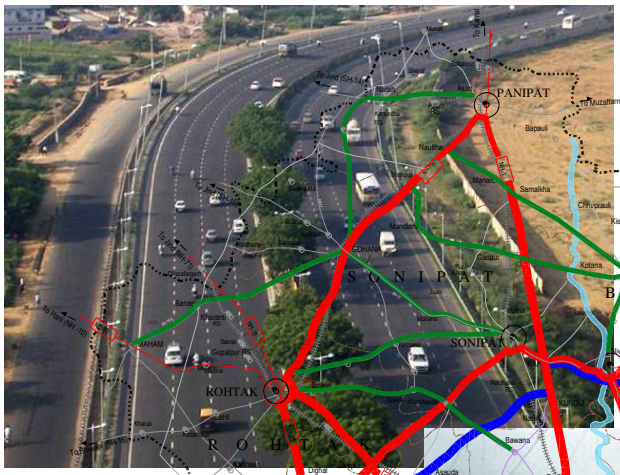
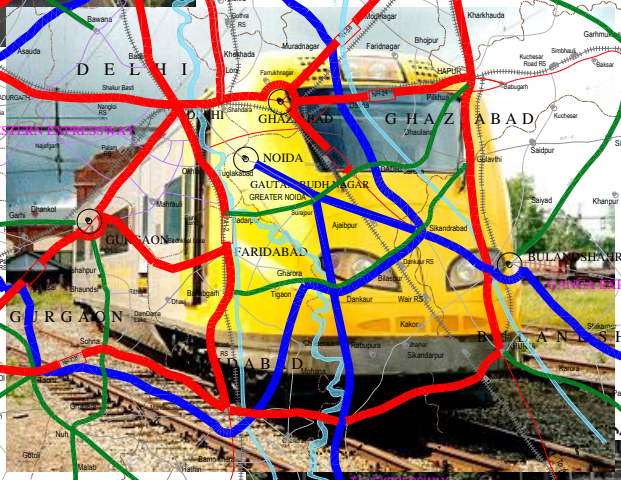
Functional Plan on Transport for National Capital Region-2032

TRANSPORT





NATIONAL CAPITAL REGION PLANNING BOARD
Ministry of Urban Development, Government of India

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

Page

LIST OF ANNEXURES

ABBREVIATIONS

3G Network	3rd Generation Network
AD	Assistant Director
ADT	Average Daily Traffic
AICTE	All India Council of Technical Education
ASI	Archeological Survey of India
AVVID	Architecture for Voice, Video and Integrated Data Technology
BIS	Bureau of Indian Standards
BOLT	Build Operate Lease and Transfer
BOOT	Build Operate Own and Transfer
BOT	Build Operate and Transfer
BPT	Bus based Public Transport
BSNL	Bharat Sanchar Nigam Limited
CAA	Constitutional Amendment Act
CBD	Central Business District
CCA	City Compensatory Allowance
CCP	Chief Coordinator Planner
C-DOT	Centre for Development of Telematics
CEA	Central Electricity Authority
CEPT	Centre for Environmental Planning and Technology
CETP	Combined Effluent Treatment Plant
CEZ	Common Economic Zone
CGHS	Central Government Health Scheme
CGI	Corrugated Galvanized Iron
CGO	Central Government Office
CGWB	Central Ground Water Board
CMA	Counter Magnet Areas
CPCB	Central Pollution Control Board
CNCR	Central National Capital Region
CPHEEO	Central Public Health and Environment Engineering Organisation
CPWD	Central Public Works Department
CRISIL	Credit Rating Information Services of India Limited
CRP	Chief Regional Planner
CS	Central Sector
CSIR	Center for Science and Industrial Research
CSS	Centrally Sponsored Schemes
CST	Central Sales Tax
CT	Census Town
DAL	Delhi Avoiding Lines
DCE	Delhi College of Engineering
DD	Deputy Director
DDA	Delhi Development Authority
DDMC	District Disaster Management Committee
DEL	Direct Extension Lines
DFC	Delhi Finance Corporation
DMA	Delhi Metropolitan Area
DMC	Disaster Management Committee
DOT	Department of Telecommunication
DSIDC	Delhi State Industrial Development Corporation
DTA	Delhi Territorial Area
DUEIIP	Delhi Urban Environment and Infrastructure Improvement Project
EDC	External Development Charges
EG	Enforcement Group
EJC	Eastern Jamuna Canal
EWS	Economically Weaker Section
FAR	Floor Area Ratio
FCC	False Colour Composite
FDI	Foreign Direct Investment
FIPB	Foreign Investment Promotions Board
FIRR	Financial Internal Rate of Return
GAL	Goods Avoiding Lines
GDA	Ghaziabad Development Authority
GDP	Gross Domestic Product
GIS	Geographical Information System
GMT	Greenwich Mean Time
GNCTD	Government of National Capital Territory of Delhi
GPRS	General Packet Radio System
GPS	Global Positioning System

GSM	Global System for Mobile Communications
HFC	Highway Facility Centres
HQ	Headquarters
HRA	House Rent Allowance
HSIDC	Haryana State Industrial Development Corporation
HSTS	High Speed Transportation System
HUDA	Haryana Urban Development Authority
HUDCO	Housing and Urban Development Corporation
IC	Installed Capacity
IEBR	Internal Extra Budgetary Resource
IGP	Interim General Plan
IIT	Indian Institute of Technology
IMD	Indian Meteorological Department
IMMTP	Integrated Multi Modal Transport Plan
IPT	Intermediate Public Transport
INTACH	Indian National Trust for Arts and Cultural Heritage
IP	Internet Protocol
IRBT	Integrated Rail-cum-Bus Transit
IRORC	Inner Regional Orbital Rail Corridor
IRS	Indian Remote Sensing Satellite
ISDN	International Subscriber Digital Network
ITC(HS)	ITC (HS)-Classifications of Export and Import Items Book
ITI	Industrial Training Institute
L&DO	Land and Development Organisation
LAN	Local Area Network
LCS	Low Cost Sanitation
LISS	Linear Image Self Scanner
LRT	Light Rail Transport
LT/HT	Low Tension/High Tension
M	Municipality
M Corp.	Municipal Corporation
MB	Municipal Boundary
MC	Municipal Committee
MC/RC	Metro Centre/Regional Center
MCD	Municipal Corporation of Delhi
MCl	Municipal Council
MDA	Meerut Development Authority
MDR	Major District Road
MHRD	Ministry of Human Resource Development
MIS	Management Information System
MNC	Multi-National Company
MOEF	Ministry of Environment and Forests
MOU	Memorandum of Understanding
MOUD&PA	Ministry of Urban Development and Poverty Alleviation
MPD	Master Plan for Delhi
MRTS	Mass Rapid Transit System
MSK Scale	Medvedev, Sponheuer and Karnik (MSK) Scale
MTNL	Mahanagar Telephone Nigam Limited
NA	Not Available
NBC	National Building Code
NCBWW	New Canal Based Water Works
NCR	National Capital Region
NCRPB	National Capital Region Planning Board
NCT	National Capital Territory
NDMC	New Delhi Municipal Corporation
NGO	Non-Government Organisation
NH	National Highway
NH/SH	National Highway/State Highway
NHAI	National Highway Authority of India
NHPC	National Hydro Power Corporation
NIC	National Informatics Centre
NOC	No Objection Certificate
NOIDA	New Okhla Industrial Development Authority
NP	Nagar Palika
NPL	National Physical Laboratory
NREB	Northern Regional Electricity Board
NRI	Non-Resident Indian
NRSA	National Remote Sensing Agency
NTPC	National Thermal Power Corporation
O&M	Operation and Maintenance

OD	Origin Destination
OFC	Optical Fibre Cable
PAN	Panchromatic
PDS	Public Distribution Scheme
PO	Private Operator
PPG	Policy and Planning Group
PPP	Public-Private Partnership
PSMG I/II	Project Sanctioning and Monitoring Group I/II
PSU	Public Sector Undertaking
PVC	Poly Vinyl Chloride
R&D	Research and Development
RCC	Reinforced Cement Concrete
RF	Radio Frequency
RF	Rapid Filtration
RIICO	Rajasthan Industrial Infrastructure Corporation
RITES	RITES (earlier Rail India Technical and Economics Services)
RORC	Regional Orbital Rail Corridor
ROW	Right-of-Way
RP	Regional Plan
RRTS	Regional Rapid Transit System
RSF	Rapid Sand Filter
RSI	Rural Small Scale Industry
RTV	Rural Transport Vehicle
RWA	Resident Welfare Association
S&JJ	Slum & Jhuggi Jhomparis
SCADA	Supervisory Control and Data Acquisition System
SEZ	Special Economic Zone
SNA	Serial Networking Architecture
SOG	Sanctioned on-going
SSF	Slow Sand Filtration
SSI	Small Scale Industries
STD	Subscriber Trunk Dialing
STP	Strategic Transport Plan
STP	Sewage Treatment Plan
STU	State Transport Undertaking
SWM	Solid Waste Management
T&D	Transmission and Distribution
T/W/Canal	Tank/Well/Canal
TCPO	Town and Country Planning Organisation
TDMA	Time-Division Multiple Access
TDR	Transferable Development Rights
TDS	Total Dissolved Salts
TMG	Traffic Management Group
TPO	Town Planning Organisation
TSDF	Treatment, Storage and Disposal Facility
UA	Urban Agglomeration
UDPFI	Urban Development Plan Formulation and Implementation Guidelines
UGC	University Grants Commission
ULB	Urban Local Bodies
UP	Uttar Pradesh
UPSIDC	Uttar Pradesh State Industrial Development Corporation
V/C	Volume to Capacity Ratio
VAT	Value Added Tax
VOC	Vehicle Operating Cost
VOT	Vehicle Operating Time

UNITS

ha.	Hectare
KM	Kilometre
KV	Kilo Volt
lpcd	Litre Per Capita Per Day
MCM	Million Cubic Metre
MGD	Million Gallon per Day
mld	Million Litre Per Day
MT	Metric Tonnes
MW	Mega Watt
sq km	Square Kilometre

CONVERSIONS

Non-Metric to Metric

Linear

To convert	*Multiply by*
Inches into millimetres	25.4
Inches into centimetres	2540
Inches into metres	2540 x 10
Feet into centimetres	30.48
Feet into metres	0.3048
Yards into metres	0.9144
Miles into metres	1609.344
Miles into kilometres	0.609344

Area

To convert	*Multiply by*
Square inches into square centimetres	6.4516
Square feet into square centimetres	929.03
Square feet into square metre	0.092903
Square yards into square metres	0.8361
Square miles into square kilometres	2.58999
Square miles into hectares	258.999
Acres into square metres	4046.856
Acres into hectares	0.4069

Volume and capacity

To convert	*Multiply by*
Cubic inches into cubic centimetres	16.3871
Cubic inches into litres	0.016387
Cubic feet into cubic metres	0.028317
Cubic yards into cubic metres	0.7646
Pints into litres	0.56826
Quarts into litres	1.13652
UK gallon into litres	4.54609
US gallon into litres	3.7854

Mass

To convert	*Multiply by*
Ounces into grams	28.3495
Pounds into grams	453.6
Pounds into kilograms	0.4536
Ton into kilograms	1016.047
Tahils into grams	37.799
Kati into kilograms	0.60479
Grains into grams	0.648

Velocity

To convert	*Multiply by*
Feet per second into centimetres per second	30.48
Feet per second into metres per second	0.3048
Miles per hour into kilometres per hour	1.609344

Power

To convert	*Multiply by*
Horsepower into kilowatts	0.7457
Horsepower into metric horsepower	1.01387
Foot pounds force/Second into kilowatts	0.001356

Force

To convert	*Multiply by*
Pounds force into newtons	4.44822
Pounds into newtons	0.138255

Degree Fahrenheit = 9/5 (°C+32)

Metric to Non-Metric

Linear

To convert	*Multiply by*
Millimetres into inches	0.03937
Millimetres into feet	3.281x10
Centimetres into inches	0.3937
Metres into feet	3.281
Metres into yards	1.09361
Kilometres into yards	1093.61
Kilometres into miles	0.62137

Area

To convert	*Multiply by*
Square millimetres into square inches	1.550x10
Square centimetres into square inches	0.1550
Square metres into square feet	10.7639
Square metres into square yards	1.19599
Square metres into acres	2.47105x10
Square kilometres into square miles	0.3861
Square kilometres into acres	247.105
Hectares into acres	2.47105

Volume & capacity

To convert	*Multiply by*
Cubic centimetres into cubic inches	0.06102
Cubic metres into cubic feet	35.3147
Cubic metres into cubic yards	1.30795
Litres into cubic inches	61.03
Litres into pints	1.7598
Litres into quarts	0.8799
Litres into UK gallon	0.219976
Litres into US gallon	0.264178

1 MCM per day = 1000 million litre per day (mld)

Mass

To convert	*Multiply by*
Grams into ounces	0.3527
Grams into grains	15.4324
Grams into tahils	0.02646
Kilograms into pounds	2.2046
Kilograms into tons	0.0009842
Kilograms into katis	1.553
Kilograms into stones	0.1575
Kilograms into hundredweights	0.01968

Velocity

To convert	*Multiply by*
Centimetres per sec. into feet per second	0.03281
Metres per second into feet per second	3.281
Metres per second into feet per minute	196.9
Kilometre per hour into miles per hour	0.6214

Power

To convert	*Multiply by*
Kilowatts into horsepower	1341
Metric horsepower into horsepower	0.98632
Metric house power into feet pounds force/second	542.48

Force

To convert	*Multiply by*
Newtons into pounds force	0.2248
Newtons into pounds	7.2330

Degree Celsius = 9/5 (°F-32)

ACKNOWLEDGEMENTS

The Functional Plan on Transportation for NCR, which is meant to detail out the policies of the Regional Plan 2021 related to this sector, is the result of concerted efforts by many people.

First and foremost, I am grateful to Dr. M. Ramachandran, Secretary, Urban Development, Govt. of India, under whose able guidance and leadership the need for looking deeper into this sector was conceived.

Dr. Noor Mohammad, Member Secretary, NCR Planning Board has been the driving force behind the Functional Plan. I am grateful to him for his vision and constant encouragement, without which this Plan would not have been completed.

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I am indebted to all the members of Consultancy Review Committee and Advisory Group for the study on "Integrated Transportation Plan for NCR".

I would also like to thank all officers from the NCR participating States, Railways, Planning Commission who are our partners in progress, and without whose cooperation this Functional Plan cannot be implemented. I would further appeal to them to continue their support for successful implementation of the Plan.

Last but not the least, I would like to acknowledge the effort that has gone into making this endeavour a success and has resulted in the publication of the Functional Plan for Transportation for NCR. I thank the team in NCR Planning Board, particularly Shri Rajesh Chandra Shukla, Joint Director (T) and Shri Syed Aqeel Ahmad, Assistant Director (T) who have toiled to make this possible.

(Rajeev Malhotra)
Chief Regional Planner
NCR Planning Board

1 *Introduction*

1.0 Background

1.1 Regional Plan 2021 for National Capital Region

National Capital Region Planning Board prepared the Regional Plan with the perspective year 2021 for the National Capital Region (NCR) as per the provisions of Section 10 of the NCR Planning Board Act, 1985 for balanced and harmonized development of the National Capital Region which was notified on 17th September, 2005.

The Region covers an area of 33,578 square kilometres with 1,483 sq kms (about 4.41%) falling in the National Capital Region Territory of Delhi; 13,413 sq kms (about 39.95%) falling in the Haryana Sub-Region; 7,829 sq kms (about 23.32%) falling in the Rajasthan Sub-Region; and 10,853 sq kms (about 32.32%) falling in the Uttar Pradesh Sub-Region. The administrative units of the NCR are:

a. Union Territory of Delhi;
b. Haryana Sub-Region comprises of the Faridabad, Palwal, Gurgaon, Mewat, Rohtak, Sonepat, Rewari, Jhajjar and Panipat districts.
c. Rajasthan Sub-Region comprises of the Alwar district; &
d. Uttar Pradesh Sub-Region comprises of Meerut, Ghaziabad, Gautam Bhudha Nagar, Bulandshahr and Baghpat districts.

A map showing the constituent areas of NCR is at **Map 1.1.**

In addition to above, Board has identified eight Counter-Magnet Areas to NCR as per Section 8(f) of the NCR Planning Board Act, 1985, namely, Ambala and Hissar in Haryana, Bareilly and Kanpur Nagar in Uttar Pradesh, Dehradun in Uttrakhand, Kota in Rajasthan, Patiala in Punjab and Gwalior in Madhya Pradesh. These are as per modified Chapter 18 of the Regional Plan-2021.

1.2 Aims and Objectives of Regional Plan 2021

Regional Plan-2021 aims to promote the economic growth and balanced development of the National Capital Region. It seeks to attain the above mentioned vital objective through an integrated strategy involving:

a. Providing suitable economic base for future growth by identification and development of regional settlements capable of absorbing the economic development impulse of Delhi;
b. Providing efficient and economic rail and road based transportation networks (including mass transport systems) well integrated with the landuse patterns to support balanced regional development in such identified settlements;
c. Minimising the adverse environmental impact that may occur in the process of development of the National Capital Region;
d. Developing selected urban settlements with urban infrastructure facilities such as transport, power, communication, drinking water, sewerage and drainage comparable with Delhi;
e. Providing a rational landuse pattern; &
f. Promoting sustainable development in the Region for improving the quality of life.

1.3 Objectives of the Study on Transport Plan

Regional Plan-2021 proposed development of road & rail network in the region in order to provide efficient and economic rail/road based transportation networks (including mass transport systems)

well integrated with the land-use patterns to support balanced regional development in the Region for sustainable development along with development of Intra-City Urban Transport. It proposed a hierarchical system of road network comprising of development/up-gradation of primary road network which included expressways, national highways and some important state highways; secondary road network which included major district roads and tertiary road network to provide access to all villages, work places, employment centres, residential areas, etc. It also proposed development of Regional Rapid Transit System (RRTS) to connect regional towns with Delhi and with Sub-regional Centres; orbital rail and Mass Rapid Transit System (MRTS) for Delhi and CNCR towns.

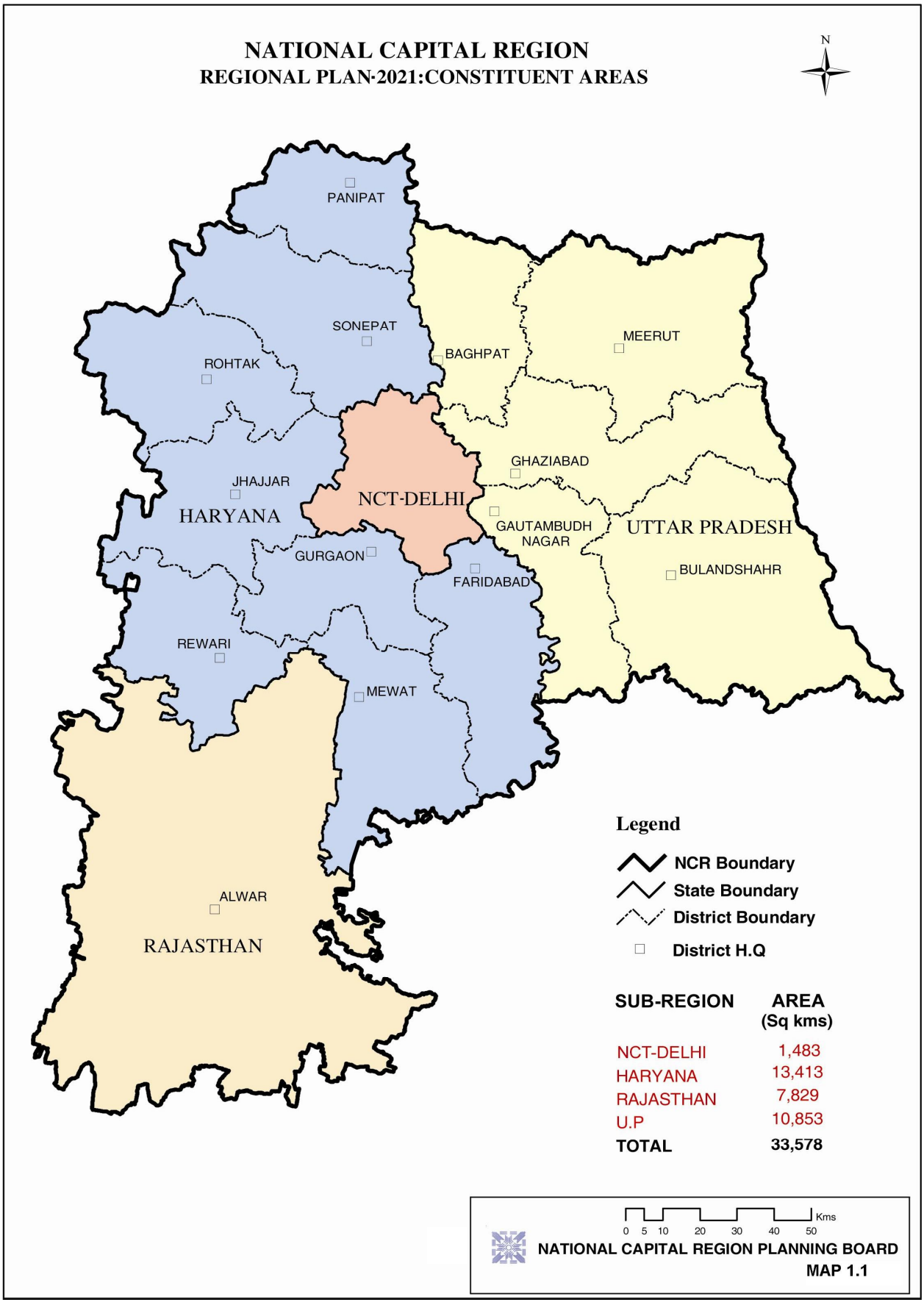
Transport affects our daily lives in its myriad forms. It influences economic development, population distribution, the shape of cities, energy consumption, access to markets and quality of life. It contributes substantially to gross domestic product, absorbs large investments and provides employment for millions of people. NCR is a high intensity, multi-level and multi-modal travel region. There is high intensity of intra-regional movement within NCR amongst Delhi and the regional centres & sub-regional centres and amongst themselves. Therefore, the recommendations of the Regional Plan-2021 were required to be elaborated on the basis of research studies on the movement of traffic after conducting appropriate surveys to prepare the Integrated Transportation Plan/Functional Plan of Transport for NCR as per the provisions of section 16 of the NCR Planning Board Act, 1985.

In view of this, NCR Planning Board commissioned a study through a Consultant with the aim to provide an adequate, accessible and affordable Integrated Multi Modal Transport System to the people of this region to cater for the needs of the passengers, goods and services of NCR in an equitable and sustainable manner. This, in turn, involves the study of traffic and travel characteristics of passengers and goods which would govern the choice of transport system for movement of goods and transport of commuters by different modes. The major objectives of the study were to:

a. Assess the level of utilization, potential and deficiencies in the present transport system
b. Assess the characteristics of the regional road and rail network for movement of passengers and goods traffic
c. Construct Regional Transport Planning Modals appropriate to conditions and planning needs of NCR so as to develop alternative transport strategies for short term, medium term and long term up to the year 2032
d. Prepare an Integrated Multi-Modal Transportation System for NCR with phased program of its implementation up to the year 2032.
e. Identify various project proposals, which are economically viable, socially acceptable, environmentally sustainable and financially feasible

1.4 Preparation of Functional Plan on Transport-2032

The study was carried out by M/s Consulting Engineering Services (India) Private Limited, New Delhi. It was guided by the Task Force for RRTS for NCR, Advisory Group to advise Consultancy Review Committee (CRC) for the preparation of Transport Plan for NCR and CRC. The recommendations of the Draft Final Report were presented by the Consultant in a Workshop held on 2nd February 2009 at India Habitat Centre, New Delhi, wherein stakeholders, experts and members of the Planning Committee, Task Force, Advisory Group and Consultancy Review Committee were invited to interact and obtain their suggestions on the Plan. The Final Report presents the findings of the surveys & studies, the policy framework and details of the Transport Plan for NCR. The Plan was approved by the Board in its 31st meeting held on 11th November, 2009. List of Members of the Task Force, Advisory Group and Consultancy Review Committee is at **Annexure-1.1.**


NATIONAL CAPITAL REGION
REGIONAL PLAN-2021:CONSTITUENT AREAS
N
PANIPAT
SONEPAT
ROHTAK
BAGHPAT
MEERUT
GHAZIABAD
JHAJJAR
HARYANA
NCT-DELHI
GAUTAMBUDH NAGAR
UTTAR PRADESH
GURGAON
FARIDABAD
BULANDSHAHR
REWARI
MEWAT
ALWAR
RAJASTHAN
Legend
NCR Boundary
State Boundary
District Boundary
District H.Q
SUB-REGION AREA (Sq kms)
NCT-DELHI 1,483
HARYANA 13,413
RAJASTHAN 7,829
U.P 10,853
TOTAL 33,578
0 5 10 20 30 40 50 Kms
NATIONAL CAPITAL REGION PLANNING BOARD
MAP 1.1

2

Road Network

2.1 Existing Road Network

The existing transport network in National Capital Region is 'radial' in nature. It comprises of expressways, national highways, state highways, major district and other district roads. The road network is being developed and maintained by NHAI, PWD, MCD, NDMC, Delhi Cantonment Board and DDA. Five National Highways (NH-1, 2, 8, 10 & 24) converge on Ring Road of Delhi and one National Highway (NH-58) meets NH-24 at Ghaziabad. In addition, NH-71, 71-A, 71-B, NH-91 and NH-119 also pass through the region. Apart from these national highways, some state highways also serve in strengthening the regional road network. Other than these highways, MDRs and ODRs also act as important linkages among these highways.

Existing road transport network of the National Capital Region was examined for the existing connectivity, mobility and accessibility in the study.

Mobility-based measurement and accessibility-based measurement are two significant approaches of measuring the transportation system performances. Mobility refers to the movement of people or goods while accessibility refers to the ability to reach "opportunities" like desired goods, services, activities and destinations. Accordingly, Road Network Analysis has been carried out and elaborated in subsequent paras.

2.2 Network form and spread

Network form and spread has been analysed in four parts in the Study as stated below:

a. Road Density
b. Accessibility
c. Mobility
d. Connectivity (Graph Theory)

a. Road Density

The region and sub-region wise road density[1] in the NCR is presented in **Table 2.1.**

Table 2.1: Sub-Region Wise Road Density in NCR

Sub-region NCR	Area (Sq. Kms)	Total Length (Km)	Km per 100 sq. km of area	Length of NH (Km)	Km per 100 sq. km of area	Length of SH (Km)	Km per 100 sq. km of area	Length of MDR (Km)	Km Per 100 sq. km of area
Haryana*	13413	7954	59.30	528	3.93	1448.2	10.79	580	4.32
UP*	10853	5504	50.71	321.4	2.96	805.6	7.42	432.66	3.98
Rajasthan*	7829	3976	50.79	35.3	0.45	1010.1	12.90	326.76	4.04
Total	32095	17434	54.32	884.70	2.76	3263.90	10.17	1339.42	4.14

Note: 1) Excludes NCTD 2) Does not includes ODRs & VRs.
*Source: * Study on Integrated Transportation Plan for NCR, CES primary survey 2007*

Road densities of NCR when compared with the national level shows that density of National Highways (2.84) and State Highways (9.72) in NCR is higher than the density of National Highways (1.99) and State Highways (4.19) in India. But in case of MDR, road density of NCR (3.95) is much

[1] *Road Density is given as length of roads per unit area of land. A high road density indicates that major share of the population has some access to the road network.*

less as compared to that in India (14.23). **Table 2.2** presents a comparative picture of the road densities by category.

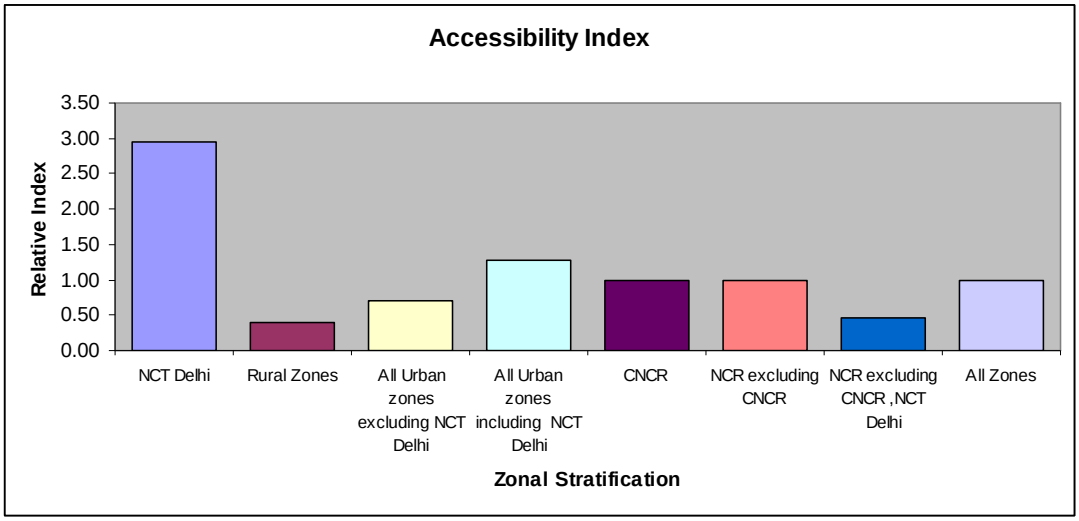
Table 2.2: Comparison of Road Density by NH, SH and MDRs

Road Type	India Road Length (kms)	Density (Km per 100 sq. km)	NCR Road Length (kms)	Density (Km per 100 sq. km)
NH	66590	1.99	1221.7 *	3.64
SH	131899	4.19	3263.9	9.72
MDR	467763	14.23	1339.4	3.95
Total	671064	20.41	5825.0	17.32

** Includes the NH length in NCTD, Source: Study on Integrated Transportation Plan for NCR*

b. Accessibility

Accessibility[2] measure is unit-free and has no intrinsic meaning, it provides an indication of the level of accessibility of employment / jobs for each zone; with jobs weighted more heavily the closer they are (in terms of travel time) to the zone.



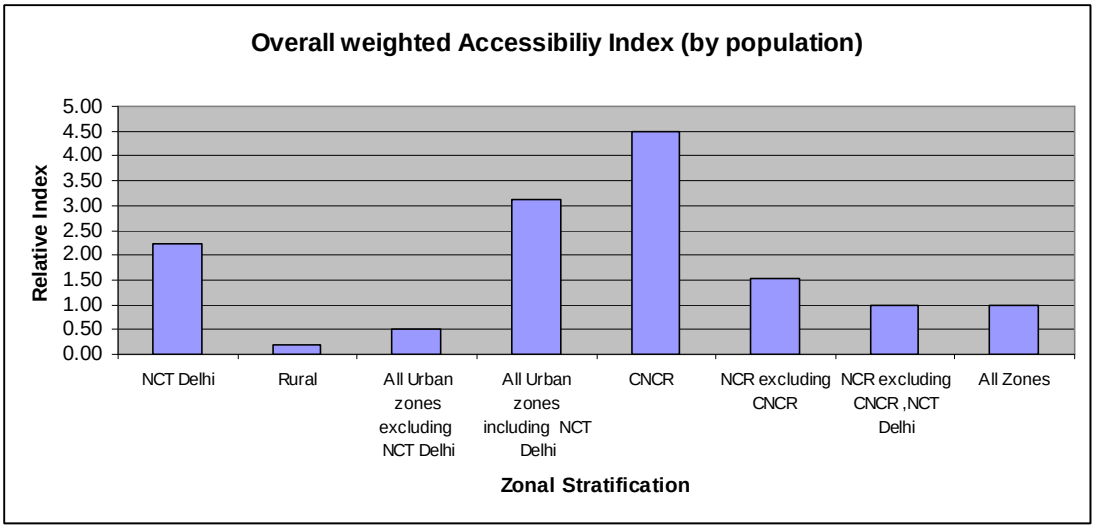
Source: Study on Integrated Transportation Plan for NCR

Figure 2.1: Accessibility Index (by Employment)

Figure 2.1 presents the accessibility with respect to employment in a particular zone. It indicates that NCT Delhi has the highest accessibility of jobs in the region followed by CNCR. Rural zones indicate poor accessibility in the region.

In **Figure 2.2**, an overall weighted accessibility score for a set of zones is calculated by considering population in addition to employment facility in that zone. The accessibility index calculated for all zones is given in **Annexure 2.1.** Weighted by population, CNCR indicates the highest accessibility, followed by all urban zones and NCT Delhi. Again rural zones indicate the poor accessibility in the region.

[2] *Accessibility is defined for personal travel as the ability to reach desired destinations. The accessibility measure selected is a gravity-modal-based measure known as the Hansen Modal. The accessibility measures are calculated for TAZ (traffic analysis zone).*

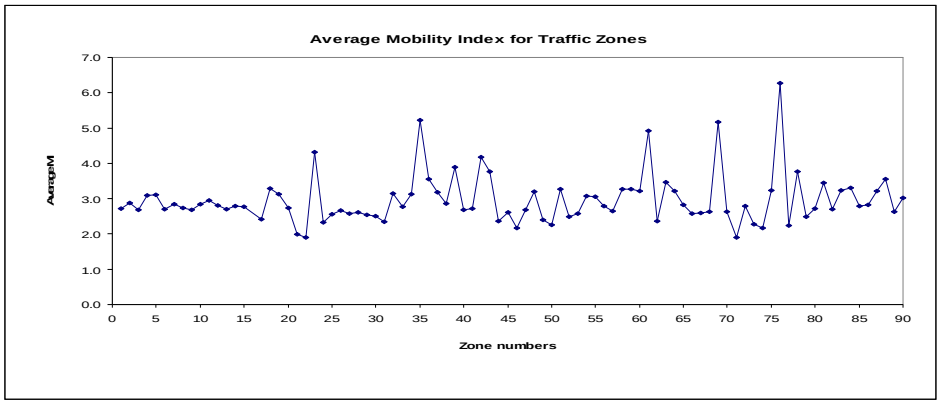


Source: Study on Integrated Transportation Plan for NCR

Figure 2.2: Weighted Accessibility Index (by population)

c. Mobility

Mobility Index[3] [4](MI) details presented in **Annexure 2.2** gives the percentage distribution of MI from each zone to all other zones in the base scenario. Overall results show very low level of mobility throughout the NCR.



Source: Study on Integrated Transportation Plan for NCR

Figure 2.3: Average Mobility Index for Traffic Zones

A mobility index below 1.5 can be considered as good inter regional connectivity. In order to assess the overall mobility of a traffic zone in NCR, the MI from each traffic zone to all other traffic zones is averaged and presented in **Figure 2.3.** In NCR, average MI is greater than or equal to 1.9 for 100 percent of the traffic zones thereby indicating requirement for better connectivity throughout the region.

[3] *Mobility Index is a measure of the efficiency of the network. It is defined as the ratio of travel time (speed determined by the condition) by the physical route between an origin and destination and the travel time by the airline distance at desired speed. An ideal network is one which provides the most direct route between an origin and destination at the desired speed.*
[4] *Network Analysis, Final Report, June 2003 prepared by Sheladia Associates, Inc.USA for Ethiopian Roads Authority.*

d. Connectivity

Graph Theory approach can be used to compare and evaluate various transport network options available and to select the best option. This approach can also be used to check the connectivity and accessibility level of different transport networks. Some of the significant interpretations that were concluded from the graph theory analysis are stated below:

- Beta index of 2.86 indicates that existing network of NCR is well connected
- Alpha Index of 32.6 indicates that the network is highly connected
- Index value of 82.7 indicates good degree of connectivity
- Cyclomatic number of 883 indicates that there is redundancy in the network system.

2.3 Road Network Inventory

The Road Inventory Survey of the whole road network system in the NCR was carried out to assess the physical characteristics and conditions of the existing major roads in NCR and to asses the scope of potential capacity for future expansion.

The existing road network for all constituent states, i.e. NCTD, States of Haryana, Uttar Pradesh and Rajasthan as shown in **Map 2.1** was characterized by the design elements like Right of Way, Carriageway Width, Type of Road Surface, Presence of Service Roads, Pavement Condition, Road Side Drainage Facilities and Road Side Furniture like signage, road markings, etc.

The above design characteristics for road side links in NCR were analyzed for assessing the Volume/ Capacity Ratio and for pavement condition so as to assess the need for capacity augmentation and up-gradation of existing roads to meet the traffic intensity and travel demand of traffic on the basis of analysis of inventory data, salient characteristics of major roads is presented in **Annexure 2.3.**

2.4 Volume / Capacity Ratio

The Volume / Capacity Ratio assessed by road links and length is presented in **Table 2.3** below:

Table 2.3: Distribution of Road Length by V/C Ratio

V/C	Road Links	%Age	Road Length	%Age
0.001 - 0.3	72.00	25.26	779.30	26.42
0.3 - 0.6	122.00	42.81	1253.40	42.49
0.6 - 0.99	63.00	22.11	697.60	23.65
> 1	28.00	9.82	219.70	7.45
Total	**285.00**	**100.00**	**2950.00**	**100.00**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

2.5 Pavement Condition

Further, the condition of the pavement was analyzed by sufficiency rating using Paser Condition Rating Criteria which is described below:

Pavement Condition		Paser Rating
No deficiencies such as rutting, corrugation, raveling, potholes, transverse cracks, alligator cracks, longitudinal cracks, etc.	:	10
Total failure	:	0
Good	:	8,9 or 10

Pavement Condition		Paser Rating
Fair	:	5,6 or 7
Poor	:	1,2,3,4

Based on this Paser Rating, all links are classified for maintenance needs. If Paser Rating is good, then it means routine maintenance would suffice, if the rating is fair, then the road needs preventive maintenance and if the road rating is poor, then the road would need rehabilitation of existing pavement. The distribution of road length by pavement condition for NCR sub-regions is presented in **Table 2.4** below:

Table 2.4: Distribution of Road Length by Type of Pavement Condition

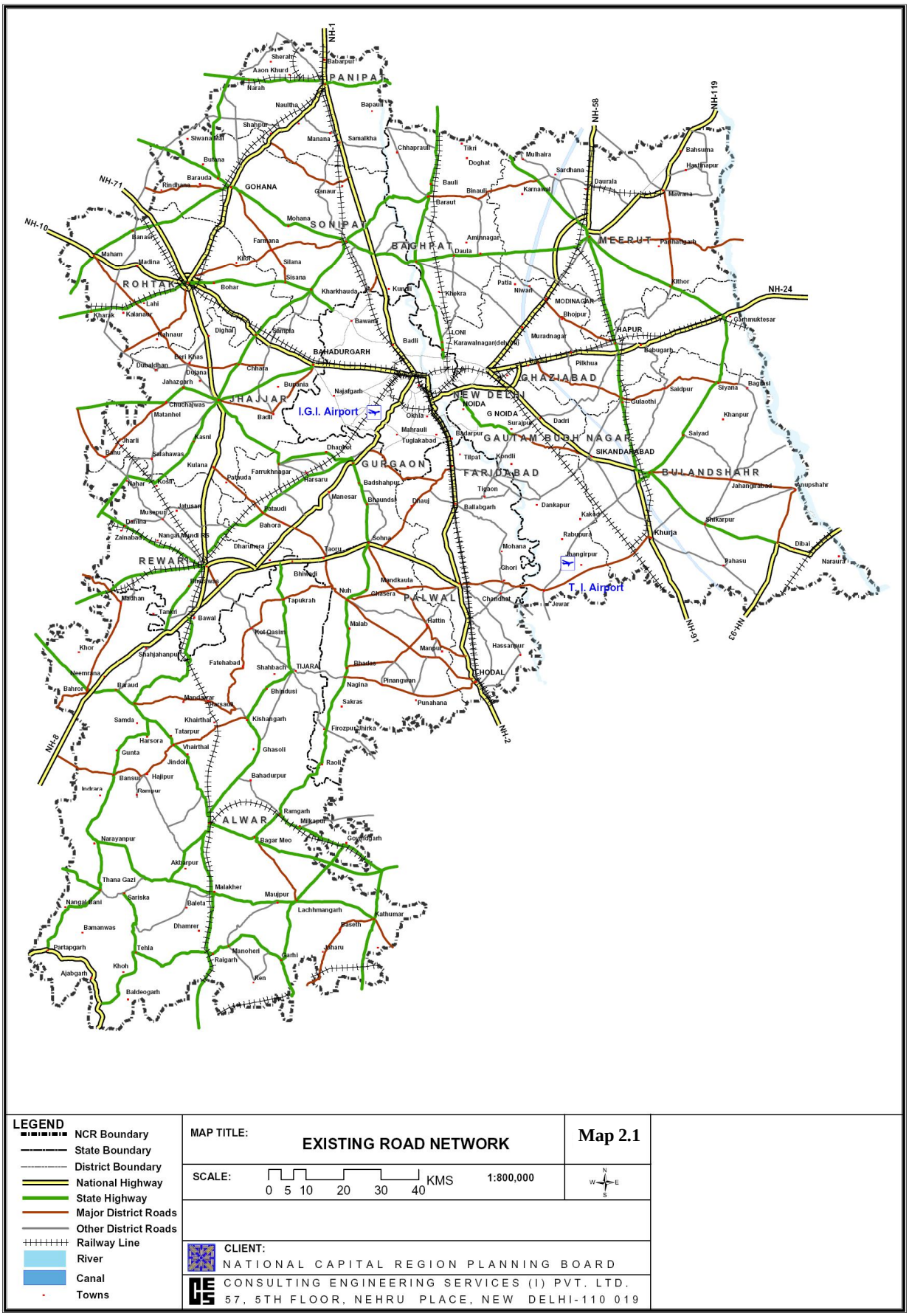
Pavement Condition	Road Length (Km)				%Age Road Length			
	Rajasthan	U.P.	Haryana	Total	Rajasthan	U.P.	Haryana	Total
Good	179.5	619.7	1061.54	1860.74	41.93	92.33	57.36	63.08
Fair	180.6	31.8	640.06	852.46	42.19	4.74	34.58	28.90
Poor	68	19.7	149.1	236.8	15.88	2.94	8.06	8.03
Total	**428.1**	**671.2**	**1850.7**	**2950**	**100**	**100**	**100.00**	**100.00**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

2.6 Road Network Analysis - Inferences and Recommendations

It was observed in the Study that the safety provisions on the highways do not match with the international standards. The road network is inadequate both in quantity and quality and therefore appropriate measures should be taken to improve the riding quality and the capacity of existing roads to meet the travel demand of goods and passenger traffic. The study proposed following improvements of road network in NCR:

a. All the road-side encroachments must be cleared to enhance the capacity of the existing corridors
b. The riding quality of the existing pavements must be improved to effect fuel savings and riding comfort
c. Dedicated facilities must be provided for pedestrians, cyclists, and other non-motorized vehicles
d. Exclusive bus lanes should be provided and other mass transport modes such as RRT System, LRT System, Metro and Mono-rails should be encouraged throughout NCR to meet inter-regional and intra-regional transport demand.
e. The alternative parallel routes must be explored to divert the traffic from the congested corridors
f. The construction of missing links, bridges, flyovers, underpasses, bypasses must be taken up on priority to improve the safety and efficiency of traffic to an acceptable level of service.


NH-1
NH-58
NH-119
NH-71
NH-10
NH-24
NH-91
NH-93
NH-8
NH-2
PANIPAT
GOHANA
SONIPAT
BAGHPAT
MEERUT
ROHTAK
BAHADURGARH
JHAJJAR
I.G.I. Airport
NEW DELHI
NOIDA
G NOIDA
GHAZIABAD
GAUTAM BUDH NAGAR
SIKANDARABAD
BULANDSHAHR
GURGAON
FARIDABAD
REWARI
PALWAL
HODAL
ALWAR
T. I. Airport
KHURJA
HAPUR
MODINAGAR
LONI
Sherahi
Babarpur
Aaon Khurd
Narah
Naultha
Bapauli
Shahpur
Siwana
Manana
Samalkha
Chhaprauli
Tikri
Muthaira
Doghat
Sardhana
Bahsuma
Hastinapur
Butana
Baraula
Rindhana
Ganaur
Baul
Binauli
Karnawal
Daurala
Mawana
Baraut
Mohana
Farmana
Amininagar
Daula
Panchnagar
Banasi
Maham
Madina
Kiloi
Silana
Sisana
Kharkhauda
Kundli
Khekra
Patla
Niwari
Kithor
Lahi
Kharak
Kalanaur
Bohar
Dighal
Sampla
Bawana
Badli
Karawalnagar(delhi)
Muradnagar
Babugarh
Kahnaur
Beri Khas
Dubaldhan
Chhara
Pilkhua
Dojana
Jahazgarh
Bupania
Najafgarh
Saidpur
Siyana
Bagpat
Chuchajwas
Matanhel
Badli
Okhla
Mahrauli
Tuglakabad
Badarpur
Surajpur
Dadri
Gulaothi
Khanpur
Jharli
Kasni
Bahu
Salahawas
Kulana
Dhankot
Tilpat
Kondli
Saiyad
Nahar
Kosli
Farukhnagar
Pataudi
Harsaru
Badshahpur
Tigaon
Jahangirabad
Anupshahr
Jatusar
Manesar
Bhaundsi
Dhauj
Ballabgarh
Dankapur
Kakrala
Shikarpur
Dahina
Nangal Mandi
Zainabad
Bahora
Dharuhera
Taoru
Sohna
Rabupura
Mohana
Jhangirpur
Ghori
Dibai
Pahasu
Narauri
Bhiwadi
Mandkaula
Nuh
Ghasera
Chandhat
Jewar
Madhan
Tapukhra
Tarant
Bawal
Hattin
Malab
Mangar
Hassanpur
Khor
Kot Qasim
Shahjahanpur
Fatehabad
Shahbad
TIJARA
Bhadas
Pleemrana
Nagina
Pinangwan
Bahror
Baraud
Bhiludusi
Mandakar
Punahana
Sakras
Samda
Khairthal
Kishangarh
Firozpur Jhirka
Tatarpur
Harsora
Vhairthal
Ghasoli
Gunta
Jindoli
Raoli
Bansur
Hajipur
Bahadurpur
Indrana
Rampur
Ramgarh
Milkapur
Bagar Meo
Govindgarh
Narayanpur
Akbarpur
Thana Gazi
Malakher
Sariska
Maujpur
Nangal Bani
Baleta
Lachhmangarh
Kathumar
Paseth
Bamanwas
Dhamrer
Tehla
Manoheri
Garhi
Partapgarh
Raigarh
Khoh
Ajabgarh
Ren
Baldeogarh
LEGEND
NCR Boundary
State Boundary
District Boundary
National Highway
State Highway
Major District Roads
Other District Roads
Railway Line
River
Canal
Towns
MAP TITLE:
EXISTING ROAD NETWORK
Map 2.1
SCALE:
0 5 10 20 30 40 KMS
1:800,000
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
CONSULTING ENGINEERING SERVICES (I) PVT. LTD.
57, 5TH FLOOR, NEHRU PLACE, NEW DELHI-110 019

3 *Traffic and Travel Characteristics*

3.1 Traffic Surveys

The characteristics of Regional Transport System were studied and assessed through conduct of following major primary surveys:

- Road Inventory Surveys
- Traffic Volume Surveys
- Origin-Destination Surveys
- Speed and Delay Surveys
- Commuter Surveys

The characteristics of road network for NCR based on these surveys are described in the following paragraphs:

3.1.1 Traffic Characteristics

The traffic characteristics on the basis of traffic volume survey, origin-destination survey and speed and delay surveys are briefly described below.

The traffic volume surveys were conducted at 82 count stations and origin-destination surveys at 44 locations on different categories of roads spread over the entire NCR network. The traffic survey locations are presented in **Figure 3.1.** The list of survey locations are presented in **Annexure 3.1.**

The traffic characteristics such as ADT, directional distribution of traffic, traffic composition, temporal variation, etc. at outer cordon & urban cordon and along road corridors are presented below:

3.1.1.1 Outer Cordon (OC) Traffic Characteristics

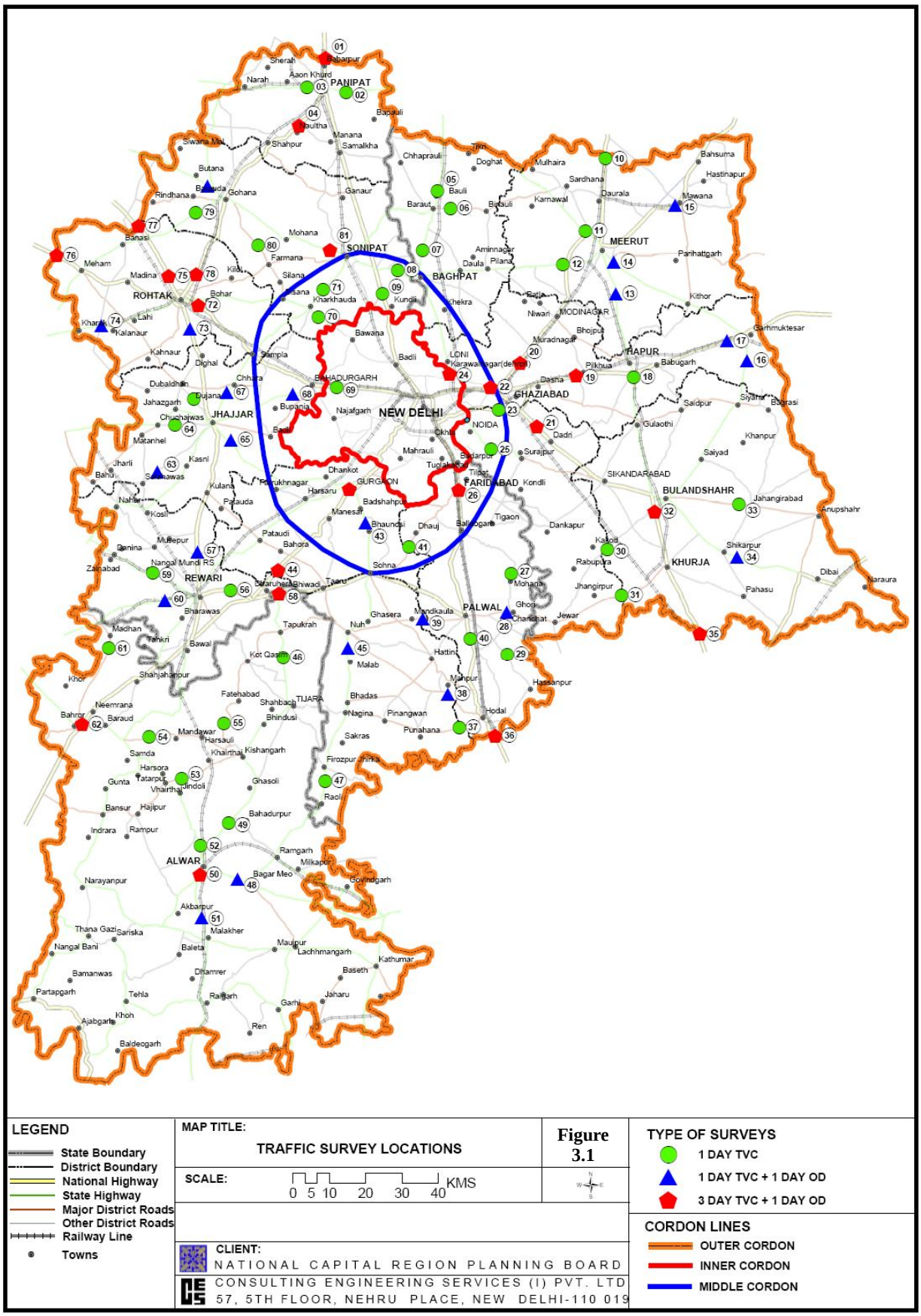
A large number of count stations fall along the outer cordon around the NCR. The traffic survey data at these locations have been analysed to appreciate the development at the outer cordon of NCR.

Average Daily Traffic (ADT)

About 2,21,575 vehicles (3,50,694 PCUs) enter and exit NCR on an average day. Amongst the count locations along the outer cordon, the highest ADT was 50,858 vehicles (90,853 PCUs) at Babarpur on Karnal road (NH-1). The lowest traffic volume (ADT) of 2,407 vehicles (3,008 PCUs) were observed at Gohana-Butana road. National Highways account for 74.57% (vehicles) of the total traffic entering and exiting the NCR.

Directional Distribution

There is no major directional imbalance (in – 50.3%; out – 49.7%) at the different count stations along the OC.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NEW DELHI
GURGAON
FARIDABAD
GHAZIABAD
NOIDA
MEERUT
HAPUR
MODINAGAR
BULANDSHAHR
SIKANDARABAD
KHURJA
REWARI
PALWAL
TIJARA
ALWAR
LEGEND
State Boundary
District Boundary
National Highway
State Highway
Major District Roads
Other District Roads
Railway Line
Towns
MAP TITLE:
TRAFFIC SURVEY LOCATIONS
Figure 3.1
SCALE:
0 5 10 20 30 40 KMS
TYPE OF SURVEYS
1 DAY TVC
1 DAY TVC + 1 DAY OD
3 DAY TVC + 1 DAY OD
CORDON LINES
OUTER CORDON
INNER CORDON
MIDDLE CORDON
CLIENT:
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Composition

Modal composition varies considerably amongst different locations. Motorized passenger vehicles accounts for 60.1% and goods vehicles for 33%. **Figure 3.2** depicts the modal composition.

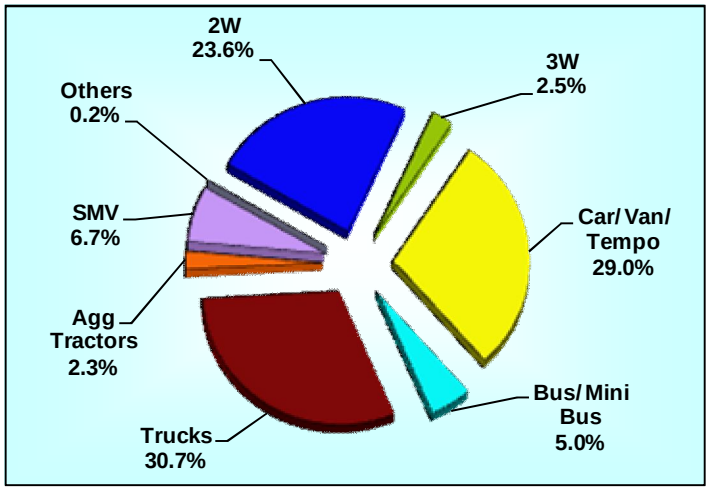


Figure 3.2: Modal Composition at National Capital Region Outer Cordon

Temporal Variation

Of the traffic at outer cordon stations, on National Highways, 80% of traffic moves during the day time (0600 hrs to 2200 hrs) and 20% during the 'night' time (2200 hrs to 0600 hrs). On State Highways & other roads, the 'day' traffic is a high of 91% and 'night' traffic is only 9%. At most of the locations, the peak flow is generally observed to be between 1000 and 1100 hrs. Generally, the peak hour flow ranges between 6 to 9%. However, at SH-16, it was a high of 12.6%. **Figure 3.3** depicts the temporal variation at NCR outer cordon locations.

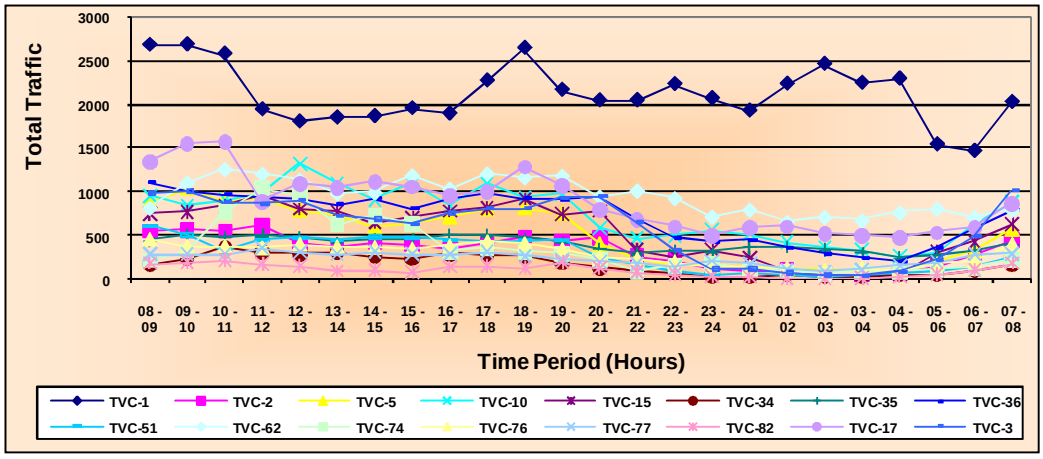


Figure 3.3: Temporal Variation of Traffic at NCR Outer Cordon

3.1.1.2 Traffic Characteristics at Urban Cordons

RP-2021 for the NCR, has proposed accelerated development of a number of towns in the region. They have been designated as Metro and Regional Centres. Sustained development of these Metro

Centres and Regional Centres is key to the success of the Regional Plan-2021. Connectivity amongst each and all of them and mobility within them are critical in their sustained development and attractiveness to receive investments. Traffic to and from these towns reflect their relative level of accessibility. Its appreciation will help in planning the regional road network system.

Urban Cordons (UC) are drawn around 10 selected Metro and Regional Centres. A number of TVC stations lie on each of these UCs. This data has been compiled and analysed to appreciate the traffic characteristics to and from the selected Metro and Regional Centres which is given in **Table 3.1.**

Table 3.1: Traffic Characteristics at Metro Centres/Regional Centres

Name of Metro Centres/ Regional Centres	Traffic Entering & Exiting Per Day		Share of Passenger mode	Share of Goods mode	Share of NMVs	Share of Night Traffic	Peak Hour share	Remarks
	Vehicles	PCU	(%)	(%)	(%)	(%)	(%)	
Rohtak	41,328	60,303	68.3	27.5	4.2	14.38 - 19.41	6.2-6.8	Important town in the state of Haryana, an administrative-cum-educational-cum trade center
Meerut	83,681	1,15,060	64.0	22.4	13.4	9.3 - 18.4	7.0 - 9.2	Biggest Metro Centre, next only to Delhi, major regional center serving its catchments as well as a major activity center consuming goods and services
Alwar	36,514	40,426	73.9	16.7	9.5	8.5 - 27.7	6.8 - 8.2	Headquarters of Alwar districts, the only district of Rajasthan which is part of NCR. Alwar is a heritage town and is important tourist center
Sonipat	20,625	25,247	71.7	20.6	7.6	8.7 - 10.6	6.7 - 8.1	Important town in Haryana and falls within CNCR
Panipat	86,604	1,36,609	60.9	35.8	3.2	7.84 - 33.39	5.3 - 7.8	Major industrial-cum-trade center on NH1 and suffers a large volume of traffic
Hapur	50,375	71,818	64.4	29.1	6.1	15 - 20	7.1 - 7.7	lies on NH-24 on the eastern part of NCR suffering a large volume of traffic
Gurgaon	3,14,609	3,17,970	69.5	29.4	0.9	10.63 - 19.03	6.3 - 8.3	Experiencing phenomenal growth
Ghaziabad	1,71,217	1,92,399	79.0	14.3	6.7	14.0 - 20.9	5.9 - 7.1	Large share of through traffic due to National Highways
Rewari	30,273	37,068	75.0	18.2	6.6	6.2 - 24.1	6.9 - 10.4	Lies at the intersection for NH-71 and NH-71 B
Faridabad	96,383	93,806	83.0	9.5	7.4	13.3	7.3	Major industrial town of Haryana which lies within CNCR

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Traffic composition at Urban Cordons around the 10 selected Metro / Regional Centres is given in **Figure 3.4**.

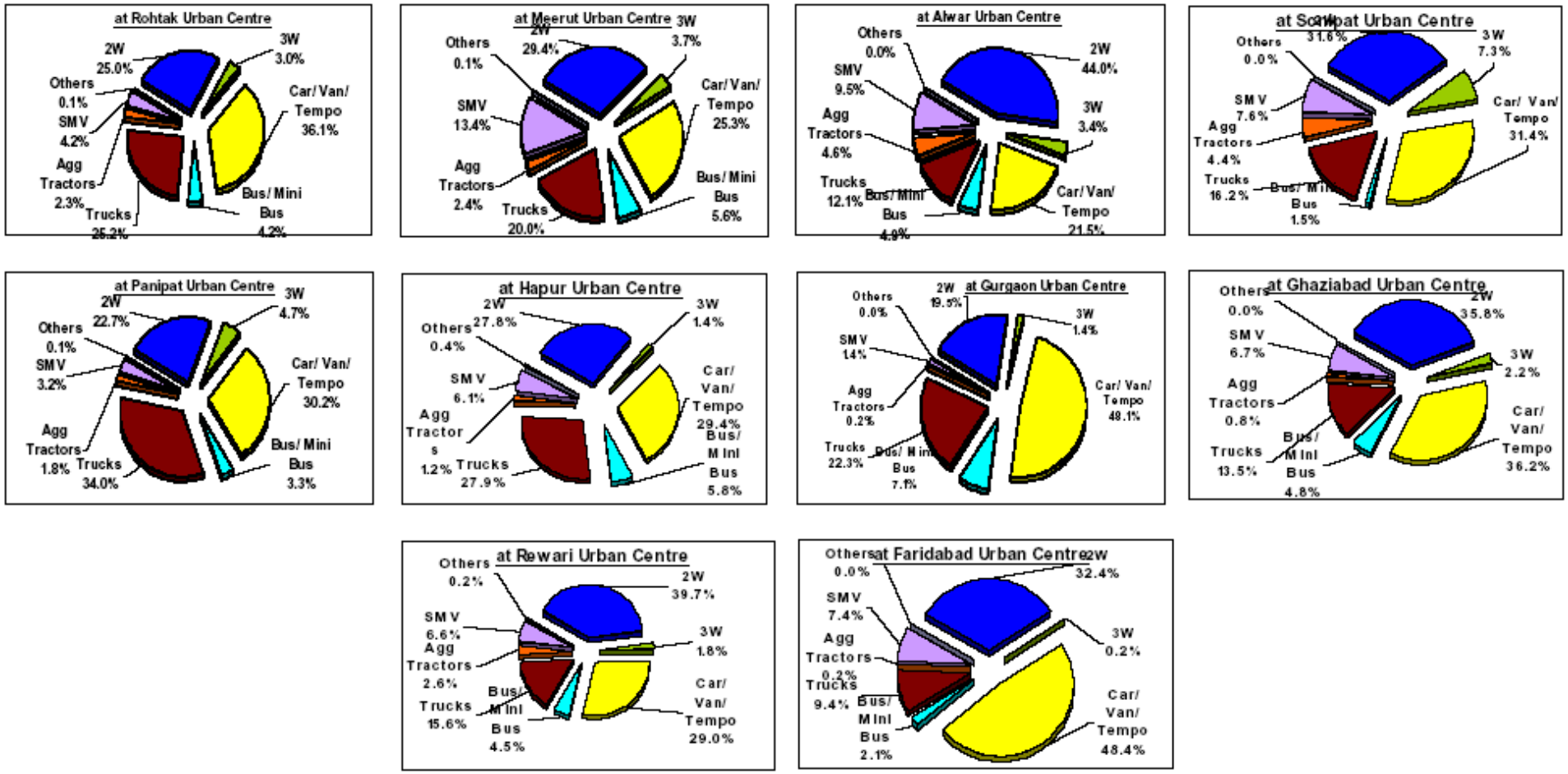


Figure 3.4: Modal Traffic Composition at Urban Cordons around Selected Metro Centre/Regional Centres in NCR

3.1.2 Speed Characteristics

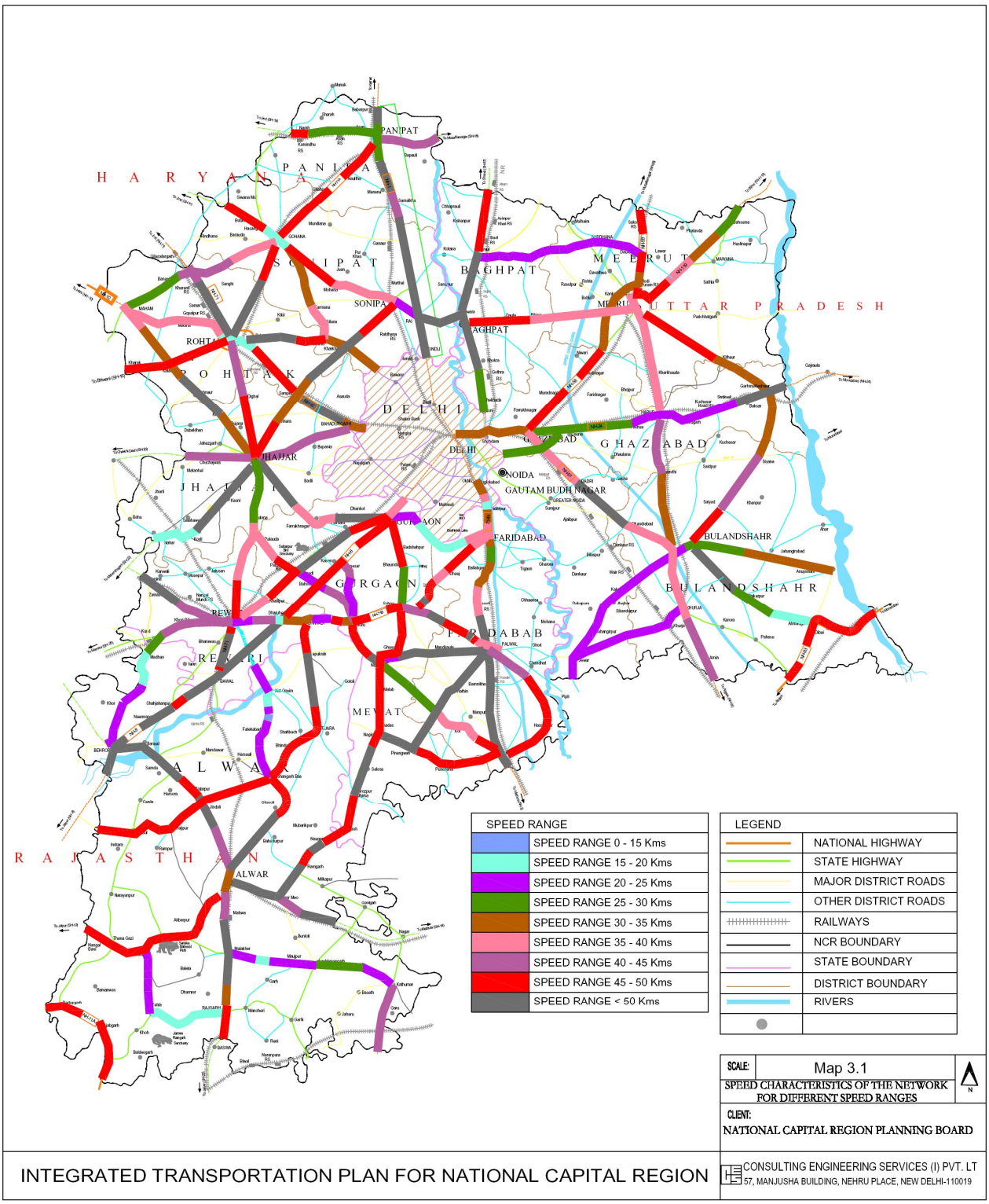
Traffic speed is an important characteristic as it determines the efficiency of the road network and helps in obtaining the level of service. The speed and delay survey was conducted using moving car observer method. The special analysis of speed for the network of roads reveals that 18% of road length has a speed of less than 20km per hour while the highest journey speed was observed to be 61.35 km / hour. The road network covered under speed and delay and the speed characteristics of the network for different speed ranges are presented in **Map 3.1.**

The data on speed analysis reveals the following preferences for improvement of NCR network:

- Clearing of road side encroachments, obstructions and physical objects for improving effective capacity of existing corridors
- Augmentation of capacity of different category of roads to meet the travel demand of today and tomorrow at present and in the future
- Exercising controls on direct access to highways and arterial roads
- Providing sufficient parking facilities with effective management to enhance the capacity of existing roads
- Provision of dedicated facilities for pedestrian and cycle movement along and across the roads to enhance highway capacity as well as safety.
- Provision of dedicated routes / lanes for buses and other public transport means
- Provision of grade separators / interchanges, pedestrian subways, foot over bridges, etc. for traffic segregation and safety.

The speed analysis also reveals that for a particular volume-capacity ratio, the speed on different sections is different mainly due to roadside encroachments, on-street parking, and absence of continuous footpaths and service lanes / roads in urban stretches, etc. It is, therefore, desirable to first improve the efficiency of existing road network through adoption of following measures before taking up capital intensive measures to minimize the operation losses:

- Clearing of encroachments within the right of way including physical objects and utilities
- Provision of dedicated pedestrian and cycle facilities along the road and at the intersections / interchange locations
- Provision of continuous footpaths and service lanes in urban stretches
- Exploring intelligent technical solutions for eradication of traffic bottlenecks in the road network
- Provision of grade separators / interchanges at major intersection locations
- Provision of pedestrian subways, FOBs, footpaths, etc. at urban settlement locations, growth centres, business centres, schools, etc.
- Augmentation of capacity of major corridors through development of alternative parallel routes links through traffic management techniques
- Lastly, augmentation of capacity of existing network to meet present and future traffic needs by capital intensive measures such as construction of new expressways, highways, bypasses, elevated corridors, etc.


H A R Y A N A
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BAGHPAT
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DELHI
NOIDA
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GHAZIABAD
FARIDABAD
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BULANDSHAHR
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SPEED RANGE 35 - 40 Kms
SPEED RANGE 40 - 45 Kms
SPEED RANGE 45 - 50 Kms
SPEED RANGE < 50 Kms
LEGEND
NATIONAL HIGHWAY
STATE HIGHWAY
MAJOR DISTRICT ROADS
OTHER DISTRICT ROADS
RAILWAYS
NCR BOUNDARY
STATE BOUNDARY
DISTRICT BOUNDARY
RIVERS
SCALE:
Map 3.1
SPEED CHARACTERISTICS OF THE NETWORK FOR DIFFERENT SPEED RANGES
N
CLIENT:
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INTEGRATED TRANSPORTATION PLAN FOR NATIONAL CAPITAL REGION
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3.2 Traffic Pattern Characteristics

The traffic pattern on the road network was established through conduct of extensive O-D surveys at 43 locations covering all types of roads within NCR in order to appreciate the intra-spatial pattern of movements.

For O-D survey & data analysis, NCR was classified into following traffic analysis zones, spatial units and cordon lines:

Traffic Analysis Zones: Traffic Analysis Zones (TAZs) were classified into 115 zones, comprising of 89 internal and 25 external zones for detailed analysis of data and modaling.

Spatial Units: Traffic movement pattern in NCR is complex in nature as it originates from all locations and also destined to all locations. For better appreciation of movement pattern, the analysis was carried out by dividing NCR into four spatial units:

- The National Capital Territory of Delhi (NCTD)
- The Central National Capital Region (CNCR)
- The rest of National Capital Region (RNCR)
- Areas Outside NCR (External)

Cordon Lines: To appreciate inter movement pattern by spatial units, the cordon lines around 3 spatial units, viz. NCR, CNCR and NCTD were drawn to delineate the spatial units, as below:

- Outer Cordon – Around NCR
- Middle Cordon – Around CNCR
- Inner Cordon – Around NCTD

The pattern of movements by passenger and goods modes for four spatial units has been analyzed by 3 cordon lines, i.e. Inner Cordon, Middle Cordon and Outer Cordon.

The intra-settlements (urban and rural) movements are not covered under this study.

3.2.1 Overall Traffic Patterns in NCR

3.2.1.1 Overall Traffic Pattern – Passenger Modes

(i) Movement Pattern

Of the 7,59,508 passenger modes crossing the O-D count stations in a day,

- Internal-Internal (II) : 69.4% (both O & D within NCR)
- Internal-External (IE) : 15.5% (Origin within NCR)
- External-Internal (EI) : 14.0% (Destination within NCR)
- External-External (EE) : 1.2% (both O & D outside NCR)

By modes, the pattern is almost similar. Nearly 85% of 2-wheeler movements, 80% of auto movements and 60% of car movements were II. Only 45% of bus movements were II, and 51% were IE / EI. While EE movements were generally very low, about 4% of bus movements were EE.

(ii) Trip Length - by modes

Trip lengths by modes indicate the intensity of usage of a mode and by implication its functional role. The average trip length of 2-wheelers and 3-wheelers (Auto-rickshaws) were low at 13.99 km and 13.35 km. Cars had a longer trip length of 125 km. Standard buses had the longest trip length of 191 km.

(iii) Trip Length frequency – by modes

Nearly 95% of 2-wheeler and 3-wheeler modes had a trip length of only upto 25 km. Car modes had fairly distributed trip lengths. Nearly 42% of buses had trip lengths in the range 100 – 250 km. Almost 41% of mini buses had trip lengths in the range 25-50 km and 30% in the range 50-100 km.

(iv) Average Occupancy - by modes

The occupancy of a mode, by number of people, indicates the intensity of use of the mode in terms of movement of people. It also indicates the efficiency of usage of the mode. The average occupancy of 2-wheeler was 1.68, of 3-wheeler was 3.55, cars 3.23 and buses 40.44. The occupancy is slightly higher than in urban areas indicating the intensive utilization of modes in the region.

(v) Trip Purpose

Overall, 'Work' was the predominant purpose (19.1%) followed by 'Business' (17.2%), 'Social' (11.7%) and 'Return Home' (14.0%). Interestingly 'Religious/Tourism' purpose showed a high share (10.5%) in trips performed by car mode. The share of passengers travelling for 'Education' purpose was low.

3.2.1.2 Overall Traffic Pattern – Goods Modes

(i) Movement Pattern

Of the 2,81,698 goods modes movement in NCR in a day,

- Internal-Internal (II) : 39.9% (both O & D within NCR)
- Internal-External (IE) : 27.6% (Origin within NCR)
- External-Internal (EI) : 27.4% (Destination within NCR)
- External-External (EE) : 5.1% (both O & D outside NCR)

(ii) Trip Length

MAVs had a long trip length of 685 km, 2/3 Axle Trucks had 321 km, while LCV and Tractors had trip lengths of 154 km and 51 kms respectively.

(iii) Trip Length Distribution

In case of MAVs, dominant distributions were in the frequency bands of 100-250 km and above. In case of 2/3 Axle Trucks, the predominant distributions were in the bands of 500-750 km. LCV modes had fairly distributed trip lengths. Tractors had a dominant distribution (44.64% in the band 0-25 km).

(iv) Load

Excluding empty vehicles, average load of MAVs was 11.7 tonnes and those of 2/3 trucks was 9.3 tonnes, while for LCV and Tractor, these values were found to be 4.4 tonnes and 2.3 tonnes respectively.

(v) Load Frequency Distribution

The load carried by a vehicle had been ascertained by enquiry. Empty vehicles accounted for a considerable share ranging from 27-28% (2/3 Axle Trucks and MAV) and 46% (Tractors). LCVs and Tractors generally carried small loads. However 2-3 axle Trucks and MAVs carried heavier loads. 31.0% of 2/3 Axle Trucks carried a load of more than 10 tonnes. Nearly 33% of MAVs carried an average load of 15 tonnes and above.

(vi) Commodity

The Commodity share indicates the multi-activity characteristics of NCR. 19 commodity types (excluding empty vehicles) had been identified. The distribution of loaded vehicles, by mode revealed that Food Grains, Fruits & Vegetables, Building Materials, Milk & Milk Products, Machinery, Petroleum Products, Iron & Steel were the major commodities carried by the goods vehicles.

3.2.1.3 Inter-State Movement Pattern

The movement patterns between the states within and outside NCR are stated in **Table 3.2.**

Table 3.2: Interstate Movement Pattern

Movement Pattern	Passenger Modes	Goods Mode
Intra-NCR	70%	40%
Between Rest of Haryana and NCR	5%	10%
Between Rest of UP and NCR	7%	14%
Between Rest of Rajasthan and NCR	13%	11%
Between NCR and Other States	5%	20%
Through movements/non-destined traffic		5%

Note: Rest of Haryana, UP and Rajasthan implies part of the state excluding portion within NCR

The above pattern indicates the high intensity of intra-NCR movements, the close affinity between NCR and the three constituent states of Haryana, UP and Rajasthan. The non-destined or through movements, though only 5% by share, by quantum they would be substantial and demand attention for their efficient movement.

3.2.2 Spatial Travel Pattern

3.2.2.1 Traffic Pattern at Outer Cordon (NCR)

ADT at Outer Cordon

A total of 94,659 passenger modes and 63,352 goods modes crossed the Outer Cordon (NCR, 12 locations) on an average per day. Of the passenger modes, 2-wheelers accounted for 35,173 (37.16%) and cars for 47,048 (49.70%). Of the goods modes, LCVs accounted for 16,223 (25.61%) and 2 / 3 Axle trucks accounted for 38,264 (60.39%). The share size of MAVs was low at only 5072 (8.02%). The pattern movements of the modes are analysed and presented below.

Tables 3.3 & Table 3.4 present the ADT, by passenger and goods modes, by count stations, at the Outer Cordon.

Table 3.3: Outer Cordon – ADT, Passenger Modes

ADT Loc	Direction	2 W	AUTO	CAR	MINI BUS	BUS	Direction Wise Total	Total
Location -1	1	3272	777	8332	42	941	13364	26931
	2	3463	618	8419	72	995	13567	
Location -15	1	2532	179	1595	22	313	4641	9068
	2	2396	175	1499	23	334	4427	
Location -17	1	2763	231	2524	21	506	6045	12183
	2	2773	249	2498	27	591	6138	
Location -34	1	878	1	470	11	105	1465	2929
	2	835	9	480	13	127	1464	
Location -35	1	848	1	1060	9	482	2400	4822
	2	869	1	1111	7	434	2422	
Location -36	1	1722	372	3187	39	267	5587	11470
	2	1780	388	3413	36	266	5883	
Location -51	1	1096	72	531	80	115	1894	4005
	2	1181	34	659	79	158	2111	
Location -62	1	1733	32	2643	151	453	5012	9223
	2	1381	39	2167	138	486	4211	
Location -74	1	910	111	1086	41	249	2397	4793
	2	898	90	1125	39	244	2396	
Location -76	1	676	59	1106	29	173	2043	4334
	2	772	76	1244	32	167	2291	
Location -77	1	675	53	791	26	80	1625	3220
	2	665	64	772	18	76	1595	
Location -82	1	473	121	186	0	15	795	1681
	2	582	138	150	0	16	886	
Total		**35173**	**3890**	**47048**	**955**	**7593**	**94659**	**94659**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Table 3.4: Outer Cordon – ADT, Goods Modes

ADT Loc	Direction	LCV	2/3 Axle	MAV	Tractor	Direction Wise Total	Total
Location -1	1	3196	7825	656	118	11795	23251
	2	3197	7278	859	122	11456	
Location -15	1	317	279	11	153	760	1722
	2	435	376	17	134	962	
Location -17	1	1508	1561	54	144	3267	6547
	2	1241	1815	70	154	3280	
Location -34	1	240	122	3	25	390	813
	2	223	150	16	34	423	
Location -35	1	538	1434	49	81	2102	4082
	2	468	1400	37	75	1980	
Location -36	1	392	1519	140	386	2437	4895
	2	459	1444	149	406	2458	
Location -51	1	116	474	97	248	935	1985
	2	75	663	71	241	1050	
Location -62	1	1039	4080	1109	320	6548	12988
	2	1042	4075	1093	230	6440	
Location -74	1	294	1067	155	118	1634	3082
	2	246	965	145	92	1448	
Location -76	1	311	368	77	90	846	1745
	2	338	373	78	110	899	
Location -77	1	218	430	89	144	881	1868
	2	246	461	95	185	987	
Location -82	1	45	62	1	96	204	374
	2	39	43	1	87	170	
Total		**16223**	**38264**	**5072**	**3793**	**63352**	**63352**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Movement pattern at Outer Cordon – Passenger Modes

Overall Pattern

Of the 94,659 passenger modes crossing the O-D count stations at the NCR outer cordon in a day,

- Internal-External (IE) : 47.4% (Origin within NCR)
- External-Internal (EI) : 49.4% (Destination within NCR)
- External-External (EE) : 3.2% (both O & D outside NCR)

Almost all the movements of 2-wheelers and autos were IE & EI. 5% of car movements and 10% of bus movements were EE.

Inter Spatial Movement Pattern

Figure 3.5 depicts the inter-spatial movement pattern of all passenger modes (a total of 94,659 vehicles) at the Outer Cordon.

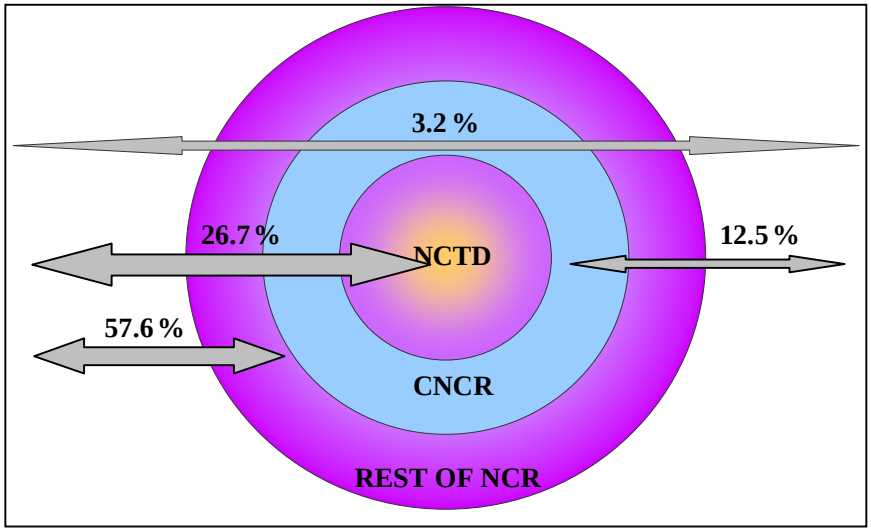


Figure 3.5: Inter-Spatial Movement Pattern of Passenger Modes in NCR Outer Cordon

Inter-spatial Movement Pattern by Passenger Modes by Type

Inter-Spatial Movement Pattern, at Outer Cordon, by individual passenger modes, presents an interesting picture. **Tables 3.5 & 3.6** present the movement pattern amongst the 'Outside NCR' and NCR spatial units, by modes and of modes.

Table 3.5: Outer Cordon – Movement Pattern, by Modes

Movement Pattern	Mode *(%)*					
	2 Wheeler	Auto	Car	Mini Bus	Bus	Total
Outside NCR & NCTD	0.0	0.4	84.4	0.9	14.3	100.0
Outside NCR & CNCR	47.1	4.2	41.8	0.7	6.1	100.0
Outside NCR & Rest of NCR	54.3	6.0	33.9	1.0	4.8	100.0
Outside NCR & Outside NCR	0.0	0.0	75.4	3.4	21.3	100.0

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Table 3.6: Outer Cordon – Movement Pattern, of Modes

Movement Pattern	Mode *(%)*					
	2 Wheeler	Auto	Car	Mini Bus	Bus	Total
Outside NCR and NCTD	0	3	45	24	47	24
Outside NCR and CNCR	16	12	11	9	10	12
Outside NCR and Rest of NCR	84	85	39	56	34	59
Out side NCR and Out side NCR	0	0	5	11	9	5
Total	100	100	100	100	100	100

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

(i) Occupancy

The average occupancy, by modes, at the outer cordon, is almost similar to the overall occupancy pattern in overall NCR. The average occupancy of two wheelers are 1.78, that of three wheelers are 3.49, cars/jeeps are 3.39, mini buses are 18.31 and that of buses are 40.72.

(ii) Trip Length

Cars had a long average trip length of nearly 160 km commensurate with their destination to NCTD. Buses had a long trip length of 217 km indicating inter-state movements.

(iii) Trip Length Frequency

About 90% of 2-wheeler and 3-wheelers had a trip length in the range 0 – 25 km. Cars and Mini Bus modes had a fairly distributed range of trip lengths. Buses had 50% of trips in the range 100 – 250 km.

(iv) Vehicle Trips by Purpose

'Work' and 'Business' trips were predominant trip purposes, overall and by modes. 'Social' trips were reasonable by different modes. The share of 'return home' trips by different modes was also significant.

Movement Pattern at Outer Cordon – Goods Modes

Overall Pattern

Of the 63,352 goods modes crossing the O-D count stations at the NCR outer cordon in a day,

- Internal-External (IE) : 44.6% (Origin within NCR)
- External-Internal (EI) : 46.3% (Destination within NCR)
- External-External (EE) : 9.1% (both O & D outside NCR)

Majority of the movements of LCV and HCV were IE & EI. 18% of MAV movements and 11.2 % of Agricultural tractor movements were EE.

Inter-spatial Movement Pattern

Figure 3.6 depicts the Inter-Spatial Movement Pattern of Goods Modes (out of a total of 63,352 vehicles) in NCR Outer Cordon.

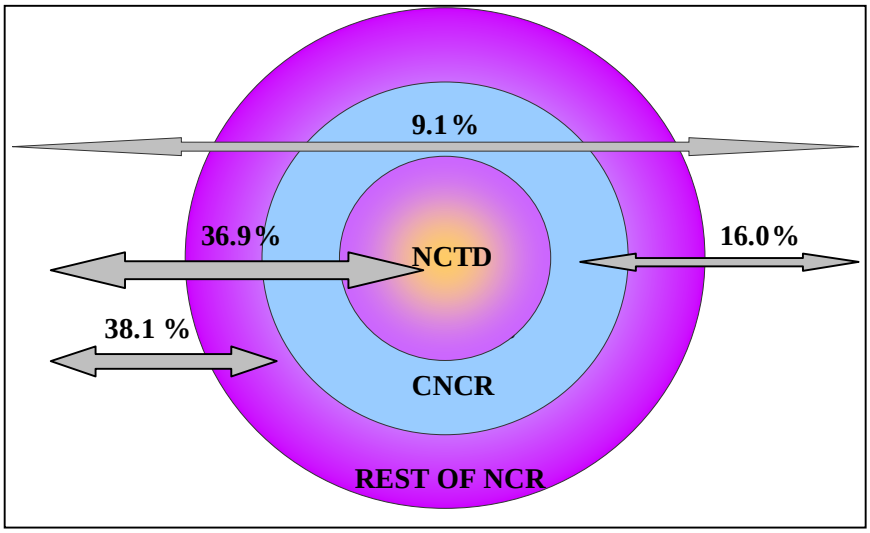


Figure 3.6: Inter-spatial Movement Pattern of Goods Modes in NCR Outer Cordon

Inter-Spatial Movement Pattern of Goods Modes by Type

Tables 3.7 & 3.8 present the spatial pattern of movement by modes and of modes, at Outer Cordon.

Table 3.7: Outer Cordon – Spatial Pattern of Movement by Goods Modes

Movement Pattern	Mode *(%)*				
	LCV	HCV	MAV	Agr. Tractors	Total
Outside NCR and NCTD	24.6	66.5	8.9	0.1	100.0
Outside NCR and CNCR	31.3	54.8	8.2	5.7	100.0
Outside NCR and Rest of NCR	26.6	56.8	5.3	11.4	100.0
Out side NCR and Outside NCR	15.8	60.8	15.7	7.7	100.0

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Table 3.8: Outer Cordon – Spatial Pattern of Movement of Goods Modes by Type

Movement Pattern	Mode *(%)*				
	LCV	HCV	MAV	Agr. Tractors	Total
Outside NCR to NCTD	35	41	41	0	37
Outside NCR to CNCR	19	14	16	15	16
Outside NCR to Rest of NCR	40	36	25	73	38
Out side NCR to Out side NCR	6	9	18	12	9
Total	100	100	100	100	100

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

(i) Trip Length

Trip lengths of different modes ranged from less than 25 km to more than 1500 km. Trip lengths were reasonably distributed over all frequency bands. The modal bands were: LCVs – 100-250 km; 2/3 Axle trucks – 100-250 km; and MAVs – 250-500 km. This indicated the generation potential of all parts of NCR.

(ii) Load

Empty vehicles accounted for a good share ranging between 17.1% (2/3 Axle Trucks) and 40.6% (Tractors). The average load ranged between 1.9 tonnes for tractors and 13.9 tonnes for MAVs

excluding empty vehicles. LCVs and Tractors generally carried small loads. However 2/3 axle Trucks and MAVs carried heavier loads. 52.8% of MAVs carried average load of 15 tonnes and above.

(iii) Commodity Type

As noted earlier, share of empty vehicles was reasonably high. Excluding empty vehicles, food grains, cash crops, fruits and vegetables, Building Materials, Cement, Iron & Steel were the major commodities carried. Petroleum Products and Chemicals & fertilizer had a high share amongst MAVs.

3.2.2.2 Traffic Pattern at Middle Cordon (CNCR)

ADT at Middle Cordon

A total of 1,61,314 passenger modes and 67,859 goods modes crossed the Middle Cordon (MC) on an average day. Of the passenger modes, 2-wheelers accounted for 40.8%, Cars for 51.9% and Buses for 5.9%. Of the goods modes, LCVs accounted 25.6%, 2/3 Axle Trucks for 60.4% and MAVs for 8.0%.

Tables 3.9 & 3.10 present the ADT by passenger and goods modes, by count stations, at the MC.

Table 3.9: Middle Cordon – ADT, Passenger Modes

ADT Loc	Direction	2 W	Auto	Car	Mini Bus	Bus	Direction-wise Total	Total
Location -9	1	4830	547	5594	236	752	11959	23455
	2	3300	658	6352	247	939	11496	
Location -20	1	6724	65	7646	127	825	15387	31644
	2	6624	74	8456	170	933	16257	
Location -21	1	3493	49	2965	171	668	7346	15139
	2	3508	61	3280	167	777	7793	
Location -42	1	6242	4	9790	402	1072	17510	35631
	2	6652	2	10078	331	1058	18121	
Location -69	1	5453	807	6006	51	583	12900	26077
	2	6060	714	5717	58	628	13177	
Location -83	1	6104	647	6569	80	561	13961	29368
	2	4987	848	9004	47	521	15407	
Total		63977	4476	81457	2087	9317	161314	161314

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Table 3.10: Middle Cordon – ADT, Goods Modes

ADT Loc	Direction	LCV	2/3 Axle	MAV	Tractor	Direction-wise Total	Total
Location -9	1	4040	7350	485	475	12350	25092
	2	4585	7339	430	388	12742	
Location -20	1	1208	1253	82	260	2803	5870
	2	1333	1442	65	227	3067	
Location -21	1	1030	2376	265	162	3833	7013
	2	1020	1779	210	171	3180	
Location -42	1	3248	2126	700	105	6179	14645
	2	3281	4258	817	110	8466	
Location -69	1	952	1200	115	225	2492	5081
	2	933	1288	110	258	2589	
Location -83	1	1223	2810	383	443	4859	10158
	2	1310	3175	327	487	5299	
Total		24163	36396	3989	3311	67859	67859

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Movement Pattern at MC – Passenger Modes

Overall Pattern

Of the 1,56,838 passenger modes (excluding autos) crossing the O-D count stations in a day,

- Internal-Internal (II) : 27.3% (both O & D within CNCR)
- Internal-External (IE) : 35.8% (Origin within CNCR)
- External-Internal (EI) : 32.8% (Destination within CNCR)
- External-External (EE) : 4.1% (both O & D outside NCR)

In the analysis, Autos were not included.

Inter Spatial Units Movement Pattern

The inter-spatial units movement pattern of all passenger modes indicated that a good share (40.7%) was performed between Outside CNCR and NCTD. 24.0% between CNCR and Rest of NCR; and 14.3% between CNCR and NCTD.

Inter Spatial Movement Pattern by Passenger Modes by Type

The distribution of Inter Spatial Movement Pattern by mode type shows that movements between Outside CNCR and NCTD account for high share. Cars accounted for 47.5%, Buses for 59.5% and even 2-wheelers for 26.6%. This indicated the high attraction of NCTD from Outside CNCR areas. Interestingly movements between CNCR and NCTD were not very high, ranging between 9.1% (Bus) and 16.6% (Cars). Intra CNCR movements was high amongst 2-wheelers (25.7%). **Figure 3.7** depicts the Inter-Spatial Movement Pattern of Passenger Modes in CNCR Middle Cordon.

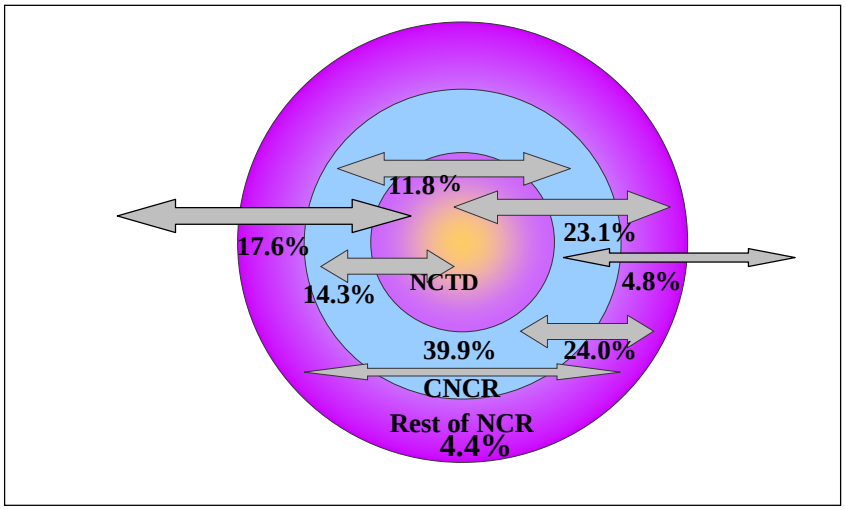


Figure 3.7: Inter-Spatial Movement Pattern of Passenger Modes in CNCR Middle Cordon

(i) Occupancy

Compared to occupancy at OC, Buses and Minibuses at MC, had higher occupancies of 42.67 and 22.41. Cars, 2 wheelers and 3 wheelers had occupancies of 1.76,3.85 and 3.38 respectively.

(ii) Trip Length

Cars had an average trip length of 151 km and buses a high of 229 km. This indicates the relatively large vehicle-kms of travel in NCR.

