CHAPTER 11.

TRANSPORTATION NETWORK MASTERPLAN

11. TRANSPORTATION NETWORK MASTERPLAN

1) Fundamental Policy

(1) Network Pattern

The evaluation of alternative traffic network, accomplished prior to the formulation of a masterplan, resulted in the two alternatives which envisaged the implementation of traffic policy measures rating best and second best. Therefore, the advantageous elements of these two alternatives are to be extracted and incorporated into the transportation network pattern of the masterplan.

(i) Traffic Pattern

The two alternatives can be fused into one by accommodating motor traffic on two parallel traffic axes running east-west, one in the northern part of Panama Urban Area and the other in the southern part, and by accommodating public transportation on an axis running through the middle of Panama Urban Area and between the first two axes (Fig. 11-1).

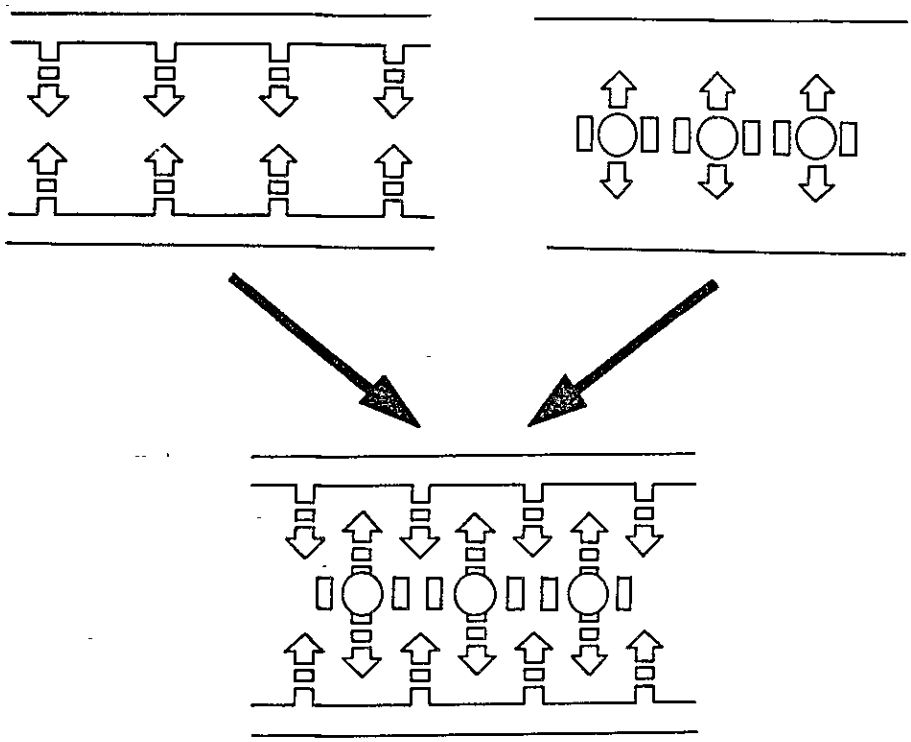


FIG. 11-1 CONCEPTION OF TRANSPORTATION PATTERN

(ii) Accommodation of Motor Traffic Demand

The volume of motor traffic in Panama City is expected to increase by 2.1 times in 2000, in terms of vehicle trips, even under the planning policy of giving priority to public transport and restricting private cars. Hence, the future road network must have an adequate capacity to satisfy

such motor traffic demand. In order to design such a road network, a number of cross-sections were established in Panama Urban Area, demand and supply of these cross-sections were measured, and road width and the number of lanes were determined for each cross-section. Also, it was ascertained that the road network has the capacity of satisfying demand indicated for the result of traffic assignment, discussed in the evaluation of alternative networks. Traffic demand and supply at major road cross-sections are shown in Fig. 11-2.

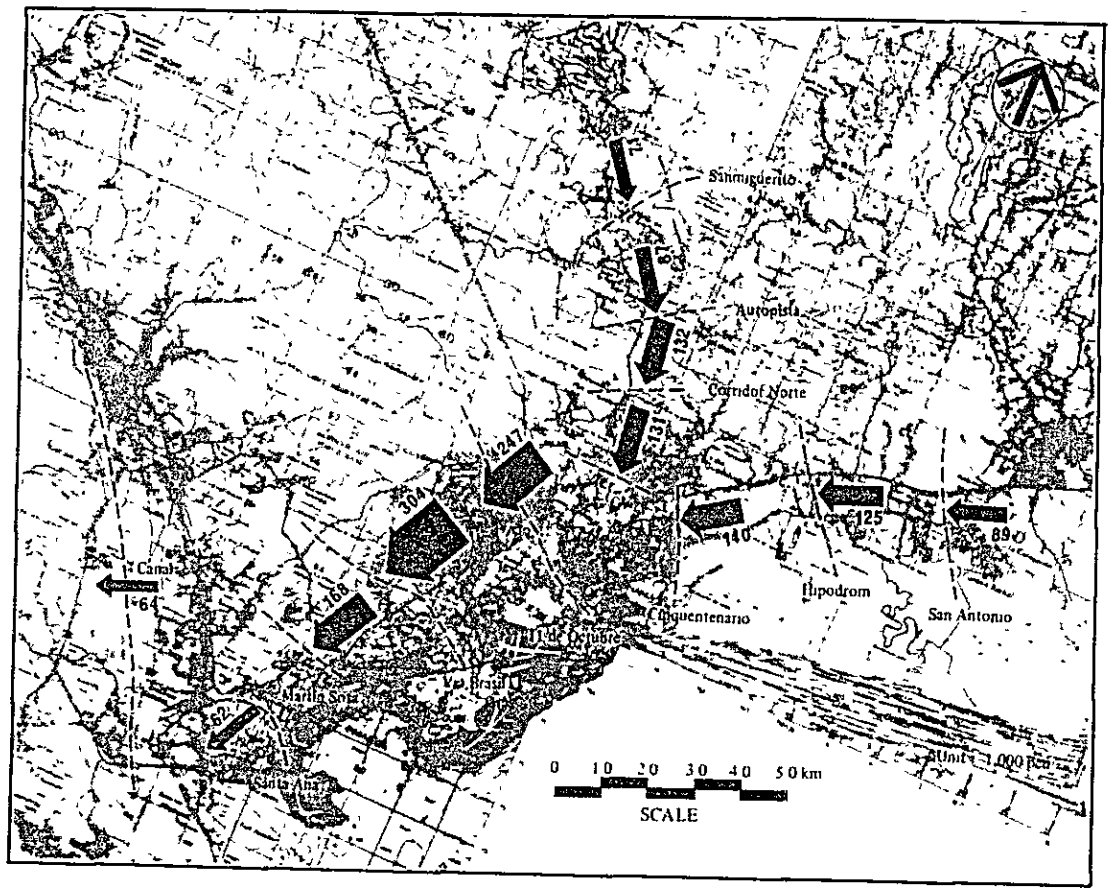


FIG. 11-2 FUTURE TRAFFIC VOLUME IN MAIN SECTIONS, 2,000

(2) Roads for Urban Development

While it is predicted that urbanization will cover the Planning Area in its entirety, worth mentioning will be the multi-purpose development of the reverted area, residential area development in Corregimientos De Juan Diaz/Pedregal, the eastern part of San Miguelito District and in Tocumen, and housing development in San Miguelito District and Corregimiento de Las Cumbres, as well as new urban land development in Arraijan, Pueblo Nuevo Arraijan, and La Chorrera District. In order to support and guide such urban development activities, arterial roads should be developed through the construction of new roads or the upgrading of the existing roads. In terms of road network, Corredor Norte is conceived of as the development axis for areas in the north and east of Panama Urban Area; Corredor Sur for Juan Diaz/Pedregal; and San Miguelito West, San Miguelito Central, and San Miguelito East will function as axes for the development of San Miguelito in the north. As for Arraijan and La Chorrera west of the Canal, the old American Highway, which traverses the central part of the urban area, as well as streets which form the circumference will function as development roads.

From the viewpoint of public transport, the main axes of bus transport will be Via Transistmica, Via Domingo Diaz, Via Espana, and Via Jose A. Arrango. In a long term future, however, rail transit, when introduced, will guide the efficient utilization of trackside land and the development of cities as strategic bases.

(3) Definition of Road Functions

A review of the street "network" existing in Panama Urban Area indicates that it presents two unique features, which resulted from the process through which the Urban Area expanded and streets were installed. One is that the network is an agglomeration of sub-networks which have no proper continuity between each other and whose patterns vary according to the individual development projects under which they were installed. Thus, the weakness of the overall network is the lack of arterials that form a distinct skeleton of the network (some 4-lane arterials end up as 2-lane streets). The other feature that roads of diverse functions from arterials to secondary streets, are diagonally connected to Via Espana, at short intervals, in a herringbone pattern with angles pointing towards the urban center, thereby impelling up traffic to flow onto Via Espana to cause chaotic congestion.

All roads which make up a network must perform distinct functions varying depending on the volume, trip length, and purpose of traffic, as well as specific land use of roadside areas. Each road function requires particular road structure, route location, and the pattern of interchange. Also, it is essential that road network be constructed so as that all constituent roads, from major arterials to local roads, will effectively perform their functions.

All roads in the Planning Area are classified as follows for road planning purposes. The transportation network masterplan, however, will deal only with arterials (principal and minor) and subordinate (collector and local) roads and streets will be planned separately.

Rural Area

a)	Freeways:	Roads which constitute the nationwide road network, particularly access controlled motorways (Turnpikes)
b)	Principal arterial roads:	Inter-provincial roads connecting major cities and constituting parts of nationwide road network
c)	Minor arterial road:	Roads which connect major parts of Panama Metropolitan Area and which, together with principal arterial roads, constitute the road network of the Metropolitan Area
d)	Collector road:	Roads which are connected to a principal or a minor arterial roads, thereby functioning to disperse traffic
e)	Local road:	Most peripheral roads, which serve local communities

Urban Area

a)	Principal arterial streets:	Roads which connect major parts of the built-up area, handle a large volume of traffic on long distance trip, and form the skeleton of downtown street network.

b)	Minor arterial streets:	Roads which connect traffic generation points within each area surrounded by principal arterial streets, function to direct long-distance trip traffic to a principal arterial street, and together with principal arterial streets, foam the skeleton of downtown street network.
c)	Collector streets:	Roads which connect between minor arterial streets and local streets, thereby dispersing traffic from them
d)	Local streets:	Roads which accommodates traffic directly serving residential areas

(4) Preservation/Improvement of Urban Environment

Panama City is not only the nation's capital but has been developed as the commercial and financial center of the Central and South America. Therefore, it must offer urban traffic service, safety, and other transport functions of levels suitable to its status, and its roads and other transport facilities must be such that the beautiful scenery of Panama City will be preserved. Particularly important will be the planting and fosteration of roadside trees, which will add immensely to the urban scenery. Beautiful treelined roads (Ave. Balboa, Ave. Justo Arosemena,Via Argetina, etc.) still represent only a small portion of the total road network.

Also necessary will be to install sidewalks on roads with a large number of pedestrians, together with flower beds, etc. also for scenic effects.

In order to protect the environment from air pollution, noise, and other traffic problems, it will be essential that a street pattern be selected which will limit, as much as possible, the flow of large volumes of motor traffic to the northern and southern "shafts" and save collector and local streets from through traffic. As it is predicted that environmental pollution by vehicles will become appreciable when the number of vehicles increase, and it will become necessary that the sources of pollution attributable to the mechanical structure of vehicles. Thus, it will be necessary to add exhaust pipe and muffler to the list of mechanical inspection of vehicles.

(5) Intensification of Traffic Management

A suitable systematic traffic management plan is essential to the safe and smooth flow of increasing motor traffic on roads. Particularly for the maximum use of the existing road facilities, thereby maximizing their capacities, traffic management is important. Any scheme for the improvement of traffic management will entail a relatively small investment (except for improvement, which requires a large facilities investment), and such improvement can be achieved through repeated trials and modifications. Therefore, the present Study will deal only in short-term programing, letting it suffice to show future direction for the purpose of long-term planning.

2) **Transportation Network Masterplan**

(1) Transportation Network

The transportation network masterplan, illustrated in Fig. 11-3 envisages that in the year 2000, La Chorrera District and Arraijan District, to the west of the Canal will be connected with Panama Urban Area by Autopista as the main traffic axis, that the old Pan American Highway will be expanded into a 4-lane arterial urban street in line with the urbanizations of La Chorrera, Nuevo Arrijan, and Arraijan, and that a perimeter street will be installed around such new urban areas.

In Corregimientos de Las Cumbres-Chilibre, in the northern part of Panama Urban Area, Via Transistmica Highway will be expanded into 4-lanes.

In the north in Corregimientos de Juan Diaz, Pedregal and Tocumen, the Corredor Norte road will be extended to meet the Pan American Highway where urbanization progresses and will form the skeleton roads in this area together with Via Jose Maria Torrijos, which will be expanded into 4 lanes and Via Domingo Diaz, which is already a 4-lane road. Pan American Highway will remain a 2-lane road in Chepo District area.

The fundamental pattern of the arterial road network in Panama Urban Area will not be much different from those of Alternative 1 and 3. The pattern consists of the three major axes: Corredor Norte running east-west in the northern part of the Area, Via Balboa/Corredor Sur running also east-west but in the southern part of the Area, and the 6-lane Via Transistmica running through the middle of the Area. The major differences of this pattern from those of the Alternatives are: (1) that Autopista access road has been incorporated into the pattern in view of the facts that (1) its plan has recently been maturated, (2) the extension of Autopista ends at the Urb.Torrijos-Carter Project Area in San Miguelito District, leaving its further extension eastward to after the year 2000, and (3) in view of the development of Albrook Airfield site and vicinity in the reverted area, a street named Via Albrook will be constructed at about the same position as under Alternative 4.

A railroad, to be explained in detail later, will be set down between Plaza 5 de Mayo and Urb Cerro Viento, chiefly along Via Transistmica and Via Domingo Diaz, for a total extension of about 15 kilometers.

In addition to said three major traffic axes, east-west arterials will be Via Espana (and Ave. Central as its extension), Ave Peru, Via Jose A. Arango, Via Richardo J. Alfaro (which is the present perimeter road of the urban part), and Via Domingo Diaz (which is the present major axis estending toward Corregimiento de Tocumen in the east). The major north-south arterials, which will function as the "crosspieces" of the ladder pattern network will be Via Martin Sosa, Via Federico Boyd, Via Brasil and its extension, Via 11 de Octubre, and Via Cincuentenario. Major arterials running parallel to Via Transistmica, which turns north words from the San Miguelito District Intersection, will be Gailard Road, which will be upgraded to 4 lanes and connected with Autopista, and San Miguelito District West, which will be newly built as a 4-lane road. In addition, San Miguelito District Central will be a 4-lane road transversing the residential area of San Miguelito District, and San Miguelito District East will be a 2-lane road running on the perimeter of the area to be urbanized in the east.

Transport network for 1990, a mid-term target year on the way to the masterplan of year 2000, is envisaged as the surperimposition of the transport facility projects to be completed by 1989 (see Chapter 13) onto the existing transport network (see Fig. 11-4). The transport network in 1990 will be highlighted by the followings:

(i) Much improved traffic flow over long distance due to the completion of Autopista (Arraijan – Panama) and the widening of Transistmica in Las Cumbres and the vicinity.

(ii) Satisfaction of expanded demand for transport to and from Panama Urban Area and the availability of a development axis for the reverted land by the completion of the reverted land portion of Corredor Norte, together with the new or improved north-south roads connecting thereto in the north-west of said Area.

(iii) Accommodation of traffic from the east by the completion of a part of Corredor Sur in the east of Panama Urban Area and the widening of Jose Arango.

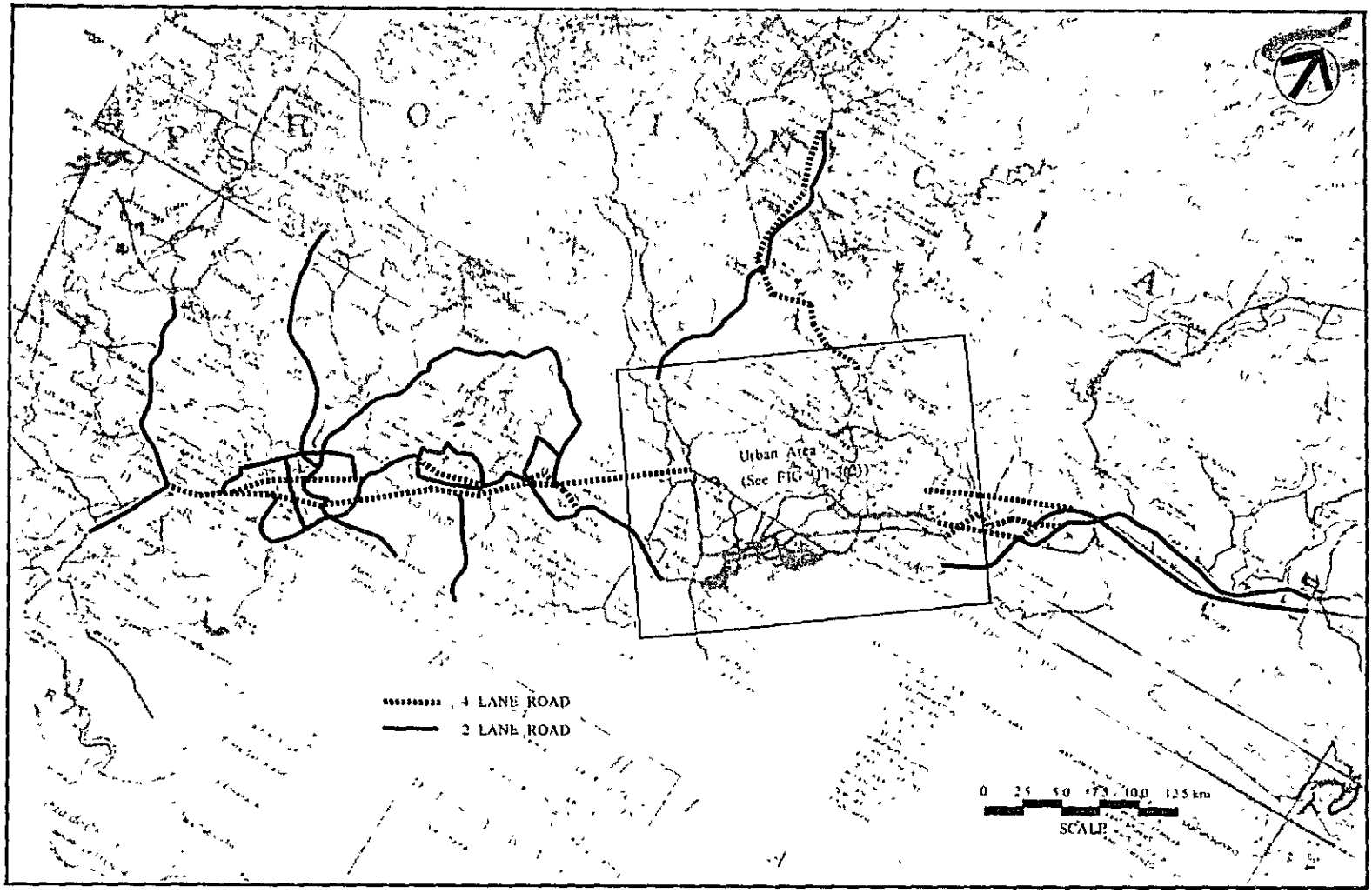


FIG. 11-3(1) TRANSPORTATION NETWORK MASTERPLAN FOR 2000 (SUBURBAN AND RURAL AREA)

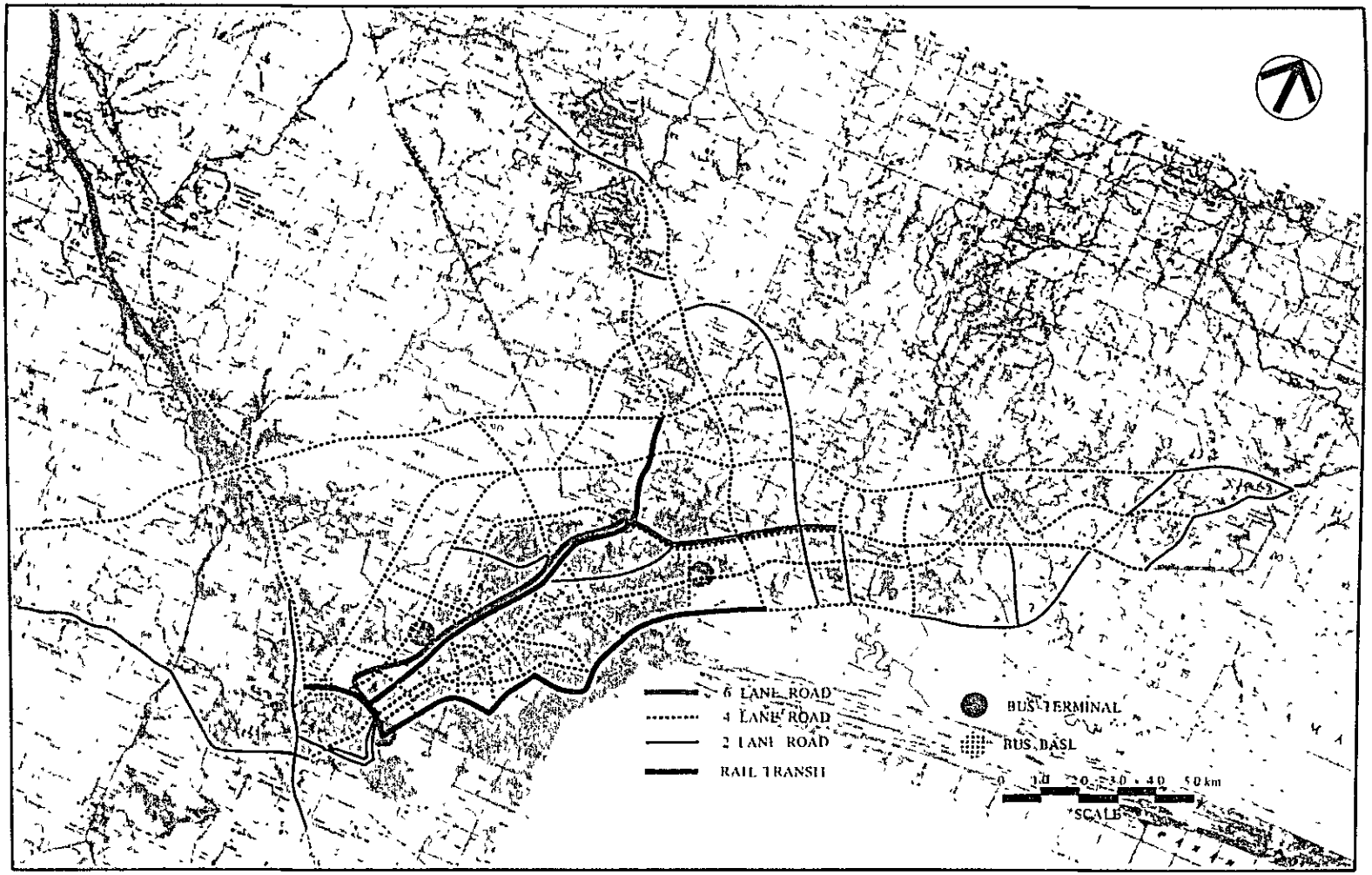


FIG. 11-3(2) TRANSPORTATION MASTERPLAN FOR 2000 (URBAN AREA)

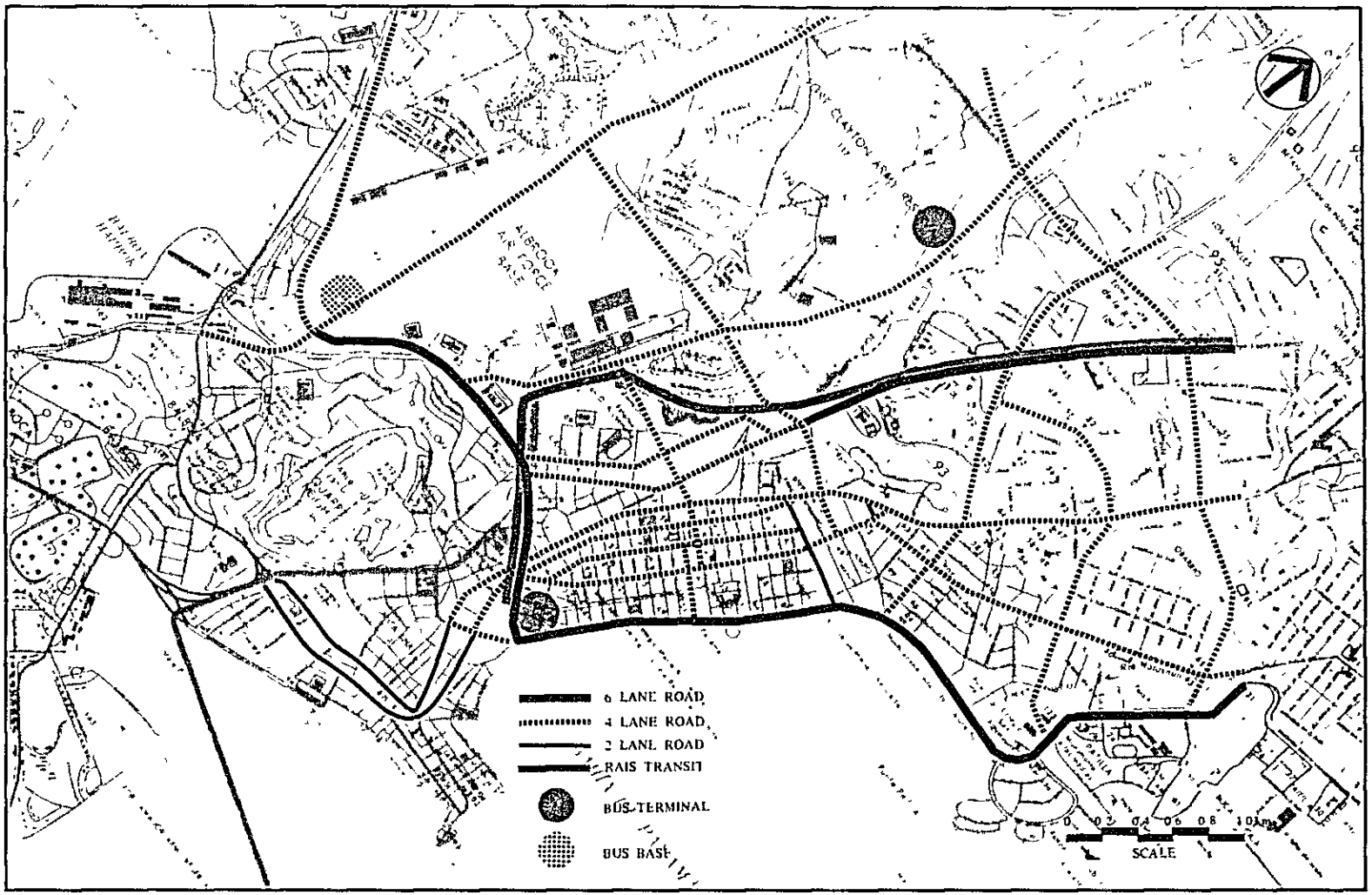


FIG. 11-3(3) TRANSPORTATION NETWORK MASTERPLAN FOR 2000 (CENTER AREA)

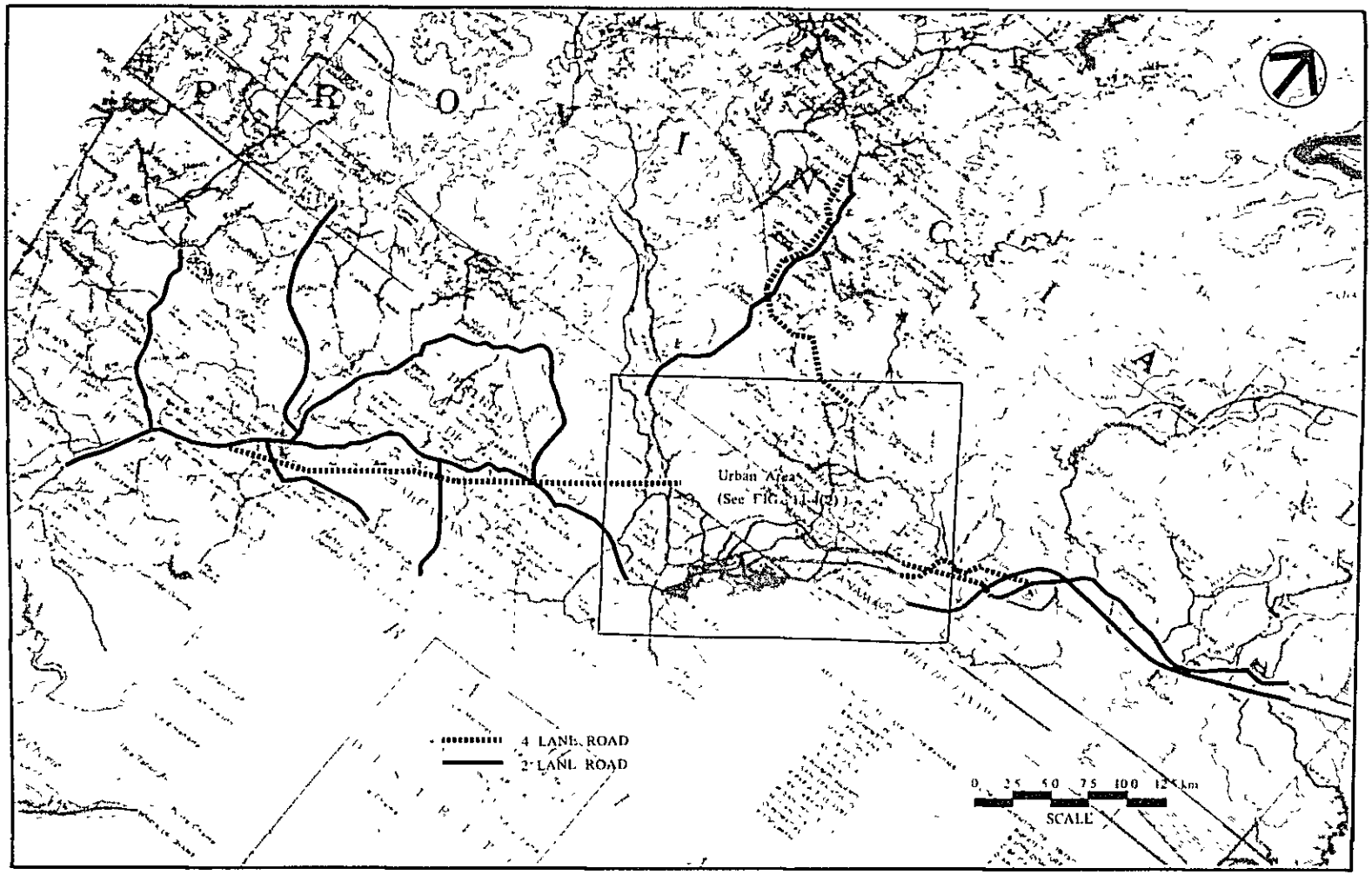


FIG. 11-4(1) TRANSPORTATION NETWORK MASTERPLAN FOR 1990 (SUBURBAN AND RURAL AREA)

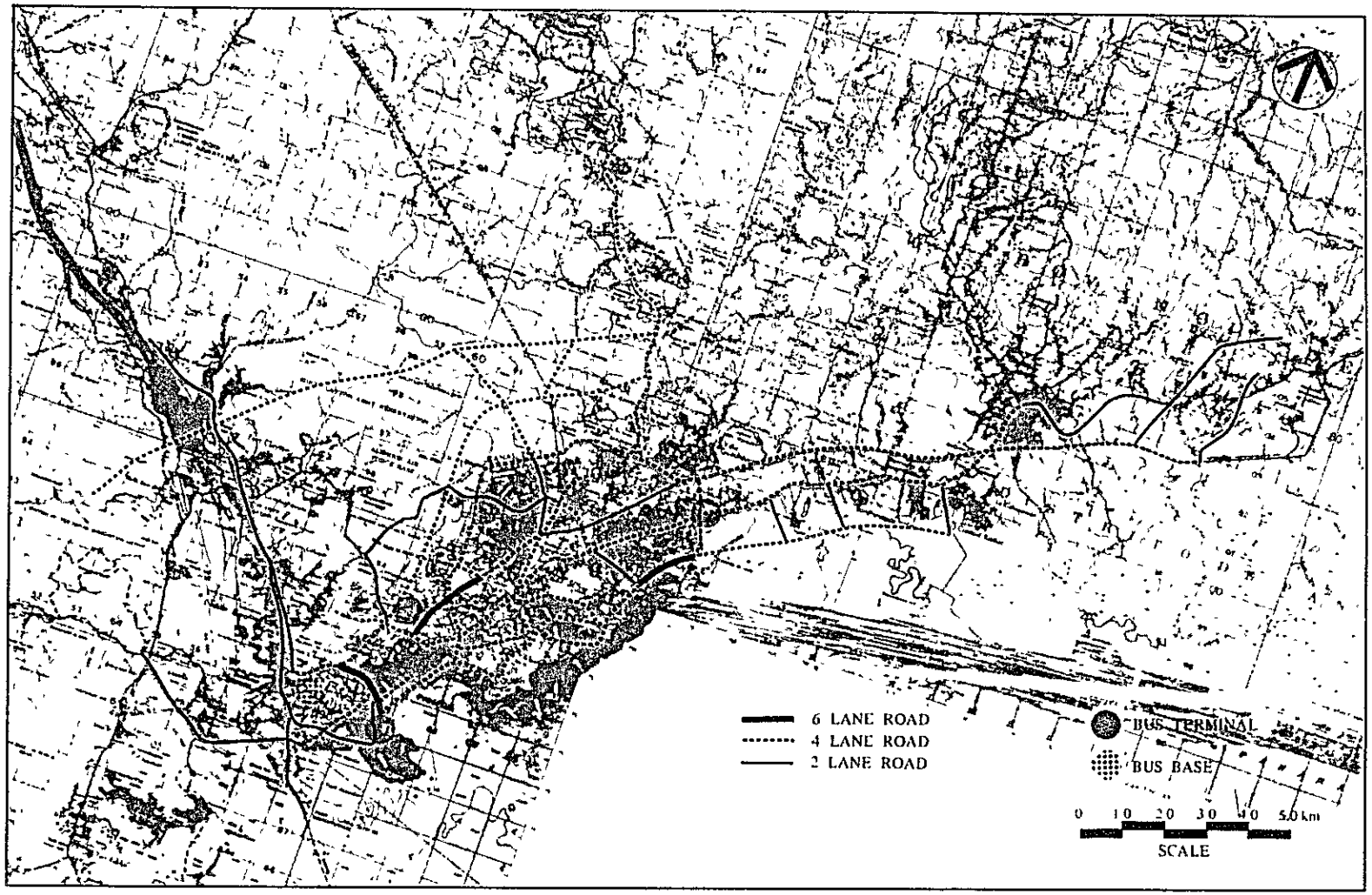


FIG. 11-4(2) TRANSPORTATION NETWORK MASTERPLAN FOR 1990 (URBAN AREA)

