**THE FEDERAL DEMOCRATIC REPUBLIC OF NEPAL**
**MINISTRY OF PHYSICAL PLANNING, WORKS AND TRANSPORT MANAGEMENT**
**DEPARTMENT OF ROADS**

# DATA COLLECTION SURVEY ON TRAFFIC IMPROVEMENT IN KATHMANDU VALLEY

# FINAL REPORT

OCTOBER 2012

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.
EIGHT-JAPAN ENGINEERING CONSULTANTS INC.

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COMPOSITION OF THE REPORT

- EXECTIVE SUMMARY
- PHOTOGRAPH
- LOCATION MAP
- MAIN REPORT
- APPENDIX

CURRENCY EXCHANGE RATE (as of October. 2011)

(1) Nepal Rupee vs. Japanese Yen
NPR 1= JPY 0.996

(2) US Dollar vs. Japanese Yen
USD 1= JPY 76.63

# EXECUTIVE SUMMARY

## CHAPTER 1 INTRODUCTION

### 1.1 Outline of the Survey

The objectives of the Survey are to collect traffic data and to identify main transport problems and issues in the Kathmandu Valley. The cooperating agencies are the Department of Roads (hereinafter referred to as "DOR"), Ministry of Physical Planning, Works and Transport Management (hereinafter referred to as MOPPWTM"), and other relevant organizations.

### 1.2 Target Area and Terms of Reference

The target area is the Kathmandu Valley, which constitutes three districts including five municipalities. The terms of reference of the Survey are as follows:

(1) Review of the Existing Information, Studies, Plans, and Projects;
(2) Basic Data Collection of Urban Planning;
(3) Traffic Survey and Road Inventory Survey;
(4) Future Traffic Demand Forecast (Target Year: 2022);
(5) Identification of Major Traffic Related Issues/Problems in the Kathmandu Valley; and
(6) Counterpart Training in Japan.

### 1.3 Schedule of the Survey

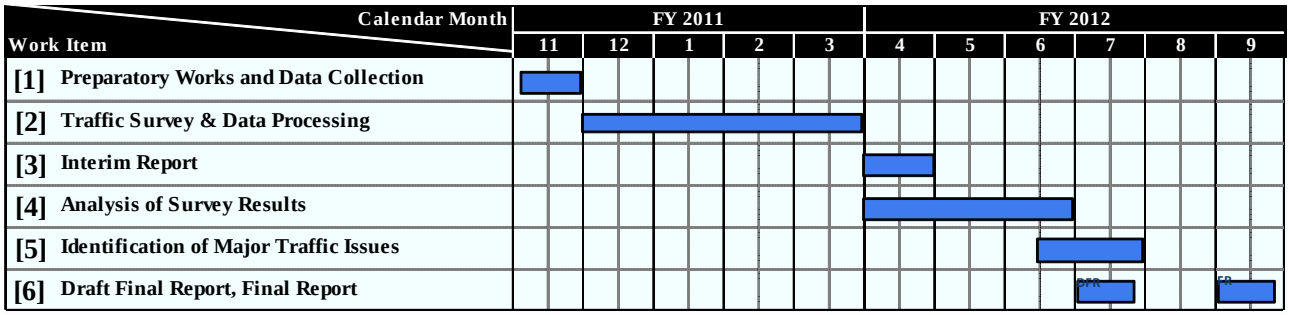



**Figure 1.1 Schedule of the Survey**

### 1.4 Organization of the Survey

The DOR set up the Technical Committee for effective and efficient implementation of the Survey under the chairmanship of the Director General of DOR. The Committee comprises representatives from the following agencies and organizations:

(1) Department of Roads (DOR);
(2) Department of Urban Development and Building Construction (DUDBC);
(3) Department of Transport Management (DOTM);
(4) Metropolitan Traffic Police (MTP);
(5) Kathmandu Metropolitan City (KMC);
(6) Lalitpur Sub-Metropolitan City (LSMC); and
(7) Bakhtapur Municipality (BMC).

# CHAPTER 2 OVERVIEW OF THE KATHMANDU VALLEY

## 2.1 Natural Condition

Kathmandu is the capital city of Nepal located in the Kathmandu Valley and it is surrounded by high mountains with 2000 meters in height. The climate of the Kathmandu Valley is sub-tropical in nature which is influenced by the south-west monsoon during summer as shown in the table.

Geologically, Kathmandu Valley consists of recent alluvial soil (sal) of the Cenzonic Era and other three formations and is located in the Himalayas orogenic zone having a long history of destructive earthquakes. The seismic record of the region suggested a return period of about 25 years, indicating that a devastating earthquake is inevitable in the long run and likely will happen in the near future.

There are four major rivers, namely, Bagmati, Manahara, Bishnumati, and Dhobi Khola, flowing through the heart of Katmandu City. These rivers function not only as storm water drainage but also served as sewerage of the Kathmandu Valley. The river banks have been encroached and squatter settlements can be found in abundance.

## 2.2 Socio-economic Profile of the Kathmandu Valley

The key macro-economic indices of Nepal are shown in Table 2.1. During the past two decades, nominal GDP rose about tenfold, from NPR111 billion to NPR1,171 billion, whereas real GDP increased only 2.5 times. Per-capita nominal GDP for 2010 was NPR41,546 or USD558, which was 7.1 times from 1990.

**Table 2.1 Key Macro-economic Indices**

| Key Macro-economic Indices in 2010 | | | Indices |
|---|---|---|---|
| Real GDP | | Billion NPR | 616.2 |
| | | Billion US$ | 8.2 |
| Growth Rate | | % | 4.4% |
| Real GDP per caipta | | NRP | 21,864 |
| | | US$ | 293 |
| Nominal GDP | | Billion NPR | 1,171.0 |
| | | Billion US$ | 15.7 |
| Growth Rate | | % | 14.7% |
| Per-capita Nominal GDP | | NRP | 41,546 |
| | | US$ | $558 |
| Inflation (CPI) | | | 9.0% |
| Exchange Rate | | US$ | 74.5 |
| DGP by Sector | Agriculture | % | 32.6 |
| | Industry | % | 15.8 |
| | Services and others | % | 51.6 |
| Population below Poverty | | % | 24.7 |
| Export (2009) | | Billon US$ | 0.85 |
| Import (2208) | | Billon US$ | 5.26 |
| Main Industry (Tourisim, garment, food and beverages, metal manufactures, herbs | | | |

Source: ADB Key Indicators 2010, UNDP Human Development Report 2010

The Kathmandu Valley comprising of three districts, i.e., Kathmandu, Lalitpur, and Bhaktapur includes five major municipalities, namely, Kathmandu, Lalitpur, Bhaktapur, Kirtipur, and Thimi. However, the combined area of the three districts covers around 899 sq.km, whereas the area of the valley as a whole is only 665 sq.km.

The preliminary results of the National Population Census in 2011 for Kathmandu Valley are as follows:

(a) Total population of Kathmandu Valley including the three districts was around 2.5 million, where 1.5 million lives in urban areas and the rest in rural areas.

(b) The population density of Kathmandu Valley was estimated at 27.9 persons per ha. The urban areas of Kathmandu and Lalitpur municipalities have the high density of 155.5 and 148.9, respectively.

(c) The population growth rate of the whole Kathmandu Valley was 4.32%.

Kathmandu is the center of administration, industrial, commercial, social, and economic activities. It is the most densely populated region in Nepal and its population has been increasing rapidly during the past two decades. It is considered to be the engine of growth since the planned urban development will result in overall economic development of the nation.

The rapid unplanned urbanization of the Kathmandu Valley caused by the informal process of settlement development in the past has brought several physical, social, and environmental problems in the Kathmandu Valley. The fragile Kathmandu Valley eco-system is severely affected by the over-expanding urban development and unsuitable economic activities.

## 2.3 Transport Sector Status

The road network in Kathmandu Valley is classified into two groups depending on the jurisdiction of administration body of DOR and local governments as shown below:

The Kathmandu Valley is served with a ring road and radial pattern of road network and the expansion of urban areas have proceeded along the major (or primary) feeder roads radiating from the Ring Road. Feeder road is classified into primary (or major) and secondary (or minor). The former generally leads from the national highway to the district headquarters and the latter connects the primary feeder road with major towns and villages.

**Table 2.2 Road Network of Kathmandu Valley**

| Jurisdiction | Classification | Kathmandu District | Bhaktapur District | Lalitpur District | Total | Remarks |
|---|---|---|---|---|---|---|
| Department of Road (DOR) | Highway | 39.9 | 14.1 | 18.0 | 72.0 | H02, H03, H16 |
| | Feeder Road (Primary) | 136.0 | 70.5 | 112.6 | 319.0 | 14 Feeder roads |
| | Feeder Road (Secondary) | 45.1 | 27.0 | 0.0 | 72.1 | 22 Feeder roads |
| | Strategic Urban Road | 59.6 | 4.9 | 27.2 | 91.7 | 59 Urban Roads |
| | Total | **280.5** | **116.5** | **157.8** | **554.8** | |
| District/ Municipality | District Road | 400.4 | 36.0 | 90.6 | 527.0 | |
| | Urban Road | 269.6 | 116.0 | 127.3 | 512.9 | |
| | Total | **670.0** | **152.0** | **217.9** | **1,039.9** | |
| | Total | **950.5** | **268.5** | **375.7** | **1,594.7** | |

Source: DOR Statistic of Strategic Road Network 2009/2010

All the national highways and strategic urban roads except for some sections of the urban road in Lalitpur District are paved, however, the feeder roads including primary and secondary are only 60% paved, and earthen road still exist in Kathmandu and Lalitpur districts.

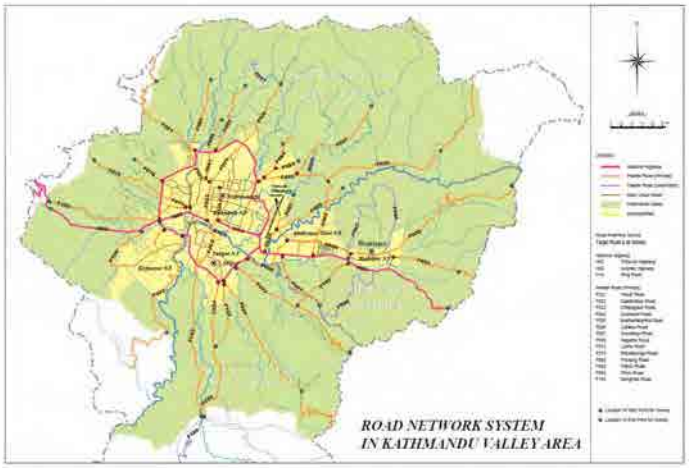



**Figure 2.1 Road Network System in Kathmandu Valley**

There are approximately 570,000 vehicles registered in the Bagmati Zone which is almost half of the total vehicles registered in Nepal. The number of registered vehicles is rapidly increasing in Kathmandu, particularly, in the recent five years accompanied with the rapid increase of urban population and economic development.

**Table 2.3 Vehicles Registered in Kathmandu Valley**

| Vehicles registered in Bagmati Zone | | | | | | |
|---|---|---|---|---|---|---|
| Year | Bus、Mini, Micro&Temp | Car/Jeep/Van | Motorcycle | Truck/others | Total | Accumulative |
| 2000 | 10,150 | 44,777 | 89,782 | 7,453 | 152,162 | 152,162 |
| 2001 | 710 | 2,649 | 22,852 | 782 | 26,993 | 179,155 |
| 2002 | 760 | 2,999 | 21,558 | 811 | 26,128 | 205,283 |
| 2003 | 1,082 | 6,788 | 18,035 | 561 | 26,466 | 231,749 |
| 2004 | 1,353 | 12,287 | 20,003 | 512 | 34,155 | 265,904 |
| 2005 | 1,048 | 3,603 | 21,604 | 1,070 | 27,325 | 293,229 |
| 2006 | 868 | 4,235 | 33,022 | 678 | 38,803 | 332,032 |
| 2007 | 1,086 | 6,601 | 38,852 | 1,237 | 47,776 | 379,808 |
| 2008 | 1,214 | 6,019 | 35,365 | 1,891 | 44,489 | 424,297 |
| 2009 | 912 | 9,471 | 69,359 | 2,096 | 81,838 | 506,135 |
| 2010 | 737 | 8,069 | 53,960 | 1,244 | 64,010 | 570,145 |
| Total | 19,920 | 107,498 | 424,392 | 18,335 | 570,145 | |
| | 3.5% | 18.9% | 74.4% | 3.2% | 100% | |

The motorcycle has increased at an alarming rate of more than 20% in the past five years. If the demand on the motorcycle will increase continuously as the people become affluent, the city roads of Kathmandu Valley will be saturated with motorcycles within the next few years.

At present, public transport is being operated by buses, mini buses, micro buses, and tempos in the valley, however, the services being provided by this public transport are far below the satisfactory level. Over-crowding, left-of-passengers, and malfunction of fleets are daily events. Vehicles used for public transport are usually old and the total number is not sufficient to cater with the demands of the riding public.

Since there is no railway system in the valley at all, public transportation in Kathmandu Valley has been provided by bus and minibuses on major roads, micro buses, and tempo network on secondary roads.

These bus services are being operated by private bus companies, however, city bus service and commuter bus service are very complicated and most of these routes that end in the central area of the city, contributes to chaotic traffic jam of the city road.

# CHAPTER 3 ROAD DEVELOPMENT POLICY AND EXISTING PLANS

## 3.1 Latest Policy of Road Development

The Twenty-year Road Plan was published in 2001 to develop the SRN by DOR. The planned future status of SRN is 4,040 km extension of the total length to reach up to 9,206 km for the whole country.

The Study on Sector-wide Road Programme and Priority Investment Plan was conducted primarily for the maintenance and development of the SRN. The key objective of the study is to prepare a Ten-year Priority Investment Plan (2007-2016) for SRN, including recommendations for expansion and improvement.

After the two primal national plans, the Business Plan was published in 2010 which is the latest activated plan in DOR. This plan is based on the performance evaluation of the Three-year Interim Plan-I (2007-2010) and covers plan period of the Three-year Interim Plan-II (2010-2013). The overall goal of this plan is the development of SRN to provide a sustainable and efficient road service by managing the main arteries of the road network.

## 3.2 Road Network Development Plan in the Previous M/P (in 1993) and Subsequent Progress

The JICA M/P "Kathmandu Urban Road Development" conducted in 1993 aimed to formulate the master plan of urban road network for Kathmandu Valley with a target year of 2015 as shown in Figure 3.1.

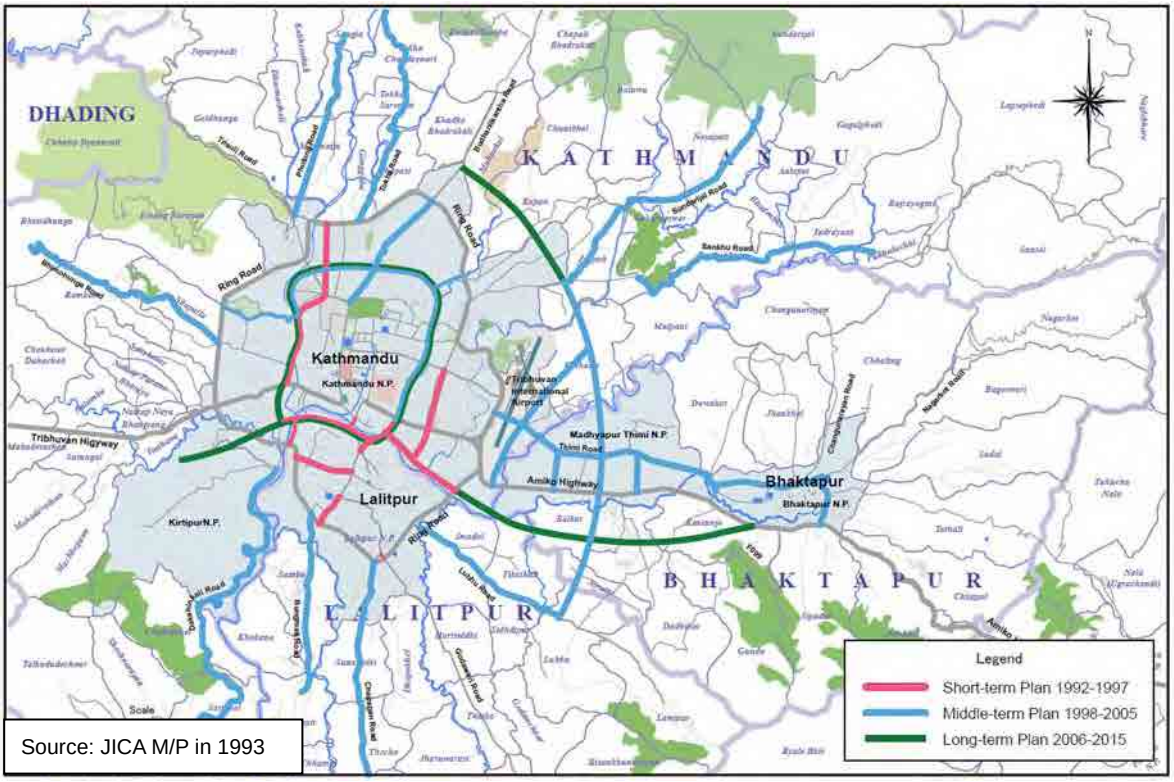



**Figure 3.1 Proposed Road Network System in 1993 M/P**

The basic concepts employed for the road development and the major development plan and projects proposed in the previous M/P (in 1993) are as follows:

(1) To strengthen the east-west transportation corridor as an axis of the capital of Kathmandu Valley;

(2) To build an efficient road network system inside the Ring Road to streamline the traffic in central areas;

(3) To strengthen the feeder road network to promote a well-balanced urban development and to provide efficient transportation network in newly developed area shifting outward; and

(4) To dissolve the bottleneck points of the city road network;

In accordance with the recommendation made in the above previous M/P (in 1993), DOR has implemented high priority projects in the past two decades to solve the bottlenecks of traffic flow in the valley and the following are the major projects implemented:

- Construction of New Bagmati Bridge including Thapatali Intersections in 1995 (JICA)
- Western Link of the Inner Ring Road along Bishunumati River (ADB)
- Signalization of Nine Major Intersections on Major Urban Road inside the Ring Road (JICA)
- Construction of Balaju Bus Terminal (JICA)
- Southern and Eastern Links of Inner Ring Road along Dhobhi Khola and Bagmati River (under construction by DOR)
- Kathmandu–Bhaktapur Road Improvement Project in 2011 (JICA)

## 3.3 On-going Major Road Improvement Project

Bhaktapur-Dhulikel Road Widening Project is planned by DOR to mitigate the traffic congestion on the road of Arniko Highway taking into consideration the full opening of the Sindhuli Road in 2015. The detailed engineering survey and design were already completed in 2011 under the administration of DOR.

Kathmandu Sustainable Urban Transport Project (KSUTP), which is being implemented with the assistance of ADB, consists of four major improvement components comprising public transport, traffic management, pedestrianisation, and air quality.

Widening of the Existing Ring Road is planned with a technical and financial assistance of the Chinese government to relieve the traffic congestion of the existing Ring Road. It is planned to widen four traffic lanes including service roads and green belts, intersection improvements, installation of parking facilities for public transport, etc. The construction of widening is expected to be commenced soon.

Outer Ring Road Development Project has been planned by the Nepalese government to facilitate the expansion of urban area as well as guiding the present trend of fast urbanization outside the existing Ring Road. Prefeasibility study was already conducted in 2000 and proposed a road alignment of 66 km. The concept of land pooling process was accepted by the Government of Nepal, and the Outer Ring Road Development Project (hereinafter referred to as “ORRDP”) Office was established in 2004/2005.

Grade Separated Intersections at Five Major Junctions in Kathmandu is planned by DOR in order to improve the level of service for vehicular and pedestrian traffic at intersections of the major road inside the Ring Road, which includes the junctions of Old Baneshwor, New Baneshwor, Thapathali, Tripureshwor, and Kalimati. Construction of flyover at New Baneshwor Intersection will be commenced in advance out of the five junctions.

Widening of Existing Major Urban Roads is being undertaken by KVTDC in collaboration with MTP and DOR. The government decided to demolish illegally occupied roadside houses and buildings built inside the ROW. The actual progress as of the end of June 2012 has reached to approximately 35 km, and another 30 km will be demolished in the near future according to the present plan of KVDA.

Railway and Metro Development Project is planned by the Department of Railways to cope up with the rapid increase of population in the future as well as the traffic demand in the Kathmandu Valley. The feasibility study of mass rapid transit system in Kathmandu Valley is undertaken by the consortium of the Korean engineering groups and will be completed within 2012. The underground and elevated railway systems along and within the Ring Road will be examined to solve the problems of traffic congestion, slow movement of traffic, and movement of large numbers of passengers in the Kathmandu cities.

# CHAPTER 4 PRESENT ROAD CONDITIONS

## 4.1 Road Inventory Survey

A road inventory survey was conducted on major arterial roads including national highways, feeder roads, and urban roads to identify the existing characteristics, problems, and issues on the traffic and road network in Kathmandu Valley.

In addition, roadside condition survey was also conducted along the major roads to examine the future road development from the viewpoint of land acquisition situation.

## 4.2 Target Road of Road Inventory Survey

Road inventory survey was conducted on the roads inside the Kathmandu Valley with a total length of 452.8 km. The 421.1 km of the total road length is under the jurisdiction of DOR and the remaining 31.7 km is under the jurisdiction of the municipality. The survey covered the three routes of the national highway, 26 routes of major feeder roads, ten routes of minor feeder roads, 48 routes of strategic urban roads, and 40 routes of ordinary urban roads.

Roadside condition survey covered 41 routes with a total span of 346.9 km covering three national highways, 26 major feeder roads, 10 minor feeder roads, and two river corridors (Dhobhi Khola and Bishunumati River).

## 4.3 Present Road Conditions

(1) National highway

Black topped pavement and good surface condition were observed along almost all the surveyed sections of the national highway. The target roads are comprised of more than two-lane sections. There are no one-lane sections observed along the national highway.

1) Tribuvan Highway (H02):

The Tribuvan Highway is composed of a four-lane section from Tripureswor to Kalanki and a two-lane from Kalanki to Nag Dhunga Bus Stop. Fair or bad surface conditions along the two-lane part from Kalanki to Nag Dhunga Bus Stop were observed. In terms of the extent of difficulty for road widening, moderate to difficult level (Number of encroached houses is about 6–10 houses or more within the ROW per 100 m) were observed at majority of the sections.

2) Arniko Highway (H03):

The Arniko Highway is composed of a four-lane section from Maitighar to Suryabinayak (Bhaktapur) and a two-lane from Suryabinayak to Sanga. Especially for the four-lane section, Arniko Highway was improved by the current project on the improvement of Kathmandu-Bhaktapur Road. Good surface conditions were observed along all surveyed sections. In terms of the extent of difficulty for road widening, a non-significant level (Number of encroached houses is about 0–5 houses within the ROW per 100 m) were observed at majority of the sections excluding the area near Sanga.

3) Ring Road (H16):

The Ring Road is composed of the two-lane section excluding sections near Kalanki, Gaushala-Chabahil, and Tinkune-Koteshwor which are four-lane partially according to the result of pavement width. Good surface condition were observed along the majority of the sections, however, fair surface condition were recorded near Sinamangal (Tribuvan Airport), Ekantakuna, and the part between Gaushala and Chabahil, specifically. In terms of difficulty for road widening, non-significant level (Number of encroached houses is about 0–5 houses within the ROW per 100 m) were observed at majority of the sections except for the area between Gaushala and Sinamangal (Tribuvan International Airport) which was recorded as difficult from medium level (Number of encroached houses is about 6–10 houses or more within ROW per 100 m).

(2) Major feeder road

The sections of black topped pavement were observed on majority of the surveyed major feeder roads, however fair and bad surface condition were recorded on 30% of the surveyed routes. Therefore, the extent of pavement surface condition was very low compared with the quality of the National Highway.

The surveyed major feeder roads were located in all directions from the center of Kathmandu Valley. The characteristics of each part are as follows:

Northern part: Except Budhanilkantha Road (F025), the present condition of pavement width is relatively narrow and the routes in general were determined to have 1 to 1.5-lane. Budhanilkantha Road (F025) was observed to have the highest upgraded road in terms of pavement width, type, and pavement condition compared with other major feeder roads located in the northern part of the valley. It was observed that all sections of this road have black topped pavement, and composed of four-lane part at the city central area from Tripureswor to Lainchaur, and two-lane part from Lainchaur to Budanilkantha.

Eastern part: The routes which have more than two-lane are located on the parts of Sankhu Road (F026) between Chabahil and Bagmati River, and whole section of Thimi Road (F086) from Jadibuti to Sallaghari. These routes were made up of black topped pavement. However, bad surface conditions were observed on some parts of these routes. Lubhu Road (F072) is one of the major radial roads in the eastern part. In terms of pavement type and condition, almost all sections were considered as black topped road and a part between Gwarko and Lubhu were observed with good surface condition. However, this road is classified as 1 to 1.5-lane only, and the extent of difficulty for widening was observed as moderate to difficult level on some parts between Gwarko and Lubhu. In the southern area from Arniko Highway within eastern part, no major arterial routes were upgraded to more than two-lane.

Southern part: Several major radial roads are located within the southern part. In terms of the results of pavement width, type, and condition, Bungmati Road (F103), Dakshinkali Road (F022), Godawari Road (F024), and Chapagaun Road (F023) can be classified as main arterial radial roads.

Western part: There were no major routes upgraded to more than two-lane section as well as black topped pavement with good condition except for Tribuvan Highway in the western part.

(3) Minor feeder road

All surveyed minor feeder roads are located in the eastern part of the valley. The routes located in remote areas such as Mulpani-Sangdaha-Changunarayan-Tilkot Road (F095), Sankhu–Kattike (F096), and Kamalbinayak-Sudal-Adikarigaun Road (F098) are classified as earthen or gravel roads. More than half of the surveyed routes were assessed to have bad surface condition. Almost all parts of the minor feeder roads comprised only of 1 to 1.5-lane section.

(4) Strategic urban road

Majority of surveyed routes were classified as black topped pavement road. Half of the routes were assessed to have good surface condition, however half of the routes were measured as fair or in bad surface condition. Kalimati-Balkhu (TU Road) (KMU002), Tripura Marga (KMU012), and Prithvi Path (KMU013) etc. are classified as four-lane routes.

(5) Urban road

Almost all routes comprised of one- to two-lane sections and made up of black topped pavement. However, about 30% of the routes were observed to have bad surface condition. Majority of the surveyed routes are located in KMC core area such as Thamel and Kathmandu Durbar Square. In this area, several routes were observed to have two-lane sections and black topped pavement based on the survey result, however, the actual condition along these routes are quite different due to many street shops opening in the daytime and tourists around the Thamel core area. Therefore, the actual capacity to deal with vehicle movement can be lowered even if there is enough space for a two–lane section.

# CHAPTER 5 METHODOLOGY OF THE TRAFFIC SURVEY

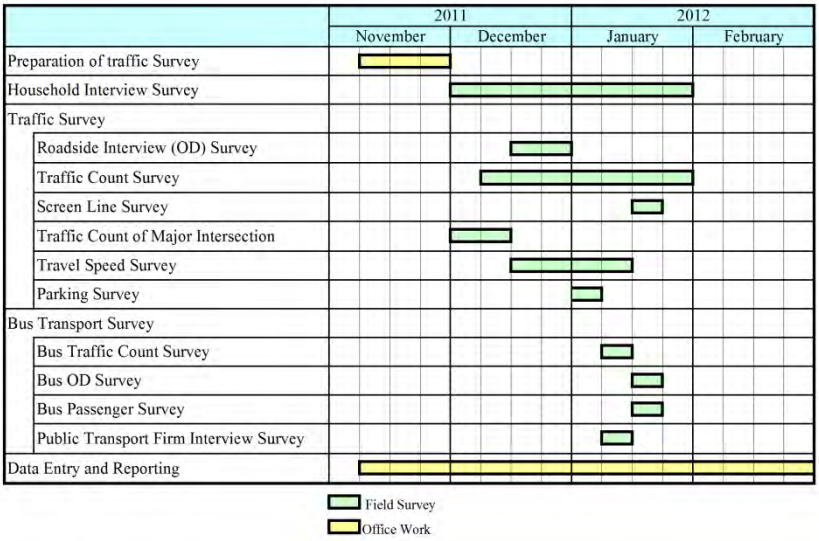
## 5.1 Basic Policy for the Traffic Survey

Traffic survey was conducted based on the following policies:

1) Consistency with the traffic survey in the previous M/P (in 1993);
   Consistency of survey method such as zoning, location of survey point, and survey duration is required for comparison of survey results between 1991 and 2021.
2) Reflection of urbanization in recent years; and
   Urban expansion and transition of land use affects the traffic movement. Decision of the survey method should be made considering the urbanization in the survey area.
3) Traffic surveys which consider measures for the improvement of traffic condition.
   To solve the current traffic issues, multiple measures including road development and public transport improvement are required. The traffic survey method should be decided in view of these measures.

## 5.2 Survey Schedule

**Table 5.1 Survey Schedule**




## 5.3 Household Interview Survey

### (1) Outline

**Table 5.2 Summary of Household Interview Survey**

| Type of survey | Purpose | Method | Contents of survey |
|---|---|---|---|
| Household interview survey | To capture people's movement such as origin, destination, trip purpose, travel time, and etc. | Interview household members in their houses and prepare questions | Sample households: 18,000 within the survey area |

### (2) Survey Area

The survey area of the household interview survey in 1991 was limited to the Kathmandu municipality, Lalitpur Municipality, and Bhaktapur Municipality. Considering the expansion of urban area and the distribution of population, the survey area of household interview survey in 2011 was expanded to the Kathmandu Valley which excludes mountainous area of three districts.

### (3) Questionnaires for Household Interview

Questionnaires for home interview consists of 1) questions for household, 2) information of family

members, and 3) questions for trips made by family members.

### (3) Number of Collected Data

A total of 18,100 households were interviewed in December 2011 and January 2012 for the survey. Sampling rate was 3.13%, which exceeded the target sampling rate.

**Table 5.3 Total Number of Collected Data for Household Interview Survey**

| | |
|---|---|
| Total number of collected household data | 18,100 |
| Valid household data | 17,592 |
| Total number of valid household member data | 70,524 |
| Sampling rate | 3.13% |

Source: JICA Survey Team

## 5.3 Traffic Survey

**Table 5.4 Summary of the Traffic Survey**

| No. | Type of Survey | Purpose | Method | Contents of the Survey |
|---|---|---|---|---|
| 1 | Roadside interview (OD) survey | To capture vehicle's origin, destination, trip purpose, and etc. Survey points surrounding the Ring Road and surrounding the Bhaktapur urban area compose cordon lines which control the result of household interview survey. | Interview drivers at survey points | Survey point: 18 points |
| 2 | Traffic count survey | To capture traffic movement | Traffic counts by direction and by type of vehicle at survey points along the arterial roads | Survey points: 44 |
| 3 | Screen line survey | To confirm the accuracy of person trip survey | Traffic count at the river crossing points | Survey point: 10 points |
| 4 | Traffic count survey of major intersections | To optimize signalized system at major intersections | Traffic count by vehicle type and by direction at major intersections | Survey point: 10 points<br>3hrs in morning peak and 3hrs in evening peak |
| 5 | Travel speed survey | To analyze vehicle speed affected by traffic congestion | Investigation of travel time by running each route | Survey route: 16<br>3 rounds per day |
| 6 | Parking survey | To capture parking demand of trucks | Counting number of vehicles parking along the Ring Road where many parking vehicles were observed regularly at night | Survey route: Ring Road once (starting 11pm) |

## 5.4 Bus Transport Survey

**Table 5.5 Summary of Bus Transport Surveys**

| No. | Type of Survey | Purpose | Method | Contents of Survey |
|---|---|---|---|---|
| 1 | Bus traffic count survey | To capture the total number of bus transport operating from bus terminals. | Counting number of bus transport at Old and Gongabun Bus Park by type | Survey point: 2<br>24 hrs, 1 day (workday) |
| 2 | Bus OD survey | To capture the operating routes of bus transport coming into the bus terminal. | Interview bus drivers at bus terminals | Survey point: 2<br>24 hrs, 1 day (workday) |
| 3 | Bus passenger interview survey | To capture the travel demand and needs of bus transport passengers. | Interview bus transport passengers | Survey point: 2<br>24 hrs, 1 day (workday)<br>2,500 passengers<br>(2,000 in Old, 500 in Gongabun) |
| 4 | Public transport firm interview survey | To obtain the information of operation and administration of bus transports. | Interview bus transport operating firms | 100 firms |

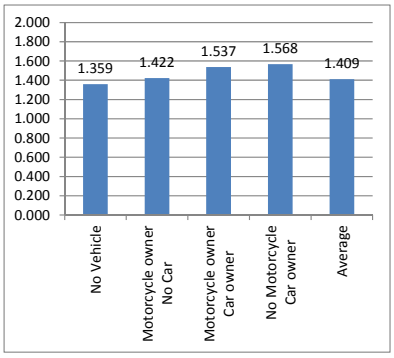
# CHAPTER 6 PRESENT TRAFFIC CONDITION

## 6.1 Movement of Persons

### (1) Trip Production Rate

The total number of trips made by residents in the survey area was counted to 3,483,393 trips. Trip generation rate is the average number of trips made by one person.

