1. THE "TRANSFORM" PROJECT

1.1 Background

The preparation of Comprehensive Transportation Plan (CTS) for Mumbai Metropolitan Region (MMR) under the title "TranSforM" is the mandate of the present assignment. The present study has been evolved by formulating strategies with a long term (2031 year) perspective and then developing medium and short term (2021 and 2016) investment programs within the context of the long term strategy and ongoing investments being planned in MMR.

Genesis

- **1962 Bombay Traffic & Transportation Study by Wilbur Smith Associates: Prepared Road network plan mainly for MCGM area**
- **1983 CTS study by CRRI (Central Road Research Institute): Prepared a master road network plan for BMR (Bombay Metropolitan Region) based on extensive home interviews and other surveys**
- **1992 CTS study by WS Atkins: Travel demand was estimated using the 1978 household survey data collected by CRRI and updated to 1992 by supplementary surveys. Recommended enhancement of sub-urban rail system, additional highway corridors, etc. and investment proposals up to 2011. The study recommended review/ updating of data every 10 years.**
- **All subsequent studies used only updated CRRI matrices and no fresh Home Interview surveys were carried out.**
- **It has been over 25 years since the last comprehensive regional transport study was undertaken for the region. Most of the previous transportation studies were limited to MCGM study area.**

World Bank recommended fresh TRANSFORM for MMR to formulate MUTP phase - II components and a comprehensive transportation strategy for the metropolitan region

The Government of Maharashtra through MMRDA with technical assistance from World Bank under MUTP has embarked on the Comprehensive Transportation Study (CTS) for MMR known as TRANSFORM (TRANSportation Study FOR the region of Mumbai) with prime objective of identifying travel pattern of residents in MMR and recommending long term comprehensive transportation strategy for MMR up to 2031.

1.2 Transportation Challenges

MMR is one of the fastest growing metropolitan regions and economic power house of the country. With a geographical spread of about 4,350 square km, it comprises 7 municipal corporations 13 municipal councils and 996 villages. The Region's present population is about 21 million, which is expected to grow to about 34 millions by the year 2031, with the distinction of becoming the largest metropolitan region in the world. The workforce participation rate is anticipated to reach about 45% by the year 2031 (37% in 2005). Mumbai aspires to be one of the globally competitive cities in the world but does not qualify on several grounds with transportation inadequacies being a notable shortcoming.

To support this scale of economic development there are many inter-related transport challenges. **The first challenge** is to improve MMR's public transport system to accommodate the growth of population and employment. This can be achieved by capacity enhancements to the existing suburban railway system; creating new metro corridors; connecting major existing and planned activity centres of the region; providing exclusive bus lanes to reinforce rail based transit with a higher order road based public transport system. **Transit First** is a guiding principle.

The second challenge is to create a hierarchical system of roads and freeways to meet a wide spectrum of travel desires, including goods vehicles and the projected large increases in traffic entering and leaving the MMR.

The third challenge is to structure the most effective institutional arrangements to efficiently implement the proposed regional transport plan in a timely and comprehensive manner. An integral part of process is the mobilization of resources from traditional as well as new funding opportunities. International experiences in resource mobilization can provide useful insights into successful financing mechanisms.

Total travel during morning peak period (6:00 to 11:00 AM) is expected to increase from 4.75 million motorized trips to 10.00 million trips by 2031. Most of these trips need to be supported by public transport modes.

Preparing a transportation plan for this scale of urbanization is a Herculean task, particularly in a country, state and region undergoing such profound social and economic change. Based on discussions and guidance from many individuals and agencies, it was concluded that the transportation study should consider several future population and employment distribution strategies for the MMR and to attempt to develop transportation strategies and plans that are resilient or robust to meet several possible long term futures. This would better serve the agencies in making the right investment choices, with some appreciation of the potential risks associated with social and particularly economic change.

The study examined the important factors that greatly influence travel in the Region, and the changing economic and social conditions, challenges and opportunities that will need to be satisfied and captured. The final recommendations of "TranSforM", will be useful in the future for updating of the Regional Plan and Development Plans of ULBs in MMR.

The TRANSFORM for MMR is divided in five major components namely:

- **Primary and Secondary travel demand surveys;**
- **Travel demand estimation for horizon period (2005-2031);**
- **Preparation of Long, Medium & Short Term Transportation Strategies/ Plans**
- **Institutional and**
- **Financial Strengthening**

This Executive Summary document is intended to provide an insight and overview of TRANSFORM to the ensuing Authority Meeting and seek its guidance to achieve the goals/ objectives for balanced development in MMR.

2. MMR TRAVEL TODAY – ISSUES & PROBLEMS

Talking of passenger and vehicle travel statistics in Mumbai Metropolitan Region tends to bring number-numbness and it requires special effort not to lose the huge sense of scale. In the following paragraphs, units such as Lakh and Crore are used to describe the situation as succinctly as possible. The travel behaviour in, probably, one of the largest and densest megalopolis in the World is being presented in the following sections.

2.1 Historical Trends

While MMR has been so far a region with one of the highest public transport share in the world, it is expected to change the status in future. Table 1 provides a summary of some changes in key transport indicators for the Region over the period 1991-2005. Although these indicators are rather simplistic they are illustrative of urban transport trends over the last 15 years.

Table 1: Key transport indicators (Growth %)

MMR	Actual 15 year 1991-2005
Population Growth	43%
Sub-urban Train Daily Trips*	35%
Bus Daily Trips (Main Mode + Feeder Trips)	9%
Registered Cars	137%
Registered Two wheelers	306%
Registered Auto Rickshaws	420%
Registered Taxis	128%
Registered Commercial vehicles	200%
Airport Passengers	94%

The transport indicators for the period 1991-2005 indicate that, buses are capturing a much smaller share of travel and suburban services is not keeping pace with population growth. Bus services are loosing out to autos and two wheelers for shorter distance trips particularly to the railway stations. The very large increase in the number of autos and two wheelers is a reflection of this trend. In the newly developing urban areas outside of MCGM the auto industry has found a niche market in areas not well served by public transit. Ride sharing of autos is an example of the private sector nimbly responding to a market opportunity to the benefit of their customers.

Suburban train ridership growth is only about 80% of the population increase. It could be argued that this is due to the severe crowding conditions on the system. But in addition to this constraint, the informal employment sector is increasing and the formal employment sector has declined in proportional terms. Informal employees have a greater propensity to live close to their work places and consequently more people walk to work.

The 137% increase in cars, a 306% increase in two wheelers, the 420% increase in autos and 128% increase in taxis during 1991-2005 has created a lethal dose of traffic congestion which has catagorised Mumbai as one of the congested cities in the world.

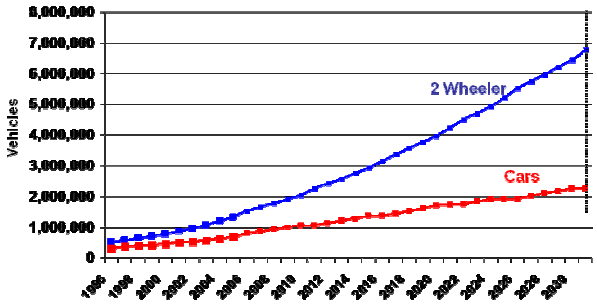


Figure 1: Projected Vehicular Growth - MMR

Parking availability is often limited in the busy parts of the city and drivers often have to "baby sit" the vehicle and are called on demand by phone. Many private cars could be characterised as "private taxis". Parking problems are acute in three distinct areas.

- Firstly in the older built-up areas and slums, which were developed without due consideration of changing vehicle ownership levels and with little available parking and poor local road accessibility. These areas could be residential, shopping or employment zones that are difficult to change and where some constraints on vehicular use will have to be considered.

- Secondly in the newly developed areas where private vehicles use is expected to be high need provision of off-street parking and access.

- Thirdly, there are many traffic corridors connecting these multiple communities to places of employment/ other urban activities.

The observed speeds on some of the major corridors in the study area during 1990 to 2005 indicate that, overall, the speeds are decreasing with time and most probable reason is the increasing trend of traffic levels. However, traffic stream speed depends on several other factors like, time of the day, level of activity along and across the road, pavement condition, etc. at the time of observation.

Over the years, minimum average travel speed in Island city has fallen from 18 to 8km/h whereas, in spite of major capacity expansion programs underway, maximum average travel speed has shown marginal increase from 25 to 30km/h, which is primarily due to construction of flyovers reducing location specific (and movement specific) delays. Most of the network remains highly congested.

Figure 2: Approaching Mahim Causeway

In the suburbs of Greater Mumbai, minimum average travel speed has fallen from 30 to 5km/h, although maximum travel speed increased from 40 to 45km/h. In Thane, maximum average journey speed has dropped from 45 to 32km/h, indicating traffic congestion due to increased traffic flows. Over four decades, there has been little change on major roads in rest of the region.

2.2 Internal Travel - 2005

During the Comprehensive Transportation Study a total of 2,75,000 interviews were conducted in 66,000 homes recording details of more than 3,25,000 journeys made by residents on an average day. This formed part of a scientifically carried out survey through a group of 400 specially trained interviewers over a period of five months.

A total of about 2 Crore people in MMR make about 2.85 Crore journeys (trips) every day, counting going-to and coming-back separately. More than half of these journeys, about 1.5 Crore, are made entirely on-foot. Another 1.35 Crore are made by a combination of modes, at least one of which is motorised. It has been estimated that all these journeys total to about 25 Crore Kilometres of travel every day. The details are presented in Table 2.

Figure 3: Home Interview Survey

Table 2: Mumbai Travel Demand – Main Mode (Average Working Day): 2005

Main Mode	Trips per day
Walk	1,48,50,000
Train	69,75,000
Bus	35,50,000
Rickshaw	10,50,000
Taxi	2,25,000
Two Wheeler	10,50,000
Car	6,25,000
Total	2,83,25,000

Almost 7 million journeys are made by Suburban Rail. It is the most important mode of travel after walk. Equally important are public bus services on which another 3.5 million trips are made. In addition, these buses also double up as an access mode for people who use suburban railways. Out of 7 million journeys made by rail, as earlier mentioned, about 1.5 to 2.0 million use buses to reach their railway station of choice. Thus, Buses in total carry a total of about 5.5 million passengers.

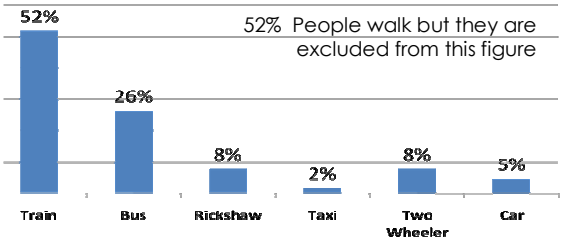


Figure 4: Mode Share (Without Walk)

About 10 lakh journeys are made by Two Wheelers. Equal numbers are made by three wheeled ubiquitous Auto-Rickshaw. About 8.5 lakh journeys are made by cars and taxis. In spite of each of these modes being less than one-fifth of either train or bus, their high per capita road coverage creates almost insurmountable congestion.

About 20 people get killed every day (approx. 13 on trains and 7 on roads Ref. Table 3.

Table 3: Daily Fatalities in Accidents in MMR

Year	Persons killed every day		
	Road	Rail	Total
2002	5	10	15
2003	5	10	15
2004	6	13	19
2005	7	12	19

Source: Basic Transport & Communication Statistics for MMR, March 2005 by MMRDA and Indian Railways

Unaffordable housing throughout the city of Mumbai forces residents to move farther away in surrounding municipalities, where, they often remain captive to rail. For this reason, average trip length for these commuters is unusually high at almost 24 km (see chart below). Length of journeys made by all other modes is much less, varying from seven to twelve km except Auto-Rickshaws which is used for even smaller journeys of 1 to 5 Km

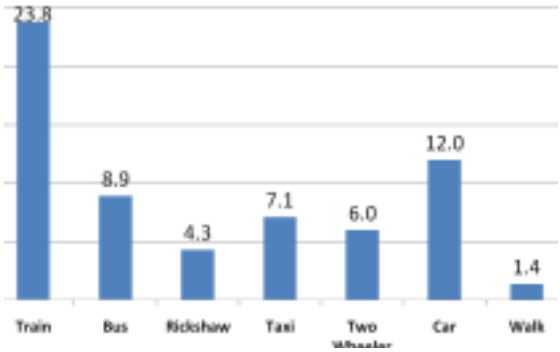


Figure 5: Average Trip Length (km)

In terms of percentage, Mumbai Region should take pride in the fact that 78% of journeys are made by trains and buses (main mode) which is highly efficient in terms of energy consumption, environmental costs and per capita space requirement. Although, as was found out, these were not the causes but effects of other phenomenon such as unusually compact urban form, high densities, low incomes and lack of affordable housing. Thus, sadly, these are signs of an overall low quality of life with lack of choices and alternatives rather than a conscious selection of most efficient mode of travel. However employees owning cars or two wheelers often choose to leave their vehicles at home and use public transport.

On an average, little over Rs 200 is spent by each person on account of transportation.

Figure below provides the variation by occupation. Full time employees spend the most where as housewives and retired spend the least.

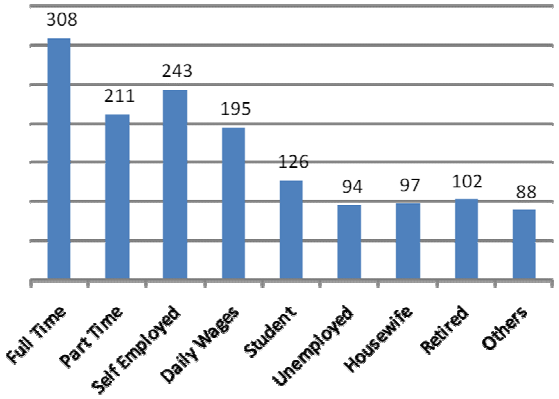


Figure 6: Expenditure on Travel (Rs per month): Variation by Occupation

Further, if one analyses the variation by mode (in terms of expenditure per worker), it can be seen that people using cars (with drivers) spend the most whereas workers using company chartered buses spend the least.

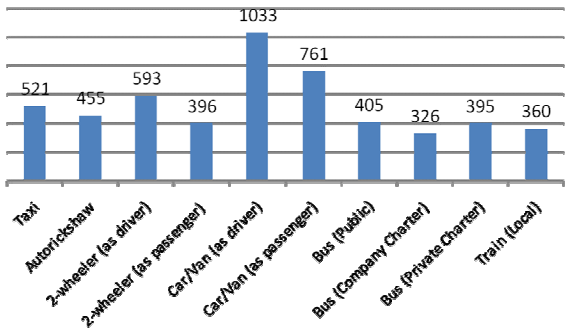


Figure 7: Expenditure on Travel (Rs per month): Variation by Mode

2.3 Slums and Transportation

There is no other Metropolitan area in the world that has such a large and diverse socio- economic milieu as Mumbai. Particularly the numbers of residents those are poor and extremely poor. This is a manifestation of the historical magnetism of Mumbai in attracting rural populace from across India by being a place which best chance of survival. This, when coupled with high birthrates in this section of population, unaffordable and restricted supply of housing has resulted in a large increases in slum population over last 20 to 30 years. TRANSFORM Household surveys corroborate earlier surveys and the 2001 Census of India that about 50% of the population of Mumbai is being housed in slums.

Slums have been characterized in the TRANSFORM as either Slum Type 1 (buildings contained within a semi-organised areas and built with semi-pucca building materials) and Slum Type 2 (representing the less structured and more temporary slum dwellings including those located on the roadways, railway corridors and watercourses). The mixture of housing is shown in Figure 8. This slum population of 10 million people in about 2.3 million households represents an enormous housing deficiency which is perhaps the most serious social problem of the Region.

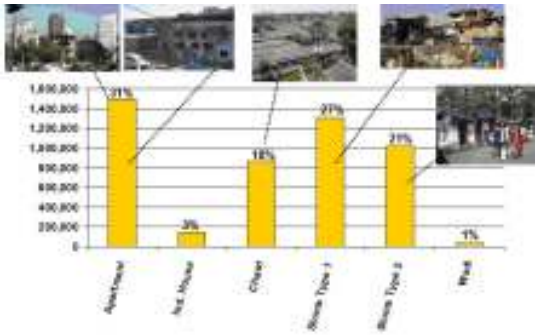


Figure 8: Distribution by Housing Type

People who live in slums represent

- 47% of total MMR population
- 48% of total MMR employment
- 60% of people who walk to get to work

Slum dwellers are an integral part of the economic and social fabric of Mumbai. Rising education standards and income levels of slum dwellers over the next 25 years, will inevitably materialize in a generational shift in housing from slums to regular permanent accommodation. This shift will be accompanied by increased demand for motorized travel with more people working in formal employment.

2.4 Income Levels and Housing Types

Slum dwellers have reported household income that is about two thirds of what families living in apartments earn (Ref: Figure 9). The potential changes in income levels over the next 25 years could have a major impact on the amount of urban travel. One of the major influences on urban travel is the practice of people changing jobs but not homes, even if this involves increased travel. The experience of developed economies is that this phenomenon in itself is creating a 30% increase in travel even with no overall increase in employment. India is now experiencing high volatility in the job market with companies aggressively competing for qualified staff and retaining employees is becoming a major business issue and is driving inflation pressures. The observed experience of large cities as they expand the average person trip lengths get longer which further generates increased travel on the transportation networks.

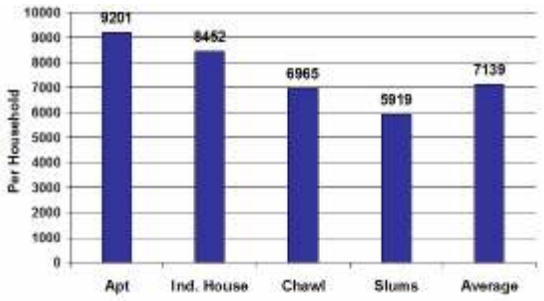


Figure 9: Reported Average Household income by Housing Type

2.5 Rehabilitating Slums

Unfortunately the need to reallocate and provide alternative accommodation for slum dwellers has become a major cost and timing constraint in undertaking infrastructure projects.

The road and rail projects, being currently undertaken under MUTP, are requiring the resettlement and rehabilitation of over 22,000 households involving 110,000 residents. Each resettlement family is provided, at no cost, with a 225 sq ft apartment including title of ownership. This resettlement programme has been estimated to cost 480 crore ($120 million)

Figure 10: Slums along suburban railway tracks

Figure 11: Slum Rehab Housing (MUTP)

Plans to undertake an expansion of the Mumbai airport are also faced with similar resettlement and rehabilitation problems with an estimated 70,000 slum families currently occupying airport lands. Government policies have established an eligibility occupancy date of 1995 for slum resettlement and rehabilitation, although this criterion is under constant review and challenge.

2.6 External Travel

Analysis of traffic counts on the outer periphery (cordon) show that four National Highways carry most traffic. A total 55,000 vehicles enter or leave MMR everyday through these corridors which is about 60% of the total external traffic. The Mumbai-Pune Expressway adds another 23% of the total traffic and various State Highways contribute a total of 18%.

The origins or destinations of passenger-vehicle movements in and out of MMR are dominated by Greater Mumbai. About 63% of all vehicle movements either originate or terminate from Mumbai. Kalyan (9%), Thane

(7%) and Navi Mumbai (4%) are also significant. Most of these trips are made for work-related purpose. In addition, about 116,000 bus passengers arrive in and depart from MMR daily. Greater Mumbai accounts for one-third of this traffic. Kalyan-Dombivilli and Thane are also important. Through-traffic, traversing the region, accounts for only 4% of passenger movements. Many buses travel on Mumbai-Pune Expressway.

MMR also produces 110,000 tonne of freight traffic daily, and attracts another 104,000 tonne on roads. Of this, Greater Mumbai generates about 43% and attracts 37%. Navi Mumbai, Bhiwandi and Thane are also important attractions for goods traffic. About 16% of the total freight movement is through-traffic, not stopping in MMR.

A comparison of traffic count data at the outer cordon locations i.e. entry/ exit locations of MMR carried out in CRRI study (1983) and present study (2005) indicates that, the traffic growth by Bus, Trucks, Car and Two wheelers is 6.3%, 7.4%, 13.1% and 11.9% per annum respectively. Inter-city passenger travel by cars & two wheelers is increasing at faster rate than by bus. The reasons could be several and the major reason is increasing private vehicle ownership.

Approximately 6,630 buses enter/ leave MMR per day through outer cordon locations of MMR. On average, the traffic split by private and Govt. buses is 45% and 55% respectively. On NH8, SH53 and Mumbai-Pune Expressway, operation of private buses are high. while, on SH35, MSH2, SH38 and NH4, operation of Govt. buses are high. Comparisons of present findings with previous studies indicate that, inter-city travel by private buses is increasing and it is expected that, the trend would further continue.

2.7 Sub-Urban Railways

Figure 12: Victoria Terminus - 19th Century

The history of transit in Mumbai and history of railways in India are tied together. Just thirteen years after the first train of India was flagged off from CST to Thane 153 years ago, the first suburban operation started between Virar and Back bay in 1867 (near Churchgate of today). For these deeply historical reasons, unlike any other city of India, Mumbai Region has greatly benefited by having a very mature and efficient rail based transit system developed, operated and maintained by Indian Railways for more than 140 years. While Indian Railways is now mainly a national intercity passenger and freight operator of India, it has continued to operate and maintain the Mumbai Transit System, a non-core activity.

'Indian Railways' operates about 2100 suburban services per weekday (1186 by Central Railway and 913 by Western Railway) over about 400 km route network (280 km of Central Railway and 120 km of Western Railway). The fleet strength of Central Railway is 86 No. of 9 car rakes & 24 No. of 12 car rakes and Western Railway is 41 No. of 9 car rakes & 31 No. of 12 car rakes. Average Weekday suburban rail travel demand is estimated to be 1.5 Crore passenger km in 2005, at an average rail journey length of 26 km. The number of weekday passenger trips by rail is estimated at 70 lakhs. The highest average commuter density is observed to be 9 persons/m² with the average 6-16 persons/m2. Maximum passenger flow is across Mahim where about four lakh passengers in morning peak hour (0900-1000 hrs) and 3.2 lakh passengers in

the evening peak hour (1800-1900 hrs.) move across (Ref. Figure 13 and Figure 14).