(iii) Trip Length Frequency

Nearly 40% of Buses had a trip length in the band 100-250 km, and another 26.7% in the band 250-500 km. A large share (98.4%) of Cars was in the bands upto 500 km. 2-wheeler (97.7%) and 3-wheelers(99.7%) were mainly of short trip length in the band 0-25 km.

(iv) Vehicle Trips by Purpose

Overall, 'Work' and 'Business' purpose accounted for a share of 15.8% and 20.3% respectively. The share of Education trips was low (2.4%). Social purpose trips were reasonably high at 13.3%. By mode, share of 2-wheeler (21% for 'work' and 34% for 'business') and 3-wheeler trips (46% for 'work' and 26% for 'business') for 'work' and 'business' purpose were very high.

Movement Pattern at Middle Cordon – Goods Modes

Overall Pattern

Of the 67,859 goods modes crossing the counts stations at CNCR Middle Cordon in a day,

- Internal-External (IE) : 46.8% (Origin within CNCR)
- External-Internal (EI) : 41.8% (Destination within CNCR)
- External-External (EE) : 7.2% (both O & D outside CNCR)
- Internal-Internal (II) : 4.2% (both O & D inside CNCR)

The share of external trips indicated the potential need for a bypass/orbital road system around CNCR. Surprisingly, Agricultural Tractors had a higher share 8.6% of EE movements. This might be due to their movements in the peripheral areas as denoted by their average trip length, which was the lowest amongst the goods modes.

Inter Spatial Movement Pattern

The inter spatial movement pattern indicated a very high share (62%) of movements between Outside CNCR and NCTD. This indicated the high generation character of NCTD. Surprisingly the share of movements between CNCR and NCTD was a low of 2.0%.

Inter-Spatial Movement Pattern of Goods Modes by Type

By each mode type, a high share of movement was observed between outside CNCR & NCTD (Outside CNCR includes Rest of NCR and Outside NCR). The share ranged from 48.8% (Agr. Tractors) to 65% (HCVs). There was a high degree of interaction between CNCR and Rest of NCR and CNCR and Outside NCR. **Figure 3.8** depicts the inter-spatial movement pattern of goods mode (out of a total of 67,859 vehicles).

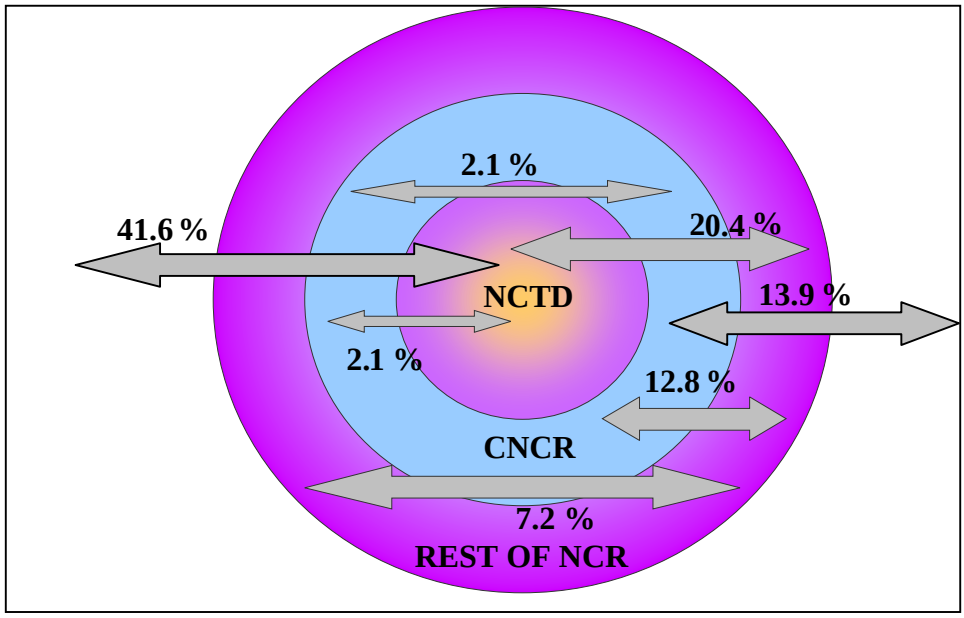


Figure 3.8: Inter-Spatial Movement Pattern of Goods Modes in CNCR Middle Cordon

(i) Trip Length

The average trip lengths of modes were reasonably high ranging from 54 km (Agri. Tractor) to 517 km (MAVs). This indicated the intense vehicular-kms within NCR.

Trip lengths were reasonably distributed amongst different frequency bands upto 750 km. MAVs had longer trip lengths with a share of 10.13% in the band above 1500 km.

(ii) Load

Empty vehicles accounted for a share ranging between 23.2% (MAVs) and 40.9% (LCVs). This indicated the imbalance in demand for goods vehicles and also perhaps the requirement of organized hubs for collection and distribution of consignments and goods vehicles. Excluding the empty vehicles, the average load of MAVs was 11.7 tonnes and that of 2/3 Axle Trucks was 7.5 tonnes.

By vehicle type, 33.0% of MAVs had a load of more than 15 tonnes and 16.8% of 2/3 Axle Trucks had a load of more than 10 tonnes. LCVs and Agricultural tractors mainly carried loads up to 7.5 tonnes.

(iii) Commodity Type

Excluding empty vehicles, minerals, food grains, cash crops, fruits & vegetables, building materials, cement, milk & milk products and petroleum products were the major commodities carried by vehicles. Of the MAVs, 20.5% carried cement and 24.1% iron & steel. Amongst 2/3 axle trucks, 19.4% carried cash crops, 11.5% building materials and 10.6% petroleum products. Large share of agricultural tractors carried food grains (20.5%), cash crops (17.4%), building materials (16.3%) and cement (14.7%).

3.2.2.3 Traffic Pattern at Inner Cordon (NCTD)

ADT at Inner Cordon

NCTD is the focus of NCR. While its physical size is small as compared to other sub-regions, its demographic size is huge and activities concentration intense. It is a major producer and attractor of people, goods and other flows. The emphasis on planning the road network system enabling movements to and from NCTD will continue. Added also is the need to divert non-destined traffic. Appreciation of traffic pattern at the cordon around NCTD (Inner Cordon) is important to plan an efficient and effective road network system in the NCR.

A total of 11,07,043 passenger modes and 1,03,853 goods modes crossed the Inner Cordon (IC) on an average day. Of the passenger modes, cars accounted for a maximum share (60.7%) followed by 2-wheelers (33.4%). Autos accounted for 3.6 % and Buses for 2.3%.

Of the goods modes, 2/3 Axle Truck had the maximum share (55%). LCVs were in good number (38,717 /37.3%). MAVs (5158 / 5.0%) and tractors (2850/ 2.7%) accounted for a low share.

Table 3.11 & 3.12 presents the ADT, by Passenger and Goods mode, by count stations on NCTD Inner Cordon.

Movement Pattern at Inner Cordon – Passenger Modes

Overall Pattern

Of the 11,07,043 passenger modes crossing the counts stations at NCTD Inner Cordon in a day,

- Internal-External (IE) : 36.7% (Origin within NCTD)
- External-Internal (EI) : 38.4% (Destination within NCTD)
- External-External (EE) : 22.9% (both O & D outside NCTD)

The high share of external movements called for a bypass orbital around NCTD and justified the proposed Eastern and Western Peripheral Expressways. The share of internal movements within the inner cordon is negligible (2%) and has hence been excluded in further analysis.

Table 3.11: Inner Cordon – ADT, Passenger Modes

LOC No.	ADT Loc	Dir	2 W	Auto	Car, Jeep***	Mini Bus	Bus	Direction Wise Total	Total
1 *	Delhi-Gurgaon section on NH-8	1	23050	35	120404	187	1609	145285	288978
		2	17917	53	124361	186	1176	143693	
2 *	Mehrauli -Gurgaon Rd (Near Aya Nagar)	1	13861	129	27557	191	496	42234	86332
		2	14838	83	28578	153	446	44098	
3 **	Surajkund Rd (Near Pulprahladpur)	1	6327	307	6487	62	117	13300	24690
		2	5207	423	5553	60	147	11390	
4 *	Delhi -Faridabad section on NH-2/ Mathura Rd	1	12263	3047	17513	214	622	33659	68336
		2	12798	2824	17991	257	807	34677	
5 *	Noida-Saritavihar/ Road No. 13A (Kalindi Kunj Rd)	1	21727	1305	23278	134	964	47408	93035
		2	20709	1272	22496	106	1044	45627	
6 *	Delhi-Noida Rd/ Noida Link Rd	1	11023	703	27978	71	205	39980	85794
		2	12352	771	32356	67	268	45814	
7 **	New Ashok Nagar Rd	1	1563	27	1539	6	8	3143	6254

LOC No.	ADT Loc	Dir	2 W	Auto	Car, Jeep***	Mini Bus	Bus	Direction Wise Total	Total
		2	1433	31	1636	7	4	3111	
8 **	Vasundhara Enclave	1	5932	765	4920	40	90	11747	24297
		2	6244	978	5136	44	148	12550	
9 **	Har Shingar Marg (Near DDA Sports Complex)	1	4723	895	4662	44	370	10694	22021
		2	5493	740	4745	11	338	11327	
10 *	Ghaziabad-Delhi section on NH-24 / NH-24 near Gazipur Border	1	18766	2729	22955	224	386	45060	92721
		2	20317	2675	23859	132	678	47661	
11 **	Koushambi Border (Near Anand Vihar ISBT)	1	13233	1026	14650	101	301	29311	59467
		2	13967	1652	13929	199	409	30156	
12 **	Dr. Bhabha Marg (Near Ramprastha)	1	4309	236	4012	36	42	8635	17326
		2	4508	195	3892	44	52	8691	
13 *	Ghaziabad-Mohan Nagar on NH 58/ Apsara Border (G.T. Rd)	1	21767	5196	17136	227	1689	46015	94773
		2	22871	5583	18164	252	1888	48758	
14 **	Mangal Pandey Marg (Bhopura Border)	1	7075	800	5674	77	330	13956	28387
		2	7876	1128	5028	73	326	14431	
15 *	Loni-Bagpat section on SH-57/ Loni Border (Saharanpur Rd)	1	1817	950	1998	8	226	4999	9421
		2	1556	886	1826	6	148	4422	
16 *	Haryana-Delhi Section on NH-1 near Singhu Border	1	3822	52	12561	77	1118	17630	36192
		2	3622	42	13786	90	1022	18562	
17 *	Bawana -Sahadpur Chowki/ Auchandi-Bawana Rd	1	715	0	1185	29	79	2008	4146
		2	870	0	1124	44	100	2138	
18 *	Bahadurgarh-Delhi Section on NH/ Rohtak Rd (Tikri Border)	1	4432	660	5608	63	678	11441	22809
		2	4295	698	5557	81	737	11368	
19 **	Dhansa Border	1	839	5	436	82	83	1445	2927
		2	964	4	339	84	91	1482	
20 *	Haryana-Delhi (Kapashera) on old NH / Old Gurgaon Rd (Near Kapasheda Border)	1	6691	596	11124	468	598	19477	39137
		2	7558	580	10324	510	688	19660	
Total			369330	40081	672357	4747	20528	1107043	1107043

*Source: * Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007 ** RITES – Primary Survey 2007-08*
*Note : ***- RITES data covers vans along with cars and jeeps, but CES data does not include vans*

Table 3.12: Inner Cordon – ADT, Goods Modes

LOC No.	Name of Location	Dir	LCV	Trucks/ 2-3 Axle	MAV	Tractors	Direction Wise Total	Total
1 *	Delhi-Gurgaon section on NH-8	1	2406	4318	684	100	7508	14846
		2	2362	4536	334	106	7338	
2 *	Mehrauli -Gurgaon Rd (Near Aya Nagar)	1	758	1305	42	104	2209	3607
		2	560	807	10	21	1398	
3 **	Surajkund Rd (Near Pulprahladpur)	1	912	1040	132	***	2084	4282
		2	1041	1033	124	***	2198	
4 *	Delhi -Faridabad section on NH-2/ Mathura Rd	1	2415	2803	193	65	5476	10837
		2	2376	2727	131	127	5361	
5 *	Noida-Saritavihar/ Road No. 13A (Kalindi Kunj Rd)	1	1063	4928	674	112	6777	12121
		2	776	4234	296	38	5344	
6 *	Delhi-Noida Rd/ Noida Link Rd	1	148	216	8	19	391	865
		2	191	246	12	25	474	
7 **	New Ashok Nagar Rd	1	26	6	0	***	32	50

LOC No.	Name of Location	Dir	LCV	Trucks/ 2-3 Axle	MAV	Tractors	Direction Wise Total	Total
		2	17	1	0	***	18	
8 **	Vasundhara Enclave	1	763	25	1	***	789	1318
		2	493	36	0	***	529	
9 **	Har Shingar Marg (Near DDA Sports Complex)	1	675	27	10	***	712	1326
		2	501	106	7	***	614	
10 *	Ghaziabad-Delhi section on NH-24 / NH-24 near Gazipur Border	1	874	1803	184	17	2878	6132
		2	815	2205	164	70	3254	
11 **	Koushambi Border (Near Anand Vihar ISBT)	1	544	259	0	***	803	2211
		2	671	585	152	***	1408	
12 **	Dr. Bhabha Marg (Near Ramprastha)	1	196	489	3	***	688	1038
		2	164	186	0	***	350	
13 *	Ghaziabad-Mohan Nagar on NH 58/ Apsara Border (G.T. Rd)	1	1676	1874	186	201	3937	8185
		2	1897	1885	208	258	4248	
14 **	Mangal Pandey Marg (Bhopura Border)	1	1878	1246	386	***	3510	6384
		2	1407	1276	191	***	2874	
15 *	Loni-Bagpat section on SH-57/ Loni Border (Saharanpur Rd)	1	151	1592	201	252	2196	4909
		2	194	1881	235	403	2713	
16 *	Haryana-Delhi Section on NH-1 near Singhu Border	1	1967	3802	11	92	5872	11276
		2	2068	3256	25	55	5404	
17 *	Bawana -Sahadpur Chowki/ Auchandi-Bawana Rd	1	332	416	14	190	952	1870
		2	202	479	10	227	918	
18 *	Bahadurgarh-Delhi Section on NH/ Rohtak Rd (Tikri Border)	1	1066	1299	259	186	2810	5457
		2	1063	1275	168	141	2647	
19 **	Dhansa Border	1	231	209	0	***	440	871
		2	190	240	1	***	431	
20 *	Haryana-Delhi (Kapashera) on old NH / Old Gurgaon Rd (Near Kapasheda Border)	1	1782	1147	92	21	3042	6268
		2	1866	1330	10	20	3226	
Total			38717	57128	5158	2850	103853	103853

*Source: * Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007, ** RITES – Primary Survey 2007-08*
*Note : ***- RITES data does not include tractors separately*

Inter Spatial Movement pattern by Passenger Modes

Interestingly share of movements between NCTD and Rest of NCR (36.21%) were almost equal to that between NCTD and CNCR (36.20%). **Figure 3.9** depicts the inter-spatial movement pattern of passenger mode (out of a total of 11,07,043 vehicles).

There were intense interactions amongst all spatial units. The highest share in all modes was between NCTD and Rest of NCR. This indicated the increasing location of activities in Rest of NCR. However the share of passenger movement observed between NCTD and outside NCR was very low (4.18%). The share of movements between outside NCTD and outside NCTD was high at 23.40%.

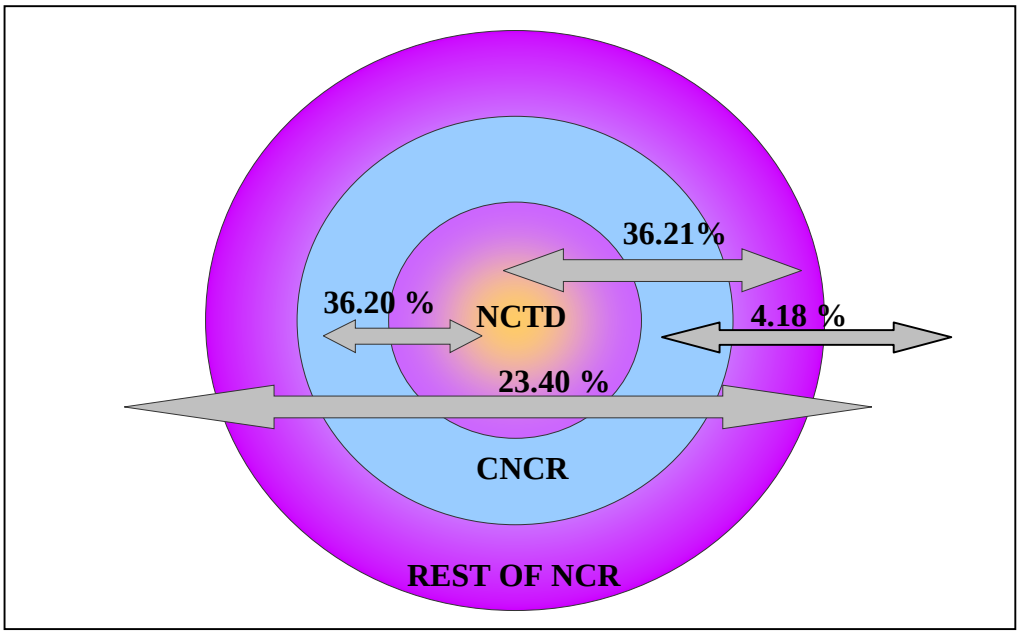


Figure 3.9: Inter-Spatial Movement Pattern of Passenger Modes in NCTD Inner Cordon

(i) Occupancy

There were variations in occupancy of modes observed at IC as compared to OC & MC. Buses showed a lower occupancy level 39.77 as compared to 42.67 at MC. Similarly mini buses also showed a much lower occupancy level 11.18 as compared to 22.41 at MC. The average occupancy of 2 wheelers, 3 wheelers, and Car/Jeep were 1.59, 2.93 and 2.79 respectively which were lower than the corresponding values observed at OC and MC.

(ii) Trip Length

Buses had the longest trip length (121.86) as compared to other modes. Trip lengths were much shorter as compared to those at OC and MC.

(iii) Trip Length Frequency

Nearly 84% of the total trips were less than 50 km in length. 87% of 2-wheelers were in the band 0-25 km while 89% of 3-wheelers had distributed trip lengths upto 100 km. Buses had fairly distributed trip lengths upto 250 km while cars,3 wheelers and mini buses had fairly distributed trip lengths upto 100 km.

(iv) Vehicle Trip Purpose

'Work' and 'Business' were the major purposes accounting for 32% and 23% of the total trips respectively. Social trips were also high at 13.0%. Education trips were low (2.3%). By mode, share of 2 wheelers, 3 wheelers, cars and mini buses for 'work' and business' purpose were reasonably high.

Movement Pattern at Inner Cordon – Goods Modes

Overall Pattern

Of the 1,03,853 goods modes crossing the counts stations at NCTD Inner Cordon in a day,

- Internal-External (IE) : 30.5% (Origin within NCTD)
- External-Internal (EI) : 38.6% (Destination within NCTD)
- External-External (EE) : 29.9% (both O & D outside NCTD)

The significant share of EE movements stressed the need for a bypass orbital road system around NCTD. The share of internal movements within the inner cordon is negligible (1%) and has hence been excluded in further analysis.

Inter Spatial Movement Pattern by Goods Mode

The movement between NCTD and rest of NCR accounted for the highest share (34.49%) followed by that between NCTD and CNCR(20.85%). The share of goods movement between NCTD and outside NCR was nearly 15% which indicated the intense interaction between NCTD and different states of the country. As already noted, share of movements between outside NCTD and Outside NCTD was high at 30.19%.

Figure 3.10 depicts the inter-spatial movement pattern of goods mode (out of a total of 1,03,853 vehicles).

(i) Trip Length

Generally at the inner cordon, trip lengths were found to be shorter than that at OC or MC. MAVs had the longest trip length of 163 km followed by 2/3 Axle Trucks at 139 km. The trip length for LCV and Tractor was 96 km and 84 km respectively.

A high share of movements of different modes was in the band 0-25 km. Trip lengths of all modes are reasonably distributed amongst bands from 0-25 km to 250 –500 km.

(ii) Load

A high share of modes by type, (ranging from around 30-33% in MAVs and 2/3 axle trucks to around 40% in Tractors and LCVs) were empty. Excluding empty vehicles, the average load of MAVs was 10.3 tonnes and 2/3 Axle Trucks was 7.8 tonnes. As it was ascertained by enquiry, there might be a possibility of understatement. About 27.2% of the MAVs were found to carry loads greater than 15 tonnes. Agricultural tractors were generally found to carry loads upto 5 tonnes.

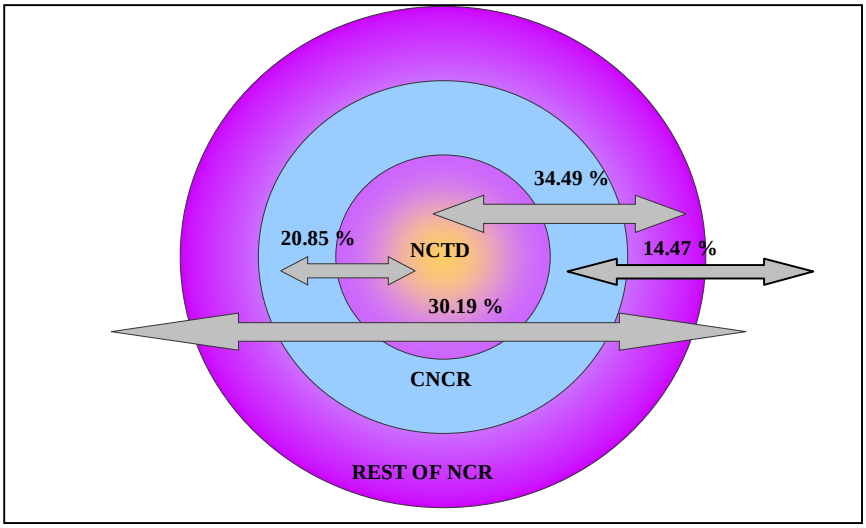


Figure 3.10: Inter-Spatial Movement Pattern of Goods Modes in NCTD Inner Cordon

(iii) Commodity

Excluding empty vehicles, Fruits & Vegetables and Building Materials were the major commodities carried by the different types of goods modes. A high share of MAVs carried Petroleum Products (12.8%) and Manufacturing products (11.2%). A high proportion of Tractors carried Petroleum products (15.0%) and Milk, Poultry, Livestock (12.6%).

3.2.3 Comparative Analysis and Issues

3.2.3.1 Comparative Analysis

i) On the whole NCR, around 10,40,000 vehicles criss-crossed the 43 O-D count stations a day of which passenger modes were about 7,60,000 and goods modes were about 2,80,000.
ii) At NCR level, Internal-Internal movements predominated with 69% for passenger modes and 40% for goods modes.
iii) At the NCR level, External-External movements were found to be low in the order of 1.2% for passenger modes and 5.1% for goods modes.
iv) The total movements from outer cordon were found to be 95,000 for passenger modes catering for 5,60,000 passenger modes per day on an average day while total goods modes were found to be 63,500 transporting 3,95,000 tonnes of goods per day.
v) At the outer cordon, External-External movements were catering for 3.2% of the passenger modes and 9.1% of the goods modes while at the inner Cordon, External-External movements were catering for 22.9 % in passenger modes and 29.9 % in goods modes.
vi) Amongst goods modes at the outer cordon, the share of empty vehicles was high, constituting 17% of 2 / 3 axle trucks,22% MAVs and 40% of tractors.
vii) NCTD of Delhi is the focus of NCR from traffic considerations as the intensity of traffic crossing IC was high. A total of around 11,07,043 passenger modes and 1,03,853 goods modes crossed the IC on an average day.
viii) At the inner cordon, trip lengths of passenger modes as well as goods modes were found to be much shorter than that at OC and MC.

3.2.3.2 Issues

The appreciation of traffic pattern characteristics has brought out the following important issues:

i) There is high intensity of traffic at all spatial levels
ii) The complex pattern of movements criss-crossing all over the NCR
iii) There is increase in share of External-External traffic as one moves from OC to IC and hence it highlights the need for screening at all spatial levels
iv) Passenger modes necessitate higher levels of service in terms of capacity and speed from the network
v) The size of goods traffic calls for appropriate logistic facilities spread over the NCR
vi) The share of buses in traffic is moderate and hence concerted efforts are required to strengthen the bus system and rationalize the routes and operation

4 *Railway Network in NCR*

The railway network in NCR consists of complex rail radials and hubs which have got developed over the last hundred years. It serves the National capital – New Delhi and strives to meet transportation needs of India's populations, people visiting it for business and social requirements. Unlike other major metros of the country, rail network in the capital also operates as a transit point for passengers and freight volumes moving between Punjab, Haryana, Himachal, J&K, Rajasthan on one side and rest of the country on the other.

4.1 Rail Radials around NCT-Delhi

NCT-Delhi is served by the following 8 rail radials:

5 Major Radials

i. New Delhi – Faridabad – Palwal (to and from Central India)
ii. New Delhi – Sonipat – Panipat (to and from Northern States)
iii. New Delhi – Rohtak (to and from parts of Haryana & Punjab)
iv. New Delhi – Gurgaon – Rewari – Alwar (to and from Western India)
v. New Delhi – Shahdara – Shamli (to and from Western UP)

3 Radials converging at Ghaziabad

i. Delhi – Ghaziabad – Khurja – Aligarh (to and from Eastern India)
ii. Delhi – Ghaziabad – Hapur – Garhmukteswhwar (to and from UP and Utrakhand
iii. Delhi – Ghaziabad – Meerut (to and from Western UP)

The following sub sections complete the rail network in NCR and around NCT:

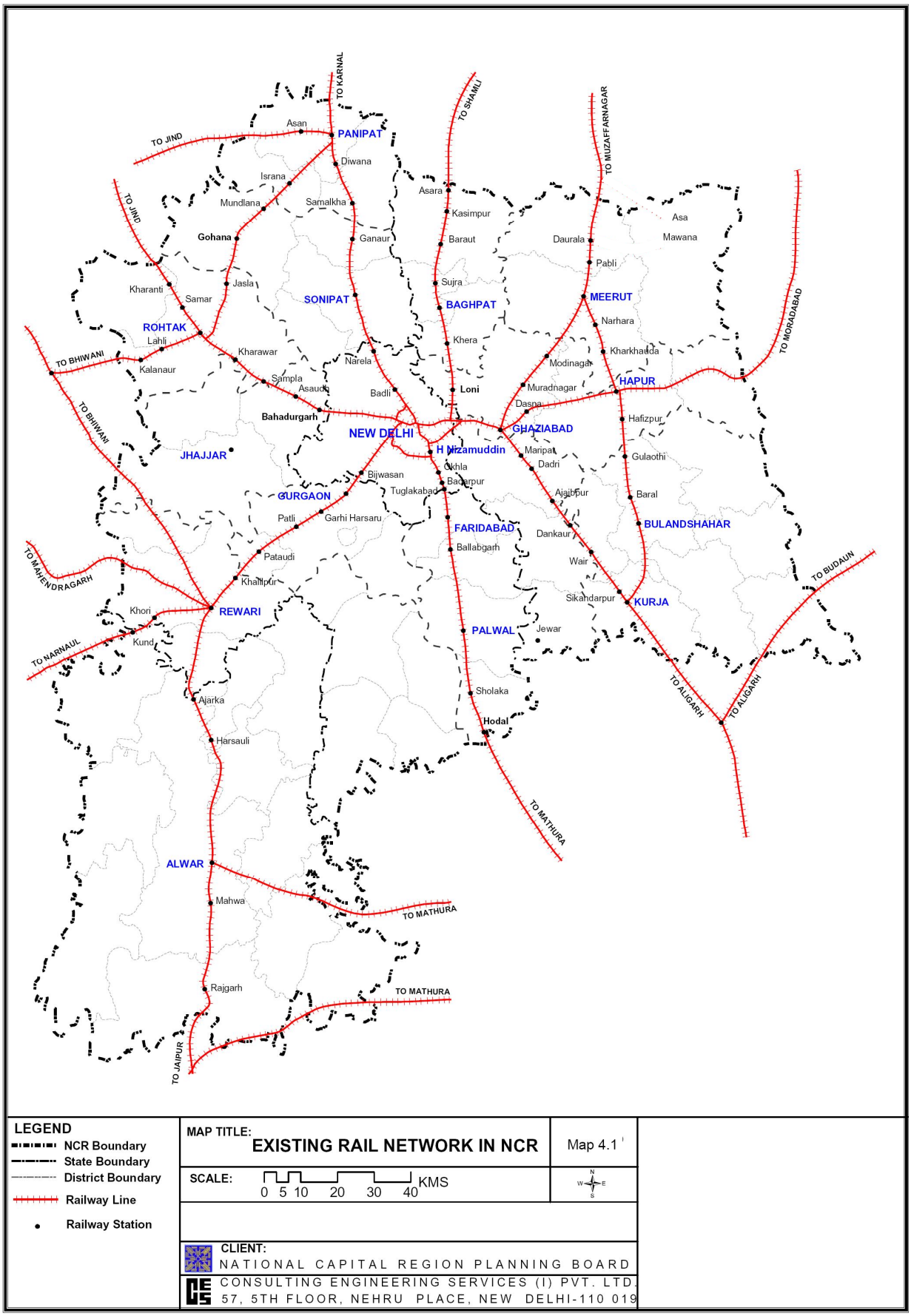
i. Delhi – New Delhi – Nizamuddin – Patel Nagar – Delhi Kishanganj – New Delhi/DLI (GAL)
ii. Delhi – Shahdara/Sahibabad – Anand Vihar- New Delhi/Delhi (DAL)
iii. Khurja – Hapur – Meerut (connecting DLI-Howarh route with DLI-Meerut- Saharanpur and Delhi-Moradabad links)
iv. Panipat – Rohtak (Branch line)
v. Sub sections of Rohtak – Jind, Rewari – Bhiwani, Rewari – Mahendragarh and Rewari – Narnaul sections

The rail network in NCR is shown in **Map 4.1.**

4.2 Passenger Terminals in the Capital

The four passenger handling terminals in the capital are:

(i) New Delhi
(ii) Delhi
(iii) H. Nizamuddin
(iv) Delhi Sarai Rohilla


TO KARNAL
TO SHAMLI
TO MUZAFFARNAGAR
TO JIND
TO JIND
TO BHIWANI
TO BHIWANI
TO MAHENDRAGARH
TO NARNAUL
TO MORADABAD
TO BUDAUN
TO ALIGARH
TO ALIGARH
TO MATHURA
TO MATHURA
TO MATHURA
TO JAIPUR
PANIPAT
Asan
Diwana
Israna
Mundlana
Samalkha
Gohana
Ganaur
Asara
Kasimpur
Baraut
Daurala
Asa
Mawana
Pabli
Sujra
Jasla
Kharanti
Samar
SONIPAT
BAGHPAT
MEERUT
ROHTAK
Lahli
Kharawar
Narela
Khera
Narhara
Kharkhauda
Modinagar
Kalanaur
Sampla
Asaudh
Badli
Loni
Muradnagar
HAPUR
Dasna
Bahadurgarh
NEW DELHI
GHAZIABAD
Hafizpur
JHAJJAR
H Nizamuddin
Maripat
Dadri
Gulaothi
Okhla
Bijwasan
Badarpur
Tuglakabad
Ajaibpur
Baral
GURGAON
Patli
Garhi Harsaru
FARIDABAD
Dankaur
BULANDSHAHAR
Ballabgarh
Pataudi
Wair
Khalilpur
Sikandarpur
KURJA
Khori
REWARI
PALWAL
Jewar
Kund
Sholaka
Ajarka
Hodal
Harsauli
ALWAR
Mahwa
Rajgarh
LEGEND
NCR Boundary
State Boundary
District Boundary
Railway Line
Railway Station
MAP TITLE:
EXISTING RAIL NETWORK IN NCR
Map 4.1
SCALE:
0 5 10 20 30 40 KMS
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
CONSULTING ENGINEERING SERVICES (I) PVT. LTD.
57, 5TH FLOOR, NEHRU PLACE, NEW DELHI-110 019

Their profile have been undergoing significant changes during the last five decades and the capacity enhancement works have been undertaken , basically to serve the needs of long and medium distance travellers using services. Traditionally, two rings have got formed viz one linking Delhi-Shahadra Anand Vihar – Tilak Bridge – New Delhi-Delhi and the other formed by joining New Delhi-NZM-PTNR-DSJ-Brar Square-PTNR-DKZ-NDLS. Historically, the first ring (GAL) got constructed when NDLS was approached directly without touching Delhi, from eastern sector (Aligarh, Moradabad, Meerut side). The second ring (so called Ring Railway) got developed, when the freight traffic could be moved from Central and/Western India to Punjab, Haryana without touching New Delhi/Delhi and conserving the terminals primarily for passenger operation.

4.3 Coaching and Freight Traffic in Delhi & NCR

NCR, particularly Delhi area handles tremendous volumes of coaching and freight traffic. The coaching traffic has grown at an exponential rate during the last two decades with addition of large number of mail, express, Shatabdi and Rajdhani trains catering to long distance, inter-city movements and EMUs, main line EMUs and diesel push-pull trains catering to fast growing commuter traffic between Delhi and the satellite towns of the National Capital Region. The freight traffic has also grown at a fast pace. Delhi Area is a complex network of railway lines with coaching and freight traffic pouring in and out of eight radials. A large volume of traffic terminates within the area, but an equally large volume of traffic moves across from one radial to another. There are three main goods terminals at Tughlakabad, Shakurbasti and Delhi Kishanganj apart from power houses, viz., Badarpur and Indraprastha which are served through their exclusive sidings. Tughlakabad harbours an International Container Depot (ICD) which has grown at a fast pace and is already bursting at its seams. It handles a growing volume of domestic container traffic as well and is also the only marshalling yard now operational on Northern Railway. Two electric loco sheds, one at Tughlakabad and the other at Ghaziabad and two diesel loco sheds, one at Tughlakabad and the other at Shakurbasti are also situated in NCTD.

4.4 Operational Complexities

The operational problems confronting Delhi Area arise mainly from over-saturation of line capacity in certain sections like Delhi – Ghaziabad, Delhi –Shakurbasti and Delhi – New Delhi –Sahibabad etc. These are not only hindering traffic flows but could put future growth of traffic in jeopardy. Unfortunately, these congested sections pass along heavily built up urban areas. Capacity expansion of these sections is either physically impossible or prohibitively expensive.

4.5 Description of Radials in Delhi Area

The brief account of major 8 radials is given below:

(i) Delhi – Ghaziabad – Aligarh Section

Ghaziabad, an important CNCR town, is situated at a distance of 20 km from Delhi. Delhi – Ghaziabad corridor is an electrified section with double lines between Delhi – Sahibabad and quadruple lines between Sahibabad – Ghaziabad. From Ghaziabad, the lines branch off into three directions/divisions touching important rail heads of NCR, controlled by one Division of Northern Railway and two divisions of North Central Railway. The segments are:

- Ghaziabad – Khurja Jn. – Aligarh Section on Allahabad Division (North Central Railway)
- Ghaziabad – Hapur – Garmukteshwar Section on Moradabad Division (NR)

- Ghaziabad – Meerut Section on Delhi Division (NR).

The NCR limit on Ghaziabad-Aligarh rail corridor extends upto Somna station at a distance of 104 km from Delhi. The section beyond Ghaziabad and up to Aligarh is presently a double line electrified route under the administrative control of Allahabad Division of North-Central Railway. It handles long distance mail / express trains, passenger shuttles and long distance freight trains on electric traction.

On the critical sub section (viz Sahibabad- Ghaziabad) of this radial, 120 trains each way is the installed sectional capacity whereas LC utilization is already above 130%. 116 passenger carrying trains and over 40 freight trains each way are operational on the critical sub-section.

Major contribution of unreserved passenger traffic is made by Ghaziabad, Delhi Shahdara, Sahibabad, Dankaur, Khurja, Dadri and Aligarh Jn. stations etc.

(ii) Ghaziabad – Hapur – Garmukteshwar –Section

The NCR limit on this rail corridor extends upto Garmukteshwar station at a distance of 87 km from Delhi. Hapur station is situated at a distance of 37 km from Ghaziabad. The section between Ghaziabad and Hapur is a double, non-electrified line route and is under the administrative control of Moradabad Division of Northern Railway. It handles 25 long distance mail / express trains, passenger shuttles and 3 freight trains each way on diesel traction. With doubling completed upto Hapur, LC utilization on the sub-section between Hapur-Ghaziabad is eased and utilization is over 60%. Being a non-electrified section, inter-radial EMU operation for commuter traffic on this sub section, is at present, not feasible. Hapur and Pilkhuwa generate significant commuter traffic.

(iii) Ghaziabad – Meerut

The NCR limit on this rail corridor extends upto Khatauli station at a distance of 101 km from Delhi. Meerut City station is situated at a distance of 69 km from Delhi and 48 km from Ghaziabad. The section between Ghaziabad and Meerut is double line non-electrified. The section handles 19 long distance mail / express, passenger shuttles and 8 freight trains each way on diesel traction system. The section is under the administrative control of Delhi Division of Northern Railway. Present utilization of Ghaziabad-Meerut sub section is comparatively lower (in the range of 50%). To make it commuter friendly, non-electrified territory may come in the way in the long run. Modinagar, Muradnagar, Meerut City and Meerut Cantt. generate substantial commuter traffic.

(iv) Delhi – Shahdara – Shamli section

The NCR limit on this rail corridor extends upto a distance of around 75 Km from Delhi. This is a single line non-electrified section operated by Diesel traction. This is relatively lightly loaded section with predominantly passenger traffic and very low goods traffic. The section is under the control of Delhi Division of Northern Railway. Line capacity, at present on the sub section (Delhi Shahdara-Shamli) is not a constraint. However, beyond Delhi Shahdara towards Delhi Jn, LC does pose a problem for operation. Loni, Khekra, Bagpat Road, Baraut, Shamli have a big share in commuter traffic.

(v) Delhi – Faridabad – Palwal Section

The NCR limit on this rail corridor extends upto Chhata station at a distance of 114 km from Delhi. This is a double line electrified section utilised for running of long distance, inter-city mail / express trains, ordinary passenger trains EMU trains and freight trains. On this section, jurisdiction of Northern Railway extends upto Palwal station (inclusive) and thereafter the section is under the

control of Agra Division of North-Central Railway. This is a major artery, which carries heavy mixed traffic from Central and Western India. 65 passenger carrying trains and over 50 freight trains each way are operated daily on this vital sub section of Indian Railway with 150% line capacity utilization. Introduction of any new passenger/freight train on this sub section becomes a major issue. Palwal, Faridabad, Ballabgarh, Kosi Kalan and Tuglakabad are the major contributors of commuter traffic.

(vi) Delhi – Gurgaon – Rewari – Alwar Section

The NCR limit on this rail corridor extends upto Alwar station is at a distance of 158 km from Delhi. Gurgaon (CNCR town) is situated at a distance of 32 km from Delhi. The entire section is non-electrified running on diesel traction system and catering to inter-city mail / express, trains, ordinary passenger and freight trains. The section upto Rewari (excluding) falls under the administrative control of Delhi Division of Northern Railway. Beyond that, it is under Jaipur Division of North-Western Railway. With complete gauge conversion of double line upto Rewari, the section is operating 20 passenger trains and 6 freight trains each way. Rewari, Pataudi road, Gurgaon, Palam and Delhi Cantt. contribute a major share in unreserved passenger stream.

(vii) Delhi – Shakurbasti – Rohtak Section

The NCR limit on this rail corridor extends slightly beyond Rohtak which station is at a distance of 70 km from Delhi. Bahadurgarh (CNCR town) is situated at a distance of 30 km from Delhi. This is a non-electrified double line section operating on diesel traction system which is utilised for running of mail / express, trains, ordinary passenger and freight trains to and from Haryana, Punjab and Rajasthan. Being a diesel section, seamless operation from and to other vital sections is a challenge for commuter operation. Rohtak, Bahadurgarh, Sampla, Nangloi and Shakurbasti are the major contributors to commuter traffic.

(viii) Delhi – Subzimandi – Sonipat – Panipat Section

The NCR limit on this rail corridor extends upto Panipat station at a distance of 89 km from Delhi. The section is an electrified double line rail corridor which is extensively utilised for running of inter-city mail / express trains, ordinary passenger carrying trains as well as freight trains to and from Haryana, Punjab, Himachal Pradesh and Jammu & Kashmir. In operational priority, this sub section falls at third position in NCR, after New Delhi – Aligarh Jn and New Delhi – Palwal sections. With electrified territory it moves around 70 trains each way, including 38 passenger carrying trains each way. Line capacity is saturated with 135% utilization. Panipat, Sonipat, Narela, Naya Azadpur, Ganaur, Samalkha and Sabzimandi contribute a major share in commuter/unreserved traffic.

4.6 Passenger Traffic Profile

4.6.1 NCR, particularly NCT, has been witnessing a stupendous growth in passenger train handling. Till early, 60s, Old Delhi Station was the only (BG) coaching terminal. In the last 40 years, New Delhi and Nizamuddin have assumed much greater importance. In terms of passenger trains, the three terminals have seen remarkable growth. A sample of growth over the last 25 years may be seen as under:

Table 4.1: Growth of Passenger Trains in Delhi Area (25 years)

Years	Delhi			New Delhi			Hazrat Nizamuddin		
	No of Pass. Trains Orig/Termin	Through	Total	No of Pass. Trains Orig/Termin.	Through	Total	No of Pass. Trains Orig/Termin	Through	Total
1980	110	22	132	54	70	124	20	64	84
1985	108	30	138	68	63	131	36	60	96
1990	104	36	140	72	74	146	36	69	105
1995	116	31	147	91	82	173	47	72	119
2000	148	36	184	103	96	199	59	76	135
2005	154	48	202	133	108	241	79	81	160
2007	150	51	201, Including *52 EMU & 70 Pass trains*	135	117	252, Including *76 EMU & 12 Pass trains*	87	85	172,Including *48 EMU & 8 Pass trains*

Source: Study on Integrated Transportation Plan for NCR,

4.7 Commuter Services in NCR

The present trends of unreserved passenger and commuter traffic in the rail corridors in NCR have been studied. The originating traffic data of unreserved passengers from most of the stations of different railway corridors have been collected. This data has been used for analyzing share of rail traffic vis-à-vis total traffic demand entering / leaving NCR. The daily passenger traffic originating at major stations in NCR is of the order of 7,24,467 passengers.

Analysis of the data of unreserved passenger and daily travelers in the NCR for the year 2007-08 reflects that majority of commuters originate their journeys from the following major stations, and this accounts for a total of 4,30,750 **(Table 4.2).**

Table 4.2: Unreserved Passengers in NCR (Major Stations)

SI. No.	Station Code	Originating Passengers per day
1	BVH (Ballabhgarh)	16180
2	FDN (Faridabad New Town)	16330
3	FDB (Faridabad)	22170
4	PWL (Palwal)	23940
5	PNP(Panipat)	15050
6	SNP(Sonepat)	30190
7	SZM(Subzimandi)	4700
8	NARELA	14700
9	ROK (Rohtak)	17720
10	SSB (Shakurbasti)	7200
11	BGZ (Bahadurgarh)	13000
12	DSA(Delhi Shahdara)	16100
13	SBB (Sahibabad)	19220
14	GZB (Ghaziabad)	40830
15	KHURJA	5030
16	DEC (Delhi Cantt)	7480
17	DEE(Delhi Sarai Rohilla)	4800
18	GGN(Gurgaon)	13000
19	RE (Rewari)	13500
20	HPU (Hapur)	7200
21	BARAUT	13600
22	MEERUT CITY	12190
23	NDLS (New Delhi)	37960
24	NZM(Nizamuddin)	13700
25	DLI (Delhi Main)	36960
26	TKD (Tuglakabad)	8000
	Total	430750

* *Details of the abbreviation used for station codes used in the table are given on last page of this chapter*
Source: Study on Integrated Transportation Plan for NCR

The rail commuter services available at present (March 2008) in NCR are given in **Table 4.3**.

Table 4.3: Commuter Services for Different Stations in NCR

S.No	Section	Type of Trains	Length in KMs	No. of Trains (Commuters + Passenger) per day in each direction.
1. 1A	Delhi-Ghaziabad New Delhi-Ghaziabad	EMU, MEMU, Conventional	20 25	42
2	Delhi-Palwal	EMU, MEMU, Conventional	60	18
3	H.Nizamuddin-H.Nizamuddin (Ring Rail)	EMU	35	7
4.	Delhi-Rewari/Alwar	Conventional, DMU	82	8
5.	Delhi-Shakurbasti-Rohtak	EMU, Conventional	70	9
6.	Delhi-Subzimandi-Panipat	MEMU,EMU, Conventional	88	11
7.	Delhi-Ghaziabad-Meerut	Conventional, DMU	68	7
8.	Delhi-Shamli	Conventional, DMU	87	8
9	Ghaziabad-Hapur	Conventional	36	2
10	Ghaziabad-Khurja-Aligarh	EMU, MEMU	105	8

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

The sectional details and the existing volume of originating passenger traffic in the sections are given in **Annexure 4.1 to 4.12.**

4.7.1 Fare Structure

The 2nd class fare structure of Railway for suburban traffic is same as that for mainline passenger train fare and is as given in **Table 4.4**.

Table 4.4: Fare Structure of 2nd Class Sub-Urban Traffic

Distance (in Km)	Fare		Distance (in Km)	Fare	
	Single Journey (Rs.)	Monthly Season Ticket (Rs.)		Single Journey (Rs.)	MST (Rs.)
0 – 5	4.00	60.00	51 – 55	12.00	180.00
6 – 10	4.00	60.00	56 – 60	13.00	195.00
11 – 15	5.00	75.00	61 – 65	13.00	195.00
16 – 20	6.00	90.00	66 – 70	14.00	210.00
21 – 25	7.00	105.00	71 – 75	15.00	225.00
26 – 30	7.00	105.00	76 – 80	16.00	240.00
31 – 35	8.00	120.00	81 – 85	17.00	255.00
36 – 40	9.00	135.00	86 – 90	18.00	270.00
41 – 45	10.00	150.00	91 – 95	18.00	270.00
46 – 50	11.00	165.00	96 – 100	19.00	285.00

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

These passengers, however, enjoy certain privileges. They can get a Monthly Season Ticket (MST) by paying merely 15 single journey fare between the two stations they want to travel and can make unlimited number of trips in a month. The MST holders are permitted to travel on some express trains also. This helps the intercity passengers to cut down their journey time. There are a large number of instances when these commuter travellers do unauthorisedly travel in reserved compartments of long distance mail/express trains and create discomfort to other railway customers. They can also procure quarterly season tickets at a concessional tariff for a period of three months. It is significant to notice that during the last 10 years, there has not been any increase in the fare structure of second class ordinary passenger fare upto 100 Kms (barring one year where some rationalization was undertaken).

Most of the commuter traffic in NCR falls in this category. As most of the commuters (nearly 70%) travel on highly subsidized season tickets, they do not contribute much to revenues; hence administrative reluctance in creating infrastructure is visible in railways planning process.

4.8 Metro Rail in NCR

Expansion of DMRC in NCR

DMRC has completed the construction of about 65km route within NCT-Delhi and it is operational. Many sub sections of DMRC are sanctioned and are under execution and are likely to be ready for operation by 2010. They are:

Table 4.5: Metro Sections to be Operational by 2010

S. No.	Section	Length (kms)	No. of stations
1.	Central Secretariat - Qutab Minar	12.63	10
2.	Qutab Minar-Sushant Lok (Gurgaon)	14.92	9
3.	Indraprastha-New Ashok Nagar	8.07	5
4.	Delhi Border-Sec-32 (NOIDA)	7.0	6
5.	Vishwavidyalaya-Jahangirpuri	6.36	5
6.	Shahdara –Dilshad Garden	3.09	3
7.	Yamuna Bank-Anand Vihar ISBT	6.17	5
8	Kirtinagar-Mundka	18.46	16
9	Dwarka Sec 9 – 21	2.76	2
10	Central Secretariat – Badarpur	20.01	16
11	Airport Express Link	19.20	4
	TOTAL	**128.06**	**81**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Regional Plan-2021 for NCR proposed the extension of Delhi Metro Rail System to NCR towns. Accordingly, it has been extended to Noida and is proposed to be extended to Gurgaon, Ghaziabad, Faridabad, Bahadurgarh and Greater Noida by Delhi Metro Rail Corporation. The work on Gurgaon corridor is in progress.

These may have an impact on existing rail-borne commuter traffic considering their catchments area, travellers' preferences, and comparative tariff etc. They will also have an impact over RRTS.

4.9 Freight movement for and beyond Delhi and NCR (Railway Network)

Major goods terminals, along with traffic volume (in terms of train loads) both outward and inward handled in 2007-08, in Delhi and NCR are given in **Table 4.6.**

Table 4.6: Inward and Outward Freight Traffic at different Goods Terminal in NCR

SI. No.	Names	Commodities handled	Inward freight train rakes (2007-08)	Outward freight train rakes (2007-08)
1	Delhi Kishanganj	G.G.	249	159
2	Tughlakabad (ICD)+Freight Tr.	Container, Steel, Coal, Auto	4255	3175
3	Faridabad	Cement	336	32
4	Ghevra	LPG	253	-
5	Ghaziabad	Cement, Steel, G.G.	1324	-
6	Loni	Containers/Steel	458	488
7	Panipat	Clinker, Containers, Cement	102	105
8	Partapur (Meerut)	POL, Fertilizers	155	-
9	Shakur Basti	Cement, POL	958	-
10	Bahadurgarh	Steel	150	-

SI. No.	Names	Commodities handled	Inward freight train rakes (2007-08)	Outward freight train rakes (2007-08)
11	Ballabgarh	Steel, Containers	467	69
12	Guldhar	Steel	235	-
13	Meerut	Steel, Military	45	67
14	Rohtak	Cement, Fertilizer, G.G. Mfg.	125	60
15	Sonipat	Cement, Fertilizer	80	-
16	Delhi Cantt.	Cement, Military, Auto	158	-
17	Bijwasan	POL, Cement	177	-
18	Patli	Container	-	24
19	Subzi Mandi	G.G.	112	11
20	Adarash Nagar	G.G., Cement	342	62
21	NFL/PNP	Fertilizer, Coal, POL	405	189
22	Palwal	Cement, Automobile	93	-
23	Asaoti	POL	62	146
24	BHUL(Panipat)	Container	105	105
25	Dadri	Container	1136	1079
26	ICB (Panipat)	POL	143	1138
27	Garhi Harsaru	Container, Auto	196	212
28	Patel Nagar	GG	77	48
29	Jind	FG	49	45
30	Alwar	GG	132	40
31	Aligarh	Cement, Fertilizer, Coal	387	-
32	Asan	Coal	1936	-
33	Badli	GG	36	-
34	B P Power House	Coal	1099	-
35	EPH	Coal	201	-
36	Faridabad (New Town)	Coal, Steel	414	-
37	Nangloi	GG, Cement	20	-
38	Rewari	Cement, Fertilizer, Coal	118	-
39	Garhmukteshwar	Coal, GG	73	-
40	Hapur	Fertilizer, FG	63	-

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Inward traffic for and beyond NCR destinations consist of Coal for power houses and industries, fertilizers, petroleum products, Cement, Iron & Steel, Containers loaded with imported traffic, automobiles and general goods etc. Onward traffic from the region mainly consists of food grains, POL, containers and general goods etc.

Many of freight trains received from Mughalsarai (Eastern India) and at Mathura (Central/Western India) pass through Delhi and NCR to their destinations in Haryana, Punjab and J&K. Many of these trains can be routed via Lucknow – Moradabad (B route) which is a shorter route and reduce congestion in Delhi / NCR Region. As doubling of the shorter route has been completed and electrification is also progressing between Mughalsarai and Moradabad, operational problems in running goods trains via the shorter route will be taken care in near future. Similarly, electrification of branch line from Khurja city to Meerut via Hapur and Saharanpur will ease the goods movement problem in Delhi and NCR. A new link of Meerut and Panipat will also offload some traffic destined to and from Panipat and beyond.

Some of the goods trains, however, can be run via Delhi/NCR during non-passenger hours (night and day) which are largely free from passenger operation. Freight trains which are interchanged at Palwal at present for further movement to Haryana, Punjab and J&K may get gradually diverted. (Via Alwar-Rewari or Ahmedabad-Rewari-Bhatinda Route) bypassing Delhi/NCR.

4.9.1 Movement of Freight Trains over alternate routes

With the coming up of route from Mathura to Alwar, an alternative route is already available for traffic from CR/WCR/WR for destinations on Rewari – Bhiwani – Hisar –Bhatinda and via routes and the return traffic from these areas for CR/WCR/WR. In fact, the investment made in the link should have given relief to the congested Delhi Area as well as the SPR (Southern Punjab – DLI-BTI Section) route. Though, the Mathura-Alwar-Bhatinda route is slightly longer than the Mathura-Tughlakabad – SPR route, the difference is not much. While the Mathura –Alwar – Bhatinda route is 497 km, the route via Tughlakabad-SPR is 453 kms – a difference of 44 Kms only. Moreover, stabling lines and diesel fuelling arrangements are already available at Mathura to facilitate traction change from electric to diesel. The Mathura – Alwar – Bhatinda line does require some upgradation of infrastructure enroute, particularly strengthening of track and signalling arrangements between Mathura-Alwar and Rewari-Bhatinda. This may involve marginal investment but will enable optimal utilization of the line.

The potential of this need to be explored fully. On a sample analysis of freight trains received from WCR/WR at Palwal shows that on an average at least 7 trains per day could be diverted over the Mathura-Alwar-Bathinda route including trains for destinations via Bhiwani-Hisar-Bhatinda. Similarly, in the return direction, Northern Railway can route all its freight trains from Punjab, including POL empties for BAD.

4.9.2 More Intensive Utilisation of GAL/DAL

Goods Avoiding Line (GAL) and Delhi Avoiding Line (DAL) were provided to give relief to the heavily congested Delhi Main route. The avowed intention was that all freight trains running across Delhi Area, viz., from SPR and DUK to via Ghaziabad and Tughlakabad and vice versa will run via GAL/DAL and Delhi Main route will cater more or less exclusively to passenger and other coaching trains and coaching yard movements with which it was already over-burdened. This was indeed the pattern of movement for a long time, and it yielded tremendous relief to the Delhi Main route.

Delhi Main and New Delhi have a very heavy schedule of coaching and yard shunting movements. It is, easy to , visualize that movement of freight trains through Delhi Main and New Delhi would be seriously affecting the fluidity of these shunting movements with repercussions on passenger train operation.

It is sometime argued that it will be advantageous to run at least a few trains via Delhi Main/NDLS strictly during non-peak periods on pre-determined economical paths, provided these do not involve detention at Naya Azadpur or Shakurbasti or Ghaziabad or Okhla. Even with a strict regime the advantage of this policy may prove illusory, as it does not take into account the possible repercussion on shunting movements at Delhi Main / New Delhi and on passenger train operation.

It is suggested that the discipline and routing freight trains via GAL/DAL only should be maintained, with the Delhi Main/ New Delhi route being used only in emergencies.

4.9.3 Catering Light Engine Movements in Delhi Area

It has been calculated that over 250 light engine movements take place everyday in Delhi Area, eating as much as 30% of the line capacity in some of the sections. A substantial number of these movements are inescapable. The coaching engine links require working a train up to Delhi and picking up another train from New Delhi/Nizamuddin or vice versa or a freight train gets dropped at a terminal (like Shakurbasti or BTPP) but does not get a return load or a loco has to go to shed for normal maintenance schedule and return after getting the necessary attention. However, with closer

scrutiny and better links light engine movement in Delhi Area needs to be brought down to lead to significant reduction in the over-congestion in Delhi Area.

4.9.4 Container Operations in NCR

The container traffic in India has grown at a CAGR of 15% since 1991, 2.5 times the average GDP in the same period. With the growth of external trade being faster than GDP, the similar trends are expected to continue in future as well. Similarly the possibilities of growth in container traffic in the Domestic sector are immense with continued strong trends in growth of GDP and the need of the industry for value added services. Logistics ports, large cargo hubs will be the requirement of the industry in very near future, as large retail chains generate the demand for professional managed cargo delivery systems

More emphasis will be required on providing total logistics and transport solutions to its customers in all the segments of the transport value chain in the Exim as well as Domestic segment. Possibilities are visible for strategic alliances, both for optimal utilization of infrastructure as well as expansion into other segments of the value chain.

The emergence of number of new ports viz. Mundra, Pipavav, Vizag, Tuticorin, Vallarpadam & some minor ports in Gujarat like Porbandar, Okha, Maroli etc. will have a large effect on the hinterland movement of containers in the country. Further, the hinterland penetration levels of the container traffic, which are very low at present, are also bound to see a many fold increase.

Business trends are now changing towards more and more door-to-door clearances. This need to provide single window clearance facilities to its customer's. Introduction of movement of Double Stack Container Trains between Kankakpura (Jaipur) & Pipavav and Kankakpura & Mundra is a milestone. Due to the presence of OHE wires and other fixed structures on P-way, double stack trains cannot be run elsewhere. These trains will provide cost-effective transportation between these ports and ICDs in Northern India.

For domestic business, given that consumption centres are vast distances away from production points, there will always be a big demand for transport. The setting up of high capacity consumer goods industries also indicates that the growth of non-bulk traffic is expected to be faster then that of bulk traffic, with the shares of both becoming decidedly better than the current 35-65 ratio. Significantly most of this non-bulk traffic is containerisable, and represents a huge market potential for container companies in the domestic sector.

The biggest ICD (Internal Container Depot) of CONCOR, catering to the export and import traffic of the country in containers, is located at Tughlakabad. CONCOR also has a facility to cater to the Domestic Container Traffic. In fact, container traffic has expanded at an explosive rate. In advanced countries, nearly 75% of the export/import cargo is containerized. In India, we are far below that level. Therefore, the projected growth in exports/imports coupled with the growing popularity of containers promise that the container traffic can continue to grow in geometric proportions. The ICD at Tughlakabad was initially designed for handling about 8000 TEUs per month, both inward and outward, with stacking capacity of 8,500 TEUs. To meet the growing needs of traffic, CONCOR has set up another ICD at Dadri in Greater Noida.

CONCOR's Rail served ICDs in NCR are, Ballabhgarh (without CFS), Dadri (Greater Noida), Rewari, Sonipat (without CFS), Tughlakabad (Delhi).

4.9.5 Entry of Private Container Companies

With larger participation of private sector in railways business, and infrastructure getting opened for their partnership, 15 container handling companies have been given licenses to operate international and domestic containers on Indian Railways. Most of them have applied for opening ICDs in NCR, putting infrastructure under newly created pressure. Preferred locations are Patli, Garhi Harsaru, Bijwasan (on Rewari-Delhi cantt. section), around Sonipat, Panipat (Panipat-Subzimandi section) and on Palwal - Tughlakabad section. Puncturing of vital routes will need to be tackled efficiently. This operation is likely to have its impact on regional commuter traffic and creation of infrastructure for it. With 20% to 25% annual growth in international container, and most of it being centralized around the national capital, along with emerging demands of logistic parks and railside warehouses, operational pressure in NCR is got to mount up.

4.10 Dedicated Freight Corridor

Economic liberalization policies of 1991 followed by information technology explosion have taken India to a new growth scenario. Indian Economy is poised to grow even further at an average of 8 to 10% in the next few years. Transport requirement in the country, being primarily a derived demand, is slated to increase with elasticity of 1.25 with GDP growth by 10 to 12% in the medium and long term range. Riding on the waves of economic success, Indian Railways has witnessed a dramatic turn around and unprecedented financial turnover in the last few years. The railway freight traffic has grown by 8 to 11%, which is projected to cross 1100 million tonnes by the end of XIth Five Year Plan.

4.10.1 Need for Dedicated Freight Corridor Project

The Indian Railways' quadrilateral linking the four metropolitan cities of Delhi, Mumbai, Chennai and Howrah, commonly known as the Golden Quadrilateral; and its two diagonals (Delhi-Chennai and Mumbai-Howrah), adding up to a total route length of 10,122 km carries more than 55% of revenue earning freight traffic of IR. The existing trunk routes of Howrah-Delhi on the Eastern Corridor and Mumbai-Delhi on the Western Corridor are highly saturated, line capacity utilization varying between 115% & 150%. The surging power needs requiring heavy coal movement, booming infrastructure construction and growing international trade has led to the conception of the Dedicated Freight Corridors along the Eastern and Western Routes**.** The DFC alignment is shown in **Figure 4.1.**

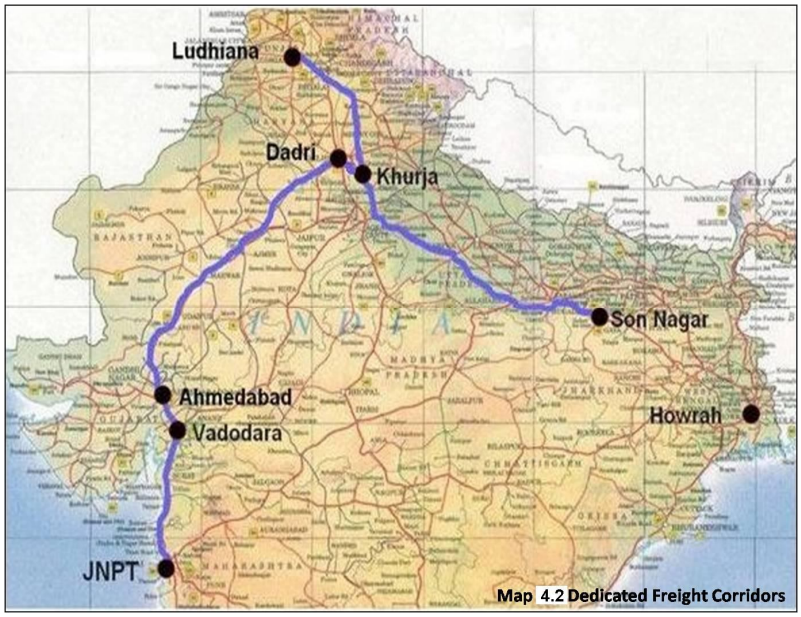


Figure 4.1: Dedicated Freight Corridor

4.10.2 The Eastern Corridor

The Eastern Corridor encompasses a double line electrified traction corridor from Sonnagar on the East Central Railway to Khurja on the North Central Railway (820 Km), Khurja to Dadri on NCR Double Line electrified corridor (46 Km) and Single electrified line from Khurja to Ludhiana (412 Km) on Northern Railway. The total length works out to 1279 Km. The alignment has to take a detour of Hathras, Aligarh, Hapur and Meerut in NCR. Since the origin and destinations of traffic do not necessarily fall on the DFC, a number of junction arrangements have been planned to transfer traffic from the existing Indian Railway corridor to the DFC and vice versa. The junctions on the Eastern Corridor in NCR are planned near Tundla, Daudkhan & Khurja etc.

The traffic on the Eastern Corridor mainly comprises of coal for the power plants in the northern region of U.P., Delhi, Haryana, Punjab and parts of Rajasthan from the Eastern coal fields, finished steel, food grains, cement, fertilizers, lime stone from Rajasthan to steel plants in the east and general goods. The total traffic in Up direction is projected to go up from 38 million tonnes in 2005-06 to 116 million tonnes in 2021-22. Similarly, in the Down direction, the traffic level has been projected to increase from 14 million tonnes in 2005-06 to 27 million tonnes in 2021-22. As a result, the incremental traffic works out to a whopping 82 million tonnes from the base year of 2005-06. The number of trains with 25 tonne axle load works out to a maximum of about 80 trains each way in Sonnagar-Mughalsarai section of the Eastern Corridor.

4.10.3 The Western Corridor

Western Corridor comprising of 1483 km of a double line diesel track from JNPT to Dadri via Vadodara-Ahmedabad-Palanpur-Phulera-Rewari. In addition a single line connection of 32km long from proposed Pirthala Junction Station (near Asaoti on Delhi-Mathura line) to Tughlakabad is also proposed to be provided. Alignment has been generally kept parallel to existing lines except provision of detour at Rewari. However, it is entirely on a new alignment from Rewari to Dadri. This new line portion of DFC is designed to cross-existing New Delhi - Mathura line near Asaoti railway station. For providing connection to Tughlakabad ICD, a single line parallel to the existing Delhi-Mathura line is proposed to be taken from Pirthala junction station (near Asaoti) to Tughlakabad. Moreover, the Western DFC is proposed to join Eastern corridor at DADRI. Junction Stations between the existing railway system and the Western DFC have been provided at Rewari and Pirthala Road.

The traffic on the Western Corridor mainly comprises of ISO containers from JNPT and Mumbai Port in Maharashtra and ports of Pipavav, Mundra and Kandla in Gujarat destined for ICDs located in northern India, especially at Tughlakabad, Dadri and Dandharikalan (Ludhiana). Besides Containers, other commodities moving on the Western DFC are POL, Fertilizers, Food grains, Salt, Coal, Iron & Steel and Cement. Further, owing to its faster growth as compared to other commodities, the share of container traffic is expected to progressively increase and reach a level of about 80% by 2021-22. The rail share of container traffic on this corridor is slated to increase from 0.69 million TEUs in 2005-06 to 6.2 million TEUs in 2021-22. The other commodities are projected to increase from 23 million tonnes in 2005-06 to 40 million tonnes in 2021-22. As a result, the maximum number of trains in the section is projected as 109 trains each way in Ajmer-Palanpur section.

It is also proposed to set up Logistics Parks at Mumbai area, particularly in the vicinity of Kalyan-Ulhasnagar or Vashi-Belapur in Navi Mumbai, Vapi in southern Gujarat, Ahmedabad area in Gujarat, Gandhidham in the Kutch region of Gujarat, Jaipur area in Rajasthan, NCR of Delhi. These locations have been selected on the basis that these have a good concentration of diverse industries and constitute major production/consumption centres. These are also well connected by rail and road systems for convenient movement in different directions. These parks are proposed to be developed on Public Private Partnership mode by creating a sub-SPV for the same. DFCCIL proposes to provide

rail connectivity to such parks and private players would be asked to develop and provide state of the art infrastructure as a common user facility.

DFC is likely to have serious impact on NCR's Railway network. Initial surveys having been completed, construction is likely to commence soon on these ambitious projects. DFC will not only impact rail freight operations, but will have its more than rippling effect on existing routes, as major share of freight traffic gets shifted to new alignments. Residual routes are expected to be available for better passenger operation. Full implications can be worked out after total business and operational plans are prepared by DFC and Indian Railways.

4.10.4 Shifting of Goods Sheds from NCTD

There is a fairly large numbers of freight booking points to service Delhi Area. Delhi Area covers a large tract of territory serving a big population. The area is not only thickly populated but also comprises a large number of big and small industries. It is, therefore, not inappropriate to have multiple freight booking points.

However, Delhi Kishanganj, Patel Nagar, Shakurbasti and Subzimandi goods sheds are located in the heart of the city. So are the most important coaching terminals like Delhi Main, New Delhi and Nizamuddin. But while the existence of passenger terminals near the city centre is a matter of great convenience to the population, the freight terminals should as far as possible be on the periphery of the city. It is from this angle that the possibility of closure of some the goods sheds needs consideration.

These stations deal primarily with block rakes, the inward traffic comprising paper, iron and salt while outward traffic consists of Wheat and pulses. If Delhi Kishanganj and Subzimandi goods sheds are closed, the inward block rakes can rationally get shifted to Nangloi and other stations. Some of the rake load traffic may also get shifted to Tughlakabad or Ghaziabad as per convenience of the trade.

4.11 Orbital Rail corridor network in NCR

The train movements in Delhi area are merged from 8 radials. Passenger and freight traffic on all the radials are on increasing trend. The growth of passenger and freight has already affected the day to day train operations and especially the average speed of all trains. The average speed has rapidly declined due to the frequent addition of new trains. The average speed of goods trains in Delhi area has reduced to 8 kmph and the average speed of passenger trains has also been reduced to less than 10 kmph.

The mixed running of goods trains, slow passenger trains, short distance commuter trains and long distance mail express trains and high speed Rajdhani and Shatabdi express trains also contribute to the deterioration in the speed of trains in Delhi area and its radial routes. As on date, over 500Mail/Express and passenger trains are being dealt with on the existing 4 coaching terminals in Delhi area. In addition, about 250 goods trains are being dealt in Delhi area daily.

The handling period of freight traffic in Delhi area is also squeezing day to day due to heavy imposition of civil restrictions on trucks movements. In some of the area the day time movement of heavy trucks has been restricted completely. Due to this reason the freight traffic at the terminals is suffering heavy detention in Delhi area.

A stage has reached where further augmentation of line capacity and throughput is not possible due to basic infrastructural constraints at the existing terminals. In the recent past, a lot of development took place to augment the through put and line capacity enhancement works in and around Delhi on

Northern Railway net work, in addition to introduction of DMRC network. But all these developments have not been able to meet the requisite passenger and freight demands. During the last five year plan period it was envisaged that capacity/infrastructure should be developed ahead of the expected demand. But despite heavy capital investment, there has not been significant increase in the speed of trains in Delhi area.

Regional Plan-2021 has proposed an Orbital Rail Corridor along the Western and Eastern Peripheral expressways. This was intended to divert through goods trains to avoid Delhi Area.

5

Air Transport and its Growth in NCR

Indira Gandhi International Airport (IGI Airport), Delhi, is the second busiest airport in India. It handled around 20.44 Million Passengers and 385,000 Tons of Cargo (2006- 07). Currently it has two operational runways. There are three separate terminal areas, domestic passenger, international passenger and cargo. The total area at IGI Airport is about 5060 acres of which about 1,907 acres is currently in use. The Airport connects 60 destinations all over the globe through 51 international airlines.

It needs to be highlighted that for the first half of calendar year 2006 (January' 06 to June' 06), World Air Traffic growth recorded 6.4% and 2.0% in the international and domestic traffic respectively. Indian Air Traffic grew at the rate of 12.15% and 31.58% in international and domestic traffic. As compared to the world average, Indian air transportation market is growing 2 times higher in international and 16 times higher in the domestic sector.

IGI Airport handled 3.12 million (18.23% growth compared to first half 2005) and 6.26 million (40.19% growth compared to first half 2005) passengers in international and domestic traffic. It handled 16.1 million passengers in 2005-06 and 20.44 million passengers in 2006-07, registering a 26.9 % growth rate in passenger traffic. It accounts for 30% of international and 23% of domestic freight in the country

With more and more foreign airlines coming to the capital city, Delhi will become the country's busiest airport for international flights as well. In 2006-07, international passenger growth for Delhi (6.44 million) was 15% as compared to 9.2% for Mumbai (7.35 million).

It is expected that by 2010, IGI Airport-New Delhi will overtake Mumbai Airport as India's busiest Airport. The gap between passengers using the two airports is closing, with more aircraft landing and leaving Delhi than Mumbai for both domestic and international travel.

Projected Air traffic

Based on the growth rates observed at the Delhi airport and the projections made by Delhi International Airport Ltd. (DIAL) the Consultant has suggested in the Study Report that the passenger traffic (international and domestic) is expected to touch 50 million mark by 2015-16. Further, it is expected to handle 82.7 million passengers by 2026 and will touch 100 million mark by 2036. Besides this, it is expected to handle large quantity of cargo, which will be induced due to commissioning of Delhi Mumbai Industrial Corridor. The international traffic at Delhi airport is about 45-50% of the domestic traffic.

5.1 Traffic Characteristics

Delhi airport attracts a total of 80,000 person trips, including passengers, both domestic and international and employees; and approximately 94,000 vehicles enter and leave the airport daily. **Table 5.1** shows the distribution of count of trips observed at the Airport. **Table 5.2** shows the traffic generated and attracted from Delhi Airport.

Table 5.1: Person Trips Observed at Delhi Airport

	Domestic			International		Total
	Terminal 1A	Terminal 1B		Terminal 2	Terminal 2	
	Departure	Arrival	Departure	Arrival	Departure	
Passengers	6528	18297	16342	11802	10134	63103
Employees	3051	1972	4132	3554	4154	16863
Total	**9579**	**20269**	**20474**	**15356**	**14288**	**79966**

Source: Study on Integrated Transportation Plan for NCR, Primary survey Conducted for Airport Metro Link, DIAL

Table 5.2: Classified Traffic Count Observed at Delhi Airport

	Domestic		International	Total
	Terminal 1A	Terminal 1B	Terminal 2	
Total Vehicles	**20278**	**48785**	**24945**	94008

Source: Study on Integrated Transportation Plan for NCR, Primary survey Conducted for Airport Metro Link, DIAL

This high intensity affects the traffic scenario in the hinterland of Airport.

5.2 O&D Pattern

The OD pattern of air passengers indicate that 75.75% were from within NCTD itself 18.75% of passenger generated from rest of NCR and 5.5% from area beyond NCR. **Table 5.3** presents the combined OD pattern.

Table 5.3: Delhi Airport – Passenger Distribution by Spatial Units

Passenger Distribution		
REGION	**Passengers per day**	**%**
NCTD	48040	75.75
NCR	11891	18.75
BEYOND NCR	3488	5.50
TOTAL	**63419**	**100.00**

Source: Study on Integrated Transportation Plan for NCR, Primary survey Conducted for Airport Metro Link, DIAL

6 *Bus System in NCR*

A fast, convenient and universally affordable mobility solution in the NCR with seamless transfers acts as a catalyst for achieving its plan objectives of a balanced and harmonious development of the Region and dispersal of economic activities. Development of an Integrated Multi-Modal Public Transport System (IMMPTS) is one of the pre-requisites to facilitate accelerated achievement of the plan objectives. An adequate, efficient, affordable and well coordinated Bus based Public transport system with easy access and seamless transfer amongst all modes, would go a long way in effectively meeting the mobility needs of the NCR.

6.1 Existing Public Transport System in NCR and its Sub-Regions

6.1.1 Rail Services

Eight Railway lines connecting Delhi and the NCR are collectively served by about 180 trains (85 mail/express, 34 passenger and 61 EMUs) between Delhi and the NCR Towns. A few railway lines exist within NCR serving the NCR towns. However, poor accessibility to stations, inadequacy of interchange facilities amongst different modes, lack of bus bays and parking facilities for public and private vehicles, long waiting periods, longer travel time, overcrowding in local trains, etc., are some of the problems faced by the commuters.

6.1.2 Existing Bus Services-characteristics, performance and issues

6.1.2.1 Bus services

i) Amongst the NCR towns, Delhi is served mainly (over 60% of total motorised passenger trips) by buses as the same is accessible, flexible, convenient and cost effective. The bus system in Delhi comprises of public (DTC) and privately owned vehicles. Some of these buses, although cost effective, are heavily crowded during peak hours and their average operating speeds are low (12-15 kilometers per hour) causing journey delays. Some others like contract carriage buses are comparatively comfortable and faster (18-20 kmph) but charge higher fares. DTC, which is responsible for providing efficient public transport services at affordable prices, operated 3467 buses (FY06)-- out of which 529 vehicles operated within NCR, 360 operated to other nearby states through NCR and 2578 buses operated within NCTD.

ii) Intercity buses between Delhi and NCR/other states and within NCR are also operated by the Uttar Pradesh SRTC (UPSRTC), Haryana Roadways (HR), PEPSU Road Transport Corporation(PRTC), Punjab Roadways(PR), Himachal RTC(HRTC), J&K RTC (JKRTC), Rajasthan State RTC (RSRTC), etc, besides some buses operated by private persons.

iii) Haryana Roadways provides bus services in the NCR and other areas mainly from 14 depots, UPSRTC from 12 depots, DTC from 28 depots (27 located in NCTD and 1 in NOIDA) and RSRTC from 3 depots located in the NCR besides those located else where in these states. Other State Road Transport Corporations (SRTCs) operate services to/from/via Delhi/other towns of the NCR from/to a number of locations in their respective states on reciprocal basis. Details are given in **Annexure 6.1.**

iv) Except NCTD, the intra-urban PT Services in most of the urban metros, regional centers and other towns of the NCR are mainly provided by mini buses, auto rickshaws and the Non Motorised Transport Services (NMTS). The quality of these services however appear to be far from being satisfactory.

v) Bus depot/terminal locations in the NCR are focused more for state level operations than for addressing NCR concerns of providing adequate transport facilities and seamless transfers to commuters

vi) The bus services provided by various states, though cater to a sizeable lot of passenger trips, lack unified planning, time table, fare structures, tax structures, etc. Services provided are not NCR focused. Their route structuring and service level provisioning is more on the basis of the individual operator (SRTC's) assessments / convenience rather than a scientific demand assessment and demand directed route structuring.

vii) Consequently, poor accessibility to public transport, indifferent quality of services, over-crowding in buses, long wait and travel period, fare/tax disparities amongst various operators, etc are causes of concern in providing effective, efficient and affordable PTS as can also be seen from the commuter survey data (CES 2007) of over 5100 persons inter alia high-lighting passenger travel characteristics/pattern/ service quality etc. (**Table 6.1.)**

Table 6.1: Commuter perceived problems of inter-city travel - percentage of commuters

S. No.	Quality parameter	NCTD sub region	Haryana sub region	UP sub region	Rajasthan sub region	NCR
1	**Inadequacy of buses**	**40.7**	**53.4**	**44.3**	**52.1**	**45.6**
2	**Unreliable services**	**35.9**	**48.0**	**34.4**	**47.9**	**39.5**
3	**Irregular frequency**	**24.3**	**14.0**	**22.0**	**28.1**	**20.8**
4	poor route coverage	3.4	2.2	3.0	9.6	3.1
5	Excessive transfers between routes	5.5	9.1	6.7	4.1	6.8
6	**High fares**	**21.5**	**26.3**	**32.1**	**34.2**	**25.5**
7	Poor quality of vehicles	12.4	6.3	7.7	9.6	9.5
8	**Poor safety performance**	11.0	**15.3**	8.4	**33.6**	12.4
9	Crew misbehavior	12.1	6.5	7.7	4.8	9.3
10	Unhealthy competition between operators	7.5	6.5	6.1	12.3	7.0
11	others	23.1	19.0	19.3	9.6	20.7

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Inadequacy of buses, poor reliability and irregularity of services besides high fares are the main problems faced by the commuters in all the sub regions of the NCR. In Rajasthan sub region commuters also perceive poor operational safety.

viii) Keeping in view the above concerns about BPTS and the overall NCR Plan aim of promoting and supporting harmonious development of NCR, the Bus based Public Transport Plan for providing accessibility to all the parts of the region and servicing a larger quantum of travel demand is proposed.

6.1.2.2 Operational Characteristics and Performance of the Bus Based Public Transport System (BPTS) services

i. Operational Characteristics and the Performance of the existing BPTS

a. Operational characteristics and the performance of the existing BPTS system were analysed w.r.t. Growth of vehicles/buses in the NCR, physical and financial performance of the bus fleet, demand serviced, passenger trips, average trip length, quality of service, institutional set up, tariff structure, taxes and their structure, bus depots and bus terminals, their location, size, capacity, facilities, fleet size, bus technology, bus capacity and other relevant information by the Consultant and an appreciation of bus based public transport system characteristics was made addressing major factors such as system and operational characteristics, their role and performance.

Passenger Trips serviced and Bus supply by the STUs from out of depots located in the NCR is given in **Table 6.2.**

Table 6.2: Passenger trips serviced and Bus supply by the STUs from depots in NCR (Aug-Oct 07)

Sub Region	No. of STU depots in NCR	No. of buses in NCR depots	Avg. no. of passengers carried daily/Bus on road	Avg. no. of passengers carried per day
A	B	C	D	E=C*FU*D
NCTD	28*	351	931	297371
Haryana	14+	1285	353	412781
Uttar Pradesh	12+	1219	230	269155
Rajasthan	3+	289	243	67418
Overall NCR	57	3144	360	1046724

Source: Study on Integrated Transportation Plan for NCR
Notes:
*1) * These depots, though mainly serve the intra urban demand in NCTD, operate 351 buses in NCR. Additional 385 buses from 5 depots of DTC operate inter city bus services from NCTD to areas beyond the NCR.*
2) + The depots located in NCR sub regions of the States provide bus services within /out side NCR
3) Over and above these 3144 buses, another 2208 buses are operated across the NCR by 11STUs (including the above three) as per data obtained from 3 ISBTs at Delhi. As nearly 18% bus trips are performed from locations outside NCTD, the above fleet of 2208 is increased proportionately to 260 buses. Further UP operates 285 private buses to/from NCTD, Data of privately operated buses from other constituent states not included due to non-availability of the same.
4) Above buses (6034) collectively service nearly 21.71 lakh passenger trips daily on an average (taking 360 passengers per bus per day- the over all average of the STU buses in the sub region-- for 2890 buses and adding it to passengers carried by 3144 STU buses).
5) FU= Fleet Utilization

b. Densities of all vehicles and that of the buses per lakh population in the sub-regions of NCR and that at the national level, are given in the **Table 6.3.**

Table 6.3: Buses per lakh population in NCR sub regions 2007

State	Population In Lakhs		Total no. of buses registered in NCR	No. of buses registered as stage carriage		No of buses per lakh population in NCR	Total no. of vehicles lakhs in NCR	No of vehicles per lakh population
	State	NCR		STUs	Total			
NCTD	163.5	163.5	43639	3449	**9000	267	51.4	31437
Haryana	237.4	108.5	6964	1285	4030	64	15.4	14194
UP	1867.6	136.7	6234	1204	2421	46	9.3	6818
Rajasthan	634.1	34.8	1509	278	1509	43	2.5	7069
Total	2902.6	443.5	58346	6216	16960	132	78.6	17718
India	11285.2			@@0.11	@0.29			
India 2004	10791.2		768000			71	727.2	6739

Source: Study on Integrated Transportation Plan for NCR
*** estimated*
@ Stage carriage buses in NCR as % of total buses in NCR
@@ Stage carriage STU buses in NCR as % of total buses in NCR.

Against an average of 71 buses per lakh persons country-wide, the NCR Sub regions of Uttar Pradesh and Rajasthan have much lower densities at 46 and 43 buses respectively, the Haryana sub region has 64. The other sub region of Delhi has significantly higher bus density of 267 compared to the national average but mainly serves the intra urban travel demand. On the other hand population density of all type of vehicles in the NCR sub regions is comparable/much higher than the national average. Out of a total of 58346 buses registered in the NCR, 6216 (29%) are stage carriage buses. Only 11% of all the registered buses and 37% of the stage carriage buses are owned by the STUs and the remaining 89% and 63% respectively owned privately.

Against an average annual growth of over 8% in bus population at national level, the growth of bus fleets in NCR states have remained far behind at less than 4% -reflecting a dismal growth rate for the Bus based public transport system in the constituent states as illustrated further by the growth scenario of one of the constituent states (UP) of the NCR. In the state of UP, while total

vehicular population has increased from about 22 lakhs (FY92) to 91 lakhs (FY07)-more than 4 fold increase during the last 15 years, the population of buses has remained static at about 25000 (25170 in FY92 and 25423 in FY07). The dismal growth of bus fleets appears to have led to a very high growth of private vehicles (nearly 11% annual average growth of all motorized vehicles in the NCR) at the cost of bus based public transport system. An accelerated growth of buses is immediately required for obtaining a sustainable bus based transport system.

c. Modal split of passenger trips between public transport modes of rail and road, during the period FY 1951 to FY 2005, and share of buses to total vehicles is given in **Table 6.4.**

Table 6.4: Country-wide share of passenger load and share of Buses to Total vehicles

year	Share of travel load -Billion passenger kms (modal split) $		Share of buses (%) in vehicular population
	Rail	Road	All India
1950-51	66.5(84.5)	23.0(15.4)	11.1
1960-61	77.7(49.0)	80.9(51.0)	8.6
1970-71	118.1(36.0)	210.0(64.0)	5.0
1980-81	208.6(27.8)	541.8(72.2)	3.0
1990-91	295.6(27.8)	767.7(72.2)	1.5
2000-01	457.0(18.0)	2075.5(82.0)	1.2
2004-05	515.7(12.9)	3469.0(87.1)	1.1

Source: Study on Integrated Transportation Plan for NCR, Planning Commission - Working Group Report – Transport - 11th Five Year Plan

During the period 1950 to 2005 while the share of travel load between Road and Rail has significantly increased in favour of buses i.e. from 15%(1950) to 87%(2005), the share of buses to total number of vehicles has decreased from 11.1% to 1.1%-the buses still serving more than 50% of the passenger Journeys. In the NCR sub region, the bus fleets constitute significantly less proportion (0.74%) of total vehicular population compared to the national average (1.1%) indicating poor growth of the Public Transport System (**Table 6.5**).

Table 6.5: Buses to total vehicles ratio in NCR 2007

State	No. of buses	Total no of vehicles in lakhs	Buses as % of vehicles
NCTD	43639	51.4	0.85
Haryana	6964	15.4	0.45
UP	6234	9.3	0.67
Rajasthan	1509	2.5	0.61
Total NCR	58346	78.6	0.74
All India 2004	768000	727.2	1.06

Source: Study on Integrated Transportation Plan for NCR

d. The movement wise share of buses as percentage of all vehicles observed during surveys (CES 2007) is given in the **Table 6.6** along with vehicle category wise breakup of the trips.

Table 6.6: Mode-Wise/Sub-Region wise Break- Up of Vehicle Trips

S.No.	Movement Pattern	2 Wheeler	Auto Rickshaw	Car	Mini Bus	Std. Bus	Total
1	NCTD-CNCR	**8.33**	**0**	**10.73**	**0.13**	**1.16**	**20.35**
2	NCTD-NCR rest	**10.69**	**0**	**24.30**	**0.22**	**3.07**	**38.27**
3	NCTD-NCR out side	5.18	0.01	14.49	0.13	1.32	21.23
4	CNCR-CNCR	2.14	0	0.62	0.05	0.10	2.91
5	CNCR-NCR rest	2.81	0	2.72	0.16	0.21	5.90
6	CNCR-NCR out side	0.82	0.07	1.75	0.06	0.18	2.88
7	NCR rest-NCR rest	**0**	**0**	**0.34**	**0.01**	**0.09**	**0.44**
8	NCR rest-NCR out side	**4.28**	**0.44**	**2.93**	**0.08**	**0.44**	**8.12**
9	**Overall NCR**	**34.24**	**0.52**	**57.88**	**0.84**	**6.51**	**100**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Out of 100 passenger vehicle trips, only 7.35 trips are of buses. 86% of buses and 54% of mini buses operate from/to/via NCTD. Over 92% of all passenger vehicle trips are made by private vehicles--cars (58%) and two wheelers (34%).

e. Distribution of bus passenger trips amongst concerned states and amongst various movement patterns, in the base year (2007), is given in **Table 6.7**.

Table 6.7: Combined Bus Passenger Trip Matrix - Base Year 2007

	Distribution of Bus passenger Trips originating from A(AB) and Those originating from B (BA) –region wise movement pattern wise									
	NCTD	**Haryana**	**UP**	**Rajasthan**	**Punjab & Chandigarh**	**Himachal**	**J & K**	**Uttarakhand**	**Others**	**Total**
NCTD-CNCR AB	471364									471364
NCTD-CNCR BA		354692	122810							477502
NCTD-CNCR AB+BA	471364	354692	122810							948866
NCTD-NCR rest AB	397155									397155
NCTD-NCR rest BA		194202	172747	52875						419824
NCTD-NCR rest AB+BA	397155	194202	172747	52875						817045
NCTD-NCR os AB	1042295									1042295
NCTD-NCR os BA		326177	211313	320690	22752	7897	5631	37596	30063	962119
NCTD-NCR os AB+BA	1042295	339768	220118	334052	23700	8226	5866	39162	31315	2004414
CNCR-CNCR		10566	24276							34841
CNCR-NCR rstAB		42320	36286							78606
CNCR-NCR rst BA		51669	49900	5429						106998
CNCR-NCR rst AB+BA		93989	86186	5429						185603
CNCR-NCR os AB		149806	10176							159982
CNCR-NCR os BA		85311	33475	6838	27983	0	89	2831	3495	160022
CNCR-NCR os AB+BA		235117	43651	6838	27983	0	89	2831	3495	320004
NCR rst-NCR rst		55652	67648	14946						138246
NCRrst-NCRos AB		122199	28266	137703						288168
NCRrst-NCRos BA		65234	93000	18705	1106	0	183	11006	12761	201995
NCRrst-NCRos AB+BA		187434	121266	156408	1106	0	183	11006	12761	490164
NCR os-NCR os		7399	23864	13368	3216	81	658	4006	8043	60635
NCRos-os+NCRrstos+osrst		194833	145130	169776	4322	81	841	15012	20804	550799
TOTAL	1910814									

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

For the NCR population of 443.5 lakhs, nearly 50 lakh bus passenger trips are performed daily. This amounts to an overall average PCTR of 0.1127 for intra region and inter-state bus passenger trips(excluding intra urban trips). For intra region (excluding intra urban) bus passenger travel, an average PCTR of 0.0479 and weighted average passenger trip length of 51 kms is estimated. On the basis of the above PCTR (0.0479), the average passenger trip length of 51 kms., and the bus capacity of 11597 seat kms per day (52 seats per bus, 349 kms of daily operation per bus on road, 96.2% fleet utilization and average load factor of 0.69 as obtained in the NCR buses of constituent states) the number of buses required for intra region travel (excluding intra urban) in NCR is assessed as 9283 in the base year. As against the above requirement of 9283 buses, only 6034 buses are operated leaving a wide gap between supply and demand of buses for intra region travel.

f. Physical Performance

As most of the bus services in the NCR are provided by various State Road Transport Corporations(SRTC), an analysis of their operational performance in respect of utilization of the fleet and productivity of buses, reliability- in terms of breakdowns per million kilometers operated (higher the break down rate lower is the reliability of operations), safety of operations- in terms of accidents per ten million kilometers operated (higher the accident rate lower is the safety of

operations), load factor has been attempted in **Table 6.8** both at the state level and in their respective sub regions of the NCR (Data for the NCR is for the year 2006-07 and that of the states for the year 2005-06. At state level-- DTC data is taken for interstate services UPSRTC for STU buses, at all India level for rural services only).

Table 6.8: Operational performance of STU buses of the sub Region FY 06

State Road Transport Corporation	Avg. fleet utilization		Avg Load Factor		Productivity kms/ on road day per bus		Reliability (No. of breakdowns/million kms)		Operational safety (accidents per ten million kms)	
Sub region	State	NCR*	State	NCR	State	NCR*	State	NCR*	State	NCR*
DTC	90.5	95.7	0.69	0.57	227	278	67	76	15	13
Haryana Roadways	97.2	95.7	0.70	0.69	363	361	7	9	8	7
UPSRTC	96.3	97.0	0.59	0.69	327	351	8	5	14	NA
RSRTC	96.2	96.4	0.67	0.62	370	373	11	NA	10	NA
AllSTUs	91.9	96.3**	0.62	0.67**	334	349**	34		19	

Source: Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007, Profile and performance of STUs - FY 2005-06
Note: NCR data for UP sub region is for UPSRT's Meerut region depots only due to non availability of data for others. For RSRTC, the NCR data is based upon June 2007 statistics as only the same was available.*
***all STUs of the NCR sub region*

Utilization of fleets and productivity of buses on road in the NCR are higher/comparable to that of the respective STU as a whole. The reliability of operations (indicated by inverse of the break down rate) is very low for DTC --much inferior to that obtained even at all India level. Similarly, the operational safety (indicated by inverse of accident rate) of the STUs of the constituent states- at state level and the NCR level, is better than that at the national level, Haryana Roadways having safest operations.

g. Financial Performance

i. Capital structure of the existing State Transport Undertakings (STUs):

Out of 52 STUs operating in the country, 23 are incorporated under the RTC Act, 11 under the Companies Act, 8 as Government Departments and 10 as Municipal Undertakings **(Ref. Annexure 6.2).** Capital structure along with other liabilities of a few sample STUs under different set ups is given in **Table 6.9** to appreciate their comparative performance.

