidity and suspended solids to some extent expected to occur due to loose and disturbed soil layer erosion and rutting. The impact will be insignificant, however adequate mitigation measures are required to be taken during construction phase, especially during monsoon months. It is notable that the Construction program envisaged for implementing JVLR project has taken into consideration the heavy monsoon season and no activity has been proposed during these monsoon months. During operation phase of the project, minor to

insignificant adverse impact is anticipated on the water quality of the surface water bodies located along JVLR

4.4.2 *Hydrology*

The existing bridge and cross-drainage structures along JVLR will also be widened to eight-lane divided carriageway configuration The DPR on JVLR has taken adequate care to ensure the hydraulic adequacy of the widened structures. Adequate culverts, storm water drainage and road surface drainage channels have been provided in the design (more details and discussion has been presented in *section 4.2.1*). Hence possibility of water logging and increase in flood levels are not anticipated both during construction and operation phases of the project

Mitigation measures

During construction phase of the project, earthwork carried out to improve the JVLR and widen it may lead to erosion This might occur especially during monsoon season. Hence the siltation of soil into water bodies shall be prevented as far as possible by adapting soil erosion control measures as per MRTH guidelines. Construction work close to streams or water bodies shall be avoided during monsoon. Other useful mitigation measures to avoid siltation will include·

- Excavated soil should be disposed off properly so that it should not block the flow of water
- In areas susceptible to soil erosion, earthwork should be carried out before rainy season & temporary or permanent erosion protection work as may be feasible shall be provided
- Drainage of water from road surface & lands along the alignment shall be planned to avoid flooding & high velocity flows be properly connected to natural streams.
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into surface water bodies or form mud puddles in the area

Longitudinal drains of sufficient capacity has been provided in the design on both sides of the road to accommodate increased run-off. However, construction material containing fine particles shall be stored in an enclosure such that sediment-laden water does not drain into nearby storm water drains and underground sewage pipes

During operation phase of the project the drains shall be maintained and cleaned periodically

4.5 SOIL

Major impact on land environment due to the implementation of JVLR project will be because of the quantum of earthwork involved in the construction phase The sub grade soil except in Section III of JVLR is residual soil overlying

weathered basalt at shallow depth. In Section III of JVLR, the soil is silty clay of marine origin overlying weathered basalt.

The DPR on JVLR project has estimated the quantity of earthwork to be carried out. The summary details of the estimate are presented below

- Quantity of cutting involved (in cubic metres - cum)
  - Cutting in Hard Murum = 85,791 cum
  - Soft rock and hard rock = 75,994 cum
  - Total qty, of cut material = 1,61,785 cum
- Quantity of cut material proposed for reuse = 1,21,194 cum
- Remaining quantity of cut material for disposal = 40,591 cum
- Amount of borrow material required to be brought from borrow pits = 1,81,355 cum
- Total amount of material to be transported in and out of project corridor = 2,21,946 cum

The project will involve cutting and replacing about 86,000 cum of hard murum with 181,000 cum of borrow material to be brought from borrow pits. This earthwork strengthening activity will have significant adverse impact along the project corridor, as it is located on a slightly rolling terrain. This calls for adequate mitigation measures during construction phase of the project.

Nearly 75% of the cut material has been proposed for reuse in the project itself. This is an appreciable aspect of the project proposal. The remaining 25% of cut material will be disposed in an area earmarked along and within the project road RoW. The DPR consultant has identified the Aarey colony area located east of SEEPZ road junction for debris disposal The Aarey colony disposal site is presently a low-lying and barren land. The available width of RoW at this site is 60m and ownership of the land rests with the State government. Nearest surface body located at about 300m from the disposal site is Mithi river. The Mithi river is seasonal and carries sewage for most of the time in a year. However, good disposal practice should be adopted at this site to avoid any adverse impact on soil erosion and aesthetics related issues.

During operation phase of the project, the reorganised embankment slopes and carriageway shoulders will take some time to stabilise. Adequate design checks have been carried out in the DPR for ensuring the slope stability of the embankment and cut sections. Hence minor adverse impact due to soil erosion is anticipated initially and after some years into operation phase, the impact may become insignificant.

Mitigation measures

The soil erosion and land degradation normally occurs during construction phase of the project Hence, during construction phase, the road embankment slopes shall be stabilised. The work shall consist of measures as per design, or as directed by the engineer to control soil erosion, sedimentation and water pollution, through use of berms, dikes, sediment basin, mulches, grasses, slope

drains and other devices. The erosional aspect in soil is characterized by the shrink / swell character of soil mass This has been noticed along Section III of JVLR, where ground improvement is suggested to protect embankment erosion.

At location where embankment height is upto 3 m vegetative turfing shall be provided to stablize side slopes Embankment of height more than 3 m are to be protected with retaining wall and/or by dry stone pitching or with turfing
The species generally recommended for turfing in soil slopes are:
Cynodan dactrylon (Doob grass), *Cynodon plectostycum, Chlorisgyma, Saccharum Spantaneum, sachharum munja, Ipomea gornea, Lantana* species etc.

Debris generated due to dismantling of existing pavement/structures shall be suitably reused in proposed construction. Un-utilisable debris shall be suitably disposed either as fill material or at pre-designated dump locations, approved by engineer Care should be taken that the material does not block natural drainage or contaminate water bodies.

The total quantity of soil (debris) to be removed is 40,540 cum. This excess soil will be dumped in low -lying areas identified by PWD and within ROW near Aarey Colony where the existing ROW is 60 m. Good disposal practice should be adopted at this site to avoid any adverse impact on soil erosion and aesthetics related issues Debris disposal site shall be monitored for soil and ground water quality as per the monitoring plan recommended in the EMP.

Oil and fuel spills from construction equipment shall be minimised by good O&M practice. Soils contaminated by such spills shall be disposed as per MoEF requirements

The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stock piles. The top soil from the stock pile shall be used to cover disturbed areas and cut slopes and also for re-development of borrow areas, landscaping and road side plantation

During operation phase, road embankment & cut section stability should be checked for erosion and rutting. Any sign of instability should warrant adequate response immediately and well before succeeding monsoon season

4.6 *AMBIENT AIR QUALITY*

Impact on AAQ during construction stage of both Phase I and II of JVLR project is anticipated. The adverse impact will be primarily due to transportation of construction debris, road construction activities, loading and unloading of construction materials, and plying of construction vehicles along unpaved shoulders

During Operation phase of the project, the AAQ might deteriorate slightly at all sections of JVLR. The deterioration in AAQ will be due to constant and considerable increase in the traffic along JVLR.

In order to estimate the contribution of JVLR to the pollutant levels along its alignment an AAQ modelling analysis was carried out during the MLEA study of the project in March, 1998 For predicting the JVLR contribution to ambient CO and NO_x levels, CALINE 3 - an air quality model for highways has been used and for predicting PM_{10} and Pb levels, a simple roll-back model was used.

Due to the change in baseline scenario since March 1998, the modelling analysis was redone following the same approach and methodology as that was adopted in the MLEA study More details on the approach and methodology adopted for carrying out modelling analysis and the results of the analysis has been presented in ***Annex E***.

CO levels

The trend in the predicted incremental concentrations of CO for No Build scenario (year 2002) when compared to the Build scenario (year 2004), the concentrations slightly increases The low increase in the concentrations is due to improved mixing zone of the widened JVLR vis-à-vis improved emissions from new vehicles despite increase in traffic during the two scenarios. Between the Build scenarios for the years 2004 and 2011, the CO concentrations are found to be slightly improved during year 2011 due to the fact of improved emission factors for all vehicles complying to the year 2000 standard and there will be no vehicle of 1996 emission factors.

The average concentration of CO monitored along the JVLR found varying from 0.5 to 4.36 ppm (i.e 0 57 to 5 mgm-3). The high concentrations violating the AAQ norm for CO (of 3 18 ppm i.e 4 mg/m^3) were found at Jogeshwari (western section) and SEEPZ area. The land use in these areas is of mixed type i.e residential and industrial dominated with slum dwellers. However, at L&T and LBS Marg despite heavy traffic movement, the CO in AAQ found to vary from 0.5 to 1 66 ppm (i.e 0.57 to 1.9 mgm-3). This suggests that the high CO level in AAQ in the Western Section of JVLR be attributed significantly from other sources.

It is expected that with the project road widening, the CO levels are expected to lower down. The project, therefore, will have moderate impact on ambient air quality in terms of CO.

NO_x levels

The trend in the predicted incremental concentrations of NOx for No Build scenario (year 2002) when compared to the Build scenario (year 2004), the concentrations slightly increases. The low increase in the concentrations is due to improved mixing zone of the widened JVLR vis-à-vis improved emissions from new vehicles despite increase in traffic during the two scenarios. Between the Build scenarios for the years 2004 and 2011, the NOx concentrations are found to be slightly improved during year 2011 due to the fact of improved emission factors for all vehicles complying to the year 2000 standard and there will be no vehicle of 1996 emission factors

The average concentration of NOx monitored along the JVLR during the years 2001 and 2002 found varying from 29 to 55.8 µgm-3. The 24 hourly Indian standard for NOx for residential areas is 80 µgm-3 With the consideration of incremental values as given in the above table, the NOx levels are expected to remain below the standards only beyond 20 m from the edge of the road. The project, therefore, will have moderate impact on ambient air quality in terms of NOx.

SPM and PM10 levels

The modelling analysis results show that the predicted SPM levels for the years 2004 and 2011 (corresponding to the same meteorological conditions and monitoring locations) would range from 276.8 to 560.6 µg/m^3 and 427.1 to 864.4 µg/m^3 respectively. The corresponding PM_{10} levels for the years 2004 and 2011 would range from 130.5 to 362 6 µg/m^3 and 201 4 to 558.3 µg/m^3 respectively. All the monitored and projected 24 hourly average values violate ambient air quality standards for SPM and PM_{10} for residential areas are 200 µg/m3 and 100 µg/m3 respectively posing significant impact on air quality.

Mitigation measures

During project initiation and construction period, the adverse impacts on ambient air quality are anticipated to occur mainly due to site clearance activities, construction material movement, and during various road construction activities

The mitigation measures recommended during construction phase are:

- All vehicles delivering material to the site shall be covered to avoid material spillage.
- Construction site to be watered periodically to minimise fugitive dust.
- All earthwork and construction material should be protected in such a manner so as to minimise generation of dust.
- The unpaved roads, if used by the contractor, shall be sprinkled with water at least once in a day to control the fugitive dust emissions.
- It is understood from the implementing authorities, that the contractor will utilise the existing Concrete, Asphalt and Hot Mix Plants. Contractor shall ensure that existing plants are licensed and authorised for operation by concerned authorities and shall intimate the engineer-in-charge prior to procuring materials from them.
- As soon as construction is over the surplus earth should be utilised to fill up low-lying areas. In no case, loose earth should be allowed to pile up along JVLR alignment.
- All possible and practical measures to control dust emission during drilling operations shall be employed. The engineer-in-charge may direct to take adequate control measures depending on site conditions.
- Idling of delivery trucks or other equipment should not be permitted during periods of unloading or when they are not in active use. This practice must be ensured especially near sensitive receptors like schools, hospitals, and places of worship.

- Exhaust and noise emissions of construction equipment's shall adhere to emission norms as laid out by MoEF/ CPCB
- Periodic inspection at construction site shall be carried out to ensure removal of construction debris to the landfill sites

During the initial years of the project into operation, the air quality of the study area will improve due to increased traffic speed all along the project road. Further technical improvement in form of superior engine design in order to meet the stringent Government regulations will also reduce emissions in the years to come. As a mitigation plan, the competent authority shall enforce vehicular emission norms of the day.

4.7 *AMBIENT NOISE LEVEL*

During Construction phase of the project, the operation of construction machinery viz , earthmoving machinery's, loaders, backhoes, concrete mixer etc , and construction vehicles employed for transporting various construction material will lead to increase in ambient noise levels.

The noise level generated from a source will decrease with distance from source as per the following Inverse Square law.

$$SPL_2 = SPL_1 - 20 \log_{10} (r_2/r_1)$$

Where, SPL_1, and SPL_2 are Sound pressure levels [dB(A)] at distance r_1 and r_2 metres respectively

Considering the stationary construction equipment as a point source generating 90 dB(A) at a reference distance of 2m, computed distance required to meet the permissible limits during day time for various land use categories is presented in the *Table 4.2*

Table 4.2 *Minimum distance required for operating stationary equipments*

Land use category	Permissible limits in day time, dB(A)	Minimum distance required, m
Silence zone	50	200
Residential	55	113
Commercial	65	36
Industrial	75	11

The minimum distances estimated in the above table, needs to be maintained from the corresponding nearest land use category.

During Operation phase of the project, the ANL might increase at all sections of JVLR. The increase in ANL will be due to constant and considerable increase in the traffic along JVLR In order to estimate the JVLR traffic induced noise levels an ANL modelling analysis was carried out during the MLEA study of the

project in March, 1998. The modelling analysis was carried out using Federal Highway Administration (FHWA) model.

Due to the change in baseline scenario since March 1998, the modelling analysis was redone following the same approach and methodology as that was adopted in the MLEA study More details on the approach and methodology adopted for carrying out modelling analysis and the results of the analysis has been presented in *Annex F*

The $L_{eq\ day}$ and $L_{eq\ night}$ noise predictions were carried out for various receptor distances viz , at 10, 20, 40, 60, 80, 100 and 200 m distance from the edge of the road. The day time $L_{eq\ day}$ covers 0600 to 2200 hours while night time $L_{eq\ night}$ covers 2200 to 0600 hours corresponding to the prescribed standard for noise levels for different land uses The results obtained out of the FHWA modelling were projected as *traffic induced noise levels.*

Background noise levels of 70 dB(A) for day time and 55 dB(A) for night time were further added to the results obtained through modelling so as to represent these as *resultant noise levels* for the different locations along the JVLR

The modelling exercise indicate that the day time resultant noise level likely to occur in the range of 70 2 to 71 6 dB(A) at 200 m from the edge of the JVLR alignment while the corresponding night time resultant noise level at 200 m from the edge of the JVLR alignment would likely to occur in the range of 56.5 to 61 1 dB(A) The modelling results clearly reveal that day and night time noise levels are exceeding the prescribed standards.

The predicted noise levels indicate that sensitive receptors located along the middle section of JVLR on its northern edge will bear the brunt of increase in noise levels.

Mitigation measures

The prime sources of noise levels during the construction phase are the construction machinery and the vehicular noise due to material movement at the site. Though the effect of noise would be insignificant during daytime, the residential areas located in the near vicinity of the construction site may experience increased ambient noise levels during nighttime.

The mitigation measures recommended during construction phase are.

- All construction equipment's shall be fitted with exhaust silencers. Damaged silencers to be promptly replaced by contractor
- DG sets, if used, shall adhere to noise standards of MoEF
- During blasting of hill section near Kamal Amrohi studios, adequate noise control measures shall be prepared in advance prior to the blasting work starts The noise levels shall adhere to local laws. Restricted blasting work hours and intermittent blasting could be few mitigation measures that can be adopted.

- Construction activity induced noise levels shall be mitigated to the extent possible near residential area and sensitive receptors such as schools, religious places and hospitals. The contractor can employ mitigation measures such as restricted and/or intermittent activity or as directed by engineer-in-charge
- Operation hours for noise generating equipments such as pile driving, concrete and drilling etc. shall be pre-approved by PIA. The PIA depending on site-conditions may regulate and/ or restrict operation hours.
- Workers exposed to loud noise (As per Factory Act requirements) shall wear earplugs/earmuffs

During operation stage, there would be an increase in the ambient noise levels along the project road due to increased traffic. The mitigation measures recommended during operation phase include:

- Noise will become a major problem if smooth flow in traffic is stopped due to congestion or bottleneck situation in the road. The traffic management unit of MCGM shall identify such locations causing hindrance to traffic flow and shall take adequate rectification measures.
- Near sensitive receptors "No Honking" zones shall be announced by placing adequate number of sign boards along the road. Road section along IIT campus, Cenral school, and all residential areas shall be declared as "No honking zones"

4.8 *ECOLOGY*

The widening of existing JVLR will require felling of about 519 trees during Phase I of JVLR project. The predominant species to be felled include *Shirish, Gulmohar, Taad, Peepal, Karanj,* and *Mango*. All these trees are indigenous species and do not fall under endangered variety. Thus during construction phase of the project, significant adverse impact is anticipated on the ecological environment of the project corridor.

The compensatory plantation proposed in the DPR will mitigate the adverse impact on ecology to large extent in the long run. The DPR has proposed for compensatory plantation near Aarey colony area, where the available RoW is 60m wide and ownership of land rests with the State government. As has been discussed in *section 4.5*, the area has been identified for construction debris disposal as well. Compensatory plantation on a closed landfill site will be an ideal solution for ecological restoration and landfill site stabilisation.

Nearly 200 m long stretch of JVLR traverses through Aarey colony area. About 30m wide RoW will be available for compensatory plantation. Thus approximately 0.6 ha of land area will be available for compensatory plantation. Planting tress at 5m spacing, nearly 240 trees can be planted in the area available within the RoW. This is far less than the number of tress felled. Hence besides Aarey colony area, other government-owned vacant area shall be identified for afforestation purpose. At least the same amount of land (i.e. 0.6 ha) might be required to equal the number of trees felled and the number of tress planted as

compensatory measure. The land area behind BSES training institute and on either side of Mithi river would be an ideal location for carrying out compensatory plantation besides the DPR-identified Aarey colony area However, the Tree authority shall be consulted for identifying compensatory plantation area.

Compensatory plantation along either side of improved and widened JVLR is not possible for want of space. The available RoW width of 30m will be occupied largely by 27.2m wide JVLR. The remaining width will also be used for service road construction proposed in stages

DPR has estimated and provided an amount of Rupees 4.7 millions for compensatory plantation and landscaping throughout Phase I stretches of JVLR. Thus with the compensatory plantation proposed, the short-term adverse impact on ecology will be largely mitigated in the long run and improve the aesthetical value of the area as well.

As for terrestrial fauna, the project does not pass through any habitat of terrestrial fauna. Hence the issue of impact on terrestrial fauna does not arise The proposed project does not envisage filling up of any existing water bodies Hence the issue of impact on aquatic fauna also does not arise.

During operation stage, the vehicular traffic on JVLR will not have major impact on the ecological environment.

Mitigation measures

During pre-construction phase, the widening of existing JVLR will require felling of about 519 trees essentially from the roadside plantations. Trees falling within the alignment which are to be removed before commencement of construction shall be identified and approved by PIA Prior permission from MCGM/ Tree authorities shall be obtained as laid out in the Tree act (the provisions of Tree act have been presented in *Section 1 3 1).*

During construction phase, compensatory plantation as provided in the DPR proposal shall be carried out in line with Tree authority regulations and guidelines. Plant species suitable for the area shall be planted. Typical species shall include a combination of indigenous, fast growing, big and small canopy trees such as *Acasia auriculiformis, Casuarina equisatefolia, Pongamia pinnata, Alstonia scholaris, Thespesia populnea, Terminalia catappa* etc. Trees with ornamental and shade values such as *Albizzia lebbeck, Delonix regia, Ficus religiousa, Sizygium cumminii* etc can also be included.

Besides Aarey colony area, other government-owned vacant area shall be identified for afforestation purpose. At least the same amount of land (i.e. 0.6 ha) might be required to equal the number of trees felled and the number of tress planted as compensatory measure. The land area behind BSES training institute and on either side of Mithi river would be an ideal location for carrying out compensatory plantation besides the DPR-identified Aarey colony area.

However, the Tree authority shall be consulted for identifying compensatory plantation area

DPR proposal includes undertaking landscaping of the roadside and medians, wherever feasible space is available. Along the medians flowering plants and shrubs that grow to a height of about 2m shall be preferred The plantation in the median will serve as a barrier against glaring headlight of traffic plying in the opposite direction. Over and above this will improve the aesthetics of the alignment.

During operation phase of the project, adequate care of the landscaping and compensatory plantation should be taken up so as to achieve tree authority's guideline survival rates

4.9 *NATURAL HABITATS*

Baseline assessment of the mangroves (discussed in *Section 3 11)* indicates that mangroves are found only on the southern side of JVLR RoW. The local community has destroyed much of the mangroves and the land use has been changed to grass lands. Baseline status also indicates that mangroves found along and within JVLR RoW is sparse and is being under destruction with the disposal of debris. Hence, the applicability of the World Bank OP 4 04 does not arise in this project. From the Indian legal framework perspective, the JVLR alignment in this region has been approved by the MoEF as a part of CZMP of Greater Mumbai under CRZ regulations.

On either side of existing 2-lane road, debris (mainly comprising of construction and soil waste) has been dumped along the eastern stretch of JVLR. Hence the project road development and widening will not impact the existing mangroves swamps found well away from the project road RoW. The widening may reclaim 0 2 ha of land on the southern side of RoW.

It is notable here that MMRDA has mooted a separate project to develop a marine mangrove park between Kanjur village and Mulund with an objective to rejuvenate and protect the existing mangroves in dilapidated form The proposed park, which will be developed over an area of 150 hectares of land initially, will be spread to all 1000 hectares of salt pan land available in the region[1]. This would go a long way in mitigating any adverse impact the JVLR project might have on the existing mangroves

Mitigation measures

During construction phase, all activities, construction vehicle movements and other miscellaneous activities must be restricted within project RoW Temporary disposal of demolition debris, felled trees or locating labour camps and

(2) [1] Source Newspaper report in the Times of India dated 3rd June 2002

stockyards beyond the project RoW must be avoided near the degraded mangrove patch observed near EEH.

During operation phase of the project, MCGM and MMRDA shall ensure that induced impacts of JVLR project does not affect the sparse mangrove swamps found in the area. The induced effect of JVLR project will be mainly proliferation of slums along the R&R site proposed near Kanjur marg railway station MCGM and MMRDA can also consider implementing a separate project for reclaiming and conserving the mangroves in the region

4.10 *PRESENCE OF SENSITIVE RECEPTORS*

During construction stage of Phase I of JVLR project, one kindergarten school located near Milind nagar along western section of JVLR will be removed. The RIP prepared by MMRDA for Phase I of JVLR has adequately addressed this issue. The R&R site identified near Majas village for the JVLR PAPs has been provided with 11 number of Balwadi (Kindergarden schools) facilities. Before removal of the school, the PAPs will be relocated to the R&R site readied with all facilities and amenities as provided in the RIP report Hence there would be no significant impact on this issue

During operation phase, the adverse impact on sensitive receptors will be due to induced impact. The induced impact due to traffic movement will be felt especially in Phase II stretches of JVLR. Along Phase II stretches, two sensitive receptors viz., IIT campus and Kendriya vidyalaya are located

The IIT campus is fairly wooded and its institutional buildings are located little far away from JVLR behind the wooded area. Due to this the induced impact will not be significantly adverse

As for Kendriya Vidyalaya located outside the RoW but close to the JVLR near LBS Marg junction the induced impact might be adverse. Near this school, the traffic on JVLR will move at two different grades during operation phase. The traffic moving at grade level of existing JVLR and other moving over flyover being constructed at LBS marg junction. The 2m high boundary wall of the school and the 1.15m high side barrier wall provided in the flyover structure may mitigate some of the noise emanated from vehicular traffic on JVLR. The plantation measures could mitigate some of the adverse impact further However, plantation has to be carried out inside school campus for want of space within JVLR project RoW

Mitigation measures

One kindergarten school has been reported to be located within the RoW along the western section of JVLR. The R&R site chosen for the PAP's will be provided with about 11 number of Balwadi's (kindergarten school) along with many other amenities proposed in the RIP. This is a sufficient R&R measure The R&R site amenities shall be made fully functional before relocating the PAP's

During Phase II of JVLR project, IIT and Central School located along RoW of JVLR may be impacted adversely during construction and operation phase. Impacts will be felt mainly on AAQ and ANL issues. Mitigation measures recommended under respective sections shall be adhered. Traffic congestion before IIT campus is frequent especially during peak hours. The DPR consultant shall prepare an exclusive traffic management scheme for the JVLR section before IIT campus

4.11 PLACES OF WORSHIP

Nine cultural properties comprising mainly of religious structures and private places of worship have been identified as affected along the western section of JVLR The eastern section has one such temple near the southern embankment of existing ROB.

MMRDA has prepared the RAP & CEMP report in compliance to Government of Maharashtra's R&R policy specifically outlined for MUTP. Since the project inception stages, MMRDA has carried out the following studies pertaining to R&R issues of the project

- Baseline socio-economic survey (BSES) of the project corridor, 1996
- Rehabilitation action plan (RAP) and Community environment management plan (CEMP), 1998
- Rehabilitation Implementation Plan (RIP) report, Draft, January, 2002

As part of these studies, MMRDA has carried out *"project-affected-community"* consultation and based on that, an action plan for R&R implementation has been outlined, which is presented in the following sections.

4.11.1 *Project-Affected-Community Consultation*

As per the RIP report, in view of the time gap between BSES (carried out in 1996) and the project implementation (tentatively scheduled for start in Sep'02), detailed information about the R&R scheme, its impact and each household entitlement was once again disseminated to the PAH's. Individual home visits and group meetings were employed for dissemination of information. During this consultation process, the issue of relocating nine cultural properties was also discussed with respective place/ structure owner.

Out of nine identified places of worship, only four of them have an affected plinth area of more than 100 sq ft size as can be inferred from *Table 3 17 in section 3.13 1* The other five places of worship were not significant ones and the issue of clearing them without relocating it anywhere was discussed during the community-level consultation process. The Slum Rehabilitation Society (SRS) - a Consultant appointed for overseeing the R&R implementation during Phase I of JVLR has asserted that clearing these five places of worship would not cause any socio-political repercussions as the PAH's and the left-over community living near these affected structures have been consulted and notified.

The results of community-level consultation process for the other *'big four"* – if they can be classified so is provided below.

Results of the community-level consultation on relocating places of worship

Name of the place/religious structure	Location chainage , kms	Results of consultation
1 Gajanan Maharaj temple (ID No 143 as per SRS)	0+300	The temple will be affected fully but the hall in front of it will not be affected Consultation was carried out with Mr Sudhakar Balapure, President of Shri Sudhakar Balapure Kaka Charitable Trust, A-4173, Mumbai During the consultation, he was informed that the temple could be shifted to a site at the rear of the existing site and the temple committee should accept responsibility for reconstruction of the temple The consultants have identified the rear of existing temple which is just away from RoW will be suitable for relocation In the new place identified for temple relocation, the RAP consultants have identified 2 households that will be affected due to shifting of temple The 2 PAH have been included under the JVLR project affected PAH's This would enable them to receive all RAP and CEMP entitlements that have been worked out as part of JVLR project Thus the issue of providing space has been sorted out As for as providing monetary support to the reconstruction, Consultants are in discussion with Project authorities to workout the modalities
2 Buddha Vihar Mandir (ID No 97 as per SRS)	0+380	The Buddha temple will be affected fully but the hall in front of it will not be affected Consultation was carried out with Mr N A Chavan, President of the temple Trust During the consultation, he was informed that the temple could be shifted to a site at the rear of the existing site and the temple committee should accept responsibility for reconstruction of the temple President of the trust agreed to undertake such responsibility provided the relocation site is identified and cost of reconstruction is sanctioned The consultants have identified the rear of existing temple which is just away from RoW will be suitable for relocation In the new place identified for temple relocation, the RAP consultants have identified 2 households that will be affected due to shifting of temple The 2 PAH have been included under the JVLR project affected PAH's This would enable them to receive all RAP and CEMP entitlements that have been worked out as part of JVLR project Thus the issue of providing space has been sorted out As for as providing monetary support to the reconstruction, Consultants are in discussion with Project authorities to workout the modalities
3 Ganpati Mandir	2+750	This temple was identified recently due to modification in the DPR proposal It is located on the proposed alignment of service roads near Kamal Amrohi studios Consultation was carried out with the Mr Datta Phalavare, President and Mr Munna During the consultation, he was informed that the temple could be shifted to a site at the rear of the existing site and the temple committee should accept responsibility for reconstruction of the temple The consultants have identified the rear of existing temple which is just away from RoW will be suitable for relocation In the new place identified for temple relocation, there is vacant space available Thus the issue of providing space has been sorted out As for as providing monetary support to the reconstruction, Consultants are in discussion with Project authorities to workout the modalities

Name of the place/religious structure	Location chainage kms	Results of consultation
4 Hanuman mandir (ID No 747)	2+800	The Hanuman temple will be affected fully Consultation was carried out with Mr Anant Narvankar, President of the trust along with Mr Mahesh Das and Mrs Draupadi Mahapurkar – Members of the trust During the consultation, they were informed that the temple could be shifted to a site at the rear of the existing site and the temple committee should accept responsibility for reconstruction of the temple President of the trust agreed to undertake such responsibility The consultants have identified the rear of existing temple which is just away from RoW will be suitable for relocation In the new place identified for temple relocation, there is vacant space available Thus the issue of providing space has been sorted out As far as providing monetary support to the reconstruction, Consultants are in discussion with Project authorities to workout the modalities

4.11.2 *Action Plan*

Based on the feedback obtained through Public consultation process, R&R Consultant has outlined an action plan. The action plan is presented below.

Sr. No	*Name of Site/Structure*	*Location*	*Methodology for deciding its fate & Year*	*Size of Structure (in Mtrs)*	*Extent of Structure affected*	*Proposed Treatment*	*Institutional Arrangement*		*Cost in Rs*	*Time Frame*
							Implementation	Supervision		
1	Buddha Vihar Mandir	ID No 97 Pratap Nagar - I	Consultation with the committees and the trustees on 3rd April 2002	27 05	Partially	Relocation to the rear side	By People	SRS	70,000	2 months after the shifting of the affected families
2	Gajanan Maharaj Mandir	ID No 143 Pratap Nagar - II	Consultation with the committees and the trustees on 3rd April 2002	11 7	Fully	Relocation to the rear side	By People	SRS	60,000	2 months after the shifting of the affected families
3	Hanuman Mandir	ID No 474 Sariput Nagar	Consultation with the committees and the trustees on 3rd April 2002	11 7	Fully	Relocation to the rear side	By People	SRS	50,000	2 months after the shifting of the affected families
4	Ganpati Mandir	Sariput nagar opposite side	Consultation with the committees and the trustees on 3rd April 2002	13 52	Fully	Relocation to the rear side	By People	SRS	60,000	2 months after the shifting of the affected families

4.11.3 *Cultural Property Issues in Phase II of JVLR*

During Phase II of JVLR project, some religious places which are located very close to the RoW, will experience the fallout of adverse impact on ambient noise levels, both during construction and operation stages of the project. Since the DPR proposals are not yet ready for the Phase II of JVLR, the places of worship that may have to be relocated could not be identified in the present study MMRDA is planning to follow the same approach that has been followed in all MUTP's including Phase I of JVLR, towards addressing the issue of relocation of places of worship. The adverse impact, if any, will be suitably addressed in the RAP and CEMP that will be prepared for the project.

As for other cultural properties viz., archeological (prehistoric), paleontological, historical, and unique natural values are not found along JVLR.

Mitigation measures

The nine cultural properties identified along Section I of JVLR shall be relocated/ cleared as per the community-level discussions and the action plan worked out with the local community/ owner of the structure. The community-level discussion reveals that all the cultural property owners are willing to relocate/ clear the area for the implementation of JVLR project. Hence, no adverse impact is anticipated on this issue. However, the R&R consultants shall constantly interact with the community till the temple is reconstructed at the agreed relocation-site. The Consultants shall also ensure that the affected households due to relocation of temples are adequately compensated as per the RAP entitlements worked out for the JVLR project.

No archaeological or historical sites exist within the project study corridor and hence no impact is anticipated on this issue. However, as a standard practice, any chance finds of fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest during pre-construction or construction stage, shall be the property of the Government and shall be dealt with as per provisions of relevant legislation. The PIA shall seek directions from Archaeological Survey of India (ASI) before instructing the contractor to recommence the work on site

4.12 *UTILITY DIVERSION*

During construction phase of the project, significant number of utility service equipments will be relocated. The list of utility services, which are to be relocated, has been presented on *Section 3.14*. A summary of the utility services to be relocated has been presented in the ***Table 4.3***

Table 4.3 Summary of utility services to be relocated during Phase I of JVLR

Utility service	Section I	Section III
Water supply line, metres	726	60
Telephone cables, metres	3,110	3,000
Underground electricity cables of BSES, metres	14,594	198
Underground electricity cables of MSEB, metres	3,214	2,804

As per the construction program, the utility services relocation will be done in two phases for Section I portion of JVLR. Both the phases will be carried out in about five month's time. Along Section III of JVLR, the utility service relocation will be carried out in single phase within 2.5 month's time. Significant adverse impact is anticipated while relocating water supply pipelines and underground electricity cables. The adverse impact will be significant on the western section of JVLR

Mitigation measures

In order to mitigate adverse impacts, all utilities, such as water supply lines, electrical installations, telephone lines etc. shall be shifted after prior approval of agencies Utility relocation shall be carried out in shortest possible time to reduce inconvenience to public.

