8. Mobility Plan Elements

8.1 Mobility Plan Elements

Based on the aforementioned framework of the plan and the strategy for achieving the vision, City Mobility plan action items are summarized as follows:

1) Mobility Corridor Plan
2) Traffic Management Plan
3) Public Transport Plan
4) Non Motorized Transport Plan
5) Passenger and Commercial Terminal Plan
6) Flyovers and Bridges Plan
7) Travel Demand Management Plan
8) Road Maintenance & Management Plan

The public transport plan is supplemented with an extensive bi-cycle network that is both interconnected and continuous that reinforces and feeds into the public transport corridors. As it is assumed that every road must have a walkable and usable footpath no separate footpath plan is provided. For efficient passenger dispersal system from the public transport corridors at-grade/grade separated pedestrian crossings are planned. In order to improve the mobility of the corridors and pave way for the public transport corridors an effective parking management plan that complements the corridor plan is identified. The parking plan in addition to freeing the right of way for the public and non-motorized transport would also act as a demand management tool. A strong and reformed institutional framework is identified to help achieve the mobility plan and the vision.

These individual plan elements are detailed in the subsequent sections.

8.1.1 Designate Mobility Corridors

Functionally urban roads are classified as Arterial, Sub-arterial, collector/distributor and Local Streets. Functional classification of the urban roads is an important step wherein design and management of roadway would be standardized. In Pune even though the hierarchy of roads exists the roads are not maintained according to the required standards. By designating certain roads as mobility corridors, these corridors get priority for increasing the throughput as well as operating level of service. Therefore for a mobility corridor increasing the throughput as well as speeds would then be focussed and appropriate solutions would be identified.

Experience indicates that as speeds of public transport vehicle reduce travel times increase to such an extent that commuters look for personalized modes of travel. In addition to the user travel preferences, the road design and operations also have bearing on the traffic congestion. Congestion results in lower

traffic speeds for all vehicles and more so for public transport vehicles.

It is very imperative that certain strategic roads be designated as Mobility Corridors for focusing the corridor mobility.

These corridors would be expected to have the following cross sectional elements:

- The road cross section would be at least 25m for mixed traffic conditions or 30m for dedicated public transport lane conditions. The roads if necessary must be widened up to the width shown in the Development Plan.
- Continuous Kerb, footpath-cum-drain & bi-cycle lanes.
- Service roads where feasible
- Restriction or preferably prohibition of parking on the carriageway/shoulders. The parking must be shifted to off-street parking locations or cross roads.
- At-grade/grade-separated public transport systems as per the public transport master plan.

The radial road network would be complemented with circumferential roads to form a radial and ring pattern of the urban network. Three circumferential rings have been envisaged in the study area:

- The first ring would utilize the existing sections of the road and encircle the core area. Traffic not destined to the core area can utilize this ring to bypass the core area thereby relieving congestion in old city and vicinity.
- The proposed HCMTR in the DP would form the second ring
- The third ring would be a regional ring circumscribing both PMC as well as PCMC. The existing westerly bypass would form the western portion of the ring. The easterly portion must be developed connecting NH4-Nasik Rd-Nagar Rd-Solapur Rd-Saswad Rd-Satara Rd.

These three rings would also be part of the mobility corridors.

Corridors designated to be as mobility corridors are shown in **Figure 8.1**.

8.1.2 Traffic Control, Operations & Management

Traffic Management is a general term for strategies that result in more efficient use of existing transportation resources, as opposed to increasing transportation system supply by expanding or new constructing of facilities. Most of the time traffic management measures require zero or minimal land acquisition. Pune city needs traffic management schemes to be implemented before major facility expansion or construction happens. Several of the traffic management schemes are low cost solutions and therefore must be used to their fullest before other measures are taken up to cope with growing congestion.

Some of the traffic management measures are listed below along with brief description:

Traffic segregation

To reduce accident risk and increase level of service central medians are to be provided on mobility corridors. Bicyclists and pedestrians are more efficient users of scarce road space than private motor vehicles, helping to combat congestion. Bicycling and walking are the most efficient and environmentally sustainable means of making short trips. Pune has already begun implementing bicycle lanes and must continue to do so on all corridors, more specifically mobility corridors. Cyclists using the carriageway along with motor vehicles and other road traffic, cause hazards for themselves. This is particularly true when cycle traffic is more. Under such circumstances, it is necessary to segregate cyclists from other traffic. Provision of a separate bi-cycle lanes of at least 2m width would improve the overall traffic flow. To provide separate NMT facilities sometimes the shoulders and carriageway may need to be widened within the ROW. Parking may need to be relocated to make way for the NMT facilities at certain locations.

Pedestrian Crossings / Signals

On the mobility corridors specifically at busy intersections and mid block bus stops (at public transit corridors) Pedestrian foot-over-bridges or subways would be required. A TEFS must be conducted before finalising the location and type of grade separation. Where grade separated facilities cannot be provided at-grade facilities such as zebra crossings, striping, pedestrian flashing signals etc would be provided.

Bus bays

Many of the bus stops are located close to major junctions and no recessed bus bays exist. There are instances when the buses are forced to stop in the middle of the road which then develop the queues behind the buses spilling back up to the junctions and disrupting the regular vehicular movement at the junction. This only worsens the traffic congestion problems in the area and creates unsafe driving conditions. It is recommended that the bus stops be moved to at least 60 meters away from the junction and wherever carriageway width permits to provide a bus lay by.

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One-way operations

One way road operations are very helpful in increasing the roadway capacity and reducing the

intersection conflicts paving the way for reduced delay to traffic and increased safety. For successful one-way operations availability of complementary parallel roads are essential.

