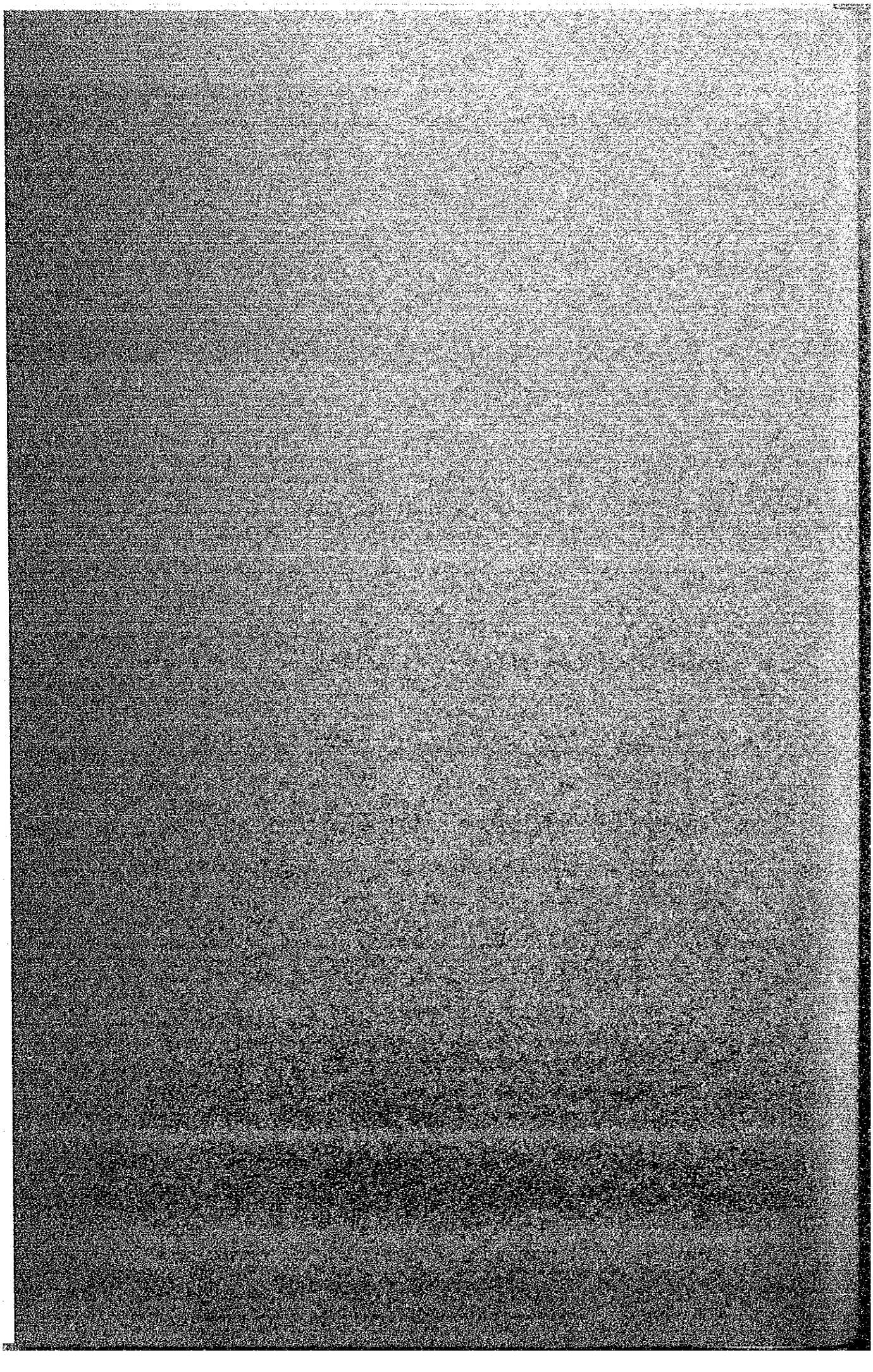
CHAPTER 4

TRAFFIC CHARACTERISTICS



Chapter 4 TRAFFIC CHARACTERISTICS

4.1 The Road Network within the DIZ

The major road network within the DIZ is shown in Fig. 4.1-1, while the width of carriageway, shoulder, etc., are presented in Appendix Table 4.1-1 and the typical cross sections in Appendix Fig. 4.1-1. Roads in the north-south direction (radial roads in the metropolis) have been developed in combination with the construction of some circumferential roads. However, the roads from the west to the east in the southern part of the DIZ are less developed for the reason that the area is extensively being utilized for agricultural produce. River streams, which originate from the mountains in Tagaytay running towards the north to Manila Bay and towards the east to Laguna Lake, hinder the east-west road connection.

4.2 Vehicles and Traffic Volume

4.2.1 Vehicle Registration

The Gross Domestic Product of the Philippine economy had grown with an annual average growth rate of 6% in the period 1970-79, while the population had grown at the rate of 2.7% p.a. Within the same period, the number of vehicle registration had increased with an overall growth rate of 9% p.a. from 1971 to 1979, approaching nearly 1.2 million in 1979, including motor-cycles (See Appendix Table 4.2-1).

In the MMA, the population had grown at 4% p.a. from 1970 to 1979. Vehicle registration for Regions IV and IV-A which cover the MMA and suburbs, on the other hand, indicates a tendency of increase at 5.4% p.a. from 1977 to 1980. However, if the preliminary figure for 1980 is finalized, it is likely that the rate will be substantially higher (See Appendix Table 4.2-2).

4.2.2 Traffic Volume in 1981

Traffic count and O-D interview surveys were conducted in May 1981. The survey locations are shown in Fig. 4.2-1. The Adjusted Annual Average Daily Traffic (AADT) is shown in Fig. 4.2-2 including the result of the traffic count conducted by the MPWH in 1980 on the roads associated with the Project. The traffic volume per day on Quirino Avenue-Highway 25 along the Manila Bay coast is 32,000 in Paranaque-Las Pinas, decreasing to 25,000 in Bacoor, and 11,000 in Kawit. On the Project Roads, A-Route and B-Route have about 14,000 and 13,500 at the mid-point, respectively. On the side of Laguna Lake at the cordon screen north of Sucat, the total traffic volume of South Luzon Expressway, its service roads and Road 303 is about 60,000 per day, while the screen line on the south of Alabang registered a total of about 40,000 vehicles per day for the Expressway and Highway No. 1 (Refer to Appendix Tables 4.2-3

