Republic of Nicaragua
Municipality of Managua

PROJECT FOR URBAN DEVELOPMENT MASTER PLAN FOR MANAGUA CITY IN REPUBLIC OF NICARAGUA

FINAL REPORT

Part - I: Current Conditions

August 2017

Japan International Cooperation Agency

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EI
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17-103

The exchange rate used in the report is

US$ 100 = NIO 2820

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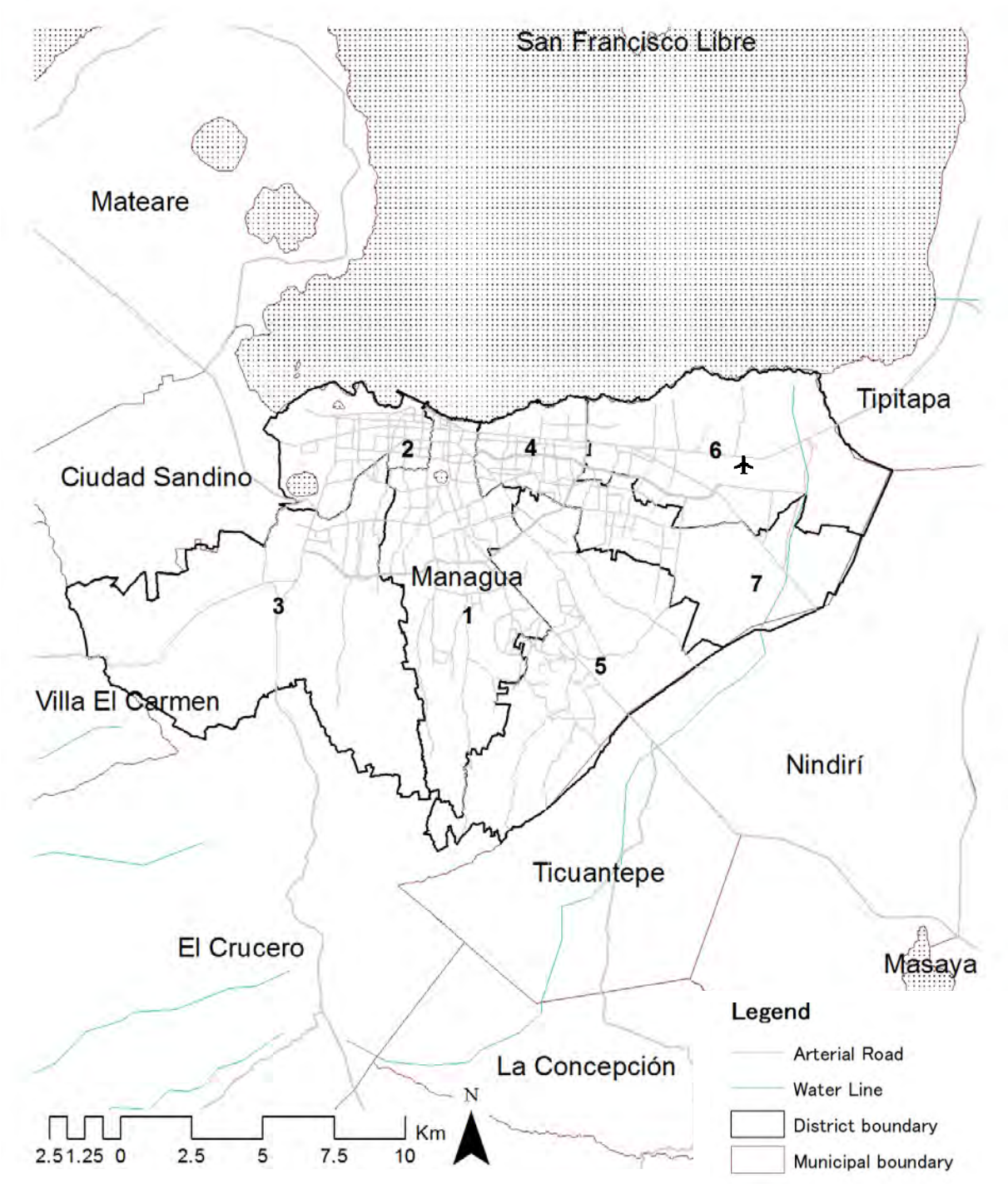
AASHTO	American Association of State Highway and Transportation Officials
AGT	Automated Guideway Transit
ALMA	Municipality of Managua
AMUSCLAM	Storm water Drainage and Development Management Sub Watershed III
APP	Public Private Partnership
ATN	Nicaraguan association of transporters
BAC	Bank of Central American
BCIE	Central American Bank for Economic Integration
BCN	National Bank of Nicaragua
BDF	Finance Bank
BEI	European Investment Bank
BOD	Biochemical Oxygen Demand
BTR (BRT)	Bus Rapid Transit
CACONIC	Nicaraguan Chamber of Commerce
CCTV	Closed-Circuit Television
COBAPRED	Barrio Community of Prevention, Mitigation and Attention of Disasters
COD	Chemical Oxygen Demand
CODIPRED	District Community of Prevention, Mitigation and Attention of Disasters
COMMEMA	Municipal Corporation of Managua Markets
COMUPRED	Municipal Community of Prevention, Mitigation and Attention of Disasters
CONAPAS	National Commission of Water and Sewerage
DBO5	Biochemical Oxygen Demand
DDV	Right of Way
DGA	Directorate General of Customs Services
DGAC	General Directorate of Civil Aviation
DGO	Official Gazette Daily
DGTT	General Directorate of Land Transportation
DQO	Chemical Oxygen Demand
DWT	Deadweight Tons
E/N, C/N	Exchange of Notes
EA	Environmental Evaluation
EAAI	International Airport Administration Company
EAE	Strategic Environmental Assessment
ECLAC/CEPAL	Economic Commission for Latin America and the Caribbean
EHMP	Household Survey to Measure Poverty
EIA	Environmental Impact Assessment
EMTRIDES	Company of Integral Solid Waste Treatment
ENACAL	The Nicaraguan Company Water Supply and Sewerage
ENATREL	The National Company of Electricity Transmission
EPN	National Port Authority
FIDEG	International Foundation for Global Economic Challenge
FMAM	Global Environment Facility
FND	Nordic Development Fund
FOS	Land Occupancy Factor
FOT	Total Occupancy Factor
FS	Feasibility Study

FSLN	Sandinista National Liberation Front
FTA	Free Trade Agreement
FTZ/ZF	Free Trade Zone / Zona Franca
GDP, PIB	Gross Domestic Product
GEF	Global Environment Facility
GIS/SIG	Geographical Information System
GIZ	German International Cooperation Company
GPS	Global Positioning System
GRDP	Gross Regional Domestic Product
HIPC/ PPME	Heavily Indebted Poor Countries
IACR	Kreditanstalt für Wiederaufbau / German Reconstruction Credit Institute
ICES	Emerging and Sustainable Cities Initiative (IDB)
IDA, AIF-BM	International Development Association - World Bank
IDB, BID	Inter-American Development Bank
IDR	Rural Development Institute
IEE	Initial Environmental Examination
IMF	International Monetary Fund
IMO	Organization Marine International
INAA	The Nicaraguan Institute for Water Supply and Sewerage
INAC	Nicaraguan Institute of Civil Aeronautics
INAFOR	National Forestry Institute
INATEC	National Technological Institute
INETER	Nicaraguan Institute of Territorial Studies
INIDE	National Statistical Institute
INIFOM	Nicaraguan Institute of Municipal Development
INVUR	Institute for Urban and Rural Housing
IRTRAMMA	Regulating Institute of Transport of the Managua City
ITS	Intelligent Transportation System
JICA	Japan International Cooperation Agency
KEXIM	Export-Import Bank of Korea
LAIF	Latin America Investment Facility
LRT	Light Rail Transit
M/M	Minutes of Meeting
MAGFOR	Ministry of Agriculture, Livestock and Forestry
MARENA	Ministry of Environment and Natural Resources
MECD	Ministry of Education, Culture and Sports
MEM	Ministry of Energy and Mines
MHCP	Ministry of Finance and Public Credit
MIFAMILIA	Ministry of Family
MIFIC	Ministry of Development, Industry and Trade
MINED	Ministry of Education
MIGOB	Ministry of Interior
MINREX	Ministry of Foreign Affairs
MINSA	Ministry of Health
MITRAB	Ministry of Labour
MRT	Mass Rapid Transit
MTI	Ministry of Transport and Infrastructure
MWWTP	Managua City Wastewater Treatment Plant
NBI	Unsatisfied Basic Needs

NTON	Nicaraguan Mandatory Technical Standard
O/D	Origen and Destination
ODECA	Organization of Central American States
OFID	OPEC Fund for International Development
PDUM	Urban Development Master Plan of Managua City
PISASH	Sectorial comprehensive program of Water and Human Sanitation in Nicaragua
PM	Master Plan
PNB	Gross National Income
PND	National Development Plan
PNSER	National Program for Sustainable Electrification and Renewable Energy
PNT	National Transport Plan
PPP	Plan Puebla-Panama
PRASMA	Water and Sanitation Program for Managua
PT	Personal Trip
RD	Minute Meetings
RICAM	International Network of Mesoamerican Highways
RPCE	Poverty Reduction and Growth Facility
SICA	Central American Integration System
SINAP	National System of Protected Areas
SINAPRED	National System for Disaster Prevention, Mitigation and Attention
TDR	Terms of Reference
TELCOR	Nicaraguan Institute For Mails and Telecommunications
TEU	Twenty-foot Equivalent Unit
TLC	Free Trade Agreement
TLC RD	Dominica Republic - Central America Free Trade Agreement
TM	Metric Ton
TPM	Deadweight Tons
UNAN-CIRA	National Autonomy University of Nicaragua, Center for Research for Aquatic Resources of Nicaragua
UNDP/ PNUD	United Nations Development Programme
VAO	High Occupancy Vehicle



Source: JICA Study team

LOCATION MAP

SUMMARY

SUMMARY

1. OUTLINE OF THE STUDY

1.1 Introduction

Managua City (administrative organization is called Alcaldía de Managua, it referred to as "ALMA") is the capital city of Nicaragua, with approximately 1.49 million inhabitants (ALMA 2016). Population have been increased 3.87% per year as average from 2005. While the population is increasing year by year, urban area tends to spread with a relatively low density which hampers effective utilization of land in ALMA endangering the precious greenery and natural reserves and lowering efficiency of infrastructure delivery.

In dealing with this situation, ALMA prepared the Action Plan for Sustainable Managua [Plan de Acción - Managua Sostenible] in 2013 under the "Emerging Sustainable City Initiative" (ESCI), financed by the Inter-American Development Bank (IDB).

In response to the background mentioned above, the Government of Nicaragua requested assistance from the Government of Japan to formulate an urban development master plan with reference to the experiences of Japan in efficient land use and natural disaster mitigation. The Japan International Cooperation Agency (hereinafter referred to as "JICA") had a series of discussion with ALMA and other concerned authorities of Nicaragua. An agreement between JICA and the concerned authorities of Nicaragua was signed on October 13, 2015, which led both parties to conclude the Record of Discussions to realize this study. Thus, JICA dispatched the JICA Study Team for the “Project for Urban Development Master Plan for Managua City in the Republic of Nicaragua” (hereinafter referred to as the Project) in January 2016 to Nicaragua.

1.2 Objective of the Study

(1) Objective of the Study

The objective of the Study is to contribute to suitable management of land use in ALMA and promote planned and efficient development of major urban infrastructure by formulating urban development master plan to strengthen and develop the capacity for formulation and implementation of urban planning.

(2) Outputs

- Proposal of urban development master plan for Managua City with the target year 2040
- Institutional capacity development of the organizations related to urban planning of Managua City

1.3 Study Area

The JICA Study Team set two types of target area, (1) Planning area which is Managua City itself and (2) Study area for Managua and its environ, as Managua City has some relation with its surrounding area. Target area for planning is Managua City (approximately 289 km^2) as shown in Figure 1.1.

Source: JICA Study Team

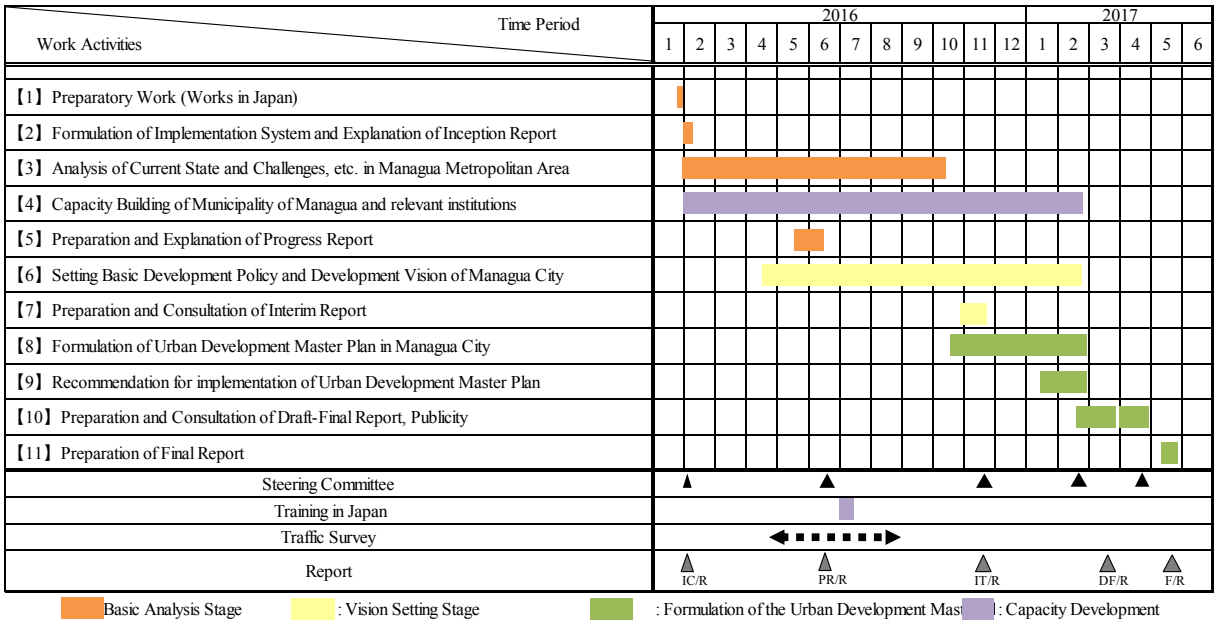
Figure 1.1 Target Area for Planning

Study area, or the target area for the Study such as data collection and analysis is the area which gives direct impact to the urban planning of Managua City. The JICA Study Team sets three alternative areas, namely: (1) Metropolitan Area and Granada City, (2) Catchment Area, and (3) Commuting Area.

1.4 Schedule and Deliverables

(1) Schedule

Figure 1.2 shows the overall schedule for the Project. As shown in the figure, the Project will run approximately one and a half years, taking into consideration the work activities and outputs of the Project. The JICA Study Team supports ALMA and other relevant organizations in Nicaragua to achieve the Project's objective and activities. The master plan was approved at Steering Committee on 22nd June 2017. ALMA hold a symposium in August 2017, and this master plan was publicized to citizen.

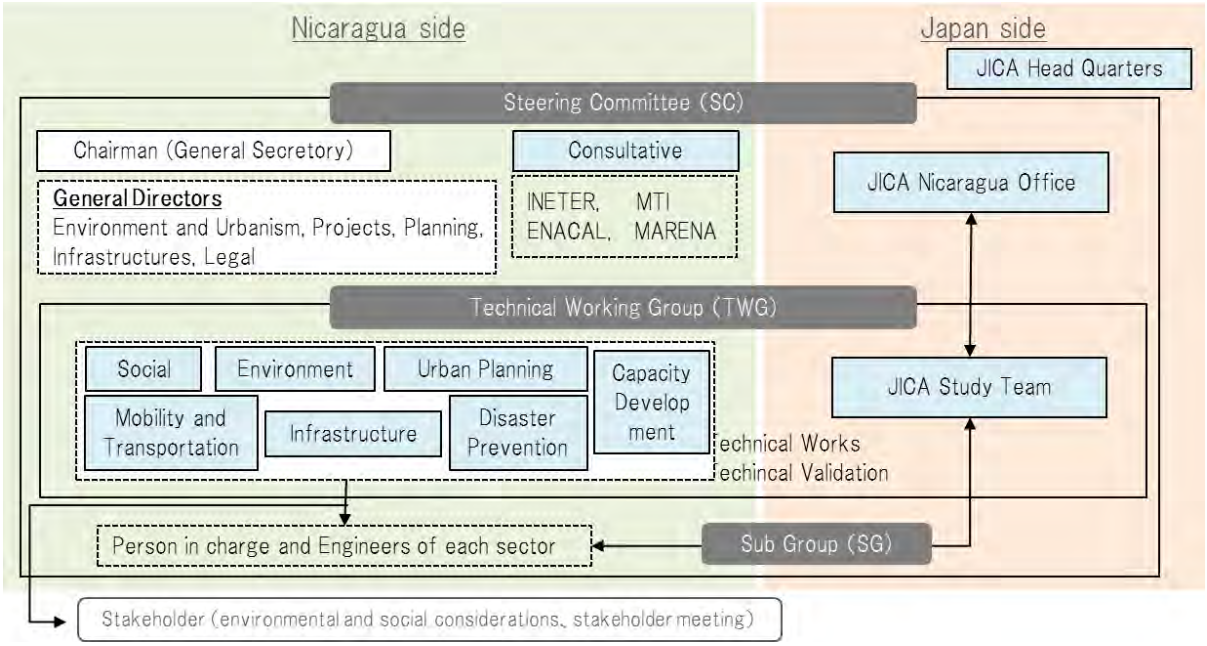


Source: JICA Study Team

Figure 1.2 Study Schedule

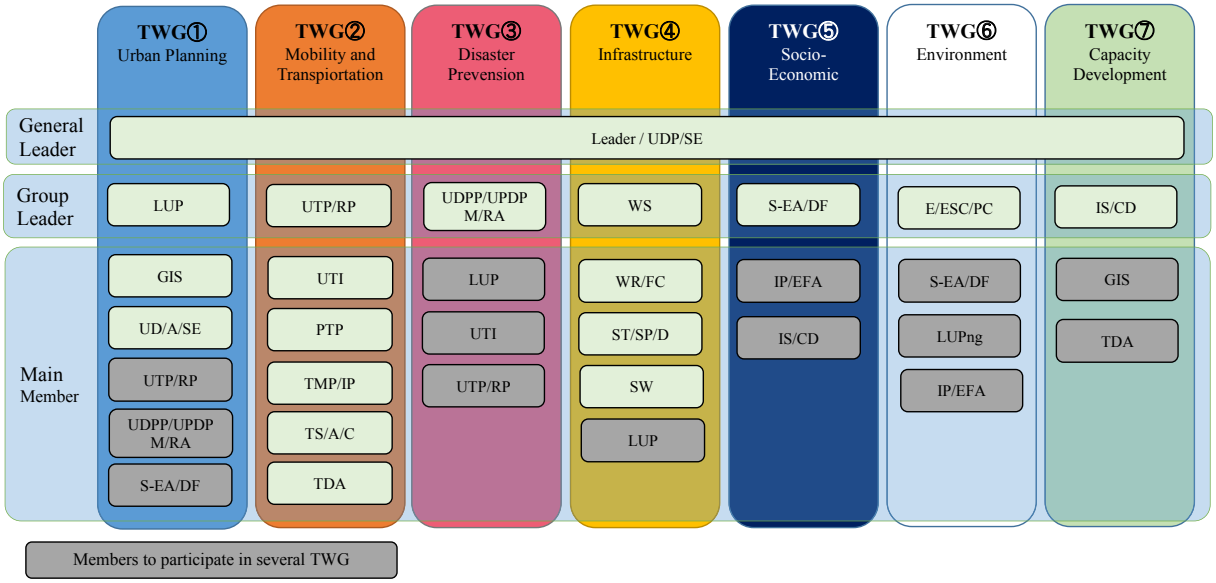
1.5 Study Organization

Counterpart of this master plan project is ALMA mainly Directorate for Planning, General Directorate of Environment and Urbanism and General Directorate of Projects and General Directorate of Planning. In addition, Steering Committee and Technical Working Group, which is consisted from District Office, INETER, MTI, ENACAL, MARENA, and JICA, was established for implementation of project. Each organization is shown in Figure 1.3 and Figure 1.4.



Source: JICA Study Team

Figure 1.3 Study Organization



UDP/SE : Urban Development Plan/Sustainability Evaluation
UTI : Urban Transport Infrastrucuture
UTP/RP : Urban Transportation Planning/Road Planning
LUP : Lan Use Planning
GIS: GIS
S-EA/DF : Socio-Economic Analysis/Development Framework
UDPP/UDP</RA : Urban Disaster Prevention Planning/
Urban Disaster Prevention Management/Risk Assessment
PTP : Public Transportation Planning

TS/A/C : Traffic Survey/Analysis/Coordination
TDA : Traffic Demand Analysis
UD/A/SEa : Urban Design/Architecture/Sustainability Evaluation assistant
WS : Water Supply
WR/FC : Water Resource/Flood Control
ST/SP/D : Sewage Treatment/Sewer Planning/Drainage
SW : Solid Waste
E/ESC/PC : Environment/Environmental and Social Consideration/Public Consultation
IP/EFA : Investment Planning/Economic and Financial Analysis
IS/CD : Institution System/Capacity Development

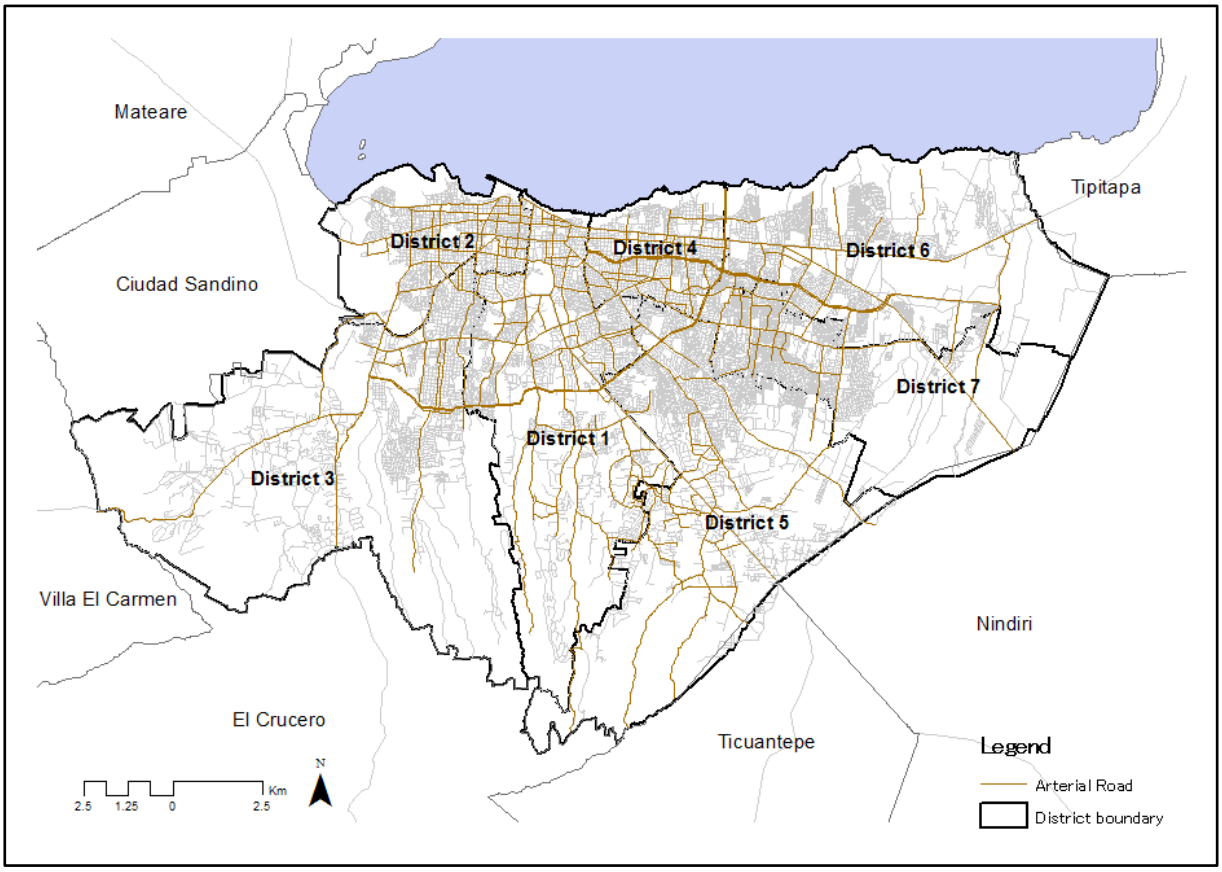
Source: JICA Study Team

Figure 1.4 Technical Working Group

2. OUTLINE AND CURRENT CONDITIONS OF THE STUDY AREA

2.1 Territory

Managua City is the capital city of Nicaragua with an area of 289 km^2. Managua city consists of seven districts and is surrounded by six municipalities as shown in Figure 2.1.



Source: JICA study team

Figure 2.1 District Boundary of Managua

2.2 Natural Conditions

Managua enjoys a tropical climate and is surrounded by mountainous area and Managua Lake. The urban area is situated generally on a flat plain which starts from the coastal area of the lake. The average rainfall annually in Managua is approximately 1,204 mm. Since Nicaragua is surrounded by the Caribbean Plate, earthquake is one of the serious disasters in Managua. Inside the boundary, there are 15 active faults and many of them are running from the southwest toward the northeast direction. A large-scale earthquake tends to occur in a 50-year cycle. The recent large-sized earthquake occurred in 1972 with a magnitude of 6.2, which caused serious damages in the city and its surrounding areas.

2.3 Population

In Nicaragua, the latest three Population and Housing Census (hereinafter referred to as "Census") were conducted in 1971, 1995 and 2005 and the next census is planned to be conducted in 2018. The total population in Nicaragua was 5,450,392 in 2005 according to the Census, and 6,262,703 in 2015 according to the population estimation made by INIDE. In the census 2005, the population of Managua City was reported as 937,489, which account for 17.73% of the total population in Nicaragua. According to ALMA and each district office, the population of Managua City, as of January 2016, is 1,495,385.

Table 2.1 Population of Managua City by District in 2016

District	January, 2016	
	Population	Percentage
Managua City	1,495,385	100.00%
District 1	218,252	14.60%
District 2	164,254	10.98%
District 3	233,456	15.61%
District 4	163,966	10.96%
District 5	230,758	15.43%
District 6	236,939	15.84%
District 7	247,760	16.57%

Source: ALMA and estimation by the JICA Study Team

2.4 Socio Economy

The economy of Nicaragua marked steady growth except for the period from 2008 to 2010 when the economy was affected by the global financial crisis. After the recovery from the economic downturns, the average growth rate of GDP in Nicaragua from 2011 to 2014 rebounds to 5.1% and it exceeded the average growth rate in developing countries in Latin America and Caribbean region for the same period. GDP per capita in US$ raised to 1,963.10 US$ in 2014.

Data of the regional gross domestic products or GDP breakdown by department is not available in Nicaragua. However, according to the estimated GDP by department and municipality in 2000 reported in the report made by UNFPA, GDP of Managua City accounts for 36.3% of the national GDP and GDP per Capita is almost double of the national average in 2000.

Managua City is the center of national economy, commerce and services, and the major manufacturing industries are located in the city such as beer and coffee, garment and shoes, and pharmaceutical products, building material and fast-moving-consumer-goods. According to Urban Economic Census 2010, Managua City accounted for 29.5% in terms of the number of establishments and 39.8% in terms of employed people in Nicaragua. Most economic establishments in Managua City are micro, small or medium enterprises. The sectors of the establishments are construction, transport, storage and communication, education, real estate, community services, health, hotels and restaurants, wholesale

trade financial intermediation, and manufacturing. In addition, 92 companies locate in Free Trade Zones in Managua City, out of 248 companies in total Free Trade Zones in Nicaragua.

2.5 On-going and Committed Projects

On-going and committed relevant projects in recent years are listed below.

Table 2.2 On-going and Committed Projects

Project	Donor/ Implementation Body	Year / Status
Urban Planning Project		
Projects of the Action Plan for Sustainable Managua (ESCI-2)	IDB	2016-2017
Lake Xolotlán (Managua) Waterfront Regeneration Project	ALMA	2016-2018
Land Use Survey Project	ALMA	2014 – 2016
Transport Project		
Annual Investment Plan for Road Development 2016 (PIA 2016)	ALMA	2016
Road Development Projects	MTI (WB, Korea, and Mexico)	2016-2022
Road Projects identified by PITRAVI (JICA)	ALMA, MTI, IRTRAMMA	1999-2018
BRT Project identified by PITRAVI	IDB	2004 Design was prepared
Transport Development Plan	Nicaragua Government	2014
Bicycle-lane Development Project	IRTRAMMA (GEF and UNDP)	2013 – 2016
Bicycle-lane Development	MTI	Unknown
Infrastructure Project		
Development and Rehabilitation of Water Resources Facilities	ENACAL (JICA)	2016 On-going
Master Plan of Flood Drainage in Managua City (ESCI-2)	IDB	2016-2017
Technical Assistance Project on Capacity Building to SINAPRED	UNDP	2013-2014
Technical Assistance Project on Capacity Building to COMPURED	EU	Unknown
Integrated Solid Waste Management Plan	AECID	2008-2013
Improvement and Expansion of the Service of Water & Sanitation in Metropolitan Managua	PRASMA-WB	2007-2015
The Water Supply Program for Managua	IDB	2011-2015
Package of Complementary Measures to MWWTP	KfW	2015
The Comprehensive Program of Sectoral Human Water and Sanitation of Nicaragua (PISASH)	AECID	2014-2019
The Master Plan Study on Efficiency Operation of ENACAL	WB	2015
Strategic Management Risk and Disaster Provention Plan for Urban Resiliency	WB	2016-2017

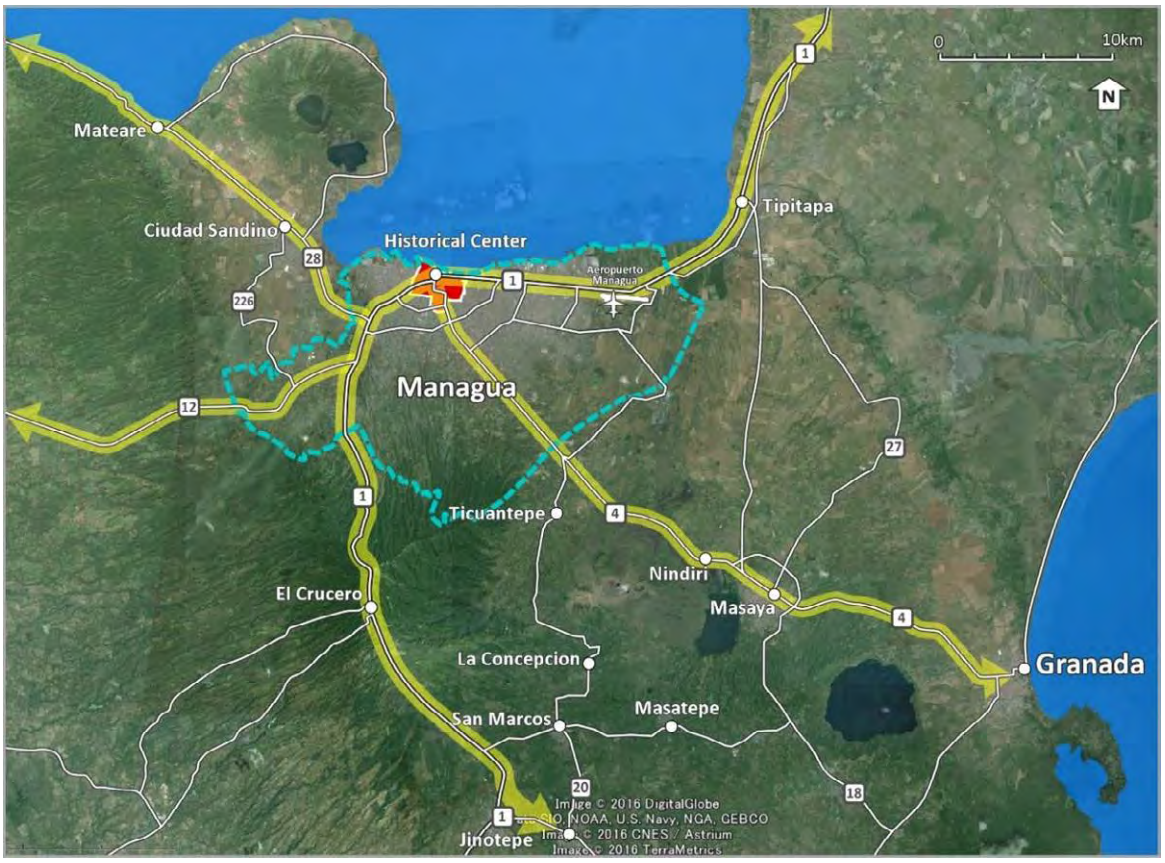
Source: JICA Study Team

3. URBAN PLANNING

3.1 Managua in Regional Context

In Central American countries, Managua City has a relatively large population and notably is in the fourth place in terms of city income index compared to other capital cities. Managua City therefore is in a position to purse one of the major regional sub-centers in Central America supplementing Panama City.

Managua City is the primary center of Managua Metropolitan Area, which plays a central role in politics, economy, social, and culture. The cities in the surrounding area, linked to Managua City by roads, have a strong relationship because of the large traffic of commuters, tourists, and logistics. The cities on Pan American Highway (N1) south and Carratera a Masaya (N4) have strong ties with Managua City because in the recent decade, as illustrated in Figure 3.1, urbanization growth tends to direct towards the southeast and south directions.



Source: JICA Study Team based on the map of Google Earth Pro

Figure 3.1 Managua City and Surrounding Cities

As the capital of Nicaragua and the center of the region, Managua City has functions listed below and is expected to be strengthened a part in the future.

- The central functions of the four branches of the nation, including legislation, administration, judiciary, and election.

- Hub of the transportation network which connects the regions in Nicaragua and other hubs in Central America and beyond.
- Function as an international gateway of Nicaraguan tourism for international and domestic markets.
- The central function of commercial and business activities for domestic and neighboring countries.
- High-level educational institutions such as universities, graduate schools, and colleges.
- Providing location for research institutions, medical institutions, and financial institutions.
- Providing location for important cultural institutions such as theaters, museums, and auditoriums.
- Diplomatic function such as embassies of alliance nations.
- International exchange function - the host function for cultural, academic, and business exchanges.

3.2 History of Urban Planning in Managua City

Several urban planning schemes of Managua were conducted since 1954. The latest scheme published is the Action Plan for Sustainable Managua [Plan de Acción Managua Sostenible] in 2013 under ESCI supported with IDB. The Action Plan considered the random expansion of urban area as an important issue, and for establishing a management framework for regulating land use appropriately.

3.3 Laws and Regulations for Urban Planning

In Nicaragua, a basic law regarding urban planning had not been established yet, but some of the regulations on the national and municipal levels forms the basis of urban planning and land use control in Managua, including the one given below. There are, however, some issues relating to uran planning practices in Managua such as limited access of zoning regulation materials (only recently, the zoning documents were made public), and belated processing of permissions.

- Regulations of Zoning and Land Use for the Area of Municipality of Managua
- Regulations of Urban Development for the Area of Municipality of Managua
- Regulations of Construction Permit for the Area of Municipality of Managua
- Regulations of the Central Area of Managua City

In addition, there are some related regulations as below.

- Regulations for gas stations for the area of the municipality of Managua.
- Regulations of road system for the area of the municipality of Managua
- Regulations of vehicular parking for the area of the municipality of Managua
- Regulations of pluvial drainage for the area of the municipality of Managua

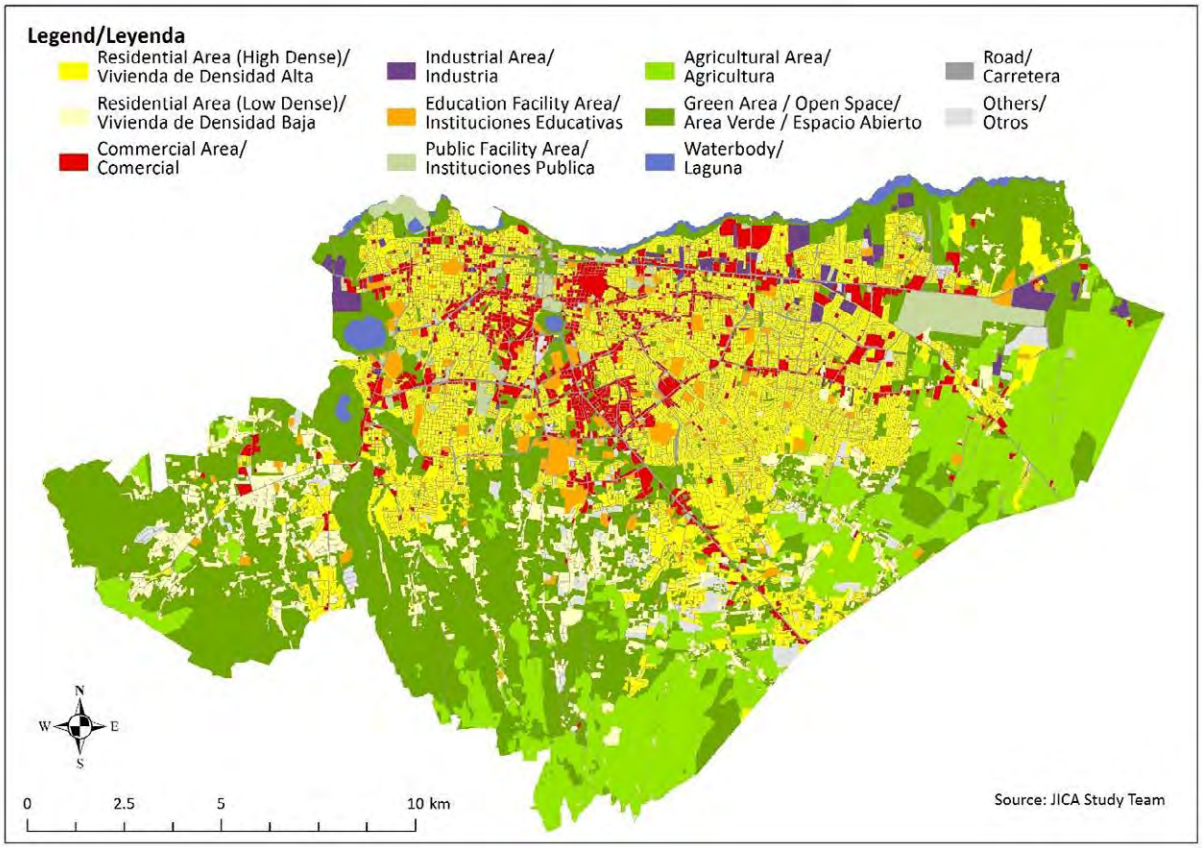
3.4 Present Implementation System of Urban Planning in Managua City

ALMA has been leading in planning and implementing of urban planning and regulation in collaboration with the national organizations. In which, General Directorate of Environment and Urbanism, is in charge of the planning of budgets and administrative management for urban planning and other projects.

Urban planning in Managua City has a long history involving a number of regulations. The present implementation system of urban planning consists of mainly two schemes; one is zoning system including architectural regulations and the other is development restriction for taking account of disaster and environment.

3.5 Existing Land Use of Managua City

Managua City consists of a variety of land use. The built-up area including housing and commercial extends from the historic central area near Managua Lake towards suburbs. The commercial area tends to be located near the hisotric center of the city and along the major roads such as Carretera a Masaya. Meanwhile, an industrial area is found in the surroundings of the airport and along Road N1. In contrast, the green area including forest and grassland spreads in the fringes along the southern boundary. Also, the surroundings of the east boundary are occupied by agricultural land. The existing land use map in 2016 is shown in Figure 3.2. At present, 93% of the total built up area including the residential zonings allow only four- or less-story buildings. These regulations may have led to Managua's urban area to be low-rise. In addition, these regulations are assumed to be also affecting the urban sprawl, and urbanization has been expanding to the green area of southern boundary, and the apprloximately 863 ha of green area has been decreased from 2005 to 2015. Therefore, it is necessary to suppress the expansion of urban area by high density land use for solving such issues.



Source: JICA Study Team based on the map prepared by ALMA

Figure 3.2 Existing Land Use Map, 2016

3.6 Spatial Data (GIS)

Various spatial data has been collected from relevant organizations, such as ALMA, INIDE, INETER, and MARENA in order to formulate a practical master plan for Managua City. ALMA is the main provider of such data since they have developed many spatial data through projects and various original applications for viewing and analysis these data. The collected data are examined and integrated into GIS format for further spatial analysis throughout this Project. All of the utilized spatial data in this Master Plan (PDUM) was integrated into the GIS based urban planning database for future planning work in Managua City.

4. TRANSPORT PLANNING

4.1 Traffic Administration, Institution and Legislation

Institutional and legislative organizations concerning traffic and transportation has problems in the coordination among the institutions. They are composed of the national government level, municipal government level, and municipalities surrounding Managua City. There is a sector division according to the responsibilities of different entities. Some of them are in charge of traffic and transportation, and the others are related to urban development and road infrastructure, signaling, etc. Some problems due to the existence of overlapping tasks, insufficient traffic control, and unsolved situations make difficulties concerning institutional aspects.

4.2 Person Trip Characteristic

The JICA Study Team conducted various traffic surveys for obtaining the characteristics of the existing traffic and transport situation. Other survey components are cordon line survey and screen line survey, which are used for calibration of the OD matrix. Passenger interview survey, travel speed survey, and truck movement survey are used for the supplementary study to grasp traffic problems and to calibrate traffic simulation.

- Average household member is 4.11 people per household.
- Excluding bicycle and motorcycle, car ownership ratio is 34%. The ratio increased by around 1.7 times from 1998.
- The primary mode of transportation in Managua City and Ciudad Sandino is bus about 52.9%. The secondary mode of transportation is taxi about 26%. These two modes account for 79% in total.
- Major purpose of the trips is “To Home”. “To Work” accounts for 22% and “To School” accounts for 15%.
- The peak hours of trip generation are 6:00-7:00, 12:00-13:00, and 17:00-18:00. 12:00-13:00 contains many trips generated by younger people. School adopt two shifts in the morning and in the afternoon, the shift is assumed to affect to the trip information.
- Average trip time is 22.6 minutes per one trip. In terms of mode of transport, truck has the longest trip time.
- The outer area of Managua City tends to have longer trip time.

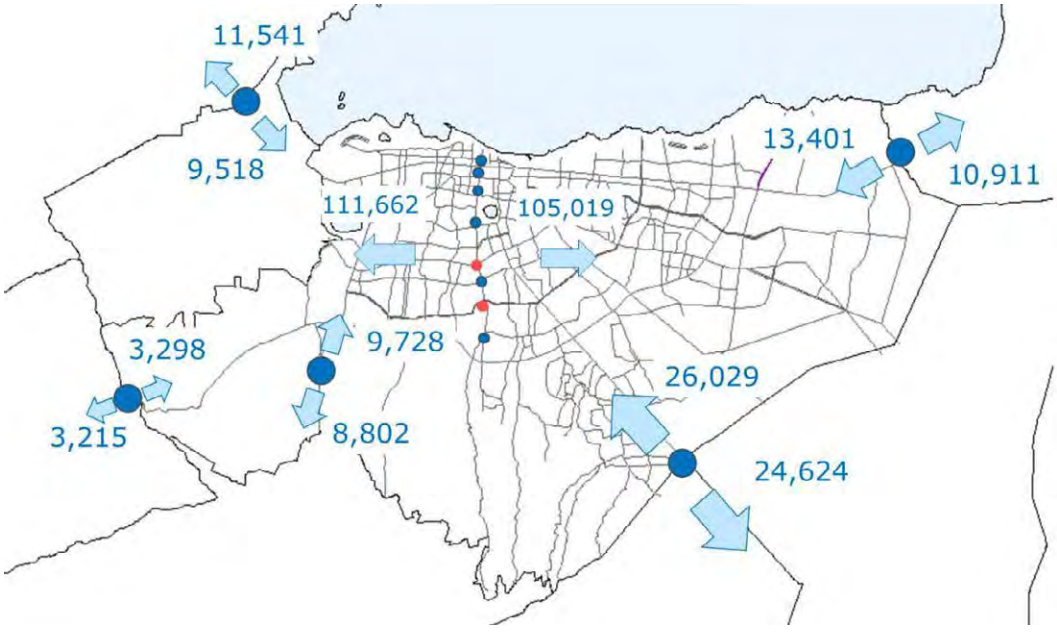
Table 4.1 Summary of Exisiting Trip Situations

Items	Managua City
Population * Data source is from ALMA, January 2016	1,495,385
Average household member	4.11
Car ownership	34%
Purpose of Trip	To Home: 47% To Work: 22% To School: 15% Business: 2% Private/Others: 15%
Peak hour of trip	6:00-7:00, 12:00-13:00, and 17:00-18:00
Average Trip Time	22.6 minutes

Source: JICA study team

Current features of road traffic are summarized below.

- In the cordon line survey, heavy traffic volume was observed in location at Carretera a Masaya
- Total incoming people from outside Managua City is estimated as 233,400 and outgoing people is calculated to be 189,837 in total.
- People from outside tend to go to the Oriental Market, Mayoreo Market, UCA, Israel Lewites Market, Huembus Market, and Centro Comercial Managua. This revealed that the market generates lots of trips.
- In the screen line survey, high traffic was observed in Pista Juan Pablo II and Pista Suburbana. The locations are indicated in red points in following figure.
- Result of OD interview in the cordon line survey indicates 23% of the trucks came to Managua City and go outside Managua City.



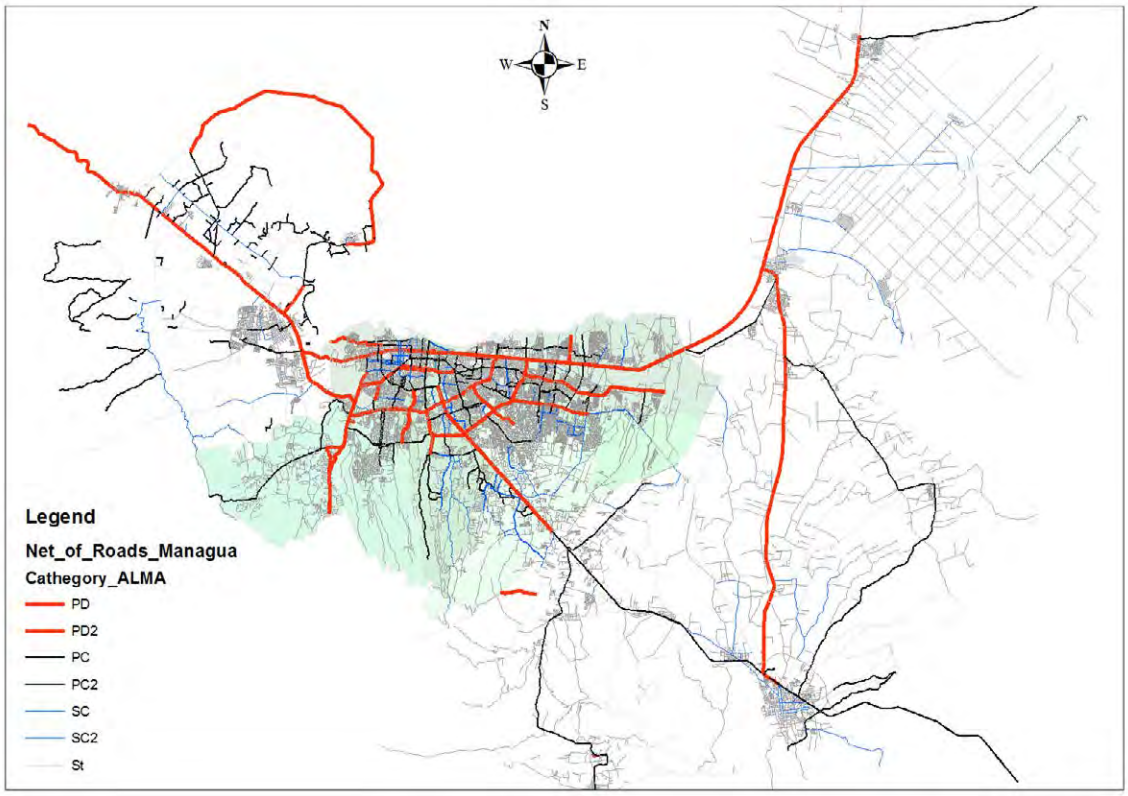
Source: JICA study team

Figure 4.1 Traffic Volume in 24 Hours in a Weekday (vol)

4.3 Road Facility and Traffic Characteristics

The ALMA is responsible to plan, build, improve, and maintain the road network including national roads under its jurisdiction. The local and smallest roads are under the responsibility of each municipality.

The road in Managua City is classified four categories, which are the Primary Distributor (red line), Primary Collector (black line), Secondary Collector (thin blue line), and Street (thin gray line).



Source: Direction Urban Planning, according to Regulatory Plan

Figure 4.2 Map of Managua, Tipitapa and Ciudad Sandino Metropolitan Road System

Some roads do not satisfy the regulation and invade the right of way. Therefore, service level of road is in low due to the lack of continuity in roads, narrow streets, and poor accessibility.

The length of the metropolitan road network planned in the Regulatory Plan in 1984 is approximately 457.72 km. It is still necessary to cover 18.4% of the planned network.

Table 4.2 Summary of the Planned and Existing Road Network

Items		System				
		Expressway	Primary Distributor	Primary Collector	Secondary Collector	Streets
Managua	Existing**	-	121.013	147.629	104.825	2,138.470
	Planned*	37.559	151.092	173.129	95.938	0,000
Construction Radius (%)		0.0%	80.1%	85.3%	109.3%	--

Source: (*) Directorate of Urbanism (SVM-1984), (**) GIS Inventory of the Road Network (18.10.2016)

According to the Infrastructure division of ALMA, only 43% of the road network is asphalt and more than 90% of them is in good condition. While 38% are dirt roads and their condition are in regular. Only 7% are hydraulic concrete roads that are in good condition and remaining 12% is cobblestone.

In order to maintain connectivity with the metropolitan road network, 61 major intersections including four flyovers have identified as major intersection for connectivity with the metropolitan road network. On the other hand, road capacity of ring roads in the Managua City has decreased for increasing of traffic volume, and number of major radial roads are a few. Therefore, the road capacity and alternative route of ring and radial road in Managua City is limited, and traffic circulation has been stucked.

4.4 Public Transport Conditions

Managua City has four types of public transport service. Public bus, taxi, and mototaxi are administered by the Institute of Transport of Managua City (IRTRAMMA). The inter-city bus is administered by the Ministry of Transport and Infrastructure (MTI), while the bus terminals are administrated by ALMA and the Municipal Corporation of Managua Markets (COMMEMA). The urban public, inter-city buses, taxi as well as bus terminals are all operated by concessionaires, while mototaxi is operated by private companies and drivers under the authorization of IRTRAMMA.

(1) The urban public bus and intercity bus service

The urban public bus service is operated by 28 concessioners along 35 fixed routes. The fare of the urban public bus is fixed at NIO 2.50 by the government, and the concessionaires receive subsidy from the government depending on the number of passengers, fuel consumption, etc. TUC Card, which is a fare collection system by IC card, is installed in all the buses, and approximately 90% of the bus passengers use this system for the payment according to IRTRAMMA. Annual average daily passengers for the whole Managua City in 2014 were 19,888 passengers on weekdays and 18,440 passengers on weekends for each route.

1,584 buses on 130 routes operate between Managua City and other cities, and the intercity bus is important for commuters who are going to Managua City.

A bus is one of the important transportationl mode for Managua citizens, but operation routes of urban bus have been bias because these routes have not been readjusted since 1980's. In addition, there is a lack of coordination between related organizations such as no information sharing and no clarified of management of intercity bus within Managua City, because the administrator of urban and intercity bus is different, the former is IRTRAMMA and the latter is MTI. Also, there are 11 bus terminals in Managua City, whose inside and surrounding area are occupied by small shops disturbing the safe and punctual operation of the buses.

(2) Taxi and Mototaxi

Approximately, there are 12,000 taxi operators under three-shift operation; morning, afternoon, and nighttime. Each taxi is allowed to operate at either morning or afternoon depending on their vehicle

body, although all the taxis can operate during the nighttime shift. The minimum fare is about NIO 25-30, and the fare is decided by negotiation between the driver and client and depends on the distance.

The main role of mototaxi service is to provide local communities with access to other public transport mode such as urban public bus, and there are 89 authorized mototaxi spots in Managua City. 90% of the passengers are residents of the area, and the daily average number of passenger per mototaxi vehicle is about 200 persons.

There are no designated waiting spaces for taxi and mototaxi, and they have blocked traffic circulation by going around in the city or waiting a customer at intersection.

4.5 Traffic Control and Management Conditions

Traffic problem in Managua City is a major issue because car fleet has been increasing very fast during the last years. In contrast, the road network has not increased much for over 20 to 30 years. The efforts of Managua City are improving the capacities of road network through the management and investment on new roads. There are two ways of traffic control. One is the traffic management and control by Traffic Police. Another is the construction of infrastructure and traffic signal control by the infrastructure division of ALMA. Urban development, promoting land use, and new roads construction are also needed for the improvement of traffic control.

Managua City has 144 traffic signals, but it is not enough to manage traffic. Recently, an advanced traffic signal system has been installed in the city, but this signal system is not synchronized yet with the old system. Therefore, integration of the old and new signal systems is necessary.

Traffic accidents have been increasing, especially the accident including motorcycles. These accidents often occur along the major roads, such as Carrterra a Masaya, Panamerican South and Panamerican North. Therefore, necessary measure for decreasing traffic accidents is required, because it is assumed that traffic volume will continue to increase. In addition, it is a necessity in mitigating traffic problems to take action about road parking and traffic education. Road capacity is decreasing due to an increase on road parking. In order to solve this problem, structural and non-structural measures are important. For instance, development of parking lots, enforcement of illegal parking, and education on traffic rules could be implemented under collaboration with police.

Some measures of intelligent transport systems (ITS) such as traffic control center, bus monitoring system, smart card, and etc. These facilities can utilize for future traffic management.

5. INFRASTRUCTURESAND DISASTER MITIGATION

5.1 Water Supply

The potable water distribution system in Managua City is managed by a governmental agency called *Empresa Nicaraguense de Acueductos y Alcantarillados Sanitarios* ("Nicaraguan Company for Water

Pipes and Sewers") or ENACAL. As suggested in the name of the entity, this is a nationwide agency, responsible for the entire country and not just the capital.

However, the service is intermittent for a significant percentage of the population; on the order of 1/4 or more of the residents do not receive water at their taps 24 hours every day,

Managua City gets its drinking water entirely from groundwater. Water is extracted from the groundwater throughout the city through over 100 wells spaced across the city. It also withdraws from Asososca Lake, which is a volcanic crater lake whose inflows are directly from groundwater. The water is generally of good quality, although some wells present contamination and there is some worry that the adjacent Managua Lake may be infiltrating into the groundwater.

5.2 Water Resources

(1) Hydrological Conditions In and Around the Study Area

Annual rainfall in the study area is ranging between 1,200 and 2,000 mm per year. The mean annual rainfall at the rainfall station in the airport is 1,301.2 mm. River basins in the south side of Managua Lake are classified into four sub-basins (i.e.: I, II, III, and IV) based on geomorphological, environmental, and urban development characteristics. Most of Managua City is located in the sub-basin II, which covers an area of 217 km². There are no large scale "río" or river in the study area but small rivers, namely "cauce", has a function for draining out surface water within the river basins. However, the river flow water in the study area is not reliable as a water resource of the area because all cauces dry up during the dry season.

(2) Current Status of Water Resources

ENACAL extracts raw water for domestic water supply in the study area from 149 wells and Asososca Lake. Annual extraction amount of raw water in 2015 was 177.1 million m^3 of which 16.7 million m^3, or 9.4% of the total amount, was taken from Asososca Lake. Within the past five years, daily average extraction amount of raw water from Asososca Lake ranges from 61,736 m^3 in 2011 to 45,657 m^3 in 2015. In order to reduce the extraction amount of raw water from Asososca Lake and to relocate some of the wells located near Managua Lake, alternative water sources shall be developed but such future development plan is not yet pursued.

(3) Groundwater Recharge Area in Upstream Basin

Forest area accounts for 5.42% of the study area. There are no national forests in channel basins flowing into Managua City. Natural forests in upstream area are often burned to be changed into a cropping area and farmland. Cropping areas and farm lands often have no appropriate construction and maintenance work by owners. INAFOR, ALMA and other organizations have implemented a reforestation program to recover the natural condition of the recharge area of aquifer, where it was developed as a burned field and farmland since 2007.

5.3 Wastewater Disposal, Sewerage, and Stormwater Drainage

The sewerage systems and wastewater treatment facilities in Managua City are managed by the Department of Sewerage and Wastewater Treatment Plant for Managua in ENACAL. ENACAL is a decentralized public organization that engages in the administration of drinking water and sewerage systems in the whole country. According to an interview to an officer of ENACAL, the estimated actual coverage of the sewerage services at Managua Metropolitan area is approximately 65%.

There is still a large population in the settlements relying on simple latrines, infiltration pits, and in minor cases, discharging directly into stormwater drainage channels or with no sanitary facilities at all. Besides that, in other unsewered areas, septic tanks are commonly used. In the periurban areas, it is quite common to see on-site sanitation systems such as latrines and toilets with no drainage. It is even more common to find septic chambers both with and without absorption wells. As a result, fecal sludge and excreta from sanitation systems tend to exceed the capacity of on-site sanitary facilities and spill into roads, ditches, gulley, and ravines near the collection point.

ENACAL´s Managua Sewerage Master Plan defined the 28 main collectors arranged from south to north of the city, namely by alphabetical order. The main collectors developed along 200 km reach two interceptors of 22 km (planned length) and diameters between ø 750 mm and ø 2,000 mm. Interceptor No.1 is a coastal gravity trunk sewer; the system has five main pump stations distributed from west to east at the lowest level of the city, close to the floodplain of Managua Lake shore.

Recently, simplified sewerage systems have allowed improvements, making possible to increase the service coverage at low-income neighborhoods. It is achieved by using the *Condominial Sewerage* approach, which combines simplified, shallow, and small diameter sewers with satisfactory results and economy.

Pending construction by ENACAL is the second phase of collector Y; it was already designed in 2009. Initially, this collector was included in the package of projects to be financed by the World Bank through the PRASMA. However, due to cut in funding, it was set aside, and even now, there is still no source of funding. An additional benefit of Collector Y´s second phase is the elimination of almost 27 little wastewater treatment facilities built by the developers. This important collector will no doubt contribute to improve the quality of life of the inhabitants, and also to reduce the risks of contamination of the groundwater aquifer to which is exposed the sub-basin.

The Cesar Sandino WWTP (MWWTP), the main wastewater treatment facility of Managua City, is located on the east side of Managua City at the floodplain of Managua Lake in the vicinity of the airport. MWWTP receives all the sewage flow collected by the ENACAL system. The construction of the MWWTP has been one of the main measures taken by the Nicaraguan government to get the environmental recovery of Managua Lake.

5.4 Flood Protection

(1) Historical Floods in the Study Area

In the last 20 years, from 1992 to 2011, large flood disasters occurred 55 times in and around Managua City. Household Interview Survey in PDUM revealed flood damages on resedeints. The JICA Study Team carried out an interview survey along the Oriental cauce, which has major drainage function, with ALMA staffs. It is a priority issue of flood management in Managua City that floods often overflow and flow down on Pista Juan Pablo II due to shortage of flow capacity of the cauce, according to the drainage section of ALMA. On June 2, 2015, a rainfall of 206 mm was recorded in three hours. Fundamental data to study flood measures including existing flow capacity and probable floods of each cauces are no available.

(2) Structural Measures

Downstream stretch of cauces has been improved with concrete linings with a length of 43.62 km in total. There are 26 micropresa built in Managua City. A micropresa, or a regulating dam, provides temporary storage for floodwater during the rainy season to reduce the amount of flood flowing down to urban areas. Approximately two million m^3 of sediment and garbage have been excavated from all of micropresas since 1992. The Department of Hydraulic Red Maintenance periodically excavates the sediment and garbage in the reservoirs of *micropresas* to maintain the function.

(3) Non-structural Measures

Rainfall stations provide only short time rainfall data, but long enough periods to analyze flood characteristics in and around Managua City. Some other rainfall stations have started hourly rainfall observation since 2011 according to INETER. INAFOR has carried out a reforestation program at upstream basins of cauces flowing into Managua City since 2007.

5.5 Solid Waste Management

Waste generated by residents and retailers in Managua City is collected door-to-door by Directorate General of Public Cleaning and district offices. For the waste generated in the areas where no such collection is conducted, as well as the green pruning waste and construction wastes, they are brought to one of the five transfer stations or to one of the seventeen communitarian boxes by the micro-waste collectors and residents before transported to the final disposal site by Directorate General of Public Cleaning. In addition, non-hazardous waste generated by public facilities, hospitals, factories and other businesses are collected by container by the Directorate General for Public Cleaning, EMTRIDES and the waste collection service companies authorized by MARENA. No separation is conducted at the household level even if they are hazardous. There are also a number of illegal dumping sites in the city.

The sanitary landfill site available in the city was constructed in 2013 with the support of the AECID and is now operated by EMTRIDES. EMTRIEDS also receives wastes generated in the neighbouring cities of Ciudad Sandino and Tipitapa, and EMTRIDES estimates that the remaining space will be filled

within 3 to 5 years. Introduction of an alternative technology to reduce the volume of landfill waste as well as construction of a new regional landfill site is now under consideration.

Part of the recyclable wastes are picked up by waste collection staffs at the time of waste collection and/or micro-waste collectors before they are sent to the separation facility at the disposal site.

ALMA does not deal with hazardous wastes. Business entities must commission authorized waste collectors by MARENA. There are recyclers for hazardous oil wastes. Other types of waste, however, are either stored or landfilled within the premises of each business. Waste generated from either public or private hospitals are separated into infectious waste and non-hazardous waste within the hospital. Non-hazardous wastes are taken to the municipal collection whereas infectious wastes are treated either by autoclaving machine or incineration facility installed at these hospitals. Infectious wastes generated from the hospitals without an incineration facility are transported to the hospitals with such facility for communal treatment. However, the treatment capacity is not sufficient.

5.6 Disaster Mitigation and Risk Management

(1) Major Natural Disaster

There are various kinds of natural disasters in the Republic of Nicaragua, namely: (1) earthquake, (2) flood inundation, and (3) landslide. A big earthquake occurred in 1972. It is also recognized that the average interval of the occurrence of big earthquakes is at about 50 years. There are 18 fault lines that are judged to be highly active, which may cause earthquake in the area. The seismic hazard map for Managua was prepared by JICA in October 2006, and was updated by INETER. The seismic hazard map with four-categorized intensities (weak, medium, strong, and very strong) was issued in 2002 by ALMA. INETER has been operating earthquake observation since 1992, and provides warning information using seismometers.

(2) Government's Organization Structure for Natural Disaster Prevention Planning/ Management and Risk Assessment

At the national level, the SINAPRED was established in November 2000, and it is in charge of formulation of a national plan, implementation of measures, and dissemination of warning for disaster prevention planning/management and risk assessment. In Managua City, Committees Municipality for Prevention Mitigation and Attention to Disasters (COMUPRED) is in charge of disaster prevention planning/management and risk assessment. There are also Committees District for Prevention Mitigation and Attention to Disasters (CODIPRED) for seven districts and Committees Barrio for Prevention Mitigation and Attention to Disasters (COBAPRED) for 1,022 barrios in the city.

COMUPRED of Managua City forecasted possible affected families/people by disasters, i.e., 390,000 people for earthquake, 10,000 people for flood inundation, and 13,000 people for landslide disasters. There are 25 evacuation areas and 44 evacuation centers.

(3) Policies and Laws for Natural Disaster Prevention Planning/ Management and Risk

Assessment

Law 337 stipulates the establishment of SINAPRED and indicates its role, responsibility, and function. As a land use restriction along the existing river channel, Managua City sets a regulation that the area from the edge of the river channel with a width of 5 m for lined channels and 7 m for not lined channelsis restricted to be used for any purpose. Furthermore, Managua City is going to set similar regulation for areas along the retarding basin with a width of 10 m, the regulation was issued as memorandum in 2002. Upcoming schedule for establish as the official regulation is not decided. However, there are many areas in the city where such regulation is not functional due to illegal settlements and improper management of land.

(4) Preliminary Risk Assessment

1) Earthquake

Average interval of the occurrence of big earthquake is considered at about 50 years. Managua City, together with SINAPRED and concerned agencies, have made various efforts to reduce an earthquake disaster risk since 1972 such as preparing seismic hazard map, installing monitoring devices, providing warning information, and conducting earthquake drills four times in a year.

It is preliminarily assessed that these efforts are reasonable, and should be continued. Meanwhile, improvements will be necessary and proposed in the master plan such as evacuation system and land use/building control by seismic hazard map or regulation. It is noted that one of the main causes of death of people in recent earthquakes in Japan was the destruction of houses/buildings due to insufficient structures. Therefore, structural measures for reinforcement of houses/buildings through appropriate law and regulation are also important.

2) Flood Inundation and Landslide

ALMA has prepared a location map of critical areas for flood inundation and landslide from 2011. Based on the location map, the number of critical points for flood inundation and landslide has been generally reduced from 84 in 2011 to 65 in 2015.

6. INSTITUTIONAL SYSTEM AND CAPACITY DEVELOPMENT

6.1 Capacity Development

JICA study team clarified the actual institutional system, defined the necessary capacities and evaluated the actual capacity of ALMA, and programmed the capacity development plan to be performed during this project so that ALMA can use and revise the master plan by itself after the completion of this study. The evaluation and planning are summarized in the following matrix. The activities identified to be carried out after the study are also presented as the “(following project)”.