Signal coordination & optimization

When properly used, traffic control signals are valuable devices for the control of vehicular and pedestrian traffic. They assign the right-of-way to the various traffic movements and thereby profoundly influence traffic flow. Traffic control signals that are properly designed, located, operated, and maintained will have many advantages. Traffic signal type, spacing, phasing, offsets should be optimized for all modes of traffic on all mobility corridors to ensure a speedy throughput. Where possible actuated (demand response) traffic signals must be provided.

Junction Improvement & Redesign

Road intersections present safety problems as accident rates are usually higher at intersections than at other sections of the road. Many factors affect accident occurrence at intersections, including traffic volume, traffic control, and frequency of access points, the number of legs, the speed limit, the median type and width, the number of traffic lanes, the existence of turn lanes, and the lighting level, as well as human factors. As such it is very critical that the intersections be properly designed. Junction improvement involves among other the following elements:

- Closure of medians at certain intersections
- Prohibition of right turns
- Providing adequate corner radii
- Providing sufficient turning radii
- Flaring approaches towards intersections
- Providing channelizers / division islands
- Providing signs / lane markings / lighting

Pavement Markings and Signage

In general, it was observed that the traffic signs are found wanting in Pune. It is recommended that proper signs be installed at appropriate locations. Road signs are classified into three categories: Mandatory/Regulatory signs, Cautionary/Warning signs, and informatory signs. It is recommended that signs near schools should be installed on priority basis. Traffic control devices such as: Center line, Traffic lane lines, Stop lines, Pedestrian crossings, Parking space limits, Kerb marking for visibility, Obstruction marking etc. must be provided keeping in view all users of the road and especially for night time driving. All the traffic signs should be facilitated as per the guidelines provided in IRC publication 67-2001.

On-Street Parking Management

Wherever feasible the open drains must be covered using stone slabs and be used for parking where pedestrian activity is less. Vehicles should never be allowed to park within 50 meters of a major intersection. In central areas parking should not be permitted on two-way carriageways

which are less than about 5.75 meters wide and on one-ways which are less than 4 meters wide. Buses, Commercial vehicles and other vehicles must not be allowed to park on mobility corridors within the city limits for most parts of the day. Where feasible on-street parking on mobility corridors from congested sections be shifted to vicinity cross roads.

Encroachment & Hawker Management

These hawker encroachments are hindrance to the movement of people and also reduction to the capacity of the roadways. The pedestrians are forced to walk on the carriageway at these locations of encroachments, thereby creating hazardous situations for both themselves and the traffic. In this regard, the Consultants have proposed "Hawker Zones" aimed at decongesting main roads in Pune, while at the same time, protecting the interests of street hawkers.

Accordingly, three types of zones are proposed for Pune to regularize the street vending operations: Green, Amber & Red zones.

Green Zone: The areas / Roadways marked as 'Green Zones' will allow hawkers to do their business at all the times at the specified locations without any restrictions. The locations around the market areas generally are designated as Green Zones.

Amber Zone: The areas that come under Amber zone have some restrictions for the vendors and hawkers. These restrictions could either be by time of the day, or by the day of the week. On the times/days specified, hawkers could not be allowed to do their trade, standing on the street. On all other times, vending is allowed at designated areas.

Red Zone: As the name itself suggests, hawking/vending are not allowed at these designated areas at any time. The zones identified as Red Zones will always prohibit hawkers. All the busy corridors of the town, will come under the cover of Red Zone, and hence, are hawker-free zones.

Accordingly, the Municipal officials in consultations with the traders and the developers of the city have to come up with a hawking zone plan. Different hawking zones need to be identified and the proposals have to be enforced stringently.

Safety

Poor road geometry and inadequate street lighting along with limited road space and lack of traffic sense both to drivers and pedestrians increase the incidence of accidents. Mainly they are caused due to the casual approach of the road users towards driving rules, safety precautions, and regulations. The following short term alternatives may be considered for implementation by the city to improve the safety of the commuters:

Black spots must be identified along the major roads and specific improvements must be proposed at those locations. A Road Accident Analysis System based on the accident database must be

implemented for accurate reporting and use in geometric improvements.

- All speed breakers and humps be marked and signed adequately for night time visibility
- All traffic signages be made retro reflective
- Create traffic safety patrol programs for student volunteers at all schools
- Install minimum pavement markings such as lane lines, median lines, stop bar, fog line, parking stalls/bays etc on all radial arterials and other major sub arterials.
- Ensure that adequate street lighting is provided on all collectors, sub-arterials, and arterials

Education & Enforcement

Overall awareness of the traffic discipline and compliance with the traffic rules by road users in Pune is much below the desired level. At present, Traffic Police in Pune will have to offer positive leadership in this direction to make people responsible and rule abiding road users. Special traffic drives are to be planned by them for making the public aware of the traffic rules. Also imposing fines at the spot procedure for defaulters may be reviewed in view of large backlog of pending traffic offence cases. Periodic road safety public campaigns including exhibitions, lectures and film shows are also necessary for road user education in Pune. The Road Safety programs should be aimed principally at adult road users and serve three main purposes:

- To inform the public of new regulations or changes to the traffic regulation system
- To influence the attitudes towards road safety
- To persuade road users to change their behavior in relation to identified causal factors in road accidents

The aforementioned traffic management measures are normally easy to implement, requires no land acquisition and not costly. The traffic management measures must be implemented at least on the following locations:

- Mobility Corridors
- Core Area
- Swargate and Vicinity
- Railway Station and Vicinity
- Shivajinagar Bus Station and Vicinity

8.1.3 Public Transport Plan for Pune City

One of the strategies identified as part of the vision is to increase the public transport trips (cumulative of road, rail and water modes but excluding IPT) to 80%. The existing level as estimated from consultants surveys is about 18% (Earlier studies indicated this share about 20-22%). For this purposes various technology alternatives in public transport are being considered. The alternate scenarios considered are:

- Do Nothing
- Augment PMPML Bus System
- PMPML Bus System + BRT
- PMPML Bus System + BRT + Ring corridors
- PMPML Bus System + BRT + Ring Corridors + High Capacity System (LRT/Metro/MonoRail etc)

Do Nothing Scenario

This scenario assumes that no major improvements are anticipated. The changes contemplated will be limited to most minimal improvement options such as providing bus shelters etc. The company and school buses would continue to run as is where is but no improvement is assumed. The existing urban transport model is used to simulate the traffic characteristics under this scenario and the results are shown in **Table 8.1**.