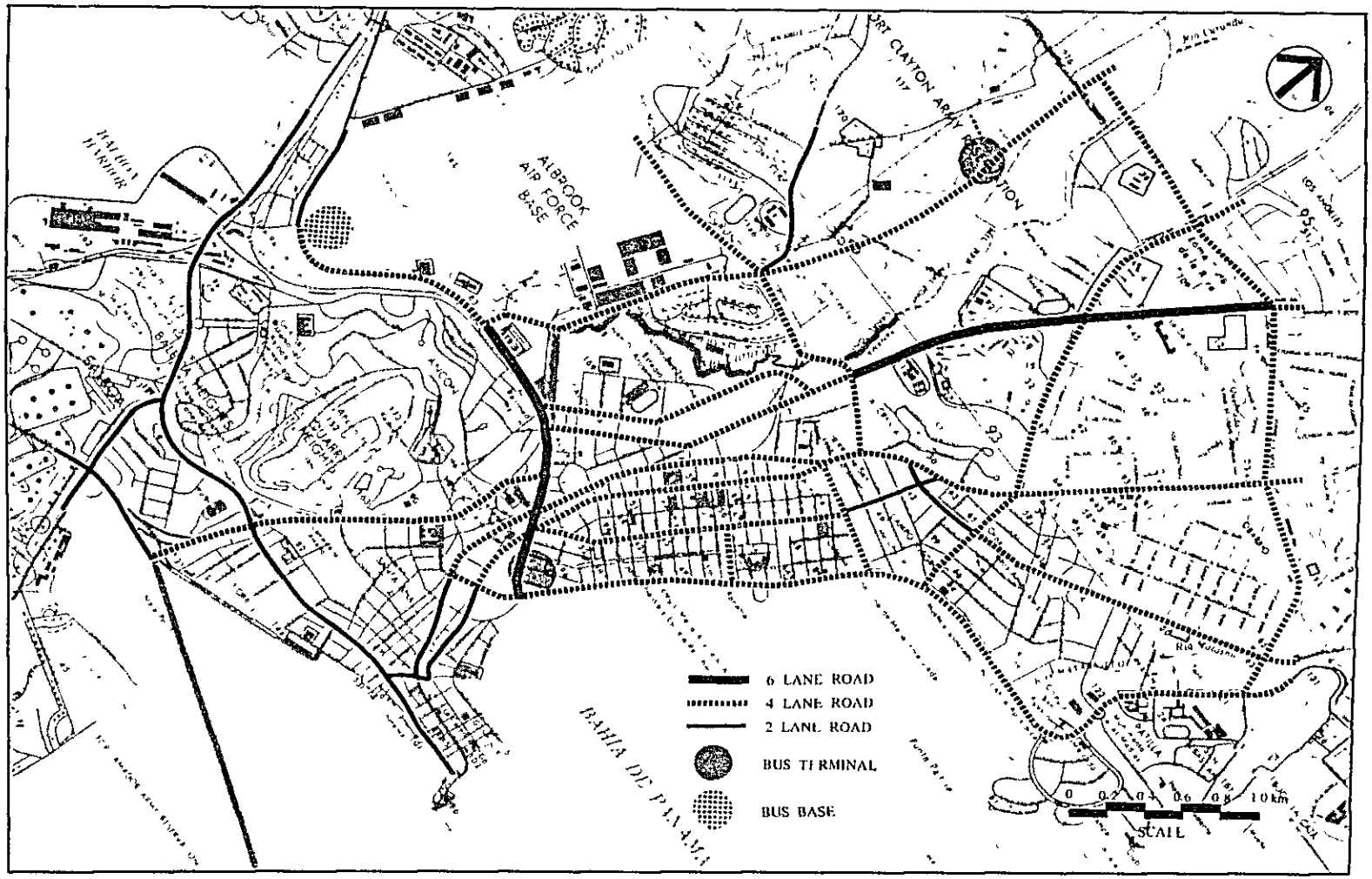


FIG. 11-4(3) TRANSPORTATION NETWORK MASTERPLAN FOR 1990 (CENTRAL AREA)

TABLE 11-1 PERSON TRIP OD TABLE IN YEAR 2000

Origin\ Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1 Centro	145846.	34665.	67009.	27718.	7745.	43315.	11513.	19433.	704.	18095.	5744.	2354.	432.	1113.	4225.	6445.	38.	396394.
2 Bella Vista	33261.	86037.	86032.	30081.	5880.	34460.	15463.	12037.	94.	13068.	7314.	164.	56.	129.	1390.	556.	0.	326022.
3 Area Residencial	59812.	84012.	261024.	42826.	12212.	66463.	16335.	23192.	1100.	15036.	5342.	664.	168.	691.	3350.	1271.	28.	593526.
4 Juan Diaz–Pedregal	22972.	24616.	41632.	132071.	24731.	35132.	4051.	12018.	305.	5397.	1464.	1683.	310.	623.	1959.	1068.	96.	310128.
5 Tocumen	6190.	6194.	13826.	19842.	36265.	14813.	2085.	4722.	68.	2406.	1214.	2123.	25.	185.	1084.	65.	0.	111107.
6 San Miguelito	43559.	33957	69257.	33173.	11024.	281698.	24648.	17491.	514.	7286.	3382.	745.	233.	239.	2555.	484.	201.	530446.
7 Las Cumbres–Chilibre	8780.	9036.	16127.	3819.	1858.	25788.	55965.	9204.	191.	2593.	1037.	175.	34.	123.	2378.	320.	0.	137428.
8 Ancon Esta	25101.	18007.	27305.	11643.	4269.	16324.	7961.	82162.	354.	8793.	3138.	88.	569.	6.	5087.	470.	0.	211277.
9 Ancon Oeste	622.	220.	1379.	349.	199.	387.	90.	416.	1766.	825.	583.	11.	0.	0.	110.	0.	0.	6957.
10 Arraijan	21707.	14592.	18001.	4941.	1861.	7234.	2409.	11361.	709.	84102	19635.	5.	2308.	151.	319.	216.	0.	189461.
11 Chorrera	3771.	6186.	3633.	1714.	1469.	3637.	807.	4246.	359.	2738.	198202.	33.	2846.	3.	399.	2410.	41.	256994.
12 Pacora	2099.	198.	834.	915.	2367.	531.	109.	3068.	9.	75.	50.	0.	11.	0.	60.	127.	0.	10453.
13 Nuevo Emperador	285.	24.	184.	262.	2.	239.	46.	267.	0.	1786.	2319.	3.	56.	10.	29.	48.	0.	5560.
14 Sector Este	771.	118	469.	572.	151.	417.	61.	4069.	0.	0.	0.	0.	12.	0.	10.	54.	0.	6704.
15 Sector Norte	5457.	1702.	2843.	1463.	665.	2412.	2233.	19881.	21.	765.	311.	63.	30.	64.	175.	194.	0.	38279.
16 Sector Oeste	5865.	247.	762.	487.	151.	1124.	201.	98.	0.	916.	2008.	20.	49.	29.	261.	0.	5.	12223.
17 Islas Del Golfo de Panama	36.	0.	27.	87.	0.	117.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	267.
Total	386134	319811	610344.	311963.	110849.	534091.	143977.	223665.	6194.	188291.	251743.	8131.	7139.	3366.	23391.	13728.	409.	3143226.

Source : ESTAMPA

Source : ESTAMPA

TABLE 11-2 MOTOR VEHICLE TRIP OD TABLE IN YEAR 2000

Origin/Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1 Centro	29128.	13313.	25675.	5764.	1603.	10404.	2930.	8009.	288.	3468.	1184.	1052.	216.	554.	1878.	2955.	2.	108423.
2 Bella Vista	13152.	44591.	42739.	10179.	1756.	10352.	6101.	5587.	46.	2921.	1544.	119.	39.	86.	845.	334.	0.	140391.
3 Area Residencial	18518.	40303.	96329.	14054.	3778.	22694.	4874.	10037.	535.	3828.	1534.	479.	108.	404.	1806.	789.	11.	220081.
4 Juan Diaz–Pedregal	4352.	7076.	12847.	33722.	6770.	14145.	1299.	3513.	109.	1393.	467.	1000.	150.	364.	951.	609.	5.	88772.
5 Tocumen	1167.	1589.	3831.	5450.	6843.	5460.	556.	1352.	26.	522.	291.	877.	12.	72.	687.	27.	0.	28762.
6 San Miguelito	9353.	8611.	20843.	12211.	3467.	48422.	11036.	5855.	198.	1955.	983.	442.	89.	87.	944.	248.	140.	124884.
7 Las Cumbres–Chilibre	1762.	2524.	3931.	1211.	554.	8199.	9550.	2827.	49.	673.	274.	27.	16.	63.	812.	146.	0.	32618.
8 Ancon Esta	11585.	8539.	11352.	3373.	1122.	5583.	2533.	19949.	185.	2642.	946.	45.	340.	4.	2548.	254.	0.	71000.
9 Ancon Oeste	196.	58.	471.	76.	42.	76.	18.	155.	450.	325.	113.	3.	0.	0.	43.	0.	0.	2026.
10 Arraijan	4952.	3024.	4394.	1112.	333.	1570.	542.	3211.	226.	16536.	5741.	1.	825.	73.	100.	84.	0.	42724.
11 Chorrera	947.	1029.	714.	339.	353.	884.	218.	1199.	77.	7479.	75402.	11.	1652.	1.	108.	1236.	13.	91662.
12 Pacora	1095.	79.	452.	721.	1132.	299.	46.	1473.	4.	51.	29.	0.	10.	0.	34.	61.	0.	5486.
13 Nuevo Emperador	131.	12.	108.	122.	1.	135.	24.	54.	0.	742.	1393.	2.	47.	6.	15.	26.	0.	2818.
14 Sector Este	382.	60.	247.	300.	88.	147.	22.	2423.	0.	0.	0.	0.	7.	0.	5.	29.	0.	3710.
15 Sector Norte	2487.	858.	1408.	607.	593.	894.	850.	10292.	10.	370.	83.	33.	17.	41.	85.	112.	0.	18740.
16 Sector Oeste	2848.	126.	394.	242.	76.	368.	82.	46.	0.	408.	991.	10.	28.	15.	185.	0.	3.	5822.
17 Islas Del Golfo de Panama	2.	0.	10.	4.	0.	59.	0.	0.	0.	0.	0.	0.	0.	0.	0	0.	0.	74.
Total	102057.	131792.	225745.	89487.	28511.	129691.	40681.	75982.	2203.	43313.	90975.	4101.	3556.	1770	11046.	6910.	174.	987994.

Source ESTAMPA

Source ESTAMPA

(iv) Improved traffic handling in the central part of Panama Urban Area by the widening of Via España and of a part of Transistmica.

(v) Much improved public transport service by the completion in Panama Urban Area of four bus centers and one bus pool.

(2) Result of Traffic Assignment

The forecast of future transport demand is accomplished once more based of zonal economic indicators according to the final land use plan, as reviewed and determined at the time of formulating Masterplan, and assuming the introduction of passenger car traffic curbing measures, and so forth. PT OD forecast for the year 2000 is shown in Table 11-1. Also, because Modal a split of transport demand depends on the level of traffic facilities development, Motor vehicle O-D table is constructed for 2000 in accordance with Masterplan, as shown in Table 11-2. Model share as the result of this O-D table are shown in Table 11-3.

Traffic on the OD table for the year 2000 is assigned to the traffic network of the year 2000, and the result of the assignment is illustrated in Figure 11-5~7. A review of this Figure indicates that, starting from the suburban area, Autopista will extend Panama Urban Area as a thick traffic axis. The old Pan American Highway will also have some heavy traffic sections. In Corregimiento de Chilibre in the north, Via Transistmica will accommodate a thick flow of traffic. In Corregimientos de Juan Diaz, Pedregal and Tocumen in the east, large quantities of traffic will be assigned to Corredor Norte and Via Domingo Diaz.

In Panama Urban Area, Corredor Norte, San Miguelito West, Via Transistmica, Via Domingo Diaz, and Corredor Sur, all of which are the "shafts" of the ladder pattern, and Via 11 de Octubre,

TABLE 11-3 FUTURE TRAFFIC DEMAND BY MODE

(1) PERSON-TRIP

Mode	Present		1990		2000	
	No. of Trip	Rate (%)	No. of Trip	Rate (%)	No. of Trip	Rate (%)
Walk/2 Wheel	330,000	22.4	442,000	19.8	632,000	20.1
Car	396,000	26.9	627,000	28.1	915,000	29.1
Truck	102,000	6.9	137,000	6.1	202,000	6.4
Taxi	71,000	4.8	81,000	3.6	102,000	3.2
Public Transport	509,000	34.5	847,000	37.9	1,162,000	37.0
Private Use Bus	65,000	4.4	96,000	4.3	130,000	4.2
Total	1,473,000	100.0	2,230,000	100.0	3,143,000	100.0

(2) VEHICLE TRIP

Mode	Present		1990		2000	
	No. of Trip	Rate (%)	No. of Trip	Rate (%)	No. of Trip	Rate (%)
Car	266,000	54.2	421,000	60.5	614,000	62.2
Truck	88,000	17.9	116,000	16.6	171,000	17.3
Taxi	91,000	18.6	104,000	14.9	131,000	13.3
Public Transport	38,000	7.6	43,000	6.2	55,000	5.6
Private Use Bus	8,000	1.7	12,000	1.7	16,000	1.7
Total	491,000	100.0	696,000	100.0	987,000	100.0

Source : ESTAMPA

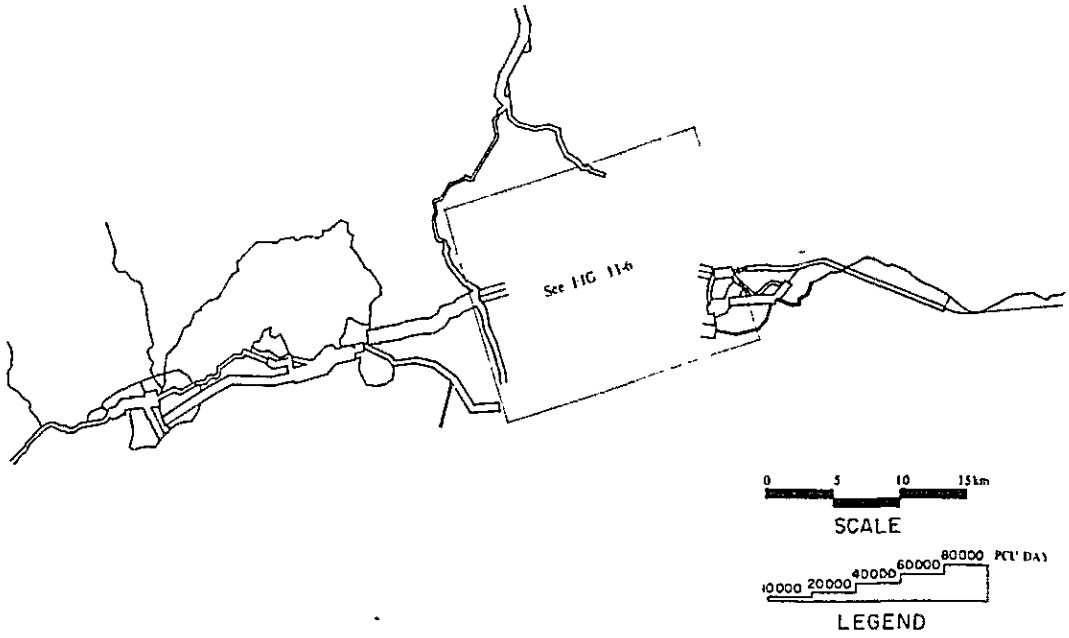


FIG. 11-5 ASSIGNED TRAFFIC VOLUME, 2000 (SUBURBAN AND RURAL AREA)

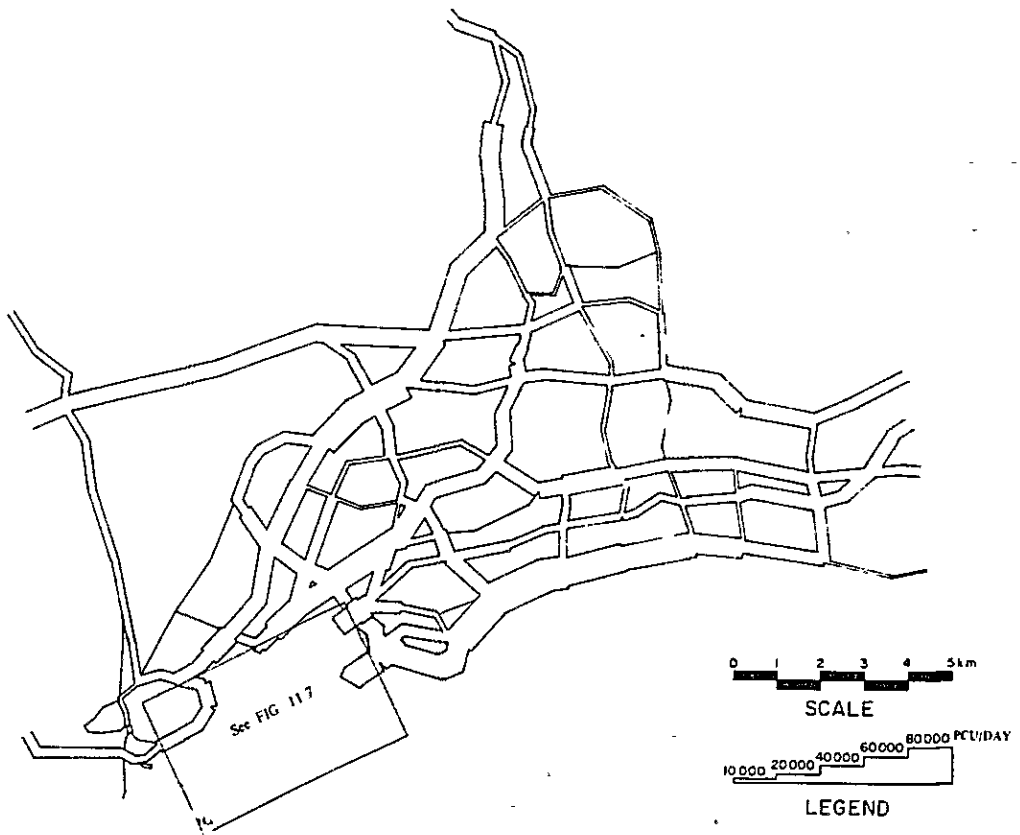


FIG. 11-6 ASSIGNED TRAFFIC VOLUME, 2000 (URBAN AREA)

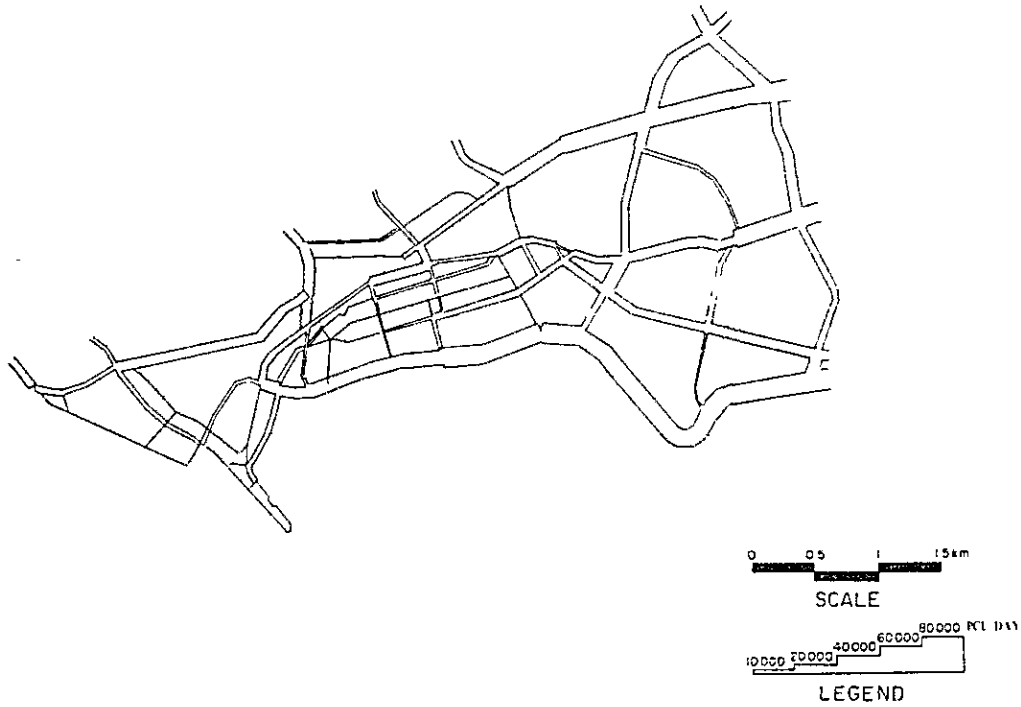


FIG. 11-7 ASSIGNED TRAFFIC VOLUME, 2000 (CENTRAL AREA)

both of which are north-south axes connecting the "shafts," show the assignments of large volume of traffic. Thus, the initially intended traffic flow pattern will be realized as substantiated by the result of traffic assignment.

A summary of the traffic assignment result, presented in Table 11-4, shows that both total traffic load (vehicle-kilometers) and total travel time (vehicle-hours) of the year 2000, as assigned, are substantially smaller compared with the "do-nothing" case, which proves that the planned network will have high efficiency. Also, average travel speed will be 25.6 kilometers per hour, which will be a fair improvement from the present 16.8 kilometers per hour. Congestion ratio will be 0.60,

TABLE 11-4 RESULT OF TRAFFIC VOLUME ASSIGNMENT ON MASTERPLAN NETWORK

	Do Nothing Case (2000)	Net Work 1990	Net Work 2000
Total Length of Network (Km)	324	338	448
Traffic Load (1000 veh · Km)	9893	5465	8178
Total Travel Time (1000 veh · h.)	1608	296	319
Average Travel Speed (Km/h)	6.2	18.5	25.6
Average Congestion Rate = (Whole Planning Area)	1.81	0.76	0.60
Average Congestion Rate = (Zone 01–10)	1.40	0.58	0 58
Total Length of Congestion Section (Km)			
Congestion Rate 1.0 or More	224	116	79
Congestion Rate 1.5 or More	172	15	7
Traffic Volume on Congested Section (1000 veh · Km)			
Congestion Rate 1.0 or More	8706	2211	2348
Congestion Rate 1.5 or More	7801	823	552

Source : ESTAMPA

as intended. Only 79 kilometers, less than 1% of the total road extension, will have a congestion ratio of 1 or higher.

Therefore, it can be safely claimed that the masterplan for the year 2000 will offer a satisfactory level of service.

Also, the result of traffic assignment to the 1990 road network to be developed according to the road investment schedule is presented in Fig. 11-8~10.

(3) Construction Cost Estimation

The construction cost for newly building or upgrading roads which will constitute the road network is separated into those elements shown in Figure 11-11 for calculation, grouped into foreign currency portion, local currency portion, and taxes, and then tabulated into financial cost and economic cost.

The construction cost estimation is based on the following conditions:

A. Unit labor cost and materials cost are based on the list of construction materials (Lista de Precios de Materiales de Construccion) published by CAPAC (Camara Panamena de la Construccion). For materials, machinery work capabilities, and unit prices, Japanese prices are referred to.

B. November 1981 prices are used.

C. Various unit work prices are obtained from the above unit prices and adjusted in comparison with unit prices for various MOP projects. For cutting, embankment, paving, and concrete work, a total of 20 items of unit work prices are prepared. For culverts, walls, bridges, overhead bridges, and other structures, a total of 12 items of unit work prices are prepared.

D. The areas in which road projects will be implemented encompass a variety of land from

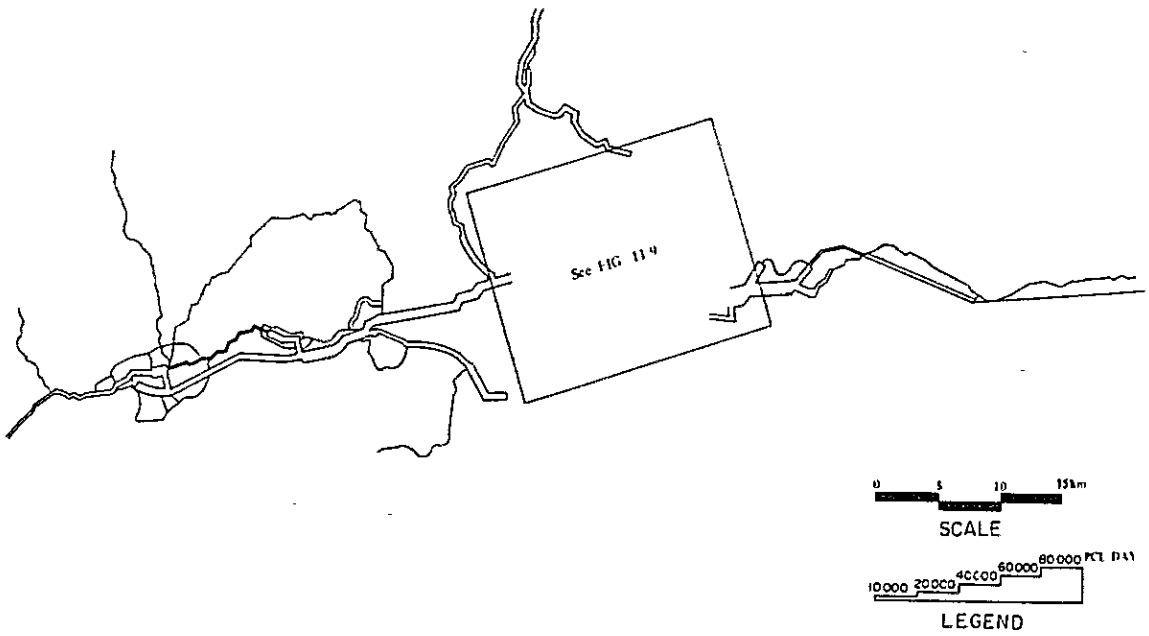


FIG. 11-8 ASSIGNED TRAFFIC VOLUME, 1990 (SUBURBAN AND RURAL AREA)

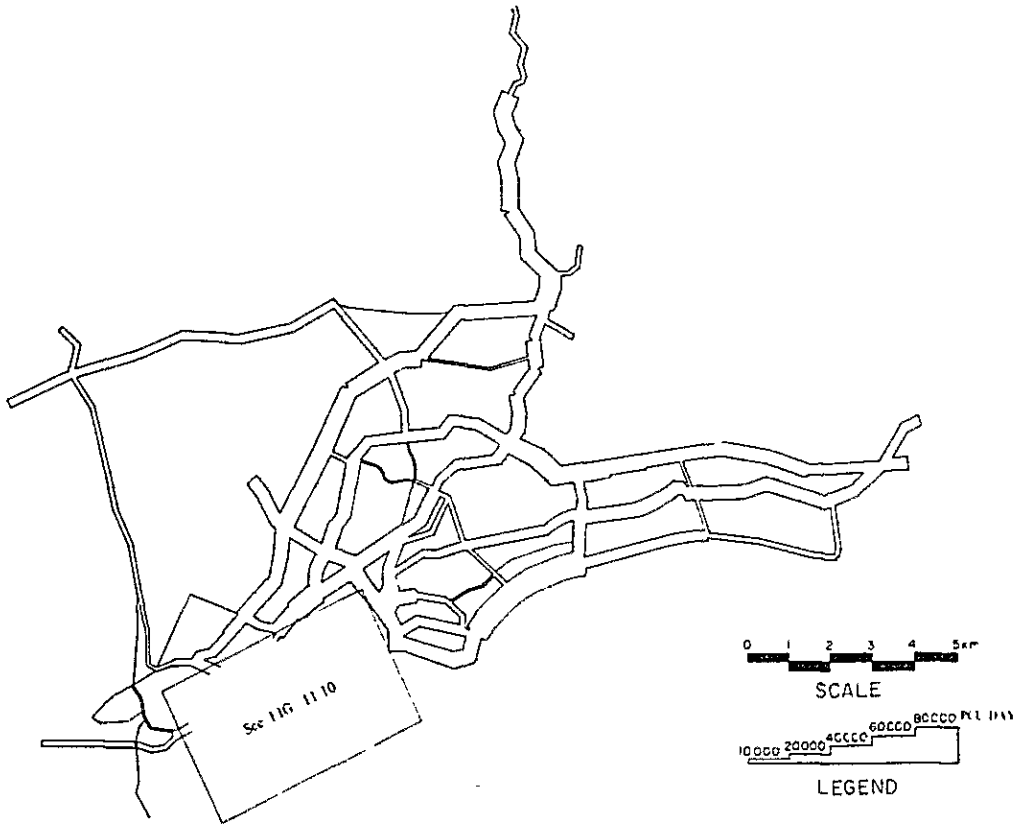


FIG. 11-9 ASSIGNED TRAFFIC VOLUME, 1990 (URBAN AREA)

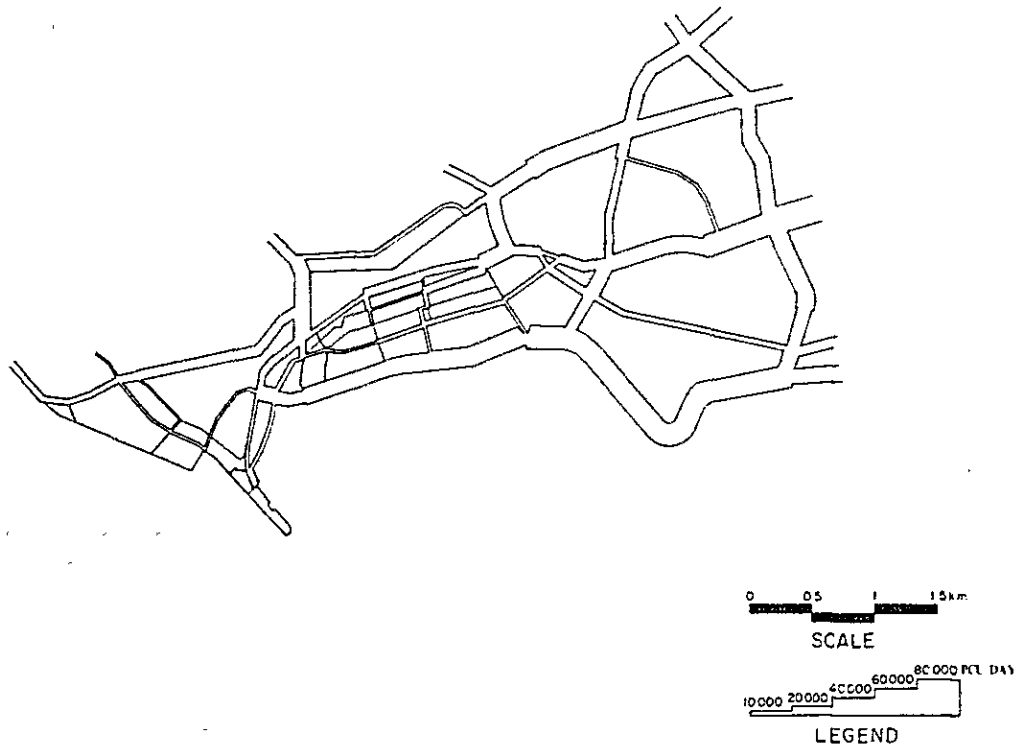


FIG. 11-10 ASSIGNED TRAFFIC VOLUME, 1990 (CENTRAL AREA)

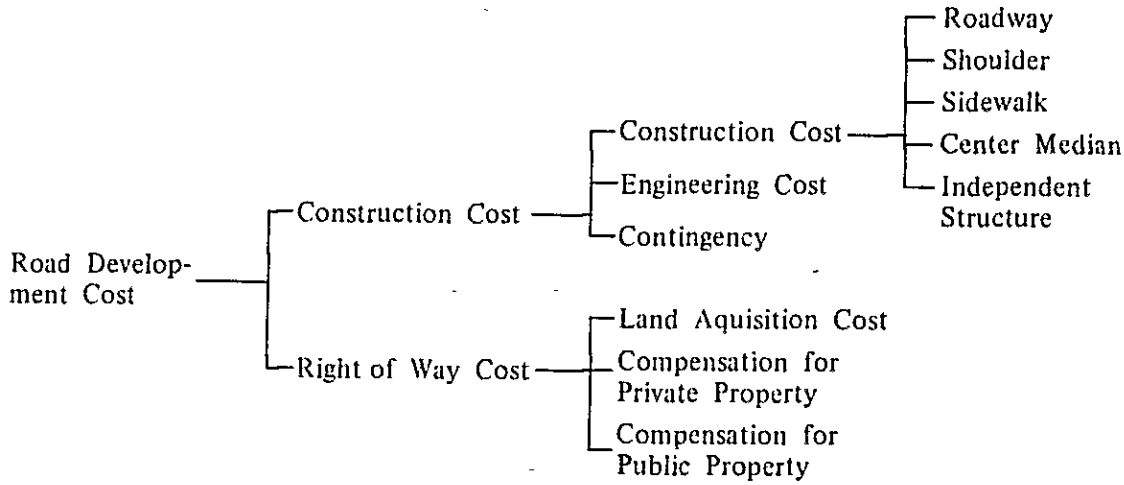


FIG. 11-11 CLASSIFICATION OF COST ITEMS

the urban center, where land price is high and many obstructions exist, to suburban areas where requires compensation for land will be small. The geometry of road also varies from that of high speed motorways to that of urban streets with wide sidewalks. Thus, many road cross-sections must be prepared for the purpose of calculating construction quantities and costs. Therefore, each link is given an different road cross-section and a different unit cost of compensation for land.

E. For this reason, the road cross-section is divided into four elements: sidewalk, shoulder, driveway and center median, and each element is classified into four to 13 types. The types of elements are selected for each link depending on its characteristics. The set of the selected elements decide road cross-section, from which construction cost is estimated. The unit prices of the elements are presented in Table 11-5~8.

TABLE 11-5 SIDEWALK COST PER METER

	Type	Width (M)	Cost (Balboa)	Fund Source Composition		
				Foreign (%)	Local (%)	Tax (%)
Urban Area	1	0.0	86.2	0.57	0.36	0.07
	2	2.5	179.2	0.52	0.39	0.09
	3	3.5	223.3	0.50	0.41	0.09
	4	5.0	262.7	0.51	0.40	0.09
Rural Area	5	0.0	11.8	0.54	0.38	0.08
	6	2.5	35.9	0.50	0.42	0.08
	7	3.5	44.0	0.50	0.42	0.08
	8	5.0	57.0	0.50	0.42	0.08

Note: 1) Including costs for traffic signs, signals, guard fences, side drains, etc.
2) Type 1 and 5 are or Autopista.