Table 6.9: Capital Structure/other liabilities-Sample STUs (FY 2005-06), Rs. in crores

S no.	Description	Under RTC Act				As Local Bodies		As Govt. Deptt.		Under Company Act	
		Rural		Urban		Urban		Rural		Rural (*)	
		UPSRTC	RSRTC	DTC	BMTC	BEST	AMTS	ST HARYANA	ST PNJB	TN STC(*)	KTC GOA
1	Government loan -central -state	 252 60	 27 193	 0 4198	 0 93		 1 1	 0 406		 9(8) 870(243)	 0 29
2	Debentures										
	Loans from: -banks -LIC	 212 0	 163		 26 0	 21 0		 119 0		 341 (90) 0	 32 0
3	Public deposits		11		17	5					
4	Others		8	1			266			669 (0)	
5	Reserves	1	5	395	37	625	108	205		2(0)	6
6	Current liabilities	762	288	140	32	122	179			1312 (276)	24

S no.	Description	Under RTC Act				As Local Bodies		As Govt. Deptt.		Under Company Act	
		Rural		Urban		Urban		Rural		Rural (*)	
		UPSRTC	RSRTC	DTC	BMTC	BEST	AMTS	ST HARYANA	ST PNJB	TN STC(*)	KTC GOA
7	Cumulative Profit/Losses	-768	-376	-4008	**261**	-251	-461	-120		-2487 (-526)	-65
8	Total current Liabilities	519	318	725	467	522	94	609		714(278)	26

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 200, Profile and performance of STUs - FY 2005-06
Notes+ all figures rounded off to nearest whole number
** figures in parenthesis pertain to Metropolitan Transport Corporation of Chennai operating urban services and registered under the Company's act*

ii. None of the STUs under any of the set ups have any equity. The STUs have mainly financed their capital requirement through government loans, bank loans, etc. None of them, except BMTC (under the RTC act), have any accumulated profits.

iii. Financial performance and Institutional set ups:

Financial performance of the STUs, under different set ups, in the recent past, is given in the **Table 6.10.**

Table 6.10: Bus Operators – Financial Performance Vs Institutional Set-ups (FY 2005-06)

	Rs./Bus km				Profit/Loss (Rs cr.)
OPERATORS	**Cost**	**Rev**	**Pr/Ls**	**Tax**	**FY 05-06**
ST Hr (Govt)	19.3	16.4	-2.9	4.5	-120
ST Pb (Govt)	32.1	19.9	-12.2	6.7	-107
UP(RTC)	12.6	12.8	0.2	3	14
RST(RTC)	15.2	14.8	-0.5	1.7	-28
TNSTC(Co)	17.4	15.9	-1.5	0.7	-36
KTC(coGoa)	21.1	17.4	-3.7	0.4	-12
AMTS(Mncpl)+	39.1	29.1	-10	0.4	-29
BEST (Mncpl)+	45.7	35.3	-10.4	1.7	-251
DTC (RTC) +	49.4	17.9	-31.4	1.3	-818
BMTC (RTC) +	18.8	19.6**	0.8	1.1	22
MTC (Co) +	26.5	22.4	-4.1	0.4	-85.5
CHNTU (GOVT)+	18.8	17.2	-1.6	2.5	-8
ALL STUs	18.8	17	-1.8	1.5	-2311

Source: Study on Integrated Transportation Plan for NCR
**operate NCR services also*
+Urban STUs under municipal corporations (AMTS, BEST), under RTC act(DTC, BMTC), under company's act(MTC –CHN) and as Government department (Chandigarh).
*** excludes reimbursement of subsidy and other income of Rs.2.9 per km*

During the financial year 2005-06, two STUs (UPSRTC and BMTC) under the RTC act operated in profit. One STU each under the RTC act (RSRTC), Company's act (TNSTC) and one as a government department (Chandigarh) made less losses per bus kilometer compared to that (Rs.1.8 per bus kilometer) at the national level-combined loss by all STUs.

h. Fares and taxes

i. Fares, taxes applicable as also the cost of bus travel in various parts of the sub region are given in **Table 6.11.**

Table 6.11: Fares, Taxes, cost of bus travel (FY 05-06)

Operator	Fare per pax km paise	Tax per pax km paise (as % of fare)	Cost to pax Paise per km
DTC (urban)	58+	<1(0)	58
ST Haryana	31	19(60%)*	50
UP SRTC	41	9(21%)	50
RSRTC	40	5(12%)	45

Source: Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06
**since reduced to 25% in 2007*
+increased to 67 paise in 2007

ii. Whereas the basic fare per passenger kilometer for ordinary buses ranges from 31-58 paise, the cost to the commuter varies between 45-58 paise and the tax varies from 0-60% of the basic fare. The fare per passenger km is highest (58 paise) in NCTD and least (31 paise) in NCR (Haryana). It is 41 and 40 paise per passenger km in the NCR (UP) and NCR (Rajasthan) respectively. The above data indicates that the buses operating in NCR (Delhi) should earn highest revenue per pax km operated there and least in NCR (Haryana). Congestion on Delhi roads however, adversely affects vehicle productivity and thus the operational revenues, costs and the profitability. While such factors do not encourage operations in the NCTD, low basic fare coupled with high incidence of tax (Haryana sub region) does not motivate the operators from other areas to enlarge their services in Haryana area of NCR for financial reasons.

iii. Tax structure for buses in NCR

Tax structures applicable to the constituent STUs (FY06) are given in **Table 6.12.**

Table 6.12: Tax structure of constituent states of NCR FY 2005-06

Rs in lakhs per bus per year- STU Data				
STU	**MV tax & permit fees**	**Passenger Tax**	**Other taxes**	**Total taxes per bus per year Rs in lakhs**
DTC*	0.21	0.68*	0.32	1.21
ST HARYANA	0.28	4.30	1.25	5.84
UPSRTC(own)+	0.11	3.03	0.02	3.15
RSRTC*	0.09	1.74	0.29	2.12

Source: Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06
**as applicable for buses operating in NCR, passenger tax is nil in NCTD*

Motor Vehicle tax and permit fees paid are Rs. 0.21, Rs. 0.11, Rs. 0.28 and Rs. 0.09 lakhs per bus per annum for buses registered/seeking permits in NCTD, UP, Haryana and Rajasthan respectively indicating that such fees are 2-3 times in the states of Delhi and Haryana compared to that in other constituent states of the NCR.

Passenger tax and other related taxes per bus per year are Rs1.00 (passenger tax within NCTD is nil), Rs.3.05 lakhs, Rs.5.55 lakhs, and Rs 2.03 lakhs for bus operations in NCTD, UP, Haryana and Rajasthan respectively. Highest level of passenger related taxes levied in NCR (Haryana) coupled with low fares does not encourage other STUs to expand their services in this vast area of NCR. Skewed fares and taxes in various constituent states of the NCR does not appear conducive to free growth of bus based Public transport system the NCR.

i. Financial performance of STU owned buses vs Hired buses:

i. Financial performance of the buses owned by the STUs and those hired by them is given in the **Table 6.13**

Table 6.13: Bus Operators: Financial Performance - FY 2006

Profit/Loss				
Operators	**Cost**	**Rev**	**Pr/Ls**	**Rs Lakh/ Bus/ Year**
BMTC (own)	18.79	19.40*	0.81*	0.64*
BMTC (PO)	17.33	20.39	3.06	2.45
UPRTC(own)	12.86	13.02	+0.15	0.31
UPRTC (PO)	10.84	11.28	+0.45	0.46
PRTC (own)	19.61	17.83	-1.78	-2.01
PRTC (PO)	14.85	16.38	1.53	2.22

Source: Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06
*Note: * Excludes Rs 2.91 per bus km as non traffic revenue (Rs.1.30) & reimbursement of subsidies (Rs.1.61)*

ii. In order to assess the factors contributing to higher profit by hired buses operating under the STUs, head wise break-up of the total cost per bus kilometer has been analysed and is detailed in the **Table 6.14**.

Table 6.14: Break-up of Operational Cost of STU Buses/Hired Buses (element-wise)

Bus owner-ship	**Cost per bus km (Rs.)**							**Bus staff ratio**	**Load Factor**	**Bus Productivity km per day (pax kms per bus per day)**
	Staff	**Materials**	**Taxes**	**Interest**	**Misc**	**Depri-ciation***	**Total**			
BMTC	7.16	8.17	1.1	0.09	0.67	1.61	18.79	5.51	0.60	218 (8764)
PO	2.07	0	1.02	0	0	14.24	17.33	1.7	0.62	220 (9139)
UPRTC	4.54	6.37	0.11	0.24	0.34	1.67	12.86	6.13	0.58	320 (10022)
PO	2.06	0	0	0	0.49	8.3	10.84	2.78	0.67	286 (8048)
PRTC	7.03	7.31	3.78	0.69	0.38	0.42	19.61	5.52	NA	309 (9641)#
PO	1.09	0.004	3.47	0	0.04	10.24	14.85	1.52	NA	397 (12386)#

Source: Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06
Notes:

- *for PO buses-- hire charges per bus km are indicated in the depreciation column*
- *PO- private operator's bus hired by the STU*
- *# worked out by assuming a load factor of 0.60 for both in absence of NA*

iii. The hired buses make higher profit per bus kilometer compared to that of STU owned buses. Cost per km. of hired buses is 7.8 to 24.3% less than that of STU owned buses– mainly due to higher capacity utilization and lower bus staff ratios (also the PO engages staff at much lower wage rate than that by the STUs) and consequently lower staff costs inter alia indicating that a public transport system would work more profitably by reducing the bus staff ratio through out sourcing most of the activities.

j. Financial performance of STU buses of the constituent states at State level and at NCR level is shown in **Table 6.15**.

Table 6.15: Operational Costs, Revenues & Profitability of Buses at State and NCR level

STU	**Operational Cost per Bus Km Rs.**		**Operational Revenue per Bus Km Rs.**		**Profit or loss (-) per bus km Rs.**		**Profit/Loss (-) per bus per year Rs. in lakhs**	
	State	**NCR**	**State**	**NCR**	**State**	**NCR**	**State**	**NCR**
DTC	49.39	39.04	17.94	16.10	-31.44	-22.94	-31.90	-23.28
ST Haryana	19.31	16.22	16.41	13.68	-2.89	-2.54	-3.83	-3.35
UPSRTC+	12.63	13.04	12.81	15.64	0.17	2.60	0.20	3.33
UPSRTC(PO)+	10.84	13.35	11.28	13.5	0.44	0.15	0.46	0.19
RSRTC*	15.24	12.57	14.78	12.84	-0.46	0.27	-0.62	0.37

Source: Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06
** RSRTC data for NCR pertains to the month of June O7 and other data is for FY 06*
+ UPSRTC data for NCR is based upon the data available for MEERUT Region (320 own buses) and 116 hired buses as data for other depots in the NCR area of UP was not available there from)

During FY 2005-06, at the state level, all the STUs except UPSRTC incurred losses ranging from Rs 0.62 to 31.90 lakhs per bus. At the NCR level however RSRTC and UPSRTC made profit, the later doing so both on buses owned as also the buses hired by it. UPSRTC's profits are significantly higher in NCR operations compared to all other STUs as also its hired buses.

k. Performance of Private Operator (PO) buses in NCR

In absence of any recorded data about physical and financial performance of privately operated buses in the NCR, a primary survey was organized at 17 bus terminals spread across the region. Operational and other performance details of 66 bus agencies, owning and operating 191 buses in the region, were collected from the available operational staff/bus owners through discussions, in view of their unwillingness to provide written and signed details.

66 private operators comprise of 16 individual owner-operators, 10 companies and 40 cooperative societies/operator unions. The average bus holding per operator is 2.89 say 3 buses, with 4 operators operating more than 10 buses each and 22 single bus each. The average purchase price of a bus is assessed as Rs 14.80 lakhs and average age as 6.6 years. Most of the buses are purchased using nearly 80% borrowed funds from Financial agencies and 20% own funds on an average, the cost of borrowings varying from 10 to 16 % with a re-payment period of about 5-7 years. Sub region wise details are given in **Table 6.16.**

Table 6.16: Ownership/Financing Pattern of PO* Buses in NCR (excluding NCTD)

Sub Region	No. of operators	Owner ship pattern of private buses			Range(numbers) of buses owned					Financing Pattern of buses		Avg cost of a bus Rs in lakhs
	Surveyed	Coop /Union	Company	Individual	1	2 to 5	6 to 10	>10	Avg. buses per owner	own funds %	Loan %	
Haryana	37	29	4	4	13	21	0	3	3.08	20	80	15.81
UP	23	6	6	11	5	17	1	0	2.26	23	77	12
Rajasthan	6	5	0	1	4	0	1	1	4.17	NA	NA	NA
Overall NCR	66	40	10	16	22	38	2	4	2.89	20.63	79.37	14.80

Source: Study on Integrated Transportation Plan for NCR
** Private Operators*

On an average, 3 persons (a driver, a conductor and a helper) are deployed per bus operating for over 13 hours daily and 24-28 days in a month. The average wages per driver, conductor, and helper are Rs, 4970, 3029, and 1672 per month respectively, the average staff cost per bus per month being Rs 9639 ranging from Rs 8667 in Rajasthan sub-region to Rs 10646 in Haryana sub-region of the NCR. Details are given in **Table 6.17.**

Table 6.17: Type, Capacity, Age, Fleet Utilization and Staffing of PO buses in NCR

Sub Region	No. of uses std+ mini	52 seater std. bus characteristics			Staff					
		No. of buses	Avg. Age yrs	Fleet utilisation	Avg. staff bus	Avg. working rs/day	Avg. salary er month or driver	Avg. salary er month or conductor	Avg. salary er month or helper	Wages/ bus month Rs
Haryana	114	96	4.5	0.88	3.0	13.7	5514	3421	1711	10646
Uttar Pradesh	52	50	10.4	0.87	3.0	12.8	3940	2582	1651	8173
Rajasthan	25	24	7	0.83	3.0	11.9	4896	2396	1375	8667
Overall NCR	191	170	6.6	0.87	3.0	13.2	4970	3029	1672	9671

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Overall utilization of PO buses, as judged from their performance parameters like bus productivity and fleet utilization, etc is low but over-crowding is prevalent in all sub regions of NCR. Operational performance characteristics of PO buses are given in **Table 6.18.**

Table 6.18: Operational Performance Characteristics of PO buses (Standard 52 Seater) in NCR

Sub Region	No. of buses	Fleet Utilisation	vehicle (on road) utilisation kms/day	Avg. load factor	avg.no. of pax carried daily/ bus	avg.no. of pax carried per trip/bus	Avg. no. of trips /bus /day	average bus trip length km
Haryana	96	0.88	247	0.89	323	46	6.96	35.7
Uttar Pradesh	50	0.87	185	0.87	199	45	4.40	42.1
Rajasthan	24	0.83	306	0.82	143	43	3.33	91.7
Overall NCR	170	0.87	237	0.88	260	46	5.69	41.8

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Comparing the operational performance of private operators' buses with that of the State Transport Undertaking (STU) buses in the sub region (ref. **Table 6.18 & 6.19**), PO Buses have:

- lower fleet utilization by about 5%
- significantly (31%) lower vehicle utilization (kms operated per bus on road per day)
- over crowding [avg. load factor significantly (38%) higher]
- low journey speeds (buses operating on an average 237 kms/bus/day in 13.2 hours perhaps by resorting to trip missing and over staying at bus stops vis a vis 342 kms by STU buses)
- 4% less passenger kms served daily per bus.

Table 6.19: Comparison of Operational performance characteristics of Private and STU buses in NCR

Sub Region	No. of buses			Fleet Utilisation			Avg. vehicle(on road) utilisation kms/day			Avg. load factor			Avg. no. of Pass. carried daily/bus		
	Pvt	STU NCR	STU State	Pvt.	STU NCR	STU State	Pvt.	STU NCR	STU State	Pvt.	STU NCR	STU State	Pvt.	STU NCR	STU State
Haryana	96	1285	3223	0.88	0.92	0.97	247	362	363	0.89	0.7	0.70	323	333	351
Uttar Pradesh	50	1219	5976	0.87	0.92	0.96	185	321	334	0.87	0.57	0.67	199	214	156
Rajasthan	24	289	4373	0.83	0.97	0.96	306	337	370	0.82	0.62	0.67	143	240	146
Overall NCR	170	2793	13572	0.87	0.93	0.96	237	342	352	0.88	0.63	0.68	260	271	199

Source: Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06

Table 6.20: Profit / Loss (-) per bus per year (Standard buses) - Private operators' and STU buses

Sub Region	No. of buses			Total cost per bus per yr Rs in lacs			Total rev. per bus per yr Rs in lacs			Profit/Loss per bus per yr Rs in lacs		
	Private	STU NCR	STU State	Private	STU NCR	STU State	Private	STU NCR	STU State	Private	STU NCR	STU State
Haryana	96	1285	3223	14.83	22.26	24.96	19.21	18.28	21.12	4.38	-3.98	-3.84
Uttar Pradesh	50	1219	5976	11.55	14.47	18.66	14.71	16.75	15.86	3.16	2.28	-2.8
Rajasthan	24	289	4373	16.11	20.19	19.89	21	19.75	19.39	4.89	-0.44	-0.5
Overall NCR	170	2793	13572	14.04	18.56	20.55	18.11	17.76	18.24	4.07	-0.8	-2.31

Study on Integrated Transportation Plan for NCR, Profile and performance of STUs - FY 2005-06

On the financial performance comparisons with STU buses (refer **Table 6.20**), the PO buses have:

- 27% higher cost per bus km on account of lower bus productivity

- 0.72% less revenue per bus per year (passenger kms operated annually and the fare structure being identical)
- 64% higher revenue per bus km due to the more revenue generated through over-loading and then distributed on less kms operations
- 561% higher profitability of operations (a PO bus earns a profit of Rs.4.08 lacs /year as against a loss of Rs.2.31lacs per bus per year by STU buses)

PO bus operation appears to be more profitable than that of STU buses but mainly at the cost of passenger convenience (over loading, low journey speeds, selective operation of trips, longer stay of buses on bus stops etc). Lower payment of taxes, exploitation of staff by way of poor wages, non adherence to any of the labor related rules/regulations etc as also non provision of any of the welfare/social security facilities and very long working hours without any compensation, appear to be other factors contributing to higher profitability of these buses. STU buses on the other hand rightly (following all applicable rules /regulations/acts etc) employ more than twice the staff employed by the PO and incur significantly higher expenses on their wages and other statutory /welfare schemes. Bus productivity, operational efficiency, punctuality (though at the cost of load factor) etc, commuter convenience and comfort, etc of STU buses is much better than the PO buses

Following above analysis, a judicious mix of the two systems on the concept of public private partnership (PPP) is expected to go a long way to provide and sustain an adequate, efficient, affordable, safe and environmentally compatible bus system in the NCR area and hence proposed for the NCR.

l. Bus technology

Buses deployed in the NCR are mainly the conventional buses, about 10.5 meters long with high floors (over 1100 mm floor height) with two doors, 2X2/3x2 seating layouts with conventional seats, fitted with manual transmission and clutching, leaf spring suspension system, etc. These buses are propelled by about 100-125 HP engines with low acceleration. Some mini buses also operate in parts of the NCR. In the interiors, jeeps/MAVs/other locally developed vehicles (Jugads) serve as passenger transport vehicles. Most of the buses do not have universal accessibility and commuter friendly provisions such as accessibility for differently-abled persons, properly illuminated route destination boards, time table etc.

The bus designs (except the buses currently being acquired by the DTC) have not undergone scientific evaluations for their structural strengths and passenger safety in the event of collisions/roll-over etc.

On considerations of economizing on investments/saving taxes (as against 16% excise duty applicable to the chassis/bus manufacturer, no excise duty chargeable if bus body constructed in the small scale sector) most of the private operators buy bare chassis and get their buses constructed by the bus body builders in the small scale sector who are deficiently equipped to ensure appropriate grade/quality of buses. Even the bus designs specified by individual private bus owners are inefficient on similar considerations and lack of knowledge/skills with the se owners.

Transport vehicles are required to undergo roadworthiness certification periodically. Almost all transport vehicles including buses under go such certification after visual inspections/checking in absence of appropriate facilities/skills available for scientific evaluation of roadworthiness by the certification agencies. Even the repair and maintenance of buses is hardly done at the properly equipped workshops(except the STU workshops) thereby telling upon the quality of buses in operation and thus diminishing commuter preference for the bus based public transport system.

Although the transport vehicles are required to undergo emission checks periodically, the quality of checks appears to be wanting as qualitatively assessed from deteriorating air quality in most of the towns of the NCR. The air quality is further affected severely by the 3 wheelers and other transport vehicles phased out of the NCTD finding an easy business opportunity in the NCR in spite of their dismal physical condition. These vehicles resort to use of adulterated fuels for economizing on operational costs without any consideration for the environment.

At present, most of the DTC buses and a few each of Haryana Roadways and the UPSRTC, operating in the NCR, are CNG fuelled, while all others are mainly diesel fuelled. All the buses registered in the NCR meet the prescribed emission norms –currently applicable norms being BSIII. Low sulphar (0.035%) diesel fuel necessary for meeting the BSIII emission norms is available.

m. Institutional Setup of STUs in NCR

The STUs, (except Haryana Roadways--a Haryana Government department), operating in the NCR are incorporated under the RTC Act 1950 for operation mainly in their respective States. As per provisions of the RTC Act, the STUs operate in other states with the prior concurrence of / agreement with the concerned state. However such operations have not been very smooth and have frequently led to interstate disputes causing disruption of transport services.

The permits issued for operation in areas/states other than those in the jurisdiction of the concerned transport authority need counter signature of the other authority leading to avoidable delays and costs.

As the NCR operations of the STUs, generally have low profitability/are loss making, the STUs hardly get motivated to expand their operations in spite of the growing travel demands in the region. Although the RTC act provides for securing of buses by agreement etc with the private bus owners/operators more economically, the permit conditions under the MV act/the MV rules framed there-under, discourage such arrangements terming them as trading on permits. The transport services by single bus owner private operators, under the stage carriage permits issued by the STA NCTD, have not been reasonably successful in Delhi/Delhi-Noida in satisfying the demand of public transport in a safe, comfortable and efficient manner. Similarly, the cooperative societies formed to operate bus transport services in some parts of NCR (Haryana), are understood to have dispensed with their buses to single owners defeating the purpose of operating such services by the organized groups for better services and coordination. The existing institutional set ups appear to have only marginally succeeded in providing a self sustaining public transport system and fuelling its growth commensurate with the ever increasing demand.

n. Bus parking, repair/maintenance facilities

For an operational fleet of over 6000 inter city buses in the NCR, space for parking/repair and maintenance of about 3200 buses of the STUs has been provided mainly by the STUs. Hardly any planned spaces/repair and maintenance facilities have been developed for the privately owned/ operated buses. Consequently on-street parking of buses is a common sight in almost all parts of the NCR. Similarly the repair and maintenance activities are carried out by unskilled technicians at inadequately equipped workshops. While poorly maintained vehicles are potential reliability, safety and environmental hazards, on-street parking causes avoidable congestion, reduced vehicle productivity and longer journey time.

o. Bus terminals and bus queue shelters

For over 6000 buses operating in the NCR, only a few terminal spaces have been provided. Even amongst them except for some terminals like ISBT Kashmeri-gate in Delhi; Meerut, ILT-Ghaziabad, etc in NCR (UP); Faridabad, Ballabgarh, Bahadurgarh, Sonipat, Panipat, etc, in Haryana, Alwar in Rajasthan, others are partially/ poorly developed. Facilities for advance reservation, passenger waiting spaces, and passenger amenities are hardly available. Similarly inter-modal transfer facilities are available only at the few terminals mentioned above.

Other than the NCTD, bus terminals/stops are located beyond a walk-able distance from the Railway stations consequently the luggage carrying commuters take inter modal transfers mainly by the NMTs/IPTs not only entailing higher costs but also causing journey delays. Sufficient number of spaces for parking of buses and for bus bays facilitating boarding/alighting of passengers are hardly observed at most of the railway stations. Similar is situation for parking spaces for private vehicles, IPTs, NMTs at these locations.

Availability of Bus Queue Shelters (BQS) along the national highways, state highways and the other roads is rare in almost all areas of the NCR except the NCTD or a few places in the CNCR causing avoidable inconveniences to the bus commuters particularly in harsh winter, summer and the rainy seasons.

7

Bus Terminals

Bus Terminals

An important factor influencing efficiency of bus transport system in any area including the National Capital Region is adequate availability of mode / route interchange facilities in the form of bus terminals/bus stations. In a vast region like NCR, passengers shift from one bus route to another, one transport mode to another, public transport buses to private transport buses to complete their end-to-end trips. Such inevitable shifts call for seamless transfer facilities in the form of bus terminals / bus stations, etc. to avoid inconvenience to the passengers.

Physical Survey of terminal facilities at 17 locations across the region was carried out by the Consultant during the Study and accordingly main issues related to bus terminals are listed below:

i) A comprehensive policy and a designated authority does not appear to exist for planning / development / operation / maintenance of bus terminals in the NCR particularly for the Private Operators' buses – an essential requirement for promoting efficient bus operations and motivating commuters for using such services.

ii) The passenger amenities at a number of existing bus terminals are bare minimum. Development of commercial space if any not coupled with improvement of passenger amenities.

iii) Based on the qualitative observations, most of the bus terminals situated in the city centers are already saturated. These bus terminals add to the congestion of the cities. There is a need to decongest these terminals - as many of them have reached saturation levels and their capacities cannot be increased, they may be shifted outside the cities.

iv) A number of bus terminals in NCR offer inadequate passenger accessibility, mode transfer and other facilities.

v) Most of the private bus operators park their vehicles on the streets/roads, hindering smooth movement of vehicles.

vi) No O & M workshops are developed by the private bus operators. Consequently most of their buses are repaired at ill equipped road side workshops telling upon service quality rendered by such buses.

vii) While STUs developed Depot and workshop facilities progressively, POs have not developed any depots or workshops for their buses presumably on account of affordability and uneconomic fleet sizes as most of the POs own fleet sizes ranging from 1-5.

viii) All the bus stops even in urban centers use road space for parking, boarding / alighting thus reducing the effective carriageway width and causing delays to other traffic.

ix) There is untapped potential for commercial exploitation in the bus terminals.

x) User charges levied at some of the terminals for private buses are on an ad-hoc basis.

Commuter Characteristics

Planning, development and operation of regional public transport system needs an appreciation of the travel characteristics of the people of the region. To assess the adequacy of public transport system and related transport infrastructure and to capture the inter-regional and intra-regional commuter movement characteristics in NCR, commuter surveys were conducted by the Consultant at different locations within and outside Delhi covering the entire NCR**.** Commuter Surveys were taken up with the following objectives:

i) Appreciate the personal characteristics of commuters, trip & travel characteristics and correlation between them
ii) Elicit the opinion of the commuters about the service provided by different public mass transport modes, reasons for choosing a particular mode of public transport, willingness to shift & willingness to pay for improved level of service
iii) Generate necessary input data for calibrating travel demand modal.

Appreciation of socio-economic and travel characteristics of the commuters in NCR along with their opinion regarding alternative mode provides a good base for rational planning, development, operation and management of the overall transport system of NCR. Findings/issues emerged in the Study are:

i) Survey results reveal the mobility problem of females and elderly people.
ii) Overall level of income of the commuters is low to medium which indicates limited paying capacity for any improved/new technology PMTS.
iii) General trend shows that commuter's average monthly expenditure on travel increases with their monthly income. Analysis was also performed to express expenditure on travel as a percentage of monthly income and results showed that lower income group spend a higher share of their income on travel.
iv) Commuters primarily comprise the student population which will affect the fare policy of any new system.
v) More than half the commuters do not own private vehicle and avail the facility of PMTS. This indicates a good size of captive passengers who needs to be retained in the proposed system.
vi) 'Work' and 'Education' accounts for more than 65% of the total trips and both these types predominantly favour PMTS.
vii) At present, expenditure per trip (origin to destination) is reasonably high in all the sub-regions. Commuters in Haryana and UP sub-regions pay higher cost per trip as compared to NCT Delhi and Rajasthan.
viii) Overall picture shows that travel time taken by the commuters are generally high.
ix) Inadequacy and lack in reliability of service are the major problems perceived by the commuters with the inter-city mode followed by problems like high fares, irregular frequency and overcrowding condition.
x) A large share of commuters prefer commuter rail stating less fare and less travel time as the primary reasons behind their preference.
xi) Commuters stating Metro as their preference for modal choice consider less travel time and riding comfort behind their choice.
xii) Propensity of commuters for shift to 'rail' system is very high subject to provision of feeder system between their origin/destination and railway stations.
xiii) Nearly 98.3% of the commuters were willing to shift to 'rail' mode if travel time was reduced by 50% while 67% of the total commuters were willing to shift to 'rail' mode if travel cost was

reduced by 50%. This shows that commuters are more sensitive to reduction in travel time than reduction in travel cost.

xiv) Almost 72% were willing to shift to 'rail' mode if only seating facility is available. This shows that less travel time and less fare are more desirable to the commuters than the level of comfort.

xv) About 61.4% of the commuters were willing to pay 20% extra for high frequency and comfortable seating and 49.9% were willing to pay 20% extra for AC facility. However 45.7% of the commuters were not willing to pay extra for AC facility. This shows that frequent service and comfortable seating are more desirable than AC facility.

xvi) Nearly 60% opinioned in favour of frequency of rail less than 15 minutes and 96% in favour of frequency less than 30 minutes which is an important factor to be considered in planning the proposed 'commuter rail' system operation.

xvii) A large share of commuters (83.1%) in the entire NCR do not like any transfers within a single journey which is significant in the design of a multi-modal transport system.

To understand the structure of network of public transport from the perspective of people who are staying in the villages, key issues were explored during the survey. The issues are:

(i) Bus is the most common mode of public transport (71.6 percent), subsequent modes being auto (56.17 percent) and jeep (41.36 percent). Status of connectivity of the villages by the public transport has also been studied during the survey. The connectivity is sorted into five categories – very good, good average, poor and very poor. It is mentioned in **Table 8.1.** Majority of the road sections have average connectivity.

Table 8.1: Connectivity by Public Transport

Sl. No.	Connectivity	Criteria for Grading the Connectivity	% of Respondents
1	Very Good	Mode of communication available at a very frequent interval (less than 15 min)	11 %
2	Good	Mode of communication available at a frequent interval (between 15 min to 30 min)	24%
3	Average	Mode of communication available but at an interval of ½ hour to 1 hour	37%
4	Poor	Mode of communication is available but after waiting for more than 1 hour	19%
5	Very Poor	Hardly any mode of communication is available	9%

Source: Study on Integrated Transportation Plan for NCR

(ii) To establish an improved and responsive system and to ensure that benefits accruing to the people in the project area are maximised, the present commuting problems were studied by the Consultant. **Table 8.2** shows that majority of the people face problem of crowded roads followed by inadequate safety on roads.

Table 8.2: Type of Problems Faced by Commuters

Sl. No.	Type of Problems	Percentage of the Total Respondents
1	Unavailability of Public Transport	64.2
2	Traffic Congestion	60.49
3	Poor Road Condition	64.2
4	Lack of Safety on Rods	79.63
5	Lack of Option	39.51
6	Misbehaviour	43.21
7	Crowded	81.48
8	Any Other	5.56

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

(iii) **Impact of Road Conditions on Economic Activities:** More than 75 percent of the respondents mentioned that there is a positive impact of the improvement in road condition on the economic situation. The major types of positive impact are: diversification of economic activities including

more job opportunities and credit facilities, increase in land price, easy accessibility to market, and accessibility to information related to economic activities and market. About 30 percent of the respondents mentioned that increase in the land price is the most common positive impact of the road.

However, 22 percent of the total respondents mentioned that the bad road condition has adverse impact on the economic condition. The major adverse impacts are problems faced in transportation of crops and in commuting to workplace, increase in cost of living, lack of diversification of the present activities, out-migration, and prone to accident.

Stated Preference Survey

Consultant carried out the Stated Preference (SP) survey with the following objectives:

i) Appreciate the personal characteristics of private mode (car and 2 wheelers) users in terms of age, level of education, monthly income pattern and average monthly expenditure on travel.

ii) Appreciate the trip and travel characteristics of private mode users in terms of trip travel time, trip purpose, trip length, expenditure per trip and trip frequency.

iii) Elicit the perception of the trip maker about the existing public mass transport system.

iv) Elicit the willingness to shift to public transport modes including their preference for improved service attributes such as reduced travel time, reduced travel cost, increased comfort level, minimal walking distance to stop/station and minimal waiting time.

v) Generate necessary input data for calibrating travel demand modal.

vi) Derive value of time of the trip maker(private mode)

Some of the important findings/issues emerged from the study are as follows:

i) Level of income is medium to high

ii) Expenditure on travel as a percentage of monthly income showed a decreasing trend with the increase in income group among all the user groups irrespective of the type of mode used.

iii) 'Business' and 'work' purpose were predominant among the respondents

iv) Long waiting time followed by absence of flexibility and lack of comfort were the main reasons cited by the private transport users for not availing the public transport system

v) Savings in travel time and better comfort are more desirable to the users as compared to savings in travel cost while considering shifting to public transport mode.

vi) Majority of the respondents, irrespective of type of mode used at present, preferred a minimal walking distance upto 200m to the Stop/Station in order to avail the public transport system.

vii) Most of the car users stated their desired minimal waiting time upto 10 minutes while considerable share of 2 wheeler users were willing to wait upto 15 minutes.

viii) Nearly a quarter of the existing private transport users wanted a savings in travel time by 15 minutes to shift to public transport system while more than three quarter of the users wanted a savings in travel time by 30 minutes.

Intermediate Public Transport System Operator Survey

The objective of the survey was to assess operational characteristics of the (Intermediate Public Transport) IPT operators, identify problems, issues and suggest appropriate policies for rational development of IPT system in the National Capital Region (NCR).

IPT operator survey was conducted at locations where maximum numbers of trips by IPT (Auto Rickshaws, chakdas etc.,) originate and destine. A total of 198 operators (Auto rickshaws and other rural transport vehicles) were interviewed and data collected from their responses was analysed by the Consultant.

The survey provided information relating to personal characteristics of operators in terms of age, education, professional experience, vehicle ownership and operational characteristics in terms of route and duration of operation, vehicle utilisation, passengers carried, operating cost and revenue. As a part of this survey, operators were requested to give their opinion on problems perceived by them during IPT operation and recommendations on the same. Some of the important findings of the Study are as follows:

10.1 Personal Characteristics

i) Nearly 96% of the operators are below 45 years of age. There is a high share (86%) of middle age groups (25-44) among the operators.

ii) Literacy rate of a significant share (59%) of the operators are restricted below secondary level followed by 29% in the secondary level. Only 3% of them are graduates.

iii) Most of the operators in the study area have an experience of less than 15 years. Operators having experience less than 5 years and between 5 - 10 years have almost equal share.

iv) Distribution of vehicles by ownership shows that nearly 28% of the total sample operators run self-owned vehicles while the remaining was hired.

10.2 Operating Characteristics

i) About 93% of operators operate between 10 to 15 hours/day.

ii) About 34.0% of the IPT operators operate between 100-150 km/day followed by 28.0 % who operate between 50-100 km per day. On an average, Auto Rickshaws operate 103.4 km/day while other vehicles(RTVs) operate 210.2 km/day.

iii) About 53.0 percent of IPT operators perform less than 5 trips/day. On an average Auto Rickshaws operate 6 trips per day while other vehicles operate 3 trips per day.

iv) Auto Rickshaws carry 96 passengers per day on an average while other vehicles like RTVs carry around 114 passengers per day on an average.

v) Auto Rickshaws operate empty (without passengers) for 11.5 km/day while other vehicles like RTVs operate empty for 8.9 km/day on an average.

vi) Operating cost of auto-rickshaw by cost components is given in **Table 10.1**.

Table 10.1: Operating Costs of Auto-Rickshaws by Components

Operation	Cost Per Day (Rs.)
Average Rent Cost	197.37
Average Fuel Cost	170.75
Average Maintenance Cost	24.39

Source: Study on Integrated Transportation Plan for NCR

vii) Operating cost of other vehicles (RTVs) by cost components is given in **Table 10.2.**

Table 10.2: Operating Costs of Other Vehicles (RTVs) by Components

Operation	Cost Per Day (Rs.)
Average Rent Cost	0.00
Average Fuel Cost	1290.00
Average Maintenance Cost	183.44

Source: Study on Integrated Transportation Plan for NCR

viii) Since all the RTVs in our sample of operators are self-owned ,there is no rent cost, the average fuel cost and maintenance cost of RTV is quite high as compared to that of auto rickshaws.

ix) Revenue per day on an average for different types of IPT as obtained from our survey responses reveals that other vehicles (RTVs) pay much higher amount (approx Rs. 1995) than the auto-rickshaws.(approx Rs. 388)

x) Annual Cost comprises of taxes, permit, charges, fees etc. Survey results show that the average annual cost for other vehicles like RTVs (approx Rs. 52831) is much higher than the auto-rickshaws (R. 6159).

xi) Some of the problems highlighted by the operators during survey by the Consultant are lack of defined terminal /waiting stands, high competition (over supply of auto) and harassment by STA/police.

10.3 Suggestions by Operators

During survey various suggestions were given by the operators, they are listed below:

i) More than half of the respondents opined in favor of making soft loans available (54%) and simplifying procedures for getting loans (53%).

ii) A significant share of operators (42.4%) also opined in favor of fare increase to be linked to increase in input costs.

iii) Nearly one-third of the operator's suggestion was to simplify the process of obtaining license and provide parking space.

Table 10.3 provides percentage distribution of IPT operator's opinion by their suggestions for improvement.

Table 10.3: Distribution of IPT Operator's Opinion by Suggestions

Suggestions (%)								
Make soft loans available	Simplify procedure for getting loans	Simplify process for obtaining license	Minimise Undue Harassment	Provide parking space	Fare increase to be linked to increase in input costs	Provide assistance/ subsidy for technology up-gradation	Provide training facilities for skills up-gradation	Others
54.0	53.0	36.4	19.2	32.3	42.4	13.6	2.5	3.0

Source: Study on Integrated Transportation Plan for NCR

11 Environmental Characteristics

Development of an Integrated Multimodal Transport Plan in NCR necessitates establishing the base line status of the environment as of date. Road transport affects mainly air and noise and these two are used in delineating road sections from the point of view of the environmental pollution. As pollution levels for air and noise were not readily available, they were measured by the consultant at 20 representative road sections / corridors spread over the entire NCR where traffic counts were also made simultaneously. The Monitoring locations for the primary data collection related to environment are listed in **Table 11.1**.

Table 11.1: Monitoring Locations for Primary Data collection on Environment

Sl. No	Station No.	Name of the Station	Distance From C/L	Description of the Location
1.	01	Babarpur on NH-1	25-30 m	Commercial Area
2.	08	Khevada	---do---	Residential Area
3.	14	Hasan pur	---do---	Residential cum Commercial Area
4.	19	Dasna Toll Plaza	---do---	Residential cum Commercial Area
5.	22	Near Mohan Nagar	---do---	Residential cum Religious Area
6.	26	NH 2 Sec 37 Faridabad	---do---	Residential cum Commercial Area
7.	28	Chaunhut Police Station	---do---	Residential cum Commercial Area
8.	32	G.T. ROAD NH 91	---do---	Commercial Area
9.	35	Arnia Check Post	---do---	Residential Area
10.	43	Near Bhondsi	---do---	Residential cum Commercial Area
11.	44	Bilaspur toll Plaza	---do---	Commercial Area
12.	45	Nuh - Firozpur Jhirka	---do---	Commercial Area
13.	47	Doha Chok	---do---	Residential cum Commercial Area
14.	50	Alwar – Seriska	---do---	Residential cum Commercial Area
15.	60	Naha	---do---	Residential cum Commercial Area
16.	62	NH 8 Behror	---do---	Industrial & Commercial Area
17.	65	Yakubnagar	---do---	Residential cum Religious Area
18.	69	Bahadurgarh-Delhi	---do---	Residential cum Commercial Area
19.	78	Bramahan Vas	---do---	Commercial Area
20.	81	Bhadwasa	---do---	Residential cum Religious Area

Source: Study on Integrated Transportation Plan for NCR

The traffic counts were however made over the entire NCR covering 82 road corridors. Air quality measured in respect of SPM, RSPM, CO and NO_x and noise levels at representative road sections were correlated with the emissions in the corresponding corridors statistically. The emissions were calculated in all the 82 corridors by converting the traffic counts using emission factors of various vehicles as suggested by CPCB. (Transport Fuel Quality for year 2005, PROBES /78/2000–01). The air quality has been expressed as Excedence Factor (EF) for various road corridors based on low (EF <0.5), moderate high (EF between 0.5-1.0) and critical (EF >1.5). In order to have a comprehensive environmental status in respect of air quality including noise, an Air Pollution Index (API) was calculated considering existing pollutant / noise levels and air / noise quality standards for all the corridors in the entire NCR region. This API is utilized in ranking the entire road sections in NCR on environmental basis in the study. This has been given in subsequent paras.

Relevant details and equations with regard to emission from traffic and air quality levels of parameters cited above and that for noise levels are given in **Annexure 11.1.**

11.1 Spatial Distribution of Pollutants

SPM

The CPCB standard for SPM is 200 µg/m^3. It is clear that out of total 82 stations, SPM level at 34 Stations is below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with

varying magnitude. At 36 stations, it is violating the standards (EF varies between 1.0-1.5; High Pollution) with varying magnitude and at remaining 12 stations it is critical (EF >1.5;Critical Pollution). Preventive and control measures are required to be undertaken at 36 stations where it is violating norms. Twelve stations where SPM level is critical are: 19(Dasna Toll Plaza),21(Near Dadri), 69(Bagadurgarh-Delhi), 62(NH-8 Behror), 20(Morta), 44(Bilaspur Toll Plaza),23(Near Indrapuram, Gaziabad) 42(Khirki Dola), 9(Kundli), 1(Babarpur), 26(Faridabad) and 22(Mohan Nagar) are violating the standards (EF >1.5;Critical Pollution) and immediate measures are required to be taken by the concerned authorities for its reduction.

CO

The CPCB standard for CO is 2000 µg/m^3. It is clear that out of 82 stations, 72 stations are well below the prescribed standards (EF varies between 0.0-0.5; Low pollution) have a rather pristine air quality and such areas are to be maintained at low pollution level by way of adopting preventive and control measures of air pollution. In the remaining, 9 Stations though below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude as of now are likely to exceed the standards in future. It is observed that the concentration of CO at station 22(Mohan Nagar) which is exceeding the standards (EF varies between 1.0 - 1.5; High Pollution), needs preventive and control measures to be taken.

NO_x

The CPCB standard for No_x is 80 µg/m^3. It is clear that out of 82 stations, 79 stations are well below the prescribed standards (EF varies between 0.0-0.5; Low pollution) have a rather pristine air quality. The remaining 3 stations, 44(bilaspur Toll Plaza), 9(Kundli) and 1 Babarpur are below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude as of now but likely to exceed the standards in future.

RSPM

The CPCB standard for RSPM is 100 µg/m^3. It becomes clear that among all 82 stations, RSPM levels of 46 stations are below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude as of now but likely to violate the standards in future. In the remaining, 26 stations which are violating the standards (EF varies between 1.0-1.5; High Pollution) with varying magnitude, preventive and control measures are to be taken. It is observed that the concentration of RSPM at Station 69(Bahadurgarh – Delhi),62(NH-8 Behror),20(Morta) 44(Bilaspur), 23(Indrapuram), 42(Khirki Dola), 9(Kundli), 1(Babarpur), 26(Faridabad) and 22(Mohan Nagar) are violating the standards(EF >1.5;Critical Pollution), where preventive and control measures have to be taken immediately.

It could be observed from above that the norm of SPM level at all the 82 locations was being violated varying between below the prescribed standards to critical level of pollution in their magnitude. Similarly, in term of CO, NO_x and RSPM the prescribed standard limits were also being violated at all the monitoring stations.

11.2 Spatial Distribution of Noise levels in NCR

In order to assess the noise impacts due to the proposed project on surrounding area base line noise levels were monitored. To determine the existing noise level, field monitoring was carried out along the existing alignment of the road with integrating sound level meter as per IS: 3029-1980.

Leq (Day)

The CPCB standard for Leq (Day) is 65 dB (A). It becomes clear that all 82 stations are above the prescribed standards. It is observed that intensity of noise level at stations No.44 (Bilaspur), 42(Khirki Dola), 9(Kundli), 1(Babarpur), and 69(Bahadurgarh) is very high (i.e. >75 dB (A)).

Leq (Night)

The CPCB standard for Leq (Night) is 55 dB (A). It becomes clear that all 82 stations are above the prescribed standards. It is observed that the intensity of noise level in stations Numbers 20(Morta), 17(Hapur),l (Garhmukteshwar Toll Plaza), 19(Dasna Toll Plaza), 7(Sisana), 21(Near Dadri), 23(Near Indra puram gaziabad), 22(Near Mohan Nagar), 26(NH 2 Sec), 37 (Faridabad), 62(NH 8 Behror), 42(Khirki Dola), 44(Bilaspur toll Plaza), 9(Kundli), and 1(Babarpur) is very high(i.e. > 65 dB(A)).

11.3 Prioritization/ Ranking of Road Sections

The API values based on the air quality in respect of SPM, RSPM, CO and NO_x and noise quality in respect of $L_{eq\ day}$ and $_{Leq\ night}$ are used to rank the road corridors of the entire NCR (Refer to **Annexure – 11.2 for locations & levels/ranks)**. Lower the API value indicates better air quality; hence preference should be given over the rest.

Consultant also projected these air quality and noise level parameters for 2015 based on previous studies carried out by them in 13 corridors covered earlier in the NCR and compared them with standards CPCB and year 2007 levels. The results compared with the current levels are tabulated in **Table 11.2**.

Table 11.2: Comparison of Pollution Parameters of CPCB Standards with 2007 and 2015 (projected) Levels

Loc No	SPM 200 µg/m^3		CO 2000 µg/m^3		NOx 80 µg/m^3		RSPM 100 µg/m^3		Leq (Day) 65 dB (A)		Leq (Night) 55 dB (A)		API	
	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015
11	192.9	193.9	531.2	537.4	16.6	17.9	88.9	89.4	69.0	69.9	58.9	61.7	0.72	0.74
10	274.7	341.3	802.1	1007.1	25.1	32.6	126.6	157.3	72.4	74.2	64.8	66.3	0.91	1.05
31	201.0	284.5	557.1	862.9	17.5	27.8	92.7	131.2	70.1	73.6	59.0	65.7	0.74	0.94
28	184.6	273.3	500.5	827.4	16.2	27.0	85.1	126.0	68.6	73.4	58.9	65.4	0.70	0.91
22	681.0	390.2	2296.2	1125.0	40.1	37.9	313.9	179.9	75.4	74.8	67.5	66.9	1.67	1.15
18	193.2	219.5	523.0	611.0	17.0	20.4	89.1	101.2	69.1	71.6	60.4	63.6	0.73	0.80
26	560.7	604.9	1906.5	2059.2	30.9	44.1	258.5	278.9	74.3	76.5	67.5	68.7	1.44	1.55
82	170.6	329.5	458.7	1029.9	14.8	33.5	78.6	151.9	65.4	74.6	54.8	66.7	0.66	1.03
66	177.3	330.3	482.8	1007.8	15.5	33.3	81.7	152.2	67.6	74.4	57.5	66.5	0.68	1.03
9	523.7	609.4	1635.7	2014.0	46.8	69.6	241.4	280.9	76.5	77.3	69.3	69.5	1.41	1.61
4	256.5	240.1	771.6	731.9	21.3	24.3	118.2	110.7	72.3	72.6	64.3	64.6	0.87	0.85
57	204.1	346.2	583.5	1154.6	18.9	32.8	94.1	159.6	70.2	74.5	62.8	66.6	0.76	1.06
58	237.5	343.6	719.1	1145.3	18.4	29.9	109.5	158.4	70.8	73.8	60.9	65.9	0.82	1.05

Source: Study on Integrated Transportation Plan for NCR

Based on the above analysis, the ranking of pollution level in 2007 and 2015 is given in **Table 11.3.**

Table 11.3: Ranking of Pollution Level in 2007 and 2015

Location No	Name	Rank In 2007		Rank in 2015	
82	Barauda	**1**	0.66	7	1.03
66	Dhare	**2**	0.68	6	1.03
28	Chaunhut Police Station	**3**	0.70	4	0.91
11	Lakhabaya	**4**	0.72	1	0.74
18	66KM BARAL	**5**	0.73	2	0.80
31	Khurja Junction	**6**	0.74	5	0.94

Location No	Name	Rank In 2007		Rank in 2015	
57	Phalhawas	**7**	0.76	10	1.06
58	Sohana to Biwadi	**8**	0.82	9	1.05
4	Mehranna	**9**	0.87	3	0.85
10	Near Daurala	**10**	0.91	8	1.05
9	Kundli	**11**	1.41	13	1.61
26	NH 2 Sec 37 Faridabad	**12**	1.44	12	1.55
22	Near Mohan Nagar	**13**	1.67	11	1.15

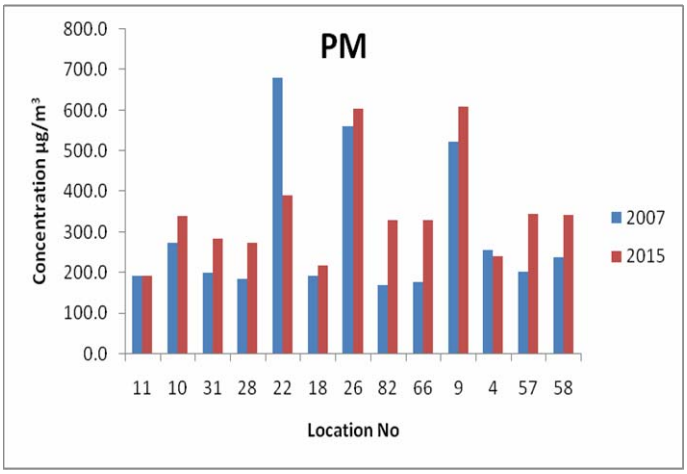
Source: Study on Integrated Transportation Plan for NCR

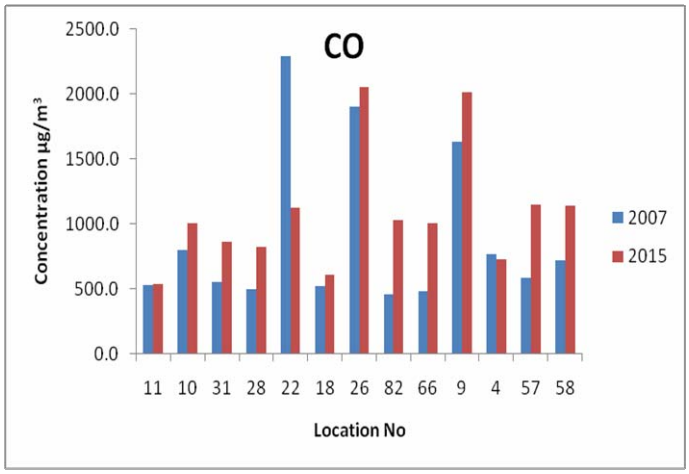
Observations on the basis of above analysis are as follows:

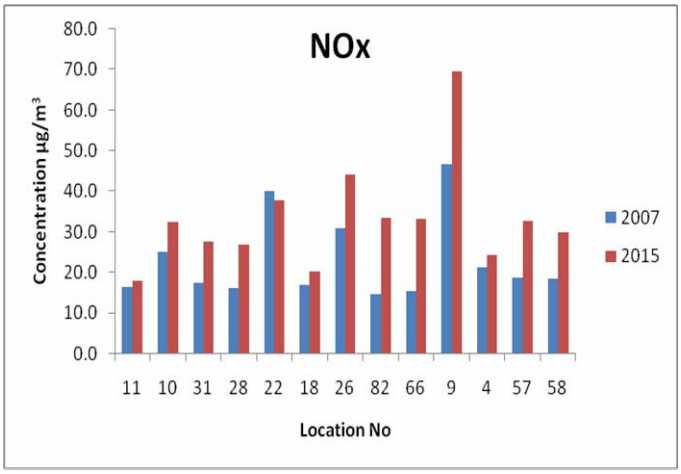
i) 11 stations are showing increased trend of pollutants and noise levels in 2015 except the two stations (No. 22 Near Mohan Nagar and No. 4 Mehranna).
ii) It is observed from the comparison between current and projected API that the ranks of all stations are varying in nature except the station No. 26 at NH -2 Sec. 37 Faridabad which holds the 12th rank.
iii) Stations No. 9 Kundli, No. 22 Near Mohan Nagar and No. 26 NH -2 Sec. 37 Faridabad register lower rank in the list in both the cases.

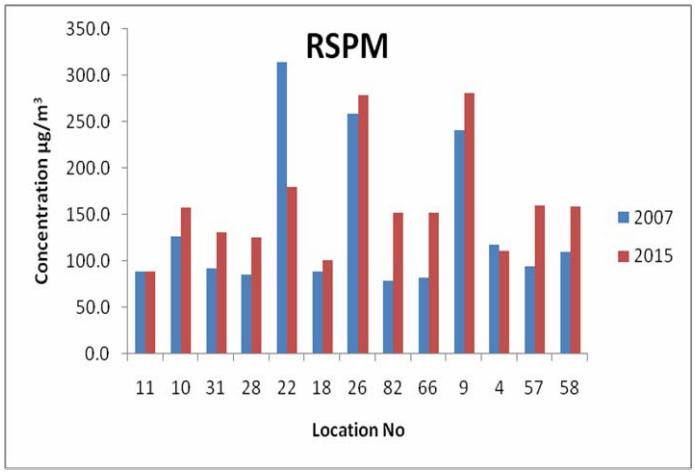
Graphic comparison of projections is given in **Figure 11.1**.

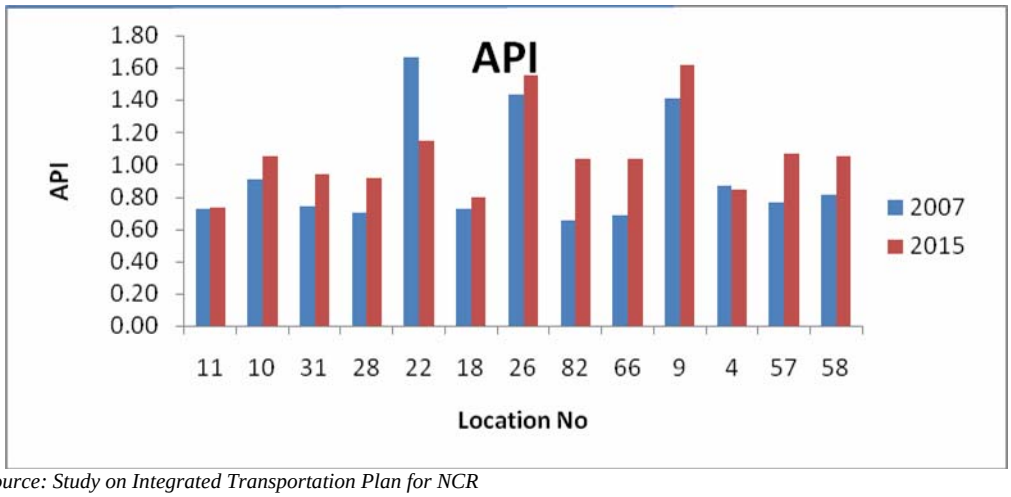
These levels are expected to rise further beyond critical limits if the proposals of the Transport Plan for NCR are not implemented in time-bound manner.











Source: Study on Integrated Transportation Plan for NCR

Figure: 11.1: Comparison of Projections

NCR Transport Modal

A four stage Urban Transport Planning System (UTPS) Modal was constructed in the Study for modalling internal-internal trips and an elasticity based growth rate modal for the other three components of trips (IE, EI & EE). The transport network comprises the road network, public transport (bus & rail) and metro network.

Nearly 5.9 million person trips are performed daily by road in the base year, of which 3.9 million trips are I-I. In terms of freight traffic, nearly 1.8 million tonnes move daily in the study area.

Regression modals based on zonal population and employment, for passenger trip production and attraction have been developed for intra-region trips, for various spatial components of NCR namely, rural, urban, service centre, sub regional centres and metro centres & regional centres. For NCTD, trip rate modal has been adopted.

The trip distribution is accomplished using gravity modal where the generalised cost used is the composite impedance represented by a logsum variable. The modal is calibrated using CUBE Voyager software wherein friction factor lookup table is generated. The validation was performed using checks such as trip length frequency distribution, coincidence ratio and mean trip length.

A nested logit choice modal was developed for mode choice modalling based on Stated Preference and Revealed Preference data. The modal was calibrated separately for five different spatial units: NCT Delhi, NCR Urban Metro & Regional Centres, NCR Urban Sub Regional Centres, NCR Urban Service Centres and NCR Rural areas. The attributes considered were travel time, travel cost and wait time for transit modes and travel time and cost for private modes. The estimation of the choice modal process comprised setting up of panel data, calibration of coefficients and modal bias from disaggregate modal and validating the same at disaggregate level. Maximum likelihood method was adopted to estimate the modal parameters. The modal was successfully validated by comparing the observed and estimated trips by different modes across various spatial stratification in NCR. Modal sensitivity tests were also carried out in terms of change in fare and time of bus and rail on their respective ridership.

Trip assignment was carried out using Capacity Restraint Assignment Technique. The highway assignment was carried out for the peak period, preloading the network with public transport and commercial vehicle flows before loading the private vehicle flows. While the highway assignment was carried out based on generalised cost (with vehicle operating cost and value of time as inputs), the public transport assignment was based on generalised time (with in-vehicle travel time, waiting time and fare in time units as inputs). The validation of the trip assignment was successfully done by comparing the assigned with the observed screen line traffic counts.

Five alternate land use development scenarios were conceptualised based on alternate policies and patterns of development. Planning variables in terms of population and employment were forecast for various spatial stratifications of NCR for each development scenario. The calibrated trip end modals in the base year for daily person trips within the region were applied along with trip rates for NCT Delhi on projected population development scenario to get future trip ends. Daily intra-regional travel demand in NCR for horizon year (2032) ranges from 10.0 million in D5 to 15.44 million in D1 scenario and daily goods generation varies from 1.79 million tonnes in D5 to 2.48 million tonnes in D1 scenario.

The inter-region traffic was forecast based on elasticity approach. Transport demand elasticity was worked out based on time series information and projected in the horizon years along with projected NSDP growth rates in the horizon years which provided the estimates of future inter-region traffic.

The horizon year trip end forecasts incorporating inter and intra-region trips ranges from 18.3 million in D5 to 23.77 million in D1 scenario in 2032 for passenger traffic while it varies between 5.87 million tonnes in D5 to 6.57 million tonnes in D1 for goods traffic.

Development Scenarios

NCR - RP-2021 has estimated the population size of NCR, by 2021, to be 64.14 million. As the Transport Plan is being envisaged for 2032, the population and employment data of NCR, extended up to 2032, are estimated to be 86.67 million and 32.67 million, respectively.

5 scenarios of spatial distribution of population and employment by 3 policy zones of NCTD, CNCR and Rest of NCR, have been conceptualized, including:

- Growth Trend Based Development (D-1)
- Regional Plan-2021 Policy Based Development (D-2)
- Dominant Delhi Based Development (D-3)
- Strong CNCR Based Development (D-4)
- Strong Rest of NCR Based Development (D-5)

Under 'Growth Trend Based Development' Scenario (D-1), the pattern of development and growth will be in line with past trends, i.e. a growth rate prevailing in the decade 1991-2001. This scenario presents a high growth rate with a high total population (102.11 million in the year 2032).

Under 'Regional Plan-2021 Policy Based Development (D-2)' Scenario, the spatial distribution of population by policy zones as proposed in RP-2021 is extended to 2032. The population, by sub-regions, in 2032, was estimated based on the proposed growth rate between 2001 and 2021. The total population size of NCR, by 2032, at 86.67 million is kept the same in the other subsequent scenarios.

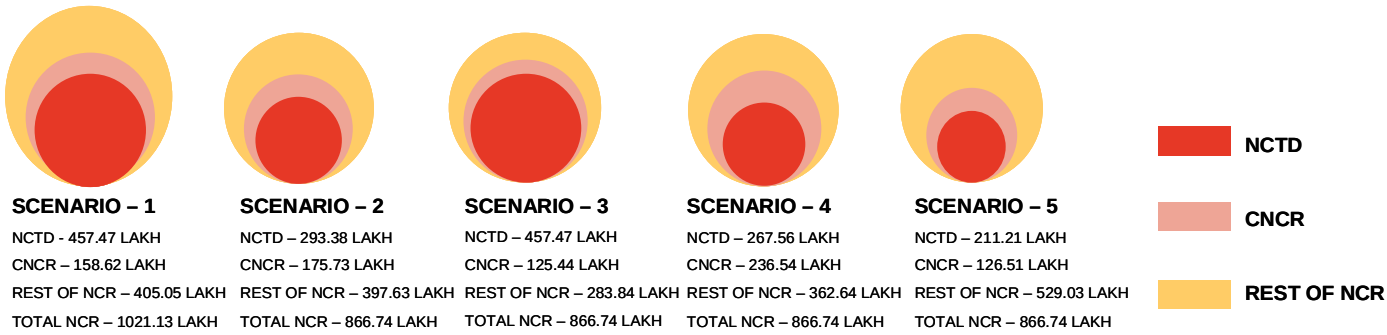
In 'Dominant Delhi Based Development (D-3)' Scenario, it presents a situation wherein the NCTD will experience unabated increase in population size. This will be contrary to NCR RP Policies. NCTD is estimated to grow at the same high decadal growth rate of 47.5% experienced during 1991-2001. This indicates a population size of 45.75 million in NCTD as against 29.34 million in 'Regional Plan-2021 Policy Based Development (D-2)' Scenario.

In 'Strong CNCR Based Development (D-4)' Scenario, the Central NCR (CNCR) zone is assumed to experience a higher growth rate. A 10 percentage point increase over the decadal (1991-2001) growth rate has been adopted and the CNCR zone population size is estimated to be 23.65 million by 2032 as against 17.57 million in 'Regional Plan-2021 Policy Based Development (D-2)' Scenario.

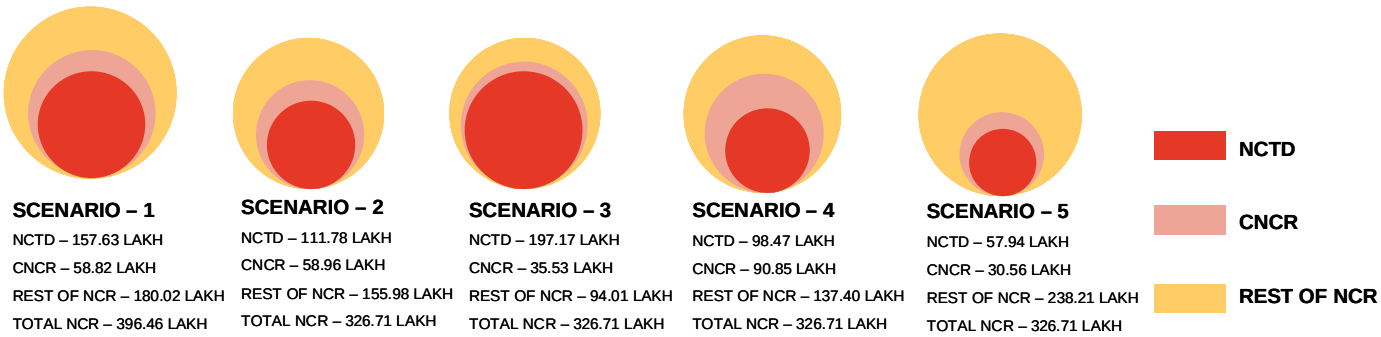
In 'Strong Rest of NCR Based Development (D-5)' Scenario, it assumes highly restricted financial and urban development policies in NCTD and CNCR zones and accelerated development, of both infrastructure and economic activities, in the 'Rest of NCR' zone. As in 'Strong CNCR Based Development (D-4)' Scenario, a 10 percentage point increase over the decadal (1991-2001) growth rate has been adopted. The population of 'Rest of NCR', by 2032, is estimated to be 52.90 million as against 39.76 million in 'Regional Plan-2021 Policy Based Development (D-2)' Scenario.

The distribution of employment size, by spatial zones, in different policy zones, has also been estimated under similar policy basis.

The comparative distribution of population and employment in policy zones, by 2032, are depicted in the following figures:



DS – Comparative Patterns of Population Estimates



Scenario-wise Employment Estimate

Transport Network Alternatives

In consonance with Development scenarios, 5 Alternate Transport Networks conceptualized, are:

N1. Do Nothing (Existing Network System)

In this alternative, existing BY network system is assumed to continue with minor improvements, up to the HY (2032).This represents the 'Do Nothing' Scenario. The Network includes National Highways, State Highways, Major District Roads, and Other Roads; commuter Rail service mixed with long distance rail services; and one airport (Indira Gandhi International Airport at Delhi).

N2: RP-2021 Network Extended

The NCR RP-2021 planned the Transport and network systems as a part of the Regional Plan. The proposed road Network includes, apart from the roads in the scenario N1, addition of 2 Expressways and upgrading of a few National Highways to Expressway standards. Under Rail Network, the proposals include, development of 15 corridors as Regional Rail Rapid Transit for commuter services, extension of 3 lines to connect the sub-regional centers, development of an orbital rail corridor and extension of Metro line to 5 regional towns as well as a 2nd international Airport.

N3: Road Dominant Network System

In this scenario a dominant, extensive, high quality road system has been conceptualized. It includes extensive expressways connecting regional towns with Delhi and amongst themselves, an extensive

National Highways network including upgrading of a number of State Highways, an extensive State highways network including upgrading of a number of Major District Roads and other roads. The Expressways are proposed to be developed as Greenfield Expressways. Under Rail Network, development of commuter rail network and operation of commuter rail services are envisaged. No metro rail extension into the region has been proposed. The 2nd International Airport forms a part of the Transport System under this scenario.

N4-Rail Dominant Network System

Under this scenario, the Road Network is envisaged to be the same as in N2. An extensive Rail Network is envisaged which would include a number of new rail links, Regional Rapid Transit System and an extensive extension of Metro Rail system to the major regional urban centers.

N5: Integrated Multimodal Transport System

An optimistic, high quality, transport system is conceptualized in this scenario. The road network would be the one envisaged in the N3 scenario and the rail network would be the one in the N4 scenario. 2 International Airports are common with the other scenarios. The network would operate as a highly integrated multimodal system, including extensive transfer stations and enabling fare policies facilitating easy and convenient transfer amongst the sub-systems.

The Scenario Matrix

Combining the 5 Development Scenarios and the 5 Network Alternatives, a scenario matrix was generated with 25 cells of different combinations, out of which, in consultation with NCRPB, 6 combinations were selected for evaluation and selection. The scenario matrix highlighting the selected combinations (cells) is presented below.

Development Scenario / Network Alternatives	D – 1: Do Nothing	D – 2: NCR RP-2021 Extended	D – 3: Delhi Dominant	D – 4: CNCR Strong	D – 5: Rest of NCR Strong
N-1: Do Nothing (Existing Network)	**D1 – N1**	D2 – N1	D3 – N1	D4 – N1	D5 – N1
N-2: NCR RP – 2021 Extended	D1 – N2	**D2 – N2**	D3 – N2	D4 – N2	D5 – N2
N-3: (Road Dominant Network System)	D1 – N3	D2 – N3	D3 – N3	**D4 – N3**	D5 – N3
N-4: Rail Dominant Network System	D1 – N4	D2 – N4	D3 – N4	D4 – N4	**D5 – N4**
N-5: Integrated Multi-modal Transport System	D1 – N5	**D2 – N5**	D3 – N5	D4 – N5	**D5 – N5**

Source: Study on Integrated Transportation Plan for NCR

Evaluation

The probable scenarios was evaluated and ranked. Evaluation was carried out by 1) graphical indices and 2) analytical quantitative indices

Graphical indices include:

- Accessibility Index
- Mobility Index

- Degree of Connectivity

The order of merit of the alternate scenarios is:

1 D 5 N 5
2 D 2 N 5
3 D 2 N 2 & D 4 N 3
4 D 5 N 4
5 D 1 N 1

The analytical quantitative indices (outputs / impacts) include the following:

- Passenger vehicles-kilometers by modes (car, 2-wheeler, bus, rail and metro)
- Passenger vehicle-hours by modes
- Person kilometers by modes
- Person hours by modes
- Goods vehicle-kms
- Goods vehicle-hours
- Goods tonnage – kms
- Goods tonnage-hours
- Energy (fuel) consumption by modes (Car, 2-wheeler, Auto Rickshaw & Goods vehicles)
- Emissions (CO2) by modes

The order of merit by this method is:

1 D 5 N 5
2 D 2 N 5
3 D 5 N 4
4 D 4 N 3
5 D 2 N 2
6 D1 N1

Selection

Under both the techniques, the combination scenario 'Strong Rest of NCR – Integrated Multi Modal Transport System' has emerged as the most optimal and the scenario 'RP 2021 (extended) – Integrated Multi Modal Transport System' was the second best. This indicates the importance of the 'Rest of NCR' zone for future development to receive larger population and activities. The scenario combination D 2 N 5 – 'RP 2021 Extended – Integrated Multi Modal Transport System – has been selected for detailing. It is noted that the conceptual transport network system is the same in both the scenarios.

Trip Forecast

Using the NCR Transport Modal, travel demand in the HY, in each of the selected scenario has been estimated. A total of 18.02 million to 23.46 million passenger trips are generated in HY under different scenarios. The total trips forecast in NCR, by HY, by modes, are presented below:

Table 12.1: Internal Trips Forecast as per Mode Choice Modal (2032)

Scenario ID	Bus		Commuter Rail		Metro		Auto		Car		Two Wheeler	
		%		%		%		%		%		%
D1N1	11,249,347	72.8	734,183	4.8	-	-	772,148	5.0	1,986,480	12.9	700,805	4.5
D2N2	5,630,173	42.5	2,004,313	15.1	804,282	6.1	661,687	5.0	2,458,647	18.6	1,674,635	12.7
D2N5	6,177,032	46.7	1,696,202	12.8	1,205,699	9.1	661,687	5.0	2,216,552	16.7	1,276,565	9.6
D4N3	7,086,007	53.6	1,189,989	9.0	-	0.0	660,634	5.0	2,577,472	19.5	1,698,587	12.9
D5N4	4,458,823	44.6	1,549,751	15.5	946,119	9.5	500,426	5.0	1,536,647	15.4	1,016,758	10.2
D5N5	4,529,312	45.3	1,544,677	15.4	917,331	9.2	500,426	5.0	1,545,511	15.4	971,266	9.7

Source: Study on Integrated Transportation Plan for NCR

Table 12.2: Total Trips Forecast as per Mode Choice Modal and Elasticity Modal (2032)

Scenario ID	Bus		Commuter Rail		Metro		Auto		Car		Two Wheeler	
		%		%		%		%		%		%
D1N1	15,421,255	65.7	734,183	3.1	-	0.0	901,606	3.8	5,160,802	22.0	1,239,351	5.3
D2N2	9,802,081	46.1	2,004,313	9.4	804,282	3.8	791,145	3.7	5,632,969	26.5	2,213,181	10.4
D2N5	10,348,940	48.7	1,696,202	8.0	1,205,699	5.7	791,145	3.7	5,390,874	25.4	1,815,111	8.5
D4N3	11,257,915	53.0	1,188,631	5.6	-	0.0	790,092	3.7	5,751,794	27.1	2,237,133	10.5
D5N4	8,630,731	47.9	1,549,751	8.6	946,119	5.2	629,884	3.5	4,710,969	26.1	1,555,304	8.6
D5N5	8,701,220	48.3	1,544,677	8.6	917,331	5.1	629,884	3.5	4,719,833	26.2	1,509,812	8.4

Source: Study on Integrated Transportation Plan for NCR
Note:1) Above figures do not include EE trips
2) Does not include long distance passenger trips by Rail

Horizon year traffic assignment was carried out for public and private trips on respective networks. Iterative process between public transport and private traffic assignment was carried out until there was no appreciable change in the link loadings and link cost.

The details of intra-regional and inter-regional traffic forecast are provided at **Annexure 12.1.**

13 *Regional Plan-2021 and Other Transport Proposals under Implementation*

Regional Plan-2021 proposals are being implemented and are at various stages of implementation by the concerned Central Ministries and State Government on their proposals which are related to road development or rail network development or development of new townships along transport corridor. Apart from this, few proposals/projects are being planned/implemented by the concerned Central Ministries and NCR Constituent States which form the part of their own proposals. Some of the major projects are briefly presented hereunder.

13.1 Regional Plan-2021 Proposals under Implementation

13.1.1 Up-gradation of National Highway within NCR

Up-gradation of National Highways No. 1, 2, 8, 10, 24, 58, 71, 71A and 91 is being carried out or proposed to be carried out by Ministry of Road Transport and Highways and are part of NHDP/other programmes. Along NH-1, at Panipat, an elevated roadway for a length of 10 km has been constructed and is under operation. Elevated road on NH-2 at Badarpur-Faridabad Stretch is under construction. Up-gradation of NH-10 & 24 is also under progress.

13.1.2 Peripheral Expressways around Delhi

It consists of two parts, namely, Kundli-Manesar-Palwal (KMP) Expressway (Western Peripheral Expressway) and Palwal-Ghaziabad-Kundli Expressway (Eastern Peripheral Expressway) and both were proposed in the Regional Plan-2021. Length of each part of expressway is 135 kms. KMP Expressway is under construction by Government of Haryana and about 48% work has been completed (May 2010). Work on Eastern Peripheral Expressway (EPE) is being carried out by Ministry of Road Transport and Highway through NHAI.

Government of Haryana has proposed development of townships along the KMP expressway corridor. New townships are envisaged as functional theme towns covering education, knowledge, trade & finance, medical health, biotech, entertainment, leisure, etc. About 62,000 hectares of land all along the 135 km long KMP expressway is proposed to be developed. The proposed development would accommodate a large size of population and activities.The functions of KMP expressway and Orbital Rail Corridor would change from that of enabling bypass movements to one of intense development and intra-corridor movement. Conceptual Plan is at **Figure 13.1**.

13.1.3 Up-gradation of Roads through NCR Financed Projects

NCR Planning Board is financing projects related to Transport sector which includes up-gradation of roads, construction of bus terminus, truck terminals/transport nagar, railway over bridges, etc. in NCR. About 58 projects have been sanctioned with an estimated cost of Rs.3131.1 crores up to March, 2010. A loan amount of Rs.2466.4 crores was sanctioned and Rs.962.9 crores have been released up to March, 2010 for transport project. This includes 27 on-going and 14 completed road projects.

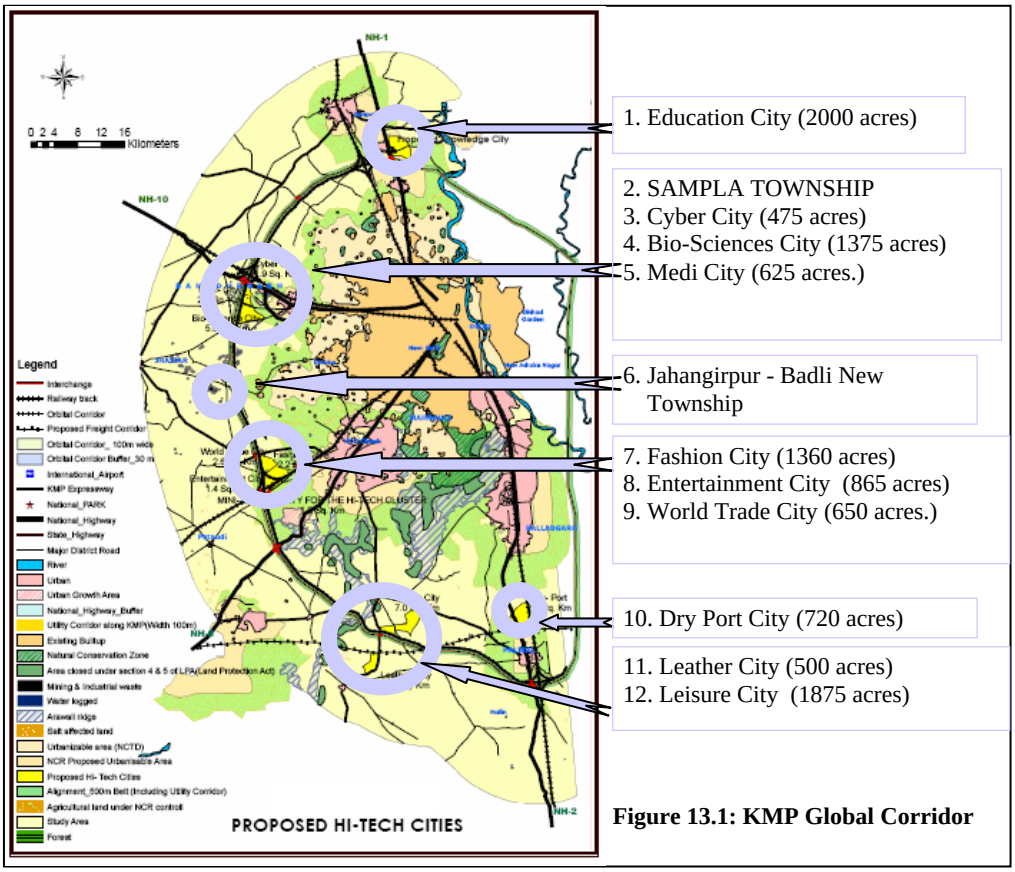


Figure 13.1: KMP Global Corridor

13.1.4 Delhi-Meerut Expressway

Ministry of Road Transport and Highways has included this proposal as part of NHDP programme and initiated action to implement the same.

13.1.5 New Rail Links

Railway has sanctioned work on Rewari-Jhajjar-Rohtak, Sonepat-Gohana-Jind, Tuglakabad-Palwal 4th Line and Sahibabad-Anand Vihar 3rd & 4th line. It has also sanctioned survey for Meerut-Panipat and Rewari-Bhiwari-Palwal Khurja rail corridors.

13.1.6 Extension of Delhi Metro to NCR Towns

Metro Rail has been extended to Noida. It is also proposed to be extended to Gurgaon, Faridabad, Ghaziabad and Bahadurgarh. The work on Gurgaon line is in progress. This would enhance the accessibility of these towns and surrounding areas and accelerate their development. It would also result in changed mode choice patterns promoting travel by public transport and reduction in personalized modes.

13.2 Other Transport Proposals under implementation

13.2.1 Dedicated Freight Corridors (DFCs)

Movement of goods and passenger trains take place on the same tracks. With passenger movements receiving priority, goods movements are adversely affected. The average speed of goods trains is only 20 – 24 kmph on different sections. Also due to track conditions, geometrics, wagon design, obsolete technology of signals and other constraints, Railways find it difficult to increase the capacity and speed of freight trains. In view of growing demand of high speed and high capacity trains, Indian Railway proposes to segregate passenger and goods train movements. It is proposed to develop dedicated fright corridors with high geometric, engineering and other standards. The goods trains are proposed to move at an average speed of 50 – 60 kmph (maximum speed 100 kmph), with a heavier axle load of 32.5 tonne and a longer tracking load of 15,000 tonne. The train lengths would be longer (1500 meters) with a new wagon design with increased height and width that would enable double stack container service.

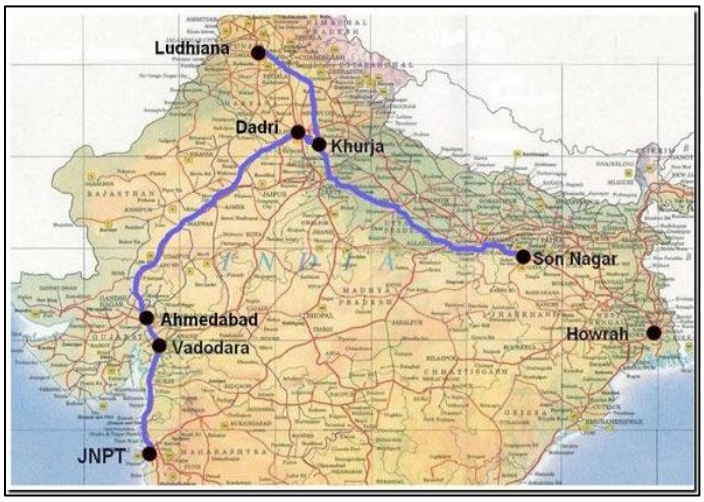


Figure 13.2: Dedicated Freight Corridors

The Dedicated Freight Corridor Network is proposed to cover the golden quadrilateral of rail network **(Figure 13.2)**. Of this, presently, two corridors have been approved for development. They are:

Western DFC: Mumbai-Delhi (Dadri)–1515 km
Eastern DFC: Ludhiana–Dadri–Son Nagar–1278 km (with provision for extension to Kolkata)

Both the Dedicated Freight Corridors run through NCR. The Western DFC enters NCR on the south-west from Jaipur to Rewari. From Rewari, a new line is proposed to link Delhi – Agra main line at Asaoti and from there onwards, this line is extended to end at Dadri interconnecting with the Eastern DFC. The Eastern DFC enters NCR at the North East from Saharanpur to Meerut – Hapur – Tundla – and on to Son Nagar exiting NCR at the south-east. Dadri is the common junction between the two corridors.

The implications of the DFCs on NCR Plan are:

- Alignment of the corridors and allocation of land for tracks, stations, terminals, etc.
- Provision for junction arrangement at Rewari, Dadri, Khurja
- Provision for logistics park and state of art terminals at Rewari and Dadri. The land requirement is estimated at 500 – 1000 acres for each logistic park.

Delhi – Mumbai Industrial Corridor:

The vision for Delhi – Mumbai Industrial Corridor (DMIC) is to create strong economic base with globally competitive environment and state of the art infrastructure to activate local commerce, enhance foreign investments and attain sustainable development. DMIC passes through a combination of well developed, moderately developed and under developed industrial areas with varying natural resources, human skills and with or without quality physical and social infrastructure. **(Figure 13.3)**. The missing link is the infrastructure logistics, industrial and social, which is incapable of handling the envisaged industrial output and exports. The DMIC proposes to address this bottleneck through holistic approach while benefiting from the inherent strengths and competitiveness of each of DMIC states.

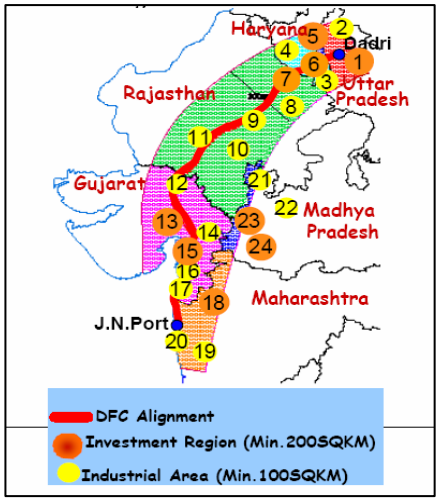


Figure 13.3: Delhi–Mumbai Industrial Corridor

Accordingly, high impact/ market driven nodes are proposed to be identified along the corridor to provide transparent and investment friendly policy/ facility regimes under which integrated Investment Regions and Industrial Areas would be set up. These regions are proposed to be self sustained industrial townships with world class infrastructure, road and rail connectivity for freight movement to and from ports and logistic hubs, served by domestic/ international air connectivity, reliable power, quality social infrastructure and provide a globally competitive environment conducive for setting up businesses. Out of 24 selected Investment Regions and Industrial Areas, 6 lie in NCR in Haryana and Rajasthan.

The DMIC takes advantage of DFC and proposes industrial complexes all along the corridor. Within NCR, investment regions and industrial areas are proposed to be developed in two phases at Dadri–Noida–Ghaziabad (Phase-I), Faridabad – Palwal (Phase-I), Meerut–Muzaffarnagar (Phase-I), Manesar-Bawal (Phase-I), Kushkhera-Bhiwadi–Neemrana (Phase-I) and Kundli-Sonepat (Phase-II). All these are part of NCR.

13.2.2 Yamuna (Taj) Expressway

Government of U.P. has proposed development of an expressway, on the eastern side of river Yamuna, connecting Greater NOIDA and Agra which is extension of NOIDA-Greater NOIDA expressway. It is estimated that this expressway will carry traffic volume of 40,000 PCUs by the year 2020 and it is being developed under PPP mode. A major township is proposed to be developed along this corridor as part of its development. This expressway would also link to the proposed Taj International Airport at Jewar.

Figure 13.4: Taj International Airport

Taj International Airport: It is proposed development of an international airport at Jewar in NCR. The airport is located on the east of river Yamuna **(Figure 13.4)** at a distance of 72 km from Indira Gandhi International Airport, Delhi.

13.2.3 Ganga Expressway

Government of U.P. has proposed development of another expressway, namely, Ganga Expressway connecting Greater NOIDA with Varanasi and Ballia. The expressway is proposed to be developed on a green field alignment under PPP mode. The expressway runs within NCR from Greater NOIDA in the south-west direction and exits NCR at Naraura in Bulandshahr District. Proposed Ganga Expressway Alignment is shown in **Figure 13.5.**

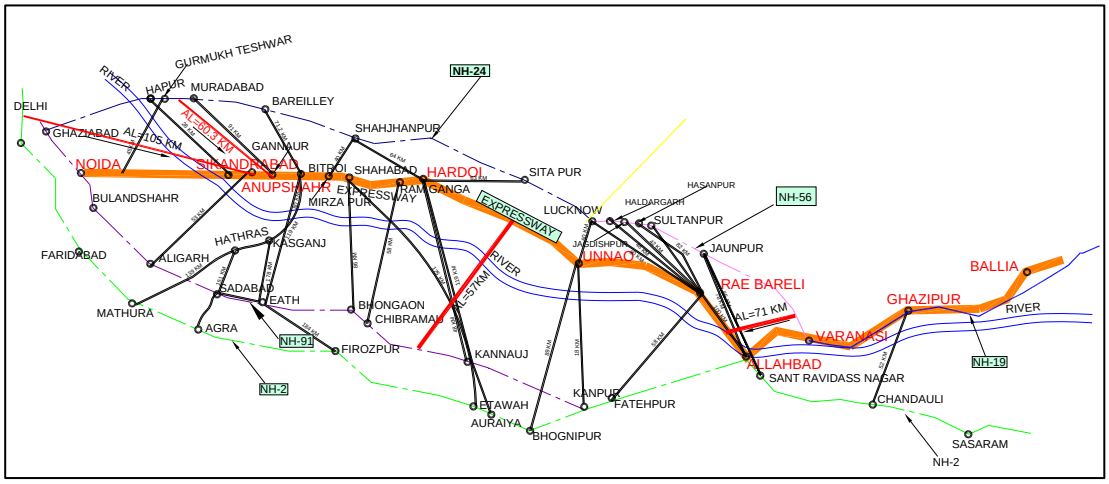
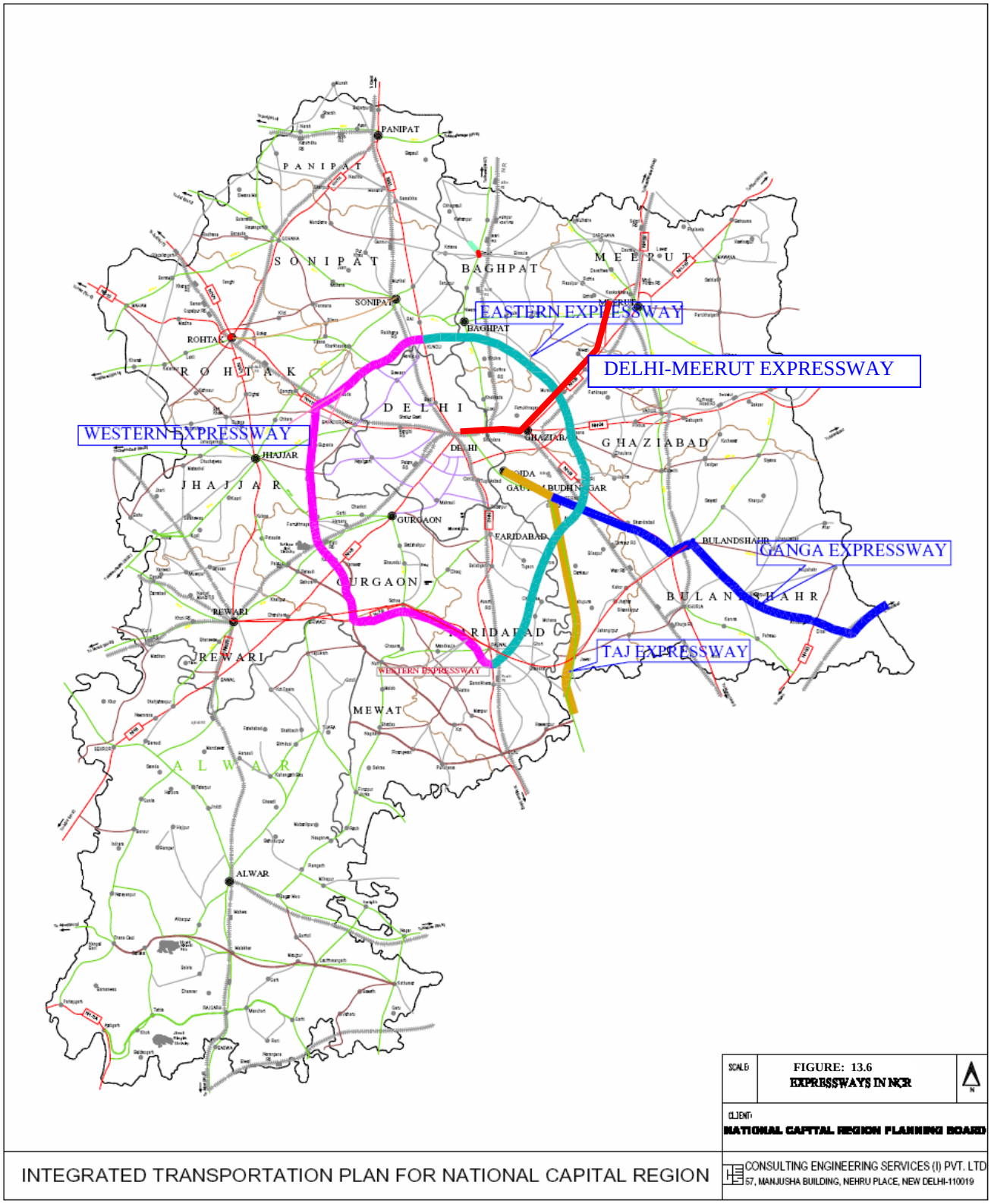


Figure 13.5: Alignment of Ganga Expressway

Tentative alignments of all the proposed Expressways in NCR have been shown in **Figure 13.6**.


PANIPAT
SONIPAT
BAGHPAT
MEERUT
ROHTAK
DELHI
GHAZIABAD
JHAJJAR
GURGAON
FARIDABAD
BULANDSHAHR
REWARI
MEWAT
ALWAR
EASTERN EXPRESSWAY
DELHI-MEERUT EXPRESSWAY
WESTERN EXPRESSWAY
GANGA EXPRESSWAY
TAJ EXPRESSWAY
SCALE
FIGURE: 13.6
EXPRESSWAYS IN NCR
N
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
INTEGRATED TRANSPORTATION PLAN FOR NATIONAL CAPITAL REGION
CONSULTING ENGINEERING SERVICES (I) PVT. LTD
57, MANJUSHA BUILDING, NEHRU PLACE, NEW DELHI-110019

Integrated Multi Modal Transport Plan for NCR

NCR is a highly dynamic region with fast increasing population and activity concentration. It is a highly urbanized and urbanizing region. It is a region of intense movement of people, goods and services. All types of movements – international, national, inter-regional, intra-regional and intra-urban – take place within, to, from and through the region by a variety of modes – roads, railways, bus, metro, IPTs, personal modes and NMVs. The movement size is intense and pattern complex. The need is to plan, develop, operate and manage an integrated, multi-modal system to enable the different movement needs to be performed efficiently, economically and safely.

Integrated Multimodal Transport Plan (IMMTP) has two conceptual components – integration and multi-modality. Integration would need to be ensured at various levels.

- At the first level is the policy integration, Transport Policy needs to blend with the overall and other sector policies of development of the region.

- The next important level is the integration between land use and transport. A region/city is a centre of concentration of people and activities dispersed over a spatial frame, resulting in interactions amongst people and activities interlinked and flows of people and goods enabled by the transport system. This symbiotic relationship needs to be maintained at a high level of efficiency to achieve the vision, goals and objectives of development on an efficient and sustained basis.

- At the third level, it is the integration amongst the sub-systems of the transport system itself. The sub-systems would include users, network, modes, technologies and the environment.

In the context of intense and diverse pattern of travel demand there is a need to have a spectrum of mode choice to serve a particular trip in the most efficient, safe and economic manner. The entry of a large number of modes to service travel demand, if left un-coordinated, results in confusion, unhealthy competition, poor service, inefficiency and negative impacts. Multi-Modal planning and operation envisages assigning a role and sphere of action for each mode, singly or in combination, such that each mode is efficient and prospers, the user gets satisfactory service and the region/city benefits.

In essence the multi-modal system enables a trip to be made using more than one mode with advantages of cost, time, comfort, safety etc. as compared to performing the trip by only one mode. This calls for building appropriate capacities and integration amongst the modes.

The Multi-Modal Transport System (MMTS) meets the needs of the system components. For the **user,** it provides right capacity at right time and place and at right cost. It provides a dependable, comfortable and safe transport service.

For the **Operator,** it lowers the cost of operation, and results in higher profits. It enables high productivity of the vehicles and manpower. It prevents unhealthy competition amongst service providers.

For the **government/region/city,** it enables optimization of scarce resources – capital, land, energy, etc. It creates less pollution and leads to high sustainability. It promotes desirable urban form and structure. It enables access to transport service and thereby to opportunities, to all the people of the region/city on an equitable basis. In short, the MMTS meets the 5 E's – Efficiency, Economy, Energy, Environment and Equity.

There is a wide difference between a Many Modal System and a Multi-Modal system. The critical element in moving from a Many Modal System to a Multi-Modal System is 'integration'.

System Integration would comprise:

- Physical integration
- Operational integration
- Financial integration and
- Institutional integration

The present Plan addresses the physical and institutional integration aspects. Operational integration which would include the service patterns of the selected modes, the fare policy and management needs to be taken care of while operating the component sub-systems.

In a multi-modal system the role, time and areas of operation of each mode needs to be assigned. Roles include operating as a basic system servicing a trip from origin to destination; as a complimentary system to another basic system feeding and extending the catchment area of the later; and as a supplementary system meeting the capacity gap of the other basic system. Every mode needs to perform all roles at some time and place or other. The essence is to allocate the right role and place as best suits the mode's inherent capacity and characteristics.

Planning of a Multi-Modal Transport System is an efficient combination of modes and roles to match the varying needs of demand by time, place and cost. It calls for an institutional and legal framework.

The IMMTP-NCR endeavors to incorporate the principles and aspects of integration and multi-modality in the planning of the transport system allocating capacities, roles and areas of operation for the different modes and promoting appropriate institutions to manage the system supported by enabling legal base.

For preparation of a long term, integrated, multi-modal transport system, extensive surveys and studies have been carried out to appreciate the physical, demographic, economic, social, traffic, road network, bus system, rail system, air transport, intermediate public transport and commuter characteristics of the NCR. The studies have enabled to identify the issues, constraints and potentials of the region and its transport system. Transport Modals have been constructed to enable forecast of probable size of travel demand in the Horizon Year. Alternate development scenarios projecting the population and employment size and distribution have been developed. Alternate Transport System comprising combination of road network, rail network, commuter rail service, metro rail, bus system (i/c IPT system) have been conceptualized. Wide options in combination of development scenario and transport network alternatives are possible. The selected combinations have been studied based on resultant travel patterns, evaluated based on relevant criteria and the most optimal alternative selected for further detailing into plan, programmes and projects.

14.1 Travel Demand

Base Year

In 2001, NCR contained a population size of 37.1 million. The population in 2007 (BY) is estimated to be 44.4 million. Urbanization was 56.3% (2001). Traffic surveys have indicated that a total of 8.7 million persons trips and 1.7 million tonnes of goods moved on the road network (2007). In addition are the intense movement by the rail system. The above figures do not include intra-urban movements that take place within the urban areas of the region.

