4.2.5 Travel Speed on Major Roads

A travel speed survey on major roads was carried out in August 1990 by the Study Team. This survey was also conducted at both peak and off-peak hours.

From the results of the travel speed survey, the following facts are relevant:

a) The roads with less than 20 km/h travel speed are concentrated in the Central Urban Area and traffic flow from Mixco to the Central Urban Area.

b) The roads with travel speed between 20 km/h and 30 km/h are concentrated on the major radial roads.

4.3 Identification of Road Facilities and Traffic Problems

4.3.1 Problems from Road Network Point of View

From the road network point of view, the following four (4) remarkable problems are identified under consideration of the function and characteristics of a roads and traffic flows/volume.

(1) Shortage of Roads

The background and the conditions of problems regarding shortage of roads are described below.

a) The traffic volume on C.A-1 and Calzada San Juan Sacatepéquez have already reached the possible capacity in 1990.

b) The future traffic volume on these roads in 2010 are projected as about twice compared with the present traffic volume.

c) Guatemala City and Mixco is linked with only two (2) major roads.

d) It is very difficult to widen the existing roads since many buildings are located on both sides of roads.

e) Therefore, construction of new roads will be required in this area.

(2) Concentrated Road Network

The background and the conditions of problems regarding concentrated road network are described below.

a) Four (4) trunk roads in Guatemala City, namely Calzada San Juan Sacatepéquez, C.A-1, C.A-9 and Avenida Petapa, are concentrated at El Trébol interchange (a cloverleaf interchange).

b) Hence, the heavy traffic volume is also concentrated at this interchange.

c) This is one of the causes to generate traffic congestions and to increase traffic accidents.

d) Additional roads to divert the traffic volume will be required to solve the traffic congestion and accident problems.

(3) Unlinked Road Network

The background and the conditions of problems regarding unlinked road network are described below.

a) There are many unlinked roads in the northern part of the Study Area.

b) If a traffic accident or a disaster will occur on those unlinked roads, colonies or villages located beyond a disaster area will be isolated by disconnection of land transportation, since there is no

diversion road.

c) Conversion of unlinked roads to linked roads by extension will be required in order to secure the safety for lives of inhabitants.

(4) Incompletion of Ring Road

The background and the conditions of problems regarding incompletion of a ring road are described below.

a) The major origins and destinations of person trips are concentrated on radial directions.

b) Trips by-passing Central Urban Area are very limited.

c) In considering the road network configuration, the functions and the characteristics of a ring road, and utilization of existing roads, the full ring road network is required.

d) At present, only a half portion of the ring road has been completed in Central Urban Area.

4.3.2 Problems from Traffic Point of View

From the traffic condition point of view, the following three (3) remarkable problems are identified.

(1) Traffic Congestions on Major Roads

a) Even though, there are many wide carriageway roads in the Study Area, the congestion degree on some of them already reached to about 1.0 or more.

b) As it is mentioned in Section 4.3.1, there is no alternative route for most of major arterial roads. Since congestion degree of many of those major arterial roads have already reached to 1.0, the traffic congestions will be just worsen in the future, unless improvement measures will be implemented.

c) At some major arterial roads, composition of buses/ microbuses are very high as more than 15% of the total traffic volume. Since, buses/microbuses are the only one public transport mode in the Study Area, smooth operation are often disturbed by heavy traffic volume.

d) The travel speed of vehicles drastically declined during peak hours in the Central Urban Area and the eastern corridor to Mixco.

(2) Traffic Bottlenecks at Intersections

a) There are several traffic bottlenecks in the Study Area and the most of them are at intersections on major arterial roads.

b) At some bottleneck intersections, major improvement works, such as grade separation, are required, since the traffic volumes are far beyond the traffic capacity.

c) Traffic accidents are concentrated at certain intersections. Traffic accidents not only cause the loss of precious life and properties, but also cause traffic congestions until completion of the accident investigation.

(3) Concentration of Traffic Flows on Certain Major Roads

a) Even though the road ratio in the urban area is relatively high, majority of traffic concentrate on certain major roads.

b) Many roads within the grid pattern in each district are not paved or not well maintained. Hence, many drivers try to avoid driving these road and utilize major roads.

4.3.3 Problems from Road Structure Point of View

From the road structure point of view, the following two (2) remarkable problems are identified.

(1) Poor Maintenance

The background and the conditions of problems regarding poor maintenance are described below.

a) The ratio of paved and unpaved road length in Guatemala City are 73% and 27%, respectively. (Total road length is 1,135 km).

b) Rehabilitations are required for 122 km (20%) of the asphalt concrete pavement roads and 87 km (48%) of the cement concrete pavement roads according to the Maintenance Office of Guatemala Municipality.

c) Main roads in Chinautla, Mixco and Villa Nueva are paved by the asphalt concrete, however, the surface conditions are not good. Hence, rehabilitation of these roads are also required as soon as possible.

d) The road markings, such as lane line markings and stop line markings at intersections have been disappeared.

(2) Bridge Structure

The background and the conditions of problems regarding bridge structure are described below.

a) Traffic congestions often occur on the bridge located near Colonia La Libertad, Zona 14, due to the shortage in the number of lanes (only one lane bridge), and this bridge become a bottleneck.

b) Avenida Petapa is a main road connecting Guatemala City and Petapa, however, there is no bridge at a crossing point of Río Villalobos.

c) At present, there is no traffic congestion on the bridge of Ave. San Christóbal crossing over Río Molino. However, when Ciudad San Christóbal will be developed, this bridge may become a traffic bottleneck, since this bridge is a 2-lane bridge, even though the approaching roads are 4-lanes.