Source: ESTAMPA

TABLE 11-6 SHOULDER COST PER METER

Type		Width (M)	Cost (Balboa)	Fund Source Composition		
				Foreign (%)	Local (%)	Tax (%)
Urban Area (Paved)	1	0 500	326.0	0.46	0.44	0.10
	2	0.800	335.0	0.46	0 44	0.10
	3	1.000	342.0	0 46	0.44	0.10
	4	1.250	349.3	0.47	0.43	0.10
	5	1.800	366.0	0.47	0.43	0.10
	6	2.000	372.9	0.47	0.43	0.10
	7	2.705	255.3	0.52	0.38	0 10
Rural Area (Non-paved)	8	0.500	97.8	0.47	0.43	0.10
	9	0.800	107.6	0.47	0.43	0.10
	10	1 000	113.7	0.47	0.43	0.10
	11	1.250	121.1	0.47	0.43	0.10
	12	1.800	138.3	0.48	0.42	0.10
	13	1.200	144.7	0.50	0.40	0.10

Note: Type 7 and 13 are for Autopista
Source: ESTAMPA

TABLE 11-7 ROADWAY COST PER METER

Type	Width (M)	Cost (Balboa)	Fund Source Composition		
			Foreign (%)	Local (%)	Tax (%)
1	2.75	94.7	0.50	0.40	0.10
2	3.05	105.0	0 50	0.40	0.10
3	3.35	115.1	0.50	0.40	0.10
4	3.65	124.2	0 50	0.40	0.10

Source : ESTAMPA

TABLE 11-8 MEDIAN STRIP COST PER METER

Type		Width (M)	Cost (Balboa)	Fund Source Composition		
				Foreign (%)	Local (%)	Tax (%)
1	Marking only	1.0	63.1	0.45	0.45	0.10
2	Mounted-up	2.0	107.5	0.46	0.45	0.10
3	Mounted-up	3.0	121.0	0.47	0.43	0.10
4	Mounted-up	7.2	195.9	0.48	0.42	0.10
5	Depressed	7.0	156.0	0.47	0.43	0.10

Source: ESTAMPA

F. Aside from the estimation based on cross-section, the costs of pavement, overlay, bridges, overpasses, and culverts are estimated separately (Table 11-9).

G. Ten percent of construction cost is allowed for contingency, and 12% of total construction cost is estimated as engineering fee.

H. Compensation for land is classified into land cost, compensation for buildings, and the cost of relocation of electric poles and other public facilities. Land cost is based on the data of

MIVI, Ministerio de Hacienda, and classified into five types, as shown in Table 11-13. Compensation for buildings is decided for each seation based on such compensations in 10 selected model areas, in view that the quality and density of buildings vary from one area to another. Compensation for buildings is shown in Table 11-10. The relocation cost of high voltage lines and electric poles is estimated and used as public facilities relocation expenses which are shown also in Table 11-10.

TABLE 11-9 OVERLAY COST AND STRUCTURE CONSTRUCTION COST

		Unit	Cost (Balboa)	Fund Source (%)		
				Foreign	Local	Tax
Overlay		m	106.6	50	40	10
Bridge	(30m span)	m^2	743.0	50	40	10
Viaduct	(20m span)	m^2	580.0	50	40	10
Culvert	(4m x 4m)	m	2458.0	50	40	10

Source : ESTAMPA

TABLE 11-10 RIGHT-OF-WAY COST

Land Aquisition Cost (Balboa/m^2)	Urban Area	1. Central Part facing Artery	250 ~500
		2. Central Part facing Artery	50 ~250
		3. Outskirt, facing Local Road	25 ~ 50
		4. Outskirt, facing Local Road	10 ~ 25
	Rural Area		~ 5
Compensation Cost	Public Utility (Balboa/m)	Transmission Line	~150
		Drain Pipe, Poles (High Density)	~ 15
		Drain Pipe, Poles (Low Density)	~ 10
	Building/House (Balboa/m^2)	Concrete	180 ~180
		Block	130 ~150
		Wooden	100 ~130

Source : ESTAMPA

The structure of each road depends on the function which it is expected to perform, volume of traffic, for which it is expected to accommodate, the characteristics of the area which it will run through, and so forth. Widening of existing road is subject to restrainsts of the width of right-of-way and construction line. In order that a sufficient space will be available for future road widening, environmental protection, and the installation of safety facilities, the width of right-of-way of new roads will be at least 50 meters. New roads will have a structure which will withstand the traffic of heavy vehicles and be paved with concrete.

Standard cross-sections are shown in Fig. 11-12 for each of hierarchial level of road, number of lanes, and zone.

The total extension of the new roads to be constructed and the sections of existing roads which are to be upgraded by the year 2000 is estimated at 241 kilometers, and the construction cost, at 354 million balboas. Of this total extension, 90% will be in Panama Urban Area and its vicinity on the west of the Canal, and the quantity of work is relatively small in east of the Canal.

Major arterial projects are: the construction of new Corredor Norte for an extension of 21.1

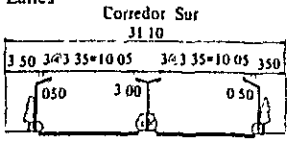
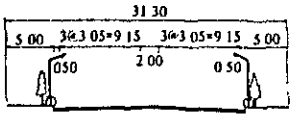
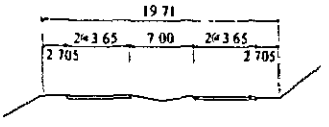
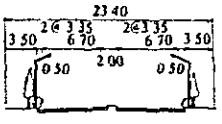
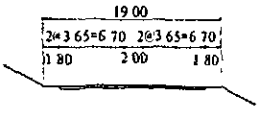
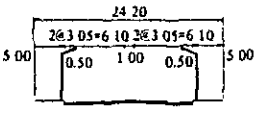
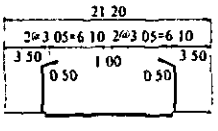
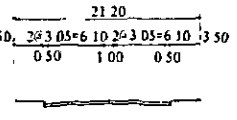
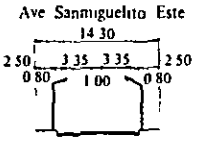
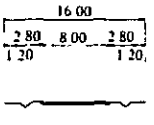
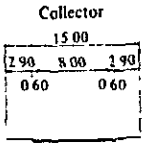
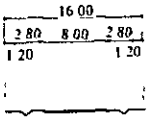
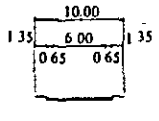
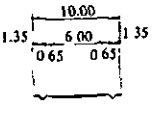
Urban Area	Sub Urban Area
Principal Arterials	
6 Lanes	
Corredor Sur 	
Ave Cerro Ancon 	4 Lanes Corredor Norte 
4 Lanes Ave Betania Central 	Via Transistmica 
Minor Arterials	
4 Lanes	
Via Argentina - Ext - 	
Via Martin Sosa 	Via Central Arraijan 
2 Lanes	
Ave Sanmiguelito Este 	
Collector	
2 Lanes	
Collector 	
Local Street (Road)	
2 Lanes	
Local Street (Road) 	

FIG. 11-12 STANDARD ROAD CROSS SECTIONS

kilometers with construction cost of 53.2 million balboas, the widening of Ave. Balboa and the construction of new Corredor Sur for 23.3 kilometers with 52 million balboas, the upgrading of Via Espana and its extension for 14.5 kilometers with 33.4 balboas, and the widening to a 6-lane road of the urban section of Via Transistmica for 19.5 kilometers with 24.6 million balboas. Total size and construction cost of road projects are shown in Table 11-11.

TABLE 11-11 TOTAL LENGTH AND CONSTRUCTION COST OF ARTERIALS

	Length (Km)	Construction Cost (Million B/.)
New Construction (Total)	133.2	171.2
6-lane	1.6	7.5
4-lane	62.2	123.7
2-lane	69.4	40.0
Widening and Up-gradings (Total)	108.0	124.3
2-lane to 6-lane	0.6	3.8
2-lane to 4-lane	81.2	80.9
4-lane to 6-lane	22.4	34.7
Up-graing	3.8	4.9
Grade Separation of Intersection	21 points	58.7
Grand Total	241.2	354.2

3) Description of Major Roads

(1) Highways

(i) Pan American Highway

In view that Pan American Highway is the most important trunk thoroughfare in the Republic and that traffic on it at the western end of the Study Area is 15,000 PCU per day, which is slightly larger than the capacity of a 2-lane road, the section from said western end to the junction with Autopista will be upgraded to 4-lane. The La Chorrera City - Arrijan section of Autopista was opened in May 1981 and is now in service, but the Arraijan - Panama City Section is still under plan for completion in 1985. Therefore, the existing plan is to be adhered to with regard to the section up to the junction with Via Transistmica. Under the plan, Autopista is to have an interchange which will connect with Gaillard Road on the east of Miraflores Lock and another interchange further east, which will connect with a road leading to the northern part of Panama Urban Area. A road is planned which will connect this interchange with Via Ricardo J. Alfaro, and, therefore, a route was suggested under one of the Alternatives as the arterial in the western part of San Miguelito District which would extend from Via Ricardo J. Alfaro, Autopista, and reach the northern part of San Miguelito District. However, a part of this route will be changed. Also, the section east of this interchange is planned as a road without access control (See Fig. 11-13).

As for the extension of Autopista, the section east of the junction with Via Transistmica to the eastern arterial of San Miguelito District which will go through the residential area of San Miguelito, will be planned as an urban street. Its extension further east toward Corregimiento de Tocumen will be worth considering only after the year 2000, in view of the small amount of external traffic passing through the Metropolitan Area. Possible routes of extension then will be either that which will extend straight from the eastern arterial of San Miguelito District or that

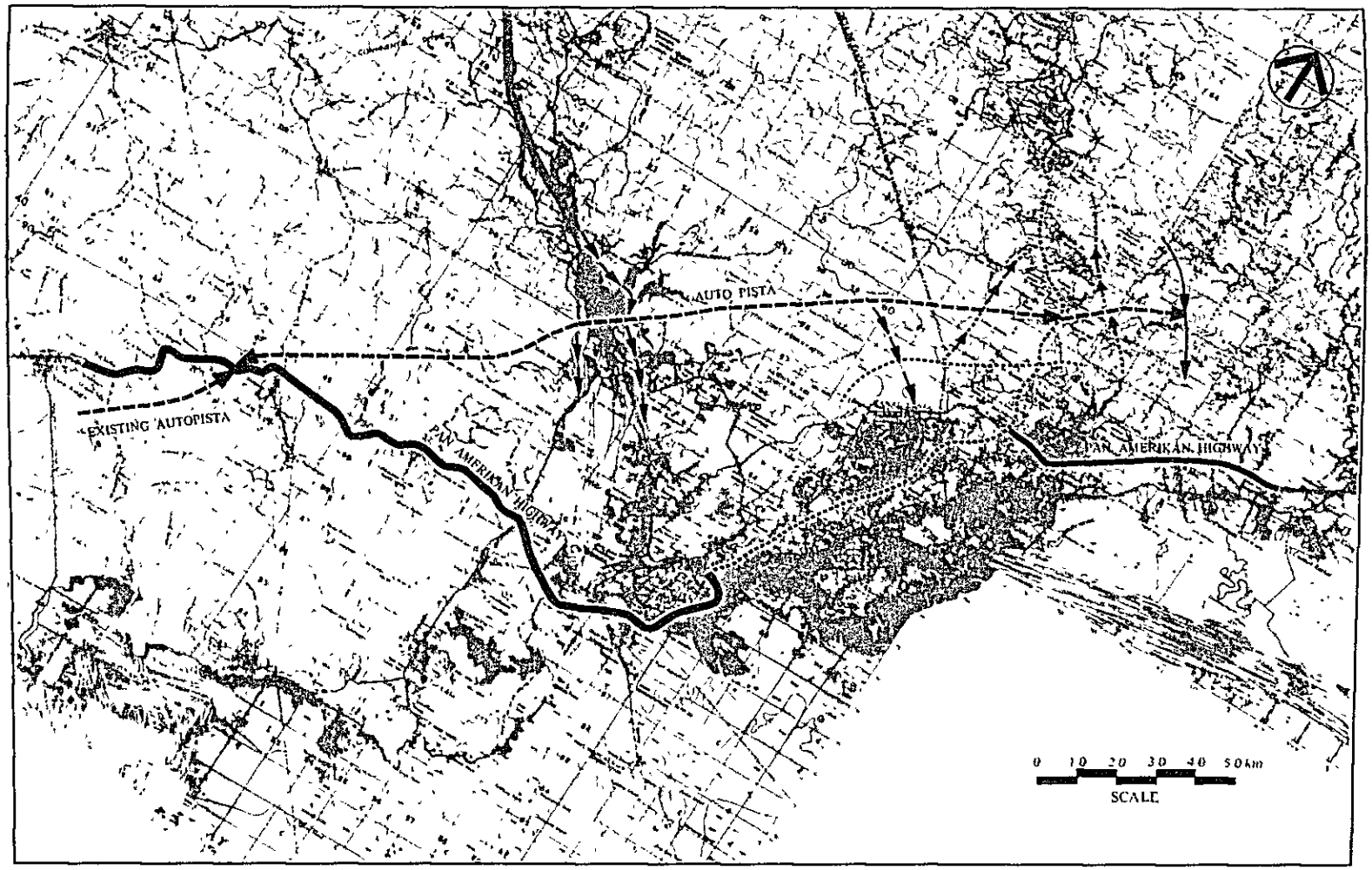


FIG. 11-13 LOCATION MAP OF AUTOPISTA AND PAN AMERICAN HIGHWAY

will detour to the north by the way of San Miguelito District western arterial.

Of the part of the old Pan American Highway in Arraijan Zone, the section in the rapidly urbanizing area will be developed as a 4-lane urban arterial but the remaining sections will be left as a 2-lane road. The section of this Highway east of Via Domingo Diaz and in Tocumen, Zone will be partly upgraded to 4-lane, but the section east of Tocumen, where traffic is not predicted to increase beyond the capacity of a 2-lane road, will be left as a 2-lane road.

(ii) Via Transistmica

Via Transistmica has a different function in urban areas from its function in suburban areas. As it will be discussed later, in urban areas it is an important urban arterial——most important to the development of a public transport system——and, therefore, the section from Centro Zone to the intersection with Autopista will be made a 6-lane road. This Highway is already a 4-lane road up to San Isidro (San Miguelito), but the section further north, beyond the boundary of the Study Area, and up to Colon will also be upgraded to a 4-lane inter-regional arterial highway (See Fig. 11-14).

(2) Corredor Norte

Corredor Norte, which will be established as the east-west traffic axis traversing the northern part of Panama Urban Area, will, together with Ave. Balboa-Corredor Sur, form the shafts of the ladder pattern network. It will be a high-speed 4-lane road, expected to accommodate a large volume of traffic from San Miguelito District and other northern areas and to direct such traffic onto Via 11 de Ocubre, Via Brasil, and other north-south dispersion roads for distributed entries into the urban center, as well as a large volume of traffic from Corregimientos de Tocumen, Juan Diaz Pedregal, and other eastern areas.

In the reverted land area, it will be the major traffic axis facilitating the implementation of various projects including large-scale residential area development at the former site of Albrook Airfield and other locations. The establishment of this Corridor in the parts of San Miguelito District Zone where no street to speak of presently exists will give impetus to the development of the zonal street network.

The Corridor will run in the north of residential areas to be developed in the eastern part of San Miguelito District, Corregimientos de Juan Diaz, Pedregal, and other eastern areas, and will provide a skeleton for the spread of such development. (See Fig. 11-15)

(3) Corredor Sur

The route consisting of Ave. Balboa, Via Israel, and Via Cincuentenario, which runs along the shore of Panama Bay and on the perimeter of Panama Urban Area, is one of the most important arterials currently handling the largest volume of traffic next to Via Transistmica, and will in the future be connected with Corredor Sur to become the southern shaft of the ladder pattern road network. This shaft will provide for a great quantity of middle-and long-distance traffic by-passing the Urban Area. It will constitute the skeleton of residential areas predicted to be developed in the future. In order for it to accommodate a large quantity of fast moving traffic, major intersections will be by grade separation and few signaled intersections will be installed. The number of lanes will be decided depending on the traffic load: the section between Centro Zone and Urb. Nuevo Panama will be 6-lane, the section east of Urb. Nuevo Panama up to Ciudad Radial will be 4-lane, and the section further east up to Via Domingo Diaz will be 2-lane.

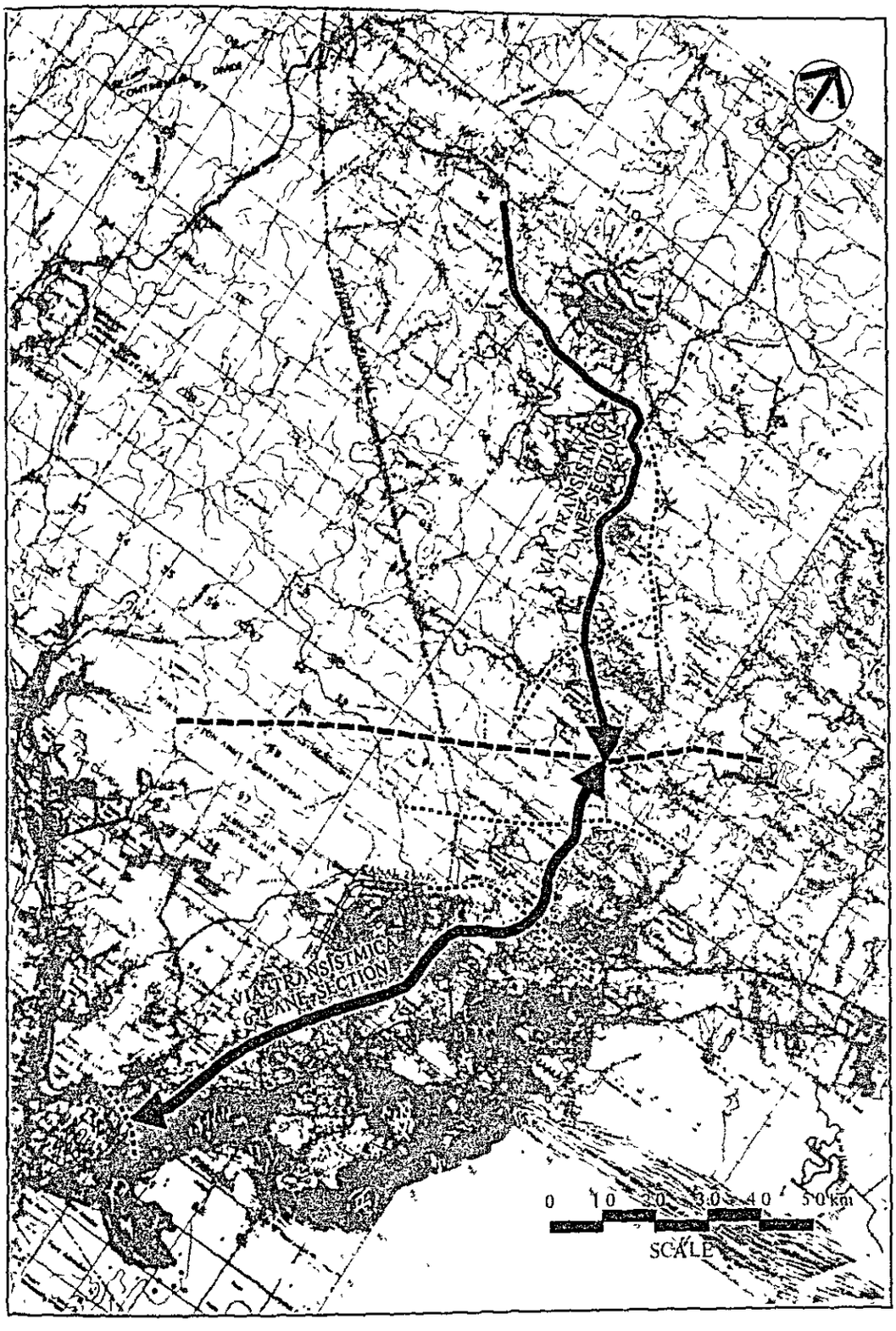


FIG. 11-14 LOCATION MAP OF VIA TRANSISTMICA

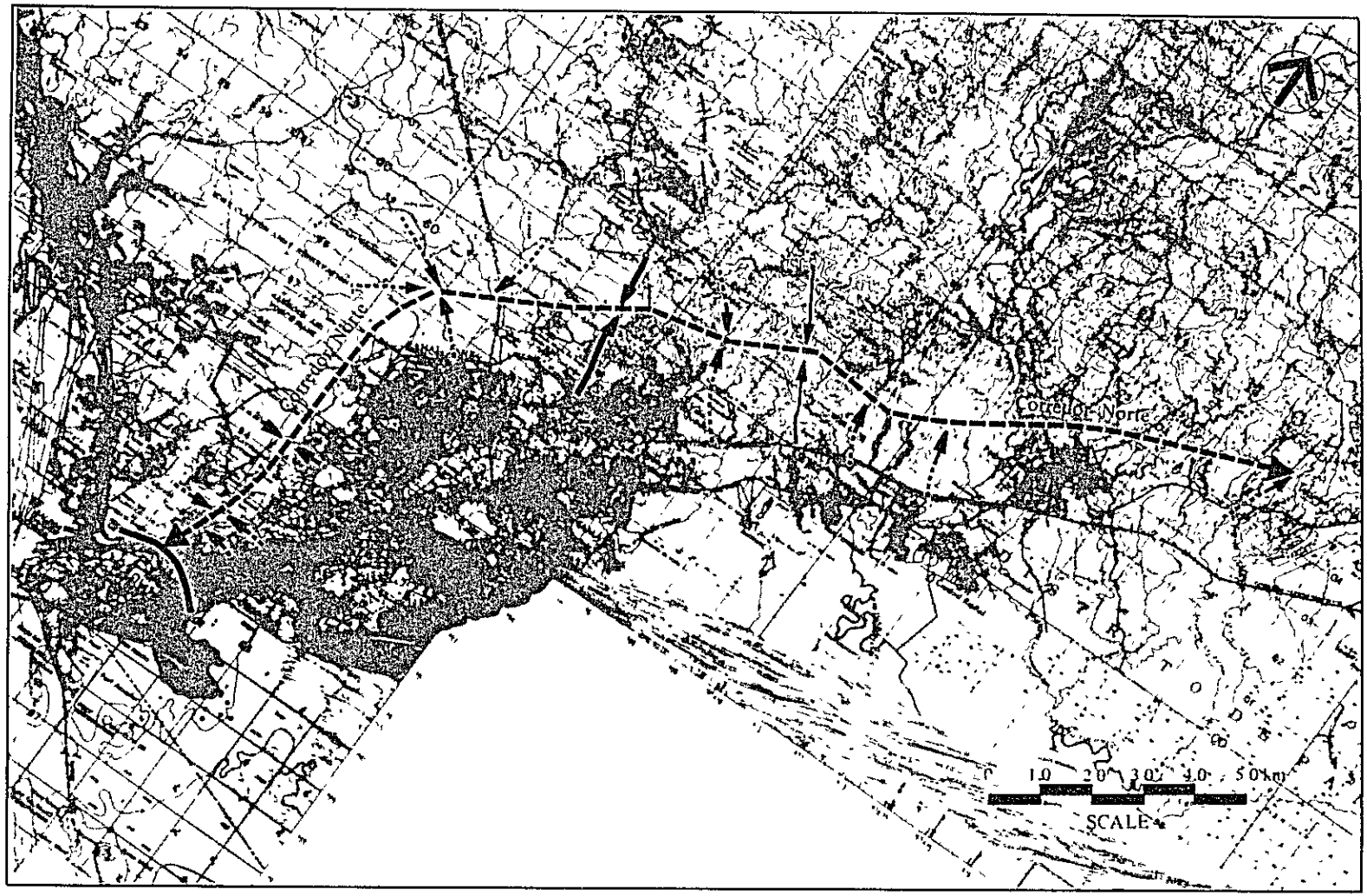


FIG. 11-15 CORREDOR NORTE

As for problems, the first to be mentioned is the difficulty of widening existing streets to become sections of the Corridor. Some of these sections occur in areas where Paitilla Airport and many schools exist or are lined with rows of houses and commercial buildings, and the expansion of streets to 6-lane roads will be difficult. Also, the expansion of sections with roadside trees will have to be accomplished with care so as not to cause any detrimental effects on the environment. The next problem to be discussed is the presence of Panama Viejo, which is currently under restoration work, in the section of Via Cincuentenario. According to the restoration program, the Corridor may not pass through Corregimiento de Panama Viejo but will have to avoid it by detouring either to the shore side or to the inland side. The former detour will require land reclamation work in the coastal waters, which, however, will contradict the Government plan to develop Panama Viejo Ruins as a major tourist spot. Thus, the only solution will be detouring to the inland side, although the route will have to go through some residential areas.

An alternative of constructing a 4-lane road by reclaiming land in the coastal water, instead of the 6-lane road inclduing Ave. Balboa, was considered but abandoned in view of the large amount of construction cost and the impossibility of connecting the route with Via Brasil. (See Fig. 11-16, 17)

(4) Via Cerro Ancon

This new arterial road will be a 6-lane road playing an important role gathering traffic from three east-west axes (Corredor Norte, Via Transistmica, and Ave. Balboa) at the western part of Panama Urban Area and distributing it onto other arterial streets. This road is the extension of Gaillard Road, which leads to Autopista, meets with Ave. de los Martires, which leads to the Puente de Las Americas, and interests with Ave. Central and Ave. Peru and, as such, is the most important of the north-south axes. In Centro Zone, it will become the main street of El Maranon Redevelopment area and, in view of the Centro Bus Center planned to be established along this road, will be an important bus route. Also, this is the route along railroad is conceived of in a long future.

Proper adjustment and coordination will be necessary with the conceptual plan for El Maranon redevelopment, which is now being formulated without including this road and the bus center.

(5) Ave. A and Ave. B

Several alternatives were proposed for the introduction of an arterial road into Corregimientos de Santa Ana, El Choraillo, San Felipe, where traffic management is difficult due to narrow streets and frequent curb parking and where traffic is barely accommodated by designating many one-way streets.

(i) One alternative was to directly connect Ave. Balboa with Ave. de Los Poetas on the west coast of Corregimiento del Chorillo across Panama Urban Area. Under this alternative, the MIVI redevelopment area could be utilized, but the road would have to go through buildings along Ave. Central——which would be a substantial problem.

(ii) Another alternative was to connect Ave. Balboa with Ave. de los Poetas by reclaiming land in Corregimiento de San Felipe coast and around the point, so as to distribute traffic from this arterial road onto narrow streets. The difficulties of this alternative were that the government, which is preserving Corregimiento de San Felipe as a historical town, would not permit the lateration of the town and that the tip of the point was already would established as a park. The land reclamation, which would substantially change the scenery, was subject to much opposition.

(iii) Still another alternative was to follow the existing pattern by extending Ave. Balboa

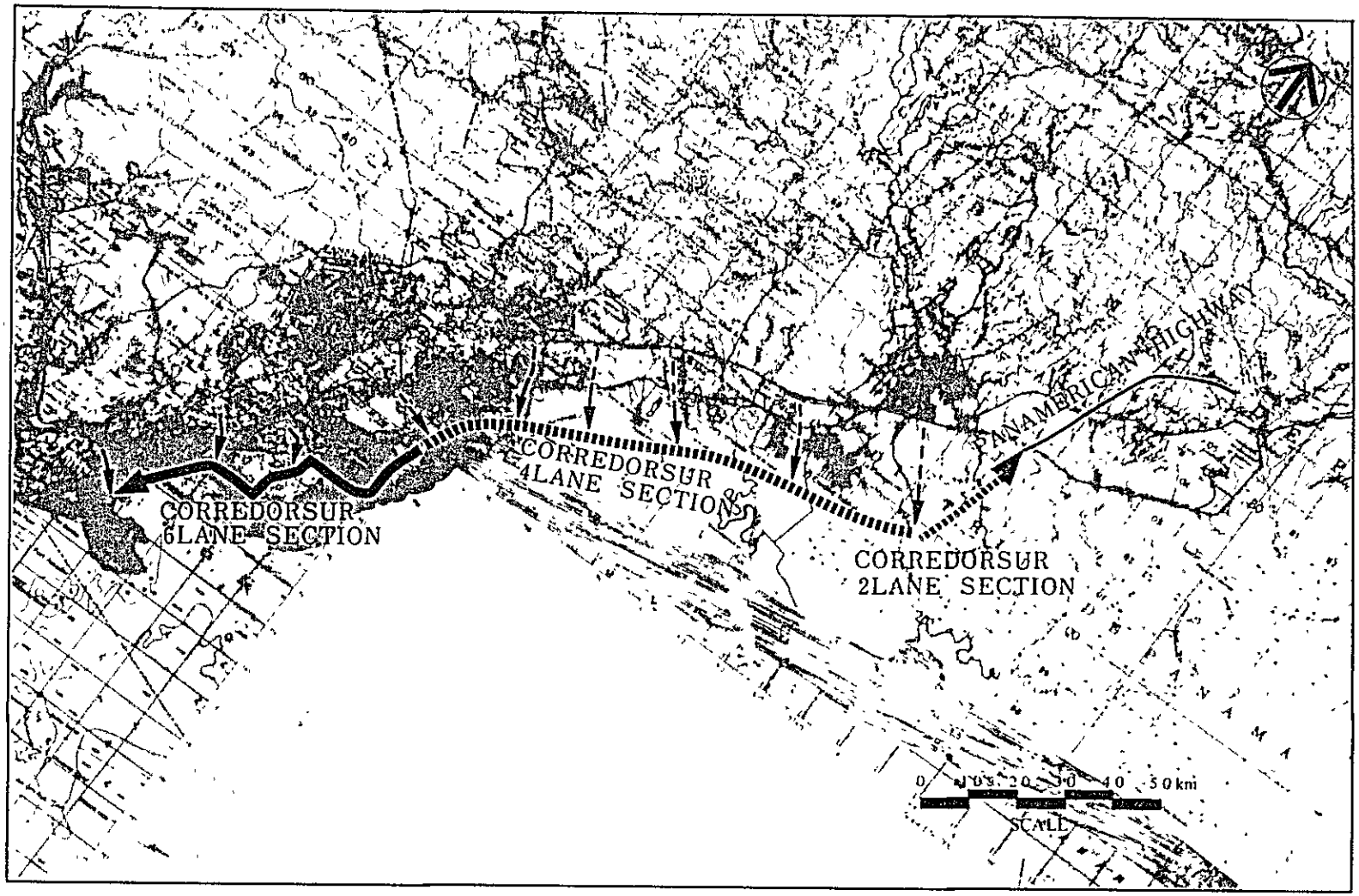


FIG. 11-16 LOCATION MAP OF CORREDOR SUR

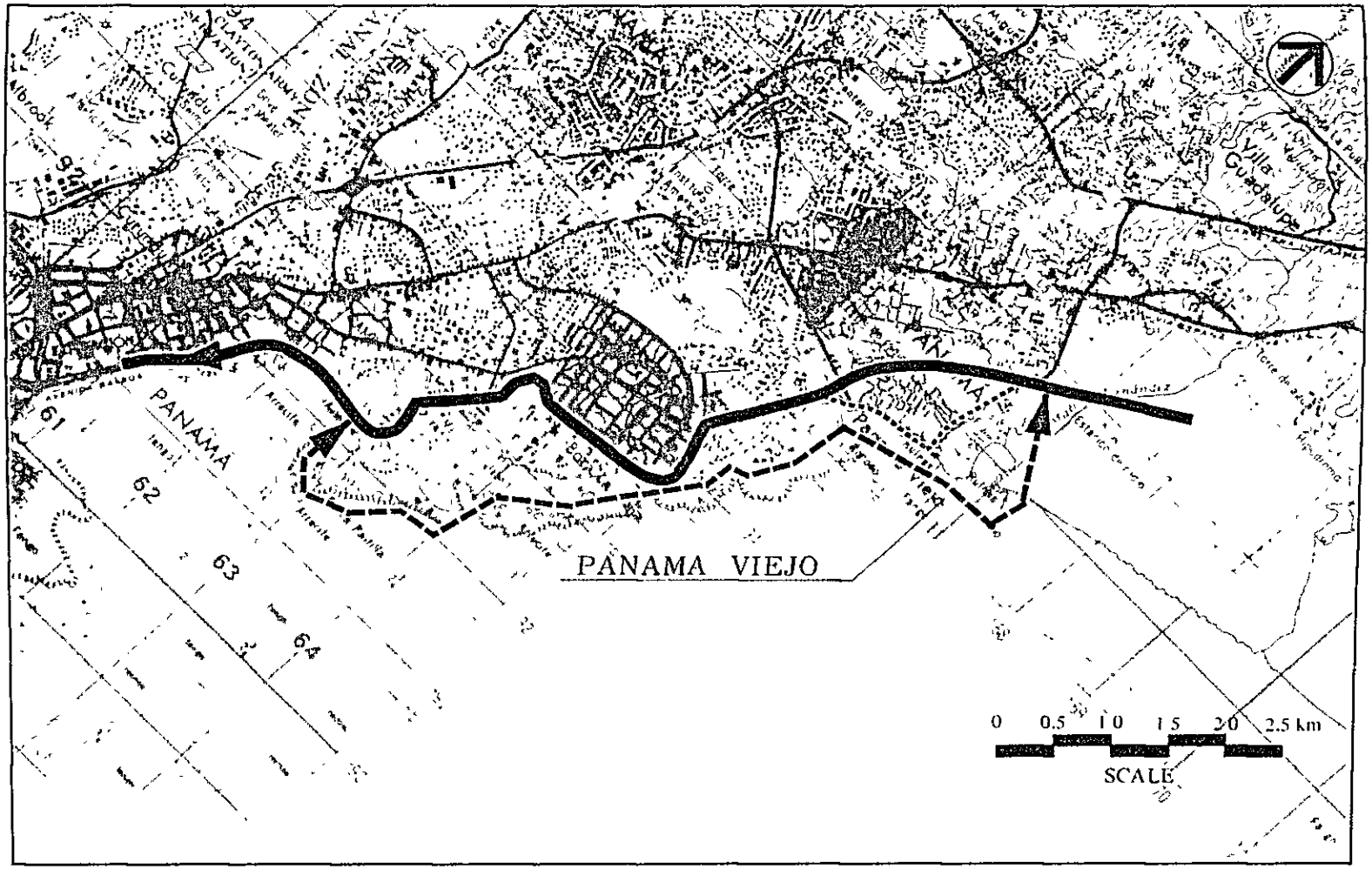


FIG. 11-17 ALTERNATIVE ROUTES OF CORREDOR SUR

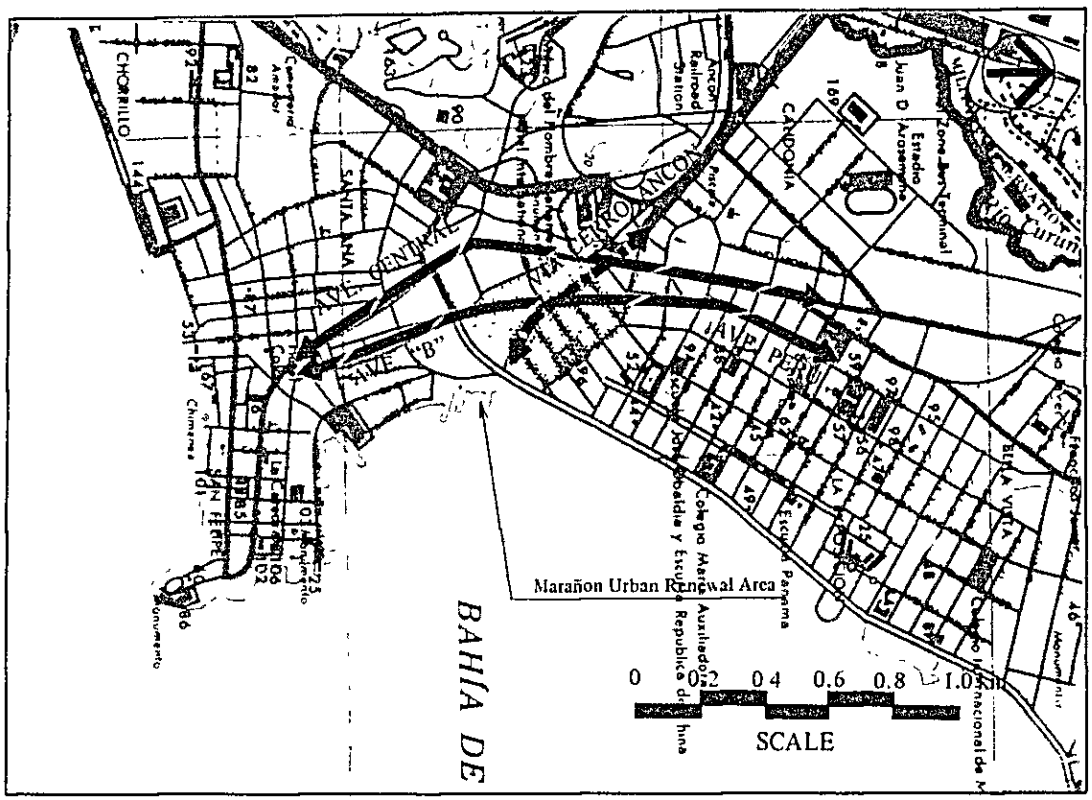


FIG. 11-18 LOCATION MAP OF VIA CERRO ANCON

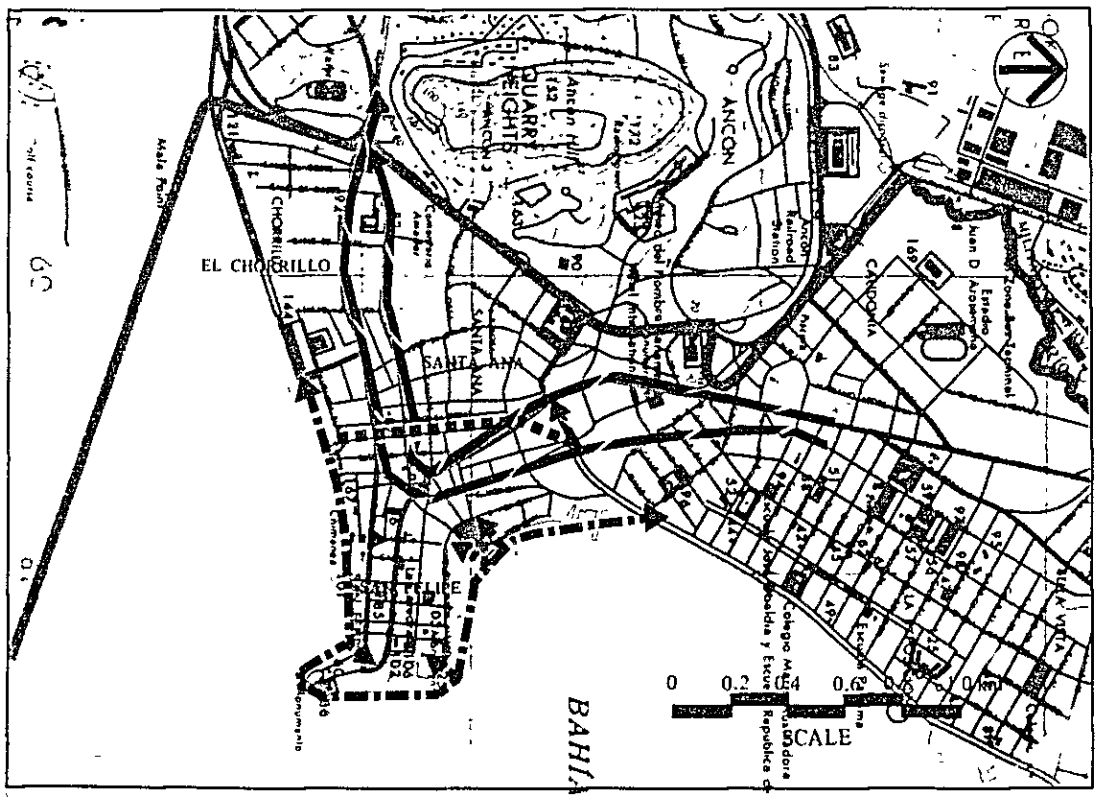


FIG. 11-19 ALTERNATIVE IDEAS FOR INTRODUCTION OF AN ARTERIAL INTO CORREGIMIENTOS SANTA ANA, EL CHORRILLO AND SAN FELIPE

only up to the junction of Calle 17 and Ave. Central, and to have Ave. Central and Ave. B function as arterial streets.