Horizon Year

The population size of NCR, by 2032, the Horizon Year, has been estimated to be 86.6 million. Transport Modal for NCR has been constructed. It indicates that by 2032, the road based inter-region trips (EE, IE, EI) will be of the order 21 million person trips – 'Optimistic Scenario' & 15 million person trips – 'Business as Usual scenario'. The road based intra-region trip production will be of the order of 9 million person trips on an average day.

14.2 Integrated Multi Modal Transport Plan –Components

Based on the surveys and studies carried out, an Integrated Multi Modal Transport Plan (IMMTP) has been identified. The IMMTP would help in improving accessibility of and connectivity to major activity locations in NCR and also promote a balanced **high capacity, high quality road and rail network systems**. The main proposals are presented hereunder.

The NCR – IMMTP includes

- Road System
- Bus System
- Bus Terminal System
- Rail System (Commuter)
- Mass Rapid Transit System
- Airport

The sub-sector systems are integrated with each other to provide for seamless transfer amongst each other and extend the accessibility of every location within the region and enable mobility of the people of the region.

14.2.1 Road Network System

Road system forms the most important component of the IMMTP in terms of its extent, spread and access.

The analysis of existing road system of the region has indicated that the extent and spread is good but the quality is lacking. The dimensions of the future travel demand are many and complex. The main characteristics are:

- Large Volume
- Diverse Pattern
- Multi-Modal
- Multi-dimensional (international, inter-city, intra-region, intra-zonal, intra-urban, etc)
- Large size of non-destined traffic with reference to different spatial units – the NCR, the Policy Zones (NCTD & CNCR), and the urban centres.

The proposed Road Network Plan provides for

- High capacity
- High mobility (speed)
- Rational movement pattern (segregation of different movement types at appropriate spatial levels)
- Re-organisation from a predominantly radial pattern oriented to NCTD into a balanced radial-cum-grid pattern for upgrading the accessibility and connectivity of the regional centres.

14.2.1.1 Hierarchy

The Road Network Plan is envisaged in a hierarchical system comprising –

i) Regional Expressways (Inter-urban)
ii) Regional Arterials (which include National Highways)
iii) Regional Sub-arterials (which include State Highways)
iv) Regional Collector Roads (which include Major District Roads) and
v) Regional Access Roads (which include ODR & Village Roads)

14.2.1.2 Road Network Extent

The proposed NCR Road Network extends over 7402 km. This does not include a large extent of ODRs and Village Roads and Urban Roads which are to be identified and planned as part of sub-regional plans and urban Master Plans. The increase in the extent of the network may seem to be small over that of 6157 km in 2007. However there is substantial increase in 1) capacity, from 11,929 lane-km in 2007 to 34,396 lane-km in 2032, and 2) quality and speeds with an extensive network of expressways and upgraded arterials. **Table 14.1** provides the details of the Regional Road Network in NCR.

Table 14.1: NCR Regional Road Network-Hierarchy and Extent

Sl No.	Classification	Base Year (2007)		Horizon Year (2032)	
		Length (kms)	Lane-kms	Length (kms)	Lane-kms
1	Expressways			1107	9398
2	Regional Arteries	1102	4408	2046	14894
3	Regional Sub Arteries	1861	3722	786	3144
4	Regional Collectors/Distributor	3194	3799	3480	6960
a)	*MDR*	*1210*	*1815*	*841*	*1682*
b)	*ODRs*	*1984*	*1984*	*2639*	*5278*
	Total	**6157**	**11929**	**7402**	**34396**

Source: Study on Integrated Transportation Plan for NCR

14.2.1.3 Regional Expressways

The Plan envisages development of an extensive Regional Expressways of 1107 km in length with lane length of 9398 kms. The expressways are important to overcome the tyranny of distance between activities and from people dispersed over the regional spatial frame, an avowed objective of the Regional Plan.

The expressways are to be developed as Greenfield expressways with a ROW of 100 m, a design speed of 120 kmph and full access control.

Exclusive High Occupancy Vehicle (HOV) lanes are proposed as part of the expressway cross-section configuration.
The expressways may be developed under PPP mode. The recommended expressway network includes:

- Delhi – Sonipat – Panipat
- Delhi – Bahadurgarh – Sampla - Rohtak
- Delhi – Gurgaon – Manesar – Rewari
- Gurgaon - Faridabad
- Delhi – Faridabad – Ballabgarh – Palwal

(may be developed along the western bund of river Yamuna as an extension of the NH-Bypass from Kalindi Kunj in Delhi to Faridabad)

- Delhi – Ghaziabad – Hapur
- Dadri – Ghaziabad – Meerut
- Loni – Baghpat (with potential to extend to Baraut and beyond)
- Sonipat – Baghpat – Meerut
- The entire outer grid from Panipat – Gohana – Rohtak – Jhajjar – Rewari – Palwal – Jewar – Bulandshahr – Hapur – Meerut

These are shown in **(Figure 14.1)** given below:

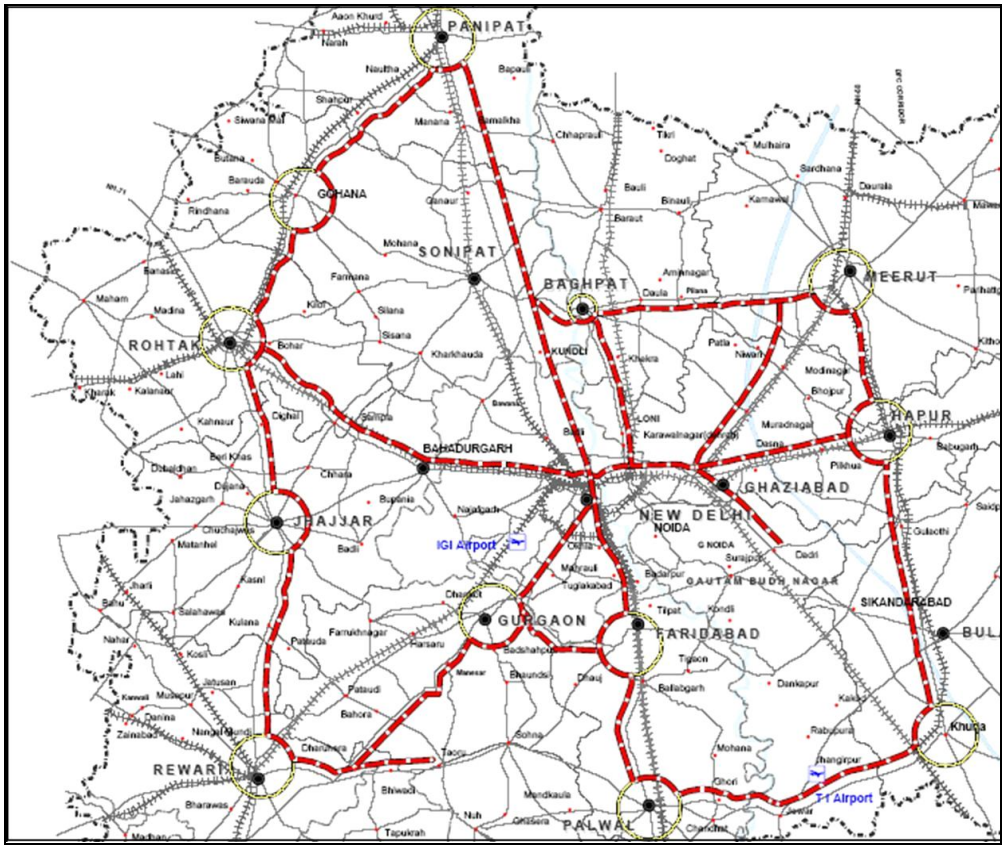


Figure 14.1: Proposed Expressway Network in NCR

The proposed expressways are:

- **Kundli-Manesar-Palwal Expressway (Western Peripheral Expressway) (135.6 km).**

  This Expressway is under construction and runs on the west of Delhi connecting Kundli, Manesar and Palwal. This along with the Palwal-Ghaziabad-Kundli Expressway (Eastern Peripheral Expressway) is envisaged as a bypass system for NCT-Delhi. This will open up development in this part of Haryana Sub-region. However, any development proposed along this corridor should not have direct access on expressway and should be preferably through inter-changes and under-passes with appropriate access control.

- **Palwal-Ghaziabad-Loni-Kundli Expressway (Eastern Peripheral Expressway) (136.0 km)**

  This Expressway, linking Palwal with Ghaziabad and Kundli running on the eastern side of Delhi, completes the ring system around Delhi. Its function is to enable bypass movements avoiding Delhi. It connects to the proposed 2nd International Airport at Jewar and crosses the proposed Yamuna Expressway (Noida-Agra Expressway) near Hodal; and the proposed Ganga Expressway at Dibai.

- **Noida –Agra Expressway (Yamuna Expressway) (65.0 km)**

  Noida-Agra Expressway, renamed as Yamuna Expressway, is a venture of the Government of Uttar Pradesh, under PPP mode. It is under construction and provides a high speed connection between Delhi and other urban centres in the eastern part of CNCR to Agra, the famous tourist place with the Taj Mahal.

- **Greater Noida-Bulandshahr – Varanasi Expressway (Ganga Expressway) (65.0 km)**

  This is another venture of the Government of Uttar Pradesh to link Delhi with Varanasi with a high speed & high quality road corridor and promote development of the western parts of the state. It is also proposed to be developed under PPP mode.

- **Delhi-Panipat Expressway (84.0 km)**

  Delhi-Panipat Expressway is proposed to be developed along the western bank of river Yamuna as a Greenfield Expressway. In its stretch within NCR, it connects Delhi, Kundli, Sonepat and Panipat with each other. In the long run it is envisaged to be extended to Chandigarh via Karnal and Ambala.

- **Delhi-Loni-Baghpat Expressway (31.0 km)**

  The Loni-Baghpat Expressway caters to the rich agricultural belt on the east of river Yamuna. In the long run, it is proposed to be extended to Saharanpur and to Dehradun, the capital of Uttarakhand. This route provides an alternate route to Dehradun from Delhi.

- **Delhi-Ghaziabad-Meerut Expressway (74.0 km)**

  The Delhi-Ghaziabad-Meerut Expressway is on the anvil for a long time. It connects Meerut, the second biggest urban centre in NCR and Delhi with a high speed road corridor. The Expressway also caters to the highly urbanized and fast growing corridor. This has been included in NHDP-VI for implementation by NHAI.

- **Ghaziabad-Hapur Expressway (37.0 km)**

  The Ghaziabad-Hapur Expressway connects Hapur, the major foodgrains trading centre, with Delhi and other parts of NCR. In the long run it has the potential to be extended to Bareilly and Moradabad, the fast growing industrial towns of the state of Uttar Pradesh. The Expressway connects to the proposed eastern arm of the Regional Outer Grid Expressway system.

- **Ghaziabad-Bulandshahr-Khurja Expressway (67.0 km)**

  Ghaziabad-Khurja Expressway provides a direct link to Khurja where the proposed Eastern Dedicated Freight Corridor (Rail) passes through. Khurja has great potential for development as a major transportation hub for collection and distribution of goods.

- **Delhi-Faridabad-Ballabgarh-Palwal Expressway (60.0 km)**

  Delhi-Faridabad-Palwal Expressway provides a high speed road system for the fast urbanizing corridor. Faridabad-Ballabgarh complex, an important industrial town of NCR, is re-emerging as a fast growing urban centre with metropolitan dimensions. Palwal, located on the cross roads of transport corridors of NCR has great potential for growth. This Expressway also connects Delhi with the proposed 2nd International Airport at Jewar.

- **Delhi-Gurgaon-Manesar-Dharuhera Expressway (79.0 km)**

  Delhi-Gurgaon Expressway has already been operationalised. The traffic volume has crossed all expectations. Extension of this Expressway is proposed upto Manesar, a planned industrial centre and to link with KMP Expressway and further on to Rewari, which is emerging as the fast growing industrial complex of NCR alongwith Bhiwadi and Dharuhera. At Dharuhera, the Expressway links with the proposed outer grid expressway. The DGMD Expressway also provides a high degree of accessibility and connectivity to the proposed Haryana SEZ at Jhajjar-Gurgaon districts.

- **Delhi-Bahadurgarh-Rohtak Expressway (70.0 km)**

  Rohtak is an important educational and service town in the Haryana Sub Region of NCR. It has the potential to develop as a major metropolitan centre. The Delhi-Rohtak Expressway links with the KMP Expressway at Barahai and the proposed western grid Expressway at Rohtak.

- **Panipat-Rohtak-Rewari Expressway (148 km)**

  The Panipat-Rohtak-Rewari (PRR) Expressway is the western part of the proposed outer grid expressway system. It is envisaged, apart from interlinking the urban centres along this part of NCR, to enable non-destined traffic with reference to NCR, to divert and bypass at the regional level. This Expressway provides an attractive, high level of service route to enable the high intensity of road based freight and passenger traffic between north India states and the western India states, particularly the western India ports oriented traffic. This Expressway substitutes the function presently envisaged for KMP Expressway. Considering the projected size of the NCR non-destined traffic, which is estimated to increase from 18,348 vehicle trip in 2007 to 75,234 vehicle trips in 2032, a 4 fold increase, the PRR Expressway corridor assumes great relevance and high importance.

- **Rewari-Palwal-Khurja Expressway (139 km)**

  The Rewari-Palwal-Khurja Expressway forms the southern portion of the outer grid Expressway system. This provides connectivity to the proposed 2nd International Airport at Jewar.

- **Khurja-Hapur-Meerut Expressway (86.0 km)**

  The Khurja-Hapur-Meerut Expressway forms the eastern portion of the outer grid Expressway system.

- **Meerut-Baghpat-Sonipat Expressway (68.0 km)**

  Meerut-Baghpat-Sonipat Expressway connects the eastern parts of NCR with the western part, on the northern half, of NCR. This forms part of the proposed inner CNCR grid to enable diversion of non-destined traffic with reference to CNCR and NCTD zones.

- **Gurgaon-Faridabad Expressway (34.0 km)**

  Gurgaon and Faridabad are two major urban centres in CNCR zone. There would be intense interactions between them resulting in flows. Presently they are constrained to move mostly through NCTD. The Gurgaon –Faridabad Expressway provides a direct, fast and quality link between the two important centres.

Expressways beyond NCR

The NCR Cell, Uttar Pradesh has suggested expressway from NCR to other parts of the state. They are:

1) Upper Yamuna Expressway from Ponta Sahib to Baghpat
2) Upper Ganga Canal Road from Roorkee to Muradnagar
3) Extension of Ganga Expressway from Narora to Haridwar

As the above expressways run in areas outside NCR, the present study has not considered them as part of NCR expressway network. It is appreciated that some of the expressways of NCR require to be extended beyond NCR to connect important cities outside NCR and form part of the national expressway system. It is recommended that separate studies at the participating state levels be carried out to identify the state expressway network system. It is noted that the National Road Development Plan envisages development of a national expressways of about 15,000 km in length.

14.2.1.4 Development of Regional Arterial Roads

A number of National Highways traverse through the NCR, mostly converging into Delhi. The traffic volume on these road stretches is high and is increasing. The traffic is mixed comprising inter-region, intra-region and intra-urban movements. This mix, apart from heterogeneous modal mix, is causing problems of congestion, delays, accidents and pollution. In addition, continuous urban development is taking place along these highways. NCR Regional Plan-2021 policy also envisages intense planned development along the highways on either side for 500 meter depth, identified as Highway Policy Zone. There is a need to reorganize the road network system to rationalize movement pattern. Some National Highway stretches and some State Highway stretches within NCR are proposed to be developed as Regional Arterials primarily catering the needs of intra regional centres and intra-regional trips.

Amongst the radial highways converging on to Delhi, Delhi-Panipat (NH-1) is part of NHDP North-South Corridor. Delhi-Palwal (NH-2) and Delhi-Gurgaon- Dharuhera-Behror (NH-8) are part of NHDP Golden Quadrilateral. They have already been taken up for widening to 6-lanes as proposed in the Regional Plan-2021.

Ghaziabad-Bulandshahr-Aligarh (NH-91) has been proposed to be developed as 4 lane highway under NHDP.

The other National Highways stretches within the region are proposed to be developed as regional arterials of appropriate capacity. Panipat-Gohana-Rohtak-Rewari-Palwal-Khurja-Hapur-Meerut (NHs, MDRs & SHs) will form part of the Regional Arterial system and will enable rerouting of inter-regional movements till the expressway network is developed.

The State Highways linking Sonipat-Sampla-Jhajjar, Jhajjar-Gurgaon and Ballabgarh-Dankepur-Gulaothi are proposed to be upgraded as National Highways and widened. They along with some of the expressway links would form the CNCR Grid system.

Alwar is an important regional centre. Its growth has suffered due to poor levels of accessibility compared to other centres. The State Highway stretch between Gurgaon and Alwar is proposed to be upgraded as National Highway and strengthened.

A number of other State Highway stretches are proposed to be upgraded as National Highways and strengthened. They interconnect National Highways (Regional Arterials) and interlink a number of sub-regional urban centres promoting their faster growth.

A number of other State Highway stretches are proposed to be widened to improve sub-regional accessibility and function as regional sub-arterials.

A few of Major District Roads are proposed to be upgraded as State Highways to balance the network hierarchy. Other MDRs are proposed to be widened to function as the Regional Collector/Distributor Road System.

The ODRs/VRs, which will function as Access Roads need to be taken up for strengthening as part of sub-regional plans. **Table 14.2** details the Road Network System Development Plan.

Table 14.2: Road Network System Development Plan

	Categories	Length (Km)	ROW	Type	Phase			
					2008-2012	2013-2017	2018-2022	2023-2032
	Expressways				**I**	**II**	**III**	**IV**
1	Ganga Expressway	65.0	100	Greenfield	6	6	6	8
2	Yamuna Expressway (within NCR)	65.0	100	Greenfield	6	6	8	8
3	Kundli – Manesar – Palwal Expressway (Western Expressway)	135.6	100	Greenfield	6	8	10	10
4	Kundli – Ghaziabad - Palwal Expressway (Eastern Expressway)	136.0	100	Greenfield	6	8	10	10
	Total	**401.6**						
	Regional Expressways							
1	Delhi – Panipat	69.75	100	Greenfield		4	6	8
2	Delhi –Ghaziabad	15.34	100	Greenfield		4	6	8
3	Ghaziabad – Modinagar – Meerut	33.21	100	Greenfield		4	6	8
4	Ghaziabad – Hapur	25.90	100	Greenfield		4	6	8
5	Delhi – Faridabad –Palwal	44.75	100	Greenfield		4	6	8
6	Gurgaon - Manesar – Daruhera	64.55	100	Greenfield		4	6	8
7	Panipat – Gohana – Rohtak	58.40	100	Greenfield		4	6	8
8	Rohtak – Rewari	80.01	100	Greenfield		4	6	8
9	Rewari – Daruhera - Bhiwadi – Palwal	21.38	100	Greenfield		4	6	8
10	Palwal – Khurja	50.98	100	Greenfield		4	6	8
11	Khurja – Hapur – Meerut	72.44	100	Greenfield		4	6	8
12	Meerut – Baghpat – Sonipat	37.48	100	Greenfield		4	6	8
13	Ghaziabad –Bulandshahr till Dadri	18.17	100	Greenfield		4	6	8
14	Delhi – Baghpat	36.28	100	Greenfield		4	6	8
15	Gurgaon – Faridabad	18.72	100	Greenfield		4	6	8
16	Delhi – Bahadurgarh – Rohtak	57.94	100	Greenfield		4	6	8
	Total Length	**705.3**						

Source: Study on Integrated Transportation Plan for NCR

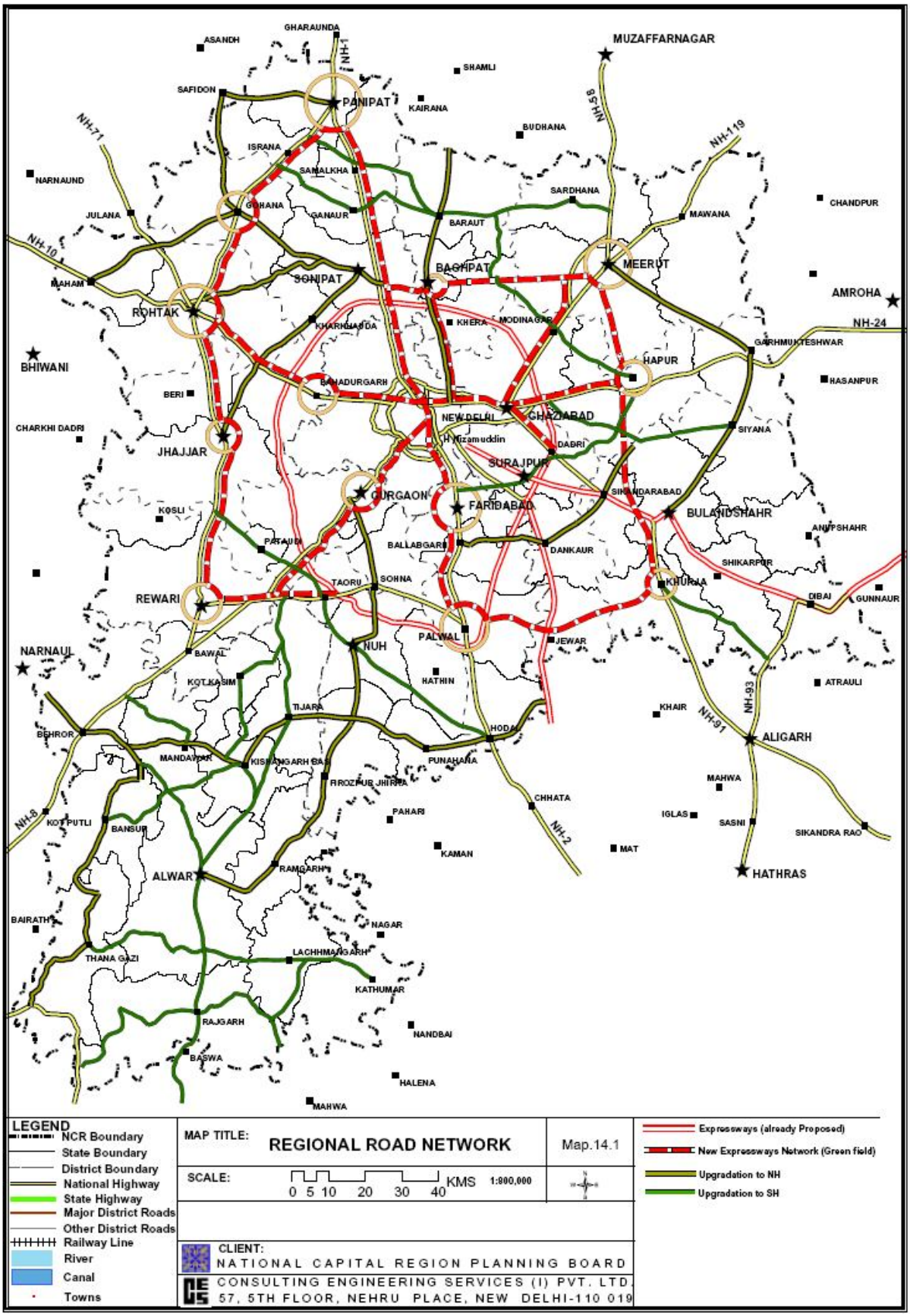
SI. No.	Regional Arterials	Length (M)	ROW	Existing Configuration	I	II	III	IV
1	Delhi – Panipat (NH-1)	84.0	60	6	6	8	10	10
2	Delhi –Ghaziabad (NH-24)	21.0	60	4	6	8	10	10
3	Ghaziabad – Modinagar – Meerut (NH-58)	53.0	60	4	4	6	8	8
4	Ghaziabad – Dadri – Bulandshahr (NH-91)	48.0	60	2	4	6	8	8
	Ghaziabad - Hapur (NH 24)	37.0	60	2	4	6	8	8
5	Delhi-Faridabad-Ballabgarh-Palwal (NH-2)	60.0	60	4	6	8	10	10
6	Delhi – Gurgaon (NH-8)	30.0	60	8	8	10	10	10
7	Gurgaon - Manesar - Daruhera (NH-8)	49.0	60	4	6	8	10	10
8	Delhi – Bahadurgarh (NH-10)	28.0	60	4	4	6	8	8
9	Bahadurgarh – Rohtak	42.0	60	2	2	4	6	8
10	Panipat – Gohana – Rohtak (NH-71A)	67.0	60	2	2	4	6	8
11	Rohtak – Rewari (NH-71)	80.0	60	2	2	4	6	8
12	Rewari - Palwal (NH-71 B)	83.0	60	2	2	4	6	8
13	Palwal – Khurja	56.0	60	1	2	4	6	8
14	Khurja – Hapur	53.0	60	2	2	4	6	8
15	Hapur – Meerut	33.0	60	2	2	4	6	8
16	Gurgaon – Sohna	23.0	60	6	6	8	8	8
17	Sohna – Alwar	94.0	60	2	2	4	6	6
18	Jhajjar – Gurgaon	48.0	60	2	2	4	6	6
19	Sonepat - Jhajjar	56.0	60	2	2	4	6	6
20	Ballabgarh – Gulavathi	45.0	60	1	1	2	4	6
21	Hodal - Tijara – Behror	133.0	60	1	1	2	4	6
22	Behror – Partapgarh	100.0	60	1	1	2	4	6
23	Meerut - Garhmukteshwar – Bulandshahr	93.0	60	2	2	4	6	6
24	Sonipat – Rohtak	46.0	60	1	1	2	4	4
25	Sonipat - Gohana - Asan Khurd	94.0	60	2	2	4	4	4
26	Gohana – Maham	51.0	60	2	2	2	2	4
27	Palwal – Hodal	33.0	60	6	6	8	10	10
28	Meerut - Muzaffarnagar (till NCR Border)	19.0	60	2	4	6	8	8
29	Rewari – Bawal (NH-71)	11.0	60	2	2	4	6	8
30	Daruhera - Behror	63.0	60	4	6	8	10	10
31	Khurja - Border of NCR to Aligarh	19.0	60	2	4	6	8	8
32	Panipat - Border of NCR (NH-1)	9.0	60	6	8	10	10	10
33	Hapur – Garhmukteswar (NH-24)	35.0	60	2	4	6	8	8
34	Rohtak – Quila Jafargarh (NH-10)	35.0	60	2	2	4	6	8
35	Meerut – Bahsuma (NH-119)	50.0	60	2	2	4	6	6
36	NH - 93	38.0	60	2	2	4	6	6
37	NH - 11 A	37.0	60	2	2	4	6	6
38	Loni - Baghpat - Baraut - Till NCR Border	68.0	60	2	4	6	8	8
39	Rohtak - NCR Border (NH -71)	22.0	60	2	2	4	6	8
	Total	**1607**						

Source: Study on Integrated Transportation Plan for NCR

SI. No,	Regional Sub-arterials	Length (M)	ROW	Existing Configuration	I	II	III	IV
1	Khurja – Pahasu – NH -93	35.0	30	IL	2	2	2	4
2	Badarpur – Dadri – Hapur	67.0	30	IL	2	2	4	4
3	Pilana – Binaula	16.0	30	IL	2	2	2	4
4	Darula – Sardhana – Baraut – Ganaur – Shahpur	93.0	30	IL	2	2	2	4
5	Baraut – Samalkha – Naultha	44.0	30	IL	2	2	2	4
6	Bansur – Hajipur – Kishangarh Bas	44.0	30	IL	2	2	2	4
7	Thana Gazi – Malakher – Lachmangarh	90.0	30	IL	2	2	2	4
8	Ajabgarh – Tehla – Rajgarh – Garhi – Lachmangarh	76.0	30	IL	2	2	2	4
9	Ghasoli – Tapukrah	33.0	30	IL	2	2	2	4
10	Samda - Alwar	36.0	30	IL	2	2	2	4
11	Hodal – Nuh – Taoru	56.0	30	IL	2	2	4	4
12	Taoru – Pataudi – Kulana	41.0	30	IL	2	2	4	4
	Total	**439**						

Source: Study on Integrated Transportation Plan for NCR

Map 14.1 depicts the Regional Road Network.


GHARAUNDA
ASANDH
MUZAFFARNAGAR
SHAMLI
SAFIDON
PANIPAT
KAIRANA
BUDHANA
NH-58
NH-71
NH-119
ISRANA
SAMALKHA
NARNAUND
SARDHANA
CHANDPUR
JULANA
GOHANA
GANAUR
BARAUT
MAWANA
NH-10
MEERUT
SONIPAT
BAGHPAT
AMROHA
MAHAM
ROHTAK
KHARKHAUDA
KHERA
MODINAGAR
NH-24
GARHMUKTESHWAR
BHIWANI
HAPUR
BAHADURGARH
HASANPUR
BERI
NEW DELHI
GHAZIABAD
CHARKHI DADRI
Hazrat Nizamuddin
SIYANA
JHAJJAR
DADRI
SURAJPUR
GURGAON
FARIDABAD
SIKANDARABAD
BULANDSHAHR
KOSLI
ANUPSHAHR
PATAUDI
BALLABGARH
DANKAUR
SHIKARPUR
TAORU
SOHNA
KHURJA
DIBAI
GUNNAUR
REWARI
PALWAL
JEWAR
NARNAUL
BAWAL
NUH
KOTKASIM
HATHIN
ATRAULI
TIJARA
KHAIR
NH-91
NH-93
BEHROR
HODAL
ALIGARH
MANDAWAR
KISHANGARH BAS
PUNAHANA
FIROZPUR JHIRKA
MAHWA
CHHATA
NH-8
KOT PUTLI
PAHARI
IGLAS
SASNI
SIKANDRA RAO
BANSUR
NH-2
KAMAN
MAT
ALWAR
RAMGARH
HATHRAS
BAIRATH
NAGAR
THANA GAZI
LACHHMANGARH
KATHUMAR
RAJGARH
NANDBAI
BASWA
HALENA
MAHWA
LEGEND
NCR Boundary
State Boundary
District Boundary
National Highway
State Highway
Major District Roads
Other District Roads
Railway Line
River
Canal
Towns
MAP TITLE:
REGIONAL ROAD NETWORK
Map.14.1
SCALE:
0 5 10 20 30 40 KMS
1:800,000
Expressways (already Proposed)
New Expressways Network (Green field)
Upgradation to NH
Upgradation to SH
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
CONSULTING ENGINEERING SERVICES (I) PVT. LTD.
57, 5TH FLOOR, NEHRU PLACE, NEW DELHI-110 019

14.2.1.5 Urban Expressways

To provide continuity of network and traffic flow, it is important that a network of expressways within each of the urban centres is planned and developed and integrated with the Regional Expressway with interchange facilities. The intra-urban network of each major urban centre within NCR should have a minimum of two axial and one circular expressway network system.

The Master Plan of all the regional urban centres needs to be reviewed and revised to bring them in consonance with the Regional Transport Plan 2032.

14.2.1.6 Urban Bypasses

A number of regional urban centres have planned and developed bypasses to divert non-destined traffic. However, there is a need to plan and develop new bypasses for each urban centre taking into consideration its growth potential upto 2032 and in integration within the Regional Transport Plan.

The new bypasses should be elevated as far as possible to avoid becoming urban arterial road in future.

These urban bypasses would need to be integrated with the Regional Expressways and Regional Arterial Road Systems.

14.2.1.7 Regional Sub-Arterial Roads

Development of the important Regional Sub-Arterial (State Highways) and Regional Collectors/Distributors (MDRs) are detailed below:

Development of Gurgaon – Alwar Highway

Gurgaon-Alwar highway was formerly part of NH-8. With Alwar being developed as a major regional center, the interaction between Alwar and Rajasthan Sub-region with other urban centers and sub-regions would increase. It will also improve the accessibility level of Alwar. It is proposed that the above highway stretch is upgraded as a 6-lane divided carriageway road in the first instance. **(Figure 14.2)**

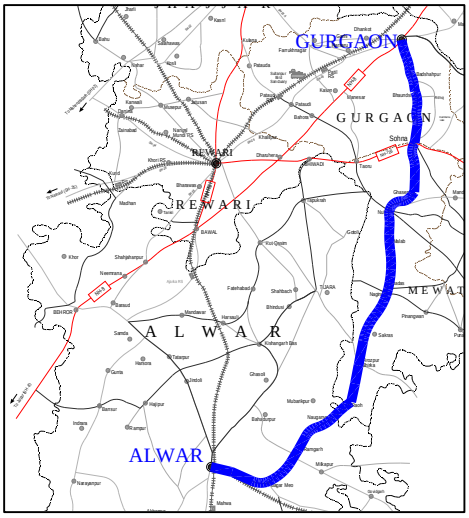


Figure 14.2: Gurgaon-Alwar Highway

Development of Loni-Baghpat-Baraut Highway

The Loni – Baghpat (Saharanpur) highway (SH-57) is an important road in the western part of UP Sub-region. It caters to the rich agricultural belt and provides an alternative route from Delhi to Roorkee & Dehradun via Saharanpur, an important town in U.P. It is proposed to upgrade this road as a 6/8-lane divided carriageway highway. It also merits to be classified as a National Highway. **(Figure 14.3)**

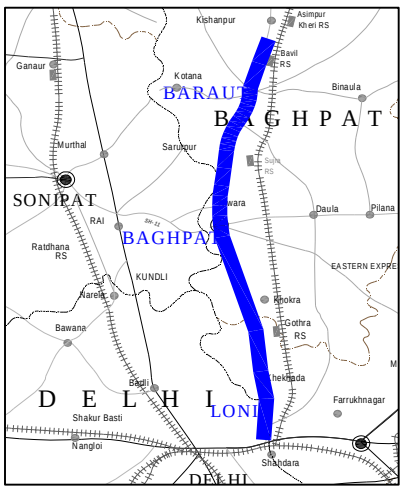


Figure 14.3: Loni – Baraut Highway

Development of Naultha (NH – 71 A) – Samalkha – Baraut – Binaula – Sardhana – Daurala (NH – 58) – and extension upto NH-119

This road stretch presently comprises State Highways and Major District Roads and forms the northern east-west link in U.P. sub-region (Meerut and Baghpat Districts) and serves the rich agricultural belt. It also interconnects 4 National Highways (71-A, 1, 58 & 119). The road is proposed to be upgraded as a State Highway and developed as a 4-lane road. **(Figure 14.4).**

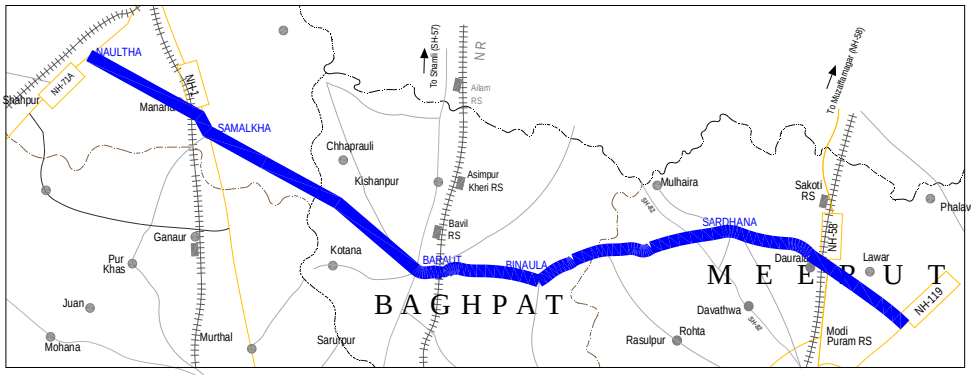


Figure 14.4: Naultha (NH -71 A) – Samalkha – Baraut – Binaula – Sardhana – Daurala (NH – 58)

Development of Meerut – Kithaur – Garhmukteswar – Siana – Saiyad – Bulandshahr – NH-91 – Jewar (to meet Palwal – Khurja road)

This road stretch is presently State Highway and serves the eastern parts of U.P. sub-region and will promote its development. It interconnects 3 National Highways (58, 24 & 91). It also links to the proposed Ganga Expressway and the under development Yamuna Expressway. More importantly, it provides connectivity to the proposed Taj International Airport from the sub-region **(Figure 14.5).** It is proposed to be developed as a 2-lane highway with reservations for development as a 4 / 6 lane highway in the long run.

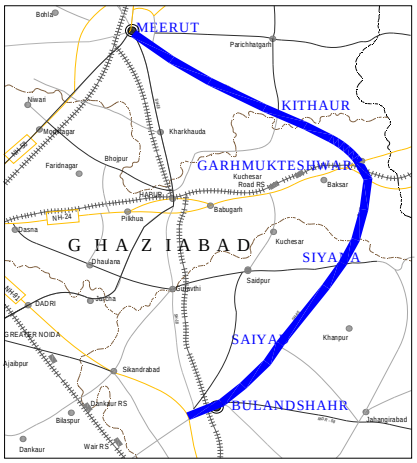


Figure 14.5: Meerut - Bulandshahr Highway

Development of Bulandshahr – Shikarpur – Ahmadgarh (NH – 93) Road

It is proposed to develop this road as a 2-lane highway with reservations for further upgrading as a 4-lane divided carriageway highway **(Figure 14.6).**

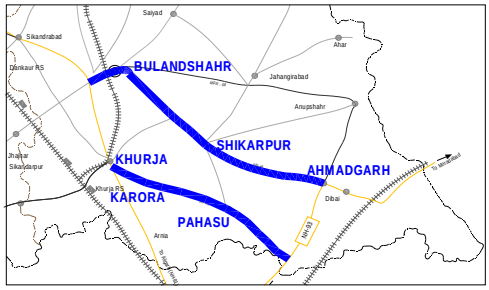


Figure 14.6: Bulandshahr - Ahmedgarh & Khurja – Pahasu Road

Development of Khurja – Karora – Pahasu – NH-93 Road

It would be a State Highway connecting Khurja to NH-93 and would serve the southern part of U.P. sub-region. The road is proposed to be developed as a 2-lane carriageway with reservation for upgrading into a 4-lane divided carriageway road **(Figure 14.6).**

Development of Ballabgarh (NH-2) – Tigaon – Gharora – Bilaspur – Sikandrabad (NH-91) – Gulavthi (on Bulandshahr – Hapur SH)

This link will enable distribution of traffic destined to Greater NOIDA, Hapur and other regional/sub-regional centers in U.P. Sub-region. It also provides a route to channelise non-destined traffic to NCTD and CNCR towns. **(Figure 14.7).**The road is proposed to be developed as a 4-lane divided carriageway.

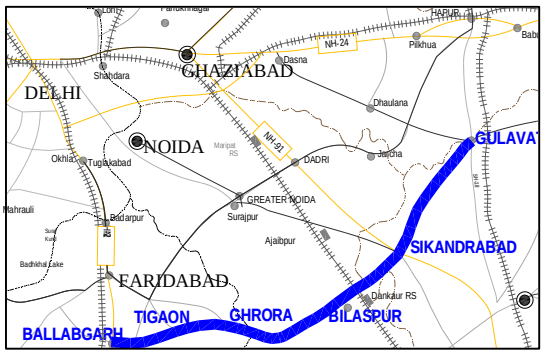


Figure 14.7: Ballabgarh-Gulavathi Road

Development of Jhajjar – Farrukhnagar – Dhankot – Gurgaon – Faridabad road

This road stretch is presently part SH and part MDR. It connects Faridabad (NH-2) – Gurgaon (NH-8) with Jhajjar and enables direct interaction amongst them. **(Figure 14.8).** The road is proposed to be developed as 6-lane divided carriageway road.

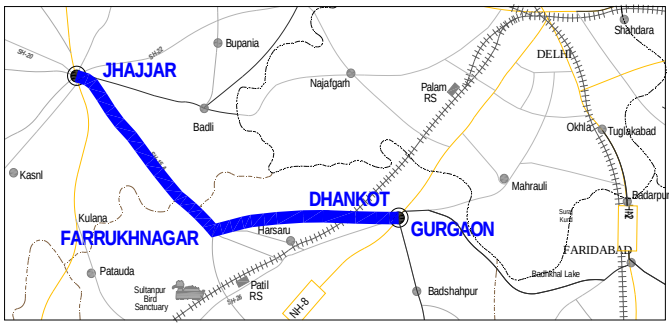


Figure 14.8: Jhajjar – Dhankot – Gurgaon Road

Development of Behror (NH-8) – Mandawan – Harsauli – Kishangarh Bas – Tijara – Nagina – Pinangwan – Punahana –Hodal – Hassanpur – Yamuna Expressway (outside NCR)

This road stretch is partly SH, partly MDR and partly ODR. There are some missing links also. This stretch acts as the southern west-east road corridor serving Rajasthan and southern part of Haryana sub-regions. It interconnects National Highways 8 and 2 and in its eastern end connects to Yamuna expressway. It is an important road to promote development of the south-western parts of NCR.

It is proposed to develop this road as a 2-lane highway in the interim phase with potential for further upgrading into 4/6 lane carriageway road. A major bridge across river Yamuna near Hassanpur needs to be constructed.

Development of Ajabgarh (NH-11 A) – Khoh – Tehla – Rajgarh – Manohari – Garhi – Lachmangarh Road

This road forms the southern most west-east link and serves the Rajasthan Sub-region. It provides connectivity to Jamwa Ramgarh Sanctuary. It is proposed to develop this road stretch to 2-lane carriageway (**Figure 14.9).**

Development of Thana Gazi – Sariska – Malakher – Maujpur – Lachmangarh –Kathumar Road

This stretch primarily consists of SHs, is another west-east road serving the Rajasthan Sub-region. It provides connectivity to Sariska National Park. (**Figure 14.9).** It is proposed to develop the above road stretches as a 2-lane carriageway.

Development of Partapgarh – Thana Gazi – Narayanpur – Bansur – Gunta – Baraud – Behror (NH-8) Road

This stretch acts as the western-most South-North axial road corridor. It connects NH-8 and NH-11 A (**Figure 14.9).** It is proposed to be developed as a 4-lane divided carriageway road. A bridge across river Sota is required to be constructed.

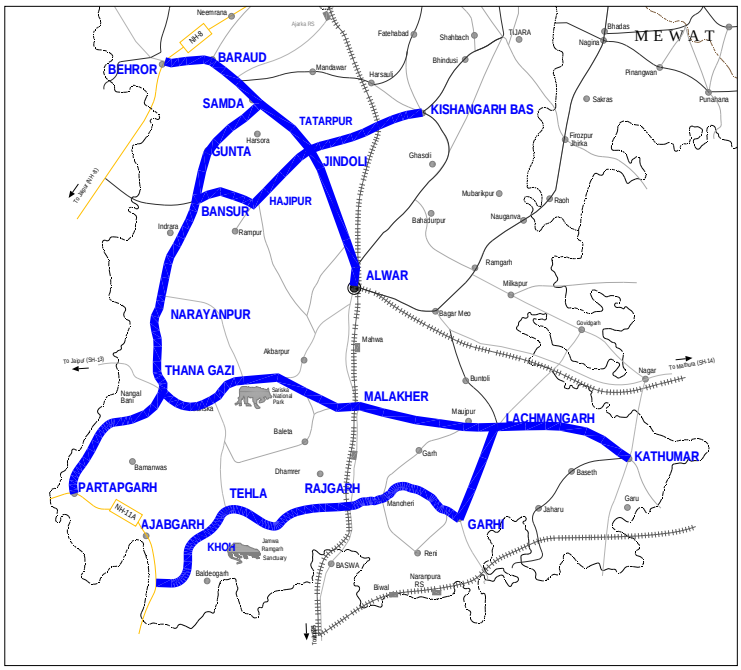


Figure 14.9: Roads to be developed in Alwar Region

Development of Bansur – Hajipur – Jindoli – Kishangarh Bas Road

The road, presently a MDR is proposed to be upgraded as a SH and developed as a 2-lane carriageway.

Development of Samda (of Pratapgarh – Behror road) – Tatarpur – Jindoli – Alwar

This road provides a direct connection from Alwar to NH-8 on the west side of the region. (**Figure 14.9).** It is proposed to develop this road as a 2-lane carriageway road with a scope for expansion to 4/6 lane.

Development of Alwar – Ghasoli – Tijara – Tapukrah – Bhiwadi

This road consists of partly SHs and partly MDR. This links Alwar, a major regional centre with the fast developing Bhiwadi Industrial Complex **(Figure 14.10).** It is proposed to develop the road as a SH with 2-lane carriageway.

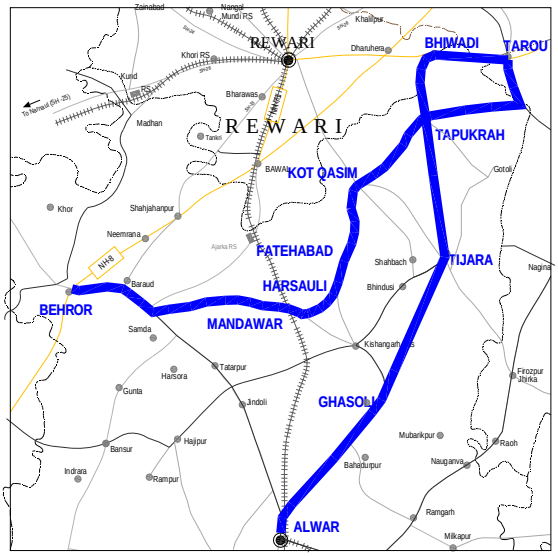


Figure 14.10: Behror – Taoru and Alwar – Bhiwadi Road

Development of Behror – Mandawar – Harsauli – Fatehabad – Kot Qasim – Tapukrah – Taoru

This road presently MDR provides an alternative route to part length of NH-8. It also links the area to the southern arm of the outer grid (NH-71 B) **(Figure 14.10).** It is proposed to upgrade this road stretch as a SH and develop as 2-lane carriageway road.

Development of Kulana – Pataudi –Bahora – Taoru – Nuh – Kot – Hodal Road

The road stretch, presently MDR, links NH-71, NH-71 B (outer grid) and NH-2. It is proposed to upgrade this road stretch as 4-lane carriageway road as a part of SH.

Development of Alternative Link Roads from Gurgaon to Delhi

The Gurgaon Master Plan (2021) has proposed 2 additional road links from Gurgaon town to Delhi. They are:

- Palam Vihar to Bijwasan-Najafgarh Road to the point where road from Dwarka joins it.
- Road connecting Gurgaon-Mehrauli Road to Nelson Mandela Road near Masoodpur flyover.
- Widening of road connecting Mehrauli-Gurgaon Road with Gurgaon-Faridabad road through Mandi village.

The above road links will augment the much needed connectivity between Gurgaon and Delhi and would bring relief to the perpetual congestion and delays being experienced along the Delhi – Gurgaon expressway (NH-8) **(Figure 14.11).**

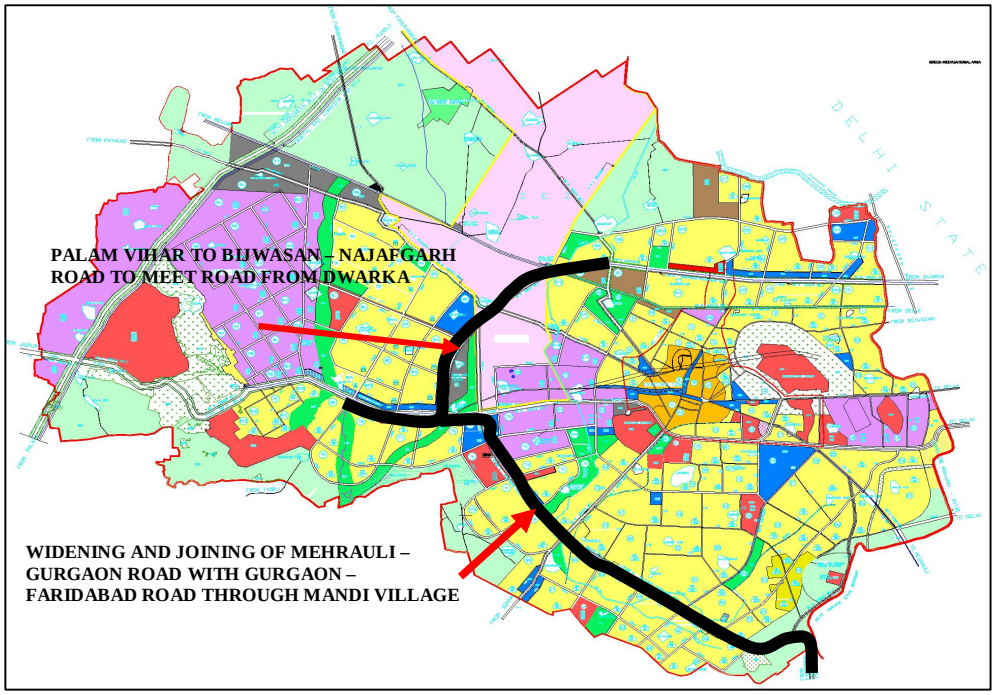


Figure 14.11: Alternative Link Roads from Gurgaon to Delhi

Development of Rajiv Gandhi Education city road at Sonipat

This road is proposed to connect Rajiv Gandhi Education city at Sonipat with Delhi.

Development of Nahar – Kosli – Kasni – Jhajjar

This road is proposed to be developed as a 2-lane carriageway road **(Figure 14.12).**

Development of Jhajjar – Sampla – Kharkhauda – Sonipat

This is an important stretch and is proposed to be developed as a 6-lane divided carriageway road **(Figure 14.12).**

Development of Rohtak –Kilol-Farmana-Sonipat road

This road, presently MDR, provides a direct link between Rohtak and Sonipat and in continuation links to Baghpat and Meerut. **(Figure 14.12).**

It is proposed to upgrade this road as NH, from Rohtak to Meerut and develop as a 4-lane divided carriageway road in the interim phase with potential for upgradation into 6/8 lane carriageway.

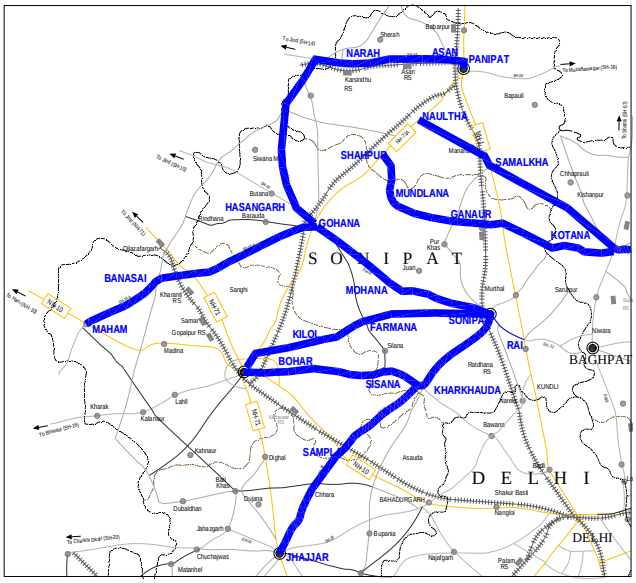


Figure 14.12: Alternative Link Roads from Gurgaon to Delhi

Development of Maham–Banasi – Gohana –Mohana-Sonipat –Rai (NH-1) Road

This road links NHs 10, 71, 71-A and 1 and serves the northern part of Haryana Sub – region. **(Figure 14.12).** It is proposed to develop this road as a 4-lane carriageway road.

Development of Gohana-Hasangarh-Narah-Asan-Panipat Road

This road connects north – west part of NCR **(Figure 14.12).** It is proposed to be developed as a 4-lane Carriageway road.

Development of Rohtak–Bohar–Sisana-Kharkhauda–(Bawana within Delhi) Road

This road stretch provides an alternative Route between Delhi and Rohtak **(Figure 14.12).** It is proposed to develop this road as a 4-lane divided carriageway road.

Development of Shahpur (NH-71 A)-Mundlana-Ganaur-Kotana-Baraut-Binanla-Daurala (NH-58)-NH-119 Road

This road is presently MDR with a missing link between Ganaur and Kotana. This is an important stretch and acts as the northern arm of the outer grid within NCR. It links 4 NHs (71-A,1, 58 and 119). It is proposed to upgrade this stretch as a SH and develop as a 4-lane divided carriageway road **(Figure 14.12).** A bridge across Yamuna at Kotana needs to be constructed. In the long term, the stretch may be upgraded as a NH.

Development of Binaula-Pilana Road

This road is presently MDR. It links northern arm of outer and inner grids. It is proposed to be upgraded it as a SH and develop as a 2-lane carriageway road.

Development of Gurgaon –Sohna road

This road is presently SH connecting NH-8 and 71-B. It provides connectivity to fast developing areas and Sohna. It is proposed to develop this road as a 6- lane divided carriageway road.

Development of Badarpur-GreaterNoida-Dadri-Dhaulana-Pilkhua-Hapur Road

This road stretch links Dadri, the newly developing important industrial and logistics complex directly with Delhi on the west and the proposed Bulandshahr – Meerut expressway on the east. As it connects Yamuna Expressway, it provides a direct link to the proposed Taj International Airport **(Figure 14.13).**

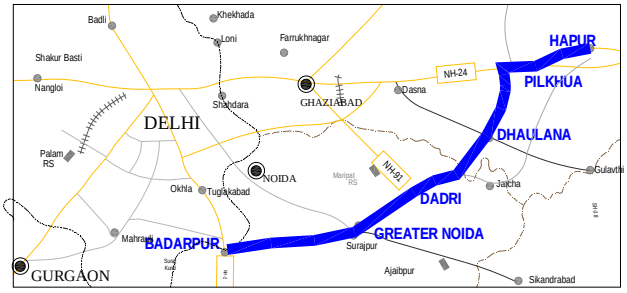


Figure 14.13: Badarpur–Dadri–Hapur Road

The road stretch is presently a MDR with some missing links. It is proposed to develop this road as a 4-lane divided carriageway road.

Development of Alwar - Rajgarh (37kms)

This road is proposed to be developed as 4-lane divided carriageway **(Figure 14.14).**

Development of Neemrana – Mandawar (20kms)

On the recommendation of NCR cell, Alwar, Rajasthan, this road is also recommended to upgrade this ODR in to 2 –lane road because of lot of industrial development coming in this region **(Figure 14.15).**

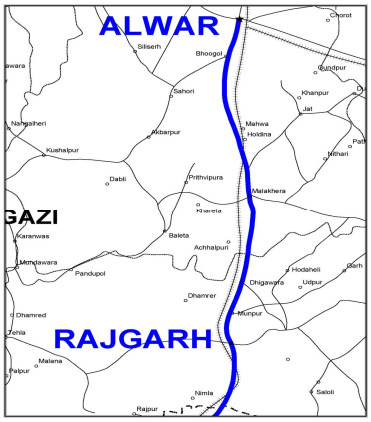


Figure 14.14: Alwar - Rajgarh Road

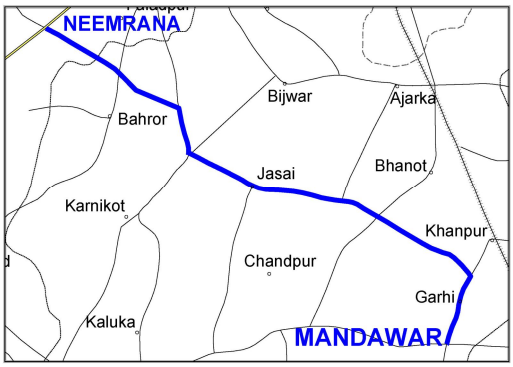


Figure 14.15: Neemrana – Mandawar Road

Development of Hapur – Singuli Ahir (43 km)

On the recommendation of NCR cell, U.P. this road has also been included in our plan to be upgraded in 2 – lane road. This road will act as an alternative route between Hapur and Baghpat **(Figure 14.16).**

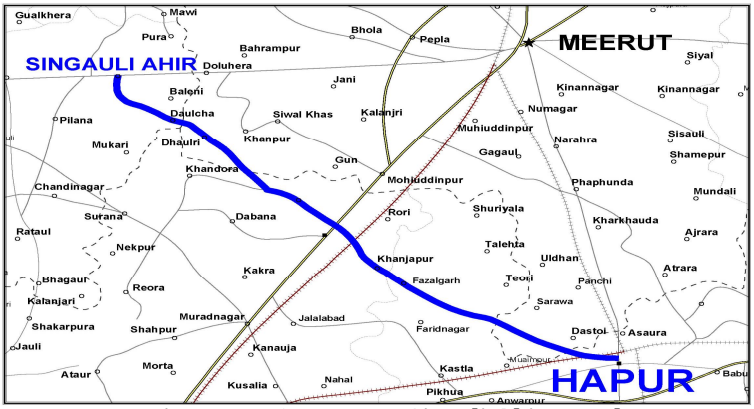


Figure 14.16: Hapur – Singuli Ahir Road

Development of Dasna – Siyana (55kms)

On the recommendation of NCR cell, U.P. this road has been included in the transport plan to be upgraded in 2 – lane road. This road will provide an alternative route to the people moving from Garhmukteshwar to Dasna or Ghaziabad. It can take the load of traffic moving on NH-24 **(Figure 14.17).**

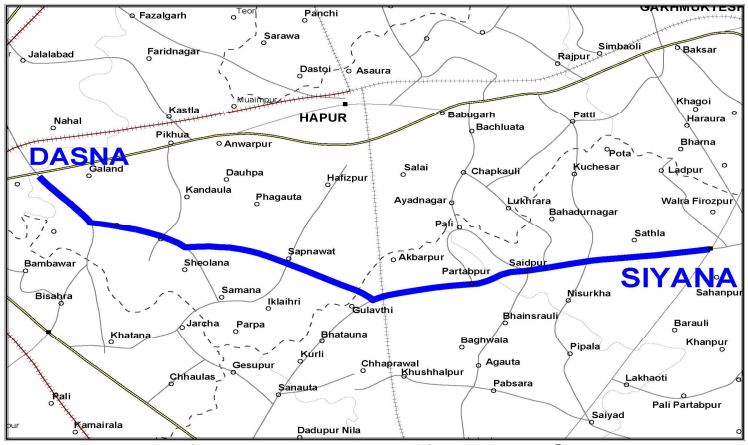


Figure 14.17: Dasna-Siyana Road

14.2.1.8 Regional Collector/Distributors

An extensive network of existing Major District Roads and upgraded Other District Roads form the Collector/Distributor system. The total extent of this network is 4266 km.

14.2.1.9 High Occupancy Lanes along all Major Regional Roads

The Integrated Multi-modal Transport System lays emphasis on, and accords priority to, the public transport system. To provide priority for movement of road based bus system, it is proposed that dedicated High Occupancy Vehicle (HOV) Lanes of 2 lanes be provided along all the proposed and existing Expressways, National Highways and other major regional Arterial roads/corridors. The HOV lanes would facilitate high efficiency and productivity of the regional bus transport system. While mainly meant for public transport, the HOV lanes may be made accessible for use by private modes having occupancy of more than a fixed number e.g. it could be minimum two or more occupants for private cars. The vehicles in HOV lanes may also be given a concession in toll charges. These measures would promote reduction in the number of personalized modes on the network system.

14.2.1.10 Interchanges

Regional Road Network System is envisaged as a high capacity, high speed, high quality road network. Access control is required to be provided at important intersections between the roads of same class or different classes enabled with full or partial grade separated interchanges. The general policy proposed is as under:

1	Between Expressway & Expressway	Full Interchange
2	Between Expressway & Regional Arterial – (National Highways)	Full or Partial Interchage
3	Between Regional Arterial & Regional Arterial	Partial Interchange
4	Regional Arterial & Regional Collector (State Highway)	Partial Interchange
5	Between Regional Collector & Regional Collector	At Grade (with proper design)

Source: Study on Integrated Transportation Plan for NCR

While the above policy is a general guideline, there may be variations based on traffic volume and other needs. Intersections along expressway networks are listed in **Table 14.3**.

Table 14.3: Proposed Locations of Interchanges in NCR

Sl. No.	Location	Between	Type
1	Kundli	KMP EW x Delhi Peripheral Expressway	Full
2	Kundli	KMP EW X Delhi Peripheral Regional Arterial (NH-1)	Parital
3	Bahadurgarh	KMP EW X Delhi-Rohtak EW	Full
4	Bahadurgarh	KMP EW x Delhi-Rohtak Regional Arterial (NH 10)	Partial
5	Farrukhpur	KMP EW X Jhajjar-Gurgaon CNCR Grid Arterial (NH)	Full
6	Manesar	KMP EW X Delhi-Gurgaon – Dharuhera EW	Partial
7	Taoru	KMP EW x Rewari-Taoru Expressway	Full
8	Taoru	KMP EW x Rewari – Palwal RA x Pataudi – Nuh RC/D	Partial
9	Palwal	KMP EW x Delhi – Peripheral EW	Full
10	Ghori	KMP EX x Palwal-Khurja EW	Full
11	Gharora	PGK EW x Ballabgarh-Sikandarabad RA	Partial
12	Kondli	PGK EW x Yanuna EW	Full
13	Surajpur	PGK EW x Ganga Expressway	Full
14	Dadri	PGK EW x Ghaziabad-Dadri EW x Faridabad-Dardri-Hapur RC/D	Full
15	Dasna	PGK EW X Ghaziabad-Hapur EW	Full
16	Dasna	PGK EW X Ghaziabad – Hapur RA	Partial
17	Murdnagar	PGK EW x Ghaziabad-Meerut EW	Full
18	Muradnagar	PGK EW x Ghaziabad-Meerut RA (NH-58)	Partial
19	Baghpat	PGK EW x Loni-Baghpat EW	Full
20	Panipiat	Delhi-Panipat EW x Panipat Bypass	Full
21	Panipat	Panipat-Rohtal EW x Panipat Byapss	Full
22	Rohtak	Rohtak Bypass x Rohtak Panipat EW	Full
23	Rohtak	Rohtak Bypass x Rohtak-Delhi EW	Full
24	Rohtak	Rohtak Bypass x Rohtak Jhajjar-Rewari EW	Full
25	Rewari	Rewari Bypass x Rewari – Rohtak EW	Full
26	Rewari	Rewari Bypass x Dharuhera-Taoru EW	Full
27	Rewari	Rewari Bypass x Dharuhera-Taoru EW	Full
28	Gurgaon	Delhi-Gurgaon-Dharuhera EW x Gurgaion –Faridabad EW	Full
29	Faridabad	Delhi-Faridabad-Palwal EW x Faridabad-Gurgaon EW	Full
30	Jewar	Yamuna EW x Palwal-Kheja EW	Full
31	Bulandshahr	Ganga EW x Khurja – Hapur-Meerut EW	Full
32	Hapur	Ghaziabad-Hapur EW x Khurja-Hapur-Meerut EW	Full
33	Meerut	Meerut Bypass x Meerut-Hapur EW	Full
34	Meerut	Meerut Bypass x Ghaziabad-Meerut EW	Full
35	Meerut	Meerut Bypass x Meerut – Baghpat EW	Full

Source: Study on Integrated Transportation Plan for NCR

14.2.1.11 Bypass System around All Major Urban Centers

It is important that intra-regional and inter-regional traffic is segregated from intra-urban traffic. Most of the master plans for regional centers have proposed some systems of bypass roads. However, in the context of higher envisaged growth of the regional urban centers, it is proposed that necessary provisions may be made in the master plans for new bypass systems around each of the urban centre planned and developed with appropriate interchanges recommended in the transport plan. These bypasses should be elevated as far as possible to avoid becoming urban arterial road in future.

14.2.1.12 Integrating and Interfacing Regional and Urban Road Network Systems

While the development of the regional roads would enable high capacity, high speed movement between urban nodes, it is important to ensure that the advantage is not lost when they move within the urban centre to reach their final destination.

It is proposed that each urban centre, as part of its road network master plan, identify an internal network system comprising radial and orbital roads to be developed to expressway standards and

integrate with the regional road system so that the destined traffic moves seamlessly to its destination point within the urban center.

Another important aspect is the interfacing of the regional and urban network systems. The intersections forming transition points need to be properly designed, preferably as grade separated interchanges, with appropriate geometric standards.

14.2.1.13 Toll Policy and Toll Plazas

Development of Road Network in NCR needs to be supported by levy of toll on the users. Presently the highway toll policy is to charge the user a part of the benefit he derives due to the improvement. It is levied along a defined section (length) of the road. In the context of NCR the toll policy needs to be formulated on a wider context of promoting equitable development of different spatial parts, ensuring equilibrium flows along the network system and enabling non-destined flows to divert at the regional level. This calls for a differential fare policy which would, for non-destined traffic, make it economical to move along the Regional Bypass System rather than on the radial routes converging onto Delhi.

Toll plaza location and design are important to ensure full collection and minimize traffic escaping toll. Toll plaza location and number would depend on the policy concept of open-barrier toll system or closed-barrier toll system. The closed-barrier toll system captures all toll facility users, captures the entire revenue stream, provides better enforcement for toll collection and ensures users pay tolls that are directly related to the distance traveled on system.

In selecting a system the cost of toll plaza development and maintenance needs to be balanced against probable revenue loss. Under the closed barrier system toll collection could either be a closed-ticket system or closed-cash system. Toll collection equipment is important in the efficiency of the toll plaza. In the NCR it is recommended that fully automatic Electronic Toll Collection (ETC) system be adopted.

14.2.1.14 Integrated Freight Complexes

A high intensity of goods movement by road and rail systems is envisaged. They include consignments to a variety of destinations within and outside the region. The goods need to be received, stored, sorted and redistributed. Historically, this function is being carried out within or at the periphery of the city central area. Apart from sub-optimal utilization of valuable urban land space, this practice has led to lower productivity of the goods vehicles, high congestion, high costs of handling the goods, environmental degradation, accidents and a number of other issues.

The need is to develop Integrated Freight Complexes (IFCs) at the outer edge of the urban area at the location of interfacing of the regional and urban network systems. Apart from the road system, the IFCs need to be integrated with the regional rail system. IFCs at all the regional urban nodes integrated with the Outer Grid Road/Expressway Systems are proposed. They are namely Sonipat, Baghpat, Bahadurgarh, Ghaziabad, Jhajjar, Gurgaon, Bulandshahr, Palwal and other towns like Alwar, Behror, Shahjahanpur or Neemrana. Master Plans need to be reviewed and revised to provide for their land use allocating adequate extent of land and integrating the same with intra-urban transport network system. The concerned city authorities may make necessary institutional arrangement to set up IFC Co. to plan, develop, operate and manage the city IFCs.

14.2.1.15 Highway Facility Centres

The quality of the road network system is also affected by the user facilities provided along the road stretches. Road side amenities are needed and expected. In the absence of planned provision these

facilities will develop in an adhoc manner, encroaching on the road right of way and causing bottlenecks and accidents.

The Highway Facility Centres (HFC) needs to be planned and developed on a comprehensive basis. They need to include parking, fuelling, servicing and repairs, telephone and telecommunication, restaurants and motels, medical, police, godown, weigh bridge, entertainment, banking (ATMs), and a host of other needed services. These HFCs need to be developed along the highways, spread over about 10 to 15 ha, at a spacing of 50-60 km. **Map 14.2** presents a Concept Plan for a HFC.

14.2.1.16 NCR – Highways Facilities Centres Development Company

It is suggested that a 'NCR – Highways Facilities Centres Development Company' may be set up for planning and developing the Facilities Centres on an integrated basis. The SPV would be responsible for land assembly and integrated planning of the Facilities Centres. The individual components of the Centres may be developed and operated by different entrepreneurs.

14.2.1.17 Road Traffic Safety Issues & Strategies

The main reasons for increase in road accidents are attributed to phenomenal increase in vehicle population and introduction of new technology vehicles without making matching improvement in road structure and lack of application of modern traffic control and management tools to tackle the burgeoning traffic problems effectively and efficiently. In addition, India, especially NCR, is undergoing a major change in the causes of mortality accompanied by a rapid motorization and urbanization. A negative externality associated with expansion in road network, motorization and urbanization in NCR has resulted in increase in road related accidents. Today, Road Traffic Injuries (RTIs) are one of the leading causes of deaths, disabilities and hospitalization with severe socio-economic costs and social implications. In fact, road accidents are being seen as an epidemic and perennial disaster.

MAP 14.2 : CONCEPT PLAN FOR HFC

14.2.1.18 Road Safety Scenario of NCR States vis-à-vis India

The Road Safety Scenario of NCR vis-à-vis India (total 28 States and 7 Union Territories) in terms of various parameters is was analyzed in a study in India and the findings of this study are summarized below.

Among 35 States and Union Territories of India, the highest number of Road Accidents per lac population was reported to be **245** for Goa and lowest **4** for Bihar against the national average of **40**. The status of Road Accidents per lac population for NCR States is reported as below:

(a)	Delhi	=	59.5
(b)	Haryana	=	40.4
(c)	Rajasthan	=	37.6
(d)	Uttar Pradesh	=	10.1

Thus, Delhi & Haryana are considered under High Risk Category as the fatality rate exceeds the threshold value of **40**, while Rajasthan & Uttar Pradesh are classified under Low Risk Category as their fatality rate is less than the threshold value.

Similarly, the number of persons killed per lac population was **21.4**, which was observed to be the highest for Dadra & Nagar Haveli and this was lowest **zero** for Lakshadeep against the national average of **8.6**. The status of NCR States in this context is as follows:

(a)	Delhi	=	12.8
(b)	Haryana	=	14.7
(c)	Rajasthan	=	11.0
(d)	Uttar Pradesh	=	5.5

Among 35 States and Union Territories of India, the National Average of Road Accidents per 10000 vehicles was found to be **59**. This Accident Rate was observed to be the highest for Kerala with **148** and lowest for Lakshadeep with **6**. The status of NCR States in this context is as follows:

(a)	Delhi	=	21.4
(b)	Haryana	=	36.6
(c)	Rajasthan	=	60.6
(d)	Uttar Pradesh	=	28.6

Similarly, the number of persons killed per 10000 vehicles was observed to be the highest for Arunachal Pradesh with **79** and lowest for Lakshadeep with **zero** against the national average of **12.7**. The status of NCR States in this context is as follows:

(a)	Delhi	=	4.5
(b)	Haryana	=	13.4
(c)	Rajasthan	=	16.9
(d)	Uttar Pradesh	=	15.4

Among 35 States and Union Territories of India, the severity of accidents related to deaths per 100 accidents was observed to be the highest for Uttarakhand with **66** and lowest with **zero** for Lakshadeep against the national average of **22**. The status of NCR States in this context is as follows:

(a)	Delhi	=	21.8
(b)	Haryana	=	36.3
(c)	Rajasthan	=	29.4
(d)	Uttar Pradesh	=	54.3

14.2.1.19 Road Safety Strategies

The following Road Safety Strategies for Accident Prevention, Reduction and Mitigation are proposed to be adopted:

(i) **Proactive Measures** (compatible with hazardous road locations i.e. junctions, non-junction locations and accident prone routes). These proactive measures will comprise preventive and corrective measures for accident prone spots / sites / routes / areas in form of geometric improvement of curves, intersections, provision of additional turning lanes, grade separations, pedestrian underpasses, realignments / bypasses, etc. based on problem diagnosis through safety audit of existing roads supplemented by site investigations. These proactive measures will be proposed on short-term and long-term basis, depending upon various factors such as cause of an accident, implementation timeframe, resource requirements, etc.

(ii) **Reactive Measures** (junctions, non-junction locations, single cause accidents requiring mass action, route action plan requiring corridor improvement, area action plan). These reactive measures will comprise rectification of minor deficiencies such as kinks, presence of sharp curve / broken back curves without adequate tangent length, inadequate sight distances at intersections due to physical obstructions, absence of traffic guidance, control and regulatory signs, road markings, guard posts, guard rails, delineators, pedestrian crossing facilities, etc. in form of traffic guidance, control and management counter measures as required for safe guidance and movement of traffic within the travel way. These counter measures are proposed to be taken on priority basis to improve the safety scenario, e.g. use of retro-reflective tapes for vulnerable vehicles such as bicycles, cycle rickshaws, and other non-motorized vehicles, use of flood lights on rear left hand side of the motorized vehicles for lighting the shoulders, use of guard rails and guard posts at vulnerable locations such as high embankment, sharp curves, structure approaches, etc.; provision of overhead gantry signs for place identification, direction and distance guidance, etc. ; compulsory delineation of the island ends with obstruction markers and delineators, provision of pedestrian facilities at vulnerable locations, heavy punitive action against law offenders / defaulters, especially for helmet use for two-wheelers, safety belt for front car passengers, drunken drivers, speed violators, etc.

(iii) **Mitigation Measures** (organizational measures such as traffic aid posts, highway patrolling, surveillance, communication system, ambulance services, trauma care and management etc.). These measures will be aimed at reducing the severity of accidents by way of emergency help to accident victims through efficient information system, accident reporting and timely treatment at trauma care centers, hospitals, etc.

In order to minimize the number, frequency and severity of accidents in NCR, the following recommendations are made:

i) Adoption of standard designs for Roads & Highways such as basic forms of intersections and their choice, road alignment and vertical profile, visibility at intersections, radii of curves, minimum design features, minimum turning radii, widths of carriageway at junctions, etc.

ii) Design of Expressways, Arterial Roads, Sub-arterial Roads & Collector Roads will specially be based on premise that accidents are bound to take place even if all possible safety measures are taken, i.e. all categories of Roads & Highways should be of forgiving nature and are provided with gentle road-side slopes, safety barriers, guard rails, guard posts, delineators, object / obstruction markers, besides adequate traffic signs with markings, etc.

iii) Adoption of standard designs for appropriate types of grade-separated interchanges for catering to all traffic movements safely

iv) Adoption of sound construction and maintenance practices.

v) Provision of adequate and effective traffic control and safety devices during construction and maintenance activities as it has been observed that the accident rate is generally 1.5 times during these activities as against normal traffic flow conditions

vi) Provision of road side amenities for pedestrians, cyclists and other special road users such as rickshaws, vans, buses, trucks, etc.

vii) In addition, all possible engineering, educational, enforcement, environment management and emergency measures (5 Es) for ensuring highway safety, including training as appropriate should be adopted.

viii) The following initiatives should be taken to enhance road safety:

- Design & Specifications of new roads to be as per International Safety Practices
- Adequate Safety Measures during construction and maintenance of highways
- Adoption of both pro-active and reactive counter measures for enhancing safety of existing highways based on diagnostic analysis.

ix) Adoption of Intelligent Transport Systems (ITS) for design of vehicles, road & road environment and traffic guidance.

The geometric design standards for road network development are given in **Annexure 14.1.** The geometric sections are shown in **Figure 14.27.**

14.2.1.20 NCR Transport Safety Authority/Cell

It is recommended that a Transport Safety Authority/Cell is proposed in each sub-region, independent of functional departments and under the direct charge of the Principal Secretary of the concerned Department in the State Government to be established to conduct Safety Audit of all transport plans, designs and operations. It could be a multi-disciplinary team. Apart from safety audit, it should also conduct detailed study and analysis of any accident that may take place within their respective sub-regions, identify causal factors and recommend guidelines for improved safety. The vision is to move towards zero fatal accidents in NCR.

14.2.2 Bus System

Considering the population growth and settlement pattern of the NCR, its current and projected travel needs, following appreciation of the travel characteristics of the commuters in the NCR and the evaluation of existing public transport services in respect of their Institutional set ups; adequacy of services, their physical and financial performance including utilization of assets; operational profitability, costs and revenues, fares and taxes; etc and analysis of causes of deficiencies, if any, recommendations for operationalisation of providing an adequate, efficient, economical and environmentally sustainable Bus based Public Transport (BPT) system has been made. It includes modal split, buses required and their distribution amongst the sub regions, bus system and bus technology, provisioning of bus depots, repair and maintenance workshops, bus terminals, Bus queue shelters, etc. besides other fiscal reforms. Investments required for development of BPT system, phasing of investments over the period spreading upto the horizon year is proposed. The Funds for investment are expected to be through PPP modals. Investment of the order of Rs 37 per person per year is proposed to be made by the government agencies.

14.2.2.1 Demand Forecast for Buses

On the basis of the average intra region (excluding intra urban and inter-state trips) Per Capita Trip Rate (PCTR) of 0.0479 by bus in base year and 0.07968 in horizon year (2032), the average passenger trip length of 51 kms in the base year (as per survey estimates-CES 2007) and 68kms in horizon year; the population projections for the horizon year 2032; and the carrying capacity of 11597 seat kms per

bus per day in base year and 12370 in horizon year; the demand of buses is as estimated in **Table 14.4.**

Table 14.4: Demand assessment of buses for Intra Region Bus Transport Services (excluding intra urban and inter state) in NCR

Demand Estimation		Base yr 2007	Horizon year 2032
a NCR population	lakhs	443.5	866.4
b Bus Pax daily trips		2124587	6900228
c Bus Pax PCTR		0.047905	0.07968
d Bus Pax avg trip lngth kms		51	68
e Total demand	pax kms	108353924	466761044
Supply side		*	
e.Kms per bus on road/day		349	331.2
f.Avg no of seats in a bus		52	58
g.Avg load factor		0.67	0.7
h. Avg fleet utilisation		0.96	0.92
i. supply per bus held per day			
=e*f*g*h		11673	12370
Buses required		9283	37734

The requirement of buses, for intra region transport services in NCR, is assessed as 9283 for the base year and 37734 buses for the horizon year (refer table above) with the following assumptions:

- the average decadal growth in bus passenger trip length (in the range of 12-13%) on account of the increasing spread of settlements in the NCR,
- the average decadal decline of vehicular utilization of about 2% due to increasing road congestion,
- seating capacity of vehicles increasing to 58 from 52 due to longer vehicles being progressively available,
- optimum fleet utilization of 92% considered against the over utilization of more than 96% in the base year

The above demand levels would significantly increase if inter state travel needs are considered. This demand however has to be serviced both by the NCR as also by other states. In both cases however intra urban travel requirement is excluded.

14.2.2.2 Bus based Public Transport System Development

Based on above analysis, various issues related to the Bus based Public Transport System has been addressed and the recommendations are as follows:

i) Based on travel demand estimates for the bus system in the NCR, the number of buses required is assessed and given in **Table 14.4**. Bus fleets, as per sub region wise requirements, be provided in each of the constituent states of the NCR, mainly under the Public Private Partnership (PPP) system. The supply of buses is proposed to be in equal proportions by the public and the private bus operators.

   Bus fleets levels in the NCR may be achieved progressively, in a phased manner, by distributing the additional fleet induction till the horizon year on a near straight line basis over the time span of 5 years each. The details of Estimated Cost and Phasing of BPT System are given in **Table 14.5.**

Table 14.5: Estimated Cost & Phasing of BPT System

Phasing of bus fleets and other Facilities along with cost estimates						
Sl. No.	Description	Periods				Total at the end of the horizon year
		2008-2012	2013-2017	2018-2022	2023-2032	
1	**Bus Fleet level**					
1.1	at the end of terminal year	12000	18000	24000	37734	37734
1.2	at the beginning of the period	0	12000	18000	24000	
1.3	addition during the period	12000	6000	6000	13734	37734
2	**Distribution of Bus fleet bus provider wise**					
2.1	NCRTC Buses	6000	9000	12000	18867	18867
2.1.1	NCRTC Owned buses	3000	4500	6000	9434	9434
2.1.2	NCRTC hired buses	3000	4500	6000	9434	9434
2.2	Private Bus Providers' buses	6000	9000	12000	18867	18867
2.3	Cost of additionasl buses @ Rs 30 Lakhs per bus on an average	360000	180000	180000	412020	1132020
2.4	cost of replacement of buses after every 8 yrs of life Rs in Lakhs	0	216000	252000	581616	1049616
3	**No. of Bus depots @1 depot per 100 buses at the end of the period**	**120**	**180**	**240**	**377**	**377**
3.1	no. of bus depots to be added during the perod	120	60	60	137	377
3.2	Land for depot @ 5 acre per depot	600	300	300	687	1887
3.3	Cost Estimates (Rs in Lakhs)					
3.3.1	Land @ Rs100 lakhs per acre	60000	30000	30000	68670	188670
3.3.2	Building cost lumpsome @ Rs 400 lakhs per depot	48000	24000	24000	54936	150936
3.3.3	Equipment @ Rs 100 Lakhs per depot	12000	6000	6000	13734	37734
3.3.4	Total cost of Bus depots Rs in lakhs	120000	60000	60000	137340	377340
4	**Workshops**					
4.1	No. of Workshops @ 1 per 3000 buses expandable to 6000 buses	2	3	4	6	6
4.2	Additional w/shops per period	2	1	1	2	6
4.3	Land required per workshop @ 15 acres per w/shop	30	15	15	34	94
4.4	Cost Estimates (Rs in Lakhs)					
4.4.1	Land for workshops @ Rs 100 lakhs per acre	3000	1500	1500	3434	9434
4.4.2	Buildings for workshops about 20000 sq mtr @ Rs 10000 /sq mtr	4000	2000	2000	4578	12578
4.4.3	Equipments @ Rs 1000 lakhs per w/shop	2000	1000	1000	2289	6289
4.4.4	Total cost of w/shops Rs in Lakhs	9000	4500	4500	10301	28301
5	Total Investment required Rs in Lakhs(2.3+2.4+3.3.4+4.4.4)	**489000**	**460500**	**496500**	**1141277**	**2587277**

Source: Study on Integrated Transportation Plan for NCR

Procurement of bus fleets, development of bus depots, workshops, etc. will require a total investment of Rs 25873 crores spread over the period of 25 years is required. Investment in about 75% of the bus fleet additions, its periodic replacements and the corresponding bus depots and workshops would be made by the private sector and through PPP modal. Only about 25% of the investment amounting to nearly Rs 6468 crores is proposed to be made by the Government agencies. This investment of Rs 6468 crores is expected to serve an average population of about seven crores during the period of 25 years. Accordingly, investment requirement by the government agencies will be about Rs. 37 lakhs per lakh population per year.

ii) Sub region-wise stage carriage bus permits be provided for the number of buses required in each sub region. The permit conditions/fees etc for buses engaged by the bus corporation be identical for all sub regions. Fiscal incentives such as sales tax holiday / concessional excise duty on purchase of buses by private operators for operation under the bus corporation could bring about enhanced participation of even the private sector's corporate entities. Rationalisation of excise

duty on buses, for the vehicle manufactures at par with that applicable to the small scale bus body builders, would encourage acquisition of fully built buses from the vehicle manufactures directly. These buses built by the vehicle manufacturers are expected to be of appropriate designs and quality.

iii) As non-uniform tax and permit fee structures, amongst the constituent states of the sub regions, does not financially motivate the bus operators towards growth of bus fleets and expansion of operations in such areas, a uniform tax/permit fee structure be worked out and maintained throughout the NCR. Losses if any, by any of the constituent states, on such rationalization of taxes etc be suitably compensated through an agreed mechanism.

iv) Passenger fares, which constitute the main source of revenue for the bus operators, are significantly different in the sub regions of the NCR. Lower fare levels in some regions coupled with high incidence of taxes neither encourage bus operators to operate/expand their services in that area nor do they motivate commuters to travel by bus based public transport. Bus fares should be such as to cost the commuter less than the operational cost of a two wheelers for affordability considerations and for increased patronization of the public transport system by the commuters. The bus fares should be fixed at a level sufficient to cover all costs at optimum physical performance of the operator and to generate surplus for growth etc. for financial sustainability of the public transport operator. Considering the contradicting demands on the system, the fare be worked out for the financial sustainability and growth objective. It could be suitably moderated by the concerned government for affordability and other socio-political considerations. The gap between the two be bridged under the viability gap funding scheme/any other scheme of the government. The fare levels and the cost of travel to the commuter be uniform in the entire sub region.

For the convenience of commuters and for encouraging seamless transfer amongst modes possibility of a single ticket for the journey by all modes be explored. Smart card based ticketing could serve the purpose.

v) Bus Rapid Transit System (BRTS), with adequate and efficient feeder network, using modern buses for high density routes (corridor loads of more than 5000 pphpd) has been proposed based on the route wise travel demand. Buses of varying capacities are recommended for other routes depending upon travel intensities.

Normally 12 meter long ultra low floor buses (of floor height of up to 400 mm) with wide (1200 mm) entry/ exit gates, 2*2 seating layout, high acceleration capability, fitted with air suspension, automatic transmission, etc are the preferred options for the main corridors of NCR, these buses (and or single/double articulated ones) are recommended for the BRTS routes for operation on dedicated road space as also for the NCTD-CNCR routes mainly on account of operational considerations.

On other national /state highways, low floor (650 mm floor height) 12 meters long buses and or standard buses (1150 mm floor height and up to 12 meter length) with wide (800-1200 mm) entry/exit gates,3*2 seating layout, medium to high acceleration capability, etc., are proposed depending upon the road conditions and travel demand intensity.

For the single lane roads, mostly for low level travel demands, smaller buses (mini and micro) be the preferred option for operation on these routes.

CNG buses are proposed for environmental considerations which are as per Reciprocal Common Transport Agreement signed by the NCR constituent states.

Buses of all comfort categories viz ordinary, semi-deluxe and super deluxe in appropriate proportions be selected depending upon travel characteristics of the route/area.

All buses be provided with electronic route-destination display system at three out side locations namely front, rear and entry side of the bus besides one inside the bus on the driver partition panel. These micro processor based systems are proposed to deliver audio- video signals/messages about route number, its destination, next stop, etc for the convenience of the commuters, including differently-abled commuters, at the bus shelter as also for those on board. These systems could also be incorporated on public private participation basis.

All the Buses be equipped with Intelligent Transport Systems (ITS) comprising of GPS / GPRS / related communication and other sub systems for on-line tracking of bus operations besides feeding the Passenger Information System (PIS). The Bus Corporations would create a set of control rooms suitably located in the NCR and adequately equipped with necessary hardware / software for on-line monitoring of buses and providing necessary information to users through IVRS / SMS, etc. Further web based information about operation schedules, seat availability, etc be available for optimal journey planning by the users.

All buses are equipped with hand held Electronic Ticketing / ticket Verification Machines (ETVMs). The ETVMs be GPS/ GPRS compatible for on-line identification of bus stops / fare stages and communication of requisite data (the way bill details, revenue collection etc) to the control rooms periodically. These machines are programmed to work out and pop up the number of passengers on-board at any point of time. Such a data would not only facilitate bus choice making for the passengers waiting enroute on the following bus stops but would also help in checking ticket-less travel.

All buses need to meet the prescribed emission norms, all statutory requirements besides the general bus specs as per AIS 052(or latest).

vi) One bus depot, of about five acre area, per 100 vehicles be planned, at suitable locations, for idle parking, repair and maintenance etc. of buses. Adequately equipped workshops for major repair of buses and reconditioning of bus aggregates are provided at suitable locations for every cluster of up to 3000 buses. While space of about 15 acres be earmarked for each of these workshops, their equipping and operations be undertaken on Public Private Partnership (PPP) basis. The NCR Bus Corporation (NCRBC) could act as the administrative agency for the purpose. Alternatively all vehicles be purchased with annual maintenance contracts with the vehicle manufacturers.

vii) Route structuring and the bus service frequencies on these routes be worked out on considerations of corridor loads, etc.

viii) The operation, repair and maintenance of these buses would call for involvement of a large labour force (generally at the rate of 5-7 persons per bus) duly qualified and trained for undertaking multifarious tasks efficiently. Training institutes for imparting systematic training in various skills particularly driving and repair and maintenance of buses are proposed to be developed across the NCR.

For servicing the growing manpower needs of the bus transport system, possibility of developing regular multi-skill/trade training courses, such as driver-mechanic trade, conductor-clerk-accounting trade, bus electronic-microprocessor-software trade, etc be evolved at the national level and regular certificate courses of 6 to 12 months duration, at par with those conducted by the Industrial Training Institutes in various industrial skills, be explored for ready availability of trained/qualified persons for deployment in the bus transport system.

Driver is the key element for providing a safe bus system. Besides his training as above, he is further trained 'on the job' for acquiring bus specific skills, before actually deploying him for bus operation. His skills be evaluated using a human intervention free driving skill evaluation system to the extent possible.

ix) Another important element for safe and reliable operation of the bus transport system is a well maintained and fully roadworthy bus. For obtaining such buses in the system, on regular basis, their periodic inspection and certification at the well equipped testing workshops preferably using human intervention free inspection facilities is essential. Such facilities therefore need to be designed and provided across the NCR at convenient locations.

x) Taxis and Auto-rickshaws are important mode of transport within the NCR and together they cater to a significant share of the transport demand. They play a crucial role in containing the levels of motorisation, particularly in respect of private vehicles. IPT modes therefore need to be accorded due attention, and necessary programs be initiated to enhance their share of travel demand. The existing fiscal and other policies, not being conducive to the free movement and operation of the IPTs across the NCR, need to be reviewed for uniformity in fares, taxes and permit fees/conditions, etc.

xi) Consultant has suggested to establish an institution at NCR level for formulation of policies, planning for transport services; scheduling of operations; setting standards for facilities, vehicles and the quality of services; facilitate provisioning / contracting of services; monitor and control operational performance etc for developing an adequate, integrated and well coordinated; affordable, safe, reliable; environment friendly and financially sustainable bus based public transport system. They suggested to establish NCR Bus Corporation (NCRBC) at the Central Government level instead of with all the constituent states, the representative of the Central Government, the NCR Planning Board, etc as members amongst others. This corporation be headed by a nominee of the Central Government. The operational jurisdiction of the NCRBC be fixed as whole of the NCR for inter-city services in accordance with the existing provisions of the act.

This suggestion of the Consultant was not agreed by the NCR Constituent States during interaction in the Workshop, therefore, it is proposed to establish such NCR Bus Corporations at Sub-regional levels by the NCR Constituent States to handle the bus based public transport system in respective sub-regions. These Corporations could operate services in other areas/states by mutual agreements. There could be an umbrella forum which includes representatives of the NCR States and take decisions with consensus among all the NCR Constituent States which could meet as & when required to facilitate efficient coordination. This forum/committee could be chaired by Member Secretary, NCR Planning Board.

xii) The capital requirement of these corporations and land for the depots could be arranged by the respective state governments and their development & operations may be undertaken on Public Private Partnership (PPP) concept. As the operational profitability of the buses hired by the RTCs is much better than that of their own buses, it would only be appropriate that the new corporation out-sources the rolling stock from private sector on wet lease and or any other system. This would not only contain the requirement of capital but would also reduce the staff cost of the new entity as high staff costs appear to be the main factor for poor financial performance of the STU owned buses. The corporation may also out-source all other services including bus fare revenue collection from private sector. The corporation would undertake mainly the policy planning, contracting / outsourcing of services, operations planning, setting standards, scheduling, monitoring and controlling of the performance and the quality of the operations etc.

14.2.3 Bus Terminals

Bus terminals constitute a most important component of the bus based road transport system for providing seamless transfer from one mode to another and one route to another as also the necessary passenger amenities and facilities. On the basis of bus fleet requirements; terminal norms and standards; and the quantum of operations, a number of bus terminals are proposed for the NCR. The size of each terminal is assessed on the basis of intensity of use. Facilities and amenities are provided on the basis of quantum of operations / population size of the cities.

Requirement of bus terminals and other facilities in terms of their numbers, locations, capacities, sizes etc could be accessed through scientifically undertaken travel demand studies and their analysis using various modalling techniques on one hand and the level of passenger amenities to be provided on the other hand.

Normally all intercity, intra-city, intra region and long distance service buses should operate between well developed bus terminals, providing not only necessary amenities to the commuters but also promoting seamless inter-modal transfer.

The function of bus terminal primarily includes processing of vehicles, passengers, etc. with provision of necessary facilities for their smooth flow. The terminal serves as a point and unit where necessary information to user is made available for processing his journey.

14.2.3.1 Main Functions of Bus Terminals

i) A passenger bus terminal broadly needs to perform the functions to meet requirements of the following:

   a. Passengers and vehicles
   b. Passengers only
   c. Vehicles only
   d. Crew
   e. Management

ii) The functions related to both passengers and vehicles include:
   - Concentration
   - Loading
   - Dispersal
   - Unloading

iii) Passenger only oriented functions of the terminal include provision of:
   - Passenger platforms to board and alight
   - Waiting lounges
   - Rest houses / rooms
   - Baggage storage facilities
   - Basic shopping and commercial facilities
   - Utilities, services and amenities
   - Information system
   - Ticketing facilities
   - Shelter from weather
   - Communication and postal facilities
   - Eating places

iv) The components related to vehicles (bus) only include provision of:
   - Bays for loading and unloading
   - Idle bus parking spaces

- Facilities related to maintenance
- Information system for movement within terminal

v) The terminal components to meet the needs of crew are:
- Rest rooms
- Information system
- Communication facilities
- Eating places

vi) The terminal facilities for the management in terms of:
- Demand management on account of concentration
- Incurring minimum expenditure
- Development of centralized information
- Ensuring better control
- Operations management-- planning, monitoring and control
- Contracting of services / service providers

14.2.3.2 Standards and norms for Bus Terminals

i) Design Criteria for bus terminals

The design criteria of terminal inter alia include determining the size of terminal and factors to be taken into consideration in planning the facilities and activities. The size of the terminal is primarily governed by the following factors:

- Traffic demand
- Traffic characteristics
- Functions of terminal
- Type, quantum and sophistication of facilities

The other factors to be considered in terminal design by appreciating activity and facility inter-relationship are:

a. Segregation of Terminal and non-terminal traffic;
b. Segregation of Vehicular and pedestrians' traffic and movement;
c. Segregation of Traffic by type, function, and direction;
d. Coordination of different activities in terms of functional and spatial inter-relationship;
e. Provision of good user and vehicular information;
f. Provision of necessary and identified facilities to meet requirement of all user groups;
g. Achieving minimum passenger and vehicular processing time;
h. Achieving overall functional and spatial efficiency;
i. Achieving smooth flow of all types of traffic to and from terminal

ii) Planning Norms and Space Standards for Bus Terminals

Planning norms and space standards further vary with type of bus operations catered by the terminals viz. interstate, intra region, urban or rural as the requirements for them are different. While in an interstate bus terminal the passengers and the crew requires facilities for overnight stay, in an intra city terminal the quantum of passengers handled during peak hour would be much larger than that of the interstate bus terminal. In rural areas on the other hand even provisioning of a few bus shelters with chairs for waiting may serve the purpose.

