NIT
SINCE 1936
Nagpur Improvement Trust

Comprehensive Mobility Plan for Nagpur

Final Report

December 2013

Urban Mass Transit Company Limited

COMPREHENSIVE MOBILITY PLAN
FOR
NAGPUR

Final Report

December 2013

Prepared by: Shripad Vaikar
Reviewed by: N Seshadri
Drawings: Suneer Vazhayil
Formatting: Ajith Kumar

Contents

Page No.

Executive Summary i

Chapter 1 Study Background 1
1.1 Background 1
1.2 Need for Comprehensive Mobility Plan 1
1.3 Objectives and Scope of the Study 2
1.4 Approach 3
1.5 Literature Review 4
1.6 Summary of Final Report 6

Chapter 2 Study Area Profile 7
2.1 Introduction 7
2.2 City Background 8
2.3 Study Area Definition 8
2.4 Climate 10
2.5 Demographics 10
2.6 Landuse 11
2.7 Urban Form 13
2.8 Economic Base of Nagpur 15
2.9 Transportation Systems 17
2.10 Road Network Characteristics and Parking 19
2.11 Vehicle Registration Data 20
2.12 Traffic Safety and Enforcement (Accident Data) 21
2.13 Existing Bus Transport System in Nagpur 21
2.14 Institutional Setup 23
2.15 Observed Key Transportation Deficiencies 23

Chapter 3 Primary Surveys - Data Collection 26

Chapter 4 Data Analysis 44
4.1 Screen line Volume Count / Outer Cordon Volume Count Survey 44
4.2 Bus Stop / Rail Passenger Volume Count 56
4.3 Pedestrian Volume Count 59
4.4 Speed and Delay Survey 60
4.5 Road Side Interview Survey 60
4.6 Household Interview 63
4.7 Turning Volume Count Survey 65
4.8 Road Inventory Survey 67
4.9 Cyclist Opinion survey 72
4.10 Truck Operator Survey 75
4.11 Parking Survey 76
4.12 IPT Operator Survey 87
4.13 Bus Occupancy Survey 88
4.14 Major Survey Findings: 91
4.15 Summary Table: 93

Chapter 5 Service Level Benchmarks 94
5.1 Introduction 94
5.2 Need for Benchmarking for Nagpur 94
5.3 Performance Bench Marks for Urban Transport 94
5.4 Computation of Indices 96

Chapter 7 Vision, Goals and Objectives 126
7.1 Vision Statement 126
7.2 Mobility Pillars 126

7.3 Goals 127
7.4 National Mission on Sustainable Habitat (NMSH) 129
7.5 Benchmarks and Scenarios 132

Chapter 8 Transport Strategies 134
8.1 Mobility Corridor Strategy 134
8.2 Land Use and Transport Strategy 138
8.3 Public Transit Strategy 142
8.4 Non-Motorized Transport Strategy 150
8.5 Freight Management Strategy 153
8.6 Parking Strategy 154
8.7 Traffic Engineering and Management Measures 154
8.8 Travel Demand Management 156

Chapter 9 Project Proposals and Impacts 157
9.1 Public Transport Proposals 157
9.2 Non Motorized Transport Proposals 163
9.3 Proposals for Freight Management 168
9.4 Parking Proposals 169
9.5 Traffic Engineering and Management Proposals 170
9.6 Short, Medium and Long Term Improvements 175
9.7 Anticipated Impact of Proposed Projects 176
9.8 Social Impact 176
9.9 Environmental impacts 177
9.10 Location Impacts 180
9.11 Construction Impacts 180
9.12 Operation Impacts 181
9.13 Disaster Management 181
9.14 Public Participation 183

Chapter 10 Implementation Plan 184
10.1 Project Costing 184
10.2 Financing Options 186
10.3 Sources of Finance 190
10.4 Revenue Estimation (Fare Box) 191

Chapter 11 Institutional Framework 192
11.1 Background 192
11.2 City Level Unified Metropolitan Transport Authority 192
11.3 Broad Functions of UMTA 194
11.4 Legal backing of UMTA 194
11.5 Manpower Requirement and Staffing Plan 195
11.6 Urban Transport Fund 195
11.7 Implementing Agencies 196

Annexure 1 Junction Count Diagrams 197

Annexure 2 Population and Employment Projections 230

Annexure 3 List of NMC Proposals 236

Annexure 4 Project Profiles 240

Annexure 5 Stakeholders' Meet and Compliance Note 262

Tables

Page No.

Table 2.1a: Census Data 1921 to 2011 10
Table 2.1b: Proposed landuse analysis of sanctioned development plan 12
Table 2.2: Nagpur Workforce Participation Rate 15
Table 2.3: MIHAN Project details 16
Table 2.4: Road Network Characteristics and Parking 20
Table 2.5: Motor Vehicles Population as on 31st March 2012 20
Table 2.6: Accident Data Nagpur 21
Table 2.7: Bus Operation Details in Nagpur 22
Table 3.1: Summary Table - List of Surveys 43
Table 4.1: PCU factors adopted for the study 44
Table 4.2: Traffic Observed at Screen-line Locations 44
Table 4.3: Peak Hour Traffic at Screenline Locations 46
Table 4.4a: Peak Hour Traffic Composition (number of Veh) at screen line locations 47
Table 4.4b: Peak Hour Traffic Composition (in Veh %) at screen line locations 49
Table 4.5: Day Traffic at Outer Cordon Locations 53
Table 4.6: Peak Hour Traffic at Outer Cordon Locations 53
Table 4.7a: Peak Hour Traffic Composition (vehicles) at Outer Cordon Locations 54
Table 4.7b: Peak Hour Traffic Composition (%vehicles) at Outer Cordon Locations 54
Table 4.8: Analysis for Internal and External trips at outer cordon 55
Table 4.9: Bus Passenger In and Out Count at Nagpur S.T. Stand (12hrs) 57
Table 4.10: Bus Passenger In and Out Count at M.P. Bus Stand (12hrs) 57
Table 4.11: Bus Passenger In and Out Count at Bardi Bus Terminal (12hrs) 57
Table 4.12: In and out Passenger Count at Nagpur City Railway station 58
Table 4.13: In and out Passenger Count at Itwari Railway station 58
Table 4.14: In and out Passenger Count at Ajni Railway station 58
Table 4.15: Pedestrian Volume Count Summary-12 Hrs and Peak Hour 59
Table 4.16: Observed Journey Speed in Peak Hour (Km/Hr) 60
Table 4.17: Outer Cordon- Trip Frequency 61
Table 4.18: Purpose of journey on Cordon Points 61
Table 4.19: Average Occupancy by Vehicle Type on Cordon Points 62
Table 4.20: Trip Frequency 63
Table 4.21: Trip Purpose – Goods Vehicles 63
Table 4.22: Distribution of Household by size 64
Table 4.23: Distribution of Households by Income Level 64
Table 4.24: Average Vehicle ownership 64
Table 4.25: Average Mode wise Trip Length 64
Table 4.26: Mode Share 65
Table 4.27: Traffic Volumes at Intersections 66
Table 4.28: Carriageway Types 67
Table 4.29: Availability of Median 68
Table 4.30: Availability of Footpath 68
Table 4.31: Trip length Distribution – Cyclists 73
Table 4.32: Average Maintenance Cost 74
Table 4.33: Problems while riding a bi-cycle 74
Table 4.34: Trip Frequency 75
Table 4.35: PCE Values Adopted for Various Vehicle Types 76
Table 4.36: Peak Hour and Maximum PCE at on-street survey locations 77
Table 4.37: Types of vehicles parked (Towards Subhash Nagar) 77
Table 4.38: Types of vehicles parked on Abhyankar Road (Towards NH4) 78
Table 4.39: Types of vehicles parked at Central Avenue Road (Towards Ring Road) 78
Table 4.40: Types of vehicles parked at Central Avenue Road (Towards Station) 79
Table 4.41: Types of vehicles parked 79
Table 4.42: Types of vehicles parked 80
Table 4.43: Types of vehicles parked (LHS) 80
Table 4.44: Types of vehicles parked 81
Table 4.45: Types of vehicles parked (LHS) 81
Table 4.46: Types of vehicles parked (RHS) 82
Table 4.47: Types of vehicles parked (Towards Market area) 82
Table 4.48: Types of vehicles parked (Towards Market Gate) 83

Table 4.49: Types of vehicles parked (Towards Pardi) 83
Table 4.50: Types of vehicles parked (Towards Itwari) 84
Table 4.51: Types of vehicles parked (Towards Sadar) 84
Table 4.52: Types of vehicles parked (Towards Wardha Road) 85
Table 4.53: Types of vehicles parked (Towards Airport) 85
Table 4.54: Types of vehicles parked (Towards Sitabuldi) 86
Table 4.55: Types of vehicles parked (Towards High Court) 86
Table 4.56: Types of vehicles parked (Towards Shankar Nagar) 87
Table 4.57: Age of the Vehicle 87
Table 4.58: Average annual maintenance cost (in Rupees) 88
Table 4.59: Average Salary of Driver 88
Table 4.60: Bus occupancy at Bhandara Road Screenline 88
Table 4.61: Bus occupancy at C.A. Road 88
Table 4.62: Bus occupancy at Kamptee Road 89
Table 4.63: Bus occupancy at Koradi Road 89
Table 4.64: Bus occupancy near Jagnade Chowk 89
Table 4.65: Bus occupancy near S.T. Bus Workshop 90
Table 4.66: Bus occupancy at Shivangaon Phata (NH 7) 90
Table 4.67: Bus occupancy at Peatri 90
Table 4.68: Summary Table 93
Table 5.1: Reference Table for Computing Overall Level of PT Facilities 98
Table 5.2: Reference Table for Computing Overall Level of Infrastructure Facilities 100
Table 5.3: Reference Table for Computing Overall Level of NMT Facilities 101
Table 5.4: Reference Table for Computing Overall Level of ITS Facilities 102
Table 5.5: Reference Table for Computing Overall Level of Travel Speed 105
Table 5.6: Reference Table for Computing Overall Level of Parking Space 106
Table 5.7: Reference Table for Computing Overall Level of Road Safety 107
Table 5.8: Reference Table for Computing Overall Pollution Level 108
Table 5.9 Reference Table for Computing Overall Level Integration for Landuse and Transport System 110
Table 5.10 Reference Table for Computing Overall Level Financial Sustainability 111
Table 6.1: Summary of Estimated Base Year (2012) Peak hour Travel Demand 114
Table 6.2: Base Year Observed OD Validation on Outer Cordon 117
Table 6.3: Highway validation- Screen line locations 118
Table 6.4: Population and Employment – 2012 118
Table 6.5: Trip End Model 118
Table 6.6: Calibrated Parameters 119
Table 6.7 Base year Travel Characteristics 119
Table 6.8: Base Year (2012) Transport Characteristics on Major roads 120
Table 6.9: Population Forecast by various Methods 123
Table 6.10 Estimated Population Year wise for Nagpur City Limits (Within Outer Ring Road) 123
Table 6.11: Population projections in study area (NMA) 124
Table 6.12: Estimated Employment in the study area (NMA) 124
Table 6.13: Summary of Forecasted Peak Hour Passenger Demand (2032) 124
Table 6.14: Travel Characteristics (Year 2032) 125
Table 6.15: Major Road Traffic Forecasts – 2032 Do Nothing Scenario 125
Table 6.16: Comparison of Travel characteristics 125
Table 7.1: Benchmarks and Targets 132
Table 8.1 Proposed Mobility Corridors in Nagpur 135
Table 8.2: Benefits of TOD: Case Study 140
Table 8.3: Fleet Estimation Scenario -1 144
Table 8.4: Base Year Passenger Loading / Bus/Day 144
Table 8.5: Share of Shared Auto 144
Table 8.6a: Base Year Fleet Estimation based on public transport demand (Occupancy 45) 145
Table 8.6b Base Year Fleet Estimation based on public transport demand (Occupancy 65) 145
Table 8.7: Horizon Year Passenger Loading / Bus/Day 145
Table 8.8: Horizon Year Fleet Estimation based on public transport demand (Occupancy 65) 146
Table 8.9: Shared Auto Rickshaw Trips in 2032 146
Table 8.10: Selection Criteria for Higher Order PT System 147
Table 8.11: PPHPD on major corridors in Nagpur for Year 2032 148
Table 8.12: Traffic Engineering and Management measures 155
Table 8.13: TDM Strategies 156
Table 9.1: Recommended Bus Augmentations 157

Table 9.2a: LRT Corridors: Proposed Alignment and PPHPD 157
Table 9.2b Light Rail Transit System Corridors – Stage-1 157
Table 9.2c Light Rail Transit System Corridors – Stage-2 (Extension Part of Stage -1 LRT corridors) 158
Table 9.3a: Proposed Alignment for BRT corridors and PPHPD 158
Table 9.3b: Bus Rapid Transit System Stage-1 158
Table 9.3c: Bus Rapid Transit System Stage-2 159
Table 9.4: Corridors eligible for developing cycle track network 164
Table 9.5: Location for major docking station 166
Table 9.6: Location for sub docking station 166
Table 9.7: Proposed off street parking locations 169
Table 9.8: Removal of encroachment 174
Table 9.9: Network capacity improvement plan 175
Table 9.10: Short, Medium and Long Term Improvements 176
Table 9.11: Anticipated Impact of Proposed Projects 176
Table 9.12: Project Impacts 177
Table 9.13 Environmental impacts of important projects 178
Table 10.1: Phase wise Costing of the CMP Projects 185
Table 10.2: Sharing of Funding 190
Table 10.3: Revenue Estimates (Fare Box Revenue) 191
Table 11-1: Details of Implementing Agencies 196

Figures

Page No.

Figure 1.1 Comprehensive Mobility Plan Objectives 2
Figure 2.1: CMP Study Area 9
Figure 2.2: Decadal Population Growth 10
Figure 2.3: Population Growth Trend with Impact of MIHAN and IT Development 11
Figure 2.4: Land Use Pattern for Developed Land 11
Figure 2.5: Existing Landuse Plan Nagpur 12
Figure 2.6: Rail Links in Nagpur 13
Figure 2.7: South – North Rail Link 14
Figure 2.8: Revised DP Plan Nagpur 14
Figure 2.9: Road Network in the Study Area 18
Figure 2.10: Rail Network in the Study Area 19
Figure 2.11: Bus Route Network Map 22
Figure 2.12: Nagpur City Bus Service 23
Figure 2.13: Existing Road Infrastructure in Nagpur (Station Road and Buldi Area) 24
Figure 2.14 Congested Core Areas 24
Figure 2.15 Trucks Parked on Amravati Road and Raipur Road 25
Figure 3.1: Network for Inventory Survey 27
Figure 3.2: Map indicating Screen Line Locations in Nagpur 29
Figure 3.3 Intersection Turning Volume Count Location Map 31
Figure 3.4: Network selected for Speed and Delay Survey in Nagpur 33
Figure 3.5: Outer Cordon Survey Location Map 35
Figure 3.6(a): Bus Terminal Survey – Location Map 40
Figure 3.6(b): Rail Terminal Survey – Location Map 41
Figure 4.1: Passenger trips across the Screenline 52
Figure 4.2 Desire line diagram for Truck movement (Base Year) 55
Figure 4.3: Internal and External Trips in Nagpur 56
Figure 4.4: Pedestrian Volume (Daily and Peak Hour) 59
Figure 4.5: Journey speeds on major corridors 60
Figure 4.6: Average Trip Frequency Distribution 61
Figure 4.7: Average Trip Purpose Distribution 62
Figure 4.8: Average Occupancy at Outer Cordon 62
Figure 4.9: All Mode Share and Motorized Mode Share 65
Figure 4.10: Carriage way types 68
Figure 4.11: Right of way availability 68
Figure 4.12: Encroachments 69

Figure 4.13: Encroachment near Agrasen Chowk 69
Figure 4.14: Encroachment near Railway Station - Parked LCV 70
Figure 4.15: Encroachments near Mandai 70
Figure 4.16: Private Buses Parked Buses near MSRTC Bus Stand Area 71
Figure 4.17: Presence of Road Markings 71
Figure 4.18: Presence of signboards 71
Figure 4.19: Trip length Distribution – Cyclists 73
Figure 4.20: Trip Purpose – Cyclists 73
Figure 4.21: Trip Frequency - Cyclists 74
Figure 4.22: Necessity of separate Cycle – track 75
Figure 4.23: Types of commodities 75
Figure 4.24: Classification of Parking Duration (Towards Subhash Nagar) 77
Figure 4.25: Classification of Parking Duration – (Towards NH4) 78
Figure 4.26: Classification of Parking Duration - Towards Ring Road 78
Figure 4.27: Classification of Parking Duration - Central Avenue Road (Towards Station) 79
Figure 4.28: Classification of Parking Duration 79
Figure 4.29: Classification of Parking Duration 80
Figure 4.30: Classification of Parking Duration (LHS) 80
Figure 4.31: Classification of Parking Duration (RHS) 81
Figure 4.32: Classification of Parking Duration (LHS) 81
Figure 4.33: Classification of Parking Duration (RHS) 82
Figure 4.34: Classification of Parking Duration (Towards Market area) 82
Figure 4.35: Classification of Parking Duration (Towards Market Gate) 83
Figure 4.36: Classification of Parking Duration (Towards Pardi) 83
Figure 4.37: Classification of Parking Duration (Towards Itwari) 84
Figure 4.38: Classification of Parking Duration (Towards Sadar) 84
Figure 4.39: Classification of Parking Duration (Towards Wardha Road) 85
Figure 4.40: Classification of Parking Duration (Towards Airport) 85
Figure 4.41: Classification of Parking Duration (Towards Sitabuldi) 86
Figure 4.42: Classification of Parking Duration (Towards High Court) 86
Figure 4.43: Classification of Parking Duration (Towards Shankar Nagar) 87
Figure 5.1: Load Factor Distributions 98
Figure 5.2: Distribution based on Journey Speed for Private Vehicles 103
Figure 5.3: Distribution based on Journey Speed for PT 104
Figure 6.1: Study area zoning 115
Figure 6.2: Base Year Study Area Road Network 116
Figure 6.3 Transit Network Maps in the Study Area 117
Figure 6.4: Desire line –Base year 119
Figure 6.5: Methodology for Travel Demand Forecast 120
Figure 6.6: Potential Areas for Future Growth 122
Figure 6.7: Population growth and Decadal growth Rate 123
Figure 7.1: Frame work for Mobility Planning 127
Figure 8.1a: Identified Mobility Corridors for Nagpur (Stage 1) 135
Figure 8.1b: Identified Mobility Corridors for Nagpur (Stage 2 up to Outer Ring Road) 136
Figure 8.2: Typical Cross Sections of Mobility Corridors for Transit Systems 137
Figure 8.3: Nagpur Growth Direction 138
Figure 8.4: Potential TOD Corridors 141
Figure 8.5: Present Catchment Area for PT (Bus) 142
Figure 8.6: Need of Bus Route Rationalization in Nagpur 143
Figure 8.7: Public Transport Strategy 143
Figure 8.8: PPHPD on major corridors in Nagpur (Year 2032) 149
Figure 8.9: Concept of Bike Sharing 152
Figure 8.10: Bike Sharing Examples 153
Figure 8.11: Freight Management Strategy 154
Figure 9.1a: Proposed corridors for higher order public transport systems (Stage-1 up to 2022) 159
Figure 9.1b: Extension of Proposed Corridors for higher order public transport system (Phase 2) 160
Figure 9.2: Proposed locations for TTMCs 161
Figure 9.3a: Transport Hub Option 1 : Existing Interstate Bus Stand 162
Figure 9.3b: Transport Hub Option 2: Patvardhan Park 163
Figure 9.4: Construction of footpaths 164
Figure 9.5: Proposed Cycle Track Network in Nagpur 165
Figure 9.6: Cycle Docking Stations 166

Figure 9.7: Walkway from MSRTC Bus Terminal to Nagpur Railway Station and Proposed Transport Hub at Patvardhan Ground 167
Figure 9.8: Areas recommended as Pedestrian Zones 168
Figure 9.9: Potential Locations for Truck Terminals 169
Figure 9.10: Off-Street parking locations on C.A. Road 170
Figure 9.11: Intersection improvement plan 171
Figure 10.1: Source of Finance 190
Figure 11:1: Recommended Structure for UMTA setup 193

List of Abbreviations

CBD: Central Business District
CDP: City Development Plan
CMP: Comprehensive Mobility Plan
ICT: Information and Communication Technology
IPT: Intermediate Public Transport
IRC: Indian Roads Congress
ITS: Intelligent Transportation System
LCV: Light Commercial Vehicle
LPA: Local Planning Area
MAV: Multi Axle Vehicle
MDR: Major District Roads
MIHAN: Multi-Modal International Hub Airport of Nagpur
MSRTC: Maharashtra State Road Transport Corporation
NH: National Highway
NIT: Nagpur Improvement Trust
NMA: Nagpur Metropolitan Area
NMC: Nagpur Municipal Corporation
NMT: Non Motorized Transport
NMV: Non Motorized Vehicle
NUTP: National Urban Transportation Policy
OD: Origin Destination
PCE: Passenger Car Equivalent
PCU: Passenger Car Unit
PPHPD: Passenger Per Hour Per Day
PT: Public Transport
PV: Private Vehicle
ROB: Road Over Bridge
RSI: Road side Interview
RTO: Regional Transport Office
SH: State Highway
TDM: Travel Demand Management
TT – Travel Time
TTMC: Traffic and Transit Management Centre
UMTA: Unified Metropolitan Transport Authority
WPR: Workforce Participation Rate

Executive Summary

Background

"Cities are the way that human societies have found convenient to create the division of labour necessary for the production of goods and services for human consumption" (Low, Gleeson, Green, & Radovic, 2005).

Inherent to the development of cities has been the need and development of transport systems which are necessary to make the goods and services (produced at a centre) available to the end user, and in most cases, a wide range of end users. Thus, Mobility (defined as the ability to move) and Accessibility (defined as the ease with which a person can access a particular service) have become two critical factors for the growth of an urban economy. While the provision of a good transport system serves the increasing demands of mobility, the existence of an efficient Land Use and Transport System ensures that the city is made accessible to its residents.

Increased interaction between various land uses, on account of increasing levels of urbanization and economic growth, has led to an unprecedented increase in the need for efficient transfer of people and goods. In case of developing countries with typically unplanned cities in the absence of sophisticated transport systems, the above phenomenon has brought planning for accessibility and mobility to the centre-stage of most urban economies. This has necessitated cities to plan for a system that enables the interaction between various land uses in an efficient, safe and sustainable manner. Thus, avoiding piece-meal measures to deal with issues of mobility and going for a holistic approach in solving mobility problems of cities are soon becoming a norm.

Need for Comprehensive Mobility Plan

To understand the need for a Comprehensive Mobility Plan, let us first look at the way transport problems emerge in a city, what dimensions they take, and the response generated from city authorities and the citizens.

Any unplanned city suffers primarily from a lack of a proper land use and transport system. Increasing urbanization leads to haphazard increase in travel demand. Till the time the city authorities realize and wake up to the fact, the urban citizen goes for the obvious option of personal mobility in the form of an automobile. This is again driven by the increasing prosperity brought on by increasing urbanization. All in all, the private vehicular ownership pattern of the city rises and its usage takes its toll on the urban transport system. Now, any urban transport system has five basic stakeholders: Consumers (the user of the system), Environment, City Authorities, the Producers/Manufacturers (the drivers of local urban economy) and the Region surrounding the city. Increasing usage of the automobile results primarily in congestion, that in turn creates varying dimensions of problems for different stakeholders of the system. The Consumer suffers from increased travel time. The urban environment suffers from pollution. The city authorities suffer from an inefficient usage of the transport system supply and face with the only prospect of increased investment on transport systems (which in most cases is to keep on increasing and widening the existing road network to alleviate congestion). Absence of suitable infrastructure and system for freight drives up the production cost of manufacturers. The region suffers from obstacles to regional traffic that has to invariably negotiate with the local urban traffic and congestion.

In this context, the Nagpur Improvement Trust (NIT) has awarded Urban Mass Transit Company Limited an assignment to carry out a Comprehensive Mobility Plan study by integrating land use and transport and come out with a plan for the safe and sustainable mobility needs of the people of Nagpur.

Objectives of the study

- To provide long-term vision(s) and goals for desirable urban development in Nagpur Metropolitan Region;
- To illustrate a basic plan for urban development and include a list of proposed urban land use and transport measures to be implemented within a time span of 20 years or more; and
- To ensure that the most appropriate, sustainable and cost-effective implementation program is undertaken in the urban transport sector.

Scope of Study

- Review past studies, reports and plans which are related to traffic and transportation issues in Nagpur city such as CDP, CTTS, Master Plan etc.
- Diagnose existing traffic and transportation system in the study area
- Perform traffic analyses based on the surveys conducted
- Suggest Short-term traffic improvements needed for Nagpur city
- Develop and validate the travel demand model for the study area
- Project travel demand in the study area for different horizon years
- Develop and evaluate various transport strategies
- Propose Medium-term and Long-term traffic improvement measures for Nagpur
- Provide Transport Investment Options and Implementation Plan
- Suggest Institutional Arrangement

Study Area

Nāgpur, "Orange City', is the winter capital of Maharashtra state, located in the central part of India. In fact, it is the geographical centre of India. Nagpur is the third largest city in Maharashtra state following Mumbai and Pune. As per census 2011, the city population was found to be 23,98,165

The CMP study generally is conducted for Local Planning Area (LPA) to provide mobility solutions comprehensively. However in Nagpur, the administration of urban development is under two domains viz. Nagpur Metropolitan Region (NMR) and the area under Nagpur Municipal Corporation (NMC – 145 wards).

For the study purpose, the area under NMC is important considering intensity of the mobility. However this needs to be addressed with the traffic impact made by rest of the metropolitan area. So NMC area along with the area within outer ring road is considered for providing various mobility development schemes but the impact of metropolitan region will be considered to formulate corresponding schemes. At present (April 2013), the part of outer ring road is still under construction; however the proposed alignment for the same is taken into account while conducting this study. The area outside Nagpur Metropolitan Region will be considered as a part of external zones.

Data collection and Survey Findings

The data required for traffic analysis and subsequent development of a four stage transport model was collected both from secondary and primary sources. The literature review was undertaken based on the available past studies, while the latest traffic data were collected through manual surveys. The summary of traffic survey analyses is presented below:

No	Content	Unit	Observation
1.	Peak Hour factor for passenger trips at screen line	Percentage	9.4
2.	Morning Peak Hour Timing	Hour	10:00 AM to 11:00 AM
3.	Average Occupancy for Two Wheeler	Passenger / vehicle	1.8
4.	Average Occupancy for Car	Passenger / vehicle	3.4
5	Average Occupancy for Auto including Share Auto	Passenger / vehicle	3.7
6	Average Occupancy for Auto including Share Taxi	Passenger / vehicle	4
7	Average household income	Rs /Month	19,600
8	Average household size	Family Members / Household	4.2
9	Average Monthly expenditure on transport	Rs /Month	2500
10	per capita trip rate	-	1.26
11	per capita trip rate (motorized)	-	0.95
12	Average trip length for cars	Km	6.87
13	Average trip length for two wheelers	Km	5.50
14	Average trip length for auto	Km	4.52
15	Average trip length for public transport	Km	9.40
16	Average distance travelled for cycle (from cyclist opinion survey)	km	3.87
17	Average travel time for cycle trip	Min	28
18	Mode Share for two Wheeler (motorized)	Percentage	65
19	Mode Share Car (motorized)	Percentage	13
20	Mode Share Auto (motorised)	Percentage	12
21	Mode Share by Bus (Motorised)	Percentage	10

Service Level Benchmarks

No	Bench mark	Level of Service	Inference as per MOUD Guidelines
1	Public Transport Facilities	21	The city has very poor Transport System which need considerable improvements in terms of supply of buses/ coaches and coverage, system quality. The system may require route rationalization and bus augmentation to improve the performance.
2	Pedestrian infrastructure facilities	8	The city has pedestrian facilities which may need some improvements at intersections, footpaths and street lighting as some parts of the city are not served by it. The system provided is otherwise comfortable and sustainable.
3	Non Motorised Transport Facilities	12	The city lacks adequate NMT facilities.
4	Level of usage of Intelligent Transport System(ITS) Facilities	20	The city lacks adequate ITS facilities.
5	Travel speed (Motorized and Mass transit)	4	Small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed
6	Availability of Parking places	8	The city authorities need to initiate immediate actions with respect of providing paid parking spaces and demand management for parking
7	Road safety	7	Level of Fatality rate in the city is very high
8	Pollution levels	5	Level of pollution in a city is very low
9	Integrated landuse Transport system	19	Faint coherence between city structure and public transport system.
10	Sustainability of public transport	9	The Public Transport of a city is financial not sustainable and needs considerable improvement

Travel Demand Forecast – Model Development

Household and roadside passenger interview data were used to develop the observed mode-wise trip matrices. The external trips for cars, two wheelers, autos, public transport and commercial vehicles were constructed based on the O-D survey conducted at the outer cordon. The mode wise matrices were developed for morning peak hour. From the primary surveys it has been observed that the morning peak is during 10:00 to 11:00. So the model was built for this duration. In total, 181 internal and 8 external zones were built in the network development of 1688 km. The model is validated across cordons and screen lines within a confidence range of +/-15%. The model was developed for three different scenarios:

- Do Nothing – Without Any Development
- Do Something – Considering Sanctioned Projects alone
- Do Everything
  a. Higher Order Mass Transit System with Do Something
  b. Route Rationalization + (a)
  c. Transit Oriented development + (b)

The results of Do-Nothing scenario are presented in the table below.

	Traffic characteristics 2012(Do Nothing)	Traffic characteristics 2032(Do Nothing)
Trips assigned (Peak hour)	329,995	606,608
Trips assigned-PV (Peak hour)	254,410 (77%)	517,952(86%)
Trips assigned –IPT (Peak hour)	43,339(13%)	57,157 (9%)
Trips assigned-PT (Peak hour)	32,246(10%)	31,499(5%)
Average Network Speed	27 Km/Hr	23 Km/Hr
Average Trip Length	PV- 5.86 Km PT- 9.10 Km	PV- 8.55 Km PT- 7.12 Km
Passenger Km (Peak Hour)	311,977 Pass-Km	224,272 Pass-Km
Passenger Hour (Peak Hour)	21,666 Pass-Hr	18,715 Pass-Hr
Vehicle Km (Peak Hour)	923,620	2637,856
Vehicle Hour (Peak Hour)	25,485	96,426
Emission	29.76 Ton/Day	69.37 Ton/Day

Vision

"To ensure that Nagpur will have a systematically planned urban transport system for the mobility of people and goods that is safe, efficient, economical and sustainable, which aims to support economic development while improving livability".

Goals

To ensure that Mobility solutions for Nagpur region that are sustainable and in conformity with sustainable mobility, following goals have been formulated:

Goal 1: Develop public transit system in conformity with the land use that is accessible, efficient and effective.

Goal 2: Ensure safety and mobility of Pedestrians and cyclist by designing streets and areas that make a more desirable, livable city for residents and visitors and support the public transport system.

Goal 3: Develop traffic and transport solutions that are economically and financially viable and environmentally sustainable for efficient and effective movement of people and goods

Goal 4: Develop a Parking Management System that reduces the demand for parking and need for private mode of transport and also facilitate organized parking for various types of vehicles.

Bench Marks and Targets

Index	Description	Formulation	Existing	Target
Average Speed of Network	Average running speed (kmph)	Average Running Speed for all vehicles	27	30
Modal Share of PT Motorized	Modal share	Public Transport Trips/Total Study Area Trips	10%	30%
Modal Share of NMT	Modal share	NMT Trips/Total Trips	25%	50%
Accessibility	Percentage of work trips with Travel Time <15min	(Work trips with Travel Time less than 15 min/ Total Trips)	8%	50%
Bus Supply (Nagpur City)	Buses per Lakh Population	(Bus Fleet in Nos.)/Population in Nos.)X100000	8	50
Walkabilty	Availability & Usability of Foot paths	(Footpath Length in Km /Road length in Km)x100	70%	100%
Cyclability	Availability & Usability of Cycle Tracks	(Cycle track Length in Km/Road length in Km)x100	0%	100%
Fatality (2012)	Fatal accidents	No of fatalities/lakh population	9.59	0

Urban mobility solutions cannot be evolved by a single source strategy. The mobility goals for Nagpur Metropolitan Region were addressed through a multipronged strategic approach.

Mobility Corridor Strategy and Proposal

As a part of this strategy, all important radial roads comprising Amravati Road, Higna Road, Wardha Road, Sadar Road, CA Road, Kamptee Road, Inner Ring Road are recommended as mobility corridors which will maximize throughput of people, focusing on mass transport and non-motorized traffic, rather than personal automobile traffic. In the first phase, 87.2 km of corridors can be developed as mobility corridors up to inner ring road. The corridors can then be extended up to outer ring road as part of the 2nd phase (58.7km).

Landuse and Transport Strategy and Proposal

The urban sprawl in Nagpur has taken place in almost all the directions; however, a greater thrust has been observed in urbanization of the South Western, Southern and South Eastern suburbs of the city. One of the strategies of integrating land use and transport is the consideration of Transit Oriented Development (TOD) strategy. This concept can be applied along the major identified mobility corridors (Figure E-1) that have the potential to carry higher order mass transit systems (Corridor 1: Kamptee Road to Wardha Road and Corridor 2: CA Road to HIngna Road).

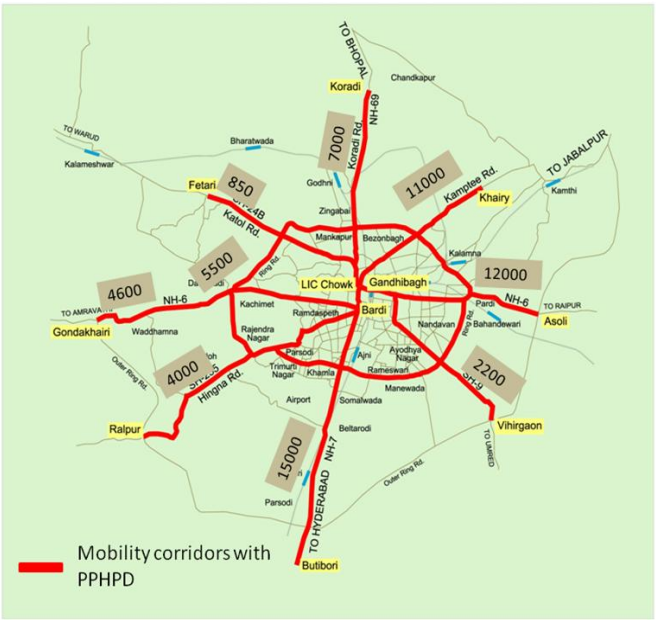


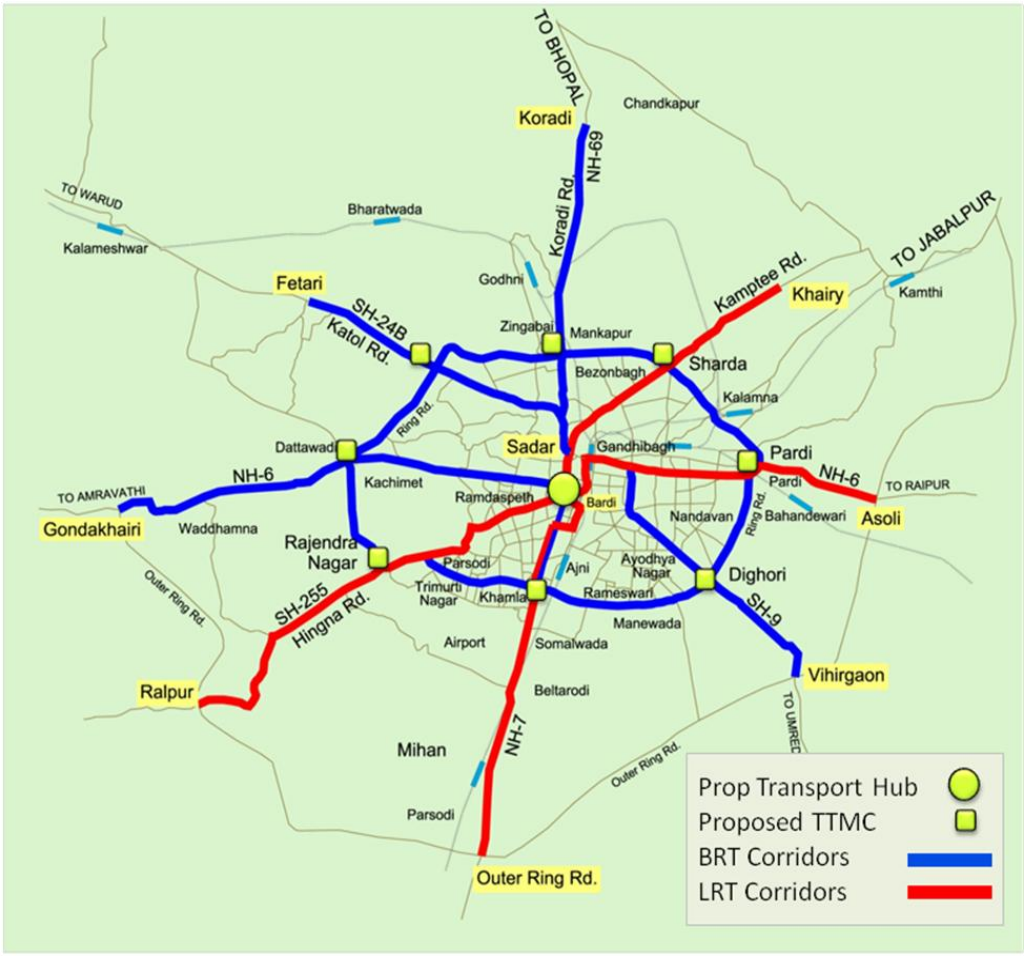
Figure E-1: Mobility Corridors

Public Transit Strategy and Proposal

One of the goals defined as part of the vision is to increase the public transport share to at least 30% from the existing 10%. For this purpose, we should consider augmentation of Buses and Route Rationalization, before embarking on other capital intensive system(s). At present in Nagpur, the

VNIL is operating city bus service with a fleet size of 170. The remaining 300 buses are idle and not on the road, which is a serious concern for the city.

Figure E-2: Mass Transit Systems



Based on the PPHPD (Passengers per Hour per Direction) values estimated from the transport model, Kamptee Road, CA Road, Wardha Road and Hinga Road are recommended for higher order rail based mass transit system. (ie. Light Rail System – 57.4 km) The remaining mobility corridors are recommended for developing a BRT (Bus Rapid Transit) network (102.5 km) which will support the LRT corridors as a feeder service. Patvardhan ground will act as a major interchange point and recommended as a Transport Hub (Figure E-2).

Non-Motorize Transport Strategy and Proposal

With the understanding of availability of footpath on major corridors, it was observed that nearly 87.2 km stretche of roadway comprising national and state highways, require pavement improvement. While focusing on the sustainable development in the city, we recommend that the corridors identified as mobility corridors in Nagpur should have cycle tracks on both sides of the road. Majority of the mobility corridors are recommended for dedicated cycle tracks on both sides of the roads. To promote NMT in the city, a Public Bike-Sharing scheme is also suggested, with docking stations proposed at all Transport and Traffic Management Centers (TTMCs). The NMT proposals also include elevated walkways between MSRTC Bus Terminal to Nagpur Railway Station and MSRTC Bus Terminal to Proposed Transport Hub at Patvardhan Ground. The approximate lengths of these two walkways are 1.9 km and 1.6 km respectively. Considering the heavy pedestrian

movement, areas like Sitabuldi, Mahal, Itwari and Sadar are recommended to be pedestrian only zones.

Figure E-3: Truck Terminals

Freight Management Strategy and Proposal

Locations near the junctions of Hyderabad Road, Amravati Road, Bhandara Road, Kamptee Road and Koradi Road with outer ring road are proposed for truck terminals (Figure E-3).

Parking Strategy and Proposal

Parking in Nagpur, especially in the core area, has become a serious concern and needs immediate attention. Because of the limited land availability for parking on ground, the existing public spaces like gardens can be considered for underground parking so as to serve dual purpose. The potential sites which can be considered for off-street parking are Gandhi Bagh, MSEB Park, Deshpande Garden, Near Raghvendra Swami Math (Shankar Nagar square), PWD land in front of NIT office. Apart from these locations, off-street parking might be considered at proposed TTMC locations.

Traffic Engineering and Management Strategy and Proposals

The traffic levels at main junctions like Shankar Nagar Chowk, Golibar Chowk, Indora Chowk, Chatrapati Chowk, Variety Chowk, Cotton Market Chowk, Ashok Chowk , RBI Chowk and Medical Chowk have already reached high in the range of 7000 to 9000 pcu during peak hour. The situation will become more critical within a year or two. Based on this, junction improvement plans can be considered as a part of short term improvement plan. As a part of traffic management stategy, it is also recommended to remove the encroachments on CA Road, Santra Market Road, Old bhandara Road etc. Almost 75% of surveyed network (approx 149 km) requires substantial improvements in providing proper sinages and markings.

Project Phasing: Short, Medium and Long Term Improvements

All the proposals are broadly grouped under three categories based on their usefulness. The usefulness of Long Term Improvements will last for more than 10-15 years; while for Medium Term Improvements, the usefulness will last for about 5-10 years. Short Term Improvements are the ones that need to be reviewed and revised within 5 years as per the need.

No	Projects	Total Cost (in Crores)	Phasing Rs (in Crores)		
			2013-2016	2017-2022	2023-2032
1	Short Term Projects : Road Markings/ Signage, Junction Improvements , Footpath, Elevated Walk way, cycle track, Provision of Pedestrian Zone, Removal of Encroachments / hawker Management / dismantling illegal development along mobility corridor	199.20	117.10	82.10	0.00
2	MediumTerm Projects : Bus Augmentation, Bus shelters, Off Street Parking, ITS, Rail Over Bridges, Truck Terminal, Transport Hub, TTMC, Bus Depot and Workshop, Bike Sharing Plan : Docking Station	1285.34	505.00	405.34	375.00
3	Long Term Projects : BRT and LRT Systems	10355.00	6476.00	1939.50	1939.50
			Total CMP Project Cost = 11839.54		

Anticipated Impact of Proposed Projects

Projects evolved in CMP will help to achieve sustainable development goals by means of reducing private mode share, emission levels and travel time. The anticipated impacts of proposed projects are presented in the table below.

Scenario	Private vehicle share (%)	IPT Share (%)	PT Share (%)	Average Trip length (PT) (km)	Emission in Tons /day	**Speed (in Kmph)
Base Year	77	13	10	9.30	29.76	27
Do Nothing -2031	86	9	5	7.12	69.37	19
Bus Augmentation	86	6	8	8.39	67.28	23
Bus Augmentation + Route Rationalization + Rapid Transit System	79	6	15	12.25	63.03	24
Bus Augmentation + Route Rationalization + Rapid Transit System + TOD	64	6	30	18.98	61.79	24

** For Nagpur City

Institutional Framework and Source of Funding

With a view to coordinate all urban transport activities in the city, it is recommended that an Urban Metropolitan Transport Authority (UMTA) be set up at the city level that acts as a planning and decision making body for all matters related to urban transport in the city. It is also recommended that the city level UMTA be set up on an executive order for the ease of formation, however, it must be given a legal backing so that its functioning falls under an act and commands greater authority. All other existing agencies need to work in tandem under the umbrella of UMTA. The umbrella agency shall have to avail the services of an expert team of traffic and transportation planners, engineers, urban planners and other technical advisers. In order to strengthen its human resource, UMTA shall have to form a schedule of officers and employees whom it shall deem it necessary and proper to maintain for the purposes of UMTA Act. In addition to this, various powers related to appointment, promotion, suspension, etc shall also have to be worked out as per the Government's schedule. Any local investment proposal that would require funding/part funding from the Local govt./State Govt. could be posed to the UTF for financial support.

Chapter 1
Study Background

1.1 Background

Recent rapid urban development in India has resulted in transport problems, such as traffic congestion and an increase in traffic accidents in all the cities/towns. Although the state governments and the local administrations have made substantial efforts to improve urban transport, problems have been exacerbated by the rapidly increasing number of private vehicles.

The existing local governments have limited capacity towards urban transport planning - specifically, the following problems are noted:

- One of the main planning issues is that most towns do not have a long-term comprehensive urban transport strategy. Accordingly, the proposals for specific projects are often not integrated with other urban transport measures or with land use patterns.
- Some cities have prepared urban transport master plans by conducting some Transport and Traffic Studies. However, these studies mainly focused on vehicle movements and did not pay enough attention to the mobility of people and goods.

It is important to prepare long-term strategic plans focused on mobility of people as a basis for developing cost-effective and equitable urban transport measures with an appropriate and consistent methodology, in line with the National Urban Transport Policy (NUTP). Accordingly, the Ministry of Urban Development (MoUD) encourages cities/towns to prepare "Comprehensive Mobility Plans" (CMPs) as part of long-term urban transport strategy providing for a sustainable improvement of people's mobility.

In this regard, Nagpur Improvement Trust (NIT) has awarded the study of Comprehensive Mobility Plan (CMP) preparation to Urban Mass Transit Company Limited (UMTC).

1.2 Need for Comprehensive Mobility Plan

To understand the need for a Comprehensive Mobility Plan, let us first look at the way transport problems emerge in a city, what dimensions they take the response generated from city authorities and the citizens and the problems generated from there.

Any unplanned city suffers primarily from a lack of a proper land use and transport system. Increasing urbanization leads to haphazard increase in travel demand. Till the time the city authorities realize and wake up to the fact, the urban citizen goes for the obvious option of personal mobility, in the form of an automobile. This is again driven by the increasing prosperity brought on by increasing urbanization. All in all, the private vehicular ownership pattern of the city rises and its usage takes its toll on the urban transport system. Now, any urban transport system has five basic stakeholders: Consumers (the user of the system), Environment, City Authorities, the Producers/Manufacturers (the drivers of local urban economy) and the Region surrounding the city. Increasing usage of the automobile results mainly in congestion, that creates varying dimensions of problems for different stakeholders of the system. The Consumer suffers from increased travel time. The urban environment suffers from pollution. The city authorities suffer from an inefficient usage of the transport

system supply and face with the only prospect of increased investment on transport systems (which in most cases goes on increasing and widening the existing road network to alleviate congestion). Absence of suitable infrastructure and system for freight drives up the production cost of manufacturers. The region suffers from obstacles to regional traffic that has to invariably negotiate with the local urban traffic and congestion.

To counter the above problem of congestion and its various dimensions, the city authorities resort to an increased supply of transport systems (in the form of roads or public transport corridors) on an as-and-when-needed basis. This leads to an increase in public investment on urban transport sector as well as an increased footprint of transport systems on the city. Increased footprint of transport systems, however, only leads to increased usage of the automobile, thus adding to overall congestion.

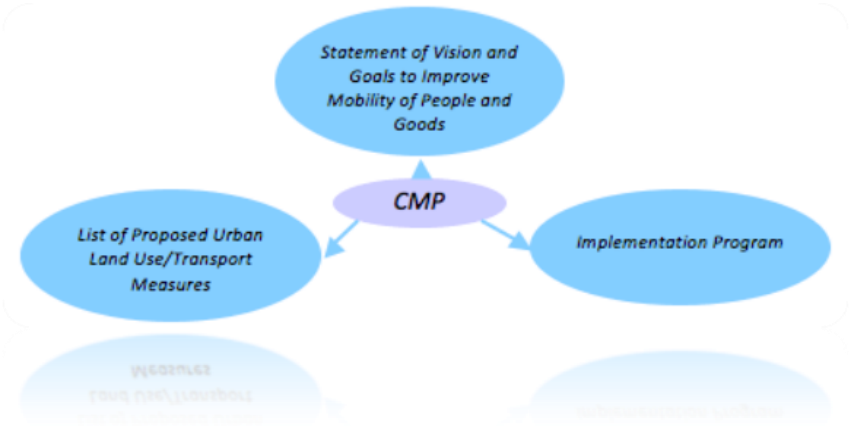
On the other hand, the supply-demand gap leads to proliferation of informal systems of transport – Intermediate Public Transport such as Autos and taxis, which further add to the traffic and congestion on roads. The production units opt for informal logistics systems. To accommodate regional traffic, bypasses at the city edge are provided, which in the absence of suitable land use control lead to development of undesirable nature along them.

1.3 Objectives and Scope of the Study

The ultimate objective of the CMP is to provide a long-term strategy for the desirable mobility pattern of the city's populace. To achieve this, the following are the main objectives:

- To provide a long-term vision(s) and goals for desirable urban development in Nagpur
- To illustrate a basic plan for urban development and include a list of proposed urban land use and transport measures to be implemented within a time span of 20 years or more; and
- To ensure that the most appropriate, sustainable and cost-effective implementation program is undertaken in the urban transport sector.

Figure 1.1 Comprehensive Mobility Plan Objectives



Besides these, we, while preparing the CMP in accordance with the Comprehensive Mobility Plan Guidelines/Toolkit published by the MoUD, will also focus on the following objectives:

- A study of Service Level Benchmarks as per MoUD's Handbook on Service Level Benchmarks for Urban Transport

- Study on Sustainable Habitat Mission for the city to make habitat sustainable through modal shift to public transport, as per National Mission on Sustainable Habitat. Besides, we look in to the possibility of enhancing the NMT programs to make the sustainable habitat an integral part of the planning process.

Scope of the study can be summarized as below:

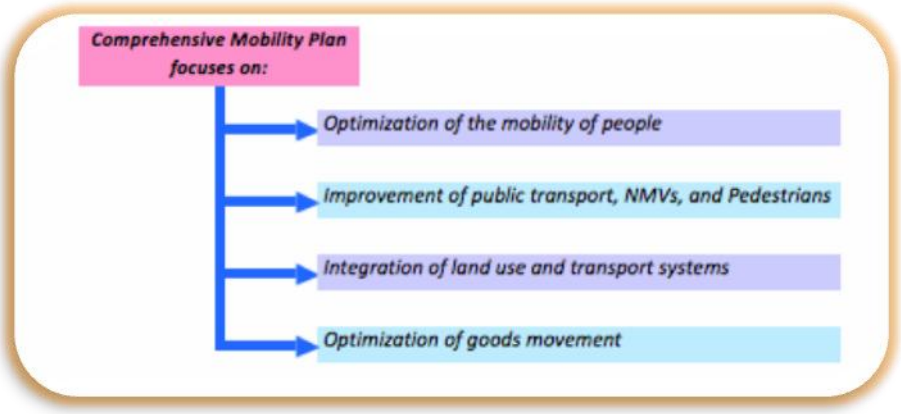
- Review past studies, reports and plans which are related to traffic and transportation issues in Nagpur city such as CDP, CTTS, Master Plan etc.
- Diagnose existing traffic and transportation system in the study area
- Perform traffic analyses based on the surveys conducted
- Suggest Short-term traffic improvements needed for Nagpur city
- Develop and validate the travel demand model for the study area
- Project travel demand in the study area for different horizon years
- Develop and evaluate various transport strategies
- Propose Medium-term and Long-term traffic improvement measures for Nagpur
- Provide Transport Investment Options and Implementation Plan
- Suggest Institutional Arrangement
- Conclusions and Recommendations on transport strategy

1.4 Approach

Our approach in conducting the CMP for Nagpur Metropolitan Area (NMA) will be in accordance with the National Urban Transport Policy Guidelines suggested by the Ministry of Urban Development (MoUD) for doing so. Accordingly, our focus will be on the following:

- To optimize the "mobility pattern of people and goods" rather than of vehicles;
- To focus on the improvement and promotion of public transport, Non-motorized vehicles (NMVs) and pedestrians, as important transport modes in the city;
- To provide a recognized and effective platform for integrating land use and transport planning; and
- To focus on the optimization of goods movement.

Figure 1.2 Comprehensive Mobility Plan Approach



Focus on the mobility of people rather than that of vehicles: Conventional urban transport plans focus on addressing issues relating to vehicles and often recommend extensive infrastructure development such as road networks and flyovers. The improvement of vehicle flows in this approach, however, is often achieved though decreased mobility of pedestrians, NMV and public transport users. Consequently, mobility of people as a whole has not been appropriately addressed. On the other hand, we focus on mobility of people to address urban transport problems, to promote better use of existing infrastructure, improvement of public transport, pedestrian and NMV facilities. We also emphasize integration of land use and transport development.

Focus on improvement and promotion of public transport, NMVs and pedestrians as important city transport modes: Promotion of the use of public transport, NMVs and pedestrians is vital for improving the mobility of people in urban areas. Public transport and NMVs are widely recognized internationally as environmentally friendly transport means and should be promoted to reduce the rate of increase in the number of vehicles.

Focus on integrating land use and transport planning: Since land use patterns directly influence travel patterns, it is essential to examine desirable land use patterns in the study area from the viewpoint of urban transport development. For instance, commercial and residential area development should be integrated with mass transit development, in pursuit of transit-oriented development, reducing dependence on private vehicles. Hence, our approach is towards the integration of land use planning and urban transport planning.

Recommend an urban transport strategy that is in line with the National Urban Transport Policy (NUTP): Since the NUTP is the upper-level strategy on urban transport development, we will pursue the concept of the NUTP, contribute to introducing NUTP strategy into the study town and propose specific measures to realize the NUTP concept.

1.5 Literature Review

We have done a review of the available past studies carried out for Nagpur that are related to traffic and transportation including the Master Plan. The gist of some of the important documents reviewed is presented in this section.

1.5.1 City Development Plan (CDP 2007)

The CDP study highlighted the need for efficient infrastructure development in Nagpur which can make city eco-friendly. The population trends of Nagpur city have shown a declining growth rate over the decades; it has decreased from 48.3% in 1921-31 to 32.6% in 1991-2001. Based on the linear projection method, the study suggested that the growth rate may decline to 22.2% in the next three decades (2021-31). But, considering the development projects and investments in the pipeline, Nagpur's growth rate may revive and the population may double at a faster pace. Nagpur needs to plan for its infrastructure accordingly. Few traffic and transport related specific suggestions are given below:

- Study also mentioned the requirement of transport network to be made complete in terms of hierarchy and accessibility, for efficient movement of traffic. In order to control the growth of private modes in the traffic stream, the city needs an efficient public transport system.
- Study suggested to develop a high frequency mini-bus based transport system sustained by eco-friendly fuels. NMC should explore the possibility of fully taking over the operation license from MSRTC. It can even explore the possibility of private participation in the operations. A specific traffic management plan should be designed for problem areas and junctions. Signals, signage and marking also need to be upgraded.
- Considering the population and spread of the city, the existing public transportation system is highly inadequate.
- Development of parking plazas should get priority in development. Facilities for pedestrians such as footpaths, railings and refuge islands at medians also need to be improved.

1.5.2 Master Plan / Perspective Plan for Transportation System of Nagpur City 2031

The study was conducted by Nagpur Municipal Corporation in 2007 -08 and highlighted may traffic and transport related issues in Nagpur. The study recommended Sadar Market, Sitabuldi, Dharmapeth, Itwari and Mahal area for immediate short term improvements comprising traffic area improvement schemes. The relocation of busy market areas such as Santra Market, Cotton Market and M. Phule market is necessary for smoothing traffic in core area. It was also proposed to construct truck terminals on important entry points of the city as a part of medium term improvements. The study identified the need for formulating parking policy for Nagpur. In longer term, the study recommends to increase public transport share for reducing air pollution which can be also supported by NMT services.

1.5.3 Review of Environmental conditions

As a part of comprehensive study, it is a need to understand the share of vehicular pollution in total pollution levels of the city. Central Pollution Control Board (CPCB) is the department that keeps track of emission levels in Nagpur at 5 locations in the city viz. NEERI, MIDC, Polytechnic College, Maskasath and Institution of Engineers. The review of CPCB report (Dec. 2007) revealed that the pollution values for RSPM, SO2 and NO2 are well within the limits however, SPM value is exceeding National Ambient Air Quality (NAAQS). This CMP study will estimate the share of vehicular pollution in the base year as well as for future planning years.

1.5.4 Existing Legal Framework and Standards

The CMP study will propose both short and long term improvement in traffic and transportation systems. The short term proposals which will include engineering measures shall be in accordance with Indian Road Congress (IRC Codes). It was aimed to review laws and regulations related to transport/traffic, however no specific document was found for Nagpur city other than the standard RTO Act.

1.6 Summary of Final Report

This document is the Final Report covering the analysis of the surveys conducted there by, presenting the existing and future transportation scenario along with the list of proposals identified for Nagpur. The report also presents the future forecasts and the strategies to overcome the transportation deficiencies in the coming years within the study area. All the recommendations in the form of short, medium and long term proposals along with their block cost estimates have been presented. An implementation plan showing the various phasing schemes of the proposals is also in place.

Chapter 2
Study Area Profile

2.1 Introduction

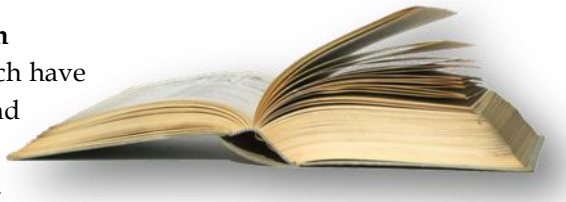
UMTC has done a thorough review of earlier available studies along with multiple site visits as a part of preliminary reconnaissance survey. This helped in understanding city profile which includes demographic details, land-use pattern explaining broad level trip generation and attraction zones, vehicle registration data and accident data, information on public transport operations their routing pattern etc. This gave us strong understanding of available infrastructure and future plans of coping with the traffic associated problems.

2.1.1 Preliminary Reconnaissance

One of the first tasks that we had undertaken to appreciate the transport issues in Nagpur was conducting a reconnaissance that covered

- Location and area
- Population and Demographic Data
- Land Use
- Regional Linkages
- Socio economic data
- Environmental Issues such as natural conservation areas.

2.1.2 Review of Past Studies and Data Collection



A thorough review of the past studies, which have significance to the current study, had undertaken to understand the growth of transport scenario in Nagpur over the years.

Study reports that had been reviewed include

- CTTS/Traffic Master Plan for Nagpur
- National Urban Transport Policy, Ministry of Urban Development and Poverty Alleviation – 2006
- Study of Traffic and Transportation Policies and Strategies in Urban Areas in India
- City Development Plan (2007)
- Land Use details
- Ongoing projects
- Accident data,
- vehicle registration data
- Any other related plans/studies (ongoing)

The Consultant team had extensively traveled in the Study Area to appreciate the transport system demand and supply scenario, problems, network deficiencies, role of public transport system and had made a preliminary assessment of the same.

2.1.3 Secondary Data Collection

The secondary data required for the development of study was collected from various sources primarily from the Government/planning organizations of Nagpur. The secondary data includes information regarding

- Population and employment distribution for past, present and future
- Land use information for past, present
- Road network details,
- Vehicle registration details, and accident data
- Public transport (Bus) route details/frequency and fare structure
- Details of other modes like auto rickshaw, taxi, share autos, etc.

The information was collected from the following organizations:

- Urban Local Bodies/Town Planning Departments /Development Authorities in Nagpur including NIT and NMC
- Census of India
- Economic Census Department
- Traffic Police
- Public Works Department
- Indian Railways
- Transport Department
- Pollution Control Board
- Applicable State & Local Government Departments.

2.2 City Background

Nāgpur is the winter capital of Maharashtra state, located in the central part of India. In fact, it is the geographical centre of India. The city is the third largest one in Maharashtra state following Mumbai and Pune. As per census 2011, the city population was found to be 23,98,165.

Nagpur city is ranked as the cleanest city and the second greenest city of India after Bangalore. In addition to being the seat of annual winter session of Maharashtra state assembly "Vidhan Sabha", the city is also a major commercial and political center of the Vidarbha region and is also famous throughout the country as "Orange City" for being a major trade center of oranges that are cultivated in the region.

Nagpur city derives political importance from being the headquarters for the Hindu nationalist organization RSS and an important location for the Dalit Buddhist movement. Nagpur is also known as the "Tiger Capital of India" as it connects many Tiger Reserves in India to the world.

2.3 Study Area Definition

The aim of this study is to provide improvements for to the existing transport system by integrated landuse transport planning approach as a part of sustainable development. The CMP study generally is conducted for Local Planning Area (LPA) to provide mobility solutions comprehensively. However in Nagpur, the administration is heading the urban

development under two domains viz. Nagpur Metropolitan Region (NMR) and the area under Nagpur Municipal Corporation (NMC – 145 wards).

For study purpose, the area under NMC is important considering intensity of the mobility. However this needs to be addressed with the traffic impact made by rest of the metropolitan area. So NMC area along with the area within outer ring road is considered for providing various mobility development schemes but the impact of metropolitan region will be considered to formulate corresponding schemes. At present (April 2013), the part of outer ring road is still under construction; however the proposed alignment for the same is taken into account while conducting this study. The area outside Nagpur Metropolitan Region will be considered as a part of external zones. The study area for CMP is presented in Fig 2.1 below.

Figure 2.1: CMP Study Area

2.4 Climate

The climate of Nagpur follows a typical seasonal monsoon weather pattern. The peak temperatures are usually reached in May/June and can be as high as 48^0 C. The onset of monsoon is usually from July. The season extends up to September with the monsoons peaking during July and August. The average annual rainfall is 45 inches, with more rain in the east than in the west.

2.5 Demographics

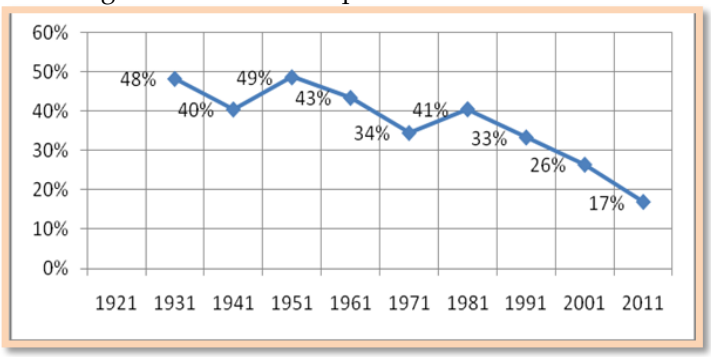
Historical population data for the Nagpur Municipal Corporation (NMC) is available since 1921 from the census department and is presented in the Table 2.1a below.

Table 2.1a: Census Data 1921 to 2011

Decade	Population	Growth Rate
1921	145000	
1931	215000	48%
1941	302000	40%
1951	449000	49%
1961	644000	43%
1971	866000	34%
1981	1217000	41%
1991	1622820	33%
2001	2051320	26%
2011	2398165	17%

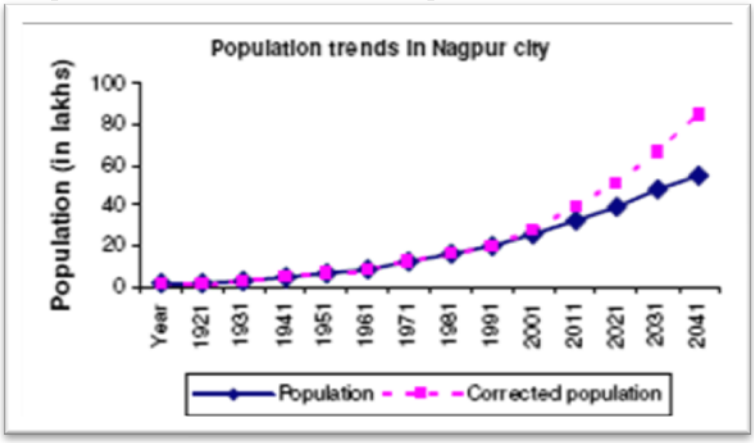
As per Census of India (2001), Nagpur's population was about 20.52 lakhs. The population trends of the city showed a declining growth rate over the decades. It has decreased from 48.3% in 1921-31 to 32.6% in 1991-2001. Figure 2.2 represents decadal population growth for Nagpur City.

Figure 2.2: Decadal Population Growth



The CDP study (2007) suggested that based on the linear projection method, the growth rate may reduce in the next three decades. Accordingly, in the next 25 years Nagpur's population would double. But, considering the recent development projects like Multimodal International Hub Airport – Nagpur (MIHAN) and IT sector's likely investments in the city, Nagpur's growth rate may revive itself and Nagpur's population may double in the next 15 years. As per the provisional census 2011, Nagpur population was 24 lakhs. MIHAN and IT sectors will have impact on further population and employment growth. Figure 2.3 shows expected change (corrected population) in present population growth.

Figure 2.3: Population Growth Trend with Impact of MIHAN and IT Development



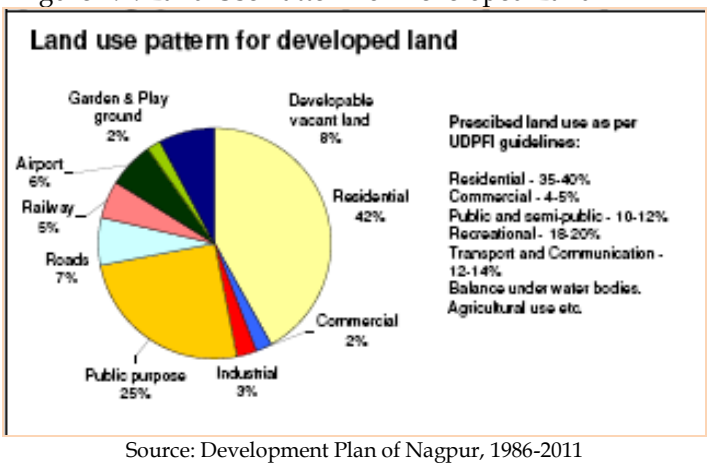
Source: Nagpur CDP 2007

As per Census of India 2001, the attractiveness of the city for migrants has been decreasing. In the last decade (1991-2001), almost 46% of the population growth has been due to in-migration. The figure has declined to 24% in the last four years (1997-2001), as per Census 2001. Further, data regarding key reasons for migration shows that attractiveness of the city as a business destination is also low. Most of the migrants have originated from the rural areas. The key reasons for migration by the male population were work/employment (49%) opportunities. The reconnaissance survey also revealed that the distribution of population in NMA is highly uneven. The city is characterized by low-rise development, which becomes dense in the older and inner parts of the city, and by a lot of vacant land in the outer areas of the city. As mentioned in the CDP 2007, the inner city area of the city had high density range of 700-850 persons per ha (as per Census 1991) and also along national highways, NH-6 and NH-7. But the peripheral areas indicated densities ranging from as low as 10 persons per ha to 150 persons per ha.

2.6 Landuse

The total area within the Municipal Corporation's limit mentioned in CDP (2007) was 217.56 sq. km. of which only 83.40 sq. km. (38%) is developed. The distribution of the developed area (as on 25th Sept. 1984) is given in Figure 2.4 below.

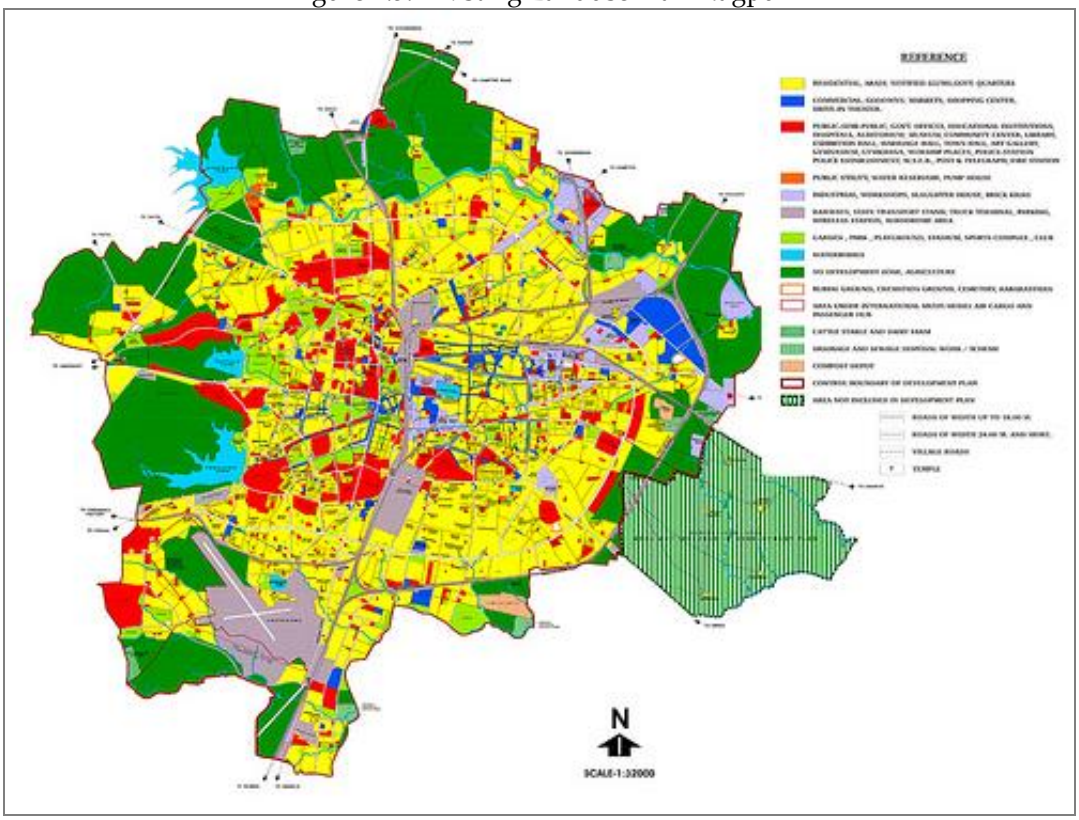
Figure 2.4: Land Use Pattern for Developed Land



Source: Development Plan of Nagpur, 1986-2011

As per Urban Development Plans Formulation and Implementation (UDPFI) guidelines, the land use distribution of developed land (as proposed in Development Plan) conforms to the guidelines in the case of residential usage. Though only 2% of the land is under parks and gardens (recreational spaces), this is adequately supplemented by the large forest cover in the city. But, land under commercial usage needs to be increased further, while the proportion of land earmarked for public and semi-public use may be decreased. The landuse distribution indicates the cosmopolitan nature of the city with a fair distribution of uses. A comparatively higher percentage of land allocated to public purpose indicates the administrative importance of the city. Area under transportation is significantly high with nearly 25% land covering roads, railway land and airport.

Figure 2.5: Existing Landuse Plan Nagpur



The total area of Nagpur district is 9810 sq. km. At present NIT has prepared the land use plan for the first phase that covers approx. 1,520 sq.km of the area. The Metropolitan Region is envisaged by the government for catering to Nagpur Region population by 2031. At present concentration is on the southern part because of MIHAN. Land use plan has earmarked for wholesale markets, warehouses, international airport, educational institutes and information technology parks and other industrial activities. To maintain the green spaces within the city and water bodies, sufficient space has been allocated in the sanctioned land use development plan

Table 2.1b: Proposed landuse analysis of sanctioned development plan

No	Type of User	Proposed Area	% with Urbanisable Area
1	Residential	7037.84	22.68
2	Shops & other commercial	419.47	1.35
3	Weekly and or daily markets	100.25	0.32

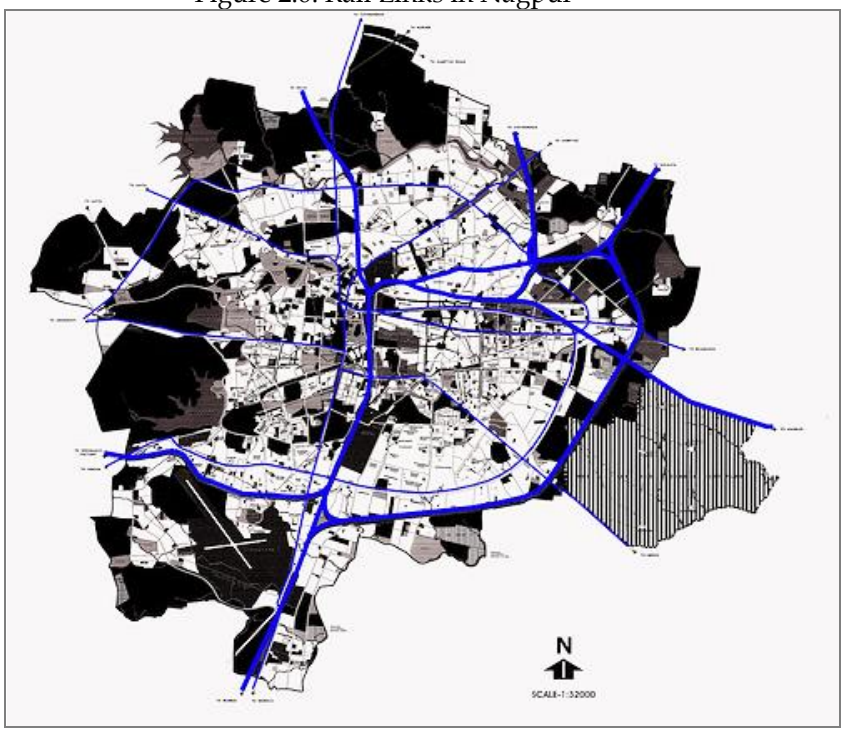
No	Type of User	Proposed Area	% with Urbanisable Area
4	Ware house & government godowns	126.91	0.14
5	Industries & work shops	847.32	2.73
6	Educational institutions	1304.12	4.2
7	Government & other offices	840.05	2.71
8	Hospital & dispensaries	454.45	1.46
9	Worship Places	99.37	0.32
10	Open Spaces Gardens & Play Grounds	804.28	2.59
11	Roads (50 ft and above)	1164.39	3.75
12	Railways	1756.08	5.66
13	Airforce, defence & police premises	2418.42	7.79
14	Water bodies	930.56	3
15	Burning ghats, burial grounds	83.01	0.27
16	Open land committed under schemes	5354.6	17.25
17	Government agriculture farms	531.7	1.71
18	Vacant lands	174.78	0.56
19	Green belt & agricultural land	6592.7	21.24
	Total	**31040.3**	**99.73**

Source: Nagpur City Environmental Status Report, 2011-12, Nagpur Municipal Corporation

2.7 Urban Form

The railway line divides the city into east and west. The east represents an old organic settlement while the west represents the new colonial town.

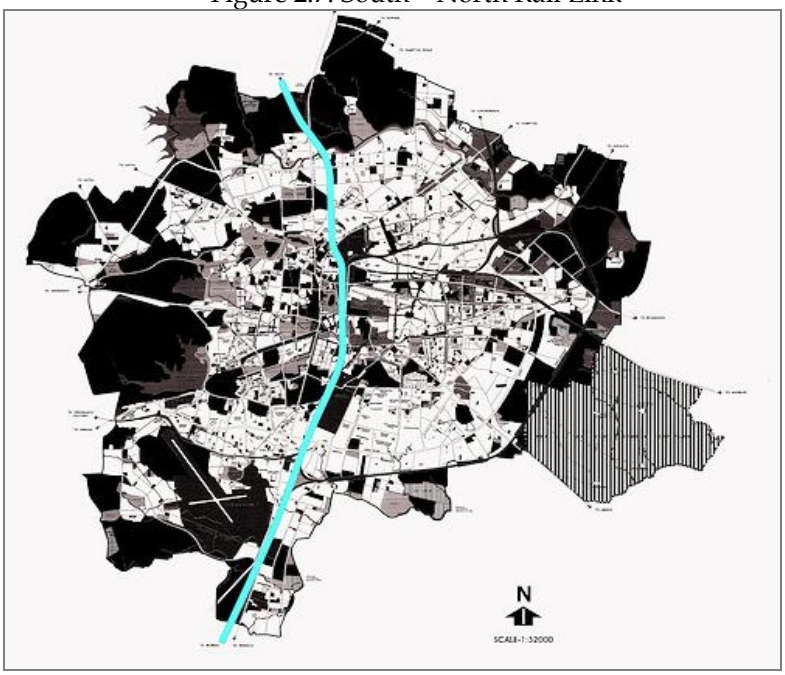
Figure 2.6: Rail Links in Nagpur



North Nagpur

- Police Line Colony (Taakli) is one of the largest sub-urban localities. It adjoins the Police Line apartments behind the Police HQ.
- Teka Naka-Kamptee is one of the biggest transport zones in central area. Many transporters and commercial vehicle owners reside in this area.

Figure 2.7: South – North Rail Link



East Nagpur

- Kalamna is one of the largest wholesale markets for oranges and grains in Asia.
- Mominpura- popularly known as the Chandni Chowk of Nagpur. Mayo Hospital and Jama Masjid are parts of Mominpura.
- Itwari is the wholesale business center of Nagpur. Hardware, cloth, household, wedding saree markets etc. are housed here.

Central Nagpur

- Mahal is the oldest part of Nagpur, and is noted for its relatively narrow streets and crowded residential quarters. The famous Bhonsale palace, residence of the Bhonsale kings, is situated in Mahal. There are many historic temples in Mahal area such as Kalyaneshwar Mandir, Pataleshwar Mandir and Aychit Mandir. Mahal is also known for its cloth market and old book market situated on Kelibagh road.
- Sitabuldi is the main commercial part of the city. It contains numerous shops of all sizes and the largest wholesale vegetable market in Nagpur. Sitabuldi Main Road is one of the main shopping streets in the area. Also located in Sitabuldi is the Sitabuldi Fort. It is situated on an elevated area. The fort is under control of the Indian Army.
- Dhantoli is a premium residential area in Nagpur.

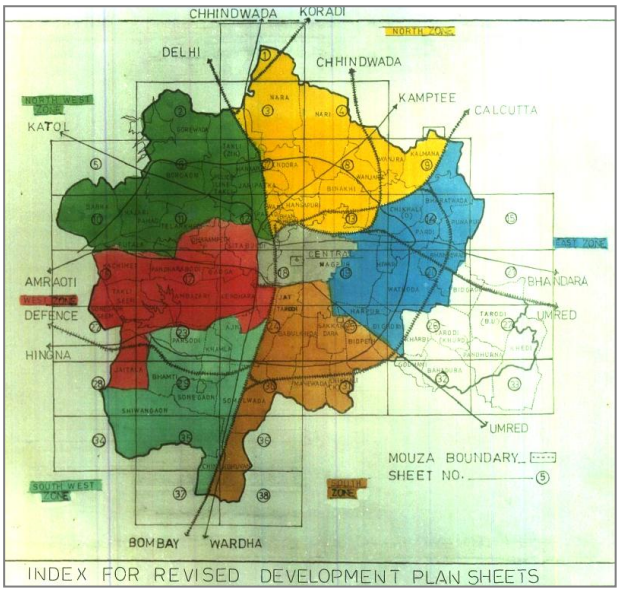


Figure 2.8: Revised DP Plan Nagpur

West Nagpur

- Dharampeth, Shivajinagar, Gokulpeth, Gandhi Nagar, Ambazari Layout, Shankar Nagar, Bajaj Nagar, Abhyankar Nagar, Laxmi Nagar, Pratap Nagar,

Khamla, Vivekanand Nagar, Somalwada, Ramdaspeth are residential areas in this region.

- The Civil Lines contains most of the government offices and residences in Nagpur including the Bombay High Court bench and the Vidhan Bhavan.
- Seminary Hills is home to educational institutes like SFS College, LAD, Nagpur veterinary college, Maharashtra Animal and Fishery Sciences University, KV, Center Point school and offices like Air Force, CGO Complex, TV Tower. Some of the famous parks and open areas are located in this part of the city.
- Sadar is a famous shopping place, close to Railway Station

South Nagpur

- The Government Medical College and Hospital which is a Govt. managed body concerning public health care is located in South Nagpur.
- Manewada, Besa, Narendra Nagar and Satyam City are suburbs with many new residential projects.
- The multimodal hub of MIHAN is located in South Nagpur along the Mumbai Trunk rail route.

2.8 Economic Base of Nagpur

About 30 percent of the city's population is 'working' as per Census of India-2001. About 85 percent of the working population is male. Trade, hotels and restaurants are the largest industry groups in the city. About 36.3 percent of the working population is engaged in these industry groups. It is interesting to notice that transportation sector employs 17.6 percent of the total working population. Nagpur's location on the confluence of various transportation routes has probably contributed to the large share of employment generation in the trade and transportation sector. Manufacturing also has a significant presence in Nagpur with 15.4 percent of the working population involved in this sector.

Table 2.2: Nagpur Workforce Participation Rate

	Persons	Males	Females
Main Workers	568283	478981	89302
Agriculture	0.6%		
Mining	0.8%		
Manufacturing	15.4%		
Water and electricity Works	0.3%		
Construction	20.6%		
Trade, hotels and restaurants	36.3%		
Transport	17.6%		
Other Services	18.4%		
Marginal Workers	59198	40123	19075
Non-Workers	1424585	540661	883924
Total	2052066	1059765	992301

Source: NSS 55th Round, Census of India, 2001.

Nagpur has adequate reasons to grow at a faster pace than the past. The slowing down in the decadal population growth can be taken as a proxy for decreasing levels of economic activity in the region.

This has mainly been attributed to the lack of adequate employment opportunities in the city. What has probably held back economic growth in the past is the lack of priority given to Nagpur (and Vidarbha in general) by successive state governments. It has been well

documented by the Dandekar Committee (1984) that at 1982-83 prices, the total developmental backlog in Maharashtra state excluding Mumbai was Rs.3177 crores. Out of which, Vidarbha's share was Rs.1247 crores, about 40% of the state backlog (excluding Mumbai). The developmental backlog for Marathwada and Western Maharashtra was relatively lower at Rs.751 crores and Rs.884 crores. The backlog over the years has increased further while that for the rest of Maharashtra has declined. As of April 2000, the developmental backlog has increased to Rs.9830 crores.

MIHAN (Multi-Modal International Hub Airport of Nagpur)

The trigger that Nagpur is mainly looking at is the MIHAN project. The proposed MIHAN project is expected to spread over 4,350 hectares at a cost of Rs.2000 crores. Besides the airport, the proposed project involves a road-rail terminal, a special economic zone (SEZ) and other urban amenities to meet the needs of the working population in around the proposed airport. The SEZ will provide the right platform for exploiting the latent economic potential of Nagpur city. The SEZ project has potential to create over 1.2 lakh jobs in Nagpur city.

The idea of the MIHAN and SEZ project together is based on detailed market studies. It has been observed that each of the industries that will be contained in the SEZ has been chosen on the basis of the human and natural resource advantages that Nagpur city has to offer to prospective investors. The same is true for the transport hub project. About 18 percent of the working population is involved in transportation and allied businesses. This figure for cities like Bangalore, Surat, Indore, Ahmedabad and Chandigarh is in single digits. This implies that the share of the working population involved in transportation and allied industries is higher than what is prevailing in other cities. This can be attributed to the unique geographical positioning of Nagpur city. This industry is mainly driven by the unorganized sector. The effort of MIHAN is to capture the inherent advantages in an organized and scientific manner. The availability of both human and natural resources goes a long way to ensure that the MIHAN project is rooted in reality. Table 2.3 shows the MIHAN Project details.

Table 2.3: MIHAN Project details

Activity	Area in hectares
Airport	1200
Road-Rail Terminal	200
SEZ	1475
- Captive Power	52
- IT Parks	400
-Health City	50
-Other Manufaturing & Value Added Units	963
Residential, Open spaces, Hotels, Roads,Water Supply	1140
Total	**4025**

Source: Maharashtra Airport Development Corporation

2.9 Transportation Systems

Distance and connectivity with all the important Indian cities through various transport modes gives Nagpur an inherent advantage. It can be seen as a transport hub, connecting the Indian cities to each other and international destinations as well. Various IT and ITES companies are also viewing this characteristic as a strong positive factor.

Road Network

Nagpur is 837 km from Mumbai, 1094 km south of Delhi, 1092 km north of Chennai and 1140 km west of Kolkata. Two important highways -- NH-7 (Varanasi - Kanyakumari) and NH-6 (Mumbai - Sambalpur – Kolkata) pass through Nagpur. The city is developed with radial and circumferential network pattern, of which outer ring is partly constructed, while inner ring road is completely operational.

Some of the Major road corridors within Nagpur City bearing the impact of traffic are:

- Amravati Road
- Ghat Road
- Ajni Road towards Medical Chowk
- Railway Station Road
- Central Avenue
- Manewada Road
- Subhash Road
- Ayachit Road
- Ambazari Road
- Wardha Road
- Hingna Road
- Kamptee Road
- Nag Road
- Pachpavli Road

The efficiency of the road network is highly dependent on the performance of traffic intersections and bottlenecks. Intersections which are over the capacity with higher degree of saturations will result in higher junction delays, traffic jams and chaos. Some of the important intersections in Nagpur are listed below.