4.3.4 Problems from Environment

Any environmental problem could not be clearly identified, because only very few data were available. However, the following two points can be described.

a) In Central Urban Area, comparatively high noise level is observed.

b) Until now, only a few studies for environmental aspects have been conducted, therefore, further studies will be required continuously.

4.3.5 Conclusion

Problems regarding road facilities and the road traffic movements are described in the previous sections. Those problems are summarized in Table 4.3.1, together with the basic solutions for each problem. In addition, location map of traffic problem sections are presented in Figure 4.3.1.

Table 4.3.1 Summary of Road Facilities Problems

Point of View	Identification of Problems	Basic Solution Measures
Road Network	1. Shortage of the Road 2. Unlinked Road Network 3. Concentration of Trunk Road Network 4. Improtection of Ring Road Network	* New Road Construction * Road Improvement * Road Rehabilitation * Intersection Improvement * New Bridge Construction * Bridge Improvement * Others
Traffic Volume	5. Traffic Congestion on Road 6. Traffic Bottleneck at Intersection 7. Ineffective Utilization of Road Space	
Road Structure	8. Poor Maintenance 9. Bridge Structure	
Environment	10. High Noise Level 11. Further Study	

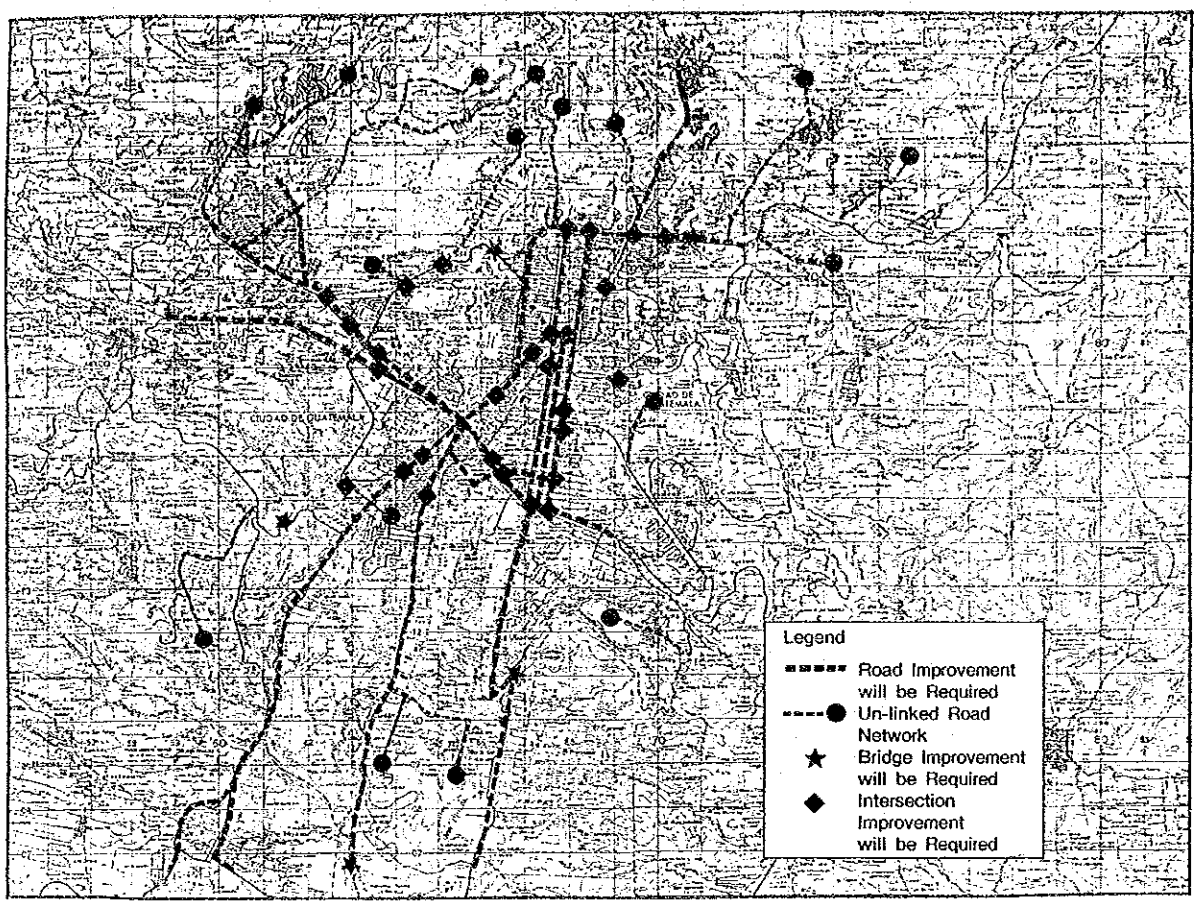

Figure 4.3.1 Location Map of Traffic Problems

5. PUBLIC TRANSPORT

The public transport within the study area consists of the following types.