Table 6.1 Capacity development matrix

Ideal status	Necessary capacity (capable of)	Actual situation	Capacity development activity	Sl No.
Analysis				
[Urban plan] Actual status of entire city is understood	Understand actual urban structure including land use, road network	Land use map, road network map etc. are formulated	(no specific needs)	-
	Manage in an integrated form (by making database) the basic data including current land use map and periodically update it	Data are not integrated and not managed as database	Interactive learning in TWG on GIS database and its updating policy	1
	Carry out necessary supplement survey for updating of current land use map etc.	Supplement survey is carried out by subcontract	(no specific needs)	-
	Utilize GIS software for urban planning	Latino GIS with limited analysis function is used	OJT of ArcGIS	2
[Urban plan] Future urban structure and land use are previewed	Formulate and apply socio-economic framework of past, today and future	Proper socio-economic framework based on quantitative data is not formulated	Interactive learning in TWG on collection and analysis of statistical data	3
	Draw future urban structure based on socio-economic framework	Urban structure map of entire city considering land use and transport is not prepared	Interactive learning in TWG on analysis and planning of urban structure	4
	Evaluate characteristics of land and identify land to be urbanized	Characteristics of land are not evaluated quantitatively	Interactive learning in TWG on evaluation of land characteristics	5
[Transport plan] Actual transport of entire city is understood	Plan and implement comprehensive traffic survey including traffic count and person trip survey etc.	Only traffic count at intersection is periodically conducted	Interactive learning in TWG on planning and implementation of traffic survey	6
			OJT of traffic survey	7
[Transport plan] future transport is forecasted	Accumulate and utilize past traffic data	Some data are available but in different formats, and not fully utilized	Interactive learning in TWG on standard traffic data format and data record policy	8
	Formulate and apply socio-economic framework of past, today and future	Proper socio-economic framework based on quantitative data is not formulated	Interactive learning in TWG on collection and analysis of statistical data	9
	Forecast future transport and identify necessary development or improvement of transport infrastructure etc.	Traffic analysis software is not utilized, and future traffic demand is not estimated	Interactive learning in TWG on traffic analysis	10
			OJT of JICA STRADA	11
Vision				
Future development vision is established based on fundamental knowledge, experience, global trends and various cases	Continuously collect and accumulate worldwide information on urban development	Fragmental information is unintentionally collected	Lecture on basic skill for information collection and accumulation	12
	Evaluate the accumulated information referring to fundamental knowledge	Information is not accumulated as institution, and knowledge is unevenly owned by experienced staff	Lecture in Joint-TWG on various practices of urban development in the world	13
			Training in Japan for practices of comprehensive urban development	14
Vision is shared among related internal / external institutions	Smoothly communicate and facilitate consensus among related institutions	Technical committees composed by related institutions share the information and reaches a consensus	(no specific needs)	-
Plan				

Plans are mutually matching and generate synergy effect	Systematically gather information of numerous plans and confirm their mutual relation	Several institutions discuss plans together in technical committees but proposed plans don't necessary generate synergy effect	Interactive learning in Joint-TWG on formulation of policy packages	15
			Training in Japan for practices of comprehensive urban development	16
[Urban plan] Land use plan is prepared	Evaluate alternatives of land use and find out the best solution	No recent experience of proactive revision of land use plan based on urban vision	Interactive learning in TWG on land use planning	17
			Training in Japan for practices of land use plan	18
			(following project) Revision of land use plan and support for its approval process	S-1
[Urban plan] Land use regulation is prepared	Establish a regulation that realizes the land use plan	No recent experience of proactive revision of land use regulation based on land use plan	Interactive learning in TWG on land use regulation	19
			Training in Japan for practices of land use regulation	20
			(following project) Support for revision of land use regulation and its approval process	S-2
[Urban plan] Public-led area development can be planned	Evaluate expected outcome and risk of area development	No experience of comprehensive area development planning	Interactive learning in TWG on area development planning	21
			Training in Japan for practices of area development	22
[Transport plan] Project long list is prepared	Prepare preliminary plan including location, route, project cost etc. of each project	Project long list based on forecast, analysis and evaluation cannot be prepared	Interactive learning in TWG on transport project planning	23
			Lecture on planning of transport project	24
			Training in Japan for practices of transport systems	25
			(following project) Support of planning and implementation of transport project	S-3
[Transport plan] Priority projects are selected	Give priorities to projects based on certain criteria	Alternative comparison from technical, economic and social viewpoints based on certain criteria is not sufficiently carried out	Interactive learning in TWG for prioritization of of transport projects	26
Utilization				
[Urban plan] Land use regulation is efficiently and effectively enforced	Publish land use regulation map along with other useful data for easy access for citizens	GIS database is not prepared, and publication tool is not organized	Interavtive learning in TWG on GIS database and publication tool	27
			Training in Japan for practices of management and utilization of GIS database	28
	Quickly process applications related to building permit	Processing takes longer than period defined by regulation by ALMA	Training in Japan for practices of management and utilization of GIS database and open data	29
			(following project) Support for revision of building permit system and its approval process	S-4

	Control illegal land use	Insufficient control of illegal land use because of lack of human resources and lack of technical capacity	(following project) Support for control system improvement	S-5
[Urban plan] Public-led area development is implemented	Carry out planned area development or invite and collaborate with developer	Despite prepared plan, invitation to developers are not responded and project doesn't proceed	Interactive learning in TWG on implementation strategy of area development	30
[Transport plan] Priority projects are detailed and implemented	Plan and carry out necessary procedure of FS/BD/DD/CS/OM*	Missions of international organizations carry out the procedure, and ALMA cannot carry them out properly by itself	(following project) Project implementation	S-6
	Evaluate financial and economic aspects of projects to acquire budget	Missions of international organizations carry out the procedure, and ALMA cannot carry them out properly by itself	(following project) Project implementation	S-7
[Transport plan] Appropriate projects from mid and long-term project lists corresponding to ongoing situation are implemented	Obtain traffic data at appropriate locations to evaluate the validity of project implementation	Traffic data are periodically recorded at several locations, but these data are not analyzed to be associated with mid and long-term projects	Interactive learning in TWG on periodic traffic survey policy for mid and long-term projects	31
[Transport plan] Related institutes cooperate with each other on traffic management	Coordinate with related institutes of road and transport, and implement comprehensive traffic management	Some roles overlap between institutes, and each institute carries out its measure individually, not necessarily coordinated with others	(following project) Restructuring of roles of institutions and development of institutional capacity	S-8

Source: JICA study team

Considering the schedule of each specialist of JICA study team, the Capacity Development Plan was established as presented in Table 6.6.2. "Matrix No." in the middle indicates the corresponding numbering at the right end of the previous table. A discussion and consideration including technical contents and task was conducted in TWG, and OJT of GIS and Traffic Demand Forecast was conducted to selected ALMA's staff as technical transfer. The lecture which contents was included other countries/cities example also presented by JICA study team. The data which was used for these TWGs/trainings/lectures was shared with ALMA, and a database including these data was prepared.

Table 6.2 Capacity development plan

Sector with methodology	Sl No.	2016											2017				
Subject		2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
Urban Planning																	
TWG meeting																	
Analysis and planning of urban structure	4			■					■	■		■	■				
Evaluation of land characteristics	5	■										■					
Land use planning based on urban development vision	17											■		■		■	■
Land use regulation based on land use plan	19																■
Area development planning	21													■			
Implementation strategy of area development	30													■			
GIS database and updating policy	1	■															
GIS database and publication tool	27												■				

On-the-Job Training																		
Qualified data development for spatial analysis using ArcGIS	2					■							■					
Mobility and Transport																		
TWG meeting																		
Planning and implementation of traffic survey	6		■	■	■			■	■	■								
Standard traffic data format and data record policy	8												■					
Periodic traffic survey policy for mid and long-term projects	31													■				
Traffic analysis	10								■	■			■	■				
Planning of transport project	23												■	■		■	■	
Prioritization of transport projects	26													■		■	■	
On-the-Job Training																		
Practice of traffic survey	7				■			■	■	■								
Traffic analysis using JICA STRADA	11												■					
Lecture																		
Planning of transport project	24				■					■								
Socio-Economic																		
TWG meeting																		
Collection and analysis of statistical data	3,9			■			■	■		■								
Integration of multiple sectors																		
Joint TWG																		
Analysis and planning of urban structure	4								■	■			■					
Various practices of urban development in the world	13									■								
Formulation of policy packages	15												■					
Training in Japan																		
Practices of comprehensive urban development	14,16						■											
Practices of land use plan and regulation	18,20						■											
Practices of area development	22						■											
Practices of disaster management	22						■											
Practices of transport systems	25						■											
Practices of GIS database and open data	28,29						■											
Lecture																		
Basic skill for information collection and accumulation	12									■								

Source: JICA study team

6.2 Institutional System

In order that ALMA becomes capable of implementing and revising the master plan after this project, JICA study team identified several challenges in institutional systems as well as the corresponding actions through process of the study in general and through discussion with ALMA personnel on this issue.

Table 6.3 Challenges and suggested actions for Institutional System

Main challenges for implementation	Suggested actions
Lack of project implementation capacity of personnel (knowledge, experience)	Accumlation of experience through implementation under necessary collaboration with conslutants
Lack of budget	Utilization of private fund (PPP etc.)
Main challenges for revision	**Suggested actions**
Absense of responsible unit for the revision	Responsible unit for follow-up of master plan (allocation of new roles to existing department or creation of Program Management Unit) <functions> • Monitoring of implementation status • Verification of relevance of project implementation considering the balance with other sectors • Verification of relevance of master plan considering the socio-economic indicator • Promotion of necessary capacity development activities and institutional system improvement
Continuous	Continuous capacity development and accumulation of experience and skill <style> • Internal workshop • Conference inviting expert/professor • On-the-job training • Preparation of working manual
Change of human resource	-
Insufficiency of urban planning capacity	Increase of urban planners (about 6-7 planners) <functions> • Coordination of entire master plan • Development of specific zones • Development of other urban area
Absense of responsible institution for transport planning	Institutional reorganization for transport sector (detailed in chapter 10) <different functions> • Transport planning • Traffic management • Public transport management
Lack of collection and accumulation of socio-economic data	Systematic collection and accumulation of socio-economic data

Source: JICA study team

6.3 Evaluation of Capacity Development Activities

Table 6.4 presents the results of self-evaluation by trained officials of ALMA on the effect of capacity development activities provided by JICA Study Team. All the items saw improvement comparing the values of Before and After. According to the observation by JICA Study Team referring also to feedback questionnaires, the capacity of ALMA got improved through a number of planned capacity development activities as well as countless daily communication out of formal activities.

Table 6.4 Self-Evaluation of Capacity Development Activities

Ideal status	Necessary capacity (capable of)	Act. No.	Evaluation		
			Bef.	Aft.	Var.
Analysis					
[Urban plan] Actual status of entire city is understood	Understand actual urban structure including land use, road network	-	N/A	N/A	N/A
	Manage in an integrated form (by making database) the basic data including current land use map and periodically update it	1	3.0	4.0	+1.0
	Carry out necessary supplement survey for updating of current land use map etc.	-	N/A	N/A	N/A
	Utilize GIS software for urban planning	2	N/A	3.7	N/A
[Urban plan] Future urban structure and land use are previewed	Formulate and apply socio-economic framework of past, today and future	3	2.9	4.3	+1.4
	Draw future urban structure based on socio-economic framework	4	3.0	4.5	+1.5
	Evaluate characteristics of land and identify land to be urbanized	5	3.0	4.5	+1.5
[Transport plan] Actual transport of entire city is understood	Plan and implement comprehensive traffic survey including traffic count and person trip survey etc.	6,7	1.8	4.1	+2.3
[Transport plan] future transport is forecasted	Accumulate and utilize past traffic data	8	1.5	4.0	+2.5
	Formulate and apply socio-economic framework of past, today and future	9	2.9	4.3	+1.4
	Forecast future transport and identify necessary development or improvement of transport infrastructure etc.	10,11	1.4	4.0	+2.6
Vision					
Future development vision is established based on fundamental knowledge, experience, global trends and various cases	Continuously collect and accumulate worldwide information on urban development	12	2.5	3.9	+1.4
	Evaluate the accumulated information referring to fundamental knowledge	13,14	2.8	4.6	+1.8
Vision is shared among related internal / external institutions	Smoothly communicate and facilitate consensus among related institutions	-	N/A	N/A	N/A
Plan					
Plans are mutually matching and generate synergy effect	Systematically gather information of numerous plans and confirm their mutual relation	15,16	2.8	4.6	+1.8
[Urban plan] Land use plan is prepared	Evaluate alternatives of land use and find out the best solution	17,18, S-1	2.6	4.2	+1.6
[Urban plan] Land use regulation is prepared	Establish a regulation that realizes the land use plan	19,20, S-2	3.0	4.3	+1.3
[Urban plan] Public-led area development can be planned	Evaluate expected outcome and risk of area development	21,22	2.6	4.4	+1.8
[Transport plan] Project long list is prepared	Prepare preliminary plan including location, route, project cost etc. of each project	23,24, 25,S-3	2.2	4.3	+2.1
[Transport plan] Priority projects are selected	Give priorities to projects based on certain criteria	26	2.1	4.5	+2.4
Utilization					
[Urban plan] Land use regulation is efficiently and effectively enforced	Publish land use regulation map along with other useful data for easy access for citizens	27,28	2.7	4.0	+1.3
	Quickly process applications related to building permit	29, S-4	2.4	4.0	+1.6
	Control illegal land use	S-5	N/A	N/A	N/A
[Urban plan] Public-led area development is implemented	Carry out planned area development or invite and collaborate with developer	30	3.0	4.5	+1.5
[Transport plan] Priority projects are detailed and implemented	Plan and carry out necessary procedure of FS/BD/DD/CS/OM	S-6	N/A	N/A	N/A
	Evaluate financial and economic aspects of projects to acquire budget	S-7	N/A	N/A	N/A
[Transport plan] Appropriate projects from mid and long-term project lists corresponding to ongoing situation are implemented	Obtain traffic data at appropriate locations to evaluate the validity of project implementation	31	1.5	4.5	+3.0

[Transport plan] Related institutes cooperate with each other on traffic management	Coordinate with related institutes of road and transport, and implement comprehensive traffic management	S-8	N/A	N/A	N/A

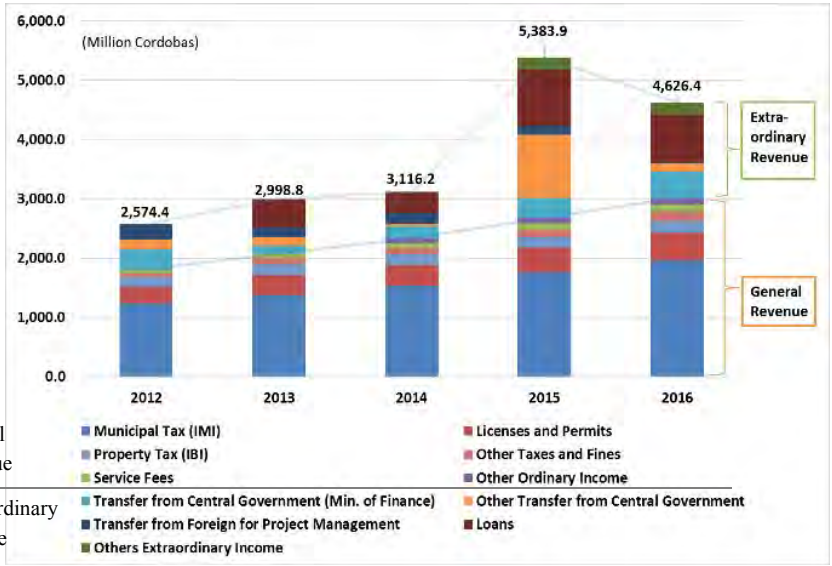
Note: "Bef." represents "Before", "Aft." represents "After" and "Var." represents "Variation"
Note: Evaluation 1 means "No idea" and 5 means "able to explain to others"
Source: JICA study team

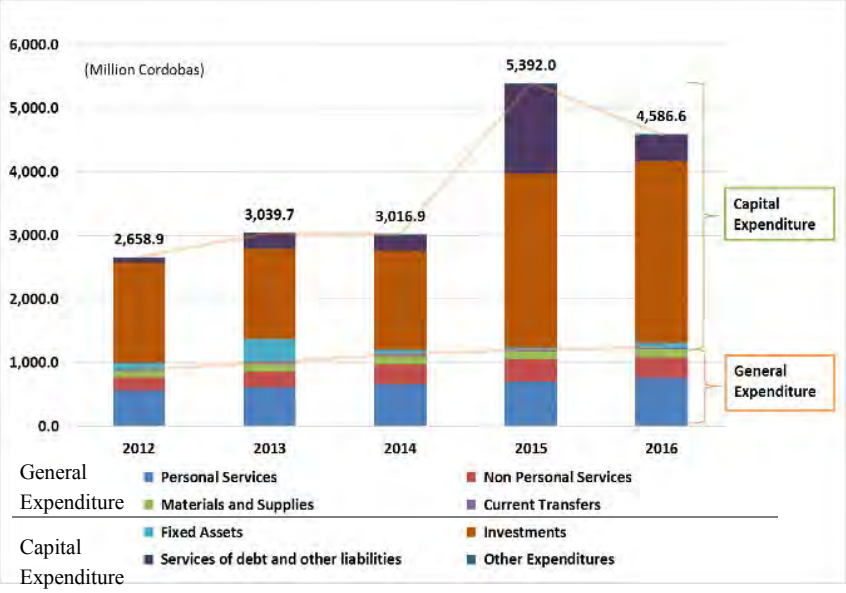
7. FINANCIAL CONDITIONS AND INVESTMENT PLANNING

7.1 Financial Conditions of ALMA

Figure 7.1 shows the income and expenditure structure of ALMA until 2016. The annual general revenue of ALMA observes rapid growth of 10.7% per annum on average in the past five years. The municipal income tax is the foundation of its general revenue structure and constitutes approximately 65% of ordinary income every year. As for extraordinary revenue, ALMA expects to receive transfers from central government agencies to cover investment costs as well as transfers from foreign organizations to cover some project management costs. ALMA acknowledges the tax collection rate is approximately 65%, and stable from observing its financial statement. It will continue to grow as population and economy grow. Extraordinary revenue seems volatile and difficult to foresee. ALMA needs to make efforts to stabilize total revenue in order to make future investment plans.

General expenditure of ALMA increased by more than 8.2% during the 2012-2014 period. However, in the general expenditure only expanded by 6.8% in 2015 and 2.3% in 2016. Payment for personal services comprises approximately 60% of the current expenditure. The rest of the current expenditure is spent on non-personal service (27%), materials and supplies (11%) and transfers to other institutions (2%). On the other hand, the capital expenditure shows a volatile trend, especially in 2015, in which the capital expenditure expanded dramatically. The components of capital expenditure include depreciation of fixed assets, investments, and service for debts and liabilities. In 2012, the share of capital expenditure from the total expenditure was 66%; however, the share of capital expenditure became 77% in 2015 and 73% in 2016.



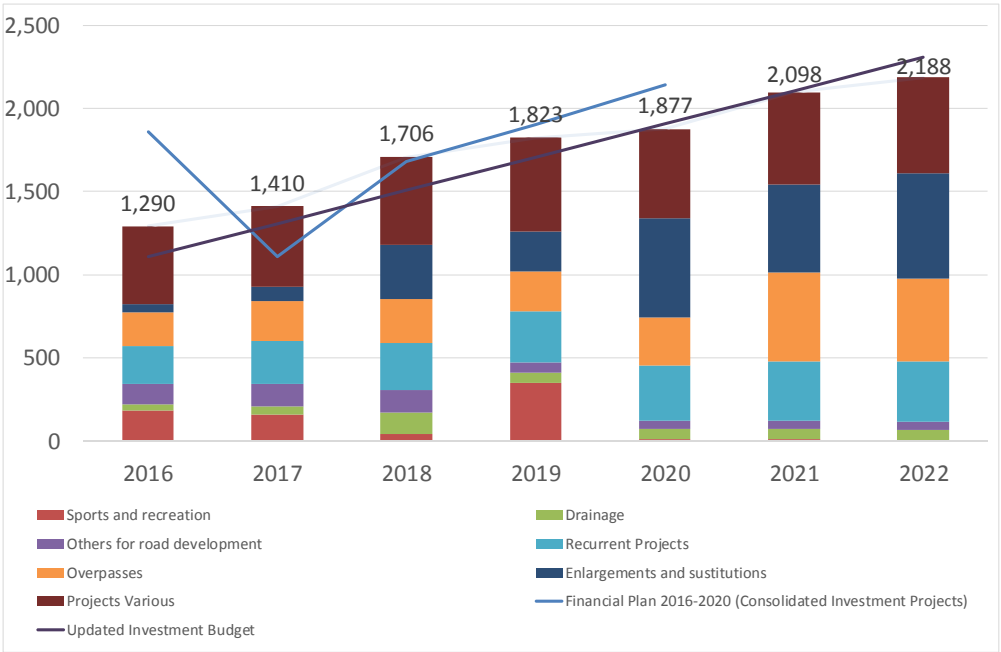


Source: JICA Study Team based on data from ALMA

Figure 7.1 Annual Revenue (Upper) and Annual Expenditure (Under) by Category of ALMA

The total revenue and expenditure seem to be kept balanced. However, the balance is sustained by large inflow of transfers from the central government and some sizable amount of loans. The size of the current expenditure compared to the ordinary income is kept at half. Investment activities need to be monitored and properly selected in order to build a sustainable finance structure.

The updated investment plan is presented in Figure 7.2.



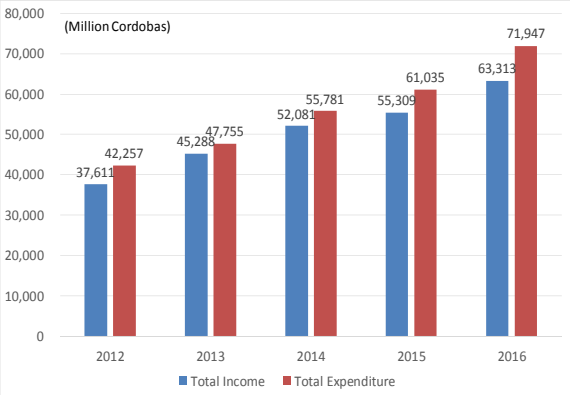
Source: JICA Study Team based on data from ALMA

Figure 7.2 Latest Investment Plan, 2016-2022 (August 2016)

7.2 Financial Conditions of National Government

Figure 7.3 illustrates the growth of national budgets in Nicaragua.

Since 2012, both national revenue and expenditure have been growing at the rate of approximately 14% per year. The national government records the fiscal deficit every year. Revenue from tax collections accounts for over 90% of the current revenue.



Source: JICA Study Team

Figure 7.3 Budgeting of the Nicaraguan National Government (2012 -2016)

In 2016, the national government issued the Policy and Projects for Development and Potential Investment 2017 – 2021. The paper laid out 33 national projects that are considered to benefit the national economic and social growth. Five projects are heavily related to infrastructure development in Managua region, such as the modernization of roads of Managua City, upgrades of Managua airport, construction of railway, inter-city bus project, metropolitan Managua lake project. In addition, seven projects are nationwide projects and Managua City is part of the targeted areas. The projects proposed in PDUM could be coordinated with these national projects.

7.3 Donor Participation in Managua and Nicaragua

Nicaragua is listed as one of the lower middle-income countries in the list of ODA recipients. The two major donors in Nicaragua are Central American Bank for Economic Integration (BCIE) and Inter-American Development Bank (IDB). For bilateral cooperation, Spain and JICA have strong presence over the years. The annual dispatch size of grant and loan from each donor organization is inconsistent. This implies that the financing to Nicaragua is given on an ad hoc project basis. It is necessary to appeal to such donors to obtain the assistance on the PDUM projects.

8. DEVELOPMENT FRAMEWORK

8.1 Vision for Managua City 2040

The counterpart group and the JICA Study Team continue to discuss formulating the future vision in the form of Joint TWGs on urban planning and transport planning. Through a series of discussions, the overall process and methodology of translating the city's vision into concrete actions were also clarified. In parallel to the discussion of backcasting approach, the following slogan was adopted for Managua City in 2040:

Managua Sustainable, Orderly, Safe and With Opportunity for All

8.2 Planning Framework

The JICA Study Team proposed the three levels of growth scenario, namely: Low Growth Scenario, Middle Growth Scenario, and High Growth Scenario, each explained as follows. The assumption of the population growth rate for each scenario in five-year period, and the corresponding population projection are suggested in Table 8.1.

1) Low Growth Scenario: Low Growth Scenario will employ the growth rate projected by INIDE and it assumes that population of Managua City will grow only by the natural increase without social increases.

2) Middle Growth Scenario: Middle Growth Scenario will employ the growth rate of the total population growth in Nicaragua projected by ECLAC. This is a moderate growth rate which is expected to balance between the natural and social increases as the same level as the average population growth in Nicaragua.

3) High Growth Scenario: High Growth Scenario will employ the growth rate similar to the urban growth rate projected by ECLAC. It assumes that urbanization will lead further social increase in the long term.

Table 8.1 Population Framework

	Estimated Population (Thousand People)					Population Growth Rate (Annual Average)					
	2020	2025	2030	2035	2040	2016-20	2020-25	2025-30	2030-35	2035-40	2016-40
Low growth	1,514	1,534	1,554	1,574	1,595	0.31%	0.26%	0.26%	0.26%	0.26%	0.27%
Middle growth	1,559	1,630	1,694	1,748	1,795	1.04%	0.90%	0.77%	0.63%	0.53%	0.77%
High growth	**1,579**	**1,679**	**1,772**	**1,860**	**1,940**	**1.37%**	**1.23%**	**1.09%**	**0.97%**	**0.85%**	**1.10%**

Source: JICA Study Team

Considering the population forecast of the above-mentioned institutions, the demographic trend data possessed by ALMA and other ministries, and the discussion in the Socio-Economic TWG, the high growth scenario was selected for the population framework of the master plan.

With regard to the socio-economic framework, the GRDP of Managua City was estimated and projected by using the estimation and projection of national GDP, working population in Nicaragua and Managua City by three sectors respectively. The socio-economic framework was selected as shown in Table 8.2.

Table 8.2 Economic Framework

	2016	2017-20	2021-30	2031-40
GRDP (Managua City) (Million NIO, NIO=2015)	117,239	147,371	235,499	368,107
Primary	1,070	1,150	1,190	963
Secondary	27,749	34,550	52,780	76,709
Tertiary	88,421	111,671	181,530	290,435
GRDP Share of Managua City in Nicaragua	32.3%	34.0%	36.7%	38.8%
GRDP per capita, Managua City (NIO, NIO=2015)	79,782	95,070	135,275	193,101
GRDP per capita, Managua City (USD, USD=2015)	2,927	3,488	4,962	7,084

Source: JICA Study Team

9. URBAN DEVELOPMENT MASTER PLAN

9.1 Urban Structure

In terms of urban center, transport, and land use including environment and densification, several alternatives of urban structure were discussed through the study. The proposed urban structure of Managua in 2040 will be

Managua City pursues a Compact City, or a city which utilizes its limited land resource, and creates quality environemt and provides effective mobility to the citizens and visitors alike.
In order to achieve this the followings will be necessary.

- In order to provide urban functions and services in balance, multiple city center (s) and or sub-centers will be established and connected by effective transport routes and corridors. In this master plan, Tranditional and Heritage Center and Metroplitan Sub Center along Carretera a Mayasa were chosen as Urban Center/Sub Center to accommodate business and commercial functions.
- The symbolic axis runs through Managua from Mt. Momotomobo in N.W. to Masaya and Granada in S.E.
- Major road network consists of five (5) radial roads connecting Managua with surrounding cities and five (5) ring roads.
- Massive transport corridors connecting City Center / Sub Centers that makes the base of economic activities.
- Natural environment shall be preserved as buffers around the city and be integrated with parks, green areas and water bodies by Eco Corridor
- For land use, densification of urban areas will be promoted in order to make Compact City and reduce the sacrifice of natural environment around the city.

The concept of urban structure is illustrated as following figure.

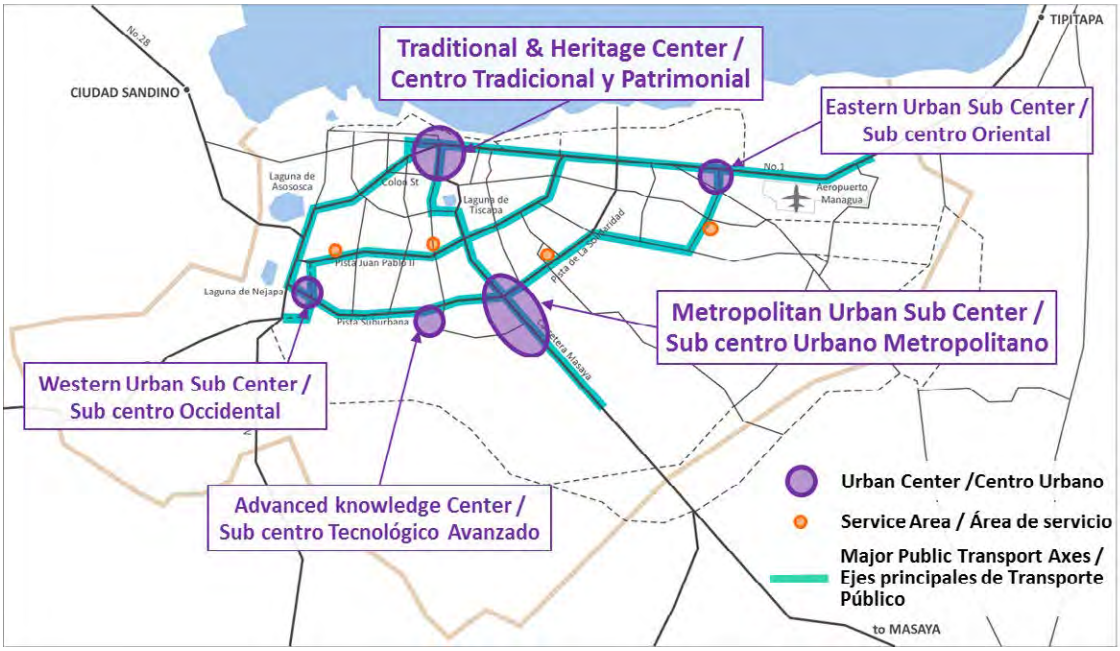
Source: JICA Study Team

Figure 9.1 A Structure Plan for Managua City 2040

9.2 Scenarios for Urban Structure

The urban center primarily provides for business center function such as administration and service provision including commerce. As Nicaragua seeks to establish Managua as a regional hub city, the urban center function is required in order to have international business operations supported by high quality infrastructure such as disaster resilient lifeline, reliable utilities, abundant greenery, and open space, which are required for an effective transport mode at the historical area or elsewhere in the city. At the same time, the urban center area also seeks to strengthen the attractiveness of the townscape, environment, and mobility.

In order to reorganize and enhance the existing functions of urban center and to promote and accommodate further growth and development, the locations of the new urban sub centers are identified based on the existing land use and transportation patterns. The sites for city urban center and sub centerss are summarized as follows:



Source: JICA Study Team

Figure 9.2 Location of the Candidate Sites for the New Urban Centers

The basic character of the five proposed urban centers is summarized in Table 9.1.

Table 9.1 Functions of the Candidate Sites for the Urban Centers

Main functions \ Core alternatives	Traditional & Heritage Center	Metropolitan Urban Sub Center	West Urban Sub Center	East Urban Sub Center	Advanced Technology Urban Sub Center
Central Function	✓		✓	✓	
Touristic and cultural attraction center	✓				
Residential	✓	✓	✓	✓	
Transport Hub	✓	✓	✓	✓	
International Exchange and Gateway	✓	✓			
Commercial and Trade	✓	✓	✓	✓	
Education	✓				✓
International Business and Financial Activity	✓	✓			✓
Administration	✓	✓	✓	✓	
Social Service	✓		✓	✓	✓
Other	Disaster Management				

Source: JICA Study Team

9.3 Urban Planning Measures

For other parts of the city which are not covered under the CBD or other subcenters, a number of other planning measures will be applied. These measures include

1) Residential area will be densified by introducing medium rise residential area with 4 stories collective housings;

2) Industrial area will be allocated in the eastern part of the city near the airport

3) Business and commercial area (other than the city center and sub center mentioned above) will stimulate commercial and business activities along the current main roads by allowing higher building with relaxed floor area ratio settings.

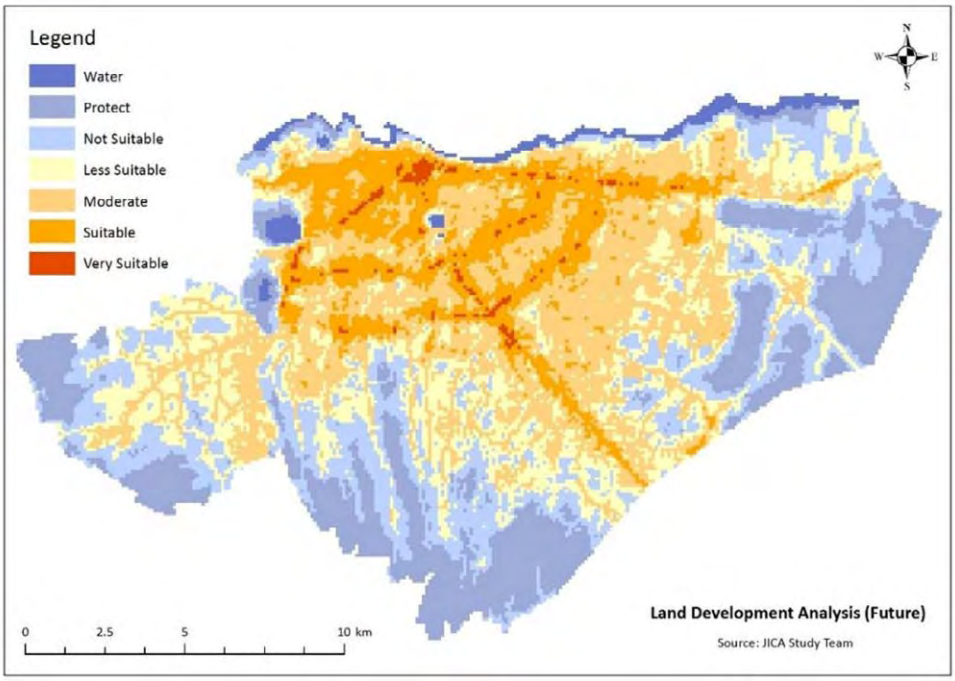
9.4 Land Use

(1) Existing Land Evaluation for Urban Development

Land potential evaluation for urban development, aims at identifying the urbanization factor of Managua City, was carried in terms of five following categories for preparing land potential evaluation map; natural and social conditions, disaster prone condition, and accessibilities of transport and infrastructure. The evaluation adopted a scoring system by 100 meter grid columns covering entire city, and the relative evaluation of existing land use was conducted with 6 levels which indicate a potential for urban development.

(2) Future Urbanization Simulation

Based upon the analysis of existing land evaluation for urban development, the urbanization simulation has established and prepared land use map of 2040. This simulation result illustrated in following figure. This result was utilized for future land use, future urbanization area with and without policy intervention, and future population allocation.



Waterbody	Not for Development	Level 4	Moderate for Development
Level 1	Protect	Level 5	Suitable for Development
Level 2	Not Suitable for Development	Level 6	Very Suitable for Development
Level 3	Less Suitable for Development		

Figure 9.3 Land Potential Evaluation in 2040

(3) Densification of Land Use

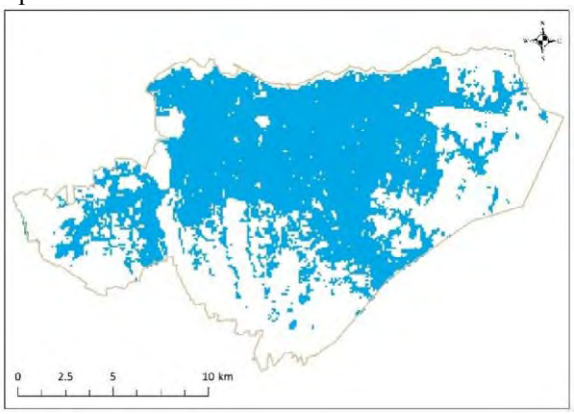
Managua City will need to accommodate a larger number of population in the future compared to today. A conventional way of urban expansion to sub urban and rural areas would lead not only to consume and revert the land resource, large part of which would be protected area, but also to require large costs for development of basic infrastructure. This could hamper the sustainability and might disturb the economic developments in Managua City. For taking account of existing low density development, densification measures could contribute to avoid urbanization expansion. Appropriate future net population densities by area and required built up area are proposed in the following Table 9.2. Applying these densification scenarios will cover the increase in population from 2016 to 2040.

Table 9.2 Future Population Density by Area

Type	2016			2040		
	Area (ha)	Net Pop. Density (per/ha)	Population	Area (ha)	Net Pop. Density (per/ha)	Population
Built Up Area in Urban Area	9,208	142	1,309,956	**10,360**	**162**	**1,678,600**
Revision of the Existing Zoning				9,100	160	1,456,000
Fill-in Development				1,110	160	177,600
Redevelopment				150	300	45,000
Built Up Area in Sub Urban Area	1,816	67	121,610	**2,300**	**87**	**199,000**
Revision of the Existing Zoning				1,800	80	144,000
Fill-in Development				200	80	16,000
New Development				300	136	39,000
Built Up Area in Rural Area	1,622	39	63,819	**1,622**	**39**	**63,819**
Total of Built Up Area and Population	**12,646**		**1,495,385**	**14,282**		**1,941,419**
Population Forecast in 2040						**1,940,078**

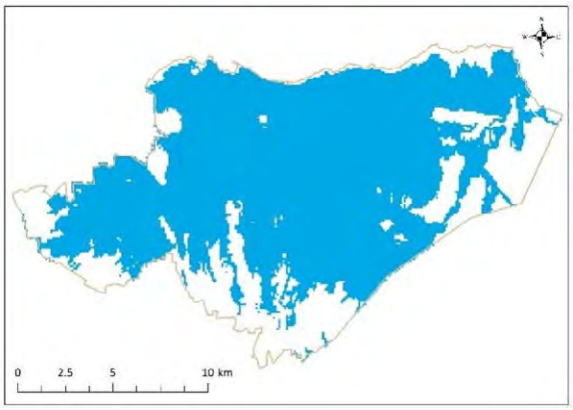
Source: JICA Study Team

Optimal Case



Total Build Up Area 14,300 ha

Worst case



Total Build Up Area 20,200 ha

Source: JICA Study Team

Figure 9.4 Built Up Area Simulation in the Worst and Optimal Cases in 2040

(4) Land Use Plan

The future land use consists of twenty-two practical categories in terms of following six major land use characteristics: 1) Mix Used, 2) Housing, 3) Commercial, 4) Industry, 5) Public Facility and 6) Conservation, by consolidation of fifty-two categories in the existing zoning system as following table.

Table 9.3 Comparison of Existing Zoning and Future Land Use 2040

Existing Zoning	Land Use Category 2040	Remarks
Mixed Use		
• Commercial Zone (Ce1)(Ce2) • Housing Zone (Vac1)(Vac2-1)(Vac2-2) • Service Mix Zone (Sm) • Housing and Service Mix Zone (Mvs1)(Mvs2) • Special Commercial Zone (Ce) • Cultural Zone (Cu1)(Cu2)(Cu3) • Government Institutional Zone (Ig) • Institutional Zone (It) • Recreation Zone (Rac-1)(Rac-2) • Tourism Zone (T) • Sport Zone (D) • Public Transport and Terminal Zone (Tt1)(Tt2)	• Traditional and Heritage Center	Refer to IDB's Plan
• Sub Center Zone (C-2) • Public-Private Investment Zone (Z-IPP)	• Metropolitan Urban Sub Center • Service Area	
• Distichal Sub Center Zone (C-3)	• Other Urban Sub Center • Service Area	
Housing		
• High Density Housing Zone (V-1)	• Middle-rise Residential Area	
• Medium Density Housing Zone (V-2) • Low Density Housing Zone (V-3)	• Low-rise Residential Area • Exclusive Low-rise Residential Area	
• High Density Housing Zone in Farm Area (ZQ-1) • Medium Density Housing Zone in Farm Area (ZQ-2) • Low Density Housing Zone in Farm Area (ZQ-3) • Village Concentrate Zone (PB)	• Sub Urban Low-rise Residential Area	Some areas belong to Sub Urban Green Area or Environmental Sensitive Area
Commercial		
• Commercial and Service Corridor Zone (C-S) • Commercial and Tourism Corridor Zone (C-CT)	• Commercial Area	
• Housing and Service Corridor Zone (V-S) • District Level Commercial and Service Zone (C-SD) • Access Corridor Zone to Sub Urban Area (CA-1) • Access Corridor Zone to Sub Urban Agricultural Production Area (CA-2) • Access Corridor Zone to Metropolitan Area (CA-3)	• Neighborhood Commercial Area	
Industry		
• Light Industry Production Zone (PI)	• Exclusive Industrial Area	
Newly proposed	• Industrial Area	
Public Facility		
• Special Institution Zone (EI-E)	• Public Institution Area	

Existing Zoning	Land Use Category 2040	Remarks
	• Educational Facility Area	
• Air Transport Zone (ET-1) • Urban, Interurban and Rural Land Transport Zone (ET-2)	• Transport Facility Area	
• Natural Reserve in Cemetery Zone (RN-4)	• Other Public Facility Area	
Conservation		
• Natural Reserve in Urban Park Zone (RN-3)	• Urban Green Area	
• No Intensive Agricultural Production Zone in Rural Area (PA-1) • Intensive Agricultural Production Zone in Rural Area (PA-2) • High Density Housing Zone in Farm Area (ZQ-1) • Medium Density Housing Zone in Farm Area (ZQ-2) • Low Density Housing Zone in Farm Area (ZQ-3) • Village Concentrate Zone (PB)	• Sub Urban Green Area	Some areas belong to Sub Urban Low-rise Residential Area
• Natural Reserve in National Park Zone (RN-1)	• National Park	
• Protection Zone of Erosion in Rural Area (PC-1) • Protection and Conservation Zone of Steep Slop Area (PC-2) • Protection Zone of Forest and Aquifer Area (PC-3) • Natural Reserve in Coastal Zone (RN-2)	• Environmental Sensitive Area	
• LAGUNA	• Waterbody	

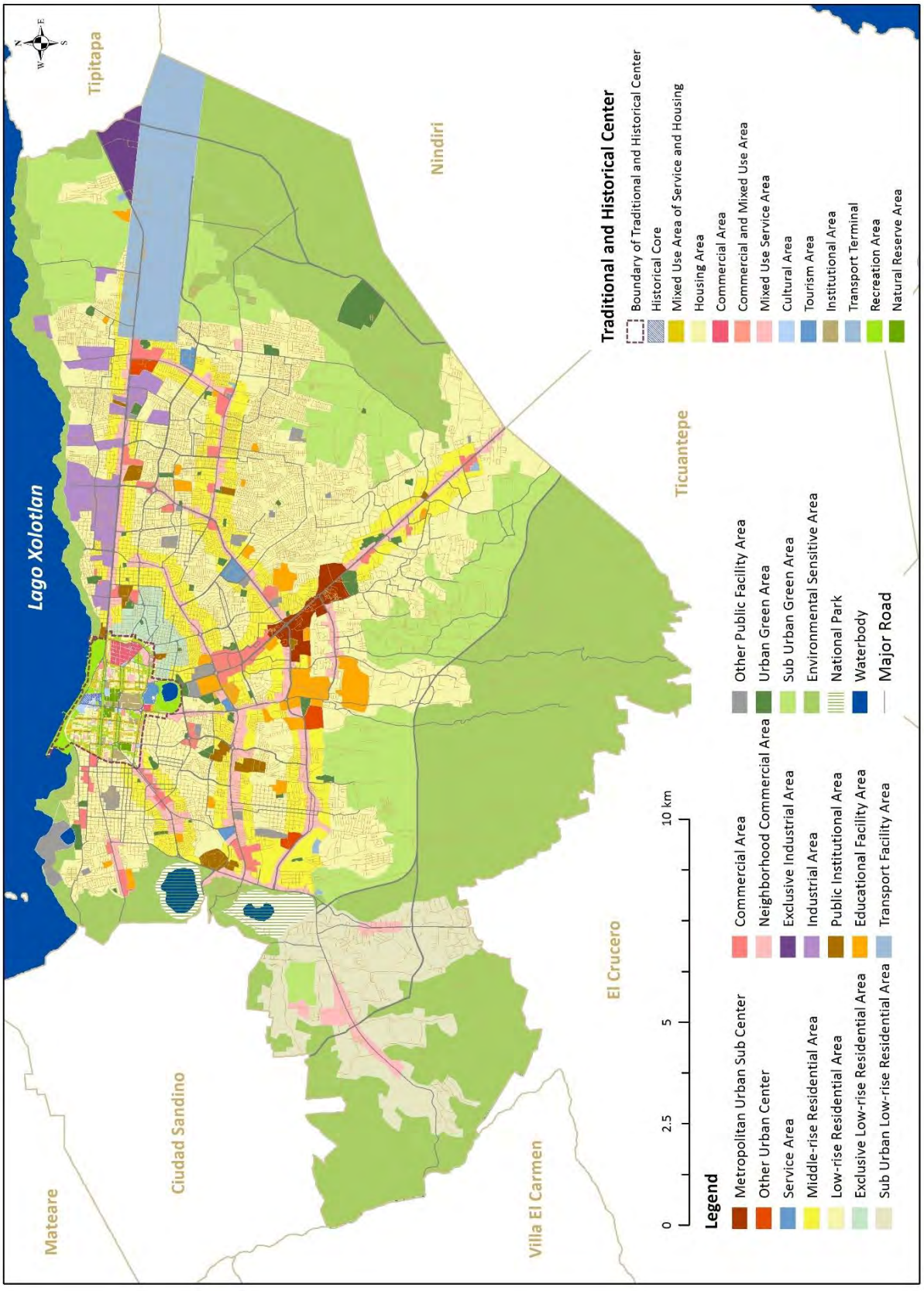
Source: JICA study team and ALMA

As shown in above table, in Mixed Used, in addition to the category for historical center, Metropolitan Urban Sub Center and Other Urban Sub Center are proposed in order to formulate urban center and to accumulate the urban functions. Besides, Service Area is considered to support these urban centers by utilizing empty plots of the bus terminal relocation. Regarding to Housing, Middle-rise Residential Area is expected to trigger urbanization in Managua, these areas are allocated within walking distance from the future public transport axis. Furthermore, these routes have also Neighborhood Commercial Area in order to enhance the convenience for public transport users. In case of incompatible land use such as industrial facilities or large-sized commercials in housing area, the land use categories are changed by applying Industrial Area or Commercial Area, however some are still remained, e.g. industrial facilities in Transport Facility Area (airport zone) and National Park.

With regards to Public Facility, the most of the area takes along the existing condition. Additionally, two areas are proposed as future depots for public transport along the route.

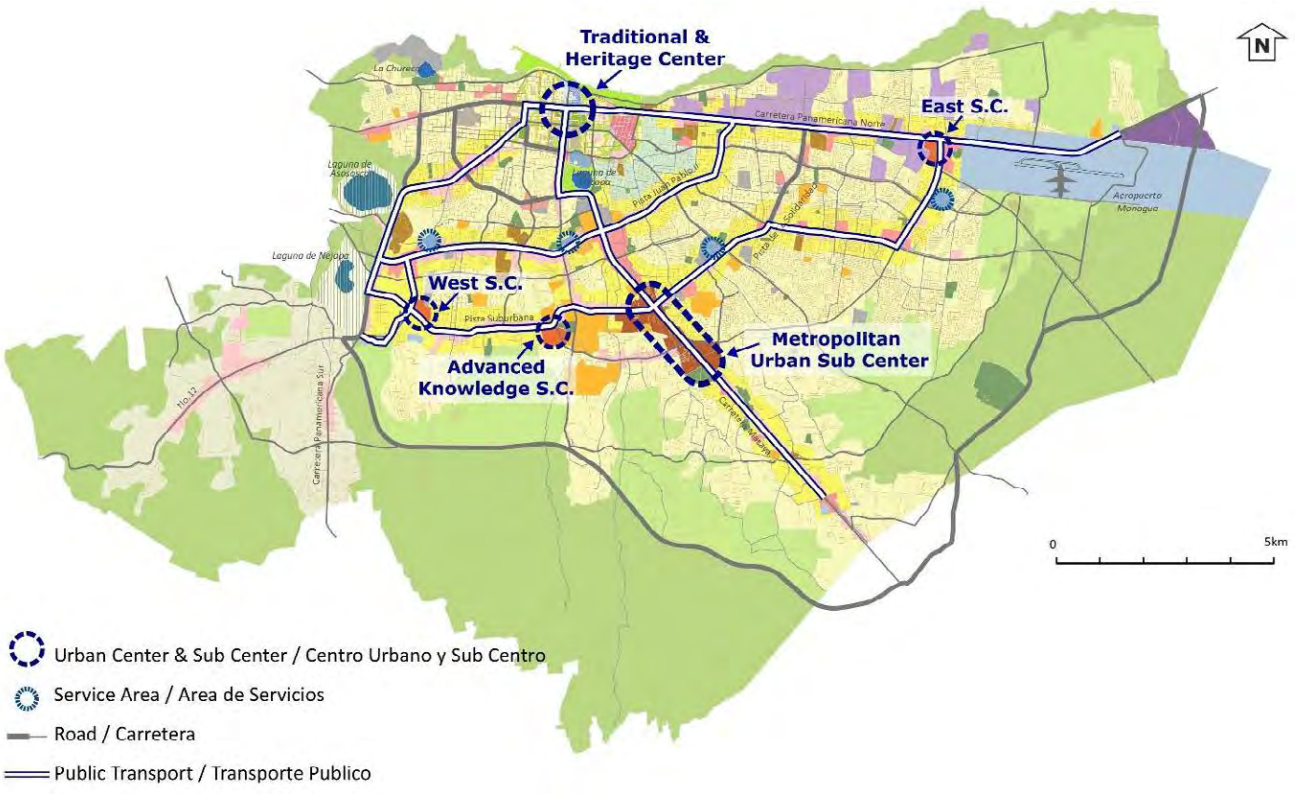
Conservation respects the existing zoning in general. In which, Sub Urban Green Area is proposed to be a buffer between the built up and natural reserved areas so as to control urban sprawl. In addition that, some green areas and open spaces are proposed as Sub Urban Green Area based on the risk analysis of natural disaster although the area is categorized as housing by the existing zoning.

The land use plan is established with a basis of the future urban structure plan, the existing zoning map, the aerophoto image in 2015, the existing land use in 2016, the disaster analysis data, the land potential evaluation analysis data and other relevant spatial data. Future Land Use Plan and Urban Structure and Land Use Plan are shown in Figure 9.5 and Figure 9.6 respectively.



Source: JICA Study Team. Traditional and Heritage Center refers to the general land use plan of IDB.

Figure 9.5 Future Land Use Plan 2040



Source: JICA Study Team.

Figure 9.6 Urban Structure and Land Use Plan 2040

(5) Further Steps for Land Control

So as to formulate compact city in Managua with the roughly two million of future population in 2040, low dense urban developments need to be controlled in order to stop further sprawl. The future land use plan takes a role as guiding principle of future development plan. Therefore, ALMA needs to revise the zoning system for adapting the future land use plan. In practical, detailed zoning maps are suggested to create based on the future land use plan less than 1: 10,000 scale and then to publish for public, since this future land use plan is still general. Beside simplified zoning and rules for encouraging densification are recommended to prepare as well

9.5 GIS

There are various kinds of data were collected through this project and these data was integrated in GIS based urban development database. Table 9.4 shows summary of contents of GIS based urban development database.

Table 9.4 Summary of GIS based Urban Developmen Database

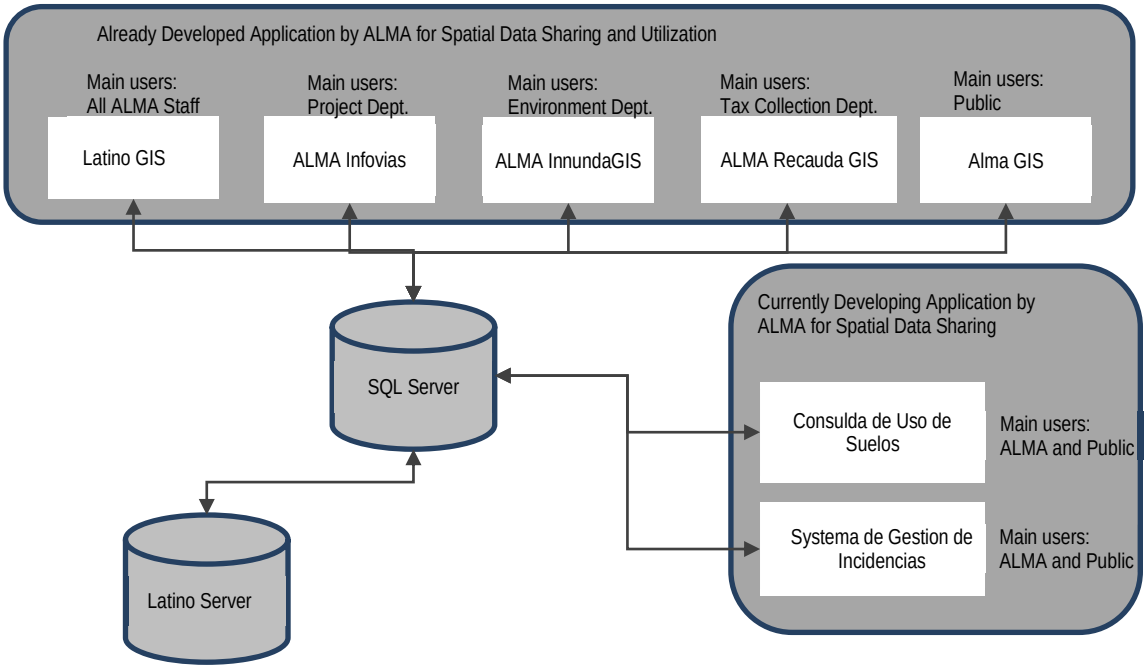
Data set	Major Contents
Administrative boundary	Municipality, District, Barrio, UTB 境界
Other boundary	Urban/ Sub-urban/ Rural 境界、歴史地区境界など
Land use	Existing land use
Natural environment	Slope condition, Elevation, Water body, Faults, etc.

Hazard information	Flood prone, Land slide prone, etc.
Transport	Road network, bus stop, bus routes, etc.
Urban infrastructure services	Water supply, sewage, electricity, drainage, etc.
Public facilities	Religeous facilities, education facilities, etc.
Development constraint	Natural reserve、Aquifer、coastal protection area, forest, etc.
Future plans	Sub ccenters, future road network, future land us, etc.
Others	Development zoning (current)
Satellite imagery/ aerial photo	Satellite imagery, aerial photo

ALMA IT section manages database which accommodate all collected and developed data by ALMA including GIS data to share data within ALMA, and also ALMA developed various application by Department or Section by purpose to access to the database. Regarding data related to urban planning sector in ALMA, an application named "Consulda de Uso de Suelos (Land use consultation)" to provide all information about applying construction permit is under developing. The idea to develop this application comes from the experience from one of sessions in the study tour at Kanazawa city in Japan, regarding "challenges of open data".

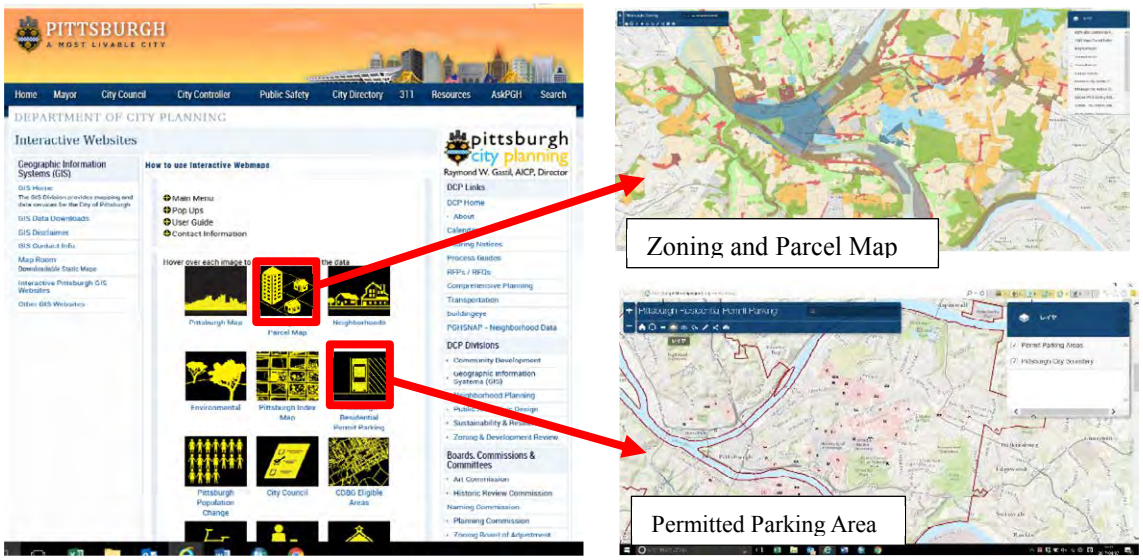
Afer completion of this project, it is important to implement proper maintenance and management of the GIS based urban development database, otherwise the database will soon be outdated and less valued, therefore, it is also important to prepare database update plan and standalization of data for easier meintenance.

In addition, it is recommended that ALMA disseminate not only this master plan map on the paper basis or Web basis, but also open data to the public for their secondary use after fully considering data security. This open data policy would contribute to securing the transparency of ALMA and might produce new and better public services in corroboration with ALMA, private sector and citizens. The image of data sharing is shown in Figure 9.7 and Figure 9.8.



Source: JICA Study Team

Figure 9.7 Image of Spatial Data Sharing System in ALMA

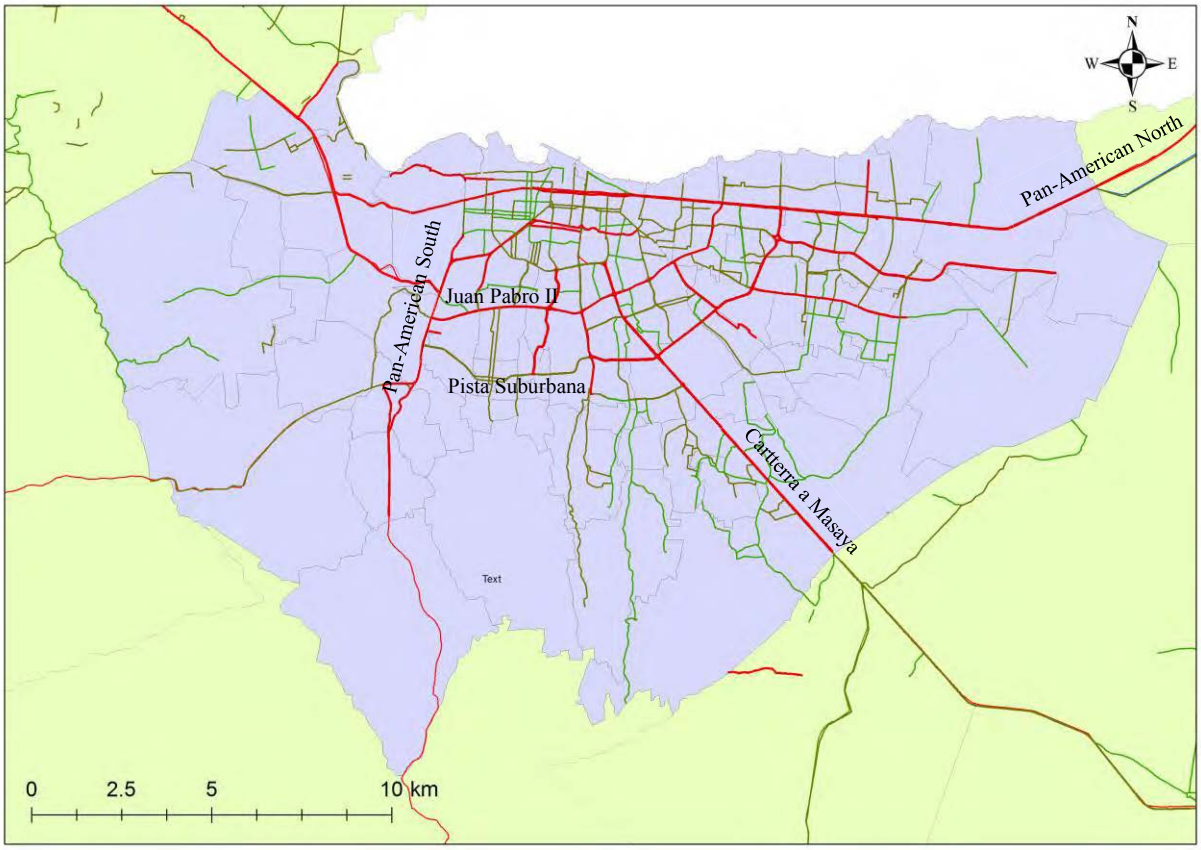


Source: http://pittsburghpa.gov/dcp/gis-webmaps-new

Figure 9.8 Sample of Data Sharing using Web GIS (Pittsburgh, USA)

10. TRANSPORT DEVELOPMENT MASTER PLAN

10.1 Traffic Demand Forecast



Source: JICA Study Team

Figure 10.1 Existing Road Network for Traffic Demand Forecast

(1) Present and Future Traffic Demand on Existing Road Network

Traffic demand forecast for existing transport network was conducted for model building and analysis of present traffic condition. The JICA Study Team conducted two cases; 1) present traffic demand (2016) on existing transport network (Existing Case), and 2) Future traffic demand (2040) on exisitng transport network (Do-Nothing Case).

Table 10.1 Primary Indices by Vehicle Assignment Results in Existing and Do-Nothing Case

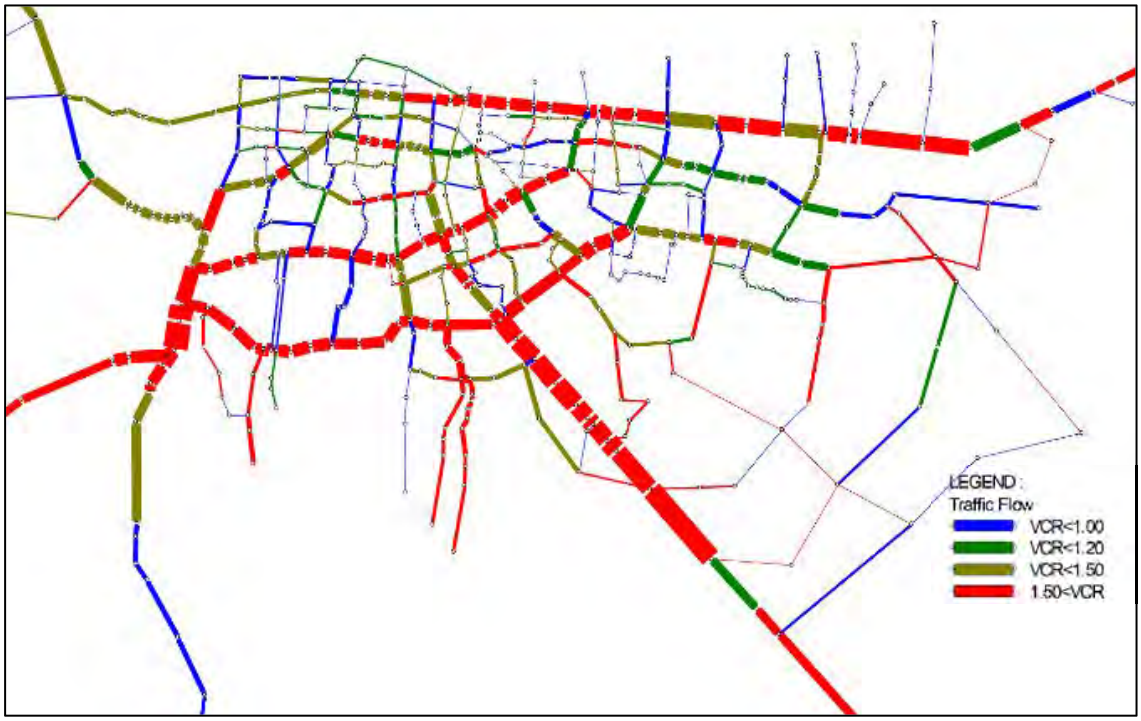
Case	Year of Traffic Demad	Year of Road Network	Vehicle-km Total (PCU-km) ('000)	Vehicle-hours Total (PCU-Hour)	Average VCR*
Existing	2016	2016	6,071	121,479	0.55
Do-Nothing	2040	2016	13,444	643,507	1.44

*: Vehicle Capacity Ratio

Source: JICA Study Team

Source: JICA Study Team

Figure 10.2 Vehicle Assignment Result in "Existing Case" (2016)



Source: JICA Study Team

Figure 10.3 Vehicle Assignment Result in "Do-Nothing Case" (2040)

In the Existing Case, traffic congestion occurs during the peak time in main road. It seems to be effected concentration of traffic to these roads as a current situation, since other roads are not so congested on the whole. In the Do-Nothing Case which show congestion degress in 2040 with existing road network,

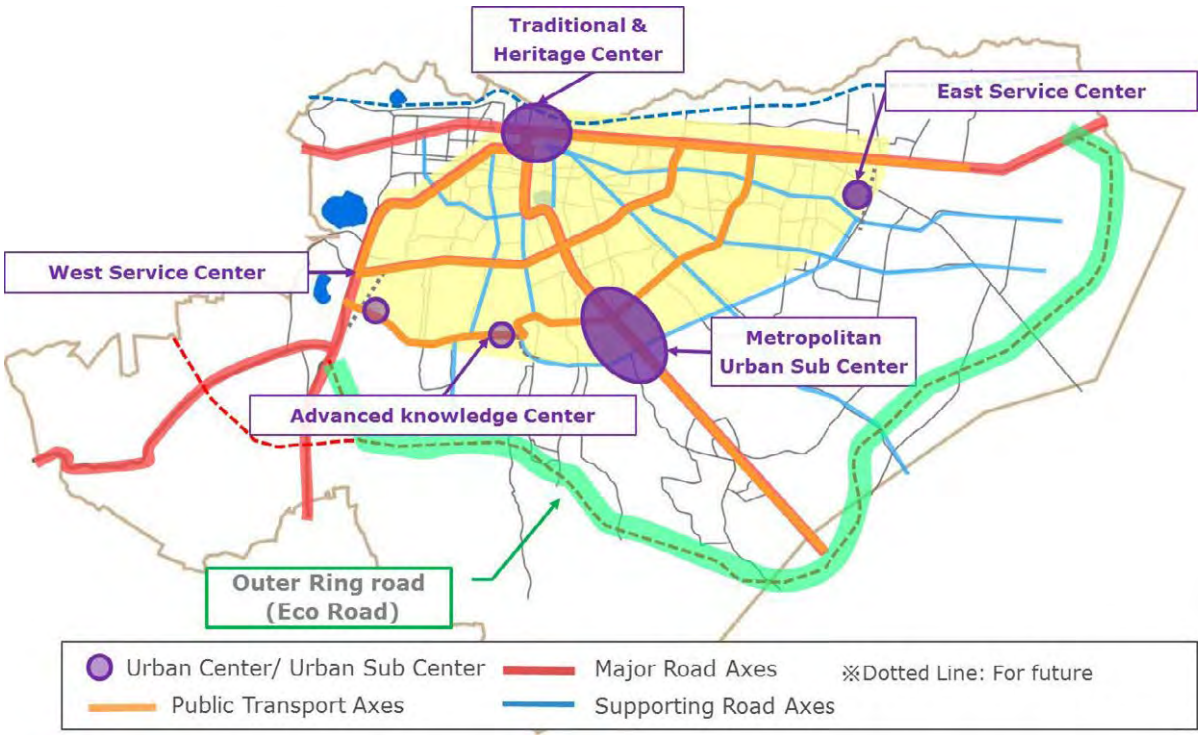
many roads are heavily congested. Several countermeasures which will strengthen road network and increase public transportation for decreasing automobile traffic in the future will be extremely necessary.

10.2 Transport Planning Scinario

(1) Policy and Strategy

Based on the future urban structure and traffic demand forecast, the JICA Study Team puts importance to future transport system that 1) strengthening connection between Urban center and Urban subcenter, 2) stimulating economy at the city center, and 3) inhibiting urban sprawl by 1) and 2). These policies are that to activate economic activity and connectivity between Urban center/Urban sub-center by 1) and 2), and then to achieve 3) by controlling development into suburban area or a vacant site.