Traffic on suburban rail is growing differentially on different parts of the network. Lines operated by Western Railway from Churchgate to Virar have a very low growth (0.65% per annum). This is mainly due to supply crunch. On the other hand, network operated by Central Railway is more diverse and has many under-utilised sections. Therefore, it has been growing at a higher rate of 2.65% per annum.

One of the remarkable attributes of the suburban rail system is the low fares compared to any other transit system in the world. However this low cost comes with a severe penalty with 10-12 casualties per day and crowding levels reaching an intolerable 16 persons/m² in the space between car doors (Average standing density is 12 persons/ m²). The average crowding level is 9 persons/m². There is an urgent need for enhancing the sub-urban rail system to reduce the over-crowding level. In addition, to cater for the future travel demand, there is a need for capacity augmentation by extending sub-urban railway system, supplementing with metro system, Exclusive Bus Lanes on major highway corridors.

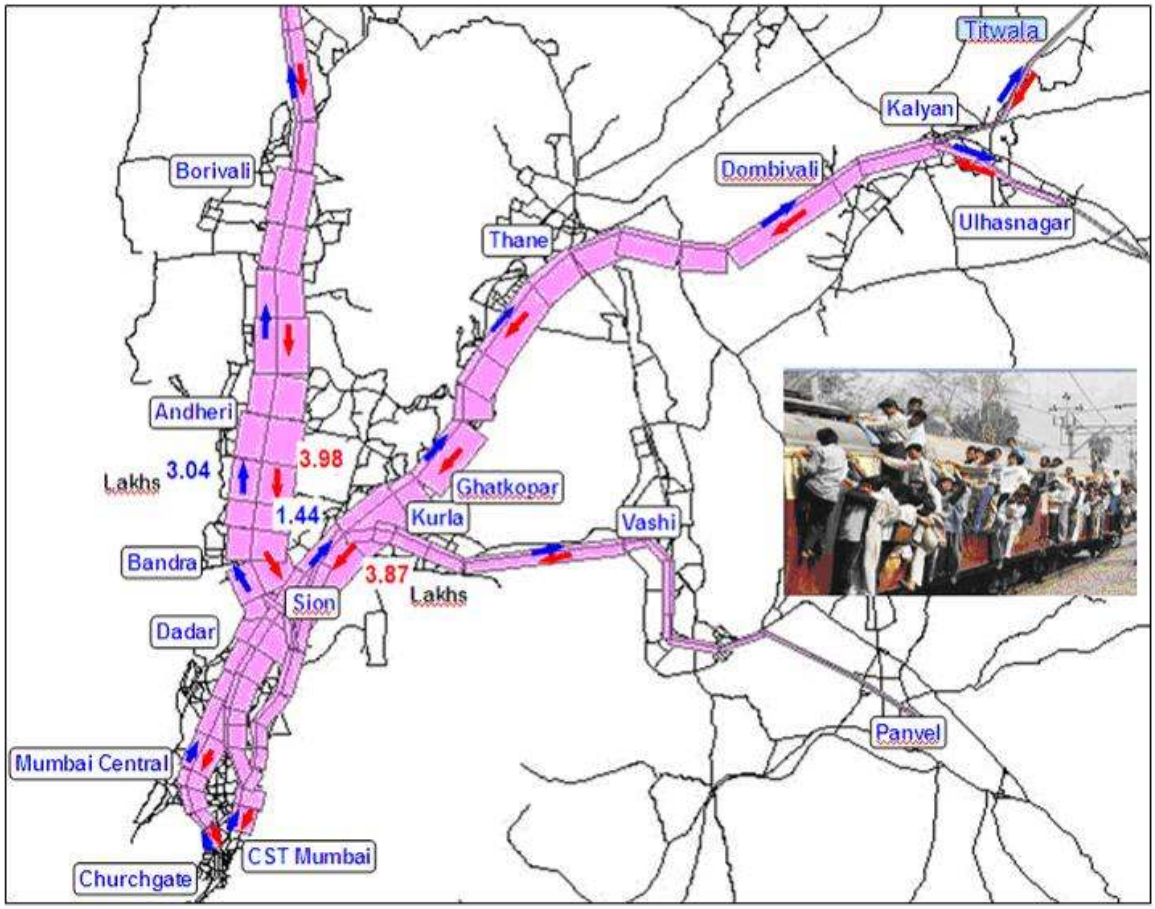


Figure 13: Suburban Train Passengers (Peak Period- 6:00am to 11:00am)

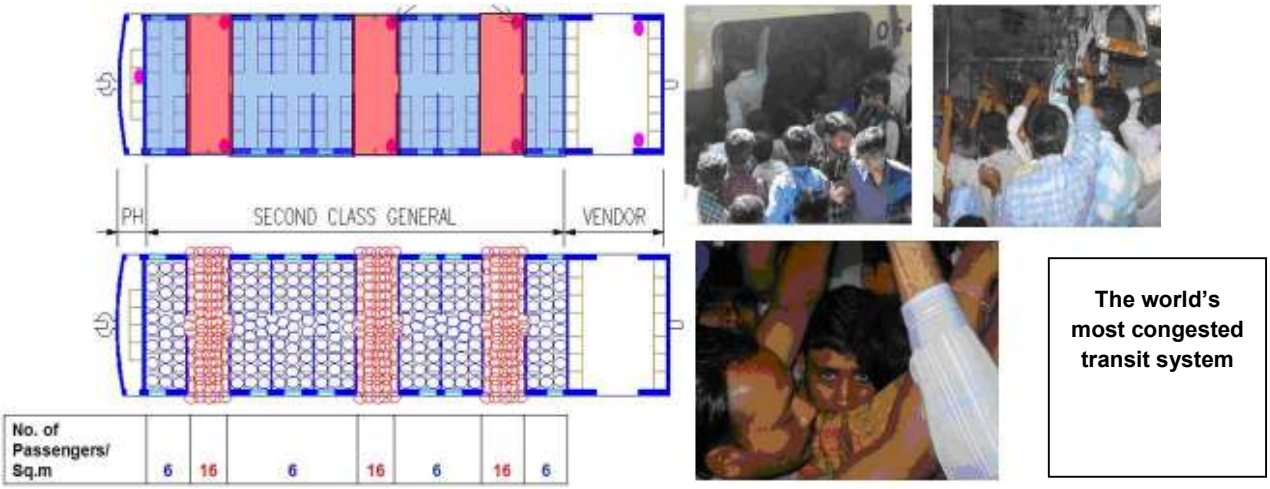


Figure 14: Measuring Crowding in Trains: Number of passengers per sq m in different parts of a second class coach

2.8 Travel by Bus

After, sub-urban rail mode, travel by Bus is predominant in MMR. Daily travel by Bus as a main mode in the base year (2005) is about 3.55 million, which is 26.3% of total travel (Without walk trips). It is pertinent to mention here that, bus mode is acting as a major feeder service to the sub-urban train. If access/ egress is also included, which generally the bus operators calculate the trips is about 5.5 millions/day.

The road based public transport system is mainly operated by municipal corporation undertakings like BEST, NMMT, TMT, KDMT, MBMCTU, etc. In addition, MSRTC (which provides services mainly for inter-city travel) also cater to the internal travel needs of MMR. These organizations are operating bus services over 5,700 routes.

Travel by contract carriages (buses operated by private operators, companies) is also predominant in some of the routes. Growth of Stage Carriages, Contract carriages and School Buses in MMR are presented in Table 4. In 2005, contract carriages have been increased from 7,396 to 10,633 and school buses have increased from 912 to 1,298. However, the no. of trips per bus carried by these contract carriages and school buses per day is approximately 1/10 of the passengers/bus carried by the public transport buses. The growth of contract carriages clearly indicates that, the public transport, sub-urban train and bus are loosing their share. The reason for more operation of contract carriages and school buses is convenient and comfort service offered by these modes.

Table 4: Growth of Stage Carriages, Contract carriages and School Buses in MMR

Year	Stage Carriages	Contract Carriages	School Buses	Total
1996	6041	7117	842	14000
1997	6293	7508	850	14651
1998	6557	7787	861	15205
1999	6737	8144	864	15745
2000	6948	8608	867	16423
2001	7144	9027	871	17042
2002	7038	6761	897	14696
2003	7149	7033	933	15115
2004	6719	7396	912	15027
2005	6740	10633	1298	18671

In MMR, BEST is the biggest public road passenger transport provider with a fleet strength of 3,380 and operating 334 routes. In fact, it is the biggest municipal public transport undertaking in India. BEST operates services within MCGM and from MCGM to other major destinations outside MCGM. Fleet and no. of routes operated by major transport undertakings in MMR are presented in

Table 5.

Table 5: Descriptive Statistics of the Major Transport Undertakings in MMR (Year 2002-03)

TU	Pass-km (million)	Bus-km (million)	No. of Buses Held	No. of Employees	Pass. Carried (million)	Average Carrying Capacity	Occupancy Ratio or Load Factor*	No. of Routes Operated	One-way Passenger Trips Originated Daily** (Millions)
BEST	10,187	237.7	3,380	35,276	1560.9	75.0	57.2	334	4.30
TMT	914	19.64	264	2,555	96.2	58.2	80.0	43	0.26
MSRTC	7,933	204.2	1,950		294.4	251.6			0.77
Raighad	2,128	65.9	660		95.0	64.1			0.26
Thane	3,384	64.3	585		97.2	63.6			0.27
Palghar	1,153	38.3	428		68.1	63.4			0.19
Mumbai	1,268	35.7	277		34.1	60.5			0.05

Note:

** The load factor is based on average carrying capacity of vehicles at the end of the year.*

*** Daily Passenger trips includes main mode trips and access/ egress trips*

Complete Statistics for NMMT, KDMT and MBMCTU are not available

Source: Basic Transport & Communications Statistics for MMR, March 2005

2.9 Travel by Para Transit Modes

Intermediate Public Transport (IPT) modes i.e. Taxi and Auto in metropolitan cities plays an important role in meeting unstructured travel demands of users. It performs as feeder service to the main mass transport system (Both rail and road based) and provides accessible movement in predefined areas. The services provided by the IPT are intermittent in nature and this has complete flexibility in destination which is determined by the passengers. In MMR, IPT is acting as competent access/ egress mode and competing with road based public transport system, especially on short trip lengths. Trip characteristics by these modes is entirely different compared to the trips made by other motorised modes, as these modes offer high flexibility, services from almost door to door, fare, etc.

As per the 2005 statistics, population of Auto in Greater Mumbai and rest of MMR is 1,02,224 and 1,17,946 respectively (46.43%:53.57%). Population of Taxi in Greater Mumbai and rest of MMR is 56,459 and 17,634 respectively (76.20%:23.80%). Operation of Autos and Taxis in Greater Mumbai is high compared to rest of the region. Past trend during 2000 to 2004 indicates that, there is an increase in Auto and Taxi population in rest of MMR, whereas it is almost stagnant in Greater Mumbai. Annual growth rate of Auto population and Taxi population in MMR is 4.0% and 3.1% respectively (2000-2004 data).

On an average, Taxis perform 10 trips a day with an average trip length of 5.1 kms. The proportion of taxis owned and hired by operators/drivers is 40%:60%. Auto perform 16 trips day with an average trip length of 2.9 kms. The proportion of autos owned and hired by operators/drivers is 61%:39%.

2.10 Travel by Private Vehicles

Daily travel by private vehicle modes, Two Wheelers and cars in the base year (2005) is about 1.05 million and 0.63 million respectively, which is 7.8% and 4.6% of total travel (Without walk trips).

The total number of motorized vehicles that is, four wheelers, two wheelers, trucks and tractor trailers registered in each sub region, from 31st March 1996 to 2005 is presented in Table 6. The growth pattern of all Motor vehicles in MMR (MCGM, Rest of MMR and MMR) and MCGM (Island city, Western suburbs, Eastern suburbs and Greater Mumbai) is presented in Figure 15.

Table 6: Growth of Motor Vehicles in MMR (On Road as on 31st March, 1996 to 2005)

Year	GM	Thane	Kalyan	Pen-Raighad	MMR
1996	0.73	0.26	0.08	0.06	1.14
1997	0.81	0.31	0.09	0.08	1.29
1998	0.86	0.36	0.11	0.10	1.43
1999	0.92	0.40	0.12	0.11	1.55
2000	0.97	0.45	0.14	0.12	1.69
2001	1.03	0.51	0.16	0.14	1.84
2002	1.07	0.58	0.17	0.16	1.98
2003	1.12	0.65	0.19	0.18	2.14
2004	1.20	0.76	0.21	0.20	2.37
2005	1.29	0.85	0.23	0.23	2.60

Source: Transport Commissioner's Office, Government of Maharashtra

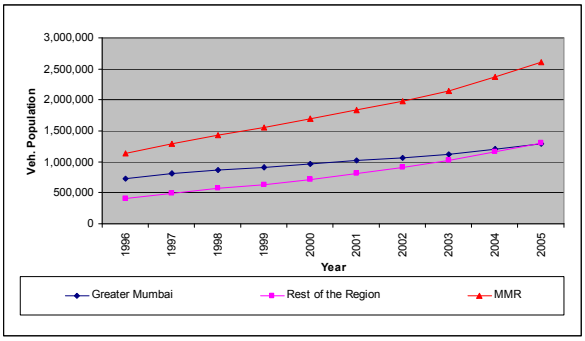


Figure 15: Growth of Total Motor Vehicles in MMR

The number of registered Two Wheelers, Cars and their total (private vehicles) as on 31st March 1996 up to the year 2005 is presented in Table 7, Table 8 and Table 9 respectively.

Table 7: Growth of Two Wheelers in MMR

Year	Greater Mumbai	Thane	Kalyan	Pen-Raighad	MMR
1996	0.30	0.13	0.05	0.04	0.52
1997	0.33	0.15	0.06	0.04	0.58
1998	0.35	0.17	0.07	0.05	0.65
1999	0.38	0.19	0.08	0.06	0.71
2000	0.41	0.21	0.09	0.07	0.78
2001	0.44	0.24	0.10	0.08	0.87
2002	0.48	0.27	0.11	0.09	0.95
2003	0.53	0.31	0.13	0.10	1.07
2004	0.58	0.36	0.14	0.11	1.20
2005	0.65	0.40	0.16	0.13	1.34

Source: Transport Commissioner's Office, Government of Maharashtra

Table 8: Growth of Cars in MMR

Year	Greater Mumbai	Thane	Kalyan	Pen-Raighad	MMR
1996	0.26	0.04	0.00	0.01	0.32
1997	0.29	0.06	0.01	0.02	0.37
1998	0.31	0.07	0.01	0.02	0.41
1999	0.32	0.08	0.01	0.02	0.43
2000	0.33	0.10	0.01	0.02	0.46
2001	0.34	0.12	0.01	0.03	0.51
2002	0.35	0.14	0.02	0.03	0.54
2003	0.37	0.16	0.02	0.03	0.58
2004	0.38	0.20	0.02	0.04	0.64
2005	0.41	0.22	0.02	0.04	0.69

Source: Transport Commissioner's Office, Government of Maharashtra

Table 9: Growth of Private Vehicles (Cars & Two Wheelers) in MMR

Year	Greater Mumbai	Thane	Kalyan	Pen-Raighad	MMR
1996	0.56	0.17	0.06	0.05	0.84
1997	0.62	0.20	0.07	0.06	0.95
1998	0.66	0.24	0.08	0.07	1.06
1999	0.70	0.27	0.09	0.08	1.14
2000	0.74	0.31	0.11	0.09	1.25
2001	0.79	0.37	0.12	0.11	1.37
2002	0.83	0.42	0.13	0.12	1.49
2003	0.89	0.48	0.14	0.13	1.65
2004	0.97	0.55	0.16	0.15	1.84
2005	1.06	0.62	0.18	0.17	2.03

The growth trend of private vehicles in MMR (MCGM, Rest of MMR and MMR) is presented in Figure 16.

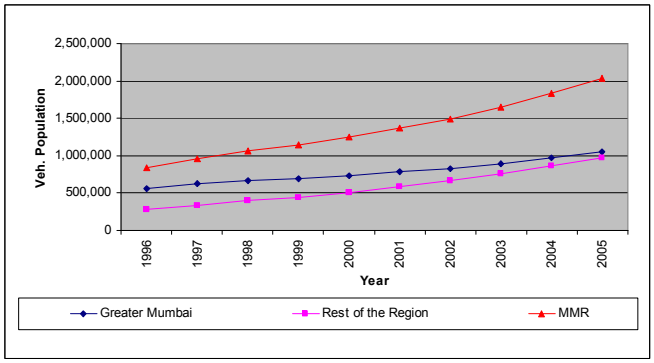


Figure 16: Growth of Private Vehicles in MMR

Compound Annual Growth Rate (CAGR) calculated for the period 1996-2005 details are presented in Table 10.

Table 10: Growth of Private Vehicles (Cars & Two Wheelers) in MMR

Mode	GM	Thane	Kalyan	PR	MMR
Total Motor Vehicles	6.5	14.1	12.5	15.2	9.7
Two Wheelers	8.8	13.7	13.3	14.8	11.1
Cars	5.1	20.0	17.9	16.4	9.0
Private Vehicles	7.2	15.6	13.7	15.2	10.3

Note: GM: Greater Mumbai, PR: Pen-Raighad

The following inferences have been made based on analysis of the above data.

- *During last 10 years period i.e. 1996-2005, total motor vehicles in MMR are increasing at 9.7% (CAGR).*
- *CAGR of two wheelers and cars is 11.1% and 8.97% respectively. CAGR of two wheelers & cars is 10.3%. High growth of private vehicles in MMR is mainly due to highly intolerable crowding*

levels in sub-urban trains, increasing income levels and easy availability of loans.

- *Growth of vehicles in Thane, Kalyan and pen-Raighad is very high compared to Greater Mumbai. The major reasons for this could be easy accessibility to public transport modes, high traffic congestion, etc. in MCGM compared to Thane, Kalyan and Pen-Raighad.*

The proportion of cars in various regions/office wise is presented in Table 11 and in Figure 17. The proportion of cars is observed to be higher in Greater Mumbai compared to rest of the region of MMR (Thane, Kalyan and Pen-Raigad).

Table 11: Proportion of Cars in Private vehicles

Year	GM	Thane	Kalyan	PR	MMR
1996	46%	25%	8%	23%	38%
1997	47%	28%	9%	26%	39%
1998	47%	29%	10%	27%	39%
1999	46%	30%	10%	27%	38%
2000	45%	31%	12%	26%	37%
2001	44%	33%	12%	27%	37%
2002	43%	34%	12%	26%	36%
2003	41%	34%	11%	26%	35%
2004	40%	35%	11%	25%	35%
2005	39%	35%	11%	25%	34%
Average	44%	32%	11%	26%	37%

Note: GM: Greater Mumbai, PR: Pen-Raighad

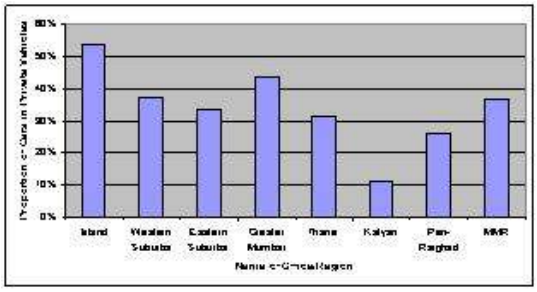


Figure 17: Proportion of Cars in Private Vehicles

Within Greater Mumbai, the proportion of car is highest in Island city and lowest in Eastern suburbs. Over a period of time i.e. during 1996-2005, the proportion of cars in different regions of Greater Mumbai is decreasing whereas in rest of the region, the proportion of cars is increasing. This trend may likely to continue further. On an average, the proportion of cars in Greater Mumbai and MMR is 44% and 37% respectively. The trends indicate that proportion of cars in Greater Mumbai as well as in MMR may reach equilibrium over a period of time.

Vehicle ownership is generally expressed as number of vehicles/1000 population. Private vehicles/ 1000 persons in different sub-regions of MMR are presented in Table 12.

Table 12: Private vehicle Population of MMR, Veh./1000 persons

Year	Island	WS	WS	GM	Rest of MMR	MMR
1996	80	45	31	52	47	50
1997	88	49	33	56	55	56
1998	91	53	35	59	63	60
1999	92	55	37	60	68	63
2000	95	58	38	63	75	67
2001	100	60	41	66	84	73
2002	103	63	43	68	92	77
2003	108	68	46	72	101	83
2004	113	73	48	77	113	90
2005	121	80	51	82	122	97

The increase in private vehicles ownership during the period 1996 to 2005 in Greater Mumbai is from 52 to 82 while in MMR increase from 50 to 97 respectively. The private vehicle (cars and two wheelers put together) ownership in rest of the region is high compared to Greater Mumbai. This phenomenon is may be due to high accessibility of public transport and IPT modes in case of Greater Mumbai and less in case of rest of region, although proportion of cars is high in Greater Mumbai.

Private vehicle growth for the horizon period has been estimated using the "Vehicle Availability Models". Forecasted growth of private vehicle in the study area are presented in Table 13. It can be seen that, high growth of private vehicle is expected from rest of MMR i.e. in Thane, Kalyan and Pen-Raighad areas compared to Greater Mumbai. In absolute terms, the private vehicle population of 2 million vehicles in the year 2005 is estimated to grow by 9 million by the year 2031 an estimated increase of approximately 4.5 times.

Table 13: Forecasted Growth of Private Vehicle Population of MMR, Veh./1000 persons

Year	Greater Mumbai	Rest of MMR	MMR
2006	95	134	110
2011	112	180	139
2016	132	228	171
2021	153	270	204
2026	175	304	236
2031	197	329	266

The high growth of private vehicle ownership may not directly indicate the use of the private vehicles for trip making. People generally use private vehicles as access/ egress mode to the main mode (like sub-urban station) and use for weekend trips (social purpose) than for regular use. However, the proposed road transport network for the horizon year has been tested for the forecasted growth of private vehicles by incorporating the growth in vehicle availability model used in mode-choice modelling.

2.11 Ports

In addition to all of the above, MMR is home to two out of twelve major ports of India i.e., Mumbai Port (MbPT) and Jawahar Lal Nehru Port (JNPT). In addition, another port is being planned at a site known as Rewas.