- Ajini Chowk
- Manewada Chowk
- LIC Chowk
- Rana Pratap Nagar Chowk
- Chatrapati Chowk
- Lokmat Chowk
- Chindwada Katol Road
- Vaishnavdevi Chowk
- RBI Chowk
- Gaddi Godam Chowk
- Kadbii Chowk
- Golibar Chowk
- Indora Chowk
- Mental Hospital Chowk

The road network of the study area is presented in Figure 2.9

Figure 2.9: Road Network in the Study Area

Rail Network

Nagpur Central Railway Station connects major railway trunk routes. An electrified broad gauge railway track connects Nagpur to the four major metros. Destinations connected include Mumbai, Delhi, Calcutta, Chennai, Kolhapur, Pune, Ahmedabad, Hyderabad, Jammu, Amritsar, Lucknow, Varanasi, Bhubaneshwar, Cochin, Thiruvananthapuram, Gorakhpur, Visakhapatnam, Bangalore, Mangalore, Patna and Indore. The Rail Network in the Study area is presented in Figure 2.10

Air Network

Sonegaon (Dr. Babasaheb Ambedkar International Airport) airport is 7.5 kilometers south of Nagpur city. It is connected to some important Indian and international cities including

Mumbai, Calcutta, Delhi, Hyderabad, Raipur and a few (connecting flights) international flights to Sharjah, Singapore, Saudi Arabia and Bangkok.

Figure 2.10: Rail Network in the Study Area

2.10 Road Network Characteristics and Parking

The road network in Nagpur is evolved with two national highways in north south and east west direction along with radial pattern formulated by two ring roads.

The total length of roads in the city is 1907 km (CDP 2007), of which the length of major roads is 500 km, the remaining being the internal roads. The Nagpur Municipal Corporation (NMC) has executed an Integrated Road Development Project (IRDP) to improve the transportation system within the city limits. Road network characteristics and parking details are presented in Table 2.4

Table 2.4: Road Network Characteristics and Parking

Total Length of city roads in NMC Area	1150 km
Total Length of roads	1907 km
Cement roads	25km
Paved Tar Roads	1502 km
Unpaved Roads	380 km
The average width of carriageway in the year 2000	6-14 m
Length of ring road around the city	41.48 km
No of flyover	3
No of river bridges	-
No. of railway over bridges	9
No of intersections	200
No of road crossings with signals	112
No of road crossings with timer	54
No of road crossings with blinkers	30
No of pay and parking zones	0

Parking

From reconnaissance survey, it is understood that parking facilities in Nagpur are inadequate as most of the city roads are clogged with parked vehicles. This brings down the effective road capacity for vehicular movement and finally the issues like traffic jams, bottlenecks, low travel speed will arise. It has become extremely important to develop and enforce strict parking norms in new buildings and make suitable parking arrangements in public spaces.

2.11 Vehicle Registration Data

The city traffic and congestion level depends on two important factors namely; transport supply which we call as availability of transport infrastructure and the second one is number of registered vehicles. There has to be a balance between vehicular demand and available road space so as to avoid chaos and traffic jams. Table 2.5 represents number of registered vehicles during last three years.

Table 2.5: Motor Vehicles Population as on 31st March 2012

Category	31.03.2010	31.03.2011	31.03,2012
Motorcycles	350638	390102	429837
Scooters	271318	293926	318999
Mopeds	283371	283810	283771
Total Two Wheelers	905327	967838	1032607
Motor Cars	79639	89479	99233
Jeeps	26181	28244	29727
Station Wagons	842	842	842
Taxi Cabs	0	0	0
Meter fitted	0	0	0
Tourist cabs	2388	2661	2907
Auto Rickshaws	16058	16417	17149
Stage Carriages	1715	1741	1741
Cont carriages /Minibuses	672	735	899
School Bus	513	575	615
Pvt Service Vehicles	1292	1307	1314
Ambulance	454	525	567
Arti & Multi Veh	867	896	925
Trucks and Lorries	12193	12658	13024
Tankers	2016	2275	2532
Delivery Van (4 whlr)	11750	12879	14183
Delivery Van (3 whlr)	5792	6161	6844

Category	31.03.2010	31.03.2011	31.03,2012
Tractors	5292	5385	5402
Trailers	5166	5263	5348
Other	1102	1153	1240
Total	1079259	1157034	1237099

Source: R.T.O. Nagpur

At present, the RTO has not given any permits for Taxi Cabs and Meter fitted cabs. The Intermediate transport is taken care by auto Rickshaws (almost 17000) and Tourist Cabs (almost 2900).

2.12 Traffic Safety and Enforcement (Accident Data)

The traffic safety is an important measure which needs to be looked to reduce number of accidents in the city. In Nagpur, NH6, NH7 and NH69 are major National highways passing through the city. In addition, State Highways SH 260 & MSH 9 connect to these National Highways and form a radial pattern. The major part of outer ring road is still under the construction. The presence of state and national highway network will naturally invite through traffic in the city. The accident records for the last five years were collected and the same are presented in Table 2.6

Table 2.6: Accident Data Nagpur

Type of Accident	2007			2008			2009			2010			2011		
	Acci-dents	Fata-lities	Injured	Acci-dents	Fata-lities	Injured	Acci-dents	Fata-lities	Injured	Acci-dents	Fata-lities	Injured	Acci-dents	Fata-lities	Injured
Fatal	250	259	80	249	263	94	229	250	50	301	317	80	228	237	45
Serious	378	-	490	341	-	456	330	-	393	375	-	456	367	-	446
Minor	1018	-	1010	913	-	915	824	-	781	872	-	868	637	-	658
Total	1646	259	1580	1503	263	1465	1383	250	1224	1548	317	1404	1232	237	1149

Source: Assistant Police Commissioner, Traffic, Nagpur 2012

2.13 Existing Bus Transport System in Nagpur

Nagpur's public transportation system was operated and maintained by Maharashtra State Road Transport Corporation (MSRTC). At present, 'Vansh Nimay Infra' is operating city buses on PPP basis. In addition to its own buses, city has received 240 buses under JNNURM funding scheme. Effectively, the operator is having an opportunity to run a total of 470 buses on PPP basis. Following is the secondary data received regarding bus service operation for Nagpur Municipal Corporation. The present bus route plan is also presented in Figure 2.11.

Figure 2.11: Bus Route Network Map

Table 2.7: Bus Operation Details in Nagpur

Bus make	No of Buses	Type	Capacity	Fuel Efficiency (KM/PL)
TATA RESLF	60	1610/1612 Re	44 Seater	3
TATA FESLF	218	1512 TC	44 Seater	3
Ashok Leyland	112	4/85 SLF BS III	44 Seater	3.5
Eicher	80	1090 Star Line	28 Seater	4

The discussion with stakeholders in NIT and NMC revealed that all of the 470 buses are not under operation. It is also conveyed that the operator has revenue generation issues with lower (almost nil) profitability, resulting in huge number of buses being kept parked without operating.

Figure 2.12: Nagpur City Bus Service

2.14 Institutional Setup

Nagpur is administered by Nagpur Municipal Corporation (NMC) which is democratically elected civic governing body. Nagpur Improvement Trust (NIT) carries out works like development of the civic infrastructure and new urban areas. The organization structure of NIT is presented in the Annexure. . The city is divided in 72 Prabhags which are in turn divided into 145 wards. Each ward is represented by a Corporator, majority of who are elected in local elections. There is absence of local authority under which all development agencies will work together in integrated manner.

2.15 Observed Key Transportation Deficiencies

The key constraints/issues due to increase in vehicular traffic in the region are summarized below:

- From the initial reconnaissance survey, it has been observed that though, the carriageway widths of main Arterial roads in Nagpur town are broad, the inner city roads and some of the roads leading to the market areas are narrow. These narrow roads carry large volumes of traffic resulting in congestion
- Absence of footpaths for pedestrians and unregulated pedestrian crossings
- Lack of facilities for cycling
- Unauthorized on street parking on both sides of road in commercial areas and encroachment of roads/foot-paths by hawkers and shopkeepers
- Lack of road signs/ intersection markings resulting in accidents

Figure 2.13: Existing Road Infrastructure in Nagpur (Station Road and Buldi Area)

2.15.1 Congested City Core Area

Rapid urbanization in the last three decades in India has resulted into mixed land uses especially in the core areas of city. Another reason is the location of intercity rail and bus terminals in the same premises (core area), in general in all cities. Nagpur is also not an exceptional case, facing the problem of congestion in core parts of the city. Almost all the streets in the core city area have turned commercial with high level encroachment by hawkers. There is complete mix of shops, retail markets, eating establishments, private tutorial, clinics etc in the core city area.

Figure 2.14 Congested Core Areas

2.15.2 Urban Goods Distribution

The reconnaissance survey was carried out to identify issues associated with heavy vehicle mobility within and around the Nagpur Corporation area. It was observed that large number of trucks and multi-axle vehicles were parked outside Chungi Naka (Octroi Naka) on all important radial roads including Bhandara Road,

Amravati Road, Kamptee Road, Wardha Road. The obvious reason was the restriction of timings to pass through the city area, besides lack of proper truck terminals. The city road network profile itself invites high number of truck movements to pass through NH6, NH69, NH9, SH260 and MSH 9. To reduce the impact of heavy vehicle movement on local traffic, trucks are banned during 7.00 am to 12 noon and 4.00 pm to 9.00pm. In addition to this, part of the North side outer ring road is still under construction inviting through traffic in the city.

This significantly increases parking demand on all major radial roads outside Chungi Naka. The reconnaissance survey highlighted lack of well planned truck terminals which can take care of huge parking demand during peak hours. Figure 2.15 shows multi axle vehicles parked outside chungi naka on Amravati Road and Raipur Road (Bhandara Road). The newly completed part of outer ring road which is under operation after 1st of June 2012 is not covered in the primary surveys however the network in the transportation model has been updated for future years.

Figure 2.15 Trucks Parked on Amravati Road and Raipur Road

Chapter 3
Primary Surveys - Data Collection

In any transport planning exercise, data collection is the cornerstone and is the very foundation on which rests the super structure. Historically and even in this study, this is treated with utmost seriousness, as it rightly should be. The data is used to analyze the existing transport and traffic situation in the study area and to develop urban transport demand model for the study area. The activity is undertaken to understand traffic and travel characteristic and highlight city specific problems.

The following surveys were carried out to meet the above objectives. The survey listing is not done based on the priority or importance of the survey. All of them are important to meet the study objectives.

- Road Network Inventory
- Screen-line Traffic Volume Counts
- Intersection Turning Volume Count surveys
- Speed and Delay surveys
- Roadside Motor Vehicle O-D Survey (including Goods Vehicles)
- Parking survey
- Non-motorized Transport surveys
- Household Interview survey
- Public Transport and Intermediate Public Transport Passengers Survey (Intra-city Passengers' Survey)
- Commuter Surveys (Intercity Passengers Survey) – Intercity Bus and rail Passenger Survey
- Goods Focal point Survey / Vehicle Operator's Survey / Commercial Vehicle Survey
- Environmental Data (information which is available from secondary sources)

1. Road Network Inventory

Objective of the Survey

Road network inventory is aimed at developing and updating the network database with the existing features of roadway sections. Details like link lengths, cross-sectional details, type and general condition of the surface, pavement width, median type and width, on-street parking provision, traffic control devices, etc., were collected.

Scope of the Survey:

- Validating the existing road network data available for the region
- Collecting the road network details for those stretches whose details are not available

Conduct of the Survey

A full-scale inventory survey was undertaken to create a road network database. Inventories of the following facilities were undertaken as part of the task.

- Road Network
- Effective Road width
- Quality of riding surface
- Adjoining Land use and available Access control
- Intersection Facilities

- Pedestrian Facilities
- Parking Facilities
- Traffic Control/management Measures like one -ways.

A team of two enumerators each traverse the road network and the datasheet to record the road network details listed above. The network selected for road network inventory is shown in Figure 3.1

Data Entry and Analysis

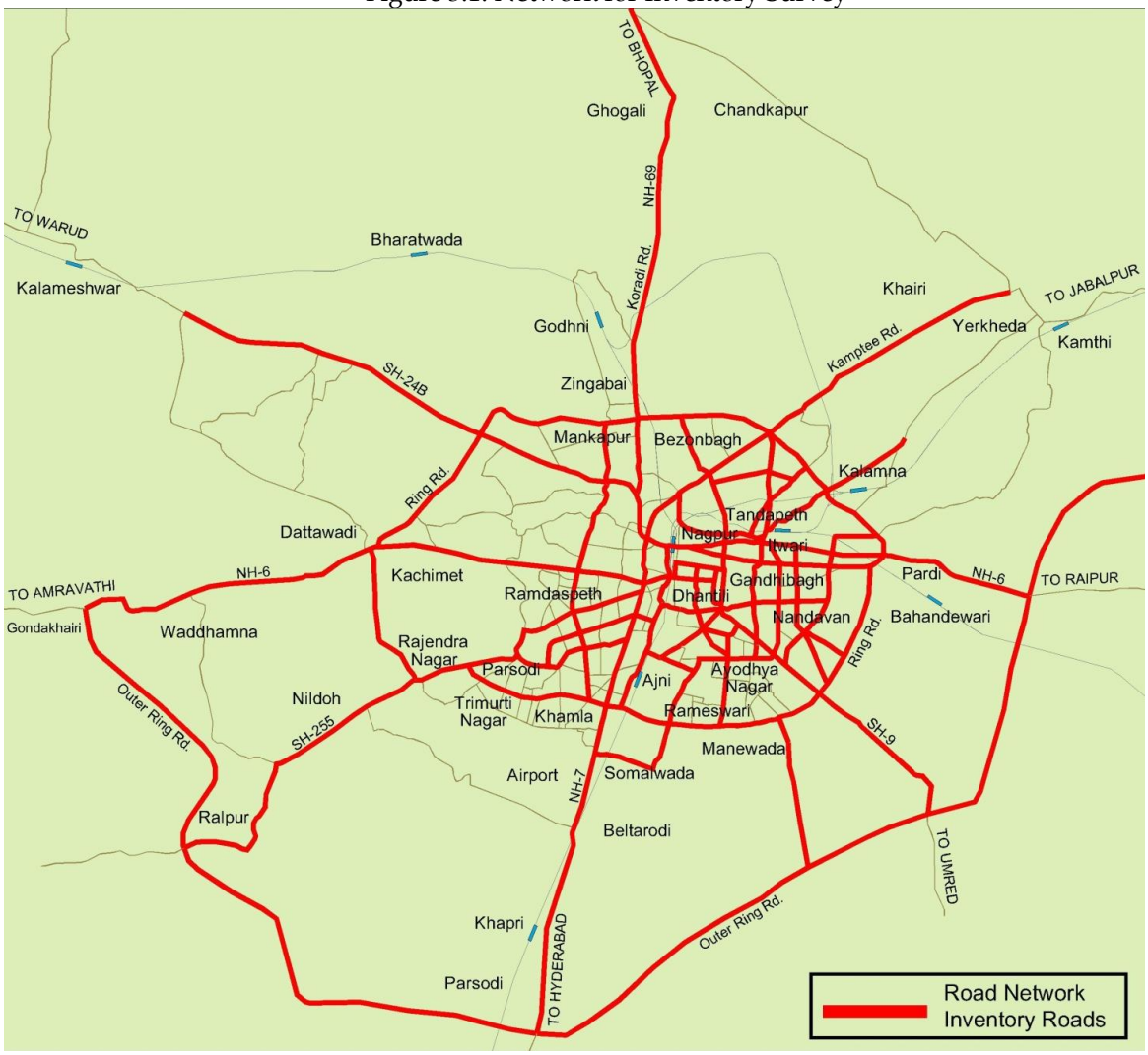
The road network attribute data collected from the field was used to develop transport network database. The database was then used in developing the base year network facilitating both qualitative and quantitative evaluation of the present sufficiency of road networks vis-à-vis existing standards and usage pattern.

Road Network Survey
KEY OUTPUTS
➔ *Transport Network database of study area*

Key Outputs

- Transport Network database of study area.

Figure 3.1: Network for Inventory Survey



2. Screen Line Classified Volume Counts

Objective of the Survey

The main objective of the survey was to estimate the classified vehicular volumes crossing the screen lines (imaginary lines drawn along water bodies and railway line) to be used for validation of the transport model.

Scope of Survey

- Defining the screen lines and designating the traffic count stations
- Counting of vehicles classified by the type of vehicle crossing the screen lines for 16 hours during the peak and the period proceeding and succeeding the peak duration.

Conduct of the Survey

Manual traffic counts were carried out at all locations where the road network cuts across the screen lines. The city has well defined railway track (North – South) which can be used for model validation. Also an additional screen line (water body in East – West direction) was used for making model more robust. Traffic counts were carried out on a typical working day for 16 hours covering both morning and evening peak periods. At each identified station, both directional counts were carried out by vehicle type. i.e. cars, jeeps, vans, buses, trucks, MAVs, LCV's tractors, motorized two wheelers and three wheelers, and slow moving vehicles. Screen line locations identified for Nagpur CMP are shown in Figure 3.2

Data Entry and Analysis

The traffic data collected from the field was scrutinized and processed. The Passenger Car Unit (PCU) values recommended by Indian Roads Congress (IRC) were used in the analysis. All results are presented in the subsequent section of this report.

Screen Line Classified Volume Counts

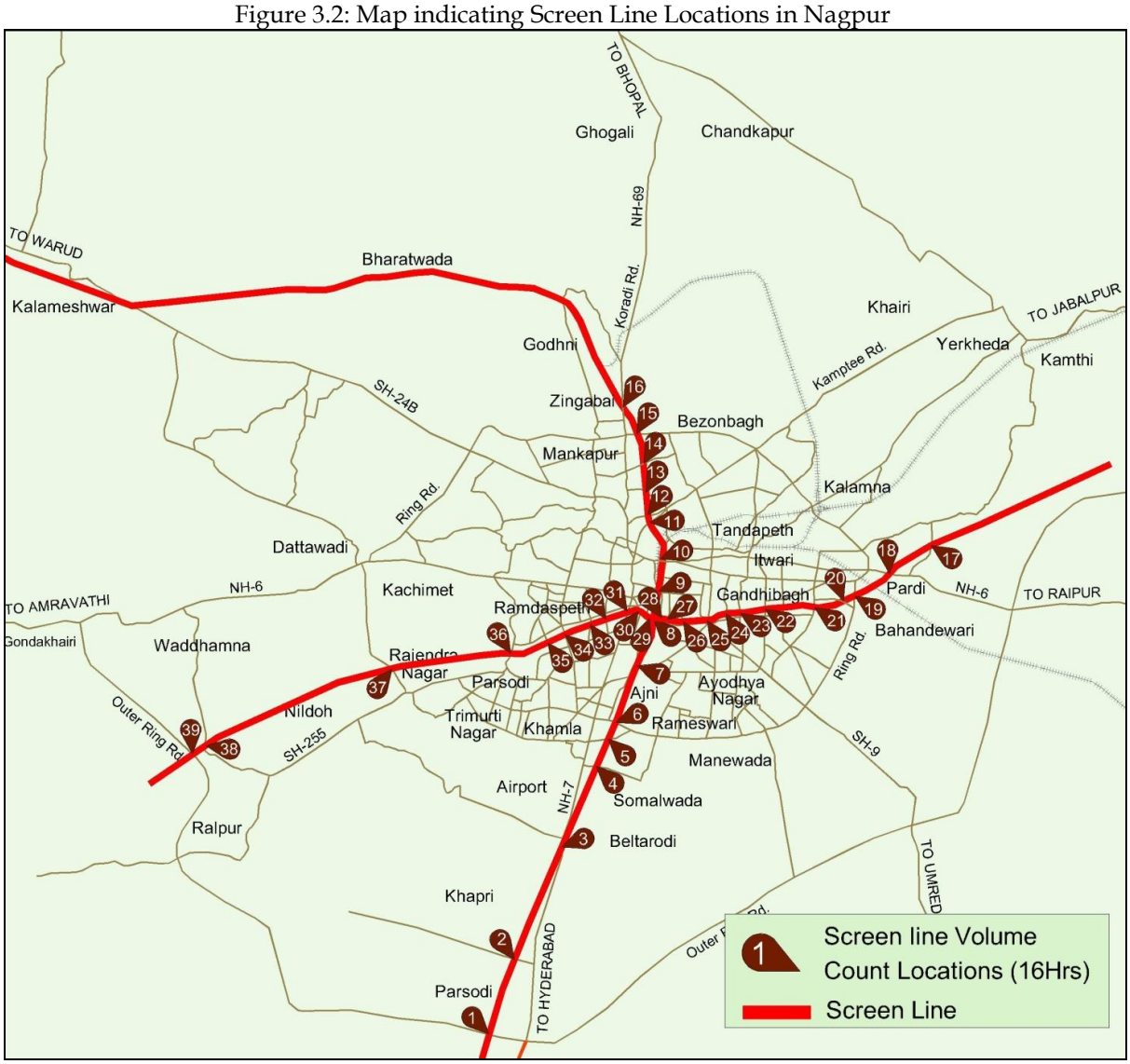
KEY OUTPUTS

- ➔ *Peak hour volume across screen lines*
- ➔ *Traffic by vehicle type*
- ➔ *Hourly distribution of traffic*

Key Outputs:

- Peak Hour Volume at the survey stations (Veh/Hr. and PCU/Hr)
- Traffic by Vehicle type and hourly distribution of Traffic
- Variation in flow during survey period

Figure 3.2: Map indicating Screen Line Locations in Nagpur



3. Intersection Turning Volume Counts

Survey Objective

Surveys were conducted at critical intersections identified within the city. The data will help in realizing the seriousness of problem at the intersection, critical movements, etc.

Classified Turning Volume Count Survey

KEY OUTPUTS

➔ *Peak hour Turning movements at major intersections in the study area*

Scope of Survey:

Counting vehicles classified by the type at the selected locations for 16 hours.

Key Outputs:

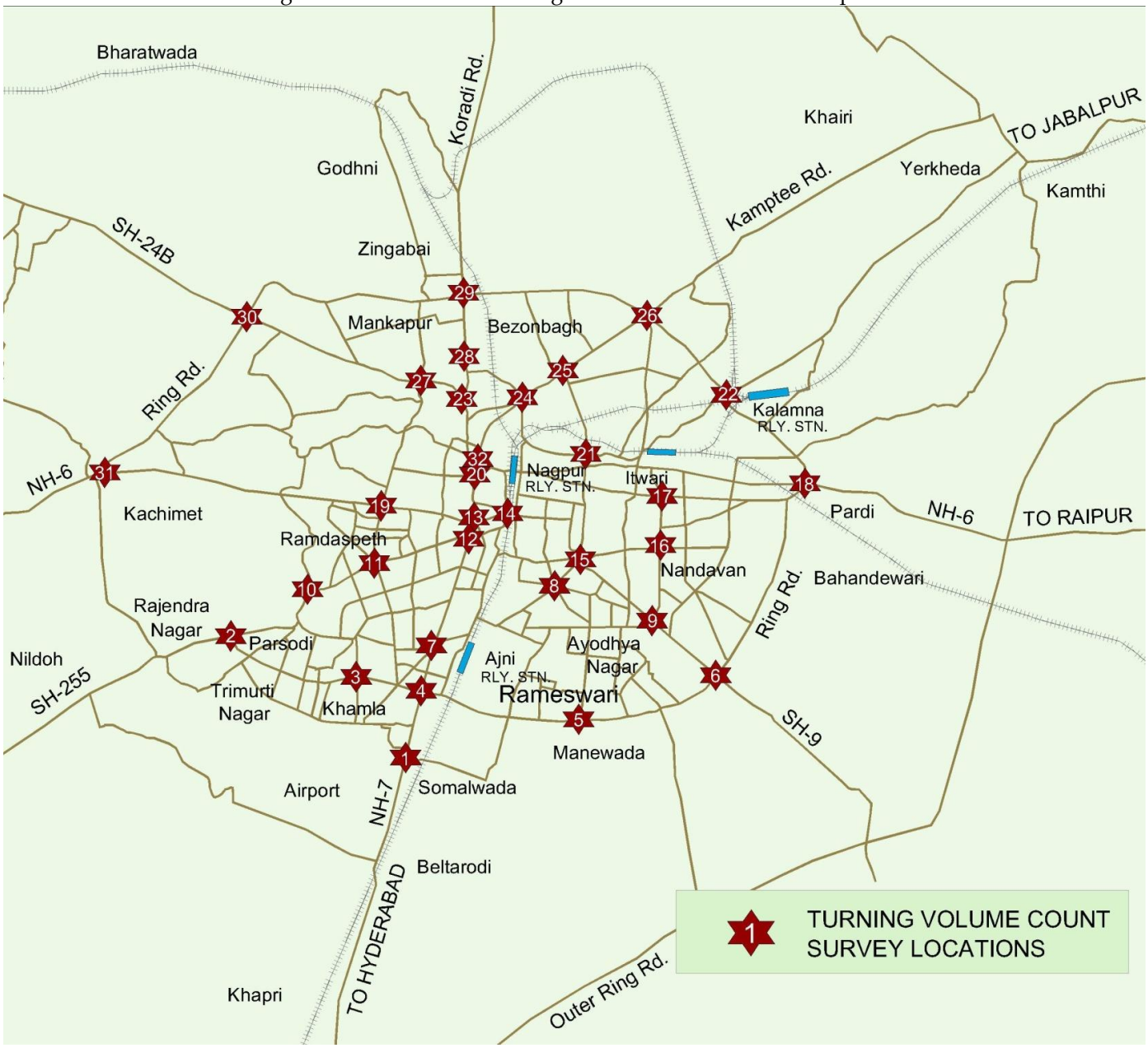
- Peak Hour Volume at critical junctions (Veh/Hr. and PCU/Hr)
- Traffic by Vehicle type and hourly distribution of Traffic
- Identification of traffic related issues at the junctions

Volume count Survey Locations

Locations selected for the volume count survey are listed below. The same is presented in Figure 3.3. The list of volume count survey locations was finalized after discussion with NIT.

1. Wardha Road
2. Hingna Road and Ring Road Junction (SH260)
3. Pratap Nagar Chowk (SH260)
4. Wardha Road and Inner Rind Road Junction (SH260)
5. Manewada Junction (SH260)
6. Umred Road and Inner Ring Road Junction (SH9 and SH260)
7. Ajni Square (On Wardha Road – 5 Arm Junction)
8. Medical College Circle (Roundabout – 6 Arm Junction)
9. Lad Hospital Junction (Umred Road)
10. Junction Near Ambazari Lake (SH255)
11. West High Court Road and North Ambazari Road Junction (Junction on SH 255 Near Screenline) – Shankar Nagar Chowk
12. Ambazari Road and Wardha Road Junction (Near Salpekar Petrol Pump)
13. Amravati Road and Wardha Road Junction (NH6 and NH7)
14. Junction near Sitaburdi Station (5 Arm Junction on Subhash Road)
15. Ashok Square (Near Screen Line / Nala)
16. Jagnade maraj Chowk on Gadgil Ghat Road (Near Screenline / Nala)
17. Telephone Exchage Chowk (on Central Avenue Road)
18. Inner Ring road and Central Avenue Road Junction
19. Amravati Roadn and West High Court Road Junction (on NH 6)
20. RBI Junction on Wardha Road (Near Kasturchand Park)
21. Golibar Chowk
22. Ranala Road (Junction of SH 260 and Inner Ring Road - newly constructed inner ring road link)
23. Katol Road and Koradi Road Junction (NH 69 and SH 248)
24. Kadbi Chowk (5 Arm Junction)
25. Tuli Mall Junction (on Kamthee Road)
26. Kamthee Road and Inner Ring Road Junction (SH 260 - 5 Arm Junction)
27. Katol Road and West High Court Road Junction)
28. Mental Hospital Junction (4 Arm Junction)
29. Koradi Road and Inner Ring Road Junction (NH69 and SH260)
30. Katol Road and Inner Ring Road Junction (SH248 After Military Training Ground)
31. Amravati Road and Inner Ring Road Junction (Take North - West Bye Pass Link)
32. LIC Chowk (Near Kasturchand Park)

Figure 3.3 Intersection Turning Volume Count Location Map



4. Speed and Delay Surveys

Survey Objective

The principle objective of the survey was to find out the running speed, journey speed and types of delay such as stopped delay and operational delay to evaluate the level of service or quality of traffic flow of a road or entire road network system. In relation to the model, the purpose of this survey is dual – Journey speeds are used for validation of the urban transport model and to develop speed- flow functions for different categories of road network in the study area.

Scope of Work

- Carryout the surveys during peak and off-peak periods in both peak and anti peak direction.

- Collection of delay information on different road stretches and at intersections in the study area

Speed studies were conducted on all critical corridors, identified in consultation with the Client.

Conduct of the Survey

There are several methods available for conducting this type of survey. Few of the methods are; moving observer method, registration number plate method and Elevated observer method. Floating car method is widely used in India and the same is followed in this study too. The enumerators recorded the distance and time of travel between two junctions and stopping time of the vehicle along the road stretches, at intersections and the reasons for the same.

Key outputs:

- Travel and journey speeds along the corridors
- Delays along each of the selected corridors by type/reason
- Intersection delays

Speed Survey

KEY OUTPUTS

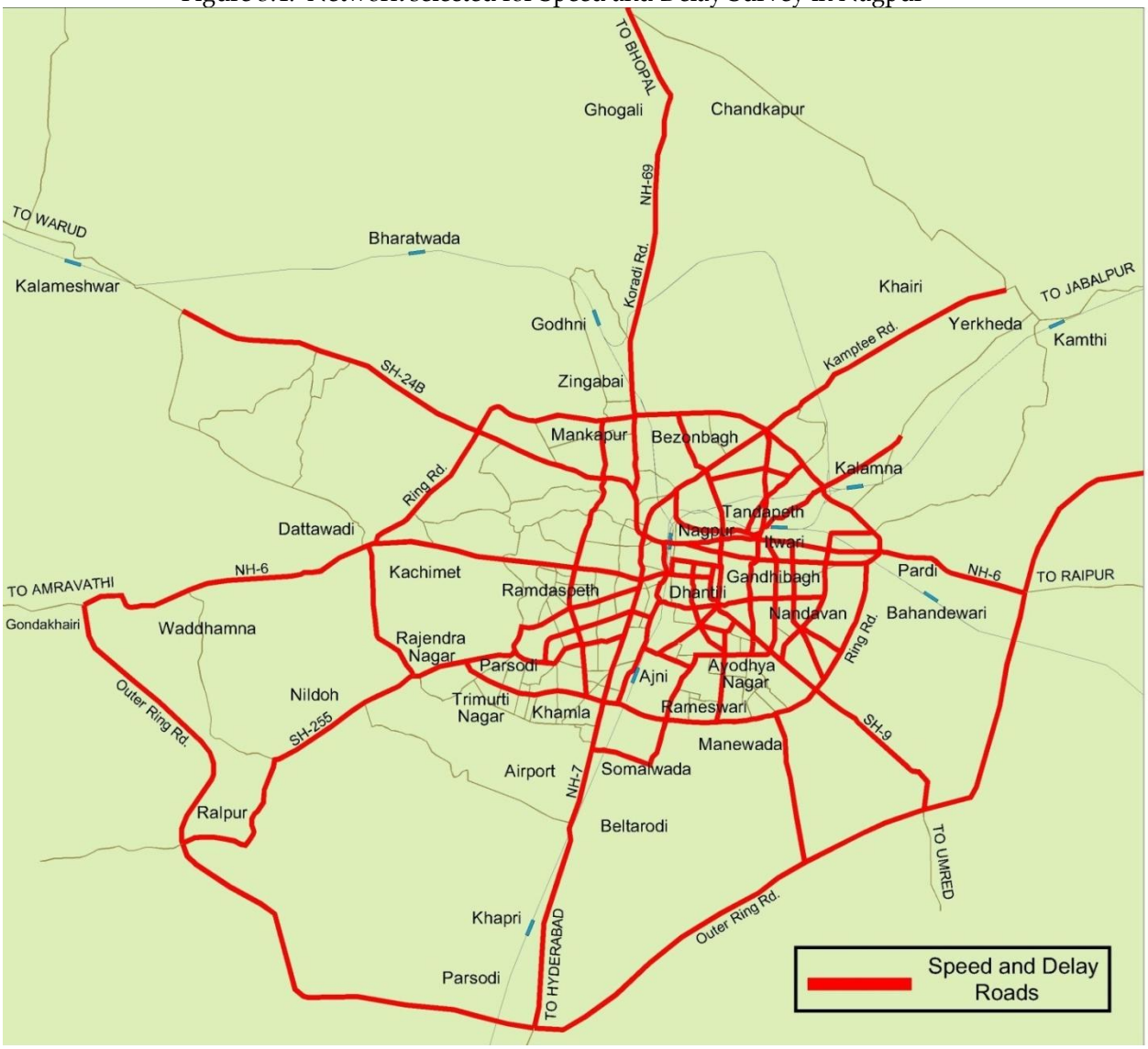
➔ *Delays along each of the selected corridors by type.*

➔ *Intersections delays*

Network for Speed and Delay survey

The network selected for this survey is highlighted in the Figure 3.4.

Figure 3.4: Network selected for Speed and Delay Survey in Nagpur



5. <u>Roadside Motor Vehicle O-D Survey (including Goods Vehicles) - Cordon Count and Origin- Destination Surveys</u>

Survey Objective

The main objective of the survey was to derive the passenger and freight travel pattern by road. The survey was conducted at the eight cordon points selected for the study area. These surveys aimed at analyzing the traffic movement within the study area and also the interaction between outer and within the study area (floating population). The data then used to validate the urban transport demand model and to estimate the significance of bypass/ring roads for the study area. Mode wise trip Characteristics such as origin, destination, trip purpose, trip frequency was elicited.

Scope of the Survey

The scope of the survey includes conducting interviews along the cordons identified in the study area. The survey was carried out for 24 hours at locations on the outer cordon and for a period of 16 hours at remaining locations on the inner cordon.

Conduct of the Survey

Interviews were carried out on a sample basis on a typical working day (to cover regular trips) by stopping the vehicles with the help of police. The objective was to achieve minimum sample coverage of 10 percent spread across the time of the day and type of vehicles proportionately. Classified volume count was carried out along with the interviews in order to calculate expansion factors. The list of outer cordon survey location is presented below. The locations area also indicated in Figure 3.5

1. Patan Bori (Wardha Road)
2. State Highway 255 and Outer Ring Road Junction
3. Amravati Road and Outer Ring Road Junction
4. State Highway 265 and 248 Junction
5. Koradi Road and State Highway 267 Junction
6. State Highway 256 Near Kamthi
7. Wadoda (Durg-Bhilai Road)
8. Umred Road and Outer Ring Road Junction

Data Entry and Analysis

Zoning: Traffic analysis zones (TAZ) adopted was utilized to establish the travel pattern. The zoning system of the study was carefully designed as its hierarchical system of the fine zones within the study area and larger districts to achieve the multiple objects of the study. For the study, the administrative boundaries of wards in the Urban local body retained as TAZ and outer areas were divided into larger zones. The zones shall relate to the road and railway networks.

Roadside Interview Survey

KEY OUTPUTS

- *Trip rates and trip matrix*
- *Desire line diagrams for passenger and goods vehicles*
- *Goods type distribution*
- *Loading and lead distance distribution*
- *Trip length distribution for passenger vehicles*

Figure 3.5: Outer Cordon Survey Location Map

The information collected include origin and destination of trip, occupancy, trip purpose and in the case of goods vehicles their type and tonnage. The collected data was coded according to TAZ and processed to eliminate all illogical data and entry errors. The data was then processed and expanded to total traffic using the expansion factors for each vehicle type. Desire line diagrams were prepared for passenger and goods vehicles separately, from which the project influence area was identified.

Location-wise and mode-wise OD matrices for peak period were merged to develop a single matrix for the study area using suitable computer programs and the merged OD was used in developing the urban transport model.

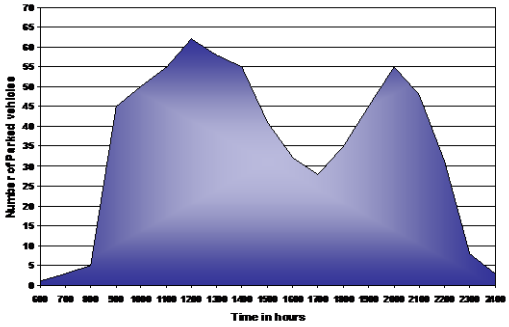
Key Outputs

- Mode-wise OD matrices
- Trip frequency
- Trip purpose
- Average Occupancy

6. Parking Survey

Survey Objective

The principal objective of the study was to assess the demand for parking, characteristics of the parked vehicles, present parking supply, etc in the study area.



Scope of the Survey

Conduct the survey for a period of 12 hours on all major corridors of work centers, business centers, shopping complexes and tourist places. The collected data were used to estimate the on-street parking demand, supply and to identify suitable short and medium term measures to handle parking demand.

Conduct of the Survey

Parking surveys were carried out on all critical area. Enumerators were asked to note the vehicle type and registration number of parked vehicles every half an hour. Information was also collected on the on associated parking fees and an inventory of the parking area was also carried out.

Parking Survey

KEY OUTPUTS

- ➔ *Parking Accumulation - peak and off peak demand at identified locations*
- ➔ *Parking Space Turn over*

On street Parking Survey Locations

1. Mangaldeep T point to Gaddigodam Chowk
2. LIC chowk to Kabdi chowk
3. Indian Coffee House to Bharat Talkies
4. Panchashil Chowk to Lokmat Bhavan Chowk
5. Verity Chowk to Munje Chowk
6. Verity Chowk to Lohapool Chowk
7. Tilak Putla to Gandhi Gate (Tilak Road)
8. Ayachit mandir to CA road
9. Ashok Chowk to Agrasen Chowk
10. Gandhi Putla to Maskasanth Chowk

Data Entry and Analysis

The parking data collected from the field was processed using the appropriate analysis tools. The results are presented in the subsequent section of this report.

Key Outputs:

- Peak Parking Demand Period and supply by Location
- Parking Demand by Vehicle Type
- Parking Duration Information

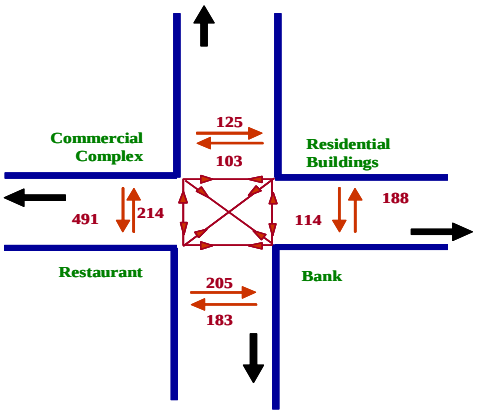
7. Non-motorized Transport Surveys

Survey Objective

The objective of the survey was to identify critical locations for pedestrian/Non-motorized vehicles movement.

Scope of the Survey

Pedestrian count surveys were proposed at critical locations where heavy pedestrian movement (along and across the roads and at intersections) was observed. The survey also covers locations abutting major traffic attraction zones like malls and major work centers.



Conduct of the Survey

Pedestrian counts were carried out at intersection crosswalks, midblock crossings, or along sidewalks for a period of eight hours covering peak periods. The survey was carried out by direction of each pedestrian crossing the roadway and walking across the sidewalks. .

Data Analysis

Data from the Pedestrian counts conducted at several locations on the selected stretches where pedestrians are exposed to risk of accidents were determined.

Key outputs:

- Identification of critical locations for pedestrian/Non-motorized vehicle movement
- Pedestrian Risk Zones
- Finalization of potential sites for safe pedestrian crossing facilities

8. **<u>Household Interview Surveys</u>**

Objective of the Survey

To establish and travel characteristics of the residents and the general socio-economic characteristics of the household influencing trip making. The data is used to develop mode-wise OD matrices to develop base year urban transport model for the study cities.

Scope of Work

The scope of the surveys includes:

- Carry out house hold surveys covering an average sample size of 2% of the population spread across the city.
- Collection of data on socio-economic characteristics, household members and their travel diary.

Conduct of the Survey

Analysis of recent electoral rolls / census details gave a basis of selection of the sample. Stratified random sampling technique representing the entire population was considered for selecting the samples. A statistically valid basis for expansion of the sample adequate to represent the total population of the study area and the

geographical distribution of trips is adopted.

The survey questionnaire comprises three sections, a) Socio-economic datasheet, b) household member characteristic datasheet, and c) the travel diary of each individual member of the household. The travel diary section requests information for all trips made by each person in the household for the previous day. This information includes the time of the trip, the trip purpose, the address of the trip starting, ending place and the mode of travel. The respondents were also given a set of stated preference questions to provide additional details about their mode choice preferences across a range of travel conditions. A complete household survey script was developed for client review. While the interviewers were trained in the details of how to collect the survey data, the forms were designed to be self-explanatory and to minimize the chances of miscoding or omitting data.

Ethical Issues

Utmost care was taken during the field work to ensure total confidentiality of the responses. Field operations were carried out as per the accepted ethical standards and human dignity. The respondents were explained about the purpose of the study and interview before interviewing them.

Data Analysis

The household travel survey sample data thus collected was expanded to represent the entire population. A bi-proportional fitting method is used to correct the socio-demographic characteristics of the sample to the known distributions in the latest Census. Corrections for non-response is developed based on the data on the number of contacts needed to generate a household response. Imputation methods that preserve the distribution of missing data elements is used wherever appropriate to fill in important pieces of missing information in the survey responses.

The household survey is used to estimate mode splits and mode choice model parameters. The trip diary information gave descriptive information about current mode choices. Combined with network information about available mode options, this information can also be used as "revealed preference" data to estimate parameters of a mode choice model.

Household Travel Surveys

KEY OUTPUTS

- ➔ *Household trip rates for different areas in region and average trip rate for entire region*
- ➔ *Detailed origin / destination trip matrix by mode and purpose*
- ➔ *Trip length distributions by trip purpose and mode*

Key Outputs:

The outputs from the survey include

- Average household trip rate for the study area.
- Origin/destination trip matrix by mode
- Mode share
- Trip length distributions by mode

9. **<u>Public Transport and Intermediate Public Transport Passengers Survey (Intra-city Passengers Survey)</u>**

Survey Objective

The objective of the survey is to assess the modal split among different modes of transportation for the intra-city travelers.

Scope of the Survey

Conduct the survey for a period of 12 hours on different routes operating within the city and terminal areas.

Conduct of the Survey

Information regarding origin, destination, trip purpose, frequency of travel and other particulars are gathered. The random survey sampling technique is adopted and survey has covered all modes i.e. taxis, auto-rickshaws, local buses, etc. Pricing information is also collected.

Data Entry and Analysis

The survey data collected from the field will be processed using appropriate analysis tools.

Public Transport Passenger Count

KEY OUTPUTS

➔ *Number of passengers boarding and alighting buses at different bus stops*

Key Outputs:

- Mode Choice Split
- Trip Characteristics of Mass Transport User

10. <u>Commuter Surveys (Intercity Passengers Survey) – Intercity Bus and rail Passenger Survey</u>

Survey Objective

The principal objective of the study is to assess the magnitude of the movements of passengers plying between study area and the rest of the state and country.

Scope of the Survey

The survey was conducted for a period of 12 hours at intercity bus stations, railway stations, and at outer cordon points.

Locations list for rail terminal survey

1. Nagpur Central Railway Station
2. Ajini Railway Station
3. Itwari Railway Station
4. Kalamna Railway Station

Locations list for bus terminal survey

1. Ganeshpeth S.T. stand
2. M.P. bus stand
3. Agayaram Devi chowk
4. Baidyanath Chowk
5. Geethanjali talkies near Gandhi Bagh
6. Ravi nagar chowk

Public Transport OD Survey

KEY OUTPUTS

➔ *Public Transport Matrix for bus users*

Conduct of the Survey

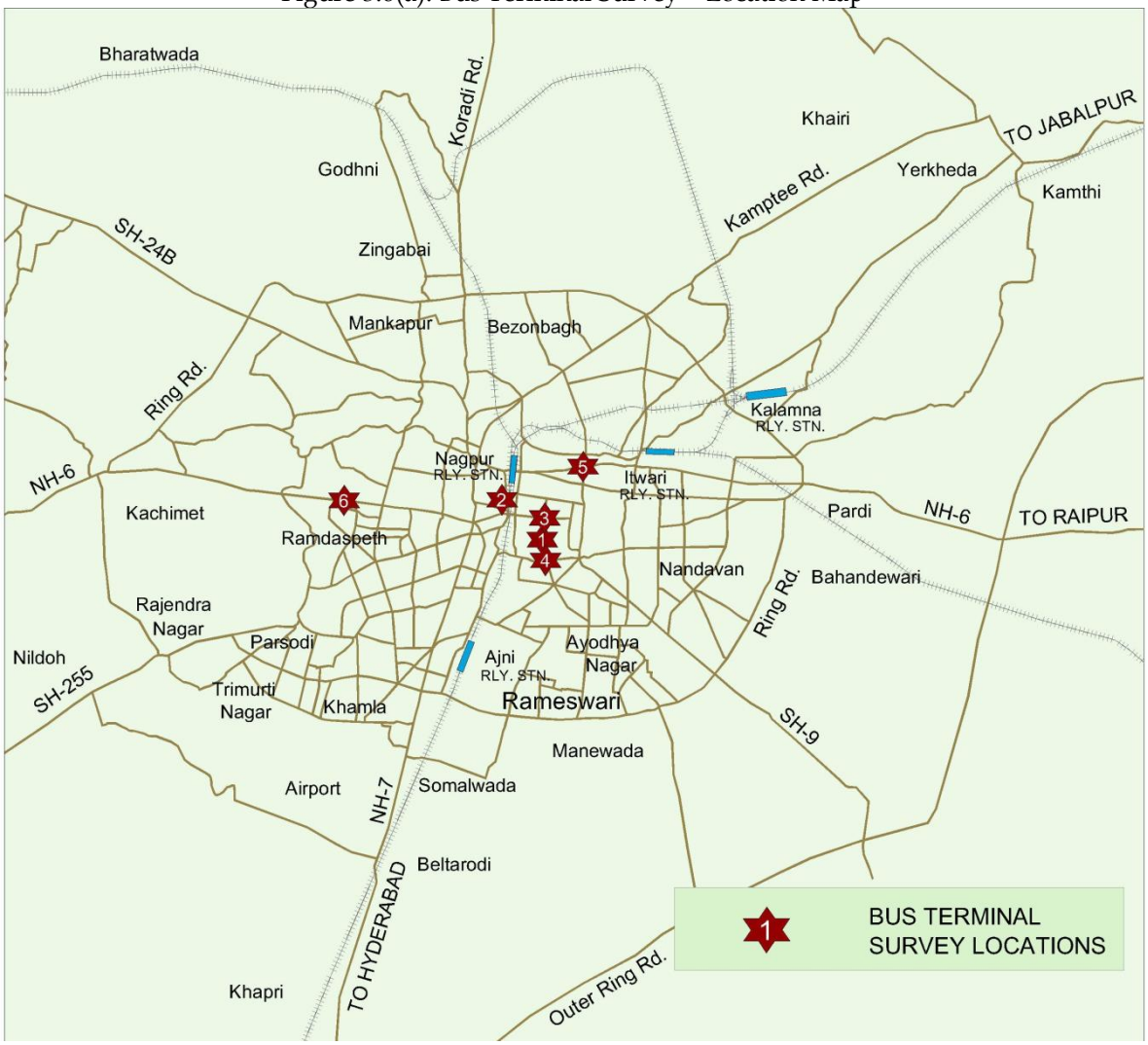
Questionnaire was designed to broadly collect the following information.

Trip Characteristics – origin, destination trip purpose, mode used, cost, travel time to access the terminal etc.

Enumerators were stationed at terminals i.e. railway station, inter-city bus stations and private bus stands to interview incoming and outgoing passengers on a sample basis. The details pertaining to the trip information, further journey details, socio-economic data etc. was collected during the interview.

Simultaneously, counts were carried throughout the survey duration to determine the sample size interviewed. The concerned Railway authorities, private bus operators and other public sector transport operators were contacted to get information on daily travel to expand the sample data.

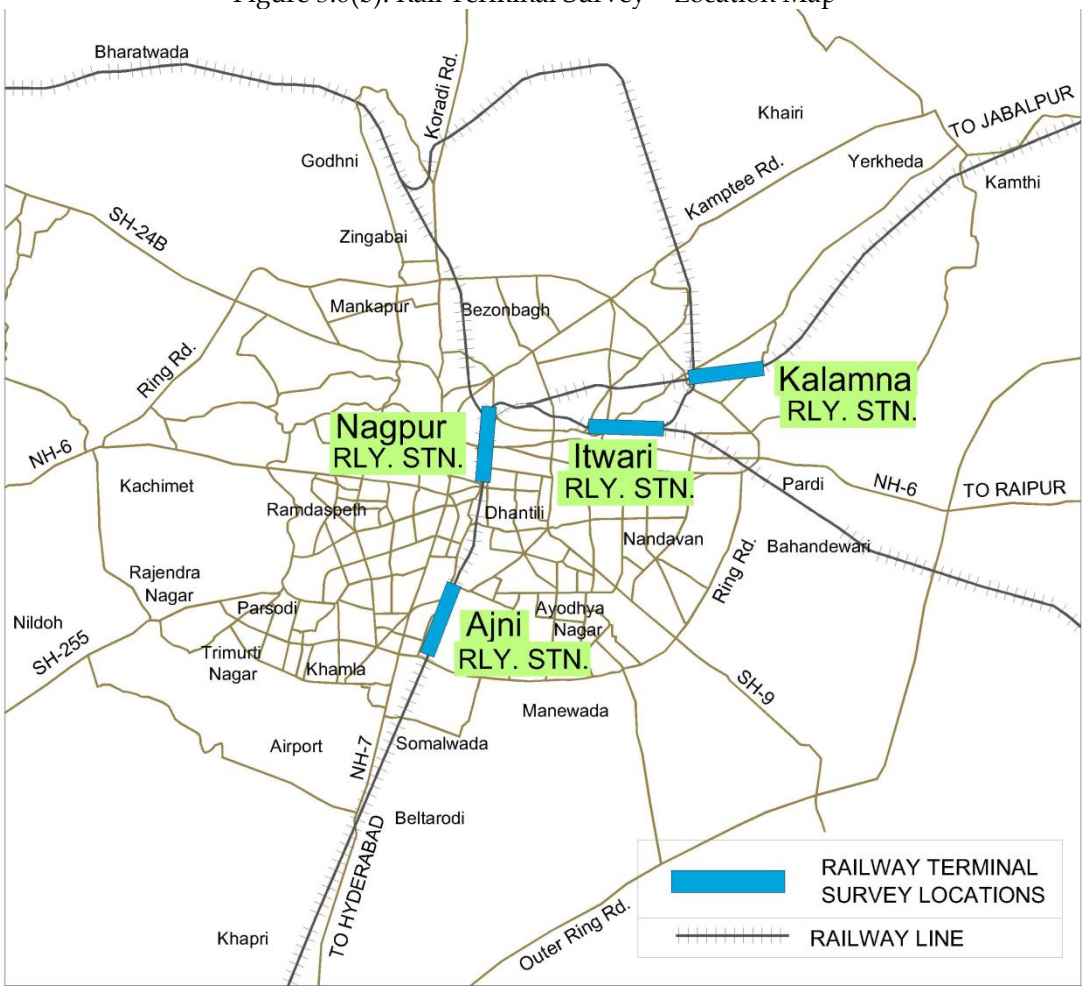
Figure 3.6(a): Bus Terminal Survey – Location Map



Key Outputs:

- External O-D matrix by mode and purpose
- Terminal Access mode choices/preferences

Figure 3.6(b): Rail Terminal Survey – Location Map



11. <u>Goods Focal point Survey / Vehicle Operator's Survey / Commercial Vehicle Survey</u>

Survey Objective

Primary objective of the freight surveys is to establish the existing commercial vehicle quantum and pattern in the study area.

Scope of Survey

Collection of regional freight movement data, their origins and destinations within and outside the study area.

Collect data on commodity-wise quantity of freight movement within the study area, their frequent origins and destinations.

Collect the data on operations of industries and firms which transport goods within and outside the study area producing the demand for goods movement.

Besides trucks, a survey of operators of taxis, auto-rickshaws was conducted to determine the operating costs, routes of operation etc.

Conduct of the Survey

Two types of field surveys were conducted to obtain data about the goods movement:

The cordon line / screenline Roadside interview surveys were carried out.

Goods Focal Point Surveys

KEY OUTPUTS

- *Commercial vehicle O D matrix*
- *Commercial Vehicle Operating costs*
- *Truck trip rates*

The survey of different categories of trucking companies operating in the study area and details on companies generating bulk goods were conducted. Data collection in the cordon survey is limited to transport characteristics of the goods vehicle such as origin and destination, type of commodity, quantity and frequency of travel. The survey of industries and trucking companies is obviously a more detailed approach of collecting the information at the level of goods demand generation process.

Key Outputs

Commercial vehicle O-D Matrix

- Commercial Vehicle Operating Cost
- Truck trip rates

12. Environmental Survey

Environmental Profile

In this phase, the available data on general and environmental profile was collected from various secondary sources. Information such as population, physical and climatic features, ambient environmental quality, details of water bodies, ecological features, etc of the town comprising the area coming under the local planning area, was obtained.

The data is collected from various government agencies such as the Municipal Corporation, Pollution Control Board, India Meteorological Department (IMD and published research papers, past study reports etc.

In addition to the above secondary data, field reconnaissance surveys and discussions were held with the stake holder agencies and institutions to understand the impacts of traffic and transportation trends on the environmental quality of the town.

Environmental Profile

KEY OUTPUTS

- *Environmental Profile and Linkages with Traffic and Transportation*

Summary

The summary list of various surveys conducted in the study area is presented in Table 3.1

Table 3.1: Summary Table - List of Surveys

Sl. No.	Name of the Survey	Quantity
1	Road Network Inventory	Major roads
2	Screen line Volume Count Survey	39
3	Turning Volume count survey	31
4	Bus stop Boarding and alighting survey	25
5	Passenger in and out count / OD survey - Railway station	10
6	Pedestrian Counts – mid-blocks	18
8	Outer Cordon Traffic Counts	8
8	Speed and Delay Survey	150 Kms
9	O – D Survey (Including Goods Vehicles)	8
10	Bus Occupancy Survey	39
11	Household Interview Survey	2%
12	IPT Operator survey	50 Samples
13	NMT Opinion survey	200 Samples
14	Parking duration survey (On street)	10
15	Truck Operator survey	50 Samples

Chapter 4
Data Analysis

The last chapter discussed the type of surveys and survey locations along with their purpose and expected outcome. In this section the salient results of primary surveys will be presented and discussed.

4.1 Screen line Volume Count / Outer Cordon Volume Count Survey

Primary traffic volume count surveys on screen lines have been conducted to collect the traffic data for the urban demand model validation. The vehicles counted were converted to Passenger Car Units (PCU) by adopting equivalent PCUs. The PCUs corresponding to urban roads as per IRC: 106-1990 are used and the PCU values adopted are given in Table 4.1.

Table 4.1: PCU factors adopted for the study

Vehicle Type	PCU Values	
	Urban	
	UP TO 5 %	> 5%
Buses	2.2	3.7
Minibus	1.5	1.5
Car/Jeep/Van	1	1
Two Wheeler	0.5	0.75
Auto Rickshaw	1.2	2
Trucks	2.2	3.7
MAV	4	5
LCV	1.4	2
Cycles	0.4	0.5
Carts	2	3
Cycle Rickshaw	2	3
Mofussil Bus	2.2	3.7
Other Bus	2.2	3.7

(Source:- IRC:106-1990)

The direction-wise daily traffic observed at all the screen line locations is presented in Table 4.2.

Table 4.2: Traffic Observed at Screen-line Locations

Sl. No	Location Name	Direction (Towards)	Count		Total	
			Vehicles	PCU	Vehicles	PCU
SCR 1	Level crossing at Gungaon Road (near Jamtha Cricket stadium)	Wardha	1620	2402	3383	4942
		Hingna	1763	2540		
SCR 2	Level crossing at Khapri Road (Near HPCL – LPG Plant)	Kaphri	1306	2540	2512	2139
		Wardha	1206	985		
SCR 3	Level crossing near Manish Nagar (near Airport)	Hyderabad	11546	16332	23286	34068
		Nagpur	11740	17736		
SCR 4	Somalwada Railway Crossing	Somalwada	6289	5418	13292	11304
		Nagar	7003	5886		
SCR 5	ROB Narendra Nagar Crossing	Manewada Chowk	31247	27106	65972	57454
		HIngna	34725	30348		
SCR 6	RUB at Narendra Nagar	Manewaad	28144	25253	62394	56989
		Chatrapati Chowk	34250	31736		

Sl. No	Location Name	Direction (Towards)	Count		Total	
			Vehicles	PCU	Vehicles	PCU
SCR 7	ROB near Ajini station	Ajini circle	28665	27996	51658	47707
		Medical Chowk	22993	19711		
SCR 8	Crossing near Ghat Road	Reshim bagh chowk	39358	34486	78251	69743
		Bardi	38893	35357		
SCR 9	Near Cotton Market Chowk	Ganeshpeth	28681	25542	56899	49929
		Bardi	28218	24387		
SCR 10	Near Nagpur Rly Stn on C.A. road	Gandhi bagh	37090	33519	69201	63866
		LIC	32111	30347		
SCR 11	RUB Near Gaddi Godam	LIC	25739	21788	51127	43288
		Kamptee	25388	21500		
SCR 13	ROB near Mecosabagh	Katol Road	10298	9122	21029	18612
		Kadbi chowk	10721	9490		
SCR 14	ROB near Jaripatka	Jaripatka	7100	5529	13247	10522
		Chinwada Rd	6147	4994		
SCR 15	ROB near Mankapur	East	13942	21139	28820	41232
		West	14878	20493		
SCR 16	Rly. Crossing on Koradi road	koradi rd	14004	16250	32178	36191
		Inner ring rd	18174	19941		
SCR 18	Nala crossing at Pardi (NH – 6)	Bhandara	33122	33322	62339	63373
		inner ring rd	29217	30051		
SCR 19	Nala crossing near Prajapathi chowk	Pardi	12566	16725	27078	36538
		Umred	14512	19813		
SCR 21	Nala crossing near Jagnade chowk	Umred	19255	16902	36409	32042
		C.A. rd	17154	15140		
SCR 22	Nala crossing near Ghat Road	Ghat Road	18916	18340	35001	33105
		Unred Road	16065	14765		
SCR 23	Nala crossing near Ashoka	Ashoka Chowk	20116	18007	38672	34592
		Mahal Square	18556	16585		
SCR 24	Nala crossing near Tulsi Bagh chowk	Tulsi bagh	7235	6390	14214	12173
		Mahal	6979	5783		
SCR 25	Nala crossing near SH-9	Medical Chowk	26938	28218	56098	58841
		Gandhi Sagar	29160	30623		
SCR 26	Nala crossing near S T Bus Stand	S T stand	22811	25474	42621	46527
		Baidyanath Chowk	19810	21053		
SCR 28	Nala crossing near ST Bus workshop	Cotton market	21695	18287	41929	36555
		Medical Chowk	20234	18269		
SCR 29	Nala crossing near Dhanroli	Bardi	21490	19292	44068	37305
		Rly stn	22578	18012		
SCR 30	Nala crossing near Yashvant Stadium	central jail	20593	19504	39097	37135
		Munje Chowk	18504	17631		
SCR 31	Nala crossing near Panchasheel Theatre	Wardha Rd	17566	17068	38690	39214
		Variety Chowk	21124	22146		
SCR 32	Nala crossing near University Library	N Ambazari rd	9554	7987	19889	16626
		Ramdas peth	10335	8638		
SCR 33	Nala crossing near Poonam Hall	N Ambazari rd	17544	15015	39064	33265
		Central Bazaar	21520	18250		
SCR 34	Nala crossing near Shankar Nagar Post Office	Ambazai Rd	19289	19452	37094	37200
		Shankar Nagar	17805	17748		
SCR 35	Nala crossing near Gandhi Bhavan	N Amzazari rd	15173	13800	25311	23240
		Ambedkar nagar	10138	9440		
SCR 36	Nala crossing near Crazy Castle Amusement park	HIngna	20075	17234	43864	37886
		Crazy Castle	23771	20652		
SCR 37	Coca Cola Factory on Inner Ring road	HIngna rd	9010	11113	16769	21222
		Amravati rd	7759	10109		
SCR 38	Nala crossing near Nildoh	Hingna rd	5311	5639	9727	11190

Sl. No	Location Name	Direction (Towards)	Count		Total	
			Vehicles	PCU	Vehicles	PCU
		New Nildoh	4416	5552		

Note: For 16 hours: 6am to 10pm also Location number 12, 17, 20, 27 and 39 are under construction hence not presented

Peak Hour Traffic

The peak hour traffic volume in PCUs, Daily PCUs and percent peak hour share at all the locations are presented in Table 4.3, and by composition of vehicles in Table 4.4a and Table 4.4b.

Table 4.3: Peak Hour Traffic at Screenline Locations

Sl. No	Location Name	Peak Hour PCU	(16 hr) PCU	Percent Peak Hour Share (%) PCU
SCR 1	Level crossing at Gungaon Road (near Jamtha Cricket stadium)	337	4942	7%
SCR 2	Level crossing at Khapri Road (Near HPCL – LPG Plant)	147	2139	7%
SCR 3	Level crossing near Manish Nagar (near Airport)	2253	34068	6.5%
SCR 4	Somalwada Railway Crossing	884	11304	8%
SCR 5	ROB Narendra Nagar Crossing	4517	57454	8%
SCR 6	RUB at Narendra Nagar	4537	56989	8%
SCR 7	ROB near Ajini station	4482	47707	9%
SCR 8	Crossing near Ghat Road	5528	69743	8%
SCR 9	Near Durga Mata Mandir at Lohapul	3625	49929	7%
SCR 10	Near Nagpur Rly Stn on C.A. road	4321	63866	8%
SCR 11	RUB Near Gaddi Godam	3818	43288	9%
SCR 13	ROB near Mecosabagh	1564	18612	8.5%
SCR 14	ROB near Jaripatka	851	10522	8%
SCR 15	ROB near Mankapur	3625	41232	9%
SCR 16	Rly. Crossing on Koradi road	3315	36191	9%
SCR 18	Nala crossing at Pardi (NH – 6)	4402	63373	7%
SCR 19	Nala crossing near Prajapathi chowk	2493	36538	7%
SCR 21	Nala crossing near Jagnade chowk	2698	32042	8%
SCR 22	Nala crossing near Ghat Road	2280	33105	7%
SCR 23	Nala crossing near Ashoka Square	2519	34592	7%
SCR 24	Nala crossing near Tulsi Bagh chowk	242	12173	8%
SCR 25	Nala crossing near SH-9	4165	58841	7%
SCR 26	Nala crossing near S T Bus Stand	3917	46527	8.5%
SCR 28	Nala crossing near ST Bus workshop	2759	36555	8%
SCR 29	Nala crossing near Dhantoli	2618	37305	7%
SCR 30	Nala crossing near Yashvant Stadium	1691	37135	4.5%
SCR 31	Nala crossing near Panchasheel Theatre	2733	39214	7%
SCR 32	Nala crossing near University Library	1380	16626	8%
SCR 33	Nala crossing near Poonam Hall	2462	33265	7.5%
SCR 34	Nala crossing near Shankar Nagar Post Office	2701	37200	7%
SCR 35	Nala crossing near Gandhi Bhavan	2674	23240	12%
SCR 36	Nala crossing near Crazy Castle Amusement park	3205	37886	8.5%
SCR 37	Coca Cola Factory on Inner Ring road	1698	21222	8%
SCR 38	Nala crossing near Nildoh	485	11190	4%

Table 4.4a: Peak Hour Traffic Composition (number of Veh) at screen line locations

		City Bus	Long Distance Bus	Institutional / Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rick-shaw	L C V	2-Axle Truck	M A V	Trac-tor	Cycle Rick-shaw	Cycle	Cart	Total Vehic les
SCR 1	Level crossing at Gungaon Road (near Jamtha Cricket stadium)	0	0	0	0	3	19	0	140	2	16	20	14	14	2	0	28	0	258
SCR 2	Level crossing at Khapri Road (Near HPCL – LPG Plant)	0	0	1	0	2	16	0	130	0	5	8	1	0	0	0	15	0	178
SCR 3	Level crossing near Manish Nagar (near Airport)	10	85	5	33	26	404	26	810	1	14	73	161	11	5	4	33	0	1701
SCR 4	Somalwada Railway Crossing	0	0	1	0	7	204	1	607	8	30	24	10	0	0	11	194	0	1097
SCR 5	ROB Narendra Nagar Crossing	1	4	0	5	0	620	72	4038	52	137	69	39	1	2	3	742	0	5785
SCR 6	RUB at Narendra Nagar	11	1	4	6	6	923	0	3591	25	156	38	8	59	1	27	531	0	5387
SCR 7	ROB near Ajini station	10	0	10	0	18	255	14	3725	266	263	43	54	4	0	26	328	0	5016
SCR 8	Crossing near Ghat Road	2	87	3	18	5	596	23	4174	150	319	101	1	4	0	28	1052	0	6563
SCR 9	Near Durga Mata Mandir at Lohapul	44	5	0	2	2	185	0	1649	186	940	19	0	11 8	16	151	197	0	3513
SCR 10	Near Nagpur Rly Stn on C.A. road	6	18	11	0	2	405	7	3108	112	470	53	25	3	0	70	356	0	4646
SCR 11	RUB Near Gaddi Godam	12	31	3	5	8	546	9	2930	0	257	123	35	3	0	86	519	0	4567
SCR 13	ROB near Mecosabagh	0	0	1	0	7	404	18	1047	6	104	96	6	1	2	10	84	0	1786
SCR 14	ROB near Jaripatka	0	0	0	0	0	275	0	547	0	45	4	0	0	0	2	207	0	1080
SCR 15	ROB near Mankapur	9	1	0	1	2	185	0	2932	129	235	4	0	60	1	67	786	0	4412
SCR 16	Rly. Crossing on Koradi road	14	17	5	12	23	544	4	1832	108	70	121	166	18	3	42	178	0	3157
SCR	Nala crossing at Pardi	55	54	0	0	0	432	8	2210	219	177	65	160	18	16	69	2140	2	5787

		City Bus	Long Distance Bus	Institutional / Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rick-shaw	L C V	2-Axle Truck	M A V	Trac-tor	Cycle Rick-shaw	Cycle	Cart	Total Vehic les
18	(NH – 6)													0					
SCR 19	Nala crossing near Prajapathi chowk	2	0	0	0	1	144	9	1231	31	63	69	128	70	8	33	534	0	2323
SCR 21	Nala crossing near Jagnade chowk	4	31	1	2	14	262	3	2151	5	72	84	64	6	0	82	451	0	3232
SCR 22	Nala crossing near Ghat Road	0	30	7	10	18	394	0	1248	22	146	15	0	73	0	93	484	0	2540
SCR 23	Nala crossing near Ashoka Square	4	17	0	9	10	297	9	1866	50	118	42	2	3	1	97	437	2	2964
SCR 24	Nala crossing near Tulsi Bagh chowk	3	2	1	1	34	59	0	663	28	60	24	0	0	1	37	208	0	1121
SCR 25	Nala crossing near SH-9	0	14	15	3	0	400	0	3200	30	303	32	1	71	0	64	770	0	4903
SCR 26	Nala crossing near S T Bus Stand	15	131	2	18	9	229	36	2111	12	510	42	1	0	2	236	324	0	3678
SCR 28	Nala crossing near ST Bus workshop	0	42	1	10	0	277	0	2513	22	72	67	8	0	0	102	144	0	3258
SCR 29	Nala crossing near Dhantoli	0	12	7	3	0	237	0	1950	12	236	41	13	1	0	36	592	0	3140
SCR 30	Nala crossing near Yashvant Stadium	1	0	2	0	1	167	4	983	171	110	25	10	0	0	116	238	0	1828
SCR 31	Nala crossing near Panchasheel Theatre	14	14	3	0	10	307	0	1383	38	494	10	3	16	0	37	331	0	2660
SCR 32	Nala crossing near University Library	0	1	0	0	0	349	6	1010	21	64	2	2	0	0	14	270	0	1739
SCR 33	Nala crossing near Poonam Hall	0	0	0	0	0	608	7	1795	13	113	27	22	2	4	28	386	0	3005
SCR 34	Nala crossing near Shankar Nagar Post Office	0	2	2	0	5	613	0	1851	13	257	0	0	14	0	7	253	0	3017
SCR 35	Nala crossing near Gandhi Bhavan	8	0	0	0	0	543	4	1658	18	287	28	6	2	2	16	351	0	2923
SCR 36	Nala crossing near Crazy Castle	8	12	4	0	4	741	0	2360	133	89	32	5	91	4	13	235	0	3731

		City Bus	Long Distance Bus	Institutional / Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rick-shaw	L C V	2-Axle Truck	M A V	Trac-tor	Cycle Rick-shaw	Cycle	Cart	Total Vehic les
	Amusement park																		
SCR 37	Coca Cola Factory on Inner Ring road	0	0	2	0	0	166	3	896	12	15	56	102	60	2	1	108	0	1423
SCR 38	Nala crossing near Nildoh	0	0	0	0	4	33	0	246	3	17	62	16	4	0	2	83	0	470

Table 4.4b: Peak Hour Traffic Composition (in Veh %) at screen line locations

No	Location Name	City Bus	Long Distance Bus	Institutional /Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Ricks haw	LC V	2-Axle Truck	MA V	Tra ctor	Cycle Ricks haw	Cycle	Cart
SCR 1	Level crossing at Gungaon Road (near Jamtha Cricket stadium)	0%	0%	0%	0%	1%	7%	0%	54%	1%	6%	8%	5%	5%	1%	0%	11%	0%
SCR 2	Level crossing at Khapri Road (Near HPCL – LPG Plant)	0%	0%	1%	0%	1%	9%	0%	73%	0%	3%	4%	1%	0%	0%	0%	8%	0%
SCR 3	Level crossing near Manish Nagar (near Airport)	1%	5%	0%	2%	2%	24%	2%	48%	0%	1%	4%	9%	1%	0%	0%	2%	0%
SCR 4	Somalwada Railway Crossing	0%	0%	0%	0%	1%	19%	0%	55%	1%	3%	2%	1%	0%	0%	1%	18%	0%
SCR 5	ROB Narendra Nagar Crossing	0%	0%	0%	0%	0%	11%	1%	70%	1%	2%	1%	1%	0%	0%	0%	13%	0%
SCR 6	RUB at Narendra Nagar	0%	0%	0%	0%	0%	17%	0%	67%	0%	3%	1%	0%	1%	0%	1%	10%	0%
SCR 7	ROB near Ajini station	0%	0%	0%	0%	0%	5%	0%	74%	5%	5%	1%	1%	0%	0%	1%	7%	0%
SCR 8	Crossing near Ghat Road	0%	1%	0%	0%	0%	9%	0%	64%	2%	5%	2%	0%	0%	0%	0%	16%	0%
SCR 9	Near Durga Mata Mandir at Lohapul	1%	0%	0%	0%	0%	5%	0%	47%	5%	27%	1%	0%	3%	0%	4%	6%	0%
SCR 10	Near Nagpur Rly Stn on C.A. road	0%	0%	0%	0%	0%	9%	0%	67%	2%	10%	1%	1%	0%	0%	2%	8%	0%
SCR 11	RUB Near Gaddi Godam	0%	1%	0%	0%	0%	12%	0%	64%	0%	6%	3%	1%	0%	0%	2%	11%	0%
SCR 13	ROB near Mecosabagh	0%	0%	0%	0%	0%	23%	1%	59%	0%	6%	5%	0%	0%	0%	1%	5%	0%

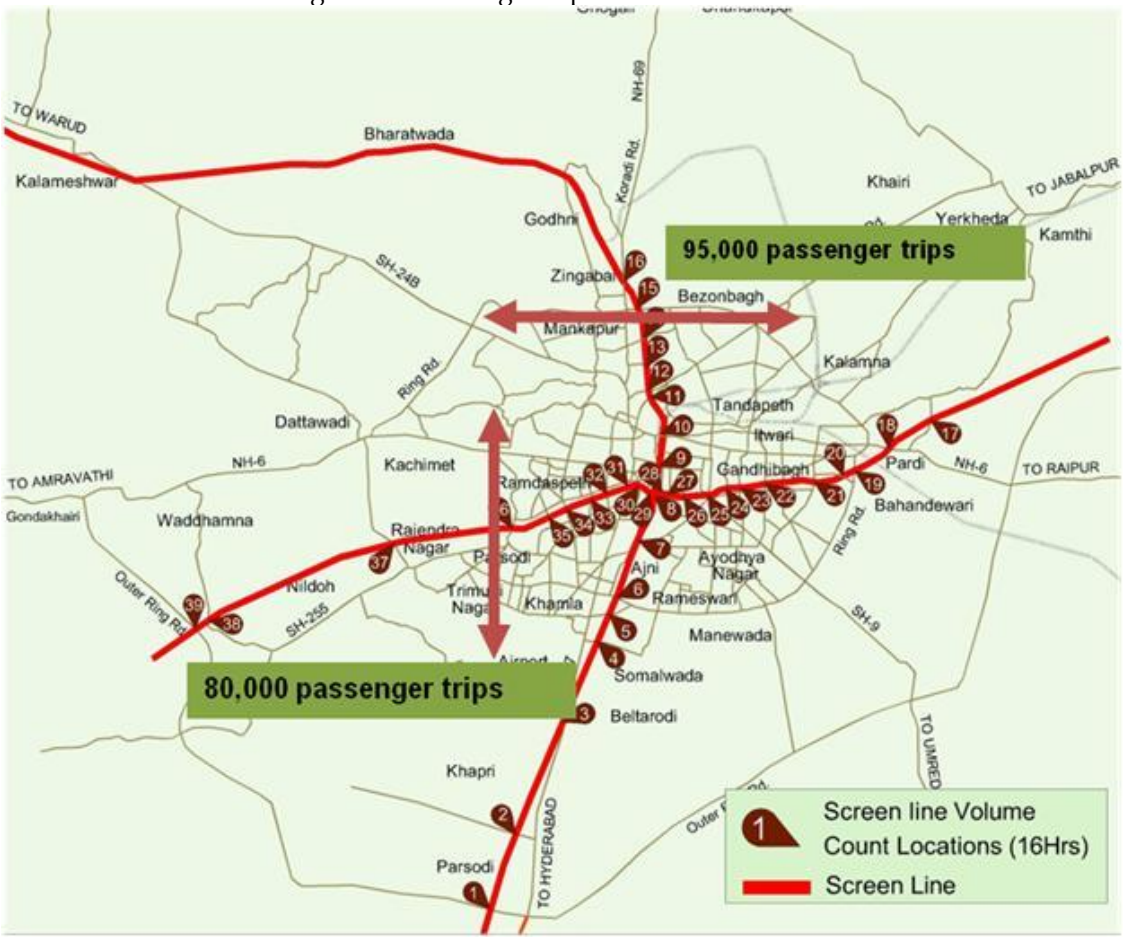
No	Location Name	City Bus	Long Distance Bus	Institutional /Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rickshaw	LCV	2-Axle Truck	MAV	Tractor	Cycle Rickshaw	Cycle	Cart
SCR 14	ROB near Jaripatka	0%	0%	0%	0%	0%	25%	0%	51%	0%	4%	0%	0%	0%	0%	0%	19%	0%
SCR 15	ROB near Mankapur	0%	0%	0%	0%	0%	4%	0%	66%	3%	5%	0%	0%	1%	0%	2%	18%	0%
SCR 16	Rly. Crossing on Koradi road	0%	1%	0%	0%	1%	17%	0%	58%	3%	2%	4%	5%	1%	0%	1%	6%	0%
SCR 18	Nala crossing at Pardi (NH – 6)	1%	1%	0%	0%	0%	7%	0%	38%	4%	3%	1%	3%	3%	0%	1%	37%	0%
SCR 19	Nala crossing near Prajapathi chowk	0%	0%	0%	0%	0%	6%	0%	53%	1%	3%	3%	6%	3%	0%	1%	23%	0%
SCR 21	Nala crossing near Jagnade chowk	0%	1%	0%	0%	0%	8%	0%	67%	0%	2%	3%	2%	0%	0%	3%	14%	0%
SCR 22	Nala crossing near Ghat Road	0%	1%	0%	0%	1%	16%	0%	49%	1%	6%	1%	0%	3%	0%	4%	19%	0%
SCR 23	Nala crossing near Ashoka Square	0%	1%	0%	0%	0%	10%	0%	63%	2%	4%	1%	0%	0%	0%	3%	15%	0%
SCR 24	Nala crossing near Tulsi Bagh chowk	0%	0%	0%	0%	3%	5%	0%	59%	2%	5%	2%	0%	0%	0%	3%	19%	0%
SCR 25	Nala crossing near SH-9	0%	0%	0%	0%	0%	8%	0%	65%	1%	6%	1%	0%	1%	0%	1%	16%	0%
SCR 26	Nala crossing near S T Bus Stand	0%	4%	0%	0%	0%	6%	1%	57%	0%	14%	1%	0%	0%	0%	6%	9%	0%
SCR 28	Nala crossing near ST Bus workshop	0%	1%	0%	0%	0%	9%	0%	77%	1%	2%	2%	0%	0%	0%	3%	4%	0%
SCR 29	Nala crossing near Dhantoli	0%	0%	0%	0%	0%	8%	0%	62%	0%	8%	1%	0%	0%	0%	1%	19%	0%
SCR 30	Nala crossing near Yashvant Stadium	0%	0%	0%	0%	0%	9%	0%	54%	9%	6%	1%	1%	0%	0%	6%	13%	0%
SCR 31	Nala crossing near Panchasheel Theatre	1%	1%	0%	0%	0%	12%	0%	52%	1%	19%	0%	0%	1%	0%	1%	12%	0%
SCR 32	Nala crossing near University Library	0%	0%	0%	0%	0%	20%	0%	58%	1%	4%	0%	0%	0%	0%	1%	16%	0%
SCR 33	Nala crossing near Poonam Hall	0%	0%	0%	0%	0%	20%	0%	60%	0%	4%	1%	1%	0%	0%	1%	13%	0%
SCR 34	Nala crossing near Shankar	0%	0%	0%	0%	0%	20%	0%	61%	0%	9%	0%	0%	0%	0%	0%	8%	0%

No	Location Name	City Bus	Long Distance Bus	Institutional /Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rickshaw	LCV	2-Axle Truck	MAV	Tractor	Cycle Rickshaw	Cycle	Cart
	Nagar Post Office																	
SCR 35	Nala crossing near Gandhi Bhavan	0%	0%	0%	0%	0%	19%	0%	57%	1%	10%	1%	0%	0%	0%	1%	12%	0%
SCR 36	Nala crossing near Crazy Castle Amusement park	0%	0%	0%	0%	0%	20%	0%	63%	4%	2%	1%	0%	2%	0%	0%	6%	0%
SCR 37	Coca Cola Factory on Inner Ring road	0%	0%	0%	0%	0%	12%	0%	63%	1%	1%	4%	7%	4%	0%	0%	8%	0%
SCR 38	Nala crossing near Nildoh	0%	0%	0%	0%	1%	7%	0%	52%	1%	4%	13 %	3%	1%	0%	0%	18%	0%

Screenline Observations

- The daily traffic at screen line ranges between 20,000 vehicles to 80,000 vehicles for period of 16 hours. The maximum traffic was found at Nala crossing near Ghat Road (SCR 8) with almost 79,000 vehicles. It was observed that the screenline locations along the Nala parallel to C.A. road carries heavy traffic with more than 50,000 vehicles per day.
- The peak hour pcu traffic is approximately 7-8% of the daily traffic pcu observed.
- The peak hour factor for passenger trips is 9.4%
- Amongst the total passenger trips, 95,000 passenger trips are observed crossing the vertical screenline (rail line) which is higher compared with the trips observed across horizontal screenline (nala).

Figure 4.1: Passenger trips across the Screenline



Outer cordon volume count survey

Classified traffic volume counts along with the road side interviews have been carried out to assess the quantum of travel across the cordon and to understand the travel patterns. Total inbound and outbound traffic at cordon locations is presented in Table 4.5

Table 4.5: Day Traffic at Outer Cordon Locations

No.	Location Name	Towards Nagpur		Outside Nagpur		Total Vehicle	Total PCU
		Veh	PCU	Veh	PCU		
1	Wardha road	13833	28081	12400	22127	26233	50208
2	Hingna road	2903	3704	3059	3971	5962	7675
3	Amaravati road	6585	13949	7518	13061	14103	27011
4	Katol road	2514	2963	2125	2554	4639	5516
5	Chindawada road	7139	9629	7697	10717	14836	20345
6	Jabalpur road	3765	7754	4869	8614	8634	16368
7	Raipur road	10591	23555	10024	21187	20615	44743
8	Umred road	8893	11806	7872	12843	16765	24649

It is observed that the major traffic flow is through Wardha Road catering 50208 pcu per day followed by Raipur Road with 44747 pcu. The difference between total vehicle and pcu shows higher percentage share of good's vehicle movement at outer cordon locations.

Peak Hour Traffic

The peak hour traffic volume and PCUs of all the locations are presented in Table 4.6. Compared to other locations, Katol Road carry less traffic (less than 600 pcu). The peak hour traffic at remaining locations is found to be in the range of 1000 to 1800 pcu.

Table 4.6: Peak Hour Traffic at Outer Cordon Locations

Location	Location Name	Towards Nagpur		Outside Nagpur		Total Vehicle	Total PCU
		Veh	PCU	Veh	PCU		
1	Wardha road	411	756	815	1075	1226	1831
2	Hingna road	236	339	206	257	442	596
3	Amaravati road	381	687	477	673	858	1360
4	Katol road	152	174	142	145	294	318
5	Chindawada road	491	605	600	685	1091	1291
6	Jabalpur road	328	546	330	418	658	964
7	Raipur road	355	648	1128	1214	1483	1861
8	Umred road	446	546	769	1052	1215	1598

Traffic Composition

Composition of outer cordon traffic during peak hour is presented in Table 4.7a and 4.7b. The share of cars varies between 10% and 29% for the different locations. The highest traffic flow was observed on Raipur Road carrying 1861 pcu per hour following by Wardha road which is catering nearly the same amount of peak hour traffic. The percentage of trucks/ multi axle vehicles varies from 2% to 15% at various locations. MAV share is higher (9%) on Jabalpur Road while major 2 Axle truck movement is found on Amravati, Raipur, Wardha Road and Hingna Road.