As per **UDPFI guidelines**, indicative norms for intra city bus terminals are as follows:

Description		Norms
Capacity of an intra city bus terminal	:	1.5 lakh passengers / day
Peak hour load	:	10% of daily passenger load
Occupancy / Bus	:	50 ideal
Time taken for loading	:	6 min; 12 min max
Time taken for unloading	:	3 min; 6 min max

Source: Study on Integrated Transportation Plan for NCR

Space standards for parking facilities for intra city bus terminals are given in **Table 14.6.**

Table 14.6: Space Standards for Parking Facilities for Intra City Bus Terminals

Description	Area / Vehicle sq. mtrs	Area in sq. meters including circulation
a. Bus bays		
Boarding /alighting of Pax		200
Idle Parking per bus	145	200
b. Parking of other Modes		
Car	25	50
Two wheeler	4	12.5
Taxi	16	50
Auto-rickshaw	1.2	3
Cycle	1.2	

Source: Study on Integrated Transportation Plan for NCR

The need for bus terminals arises for all types of operations undertaken by different passenger transport service providers. The quantum and nature of facilities in different types of bus terminals varies with the intensity of vehicles arrival / departures, density of commuters, quantum of intermediate public transport vehicles, peak hour traffic loads, etc.

While the passengers' needs at intra city bus terminals mainly consist of boarding–alighting facilities, bus shelters, and enquiry / ticketing office, wash rooms, etc., the passenger needs at interstate bus terminals would be far more than the intra city bus terminals. In addition, the interstate bus terminals need to have facilities of rest rooms, advance reservation, book stalls, telephone facilities, waiting halls, overnight staying facilities, snack bars, restaurants, and overnight stay facilities for interstate bus crew, idle bus parking facilities besides others generally required at any bus terminal. Intra region bus terminals would need to have facilities in between the above two types of bus terminals.

Bus terminals in comparatively smaller towns and cities in the NCR have to have facilities tending towards the urban bus terminals. The size of the bus terminals should be such as to provide all the above facilities, adequate number of bus bays, adequate parking space for private vehicles, boarding alighting bays for intermediate public transport modes, idle parking facilities for buses awaiting their scheduled departure from bus terminals.

On an average, about one third each of the total area may be taken for terminal built-up space, idle parking, landscaping respectively subject however to local norms.
On the basis of above requirements, the bus terminals in the National Capital Region based on the facilities may be classified as given in the **Table 14.7.**

Table 14.7: Categorization of Bus Terminal based on Amenities and city size

Sr. no.	Amenities / Facilities	Category of terminal / suitable for class of city
1	Drinking water & Hand Pumps	Category 'D'(1-6) "Class V level towns"
2	Lighting & passenger sheds & station	
3	Fans in passenger sheds	
4	Benches & chairs	
5	Display of time table and fare list	
6	Toilets and urinals	
7	Suggestions/complaint box	Category 'C1'(1-15) " Block Level Facilities" or "Class IV level cities"
8	Booking and enquiry counter	
9	Canteen/book stalls/general merchant shops	
10	Boarding platform	
11	Stalls	
12	PCO	
13	Passenger lounge	
14	Mini tube well and moulded tank	
15	Idle parking	
16	Public address systems	Category 'C2'(1-18) "Class III level cities"
17	Water cooler	
18	In-out enquiry	
19	Generator	Category 'B' (1-22) "Class II level cities"
20	Administrative office	
21	Driver/ conductors rest room	
22	Private car, scooter rickshaw parking	
23	Television	Category 'A'(1-30) "Class I level cities"
24	AC canteen	
25	AC waiting room	
26	Dormitory	
27	Computerized arrival/ departure	
28	Computerized booking/reservation	
29	Tube well & RCC overhead tank	
30	Cloak room	
31	Tourist information centre	Category 'A plus'(1-35) "Metropolitan Cities"
32	Washing machine	
33	Security room	
34	Passenger Information system	
35	Real Time Information System	

Source: Study on Integrated Transportation Plan for NCR

Considering various operational and other requirements for development of bus terminals, the terminals may be provided as under **(Table 14.8).**

Table 14.8: Suggested Operational and other facilities required in Bus Terminal w.r.t. city size

S. No	Description	Population Range	Type of Terminals				Proposed Size of Terminals (in acres) for FY 2032	Terminal classification on the basis of amenities / facilities
			Inter-state	Intra-region	Urban Services	Other Services		
1	State capitals and Metropolitan Cities	>1000000	✓	✓	✓	X	15	A+
2	Major city centers	>500000	✓	✓	✓	X	10-15	A
3	Class I settlements	>100000	✓	✓	x	X	10-15	A
4	Class II settlements	50000-99999	✓	✓	X	x	5-10	B
5	Class III settlements	20000-49999	✓	✓	X	✓	5	C2
6	Class IV settlements	10000-19999	X	✓	X	✓	3	C1
7	Class V settlements	5000-9999	X	X	X	✓	2	D

Source: Study on Integrated Transportation Plan for NCR

14.2.3.3 Development of Bus Terminals: Recommendations

The development of bus terminals calls for large investments which may be obtained through Public-Private-Participation. The public sector equity in development of bus terminals may be taken as the land value of the bus terminals. The private sector may be required to bring in investments for development of the bus terminals through any of the PPP Modals. The operations, management and maintenance expenses for the bus terminals and other facilities are proposed to be met through user charges etc.

Consultant has proposed a separate corporation for planning, designing, development, operations management, monitoring and control of operations, etc of terminals to be established under the RTC act 1950 for each sub-region.

i) Strategy for Development of bus Terminal and other Facilities

The strategy for bus terminal development in NCR comprises of – first, an assessment of space for various levels of passenger terminals; second, a hierarchical system of developing terminals in the study area which can cater to traffic in the entire State and third, outsourcing of funds and operations management through PPP. Such terminals would facilitate as an optimal interface of intra-region, intra-sub-region, intra-states and inter-state traffic.

At least one bus terminal with adequate provision for future growth is proposed in every class of city. In class I and above cities, a number of bus terminals @ of one commuter terminal for handling upto 1500 buses per day and peak hour load of 100 buses is suggested. Considering an average alighting / boarding time of about 15 minutes for a bus-a provision of about 50 bus bays at the terminal is proposed besides space for idle parking of buses, parking of private vehicles and IPTs, in addition to the requisite space for public conveniences / passenger amenities etc.

Following above discussions an area of about 2-15 acres is proposed to be allocated for the terminals. In class II/III cities, terminal space of up to 5-10 acres for each of the terminals to handle a peak hour load of about 50/25 buses in the base year with adequate provision for future expansion be provided.

ii) Category wise requirement and cost estimates of bus terminals

On the basis of above norms / standards and the class-wise distribution of cities in NCR, the minimum number of bus terminals is 50 as per details given in **Table 14.9**. City-wise categorization of terminals along with the estimates of area requirement is given in **Annexure 14.2**. Estimates of land required and that of the investments in acquisition of land and development/construction of terminals are also given therein. Cost Estimates of Land and construction / development is made on block cost basis.

An investment of Rs 3539 crores for development of bus terminals across the NCR is estimated on PPP modal. The total investment may be made in phased manner generally depending upon the induction of the bus fleet. Accordingly the investment be phased as 20%, 20%, 20% and 40% during 2008-12, 2013-2017, 2018-2022, 2023-2032 respectively.

Table 14.9: Category wise number of terminals

Category of terminal	No. of cities	Terminals				
		No.	Land in acres		Cost of Land Rs in Lakhs**	Cost of construction Rs in Lakhs #
			per terminal	Total		
A+	6	10*	15	150	15000	75000
A	29	29	12.5	363	36300	185000
B	8	8	7.5	60	6000	30000
C2	1	1	5	5	500	2500
C1	2	2	3	6	600	3000
Total		50		584	58400	295500
Total investment required Rs in Lakhs						**353900**
D	others	As per requirement in smaller towns and at the railway stations				

Source: Study on Integrated Transportation Plan for NCR
*Note: *@ 1 per 15 lakhs population of a city (excludes Delhi)*
*** cost of land taken as Rs 100 Lakhs per acre on an average*
 # cost of buildup space taken @ Rs 500 lakhs per acre of terminal area as lump sum.

iii) Bus stations at Railway Stations

Bus bays @ of one Bus bay for peak hour load of upto 200 rail passengers (assuming that 50% of rail commuters would travel by buses for access to/dispersal from the railway stations) be planned at the Railway stations besides idle parking space for buses, parking area for IPTs, private vehicles, etc. This provision is expected to facilitate seamless transfer of commuters between Rail – road modes. A space of about 200 square meters be earmarked for every bus bay and the bus circulation needs. Parking space for idle buses, IPTs and the NMTs be also provided at each of the stations.

iv) Bus Stops and Bus Shelters

For convenience of commuters boarding buses en-route, suitable bus shelters are proposed at the main bus stops as also at the route ends on PPP concept. The proposed NCRTC (Bus Terminals) is expected to take up this activity as well. Alternatively the bus providers may be entrusted the task of developing bus shelters in their respective areas allowing them the commercialization of such shelters for revenue earning. Permission of land owning agencies in any case would be required.

v) Operations Management and Maintenance (O & M) of Bus Terminals

Although the private investor brings in the investment for development of the bus terminal facilities, he may not have adequate expertise and or significant interest in (O&M) of the bus terminals in view of insignificant revenue potential there-from. (O&M) of bus terminals is proposed through a third agency on PPP concept following a process of transparent and competitive bidding. The Operations Management & Maintenance (O&M) agency would not only carry out the day-to-day operations of the bus terminals, but would also maintain the facilities available at the bus terminals. This O&M agency would be allowed to raise additional revenues by way of:

- User charges from the bus providers / operators / all other users of bus terminals
- Parking charges from all types of vehicles
- Advertisement in the bus terminal area (except that reserved for the Real Estate Developer), wherever permitted by applicable laws

- Renting out shops, offices, etc. in the bus terminal operational area allotted to the new Corporation

14.2.3.4 Public Private Partnership Options for Development of Bus Terminals and Other Facilities – Concepts and their Evaluation

Public Private Partnership or PPP is a mode of implementing government programmes / schemes in partnership with the private sector. The term private in PPP encompasses all non-government agencies such as the corporate sector, voluntary organizations, self-help groups, partnership firms, individuals and community based organizations. PPP moreover, subsumes all the objectives of the service being provided earlier by the government, and is not intended to compromise on them. Essentially, the shift in emphasis is from delivering services directly, to service management and coordination. The roles and responsibilities of the partners may vary from sector to sector. While in some schemes/projects, the private partner may have significant involvement in regard to all aspects of implementation; in others Private Operator may have only a minor role.

Development of bus terminals and other facilities for the mass passenger road transport system in the NCR, under the PPP modal, involves the following main activities:

- Assessment of total requirement of bus terminals, their location, sizes and the quantum of facilities/ amenities needed.
- Planning for phased development
- Preparation of detailed feasibility reports
- Preparation of detailed Designs of various facilities at different locations and their approvals by the competent agency.
- Contracting Real Estate Developers for construction of all facilities and the build up area in the terminals, its maintenance and commercialisation, etc.
- Detailed operations planning and management for terminal
- Out-sourcing operations and maintenance of terminals besides those of other assets
- Out-sourcing of commercial exploitation activities (e.g. renting of spaces, kiosks, parking areas, etc) of the above assets through a competitive and transparent bidding process
- Coordinating activities of various service providers
- Over all management of terminals and other facilities
- Development and management of Passenger Information Systems through PPP concepts
- Developing Management Information Reports periodically
- Any other activity related to above tasks

The above activities are proposed to be performed by an independent agency under the overall control of the Government to avoid any bias between public and private bus operators. Accordingly Bus Terminal Corporations could be established by the NCR Constituent States for each sub-region.

14.2.4 Rail System

14.2.4.1Rail Network in NCR

NCR has a fairly developed rail network system. They are mainly radial lines converging into Delhi. The rail system caters for long distance, destined and through, traffic both passenger and goods on

mixed corridors. As far as intra – regional movements in NCR are concerned, the role of railways is to cater to the large and increasing commuter travel demand. While presently, the commuter movement is mainly between Delhi and regional towns, over a period of time, there would also be very huge demand for such movements amongst the regional centers. **Figure 14.18** shows the rail network in Delhi area and surroundings.

Indian Railways, as the prominent carrier of goods and passengers, do face conflicting demands of long distance/medium distance travelers' vis-à-vis short distance and commuter traffic on one hand and fast vis-à-vis stopping passenger trains on the other. Indian Railways strive to meet the aspirations of upper class passengers of Shatabadi/Rajdhani as well as the basic needs of mobility of rural and townships populace. On the same infrastructure, they try to fulfill the requirement of agriculture, industry and other sectors of economy. With growing aspirations, trade is now demanding guaranteed transit. Hence, in their planning process, Indian Railways have not been, broadly, able to concentrate on Regional/local commuter traffic exclusively. The issues of punctuality, reliability of service, comfort, seamless operation, reduction in waiting time , and physical transfer from one mode to another, and above all affordability of tariff (or economic viability for the railways) are equally vital in determining the socially and individually preferred mode of travel. Absence of exclusive and dedicated corridors for passenger/commuter or segregation of freight and passenger corridors has been one of the main constraints to channelise resources exclusively on regional passenger traffic. Indian Railways' line capacity around Metro cities including Delhi has been predominantly saturated. Signaling up-gradation and electrification of certain sections do take place at time and pace, which fits into national priorities, considering over all availability of resources and relative importance of works. This also applies to creation of infrastructure related to terminals and rolling stock.

Existence of surface crossings needing rail-over-rail flyovers, level crossings (manned/unmanned), need of reversal of train direction, change of traction, speed differential between various types of trains running on the same section, maintenance blocks and existence of junction stations are other problems affecting provision of better commuter services in NCR. Line Capacity of Indian Railways, especially around Metro Cities, has been under severe pressure and is over-saturated.

Railways, in their normal development plans, have taken up a number of programmes for augmentation of capacities along the different corridors which also forms the part of proposals in the Regional Plan-2021. Ongoing projects on existing corridors whether by way of additional tracks, signaling, up gradation, augmentation of amenities on traffic facilities, etc. will help NCR commuters in the interim period. However, the final remedy will be manifest only after additional dedicated corridors are created, as travel demand is likely to rise tremendously. Offloading of goods traffic as a result of creation of DFC, on certain segments will also go a long way to help NCR commuter primarily on Delhi – Palwal, Delhi – Rewari and Delhi Junction -Khura sections. Phases and stages of RRTS may not be identical for each corridor in the intervening periods; adjustments of services can be made to maintain some satisfactory levels. But norms of planning process of IR may not suffice and meet the aspirations of NCR population. Issues of additional funding and minimum level of services would be their for accelerated pace of infrastructure creation. Details of projects already taken up by Indian Railways in the National Capital Region are at **Annexure 14.3.**

14.2.4.2 Issues

i) **Need for Integrated Planning:** In view of rapidly increasing population, enhanced requirement of mobility and resultant travel demand, there is a need of greater cohesion in planning and execution of rail system in National Capital Region. It is the right time to review and reconsider the movement pattern of suburban commuters, intercity passengers within NCR, long distance passenger operation originating / terminating into National Capital and voluminous freight traffic. During the last one decade, railways have already started thinking, de novo about configuration of

network as well as segregation of freight and passenger. This has resulted into sanctioning of Eastern and Western Dedicated Freight Corridor, directional coaching terminals (viz. Anand Vihar, Holambi Kalan, Bijwasan and Shakurbasti, etc.). Augmentation of line capacity by way of quadrupling of Palwal-Tughlakabad, Sahibabad-Anand Vihar, Ghaziabad-Aligarh sections as well as 6 lines entering into Delhi and New Delhi Areas are also part of schemes. To cater to suburban like passengers, EMU/MEMU operation may be extended to all the radials and EMU Car sheds planned along with acquisition of rolling stock.

ii) **Need for New Suburban Terminals:** It is expected that some freight handling terminals viz. Shakurbasti, Subzi Mandi and Delhi Kishan Ganj will undergo major changes and freight will get shifted to outskirts of NCTD. Space thus created can be utilized for creating suburban terminal. RITES report had recommended New Tilak Bridge as a NCR commuter hub. With DMRC alignment coming in that area new suburban terminal will have to be found. Tuglkabad, Okhla, Shakurbasti, Subzi Mandi, Delhi Kishan Ganj and Patel Nagar Junction can be explored to fill the gap. Considering the maximum routes can have access to Shakurbasti, it may prove to be an ideal location for suburban terminal. Other locations can be explored for mini suburban terminal.

iii) **Need of dedicated regional corridors:** Apart from the road and MRTS network, significant and substantial demands for low cost fast train services within NCR need to be met by augmentation of existing rail network. In this direction, all the 8 radials need to be electrified and provided with automatic and modern signaling. All the radials need to have independent double line electrified corridor for running of commuter trains by way of operation of EMUs. As seamless operation of Metro and Indian Railways trains does not appear to be feasible now, a smooth and fast transfer of passengers on the two networks is essential. Integrated ticketing need be experimented to save lot of time and effort. This can be done along with adequate junction arrangements and planning traveling facilities appropriately.

iv) **Smooth Transfer of Passengers:** With the establishment of Anand Vihar and sanctioning of Bijwasan, Holambi Kalan and Shakurbasti coaching terminals (apart from the existing 4 passenger terminals at Delhi, New Delhi, Nizamuddin and Sarai Rohilla), and Delhi Metro touching some of them , the conceptual plan of 70s and early 80s can get materialized in near future.

v) **Review of Freight & Coaching Complexes at same location:** Though the Railways have plans to have integrated freight terminals at Holambi Kalan and Bijwasan, they need to be reviewed keeping the future needs of NCT as well as NCR. Segregation of the two streams is recommended strongly.

vi) **Exploring new ways of financing:** NCR Rail Network Corporation need to be conceived to develop infrastructure for an efficient safe and sustainable railway system in NCR to provide comfortable and friendly service to the commuters on the lines of Mumbai Rail Vikas Nigam (MRVC). The financial modal could be equity participation and sharing of cost among the constituent States or any other financial modal which could be explored by the concerned agency/corporation. Market borrowings could also be resorted to with the consent of all participating agencies.

14.2.4.3 Travel Demand and Loadings by Corridors

An extensive Regional Rapid Transit System has been conceived along with the Regional Road Network as an integrated network, for assignment of intra-region passenger traffic by public transport (road & rail). The modal share of regional rail system has been estimated to be 12.8%. The passenger demand by HY is 1.7million passenger trips per day. It is noted that this represents only the intra-region passenger trips that may be considered as the daily commuter travel demand. The inter-region

trips are not considered, but are estimated to be 3.5 lakhs in the region. They need to be inducted to visualize the overall loading on the recommended RRTS. The estimated rail corridor commuter trip loadings along each of eight corridors of the RRTS, by the HY(2032) is given in **Table 14.10**. Section-wise travel demand for RRTS corridors is given **Annexure 14.4 (i-ix).**

Table 14.10: Travel Demand & Average Trip Length on RRTS Corridors

S.No.	Line	Length (kms)	Travel Demand in the year 2032 (Passenger Trips per Day)	Average Trip Length (kms)
1a	Delhi – Ghaziabad	20.0	385586	8.60
1b	Ghaziabad – Meerut	47.0	115692	16.32
2	Delhi – Rewari – Alwar	158.0	608643	24.77
3	Delhi – Faridabad – Palwal	60.0	214123	20.81
4	Ghaziabad – Khurja	83.0	229134	12.67
5	Delhi – Sonipat – Panipat	89.0	273264	26.64
6	Delhi – Bahadurgarh– Rohtak	70.0	81388	30.00
7	Delhi – Ghaziabad – Hapur	57.0	114213	14.75
8	Shahadra – Baraut	56.0	48223	20.47

Source: Study on Integrated Transportation Plan for NCR

14.2.4.4 Prioritization of RRTS Corridors with Costing

While all the rail corridors of the RRTS are important to cater to the commuter needs of the region, considering the constraints of money and stages of development, prioritization has been undertaken. This is based on traffic demand, trend of population and activities distribution, important programmes already on hand and other factors.

Table 14.11: Prioritisation & Cost of RRTS Corridors

Order of Priority	Corridor	Length including Delhi Urban Area (km)	Approximate cost of dedicated RRT infrastructure in NCR including Delhi Urban Area without Rolling Stock (in millions)
1	Delhi - Ghaziabad -Meerut	67.0	Rs 13400
2	Delhi - Gurgaon – Rewari - Alwar	158.0	Rs 31600
3	Delhi – Faridabad – Ballabgarh - Palwal	60.0	Rs 12000
4	Ghaziabad – Khurja	83.0	Rs 16600
5	Delhi – Sonipat - Panipat	89.0	Rs 17800
6	Delhi - Bahadurgarh - Rohtak	70.0	Rs 14000
7	Delhi - Ghaziabad-Hapur	57.0	Rs 11400
8	Delhi-Shahadra-Baraut	56.0	Rs 11200
	Total	**640.0**	**Rs128000**

Source: Study on Integrated Transportation Plan for NCR
**Rs 200 million per km (for double line) has been broadly estimated*
***Cost of length between Delhi – GZB has been taken once in GZB – Hapur line*

The broad costs of rolling stock for RRTS have been worked out with the following assumptions:

i. The trains will run at 10 minutes frequency in the peak period and 20 minutes frequency in the non-peak period.
ii. The peak period has been assumed to be between 6hrs and 10hrs and between 18 to 21 hrs. This works out to 7 hrs in a day.
iii. The non-peak period is assumed to be 10 hrs to 18 hrs and 21 hrs to 24 hrs. It works to to 11 hrs in a day.
iv. In all, approximately 160 rakes would be required.
v. Maximum speed of the trains has been taken as 100 kmph, while the average speed has been taken as 50 kmph.
vi. The trains will run with 6 coach EMU rake including 2 motor coaches and 4 trailer coaches in each rake. The cost of the motor coach has been worked out to Rs 2 crores each while the trailer coach has been assumed to be Rs 50 lakhs.
vii. A spare 7.5% has been assumed.

viii. A workshop would be established at the cost of Rs 250 crores.
ix. In all, 320 motor coaches and 640 trailer coaches would be required.
x. When the whole infrastructure will be in place, rakes are likely to give us an output of 500 km per day.

Table 14.12: Corridor-wise cost of Rolling Stock on RRTS

SI. No.	Corridor	Length (Kms)	Rolling Stock Cost (including Spares) (Rs in million)
1	New Delhi/Delhi – Palwal	60	1370
2	New Delhi/Delhi – Panipat	89	1920
3	New Delhi/Delhi – Rohtak	70	1670
4	New Delhi/Delhi – Rewari (Alwar)	158	2500
5	New Delhi/Delhi – Shahadra – Baraut	56	1300
6	New Delhi/Delhi– Ghaziabad – Khurja	83	1780
7	New Delhi/Delhi– Ghaziabad – Hapur	57	1420
8	New Delhi/Delhi– Ghaziabad– Meerut	67	1510
	Total	**640**	**13470**

Source: Study on Integrated Transportation Plan for NCR

14.2.4.5 NCR Transport Corporation

Management of Rail Network and its operation within NCR is very complex. The long and short distance passenger and goods services are under the Indian Railways Zonal management. The Dedicated Freight Corridors may come under a distinct management unit of Indian Railways for operation. The operation of the NCR – Regional Rapid Transit System (NCR – RRTS) for commuter services calls for intense and dedicated management. It is recommended that a NCR Transport Corporation (NCRTC), on the lines of Mumbai Rail Vikas Corporation, may be set up as a SPV for overall development of Integrated Multi-Modal Transport System including Commuter Rail and feeder bus services for commuter in NCR. Its objective would be:

i) To develop/strengthen the existing urban / suburban rail infrastructure and other multi-modal transport services to improve connectivity in NCR.
ii) Commercial utilization of land and air space to supplement resources to fund its activities; and
iii) To coordinate with Central Government i.e. Ministry of Urban Development; Indian Railways and NCR Planning Board and Governments of NCT-Delhi, Haryana, Rajasthan and U.P. and other related agencies and evolve and execute suitable plans for the development of Suburban Rail System of NCR i.e. Regional Rapid Transit System (RRTS).
iv) To operationalise the RRTS and other transport services in coordination with the stake holders.

Funds for implementation of 8 suburban rails projects included in RRTS and other related works shall be arranged by the NCRTC through its equity holders, market borrowings and other sources.

14.2.4.6 Regional Orbital Rail Corridor

Regional Plan-2021 for NCR proposed an Orbital Rail corridor around Delhi parallel to proposed Peripheral Expressway which is under implementation. This corridor was envisaged to enable bypassing of a number of trains, presently passing through Delhi and to provide commuter services to the proposed urbanization along this corridor. Indian Railway has proposed Delhi-Mumbai Freight Corridor which also passes through NCR and will reduce the non-destined freight movement to Delhi

and part of NCR. In view of this, the Regional Orbital Rail Corridor (RORC) was reviewed and as an alternative, Panipat-Gohana-Rohtak-Jhajjar-Rewari-Palwal-Khurja-Hapur-Meerut- Baraut-Panipat rail corridor is proposed to serve as Regional Orbital Rail Corridor (RORC). In this RORC, rail link between Panipat-Gohana-Rohtak and Khurja-Hapur-Meerut are existing rail links and rail link Rohtak-Jhajjar-Rewari is under execution. Survey for Rewari-Palwal-Khurja rail link and Meerut-Baraut-Panipat is in progress. This revised RORC would serve as a regional commuter service corridor as it inter-connects metro, regional and sub-regional centres in NCR and also provides for corridor for bypassing the freight traffic. This will increase the accessibility and potential for growth in NCR.

It is proposed that Indian Railways may take up implementation of Rewari-Palwal-Khurja and Meerut-Baraut-Panipat corridors to complete the outer orbital corridor and provide necessary commuter rail services. Section-wise passenger demand is summarized below:

Table 14.13: Regional Orbital Rail Corridor Passenger Demand

SI No.	Section	Length (km)	No. of Stations	Passenger Trips per day
1	Panipat – Gohana – Rohtak (existing)	75.0	3	40005
2	Rohtak – Jhajjar – Rewari (under execution)	80.2	3	16110
3	Rewari – Palwal – Khurja (new)	129.5	3	129284
4	Meerut – Hapur – Khurja (existing)	66.0	3	94330
5	Meerut – Panipat (new)	85.6	3	25505

Source: Study on Integrated Transportation Plan for NCR

The corridor-wise station and section loadings are given in **Annexure 14.5 (i-vi).**

It is proposed that the new lines on these corridors be initially single lines with electrification and colour light signaling with a plan to expand. With Khurja-Hapur-Meerut and Shakurbasti-Rohtak sections getting electrified, Rohtak-Panipat branch may also be sanctioned for electrification. Present traffic density may not appear to justify it. However, to obviate the problems related to multi-tractions and change of tractions in the region, it is suggested that all legs of RORC be electrified. They are also proposed to be fit to run MEMU/ EMU progressively.

Table 14.14: Cost of Development of Regional Orbital Rail Corridor

S. No.	Regional Orbital Corridor	Length (kms)	Cost excluding Rolling Stock (in millions)
1.	Panipat - Meerut (new)	86	4708
2.	Meerut - Khurja (existing)	-	-
3.	Khurja - Palwal (new)	54	2943
4.	Palwal - Bhiwadi - Rewari (new)	76	4180
5.	Rewari - Rohtak (under construction)	80	4411
6.	Rohtak - Gohana - Panipat	-	-
	Total	**296**	**16242**

Source: Study on Integrated Transportation Plan for NCR

14.2.4.7 Inner Regional Orbital Rail Corridor/Other New Rail Lines

i) Inner Regional Orbital Rail Corridor

In addition to RORC, five other rail lines within NCR are proposed to strengthen the connectivity of the rail system which will form Inner Regional Orbital Rail Corridor (IRORC). These rail lines could also form the part of RRTS. They are:

a) Sonipat-Kharkhauda-Sampla–Jhajjar (56 Kms)

It is proposed to link Sonipat with Jhajjar via Kharkhauda and Sampla. This line in continuation with the other proposed lines would form a tangential rail corridor to the CNCR. This corridor would be developed to operate both goods and passenger train services.

b) Jhajjar - Gurgaon (40 Kms)

A large SEZ has been proposed between Gurgaon and Jhajjar. It would generate intense commuter and fright traffic. It is proposed to develop a rail link between Jhajjar and Gurgaon, connecting the proposed Rohtak –Jhajjar Rewari rail line and the Delhi-Gurgaon–Jaipur–Ahmedabad-Mumbai route. The rail line may skirt the proposed SEZ. The above line may be developed under PPP mode.

c) Gurgaon - Faridabad - Dadri (53 Kms)

The Jhajjar-Gurgaon rail line is proposed to be extended upto Faridabad, connecting the two major urban nodes and linking it with Delhi–Bhopal-Chennai rail line route from Faridabad. It is proposed to be further extended to Dadri to link with Ghaziabad – Aligarh line and the proposed DFC terminal at Dadri. The above two rail lines would also cater to the intense commuter movement in this part of CNCR.

d) Meerut - Sonipat (66 Kms)

It is also proposed to connect Sonipat with Meerut.

e) Dadri – Ghaziabad - Meerut

The missing rail link in IRORC is between Dadri-Ghaziabad and Ghaziabad-Meerut which could be used from the RRTS Corridors to complete the orbit.

Both these Orbital Rails i.e. RORC and IRORC will connect most of the metro and regional centres in NCR.

ii) **Other New Rail Lines**

Sonipat - Gohana - (Jind) (51 km within NCR):

This line has been proposed to connect Jind, an important town in Haryana, with other NCR towns. It is already sanctioned and is under execution.

The estimated commuter passenger travel demand, apart from freight traffic, along these corridors/lines is given in **Table 14.15** and cost of development of IRORC is given in **Table 14.16**.

Table 14.15: Passenger Travel Demand on IRORC

S. No.	Corridor	Passengers per day
1.	Sonipat – Gohana	10282
2.	Sonipat – Meerut	22727
3.	Sonipat –Jhajjar	203750
4.	Jhajjar - Gurgaon	12420
5.	Gurgaon – Faridabad – Dadri	187981

Source: Study on Integrated Transportation Plan for NCR

Table 14.16: Cost of Development of IRORC

S. No.	Corridor	Length (kms)	Cost excluding Rolling Stock (in millions)
1	Sonipat - Jhajjar	56	3091
2	Jhajjar - Gurgaon	40	2189
3	Gurgaon - Faridabad	28	1557
4	Faridabad - Dadri	25	1359
5	Meerut - Baghpat - Sonipat	65	3614
6	Sonipat – Gohana - Jind	51	2825
	Total	**265**	**14635**

Source: Study on Integrated Transportation Plan for NCR

14.2.4.8 Cost Estimate

Total estimated cost for development of the proposed Regional Rapid Transit System (RRTS), Regional Orbital Rail Corridor (RORC) and Inner Regional Orbital Rail Corridor (IRORC) is Rs. 1,72,347 millions (cost of rolling stock is included while calculating cost for RRTS but excluded in other lines). Details are given in **Table 14.17**.

Table 14.17: Estimated Cost of Development of RRTS, RORC & IRORC

S.No.	Scheme	Estimated Cost (Rs. Millions)
i)	Regional Rapid Transit System (including rolling stock cost)	1,41,470
ii)	Regional Orbital Rail Corridor	16,242
iii)	Inner Orbital Rail Corridor & New lines	14,635
	Total Cost	**1,72,347**

Source: Study on Integrated Transportation Plan for NCR

14.2.4.9 Logistics Hubs/Inland Container Depots/ Yards

NCR is a high intense goods movement region. A large volume of goods, of all types move into/out of the region for consumption, storage and distribution. Import/export traffic from the northern region moves into the region for modal transfer. The NCR also produces goods of various types which need to move within and to other regions. Intensity of goods movement will get further intensified with the development of the two Dedicated Freight Corridors which traverse through the region and meet at Dadri. An extensive rail yard is being developed at Dadri. Presently there are a number of Inland Container Depots (ICDs) along existing rail network at

- Loni
- Faridabad
- Dadri
- Patli
- Tuglakabad
- Garhi Harsaru

In addition, an extensive Logistics Hub/Container Yard also needs to be developed at Dadri. Such yards and hubs need to be developed also at other locations within the region.
Logistics Park is proposed at Dadri where Western and Eastern Dedicated Freight Corridors are proposed to interest each other. However, considering the development prospects of CNCR of which Dadri is a part, major constraints may arise for receipt and evacuation of goods from Dadri to different originating & destination points by road system. Also, availability of land for various related needs may prove to be difficult and costly. It is suggested interlinking the two DFCs at Khurja and development of Logistics Park and other related facilities may be planned and developed at this location too. With the proposed Regional Expressway and Rail Systems in NCR, it will be more efficient to receive and distribute the goods traffic to & from Khurja. However, the final locations could be finalized after detailed survey to be carried out by the implementing agencies in consultation

with the concerned State Authorities. The proposed tentative location of Logistic hubs, Orbital Rail Corridor and proposed DFC are shown in **Map 14.3 .** Proposed tentative locations of distribution centres are as follows:

- Greater Noida
- Asaoti/ Pirthala
- Daruhera
- Rewari (along western DFC)
- Khurja (along eastern DFC)
- Rohtak (along ORC)
- Panipat (along ORC)
- Meerut (along ORC)
- Hapur (along ORC)

14.2.5 Regional Mass Rapid Transit System (MRTS)

14.2.5.1 Delhi Metro Rail System

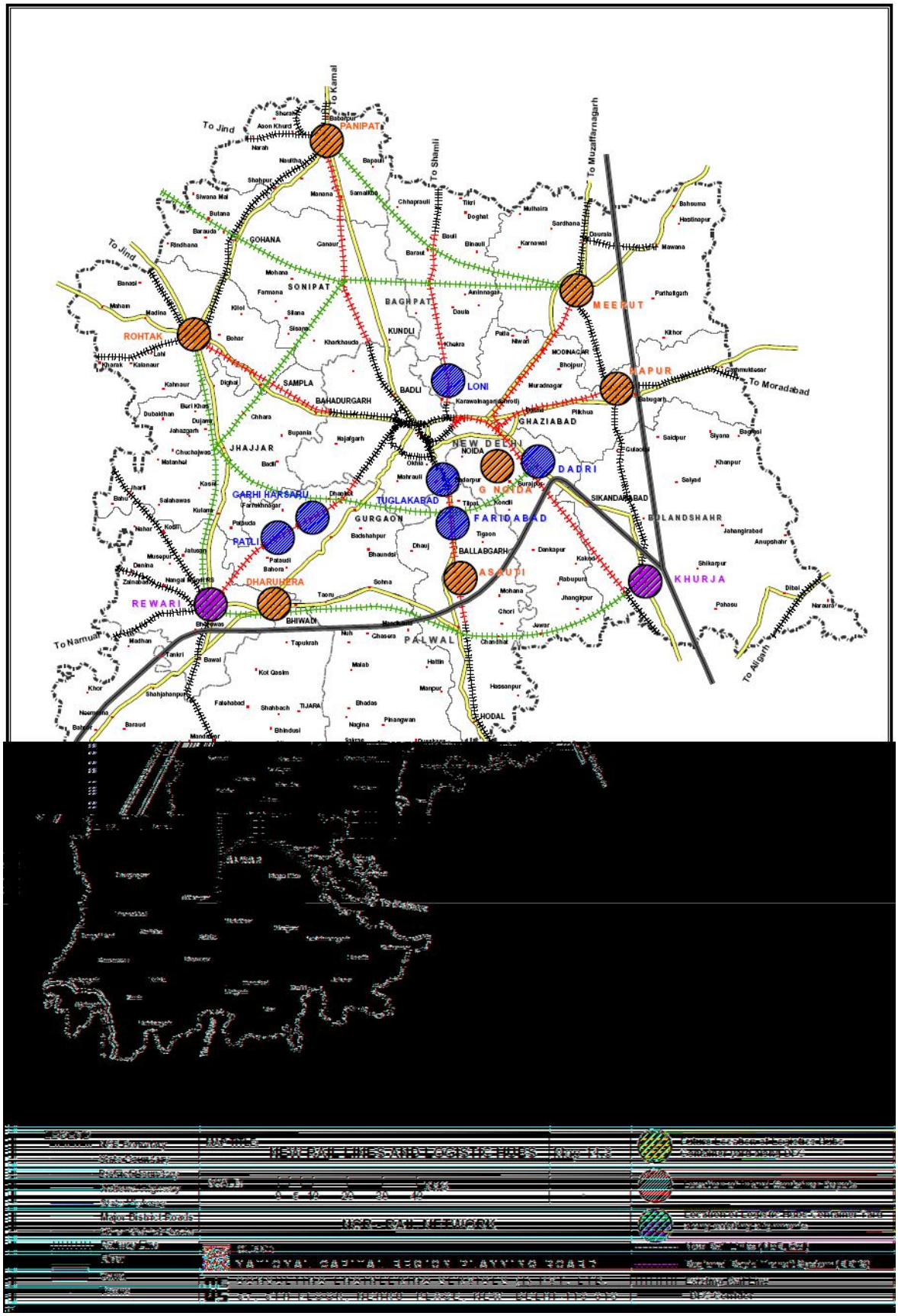
Regional Plan-2021 for NCR proposed the extension of Delhi Metro Rail System to NCR towns. Accordingly, it has been extended to Noida and is proposed to be extended to Gurgaon, Ghaziabad, Faridabad, Bahadurgarh and Greater Noida by Delhi Metro Rail Corporation. The work on Gurgaon corridor is in progress.

14.2.5.2 Mass Rapid Transit System in NCR

Regional Plan-2021 for NCR proposed Mass Transport System for commuters and also recommended high density location and development of population and activities, upto a depth of 500 m on either side of the regional highways designated as Highway Policy Zone. Delhi-Mumbai Industrial Corridor which passes through NCR also proposes to develop industrial areas on both the sides of dedicated Freight Corridor proposed by Indian Railway. All these developments would result in high intensity urban/industrial corridors with intense movement of people. These movements will be alike to intra urban movements – high volume, predominantly for work and education purpose, short trip length and highly oriented to public mass transport. It is proposed to provide MRTS in the Regional Centres & Sub-regional Centres along the proposed Regional Arterial road corridor to accelerate the process of development. The corridors proposed are as follows:

- Noida–Greater Noida–Jewar (65.0 km)
- (Badli) Sonipat-Panipat (42.0 km)
- Ghaziabad-Meerut (42.0 km)
- Ghaziabad-Hapur (35.0 km)
- Faridabad-Palwal (33.0 km)
- Gurgaon-Rewari (39.0 km)
- Bahadurgarh – Rohtak (40.0 km)

The Transport Plan for NCR 2032 showing all study proposal w.r.t. Road, Rail, MRTS, RRTS are shown in **Map 14.4.**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BADLI
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BAHADURGARH
JHAJJAR
GHAZIABAD
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FARIDABAD
GURGAON
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BULANDSHAHR
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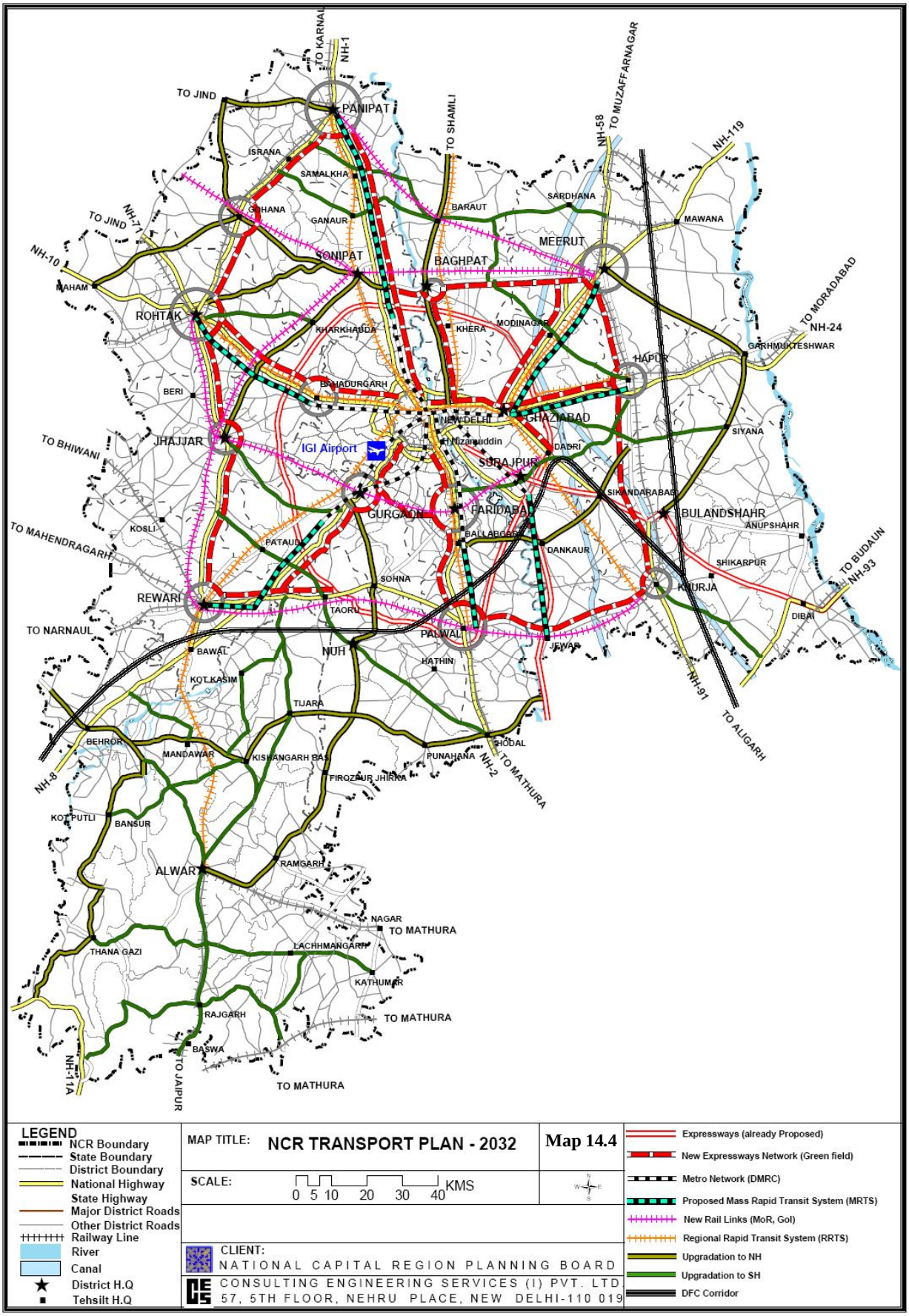
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TO MUZAFFARNAGAR
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GANAUR
BARAUT
MAWANA
TO JIND
NH-71
MEERUT
NH-10
SONIPAT
BAGHPAT
MAHAM
ROHTAK
KHARKHAUDA
KHERA
MODINAGAR
TO MORADABAD
NH-24
GARHMUKTESHWAR
HAPUR
BAHADURGARH
BERI
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FARIDABAD
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ANUPSHAHR
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LEGEND
NCR Boundary
State Boundary
District Boundary
National Highway
State Highway
Major District Roads
Other District Roads
Railway Line
River
Canal
District H.Q
Tehsilt H.Q
MAP TITLE: NCR TRANSPORT PLAN - 2032
Map 14.4
SCALE: 0 5 10 20 30 40 KMS
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
CONSULTING ENGINEERING SERVICES (I) PVT. LTD.
57, 5TH FLOOR, NEHRU PLACE, NEW DELHI-110 019
Expressways (already Proposed)
New Expressways Network (Green field)
Metro Network (DMRC)
Proposed Mass Rapid Transit System (MRTS)
New Rail Links (MoR, GoI)
Regional Rapid Transit System (RRTS)
Upgradation to NH
Upgradation to SH
DFC Corridor

14.2.5.3 Travel Demand on Mass Rapid Transit System (MRTS)

The travel demand on the MRTS for NCR is estimated to be 1.2 million passengers per day. This estimate does not include commuters travelling within the city. MRTS is proposed as an elevated system along the Regional Arterial corridors. It may be noted that Faridabad, Gurgaon – Manesar, Ghaziabad, Noida, Sonipat, Greater Noida and Meerut are likely to cross 2 million to 4 million mark in population by 2032. In case, MRTS as an option is ruled out for any reason, regional road arteries will have to take the burden and personalized mode of transport will be preferred by the users, creating imbalance.

14.2.5.4 Phasing of MRTS in NCR

The development of MRTS in NCR is proposed to be implemented in four phases as under:

Phase I (2010-2013)	:	Surveys, preparation of DFRs and resource mobilization
Phase II (2013-2017)	:	• (Badli-Delhi) – Sonipat • (Shastri Park, Delhi) – Loni • (Dilshad Garden, Delhi) – Ghaziabad (Bus Adda) • Noida City Centre – Greater Noida • (Badarpur, Delhi) – Faridabad • Rajiv Chowk, Gurgaon – Manesar • (Dwarka, Sector 21, Delhi) – Rajiv Chowk (Gurgaon) • (Mundka, Delhi) – Bahadurgarh
Phase III (2018-2022)	:	• Sonipat-Panipat • Ghaziabad-Meerut • Faridabad-Palwal-Jewar (TIA) • Manesar-Rewari • Bahadurgarh-Rohtak
Phase IV (2023-2032)	:	• Loni-Baghpat • Ghaziabad Bus Adda – Hapur • Ghaziabad-Bulandshahr-Khurja

14.2.5.5 Institution

Appropriate Institutional arrangement will have to be made to develop and operate the NCR MRTS. The options could be DMRC or NCRTC or any other suitable institution.

14.2.6 Air Transport

14.2.6.1 International/Domestic Airports

Presently Indira Gandhi International Airport is the only airport providing air service in the NCR and is being upgraded by DIAL. It was handling 20 million passengers in 2007. As per DIAL's projections given in Study Report, it is expected to touch 50 million mark by 2015-16, 82.7 million passengers by 2026 and will touch 100 million mark by 2036. Accordingly, the IGI Airport will be upgraded by DIAL. As per OD pattern of air passengers, 75.75% passengers originate from Delhi, 18.75% from rest of NCR and 5.5% from beyond NCR.

The air traffic growth and air transport development has been facilitated by the Open Air Sky Policy adopted by the Government of India and the facilitating Civil Aviation Policy (CAP), the mission of which is 'to maintain a competitive civil aviation environment which ensures safety and security in accordance with international standards, promotes efficient, cost-effective and orderly growth of air transport and contributes to social and economic development of the country'. The CAP envisages promotion and growth of air transport through a number of measures which include setting up of Facilitation Committees, establishing a regulatory framework in the form of a statutory autonomous Civil Aviation Authority (CAA), encouraging private sector participation in various aspects of air transport system development, ensuring world class airport infrastructure capacity, permitting development of Greenfield airports permitting foreign equity participation, promoting development of small airports, permitting single engine aircraft of seating capacity upto 10 seats for passenger and cargo flights, and a host of other facilitating measures.

Government of Uttar Pradesh has proposed an International Airport at Greater Noida (Jewar) as a greenfield airport which is under consideration by the GoI. It is proposed to handle traffic of 40 million passengers per annum. There are at present some constraints like restriction of a second airport within an aerial distance of 150 km from existing one and the contractual terms with DIAL, the private sector agency who have been awarded the development, operation and management of Delhi International Airport. As per OD pattern of air passengers about 24% passengers coming from rest of NCR & beyond NCR area. Some part of these passengers could get the benefit of this Airport. Apart from this, a part of Delhi-Mumbai Freight Corridor and Delhi-Mumbai Industrial Corridor (DMIC) will also be near this Airport area which could also take the benefit if this Airport is developed.

14.2.6.2 Aerotropolis

There is a great scope for development of an aerotropolis complex near the Greater Noida Airport at Jewar. A number of air transport related functional complexes could be located in this area and a New Town of reasonable size could be planned and developed.

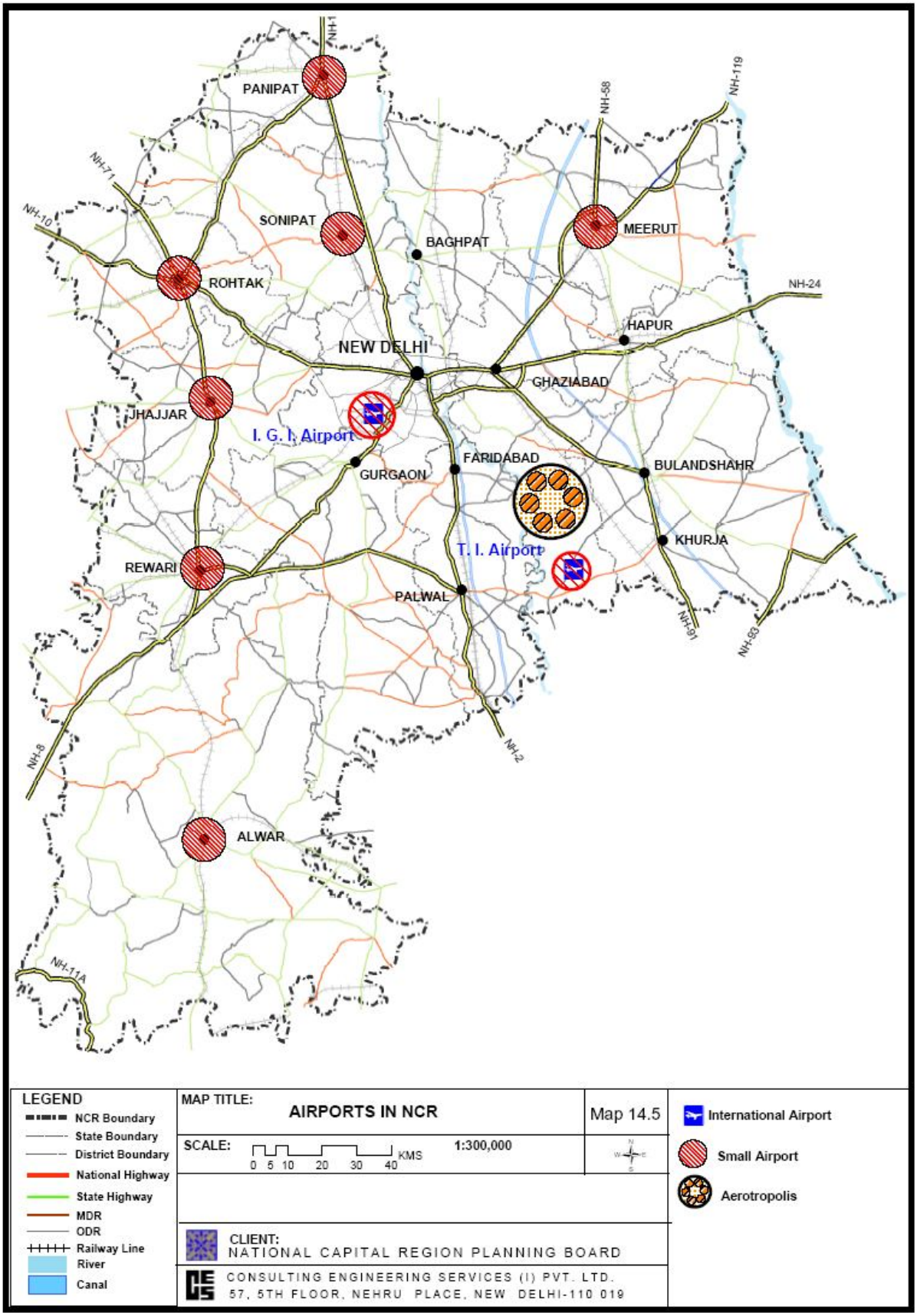
14.2.6.3 Domestic Airport at Jhajjar

Government of Haryana is considering a Domestic Airport at Jhajjar. This forms part of the mega Haryana SEZ at Jhajjar-Gurgaon. This location is very close to IGIA and will need detailed examination of operational and legal aspects apart from its viability.

14.2.6.4 Smaller Airports

NCR being a high activity area, there is a scope for developing smaller airports in some of the major urban centres within it. These would facilitate movement of business executive in smaller private aircrafts avoiding delays along the road system. The potential centres are Meerut, Rewari, Alwar, Rohtak, Sonipat and Panipat. However, their consideration will need detailed examination.

Map 14.5 depicts the proposed airports in NCR.


PANIPAT
SONIPAT
BAGHPAT
ROHTAK
MEERUT
HAPUR
NEW DELHI
GHAZIABAD
JHAJJAR
I. G. I. Airport
GURGAON
FARIDABAD
BULANDSHAHR
KHURJA
T. I. Airport
REWARI
PALWAL
ALWAR
NH-1
NH-58
NH-119
NH-71
NH-10
NH-24
NH-91
NH-93
NH-8
NH-2
NH-11A
LEGEND
NCR Boundary
State Boundary
District Boundary
National Highway
State Highway
MDR
ODR
Railway Line
River
Canal
MAP TITLE:
AIRPORTS IN NCR
Map 14.5
SCALE:
0 5 10 20 30 40 KMS
1:300,000
International Airport
Small Airport
Aerotropolis
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
CONSULTING ENGINEERING SERVICES (I) PVT. LTD.
57, 5TH FLOOR, NEHRU PLACE, NEW DELHI-110 019

Phasing & Cost Estimates

Transport system development is highly costly and calls for long gestation period. Concerted efforts need to be made to mobilize resources from a variety of sources. Institutional framework needs to be established to allocate resources on a rational and systematic basis. Appropriate recommendations covering these aspects have been made separately.

15.1 Phasing

The IMMTP is to be developed over a period of 25 years (2008-2032). The development programme is envisaged in 4 time period phases as under:

Phase I	:	2008 – 2012
Phase II	:	2013 – 2017
Phase III	:	2018 – 2022
Phase IV	:	2023 – 2032

15.2 Phasing Programmes

The programmes covering Roads, RRTS, Regional Metro, Bus System, Bus Terminals and other components have been identified into different phases based on traffic volumes, spatial development priorities and other policy measures. The proposed phase wise programmes are detailed in **Table 15.1.**

Table 15.1: NCR IMMTP – Development Programme –Road

SI. No.	Categories	Length (Km)	ROW	Type	No. of Lanes							
					Phase-I		Phase-II		Phase-III		Phase-IV	
					2008-12	Traffic	2013-17	Traffic	2018-22	Traffic	2023-32	Traffic
Expressways												
1	Ganga Expressway	65.0	100	Greenfield	6	103140	6	155198	6	233531	8	265591
2	Yamuna Expressway (within NCR)	65.0	100	Greenfield	6	53637	6	78929	8	116146	8	154687
3	Kundli – Manesar – Palwal Expressway (Western Expressway)	135.6	100	Greenfield	6	4257	8	10252	10	24689	10	35915
4	Faridabad – Noida – Ghaziabad Expressway (Eastern Expressway)	136.0	100	Greenfield	6	3540	8	9404	10	24980	10	29238
	Total	**401.6**										
Regional Expressways (Greenfield Alignments)												
1	Delhi - Panipat	69.75	100	Greenfield		109431	6	132652	6	160801	8	281180
2	Delhi –Ghaziabad	15.34	100	Greenfield		37218	4	68033	6	124361	8	244818
3	Ghaziabad – Modinagar – Meerut	33.21	100	Greenfield		38658	4	57242	6	84760	8	158122
4	Ghaziabad – Hapur	25.90	100	Greenfield		5001	4	10950	6	18022	8	23976
5	Delhi – Faridabad – Palwal	44.75	100	Greenfield		73524	4	101527	6	140196	8	231600
6	Gurgaon - Manesar - Daruhera	64.55	100	Greenfield		40663	4	54013	6	71747	8	83410
7	Panipat – Gohana – Rohtak	58.40	100	Greenfield		3092	4	8234	6	21927	8	21987
8	Rohtak – Rewari	80.01	100	Greenfield		22172	4	38229	6	65914	8	79532
9	Rewari – Daruhera -	21.38	100	Greenfield		37387	4	63928	6	109312	8	79108

SI. No.	Categories	Length (Km)	ROW	Type	No. of Lanes							
					Phase-I		Phase-II		Phase-III		Phase-IV	
					2008-12	Traffic	2013-17	Traffic	2018-22	Traffic	2023-32	Traffic
	Bhiwadi – Palwal											
10	Palwal – Khurja	50.98	100	Greenfield		1391	4	2758	6	5467	8	6471
11	Khurja – Hapur – Meerut	72.44	100	Greenfield		7167	4	10194	6	14499	8	19060
12	Meerut – Bagh pat - Sonipat	37.48	100	Greenfield		8528	4	21548	6	54447	8	63351
13	Ghaziabad –Bulandshahr till Dadri	18.17	100	Greenfield		9993	4	30786	6	94844	8	132040
14	Delhi – Baghpat	36.28	100	Greenfield		10579	4	31485	6	93703	8	121599
15	Gurgaon - Faridabad	18.72	100	Greenfield		4998	4	20846	6	86948	8	99915
16	Delhi – Bahadurgarh – Rohtak	57.94	100	Greenfield		97665	4	147180	6	221800	8	351615
	Total Length	**705.3**										

Source: Study on Integrated Transportation Plan for NCR

S. No	Regional Arterials	Length (km)	ROW	Existing Configuration	No. of Lanes							
					Phase-I		Phase-II		Phase-III		Phase-IV	
					2008-12	Traffic	2013-17	Traffic	2018-22	Traffic	2023-32	Traffic
1	Delhi – Panipat (NH-1)	84.0	60	6	6	284291	8	357819	10	450365	10	476842
2	Delhi –Ghaziabad (NH-24)	21.0	60	4	6	240348	8	320702	10	427921	10	414317
3	Ghaziabad – Modinagar – Meerut (NH-58)	53.0	60	4	4	37403	6	42692	8	48730	8	50719
4	Ghaziabad – Dadri – Bulandshahr (NH-91)	48.0	60	2	4	37892	6	48951	8	63238	8	54886
5	Ghaziabad - Hapur (NH 24)	37.0	60	2	4	22500	6	27355	8	33257	8	86970
6	Delhi – Faridabad – Ballabgarh – Palwal (NH-2)	60.0	60	4	6	353164	8	400332	10	453799	10	488300
7	Delhi – Gurgaon (NH-8)	30.0	60	8	8	263021	10	289918	10	319566	10	419631
8	Gurgaon - Manesar - Daruhera (NH-8)	49.0	60	4	6	81604	8	97744	10	117076	10	136990
9	Delhi – Bahadurgarh (NH-10)	28.0	60	4	4	35691	6	53588	8	80460	8	100373
10	Bahadurgarh - Rohtak	42.0	60	2	2	45485	4	63737	6	89314	8	133852
11	Panipat – Gohana – Rohtak (NH-71A)	67.0	60	2	2	36908	4	57723	6	90276	8	151479
12	Rohtak – Rewari (NH-71)	80.0	60	2	2	20230	4	27951	6	38620	8	66215
13	Rewari - Palwal (NH-71 B)	83.0	60	2	2	16915	4	23357	6	32253	8	36599
14	Palwal - Khurja	56.0	60	1	2	4435	4	5919	6	7900	8	12466
15	Khurja - Hapur	53.0	60	2	2	29471	4	37772	6	48412	8	73117
16	Hapur - Meerut	33.0	60	2	2	35916	4	47279	6	62238	8	80709
17	Gurgaon - Sohna	23.0	60	6	6	11842	8	19411	8	31819	8	63100
18	Sohna - Alwar	94.0	60	2	2	34181	4	42324	6	52407	6	82690
19	Jhajjar - Gurgaon	48.0	60	2	2	5960	4	8702	6	12706	6	15766
20	Sonipat - Jhajjar	56.0	60	2	2	7019	4	10983	6	17186	6	31433
21	Ballabgarh - Gulavathi	45.0	60	1	1	1020	2	2734	4	7328	6	7921
22	Hodal - Tijara - Behror	133.0	60	1	1	14829	2	27218	4	49957	6	89051
23	Behror - Partapgarh	100.0	60	1	1	26110	2	37374	4	53498	6	91542
24	Meerut - Garhmukteshwar - Bulandshahr	93.0	60	2	2	4622	4	6073	6	7980	6	8255

S. No	Regional Arterials	Length (km)	ROW	Existing Configuration	No. of Lanes							
					Phase-I		Phase-II		Phase-III		Phase-IV	
					2008-12	Traffic	2013-17	Traffic	2018-22	Traffic	2023-32	Traffic
25	Sonipat - Rohtak	46.0	60	1	1	13536	2	19639	4	28493	4	36665
26	Sonipat - Gohana - Asan	94.0	60	2	2	8385	4	13827	4	22800	4	42183
27	Gohana - Maham	51.0	60	2	2	15582	2	26116	2	43772	4	77885
28	Palwal - Hodal	33.0	60	6	6	25895	8	37062	10	53045	10	57461
29	Meerut - Muzaffarnagar (till NCR Border)	19.0	60	2	4	15254	6	20594	8	27803	8	37105
30	Rewari – Bawal (NH-71)	11.0	60	2	2	46075	4	64511	6	90324	8	69465
31	Daruhera - Behror	63.0	60	4	6	92247	8	125119	10	169704	10	142159
32	Khurja - Border of NCR to Aligarh	19.0	60	2	4		6		8		8	
33	Panipat - Border of NCR (NH-1)	9.0	60	6	8	42519	10	61239	10	88203	10	106795
34	Hapur – Garhmukteswar (NH-24)	35.0	60	2	4	16971	6	23439	8	32371	8	40776
35	Rohtak – Quila Jafargarh (NH-10)	35.0	60	2	2	47868	4	67858	6	96197	8	128354
36	Meerut – Bahsuma (NH-119)	50.0	60	2	2	13989	4	19319	6	26681	6	41140
37	NH - 93	38.0	60	2	2	396	4	255	6	164	6	569
38	NH - 11 A	37.0	60	2	2	7793	4	11096	6	15800	6	16117
39	Loni - Baghpat - Baraut - Till NCR Border	68.0	60	2	4	31747	6	34646	8	37810	8	39096
40	Rohtak - NCR Border (NH -71)	22.0	60	2	2	7202	4	13326	6	24656	8	55868
	Total	**1607**										

Source: Study on Integrated Transportation Plan for NCR

Sl. No.	Regional Sub-arterials	Length (km)	ROW	Existing Configuration	I	II	III	IV
1	Khurja – Pahasu – NH -93	35.0	30	IL	2	2	2	4
2	Badarpur – Dadri – Hapur	67.0	30	IL	2	2	4	4
3	Pilana – Binaula	16.0	30	IL	2	2	2	4
4	Darula – Sardhana – Baraut – Ganaur – Shahpur	93.0	30	IL	2	2	2	4
5	Baraut – Samalkha – Naultha	44.0	30	IL	2	2	2	4
6	Bansur – Hajipur – Kishangarh Bas	44.0	30	IL	2	2	2	4
7	Thana Gazi – Malakher – Lachmangarh	90.0	30	IL	2	2	2	4
8	Ajabgarh – Tehla – Rajgarh – Garhi – Lachmangarh	76.0	30	IL	2	2	2	4
9	Ghasoli – Tapukrah	33.0	30	IL	2	2	2	4
10	Samda - Alwar	36.0	30	IL	2	2	2	4
11	Hodal – Nuh – Taoru	56.0	30	IL	2	2	4	4
12	Taoru – Pataudi – Kulana	41.0	30	IL	2	2	4	4
	Total	**439**						

Source: Study on Integrated Transportation Plan for NCR

Table 15.2: NCR IMMTP – Development Programme – RORC/IRORC/New Rail Link

SI. No.	New Rail Links	Length (kms)	Phase			
			2008-2012	2013-2017	2018-2022	2023-2032
1	Panipat - Meerut	86		✓		
2	Rewari - Bhiwadi - Palwal	76		✓		
3	Palwal – Khurja	53		✓		
4	Rohtak – Rewari	80	✓			
5	Sonipat - Jhajjar	56			✓	
6	Jhajjar - Gurgaon	40			✓	
7	Gurgaon – Faridabad - Dadri	53			✓	
8	Sonipat - Gohana (Jind)	51		✓		
9	Meerut – Baghtpat – Sonipat	66			✓	
	Total Length	**561.0**				

Source: Study on Integrated Transportation Plan for NCR

Table 15.3: NCR IMMTP – Development Programme -RRTS

SI. No.	Regional Rapid Transit System	Length (kms)	Phase			
			2008-2012	2013-2017	2018-2022	2023-2032
1	Delhi - Panipat	89	✓			
2	Delhi - Baghpat	56		✓		
3	Delhi - Meerut	67	✓			
4	Delhi - Hapur	57		✓		
5	Delhi - Khurja	83		✓		
6	Delhi – Ballabgarh – Palwal	60		✓		
7	Delhi – Rewari – Alwar	158	✓			
8	Delhi - Rohtak	70		✓		
	Total Length	**640**				

Source: Study on Integrated Transportation Plan for NCR

Table 15.4: NCR IMMTP – Development Programme – Mass Rapid Transit System

SI. No.	Regional Metro System	Length (kms)	Phase			
			2008-2012	2013-2017	2018-2022	2023-2032
1	Bahadurgarh - Rohtak	40			✓	
2	Kundli - Sonipat	15			✓	
3	Sonipat - Panipat	42			✓	
4	Ghaziabad - Hapur	35			✓	
5	Ghaziabad - Meerut	42			✓	
6	Faridabad - Palwal	33			✓	
7	Gurgaon - Manesar	8		✓		
8	Manesar - Rewari	31			✓	
9*	Greater Noida - Jewar	47		✓		
10*	Delhi - Faridabad	36				
11*	Delhi - Gurgaon	28				
12*	Delhi - Bahadurgarh	25				
13*	Delhi - Kundli	27				
14*	Delhi - Ghaziabad	16				
	Total Length	**293**				

Source: Study on Integrated Transportation Plan for NCR
** Lengths of the alignments which are coming under DMRC plan are not considered*

15.3 Cost Estimates

The estimates of total investment cost have been made based on unit block cost collected from different sources. They are detailed in **Table 15.5.**

Table 15.5: Block Unit Costs

SI. No	Categories	Unit Cost per Km (in million)
Road Development Cost		
	Expressways (Greenfield)	
1	4L Expressway	120.0
2	6L	150.0
3	8L	180.0
	Adding additional lane to existing	
1	Expressway	2.50
2	NH/SH	1.50
3	MDR/ODR	1.00
	Widening Cost for NH/SH	
1	SL to 2L	20
2	IL to 2L	10
3	2L - 4L	80
4	4L - 6L (with shoulders)	120
5	4L - 6L (without shoulders)	80
	Widening Cost for MDR/ ODR	
1	SL to 2L	1.40
2	IL to 2L	0.70
3	2L - 4L	5.60
4	4L - 6L (with shoulders)	8.40
5	4L - 6L (without shoulders)	5.60
Rail Development Cost		
1	Additional lane to the existing corridor (flat terrain)	55.0
2	New Line	55.0
Metro Cost		
1.	Elevated Structure	1250
2	Underground	2400
Logistic Hub		
	Area of around 10 ha	1000
Inland Container Depot		
	Area of around 100 ha	2400
Bus Terminal Cost		
1	Area of around 5 acres	100
Wayside Amenities		
1	Area of around 10 acres	100
2	Area of around 5 acres	50

Source: Study on Integrated Transportation Plan for NCR

15.4 NCR - IMMTP - Investment Cost

The total investment of the proposed IMMTP over the 25 years period, is estimated at Rs 17,63,545 million with RRTS extending in Delhi. It does not include land cost. This represents the total

investment to be made. The resources may come from any sector, public or private resources may come from any sector, public or private resources. **Table 15.6** presents the phase-wise investment cost by components.

Table 15.6: NCR – IMMTP Investment Cost

	Category	Phase wise Costs (in Rs Million)				Total Cost(in Rs Million)
		I	II	III	IV	
	Road					
1	Expressways	45910	469124	52095	38515	605643
2	National Highway	13680	54990	55170	24330	148170
3	State Highways	11004	0	31584	56448	99036
4	Other Roads	0	4872	9744	9744	24360
	Sub Total (Roads)	**70594**	**528985**	**148593**	**129036**	**877208**
	Bus System					
1	Bus Fleet & Infrastructure	48900	46050	49650	114127	258727
2	Bus Terminals	7388	7388	7388	7388	29552
	Sub Total (Bus System)	**56288**	**53438**	**57038**	**121515**	**288279**
	Rail System					
1	Rail Line (New)	0	19069	8195	3614	30878
2	RRTS*	62800	65200	0	0	128000
3	Rolling Stock	5930	7540	0	0	13470
	Sub Total (Rail System)	**68730**	**91809**	**8195**	**3614**	**172348**
	MRTS	**0**	**68750**	**297500**	**0**	**366250**
	Airports	**0**	**5000**	**5000**	**7500**	**17500**
	Others					
1	Logistic Hubs	1800	2700	2250	2250	9000
2	Integrated Freight Complex	2880	4320	3600	3600	14400
3	Highway Facilities Centres	0	220	440	440	1100
	Sub Total (Others)	**4680**	**7240**	**6290**	**6290**	**24500**
	Surveys, Investigation, DPRs', Tender Documents etc. (@ 1% of total investment costs)	**2003**	**7552**	**5226**	**2680**	**17461**
	Grand Total	**202295**	**762774**	**527842**	**270635**	**1763545**

Source: Study on Integrated Transportation Plan for NCR
Note - Land cost is not included
** RRTS alignment for Delhi – Meerut, Delhi – Hapur and Delhi – Aligarh sections have common alignment till Ghaziabad.*

16 *Economic and Financial Analyses*

16.1 Economic Analysis

The objective of economic evaluation is to enable Government authorities to determine whether the project is an economically worthwhile investment proposal and whether it should be taken up for implementation. Economic evaluation is based on an analysis of economic costs and benefits over a fixed analysis period, 'with' and 'without' the project. The predominant cost is the cost of construction, followed by maintenance and operation costs. All costs and benefits were valued in monetary terms and expressed in economic prices to reflect the true resource cost to the economy. The results have been expressed in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) @ 12 percent discount rate. These were calculated using discounted cash flow methods since costs are incurred, and benefits accrue, at different dates. The feasibility of the project was determined by comparing the EIRR with the current accounting rate of 12%. This represents the opportunity cost of capital.

16.2 Transport Plan for NCR

The regional transportation system of NCR is a complex one. The NCR Transport Modal (based on CUBE Voyager software) was used to evaluate different development scenarios and network alternatives. Strategy *D2N5 (RP 2021 Extended – Integrated Multi-Modal Transport System)*, emerged as the most optimal after analysing the practical aspects and operational efficiency issues, and was thus recommended.

The transport plan comprises a number of components, viz.

- expressways,
- regional arterials,
- sub-arterials and collector roads,
- urban bypasses,
- interchanges,
- regional Rail Rapid Transit,
- regional Metro Rail,
- bus system,
- terminals,
- integrated freight complexes,
- transport hubs, and
- facility centres.

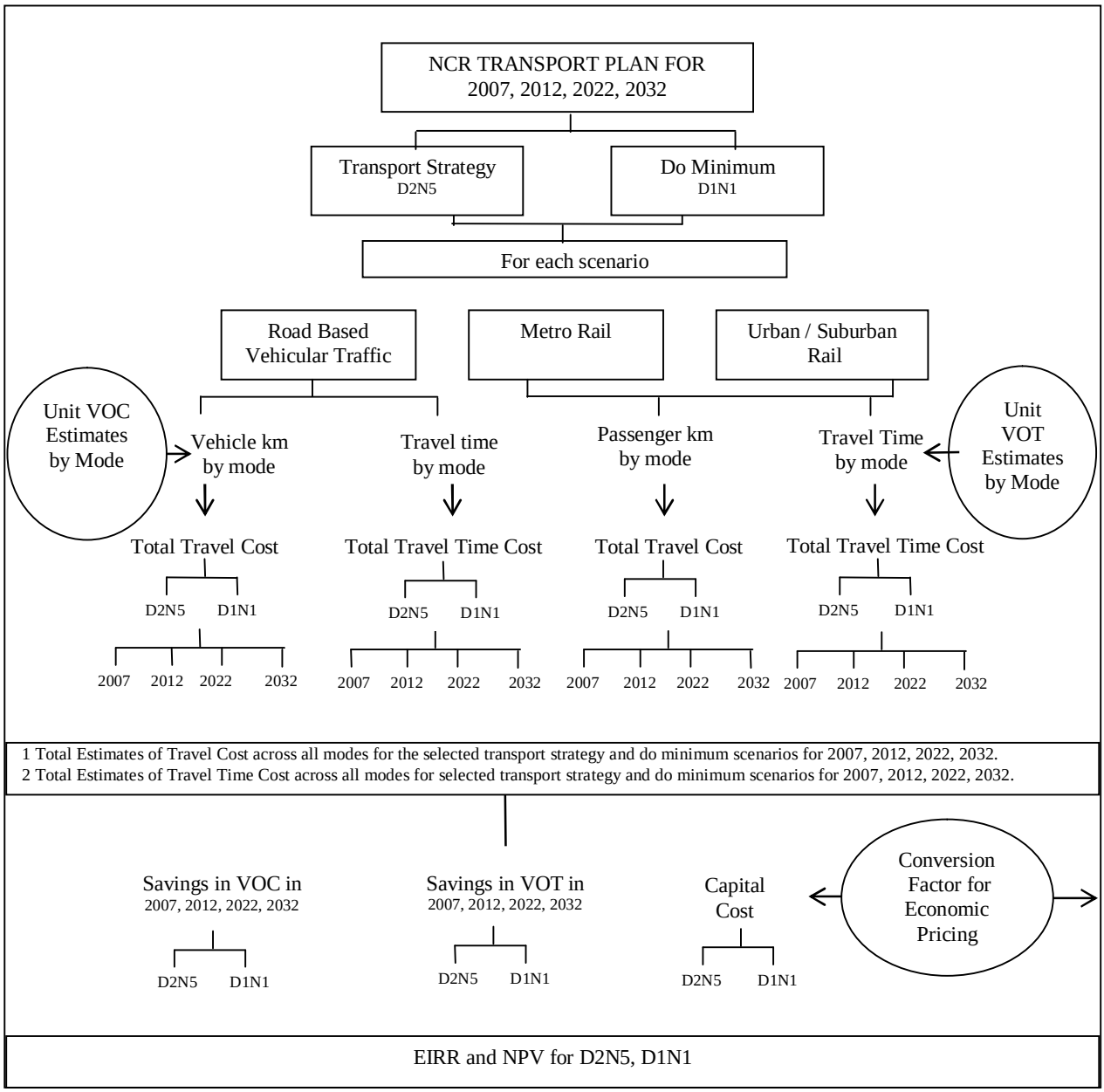
Some of the projects already exist, while others are proposed as part of the transport strategy to improve the efficiency of the transport network and system of the NCR. In order to assess the economic justification of the transportation system as a whole, a network approach was adopted, for quantifying the tangible costs and benefits due to the proposed improvements or enhancements in the existing network/systems and/or induction of new projects for meeting the assessed future travel demand. The complexities associated with the transportation system of NCR made assessment of the different indicators, and the subsequent economic analysis equally complex. The outputs of the Transport Modal, as required and developed exclusively for economic analysis, formed the inputs to the economic analysis. A generalized cost approach was adopted for estimating the operating costs and the travel time costs of the different modes of transport.

16.3 Framework for Economic Analysis

The proposed transport strategy, D2N5, is expected to result in improving the operational efficiency of the system. The benefits that are likely to accrue would be mainly savings in vehicle operating cost and travel time cost for the road-based vehicles and savings in operating cost for metro and rail.

Benefits were calculated by comparing the 'with' and 'without' project scenarios. The 'with project' case for the analysis was D2N5, which represents the development scenario considered in the Regional Plan 2021 (extended to 2032), and the integrated multi-modal network. The 'without project' situation is the base case option or the "do-minimum" case, where the existing network (N1) and existing development scenario (D1) have been considered. The analysis period is 25 years, from 2007 to 2032. The approach for economic analysis is presented in the form of a flow-diagram (**Figure 16.1)**. The economic analysis was done using a spreadsheet modal.

Figure 16.1: Framework for Economic Analysis



16.4 Economic Modal Inputs

16.4.1 Traffic

The road-based vehicle types considered include two-wheeler, autorickshaw, car, bus, light commercial vehicle (LCV), 2-axle truck, 3-axle truck and multi-axle vehicle (MAV). Rail-based modes included metro and commuter rail.

The transport modal (CUBE) was used to undertake traffic assignments for 4 cardinal years, viz. 2007 (base year), 2012, 2022 and 2032. The same assignments were used to generate inputs for economic analysis, viz.:

- Vehicle-kilometres performed by each road-based mode;
- Travel time in person-hours by each road-based mode;
- Passenger-kilometres performed by rail-based modes - metro and rail
- Travel time in person-hours by rail-based modes – metro and rail

These are presented in **Tables 16.1 to 16.4**.

Table 16.1: Vehicle-km Performed/day by Road-based Modes on NCR Network (million)

Year	Car	2 Wheeler	Auto	Bus	LCV	HCV	MAV
Base Case - D1N1							
2007	36.93	14.54	3.32	1.66	8.68	15.52	2.10
2012	73.88	33.18	4.43	10.94	10.38	18.56	2.52
2022	130.71	45.73	8.14	33.57	16.82	30.07	4.08
2032	170.34	54.56	12.85	74.28	28.41	50.80	6.89
With Project – D2N5							
2007	36.93	14.54	3.32	1.66	8.68	15.52	2.10
2012	67.44	17.11	4.78	2.24	7.36	13.15	1.78
2022	127.94	28.41	8.05	8.14	12.46	22.27	3.02
2032	175.80	39.01	13.10	25.96	22.69	40.56	5.50

Source: Study on Integrated Transportation Plan for NCR

Table 16.2: Travel Time for Road-based Modes on NCR Network (million person-hours/day)

Year	Car	2 Wheeler	Auto	Bus	LCV	HCV	MAV
Base Case - D1N1							
2007	1.29	0.50	0.09	0.01	0.30	0.54	0.07
2012	3.48	1.59	0.19	0.21	0.52	0.94	0.13
2022	14.47	4.93	0.72	0.70	2.05	3.66	0.50
2032	30.18	9.69	1.79	1.92	5.73	10.24	1.39
With Project – D2N5							
2007	1.29	0.50	0.09	0.01	0.30	0.54	0.07
2012	1.43	0.31	0.08	0.03	0.17	0.30	0.04
2022	3.14	0.51	0.12	0.10	0.30	0.54	0.07
2032	9.72	1.63	0.26	0.21	1.12	2.00	0.27

Source: Study on Integrated Transportation Plan for NCR

Table 16.3: Passenger-km Performed by Rail-based Modes on NCR Network (million)

Year	Metro	Rail
Base Case - D1N1		
2007	-	44.68
2012	-	24.43
2022	-	41.82
2032	-	70.39
With Project – D2N5		
2007	-	44.68
2012	-	51.32
2022	4.53	31.90
2032	12.57	44.30

Source: Study on Integrated Transportation Plan for NCR

Table 16.4: Travel Time for Rail-based Modes on NCR Network (in million pax-hrs/day)

Year	Metro	Rail
Base Case - D1N1		
2007	-	0.74
2012	-	0.70
2022	-	1.19
2032	-	2.01
With Project – D2N5		
2007	-	0.74
2012	-	0.86
2022	0.14	0.53
2032	0.39	0.74

Source: Study on Integrated Transportation Plan for NCR

16.4.2 Unit Costs of VOC Inputs

Vehicle operating cost (VOC) inputs for the road-based vehicles included prices of vehicle, tyres, fuel and lubricants, spare parts, labour costs, fixed costs, crew wages, etc. The unit costs of inputs for VOC estimation were collected from markets in Delhi, along with taxes and duties applicable on them. This was used for calculating economic prices from the financial prices.

16.4.3 Estimation of unit VOC

Till date no VOC equations have been developed for roads with carriageway width of more than 4-lanes with paved shoulders. While unit VOCs were basically calculated from the VOC equations developed for regional roads[1], some assumptions and modifications were necessary to cater to the entire network, which also includes 6-lane roads and expressways. This was done by deriving the unit VOCs for fixed speeds. Speeds on different links of the network were obtained from CUBE. Speed thus served as a proxy for the type of road and carriageway width. **Annexure 16.1** presents the look-up tables of speed vs unit VOC per vehicle-km.

16.4.4 Value of Travel Time

Estimation of the value of time (VOT) for passengers was based on the wage rate approach and discussed in detail in Chapter 16 The VOT for goods vehicles was based on the 'holding cost' concept, which takes into account average payload, average value of cargo per tonne, interest rate and working days in a year. **Table 16.5** shows the VOT values adopted in the economic analysis.

Table 16.5: Value of Travel Time by Vehicle Type

Vehicle Type	Value of Time (Rs/hour)	
	Financial prices	Economic prices
Car	69	62
Two-wheeler	32	29
Autorickshaw	32	29
Bus	15	13
Commuter Rail	14	13
Metro	51	46
LCV	3	2
2/3 axle truck	6	6
MAV	10	9

Source: Study on Integrated Transportation Plan for NCR

[1] *Updation of Road User Cost Data, Final Report, July 2001(MORTH) was used to derive unit VOCs. These equations take into account congestion effects of traffic.*

16.4.5 Network Level Costs

Estimates of travel cost and travel time cost were obtained by using unit VOC and unit VOT as inputs to the CUBE modal.

- Network travel cost (VOC) by each road-based mode;
- Network travel time cost by each road-based mode;

The total operating costs on the network are presented in **Tables 16.6 and 16.7**.

Table 16.6: Network Travel Cost (VOC) per Day (in Rs million)

Year	Car	2 Wheeler	Auto	Bus	LCV	HCV	MAV
Base Case - D1N1							
2007	123.53	23.52	7.45	21.00	61.96	110.77	15.02
2012	266.07	62.19	12.55	138.73	70.53	126.10	17.10
2022	685.00	122.61	33.31	425.63	116.99	209.17	28.36
2032	929.46	172.16	61.71	941.84	197.00	352.21	47.76
With Project – D2N5							
2007	23.52	7.45	21.00	61.96	110.77	15.02	23.52
2012	46.65	9.71	20.55	54.61	97.63	13.24	46.65
2022	79.26	16.41	74.68	92.31	165.03	22.38	79.26
2032	146.82	31.48	238.31	156.60	279.98	37.96	146.82

Source: Study on Integrated Transportation Plan for NCR

Table 16.7: Network Travel Time Cost per Day (in Rs million)

Year	Car	2 Wheeler	Auto	Bus	LCV	HCV	MAV
Base Case - D1N1							
2007	3.30	0.77	0.14	4.28	0.03	0.05	0.01
2012	8.19	2.19	0.30	90.61	0.04	0.06	0.01
2022	29.94	6.95	1.17	309.03	0.06	0.11	0.01
2032	50.68	13.82	2.90	847.30	0.10	0.19	0.03
With Project – D2N5							
2007	3.30	0.77	0.14	4.28	0.03	0.05	0.01
2012	4.10	0.47	0.12	12.94	0.02	0.04	0.01
2022	8.85	0.80	0.18	44.29	0.04	0.07	0.01
2032	22.52	2.44	0.41	92.93	0.06	0.10	0.01

Source: Study on Integrated Transportation Plan for NCR

16.4.6 MRT System

For estimation of operating cost of the MRT system, few cases exist that count as experience in India. The studies undertaken by DMRC for Delhi Metro formed the basis for this study. The unit O&M cost in the case of Delhi Metro was Rs 1.12 per passenger-km at 2007 prices, and found to be declining over the years as optimal utilization neared. For the purpose of economic analysis, a financial value of Rs 1.12 per pkm was assumed, which is equivalent to Rs 1.0 per pkm in economic terms.

16.4.7 Regional Rapid Rail Transit

The O & M costs adopted for the rapid rail transit have been based on the Mumbai suburban rail system, where the unit O&M cost is estimated as Rs 0.10 per passenger-km. This was converted into economic price and formed an input to the analysis.

16.5 Project Benefits

The project benefits have been estimated by taking the difference in the total operating costs in the 'Base Case' and the 'With Project Case'. The benefits have been estimated for 3 time periods – 2012, 2022 and 2032. Similar benefits have been estimated for the travel time as well. The benefits in the intermediate years were obtained through interpolation.

16.6 Project Costs

The total investment for the NCR Transport Plan over the analysis period, ie upto the year 2032, has been estimated as Rs. 1,733,650 million. The project cost components include the following:

- Cost of improvement/new proposals for road projects – both capital and maintenance cost;
- Bus system and terminals;
- Civil cost of upgrading of RRTS and cost of its rolling stock;
- Cost of new railway lines;
- Cost of metro rail system as planned;
- Airports, logistic hubs, Integrated Freight Stations and wayside amenities.

For the purpose of analysis, the costs have been phased out equally over each of the phases of implementation. The assumption here is that as individual projects are implemented they will be opened for use by traffic.

16.6.1 Maintenance Costs

The maintenance cost of the systems has been estimated @ 0.5% of the construction cost per year. All costs have been converted into economic costs by applying the standard conversion factor of 0.8.

16.7 Economic Viability

The economic analysis of the proposed transport strategy for NCR was undertaken as a single project. The annual cost and benefit streams were analysed in Excel spreadsheet to derive the net cash flow for the project. The EIRR and NPV @ 12% discount rate were determined using the discounted cash-flow technique.

The EIRR of the project worked out to 43.26%, while the NPV @ 12% was Rs 807,786 million.

The rate of return considered desirable for transport infrastructure projects is 12 percent as the opportunity cost of capital is 12%. The results indicate that the project is economically viable, as the EIRRs are far higher than 12 percent. The net cash flow statement for the project is presented in **Annexure 16.2.**

16.8 Other Benefits

Besides the benefits quantified for economic analysis, some intangible benefits would also accrue as a result of the proposed transport strategy. These are discussed below.

16.8.1 Environmental Benefit

Traffic congestion and low speeds result in high levels of air pollution. A more efficient transport system, viz. metro rail system, would result in lowering congestion on the roads, improving speeds of road-based vehicles, and consequently lowering air pollution. The emission reduction of the proposed transport plan has been detailed out in the chapter on Initial Environmental Examination.

16.8.2 Increase in Land Values

Improvement in the transportation system would foster economic development and hence result in considerable increase in land values in the NCR. The greenfield projects, in particular, are likely to have a major impact on the value of land. However, this benefit has not been considered for economic analysis.

16.9 Conclusions

The economic analysis shows that the proposed transport strategy for NCR is economically viable. With the implementation of the transport plan, the society will benefit immensely. However, in view of the huge investment involved, the level of implementation would depend on the availability of resources.

16.10 Financial Analysis of Expressways in NCR

16.10.1 Introduction

Financial analysis of a project is carried out to ascertain the viability of implementing the project with private sector participation on BOT basis. Generally, financial viability is assessed after some preliminary design and cost estimates are available. However, it was too premature to carry out this exercise as part of the overall Transport Plan for NCR. After discussions with NCRPB, it was agreed by the Consultant to carry out a preliminary financial analysis of selected expressways being proposed in the NCR. Expressways likely to carry sizeable commercial and car traffic formed the basis of the selection. The following six expressways were selected for evaluation:

- Delhi – Panipat Expressway 69.76 km
- Delhi – Ghaziabad Expressway 15.34 km
- Ghaziabad – Modinagar – Meerut Expressway 33.22 km
- Delhi – Faridabad - Palwal Expressway 44.75 km
- Gurgaon – Manesar – Daruhera Expressway 64.55 km
- Delhi – Bahadurgarh - Rohtak Expressway 57.94 km

16.10.2 Tollable Traffic

For the purpose of evaluation, all expressways are taken to be operational by 2015. The projected traffic on the expressways was obtained from the NCR Transport Modal outputs for the cardinal years, 2015, 2022 and 2032. Some traffic leakage has been assumed, viz. 10% for all vehicle types. The tollable traffic was estimated after deducting the traffic leakage. The tollable traffic categories include:

- Car/Jeep/Taxi, etc.
- Bus – standard and mini
- Light Commercial Vehicle (LCV)
- Truck – 2 axles
- Multi axle vehicle (MAV)

The tollable traffic thus estimated for the expressways are given in **Table 16.8.**

Table 16.8: Tollable Traffic on Expressways-2015

Expressway	Sections	Length (km)	AADT 2015 (vpd)	Tollable Traffic 2015 (vp)	Tollable Traffic 2015 (PCUs)
Delhi-Panipat	Delhi - Sonepat	28.47	63625	57263	71790
	Sonepat - Panipat	41.28	58015	52214	89285
	Total	69.76			
Delhi-Ghaziabad		15.34	52962	47666	62336
Ghaziabad-Modinagar-Meerut	Ghaziabad - Modinagar	22.99	21890	19701	26927
	Modinagar - Meerut	10.22	26991	24292	35254
	Total	33.22			
Delhi-Faridabad-Palwal	Delhi - Faridabad	18.90	66476	59828	63731
	Faridabad - Palwal	25.85	22591	20332	26571
	Total	44.75			
Gurgaon-Manesar-Daruhera		64.55	48133	43320	62641
Delhi-Bahadurgarh-Rohtak	Delhi - Bahadurgarh	20.95	59034	53131	55999
	Bahadurgarh - Sampla	16.26	32257	29031	32571
	Sampla - Rohtak	20.73	33471	30124	34039
	Total	**57.94**			

To account for vehicles exempted from paying toll as well as frequent users, a 3% loss in gross revenue has been considered. Toll-exempt vehicles include defence vehicles, ambulances/ funeral vans, police vehicles/ fire fighting vehicles, and non-commercial government vehicles. Frequent users would be given concessions/ discounts in the form of multiple entry tickets and monthly passes.

16.10.3 Toll Rates

The unit toll rates as per NHAI's new toll policy (Notification in the Gazette of India, Dec 2008), were taken as the basis for estimating toll rates for the expressways. The 'per km' rates, applicable for National Highways were increased by a factor of 1.5 for expressways. These are shown in **Table 16.9.**

Table 16.9: Unit Toll Rates on Expressways -2009

Vehicle Category	Toll rate for Highway (Rs /km)	Toll rate for Expressway (Rs/km)
Car/Jeep/Van	0.71	1.07
Mini Bus	1.15	3.62
Bus	2.41	3.62
LCV	1.15	1.73
2 axle truck	2.41	3.62
MAV	3.78	6.29

16.10.4 Project Cost

The expressways are proposed as greenfield projects with 4-lane carriageway widths. The block cost estimates (civil construction) have been presented in Chapter 22. These have been used for the financial analysis. Soft costs of land acquisition and R&R, utility shifting and environmental mitigation have been excluded as these are to be borne by the government. The Base Costs (2009 estimate), include contingency and PMC. The Total Project Cost (TPC) was calculated after considering escalation, financing cost and interest during construction (IDC). The costs are presented in **Table 16.10.**

Table 16.10: Expressway Costs

Expressway	Base Cost (Rs cr) 2009 prices	TPC (Rs cr)	Upgrading Cost (Rs cr) 2009 prices
Delhi - Panipat	3348.00	4617.76	348.75
Delhi –Ghaziabad	736.32	1015.58	76.70
Ghaziabad – Modinagar – Meerut	1594.08	2198.65	166.05
Delhi – Faridabad –Palwal	2148.00	2962.65	223.75
Gurgaon - Manesar - Daruhera	3098.40	4273.49	322.75
Delhi – Bahadurgarh – Rohtak	2781.12	3835.88	289.70

Source: Study on Integrated Transportation Plan for NCR

16.10.5 Financial Analysis Assumptions

The financial analysis was carried out to test which of the expressway projects was a good candidate for PPP. The main inputs included:

- Base year for cost estimates : 2009
- Escalation during construction @ : 5% per annum
- Concession period (including construction period): 20 years
- Construction period : 3 years
- Start of construction : January 2012
- Start of tolling operations : January 2015
- Construction phasing : 2012 – *30%*, 2013 – *40%*, 2014 – *30%*
- Upgrading from 4-lanes to 6 lanes : 2020-2021
- Phasing of upgrading cost : 2020 – *50%*, 2021 – *50%*
- Viability Gap Funding (VGF) : upto 40% upfront
- Debt – Equity Ratio : 70 : 30
- Inflation Rate : 5%
- Interest on Debt and IDC : 11%
- Loan repayment period : 15 years
- Loan moratorium : 4 years
- Corporate Tax Rate : 33.66%
- MAT Rate : 11.22%
- Tax exemption period : 10 years
- Tax holiday availed within : 20 years
- Tax loss carry-over limited to : 8 years
- Depreciation – SLM @ 95% of cost spread over : 17 years
- Depreciation – WDV @ : 15%
- Routine maintenance cost @ : Rs 2.2 lakhs /km for 4L
- Routine maintenance cost @ : Rs 3.3 lakhs /km for 6L
- Periodic maintenance cost every 5th year @ : Rs 3.37 million /km
- Structural overlay cost every 10^{th} year @ : Rs 26.95 million /km
- Toll plaza O&M cost @ : Rs 2.67 million/8-lane plaza
- Toll plaza O&M cost @ : Rs 4.01 million/12-lane plaza
- Illumination cost @ : Rs 1.10 lakh /km for 4L
- Illumination cost @ : Rs 1.65 lakh /km for 6L
- Emergency Services @ : Rs 1.00 lakh /km for 4L
- Emergency Services @ : Rs 1.5 lakh /km for 6L
- Insurance cost (flat) @ : 0.15% of TPC
- Target Equity IRR : 15%

16.10.6 Results of Financial Analysis

The results of the financial analysis of expressways are presented in **Table 16.11.**

Table 16.11: Results of Financial Analysis

Expressway	IRR (%)			VGF	
	pre-tax	post-tax	Equity	%	Rs crore
Delhi - Panipat	13.16%	10.73%	15.25%	30%	1385.33
Delhi –Ghaziabad	13.17%	10.84%	15.21%	35%	355.45
Ghaziabad – Modinagar – Meerut	2.17%	-0.12%	-1.30%	40%	879.46
Delhi – Faridabad –Palwal	4.71%	2.37%	2.41%	40%	1185.06
Gurgaon - Manesar - Daruhera	8.88%	6.37%	8.78%	40%	1709.40
Delhi – Bahadurgarh – Rohtak	5.98%	3.68%	4.40%	40%	1534.35

Source: Study on Integrated Transportation Plan for NCR

16.10.7 Conclusion

The results of the financial analysis indicate the following:

- Only two expressways, viz. Delhi - Panipat and Delhi - Ghaziabad, having over 60-70,000 PCUs per day, are financially viable, with Equity IRRs above the generally accepted target IRR of 15%.
- Based on this very preliminary analysis, it appears that both these expressways are suitable for implementation on BOT basis. However, detailed analysis would be required for the purpose of decision making.
- The Viability Gap Funding (VGF) required to make them viable is 30% of TPC in the case of Delhi – Panipat and 35% of TPC for Delhi – Ghaziabad.
- The other expressways could be improved by providing additional incentives such as commercial development of land, etc. which could generate additional revenue.