It may be seen that as anticipated the public transport modal share reduces from the current level of 17% to 10% under this scenario. Consequently this scenario is untenable and other public transport improvements are necessary.

Augment PMPML Bus Fleet Scenario

One of the easiest and quicker ways of increasing the public transport trips is by bus fleet augmentation. Before any serious public transport corridor plan is proposed it is important to utilize and upgrade the existing bus based mixed traffic public transport. As part of this scenario, PMPML, will be required to increase the existing bus fleet with most likely additional routes as well. The services offered would be through a variety of bus sizes suitable for various segments and services with or without ITS applications.

The 2007 existing fleet size of the PMPML is approximately 1330 buses out of which approximately 360 buses are considered not road worthy. PMPML has been expanding fleet size but nominally due to financial constraints. A Bus Transport Supply Index (buses per lakh of population) of approximately 50 is suggested during the stakeholder discussions and the same has been accepted by the PMC. The existing index is 28. Based on the proposed index PMPML would require a fleet of at least 1750 buses. This mean that the additional fleet requirement is approximately ~ 850 Buses.

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The existing urban transport model is used to simulate the traffic characteristics under this scenario and the results are shown in **Table 8.2**. It may be seen that as anticipated the public transport modal share increases from the Do Nothing level of 10% to 18% under this scenario. However the forecasted modal share is still short of the goal of 80%. It is imperative that additional strategies are required to significantly increase the public transport modal share.

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Table 8.1: Travel Characteristics under Do nothing Scenario

Trips assigned for Pune (Peak hour)	797705
Trips assigned-Tw (Peak hour)	462088 (58%)
Trips assigned-Car (Peak hour)	148675 (19%)
Trips assigned -Auto(Peak hour)	105321 (13%)
Trips assigned-PT (Peak hour)	81621 (10%)
Average Network Speed	10 Kms/hr
Average Trip Length	10.4 Km
Passenger Km (Daily)	99,553,584 Passkm
Passenger Hour (Daily)	9,955,358 Passhrs
Vehicle Km (Daily)	46,154,637 Vehkm
Vehicle Hour (Daily)	4,615,464 Vehhrs

Table 8.2: Travel Characteristics under Augmentation of PMPML Buses Scenario

Trips assigned for Pune (Peak hour)	797715
Trips assigned-Tw (Peak hour)	421333 (53%)
Trips assigned-Car (Peak hour)	135562 (17%)
Trips assigned -Auto(Peak hour)	96032 (12%)
Trips assigned-PT (Peak hour)	144778 (18%)
Average Network Speed	15 Kms/hr
Average Trip Length	10.4 Km
Passenger Km (Daily)	99,553,584 Passkm
Passenger Hour (Daily)	6,636,906 Passhrs
Vehicle Km (Daily)	42,303,415 Vehkm
Vehicle Hour (Daily)	2,820,228 Vehhrs

BRT Based Public Transport Plan

One of the successful ways of increasing the public transport trips in addition to the fleet augmentation is to increase the speed and capacity of the public transportation system by way of dedicated public transport corridors. A public transport corridor is an alignment mostly on existing transport network system either at grade or grade separated with dedicated carriageway to carry public transport trips. The forecasted model is used to designate and size the public transport corridors in terms of the carrying capacity requirements. The traffic flows of the corridors, desired line data, future growth centers and the transport model were used to identify various "public transport corridors".

PMC's BRTS Report (Network Development for BRT for Pune City under the Scheme of JNNURM – Main Report, July 2006) identifies 21 corridors/routes for BRTS, based on among others, earlier studies and some fresh surveys. Various parameters such ROW, present PMPML ridership etc are considered in the determination of the routes. The 21 routes thus identified, adding up to about 97.5 km in length are listed in **Table 8.3** and shown in **Figure 8.2.** This project was accorded an "in-principle" approval by the JNNURM Central Sanctioning and Monitoring Committee in their meeting held on August 11, 2006.

Subsequently CIRT has also developed a Draft BRTS Master Plan which are also shown in **Table 8.3**.

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Over and above the fleet augmentation, the BRTS corridors developed by CIRT/PMC are assumed for implementation and the urban transport model is used to forecast the travel characteristics under this

scenario the results of which are shown in **Table 8.4**.

The final BRT routes adopted for the purposes of CMP are shown in **Table 8.3**.

Introducing the adopted BRTS into the transport system in addition to the fleet augmentation does increase the public transport share to 60%.