Table 4.7a: Peak Hour Traffic Composition (vehicles) at Outer Cordon Locations

Sl. No.	Location	City Bus	Long Distance Bus	Institutional/ Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rickshaw	LCV	2-Axle Truck	MAV	Tractor	Cycle Rickshaw	Cycle	Carts	Total Veh	Total PCU
1	Wardha road	11	72	29	1	127	222	10	433	53	9	68	148	25	2	0	16	0	1226	1831
2	Hingna road	0	0	0	7	10	82	0	208	8	12	27	46	20	0	1	21	0	442	596
3	Amaravati road	0	26	2	1	58	130	4	328	36	20	78	127	24	3	3	6	12	858	1360
4	Katol road	0	12	2	0	0	68	0	165	6	1	14	6	7	0	0	5	8	294	318
5	Chindawada road	0	27	15	2	0	254	14	590	14	20	31	35	49	2	1	37	0	1091	1291
6	Jabalpur road	1	17	0	2	1	94	0	365	15	13	34	32	58	7	0	19	0	658	964
7	Raipur road	0	41	6	4	42	142	12	931	20	19	68	143	27	0	0	28	0	1483	1861
8	Umred road	0	34	0	63	14	352	8	450	13	9	113	83	37	0	0	39	0	1215	1598

Table 4.7b: Peak Hour Traffic Composition (%vehicles) at Outer Cordon Locations

	Location	City Bus	Long Distance Bus	International/ Company Bus	Mini Bus	Van/ Maxi Cab	Car	Taxi	Two-Wheeler	Share Auto	Auto-Rickshaw	LCV	2-Axle Truck	MAV	Tractor	Cycle Rickshaw	Cycle	Cart
1	Wardha road	1%	6%	2%	0%	10%	18%	1%	35%	4%	1%	6%	12%	2%	0%	0%	1%	0%
2	Hingna road	0%	0%	0%	2%	2%	19%	0%	47%	2%	3%	6%	10%	5%	0%	0%	5%	0%
3	Amaravati road	0%	3%	0%	0%	7%	15%	0%	38%	4%	2%	9%	15%	3%	0%	0%	1%	1%
4	Katol road	0%	4%	1%	0%	0%	23%	0%	56%	2%	0%	5%	2%	2%	0%	0%	2%	3%
5	Chindawada road	0%	2%	1%	0%	0%	23%	1%	54%	1%	2%	3%	3%	4%	0%	0%	3%	0%
6	Jabalpur road	0%	3%	0%	0%	0%	14%	0%	55%	2%	2%	5%	5%	9%	1%	0%	3%	0%
7	Raipur road	0%	3%	0%	0%	3%	10%	1%	63%	1%	1%	5%	10%	2%	0%	0%	2%	0%
8	Umred road	0%	3%	0%	5%	1%	29%	1%	37%	1%	1%	9%	7%	3%	0%	0%	3%	0%

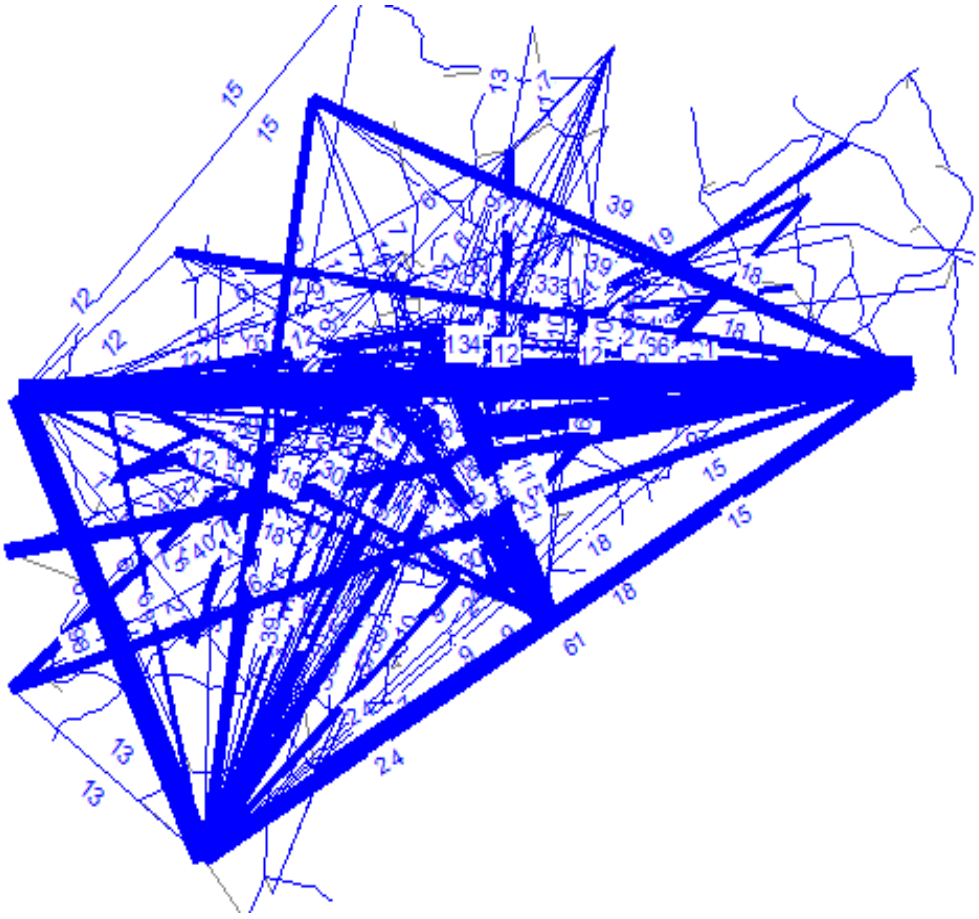
The purpose of the outer cordon survey is to understand the traffic flows from outer zones to the inner city part and vice a versa. The survey also brings out the traffic flows between external to external zones. This also helps in finalizing the truck terminal locations, warehouses and other facilities associated with freight movement. Table 4.8 shows the analysis for internal and external trips. The area within outer ring road boundary is considered as internal area while remaining zones are considered as external area.

Table 4.8: Analysis for Internal and External trips at outer cordon

Analysis	Private Vehicles (PCU)		Commercial Vehicles (PCU)	
	Internal	External	Internal	External
Internal	86%	2%	3%	29%
External	1%	10%	39%	30%

The private vehicle trips were found to be very high in the internal zones (within outer ring road) with 86% of total private vehicle trips. The internal to external and external to internal trips together form 3%. Most of the commercial vehicles are external trips. It is interesting to note that almost 30% commercial trips (in pcu) are external to external which are bypassing Nagpur city. The desire line diagram for Trucks is shown in Figure 4.2 It was observed that Wardha Road, Raipur Road and Amravati Road are carrying major commercial vehicle traffic.

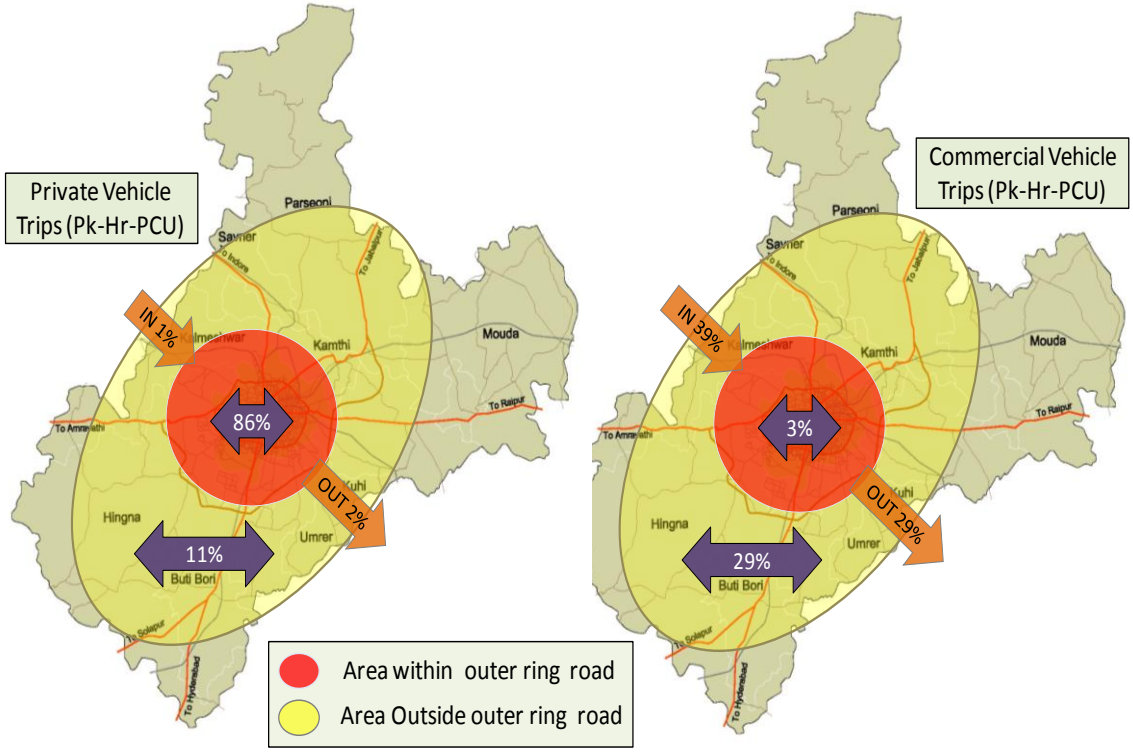
Figure 4.2 Desire line diagram for Truck movement (Base Year)



Outer Cordon Volume Count Observations

- Of the surveyed outer cordon locations, Wardha Road and Raipur Road cater to the major daily traffic.
- The lowest traffic flow was observed on Katol Road, carrying 318 pcu during peak hour.
- The highest traffic flow was observed on Raipur Road carrying 1861 pcu per hour followed by Wardha Road which is catering nearly the same amount of peak hour traffic.
- The percentage of trucks/ multi axle vehicles varies from 2% to 15% at various locations.
- MAV sharewas found higher (9%) on Jabalpur Road
- Major 2 Axle truck and MAV movements were found on Amravati, Raipur, Wardha road.

Figure 4.3: Internal and External Trips in Nagpur



4.2 Bus Stop / Rail Passenger Volume Count

Bus terminal /Railway station passenger count survey was conducted at for understanding total number of incoming and outgoing passengers in Nagpur city. The analysis for major bus stand and railway station is presented in this section.

The maximum numbers of passenger movement was observed at main Nagpur S.T. stand with more than 30,000 passengers in a day. However, the passenger movement at Bardi terminal found heavy with more than 22000 passengers during a day.

Table 4.9: Bus Passenger In and Out Count at Nagpur S.T. Stand (12hrs)

Time	Passengers In	Passengers Out	Total
8:00 to 9:00	2226	994	3220
9:00 to 10:00	1982	1024	3006
10:00 to 11:00	2119	1014	3133
11:00 to 12:00	1761	926	2687
12:00 to 13:00	1445	902	2347
13:00 to 14:00	1391	978	2369
14:00 to 15:00	1442	1006	2448
15:00 to 16:00	1200	1061	2261
16:00 to 17:00	1165	1030	2195
17:00 to 18:00	1043	1022	2065
18:00 to 19:00	903	1458	2361
19:00 to 20:00	801	1300	2101
Total	**17478**	**12715**	**30193**

Table 4.10: Bus Passenger In and Out Count at M.P. Bus Stand (12hrs)

Time	Passengers In	Passengers Out	Total
8:00 to 9:00	126	98	224
9:00 to 10:00	257	140	397
10:00 to 11:00	228	125	353
11:00 to 12:00	203	136	339
12:00 to 13:00	195	177	372
13:00 to 14:00	145	128	273
14:00 to 15:00	166	96	262
15:00 to 16:00	142	84	226
16:00 to 17:00	137	100	237
17:00 to 18:00	129	109	238
18:00 to 19:00	129	79	208
19:00 to 20:00	111	57	168
Total	1968	1329	3297

Table 4.11: Bus Passenger In and Out Count at Bardi Bus Terminal (12hrs)

Time	Passengers In	Passengers Out	Total
8:00 to 9:00	845	595	1440
9:00 to 10:00	920	636	1556
10:00 to 11:00	1193	763	1956
11:00 to 12:00	1214	632	1846
12:00 to 13:00	1053	683	1736
13:00 to 14:00	1097	614	1711
14:00 to 15:00	792	676	1468
15:00 to 16:00	1185	578	1763
16:00 to 17:00	1433	690	2123
17:00 to 18:00	1269	722	1991
18:00 to 19:00	1800	915	2715
19:00 to 20:00	1475	1083	2558
Total	14276	8587	22863

The survey was also carried at railway stations to analyze the daily intercity passenger movement by rail. The analysis for major railway stations is presented below. The main city railway station carries almost 40,000 in and out passenger trips followed by Itwari station with 15,000 passenger trips in and out during a day.

Table 4.12: In and out Passenger Count at Nagpur City Railway station

Time	Passengers In	Passengers Out	Total
8:00 to 9:00	1123	1406	2529
9:00 to 10:00	1360	2575	3935
10:00 to 11:00	1428	1757	3185
11:00 to 12:00	1347	2761	4108
12:00 to 13:00	1253	1592	2845
13:00 to 14:00	1316	1486	2802
14:00 to 15:00	1330	1486	2816
15:00 to 16:00	1642	1439	3081
16:00 to 17:00	2044	1676	3720
17:00 to 18:00	1970	1925	3895
18:00 to 19:00	1679	1460	3139
19:00 to 20:00	1341	1305	2646
Total	17833	20868	38701

Table 4.13: In and out Passenger Count at Itwari Railway station

Time	Passengers In	Passengers Out	Total
8:00 to 9:00	273	553	826
9:00 to 10:00	467	929	1396
10:00 to 11:00	612	1638	2250
11:00 to 12:00	592	1091	1683
12:00 to 13:00	785	322	1107
13:00 to 14:00	645	859	1504
14:00 to 15:00	610	176	786
15:00 to 16:00	939	783	1722
16:00 to 17:00	487	532	1019
17:00 to 18:00	494	184	678
18:00 to 19:00	577	998	1575
19:00 to 20:00	298	137	435
Total	6779	8202	14981

Table 4.14: In and out Passenger Count at Ajni Railway station

Time	Passengers In	Passengers Out	Total
8:00 to 9:00	430	519	949
9:00 to 10:00	70	637	707
10:00 to 11:00	150	445	595
11:00 to 12:00	112	46	158
12:00 to 13:00	55	17	72
13:00 to 14:00	42	398	440
14:00 to 15:00	61	16	77
15:00 to 16:00	29	30	59
16:00 to 17:00	101	170	271
17:00 to 18:00	97	76	173
18:00 to 19:00	51	292	343
19:00 to 20:00	194	37	231
Total	1392	2683	4075

4.3 Pedestrian Volume Count

Pedestrian counts were carried out for a period of 12 hours on a normal working day.

Pedestrian Volume Summary

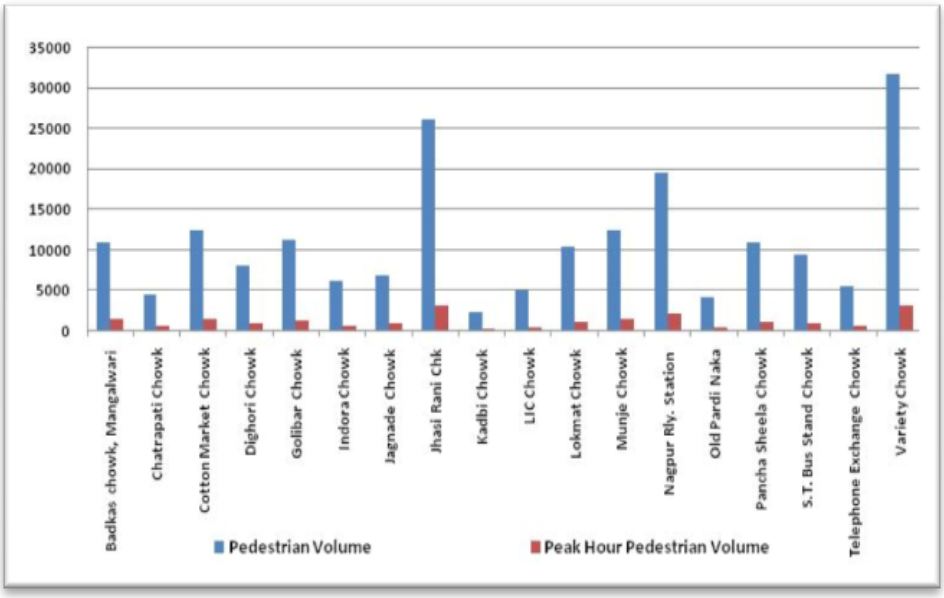
Pedestrian volume counts were carried out from morning 8:00AM to 20:00 PM. The daily pedestrian count summary at the surveyed locations is presented in Table 4.15

Table 4.15: Pedestrian Volume Count Summary-12 Hrs and Peak Hour

Sl No	Locations	Pedestrian Volume (12 Hrs)	Peak Hour	Peak Hour Pedestrian Volume
1	Badkas chowk, Mangalwari	10938	18:00 to 19:00	1501
2.	Chatrapati Chowk	4404	19:00 to 20:00	512
3.	Cotton Market Chowk	12498	11:00 to 12:00	1345
4.	Dighori Chowk	8063	18:00 to 19:00	923
5.	Golibar Chowk	11309	18:00 to 19:00	1309
6.	Indora Chowk	6089	10:00 to 11:00	612
7.	Jagnade Chowk	6931	19:00 to 20:00	981
8.	Jhasi Rani Chowk	26234	17:00 to 18:00	3082
9.	Kadbi Chowk	2358	10:00 to 11:00	254
10.	LIC Chowk	5066	18:00 tp 19:00	487
11.	Lokmat Chowk	10469	17:00 to 18:00	1062
12.	Munje Chowk	12506	18:00 to 19:00	1434
13.	Nagpur Rly. Station	19530	9.00 to 10.00	2054
14.	Old Pardi Naka	4104	18:00 to 19:00	426
15.	Pancha Sheela Chowk	10922	10.00 to 11.00	1171
16.	S.T. Bus Stand Chowk	9420	17.00 to 18.00	937
17.	Telephone Exchange Chowk	5489	10.00 to 11.00	548
18.	Variety Chowk	31661	16.00 to 17.00	3201

Of all the surveyed locations, maximum number of pedestrians was observed at Variety Chowk with 31000 pedestrians in a day followed by Jhasi rani Chowk with almost 26000 pedestrians. The maximum peak hour pestrians were observed at Variety Chowk with 3200 pedestrians.

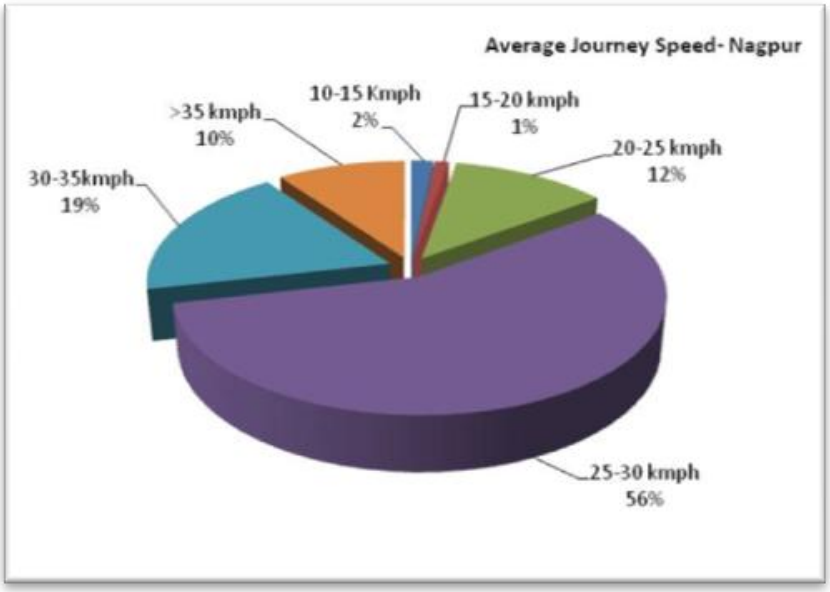
Figure 4.4: Pedestrian Volume (Daily and Peak Hour)



4.4 Speed and Delay Survey

Based on the speed and delay survey conducted on all major road stretches within the city, the journey speed on major corridors is in the range of 25 to 30 km/hr, as shown in Figure 4.5 The survey was conducted for both peak and non-peak hours. However, the data is presented for peak hour which will be used for the model development. The speed range varies between 30 to 35 km/hr for non peak hours.

Figure 4.5: Journey speeds on major corridors



Road-wise analyzed journey speeds for major corridors are presented in the table 4.16.

Table 4.16: Observed Journey Speed in Peak Hour (Km/Hr)

No.	Road Name	Observed Journey Speed in Peak Hour (Km/Hr)
1	Ajini Road	31
2	Ambazari Lake Road	28
3	Amaravathi Road	32
4	Central Avenue Road	28
5	Ghat Road	29
6	Umred Road	28
7	Wardha Road	27

Source: Primary Survey, UMTC

4.5 Road Side Interview Survey

Road side interview survey was conducted at 8 outer cordon locations and the details are presented in the next section.

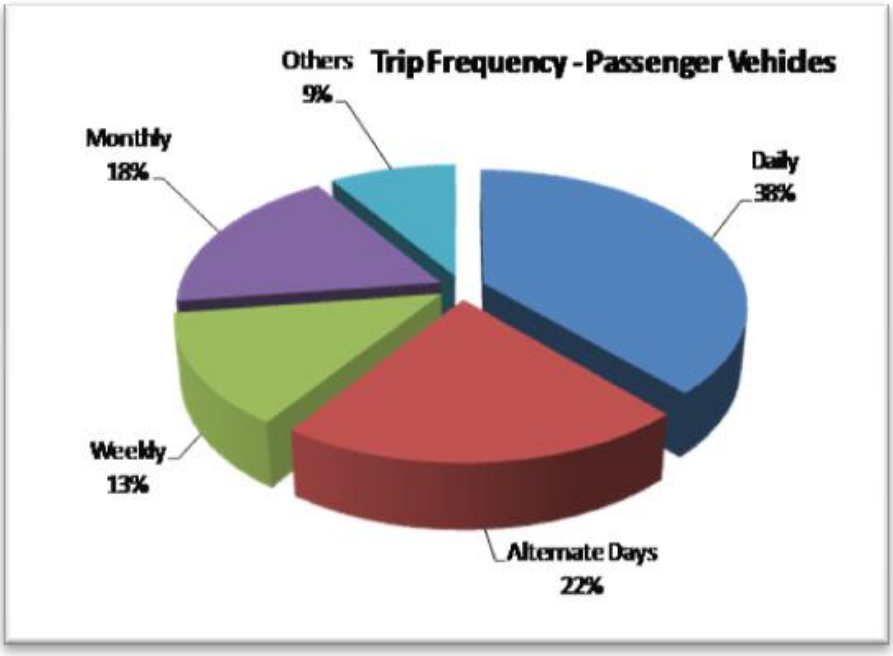
Trip Frequency- Private Vehicles

Daily trips formed majority of the trips at the outer cordons (38%), followed by alternate day trips. The trip frequency for all locations is shown in Table 4.17 and the average trip frequency is shown in Figure 4.5.

Table 4.17: Outer Cordon- Trip Frequency

Name of the Road	Trip Frequency				
	Daily	Alternate Days	Weekly	Monthly	Others
NH6 - Amaravati Road	46%	8%	12%	20%	15%
NH-7 Bhandara Road	39%	22%	12%	19%	9%
NH-7 Jabalpur Road	25%	32%	16%	15%	11%
NH-7 Wardha Road	53%	15%	13%	11%	9%
NH-69 - Chindwada Road	30%	37%	15%	15%	3%
SH-248 - Katol Road	49%	11%	9%	23%	9%
SH-255- Hingna Road	39%	26%	16%	14%	5%
Umred Road	25%	20%	15%	28%	13%
Average	38%	21%	13%	18%	9%

Figure 4.6: Average Trip Frequency Distribution



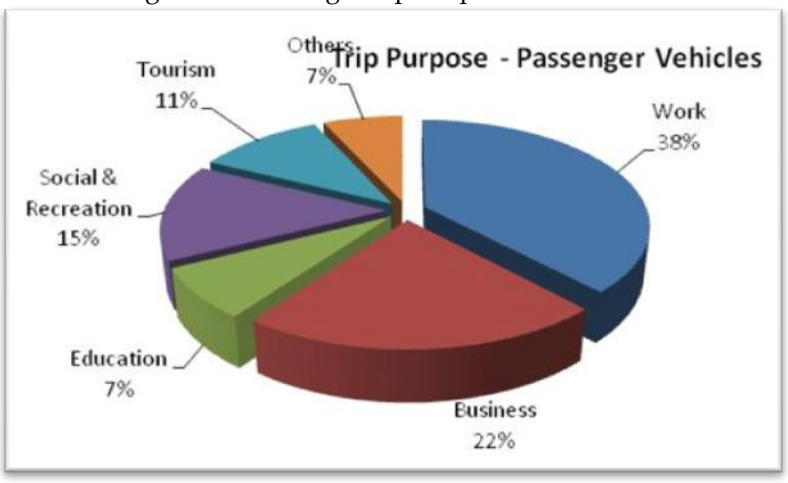
Trip Purpose- Private Vehicles

Analyses on purpose of journey revealed that majority of the trips are work trips (38%) followed by business and recreational / social trips. Table 4.18 shows the trip purpose at outer cordon points. Figure 4.7 shows the distribution of trip purpose.

Table 4.18: Purpose of journey on Cordon Points

Name of the Road	Trip Purpose					
	Work	Business	Education	Social & Recreation	Tourism	Others
NH6 - Amaravati Road	33%	26%	9%	9%	20%	4%
NH-7 Bhandara Road	38%	16%	6%	18%	10%	13%
NH-7 Jabalpur Road	32%	16%	9%	14%	6%	23%
NH-7 Wardha Road	25%	37%	8%	9%	12%	9%
NH-69 - Chindwada Road	35%	20%	2%	38%	4%	2%
SH-248 - Katol Road	35%	19%	10%	9%	24%	3%
SH-255- Hingna Road	63%	17%	7%	9%	2%	1%
Umred Road	43%	24%	12%	13%	7%	1%
Average	38%	22%	8%	15%	11%	7%

Figure 4.7: Average Trip Purpose Distribution



Occupancy- Private Vehicles

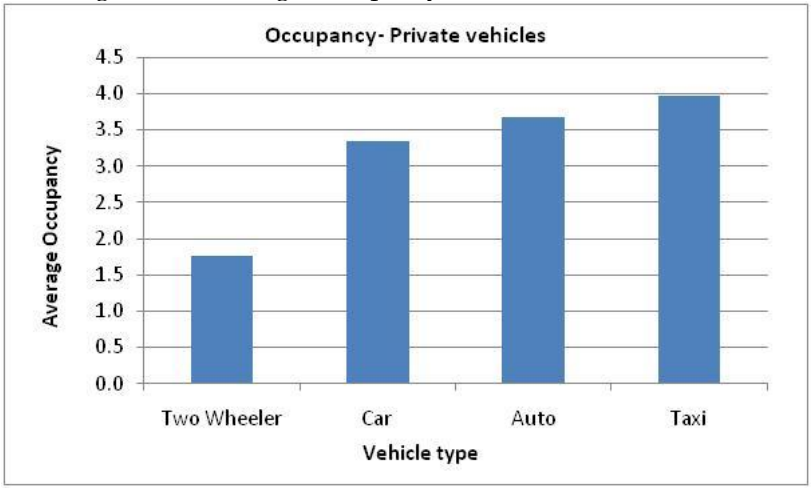
From the data, average vehicle occupancy is also estimated. Table 4.19 shows the distribution of average vehicle occupancy at all locations across cordon points. Figure 4.8 represents average occupancy observed at all outer cordon locations.

Table 4.19: Average Occupancy by Vehicle Type on Cordon Points

Name of the Road	Occupancy			
	Two Wheeler	Car	Auto	Taxi
NH6 - Amaravati Road	1.73	3.16	4.21	4.01
NH-7 Bhandara Road	1.63	3.72	4.1	4.3
NH-7 Jabalpur Road	1.87	3.27	3.57	3.9
NH-7 Wardha Road	1.63	3.72	4.1	4.3
NH-69 - Chindwada Road	1.87	3.38	3.05	3.36
SH-248 - Katol Road	1.76	3.18	3.47	3.86
SH-255- Hingna Road	1.84	3.17	3.61	4
Umred Road	1.79	3.21	3.28	4
Average	1.8	3.4	3.7	4.0

(Note: Auto Rickshaw includes Shared Auto Also. Without shared auto, the average occupancy is 3.0)

Figure 4.8: Average Occupancy at Outer Cordon



Trip Frequency- Goods Vehicles

Daily trips formed majority of the trips at the outer cordons, followed by weekly trips. The trip frequency for all locations is shown in Table 4.20.

Table 4.20: Trip Frequency

Name of the Road	Trip Frequency				
	Daily	Alternate Days	Weekly	Monthly	Others
NH6 - Amaravati Road	44%	7%	32%	15%	2%
NH-7 Bhandara Road	36%	3%	39%	18%	4%
NH-7 Jabalpur Road	54%	8%	25%	12%	1%
NH-7 Wardha Road	45%	15%	25%	15%	0%
NH-69 - Chindwada Road	48%	25%	20%	4%	2%
SH-248 - Katol Road	32%	11%	25%	31%	1%
SH-255- Hingna Road	56%	19%	20%	6%	0%
Umred Road	66%	6%	23%	4%	0%
Average	48%	12%	26%	13%	1%

Trip Purpose- Goods Vehicles

Analyses on purpose of journey revealed that majority of the trips are for unloading goods. Table 4.21 shows the trip purpose at outer cordon points.

Table 4.21: Trip Purpose – Goods Vehicles

Name of the Road	Trip Purpose		
	Loading	Unloading	Others
NH6 - Amaravati Road	46%	53%	1%
NH-7 Bhandara Road	66%	33%	2%
NH-7 Jabalpur Road	66%	33%	1%
NH-7 Wardha Road	47%	52%	1%
NH-69 - Chindwada Road	62%	37%	1%
SH-248 - Katol Road	47%	43%	9%
SH-255- Hingna Road	46%	53%	1%
Umred Road	57%	42%	1%
Average	55%	43%	2%

Observations

- Trip frequency for private vehicles shows that approximately 38% of the trips are daily trips.
- When comparing various trip purposes of passenger vehicles at the cordons, work trips are highest and are followed by business trips.
- The majority of the goods that the commercial vehicles carry in the study area include food materials, vegetables, Industrial materials and petroleum products.
- Average occupancy of two wheelers observed is 1.8, car is 3.4, auto rickshaw including shared auto is 3.7 and taxi is 4.0.

4.6 Household Interview

Survey Analysis

The data obtained from the interview forms were converted into numerical codes according to the predetermined code lists and were used as inputs for analysis. Data collected from the sample household were expanded to represent the whole population of the respective zone with the expansion factor arrived at for each traffic zone. The expansion factor was obtained by dividing the total number of estimated

households in the survey area for each traffic zone by the total number of successful households interviewed in the respective zone.

Demographic and Socio Economic Characteristics

The size of household in terms of total members in it would have a significant influence on the quantum of trips made by the household. Similarly the household and vehicle ownership could be important factors in the determination of travel modes used by the households for trip making. The population, its distribution in an area and its composition in terms of age, sex, working members and students constitute as equally important factors influencing trip making rates of a household as family size and household income. The number of vehicles available for use by the household would also influence the trip making and mode of travel. Some so-economic characteristics are shown below. Details regarding travel behavior etc are illustrated in detail in the Travel Demand Model analysis section.

Table 4.22: Distribution of Household by size

HH size	% Share
1	8%
2	11%
3	22%
4	33%
5	16%
6	8%
>=7	1%
Total	**100%**

Table 4.23: Distribution of Households by Income Level

Income Range (Rs)	Percentage of House holds
up to 1500	1%
1501-3000	1%
3001-5000	4%
5001-10000	21%
10001-20000	45%
20001-30000	18%
30001-40000	7%
40001-50000	3%
above 50000	2%

Table 4.24: Average Vehicle ownership

Average Vehicle ownership per House Hold	Vehicles per House Hold
Cycle	0.33
Two wheeler	1.33
Car	0.09
Auto	0.020
Other Vehicles	0.005

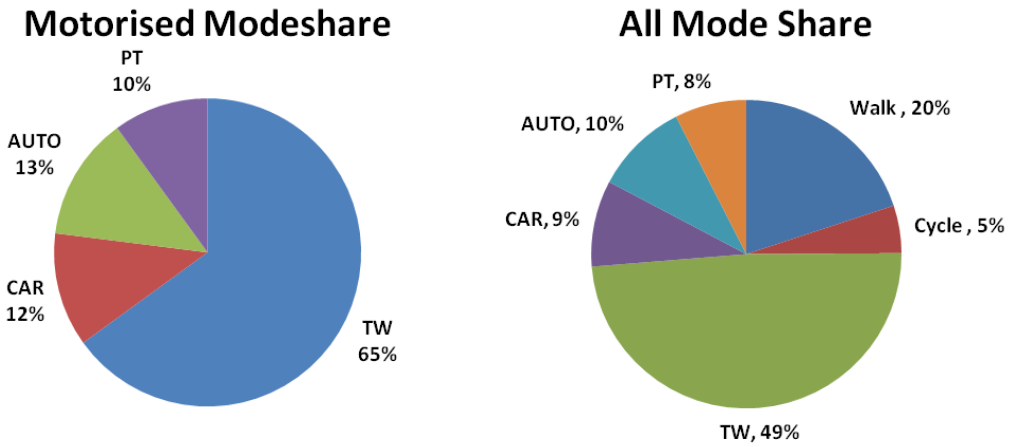
Table 4.25: Average Mode wise Trip Length

Mode	Average Trip Length (km)
Walk	1.79
Cycle	3.03
Two Wheeler	5.5
Car / Van/ Jeep	6.87
Taxi	7.30
Auto Rickshaw	4.52
Public Transport	9.40

Table 4.26: Mode Share

		Mode share (all modes)	Mode Share (excluding NMT)
1	Walk	6%	
2	Cycle	9%	
3	Two wheeler	55%	65%
4	Car/ Van / Jeep	10%	12%
5	Taxi	0%	0%
6	Public transport (MSRTC)	0%	0%
7	Public transport (Pvt Bus)	8%	9%
8	Public transport (rail)	0%	1%
9	Public transport (Ferry)	0%	0%
10	Auto Rickshaw	11%	13%
	Total (all modes)	100%	100%

Figure 4.9: All Mode Share and Motorized Mode Share



Observations

- The average household income was found Rs 19,600 per month
- The average household size is 4.2
- Average Monthly expenditure on transport is 2500 (12% of household income)
- The per capita trip rate was found as 1.26 while the motorized trip rate was observed as 0.95
- The average trip length (ATL) for car was observed as 6.87 km, for two wheelers 5.50 km and for auto 4.52 km and for public transport mode 9,40 km
- The motorized share for two wheelers was 65% followed by auto with 13% and car with 12%. The PT share was found as 10% of total motorized passenger trips.

4.7 Turning Volume Count Survey

Classified Traffic Volume Counts were done at selected intersections. The peak hour traffic volumes and the direction of maximum traffic are given in Table 4.27.

Table 4.27: Traffic Volumes at Intersections

Sl. No	Name of the junction	Peak Hour	Peak hour PCU	Peak hour Vehicles	Daily Vehicles	Daily PCU	Direction of Maximum Flow
1	Somalwada Intersection	18:30-19:30	4962	4850	49221	54816	From Airport to Chatrapati Chowk
2	Hingna road chowk	9:00-10:00	2985	3402	35805	33339	From Crazy castle to Hingna
3	Pratap Nagar Chowk	19:15-20:15	6714	7662	62655	55929	Hingna Road to Chatrapati Chowk
4	Chatrapati chowk	18:30-19:30	9355	10078	92724	93163	From Pratap Nagar to Manewada
5	Manewada Chowk	19:00-20:00	5983	7334	69924	61051	Chatrapati Chowk to Dighori
6	Dighori Chowk	10:30-11:30	3890	4660	44250	39996	From Umred Road to Ahsok Square
7	Ajni chowk	18:15-19:15	7020	7424	74902	72612	From Wardha Road to Ajini station
8	Medical Chowk	10:00-11:00	6544	6844	85550	81800	From Baidyanath Chk to Tukdoji Chk
9	Bande plat Junction (Near Ayurvedic college)	10:15-11:15	6733	8031	82907	72235	From Jagnade Chowk to Tukdoji Chowk
10	Subhash Nagar Chowk	19:15-20:15	4243	5017	55172	47613	From Subhash Nagar to Crazy Castle
11	Shankar Nagar Chowk	18:00-19:00	7955	9128	97721	85547	Ambazari road to Jhansi Rani CHk
12	Jhansi Rani Chowk	12:15-13:15	5629	5631	67500	67766	Wardha Road to Variety Chowk
13	Variety Chowk	18:15-19:15	9908	10046	110917	102942	Munje Chk to Amravati
14	Cotton Market Chowk	18:00-19:00	9952	11347	110788	99219	Sita Bardi to Ganesh Peth
15	Ashok Chowk	18:30-19:30	10604	9005	106644	94481	Reshim bagh to Baidyanath chk
16	Jagnade Chowk	18:30-19:30	4913	5154	57881	54687	Reshim Bagh to Rajendra Nagar
17	Telephone Exchange chowk	18:45-19:45	7705	8642	78623	72319	Gandhi Bagh to Ring Road
18	Old Pardi Naka Chowk	18:30-19:30	7164	7180	73579	82910	Umred to Pardi
19	Law college chowk	18:30-19:30	7700	8705	89120	79445	Ravi Nagar to Variety Chowk
20	RBI chowk	18:00-19:00	9380	10139	109357	104657	Variety Chowk to LIC Chowk
21	Golibar chowk	10:15-11:15	8231	9123	82837	76898	Gandhi Bagh to Indora Chowk
22	Rajiv Gandhi Chowk	10:00-11:00	1499	1880	16379	14895	Vinoba Nagar to Itwari
23	Chhaoni Chowk	10:00-11:00	6320	7387	70909	63699	Mental Hospital Road to Sadar
24	Kadbi Chowk	10:00-11:00	8286	7315	91103	84934	Kamptee to Gaddigodam
25	Indora Chowk	11:00-12:00	7141	8292	88914	79230	Ring Road to Kadbi Chowk
26	Kamtee Road and inner ring road junction	9:45-10:45	5724	5737	64255	71647	Kamptee to Kadbi Chk
27	Katol Road Chowk	10:15- 11:15	8262	9722	89946	80961	Raj Nagar to

Sl. No	Name of the junction	Peak Hour	Peak hour PCU	Peak hour Vehicles	Daily Vehicles	Daily PCU	Direction of Maximum Flow
							Golibar Chowk
28	Mental Hospital Chowk	18:45-19:45	4670	5379	55288	48225	Sadar to Mankapur Chowk
29	Mankapur chowk	13:00-14:00	9361	6231	77594	96850	Katol road to Koradi Chowk
30	Katol Road and inner ring road chowk	10:15- 11:15	2899	2353	21494	31238	Wadi Road to Chhaoni Chowk
31	Wadi Chowk	18:45-19:45	4175	3180	35239	45565	Law College choek to Amravati Road
32	LIC Chowk	18:00-19:00	8837	9365	99600	96174	From Gaddi godam to RBI chowk

The traffic flow diagrams for the morning peak hour for all the junctions are given in the annexure. The daily volume in vehicles and in PCUs is presented in table 4.27. Variety Chowk, RBI Chowk and Cotton Market Chowk carry more than 1 lakh pcu traffic a day and more than 10,000 pcu during peak hour. LIC Chowk, Katol Road Chowk, Golibar Chowk, Ahok Chowk, Shankar Nagar Chowk and Chatrapati Chowk carry more than 9000 pcu in the peak hour. The peak hour span vary on case to case basis, however the morning common peak hour recognized as 10.00 to 11.00 am while evening peak hour was observed as 18:30 to 19:30

The Junction Count Diagrams are given in Annexure 1.

4.8 Road Inventory Survey

A Road Inventory survey was carried out on all major stretches of roads in Nagpur, for a total of about 150 kms. Based on the survey results, an analysis has been carried out with respect to the type of carriageway (up to 2 lanes, 2-4 lanes, 4-6 lanes & more than 6 lanes), availability of median (divided/undivided Carriageway), availability of footpath, total ROW etc and the results are presented below.

Types of carriage-way

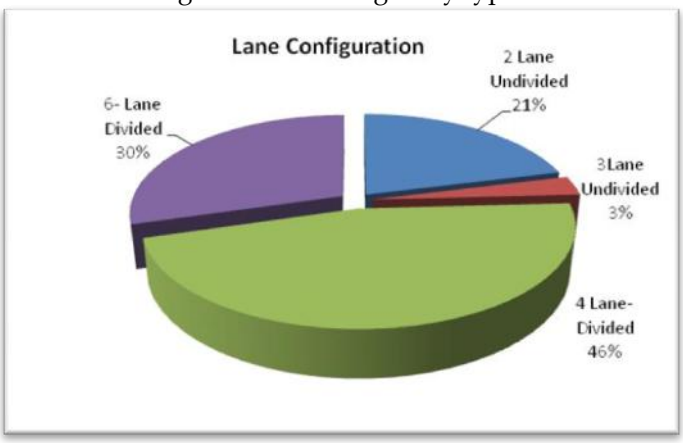
Of the total roads covered in the inventory, 56% of the road have two lane un-divided Carriageway, while, 8% is with four lane divided carriageway. Carriageway type of the roads is presented in Table 4.28 and in Figure 4.10

Table 4.28: Carriageway Types

No of Lanes	% Share
2 Lane Undivided	21%
3Lane Undivided	3%
4 Lane- Divided	46%
4-Lane Undivided	0.4%
6- Lane Divided	29%
Total	100%

Source: Inventory Survey

Figure 4.10: Carriage way types



Median Availability

Majority of the main roads (especially radial roads/ NH and SH) in Nagpur do have median and are available only for 76% of surveyed roads.

Table 4.29: Availability of Median

Median Availability	% Share
Present	76%
Absent	24%
Total	100%

Source: Inventory Survey

Availability of Footpath

Availability of footpath in the study area is presented in Table 4.30

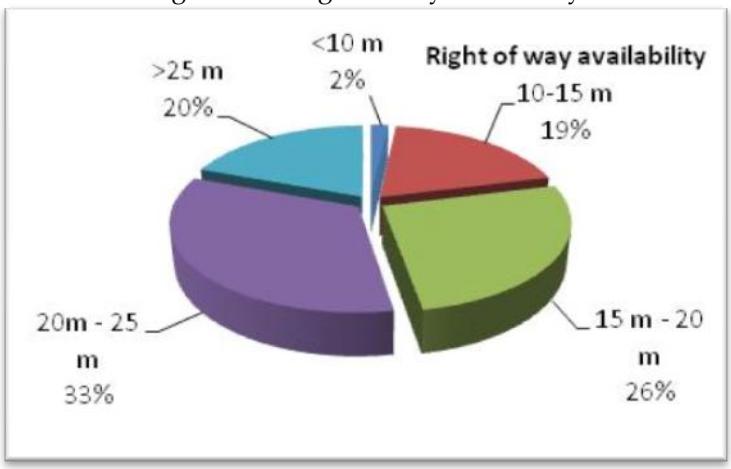
Table 4.30: Availability of Footpath

Availability of Footpath	% Share
Paved	71%
Unpaved	16%
Absent	13%
Total	100%

Source: Inventory Survey

Right of Way availability

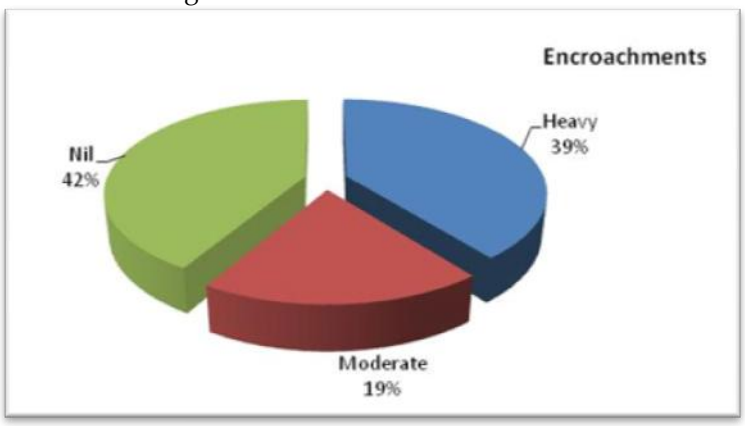
Figure 4.11: Right of way availability



Encroachments

Encroachments of the footpaths and carriageways were observed in form of parked vehicles, vendors, hawkers etc. It was observed that almost 67% of surveyed network was somehow encroached upon, resulting in less effective capacity for road usage. About 39% heavy and 19% moderate level of encroachment on roads and footpaths can be seen on major corridors in Nagpur (refer Figure 4.12).

Figure 4.12: Encroachments



The pictures taken at various locations show the extent of encroachment on corridors.

Figure 4.13: Encroachment near Agrasen Chowk

Figure 4.14: Encroachment near Railway Station - Parked LCV

Figure 4.15: Encroachments near Mandai

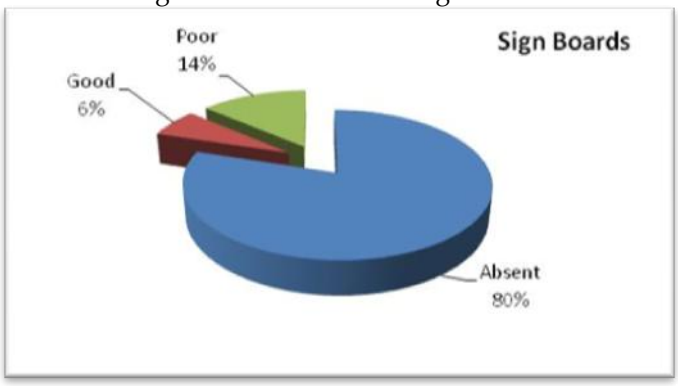
Figure 4.16: Private Buses Parked Buses near MSRTC Bus Stand Area

Presence of Road Markings and Signboards

Availability and quality of road markings have been classified into three categories such as good, fair and poor. Road markings (Figure No. 17) are not available for about 73% of total network length in the study area. Information on presence/absence of sign boards is presented in Figure 4.18. Out of total observed network in Nagpur, 70% of roads were not having signboards.

Figure 4.17: Presence of Road Markings

Figure 4.18: Presence of signboards



Source: Inventory Survey

ST Stand Chowk

Mansoor Baba Chowk

Medical Chowk

Absence of Sign Boards near Station Area

Observations

- Four lane divided roads contributed major share in surveyed network (46%) followed by six lane divided road (30%)
- 16% footpaths are unpaved and 13% of surveyed network does not have footpath availability.
- Appropriate Road markings and Signboards are not available for more than 75% of surveyed roads
- It was noticed that 60% of total surveyed network is suffering with the encroachment problem in form of parked vehicles, vendors, hawkers etc.

4.9 Cyclist Opinion survey

Cyclist Opinion Survey has been carried out on a sample basis at the locations in the study area where Non-Motorized Trips are predominant. The survey does not limit to any specific location, but covers major areas having bi-cycle (NMT) movement. The survey was carried out to understand travel characteristics of cyclists as well as their opinion on the issues related to the travel i.e., safety and comfort. For Nagpur, a total of 200 opinion survey samples were collected at Variety Chowk, Higna Road, CA Road, Wardha Road, Kamptee Road, Medical Chowk, Bardi, Mahal, Sadar, Amravati Road, Katol Road, Nagpur Station area and ST Stand area.

Survey Results

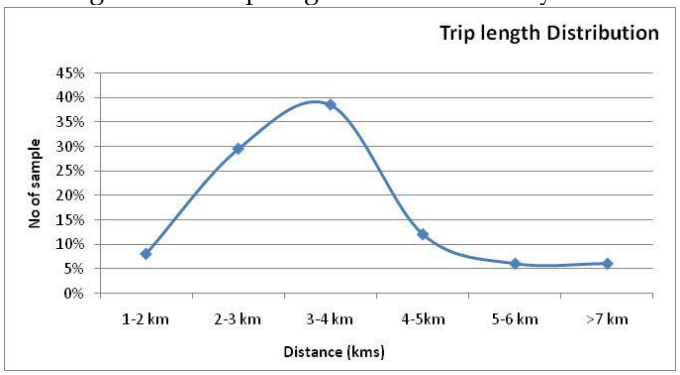
Average Distance Travelled

Information on the distance travelled and the time taken for each trip of all the respondents was collected. It was observed that the average distance travelled is 3.87 km and the average trip time is around 28 minutes.

Table 4.31: Trip length Distribution – Cyclists

Distance	% Share
1-2 km	8%
2-3 km	30%
3-4 km	39%
4-5km	12%
5-6 km	6%
>7 km	6%
Total	100%

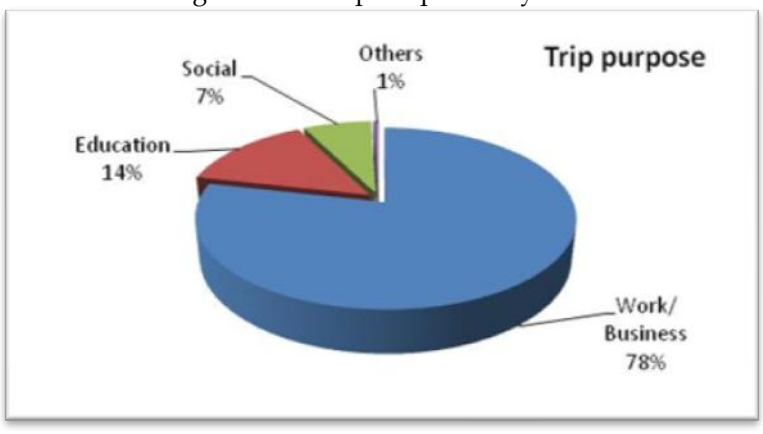
Figure 4.19: Trip length Distribution – Cyclists



Trip Purpose – Cyclists

Analysis on purpose of trip reveals that the share of work/business trips is 78% followed by education trips about 14%. The distribution of cycle trips by purpose is shown in Figure 4.20

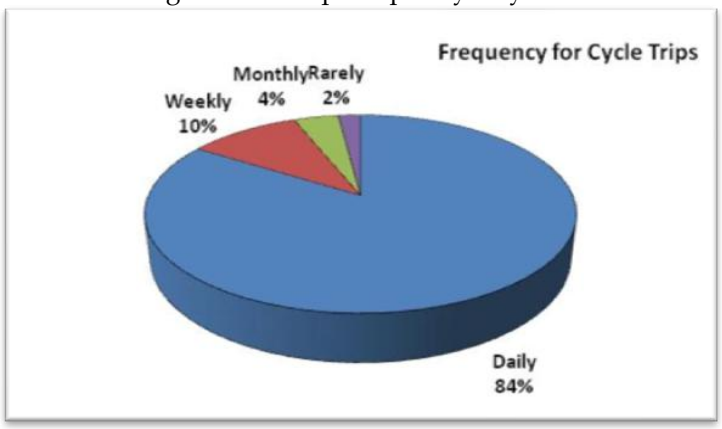
Figure 4.20: Trip Purpose – Cyclists



Trip Frequency

Analysis of trip frequency shows that daily trips are more with 84% followed by weekly and monthly trips with about 10% and 4% respectively.

Figure 4.21: Trip Frequency - Cyclists



Average travel / Maintenance Cost

The average maintenance cost per month is presented in Table 4.32

Table 4.32: Average Maintenance Cost

Average Monthly maintenance cost	%
<=50	24%
50-100	20%
101-200	21%
201-300	21%
301-500	13%
>500	2%
Total	100%

Problems while riding a bicycle

The respondents were asked to indicate their opinion on the severity of problems while riding cycles. They were given a list of usual problems and were asked to rank these options based on their view on each factor contributing to their insecure ride. Rank 1 was given to the major contributing factor and Rank 6 was given to the least contributing factor. The weighted rank was arrived by assessing the share of samples giving priority to each problem. The estimated weighted rank is given in Table 4.33.

Table 4.33: Problems while riding a bi-cycle

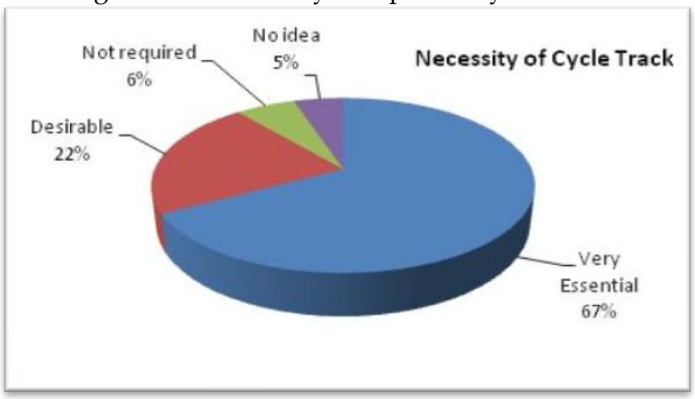
Problems while riding cycle	Rank
High Volume of Traffic	1
High Speed of Vehicles	2
Interference due to parking/pedestrians/bus stops	4
Bad condition of road/shoulders	3
Absence of proper lighting	5
Difficulty in crossing junctions	6

It was observed that most of the respondents pointed that the major factors contributing to their insecurity is mainly due to the high volume of traffic while riding cycle. This in other way illustrates the requirement of separate cycle tracks. Difficulty in crossing junctions and Interference due to parking/pedestrians/bus stops were also indicated as the problems while riding cycle.

Opinion on necessity of separate Cycle Track

Respondents were asked to indicate their opinion on the necessity of separate cycle track. Majority of the respondents (about 67%) felt that the separate cycle track is very essential followed by 22% respondents who felt it desirable.

Figure 4.22: Necessity of separate Cycle – track



4.10 Truck Operator Survey

Truck operator interview survey has been carried out to assess the characteristics of the operators in terms of their operating characteristics. This would act as a major input towards economic analysis, model development and preparation of truck routing /terminal plans.

Trip Frequency – Truck

Trip frequency of trucks is presented in Table 4.34. Majority of the truck trips are weekly trips (60%) followed by daily trips with 33%.

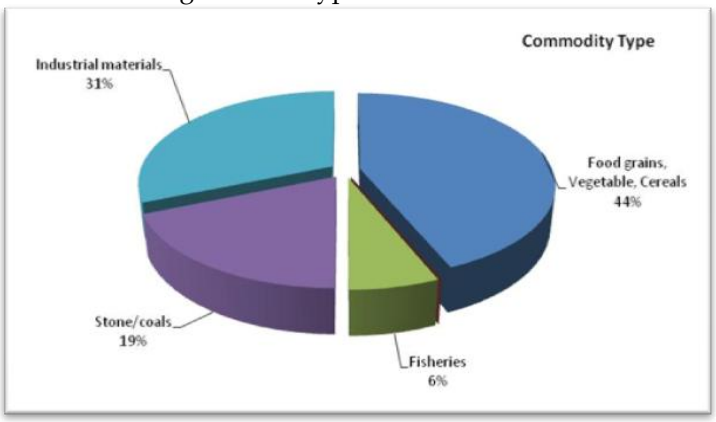
Table 4.34: Trip Frequency

Trip Frequency	% Share
Daily	33%
Alternate days	7%
Weekly	60%

Commodity Type

The types of commodities carried by trucks are shown in figure 4.23

Figure 4.23: Types of commodities



Majority of the truck operators are in the business of transporting food grains, vegetables, cereals etc. Almost 19% of operators are in the business of transporting stone and coal. It is important to notice 31% contribution of industrial material. This is because of the good connectivity of Nagpur with Durga-Bhilai, Raipur and Jabalpur cities. The operation cost varies based on toll charges, loading – unloading cost, fuel price and man power cost.

Observations:

- Average trip distance travelled: 520 km
- Range of Market value of Goods: Rs. 40,000 to Rs 290,000.
- Average Loading Capacity: 12.75 Tones which shows significance presence of multi-axle heavy duty vehicles.
- Most of the trucks (HGV) are parked on streets outside the ring road.
- The absence of designated truck terminals is resulting in heavy on-street parking just outside the boundary, reducing effective capacity for state and national highways.

4.11 Parking Survey

On-street Parking Survey Results

The Parking Car Equivalents (PCE) adopted for different vehicle types for the analysis are given in Table 4.35. The on-street parking survey was conducted at following ten locations:

- Abhyankar Road
- Central Avenue Road
- Chitnis Park (Mangalwari)
- Golibar Chowk
- Kamptee Road
- Mahal Area
- Old Bhandara Road
- Residancy Road
- Wardha Road
- West High Court Road

The results are presented in this section.

Table 4.35: PCE Values Adopted for Various Vehicle Types

Sl. No.	Vehicle Category	PCE
1	Car	1.0
2	Two Wheelers	0.2
3	Bus	2.5
4	Trucks	2.5
5	LCV	1.75
6	Auto Rickshaws (IPT)	0.5
7	Bi-Cycles	0.1
8	Cycle Rickshaw	0.8
9	Bullock Carts/ Hand Driven Carts	3.2

Results

Maximum PCE and Peak hour at the survey locations are presented in Table 4.36. The mode share and also the parking duration graphs are presented this section of the report. Two wheeler's share found predominant at all the surveyed locations. While analyzing the parking duration we observed that more than 90% of the parked vehicles are parked for less than 2 hour duration which technically can be considered as a short duration parking. This also reflects that the activities performed on these corridors are mostly associated with the mixed landuse and involves commercial predominantly.

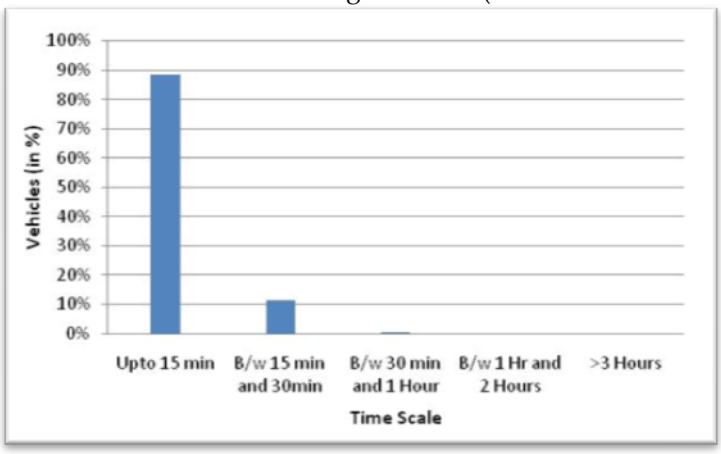
Table 4.36: Peak Hour and Maximum PCE at on-street survey locations

Sl. No.	Location	Maximum PCE	Peak Hour
1	Abhyankar Road	47	19:00-20:00
2	Central Avenue Road	110	9:00-10:00
3	Chitnis Park (Mangalwari)	58	19:00-20:00
4	Golibar Chowk	58	19:00-20:00
5	Kamptee Road	61	19:00-20:00
6	Mahal Area	70	19:00-20:00
7	Old Bhandara Road	56	19:00-20:00
8	Residancy Road	43	17:00 – 18:00
9	Wardha Road	63	17:00 – 18:00
10	West High Court Road	121	10:00 – 11:00

Parking Duration

Abhyankar Road (Towards Subhash Nagar)

Figure 4.24: Classification of Parking Duration (Towards Subhash Nagar)



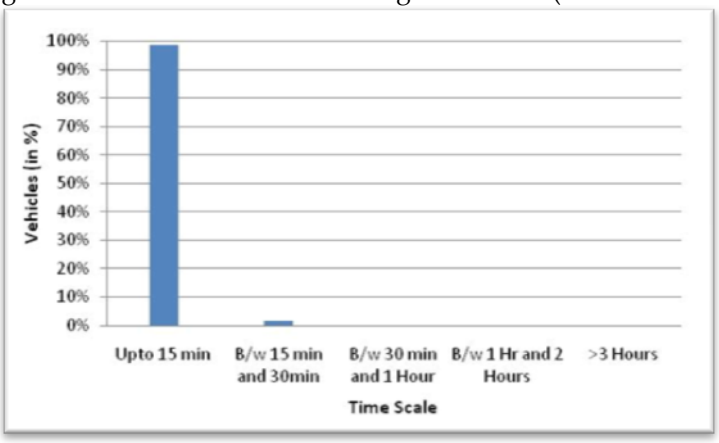
Types of vehicles parked at the survey location are presented in Table 4.37

Table 4.37: Types of vehicles parked (Towards Subhash Nagar)

Type	COUNT	% Share
Auto	2	0.47%
Car	100	23.42%
LCV	5	1.17%
Two Whlr	318	74.47%
Van	2	0.47%
Total	427	100%

Abyankar Road (Towards NH4)

Figure 4.25: Classification of Parking Duration – (Towards NH4)



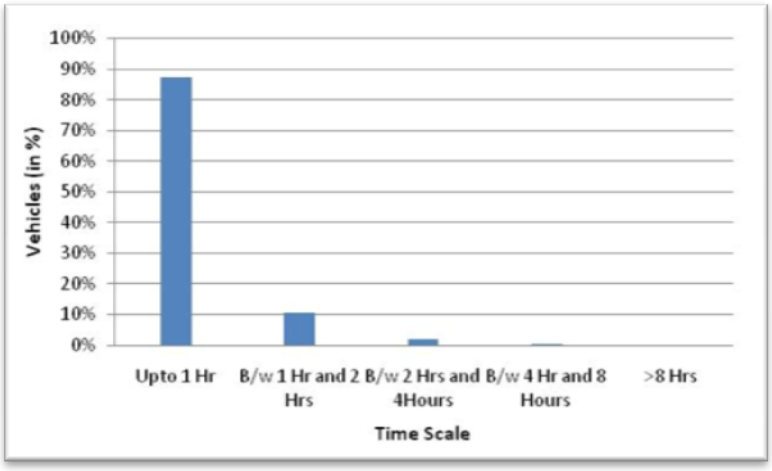
Types of vehicles parked at the survey location are presented in table 4.38

Table 4.38: Types of vehicles parked on Abhyankar Road (Towards NH4)

Type	COUNT	%
Auro	3	1%
Car	74	18%
TW	326	80%
total	407	100%

Central Avenue Road (Towards Ring Road)

Figure 4.26: Classification of Parking Duration - Towards Ring Road



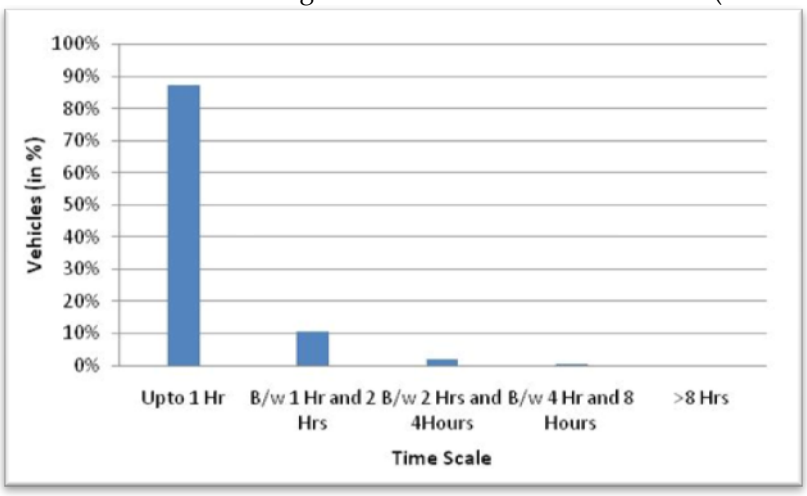
Types of vehicles parked at the survey location are presented in Table 4.39

Table 4.39: Types of vehicles parked at Central Avenue Road (Towards Ring Road)

Vehicle Type	Count	% Share
Auto	11	1%
Bus	9	1%
Car	449	26%
LCV	35	2%
TW	1246	71%
Total	1750	

Central Avenue Road (Towards Station)

Figure 4.27: Classification of Parking Duration - Central Avenue Road (Towards Station)



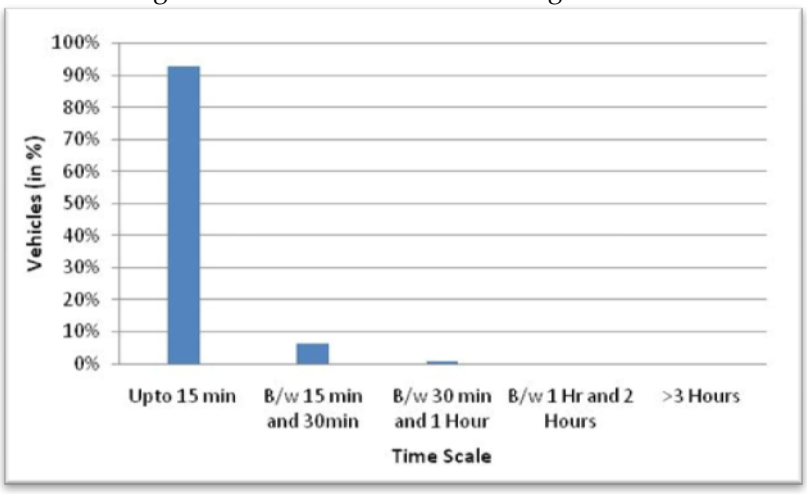
Types of vehicles parked at the survey location are presented in Table 4.40

Table 4.40: Types of vehicles parked at Central Avenue Road (Towards Station)

Vehicle Type	Count	% Share
Car	359	23%
LCV	41	3%
TW	1174	74%
	1576	

Chitnis Park

Figure 4.28: Classification of Parking Duration



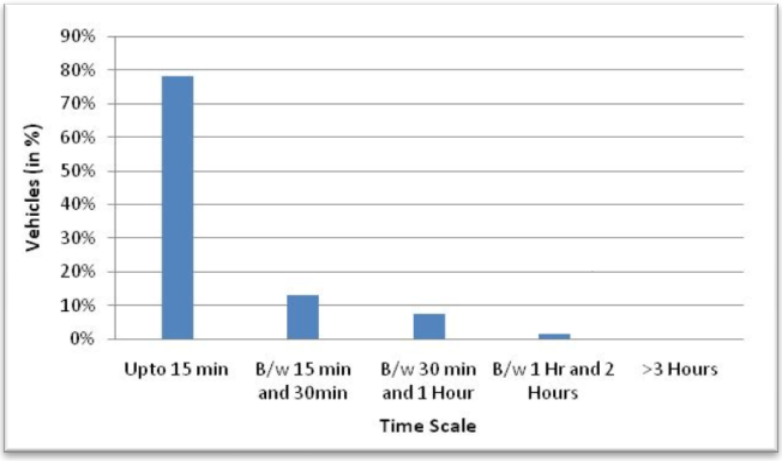
Types of vehicles parked at the survey location are presented in table 4.41

Table 4.41: Types of vehicles parked

Type of Vehicle	COUNT	% Share
Auto	4	1%
Car	13	3%
TW	405	96%
Total	424	100%

Chitnis Park

Figure 4.29: Classification of Parking Duration



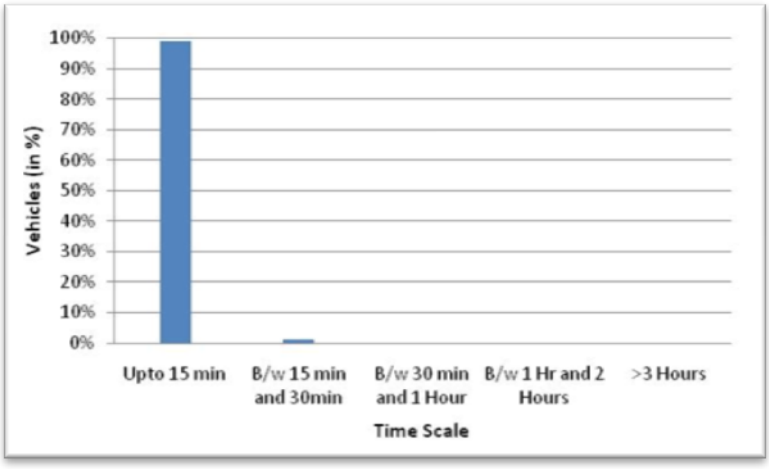
Types of vehicles parked at the survey location are presented in table 4.42

Table 4.42: Types of vehicles parked

Type	COUNT	%
Auto	2	1%
Car	5	1%
TW	381	98%
total	388	100%

Golibar Chowk

Figure 4.30: Classification of Parking Duration (LHS)



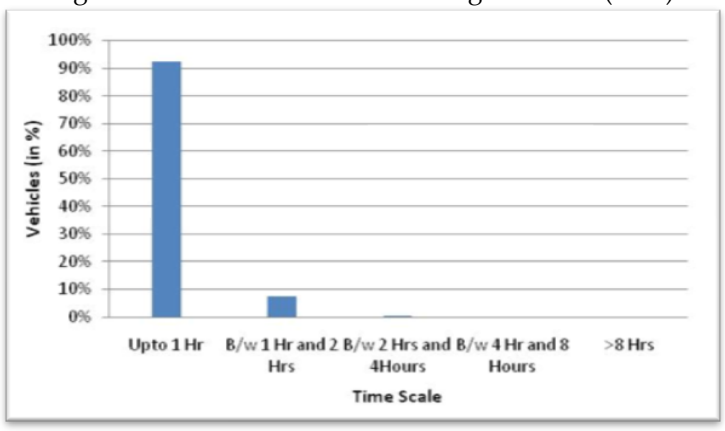
Types of vehicles parked at the survey location are presented in Table 4.43

Table 4.43: Types of vehicles parked (LHS)

Type	COUNT	% Share
Auto	7	1.44%
Bus	1	0.21%
Car	124	25.51%
LCV	10	2.06%
TW	343	70.58%
total	486	100.00%

Golibar Chowk

Figure 4.31: Classification of Parking Duration (RHS)



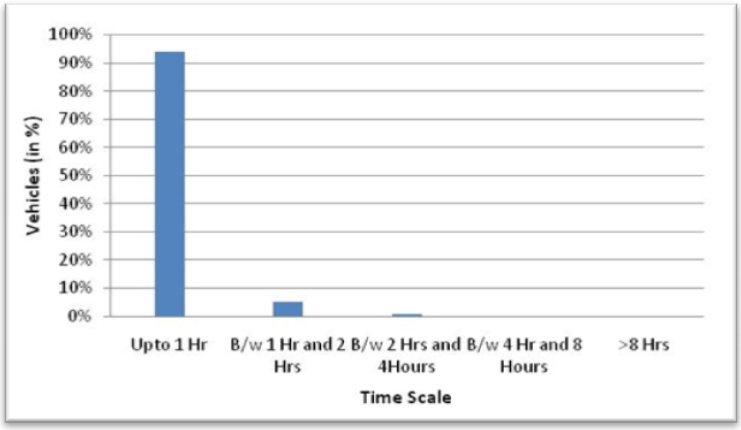
Types of vehicles parked at the survey location are presented in Table 4.44

Table 4.44: Types of vehicles parked

Type	COUNT	% Share
Auto	9	1.76%
Bus	2	0.39%
Car	73	14.26%
LCV	6	1.17%
TW	419	81.84%
Van	3	0.59%
Total	512	100%

Kamptee Road

Figure 4.32: Classification of Parking Duration (LHS)



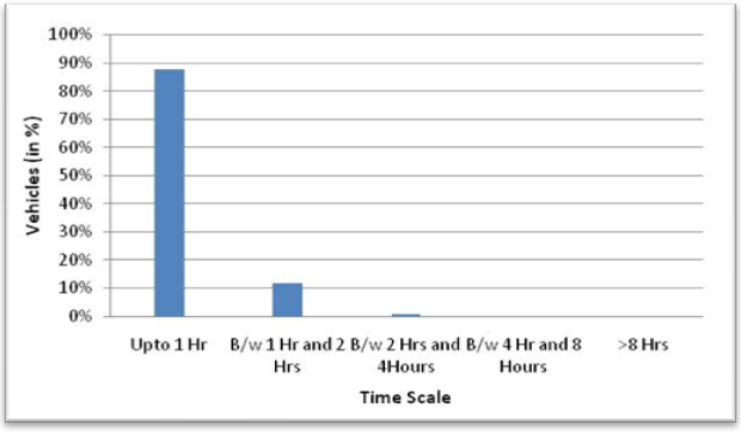
Types of vehicles parked at the survey location are presented in Table 4.45

Table 4.45: Types of vehicles parked (LHS)

Type	COUNT	%
Auto	6	1%
Car	86	20%
LCV	5	1%
TW	320	75%
Van	6	1%
total	423	100%

Kamptee Road

Figure 4.33: Classification of Parking Duration (RHS)



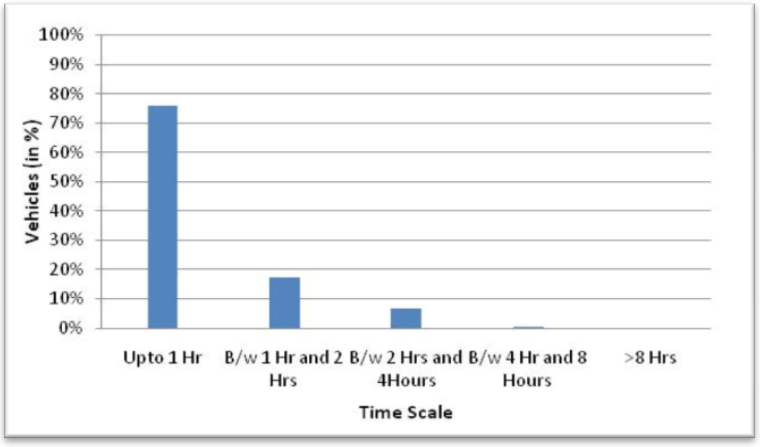
Types of vehicles parked at the survey location are presented in Table 4.46

Table 4.46: Types of vehicles parked (RHS)

Type	COUNT	% Share
Auto	31	6.81%
Car	111	24.40%
LCV	5	1.10%
TW	305	67.03%
Van	3	0.66%
Total	455	100%

Mahal Area (Towards Market area)

Figure 4.34: Classification of Parking Duration (Towards Market area)



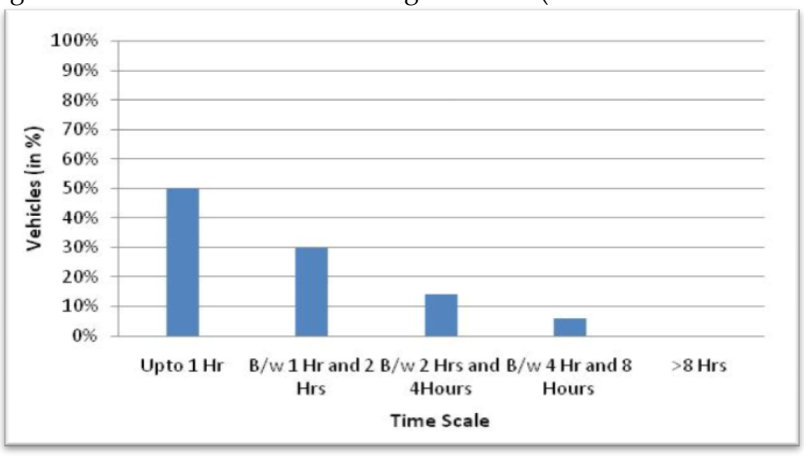
Types of vehicles parked at the survey location are presented in Table 4.47

Table 4.47: Types of vehicles parked (Towards Market area)

Type	COUNT	%
Auto	3	1.00%
Car	4	1.33%
TW	294	97.67%
total	301	100%

Mahal Area (Towards Market Gate)

Figure 4.35: Classification of Parking Duration (Towards Market Gate)



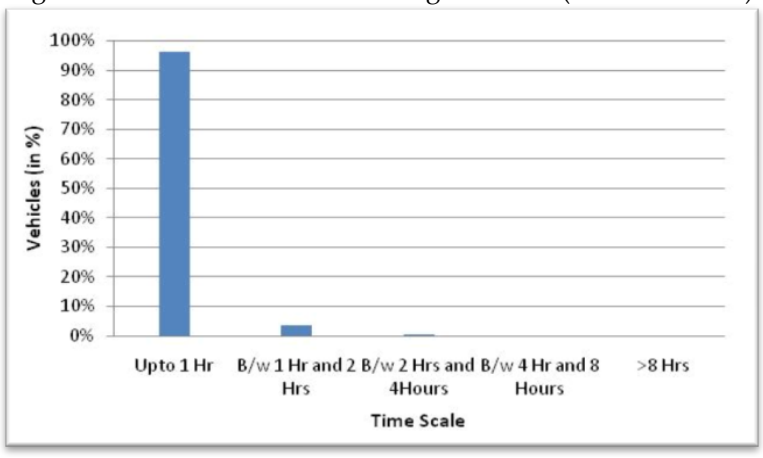
Types of vehicles parked at the survey location are presented in Table 4.48

Table 4.48: Types of vehicles parked (Towards Market Gate)

Type	COUNT	%
C	4	1.90%
TW	206	97.63%
total	211	100.00%

Old Bhandara Road (Towards Pardi)

Figure 4.36: Classification of Parking Duration (Towards Pardi)



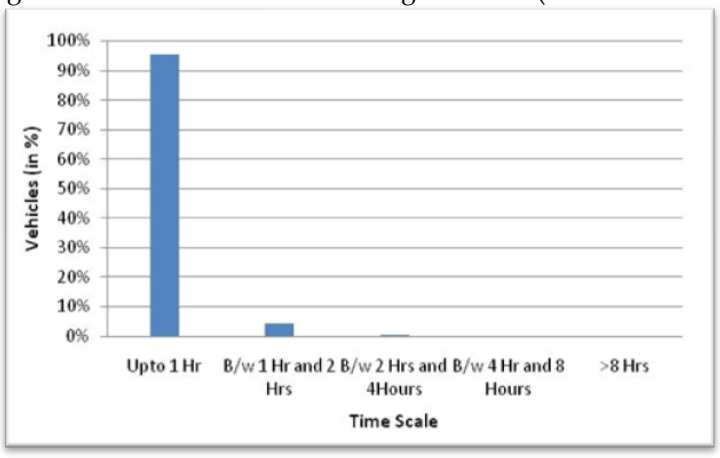
Types of vehicles parked at the survey location are presented in Table 4.49

Table 4.49: Types of vehicles parked (Towards Pardi)

Type	COUNT	%
Auto	11	2%
Bus	2	0%
Car	71	15%
LCV	12	3%
TW	378	80%
total	474	100%

Old Bhandara Road (Towards Itwari)

Figure 4.37: Classification of Parking Duration (Towards Itwari)



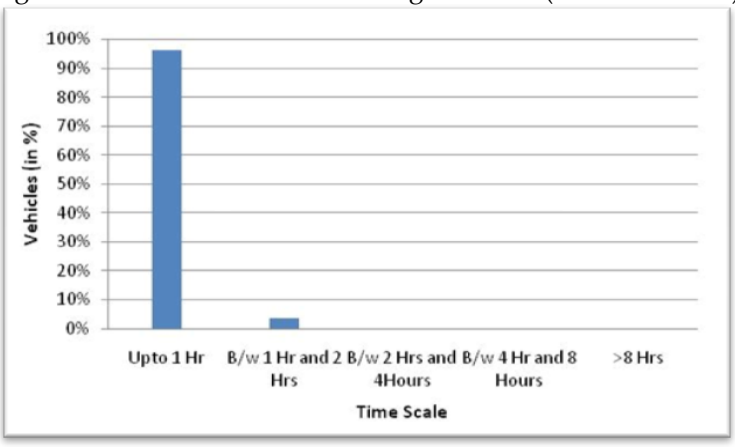
Types of vehicles parked at the survey location are presented in Table 4.50

Table 4.50: Types of vehicles parked (Towards Itwari)

Type	COUNT	%
Auto	3	0.59%
Car	82	16.11%
TW	424	83.30%
total	509	100%

Residency Road (Towards Sadar)

Figure 4.38: Classification of Parking Duration (Towards Sadar)



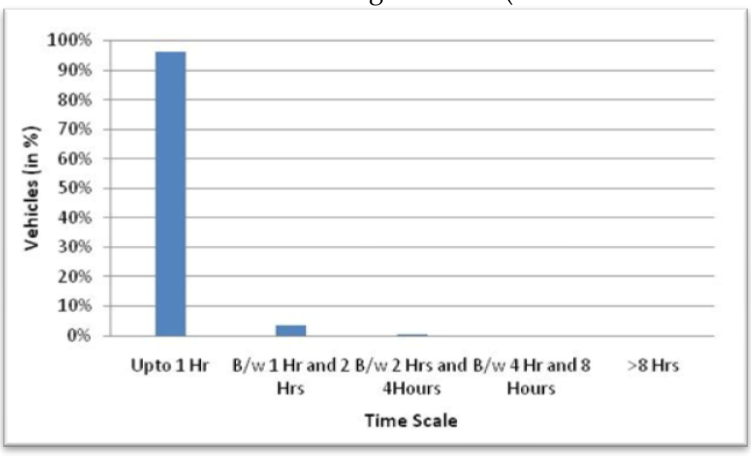
Types of vehicles parked at the survey location are presented in Table 4.51

Table 4.51: Types of vehicles parked (Towards Sadar)

Type	COUNT	% Share
Auto	8	2%
Car	81	18%
LCV	19	4%
TW	351	76%
total	461	100%

Residency Road (Towards Wardha Road)

Figure 4.39: Classification of Parking Duration (Towards Wardha Road)



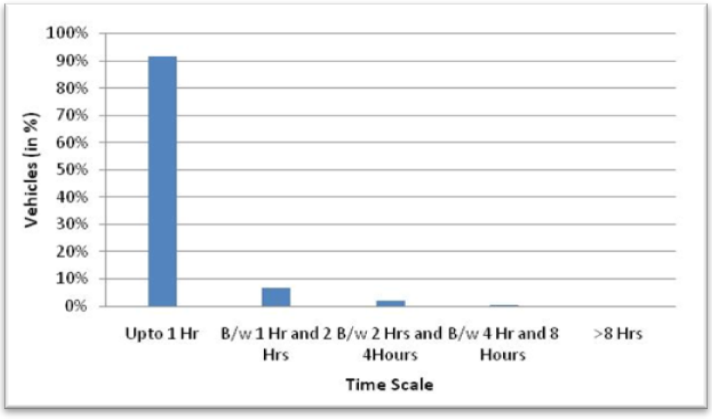
Types of vehicles parked at the survey location are presented in Table 4.52

Table 4.52: Types of vehicles parked (Towards Wardha Road)

Type	COUNT	%
Car	121	22%
LCV	5	1%
TW	411	76%
total	541	100%

Wardha Road (Towards Airport)

Figure 4.40: Classification of Parking Duration (Towards Airport)



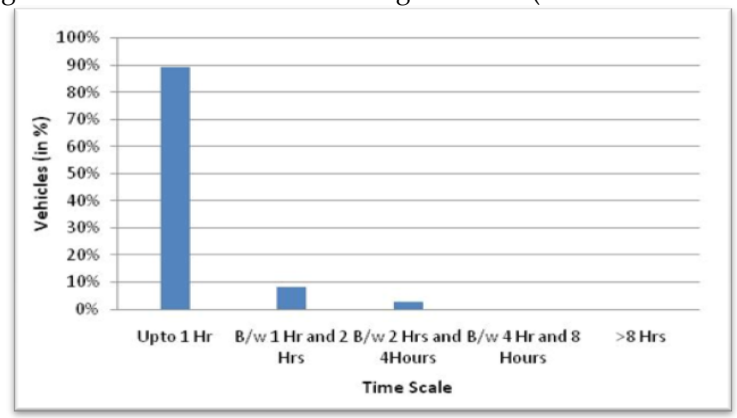
Types of vehicles parked at the survey location are presented in Table 4.53

Table 4.53: Types of vehicles parked (Towards Airport)

Type	Count	% Share
Auto	5	1%
Car	246	32%
LCV	8	1%
TW	511	66%
total	774	100%

Wardha Road (Towards Sitabuldi)

Figure 4.41: Classification of Parking Duration (Towards Sitabuldi)



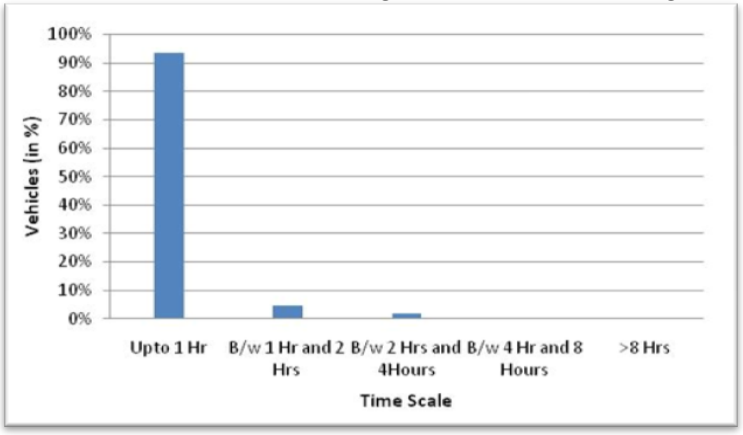
Types of vehicles parked at the survey location are presented in Table 4.54

Table 4.54: Types of vehicles parked (Towards Sitabuldi)

Type	Count	% Share
Auto	31	3%
Car	205	23%
LCV	13	1%
TW	636	71%
Van	8	1%
total	893	

West High Court Road (Towards High Court)

Figure 4.42: Classification of Parking Duration (Towards High Court)



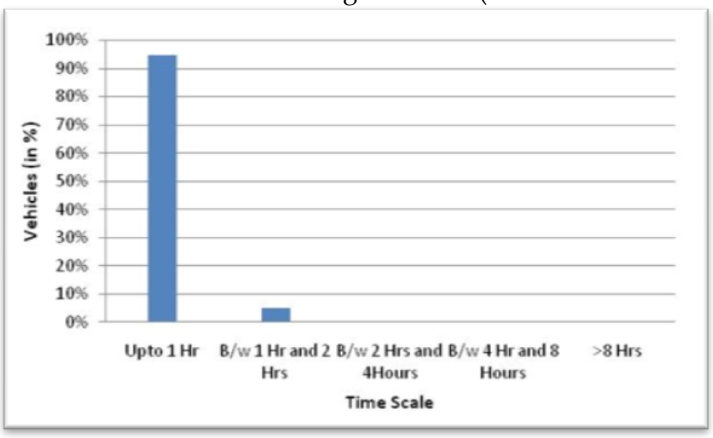
Types of vehicles parked at the survey location are presented in Table 4.55

Table 4.55: Types of vehicles parked (Towards High Court)

Type	Count	% Share
Car	227	18%
LCV	21	2%
TW	983	79%
Vav	8	1%
total	1245	

West High Court Road (Towards Shankar Nagar)

Figure 4.43: Classification of Parking Duration (Towards Shankar Nagar)



Types of vehicles parked at the survey location are presented in Table 4.56

Table 4.56: Types of vehicles parked (Towards Shankar Nagar)

Type	Count	% Share
Auto	10	1%
Car	196	17%
LCV	27	2%
TW	900	79%
total	1140	

4.12 IPT Operator Survey

Intermediate Public Transit (IPT) is also known as Para Transit. IPT plays an important and unique role in the urban transportation system of India. It plays an intermediary role between a private vehicle and a public transit. Especially in India, it provides substantial source of employment. It is the only alternative to public transport system in several cities. So, an IPT operator survey has been carried out in Nagpur to assess the travel characteristics of the different types of IPT modes. Operators were interviewed and the observations are presented below.