- Buses
  - Urban buses
  - Urban microbuses
  - Extra-urban buses
- Taxis
- Railways

Compared to the buses, the contribution of taxis and railways to the urban transport is marginal.

5.1 Urban Buses and Microbuses

The urban buses and microbuses are administratively different. Originally microbuses were introduced as a kind of paratransit, that is, flexible small public transport similar to taxis in order to complement insufficient bus services. Since then, however, the number of microbuses with relatively large capacity has increased. At present, differences in functions between the two systems in urban transport are not distinct.

5.1.1 Fleet

There are 2827 urban buses and microbuses operating in Guatemala City. 1634 buses account for 57.8% and 1193 microbuses account for 42.2%. Most buses have 40 to 50 seats. Of all the microbuses, 61.1% have 31 seats or more and 38.9% have 30 seats or less. At least 11.7% have 40 seats or more. Not all microbuses are smaller than buses.

Table 5.1.1 Operating Buses and Microbuses by Company and Size

Buses

Company	Number of buses
ADAZA	33
BOLIVAR	150
CAUSA	19
COOBUSGUA	109
EGA	194
EUREKA	247
FLORIDA	173
LA FE	238
MORENA	97
REFORMA	41
RUTA 40	34
SANTA LUISA	64
SEMSA	16
SERVIBUS	41
UNIBUS	23
UNION	155
TOTAL	1,634

Microbuses

Company	Seat capacity				Total
	40 or more	31 to 39	21 to 30	20 or less	
APMINGUA	0	0	26	53	79
CIUDAD REAL	20	57	30	19	126
COMUN	18	83	27	0	128
FLOMITAX	8	59	15	1	83
MICROPE	1	28	19	0	48
MICROTAX	47	54	14	0	115
RUTA 6	0	15	4	0	19
RAMIX	0	56	25	11	92
RAPITAX	7	35	45	7	94
SERVITAX	3	14	54	0	71
COTRUDEGUA	0	88	52	20	160
VELOTAX	35	86	12	0	133
VILLATAX	0	15	28	2	45
Total	139	590	351	113	1,193
% Share	11.7	49.5	29.4	9.5	100.0

Source : Public Transport Department of Guatemala Municipality

On average, the production year of the buses is 1976. Their actual life is as long as 25 years. The average production year of the microbuses is 1977. 75.8% are models of 1980 or before. Thus there are many old buses and microbuses. A considerable number of them look poorly maintained. Engine exhaust of some is not well treated as in cases of other vehicles.

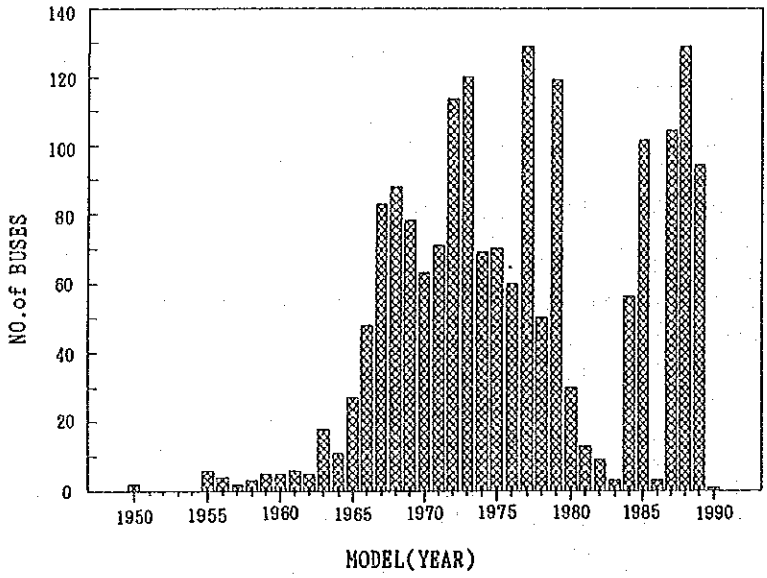

Figure 5.1.1 Registered Buses by Production Year

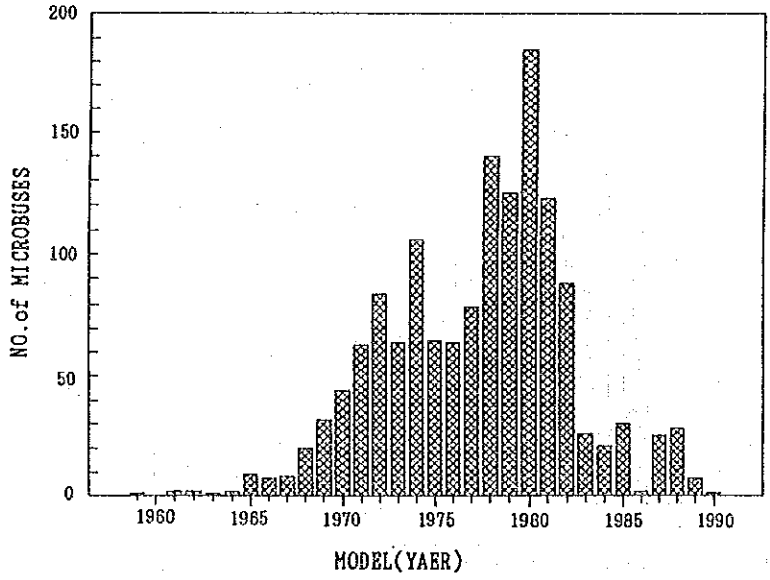

Figure 5.1.2 Registered Microbuses by Production Year

5.1.2 Routes and Operation

69 bus routes and 47 microbus routes cover main towns and colonies in and around the city. Recent changes and expansion of routes include services along the Periferico and for the newly developing residential areas south of Mixco. (See Tables 5.1.2 and 5.1.3)

