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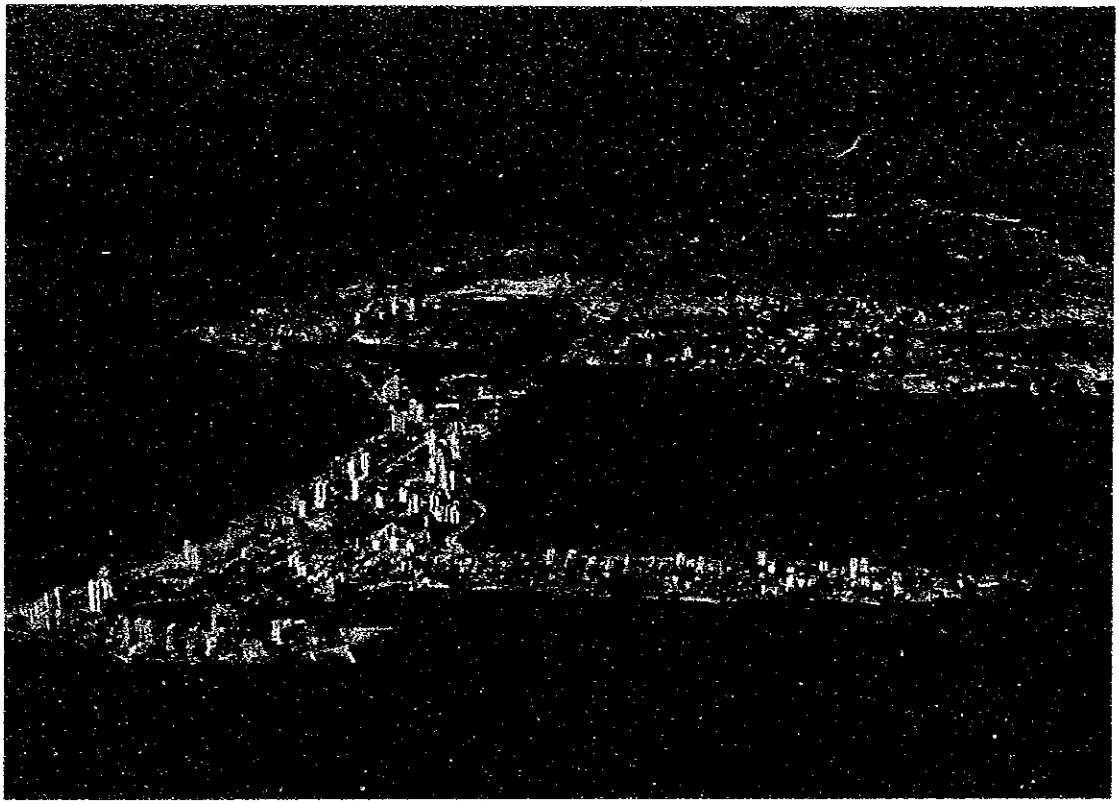
No. 52

The Urban Transport Study in the City of Cartagena de Indias of The Republic of Colombia



Final Report (Summary)

November 1992

Japan International Cooperation Agency

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PREFACE

In response to a request from the Government of the Republic of Colombia, the Government of Japan decided to conduct a study on the Urban Transport Study in the City of Cartagena de Indias of the Republic of Colombia and entrusted the study to the Japan International Cooperation Agency (JICA).

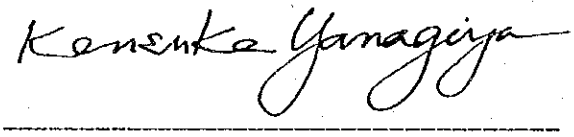
JICA sent to Colombia a study team headed by Mr. Takeo SATO, Chodai Co., Ltd., three times between March 1991 and November 1992.

The team held discussions with the officials concerned of the Government of Colombia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Colombia for their close cooperation extended to the team.

November 1992



Kensuke Yanagiya
President
Japan International Cooperation Agency

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List of Abbreviations

JICA	:	JAPAN INTERNATIONAL COOPORATION AGENCY
DNP	:	DEPARTAMENTO NACIONAL DE PLANEACION
EDURBE	:	EMPRESAS DESARROLLO DE URBANO DE BOLIVAR
INTRA	:	INSTITUTE NACIONAL DE TRANSITO
DATT	:	DEPARTAMENTO ADMINISTRATIVO DE TRANSPORTE Y TRANSITO
DANE	:	DEPARTAMENTO ADMINISTRATIVO NACIONAL DE ESTADISTICA
CBD	:	CENTRAL BUSINESS DISTRICT
GDP	:	GROSS DOMESTIC PRODUCT
GRP	:	GROSS REGIONAL PRODUCT
B/C	:	BENEFIT COST RATIO
B-C	:	DIFERENCE BETWEEN BENEFIT AND COST
NPV	:	NET PRESENT VALUE
IRR	:	INTERNAL RATE OF RETURN
VOC	:	VEHICLE OPERATING COST
TTC	:	TRAVEL TIME COST
OD	:	ORIGIN AND DESTNATION
V/C	:	VOLUME CAPACITY RATIO OF TRAFFIC
KT	:	KNOT
hr	:	hour
ha	:	hectare
m^2	:	square-meter
km2	:	square-kilo-meter
$	:	Colombian Peso
US$	:	United States Dollar

1 INTRODUCTION

1.1 Background

1. Cartagena is the capital of Bolivar State and is located about 600 km north of Bogota. During the colonial era, Cartagena developed as a sea port on the Caribbean side. In recent years, it developed as the industrial zone as well as tourism site of the historical city.

2. Its population in 1985 was about 530 thousand and has been growing at a high average rate of about 4.5% annually for a past decade. It is expected to be about 1,200 thousand in the year 2010.

3. Economic growth of Colombia is comparatively steady. GDP (Gross Domestic Products) in 1988 was 11,695 billion pesos and showed average growth rate of about 3.5% per annum for last ten years. The economy of the Study Area in recent years was based primarily on the manufacturing and tourism industries. The value added in Cartagena represented 3.4% of the national total.

4. Urban area of Cartagena has been expanding rapidly in accordance with the population growth of the City. The Central Area, called "Centro", is the major business, commercial, government administrative, residential and tourism district. This area is surrounded by stone walls from the colonial era and still has many of the historical buildings at that period.

5. Traffic condition in the urban area of the City is not yet in serious condition due to the low car ownership (about 25 thousand vehicles excluding motorcycles in July 1991). The operation of public transportation is demand-oriented and vehicles used are generally very old. More than eighty per cent (80%) of a person trips depend on public bus service. Ten (10) private enterprises operate the public bus services. There are some forty (40) bus routes covering the urban area. Bus facilities such as bus bay, terminal and exclusive bus lane are very few.

6. Due to the inadequacy of the road network system and the concentration of the urban activities into the Central area, the traffic tends to concentrate into a few major roads such as Avenida Pedro de Heredia and Diagonal 22 - Carretera Troncal de Occidente. Physical condition of the city urban center surrounded by the sea, bays, canals and lakes makes it difficult to improve the urban transportation system.

7. Based on the growth of urban population size and socioeconomic activity in the Study Area by 2010, the number of

person trips is expected to become more than twice that of the present level. This condition will place a severe strain on the current transport network system unless some improvements are introduced.

8. In view of above problems, it is imperative to improve the urban transport system in Cartagena Urban Area. In order to carry out the above program effectively, it is necessary to establish a comprehensive urban transport plan including a future land use plan for the Area.

9. With the above objectives in mind, the Government of Colombia requested the Government of Japan for an assistance to conduct the Masterplan Study on Urban Transport in Cartagena in 1990. In response to this request, the Government of Japan through its implementation agency, the Japan International Cooperation Agency (JICA), began to carry out this study jointly with the Government of Colombia since June 1991.

1.2 Objectives of the Study

10. The objectives of the Study are to formulate a transport masterplan including transport policies, a development plan and program for the short and long terms, and a future land use plan in the Study Area, that will effectively serve the present and future transport demands and contribute to urban development in the Cartagena Urban Area (CUA).

1.3 Study Area

11. The Study Area covers the present and future urbanized area of the Municipality of Cartagena de Indias, almost equivalent to its administrative territory shown in Figure 1.3-1.

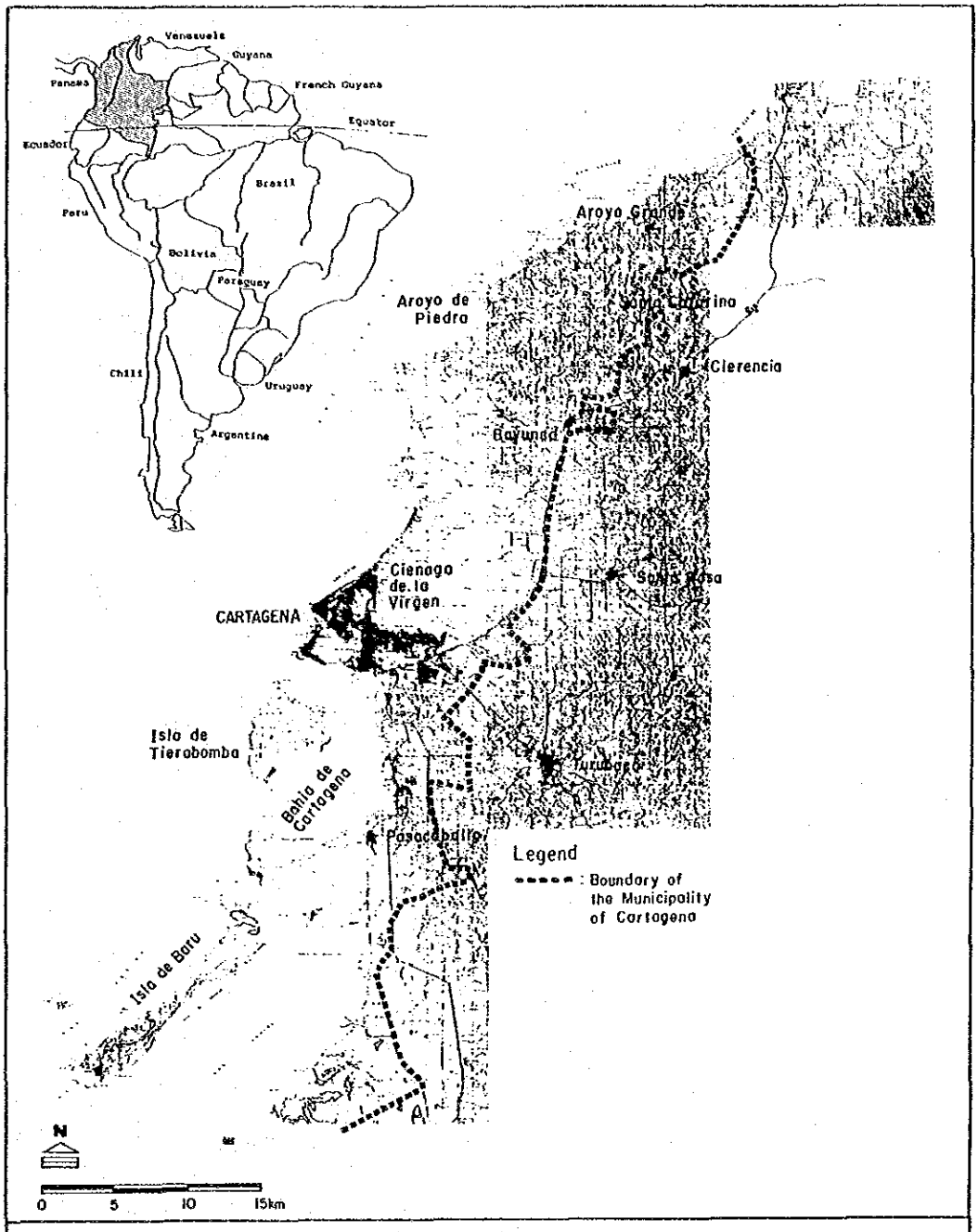


Figure 1.3-1 Study Area

2 CURRENT SOCIOECONOMIC TREND AND EXISTNG LAND USE

2.1 Demographic Characteristics

(1) Population

12. Population of the Study Area in 1990 is estimated at 660,200, 96% of which (632,900) live in the Urban Area (Comuna 1-33). As for the sex-age structure, the sex ratio is 92.4, and the proportions of population by age-groups are: 0-14 years, 33.2%; 15-64 years, 63.0% and 65 years and over, 3.8% (refer to Table 2.1-1).

Table 2.1-1 Population of Study Area and its Sex-age Composition in 1990

Population		Sex ratio	Age composition (%)		
			0-14	15-64	65-
Urban	632,900				
Sub-urban	27,300				
Total	660,200	92.4	33.2	63.0	3.8

Source : Study Team estimates based on the data of DEPLAN, DANE (Encuesta Nacinal de Hogares, 1990) and the Home Interview Survey

(2) Labor Force

13. The economic participation of population aged 12 years and above is shown in Table 2.1-2. Economically active population or labor force is 235,570 persons and represents 49.2% of the population aged 12 years and above (working age population). On the other hand, 243,080 persons (50.8%) are not in the labor force and live as students, house wives or without specific activities.

14. The employed persons belong to the three economic sectors as shown in Table 2.1-3. Although the secondary sector occupies nearly 20%, the tertiary sector is prominent. This is explained as follows: although the manufacturing industry is an important attracting power, main factories are equipment intensive and do not absorb much labor force; on the other hand, there are many kinds of informal activities in the tertiary sector.

Table 2.1-2 Economic Participation

Economic Category	
Total population (A)	660,200
Population 12 years and over (B)	478,650
Economically active population (C)	235,570
Employed	212,670
Unemployed (D)	22,900
Economically inactive population	243,080
Student	114,970
Household work	112,910
Other inactive	15,200
Crude activity rate (C/A)	35.7(%)
Refined activity rate (C/B)	49.2(%)
Unemployment rate (D/C)	9.7(%)

Source : Study Team estimates

Table 2.1-3 Employed Persons by Sector

Sector	Employed persons	%
Primary	7,610	3.6
Secondary	40,590	19.1
Tertiary	164,470	77.3
Total	212,670	100.0

2.2 Economic Activity

15. It is said that the recent economic growth of Cartagena was sparked by the manufacturing industry and by the tourist industry. According to 1988 yearbook of manufacturing industry, the value added in Cartagena represented 3.35% of the national total (refer to Table 2.2-1). Oil refining and chemicals have a very high share of 67.4% and 24.0% respectively. Of the total value added of 77.877 million pesos in Cartagena, 76.5% was generated from oil, chemical and related products. Foods and beverages are also showing a considerable contribution.

Table 2.2-1 Manufacturing Industries in Cartagena, 1988

Industrial group	No. of Persons Engaged	Value added (million pesos)	%	Share in the national total (%)
Foods and beverages	2,402	10,906	14.0	1.66
Chemicals	2,644	34,515	44.3	23.99
Chemical Products	352	1,827	2.3	1.14
Oil refining	619	19,996	25.7	67.40
Plastic products	505	3,254	4.2	5.06
Other industries	2,840	7,379	9.5	0.58
Total	9,362	77,877	100.0	3.35

Source : Anuario de Industria Manufacturera

2.3 Vehicle Ownership

16. In July 1991, the number of registered vehicles in the Study Area is approximately 22,700 exclusive of public buses (2,350) and motorcycle (4,985), of which 16,900 are car, 2,900 are taxi and the remaining (2,900) are trucks. The vehicle ownership in terms of number of vehicles per 1,000 inhabitants stands at 34 for all vehicles. Car ownership stays at comparatively low level of 26, that of the urban area is about 27. In contrast, the suburban area has lower car ownership which is only 1.2 (refer to Table 2.3-1).

Table 2.3-1 Number of Registered Vehicles in the Study Area

	Area	No.of Vehicles	Ownership Veh/1000
Car	Urban	16,912	26.7
	Suburban	32	1.2
	Total	16,944	25.7
Taxi		2,872	
Truck		2,902	
Total		22,718	34.4

2.4 Existing Land Use

(1) Present Land Use

17. Built-up areas cover 54 km^2, 8.7 % of the whole Study Area (609 km^2), and are concentrated in Traffic zones 1-40 and 44. The recent economic activity of Cartagena has been supported

by the industrial activity of the Mamonal and other industrial zones and the tourism to the beach and the historical properties in Centro. Reflecting this situation, land use areas of the industrial and tourism activities are as much as 11.9 km^2 and 4.5 km^2, respectively (refer to Table 2.4-1).

Table 2.4-1 General Land Use Areas by Traffic Zone

(km2)

Zone no.	Zone name	Zone area	General built-up area	Industrial zone 1)	Tourism zone 2)	Agricultural/ unused land
1-40	U. Area	54.0	34.2	5.1	3.0	11.7
41	A.Grande	121.1	0.3			120.8
42	P.Canoas	111.9	0.9			111.0
43	Bayunca	109.8	0.7			109.1
44	Mamonal	116.6	0.7	6.8		109.1
45	T.Bomba	20.0	0.6		0.1	19.3
46	Sta.Ana	60.5	0.3		0.4	59.8
47	Baru	15.2	0.3		1.0	13.9
41-47	SU. Area	555.1	3.8	6.8	1.5	543.0
Study Area	total	609.1	38.0	11.9	4.5	554.7

Source: Study Team caluculations with the use of a planimeter
Note: 1) Industrial zone of the Urban Area is assumed to be industrial area and industrial/residential area.
2) Tourism zone of the Urban Area is assumed to be Laguito, Bocagrande,Centro and commercial/residential area of Marbella.

(2) Population Distribution

18. Table 2.4-2 shows population of traffic zones in the Urban Area. In the urban area of 5,400 ha, population of 632,900 (96%) live, while only 27,300 (4%) in the sub-urban area of 55,500 ha.

Table 2.4-2 Population of Study Area in 1990

	Zone no.	Zone name	Average persons /house-hold *1	Average persons /house (e) *2 (A)	Number of houses *3 (B)	Popula-tion (e) (A)*(B)	Comuna, Barrio, Corregimiento
Urban Area	1	Laguito	3.17	3.57	1,705	6,080	(C 1) El Laguito
	2	C, grande	4.83	5.43	940	5,110	(C 1) Castillogrande
	3	B' grande	3.89	4.38	2,035	8,910	(C 1) Bocagrande, Base Naval
	4	Centro	4.47	5.03	5,037	25,320	(C 2) Centro, San Diego, Getsemani, Matuna
	5	Marbella	4.17	4.69	1,612	7,560	(C 3) Cabrero, Marbella, Crespo, B. Militar
	6	Comuna 3	6.00	6.75	2,361	15,940	Comuna 3
	7	Comuna 4	5.90	6.64	3,601	23,890	Comuna 4
	8	Comuna 5	5.84	6.57	3,202	21,040	Comuna 5
	9	Comuna 6	5.57	6.27	3,123	19,570	Comuna 6
	10	Comuna 7	5.38	6.05	2,179	13,190	Comuna 7
	11	P. d. Popa	4.40	4.95	2,189	10,840	(C 8) Pie De La Popa
	12	Manga	4.40	4.95	1,996	9,880	(C 8) Manga
	13	Comuna 9	5.22	5.87	2,569	15,090	Comuna 9
	14	Comuna10	5.50	6.19	2,282	14,120	Comuna10
	15	Comuna11	5.20	5.85	2,168	12,680	Comuna11
	16	Comuna12	4.55	5.12	4,099	20,980	Comuna12
	17	Comuna13	5.00	5.63	2,727	15,340	Comuna13
	18	Comuna14	6.21	6.99	3,883	27,120	Comuna14
	19	Comuna15	6.47	7.28	2,513	18,290	Comuna15
	20	Comuna16	5.33	6.00	3,542	21,240	Comuna16
	21	Comuna17	4.53	5.10	3,146	16,030	Comuna17
	22	Comuna18	5.27	5.93	2,821	16,730	Comuna18
	23	Comuna19	6.25	7.03	2,010	14,130	Comuna19
	24	N. Bosque	4.55	5.12	3,126	16,000	(C20) N. Bosque, Alcalis, Los Caramares
	25	V. Sandra	4.40	4.95	2,453	12,140	(C20) Barrios except Zone24
	26	Comuna21	5.54	6.23	3,525	21,970	Comuna21
	27	Comuna22	5.24	5.90	2,142	12,630	Comuna22
	28	Comuna23	4.75	5.34	1,869	9,990	Comuna23
	29	Comuna24	5.36	6.03	2,722	16,410	Comuna24
	30	Bosque	5.89	6.63	3,366	22,290	(C25) Barrios except Isla De Manzanillo
	31	M'nillo	4.33	4.87	180	880	(C25) Isla De Manzanillo
	32	Ceballos	5.05	5.68	3,387	19,240	(C26) Barrios except Zone33
	33	A. Barato	4.63	5.21	1,138	5,930	(C26) A'noz, M'llal, Gloria, A. B'to, P'carpa
	34	Comuna27	4.59	5.16	4,081	21,070	Comuna27
	35	Comuna28	5.50	6.19	1,778	11,000	Comuna28
	36	Comuna29	5.82	6.55	2,955	19,350	Comuna29
	37	Comuna30	6.39	7.19	2,724	19,580	Comuna30
	38	Comuna31	5.54	6.23	3,635	22,650	Comuna31
	39	Comuna32	5.48	6.17	3,718	22,910	Comuna32
	40	Comuna33	6.44	7.25	2,730	19,780	Comuna33
		U.A. Total	5.25	5.90	107,269	632,900	
Sub Urban Area	41	A. Grande				1,600	Arroyo Grande
	42	P. Canoas				6,540	Ayo Piedra, Boquilla, P'zuela, Pta Canoas
	43	Bayunca				6,120	Bayunca
	44	Mamonal				5,440	Pasacaballos
	45	T. Bomba				4,550	Bocachica, Tierra Bomba, Cano de Loro
	46	Sta. Ana				1,700	Santa Ana, Baru(p)
	47	Baru				1,350	Baru(p)
		S.U.A. Total				27,300	
Study Area Total						660,200	

*1 DANE-Encuesta Nacional de Hogares, 1990 septiembre
*2 Estimated by Study Team applying the ratio of 5.9/5.25 to the average number of persons per household
*3 DEPLAN

3 EXISTING ROAD TRAFFIC CONDITIONS

3.1 Road Network

19. The road network in Cartagena is composed of a few radial arterial roads, collector roads and local roads to the arterial and collector roads under the geographical restriction. The major traffic corridor between Centro (down town) and residential area runs in quite narrow belt surrounded by Cienaga de Tesca (swamp) in the northern side and Bahia de Cartagena (the Bay of Cartagena) in the southern side. The circumferential road is not in Cartagena because of the above reason. Figure 3.1-1 shows the existing road network.

20. At present, there are few roads serving for the east-west traffic. These are Av. Don Pedro de Heredia and Av. Alfonso Araujo. The heavy traffic volume flows in the east-west direction in which the urban area in Cartagena is developed. The demand of traffic and the capacity of roads in this direction is currently balanced.

21. Table 3.1-1 shows the road inventory of urban area in Cartagena. The total road length in the urban area of the Study Area is approximately 90 km. The road length with two lanes is approximately 57 km, equivalent to 65% of the total. Three to four (3-4) lanes and five (5) or more lanes roads are 27 km (30%) and 5km (5%) in length respectively. In the urban area, two lane roads are predominant.