System characteristics

The system characteristics like age of the vehicle, average service life of the vehicle, maintenance cost and average monthly salary of the driver/cleaner are estimated and presented below. These system characteristics are used in the economic analysis and serve as input to the transport demand model.

Age of the Vehicle

The age of the various types of intermediate public transport modes is presented in Table 4.57.

Table 4.57: Age of the Vehicle

Age of the vehicle	Auto Rickshaw
< 2 Years	6%
2-5 Years	38%
More than 5 years	31%
>10 Years	25%

It is important to notice that out of the surveyed operators almost 25% operates autos which are more than 10 years old following by 31% operators who are operating autos which are 5 to 10 years old.

Average Annual Maintenance cost (in Rupees)

The average annual maintenance cost is given in Table 4.58

Table 4.58: Average annual maintenance cost (in Rupees)

Mode	Auto Rickshaw
Average Annual Maintenance Cost (in Rs)	17,720

Average earnings of Driver (in Rs/Month)

The average earnings of driver/Cleaner for all modes of IPT is presented in Table 4.59.

Table 4.59: Average Salary of Driver

Mode	Auto Rickshaw
Average earnings for Driver/Cleaner (in Rs Per month)	4060

4.13 Bus Occupancy Survey

The bus occupancy survey was carried out along with screen line volume count survey covering morning and evening peak periods (total for 12 hrs) and the details are presented in the following tables (Table 4.60 to Table 4.67):

Table 4.60: Bus occupancy at Bhandara Road Screenline

Time	Average occupancy- Towards Bhandara	Average Occupancy- Towards Inner ring road
7:00-8:00	20	15
8:00-9:00	20	11
9:00-10:00	23	17
10:00-11:00	29	15
11:00-12:00	17	28
12:00-13:00	15	28
13:00-14:00	12	14
14:00-15:00	15	12
15:00-16:00	20	17
16:00-17:00	12	13
17:00-18:00	18	18
18:00-19:00	20	21
19:00-20:00	23	12
20:00-21:00	22	12

Table 4.61: Bus occupancy at C.A. Road

Time	Average occupancy- Towards Gandhi bhag	Average Occupancy- Towards LIC chowk
7:00-8:00	8	35
8:00-9:00	19	45
9:00-10:00	38	40
10:00-11:00	42	45
11:00-12:00	32	36
12:00-13:00	41	28
13:00-14:00	45	32
14:00-15:00	37	34
15:00-16:00	17	33

Time	Average occupancy- Towards Gandhi bhag	Average Occupancy- Towards LIC chowk
16:00-17:00	12	26
17:00-18:00	19	30
18:00-19:00	32	37
19:00-20:00	32	40
20:00-21:00	23	12

Table 4.62: Bus occupancy at Kamptee Road

Time	Average occupancy- Towards Kamptee	Average Occupancy- Towards Nagpur
7:00-8:00	47	62
8:00-9:00	43	60
9:00-10:00	44	41
10:00-11:00	44	48
11:00-12:00	44	62
12:00-13:00	44	46
13:00-14:00	43	51
14:00-15:00	43	51
15:00-16:00	39	37
16:00-17:00	44	41
17:00-18:00	45	42
18:00-19:00	44	39
19:00-20:00	42	31
20:00-21:00	40	13

Table 4.63: Bus occupancy at Koradi Road

Time	Average Occupancy- Towards Inner ring road	Average Occupancy- Towards Koradi
7:00-8:00	50	11
8:00-9:00	44	27
9:00-10:00	62	32
10:00-11:00	60	37
11:00-12:00	57	42
12:00-13:00	57	40
13:00-14:00	36	43
14:00-15:00	29	36
15:00-16:00	26	47
16:00-17:00	36	56
17:00-18:00	46	47
18:00-19:00	50	65
19:00-20:00	54	40
20:00-21:00	80	40

Table 4.64: Bus occupancy near Jagnade Chowk

Time	Average Occupancy- Towards Bhandara Road	Average Occupancy- Towards Umred Road
7:00-8:00	40	38
8:00-9:00	40	46
9:00-10:00	42	37
10:00-11:00	33	12
11:00-12:00	34	14
12:00-13:00	34	17
13:00-14:00	30	13
14:00-15:00	30	15
15:00-16:00	33	29

Time	Average Occupancy- Towards Bhandara Road	Average Occupancy- Towards Umred Road
16:00-17:00	40	27
17:00-18:00	29	23
18:00-19:00	30	26
19:00-20:00	38	33
20:00-21:00	27	20

Table 4.65: Bus occupancy near S.T. Bus Workshop

Time	Average occupancy- Towards Medical Chowk	Average Occupancy- Towards Cotton market
7:00-8:00	30	35
8:00-9:00	25	23
9:00-10:00	23	20
10:00-11:00	23	23
11:00-12:00	21	25
12:00-13:00	18	38
13:00-14:00	24	30
14:00-15:00	32	30
15:00-16:00	32	32
16:00-17:00	30	36
17:00-18:00	30	40
18:00-19:00	23	27
19:00-20:00	40	40
20:00-21:00	33	38

Table 4.66: Bus occupancy at Shivangaon Phata (NH 7)

Time	Average occupancy- Towards Wardha	Average occupancy- Towards Nagpur
7:00-8:00	25	28
8:00-9:00	20	40
9:00-10:00	15	33
10:00-11:00	25	28
11:00-12:00	30	31
12:00-13:00	34	32
13:00-14:00	30	42
14:00-15:00	28	34
15:00-16:00	37	35
16:00-17:00	36	28
17:00-18:00	30	23
18:00-19:00	23	20
19:00-20:00	20	27
20:00-21:00	23	24

Table 4.67: Bus occupancy at Peatri

Time	Average occupancy- Towards ST busstand	Average occupancy- Towards Biyaddayata circle
7:00-8:00	32	46
8:00-9:00	20	20
9:00-10:00	24	21
10:00-11:00	22	22
11:00-12:00	22	25
12:00-13:00	29	32
13:00-14:00	30	27
14:00-15:00	33	33
15:00-16:00	35	30
16:00-17:00	29	36
17:00-18:00	23	33

Time	Average occupancy- Towards ST busstand	Average occupancy- Towards Biyaddayata circle
18:00-19:00	29	34
19:00-20:00	42	34
20:00-21:00	30	36

4.14 Major Survey Findings:

1. The daily traffic along each screen line ranges between 20,000 vehicles to 80,000 vehicles for a period of 16 hours. The maximum traffic was found at Nala crossing near Ghat Road (SCR 8) with almost 79,000 vehicles. It was observed that the screenline locations along the Nala parallel to C.A. Road carry heavy traffic with more than 50,000 vehicles per day.
2. The peak hour pcu at screenline is approximately 7-8% of the daily pcu observed.
3. The peak hour factor for passenger trips at screenline is 9.4%
4. Amongst the total screenline passenger trips, 95,000 passenger trips observed crossing the vertical screenline (rail line) which is higher compared with the trips observed across horizontal screenline (nala).
5. The outer cordon survey shows that the major traffic flow is through Wardha Road catering 50208 pcu per day followed by Raipur Road with 44747 pcu. The difference between total vehicle and pcu shows higher percentage share of goods vehicle movement at outer cordon locations.
6. Compared to other locations at the outer cordon, Katol Road and HIngna Road carry less traffic (less than 600 pcu). The peak hour traffic at remaining locations is found in the range of 1000 to 1800 pcu.
7. The share of cars in peak hours at outer cordon varies between 10% and 29% for the different locations. The highest peak hour outer cordon traffic flow was observed on Raipur Road carrying 1861 pcu per hour followed by Wardha Road which is catering nearly the same amount of peak hour traffic. The percentage of trucks/ multi axle vehicles varies from 2% to 15% at various locations. MAV share was found higher (9%) on Jabalpur Road while major 2 Axle truck movements found on Amravati, Raipur and Wardha Road.
8. The maximum number of intercity passenger movement was observed at main Nagpur S.T. Stand with more than 30,000 passengers in a day. The passenger movement at Bardi terminal was also found to be high with more than 22000 passengers during a day.
9. Of all the pedestrian volume surveyed locations, maximum numbers of pedestrians were observed at Variety Chowk with almost 31000 pedestrians in a day followed by Jhasi Rani Chowk with almost 26000 pedestrians. The maximum peak hour pedestrians were observed at Variety Chowk with 3200 pedestrians.
10. The journey speed on major corridors during peak hours is in the range of 25 to 30 km/hr, while the speed range varies between 30 to 35 km/hr for non peak hours.
11. Trip frequency for private vehicles at the cordons show that approximately 38% of the trips are daily trips. When comparing various trip purposes of passenger vehicles at the cordons, work trips are highest and are followed by business trips. Average occupancy of two wheeler observed is 1.8, car 3.4, auto rickshaw including shared auto is 3.7 and taxi is 4.0.
12. The majority of the goods that the commercial vehicles carry in the study area include food materials, vegetables, Industrial materials and petroleum products.

13. The average household income is found Rs 19,600 per month; average household size is 4.2; average monthly expenditure on transport is Rs. 2500 (12% of total household income). The per capita trip rate was found to be 1.26 for all modes while the motorized trip rate was observed to be 0.95 The average trip length (ATL) for cars was observed to be 6.87 km, for two wheelers 5.50 km, for auto 4.52 km and for public transport mode 9.40 km The motorized share for two wheelers was 65% followed by autos with 13% and cars with 12%. The PT share was found as 10% of total motorized passenger trips.
14. The junction volume counts show that Variety Chowk, RBI Chowk and Cotton Market Chowk carry more than 1 lakh pcu traffic in a day and more than 10,000 pcu during the peak hour. LIC Chowk, Katol Road Chowk, Golibar Chowk, Ashok Chowk, Shankar Nagar Chowk and Chatrapati Chowk carry more almost 9000 pcu in the peak hour. The peak hour span varies from case to case basis, however the morning common peak hour recognized as 10.00 to 11.00 while evening peak hour was observed as 18:30 to 19:30
15. Of the total roads covered in the inventory, 56% of the roads have two lane un-divided Carriageway, while, 8% is with four lane divided carriageway. Around 76% of surveyed roads (especially radial roads/ NH and SH) in Nagpur have defined median.
16. In general, it is observed that both sides of the footpaths and streets have been encroached upon by parked vehicles, vendors or hawkers. It was observed that almost 67% of surveyed network was encroached and reducing the effective capacity for road usage.
17. Road markings are not available for about 73% of total network length in the study area.
18. The cyclist opinion survey revealed that the average distance travelled is 3.87 km and the average trip time is around 28 minutes. Almost 78% of cycle trips are for work or small scale business purposes. Most of them are daily trips (84%). It was found that heavy traffic with high speed on the road is making cyclists' journey unsafe and discouraging them to cycle. Majority of the respondents (about 67%) felt that the separate cycle track is very essential.
19. The truck operator surveys show that majority of the truck trips are weekly trips (60%). Majority of these truck operators are transporting food grains, vegetables, cereals. Almost 19% of operators are in the business of transporting stone and coal. It is important to notice 31% contribution of industrial material. Nagpur has strong network connectivity with Durga-Bhilai, Raipur and Jabalpur. This has an impact on freight movement in the Nagpur vicinity. Out of total fright material, 31% contributed by industrial material comprising steel, machinery, vehicle parts etc. The average trip length for fright movement was found as 520 km. The Market value of goods was found in the range of Rs. 40,000 to Rs 2,90,000 with average Loading Capacity to be 12.75 Tones. The higher side loading capacities show that majority of commercial vehicles are multi-axle heavy duty vehicles.
20. Most of the trucks (HGV) are parked on streets outside the ring road. The city has HGV movement restrictions resulting in heavy parking demand outside the corporation boundary. The absence of designated truck terminals are resulting in heavy on street parking just outside the boundary, reducing effective capacity on state and national highways.
21. While analyzing the parking duration, we observed that more than 90% of the parked vehicles are parked for less than 2 hour duration which technically can be

considered as a short duration parking. This also reflects that the activities performed on these corridors are mostly associated with the mixed landuse and involves commercial predominantly.

22. The vehicle ownership for IPT operators shows that 25% of autos are more than 10 years old followed by 31% autos which are 5 to 10 years old. The average annual maintenance cost for the IPT operator found to be Rs 17,720.
23. The bus occupancy was found high on the Kamptee Road with almost 60 passengers per bus.

4.15 Summary Table:

The summary of major survey findings is presented in Table 4.68.

Table 4.68: Summary Table

No	Content	Unit	Observation
1.	Peak Hour factor for passenger trips at screen line	Percentage	9.4
2.	Morning Peak Hour Timing	Hour	10.00 to 11.00
3.	Average Occupancy for Two Wheeler	Passenger / vehicle	1.8
4.	Average Occupancy for Car	Passenger / vehicle	3.4
5	Average Occupancy for Auto including Share Auto	Passenger / vehicle	3.7
6	Average Occupancy for Auto including Share Taxi	Passenger / vehicle	4
7	Average household income	Rs /Month	19,600
8	Average household size	Family Members / Household	4.2
9	Average Monthly expenditure on transport	Rs /Month	2500
10	per capita trip rate	-	1.26
11	per capita trip rate (mototrised)	-	0.95
12	Average trip length for cars	Km	6.87
13	Average trip length for two wheelers	Km	5.50
14	Average trip length for auto	Km	4.52
15	Average trip length for public transport	Km	9.40
16	Average distance travelled for cycle (from cyclist opinion survey)	km	3.87
17	Average travel time for cycle trip	Min	28
18	Mode Share for two Wheeler (motorized)	Percentage	65
19	Mode Share Car (motorized)	Percentage	13
20	Mode Share Auto (motorised)	Percentage	12
21	Mode Share by Bus (Motorised)	Percentage	10

Chapter 5
Service Level Benchmarks

5.1 Introduction

Benchmarking is a tool used by public agencies to make more informed decisions regarding the performance, make comparisons internally and with other organizations and continuously improve performance using the lessons learned through this comparison process. **Benchmarking allows public agencies to direct limited resources to the program.** Benchmarking helps to establish baseline measures of performance, and helps monitor the agency's individual performance over time, and also how it compares with the other organizations, and also improving performance by sharing of lessons learnt from different entities.

> On 3rd December 2009, The Ministry of Urban Development launched the Hand Book on Urban Transport Service Level Benchmarks, which has advised all JnNURM mission cities to identify their levels of service.

5.2 Need for Benchmarking for Nagpur

The National Urban Transport policy (NUTP) 2006 highlights the crucial link between transport demand and land use planning and the need to develop an integrated mobility plan for each city. Accordingly, each city should develop comprehensive mobility plan during the 12th five year plan with focus on accessibility, mobility and traffic flow (in that order). Rather than the present approach of "predict and provide" it has to be "Planning for the desirables". However, there need to be some yardstick to measure and compare the effectiveness of policies and urban projects across cities. Urban agencies in India currently do not have any system for measuring performance of urban transport activities, assessing impacts of projects and taking further action on them. Nagpur City is no exception to this. The service level benchmarks (SLB) issued by MOUD specify parameters to measure the effectiveness of land use-transport planning in Nagpur.

The SLBs describe the levels of transport performance like safety and access, pollution, accidents, congestion etc. in Nagpur currently. They indirectly reflect the state of governance in the city. Above all, these benchmark indicators allow stakeholders to quantify the past, present and changes in transport and its sustainability.

5.3 Performance Bench Marks for Urban Transport

Service level benchmarks have been identified for the following parameters by the Ministry of Urban Development (MoUD):

1. Public transport facilities
    - Presence of organized public transport system in urban area (%)

- Extent of supply availability of public transport
- Service coverage of public transport in the city
- Average waiting time for public transport users (mins)
- Level of comfort in public transport
- % of fleet as per urban bus specification

2. Pedestrian infrastructure facilities
   - Signalized intersection delay (%)
   - Street Lighting (Lux)
   - % of city covered

3. Non Motorized Transport (NMT)facilities
   - % of network covered
   - Encroachment on NMT roads by vehicle parking (%)
   - NMT parking facilities at interchanges (%)

4. Level of usage of Intelligent Transport System (ITS) facilities
   - Availability of traffic surveillance (%)
   - Passenger Information System (PIS) (%)
   - Global Positioning System (GPS)/ General Pocket Radio Service (GPRS) (%)
   - Signal Synchronization (%)
   - Integrated ticketing System (%)

5. Travel speed (Motorized and Mass Transit) along major corridors
   - Average travel speed of personal vehicles (Kmph)
   - Average travel speed of public transport (Kmph)

6. Availability of parking spaces
   - Availability of on street paid public parking spaces (%)
   - Ratio of maximum and minimum parking fee in the city

7. Road safety
   - Fatality rate per lakhs population
   - Fatality rate for pedestrian and NMT (%)

8. Pollution levels
   - Sulpher di Oxide (So2)
   - Oxides of Nitrogen
   - Suspended Particulate Matter(SPM)
   - Respirable Suspended Particulate Mattetr(RSPM) (Size less than 10 microns)

9. Integrated land use transport system
   - Financial Population Density – Gross (Persons/Developed area in hectare)
   - Mixed Land-use on Major Transit Corridors / Network (% area under non residential use)
   - Intensity of Development – City wide (FSI)
   - Intensity of development along transit corridor (FSI transit corridor/FSI)
   - Clear Pattern and Completeness of the network

- % of area under Roads
- %age network having exclusive ROW for Transit network

10. sustainability of public transport
    - Extent of Non fare Revenue (%)
    - Staff /bus ratio
    - Operating Ratio

5.4 Computation of Indices

In Service Level Benchmark, four levels of Service (LoS) have typically been specified. They are LOS1, LOS2, LOS3 and LOS4. The LOS1 represents the highest performance level whereas LOS4 represents the Lowest. Hence, the goal is to attain LOS1. This section describes the computation process for all the indicators.

5.4.1 Public transport facilities

1. Presence of organized public transport system in urban area (%)
2. Extent of supply availability of public transport
3. Service coverage of public transport in the city
4. Average waiting time for public transport users (mins)
5. Level of comfort in public transport
6. % of fleet as per urban bus specification

Presence of organized public transport system in urban area (%)

Nagpur's public transportation system was operated and maintained by Maharashtra State Road Transport Corporation (MSRTC). At present, 'Vansh Nimay Infra projects limited (VNIL)' is operating city buses on PPP basis. In addition to its own buses, city has received 200 buses under JNNURM funding scheme.

Los 1	Presence of Organized Public Transport System
1	>= 60
2	40 - 60
3	20 - 40
4	< 20

Currently, in Nagpur city out of 430 only 200 buses are operating.

A = Total Number of Buses in the City operating – 200 buses
B = Total Number of operating Buses under the ownership of STU/SPV - 0 buses
Presence of Public Transport System in Urban Area (%)
= (B/A)*100
= 0 %, Therefore LoS **1 = 4**

Extent of Supply Availability of Public Transport

In Nagpur, the sub urban train facility is absent. The trains operated in Nagpur are for interstate and intercity only. So for this calculation the train coaches are not taken into account. Only the buses operated inside the city is taken into consideration.

Los 2	Extent of Supply Availability of Public Transport
1	>= 0.6
2	0.4 – 0.6
3	0.2 – 0.4
4	< 0.2

The Population of Nagpur Urban Limits for the year 2012 is 24,49,457.

A = Total Number of Buses in the City – 200 buses
B = Total Population of the Nagpur Urban limits – 24,49,457.

Availability of Public Transport / 1000 Population
= A/ (B/1000)
= 0.081, Therefore LoS 2 = 4

Service coverage of public transport in the city

The Nagpur city area is 217sq.km while the study area is 3916 sq.km. The total length of corridor on which public transport system is plying is 642 km.

Los 3	Service coverage of public transport in the city
1	>= 1
2	0.7 - 1.0
3	0.3 – 0.7
4	< 0.3

A=Total length of road Kms of the corridors on which the PT systems ply in study area= 642 kms (in Road Kilometers) for metropolitan area
B = Area of the Urban Limits (study area)= 3916 (in Square Kilometers)

Service Coverage of public transport in the city = (A/B)
= 0.16 Therefore LoS 3 = 4

Average waiting time for public transport users (minutes)

The average headway for each bus route is about 20 to 30 minutes. Therefore the average waiting time is half the headway 1.e. 15 minutes.

Los 4	Average waiting time for public transport users (mins)
1	<=4
2	4 - 6
3	6- 10
4	> 10

Therefore LoS 4 = 4

Level of comfort in public transport

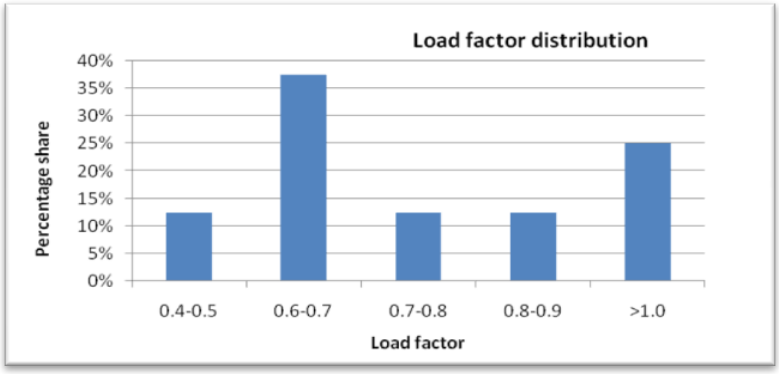
A = Key public transport corridors are identified through the Google map and Bus passenger occupancy survey were done at that selected bus stops.

Los 5	Level of Comfort of public transport in the city
1	<=1.5
2	1.5 – 2.0
3	2.0 – 2.5
4	>2.5

B = Passenger count on bus at key identified routes.
C = Seats available in the bus is taken based on its type.

Passenger comfort – Load factor (passengers per seat) = B/C

Figure 5.1: Load Factor Distributions



Load factor was calculated for different routes. From the calculated load factor distribution table was prepared. The average value obtained from the distribution is about 0.80 which is shown in the figure. Therefore LoS 5 = 1

% of Fleet as per Urban Bus Specification

The information collected as a part of secondary data collection.

A = Total Number of Buses in the City operating – 200 buses

B = Total number of buses as per the Urban Bus specifications in the city operating – 0 buses

Los 6	% of fleet as per urban bus specification
1	75 - 100
2	50 - 74
3	25 - 49
4	<=25

% of fleet = (B/A)*100 = (0/200)*100 = 0%,

% of fleet as per urban bus specification is 0%, Therefore LoS 6 = 4

Overall Level of Service of Public Transport Facilities

Table 5.1: Reference Table for Computing Overall Level of PT Facilities

Overall Level of Service of Public Transport facilities City wide		
Calculated LoS = (LoS_1 + LoS_2 + LoS_3 + LoS_4 + LoS_5 + LoS_6) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	**< 12**	The City has a good public transport system which is wide spread and easily available to the citizens. The system provided is comfortable.
2	**12 - 16**	The City has public transport system which may need considerable improvements in terms of supply of buses/ coaches and coverage as many parts of the city are not served by it. The frequency of the services available may need improvements. The system provided is comfortable.
3	**17 - 20**	The City has a public transport system which may need considerable improvements in terms of supply of buses / coaches and coverage as most parts of the city are not served by it. The frequency of the services available needs improvements. The system provided is not comfortable as there is considerable over loading.
4	**21-24**	The city has very poor/no organized public transport system

The overall LoS of Public Transport Facilities is obtained by summing up the LoS of individual parameters.

The city has very poor Transport System which need considerable improvements in terms of supply of buses/ coaches and coverage, system quality. The system may require route rationalization and bus augmentation to improve the performance.

Overall Level of Service of Public Transport facilities in Nagpur = LoS 1+ LoS 2 + LoS 3 + LoS 4 + LoS 5 + LoS 6 = 4 + 4 +4 + 4 +1 + 4 = 21

5.4.2 Pedestrian infrastructure facilities

1. Signalized intersection delay (%)
2. Street Lighting (Lux)
3. % of city covered by footpaths

Signalized Intersection Delay (%)

A = Total Number of signalized intersections in the city = 140

B = No of intersections having average waiting time of pedestrian more than 45 seconds = 0

Los 1	Signalized intersection delay (%)
1	< 25
2	25 – 50
3	50 - 75
4	>= 75

(Desired average waiting time for a pedestrian is not more than 45 seconds)

Signalized intersections delay (%) = (B/A) =0%

Therefore LoS 1 =1

Street Lighting (%)

It is estimated that the LoS 2 for the city is 3.

Los 2	Street Lighting (Lux)
1	>= 8
2	6 - 8
3	4 - 6
4	< 4

Percentage of City Covered (%) by footpaths

Almost 71% of surveyed network has a paved footpath. Some of the network has footpath on the both side but the width was less than 1.2m. Almost 129 running km was having footpaths on both the sides with more than 1.2 m width.

Los 3	% of city covered
1	>= 75
2	50 - 75
3	25 - 50
4	< 25

A = Total length of road network in the city and multiplied by 2 = 297 kilometers

B = Total length of the footpath having minimum width of 1.2 m and available on both sides = 128.7 in Kilometers.

Percentage of the city covered = (B/A)*100

= (128.7/297)*10 = 43%,

Therefore LoS 3 =3

Overall Level of Service of Pedestrian Infrastructure Facilities

Table 5.2: Reference Table for Computing Overall Level of Infrastructure Facilities

Overall Level of Service of Pedestrian Infrastructure Facilities City wide		
Calculated LoS = (LoS_1 + LoS_2 + LoS_3) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	**3 – 5**	The City has adequate barrier free pedestrian facilities along overall road network.
2	**6 - 8**	The City has pedestrian facilities which may need some improvements in terms of improvements in intersections, footpaths, and street lighting as some parts of the city are not served by it. The footpath available needs improvements. The system provided is otherwise comfortable and sustainable
3	**9-10**	The City has pedestrian facilities which may need considerable improvements. The pedestrian facilities at intersections, availability of footpath etc needs improvements as also many parts of the city are not served by it.
4	**11 - 12**	The city lacks adequate pedestrian facilities

The overall LoS of Pedestrian Infrastructure Facilities is obtained by summing up the LoS of individual parameters.

The city has pedestrian facilities which may need some improvements at intersections, footpaths and street lighting as some parts of the city are not served by it. The system provided is otherwise comfortable and sustainable.

Overall Level of Service of pedestrian Infrastructure facilities city wide = LoS 1+ LoS 2 + LoS 3 = 1+3+4= 8

5.4.3 Non Motorized Transport (NMT) Facilities

1. % of network covered
2. Encroachment on NMT roads by vehicle parking (%)
3. NMT parking facilities at interchanges (%)

JNNURM recommends that cities should have NMT tracks on all major roads within a year. In view of above said this indicator reflects the availability of dedicated cycle track along all the arterial, sub arterial roads and public transport corridors, its encroachment and parking facilities.

In Nagpur, the NMT parking facility is present at places such as railway station, and at bus stands. As an overall percentage this value is negligible and is taken as zero. Hence, for this performance indicator the level of service for all the above said three sub divisions are below the least level of service category (Normally zero for all).

Los	% of network covered	Encroachment on NMV roads by vehicle parking (%)	NMT parking facilities at Interchanges (%)
1	>= 50	<= 10	>= 75
2	50 - 25	10 - 20	50 - 75
3	25 - 15	20 - 30	25 - 50
4	< 15	>30	< 25

The overall level of NMT facilities

Table 5.3: Reference Table for Computing Overall Level of NMT Facilities

Overall Level of Service (LoS) of Non Motorized Transport facilities (NMT) City-wide		
Calculated LoS = (LoS_1 + LoS_2 + LoS_3) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	**3-5**	The City has adequate NMT facilities along overall road network.
2	**6 – 8**	The City has NMT facilities which may need some improvements in terms of encroachments, parking facilities at interchanges etc as some parts of the city are not served by it. The system provided is otherwise comfortable and sustainable
3	**9-10**	The City has NMT facilities which may need considerable improvements as many parts of the city are not served by it.
4	**11 – 12**	The city lacks adequate NMT facilities

Overall Level of Service of NMT facilities city wide = LoS 1+ LoS 2 + LoS 3 = 4+4+4=12

There is no designated NMT facility available which can take care of safety and comfort issues for NMT modes in Nagpur. Leading towards the sustainable development of the city, it is very essential to consider NMT strategies with higher consideration with priority.

5.4.4 Level of usage of Intelligent Transport System (ITS) facilities

1. Availability of Traffic Surveillance (%)
2. Passenger Information System (%)
3. Global Positioning System (GPS)/ General Pocket Radio Service (GPRS) (%)
4. Signal Synchronization (%)
5. Integrated ticketing System (%)

Availability of Traffic Surveillance (%)

A = Total no of bus stations on BRTS, major bus stops, terminals, metro stations and signalized intersection having CCTVs = 0

B = Total no of bus stations on BRTS, major bus stops, terminals, metro stations and signalized intersections = 147 (in No) (3 important Bus stands, 4 major Railway stations, 140 signalized intersections)

Los 1	Availability of Traffic Surveillance (%)
1	>= 75
2	50 - 75
3	25 - 50
4	< 25

Availability of traffic surveillance (%) = (A/B)*100 = 0/147 = 0. Therefore LoS 1 = 4

Passenger Information System (%)

A = Total no of bus stops, terminals, metro stations having Passenger Information System facility = 0

B = Total no of bus stops, terminals, metro stations = 147

Passenger Information System= (A/B)*100 = 0

Los 2	Passenger Information System (PIS)
1	>= 75
2	50 - 75
3	25 - 50
4	< 25

Therefore LoS 2 = 4

Global Positioning System (GPS)/ General Pocket Radio Service (GPRS) (%)

Los 3	Global Positioning System / GPRS
1	>= 75
2	50 – 75
3	25 – 50
4	< 25

A = No of public transport vehicles and IPT with functional on board GPS/GPRS and connected to common control center = 0

B = Total no of public transport vehicles and IPT = 21155 (in No) (Auto Rickshaws17149, taxis& Cabs -2907, contract carriages/ minibus- 899, Buses- 200)

Global Positioning System = (A/B)*100
= (0/21155)*100
= 0 %, Therefore LoS 3 = 4

Signal Synchronization (%)

In Nagpur LPA, so far no signals have been synchronized.

Los 4	Signal Synchronization (%)
1	>= 75
2	50 - 75
3	25 - 50
4	< 25

A = No of signals synchronized = 0 (in No.)

B = Total number of signalized intersections = 140 (in No.)

Signal Synchronization (%) = (A/B)*100
= (0/140)*100
=0 %, Therefore LoS 4 = 4

Integrated ticketing System (%)

Integrated Ticketing System is absent in Nagpur LPA. So the level of service for this benchmark is 4.

Los 5	Integrated Ticketing system (%)
1	>= 75
2	50 - 75
3	25 - 50
4	< 25

The overall level of ITS service

Table 5.4: Reference Table for Computing Overall Level of ITS Facilities

Overall Level of Service (LoS) of usage of Intelligent Transport System (ITS) City-wide		
The calculated LoS = (LoS_1 + LoS_2 + LoS_3 + LoS_4 + LoS_5) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	**5 - 7**	The city has adequate ITS facilities
2	**8 - 10**	The city has ITS facilities which may need some improvements in terms of Integrated Ticketing System, Signal Synchronization, GPS/GPRS, PIS etc as some parts of the city are nor served by it.
3	**11 - 15**	The city has bare minimum ITS facilities and may need considerable improvements terms of Integrated Ticketing System, Signal Synchronization, GPS/GPRS, PIS etc as many parts of the city are nor served by it.
4	**16 - 20**	The city lacks adequate ITS facilities

Overall Level of Service of ITS facilities city wide = LoS 1+ LoS 2 + LoS 3 + LoS 4 + LoS 5 = 4+4+4+4+4+4= 20

The city lacks adequate ITS facilities

5.4.5 Travel speed (Motorized and Mass Transit) along major corridors

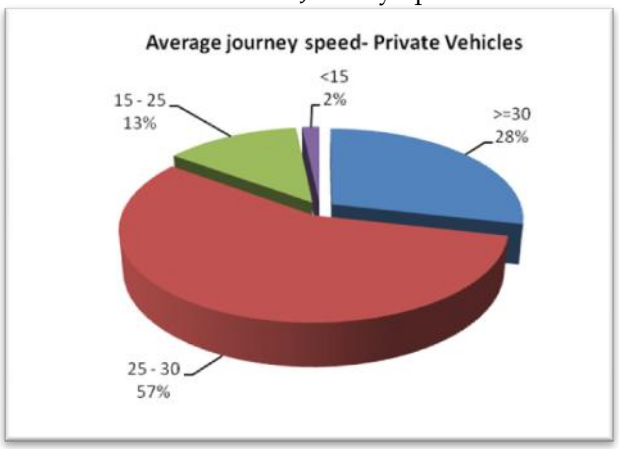
1. Average travel speed of personal vehicles (Kmph)
2. Average travel speed of public transport (Kmph)

Los 1	Average travel Speed of personal vehicles (Kmph)
1	>=30
2	25 - 30
3	15 - 25
4	<15

Average travel speed of personal vehicles (Kmph)

A = Delineate the key corridors of the road traffic (personal vehicle) in the city

Figure 5.2: Distribution based on Journey Speed for Private Vehicles



B = Compute average speed on the key corridors

From the speed and delay survey for private vehicles, the average journey speed for major corridors for the private vehicles = 27 Kmph

C= Level of service for personal vehicle along each corridor.
D = Weight of each corridor based on volume of personal traffic
Weight age of the nth corridor (Wn) = Length for nth corridor / Total length

Based on the above formula, the weight ages of all the corridors as share of total length have been calculated for both the directions.

Level of Service with	Percentage (personal vehicles) of LoS on Corridors
1 (>=30 Kmph)	29%
2 (25 – 30 Kmph)	57%
3 (15 -25 Kmph)	13%
4 (<15 Kmph)	2%

City-wide Level of Service for travel speed of motorize

d vehicles = (W1*LoS corridor1) + (W2 * LoS corridor 2) + (W3 * LoS Corridor 3) +….(Wn * LoS corridor n) = 1.88 = 2 (Rounded off to the next whole number). Therefore LoS 1 = 2

Average travel speed of Public Transport vehicles (Kmph)
This indicator is computed based on the existing city buses in the city.

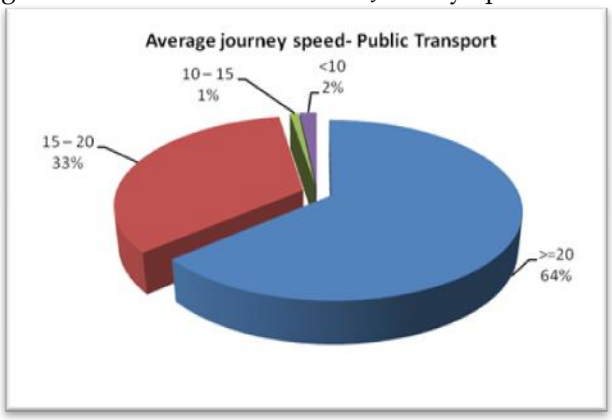
A = Delineate the key corridors of the road traffic (Public transport) in the city
B = Compute average speed on the key corridors

C= Level of service for personal vehicle along each corridor.
D = Weights of each corridor based on volume of personal traffic

Los 2	Average travel Speed of Public Transport vehicles (Kmph)
1	>=20
2	15 – 20
3	10 – 15
4	<10

From the speed and delay survey for public transport, the average journey speed for major corridors for the public transport =19.63 Kmph

Figure 5.3: Distribution based on Journey Speed for PT



The percentage of LoS on corridors based on its travel speed in public transport vehicles for the Nagpur is given in the table.

Around 52 % of the corridors in the city have a journey speeds greater than 20 Kmph and around 46% of the corridors will have a journey speed of about between 15 to 20 kmph.

Level of Service with	Percentage (personal vehicles) of LoS on Corridors
1 (>=20 Kmph)	52%
2 (15 – 20 Kmph)	46%
3 (10 -15 Kmph)	1%
4 (<10 Kmph)	2%

Weight age of the nth corridor (Wn) = Length for nth corridor / Total length

Based on the above said formula, the weightages of all the corridors as share of total length is calculated for both the directions.

City-wide Level of Service of motorized vehicles = (W1*LoS corridor1) + (W2 * LoS corridor 2) + (W3 * LoS Corridor 3) +….(Wn * LoS corridor n) = 1.52 = 2 (Rounded off to the next whole number). Therefore LoS 2 = 2

Overall Level of Service of travel Speed along Major Corridors

Table 5.5: Reference Table for Computing Overall Level of Travel Speed

Overall Level of Service of Travel Speed along major corridors City wide		
Calculated LoS = (LoS_1 + LoS_2) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	**2**	Primarily free flow- movement at average travel speeds usually about 70% of the free flow speed for the key corridors.
2	**3 -4**	Small increase in traffic causing substantial increase in approach delay and hence, decrease in arterial speed.
3	**5 -6**	Significant approach delays and average travel speed of 1/3 the free flow speed or lower. Such conditions causinga combination of one or more reasons such as high signal density, extensive queuing at critical intersections and inappropriate signal timing.
4	**7 -8**	Key corridors at extremely low speeds below 1/3 to 1/4 of the free flow speed. Intersection congestion is likely at critical signalized locations, with high approach delays.

Overall Level of Service of Travel Speed facilities city wide = LoS 1+ LoS =2+2 =4

As the calculated LoS is 4, the overall LoS can be rated as 2

Small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed

5.4.6 Availability of parking spaces

1. Availability of On-street paid public parking spaces (%)
2. Ratio of maximum and minimum parking fee in the city

This indicator represents the availability of paid on-street parking spaces for all vehicles in the Nagpur. Paid on-street parking facility is not yet introduced in Nagpur city except in some off-street locations like Bus stands and railway stations. In some places like shopping malls, Market complexes parking is maintained by private people. As the percentage is negligible it is considered as <25 %. Therefore LoS 1= 4.

Los	Availability of on street public parking spaces (%)	Ratio of Maximum and Minimum parking Fee in the City
1	>= 75	>4
2	50 – 75	2 – 4
3	25 – 50	1 – 2
4	< 25	1

The ratio of maximum and minimum parking fee is 1 for Nagpur city. Therefore LoS 2 = 4.

The Overall LoS for availability of parking spaces

Table 5.6: Reference Table for Computing Overall Level of Parking Space

Overall Level of Service (LoS) for Availability of Parking Space City-wide		
Calculated LoS = (LoS_1 + LoS_2) and identify overall LoS as mentioned below.		
Overall LoS	**Calculated LoS**	**Comments**
1	2	Paid parking spaces are available in the city and the demand is well managed by incorporating differential parking rates for the CBD.
2	3 - 4	Paid parking spaces are available in the city and the demand is well managed by incorporating differential parking rates for the CBD. However some improvements may be required
3	5 - 6	Paid parking spaces provided in the city need to be improved upon and to cater to the demand some differential parking rates for the CBD have been adopted. The city authorities need to imitative considerable improvements measures.
4	7 - 8	The city authorities need to initiate immediate actions with respect to providing paid parking spaces and demand management for parking.

The overall Level of Service of Parking Facilities in Nagpur = LoS 1+ LoS 2 = 4+ 4 = 8

The city authorities need to initiate immediate actions with respect of providing paid parking spaces and demand management for parking

5.4.7 Road safety

1. Fatality rate per lakh population
2. Fatality rate for pedestrian and NMT (%)

Fatality Rate per Lakh of Population (%)

Accident Data for the entire city was collected from Traffic police, Calculation was done only based on 2011 data and the corresponding year population.

A = Total number of fatalities recorded in road accidents within city limits in the given calendar year = 237 (in nos.)

B = Population of the Nagpur urban limits in 2011 year – 24.7(Estimated) (in Lakhs)

Los 1	Fatality rate Per Lakh of Population
1	<=2 persons
2	2 – 4 persons
3	4 – 6 persons
4	>6 persons

Fatality rate per 100000 Population (ratio)

= (A * 100000)/B

= 9.59

Approximately 10 persons, Therefore LoS 1 = 4

Fatality Rate for Pedestrian and NMT

A = Total number of fatalities recorded of persons who were pedestrians /cyclists in road accidents for the year 2011 = 98 (in nos.)

B = Total number of fatalities recorded in road accidents within city limits in the given year = 237 (in nos.)

Fatality rate for pedestrian and NMT (%)

= (A/B)*100

= 41.40%, Therefore LoS 2 = 3

LoS 2	Fatality rate Per Lakh of Population
1	<=20
2	20 - 40
3	40 - 60
4	>60

Overall Level of Service of Road Safety

The overall LOS of Availability of safety is obtained by summing up the LOS of individual parameters.

Table 5.7: Reference Table for Computing Overall Level of Road Safety

Overall Level of Service (LoS) for Road Safety City-wide		
Calculated LoS = (LoS_1 + LoS_2) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	2	Level of Fatality rate in a city is very low.
2	3 - 4	Need some improvements in road design and available road infrastructure, traffic management and in other such reasons which significantly contribute to road safety.
3	5 - 6	Need considerable improvements in road design and available road infrastructure, traffic management and in other such reasons which significantly contribute to road safety.
4	7 - 8	Level of Fatality rate in a city is very high.

Overall Level of Service of Road Safety facilities city wide = LoS 1+ LoS 2= 4+3 = 7

Level of Fatality rate in the city is very high

5.4.8 Pollution levels

The indicator indicates the level of air pollutants in the city i.e., average level of pollution in urban areas. The indicator to calculate the pollution level is Annual Mean Concentration Range.

The pollution data that needs to be collected includes:

1. Sulphur Dioxide (SO2)
2. Oxides of Nitrogen
3. Suspended Particle matter (SPM)
4. RSPM (Size less than 10 microns)

The level of service for the pollutants is divided into four categories i.e., low, moderate, high and critical. The level of service for each of the above parameters is determined using the table below as recommended by MoUD.

Level of service	1.SO2	2. Oxides of Nitrogen	3. SPM	4. RSPM (size less than 10 microns)
1 (Low)	0-40	0-40	0-180	0-40
2 (Moderate)	40-80	40-80	180-360	40-80
3 (High)	80-120	80-120	360-540	80-120
4 (Critical)	>120	>120	>540	>120

For Nagpur city, the pollution levels data is available for the year 2010 and is as shown below.

Name of city	1.SO2	2. Oxides of Nitrogen	3. SPM	4. RSPM (size less than 10 microns)
Nagpur	7	33	171.8	113

Source: Report on National Air Quality Status and Trends in India 2010, CPCB, MoEF Published in Jan 2012, Table no 2.5a and Table 6.1

Overall level of service of pollution levels

The overall LoS of availability of pollution levels is obtained by summing up the LoS of individual parameters.

Table 5.8: Reference Table for Computing Overall Pollution Level

Overall Level of Service (LoS) for Pollution level City-wide		
Calculated LoS = ($LoS_1 + LoS_2 + LoS_3 + LoS_4$) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	< = 5	Level of pollution in a city is very low.
2	6 - 9	Need some improvements in emission standards, checking pollution etc.
3	10 - 13	Need considerable improvements in emission standards, checking pollution etc.
4	14 - 16	Level of pollution in a city is very high.

Overall level of service of pollution city wide = LoS 1+ LoS 2+ LoS 3 + LoS 4 = 1+1+1+3=6

Need some improvement in emission standard, checking pollution etc

5.4.9 Integrated land use transport system

1. Financial Population Density – Gross (Persons/Developed area in hectare)
2. Mixed Land-use on Major Transit Corridors / Network (% area under non residential use)
3. Intensity of Development – City wide (FSI)
4. Intensity of development along transit corridor (FSI transit corridor/FSI)
5. Clear Pattern and Completeness of the network
6. % of area under Roads
7. %age network having exclusive ROW for Transit network

Population Density – Gross (Persons/Developed area in hectare)

A = Developed area (in Hectare) computed from City Development Plan CDP (2011) = 8340 hectares

B = Population of the year for which data is available = 24.70 lakhs

Population density (No.) = B/A

= 296.16 ,

Therefore LoS 1 = 1

Los 1	Population density / Gross
1	>= 175
2	150 – 175
3	125 – 150
4	< 125

Mixed Land Use Zoning (Proportion of non residential area)

In the city at present there is no transit corridor actually plying.

So, the zoning will be determined once transit corridor starts operating. For this study, the mixed land use is taken as 0. Thus the level of service for the inventory of land use along major transit corridors is very least taken as <5%.

Los 2	Mixed Land Use Zoning
1	>= 30
2	15 - 30
3	5 – 15
4	<5

Therefore LoS 2 = 4

Intensity of Development Citywide – FSI

As per the Development plan Floor Space Index (FSI) as applicable to the developed area lies in the range of 1.50 - 2.00. Normally, FSI varies due to plot size, ground coverage and road width.

Los 3	Intensity of development citywide FSI
1	>= 2
2	1.5 – 2.0
3	1.0 – 1.5
4	<1

Floor Space Index is between 1.5 to 2.0, Therefore LoS 3 = 2

Intensity of Development Citywide along transit corridor - FSI

A = Floor Space Index (Applicable to most part of the city as per master plan /CDP is between 1.5 to 2.0.

B = FSI for the proposed transit corridor is also 1.5 to 2.0

Los 4	Intensity of development along transit corridor
1	>= 2
2	1.5 – 2.0
3	1.0 – 1.5
4	<1

Intensity of development along transit corridor = B/A= 1, Therefore LoS 4 = 2

Clear pattern and completeness of network

The entire network in Nagpur city has a somewhat clear pattern (ring radial) but somewhat incomplete network as many the peripheral locations are not well connected.

Hence LoS 5 = 2.

Los 5	Clear pattern and completeness of network
1	Clear pattern (ring radial or grid iron)and complete network
2	Somewhat clear pattern (ring radial or grid iron) but somewhat in complete network
3	Somewhat un clear pattern and in complete network
4	No clear pattern incomplete / sparse network

% of area under roads (%)

As per master plan, the average area under transport and communication for Nagpur City area is around 12%- 14%. If we consider area only under roads it is in the range of 7%.

Los 6	% of area under roads
1	>=15
2	12 – 15
3	10 – 12
4	< 10

Therefore. LoS 6 = 4

% network with exclusive ROW for transit (For >1 million as per 2001 census)

A = total Length of roads (Arterial and sub arterial) having ROW 9m and above plus total length of urban rail network = 336.7 km (191 km - rail network + 145.7 km from Road inventory survey)

B = Total length of road having exclusive BRT/Metro/LRT/Monorail = 0 kms

% network with exclusive ROW for transit = B/A*100 = 0 , Therefore LoS 7 = 4

Los 7	% network having exclusive ROW for transit network
1	>=30
2	20-30
3	10-20
4	< 10

Overall level of service of Integrated Land use System

Table 5.9 Reference Table for Computing Overall Level Integration for Landuse and Transport System

Overall Level of Service (LoS) for Integrated Land Use Transport system City-wide			
For > =1 million population: Calculated LoS = ($LoS_1 + LoS_2 + LoS_3 + LoS_4 + LoS_5 + LoS_6 + LoS_7$) and identify overall LoS as mentioned below			
For < 1 million population: Calculated LoS = ($LoS_1 + LoS_2 + LoS_3 + LoS_4 + LoS_5 + LoS_6$) and identify overall LoS as mentioned below			
Overall LoS	**Calculated LoS**		**Comments**
	>= 1 million population	**< 1 million population**	
1	**<=8**	**<= 9**	City structure is appropriately planned in a manner which patronizes public transport.
2	**8 -15**	**9 - 14**	City structure is some what in coherence with the public transport system
3	**15 - 22**	**14 - 20**	Faint coherence between city structure and public transport system
4	**22- 28**	**20 - 24**	Inconsistency in the city structure and public transport system leading to lesser ridership and high dependence on personalized motor vehicles

For a population > 1 million, overall Level of Service of Integrated Land use system= LoS 1+ LoS 2 + LoS 3 + LoS 4 + LoS 5 + LoS 6 + LoS 7= 1+ 4 +2 +2 +2 +4 + 4 =19

Faint coherence between city structure and public transport system

5.4.10 Sustainability of public transport

1. Extent of Non fare Revenue (%)
2. Staff /bus ratio
3. Operating Ratio

Extent of Non Fare Revenue (%)

Operational performance and financial performance of VNIL had been collected as a secondary data collection.

Los 1	Extent of non fare Revenue
1	>40
2	40 – 20
3	20 – 10
4	<=10

A = Revenue collections per annum from n

on fare related sources (i.e. excluding tariff box collections) – Rs. 9.6 lakhs (Approx.)

B = Total revenue per annum from all the sources – Rs. 42 crore (Approx 3.5 cr / month)

Extent of non-fare revenue (%).

= A/B * 100

= 0.002 %, Therefore LoS 1 = 4

Staff/Bus Ratio

A = Total staff of bus operation and maintenance – 1400

B = Total number of buses – 250 (in Number)

Los 2	Staff / Bus Ratio
1	<=5.5
2	5.5 – 8
3	8 – 10
4	>10

Staff / Bus Ratio (ratio) = A/B = 5.6,

Therefore LoS 2 = 2

Operating Ratio

A = Cost/ vkm = Rs. 33

B = Earning/vkm = Rs. 28.41

Operating Ratio (ratio) = A/B = 1.16,

Los 3	Operating Ratio
1	<0.7
2	0.7 – 1.0
3	1.0 - 1.5
4	>=1.5

Therefore LoS 3 = 3

Table 5.10 Reference Table for Computing Overall Level Financial Sustainability

The Overall LoS for Financial Sustainability of Public Transport by bus city wide		
Calculated LoS = (LoS_1 + LoS_2 + LoS_3) and identify overall LoS as mentioned below		
Overall LoS	**Calculated LoS**	**Comments**
1	**< = 4**	The public transport of a city is financially sustainable.
2	**5 - 7**	The public transport of a city is financially sustainable but needs some improvements
3	**8- 9**	The public transport of a city is financially sustainable but needs considerable improvements
4	**10 - 12**	The public transport of a city is not financially sustainable.

Overall Level of Service of sustainability of Public Transport facilities city wide = LoS 1+ LoS 2 + LoS 3 = 4 + 2 + 3 = 9

The existing Public Transport system in Nagpur is financially not sustainable and needs considerable improvements

5.4.11 Summary Table

Sl. No	Bench mark	LOS calculated for NMA area	Inference as per MOUD Guidelines
1	Public Transport Facilities	21	The city has very poor Transport System which need considerable improvements in terms of supply of buses/ coaches and coverage, system quality. The system may require route rationalization and bus augmentation to improve the performance.
2	Pedestrian infrastructure facilities	8	The city has pedestrian facilities which may need some improvements at intersections, footpaths and street lighting as some parts of the city are not served by it. The system provided is otherwise comfortable and sustainable.
3	Non Motorised Transport Facilities	12	The city lacks adequate NMT facilities.
4	Level of usage of Intelligent Transport System(ITS) Facilities	20	The city lacks adequate ITS facilities.
5	Travel speed (Motorized and Mass transit)	4	Small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed
6	Availability of Parking places	8	The city authorities need to initiate immediate actions with respect of providing paid parking spaces and demand management for parking
7	Road safety	7	Level of Fatality rate in the city is very high
8	Pollution levels	6	Need some improvement in emission standard, checking pollution etc
9	Integrated landuse Transport system	19	Faint coherence between city structure and public transport system.
10	Sustainability of public transport	9	The Public Transport of a city is financial not sustainable and needs considerable improvements.

Chapter 6
Travel Demand Forecast

6.1 Development of Transport Model

An urban transport model to replicate the "Nagpur Metropolitan Area" transportation system (roads, congestion delays, transit system, etc.) has been developed with a state-of-the-art software and modeling technology. This model can be used for forecasting, using altered model inputs to reflect future year conditions. By simulating roadway conditions and travel demand on those roadways, deficiencies in the system can be assessed. Potential major future network enhancements such as introduction of an Mass Rapid Transit System (MRTS) or land use modifications can be analyzed by this tool and its efficacy can be established at a planning level.

Several software programs are available for developing travel demand models. The Nagpur transport model has been developed using CUBE (state-of-the-art Travel Demand Modeling software).

6.2 Model Structure

The model is based on a conventional 4-stage transport model approach. It includes:

- Trip Generation – calculating the number of origins and destinations for each zone.
- Trip Distribution – attaching the origins and destinations for complete trips.
- Mode Choice – determining the mode for each trip (TW, car, auto, Public transport).
- Assignment –assigning passengers to their respective highway and transit networks.

Model Input
- Road network inventory
- Public Transportation Details
- Planning variables by zones
- Trip End Information

6.3 Network Development

Transport network developed for the model comprises two components,

- Highway Network for vehicles
- Transit Network for public transport system i.e. buses, metro and any new public transportation system.

Each of the networks is described in detail below:

Modes: The modes that are modeled under the study include two wheelers, Private Cars, Taxis, Auto rickshaws, Public Transport i.e. Bus. The non- motorized transport and commercial vehicles are considered as a preload.

Zoning: 136 zones within NMC area, from 137 to 183 zones within Metropolitan area outside NMC and 8 external zones are considered, resulting in a total of 191 zones.

Network: The highway (road) network considered all the Key arterials, Sub arterials and collectors. The transit system considered include the existing public transport system in all its forms i.e. bus with routes, frequency, fare structure etc. : (1688 Km of total Roads, 2599 nodes, 213 bus routes (including mofussil Bus Routes)

Centroid connectors - from 1 to 191
Links - number from 1000 to 1691
Planning Period: Year 2012 is considered as the base year and 2032 has been set as the horizon year for the planning of the long term strategy.

The Study Area Zoning is shown in Figure 6.1

6.3.1 Highway Network

The coded highway network for the study area represents the nodes (intersections) and links between them. Connectivity between the network and zones is provided through centroid connectors. Based on the network inventory, each link has been assigned attributes such as: number of lanes; divided or undivided carriageway; encroachments; availability of footpaths etc. The road network for the base year is shown in Figure 6.2.

6.3.2 Transit Network

The transit network represents the connectivity, headways, speeds and accessibility of transit services. In Nagpur, majority of buses ply on the main radial corridors. Hence, the existing bus transport system is included in the model's transit network. The transit routes are specified as those using the transport links and having stops/stations at determined locations. The access to the stops/stations from zone centroids and other nodes is provided either by existing highway links or by defining exclusive walk links. The distance between the bus stop/stations is assumed between 500m to 1000m in the public transport assignment. The transit network for the study area is shown in Figure 6.3.

Currently, about 205 bus routes are operating in Nagpur. Information on the same was collected and coded in to the system. Fare structure and frequency for each of these services are also included.

6.4 Development of Matrices

Household and roadside passenger interview data were used to develop the observed mode-wise trip matrices. The external trips for the car, two wheeler, auto, public transport and commercial vehicles were constructed based on the O-D survey conducted at the outer cordon.

The mode wise matrices were developed for morning peak hour. From the primary surveys it has been observed that the morning peak is during 10:00 to 11:00. So the model was built for this duration.

The base year peak hour travel demand for Nagpur is presented in the Table 6.1.

Table 6.1: Summary of Estimated Base Year (2012) Peak hour Travel Demand

Trip Rate (ALL) – 1.26 Study area zoning Motorized Trip Rate – 0.95				
Mode	Trips	% share	External Trips	Total trips
Walk	87735	20%	-	87735
Cycle	21934	5%	-	21934
Two wheeler	214985	48%	1893	216878
Car	39690	9%	1318	41008
Auto Rickshaw	42997	10%	1401	44398
PT	33075	8%	16462	49537

Highway Assignment - A user-equilibrium multi-modal assignment procedure based on generalized cost was used for loading matrices in PCU values.

Transit Assignment – The public transport assignment process is a multi path assignment which enumerates and evaluates the "reasonable" or "attractive" multiple discrete routes between zones, considering number of transfers, non transit and in vehicle cost, boarding and transfer penalties and fares etc.

Figure 6.1: Study area zoning

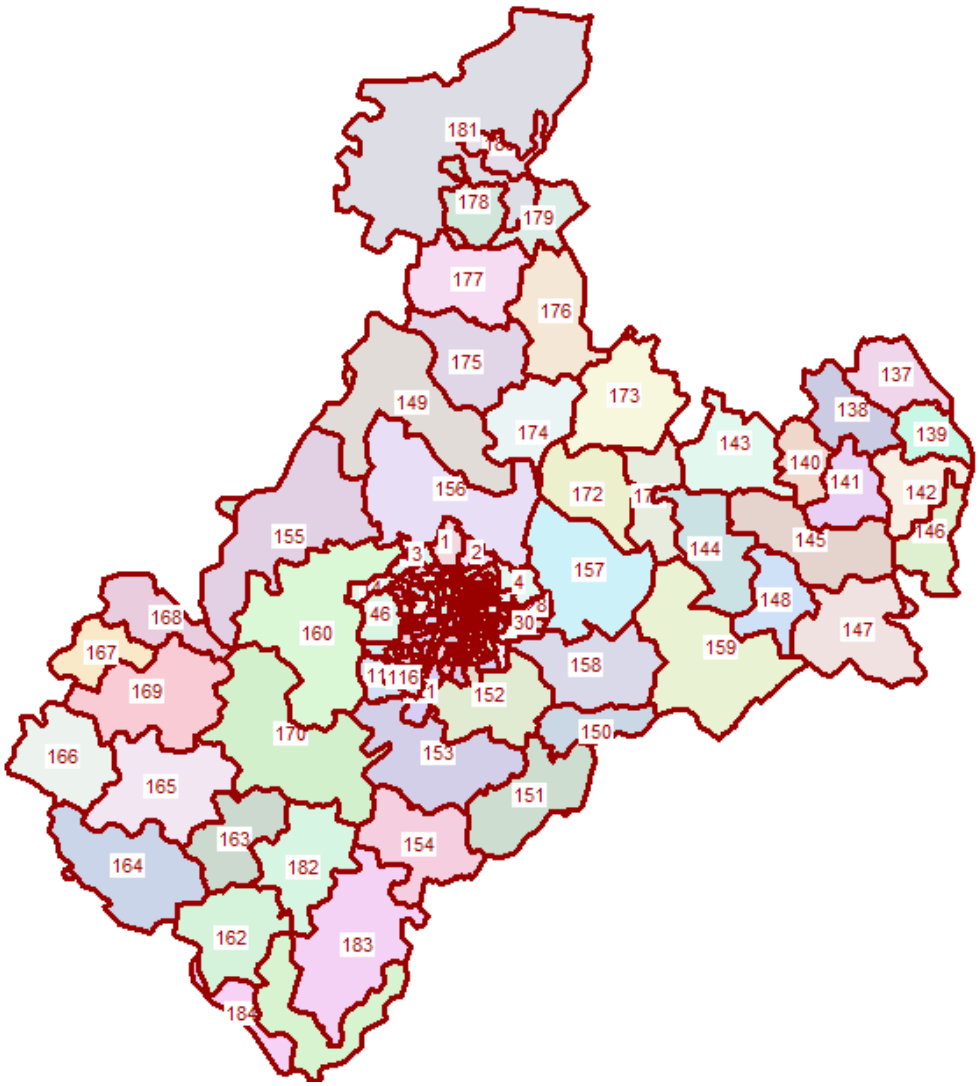


Figure 6.2: Base Year Study Area Road Network

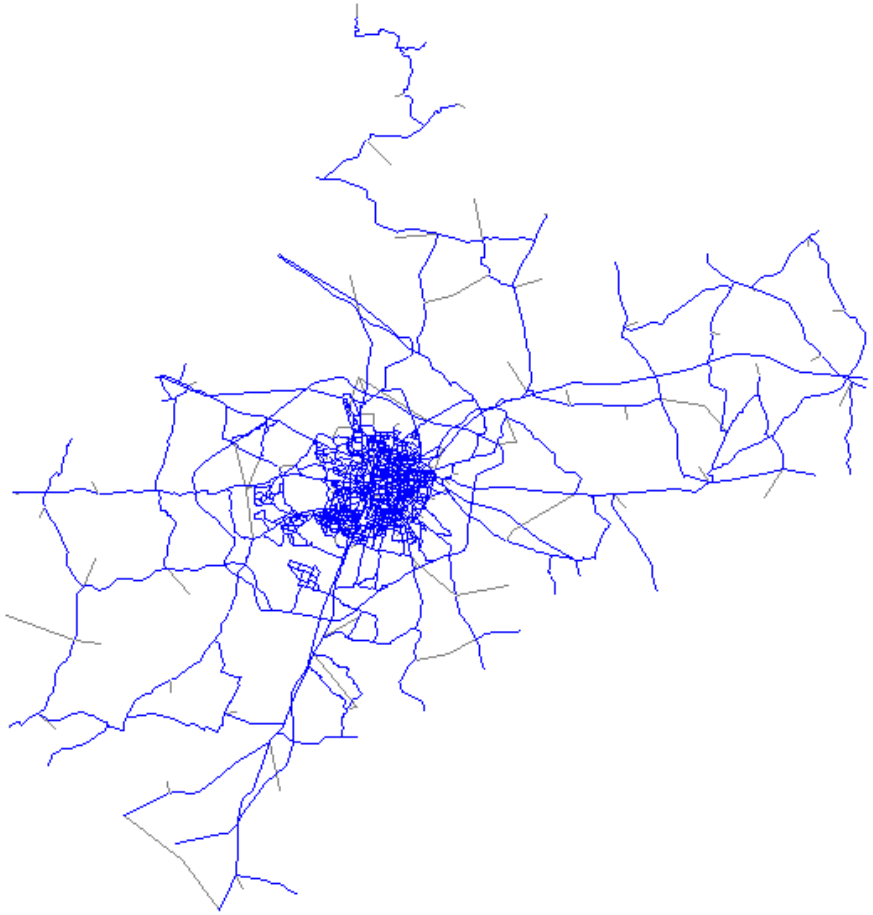
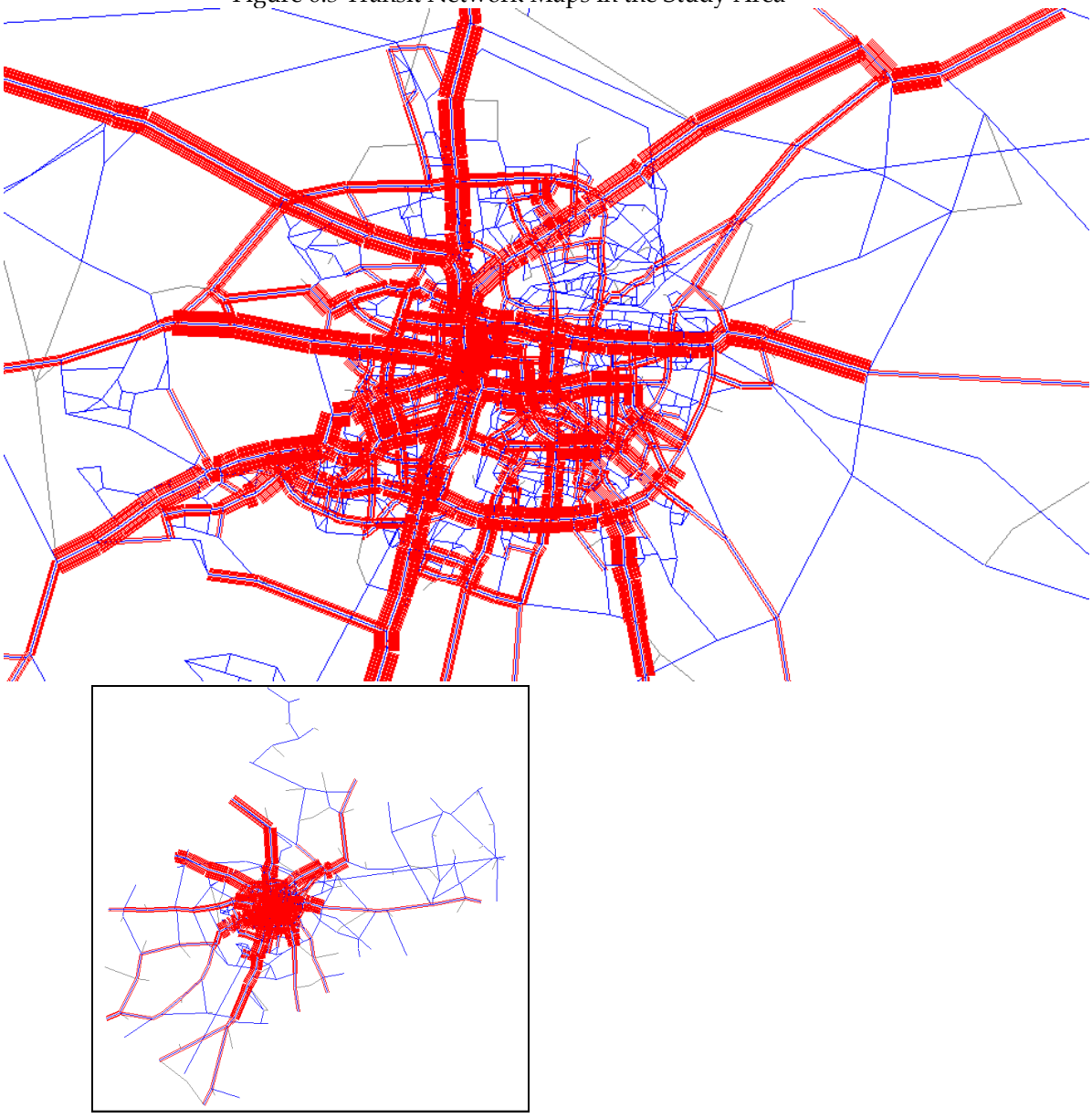


Figure 6.3 Transit Network Maps in the Study Area



6.5 Validation

The observed highway and public transport matrices were assigned on the network and the assigned traffic volume has been compared with the observed traffic counts on screen lines and at cordons. Validation results are given in Table 6.2 and 6.3.

Validation
The model is validated across cordons and screen lines within a confidence range of +/-15%

Table 6.2: Base Year Observed OD Validation on Outer Cordon

Modes	Inbound Traffic (Towards Nagpur)			Outbound Traffic (Outside Nagpur)		
	Observed	Assigned	% Difference	Observed	Assigned	% Difference
Two wheeler	868	932	+7%	1736	1671	-4%
Car	657	684	4%	978	1070	+4%
Auto Rickshaw	138	134	-3%	187	187	0%

Table 6.3: Highway validation- Screen line locations

Modes	Towards East (Towards Bhandara)			Towards West (Towards Hingna)		
	Observed	Assigned	% Difference	Observed	Assigned	% Difference
Two wheeler	7881	7379	-6%	13469	13202	-2%
Car	2613	2486	-5%	2777	2718	-2%
Auto Rickshaw	1990	1963	-1%	2251	2262	0%

Modes	Towards South (Towards Airport)			Towards North (Towards Sadar)		
	Observed	Assigned	% Difference	Observed	Assigned	% Difference
Two wheeler	11467	11155	-3%	11632	11082	-5%
Car	3198	3141	-2%	3140	3100	-1%
Auto Rickshaw	3304	3165	-4%	3423	3502	2%

6.6 Calibration

Trip Generation: Trip end models were calibrated by relating the trip produced from and attracted to the zones with the Land use. The base year population and employment for the study area are presented in the table 6.4.

Table 6.4: Population and Employment – 2012

Sub area	Population	Employment
NMA	3272647	912290

The calibrated trip end models for the peak hour are presented Table 6.5

Table 6.5: Trip End Model

Area	Equation	T-Value	F-Value	R^2
Production				
Nagpur Urban Area	Trip Production =0.118 * Population+16	21	480	0.78
Nagpur Rural	Trip Production =0.033 * Population + 28	8.6	74	0.70
Attraction				
Nagpur Urban Area	Trip Attraction = 0.3055 * Employment + 317	4.53	438	0.76
Nagpur Rural	Trip Attraction =0.2 * Employment – 91	15.12	228	0.84

6.6.1 Combined Mode choice cum Distribution Model

The Trip Distribution and Modal Split phase were carried out jointly using a combined mode choice cum doubly constrained gravity model of the form:

$T_{ijm} = r_i G_i S_j A_j F_{ijm}$

Where T= number of inter zonal trips by mode m

G= Total generation trip ends by zone

A= Total attraction trip ends by zone

i=Generation Zone

j= Attraction Zone

r,s=balancing factors (constants)

F_{ij}= deterrence function for mode m

$F_{ij} = K_m e^{-\beta c_{ijm}} C^{\alpha}{}_{ijm}$

Where K= Constant Factor

C=Generalized Cost

β= Calibration Constant –Exponential function

α=Calibration Constant- Power function

Double Constraints are imposed by ensuring that

$$\sum_{Jm} T_{ij} = G_i \qquad \text{And} \qquad \sum_{Im} T_{ij} = A_i$$

The calibrated parameters are given in the table below.

Table 6.6: Calibrated Parameters

Mode	K	α	B
Two Wheeler	322	-0.1	100
Car	740	0.65	34
Auto	6	-0.85	35
Public Transport	165000	1.7	130

The form of the model is such that exponential (α=0) or power (β=0) functions may be used for the deterrence function. The inclusion of both α and β represents a gamma function, sometimes called a Tanner function.

6.7 Base Year Travel Characteristics

Figure 6.4: Desire line –Base year

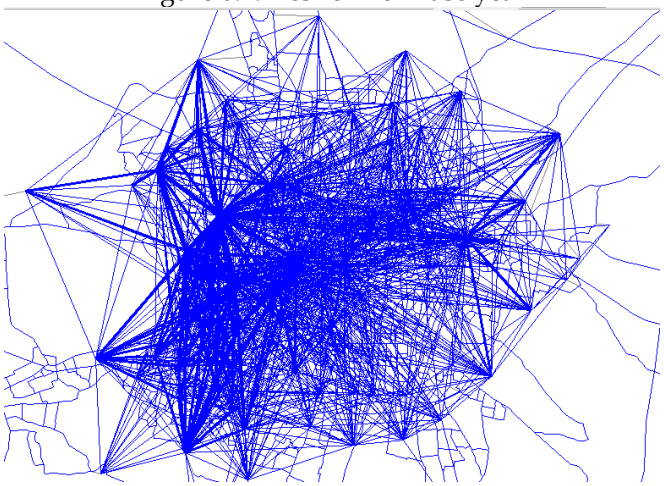


Table 6.7 Base year Travel Characteristics

Trips Assigned (Peak hour)	:	329,995
• Trips Assigned- TW (Peak Hour)	:	214,734(65%)
• Trips Assigned- Car (Peak Hour)	:	39,676(12%)
• Trips Assigned-IPT (Peak Hour)	:	43,339(13%)
• Trips Assigned- PT (Peak Hour)	:	32,246(10%)
• Average network speed (major corridors)	:	27 Kmph
• Average Trip length:		PV- 5.86 PT- 9.10
• Passenger kms(Excluding Private and IPT)	:	311977
• Passenger hours (Excluding Private and IPT)	:	21,666
• Vehicle in veh kms (Excluding PT)	:	923620
• Vehicle in veh hours (Excluding PT)	:	25485
• Emission	:	29.76 tonns/day

The traffic characteristics of the study area in terms of average network speed, average trip length volume to capacity ratio, vehicle distance travelled, total passenger hours etc. are given in Table 6.7.

The volume to capacity ratios for the major roads, average journey speed and the passengers per hour per direction (all modes) are presented in Table 6.8

Table 6.8: Base Year (2012) Transport Characteristics on Major roads

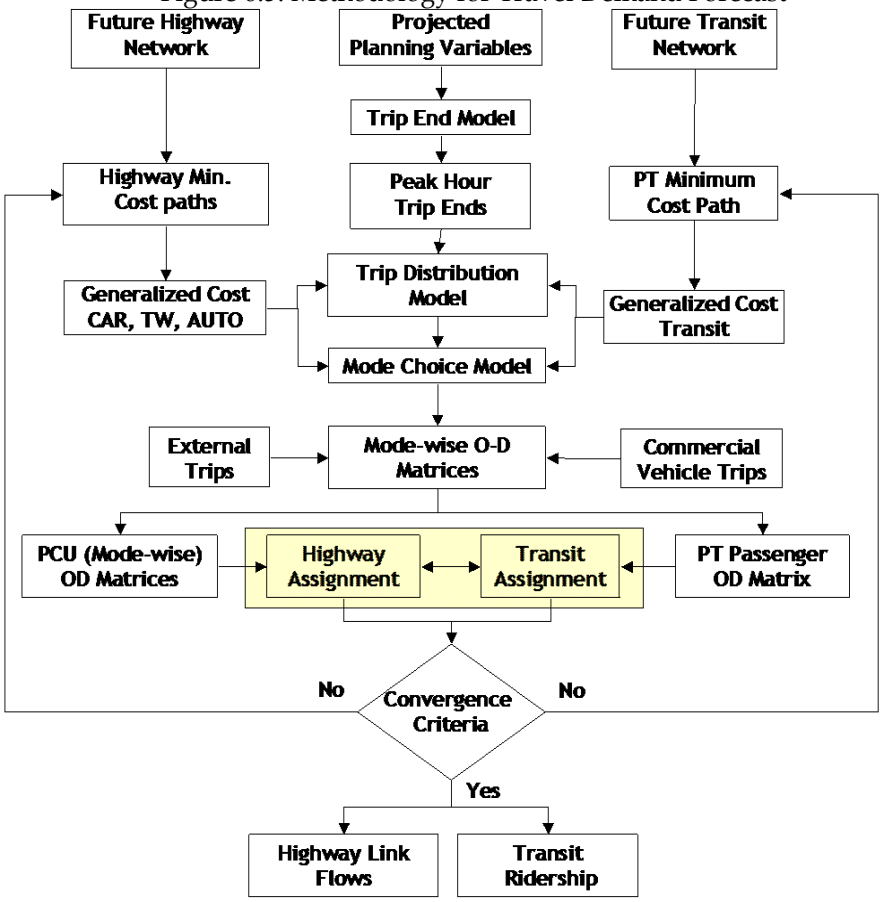
Sl no	Name of the Road	V/C Ratio		Average Network Speed (kmph)
		Maximum	Average	
1	Ajini Road	0.79	0.41	30
2	Ambazari Lake Road	0.59	0.53	26
3	Amaravathi Road	0.41	0.21	31
4	Central Avenue Road	0.67	0.30	30
5	Ghat Road	0.65	0.39	27
6	Umred Road	0.49	0.25	29
7	Wardha Road	0.43	0.21	28

From the above table, it can be concluded that the major roads in Nagpur are still operating at a fairly decent capacity with an average speed around 27 kmph.

6.8 Travel Demand Forecast

The strategic Urban Travel Demand Model developed as above has been is used to predict travel patterns and modal shares in the horizon year i.e. 2032 under respective land-use and transport network scenarios.

Figure 6.5: Methodology for Travel Demand Forecast



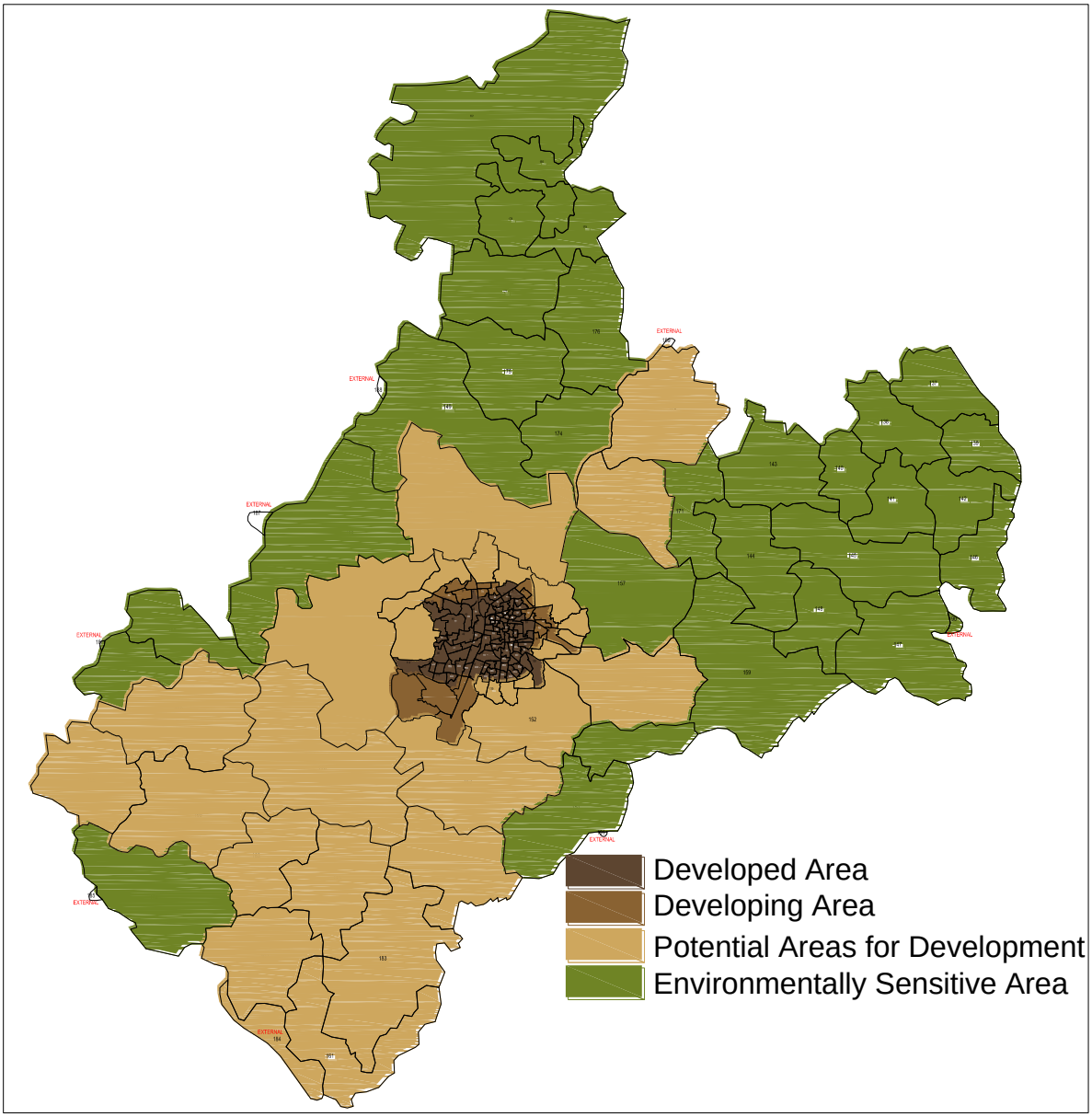
Trip End models have been used to predict the number of trips generated from and attracted to each of the zones in the study area. Projected trip ends along with the network options in the future were provided as inputs to the distribution and modal split models to arrive at future trip matrices for Car, Two Wheeler, Auto Rickshaws and Public Transport. The methodology for travel demand forecast in the study area is presented in the Figure 6.5.

6.9 Potential Areas for Future Growth

The potential growth areas of the city have been analyzed on the basis of detailed landuse plan of the city, trunk corridors and major roads, terrain and physical barriers and constraints, proximity to industrial regions and belts, presence of forest areas and area under defense use. The areas that are suitable for spread of development are along Amravati Road (NH6), Wardha Road (NH7) and Kamptee Road. The areas in the northern and eastern sides have been designated as environmentally sensitive zones due to the proximity of the Forest Ranges and Natural Reserves and Administrative boundaries.

The potential areas for future growth are shown in Figure 6.6.

Figure 6.6: Potential Areas for Future Growth

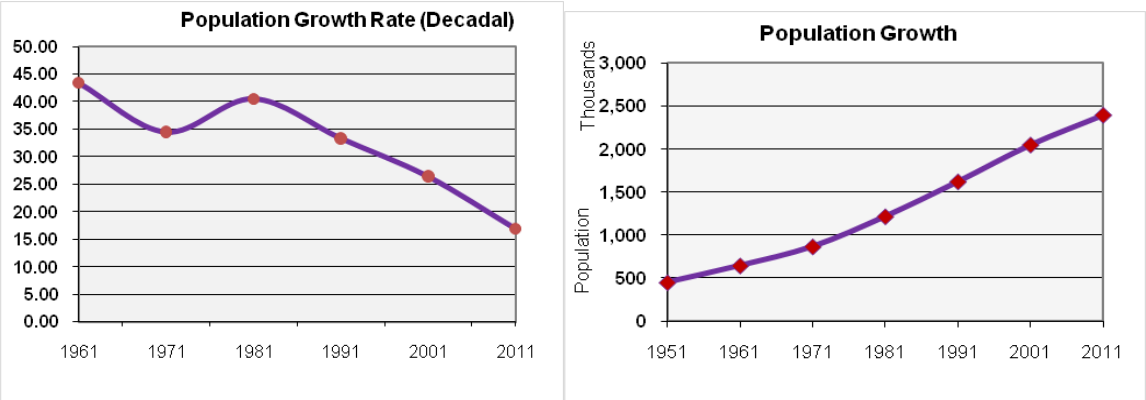


6.10 Population Forecast

For estimating the population, the growth rate of the city was studied and was tallied against the projected growth rate of the available studies like CDP. Other recently developed studies and documents were then referred to in order to arrive at the most logical population growth considering the new growth areas and development plans of the city (Refer Figure 6.7).

The population and employment projections are given in Annexure 2.

Figure 6.7: Population growth and Decadal growth Rate



The compiled forecasted population by all methods is given in Table 6.9.

Table 6.9: Population Forecast by various Methods

S No.	Forecasting Methods	Base Year Population	Forecasted Population		
		2011	2021	2031	2041
1	Arithmetic Increase method	2,398,165	3,164,248	3,547,289	3,930,330
2	Incremental Increase method	2,398,165	3,077,536	3,720,711	4,450,598
3	Geometrical Progression method	2,398,165	3,145,862	3,914,475	4,682,372
4	Exponential Method	2,398,165	3,743,731	4,990,733	4,990,733
5	Power Method	2,398,165	4,910,911	5,716,868	5,716,868
6	Log Method	2,398,165	2,263,436	2,390,831	2,390,831

Due to the minimum percentage error value and actual growth prospects, the method adopted for estimating the population of Nagpur city area is the Incremental Increase Method. The compiled population estimation figures for Nagpur Municipal Corporation area from 1991 to 2032 are given in table 6.10.

Table 6.10 Estimated Population Year wise for Nagpur City Limits (Within Outer Ring Road)

Year	Estimates	Year	Estimates	Year	Projections	Year	Projections	Year	Projections
1991	1,622,820	2001	2,051,320	2011	2,398,165	2021	3,145,862	2031	3,914,475
1992	1,661,295	2002	2,083,617	2012	2,464,139	2022	3,215,385	2032	3,985,224
1993	1,700,681	2003	2,116,423	2013	2,531,927	2023	3,286,445		
1994	1,741,002	2004	2,149,746	2014	2,601,580	2024	3,359,076		
1995	1,782,279	2005	2,183,593	2015	2,673,150	2025	3,433,311		
1996	1,824,534	2006	2,217,973	2016	2,746,688	2026	3,509,188		
1997	1,867,791	2007	2,252,894	2017	2,822,249	2027	3,586,741		
1998	1,912,073	2008	2,288,365	2018	2,899,890	2028	3,666,008		
1999	1,957,405	2009	2,324,395	2019	2,979,666	2029	3,747,026		
2000	2,003,813	2010	2,360,992	2020	3,061,636	2030	3,829,836		
2001	2,051,320	2011	2,398,165	2021	3,145,862	2031	3,914,475		

6.11 Horizon Year Growth

The projected population and employment for 2012, 2022 and 2032 were used for estimating trip ends in the corresponding years. The population and employment projections are given in Table 6.11 and Table 6.12 respectively.

Table 6.11: Population projections in study area (NMA)

Name of the Area	Projected Population in the Study Area		
	2012	2022	2032
NMA	3272647	4109655	5109727

Table 6.12: Estimated Employment in the study area (NMA)

Name of the Area	Projected Employment in the Study Area		
	2012	2022	2032
NMA	912290	1533538	2204281

6.12 Forecast Assumptions

- Per Capita Trip Rate- will grow at 1% in real terms
- Public Transport Fare will be in line with inflation
- Value of time will grow in line with per capita income
- Vehicle operating cost will grow at -2% in real terms(to take in to account technology improvement in fuel efficiency)

6.13 Future Transport Network Scenarios

Information on the transport network improvement proposals (committed) was collected from various agencies responsible for implementation of road projects. The base year network was updated with the same for development of horizon year network.

