JICA

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THE FEASIBILITY STUDY ON
THE CORREDOR SUR DEVELOPMENT PROJECT
IN THE PANAMA METROPOLITAN AREA

MAIN REPORT [FINAL REPORT]

FEBRUARY 19

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REPUBLIC OF PANAMA

THE FEASIBILITY STUDY ON THE CORREDOR SUR DEVELOPMENT PROJECT IN THE PANAMA METROPOLITAN AREA

ESTAMPA III

MAIN REPORT

[FINAL REPORT]

FEBRUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY
IN COLLABORATION WITH
MINISTRY OF PUBLIC WORKS

PREFACE

In response to the request of the Government of the Republic of Panama the Government of Japan has decided to conduct a feasibility study on the Corredor Sur Development Project in the Panama Metropolitan Area and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Panama, a study team headed by Mr. Takeshi Yoshida of Yachiyo Engineering Co. Ltd., from August of 1986 to November of 1987.

The team exchanged views on the Project with the officials concerned of the Government of Panama and conducted field surveys in the Panama Metropolitan Area.

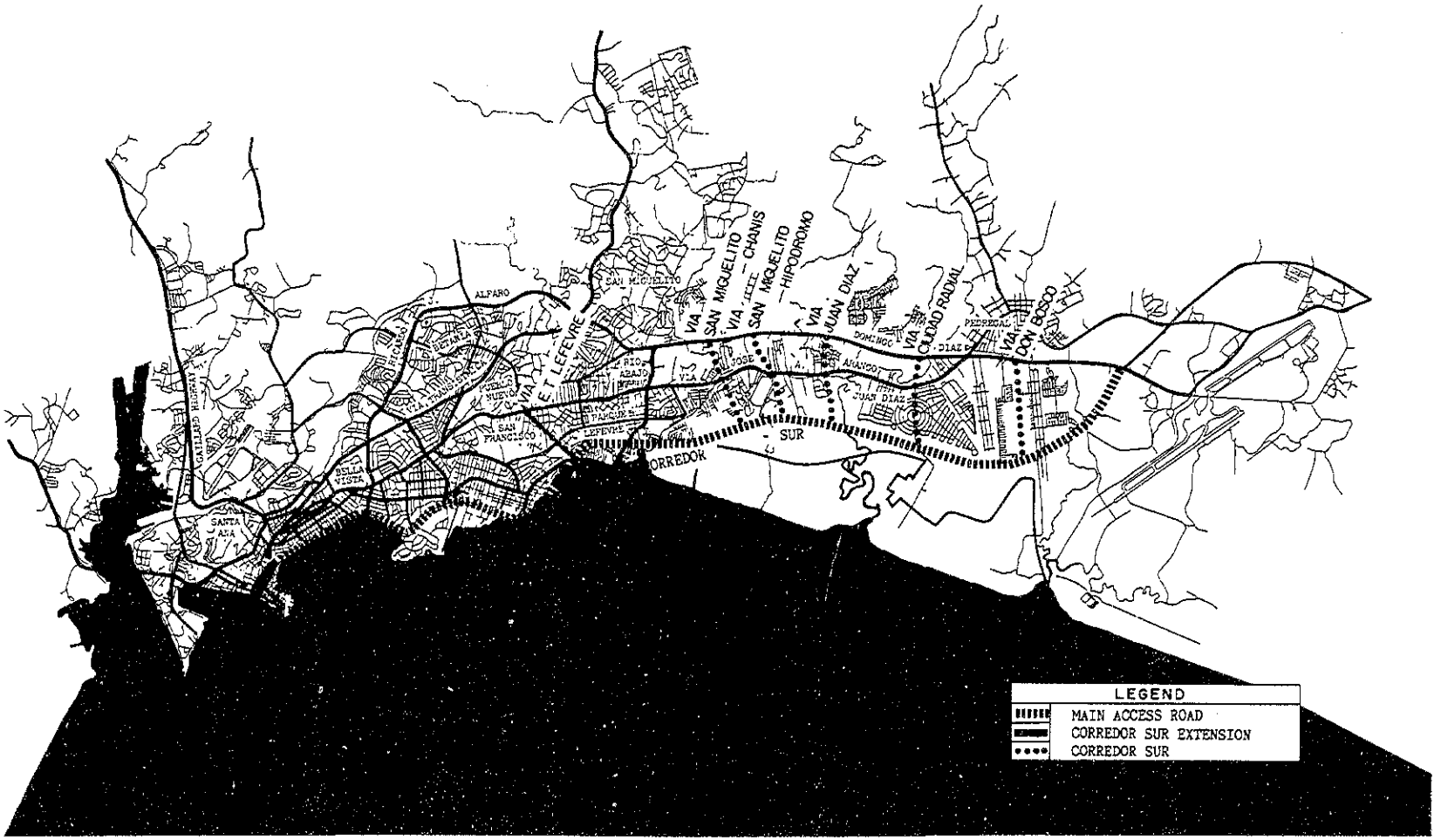
After the team returned to Japan, further studies were made and the present report had been prepared.

I hope that this report will serve for the development of the Project and contribute to promote friendly relations between our two countries.

I wish to express my deep appreciation to all the officials concerned of the Government of the Republic of Panama for their close cooperation extended to the team.

February, 1988

Kensuke Yanagiya
President
Japan International Cooperation Agency



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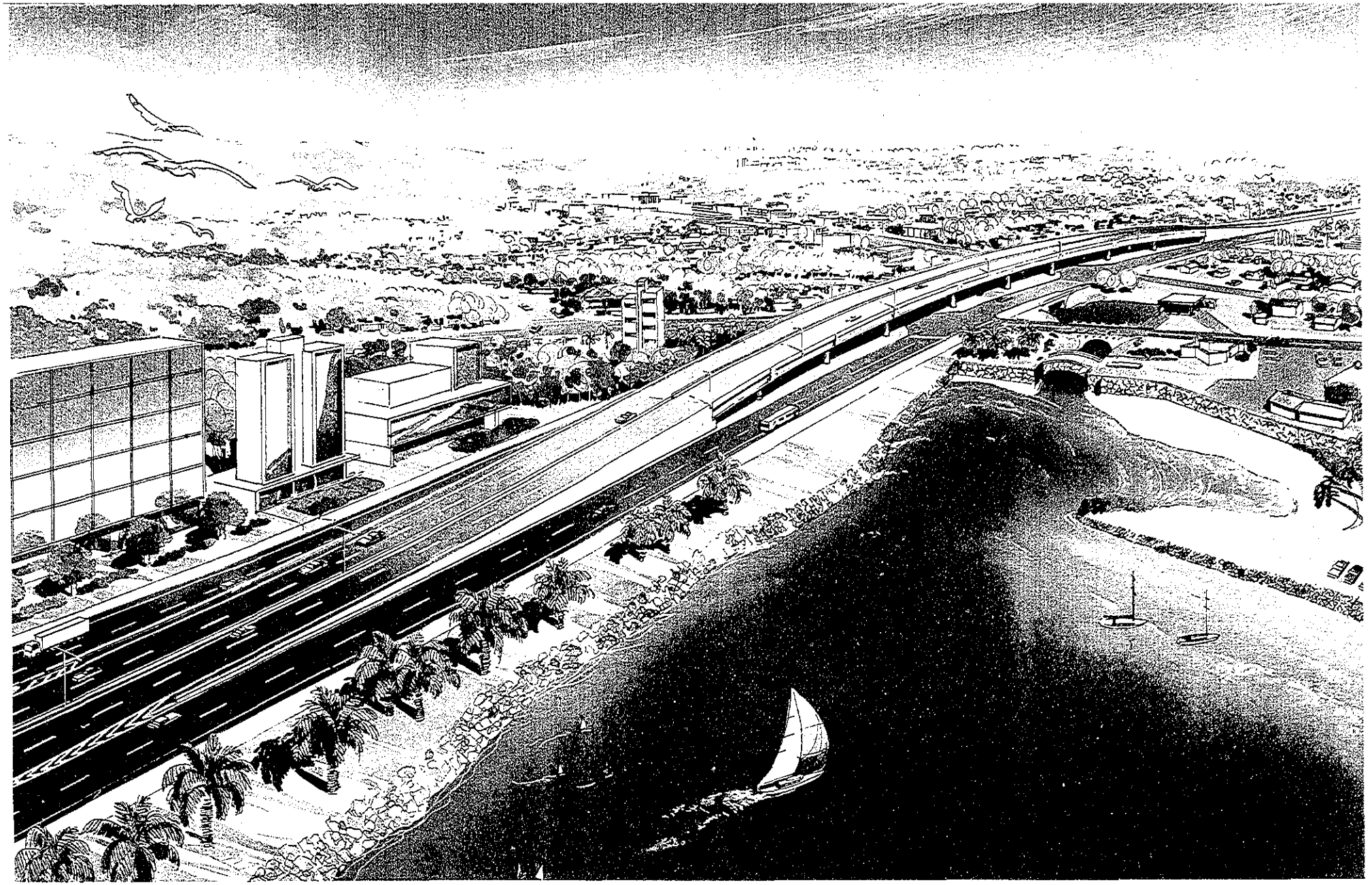

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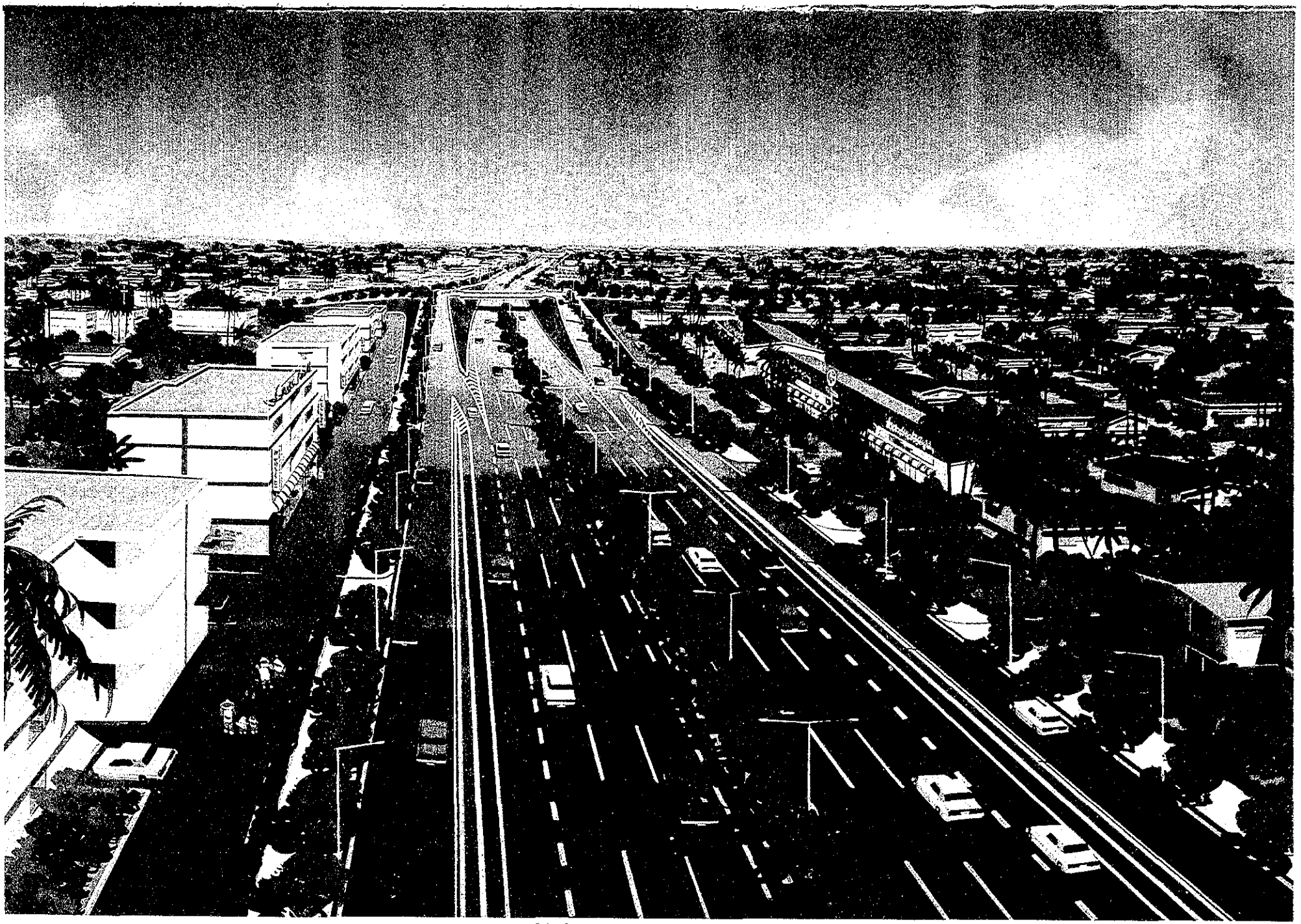

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INTRODUCTION

INTRODUCTION

(1) Study Development

In response to the request of the Government of the Republic of Panama, the Japanese Government, through the Japan International Cooperation Agency (JICA), initiated the Urban Transport Study in the Panama Metropolitan Area (called ESTAMPA).

As the first of the ESTAMPA series, the ESTAMPA Masterplan was formulated for the metropolitan urban transportation. The work conducted between January 1981, and December 1982, is referred to as ESTAMPA I.

ESTAMPA II, which was conducted from May 1983, to January 1985, was the feasibility study on the road construction project of Corredor Norte and its access roads, road improvement projects on Via Espana and other main roads, in addition to public transport facilities projects.

The feasibility study on the Corredor Sur Development Project in the Panama Metropolitan Area (hereinafter refered to as the Study), proposed in the ESTAMPA Masterplan, is recognized as ESTAMPA III.

For the study preparation the Japanese preliminary survey team, headed by Dr. Kiyoshi Sato, visited Panama in February 1986, determined the scope of work for the Study, jointly with the authorities concerned of the Republic of Panama.

The JICA full-scaled study team remained to conduct the Study in the Republic of Panama from August 1986, through November 1987.

(2) Scope of the Study

The feasibility of the following projects has been studied:

- Corredor Sur: Maranon - Pan-American Highway (Tocumen)

- Main Access Roads:
  - Via Ernesto T. Lefevre
  - Via San Miguelito Chanis
  - Via San Miguelito Hipodromo
  - Via Juan Diaz Sur
  - Via Ciudad Radial
  - Via Don Bosco

- Corredor Sur Extension: Marnon -- Puente de las Americas

In addition, the improvement plan for the bus yards and bus stops, in relation to Corredor Sur, was examined.

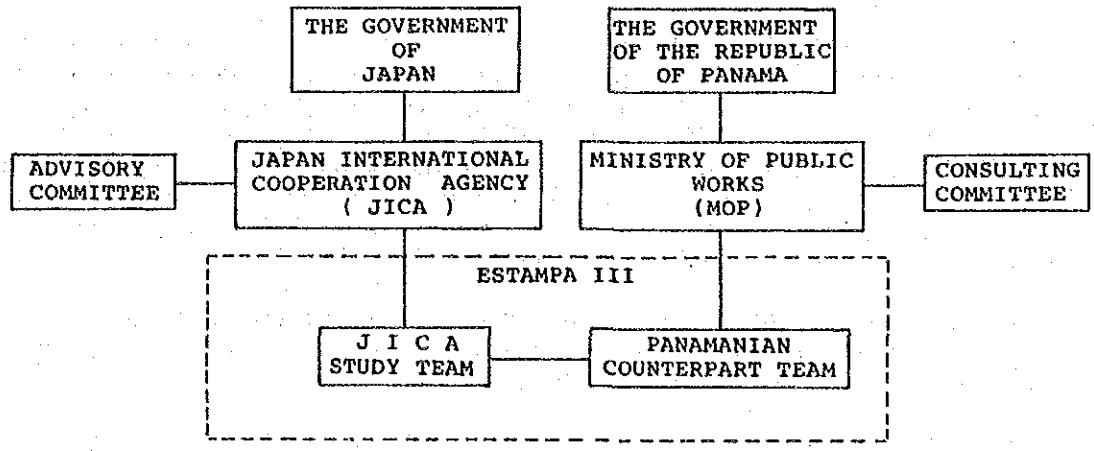
The planning area for the Study is the same area as the ESTAMPA Masterplan. The planning year is the year 2000, which is also the same year as that of the ESTAMPA Masterplan.

(3) Study Organization

JICA has organized both the Study Team headed by Mr. Takeshi Yoshida to conduct the Study, and the Advisory Committee chaired by Mr. Hiroaki

Ogawa to receive advice for the Study. The government of the Republic of Panama has formed the Counterpart Team headed by Mr. Marcos Matos under the Ministry of Public Works (MOP). MOP has organized the Consulting Committee coordinated by Mr. Roberto King to facilitate the progress of the Study.

JICA Study Team and Panamenian Counterpart Team, unified as the ESTAMPA Team, have worked jointly.



ORGANIZATION OF THE STUDY

(4) STUDY REPORT

The study report consists of three parts: (1) Executive Summary Report, (2) Main Report and (3) Drawing Volume.

The Exucutive Summary Report gives a digest not only of the conclusions and recommendations arrived at through the present Study, but also of the Study background and the descriptions of individual projects and their evaluations. The text generally appears on the left-hand side and figures on the right for easy reading and understanding.

The main Report is comprised of the following chapters in addition to the Introduction:

I. Background of Study
II. Planning Condition
III. Road Planning
IV. Bus Facilities Planning
V. Road Preliminary Design
VI. Project Evaluation

Drawing volume is a collection of drawings which are not included in the Main Report and which give a more detailed idea of the projects - in other words, land use plan of project areas and preliminary design of Road Projects.

STUDY ORGANIZATION MEMBERS

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**	Arq. Leroy Rogers	" " "
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* Predecessor
** Substitute

I. BACKGROUND OF STUDY

1. GENERAL BACKGROUND
2. OUTLINE OF ESTAMPA MASTERPLAN

I. BACKGROUND OF STUDY

1. GENERAL BACKGROUND

1-1 GEOGRAPHY

(1) Location and Size

An isthmian country connecting the North and the South American continents, the Republic of Panama (hereinafter "Panama") borders with Colombia on east and with Costa Rica on the west. With a national territory of 77,082 square kilometers, Panama is approximately located between longitudes 77 and 83 east and between latitudes 7 and 9 north.

Panama Metropolitan Area is located approximately in the middle of the nation. Centering around Panama City, it has the area of 3,570 square kilometers spreading for about 80 kilometers east-west and 50 kilometers north-south, and it is located on the Pacific entrance of the Panama Canal. The Metropolitan Area, defined and called the "Study Area" by the ESTAMPA Masterplan, consists of Panama, San Miguelito, Arraijan, and Chorrera Districts and belongs to Panama Province.

(2) Topography

A spine of ridges traverses the center of the Isthmus of Panama, and plains occupy the Pacific side. The Study Area facing the Gulf of Panama on the south, has continuous hills in the northern part, and is divided in the center by the Panama Canal running north-south. The sites of the projects subject to this Feasibility Study are located in the flat Panama Urban Area and the adjacent hilly areas.

(3) Climate

Climate in Panama is generally catagorized as the marine tropical type, with high temperatures and humidity (See detailed meteorology information in TABLE I-1-1). The period from January to April is usually called the dry season, and from May to December, the rainy season. Of the annual precipitation of about 1900 millimeters, some 89% falls during the rainy season.