4.13 OTHER CONSTRUCTION PHASE IMPACTS

4.13.1 *Impacts due to Siting of Labour Camps*

Construction camps include workers' residential areas, and the grounds where equipment is stored and serviced and where materials are stockpiled. Careless construction camp design and management can lead to serious environmental degradation including

- sewage and garbage pollution,
- depletion of fauna and flora through illegal harvesting (poaching);
- infrastructure overloading- health services,
- sewage treatment,
- schooling
- law enforcement; and
- spills from construction equipment operation and servicing.

The DPR has not identified or provided any location for siting construction camps. It would be contractor's responsibility to locate a site suitable for his work under the general conditions of contract and as per MRTH specifications for road and bridge works (MRTH specifications will form part of the contract). It would be contractor's responsibility to ensure that he complies local laws, if any, pertaining to construction camps siting and the area identified for siting construction camps are approved and authorised by competent authorities. The PIA/ PMC will approve the area selected/ identified by the contractor.

4.13.2 *Impacts due to Siting of Borrow and Quarry Material Areas*

Quarry and borrow areas identification will be the responsibility of the contractor as per his contractual conditions There are no borrow areas identified along project road corridor and hence the impact due to borrows areas opening does not arise

The PIA/ PMC will approve the area selected/ identified by the contractor before he actually procures materials from them. It would be contractor's responsibility to ensure that borrow and quarry areas that he has identified are approved and authorised to operate by competent authorities.

4.14 *IMPACT OF ONGOING OTHER DEVELOPMENT PROJECTS ALONG JVLR*

Two flyovers presently under construction stage and one flyover proposed near SEEPZ road junction along with JVLR widening proposal will have significant positive impact on the JVLR project. All the three flyover sites have been chosen at major junctions where considerable traffic flow has been observed The positive impact of these flyovers will be felt during operation phase of JVLR project

As per the traffic volume survey carried out in February 2002, a daily traffic volume of about 68,583 vehicles is plying on the middle section of JVLR. The eastern entry/ exit point to the middle section of JVLR is through LBS Marg junction. Since LBS marg is another major link in MMR, the traffic intersection at this junction is considerably congested throughout the day. Traffic signals have been installed at this junction

At the western entry/ exit point to middle section of JVLR, another flyover is presently under implementation The western entry is through Saki vihar road junction. At this junction there is a staggered intersection along Saki Vihar road This causes undue hardship to the traffic creating a bottleneck situation Hence construction of L&T flyover will have significant positive impact on the JVLR project

Near the SEEPZ road junction, one new flyover has been proposed. The SEEPZ area with an extension being planned has potential to grow exponentially Hence traffic at this junction will increase and hence a flyover at this junction would have significant positive impact on the JVLR project.

Mitigation measures

The construction programme/ schedule for the two flyovers (near L&T and LBS marg junction) presently under construction stage may overlap with the JVLR Phase I implementation schedule. In order to avoid any adverse impact on JVLR during the construction phase of flyover projects, Environmental management measures are being recommended and are presented in ***Annex H***.

These flyover projects are being implemented by MSRDC under separate contracts outside MUTP. The measures recommended in ***Annex H*** do not have any cost implications and comprises of good construction practices and housekeeping measures. As implementing agency, MSRDC - which is also the implementing agency for the JVLR project - shall ensure that the recommended measures are followed and adopted by the contractor.

5 ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) has been recommended in this Section. This EMP takes into account all the environmental issues and the corresponding mitigation measures proposed in *Section 4*. The EMP presented below includes:

- Specific actions to be taken vis-à-vis site-specific issues,
- Responsible agencies for its implementation & supervision,
- Time frame for implementing mitigative actions;
- Reference to contract documents and specifications;
- Project level environmental monitoring;
- Environmental status reporting frequency, and
- Institutional arrangement, Strengthening of their capability, and role.

5.1 ENVIRONMENTAL MANAGEMENT PLAN FOR PHASE I OF JVLR PROJECT

The EMP has been delineated for all the three stages viz., Pre-construction, Construction and Operation stages of the project and is presented in *Table 5.1 through Table 5.3.*

5.1.1 *Environmental Monitoring Plan*

In the Consolidated EA report on MUTP prepared by MMRDA, project level environmental monitoring plans have been developed for various MUTP sub-projects. The plan included recommended monitoring sites, parameters to be monitored, time and frequency of monitoring, and collection, analysis and reporting of monitoring data The objectives of the monitoring plan are:

- To record the impact of MUTP on urban environmental quality during the construction and operation phases.
- To evaluate the effectiveness of the mitigation measures during the construction and operation phases.
- To satisfy the legal and community obligations
- To respond to the unanticipated environmental issues at an early stage and to verify the accuracy of environmental impact prediction.

The monitoring plan recommended in the Consolidated EA report for the JVLR was reviewed and revised Hence, with some modifications the monitoring plan is presented in *Table 5.4.*

Table 5.1 Pre-Construction stage EMP for Phase I of JVLR Project

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Resettlement and rehabilitation	The entitlement framework to the PAPs shall be in accordance to the RAP of the project. It shall be ensured that all R&R activities be reasonably completed as per RAP, before the construction activity starts in the relevant section.	RAP Requirement	Before Start of construction of relevant section.	MMRDA	MMRDA
Resettlement of cultural property	All cultural properties that have been identified in ***Table 3.17*** as affected shall be resettled as per the action plan laid out in Rehabilitation Implementation Plan (RIP) and Consolidated EA	RIP requirement	Before Start of construction of relevant section	MMRDA	MMRDA
Ecological impacts due to tree cutting	Trees falling within the alignment which are to be removed before commencement of construction shall be identified and approved by PIA. Prior permission from MCGM/ Tree authorities shall be obtained.	Preservation of Tree Act of Maharahtra, 1975	Before Start of construction of relevant section	Contractor	PIA/ MMRDA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Natural habitats near the eastern section of JVLR	All activities, construction vehicle movements and other miscellaneous activities must be restricted within project RoW near the mangrove habitats found between *Kms 9+750 to 10+300*. Temporary disposal of demolition debris, felled trees or locating labour camps and stockyards beyond the project RoW must be avoided near this section.	MRTH 201 2	Entire Pre-construction and construction phase	Contractor/ PMC	PIA/ MMRDA
Local traffic arrangement	Temporary traffic arrangement during construction within RoW has been planned in the DPR. This plan shall be periodically reviewed with respect to site conditions. During site clearance activity, the demolition debris shall be preferably removed during non-peak hours and with deployment of more vehicles for the purpose.	MRTH: 112	During site clearance and construction	Contractor/ PMC	PIA/ MMRDA
Traffic Control and Safety	The contractor shall take all necessary measures for the safety of traffic during demolition and site clearing activities. He shall provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the PMC for the information and protection of traffic.	MRTH 112.4 MRTH. 112	During pre-construction & construction	Contractor / PMC	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Safety of pedestrians	Special consideration shall be given in the local traffic management to the safety of pedestrians especially at sections between *Kms 0+000 to 1+500, Kms 2+500 to 3+000, Kms 4+500 to 5+000 and Kms 9+250 to 9+750.* The temporary traffic arrangement within RoW as recommended in the DPR should be kept free of encroachments/ commercial activities.	MRTH. 112.2	Before Construction and during construction	Contractor/PMC	PIA
Impact on land use outside RoW	Construction related activities shall be preferably restricted within project road RoW.	MRTH 201.2	During entire site clearance and construction phases	Contractor	PIA
Utility relocation	All utilities identified for relocation in the DPR (details provided in section *3.14.1* of this report) to be shifted after prior approval of agencies. Utility relocation shall be carried out in shortest possible time to reduce inconvenience to public.	MRTH 110	Before Start of construction of relevant section	Contractor/PMC	PIA

Note PIA - Project Implementing Authority, PMC - Project Management Consultant, MMRDA - Mumbai Metropolitan Region Development Authority, MRTH – Ministry of Road Transportation and Highways (formerly Ministry of Surface Transport, MOST Specifications for Road and Bridge Works, 3rd Revision, 1997), RAP - Rehabilitation Action Plan, RIP – Rehabilitation Implementation Plan, R&R - Resettlement & Rehabilitation, CEMP – Community Environmental Management Plan, CEA – Consolidated Environmental Assessment, MCGM – Municipal Corporation of Greater Mumbai, RoW – Right of way, PRoW – Proposed Right of Way

Table 5.2 Construction Stage EMP for Phase I of JVLR Project

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Plying vehicles on unpaved roads	The unpaved roads, if used by the contractor, shall be sprinkled with water at least once in a day to control the fugitive dust emissions. This practice shall be adopted especially near sections between *Kms 0+000 to 1+500, Kms 2+500 to 3+000, Kms 4+500 to 5+000 and Kms 9+250 to 9+750.*	MRTH:111.10	Construction phase	Contractor	PMC/PIA
Material spill	All vehicles delivering material to the site shall be covered to avoid material spillage.	MRTH:111.9 MRTH:111 11 MRTH:111.12	Entire construction phase	Contractor	PMC/PIA
Using existing hot mix/ Concrete/ asphalt plants	It is understood from the implementing authorities, that the contractor will utilise the existing Concrete, Asphalt and Hot Mix Plants. Contractor shall ensure that existing plants, which are sourced, are licensed and authorised for operation by concerned authorities and shall intimate the PMC/PIA prior to procuring materials from them PMC shall procure relevant documents from the plant owners to ensure that they are adhering to relevant emission norms as laid out by MoEF/ CPCB.	MRTH· 111.5	During entire construction phase	Contractor/PMC	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Watering to control dust at site	Construction site to be watered periodically to minimize fugitive dust generation.	MRTH. 111.8	During entire construction phase	Contractor/ PMC	PIA
Roads used for transport	Contractor shall ensure that the transport vehicles used to ferry materials and dispose debris does not create hazardous conditions for general traffic using the roadway especially the WEH and middle section of JVLR.	MRTH.111.9	During entire construction phase	Contractor/ PMC	PIA
Barricading site	The construction site should be barricaded at all time in a day with adequate marking, flags, reflectors etc., for the safety of general traffic movement and pedestrians.	MRTH 112	During construction phase	Contractor/PMC	PIA
Earthwork	All earthwork and construction material should be stored in such a manner to minimise generation of dust and spillage on roads.	MRTH 201.4	During entire construction phase	Contractor/ PMC	PIA
Idling of vehicles	Idling of delivery trucks or other equipment should not be permitted during periods of unloading or when they are not in active use. This practice must be ensured especially near sensitive receptors like places of worship.	MRTH 201.2	During construction phase	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Drilling operations	All possible and practical measures to control noise emission during drilling operations shall be employed. The PMC may direct to take adequate control measures depending on site conditions.	MRTH 111	During construction phase	Contractor/ PMC	PIA
Construction equipment emissions	Exhaust and noise emissions of construction equipment's shall adhere to emission norms as laid out by MoEF/ CPCB.	Legal requirement	During construction	Contractor	PMC/PIA
Noise from construction related plants & equipments	All construction equipment's shall be fitted with exhaust silencers. Damaged silencers to be promptly replaced by contractor.	MRTH: 111	During construction	Contractor	PMC/PIA
Noise impact due to operation of DG sets	DG sets, if used, shall adhere to noise standards of MoEF.	MRTH:111	During construction	Contractor/ PMC	PIA
Noise control measures	During blasting of hill section near Kamal Amrohi studios, adequate noise control measures shall be prepared in advance prior to the blasting work starts. The noise levels shall adhere to local laws. Restricted blasting-work hours and intermittent blasting could be few mitigation measures that can be adopted.	MRTH: 302 PC Sub Clause 45.1	Before Start of construction of relevant section	Contractor/ PMC	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Noise level near residential areas and sensitive receptors	Construction activity induced noise levels shall be mitigated between *Kms 0+000 to 1+500, Kms 2+500 to 3+000, Kms 4+500 to 5+000 and Kms 9+250 to 9+750.* The contractor can employ mitigation measures such as restricted and/or intermittent activity or as directed by PMC.	MRTH:111 PC Sub Clause 45 1	During construction of relevant sections	Contractor/PMC	PIA
Noise due to foundation works at flyover site/ bridges	Operation hours for noise generating equipments such as pile driving, concrete and drilling etc. shall be pre-approved by PIA. The PIA depending on site-conditions and as per prevailing local laws may regulate and/ or restrict operation hours.	PC Sub Clause 45.1	During construction	Contractor	PMC/PIA
Exposure to loud noise	Workers exposed to loud noise (As per Factory Act requirements) shall wear earplugs/earmuffs	MRTH: 111.6 MRTH 105.2	During construction	Contractor	PMC/PIA
Storage of construction material	Construction material containing fine particles shall be stored in an enclosure such that sediment-laden water does not drain into nearby storm water drains and underground sewage pipes This practice shall be ensured especially between *Kms 0+000 to 1+500, Kms 2+500 to 3+000, Kms 4+500 to 5+000 and Kms 9+250 to 9+750.* Where drains and sewerage system is in place now.	MRTH: 306	During construction	Contractor	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Blockage and change in drainage pattern	Near Majas Nallah (Kms 0+850), Mithi river (3+600), and Kannamwar Nallah (Kms 10+100) earth, stone or any other construction material shall be properly stored so as not to block the flow of water. If the channel/ drains get blocked due to negligence, contractor should ensure that they are cleaned especially during monsoon season. Once the work is completed in all respects, the contractor shall, as a mark of good gesture, clean up the drains along the project road to the extent possible.	MRTH: 306	During construction	Contractor	PMC/PIA
Construction of new roadside drains	Roadside drains have been proposed at all sections of JVLR in the DPR to improve the drainage along JVLR. The drains shall be cleared off all construction debris before handing over to PIA.	MRTH: 306 MRTH 309	During construction	Contractor	PMC/PIA
Soil erosion	On road embankments, slopes shall be stabilised. The work shall consist of measures as per design, or as directed by the PMC to control soil erosion, sedimentation and water pollution.	MRTH : 306	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Siltation of water bodies	Siltation of soil into water bodies viz. Majas Nallah (Kms 0+850), Mithi river (3+600), and Kannamwar Nallah (Kms 10+100) shall be prevented as far as possible by adapting soil erosion control measures as per MRTH guidelines/ or as per the directions of PMC.	MRTH guidelines 305 through 309	During construction	Contractor	PMC/PIA
Foundation excavation debris	Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into surface water bodies viz. Majas Nallah (Kms 0+850), Mithi river (Kms 3+600), and Kannamwar Nallah (Kms 10+100) or form mud puddles in the area.	Project requirement	During construction	Contractor	PMC/PIA
Work during monsoon near water bodies	Construction work at sections close to water bodies viz. Majas Nallah (Kms 0+850), Mithi river (3+600), and Kannamwar Nallah (Kms 10+100) shall be avoided during monsoon or completed before monsoon	Project requirement	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Areas susceptible to erosion	In areas susceptible to soil erosion, *especially at various steep gradient locations between Kms 2+000 to 4+900*, earthwork should be preferably carried out before rainy season or temporary/permanent erosion protection work as may be feasible shall be provided.	MRTH : 306	During construction	Contractor	PMC/PIA
Inspection of site	Daily inspection at construction site should be carried out to ensure removal of construction debris	MRTH 301 3	During construction phase	Contractor/ PMC	PIA
Earthwork debris disposal	As soon as construction is over the surplus earth should be utilised to fill up low-lying areas or the area identified in the DPR i.e near *Kms 3+250*. In no case, loose earth should be allowed to pile up along JVLR alignment.	MRTH 301.3	During construction phase	Contractor/ PMC	PIA
Debris disposal	Debris generated due to dismantling of existing pavement/structures shall be suitably reused in proposed construction. Un-utilisable debris shall be suitably disposed at the site identified in the DPR near *Kms 3+250* or at locations approved by PMC/PIA. Good disposal practices recommended by various agencies/ authorities shall be followed.	MRTH 301.3	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Soil contamination by construction wastes, fuel etc.	Oil and fuel spills from construction equipment shall be minimised by good O&M practice. Soils contaminated by such spills shall be disposed as per MoEF requirements.	Project requirement	During construction	Contractor/ PMC	PIA
Sourcing quarry materials	Sand, aggregates and other quarry material shall be sourced from licensed quarries. DPR has identified few quarries viz. Dahisar, Vikhroli and Turbhe in the region for sourcing the material.	MRTH 111.3	During construction	Contractor/PMC	PIA
Compensatory plantation	Compensatory plantation as provided in the DPR at Kms 3+250 (over debris disposal location) shall be done in line with Tree authority regulations and guidelines. The species recommended in *section 4 8* of this report shall be considered for plantation. As per the Tree Act, 1975 (described in *section 1.3 1* of this report) it is the duty of Tree Authority (TA) to transplant the trees which are required to be moved due to construction of new roads or widening of existing roads Hence PIA shall consult with TA to carryout compensatory plantation.	Preservation of Trees Act of Maharashtra, 1975	During construction	Tree Authority	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Aesthetics and Landscape	Adequate landscaping of the median, embankment slopes and other open space available within RoW shall be carried out as provided in the DPR and as per the directions of PMC/PIA. The area can be utilised for growing dwarf varieties of plants (e g. Alstonia scholaris,, Thuja etc.)	Project requirement	During tag end of construction phase or within 6 months after operation starts and before monsoon	Contractor/PMC	PIA
Providing labour camps and facilities	The contractor shall abide by the contract conditions and directions of PMC/PIA with respect to siting of labour camps, providing sanitation facilities and labour welfare issues etc.	MRTH 105.2 PC Sub Clause 34.2	During construction	Contractor/PMC	PIA
Occupational Health and Safety	The contractor is required to comply with all the precautions as required for the safety of workmen as per the International Labour Organisation (ILO) Convention No. 62, as far as those are applicable to the contract.	MRTH 105.2 PC Sub Clause 34.2	During Construction	Contractor/PMC	PIA
Provision of Safety acessories/ appliances to each worker	The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, masks etc. to the worker and staff.	MRTH 105.2 PC Sub Clause 34.2; PC Sub Clause 80	During Construction	Contractor/PMC	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Safety precautions	Adequate precautions shall be taken to prevent danger from electrical equipment. All machines/equipment used shall confirm to the relevant Indian Standards (IS) codes and shall be regularly inspected by the PMC.	PC Sub Clause 34.2; PC Sub Clause 80	During Construction	Contractor/PMC	PIA
Availability of first aid kit at construction site	A readily available first aid unit including an adequate supply of sterilized dressing material and appliances shall be provided as per the requirements under the Factory Act.	MRTH 105.2 PC Sub Clause 34.2; PC Sub Clause 80	During Construction	Contractor/PMC	PIA
Workers health and hygiene	All anti-malarial measures as prescribed by the PMC shall be complied with, including filling up of burrow pits.	MRTH 105.2 PC Sub Clause 34.2	During Construction	Contractor/PMC	PIA

Note PIA - Project Implementing Authority, PMC - Project Management Consultant, MMRDA - Mumbai Metropolitan Region Development Authority, MRTH - Ministry of Road Transportation and Highways (formerly Ministry of Surface Transport, MOST) Specifications for Road and Bridge Works, 3rd Revision, 1997, RAP - Rehabilitation Action Plan, R&R - Resettlement & Rehabilitation, CEMP - Community Environmental Management Plan, MCGM - Municipal Corporation of Greater Mumbai,, DG sets - Diesel Generator set, RoW - Right of way, PRoW -Proposed right of way, O&M - Operation and Maintenance, PC Sub-Clause - Particular Conditions of Contract

Table 5.3 Operation stage EMP for Phase I of JVLR Project

Environmental Impact/Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Air quality impact	Ambient air concentrations of various pollutants shall be monitored as per the pollution monitoring plan presented in ***Table 5.4*** of this report	Project requirement	Starting immediately after completion of construction	Pollution monitoring agency (MCGM)	MMRDA
	Vehicle emission norms of the day shall be enforced	Legal requirement	Routinely after operation phase	Competent authority/MCGM	MCGM
Noise pollution	Monitoring of noise levels at sensitive receptors as per monitoring plan.	Project requirement	Starting immediately after completion of construction	Pollution monitoring agency. (MCGM)	MMRDA , World Bank
	Noise will become a major problem if congestion or bottleneck situation exists in the road. Such locations causing hindrance to traffic flow shall be rectified. Adequate "No Honking" sign boards at sensitive locations shall be installed.	Project requirement	Starting immediately after completion of construction	MCGM	MCGM

Environmental Impact/Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Storm water and drain maintenance	All drains to be maintained and cleaned periodically.	Project requirement	Starting immediately after completion of construction	MCGM	MCGM
Traffic and safety	Traffic control measures including speed limits to be enforced strictly. Traffic volume and speed to be monitored to record benefits achieved from the project	Project requirement	Through operation stage	Traffic management unit of MCGM	MCGM
Survival rate of plantation	Adequate care of the compensatory plantation should be taken up so as to comply the survival rates recommended in the relevant policies of the Tree authority	Project requirement	Upto 3 years after project becomes operational	MCGM	MCGM
Aesthetics and Landscape	The landscaping provided shall be guarded from animals with adequate monitoring to ensure their growth	Project requirement	Upto 3 years after project becomes operational	MCGM	MCGM

Environmental Impact/Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Public Health and safety	Provision of adequate traffic signals, signpost / road crossing etc	Project requirement	During operation stage	MCGM/ Traffic management unit	MCGM
Road embankment & cut section stability	Road embankment & cut section stability should be checked for erosion and rutting. Any sign of instability should warrant adequate response immediately and well before succeeding monsoon season	Project requirement	Throughout operation stage	MCGM	MCGM
Accident hazards	The entire JVLR corridor shall be monitored for any accidents. Project road management agency shall maintain a database based on data collected from traffic police. They shall analyse the database and rectify if any physical correction/ alteration in the geometry of the road is needed.	MRTH 3000	Throughout operation stage	MCGM/ Traffic management unit	MCGM

Note PIA - Project Implementing Authority, PMC - Project Management Consultant, MMRDA - Mumbai Metropolitan Region Development Authority, MRTH - Ministry of Road Transportation and Highways (formerly Ministry of Surface Transport, MOST), RAP - Rehabilitation Action Plan, R&R - Resettlement & Rehabilitation, CEMP – Community Environmental Management Plan, MCGM – Municipal Corporation of Greater Mumbai,, DG sets - Diesel Generator set, RoW – Right of way, PRoW – Proposed right of way, O&M – Operation and Maintenance,

Table 5.4 Environmental Monitoring Plan for Phase I of JVLR Project

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Air Quality	Construction	SPM, PM_{10}, SO_2, N0x	NAAQS of CPCB	- SEEPZ road junction - L&T - Gandhi Nagar Square	Once every season - Summer, Winter, post-monsoon	24 hr/day for 2 consecutive working days per week for 2 weeks	Pre-approved monitoring agency	PMC/PIA
		CO, HC (non-methane)	NAAQS of CPCB	- SEEPZ road junction - L&T - Gandhi Nagar Square	Once every season - Summer, Winter, post-monsoon	8 hr/day for 2 consecutive working days per week for 2 weeks	Pre-approved monitoring agency	PMC/PIA
Air Quality	Operation	SPM, PM_{10}, SO_2, N0x	NAAQS of CPCB	- SEEPZ road junction - L&T - Gandhi Nagar Square	Once every season - Summer, Winter, post-monsoon for 1 year after operation starts.	24 hr/day for 2 consecutive working days per week for 2 weeks.	MCGM	MMRDA

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Air Quality	Operation	CO, HC (non-methane)	NAAQS	- SEEPZ road junction - Near L&T factory - Gandhi Nagar Square	Once every season-summer, Winter, post-Monsoon for 1 year after operation starts	8 hr/day for 2 consecutive working days per week for 2 weeks	MCGM	MMRDA
Noise level	Construction	L_{eq} day, L_{eq} night, L10, L50, L90 dB(A)	CPCB noise standards	- SEEPZ road junction - Near L&T factory - Gandhi Nagar Square	Once every season-summer, Winter, post-Monsoon during construction period	Continuous 24 hour reading with a frequency of 10 minutes for 2 non-consecutive days per week for 2 weeks	Pre-approved monitoring agency	PMC/PIA
Noise level	Operation	L_{eq} day, L_{eq} night, L10, L50, L90 dB(A)	CPCB noise standards	- SEEPZ road junction - L&T - Gandhi Nagar Square	Once every season-summer, Winter, post-Monsoon for 1 year after operation starts.	Continuous 24 hour reading with a frequency of 10 minutes for 2 non-consecutive days per week for 2 weeks	MCGM	MMRDA

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Water quality	Construction	pH, BOD, TSS, TDS, DO, Turbidity and O&G	Coastal water quality - SW III & relevant Stds for Heavy metals in ground water	- Mithi river - Ground water sample near Disposal site	Once every following season - Summer, Winter and post-monsoon.	For Mithi river, 2 grab samples each at upstream and downstream side of JVLR. One sample near Disposal site	Pre-approved monitoring agency	PMC/PIA
Water quality	Operation	pH, BOD, TSS, TDS, DO, Turbidity and O&G	Coastal water quality - SW III & relevant Stds for Heavy metals in ground water	- Mithi river - Ground water sample near Disposal site	Once every following season - Summer, Winter and post-monsoon Monitoring shall be done for 1 year for Mithi river For GW sample near disposal site, it shall be done for 3 years annually	For Mithi river, 2 grab samples each at upstream and downstream side of JVLR One sample near Disposal site	MCGM	MCGM

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Soil Quality	Construction	Heavy metals and Oil and grease	Contamin-ant threshold level given by USEPA	- At all stockyard locations set-up by contractor Exact sampling spot at the yard as directed by PIA/PMC -Debris disposal location/ site	At the start and end of construction activity at the relevant section	One time sample	Pre-approved monitoring agency	PMC/PIA
Soil Quality	Operation	Heavy metals and Oil and grease	Contamin-ant threshold level given by USEPA	- At accidental spill sites -Debris disposal location/ site	-In the event of an accident -Once during post-monsoon season	-One time sample -Annually for 3 years	MCGM	MCGM
Ecology	Pre-Construction	Monitoring of tree felling	As laid out in project detail design	At all locations/ sections where tree is felled	During tree felling	--	PMC	PIA/ MMRDA

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
	Operation	Survival rate of roadside plantation and other compensate plantation	Survival rate as per the tree authority policy guidelines	At locations of compensatory plantation and landscaping	Annually	For 3 years after operation starts	MCGM	MCGM/ MMRDA
Traffic Volume	Operation	Traffic volume, characteristic and speed	As per relevant IRCspecifi -cations	-SEEPZ road junction- -Near L&T junction -Near Gandhi Nagar square	3 day hourly counts	Annually for 3 years	MCGM	MCGM/ MMRDA

5.1.2 *Key Performance Indicators*

At the project level, to evaluate the effectiveness of EMP measures, certain performance indicators have been identified. These indicators need to be analysed based on the project level monitoring data collected during construction and operation stages of the project The performance indicators that should be analysed during construction and operation phase have been provided in the ***Table.5.5*** and ***Table 5.6*** respectively.

Table 5.5 *Key Performance Indicators during Construction Phase*

Environmental Issue	*Key Indicators*	*Benchmark Values/ Standards*
Ambient air quality	SO_2, SPM, PM_{10}, CO, NO_x and HC (non-methane);	Baseline values measured during pre-project scenario and corresponding NAAQS standards
Ambient Noise level	L_{eq} day and L_{eq} Night calculated based on hourly equivalent noise levels observed	Baseline values measured during pre-project scenario and corresponding NAAQS standards
Surface water quality	pH, TDS, TSS, Turbidity, BOD, DO and O&G	Baseline values measured during pre-project scenario and Coastal water criteria SW-III
Soil quality near debris disposal site	Soil contaminants as identified in USEPA or equivalent BIS standards	USEPA soil contaminant threshold limits or equivalent BIS standards
Ground water quality near debris disposal site	Heavy metals and contaminants as per USEPA or equivalent BIS standards	Standards for heavy metals and contaminants as per USEPA or equivalent BIS standards

Table 5.6 *Key Performance Indicators during Operation Phase*

Environmental Issue	*Key Indicators*	*Benchmark Values/ Standards*
Ambient air quality	SO_2, SPM, PM_{10}, CO, NO_x and HC (non-methane);	NAAQS standards
Ambient Noise level	L_{eq} day and L_{eq} Night calculated based on hourly equivalent noise	NAAQS standards

Environmental Issue	*Key Indicators*	*Benchmark Values/ Standards*
	levels	
Surface water quality	pH, TDS, TSS, Turbidity, BOD, DO and O&G	Coastal water criteria SW-III
Soil quality near debris disposal site	Soil contaminants as identified in USEPA or equivalent BIS standards	USEPA soil contaminant threshold limits or equivalent BIS standards
Ground water quality near debris disposal site	Heavy metals and contaminants as per USEPA or equivalent BIS standards	Standards for heavy metals and contaminants as per USEPA or equivalent BIS standards
Compensatory plantation	Survival rate	As per relevant policies of tree authority
Traffic scenario	Traffic volume and density	Baseline values observed during pre-project scenario

5.1.3 *EMP Reporting Arrangements*

The supervision and evaluation of the EMP are critical activities in implementation of the projects. Supervision involves periodic checking to ascertain whether activities are going according to the plans. It provides necessary feedback for project management team to keep the program on schedule.

The supervision and reporting process with respect to implementation status of mitigation measures during construction will initiate from the contractor at the lowest rung who will report to the Project Implementation Agency (PIA) through the Project Management consultant. The desired frequency of reporting process has been presented in *Table 5.7*.

Table 5.7 *Monitoring and Reporting Process*

Stage	Format #	Reporting Parameter	Contractor Reporting Frequency to PMC	PMC Reporting Frequency to PIA	PIA reporting Frequency to MMRDA	MMRDA reporting Frequency to World Bank	World Bank desired supervisio n
PC Stage	PC-1	Pre-construction stage reporting	Monthly	Monthly	Monthly	Quarterly	Quarterly
Construction stage	C-1	Pollution monitoring schedule and reports	As per monitoring plan Refer *Table 5.4*				
	C-2	Fugitive dust mitigation	Monthly	Monthly	Monthly	Quarterly	Quarterly
	C-3	Soil erosion locations and drainage measures taken	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
	C-4	Reporting for roadside plantation	Monthly	Monthly	Monthly	Quarterly	Quarterly
Op era	O-1	Survival reporting of roadside plantation	Annually		Annually	Annually	

Stage	Format #	Reporting Parameter	Contractor Reporting Frequency to PMC	PMC Reporting Frequency to PIA	PIA reporting Frequency to MMRDA	MMRDA reporting Frequency to World Bank	World Bank desired supervision
	O-2	Survival reporting of roadside landscape	Annually		Annually	Annually	
	O-3	Pollution monitoring	As per monitoring plan Refer *Table 5.4*				

Note The ready-to-use formats as per Table 5.5 have been provided in Annex G

5.1.4 *Institutional Arrangement*

During the construction phase of the project, the EMP implementation comprises of the following key activities:

- Implementing various mitigation and enhancement measures within the time frame recommended;
- Overseeing the implementation of mitigation and enhancement measures and fine-tuning/advocating more measures, if needed, depending on site conditions;
- Project level monitoring of key performance indicators to evaluate the implementation of EMP measures at the recommended intervals;
- Periodical reporting of status of EMP implementation and monitoring results of key performance indicators; and
- Constant evaluation of the EMP measures implemented based on the data available from project level monitoring and status reports and providing directions accordingly.

These activities are to be carried out by various agencies that will be involved in the implementation of JVLR project. It is also to be noted that all these activities will be carried out concurrently or at regular intervals and at different duration and locations. This makes it pertinent that all agencies involved work within a pre-defined set-up. The co-ordination model proposed during construction and operation phases of sub-projects under MUTP is presented as ***Figure 5.1*** and ***Figure 5.2*** respectively. The agencies identified in *Figure 5.1* and their sphere of work is presented in the following sections.