6.13.1 Traffic Forecast under Do-Nothing Scenario*

The summary of the projected peak hour passenger travel demand in the study area and the corresponding modal share is given in Table 6.13

Table 6.13: Summary of Forecasted Peak Hour Passenger Demand (2032)

Year	2012		2032	
Mode share	Trips	% Share	Trips	% Share
Two wheeler	214558	65%	416891	69%
Car	39336	12%	101061	17%
Auto Rickshaw	43526	13%	57157	9%
Public Transport	32612	10%	31499	5%
Total	330032		606608	

Table 6.14: Travel Characteristics (Year 2032)

Trips Assigned (Peak hour)	:	606608
• Trips Assigned- TW (Peak Hour)	:	416891(69%)
• Trips Assigned- Car (Peak Hour)	:	101061(17%)
• Trips Assigned-IPT (Peak Hour)	:	57157 (9%)
• Trips Assigned- PT (Peak Hour)	:	31499 (5%)
• Average network speed (major corridors)	:	19 Kmph
• Average Trip length	:	PV- 8.55 PT- 7.12
• Passenger kms(Excluding Private and IPT)	:	224272
• Passenger hours (Excluding Private and IPT)	:	18715
• Vehicle in veh kms (Excluding PT)	:	2637856
• Vehicle in veh hours (Excluding PT)	:	96426
• Emission	:	69.37 tonns/day

The traffic characteristics of the study area are extracted from the model in terms of average network speed, volume to capacity ratio, vehicle distance travelled, total passenger hours etc. The same is presented in the Table 6.15

Table 6.15: Major Road Traffic Forecasts – 2032 Do Nothing Scenario

Sl No	Name of the Road	V/C Ratio		Average Network Speed (kmph)
		Maximum	Average	
1	Ajini Road	0.89	0.52	25
2	Ambazari Lake Road	0.94	0.91	15
3	Amaravathi Road	0.80	0.41	26
4	Central Avenue Road	0.82	0.38	27
5	Ghat Road	0.90	0.50	22
6	Umred Road	1.39	0.44	27
7	Wardha Road	0.96	0.49	18

The volume to capacity ratios for the major roads and the corresponding average journey speeds are presented in Table 6.15.

6.14 Comparison of Travel characteristics for Do-Nothing scenario:

The comparison of travel characteristics for Do Nothing scenario is presented in the Table 6.16

Table 6.16: Comparison of Travel characteristics

Scenario	Private vehicle share (%)	IPT Share (%)	PT Share (%)	Average Trip length(PT) in Km	Emission in Tons/day
Base Year	77	13	10	9.10	29.76
Do Nothing -2032	86	9	5	7.12	69.37

* **Do-Nothing-Scenario**: Do-Nothing-Scenario is the situation where the assumption is that no further transport related (both services and infrastructure) improvements are going to happen till the horizon year. The city is assumed to grow with the existing infrastructure and services.

Chapter 7
Vision, Goals and Objectives

7.1 Vision Statement

The mobility plan seeks to "move people, not vehicles". By emphasizing the pre-eminence of public transport and non-motorized transport, and integrating the land use with transport networks, it seeks to achieve the objectives of the National Urban Transport Policy (NUTP) in Nagpur. The CMP vision for transport in Nagpur ensures that the city will have a planned, best performing transport system(s) that addresses the needs and concerns of the city. Accordingly, the transport vision for Nagpur can be defined as:

"To ensure that Nagpur will have a systematically planned urban transport system for the mobility of people and goods that is safe, efficient, economical and sustainable, which aims to support economic development while improving livability".

"To ensure planned, best performing transport system that addresses the needs and concerns of the City"

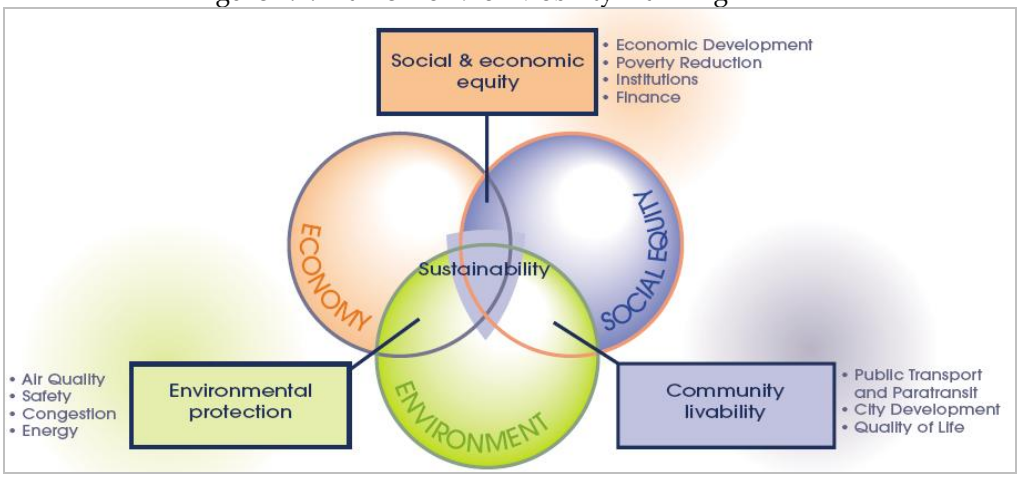
7.2 Mobility Pillars

The six most important pillars for ensuring Sustainable Mobility in urban areas are:

- Integrating Land use and Transport in Planning Process
- Recognizing the use of non motorized means of movement by introducing NMT favorable strategies
- Bringing a control on movement of personal vehicles
- Managing parking in the city
- Encouraging Public Transport System and other Sustainable modes
- Directing city growth in a uniform manner with the help of better links and access roads

Sustainable Mobility however can only be ensured if the solutions are environmentally, socially and economically sustainable as presented in Figure 7.1.

Figure 7.1: Frame work for Mobility Planning



7.3 Goals

To ensure that Mobility solutions for Nagpur that are sustainable and in conformity with sustainable mobility, following Goals have been formulated:

- Goal 1: Develop public transit system in conformity with the land use that is accessible, efficient and effective.
- Goal 2: Ensure safety and mobility of pedestrians and cyclists by designing streets and areas that make a more desirable, livable city for residents and visitors and support the public transport system.
- Goal 3 : Develop traffic and transport solutions that are economically and financially viable and environmentally sustainable for efficient and effective movement of people and goods
- Goal 4: Develop a Parking System that reduces the demand for parking and need for private mode of transport and also facilitate organized parking for various types of vehicles.

Each goal can be achieved by meeting the following objectives:

1. **Goal 1**: *Develop public transit system in conformity with the land use that is accessible, efficient and effective*

   Objectives

   (a) Provide good quality of public transport system that is accessible, efficient and effective

   (b) Develop strategy to integrate public transport system with existing IPT System

   (c) Develop strategies to encourage people to use public transport system and discourage use of private vehicles

   (d) Develop policies that encourage concentrated mixed land use development along the public transport corridors

2. **Goal 2:** *Ensure safety and mobility of Pedestrian and cyclist by designing streets and areas that make a more desirable, livable city for residents and visitors and support the public transport system.*

Objectives

(a) To improve pedestrian facilities in areas of pedestrian concentration
(b) To provide facilities to pedestrians and ensure safety to segregate their movement from vehicles along major corridors
(c) To encourage pedestrian movement in heavy pedestrian movement areas and restrict use of private vehicles
(d) To provide safe pedestrian facilities along major public transport nodes and transfer points
(e) To provide segregated facilities for movement of cyclist in Nagpur
(f) To develop a Pedestrian policy for safe and efficient movement of people within the city

3. **Goal 3:** *Develop traffic and transport solutions that are economically and financially viable and environmentally sustainable for efficient and effective movement of people and goods.*

Objectives

(a) Develop immediate / short term strategies such as traffic management and engineering solutions to ease flow of traffic at major congestion points within the city
(b) Develop medium / long term measures such as ring roads, new links, road network development, flyovers, underpasses, ROBs and RUBs to ease traffic flow along major roads within the city

4. **Goal 4:** *Develop a Parking Policy that reduces the demand for parking and need for private mode of transport and also facilitate organized parking for various types of vehicles.*

Objectives

(a) Restrict On Street Parking at critical locations in the city
(b) Create off Street Parking (wherever possible Multilevel Parking) near major activity centers, transit stations/terminals to meet the growing parking demand.
(c) To suggest various measures through a combination of demand management and fiscal measures to restrain the demand for parking of private vehicles at critical locations.

The goals and objectives set for the mobility needs of Nagpur can be achieved by formulating a series of strategies as per NUTP guidelines. Each of the strategies will be evaluated to see their suitability and applicability for Nagpur.

Besides the above mentioned Goals, some principles of National Mission on Sustainable Habitat (NMSH) need to be considered in this study before formulating the strategies. Accordingly, a brief introduction to NMSH is presented in the following section.

7.4 National Mission on Sustainable Habitat (NMSH)

Under the National Action Plan for Climate Change, the National Mission on Sustainable Habitat has been launched to cover various aspects which inter alia include better urban planning and modal shift to public transport. The main objective of the mission is to address the following:

- Development of Norms integrating measures related to taxation, parking and congestion charges, public carriage specifications and service
- Norms to encourage public transportation
- Development of Norms for pedestrianization and cycling
- Modal regulations for integrating Transport Planning (CMP) with Master Plans and Development Plans.

The habitat parameters also take note of the ongoing reform based JnNURM program that has been designed to achieve NUTP principles in the urban transport sector. Accordingly, to ensure sustainability in urban transport planning, the following eight-principles have been proposed. This CMP study also attempts to integrate these principles in its approach.

1. Make walkable Cities and Towns

A great walking environment must protect pedestrians from motor vehicles. Vehicle speeds need to be radically slowed or else, streets need footpaths. Footpaths need to be unobstructed, continuous and well lit. Crossings should be made safer with pedestrian crossing signals, pedestrian islands and pedestrian table-tops that minimize crossing distances and offer safety for pedestrians. Accessibility to wheelchairs must be ensured. The pedestrian network should foster the most direct access to all local destinations like schools, work, bus stops etc.

The following indicators have been recommended for pedestrian facilities:

- All arterial streets should have >= 75% of their lengths having non obstructed footpaths to achieve a LOS 1 for the pedestrian facility

- All other sub arterial and local streets should have 50 – 75% of their lengths having footpaths for a LOS 2
- At-grade pedestrian crossings at maximum intervals of 70-250 m

Nagpur does not meet these standards. We include a separate strategy to non motorized transport improvements where the focus is to develop better walking and cycling facilities in Nagpur.

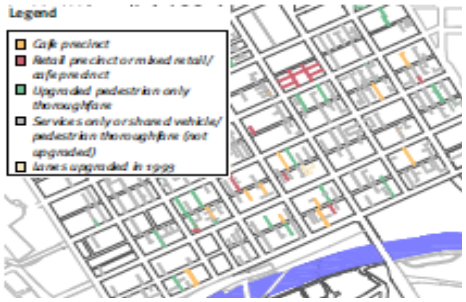
2. Create environment for bicycles

The more bicycles (and any people-powered transport) on the streets the safer and less polluted the streets become. Segregated bicycle lanes are needed on higher speed roads, while on local streets traffic calming and shared street designs are better, allowing traffic to mix at slower speeds. Building bike lanes and slowing down traffic are keys to making urban transport sustainable.

The following indicators have been recommended for pedestrian facilities:
NMT network should have at least 25% of the road network coverage to achieve a LOS 1 for NMT facilities NMT parking facilities should be available at more than 50% of the interchanges (bus stops, terminals, railway stations) to achieve a LOS 2.

Nagpur has a significant cycling population and every care must be taken to preserve and better it. The observed 5% cycle share of total trips can be improved. Our cycling strategy hence will focus on developing a strong bi-cycle network.

3. Connect the blocks



Cities that are pleasant to walk and bicycle typically have large numbers of short streets and many intersections per unit of area. This makes the traffic slow down while walking becomes more direct, varied, interesting and attractive. The tighter the street grid, the fewer detours to a destination. Detours can affect the decision to undertake a trip and by what means. Streets that are short offer good opportunities to connect with the surroundings. Buildings, shops and streetscape elements are closer to the pedestrians and cyclists as they travel.

It is recommended that the indicator for the number of intersections of pedestrian and cycle network per square kilometer be 50.

4. Get on the Public Transport

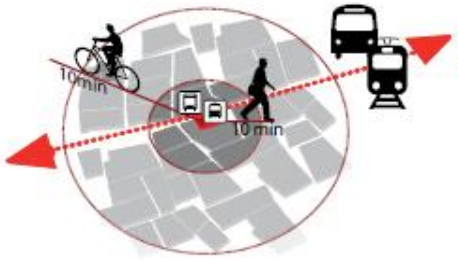
Mass transit can move a large number of people quickly and comfortably using a fraction of the fuel and street space required by automobiles. The bus transit systems are proving able to keep pace with the rapid motorization and metropolitan growth. Busses are more accessible, have a wider coverage and are cheaper.

The following indicators need to be used to assess the effective usage of public transport:

- Percentage of residents within 800 m of public transport stops
- Percent mode share of public transport and IPT desired
- Percent of stops with frequency of service greater than 15 buses per hour

When this study was done, it was observed that 50% of the total fleet is not under the operation. It was conveyed that the VNIL is facing operation loss which is restricting to run rest of the fleet in Nagpur. The system requires detail route rationalisation with well defined integration of main haul and feeder services.

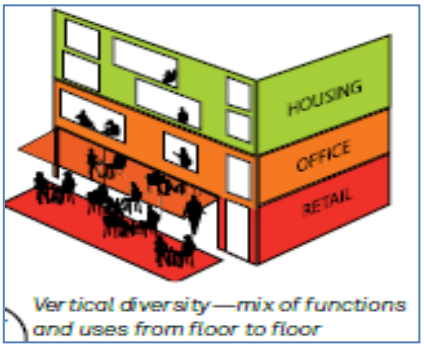
5. Build dense - people and transit oriented cities; mix people and activities



The first step to accommodating future urban growth is to densify existing urban land while providing excellent and diversified services and amenities. Dense communities are a foundation for the mixed-use urban areas where walking, cycling and transit can be integral parts of the way of life.

The following indicators are recommended for densification:

- Densify transport nodes according to pedestrian and cycling – 10 minute catchment areas
- 800 m for pedestrians and 3 km for cyclists



Vertical diversity—mix of functions and uses from floor to floor

Integrating residential, work, retail and entertainment activities into one area makes for better cities. Trip lengths and travel times can be reduced. The average trip length for cycle is 3.03 km which is ideal.

6. Shift to Public Transport

Shift from unsustainable mobility to sustainable mode like the public transport can be achieved using technology, regulating road use, parking and fiscal measures. High quality public transport vehicles with efficient service, easy accessibility, wide coverage and reasonable affordability are required to induce shift from private to public vehicles. This has to be coupled with measures like congestion charges in

core areas; high parking fee; limited parking spaces; tax on private vehicles; implementation of demand management measures etc.

No parking fees are charged in the city. As a strategy we must adopt the levy of parking charges. Also there is requirement of providing off-street parking facility which can help in increasing the effective road capacity.

7. **Urban Transport Funding**

Proper institutional set up and an efficient funding mechanism are need of the hour to ensure financial sustainability of investments in public transport and non-motorized transport. Urban transport financial resources should be pooled within an urban transport fund administered by the strategic transport authority at the municipal or metropolitan level. Private sector financing for transport infrastructure should be raised through competitive tendering of concessions that may be supported by public contributions as long as they are subjected to cost-benefit analysis.

8. **Impact Assessment**

New developments and projects will draw increasingly more attention in the future as these induce and attract additional traffic in the neighborhood. It is suggested an Impact Assessment needs to be done to estimate the additional traffic and the infrastructure needs of the neighborhood.

7.5 Benchmarks and Scenarios

From the analysis of data, various Benchmarks have been computed and presented in the earlier chapter. Benchmarks are performance indicators of various existing transportation parameters. Currently, these indicators are at unsustainable levels, and it becomes necessary to set desirable targets in this study. Accordingly, desirable targets to be achieved for Nagpur are presented in Table 7.1

Table 7.1: Benchmarks and Targets

Index	Description	Formulation	Existing	Target
Average Speed of Network	Average running speed (kmph)	Average Running Speed for all vehicles	27	30
Modal Share of PT Motorized	Modal share	Public Transport Trips/Total Study Area Trips	10%	30%
Modal Share of NMT	Modal share	NMT Trips/Total Trips	25%	60%
Accessibility	Percentage of work trips with Travel Time <15min	(Work trips with Travel Time less than 15 min/ Total Trips)	8%	40
Bus Supply (Nagpur City)	Buses per Lakh Population	(Bus Fleet in Nos.)/Population in Nos.)X100000	8	50
Walkabilty	Availability & Usability of Foot paths	(Footpath Length in Km /Road length in Km)x100	70%	100%
Cyclability	Availability & Usability of Cycle Tracks	(Cycle track Length in Km/Road length in Km)x100	0%	100%
Fatality (2012)	Fatal accidents	No of fatalities/lakh population	9.59	0

Having set the goals, objectives and the SMHS Principles to be looked in to, the next task in the CMP study is the formulation of mobility strategies based on various scenarios. Following are the different scenarios tested in the model.

- Do Nothing – Without Any Development
- Do Something – Considering Sanctioned Projects
- Do Everything
  a. Higher Order Mass Transit System with Do Something
  b. Route Rationalization + (a)
  c. Transit Oriented development + (b)

Based on the anticipated impacts of the various scenarios, the study recommends the scenario comprising transit oriented development , higher order mass transit system and route rationalization. This will help to increase the public transport share. The proposed strategies and proposals are discussed in the subsequent chapters. The anticipated impacts of the various scenarios are presented in the proposal chapter.

Chapter 8
Transport Strategies

The mobility goals for Nagpur need to be addressed through a multipronged approach. Solutions for complex transport improvements cannot be achieved by a single strategy. The following strategies need to be adopted in tandem to meet the various goals set for Nagpur.

- Land Use and Transport Strategy
- Development of Mobility Corridors
- Public Transit Improvement Strategy
- Non-Motorized Transport Strategy
- Freight Management Strategy
- Traffic Engineering Measures
- Travel Demand Management Strategy

"The complex transport situation needs a multi pronged approach"

It is important to note that each of the above strategies is equally important and the order of listing does not imply priority. Each of the broad strategies includes sub strategies of immense importance. The strategies when implemented through specific projects shall fulfill the goals and objectives of the CMP. The sections below discuss these strategies.

8.1 Mobility Corridor Strategy

The city clearly indicates the radial road network development. Majority of these corridors are either state or national highways and are important mobility corridors of Nagpur. In essence, mobility corridor maximizes throughput of people, focusing on mass transport and non-motorized traffic, rather than vehicle traffic. These mobility corridors offer a strong network providing connectivity to major attraction centers in the city along with regional connectivity. Mobility is achieved by introducing higher order mass transit systems on these designated corridors.

As a part of this strategy, it has been proposed that some corridors will act as mobility corridors in the city. The same have been presented in Figure 8.1a and 8.1b. These corridors should be considered with desired and dedicated public transport systems. The typical cross sections for dedicated public transport systems on the mobility corridors are presented in Figure 8.2. Initially, the mobility corridors should be implemented up to the inner ring road and later can be extended up to the outer ring road. The study will need revision in the ridership estimation for the extension part in future.

Table 8.1 Proposed Mobility Corridors in Nagpur

No	Road Name	Starting Point	End Point		Approximate Distance (in KM)	
			Phase I	Phase II	Phase 1 (upto 2022)	Phase II (upto 2032)
1	Wardha Road	Sitaburdi	Inner Ring Road	Outer Ring Road	5.1	10
2.	Hingna Road	Rani Jhasi Chowk	Inner Ring Road	Outer Ring Road	7.7	9.5
3.	Amravati Road	Sitabuldi Police Station	Inner Ring Road	Outer Ring Road	8.2	6.5
4.	Katol Road	LIC Square	Inner Ring Road	Outer Ring Road	6.5	5.2
5.	Koradi Road	LIC Square	Inner Ring Road (Mankapur)	Outer Ring Road	3.6	8.4
6.	Kamptee Road	LIC Square	Inner Ring Road	Kamptee	5	10
7.	C.A Road	LIC Square	Inner Ring Road (Pardi)	Outer Ring Road	7.2	4.0
8.	Umred Road	C.A Road	Inner Ring Road	Outer Ring Road	5.4	5.1
9.	Inner Ring Road	Circular loop from Mankapur Chowk to Mankapur Chowk			38.5	0
				Total	87.2km	58.7 km

Figure 8.1a: Identified Mobility Corridors for Nagpur (Stage 1)

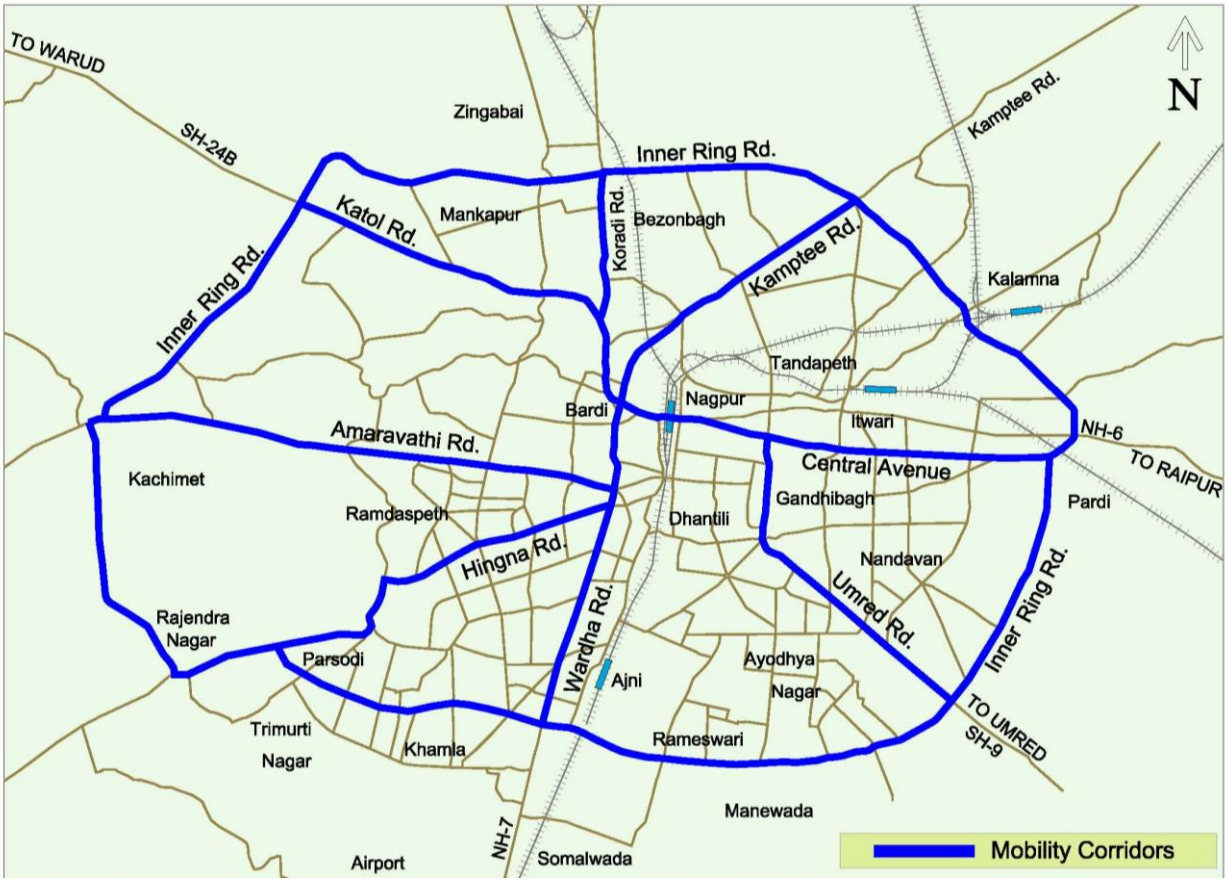


Figure 8.1b: Identified Mobility Corridors for Nagpur (Stage 2 up to Outer Ring Road)

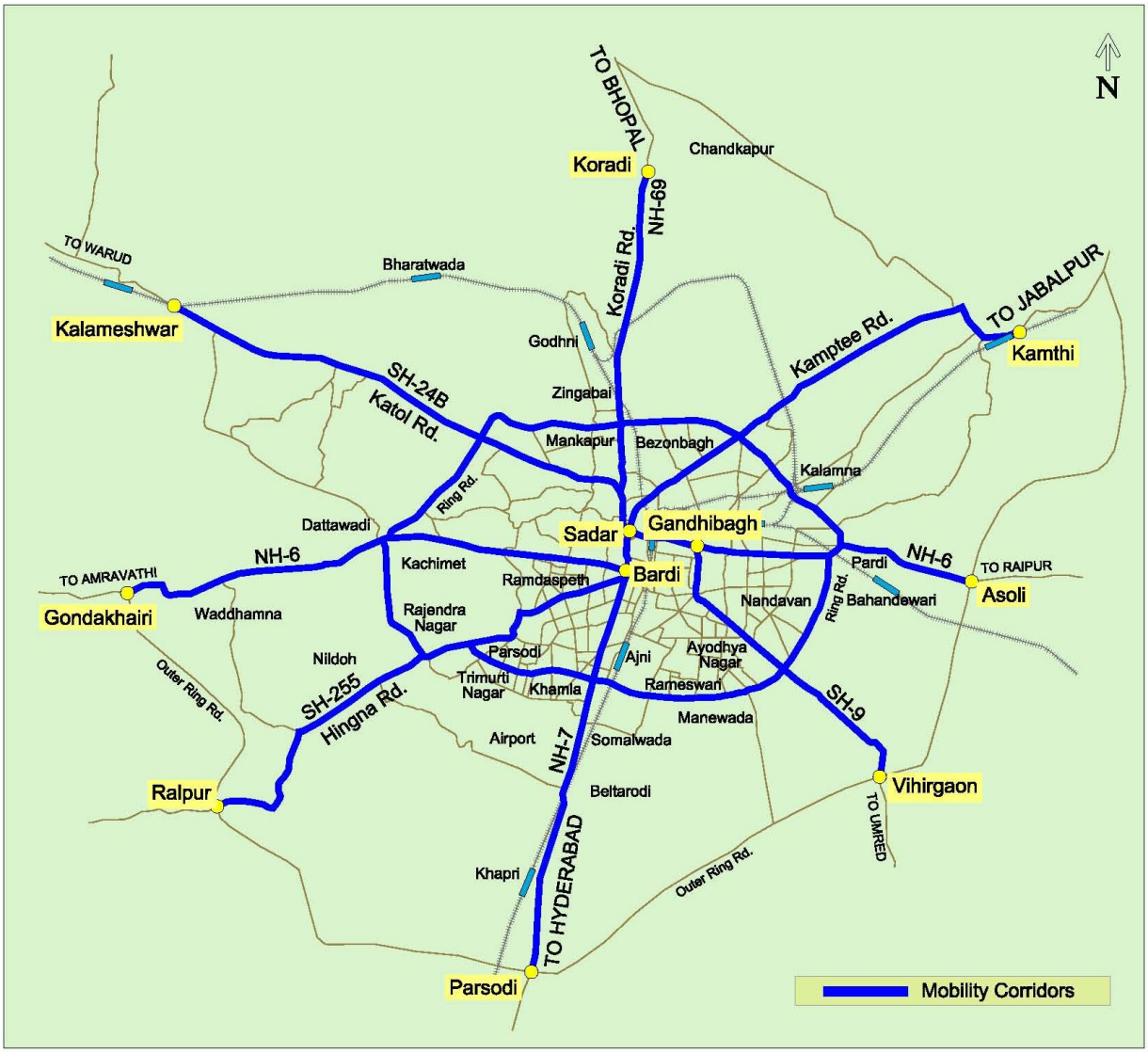
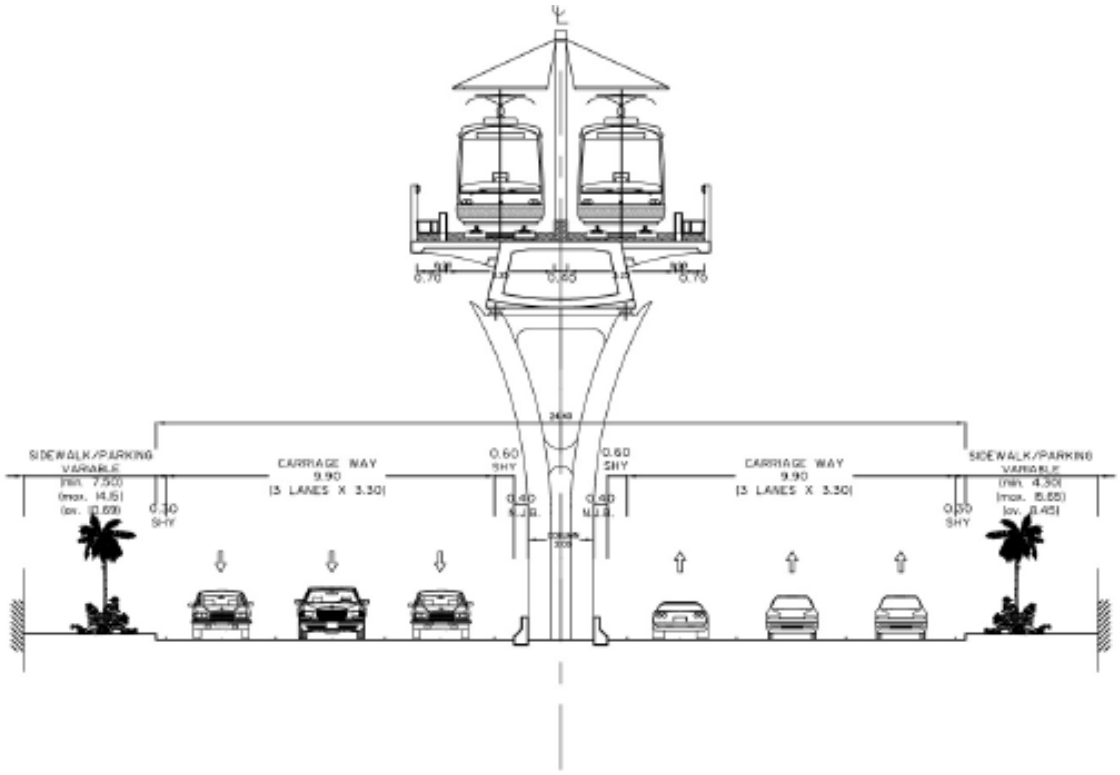
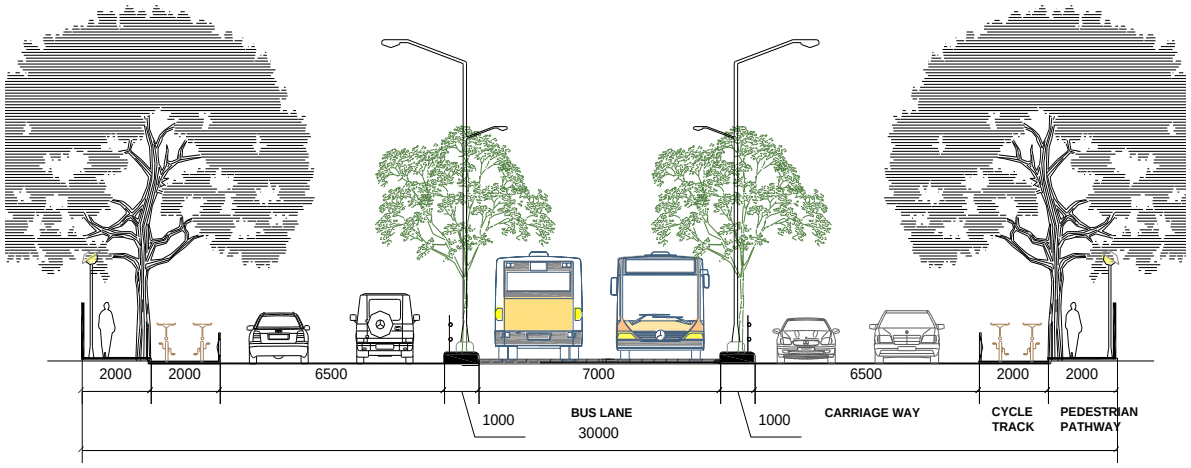


Figure 8.2: Typical Cross Sections of Mobility Corridors for Transit Systems

a. Typical Cross section of Elevated LRT



b. Typical Cross Section of BRTS (30 meter ROW) *Source: Ahmedabad BRTS*



2.0 m – Footpath
2.0 m – Cycle track
6.5 m – Mixed Traffic lane
1.0 m – Physical separator
7.0 m – BRT Lane

8.2 Land Use and Transport Strategy

The structure and shape of the transport network is dependent on land use. Land use and the network strategy must go hand in hand. As land use cannot happen as planned, if there is no connectivity. This strategy should focus on accessibility, connectivity, mixed land use developments to minimize vehicle trips, encourage transit oriented development, and the long term transport strategy be framed around the structural form of urban growth envisaged.

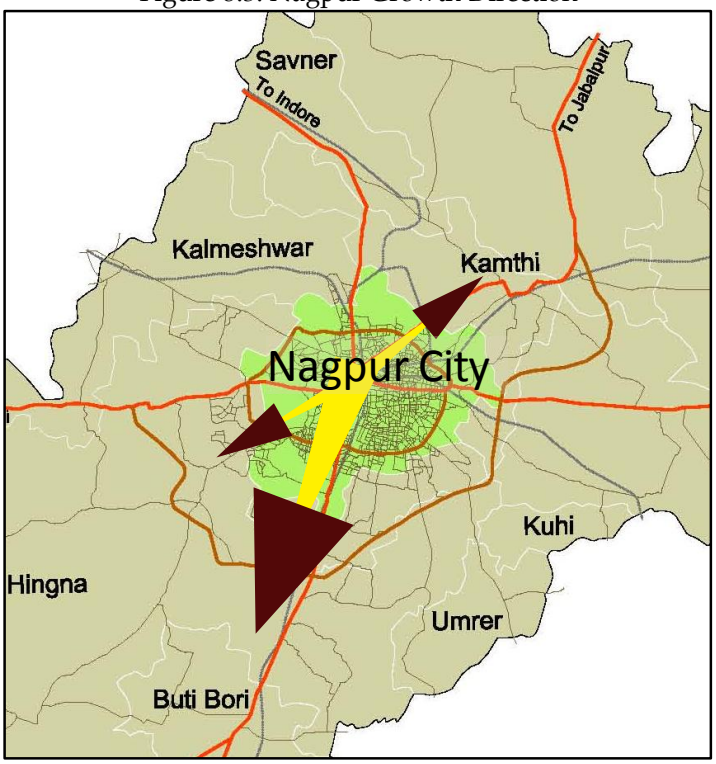
Integrated land use and transport development promotes balanced regional growth in line with regional development strategies, with the objective of:

- Promoting balanced spatial growth
- Minimizing land requirements for transport
- Promoting transit oriented growth
- Reducing the need to travel
- Encouraging walkable/cyclable neighborhoods

In order to provide mobility solutions for Nagpur it is vital that there is an effective integration between land use and transport in the entire region, without which, it will be difficult to coordinate growth in sustained manner.

The urban sprawl in Nagpur has taken place in almost all the directions. However, a greater potential for urbanization has been observed in the Southern direction, as shown in Figure 8.3. Settlements have primarily emerged along the major radial transport corridors.

Figure 8.3: Nagpur Growth Direction



One of the strategies integrating land use and transport that can be adopted for Nagpur is the Transit Oriented Development (TOD) strategy. This concept can be applied along the major identified mobility corridors that have the potential to carry higher order mass transit systems.

Transit Oriented Development (TOD)

By designating certain roads as corridors to maximize passenger throughput, these corridors get priority planning for public transit systems. Mixed use development that is cognizant of the low income users of the transit system, is important. Land use planning can be used to create urban and suburban environments where walking and transit are viable transportation options (Transit Oriented Design/Transit Supportive Design, TOD) by making it easier to go from one transportation mode to another, the connection between community and development is enhanced ensuring that a community is accessible to all. Resilient neighborhoods will provide the needs of daily living, within walking distance (1/2 to 1 km radius). Nagpur has the potential to adopt these principles. The TOD planning process includes:

Travel Connections: This would focus on convenient and direct pedestrian connections, pedestrian scale blocks, interconnected street network including bicycle circulation and parking. Increased density in neighborhood centers would make transit service more effective.

Building Scale and Orientation: Transit-supportive design assumes people are willing to walk a maximum of ½ mile for premium transit and rail service and ¼ mile for other bus services. Building placement is a powerful tool in reinforcing streets as public amenities. Sensitivity to the physical design and location of buildings is important in order for travel connections to be attractive. The quality of "out of vehicle" experiences is influenced by the placement of buildings in relation to the street and other buildings, as well as their height and scale.

Public Spaces: This would include pedestrian-friendly streets including adoption of traffic calming measures, parks and Plazas as community gathering spaces to enable social interaction, quality facilities for transit users (features such as benches, shelters, landscaping and adequate lighting make people feel comfortable while waiting for transit service). Additionally, services such as child care facilities, dry cleaners, postal facilities and health care offices can be included as part of bus transfer centers or rail stations.

Parking: The proper location and size of parking facilities are essential if pathways, buildings and public spaces are to succeed in creating transit-supportive settings. Parking structures/shared parking lots are two ways to reduce the amount of space occupied by parking facilities.

Successful Transit Oriented Development can significantly reduce per capita motor vehicle travel, and reduced travel time. Reduced travel time in turn leads to lower pollution including lower GHG and particle emissions.

Table 8.2: Benefits of TOD: Case Study

Design Feature	Reduced Vehicle Travel
Residential development around transit centers.	10%
Commercial development around transit centers.	15%
Residential development along transit corridor.	5%
Commercial development along transit corridor.	7%
Residential mixed-use development around transit centers.	15%
Commercial mixed-use development around transit centers.	20%
Residential mixed-use development along transit corridors.	7%
Commercial mixed-use development along transit corridors.	10%

Source : Features of landuse design by Dagang, 1995

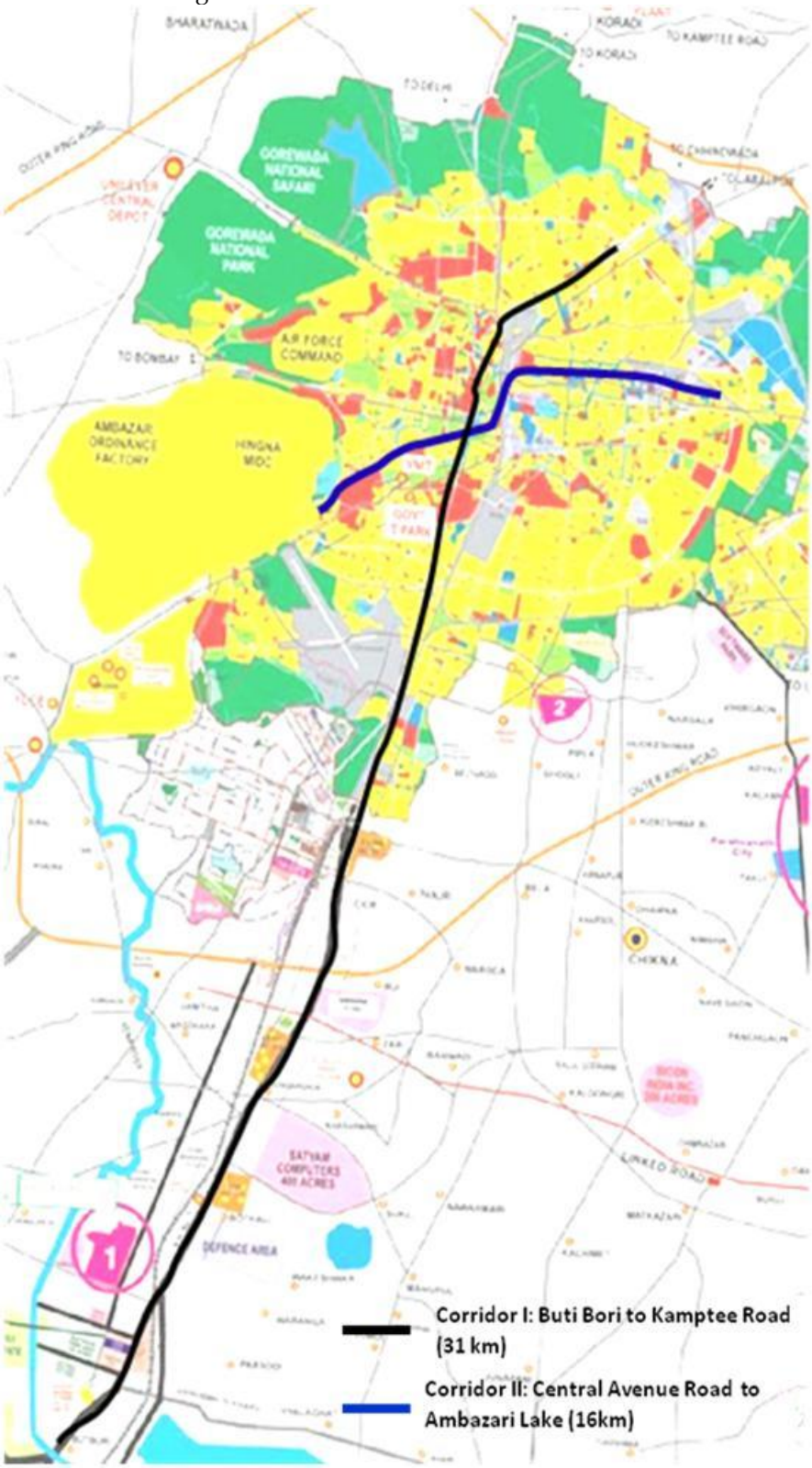
Given the benefits of a transit oriented development, it is very important to assess its impact on land price, area character, and the socio-economic profile of the corridor, so that poor and disadvantaged population does not stand to lose. The equity and inclusive planning process becomes core to this strategy.

Two major corridors that have been identified for the introduction of urban rail transit in Nagpur are the corridors along which TOD can be initiated. These corridors include:

Corridor 1: Kampthi Road to Wardha Road / Butibori
Corridor 2: CA Road to HIngna Road

These two corridors are shown in Figure 8.4

Figure 8.4: Potential TOD Corridors



A separate detailed study is needed to promote ToD along the identified corridors.

8.3 Public Transit Strategy

One of the goals identified as part of the vision is to increase the public transport share to 30% from the existing 10%. For this purpose, we could consider augmentation of Bus System, including Route Rationalization, before embarking on capital intensive system(s). Bus systems only may not be able to meet the desired goal and on key corridors (mobility corridors) a case exists for installing a higher order mass transit system namely BRT / Monorail / LRT/ Metro.

At present in Nagpur, the VNIL is operating city bus service with fleet size as 170. The remaining 300 buses are idle and not on the road which is a serious concern for the city.

1. Route Rationalization

The existing route network requires substantial modification to increase the catchment. The present catchment area is shown in Figure 8.5. The remaining areas need to be connected with updated routing and scheduling plan which in technical terms called as a route rationalization plan. The example of the southern region of Nagpur with available bus routes is given in Figure 8.6. It is analyzed that Dignori and Manewada are growing with rapid developments happening beyond inner ring road and need improved connectivity to bus routes with easy accessibility..

Figure 8.5: Present Catchment Area for PT (Bus)

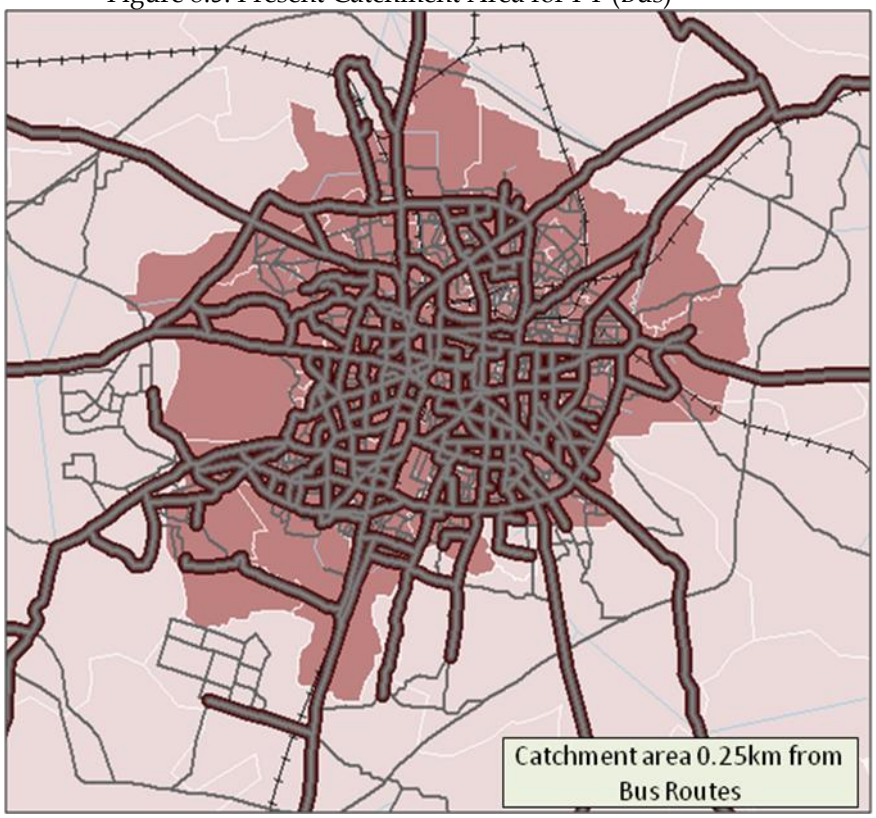
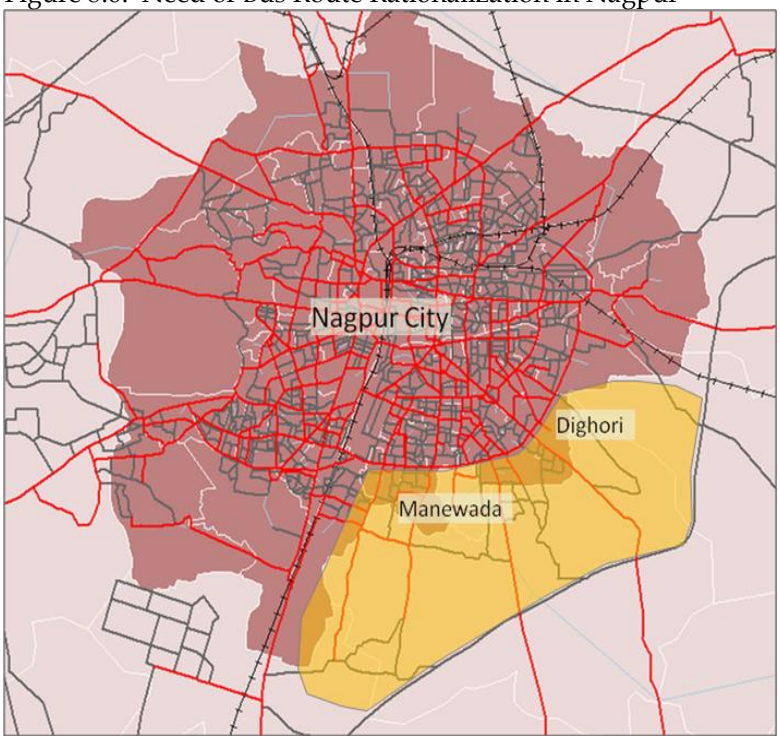


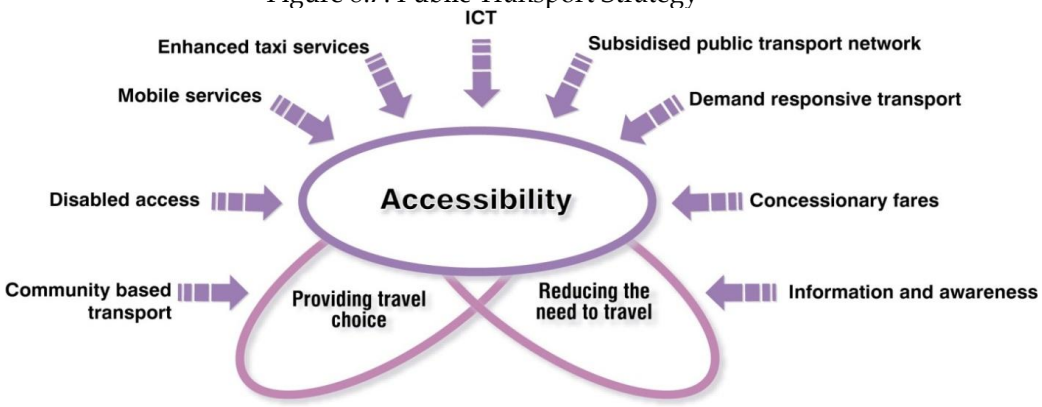
Figure 8.6: Need of Bus Route Rationalization in Nagpur



2. Bus Augmentation

As part of the public transport strategy, augmenting the existing city bus services should be considered by taking 50 buses per lakh population as a rule of thumb. The public transport strategy for Nagpur is derived considering all the factors of existing situation and the best possible reorganization factoring all components of an efficient and sustainable system as given in Figure 8.7.

Figure 8.7: Public Transport Strategy



The fleet size was estimated based on

1. Rule of thumb – 50 buses per lakh population
2. Based on travel demand (estimated ridership considering modal shift)

<u>Fleet Estimation Scenario -1 (Based on Rule of Thumb)</u>

As per rule of thumb, in base year the city needs almost 1250 buses with considering 25 lakh as present urban population. Similarly, the city may need almost 2000 buses in year 2032.

Table 8.3: Fleet Estimation Scenario -1

No	Year	Number of buses required on road for corporation area	Type of Buses Recommended
1.	2012	1250	AC low floor, semi low floor on trunk routes, standard buses on main routes other than trunk routes and mini buses for feeder routes
2.	2022	1600	
3,	2032	2000	

Fleet Estimation Scenario -2 (Based on travel Demand and Modal Shift)

Extensive testing has been carried out in the model to establish the optimum bus supply that must be made to Nagpur to ensure that the bus company operates on a profit as well. From secondary information collected on the bus operations, it was realized that the entire available fleet (approximately 470) was not utilized for operations. Prima facie, it reflects that the bus services are unable to meet expected ridership and failed to generate the revenue. The reason could be the limited coverage of catchment area, inadequate frequency or the unplanned routes. In result, the system has failed to cover all planned 210 routes with available fleet size.

a. Base Year Fleet Estimation:

The base year model generated results suggested that the bus system in Nagpur should accommodate at least 599 buses to operate with minimum 30 min headway serving 32,590 passenger trips in Peak Hr. At present (April 2013), 240 buses are operating with headways greater than 30 min. The required number of fleet of 599 was arrived considering 567 as loading per bus per day and 45 as an average occupancy.

Table 8.4: Base Year Passenger Loading / Bus/Day

Loading/Bus/Day	
Daily Running KM / Bus / Day	200
Avg Bus Trip Distance in Nagpur (Km)	17
Avg No of Trips / Bus/ Day	12
Avg. Occupancy Level	45
Loading/Bus/Day	567

The addition of few routes comprising Kamptee to Manewada, Centre Point School to Khamla, route extension in Somalwada and Manewada area has raised the share of public transport passenger trips by 1% (almost 2500 PT passenger trips in Peak HR). The other way of improving public transport demand is through modal shift from IPT to PT. At present, Nagpur has 13% motorized IPT passenger trips comprising both auto and shared auto passengers. At the screenline, the share of 'shared auto rickshaw' passenger trips was observed as 29% of total IPT passenger trips. In term of passenger trips, the shared autos carry 12,543 passengers during the peak hour. Share auto rickshaws are one of the reasons for dwindling public transport ridership. Shifting these passenger trips from shared auto to bus will help to improve the situation. Different scenarios are built based on modal shift ranging from 25% to 100% from shared auto to the public transport.

Table 8.5: Share of Shared Auto

Auto and Shared Auto Share	
No of IPT Trips (Pk Hr) from model	43253
Present IPT Share Motorised (Auto + Shared Auto)	13%
Avg. Shared Rickshaw passenger trips (out of total pk hr IPT trips) estimated from Screenline (in %)	29%
No of Shared Rickshaw passenger trips (Pk Hr)	12543

Table 8.6a: Base Year Fleet Estimation based on public transport demand (Occupancy 45)

Fleet Requirement (Base Year)	Ideal Existing Situation	With Additional Routes	Additional Routes + Modal Shift from Share Auto Trips (25%)	Additional Routes+ Modal Shift from Share Auto Trips (50%)	Additional Routes + Modal Shift from Share Auto Trips (100%)
No of PT Trips (Pk HR)	32590	36076	39212	45484	58027
Daily PT Trips	339479	375792	408457	473787	604447
Peak hour passenger trips (PT Share)	10%	11%	12%	14%	18%
Fleet Requirement	599	663	720	836	1066

The present share of 10% for public transport passenger trips can be improved up to 18% by controlling shared autos in the catchment area of public transport services. With the same loading of 567 passengers per bus per day, the required number of fleet in this case would range from 720 to 1066 based on the shared auto restriction level as 25% to 100% respectively.

The required fleet size can be reduced with optimizing the offered occupancy level. Assuming offered occupancy as 65 in the base year, the fleet requirement is presented in the table below. The required fleet size will further reduce to 745 with 18% passenger trips with public transport mode.

Table 8.6b Base Year Fleet Estimation based on public transport demand (Occupancy 65)

Fleet Requirement (Base Year)	Ideal Existing Situation	With Additional Routes	Additional Routes + Modal Shift from Share Auto Trips (25%)	Additional Routes+ Modal Shift from Share Auto Trips (50%)	Additional Routes + Modal Shift from Share Auto Trips (100%)
Fleet Requirement (with offered occupancy as 60)	418	463	503	584	745

b. Horizon Year Fleet Estimation (2032):

The total peak hour passenger trips in 2032, with do-nothing scenario are expected to reach 6.06 lakh with only 5.5% as a public transport share. With 780 passengers loading per bus per day, the estimated fleet size to carry these 5.5% PT passenger trips (33,139 PT passenger trips in Pk Hr) would be 443 in year 2032.

Table 8.7: Horizon Year Passenger Loading / Bus/Day

Passenger Loading/Bus/Day	
Daily Running KM / Bus / Day	250
Avg Bus Trip Distance in Nagpur	21
Avg No of Trips / Bus/ Day	12
Avg. Occupancy Level	65
Loading/Bus/Day	780

In horizon year, as per the bench mark set to achieve public transport share in year 2032 (around 30% motorized trips), the substantial planning intervention is required to improve public transport supply. In addition, the system should be environmentally, socially sustainable which should help to reduce the private vehicle dependency. The various scenarios along with the fleet requirement in each case are presented in the Table 8.8.

Table 8.8: Horizon Year Fleet Estimation based on public transport demand (Occupancy 65)

Fleet Requirement	DO-Nothing Situation	LRT	LRT With Route Rationalization	LRT with Route Rationalization and TOD	LRT With Route Rationalization and TOD + Banning Shared Autos
Total Pk Hr Trips	606753	607535	607486	630426	630426
No. of IPT Trips (Pk Hr)	57220	38449	38548	37676	26750
No of PT Trips (Pk Hr)	33139	87711	88162	124658	124658
No of LRT Trips (Pk Hr)	0	46706	47688	87755	87755
No of Interchagning trips (using Bus as Feeder)	0	21980	21837	47885	62979
No of Bus Trips (Pk Hr)	33139	62985	62311	84788	110808
Daily Bus Trips (Daily)	345198	656094	649073	883208	1154250
Peak hour passenger trips (PT Share)	5.5 %	14.5%	15%	19.7%	20%
Peak hour passenger trips (BUS Share)	5.5%	10%	10.5%	13.45%	17.5%
Fleet Requirement	443	841	832	1132	1480

The proposed LRT corridors will be able to carry 46706 passengers in peak hour out of which 21980 will use buses as a feeder service. The estimated number of bus passengers in case of proposed LRT scenario, would be 6.56 lakhs/day. With 780 passengers loading per bus per day, the required fleet in this case would be a thousand. The requirement can be marginally reduced by restricting overlapping LRT and bus routes. The overall public transport passenger trips share will increase by almost 9% and will reach 14.5%

Table 8.9: Shared Auto Rickshaw Trips in 2032

Auto and Shared Auto Share	
No of IPT Trips (Pk Hr in case of LRT + Route Rationalisation + TOD)	37676
Future IPT Share Motorised (Auto + Shared Auto)	6%
Avg. Shared Rickshaw Passenger Trips (out of total pk hr IPT trips) estimated from Screenline (in%)	29%
No of Shared Auto Passenger Trips (Pk Hr)	10926

The proposed transit oriented development will increase population and employment density along the LRT corridor and could effectively increase the public transport share. The estimated public transport share with TOD scenario will reach to 20% out of which 85% of the PT passenger trips are expected to happen through bus based system either on trunk or feeder routes. With 780 as a passenger loading, the system would require 1132 buses which will effectively share 13.45% of total motorized trips. This share can be further improved to achieve 17.5% by restricting shared autos inside the city. This will add 10926 public transport passenger trips and the required fleet number in this case will become 1480.

3. Higher Order Public Transport Strategy

Higher Order Public Transport refers to the rapid transit systems including Bus Rapid Transit, Monorail, LRT, Commuter Rail, Metro etc. These systems have higher carrying capacity and network speed compare to the existing city bus service. The role of higher order system is to cater more trips along the mobility corridors by public transport mode in an efficient manner. The higher order system selection is based on the Passengers per Hour per

Direction (PPHPD), cost and feasibility of implementation, along with other parameters.

The general guidelines for selection of higher order system is given in the Table 8.10

Table 8.10: Selection Criteria for Higher Order PT System

Transit Mode	Commuter Rail	Metro	Monorail	LRT	BRT
					
ROW Options	Exclusive ROW / Sharing with Long Distance Trains	Exclusive ROW Grade Separated	Elevated Monorail – 5 m	At-Grade Exclusive ROW (20 m minimum and addnl. 8m at stations); **Elevated LRT – 10m**	Exclusive ROW (28m minimum and addnl. 7m at stations) Semi-exclusive; Mixed traffic lanes
Station Spacing (Approx)	3 -15 km	1 - 2 km	1 km	1.5 km	0.5 km
Vehicles	Locomotives with the set of Passenger coaches	High platform cars operating in multiple car trains sets	High platform cars operating in multiple car trains sets, electric propulsion	Articulated, double articulated low floor can operate in multiple car sets, electric propulsion	Standard, articulated double articulated low or high platform cars diesel/hybrid propulsion, Electric Trolley Bus
Seated Capacity	90-185 per car	60-80 Per Car	25 - 45 Per Car	65-85 Per Car	40 Standard; 75 Articulated; 125 double articulated
Total Capacity	-	100 – 250 per car	50 - 100 per car	75 – 225 per car	50 – 100 Standard
Average Speed	40-70 kmph	25-55 kmph	25-40 kmph	25-50 kmph	25-50 kmph
Headways	-	3 min	2 min	2 min	1 min
Passenger Throughput PPHPD	Up to 75,000	40,000 - 60,000	Up to 20,000	20,000 (At grade) **Up to 40,000 (Elevated LRT)**	5,000 – 8,000 Up to 25,000 (with articulated buses and overtaking facilities)
Min.Curve Radius	50 m	150 m	Elevated -50 m	At Grade - 25 m **Elevated LRT – 100m**	25 m
App O & M Cost per km	40-60 lakhs	100-200 Lakhs	40-60 Lakhs	50-60 Lakhs	10 Lakhs
App Capital Cost per km (Rupees)	80 Crores	250 Crores (Elevated) **550 Crores (Underground)**	80 Crores	150 Crores	20 Crores
Environmental (sound level)			75 dBA	90 dBA	
Implemented Cities (International)	Moskow. Jakarta, Johannesburg, Buenos Aires	Bangkok, Kuala Lampur, Mexico City, Cairo	Tokyo, Kuala Lampur, Sydney, Seattle	Hongkong, Shanghai, Kuala Lampur	Istanbul, Taipei, Bogota, Curitiba, Pitts Adelaide
Implemented Cities (India)	Mumbai, Chennai, Kolkatta, Hyderabad	Delhi, Kolkata, Bangalore, Chennai Under implementation	Under Implementation in Mumbai	Kolkatta	Ahmedabad, Delhi

The output of transport model has highlighted major corridors which need to be well thought-out for selecting higher order public transport system in Nagpur. The corridors comprise Wardha Road, Amravati Road, Hingna Road, Kamptee Road, Umred Road and CA Road. The southern part of inner ring road is also considered for the higher order PT system.

These corridors have been evaluated by the travel demand model. The passenger carrying capacities on these mobility corridors for the horizon year have been predicted in the model. The capacities are expressed as "passengers per hour per direction (PPHPD)". The PPHPD values are estimated incorporating the landuse transport strategy like TOD and PT strategies like Bus Augmentation and Route Rationalization.

The estimated PPHPD values (on which the section of the transit system is based) for future years on mobility corridors are presented in Table 8.11 The maximum PPHPD values on major corridors are also shown in Figure 8.8.

Table 8.11: PPHPD on major corridors in Nagpur for Year 2032

No	Road Name	Corridor	PPHPD
1.	Hingna Road	Rani Jhasi Chowk To Outer Ring Road	4000
2.	Amravati Road	Sitabuldi Police Station To Outer Ring Road	4600
3.	Katol Road	LIC Square To Outer Ring Road	850
4.	Koradi Road	Intersection of Outer Ring Road to Koradi Road	7000
5.	Kamptee Road	LIC Square To Outer Ring Road	11000
6.	C.A Road	LIC Square To Outer Ring Road	10000
7.	Umred Road	C.A Road To Outer Ring Road	2200
8.	Wardha Road	Ajni Chowk to MIHAN access point	15000
9.	Inner Ring Road	Circular loop from Mankapur Chowk to Mankapur Chowk	5500

From the estimated PPHPD table, it is evident that Nagpur needs a light rail system on the two major corridors by the year 2032. The rest of the mobility corridors can have BRT system. The BRT system can be the feeder system for the proposed light rail on the two designated corridors. The local buses, in turn, can act as feeders to the BRTS buses.

Details of the proposed public transit improvements are presented in next chapter.

Figure 8.8: PPHPD on major corridors in Nagpur (Year 2032)

4.

u

blic transit system is incomplete without intermodal integration. Intermodal integration is crucial for success of multimodal transport system. Intermodal integration involves integrated Public transit network planning, development of feeder networks; use of NMT is these routes, etc. Strategies include -

- Intermodal Stations to minimize delay/transfers. Big hubs/transfer stations may be integrated with commercial services like groceries, laundry, city services, mobile re-charge kiosks, etc for the convenience of users.
- Intelligent Transportation Systems (ITS) for user convenience and real-time information
- Access to the public transit network that includes integration with auto-rickshaws, taxis, and NMT modes like cycle rickshaws, and inland water transport
- Park and ride Facilities along transit corridors
- Integrated Fare policy and ticketing, to ensure a single travel experience.

In order to achieve the modal integration, the concept of developing Traffic and Transit Management Centres (TTMC) is recommended at several critical locations in Nagpur. Each TTMC will consist of three main components:

- An integrated terminal facility with adequate facilities and amenities to cater to the requirements of all user groups.

- A mixed-use development with shopping, office spaces and other commercial activitiy to enable people to fulfill all the needs by using public transport.
- Provision of Park-and-Ride facility to encourage the use of public transport.

The list of proposed locations of Trafic and Transit Management Centers (TTMC) is preented in the next chapter.

The share of public transport may further improve with the integrated fare system which comprise single ticketing facility for all public transport modes. The same can be extended to mutilevel parking at trasfer stations to promote modal shift from private vehicles to public transport. The fare can be revised on periodic basis considering demand management to improve system efficencny and the system operational charges including fluctuations in the market rates of fuel.

8.4 Non-Motorized Transport Strategy

Large number of pedestrian movement is observed along roads in and around the city. Footpaths are available on majority of the radial roads but the secondary network needs substantial improvement for NMT infrastructure. Wherever available, these have been encroached upon by shopkeepers or by hawkers, forcing people to walk on pavement. Further, bicycles traverse in mixed traffic, exposing them to accidents. In fact it is mainly the bicyclists and pedestrians who are the victims of road accidents.

The cycle share in Nagpur is about 5% in overall trips, but there is no cycle track facility in the city. Based on the Cyclist opinion survey, about 67% of the respondents feel that it is necessary to have separate cycle tracks.

The proposed measures to develop facilities for pedestrians and bicyclists on the streets include:

- Development of NMT network for full width;
- Incorporating all essential elements including pedestrian paths;
- Provide grade separated facilities for pedestrian crossing designed for the convenience of pedestrians at appropriate locations;
- Specific measures for facilitating safe bicycle use;
- Cycle track network Plan;
- Cycle rickshaw management

Construction of Cycle Track, Foot-Paths and Zebra Crossings

The unplanned foot-paths and zebra crossings makes the pedestrians use normal road stretch for commuting. Many a time it has been observed that the pedestrians use the road with least concern for vehicular traffic. This leads to accidents and loss of precious human life. It is proposed that foot-paths should be urgently constructed. Zebra crossings should be provided at major intersections for safe crossing of pedestrians. Regular painting of the Zebra crossing also needs to be ensured.

The proposed cycle track network is presented in the next chapter.

Foot Over Bridges and Walkways

Providing grade separated pedestrian crossing is an efficient way of improving safety for pedestrians, particularly at locations with high traffic volumes or on the corridors with larger widths. Busy junctions like Medical Chowk, Shangar Nagar Chowk with minimum 5 arms or more can be provided with well designed circular pathways to ensure safety for pedestrian movement. The details for proposed walkways are presented in the next chapter.

Provision of the pedestrian zone

Looking at the number of pedestrians and the associated commercial activities; Sadar, Mahal, Bardi and Itwari are proposed as vehicle restricted zones where only pedestrian movement will be allowed. The location map for these vehicle restricted zones is presented in Chapter 9.

This will be further supported with identification of off-street parking facilities within nearby areas where people can park the vehicle and access the pedestrian zones easily. If required, the bus route alignment and bus stop location will be reframed for robust public transport connectivity to these areas.

Cycle Rickshaw Management

Nagpur has cycle rickshaws as one of the important modes of transport. About 2% of the trips are carried by the cycle rickshaws. However, the cycle rickshaws currently operate in a disorganized fashion. The haphazard movements of these vehicles hamper the traffic flow on the carriageways. In the absence of any organized parking, the cycle rickshaws park on the available carriageways, resulting in reduced roadway capacities and increased potential for hazards for the road users.

It is hence desirable to have a strategy to designate cycle rickshaw stands at appropriate locations in areas that have been served by cycle rickshaws. Besides, they should run on the recommended cycle tracks to ensure an orderly and safe movement.

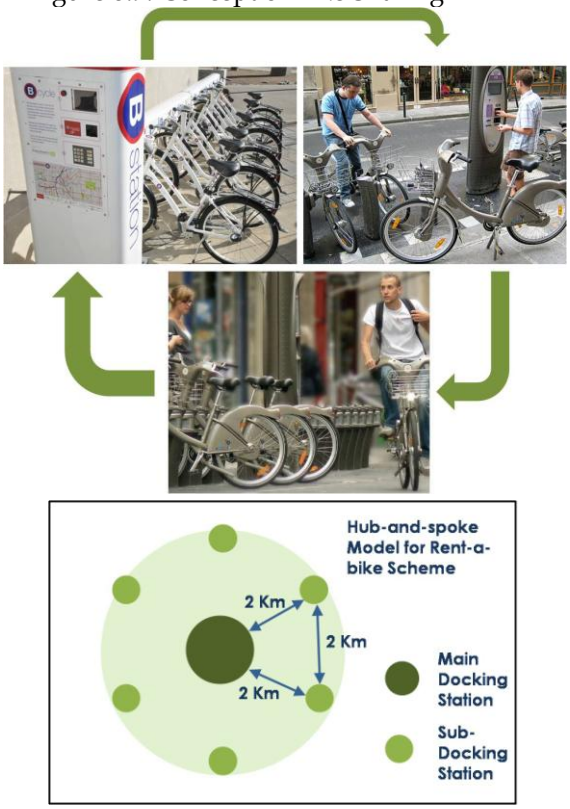
Bike Sharing Scheme

The bike sharing scheme is a part of non motorized transport scheme in which the cycle can be used to reach different destinations on the rental basis. The cycling as an activity itself has a benefit of both at a personal as well as at a social level. Riding a bicycle everyday is good exercise and improves one's health. It is very much environmentally and socially sustainable mode of transport. However, it is important to provide an infrastructure which can take care of the safety issues associated with cycling. Many of the cyclists feel that it is unsafe because of other vehicles on the road for which the running speed is immensely different. Hence the scheme is more effective with dedicated cycle tracks which can segregate cyclists from rest of the traffic.

Conceptually, the system works on a hub-and-spoke model. Typically, there is a main docking station and 6-7 sub-stations within a catchment area of 2.5 to 3 km. The main

docking station can accommodate around 25-30 bicycles and is usually installed next to a transit node. The sub-stations are located nearby in residential colonies, work centers or commercial hubs, as the case may be. A person willing to rent a cycle, goes to either the main docking station or any of the sub-stations, pays a membership fee and fills in a membership form containing certain details of the user, (both being a one-time affair), swipes a smart-card issued to him, and takes the cycle. To deposit the cycle, he goes to any docking station and swipes the card which deducts the rent for his usage period and deposits the cycle. To avail of the membership, he can go to any docking station, fill up the membership form and pay the membership fees or otherwise do it through the internet as per his convenience.

Figure 8.9: Concept of Bike Sharing



In Nagpur, the scheme can be proposed on the identified mobility corridors with the provision of appropriate infrastructure for cycling. Some of the essential components of the scheme are listed below.

Main Docking Station (at least 17m x 3m)

- Sheltered space for proper docking of at least 30 customized cycles
- A small cabin for the Docking Station manager and space for smart card/ mobility card reader and support system for transactions
- Space for washing of cycles and minor repair and maintenance of cycles

Sub Station (at least 7m x 3m)

- Sheltered space for proper docking of at least 10 customized cycles
- A small cabin for the Docking Station manager and space for smart card/ mobility card reader and support system for transactions
- Space for washing of cycles and minor repair and maintenance of cycles

Cycles

- State-of-the-art bicycles
- In-built hidden GPS devices for tracking

Figure 8.10: Bike Sharing Examples

Most of the substations can be located near activity centers including institutional buildings, hospitals, banks, commercial complex etc. The distance between two sub stations should be kept lower than 1 km.

The location list for main docking station and substations is presented in the next section of this report.

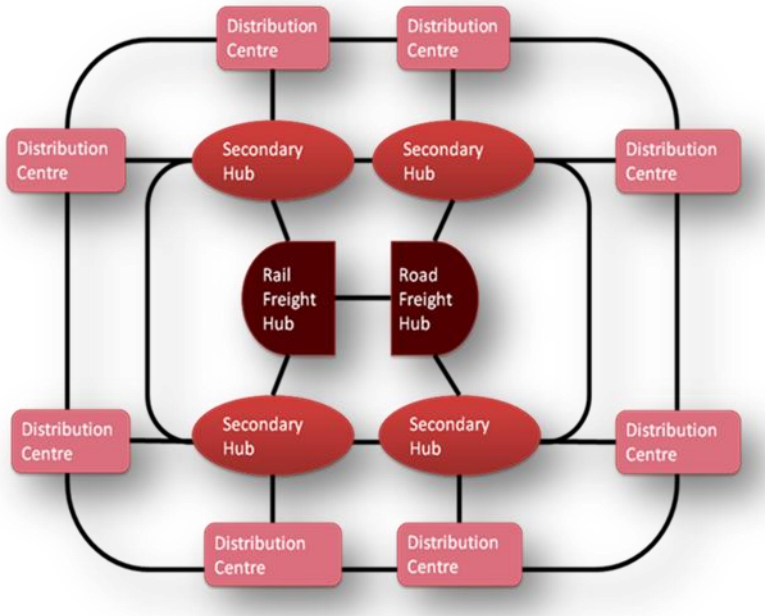
8.5 Freight Management Strategy

Freight movement in a city is an inevitable process of trade and economy. Traditionally, movement of goods for local consumption and sale generally takes place from a certain location within a city which is closest to the wholesale markets. In other cases where there have been successful planning interventions, the goods terminal is preferred to be located on the outskirts of the city, in order to prevent the entry of heavy vehicles into the congested parts of the city.

Nagpur city has a wide catchment area for truck traffic. The city connects major national and state highways. The analysis indicated that there is lack of terminal facilities for trucks and multi-axle vehicles. Most of the trucks and multi axle vehicles are parked outside Chungi Naka (Octroi Naka) on all important radial roads. The city road network profile itself invites high number of truck movements to pass through the city on NH6, NH69, NH9, SH260 and MSH 9 roads. To reduce the impact of heavy vehicle movement on local traffic, trucks are banned during 7.00 am to 12 noon and 4.00 pm to 9.00pm. This has significantly increased parking demand for trucks on all major radial roads outside Chungi Naka. Lighter modes of transport for goods movement almost take place throughout the day in all parts of the city. A definite freight management strategy needs to be devised wherein adequate consideration is given to the economic activity of the region alongside ease of operations and flow of general city traffic. The primary concepts to be used for strategizing a freight strategy would be the following:

- Provision of terminal facility outside outer ring road on major radial corridors
- Classifying primary, secondary and tertiary freight hubs.
- Road network planning for interconnectivity between the freight hubs
- Relocating activity centers for congestion free inner areas

Figure 8.11: Freight Management Strategy



A list of proposed transport hub locations for Nagpur is presented in Chapter 9.

8.6 Parking Strategy

Development of a parking strategy is necessary in order to shape the framework for the future provision, management and maintenance of parking facilities. The development of this Parking Strategy has been based on an understanding of the parking supply and demand position in Nagpur City.

The parking strategies that would be considered for Nagpur include

- Off Street parking facilities
- Parking Pricing
- Restriction of on street parking on mobility corridors

The central city area of Nagpur is developed with commercial as a predominant activity. Lack of land availability for off street parking is forcing vehicles to park on streets. The list of recommended off-street parking locations is presented in the next chapter. To encourage the use of off street parking facility, the on street parking charges should be kept higher than off street parking fees. The pricing should be based on three aspects viz type of parking, location and demand management. At introductory level, fees can be kept at Rs 10 for first two hours for on street parking and Rs 5 for off street parking. However, a detailed parking demand management study is recommended which may incorporate the financial viability and funding options for off street multistory parking schemes.

8.7 Traffic Engineering and Management Measures

Traffic Engineering Measures generally qualify as short term measures for bringing in immediate relief from traffic problems. A combination of several measures can

prove to be effective means of problem solving. These measures are generally not very capital intensive and give instant results.

Table 8.12: Traffic Engineering and Management measures

Road Markings	Signages	Intersection improvements
Traffic separator/ channelizer	Traffic Calming Techniques	Delineators
Footpath repair works	Signalization of intersections	One way streets
Road rectification-patch repair	Resurfacing/ strengthening of road stretch	Speed limits

Shankar Nagar Chowk, Golibar Chowk, Indora Chowk, Madiwala Chowk, RBI Chowk are few of them which can be considered for short term improvement plans. The construction or widening of rail over bridges can also be given consideration as a part of short term improvement measures. The detail list comprising traffic engineering projects is presented in the next chapter.

ITS Management

Another important area that will assist and help significantly is the development of electronics in traffic management. The total ITS package however is very intricate and may not find applicability immediately in true mixed traffic (Indian) conditions. However it will be essential to pursue the following:

- Set up a traffic management centre
- Install Video cameras at key locations
- Set up a communication system with local policemen
- Set up a communication with the traffic signal controller.
- Install variable message signs

At present in Nagpur, CCTV system is not in place. For better traffic management, all important junctions presented in junction analysis need appropriate number of cameras and should further be monitored from central traffic management centre.

IPT Management

The main IPT in Nagpur are the share auto rickshaws. They do not have designated parking places at most of the areas in the city which is causing an unsafe scenario for the road user. Hence it is recommended to have dedicated autorickshaw parking bays. The NMC / NIT and RTO must identify these locations for the orderly parking of auto-rickshaws. Besides at all the bus stops, terminals and railway stations, integration with IPT should be achieved for smooth interchange

It is also important to relook into the auto permits and restrict them on the public transport routes (Mainly on the bus routes) to avoid conflict of interest. To support environmental friendly development, the new auto permits or renewal of auto permits should be restricted to the less emission vehicles.

Hawker Management

There is quite a bit of encroachment of the right-of-way by hawker, as well as by illegal structures in the city. These hawker encroachments are hindrance to the movement of people and also reduce the capacity of roadways. We propose 'hawker zones' to be created at decongesting main roads in Nagpur, and at the same time, protecting the interests of hawkers.

Accordingly, three types of zones are proposed to regularize hawkers;

- Green zone – areas where hawking is allowed all the time
- Amber zone – areas where hawking is allowed at restricted hours
- Red zone – areas where hawking is not allowed anytime.

The municipality and development officials in tandem with the Traffic police should identify such zones in Nagpur and ensure safe and efficient hawking management. All the mobility corridors will fall in the red zone category while all the pedestrian zones comprising Mahal, Sitabuldi, Sadar and Itwari will fall in green zone category.

Other Traffic Management Measures

- Bus stops should be at least 60 m away from the junctions
- Bus bays should be considered at all possible bus stop locations
- Auto parking should be banned near all junctions and moved at least 50m away from junctions
- On street parking should be banned at critical locations on all major roads. To curb the menace of haphazard and illegal parking on main roads- measures like restricted parking, time limit parking and metered parking should be thought of

8.8 Travel Demand Management

Travel demand management is an intervention,(excluding provision of major infrastructure), to modify travel decisions so that more desirable transport, social, economic and/or environmental objectives can be achieved, and the adverse impact of travel can be reduced. A combination of TDM strategies and policies help reduce travel demand or redistribute this demand in space or in time. A demand management approach to transport has the potential to deliver better environmental outcomes, improved public health and stronger communities, and more prosperous and livable cities. A broad range of demand management strategies are available and can be brought to use depending on the situation and suitability. Some of the "tools" used for TDM are listed below.

Table 8.13: TDM Strategies

Subsidizing transit costs for employees or residents.
Car parking controls and pricing
Flex-time work schedules with employers to reduce congestion at peak times
Congestion pricing tolls during peak hours.
Road space rationing by restricting travel at certain times and places.
Workplace travel plans
Roadspace reallocation, aiming to re-balance provision between private cars and other sustainable modes
Introducing active trip reduction programs
Public education and awareness programs

The city can choose and implement any of these strategies, as they do not have any financial implications.

Chapter 9
Project Proposals and Impacts

The previous chapter described transport strategies and measures for the horizon year. This chapter we will discuss the strategy wise recommended projects. The proposals given in this chapter are additional to the ones given in the Study conducted by NMC earlier (Mobility plan / Transport Master Plan). The NMC study has also brought out a comprehensive list of proposals that are important. Hence, proposals given in this chapter (emerged out of this Study), together with the proposals from NMC study (listed in Annexure 3) form a good road map in providing Comprehensive Mobility solutions for Nagpur.

9.1 Public Transport Proposals

9.1.1 Bus augmentation

Based on bus augmentation scenario 1 and scenario 2 discussed in Section 8.3, Chapter 8, the proposed bus augmentation structure is presented below.

Table 9.1: Recommended Bus Augmentations

No	Year	Fleet Requirement	Scenario Details
1.	2012	600	Ideal Existing Situation (refer Table 8.6a)
2.	2032	1480	LRT + Route Rationalization + TOD + Banning Shared Autos (Refer Table 8.8)

9.1.2 Higher Order Mass Transit Systems

The mobility corridors which are eligible for a higher order mass transit system are presented below. Based on the model results, they are categorized into Light Rail Transit System corridors and Bus Rapid Transit System corridors.

LRT Corridors:

Table 9.2a: LRT Corridors: Proposed Alignment and PPHPD

No	Road Name	Corridor			PPHPD (In 2032)	Approximate Distance (Km)
		From	Via	To		
1	Kamptee road and Wardha Road	Khairi	KamteeRoad,Sadar,Humpyard Road, Jail Road,Wardha Road	Outer ring road at NH7	15000	27.10
2	CA Road and Higna Road	Ralpur	Central Avenue, Sitaburdi, North Ambazari Road	Asoli	12000	29.6
					Total	56.7

Table 9.2b Light Rail Transit System Corridors – Stage-1

No	Road Name	Corridor			Approximate Distance (Km)
		From	Via	To	
1	Kamptee road and Wardha Road	Sharda Company	Kamthi Road,Sadar,Humpyard Road, Jail Road,Wardha Road	Mihan Access point on Wardha Road	18.10
2	CA Road and Higna Road	Pardi	Central Avenue,Sitaburdi,North Ambazari Road	Rajendra Nagar	16.10
				Total	34.20

Table 9.2c Light Rail Transit System Corridors – Stage-2 (Extension Part of Stage -1 LRT corridors)

No	Road Name	Corridor			Approximate Distance (Km)
		From	Via	To	
1	Kamptee road	Sharda Company	Kamthi Road,	Khairi	5.0
2	CA Road	Pardi	NH-6	Asoli	4.0
3	Hingna Road	Rajendra Nagar	Hingna Road	Ralpur	9.5
4	Wardha Road	Mihan access road	Wardha Road	Khapri	4.0
				Total	22.5

*The MIHAN corridor has a potential to extend further upto Butibori indutrial area.