TABLE I-1-1 METEOROLOGY IN PANAMA

Month	Precipitation (mm)		Temperature (Centigrade)			Relative Humidity (%)		
	Total	Daily Average	Maximum	Minimum	Average	Maximum	Minimum	Average
1. January	17.4	0.6	31.9	20.5	26.2	96.6	56.2	76.4
2. February	14.8	0.5	32.8	21.2	27.0	94.9	53.0	74.0
3. March	18.7	0.6	32.9	21.7	27.3	93.3	52.4	72.9
4. April	76.1	2.5	32.7	22.1	27.4	94.8	56.0	75.4
5. May	266.0	8.6	31.4	22.9	27.2	97.8	68.0	82.9
6. June	239.5	8.0	30.7	22.6	26.7	98.4	73.1	85.8
7. July	194.5	6.3	30.8	22.7	26.8	98.6	70.9	84.8
8. August	196.4	6.3	30.6	22.6	26.6	98.6	72.2	85.4
9. September	266.8	8.9	30.2	22.2	26.2	99.0	72.6	85.8
10. October	330.5	10.7	29.5	22.2	25.9	99.0	74.3	86.7
11. November	177.6	5.9	30.4	22.2	26.3	98.7	70.7	84.7
12. December	82.6	2.7	30.9	21.9	26.4	97.4	66.3	81.9
Total	1,880.9	5.1	31.2	22.1	26.7	97.3	65.5	81.4

Source: PANAMA EN CIFRAS NOV. 1986
RECORD FOR THE PERIOD 1981-1985

1-2 SOCIO-ECONOMIC SITUATION

(1) Geographical Features

The geographic location of Panama is greatly resposible for the shaping of its history and its present prosperity. Since the successful Balboa Expedition across the Isthmus in the year 1503, Panama, being the nodal point between the two grand continents and the two oceans, has grown as a trade center. Particularly the Panama Canal since its opening in 1914, has immensely contributed to the socio-economic development of the nation: Colon City, situated near the Atlantic entrance to the Panama Canal, has thrived as the site of a free-trade zone. Panama has now evolved as the financial center of Central and South American countries.

(2) Population

The national population of Panama is estimated at 2,141,000 in 1985. The average annual population increase rate was 2.5 % from 1970 to 1980, but the increase has been slowing down. The Study Area had a population of 730,000 in 1980, with an average increase rate of 3.8 % during the same decade. This population was 2.3 times greater than that of 1960, as a result of the population concentrating in the Metropolitan Area (See TABLE I-1-2).

TABLE I-1-2 POPULATION OF PANAMA AND THE STUDY AREA IN 1960, 1970, 1980, AND 1985

Area	Year 1960	Year 1970	Year 1980	Year 1985
Republic of Panama	1,075,541	1,428,082	1,831,399	2,141,470
Study Area	331,804	519,643	759,153	870,220
Percentage	30.8	36.4	41.5	40.6

* Excluding the population which belongs to the non-reverted area of Ancon Corregimiento.
Source: CONTRALORIA GENERAL, CENSOS NACIONALES (1960, 1970, 1980, 1985)

Of the Study Area, heavily populated integrated zones (defined by the ESTAMPA Masterplan) are the Panama Urban Area with 300,000, San Miguelito with 160,000, and Juan Diaz and Pedregal with 80,000 in 1980. During the said decade, the population of the Panama Urban Area decreased and San Miguelito experienced a decline in population increase rates, while such rates have risen in the suburbs of Tocumen, Las Cumbres, Chilibre, and Arraijan. This phenomenon suggests that the urban area is physically expanding outward.

(3) GDP and Economic Growth

The gross domestic product (GDP) of Panama in 1985, was estimated at 1,997 million balboas. With fluctuating economic performances, the growth of Panama's GDP during the past decade averaged 43 % per annum. The rapid growth period from the end of the 1960s, to the early 1970s, was followed by the post-oil crisis stagnation, from which Panama has

recovered. The Panamenian economy has not fared so well in the worldwide recessive economic environment (See TABLE I-1-3).

TABLE I-1-3 GROSS DOMESTIC PRODUCT - YEAR 1975-1985

Year	Gross Domestic Products (in 1970 market price)		
	Total (millions B/.)	Per Capita (B/.) 1/	Increasing Rate (%)
1975	1,285.7	755	1.7
1976	1,307.1	748	1.7
1977	1,321.4	738	1.1
1978	1,450.8	791	9.8
1979	1,516.3	807	4.5
1980	1,745.8	892	15.1
1981	1,818.8	910	4.2
1982	1,918.6	939	5.5
1983	1,925.7	922	0.4
1984	1,917.6	899	- 0.4
1985 p/	1,996.7	916	4.1

1/ Based on estimation of total population
p/ Preliminary figures
Source: PANAMA EN CIFRAS, NOV. 1986

Agriculture is the major source of the GDP, whose growth, however, is deccelerating as a consequence of the shrinking sectoral composition rate to the total GDP. While the manufacturing sector represents only one-tenth of the GDP, activities in the tertiary sector from electric power generation to government services represent the already large, and still increasing, portions of the GDP (See TABLE I-1-4).

TABLE I-1-4 COMPOSITION OF GROSS DOMESTIC PRODUCT - YEAR 1985

(Unit: Million B/. in 1970 price)

Sector	GDP p/	Share
1. Agriculture	203.5	10.2
2. Mining	2.5	0.1
3. Industry	178.9	9.0
4. Construction	86.9	4.3
5. Electricity, Gas	69.1	3.5
6. Comunication, Transport	510.2	25.5
7. Commerce, Banking	244.7	12.3
8. Services	181.6	9.1
9. Government Services	261.0	13.1
10. Others	258.3	12.9
Total	1,996.7	100.0

p/ Preliminary Figures
Source: PANAMA EN CIFRAS, NOV. 1986

(4) Employment by Sector

An estimated 500,000 employees are in Panama (1980), 29% in the primary industry, 18% in the secondary, and a characteristically high 53% in the tertiary industry. Also a high 74% of the total of 220,000 employees in the Metropolitan Area is engaged in the tertiary industry, indicating a strong specialization of the economy in this sector (See TABLE I-1-5).

TABLE I-1-5 EMPLOYMENT BY SECTOR - YEAR 1980

Sector	Whole Country (exclude indigenous areas)	Study Area	Share (%)
1. Agriculture	144,590	8,155	5.6
2. Mining	965	280	29.0
3. Industry	52,720	29,680	56.3
4. Construction	29,825	14,410	48.3
5. Electricity, Gas	7,965	4,650	58.4
6. Communication, Transport	28,840	10,495	36.4
7. Commerce, Banking	87,210	57,580	66.0
8. House Rental	128,815	78,715	61.1
9. Others	22,610	15,565	68.8
10. Total	503,540	219,530	43.6

Source: CONTRALORIA GENERAL

(5) Foreign Trade

In 1985, Panama exported a total FOB value of 320 million balboas and imported a total CIF value of 1,381 million balboas (both excluding those of the Colon Free Zone). Major export items were agro-fishery products such as bananas, shrimp, sugar, coffee, beans, and beef, and refined petroleum products. Major import items were industrial products, transportation equipment, and chemical products (See TABLE I-1-6).

TABLE I-1-6 IMPORT AND EXPORT - YEAR 1981-1985

Unit : million B/.

Year	Import C.J.F.	Export 1/ F.O.B.	Balance
1981	1,562.1	328.6	- 1,233.5
1982	1,568.3	376.0	- 1,192.4
1983	1,413.2	321.5	- 1,091.5
1984	1,429.6	279.1	- 1,150.6
1985 p/	1,391.3	319.6	- 1,071.7

1/ National goods and reexport of nationalized goods
p/ Preliminary figures
Source: PANAMA EN CIFRAS, NOV. 1986

The international trade of Panama is characterized by its unusually large trade in the Colon Free Zone, which is greater than the regular

through-the-customs trade. A total FOB value of 1,793 million balboas was re-exported from that zone in 1985, (See TABLE I-1-7).

TABLE I-1-7 IMPORT AND RE-EXPORT OF COLON FREE ZONE - YEAR 1981-1985

Year	Colon Free Zone (in millions B/.)	
	Import	Re-export
1981	1,992.0	2,328.1
1982	1,703.4	2,144.6
1983	1,139.4	1,471.7
1984	1,342.5	1,535.8
1985 p/	1,588.5	1,792.8

p/ Preliminary figures
Source: PANAMA EN CIFRAS NOV. 1986

(6) Government Finance

In 1985, the government finance showed 170 million balboas in deficit and this figure has been rising in recent years (See TABLE I-1-8).

TABLE I-1-8 GOVERNMENT FINANCE - YEAR 1981-1985

Unit: million B/.

Year	Revenue	Expenditure	Balance
1981	1,155.7	1,216.5	- 60.8
1982	1,557.7	1,624.5	- 66.8
1983	1,357.3	1,370.0	- 12.7
1984	1,376.1	1,493.4	-117.4
1985	1,195.5	1,365.5	-170.0

Source: PANAMA EN CIFRAS, NOV. 1986

1-3 INTERREGIONAL TRANSPORT FACILITIES

(1) Panama Canal

After vicissitudes which followed the initial attempt by Ferdinand Lesseps in 1880, the construction of the Panama Canal was re-started by the United States of America in 1903 and was completed in 1914. Ships navigate a distance of 69.1 kilometers from entrance to exit, rising and falling a total of about 26 meters between the sea level and the level of the Gatun Lake, through three lock gates each side. At the Pacific entrance is Balboa Port, and at the Atlantic is Cristobal Port.

During the year 1986, 11,926 ships and 139.8 million long tons of cargo passed through the Canal, paying 321.1 milion dollars in toll (See TABLE I-1-9).

TABLE I-1-9 PANAMA CANAL TRAFFIC - YEAR 1980-1985

Year	Total Traffic		
	Number of Transits	Toll (Million B/.)	Long Tons of Cargo (milions)
1980	14,725	293.4	167.6
1981	15,050	303.1	171.5
1982	15,271	325.6	185.7
1983	12,954	287.8	145.9
1984	12,523	289.2	140.8
1985	12,766	300.8	138.9

Source: PANAMA CANAL COMMISSION

Control over the Canal has been transferred from what used to be called the Panama Canal Company to a newly established Panama Canal Commission. The operation and maintenance of the Canal will be completely transferred to the Republic as of the year 2000, in accordance with the treaty (usually called Torrijos-Carter Treaty) which was signed between the Republic of Panama and the United States of America in September 1977, and became effective as of October 1979. The Canal facilities are becoming old and short of capacity to accomodate ships which are becoming larger in size. The study of alternatives to the Panama Canal is being conducted.

(2) Airports

i) Omar Torrijos Herrera International Airport

This modern international airport with a 3,050-meter runway is located in Tocumen on the eastern edge of the Metropolitan Area. It is the hub of air transport in Latin America, accommodating about one million passengers and 40,000 tons of air cargo per year (See Table I-1-10).

TABLE I-1-10 PASSENGER AND CARGO IN OMAR TORRIJOS INTERNATIONAL AIRPORT - YEAR 1981-1985

Year	Passengers	Cargo (metric tons.)
1981	1,185,364	53,305
1982	1,131,721	51,200
1983	1,039,541	40,919
1984	1,134,144	42,102
1985 p/	1,165,929	39,579

p/ Preliminary figures
Source: PANAMA EN CIFRAS, NOV. 1983

ii) Marcos A. Gelabert Airport (Paitilla Airport)

Located in Punta Paitilla within the Panama Urban Area, this airport has a 1,298 meter runway and serves domestic air connections between Panama City and other parts of the nation, while also accommodating privately owned airplanes.

(3) Sea Ports

i) Balboa Port

Located at the Pacific entrance of the Panama Canal, Balboa Port is the second largest seaport in Panama (after Cristobal Port), handling a total of 461,000 metric tons of cargo in 1985.

ii) Miscellaneous Ports

Other major ports in the Metropolitan Area are Vacamonte fishery port, which was newly constructed in 1979, and Muelle Fiscal Port near Centro.

(4) Railway

The Panama-Colon Railway, a 76 km operational line, is older than the Panama Canal. Passengers have been decreasing in recent years, and the major function of this railway is the transportation of goods, rather than that of urban travellers.

(5) Highways

1) Pan American Highway

The Pan American Highway traverses the national territory east-west, running through, by, or near major cities on the relatively flat land of the Pacific coast, and may be called the "backbone" of the country. Within the Study Area, this Highway constitutes the east-west axis of the Metropolitan Area connecting Chorrera, Arraijan, Panama City, San Miguelito, Juan Diaz, Pedregal, and Tocumen. Between Chorrera and Arraijan, an Autopista offers a bypass.

2) Transistmica Highway

Connecting Panama City and Colon City across the Isthmus, Transistmica Highway constitutes the north-south axis of the Study Area. The section (Via Bolivar) where it joins with Pan American Highway in Panama City has the greatest volume of traffic.

2. OUTLINE OF ESTAMPA MASTERPLAN

2-1 ECONOMIC FRAMEWORK

(1) Population

The Study Area had a population of 732,000 in 1980. The Population increase rate which has been on average 4.3% per year during the past 20 years, will slow down slightly in the future. The population is estimated to increase to 1,020,000 by 1990, at an average rate of 3.3% and to 1,330,000 by the year 2000, at a rate of 2.75% (See TABLE I-2-1).

TABLE I-2-1 PLANNED POPULATION

AREA YEAR	1980	1990	2000
Planning Area	707,725	987,000	1,298,800
Study Area	732,840	1,018,000	1,334,800

Source: ESTAMPA I

(2) Employment

Employment in the Study Area is estimated to increase from 220,000 employees in 1980, to 340,000 by 1990, and to 490,000 by the year 2000. Specialization of employment in the tertiary industry is predicted to advance from 74% in 1980, to 79% in 1990, and to 81% in the year 2000, (See TABLE I-2-2).

TABLE I-2-2 EMPLOYMENT IN THE STUDY AREA

Industrial Sector	1980	1990	2000
Primary	8,155	7,155	6,430
Secondary	49,020	67,755	87,410
(manufacturing within secondary sector)	(29,680)	(41,110)	(53,760)
Tertiary	162,355	265,550	400,320
TOTAL	219,530	340,460	494,160

SOURCE: ESTAMPA I

(3) Economic Activities

The gross regional domestic product (GRDP) of Panama Province is expected to rise from the 1,448 million balboas in 1979, to 3,577 million balboas by the year 2000, at an average rate of 4.4% per year. Per capita GRDP, then, will grow from 1,976 balboas in 1979 to 2,680 balboas by the year 2000, at a yearly average of 1.5% (See TABLE I-2-3).

TABLE I-2-3 ECONOMIC FRAMEWORK OF STUDY AREA

(Million Balboas)
(Thousand persons)

Item	Year			
	1979	1985	1990	2000
GRDP	1,447.9	1,886.7	2,374.7	3,356.9
Regional Consumption Expenditures	1,184.6	1,443.6	1,821.3	2,755.8
Regional Gross Fixed Capital Formation	325.8	705.4	891.3	1,262.3
Population	732.8*	874.2	1,018.0	1,334.8
Economicelly Active Population	237.9*	299.3	368.0	533.4

*: Figures in 1980
SOURCE: ESTAMPA 1

2-2 LAND USE

(1) Urban Development Pattern

The present pattern of land use in the Metropolitan Area is a reversed "T" formed by the Pan American Highway and the Transistmica adjoining perpendicularly. Transfiguration of this reverse "T" into a triangle, as the future development pattern, is to be achieved through the development of the reverted area and the outward expansion of the Panama Urban Area in such a way as to distribute living centers outward in all directions.

(2) Population/Employment Distributions

The Study Area is divided into 13 integrated zones. Future population and employment have been estimated for each zone through the scrutiny of the size of the developable land,the population trend,the government's development concept, the expansion of autonomy, and other relevant factors (see TABLE I-2-4).

TABLE I-2-4 PLANNED POPULATION AND EMPLOYMENT OF EACH ZONE GROUP IN THE YEAR 2000

		Population	Employment
I	Centro	96,600	81,030
II	Bella Vista	31,300	85,185
III	Residencial Aria	210,300	87,735
IV	Juan Diaz - Pedregal	174,000	39,540
V	Tocumen	59,300	17,000
VI	San Miguelito	301,800	61,900
VII	Las Cumbres - Chilibre	89,000	15,250
VIII	Ancon Este	98,400	37,015
IX	Ancon Oeste	1,500	2,395
X	Arraijan	111,500	24,030
XI	Chorrera	125,100	32,960
Planning Area Total		1,298,800	484,040
XII	Pacora	21,600	5,990
XIII	Nuevo Emperador	14,400	4,130
Study Area Total		1,334,800	494,160

Source: ESTAMPA

(3) Urbanized Area Expansion

In 1980, urban limits encompassed an area of 12,800 hectares. This is expected to expand by 1.6 times to 20,000 hectares by the year 2000, while the urban population density will rise from 50 per hectare to 62 per hectare.The future urban population will be 1,236,000, of which 827,000 will live in the existing urban area and 409,000 in the new urban areas. Of an estimated 7,200 hectares of the new urban areas, about half, or 3,600

hectares will be developed to the east of the Panama Urban Area; Juan Diaz, Pedregal, Tocumen, and San Miguelito Oeste. Of the other half, 500 hectares will be the reverted area, and 2,300 hectares will be in Arraijan and Chorrera.

(4) Living Centers

The Reverted Area is a vast expanse, only developable under government plans, and is strongly expected to play a vital role in correcting the distorted configuration into which the Panama Urban Area has sprawled thus far. To achieve this, land for various urban functions, as well as housing areas, will be developed on the axis of Corredor Norte.

Major housing area development shall be in the reverted area itself, San Miguelito Este, Arraijan, and Chorrera. Commercial centers for the entire Panama Metropolitan Area shall be in Centro and Chorrera, while semi-urban commercial centers shall be planned in Betania, Rio Abajo, San Miguelito Centro, and Arraijan.

Public facilities shall be distributed as follows: Albrook Center, Corredor Norte Center, San Miguelito Este Suburban Center, and Chorrera Oeste Suburban Center. Industrial estates shall be developed in Tocumen, Albrook, Vacamonte, and Chorrera.

2-3 TRAFFIC DEMAND

(1) Trip Characteristics

The Person-Trip Survey in 1981, revealed that total trips relating to the Panama Metropolitan Area are 1,470,000 trips per day. Of these, 96% was internal trips, and through trips were few. By purpose, a large number of trips was to go home (44%), to go to work (18%), and to go to school (16%). By mode, a great majority, or 34% of all trips, was made by public bus, followed with 27% by car.

A characteristic gap in unit trip generation exists between the 3.39 trips by car-owning family members and the 1.94 trips by non-car-owning family members in the Study Area. The rate of car-owning families, who make trips more frequently than non-car-owning families as above indicated, accounts for 29% and is still increasing in the Study Area.

(2) Traffic Demand Increase

Traffic demands in 1990, and the year 2000, have been estimated using the result of the Person-Trip Survey, the forecast model building, the future population and other economic indicators. As estimated, the population in the Planning Area will increase 1.8 times from the existing 710,000 to 1,330,000 by the year 2000, while person-trip generation will increase 1.5 times from the present 1,430,000 trips to 2,230,000 trips for 1990, and 3,140,000 trips or 2.1 times for the year 2000. The predicted higher rate of trip increase compared to that of population increase is explained by the increase in car ownership and the consequent rise in the people's mobility.

By Integrated Zones, the Panama Urban Area will continue to have a high potential in trip generation and attraction, while the rate of trip increase will be low. Conversely, high trip increase rates are estimated for San Miguelito, Juan Diaz-Pedregal, and Ancon Este, where rapid urbanization will take place.

If future car ownership increase is not controlled in the Metropolitan Area, the rate of car-owning families will rise to 32% by the year 2000, with an accompanying increase of the passenger car's model split share from the present 27% to 32%, and, consequently, traffic volume in PCU (passenger car unit) will swell to 1,110,000, or 2.3 times the present 490,000. In view of the fact that motor traffic increase will inevitably entail enormous amounts of road investments, some effective control will be necessary on the ownership and the utilization of passenger cars. Effective measures for the qualitative and quantitative improvement of puplic transport services will also be needed.

The average length of trips for all purposes is estimated to increase from the present seven kilometers to eleven by the year 2000, reflecting outward expansion of the urbanized area. Particularly, the average length of commuting trips, whose quantity usually determines the quantity of necessary transport facilities, is estimated to increase from the current nine kilometers to twelve.

Two major traffic flows into the Panama Urban Area will be that from the east (Juan Diaz-Pedregal, Tocumen, etc.) and that from the north (San Miguelito, Las Cumbres, etc.), and the greatest cross section traffic flow will occur in the part of the urban area where the two flows merge.

2-4 TRANSPORTATION NETWORK MASTERPLAN

(1) Alternative Evaluation.