Project Implementation Agency (PIA)

The responsibility of implementing environmental mitigation measures lies with the PIA. PIA in this project will be Maharashtra State Road Development Corporation (MSRDC). The responsibility also includes various tasks such as notifying various affected parties such as the residents and commercial establishments, facilitate the relocation of people, notify other utility departments such as telephone, water supply, sewerage etc which use the road for providing public utility services.

Figure 5.1 ***Institutional mechanism for implementation of EMP during Construction Phase of both Phase I and Phase II of JVLR project***

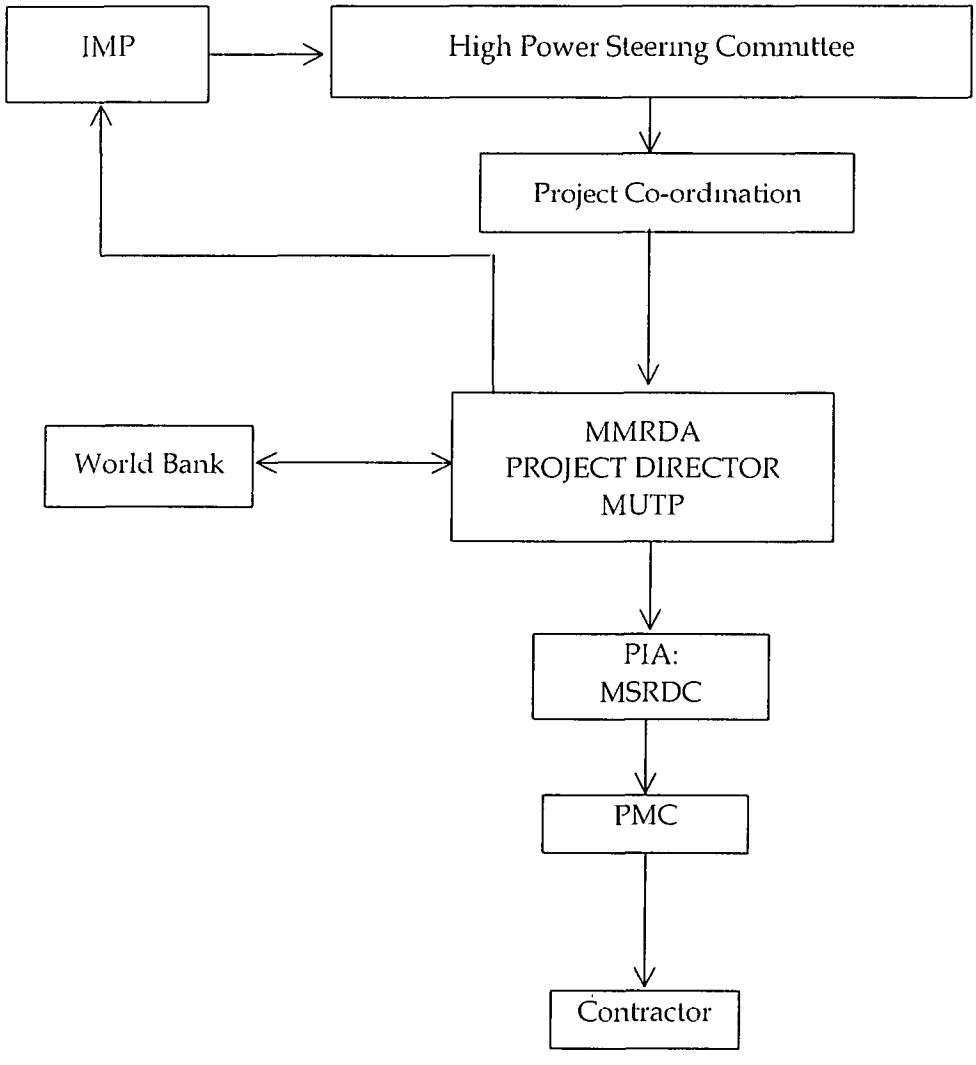
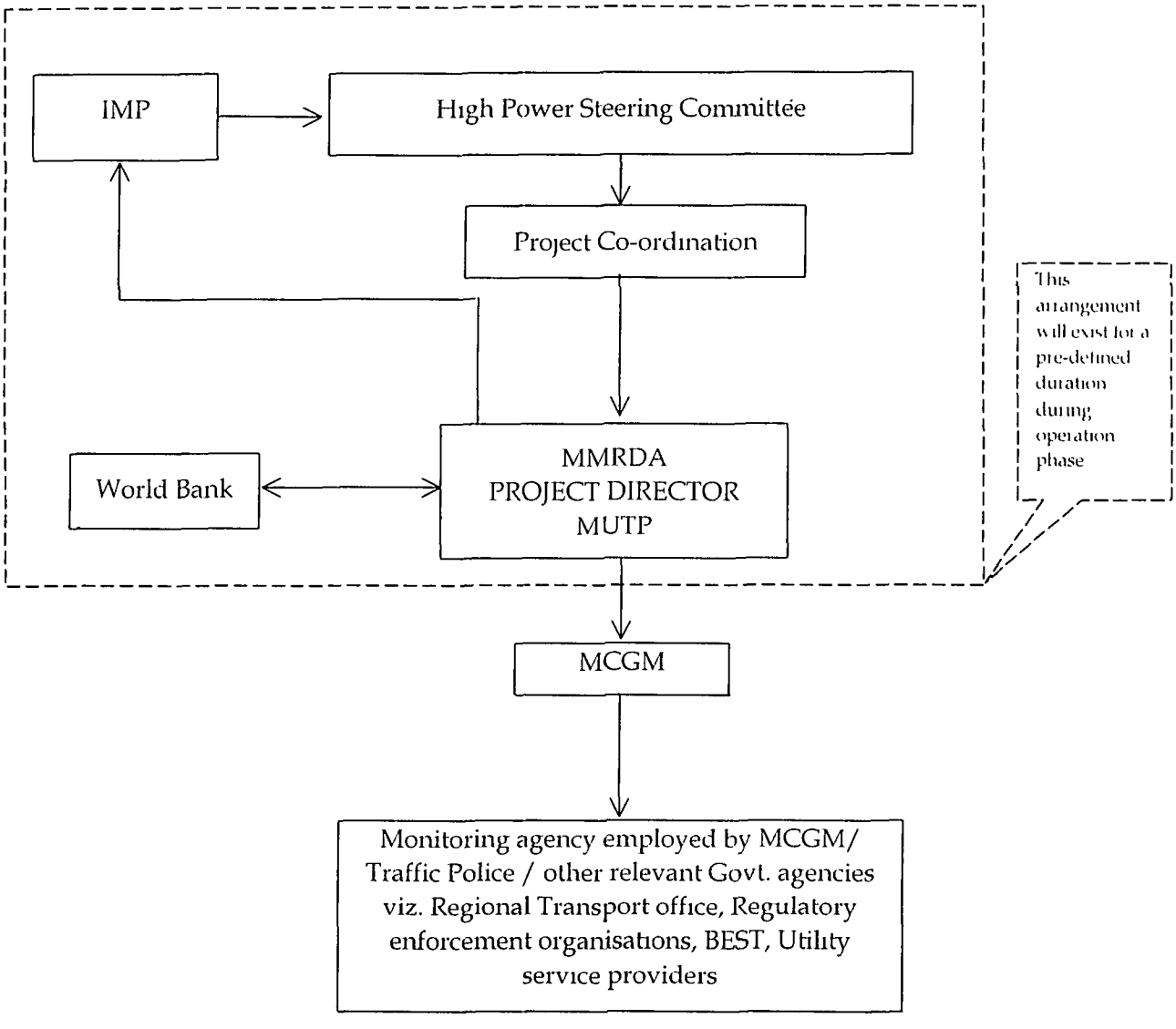


Figure 5.2 Institutional mechanism for implementation of EMP during Operation Phase of both Phase I and Phase II of JVLR project



Project Management Consultant (PMC)

The PIA will get the EMP implemented through the Project Management Consultant (PMC) appointed otherwise for managing and overseeing engineering and construction related issues. The PIA will entrust the responsibility of overseeing the implementation of EMP on the PMC in the contractual agreement that PIA will have with PMC during the construction phase In order to effectively discharge the duties entrusted on the PMC, it is required that PMC has an environmental officer/ expert in the project management team. The environment officer shall be available on a full-time basis at the site office of the PMC. The environmental officer must possess experience in the environmental management of infrastructure projects especially highway projects.

Project Contractor

The Project Contractor will be the lower most agency in the multi-level institutional arrangement. The Contractor will implement the EMP measures, enhancement measures and measures as directed by PIA and PMC. The responsibility on the contractor for implementing the EMP measures will be built-into the contractual agreement that the contractor has with the PIA. As part of his responsibility, the contractor shall submit a report on compliance with the environmental mitigation measures (Environmental Compliance Reports, ECRs) periodically to the PMC. The PMC will review and approve the ECRs submitted by the Contractor. After approval the PMC will forward the ECR to PIA. The PIAs will then submit the ECRs to the JPD (Env), which after review and monitoring will be submitted to IMP through the Project Director, MUTP for confirmation of the implementation of the environmental mitigation measures. The Project Director will accordingly submit the report to the World Bank

MMRDA

MMRDA as an apex organisation shall initiate co-ordination process among the concerned organisations for EMP implementation MMRDA shall take lead in:

- reviewing the progress of the project and plans for the subsequent year - Institution wise
- reviewing and discussing the salient features of the report in the year on environmental aspects/statistics like emission check and violations.
- organising and co-ordinating training programmes for all member organisations

An Independent Monitoring Panel (IMP) has been constituted by MMRDA with the objective to ensure that the Bank's policies related to social and environmental issues are followed. The Chairman of IMP is Ex-Chief Secretary to Government of Maharashtra. The other members are an eminent Environmental Engineer, a senior Journalist and a leading Advocate. The IMP will meet periodically to review the periodical reports, environmental compliance report, etc. submitted by PIAs and PMCs / Contractors

A co-ordination model is being proposed for promoting effective implementation of EMPs at sectoral level and at project level during construction & operation phases. The responsibilities of key functionaries for EMP implementation are:

The Project Director, MUTP has the overall responsibility of implementation of EMPs and co-ordination of all the environmental related matters of the transportation projects

The Joint Project Director (Environment) is responsible for both environmental planning and management. He will also be responsible for co-ordinating the environmental related works and ensuring preparation and implementation of sectoral and project level EMPs for the transportation projects.

Institutional Arrangements and its Strengthening

The implementation of an environmentally sound transport strategy involves a number of institutions / organisations at various levels, with each organisation having a distinct role to play. Introducing environmental dimensions in formulating and implementing a transportation strategy would require that these institutions shoulder additional responsibilities for ensuring that the strategy does not result in any significant adverse environmental impacts.

In order to examine the existing capacities & identify the additional responsibilities that the concerned Organisations / institutions shall take up to address environmental issues, these Organisations are categorised into four groups – Apex Organisations, Project Implementation Agencies, Transport Service Organisations and Regulatory Organisations.

MMRDA is the apex organisation and being the regional planning authority has to be regular interactions with various Project Implementing Agencies. The existing capacities of these organisations for environmental management have been carefully assessed. The envisaged roles & responsibilities of these organisations and additional strengthening requirements to meet the environmental obligations defined in this EA report are given in ***Table 5.8***

Table 5.8 Roles / Responsibilities for the Implementation of EMP

Organisation	*Roles & responsibilities*	*Strengthening required*
(Mumbai Metropolitan Region Development Authority (MMRDA)	Review of implementation of Environmental Mitigation Measures (EMPs). Facilitate implementation of policy directives/ emission laws etc for pollution prevention/mitigation by interacting with various the government departments like Environment Department, Urban Development Department, RTO etc Review the environmental management capabilities of implementing agencies, particularly municipal authorities and to assist them in developing their capabilities Obtain and analyse environmental information generated by organizations like MCGM, MPCB, RTO etc	Enhance the capabilities of the existing Environmental Cell" of MMRDA by out sourcing whenever required Training needed on Environmental assessment, social impacts Appreciation of Environmental impacts and EMPs Procedure and responsibilities for EMP implementation, monitoring and reporting etc
Municipal Corporation of Greater Mumbai (MCGM)	Monitoring of ambient air quality and noise at existing locations Regular report to MMRDA to enable environmental planning at a regional level	MCGM is operating air quality monitoring network for last several years and already have trained personnel Training in relation to Quality Assurance, data analysis and dissemination and other issues as suggested in the report "Study for Strengthening Air Quality Monitoring network of MCGM, Nov 2000) However the existing staff and monitoring equipment need to be upgraded for the additional

Organisation	*Roles & responsibilities*	*Strengthening required*
		monitoring load due to project.
Maharashtra State Road Development Corporation (MSRDC)	Ensuring implementation of EMPs through Contractors The responsibility also includes facilitate the relocation of people, notify other utility departments such as telephone, water supply, sewerage etc which use the road for providing public utility services The PIA will get the EMP implemented through the Project Management Consultant (PMC) by incorporating the EMP requirements in the contractual agreement	Environmental appraisal capabilities of existing staff to be enhanced through training programs Short term module type training programs needed for Environmental assessment. Appreciation of Environmental impacts and EMPs identified. Procedure and responsibilities for EMP implementation, monitoring and reporting etc
Enforcement / Regulatory Organisations. Regional Transport Office (RTO)	Enforcement of vehicular emission standards, with more emphasis on heavy vehicles, taxies and 3 wheelers	These organisations are normally aware of their responsibilities MMRDA and PIA shall emphasise their role in the implementation of operation stage EMP through meetings and discussions

5.1.5 *Possible and Practical Measures for Environmental Enhancement*

As per the recommended scheme, JVLR is proposed to be widened to 3 + 3 divided carriageway. The total top width of the proposed road will be 27.2m. The available RoW width is 30m except near high embankments where available RoW is 60m. The available RoW will be utilised almost at all sections. Thus space is a major constraint for undertaking project enhancement measures.

DPR Project proposals include provision for service roads along JVLR. However, the implementation has been proposed in phased manner after additional acquisition of land as envisaged in development plans of MCGM and PWD is completed.

Besides the service roads, the revised DPR on JVLR project has many other proposals discussed in ***Section 2.5.1***. Major project proposals that would enhance the project area include:

- The entire JVLR corridor has been proposed with a central median
- The existing structures and new bridge proposed will have divided carriageway and footpaths on either side
- New vehicular bridge at Kms 2+460 to avoid severance of habitations
- Junction improvement scheme has been proposed
- Traffic management and control systems have been proposed
- Landscaping and arboriculture
- Compensatory plantation
- Turfing of slopes of high embankment

The DPR has addressed all the basic issues and needs of the project area based on the primary and secondary data available of the project area. However, some enhancement measures could be considered for implementation along with JVLR project. The project enhancement measures proposed are presented in the following sub-sections.

Enhancement Measures along Section 1 of JVLR

The prominent physical and environmental attributes found along the section include:

- Contiguous Residential areas;
- Open hilly area;
- Aarey Farm area;
- Industrial area - SEEPZ and proposed SEEPZ extension;
- Commercial areas adjoining JVLR near Pratap nagar; and
- Recreational areas.

Considering the various DPR proposals for the JVLR project, the possible enhancement measures are presented below.

Project Enhancement measures along Section I

Locality	Enhancement measures
Contiguous Residential areas	• Pedestrian crossings at select locations • Well-planned land use along service roads to avoid encroachment and squatters • Bus-bays along service roads • Planned space for taxi-scooters (3-wheeler) to park
Industrial area - SEEPZ and proposed SEEPZ extension	• Space for parking of heavy vehicles, buses, taxi-scooters and other vehicles along JVLR • Automobile service shops shall be allowed near the parking bay • Providing space for vehicle fuel refilling station (Petrol bunk) near the SEEPZ road junction
Commercial areas	• Space for parking personal vehicles shall be provided without obstructing traffic flow along JVLR

Many of the measures recommended here have been adequately addressed in the DPR. The details of enhancement measures and the budget allocated are provided below. Hence enhancement measures recommended for Section I of JVLR does not have any additional cost implications to the project cost.

Project Enhancement measures Proposed along Section I in the DPR

Enhancement measures	Name of the costing head	Budgeted cost, Rs
• Pedestrian crossings at select locations • Bus-bays along service roads	• Traffic signs and Road furniture's	2,702,900
• Landscaping • Turfing of embankment slopes	• Landscaping and compensatory plantation	4,700,000

Enhancement Measures along Section III of JVLR

In this stretch of JVLR, the prominent physical attributes based on land use include slums near central railway tracks; mangrove swamps on eastern coastal wetlands and narrow industrial land use corridor. Considering the various DPR proposals for the JVLR project, the possible enhancement measures are presented below.

Project Enhancement measures along Section III

Locality	Enhancement measures
JVLR – LBS Marg junction	• Pedestrian crossing • Traffic signal system • Exclusive easy left-turn movement lanes from each arm of the junction
Coastal wetlands near Kannamwar Nallah	• Desilting and cleaning of the nallah upto a length of 100m on either side of JVLR • Removal of earthen bund created on either side of nallah upto a length of 100m on either side of JVLR • Prohibition on disposing solid waste on either side of JVLR along this stretch

JVLR-LBS Marg Junction improvement measures recommended here have been adequately addressed in the DPR Hence, junction enhancement measure may not have cost implication. However, cleaning of Kannamwar Nallah to avoid stagnation of sewage and facilitating the coastal wetlands for mangrove rejuvenation will have cost implications. The approximate cost estimates have been presented in detail in the following paragraphs.

Proposed Plan for Facilitating Mangrove Rejuvenation in the Region

The project implementation will reclaim about 0.2 ha of sparse mangrove area located within the project road RoW on its southern side. The density of existing mangrove vegetation is about 25 plants/shrubs per ha., which is insignificant in number.

Considering the marine Mangrove Park project mooted by MMRDA in the region, compensatory mangrove vegetation along JVLR project corridor may seem redundant. Instead, as an interim measure, about 0.4 ha of the area (0.2ha of adjoining land on either side of JVLR) shall be cleared off all debris and about 100m of the nallah on either side of JVLR be cleared off silt. This would facilitate, to some extent, the rejuvenation of mangroves and improving the aesthetics of the area.

Carrying out following measures will facilitate the rejuvenation of mangroves, present in the immediate area adjoining RoW:

- Removal of the earthen bund located alongside the Kannamwar Nallah (Canal);
- De-silting of Kannamwar Nallah
- Altering site conditions (facilitation of tidal inundation, drainage, etc.) for facilitation of tidal water in the area of study;

Cost of facilitating Mangrove Rejuvenation Plan is provided in the following table.

Cost Estimates for Facilitating Mangrove Rejuvenation Plan

No	Activity	Cost in Rupees
1	Manipulation of land (will involve removal of entire debris from the clear felled area)	The cost of this activity may require approximately Rs 50,000 per ha
2	Manipulation of channels (digging and de-silting channels for facilitating the tidal water in the areas of manipulation - which are in the upper intertidal region) near Kanjur Site	Rs 200 per metre of channel
2	As per the discussion in section 5 1 5, 0 4ha area shall be taken up for facilitating rejuvenation of mangroves, The cost of facilitating mangroves will be	Rs 60,000/-

5.1.6 *Cost of Suggested Mitigation Measures for Phase I of JVLR project*

The EMP implementation will require financial commitments for the following:

- Budget for strengthening the capacity of the concerned organisations responsible for implementing the plan;
- Budget for implementing various mitigation measures proposed in the EMP;
- Budget for undertaking enhancement measures proposed for implementation along with project; and
- Budget for undertaking project-level environment monitoring.

These budgets have been estimated and provided in the following sub-sections.

Cost Estimates for Institutional Capacity Building

The training would cover the basic principles and postulates of environmental assessment, mitigation plan and programmes (Particularly the World Bank Operational Guidelines and National Policy perspective) implementation techniques, monitoring and management methods and tools.

Looking into the potential requirements, several training modules are being suggested. The details of module contents are illustrated below

Module ID	**Brief details of module**
Module I	Environmental Overview.
Module II	Environmental Regulations and Acts
Module III	Environmental Impact Assessment.
Module IV	Environmental Management Plan.
Module V	Road Projects and Environmental Issues.
Module VI	EMP for Highway Projects.

Module VII	Environmentally Sound Construction Management.
Module VIII	Planning for Environmentally Sustainable Operation of Highways
Module IX	Long Term Environmental Issue in Highway Management

Table 5.9 lists these training programmes and also provides cost estimates for these programmes. The total cost for the training programmes is estimated to be **Rs. 2,75,000/-.**

Cost Estimates for EMP Implementation

There are no cost implications for implementing various EMP measures presented in ***Tables 5.1 through 5.3***. The measures recommended in the tables are part of good construction practices that are recommended in MRTH specifications for road and bridge works, and FIDIC General conditions of contract. These specifications, guidelines and conditions of contract are to be adopted by the contractor and other implementing agencies as part of their contractual obligations with no additional cost.

Cost Estimates for Implementing Enhancement Measures and Project Level Monitoring

The costs estimated for implementing enhancement measures as discussed in *section 5.1 5* and for carrying out project level environment monitoring proposed in *section 5.1.1* are presented in ***Table 5.10***. Provisions for these EMP implementation costs are expected to be made by the project proponent under the individual project budget.

It is to be noted that revised DPR on Phase I of JVLR project, has estimated the costs for the following items/ heads:

- Landscaping along JVLR = Rs 4,743,150
- Cross-drainage works = Rs 12,087,949
- Drainage and protective works = Rs 37,567,888
- Traffic signs and road furniture = Rs 2,702,900

Besides, the budget for implementing R&R and CEMP measures as planned in the RAP & CEMP and RIP reports has been estimated separately and accounted for in the overall project cost.

In view of this, cost estimates have been worked out excluding these provisions and other measures which are expected to be part of general contract agreement. The measures/ issues that would form part of general conditions of contract and which the civil contractor is bound to provide as part of his responsibility and legal obligations include the following:

- Providing labour camps and all other facilities as laid out in the EMP throughout the pre-construction and construction phase.
- Cost incurred towards maintaining labour camps, sanitation systems, and providing potable drinking water etc.,

- Cost incurred towards providing labourers with safety equipments and appliances during construction phase.
- Cost incurred towards organising and conducting periodical health camps for the benefit of labourers and their families

Table 5.9 Cost Estimate for Imparting Training

Target Group	Subjects	Method	Time Frame	# of Batch	Cost / Batch	Total Cost
MMRDA, MSDRC and MCGM Staff, Supervision Consultant, Environmental Specialist	*Environmental over view* - Regulation, Acts, EIA, Notification, Process and Methodology for EIA, EMP and their use	Lectures	Working day atleast 3 months before the beginning of implementation	1	15,000	15,000
Manager Level (Env.) from MMRDA / MSDRC / MCGM & Supervision Consultant Environmental Specialist	*Implementation of EMP* - Basic features of EMP, Planning, Designing and Execution of Environmental mitigation and evaluation of environmental condition - during construction and operation	Workshop and Seminar	3 working day, one month before the construction begins	1	60,000	60,000
Manager Level (Env) from MMRDA / MSDRC / MCGM & Supervision Consultant Environmental Specialist	*Environmentally Sound Construction Practices* - Clean Highway construction technology, alternative techniques for roads, waste management and minimisation in construction	Seminar/ lectures and site visits	1 week just before construction	1	1,20,000	1,20,000
Manager Level (Env.) from MMRDA / MSDRC / MCGM & Supervision Consultant Environmental Specialist	*Monitoring Environmental Performance during Construction* - Air, Water and Noise monitoring, Evaluation and Review of results, reporting requirement and mechanism	Lectures, Workshop and site visits	2 days	1	40,000	40,000
All Manager (Env) MMRDA / MSRDC / MCGM	*Long term Environmental issue in Road Management* - Designing and Implementing Survey for ambient air, noise, biological and water quality survey, data storage, analysis, contact documents and Environmental Clauses	Workshop and Services	2 days during Implementation	1	40,000	40,000

Note One Batch may cover 15 to 20 participants

Table 5. 10 *Cost Estimates for Implementing Enhancement Measures and Project Level Monitoring*

Sl. #	Item Particulars	Assumptions	Unit Rate INR	Total Cost INR
Investment during construction phase				
1	Air pollution monitoring	12 samples per season and 36 samples per year and during 2 year of construction total samples = 72	7,500/ sampling	540,000
2	Noise monitoring	12 samples per season and 36 samples per year and during 2 year of construction total samples=72	2,000/ sampling	144,000
3	Water quality monitoring	5 samples per season and 15 samples per year and during 2 year of construction total samples = 30	Rs 5000 Per sample	150,000
4	Soil quality monitoring	6 samples one-time	4,000/ sampling	24,000
5	Project enhancement near mangroves stretch along eastern section as provided in Section 5.1 5	Facilitating mangrove vegetation in an area of about 0 4 ha on southern side of JVLR	Cost as discussed in section 5 1 5	60,000
Total cost of Environmental Protection Measures for Construction Phase INR				**918,000**
1	Air quality monitoring	12 samples per season and 36 samples per year	7,500/ per sample	270,000
2	Noise quality monitoring	12 samples per season and 36 samples per year	2,000/ sampling	72,000
3	Water quality monitoring	21 samples as per Table 5 4	Rs 5000/ Sample	105,000
4	Soil quality monitoring	3 samples as per Table 5 4	Rs 4000/ sample	12,000
5	Plantation and landscaping maintenance for 36 months	5.3 km for 36 months	Lumpsum 10,000/- (per month per km)	1,908,000
6	Survival rate of road side plantation and other compensatory plantation	Ecological survey once per annum for three years	5,000/year	15,000
7	Classified traffic volume (CTV) survey	CTV surveys @ 3 sites for three days per year for 3 years	3,000/day/ site	81,000
Total Investment for Environmental Protection Measures for Operation Phase INR				**2,463,000**

5.2 *ENVIRONMENTAL MANAGEMENT PLAN FOR PHASE II OF JVLR PROJECT*

The EMP has been delineated for all the three stages viz., Pre-construction, Construction and Operation stages of the Phase II of JVLR project. The EMP is presented in ***Table 5.11 through Table 5.13.***

5.2.1 *Environmental Monitoring Plan*

Recommended Project level Environment monitoring plan is presented in ***Table 5.14.***

5.2.2 *Key Performance Indicators*

The performance indicators that should be analysed during construction and operation phase have been provided below.

Key performance indicators during construction phase

Environmental issue	Key indicators	Benchmark values/ standards
Ambient air quality	SO_2, SPM, PM_{10}, CO, NO_x and HC (non-methane);	Baseline values measured during pre-project scenario and corresponding NAAQS standards
Ambient Noise level	L_{eq} day and L_{eq} Night calculated based on hourly equivalent noise levels	Baseline values measured during pre-project scenario and corresponding NAAQS standards
Surface water quality	pH, TDS, TSS, Turbidity, BOD, DO and O&G	Baseline values measured during pre-project scenario and Coastal water criteria SW-III
Soil quality near debris disposal site	Soil contaminants as identified in USEPA or equivalent BIS standards	USEPA soil contaminant threshold limits or equivalent BIS standards
Ground water quality near debris disposal site	Heavy metals and contaminants as per USEPA or equivalent BIS standards	Standards for heavy metals and contaminants as per USEPA or equivalent BIS standards

Key performance indicators during operation phase

Environmental issue	Key indicators	Benchmark values/ standards
Ambient air quality	SO_2, SPM, PM_{10}, CO, NO_x and HC (non-methane);	NAAQS standards
Ambient Noise level	L_{eq} day and L_{eq} Night calculated based on hourly equivalent noise levels	NAAQS standards
Surface water quality	pH, TDS, TSS, Turbidity, BOD, DO and O&G	Coastal water criteria SW-III
Soil quality near debris disposal site	Soil contaminants as identified in USEPA or equivalent BIS standards	USEPA soil contaminant threshold limits or equivalent BIS standards
Ground water quality near debris disposal site	Heavy metals and contaminants as per USEPA or equivalent BIS standards	Standards for heavy metals and contaminants as per USEPA or equivalent BIS standards
Compensatory plantation	Survival rate	As per relevant policies of tree authority
Traffic scenario	Traffic volume and density	Baseline values observed during pre-project scenario

5.2.3 *EMP Reporting Arrangements*

The EMP reporting process and arrangement is similar to the one recommended for Phase I of JVLR project Discussion on this issue has been presented in *Section 5.1.3*

5.2.4 *Institutional Arrangement*

The Institutional arrangement for the implementation of Phase II of JVLR project will be the same as recommended for Phase I of JVLR project. Moreover, the strengthening of institutional capacity to manage the project will not be required, as that has been addressed in Phase I of JVLR project. Hence, cost provision for capacity development and training for the institutions involved is not accounted for in the Phase II of JVLR project.

5.2.5 *Project Enhancement measures along Section II of JVLR*

The prominent physical attributes based on land use found along the section include.

- institutional

- residential
- commercial
- surface water body -Powai Lake

Considering the various DPR proposals for the JVLR project, the possible enhancement measures have been presented below.