Mumbai Port

Mumbai Port is oldest but, being in the midst of a thriving metropolis, suffers from serious evacuation problems. A dedicated container terminal is being planned but the progress has been very slow. Most of the evacuation happens by road (trucks) in spite of port having large infrastructure of railways of its own. While road is generally accepted as an inefficient type of evacuation mode, specially for bulk or break bulk cargo, Mumbai Port has to depend on it as the only means. Railway network around the port premises is overloaded with suburban and intercity passenger traffic. With the port getting surrounded by intense commercial activities and large existing and planned employment centres, evacuation by road will get more and more difficult. This will not only create delays for passenger traffic but also make the port business more inefficient.

Figure 18: Ports in MMR

Figure 19: Mumbai Port

It is a niche port for certain specialized type of cargo such a Motor Vehicles and Oversized Project Cargo. Also, in addition to Alang in Gujarat, Mumbai Port is the second place in India for ship breaking. [1]

During 2005-06, 32% of traffic (about 14 Mt) was non POL Bulk. Top four commodities among these were Iron & Steel (likely to be output of Ship Breaking), Fertilizers/ Fertilizer related raw material (mainly due to Rashtriya

[1] Ship breaking is a highly toxic and unsafe operation. There have been several reports by ILO and Green-Peace on the environmental and safety aspects of these operations in Mumbai Port.

Fertilisers), Food Grain and Edible Oil. Small quantities of Oil Cake and Sugar is also exported but it has been decreasing over the years. Thus, overall, except POL, no single commodity is very important in terms of utility of the port.

In parallel, plans are also underway to make way for commercial exploitation of large real estate. This will surely release additional space of business and employment, which will have its own transportation requirement. But, at the same time, at least in the near future, port operations are unlikely to completely cease or dwindle to very low levels. While not a long term solution, expediting the planned dedicated rail and road link from Wadala to Kurla/ Chembur and beyond will greatly help to contain the delays occurring due to inter-mixing of port related and city traffic.

JN Port

JN port, biggest container port of the country, has three dedicated container terminals. Since its commissioning, these terminals have grown at a fast pace. World class port side facilities along with good rail and road accessibilities helped them to continuously grow. Parallel growth and globalization of economy has been hand in hand with the ports growth. In fact, till last year, growth of traffic at JNPT has been a barometer for the growth of Indian Economy. Upto 2003-04, JNPT's growth was always above 20% per annum. Severe crunch of evacuation infrastructure (both rail and road) in 2004-05 halted JNPT's growth and brought to the fore the crises which was slowly developing. This year, all the terminals together are again on double digit growth with the overall growth standing at more than 12% over last year. Of late, the port has been experiencing congestion leading to delays. Connectivity has been one of the issue highlighted for these delays. The proposed transport network provides adequate connectivity to the port.

In year 2002, a 50 year concession agreement was awarded to develop an additional private port on PPP basis for handling container traffic. Known as Rewas Port, last year, its ownership changed hands. Now, being part of a larger setup, and because of expected synergies with operations of SEZ to be developed by the same business group, the project has much higher level of interest. It is expected to a as big as port as JN Port.

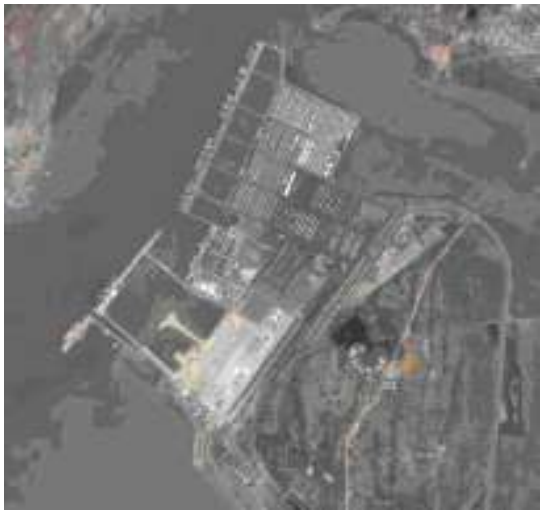


Figure 20: JN Port

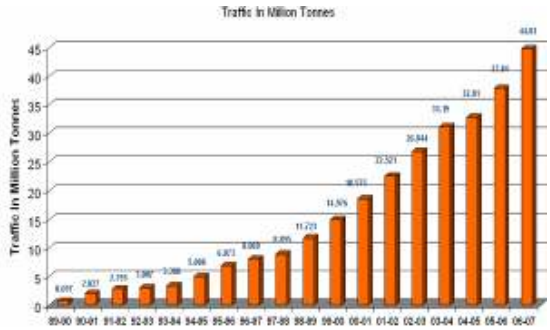


Figure 21: Growth of Traffic at JN Port

2.12 Airport

Region is host to the busiest airport of India which handles more than 400 flights, 36000 passengers and 900 Mt of cargo every day. Agency which manages this airport (Airport Authority of India) specifies 1.55 Crore passengers per annum as the ultimate capacity of total system (1 Crore for domestic terminals and 0.55 Crore International Terminal). Last year (2005-06), it handled 1.8 Crore passengers.

Traffic has been rapidly increasing in last five years but year-on-year growth rate has been varying. As part of a survey and study conducted in the project, it was estimated that

the region will need to handle 2.1 Crore International and 5.4 Crore domestic passengers by the year 2025 (Ref. Figure 24). Thus, there is a need for augmenting the airport capacity, either by expanding existing airport capacity or by planning a second airport in the region.

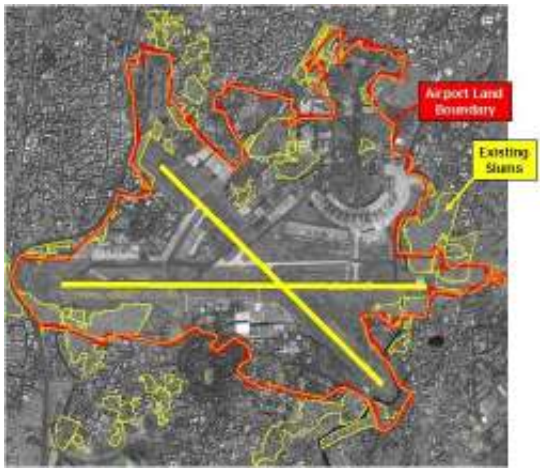


Figure 22: Slums around existing Airport

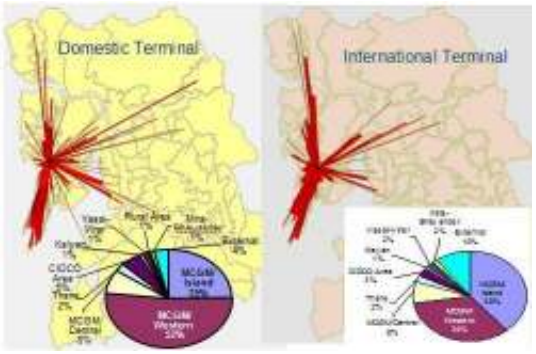


Figure 23: Desire Pattern of Air Travelers

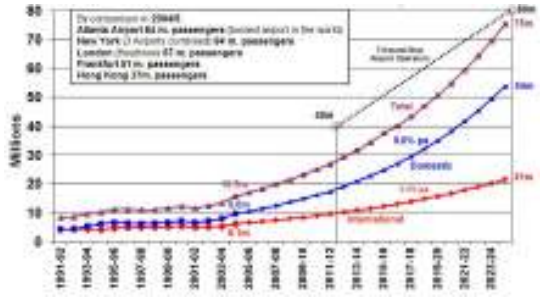


Figure 24: Project Growth of Air Traffic

2.13 Intercity Rail Terminals

Mumbai city houses headquarters of both, Central and Western Railways, which handle a major share of the inter-regional/city rail passenger traffic in India. Mumbai city has the history of “First passenger railway line from "Boree Bunder" (now Chhatrapati Shivaji Terminus) and “Tannah” (now Thane) in 1853 covering a distance of 34 km (21 miles), formally heralding the birth of railways in India. The railway line was extended from Thane to Kalyan (20 kilometers) after about a year. From Kalyan, the railway line branched into two directions, viz. the North Eastern line leading towards Igatpuri and Bhusaval and the South Eastern line towards Pune and Solapur.

Western Railway in its present form came into existence on 5th November, 1951 by the merger of its forerunner, the erstwhile Bombay, Baroda and Central India Railway (BB&CI), with other State Railways viz, Saurashtra, Rajputana and Jaipur. The BB&CI Railway was itself inaugurated in 1855, starting with the construction of a 29 mile broad gauge track from Ankleshwar to Utran in Gujarat state on the West Coast. In 1864, the railway was extended up to Mumbai.

The inter city rail passenger demand in MMR has been met by Western Railway and Central Railway which are busiest and largest railway networks among 16 zones of Indian Railways. Western Railway serves the entire state of Gujarat, the eastern portion of Rajasthan, some portions of western Madhya Pradesh and some places of coastal Maharashtra. It also operates the Western line of the Mumbai suburban railway system which extends from Churchgate to Dahanu Road. On the other hand Central Railway which has its headquarters at Chatrapati Shivaji Terminus (formerly Victoria Terminus) covers a large part of the state of Maharashtra as well as parts of north-east Karnataka and southern Madhya Pradesh.

The total no. of originating and destined rail passenger trips from/to MMR per annum (all classes) for the year 2005 was 93.6 Million (58.4 Million by Central Railway and 35.2 Million by Western Railway). The estimated annual total no. of passenger trips by 2031 is approximately 165.2 Million (101.3 Million by Central Railway and 63.9 Million by Western Railway). To meet the future demand

expansion of existing terminals and new rail terminals are needed.

2.14 Intercity Bus Terminals

Intercity bus terminal locations in MMR are mostly located near to the Suburban Railway Stations to have convenient and fast access/ egress by suburban trains. Analysis of passenger surveys carried out at 12 major inter-city bus terminals in MMR (MSRTC) indicate that, the passengers are travelling longer distances to reach bus terminals, especially outside MCGM. No. of bus services operated from these terminals are approximately 7,200/day and no. of passengers served are approximately 2.50 laks/day (2005 statistics). The estimated no. of services for a population of 34 Million by 2031 is 12,200 bus services and the estimated no. of passengers is 4.26 lakhs. Additional bus terminals are necessary to meet the travel demand upto 2031.

2.15 Goods/Truck Terminals

Goods transport movement in the study area is important as two major ports of the country are located in Mumbai region and the region is well connected by rail and road with rest of the country. Moreover, Mumbai region accommodates no. of industrial growth centres which generate lot of goods traffic movement.

Economic and physical characteristics, transportation, parking, loading and unloading requirement of goods leads to special approach. The flow of goods into and out of urban area (Inter-city movements) is characterized by bulk shipment whereas their movement within urban area (Intra-city movements) by smaller shipments. Though the physical boundary of urban area gets enlarged over time, the locations of goods activities remains unaltered. This leads to traffic congestions within the urban area. In addition to this, increase in urban area over a period of time demands more quantity of commodities.

Goods terminal surveys are carried out primarily to assess the additional terminal requirements for the horizon year. In addition to information about terminal operations has been also collected during the survey. Approximately 44 major truck terminals have been identifies in the study area based on secondary information, primary surveys (count and OD survey at Outer Cordon locations and Sub-regional cordon locations). On sample basis, about 25 truck terminals have been selected representing various functional categories. Brief findings from the analysis are presented as follows:

- MMR contains major settlements like Greater Mumbai, Navi Mumbai, Kalyan-Dombivali, Bhiwandi, Vasai-Virar, Gorai-Manori, etc. Major goods traffic generators, Mumbai Port is located in MCGM and Jawaharlal Nehru Port is located in Navi Mumbai. No. of railway yards are located at strategic locations in the study area (Reay Road, Wadi Bunder, Goregaon, Dahanu, Mulund, Kalyan and Turbhe) for loading and unloading of goods originated/ destined to the study by are by rail for further transhipment/ distribution by road. In addition, truck terminals, major truck parking areas, Oil depots are located at strategic locations in the study area for convenience of road based goods vehicle movement. Observation of truck parking on major arterials, highways, etc. in the study area indicates that, the demand for truck terminals is very high.
- City and Industrial Development Corporation (CIDCO) is planning Navi Mumbai Special Economic Zone (NMSEZ) and Maha Mumbai Special Economic Zone (MMSEZ). Other SEZs are also under contemplation. All these major nodes generate substantial goods movement and therefore planning for additional truck terminals in the study area is required.
- For estimation of horizon year goods movement, growth rates have been established based on Past Growth Trends, Elasticity Method (using NDDP growth rate of study area districts) and Fratar Method (using NSDP of the influencing states and NDDP growth rate of study area districts)

- The annual growth rate of goods vehicle traffic assessed from past growth trends, elasticity method and Frator method are 7.4%, 5.9% and 5.7% respectively. The growth rates estimates from elasticity method and Frator method are yielding similar growth rates that are more likely to happen.
- Annual growth rate of 5.7% has been adopted for forecasting of external goods movement for the study area. The inflow of goods tonnage of MMR is expected to increase from 1 lakh tonnes in 2005 to 4.4 lakh tonnes in 2031.
- Truck terminal area requirement for Base Year (2005) and Horizon Year (2031) are 350 Ha and 1450 Ha respectively. To satisfy the demand, Immediate improvements and long term improvements have been proposed. The immediate improvements mainly consists of, improving the access roads to the terminal areas, creation of adequate basic infrastructure in the terminal areas, etc.

3. GOALS & OBJECTIVES

The goals and objectives of the TRANSFORM have evolved during the course of the study. An initial reference point was the 1996 Regional Plan which set out the following:

The ***overall goal of the regional plan*** is to promote and sustain growth with social justice in a resource efficient manner. This goal is further translated into the following objectives:

- to facilitate and promote economic growth of the Region
- to improve the quality of life particularly of the poor and deprived
- to minimise adverse environmental impacts that may occur in the process of economic growth
- to improve the efficiency of existing methods of resource mobilization
- adopt innovative methods of resource mobilisation and facilitate, attract and guide private investment in desired directions
- promote effective citizen participation in the process of development through decentralisation of institutions

During the course of the study two other key goals for development of Mumbai Region were identified:

- to consider and evaluate significantly different strategies in the long term for development of the Mumbai region
- to support the goal of transforming Mumbai into a world class city with a vibrant economy and a globally comparable quality of life

Figure 25: Mumbai Island: An aerial view

3.1 Transportation specific objectives and policies

During the course of the study, the Technical Advisory Committee (TAC) comprising the officers from concerned ULBs, other stakeholders and the consulting team, raised many issues and made many recommendations related to the goals, objectives and policies of the comprehensive transportation plan. At this juncture in the study documentation, we believe it is pertinent to highlight some of the outstanding questions and issues that provide a context to the development and evaluation of longer term transportation strategies.

1. The strategies must be visionary as well as practical. The MMR is a complex and evolving urban area in a country undergoing profound economic and social change. The strategies and related plans must embody transportation solutions, priorities and investments which cater to more than one potential long term future.
2. The strategies must ensure the maintenance of the existing transportation services and promote positive change to overcome critical capacity deficiencies to support economic growth and urban expansion.
3. The strategies must be economically viable but from a broad perspective. The benefits of good transportation extend far beyond traditional indicators such as reduced travel time and cost. Among other factors good transportation can promote increased job opportunities and reduced housing costs by increasing accessibility to greater variety of housing and employment choices.

Figure 26: P D'Mello Road

4. The plan must be supportive of a "healthy MMR" but must recognize the increasing public demands for greater mobility and freedom of choice of travel mode. Any consideration of constraining private transport mobility carries the obligation of providing a reasonably comparable alternative public transport mode
5. The strategies should ensure that high quality transport consisting of urban freeways and different types of transit systems, that predominately serves middle/ higher income segments of the community, are user-funded and implemented at no or little financial or social risk to the public at large or the poor.

Figure 27: Fort

6. Strategies and plans must improve public safety which may require constraints on the freedom of movement or greater user protection, discipline and enforcement.
7. Immediate attention and resource allocation should be given to pedestrian travel and safety. It is the largest and most sustainable form of urban travel but suffers from severe degradation and neglect. It has been given very low priority from a level of service and safety standpoint.
8. Investments should be programmed to secure improvements to the 'public realm' compatible with qualities that we expect in our private spaces.

Figure 28: Dadar

9. The strategies should promote the premise that transportation infrastructure capital needs to meet growth demands should be substantially paid for by growth i.e. Development Charges

Figure 29: Mahalakshmi

10. The strategies should promote the mobilization of financial resources from a wide spectrum of other urban activities that benefit from an improved or well maintained transport infrastructure.
11. The strategies and implementation plans must be a MMR driven solution. However lessons learned from other major competing cities can provide an insight and guidance on what can be accomplished or what is needed to sustain an environmentally, economically and socially successful city in a global context.

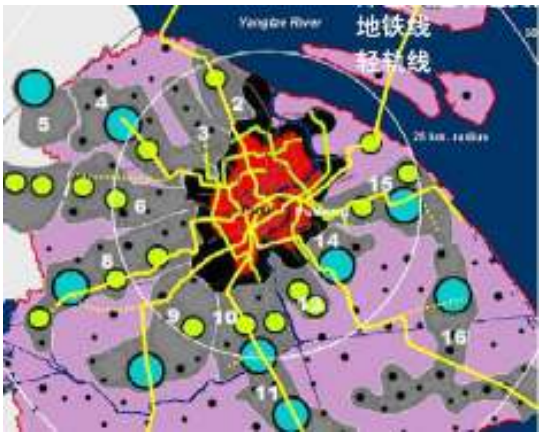


Figure 30: Shanghai : Urban Form

Along with the above issues and objectives, there are questions which may need discussion and agreement before a completely equitable and rational transportation future is blue-printed such as:

1. With the current severe traffic congestion in Greater Mumbai is the continued growth of cars, motorcycles, scooters, rickshaws and taxis inevitable or in fact sustainable from a quality of urban life and environmental standpoint?

Figure 31: Bandra West

2. Should combined policies of constrained private transport use and improved public transport be considered in the densely developed parts of the Region.?
3. Are the existing institutional arrangements in the Region properly structured for an metropolis of 34 million. Is there the institutional capacity to raise and manage the implementation funding programs envisaged in the TRANSFORM and to undertake such a major infrastructure expansion program in an efficient and timely manner.?
4. Are the proposals for the economic and transport developments described in this document too fiscally and socially ambitious?
5. Can or should, transportation investment implementation strategies, take a lead role in formulating the future urban structure of the MMR?
6. Should consideration be given to the early implementation of transport projects with the specific objective to release the logjam of constrained availability of developable land to make the Region a more affordable place to live and work?
7. What are the policies that affect the realization of proposed landuse, transport integration and ensure sustainable development?

4. ENVISIONING A 'WORLD CLASS' REGION

Early in the study, it was concluded that, with the very large population and employment expansion anticipated in the MMR, together with a rapidly changing economy, it would be very difficult to confidently establish a single long term comprehensive regional strategy for such a complex urban area. Further, a strategy based on a single land use forecast, may become outdated in a relatively short time frame, for example, due to an unanticipated major development opportunity. A transport strategy that is reasonably resilient to changing conditions is considered much more desirable and useful than a narrowly based strategy. In practice, and to facilitate urban management, comprehensive strategies and associated plans need to be "living documents" that readily respond to and accommodate changing conditions.

Being so geographically and economically diverse and dynamic, it is difficult to precisely predict the many inputs required to draft and test transportation network requirements for the Region. Thus, on the advice and agreement of MMRDA, members of Technical Advisory Committee as well as The World Bank, certain milestone decisions were taken which shaped the progress and direction of the study. This included adoption of a single overall forecast of population and employment growth over the next 25 years, since discrepancies in overall forecasts are more likely to be time related than numeric related. However it was also decided to draft four different distribution patterns of population and four distribution patterns of employment leading to a total sixteen alternative growth permutations or scenarios.

Figure 32: Shanghai Skyline

Another strategic decision was the conscious adoption of proactive and progressive changes to existing socio-economic parameters to reflect experiences of more advanced urban economies. Since travel demands are created by the socio-economic characteristics of the Region, it is reasonable and appropriate to take into account major changes occurring in the economy that will influence people's travel including housing and job spatial relationships, modes of travel and with increasing incomes how this may impact people's willingness to pay for improved transport service.

Keeping the overall population and employment in the region for the horizon year 2031 at 34 million and 15.3 million respectively, the following changes were partly assumed in response to the ***"Transform Mumbai"*** objectives and partly driven by economic growth trends.

- An overall increase in Work Force Participation Rate to 0.45 (up from existing 0.37)
- Household size reduction to about 4 persons per household (down from the existing 4.4 persons).
- In addition, a target reduction in percentage of the population living slums over the next 25 years has been considered.

No large scale relocations have been assumed which are generally associated with slum reduction. Instead, it has been envisioned that there will be innovative in-situ development of areas considered as slums. Population growth plus slum re-housing and reduced housing occupancies will require almost 5 million more households over the next 25 years…..a daunting challenge. In effect, the Mumbai Region would have to double itself.

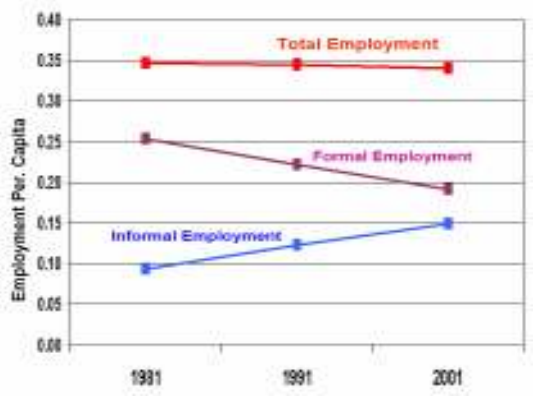


Figure 33: Work Force Participation Rate

On the employment front, progressive target assumptions have been made to reverse the trend of falling formal sector employment. This includes increasing the office employment from the current level of 31% of total employment to 42%. Similarly an increase in the industrial sector from 19.4% to 29.5% has been targeted over the next 25 years. These assumptions need to be the subject of further review in conjunction with the preparation of new Regional Development Plan. As a "living strategy" all socio-economic targets should be continually monitored to detect changes in trends that might impact the needs and timing of infrastructure investments.