The average trip production rate in the survey area was 1.409. The trip production rate of people having vehicles was higher than people without vehicles because vehicles enable people to move freely.

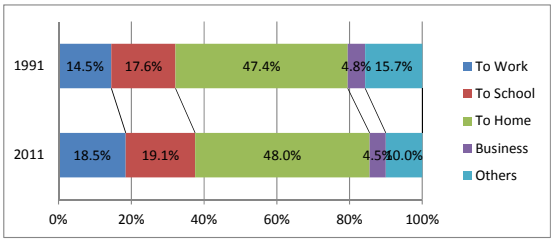



Source: JICA Survey Team

**Figure 6.1 Trip Production Rate by Ownership of Vehicles**

### (2) Trip Purpose

Comparison in the composition of trip purpose between 1991 and 2011 showed that the proportion of "Others" decreased while "To Work" and "To School" increased insignificantly. Work and school activities increased more than other activities.




Source: JICA Survey Team

**Figure 6.2 Comparison of Trip Purposes between 1991 and 2011**

**Table 6.1 Trip Composition by Purpose**

| Trip Purpose | Number of Trips | Percentage (%) |
|---|---|---|
| To Work | 634,461 | 18.5 |
| To School | 657,030 | 19.1 |
| To Home | 1,649,236 | 48.0 |
| Business | 153,469 | 4.5 |
| Others | 344,197 | 10.0 |
| Total | 3,438,393 | 100.0 |

Source: JICA Survey Team

### (3) Trip Distribution

Figure 6.3 shows the trip distribution of all purposes. Concentration of trips to Kathmandu N.P. (100) and Lalitpur N.P. (300) was evident and movement within the said municipalities was largest.

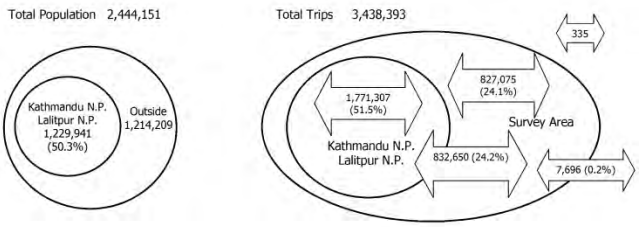
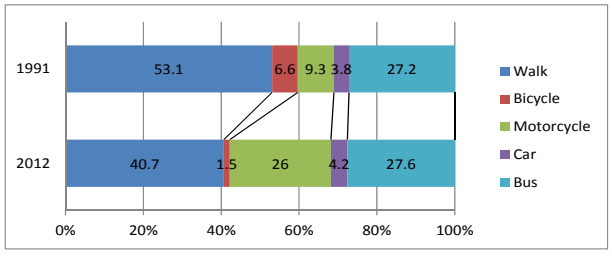



**Figure 6.3 General Person Trip Movement in the Survey Area**

### (4) Travel Mode

Walking occupied the largest proportion among travel modes. But if the 2012 survey is compared with the 1991 survey, proportion of walking decreased largely, while motorcycle increased filling the decrease as shown in Table 6.2 and Figure 6.4.




Source: JICA Survey Team

**Figure 6.4 Comparison of Travel Mode between 1991 and 2011**

**Table 6.2 Trip Composition by Mode**

| Travel Mode | Number of Trips | Percentage |
|---|---|---|
| Walk | 1,398,378 | 40.7 |
| Bicycle | 52,445 | 1.5 |
| Motorcycle | 893,126 | 26.0 |
| Car | 145,980 | 4.2 |
| Bus | 948,464 | 27.6 |
| Total | 3,438,393 | 100.0 |

Source: JICA Survey Team

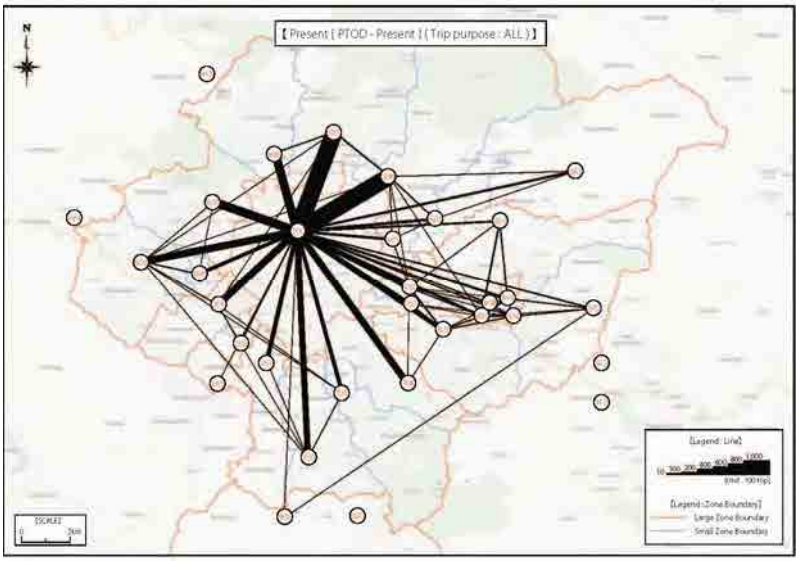
## 6.2 Vehicle Movement

### (1) Trip Distribution

Desire line of vehicle trips is shown in Figure 6.5. Almost all the desire lines of vehicle trips are concentrated in Kathmandu N.P. and Lalitpur N.P.

### (2) Traffic Volume

Figure 6.6 shows the 24 hour traffic volume of all vehicle types. Largest volume was observed at survey point 16 (Thapathali). Second largest was at 24 (in front of the Supreme Court). Inside the Ring Road, traffic volume exceeded 20,000 at most of the points.




Source: JICA Survey Team

**Figure 6.5 Vehicle Trip Desire Line (All Vehicle Type)**

## 6.3 Bus Operation and Movement

The number of operations at each bus parks was obtained through the public transport firm interview survey and bus count survey carried out by the Survey Team. The number of operations starting from these bus parks is shown in Table 6.3. The total number of operations starting from Kathmandu City Center was around 12,900. Operations from Ratnapark and N.A.C outnumbered the operations in the Old Bus Park. The area of the Old Bus Park was not sufficient to manage all the buses coming into the city center area. Since the bus parks other than the Old Bus Park are located along roadside of the trunk road in the city center, buses hampered the traffic.

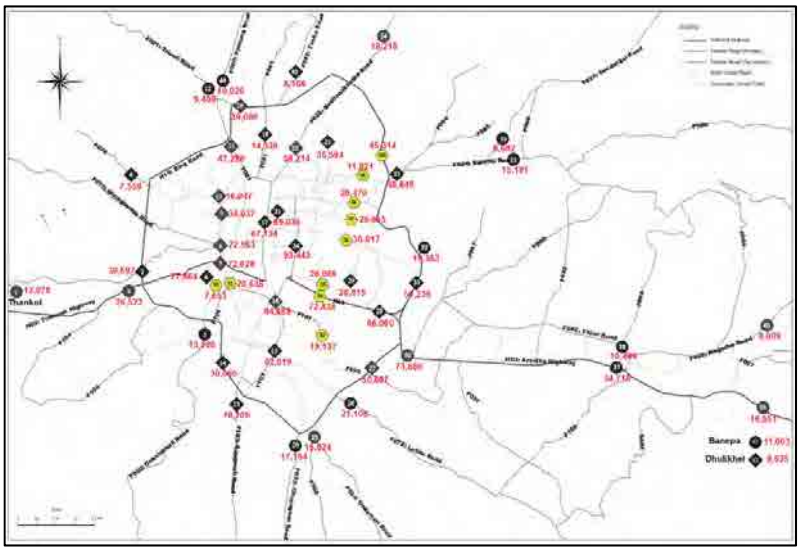


**Figure 6.6 Daily Traffic Volume (24-hour Traffic)**

**Table 6.3 Bus Operations from Bus Parks**

| | Large Bus | Minibus | Micro Bus | Tempo | Total |
|---|---|---|---|---|---|
| Old Bus Park | 110 | 1,115 | 1,086 | 0 | 2,311 |
| Ratnapark | 45 | 288 | 3,438 | 1,025 | 4,796 |
| NAC | 0 | 367 | 2,042 | 2,444 | 4,853 |
| Sahid gate | 0 | 69 | 833 | 0 | 902 |
| TOTAL (Kathmandu center) | 155 | 1,839 | 7,399 | 3,469 | 12,862 |
| Lagankhel | 80 | 1,324 | 2,584 | 1,200 | 5,144 |
| Gongabun Bus Park | 169 | 605 | 230 | 0 | 1,004 |

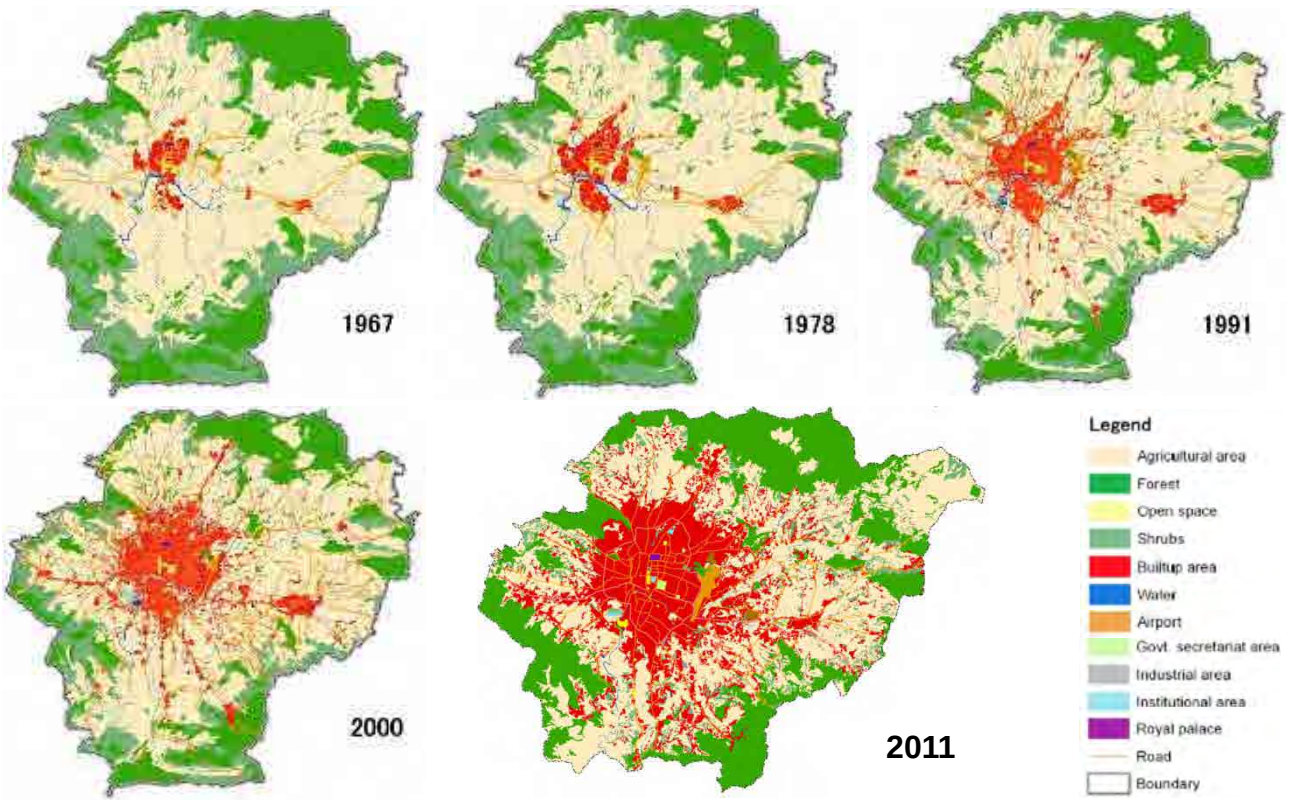
Remark: Old Bus Park and Gongabun Bus Park were surveyed using the bus count survey. Other stations were done using the public transport firm interview survey.
Source: JICA Survey Team

# CHAPTER 7 LAND-USE SURVEY AND URBAN PLANNING

## 7.1 History and Urbanization of the Kathmandu Valley

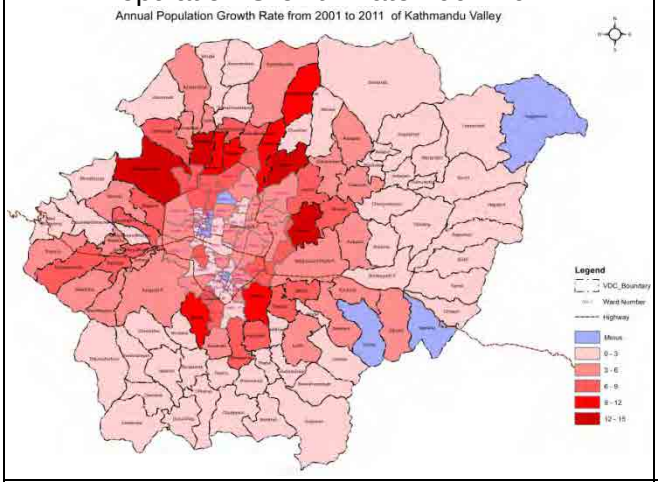
- Unplanned rapid urbanization is a major issue on the development of the Kathmandu Valley. The figures below clearly show this situation.

Expansion of Built-up Area in the Kathmandu Valley



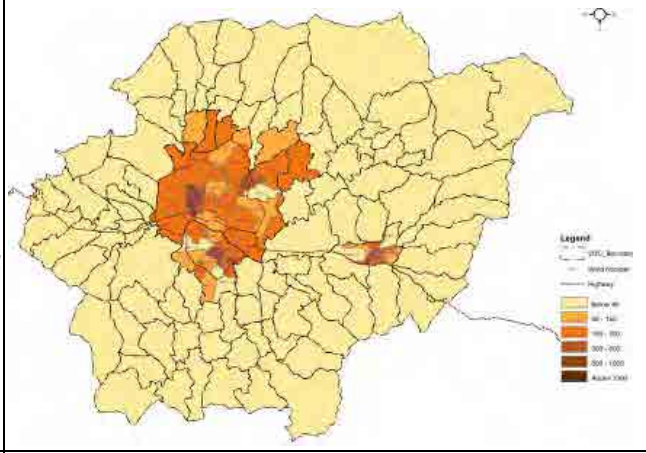

- Spill-out of population to outside the Ring Road started around the 1980s.
- Spread pattern of urbanization was just out of the fringe in the Ring Road and along the feeder roads.
- Urbanization for the last decade was widespread in the valley.

Population Growth Rate 2001-2011




- High population growth can be seen outside the Ring Road, especially in the north and east.
- 4 VDCs showed more than 12% annual growth rate in the last decade.

Population Density in 2011

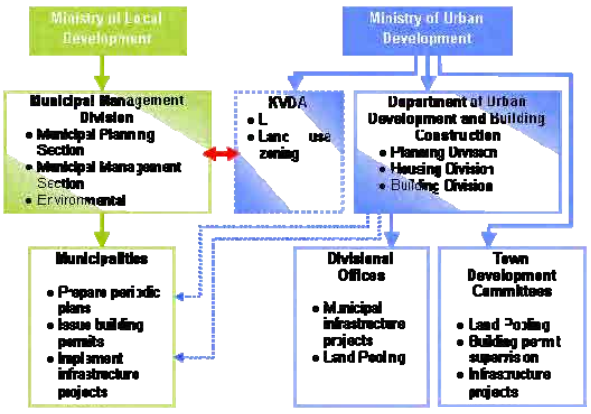



- Three-quarter of inside the Ring Road have over 200 person/ha population density.
- Old town area has over 1,000 person/ha density.
- Outside the Ring Road reached 80 person/ha.

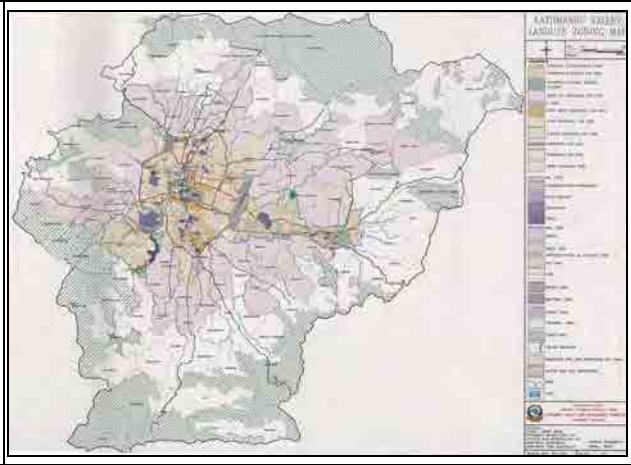
Population distribution policy and appropriate population density planning is necessary to accommodate the increasing population on limited land in the valley.

## 7.2 Institutional and Legal Framework

- Weak manpower and imperfect regulations are main issues of institutional and legal framework.




- There are two line ministries in charge of urban development.
- Ministry of Urban Development and KV Development Authority were established in April 2012. Institutional structure has changed.



- Land Use Plan in KV Building By-law 2007 was originally prepared in 1976 and minor updating in the 1990's. The land use plan should be revised and upgraded as an appropriate urbanization control tool.

## 7.3 Urban Development Activities in Kathmandu Valley

- KVTDC has completed two (2) site and service development projects and twelve (12) land pooling projects. Also, the constructions of ten (10) land pooling projects are on-going. Guided land developments opened a total of 320 km access road being undertaken by KVTDC.

**Planning Permision from Municipalities**

| | Kathmandu | | | Lalitpur | | | Bhaktapur | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of Project | Area (m2) | Unit/ Plot | No. of Project | Area (m2) | Unit/ Plot | No. of Project | Area (m2) | Unit/ Plot |
| 2003 | | | | 3 | 31,370 | 11 | | | |
| 2004 | 3 | 36,201 | 89 | 4 | 45,217 | 222 | | | |
| 2005 | 7 | 101,387 | 514 | 2 | 31,404 | 0 | 1 | 22,092 | 101 |
| 2006 | 5 | 69,017 | 375 | 2 | 20,907 | 227 | 2 | 20,711 | 45 |
| 2007 | 27 | 159,909 | 1,395 | 2 | 8,942 | 265 | 1 | 4,749 | 7 |
| 2008 | 29 | 190,318 | 2,250 | 13 | 131,836 | 1,408 | 1 | 17,607 | 88 |
| 2009 | 22 | 174,290 | 2,038 | 9 | 69,565 | 598 | 2 | 19,876 | 64 |
| 2010 | 19 | 191,157 | 2,015 | 11 | 76,921 | 2,080 | 1 | 1,725 | 10 |
| 2011 | 10 | 83,593 | 577 | 7 | 51,885 | 509 | | | |
| | 122 | 1,005,872 | 9,253 | 53 | 468,047 | 5,320 | 10 | 86,760 | 3,274 |

Source: KVTDC, 2011

- Number of planning permissions showed realty market activities. Development activities by private sector were quite active in the last five years.

**Number of Financial Institutions**

| Types of Financial Institutions | Number of Institutions in Mid July | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 |
| Commercial Banks | 2 | 3 | 5 | 10 | 13 | 17 | 27 |
| Development Banks | 2 | 2 | 2 | 3 | 7 | 26 | 79 |
| Financial Companies | - | - | - | 21 | 45 | 60 | 79 |
| Micro Credit Development Banks | - | - | - | 4 | 7 | 11 | 18 |
| Total | 4 | 5 | 7 | 38 | 72 | 114 | 203 |
| Saving and Credit Cooperatives | | | | 6 | 19 | 20 | 18,000 |

Source: Monetary Policy Report, Nepal Rastra Bank

- Number of financial institutions increased rapidly during the last decade specifically for the last five years. This showed economic growth of realty market.

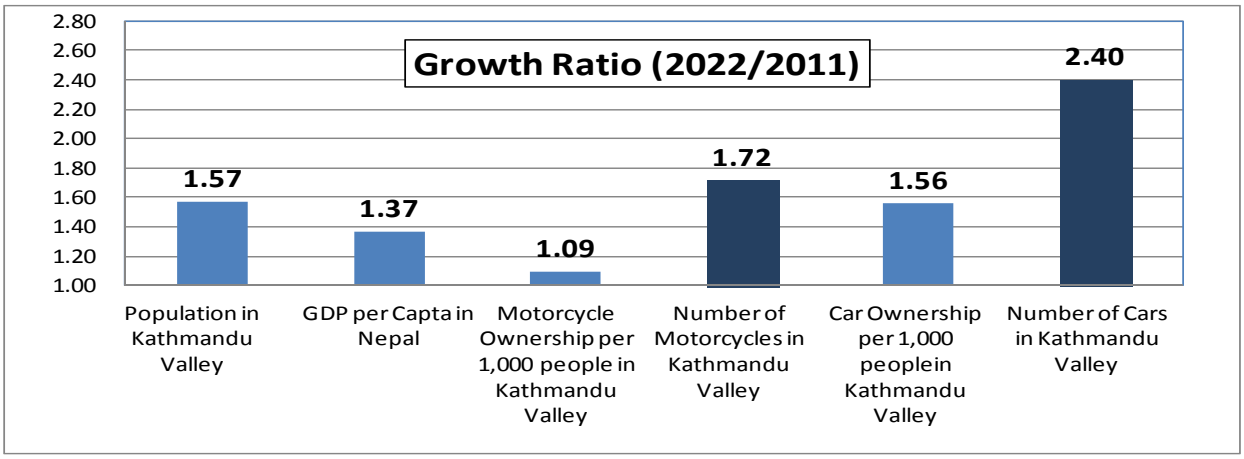
Examples of Group Housing Projects

Examples of Joint Housing Projects

# CHAPTER 8 TRAFFIC DEMAND FORECAST

## (1) Future Socio-economic Background of the Traffic Demand

- In 2022, population in the survey area is assumed to be 3,835,600, with an annual growth rate of 4.18% in 2011 to 2022, this means a population increase of 56.9% since 2011. The growth rate was estimated based on the population census in 1991, 2001, and 2011.
- Future growth of vehicle ownership was estimated by the JICA Survey Team based on household interview survey, growth of population, and GDP per capita. Motorcycle and car ownership of household in Kathmandu Valley will increase to 1.72 and 2.40 times of the present level, respectively.

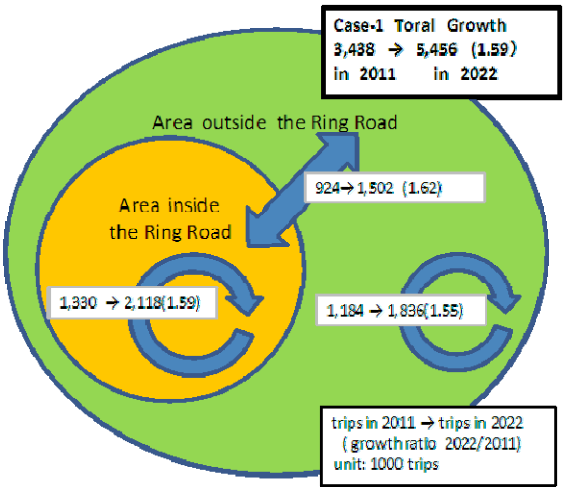


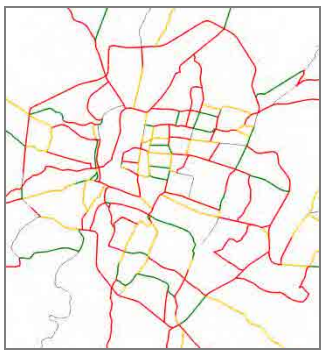

Source: JICA Survey Team

## (2) Future Traffic Demand

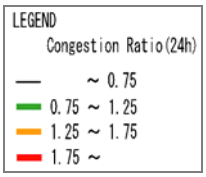
- Total trips in the valley was forecasted to be 5,456 thousand/day in 2022 by 1.59 times of the present (2011).
- Intra-central trips by 1.59 times, inter-trips between the central and suburbs by 1.62 times were relatively higher than intra-suburbs.
- Based on the vehicle ownership estimation, the share of both motorcycle and car will increase continuously in the long run.
- It is fairly said that if nothing will be done for the future, ten years later every activity will be restricted due to severe traffic congestion, particularly along the central area inside the Ring Road.
- On the other hand, if ongoing projects like the Ring Road expansion are completed, it is certain that the level of mobility in 2022 will sustain the same existing level.

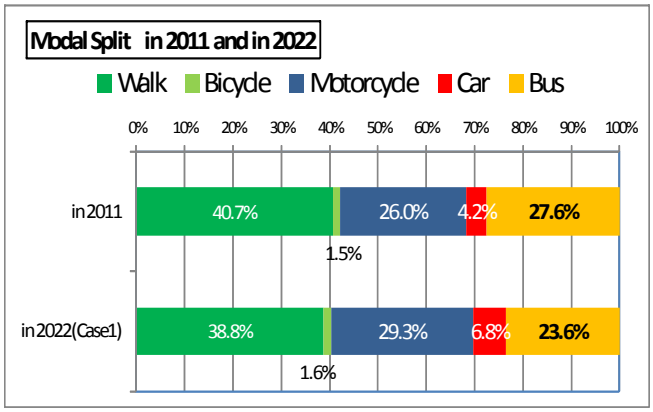
**Person Trip Distribution Pattern**



Do-nothing scenario until 2022 will lead 80% of the roads inside the Ring Road to be terribly congested.



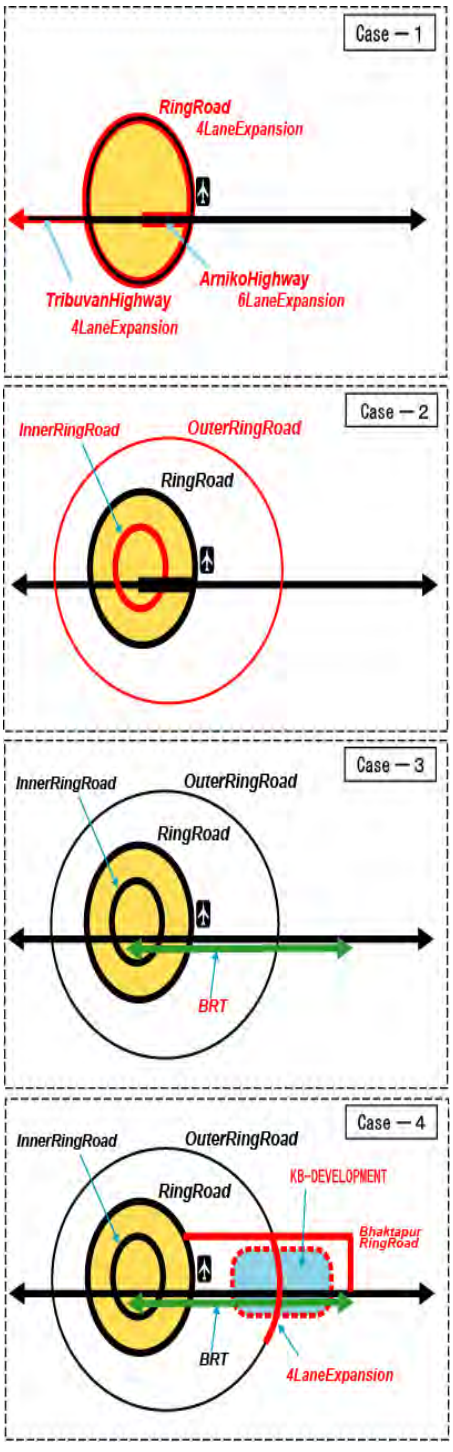




Source: JICA Survey Team

## (3) Case Study for Sustainable Transport in the Long Run

Based on the growth of population, GDP, and vehicle ownership perspectives, it seems that the growth of traffic demand after 2022 might be higher compared to the years between 2011 and 2022. Therefore, to maintain a sustainable transport in the long run, an effective and efficient measure to handle the continuous increase of traffic demand in Kathmandu Valley is required. The following four cases were studied and evaluated for the traffic demand in 2022. As a result, although it was difficult to conclude what is the most suitable strategy for the long-term, it was fairly recommended that Case-4, where the additional road network combined with a change of urban structure and a modal-shift-measure from private to public transport, should be studied as one alternative for the future M/P.

**Comparative Evaluation of Four Cases as Long-term Strategies**




**(Case-1)**----------
●Case-1 assumed that ongoing road projects will be completed: a) Expansion of 1) Ring Road, 2) Arniko Highway, and 3) Tribuvan Highway; and 4) Important feeder and urban roads will be improved to have a capacity of at least two-lane and have at least a fair surface condition.
●Against the increase of 59% demand until 2022, several expansion projects will be very effective.
●Nevertheless, it is difficult for the Case-1 network to deal with the growing demand inside the Ring Road appropriately after 2022 because the network cannot afford to have sufficient capacity.

**(Case-2)**----------
●Case-2 assumed that Inner Ring Road (four-lane) and Outer Ring Road (two-lane) will be added to Case-1 network.
●Inner and Outer Ring Road construction can greatly improve the whole mobility in Kathmandu Valley and congestion inside the Ring Road.
●To produce more effects in the long run, a future M/P envisioned to utilize three Ring Roads effectively by all transport modes in conjunction with efficient land use and preserving historical places will be planned.

**(Case-3)**----------
●Case-3 assumed that bus rapid transit (BRT) between the center of Kathmandu and Bhaktapur will be introduced to Case-2 network.
●To avoid strong dependency on private vehicles, BRT introduction will be one of the effective measures.
●Although modal shift from private motorcycle and car to bus can be promoted by BRT, an introduction of BRT without changing the urban structure and incentives for modal shift are not efficient and sufficient to catch the demand in the long run.
● In order to promote public transport use, not only BRT but also LRT and other measures should be studied in the future M/P.

**(Case-4)**----------
●In order to sustain urban mobility and vitality in the long run, in Case-4 an idea to build a compact city with twin centers is recommended as one of the solutions. As a new sub-center, KB-Development (Kathmandu-Bhaktapur Corridor Development) is suggested. Land use and distribution pattern of population are different from Cases-1, 2, and3 which are based on the trends of expanding to suburb with one center.
● Bhaktapur Ring Road (four-lane) and Outer Ring Road expansion (four-lane) in the development area are added to Case-3 network.
●Case-4 was estimated to reduce the demand of both areas within the central and between the central and suburb by 20%. In practice, it is not easy to build a compact city where people can make trips shorter and can move through walking, use of bicycle, and public transport, so as not too dependent on private vehicles. It is desirable to build, for example, a new industrial park, cargo terminal, and office area along the Arniko Highway close to the new residential towns.

# CHAPTER 9 RECOMMENDATIONS TO FUTURE TRAFFIC MASTER PLAN

## 9.1 Traffic Survey Results and Issues

### (1) Future Traffic Demand and Transport System

Based on the future traffic demand forecast the following points were identified:

- Network system of the Kathmandu Valley may withstand the traffic demand by improving the existing network system such as installation of flyover, construction of inner ring road, and widening of existing road until 2022.
- After 2022, service level of road network will decline rapidly and introduction of new transport system/land use system will be inevitable to sustain the present mobility and urban activity.
- Therefore, ten years before 2022 is the period for the introduction of new system including the establishment of implementation plan, implementation of pilot projects, and reinforcement of relevant institutions.

### (2) New Public Transport System

If the transport network system is dependent on the use of private vehicles, it is expected that the transport system will not meet the future demand in the long-term. The future M/P shall make an intensive investigation on the introduction of new public transport system. Along with the network plan, land use plan should be established simultaneously. **Transit oriented development (TOD)** system is the expected development scheme in Kathmandu Valley.

### (3) Road Network System

1) Network inside the Ring Road: Necessity for the development of basic network such as inner ring road and linking roads with arterial roads, will be required continuously.
2) Improvement of roads cleared from ROW: Importance of carriageway and sideway construction in the demolished ROW of major feeder road.
3) Improvement of feeder roads where traffic demand is concentrated.

### (4) Public Bus

1) Bus terminal: Development of a new bus terminal equipped with sufficient facilities for passengers along the Ring Road at the north-east, west, and south.
2) Bus route: Expansion of feeder road network for bus operation.

### (5) Motorcycle

Responsibility as a road user: Motorcycle users shall bear due responsibility such as payment of parking fees.

### (6) Pedestrian

1) Pedestrian at central area: Separation from vehicles is crucial in the central commercial and heritage areas where walking is the most important travel mode.
2) Pedestrian network: Establishment of a pedestrian network plan as the most primary travel mode.