Table 3.1-1 Road Inventory of Urban Area in Cartagena

	No. of Lanes	Road Length Km	(%)	Median Km	(%)	Sidewalk Km	(%)	Shoulder with Plant Km	(%)
1	7 - 8	1.10	(1.2)	1.10	(1.2)	1.10	(1.2)	1.10	(1.2)
2	5 - 6	3.60	(4.1)	3.60	(4.1)	3.60	(4.1)	3.40	(3.8)
3	3 - 4	27.18	(30.7)	20.18	(22.8)	25.93	(29.3)	20.20	(22.8)
4	2	56.71	(64.0)	0.00	(0.0)	39.31	(44.4)	38.22	(43.1)
	Total	88.59	(100.0)	24.88	(28.1)	69.94	(78.9)	62.92	(71.0)

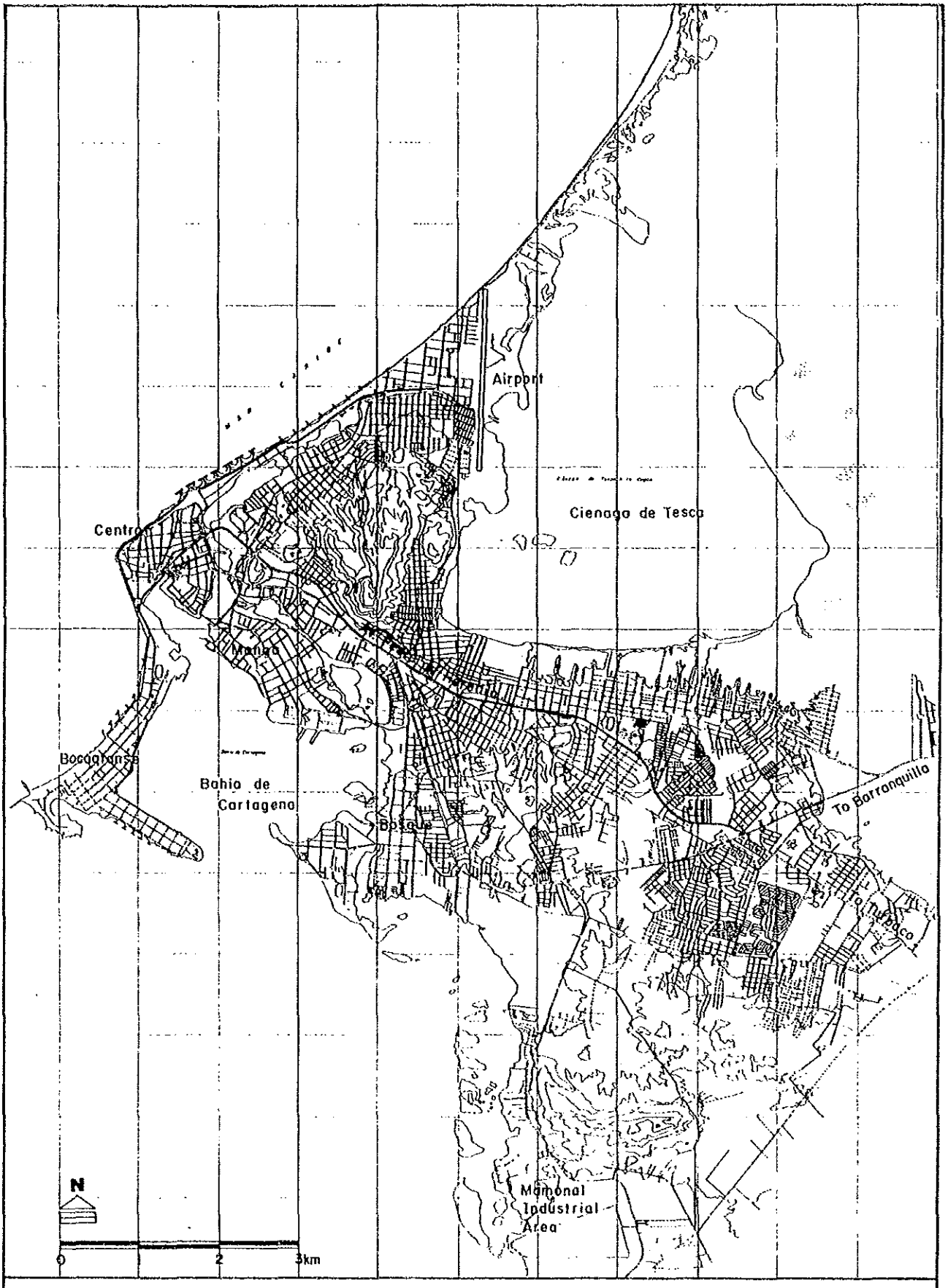


Figure 3.1-1(1) Existing Road Network (Urban Area)

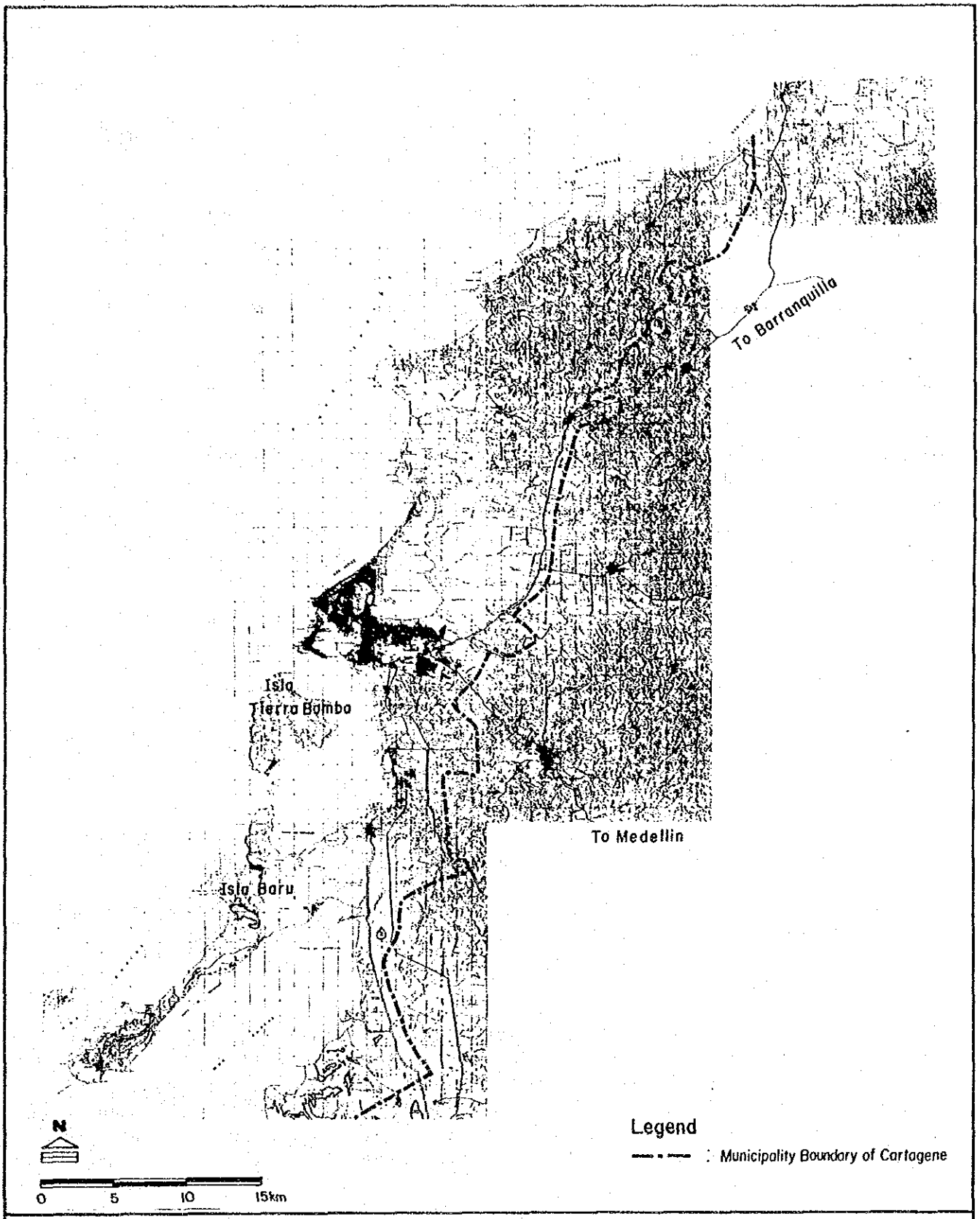


Figure 3.1-1(2) Existing Road Network (Sub-Urban Area)

3.2 Traffic Volume

1) Daily Traffic Volume

22. Daily traffic volume in the Study Area is shown in Figure 3.2-1. The heaviest traffic volume is recorded on Av. Don Pedro de Heredia on which shows a set of traffic volumes in both directions of inbound (R3) and outbound (R4) under each one-way regulation to be 56,000 veh/day. Carrera 1 at location No.R1 of Bocagrande (42,000 veh/day), Av. Blas de Lezo (38,000 veh/day), Av. Venezuela (24,000 veh/day) and Puente de Roman at R5 (28,000 veh/day) also carry heavy traffic. These roads are located in Centro and its neighboring areas.

2) Hourly Traffic Volume

23. Traffic volume distribution by hour describes the peak demand for roads. Hourly traffic volumes on Locations R1, R14 and R15 where the 24-hour counting surveys were carried are shown in Figure 3.2-2. The fluctuation of hourly traffic volume is different by each counting location according to those figures. Typical peak hour occurs during 7:00 a.m to 8:00 a.m in the morning and 5:00 p.m to 6:00 p.m in the evening.

3) Vehicular Composition

24. The vehicular compositions on major roads are shown in Figure 3.2-3. As for the vehicular composition around Centro, the passenger car ratio at R1 of Bocagrande is higher. Its figure is roughly 60% of the total. Buses at R4 on Puente de Heredia occupy approximately 34%.

25. In Bosque Industrial Area (Location R9), taxis and trucks are predominant. These figures are approximately 30% and 10%, respectively. The ratio of trucks in Mamonal Industrial Area is also higher (23%). In the residential area (Location R12 on Don Pedro de Heredia), buses represent high of about 36%.

3.3 Travel Speed

26. According to the travel time survey carried out on seven (7) major traffic corridors on September 2 to 9, 1991, vehicle travel speeds were more than 30 km/h on the average. It can be considered that almost all major roads are in good condition from the stand point of traffic flow because of the low traffic volume compared with its capacities.

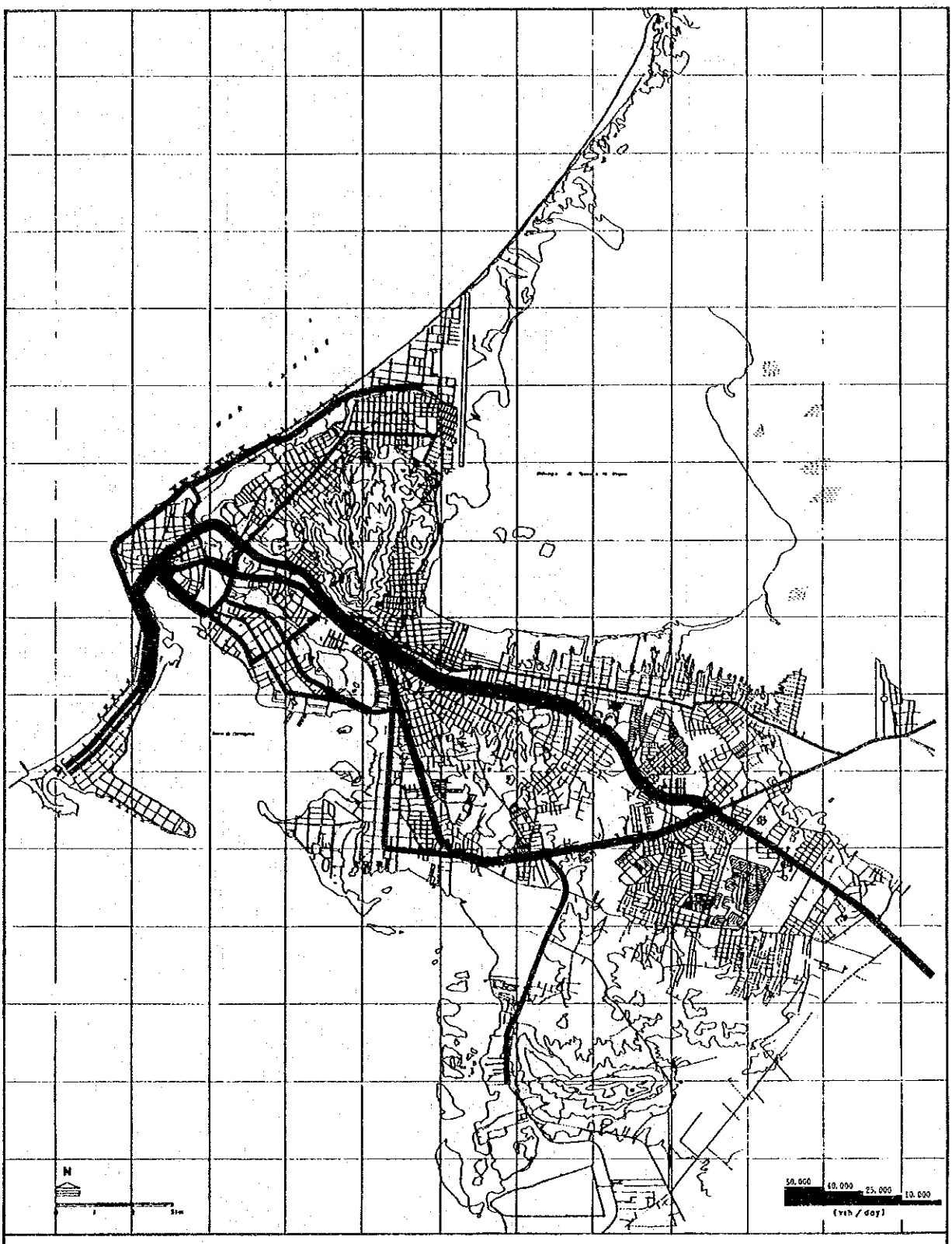


Figure 3.2-1 Traffic Volume in the Study Area

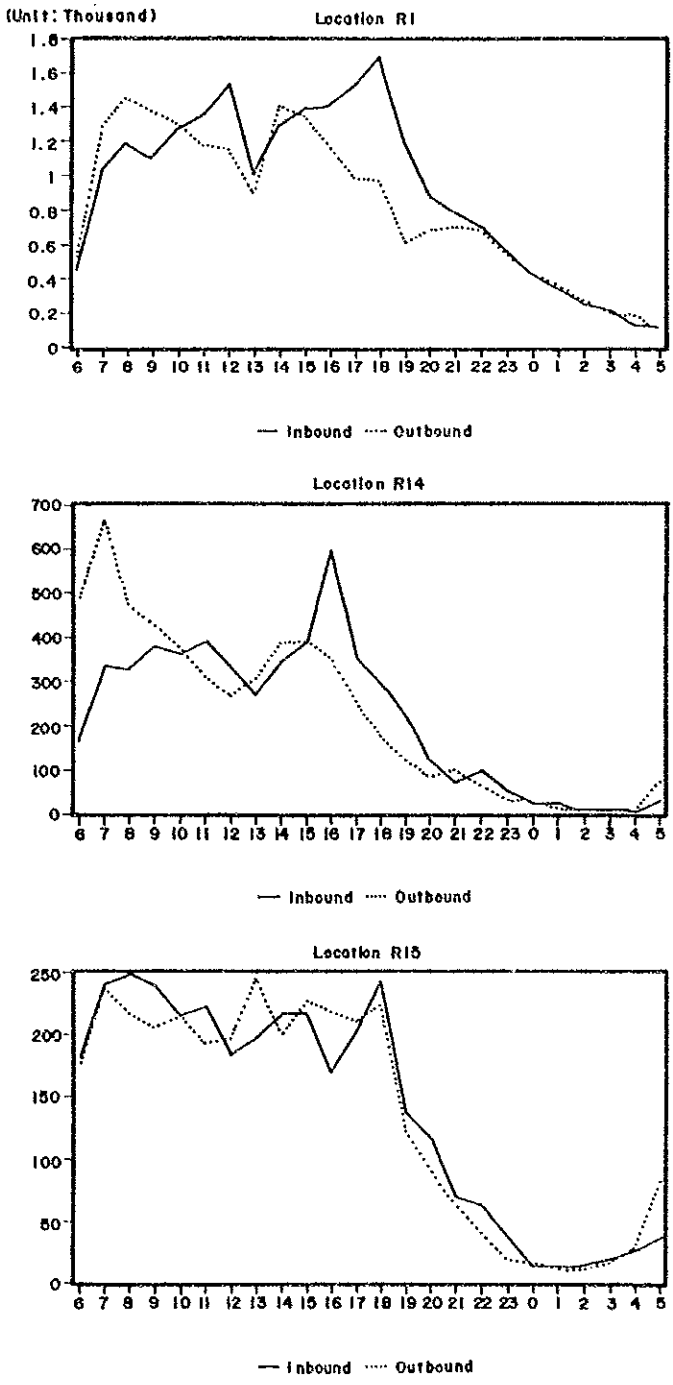


Figure 3.2-2 Hourly Traffic Volume

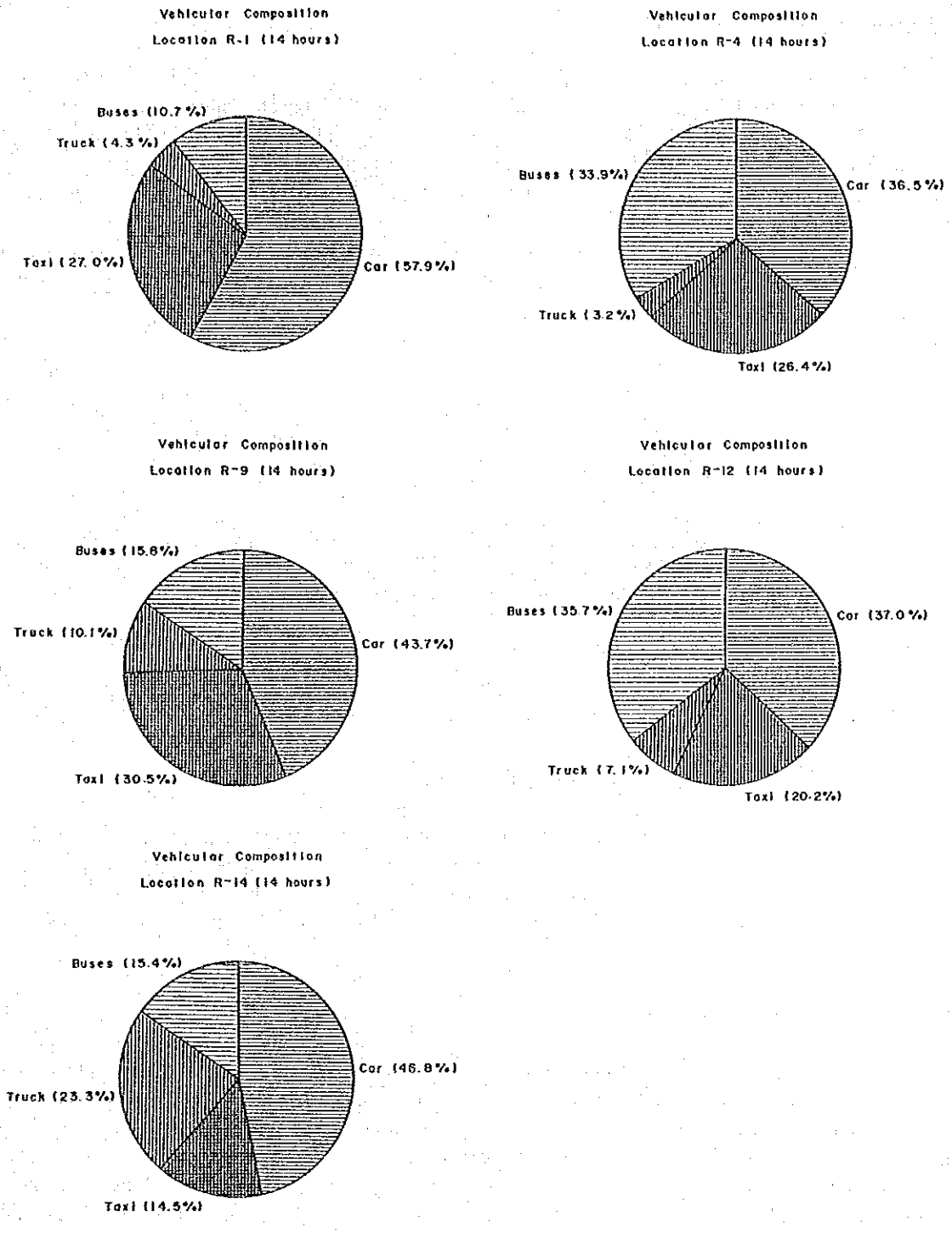


Figure 3.2-3 Vehicular Composition

3.4 Traffic Demand Characteristics

(1) Total Number of Trips

27. The total number of trips per day in the Study Area in 1991 is approximately 1.307 millions (person trip base), of which 1.259 million trips are made by residents in the Study Area, and 48 thousands by non-residents who are not dwelling in the Study Area. Since trips by residents in the Study Area have a 96% share, it seems to indicate that the Study Area is a closed area from the traffic point of view. Summarized in Figure 3.4-1 are trips of residents and non-residents according to internal and external trips.

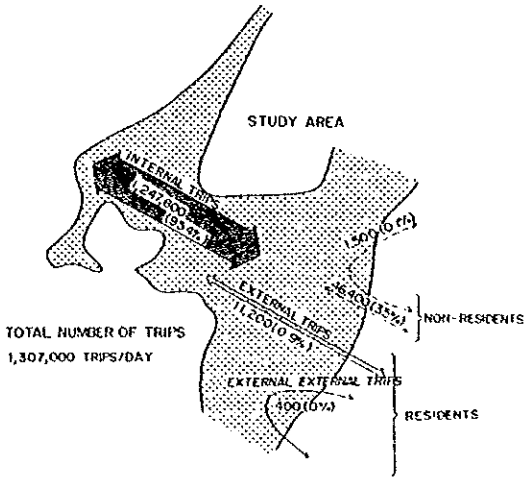


Figure 3.4-1 Total Number of Trips in the Study Area

28. Table 3.4-1 shows the summary of travel characteristics made by residents in the Study Area. The trips made by person who dwells outside the Study Area are excluded from this table.

(2) Trip Distribution

1) Car Trip Distribution

29. Trip distribution by car is shown in Figure 3.4-2 by desire line charts. As can be seen, there are large movements between zone No.2 (Centro) and its surrounding residential area composed of zone Nos. 1, 4, 5 and 12. In conclusion, strong desire lines by car concentrate to Centro from its neighbor zones due to the fact that high motorization area defined by number of cars per 1000 persons only concentrates into zones No.1 (183 car/1000), No.2 (98), No.4 (34), No.5 (228) and No.12 (43), and the remaining are 20 or less.

Table 3.4-1 Summary of Travel Characteristics

Items		Ratio
Non-Motorized Households	114,045	0.90
Motorized Households	12,860	0.10
Total Households	126,905	1.00
No.of Vehicles	16,944	
Population (5 years above)	598,800	
Motorization (veh/1000psn)	25.7	
Total Trips (person trip)	1,259,400	1.00
Car	145,769	0.12
Taxi	52,480	0.04
Truck	32,153	0.02
Bus	1,028,998	0.82
No.of Trips per person	2.05	

source: Study Team estimation

2) Bus Trip Distribution

30. The desire lines by bus are shown in Figure 3.4-3. The desire lines for bus transportation show that there are two heavy traffic movements: between the Centro and every residential area and between Mercado (Public Market) and every residential area. This is because those zones have a function as commercial and business areas as well as major bus terminal.

3.5 Tourism Trip

(1) Number of tourists

31. The annual total number of passengers arrived at Cartagena International Airport in 1990 is approximately 537,000, of which 25,000 are international tourists and 512,000 are domestic as shown in Table 3.5-1. Approximately 95% of the total are domestic tourists. Since the mid-1980s the number of passengers indicates stability with a little fluctuation.

(2) Tourism Trips

32. The influence on the urban traffic flow by tourism trips in the urban area is investigated by counting the traffic volume at several road sections in high tourist seasons (July 1991 and December 1991/January 1992) and off season (August 1991).

33. Traffic volume at high season increased by 10 -20 per cent at R1 (entrance to Bocagrande). However, at R14 (entrance to

Mamonal industrial area), traffic volume rather decreased. Between the inside and the outside of the Study Area, traffic volume increased by about 30 per cent. As for the influence on the traffic flow from tourist trip, therefore, it is considered to be limited to specific areas and during peak tourist seasons (two periods of three weeks each per year).