The JICA Study Team considered two roles for managing future traffic flow: 1) Area for prioritized public transport by strengthening connection using mass transit between the Urban center and Urban subcenter, and 2) Other area, as shown in Figure 10.4. The former is to improve connectivity the lines which connect between Urban centers and the area which connects from neighbouring area to Urban centers. The latter is to encourage to detour the center area for decreasing traffic concentration in the city.



Source: JICA Study Team

Figure 10.4 Future Transportation System

- Road Network

Chracteristics of the spatial structure of Managua City is a road network consisting of five radial roads and four ring roads. The proposed fourth ring road which located outmost area in the city makes a one

important circular road for Managua City. This circular road is set near the boundary of urbanization and is proposed as a green corridor type of a road with trees in the median or on the both sides to connect the reserved areas and water areas alongside.

- Public Transport Network

Urban buses and intercity buses are indispensable not only for citizens of Managua City but also people who coming and going to Managua City from other city, and it is also important as a major traffic mode. Strengthening and promoting of public transport route should be improved connection and convenience for both buses and bias of operation routes. Pan-American North/South, Juan Pablo II, and Carretera a Masaya should be set as major public transport axis based on traffic volume and existing urban public bus routes. These routes are connected to each new district center, and function of intra-city and inter-city is divided in major public bus terminal in each center. These terminals also have a function of several transportation mode hubs including private car, taxi, etc.

- Traffic Management

In addition to the improvement of road and public transport network, non-structural measure is also necessary to conduct several traffic management measures. Furthermore, there is no specialized organization for traffic planning in Managua City and the role of traffic-related organizations is unclear. Therefore, it is necessary to establish appropriate division/organization for traffic management and planning, as well as to clarify the roles of traffic-related organizations.

(2) Road and Traffic Management Plan

Road Plan and Traffic Management Plan were prepared based on the urban and transport Development policy and strategy. Road network is much related to Traffic Management and Public Transport Plan. Therefore, This Road Plan was considered both plans.

- Road network and traffic management planning scinarios

1) Strengthen the radial road network

As a result of the different traffic analysis, the most of traffic volume concentrate to the five radial transport hubs. Therefore, the radial transport hubs should be strengthened in order to reduce the traffic congestions. In addition to this, it is necessary to conduct the following measures 2)～5).

2) Strengthen the ring road network

Existing ring roads in Managua City occurs serius traffic congestions. Some section of ring road does not connect, and this situation becomes a cause of bottleneck. The road improvement and extension projects and new bypass projects should be implemented.

3) Strengthen the existing roads function in the urban area

The major traffic flows have concentrated in the main roads. In order to mitigate traffic congestion and maintain road function, these main roads with the function of decentration

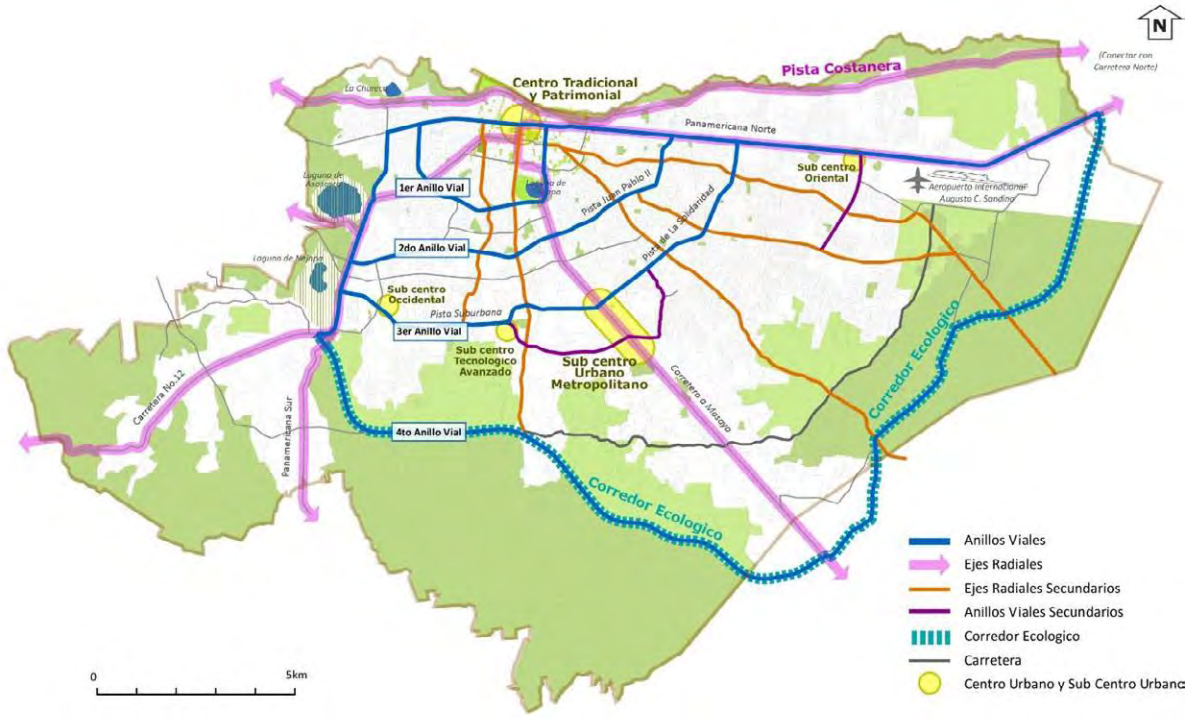
of traffic such as Pan-American North and Juan Pablo II should be reinforced by expanding the road capacity.

4) Prioritization of public transport

In order to avoid a concentration of traffic on the roads in urban area, it is important to give a priority to urban public transport. There are two important actions: (i) Integrate and harmonize the road network with the public transport corridors, and (ii) Relocation of urban and intercity bus terminals.

5) Improvement of traffic management capacity

There are many weaknesses in traffic management field. Adequate traffic management can ensure the benefit to the traffic flow of the city. If proper countermeasures are performed, successful results can be achieved in this field.



Source：JICA study team

Figure 10.5 Future Road Network

(3) Public Transport Plan

- Improvement of public transport service with mass-transit systems and the feeder buses

Public transport is currently the most dominant mode of transport in terms of modal share. It is important to improve the public transport service before the modal share of the public transport drops to the critical extent.

Furthermore, one of the problems that prevents the adequate use of public transport by the citizens is the bus routes that haven't been radically modified since long time. Urban transport service should provide an appropriate accessibility with affordable price to maximum citizens.

These issues clarify the necessity to improve the public transport service. Considering the large volume of demand and large area to be covered, the combination of mass-transit systems as the main mode of public transport and the feeder buses as the complementing system shall be proposed.

- Relocation and improvement of bus terminals along intercity roads

Existing bus terminals are located mainly inside the urban area away from the principle corridors, which cause the congestion in the surrounding area. The interconnectivity with urban public buses is not well facilitated because of narrow space. In addition, there are many small shops inside and around the terminals disturbing the safe and punctual operation of the buses. Based on these reasons, the relocation and improvement of bus terminals is proposed.

There are urban centers/urban sub-centers proposed to be located near interurban highways and they're to be connected by mass-transit systems. Their inside or neighbour would be the most appropriate locations of new bus terminals.

10.3 Proposal for Appropriate Transport Institution System

The institutional organization of urban transport in the Managua City has some gaps and overlaps. Transport planning is needed to get concensus with many sectors and many levels of government authorities. However, ALMA doesn't have transport planning unit to coordinate with other institutions. JICA Study Team proposed to establish transportation planning and traffic management institutions to ensure efficient operation and services for urban traffic control.

Reorganization of transport sector is necessary. ALMA and JICA Study Team discussed to modify the existing organization of the transport sector and the functions with three institutions: transport planning, traffic management and public transport management.

- Transport Planning

This entity has the following functions and responsibilities;

a) Management of overall urban transport
b) Transport planning in Managua City
c) Decisions of all activities of transport sector in Managua City
d) Coordination and integration of transport management in Managua City
e) Coordination and integration of the tasks for the transport sector at national and intercity level.

- Traffic Management

This should be organized as a technical office through the integration of the existing Traffic Control Center (TCC) with a broader range of functions and responsibilities. TCC should be an office with functional autonomy and should belong directly to the Mayor's Office as today, although it should have

close coordination and collaboration with the other transport-related departments of ALMA, the National Police, MTI, and other municipal agencies. The functions and responsibilities of the TCC focus on three specific field; traffic regulation; traffic control and management, road safety and accidents.

- Management of Public Transport

This organization is responsible for ensuring the conditions for the operation of public transportat services within the municipal boundaries. Its functions are the regulation of mobility service to the Nicaraguan people. The main functions of this organization are 1) the regulation of public transport, 2) the control of service, 3) the permission for operation, and 4) the responsibility for all equipment related to the operation of transport.

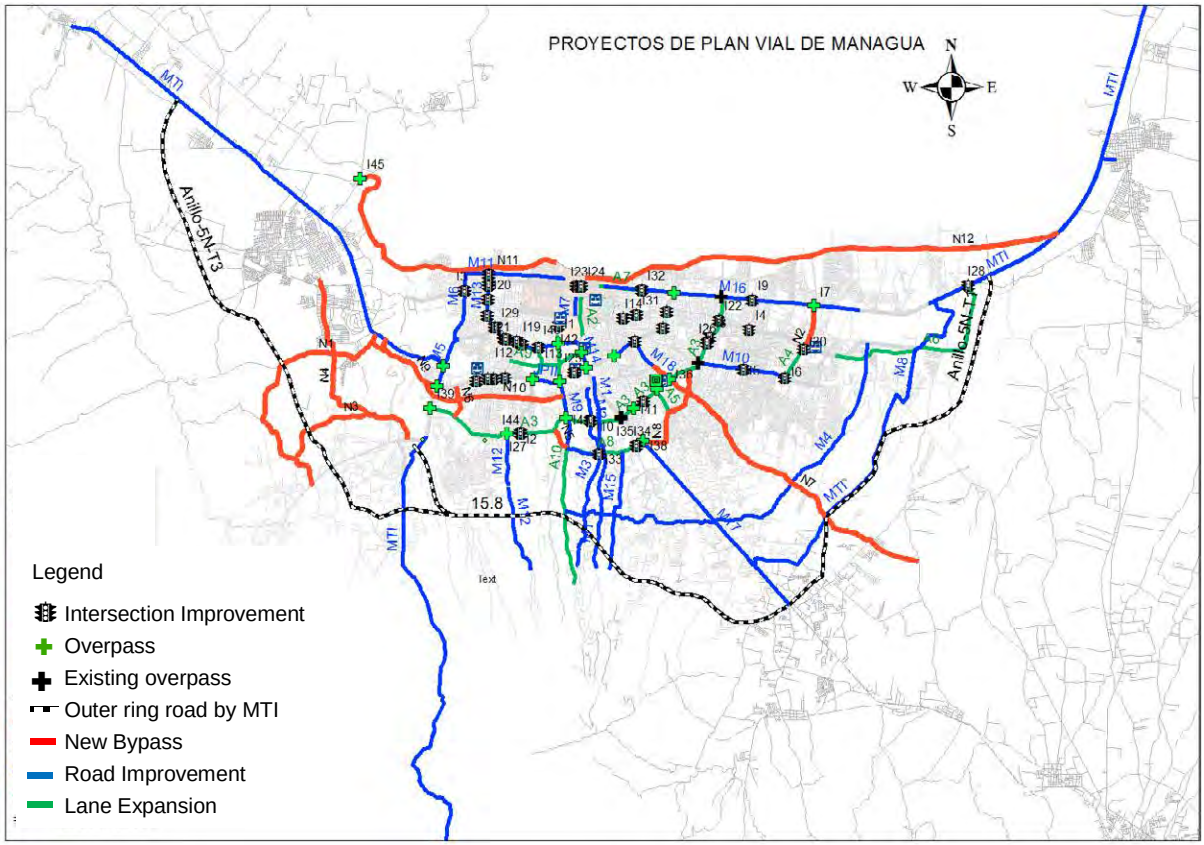
10.4 Proposed Projects for Transport Sector

(1) Road Project

The road network of Managua City has been increased without any forecast and control of the road capacities and it shows almost over the capacity and increase of bottlenecks. Based on these situations, necessary road projects for development of appropriate future road network were packaged to four projects; Improvement and Road Extensions Projects, 11 New Bypass Projects, Outer Ring Road Project and Overpass and Intersections Projects.

- Improvement and Road Extensions Projects (18 road improvements and 10 road extensions)
- 11 New Bypass Projects
- Outer Ring Road Project (4th. Ring Road)
- Overpass and Intersections Projects (19 Improvement projects for Traffic Signals, 13 Intersection Improvement Projects, 16 Overpass Projects)

The proposed road projects are shown in Figure 10.6.



Source: JICA Study Team

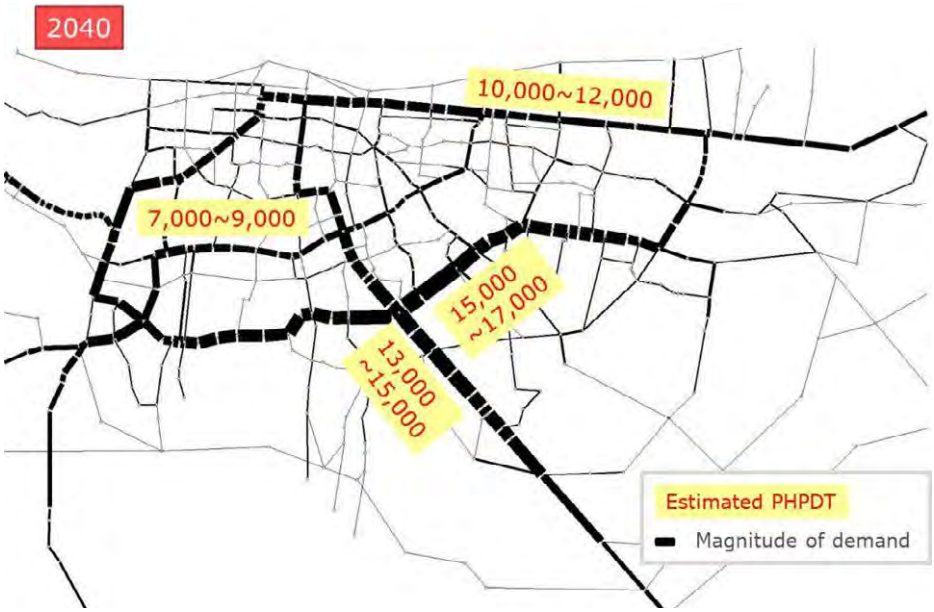
Figure 10.6 Proposed Road Plan

(2) Public Transport Project

- Mass-transit systems

Mass-transit systems are proposed to keep moving the future Managua City. The systems need to have the following features in general; proper traffic demand, broad-based service, punctual operation, comfortable and secured service, easy transit, Park & Ride, information provision, integrated pricing system and accessibility.

Demand on public transport during peak hour in 2040 is estimated as below.



Source: JICA Study Team

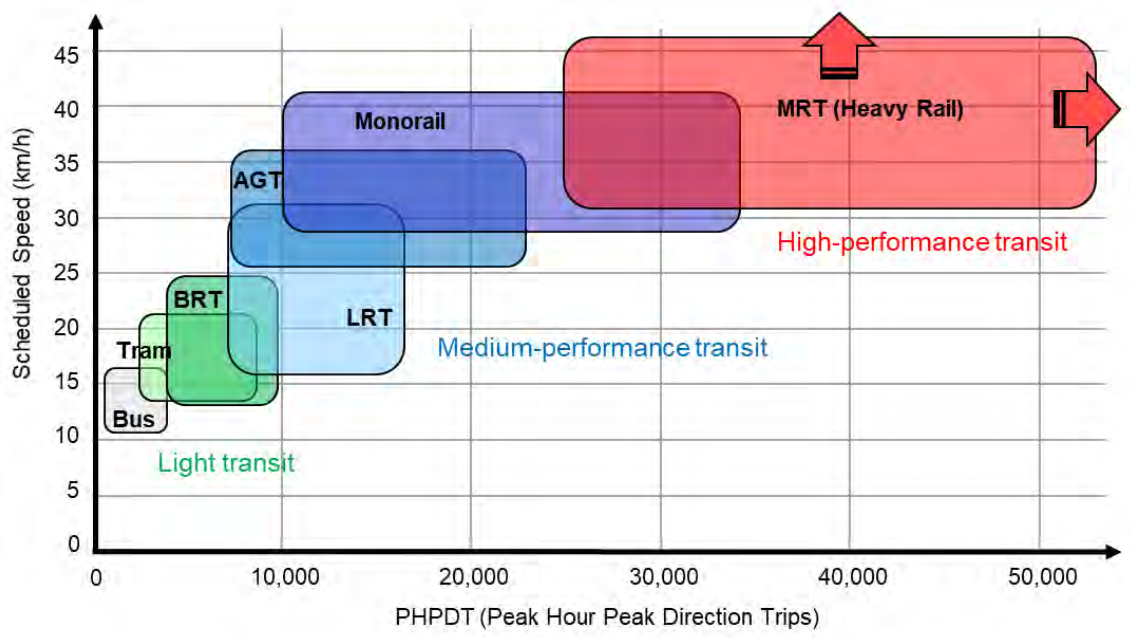
Figure 10.7 Peak hour peak direction trips (PHPDT) on public transport network in 2040

The estimated peak demand in 2040 on the proposed mass-transit lines are around 7,000-9,000 or 15,000-17000. The systems that can accommodate these volumes of demand are namely Bus Rapid Transit (BRT), Light Rail Transit (LRT), Automated Guideway Transit (AGT) and Monorail. The main features of these systems are presented in the following table. Apropriated systems by each route were considered for each line based on these features of systems as well as the characteristics of the routes.

Table 10.2 Comparison of medium capacity mass-transit systems

	BRT	LRT	AGT	Monorail
Capacity	Small-Medium	Small-Meduim	Medium	Medium-Large
Speed	Slow	Slow-middle	Middle	Middle
Required land space	Large	Large	Small	Small
Landscape	Normal	Good	Normal	Good
Construction Cost	Small-Medium	Medium-Large	Medium-Large	Large

Source: JICA Study Team



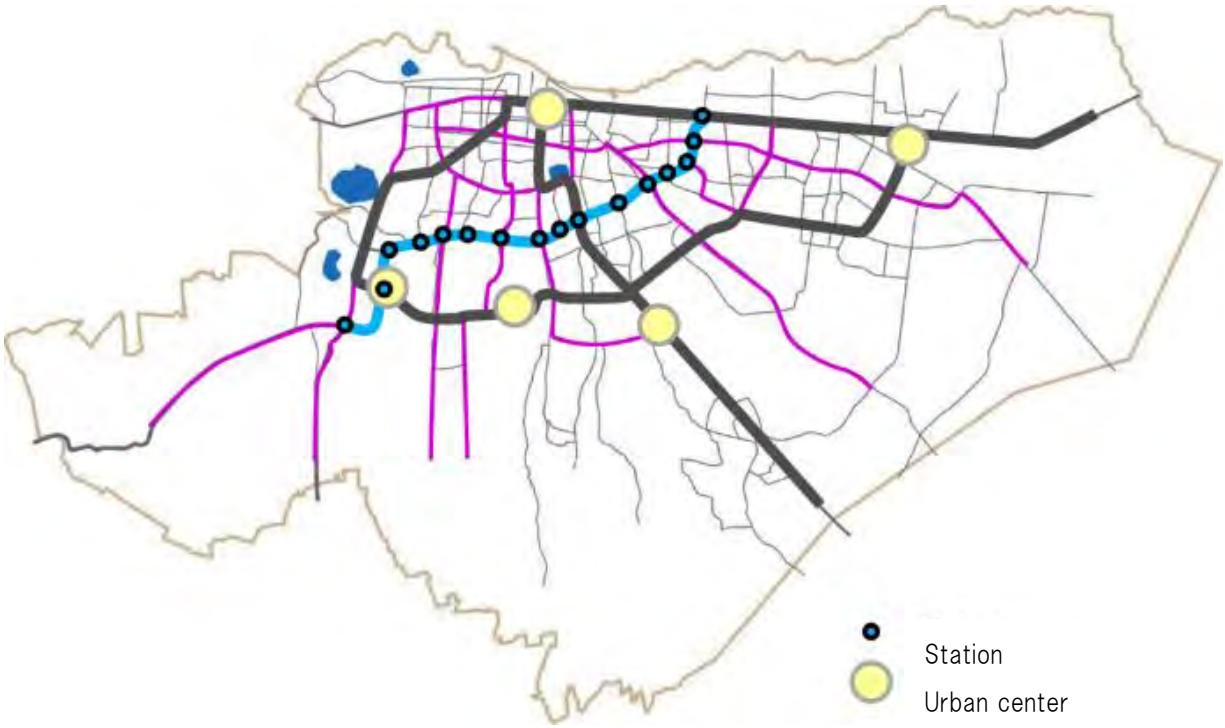
Source: JICA Study Team

Figure 10.8 Scheduled speed and PHPDT capacity of mass-transit systems

1) Juan Pablo II Line

Juan Pablo II Line with longitude of 11.6 km shall connect Juan Pablo II road and Nejapa area. The demand is estimated to be around 8,000 PHPDT in 2040. It is relatively small demand when compared with the other lines, but it could be the first line to be developed in the short term, considering that the project of widening of Juan Pablo II road is already at the point of initiation that includes the arrangement of exclusive lanes for buses. In addition, its route going in the middle of the city that shall reinforce the urban densification and have less risk to foster unexpected urban sprawl. Also, its relatively small volume of passenger demand could be handled by a lighter mass-transit system that requires relatively less investment than other systems, which should be an important aspect as the first mass-transit system in the country. By starting the project from the short term, the estimated peak demand in 2030 is 11,000. It is expected to have larger passengers until the development of other mass-transit lines.

The recommended system for this route is BRT, considering the estimated demand volume and the existing widening project to develop the exclusice lane for buses. The peak demand can be fulfilled by articulated bus (2 cars) with full capacity of 170 passengers running with 0.9 minute's headway. Stations should have 2 or 3 stopping bays by direction as well as additional passing lane for express buses. Expected number of stations would be 16 with the average interval of 0.8km.



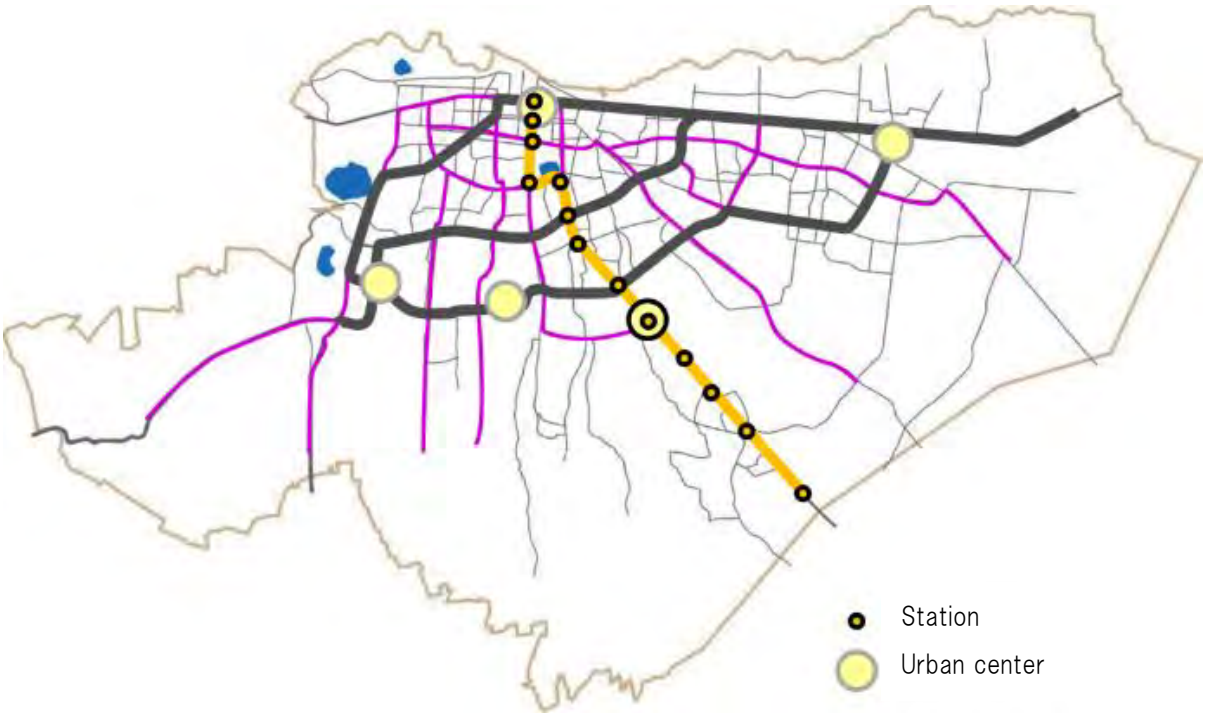
Source: JICA Study Team

Figure 10.9 Proposed routes of Juan Pablo II Line

2) Masaya Line

One of the most demanded route shall be Masaya Line with longitude of 11.9km. Considering the demand to be around 12,000 PHPDT in 2030 and around 14,000 PHPDT in 2040 at the highest demanded section, and also the function that this would connect the most important city centers of Managua City, the detailed study of this project should start in the short term to be inaugurated as soon as possible.

Concerning the demand volume, LRT and AGT are the candidate systems. It must be also considered that this route has a large longitudinal gradient and that it is better to minimize the ground occupation to leave larger space for the demanded section on Masaya highway and for the narrow section near Tiscapa lake. As the concludion, the recommended system for this line is Automated Guideway Transit (AGT) with rubber tires and on elevated lanes. The system must have a seismic resistance for the citizen can take it with confidence. The system should have vehicles with full-load capacity of 600 passengers (6 modules of 100 passengers) that run with headway of 2.5 minutes. Expected number of stations would be 13 with the average distance of 1.0km.



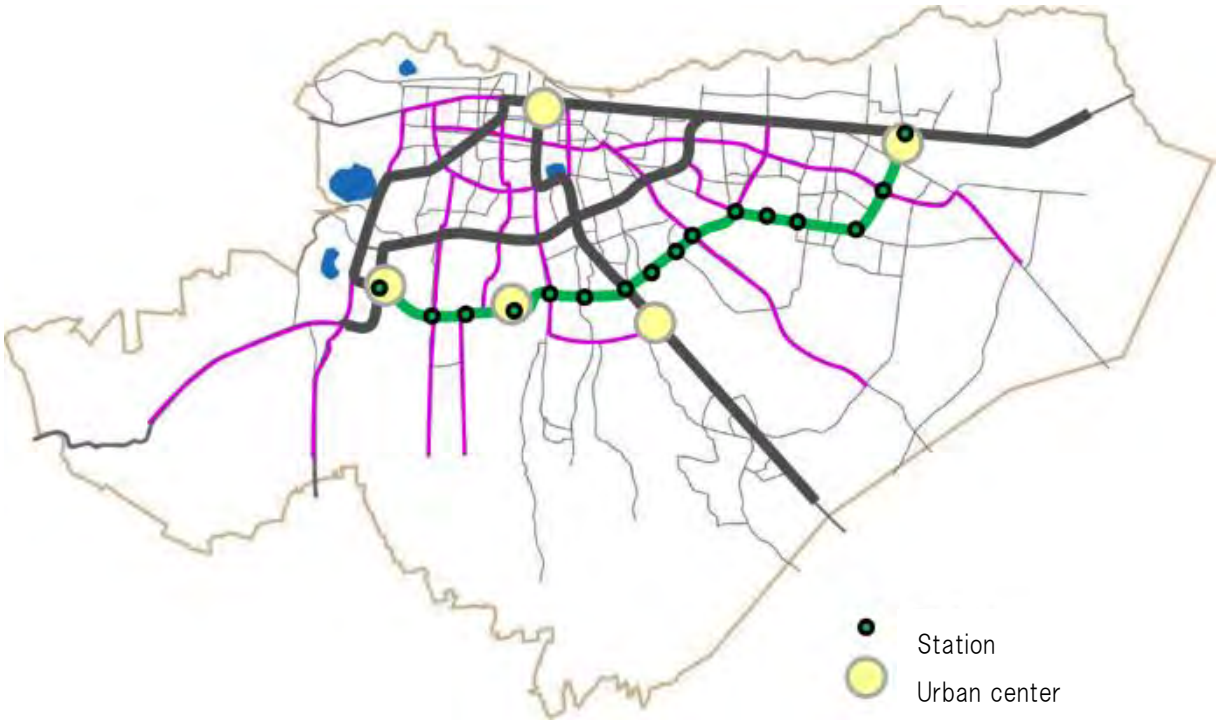
Source: JICA Study Team

Figure 10.10 Proposed routes of Masaya Line (Right)

3) Suburbana Line

The most demanded route is Suburbana Line with longitude of 15.0km. The demand is estimated to be around 16,000 PHPDT already in 2040. Considering also that this route connects three city centers to be developed, the detailed analysis of this project should be started early to be inaugurated as soon as possible.

As Masaya line, the recommended system for this line is AGT, considering the volume of passenger demand, large traffic on Pista Suburbana, narrow sections around Villa Roma and Mayoreo, undulating land, etc. The system hould have vehicles with full-load capacity of 600 passengers (6 modules of 100 passengers) that run with headway of 2 minutes. Expected number of stations would be 16 with the average interval of 1.0km.



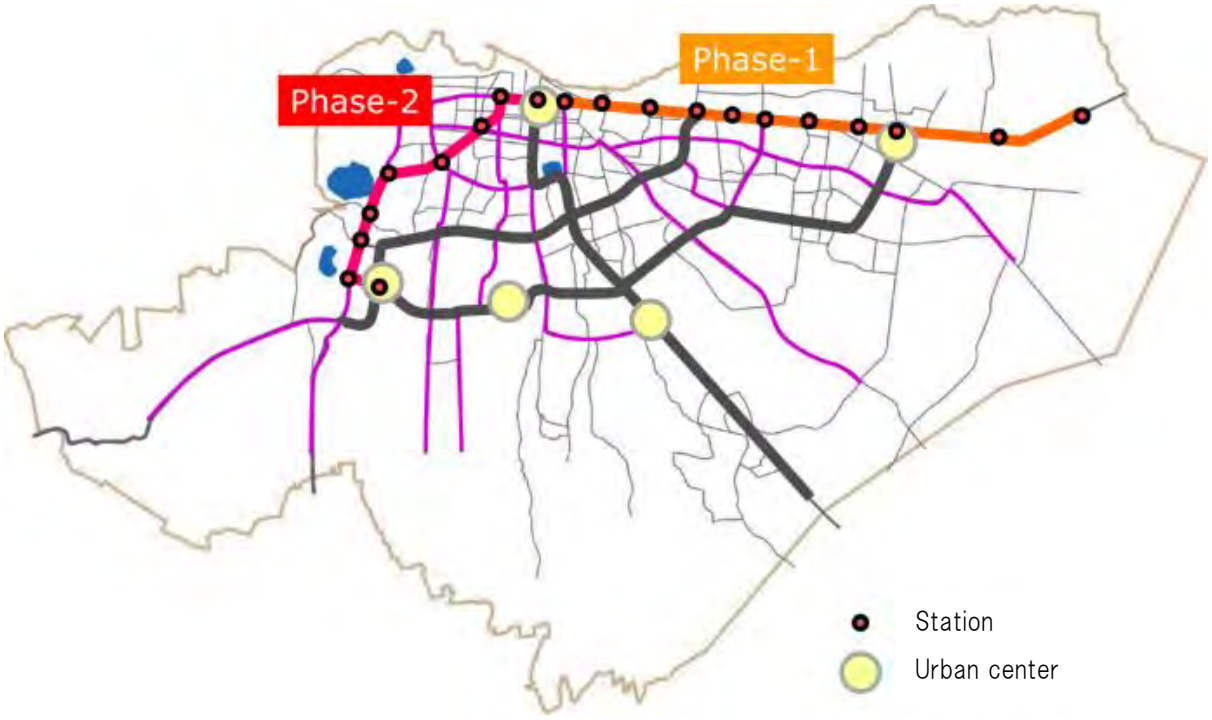
Source: JICA Study Team

Figure 10.11 Proposed route of Suburbana Line

4) Panamerican Line

Panamerican Line with longitude of 20.8km shall be devided into two phases; the phase-1 (12.8km) on the east half and the phase-2 (8.0km) on the west half. The demand is estimated to be around 11,000 PHPDT in 2040. The project phase-1 should be started right after the projects of Masaya Line and Suburbana Line which have larger demand. The phase-2 should follow the precedent phase, however the timing could be late since this section is expected to have a relatively small volume of demand.

Concerning the volume of demand, the candidate systems are BRT and LRT. Considering the function as an international gateway that serves the international visitors as the first transport service in the country, this line should have a system with adequate capacity with comfortability. The landscape is also an important element of this line, as it passes through the historical city center and the view over Managua lake from the other part of the city should be reserved. As the result, the recommended system for this route is Light Rail Transit (LRT),. The system should have vehicles with full-load capacity of 500 passengers (5 modules of 100 passengers) that run with headway of 3 minutes. Expected number of stations would be 20 with the average interval of 1.1km.



Source: JICA Study Team

Figure 10.12 Proposed route of Pan-American Line (Right)

Table 10.3 Summary of Mass-Transit Lines

	Juan Pablo II	Masaya	Suburbana	Panamerican
Main feature(s)	• Diagonal axe of the city • Road improvement project exist	• Connection of 2 principle city centers	• Connection of 3 urban centers • Largest demand volume	• International gateway
Longitude (km)	11.6km	11.9km	15.0km	20.8km
PHPDT (2040)	11,000*	14,000	16,000	11,000
Daily ridership (2040)	250,000	300,000	450,000	360,000
No. of connected urban centers	1	2 (main)	3	3
Land availability	Good**	Bad	Bad	Fair
Direction	West-East	South-North	West-East	West-East
Suggested system	BRT	AGT	AGT	LRT
Investment cost (million USD)***	116	417.5	525	520

Note*: Value of year 2030 for Juan Pablo II Line
Note**: Assumption of project implementation of widening project
Note***: Unit cost/km was assumed as 10 million USD for BRT, 35 million USD for AGT and 25 million USD for LRT
Source: JICA Study Team

Suitable modes should be decided based on the pre-feasibility study for introduction of the mass tranasport, which conducts detail analysis including operation system, infrastructure of station/terminal, economic/financial analysis and etc, because some analyses are including preliminary level.

- Urban public bus reorganization (feeder buses)

Existing bus services are important transportation mode for no-vehicle owner and citizen living surburban area to provide access. However, existing urban bus close to be sturated by lack of bus fleets, therefore improvement of existing urban bus service including increase of bus fleets would be needed. At the same time, the bus services are needed a function as the feeder buses when completed the mass-transit systems. The following steps of reorganization are proposed below;

1. Increase the total number of bus fleets (500 fleets)
2. Allocate the new fleets and the under-used fleets of existing routes to the non-served areas and to the routes of coming mass-transit systems
3. Once the mass-transit systems installed, the bus services change the routes to serve as the feeder buses

- Bus terminal relocation

Three bus terminals are proposed to be created near Metropolitan sub center, East service center and West service center. Each of them shall be associated with and integrated in city center, and be well connected with other the modes of public transport.

Masaya bus terminal

Masaya bus terminal shall serve mainly for intercity passengers from east and southeast parts of the country. The terminal shall be integrated in Metropolitan sub center, which would have an important traffic demand by itself. The bus terminal shall also provide an intermodal connectivity with Masaya Line.

It is estimated that Masaya bus terminal accommodates around 70,000 intercity passengers per day in 2040. During the evening peak hour, around 3,500 passengers would get on board the intercity buses at the terminal, and it would require about 9 berths for large buses and 8 berths for micro buses.

East bus terminal

East bus terminal shall serve mainly for intercity passengers from north and east part of the country. The access with East city center shall be facilitated. The bus terminal shall also provide an intermodal connectivity with Suburbana Line and Panamerican Line. Considering the location along Panamerican highway and near the international airport, this terminal shall also accommodate international buses.

The estimated volume of passengers is 50,000 per day in 2040, and the peak hour's demand is by 2,500 passengers who're getting on board. It would need about 7 berths for large buses and 6 berths for micro buses.

Western bus terminal

West bus terminal shall serve mainly for intercity passengers from south and west part of the country. This bus terminal shall facilitate an access with West city center and an intermodal connectivity with Suburbana Line, Panamerican Line and Juan Pablo II.

The estimated volume of passengers is 69,000 per day in 2040, and the peak hour's demand is by 4,700 passengers who're getting on board. It would need about 12 berths for large buses and 11 berths for micro buses.

(3) Traffic Management Project

- Short Term

Proposed project in short term is to organize the definitive and modern Traffic Control Center (TCC). These projects are renewal and update TCC itself and to provide resources to undertake its task in a new and modern equipment. The proposals are mainly concentrated in two fields: the development of the Traffic Control Center and traffic management measures.

- Middle Term

It is assumed that considerable measures might be acquired in the traffic management fields by this term. The project for this term are an extension or enlargement or refinement of short term project.

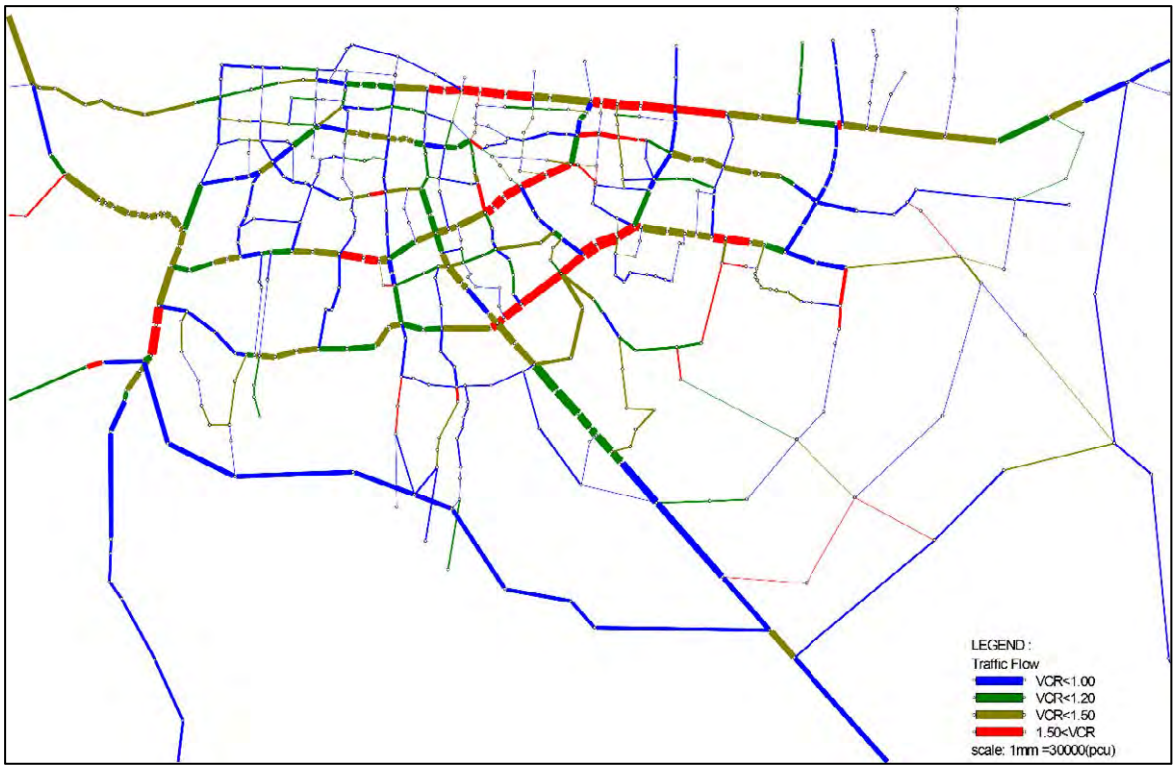
- Long Term

General measures are proposed between 2031 and 2040. It should not be forgotten the measures taken in previous periods. They are still in force and positively affect. For this reason, the proposals in long term are to continue the previous measure with little innovation. In addition, construction of parking lot and area restricution such as zone 30 would be conducted.

(4) Assessment of Future Traffic Flow with Proposed Project

Traffic demand forecast with project case was carried out. The evaluation was conducted based on with and without implementation of densification, traffic management, road and mass transportation project. Total number of evaluation case are 12, and congestion degree of future road network, which is short (2020), middle (2030), and long term (2040), was considered using these evaluation cases.The summarized results are shown in Figure 10.13 as short term , Figure 10.14 as middle term, and Figure 10.15 as long term results.

Effect of traffic management in short term is high. In the mid term, effect of traffic management is still high, but its effect decrease compared with short term project. It is assumed that traffic demand cannot be control and manage only traffic management project. In the Long term, traffic demand is increased more, and implementation of several project will be needed. It is necessary to consider mass trasnsportation mode and route based on the passenger demand.

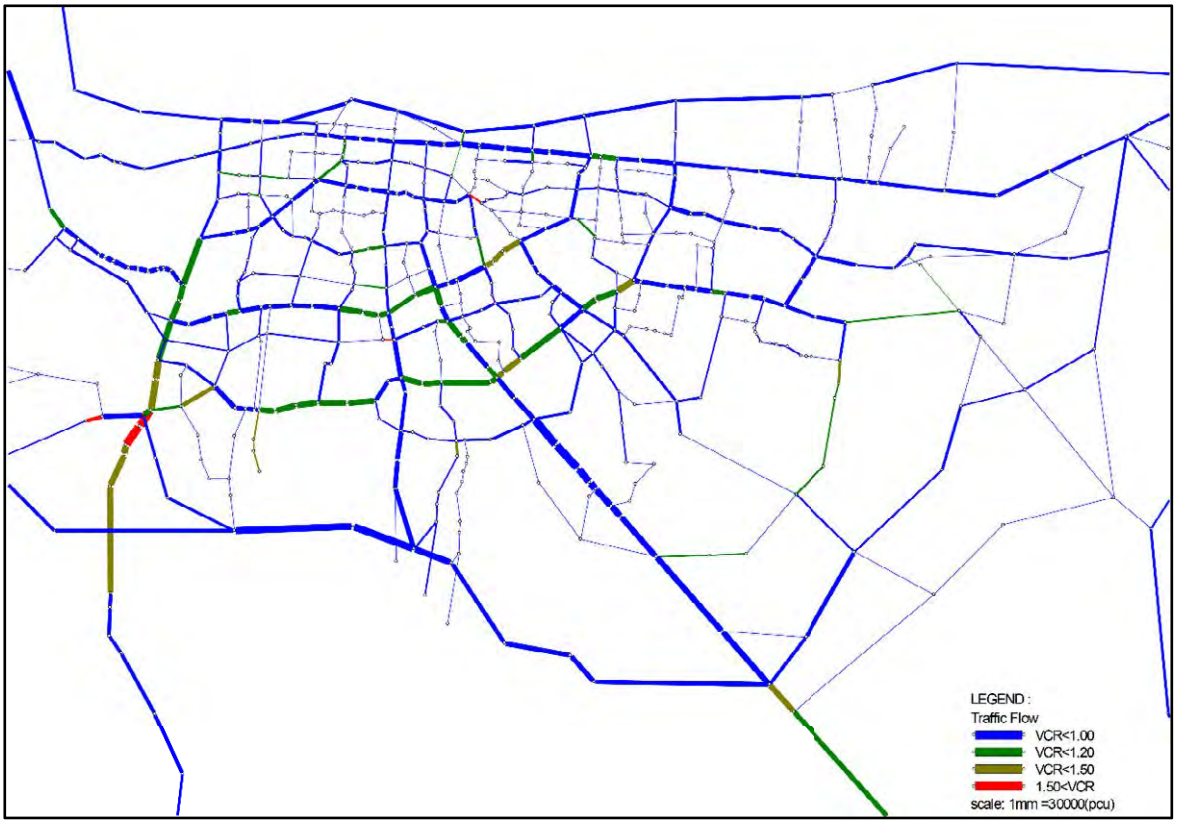


Source: JICA Study Team

Figure 10.13 Future Traffic Flow in 2020 with Project (Case 3)

Source: JICA Study Team

Figure 10.14 Future Traffic Flow in 2030 with Project (Case 7)



Source: JICA Study Team

Figure 10.15 Future Traffic Flow in 2040 with Project (Case 11)

(5) Database of Traffic Survey

Updating traffic surveys conducted in PDUM including person trip survey, traffic count survey and travel speed survey written in Appendix 1 are recommended to conduct periodically for updating transportation master plan in the future. In addition, identifying daily or monthly or seasonal variation of traffic volume should be accumulated traffic volume data for analyzing and specifying traffic issues.

Table 10.4 indicates example of survey schedule. Other organization also collect valuable data for understanding traffic situation. Those data also should be taken in consideration. In the future new organization that oversees the transport planning should be taken over the traffic survey by annual or five years.

Table 10.4 Proposal of Future Traffic Survey Schedule

●Annual Survey

Period	Component
2017~until automatic traffic count device was installed	IC (Intersection Counting 1d,12h, 25LC, Main 24h 5LC)
	ATC (Automatic Traffic Count 12m, 7d, 24h, 5LC)
	Traffic Count by control center

●Periodic Survey

Period	Component
2018	ATC (Automatic Traffic Count 12m, 7d/m, 24h, 5LC)
2020	CL& SL (1d, 24h) + TS
2025	IC (1d, 12h, Manual, 50 LC) + TS

2030	PDUM survey + IC (1d, 12h, Manual, 50LC) + Road inventory
2035	IC (1d, 12h, Manual, 50LC) + TS
2040	PDUM survey + IC (1d, 12h, Manual, 50LC) + Road inventory

*PDUM survey….CL (Cordon Line Survey), SL (Screen Line Survey),
HIS(Household Interview Survey), TM(Truck Movement Survey), TS(Travel Speed Survey)
Source: JICA Study Team

11. INFRASTRUCTURE

11.1 Water Supply

(1) Basic Policy for Development

Some of problems facing the potable water supply system for Managua City are existed. The United Nations recognizes that availability of safe, clean, accessible drinking water is a basic human right. ENACAL serves Managua relatively well, in that a large portion of the population has water some hours of the day. But it needs some improvements.

The growth projected in this master plan (PDUM) cannot occur without sufficient water supply. In fact, a robust, dependable water supply is actually a method can be encouraged and used as an enticement.

The basic policy for development of water supply is the followings;

- Increase the production and efficiency of the water supply system to ensure all users receive sufficient water 24 hours per day, and;
- Ensure planning and resources are available to meet the future growth in the city including sub center development and population increase in citywide to maintain the 24 hours per day standard for all new users.

(2) Proposed Projects

- Old and Vulnerable Pipeline Replacement
- Technical Assistance for SCADA/GIS Improvements
- Lago Nicaragua Potable Water Treatment Plant and Transmission System
- Improve water supply infrastructure to meet demand in 5 "sub-centers" and surrounding area
- Accommodate Future Growth in Water Supply System

11.2 Water Resources

(1) Basic Policy for Development

There are four key issues on the water resources i.e. i) contamination of water resources, ii) reduction of water recharge function in basins, iii) deterioration of existing water source facilities, and iv) lack of alternative water source for future water demand. As for “contamination of water resources”, ongoing projects seems to be remedy the issue. As for “reduction of water recharge function in basins”, Flood Management and Landuse Planning proposed some countermeasures. As for “deterioration of existing water source facilities”, JICA conducts project for strengthening non-revenue water management capacity in. Managua city, it contributes to be the solution. As for “lack of alternatiove water source for future water demand”, currently ENACAL and World Bank plans a new project.

(2) Proposed Projects

Proposed projects for the water resources are extracted for the urban development as following;

- Technical assistance for water quality improvement of Managua Lake

Managua Lake is one of the largest surface water resources in the country, but the water is significantly contaminated by heavy metals such as mercury, pesticide and domestic waste water. Water taken from the lake have a risk of contamination for use as tap water. Monitoring of water quality of Managua Lake and regulation of its contamination is essential to ensure safe water supply in Managua City.

11.3 Sewarage and Wastewater Disposal

(1) Basic Policy for Development

The expansion of the sewerage coverage is related to the public health protection, besides, the improvement of the quality of life for low-income people. Although the actual sewerage system in Managua City has an estimated coverage of 65%, according to the Sewerage Master Plan for Managua-PMASM (reviewed in the year 2002), the coverage projected for the year 2020 will reach 72%.

ENACAL has formulated implementation plan for priority project and its supplement project to PMASM Plan Phase 1 since 2014. This implementation plan includes three important projects for completion of sawage facilities in Mangua City: (1) development of WWTP in Managua City, (2) construction of interceptor pipe line, and (3) construction of collector pipe line. In the PDUM, the following five projects including above three projects was proposed.

(2) Proposed Projects

- Interceptor 2 – Second Phase Project
- Collector Y - Second Phase Project:
- Complementary Measures in the Wastewater Treatment Plant of Managua – MWWTP
- Expansion of the Sewerage Coverage in Managua Project
- Renewal and Improvement of Deteriorated Sewers Project:

11.4 Flood Management

(1) Basic Policy for Development

There are five key issues on the flood management i.e. i) shortage of flow capacity of *cauces*, ii) malfunction of flood management structures, iii) significant flood damage risk along *cauces*, iv) lack of information to evacuate against floods, and v) reduction of infiltration functions due to rapid urbanization. Considering basic policy and development framework of PDUM, it is needed to be solved in the future. Therefore, some of proposed projects are presented in below.

(2) Proposed Projects

Three proposed projects for the flood management are extracted for the urban development as following;

- Structural improvement of priority cauces
- Structural measures for sediment management in cauce basins

- Technical assistance for construction of rainwater storage and infiltration structures

11.5 Solid Waste Management

(1) Basic policy for development

Appropriate solid waste management is one of the important functions of urban development for keeping a safe and clean living environment as well as for ensuring people's living is less burdensome on the environment. The basic policy for development of waste management is as follows.

- Establishment of appropriate solid waste management.
- Promotion of 3R (reduce, reuse and recycle).
- Adoption of a sustainable waste management system in the environment, society, economy, technology.

(2) Priority Projects

- A New Sanitary landfill & intermediate treatment facility development project (Phase 1)

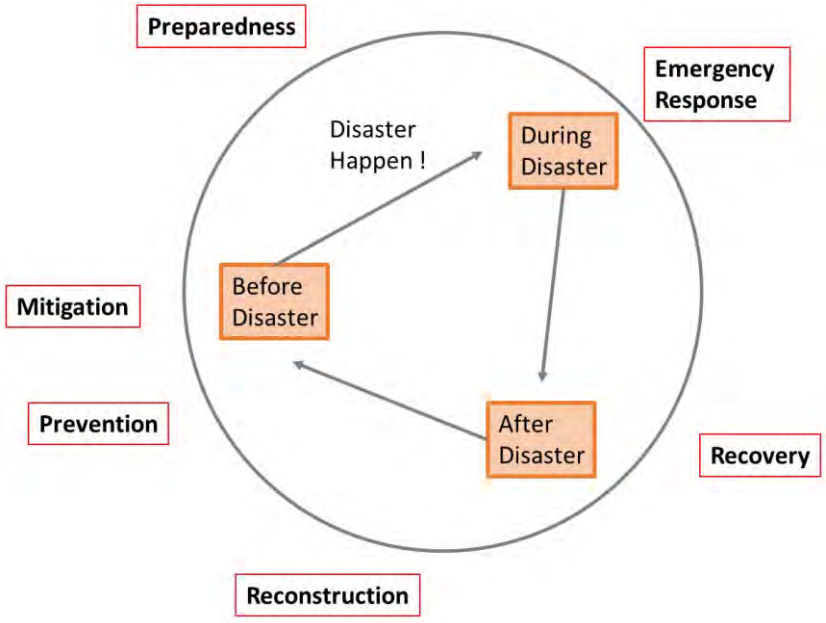
Development of a final disposal site and intermediate treatment facilities for waste volume covering up to 2030 will be implemented as the first phase.

- Capacity development for solid waste management project
- Equipment for collection & transportation procurement project
- A Sanitary landfill development project (2nd phase)

12. DISASTER MITIGATION AND RISK MANAGEMENT PLAN

12.1 Basic Approach in Disaster Risk Reduction Management (DRRM) for Managua City

Prevention, mitigation, preparedness, emergency response, recovery, and reconstruction compose the major components of the disaster risk reduction management cycle. The continuous process of the disaster management cycle as shown in the following figure was examined for the basic approach in disaster risk reduction management.



Source: JICA study team

Figure 12.1 Disaster Management Cycle

12.2 Basic Development Policy and Vision of Managua City with DRRM

Urban planning of Managua City shall be formulated based on the basic approach with well-balanced structural and non-structural measures in DRRM.

In case of natural disaster beyond the capacity of the structural and non-structural measures, then it is important to mitigate or control the damages, which will happen by reducing the vulnerability of the structures. Although step-wised improvement of structural measures is indispensable, the measures cannot control disaster completely. Thus, the well-balanced structural and non-structural measures with an effective disbursement of investment taking into account marginal capacity of structural measures will be required in the DRRM. Therefore, one of the basic development vision of the Managua Urban Master Plan (PDUM) would be “Resilient City against Disaster which shall be supported by well-balanced structural and non-structural measures in the DRRM”.

12.3 Well-balanced Structural and Non-Structural Measures in DRRM

(1) Structural Measures in DRRM

Managua City proposed some structural measures in their Annual Investment Plan in 2016. Referring from the measures, followings are considered as required structural measures for earthquake, flood and landslide for Managua City as shown in the table below:

Table 12.1 Required Structural Measures for Earthquake, Flood and Landslide for Managua City

Disaster	Required Structural Measures	Remarks
Earthquake	Adaptation of Simple and Economic Technics to Strengthen Existing Structures Adoption of New Earthquake-Resistant Buildings/Structures	
Flood	River Channel Improvement (e.g., Increase of Flow Capacity of Existing Channel by Change in Section, Concreting, Dredging including Cleaning of Solid Waste, Extension of New Channel, etc.) Development of Retarding Basin (e.g., Dredging of Existing Facilities, Construction of Additional Micropresa, etc.)	
Landslide	Soil Erosion Control (e.g. Bonas Program) Afforestation/ Reforestation	

Source: JICA Study Team

(2) Non-Structural Measures in DRRM

Required non-structural measures in the DRRM for Managua City are also considered as shown in the following:

- Establishment of Permanent Office/Staff for Disaster Management and Preparation of Program
- Update of Hazard Map and Dissemination to Citizen for Understanding/Community Based Disaster Risk Reduction Management System
- Land Use Regulation in Cause, Micropresa and High Risk Area
- Improvement of Public Emergency Facilities for Disaster Preparedness
- Development of Emergency Transportation Network
- Development/ Upgrade of Disaster Forecasting and Warning System
- Consideration on Environment including Solid Waste Management
- Assessment of Earthquake Resistance for Existing Buildings, and Study on Improvement for Earthquake-Resistant Buildings

13. ACTION PLAN AND INVESTMENT PLANNING

13.1 Overview

An urban development master plan is considered to be the making of an orderly sequence of action that will lead to the achievement of a stated goal or goals of the city. Master Plan is composed broadly of; (i) Urban development program, (ii) Transport development program, (iii) Infrastructure development program, and (iv) Disaster management program.

13.2 Selecting Criteria for Priority Projects

(1) Prioritization of the Proposed Projects

The proposed projects are categorized into sectoral programs; (i) Urban development program, (ii) Transport development program, (iii) Infrastructure development program, and (iv) Disaster management program. The list of proposed project is shown in Table 13.1. The total cost of proposed projects in this MP is 8,641 million USD. The priority of proposed projects was evaluated with following four criterias such as Development Strategy, Social and Natural Environment Indicators, Economic Indicatos, and Implementation Indicators, which is shown in Table 13.2, and the projects scoring over 70 pointwas selected as priority project. As a result of the evaluation, the bold and underlined projects are selected as the Priority Projects of MP. The total cost of the priority projects is 5,615 million USD.

Table 13.1 List of All Proposed Projects

Program	Sub-sector	No.	Code	Project Name	Total Cost (USD in Million)	Implementing Institution
Urban Development	Urban Planning	1	UD-1	Urban Planning Capacity Building Project	1.43	ALMA
		2	UD-2	New CBD Development Project in Metropolitan Urban Sub-center	1231	ALMA, Private
		3	UD-3	Residential Zone Redevelopment Project	1666.5	Private
		4	UD-4	Urban Park Development Project	265	ALMA
		5	UD-5	Public Awareness Project for Compact City Planning	0.025	ALMA
		6	UD-6	Revision of Address System Project	2.3	ALMA
Transport Development	Capacity Development	7	CD-1	Transport Planning/Traffic Management Capacity Building Project	2	ALMA
	Road Development	8	RD-1	Overpass and Intersections Project	306.9	ALMA, National Police
		9	RD-2	Road Improvement and Road Extension Project	944.3	ALMA, MTI
		10	RD-3	New Bypass Project	677.2	ALMA, MTI
	Public Transport	12	PT-1	Urban Public Bus Reorganization Project	41.2	ALMA, IRTRAMMA
		13	PT-2	Intercity Bus Terminal Project	51.3	MTI
		14	PT-3	Urban Mass Transit Project (Masaya Line (AGT))	732	ALMA, MTI
		15	PT-4	Urban Mass Transit Project (Suburbana Line (AGT))	791	ALMA, MTI
		16	PT-5	Urban Mass Transit Project (Pan-American Line (LRT))	653	ALMA, MTI
		17	PT-6	Urban Mass Transit Project (Juan Pablo II Line (BRT))	216	ALMA, MTI
	Traffic Management	18	TM-1	Increase in Value of Car Permit Tax	0	ALMA, MTI
		19	TM-2	Panels with Street Name Project	19	ALMA
		20	TM-3	Underground Parking Project	30	ALMA
		21	TM-4	Studies for the Concessions of Two Parking Sites	0.2	ALMA, Private
		22	TM-5	Studies on Traffic and Parking Project	0.2	ALMA
		23	TM-6	Traffic Management Project	30.3	ALMA
Infrastructure Development	Water Supply	24	WS-1	Technical Assistance for SCADA/GIS Improvements	20	ALMA
		25	WS-2	Feasibility Study for Lago Nicaragua Treatment Plant and Transmission System	5	ENACAL, ALMA
		26	WS-3	Improve Water Supply Infrastructure to Meet Demand in Five "Sub-centers"	20	ENACAL
		27	WS-4	Old and Vulnerable Pipeline Replacement Project	13	Private
		28	WS-5	Accommodate Future Growth in Water Supply System Project	20	ENACAL
	Water Resource	29	WR-1	Technical Assistance for Water Quality Improvement of Managua Lake	5	ENACAL
	Sewerage and Wastewater Disposal	30	SW-1	Expansion of the Sewerage Coverage in Managua Project	66.4	CIRA, UNAN, MARENA, MINSA, ENACAL
		31	SW-2	Renewal and Improvement of Deteriorated Sewers	13.6	ENACAL
		32	SW-3	Design Review and Construction of Collector Y Second Phase Project	17.9	ENACAL
		33	SW-4	Design Review and Construction of Interceptor 2 – Second Phase	14.42	ENACAL
		34	SW-5	Additional Measures to Increase the Treatment Capacity of the WWTP Managua	15.74	ENACAL
	Solid Waste Management	35	WM-1	New Sanitary Landfill and Intermedia Treatment Facility Development Project (Phase 1)	72	ENACAL
		36	WM-2	Capacity Development for Solid Waste Management Project	6	ALMA, EMTRIDE
		37	WM-3	Equipment for Collection and Transportation Procurement Project	18	ALMA, EMTRIDE
		38	WM-4	Sanitary Landfill Development Project (Phase 2)	50	ALMA, EMTRIDE
Disa	Disaster Management	39	DM-1	Project for Establishment of Permanent Offices and Staff for Disaster Management with Training Program	2.1	ALMA, EMTRIDE

		40	DM-2	Project for Update of Hazard Map and Dissemination to Citizen for Understanding/ Community-based Risk Reduction Management System	2.7	SINAPRED
		41	DM-3	Project for Land Use Regulation in Cause, Micropresa, and High Risk Area	70	INETER, SINAPRED, ALMA
		42	DM-4	Project for Improvement of Public Emergency Facilities for Disaster Preparedness	1	SINAPRED
		43	DM-5	Project for Development of Emergency Transportation Network	1	SINAPRED
		44	DM-6	Project for Study, Design, and Installation of the Flood Early Warning System for the Urban Area of Managua City	1.5	SINAPRED
		45	DM-7	Project for Consideration on Environment including Solid Waste Management	6	SINAPRED
		46	DM-8	Project for Assessment of Earthquake Resistance for Existing Buildings, and Study on Improvement for Earthquake-Resistant Buildings	1	SINAPRED
		47	DM-9	Project for Improvement of Earthquake Disaster Prevention and Warning System	1	INETER, SINAPRED, ALMA
	Flood Management	48	FM-1	Structural Improvement of Priority Cauces Project	30	ALMA
		49	FM-2	Project on Structural Measures for Sediment Management in Cauce Basins	50	ALMA
		50	FM-3	Project on Technical Assistance for Construction of Rainwater Storage and Infiltration Structures	5	ALMA
				Total	8,189.2	

Source: JICA Study Team

Note: Project cost is rough estimation including land acquisition cost.

Table 13.2 Scoring Chart for the Evaluation of Projects

Criteria		Score				Sub-Total
		Total	0%	50%	100%	
Development Strategy	Compliance with National/Sector Development Vision	10	Low	Middle	High	20
	Compliance with Implementing Institution or ALMA's Development Vision	10				
Social and Natural Environment Indicators	Social Environment Impact	10	Low (Negative)	Middle (Middle or None)	High (Positive)	20
	Natural Environmental Impact	10				
Economic Indicators	Cost Efficiency	10	Low	Middle	High	30
	Socio-Economic Benefit	20				
Implementation Indicators	Urgency of the project (timing of implementation)	20	Long (-2040)	Middle (-2030)	Short (-2020)	30
	ALMA's Involvement	10	Low	Middle	High	
Total		100				

Source: JICA Study Team

13.3 Proposal for Action Plan

Furthermore, it is necessary to have solid action plans of implementation of priority projects to achieve the visions of Managua City in 2040. The certain sets of priority projects shall be grouped together as a policy package to achieve the same objective of the development of Managua City. The policy package should be implemented in combination to maximise the impact of each project and whole program of such projects. Three policy packages of the priority projects are proposed along with the concept of

Managua City development namely: (i) **Sustainable and Attractive City Development Program**, (ii) **Accessible and Economically Active City Program**, and (iii)**Resilient and Socially Equitable City Program**.

(1) Package 1: Sustainable and Attractive City Development Program

This package is consisted of capacity building of ALMA and promotion of appropriate land use. What municipal government, ALMA, should do is to take action for promoting proper land use which is essential for urban development and attracting private resource.

(2) Package 2: Accessible and Economically Active City Program

This package is consisted of improvement of traffic condition and road infrastructure, introduction of mass transportation, and development of new urban center project. The improment of existing road network and strethening the traffic management measures shuld be implemented in early stage for mitigating traffic congestion and maintaining road function because new road development such as outer ring road needs time for construction. In addition to development new urban center, introduction of mass transportation is important. Urban center become a core for several activities, and ensuring accessibility among city and surrounding area by mass transportation is essential.

(3) Package 3: Resilient and Socially Equitable City Program

This package is consisted of infrastructure project of each sector excluding road transport and disaster prevention project.
Since water and sewarage facilities and water resources related facilities are a lack of capacity by aging, improvement and modernization of these facilities, and construction of new facilities are necessary. In the PDUM, JICA study team proposed that updating existing facilities as a project should be conducted in short term and construction project should be started after the short-term project.
Regarding solid waste management, capacity of sanitary landfill will be full in the near future. Therefore, new sanitary landfill and intermediate treatment facility development project should be conducted in short term.
In disaster management, the national government (SINAPRED) and ALMA have some tools, resources, and programs of disaster prevention such as staff of permanent office, hazard map, etc. Managua City has suffered from earthquake and flooding and ALMA should have more resources related to disaster management. Therefore, several short-term projects for updating and utilizing existing resources are needed.
The action plan of three procy packages is shown in Table 13.3, Table 13.4, and Table 13.5.

Sector	No	Code	Project Name	In Charge	Short Term				Middle Term								Long Term									
					2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transport Development	7	TD-1	Transport Planning/Traffic Management Capacity Building Project	ALMA																						
Urban Development	1	UD-1	Urban Planning Capacity Building Project	ALMA																						
	3	UD-3	Residential Zone Redevelopment Project	Private																						
	5	UD-5	Public Awareness Project for Compact City Planning	ALMA																						

Action Plan 1: Updating of resource for urban development planning

Step 1 – Revision of Zoning Scheme for implementing master plan.

Step 2 – Capacity development of ALMA for urban and transport sector for management of the urban development.

Step 3 – Publicity for improvement public awareness and for attracting private fund regarding urban development

Action Plan 2: Promoting urban development

Step 4 – Continuing action of step 3.

Step 5 – Promoting densification of land use based on new zoning scheme

Action Plan 3: Improvement of attraction of Managua City

Step 6 – Continuing action of step 3, and action plan 2.

Source: JICA Study Team

Table 13.3 Action Plan for Package 1 (Sustainable and Attractive City Development Program)

Sector	No	Code	Project Name	In Charge	Short Term				Middle Term								Long Term									
					2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transport Development	8	RD-1	Overpass and intersections project	ALMA																						
	9	RD-2	Road impovement and road extension project	ALMA																						
	10	RD-3	New bypass project	ALMA																						
	21	TM-4	Studies for the concessions of two parking sites	ALMA																						
	22	TM-5	Studies on traffic and parking project	ALMA																						
	23	TM-6	Traffic management project	ALMA																						
	12	PT-1	Urban public bus reorganization project	ALMA																						
	13	PT-2	Intercity bus terminal project	MTI																						
	14	PT-3	Urban Mass Transit project (Masaya Line (AGT))	ALMA/MTI																						
	15	PT-4	Urban Mass Transit project (Juan Pablo II (BRT))	ALMA/MTI																						
Uurban Development	2	UD-2	New CBD Development Project in Masaya Avenue Sub Center	ALMA, Private																						

Action Plan 1: Improvement of traffic condition for introduction of mass transportation

Step 1 – Improvement of Intersection and Expansion of traffic management measures (Update of Traffic control center, ITS, etc)

Step 2 – Preparation of development of New CBD and mass transportation system including its infrastructure.

Action Plan 2: Traffic Optimization based on New CBD and Mass Transportation accessibility

Step 3 – Improvement of road capacity by road construction and promoting modal shift

Step 4 – New CBD with mass transportation system

Action Plan 3: Enhancing transportation function and traffic network connectivity

Step 5 – Enhancing traffic axis by new mass transportation.