**(7) Bicycle**

1) The topography in Kathmandu Valley is generally gentle and the trip length of daily travel in Kathmandu Valley is adequate for bicycle use.

2) Therefore bicycle has potential to become citizens' means of daily transportation. The future M/P shall take into account of latent possibility of bicycle use in Kathmandu Valley.

**(8) Non-motorized Transport (NMT)**

1) Promotion of walk and bicycle will not only contribute to decreasing the vehicles but also contribute to improve environment in air quality and noise and to decrease the energy consumption.

2) The future M/P shall contain establishment of network and facilities for Non-Motorized Transportation including pedestrian and bicycle by scrutinizing the strategy.

## 9.2 Land Use Problem and Issues

**(1) Population issues**

1) Rapid population growth: Under the 4.6% annual population growth rate in Kathmandu Valley, population growth is moving towards outer VDCs of Kathmandu and Lalitpur. Built-up area expansion trend might go east and south area because of land availability.

2) Disorderly sprawling built-up area: Built-up area spreads over a large area outside the Ring Road without certain road network expansion. The KVBB 2007 did not contribute to strengthen the road network in the valley.

3) High population concentration inside the Ring Road: Most of the areas inside the Ring Road have over 300 p/ha density. If high population density land use is applied, Kathmandu Valley can accommodate a certain volume of population in the near future.

**(2) Land use and urban development issues**

1) Inappropriate land use plan especially outside the Ring Road: The existing Kathmandu Valley Land Use Plan was prepared in 1976. The outside Ring Road suburban area did not have building control regulation at that time. Land use zoning outside the Ring Road was done quite roughly to preserve and/or conserve mountain slope, river banks, and agricultural fields.

2) Inadequate use of land pooling project: Land pooling (LP) projects in the valley are not contributing much to strengthen road network although some LP projects can build connection roads to the Ring Road.

3) Inadequate urbanization control and environmental protection measure: Land use zoning outside the Ring Road was done quite roughly to control urbanization expansion. Mountain slope, river banks, and agricultural fields should be clearly defined as protection or conservation zone.

4) Lack of planned cargo terminals: Cargo trucks coming from outside the valley used the roadside of the Ring Road as transshipment yard. This caused traffic congestion along the Ring Road.

**(3) Regulation and institutional issues**

1) Divided urban development management in Kathmandu Valley: The Kathmandu Valley Development Authority (KVDA) was established as an upgraded and integrated institute from KVTDC. However, there are still unclear demarcation among related ministries, local governments (municipalities and VDCs) and KVDA.

2) Lack of manpower for building control: Building permission system is functioning only for large-size private sector development projects. The system was ineffective due to lack of manpower.

3) Necessity of continuous training for professional staffs in the public sector: Continuous training of government staffs is not enough to keep certain level of knowledge to implement projects appropriately especially in the municipality and VDC level.

## 9.3 Major Findings and Issues on Road Development

### (1) Overall observation of the existing road network

1) Need of road network reinforcement: Existing road network will become outdated in the near future due to substandard road geometry and lack of connector roads, if the recent trend in traffic volume will continue to increase at the existing road network.

2) Need of an outer ring road leading to regional development: Since the outer ring road plays a key role in facilitating the expansion of urban area as well as guiding the present trend in urbanization, it is recommended for DOR to prepare a concrete implementation plan at an early stage.

3) Necessity of additional links between Kathmandu–Bhaktapur Corridor: The city of Bhaktapur will be exposed to the wave of urbanization and as expected the city will expand in the near future. Examination of additional links between Kathmandu and Bhaktapur corridor is recommended.

4) Weakness of north-south axis inside the Ring Road: The north-south axis inside the Ring Road is extremely weak due to insufficient road capacity. Widening of these roads is expected to be implemented at an earlier stage.

5) Low standard of feeder roads: Improvement or upgrading to higher standard with more traffic lanes on the feeder road is necessary especially for those located in the northern and eastern parts of Kathmandu Valley where population is increasing with a high rate in recent years.

### (2) Specific issues on the existing road network

1) Issue in the Tribhuban National Highway: The construction of substitute route of Tribhuban National Highway should be examined in the future M/P study.

2) Need of upgrading the Bhaktapur–Dhulikhel (Arniko Highway): Since Banepa and Dhulikhel are located within the influence area of Kathmandu Valley, the upgrading of the existing road between Bhaktapur and Dhulikhel should be examined in the future M/P study.

3) Necessity of widening the existing Ring Road: Widening of the existing Ring Road is crucial as one of the vital arterial roads in Kathmandu Valley with a function of dispersing the through traffic away from the central area.

4) Need the dissolution of bottleneck on the feeder roads: DOR should examine the upgrading of the road standards including road widening in the future M/P to break off the traffic jams on feeder roads.

5) Necessity of having the inner Ring Road with high standard: The inner Ring Road was recommended in the previous M/P (1993) as a core arterial road inside the Ring Road. The function of the proposed inner Ring Road becomes more vital today than what was planned in 1993 due to an excessive increase of traffic demand.

6) Necessity of a flyover at main intersections: Intersection survey identified intersections on the main roads that are almost saturated. Since the traffic volume at these intersections which far exceeds the capacity of signalized control, the provision of either an alternative road or construction of grade separated flyover is recommended.

7) Shortage of bridge capacity inside the Ring Road: The shortage of bridge is one the major reasons of traffic congestion in the city roads inside the Ring Road. An earlier realization of the inner Ring Road is one of the solutions to this problem.

**(3) Issues on road structure and design**

1) Measures for an increasing number of motorcycles: It is suggested for DOR to examine the standardization of motorcycle lane in the road design and apply in the widening and/or new construction road project.

2) Provision of sidewalk for pedestrian safety: Provision of a sidewalk separated by roadway, pedestrian bridge, pedestrian crossing, setting of the signalized control for exclusive use of pedestrians, etc. are indispensable for securing the safety of pedestrians and these facilities should be standardized as incidental institution, especially for city roads.

3) Need of bicycle lane and road: The bicycle lane or bicycle road is considered as an effective measure for the improvement on air pollution as well as tourism development in the valley.

**(4) Traffic management, safety, environment, and others**

1) Need of a comprehensive traffic management plan: At present, various traffic management measures are being undertaken in the Katmandu Valley. However, inspite of these measures, the overall situation of road traffic is getting worse which can be seen in the increase in traffic accidents and degradation of the environment.

   The future M/P study should examine traffic management measures taking into consideration the following aspects:

   a. Engineering measures (provision of traffic signal, pedestrian bridge and crossing, etc.)
   b. Physical measures (more parking space, zebra crossing, safety fence, etc.)
   c. Legal measures (traffic regulation, penalty system, etc.)
   d. Administrative measures (one-way system, parking control, etc.)
   e. Educational measures (awareness program on better driving, TV, etc.)

2) Need of a traffic control system: A traffic control system by a traffic control center with sensors and cameras should also be examined in the future M/P either in the medium- or long-term plan.

## 9.4 Recommendation to the Future M/P Study

### 9.4.1 Necessity of the Future M/P Study

The urbanization of the Kathmandu Valley would continue at rather high speed accompanied by the population increase with a high growth rate.

This data collection surveys including road inventory survey, traffic survey, and land-use survey identified the following facts:

**(1) Traffic congestion occurs everywhere in major roads and is becoming chronic due to rapid increase of traffic demand.**

**(2) Insufficient public transport services that cannot support the increasing traffic demand.**

**(3) Urbanization is proceeding in disorderly manner due to lack of proper land-use policy and road network system as well.**

In order to solve the above problems radically, it is indispensable to conduct the future M/P which unifies with the road development, public transport development, and land-use development plans.

Furthermore, it is suggested that the future M/P should be developed taking into consideration the following:

1) To clarify the practical city image which Kathmandu should aim
2) To draw up a future urban traffic policy corresponding to the future image of Kathmandu
3) To devise a concrete enforcement plan to realize the future urban traffic policy

### 9.4.2 Issues to be Considered in the Future M/P Study

**(1) Balanced traffic development plan:**

It is expected that the population in the Kathmandu Valley will come to about 4 million within ten years or so according to the estimation made by the Survey Team. A well balanced future M/P shall be developed by the introduction of three basic polices, that is: strengthening of road network, traffic management, and public transport including the introduction of mass transit.

**(2) Greater Kathmandu covering Banepa and Dhulikhel:**

According to the past trend of urban expansion and availability of land, the expansion of urban area to the eastward will continue and proceed even beyond the Kathmandu Valley up to Banepa and Dhulikhel in the long-term.

It may be considered in the future M/P the integration of Banepa and Dhulikhel into Kathmandu Valley which will be called as “Greater Kathmandu”.

**(3) Examination of mass transit system:**

The feasibility study on Railway and Metro Development Project is being conducted by the DOR (Department of Railways), MOPPWTM, which is expected to be completed in October 2012.

The realization of the mass transit makes a big influence on the transport policy and road development network as well, it is necessary to share information in conjunction with the study results in making the future M/P.

**(4) Consideration of disaster prevention for earthquake:**

It is expected that an earthquake will hit the Kathmandu Valley in the near future. Since the core areas of Kathmandu City is densely populated and developed with small roads and old houses, it is necessary to make a proper evacuation system in the future M/P plan from the viewpoint of disaster prevention.

Evacuation routes with sufficient space for the inhabitants living in the core areas should be considered.

**(5) Needs of extension links connecting the proposed inner ring road with the existing Ring Road:**

In addition to the southern extension link proposed by ADB, northern extension, eastern extension and south-eastern extension links connecting the proposed inner ring road with the existing Ring Road should be examined in the M/P Study to decrease the traffic congestion of city roads inside the Ring Road

**(6) Surface water drainage system**

The appropriate drainage system is indispensable for maintaining the road structure. Therefore, basic plan for the surface drainage network of the Valley shall be examined in the future M/P study.

**(7) Need of supplemental road and traffic surveys:**

To proceed to the future M/P stage, following two supplemental surveys will be needed.

1) Road survey:
   - Re-survey on the urban roads inside the Ring Road where the KVDA is now performing the widening of ROW.

2) Traffic survey:
   - Parking survey at the central area of Kathmandu to clarify the parking condition.
   - Preference survey (PS) to capture the factor for promotion of envisaged traffic mode.

- Survey for goods movement between survey area and outside to identify location of cargo terminal and logistic center.

**(8) Review on the Role of Bhaktapur in the Kathmandu Valley:**

The previous M/P (1993) recommended the valley's integrated development of three core cities such as Kathmandu, Lalitpur, and Bhaktapur. However, population and economic activities are still concentrated in Kathmandu and Lalitpur, but not enough in Bhaktapur area. After the completion of the Kathmandu-Bhaktapur Road construction project in 2010, it is time to reformulate the development plan of Bhaktapur area in the future M/P.

The scenarios should consider population distribution by population density planning to accommodate increasing population in the limited land in the valley.

**(9) Concept of the Kathmandu Valley Land Use and Zoning Plan:**

Land use/zoning classifications and supporting regulations and building by-laws would be designed (amongst others) to support all aspects of improved transportation planning, especially the relative location of residential, commercial and industrial areas, as well as the increase in development densities around public transport nodes. Strengthened environmental management provisions are also needed.

It is necessary to review the direction and outline of existing Kathmandu Valley Land Use and Zoning Plan (2007). Detailed revision of the land use zoning should be discussed in the next phase.

**(10) Necessity of Bus and Cargo Terminals:**

The Survey revealed insufficient capacity of bus and cargo terminals. Although it is difficult to find an open space, these facilities are essential for facilitating the increasing traffic demand including public transport buses and cargo trucks.

The bus terminal plan should be developed in the surrounding areas along the arterial road or the Ring Road taking into consideration the future urban development scheme.

Cargo terminals and logistic center should be discussed in the future M/P to serve the existing cargo movement as well as to encourage economic and social development in Kathmandu Valley.

**(11) Need on Traffic Management Study:**

The survey on traffic management was not included in the data collection survey. Since the traffic management is one of the main means for solving the traffic problems, it should be discussed in the future M/P. Traffic management can expect an effect for few expenses in the short-term, therefore, it should be examined as an immediate action plan in the future M/P.

A traffic control system by a traffic control center with sensors and cameras should also be examined as an improvement plan in the medium or long-term plan.

**(12) Application of the JICA Guideline for Environmental and Social Considerations**

During the future M/P study, the measures for environmental and social considerations should be applied in the plan by ensuring a wide range of meaningful stakeholder participation and transparency of decision-making, as well as by working for information disclosure and ensuring efficiency.

PHOTOGRAPH

## Traffic Survey

| | |
|---|---|
| Training for Household Interview Survey on Dec.2, 2011(Fri)<br>  | Traffic Volume Count at Old Baneshwor Intersection on Dec.8,2011(Thu)<br>  |
| Roadside Interview OD survey at Dakshinkali Road on Dec.18,2011(Sun)<br>  | Re-survey for 16hrs traffic volume count at Sadobato on Mar.27, 2012(Tue)<br>  |
| Household Interview on Dec.13,2011(Tue)<br>  | Household Interview on Dec.13,2011(Tue)<br>  |

PHOTOGRAPH

## Traffic Survey

| | |
|---|---|
| Bus Passengers Interview at Purano Bus Park on Jan.3,2012(Tue)<br>  | Roadside Interview OD Survey at Dakshinkali Road on Dec.18,2011(Sun)<br>  |

## Road Inventory Survey

| | |
|---|---|
| Field Surveyor wearing Jacket, Measuring Tape and ID card.<br>  | Measuring the width of Road 1<br>  |
| Measuring the width of Road 2<br>  | Marking each 100m for measuring<br>  |

PHOTOGRAPH

**Meeting**

| | |
|---|---|
| Inception Report Meeting at DOR<br>Nov.9, 2011(Wed)<br>  | Tender for Traffic Survey & Road Inventory Survey Nov.21, 2011(Mon)<br>  |
| Workshop for Interim Report<br>Apr.27, 2012 (Fri)<br>  | Draft Final Report Meeting at DOR<br>Jul.22, 2012(Sun)<br>  |
| Workshop for Draft Final Report<br>Jul.27, 2012 (Fri)<br>  | Workshop for Draft Final Report<br>Jul.27, 2012 (Fri)<br>  |

PHOTOGRAPH

**Land Use and Urban Development**

| | |
|---|---|
| Site visit to Group Housing project site<br>Nov. 25, 2011 (Wed)<br>  | Visit to a Land Pooling project office,<br>Nov. 29, 2011 (Wed)<br>  |
| Visit to a Land Pooling project site,<br>Nov. 29, 2011 (Wed)<br>  | Site visit to apartment development project site<br>Nov. 30, 2011 (Wed)<br>  |
| Interview to former Mayer of Bhaktapur city,<br>Dec. 15, 2011 (Wed)<br>  | Site visit to Planned Outer Ring Road<br>Dec. 16, 2011 (Wed)<br>  |

**Technical Tour to Japan**

Opening Lecture from Prof. Ohta

May. 15, 2012 (Tue)

Visit to Nagoya Guide Way Bus operation center

May. 17, 2012 (Thu)

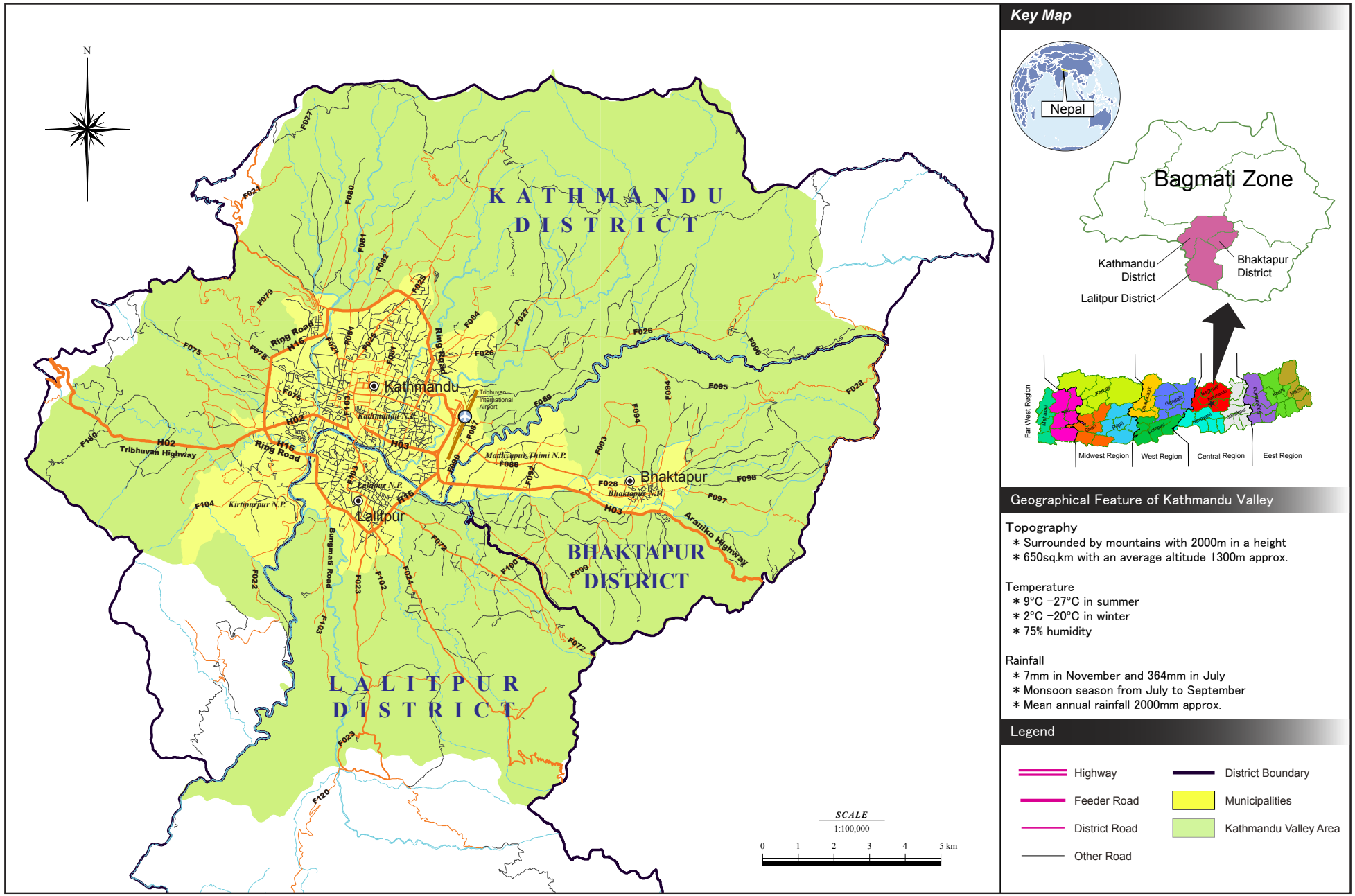
Simulation at Toyota Traffic Safety Education Center, May. 18, 2012 (Fri)


Visit Historical Landscape conservation area of Takayama, May. 20, 2012 (Sun)

Trial ride of shared bicycle system at Toyama city, May. 21, 2012 (Mon)

Visit MRT “Astram line” depot at Hiroshima city

May. 23, 2012 (Wed)




# Location Map

# FINAL REPORT

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**APPENDIX2 FUTURE TRAFFIC DEMAND**



**APPENDIX3 ROAD INVENTORY SURVEY**



**APPENDIX4 LAND-USE SURVEY AND URBAN DEVELOPMENT STUDY**



**APPENDIX5 MINUTE OF MEETING**



**APPENDIX6 WORKSHOP**



**APPENDIX7 COUNTERPART TRAINING IN JAPAN**

# FINAL REPORT

## LIST OF ABBREVIATION

| | |
|---|---|
| ADB | Asian Development Bank |
| ADT | Average Daily Traffic |
| BMC | Bhaktapur Municipality |
| BRT | Bus Rapid Transit |
| CBS | Central Bureau of Statistics |
| CDO | Chief District Officer |
| DDC | District Development Committee |
| DoLIDAR | Department of Local Infrastructure Development & Agricultural Roads |
| DOR | Department of Roads |
| DOTM | Department of Transport Management |
| DR | District Road |
| DUDBC | Department of Urban Development and Building Construction |
| EIA | Environmental Impact Assessment |
| F/S | Feasibility Study |
| FNNTE | Federation of Nepalese National Transport Entrepreneurs |
| FR | Feeder Road |
| GLD | Guided Land Development |
| GON | Government of Nepal |
| IEE | Initial Environmental Examination |
| JICA | Japan International Cooperation Agency |
| KMC | Kathmandu Metropolitan City |
| KVBB | Kathmandu Valley Building By-laws |
| KVDA | Kathmandu Valley Development Authority |
| KVTDC | Kathmandu Valley Town Development Committee |
| KVUDPP | Kathmandu Valley Urban Development Plan & Programs |
| LP | Land Pooling |
| LRT | Light Rail Transit |
| LRN | Local Road Network |
| LSMC | Lalitpur Sub-metropolitan City |
| MOE | Ministry of Environment |
| MOLD | Ministry of Local Development |
| MOLE | Ministry of Labor and Employment |
| MOPPW | Ministry of Physical Planning, Works |
| MOPPWTM | Ministry of Physical Planning, Works and Transport Management |
| MOUD | Ministry of Urban Development |
| M/P | Master Plan |
| MRT | Mass Rapid Transit |

| | |
|---|---|
| MTP | Metropolitan Traffic Police |
| N.A.C. | Nepal Airline Corporation |
| NH | National Highway |
| N.P. | *Nagar Palica* (Municipality Office) |
| NPC | National Planning Commission |
| NPR | Nepal Rupee |
| OD | Origin and Destination |
| ORR | Outer Ring Road |
| pcu | Passenger Car Unit |
| PIP | Priority Investment Plan |
| PT | Person Trip |
| QV | Quantity - Velocity |
| RBN | Road Board Nepal |
| ROW | Right of Way |
| RR | Ring Road |
| SRN | Strategic Road Network |
| TDC | Town Development Committee |
| TDF | Town Development Fund |
| TOD | Transit Oriented Development |
| TYIP | Three Years Interim Plan |
| VDC | Village Development Committee |
| VT | Vehicle Trip |
| WB | World Bank |

# CHAPTER 1 INTRODUCTION

## 1.1 Background of the Survey

The increase in the number of vehicles has caused severe traffic congestions in Kathmandu Valley. Vehicles are caught up in the traffic congestion during the entire day. Traffic congestion is currently one of the most serious problems in the valley.

In 1993, the Japan International Cooperation Agency (hereinafter referred to as "JICA") formulated the Master Plan for Kathmandu Valley Urban Development Plan. Some of the proposed projects have been implemented and helped to improve traffic conditions in Kathmandu Valley. On the other hand, it has been almost 20 years since the master plan was formulated thus it is very critical to update it.

Therefore, the Government of Nepal (hereinafter referred to as "GON") requested the Government of Japan (hereinafter referred to as "GOJ") for the study of the "Kathmandu Valley Traffic Management and Road Development Master Plan" in August 2009 and the "Traffic Improvement Master Plan Study for Kathmandu Valley FY2011-2012" in July 2010.

Based on the requests, JICA dispatched the preparatory survey mission to Nepal in September 2010 and had a series of discussions with relevant organizations and institutions.

After the above-mentioned survey, JICA decided to implement the data collection survey within the framework of the previous master plan (hereinafter referred to as "M/P") to identify main traffic issues and problems in Kathmandu Valley. It is expected that the data will be utilized by GON as well as related organizations and donors to deal with the traffic issues and problems in Kathmandu Valley.

## 1.2 Outline of the Survey

### 1.2.1 Objectives

The objectives of the Survey are to collect traffic data and to identify main transport problems and issues in Kathmandu Valley.

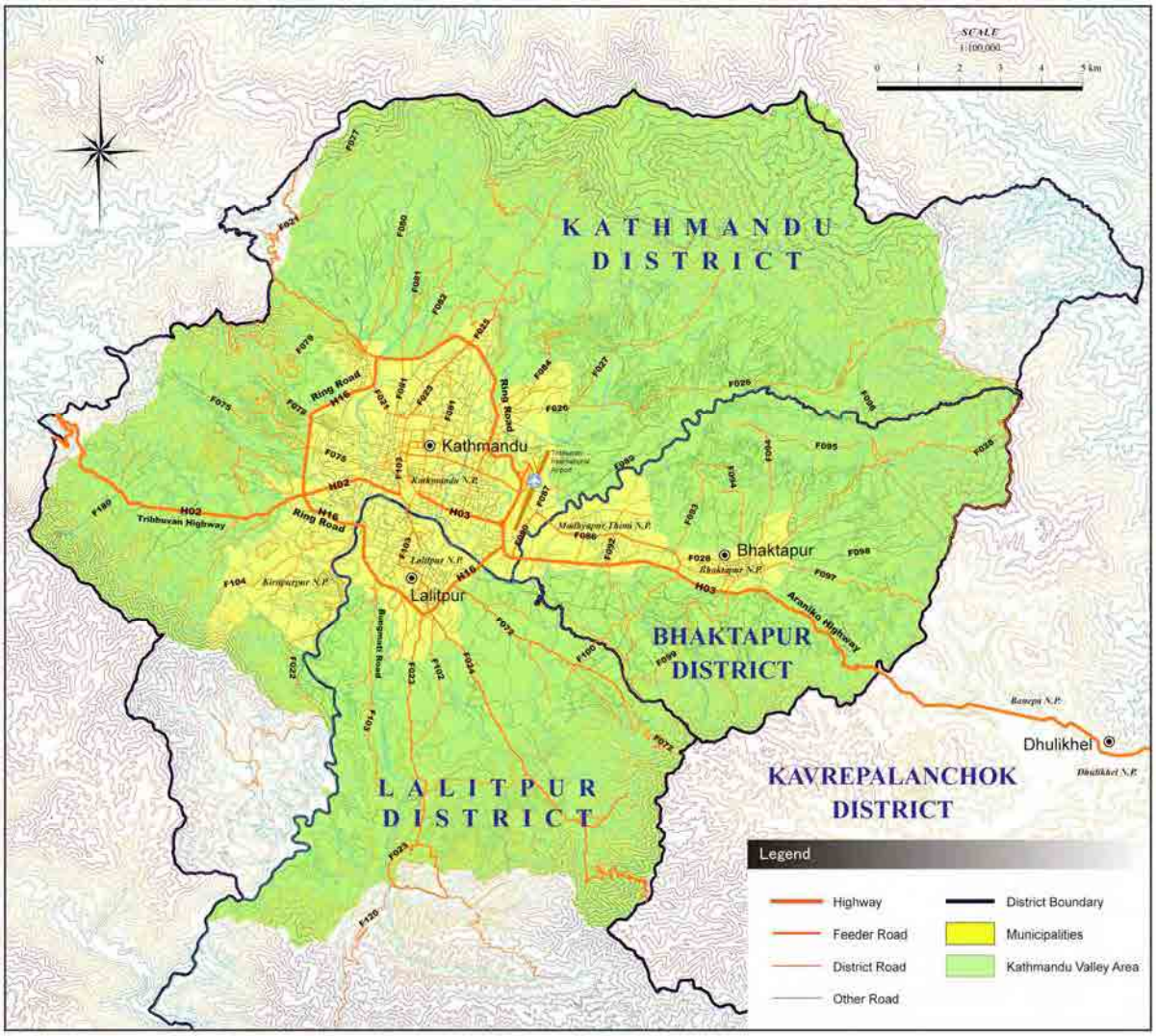
### 1.2.2 Cooperating Agencies

The cooperating agencies are the Department of Roads (hereinafter referred to as "DOR"), the Ministry of Physical Planning, Works and Transport Management (hereinafter referred to as MOPPWTM"), and other relevant organizations.

### 1.2.3 Target Area

Kathmandu Valley is shown in Figure 1.2.1. Kathmandu Valley comprises of three districts including five municipalities as follows:

1) Kathmandu District including Kathmandu Metropolitan City and Kirtipur Municipality;
2) Lalitpur District including Lalitpur Sub-metropolitan City; and
3) Bhaktapur District including Bhaktapur Municipality and Madhyapur-Thimi Municipality;




Source: JICA Survey Team

**Figure 1.2.1 Survey Area**

### 1.2.4 Terms of Reference of the Survey

**(1) Review of the Existing Information, Studies, Plans, and Projects**

1) Review the existing traffic plan of Kathmandu Valley.
2) Review the socio-economic characteristics of Kathmandu Valley.
3) Review and analyze exiting laws, regulations, policies, and institutional arrangements related to the urban transport.
4) Review the urban transport related organizations.
5) Review the urban transport projects done by other donors and related organizations and institutions.

**(2) Basic Data Collection of Urban Development Plan**

1) Review the existing urban development plans within Kathmandu Valley.
2) Review and analyze the existing land use characteristic and urban development characteristic.
3) Review the business operations of private enterprises (developers).
4) Review the urban planning related projects done by other donors and related organizations and institutions.

**(3) Traffic Survey and Road Inventory Survey**

1) Conduct the traffic surveys including household interview survey, traffic count survey, roadside interview survey (Origin-Destination survey (O-D)), travel speed survey, traffic survey at major intersections, bus transport survey, and parking survey.
2) Conduct road inventory survey and other transport facilities survey.
3) Formulate present O-D matrix.

**(4) Future Traffic Demand Forecast (Target Year: 2022)**

1) Formulate urban development scenario.
2) Estimate future socio-economic framework.
3) Identify future transport network.
4) Formulate future O-D matrix.
5) Indentify bottleneck areas.

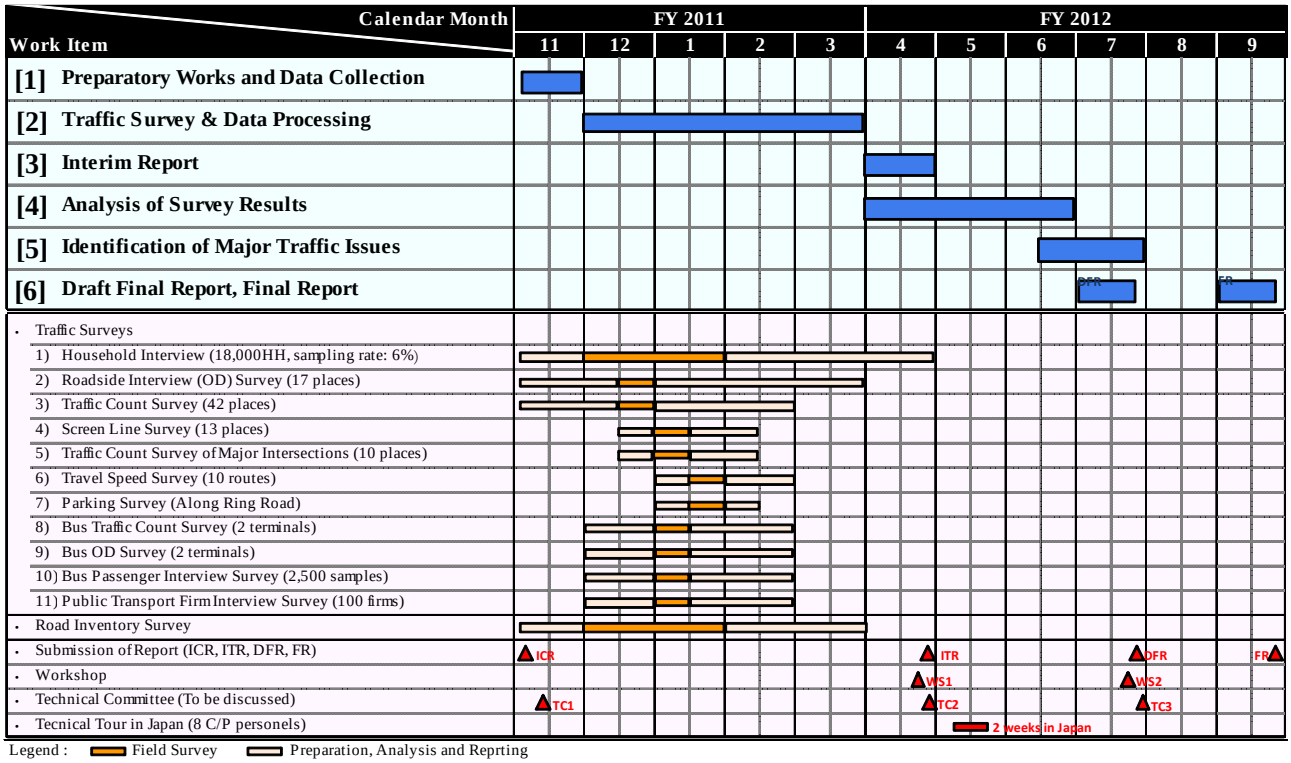
**(5) Identification of Major Traffic Related Issues and Problems in Kathmandu Valley**

1) Identify major traffic related issues and problems in Kathmandu Valley.
2) Propose major important issues related to urban development.