Table 3.5-1 Number of Passengers at Cartagena Airport

(Source: Tourist Authority)

Year	Number of Passengers			Growth Rate		
	International	Domestic	Total	International	Domestic	Total
1985	9,650	523,607	533,257			
1986	16,357	515,858	532,215	1.70	0.99	1.00
1987	25,433	525,702	551,135	1.55	1.02	1.04
1988	34,781	518,297	553,078	1.37	0.99	1.00
1989	27,681	496,495	524,176	0.80	0.96	0.95
1990	24,846	511,741	536,587	0.90	1.03	1.02

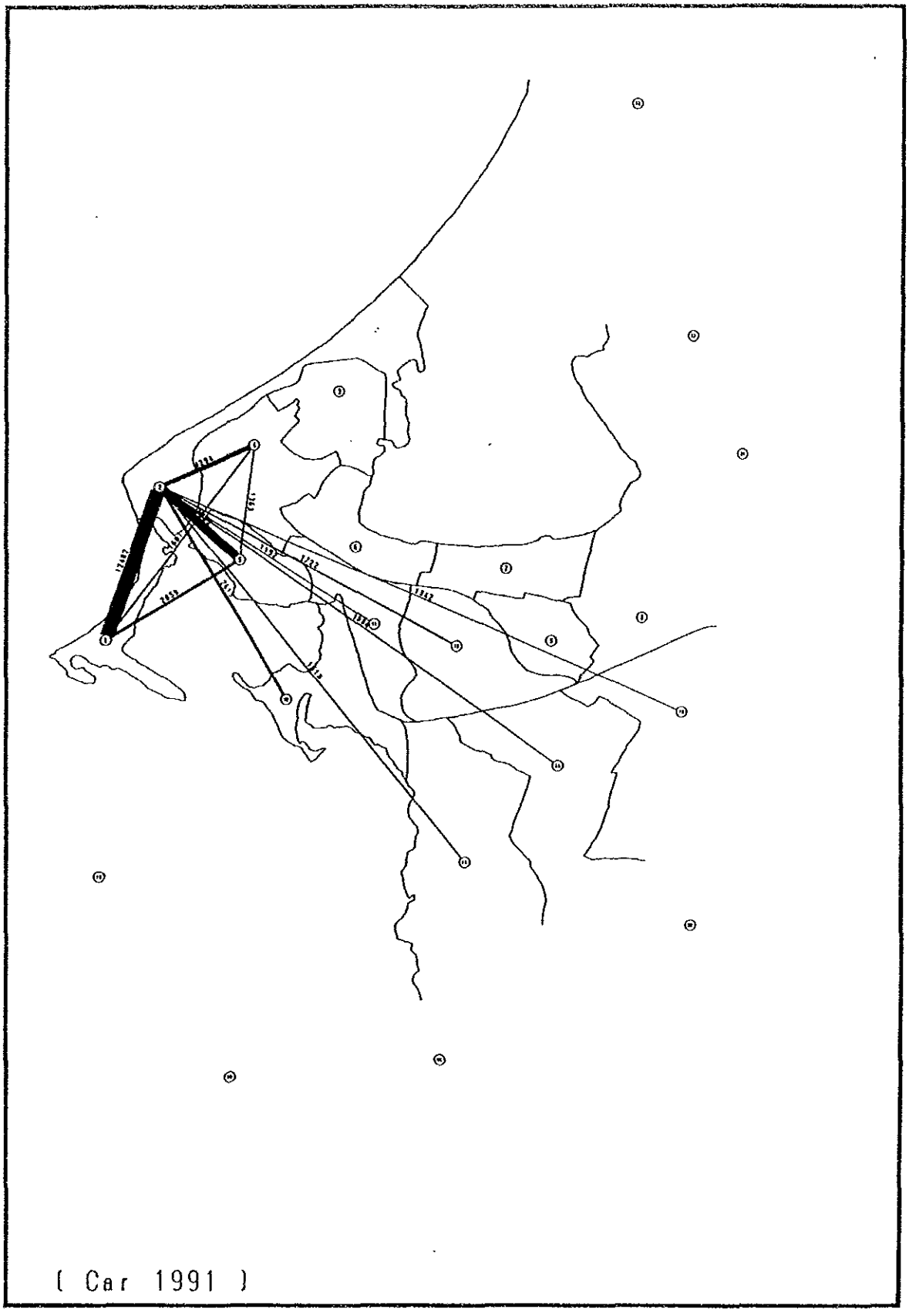


Figure 3.4-2 Car Trip Distribution

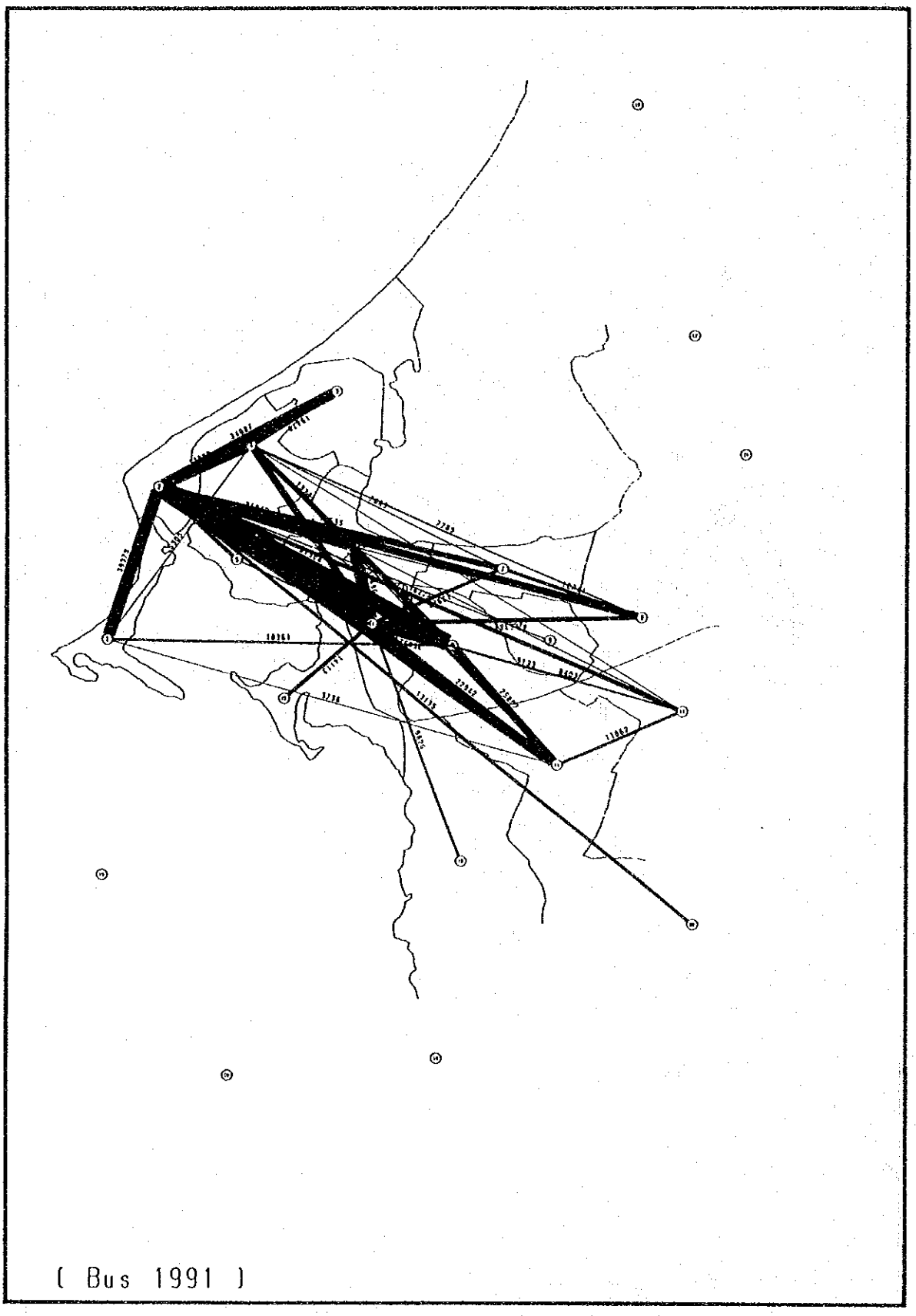


Figure 3.4-3 Bus Passenger Trip Distribution

4 PUBLIC TRANSPORTATION

4.1 Urban Bus Transportation

(1) Administration of Bus

34. From 1988, the Municipality of Cartagena has been able to control directly the public transportation for passengers, including both mass-transit (Bus and Buseta) and individual modes (Taxi). As the executing agency of the Municipality, DATT (Departamento Administrativo de Transito y Transporte, Cartagena) is in charge of transit and transportation control in the city.

35. Urban public transportation system is controlled by the transport division of DATT. This division is in charge of executing the study of new network and examining the introduction of new enterprises, and also is involved in the operation of public transport vehicles.

(2) Public Transportation Means

36. Public transportation means in Cartagena are basically bus and taxi. There is another smaller scale mean, ie. water transportation. One is a ferryboat to Baru Island whose capacity is about 3 - 4 vehicles. Another one is some small boats to Tierra Bomba Island which transport people who live there. These are used for commuting to the city center.

37. Concerning land transportation, the majority of people generally use a bus system. They use taxi as complementary system. Bus system can be classified into two categories, urban bus services and inter-city bus services.

(3) Bus Companies and Fleets

38. Urban bus services are operated by 10 companies. There is no public body. All of them are private bus companies. Those companies owned approximately 1661 bus/buseta vehicles whose average age is about 19 years for bus and 9 years for buseta in 1990.

39. According to DATT, generally the capacity of a bus is approximately 45 seats and 12 standings and that of buseta is approximately 25 seats and 5 standings. Using the data from INTRA, the capacity of a bus is 45.2 passengers and that of buseta is 25.0 passengers.

(4) Bus Passengers

40. The number of passengers by bus transport was about 354 thousand, equivalent to 89.3% of total transport demand in 1983 by the result of Person Trip Survey done by HIDOROTEC/EDURBE (refer to Table 4.1-1). In this Study the total demand of public transportation is estimated about 1,011 thousand passengers in 1991. This figure is 2.856 times as much as HIDDROTEC Survey nine (9) years earlier. Growth rate is about 12.3% annually. The growth rate of public transport demand is about 3.5 times as much as that of population which is 3.5% per annum in recent 5 years.

Table 4.1-1. Total Demand of Transportation in 1983

Category	No. of Trip	Share
Bus/Buseta	354,003	89.3
Car/Taxi	42,230	10.7
Total	396,233	100.0

Note: This value doesn't include water transport possibility.
Source: Study Report by HIDROTEC/EDURBE

(5) Service Network

41. The bus network of urban area in Cartagena is formed by 36 bus routes, at present, which are shown in Figure 4.1-1. The characteristics of this bus network pattern can be classified into four categories as follows;

a. the routes directly connecting with the Centro
b. the routes passing through the Centro
c. the routes circulating through the Centro
d. the routes which have no relation with the Centro

42. In these categories, the type (a) has the largest number of routes concentrated, such as 21 routes going down from north to south and 6 routes going down from east to west. The circulating routes are 2, the routes passing by the Centro are 5 and the route without any relation with the Centro is only one (1).

(6) Operation

43. Urban bus services have been accomplished by two types of vehicles, bus and buseta. These, bus and buseta, have three different levels of services, such as "Ordinario", "Ejectivo" and

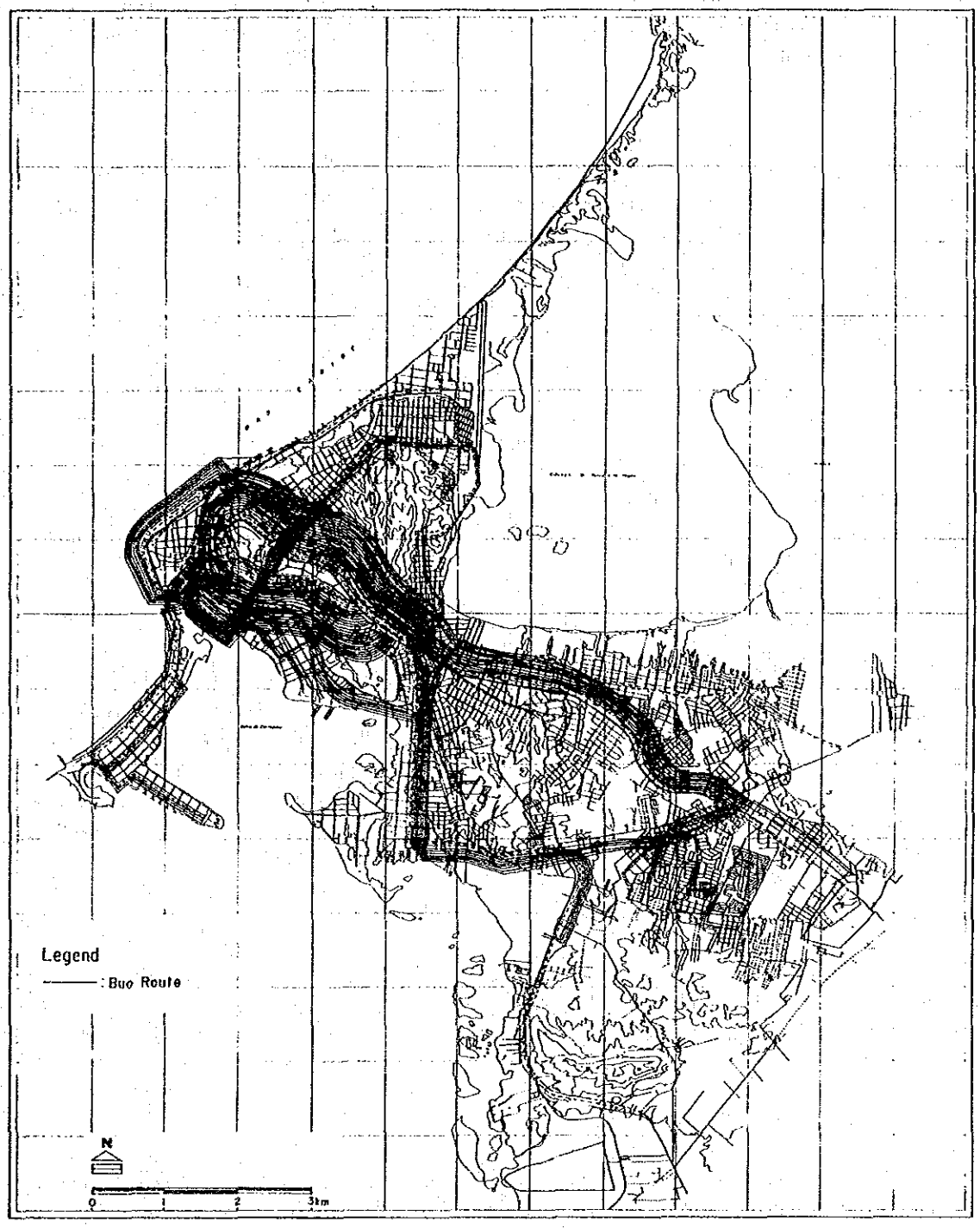


Figure 4.1-1 Bus Network

"Servicio Especial". There is another type of conveyance called "Colectivo". It can be said that the service of Colectivo is intermediate between bus and taxi, and don't have fixed routes and time tables.

1) Ordinario

44. Ordinario is an usual bus passenger transport service. Passengers can take a bus/buseta at bus stop and anywhere on the road. The legal limitation on the interval of bus stops is less than 200m. Fundamentally, bus/buseta should not stop just anywhere on the road as per the legal guidelines of DATT. But since the drivers want to get more passengers, they make unauthorized stops.

2) Ejectivo

45. "Ejectivo" contrasts so much with "Ordinario". Bus/buseta stop at fixed bus stops. The interval of these bus stops are longer than Ordinario's. The legal limitation of this interval is more than 300 m. That makes Ejectivo some kind of express bus service.

3) Servicio Especial

46. All the enterprises of urban bus services in Cartagena have a department of special services for the students, the tourists and the workers of factories, as regulated by the Decreto. 10% of the total vehicles which are affiliated by the enterprises have to be offered for these services. The vehicles of these services should not be older than 5 years.

4) Colectivo

47. "Colectivo" is a type of vehicle used also for transport service. It is a type of jeep, landcruiser or landrover converted into a bus. Its capacity of passengers is about 12 passengers.

5) The Number of Operation

48. The average number of round-trips (recorrido) is approximately 8 round-trips per one (1) bus vehicle in a day from the data of DATT and ADESTRACOSTA.

49. As for the number of round trips, there are two other different sets of data. One is the results of the survey that was done by INTRA on Oct. 24 - 30, 1988. This survey chose some samples of buses on each of 24 selected routes. The number of

round-trips by those buses in a whole day was recorded. The results show that the average number of trips is 5.2 round-trips per bus. This value is about 64% of the value from ADESTRACOSTA data.

50. Another one is the results of the bus counting survey that has been done by the Study Team on August 20 - 27, 1991. From the results of this survey, the average number of round-trips is 4.7 per bus in total. This survey carried out from 6:00 am to 6:00 pm and did not cover the whole operation hours. It can be said that this value is somewhat too low. The unofficial survey of last year carried out by INTRA indicates that about two (2) round trips should be added in operation number for before 6:00 am and after 6:00 pm. If this result is taken into consideration, the above value becomes approximately 7 round trips per bus.

6) Average Number of Passengers

51. Average number of passengers per Bus Ordinario in a day is 655 passengers and per Buseta Ordinario is 601 passengers from the data of DATT on July 1991 (refer to Table 4.1-2). The results of Survey done by INTRA, Oct. 1988, shows a little lower value, approximately 430 passengers per bus. The Study Team also carried out the bus passenger survey in August 1991. The results of this survey show the average number of passenger per bus in whole day was 568 passengers. This value is somewhere in between the values of DATT and INTRA.

Table 4.1-2 Average Number Passengers per day

Type of Service	Number of Passenger
Bus Ordinario	655
Buseta Ordinario	601
Bus Ejectivo	450
Buseta Ejectivo	400

Source: DATT

7) Length of Bus Routes

52. The length of bus routes are indicated that the longest route is 40 km and that half the routes are more than 20 km long. Thus, the average distance in operation is 20.4km.

(7) Bus Facilities

1) Bus Stop

53. In general, there should be bus stops at fixed loca-

tions. However, there is no any facility at bus stops at present. The passengers can stop a bus wherever they want on the roads. Therefore, the improvement of the bus stops has been delayed.

2) Bus Terminal

54. There is no bus terminal for urban buses where people gather and use buses in the main parts of the city. Some places in the Centro where the bus routes concentrate can be said to have a function such as a bus terminal. But, in reality, these are only big bus stops from the view point of the public facility. There are some places along the road where the buses can make a queue to park and wait the passengers. However, there is nothing organized at all, such as indications, information, control and functions for the passengers, etc.

(8) Bus Fare System

55. The fares for the urban bus service in the city of Cartagena have been regulated as follows (as of August 1991);

a. Ordinary Bus (Bus Ordinario)
   Ordinary days : 60 pesos
   Night, Sunday and Holiday : 65 pesos
b. Ordinary Buseta (Buseta Ordinario)
   Ordinary days : 65 pesos
   Night, Sunday and Holiday : 70 pesos
c. Bus Ejectivo
   Ordinary days : 140 pesos
   Night, Sunday and Holiday : 150 pesos
d. Buseta Ejectivo
   Ordinary days : 125 pesos
   Night, Sunday and Holiday : 140 pesos
e. Colectivo
   Ordinary days : 80 pesos
   Night, Sunday and Holiday : 100 pesos

(9) Financial Condition of Bus Operation

56. Managerial index is estimated using above passenger fares and vehicle operation costs. As the overall total, managerial index shows about 1.3 which seems to indicate adequate financial condition, although each route shows the index of profit or deficit.

4.2 Inter City Bus Transportation

57. The intermunicipal or inter-regional transportation for passengers is controlled by INTRA (Instituto National del Transporte, Ministerio de Obras Publicas y Transporte).

58. Inter-city bus services have two categories of services. One is inter-city bus services, which is connecting the cities within the Bolivar region. Another is inter-region (inter-Departamento) bus services, which is connecting the cities outside of Bolivar region. Inter-city bus service system has an exclusive terminal near at the intersection of Carretera de la Cordialidad with Camino a Campania. Almost all the inter-city bus routes gather in this terminal.

4.3 Taxi Transportation

59. Taxi services are offered by 6 taxi companies. Four (4) taxi companies have joined in the taxi association of "COOPROTAX". While the other two (2) companies are managed individually.

60. The total number of taxi vehicles are about 2400. They operate their taxies at the main taxi stops (Taxi-parada), which are located at 10 places in the city. There are some other small taxi stops and the inter-city taxi stops.

61. The fare of taxi is established by the Decreto No.24, 1991. The fares are fixed, generally, as the fare from the Centro to some areas. If a trip does not correspond to these fares, the taxi driver can determine the most suitable fare among them. The minimum charge is 400 pesos. Each taxi should display this fare table for the passenger's viewing. In these fares, there are special fares that are adopted for the trip to intermunicipal Bus Terminal, the Airport and some main touristic areas.

5 TRAFFIC MANAGEMENT

5.1 Traffic Regulation

62. Traffic regulation in Cartagena, such as parking restriction, one-way regulation, speed limit and heavy vehicle restrictions are being practiced.

63. One-way regulation is widely employed in the Central area and its surrounding areas such as Bocagrande or Manga where the traffic concentrates. Speed limit in the urban area is specified as 50 km per hour with the exception of 30 km per hour in the areas around the schools, hospitals, military base, etc.

64. Parking on road side is restricted on the major roads such as Av. Pedro de Heredia, Av. Venezuela and Av. del Concejo and narrower roads less than 5 meters in the Central area (refer to Figure 5.1-1). Parking facilities for public use are only nine (9) in Central area. Their parking capacity ranges from 20 to 100 vehicles totaling some 500 vehicles. Parking fees are around 100 to 250 Pesos per hour.

5.2 Sign and Signal

65. Traffic signals are installed at twenty one (21) intersections in the Study Area. There locations are mostly along the main traffic corridors of Av. Pedro de Heredia and Diagonal 22. They are electromechanic type and are set on two to four (2-4) phases control system. They are independently operated except for two signals installed recently.

5.3 Parking Demand and Capacity

(1) Parking Demand

66. Parking demand characteristics at zones 2 and 5 (Centro) are shown in Table 5.3-1 from the parking survey by the Study team. Parking purpose with the highest demand rate is "business", followed by "to office" and "shopping/private matter". "To school" purpose shows a very low rate. Parking duration is relatively short compared with that of parking facility. Walking distance is also short. Three fourths of the vehicles tend to park within 100m from the place to visit.

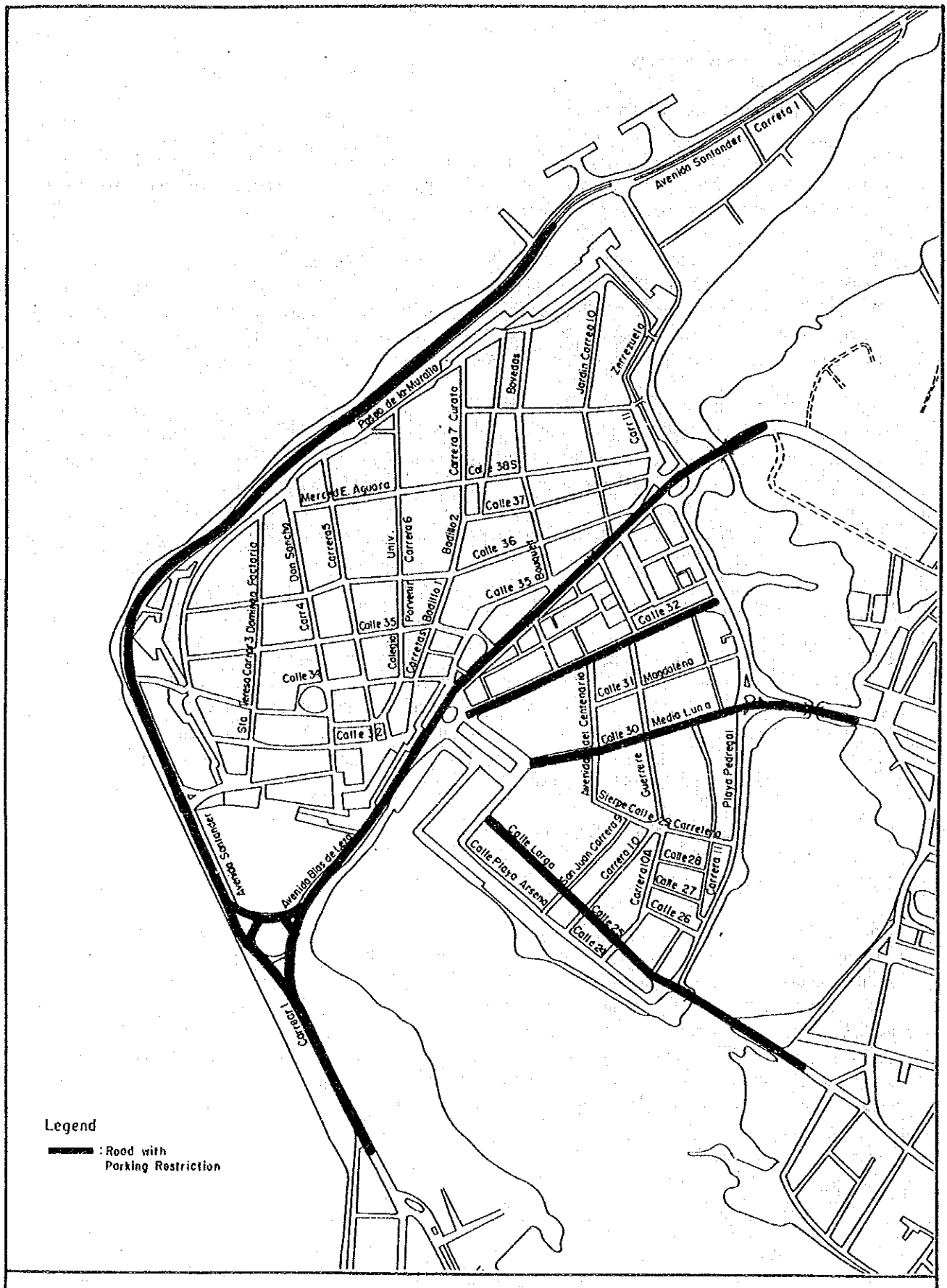


Figure 5.1-1 Parking Restriction in Central Area

Table 5.3-1 Roadside Parking Demand Characteristics

1) Purpose					
	to office	business	to school	shopping/private	
	32.7%	39.3%	0.5%	27.5%	
2) Parking hour					
	<30 minutes	30-60 m.	1-2 hours	2-3 hours	>3 hours
	45.7%	19.9%	11.2%	9.6%	13.6%
3) Walking distance					
	<50 m	51-100 m	101-200 m	>201 m	
	60.1%	16.2%	8.7%	15.0%	

source: Study Team survey result

(2) Parking Capacity

67. As for the public use parking facilities (whether privately owned or publically owned), there is lack of availability in the Central area and Bocagrande where parking demand concentrates. As before mentioned, there are nine (9) parking facilities for the Central area. Total capacity is estimated at some 500 vehicles. In Bocagrande there are several temporary parking spaces using the open spaces in vacant lots awaiting building construction. They are used mostly in the tourist season. The total capacity seems to be about three (3) hundred vehicles. In such "tourist" seasons many cars and buses gather in Bocagrande and park on road sides and even on sidewalks. It is very difficult to provide the parking space for only a few weeks in a year. Therefore, temporary imbalance between parking demand and capacity in Bocagrande shall be allowed.