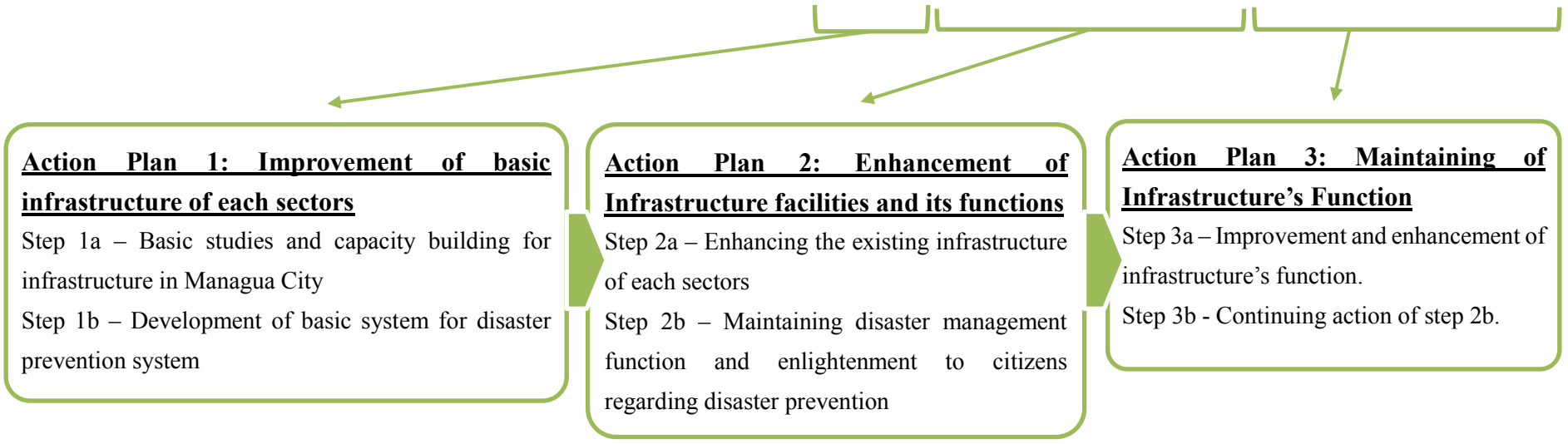
Step 6 – Improvement of urban environment and attraction by introduction several mass transportation corridor.

Step 7 - Continuing action of step 3.

Source: JICA Study Team

Table 13.4 Action Plan for Package 2 (Accessible and Economically Active City Program)

Sector	No	Code	Project Name	In Charge	Short Term				Middle Term								Long Term										
					2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Infrastructure Development	24	WS-1	Technical Assistance for SCADA/GIS improvements	ENACAL/ALMA																							
	25	WS-2	Feasibility Study for Lago Nicaragua Treatment Plant & Transmission System	ENACAL																							
	27	WS-4	Old and Vul n ernable Pipeline Replacement Project	ENACAL																							
	29	WR-1	Project on Technical Assistance for Water Quality Improvement of Managua Lake	ENACAL etc.																							
	30	SW-1	Expansion of the Sewerage Coverage in Managua Project	ENACAL																							
	31	SW-2	Renewal and Improvement of Deteriorated Sewers	ENACAL																							
	33	SW-4	Design Review and Construction of Interceptor 2 – Second Phase	ENACAL																							
	34	SW-5	Additional Measures to Increase the Treatment Capacity of the WWTP Managua	ENACAL																							
	35	WM-1	New Sanitary landfill & intermedia treatment faciliity development project (phase 1)	ALMA																							
	36	WM-2	Capacity development for solid waste management project	ALMA																							
	37	WM-3	Equipment for collection & transportation procurement project	ALMA																							
Disaster Management	39	DM-1	Project for Establishment of Permanent Offices and Staff for Disaster Management with Training Program	ALMA																							
	40	DM-2	Project for Update of Hazard Map and Dissemination to Citizen for Understanding/ Community Based Risk Reduction Management System	INETER /ALMA/ect.																							
	42	DM-4	Project for Improvement of Public Emergency Facilities for Disaster Preparedness	ALMA																							
	43	DM-5	Project for Development of Emergency Transportation Network	ALMA																							
	44	DM-6	Project for Study, Design and Installation of the Flood Early Warning System for the Urban Area of Managua City	INETER																							
	45	DM-7	Project for Consideration on Environment including Solid Waste Management	ALMA																							
	46	DM-8	Project for Assessment of Earthquake Resistance for Existing Buildings, and Study on Improvement for Earthquake-Resistent Buildings	ALMA																							
	47	DM-9	Project for Improvement of Earthquake Disaster Prevention and Warning System	INETER																							
	48	FM-1	Structural Improvement of Priority Cauces Project	ALMA																							



Source: JICA Study Team

Table 13.5 Action Plan for Package 3 (Resilient and Socially Equitable City Program)

13.4 Financial Plan for accomplishing Action Plan

(1) Overview of the Project Investment

Table 13.6 shows the total investment cost of priority projects by package, in each implementation stage and public/private sector. Total investment cost for all Priority Projects is 5,615 Million USD which is approximately 158 Billion NIO. Urban planning projects and Urban transport development projects expect the involvement of the private sector such as the private investment and PPP scheme. The total private investment in the MP investment is 3,334.5 Million USD (94 Billion NIO) which accounts for 59.3% of total investment, while the public investment is 2,279 Million USD (64,268 Million NIO).

Table 13.6 Cost Schedule of Policy Packages (Million USD)

Package	Program	Total Cost	Investment Cost Schedule							
			Public				Private			
			Short	Middle	Long	Total	Short	Middle	Long	Total
1	Urban Development	1668.0	1.5	0.0	0.0	1.5	0.0	555.5	1111.0	1666.5
	Transport Development	2.0	2.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
	Package 1 Total	1670.0	3.5	0.0	0.0	3.5	0.0	555.5	1111.0	1666.5
2	Transport Development	2418.6	239.9	975.6	676.1	1891.6	0.0	260.7	266.3	527
	Urban Development	1231.0	0.0	90.0	0.0	90.0	0.0	1141.0	0.0	1141
	Package 2 Total	3649.6	239.9	1065.6	676.1	1981.6	0.0	1401.7	266.3	1668
3	Infrastructure Development	249.2	117.0	132.2	0.0	249.2	0.0	0.0	0.0	0
	Disaster Management	46.2	42.0	3.1	1.1	46.2	0.0	0.0	0.0	0
	Package 3 Total	295.4	158.9	135.3	1.1	295.4	0.0	0.0	0.0	0
Grand-total		5615	402.3	1200.9	677.2	2280.5	0.0	1957.2	1377.3	3334.5

Source: JICA Study Team

(2) Budget Allocation

Table 13.7 categorizes the implementation institutions of priority projects and respective cost allocation. In addition to ALMA, the major implementation institution is ENACAL for water and drainage projects. In addition to the public investment, the private investment is expected in the commercial development and in the form of public private partnership (PPP). Possible funding resource should be analyzed and examined according to the implementation (Funding) Institutions.

Table 13.7 Investment Cost by Funding Institutions

Funding Institutions	Policy Package			Implementation Stage			Yearly Average Cost			Total Cost
	1	2	3	Short	Mid	Long	Short	Mid	Long	
ALMA	TD-1, UD-1, UD-2, UD-3 UD-5	RD-1, RD-2, RD-3, TM-4, TM-5, TM6, PT-1, PT-3, PT-6, UD-2	WM-1, WM-2, WM-3, DM-1, DM-2, DM-4, DM-5, DM-7, DM-8, FM-1	290.3	1,158.0	677.0	97.1	115.8	67.7	2,125.4
ENACAL	-	-	WS-1, WS-2, WS-4, WR-1, SW-1, SW-2, SW-4, SW-5	110.0	38.2	0	36.7	3.8	0.0	148.2
Private Investment	-	PT-1, PT-3, PT-6, UD-2	-		1,957.2	1,377.3	0.0	195.7	137.7	3,334.5
Others	-	PT-2	DM-6, DM-9	2.5	5.0	0.0	0.8	0.5	0.0	7.5
			Total	402.5	3158.4	2054.3	134.2	315.8	205.4	5615.5

Note: Implementation Stage show the total investment cost by each stages; Short: 2018-2020, Mid: 2021-2030 and Long: 2031-2040. Yearly Average Cost shows annual investment cost devided by implementation years.

Source: JICA Study Team

(3) Measures to fill the financial gaps

ALMA's budget is not sufficient to implement all priority projects by itself, especially for the transport projects which requires large initial investment. Although the external finance is essential to realize the implementation of priority projects, it is necessary several measures to fill the financial gap by strengthening the financial capacity of ALMA itself and promoting private sector involvement; (1) amendment of the tax decree to increase relevant tax, (2) increase of service charge and (3) promotion of private investment.

(4) PPP Opportunities for Infrastructure Investment

The National Legislature has recently enacted the law on public-private partnership (PPP) in Nicaragua (Ley No. 935/2016/Ley de Asociacion Publico Privada). This new law enables the participation of private entities in investments in national strategic projects. The enforcement body of this new act is the MHCP. PPP is more suitable to large-scale projects and revenue-generating projects. The enactment of this new PPP law could trigger a large flow of private investment into Managua's infrastructure development projects. Since it has just been enacted, continuous monitoring of the PPP implementation process is required.

14. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

14.1 Current Environmental Status of Managua City

(1) Introduction

The current major environmental issues of Managua City can be addressed through the following main perspectives: (i) the southern watershed system, (ii) Managua Lake, and (iii) the urban environment of the capital city. A brief summary of the current environmental status for each item mentioned above is summarized in the following section.

(2) Southern Watershed Group System

Twenty-two kilometers south of the capital, the land rises from 55 EL-m at the lakefront of Managua Lake to 926 EL-m in the area known as the southern watershed group, consisting of Sub-watersheds I – IV (i.e., Cuenca I – IV).

Although a vast water-recharge forest still exists therein, partial deforestations of this watershed area are still on-going. These watersheds have been deforested to make way for cattle and coffee, and, again, due to the population's need for firewood. The crops that peasants have chosen to produce there leave the soil bare and vulnerable to erosion, leading to a rapid sedimentation and/or run-off of drained waters that results to lowland urban inundation and floods to some extent. Since the water is not absorbed in the highlands, the rain causes even greater damage to the infrastructure of Managua City as the run-off passes through on its way to the lake, carrying huge quantities of sediment, local inundation, and urban flooding at lowland areas of Managua City.

Any improvement in its ecological conditions and their effects on the city demand a change in land use. Several reforestation and/or agro-forestry developments, consisting of fruit trees with wide canopies that protect the soil from erosion due to rainfall with agricultural crops grown underneath, are being undertaken by several governmental organizations such as INAFOR, the Department of Environment and Urban Planning of Alcaldia and others. This combination would improve environmental quality while still allowing for production, taking advantage of the nearby market for agricultural products.

(3) Managua Lake

Managua City is located at the southern shoreline of Managua Lake. There are several tributaries running into Managua Lake from the surrounding mountainous area, and its downstream discharge to the Nicaragua Lake is done via the Tipitapa River, located at the southeast of the Managua Lake.

Discharge of the Managua Lake through the Tipitapa River occurs when the surface water level of the Managua Lake becomes higher than 39.19 EL-m. Otherwise, no discharge occurs from the Managua Lake. In general, this no-discharge situation tends to occur during the dry season. However, different dry season situations sometime occur at the lake during El Niño events, and the continuous discharge occurred for several years in the past.

The highest water level was recorded during the flooding in October 1933 (monthly average surface water level = 43.33 EL-m). In 1998, the lake water level rose by 3 m within five days during Hurricane Mitch (the total amount of rainfall was approximately 1,900 mm during those five days), destroying the homes of many who lived on its lake shoreline (monthly average surface water level of Managua Lake in November = 42.00 EL-m). An even higher flooding occurred in September and October of 2010 (41.72 and 42.66 EL-m in September and October, respectively). Since then, the city has prohibited residential use of the most flood-prone areas, those with elevation below 42.76 meters above sea level.

After passing from the southern watershed group through Managua City, the rainwater drains into Managua Lake, dumping everything it carries with it into the lake water. The rate of sedimentation is very high due to the recent deforestation and erosion of the southern watershed system. The rain also carries most of the city's solid waste into the lake. In 1970s, the lake became the cheap dumping ground for Managua's sewage and dozens of industries that sprang up on its shores. Since the city had no sewage treatment plant at that time, the lake received approximately 130,000 m^3 per day of raw sewage (according to the 1985 statistics).

As mentioned earlier, the lake has no stable outlet except during rare years when the water level is high enough to drain down the Tipitapa River and into the downstream Nicaragua Lake. Thus, pollutants, reached therein, are to be accumulated and concentrated.

In 2008, the operation of the final waste disposal site, which moved to the lake shoreline, has started, and municipal sewerage plant did its operation (approximately 40 – 50% of the total amount of citywide sewerage are to be treated) in 2009. After those two facilities started their operation, it was reported that pollutant loading into the Managua Lake was reduced considerably, leading to the improvement of the entire water quality of the Managua Lake to some extent.

(4) Urban Environment of Capital City

Managua features three smaller crater lakes or Lakes within city limits. The most centrally located is the Tiscapa Lake (protected as Tiscapa Lake Natural Reserve), located in the south of the old downtown (formed approximately 10,000 years ago). The Asososka Lake, to the west, located at the beginning of Southern Highway, close to the connection with the new highway to León, is Managua's most important source of drinking water. Nejapa Lake, south of Asososka Lake, is also along the Southern Highway.

Due to those geological features, no physical discharge occurs at the Lakes except Tisapa Lake mentioned above. In general, Lake-wide water qualities of those Lakes are in good condition compared with those of the Managua Lake, and Asososka Lake is one of the important water reservoirs in Managua City. Recently, there were occurrences where some portions of the city sewerage (household effluents from illegal squatters' communities included) discharge into both Tiscapa and Nejapa Lakes during the rainy seasons, and it has been one of the important environmental issues.

As mentioned earlier, Managua City boasts vast amount of forest at its watershed mountainous area, but most of those areas are not protected tightly. As a general fauna in the vicinity of Managua City, it was

reported that several mammals such as foxes, armadillos, rabbits, pakas, deer, coyotes, bobcat, various rodents, and reptiles (e.g., iguana, lizards, snakes and so on) and birds occur. The local flora is also diverse due to both local complex climate and geographical features around Managua City. There were 71 species of 37 families that have been confirmed. By altitude, it was reported that there were 24 species of 28 genera in the middle of Managua City (altitude 400 EL - m ~ 600 EL - m) and vegetation of 35 species of 32 genus, 26 families in the high altitude (altitude 600 m ~ 800 m).

According to the Department of Environment and Urban Planning of Managua Municipality, there are two environmentally important areas in Managua City beside those three lakes mentioned above, i.e., (i) Sabana Groundwater Pumping Area, and (ii) Chiquilistagua Revegetation Area, at the southwest of Managua City. No strict legal protection system is established and several infrastructure and/or housing construction projects are on-going therein.

To summarize the current region-wide environmental condition of Managua City, urban development activities such as the construction of new roads and residential complex in Managua City are gaining momentum, and some of those activities tend to encroach several important ecological systems such as Lakes, water recharge area such as Sabana and highland vegetation. So, it is important to introduce some orders in the future city-wide urban development activities in order to establish the harmony and/or integrity between those developments of city infrastructure facilities and the conservation of ecologically critical areas.

14.2 Household Interview Survey (Environmental and Social Aspects)

Within this PDUM study, household interview survey was conducted in 2016, and 10,000 interviewees returned the PDUM-related questionnaire-based survey results (see Chapter 4 for more detailed descriptions for this household interview surveys). In this survey, four environmental and social concerns-related questions were incorporated.

From this survey result, it is found that most of the interviewees think that the importance and/or individual priority regarding environmental items, listed within the survey, are not high. This indicates that they may be satisfied with the current urban environmental condition. Even for the questionnaire results regarding the urban flooding/drainage, it shows that about 40% of interviewees place high importance whereas about 50% of them do not.

Also, it is found that most of the interviewees think that the importance and/or individual priority regarding socio-economical items, listed within the survey, are higher compared with the previous question. This indicates that they may not be satisfied with the current urban condition from their socio-economical points of views.

Most of the interviewees prefer to have PI option via the stakeholder meeting and/or community meeting based approach. Also, about 20% of interviewees prefer to have direct contact to ALMA for PDUM study. It is noted that most of the interviewees support the proposed PDUM study whereas about 20% of them do not know the PDUM project.

14.3 Strategic Environmnetal Assessment (SEA)

Strategic environmental assessment (SEA) is conducted within this PDUM study in order to assess the pros and cons of proposed development structure alternatives (namely, STR-1, STR-2 and STR-3, respectively, see Chapter 9 for more detailed descriptions). From this assessment, it is found that it would be difficult to establish harmony between future development activities under STR-3 development scenario and the management and/or conservation ones (i.e., No core nor sub-center system (Do-nothing scenario)).

On the other hand, under development scenarios such as STR-1 (i.e., CBD One core system (mono core)) and STR-2 (i.e., Sub-center system (poly nucleated development)), there are some possibilities to introduce some orders in future city-wide development activities that would be able to reconcile with relevant management plicies such as the conservation of ecologically important areas in Managua City. However, it is noted that it is likely to have new urban environmental concerns such as the building valley effects and/or heat island effects in the course of future city-wide development activities based on either of STR-1 and/or STR-2.

SEA methodology, implemented within this PDUM study, is “stakeholder-centered”, participatory one, and its main objective is to assess the suitable urban development alternative by sharing PDUM-related information and establishing consensus among various stakeholders through a series of stakeholder meetings. The stakeholder meeting is one of the important parts of this SEA-related technical assistance study for PDUM. Three rounds of the stakeholder meeting (SHM, city-wide) and related focal group meeting (FGM, for districts and key neighboring cities such as Tipitapa and Sandino) programs are developed in order to encourage constructive public involvement and information dissemination of PDUM study. It is noted that 2nd round of both SHM and FGM are completed as of April 21, 2017. More than 100 comments regarding the PDUM are collected through those SHM and FGM activities, and are feedbacked within PDUM as much as possible. Besides, a website for PDUM and its SEA is developed within the ALMA’s homepage in order to precipitate the interaction between ALMA and Managua citizens and to make the PDUM participatory one. PDUM-related drawing contest is conducted on April 18, 2017 in order to encourage the involvement of young generation of Managua citizen, that would play vital role in various activities of near-future Managua. 80 elementary and high school students participated and competed by drawings of future Managua City.

Currently, urban development activities in Managua are gaining momentum. It is important to establish the harmony and/or integrity between those developments of city infrastructure facilities and the conservation of ecologically critical areas. From SEA, it is found that it would be difficult to establish the harmony between future development activities under existing development scenario and the management and/or conservation ones. Therefore, urban development with sub-center system is desirable, but it is noted that it is likely to have new urban environmental concerns such as the building valley effects and/or heat island effects in the course of future city-wide development activities.

Table 14.1 Compound Matrix for Selected Development Structure Alternatives

	Natural Resources					Socio-Cultural Issues							Economic Issues				Institutional			
Evaluation Factors	Water body pollution	Erosion	Deforestation	Ecosystem Conservation	Flooding	Waste Management	Traffic Congestion	Noise/Vibration	Air Quality	Illegal settlement	Improvement of Urban Safety and Amenity	Land encroachment	High unemployment	Poor accessibility to markets/or business district due to traffic jams	Poor road network	Low Income	UrbanDevelopment Control	Urban Development Promotion System (Private Sector)	Public Participation/public awareness	Information Disclosure System
STR-1	?	?	?	?	?	−	−	−	−	?	?	?	?	+	+	0	+	+	+	+
STR-2	?	?	?	?	?	−	−	−	−	?	?	?	?	+	＋	0	＋	＋	＋	＋
STR-3	−	−	−	−	−	−	−	−	−	−	−	−	?	−	−	0	−	−	?	?

Note

+	: Likely to be Positive
−	: Likely to be Negative
0	: Likely to be Neutral
?	: Uncertain

Source: JICA Study Team

15. CONCLUSION AND RECOMMENDATION

15.1 Conclusion

- This "Urban Development Plan for Managua City in the Republic of Nicaragua" was formulated by collaborative work of ALMA and JICA study team.
- Master Plan will be respected and be used as a guidance. When Master Plan needs to be updated and modified, ALMA should do so in compliance with the principles established in the original Master Plan.
- ALMA will be responsible for implementing the Master Plan.
- Capacity development of ALMA to be continued to implement Master Plan

15.2 Recommendation

(1) Urban Planning

- ALMA shall review the existing zoning scheme and introduce a new one in compliance with the land use plan adopted in the Master Plan.
- ALMA's capacity for urban planning has to be improved.
- The urban center plan such as Traditional and Heritage Center, planning by IDB and Metropolitan Sub Center in this Master plan has to be started the implementation for realization. ALMA should prepare for implantation with stakeholders including private sectors.

(2) Transport Planning

- ALMA should start to carry out pre-feasibility studies for AGT in Carretera a Masaya line and BRT in Juan Pablo II line for preparation of introduction of mass transport system in mid term plan of PDUM.
- At present, no specific body in charge of transport planning exists in ALMA. The relevant organization needs to coordinate as to establish an integrated body. In addition, when the proposed road transport project in this master plan is implemented, it is desirable to clarify the demarcation for the implementation among relevant organizations such as ALMA, MTI, and IRTRAMMA based on the discussion and coordination.
- The non-structural measures such as traffic management and traffic regulation has to be implemented for realizing transportation system which follows urban development scenario.

(3) Infrastructure Planning

- For the infrastructure planning such as water resource, sewerage, solid waste, flood management and disaster prevention, the policies adopted in PDUM shall be respected and more detail study and planning should be carried out by ALMA, for which donors are recommended to consider assistance.

MAIN REPORT

CHAPTER 1 OUTLINE OF THE STUDY

1.1 Introduction

Managua Municipality (Alcaldía de Managua, hereinafter referred to as "ALMA") is the capital city of Nicaragua, with approximately 1.50 million inhabitants (ALMA, 2016) and its population is increasing year by year. However, urban area tends to spread with a relatively low density, which hampers the effective utilization of land in ALMA, causing problems of endangering the precious greenery and natural reserves and lowering efficiency of infrastructure delivery. In the traffic condition of the city, the rate of private traffic modes such as passenger cars, bikes, etc., is increasing, and problems in traffic such as mismatching of public transportation modes and traffic demand have also arisen. Therefore, it is necessary to control and guide the urban development based on land use planning, while ALMA does not have an effective and useful plan for this purpose and measures to implement it adequately.

In dealing with this situation, ALMA prepared the Action Plan for Sustainable Managua [Plan de Acción-Managua Sostenible] in 2013 under the"Emerging Sustainable City Initiative" (ESCI), financed by Inter-American Development Bank (IDB), and pointed to the necessity of land use planning and regulatory framework and updating of urban transport planning. Disaster mitigation is also an important point for considering sustainable urban development since ALMA has suffered extensive damages in the past by natural disasters such as earthquake and flood.

In response to the background mentioned above, the Government of Nicaragua requested the assistance of the Government of Japan to formulate an urban development master plan in reference to the experience of Japan on efficient land use. The Japan International Cooperation Agency (hereinafter referred to as "JICA") had a series of discussion with ALMA and other concerned authorities of Nicaragua, and based on the agreements between JICA and the concerned authorities of Nicaragua, the Minutes of Meeting was signed on October 13, 2015, which led both parties to conclude the Record of Discussions to realize this study.

Thus, JICA dispatched a Study Team for the “Project for Urban Development Master Plan for Managua City in the Republic of Nicaragua” (hereinafter referred to as the Project) in January 2016 to Nicaragua.

This report is final report of the Project, this report consists of part 1: diagnose of current issues, part 2: urban development master plan. In part 1, current issues are raised and analysed in terms of urban planning, transport planning, infrastructure and disaster prevention, institutional system and capacity development, financial conditions. In part 2, urban development master plan for 2040 is presented based on analyse current issues and ideal vision.

1.2 Objective of the Study

1.2.1 Objective of the Study

The objective of the study is firstly to contribute to the suitable management of land use and promote efficient development of major urban infrastructure by formulating an urban development master plan. Second objective is to strengthen and develop the capacity for the formulation and implementation of urban planning.

1.2.2 Outputs

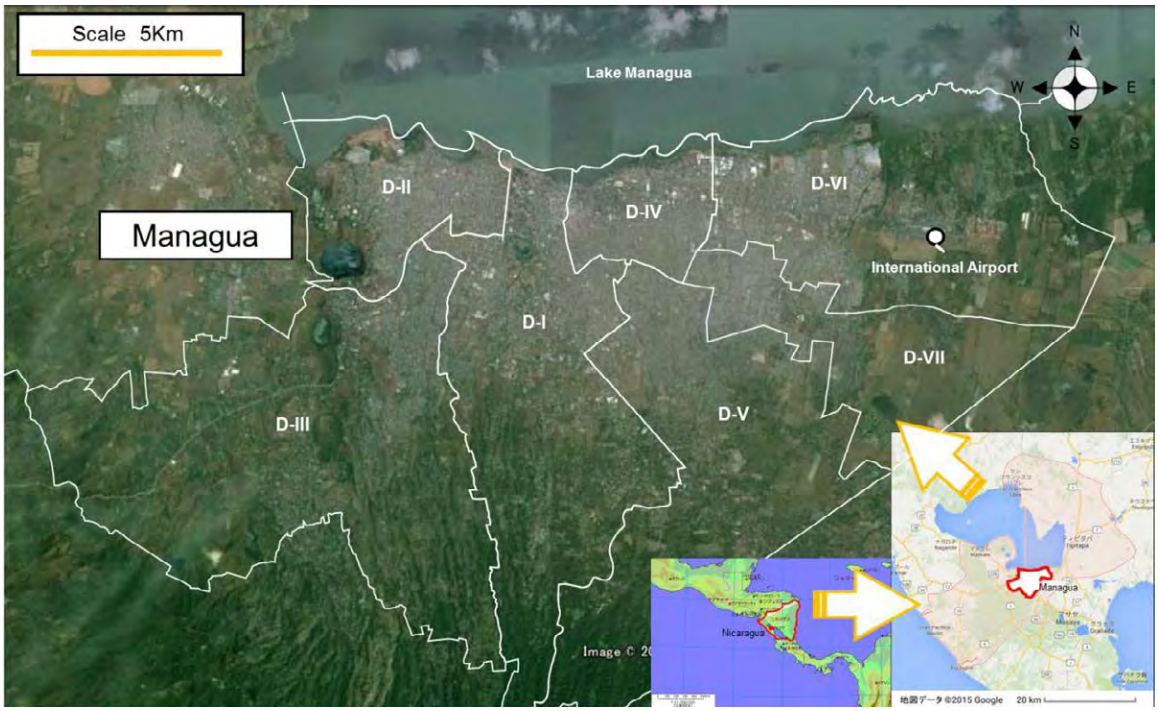
- Proposal of the urban development master plan for Managua City with a target year 2040
- Institutional capacity development of the organizations related to urban development of Managua City

1.3 Study Area

The JICA Study Team set two types of target areas: (1) Planning area, which is Managua City itself and (2) Study area for Managua and its environ, as Managua City has some relations with the surrounding area.

(1) Planning area

The target area for planning is Managua City (approximately 289 km^2) as shown in Figure 1.3.1.



Source: JICA Study Team

Figure 1.3.1 Target Area for Planning

(2) Study area for Managua and its environ

The study area, or the target area for the study such as data collection and analysis, is the area which gives direct impact to the urban planning of Managua City. The JICA Study Team will consider to include surrounding areas of Managua City such as Guranada, Masaya, etc., as the study area in response to the planning theme.

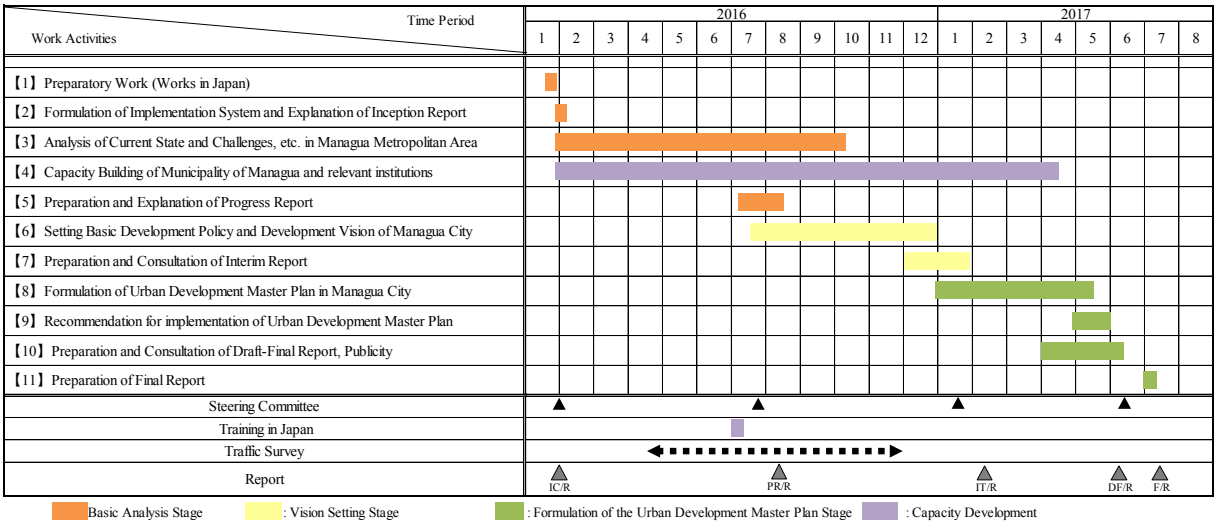
Source: JICA Study Team

Figure 1.3.2 Alternative 1: Metropolitan Area and Granada City

1.4 Schedule and Deliverables

1.4.1 Schedule

Figure 1.4.1 shows the overall schedule of the Project. As shown in the figure, the Project was continued approximately one year and seven months taking into consideration the work activities and output of the Project.

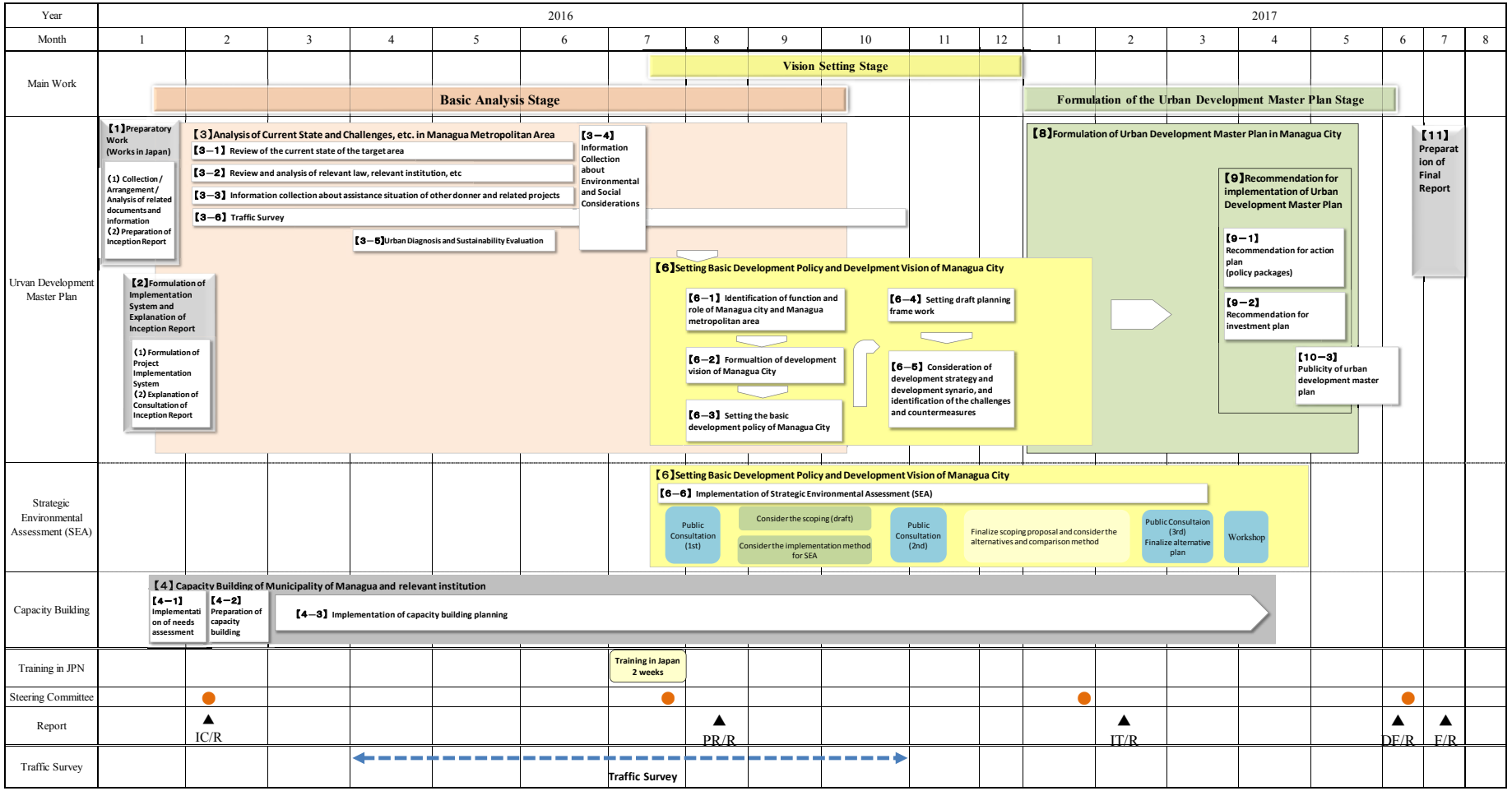


Source: JICA Study Team

Figure 1.4.1 Study Schedule

1.4.2 Work Flow

The overall work flow of this Project is shown in Figure 1.4.2.



Source: JICA Study Team

Figure 1.4.2 Work Flow

Master plan was formulated through three stages. Firstly, JICA study team analysed current status of Managua city. The components are written in below.

- Review of the current state of the target area
- Review and analysis of relevant law, relevant institution, etc
- Information collection about assistance situation of other donner and related projects
- Information Collection about Environmental and Social Considerations
- Urban Diagnosis and Sustainability Evaluation
- Traffic Survey

Secondaly, JICA study team formulated the future vision for the development. In this stage, a series of discussion was conducted to discuss “Roles&function”, “Vision”, “Concept”, “Strategies”. Those items describe future image of Managua City. In this stage, strategic environmental assessment is conducted to capture the opinion from citzen and evaluate environment impact of urban development.

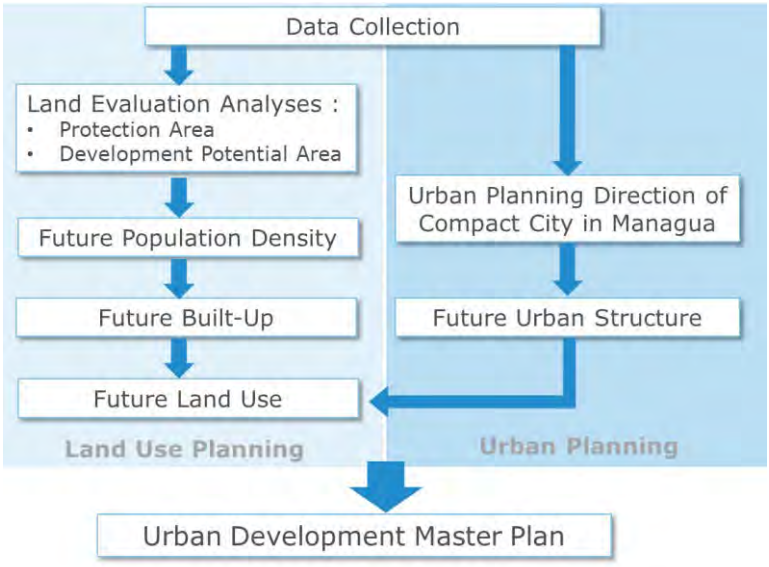
- Identification of function and role of Managua city and Managua metropolitan area
- Formulation of development vision of Managua City
- Setting the basic development policy of Managua City
- Setting draft planning framework
- Consideration of development strategy and development synario, and identification of the challenges and countermeasures
- Implementation of Strategic Environmental Assessment (SEA)

Thirdly, JICA study team finalized the urban development master plan. In this process, each sectorial master plan was compiled into one comprehensive plan by making investment plan and implementation schedule. Output of the master plan was published to citizen and surrounding city widely.

- Recommendation for action plan (policy packages)
- Recommendation for investment plan
- Publicity of urban development master plan

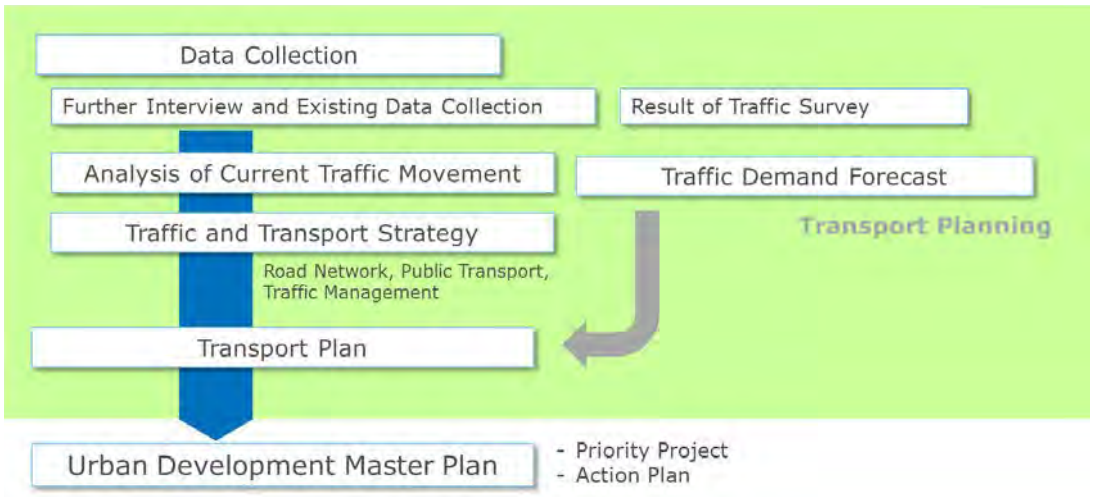
Through those process, capacity building was conducted to ALMA since the objective.

Regarding, sectorial matter, urband development master plan and transport development master plan are finalized through following flow.



Source: JICA study team

Figure 1.4.3 Formalation Flow of Urban Development Master Plan



Source: JICA study team

Figure 1.4.4 Formalation Flow of Transport Development Master Plan

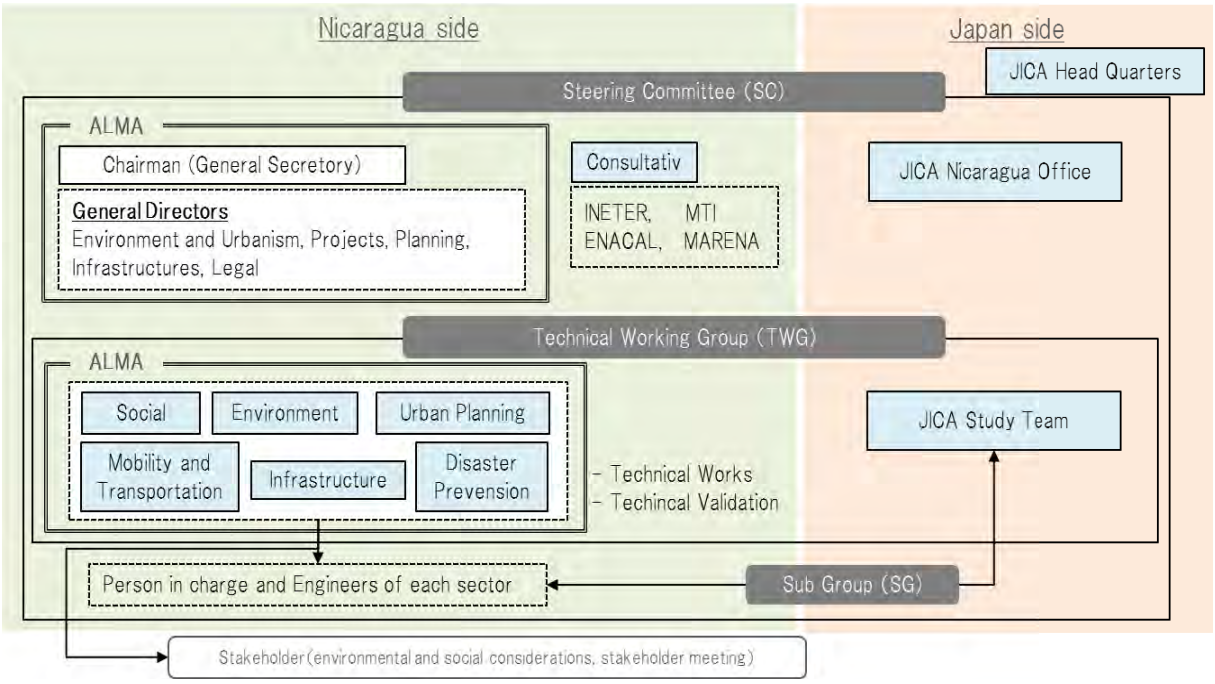
1.4.3 Deliverables

The final reports of this project are as follows.

1) Exective Summary (English, Spanish, and Japanese version)
2) Main Text: Part I. Current Conditions, Part II. Master Plan (English and Spanish version)
3) Appendix (English and Spanish version)

1.5 Organization of Study Team

The organization of this study is shown in Figure 1.5.1.



Source: JICA Study Team

Figure 1.5.1 Study Organization

1.5.1 Steering Committee

The Steering Committee (hereinafter referred to as "SC") was established in order to facilitate inter-organizational coordination. The SC was held whenever deems it necessary. The holding time of SC is the submission of ICR/PRR/ITR, preparing master plan, and completion of the project. The members of SC are the following:

- ALMA

1) Chairman

Fidel Moreno Briones	Secretary General, ALMA

2) General Directors

David Valdivia Pereira	Director General of Environment and Urban Development until 2016
Camilo Fonseca	Director General of Environment and Urban Development from 2017
Juana Cecilia Vargas	Director General of Planning
Jason Toruño	Director General of Infrastructure
Rodolfo Villachica	Director General of Projects
Javier Alonso Alvarez	Director General of Legal

3) Technical Working Group (TWG) Members

- Other Authorities

1) District offices, 2) Ministry of Transport and Infrastructure (*Ministerio de Transporte e Infraestructura*: MTI), 3) Nicaraguan Institute of Territorial Studies (*Instituto Nicaragüense de Estudios Territoriales*: INETER), 4) Ministry of Environment and Natural Resources

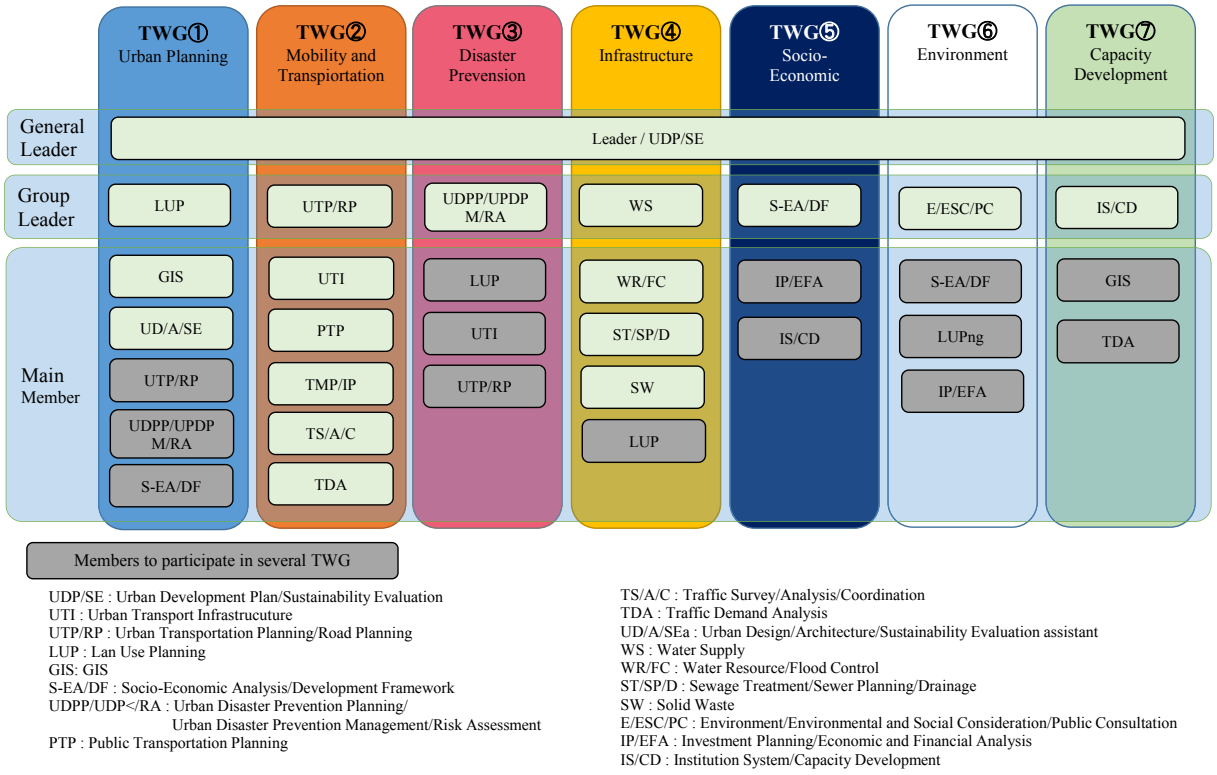
(*Ministerio del Ambiente y los Recursos Naturales*: MARENA), 5) The Nicaraguan Company Water Supply and Sewerage (*Empresa Nicaragüense de Acueductos y Alcantarillados*: ENACAL)

- JICA Nicaragua Office
- JICA Study Team

1.5.2 Technical Working Group

The Technical Working Groups (hereinafter referred to as "TWG") were established in order to work with JICA mission on daily basis. The TWG is responsible for information sharing and technical matter. Holding time of TWG depended on the related experts' assignment. The leader of each TWG was assigned from ALMA.

In addition, since comprehensive discussion is needed in considering future vision and strategy, a joint TWG which combined TWG ① and TWG ②, was held.



Source: JICA Study Team

Figure 1.5.2 Technical Working Group

CHAPTER 2 OUTLINE AND CURRENT CONDITIONS OF THE STUDY AREA

2.1 Territory

2.1.1 Territory of Nicaragua

The land area of Nicaragua is 129,541 km^2, which is the largest national land in Central America and it shares the borders with Honduras in the north and Costa Rica in the south, and surrounded by the Pacific and Caribbean oceans as shown in Figure 2.1.1.

Source: United Nations

Figure 2.1.1 Republic of Nicaragua

The total population of Nicaragua was approximately 6.1 million (World Bank, 2013) and its ethnic composition is composed of mixed-breed (70%), European (17%), African (9%), and indigenous (4%). The official language is Spanish, while English and indigenous languages are spoken in the Atlantic Coast Region. The main religion is Christianity say Roman Catholic.

Local administration system is based on the Spanish system because of the former colonial customs and local administrative boundary consists of 15 department (Departmento, No. 1 ~ No. 15 in Figure 2.1.2) and 2 autonomous regions (Región Autonomista, No. 16 and No. 17 in Figure 2.1.2). The Departmento and Región Autonomista are composed of 153 municipalities in total.

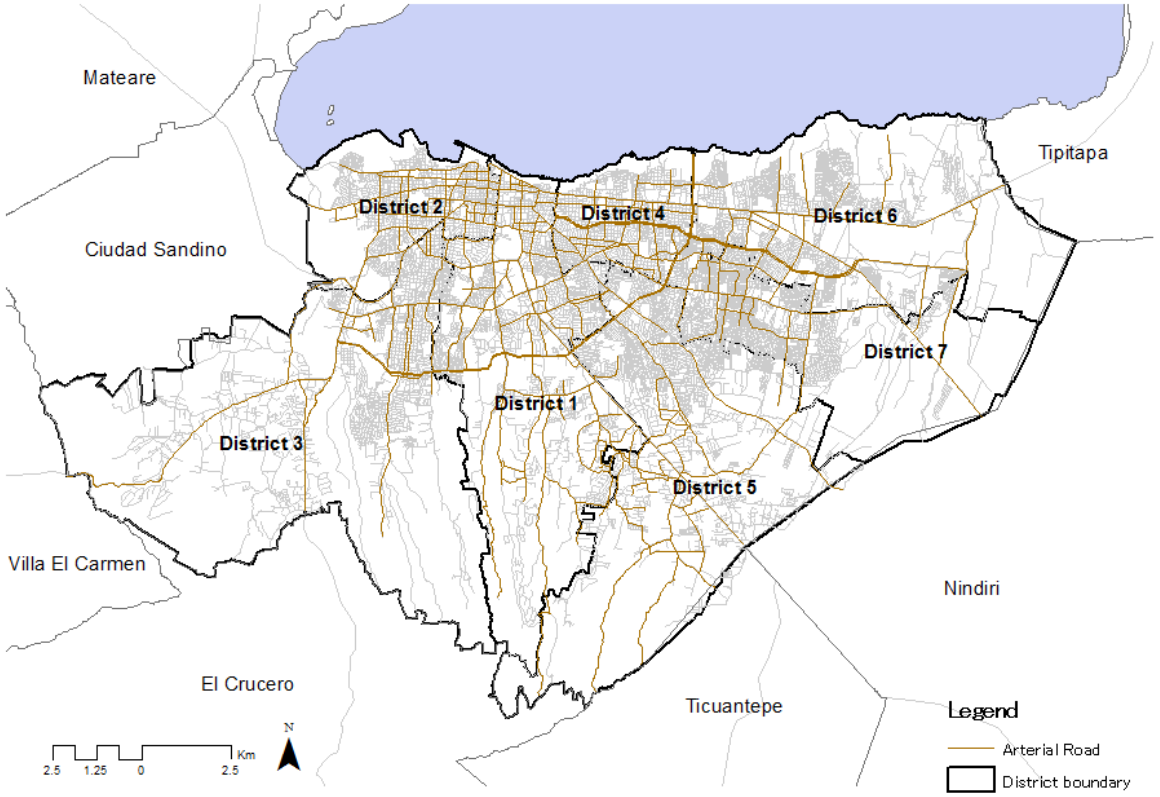
Source: JICA Study Team based on the data from ALMA

Figure 2.1.2 Administrative Boundary of Nicaragua (Departmento and Región Autonomista)

2.1.2 Territory of Managua City

Managua City is the capital city of Nicaragua located in the south coast of Managua Lake and the population is approximately 1.50 million (*Alcaldía de Managua*: ALMA, 2016). Managua City is the third largest city in terms of population in Central America and has been developed as the center of politics, economy, and culture in Nicaragua.

Managua City consists of seven districts and is surrounded by six municipalities as shown in Figure 2.1.3. In the surrounding area, there are the following eight major cities: Mateare, Ciduad Sandino, El Crucero, Nidiri, Ticuantepe, Masaya, Tipitapa, and La Concepcion.



Source: JICA study team

Figure 2.1.3 **Administrative Boundary of Managua City**

2.2 Natural Conditions

2.2.1 Climate

Nicaragua enjoys a tropical climate; however, the characteristics differ by altitude and region. According to the Köppen climate classification, the west coast area belongs to savannah climate, while the east coast has a tropical rainforest climate, and both of them have no dry season. The central mountainous area belongs to a humid subtropical climate, especially the northern mountainous area has a pleasant climate throughout the year. The west coast area including Managua Cityhas a hot and humid climate. It has two seasons: one is rainy season which starts from May to October, and dry season which starts from November to April. The annual rainfall in Managua City is approximately 1,204 mm. In the rainy season, high temperature and humidity tend to get higher due to rainshowers and squall.

Table 2.2.1 List of Climate Data in Managua City

Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual Average
Highest Temp. (°C)	31.0	32.1	33.6	34.3	34.0	31.4	30.9	31.4	30.3	30.8	30.6	30.8	31.8
Lowest Temp. (°C)	20.4	20.6	21.7	22.6	23.4	23.0	22.6	22.4	22.2	22.1	20.9	20.0	21.8
Amount of Rainfall (mm)	9	5	3	8	130	224	144	136	215	280	42	8	1,204 *Total amount

Number of average rainy days	1	0	0	0	11	13	15	15	15	15	5	0	90

Source: JICA Study Team

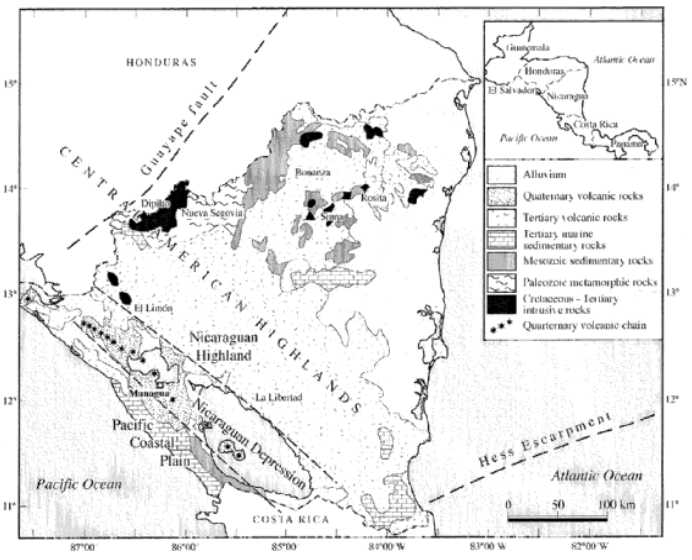
2.2.2 Geography

Since Nicaragua is located in the Central America isthmus, which is the western part of the Caribbean plate, there are therefore, many active volcanoes in the country as well as in other Central American countries. Momotombo Volcano has an altitude of about 1,700 m above sea level and the northern mountainous area borders with Honduras that reaches 2,100 m above sea level. Meanwhile, the coastal areas are generally plains. Eastern and western coastal areas are covered by the tropical plain and the central area is covered by marshy land.

Managua City is located in the lower zone between central highland and coastal mountain district and Managua Lake is located on the north side of the city. The urban area is situated generally on a flat plain starting from the coastal area of Managua Lake. The altitude of the vicinity of Managua Lake is about 55 m above sea level. The residential area is expanding to the mountain area by population growth.

2.2.3 Topography

The geology of Nicaragua's land mainly consists of the following four types: First, the Pacific Ocean Central Plains is covered by sedimentary rock and it is divided into internal highlands by Nicaragua depression contour, which is a huge rift including many volcanoes surrounded by alluvial plains. Managua City is located west of Nicaragua depression contour and its geology is consists of quaternary volcanic rocks, pyroclastic sediments, and minor alluvium. Second, internal highlands are the first semester and the tertiary volcanic region, which is adjacent to the Nicaragua depression contour. Third, is the basement which received a metamorphism of the first semester, tertiary anamorphism basement in the northwest area, Iyasgraben of the southeast, and Nicaragua Central Highlands. Fourth zone is the Atlantic coastal plain, which is known as Mosquito Trough or Bluefield area, and it is covered by alluvial deposits along the Atlantic coastline.



Source: Detailed Planning Survey (JICA, 2015)

Figure 2.2.1 Geological Map of Nicaragua

2.2.4 River and Hydrology

Managua Lake situates in the north-western part of Managua City and the area is approximately 1,050 km^2. The lake is located in the rift valley from the northwest of the Fonseca Gulf to the southeast of

Nicaragua Lake. The average altitude of the lake is 37 m above sea level and the maximum water depth is about 20 m.

Many rivers from the surrounding mountains flow in the Managua Lake and then flow out to the Nicaragua Lake through the Tipitapa River. In terms of the catchment area, it could be divided into two sections: the northern basin of the lake and the southern basin on Managua side. The major inflow river runs in the northern basin of the lake.

In the southeast of Managua City there is Nicaragua Lake beside Granada City, which is the largest lake in Central America, and its area is around 8,029 km^2. The lake attains a depth of 70 m as its deepest and its average altitude of surface is 32 m above sea level. The San Juan River starts from the south-eastern part of Nicaragua Lake and the estuary opens to the Caribbean Sea. Many volcanic islands are scattered inside Nicaragua Lake.

2.2.5 Earthquake

As explained above, earthquake is one of the serious disasters in Managua City as Nicaragua is situated in Cocos Plate. Inside Managua City, there are 15 active faults and many of them are running from the southwest toward the northeast direction. Large-scale earthquakes tend to occur in about 50-year cycle. The recent large-scale earthquake occurred in 1972 with a magnitude of 6.2 which caused serious damage to Managua City and the surrounding area.

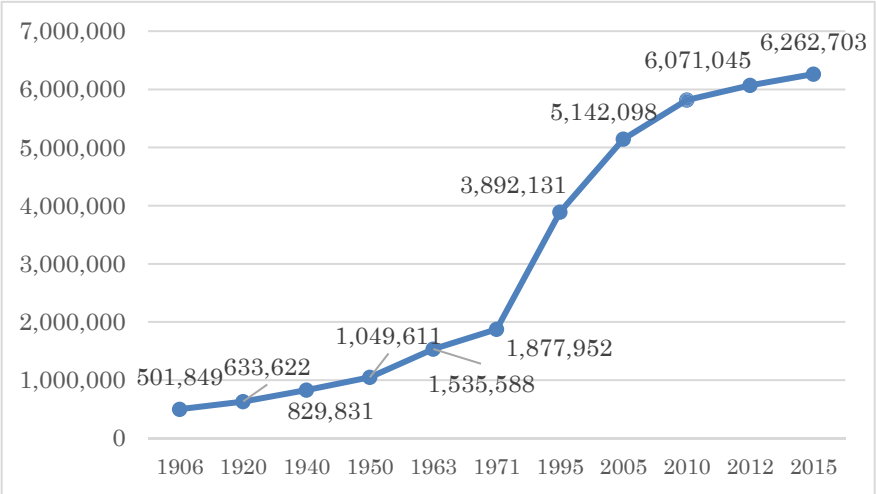
2.3 Population

2.3.1 Population of Nicaragua

In Nicaragua, the three latest Population and Housing Census (hereinafter referred to as "Census") were conducted in 1971, 1995, and 2005. The next census is planned to be conducted in 2018. In 2005, the National Statistical Institue (*Instituto Nacional de Información de Desarrollo*: INIDE) published the population projection for the period from 2005 to 2020. The projection was revised in 2007 and this revision included the adjustment to the data of Census 2005. In 2012, INIDE updated this projection again, expanding the period to 2025.

According to the series of Census data and the estimation of recent population made by INIDE, the total population in Nicaragua has grown rapidly especially since 1971, with the increase of more than tripled. Table 2.3.1 below shows the population in Nicaragua by department. The Managua Department accounts the largest share of population in Nicaragua, where almost a quarter of the total population lives in Managua Department.

Year	Nicaragua Population
1906	501,849
1920	633,622
1940	829,831
1950	1,049,611
1963	1,535,588
1971	1,877,952
1995	3,892,131
2005	5,450,392
2010	5,815,524
2012	6,071,045
2015	6,262,703



Source: 1906-1995: Census, 2005, 2010: INIDE (Estimaciones y Proyecciones de Polacion Nacional, Departmental y Municipal Revision, 2007), 2012,2015: INIDE (Estimation, 2012)

Figure 2.3.1 Total Population in Nicaragua

Table 2.3.1 Population by Department

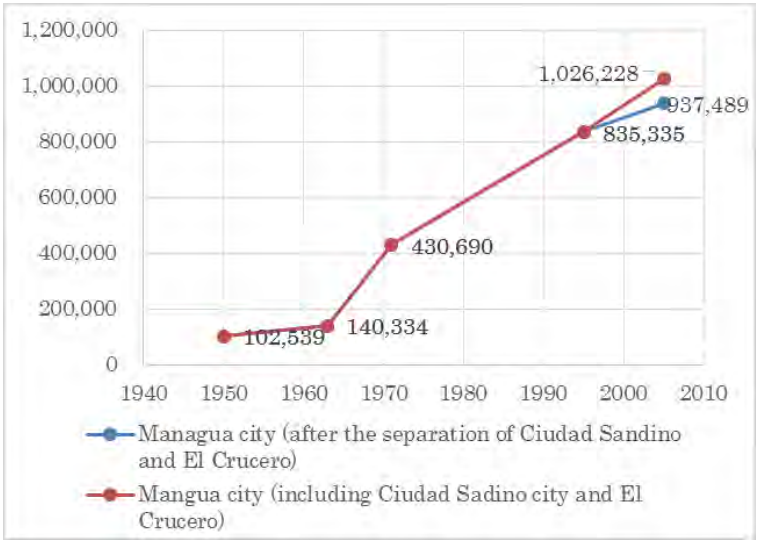
Department	Population			Percent (%)		
	1971	1995	2005	1971	1995	2005
Nueva Segovia	65,784	148,492	208,523	3.5%	3.8%	4.1%
Madriz	53,423	107,567	132,459	2.8%	2.8%	2.6%
Esteli	79,164	174,894	201,548	4.2%	4.5%	3.9%
Chinandega	155,286	350,212	378,970	8.3%	9.0%	7.4%
León	166,820	336,894	355,779	8.9%	8.7%	6.9%
Managua	485,850	1,093,760	1,262,978	25.9%	28.1%	24.6%
Masaya	92,152	241,354	289,988	4.9%	6.2%	5.6%
Granada	71,102	155,683	168,186	3.8%	4.0%	3.3%
Carazo	71,134	149,407	166,073	3.8%	3.8%	3.2%
Rivas	74,129	140,432	156,283	3.9%	3.6%	3.0%
Boaco	69,187	136,949	150,636	3.7%	3.5%	2.9%
Chontales	68,802	144,635	153,932	3.7%	3.7%	3.0%
Jinotega	90,640	257,933	331,335	4.8%	6.6%	6.4%
Matagalpa	168,139	383,776	469,172	9.0%	9.9%	9.1%
Zelaya (1)	145,508	-	-	7.7%	-	-
R.A.A.N. (1)	-	192,716	314,130	-	5.0%	6.1%
R.A.A.S. (1)	-	272,252	306,510	-	7.0%	6.0%
Rio San Juan	20,832	70,143	95,596	1.1%	1.8%	1.9%
Total	1,877,952	3,892,131	5,142,098	100.0%	100.0%	100.0%

Source: INIDE, Census 2005 *The data is based on the original census data in 2005.
(1)/ Zelaya Department was devided into R.A.A.N. and R.A.A.S in 1987.

2.3.2 Population of Managua City until 2005

Managua City has been the most populated municipality in Nicaragua being the capital city of the country. In the Census 2005, the population of Managua City was reported as 937,489. The proportion of Managua City in the national population was 20.73% in 1995 and it slightly fallen to 17.73% in 2005. Figure 2.3.2 shows the population of Managua City from 1950 to 2005 according to the Census. The pace of population growth seems to slow down from 1995 to 2005; however, it should be noted that there used to be seven districts in Managua City. Two districts out of seven, which are El Crucero and Ciudad Sandino, became independent from Managua in 2000. Thus, the population of Managua City until 1995 includes the current Ciudad Sandino and El Crucero, although the population of Managua City after 2000 includes only five districts[1]. The population growth seems to slow down after from 1995 to 2005; however, the population of Managua City adding El Crucero City and Ciudad Sandino City was 1,026,228 in 2005.

	Managua City	Managua, City Ciudad Sandino City and El Crucero City
1950	102,539	102,539
1963	140,334	140,334
1971	430,690	430,690
1995	835,335	835,335
2005	937,489	1,026,228



Source: INIDE, Census

Figure 2.3.2 Population of Managua City

(1) Current Population until 2016

After 2005, the Census has not been conducted and the precise data of population of Managua City is not available. ALMA has data based on the information that each District collects through primary and secondary sources on its residents. Each district office has information of residential people in the area, although any integrated registration system has not been established. ALMA collects the data from district offices and compiles its population data. According to ALMA, the population of Managua City in 2016 was 1,495,385, as of January 2016, and as reported in June 2016[2]. Compared with the original data of Census 2005, the population increased by almost 4.3% in every year from 2005 to 2016 in average. However, the population data of Census 2005 has several issues as pointed out by INIDE itself and ALMA. In the interview survey, INIDE recognized the possibility of omission of family members

[1] The districts were restructured into the current seven districts in 2009.
[2] The updated population is 1,527,556 as reported from ALMA in August 2016.

such as infant or elderly people in the household survey conducted for Census 2005. INIDE suggested that the possible error rate would be 5%. In fact, the population of Managua City in 2005 was stated at 966,518 in "*Estimaciones y Proyecciones de Poblacion Nacional, Departamental y Muncipal Revision 2007*" published by INIDE in 2007, which was increased by almost 3% to the census original data. If the Census 2005 is adjusted by increasing 5%, the population growth of Managua City in the annual average would be 3.9% as shown in Table 2.3.2.

Table 2.3.2 Population Change from 2005 to 2016

	Data Source	Population
2005	Census 2005 with 5% increase	984,363
2016	ALMA	1,495,385
Growth rate (2005-2016, annual average)		3.87%

Source: Prepared by the JICA Study Team

(2) Comprehensive Transportation Plan of Managua City (1999)

In "the Comprehensive Transportation Plan in the Municipality of Managua in the Republic of Nicaragua" (PITRAVI, 1999), the population of Managua City as of 1998 was estimated at 1,200,300, which was estimated by using the adjusted share of Managua City to the national total, which was 24.2%, where the share in 1995 was reported at 20.7% in the Census 1995.

(3) Base Population of Master Plan Framework

The JICA Study Team over discussion with ALMA sets the population of Managua City in 2016 as the basis of the population framework of the master plan. The population data of Managua City, which was reported from each district office to ALMA in June 2016, was adopted in the formulation of population framework for the master plan. The total population and population by district are shown in Table 2.3.3.

Table 2.3.3 Population of Managua City by District in 2016

District	January 2016	
	Population	Percentage
Managua City	1,495,385	100.00%
District 1	218,252	14.60%
District 2	164,254	10.98%
District 3	233,456	15.61%
District 4	163,966	10.96%
District 5	230,758	15.43%
District 6	236,939	15.84%
District 7	247,760	16.57%

Source: ALMA and estimation by the JICA Study Team

2.3.3 Social Conditions of Managua City

(1) Demographic Transition

Managua City has experienced the demographic transition process similar to the rest of Latin American countries, which is the decline of mortality especially infant mortality rate that led to more number of children's survival and longer life expectancy at birth. Comparing the two censuses in 1995 and 2005, infant mortality rate in Managua City had declined and it improved the life expectancy at birth. In addition, the total fertility rate shows a gradual decline not only in Managua City but also in the whole country. Table 2.3.4 shows the total fertility rate of several departments in Nicaragua, which have the highest and lowest total fertility rate in the country. The total fertility rate of Managua City is among the lowest, especially lower than that of the rural area. In addition, Table 2.3.5 suggests the total fertility rate in Managua City by district in 1995 and 2005. The average fertility rate among the districts in Managua City fell by 0.64 from 1995 to 2005.

Table 2.3.4 Total Fertility Ratein Nicaragua (by Department, Highest and Lowest Groups)

Department	1997-98	2001	2006-07	Department	1997-98	2001	2006-07
RAAN	5.9	5.2	4.5	Managua	2.8	2.5	2.2
Jinotega	6.2	5.3	4.2	Leon	3.2	2.5	2.1
Rio San Juan	5.4	4.1	3.1	Carazo	3.4	2.8	2.1
RAAS	4.3	4.4	3.0	Chontales	3.5	3.0	2.0

Source: World Bank, 2010, "Fertility Decline in Nicaragua,1980-2006 A Case Study"

Table 2.3.5 Total Fertility Rate in Managua City by District

District	Total Fertility Rate	
	1995	2005
District 1	3.05	2.36
District 2	3.07	2.39
District 3	3.13	2.51
District 4	2.96	2.22
District 5	3.13	2.51
District 6	3.20	2.67
District 7	3.11	2.47
Managua City Total	N/A	2.40
Average	3.09	2.45

Note: District boundary was changed in district 1 and 7 from 1995 to 2005. In 1995, Ciudad Sandino was a part of district 1 and 7
Source: Census 1995, 2005 cited in UNFPA (2010) and INIDE, Census 2005

(2) Migration Trend

The internal and international migration is an important factor to determine social change in population. It is said that a number of people move to Managua City from other regions of the country, especially

in the northern area to get job or go to college or university. Census 2005 surveyed the domestic and international migration of people in five years prior to the census. From 2000 to 2005, Managua City had 19,627 immigrants and 26,643 emigrants in total, therefore, the negative net migration was 7,016 during that period. However, Table 2.3.6 shows the registration of change of address managed by the registry office of ALMA (Central Registry of Civil Persons Stastus, "*Regisro Central Del Estado Civil de las Persnas*"). It suggests the positive net migration to Managua City from other cities.