**(6) Counterpart Training in Japan**

1) Counterpart personnel can participate in the related training course in Japan.

## 1.3 Schedule of Survey, Reporting, and Workshop

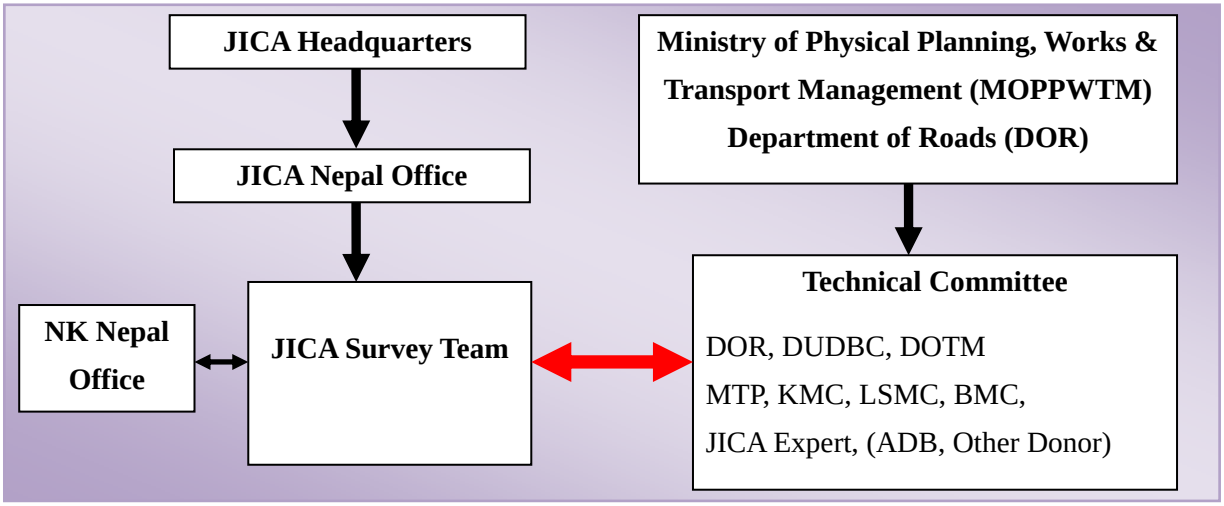



Source: JICA Survey Team

**Figure 1.3.1 Schedule of Survey, Reporting, and Workshop**

## 1.4 Organization of the Survey Team

### 1.4.1 Organizational Chart




Source: JICA Survey Team

**Figure 1.4.1 Organization of the Survey Team**

### 1.4.2 JICA Survey Team

The Study Team will include the following members:

| | | |
|---|---|---|
| 1) | Mr Hiroki SHINKAI | Team Leader/Road Planning 1 |
| 2) | Mr Yasushi OHWAKI | Traffic Survey 1 |
| 3) | Mr Atsuyuki NAKASEKO | Future Demand Forecasting |
| 4) | Mr Akio ODAKE | Urban Planning/Land Use Planning |
| 5) | Mr Hiroaki TAKAHASHI | Traffic Survey 2 |
| 6) | Mr Masahiro TORIU | Road Planning 2 |

### 1.4.3 Technical Committee

The DOR set up the technical committee for the effective and efficient implementation of the survey under the chairmanship of the Director General of DOR. The committee comprises representatives from the following agencies and organizations:

1) Department of Roads (DOR);
2) Department of Urban Development and Building Construction (DUDBC);
3) Department of Transport Management (DOTM);
4) Metropolitan Traffic Police (MTP);
5) Kathmandu Metropolitan City (KMC);
6) Lalitpur Sub-metropolitan City (LSMC); and
7) Bakhtapur Municipality (BMC).

# CHAPTER 2 OVERVIEW OF KATHMANDU VALLEY

## 2.1 Natural Condition

### 2.1.1 Topography and Climate

Nepal is a landlocked Himalayan country in South Asia with an area of approximately 147,000 sq km. It is bordered by China in the north and by India in the south, east, and west. The capital city of Nepal is Kathmandu located in the Kathmandu Valley, size of which is about 25 km from east to west and about 20 km from south to north.

Kathmandu Valley is an intermountain oval-shaped basin surrounded by high mountains with approximately 2,000 m in height. It occupies about 650 sq km of area and ranges in an average altitude of about 1300 m above sea level.

The climate condition in Kathmandu Valley is subtropical in nature which is influenced by the south-west monsoon during the summer. It is characterized as a continental climate with a large temperature difference from day to night. The temperature ranges from a minimum of -3 ºC in January to a maximum of 35 ºC in summer from June to August. The temperature in general varies from 19 ºC to 27 ºC in summer and 2 ºC to 20 ºC in winter with an annual average of 75% humidity.

The mean monthly rainfall ranges from 7 mm in November to 364 mm in July. Approximately 80% of the annual rainfall occurs during the monsoon seasons from June to September. The mean annual rainfall is as high as 2,000 mm in surrounding hills but about 1,400 mm in the valley.

The major meteorological rainfall stations are strategically located at 17 different places in the valley, namely Thankot, Godavari, Bhakutapur, Khokana, Sundarijal, Tribhuvan International Airport, and others.

Summary of geographical feature is shown below:

**Table 2.1.1 Topography and Climate of Kathmandu Valley**

| Geographical Feature of Kathmandu Valley | |
|---|---|
| Topography | Surrounded by mountains with 2000m in a height |
| | 650sqkm. with an average altitude 1300m approx. |
| Temperature | 9ºC -27ºC in summer |
| | 2ºC -20ºC in winter |
| | 75% humidity |
| Rainfall | 7mm in November and 364mm in July |
| | Monsoon season from July to September |
| | Mean annual rainfall 2000mm approx. |

Source: JICA Survey Team

### 2.1.2 Geology and Earthquake

#### (1) Geological Characteristic

Geologically, Kathmandu Valley consists of recent alluvial soil (sal) of the Cenzonic Era, Gokarma Formation of Plio-Pleistocene, Chapagoan Formation, and Kalimati Formation.

Recent alluvial soil consists of temporal sediment of a flood plain and fill terrace. The northern section consists of sand and gravel in the site river rocks. Silt, sand, and gravel can be found at the central and southern section. Density is low and the consistency of the soil is soft and clayey. It is easily eroded, settled, or flooded. The bearing capacity is expected to be poor and will be easily flooded.

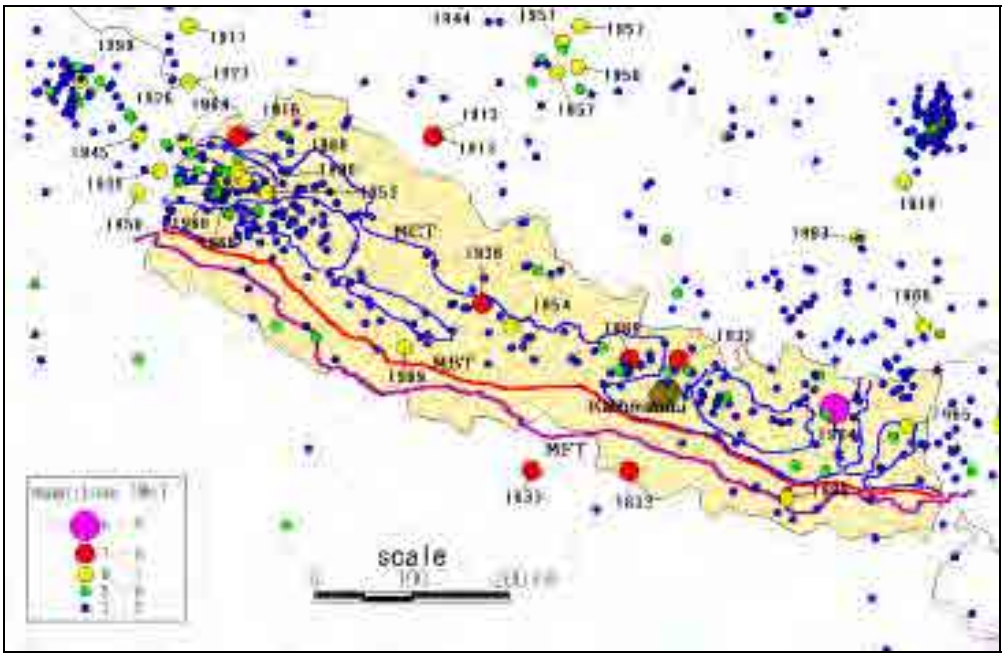
Gokarama Formation consists of bright brown gray and dense rectangular silt with poor grain size distribution. Total thickness is 330 m or thicker and the bearing capacity is expected to be between mid to high degree.

Chapagoan Formation is round or roundish silt sand, gravel, and rare input of river rocks. Total thickness is 300 m or thicker with a high bearing capacity and density. There is a danger of possible slope failure and landslide.

Kalimati Formation consists of dark grey silt, partially calcareous, organic silt and dense sand layers. Total thickness is 450 m or more and bearing capacity is from mid to low.

### (2) Earthquake

Nepal is located in the Himalayas orogenic zone, namely Main Central Thrust (MCT), Main Boundary Thrust (MBT), and Main Frontal Thrust (MFT) with three tectonic lines. Figure 2.1.1 shows the earthquake distribution map hit in Nepal from the years 1255 to 2001 as well as the three tectonic lines.




Source: JICA Study on the Earthquake Disaster Mitigation in Kathmandu Valley, 2002

**Figure 2.1.1 Earthquake Distribution Map in Nepal (1255-2001)**

Nepal has a long history of destructive earthquakes. In this century alone, over 11,000 people have lost their lives in four major earthquakes. The 1934 earthquake produced an intensity of IX-X on the Modified Mercalli Intensity (MMI) scale in Kathmandu Valley, and destroyed 20% and damaged 40% of the valley's buildings stock. In Kathmandu itself, one quarter of all homes were destroyed.

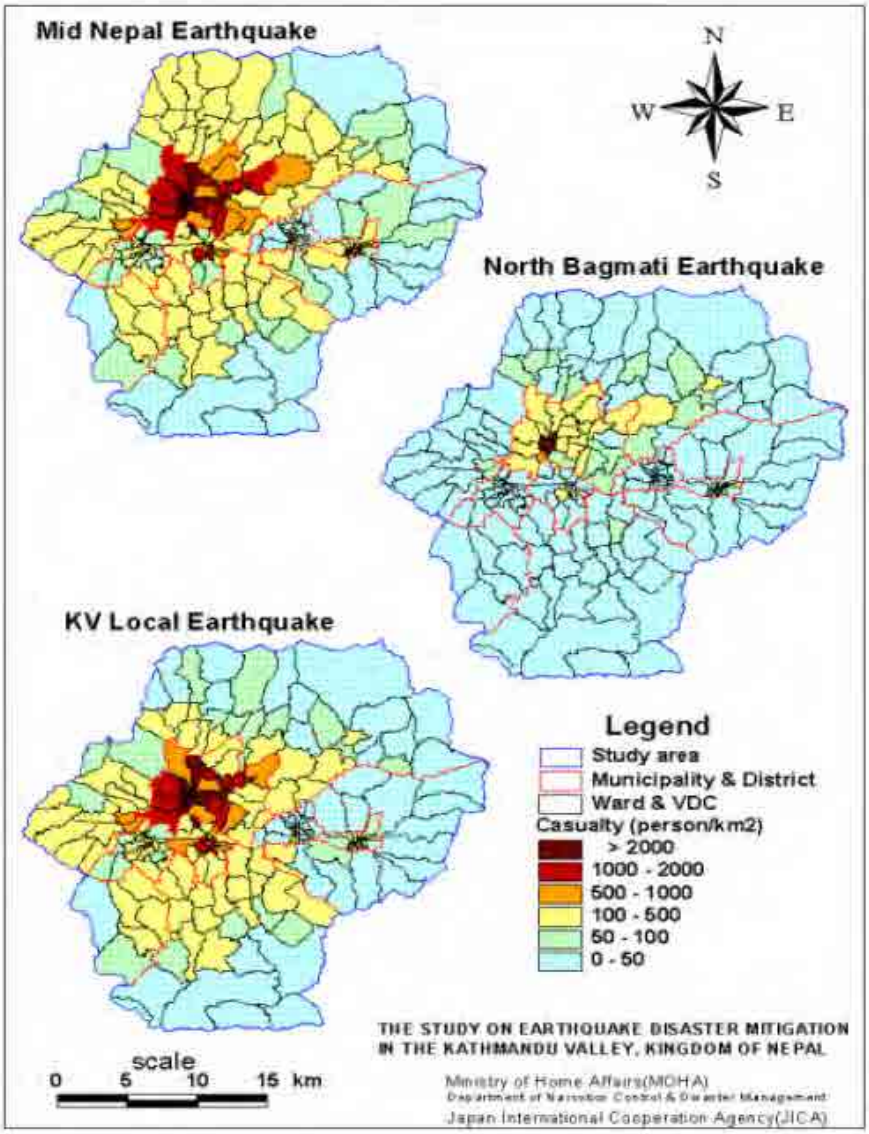
According to the JICA Study on the "Earthquake Disaster Impact Reduction and Improvement of Emergency Response Capabilities in the Kathmandu Valley", there are four critical earthquake scenarios that may heavily affect Kathmandu Valley as follows:

1) Mid-Nepal Earthquake with a magnitude 8.30 or MMI of VIII in Kathmandu Valley;
2) North Bagmati Earthquake with a magnitude of 5.99 or MMI of VI;
3) Kathmandu Valley Local Earthquake with a magnitude of 5.73 or MMI of IX along the fault; and
4) 1934 Bihar-Nepal Earthquake with magnitude of 8.2 while most of Kathmandu Valley would experience MMI of VIII.

The seismic record of the region suggested a return period of about 25 years, indicating that a devastating earthquake is inevitable in the long run and most likely in the near future.

Figure 2.1.2 shows the case study of casualty in Kathmandu Valley made by the above-mentioned JICA study based on the earthquake scenario. The scenario of Mid-Nepal Earthquake is the worst

case, and will leave tens of thousands of residents homeless, if it will hit the capital city of Kathmandu.




Source: JICA Study on Earthquake Disaster Mitigation in Kathmandu Valley, 2002

**Figure 2.1.2 Case Study on the Casualty in Kathmandu Valley based on Earthquake Scenario**

### 2.1.3 Rivers and Hydrology

There are four major rivers, Bagmati, Manahara, Bishnumati, and Dhobi River flowing through the heart of Katmandu City as shown in Figure 2.1.3. These rivers function not only as storm water drainage but also as sewerage of Kathmandu Valley.

These rivers in ancient times were the jewels of the city, but have now turned into open sewer. Unplanned and haphazard growth of the city has caused an adverse affect on the condition of the rivers both environmentally and hygienically.

The river banks have been encroached and squatter settlements are found in abundance. The disposal of sewage from household, manufacturing, and industries into the rivers is causing tremendous waste discharge which is having adverse hygienic and environmental effects on the river.

The rivers in Kathmandu Valley have a strong discharge correlation with the precipitation which shows that they are not glacier fed. This leads to a very low discharge during the precipitation poor winter months in which the river is mainly fed by spring sources and sewage discharge.

Drainage is also a significant problem in Kathmandu and water backlogging is very common in many areas of the city due to an inadequate and technically unsound drainage system. Both storm water drainage and sewerage has been combined and illegally connected in many places.

Although there are some waste water treatment systems in Kathmandu Valley, these are not functional and as a result, waste water from the drains and sewers were discharged directly into the Bagmati, Manahara, Bishnumati, and Dobhi Khola.

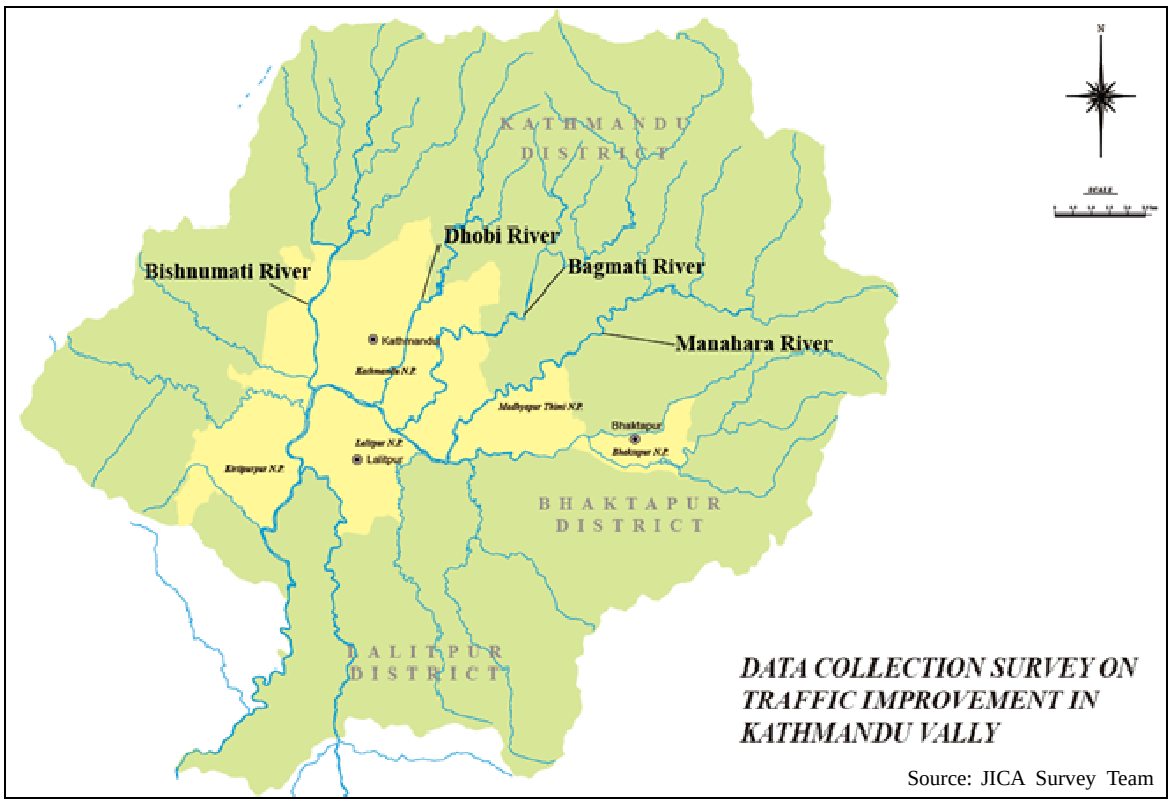



**Figure 2.1.3 Drainage System of Kathmandu Valley**

## 2.2 Socio-economic Profile of Kathmandu Valley

### 2.2.1 Administrative Division of Kathmandu Valley

Kathmandu Valley comprises of three districts namely Kathmandu, Lalitpur, and Bhaktapur and includes five major municipalities: Kathmandu, Lalitpur, Bhaktapur, Kirtipur, and Thimi as shown in the Figure 2.2.1.

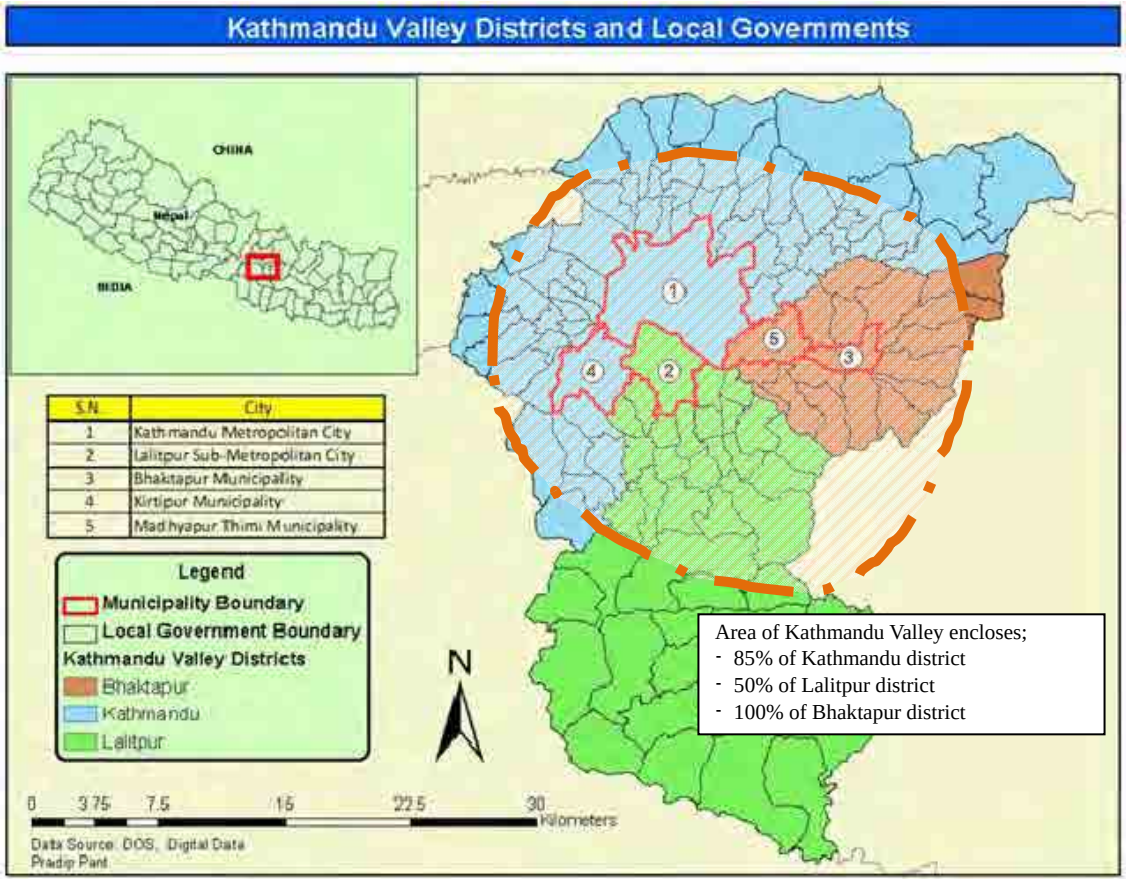
However, the area of the three districts together covers an area of 899 sq km, whereas the area of the valley as a whole is 665 sq km. The valley encloses the entire area of Bhaktapur District, 85% of Kathmandu District, and 50% of Lalitpur District.

The three valley districts have a total of 150 local administrative units (Village Development Committees and Municipalities), out of which, five city governments (municipality) have the highest population and economic activities. The Kathmandu Valley, the most important urban concentration in Nepal, possesess basic amenities like water supplies, electricity, gas, telecommunications, roads, sanitation, education security, and transportation.

Kathmandu Metropolitan City is the largest city in Nepal and the cosmopolitan heart of the Himalayan region. With a history and culture dating back 2000 years, the city along with the other towns in the valley, ranks among the oldest human settlements in the central Himalaya.

Old Kathmandu corresponds to the current city core, encompassing a compact zone of temples and narrow streets. The old royal palace complex of Durbar Square is in the center of Old Kathmandu and has been designated as a World Heritage Site by UNESCO.

Kathmandu's culture has been inspired by the convergence of Hindu and Buddhist traditions in traditional customs, festival, art, and literature.




Source: Kathmandu Valley Profile, by Pradip Raj Pant & Devendra Dongol

**Figure 2.2.1 Administrative Division of Kathmandu Valley**

### 2.2.2 Economic Profile

The key macro-economy of Nepal in 2010 is shown in Table 2.2.1.

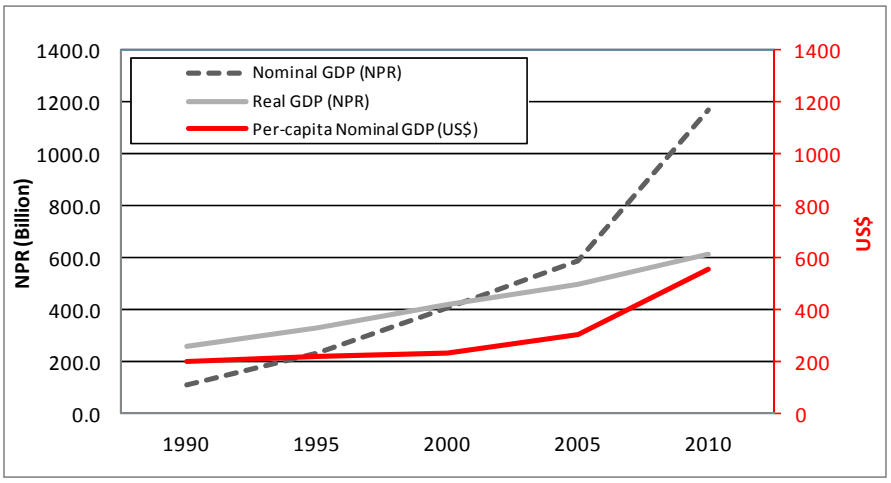
During two decades, nominal GDP rose about ten times, form NPR 111.0 billion to NPR 1,171.0 billion, whereas real GDP increased only by 2.5 times. Per-capita nominal GDP for the year 2010 was NPR 41,546 or USD 558, which rose 7.1 times from the year 1990 as shown in Figure 2.2.2

Inflation ratio ranged from 6% to 10% in the past five years and consumers price index increased from 95.20 in 2005 to 144.73 in 2010 as shown in Figure 2.2.3.

**Table 2.2.1 Key Macro-economic Indices**

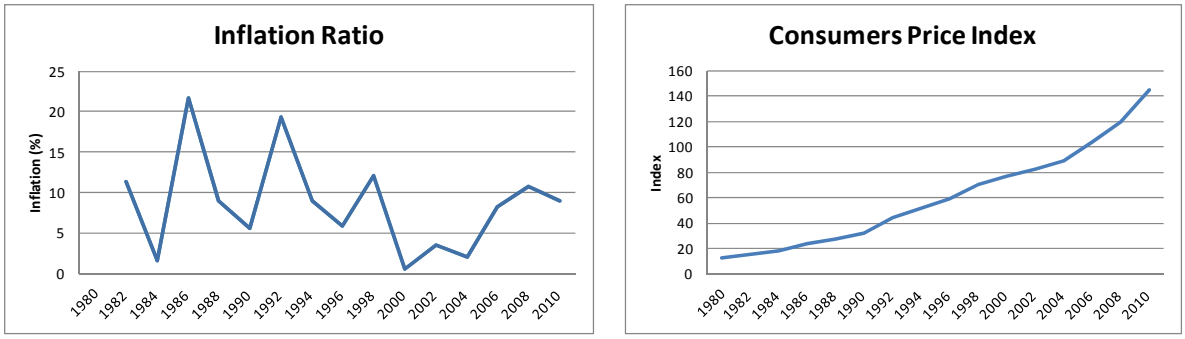
| Paticular | | 2010 |
|---|---|---|
| Real GDP | Billion NPR | 616.2 |
| | Billion US$ | 8.2 |
| Growth Rate | % | 4.4% |
| Real GDP per capita | NRP | 21,864 |
| | US$ | 293 |
| Nominal GDP | Billion NPR | 1,171.0 |
| | Billion US$ | 15.7 |
| Growth Rate | % | 14.7% |
| Per-capita Nominal GDP | NRP | 41,546 |
| | US$ | $558 |
| Inflation (CPI) | | 9.0% |
| Exchange Rate | US$ | 74.5 |
| DGP by Sector Agriculture | % | 32.6 |
| Industry | % | 15.8 |
| Services and others | % | 51.6 |
| Population below Poverty | % | 24.7 |
| Export (2009) | Billon US$ | 0.85 |
| Import (2208) | Billon US$ | 5.26 |
| Main Industry (Tourisim, garment, food and beverages, metal manufactures, herbs | | |

Source: ADB Key Indicators 2010, UNDP Human Development Report 2010




Source: IMF-World Economic Outlook (2011.9)

**Figure 2.2.2 Economic Growth Rate of Nepal**




Source: IMF-World Economic Outlook (2011.9)

**Figure 2.2.3 Inflation Ratio and Consumers Price Index in the Past 20 Years**

### 2.2.3 Population Growth

#### (1) Population Census 2011

The national population census was conducted by the Central Bureau of Statistics in 2011 last year and was published as the preliminary results of the National Population Census 2011.

Table 2.2.2 shows the population status of the whole country of Nepal.

**Table 2.2.2 Population Census of Nepal**

| Particulars | | 2001 Census | | 2011 Census | | Increase Ratio |
|---|---|---|---|---|---|---|
| Area (sq.km) | | 147,000 | | 147,000 | | 2011/2001 |
| Population (person) | Total | 23,151,423 | | 26,620,809 | | 15.0% |
| | Urban | 3,227,879 | 13.9% | 4,525,787 | 17.0% | 40.2% |
| | Rural | 19,923,544 | 86.1% | 22,095,022 | 83.0% | 10.9% |
| Population Density per sq.km | Average | 157 | | 181 | | 15.3% |
| | Urban | 985 | | 1,380 | | 40.1% |
| | Rural | 138 | | 153 | | 10.9% |
| Average Annual Growth Rate in past 10 years | Average | 2.25% | | 1.40% | | |
| | Urban | 6.65% | | 3.38% | | |
| | Rural | 1.72% | | 1.03% | | |
| Sex Ratio of Male per 100 Female | | 99.8 | | 94.4 | | |
| Population Absent (aboard) | Total | 762,181 | | 1,917,903 | | 151.6% |
| | Male | 679,469 | 89.1% | 1,663,237 | 86.7% | 144.8% |
| | Female | 82,712 | 10.9% | 254,666 | 13.3% | 207.9% |
| Housing Unit | No. | 3,598,212 | | 4,767,196 | | 32.5% |
| Households | No. | 4,253,220 | | 5,659,984 | | 33.1% |
| Average Household Size | person | 5.44 | | 4.70 | | |
| Source: Preliminary Results of National Population and Housing Census 2011 | | | | | | |

Highlights of the preliminary results reported in the census are as follows:

1) Population of Nepal as of the census day, June 2011 recorded to 26.6 million. Total addition in the population of Nepal during last ten years was recorded as 3.45 million with an average growth of 1.40 %;
2) Population density of Nepal was estimated to be 181 per sq km. Kathmandu District has the highest density (4407) and Manang has the least (only 3);
3) Kathmandu has recorded the highest decadal population growth (60.93%) compared to the entire Nepal (14.99%) and lowest in Manang (-31.92%);
4) Terai constituted 50.1% of the population while hill constituted 43.1% and mountain 6.8%;
5) The Central Development Region recorded th highest population (36.5%) and Far Western Development Region recorded the lowest (9.6%);
6) Sex ratio was estimated to be 94% (male per hundred females) in the current census as compared to 99.8% in the previous census 2001;
7) Average household size has decreased from 5.4 in 2001 to 4.7 in 2011. The household size was recorded to be highest in Rautahat (6.33) and lowest (3.71) in Kathmandu;
8) Absent population of Nepal was recorded as 1.92 million against 0.76 million in 2001; and
9) About 4.5 million (17% of the total population) lived in urban areas and the average population density in urban areas in Nepal was 1380 persons per sq km compared to 153 persons per sq km for rural areas.

### (2) Population Situation of Kathmandu Valley

The JICA Survey Team has analyzed the population situation of Kathmandu Valley based on the national population census of 1991, 2001 as well as 2011. Figure 2.2.4 shows the growth rate of population by district of Kathmandu Valley.