Project Enhancement measures along Section II

Locality	Enhancement measures
Residential areas	• Bus-bays along service roads • Planned space for taxi-scooters (3-wheeler) to park
Institutional	• DPR consultant shall carryout an exclusive traffic management study to avoid the bottleneck situation that exists opposite IIT campus The study shall analyse the feasibility of providing Road under pass opposite IIT main gate or reorganising entry/exit to IIT • Planned space for taxi-scooters (3-wheeler) to park • Bus-bays along service roads
Commercial	• Space for parking personal vehicles shall be provided without obstructing traffic flow along JVLR
Surface water body -Powai Lake	• The stretch between JVLR and Powai lake shall be converted to a park/garden with adequate seats/ benches

Table 5.11 Pre-Construction stage EMP for Phase II of JVLR Project

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Resettlement and rehabilitation	The entitlement framework to the PAPs shall be in accordance to the RAP of the project. It shall be ensured that all R&R activities be reasonably completed as per RAP, before the construction activity starts in the relevant section.	RAP Requirement	Before Start of construction of relevant section.	MMRDA	MMRDA
Resettlement of cultural property	All cultural properties that have been identified as affected shall be resettled as per the action plan laid out in Rehabilitation Implementation Plan (RIP) and Consolidated EA	RIP requirement	Before Start of construction of relevant section	MMRDA	MMRDA
Ecological impacts due to tree cutting	Trees falling within the alignment which are to be removed before commencement of construction shall be identified and approved by PIA. Prior permission from MCGM/ Tree authorities shall be obtained.	Preservation of Tree Act of Maharahtra, 1975	Before Start of construction of relevant section	Contractor	PIA/ MMRDA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Local traffic arrangement	Temporary traffic arrangement during construction within RoW shall be planned in the DPR itself. This plan shall be periodically reviewed with respect to site conditions. During site clearance activity, the demolition debris shall be preferably removed during non-peak hours and with deployment of more vehicles for the purpose.	MRTH: 112	During site clearance and construction	Contractor/ PMC	PIA/ MMRDA
Traffic Control and Safety	The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the PMC for the information and protection of traffic.	MRTH: 112.4 MRTH: 112	During pre-construction & construction	Contractor / PMC	PIA

Environmental Issue	Mitigation Measures	Cross Reference to Documents	Time Frame	Responsibility	
				Implementation	Supervision
Safety of pedestrians	Special consideration shall be given in the local traffic management to the safety of pedestrians The temporary traffic arrangement within RoW as recommended in the DPR should be kept free of encroachments/ commercial activities. The sections near IIT campus and opposite Panch kutir market area are the critical ones where pedestrian safety needs to be addressed.	MRTH: 112.2	Before Construction and during construction	Contractor/PMC	PIA
Impact on land use outside RoW	Construction activities shall be preferably restricted within project road RoW.	MRTH 201.2	During entire site clearance and construction phases	Contractor	PIA
Utility relocation	All utilities, such as water supply lines, electrical installations, telephone lines etc. to be shifted after prior approval of agencies. Utility relocation shall be carried out in shortest possible time to reduce inconvenience to public.	MRTH 110	Before Start of construction of relevant section	Contractor/PMC	PIA

Note PIA - Project Implementing Authority, PMC - Project Management Consultant, MMRDA - Mumbai Metropolitan Region Development Authority, MRTH – Ministry of Road Transportation and Highways (formerly Ministry of Surface Transport, MOST) Specifications for Road and Bridge Works, 3rd Revision, 1997, RAP - Rehabilitation Action Plan, RIP – Rehabilitation Implementation Plan, R&R - Resettlement & Rehabilitation, CEMP – Community Environmental Management Plan, CEA – Consolidated Environmental Assessment, MCGM – Municipal Corporation of Greater Mumbai, RoW – Right of way, PRoW – Proposed Right of Way

Table 5.12 Construction Stage EMP for Phase II of JVLR project

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Material spill	All vehicles delivering material to the site shall be covered to avoid material spillage.	MRTH:111.9 MRTH:111.11 MRTH:111.12	Entire construction phase	Contractor	PMC/PIA
Plying vehicles on unpaved roads	The unpaved roads, if used by the contractor, shall be sprinkled with water at least once in a day to control the fugitive dust emissions. Dust emission will be a critical issue opposite IIT and Panch kutir market sections.	MRTH:111.10	Construction phase	Contractor	PMC/PIA
Using existing hot mix/ Concrete/ asphalt plants	It is understood from the implementing authorities, that the contractor will utilise the existing Concrete, Asphalt and Hot Mix Plants. Contractor shall ensure that existing plants, which are sourced, are licensed and authorised for operation by concerned authorities and shall intimate the PMC/PIA prior to procuring materials from them PMC shall procure relevant documents from the plant owners to ensure that they are adhering to relevant emission norms as laid out by MoEF/ CPCB.	MRTH: 111.5	During entire construction phase	Contractor	PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Watering to control dust at site	Construction site to be watered periodically to minimize fugitive dust generation as the project road is in the midst of residential, institutional and sensitive areas.	MRTH: 111.8	During entire construction phase	Contractor/ PMC	PIA
Roads used for transport	Contractor shall ensure that the transport vehicles used to ferry materials and dispose debris does not create hazardous conditions for general traffic using the roadway especially the LBS marg and Western section of JVLR.	MRTH:111.9	During entire construction phase	Contractor/ PMC	PIA
Barricading site	The construction site especially near Panch kutir market area, opposite IIT campus, and along slum areas on the eastern side should be barricaded at all time in a day with adequate marking, flags, reflectors etc., for the safety of general traffic movement and pedestrians.	MRTH 112	During construction phase	Contractor/PMC	PIA
Earthwork	All earthwork and construction material should be stored in such a manner to minimise generation of dust and spillage on roads. The stacks of earthwork shall be preferably located away from Panch kutir market areas, opposite IIT campus and along Powai lake.	MRTH 201.4	During entire construction phase	Contractor/ PMC	PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Inspection of site	Daily inspection at construction site should be carried out to ensure removal of construction debris. Debris removal frequency shall be quicker to the extent possible. Piling up of debris generated near Panch kutir market area, IIT campus, Powai lake and steep slope section near LBS marg would create hazardous condition for traffic movement and pedestrians	Contract document	During construction phase	Contractor/ PMC	PIA
Earthwork debris disposal	As soon as construction is over the surplus earth should be utilised to fill up low-lying areas. In no case, loose earth should be allowed to pile up along JVLR alignment.	MRTH 201.4 MRTH 301.3.11	During construction phase	Contractor/ PMC	PIA
Idling of vehicles	Idling of delivery trucks or other equipment should not be permitted during periods of unloading or when they are not in active use. This practice must be ensured especially near sensitive receptors, viz., *IIT campus, Church, Places of worship, Central school and Panch kutir market area.*	MRTH 201.2	During construction phase	Contractor	PMC/PIA
Construction equipment emissions	Exhaust and noise emissions of construction equipment's shall adhere to emission norms as laid out by MoEF/ CPCB.	Legal requirement	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Noise from construction equipments	All construction equipment's shall be fitted with exhaust silencers. Damaged silencers to be promptly replaced by contractor.	MRTH: 111	During construction	Contractor	PMC/PIA
Noise impact due to operation of DG sets	DG sets, if used, shall adhere to noise standards of MoEF. Operation of DG sets shall be preferably avoided near IIT campus, Panch kutir market area and sensitive receptors.	MRTH:111	During construction	Contractor/ PMC	PIA
Noise control measures	If blasting of hill section near LBS marg is required, adequate noise control measures shall be prepared in advance prior to the blasting work starts. The noise levels shall adhere to local laws. Restricted blasting work hours and intermittent blasting could be few mitigation measures that can be adopted.	MRTH. 302 PC Sub Clause 45.1	Before Start of construction of relevant section	Contractor/ PMC	PIA
Noise level near residential areas and sensitive receptors	Construction activity induced noise levels shall be mitigated near *IIT campus, Central School Panch kutir market area, residential areas and places of worship* The contractor can employ mitigation measures such as restricted and/or intermittent activity or as directed by PMC.	MRTH:111 PC Sub Clause 45.1	During construction of relevant sections	Contractor/PMC	PIA
Exposure to loud noise	Workers exposed to loud noise (As per Factory Act requirements) shall wear earplugs/earmuffs	MRTH: 111.6 MRTH 105.2	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Storage of construction material	Construction material containing fine particles shall be stored in an enclosure such that sediment-laden water does not drain into *Powai lake*, other nearby storm water drains and underground sewage pipes.	MRTH: 306	During construction	Contractor	PIA
Blockage and change in drainage pattern	Along *Powai lake* and near steep slope section located towards the eastern end, earth, stone or any other construction material shall be properly stored, if storage can't be avoided, so as not to block the flow of water. If the channel/ drains get blocked due to negligence, contractor should ensure that they are cleaned especially during monsoon season. Once the work is completed in all respects, the contractor shall, as a mark of good gesture, clean up the drains along the project road to the extent possible.	MRTH: 306	During construction	Contractor	PMC/PIA
Soil erosion	On road embankment near steep hill section, slopes shall be stabilised. The work shall consist of measures as per design, or as directed by the PMC to control soil erosion, and rutting	MRTH : 306	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Siltation of water bodies	Siltation of soil into *Powai lake* shall be prevented as far as possible by adapting soil erosion control measures as per MRTH guidelines/ or as per the directions of PMC.	MRTH guidelines 305 through 309	During construction	Contractor	PMC/PIA
Areas susceptible to erosion	Along the steep hill section located near *LBS marg*, earthwork should be preferably carried out before rainy season or temporary/permanent erosion protection work as may be feasible shall be provided.	MRTH 306.2/Project/ Contract requirement	During construction	Contractor	PMC/PIA
Debris disposal	Debris generated due to dismantling of existing pavement/structures shall be suitably reused in proposed construction. Un-utilisable debris shall be suitably disposed at sites approved by PMC.	MRTH :112.10 MRTH 301.3.11	During construction	Contractor	PMC/PIA
Foundation excavation debris	Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into *Powai lake, nearby surface drains, sewage manholes* or form mud puddles in the area.	Project requirement	During construction	Contractor	PMC/PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Soil contamination by construction wastes, fuel etc.	Oil and fuel spills from construction equipment shall be minimised by good O&M practice. Soils contaminated by such spills shall be disposed as per MoEF requirements.	Project requirement	During construction	Contractor/ PMC	PIA
Sourcing quarry materials	Sand, aggregates and other quarry material shall be sourced from licensed quarries	MRTH 111.3	During construction	Contractor/PMC	PIA
Compensatory plantation	Compensatory plantation as provided in the DPR proposal shall be done in line with Tree authority regulations and guidelines.	Preservation of Trees Act of Maharashtra, 1975	During construction	Tree Authority	PIA
Aesthetics and Landscape	Adequate landscaping of the median, embankment slopes and other open space available within RoW shall be carried as provided in the DPR. The area can be utilised for growing dwarf varieties of plants (e.g Alstonia scholaris, Thuja etc.)	Project requirement	During fag end of construction phase or within 6 months after operation starts and before monsoon	Contractor/PMC	PIA
Providing labour camps and facilities	The contractor shall abide by the contract conditions and directions of PMC with respect to labour camps, providing sanitation facilities and labour welfare issues.	MRTH 105.2 PC Sub Clause 34.2	During construction	Contractor/PMC	PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Occupational Health and Safety	The contractor is required to comply with all the precautions as required for the safety of workmen as per the International Labour Organisation (ILO) Convention No. 62, as far as those are applicable to the contract.	MRTH 105.2 PC Sub Clause 34.2	During Construction	Contractor/PMC	PIA
Provision of Safety acessories/ appliances to each worker	The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, masks etc. to the worker and staff. All laws related to safe scaffolding, ladders, working platform, gangway, stairwells, excavations, safety entry and exit etc. shall be complied with.	MRTH 105.2 PC Sub Clause 34.2; PC Sub Clause 80	During Construction	Contractor/PMC	PIA
Safety precautions	Adequate precautions shall be taken to prevent danger from electrical equipment. All machines/equipment used shall confirm to the relevant Indian Standards (IS) codes and shall be regularly inspected by the PMC.	PC Sub Clause 34.2; PC Sub Clause 80	During Construction	Contractor/PMC	PIA
Availability of first aid kit at construction site	A readily available first aid unit including an adequate supply of sterilized dressing material and appliances shall be provided as per the requirements under the Factory Act.	MRTH 105.2 PC Sub Clause 34.2; PC Sub Clause 80	During Construction	Contractor/PMC	PIA

Environmental Issue	Mitigation Measures	Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Workers health and hygiene	All anti-malarial measures as prescribed by the PMC shall be complied with, including filling up of burrow pits.	MRTH 105.2 PC Sub Clause 34.2	During Construction	Contractor/PMC	PIA

Note PIA - Project Implementing Authority, PMC - Project Management Consultant, MMRDA - Mumbai Metropolitan Region Development Authority, MRTH - Ministry of Road Transportation and Highways (formerly Ministry of Surface Transport, MOST) Specifications for Road and Bridge Works, 3rd Revision, 1997, RAP - Rehabilitation Action Plan, R&R - Resettlement & Rehabilitation, CEMP – Community Environmental Management Plan, MCGM – Municipal Corporation of Greater Mumbai,, DG sets - Diesel Generator set, RoW – Right of way, PRoW – Proposed right of way, O&M – Operation and Maintenance, PC Sub-Clause' – Particular Conditions of Contract

Table 5.13 Operation stage EMP for Phase II of JVLR project

Environmental Issue	Mitigation Measures	Cross Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Air quality impact	Ambient air concentrations of various pollutants shall be monitored as per the pollution monitoring plan presented in ***Table 5.14*** of this report	Project requirement	Starting immediately after completion of construction	Pollution monitoring agency (MCGM)	MMRDA
	Vehicle emission norms of the day shall be enforced	Project requirement	Routinely after operation phase	Enforcement agency	MCGM
Noise pollution	Monitoring of noise levels at locations as per monitoring plan.	Project requirement	Starting immediately after completion of construction	Pollution monitoring agency. (MCGM)	MMRDA
	Adequate "No Honking" sign boards at sensitive locations viz. Church, IIT campus and Kendriya Vidyalaya school shall be installed.	Project requirement	Immediately after operation phase starts	MCGM	MCGM

Environmental Issue	Mitigation Measures	Cross Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Noise due to congestion	Noise will become a major problem if congestion or bottleneck situation exists in the road. Such locations causing hindrance to traffic flow shall be rectified.	Project requirement	Starting immediately after completion of construction	MCGM	MCGM
Storm water and drain maintenance	All drains leading to Powai lake and other drains along the project road to be maintained and cleaned periodically.	Project requirement	Starting immediately after completion of construction	MCGM	MCGM
Traffic and safety	Traffic control measures including speed limits to be enforced strictly. Traffic volume and speed to be monitored to record benefits achieved from the project	Project requirement	Through operation stage	Traffic management unit of MCGM/ Traffic Police	MCGM
Survival rate of plantation	Adequate care of the compensatory plantation should be taken up so as to comply the survival rates recommended in the relevant policies of the Tree authority	Project requirement	Upto 3 years after project becomes operational	MCGM	MCGM

Environmental Issue	Mitigation Measures	Cross Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Aesthetics and Landscape	The landscaping provided shall be guarded from animals with adequate monitoring to ensure their growth	Project requirement	Upto 3 years after project becomes operational	MCGM	MCGM
Public Health and safety	Periodic maintenance of traffic signals, signposts, road markings, zebra crossings etc. especially near IIT campus, Panch kutir market area and Hiranandani garden junction	Project requirement	Through operation stage	MCGM/ Traffic management unit	MCGM
Road embankment & cut section stability	Road embankment & cut section stability should be checked for erosion and rutting The high embankment section near LBS marg flyover and near eastern end of L&T flyover shall be periodically checked for soil erosion and stability. Any sign of instability should warrant adequate response immediately and well before succeeding monsoon season	Project requirement	Throughout operation stage	MCGM	MCGM

Environmental Issue	Mitigation Measures	Cross Reference to Contract Documents	Time Frame	Responsibility	
				Implementation	Supervision
Accident hazards	The entire JVLR corridor shall be monitored for any accidents. MCGM shall maintain a database based on data collected from traffic police/ competent authority. They shall analyse the database and rectify if any physical correction/ alteration in the geometry of the road is needed.	Project requirement	Throughout operation stage	MCGM/ Traffic management unit	MCGM

Note PIA - Project Implementing Authority, PMC - Project Management Consultant, MMRDA - Mumbai Metropolitan Region Development Authority, MRTH - Ministry of Road Transportation and Highways (formerly Ministry of Surface Transport, MOST), RAP - Rehabilitation Action Plan, R&R - Resettlement & Rehabilitation, CEMP – Community Environmental Management Plan, MCGM – Municipal Corporation of Greater Mumbai,, DG sets - Diesel Generator set, RoW - Right of way, PRoW – Proposed right of way, O&M – Operation and Maintenance,

Table 5.14 Environmental Monitoring Plan[1] for Phase II of JVLR Project[1]

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Air Quality	Construction	SPM, PM_{10}, SO_2, N0x	NAAQS of CPCB	- Near IIT Main gate	Once every season - Summer, Winter, post-monsoon	24 hr/day for 2 consecutive working days per week for 2 weeks	Contractor through pre-approved monitoring agency	PMC/PIA
		CO, HC (non-methane)	NAAQS of CPCB	- Near IIT Main gate	Once every season - Summer, Winter, post-monsoon	8 hr/day for 2 consecutive working days per week for 2 weeks	Contractor through pre-approved monitoring agency	PMC/PIA
Air Quality	Operation	SPM, PM_{10}, SO_2, N0x	NAAQS of CPCB	- Near IIT Main gate	One time after 6 months into operation stage	24 hr/day for 2 consecutive working days per week for 2 weeks.	MCGM	MMRDA

(1) [1] For abbreviations used in the table please refer list of abbreviations

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Air Quality	Operation	CO, HC (non-methane)	NAAQS	- Near IIT Main gate	One time after 6 months into operation stage	8 hr/day for 2 consecutive working days per week for 2 weeks	MCGM	MMRDA
Noise level	Construction	L_{eq} Day, L_{eq} night, L10, L50, L90 dB(A)	CPCB noise standards	- Near IIT Main gate	Once every season-summer, Winter, post-Monsoon during construction period	Continuous 24 hour reading with a frequency of 10 minutes for 2 non-consecutive days per week for 2 weeks	Contractor through pre-approved monitoring agency	PMC/PIA
Noise level	Operation	L_{eq} Day, L_{eq} night, L10, L50, L90 dB(A)	CPCB noise standards	- Near IIT Main gate	One time after 6 months into operation stage	Continuous 24 hour reading with a frequency of 10 minutes for 2 non-consecutive days per week for 2 weeks	MCGM	MMRDA

Component	Project Stage	Parameters	Standard	Location	Frequency	Duration	Institutional Responsibility	
							Implementation	Supervision
Water quality	Construction	pH, BOD, TSS, TDS, DO, Turbidity and O&G	Coastal water quality - SWIII	- Powai lake	Once every following season – Summer, Winter and post-monsoon.	For Powai lake 4 grab samples along JVLR at different locations	Contractor	PMC/PIA
Surface Water quality	Operation	pH, BOD, TSS, TDS, DO, Turbidity and O&G	Coastal water quality - SWIII	- Powai lake	One time after 6 months into operation stage	For Powai lake 4 grab samples along JVLR at different locations	MCGM	MCGM
Ecology	Pre-Construction	Monitoring of tree felling	As laid out in project detail design	Along Powai lake and other areas where tree felling is required	During tree felling	During tree felling period	PMC	PIA
	Operation	Survival rate of roadside plantation and other compensate plantation	Polices/ guideline of tree authority	At locations of compensatory plantation	Annually	For 3 years after operation starts	MCGM	MCGM

5.2.6 *Cost of Suggested Mitigation Measures for Phase II of JVLR project*

The EMP implementation will require financial commitments for the following:

- Budget for strengthening the capacity of the concerned organisations responsible for implementing the plan,
- Budget for implementing various mitigation measures proposed in the EMP;
- Budget for undertaking enhancement measures proposed for implementation along with project; and
- Budget for undertaking project-level environment monitoring.

These budgets have been estimated and provided in the following sub-sections.

Cost Estimates for Institutional Capacity Building

The Institutional arrangement is expected to be the same for the execution of Phase II of JVLR project. Hence no additional cost is required for the capacity building component of the EMP

Cost Estimates for EMP Implementation

There are no cost implications for implementing various EMP measures presented in ***Tables 5.11 through 5.13***. The measures recommended in the tables are part of good construction practices that are recommended in MRTH specifications for road and bridge works, and FIDIC General conditions of contract. These specifications, guidelines and conditions of contract are to be adopted by the contractor and other implementing agencies as part of their contractual obligations with no additional cost.

Cost Estimates for Implementing Enhancement Measures and Project Level Monitoring

The costs estimated for implementing enhancement measures as discussed in *section 5.2 5* and for carrying out project level environment monitoring proposed in *section 5 2 1* are presented in ***Table 5.15*** Provisions for these implementation costs are to be made by the project proponent under the individual project budget.

It is to be noted that DPR Consultant will estimate the budget for providing the following items/ heads:

- Landscaping along JVLR
- Cross-drainage works
- Drainage and protective works
- Traffic signs and road furniture

Besides, the budget for implementing R&R and CEMP measures will be estimated separately in the respective RAP report and accounted for in the overall project cost.

In view of this, cost estimates have been worked out excluding these provisions and other measures which are expected to be part of general contract agreement

The measures/ issues that would form part of general conditions of contract and which the civil contractor is bound to provide as part of his responsibility and legal obligations include the following.

- Providing labour camps and all other facilities as laid out in the EMP throughout the pre-construction and construction phase.
- Cost incurred towards maintaining labour camps, sanitation systems, and providing potable drinking water etc ,
- Cost incurred towards providing labourers with safety equipments and appliances during construction phase.
- Cost incurred towards organising and conducting periodical health camps for the benefit of labourers and their families.

The costs estimated for implementing enhancement measures as and for carrying out project level environment monitoring are presented in ***Table 5.15***.The project proponent i e. MSRDC shall include these costs as part of individual project budget.

Table 5.15 ***Cost Estimates for Implementing Enhancement Measures and Project Level Monitoring in Phase II of JVLR project***

Sl. #	Item Particulars	Assumptions	Unit Rate INR	Total Cost INR
Investment during construction phase				
1	Air pollution monitoring	4 samples per season and during 0 5 year of construction total samples = 8	7,500/ sampling	60,000
2	Noise monitoring	4 samples per season and during 0 5 year of construction total samples = 8	2,000/ sampling	16,000
3	Water quality monitoring	4 samples per season and 8 samples within assumed construction time of 6 months	Rs 5000/sample	40,000
4	Project enhancement near Powai lake as provided in Section 5 2 5	Developing small roadside park with exotic variety of vegetation, lawns, landscaping and providing all public amenities like pathways, rest benches, lighting and sanitation facilities etc over an approximate area of about 2 5 Ha	Lumpsum amount of Rs 5 0 lakhs per Ha	1,250,000
Total Investment for Environmental Measures for Construction Phase INR				**1,366,000**

Sl. #	Item Particulars	Assumptions	Unit Rate INR	Total Cost INR
1	Air quality monitoring	4 samples as per Table 5 14	7,500/ per sample	30,000
2	Noise quality monitoring	4 samples as per Table 5 14	2,000/ sampling	8,000
3	Water quality monitoring	4 samples as per Table 5 14	Rs 5000/ Sample	20,000
4	Survival rate of road side plantation and other compensatory plantation	Ecological survey once per annum for three years	5,000/year	15,000
Total Investment for Environmental Protection Measures for Operation Phase INR				73,000

Public consultation has been conducted at various stages of MUTP since the project was conceptualised in 1994

In 1994, a Comprehensive transport plan was prepared by MMRDA to arrest and improve the deteriorating transport condition in the Mumbai Metropolitan Region. The preparation of plan entrusted to M/s WS Atkins International started with a survey of Public attitude[1]. Some of the wish list expressed by the general public includes·

- No priority to tramway or Light Rail Transit (LRT) or underground metro;
- High priority to increased reliability on train services;
- Putting more buses and providing separate bus-ways; and
- Priority to road investment.

These considerations have reflected in the various MUTP proposals. Since then many public-consulting processes have taken place. Complete details of the public-consulting processes are provided in the Consolidated Environmental Assessment on MUTP. The brief details are provided below.

Details of Public Consultation Process

Public Consultation	Year	Suggestions/ Response in Brief
Survey of Public Attitude[1]	1994 as part of CTS	Support for Public transport improvement schemes/ projects and road infrastructure
Public Consultation during EA of MUTP	June 1997	Approach and methodology adopted was fine-tuned as per the suggestions given during the process
Consultation during R&R	September 2001	As part of Baseline Socio-economic survey the NGO's explained the project details to the community affected
Consultation during Updated EA on MUTP	November 2000	Impact of ongoing developmental works were to be considered while designing the EMP for MUTP sub-projects. Institutional arrangements were requested in more detail.
Public Consultation during preparation of Consolidated EA	November 2001	A consultation process was exclusively conducted for the project-affected persons The
Public Consultation during preparation of Consolidated EA	November 2001	A consultation process was exclusively conducted for the general public The

(2) [1] CTS Technical Memorandum No 5 - Analysis of Public Attitude Survey, WS Atkins International

From the various Public consultation processes, the major issues that has emerged include.

- Public concern over delay in implementing the MUTP
- Because of delay, many felt that planning MUTP on the basis of CTS carried out in 1994 may not be appropriate. MMRDA has provided in the budget for conducting a fresh CTS to develop a long-term strategy and investment program
- Strong case was made for providing adequate facilities and safety to pedestrians from the burgeoning vehicular traffic
- Public concern about decreasing Public transport system' role in MMR
- Railway station area improvement schemes were desired for easy use
- Regarding R&R, major concern was expressed related to resettlement of occupants of transit housing to permanent housing within 3 years promised.
- Concerns over locating transit camps in CRZ prohibited area were also expressed
- EMPs prepared were appreciated in general. However, for effective implementation of EMP, dissemination of information was sought through electronic media and through NGO and CBO.

MMRDA and PIA's concerned have addressed all the issues/ concerns expressed during the Public consultation process to the extent possible. The details of action taken by MMRDA and PIA's after the Public consultation process has been presented in Consolidated EA report on MUTP prepared by MMRDA.

Annex A

Policy and Legal Framework outlined in the Consolidated EA Report on MUTP, MMRDA, 2002

LEGAL AND POLICY FRAMEWORK FOR MUTP SUB-PROJECTS

1 The project will be implemented within the Indian legal framework and will also comply with the safeguard policies of the World Bank The applicable legal and policy framework is described below

Applicable Indian Legal Requirements

2. The applicable Indian legal provisions are described in two groups one related to environment and the other related to resettlement.

Legislation related to Environment:

3 There are various Acts, Rules and Notifications applicable for different environmental components such as Air Pollution, Water Pollution, Noise Pollution, Coastal Areas, Hazardous Materials Handling and Transport, Forest and Wildlife. In addition, regulatory provisions by way of environmental clearance also exist The applicable acts and regulations are listed below

Environmental (Protection) Act, 1986

4. This is an umbrella act for environmental protection Various rules and notifications are issued from time to time under the provisions of this Act. Environmental Protection Rules (2000) specify standards for ambient air quality whereas Noise Pollution (Regulation and Control) Rules, 2000 provide for the ambient noise standards in public places. However legal mechanism to achieve these are not explicit in terms of emission at source in transport sector except for the vehicle emission norms like Euro II or Bharat II that have been prescribed The Environmental Impact Assessment Notification, 1994 (as amended in May 1997) make environmental clearance mandatory for 29 categories of developmental projects listed in Schedule 1 of the notification. Railways are not listed in schedule 1 and hence do not need environmental clearance. For other components under MUTP, MoEF has confirmed that environmental clearance EIA notification is not required. *The letter received from MoEF in this regard is appended on next page.*

Coastal Regulation Zone Notification, 1991

5. The notification provides for determining certain areas between the Low Tide Line (LTL) and High Tide Line (HTL) and adjacent land ward area as the Coastal Regulation Zone and its classification into CRZ I -ecologically sensitive and coastal wetland between HTL and LTL, CRZ II - where development has already occurred and CRZ III - the residual area largely rural in character. Coastal Zone Management Plan (CZMP) of Greater Mumbai specifying the classification of CRZ as approved by MoEF is appended as ***Map 1*** in this Annexure The notification also prescribes prohibited activities in CRZ and activities that can be taken up with the approval of MoEF. Reclamation being a prohibited activity cannot be undertaken in CRZ I.

No.J-20011/8/99-IA.III
Government of India
Ministry of Environment & Forests

Paryavaran Bhavan
C.G.O. Complex, Lodi Road,
New Delhi – 110003.
Dated the 27th July, 2001

To

Shri U.P S.Madan,
Project Director, M.U.T.P.
Mumbai Metropolitan Development Authority,
Bandra-Kurla Complex, Bandra (East),
Mumbai – 400 051.

Subject: Mumbai Urban Transport Project (MUTP) – environmental clearance regarding

Sir,

The undersigned is directed to refer to your letter no. T/EA/MUTP/461/2001 dated 18th July, 2001 addressed to Shri K.Roy Paul, Special Secretary in this Ministry regarding the above mentioned subject.

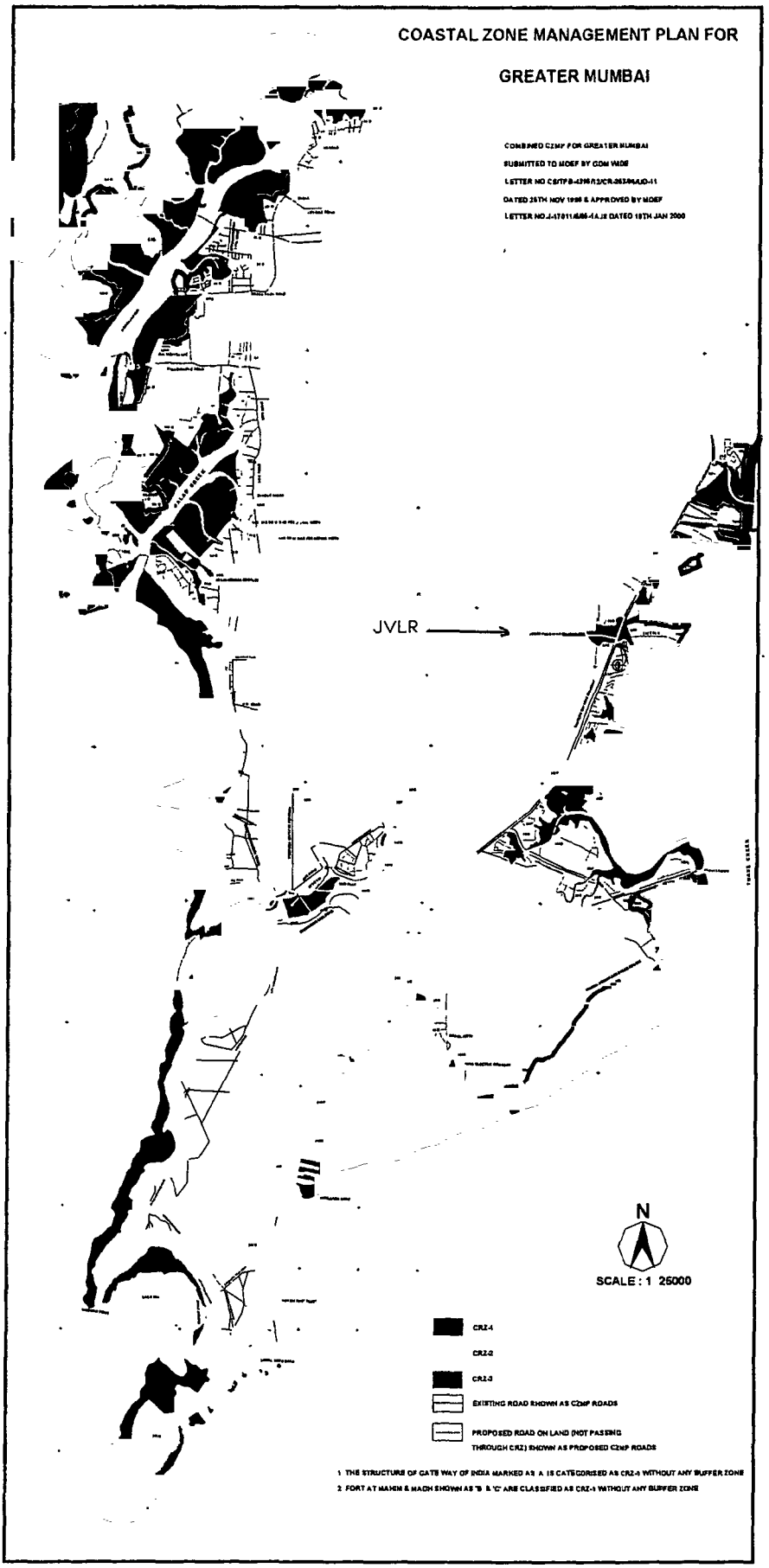
2.0 In this regard, it may be clarified that rail projects do not attract the provisions of the EIA Notification, 1994 and hence do not require environmental clearance under the provisions thereof. As regards the road projects to be undertaken as part of the Mumbai Urban Transport Project, it is noted that these projects do not fall in the category of highway projects and hence would not require environmental clearance under the provisions of the EIA Notification, 1994.

3.0 However, environmental clearance under the provisions of the CRZ Notification, 1991 and amendments thereof would need to be obtained for road and rail projects/components falling under CRZ, as may be applicable.

Yours faithfully,

Sd/-

(S.K.Aggrawal)
Additional Director
Tel. No. 436 2434



urce: Consolidated EA Report on MUTP, MMRDA, January 2002

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The Maharashtra (Urban Areas) Preservation of Trees Act, 1975

6 GOM legislation requires every local authority to constitute a Tree Authority No tree can be felled without the permission of this authority The Road development agencies will have to obtain the permission of the Tree Authority for felling of trees in the right of way and follow the Tree Authorities stipulations in respect of transplanting or compensatory plantation.

Legislation related to R & R.