2005	2031 Projected
• Population 21 million – 47% living in slums – 1,505,000 apartments – 4.4 persons/household • Employment 7.5 million – Employ. Partic. Rate 0.37 – 2.3 million working in offices – 1.5 million working in industries – 56% employed in formal sector – 40% walk to work	• Population 34 million – 14% living in slums – 6,400,000 apartments – 3.9 persons/household • Employment 15.3 million – Employ. Partic. Rate 0.45 – 6.4 million working in offices – 4.5 million working in industries – 70-80% employed in formal sector – 25-30% walk to work

These parameters were adopted in line with the overall vision of transforming Mumbai into a world class city with a vibrant economy and globally comparable quality of life.

Many improvement were made in India in the financial sector in the last couple of decades. Some of the important developments are strengthening of banks, de-regulation of interest rates and competition in the banking system; development of the government securities market; infrastructure for trading, particularly in the equity market with the move to electronic trading, etc. As a natural corollary, there is a hope of Mumbai playing a bigger role in the global market for financial services so that India's institutions get integrated with global institutions and economies in terms of provision of financial services.

As announced in Budget 2005-06, Government of Maharashtra appointed a High Powered Expert Committee to make Mumbai an International Finance and Business Centre (IFBC). The Committee recently submitted its report and made detailed recommendations which included the agenda for urban infrastructure and governance in Mumbai, particularly in the context of making it a hospitable global city for a large and demanding expatriate population that will be indispensable for the successful operation of an IFBC.

As part of its report, the committee commented in the report about poor road/rail mass transit, absence of water-borne transport, absence of arterial high-speed roads/urban expressways; poor quality of airports, airlines and air-linked connections domestically and internationally. These lacunae act as stumbling blocks in the way of Mumbai becoming a successful IFBC.

5. ONE REGION - MANY POTENTIAL FUTURES

In many ways, the Region is divided in two main parts, i.e., 'Mumbai City or MCGM' and 'Rest of the Region (RoR)'. While Mumbai is under a unified and strong municipality (Municipal Corporation of Greater Mumbai), ROR is composed of many heterogeneous urban, semi-urban and rural areas governed by a range of Urban Local Bodies. The MCGM with its historically strong municipal service, provides a much better and richer living environment than RoR. Culturally as well, it is part of the populace's psyche whether they are part of Mumbai or 'out of it'. Most of the earlier planning attempts were centred on Greater Mumbai with one of the following as focus:

- Decongest Mumbai
- Rejuvenate Mumbai
- Expand Mumbai

Create alternatives to Mumbai

Even when several areas of Mumbai seem to be bursting at seams, it keeps providing opportunities for further development, especially for commercial and service employment but also residential intensification. Most of the shift to RoR is still limited to either residential accommodation or industrial areas with most of the municipalities outside Mumbai acting as 'dormitories' or 'bedroom communities'. Thus, the city of Mumbai remains the focus of the Region.

For this reason, to start with, it was decided to chalk out and analyse alternative future demographic profiles of the region in terms of what share Mumbai will have of the future population and employment levels of horizon year 2031. Four alternative growth scenarios with share of population in Mumbai ranging from 40% to 60% were envisaged. Separately, four Alternative Growth Scenarios with share of employment in Mumbai ranging from 33% to 75% were defined. Further, it was assumed that four population scenarios would be independent of four employment scenarios leading to 4X4 = 16 possible scenarios (population plus employment scenario combinations).

The analytical process involved a first level assessment of the sixteen Options which led to a short-listing of six Options. A second level screening process of these six Options led to the TAC selecting three Options (P2E2, P3E3, and P3E4) that now form the basis for formulating long term transport strategies for MMR. Intentionally, these three population and employment scenarios represent quite diverse land use or land development phasing strategies. One of the key project evaluation criteria will be how resilient or robust is the project need and justification to each of the three scenarios. Those projects that are highly resilient will have less implementation and viability risk. Those projects that are less resilient will carry greater risks in terms of need and justification and financial viability.

The population and employment for, 2016 and 2021 were assessed for the three growth scenarios – 2 population and 3 employment scenarios. In deriving these figures reasonable judgments were made in consultation with MMRDA officials and advice from the TAC members. The estimated figures includes two population distributions (P2 and P3) and three employment distributions (E2, E3 and E4). The estimated population and employment figures for the intermediate horizon years are summarized in the following table.

Table 14: Population-Employment for MMR (in Million): Intermediate Horizon Years (2016 and 2021)

Year	Population		Employment		
	P2	P3	E2	E3	E4
2005	20.8		7.76		
2016	26.50	27.14	10.82	10.90	10.93
2021	28.99	29.64	12.25	12.30	12.32
2031	34.00		15.30		

The Long Term Growth Strategy

Orderly and planned growth of the MMR is not only important for the state of Maharashtra but also for India as a whole, particularly in the context of the region's significant contribution to the national economy. Mumbai is also a key international player in India's expanding role in the global economy and strives to achieve more of a world class metropolitan stature. An inadequate and outdated urban transport infrastructure is considered as an obstacle in achieving this objective.

As evident from numerous international examples, urban transport, plays a pivotal role in determining the liveability and quality of life in a region like Mumbai. Further, other critical factors affecting the stature of a city/ region include economic competitiveness, institutional and governance mechanisms, the ability to realize orderly and high quality development and to sustain and finance growth. The LTS is designed to be proactive rather than reactive in achieving these objectives, particularly in the absolute need to increase the supply of available space for development whether this is in "Green field" lands or sustainable increased air rights. Many of these objectives have been the corner stones in developing the LTS - 2031.

BOX-1 : LTS – A Perspective

Long Term Transportation Strategy has been proposed for MMR based on detailed travel demand analyses undertaken for each of the three growth scenarios. Some of the details are summarized below:

Importance of improving travel by public transport modes has been given major importance considering the inhuman crowding levels on the public transport modes, especially suburban trains, where a huge supply-demand gap exists. This high dependence on travel by public transport modes is expected to continue to the horizon year. Thus, the study recommends "Transit First" as a sustainable transportation policy.

Hierarchical multi-modal transport system is proposed for effectively integrating the mobility function with local area travel needs. This resulted in a combination of access controlled high speed network system, major arterials along with local roads. Similarly, multi-modal mass transit system combining functional benefits of suburban trains, metros/ other comparable transit systems and exclusive bus lane systems are proposed.

Corridor protection i.e. need for protecting and acquiring the ROW for the Regional Road and Transit Networks has been recommended on priority basis and incorporating the same in a revised MMR Regional Plan and DPs of ULBs has been recommended.

Candidate corridors for exclusive bus lane systems have been identified to handle the road based public transport demand efficiently, some of which would serve as a precursor to rail based transit.

Multi-modal transport corridors, which are cost intensive but efficient, have been proposed..

An integrated public transport fare policy that reflects the level of comfort and service levels being provided by the various transport modes. The capital costs of expanded public transport should be largely funded by development charges. Operating costs should be largely funded by fare-box revenues and other revenues such as advertising, air right leasing and other commercial development adjacent to stations that benefit from the presence of public transport..

Recognizing the importance of travel by walk, provision for the walk way facilities have been incorporated as part of the proposed transportation plan, to promote safe and comfortable pedestrian movement. Adequate footpath facilities for parallel pedestrian movement and at-grade/ grade separated pedestrian facilities for cross movements have been included in the costing provisions for all roads and public transport projects.

6. TRAVEL DEMAND ANALYSIS AND RECOMMENDED TRANSPORT NETWORK (2005-2031)

Standard four stage travel demand modeling approach has been adopted in the study. Trip Generation, Trip Distribution, Mode-Split and Assignment models have been developed after thorough validation of the demand matrices assessed from HIS and other surveys/ studies. Six purposes (Home Based Work Office, Home Based Work Industry, Home Based Work Others, Home Based Education, Home Based Others and Non Home Based) and seven modes (Sub-urban train, metro, bus, auto, taxi, car and two-wheeler) have been considered. The study area (MMR) has been divided into 1030 Traffic Analysis Zones (TAZs) for travel demand analysis. The software used for travel demand modelling and network analysis is EMME (Equilibria Multimodal Multimodal Equilibium) which is used in more than 70 cities all over the world.

As part of the study, the following major surveys have been carried out:

- Home Interview Survey (66,000 sample size)
- Road Network Inventory Surveys (2,300 km)
- Outer Cordon/ Sub Regional Cordon/ Inner Cordon/ Mid-block count surveys (93 locations)
- Rail Passenger surveys
- Speed-Flow surveys (for developing Volume-Delay functions for 16 carriageway types)
- Terminal surveys
- Journey Speed Surveys (550 kms)
- IPT surveys (50 locations)
- Pedestrian count surveys (50 locations)
- Workplace Surveys (5000 sample size)

In addition, collected secondary information on transport systems operating in MMR. GIS based maps for the entire MMR has been prepared incorporating the landuse details and Development Plans. Based on these surveys, a database on household socio-economic and travel characteristics of the region has been prepared for detailed travel demand modelling to study the future transport network requirements of the MMR.

For development of integrated landuse transport plan, four population scenarios and four employment scenarios have been considered with a strategy of either high intensification of Greater Mumbai (major Municipal Corporation with a 62% of the regions population and 72% of employment in the base year) or high intensification of rest of MMR i.e. outside MCGM and combination of sixteen population-employment scenarios have been studied for travel demand analysis. Travel demand for the horizon year 2031 has been estimated using the travel demand models and various planning parameters. Elaborate procedure has been followed for short-listing of 16 scenarios to 3 possible growth scenarios. The short-listed growth scenarios typically represent intensification of MCGM, intensification of rest of MMR and a balanced intensification of MCGM and rest of MMR.

Transport Network for the year 2031

A conceptual transport network for horizon year 2031 and beyond has been prepared keeping in view the goals & objectives set for the future MMR. It is also based on the existing transport network, planned highway sub-urban and metro corridors by various planning organizations, extending the transport network in to the Greenfield areas and improving the connectivity to various growing clusters of the region. The concept plan develops an integrated landuse transport plan and intensification focused on transport corridors (Transport Driven Development). The conceptual rail system, highway system and concept of landuse intensification focused on transportation corridors are presented in Figure 34.

The travel demand has been estimated on the above said conceptual transport network for all the three short-listed growth scenarios and the transport network for the horizon year 2031 has been chosen in such a way that it

caters to all the three short-listed growth scenarios.

The recommended transit and highway networks for the horizon year 2031 are presented in Figure 35. Recommended metro corridors/ lines, sub-urban corridors/lines and Highway corridors are presented in Table 15, Table 16 and Table 17 respectively.

Table 15: Recommended Metro Corridors/ Lines for the Horizon Year 2031

Line No.	Metro Line Description	Length (kms)
M1	Varsova-Andheri-Ghatkopar	15.00
M2	Mankhurd-Mahim-Charkope	32.60
M3	Backbay-Bandra	19.20
M4	Charkope-Dahisar	7.50
M5	Ghatkopar-Mulund	12.40
M6	BKC-Kanjurmarg via Airport	19.50
M7	Andheri (East) - Dahisar (East)	15.90
M8	Hutatma Chowk-Ghatkopar	22.40
M9	Sewri-Prabhadevi	3.50
M10	Dahisar-Mira Road-Manikpur-Virar	29.90
M11	Thane Ring Metro	19.40
M12	Thane-Ghodbander-Dahisar	27.20
M13	Balkhum (Thane)-Bhiwandi-Kalyan-Narthen Gaon	33.30
M14	Phokhran-Thane	5.00
M15	Kushavali-Ambernath	10.40
M16	Kanjurmarg-Mahape-Kalyan Phata-Pipe Line	13.20
M17	Mankhurd-Vashi-Narthen Gaon	24.10
M18	Vashi-Belapur-New Airport-Panvel	18.80
M19	Targhar-Kharkopar-Nhava Sheva-Dronagiri	18.70
M20	Kharkopar-Dhutum-Pirkone-Shirki-Vadkhal	30.50
M21	Dronagiri-Pirkone-Jite	13.80
M22	Shirki-Washi-Jite	9.90
M23	Fort (Horniman Circle) - Uran - Dronagiri	15.90
M24	Sewri-Kharkopar	19.70
Total		**435.50**

Table 16: Recommended Sub-urban Corridors/ Lines for the Horizon Year 2031

Line No.	Sub-urban Line Description	Length (kms)
S1	Diva-Vasai Road	40.1
S2	Panvel-Jite-Thal	60.9
S3	Rewas Port (new link)	10.6
S4	Panvel-Karjat	27.6
S5	Panvel-Uran	26.9
S6	Kharkopar-Jite (new link)	22.9
S7	Ranjanpada-Kharkopar-Targhar-Seawood (new link)	13.9
S8	Thal-Alibag (new link)	5.4
S9	Diva-Panvel	26.7
S10	Thane-Bhiwandi	12.5
Total		**247.50**

Table 17: Recommended Highway Corridors for the Horizon Year 2031

Sl. No.	Highway Corridor Description	Length (kms)
H1	Eastern Freeway	22.5
H2	Elevated Link (Sewri-Worli Sea Link)	5.6
H3	MTHL: Sewree to Kharkopar (Main Link over the creek)	17.2
H4	MTHL: Kharkopar to Rave (Link overground)	18.1
H5	Inner Ring (Kaman-Bhiwandi Rd.)	22.0
H6	Inner Ring (Bhiwandi Rd-Panvel-Dronagiri): EBL Corridor (2016, 2021, 2031)	34.0
H7	Middle Ring (Bhiwandi-Nandivali-Narthen Gaon)	18.6
H8	Middle Ring (Narthen Gaon-Panvel-Kharkopar): EBL Corridor (2016, 2021, 2031)	35.5
H9	Outer Ring Road: Khopoli-Jite-Rewas Port	36.8
H10	Radial-1 (NH-8)	26.0
H11	Radial-2 (Part of NH-3)	36.4
H12	Radial-3 (Bhiwandi Bypass)	14.0
H13	Radial-3 (Bhiwandi Bypass): EBL Corridor (2016, 2021, 2031)	9.0
H14	Radial-4 (Nahur-Airoli-Nilaje-Badlapur): EBL Corridor (2016, 2021)	33.8
H15	Radial-5 (Chembur-Mankhurd-Vashi-Taloja)	26.0
H16	Radial-6 (Vashi-Belapur-Kalamboli)	14.9
H17	Radial-7 (Uran-Pen)	22.3
H18	Radial-8 (New Airport-Nhava-Uran-Rewas)	22.2
H19	Thane-Ghodbunder Road: EBL Corridor (2016)	16.1
H20	Western Sea Link North Extn (Bandra-Dahisar)	26.0
H21	Western Sea Link North Extn (Dahisar-Virar): EBL Corridor 2016	38.0
H22	Western Sea Link South Extn (Worli-Colaba Sea Link)	13.7
H23	Ghatkopar - Koparkairane Creek Bridge	8.9
H24	Mumbai- Sawantwadi Expressway	21.2
Sub-Total		**538.60**
Up-gradation of Existing Arterial Roads		781.40
New Arterial Corridors/ Links		419.00
Sub-Total		**1200.40**
Total		**1739.00**

In case of the transit network, the assigned passenger flows on some of the metro corridors did not justify metro operation by the time horizon of 2031. Such corridors were considered as candidates for the initial operation of Exclusive Bus Lanes (EBL) on parallel highways in the corridors until the passenger flows justify a metro operation (They are highlighted with a label “EBL”). Two such corridors have been identified (shown with dotted lines in the transit network) in the Figure 35 namely

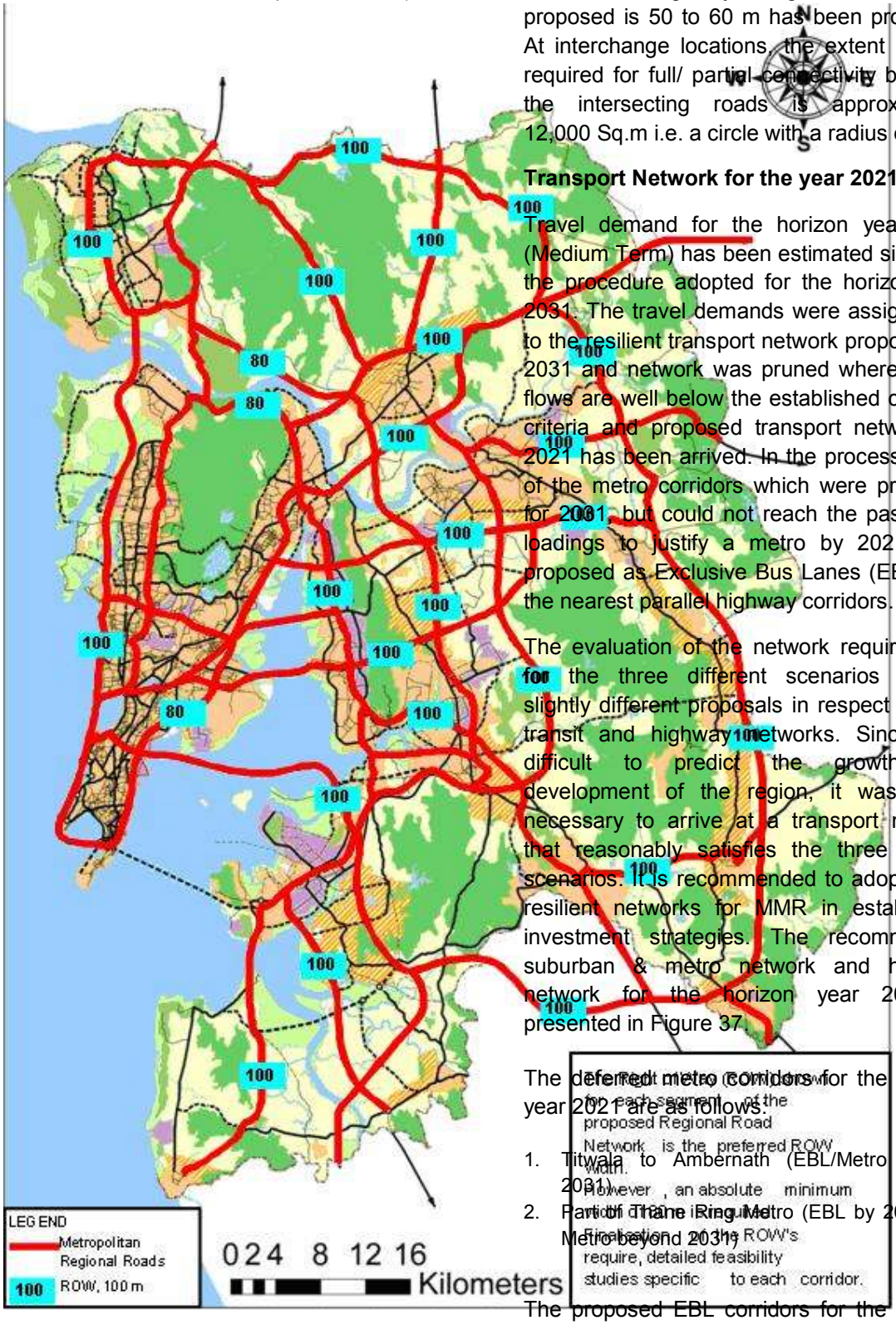
1. Thane-Panvel and
2. Narthen Gaon-Panvel

In case of highway system, some of the corridors/ links did not have sufficient loadings for the horizon year 2031 but corridor right-of-way protection measures should be implemented. Such corridors/ links have been catagorized as being deferred links i.e. they are likely to be needed beyond the horizon year of 2031. Two such corridors have been identified in the Figure 35 (Highway network) namely

1. Rewas Bridge and
2. Outer Ring Road connecting Mumbai Pune Expressway and NH8.

After deleting these links the transport network becomes the basis for the further assessment of the same for the horizon years 2021 and 2016. Thus the transport networks for 2016 and 2021 were conceptually identified based on the Long Term Transportation Strategy (2031).

For higher order highway links/ Expressway facilities (regional road network) which have regional significance, a Right of Way (ROW) in the range of 80 to 100 m has been proposed keeping in view the possibility of multi-modal corridor operations (Ref. Figure 36). At interchange locations, the extent of area required for full connectivity between the intersecting roads is approximately 26,000 Sq.m i.e. a circle with a radius of 90m. For arterial roads with 4 lane to 6 lane carriageway configuration, the ROW proposed is 50 to 60 m has been proposed. At interchange locations, the extent of area required for full/ partial connectivity between the intersecting roads is approximately 12,000 Sq.m i.e. a circle with a radius of 60m.



Transport Network for the year 2021

Travel demand for the horizon year 2021 (Medium Term) has been estimated similar to the procedure adopted for the horizon year 2031. The travel demands were assigned on to the resilient transport network proposed for 2031 and network was pruned wherever the flows are well below the established capacity criteria and proposed transport network for 2021 has been arrived. In the process, some of the metro corridors which were proposed for 2031, but could not reach the passenger loadings to justify a metro by 2021 were proposed as Exclusive Bus Lanes (EBLs) on the nearest parallel highway corridors.

The evaluation of the network requirements for the three different scenarios yielded slightly different proposals in respect of both transit and highway networks. Since it is difficult to predict the growth and development of the region, it was found necessary to arrive at a transport network that reasonably satisfies the three growth scenarios. It is recommended to adopt these resilient networks for MMR in establishing investment strategies. The recommended suburban & metro network and highway network for the horizon year 2021 is presented in Figure 37.

The deferred metro corridors for the horizon year 2021 are as follows:

1. Titwala to Ambernath (EBL/Metro beyond 2031)
2. Part of Thane Ring Metro (EBL by 2031 and Metro beyond 2031)

The proposed EBL corridors for the horizon year 2021 are as follows:

1. Chhatrapati Shivaji Airport – Kanjur Marg – Ambernath (Metro by 2031)
2. Bhiwandi to Kalyan (Metro by 2031)
3. Thane to Panvel (Metro beyond 2031)
4. Narthen Gaon to Panvel (Metro beyond 2031)

The deferred highway links/ corridors for the horizon year 2021 are as follows:

1. Western Freeway: Worli – Nariman Point – Colaba (Worli to Haji Ali by 2021 and upto Colaba by 2031)
2. Rewas Bridge (Deferred beyond 2031)
3. Outer Ring Road: Jite to Mumbai Pune Expressway and Mumbai Pune Expressway to NH8 (Deferred beyond 2031)

Transport Network for the year 2016

The recommended transport network arrived for 2021 horizon year has been further studied by assigning the travel demand and identifying the network for necessary for the horizon year 2016.