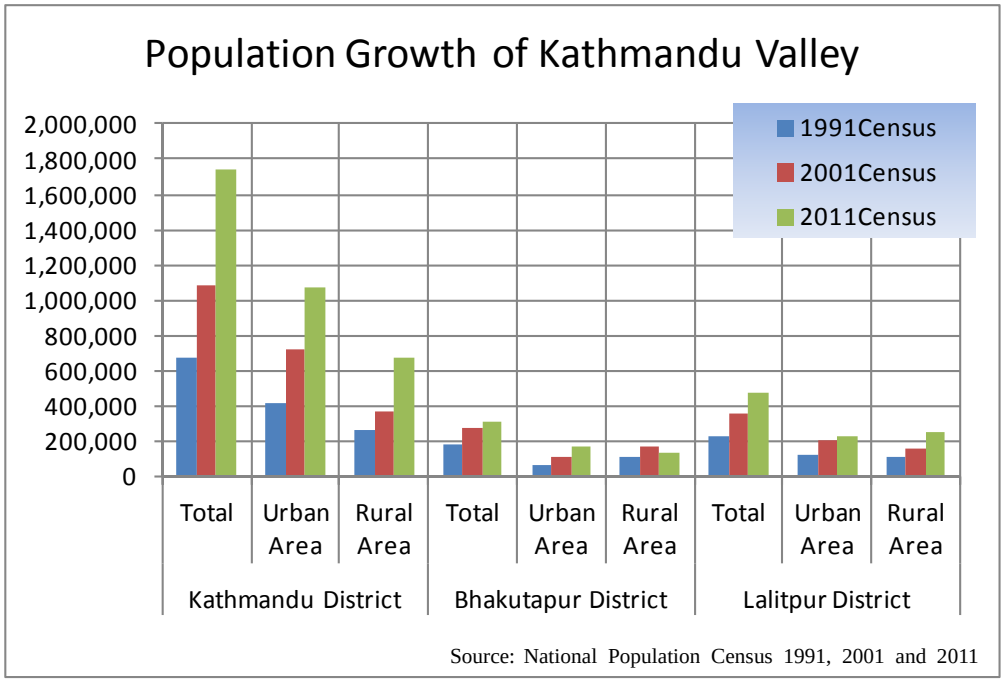



**Figure 2.2.4 Population Growth of Kathmandu Valley by District**

Table 2.2.3 shows the population situation of Kathmandu Valley by district and the summary of the analysis and highlights of the results are described as shown below:

**Table 2.2.3 Population Census of Kathmandu Valley in 2011**

| Particulars | | Kathmandu District | | Bhaktapur District | | Lalitpur District | | Kathmandu Valley | |
|---|---|---|---|---|---|---|---|---|---|
| | | area | % | area | % | area | % | area | % |
| Area (km2) | Total | 395 | 43.9% | 119 | 13.2% | 385 | 42.8% | 899 | (100%) |
| | Urban | 69 | 17.5% | 18 | 15.1% | 15 | 3.9% | 102 | 11.3% |
| | Rural | 342 | 82.5% | 52 | 84.9% | 370 | 96.1% | 764 | 88.7% |
| Population (person) | Total | 1,740,977 | 69.3% | 303,027 | 12.1% | 466,784 | 18.6% | 2,510,788 | (100%) |
| | Urban | 1,072,726 | 61.6% | 168,152 | 55.5% | 223,285 | 47.8% | 1,464,164 | 58.3% |
| | Rural | 668,251 | 38.4% | 134,875 | 44.5% | 243,499 | 52.2% | 1,046,626 | 41.7% |
| Population Density (person/km2) | Total | 4,407 | | 2,546 | | 1,212 | | 3,184 | (average) |
| | Urban | 15,547 | | 9,342 | | 14,886 | | 14,355 | (average) |
| | Rural | 1,954 | | 2,594 | | 658 | | 1,370 | (average) |
| Average Annual Growth Rate (past 10 years) | Total | 4.87% | | 3.00% | | 3.28% | | 4.32% | (average) |
| | Urban | 4.17% | | 3.41% | | 3.17% | | 3.92% | (average) |
| | Rural | 6.11% | | 2.52% | | 3.37% | | 4.89% | (average) |
| Sex Ratio of Male per 100 Female | | 109 | | 103 | | 103 | | 106 | (average) |
| Population Absent (aboard) | Total | 97,626 | | 7,701 | | 23,790 | | 129,117 | (total) |
| | Male | 69,434 | 71.1% | 7,588 | 98.5% | 16,936 | 71.2% | 93,960 | 72.8% |
| | Female | 28,192 | 28.9% | 113 | 1.5% | 6,854 | 28.8% | 35,159 | 27.2% |
| Housing Unit | No. | 242,274 | 66.1% | 50,586 | 13.8% | 73,643 | 20.1% | 366,503 | (total) |
| Households | No. | 469,145 | 71.4% | 73,084 | 11.1% | 114,443 | 17.4% | 656,672 | (total) |
| Average Household Size | person | 3.71 | | 4.15 | | 4.08 | | 3.94 | (average) |

Source: Preliminary Results of National Population and Housing Census 2011

Note: Urban area includes five (5) municipalities, Kathmandu, Kirtipur, Lalitpur, Bhaktapur, Thimi

1) Population of Kathmandu Valley and Each District

The population of Kathmandu District constituted 69.3% of population while Bhaktapur District constituted 12.1%, and Lalitpur District 18.6%.

2) Population Density

The population density of Kathmandu Valley was estimated to be 3,186 persons per sq km. The urban areas of Kathmandu and Lalitpur municipalities have the high density of 15,547 and 14,886 respectively. The urban density of 14,355 persons per sq km in Kathmandu Valley is more than ten times the density of rural areas of 1,370 persons per sq km.

It is said that, in many areas of Kathmandu, the population density exceeded 40,000 to 45,000 persons per sq km and at the core of Kathmandu, the density exceeded 80,000 sq km.

3) Annual Population Growth in the Past Ten years

The population growth rate of the whole Kathmandu Valley was 4.32%. It became clear that the growth rate of rural area was bigger than that of the urban area in the Kathmandu Valley. The main cause was that the population of rural area in Kathmandu District has increased remarkably with a growth rate of 6.11 % in the past ten years. The other three districts showed a moderate increase in both urban and rural population growth.

4) Sex Ratio (male per hundred females)

The average sex ratio in Kathmandu Valley was estimated to be 106%. Kathmandu District has 109, whereas, Bhaktapur and Lalitpur were 103 and 103 respectively.

5) Absent population

The absent population of Kathmandu Valley was recorded as 129,000 out of which 72% is male and rest is female.

6) Number of house units, Households, and Size of Household

The average household size in Kathmandu Valley was recorded to be 3.94 and Kathmandu District was lowest with 3.71.

### 2.2.4 Social Conditions and Environmental Issues

#### (1) Social Conditions

1) History, Religion, and People

Kathmandu, the center of Nepal and often called “The City of Gods”, has a history of over 2000 years. Records stated that the Newaris have settled here, whose descendants are still found. Kathmandu entered as the official capital again in 1768, when the King of Gorkha united Kathmandu Valley and moved the capital to Kathmandu. Kathmandu has been the capital of Nepal since then.

There are more than 70 different minorities in Nepal and the population is about 26.6 million. As there are numerous minorities, the language also varies, verging on 70 different kinds. According to the 2001 Census, 80% of the entire population were Hindus, 15% were Buddhists, and 3% were Muslims. The rest of the religious accounted 2% of the population.

The distribution of different races and people reflects the diversity of the topography. The majority of the population consists of Indo-Arians, and the rest include Tibetans such as Sherpas, Dolpas, and Lopas in North, Newars, Tamang, Rais, Limbus, Suwars, etc., in the central region and Tharu Rajbangsu and others in the southern Terai.

The caste system in Nepal’s Hindu religion consists of the four tiers of Brahman, Chhetris, Vaiya, and Sudra. The surname of Hindu caste reflects occupation or regionality, and the most prevalent surnames in the east and central regions are Goutam, Sharma, Regmi, Acharya, Nepal, Upadhyay, Adhikhari, Bhandari Aryal, and Paudyal, whereas, the ones in the west are Pant, Joshi, Bistha, Bhatta, Pandey, Awastthi, Lohani, Oli, etc.

2) Culture

The ancient and refined traditional culture of Kathmandu is an uninterrupted and exceptional meeting of the Hindu and Buddhist ethos practiced by its highly religious people. The city core has the most remarkable cultural wealth that evolved during the reign of the Malla (Nepal) kings between the 15th and 18th centuries. The city was filled with sculptures, pagodas, stupas, and palace buildings of exceptional beauty.

Though the valley embraces most of Nepal's ethnic group, Newars are the indigenous inhabitants and the creator of most of its cultural traditions. The variety of festivals such as the Ghode (horse) jatra, India jatra, Dasai DurgaPuja festivals, Shivratri, and many more are observed by all Hindu and Buddhist communities of Kathmandu with great devotional fervor and enthusiasm.

Cultural communities has been maintained for centuries from ancient to modern period in the exclusive worship of goddesses and deities and so forth in Kathmandu and the rest of the country.

**(2) Environmental Issues of Kathmandu Valley**

The Kathmandu, the center of administration, industrial, commercial, social, and economic activities, is the mostly densed populated region in Nepal and its population has been increasing rapidly during the past two decades. It is considered to be the engine of growth since the planned urban development will result in the overall economic development of the nation.

The rapid unplanned and haphazard urbanization of the Kathmandu Valley caused by the informal process of settlement development in the past has brought about several physical, social, and environmental problems in Kathmandu Valley. The fragile Kathmandu Valley eco-system is severely affected by the ever-expanding urban development and incompatible economic activities.

Some of the most visible consequences of the haphazard development are shown below:

1) River Pollution:

In most places of Kathmandu Valley, storm water drainage and sewerage have been combined and the four major rivers, Bagmati, Manahara, Bishnumati, and Dhobi Khola, have now turned into open sewer. The city is becoming an example of a terribly polluted city with open sewers and unhygienic disposal of waste leading to the pollution of all the existing rivers in Kathmandu.

2) Air Pollution:

Increase of vehicles, unplanned settlements, and conflicting land uses lead to air pollution caused by emissions from vehicles plying along narrow and winding roads and city streets. To reduce air pollution, the government has to take necessary actions such as the introduction of electronic vehicles, the control of smoke emissions from factories, etc.

3) Solid Waste Disposal:

Illegal dumping of waste in the areas like riverbanks, public land, and unplanned settlement is very common. Those areas are either not served by the municipal solid waste collection system or the community is not organized to handle the problem.

4) Traffic Congestions:

Inadequate road network and inefficient transport management system are creating severe traffic congestion during peak commuting periods in the city. Public transport cannot operate effectively in and outside the city areas.

5) Loss of Cultural Heritage:

The cultural heritage of the Kathmandu Valley is gradually eroding and historic ponds, courtyards, public places, and playing fields are being converted into public buildings and private properties.

6) Gaps in Supply and Demand for Basic Services:

The rapid population growth and urbanization has increased demands for housing, water, electricity, drainage, road, and other utilities. Local authorities do not have the capacity to provide trunk infrastructures and services and their roles are limited to local-level infrastructure only.

## 2.3 Transport Sector Status

### 2.3.1 Road Sector

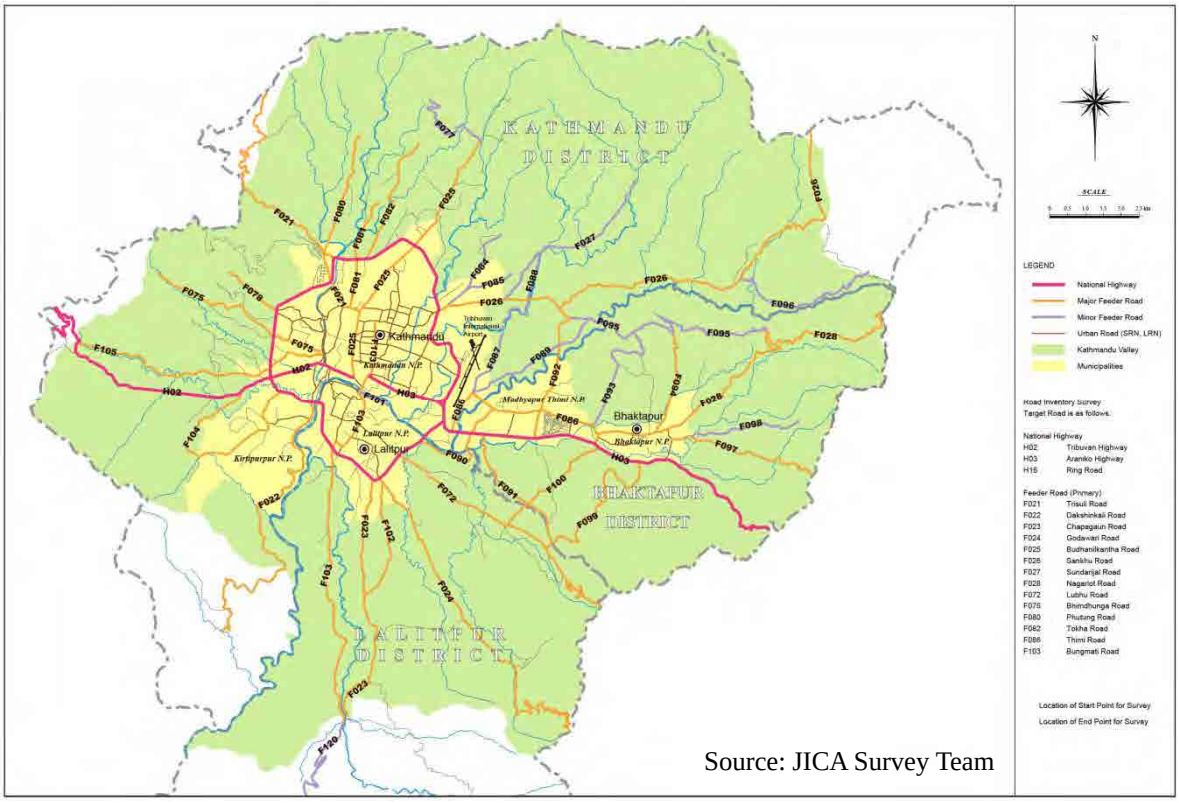
The transport system in Nepal consists of roads, civil aviation, railways and rope ways, but the major means of transportation is by road. Most commodity movements between major cities in Nepal via the Kathmandu Valley are using the road network system.

#### (1) Road Development Pattern

The Kathmandu Valley is served with the ring road and radial pattern of road network as shown in Figure 2.3.1 and the expansion of urban areas have proceeded along the major (or primary) feeder roads radiating from the Ring Road.

These radial roads are used as the main commuting and transport routes between the expanded urban areas and the central business area of Kathmandu City. The Ring Road (or Highway No.16) is one of the vital arterial roads in Kathmandu Valley with a function of dispersing traffic through the central area of Kathmandu City.

There are two major gateways in the Kathmandu Valley at the moment, Tribhuvan Highway (Highway No.02) linking Terai and the Indian border and Arniko Highway (Highway No.03) linking the Chinese border.




Source: JICA Survey Team

**Figure 2.3.1 Road Network System in Kathmandu Valley**

#### (2) Road Network System and its Function

The road network in the Kathmandu Valley is classified into two groups which depend on the jurisdiction of administration body. The DOR is responsible for the Strategic Road Network which

consists of national highway, feeder roads including primary, secondary, and strategic urban roads, whereas the local governments including districts and municipalities are responsible for the urban roads and district roads as shown in Table 2.3.1:

**Table 2.3.1 Road Network System in Kathmandu Valley**

| Jurisdiction | Classification | Kathmandu District | Bhaktapur District | Lalitpur District | Total | Remarks |
|---|---|---|---|---|---|---|
| Department of Road (DOR) | Highway | 39.9 | 14.1 | 18.0 | 72.0 | H02, H03, H16 |
| | Feeder Road (Primary) | 136.0 | 70.5 | 112.6 | 319.0 | 14 Feeder roads |
| | Feeder Road (Secondary) | 45.1 | 27.0 | 0.0 | 72.1 | 22 Feeder roads |
| | Strategic Urban Road | 59.6 | 4.9 | 27.2 | 91.7 | 59 Urban Roads |
| | Total | **280.5** | **116.5** | **157.8** | **554.8** | |
| District/ Municipality | District Road | 400.4 | 36.0 | 90.6 | 527.0 | |
| | Urban Road | 269.6 | 116.0 | 127.3 | 512.9 | |
| | Total | **670.0** | **152.0** | **217.9** | **1,039.9** | |
| | Total | **950.5** | **268.5** | **375.7** | **1,594.7** | |

Source: SSRN 2009/10

1) Highway

Highway roads are designated as national highways which basically are continuous throughout the country. These are the major connections to the capital of Kathmandu from the areas outside Kathmandu Valley.

The Tribhuvan Highway or National Highway No.2 is the most important highway connecting Kathmandu and the regions in southern Nepal and India. The road is heavily crowded and congested due to the increase in traffic volume to and from outside Kathmandu as well as the development of new settlement along the road. Widening of the road or construction of a diversion road as soon as possible is indispensable to cope with the increase in traffic volume..

The Arniko Highway or National Highway No.3 is the main road running east from Kathmandu to the eastern Nepal up to the Tibetan border. The road between Kathmandu and Bhaktapur, which is part of the Arniko Highway, was recently widened to four lanes to resolve and ease the heavy congestion. In addition, widening of the sections of this road inside the Ring Road is under construction in order to alleviate the traffic congestion.

The Ring Road identified as National Highway No.16, surrounds Kathmandu and Lalitpur cities at a radius of approximately 27 km. It is a vital arterial road with a function of dispersing traffic into the core area of Kathmandu City. The road is well engineered with a 10 m wide double carriageway, however, it needs widening from four- to a six-lane road to cope up with the rapid increase of urban traffic.

2) Feeder Road

The feeder road is classified into primary (or major) and secondary (or minor). The former generally leads from the national highway to the district headquarters and the latter connects the primary feeder road to the major towns and villages.

The feeder road, radiating from the Ring Road, constitutes the vital road network of Kathmandu Valley and plays an important role as the arterial road linking the suburbs and the city center.

3) Urban Road

The urban road is classified into two categories depending on the administration body. Strategic Urban Road (SUR) is under the jurisdiction of DOR and (ordinary) urban roads are controlled by local government including the district and municipality.

The SRU is the vital city road constituting primary road network in the city and serves greater portion of the vehicular traffic passing through the city, while (ordinary) urban road are providing access to neighboring residential and business areas.

4) District Road

The district road consists of all roads not defined as national highway, feeder road or city road and serves as primary access to the towns and villages and abutted lands. A systematic and reliable database is not available in consolidated form. Detailed information on the district roads can be obtained from the DOLIDAR.

### (3) Present Road Conditions by Type of Surface

Present conditions of the road network in Kathmandu Valley under the jurisdiction of DOR is summarized in Figure 2.3.2, referring to the Statistics of Strategic Road Network (SSRN 2009/10).

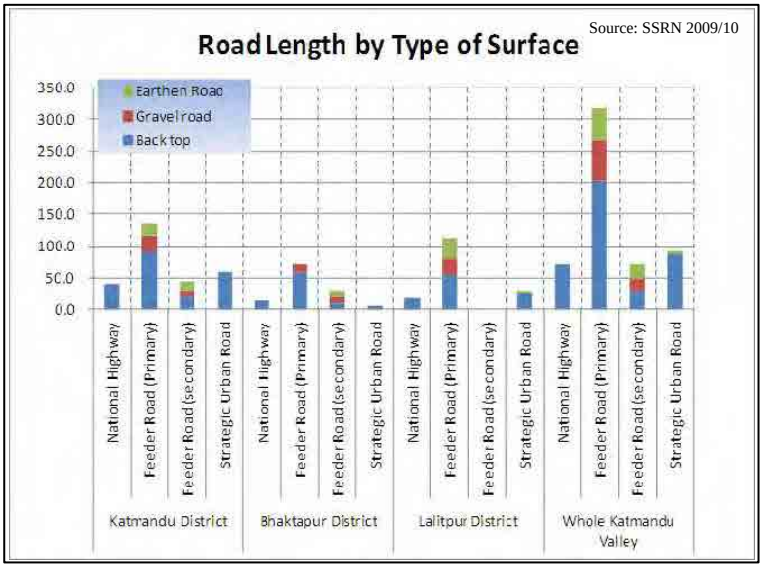



**Figure 2.3.2 Condition of Roads in Kathmandu Valley (1)**

As seen in the figure, all national highways and strategic urban roads except some sections of the urban road in Lalitpur District are paved.

However, pavement ratio of feeder roads including primary and secondary are only 60% and there are earthen roads that still exist in Kathmandu and Lalitpur District.

### (4) Road Density by District

The road density of each district in Kathmandu Valley has been analyzed to examine the service level of road infrastructure as shown in Figure 2.3.3.

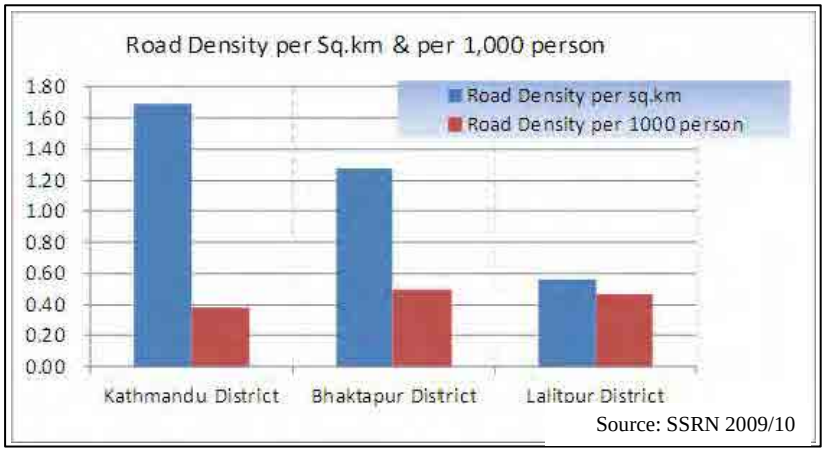



**Figure 2.3.3 Condition of Roads in Kathmandu Valley (2)**

It can be observed that the road density per sq km of Lalitpur District is extremely low compared to Kathmandu District and Bhaktapur District.

However, the road density per 1,000 person of Lalitpur is the same level as the other two districts more or less.

Therefore, it can be concluded that the service level of the road network of each city in Katmandu is relatively of the same situation in terms of the road density per 1,000 person.

### (5) Issues of Road Network in Kathmandu Valley

1) The Inner Ring Road was recommended by the previous M/P (in 1993). It was proposed to disperse the traffic in the central areas of the city to avoid its excessive concentration and to reduce the traffic on arterial roads inside the

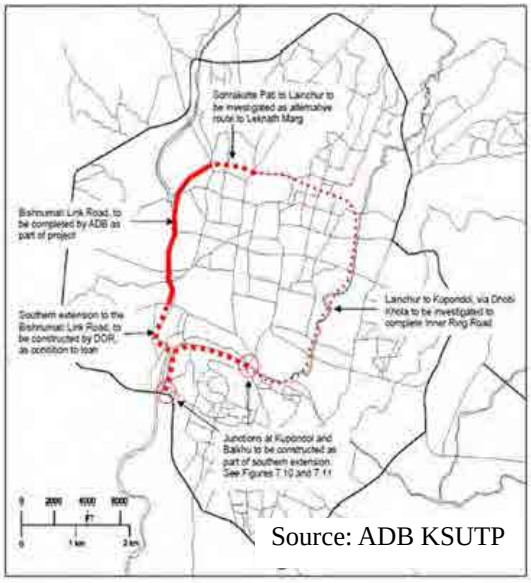



**Figure 2.3.4 Proposed Inner Ring Road**

Ring Road. The proposed route of Inner Ring Road is shown in Figure 2.3.4. It consists of the Bishnumati Link which will be implemented under the program of ADB's KSUTP, the Southern Link along Bagmati River to be constructed by DOR, the Dhobi Khola Link under improvement by DOR and the North Link to be investigated.

2) The Inner Ring Road becomes the most effective road to solve the serious traffic congestion inside the Ring Road, therefore, early implementation of the Inner Ring Road with a high design standard is expected.

3) To cope up with the future traffic demand, the Inner Ring Road should be examined, studied and considered as the most important urban road with sufficient traffic capacity having flyovers at the major intersections or as an elevated expressway.

4) River crossing capacity is too small to meet the increasing traffic demand in Kathmandu City. The number of bridges across the existing rivers, such as Bagmati, Bishunumati, and Dhobi Khola, are insufficient and most of the existing bridges are old and narrow with a small traffic capacity. These bridges create bottlenecks that block traffic to the city.

5) Traffic capacities of intersections on major roads are insufficient and seriously obstruct the smooth traffic flow in the city. A grade separation on these intersections is an urgent issue on the traffic of the Kathmandu Valley.

6) Improvement of feeder road is an urgent issue to the development of the Kathmandu Valley corresponding to the expansion of urban area with the rapid increase of population. Appropriate upgrading or widening due to the increase of traffic demand is indispensable to provide the population with adequate transportation service.

7) Evacuation roads against the expected earthquake in the near future in Kathmandu Valley are not properly provided to the inhabitants. The city road of Katmandu does not have that function as the evacuation road for earthquakes. Most of the roads are narrow and winding which are not adequate enough to safely evacuate the people and lead them outside the Ring Road at the time of the earthquake.

8) Furthermore, these evacuation roads may be disturbed by the rivers of Bagmati, Bishunumai, and Dhobi Khola, because these roads do not have enough number of bridges and sufficient capacities. There would be several possible solutions for the earthquake, however, one recommended plan is to cover the Bisunumati and Dobhi Khola with the cap made of concrete or box culvert and builds the road on the cap with sufficient width to evacuate the people outside the city.

### 2.3.2 Vehicles Registered

There are approximately 1,178,000 vehicles registered in the whole country of Nepal and Bagmati zones and out of the 14 zones accounted for an almost half of the total vehicle registered in Nepal as shown in Table 2.3.2.

**Table 2.3.2 Numbers of Vehicles Registered in Nepal**

| Number of vehicles registered (1989-2010) | Bagmati Zone | Narayani Zone | Other 12 Zones | Whole Country |
|---|---|---|---|---|
| | 570,145 | 263,815 | 344,835 | 1,178,795 |
| | 48.4% | 22.4% | 29.3% | 100% |

Source: Details of Registration of Trnasport up to Fiscal Year 2010, Department of Transport Management

The number of vehicles registered is rapidly increasing in Kathmandu particularly in the recent five years accompanied by the rapid increase of urban population and economic development.

Table 2.3.3 shows the total number of vehicles registered until 2010 in Bagmati Zone with the following

trend and distribution:

1) The number of motorcycle has remarkably increased in the past five years;
2) The car/jeep/van has increased favorably; and
3) Buses and trucks including other type of vehicles did not increase in the last five years.

In addition, it must be noted that, among the total registered vehicles, the share of vehicles for private transportation which includes car/jeep/van and motorcycle, was very high at more than 93%. On the other hand, the registration number of buses for public transport has decreased every year and the share of it accounted for only 3.5%.

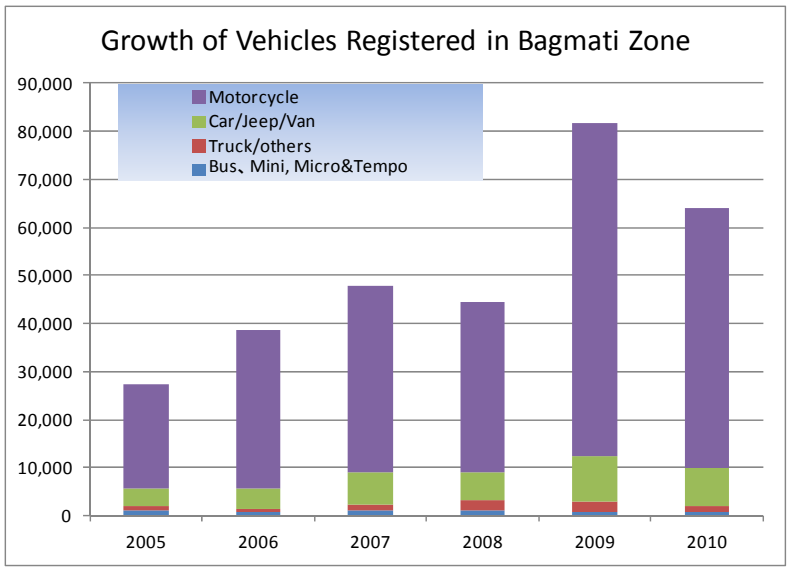
**Table 2.3.3 Vehicle Registered in Kathmandu Valley (Bagmati Zone)**

| Vehicles registered in Bagmati Zone | | | | | | |
|---|---|---|---|---|---|---|
| Year | Bus、Mini, Micro&Temp | Car/Jeep/Van | Motorcycle | Truck/others | Total | Accumulative |
| 2000 | 10,150 | 44,777 | 89,782 | 7,453 | 152,162 | 152,162 |
| 2001 | 710 | 2,649 | 22,852 | 782 | 26,993 | 179,155 |
| 2002 | 760 | 2,999 | 21,558 | 811 | 26,128 | 205,283 |
| 2003 | 1,082 | 6,788 | 18,035 | 561 | 26,466 | 231,749 |
| 2004 | 1,353 | 12,287 | 20,003 | 512 | 34,155 | 265,904 |
| 2005 | 1,048 | 3,603 | 21,604 | 1,070 | 27,325 | 293,229 |
| 2006 | 868 | 4,235 | 33,022 | 678 | 38,803 | 332,032 |
| 2007 | 1,086 | 6,601 | 38,852 | 1,237 | 47,776 | 379,808 |
| 2008 | 1,214 | 6,019 | 35,365 | 1,891 | 44,489 | 424,297 |
| 2009 | 912 | 9,471 | 69,359 | 2,096 | 81,838 | 506,135 |
| 2010 | 737 | 8,069 | 53,960 | 1,244 | 64,010 | 570,145 |
| Total | 19,920 | 107,498 | 424,392 | 18,335 | 570,145 | |
| | 3.5% | 18.9% | 74.4% | 3.2% | 100% | |

Source: Department of Transport Management

Figure 2.3.5 shows the annual growth rate of vehicle registered in the past five years.

The motorcycle has increased at an alarming rate (more than 20%) in the past five years and if the demand in motorcycle will increase continuously as the people becomes affluent, the city road of Kathmandu Valley will be saturated with motorcycles within the next few years.




Source: JICA Survey Team

**Figure 2.3.5 Growth of Vehicles Registered in Bagmati Zone**

### 2.3.3 Public Transport

#### (1) Present Public Transport

Public transport is a vital part of the urban transport. Historically, roads in the valley were developed for the operation of public transport; however, the situation became chaotic due to the rapid increase of motorcycles and cars in the past decade.

At present, public transport is operated by buses, mini buses, micro buses, and tempos in the valley, however, the services provided by these public transports were far below the satisfactory level. Over-crowding, left-of-passengers, and malfunction of fleets are the daily events and the vehicles used for the public transport are usually old and the total number is not sufficient.

The growing demand for public transport accompanied by the increase of population and economic development will bring about a number of problems in the transportation system and people cannot use any mode of transportation in the valley due to the poor operation of bus services including insufficient numbers of buses.

### (2) Public Transport by Bus Network Services

Since there is no railway system in the valley at all, public transportation in Kathmandu Valley has been provided with buses and minibuses on major roads, micro buses, and tempo network on secondary roads. These bus services are normally operated by private bus companies.

At present, there are three categories of bus services in the Kathmandu Valley as follows:

1) City bus service which operates the service within the built-up areas or core areas of Kathmandu Valley, generally within the Ring Road;
2) Commuter bus service which operates the service of 1.0 hour to 1.5 hours travel distance beyond the build-up area to towns and villages mostly within the Kathmandu Valley, such as Bakhutapur, Thimi, Kirtipur, Nagarkot, Godawari, Dakshinkali, and other important towns; and
3) Long distance bus service which operates the service to connect Kathmandu and the cities and towns throughout Nepal. The bus terminal of long distance service is located on the north-west section of the Ring Road.

Both city bus service and commuter bus service are very complicated and most of these routes end in the central area of the city, which regularly results in chaotic traffic jams in the city roads.

The Kathmandu Sustainable Urban Transport Project (KSUTP) prepared by ADB in 2009 proposed that the urban bus route network should be designated with a hierarchy of routes as follows:

- Primary route;
- Secondary route; and
- Tertiary route.

The KSUTP suggested that every type of routes shall be operated by the most appropriate type of buses, wherever possible, the small buses and mini buses will be replaced by fewer or larger buses based on the policy that a vehicle used on each route will be of maximum size and can be safely operated on the road.

It is said that this will have two benefits. First, the number of public transport vehicles on the city roads will be substantially reduced, with corresponding reductions in the level of congestion and exhaust emission. Second, the transportation cost per passenger for a larger fleet will be lower than that of smaller vehicles carrying the same number of passengers.