Table 8.3: Identified BRT Routes

Name of Corridor	PMC	CIRT	WSA
	Length (kms)	Length (kms)	Length (kms)
Satara Road	5.5	5.5	5.5
Solapur Road	7.7	7.7	7.7
Yerwada to Vishranthwadi Road	4.5	4.5	4.5
Ahmednagar Road	5.2	5.4	5.4
Sinhagadh Road	7.2	7.2	7.2
Airport Road	2.2	2.2	2.2
Mundhwa bypass	2.8	2.8	2.8
Bairoba Magarpatta Road	3.3	3.3	3.3
L.B. Shastri Road	1.4	1.4	1.4
Karve Road	6.4	6.4	6.4
J.M. Road	2.3	2.3	2.3
Sanagawadi – Kharadi IT Park	4.5	4.5	4.5
Paud Road	4.6	4.4	4.4
Old Mumbai Road	5.5	5.7	5.7
Yerwada- Bhairoba nala	4.2	4.7	4.7
Baner Road	3.2	3.2	3.2
Vishranthwadi – Dhanori Road	6	6	6
Shivaji Road	3.3	3.3	3.3
Nehru Road	5	5	5
Bajirao Road	2.3	2.3	2.3
Shivane – Sangamwadi Road	10.4	10.4	10.4
Ganeshkhind Road	_	3	3
Bibewadi Road	_	3.2	3.2
Saswad Road	_	2.6	2.6
Pashan Road	_	5.4	5.4

Name of Corridor	PMC	CIRT	WSA
	Length (kms)	Length (kms)	Length (kms)
Kondhwa Road	_	5.4	5.4
Vishranthwadi- Airport	_	_	2.2
Total	**97.5**	**117.8**	**120**

Table 8.4: Travel Characteristics under BRT based Public Transport

Trips assigned for Pune (Peak hour)	790955
Trips assigned-Tw (Peak hour)	212358 (27%)
Trips assigned-Car (Peak hour)	72722 (9%)
Trips assigned -Auto(Peak hour)	29654 (4%)
Trips assigned-PT (Peak hour)	476221 (60%)
Average Network Speed	28 Kms/hr
Average Trip Length	14.1 Km
Passenger Km (Daily)	133,829,586 Passkm
Passenger Hour (Daily)	4,779,628 Passhrs
Vehicle Km (Daily)	30,034,609 Vehkm
Vehicle Hour (Daily)	1,072,665 Vehhrs

BRT and Ring Corridors Based Public Transport Plan

In addition to the BRT corridors the following three circumferential corridors are considered for implementation:

- Core Area Inner Ring (No Construction)
- HCMTR (New Construction)
- Westerly & Easterly Bypass Road (New Construction)

Core Area Ring: This ring is developed by existing roads that form a closed loop. Core Area Inner Ring assumes implantation of the BRT on all the parts of the core area ring as well as traffic management solutions detailed in the previous section.

HCMTR: This ring of 24m is proposed by the current DP based on the RITES study. Some sections of the HCMTR are existing roads, while some are sections of the drain. Most sections are land designated for the purposes of the corridor but yet to be formed. Consequently the HCMTR alignment as shown in the DP is taken in entirety as a ring corridor. Any other form of alignment would require land acquisition that is too prohibitive considering the financial and social constraints. The alignment shown is not a closed loop but with the utilization of existing roads and road widening the loop can be a closed alignment.

Deleted: As most of the land designated by the HCMTR is already dedicated for such purpose

Deleted: The DP has proposed a land strip of 30m for the purposes of this alignment.

Westerly & Easterly Bypass: As shown in the existing traffic characteristics chapter there is a significant external-to-external trips that can be bypassable. Currently the NH-4 bypass acts as westerly bypass ring. The easterly bypass/ring is not existent. This scenario considers the construction of

easterly bypass. An optional westerly bypass further west of the NH-4 bypass must also be envisaged as the current NH4 bypass is likely to see increased developments along the road. PMC has already identified the land required for the easterly bypass. MSRDC has indicated, rightly so, that the easterly bypass when fully constructed would encircle both Pune city as well as Pimpri Chinchward.

Over and above the previous scenario, the ring roads are assumed for implementation and the urban transport model was used to forecast the travel characteristics under this scenario the results of which are shown in **Table 8.5**. Introducing the ring corridors into the system in addition to the BRTS Corridors does increase the public transport share to 65%.

The DP also proposed that the proposed 24m land strip would be entirely used for public transport purposes. Based on the ridership forecast the HCMTR ring is likely to have a system that can carry pphpd of 15,000 – 25,000. Should an elevated system (e.g. mono-rail type of system) be ultimately adopted for the HCMTR ring as a result of TEFS, then the at-grade carriageway may be used for personalized vehicles. As discussed in the network strategy, a ring corridor with mixed traffic would eliminate traffic going through the core area thereby decongesting the core area.

Deleted: The DP proposed HCMTR for public transport traffic only and did not anticipate personalized modes, though segregated, in addition to public transport modes.

Deleted: The CMP will continue to plan that the HCMTR would not allow personalized modes on this corridor. Where the corridor runs on existing road sections an elevated corridor is envisaged for purposes of HCMTR.

Table 8.5: Travel Characteristics under BRTS and Ring road based Public Transport plan

Trips assigned for Pune (Peak hour)	791015
Trips assigned-Tw (Peak hour)	185142 (23%)
Trips assigned-Car (Peak hour)	65679 (8%)
Trips assigned -Auto(Peak hour)	29074 (4%)
Trips assigned-PT (Peak hour)	511120 (65%)
Average Network Speed	30 Kms/hr
Average Trip Length	13.4 Km
Passenger Km (Daily)	127,195,212 Passkm
Passenger Hour (Daily)	4,239,840 Passhrs
Vehicle Km (Daily)	25,533,550 Vehkm
Vehicle Hour (Daily)	851,118 Vehhrs

BRT and Ring Corridors and High Speed High Capacity Mass Transit System Plan

In addition to the Ring and BRT corridors possible High Capacity & High Speed Mass Transit System such as LRT/Metro/Monorail etc are assumed for implementation on appropriate corridors. The criteria for selecting the corridors are:

- Public Transport PPHPD,
- Total trips,
- Right of Way,
- Mobility Corridor,
- Connectivity to growth centers,
- Connectivity to Pimpri Chinchward, &
- Proximity to Core Area.