BRT Corridors:

Table 9.3a: Proposed Alignment for BRT corridors and PPHPD

No	Road Name	Corridor			PPHPD		Distance -Km
		From	Via	To	(In 2022)	(in 2032)	
1	Amravati Road	Bardi (Sitabuldi Police Station)	GS College, Nagpur University	Gondakhairi(Outer Ring Road)	2300	4600	14.7
2	Katol Road	LIC Square	Military Training Ground (SH 247, 248)	Fetari(Outer Ring Road)	650	850	11.7
3	Koradi and Wardha Road	Mankapur	LIC Chowk	Outer Ring Road point on Wardha Road	4000	7000	11
4	Umred Road	C.A Road	SH9	Vihiragaon	1500	2200	10.5
5	Inner Ring Road	Mankapur chowk (on inner ring road)	Ring road connecting Katol road junction, Amravati Road junction, Hingna junction, Wardha road junction, Umred road junction, Bhandara road junction, Kamptee road junction.	Mankapur chowk (on inner ring road)	3000	5500	38.5
						Total	92.5

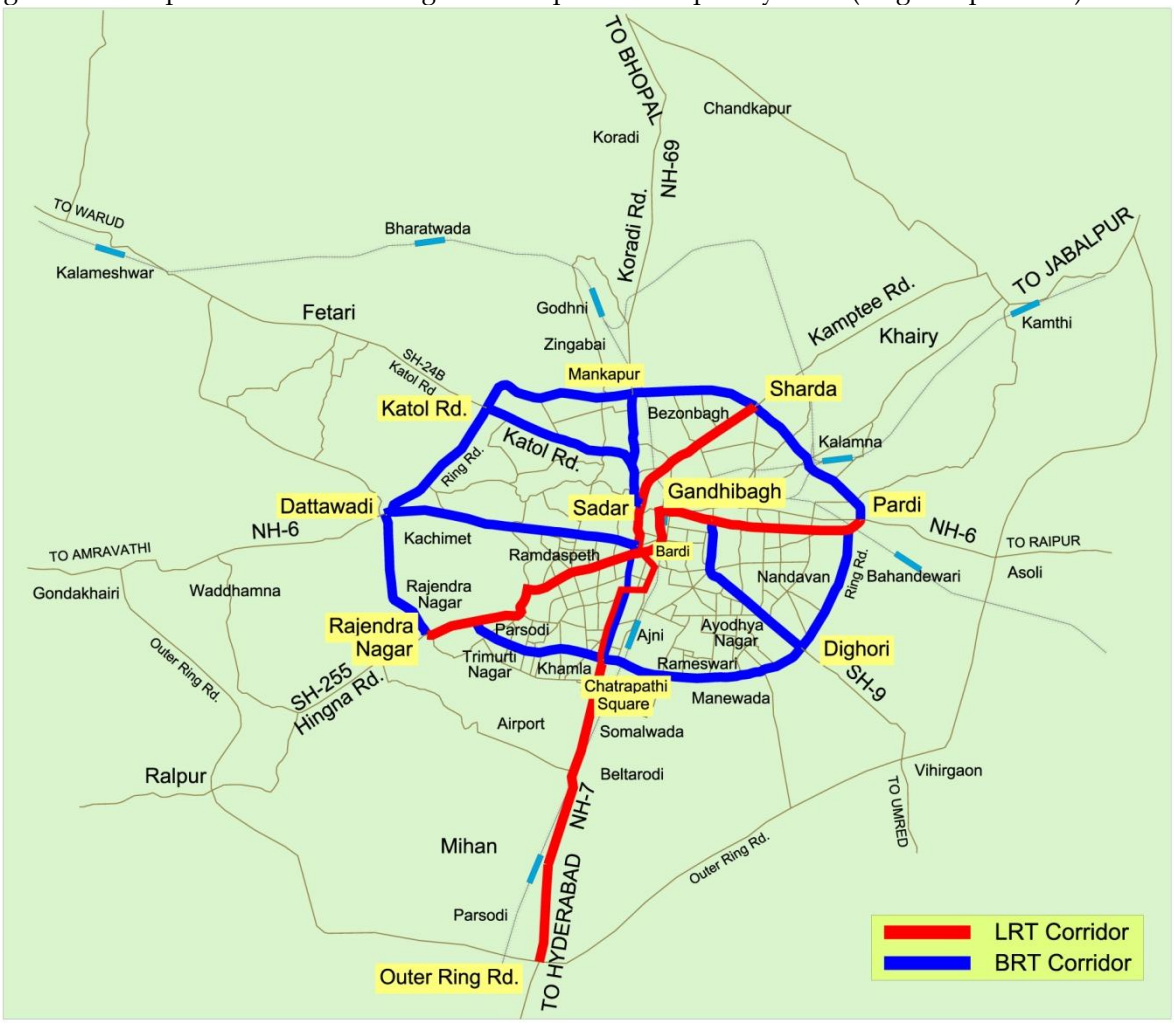
Table 9.3b: Bus Rapid Transit System Stage-1

No	Road Name	Corridor			Distance –Km
		From	Via	To	(Ph- 1)
1	Amravati Road	Bardi (Sitabuldi Police Station)	GS College, Nagpur University	Dattawadi	8.2
2	Katol Road	LIC Square	Military Training Ground (SH 247, 248)	Inner Ring Road	6.5
3	Koradi Road and Wardha Road	Mankapur	LIC Chowk	Chatrapathi Chowk	8.7
4	Umred Road	C.A Road	SH9	Dighori Square	5.4
5	Inner Ring Road	Mankapur chowk (on inner ring road)	Ring road connecting Katol road junction, Amravati Road junction, Hingna junction, Wardha road junction, Umred road junction, Bhandara road junction, Kamptee road junction.	Mankapur chowk (on inner ring road)	38.5
				Total	67.3

Table 9.3c: Bus Rapid Transit System Stage-2

No	Road Name	Corridor			Distance -Km
		From	Via	To	(Ph- 2)
1	Amravati Road	Dattawadi(Inner Ring Road)	Amravati Road	Gondakhairi(Outer Ring Road)	6.5
2	Katol Road	Katol Road(Inner Ring Road)	Katol Road	Fetari(Outer Ring Road)	5.2
3	Koradi Road	Mankapur Chowk(Inner Ring Road)	Koradi Road	Koradi	8.4
4	Umred Road	Dighori(Inner Ring Road)	Umred Road	Vihiragaon	5.1
				Total	25.2

Figure 9.1a: Proposed corridors for higher order public transport systems (Stage-1 up to 2022)



The proposed BRT corridor on inner ring road should be considered for road widening taking 36m as a base width including footpath, cycle track, BRT dedicated corridor.

Figure 9.1b: Extension of Proposed Corridors for higher order public transport system (Phase 2)

Bus Depots and Workshop Areas

To carry out daily maintenance and workshop activities for buses, following locations could be considered for developing depots and workshop activity.

- Hinge - Jaitala area – 5.5 Acres land
- Near Automotive chk (Kamptee Road)
- Patvardhan Ground Premise (could be in front of the stadium or nearby proposed Transport Hub)
- Somalwada, Wardha road (nearby London Street Project)
- Godhini (near Godhini Station)

The suggested locations act as origin or destination points for the future routes to minimize the dead mileage. At each proposed location, minimum 2 acre land is required to accommodate sufficient number (at least 100 each location) of buses for depot and maintenance activity. In absence of sufficient land, the possibility of multistory bus parking could be explored with detail study.

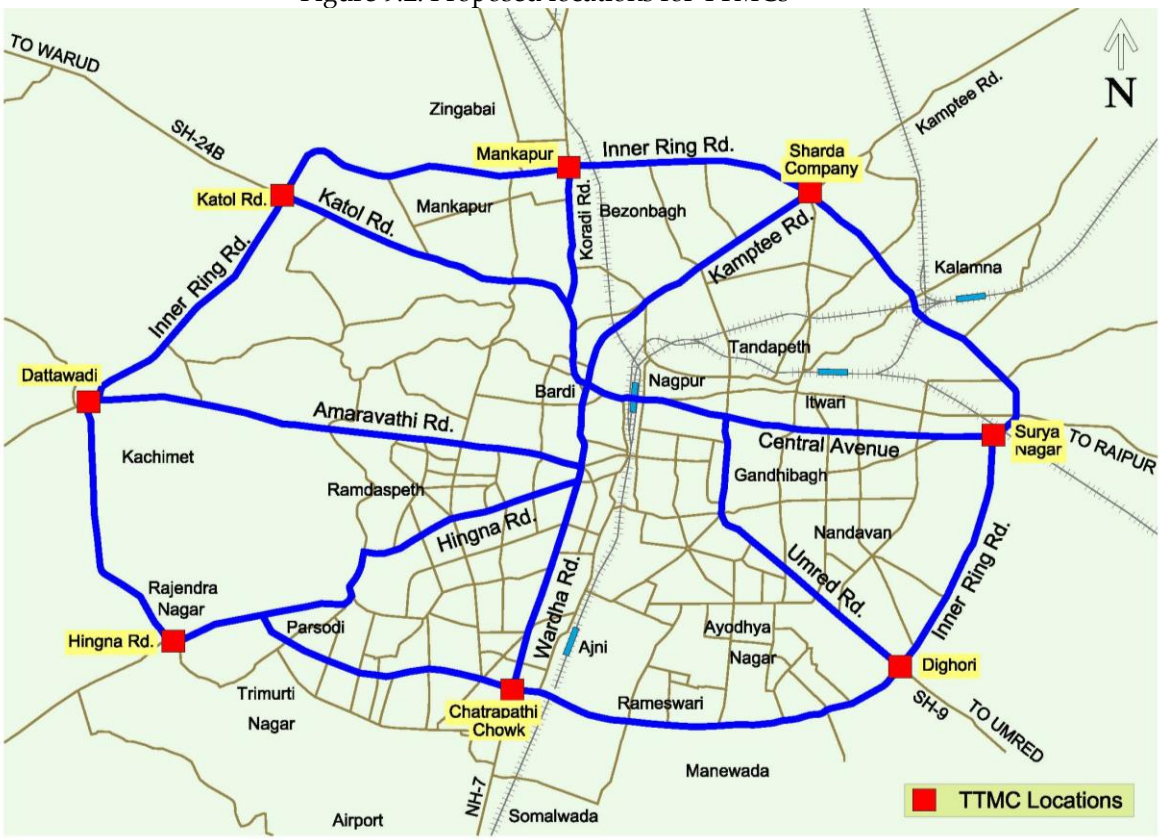
9.1.3 Modal Integration Proposals

At the intersection of each mobility corridor with the inner ring road of the city, a transfer terminal should be facilitated. The transfer terminal is technically called as Transport and Traffic Management Centers (TTMC). The proposed TTMC locations are given below:

a. Mankapur Chowk (junction on Koradi road and inner ring road)
b. Junction on Katol Road and Inner Ring Road
c. Junction on Amravati road and Inner Ring Road
d. Junction on Hingna Road and Inner Ring Road
e. Junction on Wardha Road and Inner Ring Road
f. Junction on Umred Road and Inner Ring Road
g. Junction on Bhandara Road and Inner Ring Road
h. Junction on Kamptee Road and Inner Ring Road
i. Transport Hub Core Area (2 options)
    i. Intercity Bus Stand
    ii. Land near intersection of proposed LRT corridors (Patvardhan Ground)

The proposed TTMCs will act as a transfer points for feeder routes and will also act as a terminating point for the higher order PT systems. These corridors can be extended up to the outer ring road in the next phase, subjected to the sectional loadings.

Figure 9.2: Proposed locations for TTMCs



Transport Hub :

The proposed TTMC in the city core area will act as a transport hub. It will become a transfer station for all PT modes in addition to parking facility and NMT main docking station. Two options are considered for location planning of transport hub. In the first one, the existing interstate terminal can be upgraded to meet the interchange requirements. However, the link between interstate terminal and nearest mobility corridor requires considerable improvement in terms of road widening, signaling and traffic management measures. In the second option, Patvardhan ground may be considered for the development of transport hub. The site is approximately 150m to 200m away from the LRT crossing point which needs a strong linkage with remaining mobility corridors.

Figure 9.3a: Transport Hub Option 1 : Existing Interstate Bus Stand

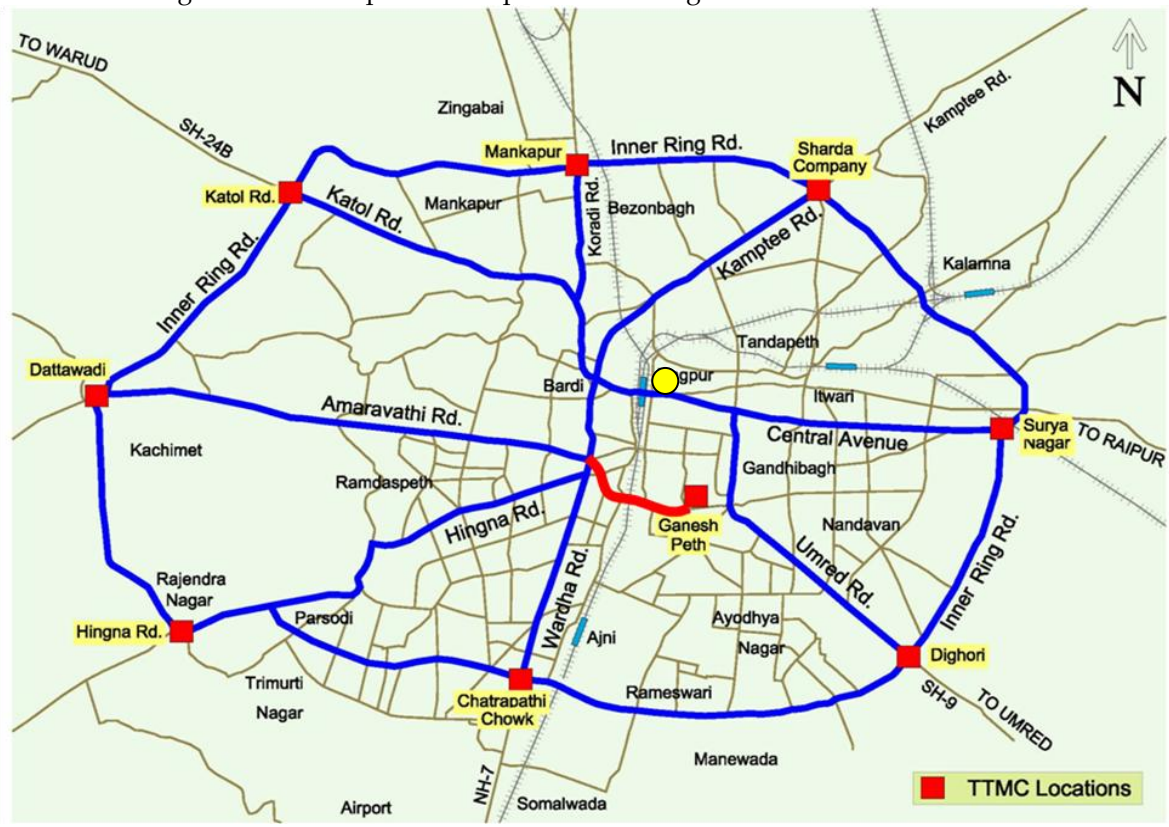
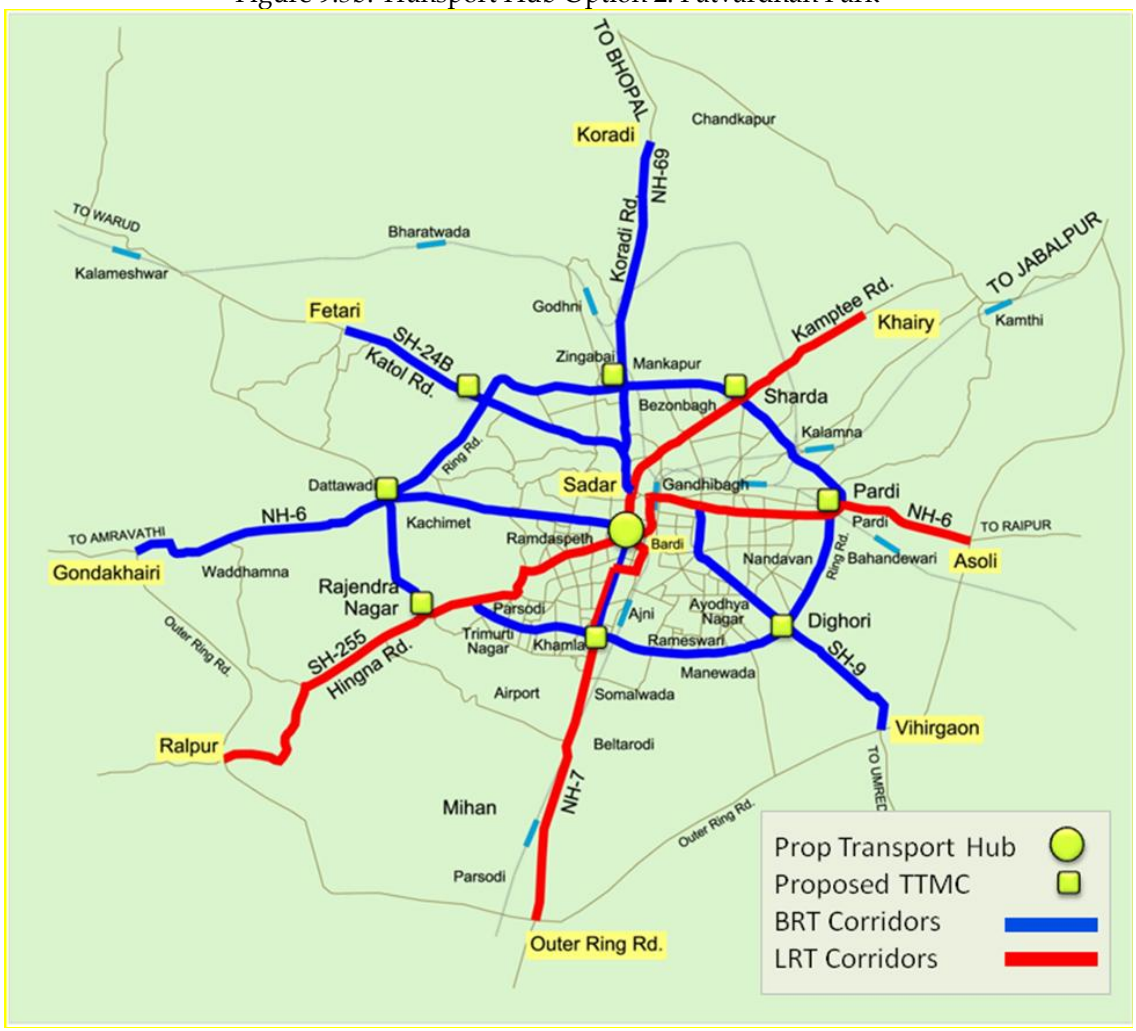


Figure 9.3b: Transport Hub Option 2: Patvardhan Park

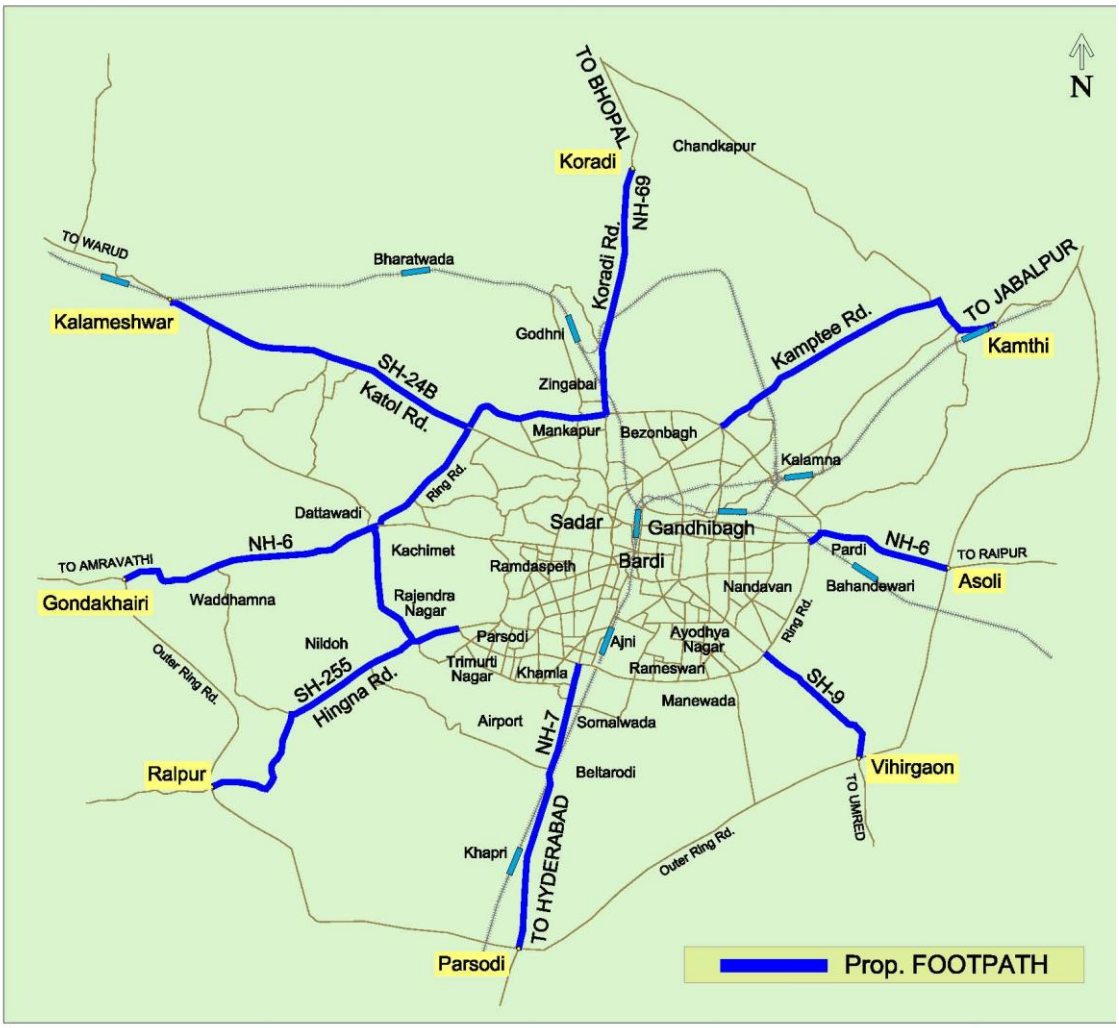


9.2 Non Motorized Transport Proposals

9.2.1 Construction of Footpaths

With careful understanding of availability of footpath on major corridor, it was observed that nearly 87.2 km stretch comprising national and state highways require pavement improvement. This can be considered as a short term proposal with immediate attention for pedestrian safety. Refer Figure 9.4

Figure 9.4: Construction of footpaths



9.2.2 Construction of cycle track

The corridors identified as mobility corridors in Nagpur can also be considered for providing cycle track on both side of the road. The same are listed in the Table below.

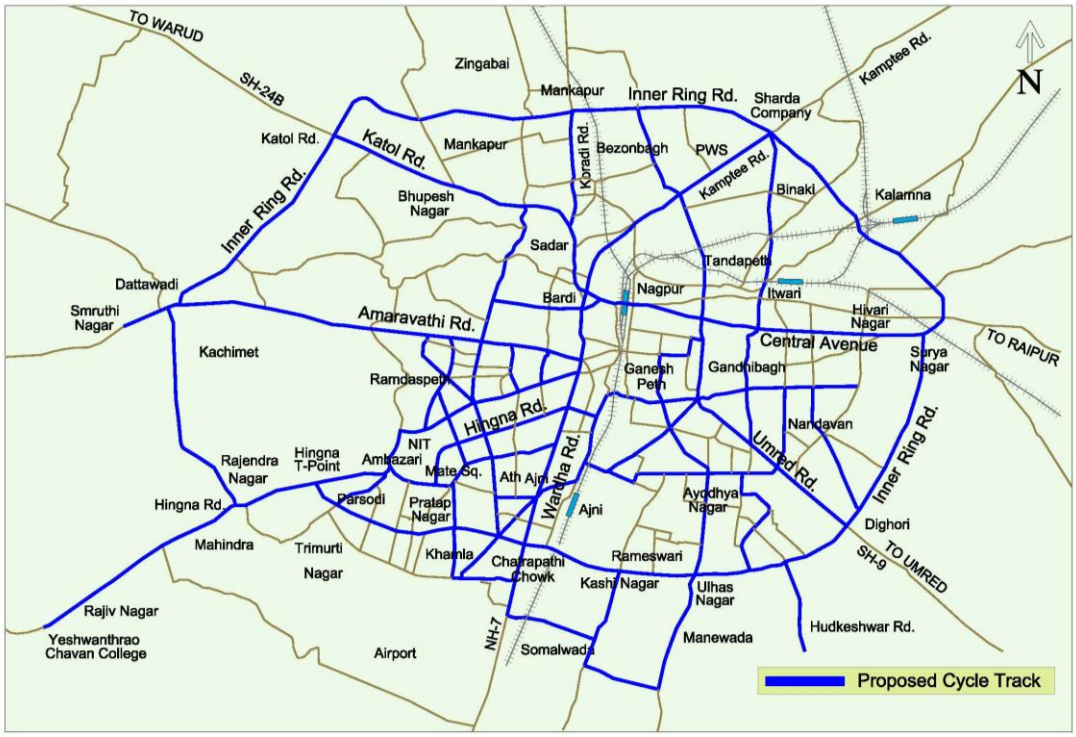
Table 9.4: Corridors eligible for developing cycle track network

No	Road Name	Starting Point	End Point		Road Length (in KM)	
			Phase I (upto 2022)	Phase II (upto 2032)	Phase 1	Phase 2
1	Wardha Road	LIC Square	Inner Ring Road	Outer Ring Road	5.10	10
2.	Hingna Road	Rani Jhasi Chowk	Inner Ring Road	Outer Ring Road	7.7	9.5
3.	Amravati Road	Sitabuldi Police Station	Inner Ring Road	Outer Ring Road	8.20	6.5
4.	Katol Road	LIC Square	Inner Ring Road	Outer Ring Road	6.5	5.2
5.	Koradi Road	LIC Square	Inner Ring Road (Mankapur)	Outer Ring Road	3.6	8.4
6.	Kamptee Road	LIC Square	Inner Ring Road	Kamptee	5.0	10

No	Road Name	Starting Point	End Point		Road Length (in KM)	
			Phase I (upto 2022)	Phase II (upto 2032)	Phase 1	Phase 2
7.	C.A Road	LIC Square	Inner Ring Road (Pardi)	Outer Ring Road	7.2	4
8.	Umred Road	C.A Road	Inner Ring Road	Outer Ring Road	5.4	5.1
9.	Inner Ring Road	Circular loop from Mankapur Chowk to Mankapur Chowk			38.5	
				Total	87.2km	58.7km

Apart from the primary road network mentioned in the Table 9.4 above, some of the secondary and tertiary roads are also proposed for cycle track provision. The detail network is highlighted in the Figure 9.5 Considering both primary and secondary road network, almost 170 km network length is proposed for cycle track provision. The approximate length of total cycle track network is around 340 running km.

Figure 9.5: Proposed Cycle Track Network in Nagpur



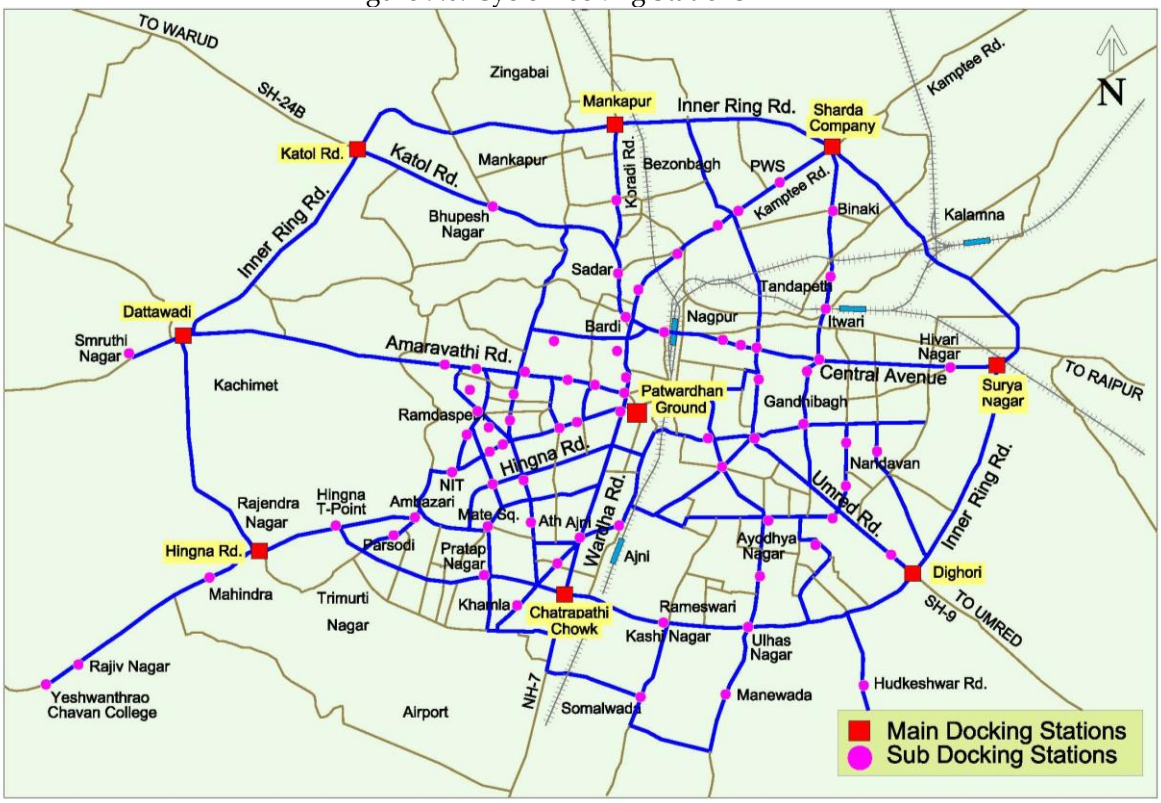
9.2.3 Bike Sharing Project

Majority of the mobility corridors are recommended for dedicated cycle tracks on both side of the roads. As part of their infrastructure requirement and bike shearing scheme, the major docking stations are proposed at each TTMC. The detail list is presented in the Table 9.5 below.

Table 9.5: Location for major docking station

No	Road Name	Location for major docking station
1	Koradi Road	TTMC near inner ring road
2	Katol Road	
3	Amravati Road	
4	Hingna Road	
5	Wardha Road	
6	Umred Road	
7	Bhandara Road	
8	Kamptee Road	
9	Abhyankar Road	Patvardhan Ground (Transport Hub)

Figure 9.6: Cycle Docking Stations



Apart from the main docking station, it is proposed that important public places like hospitals, schools, parks, museums, shopping complex, work centers should be provided with a substation. The proposed location for sub station

Table 9.6: Location for sub docking station

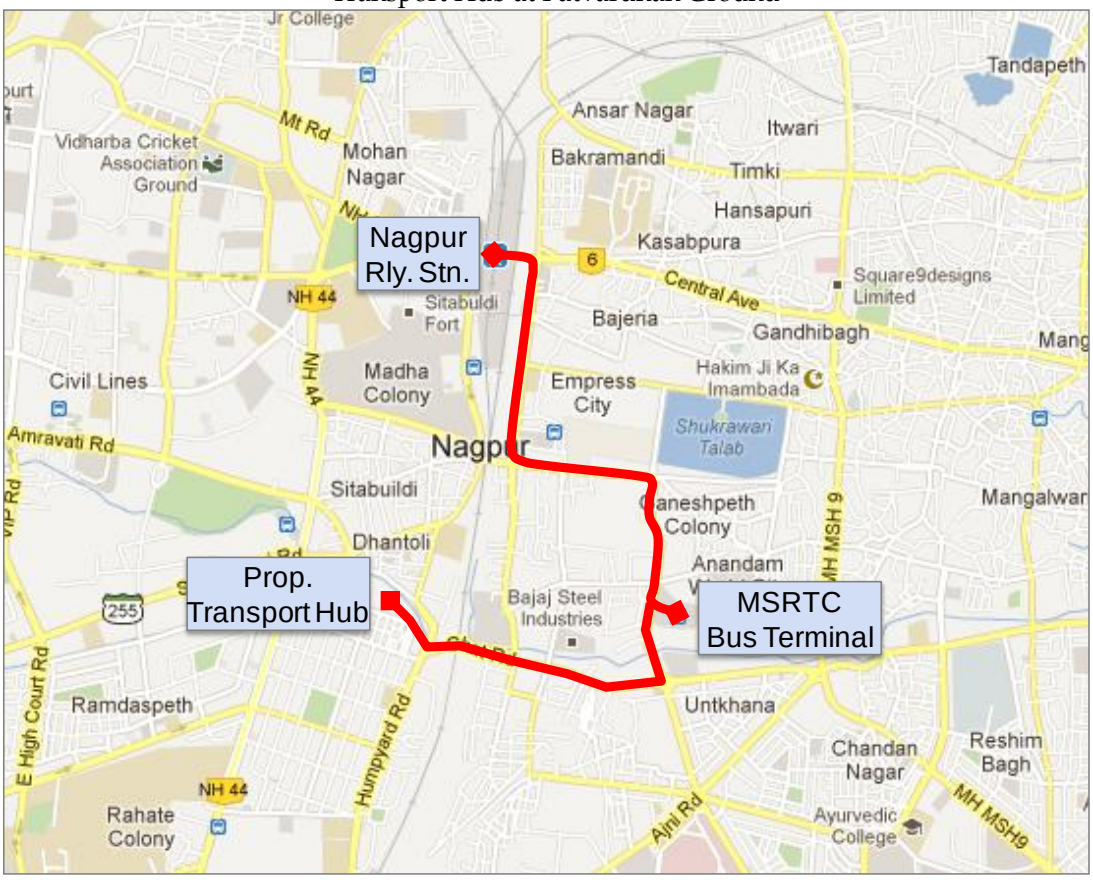
No	Road Name	Location for sub stations
1	Koradi Road	Near Mental hospital,Mankapur,Takali,Godhani
2	Katol Road	Sadar,Bhupesh Nagar,Bhishop School, NIT
3	Amravati Road	Smruti Nagar,Sanganwadi,Rajiv Nagar,LIT,Ramnagar,Rastha Chowk, Gokul Peth,GS College, Civil Lines, MHADA Complex, RST University,
4	Hingna Road	Yeshwanthrao Chavan College, Rajiv Nagar, Mahindra, Hingna T Point, Hingna, Ambazari, National Institute of Technology, LAD College, Deaf and Dumb School, Shivaji Nagar, Gandhi Nagar, ATH Rasta Chowk, Dharampwth Chowk, University Library, Agriculture College, Kanya Vidyalaya, Abhyankar Nagar, Mate Square, Bajaj

No	Road Name	Location for sub stations
		Nagar,
5	Wardha Road	Eternity Mall, Ajni Chowk, Chatrapati Chowk, Vivekanand Nagar, Khamla,Prathap Nagar Chowk, Ajni Station,Manewada, Somalwada, Kashinagar,Bharathi Vidhya Bhavan School, Patwarshan Highschool
6	Umred Road	Chitnis Nagar, Sakkardara Lake, Tukdoji Chowk, St Gyaneshwar Garden, Rameswari, Ulhas Nagar,Hukdeshwar Road, Medical Chowk,Ashirwad Talkies, Holyfamily Church, Mangalwari, Jawahar Nagar, Nandavan, Ganesh Nagar
7	Kamptee Road	St Michael School, Rail Museum, NMC School, Tuli Mall, PWS College, Binaki.
8	Central Avenue	Nagpur Rly Stn., Geetanjali Cinema, Sewasadan Chowk,Agrasen Chowk, Mahal, Near Azad Square, Ayachit Mandir, Hiwari Nagar. Itwari Station, Lalganj

9.2.4 Foot Over Bridges and Walkways

The Figure 9.7 given below represent the proposed elevated walkway between MSRTC Bus Terminal to Nagpur Railway Station and MSRTC Bus Terminal to Proposed Transport Hub at Patvardhan Ground. The approximate length is 1.9 km and 1.6Km Respectively.

Figure 9.7: Walkway from MSRTC Bus Terminal to Nagpur Railway Station and Proposed Transport Hub at Patvardhan Ground



9.2.5 Provision of the pedestrian zones

Considering heavy pedestrian movement, following areas are proposed as a vehicle free zones in Nagpur.

1. Sitabuldi
2. Mahal
3. Itwari
4. Sadar

Figure 9.8: Areas recommended as Pedestrian Zones

The restriction on vehicular movement has to be decided after careful consultations among concerned agencies including Traffic Police. The restriction could be during evening hours every day or during the weekends or at all times. Central Bazaar Road (Lokmat Square to Humpy Yard and Lokmat Square to Kalpna Apt.) can be considered for vehicle free zone or vehicle restriction zone for limited period in a day.

9.3 Proposals for Freight Management

The potential locations for truck terminals are listed below.

- Junction on Outer Ring Road and Hyderabad Road
- Junction on Outer Ring Road and Amravati Road
- Junction on Outer Ring Road and Bhandara Road
- Junction on Outer Ring Road and Kamptee Road
- Junction on Outer Ring Road and Koradi Road

Figure 9.9: Potential Locations for Truck Terminals

9.4 Parking Proposals

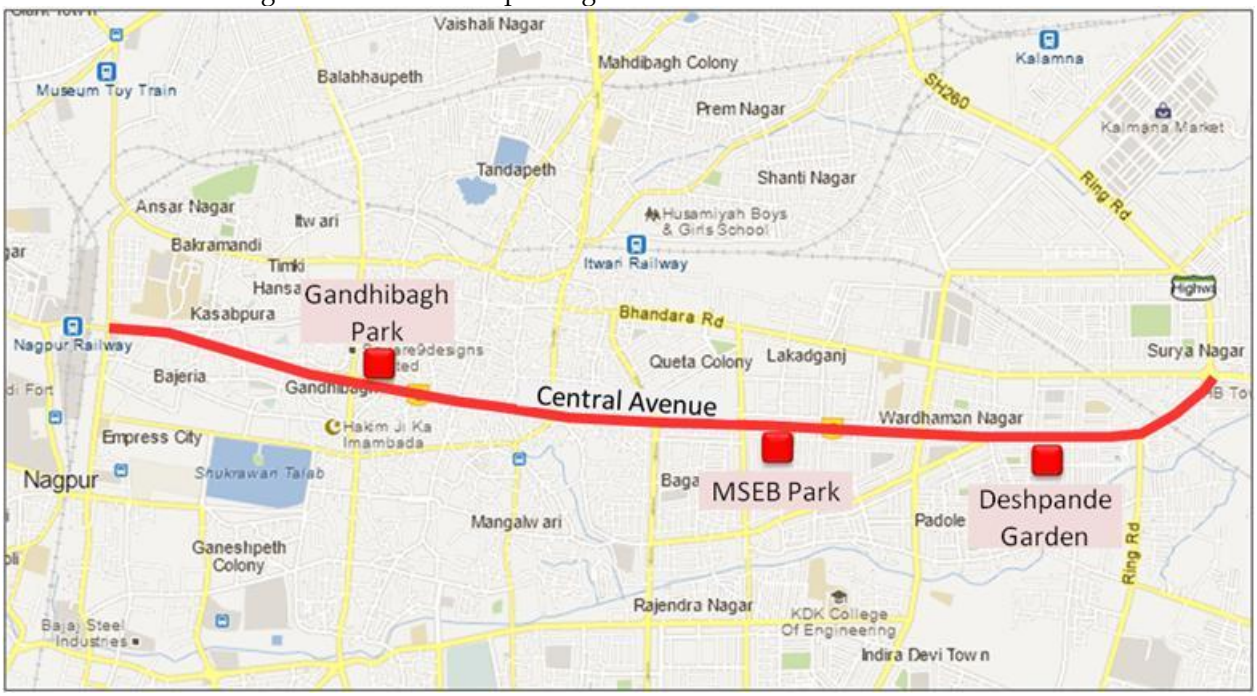
Following are the sites which may be considered for the off-street parking locations. The detail feasibility study should be undertaken for finalizing the locations.

Table 9.7: Proposed off street parking locations

No	Site Location	Approximate Land Area
1	Gandhi Bagh	7 acre
2	MSEB Park	4 acre
3	Deshpande Garden	3 acre
4	PWD land in front of NIT office and Kasturchand Park	2 acre
5	Near Raghvendra Swami Math – Shankar Nagar Square	2 acre

The available public spaces like gardens can be considered for underground parking so as to serve dual purpose. The potential sites which can be considered for off-street parking are highlighted in the Figure 9.10. Apart from these locations, the off-street parking might be considered at TTMC locations.

Figure 9.10: Off-Street parking locations on C.A. Road



9.5 Traffic Engineering and Management Proposals

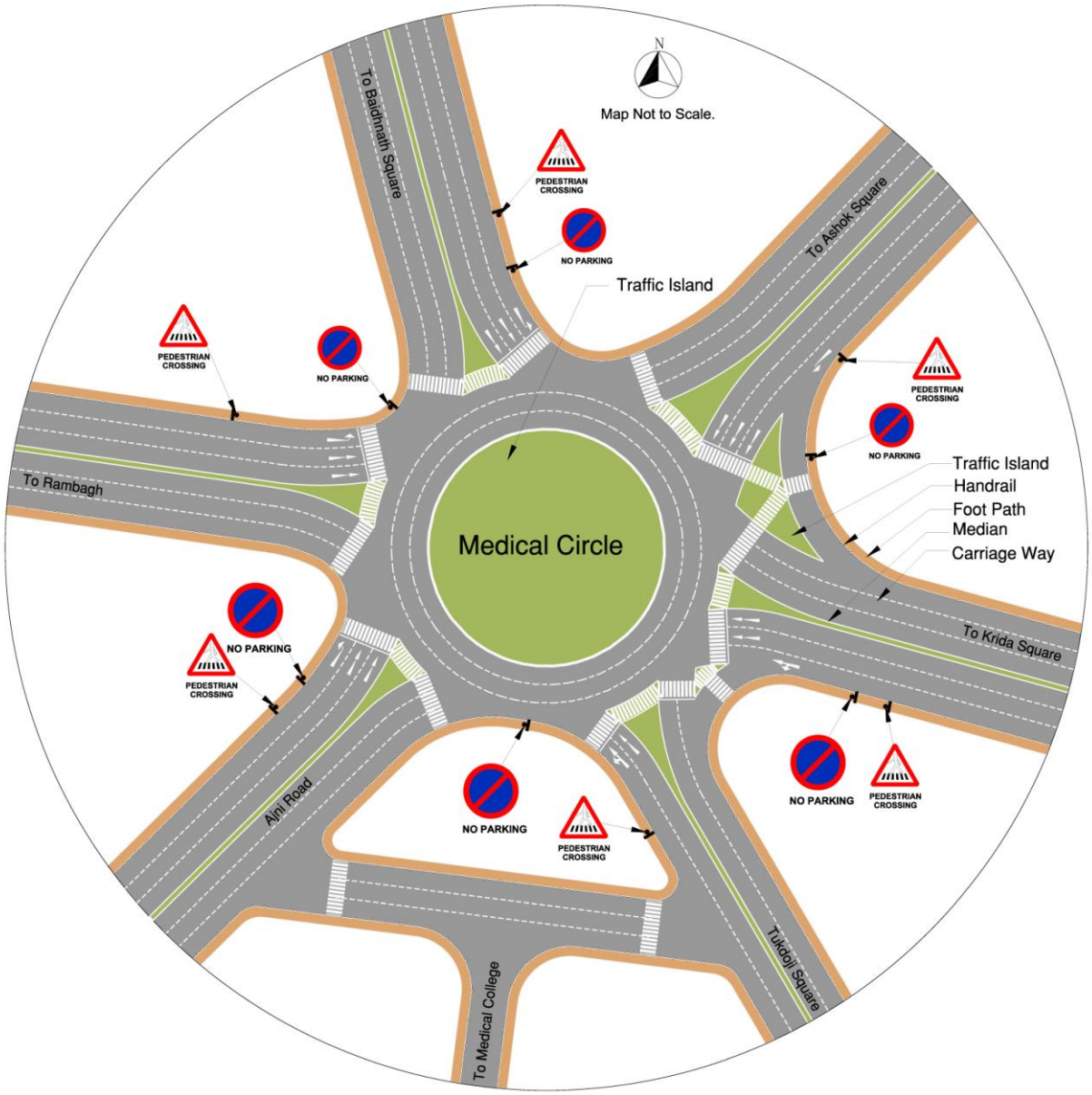
9.5.1 Proposed junctions for improvement

- Shankar Nagar Chowk
- Golibar Chowk
- Indora Chowk
- Chatrapati Chowk
- Variety Chowk
- Cotton Market Chowk
- Ashok Chowk
- RBI Chowk
- Medical Chowk
- Jaystambh chowk near railway station

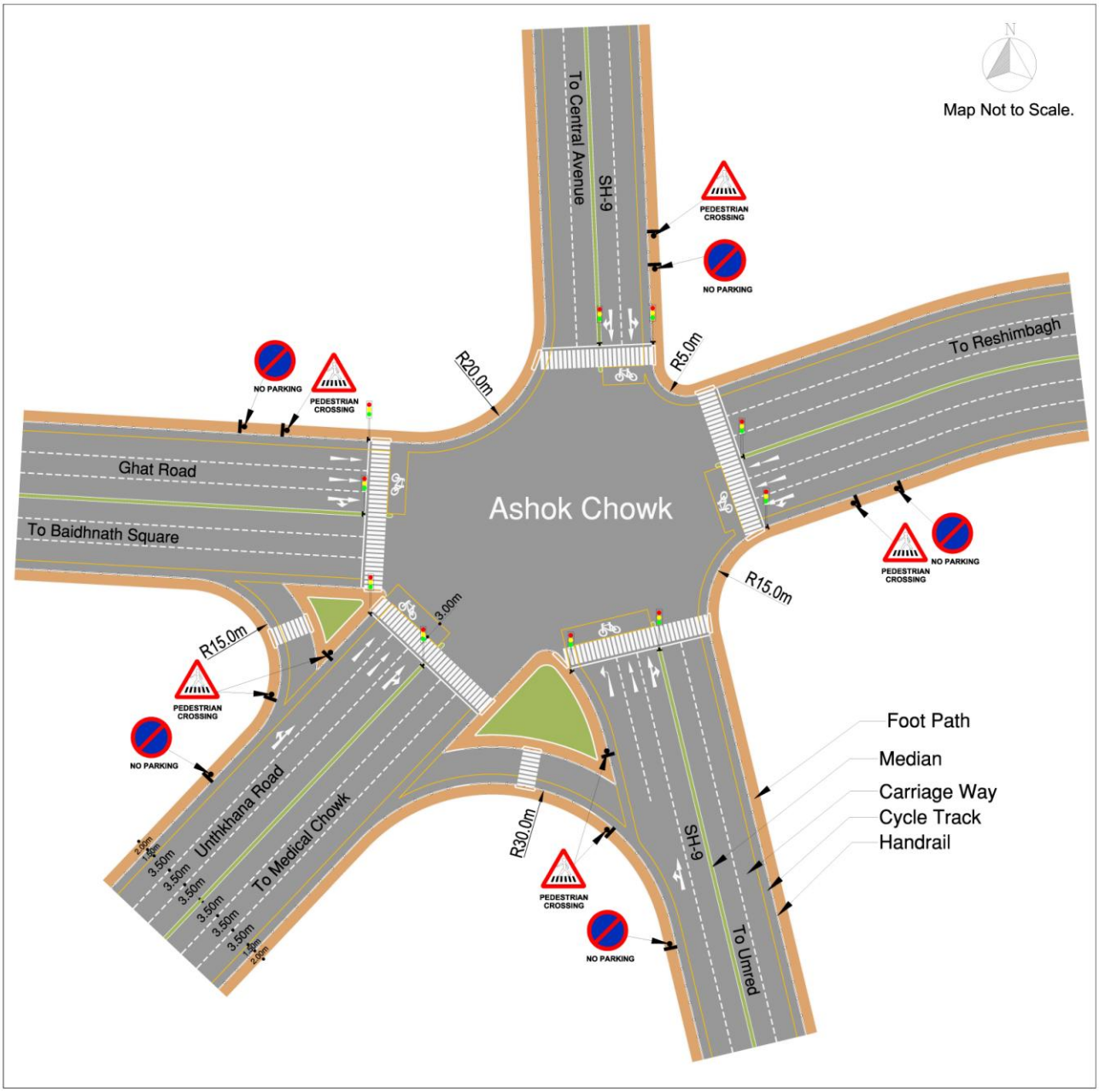
Typical junction improvements at selected locations are shown in Fig 9.11a,b,c. These are indicative, suggested improvements diagrams only. Exact improvements can be shown after conducting the necessary topographic surveys at the locations. Prima facie, the junctions are developed in the last decade (2002). However the traffic level at these junctions has already reached the rage of 7000 to 9000 pcu during peak hour. The situation will become more considerable within a year or two. Based on this, the junction improvement plan can be considered as a part of short term improvement plan.

Figure 9.11: Intersection improvement plan

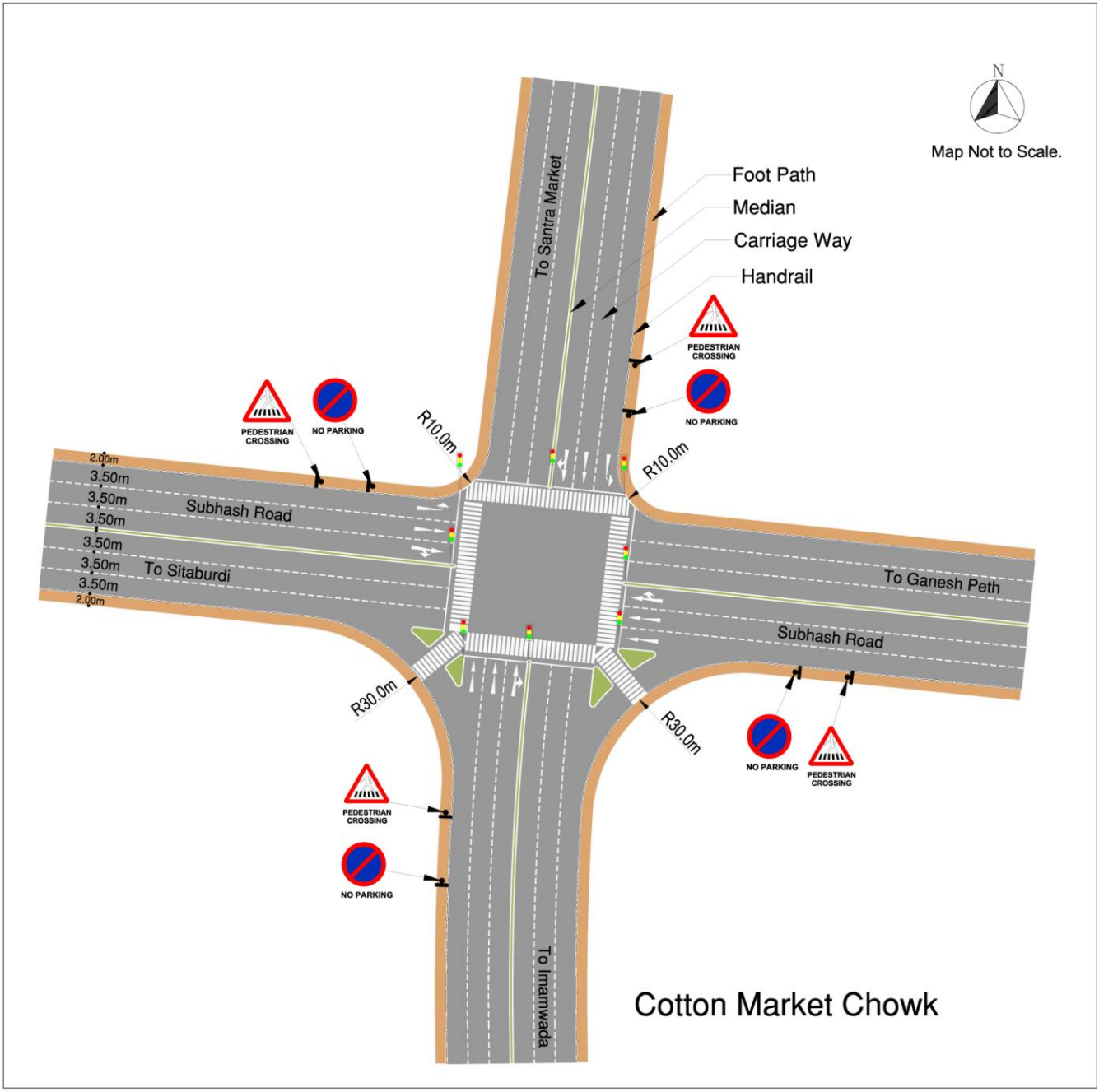
a. Medical Circle.



b. Ashok Chowk



c. Cotton Market Chowk



9.5.2 Removal of Encroachment

Table 9.8: Removal of encroachment

Road	Problems	Recommendation
Santra Market Road	Hawkers problem, reduced road capacity	Enforce it as a No Hawker Zone (Red Zone)
Central Avenue Road	Sculpture identified right on the carriage way along with heavy unauthorized parking on both side of the road. Hawkers Problem.	Sculptures may be shifted to nearby place (in no vehicle zone)
Sakkardara chk	Hawkers problem, reduced road capacity	Enforce it as a No Hawker Zone (Red Zone)
Old Bhandara Road	Loading unloading happens during daytime reducing effective road width.	Loading and unloading timings can be restricted for LCV during day time. Non peak hours or late night hours can be considered for this activity.
Indora chowk to Kamal Talkies	Parking on both side of the roads	Increase on-street parking charges. Enforce demand management measures like alternate day parking, provision for off-street parking site
Variety chowk to Munje chowk		
Jhasi Rani to Munje chowk		
Sakkardgara chowk to Ayurvedic college		
Sakkardara chowk to Umred road		
Janta chowk to Dhantoli park		
Golibar chowk to Daga hospital		
Sadar link road		
Sadar mount road		
Variety chowk to Lokahndipool one way road	Despite of one way it is congested because of heavy parking	Already one multipurpose parking (for 72 cars) is under construction. For effective use of proposed multistory parking, heavy on-street parking charges can be introduced.

9.5.3 Road Capacity Improvement Plan and Rail Over Bridges

The following road links are identified as a bottleneck and need road capacity improvement.

Table 9.9: Network capacity improvement plan

No	Name of the Road	Problem	Solution
1	Cradock Road and bridge accessing Itwari residential area	Traffic Congestion (Itwari area : Dahi Bazar Chk)	to reduce this impact parallel link capacity improvement is required
2	Godhni area connecting Ring road	Traffic Congestion	Divert traffic from Chindwara road to Ring road directly
3	Somalwada area access to Wardha road (from parallel road – behind Pride hotel)	Traffic Congestion	Road widening required is required to improve access to Somalwada area
4	Laxmi Bhavan Chowk to Traffic Park link	Traffic Congestion	Develop one way loop from Laxmi bhavan chowk to VIP road and VIP road to Coffee House chk
Rail Over Bridges			
1	Manish Nagar Railway Crossing	Bottleneck	Two parallel ROBs are required
2	Shanti Nagar Road junction improvement at second (northside) railway crossing	Inadequate at grade access	ROB is required
3	Chindwara road railway crossing	Bottleneck	ROB is required

9.5.4 Signage and Marking

The infrastructure improvement like road widening, ROB, construction of new links will be more effective with the provision of proper signage and road markings. This will increase the safety and will bring discipline in driving conditions. As per the inventory analysis, 75% of surveyed network (approx 149 km) requires substantial improvements in providing proper signage and markings.

9.6 Short, Medium and Long Term Improvements

All the proposals discussed so far can be broadly grouped under three categories:

- Long Term Improvement: the usefulness for these improvements will last for more than 10-15 years
- Medium Term Improvements: the usefulness of these improvements will last for about 5-10 years
- Short Term Improvements: these are short term proposals that need to be reviewed and revised within 5 years as per the requirement.

Accordingly, long term, medium term and short term proposals for Nagpur are shown in the Table 9.10.

Table 9.10: Short, Medium and Long Term Improvements

Short Term Improvements	Medium Term Improvements	Long Term Improvements
• Traffic and Pedestrian Management measures - Road Markings/ Signage • Junction Improvements and Management Measures • Construction of Footpaths • Bus Augmentation • Bus transport Plan - Bus shelters • Elevated Walkway • Provision of Cycle Track • Provision of Pedestrian Zones and Pedestrian Infrastructure • Removal of Encroachments / hawker Management / dismantling • Road Widening	• Off Street Parking Development • Redevelopment of City Bus Terminus • Rail Over Bridges (ROB) • Truck Terminals • Transport Hub • TTMC • Bike sharing main and sub docking stations • ITS	• Light Rail Transit System • Bus Rapid Transit System

The profile sheets of the recommended proposals are given in Annexure 4.

9.7 Anticipated Impact of Proposed Projects

Projects evolved in CMP will help to achieve sustainable development goals by means of reducing private mode share, emission levels and travel time. The anticipated impacts of proposed projects are presented in the table below.

Table 9.11: Anticipated Impact of Proposed Projects

Scenario	Private vehicle share (%)	IPT Share (%)	PT Share (%)	Average Trip length (PT) (km)	Emission in Tons /day	Speed (in Kmph)
Base Year	77	13	10	9.30	29.76	27
1. Do Nothing -2032	86	9	5	7.12	69.37	19
2. Bus Augmentation	86	6	8	8.39	67.28	23
3. Bus Augmentation + Route Rationalisation + Rapid Transit System	79	6	15	12.25	63.03	24
4. Bus Augmentation + Route Rationalisation + Rapid Transit System + TOD	64	6	30	18.98	61.79	24

* Scenario 4 was considered as a CMP scenario while recommending proposals.

9.8 Social Impact

The impact of the proposed projects from the social angle is analyzed at a broader perspective. It is found that most of the projects have significantly less impact with respect to Rehabilitation and Resettlement. Land acquisition for some of the projects is inevitable. The proposed projects significantly improve mobility with reduced travel time. The broad impacts have been compiled in Table 9.12:

Table 9.12: Project Impacts

Project	Right of way / Land Acquisition	Requirement of Rehabilitation & Resettlement	Improve Mobility	Reduction in Travel Time
Bus Fleet Augmentation	No	No	Yes	Yes
High Order Transit System	Yes	Yes	Yes	Yes
Intermodal Stations	Yes	Yes	Yes	Yes
Bus Terminals	Yes	Yes	Yes	NA
TTMC / Transport Hub	Yes	Yes	Yes	NA
Freight Terminals	Yes	Yes	Yes	NA
Bus Shelters & Bus bays	Yes	Yes	Yes	Yes
ROBs / New Roads	Yes	Yes	Yes	Yes
Ring Roads	Yes	No	Yes	Yes
Foot Path cum drains	No	No	Yes	NA
Pedestrian FoB /Subway	No	No	Yes	NA
Major Junction Improvements	No	No	Yes	Yes

9.9 Environmental impacts

Environmental and social screening is intended to provide inputs into identification of potential impacts with the implementation of the CMP. Screening is conducted by identifying the interaction of environmental components on the project activities for various projects. Screening conducted for the identified projects and respective impacts identified are presented in the Table 9.13.

Table 9.13 Environmental impacts of important projects

Broad Project category	Activities / Sub Components	Impacts
Regional Hubs based on Transit Oriented Development principles	• Development of serviced land for high density development • Public transport interchange hubs	• Land acquisition from farmers • Construction activity around the highway
Pedestrian / NMT Infrastructure Improvement	• Land acquisition for road widening and creation of service lane whereever necessary	• Relocation of existing vending activity • Removal of squatters and encroachers from the footpaths • Causing livelihood losses even though they are illegal • Loss of shelter for temporary shops / residences for squatters and encroachers
	• Construction of new footpaths	• Improvement in safety of pedestrians due to measures proposed
	• Pedestrian Infrastructure development like subways/foot over bridges/ signals etc	• Improvement in pedestrian safety • Slowing of traffic at the time of constructing and erecting structures across major intersections
Public Transport Planning	• Dedicated public transport network	• Land acquisition for dedicated lanes will cause Rehabilitation &Resettlement issues • Use of existing pavement width for dedicated bus lanes will cause removal of squatters and encroachments from roadsides causing loss of livelihood and loss of shelter • Construction / reconstruction / improvement of bus lanes will be causing construction issues as: ▪ Generation of noxious gases during construction . increasing air pollution ▪ Temporary increase in noise pollution during construction ▪ Contamination of road runoff with construction material stacked on road side ▪ Traffic safety during construction ▪ Traffic diversions causing lengthening of routes increasing air emissions and exposing previously unexposed neighborhoods. to noise • Reduction of additional lane width for other traffic if existing road width is used for demarcating the dedicated bus lanes • Reduction in private vehicles causing reduction in air / noise pollution
	• Terminals/Depots/TTMC/ Transport Hubs/ Commuter Amenity Centers	• Acquisition of land for the facilities causes . Rehabilitation &Resettlement issues as loss of livelihood, loss of shelter, severance of community & social ties • Increase of noise and air pollution in the areas of terminals and depots • Improvement in approaches to the terminals and depots causing impacts on adjacent landuses and land acquisition • Additional land acquisition, if any for the approach road improvement will lead to R&R issues along the roads and cause impacts on livelihood and shelter

Broad Project category	Activities / Sub Components	Impacts
		• Construction stage impacts include the increase in air and noise pollution • Contamination of road runoff with stacked construction materials • Improvement of traffic conditions during operation stage causing reduction in air and noise pollution
	• Bus-Stops and FOBs/Sub-ways	• Temporary interruption to traffic and increase of emissions from vehicles due to higher idling times • Temporary increase of noise levels due to idling and traffic snarls • Alternate traffic diversion routes increasing route length and consequently emissions • Alternate traffic diversion routes exposing previously low traffic routes to higher urban traffic and increasing air / noise pollution • Removal of squatters and encroachers from the footpaths causing livelihood losses at approaches to the sub-ways / FOBs • Loss of shelter for temporary shops / residences for squatters and encroachers at approaches to the sub-ways / FOBs • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
Others-Road Infrastructure	• Junction Improvements	• May cause removal / displacement of squatters & Encroachers . • Air and noise pollution from construction impacts • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
Freight Management	• Banning and restrictions	• Reduction in urban congestion due to banned movement of freight in the day hours • Banning of use of animals for movement of goods in the city may result in ▪ Animal welfare and safety ▪ Improved speeds in CBD area due to reduction in congestion
	• Relocation of Activity inside existing freight terminal	• Resistance by operators for relocation • Improved air quality in the surrounding residential areas due to shifting of transport nagar
	• Creation of new freight terminal	• Acquisition of land in the peripheries • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth

The emission level for the base year is about 29.76 tonnes/day. For the horizon year 2032, in a Do-nothing scenario, the emission levels will increase to 69.37 tonnes/day. With suggested improvements, the emission levels will reduce to 61.79 tonnes/day.

9.10 Location Impacts

The location Impacts being analyzed are associated with site selection and project location on environment and resettlement or livelihood related impacts on communities. Some of the generic impacts associated with location of project facilities that involves construction activities either by acquiring additional land and / or public land encroached by residents are as below:

- Major environmental features such as lake fronts, parks etc., in the urban areas would generally be avoided and hence environmental impacts on these areas would be minimal to absent.
- Projects do not have any major environmental features that are sensitive to acquisition of land as it is nominal in case of the conceived projects.
- Removal of encroachments and squatters lead to loss of livelihood and / or shelters.
- Vulnerable PAP within the encroachers would be further impacted by the pressure of relocation as well as loss of income and their removal.
- Breakup of established social fabric and cause severance of established relationships amongst the community.
- Temporary loss of services provided by the encroaching PAPs due to their removal.

Some of the specific impacts associated with construction of flyovers involve disruption to existing traffic flow, especially, if located in the congested urban stretches. These would also involve land acquisition (either temporary or permanent) and would also impact the squatters and encroachers affecting residences and / or livelihood.

They would cause traffic congestion and delays and may also involve changes in the project design and alternatives. Project interventions such as ITS application, improvement in public transport infrastructure would only improve the environment rather than causing pollution though resettlement impacts would be present to a limited extent.

9.11 Construction Impacts

Impacts resulting from pre-construction and construction activities including site clearance, earthworks, civil works, etc are identified in this section. Pre-construction and construction impacts arise due to dismantling of existing facilities, use of heavy construction machinery, spillage / disposal of construction debris, runoff from construction site, inadequate or inappropriate drainage of the construction site, inadequate safety measures etc. These are some of the direct impacts of construction in the project area.

In addition to the above, there are few indirect impacts or impacts that result from construction activities though not causing the impacts, support to cause the impacts. Some of these impacts include, generation of vectors and vector borne diseases, spread of STD / HIV amongst the construction workers and within the community in the vicinity of construction activities etc. The above environmental impacts are generic in nature occurring along all the project activities where civil works are involved. Impacts that are specific to the construction activities in a project intervention are presented below.

- Construction activities in case of reconstruction of footpaths or construction of new foot paths would cause temporary interruption to traffic and increase of emissions from vehicles due to higher idling times apart from temporary increase of noise levels due to idling and traffic snarls

- Loss of adequate frontage in few cases of foot path construction or provision of additional cycle lanes and bus lanes
- Relocation of utilities in the pre-construction stage causing temporary disruption to services. These impacts would be more severe in case of construction of exclusive bus lanes and foot paths
- Safety of pedestrians and traffic in the area is likely to be affected due to the progress of construction activities
- Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
- Construction activities elevate the air pollution and noise pollution in the project area temporarily. Air pollution is due to generation of noxious gases emanating from asphalt plants, construction equipment, crushers etc., while noise pollution is due to operation of various types of construction equipment
- Stacking of construction waste causing interruption to traffic and pedestrian movements.
- Runoff from staked construction waste entering the water bodies and existing drainage systems causing clogging of drain outlets as well as the drains themselves

Project interventions as procurement of low emission vehicle fleets, traffic signal prioritization, ITS, provision of signage etc., involve minimal construction activities and hence, environmental and social benefits from these activities will outweigh any minimal impacts that may occur.

9.12 Operation Impacts

These are the Impacts associated with the operation and maintenance of the infrastructure built in the project. The project interventions are conceived to provide maximum benefits to the community with the implementation of the project. The project interventions as could be judged from the discussion so far involve environmental and resettlement impacts during pre-construction and construction stages of the project and appropriate mitigation and management measures would be undertaken to avoid the same.

Negative environmental / social impacts in the operation stage would mostly be limited to air and noise pollution along the improved road infrastructure as well as the parking areas. While there would be loss of usual transport routes for provision of pedestrian routes or NMT, overall improvement in environmental quality is anticipated in the operation stage.

While in previously polluted and congested core city areas / heritage areas would be experiencing better environmental quality than before the project implementation due to pedestrianisation and encouraging NMT. Pedestrian safety would also be improved with the implementation of the project.

Implementation of ITS and traffic signal prioritization interventions would also aid in better management of traffic leading to improvements in air and noise quality.

9.13 Disaster Management

Disaster Management is "The response of the organized activities to address problems created by unusual events". The key concept in planning/ design is 'Resilience' which is the ability of the system to adopt to unexpected conditions with out catastropic failure.

The major disasters includes:

- Floods
- Fire
- Cyclone/ Earthquakes
- Crash

The various transportation issues after disasters include:

- Evacuation: Evacuation should be done before, during and after disaster.
- Delivery of emergency supplies
- Rescue Operations
- Transport Infrastructure Repair

Recommendations for effective emergency response in CMP

1. Include disaster response plan at local, regional and national level as part of transport planning. Consider possible range of disasters/ stresses on transport systems and solutions for the same.
   - The formation of a strong network strategy will be the first step to the disaster response plan at the city level.

2. Develop a plan telling ' who should do what' among civic authorities.
   - Focusing on public transport to also assist in disaster eviction can only be brought about if adequate public transport facilities are provided.

3. Develop multi modal transportation systems that provide variety of mobility options.
   - Our focus in Nagpur includes TTMC/Bus terminals/ Transport hub which would be the first steps in providing alternate evacuation points during disasters.

4. Create transport system networks that provide links to each destination- roads, rails, bridges
   - For the disaster response plan(Point 1), the basic issue of network and transport options become critical. The CMP aims at creating a network structure which would provide strong inter connectivity between regions.

5. Develop plans to provide basic mobility to all. Planning should take into account people with special needs.
   - Footpaths which are clean and clear of obstruction would be a clear avenue of escape. The strategy of the CMP that focuses on NMT would hence be critical to the mobility of people.

6. Develop effective ways to maintain information and communication systems among transport system managers and staff under emergency conditions. Training the staff for emergency preparedness.
   - The ITS system, the puclic transport operation and the police will all play a role in disaster management. The CMP would form the basic infrastructure and people who would have to be trained in the aspect.

7. Develop ways to prioritize transport system resources when necessary. For example, design or plan systems to allow emergency service and freight vehicles priority over general traffic.
   - Mobility corridor strategy in conjunction with the network strategy and ITS can ensure the facilitation of emergency vehicles. The head room standards and design standards to ensure that these vehicles are not obstructed should be strictly followed in the design and implementation of the facilities planned in the CMP.

8. Design critical components of transportation system to be fail-safe, repairable and redundant.
   - Alternate routes would render effected routes to the redundant. The design of all structures planned in the CMP must adhere to the seismic/ Flood design standards required.

9. Plan for quick deployment of buses, vans etc.
   - The CMP aims at moving people. In Nagpur we are proposing additional buses to meet cities requirements. They will be very useful during emergency times.
   -

10. Officials muct be trained in traffic management strategies- Guiding special services along evacuation routes; using contraflow lanes; using shoulders as lanes; priority to HOV etc.
    - The CMP provides/suggests an institutional structure where in traffic management is taken care of by a trained and well quipped traffic police. The training should lend itself to redesigning junctions etc.

9.14 Public Participation

The suggestions and views on the proposed projects under this study were examined thorugh public participation. Nagpur citizens were invited to express their views on 21st Oct 2013 at NIT Multipurpose Hall, Sanskrutik Bhavan. The compliance note prepared on the public participation is attached as Annexure 5.

Chapter 10
Implementation Plan

10.1 Project Costing

The projects identified in the earlier section are divided into three categories based on the urgency and duration of the implementation. The long term projects are came as the output of transportation model built specifically to understand the future demand and system requirement. Some of these evolved projects have potential to enter into Public Private Partnership (PPP); however detail case to case project reports are required for validating feasibility. **The total cost of the proposed project is around 11840 crores**. It is important to highlight that the CMP serves only to identify schemes and once these schemes are detailed for feasibility and engineering purpose, some of these costs may vary. The tentative block cost estimation is done in reference with the district scheduled rates for year 2010-11

The overall **short term project cost is estimated to be 199 crores**. All junction improvement schemes, footpath implementation, cycle track network development, removal of encroachment will fall into this category. While implementation of ROB, developing main and sub docking station for cycle network, TTMC, off-street parking / multistory parking will fall under medium term projects. The approximate **cost of medium term projects is 1285 crores. The long term projects will cost around 10355 crores** which mainly comprise rapid transit systems including BRT and LRT. The proposed Kamptee-Wardha Road LRT corridor may be further extended upto Butibori, subject to appropriate ridership and feasibility after 2032. The detail costing is shown in Table 10.1

Project Phasing:
The projects proposed are to be implemented in three phases.
Phase 1 - To be implemented between 2013-2016
Phase 2 – To implemented between 2017-2022
Phase 3 - To implemented between 2023-2032

Table 10.1: Phase wise Costing of the CMP Projects

Sl.No	Projects	Unit	Quantity	Rates (in Crores)	Total Cost (in Crores)	Project Phasing Quantities			Phasing Rs (in Crores)		
						2013-2016	2017-2022	2022-2032	2013-2016	2017-2022	2023-2032
Sl.No	**Short Term Projects**										
1	Traffic and Pedestrian Management measures - Road Markings/ Signage	Km	149	0.05	7.45	87	62		4.35	3.10	0.00
2	Junction Improvements and Management Measures	Nos	10	0.20	2.00	10			2.00	0.00	0.00
3	Construction of Footpaths	Km	85	0.20	17.00	0	85		0.00	17.00	0.00
4	Elevated Walk way from Rly Stn - Bus Stand - Transport Hub	Km	3.5	0.50	1.75	4			1.75	0.00	0.00
5	Provision of cycle track	Km	298	0.50	149.00	174	124		87.00	62.00	0.00
6	Provision of Pedestrian Zones and Pedestrian Infrastructure	Nos	4	2.00	8.00	4			8.00	0.00	0.00
7	Removal of Encrochments / hawker Management / dismantling illegal development along mobility corridor	km	14	1.00	14.00	14			14.00	0.00	0.00
8	Road Widening	km	10	5.00	50.00	10			50.00	0.00	0.00
	Total Short Term Project Cost (In Crores)				249.20				167.10	82.10	0.00
Sl.No	**Medium Term Projects**										
9	Bus Augmentation	Nos	1480	0.50	740.00	280	500	700	140.00	250.00	350.00
10	Bus transport Plan - Bus shelters	Nos	1762	0.07	123.34	1000	762		70.00	53.34	0.00
11	Off Street Parking Locations	Nos	5	10.00	50.00	4	1		40.00	10.00	0.00
12	ITS (Control room / Passenger Information System and Traffic Information System)	LS		30.00	30.00				20.00	10.00	0.00
13	Redevelopment of City Bus Terminus	Nos	1	25.00	25.00	1			25.00	0.00	0.00
14	Rail Over Bridges	Nos	4	10.00	40.00	4	0	0	40.00	0.00	0.00
15	Truck Terminal	Nos	5	15.00	75.00	2	2	1	30.00	30.00	15.00
16	Transport Hub	Nos	1	14.50	14.50	1			14.50	0.00	0.00
17	Traffic and Transport Mangement Centre (TTMC)	Nos	8	9.50	76.00	4	4		38.00	38.00	0.00
18	Bus Depot and Workshop	Nos	5	10.00	50.00	3	1	2	30.00	10.00	20.00
19	Bike Sharing Plan : Main Docking Station	Nos	9	0.50	4.50	5	4		2.50	2.00	0.00
20	Bike Sharing Plan : Substations	Nos	70	0.10	7.00	50	20		5.00	2.00	0.00
	Total Medium Term Project Cost (In Crores)				1235.34				505.00	405.34	385.00
Sl.No	**Long term Projects**										
21	Bus Rapid Transit system	km	92.5	20.00	1850.00	67.30	12.60	12.60	1346.00	252.00	252.00
22	Light Rail Transit System	km	56.7	150.00	8505.00	34.20	11.25	11.25	5130.00	1687.50	1687.50
	Total Long Term Project Cost (In Crores)				10355.00				6476.00	1939.50	1939.50
	Total Cost (In Crores)				**11839.54**						

Reference: SoR 2010-11 (The cost does not include land acquisition cost)

10.2 Financing Options

As per the Recommendations of Working Group on Urban Transport for 12th Five Year Plan, the financing of urban transport projects in the country has largely been confined to gross budgetary support from the government and the user charges. Due to heavy investment needs of urban transport and conflicting demands on the general exchequer, the investment in urban transport in past has not kept pace with the rapidly increasing requirement of the sector. The current level of user charges of limited urban transport facilities, do not make the system self sustainable. At the same time, providing safe, comfortable, speedy and affordable public urban transport to all has to be a necessary goal of the governance. The key funding sources besides GBS and fare box can be dedicated levies, land monetization, recovery from non-user beneficiaries, debt and private investments. The paradigm of financing has to clearly move towards non-users pay principle and the polluters pay principle. There is a need for long-term sustainable dedicating financing mechanism to address fast worsening scenario in the field of urban transport. All the various components in which the investment would be required in the 12th Five Year Plan would need to be funded through a combination of funding from Govt. of India, State Govt./urban local body, development agencies, property development, loan from domestic and financial institutions as well as PPP. Thus, it is imperative to identify projects that are amenable to Government funding or PPP.

10.2.1 Public Private Partnership (PPP)

Public-Private Partnerships is cooperation between a public authority and private companies, created to carry out a specific project. They can take on a number of forms, and can be a useful method of capturing property value gains generated by transport infrastructure In a PPP for a new transport infrastructure development project, the public authority creates a secure environment for the private sector to carry out the project, and the private partner offers its industry know-how, provides funding and shares in the project's risk. The objectives of the public and private sector partners appear to be quite different. The public sector aims to best serve the interests of taxpayers. The aim is not to use public money to obtain a return on capital investments. The private sector, on the other hand, aims to ensure a return on investment for its shareholders and to be as profitable as possible and yet these two contrasting goals can function perfectly well together in the framework of a PPP. The decision to undertake a public-private partnership and the choice of the most suitable form of partnership greatly depends on the context and the types of project to be developed are given below:

- The project context may influence the type of PPP to be implemented. The public partner must evaluate the total cost of the project, its importance in terms of public need, the time frame, the number of actors involved and the geographic area in question. Does providing this public service require a major infrastructure? Will it require high levels of human and financial resources to provide this service? Before a decision can be made, it is necessary to fully understand the context of the proposed project.
- The cost of the project is of course a critical factor, which will weigh on the choice. Many PPP concern projects for underground systems, LRT and BRT requiring significant levels of financing which the local authorities would have difficulty assuming alone.
- A well-structured institutional framework and the local authority's experience in developing transport projects are also decisive factors. Urban transport is an industrial and commercial activity, which involves financial risk. Bringing in

experienced partners is one way of compensating for a lack of certain skills in this field, though a good PPP should call upon other forms of expertise on the part of the public authority. This can sometimes facilitate obtaining a loan, in particular from international funding agencies.

- The tasks entrusted to the private sector (design, construction, development, operation, maintenance) will influence the type of contract.
- The sharing of responsibilities and risks will determine the degree of involvement of each partner and the type and clauses of the contract. There are many types of contracts but it is primarily the sharing of financial risk, which will determine the key characteristics. There are two categories of risk: commercial risk, related to trends in revenue, and industrial risk, related to the cost of construction and trends in operating and maintenance expenses. if both types of risk are covered by the public partner, then it would be a management contract in which the private partner is merely performing the work. The private partner must meet the specifications but will not be motivated to improve the service nor propose innovative techniques or management;
- If the project is not self-financing, i.e. if, at the end of the contract, the total revenues and gains do not balance out the total costs, the transit authority may be required to provide compensation, depending on the clauses of the contract.

10.2.2 Government sources of funding

One of the particularities of the urban transport sector is that it depends on funding from several sources and involves various partners, public and private, individual and collective.

(a) Viability Gap Funding

In a recent initiative, the Government of India has established a special financing facility called "Viability Gap Funding" under the Department of Economic Affairs, Ministry of Finance, to provide support to PPP infrastructure projects that have at least 40% private equity committed to each such project. The Government of India has set certain criteria to avail this facility under formal legal guidelines, issued in August 2004, to support infrastructure under PPP framework. Viability Gap Funding can take various forms such as capital grants, subordinated loans, O&M support grants and interest subsidies. It will be provided in installments, preferably in the form of annuities. However, the Ministry of Finance guidelines require that the total government support to such a project, including Viability Gap Funding and the financial support of other Ministries and agencies of the Government of India, must not exceed 20% of the total project cost as estimated in the preliminary project appraisal, or the actual project cost, whichever is lower. Projects in the following sectors implemented by the Private Sector are eligible for funding:

- Roads and bridges, railways, seaports, airports, inland waterways
- Power
- Urban transport, water supply, sewerage, solid waste management and other physical infrastructure in urban areas
- Infrastructure projects in Special Economic Zones
- International convention centers and other tourism infrastructure projects

(b) JnNURM funding

Since cities and towns in India constitute the second largest urban system in the world and contribute over 50% of the country's GDP, they are central

to economic growth. For the cities to realise their full potential and become effective engines of growth, it is necessary that focused attention be given to the improvement of infrastructure in an organised manner. As such, the JnNURM was launched in December 2005 with the aim to encourage reforms and fast track planned development of identified cities. Focus is to be on efficiency in urban infrastructure and service delivery mechanisms, community participation, and accountability of ULBs/Parastatal agencies towards citizens. The period of the Mission is seven years, up to 2012. During this period, funds shall be provided for proposals that would meet the Mission's requirements. Assistance under JnNURM is additional central assistance, which would be provided as Grant (100% Central grant) to the implementing agencies. The funding from JnNURM is supported by counterpart funding in the form of grants from the State and the ULBs, for which the ratio has been fixed by the Mission for different categories of cities.

10.2.3 Dedicated Urban Transport Fund at city level

For the projects, which are not admissible under JnNURM, or viability gap funding, the alternative sources of funding that a city could avail by setting up a dedicated urban transport fund at city level are given below:

A dedicated urban transport fund would need to be created at the city level through other sources, especially land monetization, betterment levy, land value tax, enhanced property tax or grant of development rights, advertisement, employment tax, congestion, a cess on the sales tax, parking charges reflecting a true value of the land, traffic challans etc.

Pimpri-Chinchwad Municipal Corporation has already set up a dedicated urban transport fund through land monetization and advertisement rights. Similarly, Karnataka has set up a dedicated urban transport fund through MRTS cess on petrol and diesel sold in Bangalore, which is being used to fund the metro rail projects. The various sources of funding that can be used to set up the urban transport fund is given below:

(a) Anticipated purchase of land

This method involves public authorities buying land before announcing that an infrastructure will be built or where the route will run. In this way, the purchase can be made at market price without the infrastructure. The strategy then consists in:

- Directly selling the land to private developers including the estimated added value in the sale price, such as was done in Aguas Claras on the periphery of Brasilia, or in Copenhagen;
- Developing the area as part of an urban renewal project and then selling it at market price, as was done in Copenhagen or in Japan, where rail companies were the first to use this method to finance their operations

A city can also levy additional stamp duty (5%) on registration of property.

(b) Betterment Tax

A betterment tax is not the same as a property tax, because the increase in value of property is not due to the action of the owner (such as would be the case with renovations and improvements) but from a community action, thus justifying the public authorities to impose such a tax. However, it is not easy to implement, which no doubt explains why this financing mechanism is still underused.

This tax must be levied on all areas that benefit from the new transport infrastructure. The land is valued each year based on an optimal use of each site, without taking into account the existing facilities. A tax based on the value of the land is then levied in order to generate funds for the public sector. Thus, if the value of the land increases, the tax collected also increases. This means that a vacant plot of land in the city centre which has been earmarked for building a residential and commercial complex will pay the same tax as an identical site which has already been developed in a similar manner. Unlike construction taxes, no tax reduction is available to landowners who leave the site empty. Likewise, taxes are not increased if the site is built upon. Landowners will therefore to seek to capitalise on the use of their land.

(c) Land Value Tax

Once an area is well connected by public transport and is accessible to the commercial area and also the liveability of the area increases it is possible that the price of the land will increase. Such increase in price can be source revenue for the municipality. Similar to parking, the obtained revenue needs to be utilized for improvement of the area and other areas in the vicinity. A substantial amount of revenue could be generated through cess on turnover, particularly in cities, based on industry, trade and commerce activities. Such cess has already been levied for Bangalore MRTS project. Bangalore has also levied luxury tax and professional tax towards the metro fund.

(d) Advertising

This is another important source of revenue for the city. When properly utilised this source can be of immense value in supporting sustainable urban transport measures in a city. The revenues from advertising in the city can be used to improve the existing transport system and/or create new schemes in sustainable transport.

Paris, France has used the advertising money in developing a public bike scheme, which is now a well renowned model. Similarly, Transport for London (TfL) has made a deal with the advertising specialist, Clear Channel, for the regular maintenance and design of the street furniture in return for the advertising space on bus shelters.

One important aspect that needs to be considered is that the advertising money needs to be utilised for improving the transport system rather than spending it on building more roads. In the similar way, the advertising should not be overdone to avoid visual pollution. Further, ideally

advertising revenue should not be a reason for building of pedestrian overpasses as the greater good for the society from these overpasses is minimal.

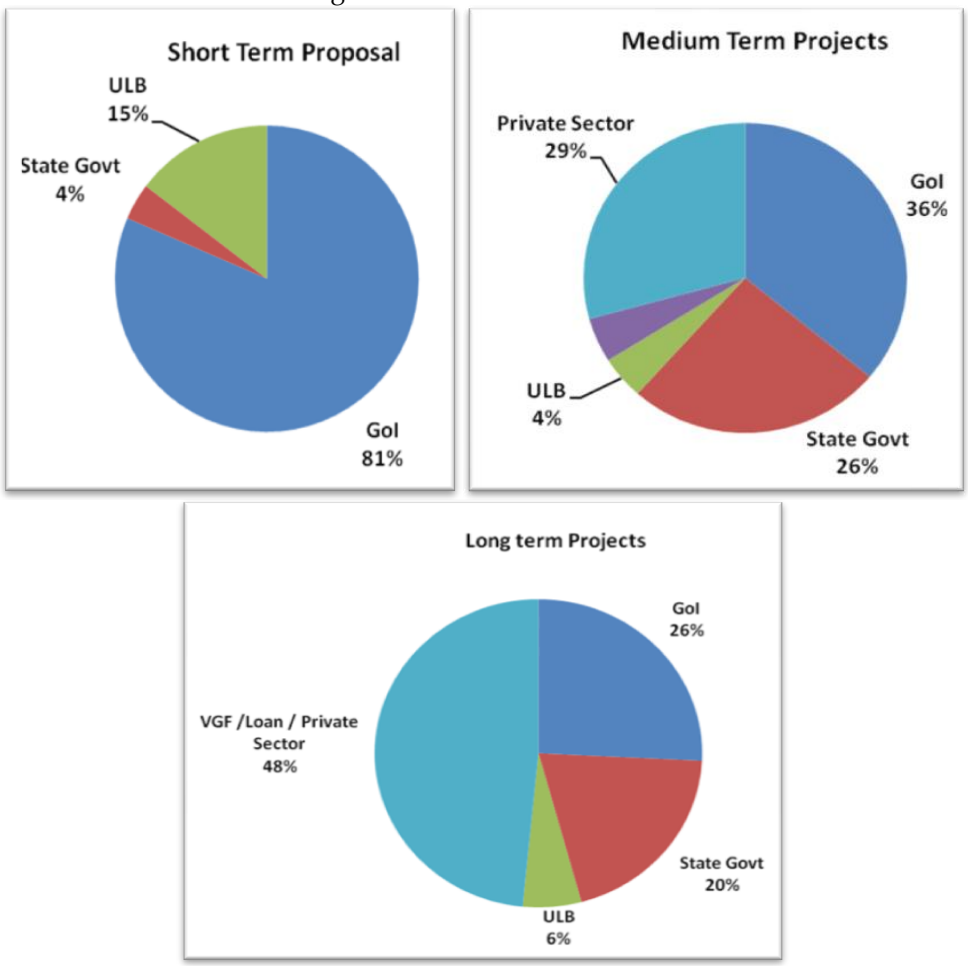
10.3 Sources of Finance

Based on the above possible sources of funding, and based on broad guidelines as per the Working Group Report for 12th 5 year Plan, the sources of financing for all the projects are given in Table 10.2 and Figure 10.1 below:

Table 10.2: Sharing of Funding

GoI	State Govt	ULB	VGF	Private Sector / Loan	Total
3251	2408	642	60	5479	11839.54
27%	20%	5.4%	0.50%	46%	

Figure 10.1: Source of Finance



10.4 Revenue Estimation (Fare Box)

Based on traffic volumes, emerging from the primary surveys, an estimation of the revenue potential during implementation period from Fare box revenue is presented in the Table 10.3.

