

PART 2

REVIEW AND UPDATE OF BASIC FRAMEWORK

PART 2 REVIEW AND UPDATE OF BASIC FRAMEWORK

1. Socioeconomic Framework

1-1 General Economic Situation of Ecuador after the M/P Study

The economy of Ecuador in the late 1970's and the following three years up to 1982 has shown not rapid, but very steady progress. The Gross Domestic Product had increased each year with average rate of 5.5%/year in net value through this term (1974-82. see Figure 1-1.1) second only to Brazil's miracle growth in South America. Every economic activity, agriculture and fishery, industrial manufacture, construction, services, etc., only except petroleum and its products being sluggish, had contributed to raising of the GDP, and the index of consumer's price in this period also had shifted very stably with average rate of 11.0¹% /year which was the lowest of all South American countries.

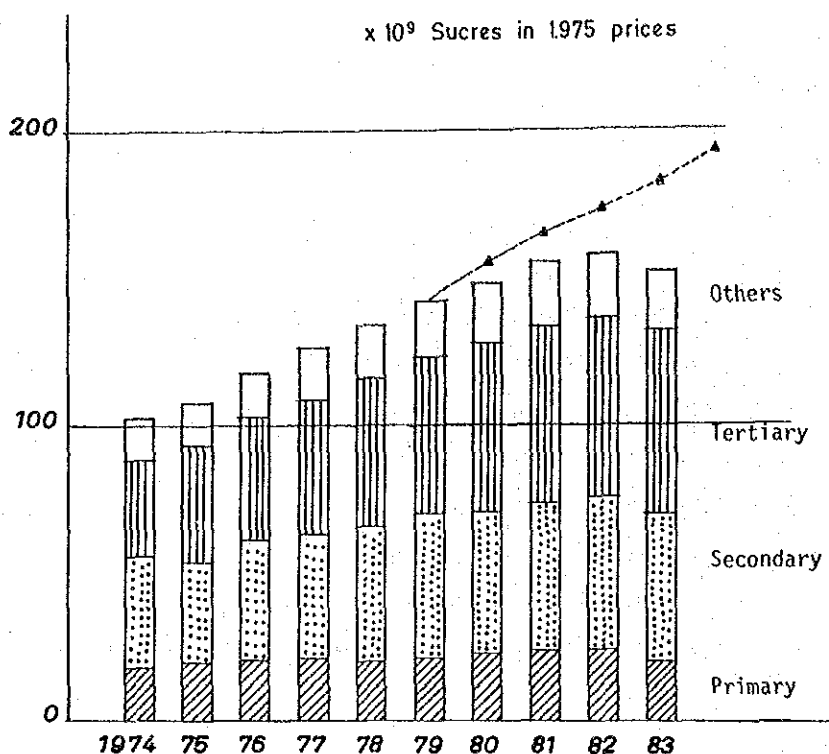
In 1983, however, Ecuadorian economy confronted the big crisis, at least, that seemed to be the worst one for most of Ecuadorian people since the economic recession had been unprecedented in the Ecuadorian history so far.

Big deficit in the national revenue, drastic devaluation of Sucres to US dollars from 35 sucres/1 dollar to 87 on the free market base of the Central Bank of Ecuador, increase of unemployment, low level of international monetary revenue which might be the lowest in the last decade, etc., all these factors decreased the GDP in that year by 3.3% in net value of the previous year, which brought about 6.2% decrease in GDP per capita taking into account the population increase of 2.9%/year.

Together with the above, the Government policy of raising public prices such as gasoline, fuel, etc. under pressure of the national budget greatly affected every price of goods and services in private sectors and led to high inflation close to 50%/year from 16.4% in 1982.

1) Banco Central del Ecuador "Boletin-Anuario N° 8 1985".

Figure 1-1.1 TREND OF GROSS DOMESTIC PRODUCT BY ECONOMIC SECTOR



NOTES:

- (1) Primary Sector: Agriculture, hunting, fishing.
 Secondary Sector: Manufacturing + Construction + Mining.
 Tertiary Sector: Electricity, gas, water + commerce +
 Transportation warehousing + financial
 establishments + services.
 Others: Governmental domestic services, net taxes on
 imports and customs duties.
- (2) The New National Development Plan (1985-88) sets up the average
 increase rate as 3.7% per year through its term.
- (3) Expected GDP by the same increase rate shown in the National
 Development Plan (1980-84). -----
- (4) Sources: a) Memoria Anual del Gerente General Del Banco
 Central del Ecuador ano 1983.
 b) Plan Nacional de Desarrollo 1979-84, primera
 parte.

This sudden change of economy, however, was not unpredictable in Ecuador, because most of South American countries that had been indebted to foreign countries for quite a large sum, had been already suffering from repayment of foreign credits and these governments proceeded on the common policy of a steep raise of public prices more in advance than did Ecuador.

In 1984, the government worked out mighty measures, which included stabilization and income programs, to counter inflation, recover the productivity and improve the monetary situation both in domestic and international. These measures immediately brought an effective result on every economic sector. Inflation of 48% in year rate as of January 1984, decreased rapidly, especially in August when the new government started, down to 21%²⁾ in year rate.

Nowadays, in Ecuador there are many signs of economic recovery in agriculture, fishery, manufacturing, and international trade, etc. in the difficult circumstances where all other South American countries are still facing to deficits in revenue and high inflation.

1-2 National Development Plan (1985 - 1988)

The National Development Plan (1985 - 1988)³⁾ which was signed by the President on October 24, 1985, manifesting the objective of the new government policy and achieving the national goals for the planning period, will suggest very important target and index to the framework for the Study.

1) General Planning goals

a. Economic Development Strategy

The economic development strategy emphasizes following basic elements;

-
- 2) Banco Central del Ecuador "Boletín Nº 590 (page 302)"
 - 3) Plan Nacional de Desarrollo 1985-1988, Consejo Nacional de Desarrollo (CONADE)

- Harmonic development in the strategic sectors such as petroleum and energy, agriculture and fishery, manufacturing and construction
- Improvement of exports
- Inducement to investment and saving
- Increase of the productivity of the whole economy.

b. Social Strategy

It bases on the integrated development of human resources by means of education, training, health services and increase of job opportunities.

Table 1-2.1 shows the planning figures in main items of the development plan.

2) Urban Transport Projects

For the urban transport the National Development Plan emphasizes such actions as analysing components of urban transport systems, evaluating the studies already carried out, etc., and adopts the following four programs⁴⁾ to improve and develop the urban transport systems in the main cities in the transport and communication sector through the planning period.

They are:

i) Mass rapid transport for Guayaquil

General action : to promote the contract of the study to the Japanese Government

Executor : Comision de Transito del Guayas (CTG)

ii) Transport master plan study for Quito

General action : to promote the contract to execute the study

Executor : Quito Municipality

4) Plan Nacional de Desarrollo 1985-1988, Anexo-1 Programas y Proyectos para el Desarrollo de los Sectores productivos: transporte.

Table 1-2.1 GOALS OF NATIONAL DEVELOPMENT PLAN (1985-1988)

Items	1985	1986	1987	1988
GDP Increase (%/year)				
Total Ecuador	3.0	3.7	3.9	4.4
Per capita	0.1	0.8	1.0	1.5
Employment (1,000 pers.)				
Economically active Population	3,123.4	3,210.8	3,300.9	3,393.1
Employment	2,800.0	2,913.4	3,025.2	3,158.2
Unemployment	323.4	297.4	275.7	234.9
International trade (mil. US\$ by 1985 price)				
Export of goods	2,714	2,828	2,959	2,972
Import of goods	1,724	1,894	2,045	2,079
Balance of services, etc.	(-)996	(-)1,099	(-)973	(-)931
Total	(-)6	(-)165	(-)59	38
Investment program for development for 4 years (billion Sucres by 1985 price)				
Development of productive sectors		617.0	58.4 %	
Special integration, etc.		113.4	10.8 %	
Development of human resources		324.2	30.7 %	
Development of science and technology		1.4	0.1 %	
Total		1,056.0	100.0 %	
Finance program for the above development				
Domestic sources; National budget		327.1	31.0 %	
National resources		392.4	37.2 %	
Others		85.1	8.0 %	
Foreing sources; Foreign Credit		197.0	18.7 %	
Others		54.4	5.1 %	
Total		1,056.0	100.0 %	

Source: Plan Nacional Desarrollo (1985 - 1988)

iii) Signalization study for Quito

General action : to control the study and its result
and prepare the final study and
execution

Executor : Consejo Nacional de Transito

iv) Recovery of fluvial transport system in the Guayas river
basin

General action : to promote the socio-economic study

Executor : Facultad de Ingenieria Maritima y
Ciencias del Mar. (ESPOL)

1-3 Population Growth in Study Area

1) Result of the Fourth National Census (1982) and the Forecast

The fourth national census which was carried out in 1982 by INEC (Instituto Nacional de Estadística y Censos), not only defined the population increase after the third census (1974), but also made very clear the difference in the gross reproduction rate (birthrate) between the actual observation in 1982 and the forecast based on the 1974 census.

Among the three factors, which affect the population growth, of fertility (gross reproduction rate), mortality (life expectancy) and international migration, the fertility is the most important and the main cause for the increase in Ecuador.

The population framework of the M/P study which started in 1982 is based on the forecast by INEC that prepared on the 1974 census base. At present, INEC is also preparing the new forecast on the 1982 base, and underestimates the fertility than the last one.

Table 1-3.1 shows the comparison in population growth of the total Ecuador between two forecasts. It shows such a new tendency as the more intensive concentration in the urban area, a rapid decrease in the rural area, and as these result, a decrease in the total Ecuador compared with the last forecast.

Table 1-3.1 COMPARISON IN THE POPULATION GROWTH OF ECUADOR BETWEEN
2 FORECASTS ON THE 1974 AND 1982 CENSUS BASE

		(1,000 population)				
Item	Year	1982	1985	1990	1995	2000
Forecast on 1974 census (adoted in the M/P)						
Urban	(a)	3,979	4,512	5,588	6,888	8,460
Rural	(b)	4,967	5,366	6,088	6,876	7,738
Total Ecuador	(c)	8,945	9,878	11,676	13,764	16,198
	(%/year)	-	(3.36)	(3.40)	(3.35)	(3.31)
Forecast on 1982 census (adopted in this study)						
Urban	(A)	4,223	4,820	5,902	7,148	-
Rural	(B)	4,383	4,558	4,880	5,66	-
Total Ecuador	(C)	8,606	9,378	10,782	12,314	13,939
	(%/year)	-	(2.90)	(2.83)	(2.69)	(2.51)
Comparison (%)						
	(A) / (a)	106.1	106.8	105.6	103.8	-
	(B) / (b)	88.2	84.9	80.2	75.1	-
	(C) / (c)	96.2	94.9	92.3	89.5	86.1

- Sources:
- 1) Proyeccion de la Poblacion del Ecuador por Areas Urbana y Rural, Provincias y Cantones, April 1978 (INEC)
 - 2) Estimaciones y Proyecciones de Poblacion 1950-2000 Diciembre 1984 (INEC)

2) Population Growth in the Study Area

In spite of the drastic decrease in the forecast on the 1982 census base of the population growth of the total Ecuador in comparison with that on the 1974, INEC estimates that a large volume will concentrate more and more in a few provinces.

The largest is Guayas with 2,156 thousands in 1982 to 3,331 thousands in 1995 (3.40%/year), second is Pichincha with 1,460 to 2,368 thousands (3.79%), and third is Manabi with 960 to 1,241 thousands (2.00%).

INEC also estimates the population growth by Canton (and inner administrative area of Province), and by urban and rural area in each Canton.

The Study Area consists of the whole urban area of Canton Guayaquil and its surroundings (see. Appendix 2-1). The surroundings, parts of the rural areas of its canton and other cantons, include Parroquia Pascuales (a parish zone), Parroquia Eloy Alfaro (usually called Duran), and additional parts without any urban component and being scarcely inhabited at present.

Accordingly, the whole size of the population in the Study Area shall be acquired actually by adding the projection in both Duran and Pascuales to that in the urban area of canton Guayaquil. Thus, population forecasts have been made as shown in Table 1-3.2.

3) Comparison in the Population Framework between this Study and the M/P Study

Table 1-3.3 shows the summary of the population growth and the comparison between this study and the former M/P study. It shows that there is almost no difference in the population growth both in the Canton Guayaquil and in the Study area between two studies in spite of the big difference of the total Ecuador.

Table 1-3.2 POPULATION GROWTH IN THE STUDY AREA

	1974 (74 census)	1980	1982 (82 census)	1985	1990	1995	2000 *
Cantón Guayaquil							
Urban	853,060	1,116,280	1,272,014	1,447,231	1,764,170	2,125,421	2,520,000
Rural	89,579	109,493	134,626	147,727	171,394	193,941	220,000
Total	942,657	1,225,773	1,406,640	1,594,958	1,935,564	2,319,362	2,740,000
(%/year)	—	(5.13 for 74-82)		(4.28)	(3.95)	(3.68)	(3.41)
Study area							
Guayaquil	853,063	—	1,272,014	1,447,231	1,764,170	2,125,421	2,520,000
Durán	23,556	—	51,023	73,864	85,697	96,971	110,000
Pascuales	4,017	—	13,678				
Additional parts	0	—	0				
Total	880,663	—	1,336,715	1,521,095	1,849,867	2,222,392	2,630,000
(%/year)	—	(5.35 for 74-82)		(4.40)	(3.99)	(3.74)	(3.43)

* : Figures in 2000 are forecast by the Study Team.

Sources: INEC's data which are being analyzed (November, 1985)

Table 1-3.3 COMPARISON IN THE POPULATION FRAMEWORK BETWEEN THE M/P STUDY AND THIS STUDY

(1,000 population)

	1982	1985	1990	1995	2000
M/P Study (1982)					
Total Ecuador (a)	8,945	9,878	11,676	13,764	16,198
Prov. Guayas					
Urban (b)	1,432.5	1,635.2	2,035.0	2,520.0	3,110.0
Rural (c)	780.6	857.3	990.8	1,136.7	1,295.6
Total (d)	2,313.8	2,492.5	3,025.8	3,656.7	4,405.6
Can. Guayaquil					
Urban (e)	1,223.3	1,392.8	1,730.9	2,140.1	2,638.4
Rural (f)	114.1	124.1	142.9	162.8	184.5
Total (g)	1,337.4	1,516.9	1,872.8	2,302.9	2,822.9
Study Area (h)	1,264.0	1,439.0	1,788.0	2,211.0	2,726.0

Feasibility study (1985)					
Total Ecuador (A)	8,606	9,378	10,782	12,314	13,939
Prov. Guayas					
Urban (B)	1,483.9	1,720.1	2,105.6	2,547.8	-
Rural (C)	672.5	680.2	736.3	782.9	-
Total (D)	2,156.4	2,400.3	2,841.9	3,330.7	-
Can. Guayaquil					
Urban (E)	1,272.0	1,447.3	1,764.2	2,125.5	2,520.0
Rural (F)	134.6	147.7	171.4	193.9	220.0
Total (G)	1,406.6	1,595.0	1,935.6	2,319.4	2,740.0
Study Area (H)	1,337.0	1,521.0	1,850.0	2,222.0	2,630.0

Comparison (%)					
Total Ecuador A/a	96.2	94.9	92.3	89.5	86.1
Prov. Guayas D/d	97.4	96.3	93.9	91.9	-
Can. Guaya. G/g	105.1	105.1	103.3	100.7	97.1
Study Area H/h	105.8	105.7	103.5	100.0	96.5

Sources: See Table 1-3.1 and 1-3.2

1-4 Economically Active Population (EAP) in Study Area

1) Definition of EAP

The economically active population (EAP) is for our purpose defined as, that part of the general population over 12 years of age who work for remuneration or help members of their household in their occupation without remuneration, those looking for work for the first time, housewives who employ part of their time on other productive tasks, and students who perform remunerated tasks in their spare time.

Growth in the EAP depends on changes in the size and composition of the total population and the economic participation rates for people of 12 years and older.

To avoid misinterpretation of the available data on Economically Active Population, both for Ecuador as a whole and for the province of Guayas, a few points should be kept in mind:

- a. Figures for EAP in Ecuador are divided into three parts. Unemployment, underemployment, and adequately employed.
- b. Serious consideration should be given to the second category (underemployment), since this includes people who perform low productivity tasks or are in occupations that do not fully utilize their abilities, and consequently get paid very low wages.
- c. One example of employment levels for EAP is shown in Table 1-4.1.

Table 1-4.1 EMPLOYMENT LEVELS FOR EAP IN URBAN AREA (1975)

EAP	Unemployment	Under-employment	Adequately employed
983,319	49,401	225,000	663,918
100%	5%	24%	71%

Source: Boletín Anuario No. 8 - Banco Central del Ecuador 1985.

2) Outline of EAP in Urban Area of Ecuador

Table 1-4.2 shows the actual number of EAP by each economic sector in the urban area in the 1974 and 1982 national census. According to the Table, the total EAP in the urban area of Ecuador has increased high with an annual rate of 5.19%/year through 1974-82, while the population in the same area has also increased with the almost equivalent rate of 4.94%/year to the EAP.

Consequently the rate of EAP to population has kept actually at the same level only with 0.6% up for the last 8 years. It seems, therefore, to be considerably difficult to substantially raise the EAP rate to population in a short period as long as the population increase seriously concentrates on the urban area as mentioned in the previous section.

3) EAP Growth in Study Area

Development of the EAP in the Study area shall follow the same general pattern as the total urban EAP in Ecuador since the share of the Study area amounted to 30.0% of the whole Ecuador in 1974 (see. the Master Plan Report 1983). Then, the EAP rate to population in the Study area shall be expected to remain at almost similar levels around 30% shown in Table 1-4.2.

As no differences in the EAP rate were found between the 1974 census on which base the estimate in the M/P study was made and the 1982 census, this F/S adopts the same EAP rate as the M/P. The EAP in Table 1-4.3 and 1-4.4 was, finally, derived by multiplying the population growth in Table 1-3.2 by the EAP rate in the M/P study.

Table 1-4.2 ECONOMICALLY ACTIVE POPULATION IN URBAN AREA

Item	Year		Increase rate %/year
	1974 Census	1982 Census	
a. Total EAP	835,511	1,252,340	5.19
1. Agriculture, fishing, forestry	63,514	66,900	0.65
2. Mining	2,489	2,859	1.75
3. Manufacturing	135,241	188,551	4.24
4. Construction	6,233	10,940	7.29
5. Electricity, gas, water	58,286	102,144	7.26
6. Commerce	153,484	218,187	4.50
7. Transportation, warehousing	42,662	76,034	7.49
8. Financial establishment	19,374	36,426	8.21
9. Services	274,324	467,093	6.88
10. Non-specified activities	63,745	42,095	(-) 5.32
11. New workers	16,159	41,111	12.38
b. Unemployment rate (see. Table 3-1.5)	5%	5%	-
c. Number of employment (a. x 95%)	793,700	1,189,700	5.19
d. Total population in urban area	2,698,722	3,968,362	4.94
e. Employment rate (c/d, %)	29.4	30.0	-
f. Total population in Ecuador	6,521,710	8,060,712	2.68

Source: Boletín Anuario No.8 - Banco Central del Ecuador 1985

Table 1-4.3 ESTIMATED EAP IN STUDY AREA
Year: 1982 - 2000

Year	Population	EAP	EAP/Population
1982	1,337,000	401,100	30.0
1985	1,521,000	456,300	30.0
1990	1,850,000	555,000	30.0
1995	2,222,000	688,800	31.0
2000	2,630,000	815,300	31.0

Table 1-4.4 ESTIMATED EAP IN STUDY AREA

By Primary, Secondary & Tertiary Sector

Year: 1974 - 2000

Year \ Sector	Primary	Secondary	Tertiary	Total
1982	8,000	97,900	295,200	401,100
%	2.0	24.4	73.6	100.0
1985	7,800	110,400	338,100	456,300
%	1.7	24.2	74.1	100.0
1990	7,800	132,100	415,100	555,000
%	1.4	23.8	74.8	100.0
1995	7,600	161,200	520,000	688,800
%	1.1	23.4	75.5	100.0
2000	7,300	187,500	620,500	815,300
%	0.9	23.0	76.1	100.0

Note: (1) Primary sector : Agriculture, hunting, fishing + mining
 Secondary sector: Manufacturing + construction
 Tertiary sector : Electricity, gas, water + commerce +
 transportation & warehousing +
 financial establishments + services.

- (2) Total EAP in each year is from Table 4-4.3.
- (3) Primary sector was supposed to be unchangeable in figures.
- (4) The share in Secondary in 2000 was supposed to be 23.0% in consideration of the decreasing tendency from '82 to 2000 in the same sector.
- (5) Shares in secondary in other years were supposed to decrease with the same percentage from '82 to 2000.
- (6) Figures in Tertiary = Total - (in Primary + in Secondary).
- (7) Item j. Non-specified activities and k. New workers were distributed to 3 - Sectors according to each share.