FIG. 4.1–1

EXISTING MAJOR TRUNK ROADS WITHIN THE DIRECT INFLUENCE ZONE

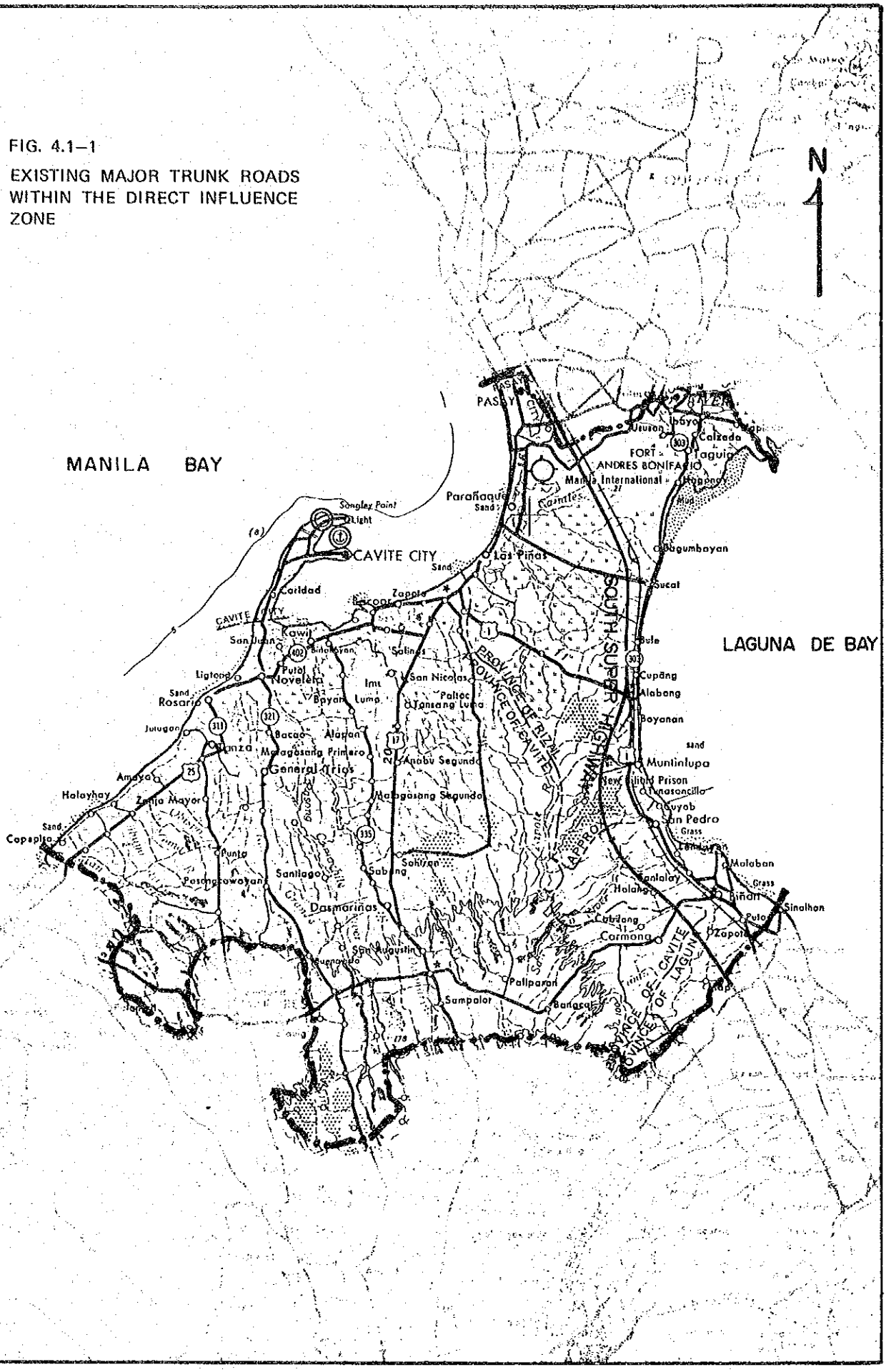
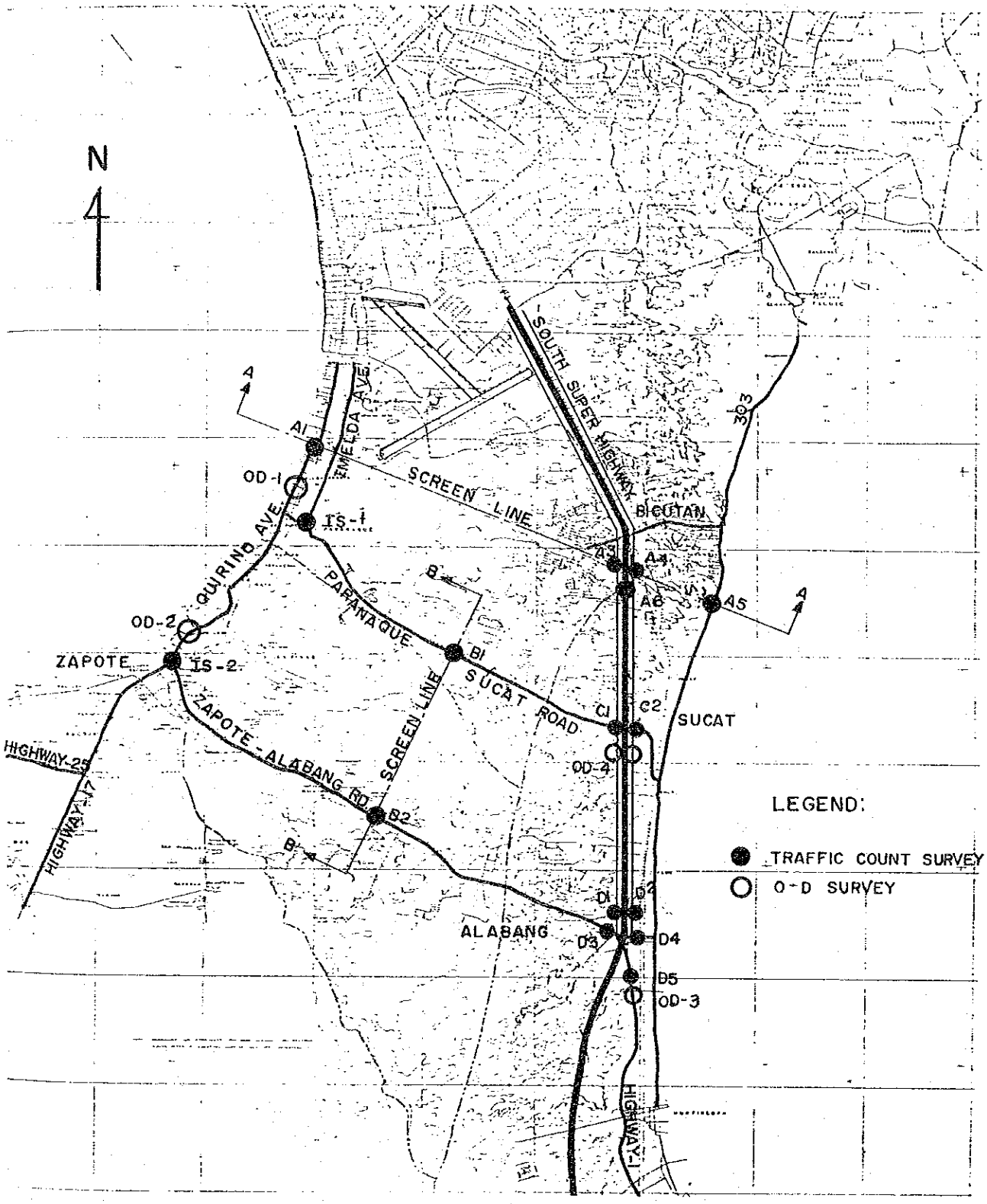


FIG. 4.2–1 LOCATION MAP OF TRAFFIC SURVEY (MAY 1981)



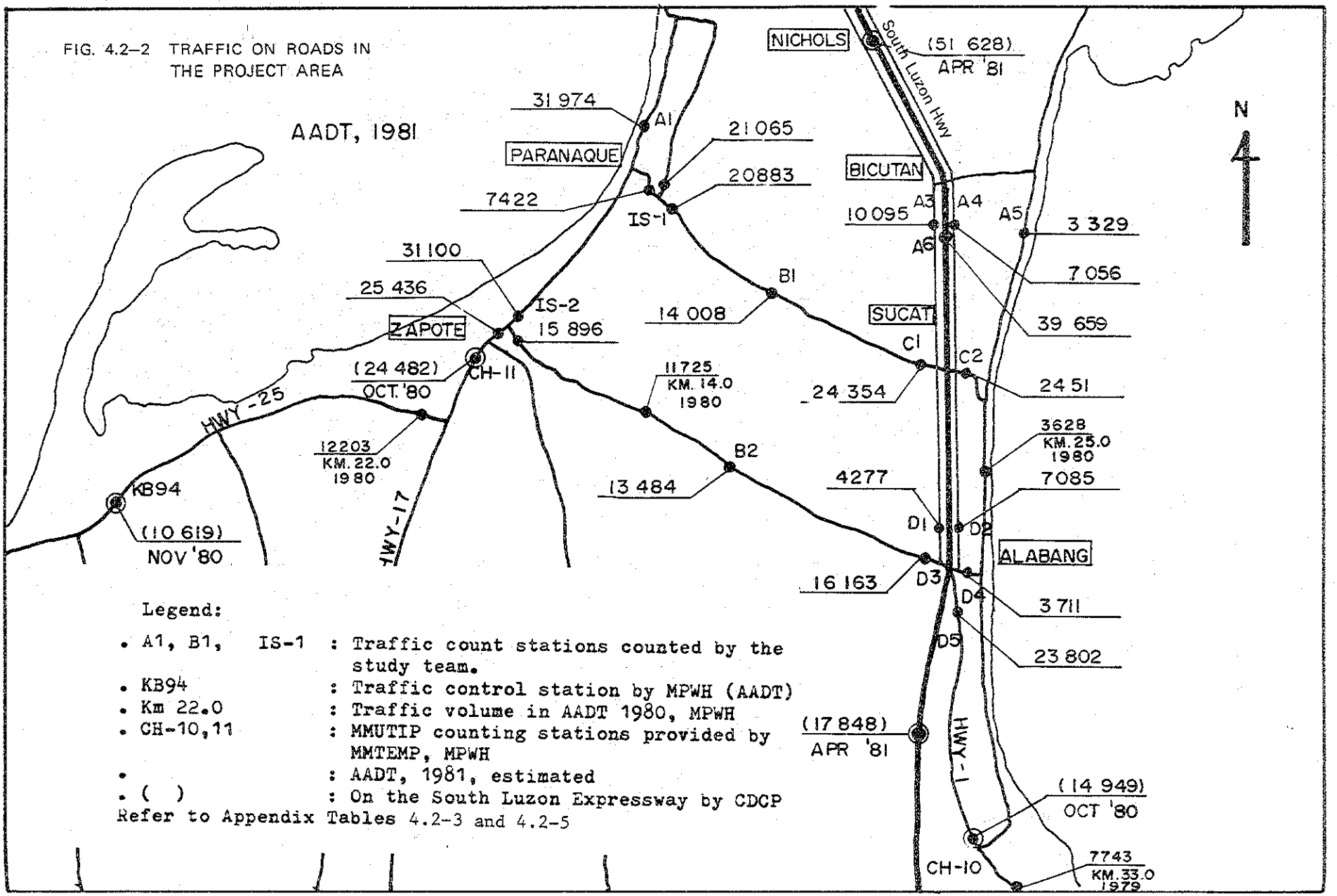


FIG. 4.2–2 TRAFFIC ON ROADS IN THE PROJECT AREA

Legend:

- A1, B1, IS-1 : Traffic count stations counted by the study team.
- KB94 : Traffic control station by MPWH (AADT)
- Km 22.0 : Traffic volume in AADT 1980, MPWH
- CH-10,11 : MMUTIP counting stations provided by MMTEMP, MPWH
- : AADT, 1981, estimated
- ( ) : On the South Luzon Expressway by CDCP

Refer to Appendix Tables 4.2-3 and 4.2-5

FIG. 4.2-3 VEHICLE COMPOSITION IN PERCENT

Screen AA'

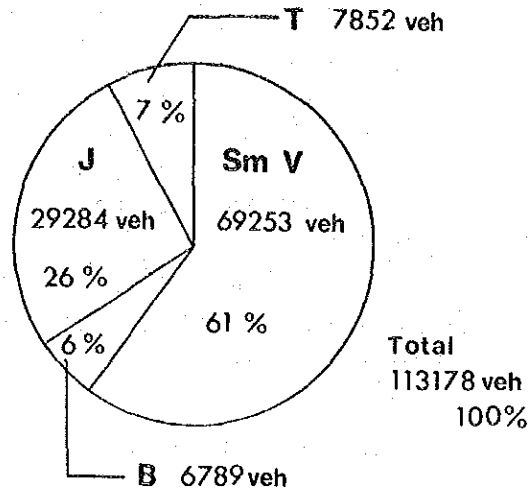
Quirino Avenue

Imelda Avenue

Service Roads outside SLE

Route 303

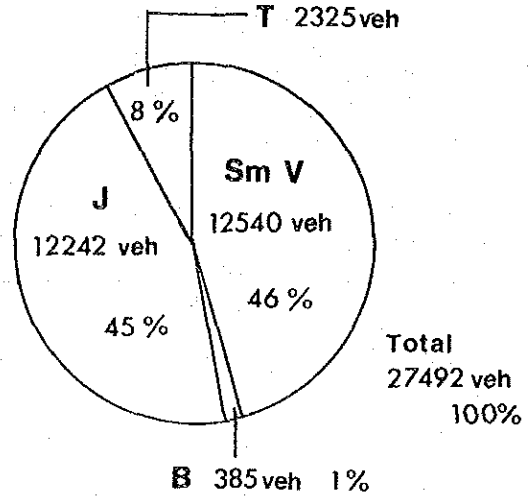
South Luzon Expressway



Screen BB'

Paranaque-Sucat

Zapote-Alabang



Legend:

Sm V	Small Vehicle
B	Bus
J	Jeepney
T	Truck

Source: Appendix Table 4.2-3

thru 4.2-5). Vehicle composition by type is shown in Fig. 4.2-3. It could be seen on the figures that the percentage of jeepneys on screen line AA' was less than that on screen line BB', but that of buses was larger in the former than in the latter. Trucks had approximately the same share of 8 percent at these screen lines. The details are shown in Appendix Tables 4.2-3A and B.