Table 10.3: Revenue Estimates (Fare Box Revenue)

Revenue Sources	Year 2022		Year 2032	
	Avg. Daily Ridership	Avg. Daily Fare Box Revenue	Avg. Daily Ridership	Avg. Daily Fare Box Revenue
LRT	4,00,488	191.06 Crore	8,73,453	583.65 Crore
BRT	3,37,138	80.62 Crore	6,97,424	194.17 Crore

Initially the fare box revenue will be low. However, it improves with increase in the public transport network and their integration with other mode of transport. There will be additional revenue from advertisement fees and parking fees. The detail DPR should be prepared for understanding the project feasibility and financial sustainability. The DPR should cover detail financial model comprising all sot of operation and maintenance with all possible revenues associated with the rapid transit system.

Chapter 11
Institutional Framework

11.1 Background

City transport system generally involves several organizations that look after various forms and aspects of the transport system and network and have overlapping functions and areas of work. Therefore to delineate areas and to remove ambiguity of functions the institutional framework has been proposed.

With the formation of a State level UMTA, part of the problem has been sorted. However, this would have a macroscopic view of resolving policy issues for all urban centres within the state. There still remains a need to set up a localized organization that results in coordinated strategic level planning at the city level and deal with more day to day issues of urban transport.

Following is the list of departments and Organizations involved in urban affairs and urban transport in Nagpur.

- Housing and Urban Planning Department
- State Urban Development Department
- Public Works Department
- National Highway Authority of India (NHAI)
- Superintendent of Police, (Traffic) Nagpur
- Nagpur Development Authority (NDA)
- District Urban Development Agency (DUDA)
- Maharashtra State Road Transport Corporation (MSRTC)
- Railways
- State Pollution Control Board, Nagpur
- Regional Transport Office (RTO)
- State Level Unified Metropolitan Transport Authority

11.2 City Level Unified Metropolitan Transport Authority

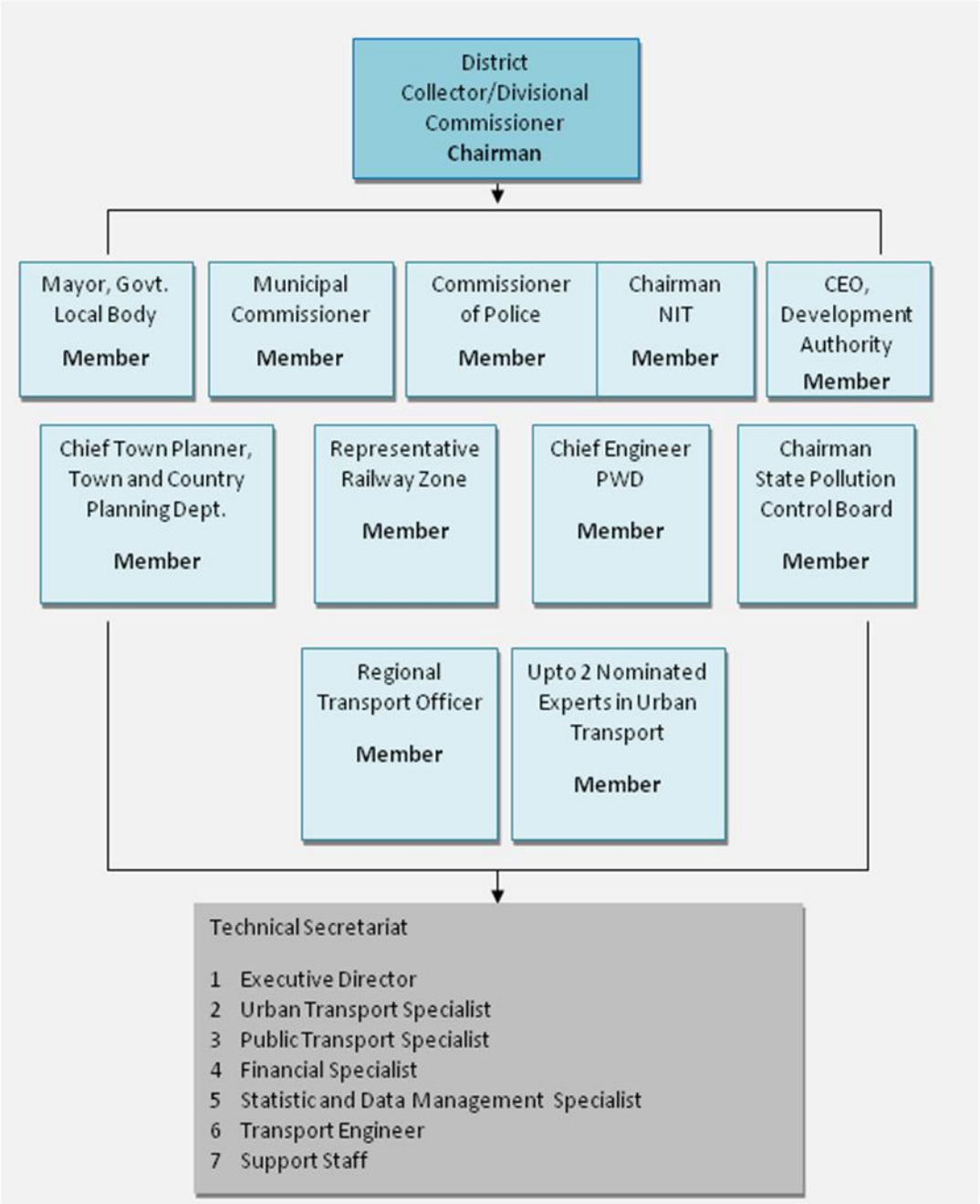
In view of bringing the institutional setup in a proper structure, it is important to understand the Issues with the present Institutional set up, listed below.

- No clear segregation between the planning and implementing bodies
- Lack of coordination amongst all the departments in the urban transport sector.
- All departments related to urban transport do not function in coherence.
- Road projects are implemented in isolation with other projects which should otherwise be an integral part of road development like footpath, cycle tracks, pedestrian facilities etc.
- No control over mushrooming IPT modes in the city, which lead to issues of congestion along with contesting with the buses for passengers.
- Operation issues in public transport due to poor route and service planning.
- No dedicated organization that is in charge of long term urban transport planning for the city.

With a view to coordinate all urban transport activities in the city, it is recommended that a UMTA be set up at the city level that acts as a planning and decision making body for all matters related to urban transport in the city.

It is recommended that the city level UMTA be set up on an executive order for the ease of formation however, it must be given a legal backing so that its functioning falls under an act and commands greater authority.

Figure 11:1: Recommended Structure for UMTA setup



11.3 Broad Functions of UMTA

The following functions are proposed to fall under the purview of the city level UMTA

- Undertake overall planning for public transport in the city, covering all modes - road, rail, water and air transport systems
- Allocate routes amongst different operators
- Procure public bus services for different routes through contracting, concessioning, etc.
- Ensure compliance of terms and conditions of license
- Recommend revocation of license for non-compliance of terms and conditions of the license
- Carry out surveys and manage a database for scientific planning of public transport requirements
- Co-ordinate fare integration among different operators of public transport and determine the basis for sharing of revenues earned from common tickets or passes.
- Operate a scheme of passes for the users of public transport and channelize subsidies to operators for any concessions that are offered in accordance with government policy.
- regulate the arrangement amongst operators for the sharing of their revenue derived from the use of passes
- promote efficiency in public transport operation
- protect the interest of the consumers
- settle disputes between different operators and between operators and infrastructure providers
- levy fees and other charges at such rates and in respect of such services as may be determined by regulations;

11.4 Legal backing of UMTA

In order to give UMTA objectives, functions and operations a legal status, a draft Act has to be prepared by UMTA to be taken up for approval by the State Cabinet after finalization. The draft Act shall cover the following:

- Objectives and functions of UMTA
- Operational area of UMTA
- Powers and delegation of powers of UMTA
- Authority to have power to acquire land by agreement
- Power of Government to transfer to the Authority lands belonging to it or to other ULBs, etc.
- Power of Authority to borrow
- Laying of annual estimate of income and expenditure
- Authority to approve or amend such estimate
- Estimates to be submitted to Government for sanction
- Supplementary estimates may be prepared and submitted when necessary
- Provisions regarding expenditure
- Accounts and audit
- Schedule of officers and employees to be submitted for sanction of Government
- Appointments, etc., by whom to be made
- Powers of entry
- Directions by the Authority
- Members and officers to be public servants

- Power to make rules
- Power to make regulations

11.5 Manpower Requirement and Staffing Plan

UMTA shall have to avail the services of an expert team of traffic and transportation planners, engineers, urban planners and other technical advisers. In order to strengthen its human resource, UMTA shall have to form a schedule of officers and employees whom it shall deem it necessary and proper to maintain for the purposes of UMTA Act. In addition to this, various powers related to appointment, promotion, suspension, etc shall also have to be worked out as per the Government's schedule.

11.6 Urban Transport Fund

Public transport sector in Nagpur is running in losses leaving little or no scope for enhanced services to the users. On the physical infrastructure side, vehicle sales generate large revenues, through taxation. Most of the proceeds, however, are treated as general taxes and do not trickle down to the urban area level as a ready pool of resources for urban transport projects.

It is thus suggested that a separate collection of funds be generated locally and so that the same may be spent locally on development and maintenance of urban transport infrastructure. This fund can be managed by a professional fund manager (appointed by the city level Unified Metropolitan Transport Authority) so that the balances in this fund can earn appropriate returns, in accordance with prevailing market potential.

Any local investment proposal that would require funding/part funding from the Local govt./State Govt. could be posed to the UTF for financial support. Approval could be given by the UMTA, after due appraisal by the Local administrator/Secretariat.

Sources of Funding:

- Taxes - property tax, sales tax on fuel, advertisement tax
- Portion of parking fees
- Collections from congestion tax
- Additional fee on PUC certificate
- Collections from traffic violation fines
- Additional registration fee on vehicles – this could be graded depending on the size of the vehicle
- Proceeds from a "Land Value Tax" or "Betterment Levy"
- Any other fee/tax that may be decided to be used exclusively for investments in improving urban transport infrastructure and services

11.7 Implementing Agencies

Based on roles and responsibilities of various institutions, the agencies responsible for implementing the proposed projects in the CMP are given in Table 11-1.

Table 11-1: Details of Implementing Agencies

S.No	Projects	Agencies responsible for Implementation	Implementation Options	
			Construction	Operation/Maintain.
1	Construction of Footpaths	NMC/PWD/NIT	PWD/ULB	ULB/ PWD
2	Grade Separated Pedestrian Facilities / FOB	NMC/PWD/NIT	PWD/ ULB	ULB/ PWD/ Private
3	Road Marking	NMC	PWD/ ULB	ULB/ PWD/NHAI
4	Restoration of Pathways	NMC	GoI/State Govt/ ULB	ULB/ PWD
5	Intersection improvement	PWD/ NMC / NIT /NHAI/MIDC	State Govt/ ULB	PWD/NHAI
6	Traffic Management Schemes	NMC / Traffic Police	State Govt/ ULB	PWD
7	City bus service(Bus Augmentation)	NMC / SPV	GoI/ State Govt/ Private	Private
8	Bus Stops	NMC	State Govt./Private	Private
9	ITS on Buses	NMC / SPV	GoI/ State Govt./ ULB	Private
10	ITS on Bus Stops	NMC / SPV		
11	Off street parking facilities	NMC/Traffic Police / Respective land owner / NIT/ PWD	Private	Private
12	Public Education and Awareness Program	Directorate of Urban Development/ NMC / Traffic Police	GoI/ State Govt / ULB	Public Education and Awareness Program
13	Bike Sharing Scheme	NMC/Directorate of Urban Development	State Govt./ Private	Private
14	Development of Freight Terminal	State Govt/NIT / Traffic Police	State Govt/Private	Private
15	Network Improvement	PWD/ NHAI/NMC/NIT	PWD/ NHAI/Private	PWD/ NHAI/MIDC / Z.P./ Private
17	Rapid Transit System	Directorate of Urban Development / SPV / NMC / NIT / MIDC	GoI / State Govt/ ULB/Private	NMC/ NIT / Private
19	Street Lights	NMC	State Govt/ ULB	NMC/Private
20	Area Pedestrianisation	NMC / NIT / Traffic Police	ULB	Private
21	New Bus Terminals / TTMC	MSRTC / NIT/ NMC / SPV	GoI / State Govt / ULB / Private	Private

Annexure 1

Junction Count Diagrams

Classified Turning Volume Count Survey

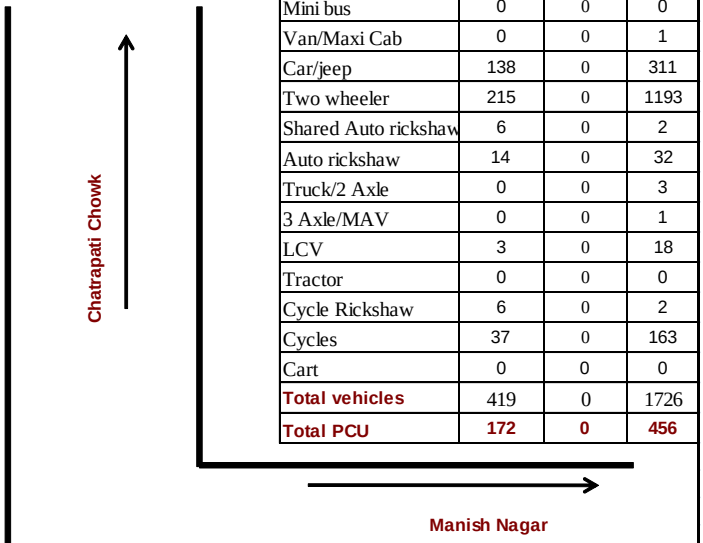
Location: NH-7 Somalwada Intersection

Date: 25-5-2012

Peak Hour	18.30 - 19.30
Peak Hour Volume (PCUs)	4962
Peak Hour Volume (Vehicles)	4850

Chatrapati Chowk			
City Bus	0	14	0
Long Distance Bus	0	93	0
Institutional/Compan	0	58	0
Mini bus	1	60	0
Van/Maxi Cab	4	77	0
Car/jeep	210	1638	0
Two wheeler	431	1672	0
Shared Auto ricksha	8	15	0
Auto rickshaw	18	112	0
Truck/2 Axle	0	115	0
3 Axle/MAV	0	108	0
LCV	1	96	0
Tractor	0	0	0
Cycle Rickshaw	1	0	0
Cycles	203	106	0
Cart	0	0	0
Total vehicles	877	4164	0
Total PCU	**259**	**1598**	**0**

Manish Nagar			
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	1
Car/jeep	138	0	311
Two wheeler	215	0	1193
Shared Auto rickshaw	6	0	2
Auto rickshaw	14	0	32
Truck/2 Axle	0	0	3
3 Axle/MAV	0	0	1
LCV	3	0	18
Tractor	0	0	0
Cycle Rickshaw	6	0	2
Cycles	37	0	163
Cart	0	0	0
Total vehicles	419	0	1726
Total PCU	**172**	**0**	**456**



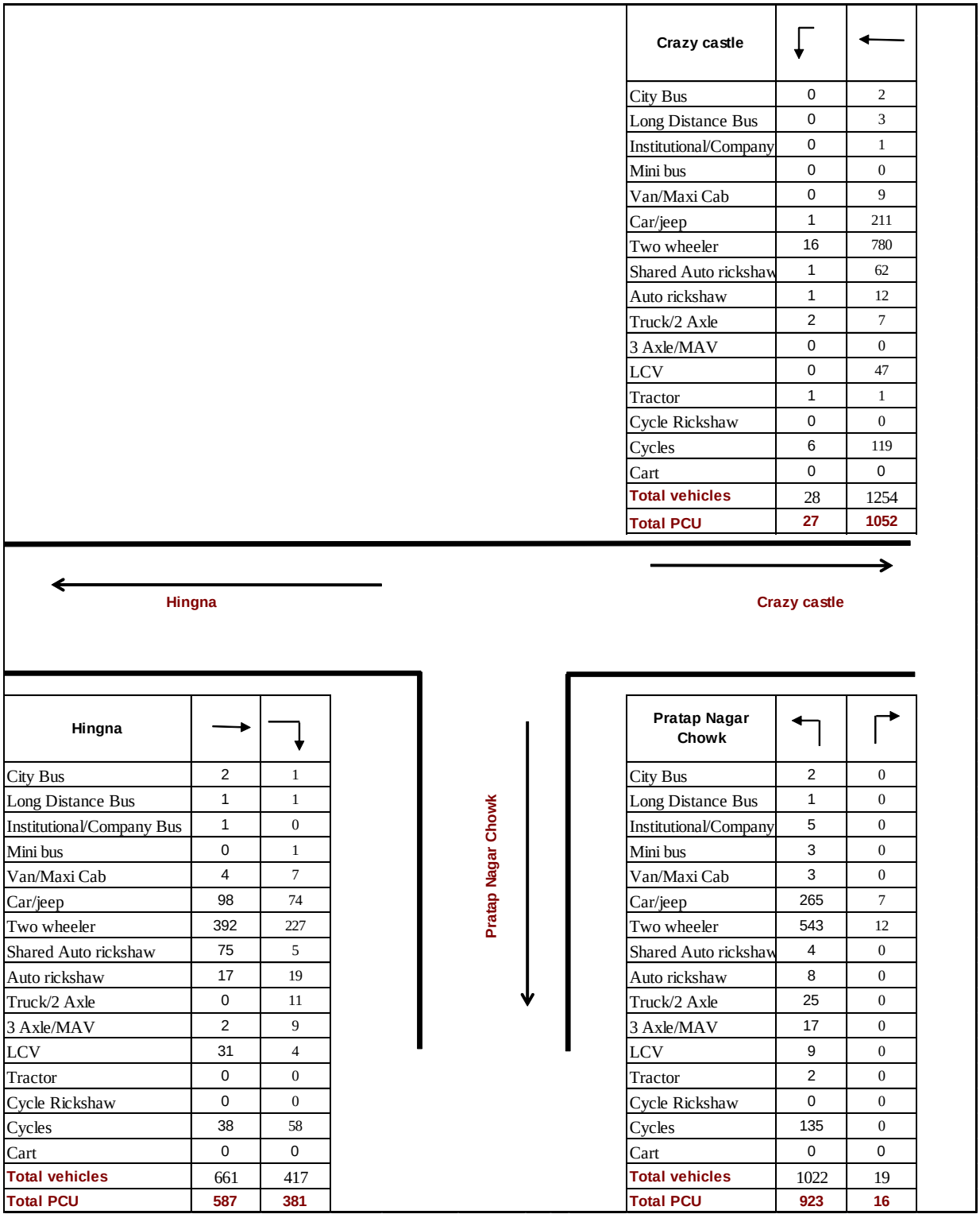
Airport			
City Bus	0	15	0
Long Distance Bus	0	153	0
Institutional/Company	0	79	0
Mini bus	0	48	0
Van/Maxi Cab	0	61	2
Car/jeep	0	1646	156
Two wheeler	0	1886	229
Shared Auto rickshaw	0	122	1
Auto rickshaw	0	400	6
Truck/2 Axle	0	302	0
3 Axle/MAV	0	152	0
LCV	0	187	7
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	0	55	15
Cart	0	0	0
Total vehicles	0	5106	416
Total PCU	**0**	**2330**	**147**

Classified Turning Volume Count Survey

Location: **2. Hingna road & Ring Road Junction**

Date: **28-5-2012**

Peak Hour	9.00-10.00
Peak Hour Volume (PCUs)	2985
Peak Hour Volume (Vehicles)	3402



Crazy castle	↓	←
City Bus	0	2
Long Distance Bus	0	3
Institutional/Company	0	1
Mini bus	0	0
Van/Maxi Cab	0	9
Car/jeep	1	211
Two wheeler	16	780
Shared Auto rickshaw	1	62
Auto rickshaw	1	12
Truck/2 Axle	2	7
3 Axle/MAV	0	0
LCV	0	47
Tractor	1	1
Cycle Rickshaw	0	0
Cycles	6	119
Cart	0	0
Total vehicles	28	1254
Total PCU	**27**	**1052**

Hingna	→	↓
City Bus	2	1
Long Distance Bus	1	1
Institutional/Company Bus	1	0
Mini bus	0	1
Van/Maxi Cab	4	7
Car/jeep	98	74
Two wheeler	392	227
Shared Auto rickshaw	75	5
Auto rickshaw	17	19
Truck/2 Axle	0	11
3 Axle/MAV	2	9
LCV	31	4
Tractor	0	0
Cycle Rickshaw	0	0
Cycles	38	58
Cart	0	0
Total vehicles	661	417
Total PCU	**587**	**381**

Pratap Nagar Chowk	←	→
City Bus	2	0
Long Distance Bus	1	0
Institutional/Company	5	0
Mini bus	3	0
Van/Maxi Cab	3	0
Car/jeep	265	7
Two wheeler	543	12
Shared Auto rickshaw	4	0
Auto rickshaw	8	0
Truck/2 Axle	25	0
3 Axle/MAV	17	0
LCV	9	0
Tractor	2	0
Cycle Rickshaw	0	0
Cycles	135	0
Cart	0	0
Total vehicles	1022	19
Total PCU	**923**	**16**

Classified Turning Volume Count Survey

Location: **3. Pratap Nagar Chowk**

Date: **28-5-2012**

Peak Hour	**19.15 - 20.15**
Peak Hour Volume (PCUs)	**6714**
Peak Hour Volume (Vehicles)	**7662**

Make Chowk	1	2	3
City Bus	1	0	3
Long Distance Bus	0	0	0
Institutional/Compan	0	0	4
Mini bus	0	0	0
Van/Maxi Cab	1	0	0
Car/jeep	105	68	147
Two wheeler	266	154	301
Shared Auto ricksha	8	0	7
Auto rickshaw	0	6	24
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	4	8	4
Tractor	0	0	0
Cycle Rickshaw	0	4	0
Cycles	15	27	0
Cart	0	0	0
Total vehicles	400	267	490
Total PCU	**476**	**330**	**370**

Chatrapati chowk	4	5	6
City Bus	0	0	0
Long Distance Bus	0	1	0
Institutional/Company	0	2	0
Mini bus	0	1	0
Van/Maxi Cab	1	3	0
Car/jeep	82	150	82
Two wheeler	120	500	236
Shared Auto rickshaw	0	3	0
Auto rickshaw	11	27	0
Truck/2 Axle	0	24	6
3 Axle/MAV	0	40	1
LCV	2	22	0
Tractor	0	1	6
Cycle Rickshaw	2	2	1
Cycles	18	33	8
Cart	0	0	0
Total vehicles	236	809	340
Total PCU	**265**	**954**	**330**

Make Chowk

Hingna road

Chatrapati chowk

Hingna road	10	11	12
City Bus	1	0	0
Long Distance Bus	0	1	0
Institutional/Compan	0	0	0
Mini bus	0	3	0
Van/Maxi Cab	0	7	0
Car/jeep	55	205	29
Two wheeler	150	1467	124
Shared Auto ricksha	0	5	0
Auto rickshaw	24	54	2
Truck/2 Axle	0	81	0
3 Axle/MAV	0	102	0
LCV	3	11	3
Tractor	0	0	0
Cycle Rickshaw	3	2	1
Cycles	4	92	15
Cart	0	0	0
Total vehicles	240	2030	174
Total PCU	**277**	**1981**	**96**

Sonegaon	7	8	9
City Bus	1	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	1	1	0
Van/Maxi Cab	0	1	0
Car/jeep	39	101	138
Two wheeler	51	728	586
Shared Auto rickshaw	0	0	0
Auto rickshaw	2	15	21
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	1	13	5
Tractor	0	1	0
Cycle Rickshaw	5	5	5
Cycles	2	18	44
Cart	0	0	0
Total vehicles	102	883	799
Total PCU	**112**	**878**	**645**

Sonegaon

Classified Turning Volume Count Survey

Location: 4. Chatrapati Chowk

Date: 28-5-2012

Peak Hour	**6.30-7.30**
Peak Hour Volume (PCUs)	**9355**
Peak Hour Volume (Vehicles)	**10078**

Ajni square	1	2	3
City Bus	2	9	0
Long Distance Bus	0	134	0
Institutional/Compan	0	18	0
Mini bus	0	20	0
Van/Maxi Cab	0	14	0
Car/jeep	297	342	147
Two wheeler	1280	394	395
Shared Auto ricksha	1	18	0
Auto rickshaw	64	268	50
Truck/2 Axle	0	70	3
3 Axle/MAV	2	73	0
LCV	27	22	3
Tractor	0	0	0
Cycle Rickshaw	8	15	1
Cycles	131	240	59
Cart	0	0	0
Total vehicles	1812	1637	658
Total PCU	**570**	**1233**	**254**

Manewada Chowk	4	5	6
City Bus	1	1	3
Long Distance Bus	0	7	0
Institutional/Company	1	1	1
Mini bus	0	2	0
Van/Maxi Cab	1	2	0
Car/jeep	341	489	630
Two wheeler	912	2183	1357
Shared Auto rickshaw	1	26	0
Auto rickshaw	43	78	94
Truck/2 Axle	55	51	0
3 Axle/MAV	0	1	0
LCV	22	59	14
Tractor	3	0	0
Cycle Rickshaw	5	21	3
Cycles	88	390	19
Cart	0	0	0
Total vehicles	1473	3311	2121
Total PCU	**486**	**1327**	**640**

Ajni square

Pratap Nagar chowk

Manewada Chowk

Pratap Nagar chowk	10	11	12
City Bus	0	3	1
Long Distance Bus	1	1	3
Institutional/Compan	1	6	6
Mini bus	0	4	4
Van/Maxi Cab	0	0	12
Car/jeep	169	500	590
Two wheeler	363	4375	1015
Shared Auto ricksha	2	2	1
Auto rickshaw	169	109	56
Truck/2 Axle	0	19	62
3 Axle/MAV	0	3	64
LCV	4	40	25
Tractor	0	0	3
Cycle Rickshaw	6	6	3
Cycles	73	771	112
Cart	0	0	0
Total vehicles	788	5839	1957
Total PCU	**268**	**1812**	**651**

Somalwada	7	8	9
City Bus	0	18	1
Long Distance Bus	2	88	9
Institutional/Company	9	5	5
Mini bus	8	4	4
Van/Maxi Cab	0	0	0
Car/jeep	435	195	483
Two wheeler	694	433	1142
Shared Auto rickshaw	0	6	4
Auto rickshaw	232	242	48
Truck/2 Axle	59	30	31
3 Axle/MAV	79	27	9
LCV	12	10	26
Tractor	1	0	0
Cycle Rickshaw	6	6	5
Cycles	54	291	193
Cart	0	0	0
Total vehicles	1591	1355	1960
Total PCU	**710**	**650**	**753**

Somalwada

Classified Turning Volume Count Survey

Location: **5. Manewada Chowk**

Date: **29-5-2012**

Peak Hour	**7.00-8.00**
Peak Hour Volume (PCUs)	**5983**
Peak Hour Volume (Vehicles)	**7334**

Thukudoji chowk	1	2	3
City Bus	0	0	0
Long Distance Bus	0	2	0
Institutional/Compan	0	0	0
Mini bus	0	0	4
Van/Maxi Cab	0	0	5
Car/jeep	35	118	91
Two wheeler	80	245	342
Shared Auto ricksha	3	2	5
Auto rickshaw	7	12	18
Truck/2 Axle	0	0	1
3 Axle/MAV	0	0	0
LCV	9	9	15
Tractor	1	0	0
Cycle Rickshaw	1	12	10
Cycles	13	123	21
Cart	0	0	0
Total vehicles	149	523	512
Total PCU	**175**	**916**	**742**

Dighori chowk	4	5	6
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	0	1	0
Van/Maxi Cab	0	0	0
Car/jeep	51	71	54
Two wheeler	46	244	129
Shared Auto rickshaw	0	0	0
Auto rickshaw	0	0	9
Truck/2 Axle	0	23	0
3 Axle/MAV	0	80	0
LCV	5	11	0
Tractor	0	0	0
Cycle Rickshaw	9	2	0
Cycles	31	9	19
Cart	0	0	0
Total vehicles	142	441	211
Total PCU	**252**	**621**	**177**

Thukudoji chowk

Chatrapati chowk

Dighori chowk

Chatrapati chowk	10	11	12
City Bus	10	0	0
Long Distance Bus	11	0	0
Institutional/Compan	0	0	0
Mini bus	0	13	0
Van/Maxi Cab	34	11	0
Car/jeep	139	99	51
Two wheeler	120	453	65
Shared Auto ricksha	0	0	0
Auto rickshaw	0	24	8
Truck/2 Axle	0	23	0
3 Axle/MAV	0	37	0
LCV	13	12	4
Tractor	0	0	0
Cycle Rickshaw	4	8	10
Cycles	35	132	5
Cart	0	0	0
Total vehicles	366	812	143
Total PCU	**330**	**1163**	**417**

Manewada chowk

Manewada chowk	7	8	9
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	54	88	76
Two wheeler	67	357	66
Shared Auto rickshaw	0	0	0
Auto rickshaw	9	44	11
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	6	0	9
Tractor	0	0	0
Cycle Rickshaw	6	6	5
Cycles	28	84	18
Cart	0	0	0
Total vehicles	170	579	185
Total PCU	**244**	**641**	**305**

Classified Turning Volume Count Survey

Location: 6. Dighori Chowk

Date: 29-5-2012

Peak Hour	**10.30-11.30**
Peak Hour Volume (PCUs)	**3890**
Peak Hour Volume (Vehicles)	**4665**

Ashok square	1	2	3
City Bus	0	3	0
Long Distance Bus	0	10	0
Institutional/Compan	0	0	0
Mini bus	0	5	0
Van/Maxi Cab	0	74	0
Car/jeep	9	133	23
Two wheeler	48	424	123
Shared Auto ricksha	1	2	1
Auto rickshaw	4	28	8
Truck/2 Axle	5	6	0
3 Axle/MAV	0	0	0
LCV	3	24	5
Tractor	0	0	0
Cycle Rickshaw	2	6	1
Cycles	25	72	29
Cart	0	0	0
Total vehicles	97	787	190
Total PCU	**82**	**689**	**149**

Pardi	4	5	6
City Bus	0	0	0
Long Distance Bus	0	0	2
Institutional/Company	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	43	0	5
Two wheeler	218	0	140
Shared Auto rickshaw	1	0	0
Auto rickshaw	7	0	7
Truck/2 Axle	33	0	3
3 Axle/MAV	3	0	0
LCV	12	0	5
Tractor	0	0	0
Cycle Rickshaw	0	0	4
Cycles	65	0	83
Cart	0	0	0
Total vehicles	382	0	249
Total PCU	**350**	**0**	**184**

Ashok square

Manewadi chowk

Pardi

Umred

Manewadi chowk	10	11	12
City Bus	0	0	0
Long Distance Bus	1	0	0
Institutional/Compan	0	0	0
Mini bus	0	3	0
Van/Maxi Cab	0	0	1
Car/jeep	29	0	61
Two wheeler	133	0	409
Shared Auto ricksha	1	0	0
Auto rickshaw	8	0	13
Truck/2 Axle	3	0	0
3 Axle/MAV	0	0	0
LCV	3	0	14
Tractor	0	0	1
Cycle Rickshaw	0	0	2
Cycles	37	0	34
Cart	0	0	0
Total vehicles	215	3	535
Total PCU	**171**	**0**	**428**

Umred	7	8	9
City Bus	0	2	0
Long Distance Bus	0	14	0
Institutional/Company	0	1	0
Mini bus	0	5	0
Van/Maxi Cab	0	9	0
Car/jeep	18	97	32
Two wheeler	276	1035	270
Shared Auto rickshaw	0	4	4
Auto rickshaw	5	44	20
Truck/2 Axle	6	7	16
3 Axle/MAV	0	1	19
LCV	4	31	7
Tractor	0	0	0
Cycle Rickshaw	0	13	0
Cycles	96	126	47
Cart	0	1	0
Total vehicles	405	1390	415
Total PCU	**298**	**1132**	**408**

Classified Turning Volume Count Survey

Location: 7. Ajni Chowk

Date: 4/6/2012

Peak Hour	6.15-7:15
Peak Hour Volume (PCUs)	7020
Peak Hour Volume (Vehicles)	7474

Bardi		
City Bus	0	14
Long Distance Bus	1	51
Institutional/Compan	0	22
Mini bus	0	15
Van/Maxi Cab	3	11
Car/jeep	245	1138
Two wheeler	382	2315
Shared Auto ricksha	0	30
Auto rickshaw	22	483
Truck/2 Axle	0	43
3 Axle/MAV	3	13
LCV	0	55
Tractor	0	0
Cycle Rickshaw	2	2
Cycles	41	123
Cart	0	1
Total vehicles	699	4316
Total PCU	**182**	**1359**

Ajni Railway station		
City Bus	0	0
Long Distance Bus	0	0
Institutional/Company	6	1
Mini bus	3	1
Van/Maxi Cab	2	4
Car/jeep	501	229
Two wheeler	722	367
Shared Auto rickshaw	4	1
Auto rickshaw	92	15
Truck/2 Axle	34	8
3 Axle/MAV	1	1
LCV	63	3
Tractor	3	0
Cycle Rickshaw	18	2
Cycles	73	56
Cart	0	0
Total vehicles	1522	688
Total PCU	**650**	**157**

Bardi

Ajni Railway station

Wardha

Wardha		
City Bus	11	0
Long Distance Bus	101	1
Institutional/Company	37	1
Mini bus	10	1
Van/Maxi Cab	25	3
Car/jeep	1607	1037
Two wheeler	2690	4074
Shared Auto rickshaw	19	46
Auto rickshaw	357	194
Truck/2 Axle	40	112
3 Axle/MAV	14	16
LCV	67	165
Tractor	0	0
Cycle Rickshaw	6	32
Cycles	239	521
Cart	0	0
Total vehicles	5223	6203
Total PCU	**2151**	**2521**

Classified Turning Volume Count Survey

Location: **9. Bande plot junction**

Date: **25-6-2012**

Peak Hour	10.15-11.15
Peak Hour Volume (PCUs)	6733
Peak Hour Volume (Vehicles)	8031

Jagnade chowk	1	2	3
City Bus	0	0	0
Long Distance Bus	0	0	1
Institutional/Compan	0	1	0
Mini bus	0	0	0
Van/Maxi Cab	0	5	0
Car/jeep	18	67	43
Two wheeler	140	710	168
Shared Auto ricksha	0	0	0
Auto rickshaw	9	28	8
Truck/2 Axle	0	2	0
3 Axle/MAV	0	0	0
LCV	1	21	5
Tractor	1	0	0
Cycle Rickshaw	5	4	8
Cycles	17	204	45
Cart	0	0	0
Total vehicles	191	1042	278
Total PCU	**162**	**805**	**229**

Dighori Chowk	4	5	6
City Bus	0	3	0
Long Distance Bus	0	18	0
Institutional/Company	0	3	1
Mini bus	1	4	0
Van/Maxi Cab	9	0	0
Car/jeep	56	121	37
Two wheeler	660	1543	236
Shared Auto rickshaw	0	5	2
Auto rickshaw	8	103	17
Truck/2 Axle	1	5	0
3 Axle/MAV	0	1	1
LCV	16	18	10
Tractor	1	0	0
Cycle Rickshaw	3	23	10
Cycles	170	217	70
Cart	0	0	0
Total vehicles	925	2064	384
Total PCU	**696**	**1732**	**321**

Jagnade chowk

Ashok square

Dighori Chowk

Thukudoji chowk

Ashok square	10	11	12
City Bus	1	3	0
Long Distance Bus	0	15	0
Institutional/Compan	1	3	0
Mini bus	0	5	0
Van/Maxi Cab	0	0	0
Car/jeep	15	159	7
Two wheeler	224	682	31
Shared Auto ricksha	0	1	0
Auto rickshaw	11	148	3
Truck/2 Axle	0	4	0
3 Axle/MAV	0	0	0
LCV	5	47	2
Tractor	0	0	0
Cycle Rickshaw	10	10	2
Cycles	37	136	7
Cart	0	0	0
Total vehicles	304	1213	52
Total PCU	**250**	**1172**	**46**

Thukudoji chowk	7	8	9
City Bus	0	0	0
Long Distance Bus	0	0	1
Institutional/Company	0	0	2
Mini bus	0	0	0
Van/Maxi Cab	0	0	8
Car/jeep	6	84	68
Two wheeler	35	748	384
Shared Auto rickshaw	0	4	0
Auto rickshaw	0	31	14
Truck/2 Axle	0	3	2
3 Axle/MAV	0	0	2
LCV	0	10	26
Tractor	0	0	4
Cycle Rickshaw	0	9	9
Cycles	7	67	59
Cart	0	0	0
Total vehicles	48	956	579
Total PCU	**36**	**779**	**506**

Classified Turning Volume Count Survey

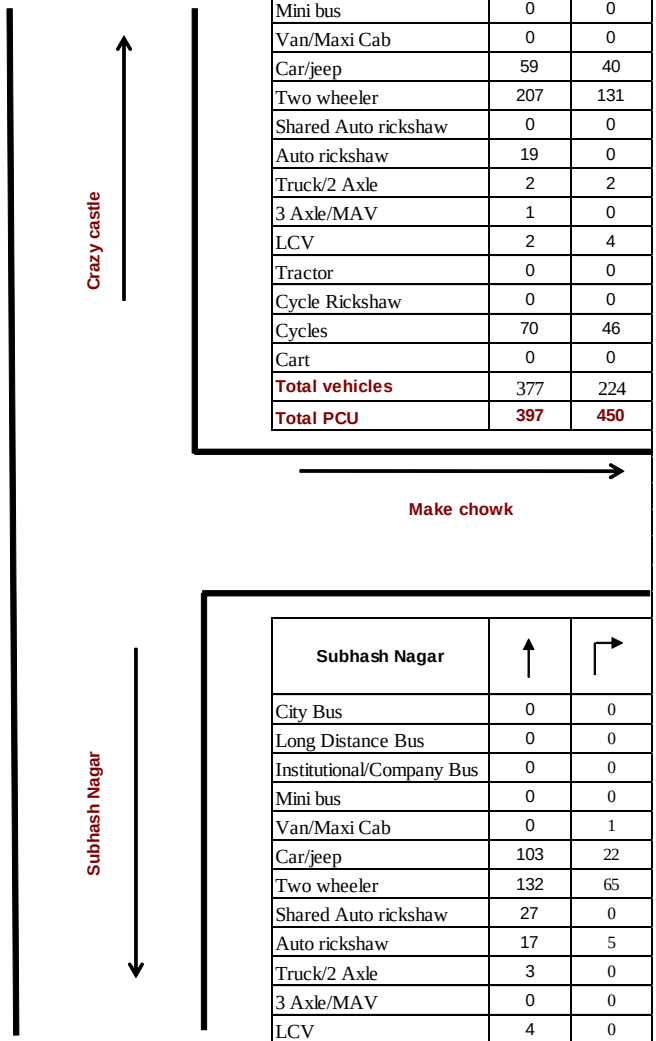
Location: 10. Subhash Nagar Chowk

Date: 4/6/2012

Peak Hour	7:15-8:15
Peak Hour Volume (PCUs)	4243
Peak Hour Volume (Vehicles)	5017

Crazy castle	↳	↓
City Bus	0	1
Long Distance Bus	0	2
Institutional/Company Bus	3	1
Mini bus	4	0
Van/Maxi Cab	0	0
Car/jeep	47	92
Two wheeler	155	136
Shared Auto rickshaw	9	34
Auto rickshaw	5	10
Truck/2 Axle	0	1
3 Axle/MAV	0	2
LCV	8	0
Tractor	0	0
Cycle Rickshaw	1	0
Cycles	33	17
Cart	0	0
Total vehicles	265	296
Total PCU	**576**	**851**

Make chowk	↓	↑
City Bus	0	0
Long Distance Bus	0	0
Institutional/Company Bus	17	1
Mini bus	0	0
Van/Maxi Cab	0	0
Car/jeep	59	40
Two wheeler	207	131
Shared Auto rickshaw	0	0
Auto rickshaw	19	0
Truck/2 Axle	2	2
3 Axle/MAV	1	0
LCV	2	4
Tractor	0	0
Cycle Rickshaw	0	0
Cycles	70	46
Cart	0	0
Total vehicles	377	224
Total PCU	**397**	**450**



Subhash Nagar	↑	↱
City Bus	0	0
Long Distance Bus	0	0
Institutional/Company Bus	0	0
Mini bus	0	0
Van/Maxi Cab	0	1
Car/jeep	103	22
Two wheeler	132	65
Shared Auto rickshaw	27	0
Auto rickshaw	17	5
Truck/2 Axle	3	0
3 Axle/MAV	0	0
LCV	4	0
Tractor	0	0
Cycle Rickshaw	2	0
Cycles	113	13
Cart	0	0
Total vehicles	401	106
Total PCU	**1260**	**709**

Classified Turning Volume Count Survey

Location: 12. Jhansi rani chowk

Date: 4/6/2012

Peak Hour	12.15-1.15
Peak Hour Volume (PCUs)	5629
Peak Hour Volume (Vehicles)	5631

Variety chowk	1	2	3
City Bus	0	5	1
Long Distance Bus	0	2	0
Institutional/Compan	0	0	0
Mini bus	0	1	0
Van/Maxi Cab	0	2	1
Car/jeep	3	148	30
Two wheeler	29	634	131
Shared Auto ricksha	0	0	3
Auto rickshaw	18	155	72
Truck/2 Axle	0	4	0
3 Axle/MAV	0	3	0
LCV	0	11	8
Tractor	0	0	0
Cycle Rickshaw	4	2	7
Cycles	11	88	19
Cart	0	0	0
Total vehicles	65	1055	272
Total PCU	**72**	**1036**	**310**

Munje chowk	4	5	6
City Bus	1	5	0
Long Distance Bus	2	0	19
Institutional/Company	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	3	0
Car/jeep	28	45	20
Two wheeler	205	458	207
Shared Auto rickshaw	1	1	2
Auto rickshaw	49	31	81
Truck/2 Axle	2	0	1
3 Axle/MAV	0	0	0
LCV	3	19	1
Tractor	0	0	0
Cycle Rickshaw	4	8	13
Cycles	18	44	17
Cart	0	3	0
Total vehicles	313	617	361
Total PCU	**311**	**532**	**413**

Variety chowk

Ambazaari Road

Munje chowk

Ambazaari Road	10	11	12
City Bus	5	2	1
Long Distance Bus	0	6	0
Institutional/Compan	0	0	0
Mini bus	0	0	1
Van/Maxi Cab	0	0	2
Car/jeep	44	67	35
Two wheeler	161	491	131
Shared Auto ricksha	14	14	0
Auto rickshaw	33	40	29
Truck/2 Axle	0	1	0
3 Axle/MAV	0	0	0
LCV	0	16	2
Tractor	0	0	0
Cycle Rickshaw	10	9	0
Cycles	21	21	8
Cart	0	1	0
Total vehicles	288	668	209
Total PCU	**284**	**600**	**204**

Wardha Road

Wardha Road	7	8	9
City Bus	0	7	0
Long Distance Bus	0	2	0
Institutional/Company	1	1	0
Mini bus	0	1	0
Van/Maxi Cab	0	5	0
Car/jeep	30	241	68
Two wheeler	109	823	53
Shared Auto rickshaw	3	3	70
Auto rickshaw	22	252	16
Truck/2 Axle	0	6	0
3 Axle/MAV	0	2	5
LCV	0	1	2
Tractor	0	0	0
Cycle Rickshaw	2	0	9
Cycles	9	14	26
Cart	0	0	0
Total vehicles	176	1358	249
Total PCU	**169**	**1424**	**273**

Classified Turning Volume Count Survey

Location: 14. Cotton Market Chowk

Date: 8/6/2012

Peak Hour	6.00-7.00
Peak Hour Volume (PCUs)	9952
Peak Hour Volume (Vehicles)	11347

Railway station	1	2	3
City Bus	0	0	0
Long Distance Bus	0	0	7
Institutional/Compan	0	0	7
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	11	59	50
Two wheeler	86	456	137
Shared Auto ricksha	0	0	0
Auto rickshaw	0	19	15
Truck/2 Axle	0	3	0
3 Axle/MAV	0	0	0
LCV	6	17	5
Tractor	0	0	4
Cycle Rickshaw	0	15	17
Cycles	61	101	45
Cart	0	0	0
Total vehicles	164	670	287
Total PCU	**114**	**542**	**285**

Ganesh Peth	4	5	6
City Bus	0	1	0
Long Distance Bus	1	1	0
Institutional/Company	0	0	0
Mini bus	0	1	0
Van/Maxi Cab	0	0	2
Car/jeep	19	116	23
Two wheeler	83	1287	57
Shared Auto rickshaw	0	43	11
Auto rickshaw	11	147	18
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	6	52	15
Tractor	0	0	0
Cycle Rickshaw	5	79	19
Cycles	18	185	33
Cart	0	0	0
Total vehicles	143	1912	178
Total PCU	**130**	**1717**	**183**

Railway station

Sita Bardi

Ganesh Peth

Sita Bardi	10	11	12
City Bus	0	1	15
Long Distance Bus	0	2	33
Institutional/Compan	0	0	2
Mini bus	0	5	0
Van/Maxi Cab	0	0	3
Car/jeep	41	185	137
Two wheeler	390	3069	1129
Shared Auto ricksha	0	189	5
Auto rickshaw	36	216	63
Truck/2 Axle	0	1	4
3 Axle/MAV	0	0	0
LCV	5	109	11
Tractor	0	1	0
Cycle Rickshaw	0	71	8
Cycles	69	218	70
Cart	0	0	0
Total vehicles	541	4067	1480
Total PCU	**447**	**3526**	**1300**

ST Bus stand	7	8	9
City Bus	14	0	0
Long Distance Bus	29	0	0
Institutional/Company	4	0	0
Mini bus	0	0	0
Van/Maxi Cab	8	0	0
Car/jeep	191	28	8
Two wheeler	711	500	26
Shared Auto rickshaw	11	0	0
Auto rickshaw	46	53	4
Truck/2 Axle	6	0	0
3 Axle/MAV	0	0	0
LCV	14	28	6
Tractor	0	0	0
Cycle Rickshaw	8	18	4
Cycles	119	63	11
Cart	0	0	0
Total vehicles	1161	690	59
Total PCU	**1045**	**607**	**55**

ST Bus stand

Classified Turning Volume Count Survey

Location: 16. Jagnade Chowk

Date: 31-5-2012

Peak Hour	6.30-7.30
Peak Hour Volume (PCUs)	4913
Peak Hour Volume (Vehicles)	5154

Telephone Exchange	1	2	3
City Bus	0	2	0
Long Distance Bus	0	1	1
Institutional/Compan	0	0	0
Mini bus	0	2	2
Van/Maxi Cab	13	0	0
Car/jeep	71	284	248
Two wheeler	497	1149	377
Shared Auto ricksha	13	3	15
Auto rickshaw	45	158	47
Truck/2 Axle	2	0	2
3 Axle/MAV	1	0	2
LCV	45	66	8
Tractor	0	0	1
Cycle Rickshaw	13	27	20
Cycles	84	276	79
Cart	0	0	0
Total vehicles	784	1968	802
Total PCU	**254**	**630**	**354**

Rajendra Nagar	4	5	6
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	0	2	1
Van/Maxi Cab	0	16	0
Car/jeep	72	71	269
Two wheeler	656	446	410
Shared Auto rickshaw	0	0	12
Auto rickshaw	37	45	39
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	4
LCV	10	22	16
Tractor	0	0	0
Cycle Rickshaw	7	4	37
Cycles	184	115	118
Cart	0	0	0
Total vehicles	966	721	906
Total PCU	**267**	**221**	**311**

Telephone Exchange

Reshim bagh

Rajendra Nagar

Reshim bagh	10	11	12
City Bus	0	0	0
Long Distance Bus	76	0	0
Institutional/Compan	0	0	0
Mini bus	1	69	0
Van/Maxi Cab	45	7	0
Car/jeep	516	429	24
Two wheeler	878	800	101
Shared Auto ricksha	9	0	7
Auto rickshaw	47	156	37
Truck/2 Axle	20	1	0
3 Axle/MAV	35	0	0
LCV	69	189	14
Tractor	0	27	0
Cycle Rickshaw	7	81	10
Cycles	88	232	34
Cart	0	9	1
Total vehicles	1791	2000	228
Total PCU	**752**	**843**	**60**

Umred Road	7	8	9
City Bus	0	0	0
Long Distance Bus	4	0	16
Institutional/Company	10	0	5
Mini bus	6	0	0
Van/Maxi Cab	36	0	9
Car/jeep	151	284	56
Two wheeler	187	966	339
Shared Auto rickshaw	87	0	52
Auto rickshaw	63	175	93
Truck/2 Axle	0	0	0
3 Axle/MAV	2	0	0
LCV	23	0	30
Tractor	0	0	0
Cycle Rickshaw	38	108	26
Cycles	203	250	143
Cart	0	0	0
Total vehicles	810	1783	769
Total PCU	**315**	**616**	**289**

Umred Road

Classified Turning Volume Count Survey

Location: 17. Telephone Exchange Chowk

Date: 30-5-2012

Peak Hour	**6.45-7.45**
Peak Hour Volume (PCUs)	**7705**
Peak Hour Volume (Vehicles)	**8642**

Toyota colony	1	2	3
City Bus	1	0	0
Long Distance Bus	0	2	1
Institutional/Compan	0	0	0
Mini bus	1	0	1
Van/Maxi Cab	1	0	2
Car/jeep	72	90	102
Two wheeler	538	1285	436
Shared Auto ricksha	1	26	151
Auto rickshaw	29	61	28
Truck/2 Axle	0	4	14
3 Axle/MAV	0	0	2
LCV	16	35	33
Tractor	0	0	3
Cycle Rickshaw	29	60	44
Cycles	88	118	80
Cart	0	0	0
Total vehicles	776	1681	897
Total PCU	**278**	**517**	**435**

Ring Road	4	5	6
City Bus	0	1	0
Long Distance Bus	0	25	0
Institutional/Company	0	0	0
Mini bus	0	5	0
Van/Maxi Cab	0	2	2
Car/jeep	119	570	57
Two wheeler	607	1672	451
Shared Auto rickshaw	0	47	9
Auto rickshaw	9	131	28
Truck/2 Axle	2	47	4
3 Axle/MAV	0	0	1
LCV	10	78	7
Tractor	0	1	0
Cycle Rickshaw	11	58	31
Cycles	38	125	90
Cart	0	0	0
Total vehicles	796	2762	680
Total PCU	**250**	**1169**	**199**

Toyota colony

Gandhi bagh

Ring Road

Gandhi bagh	10	11	12
City Bus	5	0	0
Long Distance Bus	1	14	0
Institutional/Compan	0	0	0
Mini bus	0	26	2
Van/Maxi Cab	0	1	0
Car/jeep	240	656	263
Two wheeler	645	3531	812
Shared Auto ricksha	264	89	10
Auto rickshaw	66	212	183
Truck/2 Axle	18	44	20
3 Axle/MAV	0	0	0
LCV	26	118	26
Tractor	0	2	0
Cycle Rickshaw	26	160	48
Cycles	100	893	102
Cart	0	0	0
Total vehicles	1391	5746	1466
Total PCU	**451**	**1824**	**523**

Jagnadhe chowk

Jagnadhe chowk	7	8	9
City Bus	0	0	0
Long Distance Bus	1	2	0
Institutional/Company	3	0	0
Mini bus	0	0	0
Van/Maxi Cab	1	2	1
Car/jeep	162	511	52
Two wheeler	727	2357	320
Shared Auto rickshaw	9	33	2
Auto rickshaw	131	290	10
Truck/2 Axle	8	2	0
3 Axle/MAV	0	0	0
LCV	17	29	8
Tractor	1	3	0
Cycle Rickshaw	57	56	12
Cycles	193	647	72
Cart	0	0	0
Total vehicles	1310	3932	477
Total PCU	**495**	**1440**	**124**

Classified Turning Volume Count Survey

Location: 18. Old Pardi Naka Chowk

Date: 30-5-2012

Peak Hour	**6.30-7.30**
Peak Hour Volume (PCUs)	**7164**
Peak Hour Volume (Vehicles)	**7180**

Kamtee Road	1	2	3
City Bus	0	0	1
Long Distance Bus	1	2	0
Institutional/Compan	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	15	7
Car/jeep	72	221	48
Two wheeler	290	1188	138
Shared Auto ricksha	0	2	33
Auto rickshaw	1	19	20
Truck/2 Axle	23	122	0
3 Axle/MAV	292	81	4
LCV	6	39	28
Tractor	0	2	0
Cycle Rickshaw	0	7	9
Cycles	222	207	27
Cart	0	0	0
Total vehicles	907	1905	315
Total PCU	**739**	**739**	**112**

Pardi	4	5	6
City Bus	2	0	0
Long Distance Bus	37	16	3
Institutional/Company	2	0	0
Mini bus	7	3	1
Van/Maxi Cab	2	20	0
Car/jeep	377	171	125
Two wheeler	1399	1457	337
Shared Auto rickshaw	11	144	23
Auto rickshaw	36	50	31
Truck/2 Axle	29	16	61
3 Axle/MAV	58	12	212
LCV	99	87	42
Tractor	13	2	0
Cycle Rickshaw	8	25	10
Cycles	323	299	173
Cart	0	0	0
Total vehicles	2403	2302	1018
Total PCU	**896**	**543**	**694**

Kamtee Road

Old Bhandara Road

Pardi

Old Bhandara Road	10	11	12
City Bus	1	6	0
Long Distance Bus	0	5	0
Institutional/Compan	0	4	0
Mini bus	0	14	0
Van/Maxi Cab	6	0	0
Car/jeep	47	316	22
Two wheeler	158	873	144
Shared Auto ricksha	39	383	10
Auto rickshaw	24	91	18
Truck/2 Axle	0	45	16
3 Axle/MAV	7	57	6
LCV	14	91	24
Tractor	0	5	1
Cycle Rickshaw	6	29	2
Cycles	42	473	38
Cart	0	3	0
Total vehicles	344	2395	281
Total PCU	**133**	**1067**	**72**

Umred Road

Umred Road	7	8	9
City Bus	0	0	0
Long Distance Bus	0	0	51
Institutional/Company	0	0	1
Mini bus	0	0	2
Van/Maxi Cab	0	6	77
Car/jeep	26	338	465
Two wheeler	148	594	2195
Shared Auto rickshaw	14	33	13
Auto rickshaw	24	40	170
Truck/2 Axle	15	38	51
3 Axle/MAV	13	36	35
LCV	26	26	117
Tractor	1	0	21
Cycle Rickshaw	2	34	67
Cycles	40	222	1992
Cart	0	0	0
Total vehicles	309	1367	5257
Total PCU	**96**	**591**	**1482**

Classified Turning Volume Count Survey

Location: 19. Law College Chowk

Date: 5/6/2012

Peak Hour	6.30-7.30
Peak Hour Volume (PCUs)	7700
Peak Hour Volume (Vehicles)	8705

Highcourt	1	2	3
City Bus	0	0	2
Long Distance Bus	0	0	0
Institutional/Compan	2	1	1
Mini bus	0	0	1
Van/Maxi Cab	0	0	0
Car/jeep	161	723	426
Two wheeler	487	1809	1313
Shared Auto ricksha	0	1	15
Auto rickshaw	49	81	114
Truck/2 Axle	2	1	45
3 Axle/MAV	0	1	0
LCV	2	22	30
Tractor	0	0	0
Cycle Rickshaw	2	8	4
Cycles	53	251	117
Cart	0	0	0
Total vehicles	758	2898	2068
Total PCU	**233**	**1139**	**742**

Variety Chowk	4	5	6
City Bus	2	6	0
Long Distance Bus	0	32	0
Institutional/Company	0	1	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	246	436	78
Two wheeler	1454	1667	131
Shared Auto rickshaw	0	272	0
Auto rickshaw	66	99	1
Truck/2 Axle	1	11	0
3 Axle/MAV	1	0	0
LCV	20	22	2
Tractor	0	0	0
Cycle Rickshaw	2	1	0
Cycles	127	55	18
Cart	0	0	0
Total vehicles	1919	2602	230
Total PCU	**627**	**890**	**69**

Highcourt

Ravi Nagar

Variety Chowk

Ravi Nagar	10	11	12
City Bus	0	12	0
Long Distance Bus	0	49	0
Institutional/Compan	31	4	0
Mini bus	8	41	0
Van/Maxi Cab	0	2	0
Car/jeep	522	619	228
Two wheeler	1214	2060	452
Shared Auto ricksha	34	117	0
Auto rickshaw	79	222	26
Truck/2 Axle	81	13	0
3 Axle/MAV	7	0	0
LCV	41	81	6
Tractor	0	0	0
Cycle Rickshaw	27	0	0
Cycles	266	292	30
Cart	0	0	0
Total vehicles	2310	3512	742
Total PCU	**865**	**1458**	**144**

Shankar Nagar

Shankar Nagar	7	8	9
City Bus	0	0	4
Long Distance Bus	0	0	0
Institutional/Company	0	3	0
Mini bus	0	1	0
Van/Maxi Cab	0	0	0
Car/jeep	190	568	274
Two wheeler	439	2140	450
Shared Auto rickshaw	0	29	0
Auto rickshaw	31	158	62
Truck/2 Axle	0	10	1
3 Axle/MAV	0	0	0
LCV	0	15	5
Tractor	0	0	0
Cycle Rickshaw	0	21	1
Cycles	116	321	54
Cart	0	0	0
Total vehicles	776	3266	851
Total PCU	**219**	**1016**	**298**

Classified Turning Volume Count Survey

Location: 20. RBI chowk

Date: 6/6/2012

Peak Hour	6.00-7.00
Peak Hour Volume (PCUs)	9380
Peak Hour Volume (Vehicles)	10139

LIC Chowk	1	2	3
City Bus	1	20	0
Long Distance Bus	0	33	0
Institutional/Compan	0	4	0
Mini bus	0	0	0
Van/Maxi Cab	0	15	0
Car/jeep	0	371	35
Two wheeler	19	1532	250
Shared Auto ricksha	0	103	0
Auto rickshaw	1	145	9
Truck/2 Axle	0	9	0
3 Axle/MAV	0	1	0
LCV	1	25	3
Tractor	0	0	0
Cycle Rickshaw	0	0	7
Cycles	0	111	25
Cart	0	0	0
Total vehicles	22	2369	329
Total PCU	**20**	**2188**	**268**

Central Avenue	4	5	6
City Bus	0	0	0
Long Distance Bus	3	0	0
Institutional/Company	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	2	1	0
Car/jeep	131	106	11
Two wheeler	449	360	88
Shared Auto rickshaw	1	0	0
Auto rickshaw	89	42	5
Truck/2 Axle	0	1	0
3 Axle/MAV	0	0	0
LCV	12	17	1
Tractor	0	0	0
Cycle Rickshaw	0	0	1
Cycles	9	38	4
Cart	0	0	0
Total vehicles	696	565	110
Total PCU	**677**	**506**	**92**

LIC Chowk

CP Office

Central Avenue

CP Office	10	11	12
City Bus	20	13	6
Long Distance Bus	0	2	0
Institutional/Compan	0	0	0
Mini bus	0	3	0
Van/Maxi Cab	0	0	4
Car/jeep	31	213	99
Two wheeler	99	489	359
Shared Auto ricksha	5	29	0
Auto rickshaw	8	28	9
Truck/2 Axle	0	1	0
3 Axle/MAV	0	0	0
LCV	3	0	1
Tractor	0	0	0
Cycle Rickshaw	8	12	0
Cycles	79	54	15
Cart	1	0	0
Total vehicles	254	844	493
Total PCU	**229**	**751**	**412**

Variety chowk	7	8	9
City Bus	0	2	0
Long Distance Bus	0	44	2
Institutional/Company	0	6	0
Mini bus	0	6	0
Van/Maxi Cab	0	17	21
Car/jeep	68	456	147
Two wheeler	116	1553	846
Shared Auto rickshaw	0	156	7
Auto rickshaw	33	208	208
Truck/2 Axle	0	0	3
3 Axle/MAV	0	0	0
LCV	8	104	18
Tractor	0	0	0
Cycle Rickshaw	4	11	0
Cycles	30	382	3
Cart	0	0	1
Total vehicles	259	2945	1256
Total PCU	**253**	**2717**	**1267**

Variety chowk

Classified Turning Volume Count Survey

Location: 21. Golibar Chowk

Date: 13/6/2012

Peak Hour	10.15-11.15
Peak Hour Volume (PCUs)	8231
Peak Hour Volume (Vehicles)	9123

Indora Chowk	1	2	3
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Compan	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	1
Car/jeep	86	0	3
Two wheeler	276	0	197
Shared Auto ricksha	111	0	3
Auto rickshaw	119	0	32
Truck/2 Axle	0	0	0
3 Axle/MAV	1	0	0
LCV	20	0	10
Tractor	1	0	0
Cycle Rickshaw	74	0	1
Cycles	135	0	61
Cart	0	0	4
Total vehicles	823	0	312
Total PCU	**879**	**0**	**273**

Itwari	4	5	6
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	21	9	30
Two wheeler	171	226	194
Shared Auto rickshaw	0	2	1
Auto rickshaw	24	13	8
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	5	17	8
Tractor	0	0	0
Cycle Rickshaw	12	7	0
Cycles	53	57	67
Cart	0	0	0
Total vehicles	286	331	308
Total PCU	**249**	**270**	**237**

Indora Chowk

Mominpura

Itwari

Mominpura	10	11	12
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Compan	0	0	0
Mini bus	0	11	0
Van/Maxi Cab	0	0	3
Car/jeep	4	13	4
Two wheeler	216	270	79
Shared Auto ricksha	17	0	0
Auto rickshaw	49	34	24
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	1
LCV	11	6	3
Tractor	0	0	0
Cycle Rickshaw	3	24	5
Cycles	69	59	16
Cart	3	0	0
Total vehicles	372	417	135
Total PCU	**345**	**357**	**138**

Gandhi bagh

Gandhi bagh	7	8	9
City Bus	0	0	0
Long Distance Bus	0	3	0
Institutional/Company	0	0	0
Mini bus	0	3	0
Van/Maxi Cab	0	0	5
Car/jeep	11	295	63
Two wheeler	65	2746	416
Shared Auto rickshaw	9	84	11
Auto rickshaw	35	335	81
Truck/2 Axle	1	12	0
3 Axle/MAV	1	4	0
LCV	14	250	27
Tractor	0	5	1
Cycle Rickshaw	15	225	73
Cycles	32	1139	175
Cart	0	5	9
Total vehicles	183	5106	861
Total PCU	**205**	**4466**	**812**

Classified Turning Volume Count Survey

Location: 22. Rajiv Gandhi Nagar Chowk

Date: 13-6-2012

Peak Hour	**10.00-11.00**
Peak Hour Volume (PCUs)	**1499**
Peak Hour Volume (Vehicles)	**1880**

Vinoba nagar		
City Bus	0	0
Long Distance Bus	0	0
Institutional/Company Bus	0	0
Mini bus	0	0
Van/Maxi Cab	1	2
Car/jeep	10	7
Two wheeler	96	136
Shared Auto rickshaw	4	1
Auto rickshaw	1	15
Truck/2 Axle	1	5
3 Axle/MAV	4	1
LCV	12	11
Tractor	1	0
Cycle Rickshaw	4	18
Cycles	50	121
Cart	0	0
Total vehicles	184	317
Total PCU	**160**	**260**

Kamtee		
City Bus	6	0
Long Distance Bus	0	0
Institutional/Company Bus	0	0
Mini bus	0	0
Van/Maxi Cab	8	0
Car/jeep	15	11
Two wheeler	365	113
Shared Auto rickshaw	10	0
Auto rickshaw	23	4
Truck/2 Axle	0	3
3 Axle/MAV	0	0
LCV	6	10
Tractor	0	2
Cycle Rickshaw	18	6
Cycles	285	79
Cart	0	0
Total vehicles	736	228
Total PCU	**546**	**181**

Vinoba nagar

Itwari

Kamtee

Itwari		
City Bus	0	0
Long Distance Bus	0	0
Institutional/Company Bus	0	0
Mini bus	0	14
Van/Maxi Cab	0	0
Car/jeep	10	19
Two wheeler	125	93
Shared Auto rickshaw	1	5
Auto rickshaw	5	23
Truck/2 Axle	1	0
3 Axle/MAV	0	0
LCV	14	4
Tractor	0	0
Cycle Rickshaw	5	7
Cycles	31	72
Cart	0	0
Total vehicles	192	237
Total PCU	**160**	**193**

Classified Turning Volume Count Survey

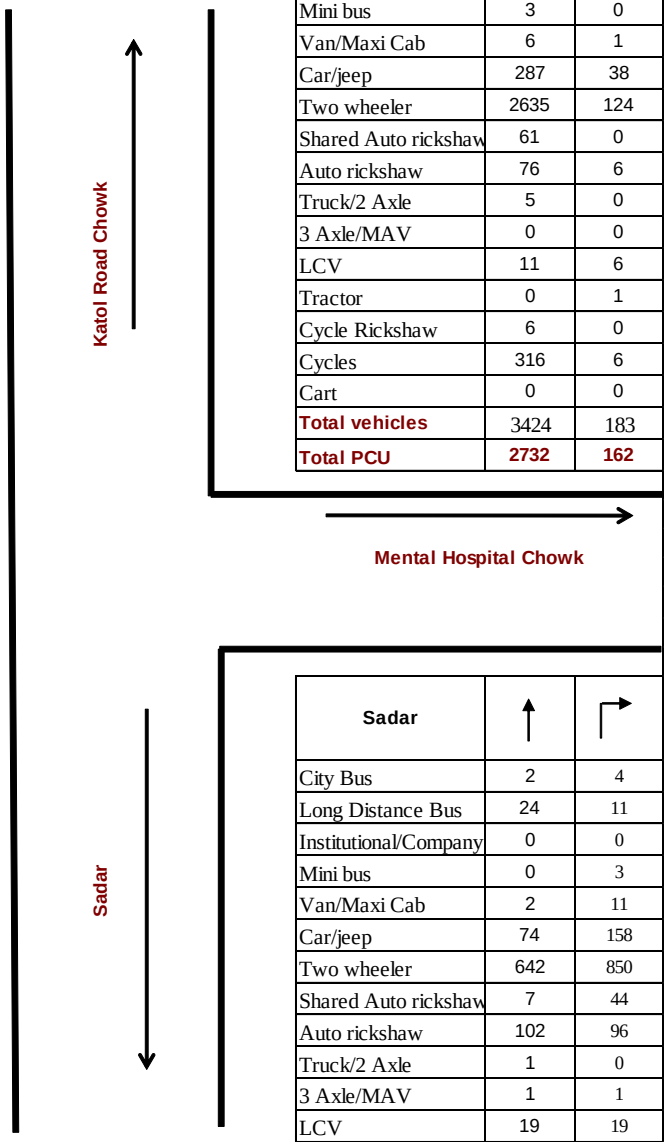
Location: 23. Chhaoni Chowk

Date: 7/6/2012

Peak Hour	**10.00-11.00**
Peak Hour Volume (PCUs)	**6320**
Peak Hour Volume (Vehicles)	**7387**

Katol Road Chowk	→	↓
City Bus	0	3
Long Distance Bus	0	0
Institutional/Compan	0	0
Mini bus	0	0
Van/Maxi Cab	0	0
Car/jeep	22	128
Two wheeler	45	964
Shared Auto ricksha	0	77
Auto rickshaw	2	120
Truck/2 Axle	0	0
3 Axle/MAV	0	0
LCV	3	14
Tractor	0	0
Cycle Rickshaw	0	3
Cycles	7	99
Cart	0	0
Total vehicles	79	1408
Total PCU	**67**	**1264**

Mental Hospital Chowk	↓	↑
City Bus	9	0
Long Distance Bus	8	1
Institutional/Company	1	0
Mini bus	3	0
Van/Maxi Cab	6	1
Car/jeep	287	38
Two wheeler	2635	124
Shared Auto rickshaw	61	0
Auto rickshaw	76	6
Truck/2 Axle	5	0
3 Axle/MAV	0	0
LCV	11	6
Tractor	0	1
Cycle Rickshaw	6	0
Cycles	316	6
Cart	0	0
Total vehicles	3424	183
Total PCU	**2732**	**162**



Sadar	↑	→
City Bus	2	4
Long Distance Bus	24	11
Institutional/Company	0	0
Mini bus	0	3
Van/Maxi Cab	2	11
Car/jeep	74	158
Two wheeler	642	850
Shared Auto rickshaw	7	44
Auto rickshaw	102	96
Truck/2 Axle	1	0
3 Axle/MAV	1	1
LCV	19	19
Tractor	0	0
Cycle Rickshaw	2	3
Cycles	103	114
Cart	0	0
Total vehicles	979	1314
Total PCU	**914**	**1181**

Classified Turning Volume Count Survey

Location: 25.indora chowk

Date: 13/6/2012

Peak Hour	11.00-12.00
Peak Hour Volume (PCUs)	7141
Peak Hour Volume (Vehicles)	8292

Jari patka	1	2	3
City Bus	0	0	2
Long Distance Bus	0	0	1
Institutional/Compan	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	2
Car/jeep	30	93	9
Two wheeler	205	800	44
Shared Auto ricksha	5	0	0
Auto rickshaw	14	89	16
Truck/2 Axle	0	0	1
3 Axle/MAV	0	0	0
LCV	9	94	0
Tractor	0	0	0
Cycle Rickshaw	11	36	2
Cycles	72	385	9
Cart	0	0	0
Total vehicles	346	1497	86
Total PCU	**283**	**1249**	**92**

Ring road	4	5	6
City Bus	0	6	0
Long Distance Bus	0	11	0
Institutional/Company	0	0	0
Mini bus	0	3	0
Van/Maxi Cab	0	18	0
Car/jeep	102	175	16
Two wheeler	544	1651	193
Shared Auto rickshaw	0	37	0
Auto rickshaw	165	77	17
Truck/2 Axle	3	10	0
3 Axle/MAV	0	0	0
LCV	7	69	8
Tractor	1	0	0
Cycle Rickshaw	40	8	1
Cycles	215	188	38
Cart	0	0	0
Total vehicles	1077	2253	273
Total PCU	**1028**	**1896**	**226**

Jari patka

Kadbi Chowk

Ring road

Kadbi Chowk	10	11	12
City Bus	1	6	0
Long Distance Bus	0	13	0
Institutional/Compan	0	0	0
Mini bus	0	4	0
Van/Maxi Cab	0	2	0
Car/jeep	13	213	4
Two wheeler	58	580	102
Shared Auto ricksha	1	37	0
Auto rickshaw	10	41	9
Truck/2 Axle	0	5	0
3 Axle/MAV	0	0	0
LCV	4	41	2
Tractor	0	0	0
Cycle Rickshaw	2	5	1
Cycles	7	58	10
Cart	0	0	0
Total vehicles	96	1005	128
Total PCU	**92**	**926**	**108**

Golibar chowk

Golibar chowk	7	8	9
City Bus	0	0	3
Long Distance Bus	0	0	0
Institutional/Company	0	0	0
Mini bus	0	0	1
Van/Maxi Cab	3	0	6
Car/jeep	20	35	58
Two wheeler	165	346	341
Shared Auto rickshaw	0	25	29
Auto rickshaw	19	37	21
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	2	11	5
Tractor	0	0	1
Cycle Rickshaw	5	5	11
Cycles	25	311	48
Cart	0	0	0
Total vehicles	239	770	524
Total PCU	**208**	**577**	**456**

Classified Turning Volume Count Survey

Location: **27. Katol Road chowk**

Date: **11/6/2012**

Peak Hour	10.15-11.15
Peak Hour Volume (PCUs)	8262
Peak Hour Volume (Vehicles)	9722

Raj nagar	1	2	3
City Bus	1	0	0
Long Distance Bus	0	1	0
Institutional/Compan	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	8
Car/jeep	33	322	20
Two wheeler	179	2535	127
Shared Auto ricksha	1	0	0
Auto rickshaw	30	29	4
Truck/2 Axle	0	8	0
3 Axle/MAV	0	4	0
LCV	3	23	5
Tractor	0	1	0
Cycle Rickshaw	0	0	0
Cycles	4	206	19
Cart	0	0	0
Total vehicles	251	3129	183
Total PCU	**237**	**2456**	**148**

Chhaoni chowk	4	5	6
City Bus	0	3	0
Long Distance Bus	0	9	0
Institutional/Company	0	1	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	179	68	4
Two wheeler	402	350	25
Shared Auto rickshaw	1	11	0
Auto rickshaw	9	72	10
Truck/2 Axle	0	2	0
3 Axle/MAV	0	1	0
LCV	10	17	1
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	22	88	0
Cart	0	1	0
Total vehicles	623	623	40
Total PCU	**525**	**595**	**44**

Raj nagar

Kadbi Chowk

Chhaoni chowk

Kadbi Chowk	10	11	12
City Bus	0	5	0
Long Distance Bus	0	3	6
Institutional/Compan	1	0	0
Mini bus	0	3	6
Van/Maxi Cab	2	9	0
Car/jeep	30	105	207
Two wheeler	111	890	1026
Shared Auto ricksha	0	13	0
Auto rickshaw	3	123	41
Truck/2 Axle	0	0	6
3 Axle/MAV	1	0	0
LCV	3	16	45
Tractor	0	0	0
Cycle Rickshaw	0	7	7
Cycles	21	100	142
Cart	0	0	0
Total vehicles	172	1274	1486
Total PCU	**142**	**1144**	**1238**

Golibar chowk

Golibar chowk	7	8	9
City Bus	0	0	0
Long Distance Bus	3	1	0
Institutional/Company	2	0	0
Mini bus	4	0	0
Van/Maxi Cab	0	32	1
Car/jeep	145	135	168
Two wheeler	402	488	295
Shared Auto rickshaw	5	0	0
Auto rickshaw	49	21	7
Truck/2 Axle	6	7	0
3 Axle/MAV	0	3	0
LCV	30	18	8
Tractor	0	2	0
Cycle Rickshaw	2	0	0
Cycles	56	38	16
Cart	0	0	0
Total vehicles	704	745	495
Total PCU	**654**	**657**	**423**

Classified Turning Volume Count Survey

Location: 28. Mental Hospital Chowk

Date: 7/6/2012

Peak Hour	6.45-7.45
Peak Hour Volume (PCUs)	4670
Peak Hour Volume (Vehicles)	5379

Mankapur Chowk	1	2	3
City Bus	0	11	0
Long Distance Bus	1	10	1
Institutional/Compan	0	0	0
Mini bus	2	1	1
Van/Maxi Cab	11	14	1
Car/jeep	164	259	303
Two wheeler	1179	1354	535
Shared Auto ricksha	5	100	3
Auto rickshaw	60	94	20
Truck/2 Axle	3	2	4
3 Axle/MAV	14	0	1
LCV	49	21	42
Tractor	0	0	0
Cycle Rickshaw	8	6	0
Cycles	103	4	24
Cart	0	0	0
Total vehicles	1599	1876	935
Total PCU	**475**	**674**	**243**

Jaripatka	4	5	6
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	0	1	0
Mini bus	0	1	0
Van/Maxi Cab	0	0	3
Car/jeep	55	160	284
Two wheeler	105	561	861
Shared Auto rickshaw	0	1	0
Auto rickshaw	16	6	68
Truck/2 Axle	0	0	0
3 Axle/MAV	0	0	0
LCV	10	23	86
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	58	26	75
Cart	0	0	0
Total vehicles	244	779	1377
Total PCU	**106**	**266**	**436**

Mankapur Chowk

Jaffar nagar

Jaripatka

Sadar

Jaffar nagar	10	11	12
City Bus	0	0	0
Long Distance Bus	0	2	0
Institutional/Compan	7	4	0
Mini bus	1	29	0
Van/Maxi Cab	0	13	0
Car/jeep	193	287	15
Two wheeler	498	991	31
Shared Auto ricksha	1	9	0
Auto rickshaw	17	44	1
Truck/2 Axle	7	21	2
3 Axle/MAV	1	12	0
LCV	29	58	2
Tractor	0	0	0
Cycle Rickshaw	1	12	0
Cycles	70	203	5
Cart	0	0	0
Total vehicles	825	1685	56
Total PCU	**360**	**568**	**21**

Sadar	7	8	9
City Bus	0	18	0
Long Distance Bus	0	30	0
Institutional/Company	3	7	0
Mini bus	0	1	0
Van/Maxi Cab	0	33	0
Car/jeep	98	755	38
Two wheeler	174	2467	97
Shared Auto rickshaw	0	621	0
Auto rickshaw	15	182	9
Truck/2 Axle	3	53	2
3 Axle/MAV	0	1	0
LCV	20	44	10
Tractor	0	0	0
Cycle Rickshaw	0	8	0
Cycles	75	123	20
Cart	0	0	0
Total vehicles	388	4343	176
Total PCU	**120**	**1322**	**80**

Classified Turning Volume Count Survey

Location: **29. Mankapur chowk**

Date: **7/6/2012**

Peak Hour	1.00-2.00
Peak Hour Volume (PCUs)	9361
Peak Hour Volume (Vehicles)	6231

Karodi	1	2	3
City Bus	0	13	0
Long Distance Bus	0	13	0
Institutional/Compan	1	1	0
Mini bus	0	0	0
Van/Maxi Cab	0	9	0
Car/jeep	188	164	145
Two wheeler	260	801	180
Shared Auto ricksha	8	26	0
Auto rickshaw	11	32	52
Truck/2 Axle	19	8	170
3 Axle/MAV	18	3	170
LCV	23	23	0
Tractor	5	0	0
Cycle Rickshaw	21	0	0
Cycles	0	6	0
Cart	0	0	0
Total vehicles	554	1099	717
Total PCU	**652**	**983**	**1821**

Bhandara Road	4	5	6
City Bus	0	0	0
Long Distance Bus	5	1	0
Institutional/Company	0	0	2
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	29	37	185
Two wheeler	135	147	275
Shared Auto rickshaw	0	0	12
Auto rickshaw	0	8	13
Truck/2 Axle	1	36	30
3 Axle/MAV	0	73	24
LCV	12	9	26
Tractor	0	0	3
Cycle Rickshaw	2	4	5
Cycles	1	11	32
Cart	0	0	0
Total vehicles	185	326	607
Total PCU	**165**	**681**	**729**

Karodi

Katol Road

Bhandara Road

Katol Road	10	11	12
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Compan	0	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	260	31	8
Two wheeler	310	171	29
Shared Auto ricksha	0	3	0
Auto rickshaw	7	2	0
Truck/2 Axle	192	57	2
3 Axle/MAV	184	107	0
LCV	0	0	0
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	0	7	1
Cart	0	0	0
Total vehicles	953	378	40
Total PCU	**2131**	**915**	**38**

Sadar

Sadar	7	8	9
City Bus	0	8	0
Long Distance Bus	0	17	0
Institutional/Company	1	13	0
Mini bus	0	6	0
Van/Maxi Cab	0	13	0
Car/jeep	3	192	39
Two wheeler	41	715	118
Shared Auto rickshaw	0	41	0
Auto rickshaw	4	43	0
Truck/2 Axle	1	11	1
3 Axle/MAV	0	2	1
LCV	1	13	17
Tractor	0	0	0
Cycle Rickshaw	1	0	0
Cycles	1	62	7
Cart	0	0	0
Total vehicles	53	1136	183
Total PCU	**48**	**1035**	**164**

Classified Turning Volume Count Survey

Location: 30. Katol & ring road junction

Date: 11/6/2012

Peak Hour	10.15-11.15
Peak Hour Volume (PCUs)	2899
Peak Hour Volume (Vehicles)	2353

Mankapur chowk	1	2	3
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Compan	0	0	2
Mini bus	0	0	0
Van/Maxi Cab	0	1	0
Car/jeep	1	21	31
Two wheeler	3	164	182
Shared Auto ricksha	25	0	2
Auto rickshaw	0	1	2
Truck/2 Axle	1	31	10
3 Axle/MAV	0	54	2
LCV	0	10	1
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	3	6	0
Cart	0	0	0
Total vehicles	33	288	232
Total PCU	**38**	**547**	**225**

Chhaoni chowk	4	5	6
City Bus	0	4	0
Long Distance Bus	0	7	0
Institutional/Company	0	8	0
Mini bus	0	1	0
Van/Maxi Cab	0	8	0
Car/jeep	40	83	1
Two wheeler	194	446	9
Shared Auto rickshaw	0	1	18
Auto rickshaw	7	4	0
Truck/2 Axle	5	1	1
3 Axle/MAV	2	0	0
LCV	9	13	1
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	15	3	2
Cart	2	0	0
Total vehicles	274	579	32
Total PCU	**245**	**498**	**35**

Mankapur chowk

Katol

Chhaoni chowk

Wadi chowk

Katol	10	11	12
City Bus	0	2	0
Long Distance Bus	0	13	0
Institutional/Compan	0	1	0
Mini bus	0	4	0
Van/Maxi Cab	0	0	0
Car/jeep	7	44	12
Two wheeler	39	221	44
Shared Auto ricksha	1	2	0
Auto rickshaw	0	6	0
Truck/2 Axle	14	1	1
3 Axle/MAV	14	0	0
LCV	4	12	2
Tractor	0	0	0
Cycle Rickshaw	0	0	0
Cycles	1	1	0
Cart	0	0	0
Total vehicles	80	307	59
Total PCU	**165**	**275**	**52**

Wadi chowk	7	8	9
City Bus	0	0	0
Long Distance Bus	0	0	0
Institutional/Company	2	0	0
Mini bus	0	0	0
Van/Maxi Cab	0	0	0
Car/jeep	78	18	9
Two wheeler	131	46	46
Shared Auto rickshaw	0	0	0
Auto rickshaw	0	0	2
Truck/2 Axle	3	33	2
3 Axle/MAV	2	69	0
LCV	1	23	1
Tractor	1	0	0
Cycle Rickshaw	2	0	0
Cycles	1	2	1
Cart	0	0	0
Total vehicles	221	191	61
Total PCU	**211**	**553**	**55**

Classified Turning Volume Count Survey

Location: 31. Wadi Chowk

Date: 11/6/2012

Peak Hour	**6.45-7.45**
Peak Hour Volume (PCUs)	**4175**
Peak Hour Volume (Vehicles)	**3180**

Mankapur Chowk	↳	↲
City Bus	0	0
Long Distance Bus	0	0
Institutional/Company Bus	0	2
Mini bus	0	0
Van/Maxi Cab	0	3
Car/jeep	50	173
Two wheeler	181	386
Shared Auto rickshaw	2	63
Auto rickshaw	11	38
Truck/2 Axle	15	97
3 Axle/MAV	22	164
LCV	105	68
Tractor	0	1
Cycle Rickshaw	11	9
Cycles	41	48
Cart	0	0
Total vehicles	438	1052
Total PCU	**308**	**684**

Law college chowk	←	↰
City Bus	13	0
Long Distance Bus	47	0
Institutional/Company Bus	2	0
Mini bus	1	0
Van/Maxi Cab	42	0
Car/jeep	482	39
Two wheeler	1290	259
Shared Auto rickshaw	124	29
Auto rickshaw	46	6
Truck/2 Axle	55	9
3 Axle/MAV	38	33
LCV	158	43
Tractor	20	1
Cycle Rickshaw	42	8
Cycles	217	6
Cart	0	0
Total vehicles	2577	433
Total PCU	**1307**	**208**

Mankapur Chowk

Amaravati

Law college chowk

Amaravati	↑	→
City Bus	0	7
Long Distance Bus	0	18
Institutional/Company Bus	0	11
Mini bus	0	31
Van/Maxi Cab	0	2
Car/jeep	90	495
Two wheeler	376	736
Shared Auto rickshaw	10	134
Auto rickshaw	22	99
Truck/2 Axle	87	66
3 Axle/MAV	254	47
LCV	31	103
Tractor	0	1
Cycle Rickshaw	28	19
Cycles	141	107
Cart	0	0
Total vehicles	1039	1876
Total PCU	**772**	**896**

Classified Turning Volume Count Survey

Location: 32. LIC chowk

Date: 6/6/2012

Peak Hour	**6.00-7.00**
Peak Hour Volume (PCUs)	**8837**
Peak Hour Volume (Vehicles)	**9365**

Gaddigodam	1	2	3
City Bus	0	11	0
Long Distance Bus	7	15	0
Institutional/Compan	0	2	0
Mini bus	0	2	0
Van/Maxi Cab	0	44	1
Car/jeep	116	322	23
Two wheeler	674	996	70
Shared Auto ricksha	2	2	9
Auto rickshaw	101	150	9
Truck/2 Axle	2	1	1
3 Axle/MAV	0	0	0
LCV	13	10	1
Tractor	0	0	0
Cycle Rickshaw	5	2	2
Cycles	64	97	4
Cart	0	0	0
Total vehicles	984	1654	120
Total PCU	**903**	**1548**	**114**