1-5 Family Income

1) Present Family Income Level

The M/P study described therein a close relation between car ownership and family income and forecasted the future one using the relationship between GNP and family income.

This study aims at its reviewal, and the relating data were collected with the supplementary survey in November 1985. Although the data were not enough to examine the change in family income for the entire population because the survey was conducted for the restricted areas only, they were sufficient for comparison with the M/P study results in 1983.

Table 1-5.1 and Figure 1-5.1 show the average family income by zone and its distribution.

They say;

- (1) Zonal family income has a pattern similar to statistical normal distribution.
- (2) Average family income level is quite different by zone, of which tendency was indicated already in the M/P study.

2) Review of M/P Study Result

Table 1-5.2 shows the comparison of average family income between the M/P study and this Study. The increase rate is between 2.0 - 4.0 although small difference can be seen by zone.

It is considered that this change is resulted from the consumer price inflation, and the actual income level is almost same as that of the survey carried out in 1982.

Therefore, it is conceivable that no correction is needed for the analysis of the family income level in the M/P study.

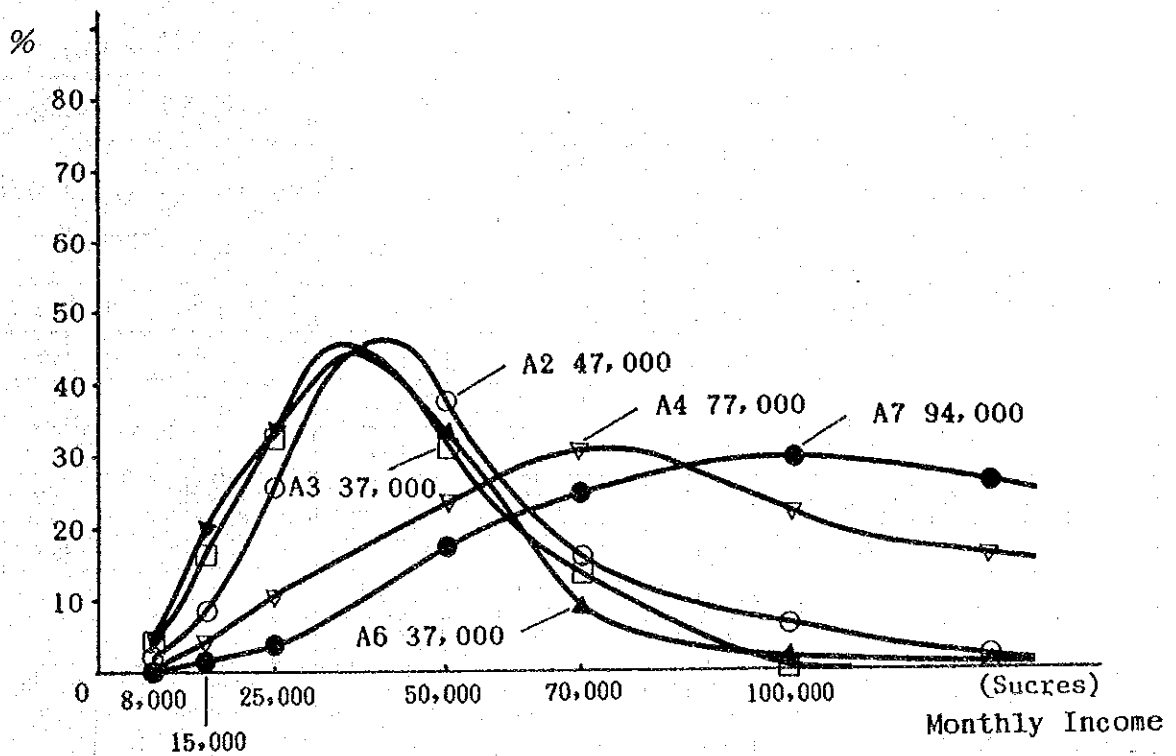


Figure 1-5.1 MONTHLY INCOME DISTRIBUTION BY ZONE

Source) Supplementary Traffic Survey by Study Team (November, 1985)

Table 1-5.1 MONTHLY FAMILY INCOME BY ZONE

UNIT : %

Range Average Zone	0	8,000	15,000	25,000	50,000	70,000	100,000	Average Monthly Income
	8,000	15,000	25,000	50,000	70,000	100,000	150,000	
A2	1.7	12.6	25.3	37.2	14.4	7.0	1.9	38,600
A3	4.4	17.3	31.2	32.2	14.6	0.3	0.0	30,000
A4	0.4	13.9	10.6	23.2	31.1	12.2	18.5	68,800
A6	2.8	20.6	32.4	32.8	8.1	2.0	1.2	30,000
A7	0.0	1.2	3.6	16.9	22.9	29.5	25.9	86,000

Table 1-5.2 MONTHLY AVERAGE FAMILY INCOME BY A-ZONE

		Sucre/Month				
Zone \ Year	(1)	(2) 1982			1985 (3)	Comprison (3)/(2)
	1975	Family with vehicles	Family without vehicles	Average (b)	Average (c)	
A - 1	3,683	30,180	16,250	19,220	-	-
- 2	3,683	25,760	14,430	16,650	38,600	2.3
- 3	2,821	20,180	13,260	13,950	30,000	2.2
- 4	8,559	21,790	17,630	18,890	68,800	3.6
- 5	-	18,490	12,150	12,470	-	-
- 6	2,821	18,810	15,210	15,920	30,000	1.9
- 7	12,478	38,350	16,980	26,740	86,000	3.2
- 8	9,751	21,140	14,500	16,650	-	-
- 9	-	19,500*	14,200*	14,900*	-	-
- 10	-	20,700*	13,900*	15,300*	-	-
Average (a)	3,840	26,180	14,240	16,460	-	-

(1) Sources; Ingreso Familiar Promedio de la Ciudad de Guayaquil, 1975 by Departamento de Planeamiento Urbano, Municipalidad de Guayaquil.

(2) Sources; Results of Trip Production Survey in M/P Study, July 1982.

(3) Sources; Results of Supplementary Traffic Survey in this Study, November 1985.

(a) Average multiplied by family sizes in each zone; 4.87 persons/family in 1982, 4.98 in 1975.

(b) Average multiplied by family sizes with vehicles and without vehicles.

* These figures were claculated as averages between zone -3 and -6 for zone-9, and between -3 and -8 for zone -10.

(c) Figures are not for entire zone by only for a district of each zone.

1-6 Vehicle Ownership

Table 1-6.1 shows the present number of vehicles registered in the study area and its comparison with the M/P study.

Present vehicle ownership was calculated as 55 vehicles per 1000 inhabitants, compared with 48 vehicles in year 1982¹), and shows small growth. This growth trend is exactly on the vehicle ownership growth curve which was indicated in the M/P study, assuming the close relationship between the car-ownership and the income level.

Therefore, this Study uses the same assumption as in the M/P study which projected that ownership rate of 150 cars per 1000 habitants would be expected in the year 2000 if the economic growth should be realised as assumed by the M/P study.

Table 1-6.1 NUMBER OF VEHICLES MATRICULATED IN STUDY AREA

TYPE OF VEHICLES	No. IN STUDY AREA (1984)				No. OF VEHICLES IN MASTER PLAN (1981)	COMPARISON (1984/1981)
	GUAYAQUIL	SAMBORONDON	YAGUACHI	TOTAL		
Passenger car	29,162	7	41	29,210	25,747	1.13
Wagons	40,758	31	370	41,159	27,804	1.48
Buses	2,583	1	9	2,593	1,473	1.76
Trucks	4,704	21	137	4,862	3,899	1.25
Tractores	127	1	1	129	2	64.50
Jeeps	5,351	7	23	5,381	1,950	2.76
Others	974	1	1	976	16	61.00
Total	83,659	69	582	84,310	60,891	1.38

Note:

- Passenger car Automobiles
- Wagons Station wagon, Camionetas, Furgonetas
- Buses Buses, Microbuses, Buses tipo, costa
- Trucks Camión, Cajon, Mixtos, Plataformas, Tanqueros, Volquetas, Trylers.
- Tractores Gruas, Tractores
- Jeeps
- Others Ambulancias, carrosas

Note) 1. The number is based on the matriculated vehicles in the Study area and different from that on the registered vehicles, shown in the M/P study.

2. Land Use Framework

2-1 Existing Conditions and Future Plan of Land Use

1) Existing Conditions of Land Use in Study Area

General view of the existing land use in the study area is shown in Figure 2-1.1. Development of residencial areas from 1982 to 1985 is remarkable in both the northern area from the Terminal Terrestre and the southern area near Guasmo, and manufacturing industries have developed alongside Via a Daule.

Urban features such as population, number of house, number of facility for the use of manufacture and service in 1985 are shown in Table 2-5.1, in Appendix 2-1 by B-zone, and the classification of the existing land use by urban features of B-zone is shown in Figure 2-1.2.

2) Planning Objectives for Future Land Use

The following items are considered as the main points in planning of a future structure for the land use in the Study Area.

a. Improvement of the CBD and Surrounding Commercial Area

- Changing over from the mixed land usage with various facilities to higher grade of urban central function.
- Supply of more space for off-street parking and provision of sidewalks and promenades suitable for pedestrians.

b. Improvement of the Periphery of the Commercial Area

- Changing to more highly urbanized functions, not only residencial but also commercial, especially tertiary activities, alongside Av. Quito, 25 de Julio, Machala, Los Ríos, Eloy Alfaro, Gomez Rendon, Portete, Venezuela.

- c. Improvement of Houses and Construction of Regional Centers in Duran, the Southern and Western Residential Areas
 - Supply of good quality houses and infrastructures such as water supply, sewerage system, etc.
 - Inducement to construction of many regional centers for community service in the residential area.
- d. Development of the far North Area
 - Developing a new urban area and gradual builtup construction of the new urban center to avoid the inconvenience of over-concentration in the existing CBD.
- e. Development of Manufacturing Industries
 - Development of manufacturing industries on the outskirts of the urban area with convenient transport by road or ship (Guasmo, Duran, Isla Trinitaria, the western part beyond Estero Salado, and alongside Via a Daule).
- f. Development of a New Educational Area
 - Development of new universities and high schools in the western hilly part.
- g. Impacts by the MRT and the Bus Route Reorganization
 - Development of facilities for the use of public or other services around stations or alongsides of the MRT
 - Inducement of public space and facility coordinating between the MRT, bus transport and pedestrian access.

3) Future Plan of Land Use in the Study Area

According to the actual development trend, planning objectives, and adoption of the most recommendable "Linear Development Type" (alternative-III) in the M/P study, a future plan of the land use in the Study Area in the year 2000 is shown in Figure 2-1.3.

4) Existing Conditions and Planning Conception of Land Use alongside MRT

a. Existing Conditions of Land Use alongside MRT

Figure 2-1.4 shows progress of developing urbanization in the influential area within 1 km from the MRT route. Main facilities and various urban establishments in this area are shown in Appendix 2-2 and 2-3. .

b. Land Value

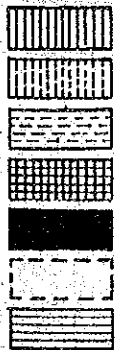
Land value and its proprietors by each spot in Guayaquil are registered in the municipality (MDG = Municipalidad de Guayaquil) and IESS (Instituto Ecuatoriano de Seguridad Social), and then three different values exist as a commercial value of MDG, cadastral value of MDG and cadastral value of IESS. In case of applying those values to land acquisition, the cadastral value of IESS is the most acceptable for proprietors with indispensable compensation.

Figure 2-1.5 shows the cadastral values of IESS, and Figure 2-1.6 shows the procedure of expropriation for the purpose of a public project with social interest.

c. Planning Conception to Land Use around MRT Wayside

For the future land use on the MRT wayside, the considerable items for planning conception are as follows.

- o The MRT encourages the location of public or other service establishments on the wayside area
- o The coordination of the MRT and bus reduces the distance between promising regional centers and the CBD, and promotes establishments in these regional centers (Figure 2-1.7).
- o It is desirable to improve accessibility by walk between the main parts of the CBD along Rio Guayas and MRT stations (Figure 2-1.8).



- RESIDENTIAL AREA (FORMAL)
- RESIDENTIAL AREA (INFORMAL)
- RESIDENTIAL AREA (DEVELOPING)
- COMMERCIAL AREA
- INDUSTRIAL AREA (MANUFACTURING)
- AREA FOR FUTURE DEVELOPMENT
- URBAN EQUIPMENT

THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

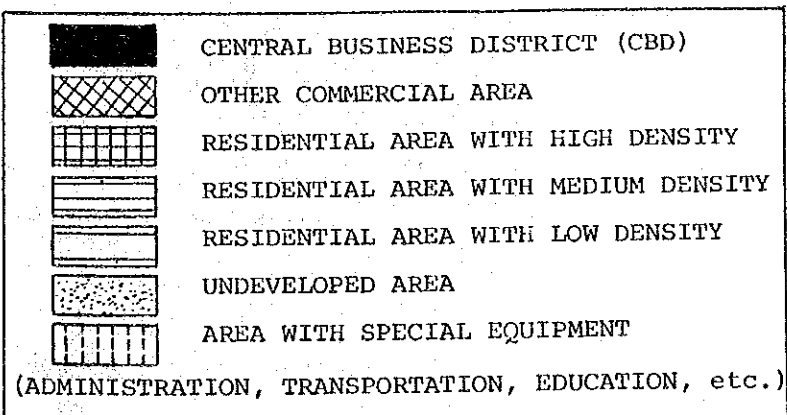
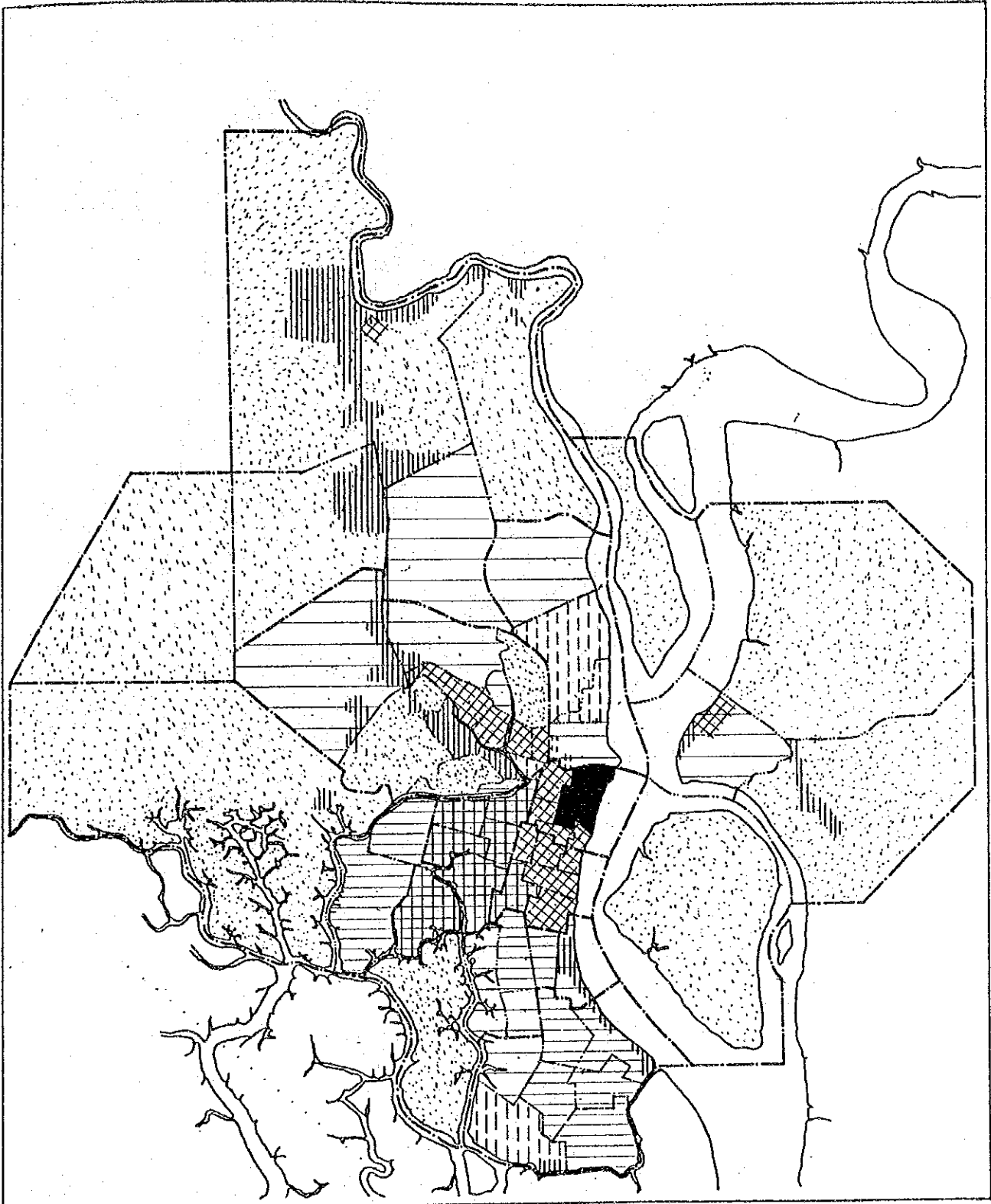
Figure 2-1.1
EXISTING CONDITION OF LAND USE
IN GUAYAQUIL CITY (1985)

JAPAN
INTERNATIONAL
COOPERATION
AGENCY



Table 2-1.1 URBAN FEATURES BY A-ZONE

No.	Urban Features		A Zone											Total Study Area
	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10				
1	Roca fuerte, Roca Carbo, 9 de Octubre, Olmedo, Sucre, Boliver	Ayasucho, Garcia Moreno, Sucre, Ictamendi, Ximena	9 de Octubre, Garcia Moreno, Urdaneta, Ictamendi, Tarqui, Sucre, Febrer, Cordero	Ximena, Isla Trinitaria	Guasmo	Febrer, Cordero, Puerto Azul	Tarqui, Bolivar, Miraflores, Mapasingue, Lirdeza, Kennedy	Tarqui, Cerro el Carmen, Aeto Puerto, Alborada, La FAE	Tarqui, Pascuales, Cerro Azul	Duran, Isla Santay, Peninsula de Samborondon			41,200.0	
2	9 de Octubre, Quito, Chile	Portete, Venezuela, Quito	Comer Rendon, Milagro	25 de Julio, Centenario, Sur, La Pradera	25 de Julio, Huancavilcas, Las Esclusas	Portete, Venezuela, Via a la Costa	Las Americas, Kennedy, C.J., Arosemena	Las Americas, P.M. Gilbert	Via a Daule, F. de Orellana	Via al Triunfo, Via al Babahoye, Via Samborondon			1,321,000	
3	443.4	575.7	750.4	1,779.1	2,061.0	6,600.0	4,131.2	1,595.0	13,187.0	10,079.0			41,200.0	
4	115,800	130,300	253,200	81,400	209,300	251,200	170,700	82,200	114,800	112,100			1,321,000	
5	26,873	27,280	48,375	16,006	37,439	45,601	27,338	15,755	6,751	13,684			265,102	
6	1,367	250	54	49	28	11	489	65	183	11			2,507	
7	7,647	1,017	369	182	58	72	988	282	152	19			10,786	
	33	8	1	7	6	3	6	6	1	1			72	
	40	41	23	4	5	14	27	10	5	3			172	
	33	13	3	2	5	3	7	6	2	2			76	
	26	9	0	3	2	1	6	3	0	0			50	
	7,515	946	342	166	40	51	942	257	144	13			10,416	
8	35,130	5,240	2,000	1,920	1,070	1,430	32,130	2,410	26,010	3,060			110,400	
9	173,910	44,290	20,730	10,560	8,810	8,760	47,880	15,970	4,470	2,720			338,100	
10	261	226	337	46	102	38 (213)	41	71	9	11			37	
11	0.335	0.046	0.009	0.014	0.002	0.002	0.054	0.022	0.050	0.002			0.050	
12	0.303	0.040	0.008	0.024	0.005	0.006	0.188	0.029	0.227	0.027			0.073	
13	1.502	0.340	0.082	0.130	0.042	0.035	0.280	0.194	0.039	0.024			0.222	
14	high density middle class	medium density middle class	high density middle class	low density upper class	medium density lower class	medium density lower class	low density upper class	low density middle class	undeveloped middle class	undeveloped middle class				
15	including CBD	commetical area	residential area	residential area	residential area with port	residential area	area for complex use	area with airport and bus terminal	area with manufacture	area with small regional core				