The following five alternatives for Metropolitan Area transportation networks have been conceived for the year 2000, as the combinations of: 1) Whether or not the ownership and utilization of passenger cars will be somehow controlled, 2) Whether the transportation axis will traverse the center of the urban area or run outside, and 3) Various kinds of transport facilities:

a. Street widening without car control
b. Expressway construction without car control
c. New road construction with control on cars
d. Exclusive bus expressway construction with control on cars
e. Rail transit construction with control on cars

Evaluation has screened out all alternatives except (c) and (e).

(2) Transportation Network Pattern

Transportation network for the year 2000, shall be of a ladder pattern formed by major east-west axis and north-south diversion axis, thereby placing motor traffic axis outside the urban area and bus or rail transit axis in its center (See FIGURE I-2-1).

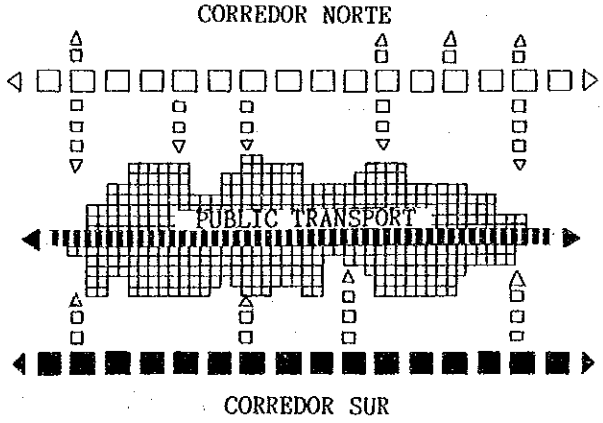


FIGURE I-2-1 CONCEPT OF TRANSPORT NETWORK MASTERPLAN

(3) Transportation Network Masterplan

Transportation network masterplan for the year 2000, (See FIGURE I-2-2),shall consist of Autopista, Pan American Highway in terms of long distance traffic, and, in terms of urban traffic, shall be formed by;

a. The construction of Corredor Norte, a new arterial which will run

east-west to the north of the urban area, for the accommodation of motor traffic while serving as development axis for the reverted area and future urbanized areas.

b. The establishment of Corredor Sur, a new arterial which will also run east-west but to the south of the urban area along the Bay of Panama, for accommodation of motor traffic while serving as a development axis for diverse urban development projects.

c. The development of previously lacking north-south streets (Via Cerro Ancon, Via Brasil, and Via Ernesto T. Lefevre) in the urban area, for the diversion of traffic to and from the said two corridors.

d. The development on the axis of San Miguelito, of an arterial road network, by the construction of three new roads (Via San Miguelito Oeste, Via San Miguelito Centro, and Via San Miguelito Este).

Public transport development projects shall include the following:

a. The introduction, under a long term plan, of a rail transit system starting from Centro, traversing the center of the urban area, and reaching San Miguelito Este and Juan Diaz.

b. The quantitative and qualitative improvement of bus services through the accomplishment of a bus rerouting scheme to include the introduction of an express bus service, mini-bus service, and circular city bus service, the discontinuation of long distance routes, and the enhancement of routes with poor service.

c. The construction of four bus centers in Panama City as strategic points for bus service improvement.

d. The construction of a bus operation base in Albrook with a maintenance center for the modernization of bus maintenance.

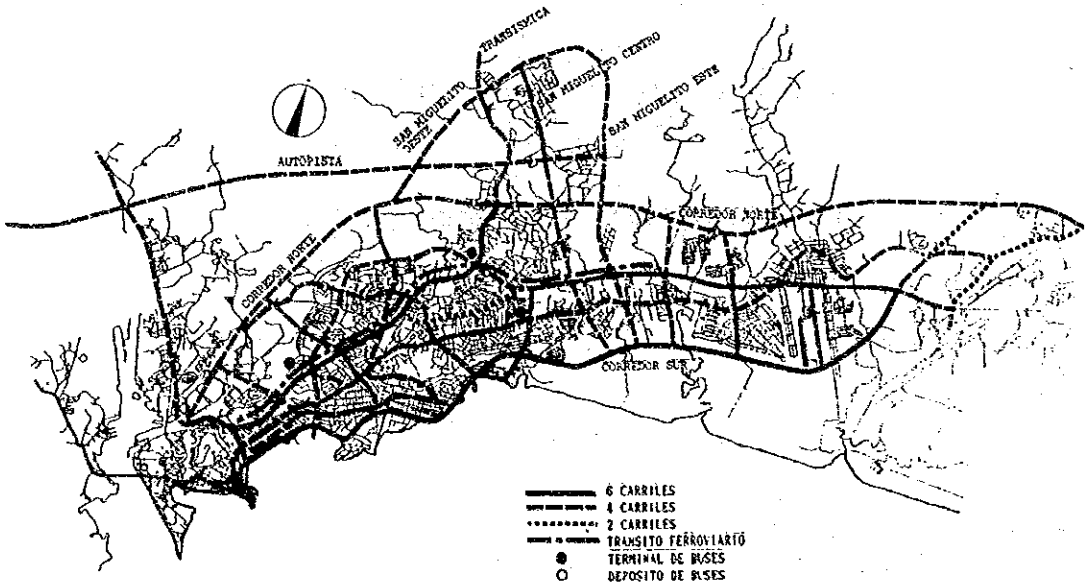


FIGURE I-2-2 TRANSPORTATION MASTERPLAN FOR YEAR 2000

2-5 INVESTMENT PROGRAM

The numerous projects proposed for the realization of the Metropolitan Area Transportation Masterplan for the year 2000, need to be arranged on the axis of chronology into an implementation schedule. This schedule must achieve early implementation of the urgent projects, the expansions of necessary investments in pace with the national economic growth, and growth of transport network in synchronization with traffic demand swelling as estimated, while maintaining harmony between these Masterplan projects and those forerunning.

(1) Road Investment

The road investment is estimated at 350 million balboas, 120 million by 1990, and 230 million from 1991, to 2000. Major projects to be implemented by 1990, will be the construction of the western half and the reverted area section of Corredor Norte, the construction and improvement of roads connecting thereto (Via Cerro Ancon, Via Martin Sosa, Via El Paical, and Via San Miguelito Oeste), the construction of the central section of Corredor Sur, and the widening and upgrading of the currently heavily congested urban streets such as Via Espana.

(2) Public Transport

Four bus centers and a maintenance center contemplated in the Masterplan are to be implemented by 1990, at a cost of 21 million balboas. The rail transit project which is estimated to require 300 to 310 million balboas.

(3) Traffic Control Projects

The improvement of the traffic signal system and other traffic control projects are estimated at 5 million balboas as a short term investment.

II. PLANNING CONDITION

1. GEOGRAPHICAL CONDITION
2. LAND USE CONDITION
3. ROAD AND TRAFFIC CONDITION
4. CONSTRUCTION CONDITION

II. PLANNING CONDITION

1. GEOGRAPHICAL CONDITION

1-1 TOPOGRAPHICAL CONDITION

1-1-1 Topography

The Panama Metropolitan Area faces the Pacific Ocean and has a relatively gentle terrain. Corredor Sur runs along the coast of Panama Bay and is situated on a long stretch of alluvial fields created by the rivers flowing down from the hills and mountains. The elevation of the hills ranges from 5 m to 100 m, and small rivers meander through these hills. Most of the built-up areas are hills, containing urban rivers such as the Rio Mataznillo, the Quebrada Santa Librada, and the Rio Abajo. The east side of the built-up area is a low swamp formed by deposits from medium and small rivers such as the Rio Matias Hernandez, the Rio Juan Diaz and the Rio Tapia. In particular, the low swamp land formed by the Rio Juan Diaz and the Rio Matias Hernandez is an intertidal zone where native mangroves grow.

(1) Rio Mataznillo

This river, with the total length of 4.4 km, runs down from the north to the south along the center of Panama City and crosses the five major roads of Via Espana, Via Porras, Calle 50, Via Brasil and Ave Balboa, just before discharging into the sea. The river bed has been improved over a distance of about 400 m from the Via Porras to the river mouth at Ave Balboa. The river mouth width is 23 m.

(2) Quebrada Santa Librada

This is a small river within the Panama City, and its mouth is situated at the west side of Panama Viejo. Its basin consists of such existing urban areas as Pueblo Nuevo and Parque Lefevre. The total length of the river is only 3.0 km. This is a natural river situated on low land of the hills, and is also used for city drainage.

(3) Rio Abajo

This river is situated at the northeast side of Panama City and runs from the northwest to the southeast to enter the bay of Panama Viejo. The total length of this river is 4.8 km, and it crosses most of the major city roads including Via R.J. Alfaro, Via Transistmica, Via Espana, and Ave. Santa Elena.
Neither, the river bed nor its basin have been improved, and its mouth is only 14 m wide.

(4) Rio Matias Hernandez

This river runs through the San Miguelito area, which was created by developing the northeast hill of Panama City, and its total length is 11.0

km. The area, about 2 km away, from the coast is a diluvial flat field where river improvement has been carried out, but the river cross section is too small for the basin of the river.

(5) Rio Juan Diaz

This river runs through the east-west mountain system comprising the Isthmus of Panama and is the second largest river in the Panama Metropolitan Area next to Rio Chagres, both in terms of total catchment area (137.5 km^2) and length (24.0 km). The area about 3 km away from the river mouth is a low diluvial swamp. This is a natural, meandering river.

(6) Rio Tapia

This river runs through the north-south mountain system derived from the east-west mountain system and converges with the Rio Tocumen at its mouth. This is a natural river running through the hills, and its total length is 11 km.

1-1-2 Land Survey

In order to cover the project areas, 1:2,500 and 1:1,000 topographic maps were prepared using the aerial photogrammetric method. The outlines, types and quantities of the work were as follows:

(1) Aerial Photography

1) 1:8,000 Aerial Photography for 1:2,500 mapping

There were six (6) flight lines, the number of total models were 70 and the total length of the lines was 72 km. The principal points are shown on FIGURE II-1-1.

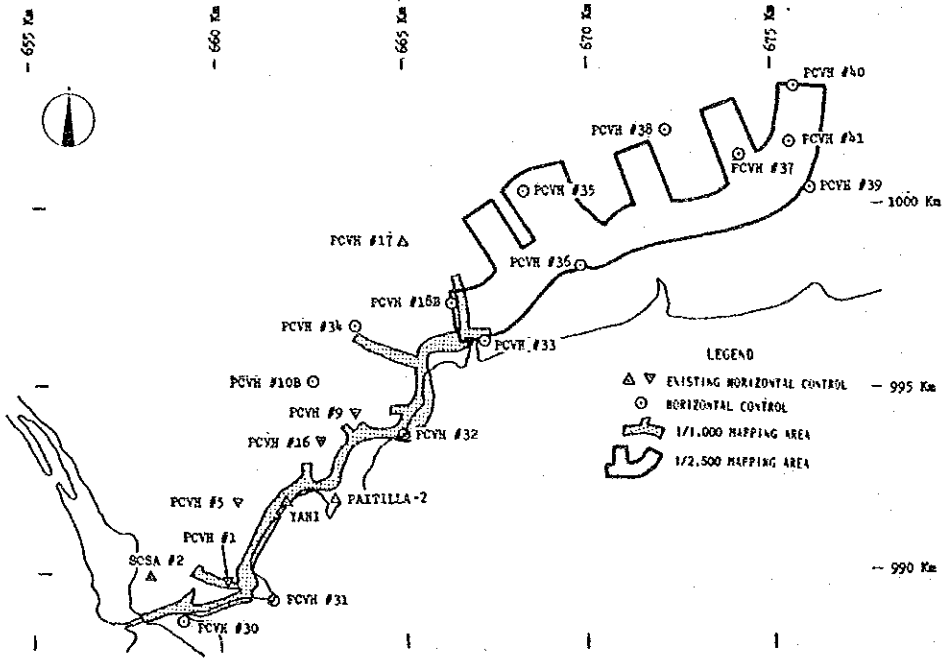


FIGURE II-1-1 INDEX MAP FOR MAPPING AREA

2) Photo Processing of the Aerial Photography

Preparation of contact prints, and diapositives and enlarged prints for aerial triangulation, pricking and field classification were included in the work.

(2) Field Survey

1) Horizontal Ground Control Survey

Fourteen ground control points were established. Traverse survey was applied. These ground controls together with existing controls, were used for photogrammetric control of the aerial photographs. Therefore, these 14 points and 8 existing controls were signalized.

2) Vertical Control Survey

To control and strengthen the vertical accuracy of the photogrammetry, direct leveling was executed along the roads in the project area. The total length of the leveling routes is approximately 62 km at intervals of 300m each. Leveled points were pricked and their positions and heights are shown on the aerial photographs.

3) Field Classification and Completion for 1:2,500 and 1:1,000 Mapping

The area of field classification and completion for 1:1,000 mapping was approximately 2.2 km^2. The area for 1:2,500 mapping was approximately 24 km^2. The field classification was carried out with enlarged aerial photographs before commencement of photogrammetric plotting so that photo-interpretation for the plotting will be effectively aided. The field completion was carried out with draft maps before commencement of the final drawing.

(3) Aerial Triangulation

The aerial triangulation was executed to establish photo controls, so called pass points for each stereo model which is to be used for photogrammetric plotting. The method applied was independent model stereo triangulation. The total number of the models was 70 in 6 flight lines.

(4) Photogrammetric Plotting

1) 1:2,500 Stereo Plotting

The total number of stereo models plotted was 36 and the area was approximately 24 km^2.

2) 1:1,000 Stereo Plotting

The total number of stereo models plotted was 59 and the area was approximately 2.3 km^2.

3) 1:2,500 Editing

The area edited was approximately 24 km^2.
There are 24 sheets (60cm x 80cm).

4) 1:1,000 Editing

The area edited was approximately 2.3 km^2. There are 14 sheets (60 cm x 80 cm).

5) 1:2,500 Fair Drawing

The area and number of sheets of 1:2,500 fair drawing corresponds to that of 1:2.500 editing.

6) 1:1,000 Fair Drawing

The areas and numbers of sheets corresponds to that of 1:1,000 editing.

1-2 SOIL CONDITION

1-2-1 Geology

The bedrock in the subject area of this project is composed of volcanic base rocks where alluvial rocks such as sandy tuff, andesite, etc. are mixed to form the so-called "Panama Formation", and can be broadly classified into the following three sections; the first section corresponds to the built-up area, going from Casco Viejo to Rio Abajo. In this section, alluvial soil forms a stratum on the bedrock with sandy tuff outcrops appearing here and there. The second section is a low swamp land between the Rio Abajo and the Rio Tapia, where alluvial deposits consisting of the foresaid materials cover the Panama Formation with a thickness of 4.5-meter. The third section extends from the Rio Tapia to the Via Domingo Diaz and forms a hill of alluvial soil over the bedrock, as in the first section, with outcrops seen here and there.

1-2-2 Soil Conditions

Corredor Sur is situated on a flat field along the Panama Bay and crosses at many locations the rivers which meander down between hills of 100 to 300 m in height. Many structures to cross over the rivers are required. Moreover, since it is situated on a low swamp land covered with deposits brought down by these rivers, the total construction cost will be affected by the kind of filling and paving structures to be provided. For this reason, both boring and soil examinations were conducted in order to determine the structures to be constructed at the river crossing points and the type of pavement structure and filling method to be applied to the swamp area (See FIGURE II-1-2).

Based on the results of the soil examinations and laboratory tests, the soil was classified under the AASHTO Standard. Its physical properties are shown in TABLE II-1-1, and its cross-section summary is given in FIGURE II-1-3. The typical soil quality and characteristics in the area subject to the Study are as follows:

1) A-7-5

This is clayey soil showing high elasticity, in addition to a proper elasticity index as compared with the liquid limit (LL) and a fair amount of volumetric variation between its wet and dry conditions. It appears on the surface soil of almost all the areas.

2) A-7-6

This consists of clayey soil having a high plasticity index as compared with the liquid limit (LL) and a fair amount of volumetric variation between its normal wet and dry conditions. It appears in the alluvial stratum.