A review of these alternatives in terms of traffic volume revealed that the capacities of Calle F. Ave. Central, and Ave. B were adequate to accommodate the volume of traffic flowing to the west of Corregimientos de Calidonia-Santa Ana border. Therefore, the pattern of the third alternative was selected with the plan that Ave. Peru would be directly connected with Ave. B in El Maranon Redevelopment Area but disconnected with Ave. Central. Also, it was planned that the narrow streets connecting Ave. Central with Calle B and Ave. B with Ave. B would be widened while their alignment would be improved at the same time. (See Fig. 11-19)

4) Plans for Collector and Local Streets

(1) Planning Policy

In addition to arterials, whose network masterplan is as previously discussed and which are the main subject of this study, collector streets and local streets are also important in that they help arterials achieve their functions by providing for the movement of traffic between traffic origins/destinations and the arterials. An organic road network is impossible without the development of both arterials and collector/local streets. Collector and local streets, the "capillaries" of urban traffic, and so deeply connected with daily life and, therefore, their form must be commensurate with the way of land use in the area. Also, their important roles are to enclose the functions which make up town blocks and lots, and the necessary urban spaces.

For these reasons, plans for collector and local streets will be formulated based on an indicator which will represent both vehicle-trip dispersion function and spatial function.

(2) Level-of-Development Indicator

As an indicator which will show the level of development of collector and local streets in each zone, a street development indicator is established as the sum of motor traffic generation and attraction, the total area of streets, and the urbanized area size. This indicator is calculated as follows:

(i) The volume of vehicle-trip generation and attraction in the zone (T) is obtained from the Car O-D Table.

(ii) Average length of trip (Lt) is obtained from the urbanized area (Au) size in each zone, assuming that Au is a circular space and that Lt is the radius of that circle. Then,

$$Lt = \sqrt{\frac{Au}{\pi}}$$

(iii) Therefore, traffic load is expressed by T. Lt (that is, total car trip generation/attraction multiplied by average trip length).

$$T \cdot Lt = T \cdot \sqrt{\frac{Au}{\pi}}$$

(iv) The areal size of collector and local streets (A_{CL}) is obtained by deducting the areal size of arterials from the urbanized area size in the zone.

(v) Assuming that all collector and local streets will have 2-lanes and a width of six

meters, their designed daily traffic capcity (CE) comes to 6,000 PCU/day.

(vi) The total extension of collector and local streets (L cl) is obtained by dividing A_{CL} by six meters, the width of the streets.

(vii) The total capacity o collector and local streets (CT) is obtained by multiplying the traffic capacity at cross-section by the extention of the streets. This value is equal to the areal size of the streets.

$$CT = CE \times Lcl = 6{,}000 \times A_{CL} / 6{,}000 = A_{CL}$$

The values of street development indicator thus calculated for P.T. zones in Panama Urban Area are presented in Table 11-12.

TABLE 11-12 STREET DEVELOPMENT INDICATOR FOR ZONES

Zone	Generated and Attracted Vehicle Trip	Urbanized Area (Km^2)	Collector and Local Street Area (m^2)	Street Development Indicator
01 San Fehpe	18,881	.30	24,223	4.28
02 El Chorrillo	17,872	.50	35,036	4.83
03 Santa Ana	43,493	.80	65,401	3.00
04 Calidonia Sur	34,908	.60	72,602	4.73
05 Calidonia Norte	54,350	1.10	175,840	5.39
06 Curundu	10,494	.50	31,487	7.50
07 La Cresta	37,193	.70	25,498	1.46
08 Urraca-Campo Alegre	44,621	1.20	97,129	3.51
09 Obarrio	29,306	1.10	83,939	4.77
10 El Cangrejo	52,408	1.50	118,593	3.23
11 Punta Paitilla	30,302	1.70	67,740	3.02
12 San Francisco	26,971	2.25	188,935	8.24
13 El Golf	31,462	2.05	59,036	2.32
14 Vista Hermosa	24,942	1.10	61,648	4.12
15 Pueblo Nuevo	21,401	2.00	105,531	6.16
16 Loceria	19,912	1.30	72,035	5.65
17 El Dorado	54,354	4.20	230,158	3.65
18 Betania	41,774	3.50	217,252	4.91
19 Parque Lefevre	69,672	2.70	152,575	2.35
20 Chanis	16,963	2.20	134,408	7.43
21 Rio Abajo	18,650	1.75	119,560	8.55
22 Villa Lorena	10,420	2.05	75,735	8.97

Source : ESTAMPA

The average value of this indicator for zones in Centro and Bella Vista (Integrated Zones I through III) is 4.3, and the indicator is the lowest in Urb. La Cresta (P.O. Zone 07), which is a unique zone with hilly topography and a number of fairly large source of traffic generation such as universities and hospitals. Curundu (P.T. Zone 06) shows a high indicator, due to small volume of traffic generation. Average for zones in Area Residencial (Integrated Zone III) is 5.6, with low indicators shown by Urb. El Golf (P.T. Zone 13), where a wide green area of a former golf course exists, and Corregimiento de Parque Lefevre (P.E. Zone 19), where a large cemetary and Corregimiento de Panama Viejo exist.

Planning values of street development standard indicator will be set for the year 2000, taking

into consideration the condition of land use, street shape, and street ratio. In Panama Urban Area, the value for Central and Bella Vista, which are already built-up and the construction of additional streets will be difficult, is set at 2.0, which is about half the current level. The favorably high indicator level of Area Residencial at the present will not sustainable as traffic will increase, and, therefore, the planning value of the indicator is set at 3.0, about one-half the present value. The value of 3.0 is set for Juan Diaz Pedregal, Tocumen, and San Miguelito, at about half the present level in Area Residencial. The 2000 planning values of street development standard indicator are presented in Table 11-13.

TABLE 11-13 PLANNING VALUE OF STREET DEVELOPMENT STANDARD INDICATOR

Integrated Zone	Planning Value
Centro, Bella Vista	2.0
Area Residencial	3.0
Suburban Area	3.0

Source: ESTAMPA

(3) Development Need

As population increases and urban expansions bring about swellings of traffic volume in the future, collector and local streets will have to be developed accordingly. The additional areal size of such streets that need to be developed by the year 2000 is estimated using the level of development indicator. The total quantity of collector and local streets needed in the year 2000, the present inventory of such streets, and the areal size that need to be developed are listed in Table 11-14.

(4) Street Development Plan

(i) Street Network Formulation

Collector and local streets must be developed in accordance with their positions and must have clearly defined functional roles as integral parts of the street network. In an effort to preserve a desirable living environment, a concept of environmental district is proposed, based on which a fundamental network pattern is formulated as presented in Fig. 11-20.

The environmental district is a residential community surrounded by arterials and collector street without through traffic and is served by internal local streets. As a principle, each collector road is to interface with two arterial streets with intersections which will preclude the entry of long-distance through traffic. Proper coordination should also be made with the service routes of mini and regular buses.

Local streets are to be connected with collector streets as a principle. Local street networks can be of various patterns such as lattice, cul-de-sac and "U" shapes. However, in Panama, the pattern has already been formed using a fairly advanced technique in each unit of urban land for housing development, depending on the topography and the status of land use. Therefore, it is planned that adequate guidance will be provided for the adoption of the most suitable pattern for each urban district to be developed in the future.

TABLE 11-14 NECESSARY LAND AREA NEEDED FOR COLLECTION AND LOCAL STREET IN YEAR 2000

Zone	Generated or Attracted Trip Vehicle Trips (pcu)	Urbanized Area (Km^2)	Standard Indicater	Necessary Collector & Local Streets ($1000m^2$) (A)	Exist. Area of Collector & Local Streets ($1000m^2$) (B)	Deficiency (Development Need) ($1000m^2$) (A–B)
01 San Felipe	16470	0.30	2	10	24	
02 El Chorrillo	24463	0.50	2	20	35	
03 Santa Ana	54232	0.80	2	54	65	
04 Calidonia Sur	45523	0.60	2	41	73	
05 Calidonia Norte	27700	1.10	2	56	176	
06 Curundu	7309	0.50	2	6	31	
07 La Cresta	37345	0.70	2	35	25	10
08 Urraca-Campo Alegre	91144	1.20	2	113	97	16
09 Obarrio	51276	1.10	2	61	84	
10 El Cangrejo	71317	1.50	2	98	119	
11 Punta Paitilla	54201	1.70	3	120	68	53
12 San Francisco	29154	2.25	3	74	189	
13 El Golf	36460	2.05	3	89	59	30
14 Vista Hermosa	28811	1.10	3	51	62	
15 Pueblo Nuevo	30747	2.00	3	74	106	
16 Loceria	19495	1.30	3	37	73	
17 El Dorado	64427	4.20	3	44	230	
18 Betania	44311	3.50	3	141	217	
19 Parque Lefevre	32782	2.70	3	9	153	
20 Chanis	21339	2.20	3	54	134	
21 Rio Abajo	26688	1.75	3	60	120	
22 Villa Lorena	16516	2.05	3	40	76	
23 Hipodromo	44657	9.23	3	229	59	171
24 Juan Diaz	58016	12.06	3	341	237	104
25 Pedregal	55829	15.45	3	372	235	137
26 Nuevo Aeropuerto	9893	7.55	3	46	0	46
27 Tocumen	42206	16.43	3	290	169	121
28 Area de Paraiso	27682	2.90	3	80	104	
29 Ameria Denis de Icasa	20376	3.20	3	62	88	
30 Samaria	21087	4.00	3	71	60	12
31 San Isidro	31953	6.40	3	137	50	87
32 Los Andes No.2	25086	6.28	3	106	49	57
33 La Pulida	65354	10.90	3	365	49	315
34 Cerro Viento	48559	6.03	3	202	122	81

Source : ESTAMPA

(ii) Area Policy for Street Development

How much more streets need to be developed with depend on the character of the area whether it is an urban center, a built-up area, or an area to be newly developed - but it is evident that a large quantity of streets will need to be developed in areas where urban development will advance quickly, and land use will be much changed.

a) Urban Center

In the parts of Centro and Bella Vista Zones where commercial and business activities will increase substantially, adequate streets should be built with proper distribution when urban

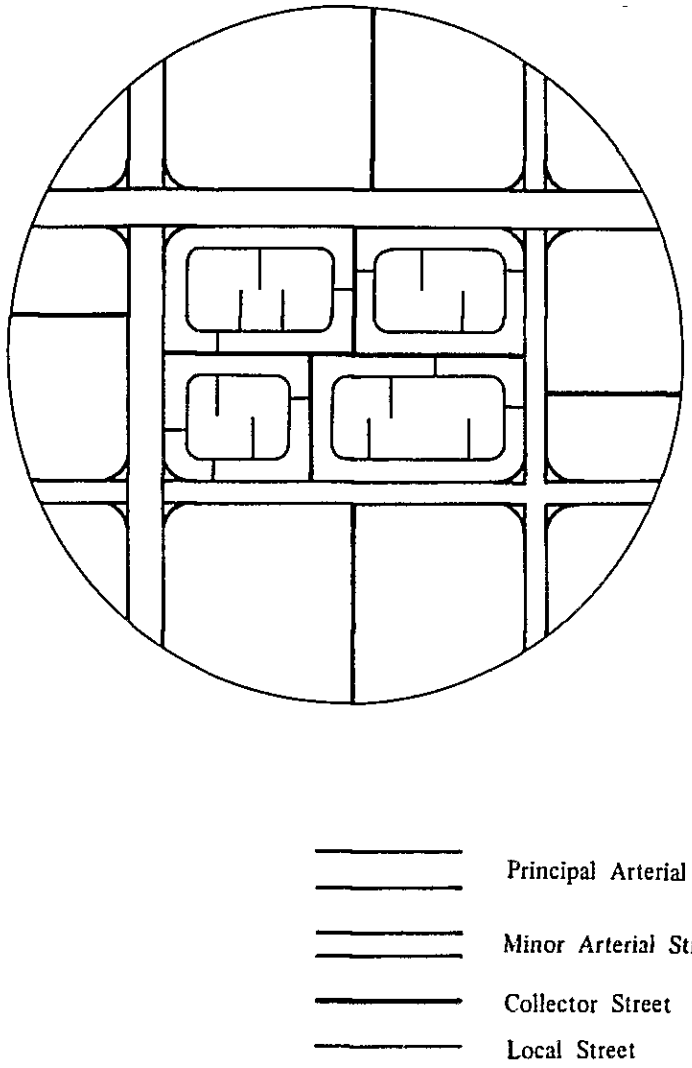


FIG. 11-20 STREET NETWORK PATTERN CONCEPT

development projects and projects for the development of existing vacant lots are to be implemented. An exception will be Urb. La Cresta (P.T. Zone 07), where sufficient road spaces will be secured within the premises of the existing universities and hospitals and no particular streets will be newly installed.

In urban centers, particular care should be used with regard to the followings:

- Pedestrian Street

For commercial districts, it will be important to try to effectuate efficient use of streets by applying various traffic regulations under a traffic management plan, but, at the same time, it will also be important to see if the designation of exclusive pedestrian streets will facilitate pleasant and safe shopping and amusement activities. It will be particularly desirable that pedestrian malls be designated on trial bases in varying fashions from time to time on some of collector and local streets in Corregimientos de Santa Ana and Calidonia so that the details of best malls will be determined and the citizens will be accustomed to the new arrangement.

o Plaza

A number of plazas in the old town of Centro offer a place of relaxation. Along with street development, plazas should also be created, view of the fact that they can be used as a park, as a disaster prevention space, and to accommodate pedestrian traffic. Particularly in Bella Vista, where no suitable plazas presently exist, future urban redevelopment projects should include the establishment of adequate plazas.

o Roadside Trees

Not only arterials but also collector and local streets should have attractive roadside trees in order to create an environment suitable to an international city.

b) Area Residencial Zone

The construction of new streets will be difficult in the built-up parts of Area Residencial. In still remaining vacant parts, however, adequate streets should be installed at the time of their development. In areas which will be used for commercial purposes, streets should be installed at the time of urban redevelopment project implementation.

c) Suburb

With regard to Juan Diaz Pedregal, Tocumen, San Miguelito, and Las Cumbres, where urban development will take place vigorously in the future, it will be essential that proper guidance be provided to parties responsible for development, whether public or private, so that adequate street development will be accomplished at the time of their project implementation. Previously, individual development projects were implemented without coordination between each other in the absence of an arterial network masterplan. However, it is believed that in the future the planning of collector and local streets will be easier than ever due to the presence of a masterplan under which such streets can be developed.

5) **Parking Lot Plans**

(1) Planning Need and Policy

Parking is not a serious problem currently in Panama Urban Area, because parking is possible with a fairly short distance of access in the urban center, due to much practiced curb parking, though often illegal. When parking demand expands as commuting, business, and shopping trips increase in the future, however curb parking, if left alone, will spread to aggravate traffic congestion and lead to frequent traffic accidents. The enforcement of parking restrictions, on the other hand, will, without the development of adequate parking lots, result in a substantial hindrance to urban functions and the deterioration of the area as the capital town and a commercial and financial center.

Nevertheless, the satisfaction of ever increasing demand for parking lots will be limited from the standpoint of effective use of urban spaces. Particularly when carrestrictive traffic policy has been adopted, parking demand should be discouraged accordingly with proper restriction on parking for commuting purpose.

(2) Scope of Planning

(i) A review of the hourly distribution of cars parked, compiled from parking data obtained

through the Person-Trip Survey, reveals that zones can be classified into day zone, where the peak of parking occurs during the day, and night zone, where it occurs at night. The day peak is attributable to parking for the purposes of commuting, business, and so forth, while the night peak is explained by parking after returning home. Of Panama Urban Area, P.T. zones in Centro (Integrated Zone I) and Bella Vista (II), with the exception of Urb. El Cangrejo (P.T. Zone 10), are day zones, while practically all zones of Area Residencial (Zone III) are night zones – a situation corresponding to the current land uses in those zones.

(ii) The field surveys on parking conditions and parking facilities, conducted in Centro and Bella Vista, resulted in the adequate understanding of parking dynamics and the supply of parking spaces.

(iii) A review of the land use plan for the year 2000 clearly shows that Centro and Bella Vista will be the center of urban activities, particularly in view of the expected CBD expansions and job increases.

In view of the above, a parking facility plan is to be formulated for Centro and Bella Vista. Also in view of the fact that these zones are business districts, parking facilities are to be planned only for cars, disregarding any parking demand involving trucks and other modes of transport.

(3) Future Parking Demand Estimate

In order to estimate the quantity of future parking demand, relationship between the present volume of trip attraction in each zone and the number of cars parked in the peak hour is obtained from the Person-Trip Survey data, and relationship between the number of cars parked per day and the number cars parked in the peak hour is obtained.

The former is a linear relationship, almost one to one. The latter, or peak rate, is also linear with the ratio of 34.7%. (See Table 11-15, 16)

TABLE 11-15 EXISTING RELATIONSHIP BETWEEN TRIP AND PARKING

Zone	Attracted Car Trip	Daily Parking (Vehicles)	Peak Hour Parking (Vehicles)
01 San Felipe	3,711	3,458	1,365
02 El Chorrillo	2,877	2,560	967
03 Santa Ana	9,659	8,550	3,424
04 Calidonia Sur	9,046	8,817	3,674
05 Calidonia Norte	17,273	16,270	5,840
06 Curundu	1,929	1,818	948
07 La Cresta	11,743	11,748	4,180
08 Urraca-Campo Alegre	16,833	16,912	5,953
09 Obarrio	10,298	10,571	2,868
10 El Cangrejo	31,474	21,935	6,364
TOTAL	104,843	102,639	35,583

Now, based on the existing relationships discussed above, the future parking demand is estimated from future trip attraction by zone as shown in the Table 11-17.

TABLE 11-16 PEAK HOUR RATIO OF PARKING VEHICLES BY PURPOSE

Purpose	Ratio of Parking to Attracted Trips	Ratio of Peak Hour Parking to Daily Parking
Work	1.131	0.614
School	0.430	0.454
Home	1.050	0.709
Business	1.166	0.359
Shopping	0.940	0.283
Private	0.882	0.200

Source : ESTAMPA

TABLE 11-17 PEAK HOUR DEMAND OF PARKING IN YEAR 2000

Zone	Attracted Vehicle Trips	Peak Hour Demand of Parking
01 San Felipe	4,354	1,494
02 El Chorrillo	7,294	2,503
03 Santa Ana	17,074	5,860
04 Calidonia Sur	14,746	5,061
05 Calidonia Norte	16,116	5,531
06 Curundu	1,828	626
07 La Cresta	13,994	4,803
08 Urraca-Campo Alegre	35,054	12,030
09 Obarrio	18,736	6,430
10 El Cangrejo	28,633	9,826
TOTAL	157,829	54,165

Source . ESTAMPA

(4) Parking Lot Establishment Policy

The total parking demand in Centro and Corregimiento de Bella Vista was indicated as 54,165 cars in the above, which is contrasted against the existing parking capacity (excluding no-parking areas) of 26,409 cars, of which off-street parking capacity is 23,002. The creation of additional spaces for about 30,000 cars as needed to satisfy the demand will be quite difficult. The Panamanian building code (Norma de Desarollo para La Ciudad de Panama) defines for each classification of building use. The parking space that must be established and as new buildings are constructed, the stipulated parking spaces will be established accordingly. However, the situation existing in Corregimientos de San Felipe, El Chorrillo, and Santa Ana, which are full of old buildings, is far from this standard.

In this view, it is planned that parking demand for returning home is to be met by obligatory parking spaces, that for commuting by obligatory parking spaces of office buildings and additional spaces privately established by office owners and that for business, shopping, and private purposes by obligatory parking spaces, as a principle, with additional public-established spaces and private parking spaces to be established under the government encouragement policy.

(5) Development Need

Future parking demand for business, shopping, and private purposes in peak hour in each zone is presented in Table 11-18.

TABLE 11-18 PEAK HOUR DEMAND OF PARKING FOR BUSINESS, SHOPPING AND PRIVATE PURPOSE IN YEAR 2000

Zone	Business	Shopping	Private	Total
01 San Felipe	70	116	233	419
02 El Chorrillo	494	145	506	1,145
03 Santa Ana	772	569	1,462	2,803
04 Calidonia Norte	569	477	1,274	2,320
05 Calidonia Norte	533	497	1,264	2,294
06 Curundu	16	27	105	148
07 La Cresta	302	123	902	1,327
08 Urraca-Campo Alegre	1,110	320	3,144	5,574
09 Obarrio	704	98	1,557	059
10 El Cangrejo	640	17	2,058	3,415
TOTAL	5,210	4,789	12,505	22,504

Source: ESTAMPA

Against the above total quantity of future demand, the total quantity of future supply is calculated as the total of existing parking spaces and the quantity of obligatory parking spaces to be established in the future, estimated at the rate of one parking lot per 10 employees.

In view of the frequently practiced illegal curb parking, parking restriction is to be strictly enforced in order to promote respect for traffic regulations. Then, "no parking" areas which are designated presently on principal arterials, will be gradually extended to minor arterials and collector and local streets in areas where street ratio is low, so as to eliminate curb parking from the congested streets. Thus, the existing curb parking spaces are calculated at 50% capacity with the exception of areas where parking meters are installed.

The quantities of obligatory parking spaces and curb parking spaces are compared against the above future demand quantity, in arriving at the quantity of parking spaces that need to be developed (see Table 11-19).

TABLE 11-19 PARKING SPACE DEVELOPMENT NEED IN YEAR 2000

Zone	Demand for Parking*	Obligatory Parking Lot	Curb Parking Lot	Total Parking Capacity (B)	Development Need (B–A)
01 San Felipe	419	602	118	720	
02 El Chorrillo	1,145	782	90	872	273
03 Santa Ana	2,803	2,303	477	2,780	23
04 Calidonia Sur	2,320	1,896	177	2,073	247
05 Calidonia Norte	2,294	2,128	956	3,084	
06 Curundu	148	273	60	333	
07 La Cresta	1,327	867	14	881	446
08 Urraca-Campo Alegre	5,574	3,243	179	3,067	2,507
09 Obarrio	3,059	1,816	40	1,856	1,203
10 El Cangrejo	3,415	3,502	235	3,737	

Note: *See Table 11-21
Source: ESTAMPA

Now, El Chorrillo (P.T. Zone 02), Calidonia Sur (04), Urb. La Cresta (07), Parque Urroca-Urb. Campo Alegre (08), and Urb. Obarrio (09), where the quantity of parking space that need to be developed is particularly large, are to be designated as the Urban Parking Space Development Area, where parking space development will be accomplished with top priority (see Fig. 11-21)

The following policy measures should be considered for the facilitation of parking space development in said Parking Sapce Development Area:

a) A subsidy and/or tax incentives (reduction/waiver of income and/or fixed property taxes) for commercial parking space operations.

b) Easement of floor space ratio requirement for private parking buildings.

c) Imposition of heavier taxes on non-utilized land.

d) Preferential development of public parking spaces.

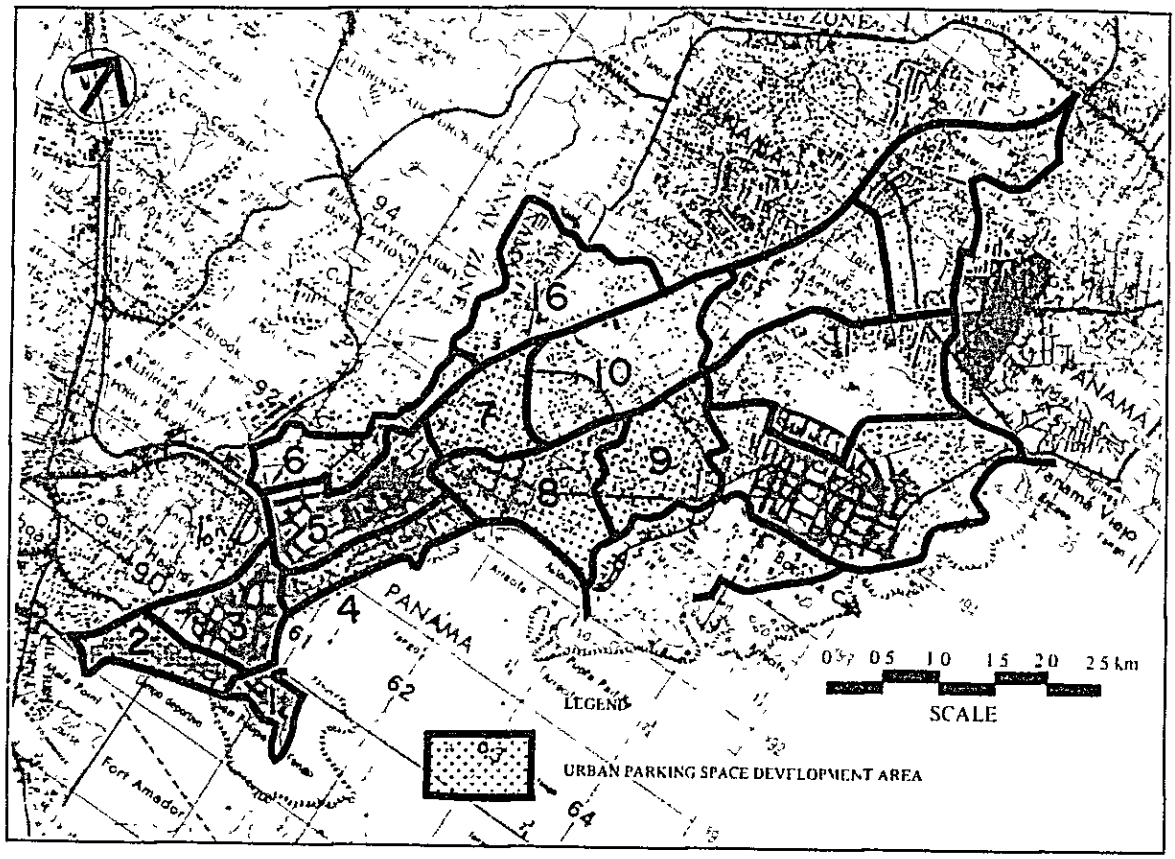


FIG. 11-21 URBAN PARKING SPACE DEVELOPMENT AREAS

6) Traffic Management Plan

(1) Need and Direction of Plan

As previously pointed out, the inadequate road capacity seen in some localities is only a minor cause of the existing traffic congestion. The major cause is presumed to be the lack of well-developed traffic management facilities. Short-term counter-measure objectives are listed below; the development of traffic facilities is believed to be the most effective measure.

a. The accomplishment of a smooth traffic flow, thereby mitigating traffic congestion.

b. The reduction of traffic accidents.

In order to accomplish these objectives, a signal control plan, an intersection improvement

plan, a safety facilities plan, and a traffic regulations plan were reviewed in the light of the previously discussed traffic problems.

The present Planning process aims at the development chiefly of basic short-term plans, but the signal plan must be developed based on the future road network plan, the implementation of which will be subject to detailed surveys in the future.

(i) Signal Control Plan

a) Basic Policy

This plan chiefly aims at the installation of new traffic signals at intersections for the purpose of controlling motor and pedestrain traffic, thereby preventing traffic accidents, and at the improvement of existing signals.

b) Plan Conditions

Subject to the signal control plan will be the signaled intersections which were recognized as traffic bottlenecks through the analysis of present status, as well as non-signaled intersections where the volume of merging and/or branching traffic is large or where traffic accidents occur frequently.