Land Acquisition Act 1894 (LA Act):

7. This act provides for compulsory acquisition of land for public purposes by paying compensation at the market rate with 30% solatium for the compulsory nature of acquisition and interest at 12 percent per annum from the date of notification of land for acquisition

Maharashtra Regional and Town Planning Act, 1966 (MR&TP Act):

8. The act provides for preparation of Regional Plan for the MMR as a whole and preparation of Development Plans (Master Plans) for the local jurisdiction of individual municipal authority like MCGM The Regional Plan of MMR has been sanctioned in 1999 whereas the Development Plan of Greater Mumbai was sanctioned in 1991. The Regional Plan is policy oriented and strategic in nature whereas Development Plan is more specific and prescribes detailed land use zoning including designation of land required for public purposes, which can then be acquired in conjunction with the provisions of Land Acquisition Act The act also provides a statutory framework for formulation and enforcement of Development Control Regulations. The sub-projects are required to be consistent with the Regional Plan and the Development Plan

Development Control Regulations for Greater Mumbai 1991 (DCRs)

9 The DCRs set out the standards for building design and construction, provision of services like water supply, sewerage, site drainage, access roads, elevators, fire fighting etc. A separate set of regulations is included for the redevelopment or resettlement of slums, which are administered by the Slum Rehabilitation Authority (SRA). Buildings procured for R & R have to conform to these DCRs Up-front clearance of the entire project is however not required under the DCR Approvals are to be obtained for individual scheme, as it gets prepared

10. These regulations prepared under the MR & TP Act offer an alternative to acquisition under LA Act by way of Transfer of Development Rights (TDR). The permissible Floor Space Index (FSI) defines the development rights of every parcel of land in Mumbai If a particular parcel of land is designated for a public purpose the landowner has an option of accepting monetary compensation under the LA Act 1894 or accept TDR (equivalent to the plot area times the permissible FSI),

which can be sold in the market for use elsewhere in Mumbai. The DC Regulations have been amended to provide incentives for rehabilitation (including resettlement of slum dwellers) in 1997. For landowners prepared to provide 225 sq.ft. dwelling units free of cost to slum dwellers, the incentive is in the form of right to build and sell floor space equivalent to that required for slum rehabilitation subject to the maximum *in-situ* utilization of FSI of 2 5. The remainder of the total development rights can be used as TDR In case of land designated for resettlement of slum dwellers affected by infrastructure projects, the land owner has an option of offering dwelling units to the project implementing agency free of cost and getting the benefit of maximum of TDR equivalent to floor area calculated at FSI of 3 5 (1 for land and 2.5 for the built-up area).

The Maharashtra Co-operative Societies Act 1960

11 This act provides for establishing, registering and administering the co-operative societies. Housing co-operative is a special form of co-operative society, where the land and building is owned by the co-operative and its members have occupancy rights of apartment occupied by them. Sale and purchase of such units can take place only with the consent of the society This is a common form of tenure in Mumbai's apartment buildings and is widely understood

Applicable World Bank Policies

12. Given that MUTP has been developed with the intention of mobilizing financial resources from the World Bank, project preparation has included a number of studies and assessments which have sought to address and meet the requirements of the World Bank's environmental and social policies, often referred as the 'safeguard' policies. The next paragraphs provide a summary overview of how these guidelines have been considered

Environmental Assessment (OP 4.01)

13 In the context of the Bank's Operational Policy (OP) 4.01 on Environmental Assessment, MUTP has been classified as category "A" project, largely on the basis of the large number of people requiring resettlement and rehabilitation. Because of the large-scale resettlement and the triggering of more than one safeguard policy the project is also classified as "S1" in terms of safeguard issues A consolidated EA including SEA has been prepared that provides the framework for preparing sub-project specific EA and EMPs in compliance with the World Bank policy

Cultural Property (OP 4.11)

14 The United Nations term "cultural property" includes sites having archeological (prehistoric), paleontological, historical, religious, and unique natural values Cultural property, therefore, encompasses both remains left by previous human inhabitants (for example, middens, shrines, and battlegrounds) and unique natural environmental features such as canyons and waterfalls The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination

15. Mumbai with its history of nearly three hundred years is rich in cultural property particularly in the form of built heritage GOM and MCGM are acutely aware of the need to conserve such heritage GOM in 1995 with the involvement of NGOs listed over 600 buildings and precincts as of heritage significance DCR 67 governs the development of these listed buildings and precincts GOM has also constituted a Heritage Conservation Committee in 1995 to advise the Municipal Commissioner regarding development permission to be granted in case of listed buildings and precincts. No development permission can be granted of the listed buildings or within the precincts without the consent of the Heritage Committee.

16 During the execution of works, if a "chance find " of archaeological significance occurs, the contract requires the contractor to immediately inform the employer and stop further work Employer will in turn inform the state Archaeology Department for further investigation.

17. The only cultural properties that are directly affected by the sub projects are small places of worship established by the community of squatters within the right of way. These have been created by the affected communities for their own use Such places of worship do not possess any historical or architectural significance and may not therefore strictly qualify to be treated as cultural property. Nevertheless they are treated as an integral part of preparation of RIPs. The places of worship and other community assets are identified during the BSES Their rehabilitation is being implemented as a part of the R & R process in consultation with the community. The impact on these properties and the manner in which such impacts can be identified can be classified in three categories Firstly the buildings that are only partially affected can be helped to add equivalent area elsewhere adjacent to the building. Secondly structures that are fully affected by the right of way but are patronized by the community that is not affected by the project could be rebuilt outside the right of way in consultation with the community and with assistance of the NGO. In some cases the entrance to the structure could be reoriented to ensure safety of the devotees visiting the place. Thirdly the affected structures that patronized by the community being resettled could be relocated in consultation with the community In addition, the community may agree to forego some places without insisting upon their resettlement

Natural Habitat (OP 4.04):

18. *Natural habitats* are defined as land and water areas where (i) the ecosystems' biological communities are formed largely by native plant and animal species, and (ii) human activity has not essentially modified the area's primary ecological functions. All natural habitats have important biological, social, economic, and existence value Important natural habitats may occur in tropical humid, dry, and cloud forests, temperate and boreal forests; Mediterranean-type shrub lands, natural arid and semi-arid lands; mangrove swamps, coastal marshes, and other

wetlands; estuaries; sea grass beds; coral reefs; freshwater lakes and rivers; alpine and sub alpine environments, including herb fields, grasslands, and paramos, and tropical and temperate grasslands *Critical natural habitats* include existing protected areas and areas officially proposed by governments as protected areas (e g , reserves that meet the criteria of the World Conservation Union [IUCN] classifications i e Strict Nature Reserve/Wilderness Area: protected area managed for science or wilderness protection; II-National Park: protected area managed mainly for ecosystem protection and recreation; III-Natural Monument. protected area managed mainly for conservation of specific natural features; IV-Habitat/Species Management Area protected area managed mainly for conservation through management intervention; V-Protected Landscape/Seascape protected area managed mainly for landscape/seascape conservation and recreation, and VI-Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development

19. From this perspective one of Mumbai's notable natural habitat is limited to the 103 sq.km National Park at Borivali, which is located in the northern part of the peninsula between the two rail corridors The National Park is protected under the Indian Forest Act None of the sub-projects passes through the National Park. The other important Natural Habitat is the coastal wetlands in the eastern and western suburbs and along the Vasai creek These are protected by the Coastal Regulation Zone (CRZ) Notification of 19 February 1991.

Involuntary Resettlement (OD 4.30)

20. The Operational Directive 4.30 describes Bank policy and procedures on involuntary resettlement, as well as the conditions that borrowers are expected to meet in operations involving involuntary resettlement. Planning and financing resettlement of projects are an integral part of preparation for projects that cause involuntary displacement MUTP will require resettlement of about 19000 households (68000 persons) The World Bank Policy on Involuntary Resettlement is therefore applicable to the project In compliance with to this policy an R & R Policy has been prepared and adopted by GOM for MUTP RAP providing the overall framework of policy, entitlements, consultative processes, grievance redressal mechanism, component costs and monitoring and evaluation mechanism has already been prepared. Sub-project specific RIPs are being prepared.

Indigenous People (OD 4.20)

21. This operational directive describes Bank policies and processing procedures for projects that affect indigenous peoples It sets out basic definitions, policy objectives, and guidelines for the design and implementation of project provisions or components for indigenous peoples. The terms "indigenous peoples," "indigenous ethnic minorities," "tribal groups," and "scheduled tribes" describe social groups with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process For the purposes of this directive, "indigenous peoples" is the term that will be used to refer to these groups. Indigenous peoples can be identified in particular geographical areas by the presence in varying degrees of the following characteristics. (a) a close attachment to ancestral territories and to the natural resources in these areas, (b) self-identification and identification by others as members of a distinct cultural group; (c) an indigenous language, often different from the national language;(d) presence of customary social and political institutions, and (e) primarily subsistence-oriented production

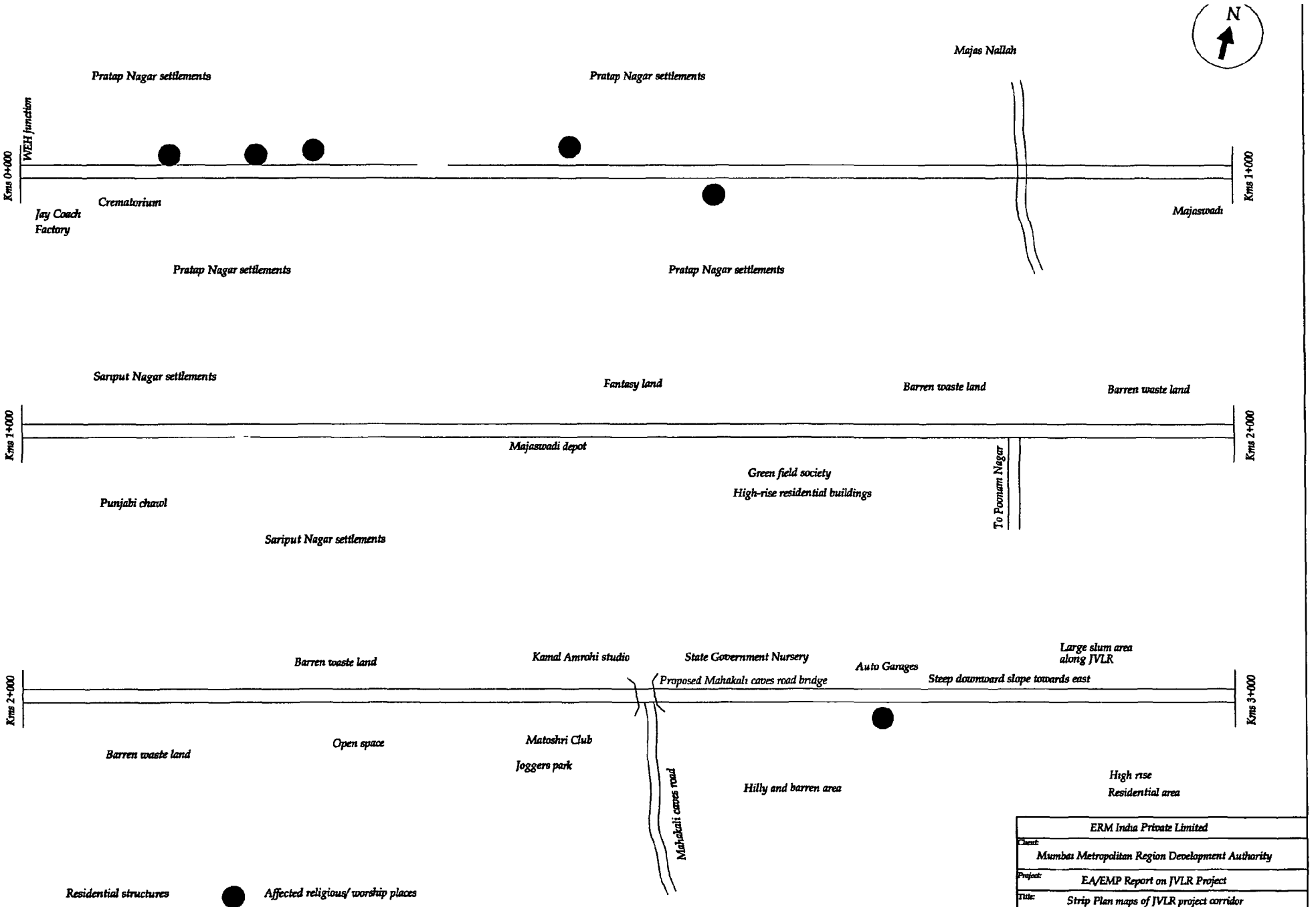
22. About 1% of the PAHs of MUTP belong to the Scheduled Tribes A field-based review was undertaken to determine if these PAHs were subject to application of this Policy since they might have originally belonged to tribal communities in the distant past. As of now they are integrated with the city life and do not have their traditional habitat or follow traditional ways of life More particularly, (a) they no longer have close attachment to ancestral territories; (b) they do not identify themselves or are identified by others as distinct cultural group; (c) they do not speak an indigenous language; and (d) they no longer belong to customary social and political institutions. There is also a general reluctance to reveal the caste or tribe particularly pronounced when data is to be kept in public domain It was determined by the review that the social impact of the project on such people is therefore similar to that on other PAHs and thus the policy does not apply No separate Indigenous Peoples Development Plan (IPDP) has therefore been prepared.

Other Safeguard Policies

23. World Bank has other safeguard policies dealing with Pest Management, Forestry, Safety of Dams and Projects in International Waterways or in Disputed Areas These are however not applicable to MUTP

Annex B

Strip Plan Maps of the JVLR Project Corridor



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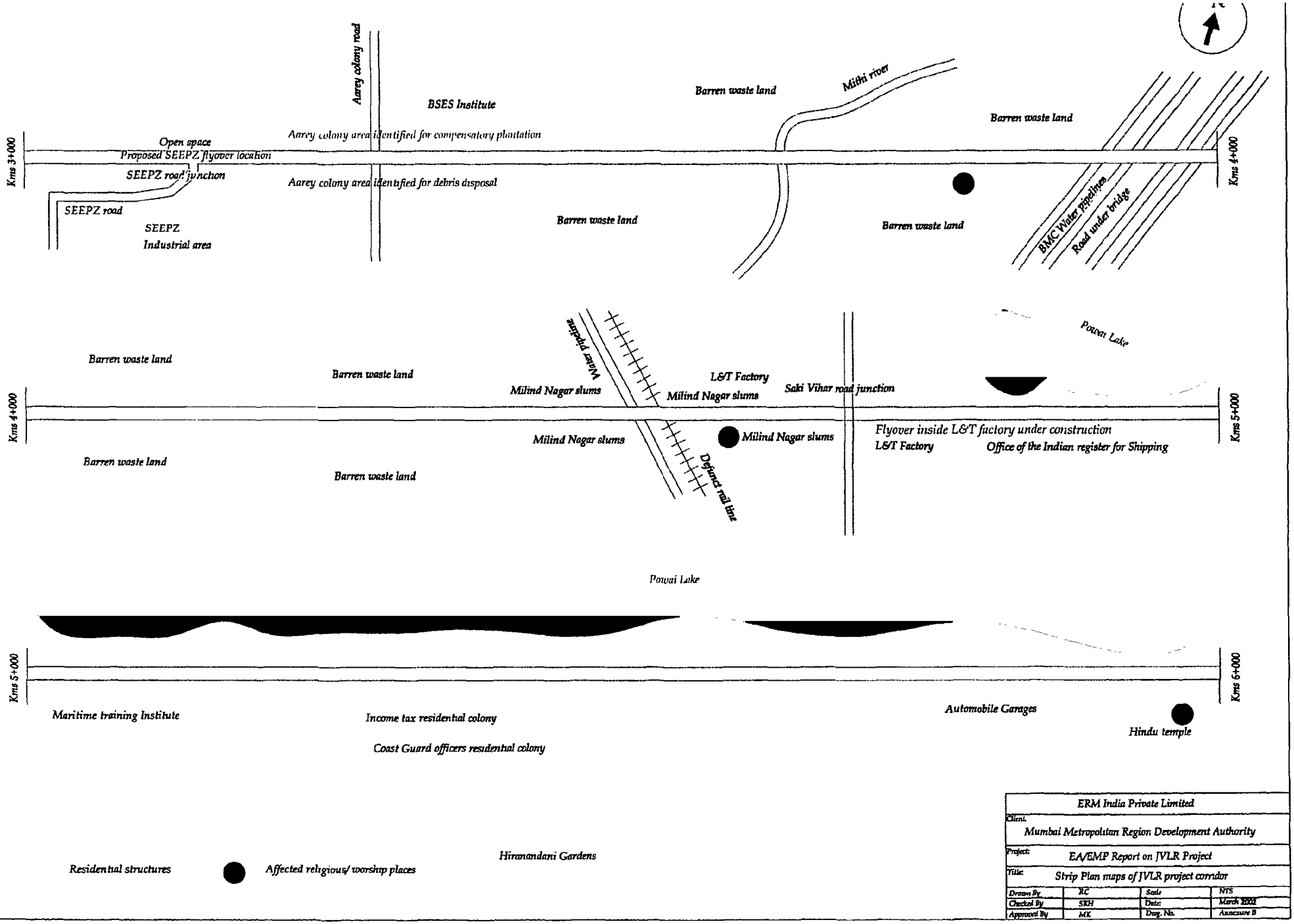
Client: Mumbai Metropolitan Region Development Authority			
Project: EA/EMP Report on JVLR Project			
Title: Strip Plan maps of JVLR project corridor			
Drawn By	RC	Scale	NTS
Checked By	SKH	Date	March 2002
Approved By	MK	Drg. No.	Annexure B



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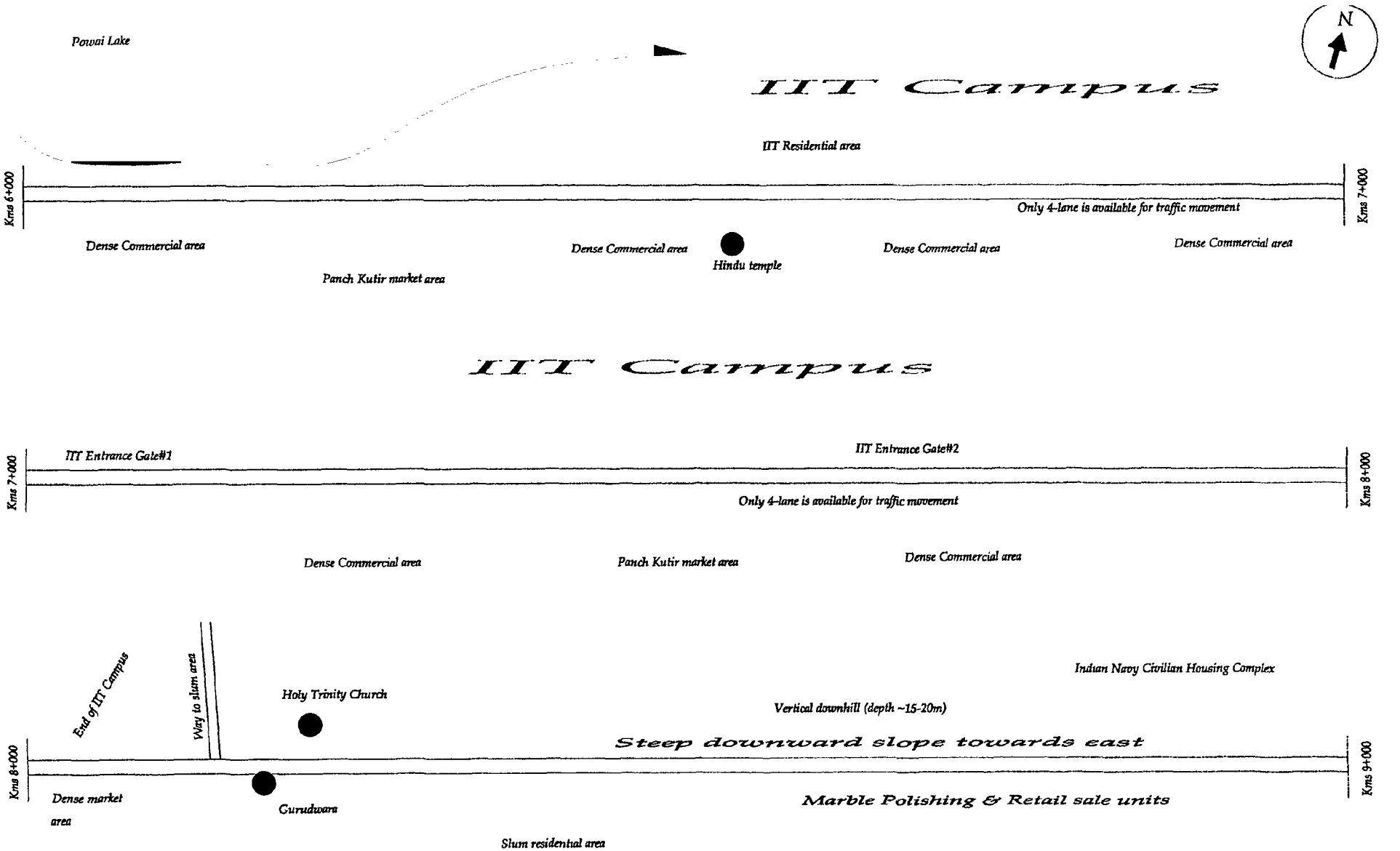
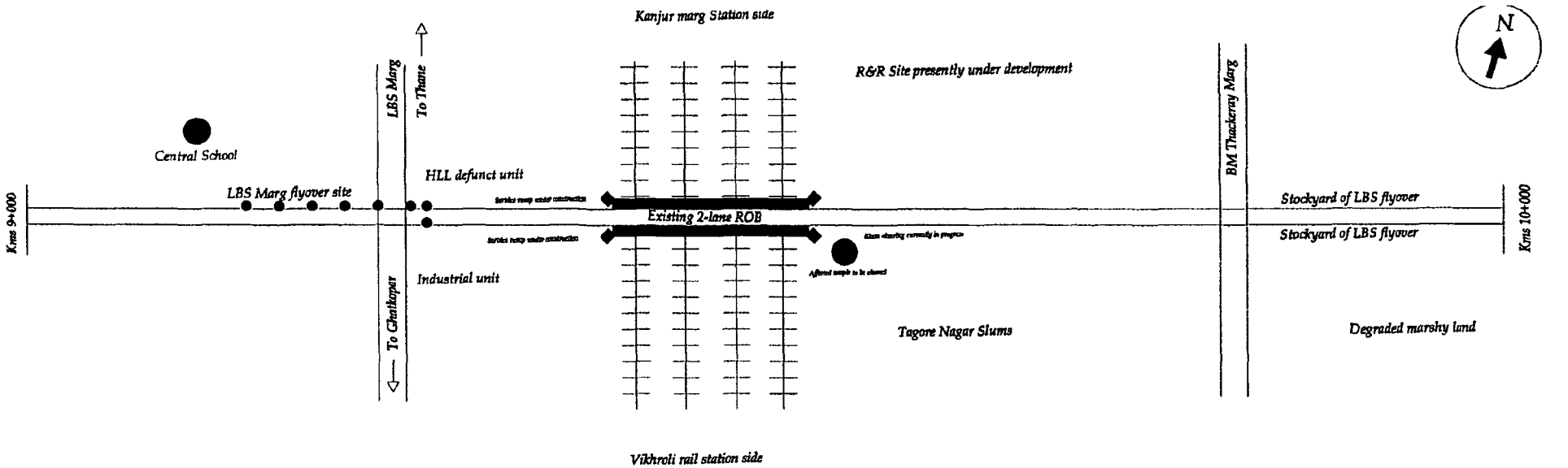
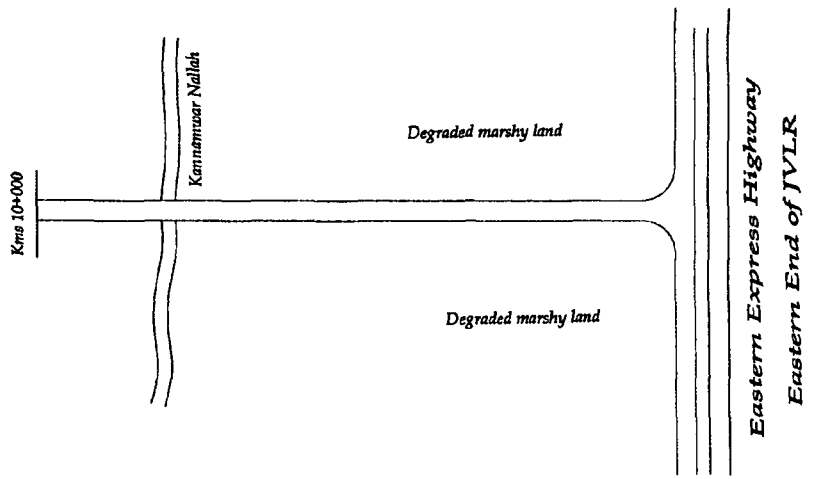
Checked By	SKH	Date	March 2002
Approved By	MK	Dwg. No.	Annexure B



ERM India Private Limited			
Client: Mumbai Metropolitan Region Development Authority			
Project: EA/EMP Report on JVLR Project			
Title: Strip Plan maps of JVLR project corridor			
Drawn By	RC	Scale	NTS
Checked By	SKH	Date:	March 2001
Approved By	MK	Drg No.	Annexure II





Residential structures

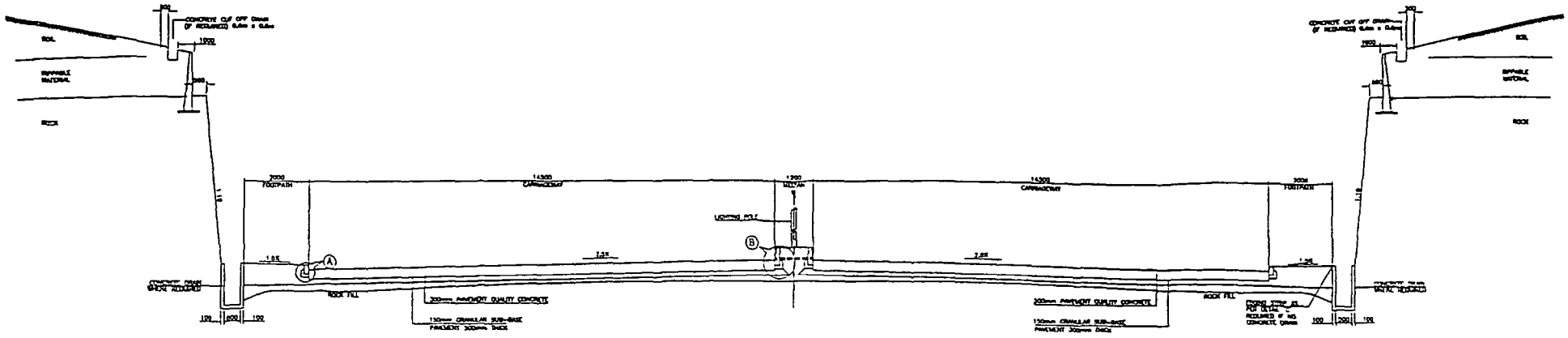
Affected religious/ worship places

Sensitive receptor

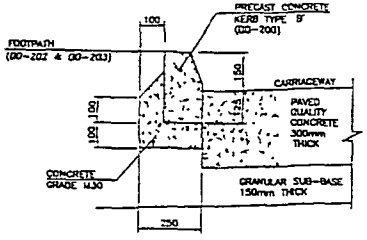
ERM India Private Limited			
Client: Mumbai Metropolitan Region Development Authority			
Project: EA/EMP Report on JVLR Project			
Title: Strip Plan maps of JVLR project corridor			
Drawn By	RC	Scale	NTS
Checked By	SKH	Date	March 2022
Approved By	MK	Drg. No.	Annexure B

Annex C

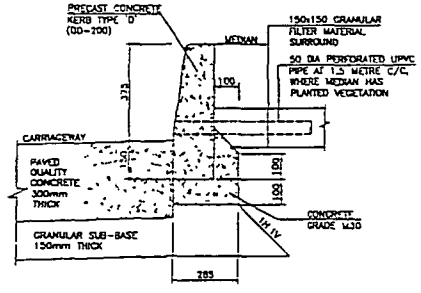
Drawings from DPR on JVLR Project



TYPICAL ROAD CROSS-SECTION OF MAIN CARRIAGEWAY FOR SECTION 1



DETAIL 'A'
(SCALE 1:10)



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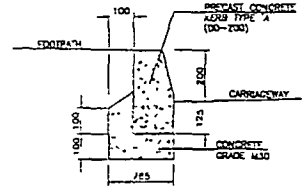
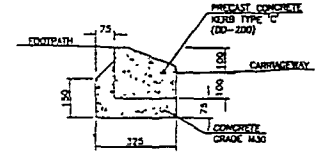


BARRIER KERB
(SCALE 1:10)



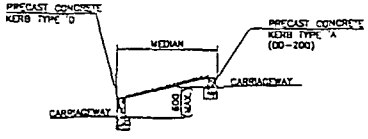
MOUNTABLE KERB
(SCALE 1:10)

NOTES:

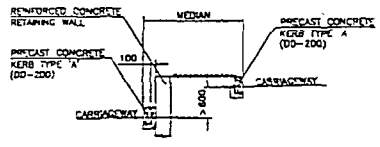
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.
2. THE MEDIAN WIDTH GENERALLY VARIES AS SHOWN ON 'PAVEMENT ELEVATION AND HORIZONTAL CONTROL DRAWINGS.
3. THE OVERALL ROAD CROSS-SECTION WIDTH OF MAIN CARRIAGEWAY IS INCREASED AT JUNCTIONS TO ACCOMMODATE TURNING LANES. DETAILS OF LANE, MEDIAN AND ISLAND WIDTHS ARE SHOWN ON 'PAVEMENT ELEVATION AND HORIZONTAL CONTROL DRAWINGS.
4. THE CARRIAGEWAY CROSSFALL OF 2.5% SHOWN IS FOR NORMAL CROSS-SECTION. CROSSFALL VARIES FOR SUPERELEVATED CROSS-SECTION AS SHOWN ON ROAD CROSS-SECTION DRAWINGS.
5. FOR CONCRETE PAVEMENT JOINT DETAILS SEE STANDARD DRAWINGS DD-101 AND DD-102.
6. FOR FOOTPATH PAVING DETAILS SEE STANDARD DRAWINGS DD-202 AND DD-203. INTERLOCKING PAVING BLOCKS AS PER DD-203 IS TO BE USED GENERALLY EXCEPT AT JUNCTIONS WHERE CONCRETE PAVING PER DD-202 IS USED, AS INDICATED ON 'ROAD PLAN' DRAWINGS AND AS DIRECTED BY THE ENGINEER. FOOTPATH WIDTH IS 2 METRES IN GENERAL, BUT INCREASED TO 3 METRES AT JUNCTIONS WHERE FEASIBLE.
7. KERB UTILIZATION IS GENERALLY AS FOLLOWS.
   - BARRIER KERB (TYPE 'A' AS PER DD-200 & DD-201) AT SPLIT LEVEL CARRIAGEWAYS AND SLIP ROAD SEPARATIONS.
   - SEMI-BARRIER KERB (TYPE 'B' AS PER DD-200 & DD-201) AT ROAD OUTSIDE EDGES.
   - MOUNTABLE KERB (TYPE 'C' AS PER DD-200 & DD-201) AT PEDESTRIAN CROSSINGS.
   - HIGH BARRIER KERB (TYPE 'D' AS PER DD-200) AT MEDIAN EDGES.

   KERB DETAILS ARE GIVEN IN DD-200 & DD-201. KERBS AS PER DD-200 ARE GENERALLY USED. ACTUAL KERB USAGE IS AS INDICATED ON ROAD PLAN DRAWINGS AND AS DIRECTED BY THE ENGINEER.

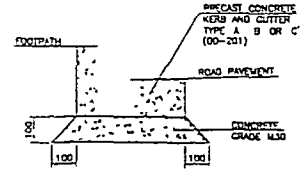
   CAST-IN-PLACE CONCRETE GRADE M35 KERB TRANSITIONS ARE TO BE USED AT CHANGES OF KERB TYPE.
8. STORMWATER DRAINAGE PIPES RUNS ARE TO BE LOCATED GENERALLY UNDER THE FOOTPATH.
9. UTILITY SERVICES RELOCATIONS ARE TO BE UNDER THE FOOTPATH OR BEYOND THE FOOTPATH.