3) A-6

This consists of clayey soil of compressibility and viscosity lower

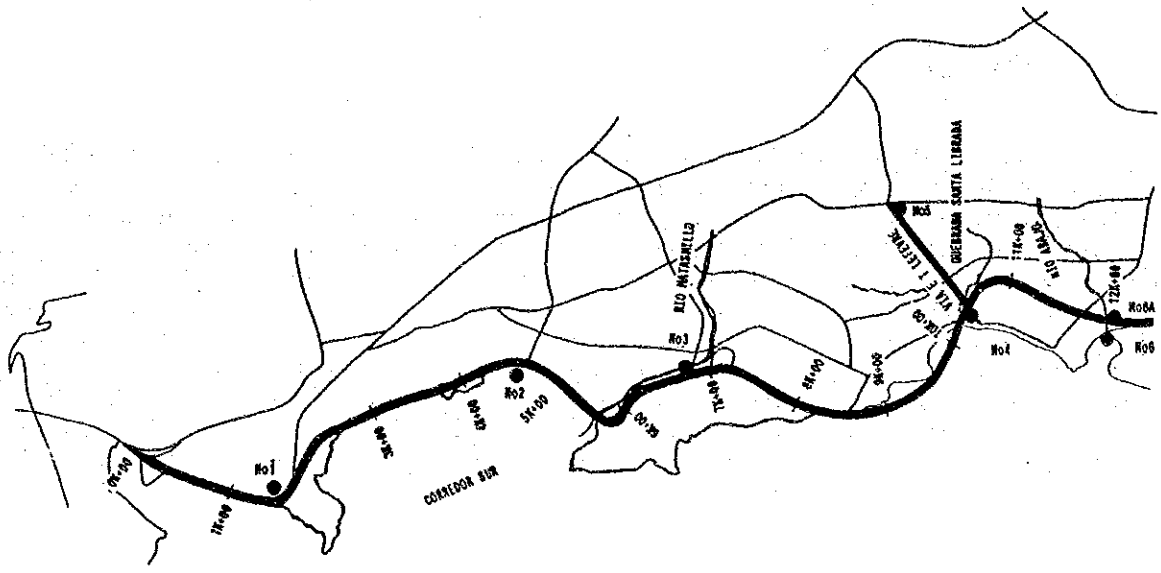


FIGURE II-1-2(1) SOIL SURVEY POINTS

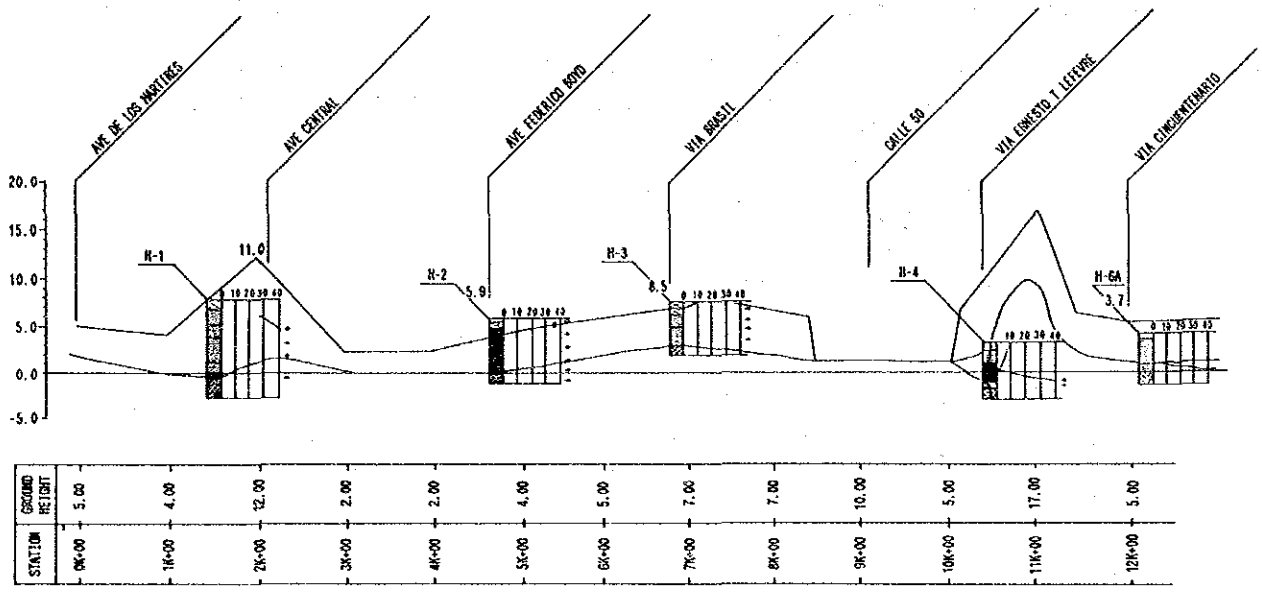


FIGURE II-1-3(1) GEOMETRICAL BORING LOG

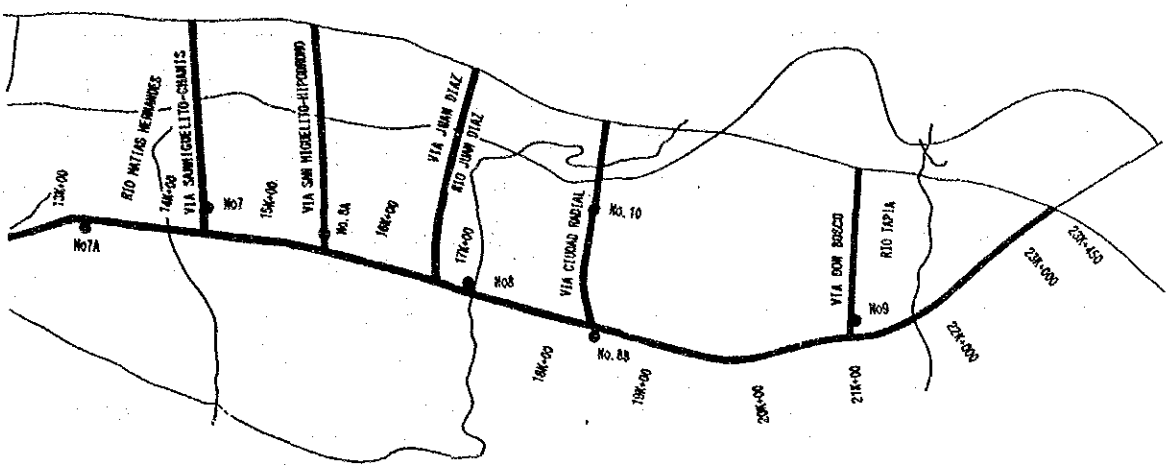


FIGURE II-1-2(2) SOIL SURVEY POINTS

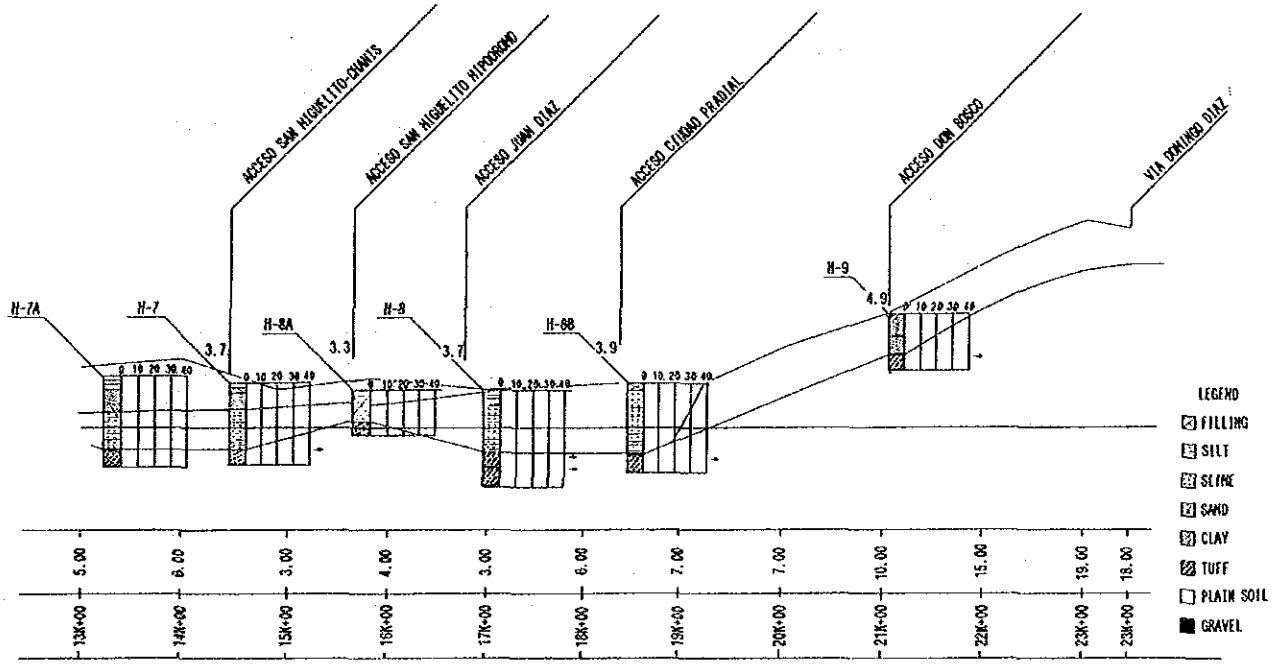


FIGURE II-1-3(2) GEOMETRICAL BORING LOG

TABLE II-1-1 PHYSICAL CHARACTERISTICS OF SOIL

Hole	Soils	Depth Rock (m)	Type	Depth Phreatic (m)
1	Silty clays with high compressibility	8.85	Tufa, RH-2, medium soft rock, weathered volcanic rock	1.45
2	Fine sand	5.50	Tuffaceous agglomerate, OH-1, weathered rock	-
3	Silty clays with high compressibility	4.65	Tuffaceous agglomerate, RH-2, soft rock,igneous rock, weathered zone	-
4	Silty clays with high compressibility and silts with low compressibility	4.10	Weathered basaltic andesite, RH-2,igneous rock of soft hardness	0.00
5	Silty clays with high compressibility	5.00	Tuffaceous agglomerate, RH-2,rock of medium-soft hardness, weathered zone, igneous rock	2.10
6	Silty sand with high compressibility	11.30	Andesitic basalt,RH-4, hard rock, weathered zone	Varies with tide
6A	Clay of low to medium compressibility and very compressible silts	4.00	Andesitic basalt, RH-4, hard rock, weathered zone	1.10
7	Clay with high compressibility	6.15	Shale, RH-2, rock of medium-soft hardness	0.00
7A	Clay with high compressibility	6.70	Weathered fractured rock	1.20
8	Silty clays with high compressibility	5.70	Desintegrated rock,shale RH-2-3, rock of medium-soft to medium-hard hardness, tabular sedimentary rock	Varies with tide
8A	Silty clays with high compressibility	2.70	Weathered rock	Varies with tide
8B	Silty clays with high compressibility	6.70	Weathered rock	0.60
9	Silty clays with high compressibility	3.90	Weathered fractured rock	-
10	Silty clays with high compressibility	3.00	Tufa, RH-1, soft rock, igneous rock	0.00

Source: ESTAMPA

than those classified as A-7, and appears in the surface stratum near Panama Viejo.

4) A-5

This consists of silty soil having a high liquid limit (LL), a high compressibility, and a plasticity limit (PL) below 10, and appears near the Rio Abajo.

5) A-3

This consists of coastal sand often seen along the Panama Bay. It forms a thin stratum of 0-2 m on the seashore between El Maranon and the Rio Mataznillo.

6) A-2-4

This consists of gravels and coarse sands containing silt with a low plasticity limit (PL), and of fine sands containing silt with hardly any plasticity. It appears in the Rio Abajo, the Rio Santa Librada, etc.

7) A-2-7

Except for the fine particles consisting of highly plastic clayey soil classified as A-7, this consists of the same kind of soil as A-2-4 above, and appears in almost the same areas as those of A-2-4.

The area with unstable soil calling for special attention in road construction is the low swamp land of about 7 km extending from the Rio Abajo to the Ciudad Radial area. All other areas are relatively stable. There are also hard rocks distributed under the ground at 3-6 m within the subject area, which offer sufficient structural support.

The soil quality by route section is summarized below:

1) Ave. Balboa (Maranon - Rio Mataznillo)

This section was constructed by reclaiming the seashore. Base rocks are seen here and there, covered with fine sand of 0-3 m thickness. There is an old water route at the west side of the mouth of the present Rio Mataznillo where the supporting stratum is 3-4 m deeper than at any other area.

2) Rio Mataznillo - ATLAPA

This section is covered with 4-5 m of alluvial soil and its quality is of relatively stable clayey soil.

3) ATLAPA - Via E.T. Lefevre

The ATLAPA - Via E.T. Lefevre seashore is a reef zone where the base rocks are exposed.

4) Via E.T. Lefevre - Rio Abajo

This section is covered with 2-3 m of alluvial soil and its soil stratum is relatively stable. The water route situated at the mouth of the Rio Abajo forms a soft ground stratum of 7-8 m thickness composed of silty clayey soil.

5) Rio Abajo - Via Don Bosco

Floods are frequent in this section, which has a soft ground stratum covering the base rocks with accumulated deposits of 4-6 m thickness.

6) Via Don Bosco - Pan American Highway (Tocumen)

This section has a 0-3 m thick alluvial stratum created from the base rocks and its soil quality is of relatively stable clayey soil.

7) Casco Viejo

The seashore in this section is a reef. The ground in the urban area is a stable clayey alluvial stratum of 7-8 m thickness.

8) Via E.T. Lefevre

This section has a 2-3 m thick alluvial stratum created from the base rocks, and its soil quality is an alluvial of relatively stable base stratum.

9) Via San Miguelito-Chanis

This road is situated near by and parallel to the Rio M. Hernandez. The valley portion of this river forms a soft ground consisting of accumulated deposits, while the hill portion consists of stable clayey soil formed by the weathering of the base rocks.

10) Via San Miguelito Hipodromo

Soft ground of 3-6 m formed by accumulated deposits exists around the intersection with Corredor Sur, but a hill consisting of stable clayey soil is the majority of this section.

11) Via Juan Diaz

This road is situated parallel with the Rio Juan Diaz. Soft ground of 3-6 m formed by accumulated deposits exists around the intersection with Corredor Sur, but a hill consisting of stable clayey soil is the majority of this section.

12) Via Ciudad Radial

Soft ground of about 7 m consisting of accumulated deposits exists around the intersections with the Rio Juan Diaz and Corredor Sur, while the remaining area is a hill consisting of stable clayey soil.

13) Via Don Bosco

This route is situated on a hill with the soil being clayey soil consisting of stable alluvial.

1-3 HYDROLOGICAL CONDITION

Since the subject route will be situated on the coastal low lands, it will cross a number of rivers. For this reason, structures to cross the rivers are designed for a number of locations. This section is used as basic reference material for determining the size of the structures so as to allow flooding water from the rivers to flow safely under the structures, as well as being reference material for planning the drainage facility design to be included in the preliminary design.

Corredor Sur crosses the rivers listed in TABLE II-1-2. The catchment areas of these rivers are also given in FIGURE II-1-4. Most of these rivers are tidal rivers.

TABLE II-1-2 CATCHMENT AREA OF RELATED RIVERS

River Name	Catchment Area (km2)	River length (Km)
Rio Mataznillo	11.1	6.4
Quebrada Sta. Librada	4.6	3.0
Rio Abajo	22.5	12.0
Rio Matias Hernandez	21.0	11.0
Rio Juan Diaz	145.2	24.0
Rio Tapia	21.7	11.0

Source: ESTAMPA

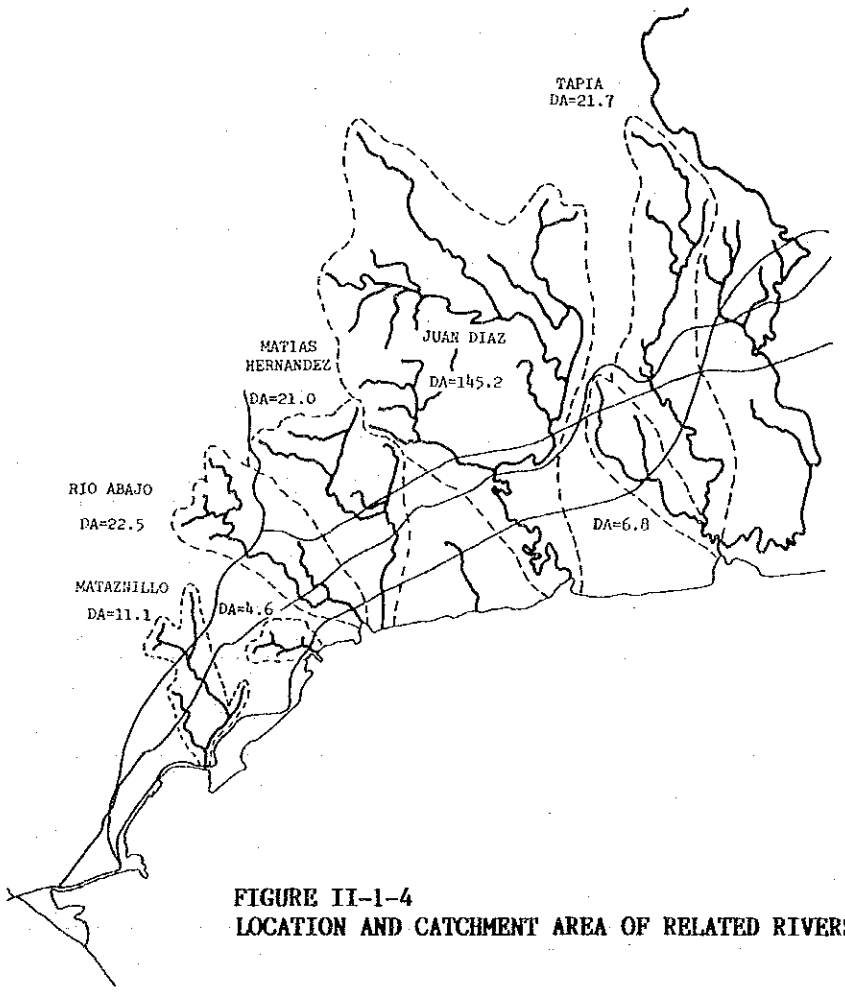


FIGURE II-1-4
LOCATION AND CATCHMENT AREA OF RELATED RIVERS

Past tide levels were determined, using the tidal observation data collected at the Port of Balboa by the Canal Commission. The results are shown in TABLE II-1-3.

TABLE II-1-3 TIDE RECORD AT BALBOA PORT

Item	(m)
Maximun tide	3.223
Mean hight tide	2.813
Mean low tide	-3.047
Minimun tide	-3.557
Mean tide range	1.963
Maximun tide range	2.883

Source: Canal Commission

For the probable rainfall intensity to be applied to the drainage structures, the Talbot's type formula obtained based on rainfall data taken in Panama City over a period of 56 years was used (TABLE II-1-4).

TABLE II-1-4 PROBABLE RAINFALL INTENSITY

Return Period (years)	Probable Rainfall Intensity (inches/hr)
2	237/(29 + t)
5	294/(36 + t)
10	323/(36 + t)
20	357/(37 + t)

Note, T: Duration in min.
Source: MOP. Informe de Drenaje Pluvial Ciudad de Panama

Since this formula is used for urban drainage with a relatively small catchment area, calculation was made by using FIGURE II-1-5 calculated by IRHE, for rivers having a catchment area of 20 km^2 or more, such as Rio Abajo, Rio Matias Hernandez, Rio Juan Diaz, and Rio Tapia (TABLE II-1-5). Based on this flood volume, the bridge length was studied.

TABLE II-1-5 PROBABLE FLOOD VOLUME

(m3/sec)

River Name	Catchment Area (Km2)	Probable Flood Volume (m3/sec) Return Period 20 years	50 years
Rio Mataznillo	11.1	96	125
Quebrada Sta. Librada	4.6	43	55
Rio Abajo	22.5	185	240
Rio Matias Hernandez	21.0	175	230
Rio Juan Diaz	145.2	1010	1250
Rio Tapia	21.7	135	180

Source: Departamento de Hidrometeorologia del I.R.H.E.

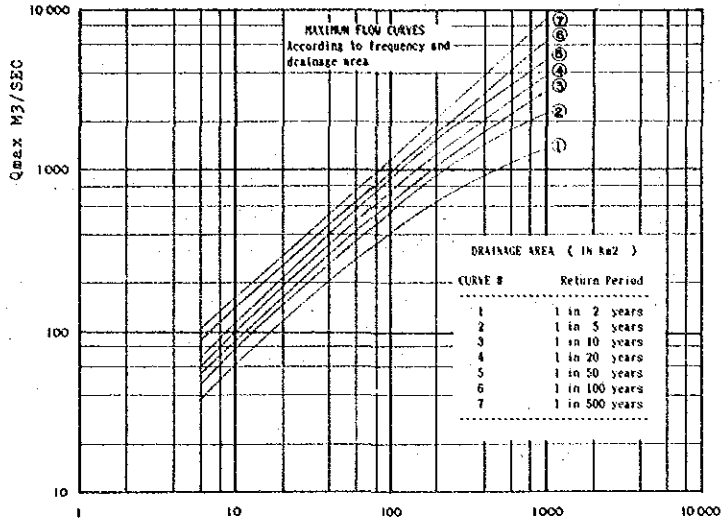


FIGURE II-1-5 MAXIMUM FLOW CURVES

The return period for each structure is set as shown in TABLE II-1-6. For the run-off coefficient, the coefficient "C" was set to be applied, taking the future land use plan into consideration (TABLE II-1-7).

TABLE II-1-6 PROPOSED RETURN PERIOD

System	Return Period (years)
Storm Drainage System	2
Culvert, Retaining Wall, Permanent Structure	5
Bridge	50

Source: ESTAMPA

TABLE II-1-7 PROPOSED RUN-OFF COEFFICIENT

Area Classification	C. Values
Park and Green Area	0.25
Hilly Area	0.30
Residential Area	0.50
Pavement	0.80

Source: ESTAMPA

2. LAND USE CONDITION

2-1 PRESENT LAND USE

The economic activities in Panama City and its surrounding area can be represented by the commercial activities such as banking facilities, retail shops for consumers and other general services.

The characteristic of land use in this area therefore can be described as the location of commercial activities and residential area which supports the above activities. (See FIGURE II-2-1)

2-1-1 Comercial and Industrial Areas

Traditional centers of commerce are located in each of the corregimientos of Santa Ana and Calidonia in the western part of Panama City. The mainly retail businesses there are still doing a brisk trade at present. Bella Vista is the new commerce, business, and financial core of Panama City. It has spread along both sides of the streets of Via Espana and Calle 50. A giant shopping center was constructed on Via Ricardo J. Alfaro in Bethania, around 1980. An explosive expansion of new locations for commercial facilities has been occurring since that time.

The result is that when commerce in the city is summarized, a total of 4 locations for commercial centers can be seen. In the traditional Centro and the Bella Vista, for central commerce and business, and in El Dorado and Paitilla, for new commerce.

Industries are scattered in the suburban areas of Panama City, along the Via Transistmica, Via Ricardo J. Alfaro, and Ave. Jose A. Arango and in the San Miguelito district. These are all either light industries or manufacturing industries such as woodworking (mainly furniture), garments, beverages, ice-making, potteries, bricks and blocks for building construction, etc.

2-1-2 Residential Area

For the past several years there has been a trend of great expansion of residential developments in 5 corregimientos (Juan Diaz, Bethania, Rio Abajo, Parque Lefevre, and Bella Vista), in Panama City, and in the San Miguelito district. This phenomenon signifies that housing development is now moving to the suburban areas. Considered by location, the north area of Via Ricardo J. Alfaro, Chanis along the Via Espana, and Juan Diaz, have shown a great increase in development. A vast housing development is now expanding in the hilly area of San Miguelito, between the two roads, Via Transistmica and Via Domingo Diaz.

In Juan Diaz, urbanization is limited to large-scale housing developments along Via Espana and in the eastern part, and the new housing development in the western part of this area, because of problems with flooding which has resulted from the rise in the water level of the river around the mangrove area.