Table 2.3.6 Registration of Change of Address

(Unit: Number of people moving)	2011	2012	2013	2014	2015	Total
Move-In	28,776	16,532	22,278	25,474	28,090	135,888
Move-Out	12,861	7,551	10,164	12,083	14,759	68,106
Net Move-In to Managua City	15,915	8,981	12,114	13,391	13,331	67,782

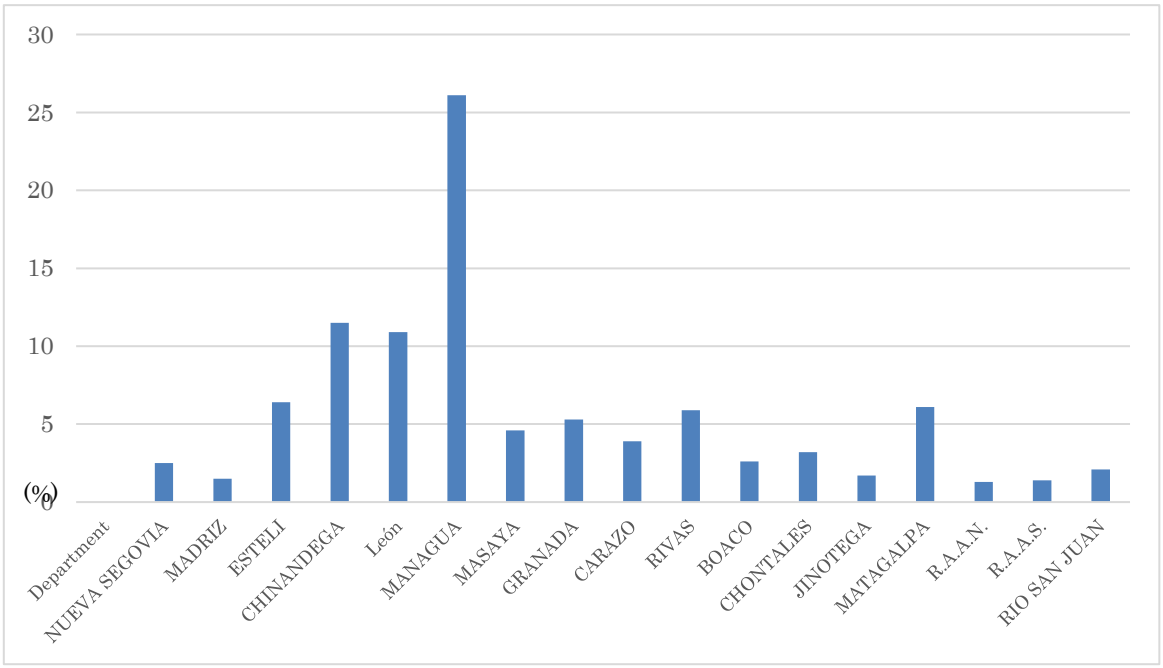
Source: ALMA

As for the international migration, a significant amount of emigration to foreign countries could be recognized according to the data by INIDE, where it was estimated that the balance of net migration was 206,400 during 2000-2005 (referring to Table 2.3.7). However, there is no statistical information of the accurate flow of immigration. The Managua Department is regarded to be the largest origin of emigrant population in the country, where 26.1% of the international emigrants from Nicaragua came from Managua Department in 2005. The major destinations of international migration from Nicaragua were Costa Rica, the United States of America (USA), Spain, Honduras, El Salvador, Canada, Panama, and other Latin American countries. The international emigration has declined in accordance with the growth of Nicaraguan economy and employment opportunity within the country, and it is expected to continue to decline in the future.

Table 2.3.7 Net Migration Balance in Nicaragua (Estimation and Projection)

Period	Net Migration Balance	Period	Net Migration Balance
1995-2000	-157,800	2020-2025	-160,000
2000-2005	-206,400	2025-2030	-140,000
2005-2010	-200,000	2030-2035	-120,000
2010-2015	-190,006	2035-2040	-95,000
2015-2020	-180,000	2040-2045	-66,000

Source: INIDE, Census, Estimaciones y Proyecciones de Problación Nacional, Department y Municipal Revisión, 2007



Source: INIDE, Census 2005. EU and International Organization for Migration (IOM), "Perfil Migratorio de Nicaragua 2012"

Figure 2.3.3 Percentage of Emigrants by Department of Origin

(3) Population by Age Group

It is assumed that Managua City has the large proportion of young population, which is the demographic feature of Nicaragua at the national level as well. There are no actual survey and database about the population by age group at the municipality level other than the census, so the latest available demographic data can be obtained from the Census 2005. Table 2.3.8 shows the Census data of population in Managua City by three age groups. The population aged from 15-64 years old accounted 65% in Managua City in 2005, while it accounted 63% in Managua Department, and 58% in Nicaragua.

Table 2.3.8 Population in Nicaragua and Managua City by Three Age Groups in 2005

Population									
	Managua City			Managua Department			Nicaragua		
2005	Total	Men	Women	Total	Men	Women	Total	Men	Women
0-14	290,064	148,024	142,040	428,227	216,109	212,118	2,060,828	1,049,850	1,010,978
15-64	605,424	279,485	325,939	828,715	392,673	436,044	3,169,467	1,555,488	1,613,979
Over 65	37,301	15,242	22,059	54,001	22,746	31,255	220,098	101,971	118,127
Total	932,789	442,751	490,038	1,310,943	631,528	243,373	5,450,393	2,707,309	2,743,084
Percentage									
	Managua City			Managua Department			Nicaragua		
2005	Total	Men	Women	Total	Men	Women	Total	Men	Women
0-14	31%	33%	29%	33%	34%	31%	38%	39%	37%
15-64	65%	63%	67%	63%	62%	64%	58%	57%	59%
Over 65	4%	3%	5%	4%	4%	5%	4%	4%	4%

Source: INIDE, Census 2005, Estimaciones y Proyecciones de Problación Nacional, Department y Municipal Revisión, 2007

(4) Working Population

As suggested in Table 2.3.8, population of 15-64 years old accounts for 65% in Managua City, which means that Managua City has a large working age population. According to the Census 2005, the proportion of Economically Active Population (EAP[3]) in Managua City was 46.1% of the total population, which corresponded to 345,865 people. It covered almost 19.77% of the total EAP in Nicaragua. Among the EAP in Managua City, 96.5% are employed and 3.5% are unemployed in 2005 as shown in Table 2.3.9. Table 2.3.10 shows the working population (people who are ten years old and above and employed) by sector. It suggests that the percentage of working population in secondary and tertiary sectors in Managua City were much higher than the national average. Therefore, it could be said that a lot of the working population are engaged in the secondary and tertiary sectors in Managua City rather than other cities in Nicaragua.

The common employment issue in Nicaragua is job security where it is not widely available and many people work in the informal sector. For example, the Nicaraguan Institute of Social Security (*Instituto Nicaragüense de Seguridad Social*: INSS) is the national social insurance institution and provides insurance to registered workers, but the coverage is low and the total registered workers in Nicaragua was 725,014 in 2014. However, it is noted the data of INSS shows that formal jobs are concentrated in Managua City. In 2014, there were 347,184 insured workers in Managua City, which corresponded to 47.9% of the total insured workers in Nicaragua. Thus, it is assumed that the accumulation of secondary and tertiary sectors leads to the increase in formal employment opportunity in Managua City.

Table 2.3.9 Economically Active Population among Population of over Ten Years Old in Nicaragua and Managua City

	1995				2005			
	Total Population 10+	Economically Active Population			Total Population 10+	Economically Active Population		
		Total (%)	Employed (%)	Unemployed (%)		Total (%)	Employed (%)	Unemployed (%)
Nicaragua	3,012,348	48.1	83.1	16.9	3,895,447	44.9	95.8	4.2
Managua City	618,800	49.2	81.7	18.3	750,250	46.1	96.5	3.5

Source: INIDE, Census 2005 (Caracterizacion Sociodemografica del Departamento de Managua)

Table 2.3.10 Working Populationin Nicaragua and Managua City by Sector

	1995					2005				
	Total	By Sector (%)				Total	By Sector (%)			
		Primary	Secondary	Tertiary	Unknown		Primary	Secondary	Tertiary	Unknown
Nicaragua	1,203,064	40.5	13.1	40.9	5.6	1,675,550	34.1	18	46.9	1
Managua City	248,816	2.3	18	72.1	7.6	342,798	1.3	23.1	73.4	2.2

Source: INIDE, Census 2005 (Caracterizacion Sociodemografica del Departamento de Managua)

[3] In the Census 2005, Economically Active Population is defined as the people that have a job, or are actively seeking, or do not seek but waiting for a response from an employer or expect to continue their agricultural work, with the age of ten and over.

(5) Number of Students

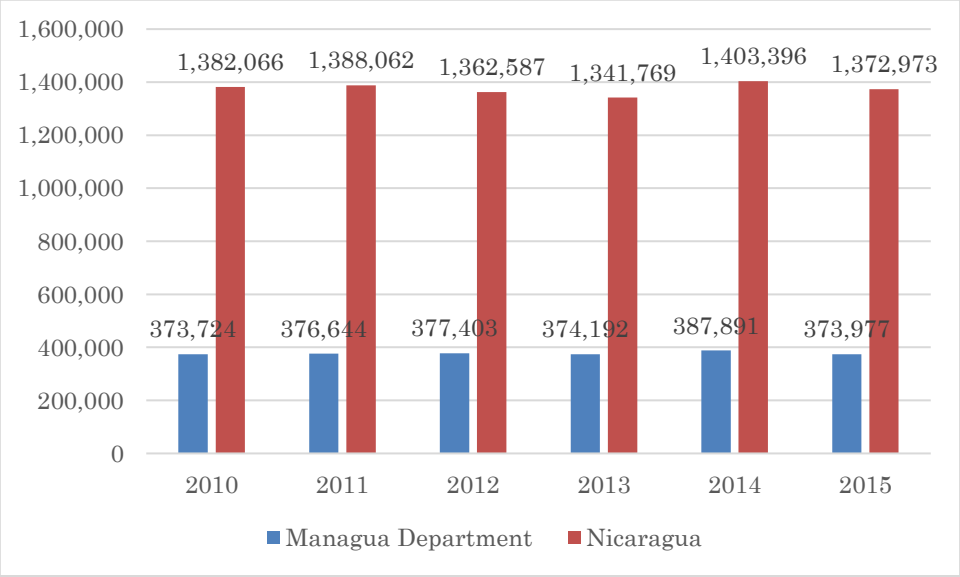
The data on student number is also scarce. In the Census 2005, the school attendance rate is shown in Table 2.3.11. From the population data by five-year age group in Census 2005, the total population of 6-29 age is estimated at 415,824, so the number of student is also estimated at 243,673 in Managua City. Compared with the data in 1995 and 2005, it is noted that the school attendance rate slightly dropped during the decade. One of the reasons of this decline is that the number of school facilities had not increased in proportion to the increase in the number of children. On the other hand, *El Ministerio de Educación* (MINED) manages the primary and secondary education, so MINED has the data of enrolment in the primary and secondary school. Figure 2.3.4 illustrates the number of school enrolment provided by MINED. This number is higher than the indicated number of student from Census 2005.

GRUN implemented policies to increase school enrolment from 2008 such as build more educational facilities. As a result, school enrollment throughout the country has increased.

Table 2.3.11 School Attendance Rate of Population of 6-29 Years Old

	Census 1995			Census 2005		
	Total	Urban	Rural	Total	Urban	Rural
Nicaragua	47.9	59.2	34.5	51.7	58.7	43.3
Managua City	62.3	62.6	53.8	58.6	58.7	54.1

Source: INIDE, Census 2005, (Caracterizacion Sociodemografica del Departamento de Managua)



Source: MINED

Figure 2.3.4 School Enrolment in Primary and Secondary School (Person, 2010-15)

Since many higher education institutions are located in Managua City, the university and college students tend to concentrate in Managua City. According to the National Council for University (CNU), Managua City has five public universities (including private universities with public funds) and 38 private universities registered in CNU. The total number of enrolment in these universities was estimated

at 103,646 students in 2015 as shown in Table 2.3.12. As for the public university and private university with public funds, approximately 46.4% of the total students are enrolled in Managua City.

Table 2.3.12 Number of Enrolment of University in Managua City

2015	Public University and Private University with Public Funds	Private University Registered in CNU (estimation)	Total Number of Enrolment
Managua City	54,856	48,790	103,646
Nicaragua	111,572	N/A	N/A

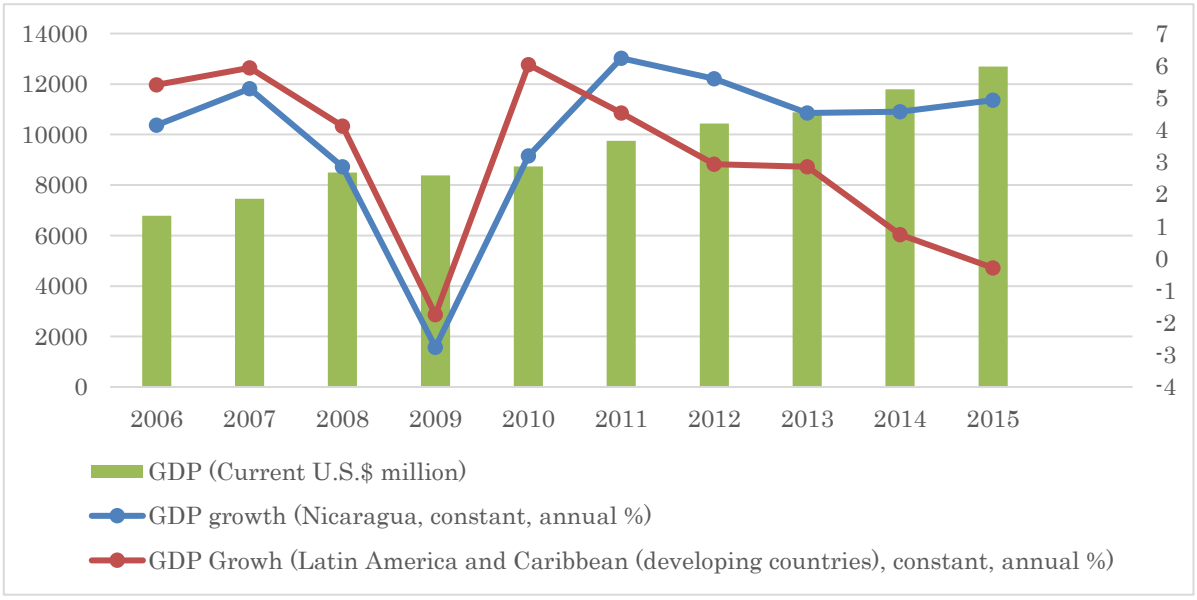
Source: CNU

2.4 Socio Economy

2.4.1 Gross Domestic Product (GDP) in Nicaragua

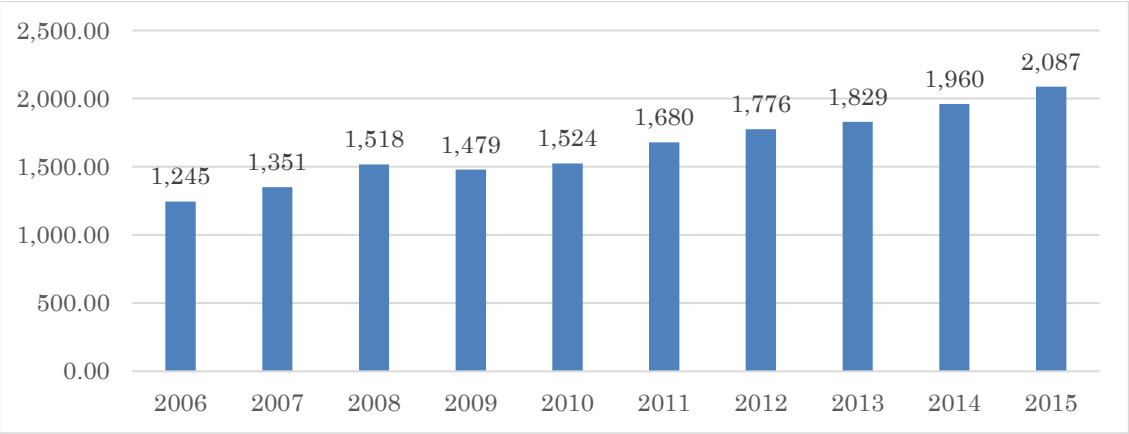
(1) National

Figure 2.4.1 shows GDP (nominal) and GDP growth rate (real) in Nicaragua and Latin American and Caribbean countries (developing countries). The economy of Nicaragua marked steady growth except for the period from 2008 to 2010 when the economy was affected by the global financial crisis. After the recovery from the economic downturns, the average growth rate of GDP in Nicaragua from 2011 to 2014 rebounds to 5.1% and it exceeded the average growth rate in developing countries in Latin America and Caribbean region for the same period. As shown in Figure 2.4.2, GDP per capita in US$ raised to 1,963.10 US$ in 2014.



Source: World Bank, World Development Indicators

Figure 2.4.1 GDP and GDP growth rate



Source: World Bank, World Development Indicators

Figure 2.4.2 GDP Per Capita in Nicaragua (Current US$)

(2) By Department and Municipality

Data of the regional gross domestic products or GDP breakdown by department is not available in Nicaragua. According to the estimated GDP by department and municipality in 2000 as shown in Table 2.4.1, GDP and GDP per capita had large difference among departments. Managua City accounted for 36.3% of total GDP and the GDP per capita was almost double of that in Nicaragua.

Table 2.4.1 GDP by Department (Current Cordoba, 2000)

Department	GDP		GDP per Capita	Department	GDP		GDP per Capita
	(million)	%			(million)	%	
Total	44,399	100	8,754	Carazo	1,407	3.2	8,385
Nueva Segovia	1,239	2.8	6,240	Rivas	1,002	2.3	6,334
Madriz	783	1.8	6,268	Boaco	1,049	2.4	6,642
Esteli	1,424	3.2	7,227	Chontales	1,052	2.4	6,268
Chinandega	2,967	6.7	7,321	Jinotega	1,793	4	6,436
Leon	2,519	5.7	6,742	Matagalpa	2,997	6.8	6,658
Managua	19,217	43.3	15,219	R.A.A.N	1,194	2.7	5,149
Masaya	2,120	4.8	7,323	R.A.A.S	1,847	4.2	5,419
Granada	1,276	2.9	7,112	Rio San Juan	512	1.2	5,858
Municipality							
Managua City	16,098	36.3	17,025				

Source: Estimation according to the information based on the system of national accounts and author's calculation in "Competitividad y distribucion territorial de lasactividades economicas en Nicaragua: impactos del Plan Nacional de Desarrollo" (UNFPA, 2004)

(3) Remittance

The remittance from foreign countries is large in Nicaragua because of the certain volume of international migration. The remittance tends to increase, as it was USD 272.2 million in the first quarter in 2014 which increased to USD 289.2 million in the same period in 2015. According to the data in 2015, the remittance accounted for 9.8% of quarterly GDP in same year. The Managua Department was the main destination of such remittance, where 40.3% of the total flow received during the first quarter in 2015 according to the quarterly report of the National Bank of Nicaragua (*Banco Central de Nicaragua*: BCN).

2.4.2 Economy and Industry in Managua City

(1) Overview

Managua City is the center of national economy, commerce, and services, where most of the domestic and multi-national companies such as Wal-mart, Telefonica, Union Fenosa, and Parmalat located in. Commerce is one of the main industries in Managua City, where large-sized shopping centers and malls such as Centro Comercial Metrocentro, Galerias Santo Domingo are situated. In addition, major international banks have their branch office in Managua City such as *Banco de America Central* and *Banco de Finanzas*. Furthermore, major manufacturing industries are located in the city such as beer and coffee, garment and shoes, pharmaceutical products, building materials, and fast-moving-consumer-goods.

1) Urban Economic Census 2010

The Urban Economic Census[4] was published in 2010 by INIDE which surveyed the economic establishments, that is permanently dedicated to a type of economic activity in a single physical location, and deliminated by fixed installations and constructions for commercial or social purpose by any type of legal status, in the urban area in Nicaragua. The Urban Economic Census 2010 suggests that Managua City has large accumulation of economic establishments. As shown in Table 2.4.2, there are 62,225 establishments in Managua Department and 51,787 in Managua City, out of 175,298 in total. Numbers of the labourers are 224,929 in Managua Department and 202,913 in Managua City, out of 509,570 in total. Thus, Managua City accounted for 29.5% in terms of the number of establishments and 39.8% in terms of employed people in Nicaragua.

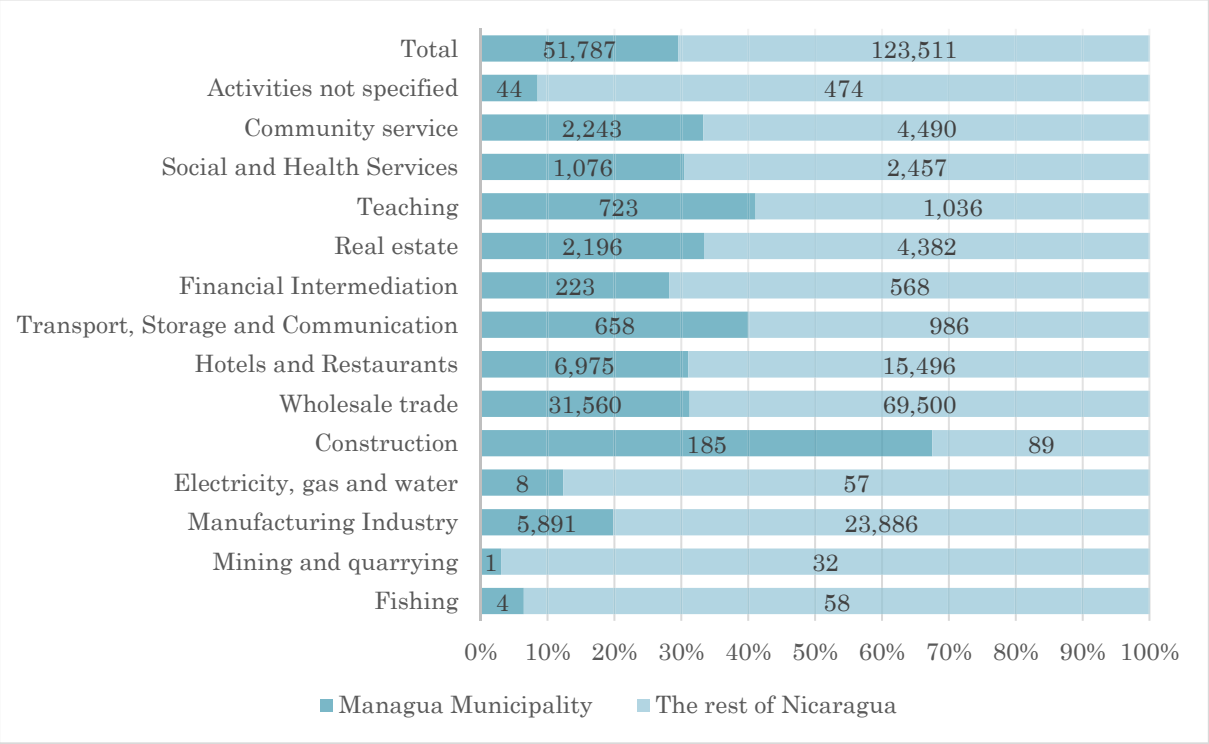
Table 2.4.2 Number of Establishments and Employed Person in Urban Area in Nicaragua (2010)

	Number of Establishments	Percent (%)	Employed person			Percent (%)		
			Total	Male	Female	Total	Male	Female
Nicaragua Total	175,298	100	509,570	232,625	276,647	100	100	100
Managua Department	62,225	35.5	224,929	107,763	116,868	44.1	46.3	42.2
Managua City	51,787	29.5	202,913	99,076	103,539	39.8	42.6	37.4

[4]Urban location is defined as "all localities with more than 1,000 people who have features such as streets, paths, utilities (electricity, potable water, schools, and others)" in Urban Economic Census 2010.

Source: INIDE, Urban Economic Census 2010

Figure 2.4.3 shows the number and percentage of establishments by industrial sector in Managua City and the rest of Nicaragua. At the national level, establishments of construction industry and major service sector are concentrated in Managua City. Around 67.5% of construction companies and around 30-40% of establishments of community services, social and health services, teaching, real estate, financial intermediation, transport, storage and communication, hotels and restaurants, wholesale trade, are located in Managua City.



Source: INIDE, Urban Economic Census 2010

Figure 2.4.3 Number of Establishments in Urban Area by Sector (2010)

Generally, most of the establishments in Nicaragua are micro or small-sized establishments or individulas which have less than ten workers as shown in Table 2.4.3. However, Managua City acommodated not only small-sized companies but also medium and large-sized companies. For example, 72.6% of the total establishments which has more than 21 workers in Nicaragua were located in Managua City.

Table 2.4.3 Number of Establishments in Urban Area by the Range of Number of Workers (2010)

	Number of Establishments	Range of Number of Workers							
		1-3	4-9	10-19	21 - 30	31 - 40	41 - 50	51 And More	Unknown
Nicaragua	175,298	153,379	16,481	2,830	657	257	138	432	1,124
Managua City	51,787	43,401	5,998	1,310	364	158	86	470	-

Source: INIDE, Urban Economic Census 2010

Note: The total numbers for Nicaragua are cited from "Results National" and the numbers for Managua City are cited from "Results Department of Managua". There are some discrepancies in the published numbers, although numbers are cited as published.

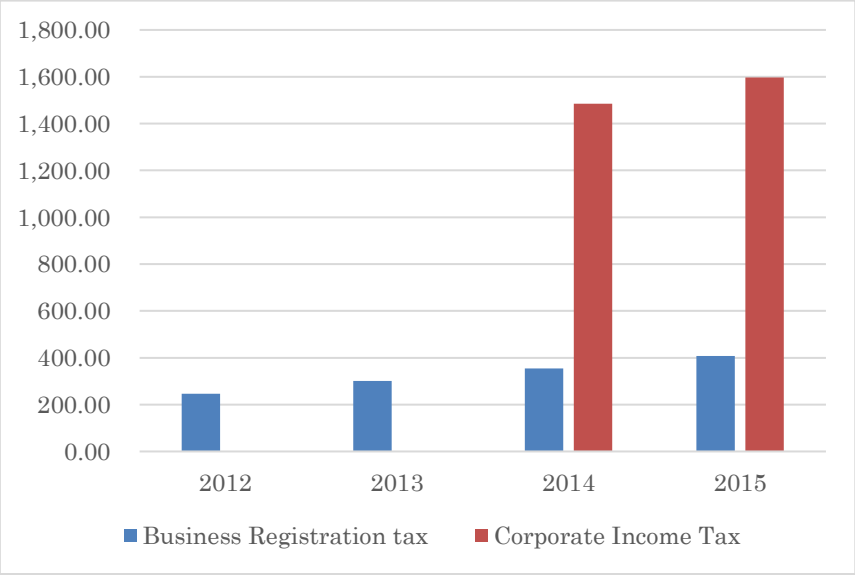
2) The Digital Cartography and Census of Building (Managua, 2017)

BCN published the reports of the results of the digital cartography and building census project in January 2017. This project focuses on the urban area and aims to identify and characterize exsisting buildings in the urban area. The survey was implemented in 2014 from April to November, and 28,267 buldings were participated in the interview.

According to this survey, the total number of buildings is 262,561 in the urban area of Managua City. 183,670 buildings are exclusive dwerlling and others 78,891 buildings are buildings with any economic activities or other uses such as warehouses, garage, or cemetaries. The economic activities are mainly micro or small enterprises, with 77.2% of economic establishments having 1-5 workers and 0.2% with100 and more workers. Regarding the business of the economic activities, the majority is small business such as home business (59.8%), local independent (21.0%), markets (16.7%), and relatively large business includes shopping mall (1.1%), banks and financial institutions (0.2%), supermarkets (0.2%).

(2) Business Registration and Tax Collection

According to the tax office of ALMA, the registration of business and tax collection has increased recently, as shown in Figure 2.4.4. The registration of business is renewed every year and the registration tax is paid once a year, while corporate income tax is paid monthly. The registration tax has increased by 65% from 2012 to 2015, and the income tax has grown by 7.5% from 2014 to 2015. The increase of tax collection represents the expansion of economy and also formalization of business in Managua City.

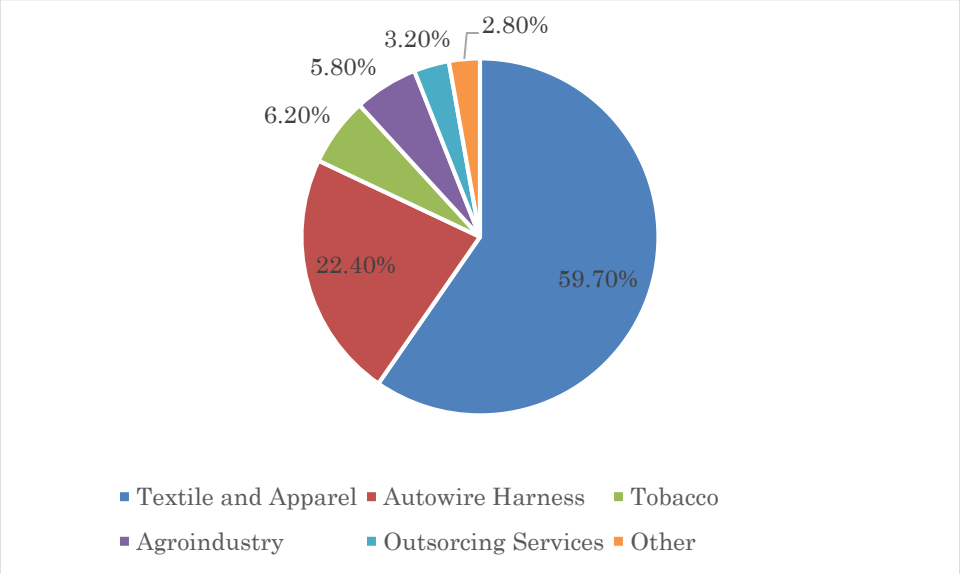


Source: ALMA
* Corporation Imcome Tax in 2012 and 2013 is not available.

Figure 2.4.4 Business Tax Collection in Managua City (NIO in Million)

(3) Foreign Direct Investment

In Nicaragua, Free Trade Zone (FTZ) is a central component of the government's policy to promote investment, to create formal jobs, and to enhance exports. The law of FTZ offers significant tax incentives for export-oriented companies, including tax exemption from income tax, taxes related to company set up, custom duties related to the import of raw materials, supplies, and machineries. The share of products exported from FTZ is shown in Figure 2.4.5, it shows the major industry promoted in FTZ includes textiles and apparel, light manufacturing, agribusiness as well as contact centers and business process outsourcing. According to the Ministry of Development Industry and Trade's (*Ministerio de Formento, Industria y Comercio:* MIFIC) data in Table 2.4.4, there were 248 companies operating in FTZ in Nicaragua and 92 companies are located in Managua City in 2016.



Source: PRONicaragua and National Free Zones Commission

Figure 2.4.5 Share of FTZ Products in Volume of Exports (2015)

Table 2.4.4 Number of Companies in Free Trade Zones (2016)

Department	Municipality	Number of Companies
Total		248
Managua		127
	Ciudad Sandino	21
	Managua	92
	Mateare	3
	Tipitapa	32

Source: MIFIC

2.5 Ongoing and Committed Projects

2.5.1 Urban Planning Project

(1) Projects of the Action Plan for Sustainable Managua by Inter-American Development Bank

(IDB) (2016 – 2017)

In the Action Plan for Sustainable Managua financed by IDB, 16 projects were proposed in all four major fields relating to the land use management, as shown in Figure 2.5.1. The first field is the provision and improvement of instruments for urban land use (indicated as "8.1.1" in the figure). The second field is the program for the intervention for urbanization strategy ("8.1.2"). The third is the regeneration of the old city center ("8.1.3"). The fourth is the program for the improvement of mobility and public transport ("8.1.4").

Among the four major field of project proposal, 8.1.3: the regeneration of old city center is to improve the historical city center area, which is predominantly low-rise residential and governmental facilities, with possible introduction of linear parks, redevelopment of low-rise building to medium- or high-rise residential quarters, pedestrian network, etc. This plan had been schedule for the period of six months from August 2015 using the grant for ESCI-2, but was delayed and started in April 2016. An image for the regeneration of the old city center is illustrated in Figure 2.5.2.

Source: IDB

Figure 2.5.1Proposed Projects for Land Use Management by Action Plan for Sustainable Managua

Source: IDB

Figure 2.5.2 Proposed Regeneration of Historical City Center

In regard to urban planning, the project listed as "8.1.3" above has been launched as a continuation project in April 2016, entitled the Comprehensive Plan for Revitalization of Traditional and Heritage Centerof Managua [*Plan Integral de Revitalización del Centro Tradicional y Patrimonial de Managua*]. The target area is basically the same as that of Master Plan of the Central Area of Managua City in 1992.

The comprehensive plan has conducted the following five items from April 2016 to June 2017.

- Conceptual and Methodological Framework
- Comprehensive Plan for Revitalization of Traditional and Heritage Center of Managua City
- Definition of Habitation Plan
- Final Document of the Revitalization of the Traditional and Heritage Center
- Recommendations for the Adjustment of the General and Specific Planning for Traditional and HeritageCenter

The zoning map in the Traditional and Heritage Center has been integrated into the future land use map according to request by ALMA. During the study period of PDUM, several discussions were conducted to integrate future frame, functions of urban center, transport and land use.

(2) Managua Lake Waterfront Regeneration Project by ALMA (2016 - 2018)

Managua Lake is the second largest lake in Nicaragua, and Managua City is bounded by the lake on the northern side. The Managua Lake Waterfront Regeneration Project focuses on the greenery along the shoreline of the lake as an important landscape feature and spatial element of Managua City, and aims at improving the zone along the lake with urban regeneration method and integrating with existing public

lands in its proximity. The project is a joint undertaking of the national government and ALMA, with a cost estimated to be approximately USD 3.7 million.

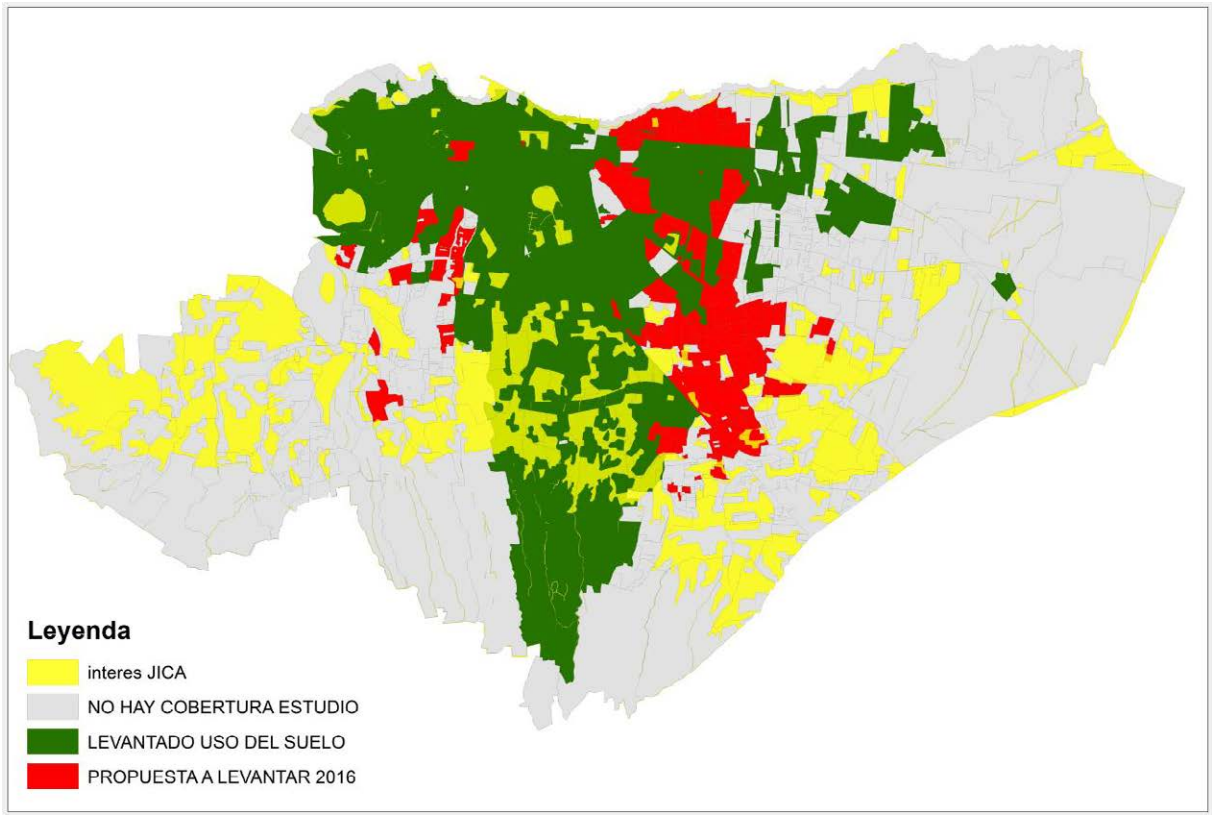
(3) Land Use Survey Project by ALMA (2014 - 2017)

Department of Urban Planning ALMA has been preparing the detailed cadastres maps with information of land use by barrio since 2014, namely, the Project for Land Use Survey Geo-referencing by Lot, and Infrastructure by Street. A series of projects are briefly explained as shown in Table 2.5.1. Phase 4 survey has been completed in Districts 3, 4 and 5 with the survey area coloured in red as shown in Figure 2.5.3. The following survey for rest of the area, District 6 and 7, suppose to start in late 2017.

Table 2.5.1 Summary of the Ongoing Project for Land Use Survey by ALMA

Phase	Period	Coverage	Project Site
Phase 1	November 2014	30 barrios	District 1
Phase 2	April to June 2015	130 barrios 15 barrios	District 1 District 2
Phase 3	January to March 2016	99 barrios	District 2
Phase 4	June to September 2016	190 barrios	Districts 3, 4, and 5

Source: ALMA



Source: ALMA

Figure 2.5.3 Survey Area of the Project (Phase 4) by ALMA

2.5.2 Transport Project

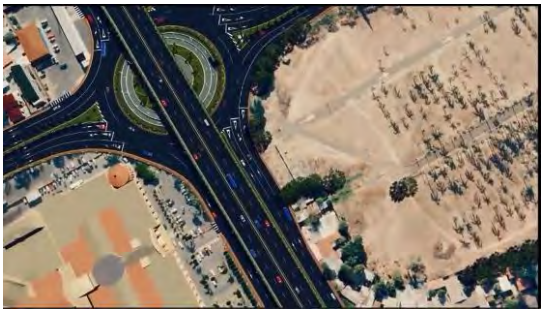
(1) Road Projects

The Managua City has an Annual Investment Plan for this year 2016 (PIA 2016). This plan has projects to be executed by the mayor and by the seven districts, and 90% of the budget is allocated for road infrastructure. With regard to the investment of ALMA, it amounts to 80% of budget on the main infrastructure projects. These projects consist of road pavement, construction of pedestrian bridges, replacement plan, installation of manhole covers and grating, road improvement with sidewalk, road improvement with asphalt, and etc.

The other 10% of that corresponds to the PIA of districts. The main tasks are road improvement with ready-mixed concrete, rehabilitation of parks, construction of sanitary, rehabilitation of drip molding systems, and etc. The detail is shown in Table 2.5.2.

In regard to larger investments, there are projects which have been studied several years ago. Several projects such as extension of 14 roads and avenues (37 km), 10 overpasses, 8 roundabouts, and 27 vehicular bridges, are included in the Roads Development Program 2015-2022.

The following Figure 2.5.4 shows some images of road project which are part of the Program of Road Development 2015-2022. There is other project for extension of 13 roads, pathways and avenues (36 km).

	
1. Pebbles, overpass, and the intersection between New Road to Leon and Road South near the Park of "The Stones".	2. Project of 7 South, overpass, located at the intersection between Road South and the Track John Paul II
	
3. "Metrocentro", overpass with roundabout, intersection between Walk The European Union (Carretera Masaya) and the track of Resistance (Track John Paul II)	4. To widen to 6 lanes of Ruben Dario

	
5. Bridge Enel (the Nicaraguan Electricity Company) from Bolivar to Chavez with Juna Pablo II	6. Step to gradient Christ the King, overpass, located at the intersection radial Santo Domingo with Track John Paul II
	
7. Step sunken "Robelo", the intersection of North Road with the Track John Paul II	

Source: General Directorate of Projects

Figure 2.5.4 Images of Road Projects

Table 2.5.2 Annual Investment Plan (PIA) - 2016 (USD)*

Concept	District I	District II	District III	District IV	District V	District VI	District VII	TOTAL**
OWN RESOURCES	10,904,842	10,965,518	10,849,535	8,478,271	12,683,776	9,659,333	8,896,927	72,438,201
INFRASTRUCTURE PROJECTS	8,945,134	9,712,922	9,440,181	7,190,031	10,575,926	7,813,569	6,899,202	60,576,965
General Directorate of Projects	5,374,157	7,448,481	7,448,481	4,917,102	5,690,579	4,460,048	4,460,048	39,798,896
Directorate of Infrastructure	921,893	957,315	623,048	913,066	3,455,169	1,963,774	978,111	9,812,377
General Directorate for the Environment	222,500	94,173	120,542	94,173	94,173	94,173	94,173	813,909
Directorate of Ornamental	2,426,584	1,212,952	1,248,110	1,265,689	1,336,005	1,295,574	1,366,869	10,151,784
INVESTMENTS FOR HUMAN DEVELOPMENT	1,059,311	498,326	477,666	478,199	662,854	518,196	648,711	4,343,264
General Directorate of Human Development:	1,050,270	489,286	468,625	469,159	653,813	509,156	639,670	4,279,979
Directorate of Culture and Historical Heritage	70,090	101,908	56,027	41,964	41,964	41,964	41,964	395,879
Direction of Social Programs	808,052	215,249	240,470	255,067	439,721	295,064	425,579	2,679,202
Directorate of Sports	172,128	172,128	172,128	172,128	172,128	172,128	172,128	1,204,898
Directorate of the woman and the Family	9,041	9,041	9,041	9,041	9,041	9,041	9,041	63,284
DISTRICT PROJECTS	900,397	0	931,688	0	1,444,995	1,327,567	1,349,014	7,517,973
EXTERNALMANAGEMENT FOR PROJECTS	0	0	0	0	0	0	0	3,392,571
Foreign resources	0	0	0	0	0	0	0	2,951,733
National funds	0	0	0	0	0	0	0	440,838

Source: General Directorate of Projects (May 2016), (*) T.C. (16.05.2016) = NIO 2,884 (USD 01)、(**) JICA Study Team modified

Table 2.5.3 Projects of the Investment Program 2015-2022

No.	Project	Year of Projected Deployment
1.	Step to gradient Rubenia	2015
2.	Step to drop the Stones	2016
3.	Step to gradient 7 South	2017
4.	Step to gradient Metro Center	2018
5.	Step Sunken Central ENEL	2019
6.	Step to gradient Journalist	2020
7.	Step to gradient Christ the King	2021
8.	Step to drop the Robelo	2021
9.	Step to gradient Santo Domingo	2022
10.	Step to gradient Roberto Huembés	2022
11.	Sub-urban /Step Rubenia/R Huembés (1.5 km)	2016
12.	Track United Nations (1.2 km)	2017
13.	City Bethlehem / Road North (3.6 km)	2017
14.	Track John Paul II (9.6 km)	2017 - 2022
15.	Bolívar Avenue / Enel - Rot Rigoberto LP (1.2 km)	2018
16.	Villa Fontana / Club Terrace (1.2 km)	2018
17.	Bolívar Avenue / Roundabout RLP /Club Terrace(2.1 km)	2019
18.	Sub-urban / Roberto Huembés /Lozelsa (1.0 km)	2019
19.	Sub-urban/Roundabout RLP/ Roundabout C.A. (1.8 km)	2020
20.	PAD Rubenia / Track Sabana Grande (3.1 km)	2020
21.	Sub-urban/Step Rubenia/Step Portezuelo (2.3 km)	2021
22.	Track Sabana Grande / Track Wholesale / Auction (2.6 km)	2021
23.	Santo Domingo / Roberto Huembés (2.4 km)	2022
24.	7 South / Linda Vista 2022 (3.4km far)	2022
25.	Road North (8.5 km)	--
26.	25 Street Southwest (4.3 km)	--
27.	Track Sub-urban (3.1 km)	--
28.	Rot. Central America / Lozelsa (0.5 km)	--
29.	Four Corners / Sabana Grande / Carr. North (7.0 km)	--
30.	Interconnected Carr. Masaya / The Jagüitas / Four Corners (12.5 km)	--

Source: General Directorate of Projects, May 2016.

Table 2.5.4 Improvement Projects with Financing in Managua City 2016 - 2019

Description	Department	Municipality	Improvement	U/M	2016	Projections			Current Financing Source 2016
						2017	2018	2019	
Feasibility and Design for the Improvement of the Road Tipitapa-Empalme San Benito (23.00 km)	Managua	Tipitapa		km	Studies	2	3	3	IDB-PAST III
Feasibility and Design for the Improvement of the Road Piedrecitas-Mateare (18.07 km)	Managua	Managua, Mateare		km	Studies		3	3	National
Improvement of the Stretch of Road Roundabout Jean Paul Genie - Roundabout Ticuantepe	Managua	Managua, Ticuantepe	MAC	km	1.5	1	1		National
Improving the Road to California - San Diego - Municipality Villa El Carmen	Managua	Managua, Villa El Carmen	Paving Stones	km	2	2	2	1	National
Road Coating The Conchitas-San Rafael del Sur	Managua	El Crucero	Coating of Road	km	15.73				National
Coating of Road La Garita- Tipitapa	Managua	Tipitapa	Coating of Road	km	3.6				National
Rehabilitation of the Road Quebrada Honda - San Francisco Free	Managua	Tipitapa	Rehabilitation of Roads	km	1.5				National
Rehabilitation of the Road Wit Victory of July - Malacatoya	Managua	Tipitapa	Rehabilitation of Roads	km	10				National
The Sabana Grande - Proinco - Cofradia	Managua	Tipitapa	Rehabilitation of Roads	km	5.6				National

Source: Ministry of Transport and Infrastructure, March 2016

The Ministry of Transport and Infrastructure (MTI) also has projects that improve the access to Managua. There are nine projects with funding for the year 2016, and there are three in the process of financing and other four projects which do not have financing yet. The details are shown in Table 2.5.4, Table 2.5.4 and Table 2.5.6, respectively.

The project of the ring road is a very important project. A ring road might divert a part of the traffic flow and international logistics between municipalities, which enters the Pan-American North and Carretera a Masaya unnecessarily and contributes to congestion in the urban area of Managua.

Table 2.5.5 Projects in the Process of Financing

In Management of Funding to the 29-02-16	Length (km)
World Bank (B.M)	
The Garita-Tipitapa	6.60
Korea (USD 75 million)	
Managua (Ticuantepe Bypass - Santo Domingo - San Judas-Nejapa)	15.74
Yucatan－Mexico (USD 67 million)	
Nejapa-Nandaime	58.17

Source: Ministry of Transport and Infrastructure,March 2016

Table 2.5.6 Projects without Source of Financing for Construction

Projects	Department	Municipality	Total Length	U/M	2016	2017	2018	2019
Improvement of the Road Free Zone - Sabana Grande - Proinco - TIP TOP	Managua, Masaya	Managua, Masaya	22.5	km	Designed	1.00	5.00	5.00
Improvement of the Road the Stones (Km. 6+830) - Mateare	Managua	Managua, C. Sandino, Mateare	18.07	km			3.00	3.00
Improvement of the Nejapa Road - the Cruise - Diramba - Jinotepe - Nandaime	Managua	Managua, The Cruise, San Marcos, Diramba, Sta. Teresa, Nandaime	58,17	km	Designed		4.00	6.00
Improving the Way toBoquete - Santa Ana, in the Municipalities of the Cruise and Villa Carlos Fonseca	Managua	The Cruise, Villa El Carmen	12.05	km	Designed		2.00	2.00

Source: Ministry of Transport and Infrastructure, March 2016

The PITRAVI (1999), previous transport master plan project by JICA, identified a lot of projects, and the current situation of implemented and notimplemented projects is shown in Table 2.5.7 .

Table 2.5.7 List of Projects Identified by PITRAVI

PITRAVI (1999)	Present 2015	Remark
Road		
1) Pan-American North	Partially implemented	MTI responsible
2) Intersection	Without implementation	Road from the Country Club could be part of a cross roads in coordination with other routes of ITNS
3) John Paul II	Without implementation	Design stage
4) Pan-American South	Partially implemented	MTI responsible
5) Portezuelo	Without implementation	ALMA responsible
6) Bypass of Rural Road	Partially implemented	Design stage MTI responsible
7) Sabana Grande	Partially implemented	ALMA responsible
8) Ave RubenDario - Carretera e Masaya	Partially implemented	MTI responsible
9) New highway to León	Partially implemented	MTI responsible
10) Old Road to Leon	Partially implemented	MTI responsible
11) Alternative road to Masaya	Partially implemented	A part of this is national road
12) Road Packages in the Center (Short term)	Annual budget is allocated to the lining of dirt streets	
13) Road Packages in the Center (Mediumterm)	Annual budget is allocated to the lining of dirt streets	
14) Road Packages in the Center (Longterm)	Annual budget is allocated to the lining of dirt streets	
15) Road Packages in the West (Mediumterm)	Annual budget is allocated to the lining of dirt streets	
16) Road Packages in the West (Longterm)	Annual budget is allocated to the lining of dirt streets	
17) Road Packages in the South (Short term)	Annual budget is allocated to the lining of dirt streets	
18) Road Packages in the South (Mediumterm)	Annual budget is allocated to the lining of dirt streets	
19) Road Packages in the South (Mediumterm)	Annual budget is allocated to the lining of dirt streets	
20) Road Packages in the East (Shortterm)	Annual budget is allocated to the lining of dirt streets	
21) Road Packages in the East (Mediumterm)	Annual budget is allocated to the lining of dirt streets	
22) Road Packages in the East (Longterm)	Annual budget is allocated to the lining of dirt streets	
23) Road Maintenance	Annual budget for the maintenance of the road network is allocated	

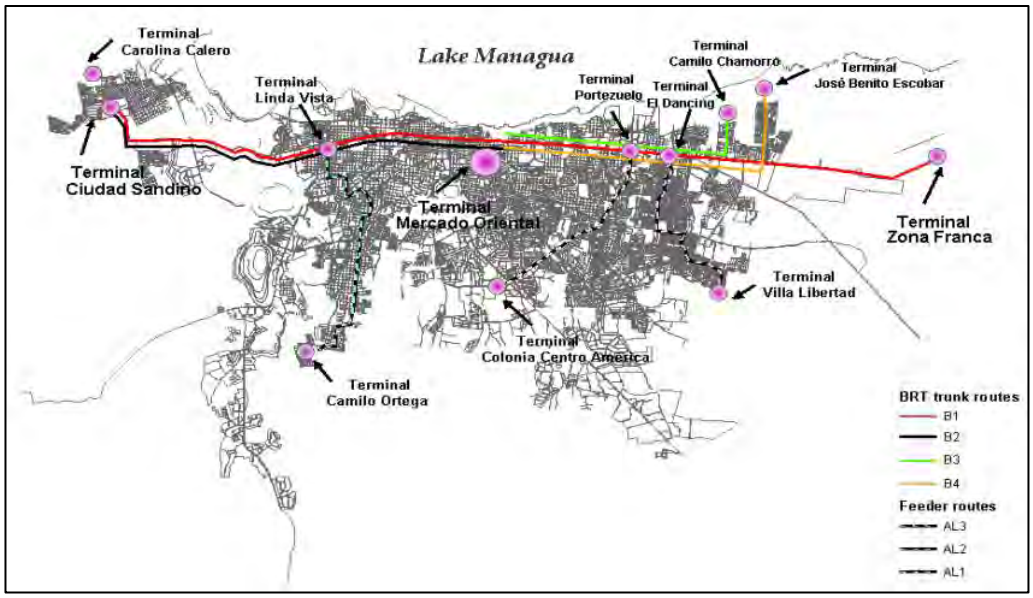
Public Transport		
1) Public Transport Corridor (Road North)	Without implement	Feasibility study was conducted
2) Public Transport Corridor (J. Paul/ S. Large)	Without implement	
3) Improved Security	Police are doing campaigns, but still lack of work	IRTRAMMA responsible for this item
4) Driving	Improve the Regulation on the Transport of buses and taxis Control	IRTRAMMA responsible for this item
5) Fare Adjustment	The fare is subsidized with 2.5 Cordobas	IRTRAMMA responsible for this item
6) Introduction of a New Service	Without implement	IRTRAMMA responsible for this item
7) Public Bus Terminal (Eastern Market)	Without implement	IRTRAMMA responsible for this item
8) Public Bus Terminal (Market Sao Judas)	Without implement	IRTRAMMA responsible for this item
9) Public Bus Terminal (CRSF. Virgin of Candelaria)	Without implement	IRTRAMMA responsible for this item
10) Public Bus Terminal (Villa Flower)	Without implement	IRTRAMMA responsible for this item
11) Public Bus Terminal (Sabana Grande)	Without implement	IRTRAMMA responsible for this item
12) Public Bus Terminal (Satellite City Asosocca)	Without implement	IRTRAMMA responsible for this item
Traffic Management		
1) Improvement of the Existing Signals	Annual budget is allocated for the maintenance of road signs	Lack to implement, especially the informative signage of streets and avenues
2) Signals and Coordinated Control (a kind term)	Intelligent traffic light is being installed	There are only 52 intersections with system of traffic lights and Smart Control Center.
3) Signals and Coordinated Control (Mediumterm)	Intelligent traffic light is being installed	
4) Signalling (Longterm)	Annual budget is allocated for the maintenance of road signs	
5) Degree of Separation (Short term)	Rubenia, Central America, Portezuelo	In the design step to gradient new highway to León (Pebbles)
6) Overpasses (Mediumterm)		Designed six overpasses at the Track John Paul II, built only 04
7) Degree of Separation (Longterm)		
8) Construction of Roundabouts (Short Term)	Partially implemented	Roundabout Metrocentro, Christ the King, the Virgin, Air Force, Hugo Chavez, the Journalist, Jean Paul Genie
9) Construction of Roundabouts(Medium	---	---

Term)		
10) Construction of Roundabouts (Long Term)	---	---
11) Steps or Pedestrian Cruises	Partially implemented	
12) Path of the Bicycle and Pedestrian Path	There is a United Nations Development Programme (UNDP) project implemented by IRTRAMMA	
13) Exclusive Area for Public Transport	There are bays for public transport in stops, but there is no dedicated lane	
14) Prohibited Area of Park on the Track	Rules of the road system prohibition and parking on tracks	
15) Increase of the Tax on the Fuel Consumption	---	---
16) Increase in Cargo Vehicles of Import	---	---
17) Designation of Truck Routes	---	MTI responsible

Source: JICA Study Team

(2) BRT Projects (2004 design was prepared)

There are some plan for Bus Rapid Transit (BRT) projects along the Pan-American North. The conceptual design was prepared in 2004, based on the recommendations by JICA (PITRAVI, 1999) and a study by IDB (2001). The figure below shows the concept of the BRT corridor with its feeder routes. As it has been more than ten years since the latest technical study was completed in 2004, it is desirable to revise not only the demand, but also the current physical conditions of the infrastructure and available technologies in order to choose an appropriate option. Another corridor is along the Juan Pablo II, which was also included in PITRAVI, as one of the bus corridor projects together with Sabana Grande.



Source: Document of Proyecto Award 48774 (UNDP)

Figure 2.5.5 Layout of BRT Route along Pan-America North

(3) National Transport Plan by the Government of Nicaragua (2014)

MTI prepared the National Transport Plan in 2014 with support from the Japan International Cooperation Agency (JICA). The projects relevant to Managua City are listed in Table 2.5.8 below. None of the listed projects has been developed yet, but these are related to this project.

Table 2.5.8 List of Projects in the National Transport Master Plan Relevant to Managua City

Project name	Description
Ring road (of Metropolitan)	L=30 km, starting from San Benito on NIC-1 passing by km 10 of Carretera Masaya then connected to NIC-12
Logistic park	Located at the logistic park in the west of Managua for Pacific corridor Located at the logistic park in the east of Managua for Atlantic corridor
Larger capacity bus	Introduce larger-sized buses, in high-demand route including Managua - Masaya, Managua - Granada and Managua – Chinandega
Bus terminal improvement	Bus terminal improvement in Managua (three terminals), Tipitapa, Masaya and Granada in the Metropolitan area

Source: National Transport Plan of Nicaragua (2014)

(4) Bicycle-lane Development (2013 - 2016)

Promotion of environmentally sustainable transport for Managua Metropolitan area *(Promoción de Transporte Ambientalmente Sostenible para Managua Metropolitana*) is a project that aims to develop bicycle lane network in Managua Metropolitan area to reduce the greenhouse gas emission in the transport sector, to improve the safety of bicycle riders and pedestrians, and to revitalize the cities. The project started in 2013 by the Regulating Institute of Transport of the Managua City (IRTRAMMA) and ALMA, which was financially supported by the Global Environmental Fund (GEF), and administratively supported by the United Nations Development Programme (UNDP).

The project proposed the design and network of bicycle lanes in Managua Metropolitan area. As of May 2016, a part of network within the neighbourhood area such as Monseñor Lezcano is approved by the ALMA and is waiting for budget allocation for implementation.

(5) Managua - Masaya - Granada Railway Project

"Proyecto de Reimplantacióndel Ferrocarril del Pacífico: tramo Managua - Masaya - Granada" is the project led by MTI and carried out by a Nicaraguan consultant. The proposed railway has 59.3 km length, composed of three parts: first part has a length of 12.7 km from the airport to Managua (red line in Figure 2.5.6), second part at a length of 45.1 km from the first part connection to Granada (blue line), and third part a 1.5 km from the second part connection to the airport (pink line).

Source: PRONicaragua

Figure 2.5.6 Route of Managua - Masaya - Granada Railway Project

2.5.3 Infrastructure Project

(1) Master Plan of Flood Drainage in Managua City by IDB (2016 - 2017)

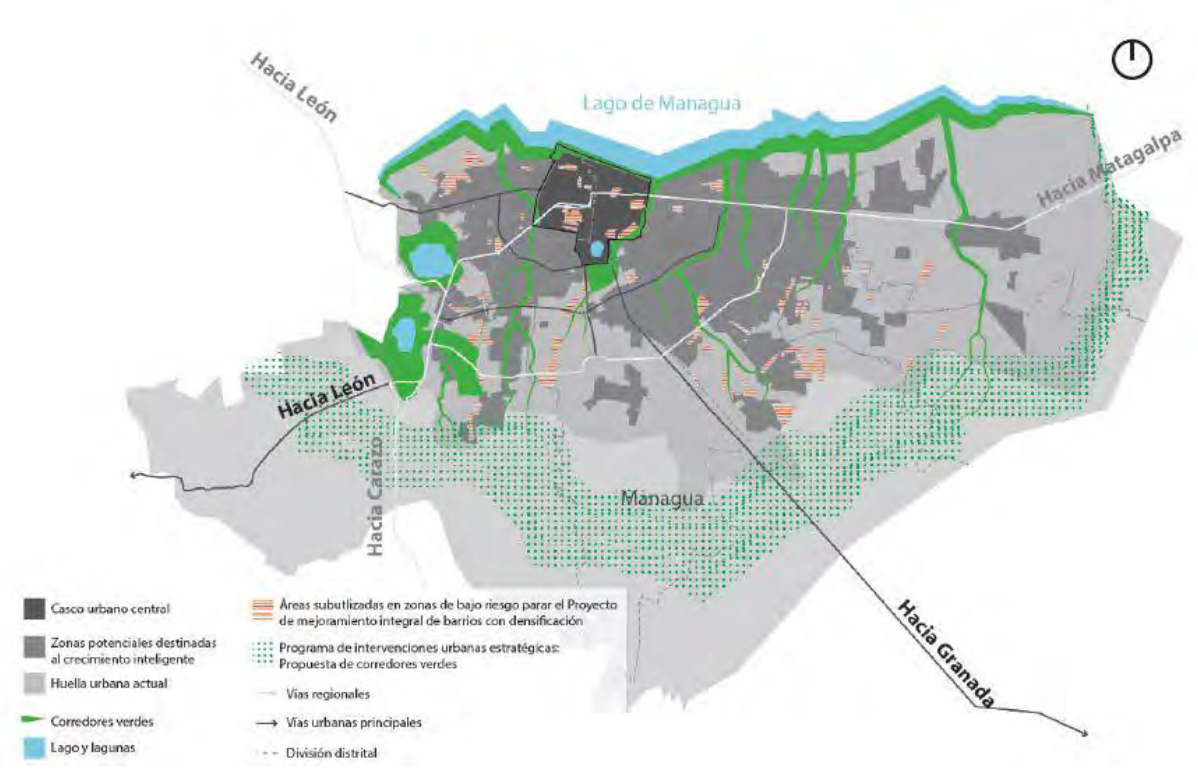
ALMA has implemented several flood measures through its by own budget or financial and technical supports by the central government and international donors. IDB have implemented a drainage project, preparation of flood drainage master plan for Managua City under the program called as ESCI-II. The project started from December 2016 and will complete October 2017. Table 2.5.9 summarizes the project. Detailed design works of two tunnel rivers: downstreams of 1) *Cauce San Isidoro de la Cruz Verde* under *Tiscapa Cauce* System and 2) *Cauce Ramal Cuajacjillo* under *Occidental Cauce* System will be carried out in the study. The master plan will determine proposed green corridors which will

allow the creation of a buffer zone and environmental protection with restricted use, so it will fulfill a double function: as an environmental support of the city, and an instrument of containment and control of urban expansion. The buffer zone will be composed of areas that must be protected and should not be urbanized due to topographical, soil and agroecological restrictions. The green corridors will integrate the protected areas and sites with archaeological, patrimonial and historical value of the city and its development will be throughout the rounds of water protection.

Table 2.5.9 Summary of Master Plan of Flood Drainage Project (IDB)

Project Name	Master Plan of Flood Drainage in Managua City: Plan de Maestro de Escorrentía Superficial del Municipio de Managua, Nicaragua (PMES)
Counterpart Agency	ALMA and other related agencies
Study Area	Managua city and upstream basin of cauces flowing into the city
Objectives	To prepare a master plan of flood drainage in Managua city to mitigate flood damages in Managua city
Scope of Works	• Compilation of basic information including topo-map and hydrological data • Hydrological/ hydraulic analysis of *cauce* systems in Managua city • Study on land use for both the current and future conditions, taking into account land management plans • Study on soil distribution to prepare hydrological model • Review on existing flood dranage system • Hydrological analysis to determine design flood discharge • Identification of flood-prone areas and flood issues in Managua city • Alternative study on flood measures (structural and non-structural measures) • Preparation of conceptual design or feasibility study • Preliminary cost estimate of flood measures • Preparation of environmental program • Environmental impact assessment on selected flood measures • Urban component • Social participate • Financial analysis • Formulation of a master plan of flood drainage • Preparation of Terms of Reference for the contracting of consulting services for the purpose of carrying out final design projects (technical, economic, financial, social, environmental and legal) of all civil works
Expected Experts	1) Team leader/ flood master plan specialist, 2) Hydrologist, 3) Hydraulics specialist, 4) Hydrodynamic modeling specialist, 5) Environmental/ watershed management specialist, 6) Hydraulic structural engineer, 7) Civil engineer, 8) Economist, 9) Urban planning specialist, 10) Urban design specialist, 11) Institutional law specialist, 12) Flood risk management specialist, 13) Social participation specialist, 14) Geologist, 15) Topographical specialist

Source: JICA Study Team prepared based on "*Solicitud de Propuesta No., Plan Maestro de Escorrentia Superficial del Municipio de Managua, Fecha: 07 de Septiembre de 2016*".
: World Bank , "*Plan of Risk Managemente for Urban resilence*"



Source: "*Solicitud de Propuesta No., Plan Maestro de Escorrentia Superficial del Municipio de Managua, Fecha: 07 de Septiembre de 2016*"

Figure 1 Conceptual Map for Pilot Project of Green Corridors

(2) Technical Assistant Project on Capacity Building to National System for Disaster Prevention, Mitigation and Attention (SINAPRED) by UNDP (2013 - 2014)

UNDP made a technical assistance on capacity building to SINAPRED and Managua City (District II, etc.), for the purpose of recovery of the areas affected by the April 2014 earthquake. The specific issues of technical assistance are recovery plan formulation, training to people in community level, preparation of guideline for damage survey of infrastructures, etc.

(3) Technical Assistant Project on Capacity Building to the Municipal Committees for Prevention, Mitigation and Disaster Relief (*Comité Municipales para la Prevención, Mitigación y Atención de Desastres* COMPURED by the European Unition (EU)

EU has made a continuous technical assistance since 2010 on capacity building to SINAPRED and Managua City, for the purpose of disaster mitigation. The specific issues of technical assistance are capacity building to COMUPRED, formulation of contingency plan, preparedness of community, etc.

(4) Integrated Plan for solid waste management (*Plan Integral para la gestión de residuos sólidos)* (AECID) (2008 - 2013)

"*Proyecto de Desarrollo integral del barrio de Acahualinca*" was implemented by the support of AECID from 2008 to 2013. The project covered three components as outlined in Table 2.5.10.

Table 2.5.10 Component of "Proyecto de Desarrollo Integral del Barrio de Acahualina"

Project	Contents
1. Improvement of waste management practices	Integrated solid waste management plan was devised with the support of UN HABITAT and AECID.
2. Construction of infrastructure and installation of new technologies	It ended the open dumping practices by introducing the sanitary landfill site. It also supported with the construction of the sorting facility and composting facility.
3. Social development project	Waste pickers who were living on the open dumping site through recycling activities at the dumping site were provided housing at the land adjacent to the landfill site. Schooling and other social participation opportunity, employment at the sorting facility at the landfill site, as well as micro credit are provided (support is still continuing until today).

Source: Based on interview with AECID

(5) Improvement and Expansion of the Service of Water and Sanitation in the Metropolitan Managua by PRASMA-World Bank (2007 - 2015)

The water and sanitation project in Managua (PRASMA-World Bank), with a cost of USD 40.0 million was carried out in the period of 2007-2015. The studies were conducted requiring macro sectoring of the distribution network. Water and sewerage works for 27 neighborhoods were carried out, and was made partial rehabilitation of the field of wells in Districts 1 and 2 in Managua City, substituting a total of nine wells. The construction of the sewerage system was carried out in the neighborhoodHermosoAmanecer while the construction of a module of wastewater treatment in Ciudad Sandino.