Based on the above parameters the following corridors qualify for the introduction of MTS systems:

- NH-4 (Old Mumbai Pune Highway)
- Ganeshkhind-Aundh Rawat Road (New Mumbai Pune Highway)
- Karve Road
- Nagar Road
- Jangli Maharaj / F.C. Road

Currently the local trains running on the Central Railway line between Pune and Pimpri Chinchward also provide an alternative way of public transport. However the existing railway line and station capacity does not accommodate the forecasted trips within the existing ROW. There is a proposal to add additional line to the pune-mumbai section. It is also expected that a dedicated freight corridor is expected between Mumbai-Chennai section. Increasing the existing frequency and routing certain PMPML buses will certainly increase the modal share carried by local trains. However the additional capacity will not be able to meet the public transport demand requirements between Pune and Pimpri. Unless exclusive used for LRT operations during peak hours, the existing railway line cannot eliminate the need for a road based public transport corridor. This would require relocation of the long distance railway line.

Deleted: Using the railway ROW for

A TEFS considering performing capacity, geometric constrains, capital & operating costs, alternative analysis etc. would determine the final alignment and technology of the corridor. **Table 8.6** shows the comparison of different types of transit systems that may be considered for the study area. The urban transport model was used to forecast the travel characteristics under this MRTS scenario the results of which are shown in **Table 8.7**. Introducing the MRTS in addition to the BRTS & Ring Corridors does increase the public transport share significantly and the increases up to approximately 69%. It may however be noted that this share still is short of the goal of 80%. The gap in the public transport share is to be covered by way of Traffic Demand Management measures such as Parking Controls & Fees, Cordon Pricing, Staggered Work Hours, and Taxes etc.

Table 8.6: Summary of Comparisons of different types of Transit Systems

Transit Mode	Commuter Rail	Metro	Monorail /AGT	LRT	BRT
ROW Options	Exclusive ROW General railroad Mixed traffic	Exclusive ROW Grade separated	Exclusive ROW Grade separated	Exclusive ROW Semi-exclusive Mixed traffic lanes	Exclusive ROW Semi-exclusive Mixed traffic lanes
Station Spacing	2 to 10 miles	1 mile	½ to 1 mile	½ to 1 mile	¼ to 1 mile
Vehicles	Locomotive with set of passenger coaches	High platform cars operating in multiple	High platform cars operating in multiple car trains sets, electric	Articulated, double articulated low floor, can operate	Standard, articulated or double articulated, low floor or high

		car trains sets	propulsion	in multiple car sets, electric propulsion	platform, diesel, diesel/hybrid propulsion or ETB
Seated Capacity	90-185 per car	60-80 per car	30-75 per car	65-85 per car	40 standard 65 articulated 85 double art.
Average Speed	25 to 45 mph (40-70 kmph)	15 – 35 mph (25-55 kmph)	15 – 25 mph (25-40 kmph)	15 – 30 mph (25-50 kmph)	15 – 30 mph (25-50 kmph)
Passenger throughput	Up to 7,500 PPHPD	Up to 60,000 PPHPD	Up to 25,000 PPHPD	Up to 30,000 PPHPD (Elevated LRT)	Up to 150000 PPHPD
Min. Curve Radius	50m	40m	20m – AGT 75m - MRL	25m	13m
App O & M Cost per km	40-60 lakh	100-200 lakh	40-60 lakh - MRL	50-60 lakh	-
App Capital Cost per km (2005 Rates)	80-100 crores	200 crores	40-50 crores	80 crores	15 crores
Implemented Cities(International)	Moscow, Jakarta, Johannesburg, Buenos Aires	Bangkok, Kuala Lampur, Mexico City, Cairo	Tokyo, Kuala Lampur, Sydney, Seattle	Hongkong, Shanghai, Kuala Lampur	Istanbul, Taipei, Leeds, Bogota, Curitiba, Pittsburgh, Adelaide
Implemented Cities (India)	Mumbai, Chennai, Kolkota, Hyderabad	Delhi, Chennai	-	Kolkota	Ahmedabad, Indore, Pune

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Table 8.7: Travel Characteristics under MRTS Scenario

Trips assigned for Pune (Peak hour)	780427
Trips assigned-Tw (Peak hour)	153990 (20%)
Trips assigned-Car (Peak hour)	51676 (7%)
Trips assigned -Auto(Peak hour)	33675 (4%)
Trips assigned-PT (Peak hour)	541086 (69%)
Average Network Speed	31 Kms/hr
Average Trip Length	13.8 Km
Passenger Km (Daily)	129,238,711Passkm
Passenger Hour (Daily)	4,168,991 Passhrs
Vehicle Km (Daily)	22,596,460 Vehkm
Vehicle Hour (Daily)	728,918 Vehhrs

There are other complimentary projects/proposals that must be implemented in tandem to the public transport corridors towards a successful public transport system that meets the objectives and goals of the mobility plan:

- Augmentation and strengthening of feeder service network
- Integrate parking with public transit terminals by way of park and ride structures
- Identify and local multi modal terminals for safe, faster and convenient inter-modal transfers
- Appropriate vehicle and terminal design
- Safe, faster and convenient pedestrian dispersal system
- Bicycle access to the public transport terminals
- Rationalize existing bus routes in light of the public transport corridors
- Public transport friendly tax structure
- Use of Intelligent Transport System (ITS) technology
- Signal prioritization public transport vehicles

It is important that the above mentioned actions must not be treated in isolation but a systems approach be adopted.

The potential public transport corridors for 2011, 2021 and 2031 are shown **in Figure 8.3, Figure 8.4,** and **Figure 8.5** respectively. These corridors would carry various rapid public transport systems such as BRT, Mono Rail, LRT, Metro etc.