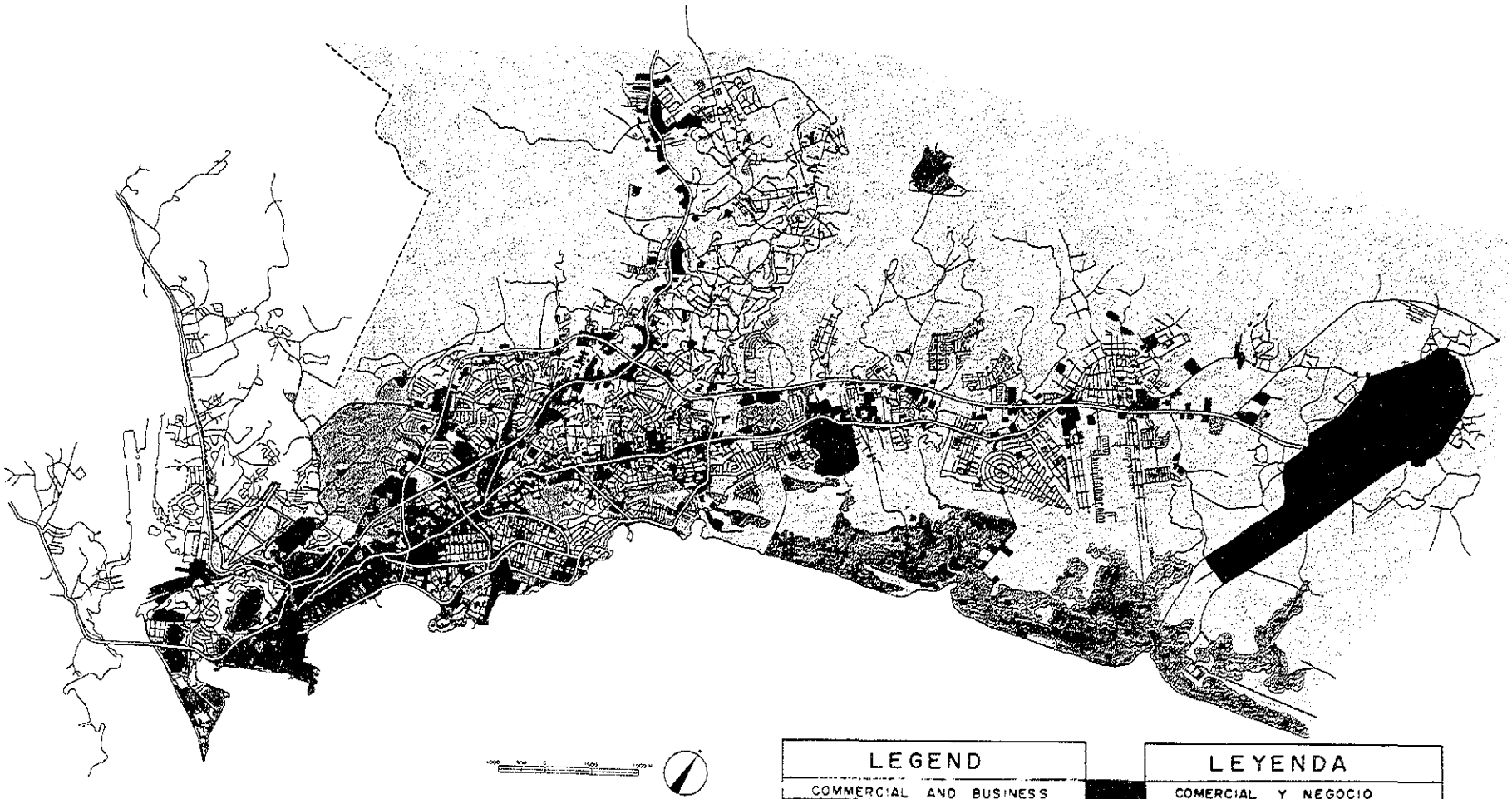


FIGURE II-2-1 PRESENT LAND USE

On the other hand, housing developments for those with low incomes have been created around Via Transistmica in the San Miguelito district, under the leadership of MIVI. Recently, large-scale housing developments have been expanding rapidly on the north side of Via Domingo Diaz, too.

2-1-3 Other Land Use

1) Governmental Facilities

Various governmental facilities are scattered in Calidonia, Albrook, Bella Vista and other areas, in addition to San Felipe where the presidential office is located.

2) Educational Facilities

In the center of the city, main campuses of both the Panama National University and the Panama Technological University are located in Bella Vista, while the private Santa Maria University is in Bethania. The Tocumen campus of the foregoing Panama Technological University is located near the Omar Torrijos International Airport in the suburban area. Private elementary and junior high schools are concentrated in San Francisco, forming an educational area.

3) Traffic Facilities

For the railway, the Balboa and Pedro Miguel stations of the Panama/Colon Railway are located in the Balboa district. For the airports, the Paitilla Airport, which mainly provides domestic services, is situated near the city center, while the Omar Torrijos International Airport is in the Tocumen area at the east end of Panama City. Port facilities include the Port of Balboa, the biggest on the Pacific side in Panama, the Muelle Fiscal in Santa Ana for transporting passengers to remote areas by boat, and a fishery port in its vicinity.

4) Recreation Facilities

The main large-scale green areas are the Metropolitan Natural Park (265 ha) located in the reverted area and the Parque Recreativo Omar in San Francisco. Historical relics, the Panama Viejo and the Casco Viejo, are situated along the seashore.

2-2 DEVELOPMENT CONCEPT AND FUTURE LAND USE

2-2-1 Proposed Roadside Projects

Most sections of the route of Corredor Sur pass through or near existing urban areas, and thus there are many concepts and plans for urban development projects. Therefore the position of Corredor Sur can be defined as that of an urban corridor which is the central axis of a cluster of these urban development projects. (See FIGURE II-2-2)

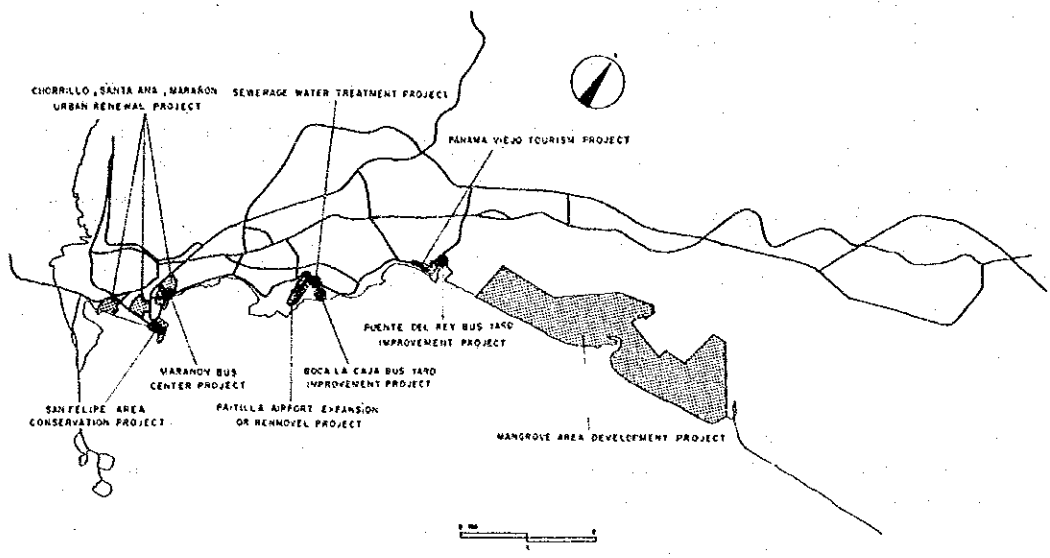


FIGURE II-2-2 EXISTING URBAN DEVELOPMENT PROJECTS ALONG CORREDOR SUR

The effects of these various development projects in the Corredor Sur plan, and the feasibility of unified improvement, will be examined in this chapter.

(1) San Felipe Historical Area Preservation Project

1) Project Background

A historical area preservation project is being considered in Panama City, for the Panama Viejo area, which was built at the beginning of the 16th century, and for the Casco Viejo area, which was built in the latter half of the 17th century. The walled castle city of Casco Viejo mentioned here was located in the San Felipe area, and contains rare historic remains.

In recent years, however, the tendency of modifying single residential houses into apartment houses has been progressing, and has led to the increase of population density. Improvements and administration of this historical area, have been carried out by I.N.A.C. (Instituto Nacional de Cultura) and I.P.A.T. (Instituto Panameno de Turismo).

2) Project Purpose and Contents

The purpose of the San Felipe historical area preservation project is to achieve both the preservation of its historic inheritance, and its improvement, as a basis for tourism.

The contents of the project are as follows;

a. Preservation of the original forms of historic structures
b. Arrangement of a proper road network, and the following on of existing road standards
c. Acceleration of the decrease in residential population density
d. Refinement of 4 plazas, which are the central components of the area
e. Conversion of the uses of historic buildings to hotels, museums, restaurants, etc.
f. Continued use of the facilities of government organizations.

3) Relation to Road Plan

From the viewpoint of preservation of the historical area and improvement of the bases for tourism, it is necessary that the beauty of the scenery around various facilities be taken into consideration.

(2) El Chorrillo and Santa Ana Urban Renewal Project

1) Project Background

The Santa Ana and EL Chorrillo areas began at the turn of the century. The majority of the buildings in both these areas were constructed of wood. Many were built in a very early period, and are therefore in a poor state of repair. The project is therefore to rebuild these areas, from time-worn, low-rise wooden houses, to medium and high-rise concrete housing, while simultaneously creating an appropriate traffic network.

2) Project Purpose and Contents

The project purpose is to carry out the transformation from superannuated houses to medium and high-rise apartment housing.

The project has been progressing in both the El Chorrillo and Santa Ana areas since 1970, and the Chorrillo East has recently been included in the urban renewal project, so as to accelerate the improvements in both the above areas. The project is for achievement of the replacement of the superannuated, mixed commercial and residential buildings in these areas.

3) Relation to Road Planning

The housing redevelopment project does not include the road widening. It is therefore necessary to make adjustments in the road plan and the redevelopment project for the purpose of reducing traffic congestion problems.

(3) Maranon Urban Renewal Project

1) Project Background

Expansion of the Maranon residential area has been evident since the 1930s, but superannuation and illegal occupancy by people of low income levels, have been increasing. As a result, since the mid-1960s, the operation of removal of residents to the east sector of the suburban area has been carried out by the government. At present, almost all of the entire area remains as vacant land. Various plans have been announced for the urban renewal of this vacant land since the latter half of the 1970s. However, none of these have attained their aim.

2) Project Purpose and Contents

A plan for the concentrated placement of facilities for government organizations was announced in 1981, for this large area of vacant land, but this plan, too, has not shown any signs of implementation.

3) Relation to Road Planning

The site for the bus center project, which will be described later, is located in a section of the area of the Maranon urban development project.

If the bus center plan is affected by a change in the project for the entire Maranon area, a readjustment with Corredor Sur will be needed.

(4) Bus Center Project in Maranon

1) Project Background

The Maranon Bus Center is one of the 4 bus centers for which a feasibility study was performed by ESTAMPA II for Panama City. This proposed bus center is to be located near Plaza 5 de Mayo, the busiest section of Panama City, and is the largest in scale of the 4 proposed bus centers.

2) Project Purpose and Contents

The bus center is to be established as the starting point and terminus for the bus routes operated in Panama City. 28 bus berths will be set up in the center facilities, with an overhead corridor connecting the individual berths. Some commercial facilities will be located adjacent to the bus center site, and unified improvement of the district is being studied.

3) Relation to Road Planning

The existing plan for the bus center is one of the considerations of the Corredor Sur planning.

(5) Expansion (or Transfer) Project for Paitilla Airport

1) Project Background

Improvement of airport facilities has been considered, because of

the increase in service (increase in number of flights), and the increase in the number of high-rise buildings around the airport. A marine airport plan was also studied in 1983, by the Direccion de Aeronautica Civil.

2) Project Purpose and Contents

The new Marine Airport, planned offshore from Boca la Caja, and the transfer of functions to other airports, etc., have been studied in the Direccion Aeronautica Civil, for the purpose of improving airport function. Extension of runways toward the sea was done in the mid-1970s, and there are no other particular development plans at present. The marine airport plan is now showing some signs of being directed toward realization.

3) Relation to Road Plan

Via Israel (the name for the east side of Ave. Balboa), curves around the north end of the existing airport's runways. The possibility of improving the alignment of Via Israel should therefore be examined, based on the plan which shifts the existing airport to the offshore location.

(6) Sewage Treatment Construction Project

1) Project Background

At present, untreated waste water from every household in the area flows directly into the nearby rivers and is carried out to the Panama Bay. As a result, water pollution in the bay has increased, and noxious odors are being emitted.

2) Project Purpose and Contents

The construction of 10 pumping stations and 2 sewage treatment plants is planned, as well as the improvement of the sewer system trunk line in the east-west direction, including the Ave. Balboa segment, in accordance with the Urban Drainage Study (prepared in 1977).

3) Relation to Road Plan

The drainage pipeline will be buried under Corredor Sur, which is under the existing Ave. Balboa, or under future land fill. At this moment, an adjustment between both projects still presents difficulties due to the difference in the progress stage of these two projects. Therefore, preliminary design work on roads would not warrant serious consideration at this point.

(7) Bus Yards

1) Project Background

At present, about 30 bus yards (piqueras) are distributed in Panama City. The piqueras near the Corredor Sur route are COOMETRAP, Boca La Caja, Puente del Rey, Bello Horizonte and Juan Diaz, but piquera functions here are carried out on the road, except COOMETRAP, even though these are both starting and terminus points for the bus routes.

2) Project Purpose and Contents

All of those piqueras use the public road, occupying the roadway exclusively, for the processing of bus services and movements in and out. This means that there is a great impact on the access of vehicles in the surrounding area, to houses or factories. In the future, it will be impossible to avoid the occurrence of traffic congestion, as the number of residents increase.

A main problem is the case of the piquera at Puente del Rey, because it was located near the solid waste treatment area on the right side of Rio Abajo until 1984. However, since 1984, this piquera has been moved to a roadside site in the Panama Viejo Historic Preservation area. This, however, is exempt from IPAT's Panama Viejo Preservation scheme. Therefore, the determination of a scale for piqueras and the selection of appropriate sites, with consideration given to the future expansion of residential areas, are necessary.

3) Relation to Road Plan

The relationship between the route of Corredor Sur and the location of expected piqueras, is to be considered.

(8) Panama Viejo Historical Area Preservation Project

1) Project Background

Panama Viejo is the section where the remains of historic buildings built in the 16th century, are found. This is the birthplace of Panama. Stone buildings built at that time have gradually been collapsing, as nearly 400 years have passed since their construction. There is also anxiety about the possible disappearance of the remains themselves, if they are left without any protection. Therefore, Panama Viejo has been designated as a "historic area" by law, and a master plan for this area was prepared.

2) Project Purpose and Contents

The proposal was presented for the purpose of the preservation of historic buildings and the restoration of street patterns to their original state, partially closing Via Cincuentenario, which passes through this area. Preservation projects have also been planned for each building, as well as the construction of cultural, educational, and tourist facilities, including a museum. The scope of this proposal covers a total of 28 ha.

3) Relation to Road Plan

The proposed plan is to close a part of Via Cincuentenario, which passes through the historic preservation area. It will be necessary therefore to establish an alternative route, either along the seashore, or inland, or else the construction of an alternative road. The relationship of the historic site to the road, must thus be carefully considered.

(9) Mangrove Area Development and Regulation Project

1) Project Background

The mangrove area is near the existing urban area, with the development of the surrounding area expected to be accelerated by the opening of Corredor Sur.

The various development projects are regulated and guided by the "Normas para el control y desarrollo del sector de manglares del Corregimiento de Juan Diaz", prepared by MIVI (the Ministry of Housing) and related government bodies, in 1979.

2) Project Purpose and Contents

Applications for housing developments in the mangrove area and the area surrounding it, have been presented to MIVI. The Ministry of Housing, the Ministry of Commerce, the Ministry of health and Welfare, and the Panama municipality, plus concerned government bodies, are to decide whether or not authorization will be granted for each of these applications.

However, all of these government bodies are concerned, and take the attitude that basically they will not authorize developments which invade the mangrove development regulated area. The main reason for restricting the development in and near the mangrove area, is the problem of destroying the spawning and hatching grounds for marine creatures, especially shrimps, by thoughtless random development.

3) Relation to Road Plan

A route for Corredor Sur will be selected which will not as a principle invade the area subject to mangrove area development restrictions.

2-2-2 Bay Area Future Scheme

This Chapter will describe the social background along Corredor Sur. The outline of socio/economic frames and direction of city growth as planned in ESTAMPA Masterplan will be described for the entire Panama Metropolitan Area and the Bay area separately. Corredor Sur will be planned based upon the future socio/economic frames as in ESTAMPA Masterplan but the future utilization concept of Panama Bay coastal area will additionally be studied to get a more concrete image of the future Corredor Sur.

(1) Urban Structure

The urban structure of Panama City in the future, that is, the urbanization of Panama City, will expand in two directions, one extending toward the Tocumen area in the eastern direction, and one in the other direction along the axis of Via Transistmica in the northern direction. The development in the northern section of Panama City will progress as an expansion triggered by the future construction of Corredor Norte and by large-scale housing development in the San Miguelito district. On the other hand, the area along the ocean shoreline is developing for the eastern direction, to provide sites for housing development. As a result,

the shape of the urban area of Panama City can be seen as roughly triangular, with Panama Bay as its base, and with Via Transistmica as its future apex. (See FIGURE II-2-3)

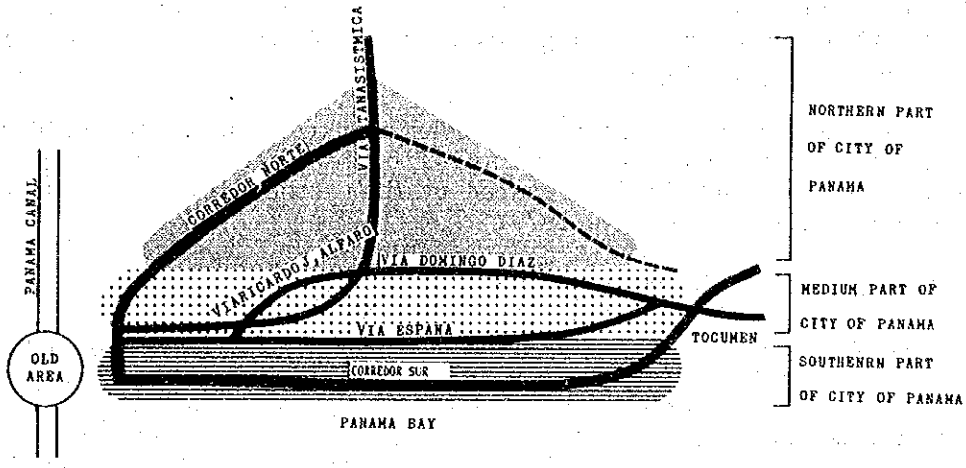


FIGURE II-2-3 FUTURE URBAN STRUCTURE OF PANAMA CITY AND ADJACENT AREAS

From the FIGURE II-2-3, future expansion of the built-up area can be characterized as three accumulated strips:

a. The northern strip has two principal arterials of Via Transistmica and the future Corredor Norte, and neighboring residential developments.

b. The central strip has the east-west axis of Via Espana, Via Ricardo

J. Alfaro and Via Domingo Diaz, consists of the built-up area and future suburban residential developments.

c. The southern strip has the east-west axis of Corredor Sur and consists of the western built-up area and the eastern residential sprawl.

In this case, the coastal area of Panama Bay means: the future urban area along the Panama Bay, from the central strip to the southern strip, of those described above.