(6) Water Supply Program for Managua by IDB (2011 - 2015)

The IDB loan 2471/SF-or the Program of Water to Managua City amounting to USD 30.0 million was financed in the year 2010.This program consisted of two main components as follows: One is the improvement and expansion of the water and sewerage services in Managua City with emphasis on the neighbourhood and human settlements. This component provided the funding for the improvement of the water distribution system in 20 settlements, installing over 50 km of pipelines, more than 8,000 new connections with meters, rehabilitating 50 wells, building 11 new wells, and other sectorization and leak reduction measures in Las Jagüitas Esquipulas, and Ticuantepe. In addition to the replacement of drinking water networks, the sanitary sewage systems were established in 15 neighborhoods of Managua City. The other is strengthening the management of ENACAL especially for the administration, operation and maintenance of services, energy efficiency, reduction of non revenue water (ANF), Remote Control Systems, and equipment for maintenance.The implementation of the program was provided for the period between 2011 and 2015.

Source: JICA Study Team

Figure 2.5.7 Motor on a Well Replaced by IDB Project

Source: JICA Study Team

Figure 2.5.8 Existing Well Necessary for Rehabilitation Works

(7) Package of Complementary Measures to the Municipal Waste Water Treatment Plant (MWWTP) by the German Bank (KfW) (2015)

In May 2015, the German and the Nicaraguan governments signed a loan agreement for funding apackage of complementary measures for the MWWTP; EUR 6 million by KfW and EUR 0.6 million by the Central Government. The project will ensure that the treatment processes in the MWWTP will retain its efficiency and that the subsequent quality of treated wastewater discharged into the Managua Lake, which should be acceptable to ecological and environmental conditions. The project will be carried out in 3.5 years with the following four components: (i) Referred to the expansion and optimization of the treatment process, including the replacement of two primary sludge pumps, installation of two mechanical thickeners , construction of two additional secondary sedimentation tanks, construction of one additional primary settling tank, and construction of an aerated grit chamber, (ii) Construction of a co-generation plant base on biogas utilization including biogasmicro-turbines, pre-treatment facilities and a gasometer, (iii) The expansion of the solar drying capacityby equipping the sixth gallery with a Wendewolf system, and construction of an additional warehouse for the biosolids storage, and (iv) To promote a consultancy service to support ENACAL for the proper implementation and efficient management of the project.According to official information, once the biogas cogeneration plant operates,it will allow ENACAL to save an electricity bill of approximately USD 837,000 in invoice for the year 2018, reaching USD 958,000 dollars in the year 2025.

(8) The Comprehensive Program of Sectoral Human Water and Sanitation of Nicaragua (PISASH) by AECID (2014 - 2019)

The Comprehensive Program of Sectoral Human Water and Sanitation of Nicaragua (PISASH) is a strategy of the Government of Nicaragua, designed up to twenty years. Phase I of the PISASH is executed by the ENACAL with a total budget of USD 337 million in the period 2014-2019.This Phase I PISASH is financed with resources of the grant of the Spanish Agency of International Cooperation for Development (AECID) and of the European Union through the initiative of the Latin American

Investment Facility (LAIF), lending resources of the Central American Bank for Economic Integration (CABEI) and the European Investment Bank (EIB) as well as the own contributions of the Government of Nicaragua.In this first phase, it will be the improvement and expansion of the potable water supply systems and sanitation in 19 cities and the preparation ofproject portfolios for other 17 cities, this also generates a great impact on the improvement of the management and operational capacity of ENACAL.In the second phase, five other cities will be incorporated to the program. However, it has no allocated projects for potable water supply system in Managua City.

(9) The Master Plan Study on Efficiency Operation of ENACAL by World Bank (2016 - 2017)

The World Bank financed a consultant to study *Plan Maestro de Eficiencia Opertivaen ENACAL*, submitted in October 2015.This project was directly focused on two objectives of reducing energy costs by the utility and to reduce non-revenue water. The study highlights that the non-revenue water greatly affects the costs for energy in the system. It also notes that non-revenue water remains high despite the previous projects designed to reduce it.

CHAPTER 3 URBAN PLANNING

3.1 Managua in Regional Context

3.1.1 Managua in International and National Context

(1) Nicaragua in Central America

Nicaragua is one of the seven Central American countries, namely: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Belize, and Panama. Nicaragua is encompassed on both sides of the country by the two seas, the Pacific and the Caribbean, and is bordered in the north by Honduras and in the south by Costa Rica. Panama has the Panama Canal, which connects the two oceans, but Nicaragua also has a plan for a second canal connecting the two seas.

The Pan-American Highway, which connects the United States and Canada in the North American Continent and all the way to the southern tip of the South American Continent, also runs through Nicaragua. With respect to logistics, Nicaragua has only a container handling facility at the Corinto Port, located on the Pacific Sea about 150 km from Managua City. For air traffic, Managua City accommodates the August C. Sandino International Airport in the eastern part of the city about 30 minutes' car ride, which is the main gateway to Nicaragua by air.

Table 3.1.1 shows the population, the gross national income (GNI), GNI per capita, and GNI growth rate for the seven countries in Central America. In terms of the nation's population, Nicaragua is ranked fourth, or in the medium range, but for the size of GNI, Nicaragua is the second from the bottom after Belize whose population is the smallest among the seven countries. In terms of GNI per capita, Nicaragua is the least among the seven nations. In contrast, in terms of GNI growth rate, Nicaragua ranks second only after Panama which shows high expectation for the future.

Table 3.1.1 Population and Gross National Income of Central American Counties

County	Population (Million)	GNI (USD in Billion)	GNI p.c. (USD p.c.)	GDPGrowth Rate (%, 2013.)
Guatemala	15.5	51.6	3,340	3.7
Belize	0.3	1.5	4,510	1.5
Honduras	8.1	17.7	2,180	2.6
El Salvador	6.3	23.6	3,720	1.7
Nicaragua	6.1	10.9	1,790	4.6
Costa Rica	4.9	46.5	9,550	3.5
Panama	3.9	41.3	10,700	8.4

Source: World Bank, World Development Indicators, 2015
Note: GNI = Gross National Income (Atlas Method)

It should be noted that economic integration is in progress in Central America. The five nations in Central America (Guatemala, Honduras, El Salvador, Nicaragua, and Cost Rica) have been launching Central America Free Trade Area (CAFTA) with the United States, to which Dominican Republic joined (CAFTA-DR). The agreement has been reached and CAFTA-DR is awaiting enforcement. The CAFTA-DR promotes stronger trade and investment ties, prosperity, and stability throughout the region.

(2) Position of Managua City in Central America

Table 3.1.2 shows the capital cities of seven countries in Central America with some characteristic parameters. In the capital cities of Central America, the most populous city is Guatemala City of Guatemala with a population in excess of two million, and the second is Managua City of Nicaragua. Followed by Tegucigalpa of Honduras.

The population density of the capital cities ranges from 1,600 person/km^2 in Belize City to 7,900 person/km^2 in San Salvador and San Jose. Managua's density is 5,173 person/km^2, which in the medium range among the seven capitals cities in Central America.

Finally, for each of the capital cities in Central America, the City Income Index is calculated. City Income Index is defined by gross national income per capita x city population, which essentially indicates the relative size of the city residents' total income. As shown in the table, among the capital cities in Central America, Panama City is in the position to pursue the central city in the region, followed by Guatemala City. Managua City is in the fourth place after San Jose. Managua City is in a position to pursue one of the major "sub-centers" in Central America supplementing Panama City.

Table 3.1.2 Population, Density, and Income of Capital Cities in Central American Countries

Country	Capital City	Population of Capital (1,000 per.)	Area of Capital (km^2)	Population Density (per./km^2)	GNI p.c. (USD p.c.)	City Income Index (USD mil.)
Guatemala	Guatemala City	2,110	692	3,049	3,340	7,047
Belize	Belize City	57	36	1,604	4,510	258
Honduras	Tegucigalpa	1,127	202	5,593	2,180	2,457
El Salvador	San Salvador	568	72	7,862	3,720	2,113
Nicaragua	Managua	1,495	289	5,173	1,790	2,676
Costa Rica	San Jose	352	45	7,892	9,550	3,362
Panama	Panama City	813	275	2,956	10,700	8,699

Source: Respective statistical office, ALMA for Managua's figure.

(3) Position of Managua in Nicaragua

Managua City is the primary city, or the city with the largest population in Nicaragua. The second largest city in Nicaragua is Leon with the population of 167,164 in 2015[1].

Managua City is the capital city of Nicaragua. Thus, the presidential office and the national assembly, as well as most of the central government offices are located in Managua City. In addition, Managua City is the center of higher education, with a number of educational institutions. Some of the universities,

[1] POBLACION URBANA ESTIMADA MUNICIPAL PERIODO 2012-202, INIDE

which are located in Managua include, the National Autonomous University of Nicaragua, which has its headquarter in Leon; however, the main campus is in Managua City; Nicaragua Polytechnic University; and Central American Institute of Business Administration.

Managua City is also playing a central role in the economy. Managua City has a number of Nicaraguan firms' headquarters including those of financial institutions such as Banco de la Producción and Banco de América Central. Managua City also has a number of commercial complexes and markets, including notably the Oriental Market. Furthermore, Managua houses national or regional operation centers of international firms such as Wallmart and Telefónic. International hotel franchises such as Crowne Plaza, Best Western, Inter Continental, and Holiday Inn are located in Managua City.

3.1.2 Roles and Functions of Managua in Regional Context

(1) Review of the Existing Studies for Managua City's Function in a Regional Context

ALMA (*Alcaldía de Managua*) discussed the function of Managua City from a regional perspective in "Plan de Acción Pala la Región Metropolitana [Action Plan for the Metropolitan Region]", published in 2007. Later, in 2013, Inter-American Development Bank (IDB) published the "Plan de Acción Managua Sostenible [Sustainable Action Plan Managua]", in which sustainability of Managua City was discussed in regional point of view.

1) Plan de Acción Pala la Región Metropolitana (ALMA 2007)

ALMA referred to metropolitan region of Managua as RMM in the "Plan de Acción Pala la Región Metropolitana [Action Plan for the Metropolitan Region]" and pointed out functions of Managua in regional context as follows:

RMM is a territorial unit functionally inter-related with the city of Managua, which constitutes 29 surrounding municipalities in the departments of Carazo, Masaya, Granada, and Managua.

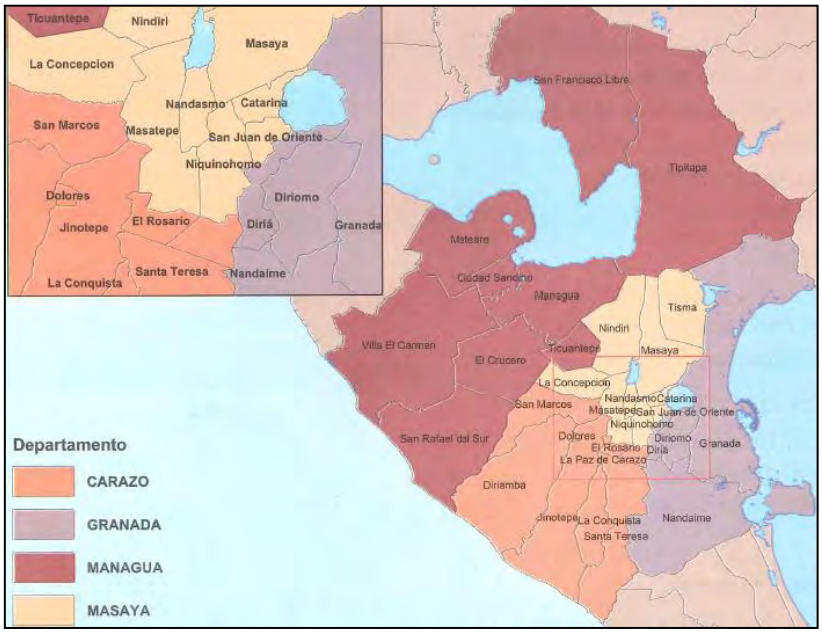
The functional relation of the municipalities of the RMM manifests through certain aspects:

- Relations with the Managua City by its statusasthe capital of the republicand for being the headquarters of political power: the National Assembly, the Central Government, and the Supreme Court.
- Relations with the Managua City inspecialized services such as international or regional headquarters office function, high level medical care, higher education, external migration, headquarters of the National Assembly.
- Relations with the Managua City by its installed capacity: urban employment capacity, purchase of goods (e.g., consumer products at the oriental market) and various specialized services.
- Relations with major cities of the regionfor its departmental or regional role: Court of Appeals, day to day medicalcare, secondary and higher education. And relationships by theircapacitiesofcity: urban employment, financial services, purchase of goods and services.

- Relations with the municipalities of theregion: access to employment and public service and purchase of basic goods and services.

Source: ALMA

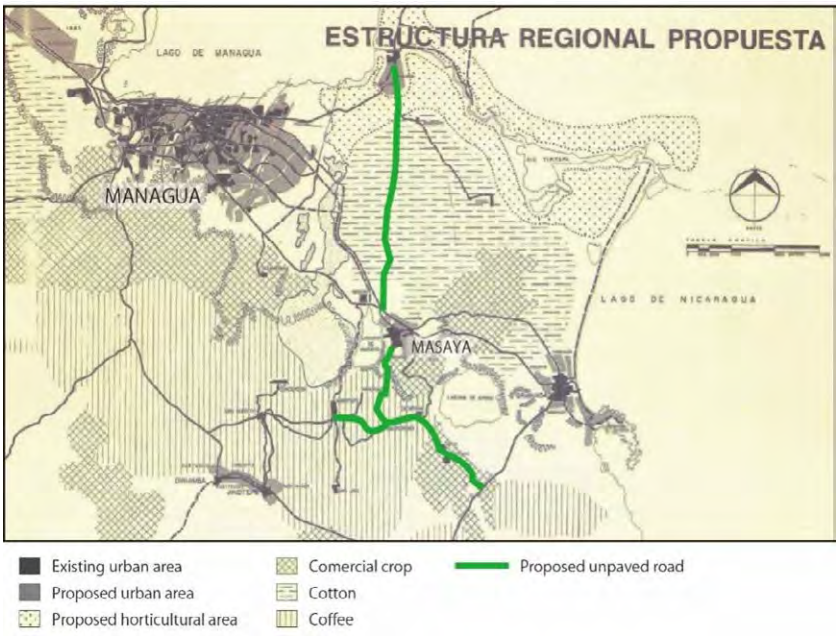
Figure 3.1.1 Plan de Acción Pala la Región Metropolitana



Source: ALMA

Figure 3.1.2 Location of Municipalities Constituting RMM

After the devastating earthquake in 1972, the Mexico's Survey Team proposed a future regional structure for the year 2000 (see Figure 3.1.3). It suggested some extent of urbanization in the vicinity of the existing urban area, while proposing a new horticultural crop area. It also proposed to build a new unpaved road running north to south, indicated as green line in the map below. The road has been developed as the current route 11A.



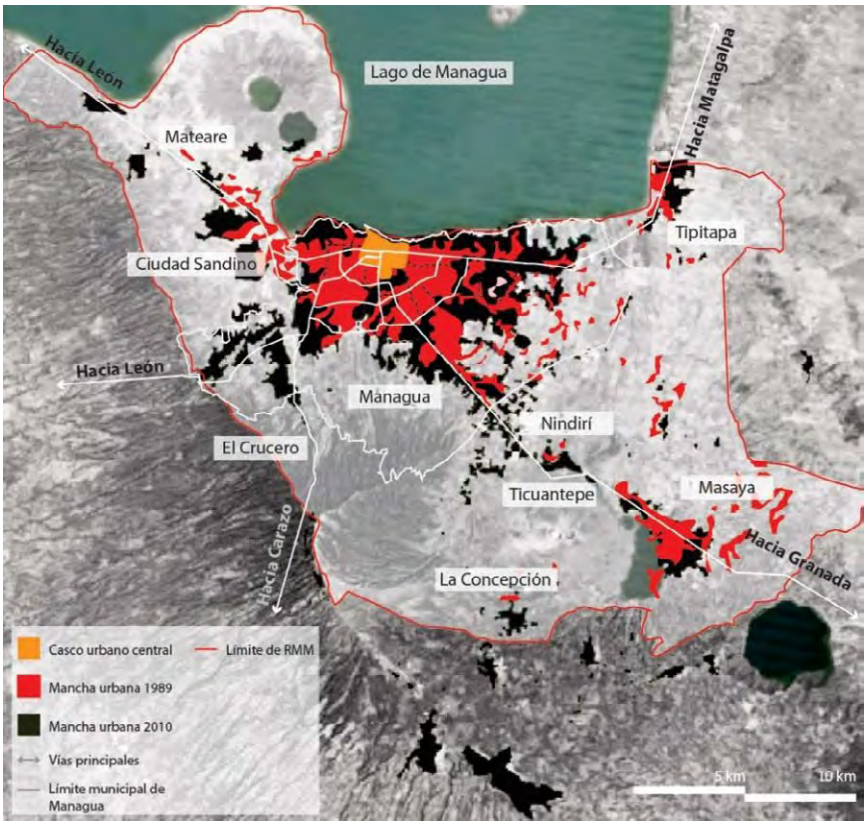
Source: ALMA, JICA Study Team

Figure 3.1.3 Mexican Proposal in 1973

2) Plan de Acción - Managua sostenible (IDB 2013)

IDB argued sustainability of Managua on a regional scale in the report "Plan de Acción - Managua sostenible" published in 2013. It analysed the issues Managua City faces; greenhouse gases emission, disaster risk and climate change, growth and expansion of the urban footprint. And it compares uncontrolled urban expansion scenario with controlled and planned scenario in the future.

It positioned Managua City as the main city at the national and departmental level, part of the so called "Metropolitan Area of Managua", formed by surrounding nine municipalities. It mentioned that the formation of the metropolitan area has been given by their functional interrelationships which include the exchanges at the economic and social level, in institutional and management aspects of the territory. Also it pointed the dynamics of this metropolitan area that is displayed in its accelerated population growth - in a single decade its growth was around 70%.



Source: IDB

Figure 3.1.4 Managua Metropolitan Region

(2) Natural Environment of Managua Metropolitan Region

Managua City and the surrounding areas lie in the rolling terrain between two large lakes, Managua Lake (Lago Xolotlan) in the north and Nicaragua Lake (Lago Nicaragua) in the east. There are several natural resources in and surrounding Managua City such as natural reserves, a national park, and a wildlife refuge defined as follows:These natural resources could be said as tourism resources for this region, and attract many international and domestic tourists here. The following are illustrated the National Park, the wildlife refuge and the natural reserves of the region. These natural resources could be considered as tourist resources for the region, making the area more attractive for national and international tourists.

National Park

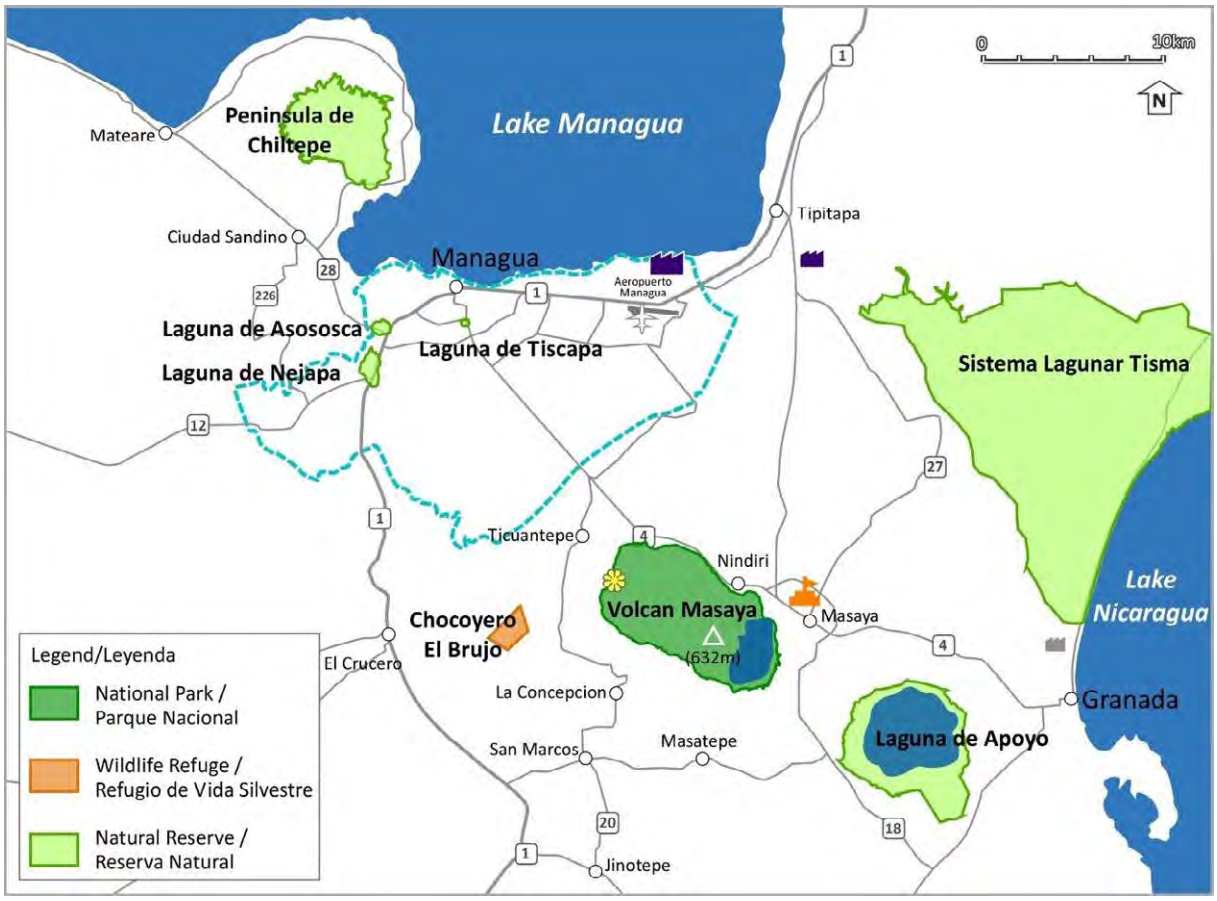
- Volcano Masaya

Wildlife Refuge

- Chocoyero El Brujo

Natural Reserve

- Laguna de Asososca
- Laguna de Nejapa
- Laguna de Tiscapa
- Peninsula de Chiltepe
- Sistema Lagunar Tisma
- Laguna de Apoyo



Source: JICA Study Team based on the data by MARENA

Figure 3.1.5 Natural Resources in Managua City and the Surrounding Area

(3) Social Environmentof Managua Metropolitan Area

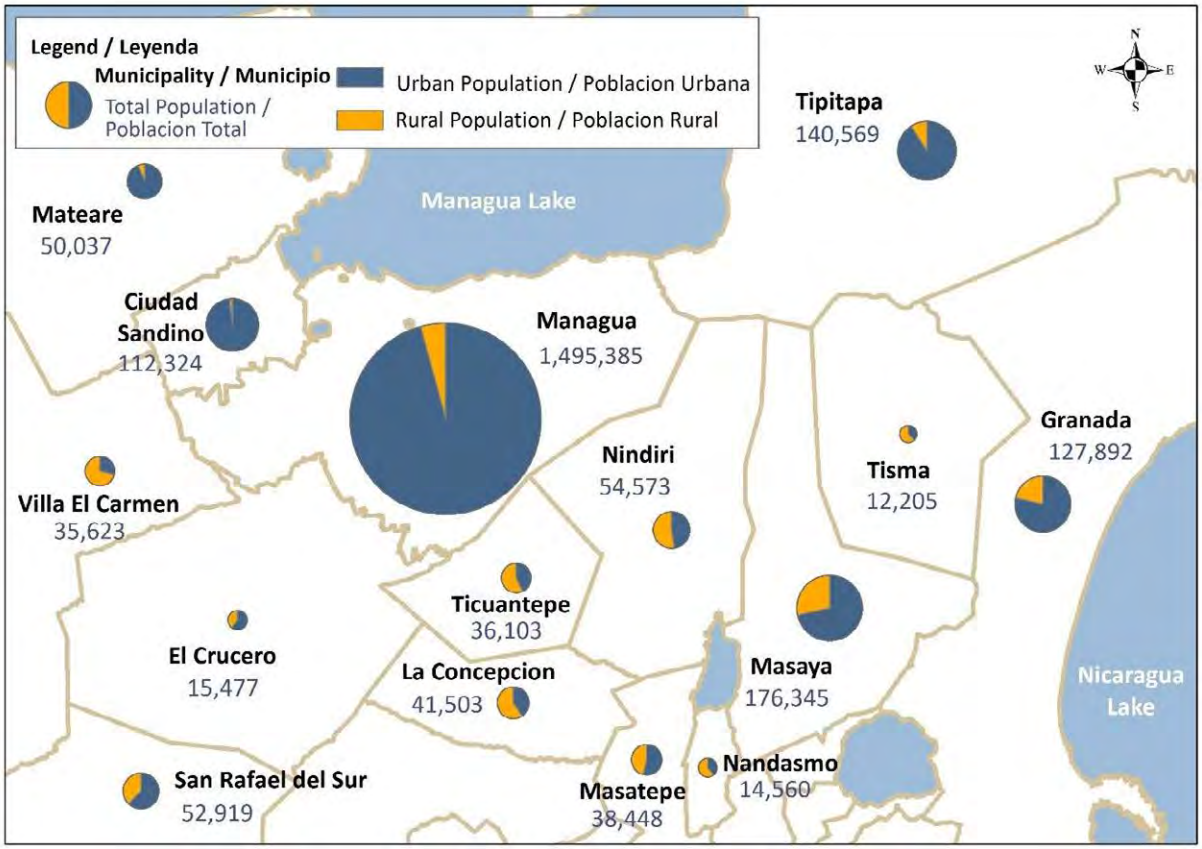
The Managua Metropolitan area consists of nine municipalities as discussed in the previous section. According to the data of ALMA and the National Information and Development Institute (*Instituto Nacional de Información de Desarrollo*: INIDE), the population of the metropolitan area in 2016 was estimated as shown in Table 3.1.3. The total population of the Metropolitan area was more than 2.1 million in which urban population accounted for around 1.9 million, or 90% of the total. Notably, the urban population is dominant in the following municipalities, namely: Managua, Sandino City, Mateare, Tipitapa, and Masaya.

Table 3.1.3 Population of Metropolitan Area in 2016

Municipality	Total Population	Urban Population	Rural Population	Urban Population Ratio
Total of Metropolitan Area	2,122,316	1,909,246	213,070	90%
Managua*	1,495,385	1,431,566	63,819	96%
Tipitapa	140,569	127,618	12,951	91%
Mateare	50,037	46,639	3,398	93%
Sandino City	112,324	110,083	2,241	98%
Ticuantepe	36,103	15,495	20,608	43%
El Crucero	15,477	9,309	6,168	60%
Nindirí	54,573	25,866	28,707	47%
Masaya	176,345	125,825	50,520	71%
La Concepción	41,503	16,845	24,658	41%

Source: Managua: Total Population from ALMA, Urban and Rural Population estimated by the JICA Study Team
Other cities from "POBLACION TOTAL MUNICIPAL ESTIMADA AL 30 DE JUNIO, PERIODO 2012-2025", INIDE

In the Metropolitan area, Managua City accommodated the largest population in 2016 which accounted for 70% of the total population. Masaya and Tipitapa had relatively large population, although a considerable difference could be recognized between Managua City and other municipalities as illustrated in Figure 3.1.6.



Source: JICA Study Team based on the data from ALMA and INIDE

Figure 3.1.6 Population of Managua City and Neighboring Municipalities

(4) Relations between Managua and Surrounding Cities

Major cities in the surroundings of Managua City are as illustrated in Figure 3.1.7, linked by national and arterial roads such as Pan American Highway (N1), Carratera a Masaya (N4), Carratera Vieja a Leon (N12), and N28. As discussed later in detail, the urbanization growth of Managua City tends to direct toward the southeast and south in recent decades. One axle to the southeast is from Managua for Nindiri, Masaya, and Granada along N4. The other to the south is for El Crucero and Jinotepe along N1 South as illustrated in arrows shown in Figure 3.1.7. Therefore, these cities have strong relationship with Managua City because of large traffics of commuters, tourists, and logistics among these cities, in which Masaya and Granada are considered to have close ties with Managua City. Besides, Sandino City has also close relation to Managua City in consideration of being historically in the same administration area and geographical proximity.

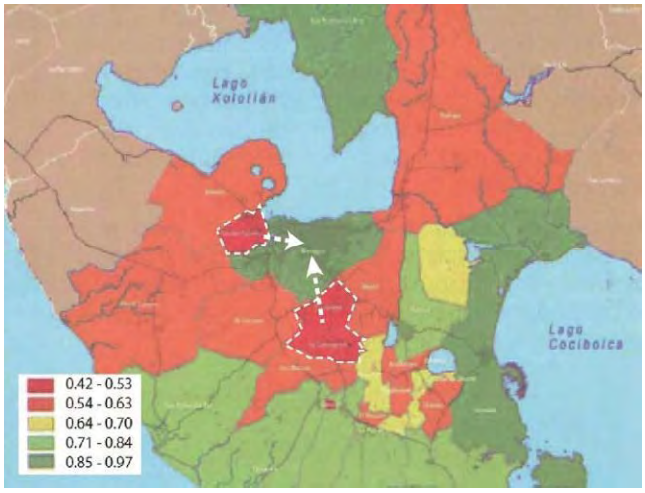
Source: JICA Study Team

Figure 3.1.7 Managua City and Surrounding Cities

Looking at the mobilization in this region, a large number of people commute from the surrounding cities to Managua City to work, in other words, Managua City is a place for providing the job opportunities to the urban population in this region. Figure 3.1.8 shows the proportion of population who works in their domiciled municipality. According to the data, green colored area means more than 70% of the residence had job within the same municipality. Meanwhile, dark red colored area indicated lower percentage (42% to 53%), which means around half of the population had their work outside their

municipality. Thus, people domiciled in Sandino City and Masaya are likely to commute to Managua City according to interview surveys.

Managua City is expected to keep providing job opportunities not only for Managua citizen but also for the urban population in surrounding cities. On the other hand, a variety of workforces including qualified human resources and skilled labour are likely to accumulate in Managua City, foreign investments are also expected to be encouraged in the future.



Source: ALMA, JICA Study Team

Figure 3.1.8 Percentage of People Who Work at their Living Municipality (2005)

Other purposes of people flowing into Managua City are for administrative procedures, transport and travels, shopping, high-level education, advanced medical care, cultural experiences, and urban recreations, since most of the urban functions are concentrated in Managua City as shown in the following Table 3.1.4.

Table 3.1.4 Number of Urban Functions in Managua and the Surrounding Area 2015-2016

	Managua	Jinotepe	Nindirí	Masaya	Granada	Sandino City	El Crucero	Ticuan-tepe	Tipitapa
Airport	1	0	0	0	0	0	0	0	0
Hospital	10	1	0	1	1	1	0	0	n.a.
Registered Public University in the CNU	5	1	0	0	0	0	0	0	0
Registered Private University in the CNU	38	1	0	1	1	0	0	0	0
Museum	3	1	2	4	2	1	0	1	0
Theater	2	0	0	0	0	0	0	0	0

Source: ALMA recaudacion 2015, and JICA Study Team by Hearing Surveys

As the capital of Nicaragua and the center of the region, Managua City has functions as below and is expected to be strengthened in the future.

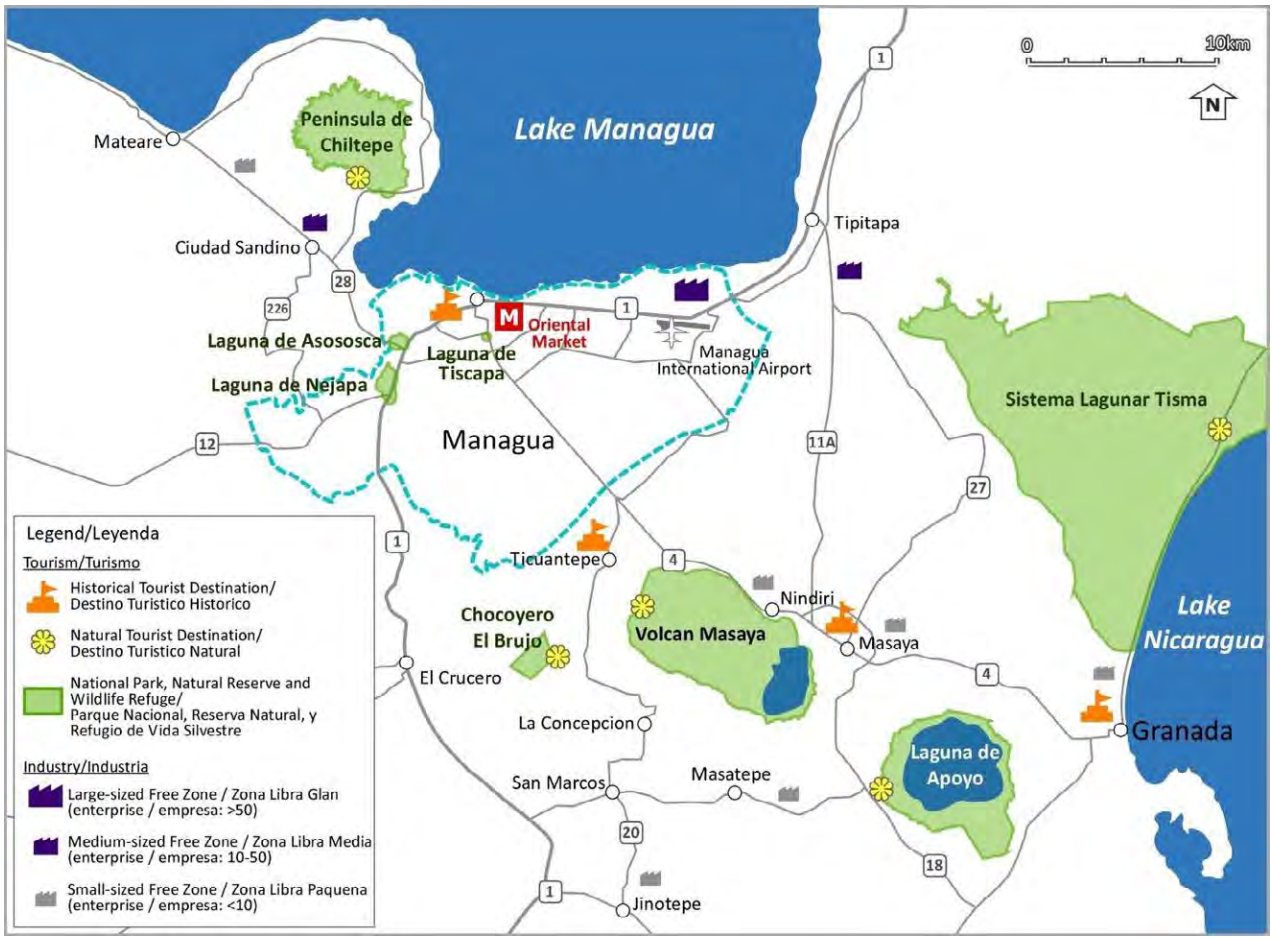
- The central functions of the four branches of the nation, including the legislation, administration,

judiciary, and election;

- Hub of the transportation network which connects the regions in Nicaragua and other hubs in Central America and beyond;
- Function as aninternational gateway of Nicaraguan tourism for international and domestic markets;
- The central function of commercial and business activities for domestic and neighboring countries;
- High-level educational institutions such as universities, graduate schools, and colleges;
- Providing location for research institutions, medical institutions, and financial institutions;
- Providing location for important cultural institutions such as theaters, museums and auditoriums;
- Diplomatic functions such as embassies of alliance nations; and
- International exchange function - the host function for cultural, academic and business exchanges.

(5) Industries of Managua Metropolitan Region

As explained in Chapter 2, in Managua City and its surrounding area, a variety of economic activities have been seen, such as commercial, tourism, and manufacturing industries. The following Figure 3.1.9 describes major locations and accumulations of such economic activities.



Source: JICA Study Team

Figure 3.1.9 Major Industrial Accumulations in ManaguaCity and the Surrounding Area

(6) Commercial Industry

A range of commercial industy activities has been performing in Managua City and the surrounding area. In terms of the number of commercial industry activities, Managua City can be judged as a commercial and financial center for this region. Thus, the largest employed population could be accommodated in Managua City as well.

Table 3.1.5 Number of Commercial Industry Activities in Managua City and the Surrounding Area 2015-2016

	Managua	Jinotepe	Nindirí	Masaya	Granada	Sandino City	El Crucero	Ticuan-tepe	Tipitapa
Private Bank	> 150	4	1	6	6	1	0	0	5
Private Company	> 29,000	15	104	1,236	360	168	n.a.	89	191
Market	5	1	1	3	1	0	0	1	0

Note: "> " means "more than"
Source: ALMA recaudacion 2015, and JICA Study Team by Hearing Surveys

The core of commercial activities in the region could be said to be the Oriental Market, which claims to be the largest of markets in Central America. The Oriental Market consists of three zones with a total area of 0.4 km^2 (97 acres) managed by *Corporacion Municipal De Mercados De Managua* (COMMEMA). The total sale is said to be USD 100 million per month, accounting for 22-25% of the nation's sales. Employees working in the Oriental Market numbered to 50,000–60,000, while visitors are 70,000 per day on average, or up to 140,000 in busy days. Monthly visitors reached 3 million in December 2015. This international market attracts visitors not only from inside Nicaragua but also from international regions. The market deals virtually everything; ranging from food, clothes, shoes, electric devices, construction materials, drugs, to used cars.

The market is faced with various challenges such as uncontrolled expansion, safety concern, waste problem, risk management difficulty, security, and others.

(7) Tourism Industry

Nicaragua is blessed with natural and cultural tourism resources such as rich ecosystems of unique climate, beaches, lakes, mountains, volcanoes, and historical sites. In Managua City and its surrounding areas, there are also many tourist destinations as shown in Figure 3.1.9.

As sites for natural tourism, there are five major destinations in this region, namely: Volcan Masaya National Park, Peninsula de Chiltepe, Laguna de Apoyo and Sistema Laguna Tisma, and Chocoyero El Brujo Wildlife Refuge. These areas attract tourists with their rich nature with variety of fauna and flora provided by the tropical climate. Among them, Volcan Masaya and Laguna de Apoyo are famous as weekend destinations for the citizens in this region. On the other hand, in view of cultural tourism, Managua, Granada, Masaya and Ticuantepe cities invite many tourists by colonial complex, arts, and living culture. In addition to the attractive tourism resources, it could be said a large advantage for

inviting visitors that Managua City and surrounding cities are remarkably safe compared with other cities in Central America.

Source: JICA Study Team

Figure 3.1.10 Natural Tourism Destination: Lake Masaya

Source: JICA Study Team

Figure 3.1.11 Cultural Tourism Destination: Granada

In recent years, with an increase of international visitors (see Table 3.1.6), enhancement of host functions for international business and cultural exchanges is required such as accommodations, business convention centres, event facilities, and relevant commercial facilities.

Table 3.1.6 Number of International Visitors to Nicaragua

Year	2011	2012	2013	2014
Number	1,060,000	1,180,000	1,229,000	1,320,000

Source: The World Bank

Managua City is a gateway for international and domestic tourists visiting this region, owing to August C. Sandino International Airport and Pan American Highway. In particular at this international airport, dominant passengers are tourists, as shown in Table 3.1.7. So as to further development of tourism industry by utilizing rich resources, Managua City is expected to play a role of the gateway and a tourism center for the region.

Table 3.1.7 Total Number of Passenger for Inbound and Outbound by Type at August C. Sandino International Airport

Purpose of Passenger	2009	2010	2011	2012	2013	2014
Tourism	589,451	587,155	584,237	628,631	627,956	622,231
Business	9,279	11,256	14,853	16,988	13,886	14,249
Other	32,347	32,252	47,007	65,961	87,827	57,119
Total	631,077	630,663	646,097	711,580	729,669	693,599

Source: Direccion General de Migracion y Extranjeria Reporte Estadistico por Motivo de Viaje Según Su Nacionalidad en Los Diferentes Puestos del Pais Año Desde 2009 Hasta 2014

(8) Manufacturing Industry (Free Zone)

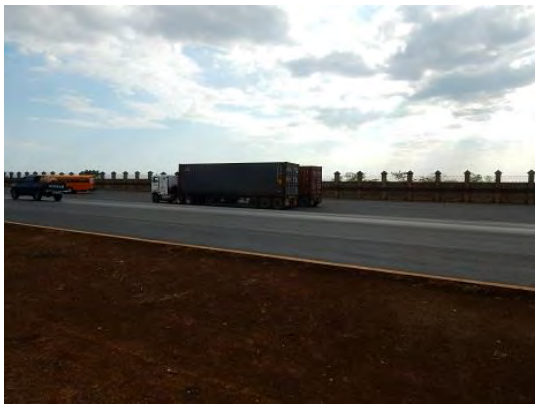
Major manufacturing industries in this region are textile, footwear, auto-parts, and food processing of agro products such as beef, coffee, sugar, and tobacco. For such industrial activities, there are tax-free

industrialzones called “Zona Franca” or Free Zone in and around Managua City. Las Mercedes Free Zone, located near the eastern end of Managua City next to the international airport, is the largest industrial accumulation which accommodates 92 enterprises in 2016. Furthermore, there are two medium-sized free zones near Sandino City and Tipitapa, the former accommodates 21 enterprises and the latter with 32 enterprises. Large- and medium-sized free zones produce a variety of products explained above. Other free zones are smallscale, mainly located near cities, and tend to produce textiles and handicrafts.

The large- and medium-sized free zones are prone to cause traffic congestion on the major arterial roads, especially Pan American Highway, Carretera Nueva Leon, and Route 11A due to commuting of workers in the morning and evening. In addition, many logistics vehicles including trucks and trailers could be found in and out of Managua City. For taking account of such issues, industrial concentration including logistics hub could be established out of Managua City, say neighbouring cities such as Sandino City and Tipitapa in light of current industrial development. Also, efficient future road network needs to be discussed from the regional viewpoint.

Source: JICA Study Team

Figure 3.1.12 Zona Franca Astro



Source: JICA Study Team

Figure 3.1.13 Industrial Area on Route 11A

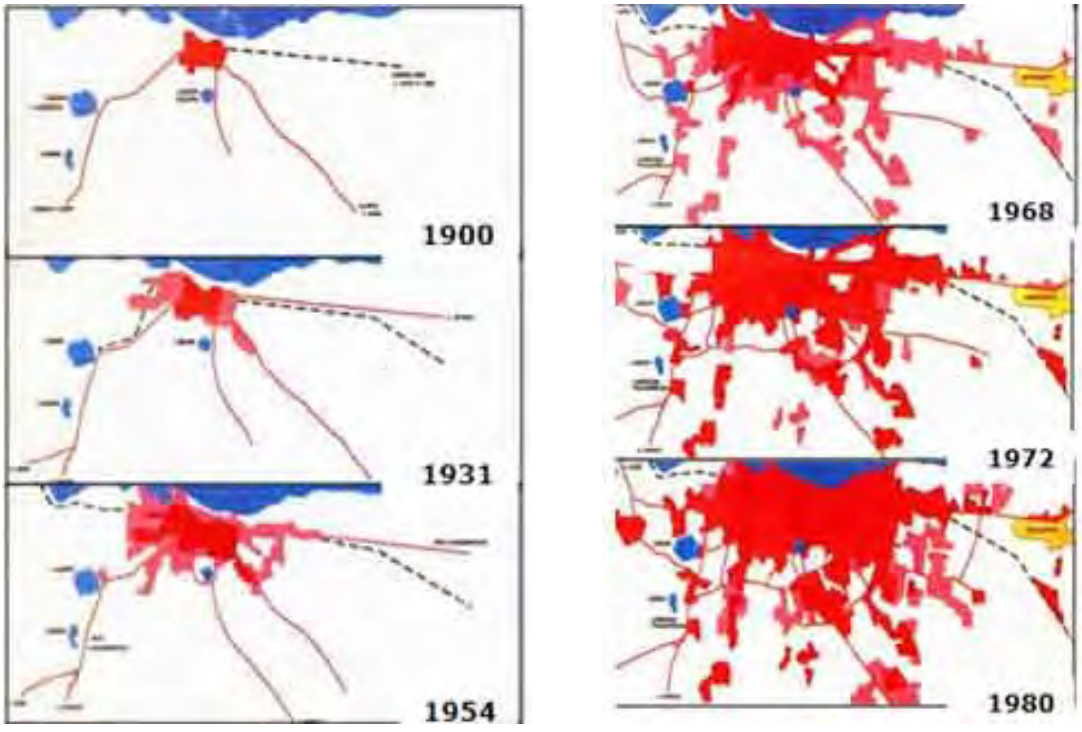
3.2 History of Urban Planning in Managua

3.2.1 Brief History of Managua City

Managua City was a mere fishing village before the colonization, but was integrated in 1819 to become Santiago de Managua. In 1821, Central American countries including Nicaragua declared independence from Spain, and came under the control of Mexico. After the fall of Mexican Empire, Federal Republic of Central America was set up in 1824, but in 1838 the republic fell, and Nicaragua had to seek for independence. After the regaining of independence, political confusion persisted with the rivalry between the Liberal elite of León and the Conservative elite of Granada.

In 1856, an American adventurer named William Walker set himself up as President of Nicaragua, but only been faced with a campaign to drive him out of Nicaragua in 1857. It was in 1857 that Managua was established as the capital of Nicaragua.

The central part of Managua City was gradually built from the 1850s through the 1920s with necessary infrastructure. A strong earthquake in 1931 and an extensive fire in 1939 destroyed a large part of the city. The Managua City, nonetheless, started to grow over the years, even under the dictatorship from 1930 to 1970.



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Source: ALMA

Figure 3.2.1 Expansion of Urban Area in Managua City

Managua City was again hit by a strong earthquake in 1972 and much of the then existing city center was damaged, and the recovery process brought about various confusion, but the city overcame the effects of the earthquake before long and started to raise again. After 1979, Nicaragua went into a civil

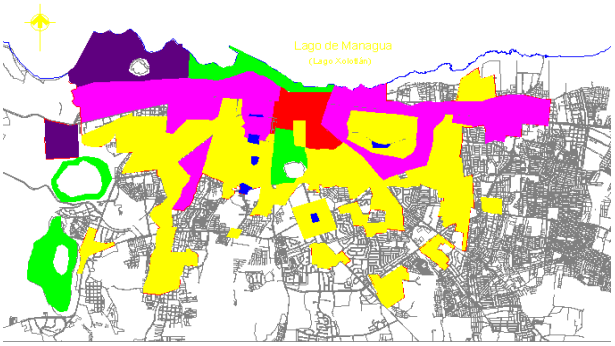
war until the National Opposition Union (UNO) took power after a general election in 1990. In 2006, Sandinista National Liberation Front (FSLN) came back to power until today.

In the course of the history, the Managua City, with about 400,000 population in 1971, doubled its population by 1995, and further increased its population. The area of Managua City had been 544 km^2, until 2000 when two parts of then Managua City, namely, Ciudad Sandino and El Crucero, were separated. The present city area, according to INIDE, is at 289 km^2.

3.2.2 Early Practice of Urban Planning

The first practice of a land use zoning scheme [*Zonificación y Uso del Suelo*] was carried out in 1954. Along the shore of the Managua Lake in the northern part of the city area, a commercial/business land use zone was designated, and a residential zone was designated southwards, as shown in Figure 3.2.1.

This zoning scheme was modified and elaborated in 1968, as shown in Figure 3.2.2. In 1968, a new airport named Las Mercedes Airportwas commissioned in the northwestern part of the city, which is today known as Augusto C. Sandino International Airport. In the land use zoning of 1968, the commercial/ business zone was further extended eastward, a new industrial zone was introduced southeast of the airport in a shape of an elongated circle. Along the lakeside was a green zone possible for the preservation of lakeside greenery. The residential zone south of the commercial/business zone was further extended southwards.



Source: ALMA

Figure 3.2.2 Zoning Scheme in 1954

Source: ALMA

Figure 3.2.3 Zoning Scheme in 1968

3.2.3 Reconstruction Plan after Earthquake and Urban Planning in 1970

Managua City was hit by a severe earthquake in 1972, and suffered an extensive damage. For the reconstruction and recovery from the earthquake damage, the Managua Regulatory Plan for Reconstruction and Development [*Managua Plano Regulador para su Reconstrucción y Desarrollo*] was formulated with the help of the Public Works Department of Mexico.

In the 1970s, the General Plan for Urban Development (*Plan General de Desarrollo Urbano*: PGDU) was said to be formulated, although the details of the plan do not seem to be available today.

3.2.4 Urban Planning in the 1980s and Early 1990s

From the early 1980s onward, various planning and legal instruments came into force, and the overall planning and legal framework has since started to resemble that of today. Some of these planning and legal instruments remain at force today, and they can be grouped into three categories (also refer to Figure 3.2.7):

Regulatory plans and urban planning studies: These are urban planning documents, plan drawings, or study schemes that are produced to promote, determine, and visualize urban planning or planning strategies of a certain area. The aspects covered are sometimes extended beyond urban planning and spatial aspects, also environment, social, economical specifics too. The physical areas covered can range from a region greater than a city, to a specific territory or district in a city, or even focus on a zone within a city center.

National laws and legislations: These are legislations that operate at a national level which provide legal basis and enforceability to a plan/study, or provide power to a government agency or governing authority. They include laws, decrees, regulations, and the Technical Norms and Obligations in Nicaragua (*Normas Technicas Obligatorias Nicarguense*: NTON) which are implemented and effective over the whole country. The legislation or passing of these laws are carried out through the National Assembly, and requires signatory from a minister and/or the President.

Municipal/urban regulations: These are legal documents that provide regulatory plans or urban planning studies with legal basis, giving particular terms on legal definitions, describing the physical extent of a regulatory plan or urban planning study, or empowering certain authority to execute or enforce a regulatory plan or urban study legally. These include regulations, ordinances, and agreements which are implemented at a municipal or city level. The legislation or passing of these instruments are carried out under the power of the Municipal Council.

It must be noted that a regulatory plan or urban planning study may often be referred to without being officially approved or backed by legislation, and that there are many plans and studies that have been produced but never officially adopted or even publicized. Some legislation are also constantly going through revision.

(1) Scheme for Urban Development of Managua

In the 1980s, Scheme for Urban Development of Managua (*Esquema de Desarrollo Urbano de Managua:* EDUM) was launched. This was later superseded later between 1982 and1984 by the Regulatory Plan of Managua [*Plan Regulador de Managua*], which was substantiated by a number of legislations. These two major documents covered Managua City's municipality and provided urban planning guidelines in the 1980s. In 1998, an updated General Plan for Urban Development (*Plan General de Desarrollo Urbano:* PGDU) was formulated, which was not officially validated but yielded various subordinate district-level plans (see section below).

(2) Master Plan of the Central Area of Managua City

One of the peculiar characteristics of urban planning in this period is the assistance from abroad. In 1992, the Master Plan of the Central Area of Managua [*Plan Maestro del Área Central de Managua*] was formulated with assistance of experts from Amsterdam City, the Netherlands. This plan covered an area in the northern part of the city, of about 3 km east-west and 2 km north-south including Tiscapa Lagoon, which has been the city center of Managua since the colonial era. The plan, as shown in Figure 3.2.4, took the Northern Highway as the central axis, and provided for a few squares at some major intersections. It also provided for two east-west, one north-south, and one lakeside pedestrian walkways.

Source: ALMA

Figure 3.2.4 Master Plan of the Central Area of ManaguaCity

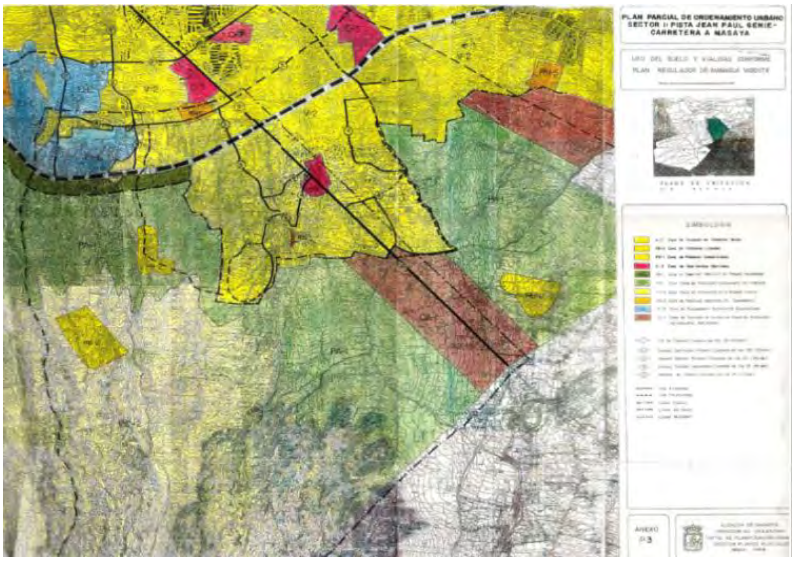
3.2.5 Urban Planning in the Late 1990s and 2000s

(1) District Plan for Urban Management

From the General Plan for Urban Development (*Plan General de Desarrollo Urbano*: PGDU) updated in 1998, a series of partial urban plans called District Plan for Urban Management [*Plan Parcial de Ordenamiento Urbano*] were formulated between 1998-2000. These include:

- [Plan Parcial de Ordenamiento Urbano Sector 1 – Pista Jean Paul Genie – Carretera a Masaya] (1998)
- [Plan Parcial de Ordenamiento Urbano Sector sub Centro Urbano Ruben Dario] (1999)
- [Plan Parcial de Ordenamiento Urbano Sector Sur Occidental] (2000)- [Plan Parcial de Ordenamiento Urbano Sector Oriental] (2000)
- [Plan Parcial de Ordenamiento Urbano Sector Nor Central] (2000)
- [Plan Maestro de del área central y Reglamento del área central de Managua]

These district plans cover the central area, area along Masaya Road, western area, eastern area, and the central northern area, and were enforced by corresponding zoning legislations on the municipal level. While they are partial and called "district" plans, the "sectors" described in the plans do not align with the district alignments at the time.



Source: ALMA

Figure 3.2.5 District Plan for Urban Management

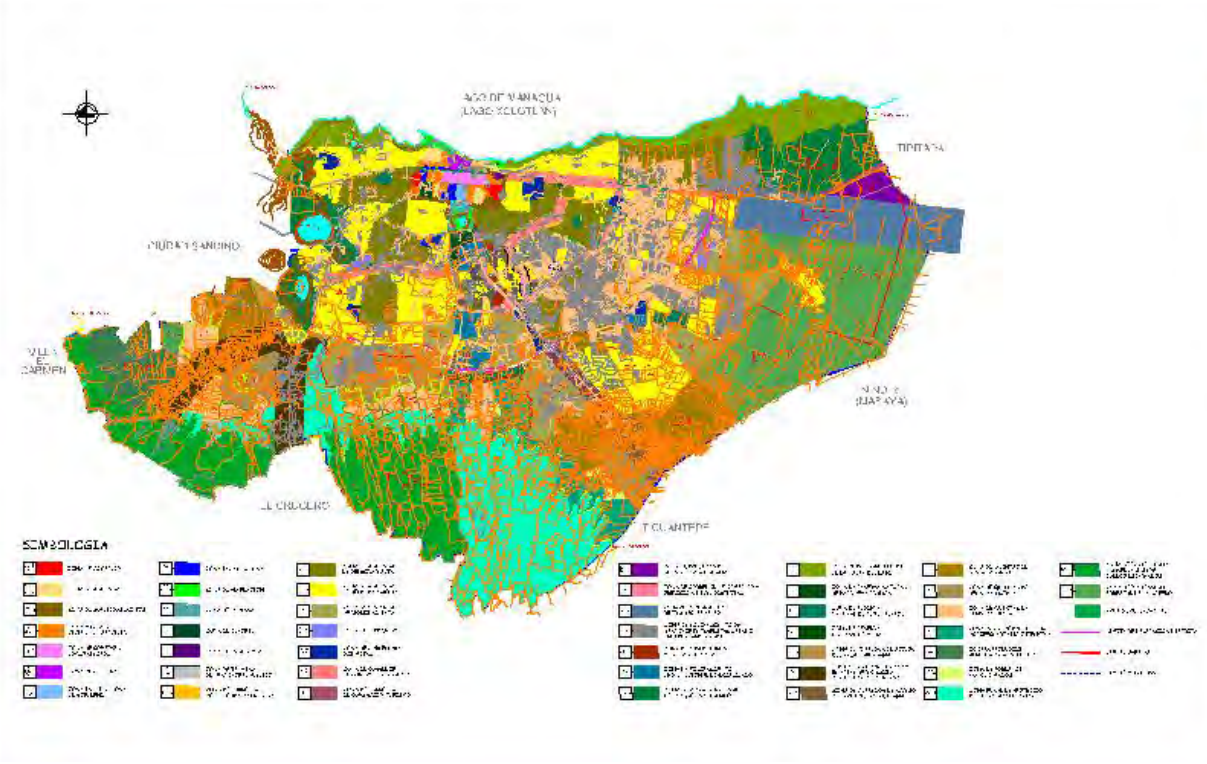
(1) Synthesis of District Plans for Urban Management

In 2000, two of the seven districts, namely, Ciudad Sandino and El Crucero, were separated from Managua City, which resulted in five districts in Managua City. In 2009, however, two new districts were created by boundary relocation of the existing districts: one along the Masaya Highway and the other in the noreastern part of the city, and Managua City again had seven districts.

Following the General Plan for Municipal Development (*Plan General de desarrollo Municipal*: PGDM) produced in 2002, an integrated plan merging the abovementioned partial plans were formulated in 2004, which was called Synthesis of District Plans for Urban Management [*Síntesis de los Planes Parciales de Ordenamiento Urbano*]. This plan included 1) permissible land use for each zone; 2) technical parameters such as FAR, minimum land area at the time of land subdivision; 3) road plans to be carried out by ALMA; and 4) regulations according to natural topographic conditions. A series of detailed zoning maps and land use tables were also created based on the new Synthesis plan. However, despite the drafting of the legislations to support the new Synthesis plan, it did not go through the official adoption process of the Municipal Council [*Concejo Municipal*], primarily because the original District plans had alreay been officially approved, and the Synthesis Plan did not contain anything new. Thus does not have statutory power as required for an official by-law of Managua City. Nevertheless, due to the comprehensiveness of the previously individual district plans, the "unofficial" Synthesis remains as one of the most important and regularly-used references today. The detailed zoning maps and land use tables created for the Synthesis plan are still currently used in the building permit process. Due to the

comprehensiveness and usefulness of the previously-separate district plans, the official adoption of the Synthesis plan was conveniently foregone.

A regional plan, called the Action Plan for the Metropolitan Region [*Plan de Accion Para la Region Metropolitana*] was created in 2007. The plan deals primarily with the overall vision, development strategies, and macro management of the greater region, which covers not only Managua City but also Carazo, Granada, and Masaya. It does not contain any urban planning guidelines or controls for Managua City.



Source: ALMA

Figure 3.2.6 Zoning in Synthesis of District Plans for Urban Management

3.2.6 Urban Planning in the 2010s

(1) Additional District Plans for Urban Management andOther Regional Plans

Following the district boundary adjustment within Managua City and reconfiguration back to seven districts in 2009, two new urban plans at the district levels were created i.e.: Municipal Planning and Territorial Development Plan for Districts 5, 6, and 7 [*Plan Municipal de Ordenamiento y Desarrollo Territorial 2012 – 2022, Distritos V, VI y VII de Managua*] (2013) and Regulatory Plans for Districts 5, 6, and 7 [*Plan Regulador Distritos V, VI y VII*] were formulated respectively for Districts 5, 6, and 7, including their adjacent municipalities. These districts cover the southeastern part of Managua City, where land use is considered to be regulated deliberately in light of flood protection downstream. While detailed in nature, these plans are not officially approved with legislation and are not referred to regularly.

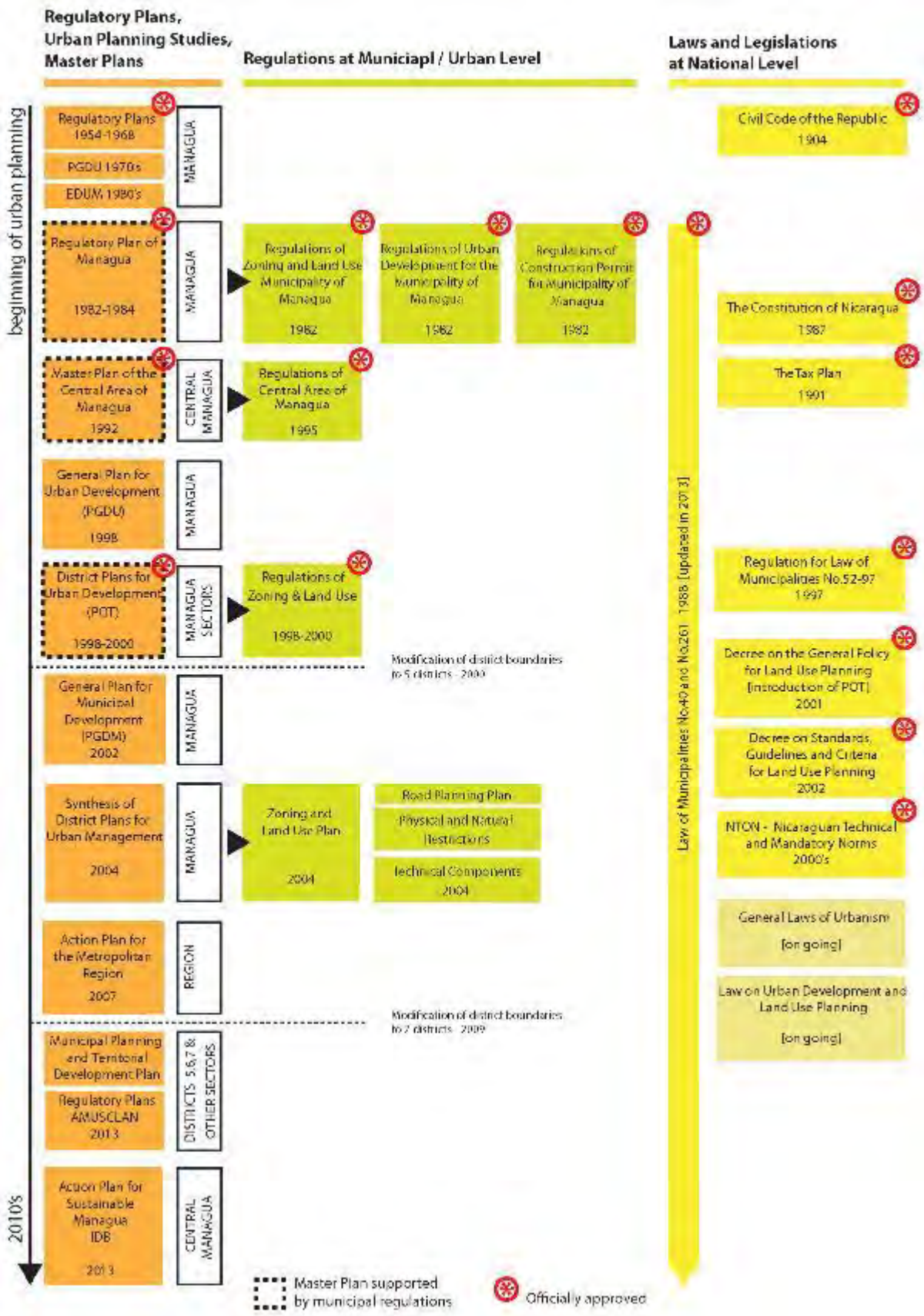
(2) Action Plan for Sustainable Managua

In 2013, the Inter-American Development Bank (IDB), under the Emerging and Sustainable Cities Initiative (ESCI), studied Managua and published the Action Plan for Sustainable Managua [Plan de Acción Managua Sostenible]. This Action Plan focused on necessary actions for the sustainable development of Managua City and the metropolitan area only. The Action Plan considered the random expansion of urban area as an important issue, and for establishing a management framework for regulating land use appropriately; it called for land use planning to be carried out at the highest priority.

(3) Plan of Municipal Development

In 2013, the Plan of Municipal Development [*Plan de Desarrollo Municipal*], was formulated as a long-term plan for the municipality up to the year 2028. This plan focused mainly on the administrative capacity development of ALMA, rather than its physical planning. While the plan was completed, it remains as a study and has not been officially adopted, nor has it been widely publicized. Due to its minor status, it is not shown in the chart

Despite the fact that many regulatory plans and urban planning studies have been made, the Synthesis of District Plans for Urban Regulation remains as the most frequently used planning instrument.



Source: JICA Study Team

Figure 3.2.7 Overview of Major Planning Documents and Associated Legislations

3.3 Laws and Legislations for Urban Planning

In regard to urban planning, the national legislations generally define the creations, powers, and responsibilities of municipalities, government authorities, and agencies. They also lay down the common development principles and terminologies, such as those on land use and sustainability that are to be applied not only for Managua City but over the whole country. These legislations do not include any major regulations, controls, or guidelines that are specific to a certain city, district, or specific area.

3.3.1 Constitution and Civil Code of Nicaragua

The Constitution of Nicaragua of 1987 provides for private ownership as Article 108 says, "Ownership of their land is guaranteed to all those owners who productively and efficiently work it." At the same time, the Constitution says regarding this right, "By virtue of the social function of property, for reason of public utility or social interest, this right [of private ownership] is subject to the limits and obligations imposed by the laws regarding its exercise". This reservation enables imposing regulation to the use of privately owned property in view of public interest such as urban planning. Also, Article 176 says that the municipality is the basic unit of the political-administrative division of the country, and Article 177 continues that municipalities possess administrative and financial autonomy and the municipal authorities are responsible for their administration and management. This provision enables the municipality to resume the function of urban planning to the effect.

Before the Constitution, the Civil Code of Nicaragua had been providing the fundamentals of citizens' rights and responsibilities. The Civil Code was first created in 1904, and has been continuously amended and revised ever since. Since the establishment of the Constitution, rules and principles from the Constitution are often incorporated and revised into the Civil Code. While the Constitution remains as the highest legal instrument of the country, the Civil Code still serves as part of the nation's constitutional foundation, and is sometimes referred to, e.g., in cases of dispute settlement regarding property ownership and determing civil relations between parties.

3.3.2 National Laws and Regulations of Nicaragua

(1) Law of Municipalities

Following the Constitution, the Law of Municipalities ([LEY DE MUNICIPIOS] No. 40 and No.261, (originally enacted as No. 40 in 1988 and amended to its current form in 2013) stipulates the municipal autonomy, competence and governance of municipalities. Article 6 stipulates that the municipality shall exercise over matters that affect their development, preservation of the environment, and meeting the needs of its people. Furthermore, Article 7 particularly defines the powers and responsibilities of the municipality, which includes among others, the planning, regulation, and control of urban, suburban, and rural development and their land use within the municipality, the building of public facilities and service infrastructures, and the control of construction standards in general.