MEDIAN DETAIL AT SPLIT LEVEL
(UP TO 600mm) CARRIAGEWAYS
(SCALE 1:50)



MEDIAN DETAIL AT SPLIT LEVEL
(GREATER THAN 600mm) CARRIAGEWAYS
(SCALE 1:50)



KERB AND GUTTER
BEDDING DETAIL
(SCALE 1:10)

FIGURE 1.3 -TYPICAL CROSS SECTION OF ROAD IN CUTTING

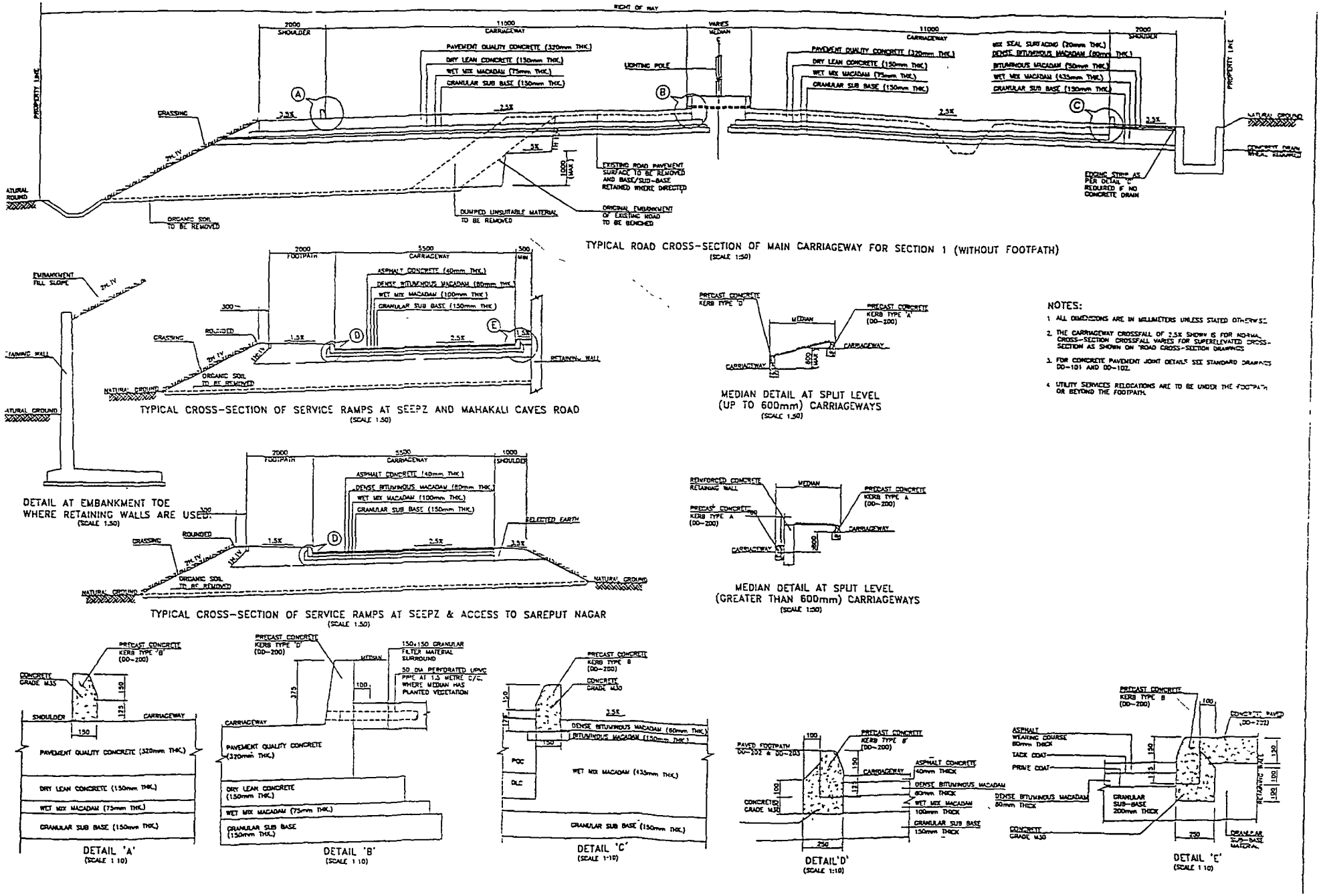
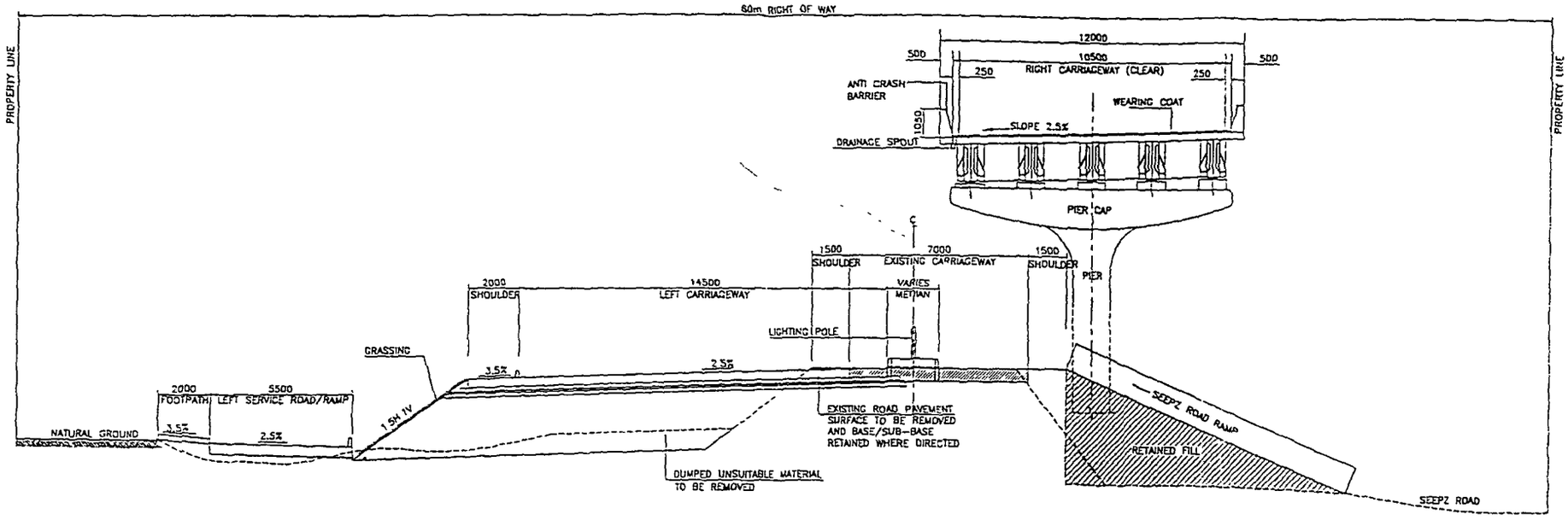


FIGURE 1.2 -TYPICAL CROSS SECTION OF ROAD IN EMBANKMENT



TYPICAL ROAD CROSS-SECTION OF MAIN CARRIAGEWAY IN FRONT OF SEEPZ JUNCTION

NOTES.

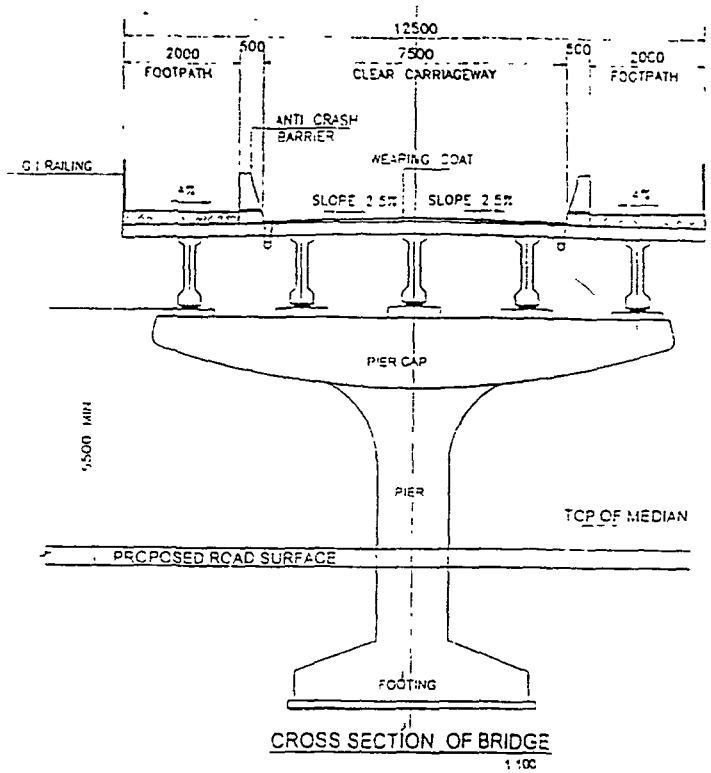
1 ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.

2. THE CARRIAGEWAY CROSSFALL OF 2.5% SHOWN IS FOR NORMAL CROSS-SECTION CROSSFALL VARIES FOR SUPERELEVATED CROSS-SECTION AS SHOWN ON ROAD CROSS-SECTION DRAWINGS.

3 FOR CONCRETE PAVEMENT JOINT DETAILS SEE STANDARD DRAWINGS DD-101 AND DD-102.

4 UTILITY SERVICES RELOCATIONS ARE TO BE UNDER THE FOOTPATH OR BEYOND THE FOOTPATH.

FIGURE 1.4 -TYPICAL CROSS SECTION OF ROAD AT SEEPZ JUNCTION



PROPOSED VEHICULAR BRIDGE NEAR MAHAKALI CAVES
AT JOGESHWARI-VIKHROLI LINK ROAD.

DRG.NO.97118/BS/SK-002

Source: Detailed Project Report on JVLR project, December, 2001,

ERM India Private Limited

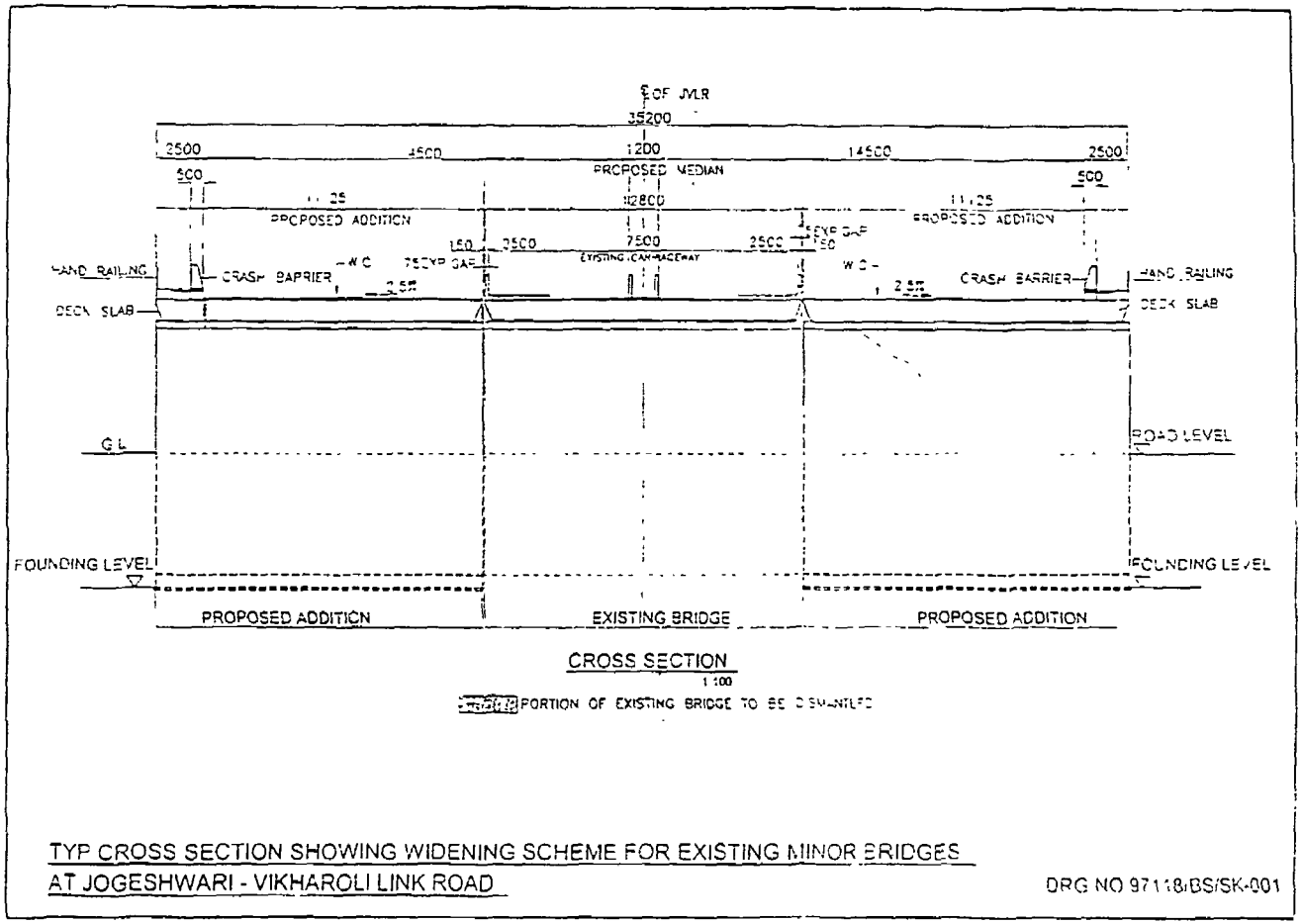
Project Preparation of EA/EMP report for JVLR project

Client Mumbai Metropolitan Region Development Authority

Title Proposed c/s details of SEEPZ flyover

Figure: Annex C

ERM



TYP CROSS SECTION SHOWING WIDENING SCHEME FOR EXISTING MINOR BRIDGES AT JOGESHWARI - VIKHAROLI LINK ROAD

DRG NO 97118/BS/SK-001

Source: Detailed Project Report on JVLR project, December, 2001,

ERM India Private Limited

Project Preparation of EA/EMP report for JVLR project

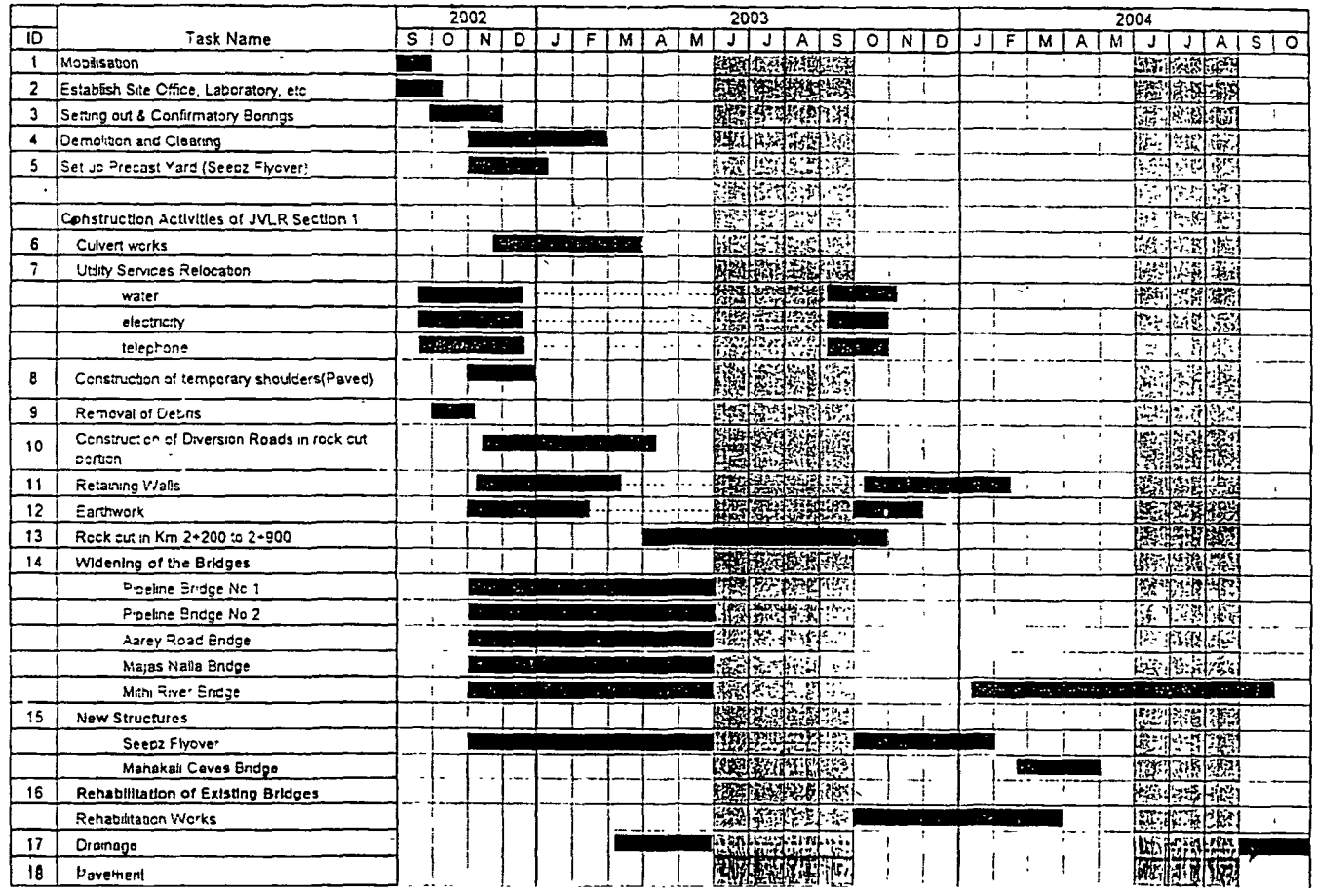
Client Mumbai Metropolitan Region Development Authority

Title Proposed c/s details of SEEPZ flyover

Figure: Annex C

ERM

Construction Program



Proposed Construction program for JVLR Project

Source: Detailed Project Report on JVLR project, December, 2001,

ERM India Private Limited

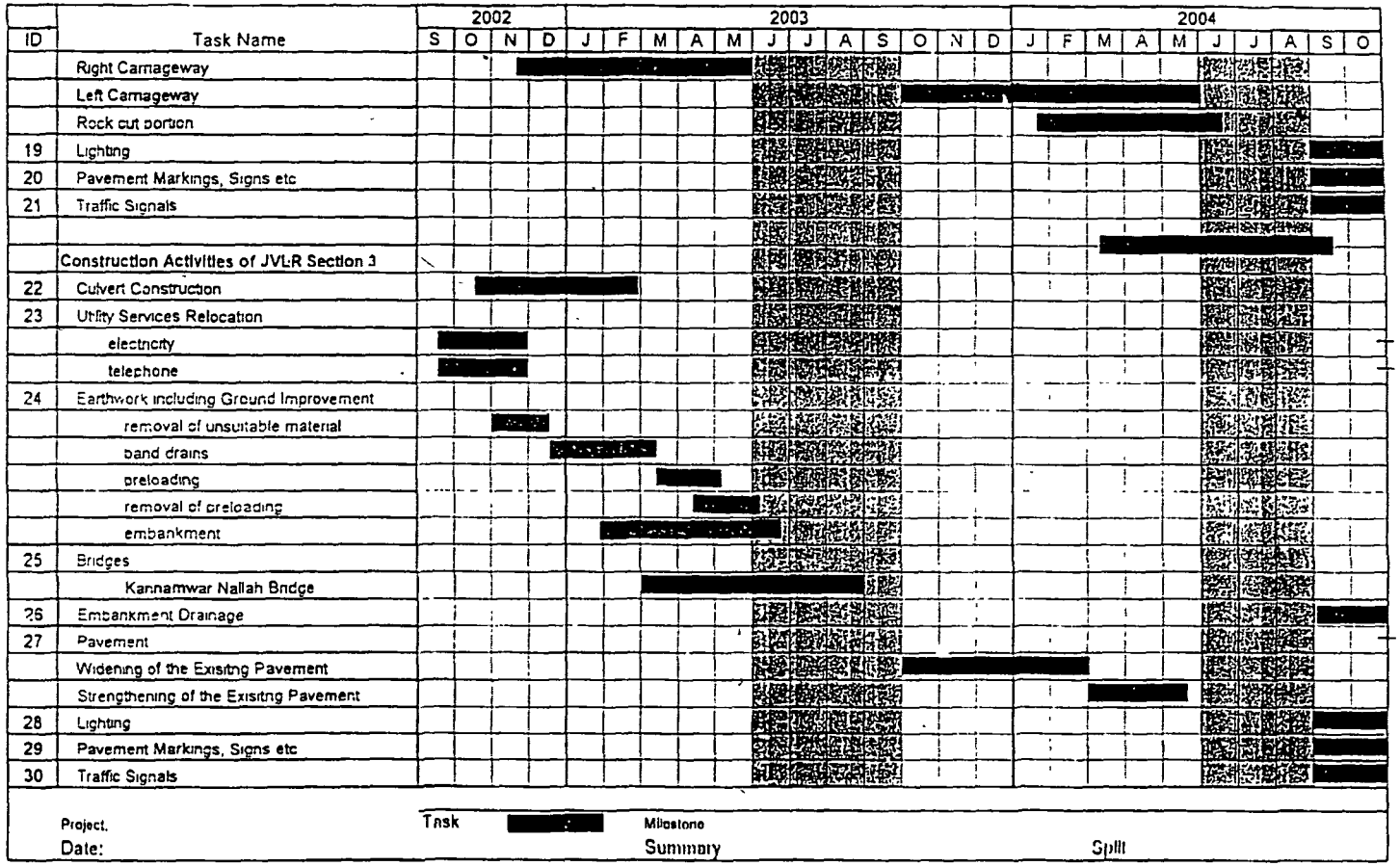
Project Preparation of EA/EMP report for JVLR project

Client Mumbai Metropolitan Region Development Authority

Title Proposed Construction program for JVLR project

Figure: Annex C

ERM



Proposed Construction program for JVLR Project

Source: Detailed Project Report on JVLR project, December, 2001,

ERM India Private Limited

Project Preparation of EA/EMP report for JVLR project

Client Mumbai Metropolitan Region Development Authority

Title Proposed Construction program for JVLR project

Figure: Annex C

ERM

Annex D

Baseline Monitoring Data

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -SEEPZ Road Junction — Date of Sampling 2/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	484	ug/m3	24 hrs
2	Respirable Particulate Matter	296	ug/m3	24 hrs
3	**Sulphur Dioxide**			
	Sample - I	36 8	ug/m3	8 hrs
	Sample - II	41 4	ug/m3	8 hrs
	Sample - III	32 2	ug/m3	8 hrs
	Sample-IV	34 2	ug/m3	24 hrs
4	**Oxides Nitrogen**			
	Sample - I	50 2	ug/m3	8 hrs
	Sample - II	58 4	ug/m3	8 hrs
	Sample - III	42 6	ug/m3	8 hrs
	Sample-IV	46 5	ug/m3	24 hrs
5	**Hydrocarbon (Non - Methane)**			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -SEEPZ Road Junction — Date of Sampling - 2/2/2002

S No	Parameters	Concentration	Units	Duration
6	**Carbon Monoxide**			
	0600	1 8	mg/m3	1 hr
	0700	2 0	mg/m3	1 hr
	0800	2 2	mg/m3	1 hr
	0900	2 1	mg/m3	1 hr
	1000	3 6	mg/m3	1 hr
	1100	4 1	mg/m3	1 hr
	1200	4 8	mg/m3	1 hr
	1300	5 4	mg/m3	1 hr
	1400	4 2	mg/m3	1 hr
	1500	3 1	mg/m3	1 hr
	1600	2 6	mg/m3	1 hr
	1700	2 8	mg/m3	1 hr
	1800	3 1	mg/m3	1 hr
	1900	4 8	mg/m3	1 hr
	2000	6 1	mg/m3	1 hr
	2100	6 4	mg/m3	1 hr
	2200	5 5	mg/m3	1 hr
	2300	5 1	mg/m3	1 hr
	2400	3 9	mg/m3	1 hr
	0100	2 8	mg/m3	1 hr
	0200	2 0	mg/m3	1 hr
	0300	1 6	mg/m3	1 hr
	0400	1 4	mg/m3	1 hr
	0500	1 6	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WEH Junction Date of Sampling 2/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	556	ug/m3	24 hrs
2	Respirable Particulate Matter	352	ug/m3	24 hrs
3	Sulphur Dioxide			
	Sample - I	39 2	ug/m3	8 hrs
	Sample - II	48 4	ug/m3	8 hrs
	Sample - III	31 5	ug/m3	8 hrs
	Sample-IV	37 6	ug/m3	24 hrs
4	Oxides Nitrogen			
	Sample - I	59 4	ug/m3	8 hrs
	Sample - II	68 2	ug/m3	8 hrs
	Sample - III	47 5	ug/m3	8 hrs
	Sample-IV	52 6	ug/m3	24 hrs
5	Hydrocarbon (Non - Methane)			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WLH Junction Date of Sampling 2/2/2002

S No	Parameters	Concentration	Units	Duration
6	Carbon Monoxide			
	0600	2 0	mg/m3	1 hr
	0700	2 2	mg/m3	1 hr
	0800	2 6	mg/m3	1 hr
	0900	3 1	mg/m3	1 hr
	1000	3 6	mg/m3	1 hr
	1100	4 2	mg/m3	1 hr
	1200	5 1	mg/m3	1 hr
	1300	6 8	mg/m3	1 hr
	1400	5 0	mg/m3	1 hr
	1500	4 1	mg/m3	1 hr
	1600	3 2	mg/m3	1 hr
	1700	4 4	mg/m3	1 hr
	1800	5 8	mg/m3	1 hr
	1900	6 6	mg/m3	1 hr
	2000	7 4	mg/m3	1 hr
	2100	6 9	mg/m3	1 hr
	2200	5 2	mg/m3	1 hr
	2300	4 3	mg/m3	1 hr
	2400	3 6	mg/m3	1 hr
	0100	2 8	mg/m3	1 hr
	0200	2 2	mg/m3	1 hr
	0300	1 8	mg/m3	1 hr
	0400	1 2	mg/m3	1 hr
	0500	1 2	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -SEEPZ Road Junction Date of Sampling 4/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	524	ug/m3	24 hrs
2	Respirable Particulate Matter	318	ug/m3	24 hrs
3	**Sulphur Dioxide**			
	Sample - I	38 6	ug/m3	8 hrs
	Sample - II	45 4	ug/m3	8 hrs
	Sample - III	30 3	ug/m3	8 hrs
	Sample-IV	36 1	ug/m3	24 hrs
4	**Oxides Nitrogen**			
	Sample - I	54 5	ug/m3	8 hrs
	Sample - II	64 2	ug/m3	8 hrs
	Sample - III	50 1	ug/m3	8 hrs
	Sample-IV	52 3	ug/m3	24 hrs
5	**Hydrocarbon (Non - Methane)**			
	Sample - I	BDI	ppm	3 hrs
	Sample - II	BDI	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDI	ppm	3 hrs
	Sample - V	BDI	ppm	3 hrs
	Sample - VI	BDI	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location : JVLR -SEEPZ Road Junction Date of Sampling · 4/2/2002

S. No	Parameters	Concentration	Units	Duration
6	**Carbon Monoxide**			
	0600	1 8	mg/m3	1 hr
	0700	1 9	mg/m3	1 hr
	0800	2 0	mg/m3	1 hr
	0900	3 1	mg/m3	1 hr
	1000	3 8	mg/m3	1 hr
	1100	4 6	mg/m3	1 hr
	1200	5 8	mg/m3	1 hr
	1300	6 1	mg/m3	1 hr
	1400	6 5	mg/m3	1 hr
	1500	5 1	mg/m3	1 hr
	1600	3 2	mg/m3	1 hr
	1700	3 8	mg/m3	1 hr
	1800	5 8	mg/m3	1 hr
	1900	6 1	mg/m3	1 hr
	2000	6 8	mg/m3	1 hr
	2100	6 4	mg/m3	1 hr
	2200	5 5	mg/m3	1 hr
	2300	5 1	mg/m3	1 hr
	2400	3 7	mg/m3	1 hr
	0100	2 4	mg/m3	1 hr
	0200	1 8	mg/m3	1 hr
	0300	1 2	mg/m3	1 hr
	0400	1 1	mg/m3	1 hr
	0500	1 6	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WEH Junction Date of Sampling 4/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	598	ug/m3	24 hrs
2	Respirable Particulate Matter	366	ug/m3	24 hrs
3	Sulphur Dioxide			
	Sample - I	44 6	ug/m3	8 hrs
	Sample - II	52 4	ug/m3	8 hrs
	Sample - III	33 9	ug/m3	8 hrs
	Sample-IV	40 6	ug/m3	24 hrs
4	Oxides Nitrogen			
	Sample - I	55 6	ug/m3	8 hrs
	Sample - II	73 8	ug/m3	8 hrs
	Sample - III	49 1	ug/m3	8 hrs
	Sample-IV	54 6	ug/m3	24 hrs
5	Hydrocarbon (Non - Methane)			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WEH Junction Date of Sampling 4/2/2002

S No	Parameters	Concentration	Units	Duration
6	Carbon Monoxide			
	0600	1 4	mg/m3	1 hr
	0700	1 6	mg/m3	1 hr
	0800	2 1	mg/m3	1 hr
	0900	3 8	mg/m3	1 hr
	1000	4 2	mg/m3	1 hr
	1100	5 1	mg/m3	1 hr
	1200	6 2	mg/m3	1 hr
	1300	6 1	mg/m3	1 hr
	1400	6 8	mg/m3	1 hr
	1500	3 8	mg/m3	1 hr
	1600	3 0	mg/m3	1 hr
	1700	4 8	mg/m3	1 hr
	1800	5 4	mg/m3	1 hr
	1900	6 9	mg/m3	1 hr
	2000	7 6	mg/m3	1 hr
	2100	7 0	mg/m3	1 hr
	2200	5 0	mg/m3	1 hr
	2300	4 8	mg/m3	1 hr
	2400	4 0	mg/m3	1 hr
	0100	2 4	mg/m3	1 hr
	0200	2 1	mg/m3	1 hr
	0300	1 8	mg/m3	1 hr
	0400	1 6	mg/m3	1 hr
	0500	1 2	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -SEEPZ Road Junction Date of Sampling 6/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	568	ug/m3	24 hrs
2	Respirable Particulate Matter	389	ug/m3	24 hrs
3	**Sulphur Dioxide**			
	Sample - I	40 4	ug/m3	8 hrs
	Sample - II	49 6	ug/m3	8 hrs
	Sample - III	38 4	ug/m3	8 hrs
	Sample-IV	39 5	ug/m3	24 hrs
4	**Oxides Nitrogen**			
	Sample - I	60 3	ug/m3	8 hrs
	Sample - II	71 4	ug/m3	8 hrs
	Sample - III	54 3	ug/m3	8 hrs
	Sample-IV	58 2	ug/m3	24 hrs
5	**Hydrocarbon (Non - Methane)**			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -SLFPZ Road Junction Date of Sampling 6/2/2002

S No	Parameters	Concentration	Units	Duration
6	**Carbon Monoxide**			
	0600	1 6	mg/m3	1 hr
	0700	1 8	mg/m3	1 hr
	0800	2 2	mg/m3	1 hr
	0900	2 8	mg/m3	1 hr
	1000	3 2	mg/m3	1 hr
	1100	4 8	mg/m3	1 hr
	1200	5 2	mg/m3	1 hr
	1300	6 4	mg/m3	1 hr
	1400	6 9	mg/m3	1 hr
	1500	4 4	mg/m3	1 hr
	1600	4 3	mg/m3	1 hr
	1700	3 8	mg/m3	1 hr
	1800	5 1	mg/m3	1 hr
	1900	6 4	mg/m3	1 hr
	2000	6 8	mg/m3	1 hr
	2100	6 4	mg/m3	1 hr
	2200	5 8	mg/m3	1 hr
	2300	4 8	mg/m3	1 hr
	2400	3 2	mg/m3	1 hr
	0100	2 4	mg/m3	1 hr
	0200	1 8	mg/m3	1 hr
	0300	1 4	mg/m3	1 hr
	0400	1 2	mg/m3	1 hr
	0500	1 4	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WEH Junction Date of Sampling 6/2/2002

S. No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	. 624	ug/m3	24 hrs
2	Respnable Particulate Matter	388	ug/m3	24 hrs
3	Sulphur Dioxide			
	Sample - I	48 4	ug/m3	8 hrs
	Sample - II	65 8	ug/m3	8 hrs
	Sample - III	31 2	ug/m3	8 hrs
	Sample-IV	11 2	ug/m3	24 hrs
4	Oxides Nitrogen			
	Sample - I	58 1	ug/m3	8 hrs
	Sample - II	78 5	ug/m3	8 hrs
	Sample - III	55 6	ug/m3	8 hrs
	Sample-IV	62 8	ug/m3	24 hrs
5	Hydrocarbon (Non - Methane)			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location . JVLR -WEH Junction Date of Sampling 6/2/2002