The type of traffic signal, whether pretimed or traffic-actuated, will be decided for each of the subject intersections depending on the volume of traffic on the main and subordinate roads and on the pattern of traffic fluctuations. For coordination of signals, the type, whether simple or automatic, will be decided based on the intervals of signaled intersections, road width, traffic regulations, and other road facility conditions on the main road.

c) Control Systems

o Independent Control

The main and subordinate roads at the bottleneck intersections are classified (Fig. 11-22) by hourly traffic fluctuation pattern. The control system most suited to the particular pattern will be selected for each intersection: one dial type signal control, multi-dial type coordinated control, semi-traffic-actuated control, or full traffic-actuated control. Intersections where mergin and branching traffic is heavy will be installed with mostly semi- or full traffic-actuated signals in view of the traffic sensors to be installed in the future. Other intersections are not believed to require the precision level of traffic-actuated control and, therefore, will be installed with single offset or multi-offset fixed cycle control signals (See Fig. 11-23, 24).

o Coordinated Conrrol

Coordinated control by traffic actuation will be introduced to routes identified as being suitable to coordinated control based on the conditions of traffic facilities and traffic at the bottleneck intersections. Such routes will be the following four (See Fig. 11-24)::

Via Espana:	About 3.1 kilometers from Via Martin Sosa to La Central
Simon Bolivar:	About 1.4 kilometers from Via R. Arias to Via Fernandez Cordoba

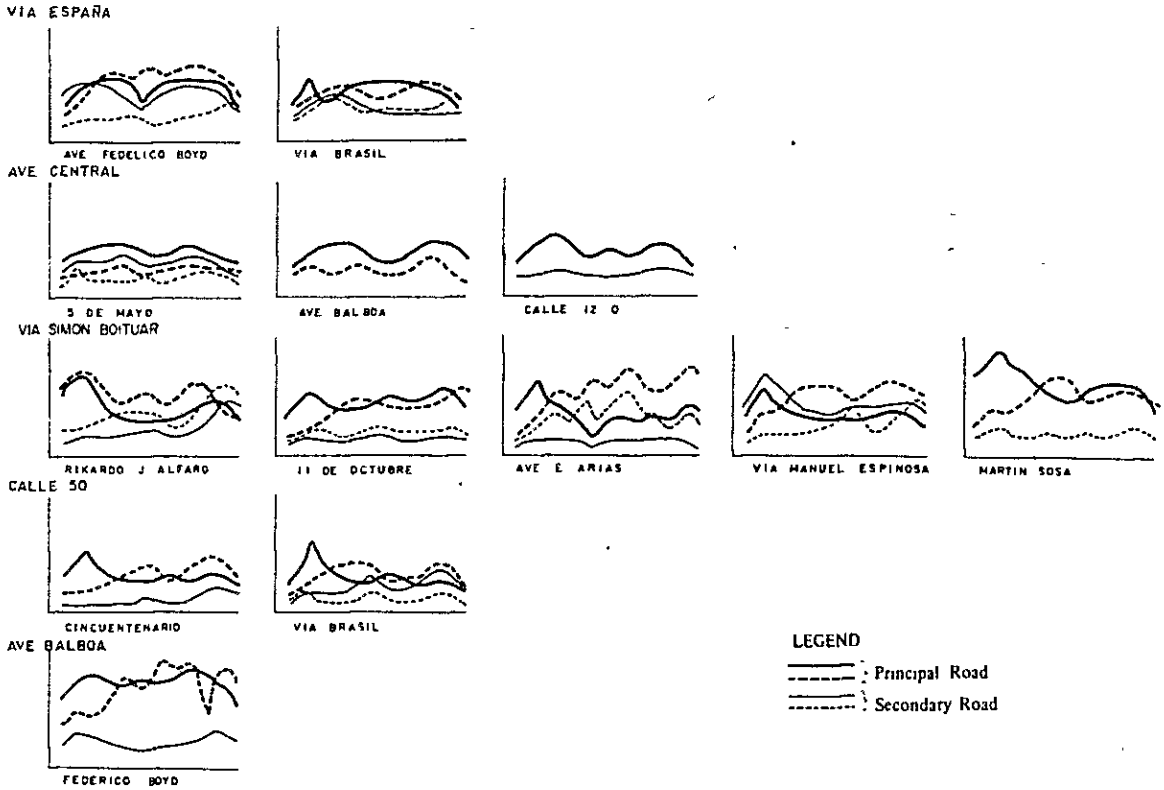


FIG. 11-22 HOURLY VARIATION PATTERN OF TRAFFIC AT BOTTLENECK INTERSECTIONS

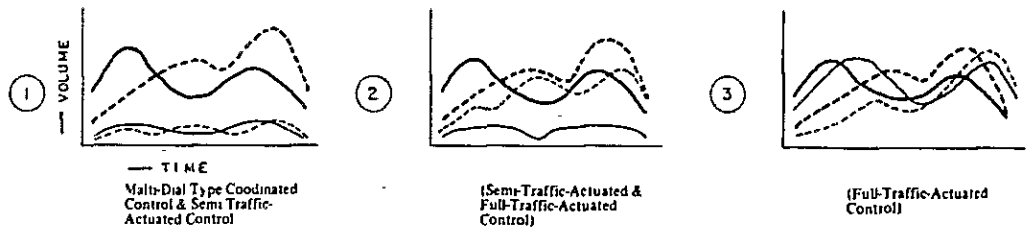
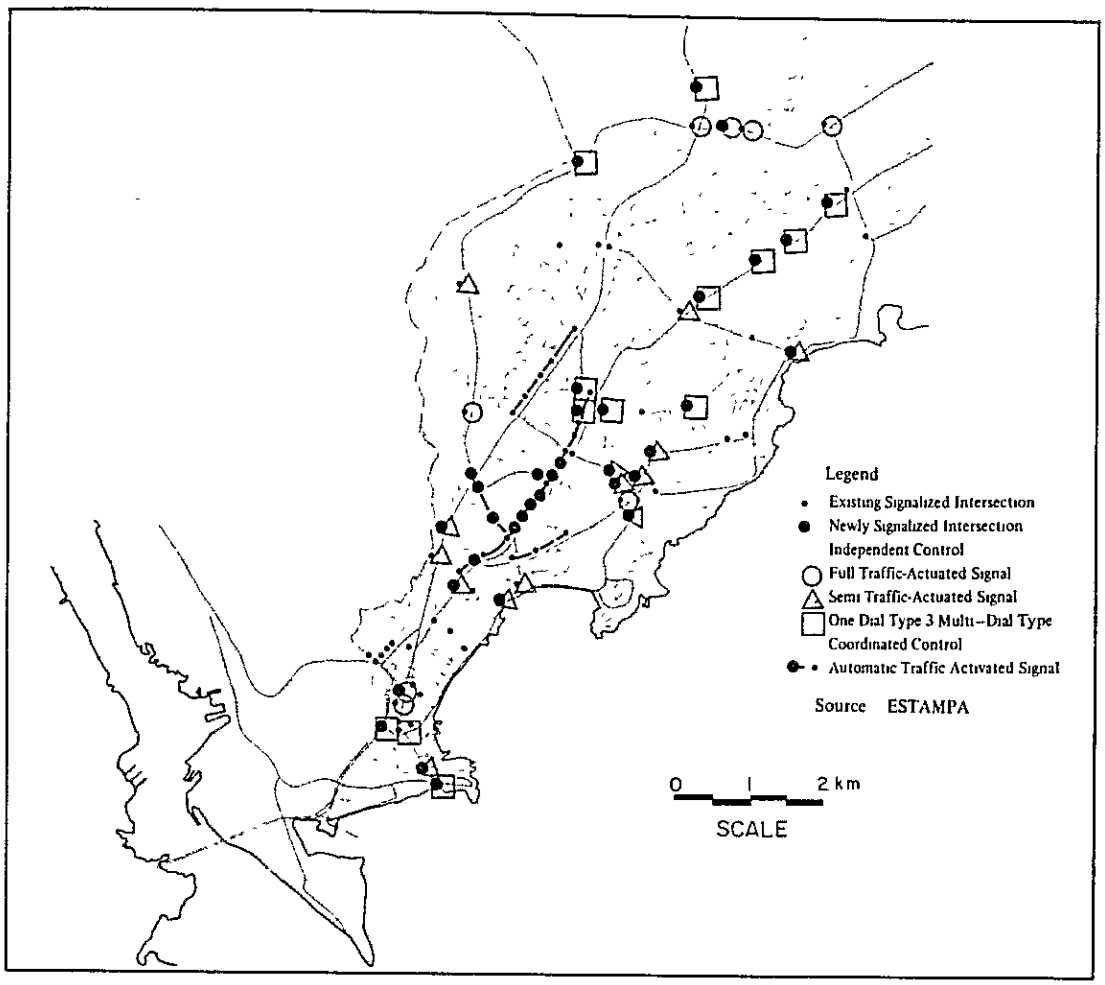


FIG. 11-23 TYPICAL HOURLY VARIATION PATTERNS OF INTERSECTION TRAFFIC

Via Manuel Espiosa Batista:	About 1.0 kilometer from Via Simon Bolivar to Via Espana
Calle 50:	About 0.8 kilometers from Via Federico Boyd to San Jose

d) Description of Control

Independent control will be chiefly accomplished by traffic-actuation capable of automatically selecting the optimum phase schedule using traffic detectors to be installed on each approach. Pretimed signals will use two-phase signal cycles, adjustable for green time on major direction in ac-



FIG' 11-24 TRAFFIC CONTROL SIGNAL PLAN

cordance with traffic fluctuations. Left-turn lanes will be installed at intersections where a large number of vehicles make left-turn. For multi-offset control, phase schedules will be pre-determined for times zones based on a detailed review of traffic fluctuation pattern.

Coordinated control will also be achieved through detector-supported traffic-actuation capable of automatically selecting the optimum phase schedule.

e) Ancillary Facilities

Upon the upgrading of existing and the installation of new signals, plans should be made for the prevention of intersection capacity deterioration and the protection of pedestrians, including the installation of left-turn lanes and safety facilities and road markings.

f) A Long Term Concept of Signal Control

As urban center will expand in the future, traffic and intersection density will become much heavier. In order to direct complicated traffic flow for smooth movement, traffic management tool

will have to be changed from line control to area control. The introduction of new traffic control systems should be best achieved on staged basis. The coverage of area control will be planned for the radius of about five kilometers up to Via Fernandez de Cordoba by 1990 and the radius of about 10 kilometers encircled by Via Ricardo J. Alfaro – Via Domingo Diaz – Via Cincuentenario by 2000. Also, efforts will be made to increase the number of signaled intersections on Via Transistmica, Via Domingo Diaz, and other arterials leading to neighboring cities.

(ii) Intersection Improvement Plan

a) Basic Policy

The purpose of this plan is to mitigate traffic congestion at intersections, thereby securing smooth flow of traffic and preventing or reducing traffic accidents. The intersection improvement plan will include the widening of the approach (additional lanes) and traffic channelization.

b) Planning Condition

Locations subject to this plan will be the signaled intersections regarded as traffic bottlenecks through the analysis of present status and intersections of high traffic accident frequencies. The capacity of each bottleneck is calculated, and in the case of bottlenecks with traffic volume in excess of the calculated capacity, signal phases will be improved and/or the approach will be widened. Also traffic channellization will be effected as revealed necessary through the analysis of traffic accidents.

c) Method and Location Improvement

Locations where signal phases will be improved and where approach will be widened are shown in Fig. 11-25. Signals will be newly installed at 10 intersections, signal phases will be improved for four intersections, and the widening of approach will be accomplished for 10 intersections.

Intersections where channellization is regarded as particularly necessary based on the analysis of traffic accidents and internations whose shape will change due to the widening of approach will be subject to improvement through the channellization shown in Fig. 11-25.

(iii) Traffic Safety Facility Plan

a) Basic Policy

This plan will require facilities for the safety of drivers and pedestrians in order that road functions, including smooth traffic flow, will approach perfection. Traffic safety facilities will include pedestrian crossings, guard fences,road markings, cat's eyes, and delineators.

b) Planning Condition

Subject to this plan are the points where motor and pedestrian traffic mingle to a high degree and, therefore, where vehicles and pedestrians should be properly guided for their smooth flowing.

c) Description of Plan

Pedestrian crossings should be installed near public facilities, bus stops, shopping areas, or other locations where the frequency of traffic accidents is high. Guard rails will be installed on both sides of intersections, pedestrian crossings, and overpasses, as well as on the roadside across from

bus stops. Traffic signs for information, warning, regulation, and direction are all important to traffic management, but the existing road signs are not necessarily sufficient in number. These signs must be increased for the achievement of traffic safety. Road markings will be used to indicate intersections, pedestrian crossings, and center line where median is not installed, as well as for calling attention of the driver, with priority emphasis on sections with a high frequency of traffic accidents. The installation of cat's eyes and delineators will generally follow the road marking plan. Various facilities plans are shown in Fig. 11-26.

(iv) Traffic Regulation Plan

a) Basic Policy

This plan is a supplementary measure for improving the efficiency of signal control and other plans, thereby contributing to the mitigation of traffic congestion and the reduction of traffic accidents. The traffic regulation plan will include parking restrictions and driving restrictions (no left-turn, one-way streets).

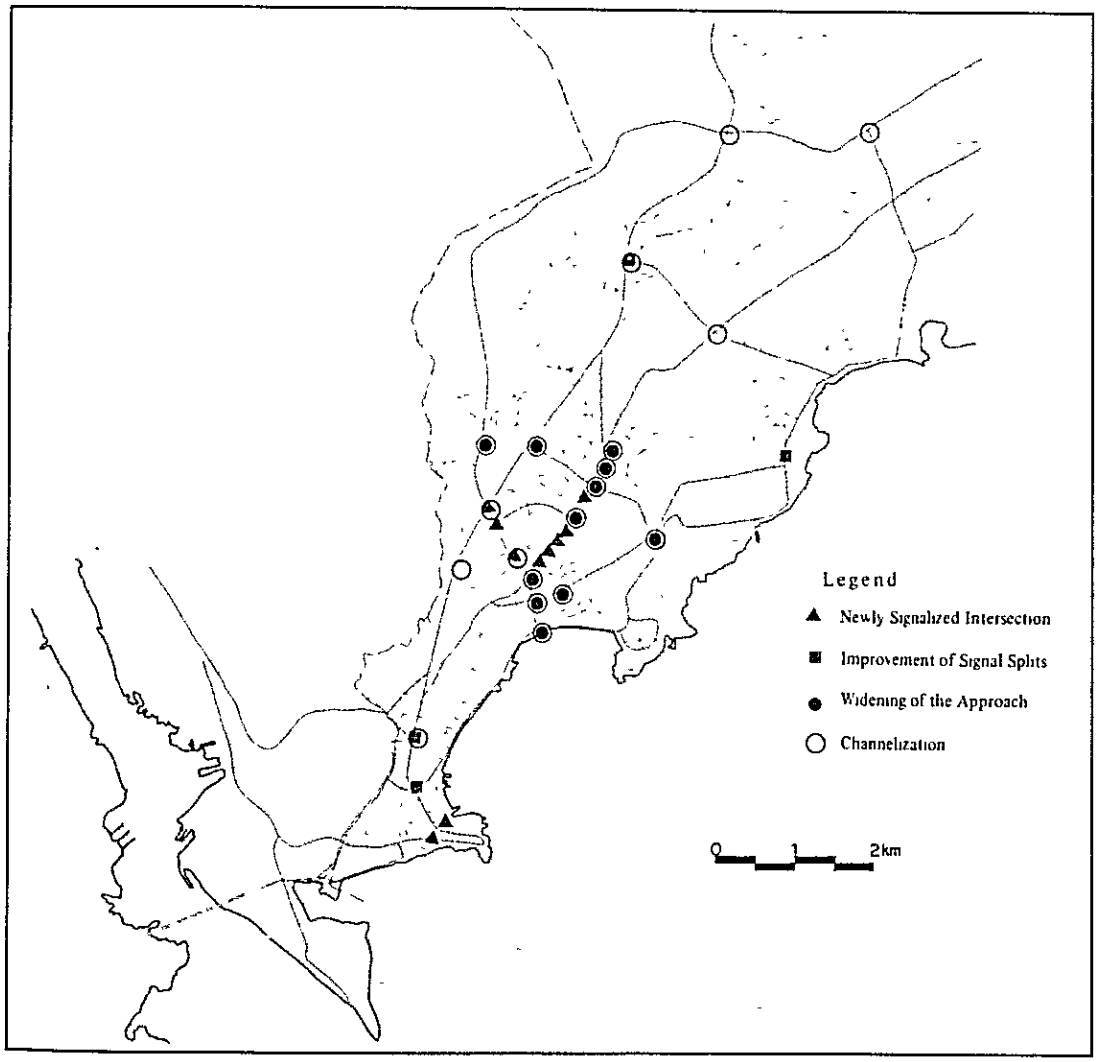


FIG. 11-25 INTERSECTION IMPROVEMENT PLAN

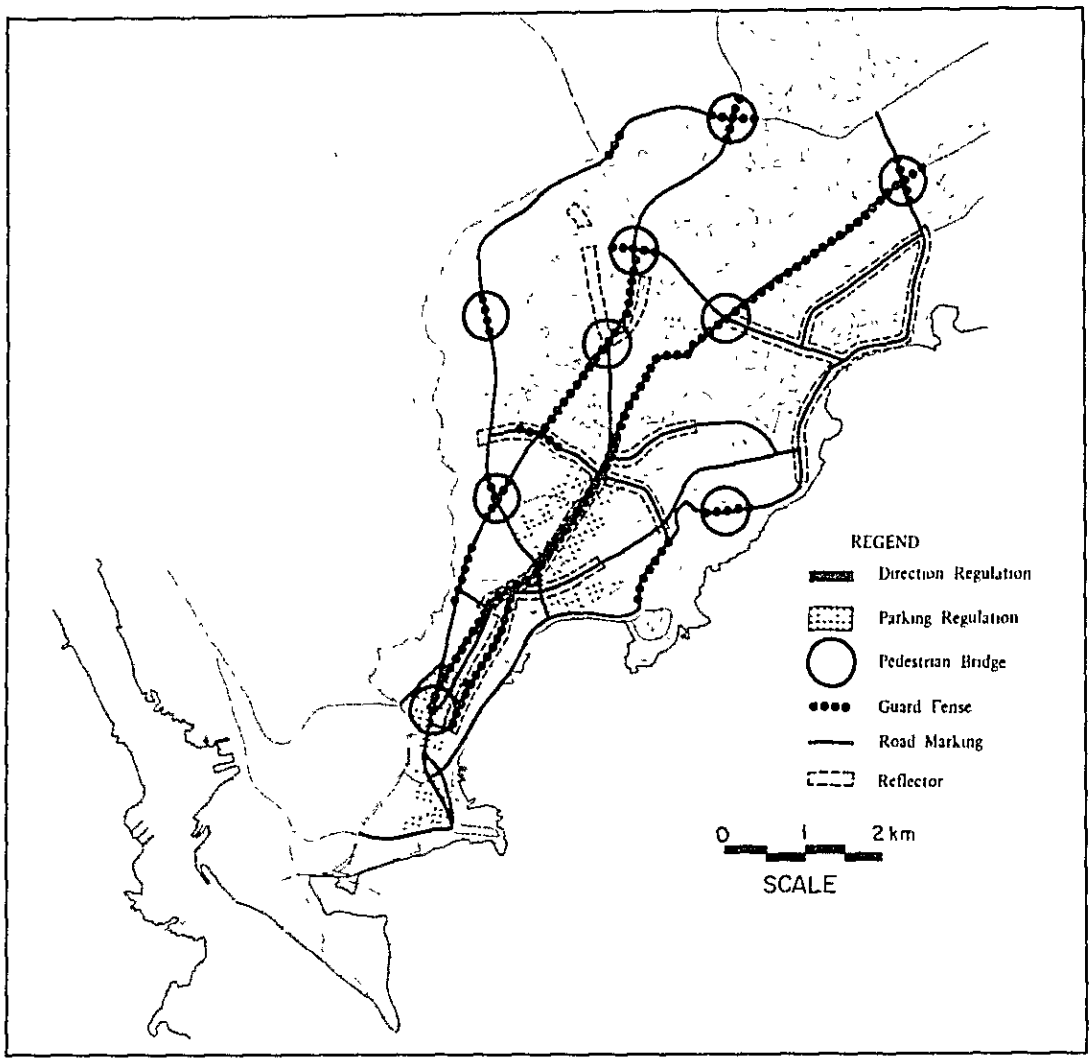


FIG. 11-26 TRAFFIC SAFETY FACILITY PLAN

b) Planning Conditions

Of the congested areas identified from the present status analysis, areas where the curb-parking rate is 50% or more will be subject to parking restriction. Subject to direction restriction will be the narrow arterial sections between major intersections where the number of vehicles turning left is large and where such vehicles are affecting the vehicles to follow them, as well as narrow streets whose capacity can desirably be expanded by designating them as one-way streets.

c) Description of Plan

When an arterial is congested, traffic congestion spreads from the arterial to the access roads connected to it and to the roads competing with it, as traffic diverts from arterial to such roads. Then, it is necessary that curb-parking be controlled lest the capacity of signaled intersection on the access roads be impaired.

The present condition analysis resulted in finding that the limits of walking distance was about 350 meters. Therefore, the area within 350-meter radius from each congested spot is subjected to parking control. Exact locations where parking should be banned should be determined depending

on the nature of road and surrounding situations. Therefore, the designation of individual no parking spots in each parking control area is to be left for future study. Here, parking will be prohibited on all of approaches to access roads connected to an arterial, within 100 meters from each signaled intersection. (See Fig. 11-27).

The prohibition of left-turn should be effected in sections where the number of vehicles turning left has been indicated to be high by the survey of travel time, fully considering traffic flow and road network, and in coordination with the traffic signal control plan. Prohibition of left turn is not to be effected at the existing and new signale controled intersections. One-way street will be designated in Calidonia and Urb. Obarrio, where street networks have been developed in a pattern relatively close to grid. Direction control is mapped in Fig. 11-28.

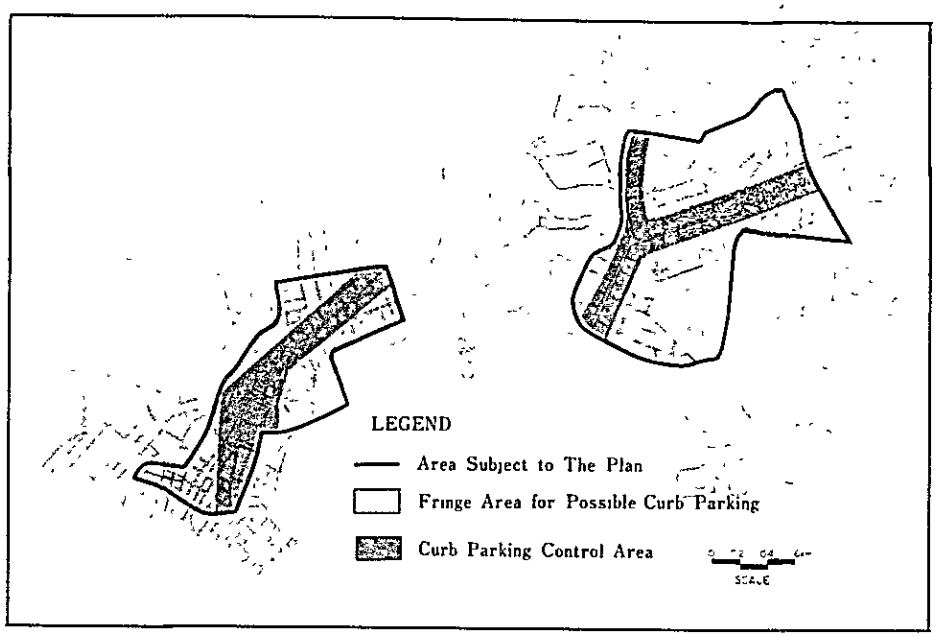


FIG. 11-27 CURB PARKING CONTROL AREA

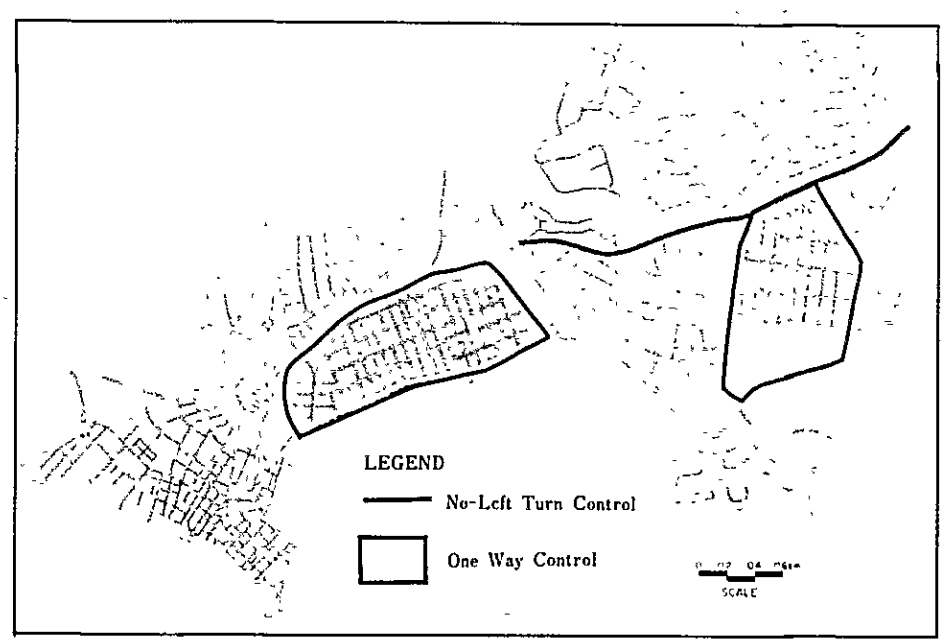


FIG. 11-28 DIRECTION CONTROL AREA

CHAPTER 12.

PUBLIC TRANSPORTATION PLAN

12. PUBLIC TRANSPORTATION PLAN

1) Public Transport Service Development Orientation

The development process of public transport network usually goes through four stages. In the first stage, there is only one urban center, to which all traffic converges. Panama City, with its urban center located at the western corner, presents the pattern of First Stage B, presented in Fig. 12-1.

In the second stage, there are more than one urban center. When all traffic tends to be directly connected with all of these centers, the network presents a complicated pattern, such as that of Second Stage A. In the case of Panama City, the network basically consists of arterials which run through both of the two urban centers, and the pattern is simpler, as illustrated by Second Stage B.

However, because the transport capacity of the bus remains throughout the entire route up to the last urban center at the level corresponding to the maximum demand in Panama Urban Area or in suburban residential area, the oversupply of the capacity is apparent in past Bella Vista.

Such confusive network pattern usually tends to be simplified chiefly at the convenience of the public transport service supplier, who would bring routes serving each residential area only to whichever the nearest of the urban centers and install separate routes to serve between centers. Thus, routes which were previously of same characteristic, are now separated into district groups of urban center routes and feeder routes. This is the third stage.

As the city grows, demand on each route increases and particularly large demands are on inter-center routes. When inter-urban center transport demand grows in excess of the capability of the bus system due to the limited capacities of roads and bus stops, the introduction of a transit system with a greater capability becomes necessary. This is the fourth stage.

The state and stage of Panama City public transport in 1982, 1990, and 1995 are predicted in the below.

In 1982, bus routes from the north and west of Panama City go through the urban center of Bella Vista and reach the urban center of Casco Viejo. It is only the SACA routes from the Canal area and routes from area across the Canal that end at Casco Viejo. As residential areas in the north and west of Panama City have expanded towards the City boundary, on the other hand, the length of bus routes has become long: of the 20 major routes, only five routes are shorter than 17 kilometers, and eight are longer than 24 kilometers. Given the difference in transport demand generation pattern between routes, the following equation expresses relationship between bus route length and profit, assuming that transport service corresponding to 1.42 times the daily demand is supplied by the operation of 60-passenger diesel engine buses and using the cost structure of SICOTRAC and the current fare rates:

$$Y = -0.7895 \ln X + 3.2084 \qquad (R^2 = 0.7788)$$

Where: X : Route length (kilometer)

Y : Sales/Cost

This regression formula shows that sales and cost breaks even at the route length of 16.40 kilometers and that when route is as long as 24 kilometers, sales is only 70% of cost. Thus, it is evident that the length of the existing routes is already too long for bus operation to be profitable. (See Fig. 12-2 for revenue/cost ratios by route lengths.)

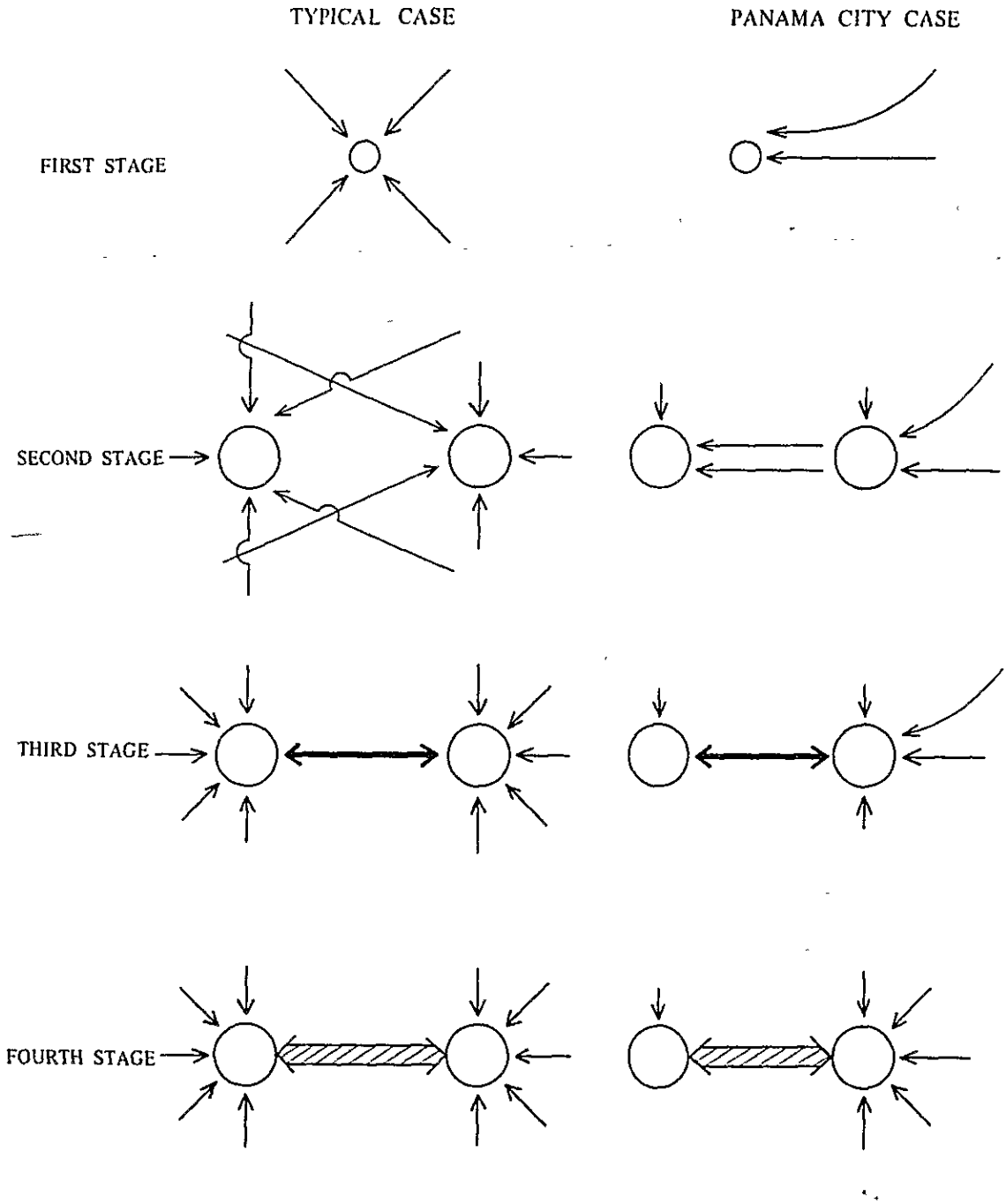
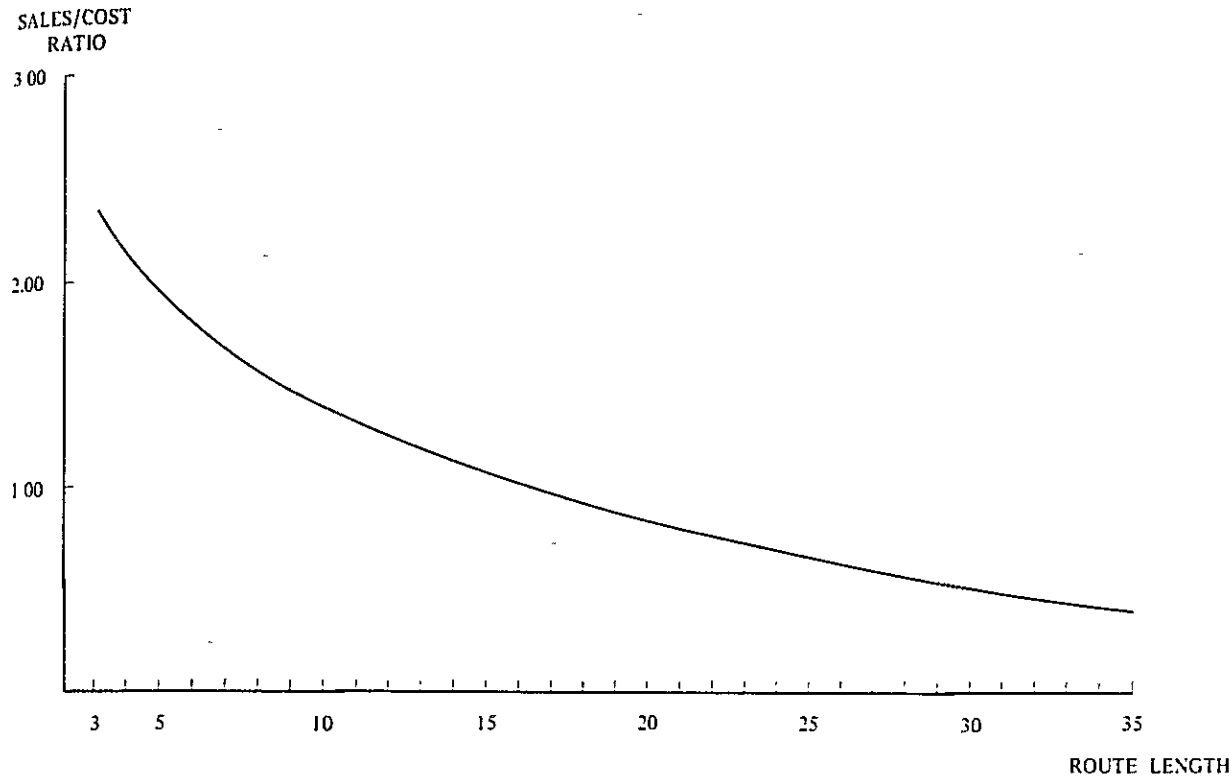


FIG. 12-1 DEVELOPMENT STAGES OF PUBLIC TRANSPORT NETWORK

Although Panama City public transport network is still in the second stage in terms of its pattern, the above observation indicates that it has reached the point of requiring the route segregation of the third stage. The existing bus routes must be divided into shorter routes.

Now that the need of shortening bus routes has been proven by the discussion in the previous paragraph, the state of 1990 is assumed to conform with the optimum 1990 bus route network to be designed later.

It is expected that daily bus traffic on Via Espana will increase from the 1,360 in 1981 to



FIG' 12-2 SALES/COST RATIO FOR BUS SERVICE AND ROUTE LENGTH

2,614 by 1990. If that many buses are to stop on road for passenger embarkation and debarkation, traffic congestion will exceed tolerable limits. The possibility of preventing such situation from occurring by the establishment of bus bays will be discussed in terms of maximum bus transport capability on arterials as qualified by bus bay capacity.

The followings are assumed:

- Each bus bay has n berths
- Bus enters into any vacant berth, regardless of route and destination
- Time required for passenger debarkation and embarkation is 30 seconds
- Time required for the entry and departure of bus to and from a berth is 10 seconds.
- All berths are occupied at all times, that is, whenever a bus leaves a berth a next bus enters into the berth immediately. (See Fig. 12-3).

The hourly capacity of each bus bay (C_n), in terms of the number of buses, is calculated as follows:

$$C_n = 3600 \div (10 + 30/n)$$

Thus, the capacity of a 2-berth bus bay is calculated at 144 buses per hour, that of 3-berth bay, 180 buses per hour, and that of 4-berth bay, 205 buses per hours.

Assuming that 10% of daily traffic occurs in peak hours, the bus pay capacity needed to accommodate for 1981 traffic on Via Espana is 136 buses per hour and that for the 1990 traffic, 261 buses per hour. This means that, while two berths will be sufficient at the present, eight berths will be needed in 1990. Needless to say, this is purely mathematics, given the above assumptions. In congested sections where buses will have difficulty of leaving a berth and joining the flow of traffic, the calculation will have to use a longer time for bus entry and departure from berth, and more berths will be needed than above indicated.