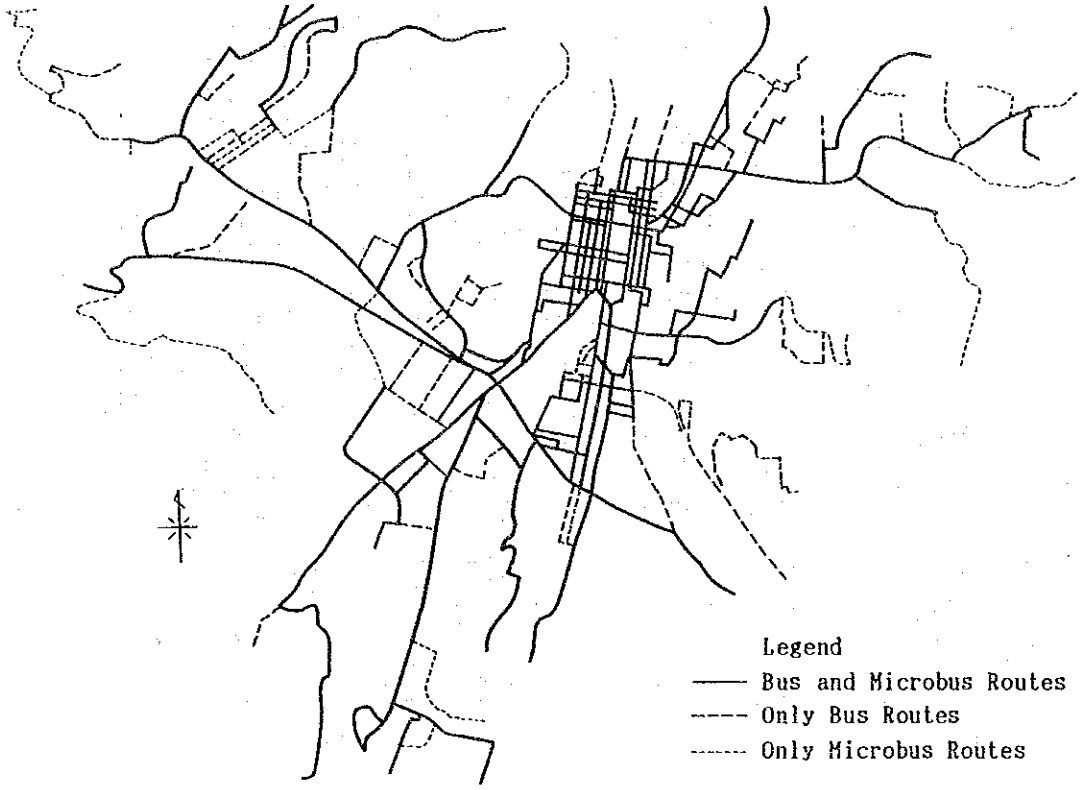

Figure 5.1.3 Urban Bus and Microbus Network

Table 5.1.2 Urban Bus Routes and Operation

Route	Company	Destination	Route length (km)	Frequency per day	No. of buses	Bus · km per day	No. of passengers per day
1VH	Bolivar	G.City	27	9	33	8,019	21,912
1URL	Bolivar	G.City	28	9	33	8,316	21,912
3	Bolivar	Chinautla	27	7	40	7,560	46,687
8A USAC B	Bolivar	Chinautla	33	7	31	7,161	17,640
8A Placita	Bolivar	Chinautla	32.5	7	31	7,053	17,640
8Terminal	Bolivar	Chinautla	32	6	12	2,304	12,015
8Placcita	Bolivar	Chinautla	30.5	9	8	2,196	8,056
10HixcoB.	Morena	Mixco	30	5	64	9,600	31,859
10HixcoT.	Morena	Mixco	30	5	64	9,600	31,859
10BelenB.	Morena	Mixco	31	4.5	27	3,767	14,436
10BelenT.	Morena	Mixco	34.5	4.5	27	4,192	14,436
21MigroT.	Florida	Mixco	36	6	48	10,368	30,144
21MigroB.	Florida	Mixco	31	6	48	8,928	30,144
21SnFcoT.	Florida	Mixco	28	8	50	11,200	31,071
21SnFco8.	Florida	Mixco	27	8	50	10,800	31,071
21BrisasT.	Florida	Mixco	31	7	15	3,255	9,673
21BrisasB	Florida	Mixco	29	7	15	3,045	9,673
21JulioT.	Florida	Mixco	30	8	26	6,240	16,499
21Julio8.	Florida	Mixco	29	8	26	6,032	16,499
16Atlantida	La Fe	G.City	29	6.5	28	5,278	31,841
31Alameda	La Fe	G.City	22	5.5	15	1,815	16,353
17Terminal	La Fe	G.City	44	5	60	13,200	67,277
17Paraiso	La Fe	G.City	40	7	25	7,000	14,170
17Landivar	La Fe	G.City	29	7	25	5,075	14,170
BC Proy Amar	La Fe	G.City	32	6	39	7,488	45,135
BC Trebol Ne	La Fe	G.City	19	6	20	2,280	23,384
BC Pnte Rojo	La Fe	G.City	19	6	20	2,280	23,384
40	Eureka	G.City	14	8.5	29	3,451	35,829
41	Eureka	G.City	21	8.5	14	2,499	14,766
42	Eureka	G.City	21	8.5	14	2,499	17,380
43	Eureka	G.City	21	7	10	1,470	11,389
44	Eureka	G.City	25	7	9	1,575	8,875
45	Eureka	G.City	30	8.5	25	6,375	29,866
46	Eureka	G.City	27	7	15	2,835	17,065