S. No	Parameters	Concentration	Units	Duration
6	Carbon Monoxide			
	0600	1 6	mg/m3	1 hr
	0700	2 0	mg/m3	1 hr
	0800	2 8	mg/m3	1 hr
	0900	3 2	mg/m3	1 hr
	1000	4 0	mg/m3	1 hr
	1100	4 8	mg/m3	1 hr
	1200	5 5	mg/m3	1 hr
	1300	6 9	mg/m3	1 hr
	1100	5 7	mg/m3	1 hr
	1500	5 2	mg/m3	1 hr
	1600	3 4	mg/m3	1 hr
	1700	4 9	mg/m3	1 hr
	1800	5 8	mg/m3	1 hr
	1900	7 0	mg/m3	1 hr
	2000	7 8	mg/m3	1 hr
	2100	7 2	mg/m3	1 hr
	2200	6 0	mg/m3	1 hr
	2300	5 2	mg/m3	1 hr
	2400	4 2	mg/m3	1 hr
	0100	3 0	mg/m3	1 hr
	0200	2 2	mg/m3	1 hr
	0300	1 4	mg/m3	1 hr
	0400	1 2	mg/m3	1 hr
	0500	1 1	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -SEEPZ Road Junction Date of Sampling 8/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	510	ug/m3	24 hrs
2	Respirable Particulate Matter	341	ug/m3	24 hrs
3	Sulphur Dioxide			
	Sample - I	35 5	ug/m3	8 hrs
	Sample - II	42 6	ug/m3	8 hrs
	Sample - III	30 2	ug/m3	8 hrs
	Sample-IV	34 4	ug/m3	24 hrs
4	Oxides Nitrogen			
	Sample - I	54 5	ug/m3	8 hrs
	Sample - II	60 3	ug/m3	8 hrs
	Sample - III	50 1	ug/m3	8 hrs
	Sample-IV	51 6	ug/m3	24 hrs
5	Hydrocarbon (Non - Methane)			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location . JVLR -SEEPZ Road Junction Date of Sampling 8/2/2002

S No	Parameters	Concentration	Units	Duration
6	Carbon Monoxide			
	0600	1 2	mg/m3	1 hr
	0700	1 8	mg/m3	1 hr
	0800	2 1	mg/m3	1 hr
	0900	2 6	mg/m3	1 hr
	1000	3 8	mg/m3	1 hr
	1100	4 2	mg/m3	1 hr
	1200	5 2	mg/m3	1 hr
	1300	6 1	mg/m3	1 hr
	1400	6 4	mg/m3	1 hr
	1500	5 0	mg/m3	1 hr
	1600	4 7	mg/m3	1 hr
	1700	5 1	mg/m3	1 hr
	1800	5 8	mg/m3	1 hr
	1900	6 2	mg/m3	1 hr
	2000	6 6	mg/m3	1 hr
	2100	6 2	mg/m3	1 hr
	2200	5 4	mg/m3	1 hr
	2300	4 2	mg/m3	1 hr
	2400	3 0	mg/m3	1 hr
	0100	2 1	mg/m3	1 hr
	0200	1 8	mg/m3	1 hr
	0300	1 6	mg/m3	1 hr
	0400	1 4	mg/m3	1 hr
	0500	1 1	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WEH Junction — Date of Sampling 8/2/2002

S No	Parameters	Concentration	Units	Duration
1	Suspended Particulate Matter	571	ug/m3	24 hrs
2	Respirable Particulate Matter	360	ug/m3	24 hrs
3	Sulphur Dioxide			
	Sample - I	42 4	ug/m3	8 hrs
	Sample - II	55 6	ug/m3	8 hrs
	Sample - III	32 4	ug/m3	8 hrs
	Sample-IV	40 5	ug/m3	24 hrs
4	Oxides Nitrogen			
	Sample - I	55 6	ug/m3	8 hrs
	Sample - II	69 6	ug/m3	8 hrs
	Sample - III	48 4	ug/m3	8 hrs
	Sample-IV	53 2	ug/m3	24 hrs
5	Hydrocarbon (Non - Methane)			
	Sample - I	BDL	ppm	3 hrs
	Sample - II	BDL	ppm	3 hrs
	Sample - III	BDL	ppm	3 hrs
	Sample - IV	BDL	ppm	3 hrs
	Sample - V	BDL	ppm	3 hrs
	Sample - VI	BDL	ppm	3 hrs
	Sample - VII	BDL	ppm	3 hrs
	Sample -VIII	BDL	ppm	3 hrs

Note Detection Limit for Hydrocarbon (Non Methane) 0 1 ppm

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR -WEH Junction — Date of Sampling . 8/2/2002

S No	Parameters	Concentration	Units	Duration
6	Carbon Monoxide			
	0600	1 6	mg/m3	1 hr
	0700	2 2	mg/m3	1 hr
	0800	3 4	mg/m3	1 hr
	0900	3 6	mg/m3	1 hr
	1000	1 8	mg/m3	1 hr
	1100	5 4	mg/m3	1 hr
	1200	6 6	mg/m3	1 hr
	1300	7 1	mg/m3	1 hr
	1400	6 1	mg/m3	1 hr
	1500	6 2	mg/m3	1 hr
	1600	5 4	mg/m3	1 hr
	1700	6 0	mg/m3	1 hr
	1800	6 2	mg/m3	1 hr
	1900	7 2	mg/m3	1 hr
	2000	7 4	mg/m3	1 hr
	2100	7 0	mg/m3	1 hr
	2200	5 8	mg/m3	1 hr
	2300	5 4	mg/m3	1 hr
	2400	4 0	mg/m3	1 hr
	0100	3 6	mg/m3	1 hr
	0200	2 2	mg/m3	1 hr
	0300	1 8	mg/m3	1 hr
	0400	1 6	mg/m3	1 hr
	0500	1 4	mg/m3	1 hr

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR-SELPZ Road Junction

Date of Sampling 2-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	32 2	41 4	36 8	4 6	36 8	40 5	41 2
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	12 6	58 4	50 4	7 9	50 2	56 8	58 1
7	CO (1 hourly), mg/m3	1 1	6 1	3 5	1 5	3 1	5 5	6 3
8	HC-Non Methane (3 hourly), mg/m3		-	-	-	-	-	-

Location JVLR-SELPZ Road Junction

Date of Sampling 4-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	30 3	45 4	38 1	7 6	36 6	44 0	45 1
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	50 1	61 2	56 3	7 2	54 5	62 3	63 8
7	CO (1 hourly), mg/m3	1 2	6 8	4 0	1 9	3 8	6 3	6 7
8	HC-Non Methane (3 hourly) mg/m3	-	-	-	-	-	-	-

AMBIENT AIR QUALITY MONITORING REPORT

Location JVLR-SELPZ Road Junction

Date of Sampling 6-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	38 4	49 6	42 8	6 0	40 4	47 8	49 2
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	54 3	71 1	62	8 7	60 3	69 2	71
7	CO (1 hourly), mg/m3	1 2	6 9	3 9	1 9	4 1	6 4	6 9
8	HC-Non Methane (3 hourly), mg/m3	-	-	-	-	-	-	-

Location JVLR-SELPZ Road Junction

Date of Sampling 8-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	30 2	42 6	36 1	6 2	35 5	41 2	42 3
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	50 1	60 3	55	5 1	54 5	59 1	60 1
7	CO (1 hourly), mg/m3	1 2	6 6	3 9	1 9	4 2	6 2	6 5
8	HC-Non Methane (3 hourly), mg/m3	-	-	-	-	-	-	-

AMBIENT AIR QUALITY MONITORING REPORT

Location JV LR-WEH Junction

Date of Sampling 2-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	31 5	48 4	39 7	8 5	39 2	46 6	48
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	47 5	68 2	58 4	10 4	59 4	66 4	67 8
7	CO (1 hourly), mg/m3	1 2	7 4	4 0	1 8	3 9	6 7	7 2
8	HC-Non Methane (3 hourly), mg/m3	-	-	-	-	-	-	-

Location JV LR-WEH Junction

Date of Sampling 4-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	33 9	52 4	43 6	9 3	44 6	50 8	52 1
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	19 4	73 8	59 6	13	55 6	70 2	73 1
7	CO (1 hourly), mg/m3	1 2	7 6	4 1	2 0	4 1	6 9	7 3
8	HC-Non Methane (3 hourly) mg/m3	-	-	-	-	-	-	-

AMBIENT AIR QUALITY MONITORING REPORT

Location JV LR-WEH Junction

Date of Sampling 6-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	31 2	65 8	49 5	15 8	48 4	62 3	65 1
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	55 6	78 5	61 2	12 5	58 4	74 5	77 7
7	CO (1 hourly), mg/m3	1 1	7 8	4 3	2 1	4 5	7 0	7 5
8	HC-Non Methane (3 hourly), mg/m3	-	-	-	-	-	-	-

Location JV LR-WEH Junction

Date of Sampling 8-2-2002

Sl No	Parameters	Min	Max	Avg	Std Dev	Percentile Values		
						50	90	98
1	SPM (24 hourly), mg/m3	-	-	-	-	-	-	-
2	RPM (24 hourly), mg/m3	-	-	-	-	-	-	-
3	SO2 (24 hourly), mg/m3	-	-	-	-	-	-	-
4	SO2 (8 hourly), mg/m3	32 4	55 6	43 5	11 6	42 1	53	55 1
5	NOx (24 hourly), mg/m3	-	-	-	-	-	-	-
6	NOx (8 hourly), mg/m3	48 4	69 6	57 9	10 8	55 6	66 8	69
7	CO (1 hourly), mg/m3	1 1	7 4	4 7	2 0	5 4	7 1	7 3
8	HC-Non Methane (3 hourly), mg/m3	-	-	-	-	-	-	-

NOISE LEVEL MONITORING REPORT

Station ID		NLMS-3				NLMS-2				NLMS-4			
Location		L B S'Marg (Dist 2 m from road edge)				Near I & I Gate (Dist 2 m from road edge)				JVLR SEEPZ Road (Dist 2m from road edge)			
Monitoring Date		9/2/2001				9/2/2002				7/2/2002			
Time		Noise Level (dB)A				Noise Level (dB)A				Noise Level (dB)A			
		Hrly Leq	Percentile 10	Percentile 50	Percentile 90	Hrly Leq	Percentile 50	Percentile 90	Percentile 98	Hrly Leq	Percentile 10	Percentile 50	Percentile 90
Day	6	73 1	78 9	82 6	88 7	72 8	77 1	82 3	85 7	67 2	75 0	80 7	82 2
	7	77 9				75 6				73 1			
	8	82 3				78 6				79 7			
	9	85 9				81 5				81			
	10	81 5				83 1				81 2			
	11	79 9				84 2				81 6			
	12	82 9				85 1				82 3			
	13	83 1				86				82 4			
	14	80 1				87 1				82			
	15	81 3				85 3				81 5			
	16	81 9				83 6				80 5			
	17	80 7				82 1				79 5			
	18	84 8				81 1				80 3			
	19	93 7				82 2				80 9			
	20	91 5				81 7				77 1			
	21	83 8				81 1				76 9			
Night	22	80 6	61 69	69 2	79 1	80 6	69 48	73 3	79 6	73 7	57 92	62 9	72 7
	23	78 5				79 2				72 3			
	24	72 5				78 6				68 8			
	1	65 9				77 1				63 6			
	2	61 2				73 5				58 1			
	3	61 9				71 7				57 5			
	4	63 5				67 8				59 3			
	5	72 1				70 2				62 1			
Leq Day		**86 0**				**83 2**				**80 4**			
Leq Night		**77 2**				**77 5**				**70 6**			
Leq Day & Leq Night		**86 5**				**85 3**				**80 5**			

NOISE LEVEL MONITORING REPORT

Station ID		NLMS-1				NLMS-5			
Location		Fantasy Land (Dist 3 m from road edge)				Nr JVLR-WTH (Dist 3 m from road edge)			
Monitoring Date		7/2/2002				7/2/2002			
Time		Noise Level (dB) A				Noise Level (dB)A			
		Hrly Leq	Percentile	Percentile	Percentile	Hrly Leq	Percentile	Percentile	Percentile
			50	90	98		50	90	98
Day	6	60 4	68 1	80 2	82 1	66 2	72 4	83 0	88 3
	7	61 5				69 4			
	8	72 3				75 4			
	9	73 5				78 6			
	10	77 4				79 5			
	11	79 2				81 3			
	12	81 5				82 5			
	13	82 3				84 6			
	14	83 1				86 7			
	15	82 5				88 4			
	16	82 1				90 1			
	17	81 6				88 1			
	18	80 2				85 2			
	19	79 8				81 6			
	20	81 5				83 2			
	21	80 2				82 7			
Night	22	76 2	11 84	55 8	70 0	81 2	63 38	70 7	79 8
	23	67 1				79 2			
	24	60 5				76 5			
	1	55 4				72 1			
	2	42 5				68 9			
	3	40 3				64 1			
	4	45 5				61 7			
	5	56 1				65 8			
Leq Day		80 1				84 8			
Leq Night		72 3				77 3			
Leq Day & Leq Night		81 1				85 9			

Classified Traffic Volume Survey

Location : IIT campus near LBS Marg

Date of Sampling : 8/2/2002

Time	Daily traffic volume, numbers				
	Two Wheelers	Three Wheelers	Four Wheelers Light	Heavy Vehicles	
				Bus	Trucks & Tempo
08 00 - 09 00	386	594	627	140	340
09 00 - 10.00	524	698	847	152	372
10 00 - 11 00	645	846	1051	160	390
11 00 - 12 00	766	1085	1240	210	542
12 00 - 13 00	948	1564	1749	290	658
13 00 - 14 00	640	1145	1342	241	580
14 00 - 15.00	685	1089	1269	224	526
15 00 - 16 00	729	1148	1146	196	511
16 00 - 17 00	850	1346	1289	220	598
17 00 - 18 00	967	1546	1484	269	645
18 00 - 19 00	1240	1642	1764	286	574
19 00 - 20.00	1311	1648	1786	271	580
20 00 - 21.00	1204	1581	1772	240	417
21 00 - 22 00	941	1071	1246	210	397
22 00 - 23 00	548	756	951	180	310
23 00 - 00 00	469	524	629	160	280
00 00 - 01 00	261	316	408	124	210
01 00 - 02 00	148	169	210	98	104
02 00 - 03 00	80	92	140	27	74
03 00 - 04 00	41	49	75	20	80
04 00 - 05 00	60	75	98	45	98
05 00 - 06 00	110	165	147	82	110
06 00 - 07 00	178	240	187	112	200
07 00 - 08 00	260	416	354	124	269
Total daily volume	14021	19805	21811	4081	8865

Note

Two Wheelers — *Scooter , Motor Bike*

Three Wheelers — *Autos*

4 Wheelers Light — *Jeep, Mini bus, Matador, Car*

Heavy Vehicles — *Bus, Trucks, Tempo*

Classified Traffic Volume Survey

Location : SEEPZ junction; Traffic count on JVLR Date of Sampling : 6/2/2002

Time	Daily traffic volume, numbers				
	Two Wheelers	Three Wheelers	Four Wheelers Light	Heavy Vehicles	
				Bus	Trucks & Tempo
08 00 - 09 00	186	217	241	85	140
09 00 - 10 00	216	241	309	97	151
10 00 - 11 00	241	326	318	101	163
11 00 - 12.00	270	448	457	93	182
12 00 - 13 00	370	504	619	113	230
13 00 - 14.00	264	455	498	99	221
14 00 - 15 00	291	419	480	94	214
15 00 - 16 00	324	411	457	85	226
16 00 - 17 00	385	475	463	92	238
17 00 - 18 00	403	532	501	100	247
18 00 - 19 00	497	602	652	107	186
19 00 - 20 00	533	617	675	116	202
20 00 - 21.00	487	526	629	99	169
21 00 - 22 00	324	401	419	85	145
22 00 - 23 00	252	300	318	66	132
23 00 - 00 00	163	140	186	54	116
00 00 - 01 00	109	116	132	45	106
01 00 - 02 00	62	47	85	31	97
02 00 - 03 00	29	38	62	14	113
03 00 - 04 00	12	29	56	12	99
04 00 - 05 00	38	53	70	35	136
05 00 - 06 00	76	85	97	62	124
06 00 - 07 00	116	138	152	75	143
07 00 - 08 00	147	192	163	81	110
Total daily traffic	5795	7312	8039	1841	3890

Note

Two Wheelers — *Scooter , Motor Bike*

Three Wheelers — *Autos*

4 Wheelers Light — *Jeep, Mini bus, Matador, Car*

Heavy Vehicles — *Bus, Trucks, Tempo*

Classified Traffic Volume Survey

Location : SEEPZ junction; Traffic count on SEEPZ road Date of Sampling : 6/2/2002

Time	No. of Vehicles				
	Two	Three	Four	Heavy Vehicles	
	Wheelers	Wheelers	Wheelers Light	Bus	Trucks & Tempo
08 00 - 09.00	54	65	69	12	40
09 00 - 10 00	62	79	89	13	43
10 00 - 11.00	69	49	92	14	47
11 00 - 12.00	78	192	132	13	53
12 00 - 13 00	159	154	179	16	66
13 00 - 14 00	98	121	143	14	64
14 00 - 15 00	106	151	138	13	62
15 00 - 16 00	94	126	132	12	65
16 00 - 17 00	111	148	134	13	68
17 00 - 18 00	116	103	144	14	71
18 00 - 19.00	143	185	188	15	54
19 00 - 20 00	154	185	194	16	58
20 00 - 21 00	140	157	181	14	49
21 00 - 22 00	98	145	121	12	42
22 00 - 23 00	73	97	92	9	38
23 00 - 00 00	47	62	54	8	34
00 00 - 01 00	31	45	38	6	30
01 00 - 02 00	18	43	25	4	28
02 00 - 03 00	9	31	18	2	32
03 00 - 04 00	3	15	16	2	28
04 00 - 05 00	11	25	20	5	39
05 00 - 06 00	22	21	28	9	36
06 00 - 07 00	33	35	44	10	41
07 00 - 08 00	43	45	47	11	32
Total daily volume	1772	2279	2317	257	1120

Note

Two Wheelers	*Scooter , Motor Bike*
Three Wheelers	*Autos*
4 Wheelers Light	*Jeep, Mini bus, Matador, Car*
Heavy Vehicles	*Bus, Trucks, Tempo*

Annex E

Projected Air Quality along JVLR

The air quality projections (predictions) have been carried out for pollutants like CO, NOx, SPM and PM_{10}. The CO and NOx levels projections in ambient air have been carried out using the air quality model CALINE3 developed by California Department of Transportation, while for SPM and PM10, the projections are based on simple Rollback model

The CALINE3 model is based on Gaussian diffusion equation and uses mixing zone concept to characterise pollutant dispersion over the roadway The model has been extensively tested for its predictive capability for traffic related air quality impacts. Given the source strength, meteorology, site geometry and site characteristics, the model can reliably predict pollutant concentrations for receptors from within 500 m of the roadway, the most important region for estimating the impacts of road project due to low elevation emissions

The impact on air quality with respect to CO and NOx due to the proposed JVLR project have been worked out both for "No Build" and "Build" scenarios. The projections for CO have been ascertained for an averaging time of 60 minutes corresponding to 1 hourly standard for CO using peak hourly traffic. While for NO_x prescribed corresponding standard of 24 hourly average has been considered as the basis using hourly average traffic data

The JV LR is proposed to comprise of 3+3 divided carriageway, which would be initiated in the year 2003 and completed in the year 2004 With this background, the year 2002 has been considered as *"No Build"* scenario, while years 2004 and 2011 have been considered as *"Build"* scenarios. The carriageway of the JVLR for No Build Scenario is 2 lane road (except for the middle section covering LBS Marg location, which is already 6 lane) having 3.5 m of black top and shoulders of 2.5 m on either side of the centreline making the road to be of 12 m width. For the Build scenario the JVLR is proposed to be of 6 (3+3) lane divided carriageway with 10.5 m of black top and 2.5 m of shoulders on either side and the carriageways separated by a median of 1.2 m. The receptors have been chosen to account for its location with respect to distance from the centreline of the carriageway with adjusted distances from the edge of the road.

The peak and average 24 hourly traffic values considered for predicting the AAQ during years ***"No Build"*** and ***Build*** scenarios have been presented in ***Tables E-1 a & b***. The peak hourly traffic volumes for these categories of vehicles as given in JVLR report of AIC Watson and traffic data collected by ERM during February 2002. The locations for which incremental projections of air quality wrt CO includes Jogeshwari near Western Express Highway, SEEPZ Road on JVLR, L&T (near Saki Vihar Road), LBS Marg and near Eastern Express Highway. The traffic volume for the year 2004 and 2011 were obtained using an annual traffic growth factor of 7 5%. The source

emission levels for CO were estimated for vehicles of categories Trucks/ Buses, LCVs/Cars, Two and Three-wheelers

Table E-1a Peak Hourly Traffic Projection

Sl. No.	Location	Year	Vehicles											
			Two Wheeler			Three Wheeler			Car/Taxi/Jeep			Bus/Truck/Tempo		
			Total	Old	New	Total	Old	New	Total	Old	New	Total	Old	New
1	Jogeshwari (Western Section)	2002	483	418	65	665	576	90	715	512	203	794	687	107
		2004	558	418	140	769	576	193	826	512	314	918	687	231
		2011	926	0	926	1276	0	1276	1370	0	1370	1523	0	1523
2	SEEPZ Junction	2002	506	438	68	582	504	78	652	467	185	293	254	39
		2004	585	438	147	673	504	169	753	467	286	339	254	85
		2011	970	0	970	1116	0	1116	1250	0	918	562	0	562
3	L&T Junction$	2002	359	311	48	406	351	55	464	332	132	224	194	30
		2004	415	311	104	469	351	118	536	332	204	259	194	65
		2011	688	0	688	778	0	778	890	0	890	429	0	429
4	LBS Marg	2002	1261	1091	170	1624	1405	219	1774	1271	503	790	684	106
		2004	1457	1091	366	1877	1405	471	2050	1271	779	913	684	229
		2011	2599	0	2599	3347	0	3347	3656	0	3656	1628	0	1628
5	JVLR Eastern section	2002	398	344	54	344	298	46	1672	1197	474	114	99	15
		2004	460	344	115	398	298	100	1932	1197	734	132	99	33
		2011	763	0	763	660	0	660	3205	0	3205	218	0	218

**As per 7.5% growth factors for each class of vehicles The old and new vehicles count has been presented due to different applicable standards for new and old vehicles i.e. vehicles before and after the year 2000*
$ Traffic for L&T = Traffic at SEEPZ on JVLR - SEEPZ inflow to JVLR

Table E-1b Average Hourly Traffic Projections

Sl. No.	Location	Year	Vehicles											
			Two Wheeler			Three Wheeler			Car/Taxi/Jeep			Bus/Truck/Tempo		
			Total	Old	New	Total	Old	New	Total	Old	New	Total	Old	New
1	Jogeshwari (Western Section)	2002	199	172	27	368	318	50	299	214	85	376	325	51
		2004	230	172	58	425	318	107	346	214	131	435	325	109
		2011	382	0	382	706	0	706	573	0	573	721	0	721
2	SEEPZ Junction	2002	241	209	32	305	264	41	335	240	95	239	207	32
		2004	279	209	70	352	264	89	387	240	147	276	207	69
		2011	462	0	462	585	0	585	642	0	642	458	0	458
3	L&T Junction$	2002	167	145	22	210	182	28	238	170	68	181	157	24
		2004	193	145	48	243	182	61	275	170	105	209	157	53
		2011	320	0	320	403	0	403	456	0	456	347	0	347
4	LBS Marg	2002	584	505	79	825	714	111	909	651	258	539	466	73
		2004	675	505	170	953	714	239	1050	651	399	623	466	156
		2011	1120	0	1120	1582	0	1582	1743	0	1743	1033	0	1033
5	JVLR Eastern section	2002	227	196	31	196	169	26	954	683	271	334	289	45
		2004	262	196	66	226	169	57	1102	683	419	386	289	97
		2011	435	0	435	375	0	375	1828	0	1828	641	0	641

**As per 7.5% growth factors for each class of vehicles The old and new vehicles count has been presented due to different applicable standards for new and old vehicles i.e. vehicles before and after the year 2000*
$ Traffic for L&T = Traffic at SEEPZ on JVLR - SEEPZ inflow to JVLR

E1.1.1 *Emissions from Vehicles*

The extent of impact on air quality, at any given time, mainly depends upon the rate of vehicular emission within a given stretch of the road and prevailing meteorological conditions. As per the Indian Institute of Petroleum (IIP), emission standards applicable for Indian vehicles, all vehicles manufactured after the year 2000 have to comply with the year 2000 standards while the older vehicles are required to comply with 1996 standards (except in Delhi)

For the purpose of modelling, it is considered that a mix of old and new vehicles ply on JVLR complying with 1996 (old) and 2000 (new) emission standards. The number of old and new types of vehicles were ascertained using 7.5% as the growth factor for all type of vehicles.

A longer time horizon has not been considered because of uncertainty in ascertaining the emission factors for various categories of vehicles beyond the year 2011 due to probable changes in technology and fuel use. The emission standards selected for the modelling are based on understanding that during the year 2011 vehicles complying with 1996 emission standards will be over 15 years older in the year 2011 and will not be allowed to ply on roads. Therefore, in the years 2002 and 2004, there will be a mix of old and new vehicles while during the year 2011 there will be only new vehicles plying on the JVLR. The emission factors considered for the projected air quality predictions are presented in *Table E-2*.

Table E-2 *Emission Factors in gm/km/Vehicle**

Vehicle Type	Carbon Monoxide(CO)		Nitrogen Oxide (NO_x)	
	1996	2001	1996	2001
2- Wheeler	4.50	2.00	1.58	0.658
3- Wheeler	6.75	4.00	2.37	0.658
Car/Taxi/Jeep	8.68	2.72	1.32	0.427
Truck/Bus	9.00	3.62	3.2	1.78

**The above emission factors were multiplied by 1.6 to get these factors in g/mile for the modelling*

E.1.1.2 *Meteorological Data Considered for Modelling*

To account for the effect of the diurnal variations in the model inputs (vehicular emissions and meteorological conditions), the averaging time for model predictions has been restricted to 60 minutes. The averaging time is so selected because the primary meteorological factors that influence the air quality predictions i.e. wind speeds and directions do not remain steady for longer time periods.

For air quality wrt CO, averaging time of 60 minutes has been considered corresponding to its one hourly standard using peak hourly traffic data inputs

as given in *Table E-1a* The meteorology considered for air quality for CO is based on use of 2 ms^{-1} of wind speed persistent for 1 hour with neutral stability class and 100 m of mixing height

For air quality wit NO_x, averaging time of 24 hours has been considered corresponding to its 24 hourly standard using hourly measured and projected traffic data using different meteorological conditions prevailing over 24 hours for the month of January when day time (7 am to 6 pm) mixing height varying from 100 to 1400 m with prevailing atmospheric stability classes of 2 and 3, and night time (6 pm to 7 am) nuxing height varying from 50 to 100 m with prevailing stability classes of 4 and 5 The hourly average traffic data as given in *Table E-1b* has been used with corresponding stability classes and wind speeds spread over 24 hours with prevailing North- easterly and South-westerly winds as inputs to the model. The 24 hourly average values have been worked out based on hourly weighted-average concentrations

The findings of the projected air quality for different scenarios have been presented in the following sections

E1.2 RESULTS AND DISCUSSIONS FOR NO BUILD & BUILD SCENARIOS

Carbon Monoxide Levels

The observed hourly highest incremental values for CO are presented in *Tables E-3.*

Table E-3 ***Results for Peak Hourly CO Concentrations (in ppm)***

Incremental Concentrations of CO (in ppm) on Jogeshwari Vikhroli Link Road					
Distance from Edge of JVLR, m	Locations Jogeshwari near WEH	SEEPZ Road on JVLR	L&T near SV Road	LBS Marg (Mid Section)	Eastern Section near EEH
No Build Scenario for the Year 2002					
5 00	1 02	0 71	0 51	2 26	0 90
10 00	0 71	0 47	0 34	1 47	0 62
20 00	0 46	0 28	0 20	0 93	0 40
40 00	0 25	0 13	0 09	0 49	0 23
60 00	0 15	0 07	0 05	0 27	0 14
80 00	0 09	0 03	0 02	0 14	0 08
100 00	0 05	0 01	0 01	0 07	0 05
200 00	0 00	0 00	0 00	0 00	0 00
a) Build Scenario for the Year 2004					
5 00	1 04	0 77	0 55	2 30	0 98
10 00	0 68	0 55	0 39	1 52	0 68
20 00	0 47	0 38	0 27	0 96	0 46
40 00	0 27	0 22	0 16	0 50	0 26
60 00	0 17	0 14	0 10	0 27	0 16
80 00	0 10	0 09	0 06	0 14	0 09
100 00	0 05	0 05	0 04	0 06	0 05
200 00	0 00	0 00	0 00	0 00	0 00

Incremental Concentrations of CO (in ppm) on Jogeshwari Vikhroli Link Road					
Distance from Edge of JVLR, m	Locations: Jogeshwari near WEH	SEEPZ Road on JVLR	L&T near SV Road	LBS Marg (Mid Section)	Eastern Section near EEH
b) Build Scenario for the Year 2011					
5 00	0 92	0 66	0 48	2 21	0 90
10 00	0 64	0 47	0 34	1 40	0 63
20 00	0 43	0 32	0 23	0 86	0 42
40 00	0 24	0 19	0 14	0 43	0 24
60 00	0 14	0 12	0 09	0 22	0 15
80 00	0 08	0 07	0 05	0 11	0 09
100 00	0 04	0 04	0 03	0 05	0 04
200 00	0 00	0 00	0 00	0 00	0 00

Note 1 Hourly Indian Standard for CO in ambient air is 3 48 ppm

The trend in the predicted incremental concentrations of CO for No Build scenario (year 2002) when compared to the Build scenario (year 2004), the concentrations slightly increases. The low increase in the concentrations is due to improved mixing zone of the widened JVLR vis-à-vis improved emissions from new vehicles despite increase in traffic during the two scenarios Between the Build scenarios for the years 2004 and 2011, the CO concentrations are found to be slightly improved during year 2011 due to the fact of improved emission factors for all vehicles complying to the year 2000 standard and there will be no vehicle of 1996 emission factors.

The average concentration of CO monitored along the JVLR found varying from 0 5 to 4.36 ppm (i e .0 57 to 5 mgm-3). The high concentrations violating the AAQ norm for CO (of 3 18 ppm i e 4 mg/m^3) were found at Jogeshwari (western section) and SEEPZ area. The land use in these areas is of mixed type i e residential and industrial dominated with slum dwellers However, at L&T and LBS Marg despite heavy traffic movement, the CO in AAQ found to vary from 0.5 to 1.66 ppm (i.e 0 57 to 1.9 mgm-3). This suggests that the high CO level in AAQ in the Western Section of JVLR be attributed significantly from other sources

It is expected that with the project road widening, the CO levels are expected to lower down. The project, therefore, will have moderate impact on ambient air quality in terms of CO

NO_x Levels

The air quality with respect to NO_x has been assessed based on prescribed standard of 24 hourly average and hourly average traffic data as given in ***Table E-1b*** with different wind speeds and stability classes spread over 24 hours as inputs to the model. The weighted-average of hourly concentrations has been used to arrive at 24 hourly average values The results are discussed in ***Table E-4.***

Table E-4 Results for 24 hour Average NO_x Incremental Concentrations (in µg/m³)

Incremental Concentrations of NOx (in µg/m³) on Jogeshwari Vikhroli Link Road					
Distance from Edge of JVLR, m	Locations				
	Jogeshwari near WEH	SEEPZ Junction	L&T Junction	LBS Marg (Mid Section)	Eastern Section near EEH
a) No Build Scenario for the Year 2002					
5 00	86 9	73 5	47 0	100 3	46 6
10 00	56 9	48 4	31 7	72 0	33 6
20 00	33 5	26 6	18 9	51 6	22 8
40 00	13 7	11 9	9 1	34 1	14 8
60 00	7 2	6 4	4 1	25 7	10 6
80 00	2 1	3 8	0 9	19 5	8 4
100 00	1 6	1 6	0 0	14 8	6 4
200 00	0 0	0 0	0 0	0 6	0 00
a) Build Scenario for the Year 2004					
5 00	89 4	78 3	48 8	106 1	51 5
10 00	59 2	50 6	32 8	74 9	38 2
20 00	33 5	29 0	20 9	52 4	26 8
40 00	15 8	13 5	9 4	35 0	17 0
60 00	7 8	6 8	3 9	26 3	12 7
80 00	2 1	4 5	1 6	20 9	10 3
100 00	1 6	1 6	0 0	18 0	7 8
200 00	0 0	0 0	0 0	1 2	0 0
b) Build Scenario for the Year 2011					
5 00	74 0	74 1	49 8	83 9	63 6
10 00	51 7	56 4	36 7	61 1	42 7
20 00	30 9	28 8	20 2	44 4	17 1
40 00	13 8	12 2	9 0	30 0	7 8
60 00	7 2	6 0	2 9	23 0	5 6
80 00	3 4	3 8	1 5	18 2	3 1
100 00	0 8	0 8	0 0	15 0	2 3
200 00	0 0	0 0	0 0	1 0	0 0

The trend in the predicted incremental concentrations of NOx for No Build scenario (year 2002) when compared to the Build scenario (year 2004), the concentrations slightly increases The low increase in the concentrations is due to improved mixing zone of the widened JVLR vis-à-vis improved emissions from new vehicles despite increase in traffic during the two scenarios. Between the Build scenarios for the years 2004 and 2011, the NOx concentrations are found to be slightly improved during year 2011 due to the fact of improved emission factors for all vehicles complying to the year 2000 standard and there will be no vehicle of 1996 emission factors.