(2) Social Movement

For the purpose of detecting the trend of future urbanization in the shoreline area along the Panama Bay, the growth of the residential population and working population, will be examined for the southern half, running southward from Via Domingo Diaz and Via Espana, which are on the east-west axis of Panama City. (See TABLE II-2-1)

TABLE II-2-1 POPULATION AND EMPLOYEES IN COASTAL ZONES (YEARS 1980, 1990, AND 2000)

Zone	POPULATION 1980	1990	80/90(%)	2000	INC.RATE% 90/2000	INC.RATE% 80/2000	EMPLOYMENT 1980	1990	80/90(%)	2000	INC.RATE% 90/2000	INC.RATE% 80/2000
1 San Felipe	11704	9700	0.83	8000	0.82	0.68	6760	6395	0.95	6025	0.94	0.89
2 El Chorrillo	25209	24030	0.95	22900	0.95	0.91	6250	7405	1.18	7830	1.06	1.25
3 Santa Ana	27803	27500	0.99	27200	0.99	0.98	15590	22330	1.43	23035	1.03	1.48
4 Calidonia Sur	5022	5540	1.10	7100	1.28	1.41	9035	16580	1.84	19200	1.16	2.13
5 Calidonia Norte	23271	21520	0.92	19900	0.92	0.86	16795	20155	1.20	21315	1.06	1.27
7 La Cresta	1489	1640	1.10	1800	1.10	1.21	6865	8085	1.21	8675	1.07	1.30
8 U.C. Alegre	8826	7230	1.06	7600	1.05	1.11	11865	24280	2.05	34115	1.41	2.88
9 Obarrio	7079	7410	1.05	7700	1.04	1.09	6965	13270	1.91	18170	1.37	2.61
10 El Cangrejo	12697	13480	1.06	14200	1.05	1.12	12610	19285	1.53	24225	1.26	1.92
11 Punta Paitilla	7745	8860	1.14	10100	1.14	1.30	7530	12040	1.60	16160	1.34	2.15
12 San Francisco	12160	13280	1.09	14500	1.09	1.19	4520	5195	1.15	5400	1.04	1.19
13 El Golf	15139	16610	1.10	18200	1.10	1.20	6890	8505	1.23	9400	1.11	1.36
14 Vista Hermosa	7351	8060	1.10	8800	1.09	1.20	4925	7590	1.54	8135	1.07	1.65
15 Pueblo Nuevo	13724	15310	1.12	17100	1.12	1.25	4195	5665	1.35	6645	1.17	1.58
19 Parque Lefevre	23309	25530	1.10	28000	1.10	1.20	5240	5305	1.01	5375	1.01	1.03
20 Chanis	10813	12130	1.12	13600	1.12	1.26	1245	2085	1.66	2255	1.09	1.81
21 Rio Abajo	15169	16570	1.09	18100	1.09	1.19	3850	5985	1.55	6355	1.06	1.65
22 Villa Lorena	16787	18960	1.13	21400	1.13	1.27	1400	2415	1.73	2680	1.11	1.91
23 Hipodromo	18885	22180	1.17	34300	1.55	1.82	6830	8900	1.30	14190	1.59	2.08
24 Juan Diaz	32879	37590	1.14	61500	1.64	1.87	2760	5895	2.14	12105	2.05	4.39
26 Nuevo Aeropuerto	0	0	-	0	-	-	2250	2880	1.28	3780	1.31	1.68
South Zones Total	295061	313130	1.06	362000	1.16	1.23	144170	210225	1.46	255070	1.21	1.77

Source: ESTAPA

1) Movement of Population

Classification of the coastal area of the Panama Bay into: the area west of Obarrio, the area from Paitilla to Rio Abajo, and the area east of Chanis, shows individual characteristics for population movement. The trend of population increase will spread over the entire area west of Obarrio by the latter half of 1980, and all vacant land will be completely occupied. The population increase will level off here, but east of Paitilla, the increase will be sharp. The area east of Chanis will have about 60% of the total population increase for the coastal area during the 10-year period ending in 1990, and will have 75% of the population increase in 20 years by the year 2000. (See FIGURE II-2-4)

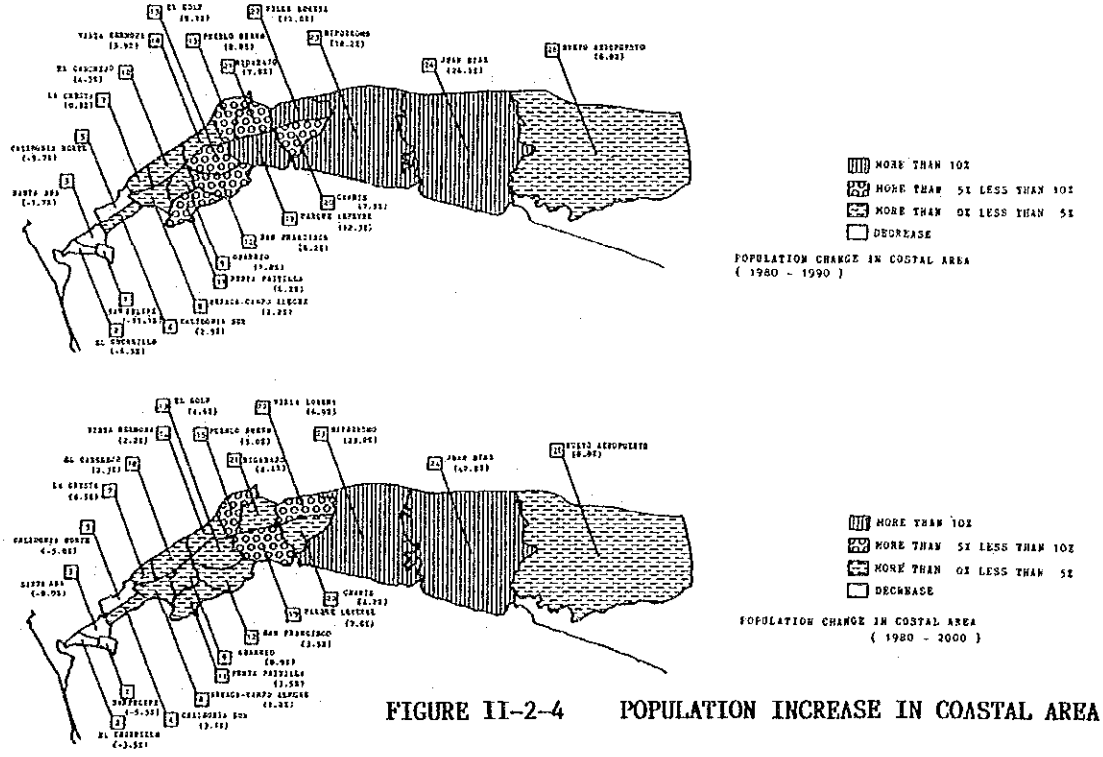


FIGURE II-2-4 POPULATION INCREASE IN COASTAL AREA

2) Movement of the Working Population

Future growth of the working population at the workplace (hereafter called "employee's population") is compared by individual zones, and results are as shown in FIGURE II-2-5.

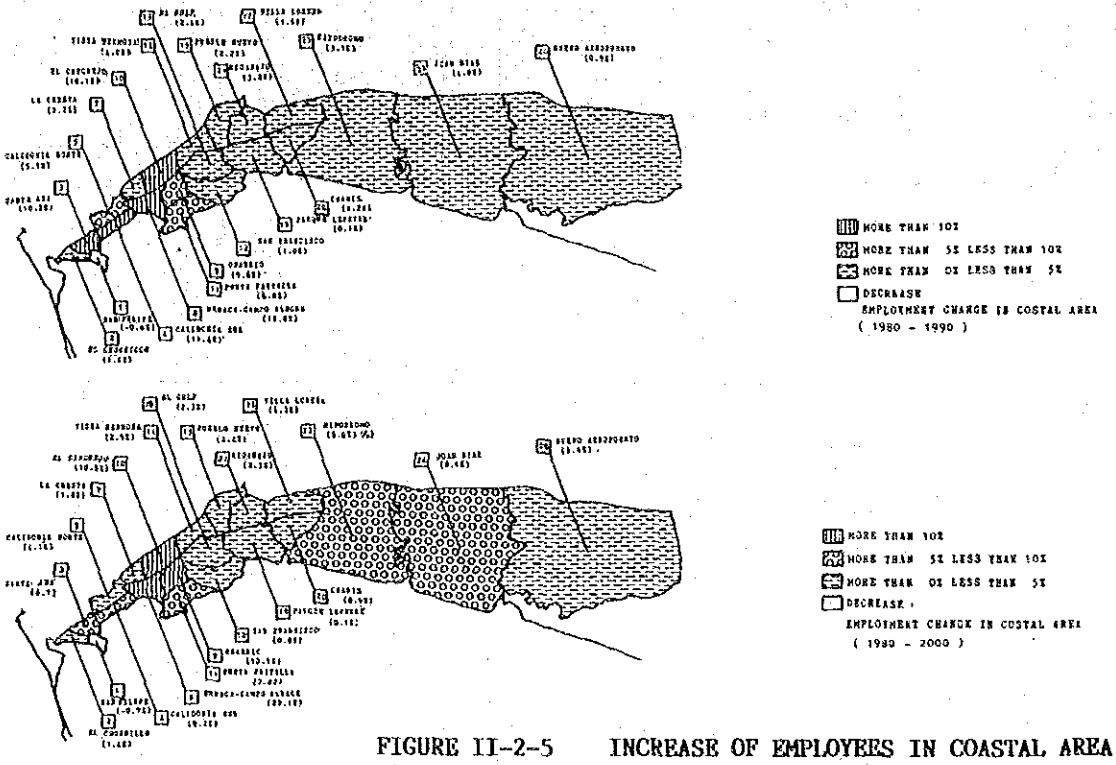


FIGURE II-2-5 INCREASE OF EMPLOYEES IN COASTAL AREA

In the 10 years from 1980, almost 75% of the total increase in employees along the entire coastal area will be in the area west of Punta Paitilla. By the year 2000, this will decrease slightly, to about 70%. However, concentration of the labor force into existing commerce areas will continue for a long period of time. In the 20-year period to the year 2000, the employee's population will increase remarkably in the Hipodromo and Juan Diaz areas, because the number of workers for local service enterprises will grow at the same rate as the explosive increase in residential population in both these areas.

(3) *Development Direction for Water Front Area*

According to the integrated consideration of, future land use of the hinterland, existing facilities, and natural environmental potential, use of the Panama Bay shoreline is expected to be improved in accordance with the following principles :

a. Improvement of tourist base points, using historical sites
b. Improvement of the base points of marine recreation facilities
c. Improvement of the hinterland recreation area, employing the distinctive features of the scenic views
d. Improvement of the shoreline, which has historic significance, by active use of the waterfront
e. Preservation of the ecological system in the mangrove vegetation area

Improvement concepts for the waterfront, based on the above improvement principles for each section, will be given below. (See FIGURE II-2-6).

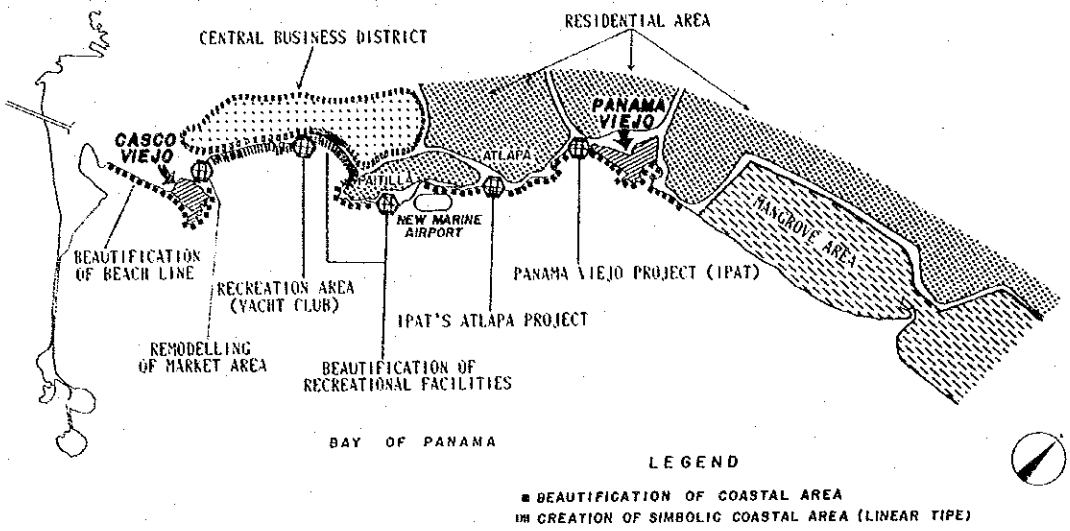


FIGURE II-2-6 DEVELOPMENT CONCEPT ON COASTAL AREA

1) El Chorrillo - San Felipe

The beautification of the waterline, which will create public access to the waterfront, along with on going redevelopment projects in the El Chorrillo and Santa Ana areas, the San Felipe historical area preservation project, and integrated improvement of the public market, and piers, etc., will be completed.

2) Maranon - Paitilla

This oceanfront road has the best scenic view in Panama City. The waterfront here should be improved, to provide an area where citizens can use the seashore and enjoy the scenic view, in the future.

This area is obviously uniquely symbolic for Panama and unified improvement should be done on various commercial and business activities of the hinterland and the shoreline, with spatial and functional considerations.

3) Paitilla - Panama Viejo

Beside the high-class residential areas, recreational facilities can be improved in Punta Paitilla. Next to it, the airport, factories and ordinary residences can be seen right to the shoreline. The vacant lot which will appear after removing the airport can be utilized for use of a tourist area by providing recreational facilities. The rest of the waterfront, however, cannot be expected to be developed due to its land use. The east side of this section has many facilities, which are suitable for use by citizens, such as the International Convention Center (ATLAPA), hotels, and Panama Viejo tourist area. Therefore, this area can be considered to have first priority for improvement as a waterfront recreational area. However, it is of urgent necessity to establish restrictions to protect the scenic view, with special concern for Panama Viejo and the surrounding area.

4) Juan Diaz

This mangrove area will continue to have restrictions placed upon every type of development, for protection against the destruction of the natural environment.

2-2-3 Future Land Use

(1) Movement of Urbanization and Land Use

The employee's population is increasing steadily in the western part of the coastal area, rather than decreasing or remaining the same as is the residential population. Therefore, the conversion of existing residential sites to the mixed use of commerce, business, and dwellings is expected. At the same time existing residential sites achieve an integrated use. Construction in U.C.Alegre, El Cangrejo, Calidonia Sur and the surrounding area where the increase in employee's population is predominant, will be especially vigorous, due to the expansion of business scale, or to the conversion of usage. This trend in land use centered around commerce and business will, however, expand toward the east, along the principal arterials, but when considered in terms of surface area, a residential urban sprawl phenomenon, or an increase of density, can be expected. Commerce in the eastern part of the city will expand along the existing Ave. Jose Arango. However, around the newly opened Corredor Sur, commerce is expected to locate, as the satelite-core type, at the major base points of various housing developments. (See FIGURE II-2-7)

(2) General View of Future Land Use along Corredor Sur

FIGURE II-2-8 is a general view of this, correlating the land uses on the inland side, and uses of the waterfront which have been described as far as the previous section.

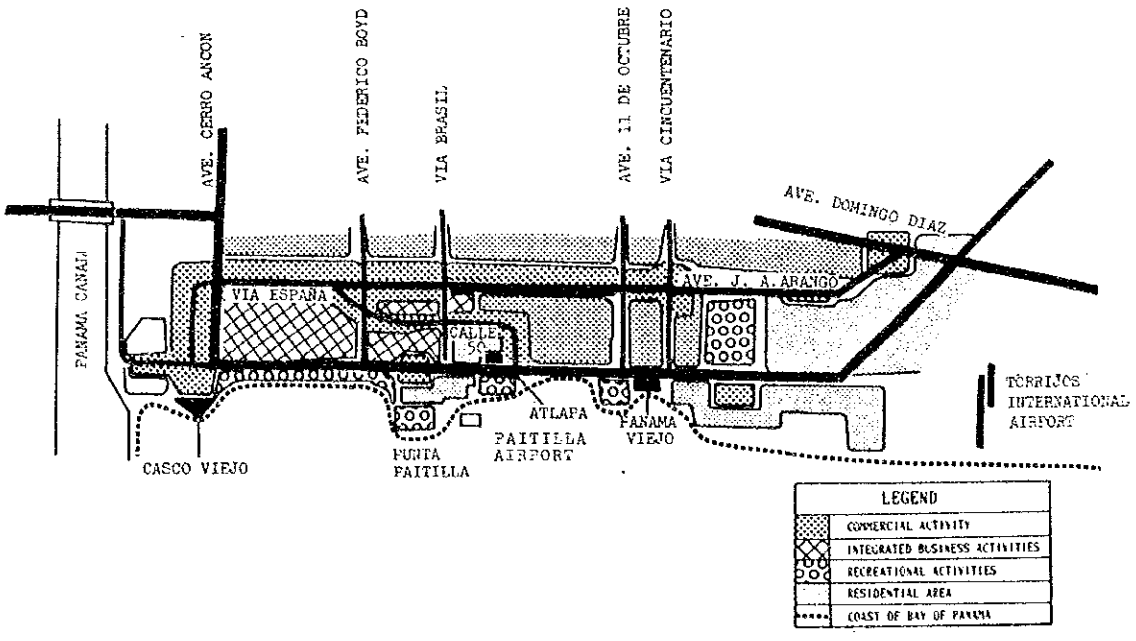
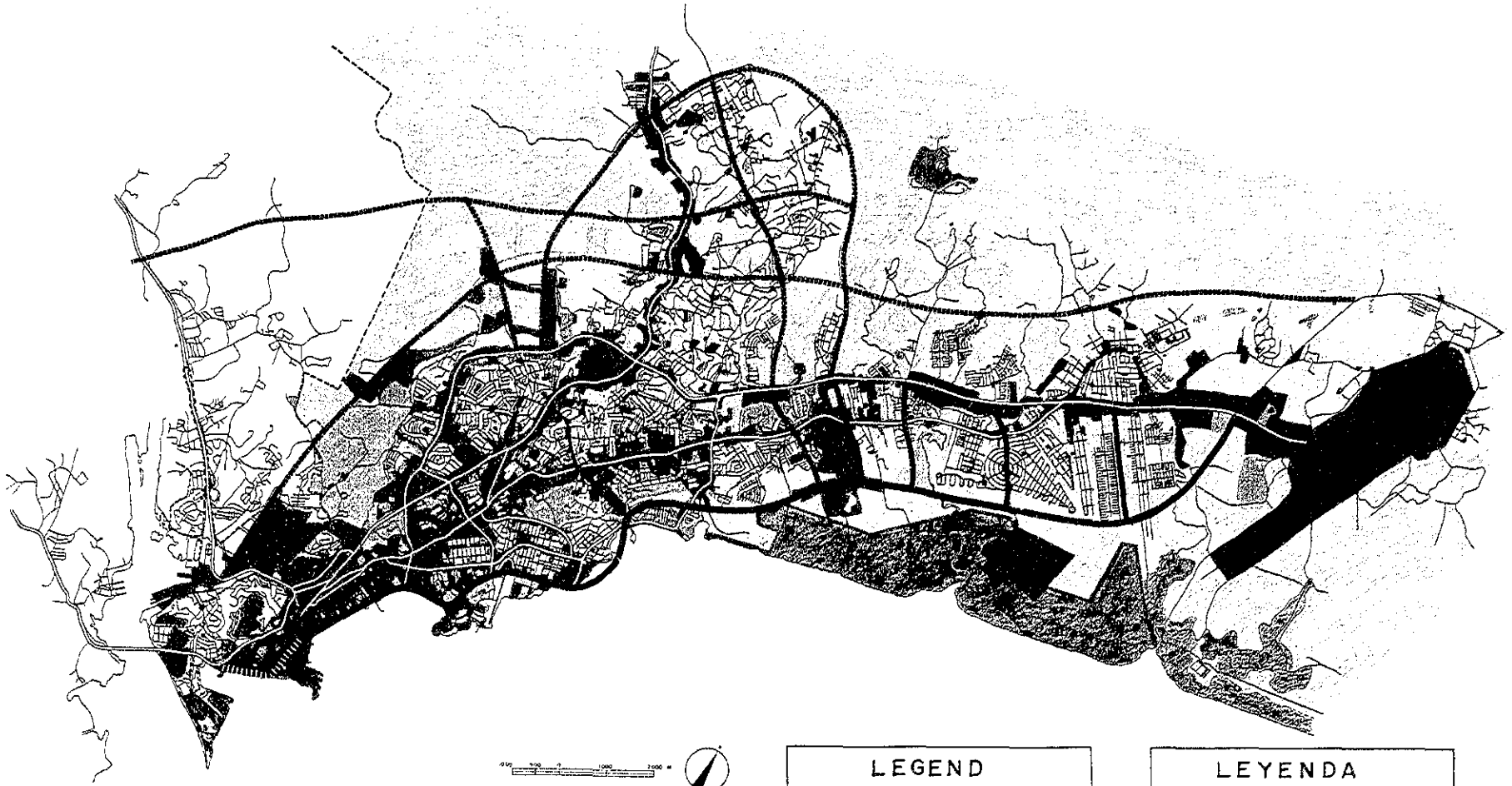


FIGURE II-2-8 GENERAL IMAGE OF FUTURE LAND USE ALONG CORREDOR SUR



LEGEND		LEYENDA
COMMERCIAL AND BUSINESS		COMERCIAL Y NEGOCIO
RESIDENTIAL – LOW DENSITY		RESIDENCIAL – BAJA DENSIDAD
RESIDENTIAL – HIGH DENSITY		RESIDENCIAL – ALTA DENSIDAD
INSTITUTIONAL		INSTITUCIONAL
RECREATIONAL AND RESERVED		RECREATIVO Y DE RESERVA
EDUCATIONAL AND MEDICAL		EDUCACIONAL Y SALUD
INDUSTRIAL		INDUSTRIAL
TRANSPORTATION		TRANSPORTE
PARKS		PARQUES
NON – USED AREA		AREA NO UTILIZADA
MANGROVE AREA		AREA DE MANGLAR

FIGURE II-2-7 FUTURE LAND USE

Corredor Sur starts from the future Ave. Cerro Ancon as its western point. Corredor Sur will apply strong pressure for conversion of the use of the Calidonia area to business purposes. The scope of this influence will expand almost to the Obarrio area. The area around Paitilla, however, is developing into a new commercial area. The hinterland behind the high class residential area is going to be used as a recreation area, and the educational zone will be concentrated next to these areas. The area from here to the Corredor Sur roadside is built-up with housing. This continues to near Panama Viejo, with high-quality private residences. The international convention center is located in this section. Improvement of recreational facilities and a greenery area are desirable, as is the improvement of cultural facilities related to the convention area.