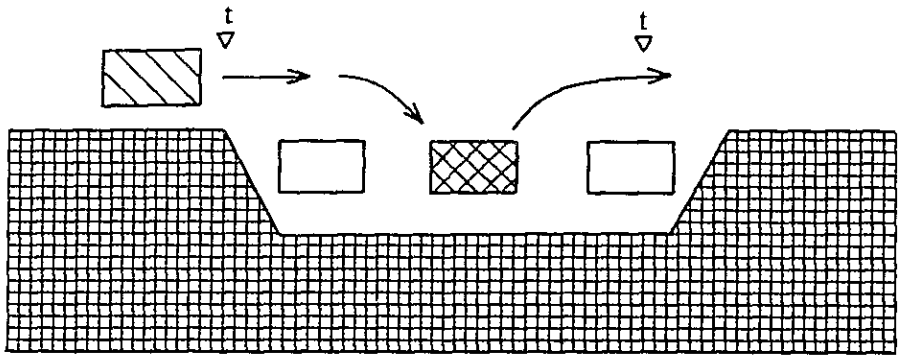


FIG. 12-3 ASSUMED PRACTICE OF BUS BAY USE

Also, to require passengers to watch for and run to the bus that comes into any of the eight berths at random will certainly be unacceptable to passengers. Bus stops will have to be divided into bus bays each with a smaller number of berths for passenger convenience. The 1990 demand will be satisfied by the establishment of two bays per each bus stop, with bus bay capacity of two or three berths.

If transition to the fourth stage is justified by the quantity of public transport demand, that transition may or may not be possible. Transition from the first stage to the second, and from the second to the third, could be accomplished with "software" improvement at a reasonable cost. Transition to the fourth stage, however, is fundamentally a matter of "hardware," and, in the case of Panama City, will require as much as more than 300 million balboas in initial investment only for section between Casco Viejo and San Miguelito. The transition, therefore, will be possible only when such a huge initial investment is justified not only from the standpoint of meeting public transport demand, but also from economic and financial aspects.

If a rail transit is opened for service (and public transport network shifted into the pattern of the fourth stage) in the year 2000 and if the owning and using of cars are discouraged through appropriate policy measures proposed in Chapter 10, motorization will still have progressed to the extent of requiring a total parking capacity of 51.337 cars per hour (peak hour) in Centro and Bella Vista alone. If curb-parking is to be banned in these two zones, a total of 25,530 parking lots will have to be built by 2000, requiring a total land space of 77 hectares at the rate of 30 square meters per lot (assuming surface parking only). After deducing the total capacity of obligatory parking lots to be installed under intensified enforcement, upon the construction of office buildings and apartment houses, a net total of 11,748 parking lots will still have to be built, requiring 35 hectares (see Table 12-1). Demand for such additional parking lots (after deducting obligatory lots) is particularly high in Urraca–Campo Alegre at 4,427 lots, or 13 hectares. If the building of such a great number of parking lots is difficult, efforts for the absorption of car transport demand by public transport

TABLE 12-1 PARKING DEMANDS (YEAR 2000)

Zone	Max parking demand in a peak hour	Shortage of parking lots	Shortage Sans Obligatory Parking lots
SAN FELIPE	1,430	1,033	526
EL CHORRILLO	2,472	2,154	425
SANTA ANA	5,940	4,336	831
CALIDONIA SUR	5,114	3,231	764
CALIDONIA NORTE	5,600	3,499	–
CURUNDU	534	–	–
LA CRESTA	4,848	3,207	2,854
PARQUE URRACA-CAMPO ALEGRE	12,315	7,894	4,427
OBARRIO	6,529	–	1,246
EL CANGREJO	10,038	3,383	635
TOTAL	55,720	25,530	11,748

Source: ESTAMPA

service will have to be made all the more seriously.

Behind the argument for the absorption of car transport demand by public transport service is not only passive factors such as the matter of parking lots but also active factors such as the matter of energy. If transition of demand from car to railroad is achieved to the extent of constituting 20% of total rail transport demand, overall transport energy saving will amount to 4.51 million balboas in 1995 and 5.15 million balboas in 2000. At this rate, cumulative savings during 25 years up to the year 2000 will be 61 million balboas, discounted at the rate of 12% per annum (see Chapter 14 for detail).

The introduction of a rail transit system will be inevitable from the theory of public transport network development stage, and will be desirable from the reasons of parking lots and energy conservation. However, the problem is the huge amount of initial investment needed for the construction of the system. Decision should be made for transition into the fourth stage and the introduction of a rail system when cost has become recoverable by the rail operation net profit. (More on this in sub-chapter 3) below.)

2) Bus Transport Service

(1) Current Problems and Solution

Current problems of bus transport service are, from the standpoint of passenger, inadequate peak hour transport capacity, arbitrariness of bus operation in low-demand hours, and the existence of low service areas and, from the standpoint of bus operators, poor profitability and superannuated bus fleets – as pointed out in Chapter 6. A number of factors are behind these prolbems (see the cause-effect diagram of the current problems presented in Fig. 12-4). That is, the inadequate transport capacities in peak hours and low-demand hours is attributable to the excessive length of routes, the convergence of routes to major arterials, and the lack of ability to achieve appropriate route allocation of buses. The inadequate capacity in certain localities is ascribable to the fact that routes

are established only for shuttle service between residential areas and Centro, in addition to the uneven concentration of routes to arterials. The poor profitability is because of the excessive route lengths, uneven assignment of buses to routes, and high bus maintenance cost.

More fundamental problems are the lack of a system for the indexing of bus fares to the rate of inflation, which leads to poor profitability, and the fact that bus service is achieved in most cases with a rented bus, as well as the lack of operation management system under cooperation of the public and private organizations concerned, which leads to the inadequate transport capacity.

Two approaches are possible for the solution of these problems. One is to reorganize the government and private bodies concerned with, and the system of, bus service operation into modernized ones and to have the new organizations accomplish bus rerouting and the improvement of bus operation management, bus maintenance system, and so forth: The other is to first achieve bus rerouting, in view of its urgency and practicality, followed by the improvement, to the extent necessary, of bus maintenance system, the established of new bus operation entities, and the enhancement of operation management system.

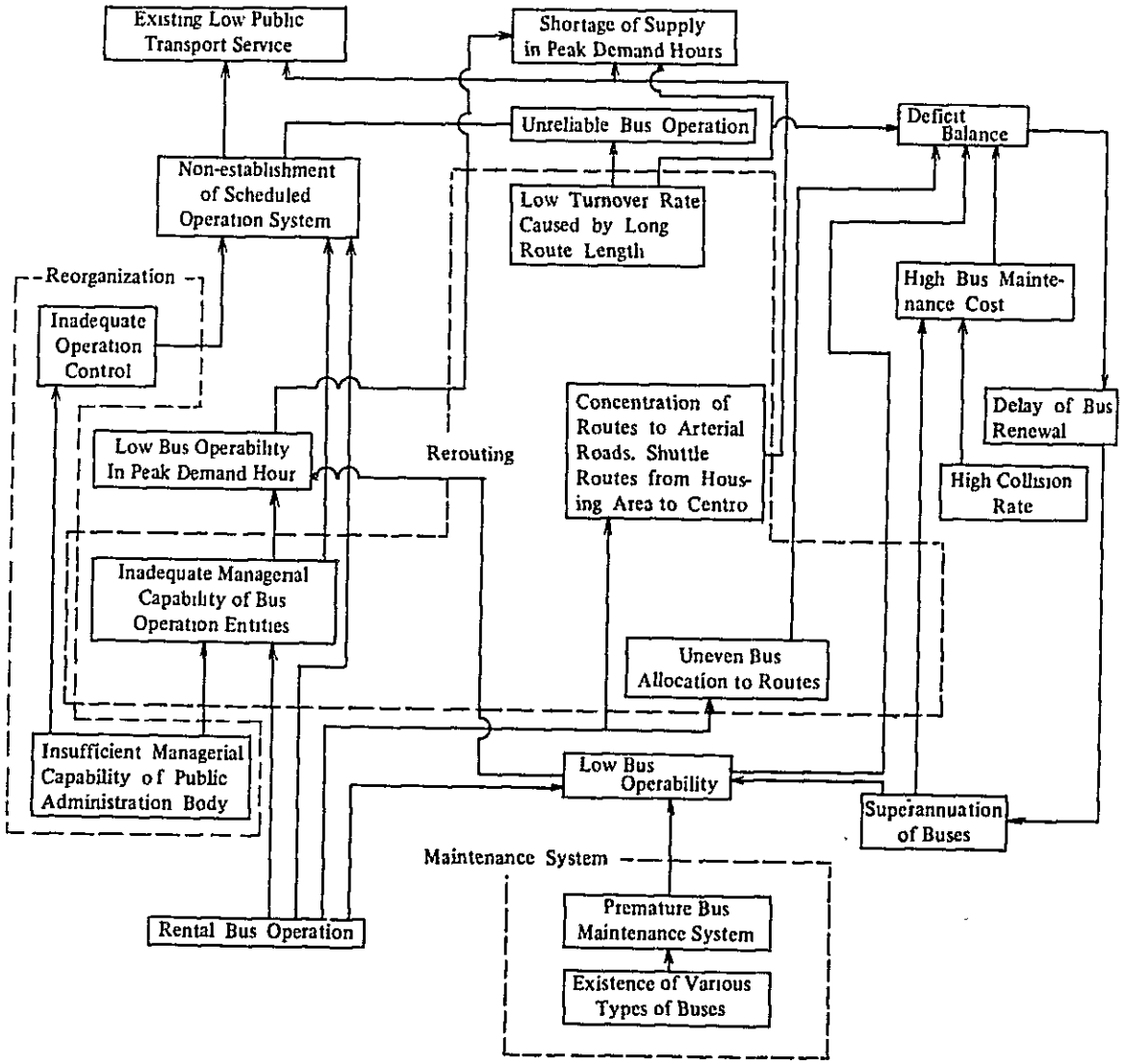


FIG. 12-4 CAUSE-EFFECT DIAGRAM OF THE CURRENT PROBLEMS

The latter approach is adopted here, in view not only of the urgency and practicality, but also of the fact that Panama Metropolitan Area has become too large to be effectively served by a bus network consisting only of shuttle services, and, therefore, the entire route network must be re-organized to conform the urban size.

Again in view of the urgency and the nature of the problems, following discussions will be limited to the target year of 1990 and to the area east of the Panama Canal, where the problems are already present: Centro (I), Bella Vista (II), Area Residencial (III), Juan Diaz-Pedregal (IV), Tocumen (V), San Miguelito (VI), and Las Cumres-Chilibre (VII).

(2) Purpose of Bus Rerouting

(i) Increase in Bus Trips (1990)

The total number of bus trips in the Study Area is predicted to increase to about 600,000 per day in 1990, or about 1.6 times the present.

Bus trips are most concentrated in Centro (I), followed by Area Residencial (III), and, Bella Vista (II). In view of the large land size of Area Residencial, the concentration density is heavy in Centro and Bella Vista, the former attracting about 2.4 times greater trips than the latter at the present, and a reduced 1.7 times in 1990. Although Bella Vista will grow as an urban center faster than will Centro, Centro will still attract 15% greater number of bus trips than will Bella Vista in 1990.

Bus trips O-D (Integrated Zones) table for 1981 is shown in Table 12-2, and that for 1990, in Table 12-3. In 1981, six O-D pairs had a heavy bus traffic of 15,000 or more person-trips (excluding inter-zonal trips): Centro to and from Area Residencial, Centro to and from San Miguelito, and Area Residencial to and from San Miguelito. Those with 10,000 or more person-trips per day were: in addition to the above six, Juan Diaz-Pedregal to and from Centro, from Area Residencial to Juan Diaz-Pedregal, Bella Vista to and from Centro, and Bella Vista to and from Area Residencial. Similarly in 1990, a bus traffic of 15,000 person-trips per day or more will be seen in all combinations of Centro, Bella Vista, Area Residencial, and Juan Diaz-Pedregal with the exception of three pairs: Juan Diaz-Pedregal to and from San Miguelito and from Bella Vista to Juan Diaz-Pedregal. However, pairs with 24,000 person trips per day (which is 1.6 times the 15,000 person trips, in view that overall bus trip is estimated to increase 1.6 times) will still be the same six pairs made up by the combination of Centro, Area Residencial and San Miguelito.

TABLE 12-2 BUS PASSENGERS OD TABLE 1981 BY INTEGRATED ZONE

FROM	TO							
	CENTRO (I)	BELLA VISTA (II)	AREA RESI-DENCIAL (III)	JUAN DIAZ PEDREGAL (IV)	TOCUMEN (V)	SAN MIGUELITO (VI)	LAS CUMBRES (VII)	TOTAL
(I)	27,503	13,430	33,746	12,482	1,854	21,740	4,267	115,022
(II)	13,960	1,863	12,767	5,608	653	9,683	1,570	46,104
(III)	34,070	13,008	34,290	10,222	1,796	18,936	3,308	115,630
(IV)	11,615	5,900	9,327	9,901	1,798	3,258	351	42,150
(V)	1,770	723	1,638	1,984	1,859	1,254	244	9,472
(VI)	20,985	9,850	19,389	3,326	1,406	16,909	2,058	73,923
(VII)	3,903	1,754	3,417	311	272	1,981	4,357	15,995
TOTAL	113,806	46,528	104,574	43,834	9,638	73,761	16,155	408,296

These O-D tables are translated into a desire line diagram in Fig. 12-5 and Fig. 12-6.

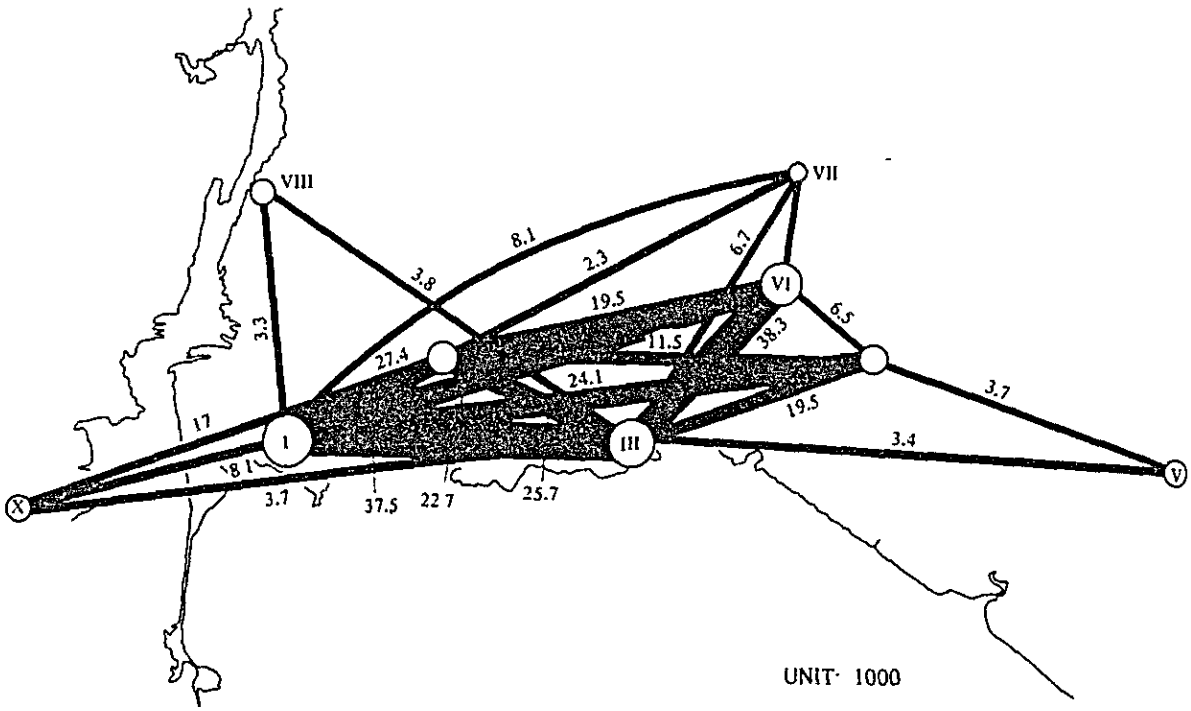


FIG. 12-5 DESIRE LINE OF BUS PASSENGERS, 1981

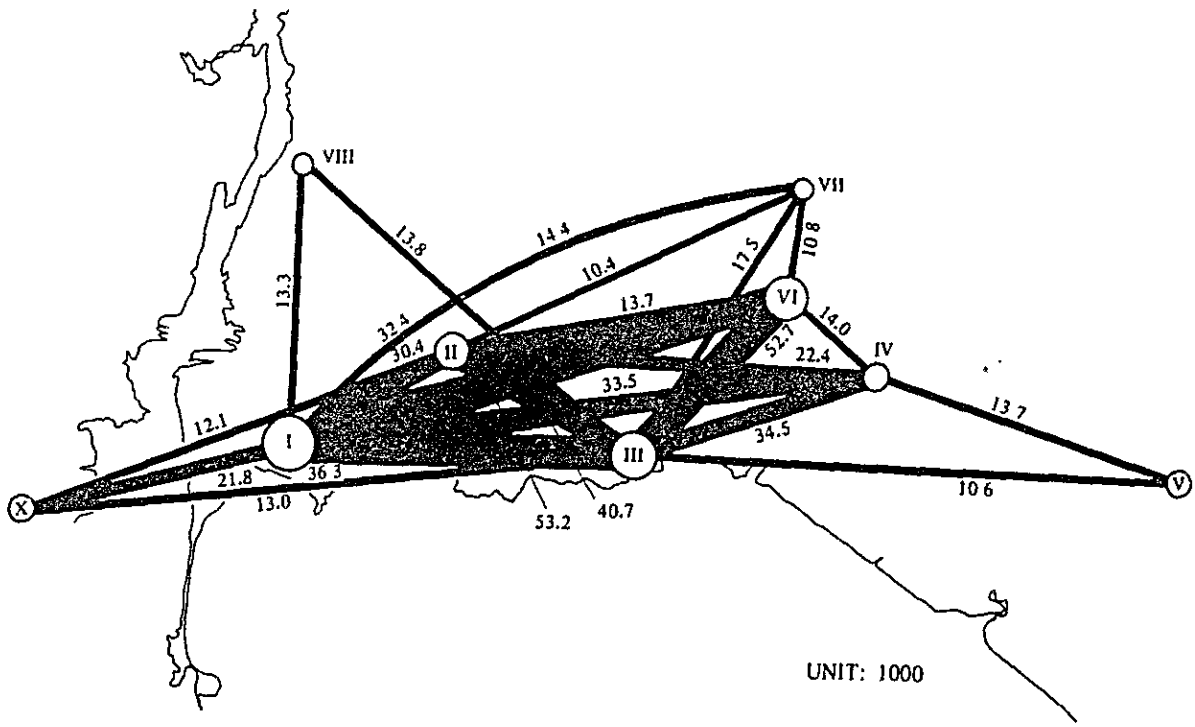


FIG. 12-6 DESIRE LINE OF BUS PASSENGERS, 1990

TABLE 12-3 BUS PASSENGERS OD TABLE 1990 BY INTEGRATED ZONE

FROM	TO							
	CENTRO (I)	BELLA VISTA (II)	AREA RESI-DENCIAL (III)	JUAN DIAZ PEDREGAL (IV)	TOCUMEN (V)	SAN MIGUELITO (VI)	LAS CUMBRES (VII)	TOTAL
(I)	24,475	16,384	36,364	17,509	4,805	26,007	8,061	113,605
(II)	15,996	5,358	18,956	11,489	2,579	15,691	5,996	76,035
(III)	40,013	21,798	47,947	17,021	5,368	25,133	8,647	165,927
(IV)	16,034	10,998	17,504	16,150	7,259	6,920	1,230	76,095
(V)	4,060	2,492	5,295	6,422	4,109	3,243	721	26,362
(VI)	27,262	16,253	27,586	7,127	2,546	23,479	4,987	109,240
(VII)	6,359	4,524	8,892	1,195	656	5,874	8,006	35,506
TOTAL	134,199	77,807	162,933	76,933	27,322	106,347	37,618	622,770

(ii) Features and Problems of Existing Bus Routes

The existing bus routes can be conceived of as those providing shuttle service between suburban residencial areas and Casco Viejo via Plaza 5 de Mayo. This is clear from Fig. 12-7, in which 54 routes are combined into 20 routes for plotting. The number of bus routes becomes greater in the urban area than in the northern and eastern suburban areas, and most of the routes converge onto either Via Transistmica or Via Espana in the vicinity of Bella Vista. After that, all routes lead to Casco Viejo, where they are divided into two: one group of routes turn around at Calle 12 and the other at El Chorrillo and both return to their origins. Therefore, the number of bus routes reaches maximum in the vicinity of Plaza 5 de Mayo, which is an entrance to Casco Viejo.

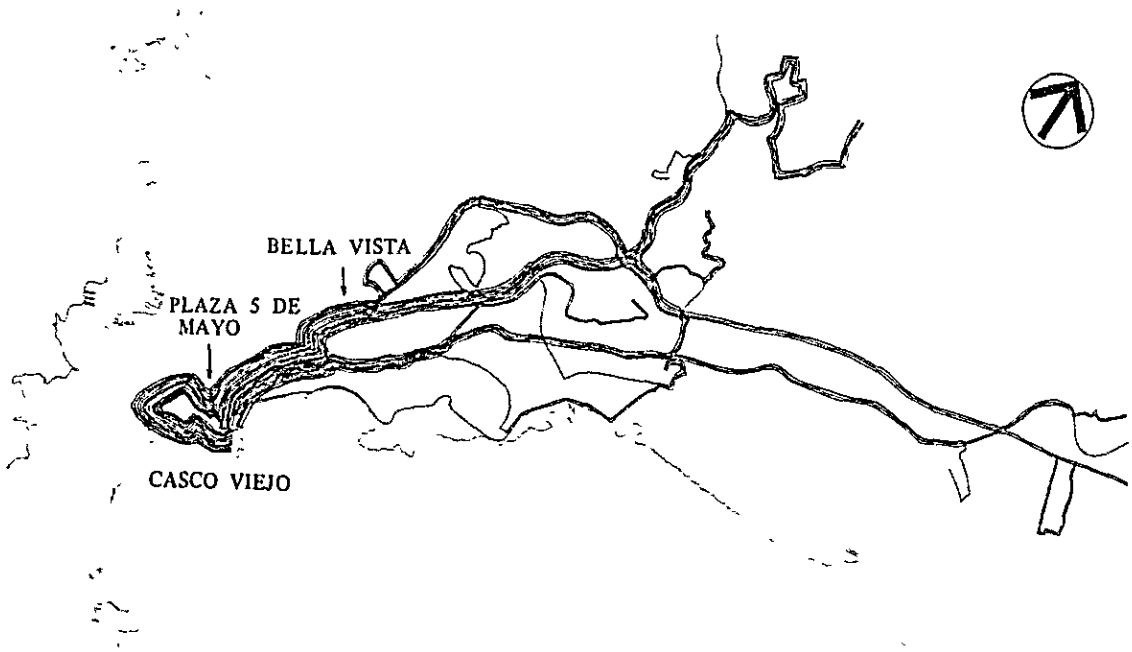


FIG. 12-7 EXISTING BUS NET WORK

The number of passengers also increases as the bus moves from suburban areas to Panama Urban Area and reached maximum between Area Residencial and Bella Vista, after which, it de-

creases slightly, towards Centro. In Centro, the concentration of bus passengers is large in Calidonia and Santa Ana, but only a small number of passengers reach deep into Casco Viejo (that is, El Chorrillo and San Felipe). This pattern will remain unchanged in 1990. (See Fig. 12-8 and Fig. 12-9)

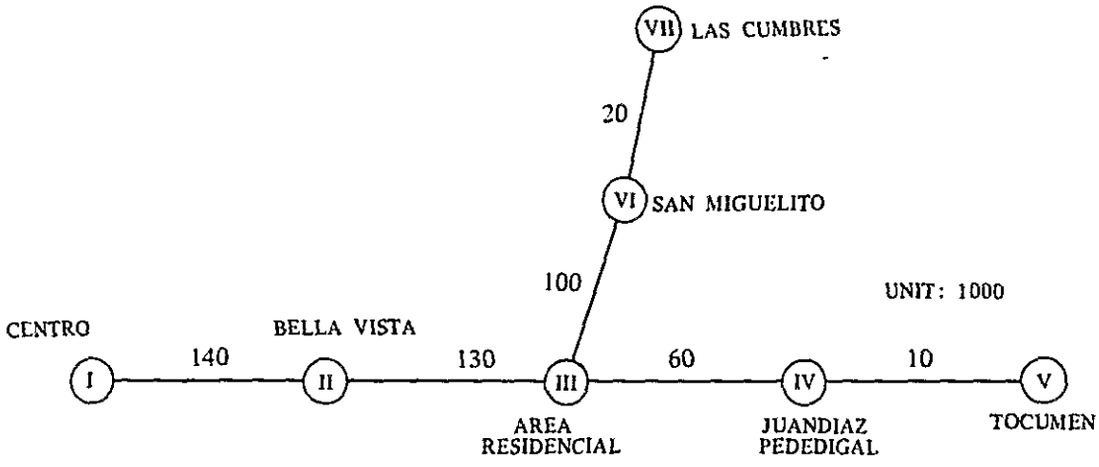


FIG. 12-8 NUMBER OF BUS PASSENGERS IN SECTIONS BETWEEN INTEGRATED ZONES, 1981

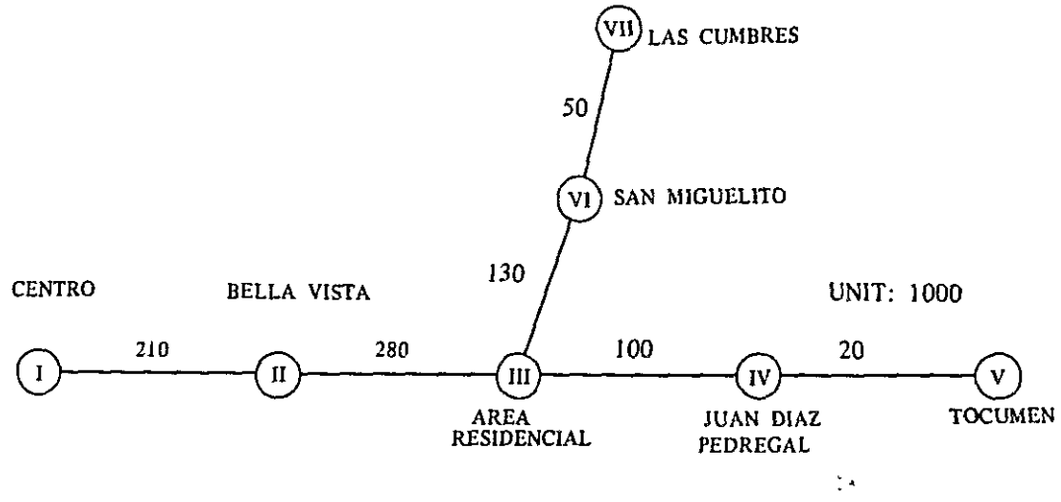


FIG. 12-9 NUMBER OF BUS USERS IN SECTIONS BETWEEN INTEGRATED PT ZONES, 1990

From the above observation of bus routes and passengers, the followings can be pointed out:

o The demand reaches maximum at the middle of bus routes, but bus service enlarges towards the end of routes (urban center), throwing demand and supply out of balance.

o From the same reason, the average congestion ratio of buses should be low from Bella Vista to Plaza 5 de Mayo and even lower in Casco Viejo, but traffic congestion caused by heavy bus

traffic in Centro is one of the most serious traffic problem in the Panama City.

o In 1990, the number of passengers will increase from Area Residencial and from San Miguelito towards Bella Vista. None of the existing routes turns back in Bella Vista.

As the boundary of Panama City has expanded, the bus routes which have all been established for shuttle service between suburban residencial areas and Centro have now come to suffer from the following problems:

o Bus operation cost has increased due to longer route lengths

o One-round operation time has increased also due to the longerr route lengths, which, in turn resulted in lower turn-over ratio, less operational flexibility in peak hours, and longer travel time particularly in the case of long distance passengers.

o Both the quantity and quality of bus service in north-south direction have been left inferior compared with east-west direction.

o Because it is intended that passengers will reach their destinations without transferring buses, the development of passenger transfer facilities has lagged.

(3) Alternative Bus Networks and Evaluation

(i) Items for Consideration

o Introduction of express buses for shorter travel (and operation) time, their routes, terminal points and mid-route bus stops

o Introduction of feeder buses service to Casco Viejo and to Calidonia, and their routes

o Introduction of circular routes in Area Residencial and in Bella Vista

o Abolishment of routes leading into Casco Viejo

o The shortening of routes from Tocumen and Alcalde Diaz, and determination of their terminal points.

o The locations of urban terminal points of medium distance routes from Chanis, Juan Diaz, and parts of San Miguelito, as well as of short distance routes from Rio Abajo, Betania, and Curundu.

o Enhancement of bus routes on Calle 50, Via Porras, and Via Federico Boyd.

o Establishment of north-south routes

o Inter-suburban routes and their terminal points

Additionally needed will be, in relation to the above discussed routes, the determination of intersecting points of passenger flows (location and capacity of passenger transfer facilities), the estimation of capacity of bus maintenance facilities, and the determination as to which bus terminal such facilities should be attached.

(ii) Discussions by Item

In order to arrive at the target of designing a bus route network with optimum route distribution of bus service supply vis-a-vis route demand so as that approximately equal level of profitability will be achieved on every route, the following process was followed.

In preparation, a bus stop O-D table for 1990 was tabulated for the area subject to rerouting, using the 1981 person-trip survey findings. Then, a model was constructed for the assignment of bus trip demand to bus route network considering competition between routes.

Because routes on same road not only compete with, but also supplement each other in facilitating the completion of trips involving transfers, the evaluation of routes can only be accomplished in network, and not individually. Therefore, a network which includes all the above items of consideration is drawn as the first alternative, or the first approximation. In other words, a likely route which will satisfy each item of consideration is proposed, and such proposed routes are structured into a network.

Then, the demand per the 1990 bus stop O-D table is assigned to this network using said assignment model. The result of assignment is reviewed for modification of routes to achieve a greater approximation of the target network, the bus operation in excess of demand in the vicinity of Plaza 5 de Mayo is actually one of the traffic problems facing Panama City.

Express Bus Routes

Proposed routes of express buses, to be introduced for the purpose of achieving reductions in travel (operation) time, are routes from Pedregal, Tocumen, San Isidro, and San Miguelito to Centro or Bella Vista.

Evaluation of the proposed express bus routes (see Table 12-4) indicates that Pedregal – Bella Vista route and San Miguelito – Plaza 5 de Mayo route, which are not so long and follow Via Transistmica, have relatively small time-reduction effects. Tocumen (Pedregal) – Plaza 5 de Mayo route is long enough but the demand is too small to support the express service. Some adjustment between this route and other competing route(s) will be necessary in order that demand for the express service will increase. San Isidro – Bella Vista route has a sufficient demand but sales/co cost ratio is poor, and it will be necessary that reasons for this be looked into and way of improvement sought for.

Proposed express bus routes are shown by solid lines in Fig. 12-10, together with slow bus routes shown by broken lines.

TABLE 12-4 EVALUATION OF EXPRESS SERVICE

Items	Route					
	Tocumen - Pedregal –Centro (1)	Pedregal –Bella Vista (2)	San Isidro –Bella Vista (5)	San Isidro –5 de Mayo (6)	San Miguelito –5 de Mayo A(3)	B(4)
No. of Pax (thousand PSN/Day)	101	323	405	112	412	111
Sales/Cost	0.61	0.86	0.57	0.64	1.17	0.99

Note : Number in parenthesis is corresponded to number indicated routes in Fig. 12-10.
Source : ESTAMPA

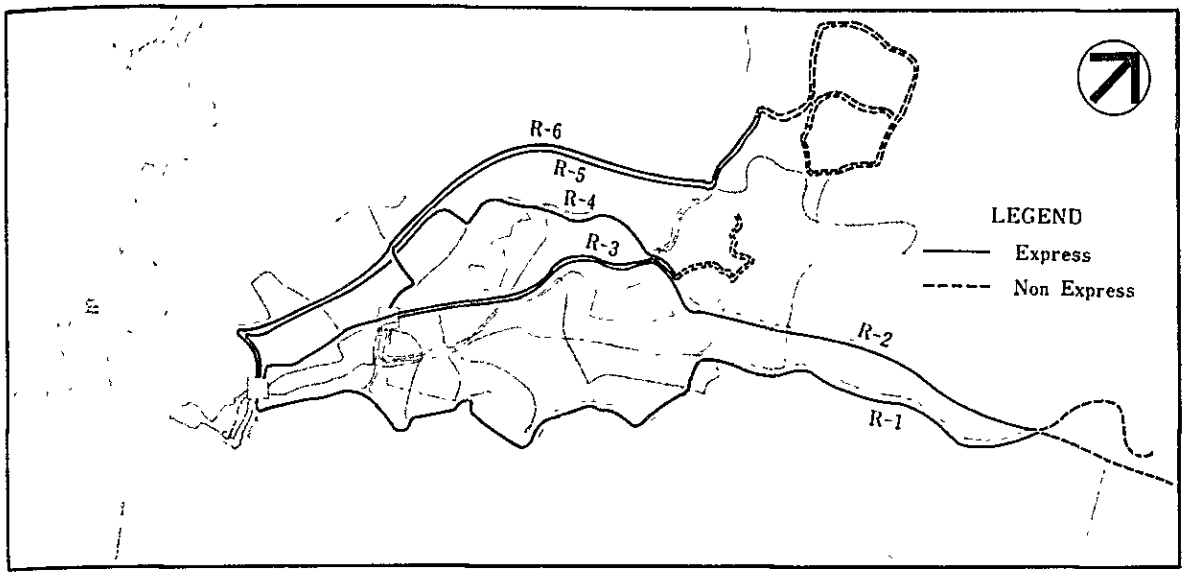


FIG. 12-10 EXPRESS BUS ROUTES REVIEWED

Suburban Bus Routes

Those which belong to the category of suburban bus routes are divided into two groups: those between suburban residential areas and urban bus terminals, and those which connect points in suburban areas.

Here, the first group is represented by routes from Tocumen and Alcalde Diaz to Bella Vista. According to the result of traffic assignment, Tocumen-Bella Vista route (by thoway of Via Espana) shows 1,558,000 person-trips per day and a sales/cost ratio of 0.68, and Alcalde Diaz - Bella Vista route (Via Transistmica) shows 527,000 person-trips per day and a sales/cost ratio of 1.08. The low sales/cost ratio of Tocumen - Bella Vista route will have to be improved. These two routes are shown in Fig. 12-11.