Turning movement of traffic at the Paranaque-Imelda intersection was studied as shown in Appendix Fig. 4.2-1. It indicates that 81% of the traffic toward and from Sucat moved toward Manila via Imelda Avenue. Appendix Fig. 4.2-2 presents the movement at the Zapote intersection, where it was found that 68% of the traffic to and from Alabang moved toward Manila via Quirino Avenue.

4.2.3 Changes in Traffic Volume

Changes in the traffic volume on the control stations within the DIZ and the automatic counting stations in Manila are shown in Appendix Tables 4.2-6 and 4.2-7. None of them presents a steady increase, but rather a fluctuation in the past few years since the traffic on these points were, it is said, subject to change because of the influence of improvement works in adjacent roads. It was found that the counting was not conducted regularly and that there was shortage of data due to mechanical failure on the automatic counting machines.

Even on the South Luzon Expressway, the normal annual rate of increase was difficult to confirm because of the increase of traffic arising from the completion of its extension to Calamba in 1978 and the decrease due to the toll rate increase in 1980. (See Appendix Table 4.3-8 for the changes since 1978).

4.2.4 Others

To find the degree of congestion on the existing roads a study was conducted by using the result of traffic count data in May 1981. It was evaluated that some sections were heavily congested, while others were approaching the capacity as presented in Appendix Note 4.3.

Based on the survey data, the average passenger occupancy was 2.9 persons for small vehicles, 9.2 for jeepneys and 30.4 for buses. The figures are shown in Appendix Table 4.2-8.

Trip purpose distribution in percent for small vehicles shown in Appendix Table 4.2-9, A, discloses that the percent share of "going home", "going to work", "going to school", "on business" and "others" were 22.5%, 20.7%, 0.9%, 29.2% and 26.7%, respectively. The small percent share for "going to school" was that schools were closed on vacation when the survey was conducted.

Trip purpose distribution in percent for the passengers in buses and jeepneys was also surveyed simultaneously. The result is shown in Appendix Table 4.2-9, B. The percent share of "going home", "going to work", "going to school", "on business" and "others" were 34.6%, 14.3%, 2.3%, 12.4% and 36.4%, respectively.

The relationship between the trip generation and population was studied to establish a regression model formula for each type of vehicles. The result was discussed in Appendix Note 4.1.

Trip length distribution was also studied and the result is shown in Appendix Note 4.2 and in Appendix Fig. 4.2-5.

4.3 Origin-Destination Table in 1981

4.3.1 Traffic Zoning

The zoning for traffic study was determined in a way that the area adjacent to the Project Roads is in smaller zones and the area distant from the Roads in larger zones. The traffic zones of the MMETROPLAN study was used as the basis of the zoning of the Project. However, it was found that some zones in MMETROPLAN adjacent to the Roads were too large for the traffic study, and for this reason, the zones within the DIZ were broken down to smaller zones.

In the whole study area, 49 zones are delineated of which 33 zones are within the DIZ. The zone map is in Fig. 4.3-1 and the zoning table is in Appendix Table 4.3-1.

4.3.2 Origin-Destination Tables, 1981

In order to present the traffic flows on the road network, an Origin-Destination (O-D) Table was developed by incorporating different types of O-D Tables. The work steps in producing the present O-D Table of 1981 are discussed in the following paragraphs.

Items A through E correspond to those in the Flow Chart of Fig. 4.3-2, which indicates the work steps in the course of synthesizing all available O-D data.

A. MMETROPLAN: O-D Tables in persons estimated for 1980 in 141 zones were provided through the Ministry of Transportation and Communications (MOTC). O-D Table for truck vehicles in 1980 was prepared separately from the file of work trips in the MMETROPLAN.

   MMETROPLAN O-D Table in 1980 was taken as the basis in producing the O-D Table for the project study. However, the O-D Table was the forecast for 1980 by using the O-D Table in 1971 of UTSMMA. It is considered better to update the trip distributional pattern if there is new information particularly associated with the Project.

FIG. 4.3–1 ZONE MAP IN THE DIZ

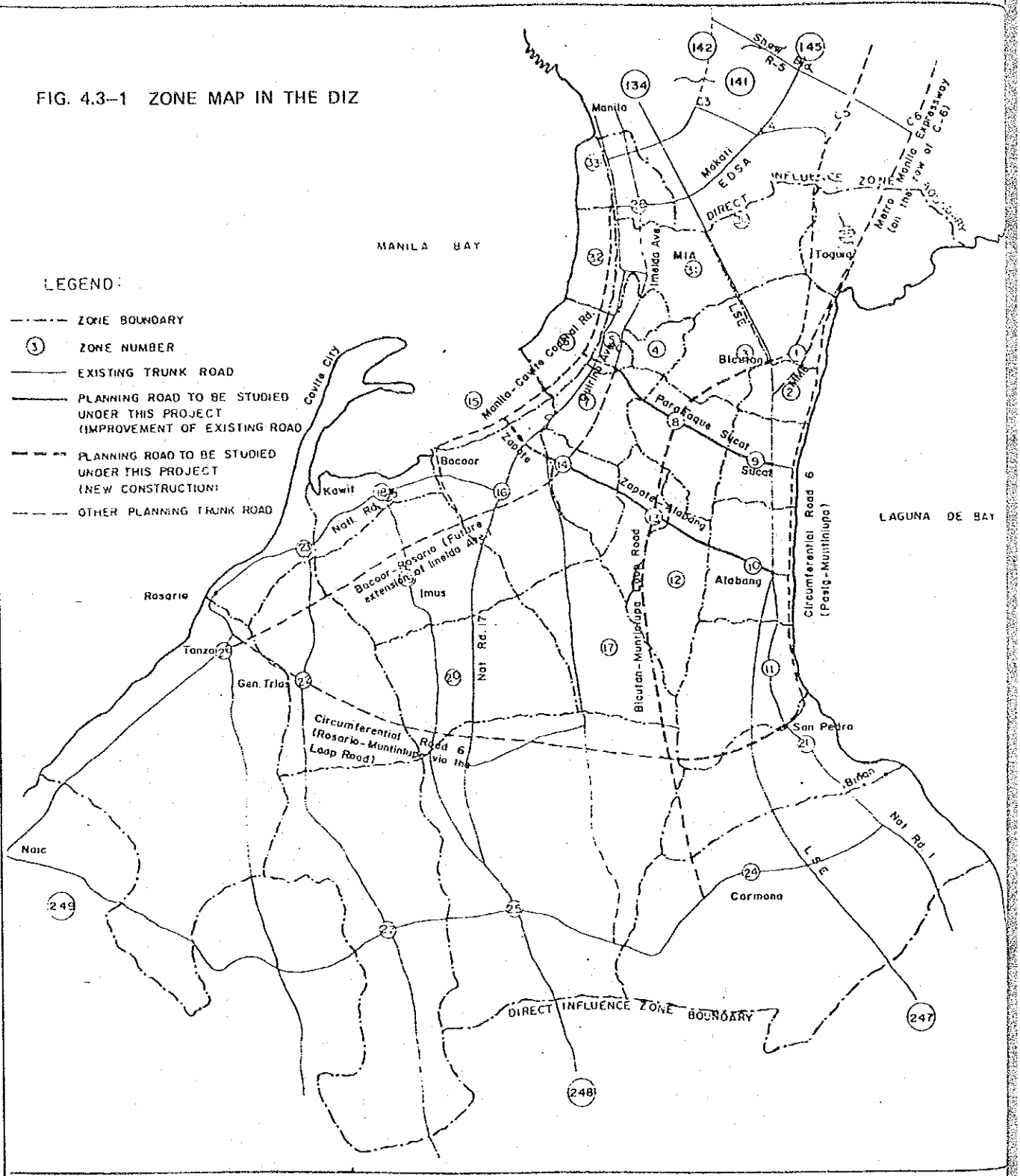
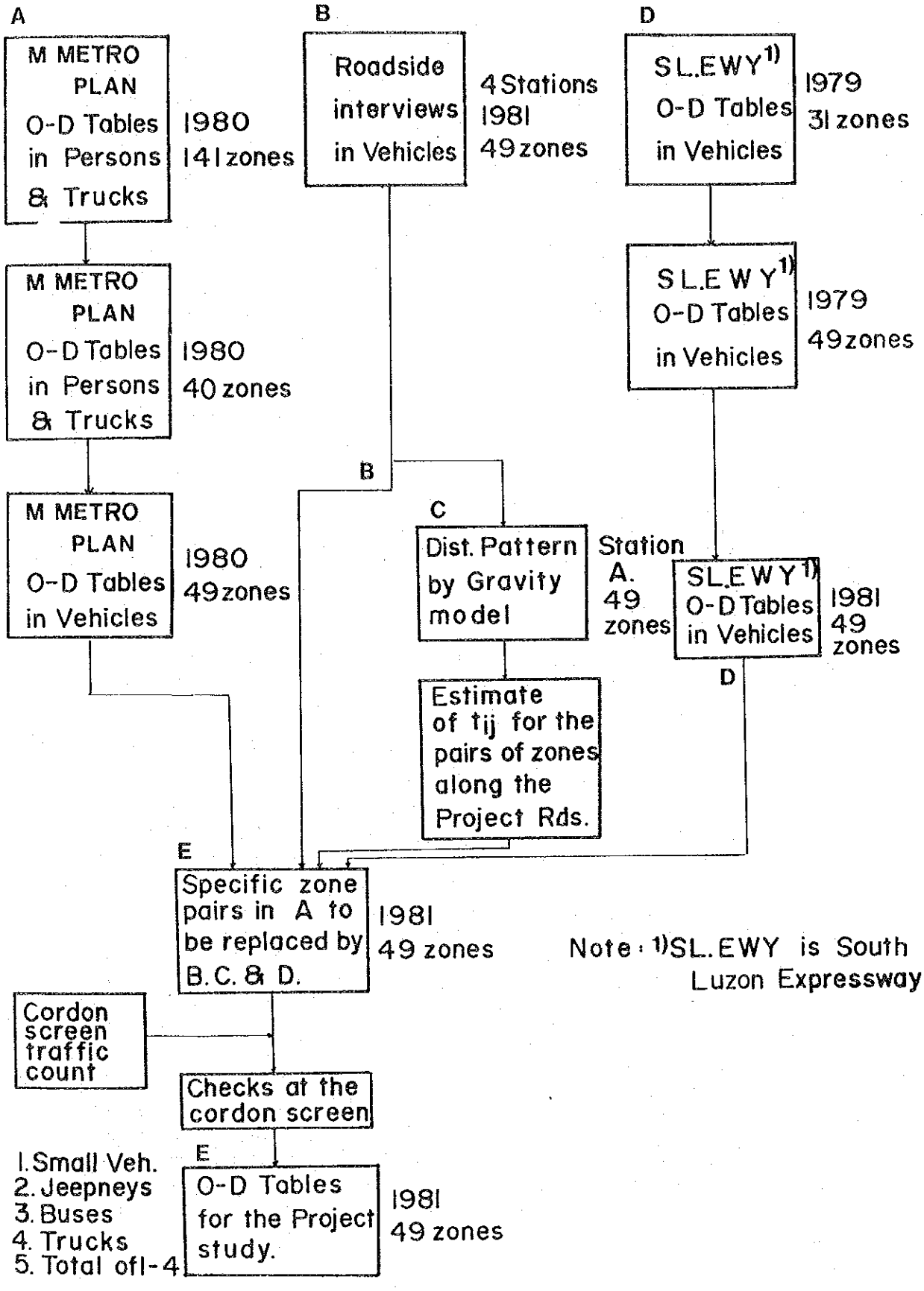