The average concentration of NOx monitored along the JVLR during the years 2001 and 2002 found varying from 29 to 55.8 µgm-3. The 24 hourly Indian standard for NOx for residential areas is 80 µgm-3 With the consideration of incremental values as given in the above table, the NOx levels are expected to remain below the standards only beyond 20 m from the edge of the road. The

project, therefore, will have moderate impact on ambient air quality in terms of NOx

SPM & PM_{10} Levels

The levels of SPM i e. Suspended Particulate Matter and PM_{10} i e. Respirable Particulate Matter (RPM) in ambient air quality have been modelled using Roll Back model (i e $C_1/C_2 = Q_1/Q_2$, where C_1 & C_2 refers to as concentrations at receptor and Q_1 & Q_2 as source data), which gives outcome for the same set of meteorological conditions and same locations of monitoring The predicted levels increases with corresponding increase in traffic projections for the corresponding years It has been considered that SPM is emitted at an emission factor of 2 g per vehicle km Based on SPM and PM_{10} levels observed during the years 2001 and 2002, the prediction have been carried out for different locations on the JVLR as given in the ***Table E-5***.

Table E-5 ***Predicted SPM & PM_{10} Levels ($\mu g\ m^{-3}$) along the JVLR Project Road***

Description	Locations/Concentrations in μgm^{-3}				
	Jogeshwari near WEH	SEEPZ Junction	L&T Junction	LBS Marg (Mid Section)	Eastern Section near ECH
Monitored Levels					
Period of Monitoring	Dec 2001	Feb 2002	Feb 2002	Dec 2001	Dec 2001
a) SPM	383 6	521 5	272 8	257 5	257 5*
b) PM_{10}	181 3	336 8	123 8	121 4	121 4*
Projected Traffic					
a) Base Year #	29811	28930	20558	73721	41060
b) Year 2004	34450	31100	22100	79250	47450
c) Year 2011	57150	51550	36650	131450	78700
Projected SPM					
a) Year 2004	443 3	560 6	293 3	276 8	297 6
b) Year 2011	636 4	864 4	452 4	427 1	427 1
Projected PM_{10}					
a) Year 2004	209 5	362 1	133 1	130 5	140 3
b) Year 2011	300 8	558 3	205 3	201 4	201 4

* For ECH, SPM & PM_{10} have been considered to be the same owing to close proximity (approx 1 km), # Base year refers to the year of monitoring

The above table shows that the predicted SPM levels for the years 2004 and 2011 (corresponding to the same meteorological conditions and monitoring locations) would range from 276.8 to 560.6 $\mu g/m^3$ and 427.1 to 864.4 $\mu g/m^3$ respectively. The corresponding PM_{10} levels for the years 2004 and 2011 would range from 130.5 to 362.6 $\mu g/m^3$ and 201.4 to 558.3 $\mu g/m^3$ respectively All the monitored and projected 24 hourly average values violate ambient air quality standards for SPM and PM_{10} for residential areas are 200 $\mu g/m3$ and 100 $\mu g/m3$ respectively posing significant impact on air quality

Annex F

Projected Noise Levels along the JVLR

F1 PROJECTED NOISE LEVELS ALONG THE JVLR

F1.1 INTRODUCTION

Projections for traffic noise levels were presented by AIC Watson using Federal Highway Administration Model (FHWA) model for the years 2001 and 2011 covering western, middle and eastern sections of the JVLR. As three major at-grade works are proposed along the JVLR at junctions like SEEPZ Road, Saki Vihar Road and LBS Marg, there is need to predict noise levels at these locations also. For this, ERM has undertaken noise levels assessment using traffic densities observed in February 2002.

F1.2 PROJECTED NOISE LEVELS ALONG THE JVLR

In order to estimate noise impacts with respect to existing situations, noise monitoring was undertaken in February 2002 at 5 locations along the JVLR.

With the Build up scenario, uninterrupted movement of heavy and light vehicles at high speeds is expected along the JVLR, which may give rise to increase in ambient noise levels. The impact of noise levels from the existing and the proposed widening on the neighbouring population is addressed by carrying out computations using Federal Highway Noise Model developed based on the guidelines suggested by Federal Highway Administration (FHWA). The details of the model and the model computations are described below.

Noise Modelling

The Highway Noise Model presented below is used for calculating the one-hour L_{eq}. The model is based upon calculating the hourly L_{eq} for automobiles and trucks separately and then adding these logarithamically to obtain the overall hourly L_{eq} as follows:

$$L_{eq}(hi) = L_{OEI} + 10 \text{ Log } \frac{(\ Ni\ )}{(\ Si*T\ )} + 10 \text{ Log} \frac{(15)}{(D)}^{\wedge(1+\alpha)} - 13$$

L_{OEI}		Reference mean energy level for (i^{th}) vehicle type
Ni	.	Number of vehicles of (i^{th}) class passing in time (T i.e 1 hour)
Si	.	Average Speed of vehicles of (i^{th}) class (kmph)
T	.	Time duration corresponding to Ni, one hour
D		Perpendicular distance in (m) from centerline of the traffic lane to observer
α alpha		Factor relating to absorption characteristics of the ground cover between roadway and observer

The combined effect of all the sources can be determined at various locations by the following equation.

$$L_{eq\ (h,\ total)} = 10 \text{ Log } \Sigma\ 10\wedge[L_{eq\ (hi)}/10]$$

Based on the above equations, user-friendly highway noise predictions were carried out for identified additional locations on the JVLR.

Traffic Volumes and Speed

The hourly traffic volume for the SEEPZ Road, L&T (near Saki Vihar Road) and IIT (near LBS Marg) as presented in *Annex D* were taken as inputs for the model. The average speed for each category of vehicle considered for the years 2002, 2004 and 2011 are presented in ***Table F-1***.

Table F-1 ***Average Speed of Vehicles along the JVLR***

Location	Vehicle Type & Average Speed (kmph)								
	No Build Scenario			Build Scenario					
	Year 2002			Year 2004			Year 2011		
	Cars	Trucks/ Buses	2/3 W	Cars	Trucks/ Buses	2/3 W	Cars	Trucks/ Buses	2/3 W
Day Time (0600 to 1800 hours)	60	50	50	70	60	60	60	50	50
Night Time (1800 to 0600 hours)	40	40	40	65	55	60	55	45	45

F1.3 PRESENTATION OF TRAFFIC NOISE PREDICTION RESULTS

The noise prediction results for the project road i.e $L_{eq\ day}$ and $L_{eq\ night}$ are presented for 10, 20, 40, 60, 80, 100 and 200 m distance from the edge. The day time $L_{eq\ day}$ covers 0600 to 2200 hours while night time $L_{eq\ night}$ covers 2200 to 0600 hours corresponding to the prescribed standard for noise levels for different landuses. The results obtained out of the FHWA modelling were projected as *traffic induced noise levels*.

Background noise levels of 70 dB(A) for day time and 55 dB(A) for night time were further added to the results obtained through modelling so as to represent these as *resultant noise levels* for the different locations along the JVLR.

The traffic induced and resultant noise levels for locations like SEEPZ Road on JVLR, L&T and IIT (near LBS Marg) are presented in ***Tables F-2a & b.*** While the same for Western, Middle & Eastern Sections of the JVLR as done by AIC Watson are presented in ***Tables F-3a & b***.

Table F-2a ***Traffic Induced Noise at SEEPZ, L&T & IIT (near LBS Marg)***

Distance	At SEEPZ on JVLR						L&T near Saki Vihar Road						IIT (near LBS Marg)					
from	2002		2004		2011		2002		2004		2011		2002		2004		2011	
Edge, m	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}
2	81 1	75 8	76 6	73 3	79 7	76 8	79 9	74 6	75 4	72 0	78 5	75 5	85.1	77 4	80 7	74 8	83 7	78 3
5	78 3	73 0	75 2	71 9	78 3	75 4	77 0	71 7	74 0	70 6	77 1	74 1	82 3	74 5	79 3	73 4	82 3	76 9
10	75 2	70 0	73 4	70.0	76 5	73.6	74 0	68 7	72.2	68 8	75 2	72 3	79 3	71 5	77 4	71 5	80 5	75 1
20	71 6	66 4	70.8	67 5	73 9	71.0	70 4	65 1	69.6	66 2	72 7	69.7	75.7	67 9	74 8	69 0	77 9	72 5
40	67 6	62 3	67 5	64 2	70 6	67 7	66 4	61.1	66.3	62 9	69 4	66 4	71.7	63 9	71 6	65 7	74.6	69 2
60	65.2	59 9	65 3	62 0	68 4	65 5	63 9	58 6	64.1	60 8	67 2	64 3	69.2	61 4	69 4	63.5	72 5	67 0
80	63 4	58.1	63 7	60 4	66 8	63 9	62 1	56.9	62 5	59 1	65.6	62 6	67.4	59 6	67 8	61 9	70 8	65 4
100	62.0	56.7	62 4	59.1	65.5	62 6	60.7	55 5	61 2	57.8	64.3	61 3	66 0	58 2	66.5	60 6	69 5	64 1
200	57 6	52 3	58 2	54.9	61 3	58 4	56 3	51 1	57 0	53 6	60.1	57 1	61 6	53 8	62.3	56 4	65 3	59 9

Note Noise modelling based on traffic count done in February 2002 , Lday = Equivalent Noise level for 6 am to 10 pm while Lnight = Equivalent Noise level from 10 pm to 6 am Day time Standard 55 dB(A) for Residential Areas and 50 dB(A) for Sensitive Areas like Schools /hospitals etc , Night Time Standard 45 dB(A) for Residential Areas and 40 dB(A) for Sensitive Areas like Schools /hospitals etc

Table F-2b ***Resultant (Predicted) Noise at SEEPZ, L&T & IIT (near LBS Marg)***

Distance	At SEEPZ on JVLR						L&T near Saki Vihar Road						IIT (near LBS Marg)					
from	2002		2004		2011		2002		2004		2011		2002		2004		2011	
Edge, m	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}
2	81 4	75 9	77.5	73.3	80 1	76.8	80.3	74.6	76 5	72.1	79.0	75 6	85.3	77.4	81.0	74 8	83 9	78 3
5	78 9	73 1	76.4	72.0	78 9	75 4	77 8	71 8	75 4	70.7	77 8	74 2	82.5	74 6	79.7	73 4	82 6	76 9
10	76.4	70.1	75 0	70 2	77 4	73 6	75 5	68 9	74.2	69.0	76 4	72 4	79.8	71 6	78 2	71 6	80.9	75 1
20	73 9	66.7	73.4	67 7	75.4	71 1	73.2	65 5	72 8	66 5	74.5	69.9	76.7	68 1	76 1	69 1	78.6	72.6
40	72 0	63.1	71.9	64.7	73 3	67 9	71 6	62 1	71.5	63 6	72.7	66 7	73 9	64 4	73 9	66.0	75.9	69 4
60	71 2	61 1	71 3	62.8	72 3	65 9	71 0	60.2	71 0	61 8	71 8	64 8	72 6	62.3	72 7	64.1	74 4	67 3
80	70.9	59 8	70 9	61 5	71 7	64 4	70 7	59 0	70 7	60.6	71 3	63 3	71.9	60 9	72.0	62.7	73 5	65 8
100	70 6	58 9	70 7	60 5	71.3	63 3	70 5	58 2	70 5	59.7	71.0	62 2	71.5	59 9	71 6	61 6	72 8	64 6
200	70 2	56 9	70 3	57.9	70 5	60 0	70 2	56 5	70 2	57 4	70.4	59.2	70 6	57 5	70 7	58 8	71 3	61 1

Note The Background Noise Level considered is L_{day} = 70 dB(A) and L_{night} = 55 dB(A)

Table F-3a ***Traffic Induced Noise at Western, Middle & Eastern Sections of the JVLR***

Distance from Edge, m	Western Section of JVLR				Middle Section				Eastern Section			
	2001		2011		2001		2011		2001		2011	
	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}
10	72 3	67 0	76 9	70 2	76.8	70 6	80 5	73 8	73 5	67 8	77 6	70 9
20	70 2	64 8	74 7	68 0	74.6	68 4	78 3	71 6	71 3	65 6	75 4	68 7
40	67 2	61 9	71.7	65 0	71 7	65 5	75.3	68 6	68 4	62 7	72 5	65 8
60	65 2	59.9	69.7	63 0	69.6	63 5	73 3	66 6	66 4	60 4	70 5	63 8
80	63 7	58.3	68 2	61 5	68 1	61 9	71 8	65 1	64 8	59 1	68 9	62 2
100	62 4	57 1	66 9	60 2	66 9	60 7	70 5	63 8	63 6	57 8	67.7	61 0
200	58 3	53.0	62 9	56.2	62 8	56 6	66.4	59 7	59 5	53 8	63.6	56 9

Source AIC Watson Report on EA/EMP for the JVLR, Day time Standard 55 dB(A) for Residential Areas and 50 dB(A) for Sensitive Areas like Schools /hospitals etc., Night Time Standard 45 dB(A) for Residential Areas and 40 dB(A) for Sensitive Areas like Schools /hospitals etc

Table F-3b ***Resultant (Predicted) Noise at Western, Middle & Eastern Sections of the JVLR***

Distance from Edge, m	Western Section of JVLR				Middle Section				Eastern Section			
	2001		2011		2001		2011		2001		2011	
	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}	L_{eqD}	L_{eqN}
10	74 4	67 5	77.7	70 3	77 7	70 6	80 9	73 8	75.2	68.2	78.3	70 9
20	73 1	65 4	76 0	68.4	75.9	68 9	78.9	71 6	73 7	66.1	76 6	69 2
40	71 9	62.7	74 0	65 5	73 9	66 0	76 5	69.1	72 3	63 4	74.5	66 3
60	71 3	61.1	72 9	63 7	72 8	64 1	75 0	67.0	71 6	61 7	73.2	64 4
80	70 3	60 0	72 2	62 4	72 2	62.8	74 0	65.6	71 2	60 6	72.5	63 0
100	70 9	59 2	71 8	61.4	71 8	61 7	73 3	64 4	70.9	59.7	72 0	62.0
200	70.4	57.2	70 8	58 6	70.8	58 9	71.6	61 0	70.5	57.5	70 9	59 1

Source AIC Watson Report on EA/EMP for the JVLR, Day time Standard 55 dB(A) for Residential Areas and 50 dB(A) for Sensitive Areas like Schools /hospitals etc , Night Time Standard 45 dB(A) for Residential Areas and 40 dB(A) for Sensitive Areas like Schools /hospitals etc

The modelling exercise indicate that the day time resultant noise level likely to occur in the range of 70.2 to 71.6 dB(A) at 200 m from the edge of the JVLR alignment while the corresponding night time resultant noise level at 200 m from the edge of the JVLR alignment would likely to occur in the range of 56.5 to 61.1 dB(A) . The modelling results clearly reveal that day and night time noise levels are exceeding the prescribed standards.

The data presented clearly reveals that day and night time noise levels are exceeding the prescribed standards. The noise computations are carried out for worst case scenarios, i.e. without taking into consideration the local features like landuse, barriers etc. In reality, the noise levels are expected to be on the lower side, as the area along the existing road stretch is covered with roadside plantation, which will act as a sound barrier. The presence of roadside plantations and berm walls would substantially help attenuate the noise levels

Annex G

EMP Implementation Status Reporting Formats

Acronym	Description
m	Meter
C	Construction phase
CEMP	Community Environmental Management Plan
cum	Cubic Meter
EMP	Environment Management Plan
ID	Identification
JVLR	Jogeshwari - Vikhroli link road
Kg	Kilogram
Km	Kilometer
lpcd	Liters per capita per day
MMRDA	Mumbai Metropolitan Region Development Authority
Nos. or #	Number
O	Operation phase
PAA	Project Affected Areas
PAH	Project Affected Household
PAP	Project Affected People
PC	Preconstruction phasee
PIA	Project Implementing Authority
PMC	Project Management Consultant
PROW	Proposed Right of Way
Qty	Quantity
R&R	Resettlement & Rehabilitation
RAP	Rehabilitation Action Plan
Regn.	Registration
Sq. m	Square meter
SY	Stockyard
WB	The World Bank

Desired Monitoring and Reporting Process

Stage	*Format #*	*Format title*
Pre-construction	PC-1	Reporting for Pre-construction stage
Construction stage	C-1	Pollution monitoring schedule and reports
	C-2	Fugitive dust mitigation
	C-3	Soil erosion locations and drainage measures taken
	C-4	Reporting for roadside plantation
Operation stage	O-1	Survival reporting of compensatory plantation
	O-2	Survival reporting of roadside landscape
	O-3	Pollution monitoring

PC-1 Reporting for Pre-construction stage

Reporting By	Reporting To	Reporting Frequency	Reporting Period	Date of Submission	Report Ref #
Contractor	PMC	Monthly			
PMC	PIA	Monthly			
PIA	MMRDA	Monthly			
MMRDA	The World Bank	Quarterly			

S No	Activity	Reported by	Units	Total Qty	Task completed	Target date	Date of completion	Reasons for delay, if any
1	Total quantity of trees felled	Contractor						
2	Status of utility & community resources shifting	Contractor/ Concerned Govt Deptt						
	Water Supply							
	Sewerage system							
	Telephones/Communication							
	Electricty-Overhead & Underground							
	Others							

For Contractor

For PMC

For PIA

C-1: Pollution Monitoring Reports

Reporting By	*Reporting To*	*Reporting Frequency*	*Reporting Period*	*Date of submission*	*Report Ref. #*
Contractor	PMC	Seasonally			
PMC	PIA	Seasonally			
PIA	MMRDA	Seasonally			
MMRDA	The World Bank	Seasonally			

Monitoring	Chainage	Details of location	Duration of monitoring	Target date	Actual date of monitoring	Reason for delay, if any
Air monitoring						
Noise monitoring						
Soil monitoring						
Water quality monitoring						

Note Annex Monitoring report carried out during reporting period

Certified that the Pollution monitoring has been conducted at all the locations specified in the EMP and as per the directions of PIA

For Contractor/ Monitoring agency **For PMC** **For PIA**

C-2 Fugitive Dust Mitigation Measures

Reporting By	Reporting To	Reporting Frequency	Reporting Period	Date of Submission	Report Ref. #
Contractor	PMC	Monthly			
PMC	PIA	Monthly			
PIA	MMRDA	Monthly			
MMRDA	The World Bank	Quarterly			

Chainage	Current construction activity in brief	Measures taken to control fugitive dust emission

Certified that the above information is correct

For Contractor **For PMC** **For PIA**

C-3 Soil erosion locations and drainage measures taken

Reporting By	*Reporting To*	*Reporting Frequency*	*Reporting Period*	*Date of Submission*	*Report Ref #*
Contractor	PMC	Quarterly			
PMC	PIA	Quarterly			
PIA	MMRDA	Quarterly			
MMRDA	The World Bank	Quarterly			

Sl. #	Chainage	Measures taken to control soil erosion	Frequency of drain cleaning	Waterlogging, if any Y/N

Note: Annex Map showing susceptible soil erosion locations, open and underground drains in the project area

Certified that the above information is correct

For Contractor For PMC For PIA

C-4 Reporting for Roadside Plantation

Reporting By	*Reporting To*	*Reporting Frequency*	*Reporting Period*	*Date of Submission*	*Report Ref. #*
Contractor	PMC	Monthly			
PMC	PIA	Monthly			
PIA	MMRDA	Monthly			
MMRDA	The World Bank	Quarterly			

Sl. #	Chainage	Total Trees planted	Total Shrubs planted	% survival rate	Turfing on median	Maintenance/ Watering frequency	Other measures taken to protect plantation

Certified that the above information is correct

For Contractor For PMC For PIA

O-1 Plantation Survival Reporting

Reporting By	*Reporting To*	*Reporting Frequency*	*Reporting Period*	*Date of Submission*	*Report Ref. #*
Monitoring agency	MCGM	Annually			
MCGM	MMRDA	Annually			
MMRDA	The World Bank	Annually			

Sl. #	Chainage	Details of location	Total # of trees planted	Total # of surviving trees	% survived
1					
2					
3					
4					
5					

Certified that the furnished information is correct

For Contractor **For PIA**

O-2: Survival Reporting of Roadside Landscaping

Reporting By	*Reporting To*	*Reporting Frequency*	*Reporting Period*	*Date of Submission*	*Report Ref. #*
Monitoring agency	MCGM	Annually			
MCGM	MMRDA	Annually			
MMRDA	The World Bank	Annually			

Sl. #	Chainage	Details of location	Shrubs on median			Turfing on median		
			Total shrubs planted	# of Shrubs survived	% survival	Total area turfed	Total turfed area surviving	% survival
1								
2								
3								
4								
5								

Certified that the furnished information is correct

For Contractor **For PIA**

O-3 Pollution Monitoring Reports

Reporting By	*Reporting To*	*Reporting Frequency*	*Reporting Period*	*Date of Submission*	*Report Ref. #*
Monitoring agency	MCGM	Seasonally			
MCGM	MMRDA	Seasonally			
MMRDA	The World Bank	Seasonally			

Monitoring	Chainage	Details of location	Duration of monitoring	Instruments used	Target date	Actual date of monitoring	Reason for delay, if any
Air monitoring							
Noise monitoring							
Water quality monitoring							
Soil quality monitoring							
Plantation survival rate survey							
Classified traffic volume suyvey							

Note Annex Monitoring report carried out during reporting period

Certified that the Pollution monitoring has been conducted at all the locations specified in the EMP and as per the directions of PIA

For Contractor **For PIA**

Annex H

Environment Management Measures for ongoing Grade Separator Works along JVLR

TABLE 1: Recommended Environmental management measures for ongoing grade separator work at LBS Marg junction

Environmental Issue	*Mitigation Measures*	*Time Frame*	*Responsibility*	
			Implementation	*Supervision*
Local Traffic management	Local traffic management plan shall be prepared before construction activity resumes Presently north side carriageway except for embankment section is almost complete The traffic management plan could consider the following options **Western side of flyover** ◆ Clearing RoW on the western side and construction of slip roads, if any, as per design ◆ Diverting JVLR traffic along both the slip roads/ road edges to seclude the construction area ◆ Construction of 15 piers and deck slab shall proceed from west to east direction Simultaneously embankment works can be carried out ◆ Obligatory central span shall be constructed finally **Eastern side of flyover** ◆ Diverting JVLR traffic along both the slip roads/ road edges to seclude the construction area ◆ Construction of 7 piers and deck slab shall proceed from east to west direction Simultaneously embankment works can be carried out ◆ If needed, traffic on eastern section of JVLR can be made one-way during construction stage ◆ Other option is to complete construction of northern carriageway of the flyover and allow both-way traffic moving along JVLR over it	Construction Phase	Contractor	MSRDC
Pedestrian safety	Service ramps on either side of existing ROB at the eastern end of flyover are partially complete Slum residents and railway commuters have started using the unpaved service ramps Resumption of construction at LBS junction might affect pedestrian movement Pedestrians shall be guided along the edges of roadway in all the four arms of the junction Their movement shall be prohibited inside active-construction area Adequate barricades be put in place to achieve the objective	Construction Phase	Contractor	MSRDC
Socio-economic scenario	The RIP report on JVLR informs that 331 PAH's of both the grade separator projects are being rehabilitated as per MUTP's R&R policy MSRDC, it seems is in the process of relocating the PAH's at MHADA flats located at Dindoshi	Construction phase	MSRDC	MSRDC
Utility relocation/ diversion	Utility relocation, such as water supply lines, electrical installations, telephone lines etc to be shifted after prior approval of agencies Utility relocation shall be carried out in shortest possible time to reduce inconvenience to public	During construction of relevant section	Contractor/ MSRDC	MSRDC

Drainage	The existing roadside drains along JVLR shall be cleared off construction debris especially before monsoon season As the flyover site is located on the downside slope of a hill, any obstruction to drainage may result in flooding	Construction phase	Contractor	MSRDC
Fugitive dust emission	For all construction activities that generate dust, adequate control measures like intermittent operation shall be employed at site	Construction phase	Contractor	MSRDC
Hot mix / Asphalt plants/ Concrete batching plants	In-situ plants were not observed during the audit If the contractor procures from existing plants in the region, MSRDC shall instruct and ensure that the contractor procures from MPCB authorised plants	Construction phase	Contractor	MSRDC
Ambient Noise levels	All possible and practical measures to control noise emission during drilling operations shall be employed MSRDC may direct to take adequate control measures depending on site conditions	Construction phase	Contractor	MSRDC
Construction equipment emissions	Exhaust and noise emissions of construction equipment's shall adhere to emission norms as laid out by MoEF/ CPCB	Construction phase	Contractor	MSRDC
Noise from construction related plants & equipments	All construction equipment's shall be fitted with exhaust silencers 'Damaged silencers to be promptly replaced by contractor	Construction phase	Contractor	MSRDC
Noise due to operation of DG sets	DG sets, if used, shall adhere to noise standards of MoEF	Construction phase	Contractor	MSRDC
Noise due to foundation works at flyover site/ bridges	Operation hours for noise generating equipments such as pile driving, concrete and drilling etc shall be pre-approved by MSRDC MSRDC depending on site-conditions may regulate and/ or restrict operation hours	Construction phase	Contractor	MSRDC
Debris/ Top soil disposal/ Construction waste disposal	At the site, except for the huge concrete blocks, there are no stacks of construction waste/debris left within the PRoW It shall be ensured that all debris/ construction waste are disposed at MSRDC approved sites	Construction phase	Contractor	MSRDC
Presence of Sensitive receptors	A Kendriya Vidyalaya (KV) located within the Naval Civilian Housing Colony on the northern side of JVLR and western side of LBS marg Idling of equipments/ vehicles shall not be permitted when they are not in active use at this location	Construction phase	Contractor	MSRDC
Location of Construction material storage yards	The storage yards have been located at the BM Thackeray marg -JVLR junction on the eastern side It shall be ensured that construction camp activities do not obstruct traffic movement along the eastern section of JVLR and also not spill over to degraded mangroves area nearby	Construction phase	Contractor	MSRDC

TABLE 2: Recommended Environmental management measures for ongoing grade separator work at L&T junction

Environmental Issue	*Mitigation Measures*	*Time Frame*	*Responsibility*	
			Implementation	*Supervision*
Local Traffic management	Construction activity is currently taking place inside the L&T Factory area On the eastern section, retaining walls for the underpass is presently being constructed Both embankment section and western section of flyover is yet to be constructed The local traffic management plan recommended is as below • On the eastern section construct the underpass and slip roads as they will not disturb the existing carriageway • Divert the traffic along new slip roads and below underpass before starting construction of eastern embankment section • On the western side, clear RoW and construct slip roads either side of flyover alignment as per design • Divert JVLR traffic on both the slip roads before starting construction of western embankment and flyover • Construct the obligatory centre span in the shortest possible time MSRDC shall review the local traffic arrangement periodically to assess the condition at site	Construction Phase	Contractor	MSRDC
Pedestrian safety	Since construction activity is currently taking place inside the L&T Factory, pedestrians have not faced any problem due to the activities at site However, when the work on western section of the flyover starts, adequate temporary pathways along the edges of roadway shall be provided for safe and easy movement of pedestrians across this junction BEST buses can halt twice before and after the construction area for the benefit of commuters During obligatory span construction at the middle of the junction, pedestrian movement shall be guided by putting up barricades	Construction Phase	Contractor	MSRDC
Ecology	Few trees located along the alignment of the flyover inside the L&T factory might have been removed On the western side, ecological impact is quite negligible MSRDC shall ensure that compensatory plantation of not less than the trees felled during construction be carried out Preferably the plantation can be done within the L&T factory area as adequate protection and maintenance can be carried out by L&T without any additional burden	Construction phase	MSRDC	MSRDC

Socio-economic scenario	331 PAH's affected by the flyover projects includes those affected in Milind nagar area as well R&R measures are presently in progress Construction work has not yet started at this location, which is an appreciable feature It shall be ensured that all RAP requirements are complete before site clearance starts	During construction of relevant section	Contractor/ MSRDC	MSRDC
Utility relocation/ diversion	Utility relocation, such as water supply lines, electrical installations, telephone lines etc to be shifted after prior approval of agencies Utility relocation shall be carried out in shortest possible time to reduce inconvenience to public	Construction phase	Contractor	MSRDC
Drainage	Physiography of the area indicates that the area drains into Powai lake located at the end of eastern section of flyover Hence adequate drainage system needs to be provided at this site The earthwork carried out should be well stabilised as there will be high erosion of disturbed/ altered soil The drains shall be provided with desilting chambers	Construction phase	Contractor/MSRDC	MSRDC
Water environment	Impact on water quality of Powai lake during construction stage is likely due to the close proximity of the site Stacking of earthwork has been carried out properly within a secluded enclosure which has been adequately barricaded upto a height of about 1 6m However, minor amount of topsoil disposal was observed along the banks of Powai lake at one location, which should be avoided in future During monsoon season, no loose soil/ debris shall be kept near Powai lake If needed temporary earthern bunds of sufficient height may be created to divert drainage from construction site flowing to Powai lake	Construction phase	Contractor	MSRDC
Fugitive dust emission	For all construction activities that generate dust, adequate control measures like intermittent operation shall be employed at site Concrete and bitumen, it seems, is being procured from existing plants as there are no concrete mixers and hot mix plants near storage yards The sourcing plants shall be authorised ones by competent authority	Construction phase	Contractor	MSRDC
Hot mix / Asphalt plants/ Concrete batching plants	In-situ plants were not observed during the audit If the contractor procures from existing plants in the region, MSRDC shall instruct the contractor to procure from MPCB authorised plants	Construction phase	Contractor	MSRDC
Ambient Noise levels	All possible and practical measures to control noise emission during drilling operations shall be employed The MSRDC may direct to take adequate control measures depending on site conditions	Construction phase	Contractor	MSRDC
Construction equipment emissions	Exhaust and noise emissions of construction equipment's shall adhere to emission norms as laid out by MoEF/ CPCB	Construction phase	Contractor	MSRDC
Noise from construction related plants & equipments	All construction equipment's shall be fitted with exhaust silencers Damaged silencers to be promptly replaced by contractor	Construction phase	Contractor	MSRDC
Noise due to operation of DG sets	DG sets, if used, shall adhere to noise standards of MoEF	Construction phase	Contractor	MSRDC

Noise due to foundation works at flyover site/ bridges	Operation hours for noise generating equipments such as pile driving, concrete and drilling etc shall be pre-approved by MSRDC The MSRDC depending on site-conditions may regulate and/ or restrict operation hours	Construction phase	Contractor	MSRDC
Debris/ Top soil disposal/ Construction waste disposal	The topsoil stacks have been adequately barricaded within a 1 6m high enclosure However, minor amount of topsoil disposal was observed along the banks of Powai lake at one location, which should be avoided in future	Construction phase	Contractor	MSRDC
Location of Construction material storage yards	The storage yards have been located at about 250m from the junction towards the western side along JVLR It shall be ensured that activities inside do not spill outside and do not obstruct traffic movement along the western section of JVLR	Construction phase	Contractor	MSRDC