(2) Regulation for Law of Municipalities

Regulation for Law of Municipalities ([REGLAMENTO A LA LEY DE MUNICIPIOS], Presidential Decree No. 52-97, 5 September 1997) stipulates regulations regarding the creation, administration, and guiding principles of municipalities in relation to the powers stipulated in the Law of Municipalities No.261.

(3) Laws on Urban Planning and Land Use Planning

In Nicaragua, neither the law regarding urban planning nor land use planning have been established yet. According to ALMA, there was a preparatory work in progress a few years ago by the Nicaraguan Institute of Municipal Development (*Instituto Nacional de Información de Desarrollo:* INIFOM), but it did not come through, and such laws are still yet to be worked out.

(4) Decree on the General Policy for Land Use

Decree on the General Policy for Land Use [*Decreto Que Establece La Politica General Para ElOrdenamiento Territoria*] was publicized on 18 September 2001 as a Presidential Decree No.90-2001. This decree defines its aim, among others, as to guide land use in a sustainable manner, including natural resources, prevention, and mitigation of natural disasters, and strengthening the administration of the State in the territory.

This decree stipulates and reinforces the objectives, definitions, guiding principles, and strategies of territorial management plans [*Planes de Ordenamiento Territorial*: POT], which is essentially a type of regulatory plan/urban study, or a master plan for a defined territory. The purposes of land use are defined as the following seven items (Article 2):

- Obtain an organized and balanced economic development in the territory;
- Natural migration to develop in an orderly manner and contribute to the economic and social development;
- Ensure the appropriate use of the territory for sustainable use of natural, productive, labor, social resources;
- Prevention and mitigation of disasters caused by natural phenomena, strategically integrated with land use planning processes;
- Ensure the protection and conservation of representative ecosystems in the country through strategic planning;
- Contribute to the creation of a "Regulation System Human Settlements"; and
- Provide a comprehensive and harmonious development of productive activity.

Also, Article 6 stipulates as part of the decentralization policy states that the Governments of the Autonomous Regions and Municipalities should prioritize POT as the fundamental basis for the strategic planning. While there had been plenty of regulatory plans or urban studies before the existence of this

decree, such as those for Managua City, this decree formalized the role, importance, and certain criteria of master plans and other planning studies and their application for other parts of the country.

(5) Decree on Standards, Guideline, and Criteria for Land Use Planning

This decree on Standards, Guideline and Criteria for Land Use [*De Normas, Pautas Y Criterios Para El Ordenamiento Territorial*] was publicized on 19 February 2002 as the Presidential Decree No.78-2002. In conjunction with territorial management plans, this decree establishes rules, guidelines, and criteria in the context of sustainable land use, preservation, protection, and recovery of ecological and cultural heritage, natural disaster prevention, and spatial distribution of human settlements (Article 1).

Article 5 defines the general criteria for municipal POT, as follows:

- The environmental dimension is an intrinsic part of the land, and its proper management and protection would ensure sustained economic development and social equity.
- Land use planning will target interventions for sustainable use of resources through usage rules that define spaces with different functions, preservation, restoration, and development.
- Land use planning should contribute to reducing the risks to production systems and human settlements from natural phenomena and manmade hazards.
- Land use planningis part of municipal planning processes and contribute to sectoral and territorial coordination.
- The environmental services provided by protected areas should be incorporated, assessing their contributions to the local economy in the strategic lines of land use planning.
- Land use planning should contribute to the development and promotion of inter-municipal partnerships to the preservation, restoration, and use of resources.

Furthermore, in Articles 19 and 22, the hierarchy of city centers based on population is described and the functions that can be housed in the capital city are outlined. Definitions of urban and suburban center are also stipulated in Articles 36 and 37, with various definitions on housing and industrial zones are described in the subsequent articles.

(6) Nicaraguan Technical and Mandatory Norms (*Normas Technicas y Obligatorias Nicaraguense*: NTON)

Throughout the 2000s, a number of NTONs were implemented. These are national legislations stipulating technical standards and norms, implemented by various ministries and are applicable to the whole country. Examples include:

- NTON on Architectural Design, Part 4 Typology, [*Norma Technica Obligatorio Nicaraguense de Diseno Arquitectonico. Parte 4 Tipologia*] issued by the Ministry of Industry and Commerce Development
- NTON on Sizing for Housing Development [*Norma Technica Obligatorio Nicaraguense de dimensionamiento para desarrollos habitacionales*] issued by the Ministry of Transport and

Infrastructure

- NTON on Accessibility [*Norma Technica Obligatorio Nicaraguense de Accessibilidad*] issued by the Ministry of Transport and Infrastructure.

In addition to those mentioned above, there are other national legislations that are in progress, such as General Laws of Urbanism [*Ley General de Urbanismo*] and Law on Urban Development and Land Use Planning [*Ley de Desarrollo y Ordenamiento Territorial*]. Both documents have been in preparation for quite some time, however, if and when they will be adopted remains unknown. Another national legislation, the Tax Plan [*Plan de Arbitrios*] also stipulates matters regarding taxes and revenues.

3.3.3 Municipal/Urban Regulations of Managua City

On a municipal or urban level, Managua City, a municipality in itself, has its own regulations for urban planning. These regulations are generally legal documents created to provide a regulatory plan, urban study, or master plan legal basis, setting regulations and ensuring their enforceability. These are explained as follows:

(1) Regulations of Zoning and Land Use for the Area of Municipality of Managua

Regulations of Zoning and Land Use for the Area of Municipality of Managua [*Reglamento de Zonificación y Uso del Suelo para el Área del Municipio de Managua*], Official Gazette No. 110 dated 12 May 1982, is the regulatory basis on which the zoning and land use is to be managed.

(2) Regulations of Urban Development for the Area of Municipality of Managua

Regulations of Urban Development for the Area of Municipality of Managua [*Reglamento de Desarrollo Urbano para el Área del Municipio de Managua*], Official Gazette No.112 dated 14 May 1982, defines the design and implementation of urban development, and aims at achieving optimum use of the works.

In this regulation, it stipulates that all urban development must adhere to the regulatory plan for urban development area, Regulations of Municipality of Managua, codes and standards applicable (Article 03), and that all urban development must follow the uses specified in zoning and land use for the area of Municipality of Managua.

The two regulations mentioned above provide a legal basis for the Regulatory Plan of Managua [*Plan Regulador de Managua*] (1982–1984). Regulations of Zoning and Land Use was also revised in 1998–2000 as well as in 2004, although only the former was formally legislated.

(3) Regulations of Construction Permit for the Area of Municipality of Managua

Regulations of Construction Permit for the Area of Municipality of Managua [*Reglamento de Permiso de Construccion para el Area de Managua*] were officially adopted in 1982. The regulations provided a legal basis for the construction permit system for Managua City, designed originally to support Regulatory Plan of Managua [*Plan Regulador de Managua*] (1982–1984).

(4) Regulations of Central Area of Managua City

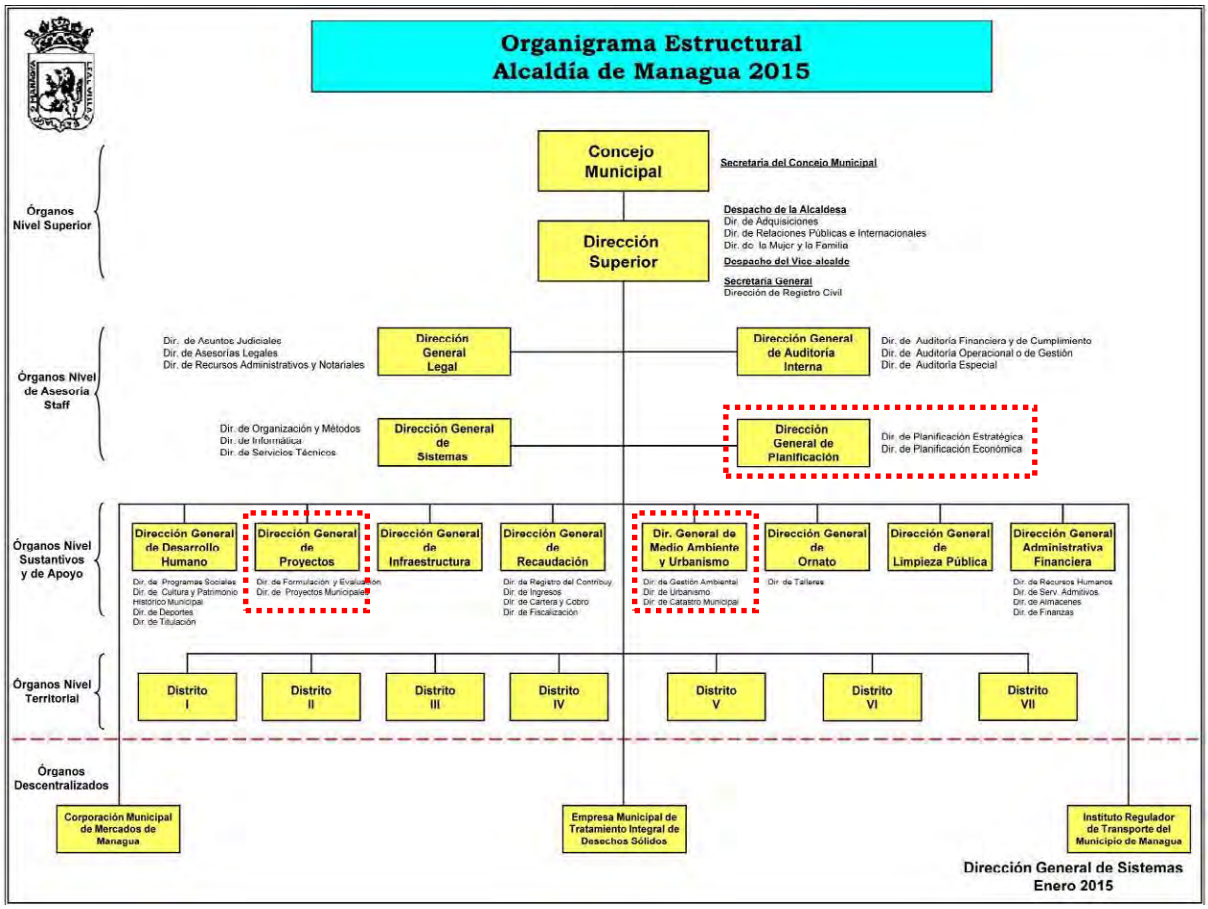
Regulations of Central Area of Managua [*Reglamento del Área Central de Managua*], Agreement of Council in March 1995, define the regulations for land use, land subdivision and use of land in Central Part of Managua City shown in Figure 3.2.4.

A number of other regulations on zoning and land use planning, road planning, physical and natural restrictions, and technical components were also made in 2004. While they provide useful guidelines on urban planning currently, there are not officially adopted.

3.4 Present Implementation System of Urban Planning in Managua City

3.4.1 Organizations for Implementation of Urban Planning in Managua City

Managua City is the capital city of Nicaragua and the largest urban center of Nicaragua, thus, ALMA has been leading in planning and implementing urban planning and regulation in collaboration with the abovementioned national organizations.



Source: ALMA

Figure 3.4.1 Organizational Chart of ALMA, as of 2015

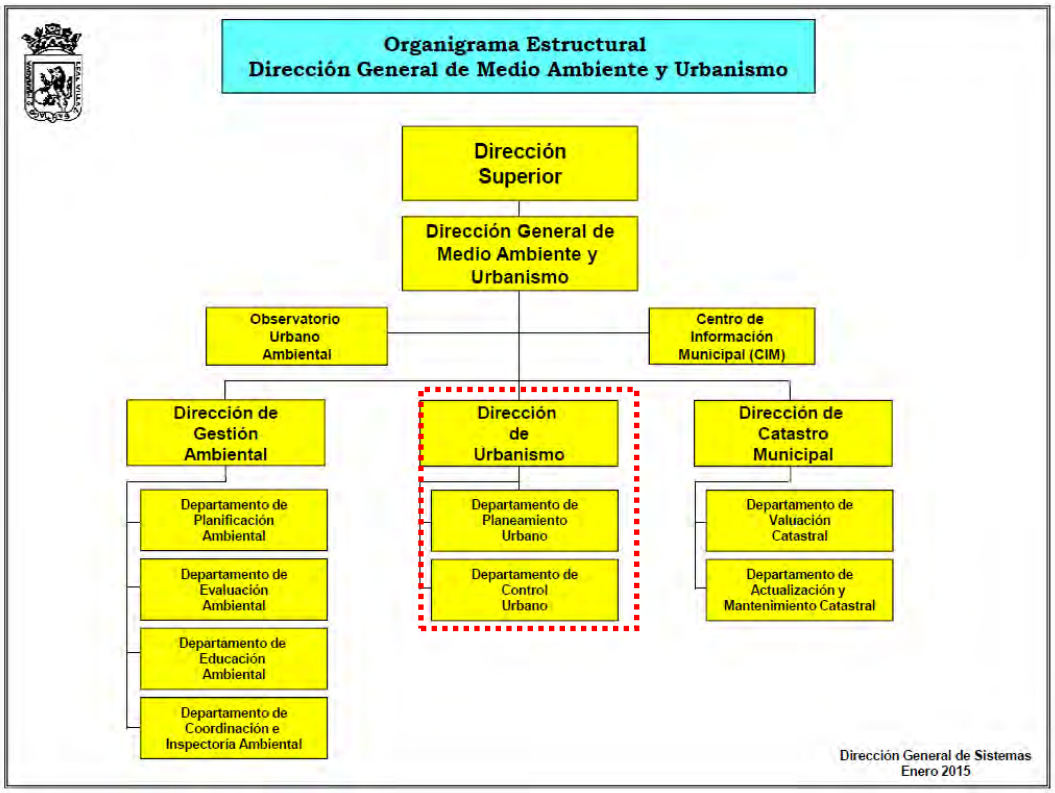
The organizational chart for ALMA in 2015 is shown in Figure 3.4.1. The Municipal Council, which is the supreme decision-making organ of the municipality, is at the top of the chart. Below are four General Directorates of the Secretariat, namely: Legal, Audit, System, and Planning. Under them are eight

General Directorates of Implementation, namely; Human Development, Projects, Infrastructure, Revenue, Environment and Urban Planning, Decoration, Pubic Hygiene, and Financial Administration. Among them, the General Directorate of Environment and Urban Planning is directly in charge of urban planning in Managua City. In addition, the General Directorate for Projects will be relevant in the implementation of infrastructure projects (planning, designing, and supervision); while the General Directorate for Planning is relevant in the planning of budgets and administrative management of urban planning and other projects. The three directorates are shown in red boxes.

A detailed organizational chart of General Directorate of Environment and Urban Planning is shown in Figure 3.4.2. There are three departments, namely: Department of Environment, Department of Urban Planning, and Department of Municipal Cadastres.

A detailed organizational chart of General Directorate of Environment and Urban Planning is shown in Figure 3.4.2. There are three departments, namely: Department of Environment, Department of Urban Planning, and Department of Municipal Cadastres.

There are 33 staff in the Department of Urban Planning, of which 22 are technical staff, as of April 2016. The department has two sections, namely: Section of Urban Planning and Section of Urban Control. Most of the technical staff work for the Urban Control Section. The Department of Municipal Cadaster is incharge of cadasters of the city and geographic information system (GIS), and often collaborates with the Department of Urban Planning in relation to GIS required for urban planning and land use zoning.



Source: ALMA

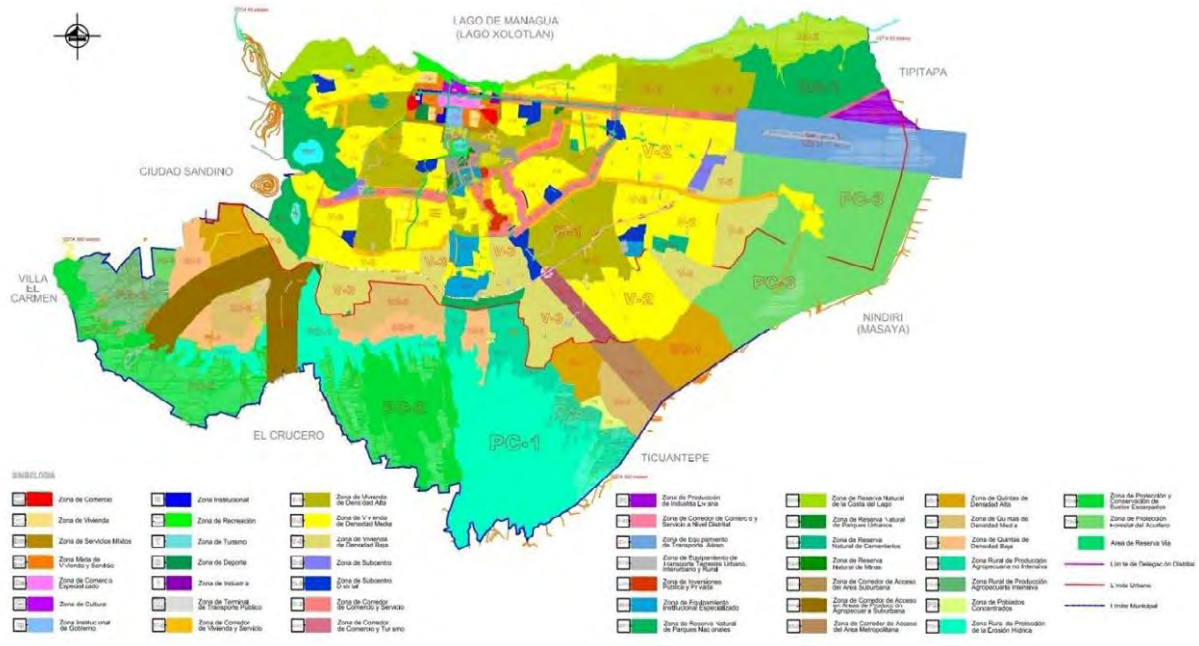
Figure 3.4.2 Organizational Chart of the General Directorate of Environment and Urban Planning as of 2015

3.4.2 Implementation System of Urban Planning in Managua

Urban planning in Managua City has a long history involving a number of regulations, as discussed in Chapter 3.1 above. The following summarizes the present implementation system of urban planning in Managua City.

(1) Zoning Scheme

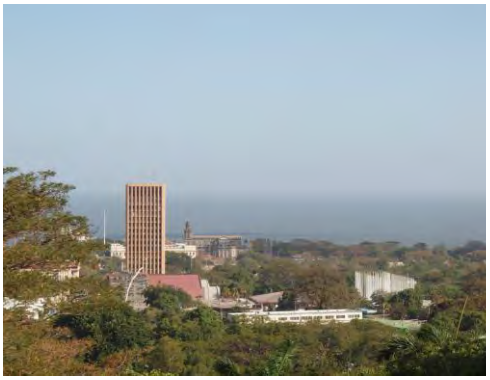
The present zoning scheme established in 2004 is shown in Figure 3.4.3. The land use zoning has been classified into 27 large and 52 small categories and shown geographically over the area of ALMA. The zoning in the central area, especially the surrounding areas of historical center, are defined by block in detailed categories. Meanwhile, the zoning in the southern outskirts area tends to be designated undeveloped zoning such as natural reserve or protection zone due to the land has slope or aquifer area.



Source: ALMA

Figure 3.4.3 Zoning Scheme in Effect in 2015

In each of the colored zone in Figure 3.4.3, urban planning parameters are defined, as shown in Table 3.4.1. The parameters defined for each zone includes net density [*Densidad neta*] in hh/ha, minimum area of land [*Area mínima de parch*] in sq.m, building coverage ratio (BCR) [FOS], floor area ratio (FAR) [FOT], number of stories [*Número de pisos*], and so on.



Source: JICA Study Team

Figure 3.4.4 Building Banco Central de Nicaragua and Surrounding Area

The FAR parameters are comparatively low compared with other country; from 2 to 4 stories in residential zones and from 3 to 8 stories in commercial zones including tourism zone. The highest FAR is 12, applied only in limited area which includes the highest building in Managua City, Banco Central de Nicaragua, categorized as the institutional and government zone. These such low parameters may account for the present low-rise buildings commonly seen in the urban area of Managua City.

Table 3.4.1 Urban Planning Parameters for Zoning Scheme

Occupation and land subdivision / Zone		Net density			Minimum area of land (m²)			Front minimum plot (m)	Retiro frontal mínimo hasta la 3ra. planta (m)		Setback side minimum (m)	Setback back minimum (m)	BCR				FAR				Number of Stories		Maximum height(m)
		Housing min - max (hh / ha)		Plot / ha									Gross		Net		Gross		Net				
		Individual and Row	Grouped, Condomin. vertical and horizontal		Individual and Row	Grouped , Condomin . vertical and horizontal	Other uses		High collector streets and alleys	In primary distributor and collector			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
C	2			6			1 750	27,00		5,00	3,00	3,00				0,68				2,65	1	4	d
	3			20			500	15,00			a	3,00				0,72				2,17	1	3	d
V	1	500/335		100/67	105 - 150			7,00	3,00		b	2,00			0,65c	0,77			1,30 c	1,54	1	2	d
		330/250		66/50	151 - 200			8,00	3,00	5,00	a	2,00			0,46c	0,50			0,92 c	1,00	1	2	d
			670	67		150		8,00	3,00		2,00	3,00				0,34				0,68	1	2	d
			750	50		200		10,00	3,00		a	3,00				0,49				1,47	1	3	d
			660	33		300		12,00	3,00 j		3,00 j	3,00 j				0,38				1,37	1	4	d
			170/340	17		600		20,00	3,00 j		3,00 j	3,00 j				0,56			1,12	2,12	2	4	d
	2	335/220		67/50	150 - 200			8,00	3,00		b	3,00			0,68c	0,75				1,50	1	2	d
		250/165		50/33	201 - 300			10,00	3,00		a	3,00			0,49c	0,56				1,12	1	2	d
		165/110		33/22	301 - 450			12,00	3,00		a	3,00			0,57c	0,63				1,26	1	2	d
		110/85		22/17	451 - 600			15,00	3,00		a	3,00			0,64c	0,68				1,36	1	2	d
			500	50		200		10,00	3,00		a	b				0,59				1,18		2	d
			660	33		300		12,00	3,50 j		3,50 b j	3,50 j				0,51				1,75		4	d
			400	20		500		15,00	3,00 j		3,00 j	3,00 j				0,49				1,83		4	d
			340	17		600		18,00	3,00 j		3,00 j	3,00 j				0,55				2,06		4	d
V	3	85/50		17/10	600 - 1,000			20,00	5,00		3,00	3,00			0,51c	0,59			1,02	1,18	1	2	d
Vac	1	500	720	100/36	100	100, e		6,50 h	0 ó 3,00						0,35	0,60			0,35	2,40		4	d
	2 - 1	500	675	100/45	100	100, e		6,50 h	0 ó 3,00						0,40	0,65			0,40	1,95		3	d
	2 - 2	500	675	100/45	100	100, e		6,50 h	0 ó 3,00						0,30	0,60			0,30	1,80		3	d
V - S			255	17		600	600	18,00	0,00 j	0,00 j	3,00 j	3,00 j				0,61				2,24		4	d

a. 3.00 m forced into one of the landmarks and artos.No . 34 and 38 of the National Building at the other edge .
b. Artos . No.34 and 38 of the National Building Regulations .
c. Land use factor (FOS) maximum for the minimum parcel indicated .
d. Maximum height determined by FOS , FOT and graphic "c"
e. Clustered housing , horizontal and vertical condominium, add additional 60,00 m² of land for each additional dwelling unit
f. Clustered housing , horizontal and vertical condominium, add additional 80,00 m² of land for each additional dwelling unit
g. 8.00 m for mixed use with individual housing, services and / or trade and other mixed uses homeless.
h. 10.00 m for other uses including the clustered housing , horizontal and vertical condominium.
i. It requires previous opinion.
j. After the 3rd . floor is calculated as the graph c .
k. The load factor Total Land is governed according to the rules (MTI) on land use near the International Airport of Managua
L. Subject to the specific requirements of each use .
m. Facing Main Road
n. As urban design project
p. Preserves existing indexes

Occupation and land subdivision / Zone		Net density			Minimum area of land (m²)			Front minimum plot (m)	Retiro frontal mínimo hasta la 3ra. planta (m)		Setback side minimum (m)	Setback back minimum (m)	BCR				FAR				Number of Stories		Maximum height(m)
		Housing min - max (hh / ha)		Plot / ha					High collector streets and alleys	In primary distributor and collector			Gross		Net		Gross		Net				
		Individual and Row	Grouped, Condomin. vertical and horizontal		Individual and Row	Grouped , Condomin . vertical and horizontal	Other uses						Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Mvs	1	500	435	100/29	100	f	120	6,50 g,h	0 ó 3,00	0,00					0,40	0,75			0,40	3,00	2, m	4	d
	2	500	435	100/29	100	f	120	6,50 g,h	0 ó 3,00	0,00					0,40	0,75			0,40	3,00	2, m	4	d
Sm							i		0 ó 3,00	0,00					0,45	0,70			0,90	2,80	2	4	d
Co	1						n						0,15	0,20			0,15	0,40				2	d
	2						n						0,20	0,25			0,20	0,50				2	d
Ce							i		0 ó 3,00	0,00					0,50	0,70			1,00	4,20	2	6	d
T							i						0,15	0,20			0,15	1,60				8	d
D							n						0,20	0,25			0,20	0,75				3	d
C	S			10			1 000	20,00	3,00 j	3,00 j	b, j	3,00 j				0,88			2,64	4,26	3	7	d
	SD			17			600	18,00	3,00 j	3,00 j	b, j	2,00 j				0,85			2,55	2,96	3	4	d
	CT			10			1 000	20,00	3,00 j	3,00 j	3,00 j	3,00 j				0,62			k	2,80 k		5	d
	A1			17			600	18,00	3,00	5,00	3,00	3,00				0,55				1,10	1	2	d
Z - IPP				10/8			1 000 - 1 200	25,00	3,00 j	3,00 j	3,00 j	3,00 j			0,65 c	0,67			1,95 c	3,96	3	7	d
P I				6			1 750	27,00	10,00	10,00	5,00	5,00				0,48				0,72 k		1	d
I													p	p	p	p	p	p	p	p	p	p	p
EI - E				1			10 000	64,00	15,00	15,00	15,00	15,00				0,43			1,29	2,15	3	5	d
Ig							i						0,20	0,25			0,40	3,00			2	12	d
It				13			750	20,00	0 ó 3,00	0,00					0,50	0,75			1,00	4,50	2	6	d
Cu	1						i						0,15	0,20			0,30	1,00			2	5	d
	2						i						0,02	0,05			0,02	0,05				3	d
	3						i								0,45	0,75			0,90	3,00	2	4	d

a. 3.00 m forced into one of the landmarks and artos.No . 34 and 38 of the National Building at the other edge .

b. Artos . No.34 and 38 of the National Building Regulations .

c. Land use factor (FOS) maximum for the minimum parcel indicated .

d. Maximum height determined by FOS , FOT and graphic "c"

e. Clustered housing , horizontal and vertical condominium, add additional 60,00 m² of land for each additional dwelling unit

f. Clustered housing , horizontal and vertical condominium, add additional 80,00 m² of land for each additional dwelling unit

g. 8.00 m for mixed use with individual housing, services and / or trade and other mixed uses homeless.

h. 10.00 m for other uses including the clustered housing , horizontal and vertical condominium.

i. It requires previous opinion.

j. After the 3rd . floor is calculated as the graph c .

k. The load factor Total Land is governed according to the rules (MTI) on land use near the International Airport of Managua

L. Subject to the specific requirements of each use .

m. Facing Main Road

n. As urban design project

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		Housing min - max (hh / ha)		Plot / ha									Gross		Net		Gross		Net				
		Individual and Row	Grouped, Condomin. vertical and horizontal		Individual and Row	Grouped , Condomin . vertical and horizontal	Other uses		High collector streets and alleys	In primary distributor and collector			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
ET	1						n	n	n	n	n	n				n				n			
	2						n	n	n	n	n	n				n				n			
Tt	1												n	n	n	n	n	n	n	n	n	n	
	2												n	n	n	n	n	n	n	n	n	n	
RN	1						1 000 000	L	L	L	L	L				L				L			
	2						5 000	L	L	L	L	L				L				L			
	3						100 000	L	L	L	L	L				L				L			
	4						254 000	L	L	L	L	L				L				L			d
	5						28 000	L	L	L	L	L				L				L			d
Rac	1						n						0,05	0,10			0,05	0,10				n	
	2						n						0,02	0,05			0,02	0,05				n	
CA	2	85	170	17			600	20,00	5,00	5,00	3,00	3,00				0.51				1,02		2	d
	3	50	100	10			1 000	20,00	5,00	5,00	3,00	3,00				0.58				1,18		2	d
PB		100	200	20	500			15,00	5,00	5,00	3,00	3,00				0.46				0,92		2	d
ZQ	1	30		6	1 750			30,00	15,00		5,00	5,00				0.44				0,66		2	d
	2	20		4	2 500			35,00	15,00		7,00	7,00				0.42				0,63		2	d
	3	15		3	3 500			45,00	15,00		10,00	10,00				0.38				0,57		2	d
PA	1						30 000	100,00	20,00	20,00	15,00	15,00				0.05				0,05		1	d
	2						60 000	200,00	20,00	20,00	15,00	15,00				L				0,05		1	
PC	1						100 000	250,00	25,00	25,00	20,00	20,00				L				0,02		1	
	2						100 000	250,00	25,00	25,00	20,00	20,00				L				0,02		1	
	3						100 000	250,00	20,00		15,00	15,00				0.02				0,02		1	

a. 3.00 m forced into one of the landmarks and artos.No . 34 and 38 of the National Building at the other edge .
b. Artos . No.34 and 38 of the National Building Regulations .
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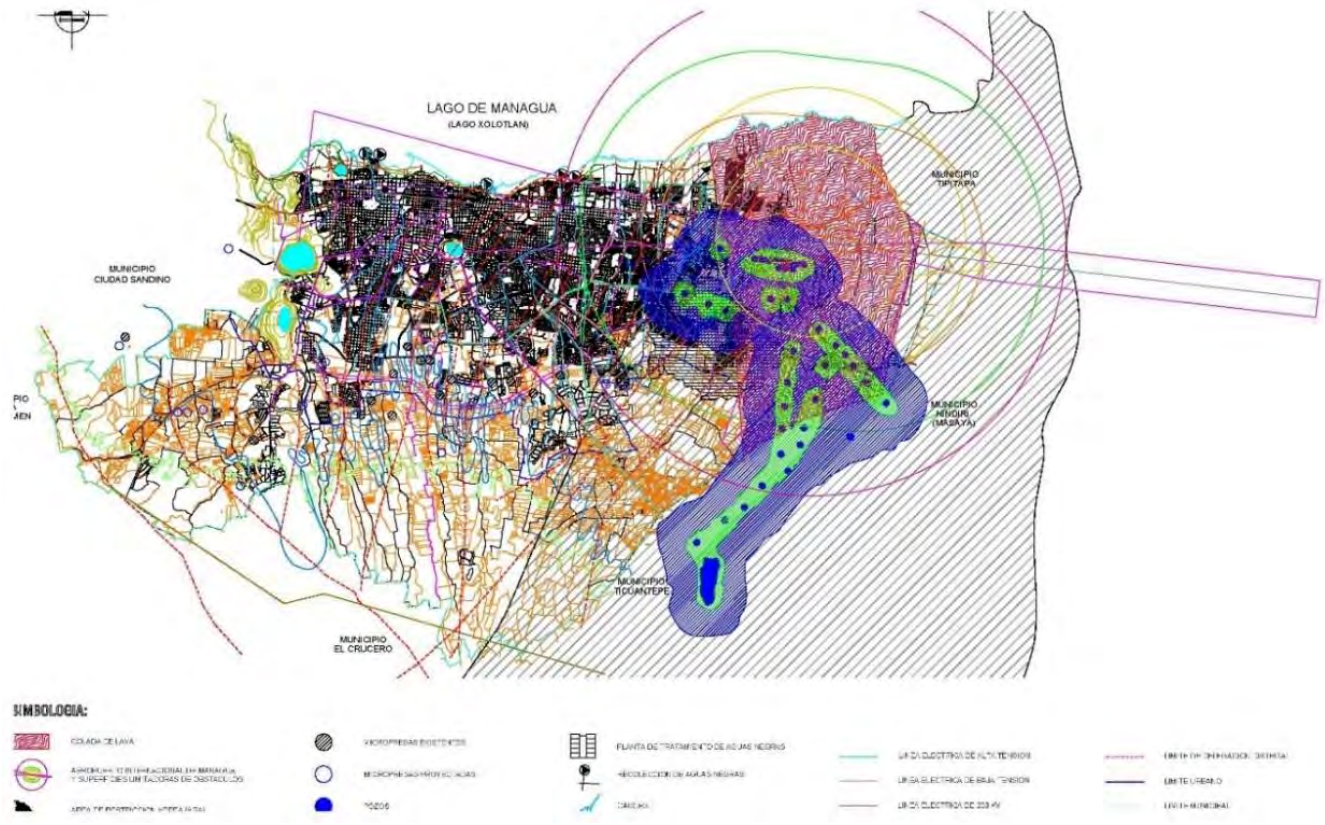
Source: ALMA

The zoning map is devised at the Department of Urban Planning, and is open access to the citizens of Managua City. This information is currently very accessible to the general public as it is available online.

(2) Development Restriction Area

Besides the zoning scheme mention above, there are other maps to indicate development restriction such as environmental protection, disaster prone, steep slopes, acquifer land, the airport and future extension area, and so on. ALMA has attempted to control the land use by using the development restriction area map as shown in Figure 3.4.5 compiling all relevant regulations. In consequence, applying for a building/planning permission tends to take a certain time.



Source: ALMA

Figure 3.4.5 Land Use Regulation Map of Managua City

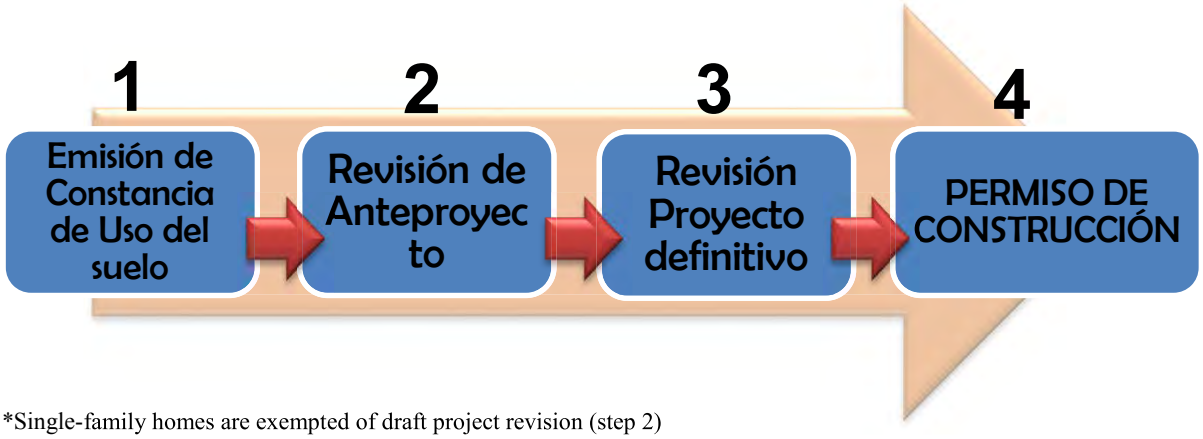
3.4.3 Implementation System of Construction Permit in Managua City

(1) Implementation Arrangement for Construction Permit

When the requirements in the land use zoning and regulations mentioned in Chapter 3.3.3 are all clear, then an application for construction permit has to be made before the start of construction on site. The organization in charge of construction permit is the Department of Urban Control under the Directorates of Urban Planning, except for the housing constructions less than 100 m^2 of floor area, which are handled by the corresponding District Office.

(1) Procedure of Construction Permit

The construction permit is administered in Managua City in four steps, as shown in Figure 3.4.6



*Single-family homes are exempted of draft project revision (step 2)
Source: ALMA

Figure 3.4.6 Four Steps in Construction Permit in Managua City

The first step is the emission of land use parameters [*Emisión de Constancia de Uso del Suelo*]. The applicant has to visit the cadastre office to confirm the land parcel on which the applicant seeks construction of a building, and asks for the relevant land use parameters to be dispensed for a fee. According to a document of ALMA describing the construction permit procedure, this step would require five working days.

The second step is the review of provisional project document [*Revisión de Anteproyecto*], where the applicant submits a provisional project document together with necessary application forms. Architectural drawings need to be signed by a certified architect, and they need to be accompanied by necessary certificates, including an opinion by the Nicaraguan Institute of Territorial Studies (*El Instituto Nicaragüense de Estudios Territoriales*:INETER) on the seismic and fault conditions, a document by ALMA on environmental impact. This step would require 15 working days according to ALMA, although single-family homes are exempted of draft project revision.

The next, or the third step is the review of definitive project document. In this step, the applicant has to turn in the necessary documents as per requirement, including the architectural drawings in A1 size signed by a certified architect together with the digital files. Necessary documents include structural, drainage, mechanical, pavement, and other technical documents properly signed by a certified expert. An estimate of construction cost by phase, together with unit prices and cost for infrastructure, will be necessary. Upon the receipt of the documents, ALMA starts the review of the application which would require 30 working days. After the review, the applicant will be given a technical comment to the application, for which the applicant needs to modify the project document within 30 days.

The fourth and the final step is the permit of construction [*Permiso de Construccion*], where all the documents and evidence of necessary payments are to be submitted, and if ALMA considers the documents to be complete and proper, then a construction permit will be dispensed to the applicant. This step would require, according to ALMA, five working days.

In all, the required time for getting a construction permit is 5 days for the first step; 15 days for the second step; 30 days for the third step; and 5 days for the fourth step, which add up to 55 working days, or about 11 weeks. The total fee for the construction permit is 1.1% of the construction cost.

According to a hearing from ALMA, the average number of applications is about 20 per month. Considering the population size of ALMA, the number of applications looks to be rather small, implying that there are a sizable number of buildings or houses built without a permit.

(2) Actual Condition of Construction Permit

The timeline mentioned in (2) above is considered to be a target for ALMA but may not necessarily the actual situation today. The World Bank group, in its "Doing Business–Dealing with Construction Permit in Nicaragua (2015)" summarizes the cost and timeline for receiving a construction permit for a warehouse in Managua City, as shown in Table 3.4.2. According to this document, the necessary period for getting a construction permit is 126 working days, or about 25 weeks, which is about 6 months.

Table 3.4.2 Period and Cost for a Construction Permit in Doing Business in Nicaragua

Work Item	Period (days)	Cost (NIO)
Request and obtain consultations with the Municipality of Managua	7	0
Request and obtain the land use certificate (*constancia de uso de suelo*) from the Municipality of Managua	30	500
Request feasibility analysis from the Nicaraguan Company Water Supply and Sewerage (*Empresa Nicaragüense de Acueductos y Alcantarillados:* ENACAL)	15	5,000
Request feasibility analysis from Union Fenosa	14	0
Request and obtain preliminary design approval from the Municipality of Managua	25	1,000
Request and obtain approval from the General Fire Department (*Dirección General de Bomberos*: DGB)	15	650
Request and obtain building permit from the Municipality of Managua	20	1.1% of the total cost
Total	126	Depends on the project

Source：World Bank, Doing Business (2015)

(3) Monitoring

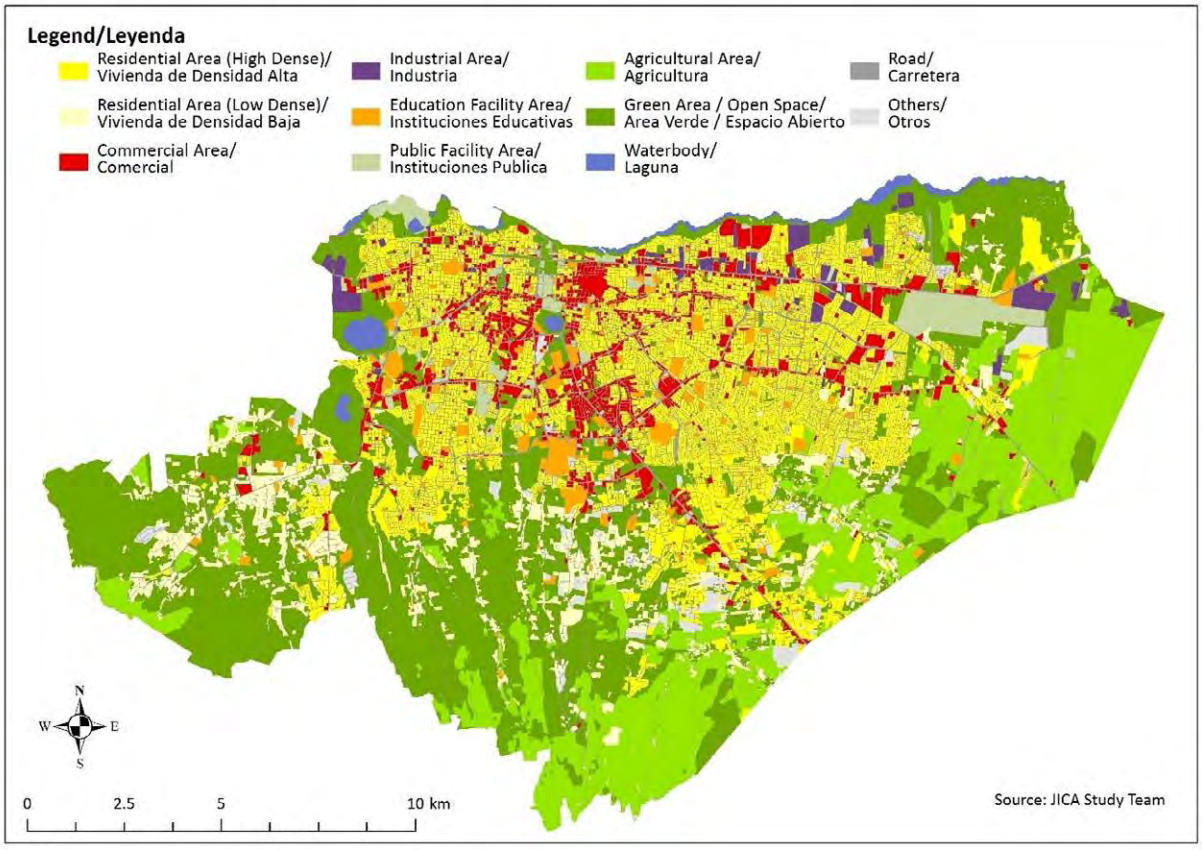
After getting a construction permit, the applicant needs to carry out consultation for infrastructure connection with respective authorities, and when this concludes, the construction work may be started. Monitoring the actual construction whether it is in conformity with the definitive project documents or not is the task for supervisors in each district and on the central level. But in reality, there is only one person or supervisor(s) per each district, and it may be difficult to monitor all the construction in progress. Improvement for reducing possible room for non-conformity needs to be devised.

3.5 Existing Land Useof Managua City

3.5.1 Existing Land Use Map

Existing land use map is useful to understand the current condition of land in the study area and analyse land evaluation in order to prepare the future land use plan. The Department of Municipal Cadastres, ALMA has been preparing the detailed cadastral maps with the information of land use by barrio (neighbourhood) as explained in Chapter 2.5.1. However, the cadastral map supposes to complete in end of 2017 and the scale is too detailed to analyse, JICA Study Team decided to employ different source.

The land use map in 2004 with the scale of 1:25,000 covering the entire study area, developed by ALMA, was found to be appropriate as a base map. Based upon this map, existing land use map in 2016 is under updating by using an aerial photo taken in 2015 and a series of site surveys. The exiting land use map has completed as illustrated in Figure 3.5.1.



Source: JICA Study Team based on the map prepared by ALMA

Figure 3.5.1 Existing Land Use Map 2016

As shown in the following figure, agriculture, green and forest areas were dominant land use in Managua City which said roughly 50% of the total land. Waterbody marked small percentage since no major river existed in Managua City. On the other hand, one-quarter of the city was occupied by residential area. The built up area including the lands for house, commercial, industry, public facilities and road covered other half.

Category	Total (ha)
Residential Area	6,890
Commercial Area	1,440
Industrial Area	380
Public Facility Area	1,420
Road	2,880
Open Space	1,030
Green and Agricultural Area	10,730
Forest	2,110
Waterbody	320
Total	27,200

Source: JICA Study Team

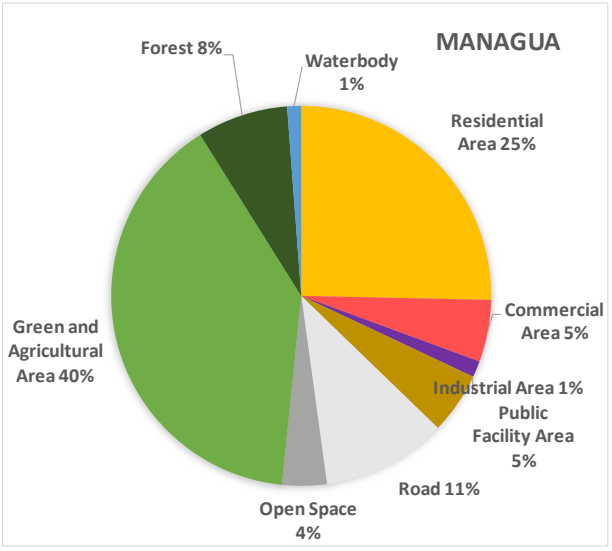
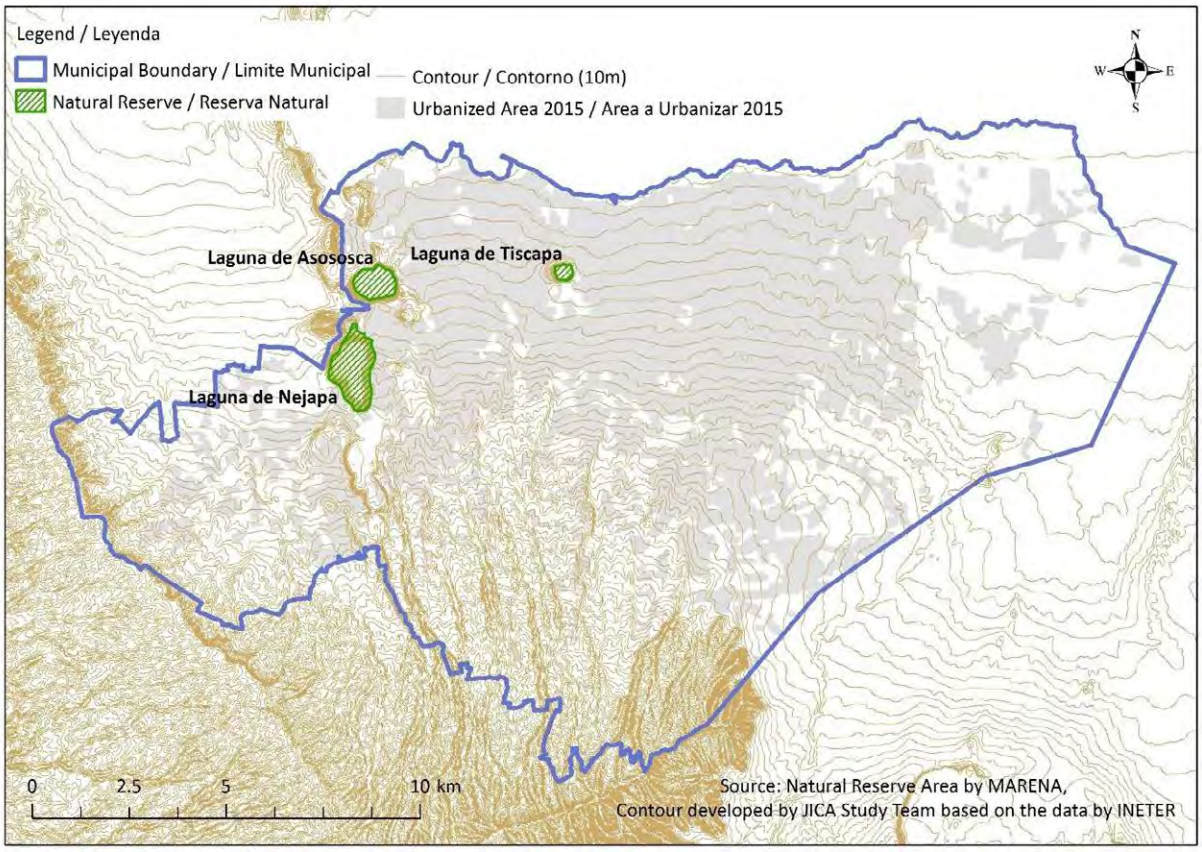


Figure 3.5.2 Area of Land Use 2016

3.5.2 Present Land Use

As Figure 3.5.1 shows Managua City consists of a variety of land use. The built up area including housing, commercial, and industry radiate out from the historic central area near Managua Lake. The commercial area tends to be located at the central of the city and along the major roads, meanwhile many industrial areas are found in surroundings of the airport and along Road N1. In contrast, the green area including forest and grass land spreads in fringe of the south boundary. Beside, the surrounding of the east boundary are occupied by agricultural land. The three lagoons and its surrounding areas are protected as "natural reserves" by the Ministry of Environment and Natural Resources (*Ministerio del Ambiente y Los Recursos Naturales:* MARENA), namely: Tiscapa Lagoon, Asososca Lagoon, and Nejapa Lagoon as shown in Figure 3.5.3.

Existing land use relates to the geographical conditions. The urban development and agricultural activities tend to concentrate on a relatively flat area, meanwhile the green and forest area remains on the slope area. The geographical condition suggests that the south and partly west areas near the municipal boundary have steep slope and seem to be inappropriate to urbanize as shown in Figure 3.5.3.



Source: JICA Study Team based on the DEM data by INETER

Figure 3.5.3 Contour Map

3.5.3 Comparative Study of Built Up Area 2005-2015

(1) Dynamics of Built Up Area in Recent Decade

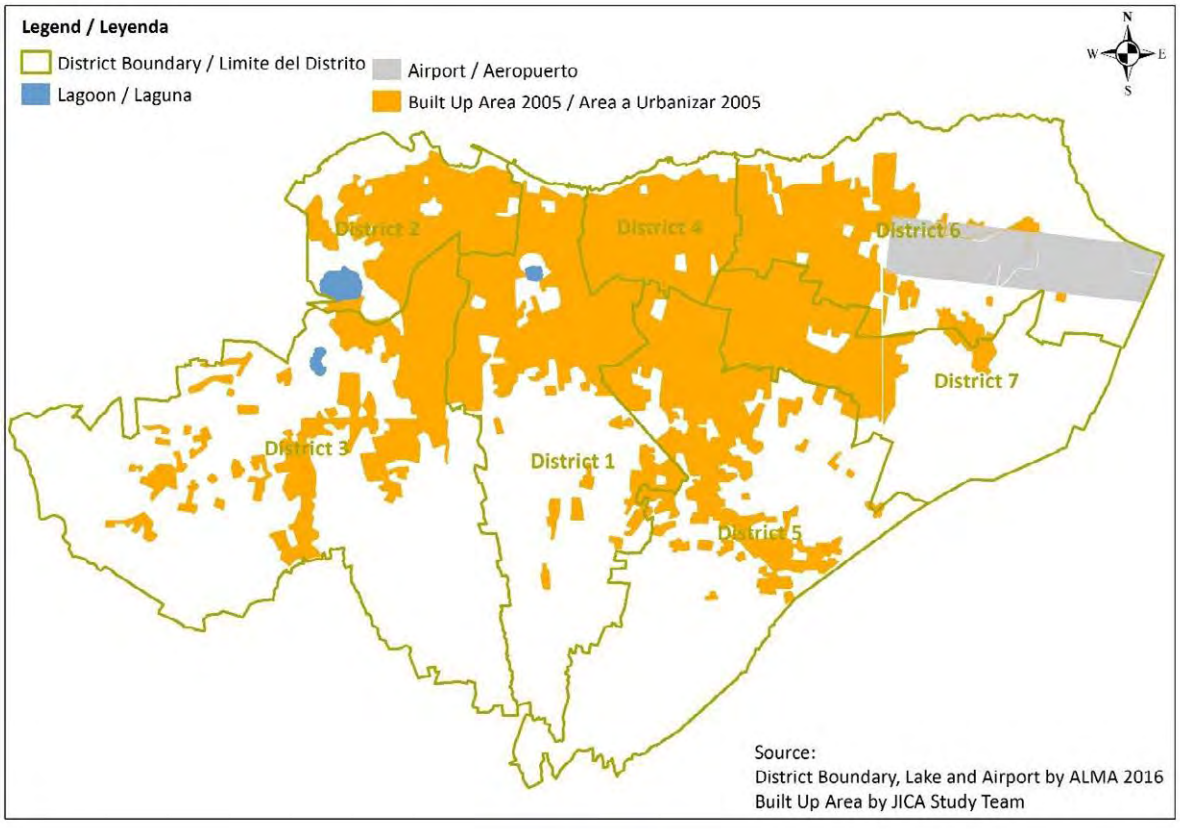
By using the GIS system, built up data with a basis of aerial photos in 2005 and 2015 has developed by the JICA Study Team as shown in Figure 3.5.4 and Figure 3.5.5. The total land of ALMA has an area of 27,200 ha, in which the built up area had an area of 9,380 ha in 2005 and 12,500 ha in 2015 based on the GIS system[2]. In 2005, approximately 35% of the total land was occupied by urbanized land, and expanded to approximately 46% of that in 2015. These numerical numbers therefore suggest that the urbanized area had increased around 11% of the total land in a decade. Looking at the district, District 4 situated in the central area of the city, accounted for more than 90% of the land covered by built up area. Besides, in Districts 1, 3, and 5, located in the southern part of the study area, the urbanized areas tended to enlarge rapidly during the ten-year period from 2005 as indicated in Table 3.5.1.

[2] The data source is ALMA GIS

Table 3.5.1 Built Up Area by District

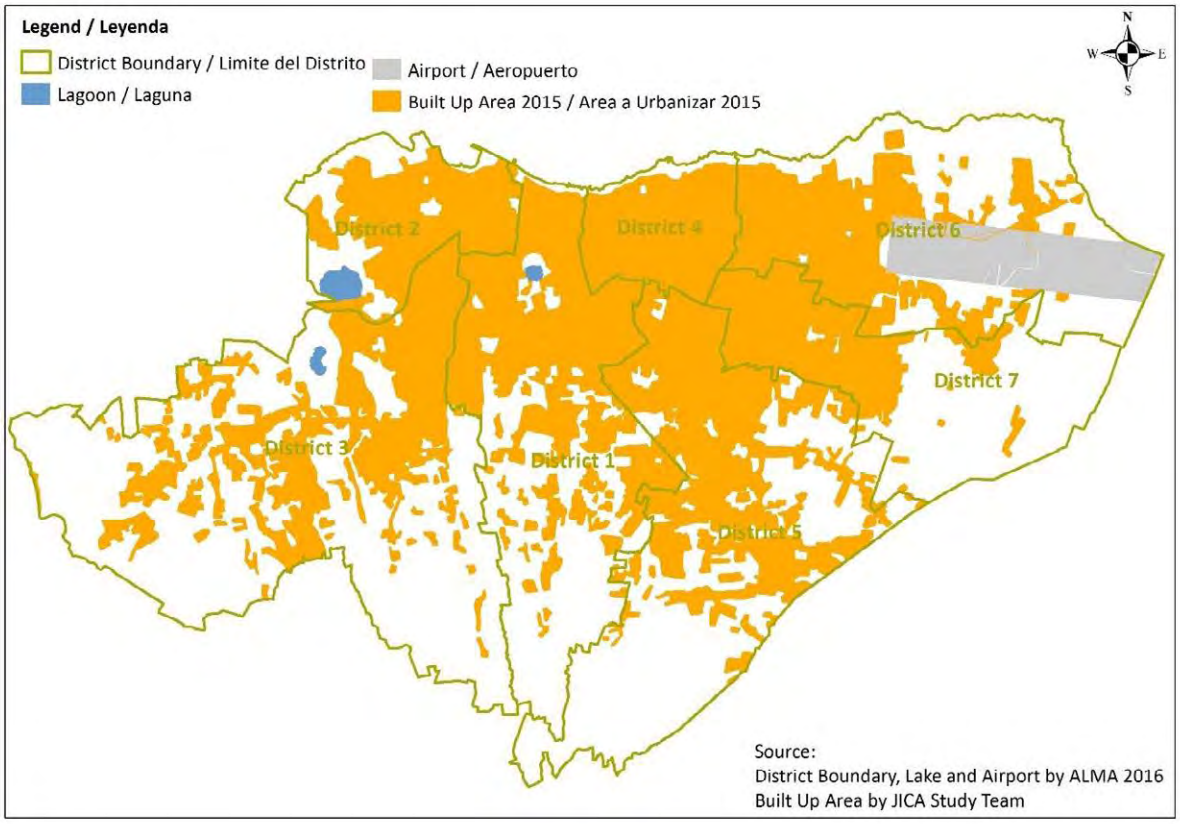
District	Area (ha)	Year 2005		Year 2015		Year 2005 - 2015	
		Built-up Area (ha)	%	Built-up Area (ha)	%	Expansion Area (ha)	%
1	4,390	1,700	39%	2,390	54%	690	16%
2	1,750	1,060	61%	1,140	65%	80	5%
3	7,320	1,550	21%	2,440	33%	890	12%
4	1,120	990	88%	1,030	92%	40	4%
5	5,250	1,640	31%	2,500	48%	860	16%
6	4,360	1,360	31%	1,800	41%	440	10%
7	3,000	1,090	36%	1,200	40%	110	4%
Total	27,200	9,380	34%	12,500	46%	3,120	11%

Source: JICA Study Team



Source: District boundary and airport by ALMA 2016

Figure 3.5.4 Built Up Area in the Study Area in 2005

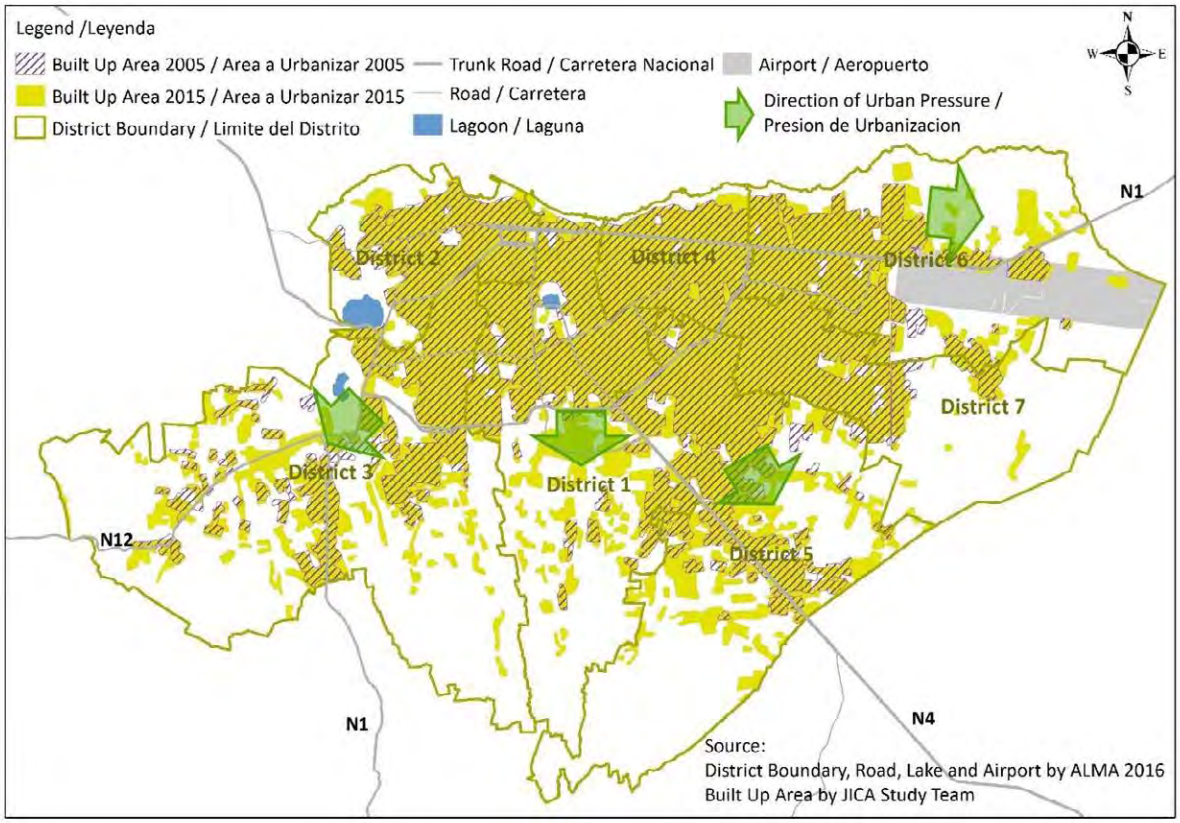


Source: District boundary, lake, and airport by ALMA 2016

Figure 3.5.5 Built Up Area in the Study Area in 2015

(2) Direction of Urbanization

According to the comparison of data between 2005 and 2015, urbanization could recognize to progress toward south and east in the study area as shown in Figure 3.5.6. The built up tends to be developed along the major arterial roads such as Pan American Highway (N1), Carratera a Masaya (N4), and Carratera Vieja a Leon (N12), and to avoid slope area as explained in the previous section.Limited open space in the central area for land development and motorization are also considered to contribute such urbanized direction in Managua City.



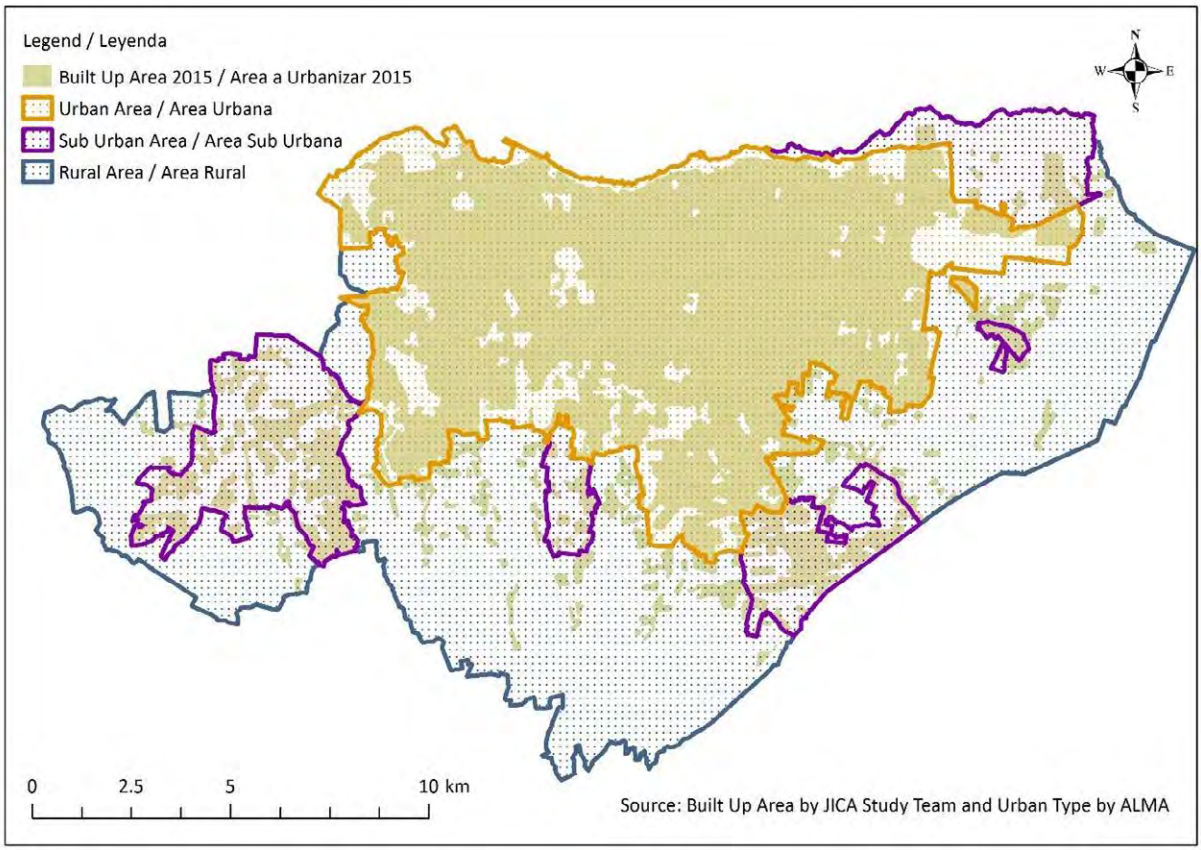
Source: District boundary, road, lake and airport by ALMA 2016

Figure 3.5.6 Urbanization Direction

3.5.4 Characteristics of Built Up Area

Municipal boundary of Managua City is divided in three characteristic area, namely: "Urban Area", "Sub Urban Area", and "Rural Area", along the barrio[3] type defined by ALMA. As illustrated in Figure 3.5.7, bold lines show the boundary of these three areas.

[3] Barrio is neighbourhood boundary under district.



Source: Built up area by the JICA Study Team and urban type by ALMA

Figure 3.5.7 Urban Characteristics by Barrio

Urban Area composes mainly built up area. Sub Urban Area consists some built up area and open spaces. Meanwhile Rural Area tends to be covered with green area including forests and agricultural land, and to have small housing area. In terms of the built up in each area also has different characteristics. The following section will explain in detail.

(1) Urban Area

Urban area is mainly composed of low rise buildings, such as one- or two-story buildings, covering most of the area including the historical center and the Oriental Market as illustrated in Figure 3.5.8. The built up area therein is used as: a) a variety of purposes such as housing, commercial, industry, institutions, and government offices and b) a variety of economic, social, and educational activities taking place here. The land use intensity[4] is relatively high and its ratio is around 80% as shown in Figure 3.5.9. It is hard to find aland for new development in urban area.

[4] Land Use Intensity = Building Coverage / Area of Residential Land

Source: Aerial Photo by ALMA

Figure 3.5.8 Urban Area of Managua City

Urban Area: Average ratio of land use intensity is 81.2%

Sample: U-1

Land Use Intensity Ratio: 84.4%

Sample: U-2

Land Use Intensity Ratio: 78.1%

Source: JICA Study Team based on aerial photos by ALMA

Figure 3.5.9 Samples of Land Use Intensity in the Urban Area

(2) Sub-urban Area

Sub-urban area consists of built up area and green area including agricultural land, bush, and forest. The built up area has been newly urbanized mainly with relatively larger size houses, shopping malls, and offices. Some open spaces for future land development, where land grading has already been done, are also found in sub-urban area as shown in Figure 3.5.10. The land use intensity is relatively low and its ratio is around 30% as indicated in Figure 3.5.11. Further urbanization will be anticipated in the sub-urban area because of the land capacity. Also active developments for not only housing but also roads and infrastructure are carried out here.

Source: Aerial photo by ALMA

Figure 3.5.10 Sub-urban Area of Managua City

Sub-urban Area: Average ratio of land use intensity is 29.8%

Sample: SU-1

Land Use Intensity Ratio: 29.4%

Sample: SU-2

Land Use Intensity Ratio: 30.2%

Source: JICA Study Team based on aerial photos by ALMA

Figure 3.5.11 Land Use Intensity in the Sub-urban Area

(3) Rural Area

Rural area covers mostly agricultural, green lands, and slope area including forests. Houses are generally scattered in this area and small agglomerations could be seen as spots in Figure 3.5.12. Not much economic activity except agricultural industry could be found in the rural area. The land use intensity is very low compared with other two areas as explained above, and its ratio is around 13% as indicated in Figure 3.5.13.