FIG. 4.3–2 FLOW CHART OF PRESENTATION OF THE ORIGIN-DESTINATION TABLES IN 1981



Some zone delineations adjacent to the Roads in the MMETROPLAN were found too large. Accordingly, zonal division was considered necessary.

All these up-dating and revisions were conducted by incorporating some zone pair trips in B, C & D into A.

MMETROPLAN O-D Tables in terms of persons in 1980 were first converted into vehicles by using the passenger occupancy ratio of the MMETROPLAN. Zone conversion was also conducted from 141 to 40 provisionally. Truck O-D Table was produced by the method indicated in the MMETROPLAN.

Further breakdown of some delineated zones in the DIZ was necessary. Consequently, the total of the zone number increased from 40 to 49. The 40 zones O-D trip matrixes were converted to 49 using the percent distribution of population in 1980 of the partitioned smaller zones. However, it was noted that the partitioned trips were mostly replaced by the updated O-D data which were developed through steps B, C and D.

In order to adjust the O-D from 1980 to 1981, the MMETROPLAN O-D Tables in 1980 were multiplied by 1.05, where 1.05 was the estimated annual rate of increase in vehicle registration in National Capital Region and Region IV-A from 1977 to 1980.

(No definite trend of increase was found in the automatic traffic counter survey data for MMA in the past few years. See Appendix Table 4.2-7. Also see Appendix Table 4.2-6 which presents the changes of traffic on a few traffic counting stations in the DIZ from 1978 to 1981.)

B. Roadside Interview: O-D Tables by vehicle type were prepared based on the results of the roadside interview. Sample question sheets are shown in Appendix Tables 4.3-2 and 4.3-3. The interview was conducted on May 20 and 21, 1981 with the resultant sampling ratio of 8.2%. The sampling ratios are shown in Appendix Table 4.3-4.

   The interview was conducted for 12 hours and was expanded to 24 hours using factors obtained by the data in Appendix Tables 4.3-4 through 4.3-6.

   The possibility of double counting trips which might come out by adding the trips on Stations No. 1 and No. 2 or Stations No. 3 and No. 4 was deleted in the computer process. Then, some designated zone pairs were selected to replace the same zone pairs of MMETROPLAN O-D Table to update and/or replace the partitioned zone pair trips of the MMETROPLAN. The designated zone pairs are incorporated in Appendix Table 4.3-7.

C. Gravity Model Formula: The trips passing O-D Station No. 1 were used to determine the distributional pattern along the Project Roads. The pattern was presented by the gravity model formula with the resultant parameters of the regression analysis as shown in Appendix Fig. 4.3-1.

$$t_{ij} = \frac{K(P_i + P_j)}{d_{ij}^{\alpha}} \quad : \text{for small vehicles, buses and jeepneys}$$

$$t_{ij} = \frac{K(W_i + W_j)}{d_{ij}^{\alpha}} \quad : \text{for trucks}$$

where: P_i = population in zone i

W_j = employed persons working in zone j

d_{ij} = time distance in minutes between zone i and j, using the speed survey results in May 1981 which showed average running speed for small passenger cars at 30-40 KPH.

K and α = parameters to be obtained in the regression analysis

t_{ij} = trips between zones i and j

The formulas were used to estimate the short distant trips along the Roads. The zone pairs adopted for this model are incorporated in Appendix Table 4.3-7. After appropriate grouping of zone pairs for the use of the gravity model, the total trips estimated by this model in each group were adjusted to the total of the corresponding trips in MMETROPLAN O-D Table as previously stated in A.

D. South Luzon Expressway O-D Tables in Vehicles: The survey[1/] was conducted in 1979 to determine the relationship between the toll rate and the traffic using the Expressway. The data gathered from interviews at Nichols gate as well as at the service roads on the west and the east sides of the gate were used for this Study.

The original 31 zones of that O-D Table had to be adjusted to conform with the zones of this study; i.e., some zones needed to be divided into two or more according to the project zoning, while some distant zones were aggregated into a larger zone. Trip distributions of sub-divided zones were done by using the percentage share of population (for small vehicles, buses and jeepneys) and employment (for trucks) in the subject zone.

The toll rate was raised by approximately 50% in July 1980. Since the increase, traffic has dropped but is just starting to recover the level before the revision. (See Appendix Table 4.3-8). Accordingly, no change was assumed from 1979 to 1981.

1/ PHILCONSULT and CDCP, Feasibility Study of Proposed Toll Rate Increase in Relation to Traffic Cost Savings on Luzon Expressway (July, 1979).

Monthly average factor was obtained by the data in 1979 (See Appendix Table 4.3-9). Weekly average traffic volume of in-and-out at the interchange on April 19-25, 1981 were provided as shown in Appendix Table 4.3-10.

E. Synthesizing: Edition of the Project O-D Table in 1981 was conducted in the following procedure: some zone pairs in the O-D Table in 1981 produced by MMETROPLAN were replaced by the zone pairs in the other O-D Tables to update trip distribution pattern associated with the Roads. The matrix in Appendix Table 4.3-7 indicates the zone pairs which were replaced from either A, B, C or D group or one or two combinations of the above groups to synthesize the O-D Table in 1981. The synthesized or aggregated O-D Table was verified by a method described in the following subsection.

4.3.3 Traffic Distribution on the Roads in 1981

1) Methodology

The traffic distribution and assignment simulation of O-D trips on the road network in 1981 was conducted in order to compare it with the actual traffic volume. This simulation was also used to formulate a model of traffic assignment applicable to the project study. The work flow is shown in Fig. 4.3-3. The methodology of assignment applied in the previous Manila-Bataan Coastal Road Project Study2/ in 1980 was also applied in this Study.

The model consists of 1) quantity-velocity (Q-V) relationship curves, 2) a diversion curve to the toll operated South Luzon Expressway, and 3) travel time minimum path searching method. Each link in the network is given various values such as length in kilometers, applicable Q-V relationship formula, etc.

The Q-V relationship formulas are shown in Appendix Fig. 6.3-1 and Appendix Table 6.3-1 of Chapter 6. A conceptual curve of the Q-V relationship model is shown in Fig. 4.3-4. The curve shows that the vehicle running velocity on a road link decreases as the traffic volume increases. Increases in the traffic volume are simulated by the aggregation of trips on every road link by repeating the traffic assignment on the route with the minimum time path for the zone pair trips in the O-D Table. The trips in the O-D Table were subdivided into five groups, namely, 30, 20, 20, 20 and 10 percent of the total of each zone pair trips. When a sub-divided group had been assigned to the road network, the running velocity based on the aggregated trips of each link can be established using the Q-V model formula. The process was repeated for the succeeding groups, thus, the total of the aggregated traffic and the final velocity are obtained on each road link.

2/ Government of the Republic of the Philippines and JICA, Feasibility Study for Manila-Bataan Coastal Road and Its Related Roads (C-5 & C-6), (March, 1980).