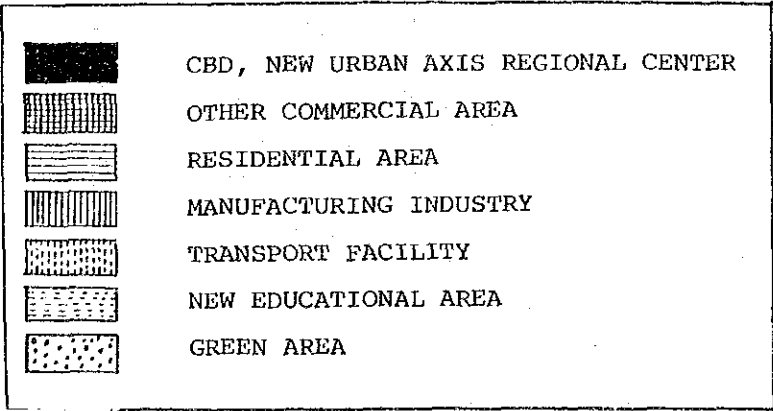
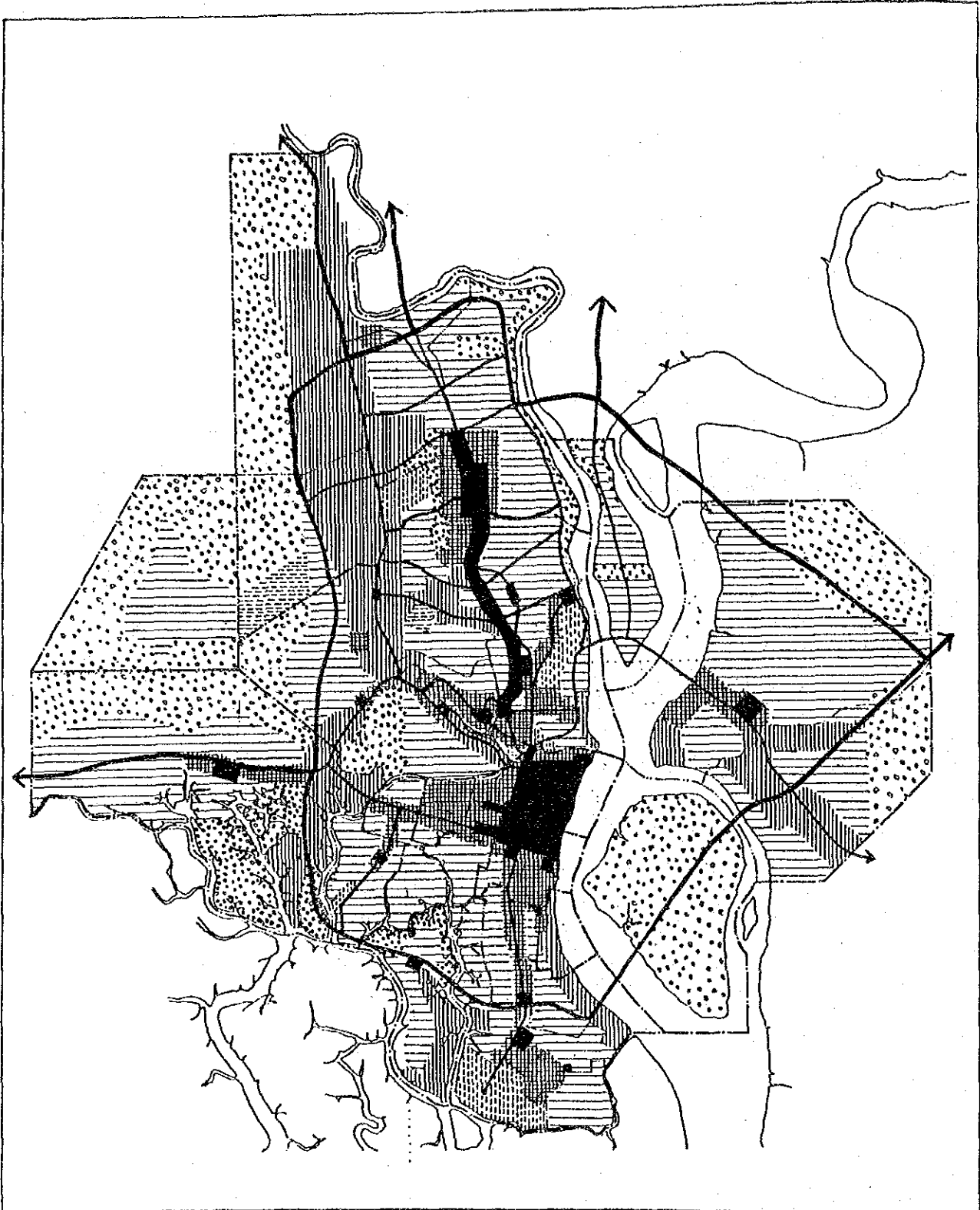


THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-1.2
CLASSIFICATION OF EXISTING
LAND USE BY B-ZONE IN 1985

JAPAN
INTERNATIONAL
COOPERATION
AGENCY



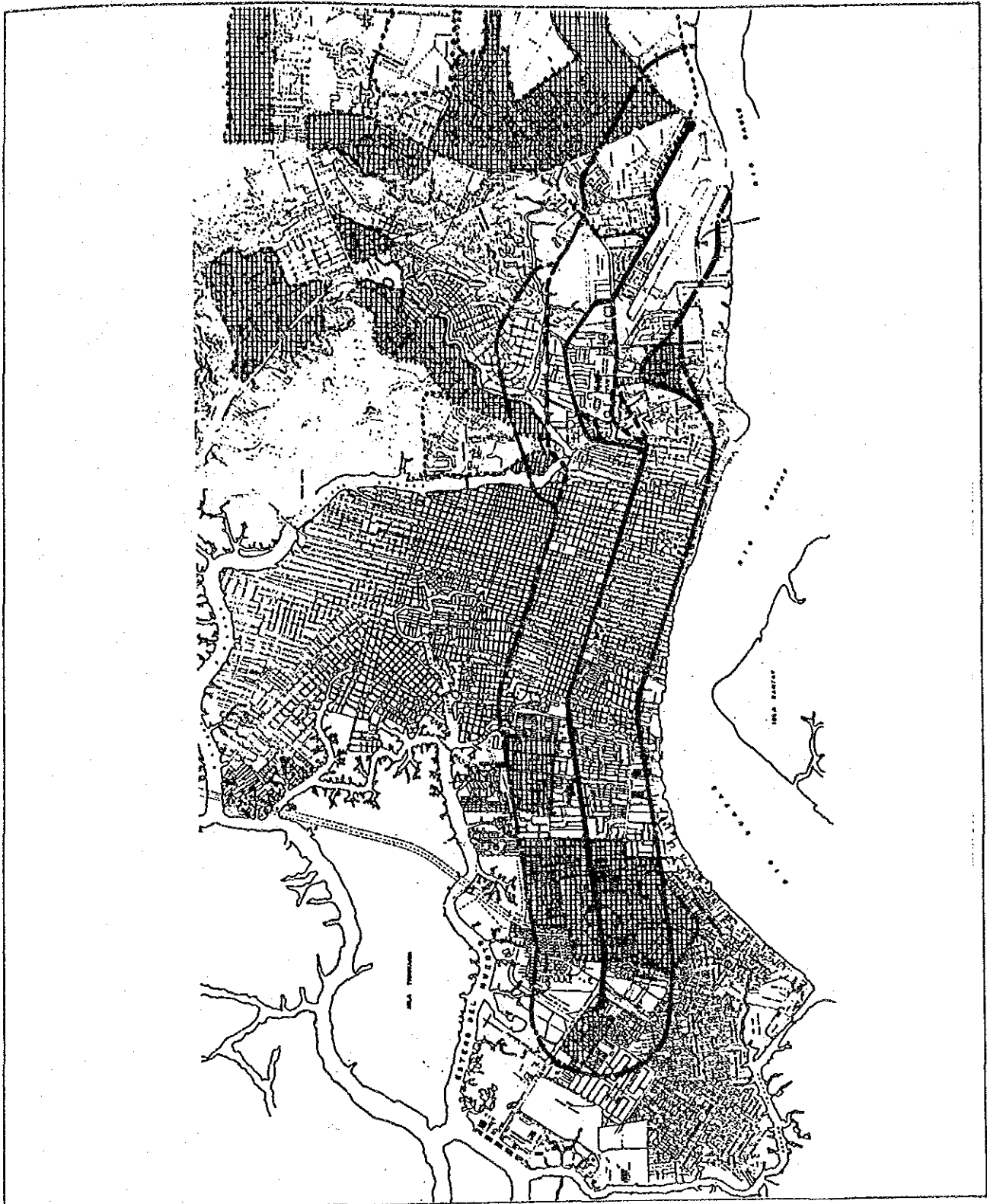


THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

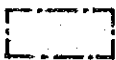
Figure 2-1.3
FUTURE LAND USE IN STUDY AREA
IN 2000

JAPAN
INTERNATIONAL
COOPERATION
AGENCY

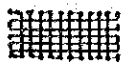




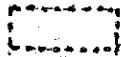
MRT ROUTE



LIMITED AREA OF 1 KM FROM
MRT ROUTE (INFLUENTIAL AREA)



PROGRESSED AND DEVELOPING AREA
FROM 1982 TO 1985



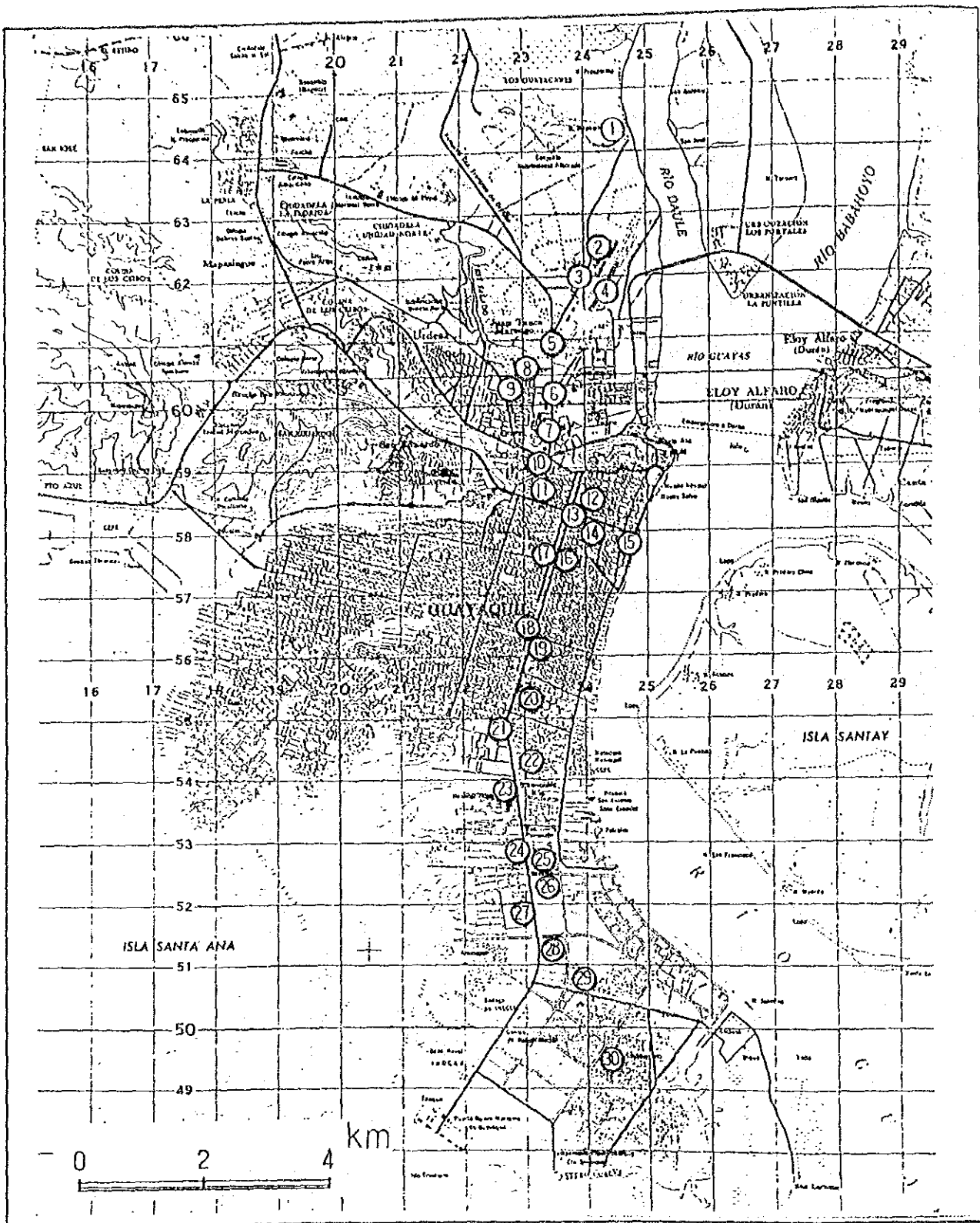
AREA FOR FUTURE DEVELOPMENT

THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-1.4
INFLUENTIAL AREA
OF MRT WAYSIDE

JAPAN
INTERNATIONAL
COOPERATION
AGENCY





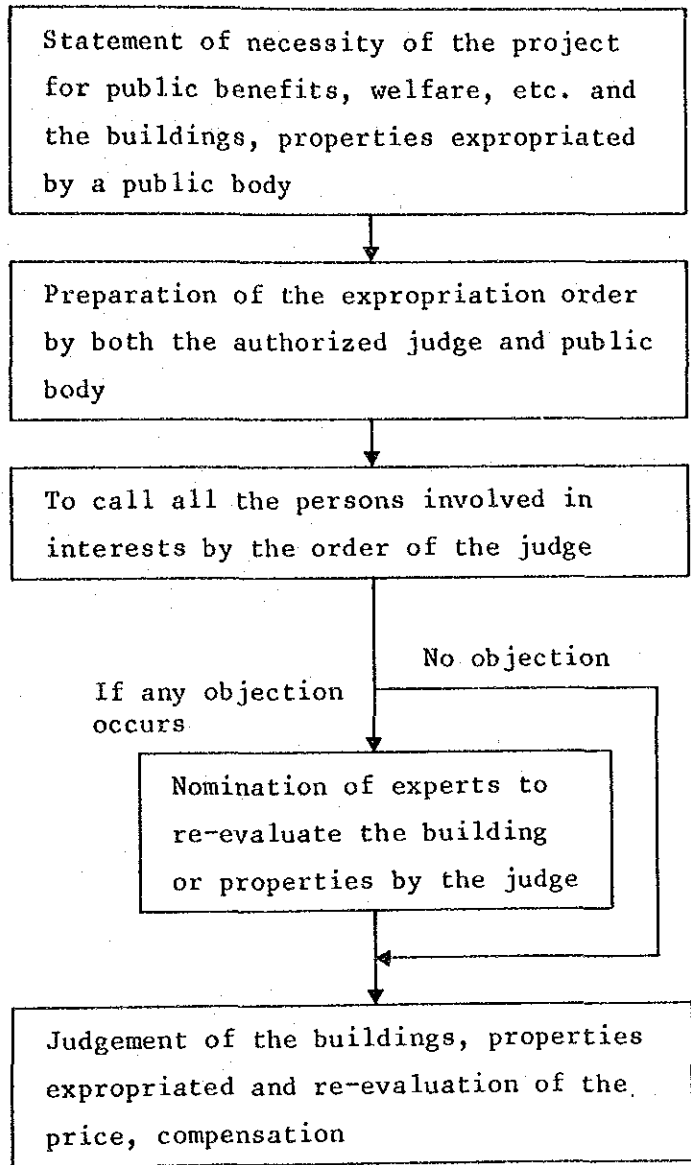
(SUCRE/m ²)					
①	390	⑪	7,800	⑳	4,550
②	3,380	⑫	20,020	㉑	3,900
③	5,200	⑬	28,600	㉒	1,300
④	2,600	⑭	42,900	㉓	3,250
⑤	3,900	⑮	57,200	㉔	3,900
⑥	3,900	⑯	20,020	㉕	3,900
⑦	3,900	⑰	17,160	㉖	3,900
⑧	3,900	⑱	5,850	㉗	3,900
⑨	8,450	㉀	7,150	㉘	2,600
⑩	7,150	㉁	5,200	㉙	390
		㉂		㉚	260

THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-1.5
DISTRIBUTION OF CADASTRAL
LAND VALUE BY IESS IN 1985

JAPAN
INTERNATIONAL
COOPERATION
AGENCY



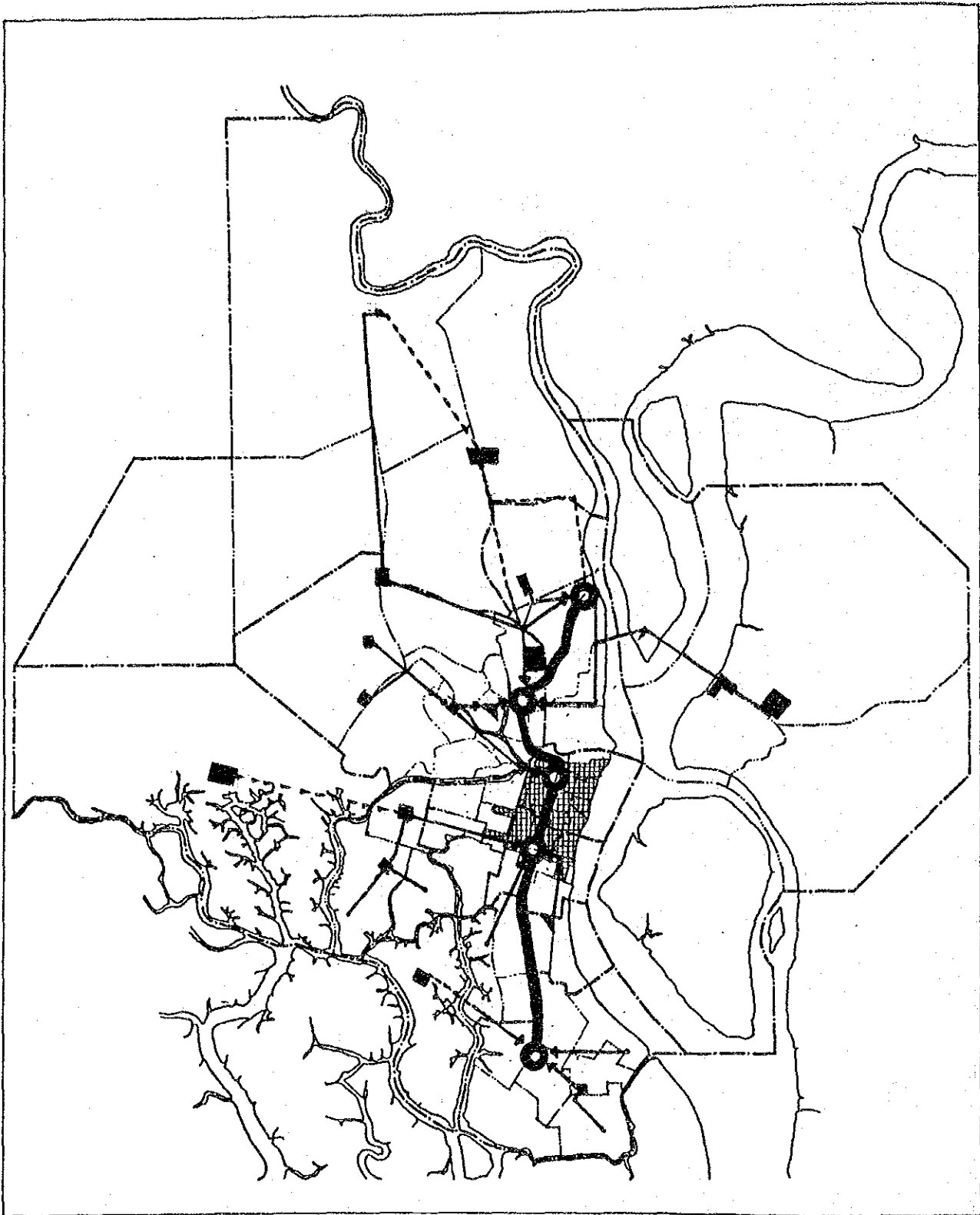


THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-1.6
PROCEDURE OF EXPROPRIATION
IN BUILDING

JAPAN
INTERNATIONAL
COOPERATION
AGENCY



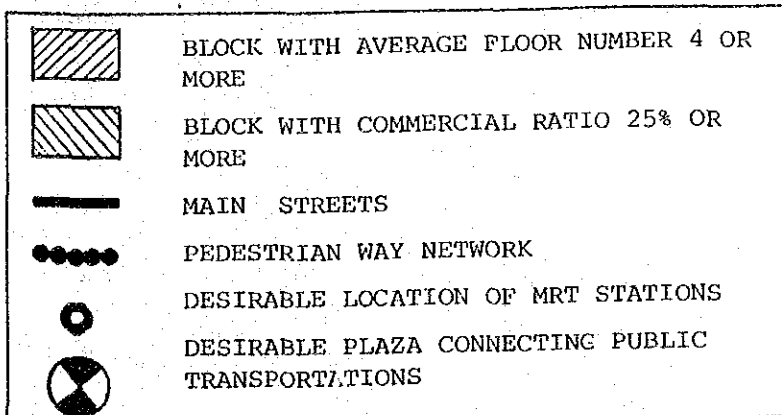
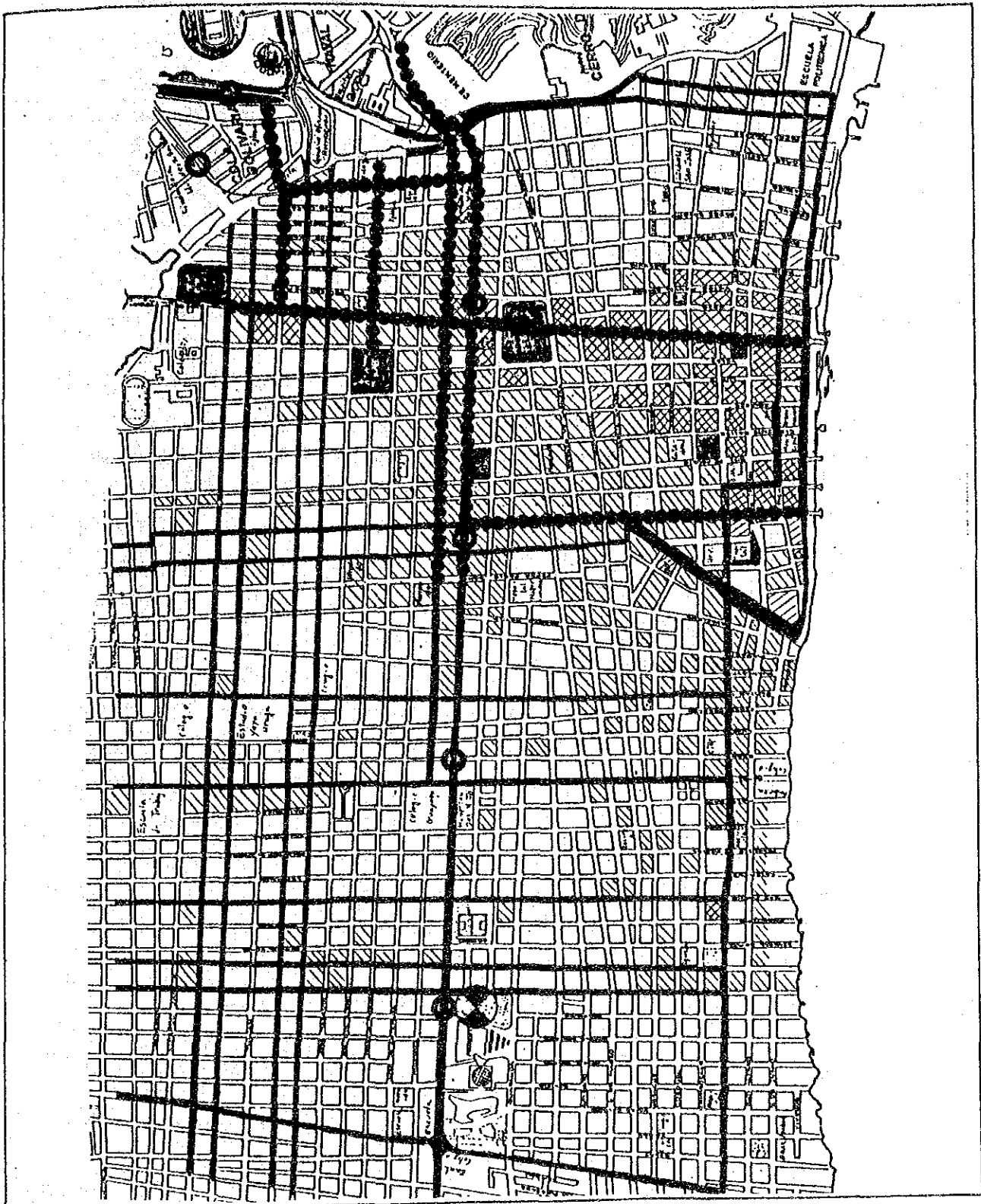


THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-1.7
CONNECTION OF REGIONAL CENTER
WITH CBD BY MRT AND ITS MAIN
STATIONS

JAPAN
INTERNATIONAL
COOPERATION
AGENCY





THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-1.8
CONCEPTIONAL PLAN OF CBD
AND SURROUNDING AREA

JAPAN
INTERNATIONAL
COOPERATION
AGENCY



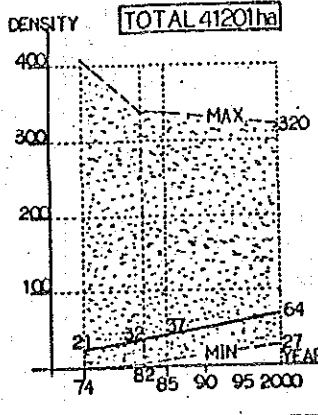
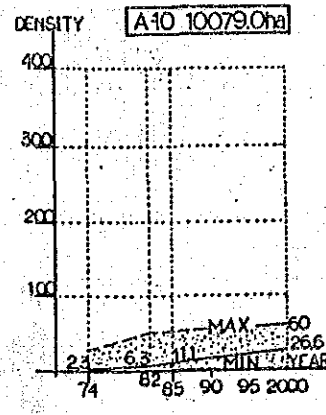
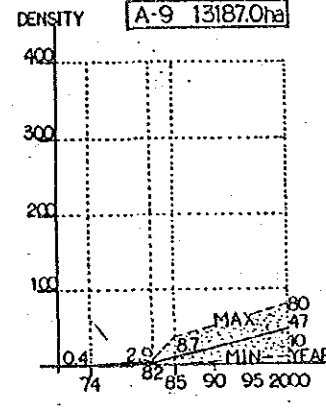
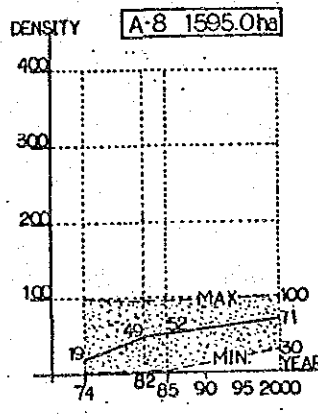
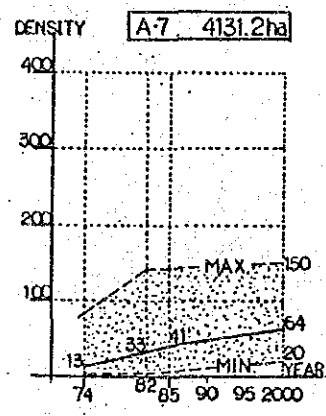
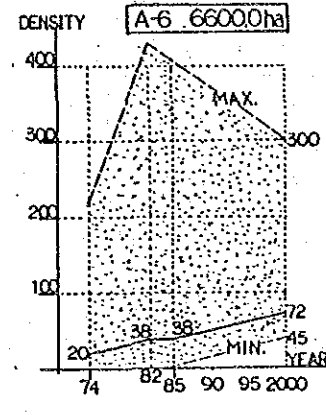
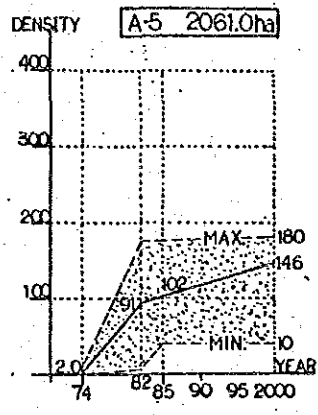
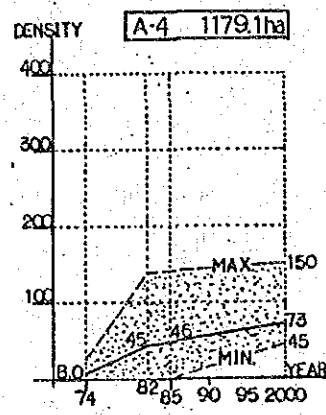
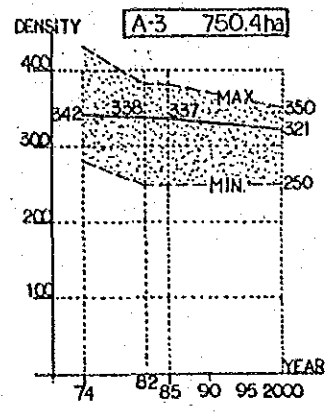
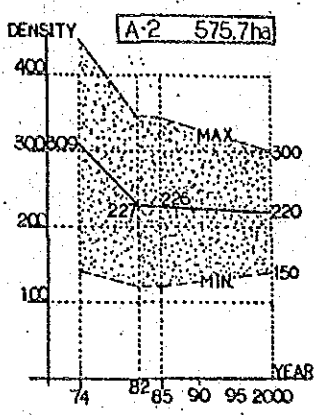
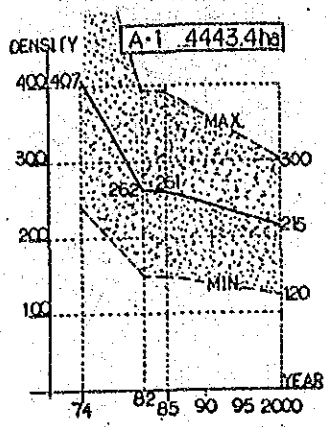
These items will affect settlement of population, increase of economically active population, and relative plannings, etc.

2-2 Allotment of Population to Traffic Zones

Taking in account the housing development projects and their characteristics and capacity, foreseeable changes in population density by the year 2000 are outlined in Figure 2-2.1.

Allotment of the forecast population 2,630,000 in the year 2000 should be based on those changes in the long term. On the other hand, 1,850,000 in the year 1990 will be rather decided by the present progressing development, while 2,220,000 in 1995 is worked out as the middle of 1990 and 2000. Table 2-2.1 shows those changes in population by B-zone and Figure 2-2.3 shows the outline of the allotment of the population in 2000.

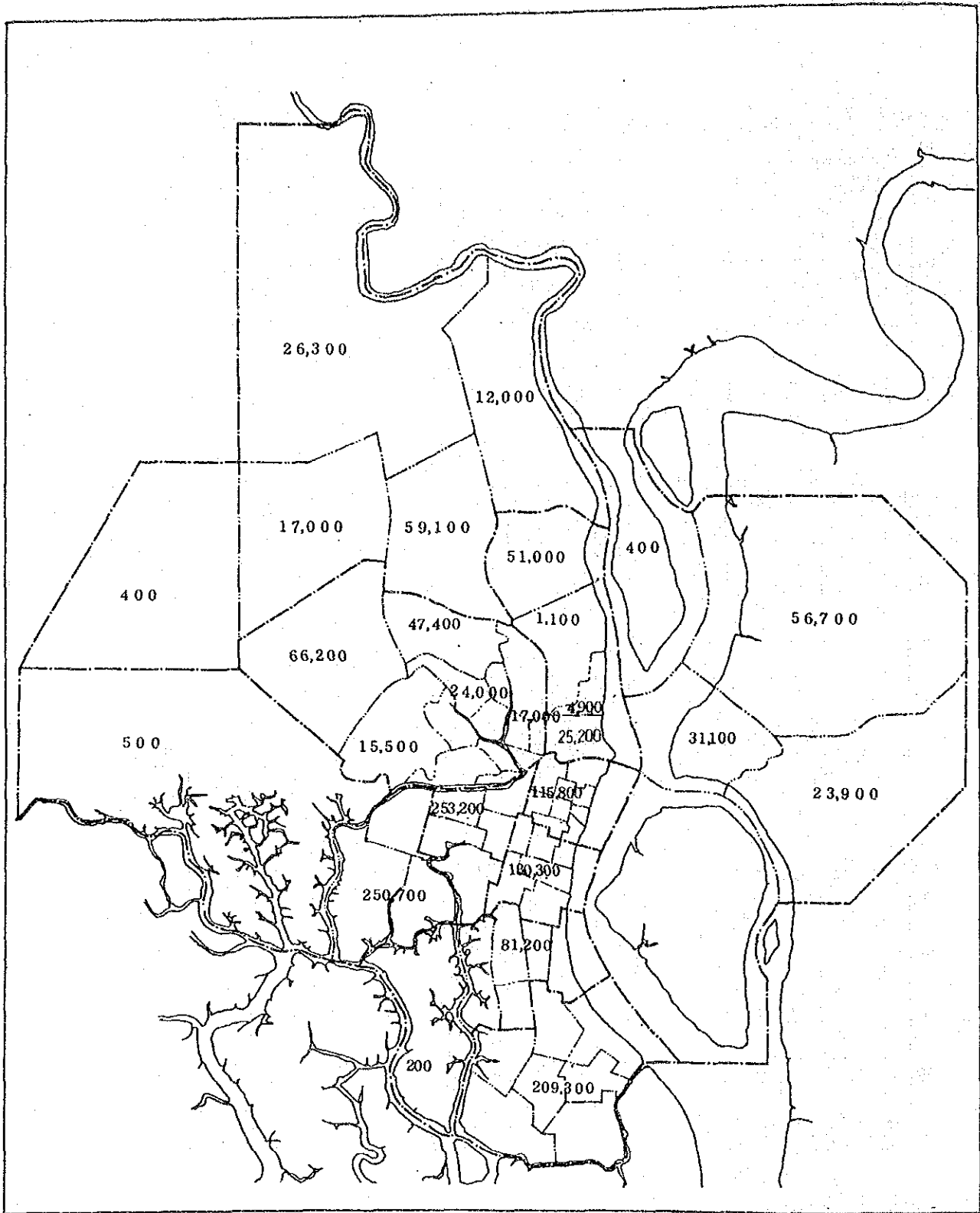
Consequently, the size of the population in the Far North Area shall reach to 614,700, being bigger than 462,900 of the existing urban central area (A-1, A-2 and A-3 zone), which will necessitate a big new urban center there. Other suburban residential areas shall also grow up and require each regional core with various services for their daily convenience. The connecting points of main transportation will have to alter their appearance to play higher role for many gathering people. Figure 2-2.4 shows trends of population distribution.



THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-2.1
CHANGE IN POPULATION DENSITY
BY 2000

JAPAN
INTERNATIONAL
COOPERATION
AGENCY

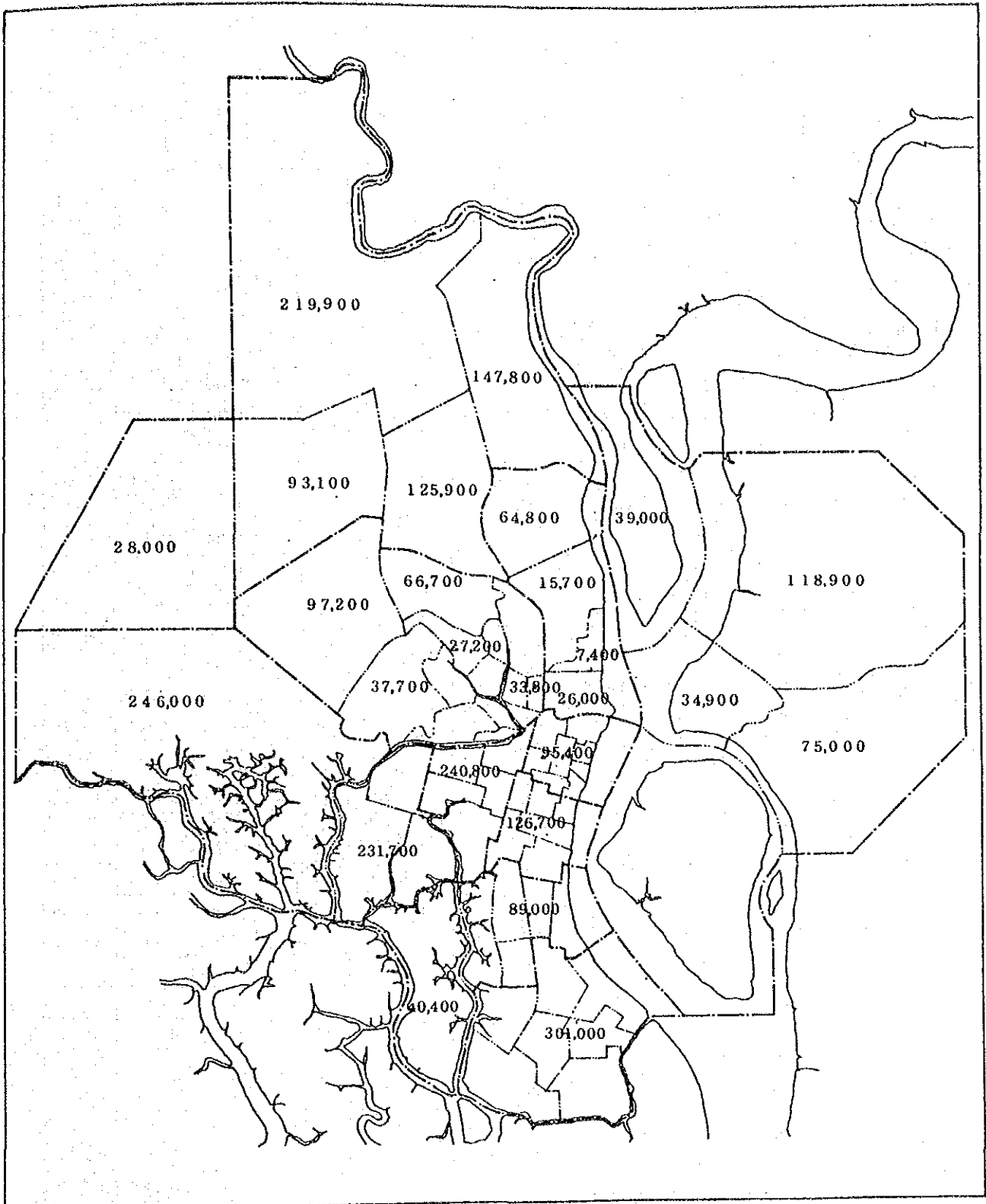


THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-2.2
ALLOTMENT OF POPULATION
IN 1985

JAPAN
INTERNATIONAL
COOPERATION
AGENCY





THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 2-2.3
ALLOTMENT OF POPULATION
IN 2000

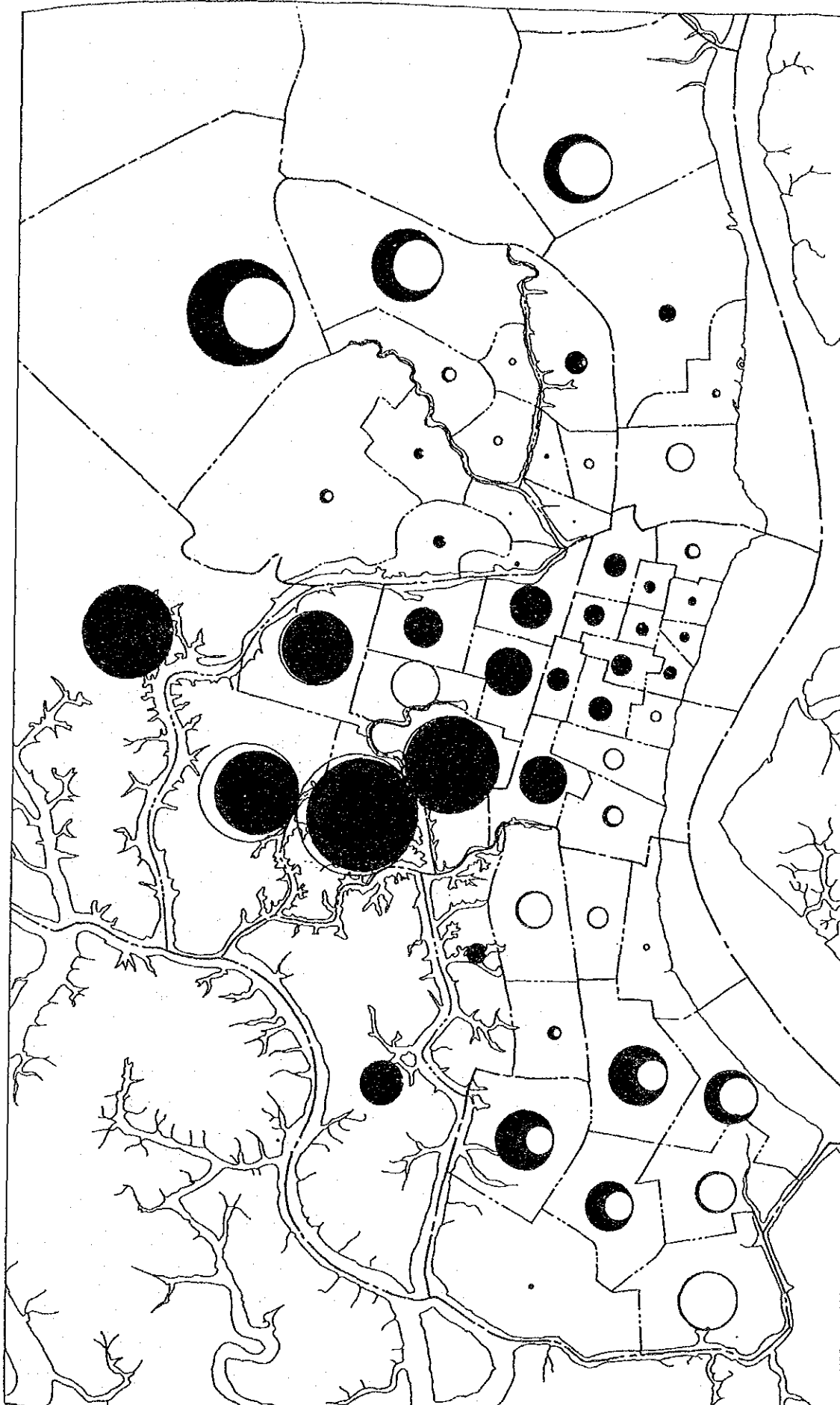
JAPAN
INTERNATIONAL
COOPERATION
AGENCY



Table 2-2.1 POPULATION IN STUDY AREA BY ZONE

Zone		Year			
A	B	1985	1990	1995	2000
1	101	7,100	6,600	6,200	5,700
	102	4,700	8,600	3,900	3,500
	103	11,600	9,900	8,300	6,600
	104	10,400	9,500	8,600	7,700
	105	11,000	11,900	12,800	13,800
	106	11,800	10,800	9,900	8,900
	107	19,400	17,900	16,400	14,900
	108	18,800	18,300	17,800	17,300
	109	21,000	19,700	18,400	17,000
	Sub-T.	115,800	113,200	102,300	95,400
2	201	9,500	9,500	9,500	9,500
	202	22,000	21,300	20,700	20,100
	203	20,400	19,500	18,700	17,800
	204	18,600	18,800	19,000	19,200
	205	15,600	16,800	18,100	19,400
	206	44,200	43,000	41,900	40,700
Sub-T.	130,300	128,900	127,900	126,700	
3	301	39,100	38,700	38,400	38,100
	302	43,800	42,600	41,400	40,100
	303	90,000	87,400	84,900	82,400
	304	35,800	35,800	35,900	36,000
	305	44,500	44,400	44,300	44,200
Sub-T.	253,200	248,900	244,900	240,800	
4	401	4,900	5,000	5,100	5,200
	402	18,600	18,900	19,300	19,800
	403	32,100	32,700	33,400	34,200
	404	7,600	9,000	10,500	12,400
	405	18,000	17,800	17,600	17,400
	406	200	300	27,000	40,400
Sub-T.	81,400	83,700	112,900	129,400	
5	501	28,900	36,900	44,900	55,600
	502	27,200	32,500	37,900	45,100
	503	53,600	54,000	54,400	55,000
	504	26,600	34,900	43,200	54,300
	505	3,000	3,300	3,600	4,100
	506	35,600	39,000	42,500	49,300
	507	34,400	35,300	36,300	37,600
Sub-T.	209,300	235,900	262,800	301,000	