Similar to the procedure adopted for the horizon year 2021, the required network required to satisfy the expected travel demand for the year 2016 has been identified. Some of the corridors on which the passenger flows are significantly low have been deferred beyond 2016 as some of them may be needed in 2021 and the others by 2031. Those metro corridors which could not attract requisite loading by the year 2016, but needed beyond 2016, have been suggested for EBL operation on roads which are parallel to the corresponding metro lines.

The identified network requirements for the horizon year 2016 for the three growth scenarios have been studied together to arrive at a possible common network that could satisfy the travel demand of all the three scenarios. The recommended Sub-urban & Metro network and Highway network for the horizon year 2016 are presented in Figure 38.

The deferred metro corridors for the horizon year 2016 are as follows:

1. Hutatma Chowk to Suman Nagar (Metro by 2021)
2. Titwala to Ambernath (EBL by 2031 and Metro beyond 2031)
3. Part of Thane Ring Metro (EBL by 2031 and Metro beyond 2031)

The proposed EBL corridors for the horizon year 2016 are as follows:

1. Andheri –Dahisar-Thane (Metro by 2021)
2. Dahisar to Virar (Metro by 2021)
3. Chhatrapati Shivaji Airport – Kanjur Marg – Ambernath (Metro by 2031)
4. Bhiwandi to Kalyan (Metro by 2031)
5. Thane to Panvel (Metro beyond 2031)
6. Narthen Gaon to Panvel (Metro beyond 2031)

The deferred highway links/ corridors for the horizon year 2016 are as follows:

1. Western Freeway: Worli – Nariman Point – Colaba (Worli to Haji Ali by 2021 and upto Colaba by 2031)
2. Rewas Bridge (Deferred beyond 2031)
3. Outer Ring Road: Jite to Mumbai Pune Expressway and Mumbai Pune Expressway to NH8 (Deferred beyond 2031)

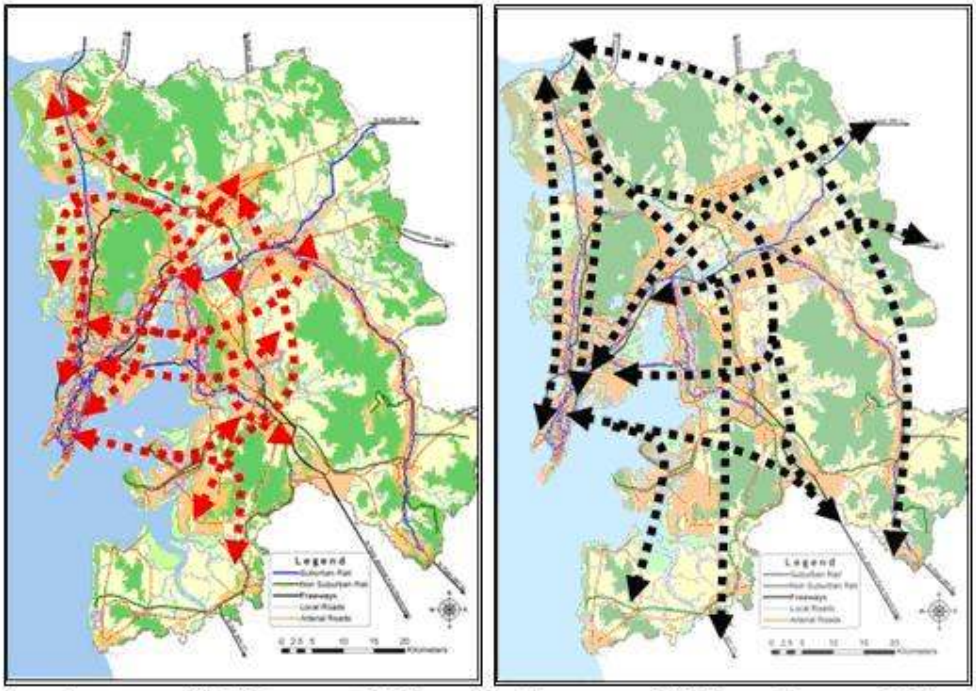
In case of sub-urban railway system, in addition to the new corridors/ tracks as presented in Table 16, the following capacity enhancement measures have been recommended.

- Headway Improvement by installation of ATC system
- Procurement of additional rakes (114 No.)
- Conversion of 9 Car to 12 Car rakes
- Station Area Improvements
- New Depots

Terminals play an important role in overall transportation system of a metropolitan area. Integrated planning of various terminal facilities viz. Inter-city rail terminals, inter-state bus terminals/ inter-city bus stations, truck terminals, airport terminals and Passenger Water Transport terminals is an

important aspect in the current study. The details are presented in **Section 7** of this report.

Under Highway system, in addition to the new corridors and improvement of existing arterial roads as presented in Table 17, Road Safety Measures and Traffic Management Measures have been recommended and the details are presented in **Section 8** of this report.



Conceptual Rail System: 2031 Conceptual Highway System: 2031

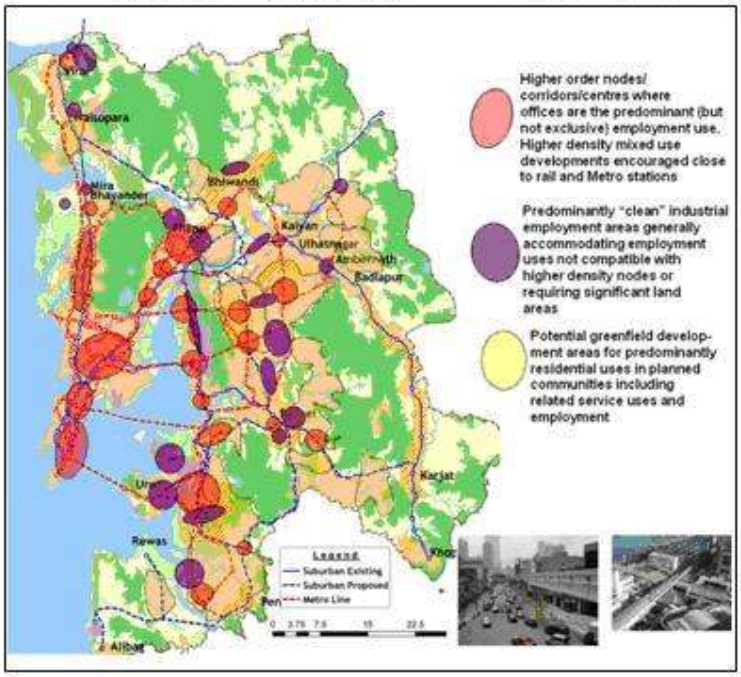


Figure 34: Concepts for developing Transport Network (Transit and Highway) for Horizon Year 2031

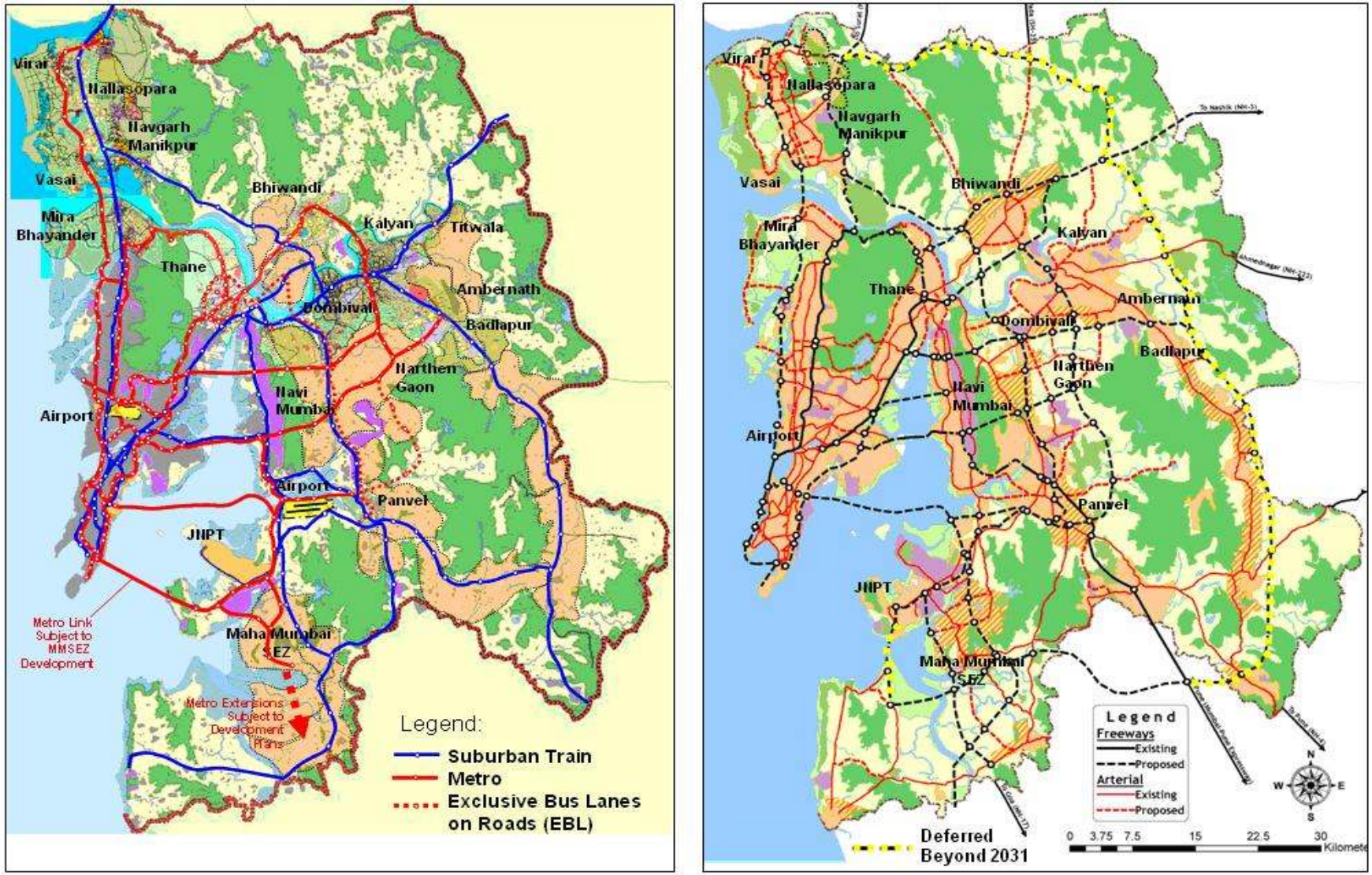


Figure 35: Recommended Transport Network (Transit and Highway) for Horizon Year 2031

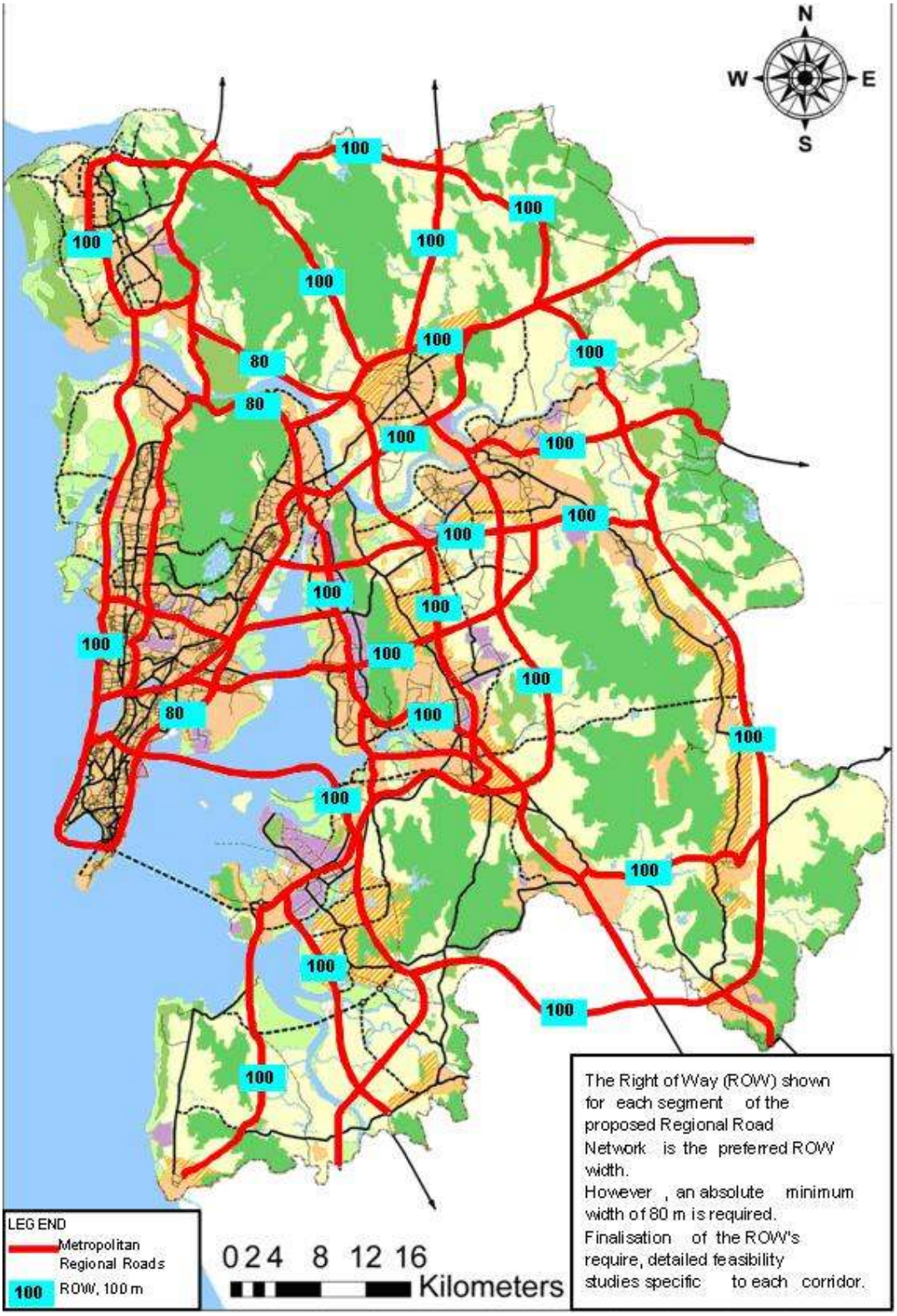


Figure 36: Right of Way Requirements for Higher Order Highway Corridors

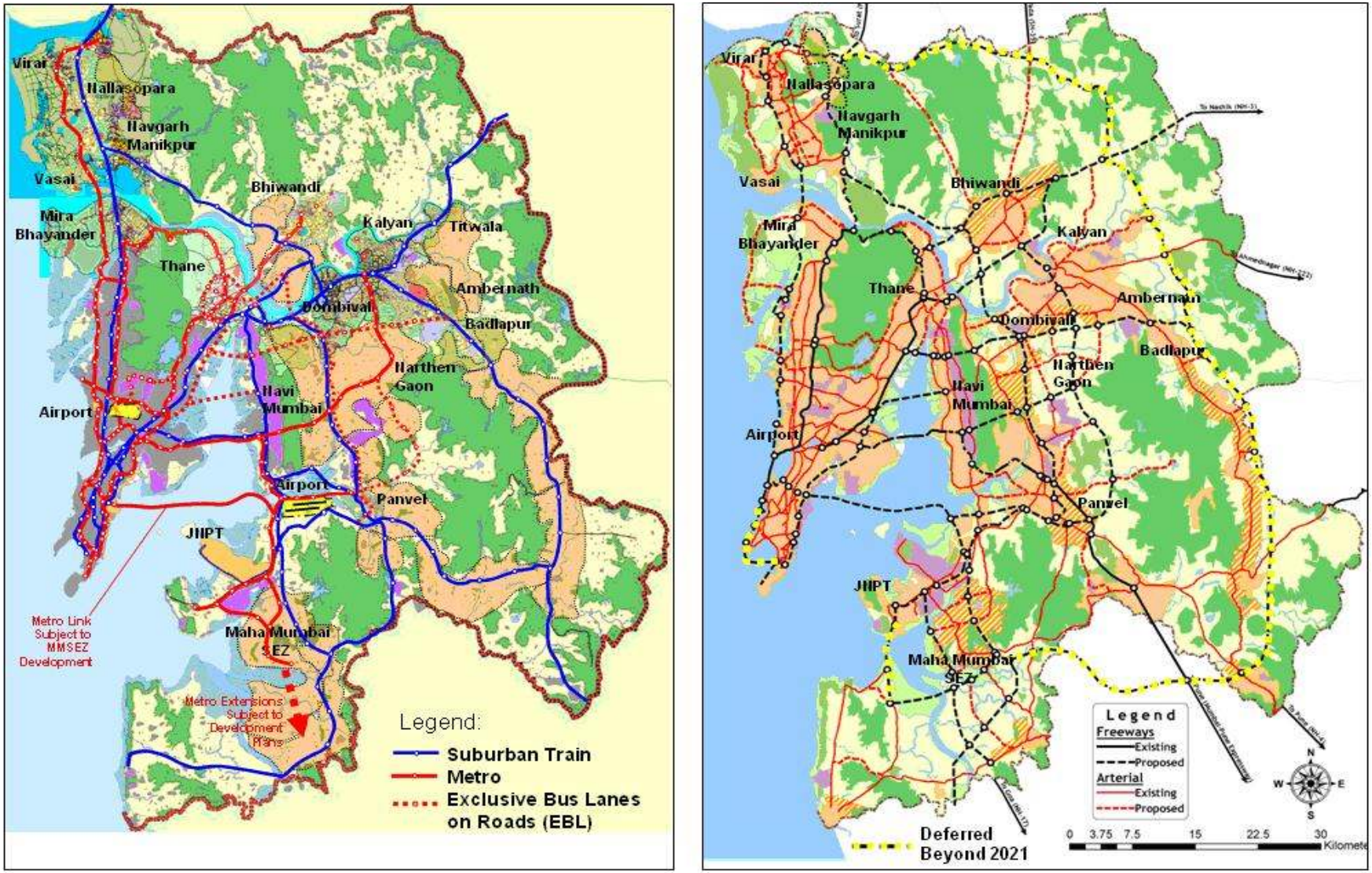


Figure 37: Recommended Transport Network (Transit and Highway) for Horizon Year 2021

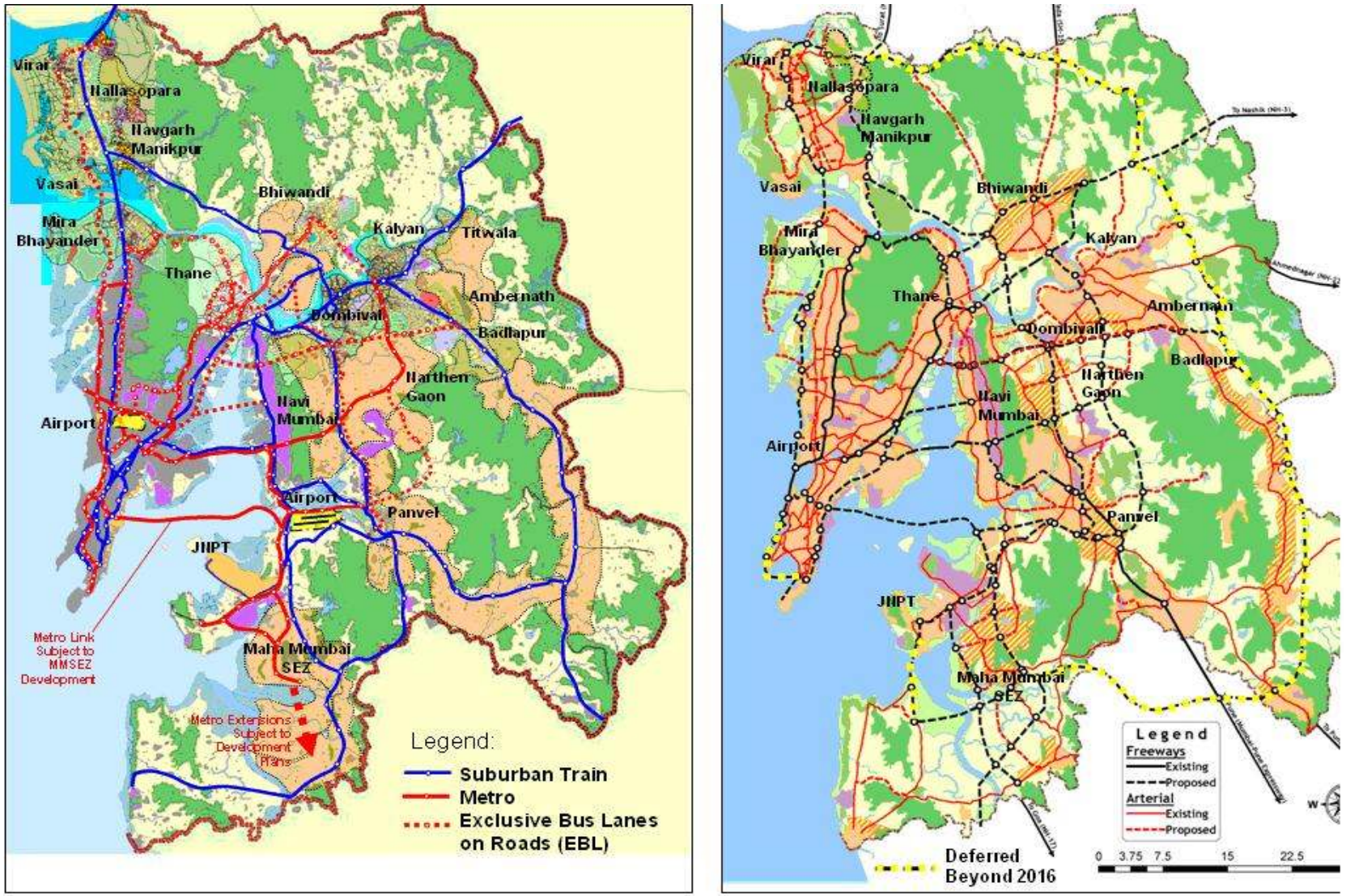


Figure 38: Recommended Transport Network (Transit and Highway) for Horizon Year 2016

7. TERMINALS

Orderly planning for the expansion and location of Inter-city Rail Terminals, Inter-city Bus terminals, Truck Terminals and airports, is an important objective in planning the transport systems for any metropolitan region. Based on the detailed analysis of primary and secondary data relevant to external travel by rail, road and goods vehicle movement and groundside air passenger travel, new transport terminals have been proposed. Potential for travel by passenger water transport along east, west coasts of Mumbai and across other major creeks of MMR has also been reviewed and the terminals identified. However water borne transport will not have a material effect on travel demands by traditional wheel modes. In case of planning terminals for air and inter-city rail mode, the prime responsibility for these modes rests with central government.