FIG. 4.3–3 FLOW CHART OF TRAFFIC DISTRIBUTION ON THE ROADS IN 1981

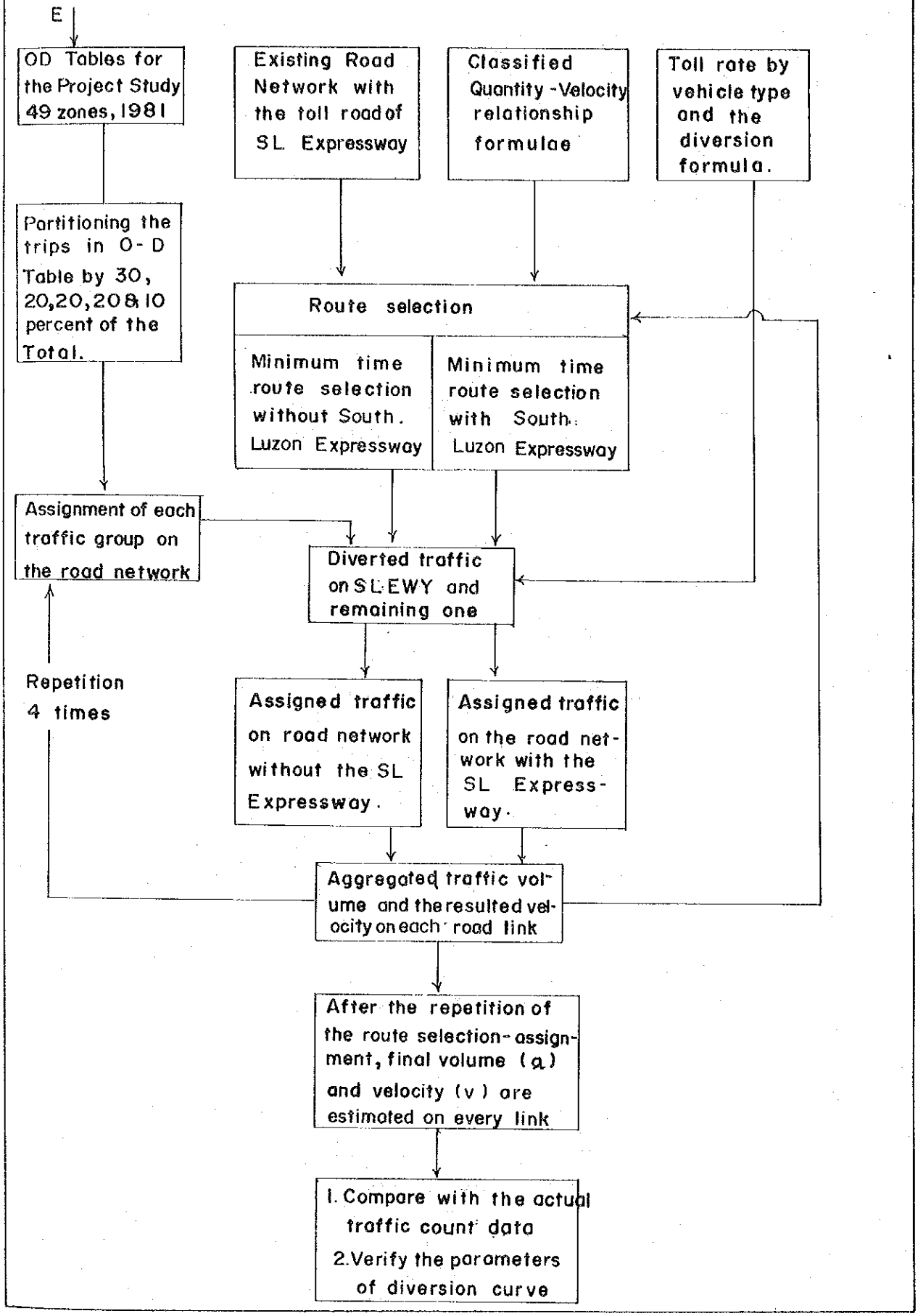


Fig. 4.3-4 VELOCITY - QUANTITY CURVE

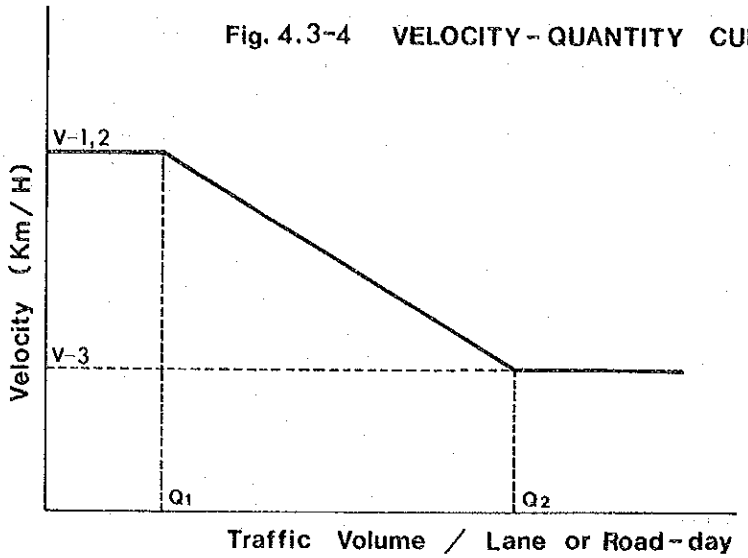
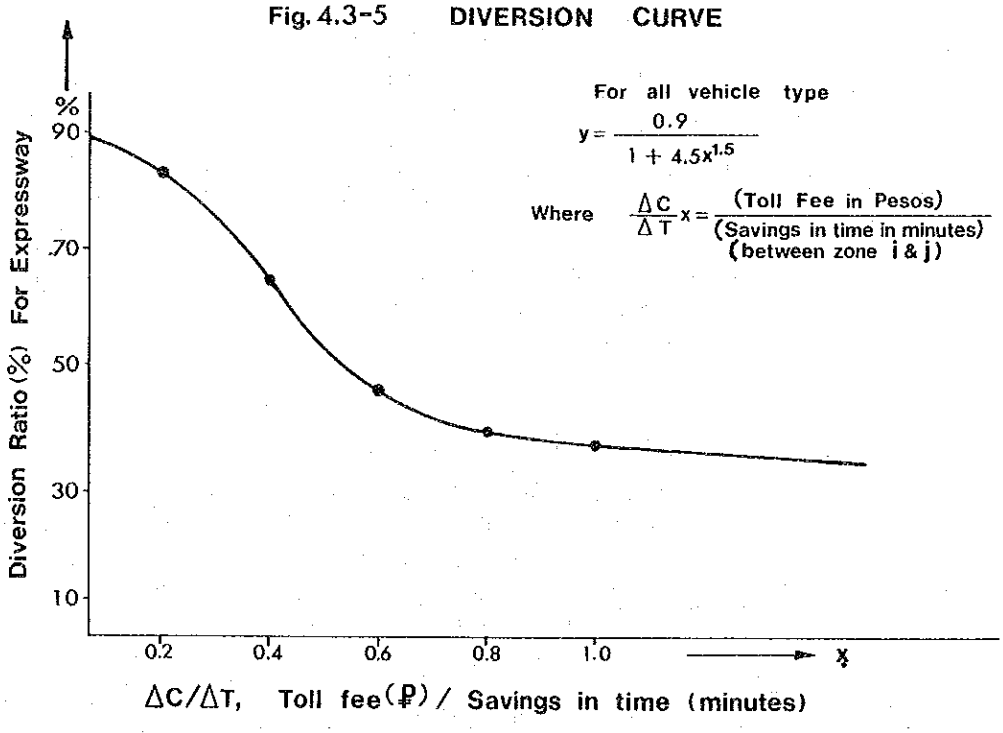


Fig. 4.3-5 DIVERSION CURVE



The diversion curve used in this Study was the same with that developed and used by the previous study3/.

Diverted traffic on South Luzon Expressway was estimated by first determining the ratio of the toll fee using the expressway and the savings in travel time in minutes with and without the expressway, then applying the curve shown in Fig. 4.3-5.

2) The Result

The result of the traffic assignment on the road network is shown in Fig. 4.3-6 together with the result of the manual traffic count survey. It could be observed that the total traffic flow on the cordon screen stations were slightly larger than the actual traffic on the same section. Particularly at the screen line AA, the flow was 122,000 vehicles per day while the actual volume was 113,000, or 8 percent higher; and at screen line BB, the flow was 34,000 which was 21% higher than the actual volume of 28,000. These large discrepancies are attributable to the short trips and trip cutting of jeepneys on these sections. Discrepancies in other screen lines are also shown in Fig. 4.3-6. It is difficult to determine a definite tendency with these discrepancies.