68. Curb parking is common way of parking in the Study Area to fulfill the capacity gap between the demand and capacity of the parking facilities. Although effective enforcement for the curb parking on the major streets in the Central area is not yet realized, curb parking shall be excluded from roadsides of the major streets in order to maintain the smooth traffic flow.

6 FUTURE SOCIOECONOMIC FRAMEWORK AND LAND USE PLAN

6.1 Future Socioeconomic Framework

(1) Economic Growth of Colombia

69. According to the Economic and Social Development Plan, 1990-1994, which was recently announced as the official development plan of present Gaviria Administration, target of economic growth rate in Colombia is set at 4.0% in 1992, 4.7% in 1993 and finally 5.0% in 1994.

70. Through a study on the relationship between the national economic growth and the planned population of the Study Area, the socioeconomic framework of Colombia is assumed as shown in Table 6.1-1. The basic considerations for setting the framework are that a long-term economic growth rate of 5% may be too high to be realized and that economic growth dependent too much on higher labor productivity will not be desirable.

Table 6.1-1 Socioeconomic Framework of Colombia, 1990-2010 (%)

Year	Population (1000 psn)	Population Growth Rate	Working Pop. Rate	GDP Growth Rate	Labor Productivity Increase Rate
1990	32,979	1.87	70.5	3.8	1.3
1995	36,182	1.72	72.5	4.5	2.2
2000	39,397	1.50	74.0	4.5	2.4
2010	45,722		76.8		

source: Study Team

(2) Socioeconomic Framework of the Study Area

71. Considering future economic growth patterns of Colombia as a whole and of Cartagena, a growth process shown in Table 6.1-2 is established as the future framework in Cartagena. The goal in this Study is set so as to build an urban structure and socioeconomic system which can accommodate 1.2 million people in 2010.

72. Future total employed persons by sector who work within the Study Area (deducting persons who commute to outside the Area from the total resident employed persons, and adding nonresident employed persons who work within the Area) is assumed as shown in Table 6.1-3. The ratios of employed persons who commute to outside the Study Area in the secondary and tertiary sectors are assumed to decline in future.

Table 6.1-2 Socioeconomic Framework of the Study Area

Year	Population	Labor Force	Resident Employed Persons	Total Employed Persons Working within S. A.	Labor Force Demand Growth Rate (%)	GRP Growth Rate(%)	GDP Growth Rate(%)
1990	660,200	235,570	212,670	215,670			
1995	773,000	281,400	253,800	257,400	3.6	4.95	3.8
2000	900,000	333,900	302,900	307,200	3.6	5.85	4.5
2010	1,200,000	460,800	421,100	427,100	3.35	5.85	4.5

note: 1) "Resident employed persons" means employed labor force living within the Study Area, including persons who commute to outside the Area.
2) "Total employed persons working within the Study Area" means sum of the residents and non residents employed persons working within the Area.
3) GRP and GDP growth rates are based on Case 3 economic growth (medium; long-term growth rate, 4.5%), but labor force demand growth rates are adjusted in order to follow almost same course as Case 1 by productivity increase or Case 2 by employment increase. In other words, labor productivity is assumed to increase as shown in Table 6.1-1.

Table 6.1-3 Future Total Employed Persons by Sector Working within the Study Area

Year	Primary S.	Secondary S.	Tertiary S.	Total
1990	4,510	42,190	168,970	215,670
1995	4,200	50,100	203,100	257,400
2000	3,900	61,000	242,300	307,200
2010	3,300	86,500	337,300	427,100

6.2 Land Use Plan

(1) Land Use Plan

73. For the urban area, DEPLAN promulgated a zoning plan as shown in Figure 6.2-1. Table 6.2-1 shows a result of measurement of use zoning areas by traffic zone. According to this table, 51% of the total area are designed as a residential zone (2,751 ha). The industrial zone is 643 ha (11.9%) and the tourism/historic zone (historic zone is 83.7 ha of traffic zone 4) is 311 ha (5.8%). There are some unique land uses such as the integrated project zone, special activity zone and special treatment zone. The integrated project zone is designed to the Navy Base, Maritime Terminal, Crespo Airport and Chambacu area as urban renewal sites for complex development.

74. For the suburban area expect the Mamonal Industrial Zone (traffic zone 44), official zoning is not yet designated. At the moment, coastal lots are being acquired by private individu-

als and companies for recreational use, tourism development or only speculation. According to the recent investigation by the National Justice Office, many national properties are occupied or made object of transaction illegally. Figures 6.2-1 (Urban Area) and 6.2-2 (Suburban Area) show the land use plan of the Study Area in 2010.

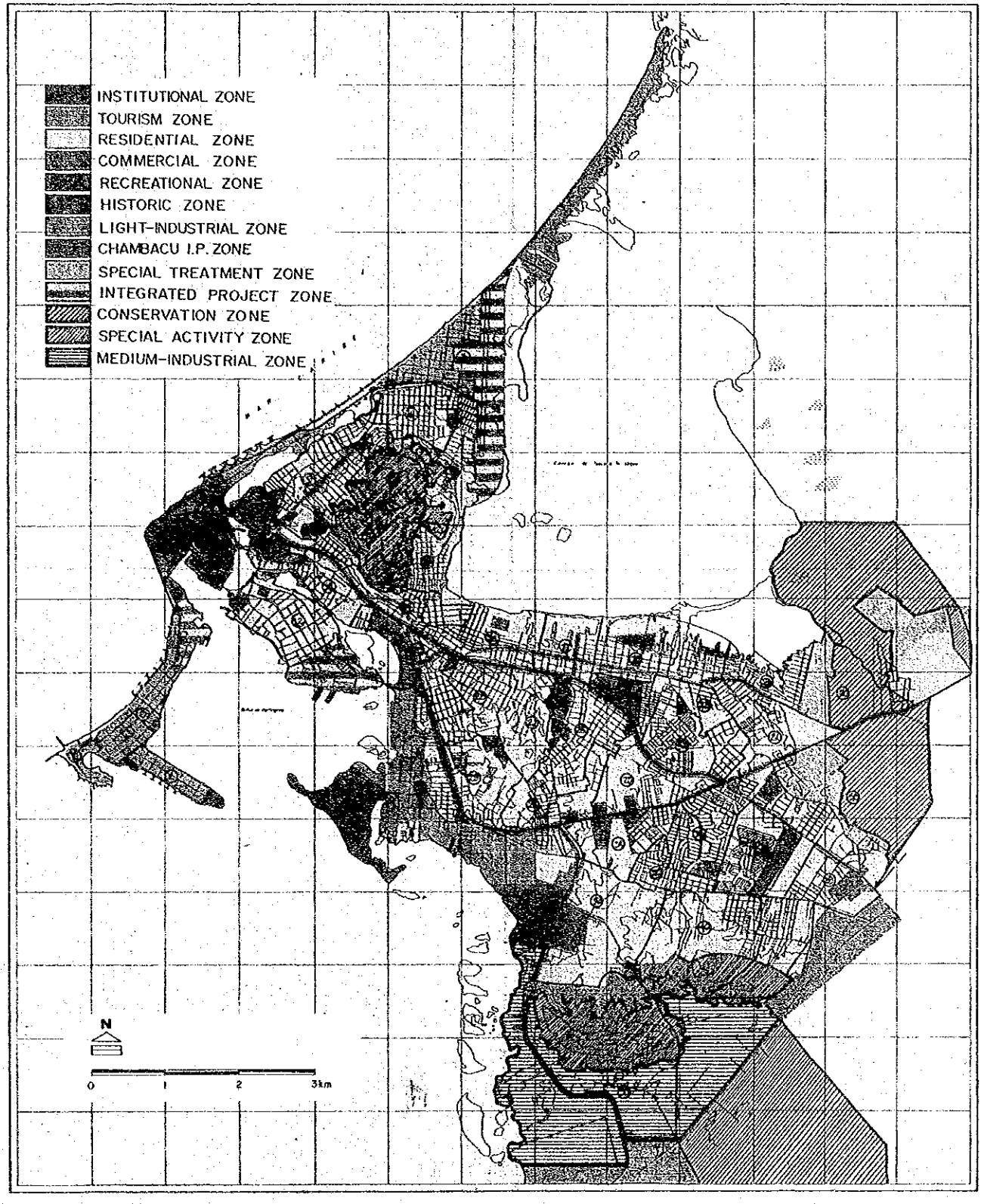


Figure 6.2-1 Land USe Plan of the Study Area in 2010 (Urban Area)

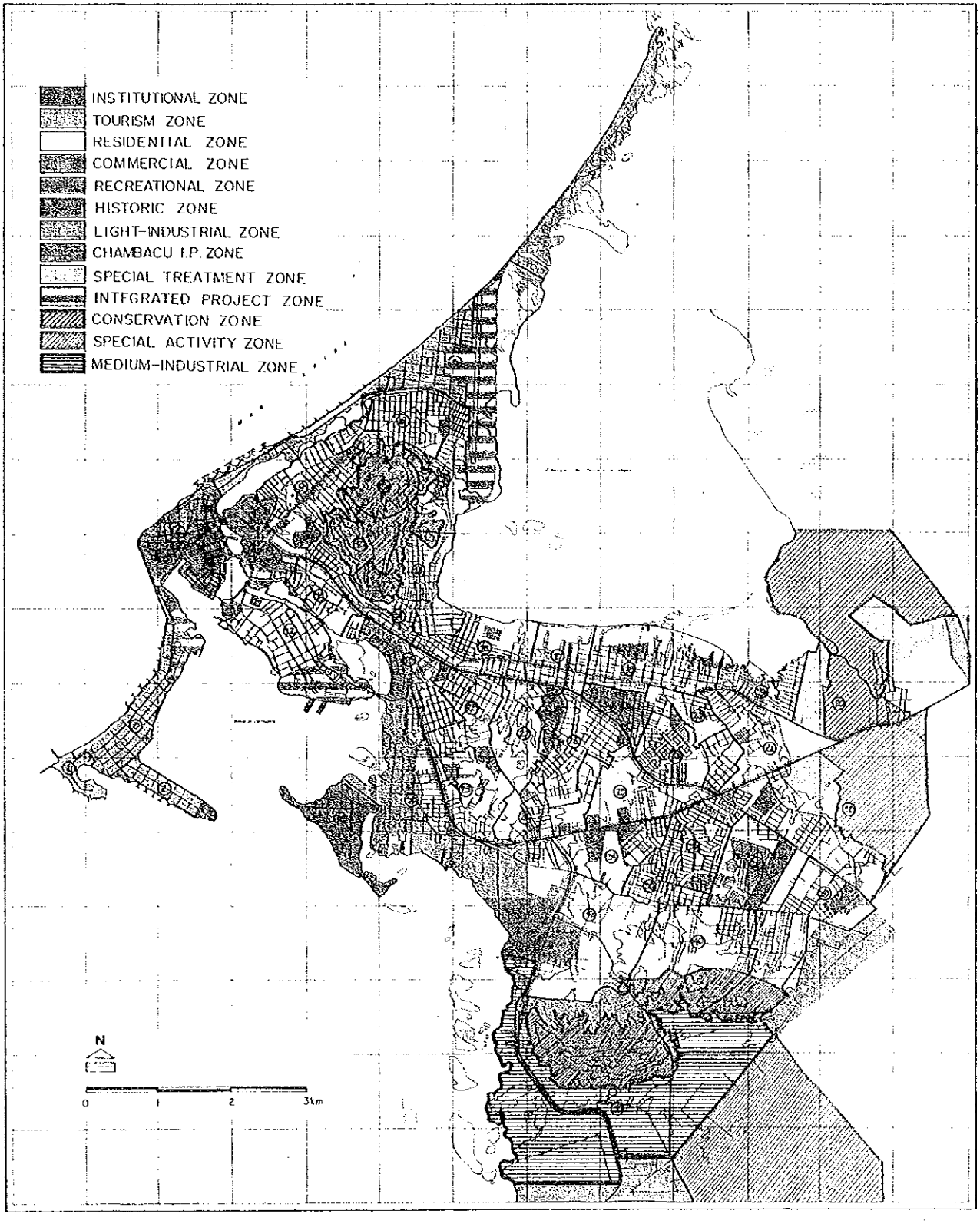


Figure 6.2-1 Land USe Plan of the Study Area in 2010 (Urban Area)

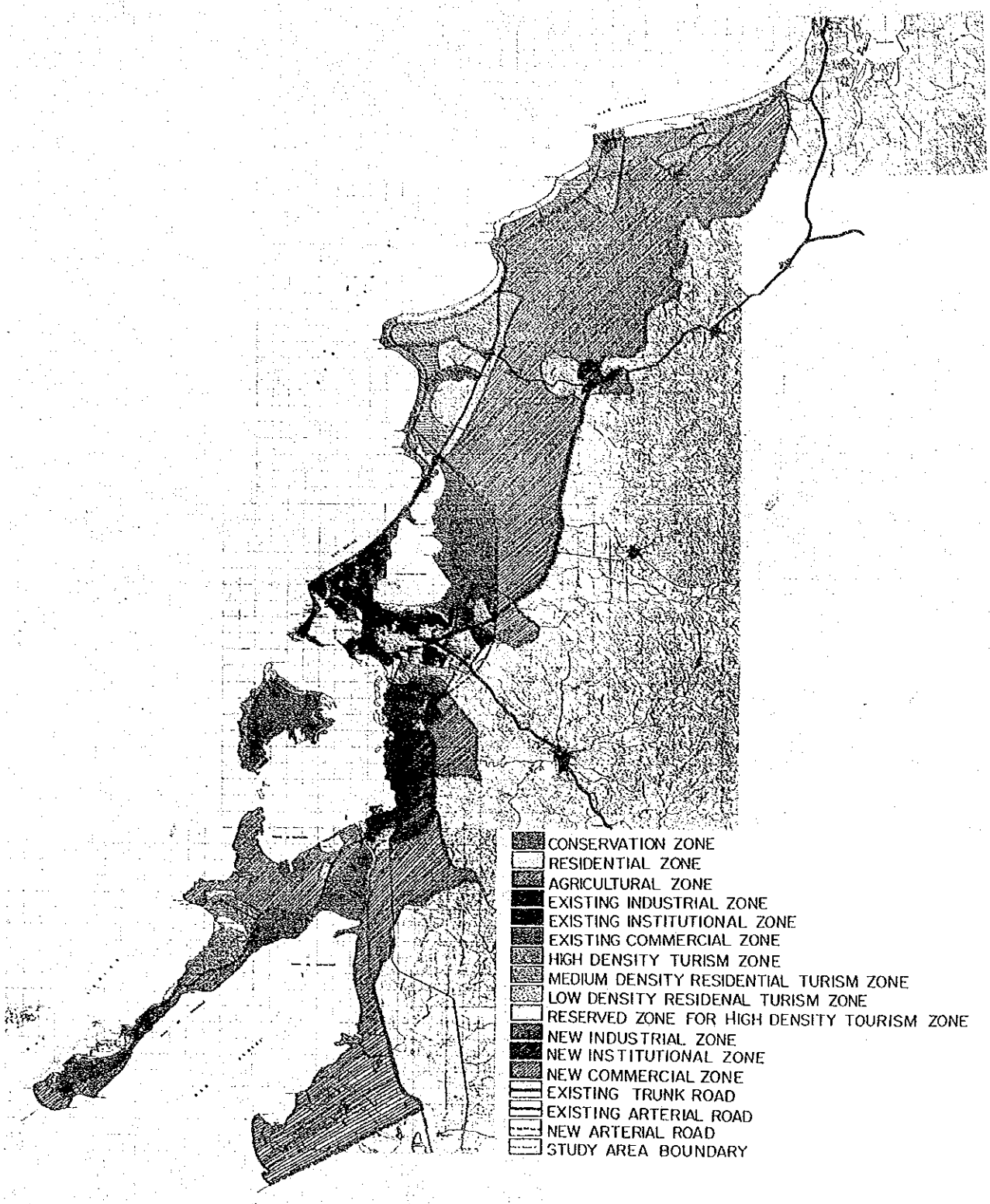


Figure 6.2-2 Land Use Plan of the Study Area in 2010
(Sub-urban Area)

Table 6.2-1 Use Zoning by Traffic Zone (Urban Area)

(ha)

Zone no.	Zone area	Residential	Commercial	Industrial	Institutional	Tourism/historic *1	Recreational *2	Integrated project *3	Special activity	Special treatment	Conservation
1	18.4					18.4					
2	38.1				5.0	31.1	2.0				
3	111.6		3.0		3.4	62.9	15.9	26.4			
4	117.1		6.2			83.7	27.2				
5	310.4					114.5	17.3	178.6			
6	67.7	63.7			2.9		1.1				
7	105.1	84.1									21.0
8	95.0	46.2									48.8
9	121.0	97.2	5.6		9.7						8.5
10	159.6	44.7	11.6		2.7		28.9	14.1			57.6
11	51.3	47.4					3.9				
12	152.4	95.0	3.2		1.3		4.7	39.5	8.7		
13	87.4	53.5	25.6		2.8		5.5				
14	74.1	49.6	3.7								20.8
15	80.9	54.5									26.4
16	94.3	82.4	8.4				3.5				
17	72.2	64.6	7.6								
18	127.8	110.8	6.3				10.7				
19	57.4	53.9	1.7				1.8				
20	270.9	89.7							12.0	90.3	78.9
21	106.9	99.4	7.5								
22	100.5	96.0	4.5								
23	79.8	52.2			4.6		23.0				
24	89.2	84.2	2.2		2.8						
25	89.8	74.3	9.2		6.3						
26	117.6	101.4	4.8		11.4						
27	90.0	84.9	2.2		2.9						
28	69.3	63.1	3.8		2.4						
29	83.5	75.9	4.2		3.4						
30	205.8	67.1	18.0	121.7							
31	68.8				68.8						
32	342.0	190.1	34.2	60.5	49.8					7.4	
33	622.8			460.8							162.0
34	86.9	66.7	1.0		10.0		9.2				
35	44.0	44.0									
36	77.5	77.5									
37	90.4	67.8	1.2		21.4						
38	435.4	280.8	7.2		10.9				156.4	60.1	
39	178.9	125.2	5.7		10.2						37.8
40	206.7	143.4									63.3
Total	5399.5	2751.3	188.6	643.0	232.7	310.6	154.7	258.6	177.1	157.8	525.1

*1: In Zone 4, 5.2 ha is the area of institutional facilities like the city hall and tourist wharves.
*2: Including nondesignated beach zones of 13.4 ha in Zone 3 and 15.8 ha in Zone 5.
*3: Including nondesignated land of 58.0 ha adjacent to the airport in Zone 5.
Only Zone II (residencial especial) of the Chambacu Project Area is shown in Zone 10.

(2) Population Distribution

75. Based on the land use plan, a population accommodation plan by zone is made as shown in Table 6.2-2 which is the result of zone distribution of the planned 1.2 million population in 2010.

Table 6.2-2 Planned Population of the Study Area in 2010

	Zone no.	Zone name	1990 Habitable area (ha)	1990 Population	1990 Semigross density (psn/ha)	2010 Residential zone (ha)	2010 Commercial zone (ha)	2010 Habitable zone total (ha)	2010 Planned density (psn/ha)	2010 Population
Urban Area	1	Laguito	18.4	6,080	330.4	18.4		18.4	400	7,400
	2	C, grande	31.1	5,110	164.3	31.1		31.1	200	6,200
	3	B' grande	37.5	8,910	237.6	47.5		47.5	500	23,800
	4	Centro	84.7	25,320	298.9	78.5	6.2	84.7	300	25,400
	5	Marbella	61.0	7,560	123.9	85.0		85.0	350	29,800
	6	Comuna 3	64.8	15,940	246.0	63.7		63.7	300	19,100
	7	Comuna 4	84.1	23,890	284.1	84.1		84.1	300	25,200
	8	Comuna 5	69.3	21,040	303.6	46.2		46.2	350	16,200
	9	Comuna 6	111.3	19,570	175.8	97.2	5.6	102.8	500	51,400
	10	Comuna 7	62.2	13,190	212.1	58.8	11.6	70.4	500	35,200
	11	P. d. Popa	50.7	10,840	213.8	47.4		47.4	500	23,700
	12	Manga	93.2	9,880	106.0	105.0	3.2	108.2	350	37,900
	13	Comuna 9	84.6	15,090	178.4	53.5	12.8	66.3	300	19,900
	14	Comuna10	53.3	14,120	264.9	49.6	3.7	53.3	300	16,000
	15	Comuna11	54.5	12,680	232.7	54.5		54.5	300	16,400
	16	Comuna12	94.3	20,980	222.5	82.4	8.4	90.8	250	22,700
	17	Comuna13	72.2	15,340	212.5	64.6	7.6	72.2	250	18,100
	18	Comuna14	108.2	27,120	250.6	110.8	6.3	117.1	250	29,300
	19	Comuna15	49.0	18,290	373.3	53.9	1.7	55.6	380	21,100
	20	Comuna16	163.3	21,240	130.1	180.0		180.0	200	36,000
	21	Comuna17	76.3	16,030	210.1	99.4	7.5	106.9	200	21,400
	22	Comuna18	86.1	16,730	194.3	96.0	4.5	100.5	200	20,100
	23	Comuna19	48.8	14,130	289.5	52.2		52.2	300	15,700
	24	N. Bosque	72.8	16,000	219.8	84.2	2.2	86.4	200	17,300
	25	V. Sandra	83.5	12,140	145.4	74.3	9.2	83.5	200	16,700
	26	Comuna21	105.4	21,970	208.4	101.4	4.8	106.2	250	26,600
	27	Comuna22	64.5	12,630	195.8	84.9	2.2	87.1	250	21,800
	28	Comuna23	66.9	9,990	149.3	63.1	3.8	66.9	250	16,700
	29	Comuna24	59.3	16,410	276.7	75.9	4.2	80.1	250	20,000
	30	Bosque	121.8	22,290	183.0	130.3	18.0	148.3	200	29,700
	31	Manillo	0.0	880	-	0.0	0.0	0.0		900
	32	Ceballos	170.8	19,240	112.6	197.5	11.4	208.9	200	41,800
	33	A. Barato	40.4	5,930	146.8	90.0		90.0	200	18,000
	34	Comuna27	67.7	21,070	311.2	66.7	1.0	67.7	350	23,700
	35	Comuna28	44.0	11,000	250.0	44.0		44.0	250	11,000
	36	Comuna29	77.5	19,350	249.7	77.5		77.5	250	19,400
	37	Comuna30	69.0	19,580	283.8	67.8	1.2	69.0	300	20,700
	38	Comuna31	157.4	22,650	143.9	260.9	7.2	268.1	200	53,600
	39	Comuna32	139.1	22,910	164.7	125.2	5.7	130.9	200	26,200
	40	Comuna33	122.4	19,780	161.6	143.4		143.4	200	28,700
		U.A. Total	3121.4	632,900	202.8	3346.9	150.0	3496.9	266	930,800
Sub Urban Area	41	A. Grande		1,600						43,200
	42	P. Canoas		6,540						116,700
	43	Bayunca		6,120						29,600
	44	Manonal		5,440						48,000
	45	T. Bomba		4,550						12,400
	46	Sta. Ana		1,700						17,400
	47	Baru		1,350						1,900
		S.U.A. Total		27,300						269,200
Study Area Total				660,200		3346.9				1,200,000

6.3 Future Vehicle Ownership

76. The vehicle number forecasted exclusive of bus and motorcycle is shown in Table 6.3-1. The passenger car is forecasted based on the population growth, income growth and past growth rate of car ownership of the Study area. The growth of truck number is considered due to the population growth and economic growth.