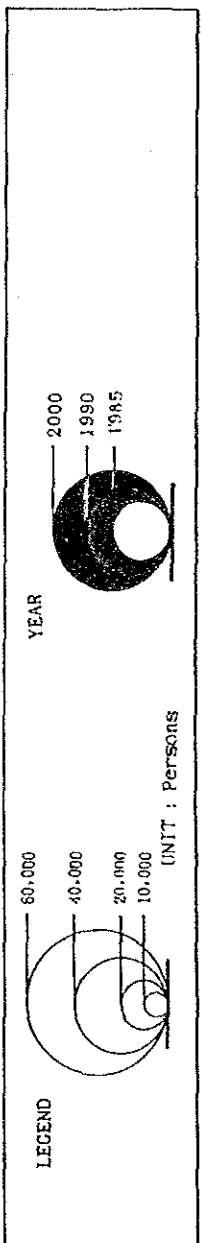
Zone		Year			
A	B	1985	1990	1995	2000
6	601	68,200	65,400	62,600	58,800
	602	112,300	103,300	94,300	82,400
	603	70,200	76,300	82,400	90,500
	604	500	85,300	170,200	246,000
	Sub-T.	251,200	330,300	409,500	477,700
7	701	1,000	1,000	1,100	1,200
	702	7,400	7,500	7,600	7,800
	703	8,000	9,200	10,500	12,200
	704	47,400	53,200	59,000	66,700
	705	66,200	72,500	78,800	97,200
	706	1,100	4,400	7,700	11,000
	707	2,800	3,100	3,400	3,800
	708	1,200	1,400	1,500	1,600
	709	2,400	4,400	6,400	9,100
	710	10,800	11,600	12,500	13,600
	711	5,800	5,800	5,800	5,800
	712	3,100	3,100	3,200	3,300
	713	8,200	8,400	8,500	8,600
	714	5,300	9,800	14,300	20,700
Sub-T.	170,700	195,400	220,300	262,600	
8	801	25,200	25,400	25,700	26,000
	802	1,100	5,500	9,800	15,700
	803	51,000	55,100	59,300	64,800
	804	4,900	5,600	6,400	7,400
Sub-T.	82,200	91,600	101,200	113,900	
9	901	59,100	74,100	89,100	125,900
	902	12,000	57,800	104,600	147,800
	903	26,300	91,900	157,400	219,900
	904	400	9,600	18,800	28,000
	905	17,000	30,400	65,500	93,100
Sub-T.	114,800	263,800	435,400	614,700	
10	1001	31,100	32,200	33,400	34,900
	1002	56,700	74,800	92,900	118,900
	1003	23,900	38,100	52,400	75,000
	1004	-	-	-	-
	1005	400	13,200	26,100	39,000
Sub-T.	112,100	158,300	204,800	267,800	
Total		1,521,000	1,850,000	2,222,000	2,630,000



THE FEASIBILITY STUDY ON GUAYAQUIL
CITY URBAN TRANSPORTATION PLAN
IN THE REPUBLIC OF ECUADOR

Figure 2-2.4
POPULATION DISTRIBUTION
BY ZONE

JAPAN INTERNATIONAL COOPERATION AGENCY



2-3 Allotment of Economically Active Population (EAP)

1) Secondary EAP

a. Existing Characteristics in 1982 by the M/P Study

- secondary EAP in 1982 -----97,900
- space for secondary activities -----982 ha
- secondary EAP per hectare -----100 EAP/ha

b. Estimated Secondary EAP in 2000 ----- 187,500

c. Space required for Future Development

- new space required in 2000;

$$187,500 \times \frac{1}{100} - 982 = 893 \text{ ha}$$

- transference from the urban central area;

$$47,018 \times 0.60 \times \frac{1}{100} = 282 \text{ ha}$$

- total additional space; $893 + 282 = 1,175 \text{ ha}$

d. Allotment of Space for Future Development

	(Zone)
• Isla Trinitaria (A-4)	----- 150 ha in B-406
• Guasmo (A-5)	----- 25 ha in B-502
• Westside Estero Salado (A-6)	----- 150 ha in B-604
• Av. Tanca Marengo (A-7)	----- 50 ha in B-704
• Via a Daule (A-9)	----- 100 ha in B-901
• Via a Daule (A-9)	----- 250 ha in B-903
• Via a Daule (A-9)	----- 150 ha in B-905
• Via Triunfo (A-10)	----- 300 ha in B-1003

e. Allotment of Future Secondary EAP

According to the space for future development, the allotment of future tertiary EAP to each B Zone at the density of 100 EAP/ha is shown in Table 2-3.1.

2) Tertiary EAP

- a. Existing Characteristics in 1982 by the M/P study
- tertiary EAP in 1982 ----- 278,800
 - floor space for tertiary activities ----- 283 ha
 - tertiary EAP per hectare ----- 9.6×10^{-4} ha/EAP
- b. Estimated Tertiary EAP in 2000 ----- 620,500

c. Floor Space Required for Future Development

- new floor space required in 2000;
 $620,500 \times 9.6 \times 10^{-4} - 283 = 312$ ha

d. Allotment of Floor Space for Future Development

Future development of tertiary activity depends on both the share in the existing allotment and the size of the future population in each traffic zone.

additional floor space by 2000 (312 ha)

= the share in the existing allotment (106 ha)

+ the size of future population in each zone (206 ha)

And allotment of additional floor space by the size of the future population in each zone is calculated as follows.

- new urban centers alongside the MRT route in the northern area

Zone 714;

$$(283+312) \times (0.008 \times 0.20 + 0.289 \times 0.10) \times 1.25 = 22.7 \text{ ha}$$

Zone 802;

$$(283+312) \times (0.005 \times 0.20 + 0.234 \times 0.10) \times 1.25 = 18.2 \text{ ha}$$

- new urban centers in the northern area

Zone 803;

$$(283+312) \times (0.025 \times 0.20 + 0.234 \times 0.10) = 16.9 \text{ ha}$$

Zone 901;

$$(283+312) \times (0.048 \times 0.20 + 0.234 \times 0.10) = 19.6 \text{ ha}$$

Zone 902;

$$(283+312) \times (0.056 \times 0.20 + 0.234 \times 0.10) = 20.6 \text{ ha}$$

• regional centers alongside the MRT route

Zone 502;	$(283+312) \times 0.038 \times 0.20 \times 1.25$	=	5.6 ha
Zone 501;	$(283+312) \times 0.040 \times 0.20 \times 1.25$	=	5.9 ha
Zone 204;	$(283+312) \times (0.114+0.181) \times 0.10 \times 1.25$	=	21.9 ha

• other regional centers

Zone 507;	$(283+312) \times 0.035 \times 0.20$	=	4.2 ha
Zone 406;	$(283+312) \times (0.015 \times 0.20 + 0.077 \times 0.10)$	=	6.4 ha
Zone 302;	$(283+312) \times 0.047 \times 0.20$	=	5.6 ha
Zone 304;	$(283+312) \times 0.030 \times 0.20$	=	3.6 ha
Zone 601;	$(283+312) \times 0.022 \times 0.20$	=	2.6 ha
Zone 602;	$(283+312) \times 0.031 \times 0.20$	=	3.7 ha
Zone 603;	$(283+312) \times 0.034 \times 0.20$	=	4.0 ha
Zone 604;	$(283+312) \times 0.094 \times 0.20$	=	11.2 ha
Zone 704;	$(283+312) \times 0.025 \times 0.20$	=	4.4 ha
Zone 704;	$(283+312) \times 0.037 \times 0.20$	=	3.0 ha
Zone 709;	$(283+312) \times (0.013 \times 0.20 + 0.037 \times 0.10)$	=	3.7 ha
Zone 903;	$(283+312) \times 0.084 \times 0.20$	=	10.0 ha
Zone 1001;	$(283+312) \times 0.087 \times 0.20$	=	10.4 ha
Zone 1003;	$(283+312) \times 0.015 \times 0.20$	=	1.8 ha

e. Allotment of Future Tertiary EAP

According to the floor space for future development, the allotment of the future tertiary EAP to each B Zone at the density of 9.6×10^{-4} ha/EAP is shown in Table 2-3.2. Figure 2-3.1 shows trends of EAP distribution.

Table 2-3.1 SECONDARY EAP IN STUDY AREA

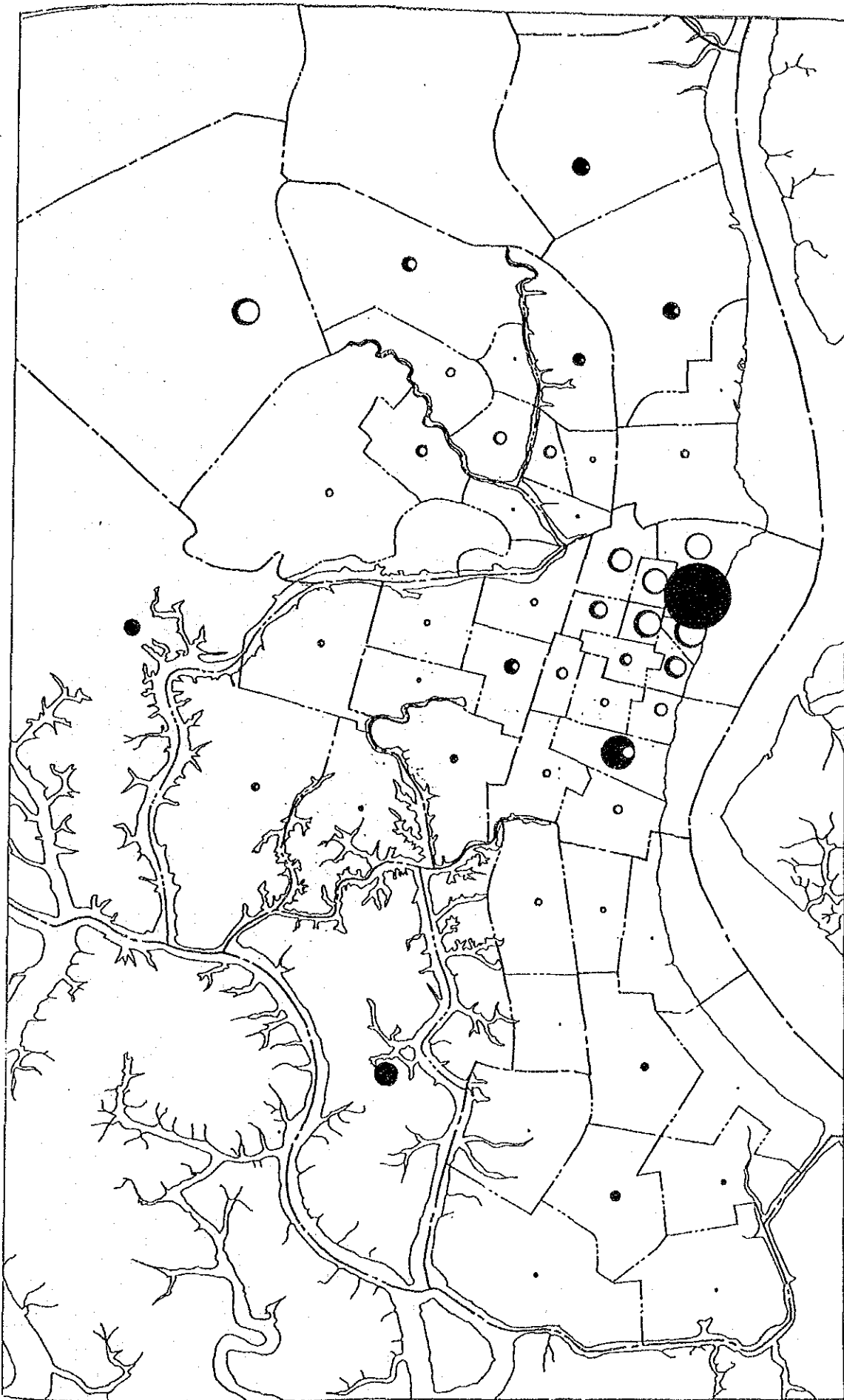
Zone		Year			
A	B	1985	1990	1995	2000
1	101	14,340	11,690	9,030	6,370
	102	3,730	3,040	2,350	1,660
	103	1,610	1,310	1,010	710
	104	3,920	3,190	2,460	1,740
	105	4,340	3,540	2,740	1,930
	106	1,900	1,550	1,200	850
	107	690	560	430	300
	108	920	750	580	410
	109	3,680	3,000	2,320	1,640
	Sub-T.	35,130	28,630	22,120	15,610
2	201	1,410	1,150	890	630
	202	610	500	390	270
	203	640	520	400	280
	204	1,220	990	760	540
	205	930	760	590	420
	206	430	350	270	190
Sub-T.	5,240	4,270	3,300	2,330	
3	301	640	550	460	370
	302	540	470	390	310
	303	240	210	180	150
	304	360	310	260	210
	305	220	190	160	130
Sub-T.	2,200	1,730	1,450	1,170	
4	401	810	810	810	810
	402	450	450	450	450
	403	540	540	540	540
	404	100	100	100	100
	405	20	20	20	20
	406	0	0	5,000	15,000
Sub-T.	1,920	1,920	6,920	16,920	
5	501	40	40	40	40
	502	60	680	1,310	2,560
	503	60	60	60	60
	504	360	360	360	360
	505	300	300	300	300
	506	210	210	210	210
	507	40	40	40	40
	Sub-T.	1,070	1,690	2,320	3,570

Zone		Year			
A	B	1985	1990	1995	2000
6	601	600	600	600	600
	602	160	160	160	160
	603	400	400	400	400
	604	270	3,960	7,650	15,020
	Sub-T.	1,430	5,120	8,810	16,180
7	701	550	550	550	550
	702	3,390	3,390	3,390	3,390
	703	2,720	2,720	2,720	2,720
	704	4,460	5,550	6,650	7,750
	705	10,800	10,800	10,800	10,800
	706	70	70	70	70
	707	30	30	30	30
	708	1,040	1,040	1,040	1,040
	709	3,110	3,110	3,110	3,110
	710	2,710	2,710	2,710	2,710
	711	670	670	670	670
	712	860	860	860	860
	713	1,020	1,020	1,020	1,020
	714	700	700	700	700
Sub-T.	32,130	33,220	34,320	35,420	
8	801	1,050	1,050	1,050	1,050
	802	780	780	780	780
	803	550	550	550	550
	804	30	30	30	30
Sub-T.	2,410	2,410	2,410	2,410	
9	901	9,170	13,070	14,700	16,320
	902	170	170	170	170
	903	10,330	20,250	31,320	33,000
	904	130	130	130	130
	905	6,210	10,830	13,570	16,300
Sub-T.	26,010	44,450	59,890	63,240	
10	1001	250	250	250	250
	1002	130	130	130	130
	1003	2,600	8,200	19,200	30,190
	1004	0	0	0	0
	1005	80	80	80	80
Sub-T.	3,060	8,660	19,660	30,650	
Total		110,400	132,100	161,200	187,500

Table 2-3.2 TERTIARY EAP IN STUDY AREA BY ZONE

Zone		Year			
A	B	1985	1990	1995	2000
1	101	46,870	49,910	53,060	54,140
	102	22,190	25,530	27,020	27,460
	103	20,020	23,030	24,370	24,770
	104	17,550	20,190	21,370	21,700
	105	19,660	20,620	21,940	23,320
	106	13,600	16,640	17,560	18,780
	107	7,010	10,060	10,530	10,700
	108	11,450	15,170	15,940	16,110
	109	15,560	18,900	19,940	20,190
	Sub-T.	173,910	200,050	211,730	216,170
2	201	9,020	10,380	10,980	11,210
	202	5,540	6,370	6,750	6,890
	203	8,050	9,260	9,800	10,010
	204	9,970	14,520	22,190	30,670
	205	6,320	7,270	7,690	7,860
	206	5,390	6,200	6,560	6,690
	Sub-T.	44,290	54,000	63,970	73,330
3	301	4,820	5,540	5,870	5,990
	302	6,170	8,060	10,720	13,500
	303	2,840	3,890	5,510	7,250
	304	4,190	4,820	5,100	5,210
	305	2,710	3,120	3,300	3,370
Sub-T.	20,730	25,430	30,500	35,320	
4	401	1,030	1,190	1,250	1,280
	402	3,620	4,160	4,410	4,500
	403	4,870	5,600	5,930	6,050
	404	860	990	1,050	1,070
	405	180	210	220	230
	406	-	-	1,830	6,640
Sub-T.	10,560	12,150	14,690	19,770	
5	501	990	2,170	4,620	7,430
	502	1,570	2,580	4,490	6,660
	503	1,960	2,250	2,390	2,430
	504	770	890	940	960
	505	2,450	2,920	3,090	3,160
	506	870	1,000	1,060	1,080
	507	110	850	2,530	4,480
Sub-T.	8,810	12,660	19,120	26,200	

Zone		Year			
A	B	1985	1990	1995	2000
6	601	3,330	4,290	5,560	6,870
	602	1,650	2,540	4,120	5,890
	603	3,620	4,870	6,730	8,720
	604	160	2,120	6,600	11,850
	Sub-T.	8,760	13,820	23,010	33,330
7	701	1,790	2,060	2,180	2,220
	702	6,930	7,970	8,440	8,600
	703	3,280	3,770	3,990	4,070
	704	4,170	5,320	6,810	8,320
	705	9,090	11,230	13,590	15,880
	706	60	70	80	110
	707	190	220	230	240
	708	650	750	790	810
	709	4,360	5,670	7,460	9,320
	710	4,600	5,290	5,600	5,710
	711	830	950	1,010	1,030
	712	8,370	9,630	10,190	10,400
	713	3,080	3,540	3,750	3,820
	714	480	3,700	10,980	19,460
Sub-T.	47,880	60,170	75,100	89,980	
8	801	5,210	5,990	6,340	6,480
	802	4,900	5,640	14,280	21,210
	803	5,140	8,840	15,940	23,990
	804	720	830	880	890
Sub-T.	15,970	21,300	37,440	52,570	
9	901	1,440	5,070	13,000	22,240
	902	110	140	11,930	21,600
	903	2,190	4,250	8,370	13,080
	904	300	340	370	370
	905	420	480	510	520
Sub-T.	4,470	10,280	34,180	57,810	
10	1001	2,040	2,350	2,480	2,530
	1002	460	2,330	6,490	11,350
	1003	160	180	190	200
	1004	-	-	-	-
	1005	60	380	1,100	1,940
Sub-T.	2,720	5,240	10,260	16,020	
Total		338,100	415,100	520,000	620,500

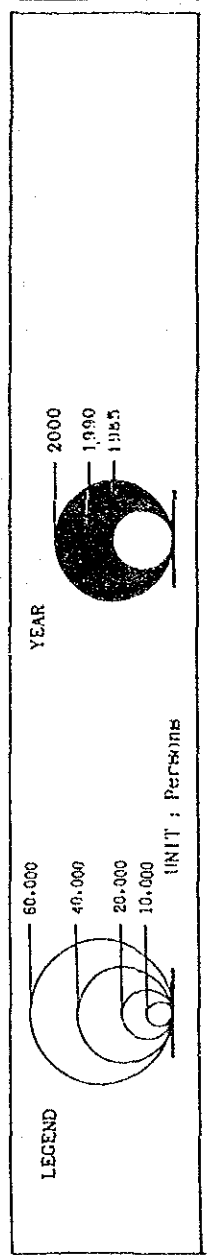


THE FEASIBILITY STUDY ON GUAYAQUIL,
 CITY AND METROPOLITAN AREA
 IN THE REPUBLIC OF ECUADOR

Figure 2-3.1

EAP DISTRIBUTION BY ZONE

JAPAN INTERNATIONAL COOPERATION AGENCY



PART 3

MRT DEMAND FORECAST

PART 3 MRT DEMAND FORECAST

1. Procedure for Forecasting

1-1 Data Base

Overall demand forecast was carried out in the M/P Study for the entire study area and it contributed to formulation of the long term transportation plan including the MRT. This Study aims finally at examination of technical and economic feasibility of the MRT project, and this chapter offers basic data on the demand forecast of several cases tested for the examination.