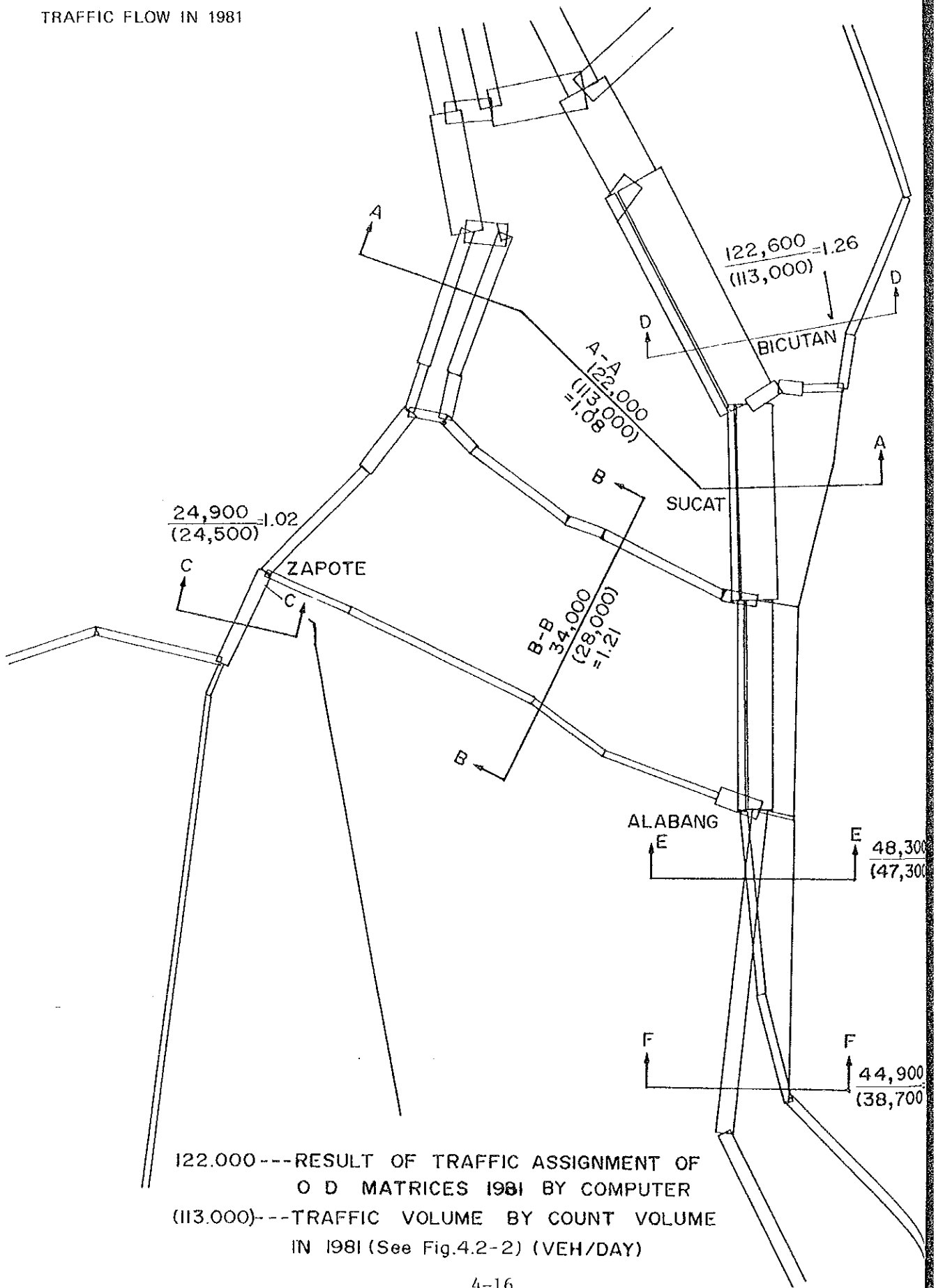
The simulated result of the traffic assignment is likely to be higher than the counted traffic by 2% to 21%, depending on the cordon screens, which could be accounted for by the variation of traffic flow throughout the year. It was assumed that the existence of these discrepancies as discussed above was reasonable when considered in the weekly, monthly or yearly variations.

The estimated diverted traffic on the Expressway was found too large when compared with the counted data. This could be due to the facts that the parameters of the curve were determined based on the traffic of North Luzon Expressway in 1979 and that the toll fee on the expressway was increased in 1980 resulting in the reduction of traffic. Accordingly, the percentage of diversion obtained by the curve was decreased by 30% for the estimate of the future traffic flows. The 30% was determined by studying the results of simulation and the actual traffic on the Expressway.

3/ The Government and JICA, Ibid.

FIG. 4.3--6

TRAFFIC FLOW IN 1981

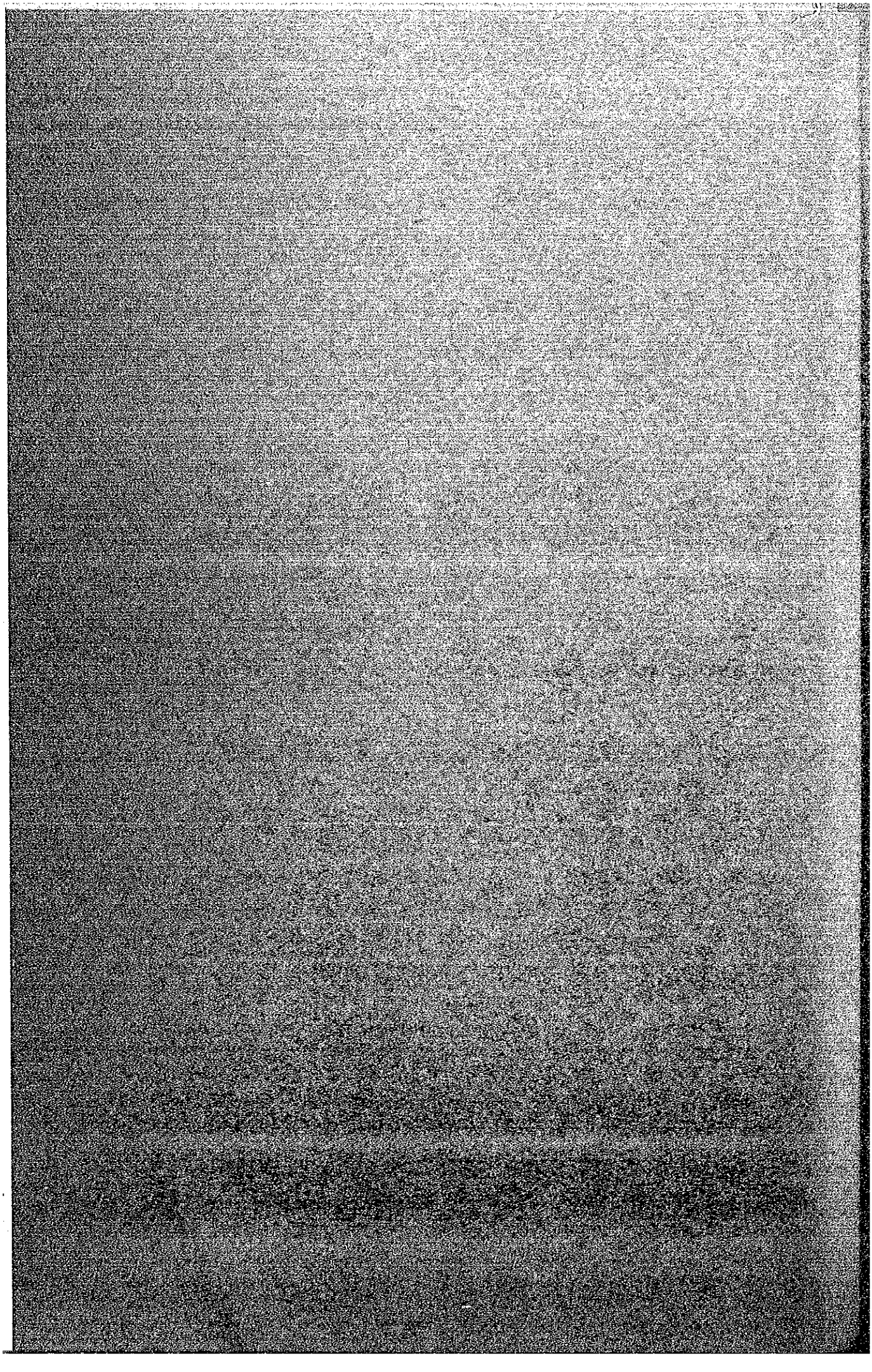


122.000---RESULT OF TRAFFIC ASSIGNMENT OF O D MATRICES 1981 BY COMPUTER

(113.000)---TRAFFIC VOLUME BY COUNT VOLUME IN 1981 (See Fig.4.2-2) (VEH/DAY)

CHAPTES 5

TRAFFIC FORECAST



Chapter 5 TRAFFIC FORECAST

5.1 General

The traffic volume on the road network including the Project Roads was presented in O-D Tables in 1981 with vehicles classified as small vehicles (cars, jeeps, vans, and taxis), jeepneys, buses (medium and large), trucks (medium and large) and the total. The O-D Tables were prepared in a separate file from the computer output with the same classification as above. Initially, the growth rates by vehicle type were calculated, which were then adopted to determine the total future traffic in the Study area as well as the controlled total of future traffic volume in the O-D Table.