47	Eureka	G.City	24	8.5	13	2,652	13,779
48	Eureka	G.City	32	7.5	10	2,400	10,241
49	Eureka	G.City	23	9.5	12	2,622	12,990
50	Eureka	G.City	25	9.5	12	2,850	12,958
51	Eureka	G.City	26	9.5	6	1,482	5,417
52	Eureka	G.City	32	10	10	3,200	9,406
11Central	Union	G.City	14	9	19	2,394	18,040
11A Terminal	Union	G.City	20	3.5	21	1,470	21,671
12A Reynita	Union	G.City	20	3	37	2,220	23,009
13Central	Union	G.City	23	7.5	38	6,555	19,961
13Reforma	Union	G.City	21	7.5	38	5,985	19,961
20 Sta Fe	Union	G.City	36	3	37	3,996	23,009
Sta Rosita	Union	G.City	12	8	9	864	9,019
70	Ega	G.City	31	7	61	13,237	72,147
71	Ega	G.City	41	5.5	26	5,863	28,543
72	Ega	G.City	31	9	39	10,881	46,464
73	Ega	G.City	25	6.5	13	2,113	6,550
74	Ega	G.City	30	5.5	13	2,145	6,550
76	Ega	G.City	30	7	8	1,680	8,036
77	Ega	Chinautla	31	7	12	2,604	12,122
2Negro	Coobusgua	G.City	22	8	21	3,696	22,535
2A Rojo	Coobusgua	G.City	36	5.5	12	2,376	10,457
5Rojo7Ave	Coobusgua	G.City	14	7	16	1,568	16,739
5R Bolivar	Coobusgua	G.City	14	7	16	1,568	16,739
5Negro7Ave	Coobusgua	G.City	18	7	16	2,016	16,739
5N Bolivar	Coobusgua	G.City	18	7	16	2,016	16,739
90	Adaza	G.City	25.3	6.5	15	2,467	15,282
91	Adaza	G.City	26	6	15	2,340	15,526
92	Adaza	G.City	24	7	4	672	3,303
93	Adaza	G.City	24	6.5	16	2,496	16,803
96	Causa	G.City	37	4.5	24	3,996	10,336
97	Causa	G.City	8	9.5	10	760	27,818
98	Sensa	G.City	37	5	42	7,770	50,461
97	Sensa	G.City	8	9.5	6	456	5,046
6 Sta Fe	Reforma	G.City	26	7.5	11	2,145	9,996
14D Reforma	Reforma	G.City	23	8	15	2,760	21,442
14A Terminal	Eureka	G.City	30	6	24	4,320	30,317
Total			1,887	496	1,709	315,369	1,470,281
Average			26.57	6.99	24.07	4,442.10	20,707.90

Note : 96 Causa and 96 Sensa are regarded to be 2 routes.
97 Causa and 97 Sensa are also regarded to be 2 routes.