16.11 Economic Evaluation of RRTS Corridors

In the first part of this chapter, the Consultants evaluated the proposed transport strategy for NCR as a single project, and found it to be economically viable. A major component of the transport plan – the RRTS corridors – was required to be tested individually for their economic feasibility. The objective of economic evaluation is to assess the viability of the proposed investment in order to justify its implementation. A project level economic evaluation of this nature is meaningful at the feasibility stage, based on cost estimates that are more detailed than the “block” cost estimates adopted in the planning stage, i.e. in this study. However, a preliminary economic evaluation has been carried out by the Consultant based on certain assumptions, as discussed in the following sections.

The main steps followed in the economic evaluation are:

- Estimation of economic cost of the project, both capital as well as annual operating costs, over the study period upto 2037.

- Estimation of direct and indirect benefits to the users, non-users and economy / community

- Comparison of annual streams of costs with benefits and estimation of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) on the basis of Discounted Cash Flow (DCF) technique, followed by the comparison of EIRR of the project with the accounting rate of return of 12 percent, which is the minimum return expected for any judicious investment decision.

16.11.1 Cost and Phasing of RRTS Corridors

The project cost consists of two main components viz. capital cost and operation & maintenance cost.

Capital Cost

The block cost estimate of the dedicated RRTS corridors, comprising components like the track structure, stations, rolling stock, etc. has been presented in *Chapter 14 – NCR Integrated Multi Modal Transport Plan*. **Table 16.12** summarises the capital cost estimates used for the economic analysis.

Table 16.12: Capital Cost of RRTS

Sl No	RRTS Corridor	Length (km)	Cost of dedicated RRT (Rs mill)	Cost of Rolling stock (Rs mill)	Total Cost (Rs mill)
1	Delhi – Ghaziabad – Meerut	67.0	13,400	1510	14,910
2	Delhi – Gurgaon – Rewari	83.1	16,620	1660	18,280
3	Delhi – Sonipat – Panipat	89.0	17,800	1920	19,720
4	Delhi – Faridabad – Ballabhgarh – Palwal	60.0	12,000	1370	13,370
5	Ghaziabad – Khurja	63.0	12,600	1780	14,380
6	Delhi – Bahadurgarh – Rohtak	70.0	14,000	1670	15,670
7	Ghaziabad – Hapur	42.0	8,400	1420	9,820
8	Delhi – Shahadara – Baraut	44.0	8,800	1300	10,100

Source: Study on Integrated Transportation Plan for NCR

Operation and Maintenance

The operation and maintenance (O&M) cost of the RRTS relate to cost of operation of the system and regular maintenance of track, rolling stock, stations, signaling & ticketing system, etc. The annual cost of O & M has been estimated as 1 percent of the base capital cost.

The RRTS corridors are proposed to be developed in 2 phases, viz. Phase I and Phase II, as shown below:

- Delhi – Ghaziabad – Meerut : Phase I
- Delhi – Gurgaon – Rewari : Phase I
- Delhi – Sonipat – Panipat : Phase I
- Delhi – Faridabad – Ballabhgarh – Palwal : Phase II
- Ghaziabad – Khurja : Phase II
- Delhi – Bahadurgarh – Rohtak : Phase II
- Ghaziabad – Hapur : Phase II
- Delhi – Shahadara – Baraut : Phase II

The investments for upgrading of the corridors are assumed to be spread equally over 5 years, following which the corridor can become operational.

16.11.2 Estimation of Economic Costs

The project costs are estimated in financial terms at 2009 prices. Economic analysis requires the conversion of financial costs into economic costs in order to take care of distortions in prices due to market imperfections, Government policies and regulations. In the present analysis the estimated financial costs have been converted into economic cost by applying Standard Conversion Factor of 0.8.

16.11.3 Estimation of Economic Benefits

The benefits arising from the implementation of the RRTS need to be identified and quantified. Construction of the dedicated and speedier RRTS will result in diversion of a sizeable proportion of current bus passenger traffic from road to RRTS. These changes are obtained from the outputs of the CUBE modal for the cardinal years, viz. 2007, 2012, 2022 and 2032. Benefits are estimated as the savings in cost incurred in "without" and "with" project situations. The direct and indirect benefits of each RRTS corridor have been quantified in monetary terms. The assumptions for estimating various benefits are discussed below.

Time Cost Savings to Bus Passengers shifting to RRTS

With the improvement/upgrading of the RRTS, passengers presently using bus transport will shift to RRTS, as they would benefit from the higher speed of the RRTS vis-à-vis the bus speed in congested conditions. The saving in travel time is translated into time cost saving using the corresponding values of time (VOT) (refer **Table 16.5)**:

- VOT of bus passenger = Rs 15 per hour
- VOT of rail passenger = Rs 14 per hour

Time Cost Savings to Users of Road based Transportation

The shift of passengers from bus to RRTS would lead to a reduction in the number of buses on the roads in the "with" project case. This will reduce congestion and release capacity on the roads parallel to the RRTS corridor (mainly national highways and expressways), resulting in higher speeds on these roads. Thus, all road traffic, viz. car, bus, two-wheeler, autorickshaw, LCV, HCV and MAV, would also benefit indirectly in terms of travel time savings. The VOT values of different vehicle types are reproduced below:

- VOT – car passenger = Rs 69 per hour
- VOT – two-wheeler / autorickshaw passenger = Rs 32 per hour
- VOT – LCV = Rs 3 per hour per tonne of cargo
- VOT – HCV = Rs 6 per hour per tonne of cargo
- VOT – MAV = Rs 12 per hour per tonne of cargo

Savings in Investment for Alternative Public Transport System and Supporting Infrastructure

The RRTS would drastically reduce the requirement for alternative public transport modes viz. buses. This would result in considerable saving to the economy in terms of reduced investment in bus fleet, bus maintenance, and supporting infrastructure such as bus depots and workshops.

The number of buses required, based on travel demand modal, was estimated for cardinal years under "without" and "with" project situations. The corresponding investment in bus fleet, O&M, depots and workshops was estimated on the following assumptions:

- Average life of a bus : 8 years
- Average cost of a bus on regional network (mix of standard and low-floor buses) : Rs. 3 million
- Average utilisation of a bus on regional network : 275 km per day
- Average O&M cost of a bus : Rs. 21 per km
- Scrap Value of a bus : 10% of cost
- Cost of a depot with capacity for 100 buses : Rs. 50 million
- Cost of a workshop with capacity for 3000 buses : Rs. 500 million

Reduction in Environmental Pollution

RRTS would help in bringing down pollution levels in the NCR because of the reduction in the number of buses on the roads. The changes in bus vehicle-km per day for "with" and "without" project strategies were analysed to estimate the savings in air pollution cost caused by buses.

The Central Pollution Control Board (CPCB) provides the norms for emission coefficients for the different vehicle types and for the different Euro-specifications for fuel and engine design. The application of these norms to daily bus vehicle-km travelled yields the emission loads of various air pollutants such as CO, HC, NOX and PM10. Literature on the cost of vehicular emissions is quite limited. Estimates provided in the "Bangalore Metro Bus Feasibility Study – SIDA (1999)" have been adopted after correction for inflation to 2010 prices. The cost of pollutants for a diesel bus is estimated as Rs 17.42 per vehicle-km. The annual pollution cost by buses is calculated for "with" and "without" project scenarios and savings derived.

Saving in Fuel Consumption

There will be savings in fuel consumption because of fewer buses on the road after passengers shift from bus to RRTS. Fuel saved due to reduction in buses is estimated from the number of buses reduced, the annual vehicle utilisation and fuel consumption norms of a bus. The average consumption of CNG by a bus is based on data published in the Operational Statistics (May 2009) of the Delhi Transport Corporation. A mix of standard and low floor buses has been assumed for the NCR regional network.

- Fuel consumption norm per bus = 3.01 km /kg of CNG
- Average utilization of bus = 275 km per day
- Fuel consumed per bus per day = 91.36 kg of CNG
- Cost of CNG (June 2010 prices) = Rs 30.60 per kg

The fuel savings are valued at 2010 prices by comparing fuel consumption costs of buses in the "without" and "with" project situations.

16.11.4 Economic Appraisal

The annual streams of economic costs and benefits have been computed over the analysis period. The project's economic viability is assessed in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) by applying the Discounted Cash Flow (DCF) technique to the annual stream of the net benefits of the project. The NPV of the stream of net benefits has been computed using prevailing discount rate of 12%.

The results of the economic analysis are presented in **Table 16.13.**

Table 16.13: Results of Economic Analysis

Sl No.	RRTS Corridor	Phase	EIRR (%)	NPV @ 12% (Rs. million)
1	Delhi – Ghaziabad – Meerut	**I**	**34.77**	**25682.69**
2	Ghaziabad – Hapur	**II**	**29.03**	**8233.31**
3	Delhi – Faridabad – Ballabhgarh – Palwal	**II**	**25.99**	**8222.81**
4	Delhi – Sonipat – Panipat	**I**	**20.99**	**11143.69**
5	Ghaziabad – Khurja	**II**	**20.42**	**4279.03**
6	Delhi – Gurgaon – Rewari	**I**	**17.73**	**5400.38**
7	Delhi – Bahadurgarh – Rohtak	**II**	**13.98**	**1047.60**
8	Delhi – Shahadara – Baraut	**II**	**6.93**	**(-) 1272.11**

Source: Study on Integrated Transportation Plan for NCR

The results of the preliminary economic evaluation indicate that out of 8 corridors, the 7 corridors are economically viable, with EIRRs above the minimum cut-off level of 12%. Of these, 3 corridors are proposed to be developed in Phase I and rest in Phase-II.

It is recommended that after 5 years a review of the developments in NCR and the subsequent traffic potential of the RRTS be carried out.

17

Social Impact Assessment

Social Impact Assessment (SIA) was undertaken by the Consultant while carrying out the Study to ensure that the benefits of the proposed transport development are equally distributed and no segment of the population is adversely affected. It is a framework for incorporating social analysis and participatory processes into project design and implementation. SIA helps in appreciating and catering to social differences and assessing impacts on different groups. Such analysis helps to clarify the social behavioural mechanism in development processes and can help in mobilising social assets and capacities to attain the objectives of development.

17.1 Impact Assessment of the Proposed Integrated Transport Plan

The impact assessment of the proposed integrated transport plan has been analysed in two categories:

i) Perception of the people regarding the possible impact of the proposed transport plan through primary survey. The indicators are:

   a) awareness about the integrated transport plan for NCR

   b) impact of proposed transport plan on (impact economic activities, impact of road and rail improvement and land use which will be affected in case of road improvement) and efficacy of the proposed transport plan.

ii) Analysis of the social composite index of the proposed transport network.

17.1.1 Awareness about the Integrated Transport Plan for NCR

97 percent of the respondents of the people were aware about the Transport Plan for National Capital Region. Only 3 percent of the respondents were either not aware or could not say anything about the Plan. **Figure 17.1** presents the percentage distribution of awareness about the transport plan among the respondents.

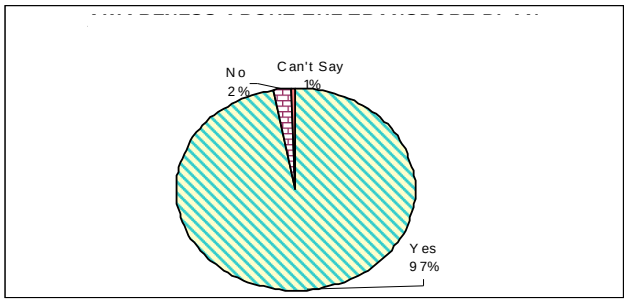


Figure 17.1: Awareness about the Transport Plan among the Respondents

17.1.2 Impact of Proposed Integrated Transport Plan for NCR

17.1.2.1 Impact on Economic Activities

92 percent of the respondents had mentioned that the economic benefits of the proposed Transport Plan would lead to increase in income and increase in business opportunity. Other major benefits of the Transport Plan according to the respondents are as follows:

- Reduction in time taken to commute
- Save money on transport
- Diversification of economy
- Increase in land price/property price
- Increase in mobility
- Access to market
- Access to facilities

Figure 17.2 shows a graphical representation of the impact of road improvements on economic activities.

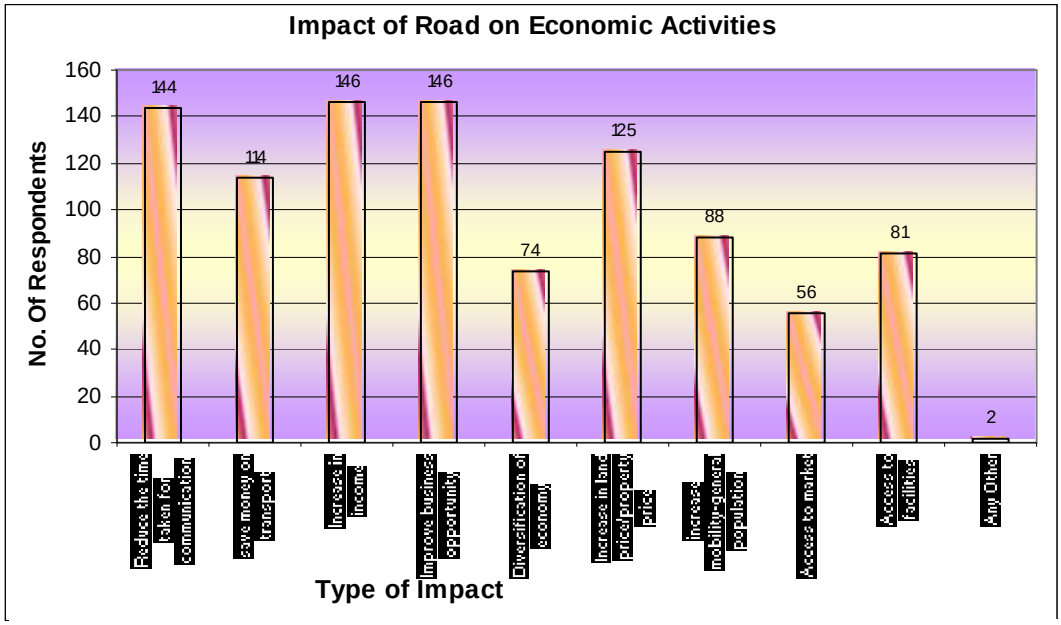


Figure 17.2: Impact of Road Improvements on Economic Activities

17.1.2.2 Impact of Road Improvement

People living in the villages along the studied road sections anticipated many probable positive outcomes which are illustrated in table given below. 35.9 percent of the respondents reckon that the road improvement would make travel easy and cheap. 10.9 percent of the respondents predicted increase in employment opportunities as another significant outcome. Other positive impacts of road improvement as anticipated by the respondents are presented in **Table 17.1.**

Table 17.1: Positive Impact of Road Improvement

Sl. No.	Positive Impact of Road Improvement	% of Respondents
1.	Reduction in Accident	4.6%
2.	Agriculture Development	4.1%
3.	Business Development	3.8%
4.	Education Opportunity will Increase	5.3%
5.	Travel will be Easy and Cheap	35.9%
6.	Employment (opportunity) will increase	10.9%
7.	Income (resources) will increase	5.1%
8.	Land/Property price will increase	6.9%
9.	Mobility will increase	4.6%
10.	Standard of Life will be high	7.1%
11.	Vehicle life will long/ fuel saving	6.6%
12.	Crime decrease	1.3%
13.	Other	0.8%
14.	No Response	3.1%

A few of the respondents could envisage the likely adverse affect of the road improvement (36 percent of the total respondents). The negative impacts of the road improvement under the proposed plan as foreseen by the people of the villages surveyed are mentioned in **Table 17.2**. The most common adverse impact of the road improvement according to the respondents are on business and increases in road accident (23 percent of the total respondents).

Table 17.2: Negative Impact of Road Improvement

Sl. No.	Likely Adverse Impacts	% of Respondents
1	Affect on Business	23%
2	Increase in accident	23%
3	Loss of agriculture land	14%
4	Loss of House	9%
5	More expense on Vehicle	9%
6	Crossing of road will be difficult	5%
7	Increase in pollution	3%
8	Increase in traffic jam	9%
9	Others	5%

17.1.2.3 Impact of Rail Improvement

Likewise, people of the villages surveyed also enumerated various possible influences that the rail improvement would have on the present transport structure and so on their lives. About 45 percent of the total respondents did not give any response to the likely impact of rail improvement. Most of the people thought that the proposed rail improvement will help in reduction of the transport cost (52 percent of the respondents) and time saving (27 percent). The other positive impacts of rail are given in the **Table 17.3.**

Table 17.3: Positive Impact of Road Improvement

Sl. No.	Positive Impact of Rail	Total
1	Reduction in Transport Cost	52%
2	Reduction in Travel Time	27%
3	Safe and Comfort	8%
4	Decrease in Pollution	4%
5	Increase in Mobility	3%
6	Increase in Employment	3%
7	Increase in Business Opportunity	2%
8	Less Traffic on Road	1%

Major share of the respondents favoured improvement of the rail network. However, 5 percent of the total respondents cited likely adverse affect of the rail improvement. The most common adverse impacts of the rail improvement according to them were increase in travel time and loss of land.

17.1.2.4 Major Land Use to be Affected in Case of Road Improvement

During the survey, it has been noticed that the land used for agricultural, residential, industrial, commercial and institutional purposes are likely to be affected in case of road widening on certain sections; details of which is provided in **Table 17.4**. Most of these abutting land uses are agricultural, followed by those which are residential. However, there is also abutting institutional and industrial land use along some of the road sections.

Table 17.4: Type of Abutting Land Use in Case of Widening of Road

Sl. No.	Type of Land Use	Points in the Various Sections
1	Agriculture	231
2	Residential	72
3	Commercial	31
4	Mix Land use	27
5	Institutional	25
6	Industrial	16

17.1.3 Efficacy of the Proposed Integrated Transport Plan

In all the road sections surveyed, out of all the respondents, 97 percent are of the opinion that the Transport Plan proposed for the NCR will be useful to them. Majority of the respondents viewed that

the proposed transport plan would help by increasing the business opportunities and income of people living along the studied road sections. Further, many of the respondents (88.89 percent) mentioned reduction in time taken to commute as another likely effect of the proposed Transport Plan. Other benefits, as anticipated by the people, are shown in **Figure 17.3**. In addition, few of the respondents suppose development of villages and increase in education level of the people staying in the villages alongside the road sections as other likely benefits of the plan. And so, the survey reveals that a majority of people residing along the road sections are appreciative of the Transport Plan, understanding its impending efficacy.

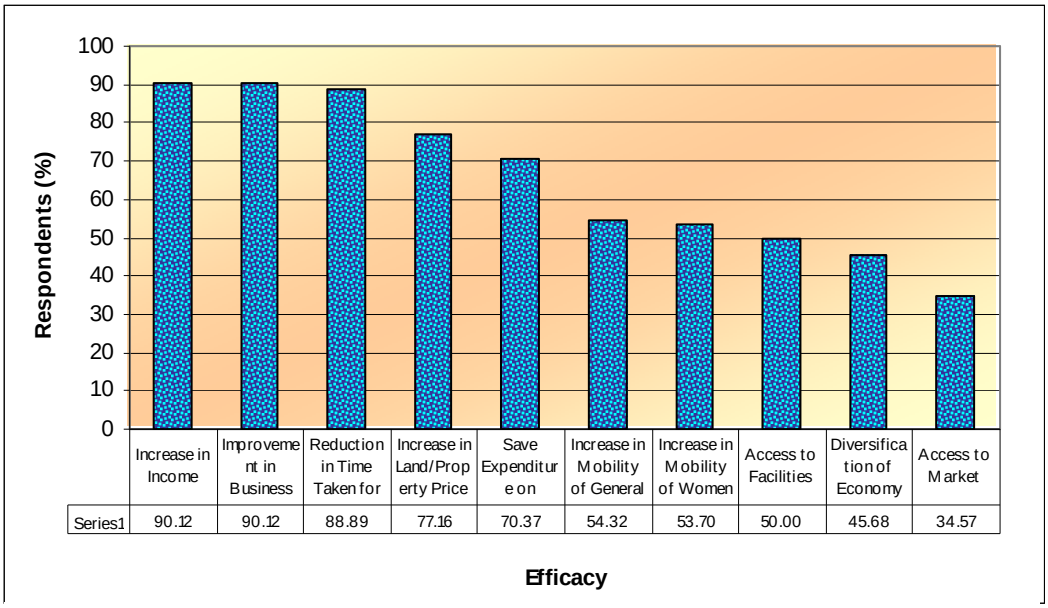


Figure 17.3: Other Anticipated Benefits by the people

17.1.4 Composite Social Index

The social indicators along the project roads have been evaluated using the social Prioritisation Matrix Modal of the existing road network. The social composite index will reflect the prioritisation of the project roads from social aspect. These indicators include data both from secondary and primary sources.

Prioritisation Matrix and Modal

Five social parameters were considered for evaluation by the Consultant. These parameters were assigned weight on a 100-point scale, depending on the relative importance of each parameter. Parameter scores, calculated on the basis of these weights were totalled, to arrive at the final score for a particular road. The parameters and the weightage assigned to each parameter for impact prediction matrix are provided in the **Table 17.5**. The method of calculating composite social index by using weighted factors is adopted from the various road projects in the country such as road project in Punjab funded by World Bank and Chhattisgarh funded by Asian Development Bank.

Table 17.5: Parameters and their Respective Weightages

Sl. No.	Parameters	WF#	Remarks
1.	Work Participation rate	10	Lower work participation ratio, more priority for the road improvement in the area for provision of better job opportunities.
2.	Vulnerable Groups	30	Higher presence of the vulnerable groups, more priority for the road improvement in the area for vulnerable population. It includes three variables – sex ratio, marginal workers and SC and ST.
3.	Literacy Rate	10	Lower the literacy rate, more priority for the road

Sl. No.	Parameters	WF#	Remarks
			improvement in the area for better access to the facilities.
4.	Abutting land use	25	The more abutting land use, lower priority and land acquisition on those roads should be avoided.
5.	Encroachment	25	The more encroachment, lower priority and land acquisition on those roads should be avoided. These sections are also having congested areas.
		100	

Weightage Factor

Social Index Evaluation

The impact evaluation technique can be expressed by the following formula:

$$I = \sum_{i=1}^{n} WF \times M$$

where: I = Total Impact Score
n = Number of parameters
WF = Weightage factor for individual parameters
M = Value of the individual parameters

The score is multiplied by the weightage factor of the respective parameters to achieve the final score.

The higher the score for a particular road, higher will be the priority for road improvement in the sections. The section with Rank 1 will have the least priority for the road development. Higher the composite social index of a section, higher priority for the road improvement. Most of the sections are in high priority for road improvement. Lowest priority sections are minimum number of sections (refer **Table 17.6**).

Behror-Jaipur Road has the highest priority with a total score of 77 while Behror-Madhan-Rewari Road has the lowest priority with a total score of 55.

Table 17.6: Priority of the Sections

Sl. No.	Score	Priority	No. of Sections
1.	<60	Very Low	2
2.	60-65	Low	11
3.	65-70	Average	18
4.	70-75	High	45
5.	>75	Very High	6

From the existing social index of the road network, the proposed network have been also been tested. The proposed networks are usually in high social priority for road improvement which implies that they have low work participation rate; presence of vulnerable groups; low literacy; and low abutting land use and encroachment. The proposed network comprises 66 percent of high priority sections, 20 percent as medium priority sections and 14 percent as low priority sections. Out of a total of 45 sections which have been in high priority (from social aspect), 73 percent of them have been considered. Thus, the proposed network will bring in social mobility which will further lead to economic development within NCR.

17.2 Suggestions and Recommendations

In areas where the transport needs of local communities are not addressed pertinently, a shift from communities as passive recipients to active participants could provide the catalyst for sustainable transport solutions. Community participation of stakeholders in planning, implementation, maintenance and evaluation of transport intervention ensure a response appropriate to local mobility

needs. Thus, solutions are to be prepared which are applicable to local needs and better acceptability of Transport Plan by the people. This can be done by utilizing local knowledge and involving their suggestions.

Survey had a focus on various social attributes viz., perception, attitude, and experiences of the local people. The survey brought about viewpoint of the users/ beneficiaries of the proposed Transport Plan to understand their current and future transport needs. Various provisions have been enumerated by the people living along the villages in the studied road sections viz.

- Improve Road Safety
- Increase the Frequency of Public Transport
- Widening of Road
- Provision for New Links
- New Bus Services
- Improvement/ Strengthening of the Existing Roads
- Provisions for alternative Modes of Communication

91.98 percent of the respondents were of the opinion that provisions for improving the road safety needs to be included. Further, necessity for increasing the frequency of public transport (85.80 percent), widening of roads (83.33 percent) and need for new links (83.33 percent) were other most commonly listed provisions to be included in the Transport Plan.

Alternative modes of communication thus suggested by the local people in various road sections are metro rail, bypass road, provision of frequent roadways bus, under pass/over bridge on certain roads, etc. Roads that have higher social composite index should be given higher priority for improvement of roads. The likely adverse social impacts of road and rail improvement should be minimized. Appropriate considerations have been made while preparing the integrated transport plan for the region.

Apart from that, the land acquisition and sensitive structures as far as possible should be avoided. Land acquisition should be carried out within the provisions of Land Acquisition or other relevant Acts only when it is unavoidable (especially during widening of road and construction of expressways). Along with that, people whose land has been acquired compensation needs to be paid as per the eligibility and provisions in various national and international policies. They should also be given training for diversification of activities and efforts to be made if not to increase but at least the income should be equivalent to the income prior to land acquisition. Priority should also be given to the people whose land has been acquired in various developmental programmes of the state. Entitlement matrix is to be prepared for the various project affected persons (PAP). Moreover, it should be ensured that all sections of PAPs are addressed in the entitlement matrix. Before acquisition of the land, detail census to be conducted for the project affected persons followed by consultations with the various groups to know their expectations. There should also be effective information dissemination about the road improvement programme and land acquisition.

18

Institutional Arrangement and Financing

18.1 Institutional Arrangement

Institutions are important for successful implementation of policies and programs. They need to be properly structured, adequately empowered and suitably supported with capacity and logistics to effectively discharge their assigned functions. Presently, in NCR, as in other regions of the developing world, the functions and responsibilities of urban transport are dispersed over a number of organizations. There is a need to consolidate, integrate and coordinate.

The proposed institutional arrangement should promote:

- Seamless movement (including modal transfers) in NCR
- Dispute free operation
- Funding of system development
- Amicable sharing of revenues generated through transport operations
- Uniform tax structure or at least avoidance of double taxation
- Uniform fare policy (for services by public transport system)

Consultant studied and analyzed the following Acts related to NCR as well as Act related to Regional Transport Sector in Spain and U.S:

i) The National Capital Region Planning Board Act, 1985
ii) Delhi Development Act, 1957
iii) The Motor Vehicles Act, 1988 and Rules thereunder
iv) The Carriers Act, 1865/The Carriage by Road Act, 2007
v) The Road Transport Corporation Act, 1950
vi) States Town & Country Planning Acts
vii) Uniform Law for Infrastructure Projects
viii) Act on Capital Status and Special Regime of Madrid (Spain)
ix) Regional Transportation Authority Act (of USA)
x) Intermodal Surface Transportation Efficiency Act of 1991 (of USA)

Detailed comments on the acts are at **Annexure 18.1**. After studying the said acts, Consultant has proposed NCR – Transport Planning and Coordination Authority (NCR – TPCA) which shall be responsible for NCR transport policy, planning, integration, funding, coordination and advocacy. Its sphere of action would cover the NCR. The Authority needs to be properly structured in terms of composition, functions, powers, responsibilities and procedures.

Consultant has further recommended another single authority, namely “Regional Transport Authority for NCR” (NCR-RTA) under the M.V. Act, 1988 for discharging all relevant functions, within NCR. In addition to the two institutions given above, a number of Special Purpose Vehicles(s) have been suggested by the Consultant in the study report.

The aspect of institution arrangement was discussed in the workshop held on 02.02.2009 with the stakeholders and the suggestions given by the Consultant were not agreed by the NCR constituent States especially the suggestion of Regional Transport Authority for NCR (NCR-RTA) under the M.V. Act, 1988 for the whole region. Therefore, this aspect will require further discussions among the stake holders before deciding about the institutional framework.

However, the matter of implementation of Regional Rapid Transit System (RRTS) and its institutional arrangement was discussed and deliberated in the 3rd meeting of the Task Force constituted by the Planning Commission under the Chairmanship of Secretary, Ministry of Urban Development, Government of India held on 09.12.2009 and it was decided that National Capital Region Transport Corporation (NCRTC) would be constituted to implement the RRTS Project in NCR on the lines of Mumbai Rail Vikas Corporation. Representatives of the NCR Constituent States participated in the said meeting. Its objective would be:

i) To develop/strengthen the existing urban / suburban rail infrastructure and other multi-modal transport services to improve connectivity in NCR.

ii) Commercial utilization of land and air space to supplement resources to fund its activities; and

iii) To coordinate with Central Government i.e. Ministry of Urban Development; Indian Railways and NCR Planning Board and Governments of NCT-Delhi, Haryana, Rajasthan and U.P. and other related agencies and evolve and execute suitable plans for the development of Sub-urban Rail System of NCR i.e. Regional Rapid Transit System (RRTS).

iv) To operationalise the RRTS and other transport services in coordination with the stake holders.

Funds for implementation of eight sub-urban rails projects included in RRTS and other related works shall be arranged by the NCRTC through its equity holders, market borrowings and other sources.

18.2 Financing of Transport Plan

Consultant has suggested that a framework needs to be established to tap various financing sources in a cost-effective manner. The design of the framework will take into account issues relating to fiscal constraints, project cash flow profiles, positioning and access to capital markets as well as availability of government funds and grants for this project. We can have appropriate debt equity ratio for the selected projects from the Transport Plan with large component of debt. The equity investment would be distributed among various stake holders. The selection and segmentation would be based on the extent of their interest in the project.

Consultant further suggested in the Study that the debt profile for the Transport Plan project would be dependent on the debt servicing capability of the project cash flows. The debt instruments should be structured with varying risk profiles to meet the requirements of different lenders/Investors. Given the nature of cash flows, the debt services in this project could include India Infrastructure Project Development Fund (IIPDF), Domestic Financial Institutions (DFIs), Jawaharlal Nehru National Urban Renewal Mission (JNNURM), multi-lateral agencies viz JBIC, ADB, World Bank, etc. and other miscellaneous sources e.g. municipal infrastructure bonds, etc. Other sources could be in the form of Tax Exemptions/concessions on account of import/excise duty levied by the Central Government and concessions on stamp duties, sales tax, etc. levied by the State governments.

Main source of project revenues would be user charges and for this purpose the average annual volume of commuter traffic and the fare structure as ascertained could be used. It has been suggested in the Study that other possible sources of revenue should be explored to enhance the commercial viability of the project. This could come in the form of advertising revenue, betterment levy, commercial exploitation of land above bus terminals/railway stations, revenue from leasing out refreshment areas & stalls at bus terminals/railway stations, surcharge to be levied on commuters, share of external development charges being collected by development authorities for land development for various purposes, etc. The advertising revenue can come through billboards at terminals and along the alignments, printing at the back of tickets etc.

The financing of various Transport Plan projects will vary from project to project and further elaboration of financing pattern and financing of the projects will be done while preparing the Feasibility Report and Detailed Project Report after carrying out detailed appropriate service. Institutional arrangement for implementation of such projects will also be decided at the same time.

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सदस्य सचिव

Dr. Noor Mohammad
Member Secretary

राष्ट्रीय राजधानी क्षेत्र योजना बोर्ड
National Capital Region Planning Board

FOREWORD

The unprecedented growth of urbanization in the country has thrown serious challenges to the Government as well as to the urban local bodies. The pace of this growth necessitates faster development of urban infrastructure and more so in the National Capital Region. During the last 10-15 years, there have been substantial changes in socio-economic profile of the NCR. Consequently traffic and travel characteristics have undergone change over the years. The interaction between Delhi and NCR States has increased manifold. These factors coupled with many changes in land use, population and public transport availability in the NCR needed to be studied in depth for a proper appreciation of traffic and transportation problems in NCR.

National Capital Region has enormous network of transport of 36,305 km and accommodates population of 371 lakhs (2001 census). Better connectivity and improved physical infrastructure in the Region can only help to achieve the balanced and harmonized development of the region. Efficient movement of the commuters from NCR to Delhi and vice-versa will encourage the people to live outside Delhi and commute to Delhi for work and other purposes and lead a good quality of life in NCR. This is possible only if the connectivity in terms of road and rail is adequate, reliable, efficient and safe.

With a view to find a viable, efficient and sustainable solution of transport problems in NCR, a study on preparation of 'Integrated Transportation Plan for NCR' with a horizon year of 2032 was initiated by the National Capital Region Planning Board. This study helped proper appreciation of traffic & transportation problems and identification of the magnitude and pattern of passenger/freight traffic movement within NCR. It made recommendations to develop/improve the major transport demand corridors to and from Delhi as well as within the NCR. The study includes estimation and projection of the regional travel demand to & from Delhi as well as within and to & from NCR and to prepare an Integrated Multi-Modal Transportation Plan for the NCR which can cater to growing transport demand at an acceptable level of service. The traffic and travel characteristics, movement of goods, regional land use, deficiencies and issues of existing transport network has been taken into account in the study. The Consultant has recommended short-term, medium-term and long-term measures for creating an efficient transportation network of the region. The Study will ultimately help in developing Mass Commuter System for NCR, which will be helpful in promoting & supporting the economic development of the Region and will ultimately help in reducing migration to Delhi.

During the Study, Air Pollution and noise level surveys were carried out by the Consultant within NCR and Air Pollution and Noise Modals were constructed. Spatial distribution of SPM, CO, NO_x, RSPM, Leq (Day) and Leq (Night) levels measured at 82 identified

…2..

locations (2007) indicate that the norm of these parameters was being violated at all the 82 locations varying between moderate to critical level of pollution. Further, the NCR – Transport Modal predicted intensity of traffic, by modes and their speeds, in the horizon year and volume of exhaust gases due to this traffic was estimated using the modals and location-wise Air Pollution Indices (API) was calculated which also exceeded the prescribed standards at 70 out of 82 stations. Emission of Green House Gas (CO_2) by modes, were estimated based on vehicle kilometres, fuel consumption and CO_2 emission factors. It was estimated that a total of 15.52 Gg (15520 M Tons) of CO_2 /day would be emitted at the 82 stations in NCR. It indicates that Transport Plan for NCR is required to be implemented in phased manner as proposed and if the rail based public transport system i.e. RRTS and Bus-based public transport system i.e. BRT are not implemented in time-bound manner, it will have serious impact on **Climate Change** apart from affecting the health of the people in the Region. Hence, there is a dire need to construct/develop Integrated Multi-Modal Transport System in NCR with major emphasis on RRTS, Regional Orbital Rail Corridor, Inner Regional Orbital Rail Corridor and efficient bus services as public transport system.

With regard to Seamless travel in NCR, two Reciprocal Common Transport Agreements for NCR have been signed - one for "Contract Carriage" vehicles on 14.10.2008 and the other for "Stage Carriage" vehicles on 22.04.2010. All the Constituent States have notified the "Contract Carriage" Agreement in their Gazettes; its implementation is in progress. The process of Gazette Notification for "Stage Carriage" is under way. Thereafter, the agreement will come in force. It is hoped that these agreements will make manifest contribution to a seamless, integrated and reliable connectivity in NCR.

In order to disseminate proposals and recommendations of the Study, to interact with experts, concerned agencies at Central, State and local levels, and to elicit the views of stakeholders, a Workshop was organized on 02.02.09. After a full day of discussions, during which valuable contributions were made, the outlines of Functional Plan for Transportation in NCR emerged. The suggestions of the participants - including those of members of Consultancy Review Committee, Advisory Group, representatives of the participating States, Planning Commission & Railways - were incorporated and the Final Report has been prepared by the Consultant, which is now being published as "Functional Plan on Transportation for NCR-2032". The Functional Plan was approved by NCR Planning Board on its 31st meeting held on 11th November, 2009. The basic objective of this Plan, as per provisions contained in Section 16 of NCRPB Act, 1985, is to provide proper guidance to the NCR States and the concerned Ministries responsible for various aspects of transportation.

This Functional Plan on Transportation includes Demographic characteristics, Transport System, Traffic and Travel characteristics, Transport Demand Modaling, development Scenarios, Network Alternatives, Evaluation and Selection, Integrated Multimodal Transport Plan and Institutional & Legal Framework. The block cost estimates have also been worked out, which will serve as a guide to the NCR States in formulating detailed project reports.

The Functional Plan would have to be detailed out by the NCR States and their concerned agencies, by formulation of district-wise Plan of Action, where required, for implementation, detailing out shelf of projects for the sector and identification of sources of funding through convergence with other governmental programmes. Similarly, the Central Ministries will have to integrate this plan with their Development Plans.

…3..

I congratulate NCR Planning Board for its efforts to prepare Functional Plan on Transportation for NCR and thereby contribute to sustainable development of the region. Thanks are due to the Members of the Consultancy Review Committee whose valuable inputs have been helpful in shaping this "Integrated Transport Plan for NCR". I am sure that, with cooperation of the implementing agencies of the NCR States, Central Ministries and enthusiastic support of the people, this Functional Plan would bring about a substantial improvement in transportation facilities in NCR.

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Member Secretary
NCR Planning Board

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Transport Demand Modeller

EXECUTIVE SUMMARY

Functional Plan on Transport for National Capital Region-2032

1. Introduction

National Capital Region Planning Board prepared the Regional Plan with the perspective year 2021 for the National Capital Region as per the provisions of Section 10 of the NCR Planning Board Act, 1985 for balanced and harmonized development of the National Capital Region which was notified on 17th September, 2005.

The Region covers an area of 33,578 square kilometres with 1,483 sq kms (or about 4.41%) falling in the National Capital Territory of Delhi; 13,413 sq kms (or about 39.95%) falling in the Haryana Sub-Region; 7,829 sq kms (or about 23.32%) falling in the Rajasthan Sub-Region; and 10,853 sq kms (or about 32.32%) falling in the Uttar Pradesh Sub-Region. It includes nine districts of Haryana, namely, Faridabad, Palwal, Gurgaon, Mewat, Rohtak, Sonepat, Rewari, Jhajjar and Panipat; five districts of Uttar Pradesh, namely, Meerut, Ghaziabad, Gautam Bhudha Nagar, Bulandshahr and Baghpat; and Alwar district of Rajasthan apart from NCT-Delhi. In addition to above, there are eight Counter-magnet Areas, namely, Ambala and Hissar in Haryana, Bareilly and Kanpur Nagar in Uttar Pradesh, Dehradun in Uttrakhand, Kota in Rajasthan, Patiala in Punjab and Gwalior in Madhya Pradesh.

One of the objectives of the Regional Plan-2021 is to provide efficient and economic rail and road based transportation system (including mass transport systems) well integrated with the landuse patterns for balanced regional sustainable development.

National Capital Region Planning Board (NCRPB) initiated preparation of an Integrated Multi Modal Transport Plan (IMMTP) for NCR to be in consonance and within the policy framework of the Regional Plan. The study was carried out by M/s Consulting Engineering Services (India) Private Limited, New Delhi. On submission of the Draft Final Report, a workshop was organized on 02 February 2009, at India Habitat Centre, New Delhi, wherein stakeholders, experts and members of Planning Committee, Task Force, Advisory Group and Consultancy Review Committee were invited to interact and obtain their suggestions on the Plan. The Final Report presents the findings of the surveys & studies, the policy framework and details the Integrated Multi Modal Transport Plan for NCR. The Functional Plan on Transport-2032 for NCR has been prepared based on the findings and recommendations of this Study Report and as per the provisions of section 16 of the NCR Planning Board Act, 1985.

2. NCR Transport System

NCR transport system includes an extensive road network system of about 36,305 km; a large bus fleet, a good rail network of about 1000 km; and an International Airport at Delhi.

3. Surveys and Studies

A large number of extensive and in-depth surveys and studies were carried out to appreciate the characteristics of NCR and identify issues, constraints and opportunities which includes Road Network Inventory; Speed & Delay Survey of 2950 kms; Classified Traffic Volume Count Survey at 82 locations (3- day Traffic Volume Count at 22 locations and 1-day Traffic Volume Count at 60 locations); Origin - Destination Survey at 43 locations; Commuter Survey (5156 samples); Environmental Status Survey at 20 locations; Bus Terminal Survey at 20 terminals; Stated Preference Survey (748 samples); Freight Operator Survey (100 samples); Social Impact Survey along major corridors and Intermediate Public Transport Survey (198 samples).

4. Road Network

NCR has a good road network system. The road density is 108 km/100 Sq. km, which is higher than the national road density. The accessibility levels are good with NCT-Delhi having the highest accessibility. Connectivity is also good. Mobility index indicates the need for improving the quality of the road network.

5. Traffic Volume

NCR is a high movement area and high intensity traffic of all types move on the road network. 2,21,575 vehicles (3,50,694 PCUs) enter and exit NCR (outer cordon – OC) on an average per day. National Highways account for 74.75% (vehicles) of the total traffic volume. The traffic volume increases to 2,72,891 vehicles (3,87,565 PCUs) at the Middle Cordon – (MC) around the CNCR area; and reaches a high of 12,10,896 vehicles (12,27,873 PCUs) at Inner Cordon – (IC) around NCTD.

6. Traffic and Travel Characteristics

The traffic pattern in the NCR presents interesting features. At the Outer Cordon, nearly 97% of passenger modes movement was Internal – External and External – Internal. Only 3.2% was External – External (non destined). The inter-spatial movement pattern of passenger modes showed a high share between 'Rest of NCR' and 'Outside NCR' areas. Of the goods modes movement at Outer Cordon, 9.1% was non-destined.

At the Middle Cordon, Internal-External and External-Internal passenger mode movement accounted for 68.6%. The share of through movement was 4.1%. A high intensity of interaction between CNCR and outside areas was observed. Internal-Internal passenger movement was 27.3% within CNCR. Of the goods modes, 7.2% was non-destined.

At the Inner Cordon, of the passenger modes, the non-destined traffic was a high of 12.9%; and of goods modes, 29.9%.

7. Rail System

NCR has a good rail network system with 5 Divisions of 3 Zonal Railways. Three rail corridors converge at Ghaziabad and six rail corridors converge at Delhi. They are Ghaziabad – Khurja, Ghaziabad – Hapur – Garmukteshwar & Ghaziabad – Meerut and Delhi – Ghaziabad, Delhi (Shahadara) – Shamli – Saharanpur, Delhi – Faridabad – Palwal – Mathura, Delhi – Gurgaon – Rewari – Alwar, Delhi – Shakurbasti – Rohtak and Delhi – Subzimandi – Sonipat – Panipat.

A large number of long distance passenger trains, commuter suburban trains and goods trains move into and out of NCR. The commuter traffic in NCR is about 0.61 million per day.

8. Air Transport

Indira Gandhi International Airport (IGIA) is the major airport in NCR. In terms of traffic volumes, it is second to Mumbai, and handles annually about 20.44 million passengers and 0.39 million tons of cargo traffic (2006-07). Air traffic is increasing at a high rate and it is forecasted that Delhi airport would handle 82.7 million passengers by 2026 and would touch 100 million by 2036. Of the passenger traffic, 75.75% was generated within NCTD, 18.75% in NCR (excluding NCTD) and 5.50% beyond NCR.

9. Bus System

NCR is served by an extensive bus service operated by STUs of NCTD, Haryana, Uttar Pradesh, Rajasthan, Uttaranchal, Punjab, Himachal Pradesh and Jammu and Kashmir; and a host of private operators. The STUs operated about 3144 buses from NCR depots and carried 1.05 million passengers per day. The overall NCR bus density (number of buses per lakh people) is much higher (132) compared to national density (71) in the year 2004. The physical performance of the bus system (STUs) in NCR is good. However the financial performance is poor, leading to a loss of Rs 22.94 per bus km.

The demand for buses in NCR would continue to increase at a high rate and it is estimated that by 2032, more than 37,000 buses will be required to cater to the demand.

10. Intermediate Public Transport System (IPTS)

A large number of auto rickshaws and taxis operate within NCR providing the much needed capacity and service. However this operation is mainly intra urban. The operation (driving) is mostly by hired vehicles (72%). An auto rickshaw carries 96 passengers per day and other vehicles carry 114 passengers per day on an average. The IPTS suffers from many constraints like lack of terminal facilities, technological obsolescence, uneconomic fares, harassment, etc. There is a need to facilitate growth and operation of IPTS within the NCR.

11. NCR Transport Modal, Development Scenario, Transport Network Alternatives, Recommended Alternative for NCR and Trip Forecast

A four stage Urban Transport Planning System (UTPS) modal has been constructed for modalling internal-internal trips and an elasticity based growth rate modal for the other three components of trips (IE, EI & EE). The transport network comprises the road network, public transport (bus & rail) and metro network.

Nearly 5.9 million person trips are performed daily by road in the base year, of which 3.9 million trips are I-I. In terms of freight traffic, nearly 1.8 million tonnes move daily in the study area.

Regression modals based on zonal population and employment, for passenger trip production and attraction have been developed for intra-region trips, for various spatial components of NCR namely, rural, urban, service centre, sub regional centres and metro centres & regional centres. For NCTD, trip rate modal has been adopted.

The trip distribution is accomplished using gravity modal where the generalised cost used is the composite impedance represented by a logsum variable. The modal is calibrated using CUBE Voyager software wherein friction factor lookup table is generated. The validation was performed using checks such as trip length frequency distribution, coincidence ratio and mean trip length.

A nested logit choice modal was developed for mode choice modalling based on Stated Preference and Revealed Preference data. The modal was calibrated separately for five different spatial units: NCT Delhi, NCR Urban Service Centres, NCR Urban Sub Regional Centres, NCR Urban Metro and Regional Centres and NCR Rural. The attributes considered were travel time, travel cost and wait time for transit modes and travel time and cost for private modes. The estimation of the choice modal process comprised setting up of panel data, calibration of coefficients and modal bias from disaggregate modal and validating the same at disaggregate level. Maximum likelihood method was adopted to estimate the modal parameters. The modal was successfully validated by comparing the observed and estimated trips by different modes across various spatial stratification in NCR. Modal sensitivity tests were also carried out in terms of change in fare and time of bus and rail on their respective riderships.

Trip assignment was carried out using Capacity Restraint Assignment Technique. The highway assignment was carried out for the peak period, preloading the network with public transport and commercial vehicle flows before loading the private vehicle flows. While the highway assignment was carried out based on generalised cost (with vehicle operating cost and value of time as inputs), the public transport assignment was based on generalised time (with in-vehicle travel time, waiting time and fare in time units as inputs). The validation of the trip assignment was done by comparing the assigned with the observed screen line traffic counts.

Five alternate land use development scenarios were conceptualised based on alternate policies and patterns of development. Planning variables in terms of population and employment were forecast for various spatial stratifications of NCR for each development scenario. The calibrated trip end modals in the base year for daily person trips within the region were applied along with trip rates for NCT Delhi on projected population development scenario to get future trip ends.

The inter-region traffic was forecasted based on elasticity approach. Transport demand elasticities were worked out based on time series information and projected in the horizon years along with projected NSDP growth rates in the horizon years which provided the estimates of future inter-region traffic.

The horizon year trip end forecasts incorporating inter and intra-region trips ranges from 18.3 million to 23.77 million in different scenario in the Horizon Year 2032 for passenger traffic while it varies between 5.87 million tonnes to 6.57 million tonnes for goods traffic.

Regional Plan-2021 has estimated the population size of NCR, by 2021, to be 64.14 million. As the Transport Plan is being envisaged for 2032, the population and employment data of NCR, extended up to 2032, are estimated to be 86.67 million and 32.67 million, respectively.

Five scenarios of spatial distribution of population and employment by three policy zones of NCTD, CNCR and Rest of NCR, were conceptualized in the study which includes:

- Growth Trend Based Development
- NCR – RP-2021 Policy Based Development
- Dominant Delhi Based Development
- Strong CNCR Based Development
- Strong ‘Rest of NCR’ Based Development

Distribution of employment size, by spatial zones, in different policy zones, was estimated under similar policy basis and comparative distribution of population & employment in policy zones, by 2032, were depicted in the study. Five alternate Transport Networks were conceptualized in the study in consonance with the Development scenarios. Combining the five Development Scenarios and five Network Alternatives, a scenario matrix was generated with 25 cells of different combinations, out of which six combinations were selected for evaluation and selection.

The probable scenario was evaluated and ranked in the Study which was carried out by i) graphical indices and ii) analytical quantitative indices. Graphical indices include Accessibility Index, Mobility Index and Degree of Connectivity. The analytical quantitative index (outputs / impacts) includes the following:

- Passenger vehicles-kilometers by modes (car, 2-wheeler, bus, rail and metro)
- Passenger vehicle-hours by modes
- Goods tonnage – kms
- Goods tonnage-hours
- Energy (fuel) consumption by modes (Car,

- Person kilometers by modes
- Person hours by modes
- Goods vehicle-kms
- Goods vehicle-hours
- 2-wheeler, Auto Rickshaw & Goods vehicles)
- Emissions (CO_2) by modes

Under both the techniques, the combination scenario 'Strong Rest of NCR – Integrated Multi Modal Transport System' emerged as the most optimal and the scenario 'RP 2021 (extended) – Integrated Multi Modal Transport System' was the second best. This indicates the importance of the 'Rest of NCR' zone for future development to receive larger population and activities. However, the scenario combination RP 2021 Extended – Integrated Multi Modal Transport System – was selected for detailing. The conceptual transport network system is the same in both the scenarios. Using the NCR Transport Modal, travel demand in the Horizon Year was estimated in the Study. Horizon year traffic assignment was carried out for public and private trips on respective networks. Iterative process between public transport and private traffic assignment was carried out until there was no appreciable change in the link loadings and link cost.

12. NCR – Integrated Multi Modal Transport Plan

Based on the selected scenario, the Integrated Multi Modal Transport Plan (IMMTP) for NCR has been prepared. The Plan emphasizes on two aspects, namely, Integration and Multi-Modality. The Network Plan provides for physical integration. Operational integration needs to be ensured while detailing the operational plan of the component systems.

The NCR – IMMTP includes:

- An extensive network of Regional Expressways (1376 kms)
- An extensive network of Regional Arterials (1801 kms)
  (which are the strengthened National Highways and upgraded State Highways)
- An extensive network of Regional Sub-Arterials (631 kms)
  (which are the strengthened State Highways and upgraded Major District Roads)
- An extensive network of Regional Collectors/Distributors
  (which are the strengthened Major District Roads and upgraded Other District Roads)
- An extensive network of Sub-Regional Access Roads
  (*which are the Other District Roads and Village Roads to be detailed in Sub-Regional Plans)*
- An extensive Bypass system around the regional urban centres
- A large number interchanges on the road network system
- A Network of Regional Rapid Rail System (RRTS) (640 kms) running on dedicated tracks and providing rail service for commuters
- New Rail lines linking some of the regional centres and metro centres in the form of Regional Orbital Rail Corridor (RORC) and Inner Regional Orbital Rail Corridor (IRORC) (561 kms)
- An extended network of Metro Rail System connecting the Regional Centres
- An extensive fleet of Bus System with supporting infrastructure (Depots, Workshops)
- A number of Bus Terminals and Rail Terminals enabling integration of and smooth transfer amongst modes
- A number of Logistics Hubs
- A number of Highway Transport Facility Centers
- A number of Integrated Freight Complexes and Truck Terminals

- A second International Airport and a number of small airports in a few of the Regional Centres

The Map 0.1 presents the proposed NCR Transport Network System.

Road System

Road Network forms the main component of the IMMTP. A revised hierarchical classification comprising Regional Expressways, Regional Arterials, Regional Sub-Arterials, Regional Collectors / Distributors and Regional Access Roads is proposed. An extensive Regional Expressway Network extending over a length of 1245 km is proposed. These expressways will enhance the quality of the road system.

High Occupancy Vehicle (HOV) lanes in Expressway and Regional Arterials need to be provided. Regional bypass system (connecting Panipat, Rohtak, Rewari, Palwal, Khurja, Hapur, Meerut, Panipat) is important to enable the high intensity inter region goods traffic to move at the regional level. The quality of the Regional Bypass must be better than radial expressways to facilitate the process of diversion. Differential fare policy, between radial & grid corridors and general & HOV lanes, needs to be adopted.

The Kundli-Manesar-Palwal and Palwal-Ghaziabad-Kundli expressways are important, but would tend to become urban expressways due to intense urban development in CNCR.

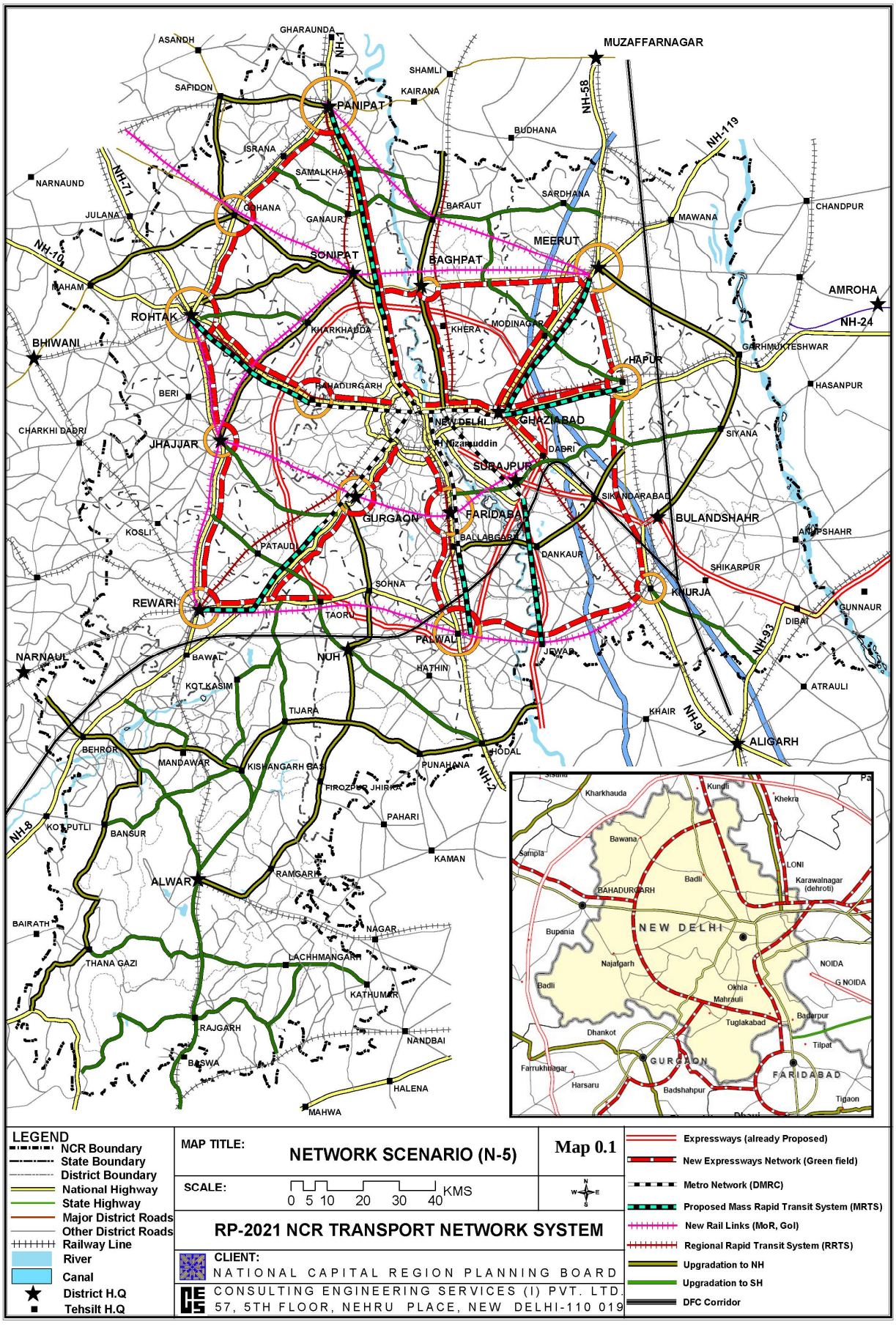
At the second level, the existing radial NH corridors converging into Delhi are proposed to be developed as Regional Arterials. NCR-RP 2021 has recommended high intensity development along major highway corridors. Hence, these highways would almost become urban corridors with high intensity of traffic.

Along the NCR-Road Network, a number of support facilities are suggested. They include development of Facilities Centers, Logistic Hubs and Integrated Freight Complexes.

Regional Rail System

NCR has a good rail network system. A variety of movements take place on it. Commuter service is important for people within NCR. The rail commuter demand is estimated to be 1.7 million passengers per day. An extensive commuter survey network designated as Regional Rapid Transit System is proposed along dedicated tracks, with electrification and modern signal and communication systems to enable safe, high speed, high frequency services.

The Regional Orbital Rail Corridor (RORC) connecting Panipat-Rohtak-Rewari-Palwal-Khurja-Hapur-Meerut-Panipat enables re-routing of national rail goods movements at the regional level avoiding Delhi Area. In this corridor Panipat-Meerut, Palwal-Khurja and Palwal-Bhiwadi-Rewari are new rail lines and Rohtak-Rewari rail line is under construction. Meerut-Khurja and Rohtak-Gohana-Panipat Corridors are existing corridors. RORC also interconnects the regional centers increasing their accessibility and potential for growth.


GHARAUNDA
ASANDH
NH-1
MUZAFFARNAGAR
SHAMLI
SAFIDON
KAIRANA
PANIPAT
NH-58
BUDHANA
NH-119
ISRANA
SAMALKHA
NARNAUND
NH-71
SARDHANA
JULANA
GOHANA
GANAUR
BARAUT
MAWANA
CHANDPUR
MEERUT
NH-10
SONIPAT
BAGHPAT
MAHAM
AMROHA
ROHTAK
KHARKHAUDA
KHERA
MODINAGAR
NH-24
BHIWANI
GARHMUKTESHWAR
HAPUR
BERI
BAHADURGARH
HASANPUR
NEW DELHI
GHAZIABAD
CHARKHI DADRI
JHAJJAR
H Nizamuddin
SIYANA
DADRI
SURAJPUR
SIKANDARABAD
BULANDSHAHR
GURGAON
FARIDABAD
KOSLI
PATAUDI
BALLABGARH
DANKAUR
SHIKARPUR
SOHNA
KHURJA
REWARI
TAORU
GUNNAUR
DIBAI
PALWAL
NH-93
NARNAUL
BAWAL
NUH
JEWAR
HATHIN
KOT KASIM
ATRAULI
TIJARA
KHAIR
NH-91
ALIGARH
BEHROR
HODAL
MANDAWAR
KISHANGARH BAS
PUNAHANA
NH-2
FIROZPUR JHIRKA
PAHARI
NH-8
KOT PUTLI
BANSUR
KAMAN
RAMGARH
ALWAR
BAIRATH
NAGAR
THANA GAZI
LACHHMANGARH
KATHUMAR
RAJGARH
NANDBAI
BASWA
HALENA
MAHWA
Kharkhauda
Kundli
Khekra
Bawana
Sampla
LONI
Badli
Karawalnagar (dehroti)
BAHADURGARH
NEW DELHI
Bupania
Najafgarh
NOIDA
Badli
G NOIDA
Okhla
Mahrauli
Tuglakabad
Badarpur
Dhankot
Tilpat
GURGAON
FARIDABAD
Farrukhnagar
Harsaru
Badshahpur
Tigaon
LEGEND
NCR Boundary
State Boundary
District Boundary
National Highway
State Highway
Major District Roads
Other District Roads
Railway Line
River
Canal
District H.Q
Tehsilt H.Q
MAP TITLE:
NETWORK SCENARIO (N-5)
Map 0.1
SCALE:
0 5 10 20 30 40 KMS
RP-2021 NCR TRANSPORT NETWORK SYSTEM
CLIENT:
NATIONAL CAPITAL REGION PLANNING BOARD
CONSULTING ENGINEERING SERVICES (I) PVT. LTD.
57, 5TH FLOOR, NEHRU PLACE, NEW DELHI-110 019
Expressways (already Proposed)
New Expressways Network (Green field)
Metro Network (DMRC)
Proposed Mass Rapid Transit System (MRTS)
New Rail Links (MoR, GoI)
Regional Rapid Transit System (RRTS)
Upgradation to NH
Upgradation to SH
DFC Corridor

In addition to RORC, five other rail lines, within NCR, are proposed to strengthen the connectivity of the rail system which will form Inner Regional Orbital Rail Corridor (IRORC). They are Sonipat – Jhajjar, Jhajjar – Gurgaon, Gurgaon – Faridabad, Faridabad – Dadri, Meerut - Baghpat – Sonipat and Sonipat – Gohana – Jind. Sonipat – Gohana – Jind corridor is under execution. Dadri-Ghaziabad-Meerut connectivity would be available through RRTS Corridors. This will connect most of the metro centres and regional centres in NCR.

The proposed two Dedicated Freight Corridors (DFCs) run through the region and meet at Dadri. In addition to the rail terminal at Dadri, a major logistics and container terminal is proposed to be developed at Dadri. Further, such terminals would also be developed at Khurja, Palwal, Rewari, Rohtak, Panipat and Meerut.

NCR Transport Corporation under the Ministry of Urban Development is being proposed to develop and operate the RRTS.

Regional Mass Rapid Transit System (MRTS)

Regional Plan-2021 for NCR proposed the extension of Delhi Metro Rail System to CNCR towns and Mass Transport System in NCR. Accordingly, it has been extended to Noida and is proposed to be extended to Gurgaon, Ghaziabad, Faridabad, Bahadurgarh and Greater Noida by Delhi Metro Rail Corporation. The work on Gurgaon corridor is in progress. It is proposed to provide MRTS in the Regional Centres & Sub-regional Centres along the proposed Regional Arterial road corridor to accelerate the process of development in a later phase. The Regional MRTS is estimated to cater to a share of 9.1% of NCR internal-internal person trips with a demand size of 1.2 million passengers per day.

Bus System

A regional Bus based Public Transport System (BPTS) has been conceptualized for the NCR area excluding intra-city transport needs of Delhi and other urban areas.

At present, more than 6200 buses, mainly from 57 depots of the STUs located in the NCR, and others located outside, serve the intercity, inter and intra region transport needs of NCR. The bus system growth in the region has not kept pace with growth in travel demand.

Against an average of 71 buses per lac persons country-wide, the NCR sub regions of Uttar Pradesh and Rajasthan have much lower densities with 46 and 43 buses respectively; Haryana has 64 and Delhi, 267.

As per CES survey 2007, nearly 53% (50% by bus and 3% by mini bus) of all the motorised passenger trips are served by buses constituting 7.35% of all the passenger vehicle trips observed. The average trip length of intra region bus passengers is 51 kms, and the PCTR, 0.0479.

A number of recommendations in respect of fleet size, fleet ownership, institutional set-up, bus depots, capacity building, bus terminals / BQS, rationalization of fares & taxes, bus technology, seamless integration of travel trips, etc. have been made for bus based public transport in the Multi-modal Integrated Transport System. On the basis of the current PCTR, the population of NCR and the bus capacity of 11673 seat kms daily, a requirement of 9283 standard buses is assessed as base year demand for intra region travel, the number increasing progressively to 37734 in the horizon year 2032. These demand levels would increase significantly if interstate travel needs are considered. This demand however

has to be served both by the NCR as also by other States. In both cases, intra urban travel requirement is excluded.

The induction of bus fleets - both on addition and replacement accounts and creation of bus depots and the Workshops, require a total investment of about Rs 25873 crores (at base year prices) spread over the period of 25 years. The investment in about 75% of the bus fleet additions, its periodic replacements and the corresponding bus depots and workshops would be made by the private sector through a PPP modal. Only about 25% of the investment amounting to nearly Rs 6468 crores is proposed to be made by the Government agencies. The above investment of Rs 6468 crores is expected to serve an average population of about 7 crores during the period of 25 years. Investment requirement by the Government agencies comes to Rs 37 lakhs per lakh population per year or Rs 37 per person per year. All buses are to be provided with electronic route-destination display system.

All the buses are to be equipped with Intelligent Transport Systems (ITS) comprising of GPS / GPRS / related communication and other sub systems for on-line tracking of bus operations besides feeding the Passenger Information System (PIS). All buses are to be equipped with hand held Electronic Ticketing / Ticket Verification Machines (ETVMs). The ETVMs need to be GPS/ GPRS compatible for on-line identification of bus stops / fare stages and communication of requisite data (the way bill details, revenue collection, etc.) to the control rooms periodically.

Bus Terminals

In a large region like NCR, passengers shift from one bus route to another, one transport mode to another, public transport buses to private transport buses to complete their end-to-end trips call for seamless transfer facilities in the form of bus terminals / bus stations, to avoid inconvenience to the passengers. Mode / route interchange facilities in the form of bus terminals/bus stations is an important factor influencing efficiency of bus transport system. For more than 6000 buses operating in the NCR, only a few terminal spaces have been provided. Even amongst these, except for some terminals, the rest are partially / poorly developed. A passenger bus terminal broadly needs to perform various functions to meet requirements of passengers and vehicles; passengers only; vehicles only; crew and the management. Considering the requirements, the facilities planned, and the population of the settlements, the bus terminals is to be classified.

At least one bus terminal with adequate provision for future growth is proposed in every city. In Class I cities and above, a number of bus terminals at the rate of one commuter terminal for handling up to 1500 buses per day is suggested. A requirement of 50 bus terminals (minimum) is assessed. Development of bus terminals calls for large investments which are proposed to be obtained through Public-Private-Partnership (PPP), the public sector equity coming mainly as the land value of the bus terminals. A total investment of Rs 3539 crores for development of bus terminals across NCR is estimated. The investment is proposed to be made on PPP basis in a phased manner generally at the rate of 20%, 20%, 20% and 40% during the years 2008-12, 2013-2017, 2018-2022, 2023- 2032 respectively. Development of bus terminals and other facilities under the PPP modal, involves a large variety of activities. These are proposed to be performed by an independent agency under the over all control of the Government to avoid any bias between public and private bus operators.

Airports

Indira Gandhi International Airport (IGIA), Delhi is the only commercial airport serving NCR. It is the second biggest in the country, handling a passenger traffic on 20.44 million per annum and cargo traffic of 0.39 million tonnes per annum. Of the passenger traffic, 75.75% is generated within NCTD, 18.75% in NCR excluding Delhi and 5.5% from outside NCR. IGIA development, operation and management has been privatized. It is estimated that IGIA will need to handle a traffic of 100 million passengers by 2036.

The Government of Uttar Pradesh have proposed development of a 2nd International Airport in Greater Noida (Jewar) named as Taj International Airport. The proposal is under active consideration of the Government of India. It is expected to handle about 40 million passengers per annum.

Considering the growing importance of air transport, facilitated by an enabling Civil Aviation Policy, the demand for air connectivity to and from the regional centres in NCR would increase. The national and business traffic generated by these centres would need quick access to and from the international airports. A number of smaller airports in a few of the major regional centres are proposed.

13. Environmental Impact Assessment

Air Pollution and noise level surveys were carried out at a number of locations within NCR by the Consultant and Air Pollution and Noise Modals constructed. Spatial distribution of SPM, CO, NO_x, RSPM, Leq (Day) and Leq (Night) levels measured at 82 identified locations by the Consultant in the year 2007 have been detailed out following paras:

SPM

The CPCB standard for SPM is 200 µg/m^3. It is clear that out of total 82 stations, SPM level at 34 Stations is below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude. At 36 stations, it is violating the standards (EF varies between 1.0-1.5; High Pollution) with varying magnitude and at remaining 12 stations it is critical (EF >1.5;Critical Pollution). Preventive and control measures are required to be undertaken at 36 stations where it is violating norms. Twelve stations where SPM level is critical are: 19(Dasna Toll Plaza), 21(Near Dadri), 69(Bagadurgarh-Delhi), 62(NH-8 Behror), 20(Morta), 44(Bilaspur Toll Plaza), 23(Near Indrapuram, Ghaziabad), 42(Khirki Dola), 9(Kundli), 1(Babarpur), 26(Faridabad) and 22(Mohan Nagar) are violating the standards (EF >1.5;Critical Pollution) and immediate measures are required to be taken by the concerned authorities for its reduction.

CO

The CPCB standard for CO is 2000 µg/m^3. It is clear that out of 82 stations, 72 stations are well below the prescribed standards (EF varies between 0.0-0.5; Low pollution) have a rather pristine air quality and such areas are to be maintained at low pollution level by way of adopting preventive and control measures of air pollution. In the remaining, 9 Stations though below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude as of now are likely to exceed the standards in future. It is observed that the concentration of CO at station 22(Mohan Nagar) which is exceeding the standards (EF varies between 1.0 - 1.5; High Pollution), needs preventive and control measures to be taken.

NO_x

The CPCB standard for No_x is 80 µg/m^3. It is clear that out of 82 stations, 79 stations are well below the prescribed standards (EF varies between 0.0-0.5; Low pollution) have a rather pristine air quality. The

remaining 3 stations, 44(bilaspur Toll Plaza), 9(Kundli) and 1 Babarpur are below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude as of now but likely to exceed the standards in future.

RSPM

The CPCB standard for RSPM is 100 µg/m^3. It becomes clear that among all 82 stations, RSPM levels of 46 stations are below the prescribed standards (EF varies between 0.5-1.0; Moderate pollution) with varying magnitude as of now but likely to violate the standards in future. In the remaining, 26 stations which are violating the standards (EF varies between 1.0-1.5; High Pollution) with varying magnitude, preventive and control measures are to be taken. It is observed that the concentration of RSPM at Station 69(Bahadurgarh – Delhi),62(NH-8 Behror),20(Morta) 44(Bilaspur), 23(Indrapuram), 42(Khirki Dola), 9(Kundli), 1(Babarpur), 26(Faridabad) and 22(Mohan Nagar) are violating the standards(EF >1.5;Critical Pollution), where preventive and control measures have to be taken immediately.

In order to assess the noise impacts due to the proposed project on surrounding area base line noise levels were monitored. To determine the existing noise level, field monitoring was carried out along the existing alignment of the road with integrating sound level meter as per IS: 3029-1980.

Leq (Day)

The CPCB standard for Leq (Day) is 65 dB (A). It becomes clear that all 82 stations are above the prescribed standards. It is observed that intensity of noise level at stations No.44 (Bilaspur), 42(Khirki Dola), 9(Kundli), 1(Babarpur), and 69(Bahadurgarh) is very high (i.e. >75 dB (A)).

Leq (Night)

The CPCB standard for Leq (Night) is 55 dB (A). It becomes clear that all 82 stations are above the prescribed standards. It is observed that the intensity of noise level in stations Numbers 20(Morta), 17(Hapur),l (Garhmukteshwar Toll Plaza), 19(Dasna Toll Plaza), 7(Sisana), 21(Near Dadri), 23(Near Indra puram gaziabad), 22(Near Mohan Nagar), 26(NH 2 Sec), 37 (Faridabad), 62(NH 8 Behror), 42(Khirki Dola), 44(Bilaspur toll Plaza), 9(Kundli), and 1(Babarpur) is very high(i.e. > 65 dB(A)).

It could be observed from above that the norm of SPM level at all the 82 locations was being violated varying between moderate to critical level of pollution in their magnitude. Similarly, in term of CO, NO_x and RSPM the prescribed standard limits were also being violated at all the monitoring stations. These levels are expected to rise further beyond critical limits if the proposals of the Transport Plan for NCR are not implemented in time-bound manner.

The NCR – Transport Modal predicted intensity of traffic, by modes and their speeds, in the horizon year. Volume of exhaust gases due to traffic was estimated using the modals and location-wise Air Pollution Indices (API) were calculated. The locations were ranked on the basis of API ranging from a minimum 0.66 to maximum 1.67. Assessment indicates that the API in the horizon year will exceed the prescribed standards at 70 out of 82 stations. Environmental Pollution due to traffic will be a serious problem in NCR. **Emission of Green House Gas (CO_2) by modes, were estimated based on vehicle kilometres, fuel consumption and CO_2 emission factors. It was estimated that a total of 15.52 Gg (1Gg = 10^6 Kg = 1000 M Tons) of CO_2 /day would be emitted at the 82 stations in NCR.** It indicates that if the rail based public transport system i.e. RRTS and Bus-based public transport system i.e. BRT are not implemented in time-bound manner, it will have serious impact on **Climate Change** apart from affecting the health of the people in the Region.

Hence, there is a dire need to construct/develop Integrated Multi-Modal Transport System in NCR with major emphasis on RRTS, Regional Orbital Rail Corridor and Inner Regional Orbital Rail Corridor as public transport system. However, a set of mitigation measures at pre-construction, during construction and post-construction stages are also required to be taken simultaneously.

It is proposed that a NCR-Environmental Monitoring Cell may be set up in Central Pollution Control Board to continuously monitor at various locations in NCR and map environmental pollution.

14. Social Impact Assessment (SIA)

The development scenario of NCR envisages large scale movement of people for work and other purposes. A Social Impact Assessment was undertaken to ensure that the benefits of the proposed transport development, are equally distributed, and no segment of the population is adversely affected.

The impact assessment of the proposed integrated transport plan was done with regard to the following two categories: a) the perception of the people regarding impact through primary survey, and b) analysis of the social composite index of the proposed transport network.

The common benefit of the implementation of the transport plan would be an increase in the income and improvement in the business opportunity (92 percent of the respondents). The other anticipated benefits are reduction in the time taken for commutation, saving money on transport, increase in income, improvement in business opportunity, diversification of economy, increase in land price, increased mobility, access to market facilities, etc.

Likewise, people in the villages surveyed enumerated various influences like rail improvement. Most of the respondents think that the proposed rail improvement would help in reduction of transport cost (52 percent) and time saving (27 percent) and favoured improvement of the rail network. However, 5 percent of the total respondents envisage a likely adverse effect of the rail improvement in terms of loss of land.

The social composite index reflects the prioritization of the project roads with regard to the social aspect. Five social parameters were considered for evaluation (presence of vulnerable groups, work participation rate, literacy rate, abutting land use and encroachment). Parameter scores, calculated on the basis of these weights were totaled, to arrive at the final score for a particular road. The higher the score for a particular road, higher will be its priority for road improvement. Most of the sections have high priority for road improvement.

From the existing social index of the road network, the proposed network was also tested. The proposed network is usually in the high social priority for road improvement. Out of the total of 45 sections in high social priority, 73 percent of these sections have been considered. Thus, the proposed network will bring in social mobility leading to economic development within NCR.

Community participation of stakeholders in planning, implementation, maintenance and evaluation of transport intervention ensures a response appropriate to local mobility needs. The solutions which meet to the local needs facilitate better acceptability of transport plan by the people. Suggestions made in this regard by local people include improvement of road safety, increasing the frequency of public transport, widening of road, provision for new links, bus services, improvement of existing roads and provisions for alternative modes.

Roads with a higher social composite index should be given higher priority for improvement of roads. The likely adverse social impacts of road and rail improvement should be minimized.

Land acquisition and adverse impacts in sensitive structures should be avoided as far as possible. Wherever it is unavoidable, especially during widening of road and construction of expressways, land acquisition should be done as per the Land Acquisition Act prevalent in the area, and compensation paid as per eligibility and policy provisions. The Project Affected Persons (PAPs) should be trained for other activities and efforts be made that at the least their income should be equivalent to the income prior to land acquisition. Entitlement matrix has to be prepared for the various PAPs addressing all sections. Before acquisition of the land, detailed census of and consultations with the project affected persons to be conducted. There should also be effective information dissemination about the road improvement programme and land acquisition.

15. Cost Estimates

The total estimated cost to implement the Functional Plan on Transport (Integrated Multi-modal Transport Plan) for NCR with the perspective year 2032 is estimated on block cost basis and is Rs 1,763,545 millions. Component and phase-wise costs are given in Table 0.1.

Table 0.1: NCR – IMMTP Investment Cost

Sl. No.	Category	Phase wise Costs (in Rs Million)				Total Cost (in Rs Million)
		I	II	III	IV	
I	**Road**					
1	Expressways	45910	469124	52095	38515	605643
2	National Highway	13680	54990	55170	24330	148170
3	State Highways	11004	0	31584	56448	99036
4	Other Roads	0	4872	9744	9744	24360
	Sub Total (Roads)	**70594**	**528985**	**148593**	**129036**	**877208**
II	**Bus System**					
1	Bus Fleet & Infrastructure	48900	46050	49650	114127	258727
2	Bus Terminals	7388	7388	7388	7388	29552
	Sub Total (Bus System)	**56288**	**53438**	**57038**	**121515**	**288279**
III	**Rail System**					
1	RRTS*	62800	65200	0	0	128000
2	RORC & IRORC – New Rail Line	0	19069	8195	3614	30878
3	Rolling Stock for RRTS	5930	7540	0	0	13470
	Sub Total (Rail System)	**68730**	**91809**	**8195**	**3614**	**172348**
IV	**MRTS**	**0**	**68750**	**297500**	**0**	**366250**
V	**Airports**	**0**	**5000**	**5000**	**7500**	**17500**
IV	**Others**					
1	Logistic Hubs	1800	2700	2250	2250	9000
2	Integrated Freight Complex	2880	4320	3600	3600	14400
3	Highway Facilities Centres	0	220	440	440	1100
	Sub Total (Others)	**4680**	**7240**	**6290**	**6290**	**24500**
VIII	**Surveys, Investigation, DPRs', Tender Documents etc. (@ 1% of total investment costs)**	**2003**	**7552**	**5226**	**2680**	**17461**
	Grand Total	**202295**	**762774**	**527842**	**270635**	**1763545**

Source: Study on Integrated Transportation Plan for NCR
Note - Land cost is not included
** RRTS alignment for Delhi – Meerut, Delhi – Hapur and Delhi – Aligarh sections have common alignment till Ghaziabad.*

16. Economic Evaluation & Financial Analysis

Economic Evaluation of Transport Plan of NCR

The economic analysis of the proposed transport strategy for NCR was undertaken as a single project in the Study. The annual cost and benefit streams were analysed in Excel spreadsheet to derive the net cash flow for the project. The EIRR and NPV @ 12% discount rate were determined using the discounted cash-flow technique. The EIRR of the project worked out to 43.26%, while the NPV @ 12% was Rs 807,786 million. The rate of return considered desirable for transport infrastructure projects is 12 percent as the opportunity cost of capital is 12%. The results indicate that the project is economically viable, as the EIRRs are far higher than 12 percent.

Economic Evaluation of Expressways

A financial analysis of selected expressways proposed in the NCR was carried out in the Study by the Consultant to ascertain the viability of implementation on BOT basis. The results of the financial analysis indicate that Delhi - Panipat and Delhi - Ghaziabad, having over 60-70,000 PCUs per day, are financially viable, with Equity IRRs above the target IRR of 15%. The Viability Gap Funding (VGF) required to make them viable is 30% of TPC in the case of Delhi – Panipat and 35% of TPC for Delhi – Ghaziabad. The other expressways would require additional incentives, such as revenue from commercial development of land in order to be financially viable.

Economic Evaluation of RRTS Corridors

The Transport Plan identified 8 RRTS corridors to be developed in two phases and preliminary economic evaluation of each corridor was carried out based on block cost estimates, comprising components like tracks, stations, rolling stock, etc. The capital investments are assumed to be spread equally over 5 years, following which the corridor can become operational. The annual streams of economic costs and benefits have been computed over the analysis period. The project's economic viability is assessed in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) by applying the Discounted Cash Flow (DCF) technique to the annual stream of the net benefits of the project. The NPV of the stream of net benefits has been computed using prevailing discount rate of 12%. The results of the economic analysis are presented in the following **Table:**

Results of Economic Analysis

Sl No.	RRTS Corridor	Phase	EIRR (%)	NPV @ 12% (Rs. million)
1	Delhi – Ghaziabad – Meerut	**I**	**34.77**	**25682.69**
2	Ghaziabad – Hapur	**II**	**29.03**	**8233.31**
3	Delhi – Faridabad – Ballabhgarh – Palwal	**II**	**25.99**	**8222.81**
4	Delhi – Sonipat – Panipat	**I**	**20.99**	**11143.69**
5	Ghaziabad – Khurja	**II**	**20.42**	**4279.03**
6	Delhi – Gurgaon – Rewari	**I**	**17.73**	**5400.38**
7	Delhi – Bahadurgarh – Rohtak	**II**	**13.98**	**1047.60**
8	Delhi – Shahadara – Baraut	**II**	**6.93**	**(-) 1272.11**

Source: Study on Integrated Transportation Plan for NCR

The results of the preliminary economic evaluation indicate that out of 8 corridors, the 7 corridors are economically viable, with EIRRs above the minimum cut-off level of 12%. Of these, 3 corridors are proposed to be developed in Phase I and rest in Phase-II.

17. Institutional Arrangement and Financing

Institutional Arrangement

Institutions are important for successful implementation of policies and programs. They need to be properly structured, adequately empowered and suitably supported with capacity and logistics to effectively discharge their assigned functions. Presently, in NCR, as in other regions of the developing world, the functions and responsibilities of urban transport are dispersed over a number of organizations. There is a need to consolidate, integrate and coordinate.

The proposed institutional arrangement should promote:

- Seamless movement (including modal transfers) in NCR
- Dispute free operation
- Funding of system development
- Amicable sharing of revenues generated through transport operations
- Uniform tax structure or at least avoidance of double taxation
- Uniform fare policy (for services by public transport system)

Consultant studied and analyzed the relevant Acts related to Transport, DDA, NCR, etc. as well as Acts related to Regional Transport Sector in Spain and U.S. After studying the said acts, Consultant has proposed NCR – Transport Planning and Coordination Authority (NCR – TPCA) which shall be responsible for NCR transport policy, planning, integration, funding, coordination and advocacy. Its sphere of action would cover the NCR. The Authority needs to be properly structured in terms of composition, functions, powers, responsibilities and procedures. Consultant has further recommended another single authority, namely "Regional Transport Authority for NCR" (NCR-RTA) under the M.V. Act, 1988 for discharging all relevant functions, within NCR. In addition to the two institutions given above, a number of Special Purpose Vehicles(s) have been suggested by the Consultant in the study report. The aspect of institutional arrangement was discussed in a workshop held on 02.02.2009 with the stakeholders and the suggestions given by the Consultant were not agreed by the NCR constituent States especially the suggestion of Regional Transport Authority for NCR (NCR-RTA) under the M.V. Act, 1988 for the whole region. Therefore, this aspect will require further discussions among the stake holders before deciding about the institutional framework.

However, the matter of implementation of Regional Rapid Transit System (RRTS) and its institutional arrangement was discussed and deliberated in the 3rd meeting of the Task Force constituted by the Planning Commission under the Chairmanship of Secretary, Ministry of Urban Development, Government of India held on 09.12.2009 and it was decided that National Capital Region Transport Corporation (NCRTC) would be constituted to implement the RRTS Project in NCR on the lines of Mumbai Rail Vikas Corporation. Representatives of the NCR Constituent States participated in the said meeting. Its objective would be:

i) To develop/strengthen the existing urban / suburban rail infrastructure and other multi-modal transport services to improve connectivity in NCR.

ii) Commercial utilization of land and air space to supplement resources to fund its activities; and

iii) To coordinate with Central Government i.e. Ministry of Urban Development; Indian Railways and NCR Planning Board and Governments of NCT-Delhi, Haryana, Rajasthan and U.P. and other

related agencies and evolve and execute suitable plans for the development of Sub-urban Rail System of NCR i.e. Regional Rapid Transit System (RRTS).

iv) To operationalise the RRTS and other transport services in coordination with the stake holders.

Funds for implementation of eight sub-urban rails projects included in RRTS and other related works shall be arranged by the NCRTC through its equity holders, market borrowings and other sources.

Financing of Transport Plan

The Consultant has suggested that a framework needs to be established to tap various financing sources in a cost-effective manner. The design of the framework will take into account issues relating to fiscal constraints, project cash flow profiles, positioning and access to capital markets as well as availability of government funds and grants for this project. We can have appropriate debt equity ratio for the selected projects from the Transport Plan with large component of debt. The equity investment would be distributed among various stake holders. The selection and segmentation would be based on the extent of their interest in the project.

The Consultant further suggested in the Study that the debt profile for the Transport Plan project would be dependent on the debt servicing capability of the project cash flows. The debt instruments should be structured with varying risk profiles to meet the requirements of different lenders/Investors. Given the nature of cash flows, the debt services in this project could include India Infrastructure Project Development Fund (IIPDF), Domestic Financial Institutions (DFIs), Jawaharlal Nehru National Urban Renewal Mission (JNNURM), multi-lateral agencies viz JBIC, ADB, World Bank, etc. and other miscellaneous sources e.g. municipal infrastructure bonds, etc. Other sources could be in the form of Tax Exemptions/concessions on account of import/excise duty levied by the Central Government and concessions on stamp duties, sales tax, etc. levied by the State governments.

Main source of project revenues would be user charges and for this purpose the average annual volume of commuter traffic and the fare structure as ascertained could be used. It has been suggested in the Study that other possible sources of revenue should be explored to enhance the commercial viability of the project. This could come in the form of advertising revenue, betterment levy, commercial exploitation of land above bus terminals/railway stations, revenue from leasing out refreshment areas & stalls at bus terminals/railway stations, surcharge to be levied on commuters, share of external development charges being collected by development authorities for land development for various purposes, etc. The advertising revenue can come through billboards at terminals and along the alignments, printing at the back of tickets etc.

The financing of various Transport Plan projects will vary from project to project and further elaboration of financing pattern and financing of the projects will be done while preparing the Feasibility Report and Detailed Project Report after carrying out detailed appropriate service. Institutional arrangement for implementation of such projects will also be decided at the same time.