7.1 Rail terminals

The estimated passengers originated/ destined at various stations of MMR warrant for planning for expanding some the existing terminal facilities or providing new terminal facilities near the existing terminals within the catchment area of the terminal/ station. Based on the proposed transport network (road, rail and metro) for the horizon year 2031, proposed international airport in Navi Mumbai, some preliminary locations for inter-city bus terminals, truck terminals, etc., new inter-city rail terminals, etc. have been proposed at the following six locations.

1. Near Vasai Virar
2. Near Kalyan
3. Near Khandeshwar sub-urban railway station and retaining the Panvel as en-route station
4. Intersection of MTHL Metro corridor and Belapur-Uran Railway Line
5. Near Bhiwandi (Near Vasai Road-Diva Line)
6. Near Jite on Panvel-Thal Railway Line

In addition, the existing terminals and stations need to be improved to handle the additional demand.

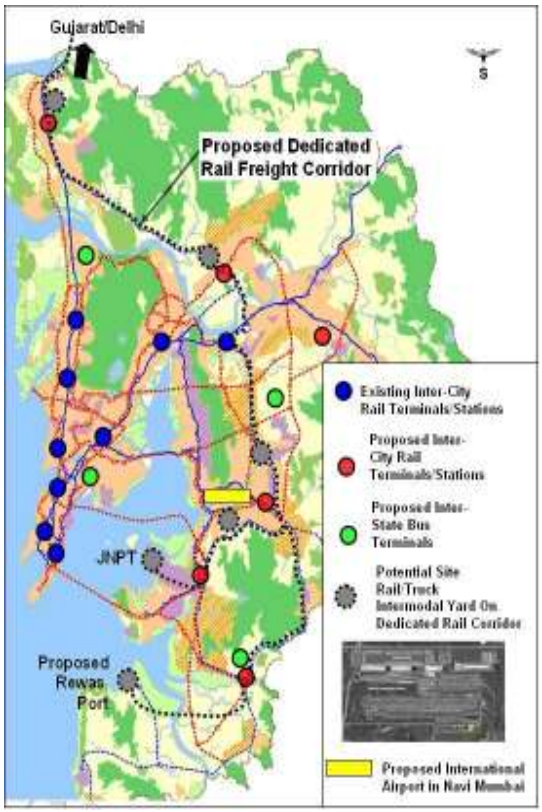


Figure 39: Proposed Terminals & Inter-modal Strategy

Based on the 2016 and 2021 population and economic indicators the demand for inter-city terminals has been estimated. It is expected, at least two new terminals are to be developed during the period 2005-16 (Sl. No.1 and Sl. No. 2) and another two terminals (Sl. 3 and Sl. No.4) during the period 2016-21. The terminals at Sl. No. 5 and 6 shall be developed during the period 2021-31.

7.2 Inter state/ Inter city bus terminals

Local bus transportation demands of the people within the urban areas are met by the local transportation organizations/ undertakings operated by the respective municipal corporations. Long distance and inter regional travel demands of the MMR are met by state road transportation corporations and private bus operators.

Primary surveys have been carried out at 13

bus terminals in MMR to capture the socio-economic and travel characteristics of the inter-city bus passengers. Analysis of the surveys and future bus terminals requirements have been presented in a separate report on "Bus Terminal Studies" submitted in September, 2006. It was recommended that, the MMR needs 4 interstate bus terminals and 13 bus stations by 2031 and the tentative locations are as follows.

Inter-State Bus Terminals

1. Near Wadala Truck Terminal, MCGM
2. Near Mira-Bhayander
3. Kalyan area
4. Panvel area

Based on the estimated population growth and UDPFI guidelines, it is suggested that, the inter-state bus terminals of Sl. No. 1 and Sl. No. 2 are required immediately. While the terminals in Sl. No. 3 and Sl. No. 4 should be developed during 2016-21 and 2021-31 respectively. Approximate area proposed for these terminals is 20 Ha.

Inter-City Bus Terminals

1. Western Suburbs of MCGM: In between Bandra and Borivali
2. Eastern suburbs of MCGM: In between Kurla and Mulund
3. Western part of Thane Municipal Corporation area
4. Nerul in NMMC
5. Kalyan Dombivali Municipal Corporation area
6. Vasai/ Virar area
7. Pen-SEZ area
8. Bhiwandi-Nizampur MC area
9. Mira-Bhayandar MC area
10. Navgarh-Manikpur Municipal Council area
11. Alibagh Municpal Council area
12. Karjat Municipal Council area
13. Badlapur Municipal Council area

Based on the estimated population growth and UDPFI guidelines, it is suggested that, the inter-city bus terminals of Sl. No. 1 and Sl. No. 5 are required by 2016. While the terminals from Sl. No. 6 to to Sl. No. 8 should be developed during the period 2016-21 and the remaining during 2021-31. Approximate area proposed for these terminals is 3 Ha.

Major Multi-modal Transit Terminals

It is recommended that consideration be given to developing three major rail and bus terminals as important interchange points between inter-city rail/intercity bus/ suburban rail/metro and MMR express bus services namely:

- Existing Thane Station
- In the Vashi Area to interface with the suburban rail and two proposed metro lines
- In the Mira Bhayander Area to interface with the Western Railway and the two proposed north-south metro lines and the metro line to Thane

Because of space limitations these multi-modal terminals/stations would likely to involve elevated structures spanning over the railway tracks. Subject to feasibility studies, commercial and residential air-right development could be incorporated to create significant nodal centres that would benefit from the regional transport accessibility. Recent initiatives of BEST in tendering 30 year air-right leases above bus terminals suggests that similar revenue generating opportunities should be explored at all stations and terminals.

7.3 Truck terminals

Approximately 44 major truck terminals have been identified in the study area based on secondary information, primary surveys (count and OD survey at Outer Cordon locations and Sub-regional cordon locations). On sample basis, about 25 truck terminals have been selected representing various functional categories for primary surveys to capture the travel pattern of goods vehicles. Detailed analysis and forecast is presented in report "Goods Terminal Studies" submitted in September, 2006. Five major truck terminals and 10 mini truck terminals have been proposed for the horizon year 2031, taking into consideration the expected Dedicated Rail Freight Corridor (DRFC). The major truck terminal locations are as follows:

1. On DRFC, near boundary of MMR on NH-8 (Mumbai-Ahmedabad)
2. On DRFC, near Taloja Industrial area
3. Near JNPT
4. Near the proposed international airport in Navi Mumbai
5. Near intersection of NH3 (Mumbai-Nashik Road) and DRFC.

Based on the estimated population growth, other economic & industrial activities and UDPFI guidelines, it is suggested that, the truck terminals of Sl. No. 1 and Sl. No. 2 are required by 2016. The terminals in Sl. No. 3 is required during 2016-21 and the rest during 2021-31. Approximate are proposed for major and minor truck terminals is 200 ha and 10 ha respectively.

7.4 Airport terminals

Travel projections made based on time series data, economy growth of the region and estimates reported by world agencies have indicated that the domestic travel may grow at the rate of 9% pa while the international travel may grow by 6.5%.pa. These growth rates imply that by the year 2024 the domestic demand may increase to 54 million (9.6m in 2003/4) while the international may reach 21 million (6.1m in 2003/4). Based on trends over the last 2 years these forecasts may be somewhat low.

The conclusion from the above discussed forecasts is that, either a new airport should be available by 2015, which probably means it should now be under construction, or every effort should be made to add a "parallel" runway at the existing airport. By comparison 40 million passengers are about the passenger volume at the Hong Kong and JFK New York airports.

From an initial assessment it is concluded that:

1. There is little doubt that an urban region having a population of 34 million (2031) will require more than one airport…the issue is more when, where and how?
2. Not only will at least two airports be required but both should have, as a minimum, two parallel runways
3. The potential capacity of the existing airport location should be maximized to meet short to medium term needs as well as the long term requirements?

From perspective of the TRANSFORM it appears to be a reasonable premise that the short and medium term program strategies should assume that, a new airport in Navi Mumbai which is already in advanced stage of planning, is required by 2016.

7.5 Passenger water transport terminals

Passenger Water Transport services have been studied separately for West Coast, East Coast and although the study area is limited to the influence area of the PWT mode. In case of PWT in west coast study, the catchment areas in western suburbs up to Western Express Highway and western parts of Island city of Greater Mumbai have been considered. The total daily passenger use estimated for the base year (2005) and horizon year (2031) are 0.97 and 1.39 lakhs respectively for "Catamaran option" or 0.89 and 1.27 lakhs respectively for "Hovercraft Option". In case of PWT study for East coast, the potential catchment areas considered

were Navi Mumbai zones and Island city zones. The total daily ridership estimated for the base year (2006) and horizon year (2031) are 6,653 and 10,391 respectively for "Catamaran option" or 5,895 and 10,068 for "Hovercraft Option".

The findings of several investigators on the estimated traffic flows on both the coasts indicate that the commuter patronage expected for PWT mode, although marginal in relation to rail and road modes, they have different roles to play especially in serving local needs of coastal areas. The following are the critical issue that may affect the above said ridership estimates with respect to hinterland OD pairs.

- Providing easy accessibility to the PWT terminals
- Uncertainty of schedules due to effect of weather condition, tides, currents, navigational conditions, etc.
- Reliable disaster management plans
- Restricted period of operation during the day as well as over the year

With the proposal of extensive transport network proposed for 2031, committed metro network in MCGM and Thane and extension of the metro network in the rest of the region, Western Freeway sea link and its extension towards suburbs in the North direction, and east west links between MCGM and Navi Mumbai, such as Trans harbour link (i.e. MTHL) and expressway network in the rest of the region, etc. the expected growth rate for PWT will be less than what was anticipated in studies that are carried out so far. However, such projects would attract traffic from tourism, fishing activities and recreational trips. Detailed feasibility studies have been proposed for identification of new water transport routes.

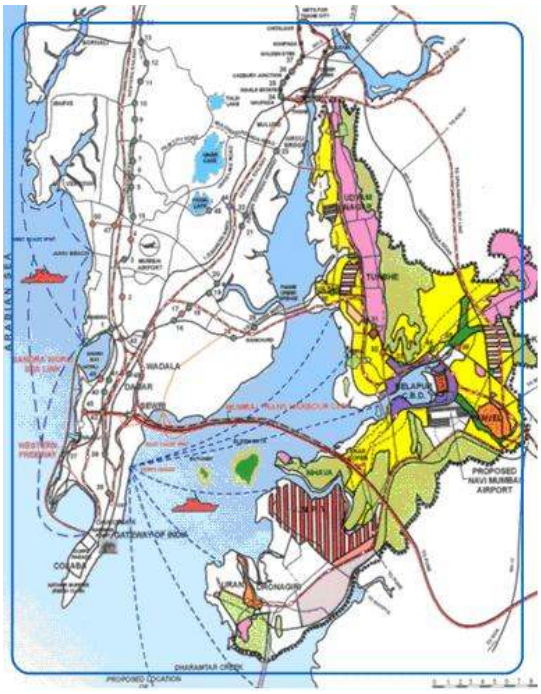


Figure 40: PWT Routes and Terminals

It was found that detailed engineering studies have been completed for passenger water transport operations in the east and west coasts of Mumbai and these projects are being let out for execution (Ref. Figure 40). Although these projects may be considered as committed and the tentative cost estimates have been included in the present study, we are of the opinion that the feasibility studies should be revisited in the context of the land based transport strategies recommended in this study.

8. TRAFFIC ENGINEERING MEASURES

In the short term to 2016, there will be the need to undertake transportation projects that addresses specific existing deficiencies, in order to provide some relief to the current congestion levels and safety concerns. These have been characterized as "Traffic Engineering Measures". Based on the review of numerous background studies, reports and recommendations and supplemented with further data compiled in the TRANSFORM an initial assessment of traffic engineering measures or initiatives have been compiled and presented in Table 18 and the associated costs have been included the cost estimates.

For other measures such as ATC, traffic signs & markings, bus bays & shelters, infrastructure for traffic police, etc., which could not be quantified in numbers, lump sum estimates has been assumed. It is recommended that, traffic engineering measures need to be implemented well before 2016.

Table 18: Proposed Traffic Engineering Measures

Components	Intersection Imp. (No.)	Flyovers/ Interchanges (No.)	FOBs (No.)	ROBs/ RUBs (No.)	Ped. Subways (No.)	Parking Plazas (No.)	Footpath Imp. (avg. 2 m wide) (kms)
MCGM	250	30	75	25	50	50	1000
TMC	27	13	4	2	10	3	250
KDMC	14	8	5	5	6	5	200
NMMC	15	12	17	5	6	2	100
Mira Bhayandar	4	2	2	2	2	1	80
Bhiwandi-Nizampur	5	2	2	2	1	1	80
Ulhasnagar	2	1	2	1	1		40
Ambernath	2	1	2	1	1		10
Kulgaon-Badlapur	1	1	2	1	1		10
Nallasopara	1	1	2	1	1		10
Vasai	1	1	2	1	1		10
Virar	2	1	2	1	1		10
Navgarh-Manikpur	1	1	2	1	1		10
Alibagh	1	1	1	1	1		10
Karjat	1	1	2	1	1		10
Khopoli	1	1	2	1	1		10
Matheran	1	1	1	1	1		10
Panvel	3	1	3	1	1	1	20
Pen	1	1	1	1	1		10
Uran	1	1	1	1	1		10
Total	334	81	130	55	89	63	1890

9. COST ESTIMATES AND PHASING

9.1 Cost Estimates

Cost of the proposed transport network for the horizon year 2016, 2021 and 2031 has been estimated based on the unit rates that were estimated from the recently completed DPR projects. In addition to transport network, other transport infrastructure facilities like Inter-state bus terminals, major bus stations for inter-city travel, capacity expansion of existing rail terminals & new rail terminals, major & minor truck terminals, Traffic management and safety measures, passenger water transport, etc. also have been estimated. The details are presented in Table 19. The proposed metro, sub-urban and highway network for the horizon year 2031 is 435, 248 and 1661 kms respectively. The total cost of transport infrastructure for the horizon year 2016, 2021 and 2031 is approximately INR 2.1, 1.6 and 1.3 lakh crores (US 50.4, 40.1 and 32.7 Billion) respectively estimated @ 2005-06 prices.

Table 19: Summary of Preliminary Cost Estimates for Proposed Transport Networks for Horizon Years 2031, 2021 and 2016

Component	2008- 2031		2008- 2021		2008- 2016	
	Length km	Cost Rs Crores	Length km	Cost Rs Crores	Length km	Cost Rs Crores
Metro System	435	1,08,373	318	83,700	208	60,902
Sub-Urban Railway System	248	31,418	237	29,113	237	28,362
Highway System	1661	57,374	1117	44,836	817	30,810
Highway Corridors with EBL	79	1,695	112	2,021	165	11,423
Bus System		4,280		2,150		1,104
Passenger Water Transport		480		480		480
Truck Terminals, Inter-Bus and Rail Terminals		3,040		2,038		1,126
Total	2,422	2,06,661 **US $ 50.41 Billion**	1,636	1,64,338 **US $ 40. 08 Billion**	1,427	1,34,208 **US $ 32.73 Billion**

Cumulative capital cost for recommended Metro, Suburban Rail and Highway system Improvements is presented in Figure 41. The cumulative program capital expenditures illustrated in the figure shows that from a demand point of view there is significant front-end loading of costs that can be attributed to the following factors:

There is an inherent capacity deficiency in the existing public transport and highway systems and the correction of this deficiency, based on adopted capacity design criteria, means that many projects are needed in the first tranche of improvements (2008-2016). This is largely a reflection of the underinvestment in transport projects over the last 25 years.

Many transport projects, particularly bridges and tunnels are difficult to incrementally expand as traffic increases and inevitably such structures have to be built to accommodate fairly long term travel demands. This need to construct for the future leads to front end loading.

The cost of providing fixed rail transport is heavily weighted to the civil and other unavoidable costs such as property acquisitions power transmission, stations signalling etc. While the cost of rolling stock can be incrementally managed to meet increasing travel demands, rolling stock costs are typically only in the order of 20% of the overall project costs. This means that the remaining 80% of a project cost, that are typically designed to handle 20-40 year passenger volumes, are effectively a pre-investment for future needs.

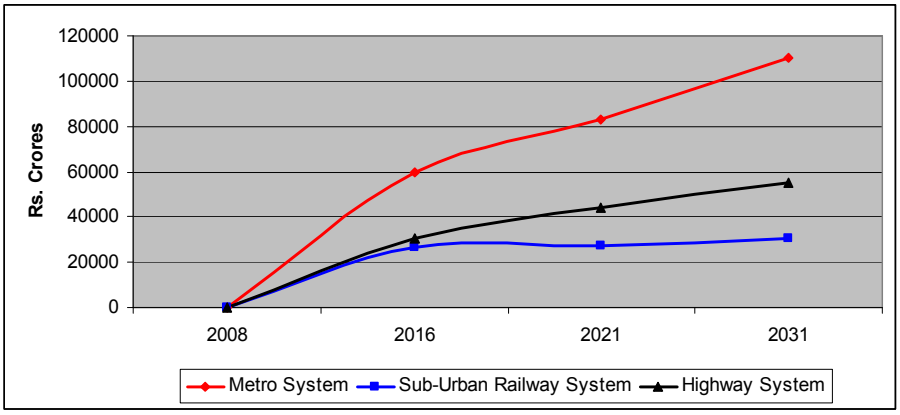


Figure 41: Cumulative Cost Estimates for Horizon Year Period 2008-2031

9.2 Preliminary Implementation Schedule

In preparing the preliminary incremental budgetary requirements, efforts were made to progressively increase system capacities and where possible delay capital expenditures. With at-grade roads, lanes can progressively added, providing controlling structures are pre-designed with future widening in mind. Roads initially designed on embankments or cuts can be widened by using retaining walls to minimize initial ROW requirements. In the TRANSFORM, the strategy of delaying fixed rail projects, such as the metro, by meeting corridor travel demands with a prioritized bus system on exclusive bus lanes (to handle passenger flows up to 10,000 PHPD/lane in existing urbanised areas with limited availability of right of way and presence of number of signalised/ uncontrolled intersections and up to 15,000 PHPD/lane in case of Greenfield areas, on controlled access highways/expressways) in multi-modal roadways has been recommended. Metro lines have proposed for the passenger demand exceeding 10,000 PHPD in case of urbanised areas and 15,000 PHPD in case of Greenfield areas.

The strategy involves the effective management of corridor demands where there are parallel transport facilities in the same general corridor. In Greenfield situations, the use of multi-modal corridors are recommended in both the medium and long term with the main linear transport infrastructure being on-grade or if drainage permits slightly below grade. There are many examples of multi-modal corridors accommodating not only transport, but a range of utilities that are often required to meet the same urbanisation demands as transportation. One of the key issues in transportation corridor design is trading-off short and long term property costs against using more extensive structures such as double decking transit over roads which is often the retrofit solution in many built-up areas. The use of elevated transport structures has been questioned with regard to long term sustainability, noise and aesthetic impacts.

It should be stressed that the scheduling of transport projects, as described in this report could be characterized as a “wish list” of projects which is largely based on travel demand forecasts for each horizon year.

A preliminary schedule to implement the various recommended transport projects is shown in Figure 42. This schedule has been prepared based on prioritization of projects considering the demand, cost, environmental and social impacts. The intent of this schedule is to provide an initial assessment of a possible phasing scenario for the 60+ different projects over the next 20-25 years within the short, medium and long term time horizons. The schedule further illustrates that a future travel demand/deficiency correction approach to prioritization or implementation timing is too simplistic and probably overly optimistic or ambitious.

9.3 Funding of Projects

In the Business Plan project, a potential financing mechanism is outlined that assumes that about 60% of the capital cost for the metro system would be borne by the private sector or some related SPV. The assumption for the highway investment was about 20% would flow from PPP's.

There is some evidence in the MMR and perhaps across the world, that the Public:Private:Partnership route is being viewed by the public sector as a mechanism to confirm the economic viability of major capital transport projects at the cost of the private sector. Or alternatively a process to transfer risks or responsibilities from the public to the private sector, with the public sector still having effective control. Until quite recently the private sector had shown a considerable appetite for PPP's and were prepared to make considerable investments in submitting costly proposals. However there may have been a shift in the interest levels of the private sector in PPP,s for a variety of reasons including:

- The costs of preparing risk managed bids compared to the probability of winning a bid can reduce overall profitability levels to unacceptable levels particularly where the downstream rewards are limited or uncertain
- Pricing risks and higher borrowing costs of private companies compared to governments can increase the cost of a project beyond the public sectors expectations including exceeding gap funding levels
- Often the bid process is not transparent and the clause of "not necessarily accepting any bid" has allowed the public sector to walk away and the private group left holding the bidding cost
- Contractors are busy and even traditional construction projects carry considerable risks. Another level of risk deters bidding
- Contractors are often more comfortable with a Private:Private partnership and sharing of risks with partners that better understand the pricing and sharing of risks and possibly performance bonuses
- Where the financial performance of a project can be impacted by future political, social or economic changes, over which the private sector can exercise no control or there are no mechanisms to seek compensatory relief the private sector may decline to bid

A program of the scale of investment requirements (US $39 billion by 2021 and $50 billion by 2031) is so large that the infrastructure program should only be considered as a reference point for post-TRANSFORM discussions on broad urban investment strategies. In the LTS Report of TRANSFORM study and the Draft Final Report of the Business Plan project, preliminary assessments of resource mobilization and institutional strengthening issues were explored. It was concluded that a more comprehensive and bold approach is necessary to secure the resources to implement the recommendations of the TRANSFORM. In addition to resource mobilization, the present institutional structures in MMR do not have either the clear mandate or the capacity to implement the recommendations. Perhaps a pertinent comparison is the "outside of the box" approaches taken by large cities in winning and hosting an Olympic Games. Only in the case of the TRANSFORM and the MMR the time frame is 25 years instead of 6-8 years and the marathon gold medal is:

"Transforming Mumbai into a world class city with a vibrant economy and globally comparable quality of life".