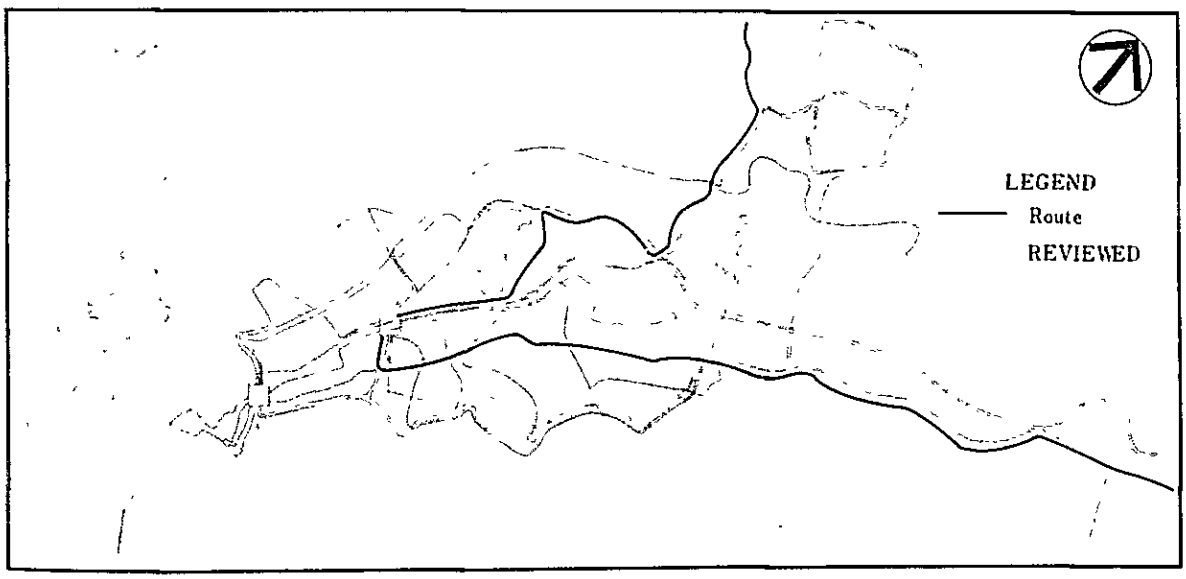


FIG. 12-11 EXAMINED SUBURBAN-TO-CITY ROUTES

As for the second group, San Isidro - Juan Diaz route is proposed in view of the currently weak connection between, and the presence – according to O-D table – of not much but enough demand to support a route between, San Miguelito and Juan Diaz Pedregal. According to the result of traffic assignment, this route will possibly be feasible after some modification for the improvement of its sales/cost ratio. This route is described in Fig. 12-12.

Circulating City Bus Routes

A circulating route is considered for Bella Vista, which, as the result of traffic assignment, shows a favorable sales/cost ratio of 1.37 but an unexpectedly small demand of only 132,000 person-trips per day. This route should be extended into Area Residencial in order to gain increased demand. This route is described in Fig. 12-13.

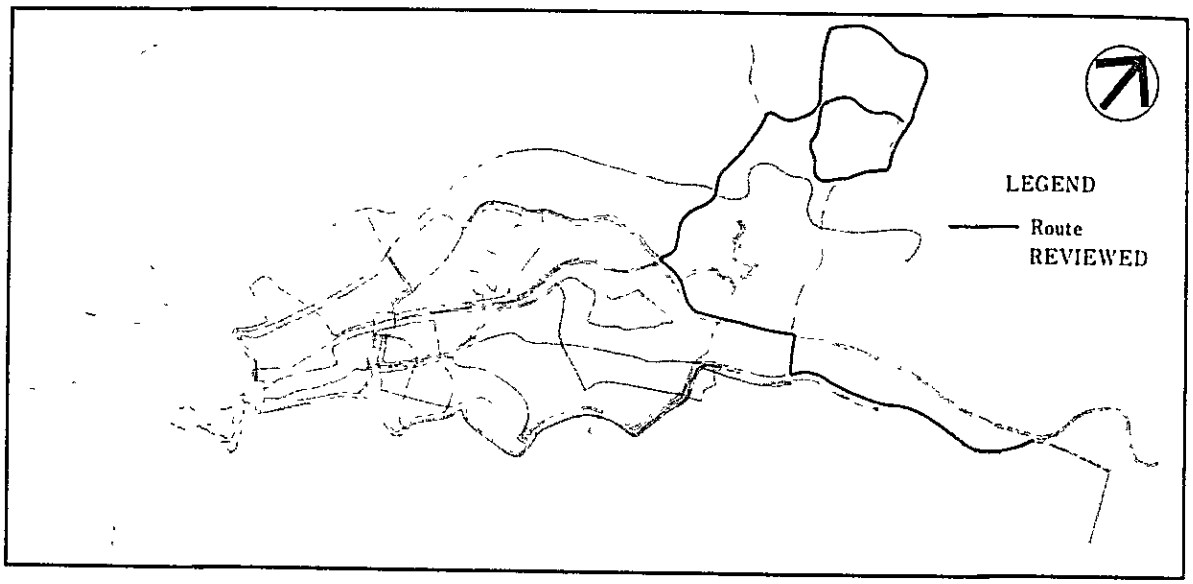


FIG. 12-12 EXAMINED SUBURBAN-TO-SUBURBAN ROUTES

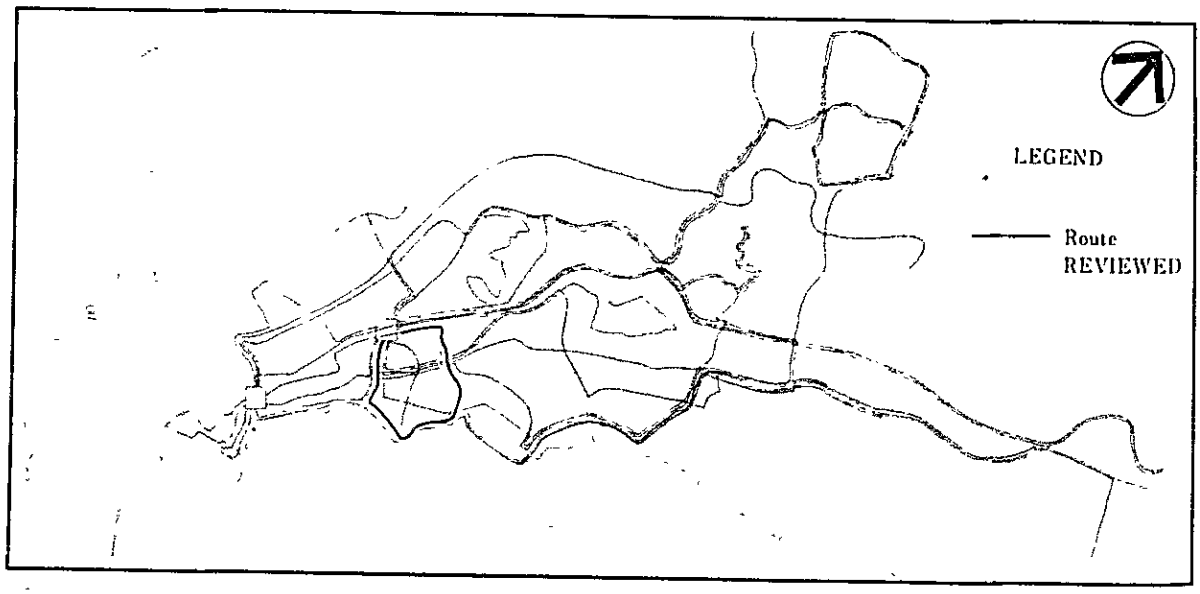


FIG. 12-13 EXAMINED CIRCULATING CITY BUS ROUTES

Casco Viejo Routes

In view of the land size of and road capacities in Casco Viejo, mini bus service will be provided on two circulating routes both originating from the Bus Center planned to be established in El Maranon. Both routes are proven to be feasible with 132,000 person-trips and a sales/cost ratio of 3.19 for Casco Viejo Route A and 276,000 person-trips and a sales/cost ratio of 1.98 for Casco Viejo Route B. The routes are shown in Fig. 12-14.

Medium Distance City Bus Routes

Routes to connect San Miguelito and Juan Diaz with the urban center and/or shorter routes are decided based on the existing routes and in coordination with the above discussed routes, but with particular care so as to raise the presently low service frequency along Via Santa Elena and to introduce new route(s) to Via Porras and Calle 50, where no service is currently offered. The routes, as decided, are described in Fig. 12-14.

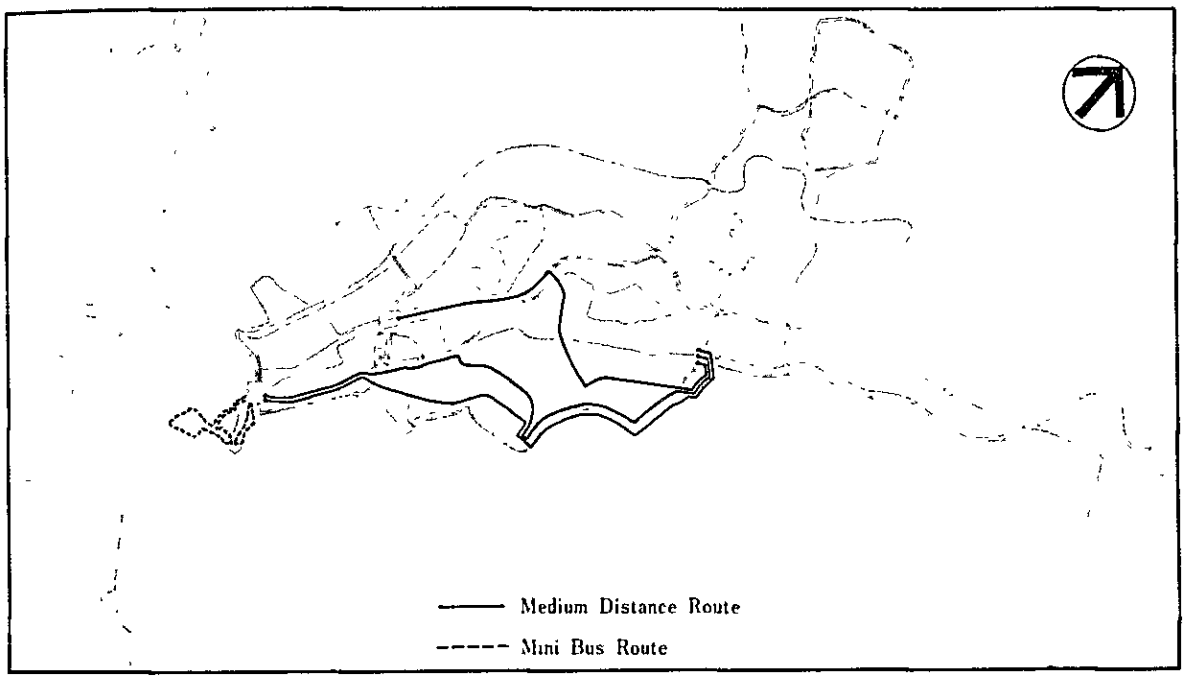


FIG. 12-14 EXAMINED CASCO VIEJO ROUTES AND MEDIUM DISTANCE CITY BUS ROUTES

(4) Recommended Bus Route Network

(i) Description of Routes

The above discussed alternatives have been modified a several times from the viewpoints of competition between routes, adjustment of route profitability, avoidance of excessively long routes, minimization of the number of passengers required to transfer, and the recommended route network, presented in Table 12-5 and Fig.12-15,has been arrived at.

Differences between the existing and the recommended networks can be clearly understood by comparing the recommended network presented in Fig. 12-15 with the existing network presented in Fig. 12-7.

The conformity of the recommended network with the rerouting themes will be discussed

hereunder.

Express Bus Route

Adopted Express bus routes are: Tocumen – Centro route, San Isidro – Bella Vista route, and San Isidro – Centro route. These routes utilize Corredor Norte or Ave. Balboa so as that

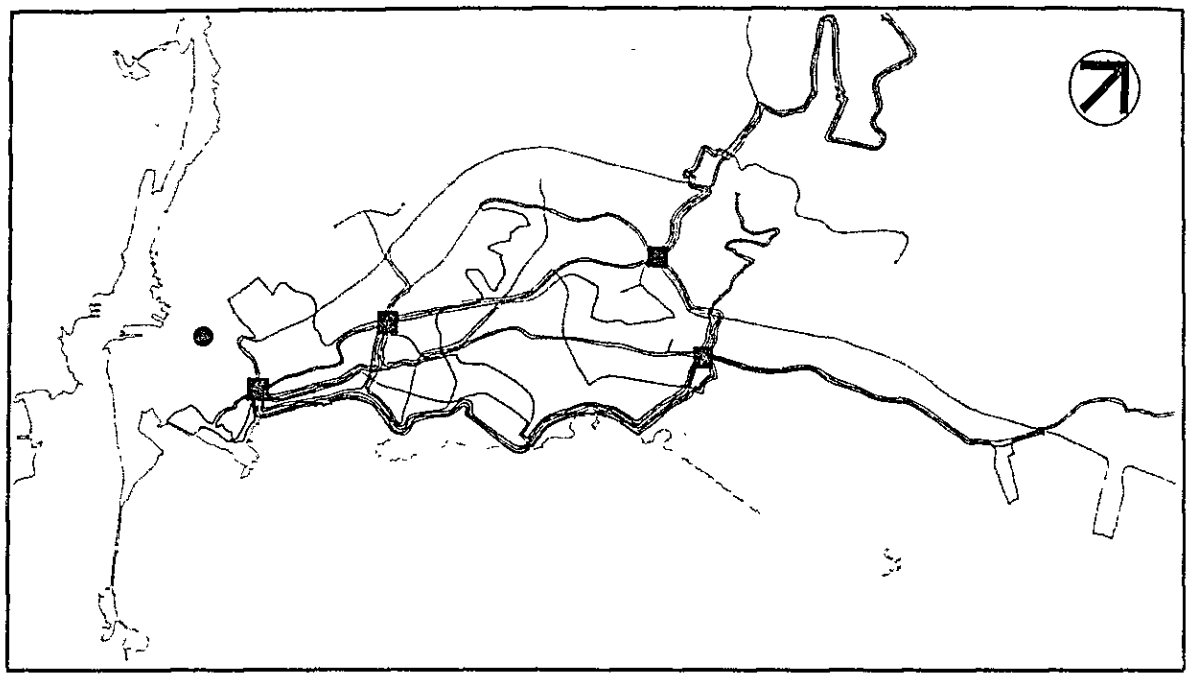


FIG. 12-15 RECOMMENDED FUTURE BUS NETWORK, 1990

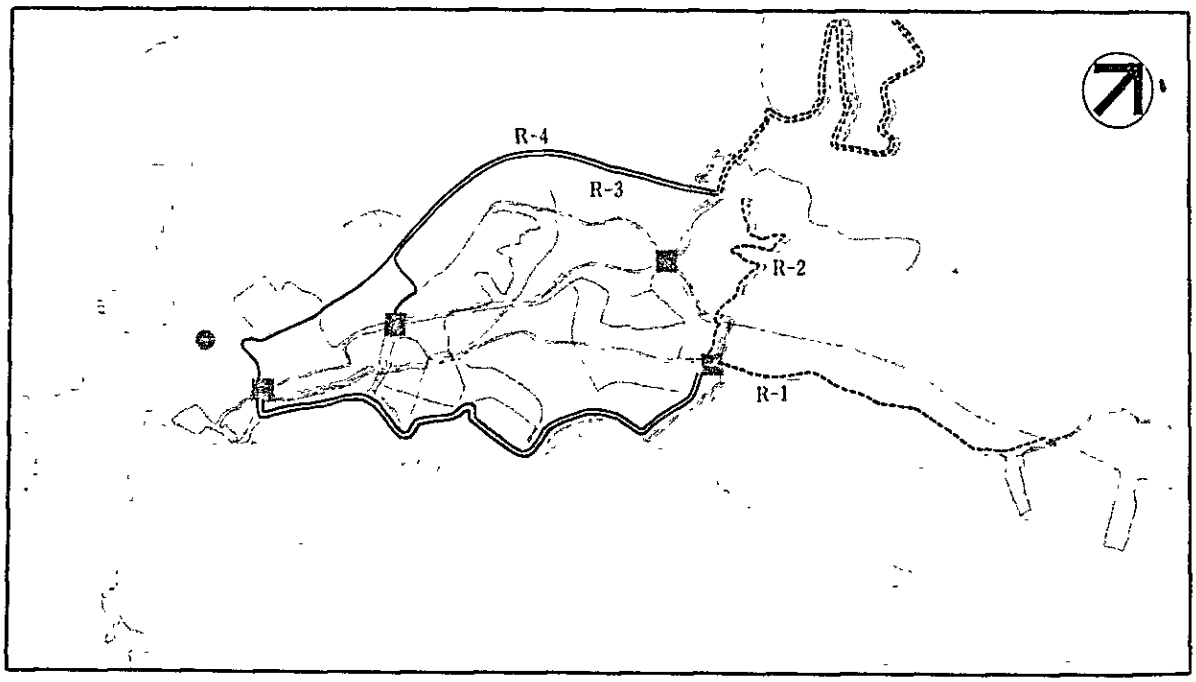


FIG. 12-16 RECOMMENDED EXPRESS BUS ROUTES

TABLE 12-5 RESULTS OF PRESENT DEMAND ASSIGNMENT ONTO THE PROPOSED BUS NETWORK

	Route	Total Passengers by Route (Thousand Psn/Day)	Sales/Cost Ratio
(1)	Entrada de Pedregal – El Maranon, Via J. Arango, Via Cincuentenario, Balboa. (Exp.)	27,601	0.94
(2)	Veranillo – El Maranon, Via Cincuentenario, Ave. Balboa (Exp.)	43,547	0.79
(3)	San Isidro – Univ. of Panama, Via Transistmica, Corredor Norte (Exp.)	8,512	0.90
(4)	San Isidro – El Maranon, Via Transistmica, Corredor Norte	25,014	0.62
(5)	Tocumen – Chanis, Via Domingo Diaz, Via Jose A. Arango	18,666	0.79
(6)	Alcalde Diaz – San Miguelito Bus Center, Via Transistmica	9,627	1.40
(7)	Pedregal – Curundu Norte, Via Jose A. Arango, Via Espana, Via M.E. Batista	45,326	0.82
(8)	Pedregal – El Maranon, Via Domingo Diaz, Via Ricardo J. Alfaro, Curundu Norte , Via M.E. Batista, Via Justo Arosemena	44,676	0.86
(9)	San Isidro – Curundu Norte, Via Transistmica, Via Brasil, Ave. Balboa, Via Federico Boyd	21,752	0.48
(10)	San Isidro – Chanis, Via Transistmica, Via Domingo Diaz, Via Cincuentenario	8,682	0.76
(11)	Veranillo – El Maranon, Via Cincuentenario, Via Balboa, Via Porras, Via Espana	29,749	0.98
(12)	Roberto Duran – El Maranon, Via Transistmica, Via R.J. Alfaro, Betania. Curundu Norte, Ave. Peru	34,233	0.85
(13)	San Miguelito Bus Center – El Maranon, Via Cincuentenario, Ave. Balboa	17,408	1.07
(14)	Chanis – El Maranon, Via Santa Elena, Via 11 de Octubre, Via Transistmica, Curundu	8,141	1.76
(15)	San Miguelito Bus Center – Curundu Norte, Via F. de Cordoba, Via Espana, Via Argentina	10,030	1.23
(16)	El Maranon – El Maranon Circulation, Via Peru, Via Transistmica, Via Domingo Diaz, Via Cincuentenario, Via Espana, Ave.J. Arosemena	157,892	0.97
(17)	Chanis – El Maranon, Via Cincuntenario, Ave. Balboa, Calle 50, Ave. J. Arosemena	1,216	1.46
(18)	Panama Inst. of Tech. – Curundu Norte, Ave De La Paz Via F. de Cordoba, Via Espana, Ave Balboa, Ave F. Boyd	1,047	1.54
(19)	Curundu – El Maranon, Curundu Norte, Via H.E. Batista, Ave Balboa	185	1.49
(20)	El Maranon – El Maranon Circulation, Casco Viejo Area Service (Route A)	23,252	3.36
(21)	El Maranon – El Maranon Circulation, Casco Viejo Area Service (Route B)	53,718	1.92
	TOTAL	591,385	0.93

Source: ESTAMPA

they will not constitute burden on roads which traverse the center of Panama Urban Area (See Fig. 12-16).

Suburban Bus Routes

Routes from remote suburban residential areas to Panama City Center are now designed to

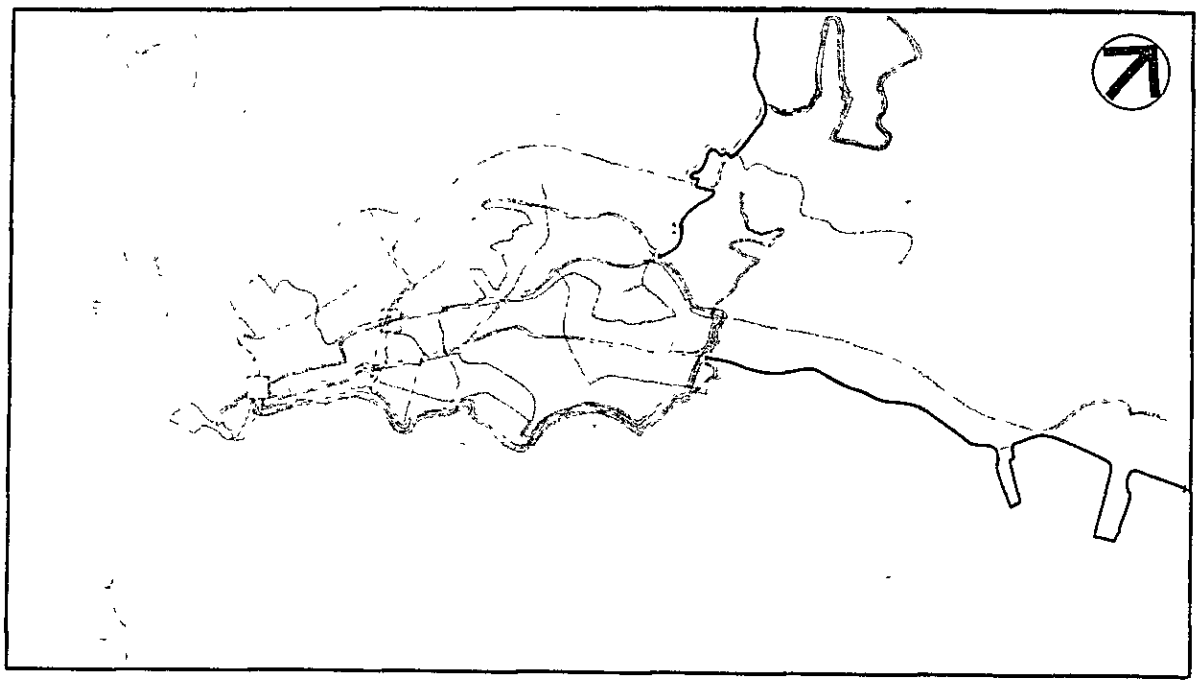


FIG. 12-17 RECOMMENDED LONG DISTANCE BUS ROUTES

terminate at Chanis or San Miguelito Intersection, which are entrance to Area Residencial.

Alcalde Diaz - San Miguelito route is expected to achieve a high profitability at sales/cost ratio of 1.37. Such ratio for Tocumen – Chanis route is slightly less than satisfactory at 0.78. These two routes are illustrated in Fig. 12-17.

The San Isidro – Juan Diaz route has been adopted as proposed in the original plan.

Circulating City Bus Routes

The city bus route, which was originally thought of as circulating within Bella Vista, has been expanded to cover Area Residencial in view of the fact that routes from Alcalde Diaz and Tocumen were cut off at San Miguelito Intersection or Chanis. Thus, the adopted route will circulate on Ave. Peru – Via Martin Sosa – Via Transistmica – Via Domingo Diaz – Via Cincuentenario – Via Espana – Ave. Justo Arosemena (See Fig. 12-18). This route will cover all of the four bus Centers.

Casco Viejo Route

The original plan was adopted. For comparison, a route which runs from Area Residencial to Casco – Viejo through Calidonia was considered, but the mini bus service was selected in view of the distinct difference in sales/cost ratio.

Medium Range City Bus

A route from San Miguelito to Bella Vista has been adopted. The route has been designed to go along Via Brasil and Via Federico Boyd to provide service within Bella Vista. The number of passengers is estimated at 613,000 per day, but sales/cost ratio is estimated at rather unfavorable 0.54.

As for Juan Diaz – Chanis route, one which will use Via 11 de Octubre and one which will use Calle 50 were considered. Both showed favorable results, and both have been adopted. That is, Chanis – Via Santa Elena – Via 11 de Octubre – Via Transistmica – Bella Vista route will have an

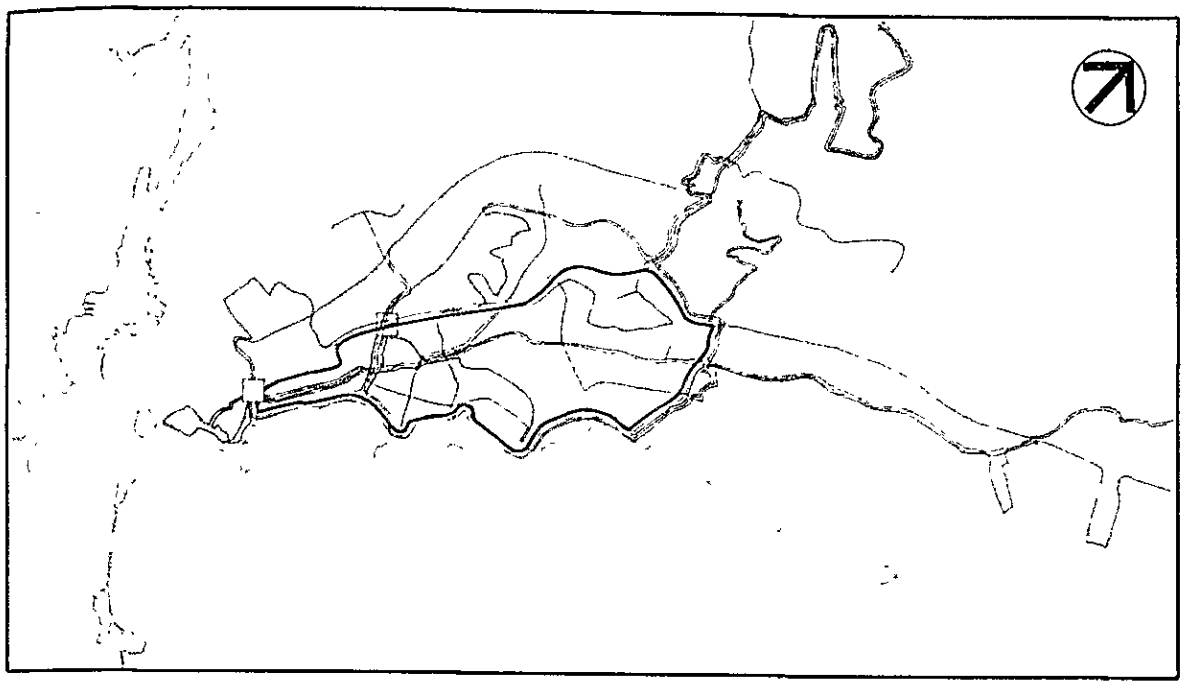


FIG. 12-18 RECOMMENED CIRCULATING ROUTES IN PANAMA

estimated 23,000 passengers per day with sales/cost ratio of 1.35, and Chanis–Via Cincuentenario – Calle 50 – Via Espana – Ave. Justo Aorsemena – Centro route will have an estimated 332,000 passengers per day with sales/cost ratio of 1.31.

In order to serve Via Porras roadside area,.San Miguelito – Via Cincuentenario – Via Espana – Centro route has been designed. This route will have an estimated 324,000 passengers per day with sales/cost ratio of 0.94. See Fig. 12-19 for these routes.

(ii) Evaluation

The results of assignment of the existing bus trip demand (OD) and bus trip demand estimated for 1990 (OD) onto the existing network and the recommended network are shown in Table 12-6.

The 1990 situation will be discussed first. See from bus route network, the major change in land use will occur in the reverted area (particularly areas along Corredor Norte). It is estimated that 49,000 people will live and 10,000 jobs will be available along Corredor Norte. Therefore, three routes which will serve Corredor Norte roadside area have been added to the existing network to make it comparable with 1990 network.

It is very desirable for passengers to be able to reach their destinations without transferring buses. In terms of the number of non-transferring passengers, the existing network (with 473,000) is clearly more desirable that the recommended network (with 230,000). The number of passengers tolerating one transfer, however, is 63,000 larger on the recommended network (with 624,000) than on the existing network (with 561,000). This means that the existing network lacks the flexibility of serving trips between two suburban points, or, expressed differently, the number of destinations which cannot be reached without two or more transfers is large under the existing network.

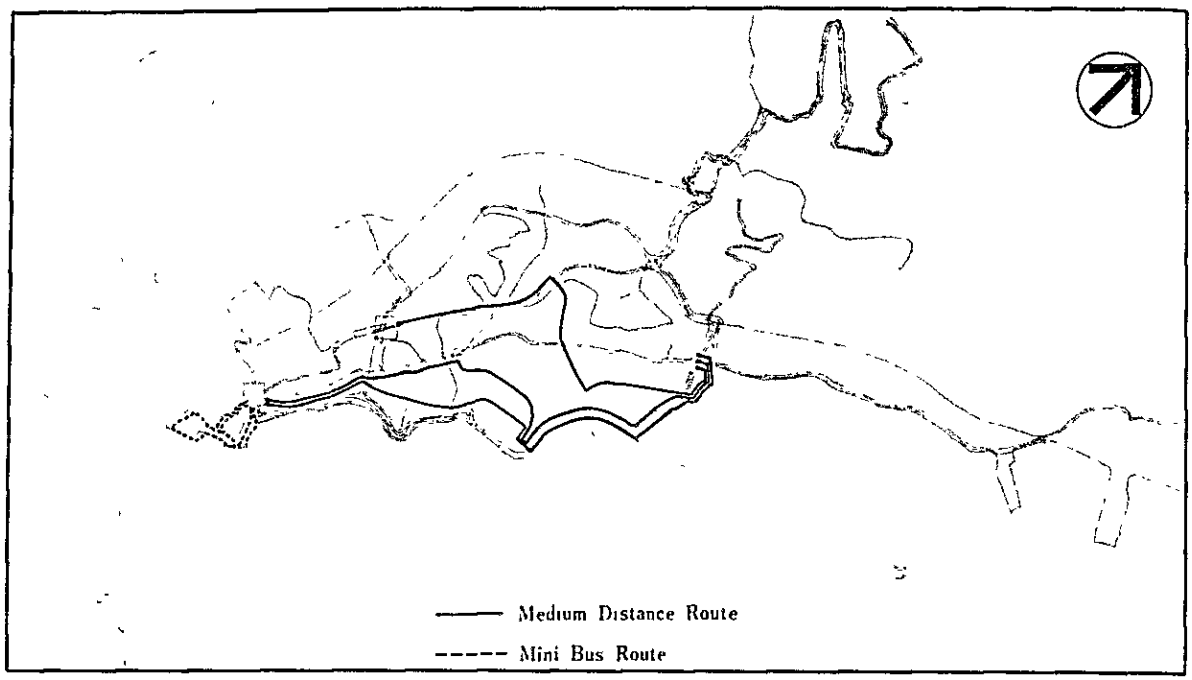


FIG. 12-19 RECOMMENDED CASCO VIEJO ROUTES AND MEDIUM RANGE CITY BUS ROUTES

The efficiency of the recommended network can be known form following indicators. The number of passengers per vehicle-kilometer of total buses operated will increase by 1.3 times from the 3.14 on the existing to 4.12 on the recommended. The total sales per vehicle-kilometer of total buses operated will rise from the 64 centavos to 77 centavos. The number of passengers per vehicle-kilometer of total buses operated can be considered the measure of network economy, and total sales per vehicle-kilometer of total buses operated, of the financial assessment of the network.

The comparison of total sales is the current $133,000 per day against $181,000 per day, while that of total costs is $175,000 against $200,000. Sales/cost ratio, however, is a favorable 0.91 on the recommended network against 0.76 on the existing network.

Provided that passengers will tolerate one transfer per trip, the recommended network is generally superior to the existing. In other words, bus route network necessarily has to change from the existing pattern of providing shuttle servive between residential areas and the city center to a pattern such as that of the recommended network, as urban area expands, as more than one urban nucleus emerges, and as living mode is urbanized and diversified.

Then, in what stage of transition from the existing to the recommended network does 1981 fall? The requirement of Panama citizens on bus route network is clarified using the result of assignment of 1981 bus trip demand (OD) onto the existing and the recommended networks. It should be noted, however, that the recommended network, which includes routes to serve the reverted area, particularly the roadside areas of Corredor Norte that are not needed in 1981, will compare unfavorably than it actually is.

TABLE 12-6 BUS ROUTE NETWORK EVALUATION INDICATORS (Per Day)

Evaluation Item	Unit	1990 Bus Trip Demand (OD) Recommended Network	1990 Bus Trip Demand (OD) Existing Network	1981 Bus Trip Demand (OD) Recommended Network	1981 Bus Trip Demand (OD) Existing
Non transferring Passengers	Person per day	289,648	472,845	206,380	370,720
Passengers transferring one time per trip	Person per day	689,646	175,551	385,005	49,419
Passengers tolerating one transfer	Person per day	624,471	560,621	398,883	395,430
Average trip length	Km	6.53	8.87	6.47	8.79
Total passenger Km per total route extension	Passenger-km per km per day	19,888	12,204	12,012	8,220
Total route extension	km	318.42	471.14	318.42	449.29
Total vehicle-km operated	Vehicle-km per day	235,551	206,737	148,904	134,737
Passengers per bus per total route extension	Passenger-km per bus	3,044	1,376	1,857	935
Passengers per bus total vehicle-km operated	Person per vehicle-km per day	4.12	3.14	3.97	3.12
Total sales to total operation vehicle-km	Balboa per vehicle-km per day	0.77	0.64	0.75	0.64
Total service frequency	Time per day	14,567	9,160	9,198	5,641
Lowest service frequency	Times per day	204	79	33	74
Total Sales	Balboas per day	181,072	133,248	111,696	86,554
Total Costs	Balboas per day	199,747	175,313	120,568	109,098
Total Sales/total costs		0.91	0.76	0.93	0.79

Source: ESTAMPA

The number of non-transferring passengers is 1.8 times greater on the existing network than on the recommended, and this factor is slightly larger than the 1.7 indicated with regard to 1990 bus trip demand. The number of passengers tolerating one transfer is about comparable at 395,000 on the existing network and 399,000 on the recommended. This indicates that, in 1981, those who require two or more transfers are still small in number.

The number of passengers per bus per kilometer of total network extension is 1,857 on the

recommended network as against 935 on the existing, while the number of passengers per vehicle-kilometer of total buses operated is 3.97 against 3.12. These improvements generally compare to improvements with regard to 1990 demand.

Lastly, indicators of sales and costs will be reviewed. Total sales per vehicle-kilometer operated is 75 centavos per day on the recommended network, an improvement from 64 centavos on the existing. The ratio of total sales to total costs are 0.93 on the recommended network as compared with 0.79 on the existing, which are slightly higher than those with regard to 1990 demand. This indicates that as the urban area expands, the profitability of public transport system deteriorates. Total sales will increase from the current 87,000 balboas to 112,000 balboas, while costs will also increase from the current 109,000 balboas to 121,000 balboas.

These results with regard to 1981 demand also indicate that the time of rerouting has already arrived, with somewhat moderate urgency than in 1990. (Incidentally, the direct application of the recommended network, designed based on 1990 demand, to 1981 demand results in some minor contradictions; for instance, the lowest route bus operation frequency is 33, but this is low enough for the route to be abolished in favor of routes with a frequencies for a better service to inhabitants.) Therefore, phased rerouting in pace with road and ancillary facility improvements will be discussed in this Chapter.

(iv) Financial Analysis of Rerouting Effects

The recommended network is clearly more reasonable than the existing, provided that one transfer per trip is tolerated, because the network guarantees that passengers will reach their destinations within a reasonable length of time. The major benefit, however, will accrue to bus operating entities.