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Annexure 1.1

MEMBERS OF TASK FORCE

1.	Secretary, Ministry of Urban Development	Chairman
2.	Chief Secretary, GNCT-Delhi	
3.	Advisor (HUD), Planning Commission	
4.	OSD (MRTS), Ministry of Urban Development	
5.	Executive Director (Metro Projects), M/o Railways	
6.	Advisor (Transport), Planning Commission	
7.	Representative of M/o Road Transport & Highways	
8.	M.D., DMRC	
9.	Commissioner & Secretary, Town & Country Planning, Govt. of Haryana	
10.	Pr. Secretary (Housing), Govt. of Uttar Pradesh	
11.	Pr. Secretary (Urban Development & Housing), Govt. of Rajasthan	
12.	Member Secretary, NCR Planning Board	

MEMBERS OF ADVISORY GROUP

1.	Member Secretary, NCR Planning Board	Chairman
2.	OSD (MRTS), Ministry of Urban Development, Govt. of India	
3.	Executive Director (WP), Ministry of Railways	
4.	Advisor (T), Planning Commission	
5.	Principal Secretary-cum-Commissioner (Transport), GNCT-Delhi	
6.	Principal Secretary, Transport, Govt. of Uttar Pradesh	
7.	Principal Secretary, Transport, Govt. of Haryana	
8.	Principal Secretary, Transport, Govt. of Rajasthan	
9.	Commissioner (NCR), Govt. of Uttar Pradesh	
10.	Director (A&F), NCR Planning Board	
11.	Chief Town Planner (NCR), Town Planning Deptt., Govt. of Rajasthan	
12.	Chief Coordinator Planner, NCR Cell, Government of Haryana	
13.	Chief Coordinator Planner, Govt. of Uttar Pradesh	
14.	Joint Secretary (PWD), GNCT-Delhi	

MEMBERS OF CONSULTANCY REVIEW COMMITTEE

1.	Member Secretary, NCR Planning Board	Chairman
2.	OSD (MRTS), Ministry of Urban Development, Govt. of India	
3.	Prof. (Dr.) P.K. Sarkar, School of Planning & Architecture	
4.	CEO, DIMTS, GNCT-Delhi	
5.	Chief Regional Planner, NCR Planning Board	
6.	Director (A&F), NCR Planning Board	
7.	Joint Director (T), NCR Planning Board	
8.	Assistant Director (T), NCR Planning Board	Member-convener

Annexure 2.1

Zone-wise Accessibility Index			
Zone No.	**Zone Name**	**Employement (2007)**	**Relative Indices**
1	Old City (A)	**10899**	**2.5**
2	City Extension (Karol Bagh) (B)	**6538**	**1.5**
3	Civil Lines (C)	**6584**	**1.5**
4	New Delhi (D)	**23191**	**5.4**
5	Trans Yamuna (E)	**31895**	**7.4**
6	South Delhi - I (F)	**13328**	**3.1**
7	West Delhi – I (G)	**18383**	**4.2**
8	North West Delhi – I (H)	**13083**	**3.0**
9	South Delhi – II (J)	**12115**	**2.8**
10	K – I West Delhi k - II Dawarka (K)	**12427**	**2.9**
11	West Delhi – III (L)	**8925**	**2.1**
12	North West Delhi – II (M)	**10073**	**2.3**
13	North West Delhi – III (N)	**8917**	**2.1**
14	River Yamuna/River Front (O)	**8098**	**1.9**
15	P – I Narela & P - II North Delhi (P)	**6531**	**1.5**
17	Southern part of Faridabad (between Palwal & Hodal	**10370**	**2.4**
18	Northern Part of Faridabad	**1499**	**0.3**
19	Eastern Part of Gurgaon	**3823**	**0.9**
20	Western Part of Gurgaon	**2245**	**0.5**
21	Rohtak (SW side of Rohtak)	**2271**	**0.5**
22	Rohtak (EW & NW side of Rohtak)	**1540**	**0.4**
23	Rewari (Rest of the Distric	**1736**	**0.4**
24	Eastern Part of Jhajjar (between NH 10 and Jhajjar)	**1278**	**0.3**
25	Remaining part of Jhajjar	**4336**	**1.0**
26	Mewat (Between Sohna & Nuh)	**1482**	**0.3**
27	Rest of the Mewat	**1345**	**0.3**
28	East of Panipat	**764**	**0.2**
29	West of Panipat	**1086**	**0.3**
30	North East of Sonepat	**797**	**0.2**
31	North West of Sonepat	**2626**	**0.6**
32	North side (Between State Boundary & NH 8)	**1363**	**0.3**
33	Rest of Alwar Distt	**1030**	**0.2**
34	Meerut (Western Side)	**318**	**0.1**
35	Meerut (Southern Side)	**1269**	**0.3**
36	Meerut (South East Side)	**673**	**0.2**
37	North side of Ghaziabad	**1074**	**0.2**
38	Eastern side Ghaziabad	**2081**	**0.5**
39	Western Side of Ghaziabad	**2064**	**0.5**
40	Gautam Budh Nagar (Noida & NH -24, G. Noida till Rabpura)	**4191**	**1.0**
41	Remaining Part of Gautam Budh Nagar Distt.	**2593**	**0.6**
42	Southern Part of Bulandshahr	**1603**	**0.4**
43	Northern Part of Bulandshahr	**666**	**0.2**
44	Baghpat	**361**	**0.1**
45	Panipat	**1416**	**0.3**
46	Rohtak	**1087**	**0.3**
47	Palwal	**2322**	**0.5**
48	Rewari	**2310**	**0.5**
49	Sonipat	**2102**	**0.5**
50	Bahadurgarh	**3465**	**0.8**
51	Faridabad	**10695**	**2.5**
52	Gurgaon	**5100**	**1.2**

Zone-wise Accessibility Index			
Zone No.	Zone Name	Employement (2007)	Relative Indices
53	Alwar	**6847**	**1.6**
54	Meerut	**1487**	**0.3**
55	Gaziabad	**1478**	**0.3**
56	Hapur	**4231**	**1.0**
57	Loni	**2791**	**0.6**
58	Modinagar	**3411**	**0.8**
59	NOIDA	**2561**	**0.6**
60	Bulandshahr	**6269**	**1.4**
61	Mawana	**918**	**0.2**
62	Barut	**1840**	**0.4**
63	Behta Hajippur	**3880**	**0.9**
64	Muradnagar	**1322**	**0.3**
65	Pilkhuwa	**3362**	**0.8**
66	Dadri	**2910**	**0.7**
67	Khurja	**4896**	**1.1**
68	Sikandrabad	**1025**	**0.2**
69	Jahangirabad	**2232**	**0.5**
70	Samalkha	**1323**	**0.3**
71	Gohana	**1790**	**0.4**
72	Sohna	**2637**	**0.6**
73	Hodal	**2188**	**0.5**
74	Jhajjar	**1432**	**0.3**
75	Bhiwadi	**3607**	**0.8**
76	Behror	**1609**	**0.4**
77	Sardhana	**645**	**0.1**
78	Khekada	**1516**	**0.4**
79	Baghpat	**4993**	**1.2**
80	Guloathi	**2917**	**0.7**
81	Siana	**1667**	**0.4**
82	Kundli	**920**	**0.2**
83	Manesar	**6537**	**1.5**
84	Daruhera	**3574**	**0.8**
85	Ballabgarh	**1907**	**0.4**
86	Greater Noida	**6998**	**1.6**
87	Shahjahanpur	**5725**	**1.3**
88	Neemrana	**842**	**0.2**
89	Khairthal	**745**	**0.2**
90	Bawal	**5951**	**1.4**

Annexure 2.2

Zone Number	Percentage Distribution of Mobility Index from one zone to other zones															
	<1.0	1.0-1.25	1.25-1.5	1.50-1.75	1.75-2.0	2.0-2.25	2.25-2.5	2.5-2.75	2.75-3.0	3.0-3.25	3.25-3.5	3.5-3.75	3.75-4.0	4.0-4.25	4.25-4.50	>4.5
1	15.91	2.27	1.14	7.95	4.55	3.41	9.09	7.95	9.09	5.68	7.95	4.55	5.68	2.27	0.00	12.50
2	15.91	0.00	1.14	0.00	2.27	1.14	7.95	12.50	17.05	6.82	9.09	5.68	4.55	4.55	2.27	9.09
3	15.91	0.00	0.00	1.14	1.14	9.09	13.64	10.23	11.36	11.36	7.95	4.55	3.41	1.14	1.14	7.95
4	15.91	0.00	0.00	0.00	0.00	3.41	4.55	5.68	17.05	13.64	7.95	3.41	7.95	2.27	5.68	12.50
5	15.91	0.00	0.00	0.00	0.00	2.27	5.68	4.55	15.91	17.05	5.68	6.82	3.41	4.55	4.55	13.64
6	15.91	0.00	0.00	0.00	2.27	11.36	6.82	6.82	19.32	14.77	5.68	3.41	2.27	1.14	2.27	7.95
7	15.91	0.00	0.00	0.00	0.00	7.95	12.50	7.95	12.50	10.23	7.95	4.55	4.55	3.41	2.27	10.23
8	15.91	0.00	0.00	0.00	0.00	7.95	14.77	7.95	14.77	13.64	6.82	2.27	3.41	2.27	2.27	7.95
9	15.91	0.00	0.00	1.14	0.00	7.95	14.77	10.23	14.77	11.36	5.68	3.41	3.41	1.14	2.27	7.95
10	15.91	0.00	0.00	0.00	0.00	7.95	12.50	3.41	15.91	13.64	5.68	4.55	5.68	2.27	3.41	9.09
11	15.91	0.00	0.00	0.00	0.00	6.82	14.77	2.27	13.64	7.95	7.95	6.82	5.68	3.41	1.14	13.64
12	15.91	0.00	0.00	0.00	1.14	4.55	7.95	13.64	13.64	10.23	10.23	6.82	2.27	1.14	2.27	10.23
13	15.91	0.00	0.00	1.14	2.27	6.82	14.77	9.09	11.36	12.50	10.23	2.27	3.41	1.14	1.14	7.95
14	15.91	0.00	0.00	0.00	0.00	9.09	13.64	4.55	13.64	12.50	9.09	4.55	3.41	3.41	1.14	9.09
15	15.91	0.00	0.00	0.00	1.14	9.09	11.36	5.68	12.50	14.77	10.23	2.27	5.68	1.14	2.27	7.95
17	1.14	0.00	1.14	10.23	13.64	14.77	21.59	7.95	10.23	14.77	0.00	2.27	1.14	0.00	0.00	1.14
18	2.27	0.00	1.14	4.55	5.68	7.95	11.36	14.77	11.36	9.09	2.27	1.14	4.55	1.14	2.27	20.45
19	1.14	1.14	0.00	4.55	7.95	6.82	18.18	9.09	6.82	9.09	9.09	2.27	2.27	4.55	4.55	12.50
20	2.27	0.00	1.14	11.36	12.50	7.95	12.50	11.36	7.95	9.09	4.55	6.82	3.41	4.55	0.00	4.55
21	0.00	1.14	9.09	23.86	17.05	28.41	11.36	4.55	0.00	1.14	2.27	0.00	0.00	0.00	1.14	0.00
22	2.27	3.41	11.36	22.73	29.55	17.05	5.68	2.27	1.14	0.00	0.00	2.27	1.14	1.14	0.00	0.00
23	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.14	14.77	14.77	12.50	7.95	5.68	7.95	34.09
24	0.00	0.00	2.27	10.23	17.05	17.05	26.14	12.50	6.82	1.14	1.14	0.00	4.55	0.00	0.00	1.14
25	1.14	2.27	13.64	6.82	4.55	13.64	13.64	12.50	11.36	3.41	6.82	2.27	1.14	0.00	1.14	5.68
26	1.14	0.00	1.14	5.68	7.95	14.77	13.64	19.32	9.09	4.55	6.82	7.95	4.55	1.14	1.14	1.14
27	1.14	0.00	1.14	6.82	7.95	12.50	19.32	17.05	5.68	7.95	13.64	3.41	1.14	1.14	0.00	1.14
28	0.00	0.00	1.14	9.09	9.09	18.18	32.95	11.36	6.82	1.14	0.00	1.14	1.14	0.00	0.00	7.95
29	0.00	0.00	1.14	5.68	6.82	21.59	21.59	14.77	17.05	3.41	1.14	2.27	0.00	1.14	0.00	3.41
30	1.14	1.14	6.82	11.36	4.55	14.77	21.59	10.23	4.55	2.27	5.68	7.95	3.41	1.14	1.14	2.27
31	2.27	0.00	3.41	6.82	14.77	23.86	14.77	20.45	4.55	1.14	0.00	1.14	1.14	1.14	0.00	4.55
32	0.00	0.00	0.00	0.00	1.14	2.27	7.95	30.68	15.91	17.05	10.23	6.82	2.27	2.27	1.14	2.27
33	0.00	0.00	0.00	0.00	0.00	3.41	23.86	32.95	12.50	15.91	9.09	0.00	1.14	0.00	0.00	1.14
34	1.14	0.00	0.00	0.00	6.82	11.36	7.95	12.50	18.18	18.18	5.68	7.95	3.41	0.00	3.41	3.41
35	3.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.14	5.68	10.23	6.82	7.95	64.77
36	0.00	0.00	0.00	1.14	0.00	1.14	2.27	14.77	17.05	10.23	9.09	7.95	23.86	4.55	1.14	6.82
37	1.14	0.00	2.27	0.00	1.14	2.27	7.95	22.73	18.18	13.64	3.41	1.14	12.50	4.55	4.55	4.55
38	1.14	0.00	1.14	2.27	1.14	7.95	13.64	22.73	13.64	17.05	6.82	6.82	1.14	0.00	1.14	3.41
39	1.14	1.14	0.00	1.14	1.14	1.14	5.68	4.55	14.77	11.36	6.82	7.95	5.68	5.68	6.82	25.00
40	3.41	0.00	2.27	2.27	10.23	14.77	17.05	10.23	4.55	13.64	10.23	3.41	0.00	2.27	0.00	5.68
41	2.27	0.00	0.00	3.41	13.64	9.09	11.36	13.64	11.36	4.55	20.45	4.55	2.27	0.00	1.14	2.27
42	1.14	0.00	0.00	0.00	0.00	1.14	0.00	2.27	2.27	10.23	12.50	7.95	9.09	11.36	4.55	37.50
43	1.14	0.00	0.00	0.00	0.00	0.00	0.00	1.14	10.23	19.32	13.64	11.36	4.55	17.05	7.95	13.64
44	2.27	0.00	1.14	13.64	11.36	15.91	20.45	12.50	6.82	7.95	4.55	0.00	1.14	0.00	0.00	2.27
45	0.00	0.00	1.14	4.55	4.55	12.50	30.68	17.05	14.77	7.95	0.00	2.27	1.14	0.00	0.00	3.41

Zone Number	Percentage Distribution of Mobility Index from one zone to other zones															
	<1.0	1.0-1.25	1.25-1.5	1.50-1.75	1.75-2.0	2.0-2.25	2.25-2.5	2.5-2.75	2.75-3.0	3.0-3.25	3.25-3.5	3.5-3.75	3.75-4.0	4.0-4.25	4.25-4.50	>4.5
46	0.00	2.27	2.27	20.45	14.77	20.45	15.91	13.64	4.55	1.14	1.14	2.27	0.00	0.00	0.00	1.14
47	0.00	0.00	2.27	7.95	11.36	9.09	18.18	13.64	5.68	4.55	14.77	6.82	1.14	1.14	1.14	2.27
48	0.00	0.00	0.00	0.00	0.00	1.14	6.82	26.14	17.05	22.73	4.55	7.95	5.68	2.27	1.14	4.55
49	1.14	1.14	10.23	6.82	3.41	21.59	19.32	7.95	6.82	9.09	4.55	3.41	1.14	1.14	0.00	2.27
50	0.00	3.41	2.27	10.23	25.00	20.45	12.50	10.23	6.82	2.27	1.14	0.00	4.55	0.00	0.00	1.14
51	2.27	0.00	1.14	3.41	2.27	12.50	9.09	14.77	11.36	9.09	4.55	0.00	2.27	5.68	2.27	19.32
52	0.00	0.00	2.27	6.82	21.59	17.05	6.82	18.18	10.23	4.55	5.68	2.27	0.00	2.27	0.00	2.27
53	1.14	0.00	0.00	0.00	0.00	20.45	38.64	12.50	13.64	5.68	3.41	2.27	0.00	0.00	0.00	2.27
54	3.41	0.00	0.00	1.14	0.00	2.27	9.09	17.05	17.05	11.36	9.09	5.68	5.68	13.64	2.27	2.27
55	0.00	0.00	0.00	3.41	10.23	5.68	11.36	18.18	10.23	12.50	5.68	0.00	11.36	0.00	2.27	9.09
56	1.14	0.00	2.27	1.14	4.55	5.68	20.45	22.73	22.73	3.41	6.82	1.14	2.27	2.27	1.14	2.27
57	0.00	0.00	2.27	6.82	9.09	10.23	26.14	9.09	17.05	3.41	3.41	2.27	1.14	1.14	3.41	4.55
58	1.14	0.00	0.00	0.00	0.00	7.95	7.95	17.05	19.32	10.23	5.68	4.55	3.41	13.64	2.27	6.82
59	1.14	1.14	0.00	2.27	1.14	3.41	9.09	14.77	9.09	17.05	4.55	6.82	12.50	3.41	1.14	12.50
60	0.00	0.00	0.00	1.14	0.00	2.27	14.77	18.18	18.18	9.09	3.41	15.91	5.68	0.00	2.27	9.09
61	3.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.68	10.23	7.95	9.09	3.41	60.23
62	1.14	1.14	3.41	11.36	9.09	22.73	26.14	6.82	9.09	1.14	0.00	1.14	2.27	1.14	0.00	3.41
63	0.00	0.00	0.00	0.00	0.00	0.00	5.68	13.64	19.32	18.18	5.68	5.68	2.27	14.77	3.41	11.36
64	1.14	1.14	0.00	1.14	1.14	2.27	10.23	18.18	17.05	14.77	6.82	1.14	1.14	3.41	12.50	7.95
65	0.00	2.27	0.00	1.14	3.41	6.82	21.59	23.86	18.18	4.55	3.41	6.82	1.14	1.14	2.27	3.41
66	1.14	0.00	3.41	1.14	14.77	12.50	20.45	20.45	6.82	6.82	4.55	1.14	0.00	2.27	1.14	3.41
67	0.00	0.00	2.27	3.41	14.77	14.77	13.64	12.50	15.91	12.50	2.27	1.14	3.41	0.00	1.14	2.27
68	0.00	0.00	0.00	0.00	12.50	19.32	26.14	20.45	10.23	1.14	1.14	1.14	1.14	2.27	0.00	4.55
69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.14	0.00	4.55	2.27	6.82	10.23	10.23	6.82	57.95
70	0.00	0.00	0.00	3.41	5.68	14.77	30.68	13.64	14.77	7.95	2.27	0.00	1.14	1.14	0.00	4.55
71	2.27	2.27	13.64	18.18	21.59	27.27	6.82	2.27	1.14	1.14	1.14	1.14	1.14	0.00	0.00	0.00
72	0.00	1.14	0.00	5.68	6.82	7.95	11.36	17.05	17.05	4.55	17.05	2.27	2.27	3.41	0.00	3.41
73	1.14	0.00	3.41	11.36	14.77	23.86	13.64	9.09	17.05	1.14	2.27	1.14	0.00	0.00	0.00	1.14
74	0.00	1.14	4.55	27.27	19.32	15.91	11.36	5.68	4.55	4.55	3.41	0.00	0.00	0.00	0.00	2.27
75	1.14	0.00	0.00	0.00	0.00	1.14	25.00	13.64	14.77	4.55	11.36	6.82	4.55	6.82	4.55	5.68
76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.14	0.00	2.27	9.09	87.50
77	4.55	0.00	0.00	7.95	13.64	11.36	31.82	19.32	5.68	1.14	4.55	0.00	0.00	0.00	0.00	0.00
78	0.00	0.00	0.00	0.00	0.00	0.00	3.41	13.64	10.23	19.32	11.36	1.14	9.09	3.41	4.55	23.86
79	1.14	1.14	1.14	9.09	12.50	17.05	17.05	7.95	15.91	5.68	2.27	0.00	3.41	2.27	1.14	2.27
80	0.00	0.00	2.27	2.27	5.68	11.36	19.32	22.73	18.18	4.55	6.82	0.00	2.27	1.14	0.00	3.41
81	0.00	0.00	0.00	0.00	1.14	4.55	5.68	14.77	6.82	10.23	13.64	9.09	14.77	5.68	4.55	9.09
82	0.00	1.14	3.41	6.82	6.82	10.23	11.36	19.32	13.64	4.55	10.23	1.14	5.68	1.14	1.14	3.41
83	0.00	0.00	0.00	2.27	5.68	7.95	12.50	15.91	11.36	7.95	9.09	2.27	2.27	5.68	3.41	13.64
84	1.14	0.00	0.00	0.00	1.14	2.27	13.64	26.14	5.68	12.50	4.55	5.68	5.68	12.50	0.00	9.09
85	2.27	1.14	1.14	6.82	7.95	11.36	15.91	15.91	9.09	3.41	2.27	2.27	0.00	1.14	11.36	7.95
86	1.14	1.14	3.41	5.68	5.68	15.91	12.50	10.23	5.68	3.41	14.77	6.82	1.14	5.68	1.14	5.68
87	0.00	0.00	0.00	0.00	0.00	0.00	2.27	28.41	20.45	19.32	5.68	11.36	6.82	0.00	3.41	2.27
88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.27	14.77	21.59	15.91	17.05	12.50	5.68	4.55	5.68
89	1.14	0.00	0.00	0.00	1.14	15.91	32.95	22.73	15.91	3.41	2.27	1.14	1.14	0.00	0.00	2.27
90	0.00	1.14	0.00	0.00	0.00	1.14	3.41	32.95	17.05	14.77	15.91	6.82	4.55	1.14	0.00	1.14

Annexure 2.3

Salient Characteristics of Major Roads

SI. No	Roads	Type	Effective Carriagway Width (M)		R.O.W		Road Type
			Maximum	Minimum	Maximum	Minimum	Divided 1. Undivided 2.
A	**NATIONAL HIGHWAYS**						
1	Delhi - Babarpur (Delhi to Panipat)	NH-1	29	15	51	28	1/2
2	Delhi - Rohtak	NH-10	8	15	37	19.5	1/2
3	Rohtak - Maham	NH-10	8	15	29.5	26	1/2
4	Panipat - Gohana	NH-71A	8	8	22	22	2
5	Gohana - Rohtak	NH-71A	8	8	26	26	2
6	Rohtak - Jhajjar	NH-71	8	8	25	28	2
7	Jhajjar - Rewari	NH-71	10.5	8	26	26	2
8	Rohtak – Qilla Zafargarh	NH-71	8	8	26	26	2
9	Rewari - Daruhera	NH-71B	7.5	7.5	31.5	31.5	2
10	Daruhera - Taoru	NH-71B	13	9.5	29.5	25.5	2
11	Taoru - Sohna	NH-71B	7.5	6	33.5	33.5	2
12	Sohna - Palwal	NH-71B	7.5	7.5	30.5	25.5	2
13	Modi Puram - Ram Raj	NH-119	6	6	22	18	2
14	Ghaziabad - Raniyabali	NH-91	6	6	32	29	2
15	Nizamuddin Bridge - Brajghat	NH-24	12	6	48	22	2
16	Delhi ISBT – Dadri (Border)	NH-58	17	7	35	24	1/2
17	Delhi - Daruhera	NH-8	18	18	58	37.5	1
18	Daruhera - Bawal	NH-8	9	9	58	58	2
19	Bawal - Behror	NH-8	18	18	58	37.5	1
20	Hodal - Palwal	NH-2	14	14	49	27	1
21	Delhi (Ashram) - Palwal	NH-2	14	14	60	60	2
B	**STATE HIGHWAYS**						
1	Behror-Alwar	SH-14	6	6	26	26	2
2	Alwar-Ferozepur Jhirka1	SH-14	10	7	43	27	2
3	Malakhera-Laxmangarh	SH-44	3	3	27	27	2
4	Kathumar-Kherli	SH-22	7	7	23	23	2
5	Alwar-Rajgarh -Baswa	SH-25	10	10	30	30	2
6	Rajgarh-Telha	SH-25A	3.5	3	27	7.5	2
7	Alwar-Kishangarh	SH-25	7	7	31	31	2
8	Shahpura - Alwar	SH-13	13	6.5	27	24.5	1/2
9	Rewari - Behror	SH-26	8	8	24	24	2
10	Daruhera-KishangarhBas	SH-25	7	7	40	40	2
11	Hamidpur-Palwal	SH-22A	10	7.5	31.5	30	2
12	Gurgaon-Sohna	SH-13	9.5	8.5	59.5	45.5	2
13	Sohna-Ferozpur Jhirka	SH-13	7	5.5	34	33.5	2

SI. No	Roads	Type	Effective Carriagway Width (M)		R.O.W		Road Type
			Maximum	Minimum	Maximum	Minimum	Divided 1. Undivided 2.
14	Panipat-Khairana	SH-12	8	8	22	22	2
15	Panipat-Narah	SH-14	8	8	22	22	2
16	Ochandi-Rohtak	SH-18	8	8	24	14	2
17	Sisana-Saraya Nandar	SH-?	8	8	20	20	2
18	Gohana-Bhutana	SH-10	15	8	22	17.5	1/2
19	Gohana-Sonipat	SH-11	8	8	22	22	2
20	Rohtak-Thana Kharak	SH-16	15	8	22	21.5	1/2
21	Gohana-Sonipat	SH-16A	8	8	22	20	2
22	Jhajjar-Maham	SH-?	8	8	21	20	2
23	Jhajjar-Chuchawas	SH-?	8	8	22	12	2
24	Jhajjar-Dhaina	SH-22	8	8	25	22	2
25	Jhajjar-Gurgaon	SH-15A	8	8	22	19	2
26	Gurgaon-Rewari	SH-26	8	8	22	19	2
27	Jhajjar-Bahadurgarh	SH-22	8	8	21	21	2
28	Sonipat-Jhajjar	SH-20	8	8	22	22	2
29	Loni (Delhi)-Sisana	SH-57	15	8	30.5	21	1/2
30	Bhagpat-Sonipat	SH-14	15	8	20.5	18	1/2
31	Bhagpat-Baraut	SH-57	8	8	21	21	2
32	Baraut-Ramala	SH-57	8	8	26	26	2
33	Meerut-Garhmukteswar	SH-14	12	6	31.3	25	1/2
34	Meerut-Bagpat	SH-14	7	7	26	26	2
35	Meerut-Bhim pur	SH-18	6	6	26	22	2
36	Garhmukteswar-Bulandshahr	SH-65	6	6	30	28	2
C	**MDR**	**All**	**7**	**3**	**25**	**10**	**2**
D	**ODR**	**All**	**10**	**3**	**31.5**	**6**	**2**

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 3.1

List of Traffic Survey Locations

Location Code	Name & Chainage	Road	Survey Type
TVC 1	Babarpur @ km 90 on NH 1	Panipat - Ambala Road (NH - 1) (Panipat to Karnal)	3 TVC + 1 OD
TVC 2	SH-14 @km 11, Chaj	Panipat - Shamli Road (Panipat to Muzaffarnagar)	TVC
TVC 3	SH-14 @ km 7, Asan	Panipat - Assand Road (panipat - jind)	TVC
TVC 4	NH 71 A @ km 93,Mehrana	Panipat - Gohana Road	3 TVC + 1 OD
TVC 5	SH-57 @km 63,Baavli	Baraut - Shamli Road	TVC
TVC 6	Vijipur	Baraut - Sardhana Road	TVC
TVC 7	SH-57 @km 42, Sisana	Baghpat - Baraut Road	TVC
TVC 8	SH-14 @km 102, Khevada	Baghpat - Sonipat Road	TVC
TVC 9	NH-1 @ km 36, Kundli	Rai - Delhi Road (NH - 1)	TVC
TVC 10	Daurala NH58 @ 87 km	Meerut - MuzafarNagar Road (NH 58)	TVC
TVC 11	Lakhsya MDR 34@ 10 km	Meerut - Sardhana Road	TVC
TVC 12	Nagala Jamalpur majra SH 14 @58 km	Meerut - Baghpat Road	TVC
TVC 13	Kharkhoda SH 18 @ 19 km	Meerut - Hapur Road	1 TVC + 1 OD
TVC 14	Hasanpur SH 14 @ 34 km	Meerut - Garhmukteshwar Road	1 TVC + 1 OD
TVC 15	Incholi NH 119 @ 18 km	Meerut - Mawana Road	1 TVC + 1 OD
TVC 16	Bhadurgarh Thana @ 40 km on SH65	Garhmukteshwar - Bulandshahr Road	1 TVC + 1 OD
TVC 17	Toll Plaza @ 60 km on NH 24	Garhmukteshwar - Hapur Road (NH 24)	1 TVC + 1 OD
TVC 18	Baral @ 66 Km	Hapur - Bulandshahr	TVC
TVC 19	Toll Plaza @ 29 km on NH 24	Hapur - Gaziabad Road (NH 24)	3 TVC + 1 OD
TVC 20	Near Morta @ 25.4 km	Gaziabad - Meerut Road (NH 58)	3 TVC + 1 OD
TVC 21	Near Dadri @ 34.4 km	Gaziabad - Dadri Road (NH 91)	3 TVC + 1 OD
TVC 22	Mohan Nagar @ 16.5 km on NH-24	Gaziabad - Delhi Road (NH 24)	3 TVC + 1 OD
TVC 23	Near Indrapuram , Ghaziabad @ 12.5 km	Delhi - Hapur Road (NH - 24) before NH -91 crossing	1 OD
TVC 24	SH-57 @ 21.2 km,Loni	Shahadra - Loni Road	3 TVC + 1 OD
TVC 25	Surajpur	NOIDA - Dadri Road	1 OD
TVC 26	Sec 27 Faridabad @ km 22 on NH-2	Delhi - Faridabad Road (NH 2)	3 TVC + 1 OD
TVC 27	At Pelak between Palwal and Mohana	Palwal - Mohna Road	TVC
TVC 28	Chaunhut Police Station	Palwal - Jewar Road	1 TVC + 1 OD
TVC 29		Palwal - Hassan pur Road	TVC
TVC 30	Chola choki @14 km	Bulandshahr - Kakor Road	TVC
TVC 31	Khurja Junction @ 62 km	Khurja - Jewar Road	TVC
TVC 32	Thandi Payaoo @ 71 Km NH91	Bulandshahr - Khurja Road	3 TVC + 1 OD
TVC 33	Shivali @14 km	Bulandshahr - Anupshahr Road	TVC
TVC 34	Salempur Thana @ 85 on NH	Bulandshahr - Ahmadgarh Road	1 TVC + 1 OD
TVC 35	Arnia post @ 107 Km NH91	Khurja - Aligarh Road (NH - 91)	3 TVC + 1 OD
TVC 36	@ km 105 on NH-2 near Hodal	Palwal-Hodal Road (NH-2)	
TVC 37	At Punahana	Hodal - Punahana - Nagina Road	TVC
TVC 38	At Malal on Hodal-Nuh Road	Hodal - Nuh	TVC + OD
TVC 39	At Mandakola between Palwal and Nuh	Palwal - Nuh Road	TVC + OD
TVC 40	At Tikari between Palwal and Hathin	Palwal - Hathin Road	TVC
TVC 41	@ km 16 on NH-71B near Hodal	NH 71B- Dauj - Faridabad Road	TVC
TVC 42	Khirki Dula, @km 43 on NH-8	Delhi - Gurgaon Road (NH 8)	3 TVC + 1 OD
TVC 43	@ km 14 on SH, Bhondsi	Gurgaon - Sohna Road	1 TVC + 1 OD
TVC 44	Bilaspur toll Plaza @62 on NH8	Daruhera - Gurgaon	3 TVC + 1 OD
TVC 45	At Mandi Kherea	Nuh - Mandi Kherea - Firozpur Jhirka Road (SH)	1 TVC + 1 OD
TVC 46	Chawandi khud	Tijara - Daruhera Road	1 TVC
TVC 47	Doha Chok	Bager Meo - Frozepur Zirka Road (SH) (Ferozpur to Alwar)	1 TVC
TVC 48	Bager ka Tiraha	Alwar - Bager Meo Road (SH) (Alwar to Delhi)	1 TVC + 1 OD
TVC 49	Katoriwala Tiwara	Alwar - Kisahangarh Road (SH)	1 TVC
TVC 50	Akbarpur	Alwar - Seriska Road (SH)	3 TVC + 1 OD
TVC 51	Kothi Narayanpur	Alwar - Malakher Road (SH)	1 TVC + 1 OD
TVC 52	Dholi dhoop	Alwar - Behror Road (SH)	1 TVC
TVC 53	Tarapur	Kishangarh - Kairthal - Tatarpur Road	1 TVC
TVC 54	Pipli	Kishangarh - Mandawar - Behror Road (Behror to Khairthal)	1 TVC

Location Code	Name & Chainage	Road	Survey Type
TVC 55	At Bhindusi between Kishangarh Bas and Kot Qasim	Kishangarh - Kot Qasim Road (Rewari - Alwar)	1 TVC
TVC 56	Hansanka Majra	Daruhera - Rewari Road (NH -71B)	TVC
TVC 57	Palhawas	Rewari - Jhajjar Road (NH 71)	1 TVC + 1 OD
TVC 58	Near Bhiwadi @km 26 on NH-71B	Daruhera - Palwal Road (NH -71B)	3 TVC + 1 OD
TVC 59	Mundi Nangal ,SH-24 @ 11.2 KM	Rewari - Kanina Road (SH)	TVC
TVC 60	Naha	Rewari - Shahjahanpur Road (Rewari to Goglekota)	1 TVC + 1 OD
TVC 61	Majra @ 135 km	Behror - Madhan - Rewari Road	TVC
TVC 62	Behror @135 km	Behror - Jaipur Road (NH - 8)	3 TVC + 1 OD
TVC 63	SH-22 @ km 60, Nahar	Kanina - Nahar - Salhawas Road (Kanina - Roshni)	1 TVC + 1 OD
TVC 64	@ 8 km Dadri Road	Jhajjar - Charkhi Dadri Road	TVC
TVC 65	@ 26 km on SH-11, Yakub Nagar	Jhajjar - Farrukhnagar Road	1 TVC + 1 OD
TVC 66	@ 6.5 km Dhare Road	Jhajjar - Dujana Road	TVC
TVC 67	@ 62 km Chora	Jhajjar - Sampla Road	1 TVC + 1 OD
TVC 68	SH @ 17 km, Bhupania	Jhajjar - Bahadurgarh Road	1 TVC + 1 OD
TVC 69	@ 31 km Bahadurgarh	Bahadurgarh - Delhi Road	TVC
TVC 70	SH-18 @km 38, Halalpur	Kharkhauda - Bawana - Delhi Road	TVC
TVC 71	SH @ km 45, Kharkhoda	Sonipat - Kharkhauda Road	TVC
TVC 72	Kherisad @ 65 Km on NH10	Rohtak - Bahadurgarh Road (NH 10)	3 TVC + 1 OD
TVC 73	Baba Ram Dev Ashram @375 km on NH-71	Rohtak - Jhajjar Road (NH 71)	1 TVC + 1 OD
TVC 74	SH 16 @ km 112, Kalanaur	Rohtak - Bhiwani Road	1 TVC + 1 OD
TVC 75	Sunderpur @350 km on NH-71	Rohtak - Jind Road (NH 71)	3 TVC + 1 OD
TVC 76	Meham Crossing @105 km on NH-10	Rohtak - Hissar Road (NH 10)	3 TVC + 1 OD
TVC 77	Lakhan Majra'@ 320 km NH-71	Rohtak - Jind Road (NH 71)	3 TVC + 1 OD
TVC 78	.@13 km on NH-71A near Brahamanwas	Rohtak - Gohana Road (NH 71A)	3 TVC + 1 OD
TVC 79	SH 16 @ 5 Km	Gohana - Bainsi Road	TVC
TVC 80	SH @ km 23, Sarmana	Gohana - Farmanah Road	TVC
TVC 81	SH-11 @km 98, Bhadwesa	Sonipat - Gohana Road	3 TVC + 1 OD
TVC 82	Barauda SH 14 @ 10 km	Gohana - Butana Road	1 TVC + 1 OD

Annexure 4.1

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR (2007-2008)

SR_NO	LOC_CODE	JRNY_TKT	MST_TKT	QST_TKT	Total_Tkt	JRNY_Psgn	MST_Psgn	QST_Psgn	Sea_Psgn	Total Psgn	DAYS	Dly_AVG_ Jrny_Psgn	Dly_Avg_ Sea_Psgn	Dly_Avg_ Psgn
1	BGZ	721276	62219	4672	788167	972166	3110950	700800	3811750	4783916	365	2664	10444	13107
2	BVH	1168020	70586	4741	1243347	1666239	3529300	711150	4240450	5906689	365	4566	11618	16183
3	CSB	796782	1896	416	799094	1028386	94800	62400	157200	1185586	365	2818	431	3249
4	DAZ	291892	7842	283	300017	376521	392100	42450	434550	811071	365	1032	1191	2223
5	DBSI	456416	4892	355	461663	650742	244600	53250	297850	948592	365	1783	817	2599
6	DEC	928454	25330	1215	954999	1283751	1266500	182250	1448750	2732501	365	3518	3970	7487
7	DEE	1073988	4578	413	1078979	1473207	228900	61950	290850	1764057	365	4037	797	4834
8	DKZ	480575	7106	588	488269	674640	355300	88200	443500	1118140	365	1849	1216	3064
9	DLI	8812105	13189	2567	8827861	12446436	659450	385050	1044500	13490936	365	34100	2862	36962
10	DSA	2591362	34454	4156	2629972	3535241	1722700	623400	2346100	5881341	365	9686	6428	16114
11	FDB	1724261	90046	7720	1822027	2431113	4502300	1158000	5660300	8091413	365	6661	15508	22169
12	FDN	1367497	63289	5685	1436471	1943672	3164450	852750	4017200	5960872	365	5326	11007	16332
13	GGN	1264971	48739	3077	1316787	1843627	2436950	461550	2898500	4742127	365	5052	7942	12993
14	GMS	96731	2948	59	99738	141621	147400	8850	156250	297871	365	389	429	817
15	GZB	4151624	147802	12725	4312151	5604860	7390100	1908750	9298850	14903710	365	15356	25477	40833
16	HNZM	3048340	5552	799	3054691	4593596	277600	119850	397450	4991046	365	12586	1089	13675
17	MGLP	234861	6732	148	241741	328629	336600	22200	358800	687429	365	901	984	1884
18	MTC	1582699	40496	1582	1624777	2188345	2024800	237300	2262100	4450445	365	5996	6198	12193
19	MUT	600298	23850	829	624977	853644	1192500	124350	1316850	2170494	365	2339	3608	5947
20	NDLS	8952384	13093	4830	8970307	12478696	654650	724500	1379150	13857846	365	34189	3779	37967
21	OKA	616380	8776	779	625935	868051	438800	116850	555650	1423701	365	2379	1523	3901
22	PNP	2321438	42580	2105	2366123	3049761	2129000	315750	2444750	5494511	365	8356	6698	15054
23	PWL	1062358	127911	5136	1195405	1573909	6395550	770400	7165950	8739859	365	4313	19633	23945
24	ROK	1708504	52853	8916	1770273	2488447	2642650	1337400	3980050	6468497	365	6818	10905	17722
25	SBB	1307193	70633	7851	1385677	1834687	3531650	1177650	4709300	6543987	365	5027	12903	17929
26	SNP	1544316	127800	16922	1689038	2093273	6390000	2538300	8928300	11021573	365	5735	24462	30197
27	SSB	844778	19759	2606	867143	1248156	987950	390900	1378850	2627006	365	3420	3778	7198
28	SZM	815917	9540	866	826323	1125668	477000	129900	606900	1732568	365	3085	1663	4747
29	TKD	540489	37273	1647	579409	769651	1863650	247050	2110700	2880351	365	2109	5783	7892
30	TKJ	711068	2331	618	714017	950085	116550	92700	209250	1159335	365	2603	574	3177
31	VVB	454266	15823	1800	471889	608484	791150	270000	1061150	1669634	365	1668	2908	4575
32	VVKP	557168	4652	321	562141	756672	232600	48150	280750	1037422	365	2074	770	2843
33	ALJN	2593912	23678	466	2618056	3603851	1183900	69900	1253800	4857651	270	13348	4644	17992
34	MTJ	2017484	27248	669	2045401	3217673	1362400	100350	1462750	4680423	270	11918	5418	17335
35	AWR	831056	12146	356	843558	1267390	607300	53400	660700	1928090	270	4695	2448	7142
36	RE	1411387	26162	1479	1439028	2140470	1308100	221850	1529950	3670420	270	7928	5667	13595
37	NUR	310489	23186	1301	334976	409437	1159300	195150	1354450	1763887	150	2730	9030	11760
38	GNU	181013	14829	675	196517	259756	741450	101250	842700	1102456	150	1732	5618	7350
39	NNO	186781	17601	635	205017	253021	880050	95250	975300	1228321	120	2109	8128	10237
40	SPZ	95223	10122	579	105924	134314	506100	86850	592950	727264	120	1120	4942	6061

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.2

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - APRIL 2007

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	50755	4642	293	72099	232100	43950	348149
2	BVH	76664	5723	376	109917	286150	56400	452467
3	CSB	62887	259	33	81540	12950	4950	99440
4	DAZ	20661	690	18	26956	34500	2700	64156
5	DBSI	37021	405	20	54049	20250	3000	77299
6	DEC	81078	2004	93	117037	100200	13950	231187
7	DEE	96618	345	27	138061	17250	4050	159361
8	DKZ	36692	727	65	52455	36350	9750	98555
9	DLI	784829	1190	211	1117140	59500	31650	1208290
10	DSA	212768	2730	296	298119	136500	44400	479019
11	FDB	137186	7447	516	199385	372350	77400	649135
2	FDN	109274	5143	451	159021	257150	67650	483821
13	GGN	101483	3976	238	159347	198800	35700	393847
14	GMS	5948	189	3	9236	9450	450	19136
15	GZB	304001	12006	1028	428644	600300	154200	1183144
16	HNZM	272660	474	69	425594	23700	10350	459644
17	HPU	45333	2309	54	67655	115450	8100	191205
18	MGLP	20114	573	13	28979	28650	1950	59579
19	MTC	120992	3350	122	179250	167500	18300	365050
20	MUT	49571	1880	44	71319	94000	6600	171919
21	NDAZ	35534	293	21	50292	14650	3150	68092
22	NDLS	735979	1028	294	1052836	51400	44100	1148336
23	OKA	47471	708	62	67819	35400	9300	112519
24	PNP	156294	3252	144	227431	162600	21600	411631
25	PWL	59272	9981	335	88038	499050	50250	637338
26	ROK	147351	4695	575	209023	234750	86250	530023
27	SBB	93301	5422	615	137859	271100	92250	501209
28	SMQL	23894	231	3	36060	11550	450	48060
29	SNP	122912	12081	1206	175390	604050	180900	960340
30	SSB	69914	1588	195	108271	79400	29250	216921
31	SZM	66047	729	48	93788	36450	7200	137438
32	TKD	40161	2738	109	60083	136900	16350	213333
33	TKJ	53941	157	42	71931	7850	6300	86081
34	VVB	30812	1122	146	43010	56100	21900	121010
35	VVKP	48482	411	29	67898	20550	4350	92798

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.3

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - MAY 2007

	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	54198	3866	204	74269	193300	30600	298169
2	BVH	82319	5901	284	120230	295050	42600	457880
3	CSB	66292	233	52	87337	11650	7800	106787
4	DAZ	25367	674	27	33493	33700	4050	71243
5	DBSI	36006	422	36	52187	21100	5400	78687
6	DEC	75199	2014	89	107856	100700	13350	221906
7	DEE	88698	363	32	126130	18150	4800	149080
8	DKZ	35458	714	52	50212	35700	7800	93712
9	DLI	779996	1165	204	1111115	58250	30600	1199965
10	DSA	213373	2827	318	298617	141350	47700	487667
11	FDB	135013	7504	532	192647	375200	79800	647647
12	FDN	110054	5232	391	159098	261600	58650	479348
13	GGN	97235	3903	212	141429	195150	31800	368379
14	GMS	7856	226	2	12095	11300	300	23695
15	GZB	325447	12622	916	455610	631100	137400	1224110
16	HNZM	259142	478	47	400937	23900	7050	431887
17	HPU	52053	2563	44	78434	128150	6600	213184
18	MGLP	20675	543	9	29105	27150	1350	57605
19	MTC	129490	3343	117	191663	167150	17550	376363
20	MUT	53602	2009	51	76924	100450	7650	185024
21	NDAZ	35844	282	25	50879	14100	3750	68729
22	NDLS	731911	1103	286	1058856	55150	42900	1156906
23	OKA	48025	754	32	68169	37700	4800	110669
24	PNP	176959	3709	142	240007	185450	21300	446757
25	PWL	67492	10572	256	101040	528600	38400	668040
26	ROK	146561	4915	557	212770	245750	83550	542070
27	SBB	98695	5662	566	143727	283100	84900	511727
28	SMQL	31634	259	9	48846	12950	1350	63146
29	SNP	128948	11974	1009	181273	598700	151350	931323
30	SSB	66261	1671	201	101422	83550	30150	215122
31	SZM	64413	738	32	90752	36900	4800	132452
32	TKD	44147	2946	122	64354	147300	18300	229954
33	TKJ	57316	163	35	77395	8150	5250	90795
34	VVB	36295	1173	147	50187	58650	22050	130887
35	VVKP	48213	387	26	66406	19350	3900	89656

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.4

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - JUNE 2007

	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	58619	3867	251	83905	193350	37650	314905
2	BVH	90066	5695	343	134622	284750	51450	470822
3	CSB	67838	219	38	90008	10950	5700	106658
4	DAZ	26007	645	25	33919	32250	3750	69919
5	DBSI	38737	394	35	56484	19700	5250	81434
6	DEC	76706	1957	76	111556	97850	11400	220806
7	DEE	99553	346	39	138388	17300	5850	161538
8	DKZ	38485	642	49	56045	32100	7350	95495
9	DLI	782098	1157	204	1135361	57850	30600	1223811
10	DSA	208068	2552	342	299013	127600	51300	477913
11	FDB	147040	7186	539	216772	359300	80850	656922
12	FDN	112917	5037	396	166038	251850	59400	477288
13	GGN	102463	3672	190	153220	183600	28500	365320
14	GMS	9293	264	0	14805	13200	0	28005
15	GZB	252427	8619	650	358805	430950	97500	887255
16	HNZM	274347	418	61	438131	20900	9150	468181
17	HPU	50491	2472	65	77479	123600	9750	210829
18	MGLP	22678	560	15	33018	28000	2250	63268
19	MTC	128843	3138	94	191778	156900	14100	362778
20	MUT	54582	1857	48	80280	92850	7200	180330
21	NDAZ	39536	278	34	56702	13900	5100	75702
22	NDLS	739512	1055	270	1074357	52750	40500	1167607
23	OKA	51037	688	47	72784	34400	7050	114234
24	PNP	212906	3534	171	291988	176700	25650	494338
25	PWL	90017	10566	310	139334	528300	46500	714134
26	ROK	143555	3980	391	222671	199000	58650	480321
27	SBB	105922	5359	562	155636	267950	84300	507886
28	SMQL	47974	305	6	75693	15250	900	91843
29	SNP	140946	10854	1042	204169	542700	156300	903169
30	SSB	71491	1557	215	112571	77850	32250	222671
31	SZM	67456	730	45	97908	36500	6750	141158
32	TKD	44069	2741	117	65107	137050	17550	219707
33	TKJ	58005	147	37	79872	7350	5550	92772
34	VVB	36534	1155	134	50835	57750	20100	128685
35	VVKP	51307	378	18	71253	18900	2700	92853

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.5

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - JULY 2007

S.No	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	60095	5800	416	80885	290000	62400	433285
2	BVH	93183	6406	440	133684	320300	66000	519984
3	CSB	73041	199	30	95058	9950	4500	109508
4	DAZ	24166	689	21	31643	34450	3150	69243
5	DBSI	38912	446	28	55067	22300	4200	81567
6	DEC	77499	2133	103	106124	106650	15450	228224
7	DEE	91975	385	38	126796	19250	5700	151746
8	DKZ	41107	610	51	56958	30500	7650	95108
9	DLI	771092	1154	219	1091632	57700	32850	1182182
10	DSA	206508	2970	324	287149	148500	48600	484249
11	FDB	146028	8150	655	205519	407500	98250	711269
12	FDN	112294	5741	501	157618	287050	75150	519818
13	GGN	108867	4033	262	160646	201650	39300	401596
14	GMS	8506	292	3	13530	14600	450	28580
15	GZB	355646	13256	1127	484339	662800	169050	1316189
16	HNZM	247061	501	49	370645	25050	7350	403045
17	HPU	53785	2851	73	79780	142550	10950	233280
18	MGLP	22951	647	18	31688	32350	2700	66738
19	MTC	127926	3542	145	183583	177100	21750	382433
20	MUT	52662	2080	64	72725	104000	9600	186325
21	NDAZ	39895	325	24	54378	16250	3600	74228
22	NDLS	755800	1213	349	1053229	60650	52350	1166229
23	OKA	55173	776	43	76930	38800	6450	122180
24	PNP	198368	3890	192	260925	194500	28800	484225
25	PWL	92184	10182	421	140781	509100	63150	713031
26	ROK	141791	4315	821	207174	215750	123150	546074
27	SBB	106515	6166	694	148669	308300	104100	561069
28	SMQL	53704	401	3	83117	20050	450	103617
29	SNP	135573	12405	1924	184959	620250	288600	1093809
30	SSB	71798	1652	222	105313	82600	33300	221213
31	SZM	67775	825	64	92757	41250	9600	143607
32	TKD	49349	3171	152	70819	158550	22800	252169
33	TKJ	63398	218	37	83269	10900	5550	99719
34	VVB	38602	1311	162	51156	65550	24300	141006
35	VVKP	46857	380	23	64368	19000	3450	86818
36	ALJN	294140	2706	43	424927	135300	6450	566677
37	MTJ	239652	2975	72	396604	148750	10800	556154
38	AWR	90494	1351	22	140839	67550	3300	211689
39	RE	148616	1016	93	232953	50800	13950	297703

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.6

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - AUGUGST 2007

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	65689	5921	462	86243	296050	69300	451593
2	BVH	107026	6098	354	149247	304900	53100	507247
3	CSB	71613	170	41	90707	8500	6150	105357
4	DAZ	24711	689	29	32190	34450	4350	70990
5	DBSI	38105	421	36	53776	21050	5400	80226
6	DEC	80247	2172	107	107582	108600	16050	232232
7	DEE	85166	410	41	116406	20500	6150	143056
8	DKZ	41990	560	48	58142	28000	7200	93342
9	DLI	747925	1117	232	1052721	55850	34800	1143371
10	DSA	229269	2936	343	309339	146800	51450	507589
11	FDB	150382	7850	794	210328	392500	119100	721928
12	FDN	116322	5392	531	163947	269600	79650	513197
13	GGN	108243	4213	285	153492	210650	42750	406892
14	GMS	11000	269	3	17110	13450	450	31010
15	GZB	387323	12815	958	523389	640750	143700	1307839
16	HNZM	254472	503	71	378789	25150	10650	414589
17	HPU	51711	2491	51	74921	124550	7650	207121
18	MGLP	23103	609	8	31559	30450	1200	63209
19	MTC	160986	3565	122	219056	178250	18300	415606
20	MUT	65071	2190	74	89844	109500	11100	210444
21	NDAZ	41577	328	27	55142	16400	4050	75592
22	NDLS	748087	1179	522	1017230	58950	78300	1154480
23	OKA	55237	774	102	76052	38700	15300	130052
24	PNP	207133	3829	173	261417	191450	25950	478817
25	PWL	89395	9751	526	130412	487550	78900	696862
26	ROK	149536	4446	1157	215971	222300	173550	611821
27	SBB	123551	6110	675	170224	305500	101250	576974
28	SMQL	54192	371	12	83891	18550	1800	104241
29	SNP	151711	12310	1822	203508	615500	273300	1092308
30	SSB	69760	1592	219	101195	79600	32850	213645
31	SZM	71897	884	101	96957	44200	15150	156307
32	TKD	46764	3168	146	66228	158400	21900	246528
33	TKJ	65360	207	70	85161	10350	10500	106011
34	VVB	44915	1384	169	59148	69200	25350	153698
35	VVKP	43914	360	32	59506	18000	4800	82306
36	ALJN	287039	2680	52	392366	134000	7800	534166
37	MTJ	250991	3057	71	420883	152850	10650	584383
38	AWR	97378	1474	38	145271	73700	5700	224671
39	RE	177096	3232	270	265430	161600	40500	467530

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.7

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - SEPTEMBER -2007

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	60228	5413	500	78648	270650	75000	424298
2	BVH	101612	5730	452	140513	286500	67800	494813
3	CSB	65612	134	40	83201	6700	6000	95901
4	DAZ	24412	683	27	30774	34150	4050	68974
5	DBSI	35794	411	27	49207	20550	4050	73807
6	DEC	74734	2083	109	100655	104150	16350	221155
7	DEE	81430	397	27	116723	19850	4050	140623
8	DKZ	40621	529	41	55953	26450	6150	88553
9	DLI	711146	1113	213	1001484	55650	31950	1089084
10	DSA	206096	2867	384	270164	143350	57600	471114
11	FDB	137913	7466	712	187821	373300	106800	667921
12	FDN	109637	5289	498	150765	264450	74700	489915
13	GGN	100573	4104	221	140617	205200	33150	378967
14	GMS	8346	276	4	12190	13800	600	26590
15	GZB	339760	12644	1087	447595	632200	163050	1242845
16	HNZM	233921	484	92	339609	24200	13800	377609
17	HPU	47076	2761	70	67173	138050	10500	215723
18	MGLP	13222	469	8	17807	23450	1200	42457
19	MTC	125704	3427	125	164876	171350	18750	354976
20	MUT	44793	1936	62	61701	96800	9300	167801
21	NDAZ	41011	327	26	54190	16350	3900	74440
22	NDLS	703176	1077	533	955709	53850	79950	1089509
23	OKA	50834	784	74	69309	39200	11100	119609
24	PNP	184236	3471	160	239709	173550	24000	437259
25	PWL	90109	9882	487	130757	494100	73050	697907
26	ROK	142169	4411	852	204598	220550	127800	552948
27	SBB	109940	5989	677	147280	299450	101550	548280
28	SMQL	53986	402	16	79660	20100	2400	102160
29	SNP	138244	11785	1676	183466	589250	251400	1024116
30	SSB	67538	1644	225	95930	82200	33750	211880
21	SZM	70085	888	87	93844	44400	13050	151294
32	TKD	44741	3131	135	61262	156550	20250	238062
33	TKJ	58705	200	66	76444	10000	9900	96344
34	VVB	36871	1385	125	47675	69250	18750	135675
35	VVKP	39400	391	18	53881	19550	2700	76131
36	ALJN	286988	2751	42	399292	137550	6300	543142
37	MTJ	239604	3173	92	392512	158650	13800	564962
38	AWR	98164	1298	48	154985	64900	7200	227085
39	RE	171245	3097	181	271034	154850	27150	453034

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.8

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - OCTOBER 2007

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	61762	5971	435	81496	298550	65250	445296
2	BVH	106553	6107	471	153290	305350	70650	529290
3	CSB	64601	140	29	81760	7000	4350	93110
4	DAZ	24201	666	17	30732	33300	2550	66582
5	DBSI	39089	438	31	55003	21900	4650	81553
6	DEC	77651	2208	122	106229	110400	18300	234929
7	DEE	89757	438	46	120204	21900	6900	149004
8	DKZ	42832	588	54	59347	29400	8100	96847
9	DLI	727273	1128	231	1022752	56400	34650	1113802
10	DSA	222834	3121	341	297121	156050	51150	504321
11	FDB	144594	7880	654	202731	394000	98100	694831
12	FDN	121025	5530	536	171559	276500	80400	528459
13	GGN	111192	4477	307	163596	223850	46050	433496
14	GMS	7736	261	7	11309	13050	1050	25409
15	GNU	14639	835	44	20871	41750	6600	69221
16	GZB	354948	13315	1175	474956	665750	176250	1316956
17	HNZM	245643	534	70	358972	26700	10500	396172
18	HPU	47691	2778	57	68785	138900	8550	216235
19	MGLP	11842	462	13	16127	23100	1950	41177
20	MTC	128941	3546	149	172953	177300	22350	372603
21	MUT	46672	2094	86	65592	104700	12900	183192
22	NDAZ	42624	339	27	56549	16950	4050	77549
23	NDLS	721248	1179	433	987655	58950	64950	1111555
24	NUR	19762	1787	124	26717	89350	18600	134667
25	OKA	63999	760	53	100284	38000	7950	146234
26	PNP	201396	3570	218	262158	178500	32700	473358
27	PWL	96128	11090	432	142786	554500	64800	762086
28	ROK	137948	4378	718	202252	218900	107700	528852
29	SBB	115480	6391	727	158955	319550	109050	587555
30	SMQL	49368	401	6	75716	20050	900	96666
31	SNP	129260	10780	1568	172734	539000	235200	946934
32	SSB	71279	1823	227	102095	91150	34050	227295
33	SZM	73248	879	87	99532	43950	13050	156532
34	TKD	45585	3436	163	63069	171800	24450	259319
35	TKJ	55312	214	54	72270	10700	8100	91070
36	VVB	39962	1475	170	52255	73750	25500	151505
37	VVKP	43981	410	24	59040	20500	3600	83140
38	ALJN	291330	2867	56	404294	143350	8400	556044
39	MTJ	205291	3367	80	313055	168350	12000	493405
40	AWR	87578	1412	85	131267	70600	12750	214617
41	RE	161714	3487	180	244731	174350	27000	446081

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.9

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - NOVEMBER 2007

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	65135	5371	404	88790	268550	60600	417940
2	BVH	105278	5774	349	152307	288700	52350	493357
3	CSB	66963	116	30	87541	5800	4500	97841
4	DAZ	27094	584	23	34531	29200	3450	67181
5	DBSI	41403	391	23	59935	19550	3450	82935
6	DEC	86321	2026	97	120324	101300	14550	236174
7	DEE	112837	391	35	150670	19550	5250	175470
8	DKZ	45434	499	55	64532	24950	8250	97732
9	DLI	789902	982	205	1126088	49100	30750	1205938
10	DSA	225494	2810	330	312525	140500	49500	502525
11	FDB	154433	7355	666	221012	367750	99900	688662
12	FDN	122237	5134	487	177235	256700	73050	506985
13	GGN	105485	3929	241	157160	196450	36150	389760
14	GMS	7232	242	9	10482	12100	1350	23932
15	GNU	31100	2283	101	46106	114150	15150	175406
16	GZB	379333	12316	975	520220	615800	146250	1282270
17	HNZM	268484	443	64	409261	22150	9600	441011
18	HPU	53505	2692	69	80185	134600	10350	225135
19	MDNR	1	1	0	1	50	0	51
20	MGLP	19585	530	10	28167	26500	1500	56167
21	MTC	141948	3234	146	194410	161700	21900	378010
22	MUT	50941	1934	88	75064	96700	13200	184964
23	NDAZ	43816	303	28	60669	15150	4200	80019
24	NDLS	846932	1105	487	1182776	55250	73050	1311076
25	NNO	2556	192	8	3965	9600	1200	14765
26	NUR	39606	2704	151	54560	135200	22650	212410
27	OKA	52551	711	93	73056	35550	13950	122556
28	PNP	212262	3323	181	278941	166150	27150	472241
29	PWL	100464	10591	498	151796	529550	74700	756046
30	ROK	152130	4156	934	219233	207800	140100	567133
31	SBB	119053	5789	672	169161	289450	100800	559411
32	SMQL	45307	387	10	68625	19350	1500	89475
33	SNP	131004	9248	1365	175058	462400	204750	842208
34	SPZ	12835	1252	77	18782	62600	11550	92932
35	SSB	81590	1632	211	122422	81600	31650	235672
36	SZM	70961	754	75	99014	37700	11250	147964
37	TKD	45794	3107	147	66943	155350	22050	244343
38	TKJ	67022	190	60	96617	9500	9000	115117
39	VVB	41920	1302	151	56573	65100	22650	144323
40	VVKP	61490	366	35	80238	18300	5250	103788
41	ALJN	300888	2507	90	424463	125350	13500	563313
42	MTJ	238362	2921	65	380394	146050	9750	536194
43	AWR	95710	1338	40	149705	66900	6000	222605
44	RE	168729	2919	150	263821	145950	22500	432271

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.10

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - DECEMBER 2007

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	57754	5297	406	78381	264850	60900	404131
2	BVH	95749	5639	423	133118	281950	63450	478518
3	CSB	65362	115	38	84222	5750	5700	95672
4	DAZ	24244	662	24	31100	33100	3600	67800
5	DBSI	38047	423	31	54574	21150	4650	80374
6	DEC	75839	2110	115	102968	105500	17250	225718
7	DEE	83209	382	29	110151	19100	4350	133601
8	DKZ	39207	552	37	54773	27600	5550	87923
9	DLI	686029	1035	219	957444	51750	32850	1042044
10	DSA	209780	2900	391	282573	145000	58650	486223
11	FDB	137696	7121	632	190419	356050	94800	641269
12	FDN	111209	5067	496	155072	253350	74400	482822
13	GGN	106572	3899	250	151300	194950	37500	383750
14	GMS	7519	213	5	10066	10650	750	21466
15	GNU	26144	2073	87	37927	103650	13050	154627
16	GZB	353007	12439	1263	465877	621950	189450	1277277
17	HNZM	234202	430	80	347307	21500	12000	380807
18	HPU	46492	2913	84	66786	145650	12600	225036
19	MGLP	19556	564	11	27344	28200	1650	57194
20	MTC	121603	3277	131	161736	163850	19650	345236
21	MUT	45825	1888	72	64939	94400	10800	170139
22	NDAZ	37578	292	31	50900	14600	4650	70150
23	NDLS	756794	1078	380	1042215	53900	57000	1153115
24	NNO	34661	3780	157	47084	189000	23550	259634
25	NUR	51061	3634	184	68603	181700	27600	277903
26	OKA	46985	690	54	64305	34500	8100	106905
27	PNP	187046	3423	167	239614	171150	25050	435814
28	PTRD	6215	386	2	8614	19300	300	28214
29	PWL	95045	11112	400	138333	555600	60000	753933
30	ROK	136652	4261	663	196486	213050	99450	508986
31	SBB	110069	5901	644	153117	295050	96600	544767
32	SMQL	38544	402	13	56793	20100	1950	78843
33	SNP	118635	8929	1091	156587	446450	163650	766687
34	SPZ	20902	1872	86	29412	93600	12900	135912
35	SSB	67949	1580	232	98958	79000	34800	212758
36	SZM	66705	800	72	91522	40000	10800	142322
37	TKD	46933	3171	124	64993	158550	18600	242143
38	TKJ	57407	193	43	76379	9650	6450	92479
39	VVB	37626	1369	135	49869	68450	20250	138569
40	VVKP	43051	366	21	57072	18300	3150	78522
41	ALJN	276453	2506	55	378400	125300	8250	511950
42	MTJ	220434	2877	78	347108	143850	11700	502658
43	AWR	85009	1284	42	128925	64200	6300	199425
44	RE	153081	3050	116	226648	152500	17400	396548

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.11

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - JANURY 2008

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	58806	5602	506	78367	280100	75900	434367
2	BVH	95451	5985	509	131810	299250	76350	507410
3	CSB	65499	107	26	82876	5350	3900	92126
4	DAZ	23238	692	27	29762	34600	4050	68412
5	DBSI	37042	396	39	52011	19800	5850	77661
6	DEC	69436	2279	112	92502	113950	16800	223252
7	DEE	70037	386	35	94030	19300	5250	118580
8	DKZ	36554	549	61	50236	27450	9150	86836
9	DLI	633240	1099	226	869237	54950	33900	958087
10	DSA	204433	3021	393	269750	151050	58950	479750
11	FDB	139135	7520	708	192432	376000	106200	674632
12	FDN	108810	5367	551	151240	268350	82650	502240
13	GGN	98791	4208	313	138373	210400	46950	395723
14	GMS	6986	235	11	8834	11750	1650	22234
15	GNU	34113	3249	169	47677	162450	25350	235477
16	GZB	347969	12927	1413	455857	646350	211950	1314157
17	HNZM	248373	445	62	367202	22250	9300	398752
18	HPU	43183	2913	62	61947	145650	9300	216897
19	MDNR	826	520	6	1229	26000	900	28129
20	MGLP	18369	543	21	25353	27150	3150	55653
21	MTC	121627	3423	163	159007	171150	24450	354607
22	MUT	42071	2036	74	59386	101800	11100	172286
23	NDAZ	34998	302	25	45968	15100	3750	64818
24	NDLS	715846	1050	463	982889	52500	69450	1104839
25	NNO	46279	4612	185	61475	230600	27750	319825
26	NUR	63161	5139	325	80529	256950	48750	386229
27	OKA	47227	733	81	63619	36650	12150	112419
28	PNP	179992	3596	204	227643	179800	30600	438043
29	PTRD	15065	1127	36	21592	56350	5400	83342
30	PWL	93240	11479	600	132435	573950	90000	796385
31	ROK	131040	4500	809	186553	225000	121350	532903
32	SBB	107007	6050	731	146256	302500	109650	558406
33	SMQL	39791	417	11	58650	20850	1650	81150
34	SNP	111964	9423	1460	144779	471150	219000	834929
35	SPZ	18107	2229	147	24998	111450	22050	158498
36	SSB	65113	1732	231	93184	86600	34650	214434
37	SZM	60807	807	106	81730	40350	15900	137980
38	TKD	42495	3308	165	58804	165400	24750	248954
39	TKJ	57331	217	58	75931	10850	8700	95481
40	VVB	35990	1410	167	47327	70500	25050	142877
41	VVKP	37973	429	32	50954	21450	4800	77204
42	ALJN	266769	2694	50	359200	134700	7500	501400
43	MTJ	188549	3047	82	281255	152350	12300	445905
44	AWR	82626	1326	35	122825	66300	5250	194375
45	RE	136821	3193	175	196020	159650	26250	381920

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 4.12

SUMMARISED UNRESERVED PASSENGER TRAFFIC AT SELECTED STATIONS IN NCR - FEBRUARY 2008

S.No.	LOCATION_CODE	JRNY_TKT_ISSUED	MST_TKT_ISSUED	QST_TKT_ISSUED	JRNY_PSGN_BOOKED	MST_PSGN_BOOKED	QST_PSGN_BOOKED	TOTAL_PSGN
1	BGZ	54856	4659	349	70736	232950	52350	356036
2	BTU	4865	124	6	7450	6200	900	14550
3	BVH	98285	5533	349	138997	276650	52350	467997
4	CSB	63105	111	25	80985	5550	3750	90285
5	DAZ	22596	559	25	29211	27950	3750	60911
6	DBSI	35739	363	19	50862	18150	2850	71862
7	DEC	70580	2105	101	96026	105250	15150	216426
8	DEE	79601	352	35	105091	17600	5250	127941
9	DKZ	36521	536	38	51128	26800	5700	83628
10	DLI	636984	1022	202	885258	51100	30300	966658
11	DSA	209028	2767	307	284842	138350	46050	469242
12	FDB	138283	7076	693	190865	353800	103950	648615
13	FDN	110792	5038	418	155213	251900	62700	469813
14	GGN	102031	4017	267	144217	200850	40050	385117
15	GMS	6996	194	8	9223	9700	1200	20123
16	GNU	32232	2627	113	45393	131350	16950	193693
17	GZB	358703	12019	957	469831	600950	143550	1214331
18	HNZM	241121	406	67	356026	20300	10050	386376
19	HPU	45024	2733	74	66937	136650	11100	214687
20	MDNR	1342	2578	34	2012	128900	5100	136012
21	MGLP	18535	578	10	25542	28900	1500	55942
22	MTC	125750	3126	137	168440	156300	20550	345290
23	MUT	45774	1895	89	65324	94750	13350	173424
24	NDAZ	35830	294	27	47802	14700	4050	66552
25	NDLS	688268	973	475	949055	48650	71250	1068955
26	NNO	46711	4305	126	62845	215250	18900	296995
27	NUR	63216	4541	260	81100	227050	39000	347150
28	OKA	47536	681	80	65056	34050	12000	111106
29	PNP	181463	3435	200	227138	171750	30000	428888
30	PTRD	21807	1821	57	31343	91050	8550	130943
31	PWL	89897	10664	480	131724	533200	72000	736924
32	ROK	118696	4208	831	170802	210400	124650	505852
33	SBB	104764	5841	619	145249	292050	92850	530149
34	SMQL	40989	328	9	61873	16400	1350	79623
35	SNP	106948	8601	1679	139713	430050	251850	821613
36	SPZ	18590	2202	114	25891	110100	17100	153091
37	SSB	63731	1584	216	91899	79200	32400	203499
38	SZM	62149	719	94	84573	35950	14100	134623
39	TKD	44177	3065	146	61923	153250	21900	237073
40	TKJ	57159	206	62	75003	10300	9300	94603
41	VVB	35546	1336	153	47706	66800	22950	137456
42	VVKP	41296	368	42	55493	18400	6300	80193
43	ALJN	281653	2391	42	390108	119550	6300	515958
44	MTJ	188851	2759	63	289925	137950	9450	437325
45	AWR	90475	1262	24	138198	63100	3600	204898
46	RE	138169	2961	173	204204	148050	25950	378204

Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Annexure 6.1

Details of Services of Other State Road Transport Corporations (SRTCs) to/from/via Delhi/other towns of the NCR from/to a number of locations in their respective states on reciprocal basis

Sr.No.	Sub Region State	Name of the depot	No. of Buses
1	NCTD	28 depots partly housing NCR veh.	351
2	Haryana (NCR)	Panipat	116
		Sonepat	207
		Rohtak	159
		Delhi	120
		Jhajjar	127
		Gurgaon	190
		Faridabad (Ballabgarh, sub-depot Palwal)	235
		Rewari (Bahadurgarh sub-depot)	131
		Total Haryana	1285
3	Uttar Pradesh(NCR)	Gazhiabad (including Buland shahar)	499
		Noida	150
		Meerut	500
		Total Uttar Pradesh	1219
4	Rajasthan(NCR)	Alawar, Tizara, Mastya Nagar	289
5	Total STU buses in NCR depots excluding DTC city buses		3144
6	Additional No. of buses from 11 STUs and private operators arriving at three ISBTs (Sarai Kale Khan, Kashmere Gate & Anand Vihar)		2208
7	Others		682
		Total	**6034**

Annexure 6.2

MEMBERS OF ASRTU

Members of the Association of State Road Transport Undertakings = **52 + 3**

CORPORATIONS
DEPARTMENTS

1 Andhra Pradesh SRTC
2 Assam STC
3 Bihar SRTC
4 Calcutta STC
5 Delhi TC
6 Gujarat SRTC
7 Himachal RTC
8 Jammu & Kashmir SRTC
9 Karnataka SRTC
10 Kerala SRTC
11 Maharashtra SRTC
12 Manipur SRTC
13 Meghalaya TC
14 North Bengal STC
15 North West Karnataka RTC
16 North East Karnataka RTC
17 Orissa SRTC
18 Pepsu RTC
19 Rajasthan SRTC
20 South Bengal STC
21 Tripura RTC
22 Uttar Pradesh SRTC
23 Uttaranchal TC

MUNICIPAL UNDERTAKINGS

1 Ahmedabad MTS
2 Bangalore Metropolitan TCL
3 BEST Undertaking
4 Kolhapur MTU
5 Navi Mumbai MT
6 Pimpri Chinchwad MT
7 Pune MT
8 Solapur MTU
9 Thane MTU
10 Kalayan Dombivli MTU

GOVERNMENT

1 Andaman & Nicobar ST
2 Arunachal Pradesh ST
3 Chandigarh TU
4 ST Haryana
5 Mizoram ST
6 Nagaland ST
7 ST Punjab
8 Sikkim NT

COMPANIES

1 Metropolitan TCL (CNI)
2 State Express TCL (TN)
3 Tamil Nadu State TCL (CBE)
4 Tamil Nadu State TCL (KUM)
5 Tamil Nadu State TCL (MDU)
6 Tamil Nadu State TCL (SLM)
7 Tamil Nadu State TCL (VPM)
8 Kadamba TCL
9 Calcutta Tram. Co. Ltd.
10 Pondicherry RTCL
11 West Bengal Surface TCL

ASSOCIATE MEMBERS

1 Delhi Tourism DC
2 Himachal Pra. TDCL
3 The National TC, Mauritius

Annexure 11.1

Relevant details and Equations with regard to Emission from Traffic and Air Quality Levels of Parameters cited above and that for Noise Levels

1. Emissions from Traffic and Air Quality Levels

A detailed analysis has been carried out to arrive at the emission rate of different pollutants for different road sections where the road traffic counts have been made. The average daily traffic data (ADT) for the 82 corridor sections in NCR was converted into pollutant emissions in respect of SPM, RSPM, CO and NO_X, utilizing the emission factors suggested by CPCB (Transport Fuel Quality for year 2005, PROBES/78/2000 – 01).

This involves the following steps.

The ADT data has been classified in to six categories as Two Wheelers, Auto Rickshaws, Cars, Buses, LCV and Trucks. By the following formula, the total emission of each pollutant for each vehicle category has been calculated. Based on this, the total emission for a day of each pollutant was calculated by summing up emissions from all the categories of vehicles.

Total Emission of each pollutant in g/min = Total Number of Vehicle/ Day * Emission Factor * Coverage Distance * $\left(\frac{1}{24X60}\right)$

(Coverage distance is the distance up to which the traffic would affect the monitoring station. As the traffic is more or less a ground source coverage distance is taken as 50 m.)

A linear relationship between the monitored pollutant levels (at 20 Stations) and the emission strength for the same 20 stations was developed by the method of least squares. The following are the equations arrived at for different pollutants.

$$Y = a_0 + a_1X$$

Where, Y = Emission strength from the Traffic Volume Count data (g/min)
X = Monitored Pollutants level (µg/m^3) a_0 and a_1= Constants

$$a_0 = \frac{(\sum Y)(\sum X^2)-(\sum X)(\sum XY)}{N\sum X^2-(\sum X)^2} \qquad a_1 = \frac{N(\sum XY)-(\sum X)(\sum XY)}{N\sum X^2-(\sum X)^2}$$

$$cc = r = \frac{N(\sum XY)-(\sum X)(\sum XY)}{\sqrt{[N\sum X^2-(\sum X)^2][N\sum Y^2-(\sum Y)^2]}}$$, Where CC- Co-relation coefficient.

The Standard Deviation of air quality was also determined as

$$SD = \sqrt{\frac{\sum(X-\bar{X})^2}{N}}$$

Where, X = Individual air quality

$\bar{X}$ = Average air quality

SPM: Y = - 0.06079 + 0.000384 X (CC = 0.711025, SD = 100.6553)
CO: Y = - 1.07721 + 0.002622 X (CC = 0.565154, SD = 355.022)
NO_x: Y = - 1.88324 + 0.132585 X (CC = 0.494285, SD = 7.2915)
RSPM: Y = - 0.08114 + 0.001002 X (CC = 0.737516, SD = 46.40209)

(The ratio between the RSPM to SPM from the Monitored value came out to be 0.461. As there is no emission factor, this relationship is used to calculate the RSPM concentration at 82 stations.)

Where, X = Pollutants Level in $\mu g/m^3$

Y = Emission strength of Pollutants in g/min.

These equations are used to determine the various pollutants level at all the 82 stations.

The air quality is expressed as of low, moderate, high and critical for various road corridors based on the Excedence Factor (CPCB has delineated the ratio of 24 hourly mean concentration of a pollutant with that of a corresponding standard in to four categories).

2. Noise Level in NCR and Monitoring of Ambient Noise Levels

In order to assess the noise impacts due to the proposed project on surrounding area base line noise levels were monitored. To determine the existing noise level, field monitoring was carried out along the existing alignment of the road with integrating sound level meter as per IS: 3029-1980.

Ambient noise level or sound pressure levels (SPL) were measured by a portable sound level meter having in built facilities to read noise level directly in dB (A). Noise measurements were made as suggested by CPCB. Ambient noise level monitoring was carried out during the month of July and August 2007. At each location, noise was monitored continuously over a period of twenty-four hours to obtain L_{eq} values at uniform time intervals of 1 Hour.

In each hourly time interval L_{eq} values have been computed from SPL readings taken at uniform time interval of 30secs.

$$L_{eq} = 10\,Log\,\frac{1}{n}\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}$$

Where, L_{eq} = Hourly Equivalent Noise Level

n = No of equal time intervals (12)

SPL_i = Sound Pressure Level Value of the i^{th} time interval.

For each location, day and night Time Leq values have been computed from the hourly L_{eq} values.

$$L_{eq_{day}} = 10\,Log\,\frac{1}{16}\sum_{i=1}^{16} 10^{\frac{L_i}{10}} \qquad L_{eq_{night}} = 10\,Log\,\frac{1}{8}\sum_{i=1}^{8} 10^{\frac{L_i}{10}}$$

Where, L_i = Value of the i^{th} hourly time interval.
Day = From 06:00 AM To 22:00 PM
Night = From 22:00 PM To 06:00 AM

Determination of Integrated/Generated Noise Levels by the Highway Noise Model

From the Traffic Volume Count (TVC) data at each location, three type of vehicle categorization (A – Two and Three Wheelers, B – Cars and Vans, C – Buses, Tractors and Trucks) has been done. The integrated/generated noise level Leq(h_i)is obtained by calculating the Leq for all categories of vehicles separately and adding them (logarithmic values only).

$$L_{eq}(h_i) = L_{oei} + 10\,Log\,\frac{N_i}{S_i T} + 10\,Log\left(\frac{15}{D}\right)^{1+\alpha} + \delta_s - 15$$

Source :(Hand Book of Transport and the Environment, David A Hensher and Kenneth T. Button)

Where, $L_{eq}(h_i)$ = Hourly integrated noise level
L_{oei} =Reference mean sound level for the i^{th} vehicle type

A. For Two and Three Wheelers -63 dBA
B. For Cars and Vans -65 dBA
C. For Buses, Trucks and Tractors -76 dBA

N_i = No. of class i vehicle passing at time T (1 Hr) in the particular road section.
S_i = Average speed for the i^{th} vehicle class (Km/Hr) on the particular road section obtained from survey results.

A. For Two and Three Wheelers -50 Km/Hr
B. For Cars and Vans -60 Km/Hr
C. For Buses, Trucks and Tractors -40 Km/Hr

T = duration for which L_{eq} is desired and must correspond to N_i (T =1 Hour)
D = Perpendicular distance (m) from the centre line of the traffic lane to the location of the observer. (15 m)
α = The factor which relates to the adsorption characteristics of the ground cover between the road way and the observer. (Taken as 0)
δ_s = Shielding factor provided by a noise barrier. (Taken as 0)

The combined effect of all the vehicle categories at the receptor has been determined by adding individual values using the following equation:

$$L_{eq}(h_i, total) = 10\,Log\sum_{h=1}^{i} 10^{\frac{L_{eq}(h_i)}{10}}$$

(Source: Hand Book of Transport and the Environment, David A Hensher and Kenneth T. Button)

By using this hourly Leq values, the day and night noise levels were determined in the same way as mentioned in the previous section.

Co-relation between Ambient Noise Levels and Generated Noise Levels

A linear relationship between the monitored noise levels (at 20 Stations) and the noise levels (from ADT data) for the same 20 stations was developed by the method of least squares. The following are the equations arrived at for different pollutants

Y = - 32.2126 + 1.484435 X (CC = 0.925038, SD = 2.5958, Day Time)
Y = - 22.4091 + 1.423612 X (CC = 0.930429, SD = 3.6453, Night Time)

Where, X = Ambient Noise Levels in dB (A). Y = Generated Noise Levels in dB (A).

These linear equations are used to calculate the day and night time noise levels at all 82 stations in the NCR region.

The Day- Night average Leq for the corrected noise level has been calculated from the following formula. *(Environmental Impact Assessment by Canter,1996).*

$$L_{dn} = 10Log\left[0.625\left(10^{(Ld/10)}\right) + 0.375\left(10^{\frac{(Ln+10)}{10}}\right)\right]$$

Where, L_d = Leq for the day time
L_n = Leq for the night time.
L_{dn} = Day – Night Average sound level.

3. Air Pollution Index (API)

As there are a number of pollutants, it is difficult to comprehend the impacts of each and arrive at an objective decision. Therefore a consolidated air pollution index (API) considering all of them is developed for comparing and ranking the road sections. The air pollution index (API) is defined as,

$$= \frac{1}{6}\left[\frac{C_{SPM}}{SPM\ Std} + \frac{C_{CO}}{Co\ Std} + \frac{C_{NOx}}{NOx\ Std} + \frac{C_{RSPM}}{RSPM\ Std} + \frac{Leq\ Day}{Leq\ Day\ Std} + \frac{Leq\ Night}{Leq\ Night\ Std}\right]$$

Where, C_{SPM}, C_{NOx}, C_{RSPM}, and C_{CO} are the ambient concentrations of SPM, NO_x, RSPM and CO respectively, and SPM_{Std}, CO_{Std}, NOx_{Std}, $RSPM_{Std}$ are the respective standards laid down.The L_{eqDay} and $L_{eqNight}$ are the ambient noise levels and $L_{eqDayStd}$ and $Leq_{NightStd}$ are the respective standards. These standards are for 24 hours averaging period, except CO_{Std}, which is for 1 h averaging period.

Annexure-11.2

API and Ranking of all Road Sections Based on API (SPM, Co, NOx ,RSPM $L_{eq\ DAY}$ & $L_{eq,NIGHT}$)

Rank	Station No.	Description	SPM ($\mu g/m^3$)	CO ($\mu g/m^3$)	NOx ($\mu g/m^3$)	RSPM ($\mu g/m^3$)	Leq Day dB(A)	Leq Night dB(A)	API
		CPCB Norm	**200**	**2000**	**80**	**100**	**65**	**55**	
1	53	Tatarpur Chouraha to Kherthal	169.88	452.95	14.93	78.31	65.69	54.80	0.66
2	60	Naha	173.63	468.66	14.88	80.04	65.29	53.04	0.66
3	82	Barauda	170.64	458.73	14.78	78.67	65.35	54.80	0.66
4	55	Kishangarh - Kot Qasim Road	174.64	470.13	15.20	80.51	66.70	55.57	0.67
5	70	Halal pur	176.08	476.85	15.02	81.17	66.63	55.78	0.67
6	38	Hodal-Nuh	176.02	479.89	15.18	81.15	66.36	57.33	0.68
7	30	Choda Choki	176.24	473.33	15.28	81.25	67.37	56.62	0.68
8	63	Nahar	178.83	488.78	15.23	82.44	66.63	57.54	0.68
9	66	Dhare	177.41	482.79	15.52	81.79	67.64	57.54	0.68
10	61	Majra	176.25	471.41	15.57	81.25	67.78	58.52	0.69
11	80	Sarmana	179.38	488.62	15.63	82.69	67.91	56.48	0.69
12	16	Bahadurgarh Thana	177.96	473.91	15.68	82.04	67.71	58.73	0.69
13	54	Pipli	178.76	483.84	15.87	82.41	67.24	59.71	0.69
14	34	Bulandshahr-Ahmadgarh	181.55	485.98	15.63	83.70	67.85	58.24	0.69
15	29	Palwal - Hasanpur	180.23	491.40	15.74	83.09	67.71	58.94	0.69
16	47	Doha Chok	181.37	495.18	15.90	83.61	67.58	58.31	0.69
17	6	Vijipur	186.74	509.93	15.94	86.09	68.38	55.78	0.70
18	33	Shivali Anupshahr Road	183.90	498.44	15.83	84.78	67.85	59.15	0.70
19	28	Chaunhut Police Station	184.57	500.48	16.16	85.09	68.59	58.87	0.70
20	39	Nuh-Palwal	185.81	513.97	16.04	85.66	68.45	58.52	0.71
21	67	Chora	185.03	509.35	16.61	85.30	69.40	58.59	0.71
22	59	Mundi Nangal	191.03	532.85	15.75	88.06	67.71	57.54	0.71
23	79	SH 16 A	191.54	532.28	15.93	88.30	68.79	57.18	0.71
24	11	Lakhabaya	192.83	531.17	16.56	88.89	68.99	58.94	0.72
25	18	66KM BARAL	193.16	522.97	17.04	89.05	69.06	60.42	0.73
26	45	Nuh - Firozpur Jhirka	194.82	545.09	17.01	89.81	69.33	59.57	0.73
27	46	Chawandi Khud	195.68	548.78	16.75	90.21	68.65	60.14	0.73
28	77	Lakhanmajra	194.25	537.96	17.13	89.55	69.26	61.47	0.73

Rank	Station No.	Description	SPM ($\mu g/m^3$)	CO ($\mu g/m^3$)	NOx ($\mu g/m^3$)	RSPM ($\mu g/m^3$)	Leq Day dB(A)	Leq Night dB(A)	API
		CPCB Norm	**200**	**2000**	**80**	**100**	**65**	**55**	
29	73	Baba Ramdev Ashram	194.91	539.88	17.25	89.85	69.60	61.05	0.73
30	27	Palwal - Mohna	196.85	555.80	16.59	90.75	68.18	61.54	0.73
31	71	Kharkhauda	197.40	552.11	17.02	91.00	70.14	59.78	0.74
32	52	Dholi Dhoop	202.97	576.02	16.41	93.57	68.45	59.71	0.74
33	31	Khurja Junction	201.13	557.15	17.50	92.72	70.14	59.01	0.74
34	2	Chhaj	201.70	571.07	16.72	92.98	69.19	59.85	0.74
35	37	Punhana to Hodal	199.22	570.67	17.07	91.84	69.13	61.26	0.74
36	76	MEHAM	200.24	551.18	17.43	92.31	69.80	60.70	0.74
37	51	Kothi Narayanpur	20323.77	570.59	18.22	93.94	70.47	58.80	0.75
38	64	Dadri Road	199.22	555.30	17.95	91.84	69.80	62.59	0.75
39	50	Alwar - Seriska	203.42	574.44	17.51	93.78	69.40	61.47	0.75
40	40	Palwal - Hathin	203.17	580.90	17.50	93.66	69.60	61.47	0.75
41	65	Yakubnagar	202.71	572.16	18.20	93.45	70.94	61.40	0.75
42	8	Khevada	208.89	598.19	17.53	96.30	70.47	60.63	0.76
43	57	Phalhawas	204.10	583.49	18.86	94.09	70.20	62.80	0.76
44	5	Baavli	214.60	607.23	17.83	98.93	70.00	61.12	0.77
45	68	Bhupania	210.74	596.17	18.86	97.15	70.34	63.30	0.77
46	48	Bager ka Tiraha	219.20	616.09	18.92	101.05	70.68	59.64	0.78
47	75	Sunderpur	216.64	621.90	18.10	99.87	70.20	62.24	0.78
48	49	Katoriwala Tijara	223.96	650.70	18.29	103.24	70.74	59.01	0.78
49	12	Nagala Jamalpur Majra	220.82	639.86	18.15	101.80	70.47	61.68	0.79
50	74	Kalanaur	219.15	620.09	19.85	101.03	71.48	60.98	0.79
51	15	Near Inchauli ps	223.62	633.21	18.07	103.09	70.27	60.98	0.79
52	81	Bhadwasa	226.10	667.71	17.20	104.23	70.27	61.05	0.79
53	3	Asan	230.14	681.38	17.63	106.09	70.41	59.92	0.80
54	43	Near Bhondsi	225.03	649.89	19.02	103.74	71.28	61.40	0.80
55	56	Hansanka Majra	236.61	680.94	19.20	109.08	70.68	60.91	0.81
56	58	Sohana to Biwadi	237.59	719.06	18.42	109.53	70.81	60.91	0.82
57	25	Near Surajpur	233.58	673.58	19.74	107.68	71.01	63.02	0.82
58	72	Kherisad	244.10	711.62	19.48	112.53	71.15	62.66	0.83
59	35	Arnia Check Post	237.62	665.07	22.23	109.54	71.42	64.84	0.83
60	41	Ballabhgarh - Sohna	237.88	708.61	21.79	109.66	72.29	63.72	0.83

Rank	Station No.	Description	SPM ($\mu g/m^3$)	CO ($\mu g/m^3$)	NOx ($\mu g/m^3$)	RSPM ($\mu g/m^3$)	Leq Day dB(A)	Leq Night dB(A)	API
		CPCB Norm	**200**	**2000**	**80**	**100**	**65**	**55**	
61	32	G.T. ROAD NH 91	248.45	704.09	22.78	114.53	71.96	64.77	0.86
62	78	Bramahan Vas	250.06	733.46	22.98	115.28	72.49	64.00	0.86
63	4	Mehranna	256.57	771.58	21.31	118.28	72.29	64.28	0.87
64	14	Hasan pur	257.57	761.46	21.64	118.74	71.62	64.42	0.87
65	24	Panchlok Loni	261.34	772.62	21.95	120.48	72.22	64.07	0.88
66	13	Kharkoda	266.38	778.66	22.97	122.80	72.76	62.52	0.88
67	36	Near Kosi	268.10	808.56	22.82	123.60	72.49	63.93	0.89
68	10	Near Daurala	274.76	802.16	25.05	126.66	72.36	64.77	0.91
69	17	Hapur - Garhmukteshwar Toll Plaza	288.32	839.11	23.99	132.91	72.63	65.97	0.93
70	7	Sisana	297.05	910.04	25.35	136.94	72.90	66.18	0.95
71	19	Dasna Toll Plaza	305.99	907.36	25.43	141.06	72.97	65.97	0.97
72	21	Near Dadri	319.38	949.02	27.36	147.24	73.10	66.60	1.00
73	69	Bahadurgarh-Delhi	335.69	1044.03	24.18	154.75	75.59	64.42	1.02
74	20	Morta	389.65	1205.95	27.81	179.63	73.71	65.68	1.12
75	62	NH 8 Behror	383.38	1206.09	38.86	176.74	74.92	68.14	1.14
76	23	Near Indra puram gaziabad	472.95	1569.17	30.03	218.03	73.64	67.02	1.28
77	44	Bilaspur toll Plaza	468.68	1443.15	43.73	216.06	75.53	68.99	1.30
78	42	Khirki Dola	501.79	1591.66	39.94	231.33	75.59	68.49	1.35
79	9	Kundli	523.74	1635.69	46.76	241.45	76.54	69.27	1.41
80	1	Babarpur on NH-1	534.46	1722.90	48.26	246.39	76.47	69.20	1.43
81	26	NH 2 Sec 37 Faridabad	560.60	1906.51	30.94	258.43	74.31	67.51	1.44
82	22	Near Mohan Nagar	681.06	2296.21	40.07	313.97	75.39	67.51	1.67

Annexure 12.1

TRAVEL DEMAND FORECAST FOR HORIZON YEAR (2032)

1. Background

Trip end forecasts for the Horizon year (2032) have been carried out at inter and intra regional level. The calibrated trip end equations for the daily person trips made within the study area were applied on the projected planning variables for the horizon years (2032) under different development scenarios to get the future trip ends of internal-internal trips. The flow chart given below shows the methodology adopted for forecasting the passenger traffic for various network scenarios.

2. Planning Forecast

Planning variable forecasts for various spatial components as per five development scenarios are presented in **Table 1**.

Table 1: Planning Variable Forecast for Development Scenarios

Spatial Stratification	Population-2032				
	D1	D2	D3	D4	D5
NCT Delhi	45,746,657	29,338,490	45,746,657	26,756,421	21,121,168
NCR-Rural	30,668,632	24,467,900	17,465,777	22,314,489	42,500,460
Service centers	1,167,667	2,315,135	1,652,599	1,920,278	1,328,879
Sub-regional centers	8,739,530	12,657,085	9,034,933	11,446,920	9,308,290
Metro Centers	6,498,327	7,720,878	5,511,349	7,067,306	4,428,132
Regional Centers	9,292,675	10,174,960	7,263,132	17,169,032	7,987,518
Total	**102,113,489**	**86,674,447**	**86,674,447**	**86,674,447**	**86,674,447**

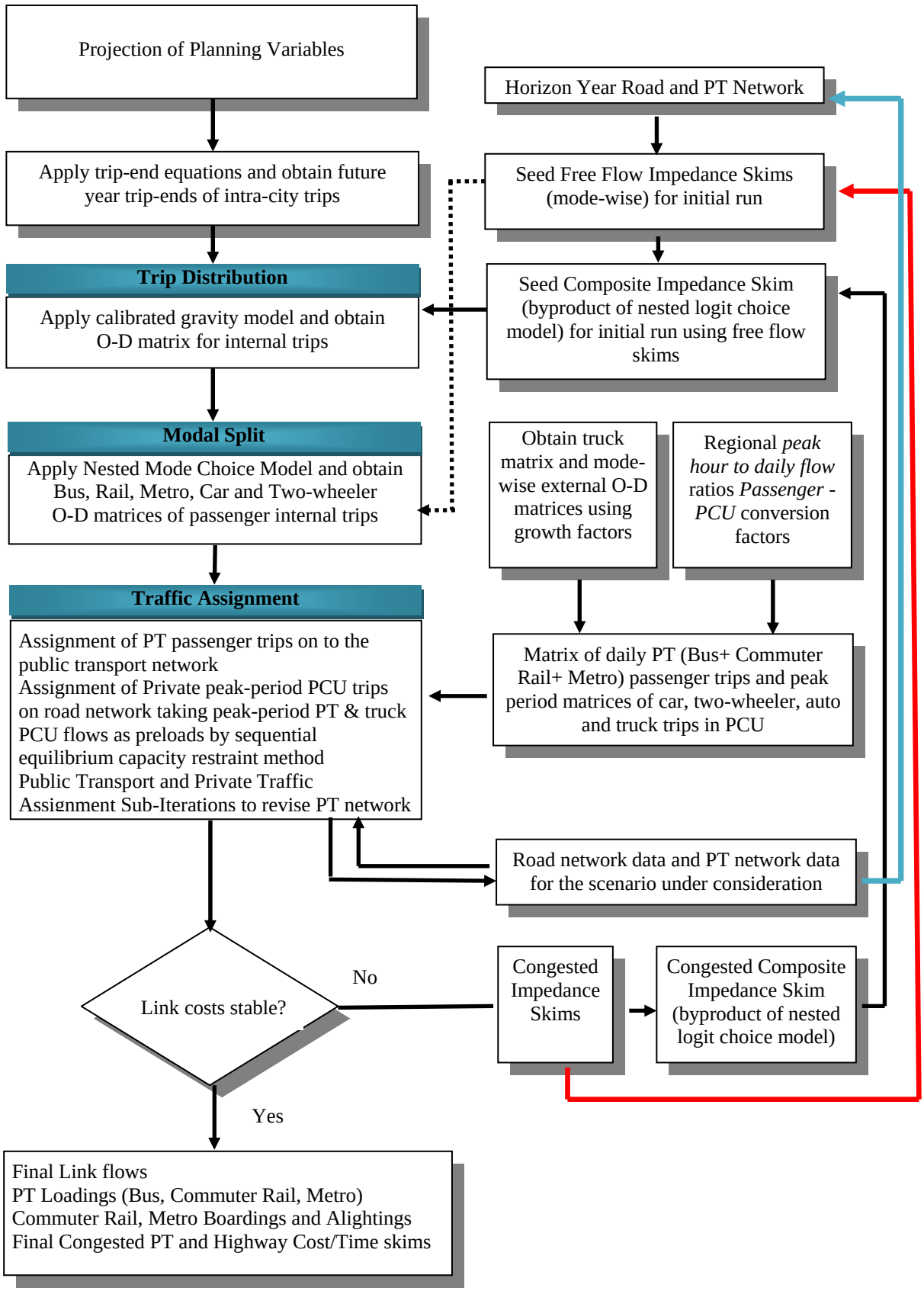
Spatial Stratification	Employment				
	D1	D2	D3	D4	D5
NCT D	**15,762,617**	**11,177,965**	**19,716,809**	**9,846,713**	**5794047**
NCR-Rural	14,219,599	10,728,583	6,452,357	9,430,364	19,137,466
Service centers	5,56,931	7,36,392	4,45,559	594,563	5,41,345
Sub-regional centers	3,181,072	4,171,257	2,518,509	3,998,652	3,077,542
Metro Centers	2,712,092	2,603,728	1,574,453	2,409,784	1,658,000
Regional Centers	3,214,077	3,253,519	1,963,757	6,391,367	2463044
Total	**39,646,388**	**32,671,443**	**32,671,443**	**32,671,443**	**32,671,443**

3. Trip End Forecasts

3.1 Intra Region Travel Demand

3.1.1 Passenger Traffic

The calibrated trip end models, which were based on linear regression equation and trip rate method, for daily person trips made within the region were applied on projected population development scenario to get future trip ends. The trip generation rates were adopted for NCT Delhi in the horizon year were 0.218 and 0.237 for the generation and attraction respectively. **Table 2** shows the intra region travel demand forecasts for horizon year - 2032.



Flow Chart for Forecasting of Passenger Traffic

Table2: Daily Intra Regional Travel demand in NCR Region for Horizon Year - (2032)

Spatial Stratification	Persons Trips –Production				
	D1	D2	D3	D4	D5
NCT Delhi	9,988,783	6,406,059	9,988,783	5,842,264	4,611,807
NCR-Rural	7,70,883	6,55,614	4,98,057	6,07,159	1,063,036
Service centers	2,85,302	5,93,982	4,14,955	4,96,079	3,35,925
Sub-regional centers	1,982,974	2,853,649	2,005,005	2,610,701	2,078,910
Metro Centers	1,013,844	1,193,559	8,68,758	1,097,484	7,09,525
Regional Centers	1,401,177	1,530,873	1,102,834	2,559,002	1,209,319
All NCR	**15,442,963**	**13,233,737**	**14,878,392**	**13,212,689**	**10,008,523**

3.1.2 Goods Traffic

The goods tonnage trip rate adopted for NCT Delhi in the horizon year 2032 was 0.021 and 0.020 for trip generation and attraction respectively.

The daily goods tonnage generation in the horizon year is shown in **Table 3**.

Table 3: Daily Goods Tonnage Generation in NCR Region for Horizon Year (2032)

	Tonnage Production				
Spatial Stratification	**D1**	**D2**	**D3**	**D4**	**D5**
NCT D	972,940	623,971	972,940	569,056	449,205
NCR-Rural	141,271	117,082	78,977	105,519	189,649
Service centers	252,063	393,872	232,070	307,448	240,384
Sub-regional centers	445,130	577,169	346,245	558,577	427,766
Metro Centers	316,067	304,580	195,477	284,022	204,333
Regional Centers	357,843	362,024	225,309	694,636	278,234
Total	**2,485,313**	**2,378,699**	**2,051,018**	**2,519,258**	**1,789,571**

3.2 Inter-Regional Traffic

3.2.1 Approach

Inter-region traffic forecast is based on the elasticity approach. A long-term forecast of traffic is done for a) originating outside NCR and passing through the region, b) originating outside and terminating within the region and c) originating inside the NCR and terminating outside the region. Zonal matrices of traffic growth rates, for these three categories of movement have been evolved using the elasticity approach. It is based on the premise that vehicular growth rates are influenced by the area economies of the traffic originating and destining states/regions. Under this methodology, a quantitative relationship is established between time series vehicle registration data and socio-economic indicators. This is done by fitting log-log regression equations with vehicle registration data as the dependant variable and socio-economic indicators as the independent variable. Using the vehicular growth rates, projections of vehicular traffic have been made over the analysis period. Based on vehicular traffic, total daily trips & tonnage carried, vehicle wise, have been projected using average occupancy and load carried, respectively.

3.2.1.1 Transport Demand Elasticities

Past traffic data at the external cordon points was available only for a few selected locations and this was insufficient for estimation of elasticities. Thus, vehicular elasticities have been worked out using time series vehicle registration data at the national level as the dependant variable and Net National Product as the independent variable, over the period 1993-1994 to 2003-04 and are presented in **Table 4**.

Table 4: Vehicular Elasticities (1993-94 to 2003-04)

Vehicle Type	Elasticity	R Square	t-Stat
Trucks	1.4	0.99	25.67
Bus	1.1	0.97	15.19
Three wheelers (Passenger)	1.8	0.99	25.89
Two Wheelers	1.8	0.99	33.14
Car, Jeep, Taxi	1.7	0.98	21.53

Table 5 presents the data set used for the regression analysis.

Table 5: Data Set for the Regression Analysis

Year	NNP at Factor Cost (Rs crore)	Number of Registered Vehicles						
		MAV (Truck)	LMV (Goods)	Bus+ Omni Bus	LMV (Passenger)	Two Wheelers	Car+ Jeep+ Taxi	Truck+ LCV
1993	1078761	1650105		418845	756797	18338480	3617050	1650105
1994	1154954	1793574		423383	897383	20831428	3840549	1793574
1995	1239019	1681309	349419	448415	1010344	23252287	4203644	2030728
1996	1340106	1805195	454857	488169	1165140	25693206	4661924	2260052
1998	1491870	1844628	709061	539819	1495200	31327607	5555923	2553689
1999	1585501	1891098	823907	562308	1583561	34117662	6142648	2715005
2000	1643998	2053942	894358	633900	1777130	38556026	7057724	2948300
2001	1739876	2002673	971067	635006	1878261	41581058	7613485	2973740
2002	1801430	2259752	1231885	720696	2113781	47519489	8599639	3491637
2003	1959599	2372702	1375782	767593	2167324	51921973	9451176	3748484

Elasticity values thus obtained are thereafter projected over the entire study duration (**Table 6**). Values in the initial period are related to past values as obtained and are projected to decline on the premise that transport demand elasticities for both freight and passenger traffic tend to go down over time and approach unity and sometimes even below that as regional imbalances are corrected and regions become self sufficient. Projected transport demand elasticities, vehicle-wise would be of the following order.

Table 6: Projected Vehicular Elasticities

Vehicle Type	Past	2007-2012	2012 - 2017	2017-2022	2022-2032
Trucks	1.3	1.10	1.00	1.00	0.90
Bus	1.1	1.10	1.00	1.00	0.90
Three-wheeler (Passenger)	1.8	1.40	1.20	1.10	1.00
Two Wheelers	1.8	1.50	1.40	1.30	1.10
Car	1.7	1.40	1.30	1.20	1.00

Vehicular elasticities take into account trends in vehicular growth, improvements in the road quality and network, technological and market changes and socio-economic developments.