8.1.4 Non Motorized Plan

Install Footpaths

Walking is healthy, cheap and effective mode of transportation for shorter trips. Most of the motorized trips begins and ends in walking. A significant portion of the study area trips (~ 22%) are made completely by walk. Sidewalks have valuable community benefits. To encourage and cater to walking trips footpaths must be installed on all roads without any exception. The following is suggested for the installation of footpath:

- A minimum usable width of 1.5meters should be provided for footpath.
- It is desirable to have a footpath width of 2.0meter for all roads.
- Where possible obstructions on footpath must be relocated
- Footpath design must discourage two wheelers using the footpath during periods of congestion
- A all signalized intersections pedestrian zebra crossings must be clearly marked
- Footpaths at all busy intersection must be provided with handrails to enforce pedestrians cross at zebra crossings

Install Pedestrian Grade Separated Facilities

It is very essential that pedestrians are dispersed from public transportation systems safely onto footpaths. If dedicated carriageway is provided for public transport, the method of dispersal must take into consideration the bus stop location. If the center lane of carriage way is dedicated for public

transportation grade separated pedestrian crossing facilities must be provided for bus-stops located away from major intersections.

In addition to these situations grade separated pedestrian crossing facilities must be located on mobility corridors and near pedestrian intensive land uses after completion of a TEFS. A review of the past studies and pedestrian crossing demand was utilized in identifying prima facie a few selective locations (refer to **Figure 8.6**) where grade-separated crossing facilities are warranted.

Install Bi-cycle Lanes

Cycling is healthy and effective mode of transportation for many commuters in Pune. Several trips exceeding a trip length of 3-4KM are made through bi-cycle. A significant portion of the study area trips (~ 11%) are made completely by cycling. To encourage and cater to cycling trips dedicated bi-cycle lanes must be provided on strategic locations. The cycle lane must be continuous and form a network.

As part of the Master Plan of the BRT, submitted by CIRT and IIT-Delhi, a cycle network has been prepared for the Pune city. A review and study of the network indicates that it is continuous and forms a network connecting all the important destinations of the core city as well as the rest of the Pune city.

The cycle lanes are provided on all roads that have high share of bi-cycle traffic as well as on those roads that constitutes the draw area for the proposed public transport corridors. This network must be integrated along with public transport network improvements. The cycle master plan layout is shown in **Figure 8.7**. It is recommended that this network be implemented.

Encourage and Designate Pedestrianisation in Core Area

The core area with its array of high density retail and commercial uses and narrow streets is wells suited for pedestrianization. Converting a street or an area to car-free use is called pedestrianisation. Well-designed and placed public spaces can enliven an area. M.G. Road in the city is already being made as a Pedestrian Plaza on Sundays. One of the pedestrian busy streets in core area is Laxmi road as can be seen from the pedestrian survey results. Similarly the surrounding roads also have very high pedestrian volumes. On an experimental basis vehicles may be banned on Laxmi Road and adjoining streets (within 50m to 200m) from 8 am to 8 pm, effectively turning an area of approximately about 0.5~1.0 square kilometers into a vehicle-free zone to ease the chronic air pollution and traffic jams thatplague the old city. International experience shows that despite the initial resistance and acceptance, pedestrianisation often improved the businesses and economy of the area in addition to the social benefits. If the ban proves successful, it could become permanent and extended.

The implementation must take into confidence the public and affected retail entities. The pedestrianisation must also include design of appropriate parking plazas, as well as alternative circulation strategies. A detailed traffic study must be prepared considering the impacts as well as the alternative routes and traffic routing plan. The area selected for pedestrianization is shown in Figure 8.8.

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8.1.5 Passenger & Commercial Terminal Plan

Bus Terminals

PMPML have 5 depots from which city buses are operated to various parts of Pune. Out of the existing terminals, the Swargate and Shivajinagar bus stations are located in very congested environs. Station area traffic improvement schemes (STATIS) must be implemented for all the stations but more specifically for the two stations. STATIS must include the traffic management improvements discussed earlier.

It is very important that the bus stations are conveniently and quickly accessible by public transport and NMT. Currently the terminals run public buses to various parts of Pune and surrounding areas. The Swargate junction is one of the busiest intersections in Pune. The public transport and NMT master plan suggested by the PMT shows that the terminals will continues to have faster and convenient connectivity through alternate modes of transport system on the approach roads of Swargate Junction. It is also suggested that the Swargate terminal have inter-modal terminal with provision for park-and-ride system. Any potential grade separation at Swargate junction must consider the alternative modes of public transport and inter-modal terminal.

There are currently significant private inter state buses plying through the city. Many of them are seen parked on the city roads for lack of dedicated parking facilities. At the time of locating and designing the intermodal transfer terminals, the parking for private buses must be integrated with the intermodal terminals.

Pune Railway Station

PMPML buses also run to the railway station in old city. The Railway and PMC officials have recently improved the traffic operations of station road and vicinity of the railway station. However, the terminal and vicinity still is very congested due to hawkers, heavy traffic among other reasons. Through traffic from Shivajinagar towards Bundgarden and Nagar Road are currently forced to go through the station area and vicinity causing needless traffic on the roads. The proposed east-west alignment connecting Karve Road to Nagar Road directly through the Sangam is likely to remove by at least 10% of the through traffic from the station area roads. STATIS schemes must also be implemented for the railway station. It is expected that an intermodal terminal would be located at the Sangam and due to the proximity to the railway station the sangam terminal must be connected to railway station.

Airport

Based on the public transport master plan under the CMP the existing airport is connected with bus based rapid transport in the interim. One of the potential locations for a new international airport for Pune city is identified as Chakan towards Nasik. Based on the experience with the Bangalore and Hyderabad airport controversies, connectivity to Chakan airport must be well planned and integrated into the airport development.