Premises for the forecast are;

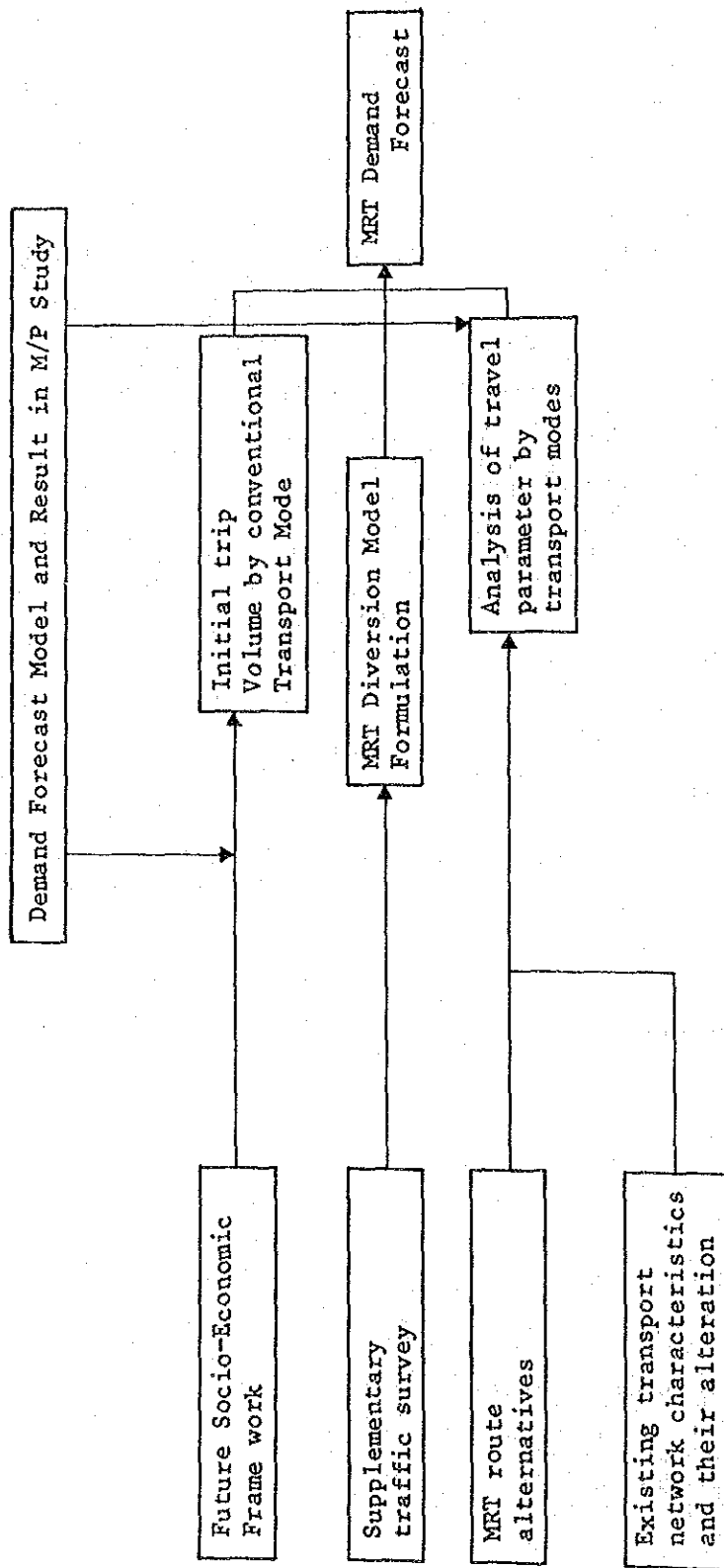
- (1) Since the demand for the whole route (2 lines, about 50 kilometers in 2000) is given in the M/P Study in 1983, this Study examines more in detail and updates that of the north-south route from Terminal Terrestre to Guasmo, basically using the data in 1983.
- (2) Planning years for the forecast are supposed to be 1990, 1993, 1996 and 2000.

Based on the above supposition, the data base is derived from the future trip estimation results in the M/P, modified and updated.

1-2 Forecast Method

The MRT demand forecast consists of several sub-tasks illustrated in Figure 1-1.1. Its basic ideas are as follows;

- (1) Future total trip demand is basically derived from the forecast results in the M/P, being modified by the future socio-economic framework in the PART 2 and trips are updated.
- (2) A demand diversion model to the MRT from other transport modes should be adaptable to changes of various elements such as fare, travel time, transfer, and other services, etc.,



THE FEASIBILITY STUDY ON GUAYAQUIL CITY
 URBAN TRANSPORTATION PLAN IN THE
 REPUBLIC OF ECUADOR

Figure 1-1.1 DEMAND FORECAST METHOD

JAPAN
 INTERNATIONAL
 COOPERATION
 AGENCY

since they are tested later on. Therefore, the model is desirable to be a mathematical function type which consists of many planning indicators so that it can analyse precisely actual behavior of trip makers.

- (3) The MRT and conventional urban bus systems are both typical public transport and may be competitors each other in accordance with the existing bus routes and their route reorganization. Demand forecast should reflect the differences of characteristics existed in both systems concerning level of service, network density, etc.

1-3 Cases for Forecast

The cases for demand forecast are determined from the viewpoints of subsequent tasks, i.e. economic and financial analysis;

Items to be considered to adopt the test cases are;

- (1) The final purpose of the Study is to decide the most feasible route section, opening year and its extension plan to the whole object route.
- (2) Financial analysis needs the trip demand through the entire project life. Therefore, it has to be estimated by several planning years; 1990, 1993, 1996 and 2000.
- (3) This MRT plan presumes bus route reorganization. This policy choice is considered to be very important to realize the MRT project effectively, and evaluation heavily depends on the demand forecast.

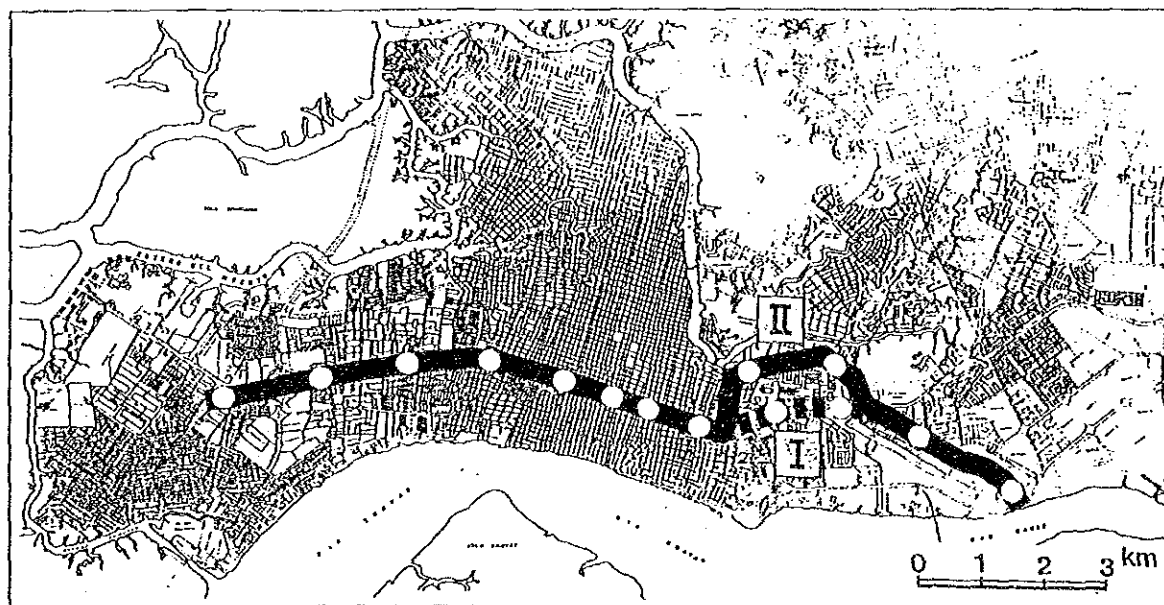
Taking the above into account, the demand is forecasted by each section pattern and forecasting years under some conditions. The cases for demand forecast are shown in Table 1-3.1.

The economic and financial analysis refer to 10 test cases which stand for the stage construction and are divided into several section patterns. The test cases relate to the section patterns as shown in Table 1-3.2.

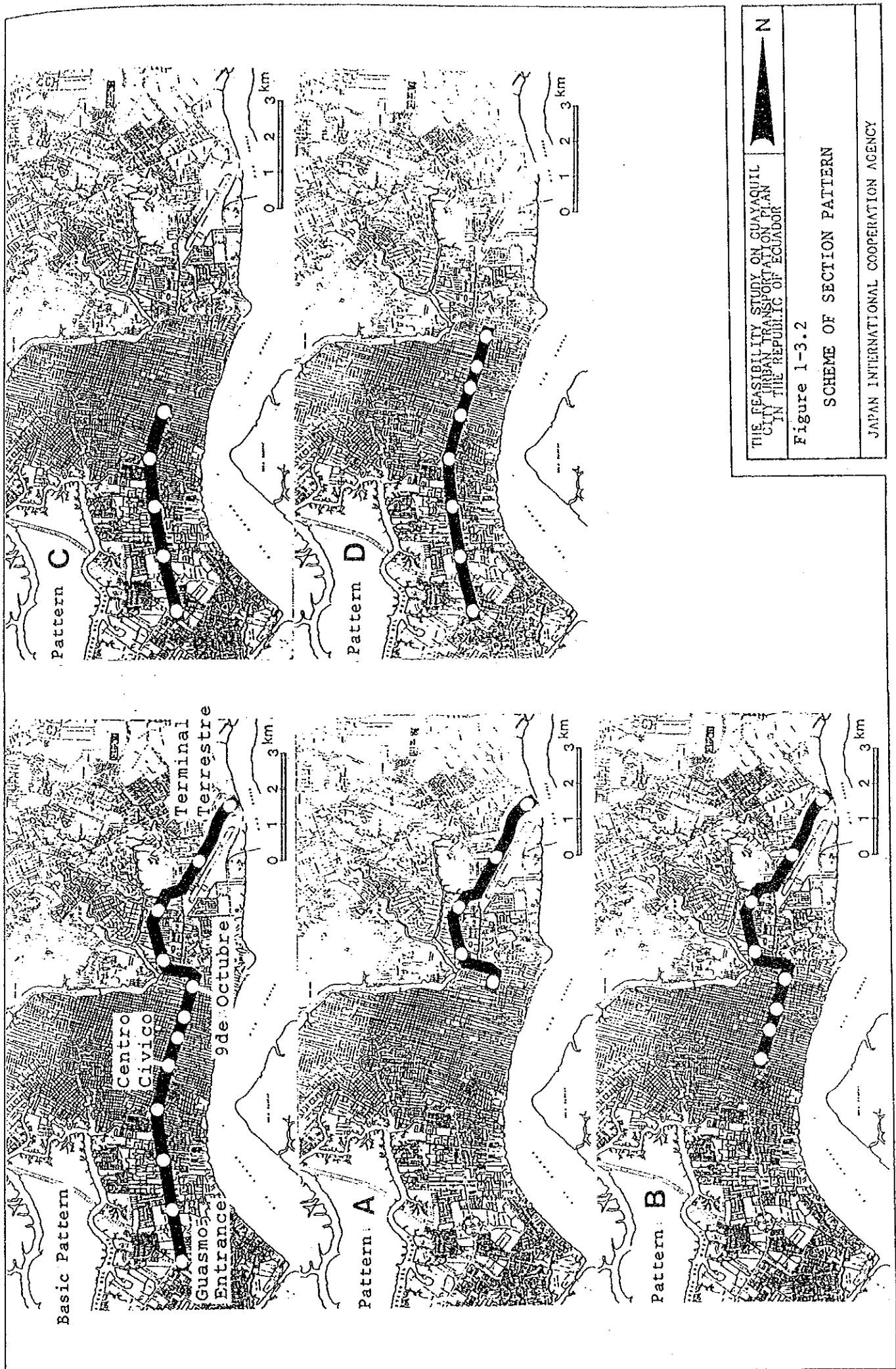
Table 1-3.1 CASES FOR DEMAND FORECAST

Route Alternative	Section Pattern	Bus Route Reorganization	Forecasting Year			
			1990	1993	1996	2000
I	Basic Pattern	With	o			
II	Basic Pattern	With	o	o	o	o
II	Pattern A	With	o	o	o	o
II	Pattern B	With	o	o	o	o
II	Pattern C	With	o	o	o	o
II	Pattern D	With	o	o	o	o
II	Basic Pattern	Without	o			

- Note) 1. Symbol (o) shows case to be tested.
 2. The route alternatives and section patterns are illustrated in Figure 1-3.1 and 1-3.2.



THE FEASIBILITY STUDY ON GUAYAQUIL CITY URBAN TRANSPORTATION PLAN IN THE REPUBLIC OF ECUADOR
 Figure 1-3.1 ROUTE ALTERNATIVES
 JAPAN INTERNATIONAL COOPERATION AGENCY



THE FEASIBILITY STUDY ON GUAYAQUIL
CITY URBAN TRANSPORT SECTION PLAN
IN THE REPUBLIC OF ECUADOR

Figure 1-3.2

SCHEME OF SECTION PATTERN

JAPAN INTERNATIONAL COOPERATION AGENCY

Table 1-3.2 RELATIONSHIP BETWEEN THE SECTION IN SERVICE AND TEST CASES

Test Case		Section on Service by Year			
		1990	1993	1996	2000
Basic Case		Basic Pattern			
Case A-1		Pattern A	Basic Pattern		
Case A-2		Pattern A	Pattern B	Basic Pattern	
Case B-1		Pattern B	Basic Pattern		
Case C-1		Pattern C	Basic Pattern		
Case C-2		Pattern C	Pattern D	Basic Pattern	
Case D-1		Pattern D	Basic Pattern		
Case E		Pattern A			
Case F		Pattern B			
Case G		Pattern d			

1-4 Basic Idea on Bus Route Reorganization to Forecast Demand

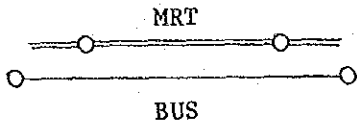
For the MRT demand forecast, the present bus network is treated in 2 kind of ways; one is a reorganized network of the present routes to coordinate the MRT and the bus and drastically to improve the public transport system in Guayaquil, while the other is the present network itself. Accordingly, the difference in the MRT demand between with- and without- bus route reorganization will be analyzed clearly.

Basically it is recommendable that the present bus routes are reviewed again and reorganized to form the most efficient and convenient urban transport system for both passengers and bus companies after the operation of the MRT, and then this Study assumes that all the bus routes directly related to the MRT will be reorganized based on the four categories below;

- (1) The completely competitive bus routes with the MRT will be abolished and substituted by the MRT to provide high level of services for passengers.
- (2) The bus routes crossing the MRT will just drop by the MRT stations to improve the connection between MRT and the bus.
- (3) The routes running in areas beyond the MRT service are left to maintain the present service level there.
- (4) New routes from the MRT station are set to extend the catchment area of the MRT.

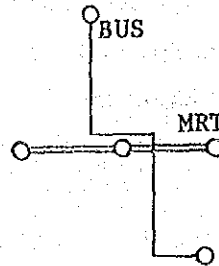
(1) SUBSTITUTE

The bus routes which are completely competitive with the MRT are substituted by the MRT.

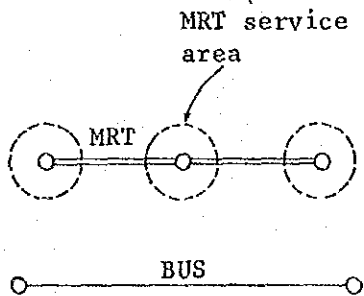


(2) DROPPING-BY

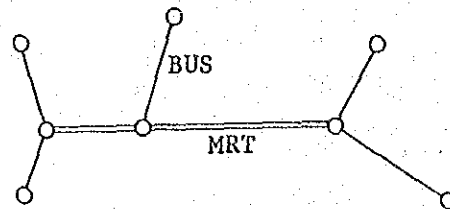
The bus routes crossing the MRT drops by stations.



(3) NO ALTERATION



(4) NEW ROUTE



The bus routes beyond the MRT service area are kept as the present.

New bus routes are established or existing one are extended to developing areas.

Figure 1-4.1 PATTERNS OF REORGANIZATION FOR MRT DEMAND FORECAST

2. Forecast of Trips in Future

2-1 Introduction

The total trip demand has to be estimated before the MRT demand forecast because the MRT demand is forecast on the basis of trip diversion from the existing transport mode to the MRT. The total trip demand in future is already estimated in the M/P Study, while some alterations are needed because;

- (1) New traffic zoning is introduced in this Study in order to obtain the MRT trip demand precisely. Some zones near the MRT route are subdivided into new traffic zones and thus the previous origin-destination tables are converted.
- (2) Since zonal population and Economically Active Population (EAP) are also reviewed and updated in this Study in accordance with the new traffic zoning, trip generation and attraction by zone are also corrected.

The total trip demand is estimated through these conversion. Other items to keep in mind are;

- (1) The growth in car ownership has strong influence on the private car trip production and in Guayaquil, future car ownership is forecast to be a high level. However, no alterations were found in the total trip demand in this examination because the forecast results worked out in the M/P Study correspond quite well with those forecast in this Study.
- (2) Some road projects are officially approved in Guayaquil. They are being executed at present, and then taken into account for demand forecast.

The M/P Study named them on-going projects and the future trip estimation results considering these projects in the M/P Study are used for the data base.

2-2 Forecast Results

The overall trip demand was estimated by modes and planning year. Its results are shown in Appendix 3-1. Figure 2-2.1 - 3 show the change of trip generation and attraction by zone, mode and planning year.

3. Formulation of Diversion Model

3-1 Purpose

The MRT trip demand is estimated from the total trip demand, taking each transport characteristics into consideration as described before. The diversion model from the existing transport mode to the MRT compares the service characteristics of both transport modes and measures their utility to specify the respective travel choice ratio.

It is called the Disaggregate Behaviour Model and formulated through statistical analysis of the trip choice information obtained from the supplementary traffic survey.