Table 6.3-1 Vehicle Forecast in the Study Area by 2010

Year	1990	1995	2000	2005	2010
Passenger Car	15,924	25,640	37,670	50,410	67,460
Taxi	2,777	4,890	6,240	7,230	8,420
Truck	2,842	4,310	6,570	9,920	14,990
Total	21,543	34,840	50,480	67,560	90,870
Ownership per 1000 inhabit.	32.6	45.1	56.1	65.0	75.7

7 FUTURE TRAVEL DEMAND

7.1 Travel Demand Model

77. The urban travel demand model commonly known as the "Four Step Method" was basically employed in the Study. For the modal split model, the model known as a "trip-end" model was employed. In Cartagena, the modal choice between private car and public bus is primarily determined by whether the passengers are car owners or not, and not by the travel time or cost.

7.2 Projection of Travel Demand

(1) Total Number of Trips

78. The total number of trips per day in the Study Area in 2010 is approximately 2.76 millions, of which 2.64 million trips, equivalent to 96% to the total, are made by residents within the Study Area, and 124 thousand trips (4%) are for persons who are outside of the Study Area. The trip increase ratio of the year 2010 to 1991 is approximately 2.1, in contrast to 1.8 of the population growth ratio. Summary of trip flows in 1991 and 2010 is shown in Figure 7.2-1, and summary of socioeconomic and travel demand is shown in Table 7.2-1.

Table 7.2-1 Summary of Socioeconomic and Travel Demand

Items	1991 Figures	Ratio	2010 Figures	Ratio	2010/1991
1) Population	660,200		1,200,000		1.82
2) Population (5 years above)	598,800		1,108,800		1.85
3) No. of Vehicles	22,718	1.00	90,870	1.00	4.00
- Car	16,944	0.75	67,460	0.74	3.98
- Taxi	2,872	0.13	8,420	0.09	2.93
- Truck	2,902	0.13	14,990	0.16	5.17
4) Cars/1000 population	25.66		56.22		2.19
5) No. of Trips (all)*	1,259,400	1.00	2,639,358	1.00	2.10
No. of Trips * (Car+Taxi+Bus)	1,227,247		2,473,413		2.02
- Car	145,769	0.12	525,914	0.20	3.61
- Bus	1,028,998	0.82	1,786,883	0.68	1.74
- Taxi	52,480	0.04	160,616	0.06	3.06
- Truck	32,153	0.02	165,945	0.06	5.16
6) Trips /Population (5 Years above) (Car+Taxi+Bus)	2.05		2.23		1.09

Note: * Unit of trips is person base, not vehicle base.
The figures are only trips within the Study Area.

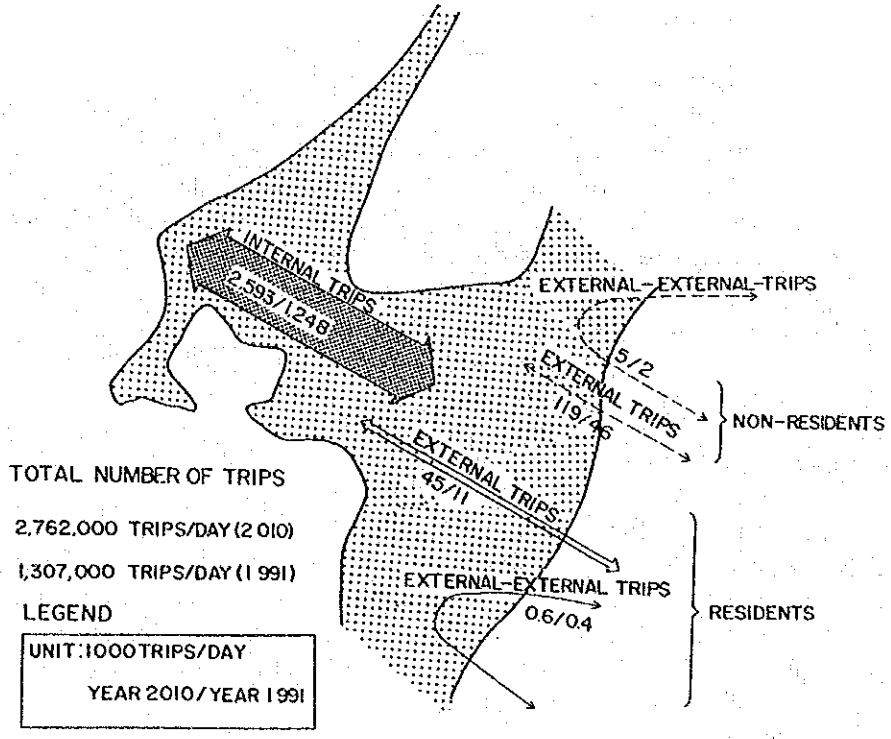


Figure 7.2-1 Summary of Trip Flow in 1991 and 2010

(2) Trip Generation and Attraction

79. Estimated trip generation and attraction in the year 2010 according to the integrated zone are shown in Figure 7.2-2 which shows the composition of each mode by zone. The detailed discussions are as follows;

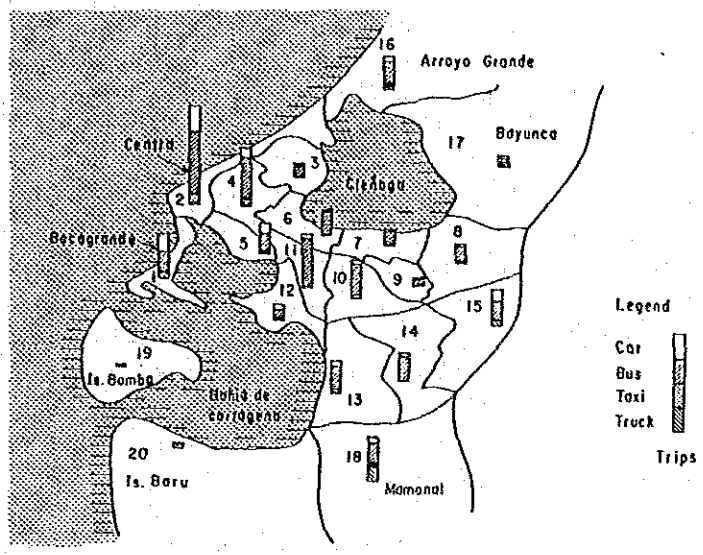
1) Car

80. As seen, the trip generation and attraction in 2010 in zone Nos.1, 2, 4 and 5 are heavy volume, maintaining the present trip pattern. The higher increase ratio of trip generation and attraction between 1991 and 2010 are in zone Nos.13, 18 and 15, i.e, the first two zones are in Mamonal industrial zones and the last is in the new development area.

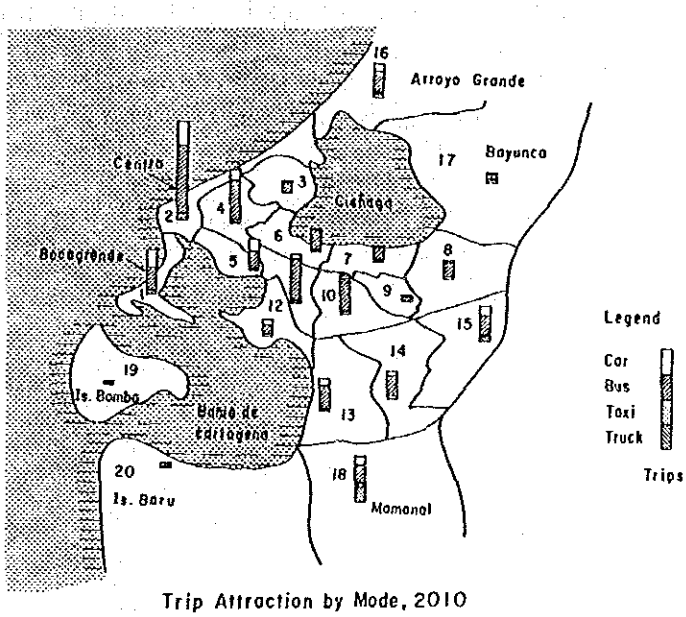
2) Bus

81. The future trip generation and attraction in zone Nos. 2, 4, 10 and 11 maintain heavy volume, and those places will play the same important role in public transportation as at present. The increase rate of trip generation and attraction

during two decades in zone Nos. 13, 15, 16 and 18 becomes high (2.0 times or more), while residential area (zone Nos. 6-12) is somewhat low (1.1-1.5 times). This tendency is related to the population growth for trip generation and to the employment growth for trip attraction, respectively.



Trip Generation by Mode, 2010



Trip Attraction by Mode, 2010

Figure 7.2-2 Trip Generation and Attraction by Zone in 2010

(3) Trip Distribution

82. Figure 7.2-3 illustrates the desire lines by car for interzonal trips in 2010. As seen, car heavy trip flows in 2010 are between Centro (Zone No.2) and its surrounding area (zone Nos.1,4 and 5), and between Centro and the future developed area in sub-urban (zone Nos. 13, 16 and 18). The former shows the same trip movement as that at the present, and the latter shows those corresponding to the traffic to generate/attract from/to the future large scale developed areas. This shows that in future car trip movement will widely extend to the whole Study Area with heavy traffic.

83. The desire lines in 2010 by public bus transportation are shown in Figure 7.2-4. The desire lines by bus also involve two trip patterns; one is the present trip pattern with more heavy traffic, and the other is new trip movements between Centro and sub-urban area (zone Nos.13, 16 and 18). In future, the strong desire lines by bus also widely extend to all the Study Area.

7.3 Traffic Demand on Present Network

84. Traffic assignment is made under the conditions on which the OD trips in 2010 loads on the present network to disclose traffic demand on major corridors. The traffic demand in 2010 is shown in Figure 7.3-1. In this figure, the traffic volume on each road is drawn by a narrow band whose width is proportional to the assigned traffic volume. The traffic volume-capacity ratio in 2010 is more than 1.5 on almost all the roads as represented with black line in the figure, while at the present no roads exceed 1.5. The future traffic conditions will be severe, if no improvement will be made for the transport network.

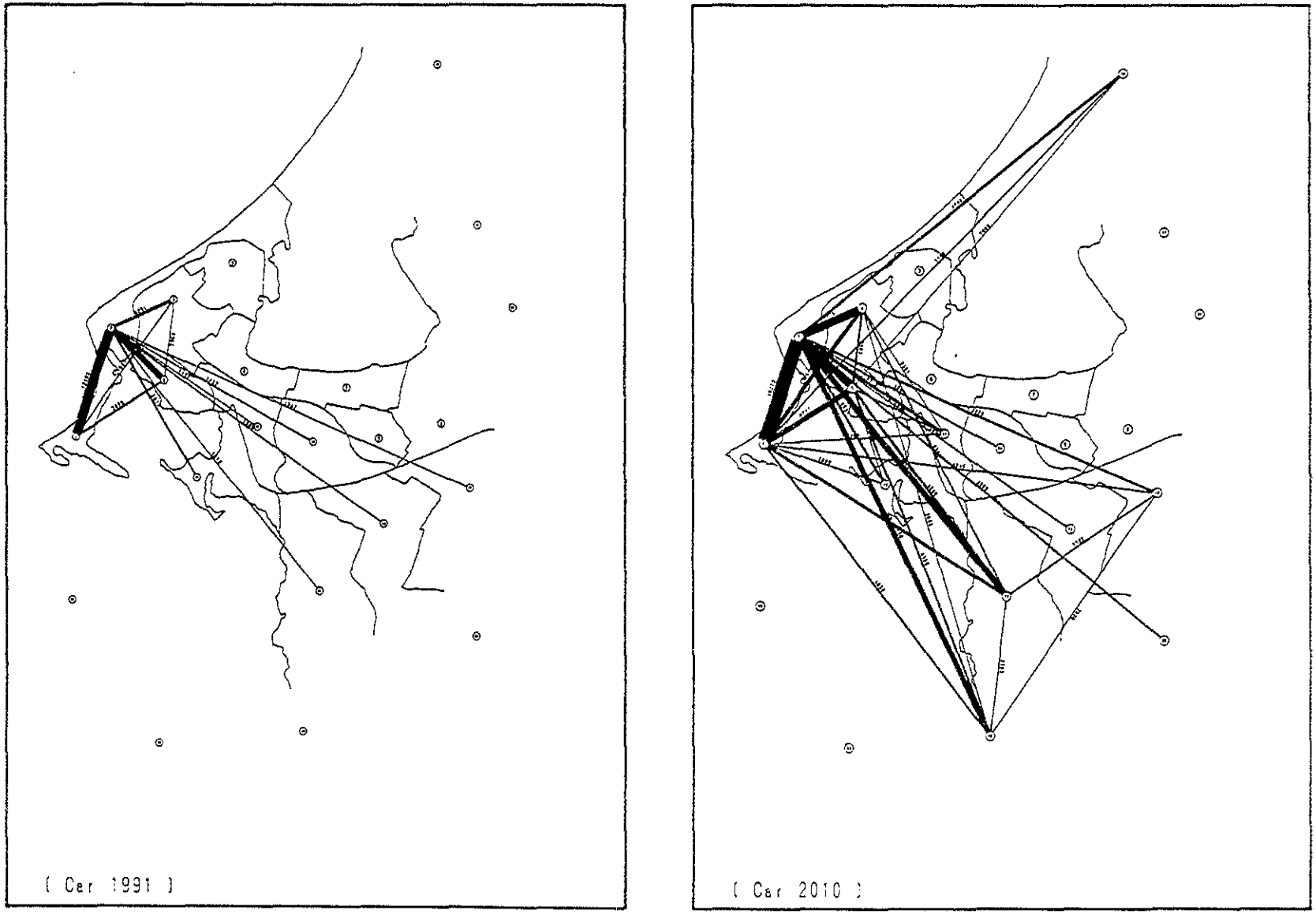


Figure 7.2-3 Car Trip Desire Lines in 1991 and 2010

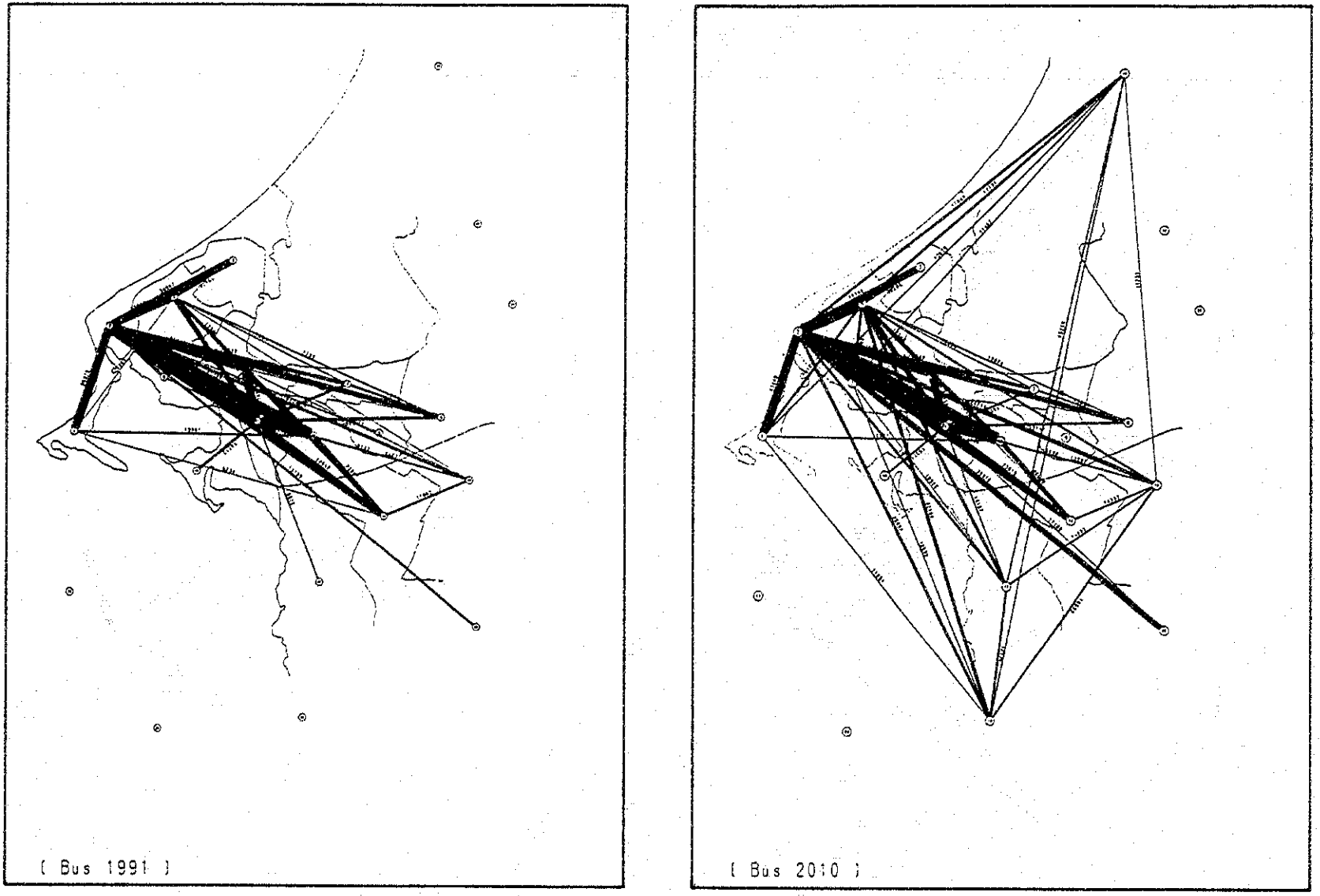


Figure 7.2-4 Bus Trip Desire Lines in 1991 and 2010

Figure 7.3-1 Traffic Demand in 2010 on the Present Network

8 URBAN TRANSPORT PLANNING POLICIES

8.1 Planning Policies

85. The following are the basic Policies for planning the urban transport network in Cartagena taking into consideration the existing and future socioeconomic and traffic/transport situation;

a. satisfaction of transport needs at present and in future,
b. effective use of existing facilities,
c. compatibility with future urban structure and land use plan,
d. equal access to transport services for the residents,
e. improvement of traffic safety,
f. saving of social transport cost, and
g. minimization of adverse effects on the environment.

8.2 Road Network System

86. The arterial and collector road networks in the urban area are shown in Figure 8.2-1. They will be necessary to be improved to satisfy the growing transport demand of the area. In addition to this, the local road network available for motor vehicles shall be established especially in the residential area.

8.3 Public Transportation System

87. The following basic polices for the improvement of public bus transportation are used;

1) in short term (public bus facilities improvement)

- construction of bus stop and bus terminal
- renewal of old bus vehicle
- designation of public bus arterial routes

2) in medium/long term (bus operation system improvement)

- introduction of trunk-feeder system
- construction of public bus trunk/feeder terminal

88. In regard to the water transport, operation possibility on several routes are examined from socioeconomic as well as financial view points. In order to confirm the inter-relationship with bus network, several transfer points are prepared for the passenger convenience.

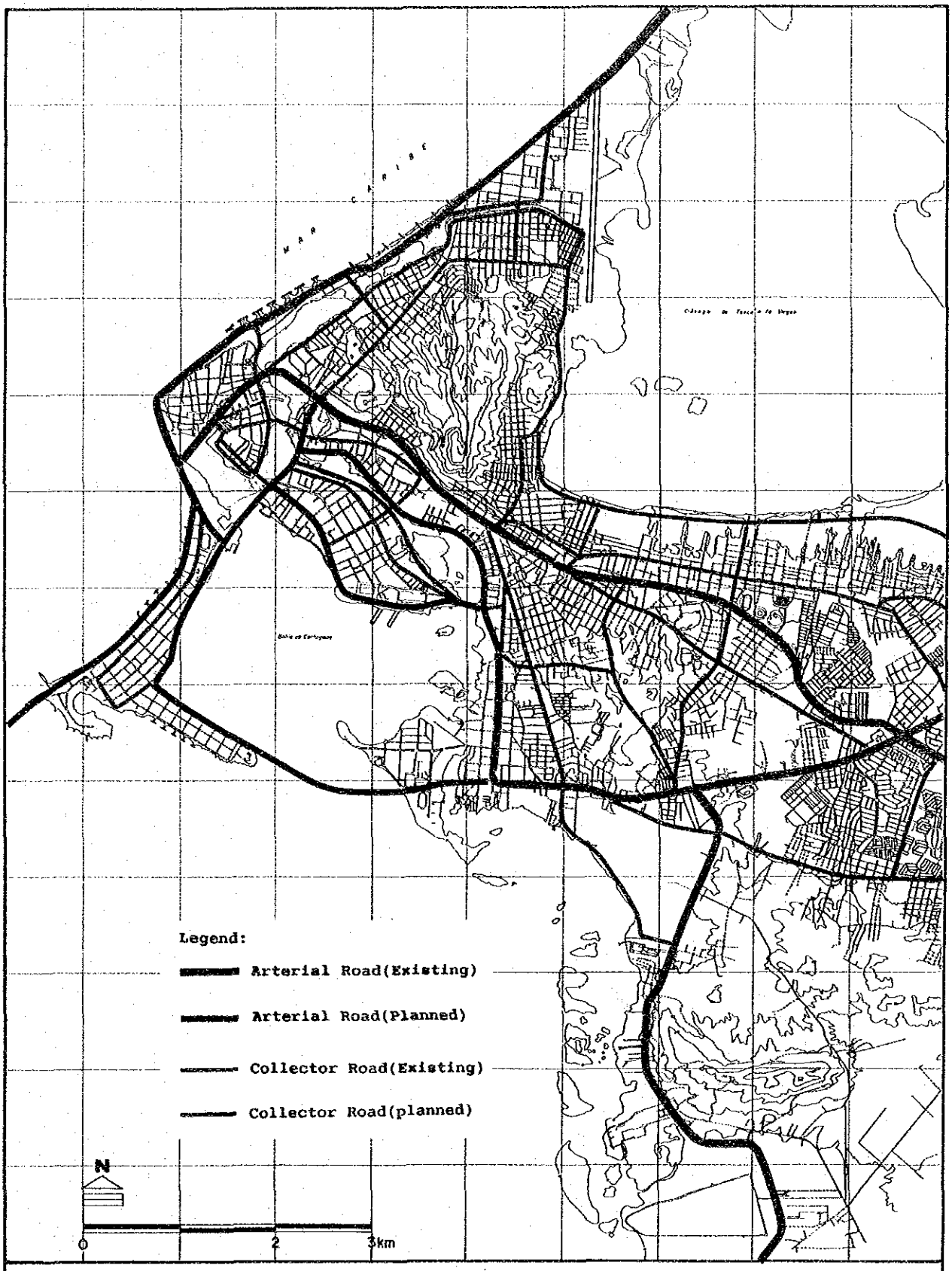


Figure 8.2-1 Future Road Network

8.4 Traffic Management

89. Taking into consideration the improvement progress of the road network and public bus transportation, the following countermeasures are examined;

a. classification of road network by function,
b. reassignment of one-way system,
c. assignment of public traffic arteries,
d. reevaluation of parking and stop regulation,
e. intersection improvement including signal installation, and
f. signal coordination.

8.5 Environmental Consideration

90. There are several limitations to carry out the detailed environmental assessment for the planned projects in this Study. However, it is possible to point out the areas and necessities for the environmental assessment for the project implementation.

91. The following items which seem to have potential environmental impacts on the planned projects shall be checked;

a. kind and degree of impact,
b. avoidable or not by alternative plan, and
c. necessity for detailed environmental study.

9 ROAD NETWORK PLAN

9.1 Long Term Plan

92. First of all, in the planning procedures, a long term plan was prepared to achieve the ideal road network to meet future land use plans, regardless as to whether road implementation is completed or not by the target year. The long term plan was made by reviewing the existing road network plan: "Plan De Desarrollo De Cartagena in 1987-2010" made in 1987 by the municipality of Cartagena, and by including the committed projects by EDURBE and Departamento Administrativo de Valorizacion Distrital.

93. Figure 9.1-1 shows the long term plan. The total project length is approximately 264 km in the Study Area, of which 157 km involve for new road construction, 90 km are for road improvement and 17 km are for bridge construction.

94. The demand-supply balance on the imaginary sections in this long term plan is shown in Table 9.1-1 which is compared to "Do-Nothing case". The demand and supply are well balanced in every direction under the long term plan.