Source : Public Transport Division of Guatemala Municipality

Table 5.1.3 Microbus Routes and Operation

Ref. no.	Route	Company	Route length (km)	Frequency per day	No. of micro-buses	Bus · km per day	No. of passengers per day
201	Jardines-Jocotales	Cootrudegua	25	8	39	7,800	25,727
202	Bolivar - J.R.B.	Microtax	29	9	43	11,223	41,500
203	Mixco - Bolivar	Ramix					
204	Mixco Terminal	Ramix	25	9	56	12,600	46,070
205	Belen - Bolivar	Ramix					
206	Belen Terminal	Ramix	27	7	33	6,237	23,840
207	Milagro - Terminal	Flomitax	30	7	9	1,890	7,880
208	Milagro - Bolivar	Flomitax	31	9	43	11,997	40,245
209	Alameda - Centro	Comun	23	10	34	7,820	28,754
210	Amparo - Terminal	Rapitax	24	11	52	13,728	42,921
211	AmparoPuenteTerminal	Rapitax	17	10	52	8,840	43,079
212	Cdd Real-Plz Bolivar	Ciudad Real	24	6	33	4,752	29,560
213	Mezquital-Centro	Cootrudegua	35	6	39	8,190	35,729
214	Nimajuyu-Bolivar	Ciudad Real	28.5	6	28	4,788	25,971
215	Chacara-Centro	Apmimgua	10	10	28	2,800	16,940
216	Chacara-Terminal	Apmimgua	10	10	16	1,600	9,860
217	Terminal-Reinita	Cootrudegua	21	9	9	1,701	8,202
218	Ruta 13	Microfe	20.5	8	26	4,264	21,716
219	Ruta 20	Microfe	22	8	26	4,576	24,634
220	Ruta 14 'A' Terminal	Microfe	14.5	12	23	4,002	18,960
221	SantaRosita-Terminal	Apmimgua	17	10	11	1,870	6,840
222	1.JulioTerm' lBolivar	Servitax	33	9	25	7,425	21,266
223	1.JulioBolivarTerm' l	Servitax	33	9	24	7,128	19,039
224	1.Julio-Periferico	Servitax	31	9	29	8,091	23,724
225	Florida-1. de Mayo	Servitax	14	9	10	1,260	9,232
226	Ruta Maya	Velotax	21	8	51	8,568	48,921
227	Ruta 14 Directo	Microfe	15	12	22	3,960	17,869
228	Ruta 6	Microfe	19	8	3	456	2,600
229	Amparo - Bolivar	Rapitax					
230	Comunidad-Terminal	Ramix					
231	Bolivar-Venezuela	Microtax	24	9	19	4,104	18,600
232	Terminal - Guajitos	Microtax	26	8	23	4,784	21,760
233	Brisas - Terminal	Flomitax	34.5	6	11	2,277	8,948
234	Mezquital - Terminal	Cootrudegua					
235	Jocotales-Terminal	Cootrudegua	21	8	32	5,376	25,358
236	Terminal-Placita	Cootrudegua	4	10	5	200	2,400
237	Ruta Paraiso II	Comun	25	10	36	9,000	34,960
238	Ruta Kennedy	Comun	25.5	8	16	3,264	16,000
239	C.RealNimajuyuTerm' l	Ciudad Real	22	6	13	1,716	11,868
240	Ruta Periferico	Ciudad Real	28	6	26	4,368	20,187
241	INCAP-Ciudad Real	Ciudad Real	9.5	8	9	684	5,230
242	Jardines-Terminal	Apmimgua	11	10	26	2,860	15,030
243	Ruta Limon	Velotax	19.5	8	19	2,964	17,664
244	Ruta Canalitos	Velotax	17	8	7	952	6,960
245	Ruta Llano Largo	Velotax	29	8	18	4,176	18,116
246	Galilea	Velotax	20	9	8	1,440	7,303
247	Pinares	Comun	26	10	10	2,600	9,180
	Total		941.5	361	1042	208,331	880,643
	Average		22.42	8.60	24.81	4,960.26	20,967.69

Source : Public Transport Division of Guatemala Municipality

The skeleton of the urban public transport network is composed of several major suburban corridors and a triangular configuration of the Centro, the Trebol and Zone 9, which includes the stop at Avenida Castellana. Among the major corridors, Calzada San Juan Sacatepequez (NR5), Calzada Roosevelt (CA1West), Calzada Raul Aguilar Batres (CA9South) and CA9North carry the largest numbers of public transport. Of these 4 corridors, NR5 and CA9South have more bus traffic than microbus traffic, and CA1West and CA9North have more microbuses than buses.

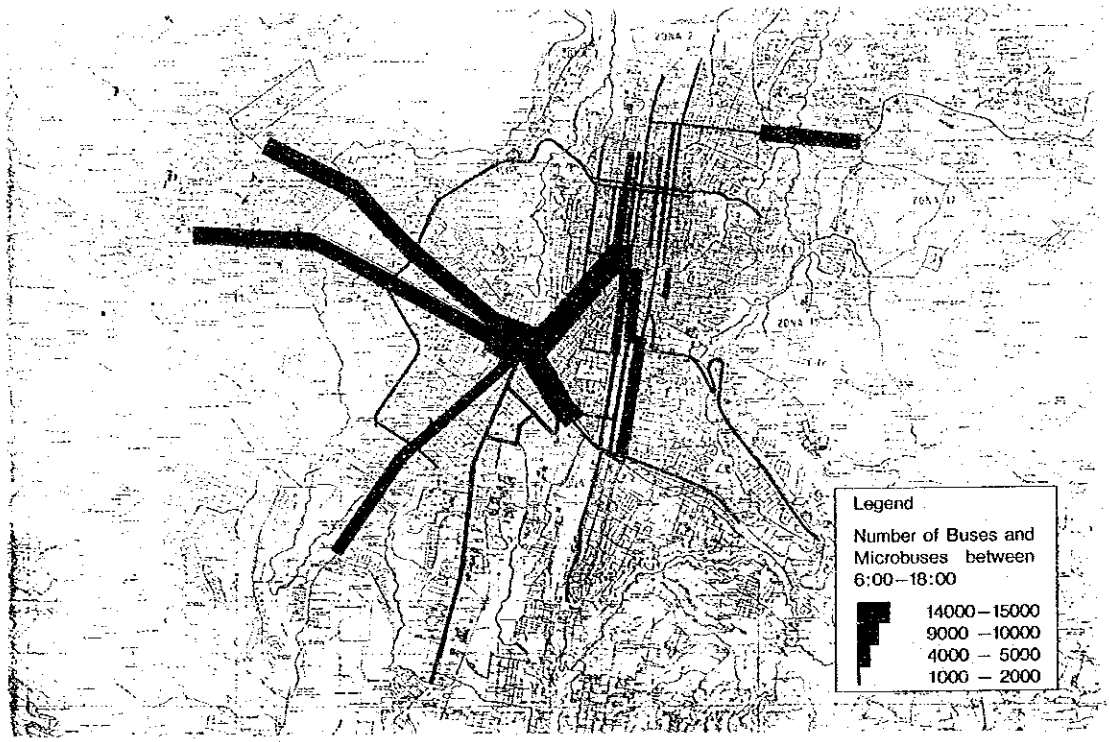

Figure 5.1.4 12 Hour Traffic Volume of Buses and Microbuses

Bus routes as well as road networks are largely constrained by a number of very steep and deep valleys surrounding the city.