Railway station	4	5	6
City Bus	0	1	0
Long Distance Bus	0	0	3
Institutional/Company	0	1	0
Mini bus	0	1	0
Van/Maxi Cab	0	0	1
Car/jeep	8	132	128
Two wheeler	13	786	363
Shared Auto rickshaw	0	4	2
Auto rickshaw	8	121	105
Truck/2 Axle	0	2	2
3 Axle/MAV	0	0	0
LCV	0	22	8
Tractor	0	0	0
Cycle Rickshaw	0	0	7
Cycles	9	118	26
Cart	0	0	0
Total vehicles	38	1188	645
Total PCU	**38**	**1068**	**659**

Gaddigodam

Sadar

Centre point School

Sadar	10	11	12
City Bus	0	0	24
Long Distance Bus	0	4	36
Institutional/Compan	0	1	6
Mini bus	0	1	22
Van/Maxi Cab	0	0	0
Car/jeep	22	320	380
Two wheeler	111	922	340
Shared Auto ricksha	3	9	57
Auto rickshaw	10	167	58
Truck/2 Axle	1	7	20
3 Axle/MAV	0	0	0
LCV	1	82	45
Tractor	0	0	0
Cycle Rickshaw	2	0	2
Cycles	33	100	35
Cart	0	0	0
Total vehicles	183	1613	1025
Total PCU	**152**	**1548**	**1125**

RBI chowk	7	8	9
City Bus	0	18	0
Long Distance Bus	0	18	0
Institutional/Company	1	5	0
Mini bus	0	2	0
Van/Maxi Cab	0	53	0
Car/jeep	3	249	28
Two wheeler	11	985	83
Shared Auto rickshaw	0	28	0
Auto rickshaw	1	70	17
Truck/2 Axle	0	5	0
3 Axle/MAV	0	4	0
LCV	0	26	0
Tractor	0	0	0
Cycle Rickshaw	0	12	4
Cycles	6	254	33
Cart	0	0	0
Total vehicles	22	1729	165
Total PCU	**18**	**1516**	**147**

RBI chowk

NAGPUR CMP

Classified Volume Count Survey

Location: Medical Chk

Baidyanath	Ashok Chk	Krida Chk	Tukdoj	Ajini	Rambagh Chk
City Bus	0	3	0	0	0
Long Distance	0	0	0	1	0
Institutional/Co	0	2	0	0	0
Mini bus	3	0	2	2	3
Van/Maxi Cab	5	2	4	4	3
Car/jeep	22	24	38	54	28
Two wheeler	57	162	165	238	79
Shared Auto ric	4	5	2	3	0
Auto rickshaw	16	15	27	38	9
Truck/2 Axle	1	2	1	2	1
3 Axle/MAV	0	0	0	0	0
LCV	17	10	13	29	7
Tractor	0	0	0	0	0
Cycle Rickshaw	6	0	6	0	3
Cycles	12	12	23	17	15
Cart	0	0	0	0	0
Total vehicles	143	237	281	388	148
Total PCU	158	223	258	374	137

Baidyanath Chk

Ashok Chk	Krida Chk	Tukdoji Chk	Ajini Chk	Rambagh	Baidyanath
City Bus	0	0	0	0	0
Long Distance Bus	0	0	0	0	0
Institutional/Company Bus	0	0	0	0	0
Mini bus	0	0	1	0	0
Van/Maxi Cab	0	2	0	0	0
Car/jeep	26	22	49	23	13
Two wheeler	51	99	195	170	44
Shared Auto rickshaw	4	0	9	5	3
Auto rickshaw	6	6	15	15	8
Truck/2 Axle	0	1	0	2	0
3 Axle/MAV	0	0	0	0	0
LCV	5	1	14	11	5
Tractor	0	0	0	0	0
Cycle Rickshaw	1	3	7	6	0
Cycles	14	16	29	20	6
Cart	0	0	0	0	0
Total vehicles	107	150	319	252	79
Total PCU	99	124	289	230	76

Rambagh Chk

Rambagh Chk	Baidyanath Chk	Ashok Chk	Krida Chk	Tukdoji Chk	Ajini Chk
City Bus	0	0	0	0	0
Long Distance Bus	1	0	0	0	0
Institutional/Company Bus	0	0	0	1	3
Mini bus	2	0	1	1	5
Van/Maxi Cab	5	3	5	2	6
Car/jeep	17	18	12	13	13
Two wheeler	119	68	56	37	47
Shared Auto rickshaw	6	4	1	4	5
Auto rickshaw	20	15	12	14	13
Truck/2 Axle	1	1	1	1	1
3 Axle/MAV	0	0	0	0	0
LCV	9	12	11	11	10
Tractor	0	0	0	0	0
Cycle Rickshaw	7	6	5	2	2
Cycles	33	24	4	15	3
Cart	0	0	0	0	0
Total vehicles	220	151	108	101	108
Total PCU	203	149	115	110	124

Ashok Chk

Krida Chk	Tukdoji Chk	Ajini Chk	Rambagh Chk	Baidyanath Chk	Ashok Chk
City Bus	0	0	0	3	0
Long Dista	0	0	0	0	0
Institution	2	0	0	7	1
Mini bus	1	2	1	4	1
Van/Maxi	4	5	1	6	3
Car/jeep	24	15	22	33	32
Two whee	102	33	134	140	111
Shared Au	3	2	4	4	4
Auto ricks	13	9	16	45	23
Truck/2 A	0	1	1	2	1
3 Axle/MA	0	0	0	0	0
LCV	11	12	11	14	13
Tractor	0	0	1	0	0
Cycle Rick	0	0	0	7	0
Cycles	0	2	6	12	7
Cart	0	0	0	0	0
Total	160	81	197	277	196
Total PC	156	94	185	289	194

Ajini Chk

Ajini Chk	Rambagh Chk	Baidyanath Chk	Ashok Chk	Krida Chk	Tukdoji Chk
City Bus	0	0	0	1	0
Long Distance Bu	1	0	1	0	0
Institutional/Com	1	1	1	4	1
Mini bus	1	1	2	1	2
Van/Maxi Cab	4	0	4	4	3
Car/jeep	15	22	50	36	2
Two wheeler	189	162	292	112	77
Shared Auto ricks	5	2	12	1	5
Auto rickshaw	38	8	21	9	22
Truck/2 Axle	2	1	0	1	2
3 Axle/MAV	0	0	0	0	0
LCV	14	11	18	7	7
Tractor	0	0	0	0	0
Cycle Rickshaw	5	6	1	1	1
Cycles	10	17	18	2	2
Cart	0	0	0	0	0
Total vehicles	285	231	420	179	124
Total PCU	274	207	380	171	130

Krida Chk

Tukdoji Chk

Tukdoji Chk	Ajini Chk	Rambagh Chk	Baidyanath Chk	Ashok Chk	Krida Chk
City Bus	0	0	0	0	0
Long Distance Bus	0	0	0	0	0
Institutional/Company Bus	0	0	1	1	4
Mini bus	4	1	1	3	4
Van/Maxi Cab	3	5	6	4	7
Car/jeep	45	52	56	45	31
Two wheeler	245	322	294	219	141
Shared Auto rickshaw	7	5	4	5	4
Auto rickshaw	36	51	59	53	19
Truck/2 Axle	2	2	2	1	2
3 Axle/MAV	0	0	0	0	0
LCV	19	17	26	16	18
Tractor	0	0	1	0	0
Cycle Rickshaw	1	1	3	0	0
Cycles	2	2	19	19	12
Cart	0	0	0	0	0
Total vehicles	364	458	472	366	242
Total PCU	347	419	446	342	243

NAGPUR CMP

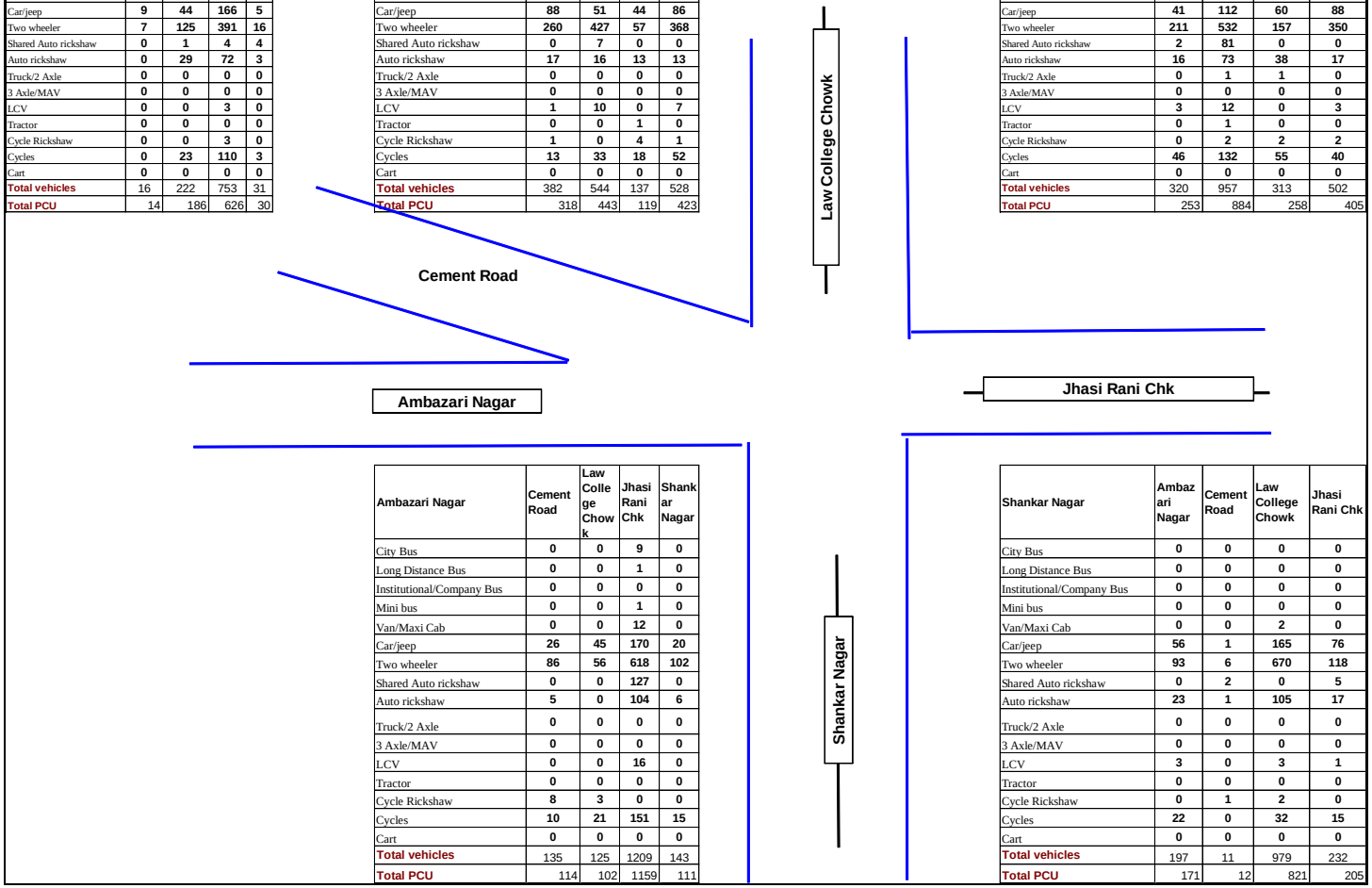
Classified Volume Count Survey

Location: Shankar Nagar CHk

Cement Road	Law College Chowk	Jhasi Rani Chk	Shankar Nagar	Ambazari Nag
City Bus	0	0	0	0
Long Distance Bus	0	0	2	0
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	2	0
Car/jeep	9	44	166	5
Two wheeler	7	125	391	16
Shared Auto rickshaw	0	1	4	4
Auto rickshaw	0	29	72	3
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	0	0	3	0
Tractor	0	0	0	0
Cycle Rickshaw	0	0	3	0
Cycles	0	23	110	3
Cart	0	0	0	0
Total vehicles	16	222	753	31
Total PCU	14	186	626	30

Law College Chowk	Jhasi Rani Chk	Shankar Nagar	Ambazari Nagar	Cement Road
City Bus	0	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	2	0	0	1
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	0	0
Car/jeep	88	51	44	86
Two wheeler	260	427	57	368
Shared Auto rickshaw	0	7	0	0
Auto rickshaw	17	16	13	13
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	1	10	0	7
Tractor	0	0	1	0
Cycle Rickshaw	1	0	4	1
Cycles	13	33	18	52
Cart	0	0	0	0
Total vehicles	382	544	137	528
Total PCU	318	443	119	423

Jhasi Rani Chk	Shankar Nagar	Ambazari Nagar	Cement Road	Law College Chowk
City Bus	0	8	0	0
Long Distance Bus	0	1	0	0
Institutional/Company Bus	0	0	0	2
Mini bus	0	1	0	0
Van/Maxi Cab	1	1	0	0
Car/jeep	41	112	60	88
Two wheeler	211	532	157	350
Shared Auto rickshaw	2	81	0	0
Auto rickshaw	16	73	38	17
Truck/2 Axle	0	1	1	0
3 Axle/MAV	0	0	0	0
LCV	3	12	0	3
Tractor	0	1	0	0
Cycle Rickshaw	0	2	2	2
Cycles	46	132	55	40
Cart	0	0	0	0
Total vehicles	320	957	313	502
Total PCU	253	884	258	405



Ambazari Nagar	Cement Road	Law College Chowk	Jhasi Rani Chk	Shankar Nagar
City Bus	0	0	9	0
Long Distance Bus	0	0	1	0
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	1	0
Van/Maxi Cab	0	0	12	0
Car/jeep	26	45	170	20
Two wheeler	86	56	618	102
Shared Auto rickshaw	0	0	127	0
Auto rickshaw	5	0	104	6
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	0	0	16	0
Tractor	0	0	0	0
Cycle Rickshaw	8	3	0	0
Cycles	10	21	151	15
Cart	0	0	0	0
Total vehicles	135	125	1209	143
Total PCU	114	102	1159	111

Shankar Nagar	Ambazari Nagar	Cement Road	Law College Chowk	Jhasi Rani Chk
City Bus	0	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	2	0
Car/jeep	56	1	165	76
Two wheeler	93	6	670	118
Shared Auto rickshaw	0	2	0	5
Auto rickshaw	23	1	105	17
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	3	0	3	1
Tractor	0	0	0	0
Cycle Rickshaw	0	1	2	0
Cycles	22	0	32	15
Cart	0	0	0	0
Total vehicles	197	11	979	232
Total PCU	171	12	821	205

Nagpur Improvement Trust SINCE 1936

Urban Mass Transit Company Limited

NAGPUR CMP

Classified Volume Count Survey

Location: Variety Chk

LIC Chk

LIC Chk	Sita Burdi	Munje Chk	Bardi	Amravati Chk
City Bus	0	2	5	36
Long Distance Bus	0	0	6	8
Institutional/Company Bus	0	2	0	10
Mini bus	0	0	3	0
Van/Maxi Cab	0	0	5	0
Car/jeep	32	55	98	146
Two wheeler	92	312	648	176
Shared Auto rickshaw	0	0	47	11
Auto rickshaw	29	36	273	42
Truck/2 Axle	0	0	2	0
3 Axle/MAV	0	0	3	0
LCV	0	8	4	26
Tractor	0	0	0	0
Cycle Rickshaw	4	0	0	0
Cycles	10	35	38	17
Cart	0	0	0	0
Total vehicles	167	450	1132	472
Total PCU	147	376	1087	535

Sita Burdi

Sita Burdi	Munje Chk	Bardi	Amravati Chk	LIC Chk
City Bus	0	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	0	0
Car/jeep	0	0	0	0
Two wheeler	0	0	0	0
Shared Auto rickshaw	0	0	0	0
Auto rickshaw	0	0	0	0
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	0	0	0	0
Tractor	0	0	0	0
Cycle Rickshaw	0	0	0	0
Cycles	0	0	0	0
Cart	0	0	0	0
Total vehicles	0	0	0	0
Total PCU	0	0	0	0

Amravati Chk

Amravati Chk	LIC Chk	Sita Burdi	Munje Chk	Bardi
City Bus	0	0	2	4
Long Distance Bus	7	0	8	1
Institutional/Company Bus	0	0	0	1
Mini bus	0	0	0	0
Van/Maxi Cab	1	4	4	2
Car/jeep	68	25	85	44
Two wheeler	131	343	469	134
Shared Auto rickshaw	47	0	1	19
Auto rickshaw	118	66	51	62
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	10	16	8	0
Tractor	0	0	0	0
Cycle Rickshaw	0	29	2	7
Cycles	27	110	43	38
Cart	0	0	0	0
Total vehicles	409	593	673	312
Total PCU	454	499	568	302

Munje Chk

Munje Chk	Bardi	Amravati Chk	LIC Chk	Sita Burdi
City Bus	0	0	0	0
Long Distance Bus	0	1	0	0
Institutional/Company	0	0	0	0
Mini bus	0	1	0	0
Van/Maxi Cab	0	0	3	0
Car/jeep	1	75	79	6
Two wheeler	78	943	436	13
Shared Auto rickshaw	1	0	4	0
Auto rickshaw	12	69	13	1
Truck/2 Axle	1	0	0	0
3 Axle/MAV	0	0	0	0
LCV	2	20	10	1
Tractor	0	0	0	0
Cycle Rickshaw	4	16	3	0
Cycles	21	292	47	6
Cart	0	0	0	0
Total vehicles	120	1417	595	27
Total PCU	101	1083	483	22

Bardi

Bardi	Amravati Chk	LIC Chk	Sita Burdi	Munje Chk
City Bus	24	1	0	2
Long Distance Bus	30	11	0	0
Institutional/Company Bus	2	0	0	0
Mini bus	5	4	0	0
Van/Maxi Cab	13	1	0	0
Car/jeep	20	106	27	6
Two wheeler	189	383	113	22
Shared Auto rickshaw	24	59	5	0
Auto rickshaw	77	209	35	2
Truck/2 Axle	2	6	0	0
3 Axle/MAV	0	0	0	0
LCV	18	2	0	0
Tractor	0	0	0	0
Cycle Rickshaw	4	2	5	1
Cycles	28	64	23	2
Cart	0	0	0	0
Total vehicles	436	848	208	35
Total PCU	513	859	183	32

Nagpur Improvement Trust

Urban Mass Transit Company Limited

NAGPUR CMP

Classified Volume Count Survey

Location: Ashok Chowk

Gandhi Gate	Reshim Bagh	Sakkardar Chowk	Medical Chowk	Baidyanath Chowk
City Bus	0	0	0	0
Long Distance Bus	2	9	0	0
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	1	0
Van/Maxi Cab	0	0	0	0
Car/jeep	34	65	80	7
Two wheeler	169	455	435	110
Shared Auto rickshaw	0	8	16	0
Auto rickshaw	26	65	55	3
Truck/2 Axle	4	2	2	1
3 Axle/MAV	1	0	0	0
LCV	3	10	5	4
Tractor	0	0	0	0
Cycle Rickshaw	0	5	11	5
Cycles	12	193	131	38
Cart	0	0	0	0
Total vehicles	251	812	736	168
Total PCU	229	654	607	132

Gandhi Gate

Reshim Bagh	Sakkardar Chowk	Medical Chowk	Baidyanath Chowk	Gandhi Gate
City Bus	0	0	0	0
Long Distance Bus	0	1	36	0
Institutional/Company Bus	0	0	10	2
Mini bus	0	1	0	0
Van/Maxi Cab	0	0	6	0
Car/jeep	5	41	270	48
Two wheeler	107	312	1117	437
Shared Auto rickshaw	1	2	12	3
Auto rickshaw	4	13	115	34
Truck/2 Axle	0	9	12	5
3 Axle/MAV	0	0	9	0
LCV	1	8	13	8
Tractor	0	0	0	0
Cycle Rickshaw	2	7	16	2
Cycles	32	166	118	41
Cart	0	0	0	0
Total vehicles	152	560	1734	580
Total PCU	113	445	1573	488

Reshim Bagh

Baidyanath Chowk	Gandhi Gate	Reshim Bagh	Sakkardar Chowk	Medical Chowk
City Bus	0	0	0	0
Long Distance Bus	0	19	15	0
Institutional/Company Bu	0	0	1	0
Mini bus	0	0	1	0
Van/Maxi Cab	0	1	1	0
Car/jeep	3	24	18	2
Two wheeler	33	169	116	1
Shared Auto rickshaw	0	0	0	0
Auto rickshaw	1	40	23	0
Truck/2 Axle	0	0	1	0
3 Axle/MAV	0	0	0	0
LCV	0	8	1	0
Tractor	0	0	0	0
Cycle Rickshaw	1	13	4	0
Cycles	17	35	18	1
Cart	0	0	0	0
Total vehicles	55	309	0	0
Total PCU	39	296	192	3

Baidyanath Chowk

Medical Chowk

Medical Chowk	Baidyanath Chowk	Gandhi Gate	Reshim Bagh	Sakkardar Chowk
City Bus	0	0	0	0
Long Distance Bus	0	2	0	0
Institutional/Company Bus	0	0	1	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	1	0
Car/jeep	7	65	76	20
Two wheeler	47	725	248	45
Shared Auto rickshaw	0	1	2	1
Auto rickshaw	2	39	20	7
Truck/2 Axle	0	0	12	0
3 Axle/MAV	0	0	1	0
LCV	1	14	14	1
Tractor	0	0	0	0
Cycle Rickshaw	0	8	4	1
Cycles	4	220	75	8
Cart	0	0	0	0
Total vehicles	61	1074	454	83
Total PCU	49	815	420	72

Sakkardar Chowk

Sakkardar Chowk	Medical Chowk	Baidyanath Chowk	Gandhi Gate	Reshim Bagh
City Bus	0	0	0	0
Long Distance Bus	0	6	1	0
Institutional/Company Bus	0	0	13	0
Mini bus	0	0	2	0
Van/Maxi Cab	1	0	0	0
Car/jeep	11	56	98	1
Two wheeler	258	515	836	3
Shared Auto rickshaw	0	18	2	0
Auto rickshaw	8	55	80	0
Truck/2 Axle	1	2	18	0
3 Axle/MAV	0	0	0	0
LCV	3	0	27	0
Tractor	0	0	0	0
Cycle Rickshaw	0	15	32	0
Cycles	47	187	118	2
Cart	0	0	0	0
Total vehicles	329	854	1227	6
Total PCU	249	681	1097	4

NAGPUR CMP

Classified Volume Count Survey

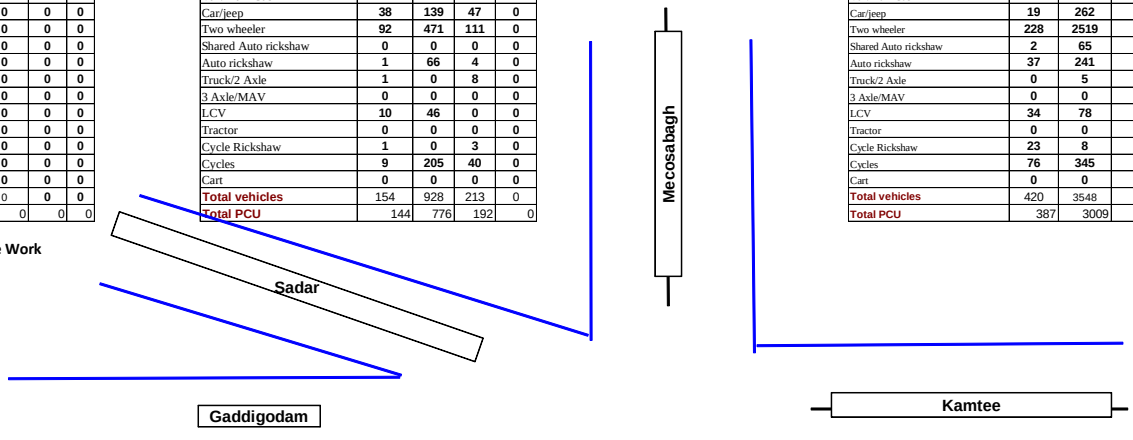
Location: Kadbi Chowk

Sadar	Mecosabagh	Kamtee	Rly Stn	Gaddigodam
City Bus	0	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	0	0
Car/jeep	0	0	0	0
Two wheeler	0	0	0	0
Shared Auto rickshaw	0	0	0	0
Auto rickshaw	0	0	0	0
Truck/2 Axle	0	0	0	0
3 Axle/MAV	0	0	0	0
LCV	0	0	0	0
Tractor	0	0	0	0
Cycle Rickshaw	0	0	0	0
Cycles	0	0	0	0
Cart	0	0	0	0
Total vehicles	0	0	0	0
Total PCU	0	0	0	0

Mecosabagh	Kamtee	Rly Stn	Gaddigodam	Sadar
City Bus	1	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	0	0	0	0
Mini bus	1	0	0	0
Van/Maxi Cab	0	1	0	0
Car/jeep	38	139	47	0
Two wheeler	92	471	111	0
Shared Auto rickshaw	0	0	0	0
Auto rickshaw	1	66	4	0
Truck/2 Axle	1	0	8	0
3 Axle/MAV	0	0	0	0
LCV	10	46	0	0
Tractor	0	0	0	0
Cycle Rickshaw	1	0	3	0
Cycles	9	205	40	0
Cart	0	0	0	0
Total vehicles	154	928	213	0
Total PCU	144	776	192	0

Kamtee	Rly Stn	Gaddigodam	Sadar	Mecosabagh
City Bus	0	7	0	0
Long Distance Bus	0	16	0	0
Institutional/Company Bus	0	1	0	0
Mini bus	0	4	0	0
Van/Maxi Cab	1	4	0	0
Car/jeep	19	262	0	50
Two wheeler	228	2519	0	182
Shared Auto rickshaw	2	65	0	0
Auto rickshaw	37	241	0	8
Truck/2 Axle	0	5	0	7
3 Axle/MAV	0	0	0	0
LCV	34	78	0	4
Tractor	0	0	0	0
Cycle Rickshaw	23	8	0	3
Cycles	76	345	0	30
Cart	0	0	0	0
Total vehicles	420	3548	0	284
Total PCU	387	3009	0	252

Under Maintenance Work



Gaddigodam	Sadar	Mecosabagh	Kamtee	Rly Stn
City Bus	0	0	11	0
Long Distance Bus	0	0	11	0
Institutional/Company Bus	0	4	0	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	0	1
Car/jeep	0	18	71	3
Two wheeler	0	85	610	90
Shared Auto rickshaw	0	0	3	2
Auto rickshaw	0	2	74	1
Truck/2 Axle	0	0	7	0
3 Axle/MAV	0	0	2	0
LCV	0	0	19	0
Tractor	0	0	0	1
Cycle Rickshaw	0	1	1	3
Cycles	0	10	23	16
Cart	0	0	0	0
Total vehicles	0	120	832	117
Total PCU	0	99	763	91

Rly Stn	Gaddigodam	Sadar	Mecosabagh	Kamtee
City Bus	0	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	0	0	0	0
Mini bus	1	0	0	0
Van/Maxi Cab	0	0	0	0
Car/jeep	27	0	58	43
Two wheeler	275	0	550	260
Shared Auto rickshaw	24	0	0	2
Auto rickshaw	4	0	35	45
Truck/2 Axle	2	0	8	4
3 Axle/MAV	1	0	0	0
LCV	3	0	14	11
Tractor	2	0	1	0
Cycle Rickshaw	5	0	2	15
Cycles	132	0	43	96
Cart	0	0	0	0
Total vehicles	476	0	711	476
Total PCU	382	0	601	407

NAGPUR CMP

Classified Volume Count Survey

Location: Kamptee road and Inner ring road

Kamptee	Pardi	Itwari	Kadbi	Mankapur CHk
City Bus	0	0	4	0
Long Distance Bus	0	0	10	0
Institutional/Company Bus	0	0	1	3
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	16	0
Car/jeep	30	0	132	39
Two wheeler	180	0	754	137
Shared Auto rickshaw	1	0	31	0
Auto rickshaw	8	0	12	14
Truck/2 Axle	8	0	13	15
3 Axle/MAV	4	0	11	12
LCV	20	0	37	25
Tractor	0	0	3	0
Cycle Rickshaw	6	0	17	1
Cycles	39	0	150	37
Cart	0	0	0	0
Total vehicles	296	0	1191	283
Total PCU	297	0	1105	348

Kamptee

Pardi	Itwari	Kadbi	Mankapur CHk	Kamptee
City Bus	0	0	0	0
Long Distance Bus	0	0	0	1
Institutional/Company Bus	0	0	0	0
Mini bus	0	0	0	1
Van/Maxi Cab	0	0	6	1
Car/jeep	0	12	43	27
Two wheeler	0	247	194	100
Shared Auto rickshaw	0	0	0	1
Auto rickshaw	0	3	12	6
Truck/2 Axle	0	2	48	8
3 Axle/MAV	0	6	98	10
LCV	0	6	20	18
Tractor	0	0	0	0
Cycle Rickshaw	0	0	9	1
Cycles	0	237	415	27
Cart	0	0	0	0
Total vehicles	0	513	845	201
Total PCU	0	365	1058	243

Mankapur CHk

Pardi

Mankapur CHk	Kamptee	Pardi	Itwari	Kadbi
City Bus	0	0	0	0
Long Distance Bus	0	0	0	0
Institutional/Company Bus	3	0	0	0
Mini bus	0	0	0	0
Van/Maxi Cab	0	0	0	0
Car/jeep	43	32	0	8
Two wheeler	145	236	0	22
Shared Auto rickshaw	0	0	0	0
Auto rickshaw	14	7	0	0
Truck/2 Axle	8	17	0	7
3 Axle/MAV	8	51	0	0
LCV	25	32	0	1
Tractor	0	0	0	0
Cycle Rickshaw	0	4	0	3
Cycles	71	118	0	21
Cart	0	0	0	0
Total vehicles	317	497	0	62
Total PCU	330	625	0	70

Itwari

Kadbi

Kadbi	Mankapur CHk	Kamptee	Pardi	Itwari
City Bus	0	4	0	0
Long Distance Bus	0	9	0	0
Institutional/Company Bus	0	1	0	0
Mini bus	0	2	0	0
Van/Maxi Cab	0	54	0	0
Car/jeep	4	171	68	0
Two wheeler	20	496	149	0
Shared Auto rickshaw	0	73	1	0
Auto rickshaw	0	27	6	0
Truck/2 Axle	0	20	23	0
3 Axle/MAV	1	19	30	0
LCV	2	66	26	0
Tractor	0	3	0	0
Cycle Rickshaw	0	6	0	0
Cycles	20	114	20	0
Cart	0	0	0	0
Total vehicles	47	1065	323	0
Total PCU	37	1181	468	0

Itwari	Kadbi	Mankapur CHk	Kamptee	Pardi
City Bus	0	0	0	0
Long Dista	0	0	0	0
Institution	0	0	0	0
Mini bus	0	0	0	0
Van/Maxi	0	0	0	0
Car/jeep	0	0	0	0
Two whee	0	0	0	0
Shared Au	0	0	0	0
Auto ricks	0	0	0	0
Truck/2 A	0	0	0	0
3 Axle/MA	0	0	0	0
LCV	0	0	0	0
Tractor	0	0	0	0
Cycle Rick	0	0	0	0
Cycles	0	0	0	0
Cart	0	0	0	0
Total	0	0	0	0
Total PC	0	0	0	0

Under Construction

Nagpur Improvement Trust

Urban Mass Transit Company Limited

Annexure 2

Population and Employment Projections

Zone	Population			Employment		
	2012	2022	2032	2012	2022	2032
1	15326	18549	26167	2428	5856	10897
2	23284	32741	46010	2675	6159	11021
3	26486	32945	47239	2550	5831	10345
4	23707	47700	75507	3847	8843	15598
5	11764	15749	18896	1452	3392	6224
6	10292	12279	14407	1816	4417	8346
7	21739	27003	32215	2704	6372	11768
8	19356	25156	25470	5971	14889	28683
9	26916	27248	32588	2442	5686	10409
10	14373	24575	29907	1811	1622	1266
11	13590	15541	17673	1394	3245	5962
12	20844	27546	34765	1920	1685	1226
13	27750	52056	65028	2475	5181	8645
14	15956	22781	32137	903	1799	2774
15	12633	23151	31590	4737	11736	22334
16	26217	35915	42239	4222	7451	11131
17	20813	24561	28947	4248	7772	11971
18	24309	32445	36725	3663	6433	9604
19	22690	24269	29560	3149	3261	3272
20	17039	21839	22112	2465	2485	2503
21	14291	16086	17769	1896	1929	1929
22	20807	24135	27719	3255	3393	3476
23	14811	16672	18416	2471	2616	2750
24	11520	12967	14324	2243	4104	6344
25	10371	22029	24334	2968	5314	8077
26	13518	15216	16808	1822	3221	4847
27	24520	40197	50214	3103	7091	12754
28	11522	34737	49005	645	845	497
29	15103	23158	42670	1036	2137	3188
30	15335	20731	25897	3542	8694	16485
31	9184	12962	14318	2862	7115	13655
32	10017	12053	16477	2137	3918	5989
33	16408	18470	20402	4709	8825	13889
34	17187	19345	21369	4181	4636	5142
35	17075	16942	18714	4865	5527	6292
36	13903	15649	17287	7850	9197	10800
37	19201	21613	23874	3986	4345	4728
38	16566	18647	20597	4361	4872	5449
39	13201	14859	16414	3847	4336	4895
40	14481	16300	18005	6945	8078	9419
41	19850	24941	27551	3892	4151	4404
42	21837	31792	49777	7627	8540	9226

Zone	Population			Employment		
	2012	2022	2032	2012	2022	2032
43	23497	42002	65762	17711	20590	23534
44	10188	19545	21589	2245	2272	2256
45	12762	29935	44903	17795	45443	88325
46	4203	24893	46903	6717	16829	31990
47	23751	29899	35981	20797	40198	64623
48	35453	38515	42499	30570	59220	95452
49	29280	32666	36489	26473	51299	82692
50	15042	19165	30006	8828	10305	11847
51	13208	19333	20430	2941	3125	3323
52	16076	17818	18897	3978	4426	4945
53	20717	21858	22937	3024	3166	3313
54	19991	20238	24310	3895	4266	4621
55	17811	18810	20884	5578	6352	7246
56	21787	22911	26995	5715	6421	7185
57	20757	22803	26887	9337	10839	12572
58	16109	16862	17742	18013	21557	25855
59	24127	25767	27416	2625	2587	2501
60	5980	15637	17273	2583	2776	2973
61	19981	19085	21082	6933	7997	9247
62	13149	17700	19552	12443	14746	17510
63	10918	15887	17549	11153	13218	15695
64	18209	17263	17699	3111	3382	3701
65	18702	18774	19248	7660	8891	10380
66	18164	18234	18695	6173	7091	8199
67	19678	19753	20252	3171	3395	3657
68	11003	12385	13681	13764	16484	19768
69	12717	14315	15812	12748	15199	18151
70	17981	21428	23670	7051	8085	9292
71	16233	21836	22388	11159	13083	15416
72	12320	16974	18750	14161	16858	20104
73	12524	11288	12469	6206	7296	8597
74	13346	13397	13736	3803	4317	4936
75	8704	8737	8958	3872	4512	5287
76	20889	20969	21499	5137	5763	6513
77	10177	20154	22262	5000	5615	6315
78	23192	27738	29594	19608	23241	27627
79	8131	14475	27036	18879	22669	26990
80	20252	23600	26293	25996	31128	37319
81	12412	25815	40418	26870	52242	84135
82	16041	18056	19946	12195	23559	37900
83	11169	14381	17965	10270	19861	31923
84	36949	30474	33662	2871	4922	7216
85	10010	14943	19878	3024	5593	8637

Zone	Population			Employment		
	2012	2022	2032	2012	2022	2032
86	35420	26829	29635	6513	7301	8194
87	24726	49483	77476	14672	16707	18522
88	21696	29749	46578	12185	14145	16135
89	18967	29134	32182	9619	11032	12682
90	6215	12691	14019	7526	8872	10481
91	10857	20194	22307	9541	11150	13061
92	5347	10576	11682	7681	9111	10829
93	15712	26874	29685	3919	4137	4337
94	11332	15034	16607	3632	4070	4566
95	10955	16888	18655	3202	3502	3825
96	17471	21944	24239	4331	7998	12451
97	22377	34903	49239	3804	9035	16601
98	11144	15959	17629	2045	3643	5515
99	14872	22436	24783	2310	4010	5942
100	14485	14919	16480	4750	8990	14251
101	15158	18569	20512	3542	6526	10143
102	17057	11028	12182	2583	4819	7559
103	15082	22672	25044	2295	3975	5880
104	19095	20533	22681	3892	7167	11135
105	14925	16800	18557	2995	5491	8503
106	16656	13018	14379	1437	2516	3756
107	29842	31313	34589	2964	5085	7460
108	15860	28362	44406	4324	7832	11700
109	11134	20269	31736	5402	10143	15767
110	19664	22135	24450	7673	14567	23146
111	22622	25464	28128	8365	15848	25146
112	17106	16976	18752	8086	15502	24805
113	16788	18077	19968	3696	6840	10666
114	26775	39181	48946	5806	10488	15920
115	11923	32766	75063	1883	2925	2978
116	47782	57246	62682	2325	3211	3738
117	22371	18414	20340	5303	9993	15794
118	19838	14438	15948	6975	13377	21411
119	22239	23654	37035	6047	11332	17578
120	27534	49151	86956	5850	10338	14770
121	26841	30340	63514	1542	2311	2253
122	24493	33929	42384	1828	2788	3532
123	22555	26527	29303	1471	2262	2987
124	18264	18280	20192	1746	3000	4406
125	19849	22342	24679	2148	3694	5430
126	13847	21236	23458	2188	3799	5630
127	15120	22715	25092	2509	4395	6562
128	15968	10694	11813	2604	4867	7647

Zone	Population			Employment		
	2012	2022	2032	2012	2022	2032
129	16420	21899	24191	1449	2329	3218
130	31919	59807	74712	2125	2757	2712
131	24608	45492	56829	2684	5878	10211
132	13687	18824	20793	1447	3306	6008
133	21465	27269	30122	3012	7163	13373
134	26769	34688	38317	2494	5644	10191
135	22292	41468	58501	4519	10733	19721
136	24947	33105	36568	3277	7711	14298
137	10344	13680	15732	1747	2130	2222
138	13284	13551	13686	1899	2315	2496
139	7519	7670	7747	1938	2362	2695
140	6607	6740	6807	2017	2459	2835
141	13021	13283	13416	2196	2677	2944
142	11945	12185	12307	1936	2360	2584
143	14044	14326	14469	4292	5232	6033
144	19884	20283	20486	1187	1447	1276
145	16248	16575	16741	1995	2432	2566
146	12407	12657	12783	1400	1707	1776
147	22083	22527	22753	2145	2615	2646
148	20663	21079	21289	1315	1603	1447
149	40728	46577	59622	3500	4266	3782
150	4576	5233	6699	1398	1705	1918
151	13350	15267	19544	2810	3425	3710
152	33971	38849	49730	4682	9210	13819
153	21261	8314	11124	4411	127590	179000
154	11500	13151	16835	4115	10673	20595
155	48775	55779	71401	1496	3880	5933
156	28239	31506	35673	3231	8380	15636
157	114212	130612	167195	2345	6082	7986
158	10240	11424	12935	2086	5411	10336
159	26721	30558	39117	2366	2884	2585
160	35450	39550	64782	1833	2234	1182
161	13891	15885	20335	1329	1620	1491
162	10876	12134	13738	5425	6613	7734
163	6680	7453	8439	1441	1757	1940
164	11767	13128	14864	1396	1702	1721
165	4679	5221	5911	1030	1256	1390
166	7267	8310	10638	1250	1524	1604
167	9102	10409	13325	1107	1349	1328
168	8258	9444	12089	1701	2074	2240
169	10740	12282	15722	1882	2294	2422
170	31538	36066	66168	3011	3670	2899
171	14759	16878	21606	1510	1841	1730

Zone	Population			Employment		
	2012	**2022**	**2032**	**2012**	**2022**	**2032**
172	9913	11336	14512	2909	3546	3977
173	16573	18490	20935	2064	2516	2569
174	11365	12997	16638	2473	3015	3279
175	9001	10294	13177	2115	2578	2829
176	16243	18121	20518	1864	2272	2281
177	8914	9945	11260	1624	1980	2145
178	2407	2685	3041	1454	1772	2087
179	3817	4258	4822	1256	1532	1752
180	4886	5452	6173	1358	1656	1871
181	2224	2481	2810	1310	1596	1879
182	23312	26659	34126	5315	13786	26306
183	27905	31912	40850	5715	14823	28187

Annexure 3

List of NMC Proposals

Road Widening and Development Proposals

Sr.No	Name of Road	Unit	Length in Km	Cost per Km	Amount in Rs. lakhs
1	Old Bhandara Road, Mayo Hospital Chowk to Juni Motor Stand Chowk	Km	3.0	100	300
2	Road in front of Itwari Railway Station	Km	0.5	100	50
3	Inner Circular Corridor (Four Lane to Six Lane)	Km	19.0	100	1900
4	North-South Corridor (Four Lane to Six Lane)	Km	10.0	100	1000
5	All Radial Roads (Except Katol Road) (Four Lane to Six Lane)	Km	94.0	100	9400
6	Inner Ring Road (Four Lane to Six Lane)	Km	45.0	100	4500
7	Wardha Road to Jaitala Road up to Hingana Road	Km	8.0	100	800
8	Wardha Road via Manishnagar Railway Crossing up to Beltarodi Road	Km	4.0	100	400
9	Parallal Road to Railway line from Narendranagar RoB to Khapari RoB	Km	5.0	100	500
10	Manishnagar T-Point to Beltarodi via Reliance Fresh	Km	2.0	100	500
	Total				19350

Development of Missing Links

Sr. No	Name of Missing Link	Unit	Length in Km.	Unit Cost (in lakhs)	Total Cost (in lakhs)
1	Four Lane (Ridge Road to Ajani Road)	Km	0.5	300	150
2	Four Lane (Narendra Nagar Ring Road to Suyog Nagar T Point)	Km	0.5	300	150
4	Four Lane (NH-7 to Mangalwari level crossing, Sadar)	Km	0.5	300	150
5	Road connecting from Inner ring road - Babulkheda-Chinchbhavan	Km	7	300	2100
6	Old Morris College - Rabindaranath Tagore Marg (via Science College)	Km	0.7	300	210
7	Road connecting from Ring road to Middle ring road	Km	1.2	300	360
8	Road connecting from Kamptee road to Nari road	Km	2.5	300	750
9	Road connecting from Kamptee road to Guru Nanak College road	Km	0.4	300	120
10	Road connecting from Wardha road to North of Central jail	Km	1.8	300	540
11	Road from Nari Village to Proposed outer ring road	Km	1.8	300	540
	Sub Total				5070

Proposals for Grade Separators/Fly Overs

Sr.No.	Location	Unit	Length	Unit Cost in Rs.lakhs	Amount in Rs.Lakhs
1	N.I.T. Square to Chhavani	Rm	1400	6	8550
2	Telephone Exchange Chowk	Rm	300	6	2100
3	Agrasen Chowk- GanjaKhet Chowk	Rm	1000	6	6300
4	Automotive Square	Rm	300	6	2100
5	Ashok Chowk	Rm	300	6	2100
6	Manewada Ring Road Junction	Rm	300	6	2100
7	Shankar Nagar Square	Rm	300	6	2100
8	All major Ring road Junctions(10 Junctions)	Rm	300	6	1800
9	Bhandara Road at Near Pardi Village	Rm	1140		6350
Sub Total					31400

Rail Under Bridge (RUB) proposals

Sr.No.	Location	Unit	No	Unit Cost in Rs.lakhs	Amount in Rs.Lakhs
1	Four Lane RUB near Kamptee Naka	Nos	1	2500	2500
2	Four Lane RUB near Gurudwara, NH-7	Nos	1	2500	2500
3	Four Lane- RUB near Noga Factory,Kadabi Chowk to Mominpura Road	Nos	1	2500	2500
4	Loha Pool	Nos	1	2500	2500
Sub Total					10000

Rail Over Bridge (ROB) Proposals

Sr.No.	Location	Unit	Length	Unit Cost in Rs.lakhs	Amount in Rs.Lakhs
1	Four Lane- Kawalapeth Level Crossing	Rm	225	6	1650
2	Two Lane to Four Lane- ROB near Panchpaoli	Rm	1140	2.5	3150
3	Two Lane to Four Lane- ROB near Jaripataka Water Tank	Rm	225	2.5	863
4	Widening of RoB at Ajani to 6 lane	Rm	100	50	5000
5	Four Lane- Mangalwari Level Crossing	Rm	225	6	1650
6	Two Lane to Four Lane- ROB near Noga Factory,Kadabi Chowk to Mominpura Road	Rm	225	2.5	863
7	Four Lane- Manish Nagar Level Crossing	Rm	225	6	4600
8	Four lane- Deshpande lay out, Ring Road	Rm	225	6	1650
	Total				17776

Proposal of Bridges on the River

Sr.No.	Location	Unit	Length	Unit Cost in Rs.lakhs	Amount in Rs.Lakhs
1	Improvement of Bridge on Nag River near Needose Hotel, Dhantoli	Rm	70	6	420
2	Improvement of Bridge on Nag River near Old Shukkrawari	Rm	70	6	420
3	Improvement of Bridge on Hattinalah near Gangabai Ghat	Rm	70	6	420
4	Improvement of Bridge on Pioli River near Transport Plaza, Kamptee Road	Rm	40	6	240
5	Improvement of Bridge on Pioli River near Mankapur	Rm	60	6	360
6	Bridge on Pioli River ,Near Nara Ghat	Rm	50	6	300
6	4 Bridges on Inner Ring Road	Rm	120	6	720
7	Bridge on Middle ring road near KDK college	Rm	70	6	420
	Total				2880

Goods Transport Improvement Proposals

Sr.No.	Location	Unit	No	Unit Cost in Rs.lakhs	Amount in Rs.Lakhs
1	Pardi Naka,Bhandara Road	Nos	1	5000	5000
3	Wadi Naka, Amaravati Road	Nos	1	5000	5000
4	Khapri Naka, Wardha Road	Nos	1	5000	5000
	Total		3		15000

Abstract

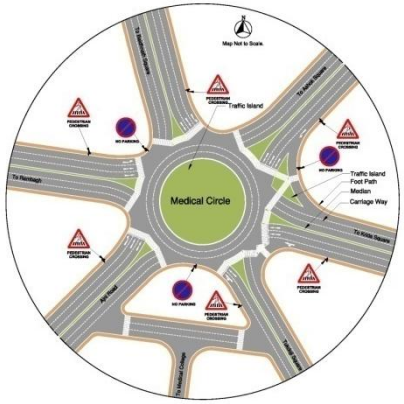
Sr.No	Sector	No/Km	Estimated Cost in Rs. Lakhs
1	Road Widening and Development Proposals	190.50 Kms	19350
2	Development of Missing Links	16.90	5070
3	Proposals for Grade Separators/Fly Overs	9 Nos	31400
4	Rail Under Bridge (RUB) proposals	4 Nos	10000
5	Rail Over Bridge (ROB) Proposals	8	17776
6	Proposal of Bridges on the River	7	2880
7	Goods Transport Improvement Proposals	3 Nos.	15000
		Total	85476 Lakhs

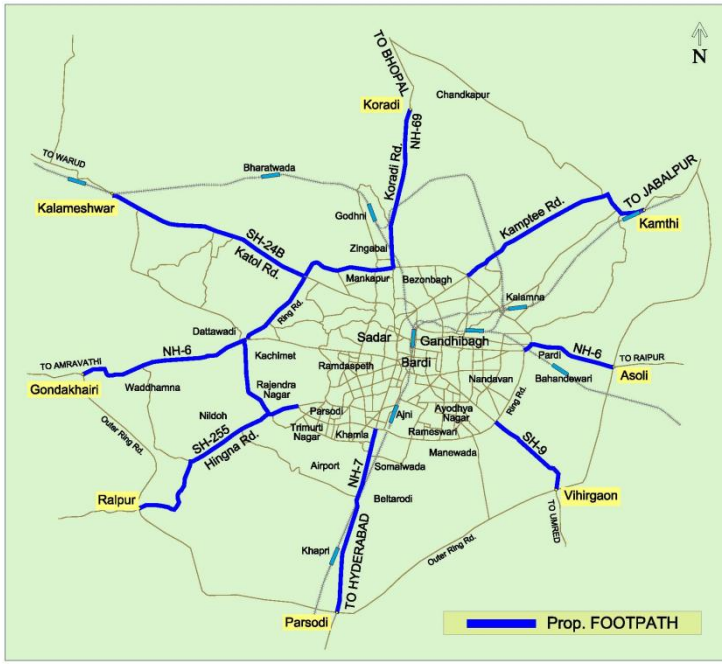
Annexure 4

Project Profiles

Project No: 1	**Project Title:** Traffic & Pedestrian Management Measures – Signage and Markings
Project Type : Short term	**Length:** 149 Km
Locations: Roads with in Nagpur City and critical stretches outside city.	**Approximate Capital Cost (Rs) : 7.45 Crores**
Detailed Description: **Pavement Markings** such as center line, traffic lane lines, stop lines, pedestrian crossings, parking space limits, kerb marking for visibility, Obstruction marking etc should be provided. Markings should be provided according to IRC: 35-1997 Signage: It is recommended that signs near schools should be installed on priority basis. All the traffic signs should be facilitated as per the guidelines provided in IRC publication 67-2001.	
Implementation Period: 2012-2016 (58%) **2017-2022 (42%)**	**Potential Benefits:** Benefits include smooth traffic flow, vehicle safety especially for night time driving and pedestrian safety.

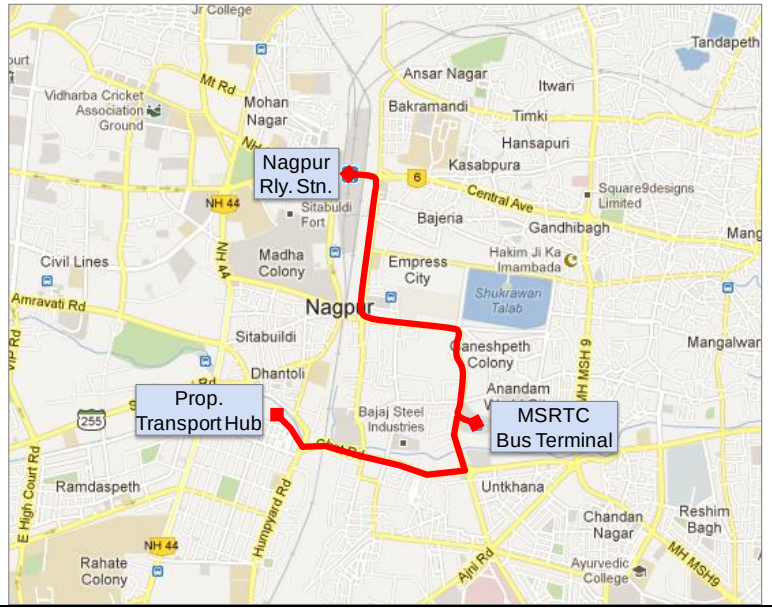
<table>
<tr><td>Project No: 2</td><td colspan="2">Project Title: Traffic Management – Junction Improvement</td></tr>
<tr><td colspan="2">Project Type : Short Term</td><td>No of Junctions: 10 (with in Town)</td></tr>
<tr><td colspan="2">Locations: With in town
Shankar Nagar Chowk
Golibar Chowk
Indora Chowk
Chatrapati Chowk
Variety Chowk
Cotton Market Chowk
Ashok Chowk
RBI Chowk
Medical Chowk
Jaystambh chowk near railway station</td><td>Approximate Capital Cost (Rs) : 2.0 Crores</td></tr>
<tr><td colspan="2">Detailed Description:

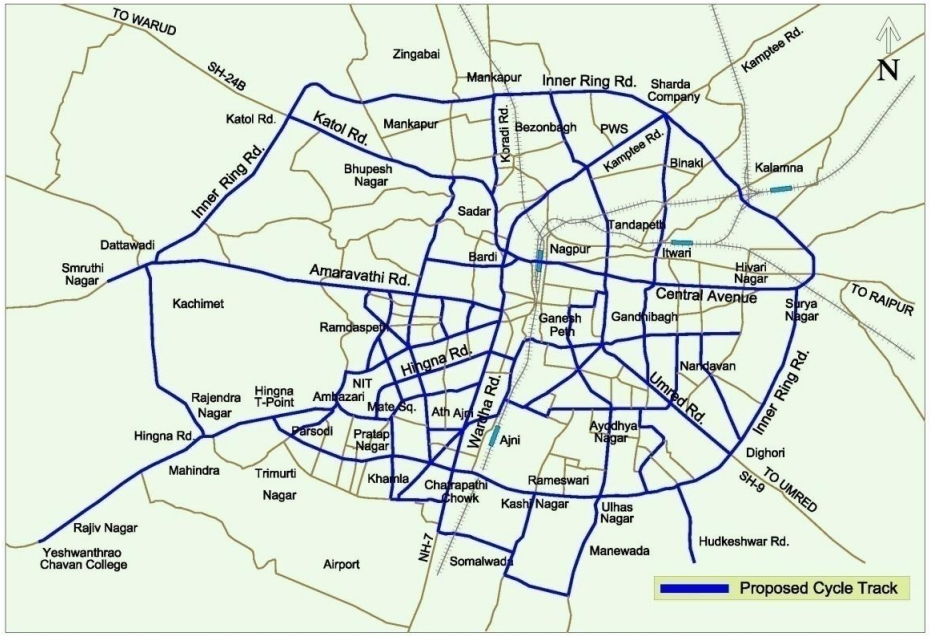
The critical junctions to be improved by utilizing the existing RoW or with minimum land acquisition are evolved as part of this project. The proposed improvements include redesign of junctions by providing better turning radius, removal of obstructions, provision of median, footpath, installation of traffic/pedestrian markings and signage etc.</td><td> 
</td></tr>
<tr><td>Implementation Period: 2012-2016</td><td colspan="2">Potential Benefits:
The proposed traffic management measures will reduce traffic conflicts and delay at junctions, ensure smooth traffic maneuvering, enable safe pedestrian movements and crossing with minimum cost.</td></tr>
</table>

Project No: 3	**Project Title:** Construction of footpaths – Nagpur city
Project Type : Short Term	**Length : 85 Km**
Location: Nagpur Metro Region	**Approximate Capital Cost (Rs) : 17 Crores**
Detailed Description: Foot paths are constructed along 1. NH-6 2. Kamptee road 3. SH-9 4. NH-7 5. Hingna road /SH-255 6. SH24 B/ KAtol Road 7. Koradi Road	
Implementation Period: 2017-2022 (85Km)	**Potential Benefits**: Quick movement of people in entering Nagpur Metro region through public transport.

Project No: 4	**Project Title:** Bus Augmentation
Project Type : Medium Term	**No of Buses: 1480**
Locations: In Nagpur Metro region	**Approximate Capital Cost (Rs) : 740 Crores**
Detailed Description: Augmenting the buses based on population i.e., 50 buses per lakh population.	
Implementation Period: 2012- 2016 (1250 Buses) **2017-2021 (350 Buses)** **2022- 2031 (400 Buses)**	**Potential Benefits:** Reduction in Vehicular traffic, Congestion on roads, Vehicular emissions and therefore increase in speeds.

Project No: 5	**Project Title:** Bus Transport Plan – Bus shelters
Project Type : Short term and Medium Term	**No of Bus shelters:** 1762
Locations: Roads with in town and outside areas	**Approximate Capital Cost (Rs) : 123.34 Crores**
Detailed Description: Bus shelters are proposed on all the present bus routes in the Nagpur city area for every 500 meters and for every 1km outside the city area.	
Implementation Period: 2012 -2016 (1000 shelters) **2017-2022 (762 shelters)**	**Potential Benefits:** Benefits for passengers boarding and alighting from the bus. Designating the bus stop locations will provide smooth traffic flow.

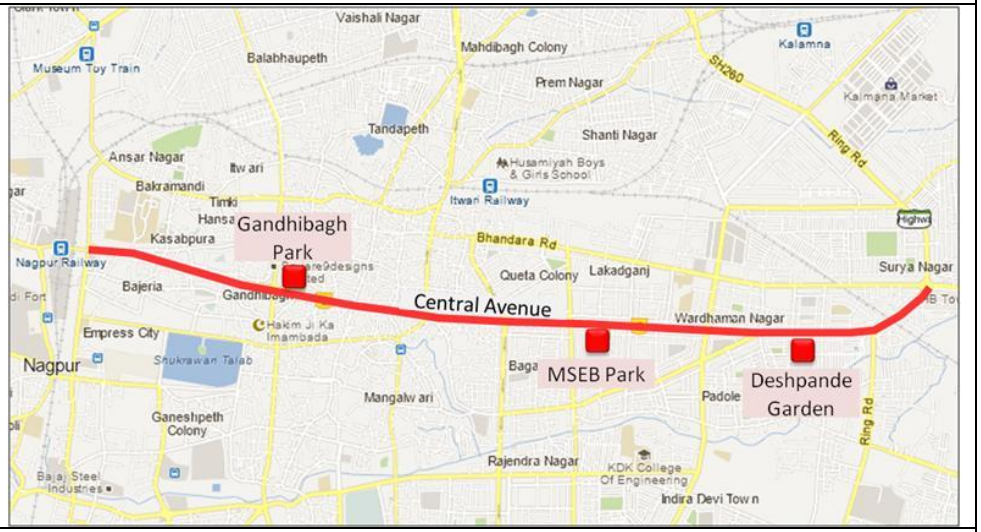
Project No:6	**Project Title:** Elevated Walk Way from Railway station to Bus stand
Project Type : Short Term	**Length : 3.5 Km**
Location: Nagpur city	**Approximate Capital Cost (Rs) : 1.75 Crores**
Detailed Description: The distance from the railway station to the bus stand is 800 meters. It would be a good idea to have an elevated walk way connecting the two.	
Implementation Period: 2012-2016	**Potential Benefits:** For the movement of pedestrians from transport hub to bus stand and railway station without conflicting with the vehicular traffic.

Project No: 7	**Project Title:** Provision of Cycle Track
Project Type : Short Term	**Length : 298 Kms**
Location: Nagpur City	**Approximate Capital Cost (Rs) : 149 Crores**
Detailed Description: A cycle track is provided on all major roads in Nagpur city 	
Implementation Period: 2012- 2016 (58%) **2017-2022 (42%)**	**Potential Benefits**: For the movement of cyclists without interacting with the vehicular traffic.

Project No: 8	**Project Title:** Provision of Pedestrian Zones and Pedestrian Infrastructure
Project Type : Short Term	**No of Pedestrian Zones : 4**
Locations: 1. Sitabuldi 2. Mahal 3. Itwari 4. Sadar	**Approximate Capital Cost (Rs) : 8 Crores**
Detailed Description: Considering heavy pedestrian movement, following areas are proposed as vehicle free zones in Nagpur.	
Implementation Period: 2012-2016	**Potential Benefits:** Free movement of pedestrians in Nagpur city with no vehicular conflicts.

Project No: 9	**Project Title:** Removal of Encroachments / hawker Management / dismantling illegal development along mobility corridor
Project Type : Short Term	**No of Locations : 14**
Locations: In Nagpur Metropolitan region The removal of encroachments is proposed on roads like Santra Market Road, Central Avenue Road, Sakkardara chk, Old Bhandara Road, Indora chowk to Kamal Talkies, Variety chowk to Munje chowk, Jhasi Rani to Munje chowk, Sakkardgara chowk to Ayurvedic college, Sakkardara chowk to Umred road, Janta chowk to Dhantoli park, Golibar chowk to Daga hospital, Sadar link road, Sadar mount road, Variety chowk to Lokahndipool one way road	
Detailed Description: The problems because of encroachments are indentified and suitable recommendations are suggested.	**Approximate Capital Cost (Rs) : 14 Crores**
Implementation Period: 2012-2016	**Potential Benefits:** Safe movement of pedestrians on the foot paths, thereby increasing the speeds of vehicular traffic.

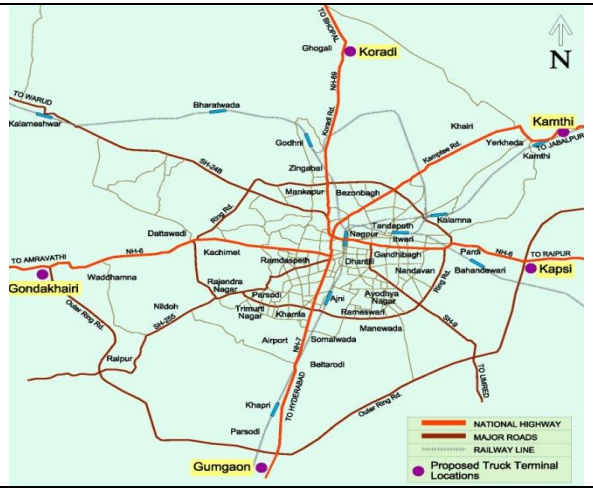
Project No: 10	**Project Title:** Road Widening
Project Type : Short Term	**Length: 10 kms**
Locations **Road widening is proposed on roads like** • Cradock Road and bridge accessing Itwari residential area • Godhni area connecting Ring road • Somalwada area access to Wardha road (from parallel road – behind Pride hotel) • Laxmi Bhavan Chowk to Traffic Park link	**Approximate Capital Cost (Rs) : 50 Crores**
Detailed Description: To reduce the traffic congestion, capacity improvements of the proposed roads is considered.	
Implementation Period: 2012-2016	**Potential Benefits:** To increase the traffic speeds in the Nagpur city**.**

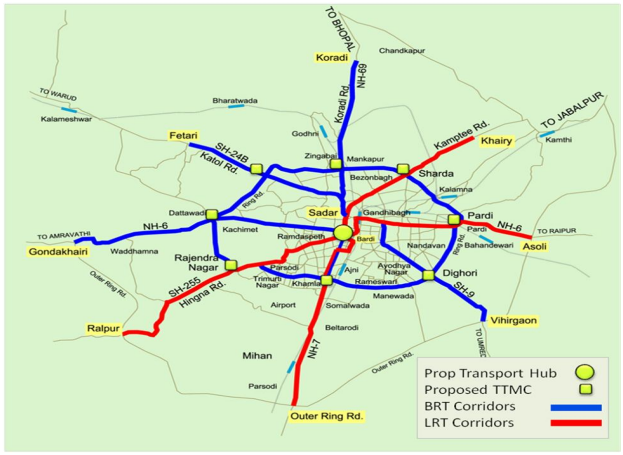
Project No: 11	**Project Title:** Off- street Parking Site – Multi Storey Parking Site
Project Type : Medium Term	**No of Parking Sites:** 5
Locations: 1. At Gandhi bagh 2. At MSEB Park 3. At Deshpande Garden	**Approximate Capital Cost (Rs) : 50 Crores**
Detailed Description: The available public spaces like gardens can be considered for underground parking so as to serve dual purpose. 	
Implementation Period: 2012-2016 (1 Location) **2017-2021 (2 Locations)**	**Potential Benefits:** When the project is implemented, it is possible to ban parking on the roads in the vicinity. Reduce Traffic congestion in the city area

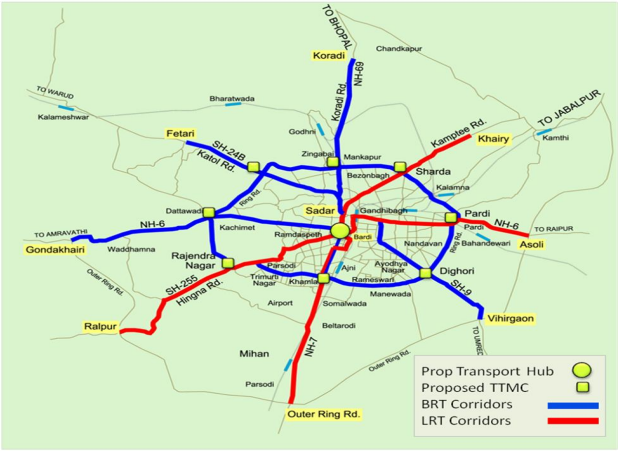
Project No: 12	**Project Title:** ITS – Intelligent Transportation systems
Project Type : Medium Term	**No of locations:**
Locations: In Nagpur Metro Region	**Approximate Capital Cost (Rs) : 30 Crores**
Detailed Description: ITS consists of: • Setting up a traffic management centre • Installing Video cameras at key locations • Setting up a communication system with local policemen • Setting up a communication with the traffic signal controller. • Installing variable message signs ITS is used for arterial management system, freeway management system, Freight management system, Transit management system, Incident management system.	
Implementation Period: 2012-2016 (67%) **2017-2022 (33%)**	**Potential Benefits:** The benefits include improved safety, efficiency, mobility, accessibility, and intermodal connections. ITS deployment improvements also include the promotion of environmental responsibility, energy use, and economic development. These benefits can be increased through regional cooperation and partnerships.

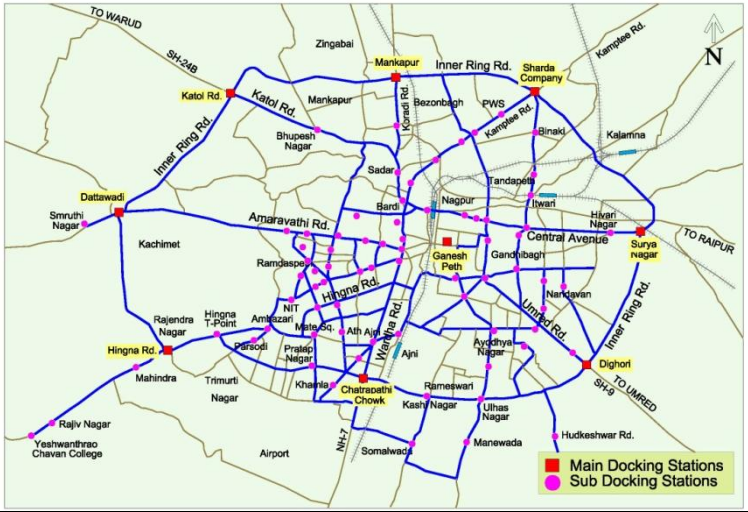
Project No: 13	**Project Title:** Redevelopment of city bus terminus
Project Type : Medium Term	**No of locations:** 1
Locations: Nagpur	**Approximate Capital Cost (Rs) : 25 Crores**
Detailed Description: Reconstruction of Bus terminal is proposed. This Terminal will have the following facilities • Bays for Mofusil buses • Bays for city buses • Pickup and Drop points for Jeeps and Auto rickshaws	
Implementation Period: 2012 -2016	**Potential Benefits:** Reduce the conflicts between pedestrians and Buses. Improve the access and egress for the buses.

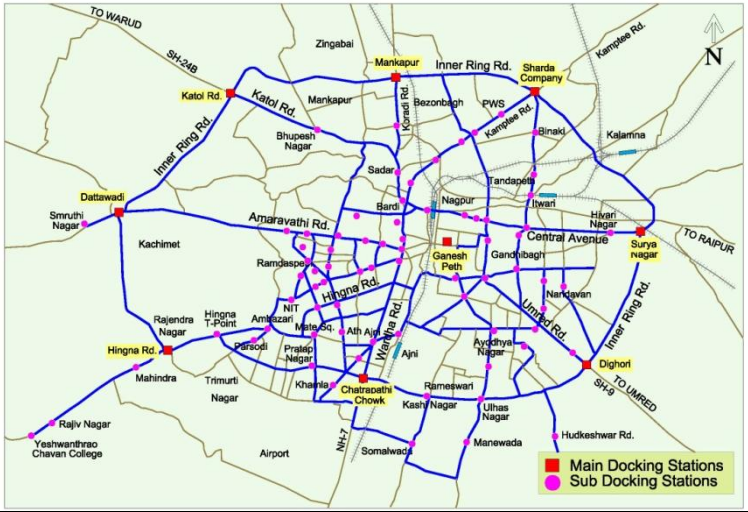
Project No: 14	**Project Title:** Rail Over Bridge
Project Type : Medium term	**No of Rail over bridges : 4**
Locations: ▪ Manish Nagar Railway Crossing ▪ Shanti Nagar Road junction improvement at second (north side) railway crossing ▪ Chindwara road railway crossing	**Approximate Capital Cost (Rs) : 40 Crores**
Detailed Description: Elimination of rail crossings by providing ROB's. .	
Implementation Period: 2012-2016 (3 Locations)	**Potential Benefits:** Enable continuous traffic movement.

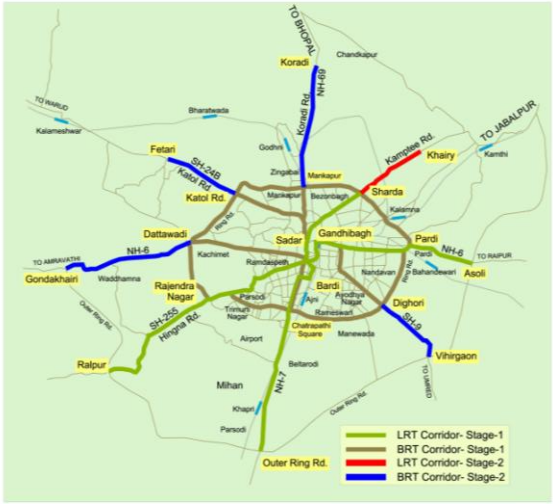
Project No: 15	**Project Title:** Commercial Terminal Plan – Truck Terminal
Project Type : Medium term	**No of Truck terminals:** 5
Locations: • junction on outer ring road and Hyderabad road • junction on outer ring road and Amravati road • Junction on outer ring road and Bhandara road • junction on outer ring road and Kamptee road • junction on outer ring road and Koradi road	**Approximate Capital Cost (Rs) : 75 Crores**
Detailed Description: The truck terminals proposed at these four locations are proposed to have 50 truck parking spaces and with ancillary facilities.	
Implementation Period: 2012-2016 (2 Locations) **2017-2022 (2 Locations)** **2022-2032 (1 Location)**	**Potential Benefits:** The project is intended to organize/ manage commercial traffic in the town in a better way. This proposal will help to avoid haphazard parking of trucks on the roads. Also it will add economic benefits to the surrounding area.

Project No:16	**Project Title:** Transport Hub
Project Type : Medium term	**No of Transport Hubs:** 1
Locations: Bardi	**Approximate Capital Cost (Rs) : 14.5 Crores**
Detailed Description: The transport hub is proposed at Bardi to integrate with all the proposed TTMC's in the Nagpur Metro Region. This transport hub will have the following facilities. • Bays for Mofusil buses • Bays for City Buses • Passenger facilities like platform, waiting area, clock room etc • Basement Car/ Two wheeler parking • Pre-paid taxi/ Auto rickshaw booth • Commercial Office Spaces	
Implementation Period: 2012-2016 (4 Locations) **2017-2022 (4 Locations)**	**Potential Benefits:** The transport hubs are considered for the quick movement of people and devotees in the Nagpur Metro Region

Project No:17	**Project Title:** Passenger Terminal Plan – Traffic and Transport Management Centres
Project Type : Medium term	**No of Transport Hubs :** 8
Locations: j. Mankapur Chowk (junction on Koradi road and inner ring road) k. Junction on Katol Road and inner ring road l. Junction on Amravati road and inner ring road m. Junction on Hingna road and inner ring road n. Junction on Wardha road and inner ring road o. Junction on Umred road and inner ring road p. Junction on Bhandara road and inner ring road q. Junction on Kamptee road and inner ring road	**Approximate Capital Cost (Rs) : 76 Crores**
Detailed Description: The TTMC's are proposed at above locations. These transport hubs will have the following facilities. • Bays for Mofusil buses • Passenger facilities like platform, waiting area, clock room etc • Basement Car/ Two wheeler parking • Pre-paid taxi/ Auto rickshaw booth • Commercial Office Spaces	
Implementation Period: 2012-2016 (4 Locations) **2017-2022 (4 Locations)**	**Potential Benefits:** The transport hubs are considered for the quick movement of people and devotees in the Nagpur Metro Region

Project No: 18	**Project Title:** Bike sharing Plan – Main Docking stations
Project Type : Medium Term	**Locations : 9**
Location: Nagpur Metro Region	**Approximate Capital Cost (Rs) : 4.5 Crores**
Detailed Description: Majority of the mobility corridors are recommended for dedicated cycle tracks on both side of the roads. As part of their infrastructure requirement and bike shearing scheme, the major docking stations are proposed at each TTMC.	
Implementation Period: 2012-2016 (5 Locations) **2017-2022 (4 Locations)**	**Potential Benefits:** Free movement of cyclists in Nagpur Metro Region

Project No: 19	**Project Title:** Bike sharing Plan – Sub stations
Project Type : Medium Term	**Locations : 70**
Location: Nagpur Metro Region	**Approximate Capital Cost (Rs) : 7 Crores**
Detailed Description: Apart from the main docking station, 70 sub stations are proposed at important public places like hospitals, schools, parks, museums, shopping complex, work centers in the Nagpur city	
Implementation Period: 2012-2016 (50 Locations) **2017-2022 (20 Locations)**	**Potential Benefits:** Movement of cyclists in Nagpur Metro Region

Project No: 20	**Project Title:** Bus Rapid Transit System (BRTS)
Project Type : Long term	**Length : 92.5 Km**
Location: Nagpur Metro Region	**Approximate Capital Cost (Rs) : 1850 Crores**
Detailed Description: The Stage 1 Bus Rapid Transit system is proposed for a length of about 67.3 kms and in the Stage 2 it will be extended for about 35.2 kms in the horizon years. 	
Implementation Period: 2012-2016 (67.3 kms) **2022-2032 (35.2 kms)**	**Potential Benefits:** Quick movement of people in entering Nagpur Metro Region through public transport.

Project No: 21	**Project Title:** Light Rail Transit system (LRTS)
Project Type : Long term	**Length : 56.70 Km**
Location: Nagpur Metro Region	**Approximate Capital Cost (Rs) : 8505 Crores**
Detailed Description:  The stage-1 Light Rail Transit system is proposed from Sharda company to Mihan access point on Wardha Road via Sadar, humpyard road, jail road and from Pardi to Rajendra Nagar on CA road and Hingna road via Central avenue and Ambazari road of length 18.31 kms. Further as stage 2, this LRT is extended from sharda company to Khairy , Pardi to Asoli, Rajendra nagar to Ralpur, and from Mihan to khapri of length 22.5 kms	
Implementation Period: 2012-2016 (34.2 kms) **2022-2032 (22.5 kms)**	**Potential Benefits**: Quick movement of people in entering Nagpur Metro Region through public transport.

Annexure 5
Stakeholders' Meet and Compliance Note

Stakeholders' Meet Photographs

Compliance Note on Stakeholders' Comments

(Comprehensive Mobility Plan for Nagpur)

Date of Presentation / Public Participation – 21st Oct 2013
Venue – NIT Multipurpose Hall, Sanskrutik Bhavan

S. No	Name	Suggestions	Addressed/ Not Addressed	Remarks/ Comments
1	Anup M Ramteke	1.Provide every signal or some signal with CCTV cameras 2.Create every vehicle with smart card / to find directly to the vehicle	Addressed Not addressed	This is covered as a part of junction improvement plan under short term measures. The detail ITS technology shall be covered at the stage of Implementation stage DPR.
2	Mithun Nichwani 9579588896 mithun.nichwani@gmail.com	We are talking of speed buses, metros and all; but first we should construct good roads in each area. Till now so many areas are there, where there are no road networks - for example areas near Kharadi road where so many people live in that area, but no road network is there.	Addressed	The given proposals are arrived considering transport projects already approved in given master plan / CDP/ relative studies which comprise ongoing and sanctioned network improvements.
3	Nikhil Kale 9422965476 Master-nikhilkale@tahoo.com	For short term goals - include VIP junction also	Addressed	Suggested one way loop from Laxmi bhavan chowk to VIP road and VIP road to Coffee House chk which will automatically ease the pressure on VIP junction. Also the improvements suggested in the subordinate junction will decongest VIP junction.
4	M. Hareesh 9493341945 nareshmanchikanti@gmail.com	1. The public transport system must be implemented so that the public should be encouraged to use that transport instead of their own vehicles which in turn causes	Addressed	The proposed public transport strategy comprises the given suggestions.

		other problems like parking & emission etc. 2. The bus system must be developed to all the roads and necessary improvements must be made for using this bus system which in turn generates more income to the Government.		
5	Vinod Navghare 9730381740 Vnavghare475@gmail.com	1.In Dharampet there is one chowk which is very problematic, No one is following that rules, we need to look at that intersection.(VIP square) 2. All VIP roads in City should be true	Not addressed	Specific junction/road name is not mentioned. As a part of junction improvement program, the City has to improve all junctions. The CMP study will not go to the details of every junction.
6	K.Vasudevaraju 7769940478 vasukumar@yahoo.com	1.Improve the public Transportation. 2.Provide roads for Non Motorized vehicles. 3.Place the signals in right positions	Addressed	One of the CMP objectives is to improve public transport and non motorized share. The bike sharing scheme and cycle track network are presented in the report.
7	Harshal Kaddak 8600695651 harshalkaddak@gmail.com	1.Do provide provisions for the daily commuters like shop keeper, office works etc, at Sitabuldi, incase of non motorized vehicle zone. 2. Why don't you involve ITS in your futuristic planning?	Not addressed Addressed	Not within the scope of CMP. The proposed traffic improvement system requires ITS and accordingly recommended in the proposals.
8	Nikhilesh 8404066263 CNIKHILESH@GMAIL.COM	1.Why you didn't involve ITS seriously in your vision. 2. And the main problem is waiting on intersection due to improper traffic 3. Control device which are not based on real time, so provide real time traffic control devices.	Not addressed	The recommendations are given on strategic level planning and the details can be covered in project specific DPR.
9	V.P.Gajge 7875760555	Underground services duct to be incorporated for laying water pipeline /	Not addressed	Not within scope of CMP. The recommendations

	Aditi_gajge@rediffmail.com	Telephone/power etc, so that there should not be nay digging of road which which will cause inconvenience to people.		are given on strategic level planning and the details can be covered in project specific DPR.
10	Ashish A Gokate 9890614386 ashish.gokate@yahoo.com	CMp should also include Industrial Area like Butibori, Addl. Butibori, NMIZ (national Investment & manufacturing Zone) in your plan, because it generates more traffic (trucks etc)	Addressed	These areas are covered in the zoning plan.
11	Sameer deshkar 9850376704 sdeshkar@gmail.com	1.Need for integrating land use planning highlighted but no such integration is deliberated at any level in the presentation. 2. Need for augmenting public transportation systems evaluated (increasing no of buses), but ways to minimize private vehicles not addressed. 3.Accessibility discussed only from physical dimensions. "Economically" accessibility needs to be considered for viability of project. 4. Ideas of time distance, resilient systems, Land value capture, to be capitalized for TOD, which lacks in current study.	Addressed Addressed Not addressed Not addressed	The trip generation and attraction equations have prepared based on integrated landuse transport planning. The meaning of improvement in the public transport share is nothing but the modal shift from private to public vehicles. The financial analysis in terms of Economic Sustainability can be performed at the stage of preparing detail DPR. This cannot be a part of vision document CMP. However, a separate study is being undertaken for TOD in Nagpur that will cover all these aspects.
12	H.L.Kawre 9766342041 kawrehl@yahoo.com	1.There must be integration between Railway station and Metro (LRT) Station. 2.Suburb Station should also be integrated with BRT and LRT system. 3 a. Nagpur Station is congested due to non	Addressed	The proposed TTMC will act as interchanging points. A separate parking policy and parking demand management study should be undertaken.

		availability of land for parking & circulating area, CMP on suggest. 3b. In Nagpur station, west side there is problem of congestion, due to shops and zero width of road after construction of ROB/ CMP may proposed some alternative to decongest the area.		The brief hawker management plan is explained in the proposals section.
13	Rashid M haider 9372391186 Glass. studiokb@gmail.com	1.Provide facilities before asking people to be law abiding. 2.Speed not measured on small roads. 3.Entire focus is development towards South and South West, north Nagpur has no plans. 4. Stopping Truck outside the city will put lot of expenditure on loading and unloading account.	Not addressed Addressed Addressed	The CMP survey covers major road network in the city. BRT, LRT and vehicle free zones are proposed in the said areas. A proposed integration of LCV and MAV is recommended at the truck terminals.
14	Aman Vyaghra 8888819699 Aman.hydrotech@gmail.com	Suggest to have same kind of program for the details of short term planning:- What went wrong. Corrective action taken How are we going to make our city bus services clean/ Economical/ Convenient/ Safe/ Timely City bus service. City bus services should be first targeted to Office (working people and student)	Addressed	The traffic assessment zones were prepared accordingly.
16	Jamil Ahmed 9823160799	1.Footpath encroachments should be removed. 2. Public transportation should be started as much as possible	Addressed	The recommended proposals comprise given suggestions.

		3. Parking Zone should also be constructed as much as possible. 4. No permissions should be given to parking places, new hotels or malls.		
17	Arvind kale 8888831110	1. Important issue is regarding parking which should be thought of. 2. important lanes to be made regarding cycle, motor cycle, bus track etc.	Addressed	Off street parking lots are identified and proposed. BRT lanes and cycle track network is identified and proposed.
18	Uday Upasani 9324843444 udayupasani@yahoo.com	1.Convert all octroi naka to bus depot to solve bus parking Naka- Wadi Naka, Hingna, Khapri, Karadi naka etc. 2. Stringent laws for basement parking, as many buildings are using basement for Commercial use. 3.Use defense rail track for fast implementation of Local railway.	Addressed Not Addressed	The bus depot locations are proposed and will be sufficient for given demand at present. Converting octroi land for depot purpose require land acquisition / clearance from ULB / State govt. It does not fall under given scope of work.
19	Rajani Pradeep Lonare 7723576008 Rajani.lonare@yahoo.com	In This Comprehensive mobility Plan one suggestion is recommended, that also includes the road strengthening work in preliminary development plan	Addressed	The network improvement plan in terms of widening (limited roads) is proposed.
20	Chandashekar J Bankar 9890900103 Cj.bankar@gmail.com	1Only people having parking spaces within their premises should be allowed to buy vehicles/ cars. 2.If they emphasize on Public Transport then quality and quantity desired for the city needs to be implemented form today itself.	Not addressed	The given suggestion comes under the policy measures. The ULB / bus operator / SPV should jointly put efforts to get the results.
21	Mandar Bokare 7709778245 Mandar1729.lokar	1.Reducing number of auto rickshaw in city core areas. 2. Compulsory use of CNG for public		

	e@gmail.com	transport vehicles. 3. Strict lane implementation for cars and 2 wheelers. 4. Separate lanes for buses , taxis, and auto rickshaws. 5. Designating major roads as One way roads. 6. Speed bumps before and after pedestrian crossings.	Addressed	The given suggestions were covered in the report, as necessary.
22	Narendra N Daware 8805910744	1.Presentation Plan well explained. 2.More concern regarding its implementation needs, Behavioral training for people (unified discipline code),penalty if not followed. 3.Cameras system should get increased specially at Main routes, square. 4. Effecting monitoring of braking traffic rules through cameras system and immediate action (find any solution beside this for effective implementation of plan). Physical development of City, if supported by Human monitoring system. We hope for a better tomorrow.	Addressed	The suggestions were considered while forming various CMP strategies.
23	Sachin Tiwarkhede 9970186723 stiwarkhede@gmail.com	1.City population mention is For 2011 is 32 lacs, its 24 lacks (appox) as per census 2011	Addressed	The given population is for study area which comprise NMA area.
24	Dr.Rajesh	1.One of the important deliverables of CMP		

	Biniwale 9822745768 rb-biniwale@neeri.res.in rajeshbiniwale@gmail.com	could be reduction of pollution from vehicles and due to traffic. A grid wise emission inventory with BQU/ Technical intervention prediction is necessary to include NEERI has done similar EI for Mumbai, Delhi Dhaka and several places even latest for a small place as Wani Dist-Yavatmal. Study to include more expertise. 2. Draft report may be evaluated by experts and institutions before finalization. City based institutions must be involved as is done in all other big cities. 3. In addition to Mass transit System, feeder vehicle fleet and trip planning need to be considered. 4. Present foot paths are not designed for easy use by pedestrians particularly with steps for changing at certain lengths are not suitable (specially for elders)	Not Addressed Addressed	The details on environmental impact can be assessed though separate study. Stakeholders / experts invited by NIT were involved while at various stages of presentations and discussions on CMP. Feeder service planning is a separate study which looks into detail operational planning of trunk and feeder routes. However, feeder service is recommended in the study. The footpath design would be part of DPR.