### (3) Issues of Bus Services Level

The service level, in general, is very low as against growing demand by users in the following points:

1) Absolute shortage in fleet numbers;
2) Fleets in use are obsolete and prone to break down during the service;
3) The service routes are not always provided with sufficient number of buses, keeping imbalance with the size of demand;
4) Bus stops are not located systematically by the different companies and there is no coordination among the companies;

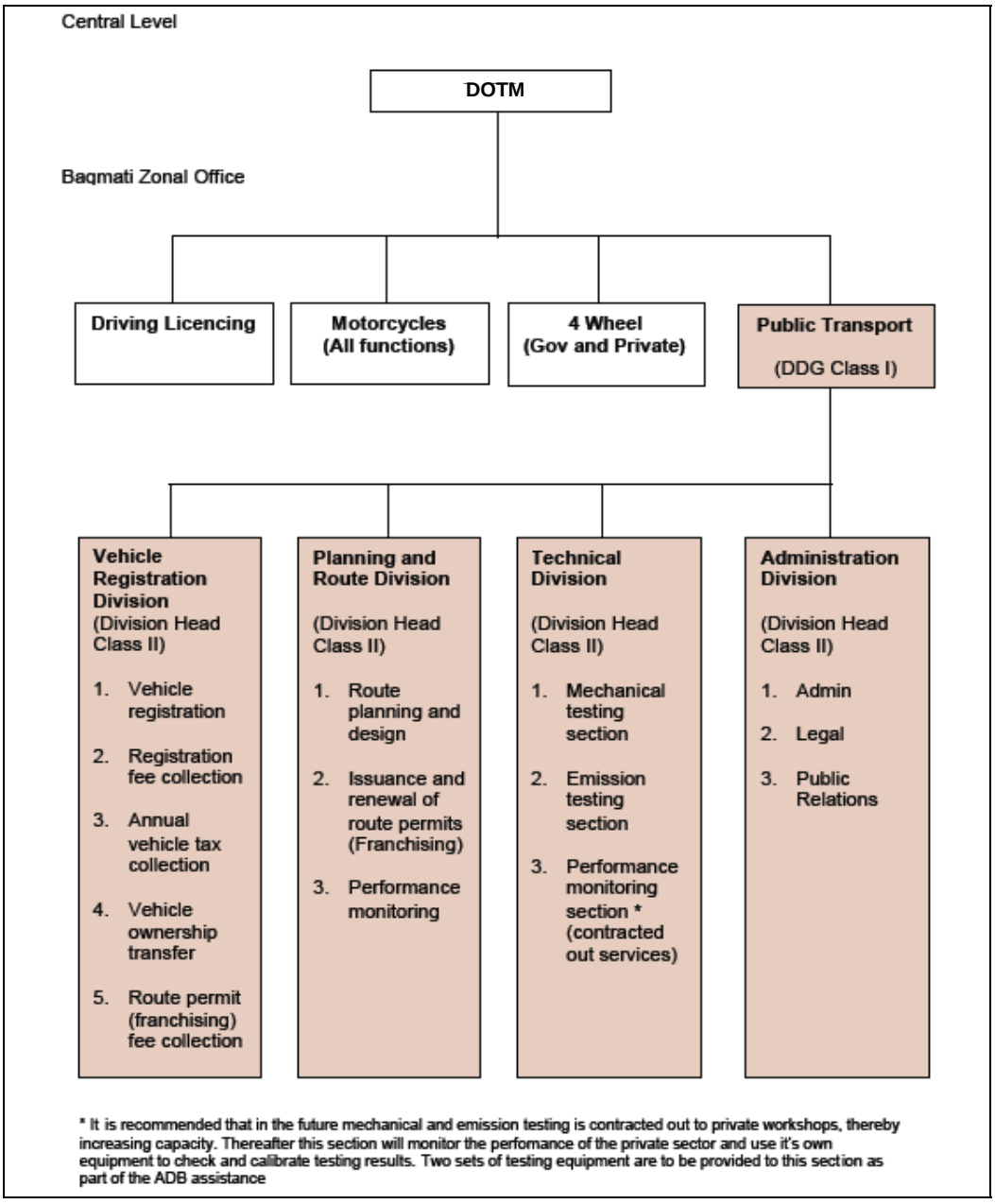
5) The location of bus stops are usually not marked clearly and most of the bus stops are not provided with minimum facilities such as shelters and bus bays; and

6) No time table, route map and fare-rate have been made in public for the convenience of users.

### (4) Organization Responsible for Public Transport

The Department of Transport Management (DOTM), under the Ministry of Labour and Transport Management, is the responsible agency for the public transport, however, its function are limited to issuing public transport routes permits, vehicle registration, and transfer of vehicle ownership. Other works relating to traffic management are done by the Metropolitan Police under the Ministry of Home Affairs.

Presently, the program to strengthen the capacity of DOTM and in particular the Bagmati Zone Office, is progressing under the KSUTP to cope up with the rapid growth of vehicles within the valley. Suggested structural strengthening of the DOTM and its Bagmati Zone Office is shown in Figure 2.3.6 below:




Source: ADB KSUTP

**Figure 2.3.6 Strengthening Plan of DOTM and it's Bagmati Zone Office**

# CHAPTER 3 ROAD DEVELOPMENT POLICY AND EXISTING PLANS

## 3.1 Latest Policy of Road Development

### 3.1.1 Twenty-Year Road Plan

Based on 9th Five-Year Plan including the long-term development goal by formulating the 20-Year Development Concept from the 10th Plan to 13th Plan, the 20-Year Road Plan was published in 2001 to develop the Strategic Road Network (SRN) by DOR. The planned future status of SRN is 4,040 km extension of total length to reach 9,206 km in the whole country. The major four objectives of this plan are as follows;

1) Strengthening of political and administrative linkages;
2) Poverty alleviation;
3) Development and utilization of social, economic, and cultural potentials; and
4) Minimisation of the total transportation cost and the adverse effect on the environment.

### 3.1.2 Sector-wide Road Programme and Priority Investment Plan

The study was conducted in two major parts by DOR: Part I was the overall planning study and Part II involved the detailed feasibility study of approximately 800 km of high priority road improvement. The study was carried out with funding support from the World Bank/International Development Association Loan, over a 18-month period commencing in September 2005.

The study was primarily concerned with the maintenance and development of the SRN. The objective of the study was the preparation of a 10-year Priority Investment Plan (2007-2016) (PIP) for the SRN, including recommendations for its expansion and improvement. The contents of PIP comprised the following three main tasks:

1) Regular annual maintenance and periodic maintenance plan;
2) Upgrading to sealed standards plan; and
3) Expansion/extension plan by new construction, network strengthening, and improvement.

### 3.1.3 Business Plan

After the two primal national plans, the 20-Year Road Plan published in 2001 which envisioned the development of the SRN (2002-2021) and PIP approved in 2007 as a form of 10-year priority investment plan (2007-2016), the Business Plan was published in 2010 which is the latest activated plan by DOR. This plan is based on the performance evaluation of Three-Year Interim Plan-I (2007-2010) (TYIP-I) and covering the plan period of Three-Year Interim Plan-II (2010-2013) (TYIP-II), and it seeks to present clearly and concisely the DOR vision for the road sector such as the goals and outcomes to be achieved. The overall goal of this plan is the development of SRN to provide sustainable and efficient road service by managing the main arteries of the road network, links to rural roads and connectivity to potential tourism, hydropower and natural resources development areas, and the area along international trade routes. It also intends to contribute towards the betterment of the living conditions of the people through effective, efficient, safe, and reliable road connectivity.

## 3.2 Road Network Development Plan in the Previous M/P (in 1993) and Subsequent Progress

### 3.2.1 Development Concept of the Previous M/P (in 1993)

The JICA M/P "Kathmandu Urban Road Development" was conducted in 1993 aiming at the formulation of the M/P of urban road network for Kathmandu Valley with a target year of 2015. The basic concepts employed for the road development, the major development plan, and the projects proposed in the previous M/P (in 1993) are as follows:

**(1) To strengthen the east-west transportation corridor as an alignment of the capital of the Kathmandu Valley.**

1) Construction of Arniko Bypass (Kathmandu-Bhaktapur)
2) Construction of 2nd Tribuvan Highway

**(2) To build an efficient road network system inside the Ring Road to streamline the traffic in central areas.**

1) Development of Inner Ring Road

The Inner Ring Road was proposed to promote the urban development inside the Ring Road as well as to disperse the traffic in the central areas of the city. It was recommended to apply the following stages of construction:

- 1st Stage (Short-term) : Completion of the construction of a 2-lane road
- 2nd stage (Long-term) : Widening into a 4-lane road

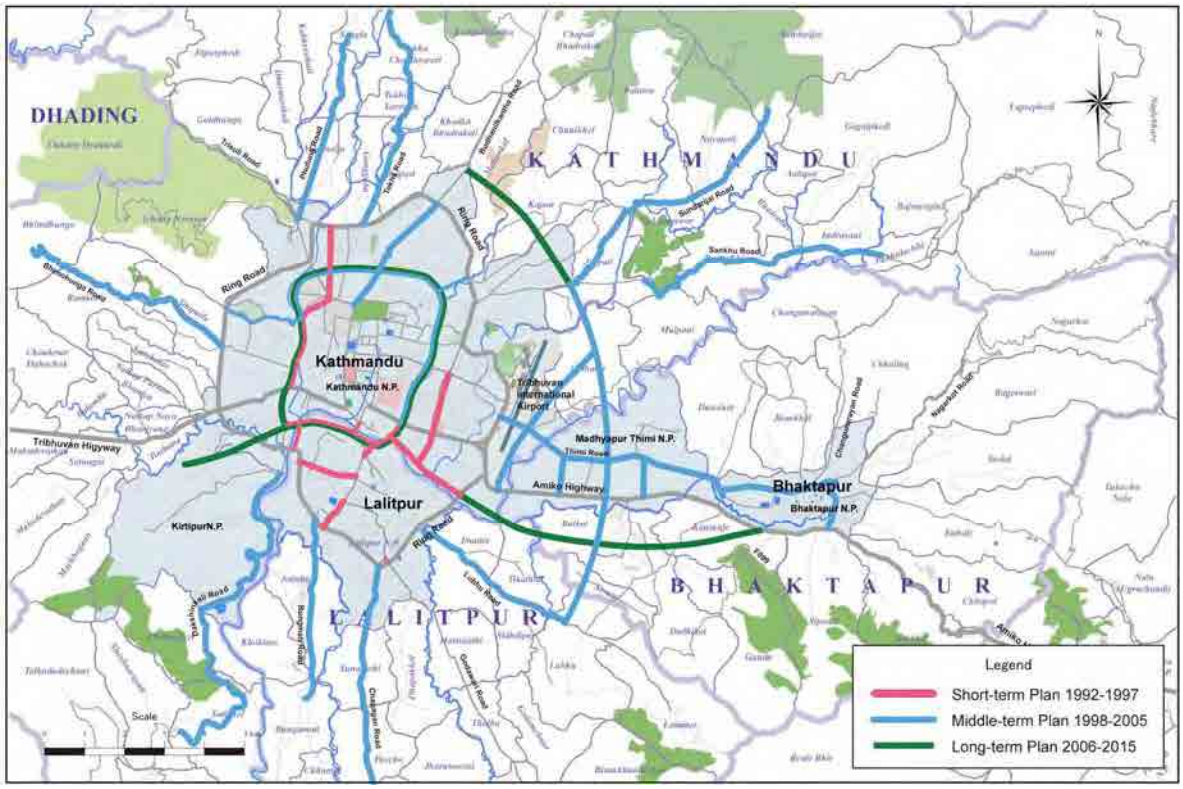
**(3) To strengthen the feeder road network to promote a well-balanced urban development and to provide an efficient transportation network in newly developed areas shifting outward.**

1) Eight feeder roads which are used as the main bus routes were proposed to be upgraded to accommodate the increasing traffic demand
2) Development of the Outer Ring Road
3) Development of the Thimi North-South Ladder Step Roads

**(4) To dissolve the bottleneck points of the city road network.**

1) Widening of Bagmati Bridge at Kupanddol to increase river crossing capacity over Bagmati River
2) Improvement of road connecting Nayabazar to the bus terminal in Balaju
3) Widening of Kantipath Road (F025) and Thapatari-Patan Road (F103), etc.

Figure 3.2.1 shows the Road Network Plan proposed by the previous M/P (in 1993).

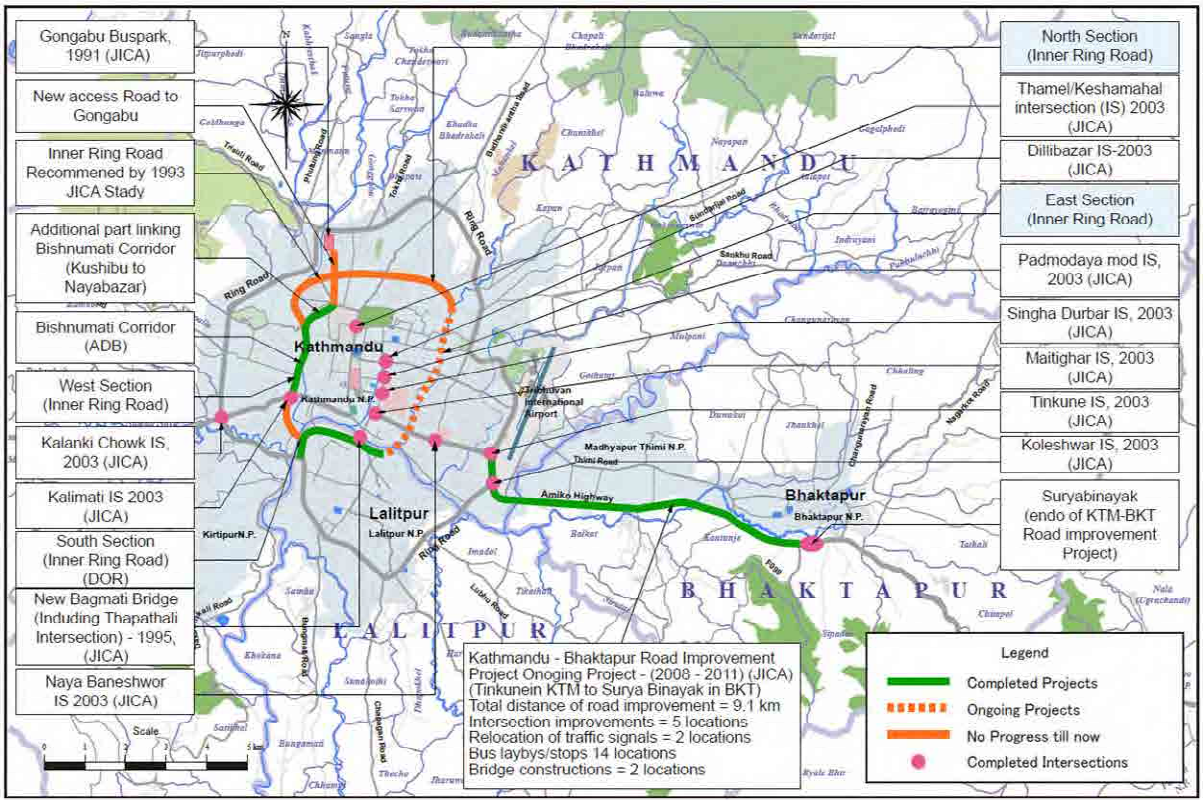



Source: JICA Survey Team

**Figure 3.2.1 Proposed Road Network System in Previous M/P (in 1993)**

### 3.2.2 Implemented Projects after the Previous M/P (in 1993)

The implemented projects after the previous M/P (in 1993) are presented in Figure 3.2.2.




Source: JICA Survey Team

**Figure 3.2.2 Implemented Projects after the Previous M/P (in 1993)**

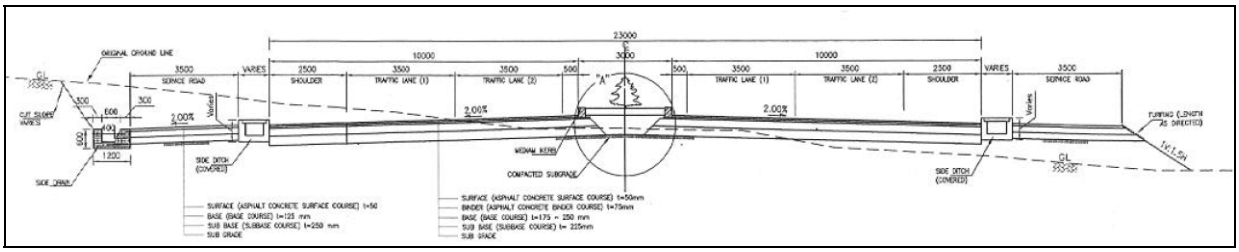
## 3.3 On-going Major Road Improvement Project

### 3.3.1 Bhaktapur–Dhulikel Road Widening Project

The need for the immediate improvement of the corridor between Kathmandu and Terai was indicated in the 20-Year Road Plan of 2002 and the condition of the traffic congestion plying in this corridor have been considered not only in the 20-Year Road Plan but also in the PIP and Business Plan such as the bypass of Bagmati Corridor, Kathmandu-Terai Tunnel Fast Track, etc.

The Bhaktapur-Dhulikel Road Widening Project was planned by DOR to mitigate the amount of vehicles plying the route of Kathmandu-Naubise-Birgunj as an alternative route with the widening of the existing road between Kathmandu-Bhaktapur Road and the construction project of Bardibas-Dhulikel Road under the funding of JICA.

Based on the above mentioned project background, the Detailed Engineering Survey and Design of the Widening of Roads to Six-Lane Standard including initial environmental examination, preparation of contract documents for execution of construction works, and the preparation of detailed project report were completed on 2011 under the administration of DOR. The construction period will commence within several years. The planned typical cross-section of the road is shown in Figure 3.3.1 below.




Source: Detailed Design of Upgrading/Widening of Roads to Six-Lane Standard
Arniko Lokmarg (Suryabinayak-Dhulikhel Section) by Full Bright Consultancy (Pvt.) Ltd.

**Figure 3.3.1 Typical Cross-section Planned in the Detailed Design on 2011 Administered by DOR**

### 3.3.2 Kathmandu Sustainable Urban Transport Project (KSUTP)

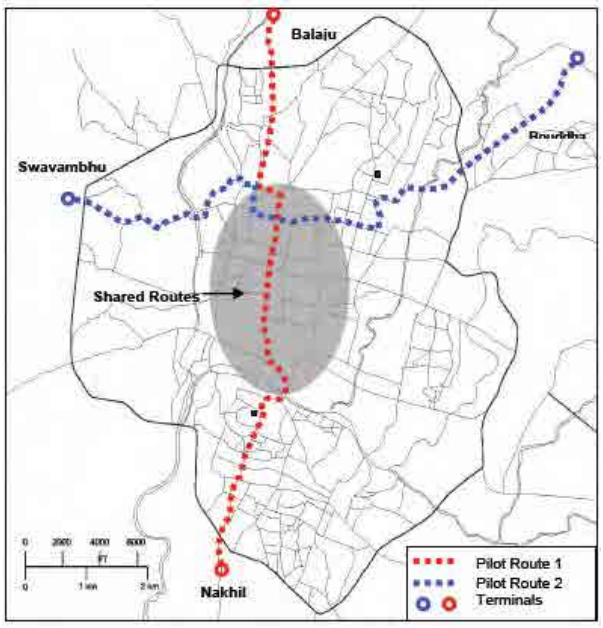
This project proposed four major improvement components comprising of public transport, traffic management, pedestrianization, and air quality by ADB. Based on these components, this project mainly focuses on the issues due to the lack of adequate public transport management and poor conditions experienced by pedestrians within the Kathmandu Valley Core Area such as Thamel, Tundikhel, New Road, Putalisadak, etc.. Major development plans related with road and transportation are as follows:

**(1) Public Transport Component**

1) Existing fleet of public transport vehicles, its owners, and routes will be rationalized.
2) Rules and regulations relating to the operation of public transportation will be reviewed and amended.
3) Two pilot bus routes will be developed and implemented to start the process of route rationalization and fleet renewal of public bus transportation administered by DOTM.
4) Capacity building of DOTM will be conducted to implement the development such as new regulations, systems, and procedures including the planning of the new route network and subsequently continuing the operation of the new systems.

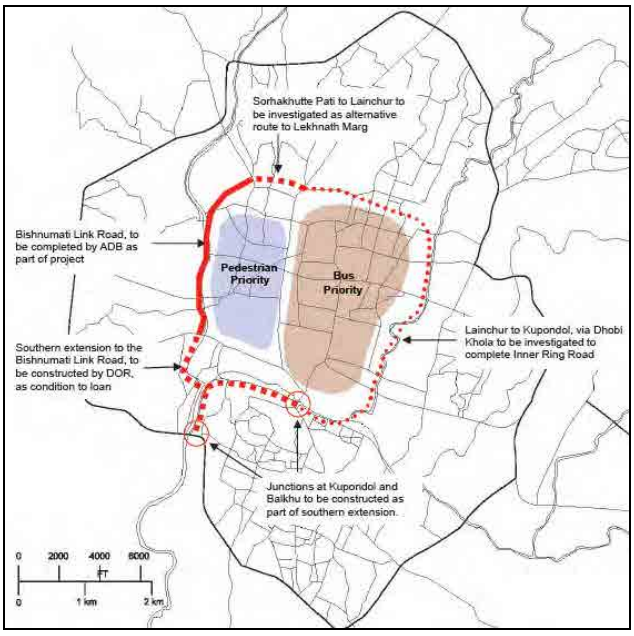
**(2) Traffic Management Component**

1) Improvements of Bishnumati Link Road junctions will be conducted.
2) Extension of the link road to the existing Bagmati and Blkhu Bridge from Bishnumati Link Road will be conducted.




Source: KSUTP Final Report

**Figure 3.3.2 Two Pilot Routes for Public Bus Operation**




Source: KSUTP Final Report

**Figure 3.3.3 Improvement of Inner Ring Road including Bishnumati Link Road and Southern Extension Project**

The assistance to the above mentioned survey began on October 5, 2009 and completed in mid-April 2010. At this time it is being implemented on which the Project Coordination Office (PCO) has been established under MOPPW and new units under PCO are being created to manage, coordinate, and monitor each component in DOR, KMC, DOTM, MTP, and MOE. An international consultant who will support the works of PCO, DOR, and KMC will be selected within a couple of months.

Activities of each component under KSUPT are shown in Table 3.3.1 as follows:

**Table 3.3.1 Activities of Each Component**

| Components | Implementing Agency | Activities |
|---|---|---|
| Public Transport | DOTM | Redesign bus route network and introduce new types of service |
| | | Identify locations for bus stops and locations for lay-bys and peripheral terminals |
| | | Review public transport regulations and amend as necessary, including introduction of franchising |
| | | Restructure public transport industry and rationalize bus fleet |
| | | Determine bus depot requirements |
| | | Rationalize taxi operations |
| | | Ensure that all public transport vehicles abide by standard and regulations for vulnerable groups |
| | | Operate public transport cross subsidy for the poor |
| | | Awareness campaigns for promotion of public transport |
| | | Financial advice to DOTM |
| | DOR | Construct bus stop lay-bys in central area |
| Traffic Management | Police | Improved traffic management, operations, and enforcement, including demonstration projects |
| | | Assessment and revision of traffic regulations and enforcement of penalties |
| | | Awareness campaigns for better driving |
| | | Installation of CCTV cameras and monitors |
| | | Purchase of other equipment for Traffic Police |
| | | Traffic management trainer (UK police) |
| | KMC, DOR | Ensure that physical works comply with appropriate standards for vulnerable groups |
| | | Parking policy and traffic entry restraints |
| | DOR | Leknath Marg/Lazimpat road junction improvement and road widening |
| | | Junction improvements in central area (excluding the Bishnumati Link Road) |
| | | Construction of junctions along Bishnumati Link Road (Sorhakhutti Pati to Teku) |
| | | Construction of bus lanes |
| | | Southern extension to Bishunmati Link Road (DOR) |
| | | Install new traffic signals in central area |
| | | Resettlement of affected persons |
| Pedestrianization | KMC | Contract out bus station /parking west side of Tundikhel |
| | | Contract out redevelopment of the Old Bus Park |
| | | Contract out development and operations of car park in Social Welfare Compound |
| | | Improvements to pedestrian routes and related traffic management in historic core |
| | | Traffic management regulations and enforcement |
| | | Public awareness campaign |
| | | Construct 2 and upgrade 2 pedestrian bridges over Bishnumati River |
| | | Financial advice to KMC |
| | | Pedestrian links & footpaths in central area (33.3%ADBcontribution) : Phase I |
| | | Pedestrian links & footpaths in central area (33.3%ADBcontribution) : Phase II |
| Air Quality | Police | Mobile emission testing equipment for police |
| | MOE | Resume air quality monitoring and disseminate results to people |
| | DOR | Feasibility for trolley bus (Separate TA) |
| | DOTM | Purchase and install emission testing equipment |
| | | Purchase and install mechanical testing equipment |

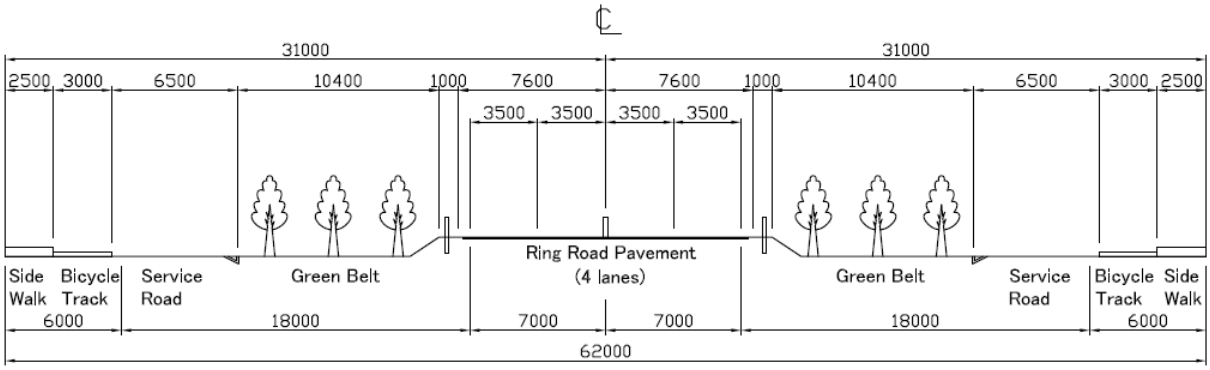
Source: KSUTP Final Report

### 3.3.3 Ring Road Improvement Project

The existing Ring Road with a length 27.8 km was constructed from 1978 to 1979. This road is considered as an important part of SRN of the Kathmandu Valley which has links to major arterial radial roads from the Kathmandu City Core Area to the borders of Kathmandu Valley.

The existing Ring Road is characterized with rapid growth of the settlement on both sides and high volume of traffic. Presently, the encroachments on the Ring Road, the unaccounted number of access roads, and poor service road system have heightened in the road corridor. These issues significantly reduced the vehicular traffic speed.

To address these issues, the KVTDC has initiated and studied the Ring Road Improvement Project comprising the development and improvement of the service road, conservation and management of green belts, intersection improvement of access roads within the Ring Road, and the installment of road furniture such as parking facilities for public vehicles in 2003. In this report administered by KVTDC, a total of four-lane typical cross-section was planned as shown in Figure 3.3.4 below.




Source: KVTDC (KVDA)

**Figure 3.3.4 Typical Cross-section after Widening of the Existing Ring Road**

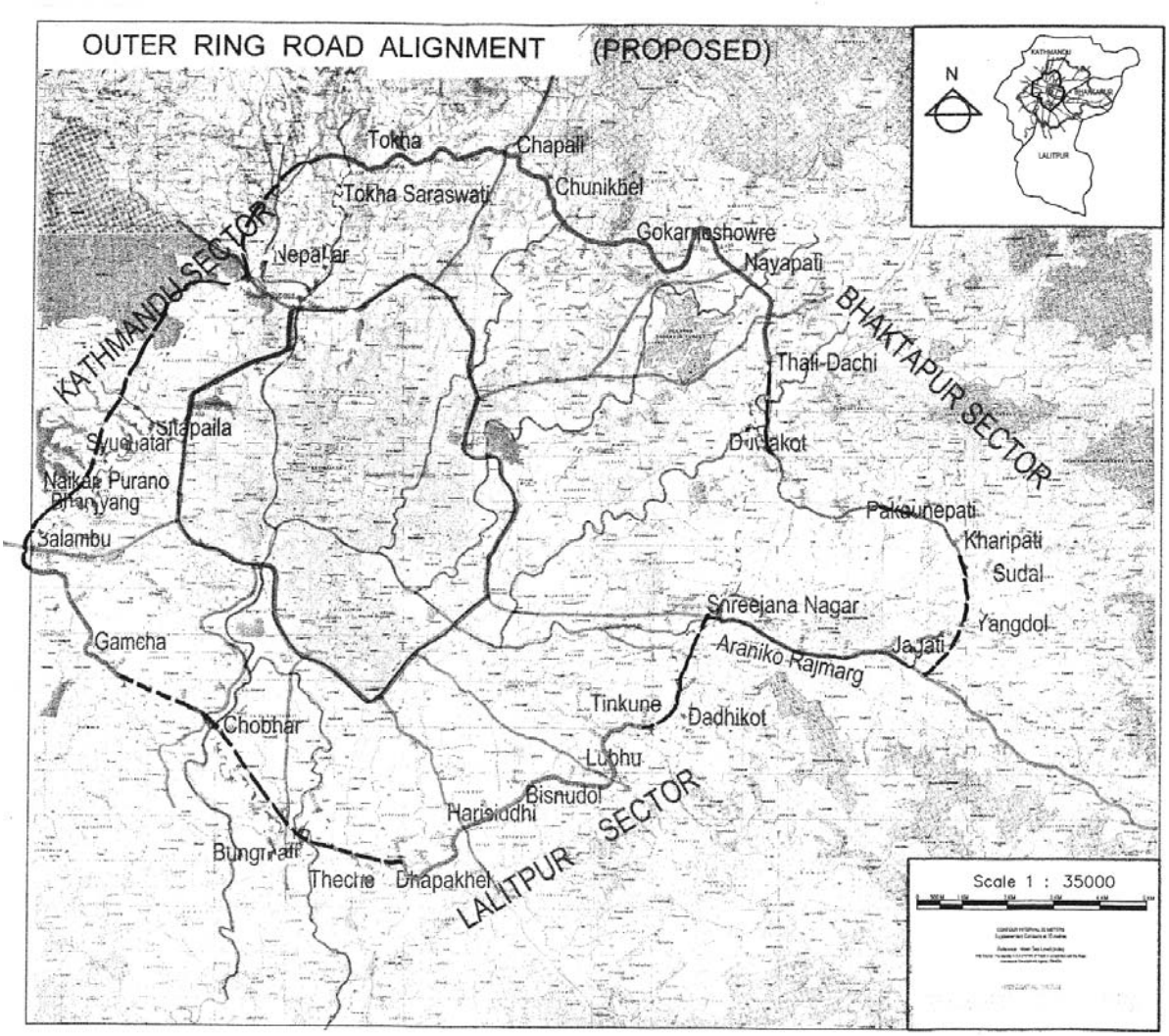
Subsequent to the above mentioned report by KVTDC, the widening of the Ring Road to four-lane is being re-designed in coordination with the Government of People's Republic of China (China) in 2011-2012. The construction works of this widening project will commence within the next Nepali fiscal year with grant assistance of the Chinese government.

### 3.3.4 Outer Ring Road Development Project

Due to lack of proper connectivity between the radial roads leading outwards from the existing Ring Road, the pressure of traffic flow is more concentrated in the Ring Road and the increasing unplanned settlement growth on either side of the radial roads has created more problems in the Kathmandu Valley. The need for an Outer Ring Road has been felt and the 20-Year Road Plan envisions the construction of the Outer Ring Road as Priority II.

Pre-feasibility study of the Outer Ring Road was conducted by the Nepal Engineering Consultancy Services (NEPECON), a government undertaking consultancy in 2000, proposed a road alignment of 66 km. The concept of land pooling process was accepted by the Government of Nepal and the Outer Ring Road Development Project (ORRDP) Office was established in the fiscal year of 2004/2005.

After the establishment of ORRDP Office, the proposed alignment of 66 km was evaluated and amended to a new alignment of about 72 km in accordance with the nodal points decided by the cabinet. The present proposed alignment of the Outer Ring Road is shown in Figure 3.3.5 below.