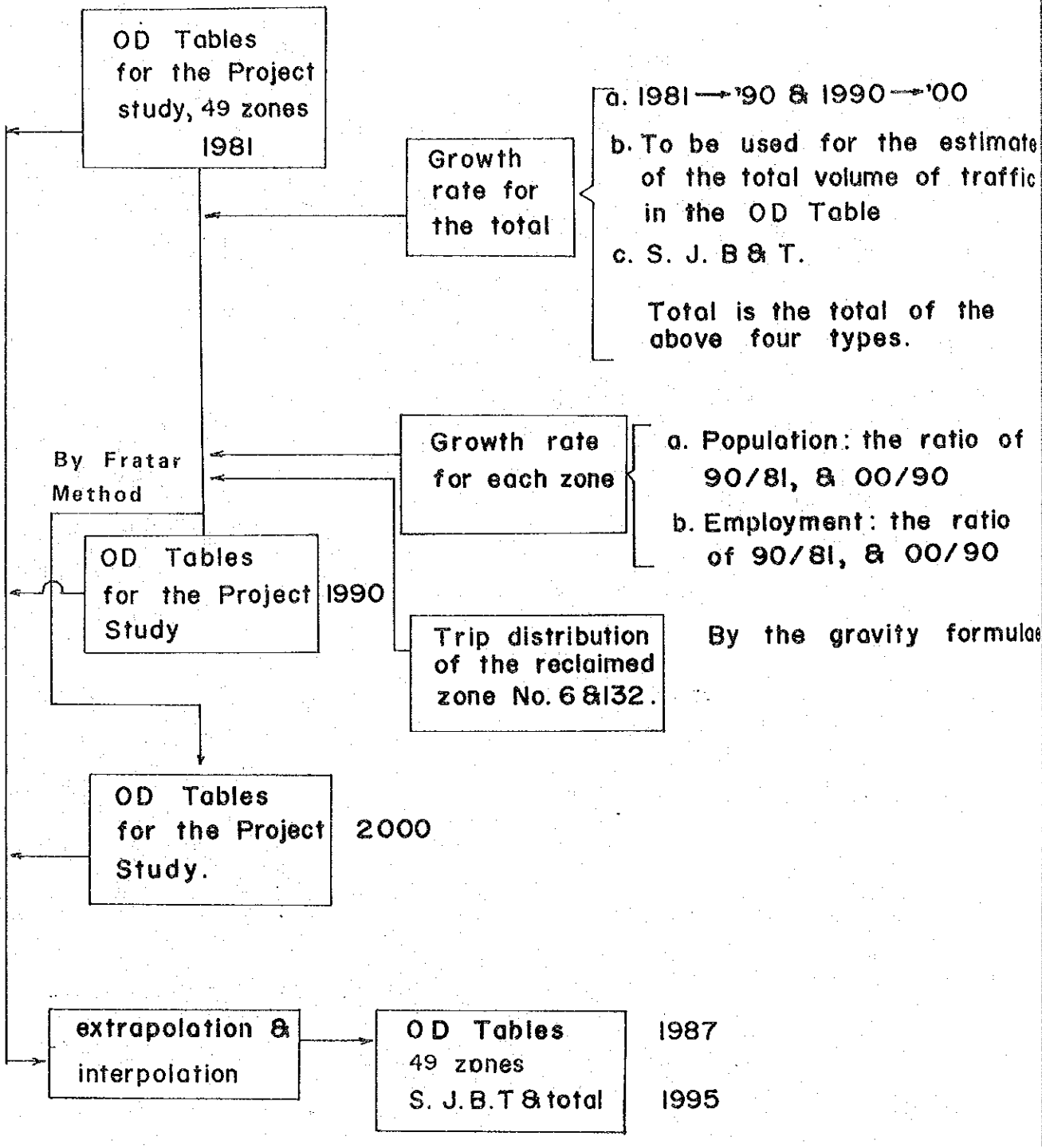
The growth rate by vehicle type in each zone was determined by estimating the growth ratio of the population and the work opportunity in the zone. The growths of these demographic indexes were estimated in Chapter 3 of this Report. Basically, the growth ratio of a zone-pair traffic, t_{ij}, is the average of the growth ratio of the zone i and j, constrained, however, by the controlled total volume of overall traffic. Fratar method was applied for the conversion of the O-D matrix to the controlled total of the traffic in the Study area. The zonal growth ratio for each vehicle type is stated in the following section, 5.3. Fig. 5.1-1 is the flow chart indicating the work sequence to produce the O-D Table in the future years. The reclaimed zones (Nos. 6, 15 and 32) have no trips generated and attracted at present. The gravity formula is applied when the reclamation is completed to estimate the trip distribution to and from these zones.

Induced and generated traffic caused by the construction of the Project Roads would augment the traffic to and from Metro Manila, while the expansion of residential and industrial areas in the DIZ would develop a new traffic pattern. The new pattern will differ from the present pattern so that the intrazonal and short distant traffic connecting the housing with the industrial areas is substantially increased. The new pattern may include a shift of trips from those going to and coming from Metro Manila. These two features of the traffic are hard to estimate accurately. However, it was assumed that the two patterns would generally offset each other resulting in negligible impact on the estimate of the overall traffic volume.

The diversion of the traffic to the southern line of the Philippine National Railways (PNR) was also studied. However, no future volume estimated by them is provided by the PNR yet because a study on the PNR Commuter Service Project is still on-going. It is likely that the improvement will attract more commuters than at present. However, the attraction of road users will be most noticeable on roads parallel to the PNR line (i.e., South Luzon Expressway, service roads, and Road 303).

Consequently, when the estimate of passengers of the improved PNR Commuter Service is determined with the resultant diversion to the rail commuters from the road public service users, the modification of O-D Tables, traffic assignment, traffic cost, and benefit

FIG. 5.1-1 FLOW CHART OF ESTIMATE OF TRAFFIC IN OD TABLE



calculation will be necessary. However, it is to be noted that PNR Commuter Service Project will have little influence on the traffic flow on the Project Roads since they are not competing in their services, but rather are supplementary to each other.

5.2 Vehicle Traffic Forecast

Two approaches were conducted to determine the overall growth ratio of passenger vehicles (small vehicles, jeepneys and buses): one is the income elasticity approach and the other is the car ownership approach.

5.2.1 Income Elasticity Approach

The MPWH has been using a model in determining the growth rates of passenger vehicles, such as small vehicles, including private cars, jeepneys and buses, applying the following formula:

$$TGR\ (\%) = 100 \times \left[\left(\frac{I \times E}{100} + 1\right)^{CP} - 1.\right]$$

where: TGR = traffic growth rate p.a. in percent

I = growth rate in percent for per capita income at constant prices.

E = elasticity of transport expenditure on disposable household income

CP = compound ratio of population growth p.a. (not in percent)

The 1971 Household Survey conducted by the National Census and Statistical Office (NCSO) provided the basic data for the

TABLE 5.2-1 PASSENGER TRANSPORT INCOME ELASTICITIES (PTIE)

Annual per capita income in pesos 1971[1/]	Private & Public PTIE	Public PTIE
₱ 170 - 350	0.5	0.5
351 - 520	0.9	0.7
521 - 690	1.1	0.8
691 - 860	1.3	1.0
861 - 1040	1.5	1.1
1041 - 1210	1.6	1.0
1211 - 1550	1.6	0.8
1551 - 2070	1.7	0.6
2071	1.7	0.5

Source: Samar Integrated Rural Dev. Project, quoted from NCSO

Note: 1) Family income is divided by 5.8 persons.

analysis of public and private passenger transport income elasticities which were rechecked again in the 1975-1976 household survey. Furthermore, the elasticity has been calibrated on the basis of actual past transport growth rates. The elasticities derived are shown in Table 5.2-1[1/]

The elasticity assumed in the National Transport System Study[2/] was 1.8 for private transport and 1.0 for public transport. From the figures in Table 5.2-1 as well as the above assumptions, the elasticities (E) of private transport were assumed at 1.6 and of public transport at 1.0. These were also adopted in the traffic forecast for the project study of Manila-Bataan Coastal Road[3/]. The Feasibility Study of Metro Manila Expressway assumed the value of E at the level of 1.5[4/]. According to the long term development policy of the Government[5/], per capita real GNP and per capita real income would grow at the rate of 4.8% p.a. and 4.0% p.a., respectively, from 1976 to 2000. Considering the development potential of MMA, the growth of per capita income in the Project area would be higher than the national average rate of 4.0%.

However, the country, like other oil-importing countries, would suffer from economic stagnation and inflation due to the price fluctuation of crude oil and other impacts from international trade. Also the past growth trends of national income (See Appendix Table 5.2-1) and population (See Appendix Table 5.2-2) must be considered. The value of I is therefore determined by reducing the growth target by one third, thus obtaining a rate of 3% p.a. As shown in Appendix Table 5.2-3 GDP per capita has increased at 3.2% p.a. from 1970 to 1979.

The rate would taper off gradually in the long run. It is considered that 3.0% p.a. is a reasonable assumption.

1/ PPDO of MPWH and Samar Integrated Rural Development Project Office, Samar Integrated Rural Development Project: Road Component, Feasibility Study Re-evaluation (March 1979).

2/ Inter-Agency Technical Committee on Transport Planning National Transportation System Study, Vol. II (Interim Report) (February 1980).

3/ Gov't. of the Philippines and JICA, Feasibility Study for Manila-Bataan Coastal Road and Its Related Road (C-5 & C-6) Project (March 1980)

4/ CDCP-PHILCONSULT, Feasibility Study of Metro Manila Expressway-Bicutan-Marikina-Maycauayan (December 1980)

5/ NEDA, Ibid.

The population growth rate is estimated to be 3.0% p.a. in the total study area from 1980 to 1990 (See Chapter 3).

By adopting the above parameters, the growth rates are as follows:

Vehicles	TGR, 1981-1990
Cars	7.9% p.a.
PU Jeepneys	6.0% p.a.
PU Buses	6.0% p.a.

For reference, the growth rates adopted in the Manila-Bataan Coastal Road Project are shown below. The growth rates were forecasted by the same formula and parameters except a smaller population growth rate of 2.4% p.a.

Vehicles	TGR, 1979-1990
Cars	7.3% p.a.
PU Jeepneys	5.3% p.a.
PU Buses	5.3% p.a.

5.2.2 Per Capita Trips Approach

1) MMETROPLAN

Changes of the per capita trips and the percent share of car-owning families were studied in the MMETROPLAN. The assumptions used for the traffic forecast in the Study are summarized in Appendix Table 5.2-4. The following points are the forecast of the overall traffic and demographic changes of the study area of MMETROPLAN. (A through E correspond to the items in Appendix Table 5.2-4).

A. Population will grow at 4.43% p.a., reaching 7.7 million in 1980 and at 3.28% p.a. thereafter to 10.6 million in 1990.

B. Car-owning family will increase in percent share from 17.5% in 1971 to 25.5% in 1980 and 38% in 1990.

C. Family size will decrease from 6.15 persons in 1971 to 5.8 persons in 1980 and 5.0 persons in 1990.

D. Trips per capita were calculated for non-car users as 1.282 per day in 1971, 1.353 in 1980 and 1.311 in 1990. Trips per capita for car users were 1.394 per day in 1971, 1.324 in 1980 and 1.635 in 1990.

E. The number of public transport users was assumed to increase 1.0% p.a., from 1980 to 1990, while that of car users to increase 9.7% p.a., for the same period.

Traffic growth rates were calculated by using the above figures for the overall area. They were modified slightly in the course of the assignment on the road network by using the counted traffic on the cordon screens. However, it was found that the figures in the table present an overall tendency of that study area.

2) This Study

In the study of this Project, the overall average figures in the above MMETROPLAN were used with a few modifications in assuming the constant compound growth of private and public traffic. The forecasted figures are shown in Table 5.2-2. The forecasted growth of the traffic of the whole study area of the Project is based on the following assumptions: (A through E correspond to the items in Table 5.2-2).