The view changes completely just past Panama Viejo. Large-scale independent housing complexes surround the road. Churches and stores are scattered through these areas, forming their community centers. The center of commerce will be established in an organized way, in the area near the Hipodromo recreation area.

Corredor Sur extends eastward through the large-scale residential areas such as Don Bosco, etc., almost parallel to the boundary line of the mangrove area, and will connect with the Pan-American highway on the west side of the Torrijos International Airport.

3. ROAD AND TRAFFIC CONDITION

3-1 ROAD CONDITION

3-1-1 Existing Roads Related to Project

The existing road network in Panama Urban Area is shown in FIGURE II-3-1. The existing roads related to the project are as follows:

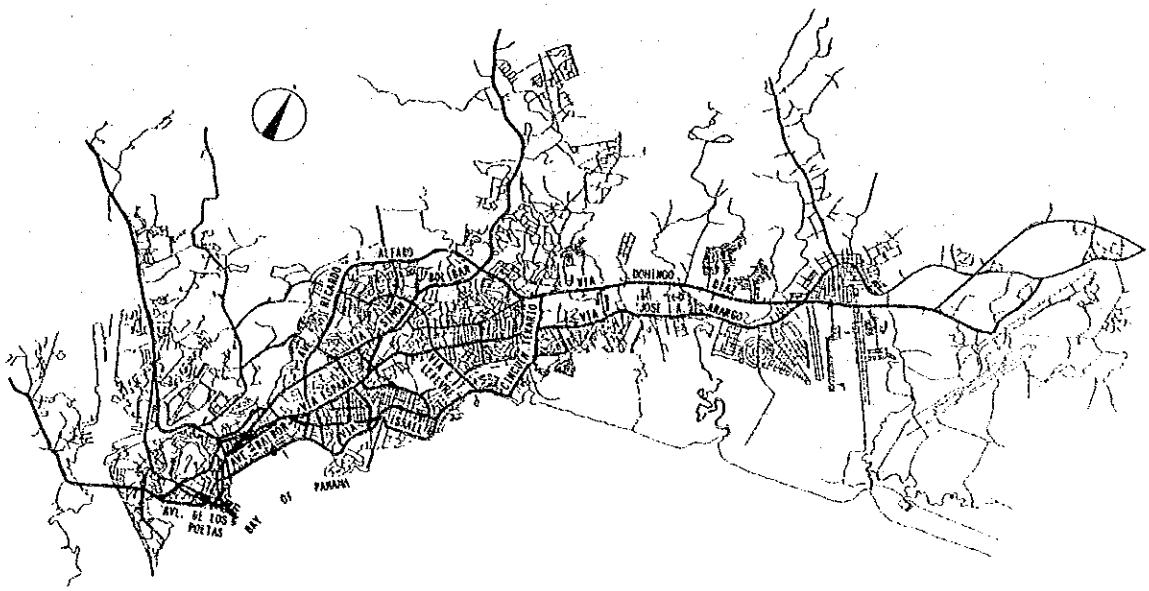


FIGURE II-3-1 PRESENT ROAD NETWORK

a. Corredor Sur

Ave. Balboa	3.8km
Via Israel (Via Cincuentenario)	4.6km

b. Corredor Sur Extension

Ave. de los Poetas	0.9km

c. Main Access Roads

Via E.T. Lefevre	1.6km

These roads are outlined as follows:

(1) Ave. Balboa

The cross section of Ave. Balboa (Ave. B - - Calle 53A Este) is basically a 4-lane, 2-way road with median, for which 8.0 m of roadway width is secured. The median is 9.0 m wide, and sidewalks of over 2.8 m width are provided on both sides of the road. Many drainage pipes cross this road. However, most of these pipes have diameters smaller than 1.0 m The only bridge can be seen over the Mataznillo River. A 3 km long, retaining type sea wall runs along the seashore.

(2) Via Israel, Via Cincuentenario

Via Israel and Via Cincuentenario (Calle 53A Este - - Ave. Ernesto T. Lefevre) can be divided roughly into 3 types of sections, as follows.

1) Type A: 4-lane road with median
2) Type B: 4-lane road without median
3) Type C: 2-lane road

1) Type A

This type of section can be seen beside the Paitilla Airport and in front of the International Convention Center (ATLAPA). At the former, the road detours around the airport, curves sharply and enters a grade separation. Concerning the component of road section, the roadway width is over 7.6 m (one way), the sidewalk width is over 1.5 m on each side and at its widest, the median measures 6.2m and is used for planting, drainage and as a retaining wall. At the latter, the component of road section is the same as the former, except that the median width is no wider than 1.5 m.

2) Type B

This type can generally be seen on Via Israel. With respect to the roadway, a 14.6 m width (3.66 m/lane) is provided, but it includes the surface drainage on both sides; therefore, the actual lane width is only 3.35 m. Concerning the sidewalk, 1.3 m minimum on both sides, its width is insufficient in the areas in front of schools. There is only one pedestrian overpass over the roads, while no bridge construction is in progress.

3) Type C

This type can be seen from Calle 81 Este intersection on Via Cincuentenario to Ave. Ernesto T. Lefevre. A 13.4m wide carriage way is provided and each lane is 3.65 m wide. The sidewalk is more than 1.8 m wide, however, and is also used as the shoulder of the road. There is a bridge at the crossing point with the Santa Librada River.

(3) Ave. de los Poetas

The cross section of Ave. de los Poetas consists of 2 lanes 5.5 m wide in each direction, with a 4 m median and sidewalks of 2.0 m on each side. The median has facilities such as lights, trees, and others. The road ends at the Calle 19 Oeste intersection.

(4) Ave. E. T. Lefevre

Ave. Ernesto T. Lefevre is a 2-lane road with a carriageway width of 9.2 m (curb to curb). This road crosses 2 branches of the Santa Librada stream which have box culverts. The carriageway width above these structures is 8.0 m wide.

3-1-2 Road Inventory

Road width configuration, drainage facilities, etc. of the existing roads considered under this project are shown in TABLE II-3-1.

TABLE II-3-1(1) ROAD INVENTORY

(Ave. Los Poetas)

Name of Road	Section	Distance	Right of Way	Construction Line	Carriageway L	Carriageway R	Median	Side Walk L	Side Walk R	Drainage L	Drainage M	Drainage R	Planting L	Planting M	Planting R	Transmission Line L	Transmission Line M	Transmission Line R	Lighting L	Lighting M	Lighting R
Ave.Los Poetas	Calle 19																				
		226	21.00	15.00	15.00		-	2.95	9.35	-	-	-	-	-	9/M	-	-	-	-	-	45/6
	Calle 21 Oeste							2.90	3.30												
		280	21.00	15.00	5.50	5.50	4.00	2.85	2.10	Y	-	Y	-	2/M	4/M	-	-	-	-	60/5	-
	Tribunal Tutelar de Menores				5.50	5.60	4.00	2.85	2.65												
		379	21.00	15.00	5.60	5.50	3.95	3.85	5.65	-	-	Y	-	17/M	-	-	-	-	-	60/7	-
	Calle 27				4.95	4.85	5.55	-	-												

Road Inventory (Via E.T.Lefevre)

Name of Road	Section	Distance	Right of Way	Construction Line	Carriageway L	Carriageway R	Median	Side Walk L	Side Walk R	Drainage L	Drainage M	Drainage R	Planting L	Planting M	Planting R	Transmission Line L	Transmission Line M	Transmission Line R	Lighting L	Lighting M	Lighting R
Via E.T.Lefevre	Via Cincuentenario				4.10	4.00	-	1.60	1.60												
		206	20.00	15.00	4.60	4.60	-	0.75	0.55	Y	Y	Y	5/M	-	5/M	-	-	-	30/8	-	50/7
	Calle F																				
		156	20.00	15.00	4.55	4.60	-	5.60	5.25	-	Y	-	-	-	1/M	-	-	-	50/4	-	50/4
	Ave.Santa Elena																				
		376	20.00	15.00	4.60	4.60	-	5.30	6.60	Y	Y	-	10/M	-	8/M	-	-	-	60/7	-	40/11
	Calle 4a.							9.00	5.50												
		612	20.00	15.00	4.60	4.60	-	5.70	10.30	Y	Y	-	3/B	-	7/M	-	-	-	50/9	-	40/15

Source: ESTAMPA

TABLE II-3-1(2) ROAD INVENTORY

(Ave.Balboa - Via Cincuentenario)

Name of Road	Section	Distance	Right of Way	Construction Line	Carriageway L	Carriageway R	Median	Side Walk L	Side Walk R	Drainage L	Drainage M	Drainage R	Planting L	Planting M	Planting R	Transmission Line L	Transmission Line M	Transmission Line R	Lighting L	Lighting M	Lighting R
	Ave.B																				
		560	31.20	20.50	8.00	8.00	9.00	4.80	7.90	-	Y	Y	10/B	23/M	-	-	-	-	/1	50/8	/1
	Calle 24																				
		600	31.20	20.50	8.00	8.00	9.00	4.80	7.90	Y	Y	-	-	8/M	20/B	-	100/7	-	-	30/21	-
	Calle 32																				
		250	31.20	20.50	7.60	7.60	9.20	4.90	4.20	Y	Y	Y	9/B	20/M	8/B	-	100/1	-	/1	40/6	-
	Calle 34																				
		234	31.20	20.50	7.75	7.75	9.00	10.00	4.90	Y	Y	Y	10/B	16/M	5/M	-	100/2	-	-	40/4	-
	Calle 37																				
		234	31.20	20.50	7.75	7.75	9.00	10.00	4.90	Y	Y	Y	17/B	16/B	8/M	-	100/3	-	-	45/6	/1
	Calle 40																				
		260	31.20	20.50	7.75	7.75	9.00	10.00	4.90	Y	Y	Y	17/B	16/B	8/M	-	100/3	-	-	45/6	/1
Ave. Balboa	Calle 42																				
		290	35.00	25.00	7.90	10.80	5.90	5.40	1.50	Y	-	Y	11/B	13/M	-	-	120/3	-	-	50/7	-
	Av. F.Boyd																				
		500	35.00	25.00	7.95	8.00	8.90	6.40	5.00	Y	-	Y	25/M	28/M	-	-	-	-	-	45/11	
	Calle 49																				
		508	35.00	25.00	8.00	8.00	9.00	6.40	4.80	Y	-	Y	9/M	15/M	-	-	-	70/6	50/2	50/11	50/2
	Via Italia																				
		350	35.00	25.00	8.60	9.40	8.95	5.20	6.45	Y	-	Y	-	11/M	6/M	-	-	45/5	/12	50/12	/2
	M.A la Madre																				
					7.30	9.50		2.50	0.90												
		800	35.00	15.00	7.35	7.35	-	4.00	4.00	Y	Y	Y	12/M	-	4/M	-	-	-	45/24	-	45/19
Via Israel	Via Brasil				8.50	8.00	1.40	3.00	1.50												
		460	30.00	15.00	11.60	11.45	3.00	7.70	7.50	Y	-	Y	-	23/M	14/M	-	-	-	45/12	-	45/10
	Calle 65				11.60	11.45	3.00	-	-												
		1025	30.00	15.00	7.45	7.30	-	1.90	3.00	Y	Y	Y	8/M	20/M	7/M	-	-	-	40/19	-	30/33
Via	Calle 75				10.10	7.60	1.40	2.30	4.95												
Cincuentenario		1080	30.00	15.00	6.80	6.80	-	3.20	1.60	Y	Y	Y	-	-	17/M	-	-	-	50/11	-	40/12
	Calle 79				7.30	7.30	-	2.00	4.70												
		600	20.00	15.00	6.80	6.80	-	1.90	1.40	Y	Y	Y	-	-	16/M	100/3	-	-	30/19	-	30/20
	Calle 50																				
		660			6.80	6.80	-	1.90	1.40												
	Ave.E.T.Lefevre		20.00	15.00	3.95	3.95		1.85	1.85	Y	Y	Y	2/M	-	1/M	150/3	-	-	50/22	-	50/15

Source:ESTAMPA

TABLE II-3-1(3) ROAD INVENTORY

Access Road

Name of Road	Section	Distance	Right of Way	Construction Line	Carriageway	Median	Side Walk L	Side Walk R	Lighting L	Lighting M	Lighting R
San Miguelito Chanis Alternative 1	Domingo Diaz	7.90	20	15	14.89	2.65	1.27	1.19	40/23	-	40/17
	Via Espana				6.76						
	Calle 114 Ave. Las Mercedes Urb.Olimpico										
	Corredor Sur										
San Miguelito Chanis Alternative 2	Domingo Diaz	8.25	15	10	9.06	-	1.20	1.20	40/25	-	-
	Via Espana Ave.A.Santa Clara										
San Miguelito Hipodromo Alternative 1	Domingo Diaz Calle 125 Oeste (E.C.Matias Hernandez)	8.90	15	15	11.83	-	-	-	-	-	50/16
	Via Espana Calle 125 Este (Calle 2a.Llano Bonito)	390	20	10	7.45	-	-	-	80/9	-	150/4
	Corredor Sur										
Via Juan Diaz Alternative 1	Domingo Diaz Calle 130 Urb.Altos Nuevo Hipodromo	740	15	10	15.07	-	1.20	1.20	70/10	-	50/57
	Via Espana Calle 131 este Calle 3a.	515	10	10	9.23	-	-	-	-	-	-
	Corredor Sur										
Via Ciudad Radial	Domingo Diaz										
	Via Espana Calle E	1030	15	15	9.00 7.78	-	1.00	1.22	-	-	50/12
	Corredor Sur	950	20	25	11.32	-	-	-	-	-	60/8
	Calle al Manglar										
Via Don Bosco	Domingo Diaz Ave.3a. Don Bosco	1615	15	10	19.12	-	1.20	1.20	60/22	-	60/30

Source: ESTAMPA

(1) Road Width

For the right-of-way of existing major roads considered under this project, a 20-35m width is appropriated, but at least a 35m width is required for 6-lane roads to secure the kind of function that will act as a traffic flow skeleton for Panama City. Therefore, land purchases will be required for all the routes.

(2) Construction Lines

Strips of land along the roads in the Panama Urban Area have been established with construction lines restricting the construction of buildings. The construction line establishes a building set-back at a fixed width from the road center, regardless of the roadway width.

(3) Road Surface

All routes are paved in concrete. Where a surface has been greatly damaged, the wearing surface is overlayed with asphalt. Extremely worn out areas on the concrete-paved surfaces is one of the factors which raises the noise level when vehicles pass by.

(4) Horizontal Alignment

At Ave. Balboa, three sharp curves exist before and after the intersection of the Monumento a la Madre (R=150m), at the detour portion of the Aeropuerto Marcos Gelabert (R=70m) and before ATLAPA (R=80m) in the Paitilla area.

(5) Vertical Alignment

The vertical alignment is generally favorable except in the 200 m section on Ave. Balboa between the intersection with the Monumento a la Madre and the intersection with Via. Brasil, and in the 200 m section in the detour portion of the airport. In these sections, the vertical gradient is 6% while the horizontal curve is sharp.

(6) Number of Lanes

The sections of about 600 m on Ave. de los Poetas and about 7.8 km from the Maranon to the Quebrada Santa Librada on Ave. Balboa are of 4-lanes, and all others, of 2-lane.

(7) Median

A median is important for such aspects as environmental preservation of roads and as installing space for urban facilities. A median is currently provided in the sections of 3.5 km between the Maranon and the Rio Mataznillo and about 0.5 km on Ave. de los Poetas. Other functions such as protection against traffic accidents would be expected both at the detour portion of the airport and the sharp-curving portion of ATLAPA.

(8) Sidewalks

Sidewalks of at least 1.5 m in width are provided along both sides of the road. A standard 4.8 m-wide sidewalk (2.8 m at the minimum width) is provided for Ave. Balboa so that people can enjoy a walk along the seashore. Sidewalks above 5 m in width are provided in the educational area from near the intersection of the Monumento a la Madre to ATLAPA. At bus stops points, it should be kept at a width of more than three meters.

(9) Structures

A retaining wall of plain concrete is provided along the sea side of Ave. Balboa between El Maranon and the Rio Mataznillo. The height of the wall is 8 m at maximum. A pedestrian bridge is located between Via Brasil and the Monumento a la Madre in the educational area, in addition to a river bridge between the Rio Mataznillo and the Qda. Santa Librada. Each bridge type is shown in TABLE II-3-2.

TABLE II-3-2 TYPES OF BRIDGES

Location	Type	Span(m)	Width(m)
Rio Mataznillo	R.C. Rigid Arch	25.85	7.40
Qbda. Santa Librada	Box Culvert	8.00	7.30

Source: ESTAMPA

(10) Drainage Facilities

Many drainage pipes in Panama City are exposed, so that the roads passing through the coastal area cross them at many locations. Since each drainage pipe is projected directly into the sea, the pipe diameter is only 80 inches at maximum. The number of such pipes is the same as the number of roads currently crossing them.

(11) Power Transmission Facilities

High-voltage transmission lines are installed along the medians or road edges at the section of Ave.Balboa, Via Cincuentenario and Via E.T. Lefevre.