Most routes have terminals at both ends in suburbs and pass through the central districts. At the terminals, operation of buses and microbuses are controlled by the operators.

No distinct hierarchy of the routes is observed. Routes of buses and microbuses are not clearly separated. There are certain road sections which are only served by either buses or microbuses but there are also a number of roads served by both systems.

Operation hours vary with routes. In general, buses operate form 5:00 or 6:00 to 20:00 or 21:00 with some exceptions such as a route to Colonia Primer de Julio, where operation is till midnight.

Operation hours of microbuses are longer. Generally they operate form around 5:00 till after 21:00. Operations decrease late at night but some microbuses do operate even around midnight such as routes to Jardines, Joco-

tales, Maya, Amparo, Justo Rufino Barrios, Nimajuyu and Ciudad Real.

The average route lengths of a round trip are 26.6 km for buses and 22.4 km for microbuses. In general, bus routes are longer than microbus routes.

The average numbers of vehicles in operation along a route are 24.1 buses and 24.8 microbuses. Routes for Mixco have a comparatively large number of buses and microbuses.

The average frequencies per route of buses is 160.2 and that of microbuses is 215.0. On average, a bus makes 7.0 round trips and a microbus 8.6 round trips. The headway of buses varies from 3 minutes to 13 minutes with an average headway of 5.2 minutes.

Microbuses are usually a little faster than buses because microbuses are smaller and have a conductor for collecting fares, while in buses it is the drivers' responsibility. According to sample surveys during morning hours, the average travel speed of the buses was 15.9km/h and that of the microbuses was 19.3km/h. Most routes had sections with a speed of less than 12km/h.

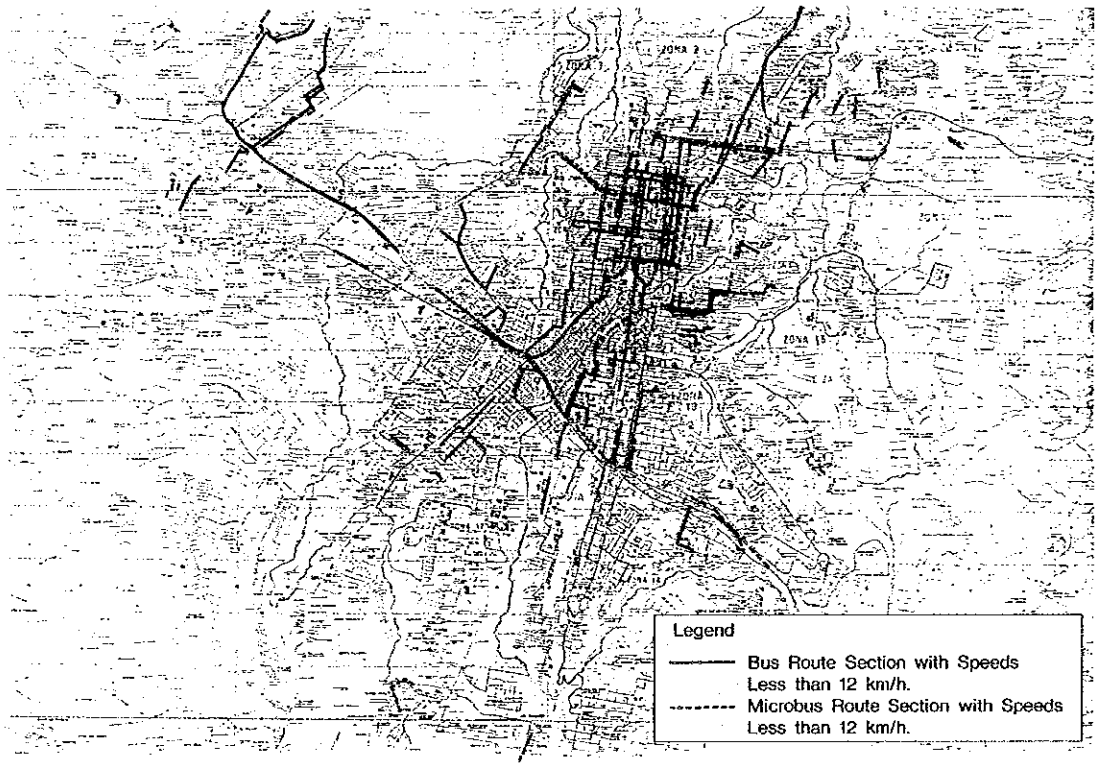

Figure 5.1.5 Low Speed Sections of Surveyed Urban Buses and Microbuses

Operation of buses and microbuses is controlled by each company, however control on microbuses at night is loose.

Bus drivers collect fares and give tickets basically when passengers get on the buses. Every microbus has a conductor for calling the destination and ticketing. Microbuses use tickets only from 5:00 to 21:00.