A. Population will grow at 3.0% p.a., reaching 9.9 million in 1990 and at 2.03% p.a., reaching 12.1 million in 2000.

B. Family size will decrease rather drastically: 5.37 persons using the preliminary output of the census in 1980, 4.5 persons in 1990 and 4.0 persons in 2000.

C. The percent shares of car-owning families are 25.5% in 1980, 33.0% in 1990 and 40% in 2000. Using the provisional figures for 1980, the population in the National Capital Region (previously Region IV) is 6.0 million, registered small vehicles 290 thousand and a family size 5.37 persons; it was also found that the car owning families are 26% in 1980.

D. Trips per person are assumed at 1.35 in 1980, 1.50 in 1990 and 1.65 in 2000 for non-car users. Those using small vehicles are 1.50 in 1980, 1.65 in 1990 and 1.80 in 2000.

E. Total trips in terms of persons for future years are calculated by applying the above assumptions. Also assuming no changes in the average occupants per vehicle (See Appendix Table 4.2-8), the average annual growth rates thus obtained are:

	1981-1990	1990-2000
Cars and small vehicles	6.7% p.a.	4.9% p.a.
Jeepneys and buses	3.0% p.a.	1.9% p.a.

5.2.3 Truck Traffic

In order to determine a growth rate for the truck traffic, the Manila-Bataan Coastal Road Project Study projected the commodity component in percent from the present to the future. The component change which was applied to the traffic flow

TABLE 5.2-2 FORECAST OF THE FAMILIES, TRIP RATES, CAR OWNERSHIP, AND TRAFFIC GROWTH

	1970		1980		1990		2000
A. POPULATION[1] (1000 persons)							
All Area	4,883		7,353		(9,881)		(12,083)
% p.a.		4.12		3.00		2.03	
B. FAMILIES (1000)							
Person/Family[2]	6.15		5.37		(4.5)		(4.0)
All Area	794		1,369.3		2,195.8		3,020.8
All Area NCO[3]	655.0		1,020.1		1,471.2		1,812.5
All Area NCO %	82.5		74.5		(67.0)		(55.0)
All Area CO[3]	139.0		349.2		724.6		1,208.3
All Area CO %	17.5		25.5		(33.0)		(40.0)
C. POPULATION by Two Classifications (1000 persons)							
Per Family	6.15		5.37		(4.5)		(4.0)
All Area NCO	4,028.3		5,477.9		6,620.3		7,250.0
CO	854.9		1,875.2		3,260.7		4,833.2
T O T A L	4,883.2		7,353.1		9,881.0		12,083.2
D. TRIP RATE: Trips/Population							
NCO (Public Transport Users)	1.282		1.353		(1.50)		(1.65)
CO (Private Vehicle Users)	1.395		(1.50)		(1.65)		(1.80)
E. OVERALL TRAFFIC in terms of Persons and Growth Rate							
1. Trips (1000 persons)							
All Area NCO	5,164.3		7,411.6		9,930.4		11,962.5
CO	1,191.7		2,812.8		5,380.2		8,699.8
T o t a l	6,356.0		10,224.4		15,310.6		20,662.3
2. Growth Ratios							
All Area NCO		1.435		1.340		1.205	
% p.a.		3.67		2.97		1.88	
CO Ratio		2.360		1.913		1.617	
% p.a.		8.97		6.70		4.92	
T o t a l		1.609		1.497		1.350	
% p.a.		4.87		4.12		3.04	

Notes: 1) From Section 3.4-1 of this report.
2) Persons per family for 1990 and 2000 are assumed.
3) NCO: non-car owners, CO: car owners. The percentages for 1990 and 2000 are assumed.

on the Project Roads, the forecast of the long term growth target of NDP (8.3% p.a. up to 2000), the past performance of NDP from 1969 to 1978 (5.4% p.a.), etc., were used with some modifications to assume the annual growth rate of 6.6% for the overall traffic flow for the 1980's.

In other studies, the growth rate of truck traffic was determined by assuming the same growth rate of GDP (7%)[6/] or by associating the annual growth rate of real income with the annual growth rate of employment. This resulted in the truck growth rate of approximately 6% p.a. in the area south of Metro Manila[7/].

Since detailed data of the commodity movement by trucks on the Project Roads were not obtained, it is determined that the growth of truck traffic is to be forecasted by the growth of GDP in constant prices. Keeping in mind the tendency that GDP in constant prices had increased at 5.8% p.a. from 1967 to 1979 and the target growth rate is 8% p.a.[8/] from 1978 to 1987, the overall growth rate of truck traffic in the study area is likely to be some points between 5.8% and 8.0%. The growth of the commodity movement in the Manila Area and its vicinity is conclusively higher than the national average. It is determined that the rounded figure of 6.0% p.a. (5.8 ≒ 6.0) be applicable to the Study.

5.2.4 Determined Growth Rates

The approach in Section 5.2.1 indicated that the income elasticity of transport demand for the users of small vehicles was larger than that of public transport services. However, the elasticities shown in Table 5.2-1 had not been updated since 1975. The value of I in association with CP in the formula shown in 5.2.1, should also be specifically studied when applied to a zone or a region.

The resultant annual growth rates were larger than the forecasts of the Manila-Bataan Coastal Road Project which was studied in 1979 using the same formula but with slightly different parameters. The study of Manila-Bataan Coastal Road Project covered the northern suburbs of MMA, while this study covered the southern suburbs. However, both studies included MMA in the traffic zoning, which generates the majority of the trips. Accordingly, both forecasts would be substantially at the same level, if the forecasts used the NEDA projection and MMETROPLAN forecast.

6/ Gov of RP & Freeman Fox and Ass, MMETROPLAN (July 1977).

7/ CDCP & PHILCONSULT, Feasibility Study of Metro Manila Expressway and Circumferential Road (C-5)(December 1980).

8/ NEDA, Summary of the Five-Year Development Plan, 1978-1982 (Including the Ten-Year Development Plan, 1978-1987)(September 1977).

The results of the approach in Section 5.2.2 were smaller in terms of annual growth rate, than those of the previous approach but closer to the figures used in the Manila-Bataan Coastal Road Project. It was noted that the estimated growth rates in the case of 5.2.2 implied a tendency for strong preferential use of small vehicle (6.7% p.a.) rather than public road transport services (3.0% p.a.). The approach in Section 5.2.2 also had problem of insufficient current data such as the percent figures of small-vehicle owning families and non-owning families in the Study Area, average number of trips per person under various classification, etc. When this information is up-dated, the forecast should be revised.

Since the basic O-D data were quoted from the MMETROPLAN and the approach in Section 5.2.2 was also based on the method in that study; the use of the forecast in the approach in Section 5.2.2 is preferred.

It was determined to use the growth rates assumed in Sections 5.2.2 and 5.2.3 to estimate the overall traffic volumes in the Study Area. Shown below are the ratio of increase and the annual growth rate up to 1990 and 2000.

Type of Vehicle	1981-1990	'90/'81	1990-2000	'00/'90
Cars and small vehicle	6.7% p.a.	1.80	4.9% p.a.	1.61
Jeepney	3.0% p.a.	1.30	1.9% p.a.	1.21
Buses	3.0% p.a.	1.30	1.9% p.a.	1.21
Trucks	6.0% p.a.	1.69	4.2% p.a.	1.50
Average	5.8% p.a.	1.66	4.3% p.a.	1.53

5.3 Growth Rates of Traffic in Each Zone

The population and employment opportunity in each zone of the Study Area were estimated as shown in Chapter 3. The results of the estimated population and employment are again presented in Appendix Tables 5.3-1 and 5.3-2, respectively.

Traffic generation and attraction increases invariably with the increase in population, income, economic and social activities in the zone. The forecast of income and other activities, such as production, trade and transactions in each zone of the Study Area is virtually impossible, particularly when the zone is located within a large urban area.

In order to forecast the growth of traffic in a zone, the increases of population and employment were used in the estimate. The growth rate by vehicle type in a zone was determined by estimating the growth of the population and work opportunity in the zone. The formula for calculating the growth ratio is shown below:

a. For Cars, Buses and Jeepneys

$$T_{i'90} = T_{i'81} \times \left[a \frac{P_{i'90}}{P_{i'81}} + b \frac{W_{i'90}}{W_{i'81}} \right] \quad \ldots\ldots \quad (1)$$

where: $T_{i'90}$ = Total trips generated and attracted in zone i in 1990

$T_{i'81}$ = Total trips generated and attracted in zone i in 1981

$P_{i'90}$, $P_{i'81}$ = Population in zone i in 1990 and in 1981. $P_{i'81}$ is calculated by the interpolation between 1980 and 1990.

$W_{i'90}$, $W_{i'81}$ = Employment opportunity in zone i in 1990 and 1981. $W_{i'81}$ is calculated by the interpolation between 1980 and 1990.

a, b: To be confirmed by the regression analysis of O-D trips and associated data in the DIZ in 1981. (See Appendix Table 5.3-3).

b. For Trucks

$$T_{i'90} = T_{i'81} \times a \frac{W_{i'90}}{W_{i'81}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where: $T_{i'90}$ = Trips generated and attracted in zone i in 1990

$T_{i'81}$ = Trips generated and attracted in zone i in 1981

$W_{i'90}$ = Employment opportunity in zone i for 1990

$W_{i'81}$ = Employment opportunity in zone i for 1981

The figure in 1981 is calibrated by interpolating from 1980 to 1990

a : To be confirmed by the regression analysis of O-D trips and associated data in 1981 (See Appendix Table 5.3-3).

The growth ratio for the year 2000 is estimated in a similar way as in the year 1990. All t_{ij}s on the matrix are subject to conversion through the Fratar method using $T_{i'90}$ and $T_{i'00}$ as the control total of traffic in the Study Area. The control total was discussed in Section 5.2.4 of this Chapter.

5.4 O-D Tables in Future Years

The computer outputs of O-D Tables for 1981, 1990 and 2000 were prepared and a copy was submitted to the MPWH in a separate file together with the submittal of the Interim Report. Appendix Tables 14-1 through 14-3 present the O-D Table of the total vehicle in 1981, 1990 and 2000, respectively.