The example of London's success in winning the 2012 Olympics provides useful positive and negative pointers to an undertaking a US $ 20 billion project in an 8 year period. The key factor involved removing inter-governmental gridlock by the top decision makers agreeing that the objective was more important than party lines and tangled processes.

Figure 42: Cost Estimate (2031) and Phasing (2010-31) for Recommended Transport Infrastructure in MMR

Project No.	Project Name	Length (Kms.)	Cost (Rs. Crores)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
M1	Varsova-Andheri-Ghatkopar	15.0	2070																						
M2	Mankhurd-Bandra-Charkope	32.6	5153																						
M3	Backbay-Bandra	19.2	8870																						
M7	Andheri (East) - Dahisar (East)	15.9	2194																						
M5	Ghatkopar-Mulund	12.4	1711																						
M17	Mankhurd-Vashi-Narthen Gaon	24.1	5169																						
M11	Thane Ring Metro	19.4	2680																						
M13	Balkum (Thane)-Bhiwandi-Kalyan-Narthengaon	33.3	4340																						
M12	Thane-Ghodbander-Dahisar	27.2	3182																						
M4	Charkope-Dahisar	7.5	1035																						
M8	Hutatma Chowk-Ghatkopar	22.4	10349																						
M10	Dahisar-Mira Road-Manikpur-Virar	29.9	5618																						
M6	BKC-Marol Naka via Airport	17.2	5128																						
M9	Sewri-Prabhadevi	3.5	1617																						
M24	Sewri-Kharkopar	19.7	9633																						
M19	Targhar-Kharkopar-Nhava Sheva-Dronagiri	18.7	2299																						
M18	Vashi-Belapur-New Airport-Panvel	18.8	3525																						
M20	Kharkopar-Dhutum-Pirkone-Shirki-Vadkhal	30.5	4028																						
M14	Phokhran-Kharegaon	5.0	865																						
M15	Kushavali-Ambernath	10.4	1199																						
M16	Kanjurmarg-Mahape-Kalyan Phata-Pipe Line	13.2	3447																						
M21	Dronagiri-Pirkone-Jite	13.8	2119																						
M22	Shirki-Washi-Jite	9.9	1441																						
M23	Fort (Horniman Circle) - Uran - Dronagiri	15.9	5024																						
SR7	Ranjanpada-Kharkopar-Targhar-Seawood (new link)	13.9	834																						
SR1	Diva-Vasai Road	40.1	2406																						
SR5	Panvel-Uran	26.9	1614																						
SR9	Diva-Panvel	26.7	1602																						
SR6	Kharkopar-Jite (new link)	22.9	1374																						
SR4	Panvel-Karjat	27.6	1656																						
SR8	Thal-Alibag (new link)	5.4	324																						
SR2	Panvel-Jite-Thal	60.9	3655																						
SR10	Thane-Bhiwandi	12.5	750																						
S3	Rewas Port (new link)	10.6	636																						
H1	Eastern Freeway	22.5	1350																						
H2	Elevated Link (Sewri-Worli Sea Link)	5.6	336																						
H3	MTHL: Sewree to Kharkopar (Main Link over the	17.2	4134																						
H22	Western Sea Link South Extn (Worli-Colaba Sea Lin	13.7	3850																						
H6	Inner Ring (Bhiwandi Rd-Panvel): EBL Corridor (201	34.0	734																						
H5	Inner Ring (Kaman-Bhiwandi Rd.)	22.0	475																						
H19	Thane-Ghodbunder Road: EBL Corridor (2016)	16.1	348																						
H13	Radial-3 (Bhiwandi Bypass): EBL Corridor (2016, 202	9.0	194																						
H15	Radial-5 (Chembur-Mankhurd-Vashi-Taloja)	26.0	562																						
H12	Radial-3 (Bhiwandi Bypass)	14.0	303																						
H14	Radial-4 (Nahur-Airoli-Nilaje-Badlapur): EBL Corridor	33.8	730																						
H8	Middle Ring (Narthen Gaon-Panvel): EBL Corridor (2	35.5	767																						
H23	Ghatkopar - Koparkairane Creek Bridge	8.9	801																						
H20	Western Sea Link North Extn (Bandra - Dahisar): EB	26.0	6235																						
H21	Western Sea Link North Extn (Dahisar - Virar): EBL (	38.0	9120																						
H16	Radial-6 (Vashi-Belapur-Kalamboli)	14.9	322																						
H10	Radial-1 (NH-8)	26.0	561																						
H7	Middle Ring (Bhiwandi-Nandivali-Narthen Gaon)	18.6	402																						
H11	Radial-2 (Part of NH-3)	36.4	786																						
H18	Radial-8 (New Airport-Nhava-Uran-Rewas)	22.2	479																						
H9	Outer Ring Road: Khopoli-Jite-Rewas Port	36.8	794																						
H17	Radial-7 (Uran-Pen)	22.3	482																						
H24	Mumbai- Sawantwadi Expressway	21.2	458																						
H4	MTHL: Kharkopar to Rave (Link overground)	18.1	2169																						
Rolling stock for Metro Corridors			15676																						
Rolling stock for new sub-urban lines/ operations			3333																						
Sub-urban rail improvements			13235																						
Arterial Corridors: Upgradation		781	10101																						
Arterial Corridors: New Links		419	6034																						
Road Safety & Traffic Management Measures			6545																						
Bus System: Bus fleet & Depots for EBL operations			2450																						
Bus System: Bus fleet for ordinary bus public transport operations			1830																						
Passenger Water Transport (PWT)			480																						
Terminals (Truck, Bus, Inter-city rail)			3040																						

Legend:

- Transit/ Highway Construction
- Upgradation of Arteral Corridors
- Projects in advanced stage of planning by various clients in MMR
- Planning & Procurement of Rolling Stock for Transit
- Bus fleet
- Road Safety & Traffic Management Measures
- Passenger Water Transport
- Terminals (Truck, Inter-city Bus, Inter-city Rail)

10. INSTITUTIONAL ARRANGEMENTS AND NEED FOR CHANGE

In MMR there are multiple organisations responsible for various transportation related matters. Each of these organisations formulate projects based on its own needs without considering those of other organisations. This results in projects with conflicting objectives, inconsistent with the overall development objectives.

NEED FOR INSTITUTIONAL STRENTHENING

- **Multiplicity of agencies**
- **Difficulty in coordinating the roles of central, state and Local Government agencies**
- **Lack of inter-sectoral institutional coordination resulting in schemes with conflicting objectives which are inconsistent with overall development objectives.**
- **MMRDA's constrained institutional influence**
- **It is rare to find a single authority needed to deal with the large range of transportation problems and to coordinate over all solutions.**
- **Lack of adequate resource allocation has a crippling effect on the performance of the institutions resulting in delayed implementation or non implementation of essential schemes**
- **Difficulties Encountered Within Individual Transport Agencies**
- **Functional responsibility unrelated to available resources**
- **Rarely the transport planning/ execution/ operational organizations are staffed with the professionals required to accomplish the given objectives**
- **Inadequate trained staff resulting in inability to deal with the problems they encounter. This is more apparent at medium and senior levels of management**
- **Lack of Legislative Support**
- **In order to promote integrated transport system development, regulate transport services comprising various modes, inter & intra sectoral coordination consolidation of objectives, functional processes and procedures under one comprehensive statute is required.**
- **Lack of expertise in Traffic & Transportation Planning/ Engineering field**
- **No dedicated cell in ULBs and concerned agencies to look after traffic & transportation aspects**

UMTA a Separate Authority or Within a Regional Government Structure?

It is important for regional transport authority to have a specific and focused regional-wide mandate. While existing MMRDA does have a regional mandate, presence of many other independent ULBs in direct control of the state government through Urban Development Department dilutes it.

Partly, this is rightly so, as MMR is a very important component of the State's economy and identity. It is also the seat of government, a dominant generator of economic wealth and prosperity, a centre for institutions of higher learning and many other attributes typical of state capitals of historical prominence. The spectre of the MMR tilting towards the status of a "City State" is a very sensitive issue. While Shanghai is often preferred as a model for Mumbai, fundamental difference between them is on this account that Shanghai is a city-state.

There are on-going debates in many global cities and metropolitan areas on whether the existing governance structures are appropriate for today's age and demands being put on urban governments. Cities and regions are arguing that, with current legal frameworks, they cannot access the range of resources to effectively deliver services, including urban transport. In many older cities, requirement for resources to maintain deteriorating infrastructure in a state-of-good-repair can far exceed growth demand.

Mumbai is faced with a large deficit on the "state of good repair" account and the need to expand the infrastructure to accommodate rapid growth.

Further, the introduction of a regional form of elected government, in between the State and the municipalities is constitutionally infeasible.

Under such circumstances, the most practical solution to establish a regional authority is to expand the role of MMRDA by fully utilizing its current powers, making the appropriate revisions to its mandate and establishing a more inclusive accountability process to the citizens of the Region.

Based on the review of the existing working of the organizations responsible for transport

infrastructure with regard to institutional performance in MMR, transport institutional arrangements in major international metropolitan regions, previous attempts for improving institutional & program implementation coordination, etc. the options evolved are described in the following sections.

10.1 Options for a Regional Authority

The NUTP acknowledges that the formation of a UMTA would have to respond to the particular needs of the metropolitan area. Several options were initially examined including:

- Reinforcing the Coordinating Role of MMRDA
- Formally Establishing a New Unified Metropolitan Transport Authority (UMTA)

Option 1: Reinforcing the Coordinating Role of MMRDA

In a concurrent study on "Business Plan for Mumbai Metropolitan Region" the report has recommended additional functional areas for MMRDA and Transport is one amongst them.

The main objective of the proposed "MMR Transport" functional unit is to provide support in;

1. Planning and development of infrastructure
2. Operating the various services in seamless manner
3. Coordinating all these functions through authority

Urban transport infrastructure at the moment is catered to by various National, State, and Municipal Governments and undertakings. For example Railways, National Highways, Airports, are National level subjects, while State Highways, State Transport Bus services, are State level subjects. Several major arterials, bus services, etc are under the control of Municipal authorities. MMRDA has the mandate of developing Regional Plan, and now has taken itself the responsibility of developing Metro Transit system. It is increasingly becoming difficult to satisfy over all commuter and public transport needs under the existing set up, as each authority is functioning in isolation.

Creation of separate UMTA may take some time, and meanwhile TRANSFORM *study* recommends an interim "Unified Transport Administration (UTA)" for evolving coordinated transportation set up.

To achieve the objectives mentioned above, we need to bring together all these authorities creating "Unified Transport Administration" where decisions are taken on common platform in at State, Regional and at Local level respectively (Ref. Figure 43). Details of the restructuring are presented as follows:

1. **Formation of Transport Board/High Powered Committee:**

   Pending the creation of full fledged Unified Metropolitan Transport Authority, it is proposed to create "Transport Board" (TRB) or "High Powered Committee": at State Government level to facilitate the various Authorities belonging to Centre, State and Regional level, to take decisions that are common to Metropolitan area. "Transport Board" will have the mandate to coordinate between State and Regional level authorities including cost sharing and sort out the differences between related agencies. It will have to find ways and means for financing regional level transport projects, and form Special Purpose Vehicles (SPVs) as and when necessary. It will raise required resources through different instruments.

   This Board/HPC will be functioning at State Secretariat within the Urban Development Department, with Minister being the Chairman. The Secretary Urban Development will coordinate the Board activities. The Board will have responsible members from Transport and planning related Stakeholders from Central, (Railways, NH, Ports, Airport etc) State Governments (Transport, Home, PWD, Municipal Administration, MRVC, MSRDC etc), Heads of Service providers, and the MMRDA Commissioner as its secretary.

It can have invitees depending upon the nature of project under discussion.

MMRDA will provide secretarial, planning and coordination functions of this Board.

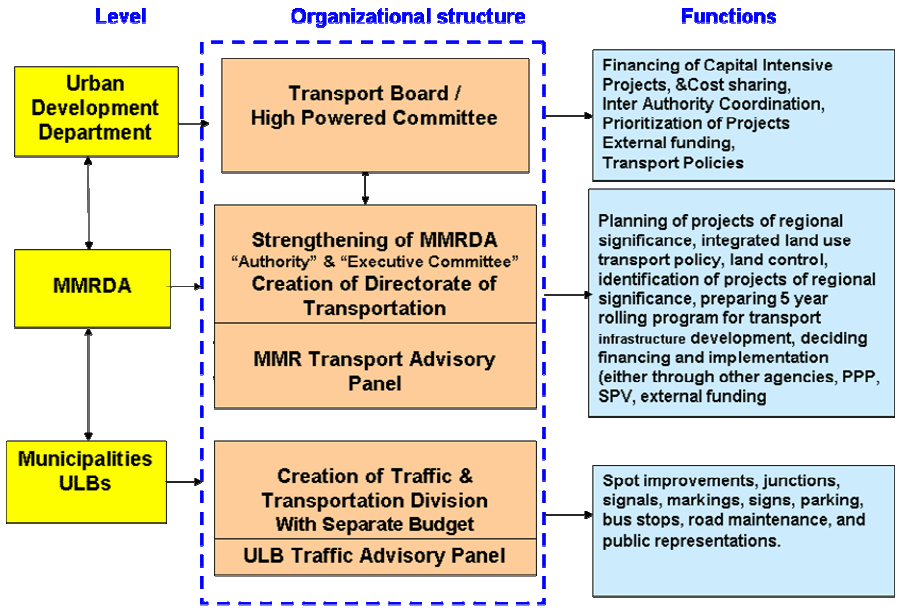


Figure 43: Strengthening MMRDA to include transport functions-"Unified Transport Administration"

2. Strengthening MMRDA

It is proposed to strengthen the MMRDA "Authority" and it's "Executive Committee" with additional members in order to represent other stake holders. It is proposed to create additional Departments to shoulder newly emerging transport functions, by strengthening MMRDA in three aspects and the details of the proposed organisational structure are presented in the Figure 44.

- First by expanding the "Authority" by involving elected Mayors from all Municipalities and urban local bodies as regular members and not as invitees to increase their commitment;
- Second by including the Secretaries of Transport and Home Departments in the Executive Committee as new members in arriving at suitable transport decisions;
- Third by expanding the functional areas of MMRDA by creating "Directorate of Transportation" to handle the newly emerging Metro systems, Regional Highways, Exclusive Bus Lanes, coordinating transit and para-transit operations of various service providers, creating integrated transportation system for seamless travel in MMR etc.

The Department would be subdivided into divisions such as "Surface Transport department", "Regional Metro Department", Sub-urban Rail Transport Department (Coordination), "Marine Transport Department", "ITS and Corridor Management Department" each headed by professional managers. Further, Regional Surface Transport Department will have two divisions, MMR Bus Transport Division and MMR Road Transport Division. These departments and divisions will have separate supporting professional staff and annual recurring budgets. The Transport Department will be guided by "Transport Advisory Panel" for inter carrier and sub regional coordination.

In fact the whole MMR Transport organizational structure presented enclosed in dotted lines in the Figure 44 will be equivalent to the technical role of UMTA.

The main purpose of all these departments is to plan Regional level transport systems and facilities, coordinate all the activities for seamless travel over the region and to provide common standards and specifications for common to all local bodies. They will have team of professionals in relevant disciplines to provide most up to date solutions. These units will arrive at resource generation plans to create new transport facilities in the region. Ultimately these units will have to take over all the Regional Transport System responsibilities when the full fledged UMTA is constituted.

It must be noted that in this interim model, actual transport services are provided through service providers, such as Regional Metro Department, Regional Bus Transport Division, etc; However, planning of bus routes, common ticketing etc are, arrived at the Transport Advisory Panel level.

The Directorate has to create a centralized Data and Computer Modeling Centre, the expenditure of which can be shared among beneficiaries.

The MMRDA will create separate budget subheads for Traffic and Transportation projects under the Directorate of Transportation.

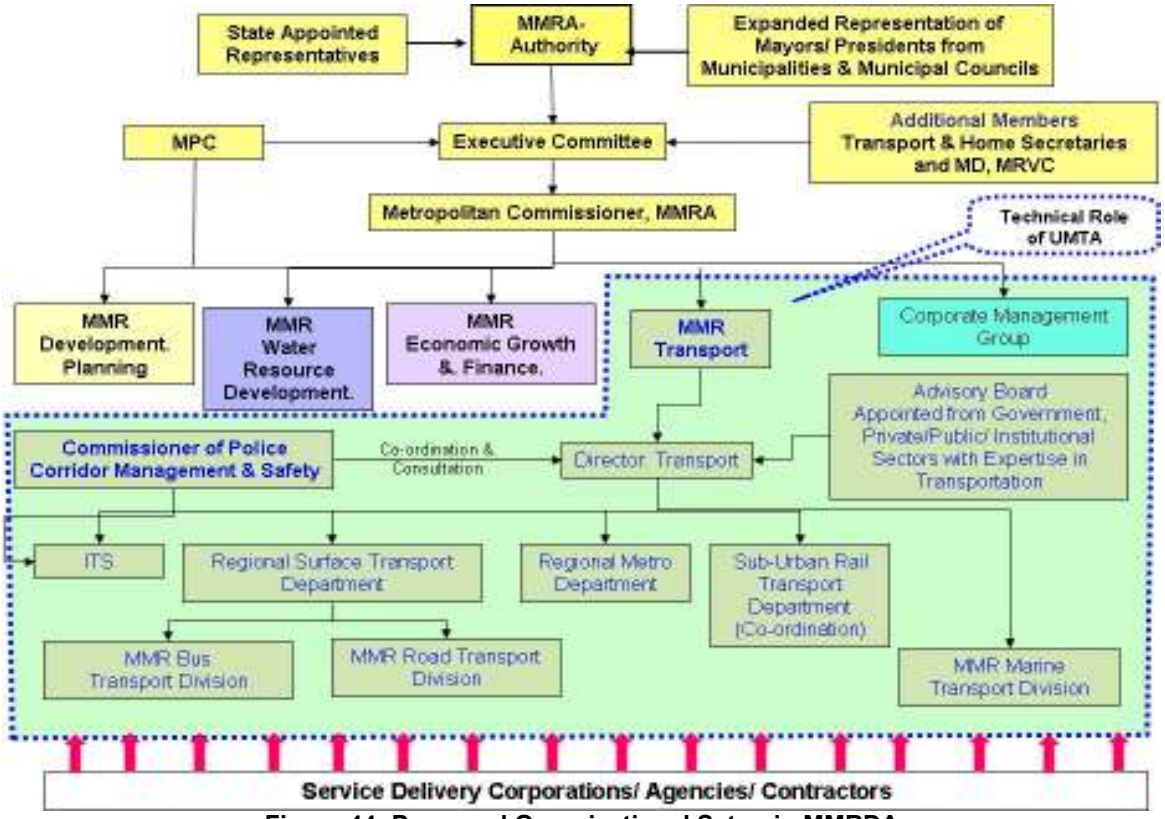


Figure 44: Proposed Organisational Setup in MMRDA

3. **Creation of Traffic & Transportation Departments in Municipal Bodies:**

It is proposed to strengthen Municipal bodies by creation of Traffic & Transportation Departments, supported by "Traffic Advisory Panel" with stake holders to coordinate local activities. The proposed organizational setup in Figure 45.

Necessary technical function will be provided by Traffic & Transportation Department to be created in Local Authority. This unit is to be headed by Transportation professional, and will have separate budget subhead from out of its regular funds.

The Advisory Panel is to be constituted in respective Municipal Corporations and local bodies. Municipal Commissioner will

chair the panel, with members comprising of RTA, Traffic Police, Bus Transport, Municipal Transport, and Utility Departments operating in the area etc. The Traffic & Transportation division head will be it secretary.

Their functions are to coordinate various functional providers within municipal area, to look after Spot improvements, design and modify junctions, signals, providing lane markings, traffic signs, parking facilities & controls, bus stops, road maintenance, and attend to public representations. One of the major issues is to integrate the services of Electricity, Telephone, water, sewerage and other municipal related services. They can have separate units for Parking, advertisement etc. All projects that are of regional significance are to be referred to MMR Board for arriving at decisions. They can approach MMRDA for additional grants

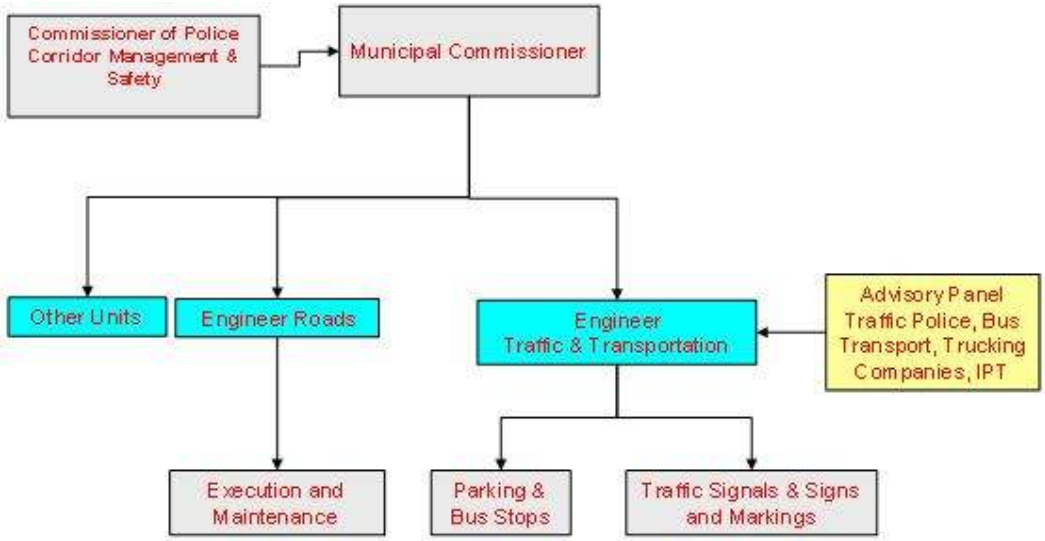


Figure 45: Proposed Organisational Setup in Municipal Corporations and ULB's

Regarding traffic budgets, it was observed that several local bodies have budget sub head for roads, but not for traffic related works. Traffic related equipment and works deserve equal attention by way of having a separate sub-head. A separate budget subhead for "Traffic & Transportation", need to be created from out of ULB's annual recurring grants. This will ensure focused attention on traffic improvements.