Table 9.1-1 Traffic Volume and Volume-Capacity in Long Term Plan

No.	Section	Traffic Volume		Volume-Capacity	
		Do-Nothing	Full Net	Do-Nothing	Full Net
1	Bocagrande(1)	120,894	109,442	1.66	0.65
2	Bocagrande(2)	120,894	109,442	2.01	0.91
3	Centro	327,938	235,673	2.05	0.82
4	Screen Line	304,971	248,535	3.31	0.89
5	Industrial Area	134,272	97,843	1.75	0.87
6	Central/South Oriental	216,001	137,068	1.78	0.65
7	Boundary of Urban Area	119,375	72,036	3.73	0.66
8	Mamonal Industrial Area	151,710	73,404	9.48	1.02
9	North (Bayunca)	124,349	125,222	4.32	1.04
10	South-East (Turbaco)	37,891	144,526	2.37	0.86

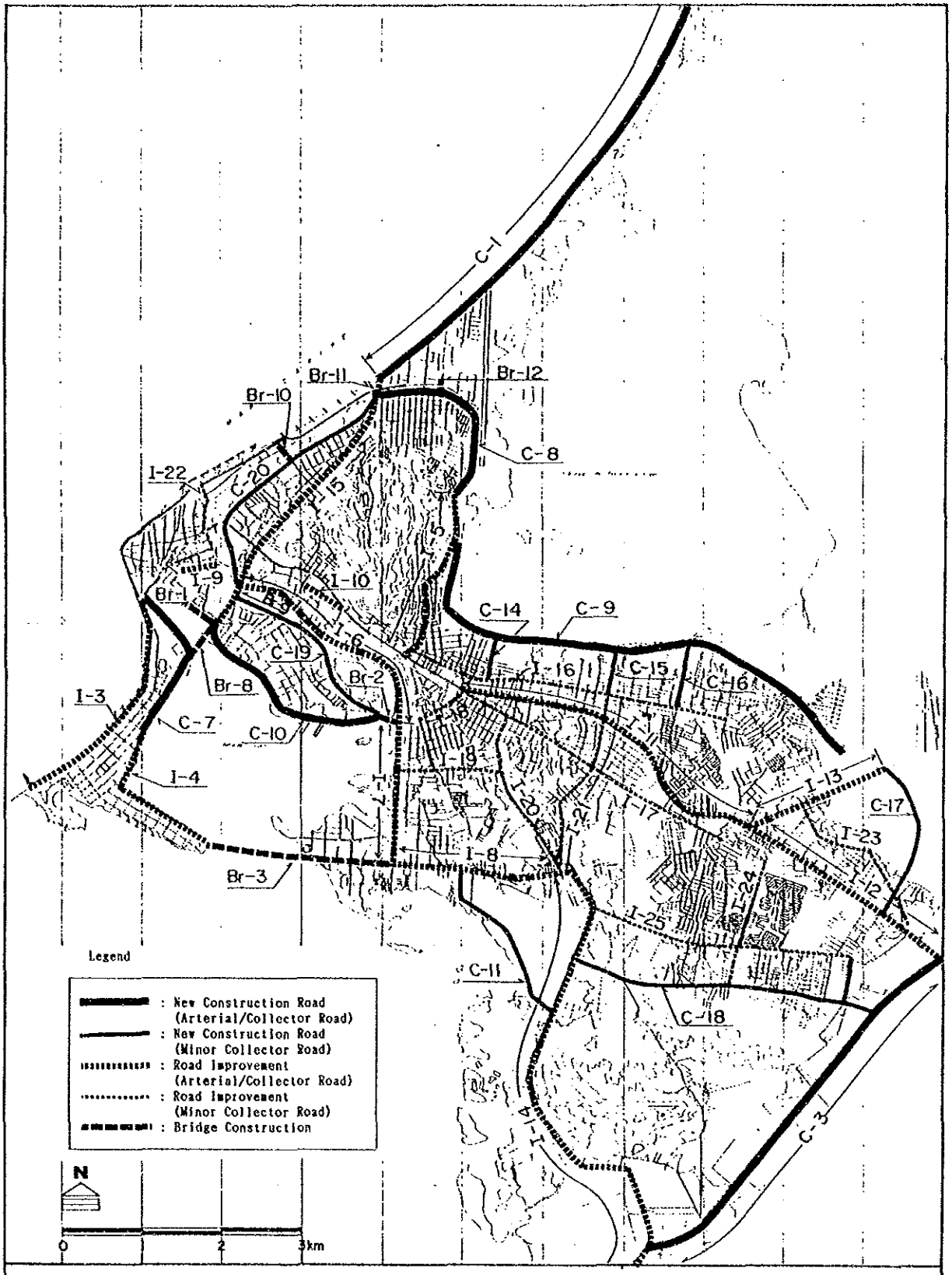


Figure 9.1-1 (1) The Long Term Road Plan in Cartagena (Urban Area)

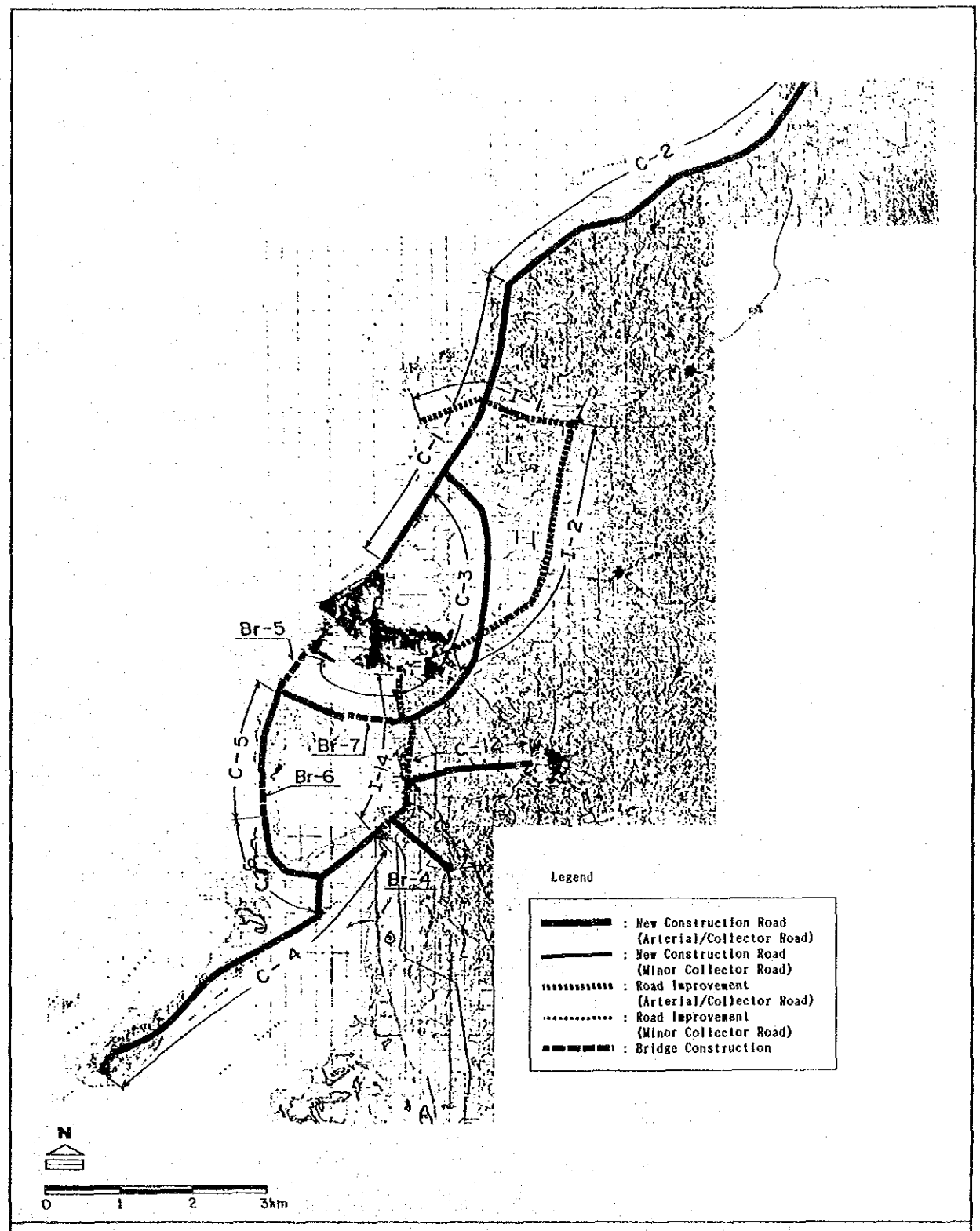


Figure 9.1-1(2) The Long Term Road Plan in Cartagena (Sub-Urban Area)

9.2 Road Masterplan in 2010

95. The road masterplan in the target year of 2010 was prepared incorporating those projects in the long term plan according to the results of the traffic assignment and economic evaluation. In order to select the most effective plan as "the road masterplan", five (5) alternatives of the road masterplan in 2010 were also made from the long term plan. From those alternatives, the road masterplan in 2010 was selected taking into consideration of traffic and economic aspects.

96. The planned total road length is approximately 211 km, of which 129 km (inclusive of 6 km for bridge construction) is for new road construction and 82 km is for road improvement. The ratio of project length in the masterplan to that in the long term plan will be about 80%. This is because new construction roads across the Baru and Tierra Bomba Islands are suspended.

97. The total construction cost for the Masterplan project is approximately 271 billion Pesos, of which 108 billion Pesos are for new road construction projects, 83 billion Pesos are for road improvement projects and the remaining 80 billion Pesos are for bridge construction cost.

98. Figure 9.2-1 shows the ratio of road length by level of the volume-capacity ratio according to four road/traffic conditions: a) 1991 road/traffic conditions, b) Do-nothing case (1991 network/2010 traffic conditions), c) the long term network/2010 traffic conditions and d) 2010 Masterplan network/2010 traffic conditions. The volume-capacity ratio is classified into 3 levels: less than 1.0, less than 1.5 and 1.5 or over. At the present 98% of the total length are less than 1.0 in the v/c ratio. In Do-nothing case the figure falls to 27%, while road sections with the v/c ratio 1.5 or over sharply rise at 57%. In the 2010 Masterplan, those levels will be close to the present conditions.

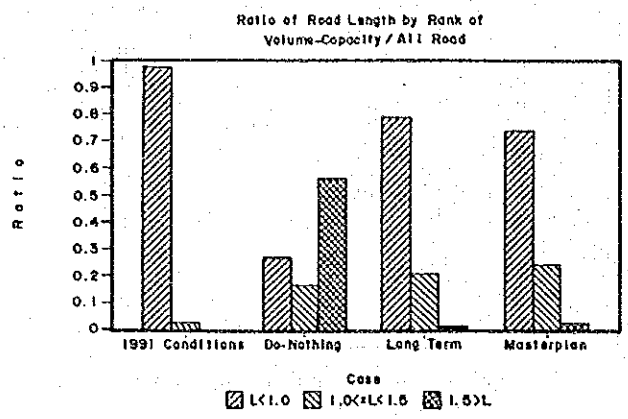


Figure 9.2-1 Ratio of Road Length by Volume-Capacity Ratio

9.3 Priority of Road Projects

99. There are many elements for determining the project priority. The elements chosen in the Study were classified into 3 categories:

1) Economic viability: B/C ratio,
2) Traffic aspect: Traffic volume, trip length, etc., and
3) Social conditions: Progress of planning, project consensus, etc.

The elements 1) and 2) are composed of tangible measures such as B/C ratio, traffic volume and trip length and 3) is for intangible.

100. Priority ranks for planned projects were determined by totaling above three (3) elements of which each measure by element is divided into 3 ranks: high, medium and low priorities, corresponding to criteria of ranking.

101. The project priority was conducted by group which is composed of area: urban or sub-urban area, and road function: arterial/collector or minor collector. It is because the projects on arterial road in urban area will only be chosen as high priority project if the criteria of ranks is not shifted corresponding to group. Therefore, in the Study four (4) groups were made as shown in Table 9.3-1. In this table, the bridge construction projects take one group because of the above reason.

Table 9.3-1 Grouping for Project Priority

Area	Road Function		Bridge Const.
	Traffic	Access	
Urban	Group-1	Group-2	Group-4
Sub-Urban	Group-3	-	Group-4

102. Table 9.3-2 shows the final priority rank of projects. The projects with Rank A on the arterial/collector roads (Group-1) are included C-9: Cienaga de la Virgen Road, C-10: Av.Miramar Road, I-6: Av. Jacobo del Valle, I-12: Amplicacion Troncal Sta.Lucia-Temera and I-14: Diagonal 30. Of these, the rank "A" projects evaluated from the Economic and Traffic elements are I-4, I-12 and I-14. The I-4 project is finally determined in rank "B" because of the ranks of adjacent projects: Rank "B" for Br-3 and "C" for Br-8. The C-7 project is evaluated in rank "C" because the planned road passes through the Navy base on which it

will be difficult to remove by the year 2000, though being evaluated in rank "B" in the first step.

103. As for the minor collectors (Group-2), C-14: Boston Road, C-15: Carrera 51, C-19: 5th Av.Manga and C-20: Chambacu Road are determined in rank "A" because the "Progress of Planning" measure participates in high rank due to the fact that these projects are now under study.

104. The C-1: Anillo Vial Road project priority in sub-urban road (Group-3) has high rank "A" in every element. This project is now under construction with 2 lanes. In this Study, however, 4 lane road but some section on 6 lanes is planned corresponding with assigned traffic volume.

105. As for priority rank for bridge construction projects (Group-4), Br-1: San Lorenzo Bridge and Br-2: Bazurto Bridge are in rank "A". Although Br-1 itself is in rank "B", this project is shifted to rank "A" corresponding with ranks of adjacent projects. Br-3: Manzanillo Bridge which is the most biggest project in the Study is evaluated in rank "B", of which the element for Traffic Aspect is in rank "A", and Economic Viability is in rank "C" due to the fact that project cost is big.

Table 9.3-2 Priority Rank of Projects

Priority Rank of Projects

Projec	Distance (km)	Project Cost (Mill. Ps$)	1) Econimic Factor	2) Traffic Factor: Traffic on Project	2) Traffic Factor: Traffic on Area	2) Traffic Factor: Estimate	3) Priority Rank 1)+2)	4) Social Factor: Progress of Planning	4) Social Factor: Difficulty of Consensus	4) Social Factor: Network Interaction	5) Final Rank	Project
1) Arterial/Collectors											1) Arterial/Collectors	
C-7	1.50	1,007	C	B	C	B	B		C		C	C-7
C-8	2.68	5,942	C	B	B	B	B				B	C-8
C-9	5.92	6,659	C	C	B	B	B	A			A	C-9
C-10	2.67	3,001	C	B	B	B	B	A			A	C-10
I-3	2.64	1,067	C	B	C	B	B				B	I-3
I-4	2.13	928	A	B	B	B	A			B	B	I-4
I-5	2.05	2,819	C	B	C	B	B				B	I-5
I-6	2.88	1,001	B	B	C	B	B	A			A	I-6
I-7	1.80	2,082	C	B	C	B	B				B	I-7
I-8	2.29	2,998	B	A	C	B	B				B	I-8
I-11	4.26	6,218	C	A	C	B	B				B	I-11
I-12	3.66	1,758	A	A	A	A	A				A	I-12
I-13	1.90	913	C	B	C	B	B				B	I-13
I-14	13.42	11,456	B	A	A	A	A				A	I-14
I-15	3.27	4,562	C	B	B	B	B				B	I-15
2) Minor Collectors											2) Minor Collectors	
C-11	2.19	2,258	A	A	A	A	A				A	C-11
C-14	0.53	678	C	C	C	C	C	A			A	C-14
C-15	0.58	691	C	C	C	C	C	A			A	C-15
C-16	0.89	1,254	C	C	C	C	C				C	C-16
C-18	1.55	1,039	C	C	C	C	C				C	C-18
C-19	2.25	5,053	C	B	C	B	B	A			A	C-19
C-20	3.50	5,550	B	C	A	B	B	A			A	C-20
I-16	4.21	4,370	A	B	B	B	A				A	I-16
I-17	3.85	6,005	C	C	C	C	C				C	I-17
I-18	0.65	915	C	A	C	B	B				B	I-18
I-19	1.25	1,090	B	B	C	B	B				B	I-19
I-20	2.32	2,109	C	C	C	C	C				C	I-20
I-21	2.13	2,676	A	C	C	C	B				B	I-21
I-22	0.62	535	C	C	C	C	C				C	I-22
I-23	2.16	1,080	A	B	C	B	A				A	I-23
I-24	1.69	928	B	B	C	B	B				B	I-24
I-25	3.38	3,355	B	C	C	C	B				B	I-25
3) Sub-Urban Roads											3) Sub-Urban Roads	
C-1	22.32	27,621	A	A	A	A	A	A			A	C-1
C-2	23.78	19,596	C	B	C	B	B				B	C-2
C-3	21.34	16,354	B	B	A	A	A				A	C-3
C-4	25.10	9,237	C	B	C	B	B				B	C-4
C-12	2.39	814	C	C	C	C	C				C	C-12
C-13	3.60	1,184	C	C	C	C	C				C	C-13
I-2	18.26	19,160	B	A	C	B	B				B	I-2
4) Bridge Construction											4) Bridge Construction	
Br-1	0.42	2,254	B	B	C	B	B			A	A	Br-1
Br-2	0.32	700	A	A	C	B	A				A	Br-2
Br-3	2.70	56,844	C	B	A	A	B				B	Br-3
Br-4	1.05	3,816	C	B	C	B	B				B	Br-4
Br-8	0.60	10,602	C	B	A	A	B		C		C	Br-8
Br-9	0.21	1,192	B	B	C	B	B				B	Br-9
Br-10	0.32	1,319	C	B	C	B	B				B	Br-10
Br-11	0.10	1,319	C	B	C	B	B				B	Br-11
Br-12	0.10	1,319	C	A	B	A	B				B	Br-12
Br-13	0.60	700	C	B	C	B	B				B	Br-13

10 PUBLIC BUS TRANSPORTATION PLAN

10.1 Future Bus Operation System

(1) Basic Policy for Improvement

1) Medium/Long Term Plan

106. The problems of the current bus operation system are;

a. Every bus operation has feeder/collector and trunk operation functions,
b. Route length tend to become longer, and
c. Vehicle capacity is little due to the road condition.

107. Current operation system is forecasted to become difficult in operational condition as well as in financial condition in future, which in turn will bring to the passengers a lower service level than ever (refer to Table 10.1-1).

Table 10.1-1 Operational Data of Public Bus Transport by Current Public Bus Operation System

	1991	2010
Public Bus Passenger Demand	1,016,248	1,774,263
Passenger Number Transported	1,190,810	2,354,550
Transfer Passenger Number	174,562	580,287
Bus Operation Kilometer/Day	297,575	610,311
Number of Bus Operation/Day	12,658	24,367
Number of Bus Vehicle	1,339	2,684
Bus operation No. at Mercado Bazurto at Peak Hour	440-470	880-940

note: only in urban area operation
source: Study Team

108. In order to improve these problems, the following measures are considered;

a. division of the operational functions: trunk service and feeder service,
b. setting the short route length, and
c. selection of capacity suitable for operation area.

109. It seems that trunk-feeder bus system is optimum urban mass transportation system in medium size city of 1 million population like Cartagena to serve amount public passenger trip demand. Introduction of railway or subway system to the same sized cities is forced large amount investment and is severe in financial evaluation. In the Study, trunk-feeder bus system is

examined by using computer simulation model.

2) Short Term Plan

110. Improvement concentrates in bus facilities plan and operation management plan, as explained in Chapter 8.

(2) Trunk-Feeder Bus System

111. The new bus network plan aims to improve wasteful competition of the present bus routes on the same road section. The major point of improvement is a division of route function. The routes are classified into a trunk route and a feeder route where at present, each bus route has both of those functions.

112. The trunk bus routes are assigned on the trunk bus passenger corridors connecting with the major bus terminals. Between these major terminals the large capacity buses are operated frequently. In future the capacity of bus is to be about 80 passengers. The major terminals are expected to be facilitated at, for example, Centro (India Catalina), Mercado Bazurto, Inter-municipal bus terminal and Mamonal.

113. The feeder bus routes are assigned on the secondary roads (collector roads) which serve in residential area. These feeder buses collect passengers in the residential area and transfer the passengers to the trunk buses.

114. The major points to be improved by this plan are as follows;

a. For operational side:
- The cost of operation will decrease.
- The occupancy rate will increase.

b. For bus passenger side:
- The fare level is expected to be lower.
- The travel time will be decreased.
- The service level will be improved.

(3) Evaluation of Trunk-feeder System

115. Table 10.1-2 shows the comparison of two bus operation system (Network A: Present network and Network B: Trunk-Feeder System on present road network) in urban area on the assignment of the 1991 OD trips excluding the passengers and buses from outside area. Following points are indicated as the favorable aspects by trunk-feeder bus system;

a. Bus vehicles * km reduction ..... 21 %
b. Total bus vehicles reduction ..... 11 %
c. Passengers * time reduction ..... 8 %
d. Bus operation frequency increase ... 54 %

Table 10.1-2 Comparison of Urban Bus Operation Data (1991 Year OD Trips)

	Network A	Network B	B/A
Total Passenger OD	1,016,248	1,016,248	1.00
No. of Passenger	1,190,810	1,567,535	1.32
Total Passenger*km	5,979,623	5,731,349	0.96
Number of Transfer	174,375	551,287	3.16
Peak Hour Operation	994	1,534	1.54
Operation per Day	12,658	19,181	1.52
Average Passenger per Bus	94.1	81.7	0.87
Bus Vehicle*km	297,575	234,586	0.79
No. of Vehicles	1,339	1,196	0.89
No. of BUS	887	750	0.85
No. of BUSETA	452	449	0.99
BUS Vehicle*km	184,235	166,885	0.91
BUSETA Vehicle*km	113,340	67,701	0.60
Average Occupancy	19.6	24.4	1.24

(4) Future Bus Operation System

116. In order to evaluate the optimum bus operation system in future, four (4) bus operation alternatives were made. Among from those alternatives, Alternative C (see Figure 10.1-1) is chosen as a recommended plan by comparing bus operation indices obtained from the bus simulation model.

10.2 Public Bus Operation

(1) Trunk-Feeder Bus Operation System

117. The trunk route should be operated by a large capacity bus, such as about 80 passengers or more. This capacity will be introduced by standing passenger type bus or the articulated bus. These large type buses will serve at high frequency on this trunk bus routes.

118. Trunk bus routes are formed by connecting the major bus terminals. The operational variation will be necessary. That is, one is express type directly connecting between the terminals, and another one is local type stopping at each bus stop on trunk route.

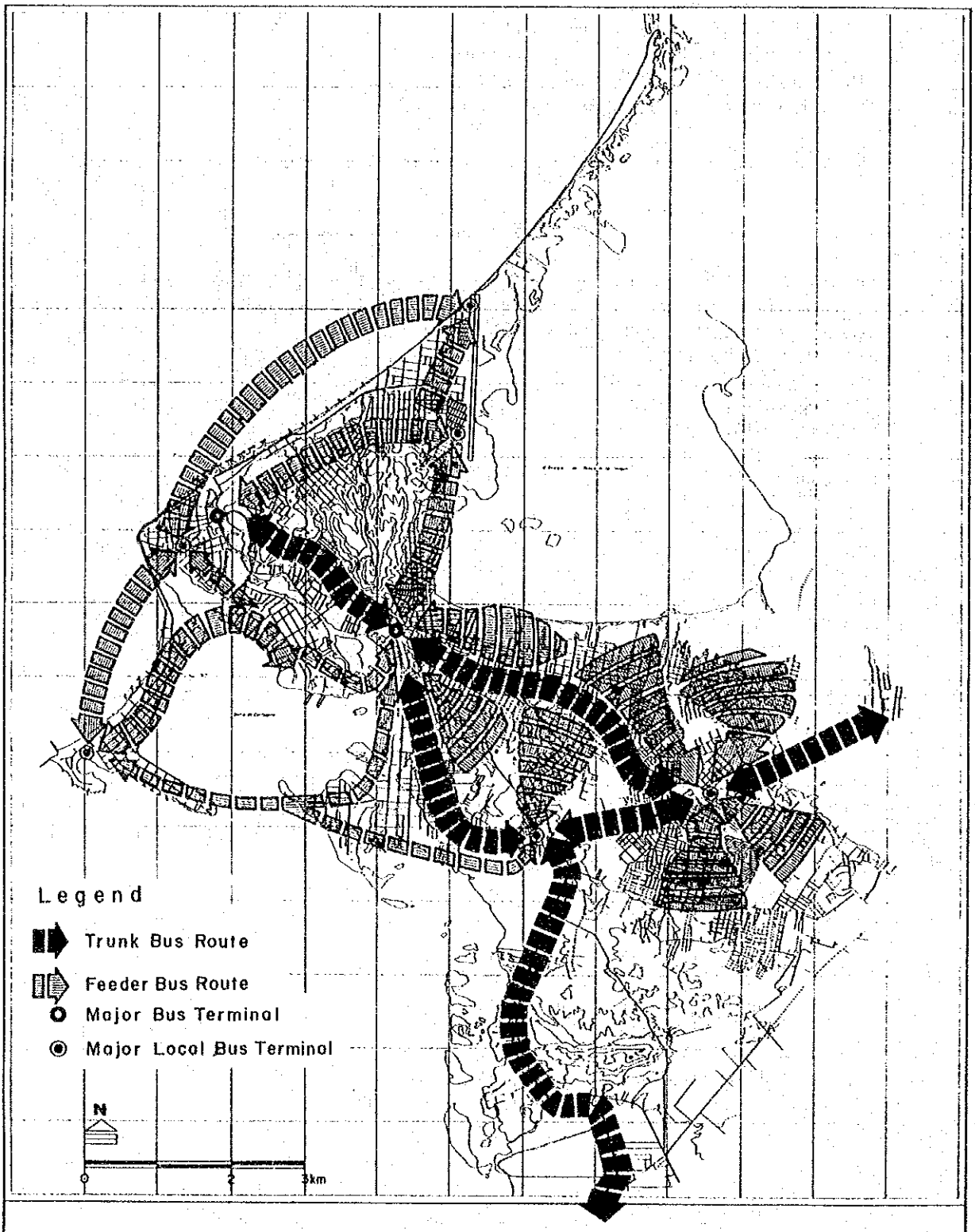


Figure 10.1-1 Bus Network Alternative C

119. Feeder bus is to collect the passengers in the residential area and transfer those passengers to trunk routes at the major terminals. Thus feeder bus is operated by smaller buses such as BUSETA in its short bus route. Due to this short length of feeder bus route, the frequency can be kept high and bus vehicle*km does not increase appreciably.