Nasik Rd would provide primary connectivity to the potential airport. Nasik Rd-Alandi Rd, Nasik Rd-

NH4, & Nasik Rd-Ring Rd must be developed as alternate airport transport connectors. The public transport corridor along NH-4 must extend along Nasik Road up to the potential airport using preferably a high speed Rail/Road based system for a fast, convenient and safe transport to the airport.

Truck Terminal

There currently is no truck terminal on the proposed easterly bypass or on roads that form sections of the bypass. With the implementation of the bypass it is essential that truck terminals accommodating the parking and other needs of commercial vehicles are built at suitable locations along the easterly bypass. A review of the past studies and discussions with PMC identified prima facie a few selective locations (refer to **Figure 8.9**) where truck terminals may be located. The truck terminals also serve as job-growth and economic catalyst for the area. Other expected benefits of the terminal are a reduction in truck traffic on city roads and roads in the vicinity of core area and market yards.

One of the main problems with the Pune city is that lot of activities are all clustered together in old city and vicinity. One of the solutions for the problem would be to relocate some of the activity centres to less congested areas. It is suggested that the existing goods market at Railway Station & Market Yard are relocated. The relocation must consider the potential truck terminals as they can be integrated.

8.1.6 Flyover & Bridges Plan

Junctions and Bridges are the major sources for bottlenecks in the transportation system. As traffic increases on major roads to improve safety and provide orderly movement of vehicles traffic signals would be warranted. Junctions that satisfy the IRC traffic signal warrants must be installed preferably with demand responsive traffic signals. As traffic delays continue to increase at junctions the following traffic management measures must be considered before any major improvements:

- Reduction of number of phases
- Restriction of right turns. The restricted right turn traffic must suitably be rerouted through indirect right turns or U-turns etc.
- Widening the intersection throat to increase the approach capacity
- Coordinating with traffic signals on adjacent intersections using ITS technology
- Installation of medians and closing the cross street to divert traffic to other high capacity intersections if feasible

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Since auto ownership will not come down immediately in a developing economy, highly congested junctions would continue to witness large delays and traffic jams even after trying the above mentioned traffic management measures. Such critical intersections can be potential candidates for capacity augmentation by way of grade separation of one or more traffic movements. In the case of bridges capacity augmentation can be done by improving those bridges. Intersection grade separation may be considered under the following situations:

- Low cost traffic management measures have been tried but not effective
- A TEFS has been prepared by a professional and competitive agency
- The grade separation reduces the pollution and junction delays for the overall corridor and more importantly for public transport commuters
- The fly over design must take into consideration the comprehensive plan for the corridor including public transport systems

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A review of the past studies and discussions with various implementing agencies and available traffic data identified prima facie a few selective locations (refer to **Figure 8.10**) where such grade separated facilities may be located.

8.1.7 Traffic Demand Management Plan

The improved public transportation and associated improvements to the study area would substantially shift the travel patterns of the study area. Results from the travel demand model indicate that after implementing the public transport corridors and the other necessary proposals public transport share of the trips would increase to approximately 60-65% of the motorized trips.

To further increase in public transport modal shares additional demand management interventions are necessary:

- Corridor Densification
- Limited availability of parking as well as high parking fees
- Congestion charges

Corridor Densification Plan

The Development Plan must anticipate the increase in value of land due to the public transport investments and must capture the land value. The DP for the study area must orient itself towards densifying the proposed public transport corridors and vicinity to improve the ridership. Consequently the land use structure and regulations must be corridor based. Increase FSI on the public transport corridors and additional FSI may be sold at market value.

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Parking Management Plan

Presently most of the roads in Pune city are having free on-street parking. Parking control is important from many considerations including the following:

- Control the personalized vehicles plying in the system
- Potential to augment and facilitate the public transport corridor Ridership
- Loss in the throughput of the adjacent street due to parking interference
- Consolidation of the on-street parking
- Gain/Loss of the business of the commercial uses on the street

- Revenue generation potential through parking charges
- Facilitate pedestrianisation policy through locating parking in the vicinity of vehicle free roads.

CMP proposals such as Mobility Corridor Development, Public Transport Corridors and Terminals, etc require that parking be suitably be integrated and managed for their successful implementation.

As part of the principles upon which the CMP is being developed, it is envisaged that strategic parking plazas would be developed and integrated with the other CMP elements. The parking structures, either isolated or integrated with the public transport terminals, should meet some or all of the following requirements before implementation:

- The parking plaza must discourage other commercial uses in the same premises
- The parking plaza must facilitate public transport
- The parking plaza must facilitate non-motorized transport
- The parking plaza should off-set removal of on-street parking
- The parking plaza should improve the traffic circulation of the vicinity

Parking structures in the core city area included in the DP must be implemented and integrated with the public transport and NMT proposals.

Parking plaza locations for other areas and roads must be based on a TEFS. Capacity and Parking Pricing of the parking plaza must consider the prevailing parking policy of the study area. Parking Pricing may be implemented as a Parking Management Strategy (reduce parking problems), Transport Demand Management (TDM) strategy (to reduce vehicle volumes), to recover facility costs or for a combination of these strategies. It is anticipated that the pricing must emphasise TDM also Parking Management Strategy may be an interim policy.

Pricing and the method must be convenient, transparent and fair. The pricing strategy must be used to improve consumers' Transportation Choices. Real time information on parking prices, availability and transportation alternatives must be made.

The prevailing parking policy must be taken into account before the parking pricing is implemented.

Road Pricing

Congestion charges refers to variable tolls, with higher prices under congested conditions and lower prices under less congested conditions, intended to reduce peak-period traffic volumes to optimal levels. The objective of congested pricing is to reduce peak period vehicle traffic and facilitate a shift to sustainable modes of transport or to other times.

With the improved public and non-motorized transport, land use interventions, parking and congestion pricing the study area can expect a public transport share of about 80% fulfilling the vision of the CMP.