Option 2: Formally Establishing a New Unified Metropolitan Transport Authority (UMTA)

The urgency for this option became apparent after the announcement by the Prime Minister in Mumbai in August 2006. This could take the form of a separate authority headed by a senior most bureaucrat (e.g. Chief Secretary) and empowered by a separate legislation to take control of coordination, integration and funding.

The NUTP acknowledges that the formation of a UMTA or similar set up would have to respond to the particular needs of the metropolitan area.

Regional Road and Transit Network Responsibilities

- to manage public transport in the region, the envisaged authority can have following alternatives:
- an agency responsible for the implementation and operation of the proposed Metro system
- an agency responsible for Metro and the Suburban Rail to ensure modal integration
- an agency responsible for the Metro, the Suburban Rail and all bus systems

There are many international models for each of the options outlined above. There is a clear trend, worldwide, for fully integrated regional transit to satisfy the desire of transit passengers to readily transfer between different public modes in order to meet the growing demands for longer distance commutes. This public transport integration, whether it is in the form of integrated schedules or seamless fare structures, is essential if public transport is to successfully compete with the private modes that freely move through the road and highway system traveling door-to-door.

The rationale for designating Regional or Metropolitan responsibilities for roads presents a greater variety of choice, because many of the road links serve a very local but multi- functional service and are not solely provided for transportation. Water supply, sewerage, electricity, telecommunications, garbage collection, fire protection and security are all very dependant on a well functioning road network.

Worldwide, regional authorities limit their jurisdiction to major roads of regional importance. For instance, the Greater London Authority has control of only 5% of the road network but these 5% roads carry 33% of the total traffic in the region.

Potential Structure of Regional Transport Agency

A potential institutional arrangement to effectively deliver the transport proposals is shown in Figure 46. The main delivery vehicle for transport infrastructure would be three corporations under the full control of a regional authority namely:

- MMR Surface Transport Corporation
- MMR Rail Transport Corporation
- MMR Marine Transport Corporation

The **MMR Surface Transport Corporation** will be responsible for the designated regional road network. This Corporation will also take responsibility of all local bus corporations with a mandate to manage the road network that provides priority to public transport. An alternative to this arrangement would be to have an integrated bus and rail transit corporation. The argument in favour of former is that the performance of the road system dictates the efficiency of bus operations. 'Bus Operation' (people movement) shall take precedence over simplistic 'vehicle running'.

The MMR Marine Transport Corporation should oversee the operation of water based public transport services in the region as suggested in this study. Transport by water in Mumbai Metropolitan Region, is viewed by some as promising supplementary mode to the rail and road based public transport system. Main argument in its favour is because the region is blessed with long coast lines (west and east coast lines). The western coast line is exposed to the Arabian Sea, whereas the east coast line has comparatively more sheltered waters formed into a bay.

A critical economic factor with faster ferries is the high cost of vessel maintenance and the fuel consumption demands which rise dramatically with speed. The Marine Transport Corporation mandate should include undertaking balanced assessments of need and justification for any public investment in marine transport in relation to other planned investments in urban transport.

The Corporate Management Wing of the Regional Authority should include a complete range of functions to plan, design, fund, construct, operate and maintain security of persons and property of the transport infrastructure under its control through the corporations described above.

- Finance & Programming
- Administration
- Legal
- System Planning & Integration
- Project Management
- MIS/ IT
- Public Liaison
- Regional Transport Police & Security

This would require a major increase in MMRDA staffing levels within the Corporate Management Wing as well as in each of its implementing corporations. The institutional structure described would facilitate the contracting out of many delivery functions.

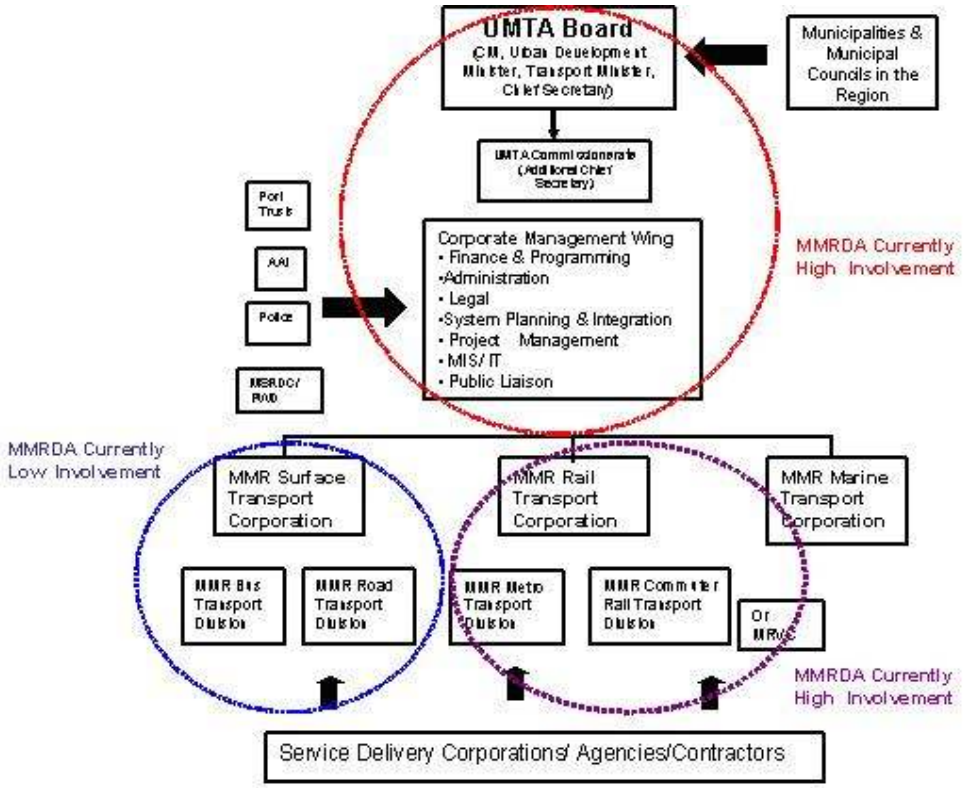


Figure 46: Institutional Arrangement for Option 2: Proposed Organisational Structure for UMTA

11. MOBILIZATION OF RESOURCES FOR TRANSPORTATION PROJECTS

11.1 Background

Financing for urban transportation involves complex issues regarding costs and benefits. This is because the benefits of transportation are so wide spread and are critical to the efficient functioning of a city. Regardless of these complexities those government institutions responsible for urban transportation, should now pursue a wide range of resource mobilization opportunities.

The following resource mobilization opportunities have been categorized under the groupings of General Revenue Sources, User Pay Sources and Transport System Leverage Sources.

General Revenue Sources:

- Inter-Governmental Transfers*
- Borrowings*
- Octroi*
- Property Taxes*
- Business Taxes**
- Employment Taxes***
- Dedicated Income Tax***
- Dedicated General Sales Taxes***

User Pay Sources

- Fares*
- Tolls*
- Dedicated Fuel Taxes**
- Betterment Charges**
- Development Charges**
- Targeted Sales Taxes**
- Parking Levies***
- One Time Cess on New vehicles ***
- Congestion Charges***
- Mileage Charges***

Transport System Leverage Sources

- Public Private Partnerships**
- Advertising Rights**
- Commercial Leasing**
- Air Right Development***

** Current practice but could be further optimized to increase resource mobilization*

*** Currently being marginally applied significant opportunities to optimize resource generation*

**** Potential new resource mobilization opportunities to be evaluated*

Under mobilization of resources for the TRANSFORM project, potential resource mobilization opportunities are presented below.

11.2 General Revenue Sources

11.2.1 Inter Governmental Transfers

Typically, these programs require financing from all three levels of Government, such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM) under which the sources are 35% as GOI contribution, 15% as state contribution and 50% as ULB resources or borrowings & funds. In 2007, Mumbai is to receive Rs. 1,100 crores under JNNURM. While this is also seen as a risk, predictability will be an issue. The State Finance Commission is supposed to propose five yearly devolutions, thereby assuring more general predictability of its funding. This practice must be followed so that recipients can plan their cash flows and make the financial commitments necessary for infrastructure financing. Wherever possible grant programs should be formula based to maximize transparency.

11.2.2 Borrowings

These measures are critical for the ULBs both in terms of contributing own capital and borrowing from the market and financial institutions. In order for ULBs to increase their borrowings they must:

- Be able to quantify the benefits of these investments so as to demonstrate their cost-effectiveness;
- Achieve a track record of financial sustainability and sound financial management;
- Adopt accrual accounting methods and prepare balance sheets, capital budgets and capital improvement plans; and
- Obtain a credit rating.

The newly formed Maharashtra Urban Infrastructure Fund (MUIF), in the process of being operational is expected to help ULBs in terms of project development and access to the market through the following components:

- Project Development Fund;
- Debt Service Fund; and
- Partial Direct Loan Fund.

The MUIF has the potential to play an important role in facilitating project preparation and ULB borrowings. However to achieve its potential, it will need a reorientation from the structure. It is recommended that MUIF be enlarged from what is currently being planned and that private sector participation be invited to create the entity. The Business Plan for MMR should be revisited and updated to reflect the recommended focus on finance, the need to create an State Pooled Finance Entity (SPFE) and the need for a greatly expanded role in view of the investment needs requiring funding.

11.3 User Pay Sources

11.3.1 Tolls

Applying tolls on all higher order roads and bridges in the MMR has been assumed in "Transform". One of the key structural issues is that typically in urban areas there are multiple points of entry and exit on urban freeways since longer distance through traffic is relatively insignificant. This can complicate toll collection if delays occur at collection facilities. In developed economies electronic toll collection has largely removed this issue.

11.3.2 Dedicated Fuel Taxes

The State of California funds 75% of its transport capital program from dedicated "ring fenced" fuel taxes. Petrol sale price is 35% cheaper in California compared to Mumbai. On the other hand petrol prices in Europe are generally 20% higher than Mumbai but the higher taxes being paid appear to be reinvested in urban and inter-urban transport by means of central government program subsidies.

Since petrol prices in Mumbai are the highest in India due to the application of a special levy, it was concluded that at this time it would be difficult to justify a further dedicated fuel tax.

11.3.3 Development Charges

The idea is to capture the land value gains on account of infrastructure (called betterment or land value increment tax LVIT), recover the cost of infrastructure required to be provided for servicing new growth (impact fees), a tax levied on value of ll new construction as a benefit tax. All three are distinct from property tax in that they are one-taxes.

A simplified and approximate illustration of the scale of development charge potential in the Region, based on the projections of population and employment growth during the period 2005-2031, and resulting residential and non-residential building and land values is given in Table 20. These figures should be considered as indicators of the order of magnitude of DC's.

To compute this, sources are divided into two components. The First source is value addition due to Residential buildings growth due to increase in population for a typical growth scenario as shown in Table 20. This works out Rs 11,19,253 crores.

The second source is due to Non residential building value. This is estimated as given in Table 21. The additional value addition on this account could be Rs 6,20,00 crores.

Adding these two sources the approximate Development Charges potential for the period 2007-2031 is summarized in Table 22. The estimated resources from Development Charges range from Rs. 86,000 crores to 1,72,000 crores (assuming Development Charges, 5% and 10% of Building Values respectively) for the period 2006-2031.

11.3.4 One Time Cess on the New Vehicles

Each year several new vehicles are being acquired and registered in the region. The estimated increase in vehicle registration is presented Table 23. In many countries annual vehicle license fees and annual driver license fees are collected but often are not dedicated to fund transportation services. The estimated number of the vehicles during the period 2005-2031 is shown in Table 23.

Even if one time cess of Rs. 10,000 for each, car Rs. 2,000 for each two wheeler is levied the source can generate a sum of Rs 1,570 crores, and 1,090 crores totaling to Rs 2,660 crores.

Table 20: Residential building value Growth Forecast –P3E3

Location	Low Rs/ sq. ft.	Building Value High Rs/ sq. ft	Assumed Rs/ sq. ft.	Assumed Unit Size sq. ft./unit	Unit Cost Rs	Unit Cost Lakhs Rs	Population Increase 2005-31 Lakhs	Units (4ppu) Increase 2005-31 Lakhs	Building Value Rs Crore	Building Value US$ Billion
South Mumbai	15,000	45,000	25,000	1,000	25,000,000	250	6.4	1.60	400000	89
Western Suburbs(S)	9,000	12,000	10,500	850	8,925,000	89.25	6.0	1.50	133875	30
Western Suburbs(N)	3,000	6,000	4,500	850	3,825,000	38.25	9.2	2.30	87975	20
Central Suburbs	3,000	5,000	4,000	850	3,400,000	34	9.2	2.30	78200	17
Thane	3000	5000	4000	700	2,800,000	28	11.0	2.75	77000	17
Kalyan/Dombivali	1000	3000	2000	700	1,400,000	14	23.7	5.93	82950	18
Mira	1200	2500	1600	700	1,120,000	11.2	7.3	1.83	20440	5
Navi Mumbai	3000	4000	3500	700	2,450,000	24.5	18.0	4.50	110250	25
Vasai Virar	1000	1500	1250	600	750,000	7.5	7.9	1.98	14813	3
SEZ/Alibag			2500	700	1,750,000	17.5	26.0	6.50	113750	25
Total							124.7	31.18	1119253	249

Table 21: Employment Growth Forecast

	2005	2031	Increase 2005-31	Approx. Occupancy Emp/sq. ft.	Required Building Area sq. ft.	Building Cost Rs/sq. ft.	Total Building Cost Rs Crore	Total Building Cost US$ Billion
Office Employment	2,310,000	6426000	4,116,000	40	164,640,000	25,000	411600	89
Industrial Employment	1,495,000	4513000	3,018,000	100	301,800,000	6,000	181080	39
Other Employment	3,795,000	4361000	566,000	60	33,960,000	10,000	33960	7
Total	7,600,000	15,300,000	7,700,000		500,400,000		626640	136

Table 22: Approximation of DC Potential 2006-2031

	Rs. Crore	$ Billion
Residential Building Value	11,00,000	250
Residential Building Value	6,20,000	140
Total Building Value	**17,20,000**	**390**
Approx DC Potential		
Regional Transportation		
(DC 5%)	86,000	20
(DC 10%)	1,72,000	39

Table 23: Vehicle Growth Forecast

	2005	2031	Increase 2005-31	Average Unit Cost Rs.	One Time Cess on New vehicles (Rs. Crores)
Cars	6,90,000	22,60,000	15,70,000	3,50,000	1,570
Two Wheelers	13,30,000	67,80,000	54,50,000	50,000	1,090
Total	**20,20,000**	**90,40,000**	**70,20,000**		**2,660**

11.4 Transport System leverage Sources

11.4.1 Private Investment Options

Ministry of Finance, Department of Economic Affairs, GoI (DEA) promotes public private partnerships in infrastructure. In order to guide formulation and implementation of Public Private partnership (PPP) projects, DEA has formulated a number of guidelines. Important amongst these are:

- Guidelines for financial support to Public Private Partnerships in infrastructure

- Project risk assessment for PPP Projects sponsored by Government / Government Agencies / PSUs prior to bid

In addition GOI has set up India Infrastructure Finance Company Limited (IIFCL) with a authorized capital Rs.10,000 million and paid capital of Rs. 1,000 million. IIFCL is an apex financial intermediary for the purpose of development and financing of infrastructure projects and facilities in the country. This is to be effected by developing and disseminating appropriate financial instruments and negotiating loans and advances as per the given mandate. The Company renders financial assistance through:

- Direct lending to eligible projects
- Refinance to banks and FIs for loans with tenor of five years or more
- Any other method approved by GOI

MMRDA has successfully structured a PPP project for mass transit viz. Versova – Andheri-Ghatkopar corridor and has begun the process of selecting private partner for Charkop-Bandra-Mankhurd corridor.

The initial revenues on the Delhi Metro are only sufficient to cover operating costs which is not unusual for mass rapid transit projects. The financial planning of the transport program will require constant monitoring and adjustment to reflect incremental implementation experiences.

The PPP route may be more vigorously pursued in other infrastructure projects like urban expressways, water source development. Navi Mumbai Municipal Corporation has successfully bid out an annuity based contract for water supply source development.

11.4.2 Advertisement Rights

The travelling public are prime consumers of advertising but many transport agencies fail to capture the value of this attribute. It is reported that the private company operating the metro system in Hong Kong earns more revenue from advertising than from the fare-box.

Figure 47: Metro Advertisements in Shanghai

11.4.3 Air Right Development

Typically the highest urban land values are in the vicinity of transit stations, particularly in a city like Mumbai, which is so public transport dependant. Unfortunately some of the stations are so overcrowded and the surrounding streets so congested, that it greatly detracts from the inherent location advantages.

Where transit or railway agencies have proactive land development divisions with a commercial real estate focus, the capturing of air and non-operating land development potential, has provided sustainable revenues to support the economics of the primary transport functions. In Holland, the Dutch Railways are generating 40% 0f their annual revenues, from property development.

Figure 48: Air Right and Transit Orient development (Kuala Lumpur and Tokyo)

11.4.4 Funding Requirement and Funding Sources for Transport Infrastructure in MMR

The total investment needed for the period 2008 – 2031 is Rs 2,06,661 crores. Excluding the projects on which the authorities have taken decision like Metro lines proposed in Greater Mumbai under Phase I, Eastern Freeway, Western Freeway, MTHL, the total estimated investment needed for the period 2008-2031 is about Rs. 1,80,899 crores. Component wise funding requirement and the probable funding sources is presented in Table 24.

Table 24: Summary of Funding Requirement and Sources: Horizon Period 2008-2031

Project	Total Investment (Rs. Crores)	Sources of Resource Mobilisation (%)			
		Private Sector Investment	SPV	Borrowings by Government	Government Own Funds
Metro System	76,603	59%	11%	21%	9%
Sub-urban Rail System (New Proposals)	14,851	79%	-	14%	6%
Freeways	26,722	38%	59%	2%	1%
Rolling stock for Metro Corridors	15,676	78%	-	15%	7%
Rolling stock for new sub-urban lines/ operations	3,333	100%	-	-	-
Sub-urban rail improvements	13,235	-	-	70%	30%
Arterial Corridors: Upgradation	10,101	-	-	70%	30%
Arterial Corridors: New Links	6,034	-	-	70%	30%
Road Safety & Traffic Management Measures	6,545	-	-	70%	30%
Bus System: Bus fleet & Depots for EBL operations	2,450	50%	-	35%	15%
Bus System: Bus fleet for ordinary bus public transport operations	1,830	-	-	70%	30%
Passenger Water Transport (PWT)	480	50%	-	35%	15%
Terminals (Truck, Bus, Inter-city rail)	3,040	50%	-	35%	15%
TOTAL	**1,80,899**	**47%**	**13%**	**27%**	**12%**

12. SUMMARY

The recommended transport network plans for the horizon years 2031, 2021 and 2016 have been presented in Figure 35, Figure 37 and Figure 38 respectively. Some of the salient features of the proposed short and medium term plans and their extent by 2031 are described below:

- *The length of metro network for the horizon year 2016 and 2021 is 208 km and 318 km respectively, which further expands to 435 km by 2031. Most of the metro network proposed by 2016 is located in MCGM and Navi Mumbai. The metro lines considered are of twin track, one track per direction.*
- *Total length of new suburban rail network is approximately 248 km. The majority of the new suburban rail network corridors are required by 2016, with minimal addition thereafter. Only twin track corridors have been proposed, with one track per direction.*
- *The highway network, which includes higher order transport network (fully access controlled) and arterial corridors for the horizon year 2016 and 2021 is 982 km and 1,229 km respectively. The 2021 network is further required to be developed and augmented by another 510 km by 2031 to be extending over 1,740 km. It is recommended that, all major sea-links and bridges will have the lane configuration reflecting 2031 requirements. Most of the higher order transport network has been considered to have at least eight (8) lane divided main carriageway by 2031. However, for 2021/2016 they shall be of six (6) lane divided carriageway only.*
- *Along some of these corridors, Exclusive Bus Lanes (EBL) have been proposed for the horizon years where the travel demands on parallel metro corridors were insufficient to justify investments in a metro line for the time horizons being considered. The approximate length of EBL network proposed by 2016, 2021 and 2031 is 165 km, 112 km and 79 km respectevely.*
- *Based on studies made by other agencies provisions have been made in the budgets for Passenger Water Transport (PWT) on the west coast, east coast and on other routes. The proposed investment by the horizon year 2016 is about Rs.480 crores.*
- *Inter-State bus terminals, inter-city/ intra regional bus stations, major/ minor truck terminals, inter-city rail terminals have been proposed as part of transport plan for the horizon years 2016 (Rs.1126 crores), 2021 (Rs.2038 crores) and 2031 (Rs. 3040 crores).*
- *Road safety measures, traffic management measures are being recommended. These measures include intersection improvements, flyovers/ interchanges, pedestrian facilities (FOBs and Subways), ROBs/ RUBs, footpath improvements, traffic signal installation/ Area Traffic Control Systems, etc. An approx. investment needed for these is assessed to be Rs 5860 crores by 2016.*
- *Along the entire higher order road/highway network and on proposed new and upgraded arterial roads it is recommended to have footpath facilities on either side with guard rails (typically of to 2.0 m width). This is for safe movement of pedestrians. The cost for footpaths is included in the roadway costs.*
- *Safety measures within the existing suburban railway stations like FOBs for non-rail commuters, provision of guard rails between the tracks to avoid crossing of tracks by rail commuters, etc. have been proposed. Budget provisions for these improvements are Rs.480 crores.*
- *The total cost of transport network for the horizon year 2031, 2021 and 2016 is Rs. 2.07, Rs. 1.64 and Rs 1.34 lakh crores respectively at 2005-06 prices which is approximately US$ 50.41, US$ 40.10 and 32.73 billions respectively.*
- *Alternative institutional arrangements have been examined such as "Reinforcing the coordinating role of MMRDA" and "Establishing a new Unified Metropolitan Transport Authority (UMTA)".*
- *The total infrastructure investment is proposed to be funded by 47% by private investment in PPP format, 27% by borrowings, 13% by SPV and 12% by Government own funds. This allows enough cushion to allow for uncertainties.*