Source: Aerial photo by ALMA

Figure 3.5.12 Rural Area of Managua City

Rural Area: Average ratio of land use intensity is 13.3%

Sample: R-1

Land Use Intensity Ratio: 13.7%

Sample: R-2

Land Use Intensity Ratio: 12.8%

Source: JICA Study Team based on aerial photos by ALMA

Figure 3.5.13 Land Use Intensity in the Rural Area

3.6 Spatial Data (GIS)

Spatial data generaly means data connected with particular area or point of the earth directly or indirectly using address or coordinates. Needless to say GIS data and the satellite image data are spatial data, but in the broad sense it can hold coordinate values, CAD data and some of drawing files can also be said to be spatial data including microstation data which utilized in ALMA for long time. In this section, current status of spatial data development, especially GIS data and utilization of GIS technology in Managua are mentioned, in addition to result of GIS data collection for this master plan.

3.6.1 Spatial Data Collection and Development

In Nicaragua, there are many of spatial data producers exist, such as ALMA, INIDE, INETER, MARENA and various donor projects. These produced spatial data from various organizations are utilized for their own purpose and accumulated in each organization. In PDUM, necessary data to support formulation of urban development maseter plan are collected from relevant organizations which are administrative boundaries, natural environmental data, transport data, and so on. All of the collected data were examined and cleaned if any issues arose on the data in order to carry out spatial analyses as GIS data. Besides, all of these GIS data are integrated as an urban planning database at the end of this Project for future planning works and monitoring progress of master plan. In addition, collected numerical data such as population data, and various statistical data also integrated into GIS data for helping further analyses. The followings are five types of GIS data development method employed by PDUM;

- GIS data collected from relevant organizations and cleaned by PDUM (e.g. road network, administrative boundary)
- GIS data developed/ updated by PDUM (e.g. urbanized area, existing and future land use, traffic analysis zone)
- GIS data integrated with collected numerical data from relevant organization (e.g. population by barrio, traffic accident)
- GIS data integrated with additional information by PDUM (e.g. road network by function)
- GIS data converted from CAD data collected from relevant organization, and cleaned by PDUM (e.g. type of residential area, development zoning)

Table 3.6.1 shows a summary of collected and developed GIS data in PDUM project.

Table 3.6.1 Summary of Spatial Data Collection and Data Development by JICA study team

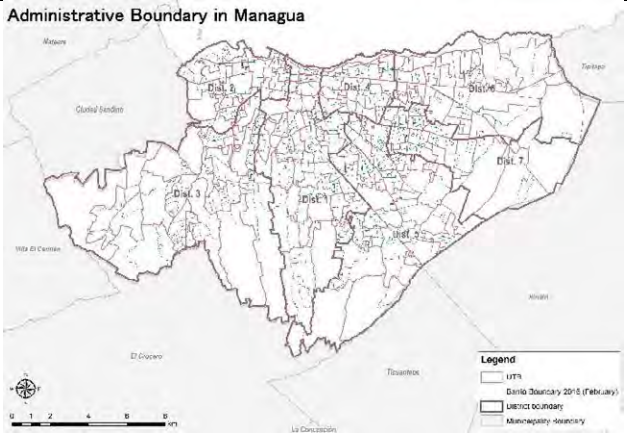
Category	Name of Data	Source	Remarks
Administrative Boundary	• Municipality boundary • District Boundary • Barrio Boundary • UTB	INETER, ALMA	
Other Boundary	• Urban/ Sub-urban/ Rural area • Historical area	ALMA,IDB, PDUM	Urban/ Sub-urban/ Rural areas are identified from types of Barrios

	• SEZ • TAZ (Traffic Analysis Zone)		
Land use	• Existing Land use 2016	ALMA, PDUM	Existing land use data was developed based on ALMA "Uso actual", and updated using land use survey data done by ALMA
Natural Condition	• Slope condition • Elevation • Contour • Waterbody • Fault	ALMA/ INETER/ SINAPRED/ PDUM/ SRTM[5]	
Social Condition	• Illegal Settlement	ALMA	Excluded (Source data was not available)
Hazard Information	• Flood prone • Land slide prone • Evacuation point	ALMA/ SINAPRED	
Transport	• Road network • Bus stops	ALMA, Web	
Urban infrastructure	• Water supply • Electricity • Sewage • Solid waste collection route	ALMA and other relevant organization	
Facilities	• Religious Facility • Public facilities	ALMA	
Development Constraints	• Natural reserve • Aquifer • Coastal zone • Forest • Green area	MARENA/ ALMA/ PDUM	
Future Plans	• Sub-centers • road network plan • public transport plan • land use plan	ALMA, Min. of Industry, PDUM	
Others	• Zoning map (current)	ALMA	Converted to GIS format and cleaned by PDUM
Satellite Imagery/ Aero photo	• Aerial Photo	ALMA	2002, 2005, 2010 and 2015 (year)

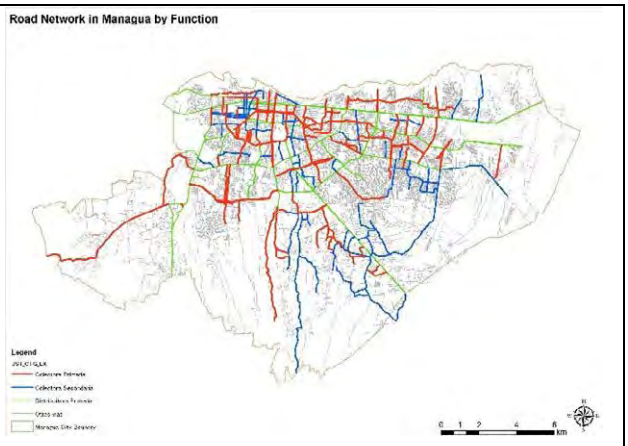
Source: JICA Study Team
Source: ALMA, PDUM, INETER

Figure 3.6.1 shows samples of collected or developed GIS data.

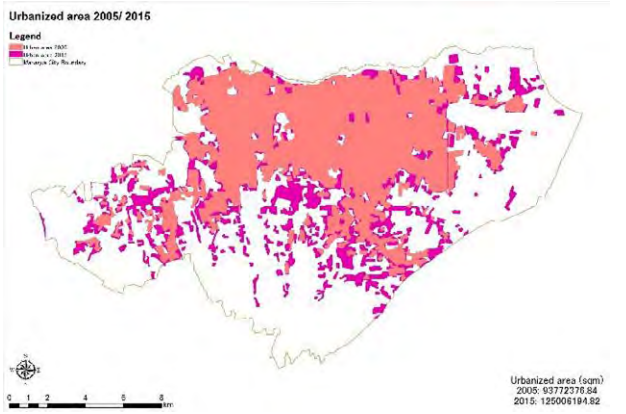
[5] The highest-resolution topographic data generated from NASA's Shuttle Radar Topography Mission (SRTM)



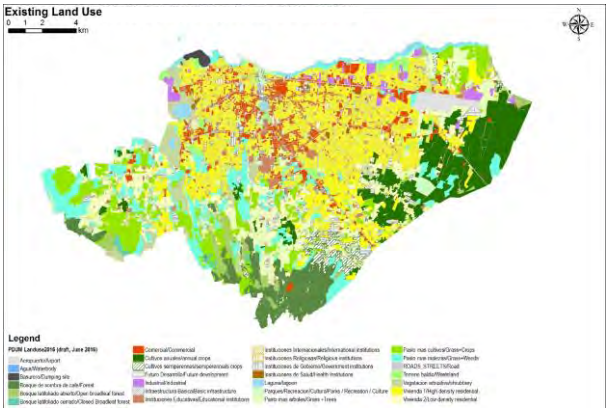
Administrative Boundary



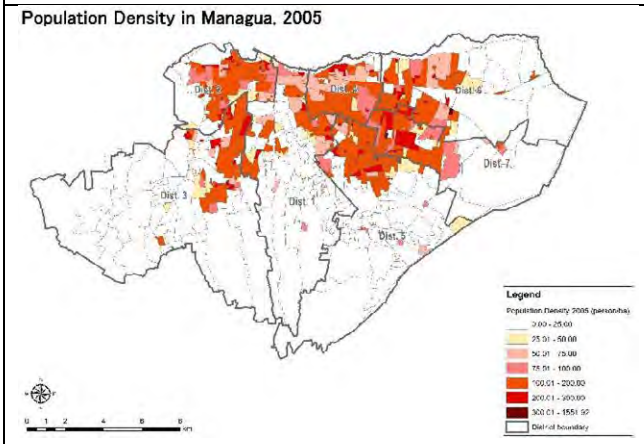
Road Network by Function



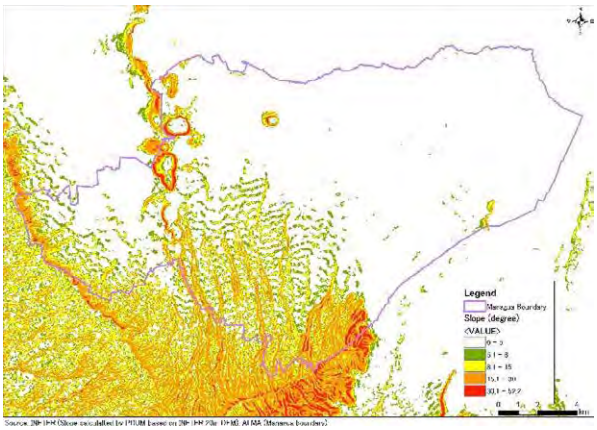
Urbanized area 2005 and 2015



Existing land use



Population Density by Barrio



Steep Slope areas

Source: ALMA, PDUM, INETER

Figure 3.6.1 Samples of Collected and Developed Spatial Data

3.6.2 Major Spatial Data Producers and Users in Managua City

Collecting spatial data from relevant organizations was carried out in this project. Main spatial data sources for PDUM are ALMA and INETER, in addition that, some other data related to environment and disaster expects to be collected from the National System for Disater Prevention, Mitigationand Attention (*El Sistema Nacional para la Prevención, Mitigación y Atención de Desastres:* SINAPRED) and MARENA.

(1) ALMA

ALMA produces and stores various kinds of spatial data not only basic spatial data such as administrative boundaries and land plots, but other data such as data related hazard and environmental resources also stored in their database as results from many projects. Especially land plots data developed by Directorate Cadastral is significantly important for ALMA because of this data is a basis of their tax collection, therefore ALMA updates the land plot data daily basis.

These data are stored as database in Latino server, which is integrated database managed by ALMA IT section, and ALMA utilize these data in order to check the locations of building or/and land developments for issueing building permission, tax collection and to produce various thematic maps. Since ALMA database contains not only GIS data but also other types of spatial data such as CAD drawings, numerical data and documents, so that the contents of database became significantly huge. In order to access the database, various original applications were developed by purpose by duty of each Department with own budget, such as LatinoGIS, InfoVias and SISCATNET. Table 3.6.2 shows applications used by ALMA.

Table 3.6.2 Summary of Application Related to Spatial Data in ALMA

Name of Application	Objectives of Application/ Functions	Main User	Status	Remarks
LatinoGIS	Cartographic basic platform for editing boundaries, calculating area of properties for calculation of property tax	ALMA (Direccion Gen. de Catastro Municipal)	Operating	Periodically updating since 2002.
	Viewer for orthophoto. Maps, spatial data such as administrative boundaries, roads, equipment's, etc.	ALMA (Direccion Gen. de Proyecto, Dir. Gen. de Ambiente y Urbanismo, Dir. Gen. de Infrastructura, Centro de Information Municipal, District)		
AlmaInfoVias	For comprehensive management of storm water drainage in Managua City, which includes roads, storm sewage and riverbeds.	ALMA (Dir. Gen. de Proyectos, Dir. Gen. De Infrastructura), AMUSCLAN	Operating	Since 2013, developing several versions.
SISCATNET	For register property information for taxation and issue property tax information to public	ALMA	Operating	
AlmaGIS	Data viewer for public and stakeholders through Web. Users can access basic data such as orthophoto and administrative boundaries	ALMA and Public	Operating	Since 2011, developing several versions.

AlmaInundaGis	For flood risk management and manage supply.	ALMA (*Dir. Gen. de Proyectos, Dir. Gen. De Infrastructura*), Stormwater Drainage and Development Management Sub Watershed III (AMUSCLAN)	Under Developing	Will start operation within 2016
AlmaRecaudaGis	For management and examine property tax collection for decision making.	ALMA (Dir. Gen. de Recaudacion, Dir. Gen. De Planificacion)	Under Developing	Will start operation within 2016
Consulta de Uso de Suelos	To support issuing construction permit by ALMA. Reduce time to process construction permit. Everyone can check related regulation of each land plot through Web.	ALMA (Dir. Urbanism) and Public	Under Developing	Start development since December 2016, will start operation within 2017
Systema de Gestion de Incidencias	Provide general information (e.g. market, park, district offices, etc.) to Public and collect data from Public through Web.	ALMA and Public	Under Developing	Will start operation within 2017

Source: ALMA

(2) INETER

INETER established as the scientific and technical body of Nicaragua, creating basic information such as cartographic, cadastral, meteorological, hydrological, geological, etc., and studies and research of the physical environment that contribute to socioeconomic development, the reduction of vulnerability against natural disasters and permanently watching natural hazards. INETER produced topographic maps for entire Nicaragua area in 2006 funded by JICA[6]. In this project, INETER produced several scale topographic and hazard maps in Managua City as shown in Table 3.6.3. PDUM project was provided data of the topographic maps in ArcInfo coverage format, CAD format and raster format by INETER.

Table 3.6.3 Summary of Outputs INETER-JICA Mapping Study 2006 (For Managua City area)

Item	Scale
Topographic Maps for Managua and GIS Database	1/5,000
Topographic Maps and GIS Database	1/50,000
Topographic Maps	1/50,000
Seismic Hazard Maps	1/125,000

Source: The study for establishment of base maps and hazard maps for GIS in the Republic of Nicaragua final report, (JICA, 2006)

[6] The study for establishment of base maps and hazard maps for GIS in the Republic of Nicaragua in 2006

In addition, there are various INETER data was collected to understand charactoristics of Managua City in the view from natural condition, such as land potential and active faults. Most of GIS data from INETER was prepared in rather small scale compare to data prepared by ALMA because data produced by INETER covers entire Nicaragua, so most of INETER data utilized as reference data.

(3) Other Spatial Data Producers

There are various data sources are available related to spatial data covering Managua City not only governmental organization, but also other donor projects or public initiatives including MapaNica[7]. These collected data was fully utilized in formulating urban development master plan.

3.6.3 Utilization of Spatial Data in Managua City

As mentioned in the previous sections, there are various spatial data are developed and these data are stored in ALMA database. So as to access ALMA database a variety of web-based applications has been developed such as LatinoGIS and InfoVias which are able to edit, view, search, visualize data and conduct simple analyses. However in previous time these spatial data and maps were used to be prepared in CAD format, so many of spatial data are still difficult to use with other spatial data because of different coordinate system and different format. Through PDUM activities, ALMA understood usefulness of GIS techniques and decided to accumulate spatial data in GIS format, so data conversion to GIS format and production of spatial data in GIS format are gradually started in ALMA.

With regards to data dissemination to public, ALMA also developed AlmaGIS which is web-based viewer of spatial data, it is accessible from ALMA Web-site. This AlmaGIS[8] used to developed as indipendent web-site apart from official ALMA Web-site, however it is accessible from new ALMA official Web-site as of January 2016 as a part of data dissemination and improvement work done by ALMA. Followings are brief summary of accessible data and functions of AlmaGIS;

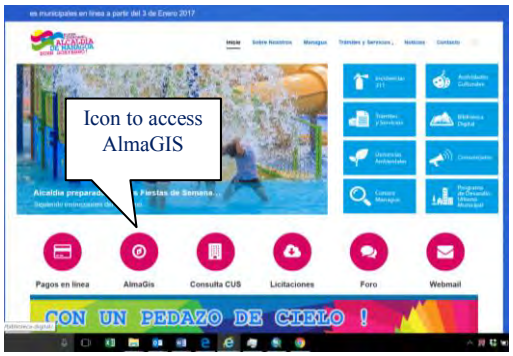
- Accessible data: Administrative Boundaries (Barrio, District), Block (Manzanas), Aero photo 2015, Reference names (e.g. name of road, place of interest, tax number)
- Functions: View data, search data by name of interest, measure distance and area, export or print map

Figure 3.6.2 shows screenshot of AlmaGIS as of April 2016.

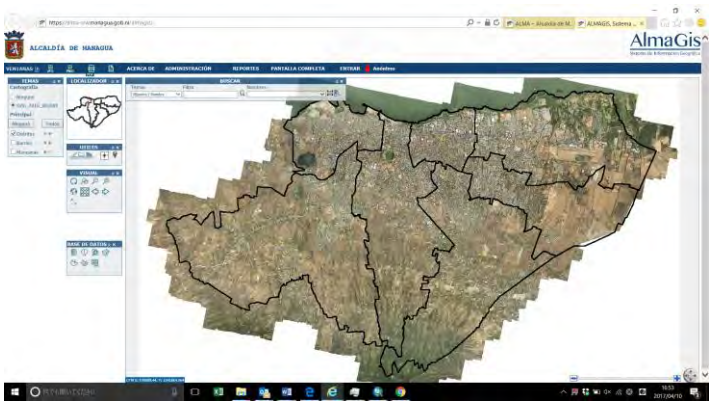
In addition to AlmaGIS, ALMA also start to develop new web-based application named as “Consulta de Uso de Suelos (Land Use Consultation in English)” for Public to share regulation and information related to construction permit which need to vist ALMA to collect these information currently. This new application was planed based on “open GIS” idea which experienced from study tour in Japan, July 2016 under this PDUM project. This new application plans to start operation within 2017 and this application expects to reduce burdun to apply construction permit by citizens and reduce work load

[7] MapaNica is a initiatives of create, share geographic information for the use of new free technologies and main activities are updating and producing road network data and bus route data and sharing data on the Web.. http://rutas.mapanica.net/
[8] http://alma-srw.managua.gob.ni/almagis/

within ALMA to issue construction permit. Figure 3.6.3 shows screenshot of new ALMA application named as Consulta de Uso de Suelos.



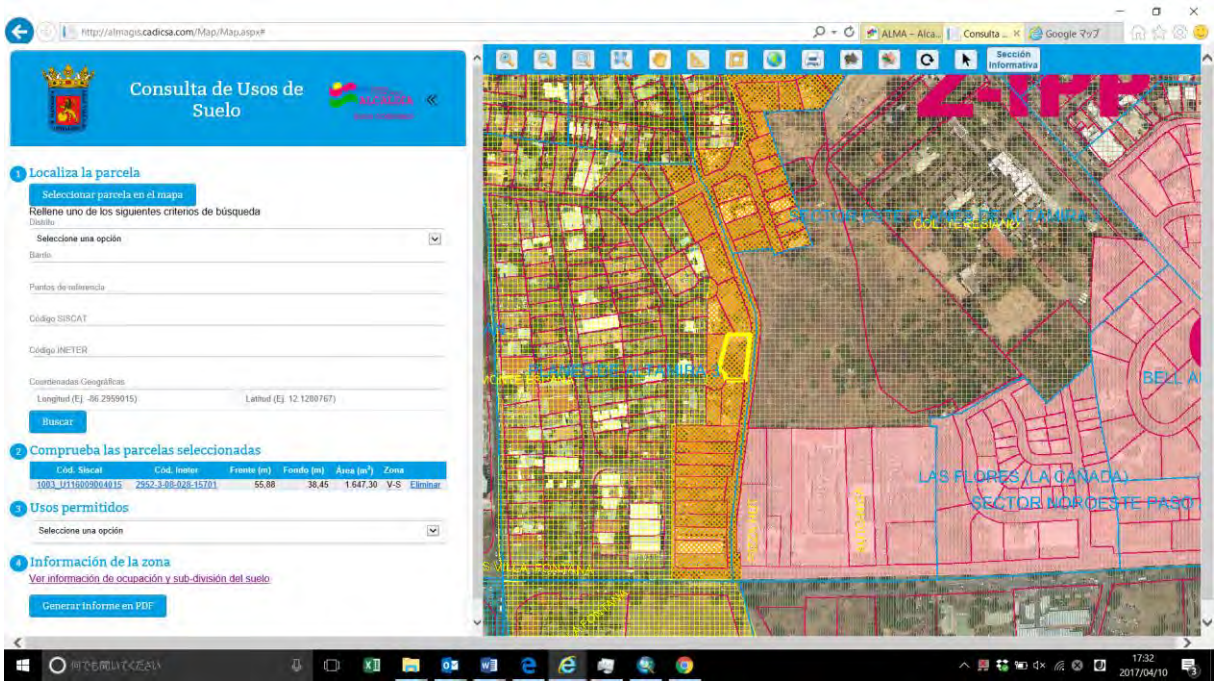
ALMA official Web-site

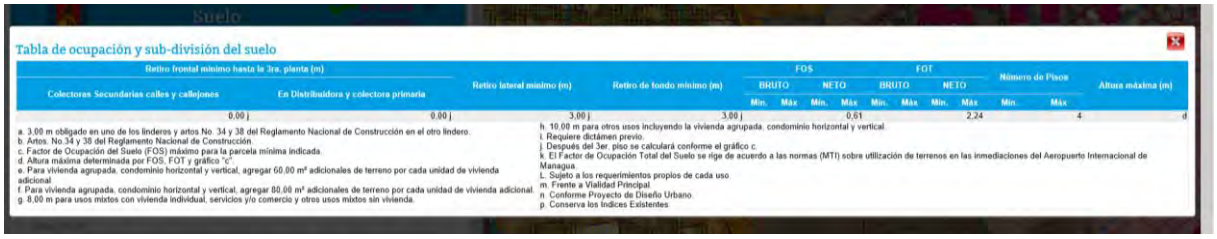


AlmaGIS

Source: ALMA

Figure 3.6.2 Screenshot of AlmaGIS as of April 2016





Source: ALMA

Figure 3.6.3 Screenshot of Consulta de Uso de Suelos (Under developing as of April 2017)

Using this "Consulta de Uso Suelos", everyone can view information about particular land plot, also everyone can download related regulations, so those who would like to develop particular land can easy to understand available usage of the land plot before apply building permit, because currently those who would like to develop particular land, need to apply construction permit to ALMA, then they can get information of regulation and limitation of development of the land. In addition, currently ALMA need to check and review each application of construction permit manually using hard copy map plot by plot, it is quite time consuming work for ALMA. So, once this application start operation, it is significantly reduce time to issue construction permit, accerelate development process and bring benefits for both Public and ALMA. Followings are planned functions accommodate in this new application.

- Accessible data: Administrative Boundaries (Barrio, District), Block (Manzanas), land plot, Aero photo 2015, current zoning regulation, reference names (e.g. name of road, place of interest, tax number), related regulations in PDF format
- Functions: search particular land plot on map, input SISCAT code (reference code of land plot for tax collection) or input INETER code (reference code of land plot used in INETER), view regulation related to the land plot and available type of development, download related regulations in PDF format and generate all information and regulation on the land plot

3.6.4 Issues in the GIS Sector

There are various data collected from various organization. All these data should be examined in a view from quality for spatial analysis for urban planning work and there are some issues which are identified. In PDUM, all of spatial data would be prepared in the same coordinate system and proper topology to develop urban planning database, so it is essential to put continuous efforts to update and manage urban planning database by respective organizations for future urban planning work. To support future planning work in ALMA, PDUM provided GIS training to ALMA staff to transfer necessary skill related to GIS for urban planning. Detail information of GIS training was mentioned in the Chapter 6 in this report.

(1) Insufficient Data for Spatial Analysis (Quantitative Analysis)

A number of key spatial data was provided by ALMA to JICA Study Team. ALMA currently produces GIS data mostly for searching for a particular location or preparing thematic maps, so it was good enough quality for ALMA for their current purpose. However it is necessary to upgrade the data level to conduct a spatial analysis such as urbanization simulation or to identify spatial relationships/ patterns quantitatively using multiple factors.

Table 3.6.4 shows description of types of spatial data in general. Through examination of spatial data provided by ALMA, it was found that ALMA spatial data are either type 2 or 3. Through PDUM activities, necessary spatial data for urban planning worl was upgraded into to type 4, for further analysis.

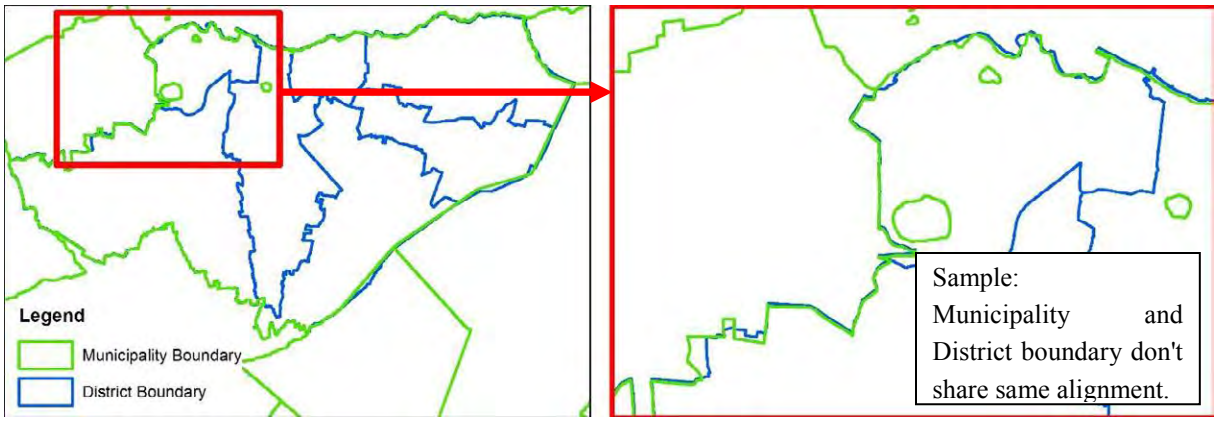
Table 3.6.4 Description of Types of Spatial data

Types of GIS Technique	Data type	Spatial aspect (map object)	Phenomenon/ Condition (Attribute)	What you can do?
GIS for mapping	type 1	No Quantitative	No Quantitative	visualize map as a picture/ figure get attribute value only on the map using your eye (e.g. CAD drawings)
	type 2	No Quantitative	No Quantitative	search answer using PC, such as "Where airport locate?" (e.g. Google map)
	type 3	No Quantitative	Quantitative	calculate/ search "at Where" or "What is there" or "How much (many)" summarize attribute (e.g. summarize Top 10 Barrio population)
GIS for Spatial Analysis	type 4	Quantitative	Quantitative	calculate spatially with other spatial data refer other spatial data overlay with other spatial data

Source: JICA Study Team

(2) Discrepancy of Data and Digitizing Errors

It is observed that there are some data discrepancies in collected data such as Municipality boundary and District boundary as shown in Figure 3.6.4. These discrepancies will be fixed by PDUM through discussion with ALMA. The reason for these discrepancies are considered to be due to the data development using different source and/ or different scale.



Source: JICA study team

Figure 3.6.4 Sample of Data Discrepancy

Figure 3.6.5 shows a sample of digitizing error in road network in Managua City. For PDUM, the road network is a key spatial data to formulate urban development plan. Though Spatial data editing work is time consuming and needs lots of manpower, without this efforts spatial analysis would be impossible and less accurate. So, it is necessary to undertake not only spatial data editing skills, but also data error check skills and management skills.

Original data: Many Roads are not connected properly

After Cleaning: Roads are connected properly

Source: JICA study team

Figure 3.6.5 Sample of Data Errors (Roads network data)

(3) Need for Standardization of Coordinate System

There are several coordinate systems used for spatial data in Nicaragua, and some of data shows a coordinate system as "unknown". This situation leads to a kind of obstacles for GIS users to fully utilize spatial data. For spatial analysis, data should have a projected coordinate system, such as universal transverse Mercator (UTM), Albers Equal Area, or Robinson. In addition, many of spatial data in ALMA are originally prepared in CAD format and most of these data uses geographic coordinate system (GCS) or maps are draw without a coordinate system, which will make the results of spatial analysis less accurate and difficult.

(4) Necessity of Data Sharing and Dissemination

In ALMA, there is big and strong database, so called "ALMA database" is available and applications to utilize this ALMA database are also available. However still various map data and maps which are important information to Public are still closed or have not yet developed by ALMA, such as hazard maps, evacuation areas and public transport network. To make these data more valuable and useful for everyone, spatial data which are not include indivisual information or confidential information should open to Public.

In addition, it is identified that to access or understand exact location of the point of interest is currently quite difficult for everyone because clear addres system is not exist in Nicaragua. This is inconvenient and insufficient for movement of people and goods, even detailed map and spatial data are available. To disseminate spatial information, it might necessary to revise address system with user friendly manners.

3.7 Issues in Urban Planning

(1) Enhanced Service, Business, and Commercial Function of Managua City

As discussed in Chapter 3.1.2 (1), Managua City is the capital city of Nicaragua and this requires Managua City to continue acting as the political, administrative, and legislative center of the country. In addition to this, Managua is the primary city of Nicaragua having by far the largest population among all the cities in the country. The primary city is expected to host various commercial and business functions to serve the whole nation. Thus, Managua City will continue to provide the service, business, and commercial functions of Nicaragua.

In addition to this, as economic integration is in progress in Central America, Managua City will have to compete with major cities of neighbouring nations such as San Jose, San Salvador, and Tegucigalpa to win investments in the city for business development and others. As seen in "The Global Competitiveness Report 2015-2016" by the World Economic Forum, Nicaragua is behind the neighbouring countries in terms of global competitiveness in almost all categories. For this reason, the city needs to act proactively to attract foreign and domestic investment in the urban environment and infrastructure such as the development of new city service centers in order to elevate the economic performance of the city and the country.

Table 3.7.1 Global Competitiveness Index (GCI) Comparison with Neighbouring Countries

2015 – 2016 GCI Ranking (out of 140)	**Nicaragua**	Panama	Honduras	Costa Rica	El Salvador
Overall GCI	**108**	50	88	52	95
Institutions	**99**	73	88	49	117
Infrastructure	**102**	40	93	71	60
Macroeconomic environment	**62**	60	112	94	100
Health and primary education	**99**	82	92	55	94
Higher education and training	**119**	77	94	35	105
Goods market efficiency	**125**	41	68	67	86
Labor market efficiency	**119**	80	120	70	124
Financial market development	**112**	15	38	85	89
Technological readiness	**116**	52	97	49	81
Market size	**107**	80	96	83	93
Business sophistication	**133**	45	54	37	64
Innovation	**137**	45	55	39	99

Source: The Global Competitiveness Report 2015 – 2016 by World Economic Forum

In contrast to the low economic performance, Nicaragua provides substantially better safety and security to businesses than the neighboring countries and Managua City has a relative advantage of high level of security in comparison with major cities in the region. This is favorable in attracting international visitors for business as well as for tourism. Thus, the function of Managua City as the political, administrative, and commercial center of Nicaragua has to be maintained and further enhanced so as to attract more domestic and international firms' operation and as a service center.

Table 3.7.2 Global Competitiveness Index (GCI) in Safety and Security Comparison with Neighboring Countries

GCI Ranking (Out of 140)	**Nicaragua**	Panama	Honduras	Costa Rica	El Salvador
Business costs of terrorism	**12**	49	98	24	127
Business costs of crime and violence	**46**	81	133	87	137
Organized crime	**34**	68	134	55	140

Source: The Global Competitiveness Report 2015–2016 by World Economic Forum

(2) Need for Revitalization of the Historical Area

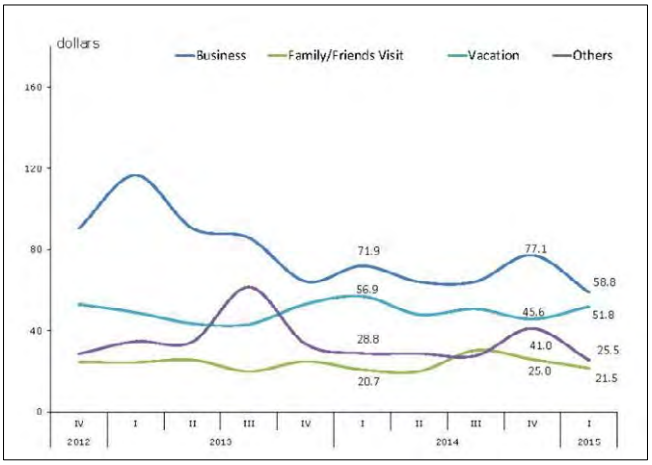
The historical area of Managua, was where the city of Managua started and was the urban center of Managua during the colonial era. The historical area follows from the Master Plan of the Central Area of Managua [*Plan Maestro del Área Central de Managua*], as shown in Figure 3.7.1, As the area is located along the Pan-American North and connected to the regional artery of Masaya, the locational potential of this area is high. Despite its history, the area was heavily damaged by the earthquake of 1972 when a number of historical buildings were lost or damaged and a large part of the area was reverted for disaster housings, which has seemingly impaired the potential of the historical area of Managua largely.

Source: JICA Study Team

Figure 3.7.1 Historical Area of Managua City

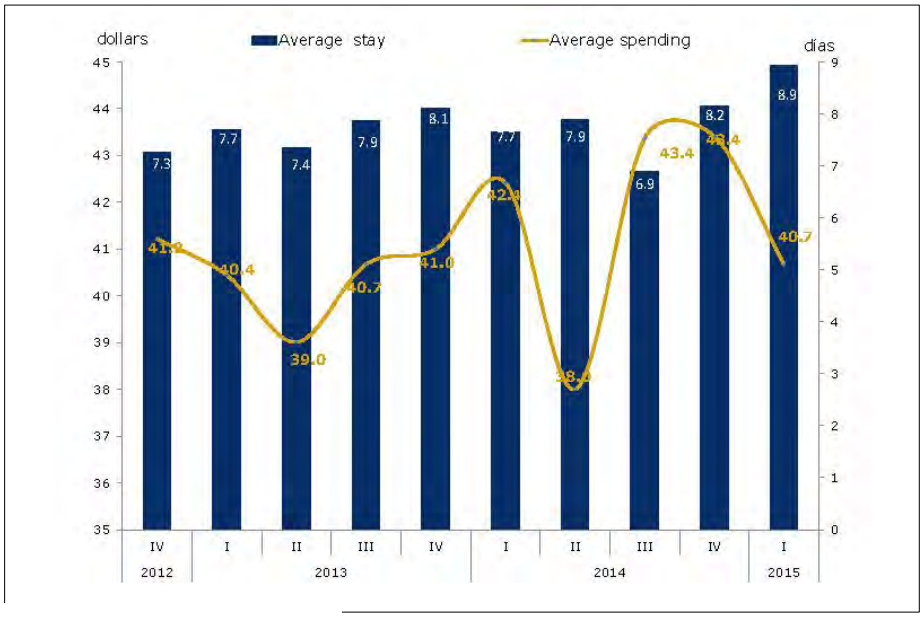
(3) Need to Promote Tourism

With the increasing accumulation of cultural facilities in the historical area, the area's potential for accommodating tourists is getting higher. International tourists visiting Managua City and its environs are increasing as seen in Chapter 3.1.2 (7). There are a number of tourist attractions in Managua Metropolitan Area including volcanoes, lakes, and historical cities such as Granada and Leon. Managua City is serving as the gateway for the tourists with the airport and hotels, but the attractiveness of Managua City itself is limited. This seems to be supported by recent figures in inbound tourism where expenditure per capita by foreign visitors per day has been either falling or sluggish (regardless of visit purposes).



Source: Central Bank of Nicaragua

Figure 3.7.2 Inbound Tourism: Trend in Daily Average Expenditure According to Trip Purpose



Units: (USDs and number of days)

Source: Central Bank of Nicaragua

Figure 3.7.3 Inbound Tourism: Trend in Expenditure and Average Stay Per Capita

The historical area of Managua City today is not a typical CBD area with numerous office buildings, nor a popular area for tourists, as heritage buildings are few and shopping and dining facilities are limited. In order for Managua City to be a more economoically avtive in terms of business and commercial, as well as popular destination for international tourists, revitalization particularly of the historical area of Managua City needs to be carried through. More cultural and touristic activities and attractions in the city are required to increase the length of stay and expenditure of tourists. i

Enhancing attractiveness is not only for international tourists but also for the domestic visitors and tourists alike. Developing new and diverse activities, such as shopping and services unique for visitorsque to Managu will continue to be important for Managua City. Safe and enjoyable environment for the visitors and residents, such as promenades and shopping arcades, will be crucial. Attractive events, fairs and festivals ought to be scheduled and implemented regularly.

The revitalization of the historical area of Managua thus needs to be streamlined over the expansion of business and commercial functions in the area and expanding various service functions for domestic as well as international visitors. The revitalization will need to consider creation of comfortable emvironment with greenery and safe and easy mobility, particularly for pedestrians. Also, the area has potential for residential facilities such as condos and high rise apartments for relatively well-to-do families. The revitalization has to incorporate various necessities for the Historical and Heritage Area to integrate into a mixed use zone. This task is now carried out by the Inter-American Development Bank (*Inter-American Development Bank*: IDB), and the results of their work will be consolidated to this project in the upcoming phase.

(4) Need for Improvement in Land Use Zoning and Data Sharing

The current zoning system has fifty-two (52)[9] zonings covering over Managua City. The zonings for built up area including housing, commercial, institutional, and industrial areas utilize maximum/minimum building coverage ratio (BCR), floor area ratio (FAR), and number of building storeys as described in Chapter 3.4.

[9]There were 54 zones originally; however, 2 zones were cancelled in 2004.

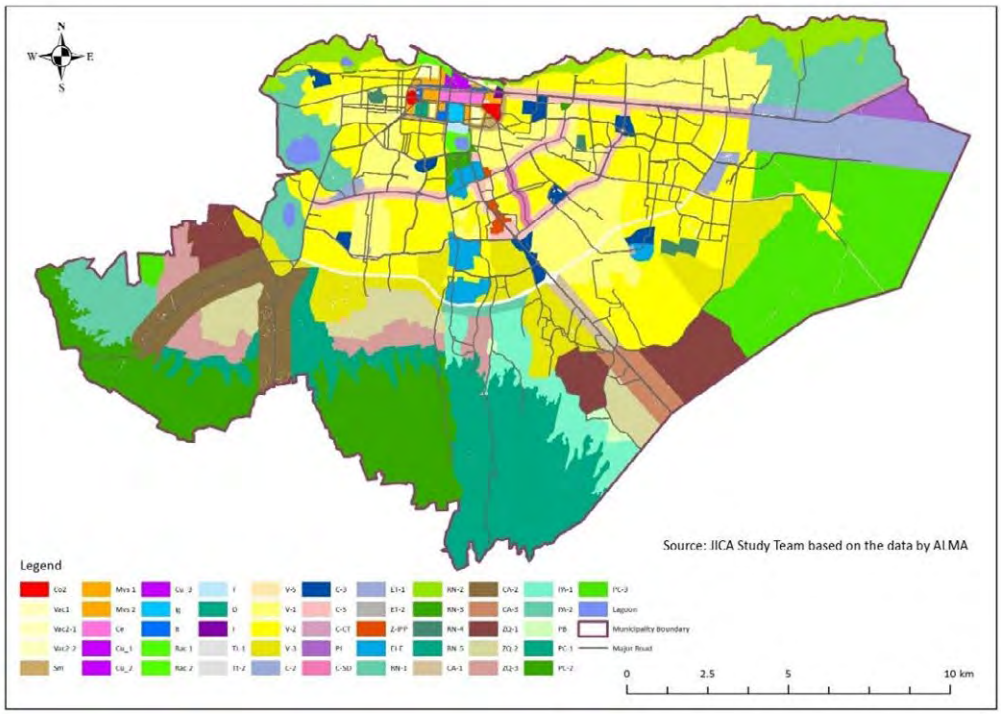


Figure 3.7.4 Existing Zoning Map in Managua

The present zoning system seems to have the following issues: 1) the zoning system is strict against high buildings, 2) differences between the current zoning and existing land use, and 3) the zoning map and information have not been published appropriately.

The current zonings for built up area covers roughly 13,800 ha in total. With this, the zonings allow twelve-story buildings at the highest in limited areas like the "Government Institutional Area (Ig)" set in the historical area. The second highest floor is eight-story buildings applied only in the "Tourism Area (T)". Relatively higher floor, say more than five-story buildings, is allowed only in nine zonings listed in TableTable 3.7.4. Other zonings, which cover 93% of the total built up area allow only four- or less-story buildings. With this, the residential zonings which occupy most of the built up area in Managua City are allowed to be one- or two-story building of detached houses or four-story building apartments. These regulations may have led to Managua's urban area to be low-rise.

Table 3.7.3 The Current Zoning applied Higher Building above 5th Floor

Maximum Floor	Zoning	Total Area (ha)	
12th Floor	Ig: Government Institutional Area	24	0.2%
8th Floor	T: Tourism Area	17	0.1%
7th Floor	C-S: Commercial and Service Corridor Area Z-ipp: Public and Private Investment Area	545	3.9%
6th Floor	It: Institutional Area Ce: Special Commercial Area	59	0.4%
5th Floor	Cu-1: Cultural Area 1 EI-E: Special Institutional Area C-CT: Commercial and Tourism Corridor Area	314	2.3%
Total		959	6.9%
Zonings for Built Up Area		13,830	100.0%

Source: JICA Study Team based on the information from ALMA

The zonings, which allow for relatively higher maximum floors, are distributed in the historical area, universities, and major roads as shown in Figure 3.7.4.

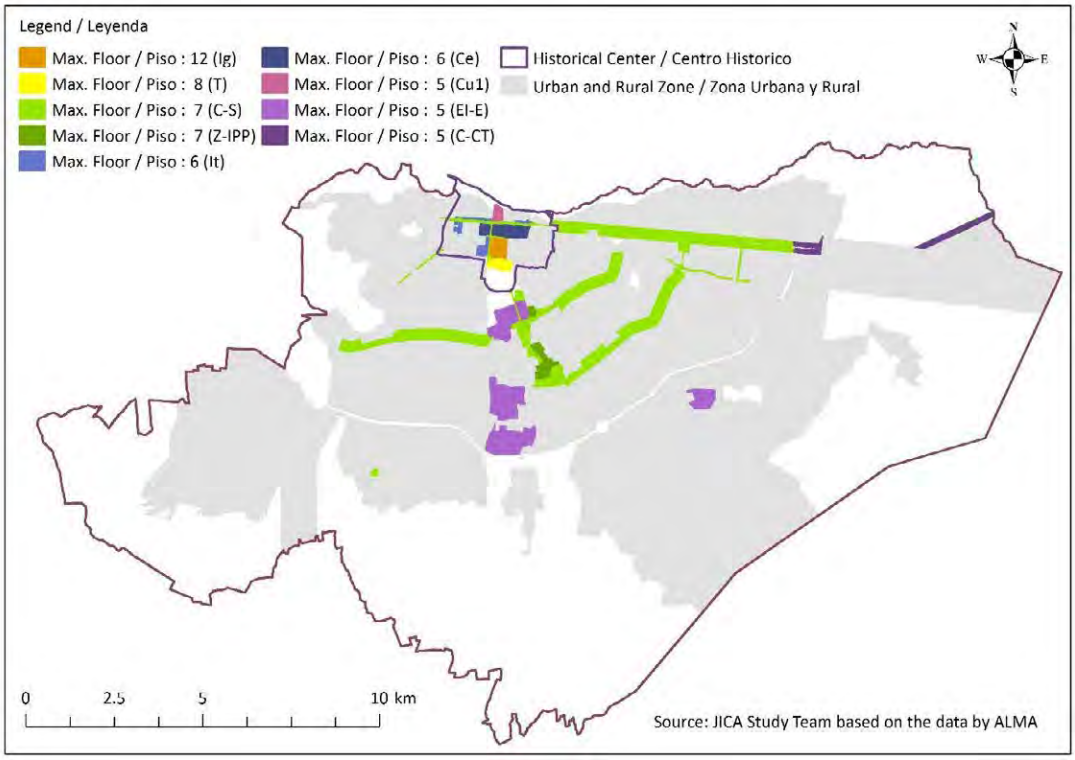
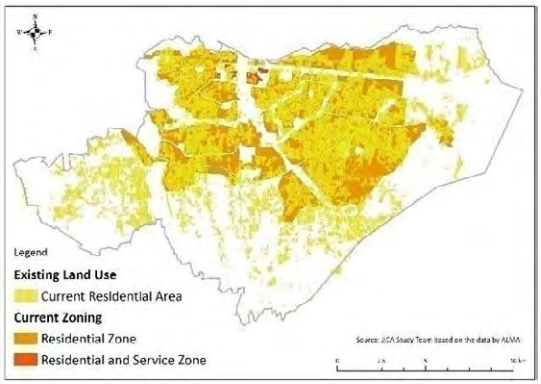
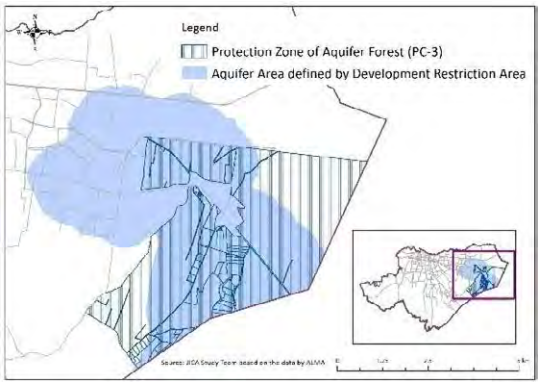


Figure 3.7.5 The Current Zonings applied Relatively Higher Building

Differences could be found among the current land use and the zoning. Compared with the current land use and zoning, the housing area is spread beyond the residential zonings such as Housing Zones[10]. The industrial area also has a discrepancy between actual land use and the zoning. Besides, some areas defined as "Development Restriction Area" have also differences from the zoning. Notably, the protected area for aquifer has contradiction of the limits between the land regulation map and the zoning.



Existing Land Use and the Zoning of Residential Area



Development Restriction Area and the Zoning of Aquifer Area

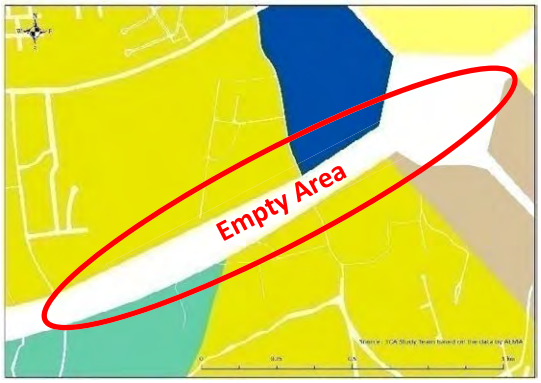
Figure 3.7.6 Differences among Existing Land Use, Development Restriction Area, and the Current Zoning

[10] Housing Zones include Vac 1, Vac 2-1, Vac 2-2, V-1, V-2 and V-3 described in Chapter 3

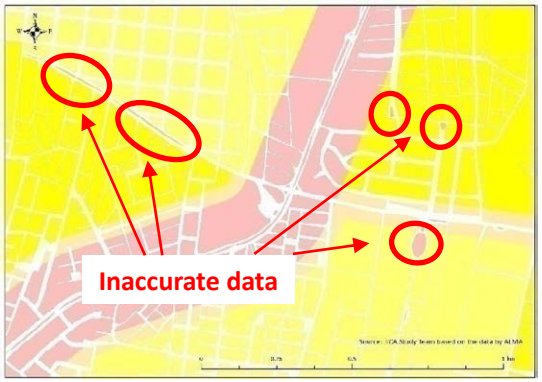
This is in part because the zoning system now in effect in Managua City has been set a long time ago. As mentioned earlier, there are 52 zonings in the system, in which, 2 zonings were set in 1982, 21 zonings were set in 1995, and the rest, 29 zonings, done or updated in 2004. Thus, the city administration needs to review the zoning schemes as well as the combination of regulation parameters so as to realize and/or regulate urbanization to match the desired form of urbanization in the area.

Furthermore, the data and information of the zoning system, especially the zoning map, needs to be shared with the public in a more convenient way, say, by using digitalized tools. At this moment[11], the Municipality of Managua (*Alcaldía de Managua*: ALMA) published the map in PDF format in their own website; however, this map does not allow the zoning boundary exactly. According to the series of stakeholder meetings, necessity of the publication of zoning map was pointed out by private housing developers in order to advance their own project.

Nevertheless, the current zoning map was established by using CAD originally and ALMA attempts to convert it into GIS so as to identify the boundary of zoning and exact location easily. The current map in GIS has still room for improvement as some missing areas and inaccurate data could be recognized as shown in Figure 3.7.7. Since the zoning map tends to be used in an enlarged image, the data accuracy is important for preventing misleading information. Therefore, the capacities of data management and sharing need to be enhanced in order to avoid stagnation of citizens and private investments.



Empty areas (white color area) could be found



The zoning consists of many small pieces and not yet cleaned appropriately

Figure 3.7.7 Details of the Current Zoning Map and its Digital Data Errors

(5) Urban Sprawl

As mentioned in Chapter 3, the urban area of Managua City has been expanding remarkably. In ten years, from 2005 to 2015, the built up area increased more than 10% of the total land. Such urbanization dynamics tend to bring pressure on the green area including natural and protected areas[12]. In comparison of the two figures, Figure 3.7.8 and Figure 3.7.9, increase of developed land in the green area could be observed clearly. In fact, approximately 1,313 ha of land has been converted from green area into built

[11] As of December 2016. ALMA attempts to publish the zoning map and others soon. The details will be clarified in the Draft Final Report.

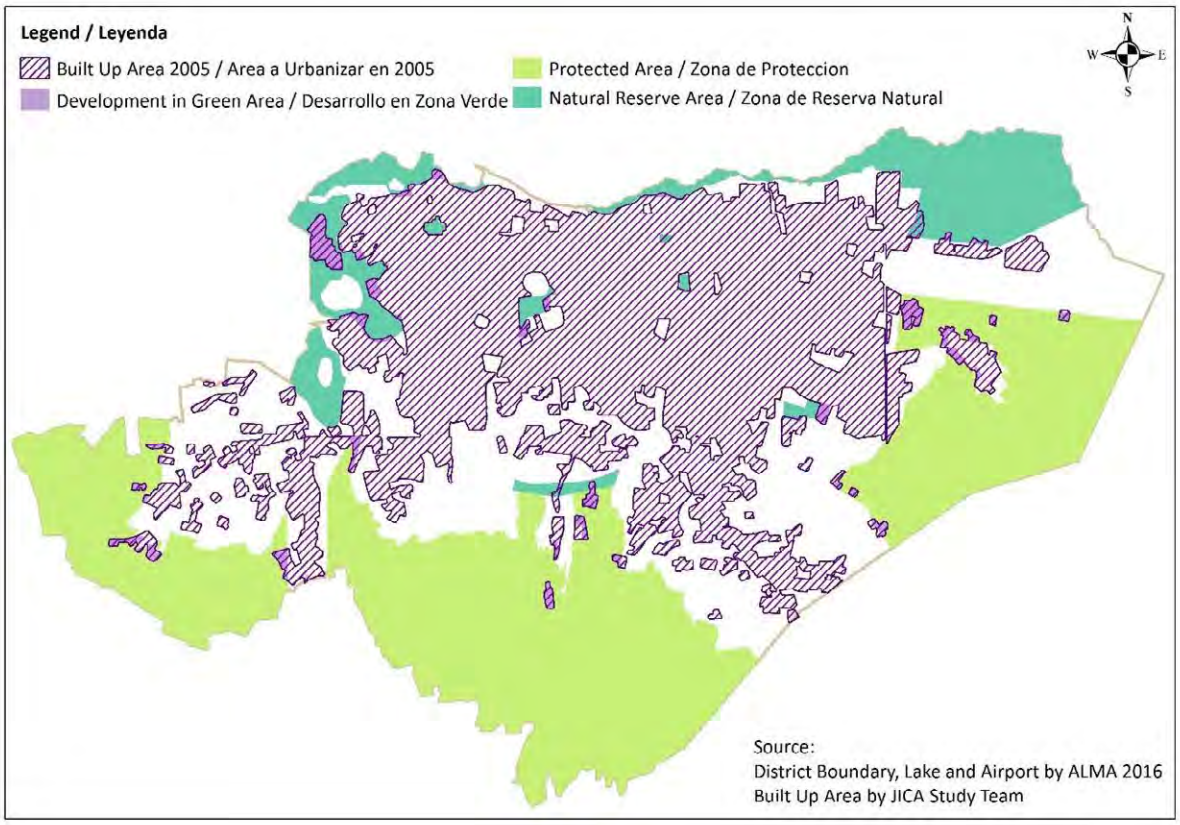
[12] The natural reserve and protected area are defined in the existing zoning by ALMA

up area up in 2015. Compared with the data in 2005, approximately 863 ha of that has been urbanized in the protected zone in a decade.

Table 3.7.4 Newly Urbanized Area in Protected Zone in 2005 and 2015

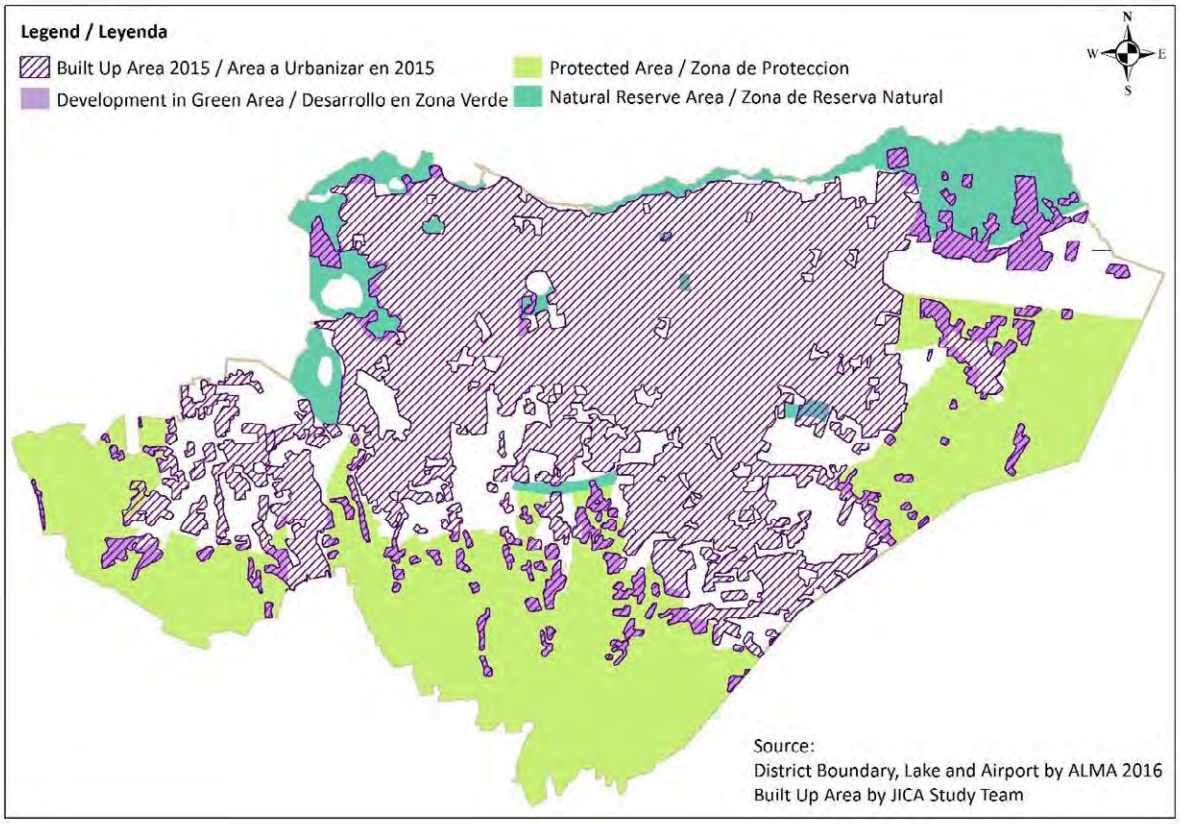
Year	Built Up Area (ha)	Protected Area and Natural Reserve Area (ha)	Other Area* (ha)	Newly Urbanized Area in Protected Zone (ha)
Year 2005	9,380	10,280	7,540	449
Year 2015	12,500	9,420	5,280	1,313

Note: Other area includes agricultural land and open space
Source: JICA Study Team



Note: Airport means Air Transport Facility Zone

Figure 3.7.8 Built Up Area and Protected Area in 2005



Note: Airport means Air Transport Facility Zone

Figure 3.7.9 Built Up Area and Protected Area in 2015

Looking at the location of the newly urbanized area, the hilly area in southwest of Managua City has developed significantly. These areas tend to be popular with large-sized houses, say, high status houses. On the other hand, the surroundings of the airport and expansion area have also been urbanized sharply. Since this area is comparatively flat and close to the historical area, housing development including resettlement programs has been in progress. Besides, the road development linking Carratera a Masaya (N4) and south of the airport in this area could contribute to increase land development.

Both of the areas, namely, the southwest hilly area and surrounding of the airport, however, need to be controlled in terms of environmental protection such as forest and slope areas. Development of steep slope area is prone to have an influence on natural disaster such as landslide in the southern area near the boundary of Managua City should be protected appropriately. Furthermore, aquifer area is situated in the surrounding of the airport where new urbanization is in progress recently. This aquifer is thought to provide roughly 30% of the water supply source of Managua citizens. Since disorganized development could cause soil pollution and inappropriate water withdrawal and eventually may threaten the water supply source, the aquifer area needs to be well controlled under suitable regulations.

The master plan, especially the future land use plan, should take into account such protected and vulnerable area in order to avoid unorganized urban development and to reduce risks for living environment.

(6) Weak Urban Core Function

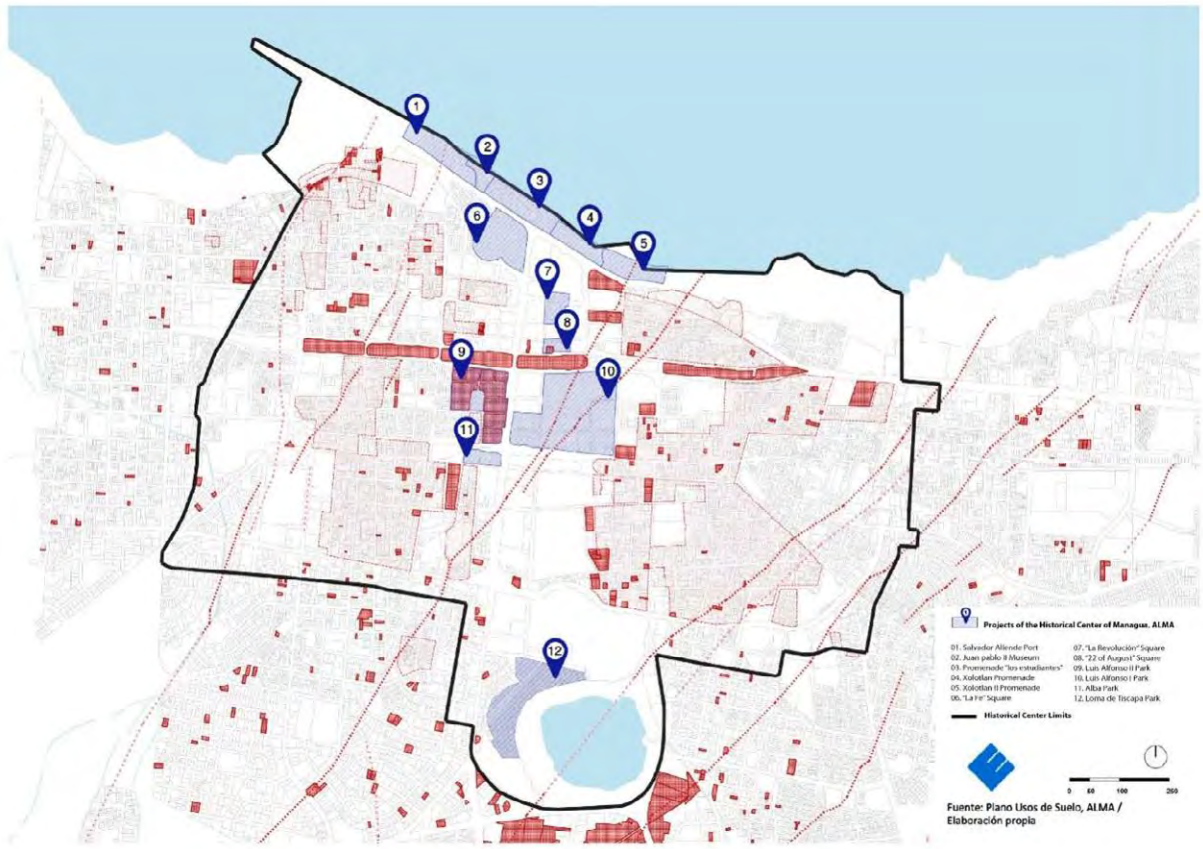
Managua City is the capital of Nicaragua and the largest urban accumulation in Nicaragua. As it is, administrative, judiciary, and legislative functions as well as the national headquarter function of Nicaragua firms would be accumulated in Managua City.

IIn addition, with the economic partnerships and free trade area (FTA) / tariff integration in progress in Central America, Managua City will be faced with more intese, or tougher inter-regional competition for regional centre functions of business and commerce with other major cities in the region. At the moment, though, the urban core within the historical area of Managua City has little ready to go spaces, or plots, conveniently located and equipped with necessary infrastructure for such international level of businesses and commercial/services activities. This leads to lack of accumulation of modern office buildings nor commercial, residential facilities within the Historical and Heritage area.

The urban core in Managua Cityhas been generally considered to coincide with the historic area of Managua City mentioned in item (2) above, with heritage architecture dating back to the colo nial era. The boundary of the historical area is indicated in Figure 3.7.10. As indicated in Figure 3.7.10, the historical area of Managua is served by Carretera Norte from east to west and Bolivar Avenue, which connects to Carretera a Masaya, that forms a regional trunk road and thus, easily accessible from anywhere in Managua.

This area was seriously damaged by the earthquake of 1970', and office buildings which had been many in this area were affected or damage, and not recovered entirely. Today there are a few tall buildings accommodating offices or hotels, but not many in this area, The area is generally low in activities, and lacks livelihood necessary for the city center.

In recent years, several cultural facilities have been seated in the historical area, including parks and promenades. A baseball statdium is under construction, which is due to completion soon. The historical area is gaining importance as a cultural center of Managua. Yet, the historical area seems to lack in liveliness in comparison with historical areas in neighboring countries's capital or historical cities. This probably attributes to the low level of commercial and/or business functions accumulated in Managua's historical area.



Source: IDB

Figure 3.7.10 On-Going Cultural Facilities in the Historical Area

In the eastern part of the historic area is Oriental Market, which is the largest open air market for the city, where much of the city's commercial activities are concentrated. The historical area has a few modern commercial/business buildings such as Crowne Plaza Hotel, Plaza Inter Shopping Center, and others.

The beautification of the historical area is insufficient and the attractiveness for the tourists is to be improved. There should be more commercial activities linked to the heritage resources such as tourism industries including restaurants, souvenir shops, service providers, etc., to create a lively urban entertainment space. Safe and convenient mobility is to be improved.

Along the Carretera a Masaya between the third and fourth ring roads are growing accumulation of business and commercial functions such as office complex and shopping malls. This commercial center is expected to grow in the future as the site provides good access from inside and outside of Managua City and has potential for urbanization in the future.

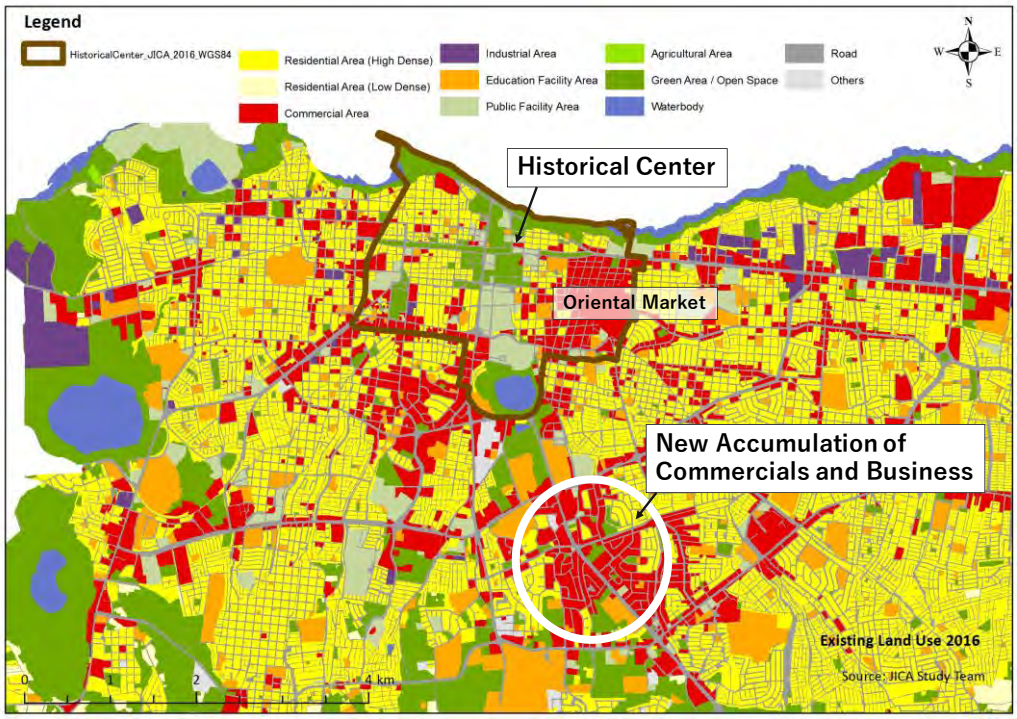


Figure 3.7.11 Existing Land Use in Central Area of Managua

A master plan shall be necessary to integrate and harmonize various functions to be introduced in the urban core. Environmental and mobility aspects would need to be given special consideration. In view of land use, possible intensification of land use allowing for medium-rise buildings may be given specific consideration. This task is carried out by the IDB's Master Plan of the Historical Area of Managua.

(7) Vulnerability of Oriental Market

Though Oriental Market is a powerful market serving the citizens and visitors with a variety of commodities and services, the status of the market is very vulnerable. The market has been expanding almost uncontrollably over the period of time, taking over surrounding private properties and occupying public assets such as roads. Land use or zoning schemes are not observed in the market.

The core of the market is not accessible by cars or buses due to vendors occupying much of the space of roads, and thus clogging access. This clogging of roads causes not only inconvenience to the shoppers but also imposes disaster risk by hampering service of emergency vehicle. Also, the clogging of roads is imposing negative effect on the wider road network's performance.

Oriental Market is vulnerable against disaster, particularly fires. Extensive fires occurred several times, damaging a number of shops and shacks, causing serious damages to the economy. As the market is composed mostly of combustibles, it is difficult to secure safety againt fires or provide firefighting facilities.

Security in the market is also an issue with frequent occurrence of robbery and other criminal acts. The condition of the market needs to be surveyed to identify necessary actions. Deteriorating security in the market may affect the attractiveness of the market in future.

Thus an effective plan for improvement of Oriental Market has to be considered in future. The primary task is to stop the unctrolled expansion of the market to its surrounding area, and eradiating the tranffic and transport issues.