3-1-3 Intersection

A total number of intersections with the roads subject to the Study is 144, as shown in TABLE II-3-3, of which the number of signaled intersections is only 4, such as Ave. B, Ave. Ecuador, Ave. Federico Boyd and Calle 68 with Ave. Balboa. All are at-grade except for the grade-separated intersection between Ave. de los Poetas and Ave. de los Martires,

TABLE II-3-3 NUMBER OF INTERSECTIONS ON EACH ROAD

Name of Road	Number of Intersections
Corredor Sur	64
E.T. Lefevre	11
San Miguelito - Chanis	15
San Miguelito - Hipodromo	3
Juan Diaz	16
Ciudad Radial	16
Don Bosco	3
Corredor Sur Extension	16
Total	144

Source: ESTAMPA

3-2 TRAFFIC CONDITION

3-2-1 Traffic Survey and Results

(1) Purpose of Survey

The traffic volume survey is the basic survey for traffic management and road planning.

The following, is the purpose of the this survey:

a. To recognize the actual use of roads which are related to main access roads and to Corredor Sur, such as the Ave. Balboa, Via Cincuentenario, etc.

b. To obtain basic data for the planning and design of the Corredor Sur and its related access roads.

c. To recognize the changes in traffic volume in the past 5 years, by comparison with results of surveys of ESTAMPA Masterplan in 1981.

(2) Content and Method of Survey

The survey was conducted at the intersections of major roads, and classified into two types of survey points. Type one is for 12-hour traffic volume survey and type two is for 24-hour survey.

FIGURE II-3-2 shows these survey points: a total of 24 points, including 18 points for the surveying of 12-hour traffic volume, and 6 points for the surveying of 24-hour.

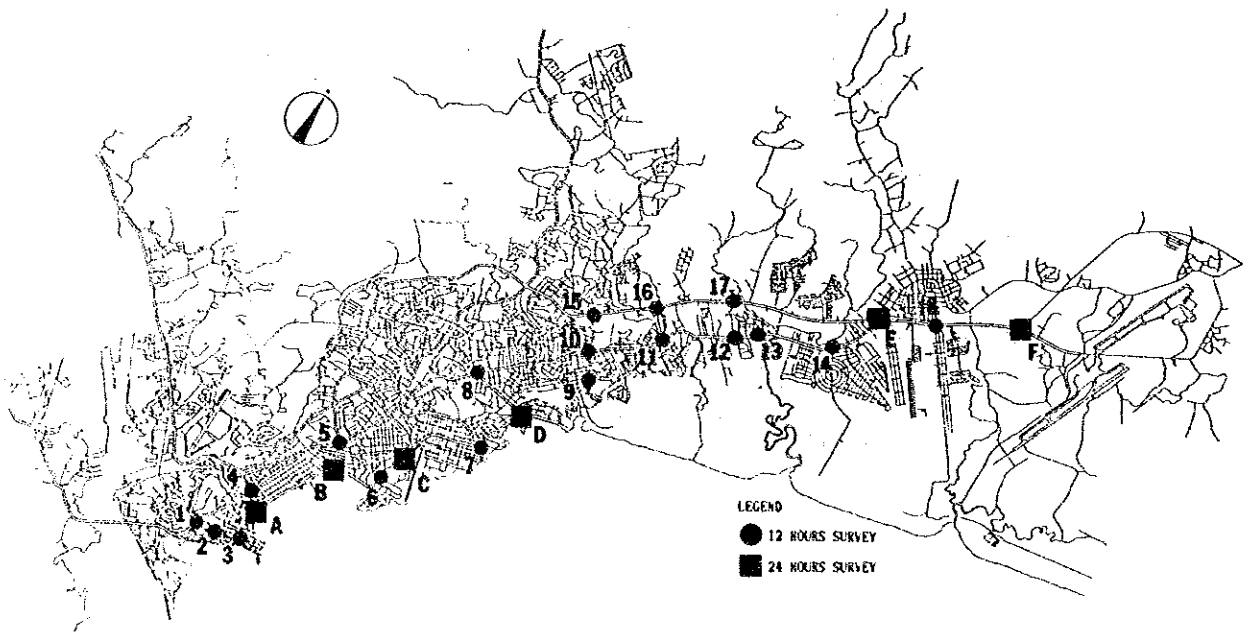


FIGURE II-3-2 TRAFFIC VOLUME SURVEY POINTS

Survey time zones were set as from 6 a.m. to 6 p.m. for the 12-hour traffic volume survey, and from 6 a.m. to 6 a.m. for the 24-hour survey. The survey was done on weekdays from the 12th to the 19th of September, except Saturday, Sunday, and holidays.

All survey points are located at the intersections. Therefore, an observation was done for each direction, and the traffic volume was totaled for each hour. Motor vehicles were classified into 4 types (passenger cars, buses, small trucks, and large trucks).

(3) Results and Considerations

The traffic flow diagram for 12-hour traffic at the 24 points is shown in FIGURE II-3-3, where the survey was conducted at this time. The great traffic flow on Ave. Balboa is evident here.

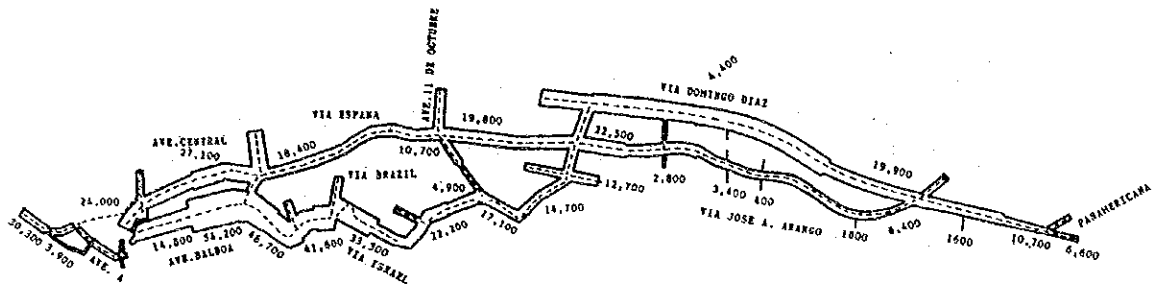


FIGURE II-3-3 TRAFFIC FLOW DIAGRAM BASED ON 12-HOUR SURVEY

TABLE II-3-4 shows 24-hour traffic volume, composition by vehicle types (especially buses and large trucks), and the rate of daily traffic to day time traffic, of the roads where 24-hour traffic volume was observed.

TABLE II-3-4 RESULTS OF 24-HOUR TRAFFIC VOLUME SURVEY

	Points	24-hour Volume	Bus	Large Truck Ratio	Day / Night Ratio
A	Ave. Balboa	38,878	4.5	0.7	1.282
B	Ave. Balboa	68,092	5.2	0.4	1.257
	Calle Federico Boyd	13,159	2.8	0.8	1.231
C	Via Israel	54,009	7.6	0.8	1.298
	Via Brasil	15,905	7.1	0.9	1.303
D	Via Cincuentenario	27,903	8.1	1.5	1.383
	Ave. Ernesto T. Lefevre	6,687	5.0	2.6	1.368
E	Via Jose Agustin Arango	13,531	20.9	2.7	1.518
	Via Domingo Diaz	28,364	10.7	3.3	1.435
F	Panamericana	6,022	8.4	7.6	1.375
	Via Domingo Diaz	14,716	10.7	5.1	1.381

Source: ESTAMPA

3-2-2 Traffic Characteristics

Ave. Balboa, which passes near the central business district of Panama City, has a traffic volume of 68,000 vehicles/day. The mixing rate of large scale vehicles on Ave. Balboa, Via Israel, and Via Cincuentenario, is relatively smaller than that on other major roads, and shows rates of 5 to 8% and 0.5 to 1.5%, respectively.

The traffic rate varies from day to night, according to the character of the road. It is obvious from the differences between the figures for the individual roads surveyed at this time, that the figure for Ave. Balboa is smaller, and shows less night traffic.

The following figures show peak rates on major roads in the built-up area and the suburbs of Panama City.

a. Built Up Area

Ave. Balboa	7.5 % to 8.5 %
Ave. Federico Boyd	9 %
Via Brasil	9 %
Ave. Ernesto T. Lefevre	8 %

b. Suburban Area

Via Domingo Diaz	7 % to 8%
Ave. Jose A. Arango	8 %

Comparison of the results of the traffic volume survey done at this time, with the results of the traffic volume survey done at the time when the ESTAMPA Masterplan was studied in 1981, appears as shown in TABLE II-3-5.

Traffic volumes in Via Domingo Diaz, Via Cincuentenario, and Ave. Balboa, show an increase of about 1.5 times, considerably greater than the rate of population growth of Panama City.

TABLE II-3-5 COMPARISON OF TRAFFIC VOLUME BY MAJOR INTERSECTIONS

	1981	1986	1986/1981
Via Domingo Diaz	20,339	31,675	1.56
Cincuentenario	11,119	17,988	1.65
Via Jose Agustin Arango	17,211	22,461	1.31
Cincuentenario	8,487	14,658	1.73
Via Espana	16,706	19,855	1.19
Ave. Ernesto T. Lefevre	8,047	10,383	1.29
Cincuentenario	12,903	17,053	1.32
Ave. Ernesto T. Lefevre	4,067	4,889	1.20
Ave. Balboa	25,565	33,287	1.30
Via Brasil	13,501	12,206	0.90
Via Espana	17,966	18,414	1.03
Ave. Federico Boyd	16,092	16,099	1.00
Ave. Balboa	34,570	46,744	1.35
Ave. Federico Boyd	11,201	10,690	0.95
Ave. Central	13,031	17,049	1.31
Ave. B	8,088	6,942	0.86
Ave. Balboa	20,089	30,316	1.51
Ave. A	9,774	9,515	0.97

Source: ESTAMPA

3-3 ENVIRONMENTAL CONDITION

3-3-1 Traffic Noise Survey And Results

(1) Purpose of Survey

The traffic noise survey was carried out on the route proposed for Corredor Sur, and on the surrounding roads, for the purpose of recognizing the actual traffic noise in the area surrounding the proposed project, and also to obtain a fundamental unit (power level per vehicle and coefficient of conversion from large vehicle to small vehicle) to be used for the estimation of noise level in the future.

(2) Survey Points

FIGURE II-3-4 shows the 9 survey points. The noise level was measured at the roadside in each of these locations.

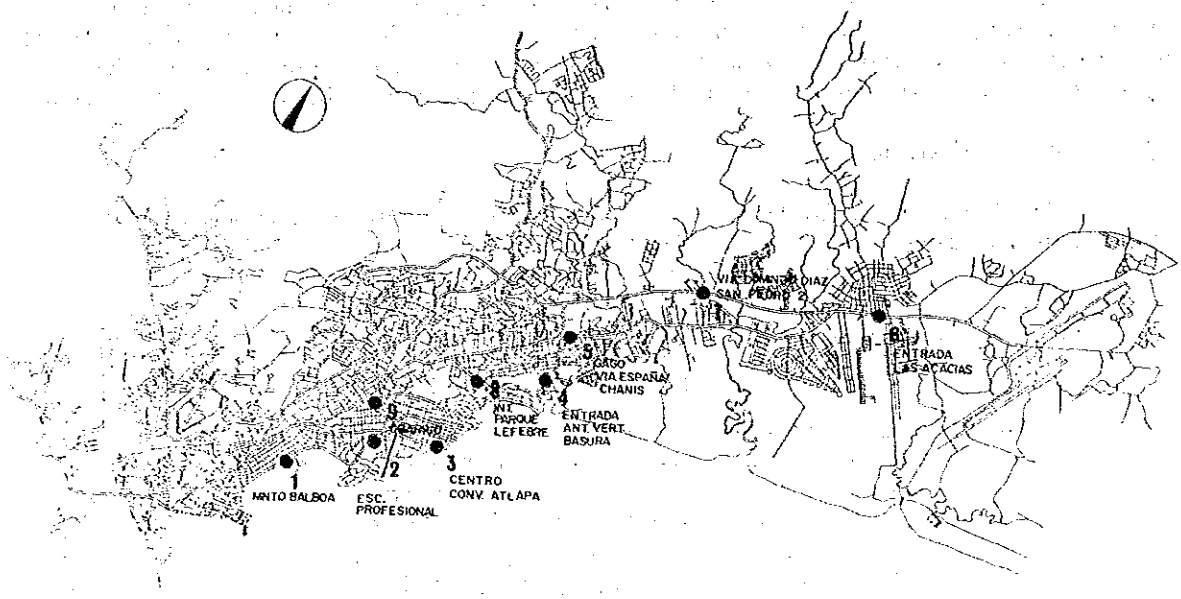


FIGURE II-3-4 LOCATION OF TRAFFIC NOISE SURVEY POINTS

(3) Survey Method and Measurement Condition

Measurement of noise level was made 6 times, for 10 minutes each, using a combination of an ordinary sound level meter and a high-speed level recorder.

(4) Results of Survey and Consideration

Consideration of the survey results shown above reveals rather high levels even when measured at the roadside. (There are differences in road structures, but the noise level is about 2-5 db(A) higher than is to be expected for the present traffic intensity.)

The following can be considered as reasons for this high noise level:

a. Conditions of vehicles as source of noise
b. No sufficient control standards for mechanical maintenance and inspection system
c. Road paving conditions

3-3-2 Method of Traffic Noise Calculation

(1) Basic Formula for Forecasting Traffic Noise

As one of the calculation methods for forecasting the median of road traffic noise level, there is the formula based on the report of the Acoustical Society of Japan.

1) Scope of Application

The calculation method for forecasting traffic noise referred to herein shall, in principle, be used to forecast the median of noise level at points up to about 100 m away from a road with a constant traffic of 1,000 or more vehicles per hour driving at a speed of about 30 to 100 km/h.

2) Basic Formula

The basic formula for forecasting and calculating the median of road traffic noise level is given as follows:

$$L_{50} = Lw - 8 - 20 \log_{10} l + 10 \log_{10} \left(\frac{1}{d}\pi - \frac{1}{d} \tan h \frac{1}{d} 2\pi\right) + \alpha_d + \alpha_i$$

where: L_{50} = Median of traffic noise level (dB(A))
Lw = Average power level per vehicle (dB(A))
l = Distance from sound source (m)
d = Average headway (m) (d=1,000 V/N)
N = Traffic volume (vehicles/h)
V = Average running speed (km/h)
αd = Adjustment factor of diffraction (dB(A))
αi = Adjustment factor of various causes(dB(A))

3) Calculation Formula of Average Power Level (Lw)

The average power level by characteristic A of noise generated per vehicle is calculated with the following formula in terms of average driving speed and vehicle type composition.

$$L_w = A + 0.2V + 10 \log_{10} (a_1 + Ba_2)$$

where: V = Average running speed (km/h)
a_1 = Ratio of small vehicles
a_2 = Ratio of large vehicles $a_1 + a_2 = 1.0$
A = Power level of small vehicles at standard velocity (dB(A))
B = Coefficient of conversion from large vehicle to small vehicle

4) Correction by Refraction Attenuation (αd)

The correction (αd) by refraction attenuation can be obtained from FIGURE II-3-5.

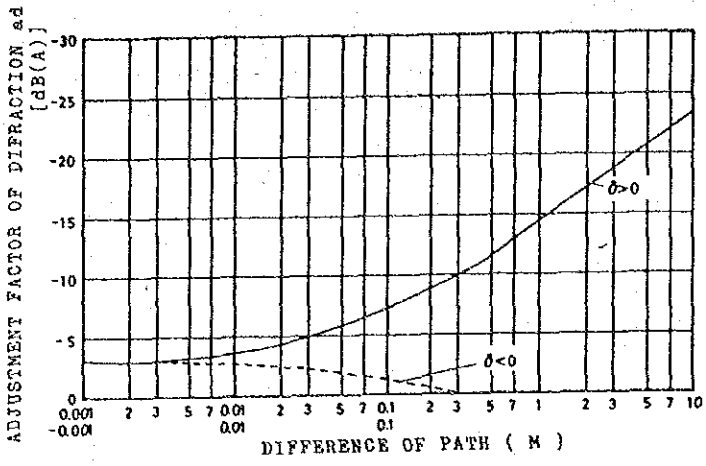


FIGURE II-3-5 ADJUSTMENT FACTOR OF DIFFRACTION

5) Correction by Various Factors (αi)

The correction (αi) by various factors like ground conditions, etc. is obtained per road structure from FIGURE II-3-6.

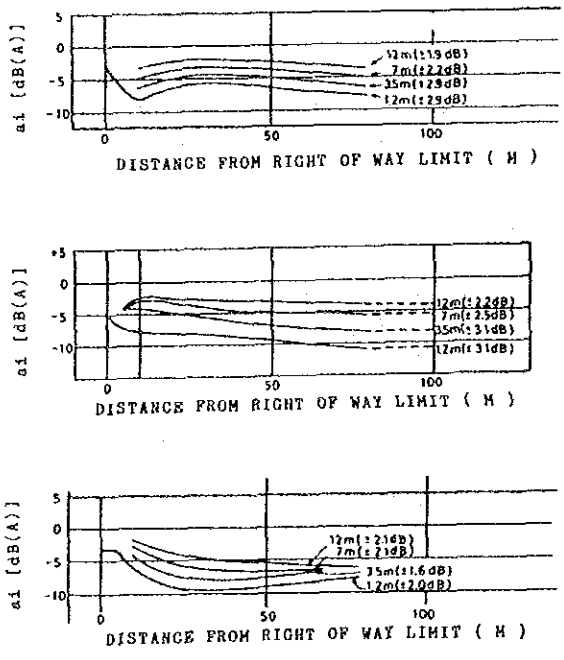


FIGURE II-3-6 ADJUSTMENT FACTOR "αi" OF VARIOUS CAUSES

(2) Correlation Coefficient in Panama

The correlation between the road traffic noise survey results and the calculation results using the foregoing formula under the same conditions as at the survey (road structure, traffic volume, ratio of large vehicle mix and driving speed) resulted in the finding that the use of power level A = 91 dB(A) at a reference speed of small vehicles and conversion coefficient B = 10 from large to small vehicles maximized the correlation. This value shall, therefore, be established as a correlation for forecasting the road traffic noise. (See FIGURE II-3-7).

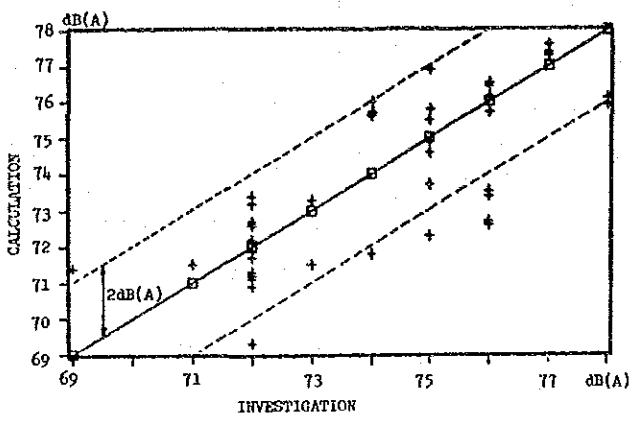


FIGURE II-3-7 CORRELATION OF RESULTS OF NOISE SURVEY AND CALCULATION

3-3-3 Other Environmental Factors

The major environmental factors other than noise to be considered in relation to roads, are air pollution and vibration. A factor in air pollution is the exhaust gas discharged from vehicles. No regular observation has been carried out in Panama on this. There are also no restrictions on the vehicles, a source of generation. In addition, there is no data on stationary sources of generation (factories, work sites, etc.) nor on movable sources (ships, etc.). It is, therefore, impossible to make a quantitative analysis.

The only thing that can be said is that the wind in Panama City is dominant from the north, i.e. from inland (FIGURE II-3-8), so that exhaust gas concerning Corredor Sur to be constructed at the south side of the city is dispersed mainly toward the sea, thus reducing the effects.

Vibration is an issue only in the Panama Viejo area. This area is where hard rocks are exposed, so that vibrations likely to affect the historical sites will not be generated.

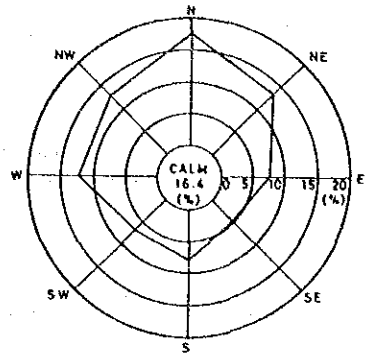


FIGURE II-3-8 DIAGRAM ON RATIO OF WINDS BY DIRECTION