(2) Bus Stop

120. The bus operation in future should fundamentally be based on the bus stop system. At present, passengers can ride on/off the bus anywhere along the road. This seems to be a convenient system for passengers, but it gives reverse effect for the smooth traffic flow and traffic safety. Therefore, from an overall point of view, passengers do not receive much benefit from this free ride system.

(3) Bus Priority Lane and Bus Exclusive Lane

121. Bus exclusive lane is so much effective for the bus operation with high frequency. It can be introduced in case the road has enough capacity for the traffic volume. From view point of the trunk bus route operation, it is better to have a bus exclusive lane system. This possibility depends upon the improvement of arterial road network in future. The proposed road sections of the bus exclusive lane are as follows;

a. Av. Pedro Heredia; India Catalina- Bomba del Amparo
b. Via de la Cordialidad Transversal 54; Bomba del Amparo - Inter departmental bus terminal
c. New road along the Cano de Bazurto; Pie del Cerro - Pie de la Popa - Mercado Bazurto

(4) Fare System

122. Trunk/Feeder Bus System is based on the free transfer at the terminal. Therefore, the fare system is better if kept uniform same as the present fare system. Ticket system will provide easier operation for these functions.

(5) Bus Fleet

123. For the trunk route large size bus vehicles are used to improve the efficiency of operation. Articulated bus is a alternative for this type of vehicle. For the feeder route current vehicle types of bus and buseta are available depending on the road condition.

(6) The Organization for Trunk-Feeder Bus System

124. In order to provide the operation and tariff system in trunk-feeder bus system, a new organization should be established.

10.3 Public Bus Facilities

125. The major terminals of the trunk bus routes are planned at the end of the routes. These are as follows;

a. India Catalina in Centro area
b. Mercado Bazurto
c. Inter-Departamental Bus Terminal
d. Mamonal area

10.4 Financial Condition of Trunk-Feeder Bus Operation

126. Using the result of trunk-feeder bus operation system, the financial condition of the operation in 2010 is analyzed. Total system indicates the enough managerial index, however, some of the routes especially in trunk routes show low managerial index less than 1.0 due to the free transfer system. This represents the necessity to establish the organization for the trunk-feeder bus operation system as to the coordination on operational aspects as well as financial one.

10.5 Short Term Improvement Plan

(1) Facility Plan

127. The construction of bus stops and bus terminals is the first step for the improvement of current bus operation problems. Renewal of bus vehicles of old age is also required through the DATT's guidance.

(2) Operational/Institutional Improvement Plan

1) Determination System of Public Bus Fare

128. DATT has a standard calculation formula for fare level estimation. This is the same formula as described in Chapter 4, section 4.1 (9). If the data used in this formula are correct, the fare level estimated is considered to be the reasonable one for the basis to negotiate and determine the public bus tariff system in Cartagena. In order to get the leading position to determine the public bus tariff system, DATT has to publish her firm attitude for this matter and to investigate the latest and correct data for the estimation of the tariff system.

2) Aged Vehicle Control

129. There are many aged public bus vehicles in use. Based on the INTRA data, some 40 per cent of BUS is older than 20 years and some 20 per cent of BUSETA older than 15 years. It is not generally recommendable to use such aged vehicle for public transportation because of the lower operational efficiency, worse exhaust quality and lesser passenger accommodation.

130. However, it is very difficult to stop these vehicle use immediately from now on. DATT shall make a legal guideline for this matter taking into consideration the passenger service quality as well as the tariff determination system. Through yearly vehicle inspection and licensing system, DATT will able to improve the vehicle condition of public bus transport.

11 WATER TRANSPORT

11.1 Network and Service Area

131. Figure 11.1-1 shows the service network at 2010, which includes the introduction of Mamonal route and the extension of Canal route from San Pedro to Olaya Herrera into the preliminary network of water transport in 1995.

1) Route No.101, Bay Area Route
2) Route No.102, Centro Route
3) Route No.103, Canal Route
4) Route No.104, Mamonal Route

11.2 Demand Forecast

(1) Service Network without Bus Service Improvement

132. Table 11.2-1 shows the result of computer simulation for the water transport traffic demand in 1991 and 2010. Public bus network in 2010 is assumed as those by current operation system with additional introduction of several new routes on the roads implemented and the operation of Mamonal route and Canal route extension is assumed.

Table 11.2-1 Water Transport Traffic Demand

	1991	2010	2010/1991
Passenger Od Volume between DIA only	33,076	60,128	1.82
Potential Demand (under condition of T >= 0)			
Boat only	28,499	124,637	4.37
Boat + Bus	14,313	47,237	3.30
Total	42,812	171,874	4.01
Demand diverted to Boat			
Boat only	15,815	58,132	3.68
Boat + Bus	4,822	19,239	3.99
Total	20,637	77,371	3.75

(2) Service Network with Bus Operation System Improvement

133. Using the 1991 and 2010 public passenger ODs and water transport network with Mamonal route and Canal route extension in 2010, water transport demand was analyzed. In this case, public bus network in 2010 was supposed as those of trunk-feeder system. The result is shown in Table 11.2-2.

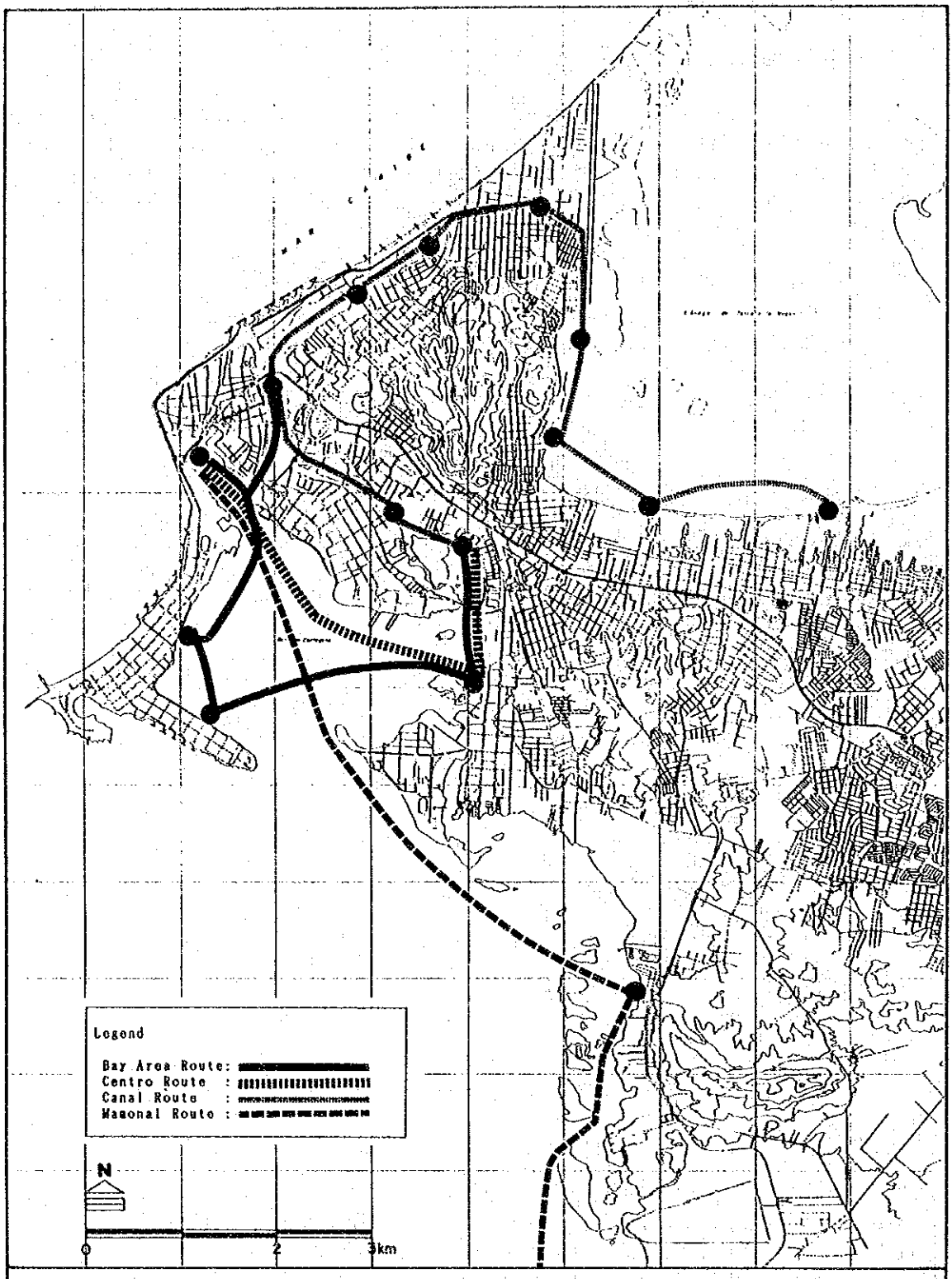


Figure 11.1-1 Service Network in 2010

Table 11.2-2 Water Transport Traffic Demand

	1991	2010	2010/1991
Passenger Od Volume between DIA only	33,076	60,128	1.82
Potential Demand (under condition of T >= 0)			
Boat only	28,499	83,618	2.93
Boat + Bus	14,313	1,684	0.11
Total	42,812	85,302	1.95
Demand diverted to Boat			
Boat only	15,815	38,419	2.43
Boat + Bus	4,822	688	0.14
Total	20,637	39,107	1.87

134. The comparison between the results of Table 11.2-1 and Table 11.2-2 indicates;

a. Demand for water transport is depend on the progress of the improvement of road network and public bus operation.
b. Water transport demand will increase from 39 thousand to 77 thousand when no improvement of bus operation system.
c. If without any improvement on road network and bus operation, computer simulation indicates the demand for water transport will be about 134 thousand trips per day.

11.3 Selection of Boat Dimension

135. Tables 11.3-1 and 11.3-2 show the results of boat size for each route.

Table 11.3-1 Boat Size for Canal Route Operation

Boat Type	Catamaran	Catamaran
Passenger Capacity	75	100
Overall Length	15.8 m	19.1 m
Breath Maximum	5.8 m	5.8 m
Depth	1.46m	1.54m
Waterline Length	14.5 m	17.8 m
Operation Speed	7.6 kt	8.4 kt
Engine Power	111 ps	102 ps
Boat Cost(million $)	117.6	154.2

source: Study Team

Table 11.3-2 Boat Size for Bay Area Route and Centro Route

Boat Type	Catamaran	Catamaran
Passenger Capacity	100	200
Overall Length	19.1	33.0 m
Breath Maximum	5.8 m	5.8 m
Operation Speed	20 kt	20 kt
Engine Power	711 ps	895 ps
Boat Cost (Million $)	248.6	498.7

11.4 Operation System

136. From the demand analysis, the daily maximum passenger number of each route section is given. Assuming peak hour ratio of 8 %, the operation frequency and necessary boat number is estimated as shown in Table 11.4-1 (Demand in 1991 is employed).

Table 11.4-1 Operation Frequency and Boat Number Required

Route No.	101		102		103	
Max. Psn Demand	3,580		2,478		4,185	
Peak Psn Demand	286		198		335	
Boat Capacity	200	100	200	100	100	75
Frequency/hour	1.4	2.9	1.0	2.0	3.3	4.5
Max. Transfer Time (minute)	43	21	60	30	19	14
Round Trip Length (k.mile)	11.17		8.40		13.49	
Average Operation Speed (kt)	14	14	14	14	7	7
Round Trip Time (minute)	48		36		116	
Operation Frequency/hour	2	3	1	2	4	5
Revised frequency	2	3	2	2	4	5
Frequency/day	30	38	30	30	50	62
Boat Number	2	3	2	2	7	9

source: Study Team
note: Based on the demand forecast in 1991.

11.5 Evaluation of Water Transport Project

137. Financial evaluation is made on the water transport project from the viewpoint whether the project is profitable enough to attract private enterprises to this business, because EDURBE has a basic policy that boat operation shall be managed by private sector, while infrastructure such as canals and termi-

nals be developed by public sector. For this reason, public investment is excluded from this analysis.

1) Boat Operating Cost

138. As for the boat types previously selected, their specifications, prices, annual operating distances and operation hours are summarized as shown in Table 11.5-1. Based on these assumptions, boat operating costs are estimated as shown in Table 11.5-2.

Table 11.5-1 Characteristics of Recommendable Boat

Characteristcs	unit	High Speed Boat		Low Speed Boat	
		Boat A	Boat B	Boat C	Boat D
1 Capacity	Person	200	100	100	75
2 Maximum Speed	Knot	20	20	8.6	7.4
3 Engine Power	PS	895	711	102	111
4 Cost					
Hull	mill. $	363.6	141.2	138.8	100.8
Engine	mill. $	135.1	107.4	15.4	16.8
Total	mill. $	498.7	248.6	154.2	117.6
5 Operater					
Captain	Person	1	1	1	1
Mate	Person	1	1	1	1
Crew	Person	2	2	2	1
6 Cruising Distance	N.mile/yr	50,000	50,000	30,000	30,000
7 Operating Hour	Hours/yr	4,500	4,500	4,500	4,500

Table 11.5-2 Boat Operating Cost

(at 1992 price)

Characteristcs	unit	High Speed Boat		Low Speed Boat	
		Boat A	Boat B	Boat C	Boat D
1 Variable Cost					
1) Fuel	$/N.mile	953	757	253	320
2) Oil	$/N.mile	18	14	2	2
3) Maintenance	$/N.mile	499	249	257	196
Total	$/N.mile	1,470	1,020	512	518
2 Fixed Cost					
4) Depreciation	1,000$/Yr	33,247	16,573	10,280	7,840
5) Interest	1,000$/Yr	299,220	149,160	92,520	70,560
6) Personnel	1,000$/Yr	27,600	27,600	27,600	24,000
7) Overhead	1,000$/Yr	21,677	12,217	7,287	5,897
Total	1,000$/Yr	381,744	205,550	137,687	108,297

139. Using the annual operating mileage assumed in Table 11.5-1, total daily operating cost of each boat is estimated as shown in Table 11.5-3. As seen, it is difficult for every case to recover the cost by tariff revenue. Of those cases, Type A (with 200 passengers of capacity) in the high speed boat and for the low speed, Type C (with 100 passengers) take advantage in the cost recovery relatively. Therefore, these types are taken in the following discussion.

Table 11.5-3 Comparison of Daily Cost and Necessary Passengers

(at 1992 price)

Item	unit	High Speed Boat		Low Speed Boat	
		Boat A	Boat B	Boat C	Boat D
1 Operating Cost	1000$/day	1,247	703	419	339
2 Needed Passengers	Person	10,393	5,857	3,494	2,827
3 Seat Turnover	Times/day	52	59	35	38

2) Economic Comparison of Routes

140. Financial conditions of planned three routes are compared based on the demand forecast results. Route 101 and 102 are operated by Type A boats and route 103 by Type C boat. The results of analysis are shown in Table 11.5-4. The transport costs per passenger of routes 101, 102 and 103 are $277, $446 and $317, respectively, all of which exceed each revenue significantly. As a result, the revenue cannot cover even one half the cost of every route. In particular, route 102 shows very low performance.

141. It is recognized that to improve the financial conditions, the tariff rate and the interest rate of capital opportunity cost are the most dominant factors. Changing these rates, the equilibrium points are searched as shown in Figure 11.5-1, which reveals that to make interest zero or to raise the tariff up to $330 will be needed to recover the cost, as long as the tariff raising does not affect the demand.

Table 11.5-4 Route-wise Evaluation of Water Transport Project

Item / Route	unit	Route 101	Route 102	Route 103
1 Route				
1) Route Length (One way)	N.mile	5.59	4.20	3.80
2) No. of Station	station	5	6	5
2 Vessel				
1) Type		Boat-A	Boat-A	Boat-C
2) Capacity	person	200	200	100
3) Speed Maximum	knot	20	20	8.6
Average	knot	14	14	7
4) Operating Cost				
Variable Cost	$/N.mile	1,470	1,470	512
Fixed Cost	1,000$/yr	381,744	381,744	137,687
3 Operation				
1) Operating Hours	Hours/day	15	15	15
2) No. of Round Trip	r.trp/day	30	30	50
3) No. of Boat assigned	boat	2	2	7
4) Tariff	$/ride	120	120	120
4 Demand and Revenue				
1) No. of Passenger in 1991	person	9319	5517	8939
2) Revenue	1,000$	1118	662	1073
5 Evaluation				
1) Daily Operating Cost	1,000$	2584	2462	2835
2) Transp.Cost/Passenger	$/pax	277	446	317
3) Profit or Loss	1,000/day	-1466	-1800	-1762
4) Capital Recovery Factor	%	43	27	38

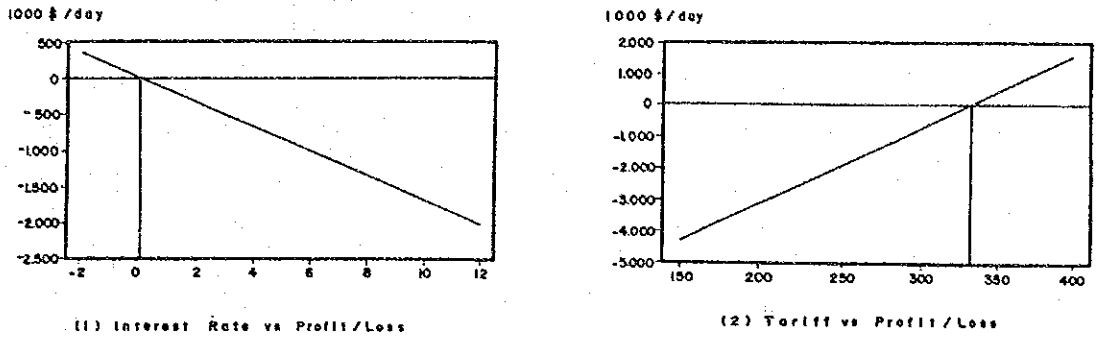


Figure 11.5-1 Sensitivity of Interest Rate and Tariff to Profit/Loss

12 TRAFFIC MANAGEMENT PLAN

12.1 Improvement Plan of Existing Facilities

(1) Traffic Flow Plan

142. In short term stage, traffic flow plan concentrates into the section between Castillo San Felipe and India Catalina of Av. Pedro Heredia. Alternative plan involves the following changes;

a. left turn restriction of north bound on Cra.17 at intersection of Castillo San Felipe,
b. two-way system on Cra.11

143. Alternative plan intends to improve the traffic flow efficiency at intersection of San Felipe, mainly for the traffic flow of Cra. 17 (north and south bounds) by changing the phase number from three (3) to two (2) and extending the green time for such flows. The left turn flow shifts to the intersection of India Catalina.

144. Table 12.1-1 indicates the total vehicle.kilometers and vehicle.hours at each alternative case, based on the computer simulation of the traffic flow using traffic ODs at 1991 and 1995.

Table 12.1-1 Comparison of Veh*km and Veh*hr (per day)

	Veh*km		Veh*hr	
Year	1991	1995	1991	1995
Current System	1,368,313	1,840,851	30,865	51,136
Alternative (A)	1,362,289	1,836,268	30,163	52,013
Alternative (B)	1,362,565	1,834,399	30,081	51,510
Difference (A)	6,024	4,583	702	- 877
Difference (B)	5,748	6,452	784	- 374

note: Alternative (A); Roman Bridge is assumed 2 lanes.
Alternative (B); Roman Bridge is assumed 4 lanes.

(2) Curb Parking Restriction

145. Curb parking restriction shall be enforced on the arterial and collector roads in urban area at least (refer to Figure 12.1-1).

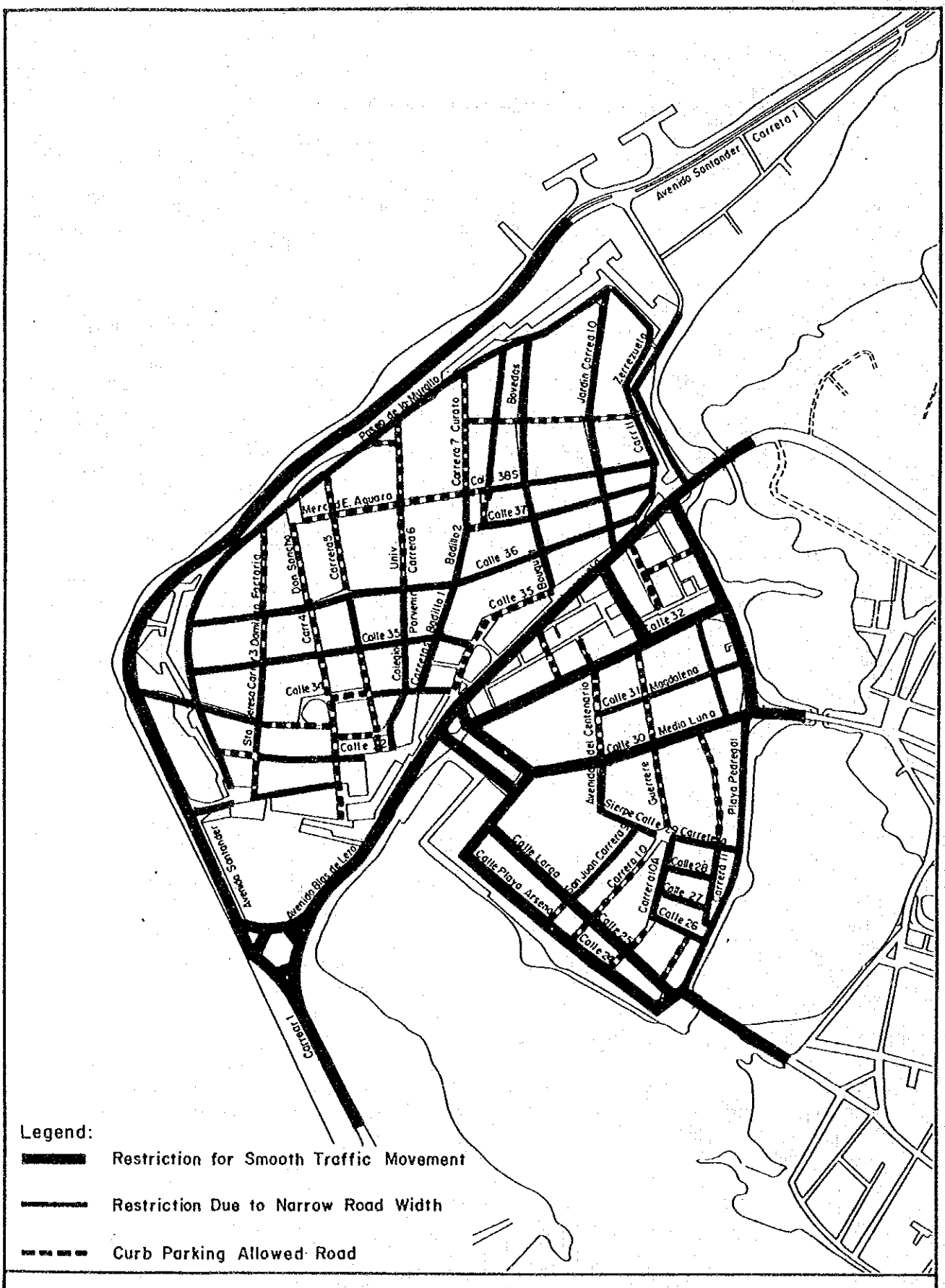


Figure 12.1-1 Curb Parking Restriction Plan (Central Area)

(3) Existing Traffic Signal Improvement

146. It does not necessarily follow that when traffic volume exceeds the traffic capacity of the intersection, traffic congestion would become serious. However, to improve the signal phases and/or green time ratio is very useful to utilize the existing traffic facilities more efficiently. The improved traffic signals are shown in Figure 12.1-2.