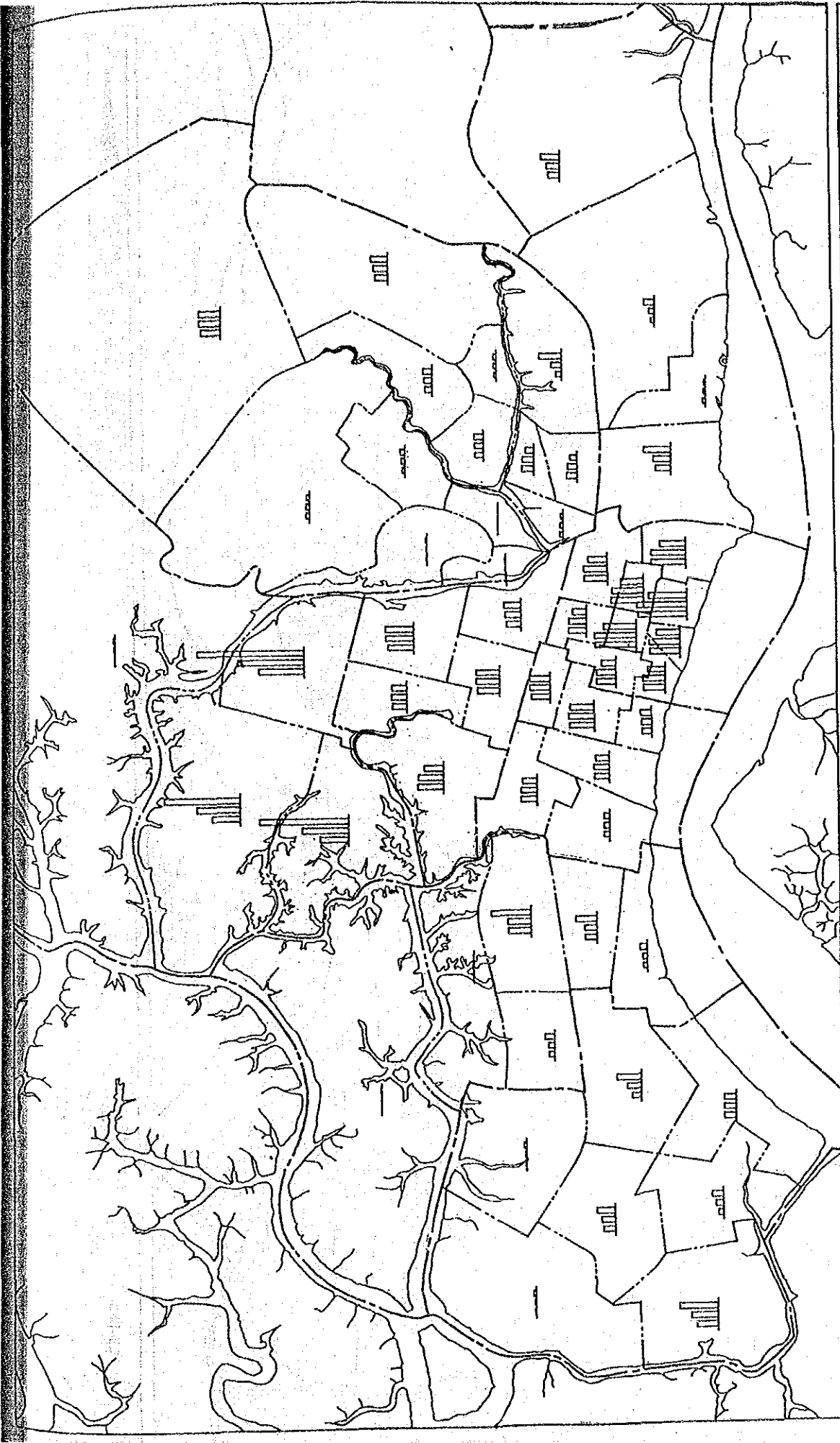
3-2 Analysis

The trip choice behaviour is analyzed based on the collected data through the following considerations;

(1) Data Verification

Although the data was collected on random sampling base by the home interview survey, office interview survey, etc., there exists some possibility of sample bias because their survey area was not for the whole study area.

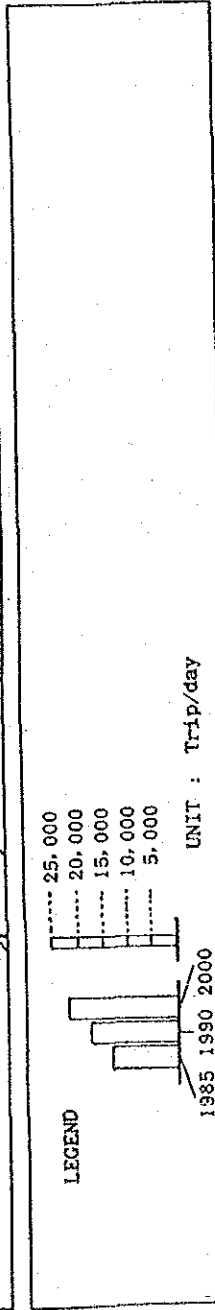
Therefore, the sample characteristics must be verified and corrected statistically. The precise results after correction are shown in Appendix 3-2 and indicate that the collected data are allowable statistically for the model formulation.

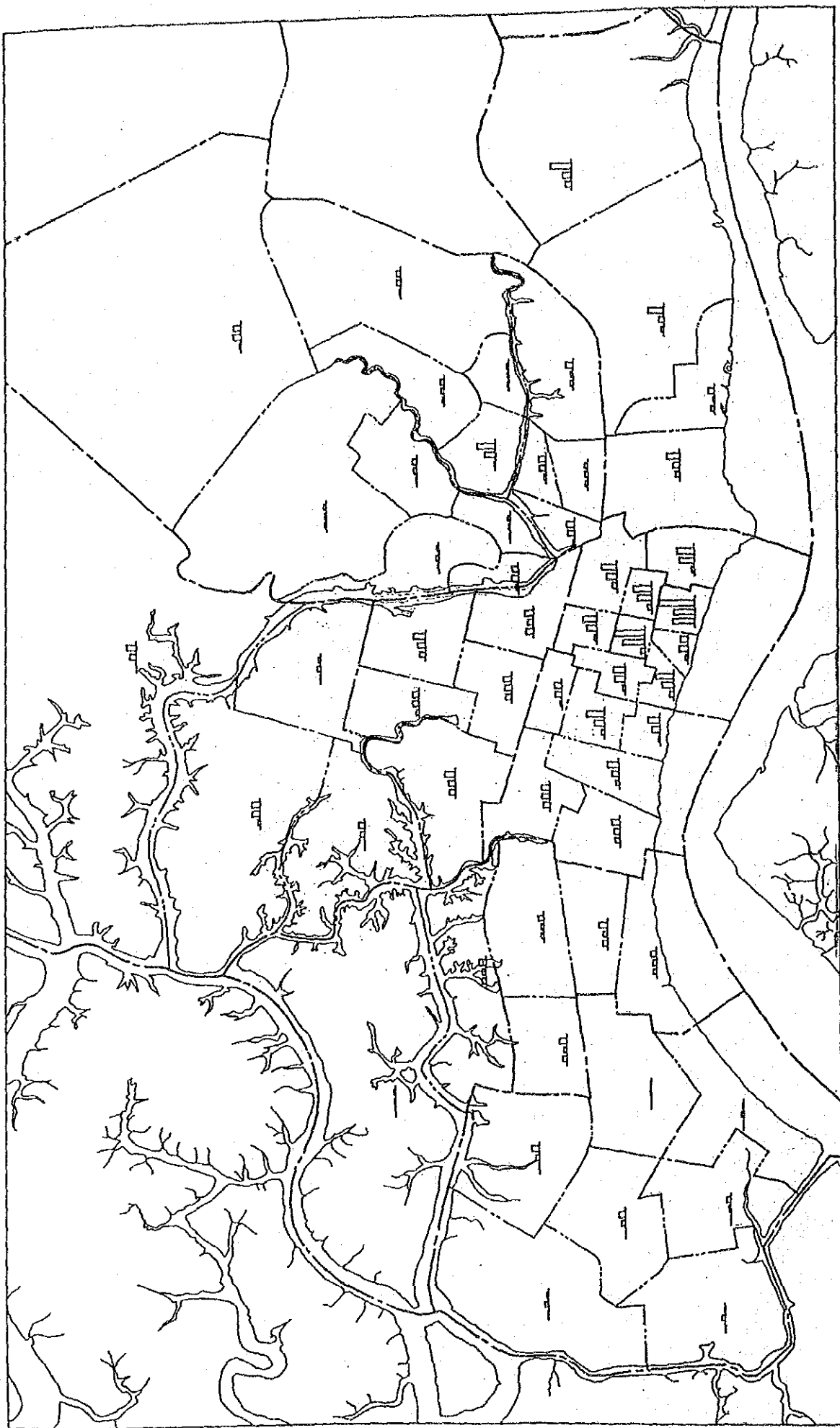


THE FEASIBILITY STUDY ON GUAYAQUIL
 CITY URBAN TRANSPORTATION PLAN
 IN THE REPUBLIC OF ECUADOR

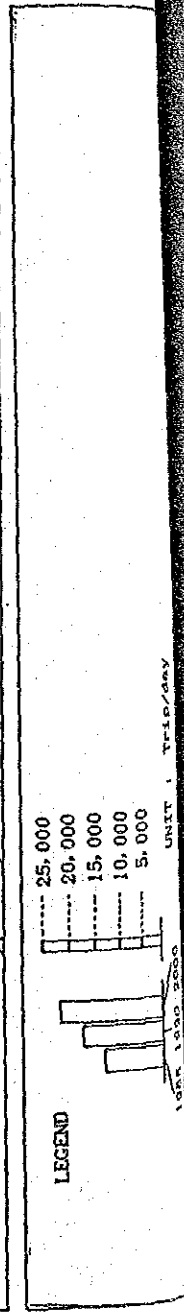
Figure 2-2.1
**BUS TRIP GENERATION AND
 ATTRACTION BY ZONE**

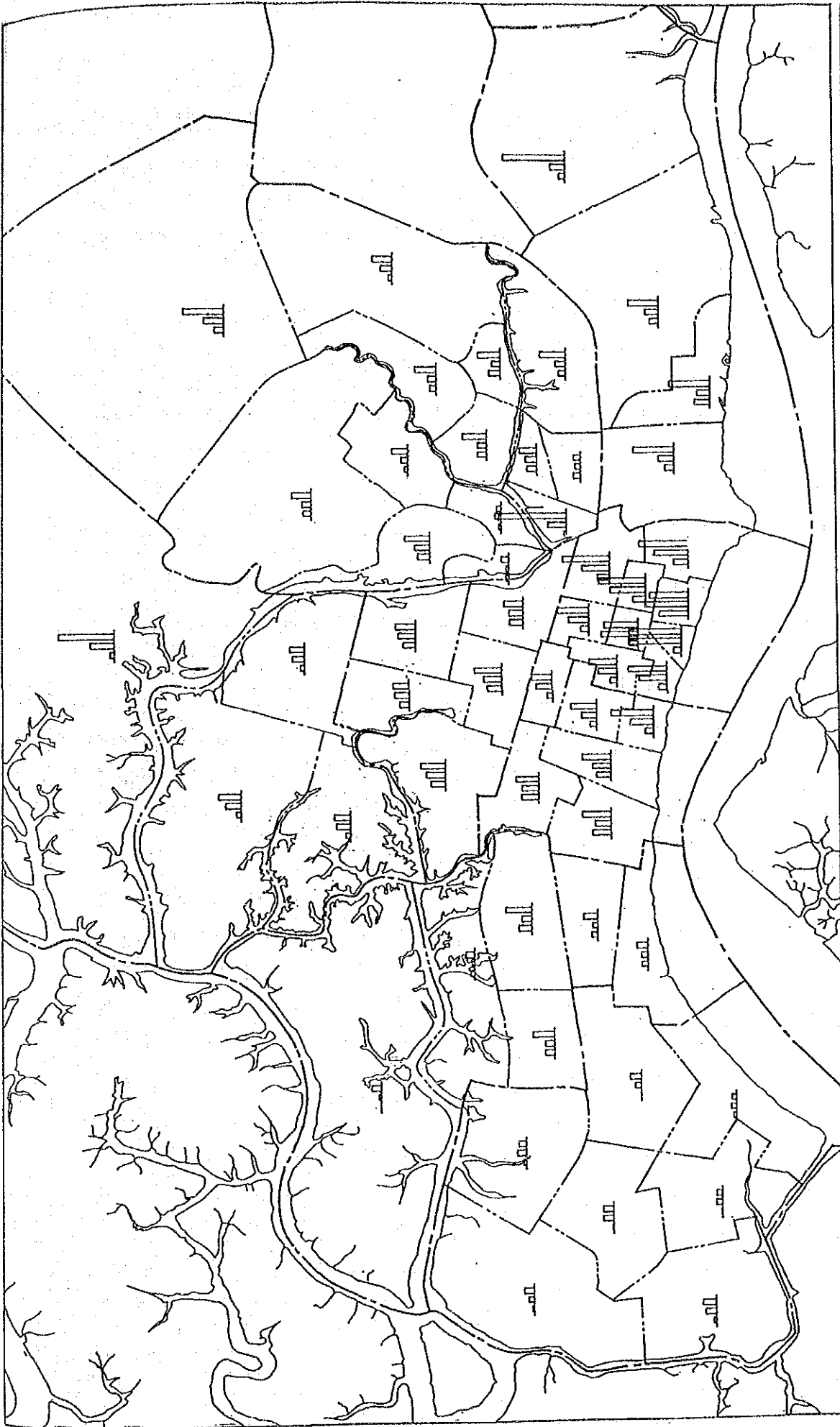
JAPAN INTERNATIONAL COOPERATION AGENCY





THE FEASIBILITY STUDY ON GUAYAQUIL CITY URBAN TRANSPORTATION PLAN IN THE REPUBLIC OF ECUADOR
 Figure 2-2.2
 TAXI TRIP GENERATION AND TAXI TRIP GENERATION ZONE AND TAXI TRIP GENERATION BY ZONE





THE FEASIBILITY STUDY ON GUAYAQUIL
CITY TRANSPORTATION PLAN
IN THE REPUBLIC OF ECUADOR

Figure 2-2.3
CAR TRIP GENERATION AND
ATTRACTION BY ZONE

JAPAN INTERNATIONAL COOPERATION AGENCY

LEGEND

25,000	1985	1990
20,000	1985	1990
15,000	1985	1990
10,000	1985	1990
5,000	1985	1990

UNIT : Trip/day

1985 1990 2000

(2) Choice of Explanatory Variables

There are many factors to affect trip modal choice, i.e. time spent for trips, cost, fare, etc. The suitability of each factor as an explanatory variable is examined with the statistical method.

Appendix 3-3 shows cross tabulation between each factor and modal choice result and it indicates that some of the factors have strong relationship with modal choice.

Discriminant analysis was adopted to examine which factor is more significant in order to explain modal choice.

Table 3-2.1 shows a typical result of this analysis as bellow;

- (a) The range in the Table explains the factor's degree of contribution to the discriminant model. (Larger figure of the range indicates that the factor is more suitable.)
- (b) The chart shows the tendency of modal choice by item category and such a factor with linear relationship to category change is considered to be suitable for explanatory variable.

As a result of analysis, the following 5 factors are reserved for the explanatory variables of the diversion model.

- 1 Car ownership
- 2 Occupation
- 3 Monthly income of household
- 4 Total trip time
- 5 Total trip cost

Table 3-2.1 RESULT OF DISCRIMINANT ANALYSIS

Item	No	Category	No. of Samples	Category score	Range	Score Chart								
						Bus				Others				
						-0.4	-0.3	-0.2	-0.1	0	0.1	0.2	0.3	
Trip Purpose	1	To work	487	-0.0091	0.7210									
	2	To school	547	-0.1063										
	3	Business	258	0.2769										
	4	Private	892	0.1058										
	5	To home	1,384	-0.0755										
	6	Almuerzo	453	0.0292										
	7	Others	27	-0.4441										
Travel time (Bus-Taxi)	1	0 - 5 minutes	1,219	-0.1635	0.7936									
	2	6 - 10	1,536	-0.0861										
	3	11 - 20	1,102	0.3071										
	4	21 - 30	156	0.0715										
	5	31 -	37	-0.4866										
Travel time (Bus-Car)	1	0 - 5 minutes	1,023	0.0266	0.6592									
	2	6 - 10	1,587	0.0365										
	3	11 - 20	1,200	-0.1303										
	4	21 - 30	186	0.2290										
	5	31 -	54	0.5289										
Bus Access	1	0 - 5 minutes	980	-0.1554	0.2792									
	2	6 - 10	1,921	0.1238										
	3	11 -	1,149	-0.0744										

Table 3-2.1 RESULT OF DISCRIMINANT ANALYSIS (Cont'd)

Item	No	Category	No. of Samples	Category score	Range	Score Chart										
						Bus					Others					
						-0.4	-0.3	-0.2	-0.1	0	0.1	0.2	0.3	0.4		
Total time (Bus-taxi)	1	0 - 10 minutes	575	0.1864	0.7626											
	2	11 - 15	1,074	0.2345												
	3	16 - 20	1,040	0.0589												
	4	21 - 25	638	-0.1073												
	5	26 - 30	340	-0.4400												
	6	31 -	383	-0.5281												
Total time (Bus-Car)	1	0 - 10 minutes	547	0.1299	0.2343											
	2	11 - 15	928	-0.0808												
	3	16 - 20	1,057	0.0285												
	4	21 - 25	707	-0.1045												
	5	26 - 30	368	0.0381												
	6	31 -	443	0.0758												
Relative cost (Bus-Taxi)	1	- 0.010	286	-0.0654	0.1359											
	2	-0.010 - -0.008	155	-0.0610												
	3	-0.008 - -0.006	293	0.0673												
	4	-0.006 - -0.004	509	-0.0361												
	5	-0.004 - -0.002	1,066	0.0704												
	6	-0.002 - -0.000	1,741	-0.0277												
Relative cost (Bus-Car)	1	- -0.0010	153	0.2234	0.3401											
	2	-0.0011 - -0.0008	75	0.1361												
	3	-0.0009 - -0.0006	115	0.1332												
	4	-0.0007 - -0.0004	287	0.1915												
	5	-0.0005 - 0.0002	545	0.0713												
	6	-0.0002 - -0.0001	2,597	-0.0466												
	7	-0.0001 -	278	-0.1167												

Table 3-2.1 RESULT OF DISCRIMINANT ANALYSIS (Cont'd)

Item	No	Category	No. of Samples	Category score	Range	Score Chart										
						Bus					Others					
						-0.4	-0.3	-0.2	-0.1	0	0.1	0.2	0.3	0.4		
Sex	1	Male	2,242	-0.0047	0.0106											
	2	Female	1,808	0.0059												
Age	1	- 11	146	-0.1888	0.4513											
	2	12 - 19	876	-0.1963												
	3	20 - 29	1,190	-0.1413												
	4	30 - 39	753	0.1273												
	5	40 - 49	628	0.2550												
	6	50 -	457	0.2443												
Occupation	1	Professional	417	0.3551	1.048											
	2	Administrative	103	0.7587												
	3	Office employee	533	-0.1026												
	4	Commercial sales	312	0.1934												
	5	Agriculture	28	0.2186												
	6	Conductor	54	0.4758												
	7	Artisan	85	0.4227												
	8	Daily laborer	154	-0.2896												
	9	Private work	197	-0.1720												
	10	Student	287	-0.0838												
	11	House wife	649	-0.1338												
	12	Others	231	-0.1146												

Table 3-2.1 RESULT OF DISCRIMINANT ANALYSIS (Cont'd)

Item	No	Category	No. of Samples	Category score	Range	Score Chart									
						Bus					Others				
						-0.4	-0.3	-0.2	-0.1	0	0.1	0.2	0.3	0.4	
Monthly Family Income	1	- 8,000 sucres	64	-0.4652	1.2151										
	2	- 15,000	426	-0.3059											
	3	- 25,000	860	-0.2416											
	4	- 50,000	1,252	-0.1735											
	5	- 70,000	713	0.1380											
	6	- 100,000	396	0.5871											
	7	100,000 -	339	0.7499											
Car Own.	1	No car	2,276	-0.5211	1.1895										
	2	Own car	1,774	0.6685											

3-3 Model Building

1) Formulation

Multi-nominal Logit Model is used for the MRT diversion model. Its standard formula is shown as follows:

$$P_{in} = \frac{e^{\lambda \cdot V_{in}}}{\sum_{j \in A_n} e^{\lambda \cdot V_{jn}}}$$

where; A_n : Choice set of sample n
 P_{in} : Probability to select mode i in sample n
 V_{in}
 (V_{jn}) : Determinate part of the utility of mode i(j) for sample n
 λ : A parameter to show the variation of stochastic part of the utility

This formula indicates that the modal choice is determined as a rate of the utility for the sum of utilities.

The following linear type is used as a utility function.

$$V_{in} = \theta_1 \cdot X_{in1} + \theta_2 \cdot X_{in2} + \dots + \theta_k \cdot X_{ink}$$

where; θ_k : Unknown parameter vector for explanatory variable X_k
 X_{ink} : Value vector of mode i for sample n

2) Estimation of Parameters

The unknown parameters of the model are estimated by the most likelihood method.

The following 4 variables were finally used as explanatory variables.

- (1) Total trip time including the access time
- (2) Total fare including access charge
- (3) Vehicle cost (applied to private car user only)
- (4) Condition of car ownership (1 is given for a car owner and 0 is given for a non-car-owner)

Other possible factors are excluded because;

- (1) Monthly income is a fairly good estimator judging from the statistical examination and it has strong relationship with car ownership but model building including this factor becomes unstable because of multi-correlation.
- (2) Occupation is also highly related to modal choice but it is not easy to use in practice because of difficulty to get future population by occupation.

Estimation result is shown in Table 3-3.1.