Source: ORRDP Office

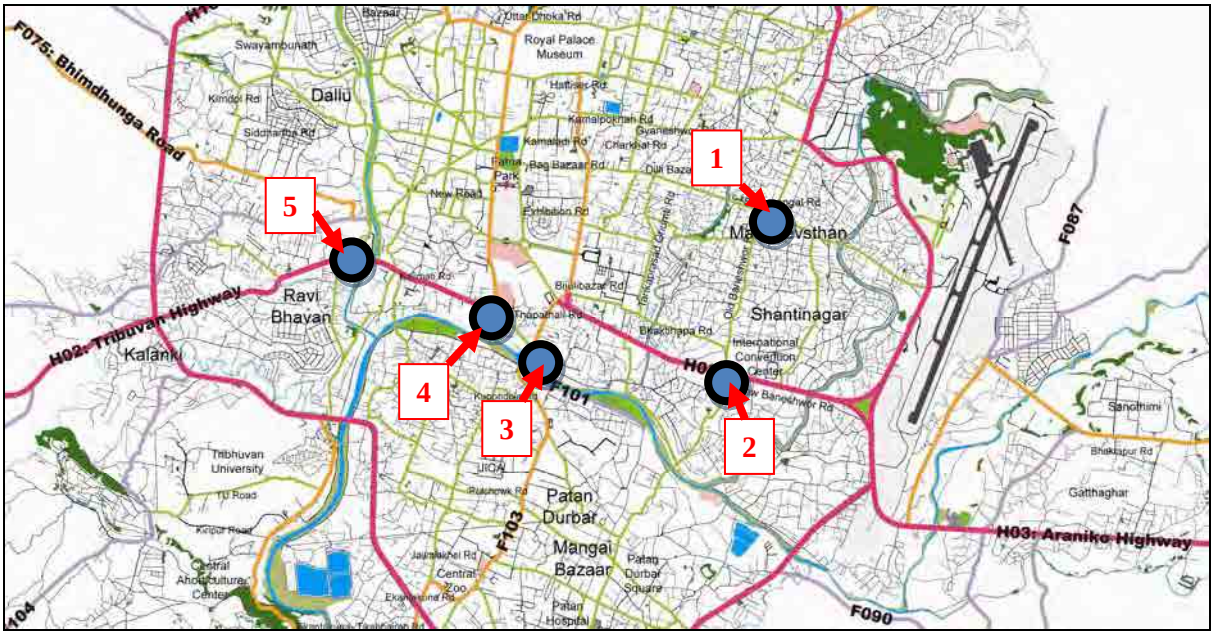
**Figure 3.3.5 Present Proposed Alignment of the Outer Ring Road**

### 3.3.5 Grade-Separated Intersections at Five Major Junctions in Kathmandu

The DOR has planned to develop five major intersections as grade-separated ones in order to improve the level of service for vehicular and pedestrian traffic in the entire network of intersections along the arterial axes for East West Corridor and North South Corridor within the Kathmandu Valley. Furthermore, it intended to contribute significantly towards mitigating traffic congestion and safety in the entire city. The proposed intersections are as follows and shown in Figure 3.3.6:

1) Old Baneshwor Junction
2) New Baneshwor Junction
3) Thapathali Junction
4) Tripureshwor Junction
5) Kalimati Junction

In this project, the basic design and detailed project report of all the five junctions were prepared under the administration of DOR in recent months and the New Baneshwor Junction has the most progress in the preparation of the detailed project report and commenced the construction in advance compared to the other target junctions.

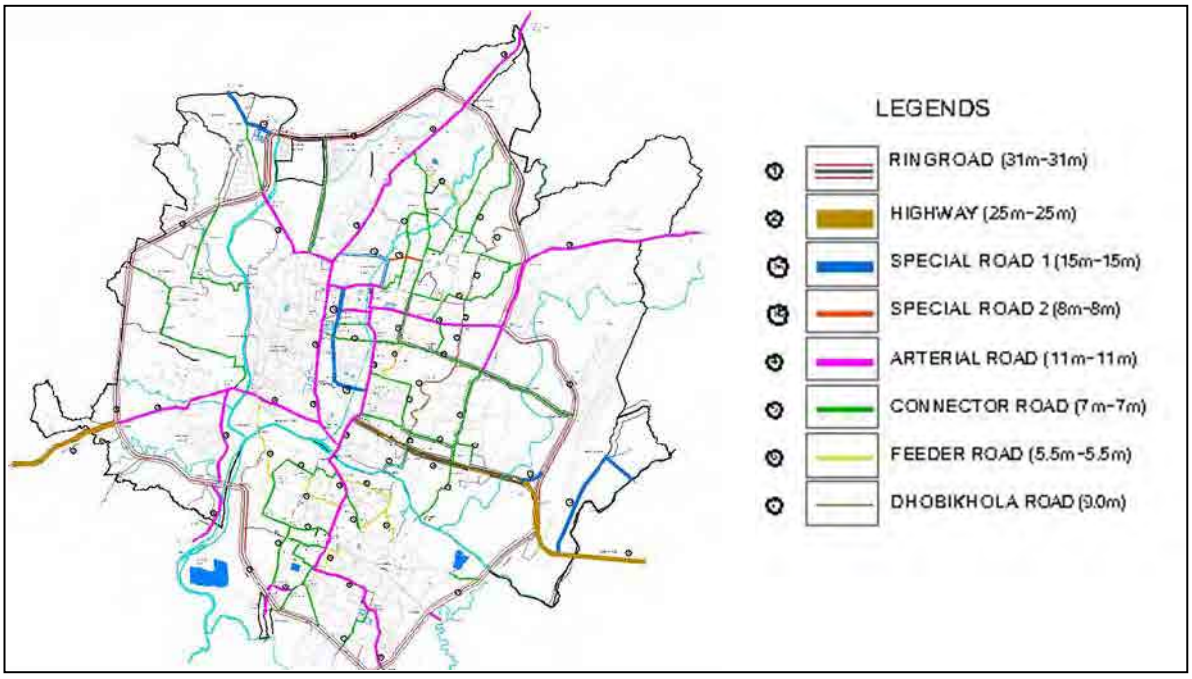



Source: DOR

**Figure 3.3.6 Target Five Intersections for Flyover Project in Kathmandu City Area**

### 3.3.6 Kathmandu Valley Road Widening Projects

In recent months, after the end of 2011, improvement of major roads including not only the national highway and the feeder road but also the urban roads requiring high traffic capacity under DOR and municipalities within Kathmandu Valley Core Area has been conducted especially for land preparation works administrated by KVTDC (KVDA) in cooperation with the Municipality, MTP, and DOR to facilitate substantial progress. The houses which encroached within ROW have been demolished. The actual progress until the end of June 2012 has reached to approximately 35 km, and another 30 km will be demolished aftertime according to the present plan of KVDA. The ROW was defined by Kathmandu Valley Building By-laws issued by KVTDC in 2007, and the defined routes and width for each route are shown in the following figure.




Source: KVTDC (KVDA)

**Figure 3.3.7 Kathmandu and Lalitpur Roads By-laws Map (Width of defined ROW)**

### 3.3.7 Railway and Metro Development Project

The Department of Railways under Physical Planning and Works, Government of Nepal assigned on December 28, 2011 the consortium to Chungsuk Engineering. Co. Ltd., Korea, Transport Institute, Korea, Korea Rail Network Authority, Korea, ERMC (P) Ltd, Nepal, BDA (P) Ltd., Nepal for the Feasibility Study of Mass Rapid Transit (Underground and Elevated Railway) Systems in Kathmandu Valley.. The study will be completed within ten months (until the middle of November 2012).

According to inception report of the above mentioned study, scope of works are as follows:

**(1) Status analysis and related plans review:**

1) Analyze the socio-economic status and railway operation status.
2) Review the national and regional development plans and the plans for reinforcing transportation and industrial facilities.

**(2) Demand forecast:**

1) Forecast the total future transport demand, including departures and arrivals.
2) Forecast passenger and freight demands.

**(3) Review urban railway system and set technological standards:**

1) Review and propose vehicle systems.
2) Set technological standard and propose design basis for the vehicle systems.

**(4) Train operation and management plan:**

1) Review and propose train operation and management plans, considering transport demands.

**(5) Route selection and technological review through preliminary designs:**

1) Route selection, construction plans based on preliminary designs.
2) Technological review regarding roadbed, track, power, signal, communication, car, station, structures, and depots/estimate project cost.

**(6) Economic and financial feasibility analysis:**

1) Estimate economic cost and benefit and conduct economic feasibility study and sensitivity analysis.
2) Estimate financial cost, earnings, and conduct financial analysis.

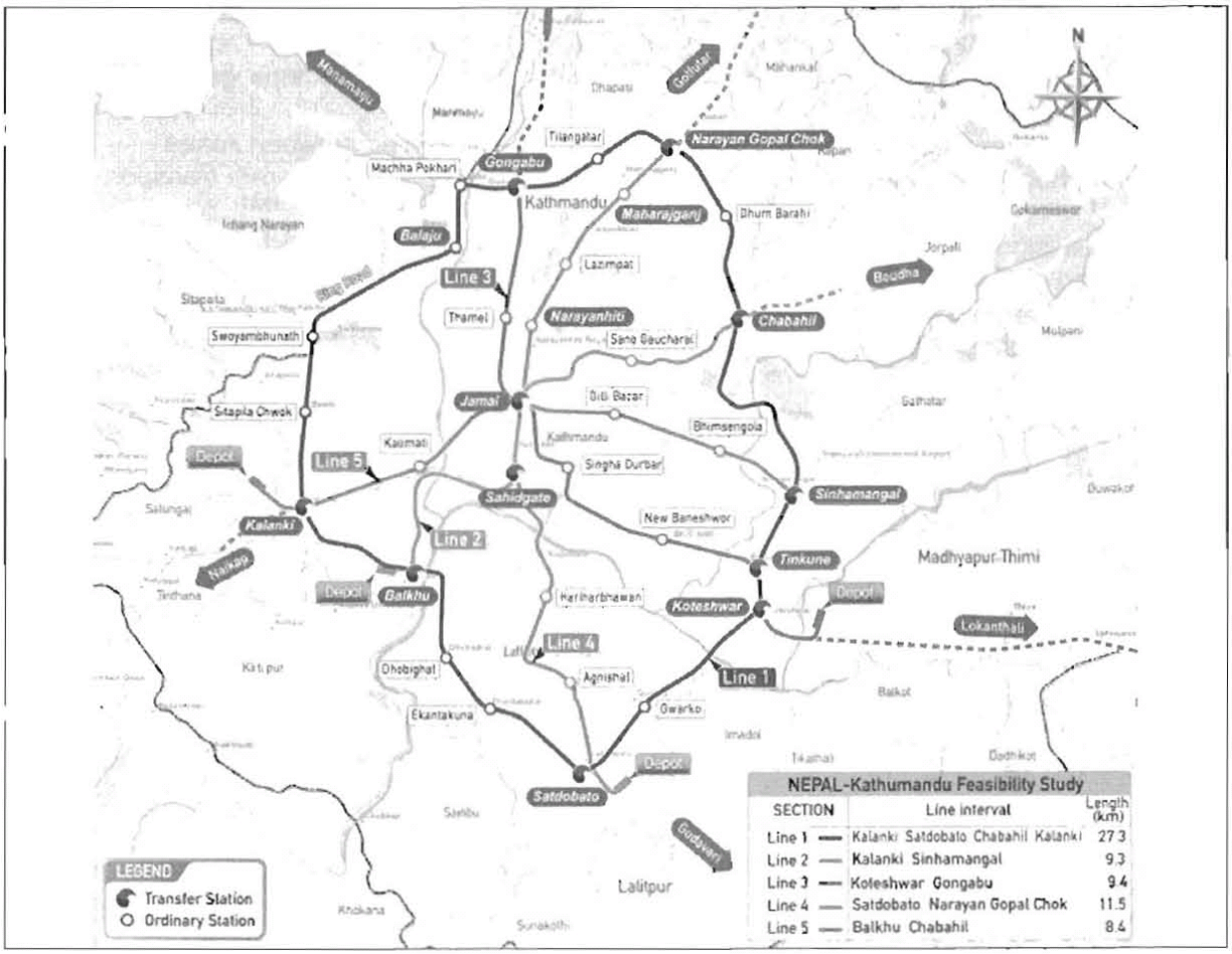
**(7) Review socio-environmental impacts:**

1) Review socio-environmental impacts and establish socio-environmental impact management plans.

**(8) Project execution strategy:**

1) Comprehensive review and proposal of construction plans and yearly investment plans.
2) Establish financing measures and development methods.
3) Comprehensive evaluation and proposal of the execution plan.

The proposed route network for metro railway is as shown in Figure 3.3.8.




Source: Inception Report on the Feasibility Study of Mass Rapid Transit Systems in Kathmandu Valley

**Figure 3.3.8 Proposed Route Network**

# CHAPTER 4 PRESENT ROAD CONDITION

## 4.1 Outline of Road Inventory Survey

### 4.1.1 Road Inventory Survey

A road inventory survey on major arterial roads was conducted by the JICA Survey Team from December, 2011 to April, 2012. The survey constitutes the frame of Kathmandu Valley which includes all national highways, feeder roads and urban roads. The inventory survey aims to identify the existing characteristics, problems and issues on the traffic and road network in Kathmandu Valley. In this survey, the road width (roadway width, pavement width), pavement (type, condition), bridge and box culvert (number of location), short sight distance (number of location), condition of traffic control (length of one-way and two-way system route) and parking place (number of location) were measured on target routes at 100 m intervals based on the field works. The pavement type and condition were judged especially through visual observations in the field. A detailed explanation and definition of survey items are presented in Appendix 3.2.

### 4.1.2 Roadside Condition Survey

Roadside condition surveys were conducted on national highways, feeder roads and major river corridors (Bishnumati River and Dhobi Khola) to clarify the possibility of improvement of the road for future road widening, in terms of the difficulty of land acquisition. In this survey, a number of houses encroached within the ROW of target roads, river width, land clearance along target river corridors and the number of houses within 30 m from the center of the target river corridors were measured using satellite image maps in AutoCAD application. The ROW for this survey is referred to the Nepal Road Standards (2027) issued by DOR. In the standard, 25 m and 15 m width on either side of the road center line were defined as optimal ROW for national highways and feeder roads, respectively. A detailed explanation and definition of survey items are mentioned in Appendix 3.2.

## 4.2 Target Route of the Survey

### 4.2.1 Road Inventory Survey

All existing routes which are operated and maintained by DOR within Kathmandu Valley, such as national highways, major and minor feeder roads, as well as strategic urban roads, are decided as target routes of the survey by the JICA Survey Team. Furthermore, major urban roads under the municipality, which links the roads under DOR within Kathmandu Valley, are selected by the JICA Survey Team as shown in Table 4.2.1 and Figure 4.2.1.

**Table 4.2.1 Summary of Target Roads for Road Inventory Survey**

| Class of Roads | Jurisdiction | Number of Target Routes | Target Length km | Total network length within 3 districts* km | Occupancy of target road to total length of 3 districts* % |
|---|---|---|---|---|---|
| National Highway | DOR | **3** | **58.4** | 72.0 | 81.1% |
| Major Feeder Road | DOR | **26** | **222.9** | 319.0 | 69.9% |
| Minor Feeder Road | DOR | **10** | **54.6** | 72.1 | 75.7% |
| Strategic Urban Road | DOR | **26** | **85.2** | 91.7 | 92.9% |
| Urban Road | Municipality | **1** | **31.7** | 512.9 | 6.2% |
| Total | | **66** | **452.8** | 1067.7 | 42.4% |

* The districts are Kathmandu, Bhaktapur and Lalitpur districts and the total network length within 3 districts refers to Statistics of Strategic Road Network (SSRN 2009/10) published by DOR.

Source: JICA Survey Team

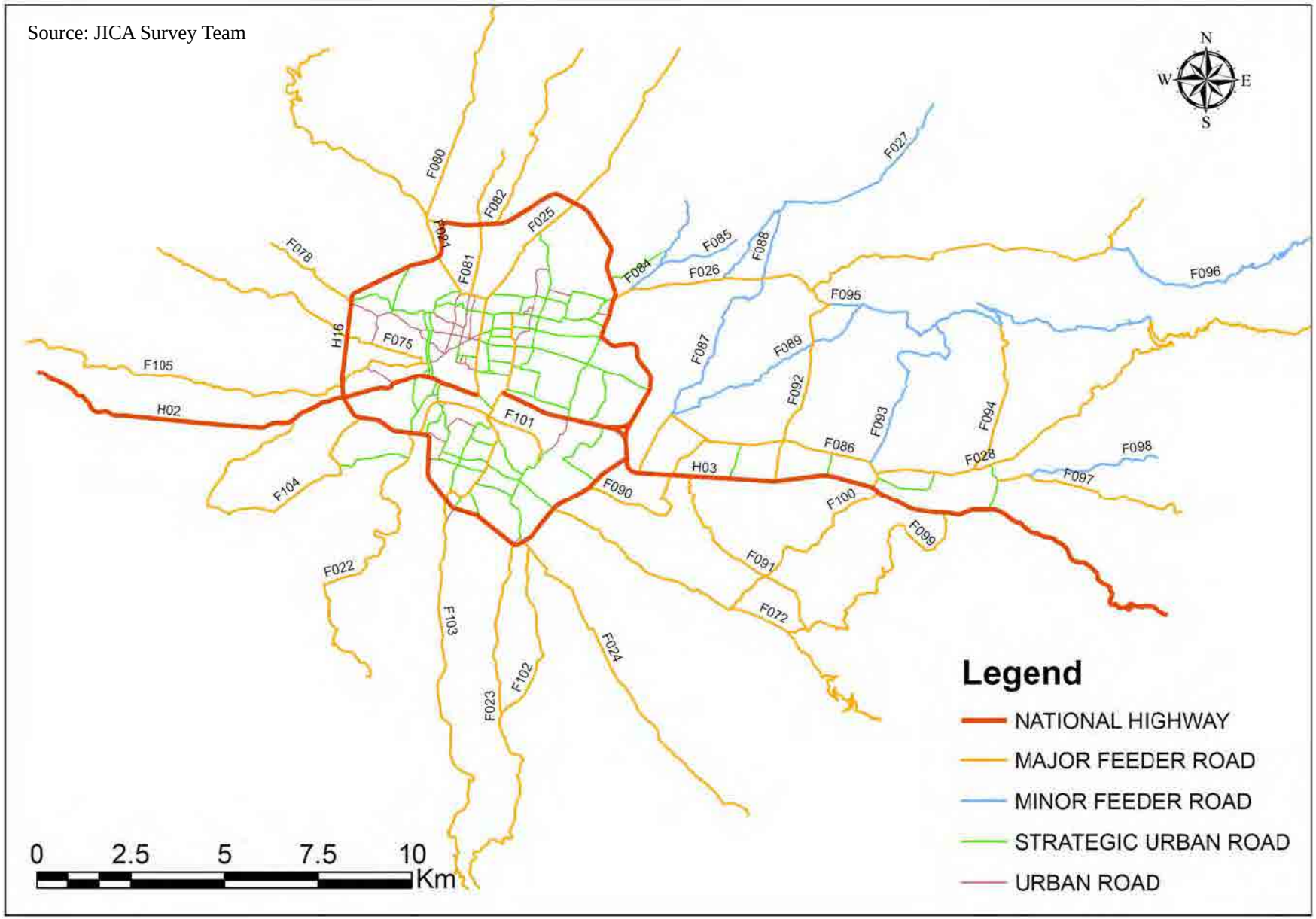



**Figure 4.2.1 Target Road Map Classified by Road Classification**

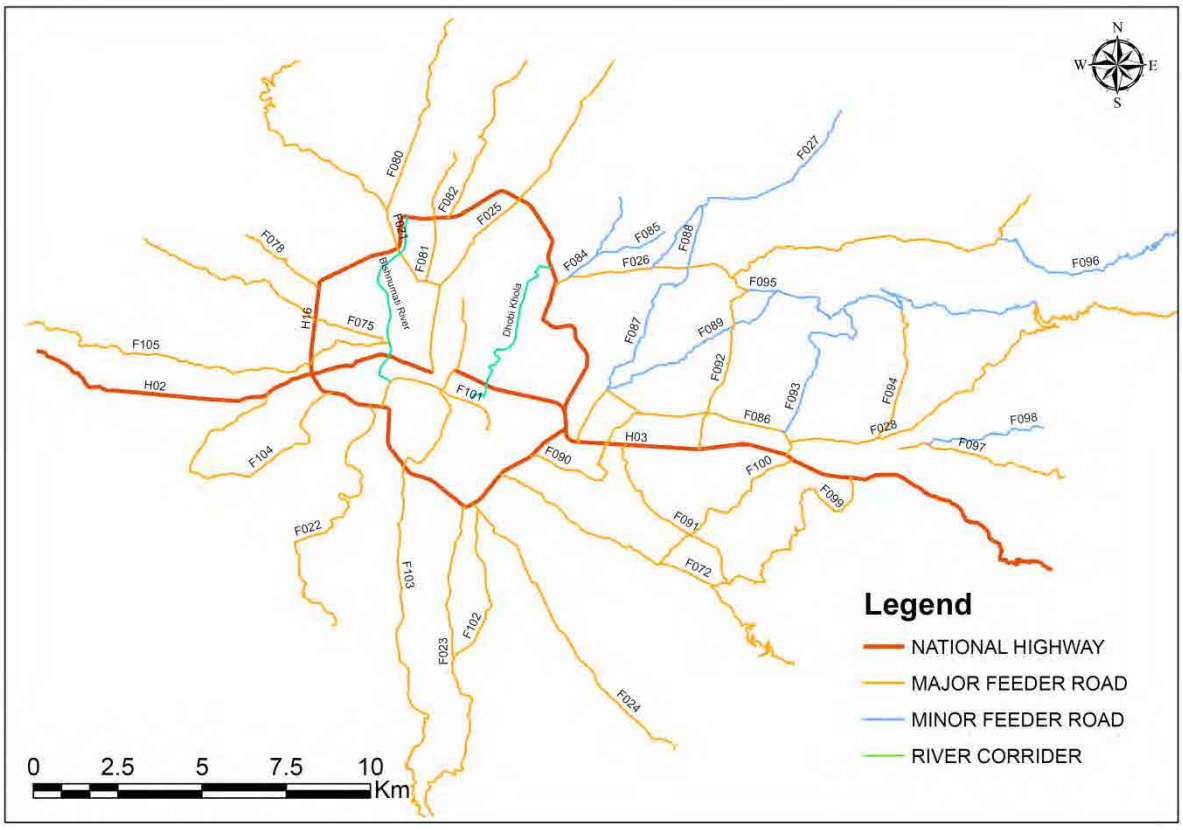
### 4.2.2 Roadside Condition Survey

Roadside condition surveys have been conducted on the following routes as shown in Table 4.2.2 and Figure 4.2.2.

**Table 4.2.2 Details of Target Routes for Roadside Condition Survey**

| Class of Roads | Jurisdiction | Number of Routes | Length km |
|---|---|---|---|
| National Highway (SRN) | DOR | 3 | 58.4 |
| Major Feeder Road (SRN) | DOR | 26 | 222.9 |
| Minor Feeder Road (SRN) | DOR | 10 | 54.6 |
| River Corridor | - | 2 | 11.0 |
| Total | | 41 | 346.9 |

Source: JICA Survey Team




Source: JICA Survey Team

**Figure 4.2.2 Target Route Map for Roadside Condition Survey**

## 4.3 Survey Results

### 4.3.1 Overall Characteristics of SRN

The following table shows the summary of characteristics for SRN based on the road inventory survey. Details of characteristics of all surveyed roads are explained in Appendix 3.11.

## Table 4.3.1 Characteristics of National Highway and Feeder Road

| Route No. | | Name of Road | Lane No. Based on Pavement Width Approx. | Ave. Pavement Width (m) | Pavement Type | | | | House within R.O.W | | Location of Start | Location of End |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BT (km) | GR (km) | ER (km) | Total (km) | Total No. | No. per km | | |
| National Highway | H02 | Tribuvan Highway | 4 | 9.87 | 12.1 | 0.0 | 0.0 | 12.1 | 935 | 77 | Tripureswor | Kalanki |
| | | | 2 | | | | | | | | Kalanki | Nag Dhunga Bus Stop |
| | H03 | Arniko Highway | 4 | 14.74 | 18.7 | 0.0 | 0.0 | 18.7 | 230 | 12 | Maitighar | Suryabinayak |
| | | | 2 | | | | | | | | Suryabinayak | Sanga |
| | H16 | Ring Road | 2 ~ 4 | 11.28 | 27.6 | 0.0 | 0.0 | 27.6 | 210 | 8 | Kalanki | Kalanki |
| Major Feeder Road | F021 | Trisuli Road | 1 ~ 2 | 4.86 | 11.6 | 0.0 | 0.0 | 11.6 | 336 | 29 | Lainchaur | Tinpiple Bus Stop |
| | F022 | Dakshinkali Road | 2 | 5.33 | 10.1 | 0.0 | 0.0 | 10.1 | 341 | 34 | Balkhu | Chobhar |
| | | | 1 ~ 1.5 | | | | | | | | Chobhar | Bansbari |
| | F023 | Chapagaun Road | 1 ~ 1.5 | 5.65 | 8.6 | 2.6 | 0.0 | 11.2 | 707 | 63 | Satdobato | Tikabhairav |
| | F024 | Godawari Road | 1 ~ 2 | 4.98 | 9.5 | 0.0 | 0.0 | 9.5 | 698 | 73 | Satdobato | Godawari |
| | F025 | Budhanilkantha Road | 2 ~ 4 | 8.98 | 10.8 | 0.0 | 0.0 | 10.8 | 726 | 67 | Tripureswor | Lainchaur |
| | | | 2 | | | | | | | | Lainchaur | Budanilkantha |
| | F026 | Sankhu Road | 2 | 5.98 | 13.4 | 2.1 | 0.0 | 15.5 | 1028 | 66 | Chabahil | Bagmati River |
| | | | 1 ~ 1.5 | | | | | | | | Bagmati River | Lapsephedi |
| | F028 | Nagarkot Road | 1 ~ 2 | 4.28 | 18.0 | 0.0 | 0.0 | 18.0 | 507 | 28 | Sallaghari | Nagarkot |
| | F072 | Lubhu Road | 1 ~ 1.5 | 3.96 | 9.3 | 0.0 | 3.9 | 13.2 | 617 | 47 | Gwarko | Lakuri Bhanjyang |
| | F075 | Bhimdhunga Road | 1 ~ 1.5 | 5.11 | 6.1 | 1.9 | 0.0 | 8.0 | 522 | 65 | Tankeswor | Bhimdhungga |
| | F078 | Hal Chok - Narayanthan Road | 1 | 3.94 | 2.7 | 0.0 | 0.0 | 2.7 | 142 | 53 | Swayambhu | Narayanthan |
| | F080 | Phutung Road | 1 ~ 1.5 | 5.24 | 3.6 | 2.6 | 0.0 | 6.2 | 557 | 90 | Balaju | Chunigaon |
| | F081 | Lainchaur - Samakhusi Chok - Baniyatar Road | 1.5 | 5.51 | 4.1 | 0.0 | 0.0 | 4.1 | 596 | 145 | Lainchaur | Baniyatar |
| | F082 | Tokha Road | 1 ~ 1.5 | 4.83 | 4.1 | 1.5 | 0.0 | 5.6 | 414 | 74 | Samakhusi Chowk | Chandesh warigaon |
| | F086 | Thimi Road | 2 | 6.95 | 7.5 | 0.0 | 0.0 | 7.5 | 738 | 98 | Jadibuti | Sallaghari |
| | F090 | Dharmeshwar - Tikathali - Manohara - Lokanthali - Thimi Road | 1 ~ 1.5 | 4.01 | 4.2 | 0.6 | 0.1 | 4.9 | 354 | 72 | Balkumari | Sano Thimi |
| | F091 | Kausaltar - Balkot - Sirutar - Chamelidada Road | 1 | 3.55 | 4.0 | 0.2 | 0.6 | 4.8 | 354 | 74 | Kausaltar | Chamelidada |
| | F092 | Thimi - Mulpani Road | 1.5 | 4.43 | 5.2 | 0.3 | 0.0 | 5.5 | 342 | 62 | Thimi | Mulpani |
| | F094 | Byasi - Changunarayan Road | 1.5 | 4.64 | 6.0 | 0.0 | 0.0 | 6.0 | 171 | 29 | Chocckhen | Sangdaha |
| | F097 | Bhaktapur - Nala - Banepa Road | 1 ~ 2 | 4.86 | 2.6 | 3.3 | 0.0 | 5.9 | 279 | 47 | Kamalhinayak | Amaldol |
| | F099 | Suryabinayak - Chamelidada - Bhujunge Road | 1 | 3.76 | 2.8 | 5.7 | 0.0 | 8.5 | 508 | 60 | Suryabinayak | Bhujunge |
| | F100 | Sallaghari - Katunje - Sumlingtar Road | 1 | 2.83 | 3.3 | 0.0 | 2.1 | 5.4 | 292 | 54 | Sallaghari | Lubhu |
| | F101 | Balkhu - UN Park Lane - Shankhamul | 1.5 ~ 2 | 6.14 | 4.1 | 0.0 | 0.0 | 4.1 | 128 | 31 | Balkhu | Shankhamul |
| | F102 | Satdobato - Dhapakhel - Thecho Road | 1 ~ 1.5 | 4.24 | 4.9 | 0.0 | 0.0 | 4.9 | 307 | 63 | Satdobato | Thecho |
| | F103 | Bungmati Road | 2 ~ 4 | 7.39 | 12.0 | 6.2 | 0.0 | 18.2 | 899 | 49 | Hattisar | Bhaisepati |
| | | | 1.5 | | | | | | | | Bhaisepati | Bungamati |
| | F104 | Kashibazar - Kirtipur - Machhegaun - Tinthana Road | 1 ~ 2 | 4.36 | 8.3 | 1.2 | 0.0 | 9.5 | 705 | 74 | Nariwalphant | Tinthana |
| | F105 | Nagdhunga - Tankeswor Road | 1.5 | 5.11 | 5.3 | 5.9 | 0.0 | 11.2 | 590 | 53 | Tankeswor | Nagdhunga |
| Minor Feeder Road | F027 | Sundarijal Road | 1.5 | 4.67 | 7.0 | 0.0 | 0.0 | 7.0 | 579 | 83 | Jorpati | Sundarijal |
| | F084 | Chuchepati - Mahankal - Kapan - Dandagaun Road | 2 | 6.37 | 3.1 | 0.0 | 0.0 | 3.1 | 281 | 91 | Chuche Pati | Mahankal |
| | | | 1.5 | | | | | | | | Mahankal | Kapan |
| | F085 | Mahankal - Atterkhel Road | 1.5 | 5.97 | 2.1 | 0.0 | 0.0 | 2.1 | 185 | 88 | Mahankal | Tinchuli |
| | F087 | Pepsikola - Gothatar Road | 1 ~ 2 | 5.64 | 2.7 | 0.0 | 0.0 | 2.7 | 31 | 11 | Sinamangal | Gothatar |
| | F088 | Gokarna - Jorpati - Gothatar | 1.5 | 5.89 | 3.7 | 0.1 | 0.0 | 3.8 | 165 | 43 | Gokarna | Gothatar |
| | F089 | Pepsicola - Karkigaun Road | 1 ~ 1.5 | 5.24 | 5.2 | 1.6 | 0.0 | 6.8 | 396 | 58 | Sinamangal | Phuyalgaon |
| | F093 | Sallaghari - Duwakot-Changunarayan Road | 1 ~ 1.5 | 4.17 | 4.7 | 0.0 | 0.0 | 4.7 | 384 | 82 | Nekosera | Changu |
| | F095 | Mulpani - Sangdaha - Changunarayan - Tilkot Road | 1 ~ 1.5 | 4.39 | 1.7 | 9.8 | 0.0 | 11.5 | 283 | 25 | Mulpani | Tilkot |
| | F096 | Sankhu - Kattike | 1 ~ 1.5 | 4.27 | 2.5 | 5.0 | 0.0 | 7.5 | 234 | 31 | Sankhu | Kattike |
| | F098 | Kamalbinayak - Sudal - Adikarigaun Road | 1.5 | 5.24 | 2.6 | 2.8 | 0.0 | 5.4 | 185 | 34 | Kamalbinayak | Sudal |

Source: JICA Survey Team

**Table 4.3.2 Characteristics of Strategic Urban Road***

| Route No. | | Name of Road | Lane No. Based on Pavement Width Approx. | Ave. Pavement Width (m) | Pavement Type | | | | House within R.O.W | | Location of Start | Location of End |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BT (km) | GR (km) | ER (km) | Total (km) | Total No. | No. per km | | |
| Strategic Urban Road | KMU001 | TU Gate - Naya Bazar (TU Road) | 2 | 7.39 | 1.7 | 0.0 | 0.0 | 1.7 | No Data | | TU Gate | Naya Bazar |
| | KMU002 | Kalimati - Balkhu (TU Road) | 2 ~ 4 | 12.33 | 1.7 | 0.0 | 0.0 | 1.7 | No Data | | Kalimati | Balkhu |
| | KMU004 | Kalimati - Bijeshwari - Sorhakhutte | 1 ~ 4 | 11.99 | 3.5 | 0.0 | 0.0 | 3.5 | No Data | | Kalimati | Sorhakhutte |
| | KMU006 | Kalimati Bridge - Puspalal Path | 2 ~ 4 | 9.50 | 1.8 | 0.0 | 0.0 | 1.8 | No Data | | Kalimati Bridge | Indrani Temple |
| | KMU012 | Tripura Marga | 4 | 17.52 | 0.5 | 0.0 | 0.0 | 0.5 | No Data | | Tripureswor | Thapathali |
| | KMU013 | Prithvi Path | 4 | 17.78 | 0.9 | 0.0 | 0.0 | 0.9 | No Data | | Singha Durbar | Sundhara |
| | KMU014 | Exhibition Road | 4 | 12.00 | 0.5 | 0.0 | 0.0 | 0.5 | No Data | | Padmodaya Junction | Durbar Murg Junction |
| | KMU015 | Sinamangal Road - Dilli Bazar Road - Bag Bazar Road - Ratnapark Road | 2 | 7.93 | 4.2 | 0.0 | 0.0 | 4.2 | No Data | | Sinamangal | Bhotahiti |
| | KMU016 | Gyaneshwor Road | 1.5 ~ 4 | 9.91 | 3.0 | 0.0 | 0.0 | 3.0 | No Data | | Gaushala | Jamal |
| | KMU017 | Chabahil - Narayanhiti Path | 1.5 ~ 4 | 7.75 | 3.5 | 0.0 | 0.0 | 3.5 | No Data | | Chabahil | Kanti Path Junction |
| | KMU019 | Gairidhara Road - Uttar Dhoka Road | 2 | 7.72 | 1.3 | 0.0 | 0.0 | 1.3 | No Data | | Maligaon | Budhanilkantha Road Junction |
| | KMU021 | Durbar Marg | 4 | 15.37 | 1.6 | 0.0 | 0.0 | 1.6 | No Data | | Prithvi Path Junction | Narayanhiti |
| | KMU022 | Narayanhiti Path - Uttar Dhoka Road | 2 | 8.56 | 0.5 | 0.0 | 0.0 | 0.5 | No Data | | Narayanhiti Path Junction | Uttar Dhoka Road Junction |
| | KMU024 | Maharajgunj - Dilli Bazar - Kumari Galli 2 | 1.5 ~ 2 | 5.88 | 4.0 | 0.0 | 0.0 | 4.0 | No Data | | Maharajgunj | Kumari Galli 2 Junction |
| | KMU025 | Kumari Galli 2 - Tankaprasad Ghumuti Road | 2 | 9.71 | 1.5 | 0.0 | 0.0 | 1.5 | No Data | | Padmodaya | Bijulibazar Road Junction |
| | KMU026 | Pattisputali Road - Old Baneshwor Road | 2 ~ 4 | 10.35 | 2.2 | 0.0 | 0.0 | 2.2 | No Data | | Gaushala | New Baneshwor |
| | KMU027 | Bjulibazar Road - Bhaktithapa Road | 2 | 7.78 | 1.6 | 0.0 | 0.0 | 1.6 | No Data | | Maitighar | New Baneshwor |
| | KMU029 | Teku - Kalo Pul Road | 1.5 ~ 2 | 5.68 | 0.5 | 0.0 | 0.0 | 0.5 | No Data | | Teku | Kalo Pul |
| | KMU030 | Chabahil - Tenzing Chowk Road | 2 | 7.61 | 1.6 | 0.0 | 0.0 | 1.6 | No Data | | Chabahil (Dhobi Khola) | Tenzing Chowk |
| | KMU031 | New Road | 2 | 11.68 | 0.5 | 0.0 | 0.0 | 0.5 | No Data | | Kantipath Road Junction | Ganga Path Junction |
| | KMU033 | Kamaladi Road | 2 | 7.58 | 0.6 | 0.0 | 0.0 | 0.6 | No Data | | Bungmati Road Junction | Durbar Murg Junction |
| | BMU001 | Gathaghar - Sano Thimi | 1.5 ~ 2 | 6.12 | 1.0 | 0.0 | 0.0 | 1.0 | No Data | | Gathaghar | Sano Thimi |
| | BMU003 | Sallaghari - Tekhacho - Nagarkot Road | 1.5 ~ 2 | 6.27 | 1.8 | 0.0 | 0.0 | 1.8 | No Data | | Sallaghari | Nagarkot Road Junction |
| | BMU004 | Garud Kundal Road | 2 ~ 4 | 10.89 | 1.3 | 0.0 | 0.0 | 1.3 | No Data | | Jagati | Kamalbinayak |
| | LMU001 | Gwarko - Pulchowk - Sanepa - Kalo Pul Road | 1.5 ~ 2 | 6.45 | 4.8 | 0.0 | 0.0 | 4.8 | No Data | | Gwarko | Kalo Pul |
| | LMU004 | Lagankhel Road | 2 ~ 4 | 12.52 | 2.3 | 0.0 | 0.0 | 2.3 | No Data | | Satdobato | Jawalakhel |

Source: JICA Survey Team

* Above listed roads were selected as major strategic urban roads by the JICA Survey Team

Route numbers for national highways as well as major and minor feeder roads were defined in the above table as per reference number mentioned in the Statistics of Strategic Road Network (SSRN 2009/10) published by DOR. Route numbers for strategic urban and rural roads were numbered by the JICA Survey Team.