1) intersections with 4 phases signal
   a. Intersection No. 13
   b. Intersection No.20
   c. Intersection No.21

2) intersections of 3 phases signal
   d. Intersection No.7
   e. Intersection No.15
   f. Intersection No.16

3) Installation of Traffic Signal
   a. intersection of Av. Santander and Av. Blas de Lezo
   b. intersection of Av. Pedro de Heredia and Cra. 11
   c. intersection of Av. Pedro de Heredia and Carretera Troncal

12.2 Future Traffic Improvement Plan

147. Following are the major issues to be considered in the future traffic management plan;

a. classification of road function,
b. public bus exclusive lane on public arterials,
c. parking restriction and curb parking spaces,
d. traffic signal system development, and
e. pedestrians' traffic facilities.

(1) Traffic Signal Development Plan

148. A rough standard of traffic volume for the establishment of traffic signal is shown in Table 12.2-1.

Table 12.2-1 Traffic Volume for Traffic Signal Establishment

	Traffic Volume
Major Approach	> 600
Minor Approach	> 200
Left Turn Veh. Ratio	> 0.25

unit: vehicle/hour/lane

149. Signal system improvement shall be carried out based on the following steps;

a. 1st step: installation of signals (refer to Figure 12.2-1),
b. 2nd step: group control of signals, and
c. 3rd step: centralization of signal control.

Figure 12.2-1 shows the installation plan of traffic signal in 2010.

(2) Parking Plan in Central Area

150. There is an idea to restrict all the vehicles from entering into the Central area from view point of the conservation of historical and cultural monuments of the Area. The complete and immediate implementation of this idea is impossible due to the concentration of urban functions in the Area and socioeconomic losses caused within this Masterplan period.

151. However, it is necessary to restrict the increase of vehicle entering into the Area by diversification of urban functions of the Area, road network improvement and parking restriction for preserving the precious monuments for the future of Cartagena.

152. In case of cars, an imbalance for curb parking capacity in Central Area will become 13 thousands per day in 2010, if remaining at the same level as the present. About one (1) thousand parking spaces are totally required outside the Central Area, no matter what in future the parking facilities and restriction in the Central Area are planned and introduced. The planning locations are at the following points;

a. Chambacu area,
b. Cabrero, and
c. Tourist terminal area.

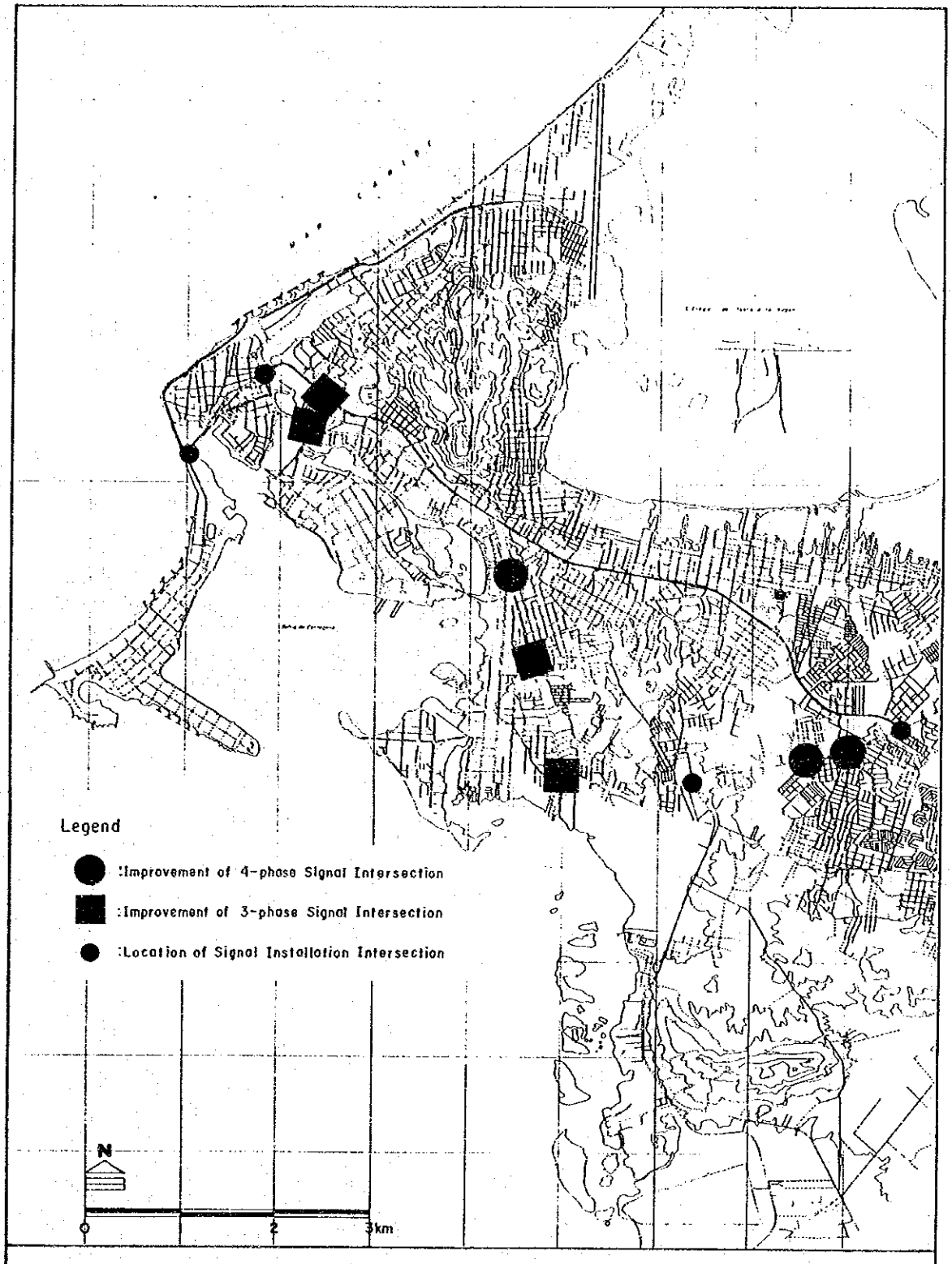


Figure 12.1-2 Existing Traffic Signal Improvement Plan

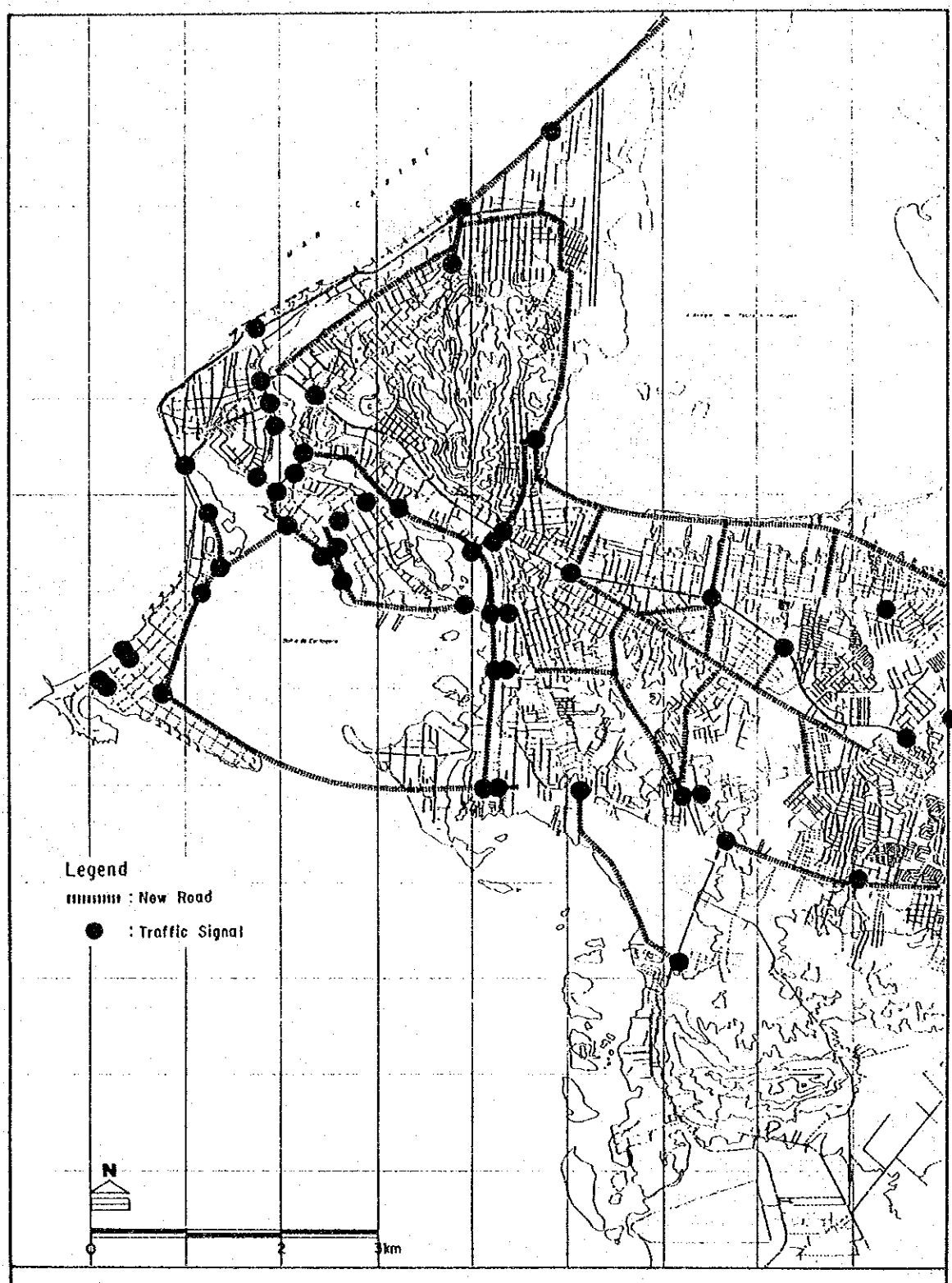


Figure 12.2-1 Traffic Signal Installation Plan

153. As for the curb parking, the introduction of charged parking system will become the useful tool for the restriction of vehicle entrance into Central area as well as the financial resource for the improvement of traffic management system in Cartagena.

(3) Pedestrian Facilities

154. Current pedestrians' traffic facilities such as pedestrian signal, crosswalk, pedestrian crosswalk overbridge, etc. are in very poor condition in the Study Area. Only one pedestrian bridge on Av. Pedro Heredia is available near the stadium. Except on Av. Venezuela, a pedestrian cross walk is not clearly assigned and a pedestrian is frequently interrupted by right/left turn vehicles when crossing at the green light.

155. In order to keep pedestrian safety and smooth traffic flow, the pedestrian facilities on the following streets has to be introduced (refer to Table 12.2-2).

1) Exclusive pedestrian signal system
   a. Av. Venezuela,
   b. Av. San Martin, and
   c. Av. del Concejo.

2) pedestrian overbridges

   a. Av. Pedro de Heredia,
   b. Carretera Troncal de Occidente, and
   c. Diagonal 22.

Table 12.2-2 Installation of Traffic Signal and Pedestrian Bridge (location)

Item	Existing	New Installation	Total
Traffic Signal	21	51	72
Pedestrian Bridge	1	17	18

note: Traffic signal installation is only estimated for the arterial-arterial/collector road intersections.

13 IMPLEMENTATION SCHEDULE

13.1 Road Network Plan

(1) Identified Projects

156. In the Masterplan of road network, 17 projects of new road construction, 9 projects of bridge construction and 22 projects of existing road improvement are identified. Total cost is estimated 266,031 million pesos, equivalent to 409.28 million US$, (new road construction: 107,940 million, bridge construction: 80,064 million, and road improvement: 78,026 million).

(2) Implementation Schedule

157. The implementation schedule was formulated as shown in Figure 13.1-1, taking into consideration the priority ranks of each road project. As seen, the rank "A" projects are allocated on the period completed by the year 2000. The projects in rank "B" are scheduled to complete until year 2005 or over. The remaining projects (rank "C") will be completed by the masterplan target year 2010.

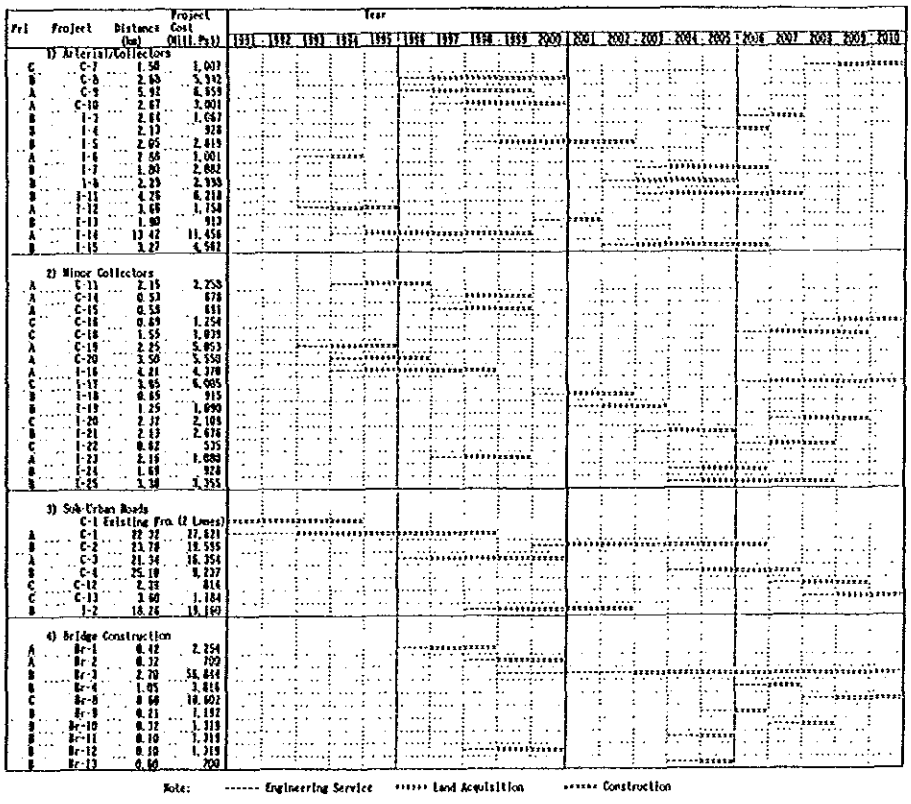


Figure 13.1-1 Implementation Schedule

13.2 Public Bus Transportation Plan

(1) Identified Projects

158. Masterplan of the public transportation consists of the public bus operation system improvement (introduction of trunk-feeder bus system) and public bus facilities improvement (construction of bus stops, bus bays and bus terminals). The construction of 262 bus stops, 171 bus bays and 11 bus terminals is identified in this Masterplan.

(2) Implementation Schedule

159. Implementation schedule of public bus transportation plan is shown in Figure 13.2-1. Total cost of public bus transport will be 34,653.5 million pesos, equivalent to 53.31 million US$.

Project	Cost (million $)	'92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Passenger Terminals	34,406.6	
India Catalina	4,906.6	==========
Nueva Bosque	5,546.0	==========
Inter. Terminal	1,314.8	======
Mercado Bazurto	8,892.3	======
Bomba Amparo	10,125.9	======
Mamonal	2,291.0	======
Parque Centenario	197.1	======
Daniel Lemaitre	425.1	======
Manga	497.3	======
Bocagrande	157.6	======
Airport	52.9	======
Bus Bays/Bus Stops	246.9	
Bus Stop	31.0	==========
Bus Bay	215.9	==========
Trunk-Feeder System		
Primary Introduction (partial)		----------++++++++++
Secondary Introduction (partial)		----------++++++++++
Tertiary Introduction (partial)		----------++++++
Total System Adjustment		------
Total System Operation		++++++

note: ======; construction, ------; preparation, ++++++; operation

Figure 13.2-1 Public Bus Transport Implementation Schedule

13.3 Public Water Transport Plan

(1) Identified Projects

160. Circumstances for public water transport is very hard to introduce the system into Cartagena at present from socioeconomic viewpoint. However, in order to initiate the water transport from 1995 by three (3) routes as described in Chapter 11, the construction of 9 passenger terminals, 11 wharves, fuel supply station and maintenance yard, and channel preparation are required. For the future extension of its operation including Mamonal route, the construction of 7 additional passenger terminals and 7 wharves are necessary.

(2) Implementation Schedule

161. Implementation schedule of water transport plan is indicated in Figure 13.3-1. Total cost of water transport plan will be 3,788.1 million pesos, equivalent to 5.83 million US$.

Project	Cost (million $)	'92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Passenger Terminals	2,252.5	========== =======
Wharves	347.0	========== ===
Fuel Supply		===
Maintenance Yard	1,188.7	===
Channel Equipments	-	====== ===

Figure 13.3-1 Water Transport Implementation Schedule

13.4 Traffic Management Plan

162. Implementation schedule is shown in Figure 13.4-1. Total cost of the traffic management plan will be about 1,292.9 million pesos, equivalent to 1.99 million US$.

Project	Cost (million $)	'92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Existing signal	-	======
Traffic flow	-	===
Curb parking	-	======
Future signal	352.8	==========
Pedestrian facility	940.1	==========

Figure 13.4-1 Traffic Management Implementation Schedule

13.5 Budgetary Consideration

163. In order to carry out the proposed Masterplan, it is important to assess the possible governmental financial resources to determine the financial capability for the projects.

164. As possible financial resources, following are considered due to lack of available funds from the general budget of Municipality of Cartagena for the projects of Masterplan;

a. Special tax on gasoline, diesel oil and natural gas,
b. "Valorizacion",
c. Toll road charge,
d. Licence fee, parking charge, fines, etc., and
e. Subsidies from Central government.

14 ECONOMIC EVALUATION

165. A sum of 272.0 billion pesos will be needed to accomplish all the projects in the Masterplan in economic terms at 1992 price. Out of this, 86.8 % is allotted to road and bridge sector, 12,7% to public transport sector and 0.5% to traffic management sector. If all these investment is attained, total travel cost (VOC plus TTC) would amount to 222.4 billion pesos (at 1992 price) in the year of 2010. On the other hand, that would be 508.6 billion pesos if the present network remains as it is. Hence, the economic benefits in 2010 expect to derive by the Masterplan is estimated to be 286.2 billion pesos. Of this, 22% is attributed to the VOC savings and 78% to TTC savings.

166. Annual profit estimated for each years is compared with investment cost in the form of cash flow in Table 14.0-1. As the percentage of TTC savings are extremely high, another case where only VOC saving is regarded as benefit is shown as the reference. Under the discount rate of 12%, the cost benefit ratio (B/C) is 5.9 and the net present value (NPV)is 370.9 billion pesos, which assures the high economic returns by Masterplan. The Internal rate of return (IRR) is also high at 56%.

Table 14.0-1 Cost-Benefit Analysis of Masterplan as a Whole

(Million Peso)

Year	Road & Bridge	Public Transp.	Traffic Management	Total Cost		Benefit		Cash Flow	
				Total	Land	VOC only	VOC+TTC	VOC only	VOC+TTC
1991	983	0	0	983	0	0	0	-983	-983
1992	983	0	0	983	0	0	0	-983	-983
1993	1,708	27	0	1,735	1,358	0	0	-1,735	-1,735
1994	7,871	27	72	7,969	5,071	0	0	-7,969	-7,969
1995	14,569	1,419	72	16,059	8,524	271	1,166	-15,789	-14,893
1996	13,170	1,533	72	14,775	1,930	2,276	9,799	-12,499	-4,976
1997	15,375	5,197	72	20,644	9,696	5,036	21,681	-15,608	1,037
1998	16,822	4,726	72	21,620	8,002	5,432	23,386	-16,188	1,766
1999	16,137	3,980	72	20,189	5,292	16,005	68,906	-4,185	48,717
2000	13,810	605	82	14,497	1,133	24,889	107,157	10,392	92,660
2001	10,734	3,435	82	14,251	3,441	30,429	131,892	16,178	117,641
2002	10,273	6,565	82	16,920	4,870	30,720	133,193	13,801	116,273
2003	14,597	6,673	82	21,752	3,282	34,958	152,115	13,206	130,363
2004	16,346	313	82	16,741	7,635	35,168	153,052	18,427	136,311
2005	16,590	0	93	16,683	6,318	36,166	157,508	19,483	140,824
2006	14,602	0	93	14,695	1,103	39,494	172,364	24,799	157,669
2007	15,011	0	93	15,104	3,227	44,663	195,442	29,558	180,338
2008	12,784	0	93	12,877	3,777	48,415	212,197	35,538	199,320
2009	13,445	0	93	13,538	1,121	49,382	216,516	35,844	202,978
2010	9,909	0	93	10,002	0	64,990	286,201	54,988	276,199
2011			Residual	-186,981	-75,780			262,761	262,761
Total	236,119	34,501	1,399	272,018	75,780	468,293	2,042,574	459,036	2,033,317
							IRR	18.0	55.9
							B/C	1.36	5.91
							NTV	34,374	370,983

167. In other words, traffic congestion would be so horrible that the diseconomies by congestion will become so serious, if the effort for improving transport facilities be neglected. The economic returns is so significant that the VOC savings alone can cover the cost, deriving IRR at 18% and B/C at 1.36.

15 CONCLUSION AND RECOMMENDATIONS

15.1 Conclusion

168. 123 km of new road construction, 81 km of existing road improvement and 6,420 m of new bridge construction are proposed to be implemented until the year of 2010. Total project cost for the masterplan of road network is estimated at 266,031 million pesos, equivalent to 409.28 million US$.

169. Regarding the public bus transport, it is recognized that several points are necessary for improving its transport condition as for the operation system as well as the facilities. The facilities of bus stops and bus terminals are required to be prepared in order to provide the customers better services and also to make smoother traffic flow by regulated operation of bus vehicles.

170. Current operation system is to be changed to trunk-feeder operation system to meet the future public passenger demand increase. This operation system change is not easily realized because of the necessity of global consensus among the many organizations and personels concerned. However, it is concluded that the installation of this system in Cartagena will bring enough socioeconomic benefits not only for the public bus operators but also for the bus passengers.

171. The possibility of water transport introduction in Cartagena was investigated based on the comprehensive transport demand analysis and socioeconomic/financial analysis of its operation. The result showed that from socioeconomic point of view, the introduction of water transport would bring a little benefit to the Study Area. Financial analysis also indicated that under the current public bus fare level, the revenue would be very difficult to recover the expense of the operation. However, the water transport project has already started and it is on its implementation stage. Therefore, it is necessary to establish a much favorite circumstance of less ship cost, less interest rate and higher fare level than the assumed in order to make water transport financially feasible.

172. Regarding traffic management, following projects are proposed as masterplan component;

a. improvement of curb parking system,
b. improvement of existing traffic signal phasing system,
c. improvement of signal system by signal installation, synchronization and centralization, and
d. construction of pedestrian overcrossing bridges.

15.2 Recommendations

173. To actualize the Masterplan, the following actions are recommended;

(1) Strengthening of Planning Sections

174. It is necessary to review the masterplan repeatedly because the socioeconomic conditions of the study area will change from those it assumes. Masterplan includes many aspects of municipal activities. Therefore, such reviewing works shall be coordinated by right municipal organization of planning sections.

(2) Financial Resources

175. In order to realize the masterplan, it is essential to establish a solid self-sustained fund as well as to utilize the vitality of the private sector. In these respects, the followings are suggested;

a. To apply, more strongly, the benefit principle: The primary beneficiaries of the road and bus facility development are car owners as well as inhabitants along the road. Consequently car owners and inhabitants should shoulder the costs.
b. To introduce the toll road system: Toll roads shall be developed where the alternative road exits. The utilization of private sector funds shall be considered together with the funds from public sector.
c. To establish public enterprises: New enterprises should be set up to undertake such public-type business as urban bus terminal. Their profits should be reinvested in public works. If the water transport will be introduced, the cost shall be subsidized from this revenue.

(3) Feasibility Study

176. As the major large-scale projects, the following are identified through the masterplan study.

a. Road network development,
b. Public bus system improvement, and
c. Water transport system introduction.

177. As for the projects with high priority, it is recommended to undertake a feasibility study at an early stage. Among the above, the projects indicated below are to be the candidates for the feasibility study;

a. road network improvement around the Bay of Animas,
b. trunk-feeder public bus system introduction, and
c. water transport system introduction

178. The financial condition of water transport is indicated to be very difficult from the preliminary analysis in this masterplan. To implement the project without further detailed investigation is not desirable and will lead into the severe situation of its operation. Much detailed investigation to find out the more favorable condition for the water transport shall be undertaken.

(4) Environmental Consideration

179. There is considered to be few influence on the environment of the Study Area by the masterplan implementation. Projects planned in the masterplan are located almost in the already urbanized area and the water area inside this urban area.

180. However, some road constructions in rural area such as the Bayunca Road and Trans-Baru Road are considered to give a reverse influences on their environments of water quality and vegetational condition. The detailed assessment for these aspects is recommended to be undertaken before their implementation.