8.1.8 Road Maintenance and Management Plan

Despite best efforts of concerned authorities aimed at improving the urban road network the roads continue to exist below desired standards. However urban roads could be maintained and managed at a very high level of serviceability using modern techniques of Road Maintenance Management System (RMMS), supported be a systematic Road Information System (RIS). This will help to evaluate the existing condition of the roads and to suggest needed improvement measures for the roads so that cost-effective modern technologies can be used to provide higher level of serviceability by applying regular and timely maintenance.

RMMS is a tool to facilitate the road network asset management at rural and urban levels within the study area. As an asset management tool, RMMS require a strong data base (Road Information System) to be collected, maintained and managed scientifically by using the latest techniques like GIS. RMMS is characterized by:

- Creation of a database on road inventory, road condition, traffic, geographic data, demographic and socio-economic parameters;
- Finalization of performance standards for necessary maintenance activities;
- Create the cost data base in respect of various regions for the network;
- Data base on budgetary support available for maintenance;
- Design a maintenance model to make predictions with respect to short, medium and long-term frames
- Generate various scenarios of maintenance within the given constraints of funding and predict the level of service achieved within these constraints
- Priorities the investment needs
- Ensure the available recourses are put into optimum use, and
- Centralized outputs of the proposed maintenance management system to decide the state level planning, prioritization and optimization for network

The overall CMP Plan for the Pune City and the Core Area are shown in **Figure 8.11** & **Figure 8.12** respectively.

8.2 Institutional Framework for Pune Metropolitan Region

The NUTP in its Para 37 under Legal and Administrative Issues recommend that Unified Metropolitan Transport Authorities (UMTA) is to be setup in all million plus cities:

"The current structure of governance for the transport sector is not equipped to deal with the problems of urban transport. These structures were put in place well before the problems of urban transport began to surface in India and hence do not provide for the right co-ordination mechanisms to deal with urban transport. The Central Government will, therefore, recommend the setting up of Unified Metropolitan Transport Authorities (UMTA's) in all million plus cities, to facilitate more coordinated planning and implementation of urban transport programs and projects and an integrated management of urban transport systems. Such Metropolitan Transport Authorities would need statutory backing in order to be meaningful."

Accordingly in December 2007 the Maharastra government has setup Pune Metropolitan Transport Authority (PMTA). It has been proposed that the State Urban Development Secretary will head the PMTA. Representatives from two municipal bodies and three cantonment boards along with those from the transport sectors - road, rail and water - will be made members. Representatives from bodies such as MSRDC and various state departments from the traffic and transport sectors too are likely to be part of PMTA.

PMTA will coordinate with various agencies - central and state government departments, Pune Municipal Corporation (PMC), Pimpri Chinchwad Municipal Corporation (PCMC) and the three cantonment boards. Planning will be done across the boundaries of the urban areas within the metropolitan region.

PMTA may be entrusted with the following functions:

- Strategic Regional and Transportation Planning
- Investment, Management and Operations Policy Planning
- System/Corridor Planning
- Financial Planning
- Long and Short-Term Priority Setting, Decision Making for Investment and Operating Subsidies
- Infrastructure Project Implementation
- Service and Operations Regulation
- e and Operations Management
- Service Provision and Operations

The purview of PMTA is expected to include the following urban transport entities:

- Bus Transport system
- Rapid Transport System

- Inland Water Transport
- Existing and Proposed Airport
- Roads, Bridges and Highways
- us, Railway and Truck Terminals
- Parking
- Pedestrian and bi-cycle transport

While PMTA is a governmental agency, it is suggested that the setup must made in a manner such that PMTA operates like an efficient business corporation that plans and conduct the functions in an independent manner without the uncertainties arising from changing political controls and policies. PMTA may be made to generate and manage its own revenues so that it is not dependent on the state legislatures for appropriations.

The Regional Traffic Authority is expected to continue to exist and its role would be to mostly act as a regulatory body. A schematic of the institutional setup is shown in **Figure 8.13.**

Until the proposed PMRTA is setup and fully functional PMPML must consider the following improvements in the interim:

- A BRT Cell must be created within the PMPML to cater specifically to the BRTS and its operations
- An organizational appraisal study considering the organisational structure, manpower skill, recruitment and purchasing procedures etc must be prepared by a professional consultant and the recommendations must be implemented

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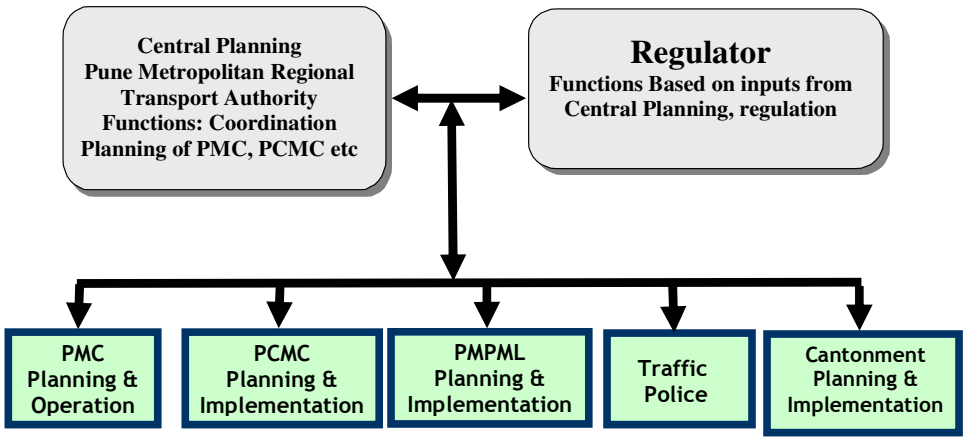

Figure 8.13: Institutional Setup