In order to assess the overall operator benefits, financial evaluation is done assuming one bus company operating the entire bus network, using a financial model. This analysis is described in the below.

Assumptions for the financial analysis are listed in Table 12-7. The 1983 initial value of bus passengers and their growth rates up to 1994 have been calculated from the 1981 bus trip survey findings and forecast 1990 bus trips. A flat rate of 4% is used as growth rate for 1995 and thereafter. Average basic fare has been calculated in the process of route network evaluation on the basis of the existing fare system. On the recommended network, whose average travel distance per trip is shorter, average base fare is 1.6 centavos lower. A fare increase of 26% is to be allowed once in three years, which conforms to the rate of price inflation. Because bus maintenance and other work are to be contracted out (as present), the number of buses has been decided including some spare buses. The rate of increase in the number of employees has been decided by modifying passenger increase rate by the coefficient at which buses will be replaced by large buses. In the case of the recommended routes, the number of existing buses is greater than the number needed, and it has been assumed that the number of employees will begin to increase after being frozen for five years. Operating cost, repair and maintenance cost, and other expenses have been calculated by multiplying the costs discussed in Chapter 6 by the value of vehicle-kilometers operated. It has been assumed that repair and maintenance cost will be reduced to 60% of the present level by the modernization and rationalization of maintenance system. For the growth rate, the rate of increase in the value of vehicle-kilometers operated is used.

Assuming a discount rate of 12%, the benefit/cost ratio of the existing network is less than 1.0 and that of the recommended, more than 1.0; that is, the costs of the existing network is greater than benefits, and the benefits of the recommended network is greater than costs. At the discount rate of 12%, net present value is −2.090, a minus figure, in the case of the existing network, and is

16.914, a plus fiture, in the case of the recommended. The rate of interest at which revenues and expenditures will balance out is 9.514% per annum for the existing network and 23.111% per annum for the recommended. This shows that cost savings resulting from rationalization of route network are substantial.

Cumulative revenues and expenditures of each route when discount rate is 12% are shown in Figure 12-20. A moderate fluctuation at a 3-year cycle represents the joint effect of fare increase and the offsetting of inflation.

TABLE 12-7 FINANCIAL EVALUATION OF CURRENT BUS ROUTES AND PROPOSED BUS ROUTES

	Current Bus Route Case	Proposed Bus Route Case
Operation Period	1983 – 2002	1983 – 2002
New Bus Purchases	As Yearly Required	As Yearly Required
Renewal	8% of Existing Buses	8% of Existing Buses
Loan Condition	15% per annum Interest Redemption over 5 years	15% per annum Interest Redemption over 5 years
Initial Passenger	458,220 psn	660,000 psn
Growth of Passenger	4.4% per annum in first 10 years	5.6% per annum in first 10 years
	4.0% per annum after the 11th year	4.0% per annum after (including) the 11th year
Initial Standard Tariff	20.6¢	18.9¢
Growth of Standard Tariff	26% each 3 years	26% each 3 years
Employees	1,100 person in first 10 years Increase of 4.1% per annum	1,100 person in first 5 years Increase of 3.6% per annum
	thereafter	thereafter
Average Salary	6,600 Balboa per annum	6,600 Balboa per annum
Operating Cost	Initially 5,275,000 Balboas per annum	Initially 7,455,000 Balboas per annum
	Increase of 12.7% per annum	Increase of 13.1% per annum
Maintenance Cost	Increase of 12.7% per annum	Increase of 13.1% per annum
Other Cost	Initially 4,316,000 Balboa Increase of 12.7% per annum	Initially 6,098,000 Balboa Increase of 13.1% per annum
Short Term Credit	At 15% per annum interest	15% per annum interest
Short Term Deposit	At 5% per annum interest	5% per annum interest
Subsidies	None	None
Benefit/cost (12% Discount Rate)	0.968	1.190
Present Net Value (12% Discount Rate)	–2.090	16.914
Internal Rate of Return	9.514	23.111

Source: ESTAMPA

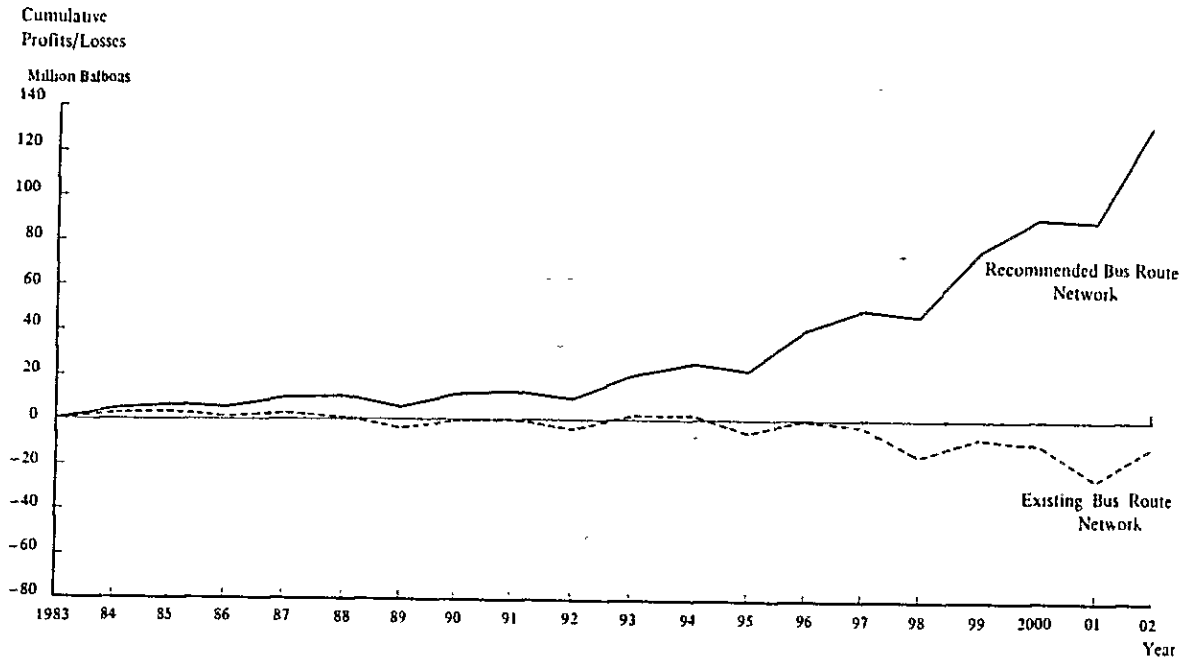


FIG. 12-20 PROFITABILITY OF BUS BUSINESS : EXISTING VS. RECOMMENDED BUS ROUTE NETWORK

(5) Bus Center Plan

(i) Required Facilities

Necessary for the efficient functioning of bus service network in urban area are facilities for passenger service, for operation management, and for vehicle maintenance.

The followings are passenger service facilities:

- Boarding/alighting facility at starting bus stops and facility for waiting passengers.
- Intermediate bus stops, and bus centers as transfer bus stops
- Bus centers as terminal bus stops

The followings are operation management facilities:

- Piquera as starting bus stop
- Bus bays at intermediate bus stops, exclusive bus lanes on major bus routes
- Bus parking facilities at terminal bus stop

The followings are vehicle maintenance facilities:

- Periodical vehicle inspection center
- Vehicle repair center
- Parts center

As most important of the above, bus center (including bus base) will be discussed together with its ancillary functions.

(ii) Purpose and Function of Bus Center

Bus center is for passengers, established at a location where bus routes converge and at which a large number of passengers (including transfer passengers) board and alight buses. The bus center must perform the following functions:

- Offer a safe and convenient place of boarding and alighting buses to passengers concentrating in urban center.
- To offer a place of safe and convenient place of transfer to transferring passengers
- To offer a turning circuit to concentrating route buses, in a place isolated from road traffic.

(iii) Bus Center Locations seen from Bus Network

The characteristics of the recommended bus network can be summarized as follows:

- All existing bus routes are cut off at Plaza 5 de Mayo.
- A group of new bus routes terminating in Bella Vista are established.
- Mini bus service is introduced to Casco Viejo area. This route will start and terminate in Plaza 5 de Mayo
- Important will be interface between mini bus routes and the bus routes starting and terminating in Plaza 5 de Mayo.
- Tocumen – Chanis and Alcalde Diaz – San Miguelito routes are newly established, and the direct route to Plaza 5 de Mayo is abolished.
  At these intersections, connection with other routes will be important.

In view of the characteristics of the recommended bus route network, the establishment of bus centers at the following locations is believed essential for securing safe and smooth flow of passengers.

- Near Plaza 5 de Mayo
- Northern side of the Curundu River, at the back of National Panama University.
- Near San Miguelito Intersection
- Near Chanis Intersection

(iv) Description and Scale of Bus Center Facilities

The followings are the facilities required any bus center

- Boarding/alighting area and bus standing space
- Pathway for transferring
- Concourse
- Bus turning circuit and passageway
- Bus operation survellance facility and center use fee collection booth
- Bus center office
- Passenger information service counter

The indicators which determine the condition of calculation of necessary facility scale of each bus center are presented in Table 12-8.

TABLE 12-8 NUMBER OF PASSENGERS AND ARRIVING BUSES AT PLANNED BUS CENTERS

Name of Bus Center	Number of Passengers (pass/day)	Number of Arriving Buses (buses/day)	Number of Arriving Buses (buses/peak hour)
El Maranon	332,000	13,000	1,132
Curundu Norte	133,000	6,200	754
San Miguelito	104,000	5,100	550
Chanis	79,000	6,100	700

Source: ESTAMPA

The basic planning condition of bus center facilities is the number of bus berths, which is calculated based on the number of buses arriving/departing in peak hour. The number of bus berths calculated for each bus center, based on the followings, are listed in Table 12-9.

a)	Peak hour concentration rate of passengers:	10%
b)	Peak hour direction rate:	80%
c)	Peak hour congestion rate in peak direction:	100%
d)	Average bus capacity	60 passengers per bus
e)	Turnover ratio of departing bus berth for medium distance routes of 15 kilometers or longer:	6 per hour
	Also of arrival bus berth:	10 per hour
f)	Turnover ratio of departing bus berth for short distance routes of 15 kilometers or shorter:	12 per hour
	Also of arrival bus berth:	20 per hour
g)	Turnover ratio of circulating city bus:	20 per hour
h)	Turnover ratio of mini bus:	30 per hour

(v) Bus Center Site Selection

Areas of Plaza 5 de Mayo and of the North of Bella Vista, as well as vacant lots about one hectare of larger existing between the two urban centers, have been identified for consideration as sites of bus centers (See Fig. 12-21). The result of their evaluation is shown in Table 12-10.

In Centro, site C is the best in view of its location and size. In Bella Vista, where no site conspicuously excel others as did site C, site I is selected.

The two suburban bus centers should be located desirably near an intersection, in view of the nature of routes which will utilize them. The vacant lot on the northwest corner of San Miguelito intersection will be purchased for use as San Miguelito Bus Center, and the residential hinterland in the northeast of Chanis intersection will also be purchased for the location of Chanis

TABLE 12-9 NUMBER OF BUS BERTHS NEEDED AT EACH BUS CENTER

Location	Plaza 5 de Mayo	Curundu Norte	San Miguelito Intersection	Chanis
Routes originating and terminating at the bus center				
Bus service frequency on 15-km or longer routes (Times per hour)	145	55	54*	98*
Departure Berths	14	8	8	14
Arrival Berths	11	5	5	8
Bus service frequency on 15-km or shorter routes (Times per hour)	189	129	–	–
Departure Berths	12	11	–	–
Arrival Berths	8	7	–	–
Routes going through the bus center				
Circulating city bus service frequency (Times per hour)	100	100	100	100
Berths for same	6	4	4	4
Mini bus service frequency (Times per hour)	220	–		–
Berths for same	8	–		–
Transit bus service	–	91	121	152
Berths for same	–	5	6	8
Other routes				
For Colon, La Chorrera, Arraijan, Las Cumbres (Times per hour)	35	–	–	–
Departure Berths	6	–	–	–
Arrival Berths	4	–	–	–
Total number of berths	69	40	23	34

*: Those originating and terminating at the bus center, regardless of the route length.

Source: ESTAMPA

Bus Center. These four bus centers will be referred to as El Maranon, Curundu Norte, San Miguelito, and Chanis Bus Center (See Fig. 12-22).

Bus Center development costs are estimated at 15.0 million balboas in total, which is reduced to about 12 million balboas, excluding costs of a commercial building in San Migelito Center and off-site auxiliary facilities such as access roads, a taxi pool and a bus bay (Table 12-11). The cost of El Maranon Bus Center is comparatively high due to the pedestrian deck covering about one-third of the site and also to the usage of high quality tiles for concources and platforms.

TABLE 12-10 PROPOSED BUS CENTER LOCATIONS

Current Land Use	Use Status	Area (Hectare)	Owner of Land	Evaluation
A. Parking	Temporary	0.5	Public	El Maranon urban renewal area; farer away from Calidonia than other sites.
B. Inter-city bus terminal	Temporary	0.8	Public	Same as above; unusable unless the existing bus terminal is relocated.
C. Athletic field and parking	Temporary	3.5	Public	Same as above; located between Santa Ana and Calidonia
D. Park land	Permanent	1.0	Public	A part of Legislativo Park; convenient location but small in size as in the case of C.
E. Open space	–	2.0	Public	A part of the reverted area; farer away from business area than other sites.
F. Commercial/ residential	Permanent	0.8	Public	Within San Miguel Urban Renewal Area; small in size and a little too far from CBD.
G. Commercial/ Industrial	Permanent	4.8	Private	Land must be purchased for use
H. Commercial	Permanent	4.3	Private	Same as above.
I. Open space	–	–	Public	A part of the reverted area; Planned to be developed as university campus.
J. Parking	Permanent	2.0	Public	Mostly inside the premises of the National Institute of Geography. Parking space must be relocated for use.
K. Athletic Field	Permanent	1.3	Public	On university campus; for use, the athletic field must be relocated.
L. Open space	–	1.8	Private	Designated for commercial/ residential; for use, land must be purchased.
M. Open space	–	4.5	Private	Designated for commercial use; same as above.
N. Open space	–	10.5	Private	Designated for commercial/ residential use; same as above.

Source: ESTAMPA

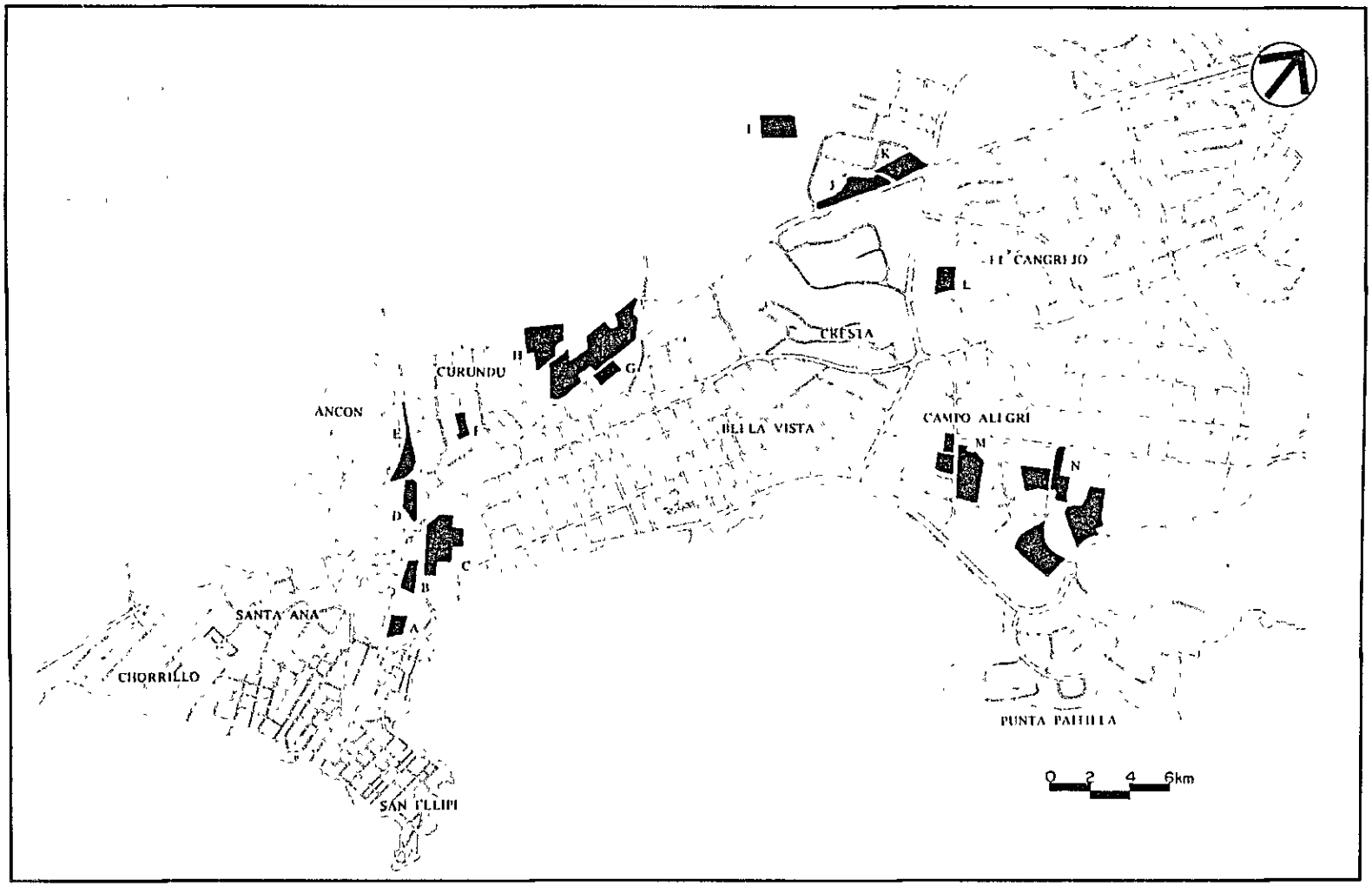


FIG. 12-21 POSSIBLE SITES FOR BUS TERMINALS IN CBD AREA

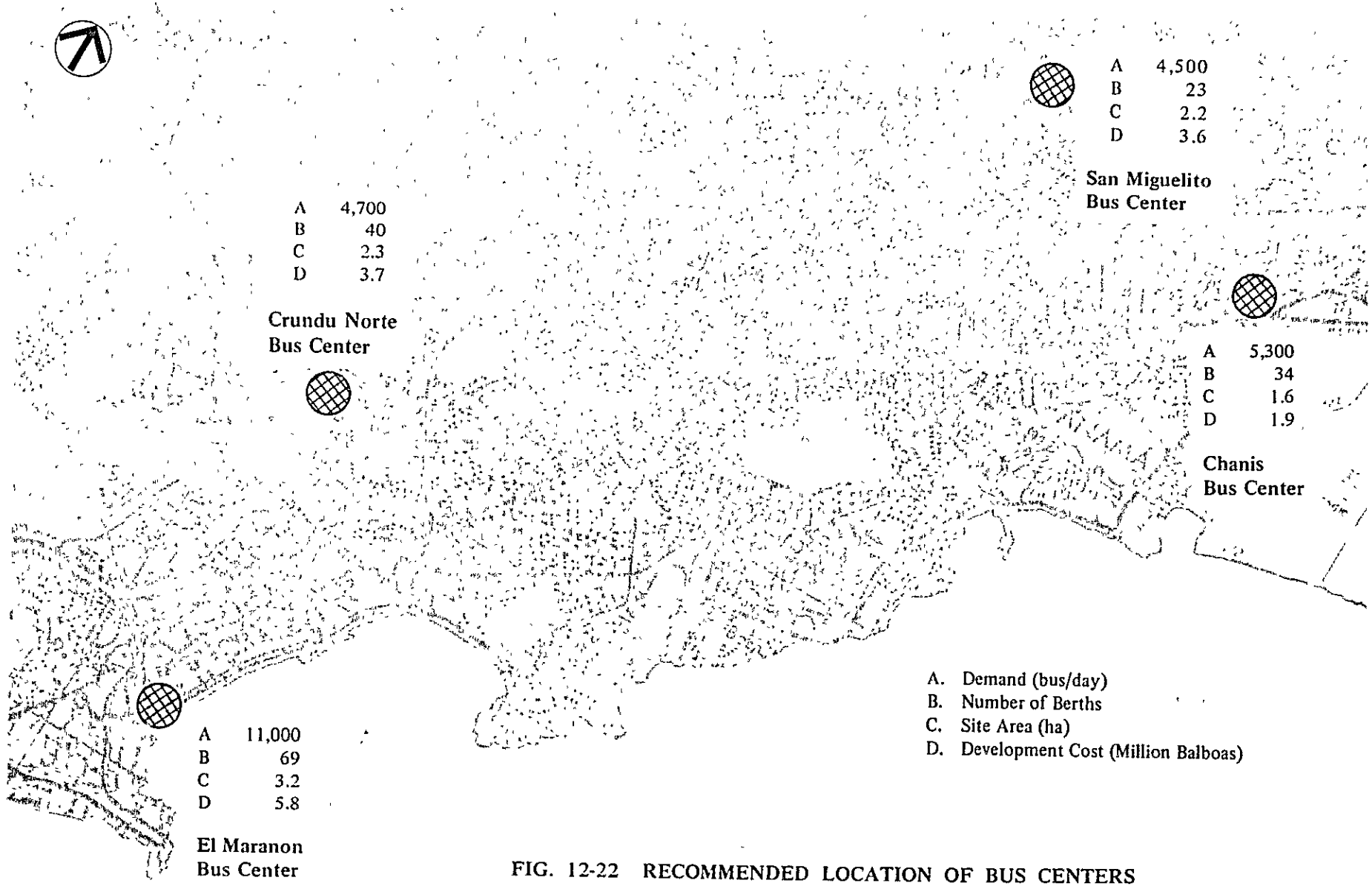


FIG. 12-22 RECOMMENDED LOCATION OF BUS CENTERS

TABLE 12-11 COST ESTIMATES OF BUS CENTERS

	El Maranon		Crundu Norte		San Miguelito		Chanis	
	Quantity (m^2)	Cost (1000 B/.)	Quantity (m^2)	Cost (1000 B/.)	Quantity (m^2)	Cost (1000 B/.)	Quantity (m^2)	Cost (1000 B/.)
1. Berths, Corridor for Bus	22,600	1,136	14,600[2]	990	12,600	490	10,800	590
2. Concource, Platform	10,100	402	5,500	90	2,600	50	5,600	90
3. Pedestrian Deck, Stair	11,400	2,900	–	–	1,740	440	–	–
4. Office, Other Facilities	–	270	–	200	–	1,020[3]	–	240
5. Access Road[1]	–	–	1,600m	1,700	–	–	700m	440
6. Taxi Pool[1]	–	–	–	–	1,100	50	–	–
7. Bus Bay[1]	–	–	–	–	1,500	120	–	–
8. Contingency	–	470	–	300	–	220	–	140
9. Engineering Cost	–	620	–	420	–	290	–	180
10. Land Aquisition Cost	–	–	–	–	17,800	920	7,300	220
Total	–	5,800	–	3,700	–	3,600	–	1,900

Note: 1) Auxiliary facilities outise the Bus Centers.
2) Including drainage facilities
3) Including commercial buildings and facilities.
Source : ESTAMPA

(vi) Bus Pool

A bus pool will be established for the purpose of improving the maintenance level of buses for safe and reliable operation and of providing, as a supplementary function to the Centro Bus Center, bus parking space for operation adjustment. The former Albrook Air Field is planned for the location. The major facilities to be installed in the bus pool will be:

- A shop for the periodical preventive inspection/maintenance and statutory inspection/repair of buses
- A Bus repair and maintenance shop
- A parts storage attached to the above
- Parking space
- Facilities for communication with Centro Bus Center

At the inspection shop, the following inspections and repair and maintenance will be accomplished:

- Biweekly inspections
- Monthly inspections
- Quarterly inspection
- Annual inspection (statutory)

Planning data of the inspection maintenance shop needed to serve fleet of 1,000 operative buses (the number estimated for 1990, plus 10% reserve buses) are presented in Table 12-12. The size of land and the size of floor space needed for said shop are also shown in Table 12-13.

The size of parking space that should be prepared in the bus pool, as a supplementary facility to bus terminal in Centro, is calculated as follows. First, if 65% of the 1,000 city buses existing in 1990 will stand-by during off-peak hours, and if one-half of the 65% will stand-by in the piguera, 300 to 350 buses will be parked in the bus pool parking space. Likewise, if 30% of 400 buses, which will come from La Chorrera, Arraijan, Capira, and Veracruz, will also utilize the bus base for parking, additional parking lots for 120 buses will be needed. Then, the bus parking space to be prepared

in the bus pool will require 2.3 hectares of land, and the total land space of the bus pool will be 3.7 hectares.

TABLE 12-12 DATA OF INSPECTION/MAINTENANCE SHOP

Item	No. of Bus needing Inspection/ Maintenance (Bus/Day)	Inspection/ Maintenance Time (Hour per Bus)	Workers needed (Teams)	Space (Buses)
Biweekly Inspection	40–45	1.0	6	3
Monthly Inspection	30	1.05	6	3
Quarterly Inspection	11	3.0	5	3
Annual Inspection	3– 4	4.0	2	2
Engine Overhaul	1	4.0	1	1
Ordinary Repairs	30	1.0	4	4

Source: ESTAMPA

TABLE 12-13 BUILDINGS AND AREA OF INSPECTION/MAINTENANCE SHOP

Building Type	Floor Area (m^2)	Site Area (m^2)	Note
Repair Shop (Including space for statutory inspection of 2 Buses)	1200		8 BLDG (16 BUSES) x (10m x 15m)
Engine Shop	75		1 BLDG (1 BUSE) x (5M x 15m)
Parts Storage	350		
Office	1000	8000	
Cafeteria and Welfare Facilities	500		
Conference/Training Room	300		
Fuel Pump Stand	100		
Sub-Total	2450	8000	
Parking Space (For Inspection/Repair)		3000	115 (BUSES/DAY) ÷ 2 x $50m^2$
(For Personel's Cars)		3000	200 PSN x 50% x $30m^2$
Total	1450	14000	

Source : ESTAMPA

(6) Reorganization

The improvement and enhancement of bus operating organizations to the extent necessary for

the purpose of realizing the recommendation will be discussed here.

Organizational improvement in the private sector is to be achieved for the purpose of establishing modern entities for the management of public transport business. In more detail, the primary aim is to make sure that bus operation conforms with public interest and the second, to modernize the presently unmodern arrangements between bus owners and bus drivers for the renting of buses and franchise. Organizations subject to modernization are syndicates represented by SICOTRAC and cooperatives represented by COMETRAP. New types of business entities should also be taken into consideration with regard to new types of bus services.

The business operation of SICOTRAC, the largest of bus operating entities in Panama City, is efficient in the pursuit of individuals' profits, but has a number of problems including the exploitation of drivers by bus owners and arbitrariness of bus operation under the non-restricted bus renting system. The followings will improve SICOTRAC and other syndicates:

o At an appropriate time, the route franchise of each bus owner is transferred to the syndicate to which he belongs.

o At the same time, an operation division is established within the syndicate organization.

o The operation division employs drivers, only in the number needed. Guaranteed to the drivers, as syndicate employees, are social security and other rights of workers, which they have not previously enjoyed.

o The operation division is given authority to, and be assigned with responsibility to, achieve, with no owner participation or interference, most efficient route allocation of buses in accordance with the level of demand on each route as fluctuating from time to time.

o The operation division also has right and responsibility to determine new routes, to apply for the approval of such routes, and to coordinate with other bus operating entities on the routes at the time of application.

o The operation division is responsible to all member owners for the performance of bus business.

The way of business of COMETRAP and other cooperatives is in advance of syndicates: buses are gathered to a motorpool for management, drivers are assigned to buses according to their work schedule, and the cooperative has a central maintenance shop where the entire maintenance service is offered. Laxity is obvious, however, in some aspects of management: personnel expenses, although per capita salary is low, are a strong element of financial burden due to seemingly excessive number of employees. If the future of Panama urban transport is to be entrusted with them, the existing situation must be improved through the followings:

o The cooperatives are subjected to strict audit. (The attempt of ESTAMPA to achieve the business analysis of the cooperatives met their strong resistance). If the cooperatives are to survive and compete with the syndicates, cooperative members themselves must be willing to reveal facts and strive to take necessary remedial actions.

o In recognition of the importance of those cooperatives as common carriers, the Government gives appropriate subsidies and non-monetary assitances to the cooperatives, as necessary for them to effectuate the remedial measures as identified through the business analysis and audit. The non-monetary assistances may include the granting of franchise on highly profitable routes to the cooperatives or the approval of parallel operation on such routes by the cooperative and the syndi-

cate.

Many of bus operating entities in Panama City are either syndicate or cooperative. However, the establishment of new entities may be justified for the operation of some of the recommended routes, such as the mini bus service routes in Casco Viejo and the express routes between residential areas and urban centers. Particularly in view of the fact that a fairly high level of profit can be expected from the mini bus service, while a number of express bus routes are hardly feasible under the current fare system, it is rational to establish a new organization for the operation of both the profitable and the hardly feasible routes together for the pooling of their profits and losses. The recommended new organization is described as follows:

- The new organization is granted with franchise on the mini bus service routes and the express bus service routes.

- The new organization is established as a stock company, by public offering.

- The new company purchases mini buses and buses for express service.

- Net profits after setting aside a sufficient reverse for the future reproduction and expansion are returned to the stockholders in the form of stock dividend.

- Until a stock market is estabished and the company is listed on the market, the company stocks are to be transferred through negotiation.

The roles to be performed by the supervisory authorities are primarily to maintain surveillance, from the viewpoint of public interest, over bus operating entities with regard to the formulation and effectuation of their bus operation plans, bus operation management, and the condition of bus operation and, secondarily, to formulate new projects and to coordinate the implementation of same. The performance of the first role will require ability to achieve continuous monitoring of the activities of bus operating entities and to analyze the information obtained through monitoring. The performance of the second role will require ability to formulate facility plans, routing schemes, and franchising programs, to devise a system of mechanical inspection and maintenance of buses, and to investigate and design bus fare systems. These abilities (functions) should be unified into one government agency.

In addition to organizations for bus operation, an organization should be considered for the establishment and operation of facilities bus centers for the transferring passenger convenience and for promoting bus operation in adherence to prescribed schedules. The below described organization will be desirable.

- The organization will be established as a so-called third sector (a sector in addition to government sector and private sector) with the necessary land space provided by the state and the necessary funds generated from private sources by the means of stocks or debentures. Also, efforts will be made to obtain foreign loans under Government guarantee in view of the public nature of this organization.

- The organization will establish and operate four bus centers and a bus pool with maintenance shop and collect charges from bus operating entities.

- This organization will operate an inspection center under the supervision of the competent authority. The maintenance center (shop) will constitute the core of operation of this organization.

o For the establishment and operation of this third sector organization, necessary legislative actions are to be taken in advance. Its qualification for foreign technical cooperation as a public organization will be indispensable for it to be able to develop a bus maintenance system through fosteration and certification of automobile mechanics and establishment of statutory inspection and maintenance requirements, as well as the system of compulsory automobile indemnity insurance.

(7) Implementation Schedule

A schedule for the realization of the recommended bus route network must be decided with the followings in mind:

o Every new bus route should be opened at the time a newly established bus center at either end of the route is opened.

o For the effective use of the investment funds, time for constructing bus centers should be decided in coordination with time for road network improvement through the construction/ upgrading of arterials and intersection grade separation.

Of the 21 routes constituting the recommended route network, those which are believed to become feasible within the near future, judging from the result (see Table 12-5) of assignment of 1981 O-D trips to the recommended road network, are:

o Express service between Juan Diaz and El Maranon Center via Ave. Balboa.

o Juan Diaz–Curundu Norte Center route by the way of Via Espana

o Veranillo – El Maranon Center route via Ave. Balboa

o San Miguelito Center – Maranon Center via Ave. Balboa

o San Miguelito Center – Curundu Norte Center route via Via Cincuentenario and Via Porras

o Bus Center Circulation route

o Mini bus service routes in Casco Viejo

Timing for the development of bus center, bus pool, and the arterial network is shown in Table 12-14 with the time of introduction of new routes. The use of temporary El Maranon Bus Center and a portion (parking space) of Albrook Bus Pool will start before the construction of the permanent El Maranon Bus Center. The express bus service from Juan Diaz and the city bus service on circulating routes will start as soon as the temporary El Maranon Bus Center will be opened. It will be desirable that Curundu Norte Bus Center and San Miguelito Bus Center be opened upon the completion of San Miguelito Intersection grade separation and the widening of Via Simon Bolivar in 1986. Upon the opening of these bus terminals, San Miguelito Bus Center – Curundu Norte route and Alcalde Diaz – San Miguelito Bus Center route will be opened.

The relocation of SACA piquera will be a precondition to the opening of Via Cerro Ancon in 1987, when El Maranon Bus Center will be expanded (for SACA relocation) and Albrook Bus Pool will be opened for full operation. At such time, Veranillo – El Maranon Center route and San Miguelito Bus Center – El Maranon Center route will be opened.

Also in 1987 the upgrading of Via J. A. Arango will be completed, at which time Chanis Bus Center will be opened for the commencement of service on Tocumen – Chanis Bus Center route, San Isidro – Chanis route, Chanis Center – Curundu Norte Center – Albrook Bus Pool – Maranon Center route.

In 1988, entire Corredor Norte will be completed up to Via Transistmica, at which time San Isidro – El Maranon Center route and express San Isidro – Curundu Norte Center route will be opened for servide. The year 1988 is designated for the implementation of the masterplan. Therefore, El Maranon Bus Center will operate in full as a permanent facility starting in this year.

Incidentally, these new routes will, when opened. compete with the existing routes. Because the total number of buses will not be increased at the time of creating new routes, the key to the successful shift to this new system with a minimum of friction will be the devising of an effective

TABLE 12-14 IMPLEMENTATION SCHEDULE

Year	Related Road Construction /Improvement	Bus Center Operation	Bus Route Operation
		El Maranon Temporal Bus Center	Juan Diaz – El Maranon (exp.)
1984 ~ 1985		Albrook Bus Pool (Partially)	Ave Central – Via S. Bolivar – Via Espana – Ave J. Arosemena (Circl.)
1986	S. Bolivar	Curundu Norte Bus Center	Juan Diaz – Curundu Norte
	San Miguelito Intersection	San Miguelito Bus Center	San Miguelito Bus Center – Curundu Norte
			Alcalde Diaz – San Miguelito Bus Center
1987	Via Cerro Ancon	Albrook Bus Pool (Full Size)	Veranillo – El Maranon
	Via J. A. Arango	Chanis Bus Center	San Miguelito Bus Center – El Maranon
			Tocumen – Chanis
			San Isidoro – Chanis
			Chanis – Curundu Norte – Albrook Bus Pool – El Maranon
1988	Corredor Norte	Maranon Bus Center	San Isidro – El Maranon (Exp.)
			Mini Bus in Casco Viejo

Source: ESTAMPA