Vehicle registration data was used to establish vehicular elasticity, since past traffic data was available only for a few locations at the external cordon points. Results of O-D survey carried out at different locations indicate the influence of almost all states on traffic. Average vehicular elasticities based on time series vehicle registration data at the state level & Net State Domestic Product of some of the surrounding states from where traffic is originating & destining, were examined. Transport demand elasticity estimated at the national level using time series vehicle registration data & time series Net National Product were found to lie close to elasticities obtained from this state level analysis. However, regression analysis carried out using National level vehicle registration data for estimation of transport demand elasticities showed higher R squared values vis a vis state level data. In view of the above and for long term traffic forecasting exercise, national level transport demand elasticities were adopted for the analysis.

Other studies carried out in the region were also consulted and traffic growth rates were looked into while carrying out the forecasting exercise. RITES Traffic Survey Report - Transport Demand Forecast Study and Development of an Integrated Road cum Multi-modal Public Transport Network For NCT of Delhi–May 2008, showed that over the period 2001 to 2007, traffic growth ranging between 7 and 12 percent were observed at various locations on the outer cordon of NCT Delhi such as Ashram ROB, Wazirabad Bridge, Dhansa Border, Rohtak Road (Tikri Border), Auchandi Bawana road (Near Auchandi Border), NH-1 Singhu Border and Mathura Road (Near Badarpur Border) and higher growth rates over 15 percent were also observed at some locations. The Consultant's own Report: Integrated Transportation Plan for NCR, Traffic Characteristics Report, 2007 showed that on NH-2 (km 86), a growth rate of 9 percent (over the period 2003-07) was observed for car and 6 percent for truck, while on NH-8 (km 112) a growth rate of 13 percent for car and 16 percent for truck and on NH-1 (km 33) a growth rate of 3 percent for car and 13 percent for truck was observed over the same period.

An analysis of Vehicle Registration data at the national level shows that goods vehicles have witnessed an average annual growth rate of 8 percent, cars (including jeeps and taxis) 10.7 percent, buses 7 percent over the period 1995 to 2003. The growth of the trucking sector is evident from the increasing population of trucks over the years and increasing share of road transport vis a vis rail. Commercial vehicle sales which have long grown at twice the GDP rate grew at a compound annual growth rate of 25 percent for the last 4 years. In the trucks category, the higher tonnage trucks have gained in the medium and heavy segment while in the LCV category, sales of the below 3.5 tonne trucks far outstripped the 5 tonne and 7 tonne trucks. With road improvements, heavier trucks are being used since the economies are much higher especially for long haul transportation. The heavier trucks are now used for point- to- point deliveries from the factory to the main depot. The LCVs takeover from then on. Tata and Volvo have stepped up sales in heavy trucks, the former with the Daewoo range of Novus trucks in 2006. Also with a range of vehicles available in the category of LCV, with carrying capacity less than 5 tonnes, this mode has a definite advantage for carrying small consignments on short haul. Newer LCVs have emission-norms-compliant engines because of which, apart from new purchase, there are replacement purchases.

In the bus category, the demand for luxury buses has grown two-fold in the last few years. Improved highways, which can support these large luxury buses and the tourism boom impelling tour operators to expand their bus fleet size to meet new demand, have attracted significant players including Ashok Leyland, Volvo India, Swaraj Mazda and Eicher Motors to come into the market.

Personalised passenger modes, especially cars, have experienced high growth rates in the past. Growing personal incomes, changes in lifestyle and higher ownership of cars have been responsible for this trend. This mode is likely to demonstrate a higher growth rate in the near future given the availability of affordable models and possible shift from autos/two wheeler.

3.2.1.2 Economic Perspective

An economic perspective has been developed for the traffic influencing states taking into account their growth in the past and future growth prospects. Two scenarios of economic growth have been developed. The first, optimistic scenario, assumes the growth rates based on the growth targets of the 11th Five Year Plan to continue in the future till 2017 coinciding with termination of the 12th Plan and then decline. The second scenario, assumes that the targets set out by the government may not materialize owing to external influences such as rising global oil prices, recessionary trends in the international economy or restrictive domestic policies that could lead to deceleration in investment growth and government spending. In this Business as Usual scenario, the economy is assumed to

grow at the same rate as the past. The economic growth rates in the past are therefore presumed to continue in the future till 2017 and then decline.

The Indian economy has displayed vigorous growth with strong macroeconomic fundamentals. The Indian economy is now much more integrated with the world economy and has benefited from this integration. During the Tenth Five Year Plan (2002-07), the economy has grown at a rate of over 7 percent against the targeted growth of 8 percent. Infact, GDP growth rates witnessed during the last two years have been over 9.0 percent per annum. Both the services sector and Industry have witnessed a growth of about 10 percent during these two years. The sharp rise in the rate of investment in the economy has sustained the industrial performance and reinforces the outlook for growth. The growth performance of the Indian economy and the states, during the period 2001-02 to 2004-05 and the 11th Plan targets are presented in **Table 7.**

Table 7: Past Performance & 11th Plan Targets: Growth Rate

States	Growth Performance 10th Plan (2001-02 to 2004-05)	Growth Targets 11th Plan (2007-08 to 2011-12)
Andhra Pradesh	6.37	9.50
Arunachal Pradesh	4.63	6.40
Assam	5.37	6.50
Meghalaya	5.86	7.30
Manipur	4.09	5.90
Mizoram	5.28	7.10
Nagaland	10.32	9.30
Sikkim	7.79	6.70
Tripura	8.70	6.90
Bihar	5.67	7.60
Chandigarh	10.74	13.50
Chattisgarh	8.94	8.60
Delhi	8.69	11.20
Goa	8.39	12.10
Gujrat	9.17	11.20
Haryana	7.33	11.00
Himachal Pradesh	6.81	9.50
Jammu & Kashmir	5.25	6.40
Jharkhand	5.64	9.80
Karnataka	6.42	11.20
Kerala	9.29	9.50
Madhya Pradesh	4.01	6.70
Maharashtra	8.20	9.10
Orissa	8.11	8.80
Punjab	4.69	5.90
Rajasthan	5.68	7.40
Tamil Nadu	5.07	8.50
Uttar Pradesh	5.05	6.10
Uttaranchal	11.20	9.90
West Bengal	7.22	9.70
ALL INDIA	**6.45**	**9.00**

Source: Planning Commission

BRIC Report

According to the Goldman Sachs BRIC Report of 2004, India has the potential to grow higher than 5 percent over the next 30 years and close to 5 percent as late as 2050. The revised report (2007), however, agues that India whose trade has been growing 25 percent annually since 2003, will grow at 8 percent a year through 2020, higher than the 5.7 percent predicted earlier, the key underlying assumption being that growth supportive policies, will continue to be implemented.

11th Five Year Plan

The 11th Plan provides an opportunity to restructure policies to achieve a new vision of growth that will be much more broad based and inclusive. The Approach paper to the 11th Five Year Plan emphasizes that "the economy can grow between 8 percent and 9 percent on a sustained basis provided appropriate policies are put in place. With population growing at 1.5 percent per year this would ensure that real income of an average Indian will double in 10 years." In this optimistic scenario the growth rates of the 11th Plan have been assumed to continue even during the 12th Plan period. However, such high growth rates may not be sustainable over the very long run and hence have been assumed to taper for the period, thereafter. The NCR which has witnessed very high growth rate of 7.7 percent in the past is assumed to grow at the same rate as the national economy i.e. 9 percent per annum uptil the 12th Five Year Plan and then decline to 8 percent, thereafter. In the Business as Usual scenario, the NCR is assumed to grow at 7.7 percent per annum uptil the 12th Plan and then decline to 6.7 percent.

Table 8 and 9 present the perspective growth rates for the national and state economies during the periods 2007-08 to 2011-2012; 2012-13 to 2016-17; 2017-2018 to 2021-22 and beyond 2022 until 2030 for the two scenarios, namely, optimistic and Business as Usual.

Table 8: Projected NSDP Growth Rate (State-wise)-Optimistic Scenario

States	Growth Targets 11th Plan (2007-08 to 2011-12)	Growth Targets (2011-12 to 2016-17)	Growth Targets (2016-17 to 2021-22)	Growth Targets (2022-2032)
NCR	9.00	9.00	8.00	8.00
Andhra Pradesh	9.50	9.50	8.50	8.50
Bihar	7.60	7.60	6.60	6.60
Chattisgarh	8.60	8.60	7.60	7.60
Goa	12.10	12.10	11.10	11.10
Gujarat	11.20	11.20	10.20	10.20
Rest of Haryana	11.00	11.00	10.00	10.00
Himachal Pradesh	9.50	9.50	8.50	8.50
Jammu and Kashmir	6.40	6.40	5.40	5.40
Jharkhand	9.80	9.80	8.80	8.80
Karnataka	11.20	11.20	10.20	10.20
Kerala	9.50	9.50	8.50	8.50
Madhya Pradesh	6.70	6.70	5.70	5.70
Maharashtra	9.10	9.10	8.10	8.10
Orissa	8.80	8.80	7.80	7.80
Punjab	5.90	5.90	4.90	4.90
Rest of Rajasthan	7.40	7.40	6.40	6.40
Tamil Nadu	8.50	8.50	7.50	7.50
Rest of Uttar Pradesh	6.10	6.10	5.10	5.10
Uttranchal	9.90	9.90	8.90	8.90
West Bengal	9.70	9.70	8.70	8.70
North Eastern Region	7.01	7.01	6.01	6.01
Rest of India (chandigarh)	13.50	13.50	12.50	12.50
International		0.00		0.00
West of Haryana beyond NCR Boundary	11.00	11.00	10.00	10.00
North East of Uttar Pradesh Beyond NCR Boundary	6.10	6.10	5.10	5.10

Table 9: Projected NSDP Growth Rate (State-wise): Business as Usual Scenario

STATES	Growth Targets 11th Plan (2007-08 to 2011-12)	Growth Targets (2011-12 to 2016-17)	Growth Targets (2016-17 to 2021-22)	Growth Targets (2022-2032)
NCR	7.72	7.72	6.72	6.72
Andhra Pradesh	6.37	6.37	5.37	5.37
Bihar	5.67	5.67	4.67	4.67
Chattisgarh	8.94	8.94	7.94	7.94
Goa	8.39	8.39	7.39	7.39
Gujarat	9.17	9.17	8.17	8.17
Rest of Haryana	7.33	7.33	6.33	6.33
Himachal Pradesh	6.81	6.81	5.81	5.81
Jammu and Kashmir	5.25	5.25	4.25	4.25
Jharkhand	5.64	5.64	4.64	4.64
Karnataka	6.42	6.42	5.42	5.42
Kerala	9.29	9.29	8.29	8.29
Madhya Pradesh	4.01	4.01	3.01	3.01
Maharashtra	8.20	8.20	7.20	7.20
Orissa	8.11	8.11	7.11	7.11
Punjab	4.69	4.69	3.69	3.69
Rest of Rajasthan	5.68	5.68	4.68	4.68
Tamil Nadu	5.07	5.07	4.07	4.07
Rest of Uttar Pradesh	5.05	5.05	4.05	4.05
Uttranchal	11.20	11.20	10.20	10.20
West Bengal	7.22	7.22	6.22	6.22
North Eastern Region	6.51	6.51	5.51	5.51
Rest of India (chandigarh)	10.74	10.74	9.74	9.74
International		0.00		0.00
West of Haryana beyond NCR Boundary	7.33	7.33	6.33	6.33
North East of Uttar Pradesh Beyond NCR Boundary	5.05	5.05	4.05	4.05

Realistic Growth Scenario

In light of the scenarios described above and the prevailing trends of growth in economy and transport demand a more realistic growth scenario based on moderated growth rate of economy **(Table 10**) from the optimistic scenario and a moderation in the transport demand elasticities in the horizon year particularly for two wheelers and cars **(Table 11**) looks more appropriate and hence has been adopted for transport demand forecasting in the horizon years.

Table 10: Projected NSDP Growth Rate (State-wise)-Realistic Scenario

Zone No	STATES	Growth Targets 11th Plan (2007-08 to 2011-12)	Growth Targets (2011-12 to 2016-17)	Growth Targets (2016-17 to 2017-22)	Growth Targets (2022 onwards)
1 to 90	NCR	8.00	7.50	7.00	6.50
91	Andhra Pradesh	8.50	8.00	7.50	7.00
92	Bihar	6.60	6.10	5.60	5.10
93	Chattisgarh	7.60	7.10	6.60	6.10
94	Goa	11.10	10.60	10.10	9.60
95	Gujarat	10.20	9.70	9.20	8.70
96	Rest of Haryana	10.00	9.50	9.00	8.50
97	Himachal Pradesh	8.50	8.00	7.50	7.00

Zone No	STATES	Growth Targets 11th Plan (2007-08 to 2011-12)	Growth Targets (2011-12 to 2016-17)	Growth Targets (2016-17 to 2017-22)	Growth Targets (2022 onwards)
98	Jammu and Kashmir	5.40	4.90	4.40	3.90
99	Jharkhand	8.80	8.30	7.80	7.30
100	Karnataka	10.20	9.70	9.20	8.70
101	Kerala	8.50	8.00	7.50	7.00
102	Madhya Pradesh	5.70	5.20	4.70	4.20
103	Maharashtra	8.10	7.60	7.10	6.60
104	Orissa	7.80	7.30	6.80	6.30
105	Punjab	4.90	4.40	3.90	3.40
106	Rest of Rajasthan	6.40	5.90	5.40	4.90
107	Tamil Nadu	7.50	7.00	6.50	6.00
108	Rest of Uttar Pradesh	5.10	4.60	4.10	3.60
109	Uttranchal	8.90	8.40	7.90	7.40
110	West Bengal	8.70	8.20	7.70	7.20
111	North Eastern Region	6.01	5.51	5.01	4.51
112	Rest of India (chandigarh)	12.50	12.00	11.50	11.00
113	International				
114	West of Haryana beyond NCR Boundary	10.00	9.50	9.00	8.50
115	North East of Uttar Pradesh Beyond NCR Boundary	5.10	4.60	4.10	3.60

Table 11: Transport Demand Elasticities- Realistic Scenario

Vehicle Type	2007-2012	2012 to 2017	2017-2022	2022 onwards
LCV/Trucks	1.10	1.00	1.00	0.90
Bus, Omni Bus	1.10	1.00	1.00	0.90
3 wheeler (Passenger)	1.40	1.20	1.10	1.00
Two Wheelers	1.50	1.30	1.10	1.10
Car, Jeep, Taxi	1.40	1.20	1.00	1.00

3.2.1.3 Traffic Forecast

Vehicular future traffic, for the three categories of traffic movement, namely EI (external to internal- originating outside and terminating within the region), EE (external to external- originating outside NCR and passing through the region) and IE (Internal to external- originating inside the NCR and terminating outside the region) has been estimated for the three scenarios based on the derived zonal growth rates is presented in **Table 12 (a) & 12 (b).**

Table 12 (a): Projected Number of Daily Vehicles (in Optimistic Scenario & BAU Scenario)

Travel Pattern	Vehicle Types/ Year	Optimistic Scenario					Business as usual Scenario				
		2007	2012	2017	2022	2032	2007	2012	2017	2022	2032
EI	Goods										
	LCV	15255	24010	36424	52904	74297	15255	22128	31114	41809	54663
	2/3 Axle	37532	59164	89868	130674	183667	37532	54586	76942	103647	135822
	MAV	5915	9394	14360	21006	29675	5915	8670	12309	16705	22038
	Passenger										
	Bus	13673	21393	30680	41324	57720	13673	19884	28677	38581	50625
	Car	106481	186804	297265	407821	590183	106481	169617	271333	373954	502621
	Auto	4292	7615	11789	16422	24025	4292	6820	10688	14957	20045
	2 Wheeler	32623	59269	97449	137508	206177	32623	53228	87885	124456	170953
IE	Goods										
	LCV	17431	27501	41808	60844	85587	17431	25393	35849	48375	63497
	2/3 Axle	35518	55752	84347	122139	171018	35518	51493	72370	97204	127049
	MAV	5454	8588	13024	18899	26503	5454	7938	11197	15096	19799
	Passenger										

Travel Pattern	Vehicle Types/ Year	Optimistic Scenario					Business as usual Scenario				
		2007	2012	2017	2022	2032	2007	2012	2017	2022	2032
	Bus	13499	21154	30393	41032	57454	13499	19666	28413	38310	50388
	Car	108644	190086	301580	412498	595163	108644	172605	275320	378347	507166
	Auto	2824	5131	8110	11511	17118	2824	4532	7264	10370	13988
	2 Wheeler	28554	52202	86363	122558	184724	28554	46737	77651	110596	152317
EE	Goods										
	LCV	1877	2917	4389	6343	8890	1877	2670	3702	4919	6387
	2/3 Axle	6826	10747	16381	24007	34110	6826	9755	13577	18117	23611
	MAV	2011	3224	4991	7417	10660	2011	2889	4036	5402	7054
	Passenger										
	Bus	1499	2326	3325	4483	6293	1499	2142	3077	4137	5387
	Car	5703	9709	15143	20558	29642	5703	8763	13708	18661	24719
	Auto	87	149	226	311	454	87	130	199	275	356
	2 Wheeler	345	632	1060	1538	2382	345	562	943	1368	1907

Table 12 (b): Projected Number of Daily Vehicles (in Realistic)

Travel Pattern	Vehicle Types/ Year	Realistic Scenario				
		2007	2012	2017	2022	2032
EI	Goods					
	LCV	**15255**	**22828**	**32308**	**44792**	**59042**
	2/3 Axle	**37532**	**56253**	**79715**	**110641**	**145962**
	MAV	**5915**	**8932**	**12739**	**17789**	**23589**
	Passenger					
	Bus	13673	20338	28618	39440	51699
	Car	106481	175410	263382	362751	489196
	Auto	4292	7151	10860	15607	21291
	2 Wheeler	32623	55430	85836	121851	169136
IE	Goods					
	LCV	**17431**	**26149**	**37086**	**51518**	**68019**
	2/3 Axle	**35518**	**53007**	**74810**	**103400**	**135883**
	MAV	**5454**	**8165**	**11552**	**16000**	**21060**
	Passenger					
	Bus	13499	20112	28352	39162	51464
	Car	108644	178486	267250	367090	493567
	Auto	2824	4821	7474	10942	15176
	2 Wheeler	28554	48825	76049	108516	151427
EE	Goods					
	LCV	**1877**	**2773**	**3893**	**5370**	**7065**
	2/3 Axle	**6826**	**10218**	**14532**	**20333**	**27125**
	MAV	**2011**	**3066**	**4429**	**6285**	**8482**
	Passenger					
	Bus	1499	2211	3101	4279	5637
	Car	5703	9113	13429	18310	24578
	Auto	87	140	208	295	402
	2 Wheeler	345	591	933	1357	1945

Projections of total daily trips, mode-wise & tonnage carried for the three categories of movement has been estimated based on average occupancy and load carried. **Table 13** presents the projected daily passenger trips & tonnage carried for three categories of traffic movement, namely EI, IE and EE.

Table 13 Projected Number of Daily Persons Trips/ Tonnage carried (in Optimistic and BAU Scenario)

Travel Pattern	Vehicle Types/ Year	Optimistic Scenario					Business as usual Scenario				
		2007	2012	2017	2022	2032	2007	2012	2017	2022	2032
EI	Tonnage										
	LCV	67122	105643	160265	232779	326907	67122	97364	136902	183958	240517
	2/3 Axle	349048	550226	835769	1215265	1708107	349048	507654	715561	963919	1263140
	MAV	69206	109904	168009	245771	347200	69206	101438	144020	195445	257850
	Persons Trips										
	Bus	552919	865119	1240686	1671127	2334207	552919	804097	1159689	1560199	2047267
	Car	343934	603378	960167	1317261	1906290	343934	547862	876406	1207873	1623467
	Auto	15237	27032	41852	58297	85289	15237	24211	37941	53098	71158
	2 Wheeler	54806	99572	163714	231014	346377	54806	89424	147646	209086	287201
IE	Tonnage										
	LCV	76696	121007	183955	267712	376581	76696	111727	157735	212848	279386
	2/3 Axle	330317	518497	784423	1135892	1590468	330317	478883	673040	903999	1181555
	MAV	63812	100475	152379	221115	310088	63812	92874	131006	176622	231650
	Persons Trips										
	Bus	545914	855462	1229092	1659329	2323444	545914	795310	1149010	1549267	2037683
	Car	350919	613978	974103	1332367	1922375	350919	557514	889282	1222062	1638147
	Auto	10026	18217	28791	40864	60770	10026	16088	25789	36813	49658
	2 Wheeler	47971	87700	145090	205897	310337	47971	78518	130453	185802	255892
EE	Tonnage										
	LCV	8259	12836	19314	27909	39117	8259	11750	16287	21644	28104
	2/3 Axle	63482	99948	152343	223262	317226	63482	90719	126263	168493	219580
	MAV	23529	37726	58390	86780	124725	23529	33796	47218	63201	82527
	Persons Trips										
	Bus	60635	94061	134453	181311	254481	60635	86641	124426	167286	217841
	Car	18420	31359	48911	66403	95743	18420	28306	44278	60274	79844
	Auto	308	528	801	1103	1611	308	462	707	977	1266
	2 Wheeler	579	1061	1781	2584	4002	579	944	1584	2298	3203

Table 14 shows the projected daily trips and tonnage carried in the Realistic Scenario.

Table 14: Projected Number of Daily Person Trips/Tonnages carried

Travel Pattern	Vehicle Types/Year	Realistic Scenario				
		2007	2012	2017	2022	2032
EI	Tonnage					
	LCV	67122	100444	142155	197086	259785
	2/3 Axle	349048	523152	741350	1028959	1357446
	MAV	69206	104504	149051	208135	275991
	Persons Trips					
	Bus	552919	822488	1157330	1594935	2090711
	Car	343934	566576	850723	1171687	1580102
	Auto	15237	25387	38554	55406	75582
	2 Wheeler	54806	93122	144205	204710	284149
IE	Tonnage					
	LCV	76696	115053	163176	226677	299284
	2/3 Axle	330317	492963	695734	961617	1263713
	MAV	63812	95530	135158	187203	246400
	Persons Trips					
	Bus	545914	813321	1146548	1583712	2081197
	Car	350919	576508	863217	1185701	1594220
	Auto	10026	17113	26531	38845	53876
	2 Wheeler	47971	82025	127762	182307	254397

Travel Pattern	Vehicle Types/Year	Realistic Scenario				
		2007	2012	2017	2022	2032
EE	Tonnage					
	LCV	8259	12203	17128	23627	31084
	2/3 Axle	63482	95031	135150	189097	252258
	MAV	23529	35877	51819	73534	99236
	Persons Trips					
	Bus	60635	89420	125417	173049	227967
	Car	18420	29436	43375	59141	79387
	Auto	308	495	737	1049	1427
	2 Wheeler	579	993	1567	2280	3267

3.3 Horizon Year Total Trip Ends

3.3.1 Passenger Travel Forecast

The Passenger Trip Production forecast for horizon years is shown in **Table 15.**

Table 15: Daily Passenger Trip Production Forecast

Persons Trips-Production	D1	D2	D3	D4	D5
Internal-Internal	15442963	13233737	14878392	13212689	10008523
External (IE,EI,EE)-Realistic Scenario	8326282	8326282	8326282	8326282	8326282
All	**23769245**	**21560019**	**23204674**	**21538971**	**18334805**

3.3.2 Goods Traffic Forecast

The goods traffic forecast on terms of tonnage and vehicle trips is shown in **Table 16**.

Table 16: Daily Goods Traffic Forecast

Tonnage Production	D1	D2	D3	D4	D5
Tonnage Trips					
Internal	2485313	2378699	2051018	2519258	1789571
External	4085197	4085197	4085197	4085197	4085197
All	**6570510**	**6463896**	**6136215**	**6604455**	**5874768**
PCU Trips					
Internal	873248.5	835788	720653	885175	628789
External	1435389	1435389	1435389	1435389	1435389
All	**2308638**	**2271177**	**2156042**	**2320565**	**2064179**

4. Horizon Year OD Matrices

The future year trip ends obtained in trip generation module were distributed by applying the calibrated gravity distribution model using the composite skims. Friction factors for given impedance are assumed not to change for horizon years. Composite skims, for the initial run, which was generated from the modal choice module, was based on free flow skims. The composite skims used in gravity distribution model and mode choice models were revised using the ones obtained by assigning the public transport trips and highway trips on to their respective networks. Later as a result, the free flow skims were replaced by the ‘congested’ and ‘perceived’ skims of the ‘stabalised’ model obtained after subsequent iterations. Goods O-D matrix and mode-wise external trips were forecasted using zonal growth factors.

5. Horizon Year Mode Choice Model

Modal Split for the horizon year for internal–internal movement as per Nested Logit under different scenarios is presented in **Table 17.**

Using the calibrated mode choice model , the O-D matrix of daily person trips thus obtained for the future year under consideration was split into five O-D matrices - viz.

- *bus matrix of daily passenger trips*
- *rail matrix of daily passenger trips*
- *metro matrix of daily passenger trips* and
- *two-wheeler matrix of daily passenger trips*
- *car matrix of daily passenger trips*

For the horizon year the auto percentage share is assumed to remain static at 5% of the internal trip. Modal Split for the horizon year for internal–internal movement as per Nested Logit under different scenarios and Elasticity Model is presented in **Table 18.**

Table 17: Internal Daily Trips Forecast as per Mode Choice Model (2032)

Scenario	ID	Bus		Commuter Rail		Metro		Auto		Car		Two Wheeler	
			%		%		%		%		%		%
Do-Nothing	D1N1	11,249,347	72.8	734,183	4.8	-	0.0	772,148	5.0	1,986,480	12.9	700,805	4.5
Regional Plan 2021	D2N2	5,630,173	42.5	2,004,313	15.1	804,282	6.1	661,687	5.0	2,458,647	18.6	1,674,635	12.7
Integrated Multi Modal Transport System	D2N5	6,177,032	46.7	1,696,202	12.8	1,205,699	9.1	661,687	5.0	2,216,552	16.7	1,276,565	9.6
Road Extensive	D4N3	7,086,007	53.6	1,189,989	9.0	-	0.0	660,634	5.0	2,577,472	19.5	1,698,587	12.9
Rail Extensive	D5N4	4,458,823	44.6	1,549,751	15.5	946,119	9.5	500,426	5.0	1,536,647	15.4	1,016,758	10.2
Integrated Multi Modal Transport System	D5N5	4,529,312	45.3	1,544,677	15.4	917,331	9.2	500,426	5.0	1,545,511	15.4	971,266	9.7

Table 18: Total Daily Trips Forecast as per Mode Choice Model and Elasticity Model (2032)

Scenario	ID	Bus		Commuter Rail		Metro		Auto		Car		Two Wheeler	
			%		%		%		%		%		%
Do-Nothing	D1N1	15,421,255	65.7	734,183	3.1	-	0.0	901,606	3.8	5,160,802	22.0	1,239,351	5.3
Regional Plan 2021	D2N2	9,802,081	46.1	2,004,313	9.4	804,282	3.8	791,145	3.7	5,632,969	26.5	2,213,181	10.4
Integrated Multi Modal Transport System	D2N5	10,348,940	48.7	1,696,202	8.0	1,205,699	5.7	791,145	3.7	5,390,874	25.4	1,815,111	8.5
Road Extensive	D4N3	11,257,915	53.0	1,188,631	5.6	-	0.0	790,092	3.7	5,751,794	27.1	2,237,133	10.5
Rail Extensive	D5N4	8,630,731	47.9	1,549,751	8.6	946,119	5.2	629,884	3.5	4,710,969	26.1	1,555,304	8.6
Integrated Multi Modal Transport System	D5N5	8,701,220	48.3	1,544,677	8.6	917,331	5.1	629,884	3.5	4,719,833	26.2	1,509,812	8.4

Note: 1) above figures do not include EE trips
2) Does not include long distance passenger trips by Rail

6. Horizon Year Traffic Assignment

6.1 Public Transport Assignment

The daily O-D matrix of public transport passenger trips was assigned on to the public transport network. The validated public transport assignment model of base year when employed on future network provided the proportion of public transport trips on to bus, commuter rail and metro. The public transport network consists of all the road links coded with appropriate characteristics like length, speed, etc., regional rail links on which the trains move and the links of metro network for the scenario considered. The bus routes were defined by specifying the links on which these routes traverse. The regional rail routes and metro routes were defined by specifying the links on which they run. The characteristics of these routes were coded accordingly. The public transport assignment was done based on generalised time approach. For initial assignment (first iteration) the network with free flow speeds was used. The bus passenger link loadings obtained after public transport assignment were transferred on to the road network as peak hour PCU flows by employing appropriate passenger-

PCU conversion factors and peak flow to daily flow ratios applicable to bus flows. Auto trips were assigned on highway network.

6.2 Assignment of Private Trips

The daily truck matrix was also converted into peak hour PCU matrix. On similar lines the daily matrices of car and two-wheeler person trips were converted into peak hour, O-D matrices in passenger car units (PCU) by applying peak hour to daily flow ratios and passenger to PCU conversion factors. First the network was pre-loaded with the goods PCU flows and bus PCU flows. The car, two-wheeler and auto PCU peak hour PCU matrix were then loaded using incremental capacity restraint assignment

6.3 Public Transport and Private Traffic Assignment Iterations

The public transport network was revised with the speeds obtained after assigning the private trips. The assignment of public transport trips was performed on this revised network and the next iteration of private traffic assignment was carried out by taking the bus, auto-rickshaw and truck flows as preloads. This iterative process between PT and private traffic assignment was carried out until there was no appreciable change in the link loadings and link costs. The public transport and road time/cost skims were worked out based on these final link costs.

These cost/time skims were used to update the matrices by applying gravity distribution and mode choice models. The whole process is then repeated till stable link costs are achieved. At this stage the loadings on bus, auto, commuter rail and metro links are taken as final.

Annexure 14.1

Geometric Design Standards for Road Network Development

The following geometric design standards for various categories of roads such as regional expressways, regional arterials (which include NHs), regional sub-arterials (which include SHs), regional collector roads (which include MDRs) and regional access roads (which normally comprise ODR & Village Roads) are covered in the following paras:

Geometric Design Standards for Expressways

An expressway may be defined as an arterial highway for motor traffic with full control of access and therefore the intersections are provided with grade separation. The guidelines on geometric design standards for expressways are under preparation by Indian Roads Congress (IRC) and hence these proposed design standards for expressways will be reviewed & modified as and when available for design of expressway in NCR.

i) **Design Speed** = 100 – 120 km/h, where 100 km/h is the minimum design speed whereas 120 km/h is the ruling design speed. The minimum section length for design speed should not be less than 5 km.

ii) **Terrain Classification:**

a) Plain Terrain – The cross slope of the country = 0 to 10%

b) Rolling Terrain – The cross slope of the country = 10 to 25%

iii) **Cross-section elements:**

a) Right of Way = 90m – 100 m

b) Overall width between the building lines in open areas = 130m

c) Overall width between control lines in open areas = 200m

d) Setback distance between building line and road boundary (ROW) in built-up areas = 6m

e) Lane width: The width of the lane for expressway shall be 3.75m for Plain & Rolling Terrain and hence 2-lane dual carriageway = 7.5m with provision for widening to 11m, and 3-lane dual carriageway = 11.0 m with provision for widening to 14.5 m

f) Shoulder Width: The roadway will have an outer shoulder width of 3.0m and inner shoulder width of 0.7m. The outer shoulder width will comprise 2.5m of paved shoulder and 0.5m of edge strip. The inner shoulder will be an edge strip only. A minimum median width excluding edge strip will be 4.5m and with a concrete safety barrier

g) Cross slope: The cross slope for the carriageway and paved shoulders in case of flexible pavement will be 2.5% (2% for carriageway in case of concrete pavements) and it is 3% for earthen shoulders (verge)

h) Stopping Sight Distance (SSD): The minimum Stopping Sight Distance for design speed of 120 km/h is 250m.

iv) **Horizontal Alignment:** The minimum radius of the curve will be calculated by following equation:

$R = V^2 / (127 * (e_{max} + f_{max}))$

Where, R = Minimum radius of curve (m)

V = Design speed (120 km/hr)

e_{max} = Maximum superelevation (0.06)

f_{max} = Maximum side friction factor (0.100 recommended in MOST Guideline)

From the given conditions, the minimum radius of curve for 120 km/hr design speed is to be 710m

A maximum super-elevation of 6.0% will be adopted in accordance with MOST Guidelines. This value is considered reasonable since the vehicle types likely to dominate on the expressways are trucks and multi-axle vehicles, and the operational speed will be expected to fall well below the design speed in a high volume operation.

v) **Vertical Alignment:** The normal maximum grade for 120 km/hr design speed in plain terrain should be 2% as per MOST Guidelines. The minimum grade for drainage should be 0.3% as per MOST Guidelines. For cut sections, the minimum gradient for drainage may be kept 0.5% for lined side drains and 1% for un-lined side drains. To minimize the cost of construction for structures, the absolute maximum grade and length are recommended to be 3.0% and 500m respectively for shortening the length of stretches for grade separation / structure approaches. The vertical curves will be designed as square parabolas and minimum length of vertical curves for different speeds is presented in **Table 1.**

Geometric Design Standards for Interchange Ramps

(i) Design Speed of Ramps

There are two types of interchanging facilities; the junction (JCT) for joining an expressway to another expressway, and the interchange (IC) with a function of joining an expressway to at-grade arterial roads. The type of ramps applicable to junctions and interchanges are as follows:

-Junction :Direct connector, Semi-direct connector including outer connector

-Interchange : Semi-direct connector including outer connector and loop

The design speed of the above ramps when the design speed of the throughway is 120 km/hr will be as follows in accordance with MOST Guidelines:

Direct Connector	:	80 km/h
Semi-direct Connector	:	60 km/h
Loop	:	50 km/h

However, these values will be adopted only for the ramps from/to the expressway lanes, and the interchange ramps from/to the at-grade arterial roads are to be as follows in accordance with IRC: 92-1985 Guidelines for the Design of Interchanges in Urban Areas:

Semi-direct Connector	:	40 km/h
Loop	:	30 km/h

(ii) Cross Section Elements

The lane configuration will be in two cases, which are a) one lane – one way operation with no provision for passing a stalled vehicle on the lane, and b) two lane – two way operation. The lane width for these cases will be as follows:

a) one lane – one way operation: 4.50 m for one lane
b) two lane – two way operation: 7.75 m for two lanes

A 2.0m wide outer shoulder and a 0.7m wide inner shoulder will be adopted. The outer shoulder will consist of a 0.5m wide edge strip and a 1.5m wide paved shoulder. The inner shoulder will be an edge strip only. These values will satisfy the requirement (0.6 to 1.2m) in MOST Guidelines. The edge strip is the same width as the throughway.

Since there are no rules mentioned for median width on rampways in MOST Guidelines, a 1.0m wide median with kerbstones is recommended for the following reasons:

- It can substitute for concrete barriers
- The stretch is relatively short where this median is provided
- This is a typical ramp median width by international standards

(iii) Horizontal Alignment

The minimum radius of curves for each design speed of ramps is as follows:

R = 280m for 80 km/h (f = 0.125)
R = 150m for 60 km/h (f = 0.140)
R = 100m for 50 km/h (f = 0.150)
R = 60m for 40 km/h (f = 0.150)
R = 30m for 30 km/h (f = 0.150)

The maximum superelevation is to be 6.0% as same as in the throughway design standard. Since the relations between superelevation and radius of curves are not presented in MOST Guidelines, the relation between e : superelevation and R : radius of curvature for each design speed is derived from MOST Guidelines (AASHTO). The values for the design speed of 40 km/hr or less will be based on MOST Guidelines.

(iv) Vertical Alignment

The maximum grade for direct connections and semi-direct connections at a junction applies to the throughway standard, the absolute minimum value is recommended to be 3.0%. The maximum grade for semi-direct connections and loops at an interchange is recommended to be 4.0% considering the situation that the ramps will carry a number of heavy commercial vehicles.

The recommended summary on Geometric Design Standards for Expressways is presented in Table 1 below:

Table 1: Recommended Geometric Design Standards for Expressway

Design Elements		Unit	Throughway	Rampway		
				Direct connection	Semi-direct connection	Loop
Terrain			Plain	Plain	Plain	Plain
Design Speed		km/h	120	80	60	50
Cross – Section	Right of Way	m	100	Nil	Nil	Nil
	Road Width (both sides fill)	m	37.4	-	-	-
	No. of Carriageway and Lane	No.	2 * 3 (2)	3 (2)	1 (2)	1 (2)
	Carriageway Width	m	3.75	3.75	4.45 (7.75)	4.45 (7.75)
	Outer Edge Strip	m	0.5	0.5	0.5	0.5
	Inner Edge Strip	m	0.7	0.7	0.7	0.7
	Outer Paved Shoulder Width	m	2.5	2.5	1.5	1.5
	Inner Paved Shoulder Width	m	Nil	Nil	Nil	Nil
	Median Width	m	12.0 (4.5)	Nil	Nil	Nil
	Outer Verge (Earth Shoulder)		1.5	1.5	1.5	1.5
	Crossfall					
	Carriageway	%	2.5	2.5	2.5	2.5
	Outer Shoulder Paved	%	2.5	2.5	2.5	2.5
	Outer Shoulder Earthen (Min.)	%	3.0	3.0	3.0	3.0
	Inner Shoulder Paved	%	2.5	2.5	2.5	2.5
Sight Distance	Stopping Sight Distance	m	250	115	80	60
	Passing Sight Distance	m	Nil	Nil	Nil	Nil
Horizontal Alignment	Max. Superelevation	%	6.0	6.0	6.0	6.0
	Max. Rate of Superelevation Run-off	-	1 / 263	1 / 196	1 / 166	1 / 142
	Min. Radii of Horizontal Curve	m	710	280	150	100
	Min. Length of Curve	m	240	160 (160)	110 (110)	90 (100)
	Min. Radii without Superelevation	m	7,000	3,500	2,000	1,300
	Min. Transition Length	m	120	80 (80)	55 (55)	45 (50)
	Min. Radii Without Transition Curve	m	4,000	2,000	1,000	700
	Extra Width at Min. Radii	m	Nil	Nil	Nil (0.50)	Nil (0.75)
Vertical Alignment	Max. Grade	%	2.0	2.0	4.0	4.0
	Absolute Max. Grade	%	3.0	3.0	Nil	Nil
	Max. Length with Limiting Grade	m	500	500	Nil	Nil
	Min. Gradient	%	0.3	0.3	0.3	0.3
	Summit Vertical Curve Length	m	L>S : L=NS^2 / 404, L<S : L=2S – 404 / N			
	Valley Vertical Curve Length	m	L>S : L=NS^2 / (120 + 3.5S), L<S : L=2S – (120+3.5S) / N			
	Min. Vertical Curve Length	m	100	70	50	40

Notes : 1. The values in brackets indicate for initial stage in phase construction

2. The values in bracket are for substantially large traffic volume

Design Standards for National Highways, State Highways, Major District Roads and Other District Roads

Design Speeds for Various Classes of Roads (km/h)

Sl. No.	Road Class	Plain Terrain		Rolling Terrain	
		Ruling	Minimum	Ruling	Minimum
1	NHs & SHs	100	80	80	65
2	MDRs	80	65	65	50
3	ODRs	65	50	50	40

Right-of-Way Width for Different Classes of Roads in India

Sl No.	Class of Road	Right-of-Way Width (m)			
		Plain and Rolling Terrain			
		Rural Areas		Urban Areas	
		Normal	Range	Normal	Range
1.	National and State Highways	45	30-60	30	30-60
2.	Major District Roads	25	25-30	20	15-25
3.	Other District Roads	15	15-25	15	12-20

Standards for Building Lines and Control Lines in India

Sl. No.	Class of Road	Plain and Rolling Terrain		
		Rural Areas		Urban and Industrial Areas
		Width between building lines (m)	Width between control lines (m)	Distance between building line and road boundary (m)
1.	National and State Highways	80	150	3-6
2.	Major District Roads	50	100	3-5
3.	Other District Roads	25-30*	35	3-5

*****If the land width is equal to the width between building lines indicated in this column, the building lines shall be set 2.5m from the road land boundary lines.

Design Speed & Space Standards for Urban Roads / Stretches

Sl. No.	Category of Road	Design Speed (km/h)	Minimum Space in m
1.	Expressway (6 lane divided)	100	60
2.	Arterial Street (4 lane divided with cycle tracks)	80	50-60
3.	Sub-arterial Street (4 land divided)	60	30-40
4.	Collector Street	50	20-30

Standards for Roadway Width

Sl. No.	Highway Classification	Width of Roadway (in m)
		Plain and Rolling
1.	National and State Highways: (a) Single Lane (b) Two Lane	 12.0 12.0
2.	Major District Roads: (Single Lane or Two Lane)	 9.0
3.	Other District Roads: (a) Single lane (b) Double lane	 7.5 9.0

Roadway Width at Cross Drainage Structures

(A) For Culverts (upto 6m span). For Plain & Rolling Terrain, overall width (outside to outside of parapet walls) will be same as Normal Roadway Width given above.

(B) For Bridges (Greater than 6m span). The Clear Roadway Width between the kerbs is as below:

- Single lane Bridge - 4.25m
- Two lane Bridge - 7.50m
- Multi-level Bridge - 3.5m per lane plus 0.5m for each carriageway

e.g.
For 4-lane Divided Bridge - 14.0m + 2 x 0.5 = 15.0m

Carriageway Width

The single lane pavements in India are generally 3.75 m wide, whereas two lane pavements without raised kerb are 7.0 m wide while with raised kerbs in urban areas, the width is 7.5m. An intermediate width of 5.5 m is generally adopted for less important two lane roads. For multiple lane pavements, the width of each additional lane is taken as 3.50m.

Median Width (Central Reserve)

A central reserve or a median in longitudinal space separating two carriageways is generally taken from 3.0 to 5.0m (5m is desirable but in constrained conditions, it can be 3.0m). For urban situations, a median width of 5.0m is desirable but a minimum width of 1.2 m is accepted under constrained conditions.

Shoulders

A shoulder width of 2.5 m for two lane roads for rural highways is recommended.

The Shoulder width for each class of Road can be taken as one half of difference between Roadway Width and Carriageway Width

Kerbs

Kerbs are either classified "barrier type or mountable type". The face of the kerb may be vertical or sloping and height ranges from 15 to 25 cm. A small height of 15cm is adopted for refuge islands while larger height of 22.5 cm is adopted for bridges

Camber (Cross Slopes)

The Cross Slope of carriageway as per IRC is as follows:

(a) High type bituminous surfacing or cement concrete pavement = 1.7 – 2.0 percent

(b) Thin Bituminous surfacing = 2.0 – 2.5 percent

Generally, the Cross Slope of the hard shoulder is kept 0.5 percent steeper than the carriageway and the slope of the soft shoulder is kept 1.0 percent steeper than the cross slope of hard shoulder.

Side Slope of the Embankment

The Flatter Slopes are generally preferred as they are conducive for erosion control. Generally, a side slope of 1.5:1.0 to 2:1 in uninundated conditions and 2:1 to 3:1 in inundated conditions can be provided.

Lateral and Vertical Clearances

Type of Roads	Minimum Lateral Clearances
A. Rural Highways	
1. Single Carriageway	
(i) National and State Highways	Normal 2.5m, Exceptional 2.0 m
(ii) Major District Roads and Other District Roads	Normal 2.0 m, Exceptional 1.5 m
2. Divided carriageway	
(i) Left hand clearance	As in 1 above
(ii) Right hand side clearance	2.0 m desirable, 1.5m minimum
B. Urban Highways	
(i) Single carriageway	a) 0.25m for lower category & 0.5 m for higher category of Roads for kerb shyness b) When no footpath, then in addition, lateral clearance of 0.5m for lower category & 1.0m for higher category to be provided.
(ii) Divided carriageway	a) Same Kerb Shyness as for (i) a) above b) Right hand clearance in addition to Kerb Shyness, 0.5m for lower category & 1.0 m for higher category to be provided.

The Minimum Vertical Clearances are recommended as below:

(a)	For Pedestrian Underpass or Box Culvert	=	3.0 m
(b)	For Vehicular Underpass or Box Culvert	=	5.0 m
(c)	For Urban Areas - Flyovers	=	5.5 m
(d)	For Railway Over Bridge (ROB)	=	7.5 m

Sight Distance ♣

Driver should have enough visibility from a distance to react to different situations to avoid Unwarranted Accidents. It is recommended that the driver should have enough distance to enable him to overtake another vehicle safely on a 2-lane road and enough distance at any point on any road to stop it safely whenever and wherever required. The Safe Stopping Sight Distance (SSD), Intermediate Sight Distance (ISD) and Overtaking Sight Distance (ODS) for varying speeds are as follows:

Speed (V) (km/h)	**Safe SSD (m)**	**ISD (m)**	**OSD (m)**
40	45	90	165
50	60	120	235
65	90	180	340
80	120	240	470
100	180	360	640

Horizontal Alignment

To negotiate changes in direction of alignment, horizontal curves are introduced:

Radius of Horizontal Curve $R = V^2 / (127 * (e_{max} + f_{max}))$

Where V = Vehicle Speed in km/h

e = Superdirection ratio

f = Coefficient of side friction between vehicle tyre & pavement (taken as 0.15)

R = Radius in metres

♣ The criteria for Sight Distance measurement is as follows:

1.Safe Stopping Sight Distance (SSD) – Driver Eye Height = 1.2m; Object Height = 0.15m

2.Intermediate Sight Distance (ISD) - Driver Eye Height = 1.2m; Object Height = 1.2 m

3.Overtaking Sight Distance (ODS) - Driver Eye Height = 1.2m ; Object Height = 1.2m

Minimum Radii of Horizontal Curves for Plain & Rolling Terrain is as follows:

Sl. No.	Road Type	Plain Terrain		Rolling Terrain	
		Ruling (Minimum)	Absolute (Minimum)	Ruling (Minimum)	Absolute (Minimum)
1	NHs & SHs	360	230	230	155
2	MDRs	230	155	155	90
3	ODRs	155	90	90	60

Widening of Carriageway on Curves

Radius (m)	Upto 20	21 to 40	41 to 60	61 to 100	101 to 300	Above 300
Extra width(m)						
(i) Two Lane	1.5	1.5	1.2	0.9	0.6	Nil
(ii) Single Lane	0.9	0.6	0.6	Nil	Nil	Nil

Vertical Alignment

To negotiate changes in elevation in alignment, vertical curves and Gradients are introduced:

Minimum Length of Vertical Curves:

Design Speed (km/h)	Maximum Grade Change (%) not requiring Vertical Curve	Minimum Length of Vertical Curve (m)
Upto 35	1.5	15
40	1.2	20
50	1.0	30
65	0.8	40
80	0.6	50
100	0.5	60

Plain & Rolling Terrain	Ruling Gradient	Limiting Gradient	Exceptional Gradient
	3.3% (1 in 30	5% (1 in 20)	6.7% (1 in 15)

Minimum Gradient for Drainage: To drain off storm water on kerbed roads:

- Desirable Gradient (Min) = 0.5% (if lined side drains)
- Desirable Gradient (Min) = 1.0% (if unlined side drains)

Control of Access

The minimum spacing between points for different categories of roads is as follows:

Type of Street	Suggested minimum spacing
Expressways	1000 metres
Regional Arterial Roads	500 metres
Regional Sub-arterial Roads	300 metres
Regional Collector Roads	150 metres
Sub-Regional Access Roads	Free Access

Bridge Design Standards

The following design guidelines and design standards as practiced in India will be adopted for design of relevant structures:

A.	Design Method	:	IS:456-1987 Code of Practice for Plain and Reinforced Concrete
B.	Material Strength		
B-1	Concrete Structure	:	IRC:21-1987 Standard Specifications and Code of Practice for Road Bridges, Section III-Cement Concrete (Plain and Reinforced) (Second Revision)
B-2	Pre-stressed Concrete	:	IRC:18-1985 Design Criteria for Prestressed Concrete Road Bridges (Post-tensioned Concrete) (Second Revision)
C.	Live Load	:	IRC:6-1966 Standard Specifications & Code of Practice for Road Bridges, Section II – Loads and Stresses (Third Revision)
D.	Horizontal Seismic Force	:	IRC:6-1966
E.	Reference Standards	:	AASHTO Standards and Specifications

Category & Size-wise Classification of Bus Terminals w.r.t. City Size

		10	11	12	13	14		
		DS 1	DS 2	DS 3	DS 4	DS 5	Category as per details at Annexure ---	Area Code
Regional Centre	Neemrana	8925.0551	100589	71803	91736	11197	C1	S4
	Shahjahanpur	18242.159	207098	147832	188871	23052	C2	S3
	Kundli	32606.53	76559	54650	63622	55116	B	S3
	Bawal	22800.795	61278	43742	55885	32244	C2	S3
	Daruhera	78499.912	95329	68048	86939	50160	B	S3
	Behror	62434.811	545199	389176	497216	60685	B	S3
	Manesar	256706.4	322986	230555	109656	232522	A	S2
	Sohna	103696.48	125679	89713	114618	73202	B	S3
	Khairthal	87389.694	81465	58152	74295	84977	B	S3
	Samalkha	100040.43	121248	86550	110577	79298	B	S3
	Khekada	43775.623	56849	40580	51846	107094	A	S2
	Baghpat	64297.056	135348	96614	123436	96604	B	S3
	Siana	51868.483	82157	58646	74927	103547	A	S2
	Jhajjar	83911.756	101700	72596	92750	103555	A	S2
	Hodal	99052.096	120050	85695	109484	101715	A	S2
	Guloathi	53419.763	81601	58249	74419	113912	A	S2
Sub Regional Centre	Sardhana	51827.104	64112	45765	58470	128279	A	S2
	Bhiwadi	378062.96	878574	627147	801251	89947	B	S3
	Jahangirabad	73509.136	121186	86506	110521	136457	A	S2
	Gohana	125243.87	151794	108354	138435	128858	A	S2
	Sikandrabad	75800.423	98296	70166	89645	185505	A	S2
	Pilkhuwa	92982.631	129687	92574	118274	177646	A	S2
	Dadri	177095.23	298395	213001	272133	152446	A	S2
	Mawana	96802.769	157661	112542	143785	183710	A	S2
	Barut	107290.05	318832	227590	290772	227565	A	S2
	Muradnagar	199309.25	335824	239719	527996	241764	A	S2
	Rewari	121320.78	508049	362657	463336	267328	A	S2
	Khurja	116148.75	213767	152592	194953	261821	A	S2
	Modinagar	120774.35	145967	104195	133121	300607	A	S2
	Behta Hajippur	202262.32	340800	243271	310806	250372	A	S2
	Palwal	389990.53	770348	549893	702550	267429	A	S2
	Bahadurgarh	1307084.1	425177	303502	939378	306091	A	S2
	Ballabgarh	239613.83	499204	356344	1334804	359384	A	S2
	Bulandshahr	266538.02	382455	273005	348795	468429	A	S2
	Loni	2704193.4	542283	387095	861195	390397	A	S2
	Gurgaon	856677.08	3935250	2809076	1629324	2833039	A+	S1
	Hapur	367037	410891	293304	374729	562840	A	S2
	Sonipat	669966.67	1928533	1376633	1602650	1388376	A+	S1
Regonal Centre	Alwar	524486.5	530030	378348	483382	706800	A	S2
	Panipat	575880.46	1068661	762836	974609	713958	A	S2
	Rohtak	572827.68	800363	571319	729924	782136	A	S2
	Greater Noida	3201357.4	2968465	2118962	2707212	531023	A	S2
	NOIDA	1623775.2	2353359	1679884	2172180	1694214	A+	S1
Metro Centre	Meerut	1320564.5	3021592	2156886	2755663	2837715	A+	S1
	Gaziabad	3830364.2	4341383	3098984	6894513	3125419	A+	S1
	Faridabad	4141746.6	2811984	2007262	7518857	2024385	A+	S1
		25698200	32868057	23462012.58	37603536.59	23052819		

**Note

Area Code	Proposed Area for FY 2032 (Acre)
S1	15
S2	10 - 15
S3	5 - 10
S4	2 - 5

City Size	Pop.	Category	Proposed Area for FY 2032 (Acre)	No. of Cities
Metropolitan	>1000000	A+	15	6
Class I & Major City Centres	100000	A	10 - 15	29
Class II	50000 - 99999	B	5-10	8
Class III	20000 - 49999	C2	5	2
Class IV	10000 - 19999	C1	3	1
Class V	5000 - 9999	D	2	0

Annexure 14.3

Details of Projects in Hand

Railways, in their normal development plans, have taken up a number of programmes for augmentation of capacities along the different corridors which also forms the part of proposals in the Regional Plan-2021. These programmes help in provision of intra-regional commuter rail services. But norms of planning process of IR may not suffice and meet the aspirations of NCR population. Issues of additional funding and minimum level of services need to be sorted out for accelerated pace of infrastructure creation.

To tackle capacity problems, a large number of works have either been sanctioned, or are under execution by Indian Railways. These relate to enhancement of line capacity & terminal capacity, signaling up-gradation and electrification in NCR. Planning process in the railways has necessarily to take care of needs of long, medium and short distance keeping financial justification as a prime consideration. As commuter services normally run below the cost, it does not generate economic returns to the system and works as a disincentive for railway planners.

Major sanctioned works (section-wise) falling in NCR are summarized below:

I NDLS – Palwal – Mathura

SI.No.	Works	Cost
i	NDLS – Tilak Bridge (3 KM) provision of 5th & 6th line	Rs. 58 crores
ii	TKD- PWL (33 KMs) provision 4th line	Rs. 123 crores
iii	TKD JN – PWL (33 KMs) Auto signaling	Rs. 9.15 crore
iv	FDB- Development of Freight terminal	Rs 7.86 crores
v	Palwal – Mathura (Third Line)	Rs 330 crores

II Delhi – Ghaziabad – Khurja (Aligarh)

SI.No.	Works	Cost
i	Ghaziabad – Aligarh Third line	Rs. 230 crores
ii	Ghaziabad-Aligarh Auto Signaling	Rs. 110 crores
iii	Ghaziabad – Freight Handling development	Rs 8 crores

III New Delhi – Panipat

SI.No.	Works	Cost
i	Sabzi Mandi-Panipat (Auto Signaling)	Rs. 21 crores
ii	Subzi Mandi-Delhi : Additional lines	Rs. 18 crore
iii	Holambi Kalan Terminal Land Acquisition	Rs. 473 crores
iv	Jind-Sonipat (New Line) 89 KMs	Rs. 117 crores

IV Delhi – Shakurbasti – Rohtak

SI.No.	Works	Cost
i	Shakurbasti Coaching Terminal (2008-9)	Rs. 108 croes
ii	Electrification of SSB-ROK Section (2008-9) (60 Kms)	Rs.70 crores
iii	Dayabasti-Grade Separator	Rs. 55 crores
iv	SSB-Rohtak – signaling upgradation	Rs. 24.13 crores
v	Shakurbasti-RRI Pane	Rs. 6.72 crores

V Delhi-Gurgaon-Rewari/Alwar

SI.No.	Works	Cost
i	Bijwasan (Coaching Terminal) (Land)	Rs. 235 crores
ii	Bijwasan terminal (8-9) :Development of Chg Terminal	Rs. 59 crores
iii	Rewari Yard Remodelling	Rs. 44 crores
iv	Rewari-Rohtak (New Line) 82 kms	Rs. 237 crores
v	Brar Square – Delhi Cant (Bye Pass Line)	Rs. 33 crores
vi	Delhi Sarai Rohilla-Gurgaon Electrification (30 KMs)	Rs. 12 Crores
vii	Delhi Sarai Rohilla (Coaching Terminal) Development	Rs. 11 crores

VI Ghaziabad – Hapur - Moradabad

SI.No.	Works	Cost
i	Doubling between Hapur – Moradabad	Rs. 276 crores
ii	Khurja – Hapur – Meerut Electrification	Rs. 234 crores

VII Delhi Area

SI.No.	Works	Cost
i	Third line/fourth line on Anand Vihar-Sahibabad (4 Kms)	Rs.88 crores
ii	Anand Vihar Chg Terminal Phase _ 1 & Phase II	Rs. 120 +Rs125 crore
iii	Addl. Facilities at Stations (Tilak Bridge, Subzimandi, Delhi Sarai Rohilla, Shakurbasti, Ghaziabad, Nizamuddin, Tuglkabad)	Rs.120 crores
iv	New Delhi – Phase III (Dev. Of Chg Terminal)	Rs. 29 crores
v	New Delhi – Phase IV (Dev. Of Chg Terminal)	Rs. 60 crores

In nutshell, railways projects costing Rs. 3452 crores (approximately) are under execution in NCR.

Annexure 14.4 (i)

NCR-IMMTP - Rail Network

Rail Rapid Transit System (RRTS)

Line	**Delhi-Shahdra-Ghaziabad**
Length (Km)	20.00
Travel Demand (Passenger Trips Per Day)	385586
Avg Trip Length (Km)	8.60

		Pax/Day		
Station	**Section Length**	**Station Load**	**Section Load**	**pphpd**
Delhi/ New Delhi		385586		
	7.00		385586	23135
Shahdara		64626		
	2.00		330505	19830
Vivek vihar halt		19107		
	11.00		311607	18696
Ghaziabad		311607		

Annexure 14.4 (ii)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	**Ghaziabad-Meerut**
Length (Km)	45.00
Travel Demand (Passenger Trips Per Day)	115692
Avg Trip Length (Km)	16.32

Station		**Pax/Day**		**pphpd**
	Section Length	**Station Load**	**Section Load**	
Ghaziabad		99464		
	1.39		99464	5968
Naya gzbd junc		35229		
	7.00		92432	5546
Duhai halt		2857		
	8.06		90126	5408
Murradnagar		10735		
	9.86		81423	4885
Modi Nagar		5064		
	18.72		78035	4682
Meerut City		78035		

Note: For total station load of Ghaziabad see Delhi - Ghaziabad Line

Annexure 14.4 (iii)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	**Ghaziabad-Hapur**
Length (Km)	36.00
Travel Demand (Passenger Trips Per Day)	114213
Avg Trip Length (Km)	14.75

Station		**Pax/Day**		**pphpd**
	Section Length	**Station Load**	**Section Load**	
Ghaziabad		104497		
	7.00		104497	6270
Raispur		13230		
	3.20		91321	5479
Dasna		1379		
	13.80		90084	5405
Pilkhua		7558		
	6.90		83986	5039
Kastha kasamadad halt		6528		
	5.50		95234	5714
Hapur		95234		

Note: For total station load of Ghaziabad see Delhi - Ghaziabad Line

Annexure 14.4 (iv)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	Ghaziabad - Khurja
Length (Km)	59.00
Travel Demand (Passenger Trips Per Day)	229134
Avg Trip Length (Km)	12.67

Station		Pax/Day		pphpd
	Section Length	Station Load	Section Load	
Ghaziabad		218565		
	4.00		218565	13114
Bamheta		18493		
	2.50		204726	12284
Chipyana buzurg		19593		
	4.40		189805	11388
Maripat		42700		
	4.10		151781	9107
Dadri		51456		
	17.60		100365	6022
Dankaur		6452		
	4.50		94151	5649
Fetehpur makrandpur halt		41975		
	4.00		58738	3524
Wair		19171		
	10.00		39646	2379
Block hut gg gangraul		22197		
	7.90		17665	1060
Khurja		17665		

Note: For total station load of Ghaziabad see Delhi - Ghaziabad Line

Annexure 14.4 (v)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	Shahdra - Baraut
Length (Km)	42.00
Travel Demand (Passenger Trips Per Day)	48223
Avg Trip Length (Km)	20.47

Station		Pax/Day		pphpd
	Section Length	Station Load	Section Load	
Shahdra		48222		
	31.70		48222	2893
Baghpat Road		6612		
	10.70		41612	2497
Baraut		41612		

Note: For total station load of Ghaziabad see Delhi - Ghaziabad Line

Annexure 14.4 (vi)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	**Delhi-Palwal**
Length (Km)	60.00
Travel Demand (Passenger Trips Per Day)	214123
Avg Trip Length (Km)	20.81

Station		**Pax/Day**		**pphpd**
	Section Length	**Station Load**	**Section Load**	
Delhi/ New Delhi		208731		
	31.00		208731	12524
Faridabad		108066		
	8.00		110362	6622
Ballabgarh		37346		
	21.00		74102	4446
Palwal		74102		

Annexure 14.4 (vii)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	**Delhi-Rewari-Alwar**
Length (Km)	160.00
Travel Demand (Passenger Trips Per Day)	608643
Avg Trip Length (Km)	24.77

Station		**Pax/Day**		**pphpd**
	Section Length	**Station Load**	**Section Load**	
Delhi/ New Delhi		529385		
	34.80		529385	31763
Gurgaon		259637		
	2.20		383310	22999
Manesar		189517		
	2.30		196769	11806
Basti Dhankot		8858		
	18.00		187912	11275
Jataula jauri		1397		
	13.30		189308	11358
Khalilpur		1850		
	7.40		190365	11422
Dabbi		714		
	5.10		190864	11452
Rewari		133022		
	14.60		92775	5567
Aljarka		79730		
	60.90		13176	791
Alwar		13176		

Note: Delhi/ New Delhi station/ section loads will be distributed amoungst all intermediate stations between Gurgaon Delhi

Annexure 14.4 (viii)

Regional Rapid Transit System (RRTS)

Line	Panipat-Delhi
Length (Km)	89.00
Travel Demand (Passenger Trips Per Day)	273264
Avg Trip Length (Km)	26.54

Station		Pax/Day		pphpd
	Section Length	Station Load	Section Load	
Panipat		33251		
	9.52		33251	1995
Diwana		36072		
	8.87		55948	3357
Samalkha		6313		
	6.57		55589	3335
Bhodwa Majri		1994		
	5.76		53715	3223
Ganaur		4169		
	10.10		55188	3311
Sandal kalan		4993		
	5.14		59943	3597
Sonipat		200347		
	0.84		244405	14664
Harsala kalan		5883		
	6.10		250285	15017
Rathdhana		4024		
	41.77		249481	14969
Delhi/New Delhi		249481		

Annexure 14.4 (ix)

NCR - IMMTP - Rail Network

Regional Rapid Transit System (RRTS)

Line	Delhi-Rohtak
Length (Km)	70.00
Travel Demand (Passenger Trips Per Day)	81388
Avg Trip Length (Km)	30.00

Station		Pax/Day		pphpd
	Section Length	Station Load	Section Load	
Delhi		82574		
	29.56		82574	4954
Bahadurgarh		21527		
	36.17		63194	3792
Asmal Bohar		17073		
	3.77		41601	2496
Rohtak Junction		41601		

NCR Regional Rail Rapid Transit (Commuter Rail System)

Line : Rohtak - Rewari

Length (Km)	65.21
Stations	3
Travel Demand (Passenger Trips Per Day)	800
Avg Trip Length (Km)	29.82

Sl.no	Station Name	Section Length (Km)	Station Load (Passenger per Day)	Section Load (Passenger per Day)
1	Rohtak		454	
		29.82		454
2	Jhajjar		454	
		35.49		691
3	Rewari		691	

Note : The traffic figures indicate only intra-region movements and do not include intra-urban movements that may take place on the line

NCR Regional Rail Rapid Transit (Commuter Rail System)

Line : Meerut - Panipat

Length (Km)	79.15
Stations	4
Travel Demand (Passenger Trips Per Day)	35658
Avg Trip Length (Km)	37.97

Sl.no	Station Name	Section Length (Km)	Station Load (Passenger per Day)	Section Load (Passenger per Day)
1	Panipat	6.14	16103	
				16103
2	Daurala	9.75	28134	
				12405
3	Sardhana	13.30	8996	
				12082
4	Meerut City RS	7.78	12082	

Note : The traffic figures indicate only intra-region movements and do not include intra-urban movements that may take place on the line

NCR Regional Rail Rapid Transit (Commuter Rail System)

Line : Hapur-Meerut

Length (Km)	30.16
Stations	5
Travel Demand (Passenger Trips Per Day)	27851
Avg Trip Length (Km)	16.61

Sl.no	Station Name	Section Length (Km)	Station Load (Passenger per Day)	Section Load (Passenger per Day)
1	Hapur		13956	
		8.39		13956
2	Kalli		7542	
		5.93		13956
3	Kharkhauda		4532	
		5.80		13956
4	Narhara		1516	
		10.04		28155
5	Meerut city		28155	

Note : The traffic figures indicate only intra-region movements and do not include intra-urban movements that may take place on the line

NCR Regional Rail Rapid Transit (Commuter Rail System)

Line : Panipat - Rohtak

Length (Km)	72.18
Stations	9
Travel Demand (Passenger Trips Per Day)	27899
Avg Trip Length (Km)	31.75

Sl.no	Station Name	Section Length (Km)	Station Load (Passenger per Day)	Section Load (Passenger per Day)
1	Panipat		471	
		8.87		471
2	Naultha		4856	
		6.96		5013
3			6526	
		5.05		4081
4	Gohana		3589	
		10.60		3269
5	Shahpur		7075	
		9.38		7418
6	Kharar		9726	
		12.60		16155
7	Hafizpur		1699	
		6.33		13086
8	bahar		4759	
		9.06		17096
9	Rohtak		17096	

Note : The traffic figures indicate only intra-region movements and do not include intra-urban movements that may take place on the line

NCR Regional Rail Rapid Transit (Commuter Rail System)

Line : Rewari - Khurja

Length (Km)	99.62
Stations	2
Travel Demand (Passenger Trips Per Day)	2391
Avg Trip Length (Km)	47.01

Sl.no	Station Name	Section Length (Km)	Station Load (Passenger per Day)	Section Load (Passenger per Day)
1	Rewari		691	
		59.97		691
2	Palwal		4091	
		39.65		4625
3	Khurja		4625	

Note : The traffic figures indicate only intra-region movements and do not include intra-urban movements that may take place on the line

NCR Regional Rail Rapid Transit (Commuter Rail System)

Line : Khurja-Meerut

Length (Km)	31.62
Stations	3
Travel Demand (Passenger Trips Per Day)	12156
Avg Trip Length (Km)	10.54

Sl.no	Station Name	Section Length (Km)	Station Load (Passenger per Day)	Section Load (Passenger per Day)
1	Khurja		2561	
		12.74		2561
2	Bhulandshar		2561	
		18.88		19189
3	Meerut city		19189	

Note : The traffic figures indicate only intra-region movements and do not include intra-urban movements that may take place on the line

Annexure 16.1

Vehicle Operating Cost at Economic Prices

Speed (km/hr.)	Vehicle Operating Cost (Rs./km)		
	Car	Two Wheeler	Goods Vehicles
10	8.0	4.0	9.4
15	6.0	3.0	7.5
20	5.0	2.5	6.4
25	4.4	2.2	5.7
30	3.8	1.9	5.3
35	3.2	1.6	5.0
40	2.9	1.4	4.8
45	2.7	1.4	4.6
50	2.6	1.3	4.6
55	2.6	1.3	4.6
60	2.5	1.3	4.6
65	2.5	1.3	4.7
70	2.6	1.3	4.8
75	2.6	1.3	4.9
80	2.7	1.3	5.1

Annexure 16.2

Net Cash Flow Statement

(in Rs millions)

Year	Economic Cost			Base Case - D1N1			With Project - D2N5			Economic Benefits					Net Benefits
	Capital	Maint.	Total	VOC	Time	Total Cost	VOC	Time	Total Cost	VOC Savings	Time Savings			Total	
											Road	Metro	Rail		
2007				132584	3133	135716	132584	3133	135716	0	0		0	0	0
2008	27888	139	28027	156675	9908	166584	156675	9908	166584	0	0		-130	-130	-28157
2009	27888	139	28027	180767	16684	197451	180767	16684	197451	0	0		-260	-260	-28287
2010	27888	139	28027	204858	23460	228318	204858	23460	228318	0	0		-390	-390	-28417
2011	27888	139	28027	228950	30236	259185	228950	30236	259185	0	0		-520	-520	-28547
2012	27888	139	28027	253041	37011	290053	165089	6463	171552	87952	30548		-650	117851	89824
2013	121740	609	122349	286907	45986	332893	180341	7797	188137	106566	38189		-312	144444	22095
2014	121740	609	122349	320772	54960	375733	195592	9130	204723	125180	45830		26	171037	48688
2015	121740	609	122349	354638	63935	418573	210844	10464	221308	143794	53471		364	197629	75281
2016	121740	609	122349	388504	72910	461413	226095	11798	237893	162408	61112		702	224222	101873
2017	121740	609	122349	422369	81884	504253	241347	13132	254479	181022	68752		1040	250815	128466
2018	84455	422	84877	456235	90859	547093	256599	14466	271064	199636	76393		1379	277408	192531
2019	84455	422	84877	490100	99833	589934	271850	15799	287650	218250	84034		1717	304000	219123
2020	84455	422	84877	523966	108808	632774	287102	17133	304235	236864	91675		2055	330593	245716
2021	84455	422	84877	557831	117783	675614	302353	18467	320821	255478	99315		2393	357186	272309
2022	84455	422	84877	591697	126757	718454	317605	19801	337406	274092	106956	1510	2731	385289	300412
2023	21651	108	21759	631155	147479	778634	345466	22145	367611	285689	125334	1779	2982	415784	394025
2024	21651	108	21759	670613	168202	838815	373327	24490	397817	297286	143712	2047	3233	446278	424519
2025	21651	108	21759	710071	188924	898995	401188	26834	428022	308883	162090	2316	3484	476773	455014
2026	21651	108	21759	749530	209646	959176	429049	29178	458228	320481	180467	2584	3735	507267	485508
2027	21651	108	21759	788988	230368	1019356	456910	31523	488433	332078	198845	2853	3986	537762	516003
2028	21651	108	21759	828446	251090	1079536	484771	33867	518638	343675	217223	3122	4237	568256	546497
2029	21651	108	21759	867904	271812	1139717	512632	36212	548844	355272	235601	3390	4488	598751	576992
2030	21651	108	21759	907363	292535	1199897	540493	38556	579049	366869	253979	3659	4739	629245	607486
2031	21651	108	21759	946821	313257	1260078	568354	40900	609255	378466	272357	3927	4990	659740	637981
2032	21651	108	21759	986279	333979	1320258	596215	43245	639460	390064	290734	4196	5241	690234	668475
	1386920	6935	1393854												
														EIRR	43.26%
													NPV @ 12%		807786

Annexure 18.1

Review of Various Existing Acts in NCR States and Abroad

Various Indian laws, codified in the Constitution of India as well as Central/State enactments impact the proposed Integrated Transport Plan for NCR (ITPNCR) directly or indirectly. The legal issues pertaining to the ITPNCR contained in the following Acts/Laws, are discussed hereunder.

- The National Capital Region Planning Board Act, 1985
- Delhi Development Act, 1957
- The Motor Vehicles Act, 1988 and Rules thereunder
- The Carriers Act, 1865/The Carriage by Road Act, 2007
- The Road Transport Corporation Act, 1950
- States Town & Country Planning Acts
- Uniform Law for Infrastructure Projects
- Foreign Enactments on Regional Transport Authority

1. The National Capital Region Planning Board Act, 1985

Constitution and Functions of NCRPB

The National Capital Region Planning Board Act, 1985 provides for the constitution of a Planning Board (NCRPB) for preparation of a plan for the development of the National Capital Region and for coordinating and monitoring the implementation of such plan and for evolving harmonized policies for the control of land-uses and development of infrastructure in the National Capital Region so as to avoid any haphazard development thereof.

The functions of the NCRPB, under the Act, are, inter alia, to -

- Prepare the Regional Plan and Functional Plans supplementary thereto as well as to arrange for preparation of Sub-Regional Plans and Project Plans by the participating States and the NCT of Delhi;

- Coordinate the enforcement and implementation of the Regional Plan, Functional Plans, Sub-Regional Plans and Project Plans through the participating States and NCT of Delhi;

- Ensure systematic programming with regard to determination of priorities & phasing of development and project formulation in accordance with the strategy enunciated in the Regional Plan by the participating States and NCT-Delhi; &

- Arrange for, and oversee, the financing of selected development projects in the National Capital Region through Central and State Plan funds as well as other sources of revenue.

Constitution of the Fund

NCRPB Act 1985 provides for Constitution of the National Capital Regional Planning Board Fund and there shall be credited thereto –

a) any grants and loans made to the Board by the Central Government under section 21;
b) all sums paid to the Board by the participating States and the Union territory, and

c) all sums received by the Board from such other sources as may be decided upon by the Central Government in consultation with the participating States and the Union Territory.

The National Capital Region Planning Board Rules, 1985

NCRPB Rules contain provisions relating to Constitution of the Board and the Committee, Conduct of Business, Administration, Procedure for publication of draft and final regional plan and budget, accounts and audit rules. The provisions relating to organizational set-up are given hereunder:

Organizational set-up

Minister of Urban Development, Government of India is the Chairman of the National Capital Region Planning Board is the Minister of Urban Development, Government of India. The Board has 21 regular members and 10 co-opted members which include inter-alia the Union Ministers of Power, Communication & IT, Railways, Shipping, Road Transport & Highways; the Chief Ministers of Haryana, Uttar Pradesh, Rajasthan and NCT-Delhi; the Lt. Governor of the NCT of Delhi; the Secretary, Ministry of Urban Development; Chief Secretaries of Haryana, Rajasthan and NCT of Delhi; Principal Advisor (HUD), Planning Commission; Secretary, Housing & Urban Development of U.P.; and Member Secretary of the NCR Planning Board.

The Board's Secretariat consists of Planning, Financing and Administration Wings and has one NCR Planning and Monitoring Cell working within each of four participating States for coordination and monitoring the implementation of the policies and proposals of the Regional Plan-2021.

At the headquarters of the Board, there are two Project Sanctioning and Monitoring Groups (PSMG). Group-I is headed by the Secretary, Ministry of Urban Development and has powers to sanction funds for projects costing more than Rs.5 crore Group-II headed by Member Secretary of the Board, can sanction funds for implementing projects costing less than Rs.5 crore. Projects, falling under the NCR, are planned and implemented in the sub regions, by various Departments/Authorities of the Constituent State Governments operating within their respective zones.

2. Delhi Development Act, 1957 (*As amended by The Delhi Development (Amendment) Act, 1996)*

This Act provides for the development of Delhi according to a Master Plan and matters ancillary thereto. It extends to the whole of the National Capital Territory of Delhi, and deals with the following matters:

- The Development Authority and its objects (Sections 3 to 6)
- Master Plan and Zonal Development Plans (Sections 7 to 11)
- Modifications to the Master Plan and the Zonal Development Plan (Section 11A)
- Development of Land (Sections 12 to 14)
- Acquisition and Disposal of Land (Section 15 to 22A)
- Finance, Accounts and Audit (Sections 23 to 27)
- Supplemental and Miscellaneous Provisions (Sections 28 to 60)

Section 36 of the Act empowers the Delhi Development Authority (DDA) to require a local authority to assume responsibility for amenities in certain cases. Section 37 authorizes the DDA to levy betterment charges in such cases.

With a view to enhance mobility, reduce congestion and to promote traffic safety by adopting standard transport planning practices, capacity building, enforcement measures, road safety audits, traffic engineering practices and better organizational co-ordination for improved traffic management

by efficient lane capacity and work zone management, , utilities coordination, developing traffic culture and avoiding transport planning pitfalls in the National Capital Territory of Delhi, the Unified Traffic and Transportation Infrastructure (Planning and Engineering) Centre has been set up by Delhi Development Authority in exercise of powers under section 5A of the Act.

3. Motor Vehicle Act 1988 and Rules there under

The Motor Vehicles Act, 1988, as amended by the Motor Vehicles (Amendment) Act, 1994, 2001 and 2007, is a national enactment with jurisdiction all over the country. This is supported by the Central Motor Vehicle Rules, 1989 and further supplemented by state level rules that apply within individual state jurisdictions.

The Motor Vehicles Act, 1988 (MV Act) deals with the law relating to motor vehicles and Road Transport.

***Control of road transport**:*

Section 67 empowers the State Government to control road transport. A State Government, having regard to (a) the advantages offered to the public, trade and industry by the development of motor transport, (b) the desirability of co-ordinaing road and rail transport, (c) the desirability of preventing the deterioration of the road system and (d) the desirability of preventing uneconomic competition among holders of permits, may, from time to time, by notification in the Official Gazette, issue directions both to the State Transport Authority (STA) and Regional Transport Authority (RTA) regarding-

(i) fixing of fares and freights (including the maximum and minimum in respect thereof) for stage carriages, contract carriages and goods carriages;
(ii) prohibition or restriction, subject to such conditions as may be specified in the directions, of the conveying of long distance goods traffic generally, or of specified classes of goods by goods carriages;
(iii) any other matter which may appear to the State Government necessary or expedient for giving effect to any agreement entered into with the Central Government or any other State Government or the Government of any other country relating to the regulation of motor transport generally, and in particular to its co-ordination with other means of transport and the conveying of long distance goods traffic.

However, fares and freight rates for contract carriages and goods carriages, mentioned in clause (i) above, operated by battery, compressed natural gas or solar energy are fixed by the owner or operator. (with effect from 14.11.1994 under the Amendment Act of 1994).

Under Section 68(3), the State Transport Authority and every Regional Transport Authority shall give effect to any directions issued under Section 67.and the State Transport Authority shall, subject to such directions and save as otherwise provided by or under this Act, exercise and discharge throughout the State the following powers and functions, namely :-

(a) to co-ordinate and regulate the activities and policies of the Regional Transport Authorities, if any, of the State;
(b) to perform the duties of a Regional Transport Authority where there is no such Authority and, if it thinks fit or if so required by a Regional Transport Authority, to perform those duties in respect of any route common to two or more regions;
(c) to settle all disputes and decide all matters on which difference of opinion arise between Regional Transport Authorities; and

(d) to discharge such other functions as may be prescribed.

Section 68 provides that the State Government shall by notification in the Official Gazette, constitute for the State a State Transport Authority and Regional Transport Authority to exercise and discharge functions specified therein.

Section 2 (42) defines State Transport Undertaking meaning any undertaking providing road transport service, where such undertaking is carried on by (i) the Central Government or a State Government, (ii) any Road Transport Corporation established under the Road Transport Corporation Act, 1950,(iii) any municipality or any corporation or company owned or controlled by the Central Government or any or more State Governments, or by the Central Government and one or more State Governments and (iv) Zila Parishad or any other similar local authority.

Section 69 deals with general provision as to applications for permits to the Regional Transport Authority, which, inter-alia, provides that if it is proposed to use the vehicle or vehicles in two or more regions lying in different States, the application shall be made to the Regional Transport Authority of the region in which the applicant resides or has his principal place of business.

Validation of permits for use outside Region:

Section 88 provides validation of permits for use outside region in which granted. It provides that a permit granted by the Regional Transport Authority of any one region shall not be valid in any other region, unless the permit has been countersigned by the Regional Transport Authority of that other region. Further, a permit granted in any one State shall not be valid in any other State unless it is countersigned by the State Transport Authority of that other State or by the Regional Transport Authority concerned of the other state.

Control of Traffic

The provision regarding control of traffic contained in Chapter VIII (Section 112 to 138) pertains, inter-alia, to limits of speed, limits of weight and limitations on use, power to have vehicle weighed, power to restrict the use of vehicle, power to erect traffic signs, parking places and halting stations, driving regulations, duty of driver to stop in certain cases, power of State Government to make rules providing for – the removal and safe custody of certain vehicles, the installation and use of weighing devices, the maintenance and management of wayside amenities/complexes, the exemption from all or any of the provisions of Chapter VIII of special classes or descriptions of vehicles, the maintenance and management of parking places and stands, and the fees, if any, which may be charged for their use, etc.

The NCT of Delhi, Haryana, U.P. and Rajasthan have framed the respective Motor Vehicles Rules, keeping in view the Central Motor Vehicle Rules, 1989. The Rules in respect of Control of Traffic covers, inter-alia, signalling devices, vehicles abandoned on the roads, installation and use of weighing devices, restricted of driving with gear disengaged, prohibition on mounting or taking hold of vehicle in motion, towing, projection of loads, restriction as to carriage of dangerous substance, restriction on use of siren and sound signals, restriction of dazzling light, visibility of lamps and registration marks, prohibition of erection or placing of signs or advertisement on roads.

Many of the powers relating to control of traffic (Chapter VIII, Section 112 to 138 of the Act) are delegated to the State Government or any other person authorized by the State Government. The power relating to following matters are with the Central Government:-

- Driving Regulations (Sec. 118)
- Duty to obey traffic signs (Sec. 119)

- Signals and signalling devices (Sec. 121)
- Safety measures for drivers and pillion riders (Sec. 128)
- Duty to produce licence and certificate of registration (Sec. 130)
- Occasions on which signals to be made by drivers of motor vehicles and the manner in which the licences and certificates may be produced to the police officer (Sec. 137)

In all other cases the powers are with the State Government. The State Government has the power to regulate the conduct of traffic on the roads along with all residual powers in Sec. 138 of the Act. For example clause 138(d) provides the State Government to exempt special class of vehicles, from the provisions of this Chapter. The State Government has the exclusive right to provide for wayside amenities.

The Central Motor Vehicles Rules, 1989 (CMVR) deal with the following matters:

- Licensing of Drivers of Motor Vehicles
- Registration of Motor Vehicles
- Control of Transport Vehicles Tourist Permits
- Construction, Equipment and Maintenance of Motor Vehicles including Safety Devices
- Control of Traffic
- Insurance of Motor Vehicles against third party risks
- Offences, Penalties and Procedure

4. The Carriers Act. 1865/The Carriage by Road Act, 2007

The Carriers Act, 1865 deals with the rights and liabilities of Common Carriers. It empowers the common carrier to restrict his liability, as well as, make him liable for the loss or damage, caused by the negligence or criminal acts of himself, his agent or servant to such property delivered to him to be carried.

According to the Carriers Act, 1865, "common carrier" denotes a person, other than the Government, engaged in the business of transporting property under multimodal transport document or of transporting for hire property from place to place, by land or inland navigation, for all persons indiscriminately. Carrier by air and sea are not included.

The Parliament passed the Carriage by Road Act, 2007 and the assent of the President to the said Act was received on the 29th September, 2007. The new law will replace the Carriers Act, 1865 and its scope is very wide. The new Act will provide for the regulation of common carriers, limiting their liability and declaration of value of goods delivered to them to determine their liability for loss of, or damage to, such goods occasioned by the negligence or criminal acts of themselves, their servants or agents and for matters connected therewith or incidental thereto.

The new Act has also revised the meaning of "common carrier" as a person engaged in the business of collecting, storing, forwarding or distributing goods to be carried by goods carriages under a goods receipt or transporting for hire of goods from place to place by motorized transport on road, for all persons undiscriminatingly and includes a goods booking company, contractor, agent, broker and courier agency engaged in the door-to-door transportation of documents, goods or articles utilizing the services of a person, either directly or indirectly, to carry or accompany such documents, goods or articles, but does not include the Government. Any person engaged in the business of common carrier on the date of commencement of the Act, has to apply for registration within 90 days. The registering authority is the State Transport Authority (STA) or Regional Transport Authority (RTA) constituted under section 68 of the Motor Vehicles Act, 1988,

5. The Road Transport Corporation Act, 1950

The Act provides for the incorporation and regulation of Road Transport Corporation. It extends to the whole of India. It shall come into force in a State on such date as the Central Government may, by notification in the Official Gazette, appoint in this behalf for such State. The Act has been brought into force in all the States of NCR as indicated in the following table:

State/UT	Date of commencement	Notification No.	Where published
Delhi	03-11-1971	S.O. 5081	Gazette of India, Extra1971, Pt.II, Sec.3 (i), p.3057
Punjab (Haryana & Chandigarh)	10-08-1954	S.R.O.2629	Gazette of India, 1954, Pt.II Sec.3, p. 1959
Rajasthan	05-09-1964	S.O. 3049	Gazette of India, 1964, Pt.II Sec.3, p. 3417
Uttar Pradesh	01-04-1972	S.O. 1074	Gazette of India, 1972, Pt.II Sec.3 (ii), p.1698

The Act deals with the following aspects:

- Road Transport Corporations (Sections 3 to 17)
- Establishment of Road Transport Corporations in the States,
- Incorporation, Management of Corporation and Board of Directors, etc.
- Subsidiary Corporations (Section 17A)
- Powers and Duties of Corporation (Sections 18 to 21)
- Finance, Accounts and Audit (Sections 22 to 33)
- Miscellaneous (Sections 34 to 48)

Section 3 of the RTC Act provides for the establishment of a Road Transport Corporation for the whole or any part of the State under such name as may be specified in the notification in the Official Gazette. While Sections 18 and 19 of the Act provide the general duty and powers of the Corporation, Section 20 the Act provides for the extension of the operation of the road transport service of a Corporation to areas within another State, to any route or area situated within another State, if it considers to be expedient in the public interest, with the permission of that State Government.

There is no provision under this Act to create any Authority to coordinate the transport system in the NCR.

6. States' Town and Country Planning Acts (Control of Local Authorities)

The Constitution of India, vide 74th Amendment in 1992 of Article 243 (W), enables the Legislature of a State to endow the Municipalities/Committees with necessary power and authority to assist them in carrying out the responsibilities conferred upon them. Such responsibilities include, inter alia, those in relation to matters listed in Twelfth schedule of the Constitution of India which include urban planning including town planning, regulation of land use and construction of buildings, roads, and bridges, as well as public activities including street lighting, parking lots, bus stops and public conveniences.

The manner in which the State and local bodies can exercise control over the land is relevant as any land within the limits of a Municipality, a Notified Area Committee, a Town Area Committee, a City and Town Committee, a Small Town Committee, a Cantonment Board, a Panchayat or any land which is used primarily for the purpose of agriculture is not considered urban land and can be controlled by the relevant authority.

In this context, the provision of Delhi Development Act, 1957, Haryana Development and Regulation of Urban Areas Act, 1975 and Rules, 1976, Haryana Urban Development Authority Act, 1976, Haryana Urban Development (Disposal of Land and Buildings) Regulation, 1978, Punjab Scheduled Roads and Controlled Area Restriction of Unregulated Development Act, 1963 and Rules, 1965, have to be kept in view. For instance, under the last mentioned Act of 1963, no person shall erect or re-erect any building or make or extend any excavation or layout any means of access to a road within one hundred metres on either side of the road reservation of a bye-pass or within thirty metre on either side of the road reservation of any scheduled road not being bye-pass with certain exception. Grant Trunk Road (NH-1), Delhi-Mathura Road (NH-2) are scheduled roads under this Act.

7. Uniform Law for Infrastructure Projects

The Constitutional framework in India does not permit a single law governing grant of rights for development of projects in all the infrastructure sectors. The Constitution of India, through Article 246 read with the Seventh Schedule, distributes various legislative fields between the Union Parliament and the State Legislatures. The Seventh Schedule provides for three lists of legislative fields: the Union List, the State List and the Concurrent List. Further, the Constitution of India, and the State laws vest municipalities and panchayats with responsibilities and jurisdiction over certain infrastructure facilities within their territorial jurisdiction. Matters listed under the Constitution as capable of being delegated to municipal bodies pertain largely to urban planning, including town planning; regulation of land use; water supply and public amenities within the municipal jurisdiction. Hence, any law governing the grant of rights/licence/concession for development of infrastructure projects would have to take into account these aspects.

A number of States in India are in the process of drafting laws for facilitating infrastructure projects within their territories. The States of Gujarat and Andhra Pradesh have already enacted such laws.

8. Foreign Enactments on Regional Transport /Transport Coordination

Apart from above Acts, consultant also examined following three Acts prevailing in different part of the World for Regional Transport System:

(i) Act on Capital Status and Special Regime of Madrid (Spain)
(ii) Regional Transportation Authority Act (of USA)
(iii) Intermodal Surface Transportation Efficiency Act of 1991 (of USA)

Some of the features / provisions of the Foreign Enactments related to Transport are elaborated below:

(i) Act on Capital Status and Special Regime of Madrid (Spain)

In Madrid (Spain), Madrid Regional Transport Consortium (Consorcio Regional de Transportes de Madrid – CRTM) was founded by Madrid Regional Government under Law 5/1985 just after two years of creation of Madrid Region. The Madrid Region was constituted in accordance with the Article 5 of the Spanish Constitution, which provides that the capital of the State shall be the City of Madrid, and in compliance with the provisions of Section 6 of the State of Autonomy of the Madrid

Region, promulgated by Organic Act 3/1983, of 25 February. This Act regulates the relations between the State, regional and local institutions in the territorial area of the city of Madrid relating to those aspects connected with its status as capital.

CRTM is an autonomous agency of the Regional Government, responsible for regular passenger public transport services to the inhabitants of the entire Madrid Region and its associated municipalities. The strategy of the Transport Authority is based on three fundamental features:

a. Administrative Integration, as an unique authority for public transport, taking up former transport responsibilities of the region and of adhered municipalities;
b. Fare integration, with implementation of the travel pass (Abono de Transportes), currently used in more than 60 per cent of public transport journeys, and
c. Modal Integration, considering that different transport modes are complementary, inter-modality being a key issue.

CRTM was created by law on 16th May, 1985. The Regional Minister for Public Works, Housing and Transportation, is the Chairman of the CRTM Board of Directors which includes representatives from the Regional Government/the City of Madrid/other municipalities/ the National Government/ Transport Operators Associations/Trade Unions/Consumers Associations.

The main functions of CRTM are:

- Planning of public transport infrastructures and coordination of all transport modes
- Establishment of an integrated fare system for the whole public transport network
- Promotion of an overall image of the public transport system, and between the CRTM and the users.

A sustainable policy of investment in improving the quality and accessibility of public transport, promotion of multimodal travel cards and multi-trip tickets and the construction of inter-modal transfer terminals, enabled the Regional Transport Authority to increase the number of public transport users by 49 percent since the creation of the Authority in 1986. Madrid Region has the highest public transport modal share of motorized trips compared with the main European metropolitan areas, according to data analysis by European Metropolitan Transport Authorities (EMTA) from 1995 to 2000 in Madrid Region.

(ii) Regional Transportation Authority Act of USA (70 ILC 3615)

In the USA, powers to regulate the public transit at the national level are with the Federal Transit Administration (FTA) under the US Department of Transportation . The US Congress established the legal authority to commence and continue FTA programs through authorizing legislation covering several years. On August 10, 2005, the US President signed the Safe, Accountable, Flexible, and Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU), reauthorizing surface transportation programs through fiscal year 2009.

At the Regional Level, public transit is governed by the Regional Transportation Authority Act for various Regions. In case of Chicago, it is governed by Regional Transportation Authority Act (70 ILCS 3615). Important provisions of the Act are given below:

a) *Service Boards:* The responsibility for operations, establishing service at the fare level is allocated to Service Boards, each of which is controlled by boards appointed by elected officials whose constituents receive those services.

b) *Responsibility for financial condition:* The responsibility for the financial condition of the overall system is allocated to the Regional Transportation Authority (RTA) which is controlled by a Regional Board appointed by the same elected officials.

c) *Taxing power:* RTA has three essential sources of revenue:

- Power to tax and allocate operating funds to the Service Boards;
- Power to issue bonds to fund capital projects of the Service Boards and regulate the undertaking of capital projects by Service Boards, regardless of the source of funding of the project,
- Power to approve Service Board budgets.

The exercise of each of these powers requires a vote of nine directors, mandating consensus among regional interests.

RTA's power to tax is limited to specific taxes. The RTA Act authorizes RTA to impose, by a vote of nine of its directors, a series of taxes within the six country metropolitan region: a sales tax, a car rental tax, a motor fuel tax, an off-street parking tax, and a replacement vehicle tax., although there are limits on the combinations of these taxes that can be imposed at the same time.

d) *Bonding Power:* RTA has been given and has exercised substantial bonding power, with the majority of debt service expenses reimbursed by the State. The Act requires that any capital expenditure of more than $250,000 by a Service Board must be included in the Capital Program adopted by RTA.

e) *Budget oversight:* Oversight powers of RTA over a Service Board's operations are not focused on service levels or equality, nor on fare structure or level, but on the overall financial condition of the system and each individual Service Board.

Additionally, the Act charges the RTA with achieving the legislatively mandated balance between rider and taxpayers support for the transit system – at least 50% of the costs of operations must be funded with fare box revenues.

(iii) Inter-modal Surface Transportation Efficiency Act of 1991 in USA

The Inter-modal Surface Transportation Efficiency Act (ISTEA), 1991 establishes a new vision for surface transportation in America. The purpose of the Act is "to develop a National Inter-modal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy and will move people and goods in an energy efficient manner".

The provisions of the Act reflect these important policy goals. Some of the major features include:

- A National Highway System (NHS), consisting primarily of existing interstate routes and a portion of the Primary System, is established to focus Federal resources on roads that are the most important to interstate travel and national defense, roads that connect with other modes of transportation, and are essential for international commerce.
- State and local governments are given more flexibility in determining transportation solutions, whether transit or highways, using the tools of enhanced planning and management systems to guide them in making the best choices.

- New technologies, such as intelligent vehicle highway systems and prototype magnetic levitation systems, are funded to push the Nation forward into thinking of new approaches in providing 21st Century transportation.
- The private sector is tapped as a source for funding transportation improvements. Restrictions on the use of Federal funds for toll roads have been relaxed and private entities may even own such facilities.
- The Act continues discretionary and formula funds for mass transit.
- Highway funds are available for activities that enhance the quality of environment, such as wetland banking, mitigation of damage to wildlife habitat, historic sites, activities that contribute to meeting air quality standards, a wide range of bicycle and pedestrian projects, and highway beautification.
- Highway safety is further enhanced by a new program to encourage the use of safety belts and motorcycle helmets.
- Uniformity between States in vehicle registration and fuel tax reporting is required. This will ease the recordkeeping and reporting burden on businesses and contribute substantially to increased productivity of the truck and bus industry.

The comprehensive coverage of ISTEA is reflected in its eight titles, viz.

a) Surface Transportation (related to highways),
b) Highway Safety
c) Federal Transit Act Amendments of 1991,
d) Motor Carrier Act of 1991, Inter-modal Transportation
e) Research,
f) Air Transportation,
g) Extension of Highway –related taxes and Highway Trust Fund.

ISTEA and its regulations require states to develop and maintain their own transportation planning processes. These statewide transportation planning requirements were revised in the Transportation Equity Act for the21st Century (TEA-21), which was signed into law in June 1998.