The result of the survey for pavement width on all target roads is shown in Figure 4.3.4. Pavement width for roads comprising of gravel or earthen type was measured as roadway width as shown in Figure 4.3.1.

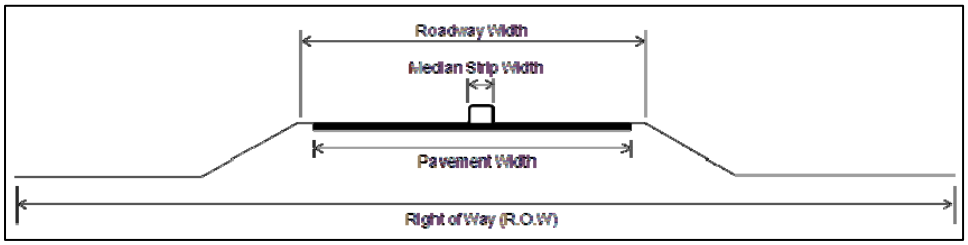



**Figure 4.3.1 Measurement Length**

### 4.3.2 Major Findings

#### (1) National Highways

Black topped pavements were observed on all surveyed routes. Good surface conditions were judged along almost all of the surveyed sections of the national highway as shown in Figure 4.3.2, Figure 4.3.3, Figure 4.3.5, and Figure 4.3.6.

The target roads are comprised of two-lane sections or more, as shown in Table 4.3.1 and Figure 4.3.4. There is no one-lane section along the national highway.

1) Tribuvan Highway (H02):

The Tribuvan Highway is composed of a four-lane section from Tripureswor to Kalanki and a two-lane section from Kalanki to Nag Dhunga bus stop. Fair to bad surface conditions were observed along the two-lane part of the road from Kalanki to Nag Dhunga bus stop. In terms of the extent of difficulty for road widening, it is determined to be medium to difficult level (the number of encroached houses is about 6–10 houses or more within ROW per 100 m) as observed in majority of the sections as shown in Figure 4.3.7.

2) Arniko Highway (H03):

The Arniko Highway is composed of a four-lane section from Maitighar to Suryabinayak (Bhaktapur) and a two-lane section from Suryabinayak to Sanga, respectively. The four-lane section of the Arniko Highway was improved by the current project for the improvement of the Kathmandu-Bhaktapur Road. Good surface conditions are observed along all of the surveyed sections. In terms of difficulty for road widening, it is determined to be easy (the number of encroached houses is about 0-5 houses within ROW per 100 m) as observed on majority of the sections, excluding the area near Sanga as shown in Figure 4.3.7.

3) Ring Road (H16):

The Ring Road is composed of a two-lane section excluding the sections near Kalanki, Gaushala-Chabahil and Tinkune-Koteshwor which partially has four lanes, according to the result of pavement width. Good surface conditions are observed along majority of the sections, however, fair surface condition are recorded near Sinamangal (Tribuvan Airport), Ekantakuna and the part between Gaushala and Chabahil. In terms of difficulty for road widening, it is determined to be easy (number of encroached houses is about 0-5 houses within ROW per 100 m) as observed on majority of the sections, excluding the area between Gaushala and Sinamangal (Tribuvan International Airport) which is determined to be medium to difficult level (number of encroached houses is about 6-10 houses or more within ROW per 100 m), as shown in Figure 4.3.7.

#### (2) Major Feeder Roads

Sections of black topped pavement are observed on majority of the surveyed major feeder roads. However, fair and bad surface conditions were recorded on 30% of the surveyed routes as shown in Figure 4.3.2 and Figure 4.3.3. Therefore, the extent of pavement surface condition is very low compared with the pavement quality of national highways.

The surveyed major feeder roads are located in all directions, starting from the center of Kathmandu Valley. The characteristics of each part are as follows:

1) Northern part:

Except for the Budhanilkantha Road (F025), the present condition of pavement width is relatively narrow. The routes are judged as generally one to 1.5-lane. However, in terms of the level of difficulty for road widening, Phutung Road (F080), Lainchaur-Samakhusi Chok-Baniyatar Road (F081) and Tokha Road (F082) are determined to be difficult (number of encroached houses is more than 11 within ROW per 100 m). In terms of pavement conditions, almost all parts of the Tokha Road (F082) are judged to have bad surfaces.

Budhanilkantha Road (F025) is observed as the highest upgraded road in terms of pavement width, type and pavement condition as compared with other major feeder roads located in the northern part of the valley. Along all sections of this road, black topped pavements were observed. The road is composed of a four-lane part located at the central area of the city from Tripureswor to Lainchaur, and a 2-lane part located from Lainchaur to Budanilkantha, respectively. Fair pavement conditions are observed outside of Ring Road. Bad pavement conditions were also found at some partial section near Budhanilkantha.

2) Eastern part:

The routes with more than two lanes are located on a part of the Sankhu Road (F026) between the Chabahil and Bagmati River, and the whole section of the Thimi Road (F086) from Jadibuti to Sallaghari. These routes are composed of black topped pavement. However, bad surface conditions are observed on these routes partially.

The Lubhu Road (F072) is one of the major radial roads in the eastern part. In terms of pavement type and condition, almost all of the sections are judged as black topped road and a part between Gwarko and Lubhu are observed to have good surface condition. However, this road only has 1-1.5 lanes and the extent of difficulty for widening was determined as medium to difficult on a part between Gwarko and Lubhu.

Nagarkot Road (F028) has a role of linkage between Kathmandu and Nagarkot. The road is one of the familiar travel spots that people take when seeing the scenery, although the number of lanes on this road was judged to have 1-1.5 lanes. The road is generally comprised of black topped pavement and good pavement conditions along majority of the sections.

In the southern area from Arniko Highway within the eastern part, there are no major arterial routes which are to be upgraded to more than 2-lane especially.

3) Southern part:

Several major radial roads are located within the southern part. In terms of the result of pavement width, type and condition, Bungmati Road (F103), Dakshinkali Road (F022), Godawari Road (F024), Chapagaun Road (F023) can be classified as a main arterial radial road.

Bungmati Road (F103) is one of the major radial roads. The road is composed of 2-4 lane sections from Hattisar to Bhaisepati, with some parts having 1-1.5 lane sections from Bhaisepati to Bungamati. All parts of the 2-4 lane section between Hattisar and Bhaisepati are classified as black topped pavement with good surface condition. On a part between Bhaisepati and Bungamati which has only 1-1.5 lanes, the pavement type was judged as black topped generally. The pavement condition was classified however as bad or fair pavement conditions on approximately 50% of the route.

Dakshinkali Road (F022) is also one of the major radial roads. This road is comprised of one to two lanes generally. The route between Balkhu and Chobhar was classified as a 2-lane and judged as having black topped pavement with good surface condition. The other section from Chobhar to Bansbari is observed as 1-1.5 lanes and black topped pavements. The condition of the pavement was determined as fair condition.

Chapagaun Road (F023) has black topped pavement on majority of the route and the pavement condition is judged as good. However, majority of the routes are classified as 1.5-lane.

Godawari Road (F024) was classified as a 1-2-lane section road. A part between Satdobato and Harisiddhi is judged as 2-lane and classified as black topped pavement. However, in terms of pavement condition, majority of the routes are recorded as fair.

4) Western part:

Almost all routes within the western part of the valley were classified as 1-1.5 lanes and were judged as fair or bad pavement conditions. Therefore, there are no major routes to be upgraded to more than a 2-lane section. The road was maintained with black topped pavement and with good condition excluding Tribuvan Highway in the western part.

### (3) Minor Feeder Roads

All of the surveyed minor feeder roads are located in the eastern part of the valley. The routes which are located in remote areas such as Mulpani–Sangdaha–Changunarayan–Tilkot Road (F095), Sankhu–Kattike (F096) and Kamalbinayak–Sudal–Adikarigaun Road (F098) are generally classified as earthen or gravel roads.

More than half of the surveyed routes are judged as having bad surface conditions as shown in Figure 4.3.3.

Almost all parts of minor feeder roads are comprised of only 1-1.5 lane sections. Especially, the roads which are classified as 2-lane sections are as follows:

1) A part of Chuchepati–Mahankal–Kapan–Dandagaun Road (F084) between Chuche Pati and Mahankal
2) A part of Pepsikola–Gothatar Road (F087) from Sinamangal to Kandhaghari

### (4) Strategic Urban Road

Majority of the surveyed routes are classified as black topped pavement road. Half of the routes were judged as having good surface conditions, however, the other half of the route were observed as having fair or bad surface conditions as shown in Figure 4.3.2 and Figure 4.3.3.

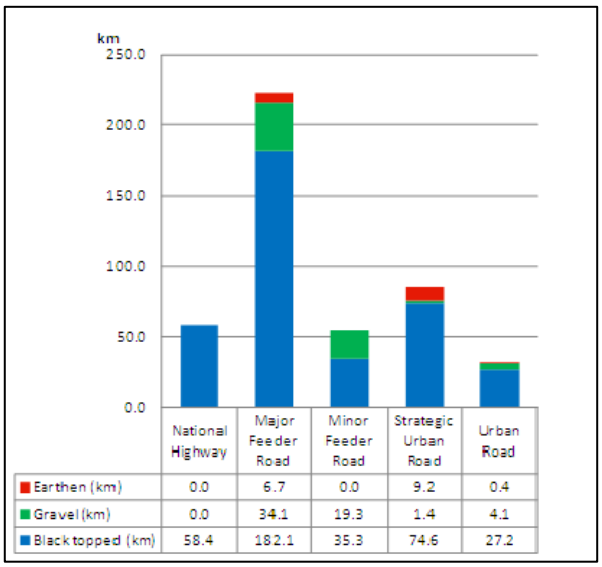
The major arterial roads which are composed of 4-lane sections are as follows:

1) Kalimati–Balkhu (TU Road) (KMU002) except a part of 2-lane section between Kuleshwor to Balkhu;
2) Kalimati–Bijeshwari–Sorhakhutte (KMU004) except a part of 1 to 1.5-lane from Dallu to Bijeshwari;
3) Kalimati Bridge–Puspalal Path (KMU006) except a part of 2-lane from Kalimati Bridge to Dallu;
4) Tripura Marga (KMU012);
5) Prithvi Path (KMU013);
6) Gyaneshwor Road (KMU016) in a part from Gaushala to Dhobi Khola and from Jamal to Durbar Marg;
7) Chabahil–Narayanhiti Path (KMU017) only in a part near Narayanhiti Palace Museum;
8) Durbar Marg (KMU021);
9) Pattisputali Road–Old Baneshwor Road (KMU026) only in a part near New Baneshwor and from Old Baneshwor to Gaushala; and
10) Lagankhel Road (LMU004) only in a part between Jawalakhel and Lagankhel.

### (5) Urban Road

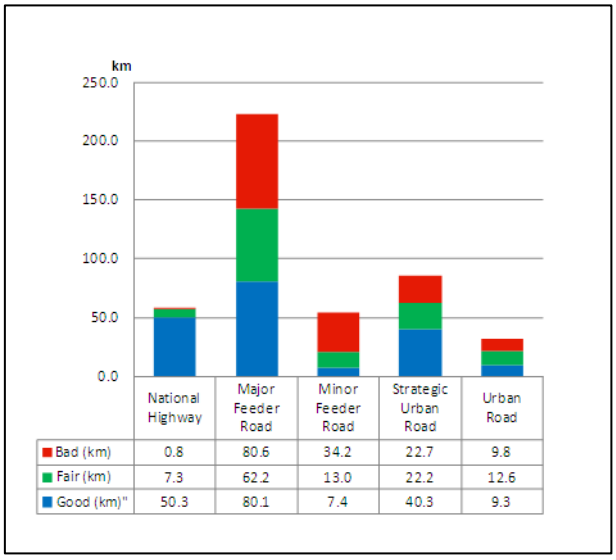
Almost all of the routes are comprised of 1 to 2-lane sections and classified as black topped pavement. However, about 30% of the routes are classified as bad surface conditions as shown in Figure 4.3.2 and Figure 4.3.3.

The majority of surveyed routes are located in the KMC core area such as Thamel and Kathmandu Durbar Square where many street vendors sell and tourists are walking around. In these areas, Tankeswor–Paropakar Marga–Paknajol Road (KMU008) and Hanuman Dhoka Road (KSU019) are especially observed as 2-lane section roads and judged as black topped pavement based on the survey results. The actual conditions along these routes are quite different due to many street sales opening in daytime and tourists walk around the Thamel core area as mentioned above. Therefore, the actual capacity to deal with vehicle movement can be lower than the existing condition even if there is enough space such as 2-lane.




Source: JICA Survey Team

**Figure 4.3.2 Road Length by Pavement Type**




Source: JICA Survey Team

**Figure 4.3.3 Road Length by Pavement Condition**

### (6) River Corridor

The condition survey along the Bishnumati River and Dhobi Khola was conducted to clarify the availability of river beds for future road construction site. The result is shown in Table 4.3.3. In terms of land clearance along target river corridors, the widths which were less than 40 m in length were observed at several local points. However, in terms of the average result, widths along both corridors were observed to be more than 40 m as shown in Table 4.3.3. Detailed information about land clearance is described in Appendix 3.10.

**Table 4.3.3 Result of Roadside Condition Survey for River Corridor**

| Name of River Corridor | Target Length | River Width (Avg.) (m) | Land Clearance (Avg.) (m) | No. of Houses within 30 m from the center of river |
|---|---|---|---|---|
| Dhobi Khola | 5.50 | 9.4 | 42.1 | 658 |
| Bishnumati River | 5.45 | 20.1 | 52.8 | 508 |

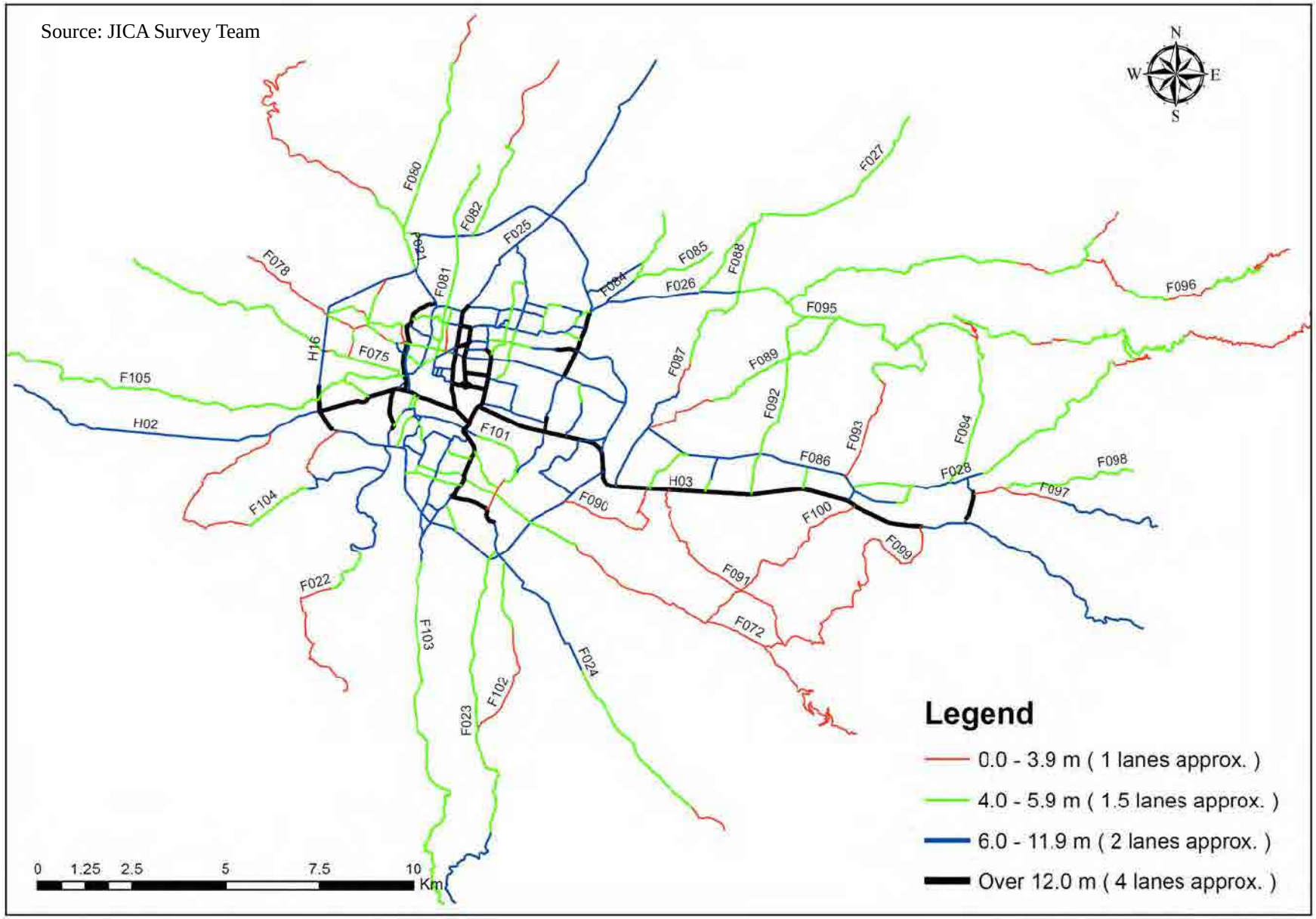



**Figure 4.3.4 Road Network Classified by Pavement Width**

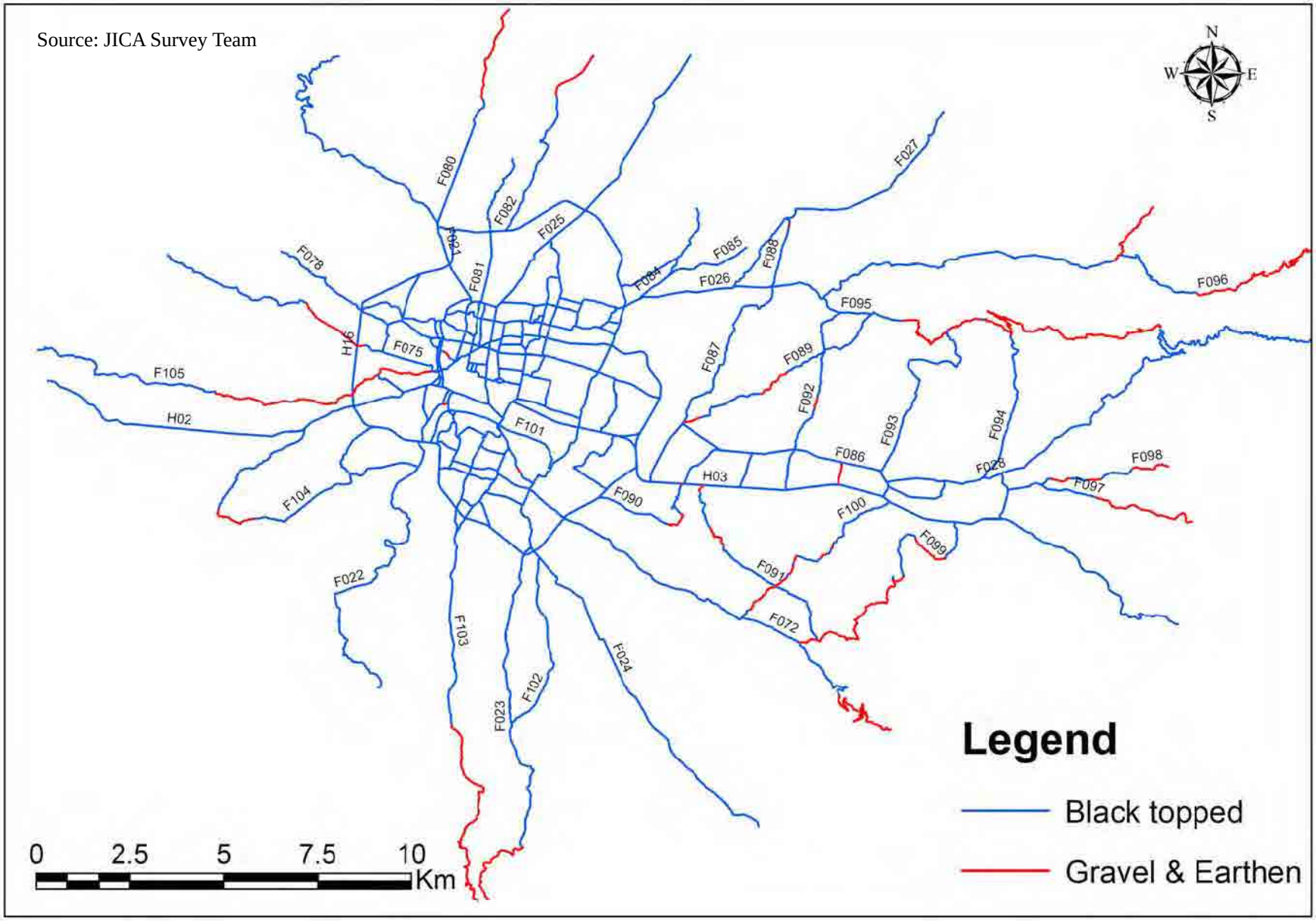



**Figure 4.3.5 Road Network Classified by Pavement Type**

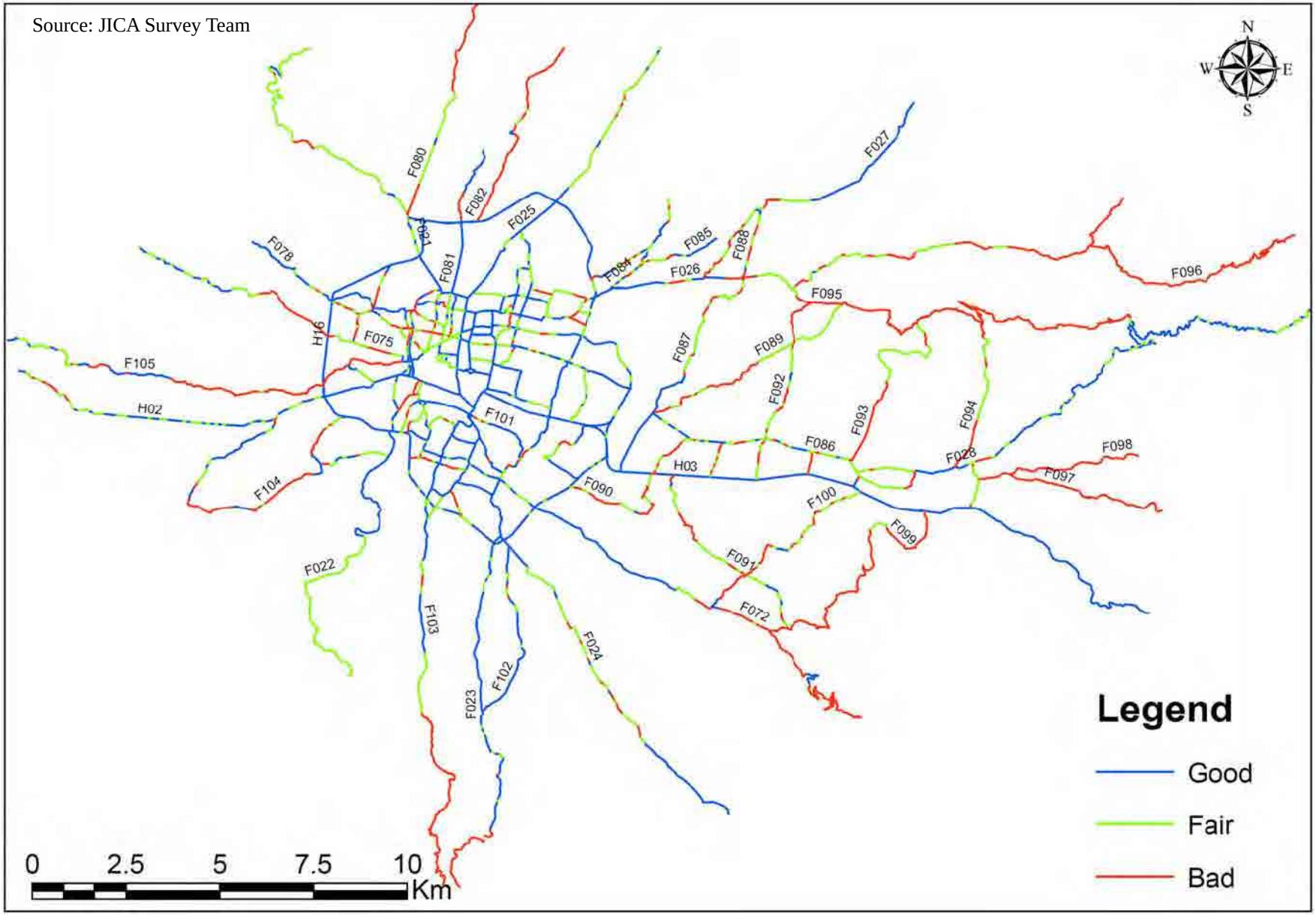



**Figure 4.3.6 Road Network Classified by Pavement Condition**

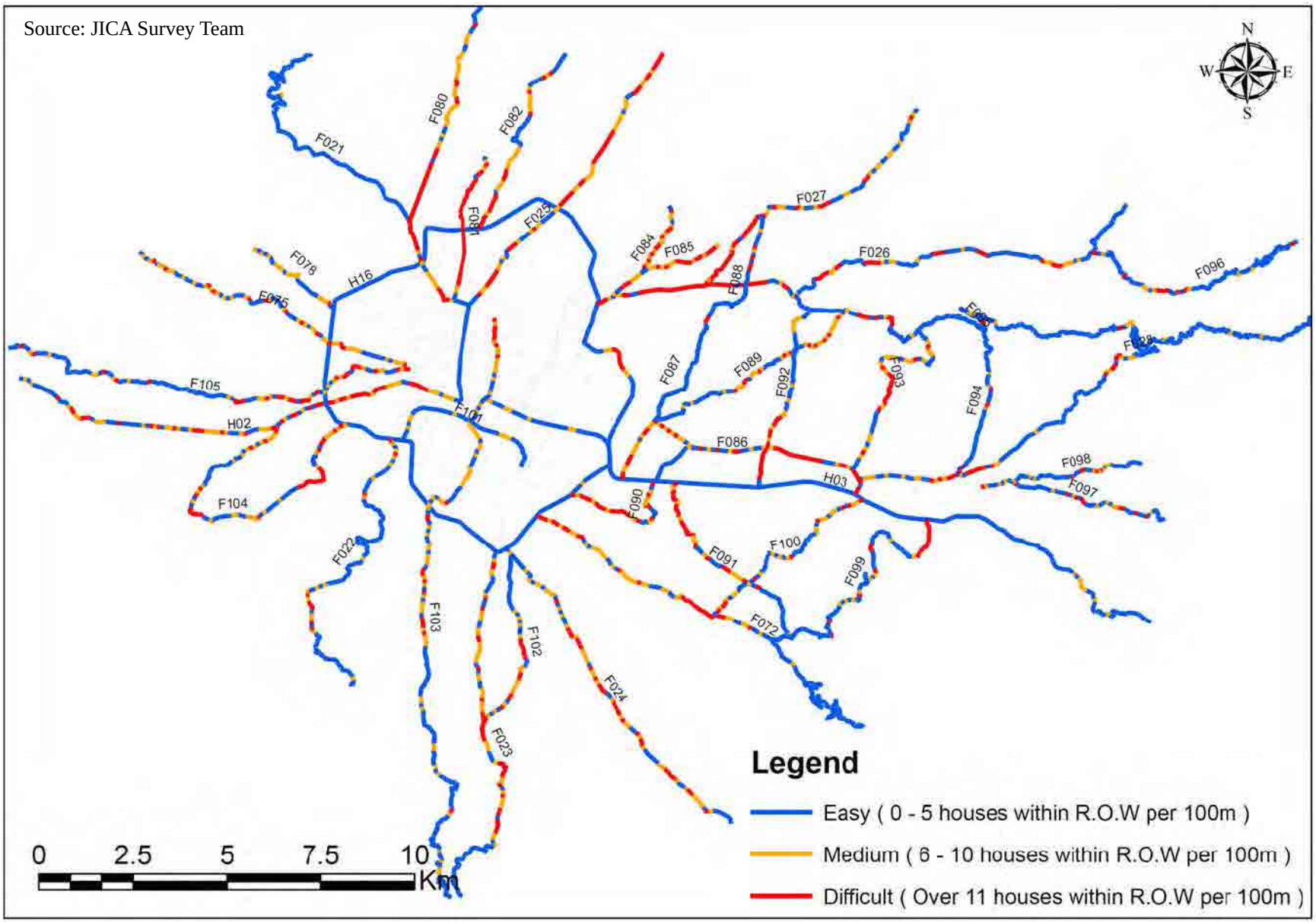



**Figure 4.3.7 Road Network Classified by the Extent of Difficulty for Road Widening**