Table 3-3.1 MODEL PARAMETERS ESTIMATION RESULT

No.	Variable name	Unit and range of Variable value		Parameter
		Unit	Value range	
1	Car ownership condition	-	1: Car own 0: No car	1.0521
2	Car user cost	100 Sucres	Assumed value based on the fuel cost	-41.062
3	Transport fare	100 Sucres	Actual fare	- 7.5423
4	Trip time	10 Minutes	Total trip time including access	- 0.67314

3) Model Test

Statistical test was applied to the parameters estimated. Its result is shown in Table 3-3.2. The absolute value of T-value shows that each figure is greater than 2.0 and proves that these parameters are highly meaningful. The sign of each parameter shows the normal tendency of each variable and practical usefulness.

Table 3-3.2 JUSTIFICATION OF MODEL PARAMETERS

Variables Item	1. Car Ownership	2. Car user cost	3. Transport fare	4. Trip time
Standard Error	0.36771	4.2039	0.51928	0.13652
T-value	2.8611	-9.7677	-14.524	-4.9307
Correlation coefficient	0.87689			
Hit ratio (%)	Mode 1 : 98.6 (Bus) Mode 2 : 0.1 (Taxi) Mode 3 : 50.5 (Car)			
Sign of parameter	Good	Good	Good	Good

The hit ratio shows the rate of choice estimation for actual choice and the result shows that the adaptability for taxi is not good while other ones are fairly good. This is only why the number of samples to select taxi are fewer and it is thought that the model is justified as a whole.

4. MRT Demand Forecast

4-1 Setting of Basic Data for Forecasting

Basic data for the MRT demand forecasting is determined as follows:

1) Objective Networks

A network is assumed by each transport mode.

a. Bus

Although the actual bus network consists of many routes, about 80, several typical patternized routes are used for computation shown in Figure 4-1.1 and have different route characteristics and different demand. Diversion is calculated by each route pattern respectively.

b. Car and Taxi

The network consists of the existing road network and some project roads.

c. MRT

The network is determined by the route alternatives and sections.

2) Running Speed by Each Mode

The running speed is assumed as shown in Table 4-1.1.

3) Fare Level

The fare levels are assumed for bus and the MRT as shown in Table 4-1.2.

4) Access, Egress and Transfer Time

Access, egress and transfer time are assumed as shown in Table 4-1.3.

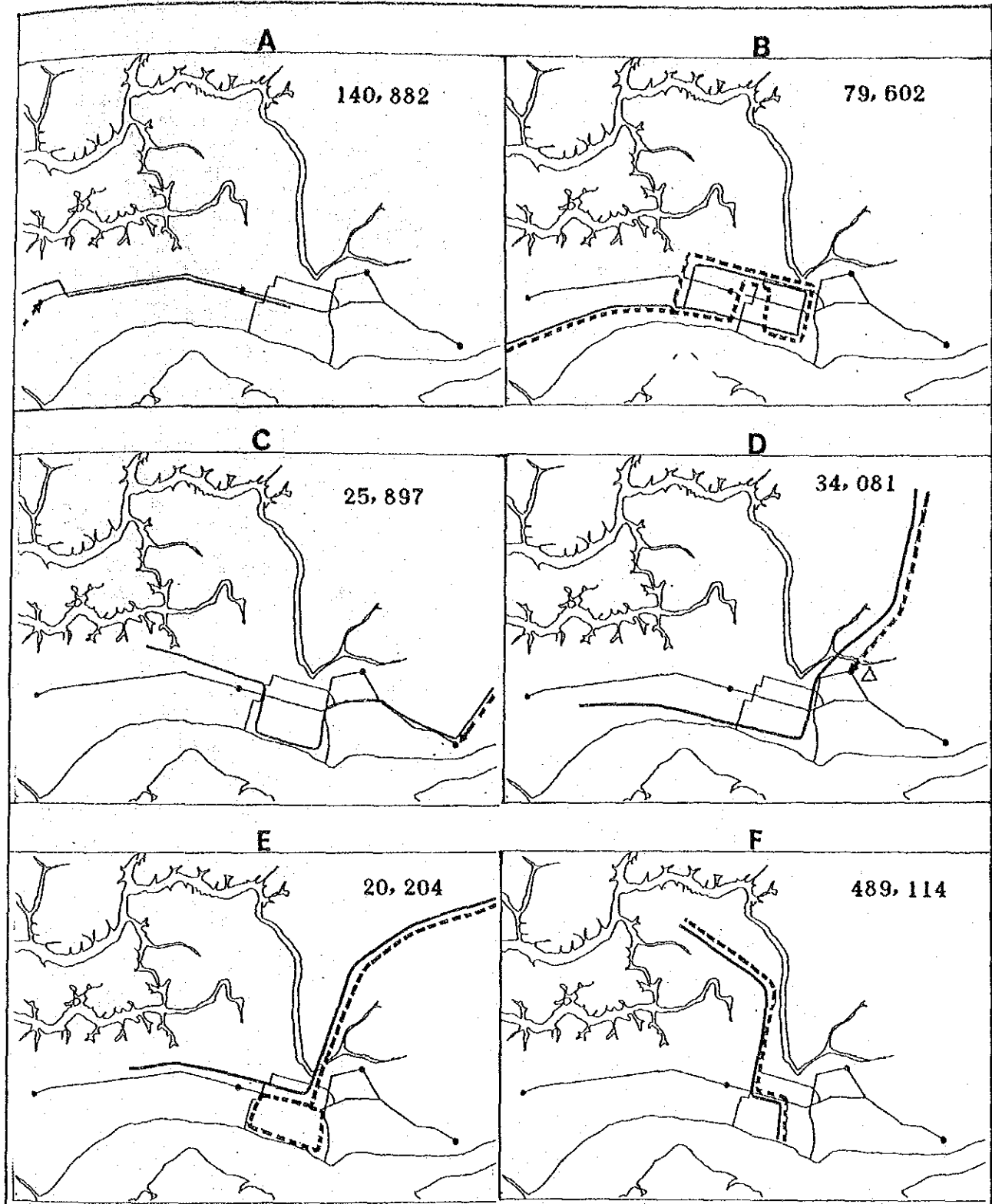
5) Consideration on Bus Route Reorganization

Bus route reorganization is the most influential factor and is basic assumption for demand forecast in this Study. The effect of bus route reorganization is classified into 2 categories:

a. Total demand of a certain bus route is almost completely diverted to the MRT when it is removed because of its route conflict with the MRT

b. Trip diversion from bus is encouraged by smooth connection between bus and the MRT.

Above consideration was taken into demand forecast as shown in Table 4-1.4.



Note) Figures show present bus passengers volume by route pattern

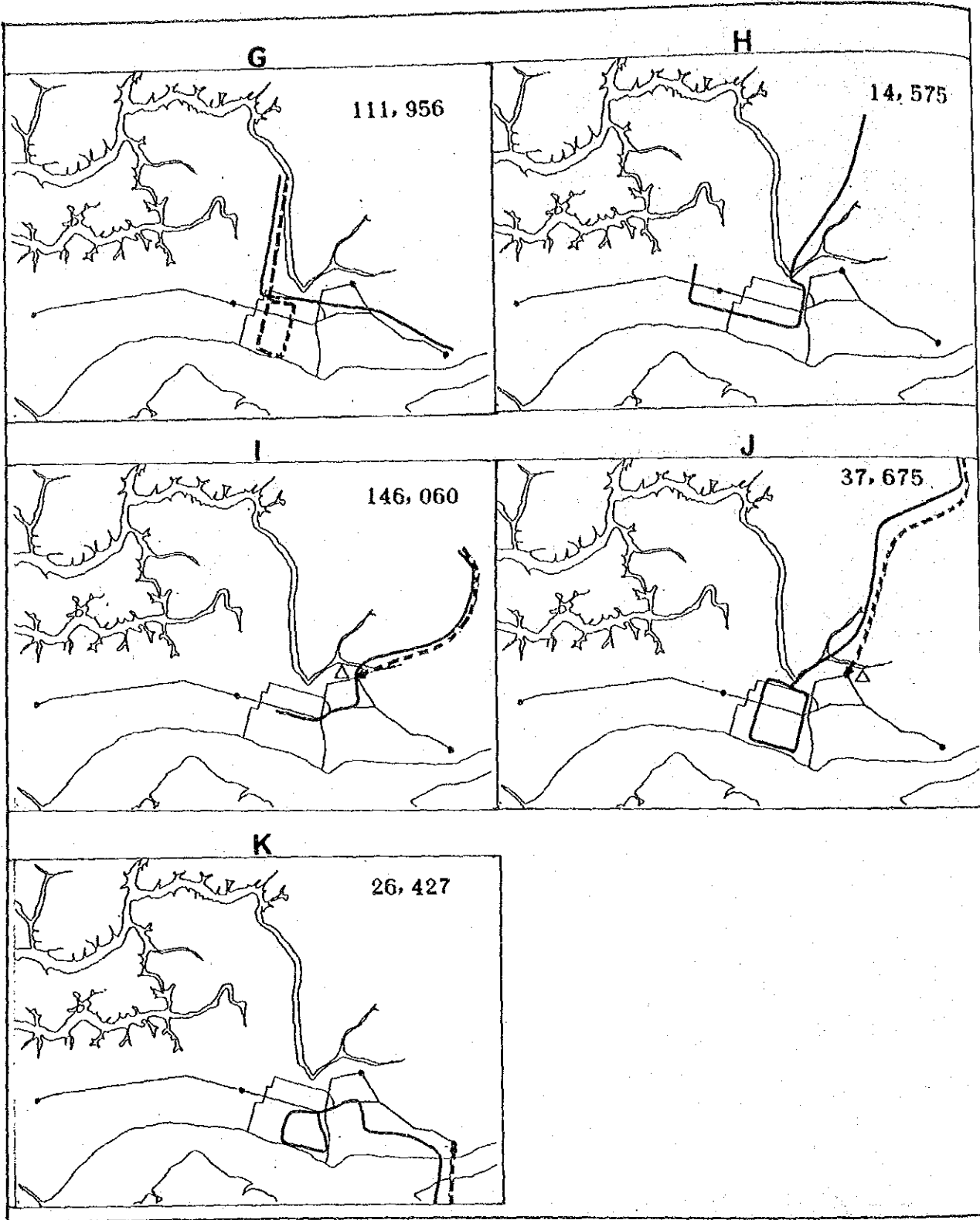
THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 4-1.1

EXISTING BUS
ROUTE PATTERN

JAPAN
INTERNATIONAL
COOPERATION
AGENCY





THE FEASIBILITY STUDY
ON GUAYAQUIL CITY
URBAN TRANSPORTATION
PLAN IN THE
REPUBLIC OF ECUADOR

Figure 4-1.1

EXISTING BUS
ROUTE PATTERN

JAPAN
INTERNATIONAL
COOPERATION
AGENCY



Table 4-1.1 RUNNING SPEED CHARACTERISTICS BY MODE

Mode	Running speed (km/h)	Explanation
Bus	15: suburbs 10: central area	Based on the Bus speed survey by study team
Car Taxi	10 - 30	Based on the Road speed survey in M/P study
MRT	30	Assumption by theoretical calculation
Walking	4	Access egress only

Table 4-1.2 ASSUMPTION OF FARE LEVEL BY MODE

Mode	Fare level (Suces)	Explanation
Bus	8	<ul style="list-style-type: none"> • Actual fare level • Uniform fare
MRT	25	<ul style="list-style-type: none"> • Assumption • Uniform fare

Table 4-1.3 ASSUMPTION OF TRANSFER AND ACCESS TIME

Condition	Time (minutes)	Remarks
Access, Egress by walk	$15 \times \left(\frac{\text{Approach}}{\text{Distance}} \right)$ (km)	Within 1 km from MRT stations
Access, Egress by bus	$4 \times \left(\frac{\text{Approach}}{\text{Distance}} \right)$ (km)	More than 1 km from MRT stations
Transfer from bus to MRT	0	With bus route connection
	5	Without bus route connection

Table 4-1.4 ASSUMPTION OF BUS ROUTE REORGANIZATION
INFLUENCE FOR MRT DIVERSION

Category	Concept	Consideration in forecast model
Trip diversion from removed bus routes	Bus demand is substituted by MRT without competition.	Certain portion of demand on the removed bus route is replaced to MRT.
Effect of smooth connection between bus and MRT	Bus access to MRT is improved with smooth connection.	Transfer time is ignored between bus and MRT at connection points.

4-2 Demand Forecast in Each Mode Diverted to MRT

1) Urban Transport Demand

Urban transport demand consists of urban bus, car and taxi demand. The MRT demand is obtained by diversion calculation from each mode.

Table 4-2.1 shows the estimation result for the year 1990 and 2000 cases.

About 30% of bus trip is diverted to the MRT while only 0.3% of car trip is diverted. In each case, the bus route reorganization is taken into account and it produces large trip diversion to the MRT.

Figure 4-2.1 shows the diversion rate distribution by zone. It can be seen that more trip diversion takes place in zones nearer to the MRT route.

2) MRT Demand from Bus Terminal (Terminal Terrestre)

The present situation of Bus Terminal is already described in the PART 1. Passengers of Bus Terminal are largely expected to use the MRT because the MRT route directly connects to Bus Terminal.

a. Analysis of Bus Terminal Passengers

Bus Terminal passengers are estimated approximately 78,000 a day and about 85 percent of them use buses, 10 percent use taxi and 5 percent use private vehicles. (see Table 4-2.2)

Table 4-2.2 ARRIVAL AND DEPARTURE PASSENGERS OF BUS TERMINAL

Item Access Egress Transport	Arrival		Departure		Departure vehicles	
	Passenger number	Modal Choice (%)	Passenger number	Modal Choice (%)	Car number	Occupancy (persons/v)
Bus	33,122	83.9	33,212	85.3	1,560	21.3
Taxi	3,274	8.3	3,651	9.4	2,353	1.6
Private Vehicle	3,071	7.8	2,089	5.4	1,577	1.3
TOTAL	39,467	-	38,952	-	-	-

Source) The Bus Terminal survey by the Study Team (November, 1985)

Table 4-2.1 MRT ESTIMATION RESULT FROM URBAN TRANSPORT MODE

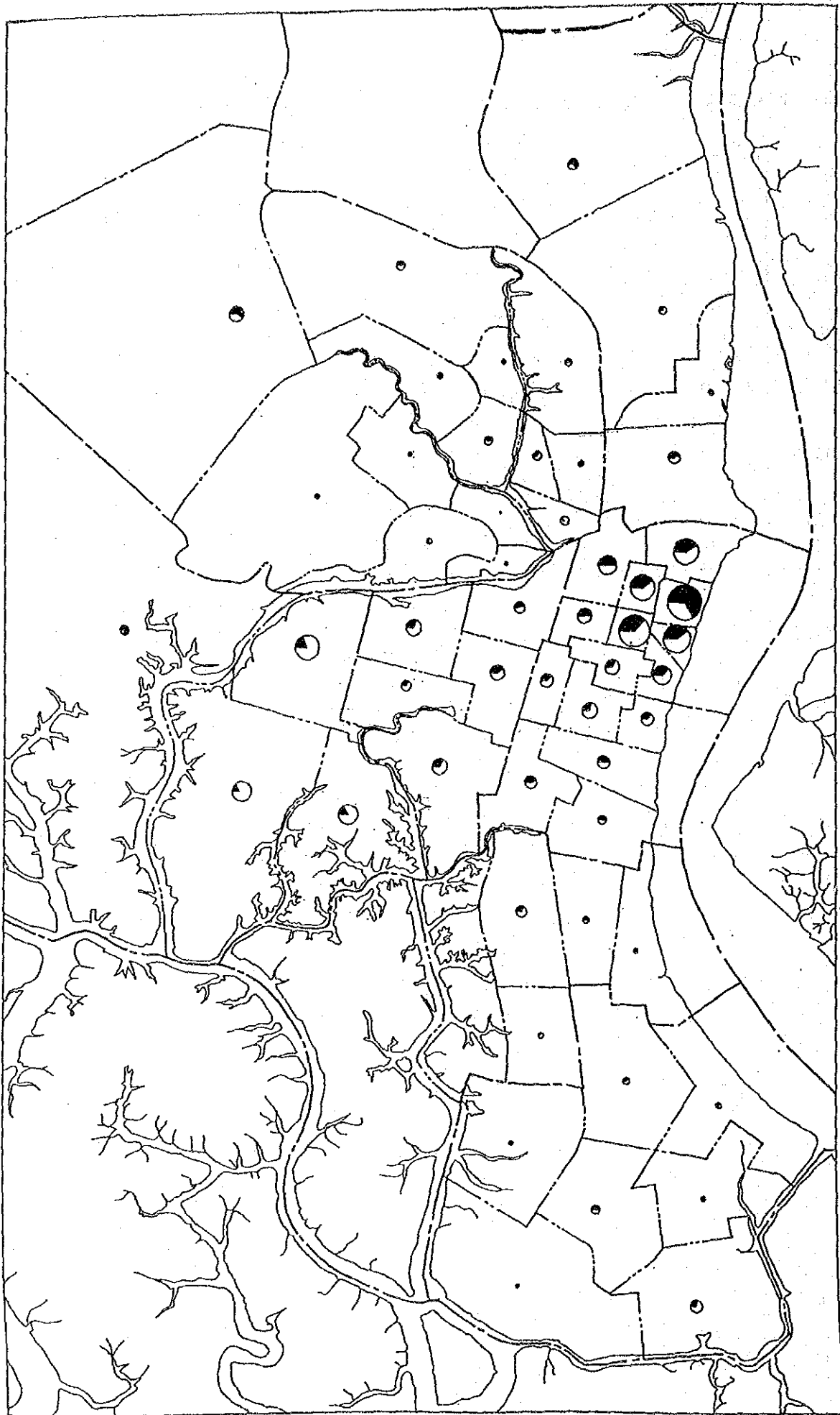
YEAR	1990			
CASE	Basic Pattern			
MODE	Initial no. of trips	Not diverted	Diverted to MRT	Diversion rate
BUS	1,381,000	1,017,100	363,900	26.3%
CAR	1,348,500	1,344,700	3,800	0.3%
TAXI	574,100	540,800	33,300	5.8%
Total	3,303,600	2,902,600	401,000	12.1%
No. of Stations	12			
Route Length	14 K 690 M			

YEAR	1993			
CASE	Basic Pattern			
MODE	Initial no. of trips	Not diverted	Diverted to MRT	Diversion rate
BUS	1,473,300	1,070,400	402,900	27.3%
CAR	1,721,100	1,716,600	4,500	0.3%
TAXI	656,500	616,700	39,800	6.1%
Total	3,850,900	3,403,700	447,200	11.6%
No. of Stations	12			
Route Length	14 K 690 M			

Note) Bus includes the demand from Terminal Terrestre.

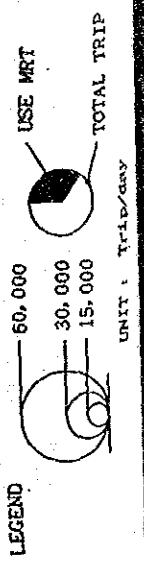
Table 4-2.1 MRT ESTIMATION RESULT FROM URBAN TRANSPORT MODE (Cont'd)

YEAR	2000			
CASE	Basic Pattern			
MODE	Initial no. of trips	Not diverted	Diverted to MRT	Diversion rate
BUS	1,663,200	1,195,000	468,200	28.2%
CAR	2,590,500	2,584,300	6,200	0.2%
TAXI	848,500	793,400	55,100	6.5%
Total	5,102,200	4,572,700	529,500	10.4%
No. of Stations	12			
Route Length	14 K 690 M			



THE FEASIBILITY STUDY ON GUAYAQUIL
CITY URBAN TRANSPORTATION PLAN
IN THE REPUBLIC OF ECUADOR

Figure 4-2.1
MRT CHOICE RATE
DISTRIBUTION



Personal characteristics of Bus Terminal users were analysed as shown in Appendix 3-4.

According to it, trip purpose of the terminal departure passengers is broken down to 21% for working, 19% for social visit and 15% for business. 22% for student shares the highest portion in occupational distribution and 14% for commerce follows after them. Monthly income of passengers distributes largely from 8,000 to 15,000 Sucres.

b. Estimation of Trips

The future trip volume originated in Bus Terminal is forecasted as shown in Table 4-2.3 under the assumption that the total trip volume will increase in proportion to the population growth in the study area.

Table 4-2.3 TOTAL PASSENGER VOLUME ORIGINATED IN BUS TERMINAL

Unit: Persons/day

Year	1985	1990	1995	2000
Passenger volume	78,000	95,000	114,000	135,000

Since future modal choice rate was assumed to be same as the present, such assumption was adopted as access trip by bus and taxi would be almost entirely diverted to the MRT. Accordingly, the MRT demand from Bus Terminal is estimated as shown in Table 4-2.4.

Table 4-2.4 FUTURE MRT DEMAND FROM BUS TERMINAL

Year	1985	1990	1995	2000
Passengers Volume to MRT	74,000	90,000	110,000	128,000