5.1.3 Terminals and Stops

There are 87 urban bus and/or microbus terminals in Guatemala City in addition to extra-urban bus terminals and international bus terminals.

Urban bus and microbus routes start or terminate their operation at these terminals. Most terminals are located in the suburbs. At many terminals, there are no special facilities for bus operation and buses are waiting for their turn on the road. However, many of the terminals seem to have customer facilities such as local open-air markets, restaurants, shops, etc.

Many bus/microbus stops are not established ones. Most of them are without bus stop facilities. Only 16.9% of the observed stops have sign posts and 10.3% have bus bays.

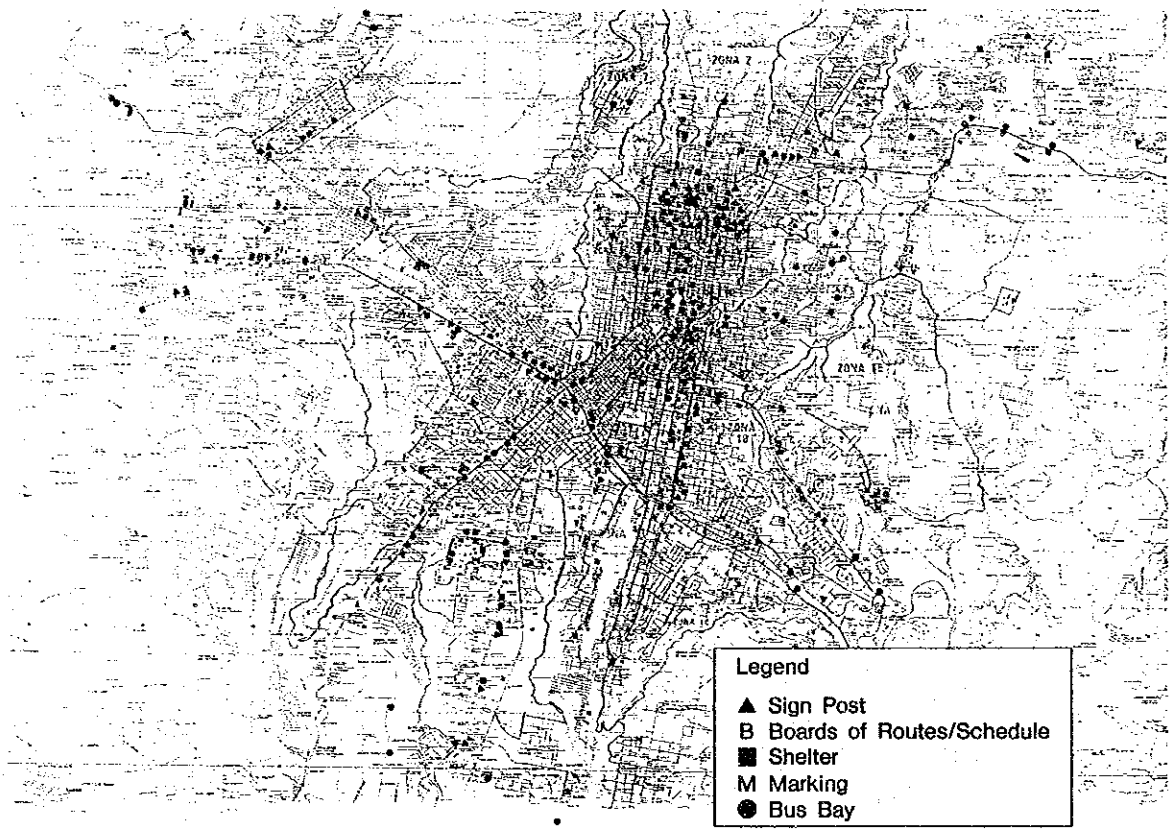

Figure 5.1.6 Location of Facilities at Bus and Microbus Stops

Buses and microbuses do not only stop at specified locations. They usually stop at most corners where there are passengers getting on or off especially in the central districts. To be exact, they often stop just before cross roads regardless of the traffic signals and the frequent stops sometimes disturb the traffic flow.

At major stops, passengers often rush to one direction and another trying

to catch the right buses because the range where the expected buses may stop is quite long.

According to the sample surveys, the average distance between bus stops was 411m and that of microbus stops was 609m. The microbuses do not necessarily work as a feeder service.

5.1.4 Passengers

The buses transport 1,470,000 passengers and the microbuses transport 881,000 passengers totaling daily 2,351,000 passengers. The ratios of passengers to vehicles are 860 passengers per bus and 845 passengers per microbus. According to the sample surveys during morning hours, an average bus with 37.1 seats had 40 passengers and an average microbus with 30 seats had 31 passengers. Areas of congestion over 1.5 times the seat capacity were seen in central zones and along major corridors. (See Table 5.1.4 and Figure 5.1.7)

Table 5.1.4 Summary of Passengers Counting Survey Results

Items	Urban Bus (40 routes)	Urban Microbus (29 routes)	Extra-urban Bus (8 routes)
Average Seat Capacity	37.1	30.0 (20.6,39.4)	36.9
Average Distance between Stops (m)	411	609 (565,622)	1023
Average Number of Passengers per Distance	40.0	31.0 (27.0,35.4)	46.5
Average Trip Distance of a Passenger (km)	5.219	6.466 (5.231,7.466)	11.4
Travel Speed (km/h)	15.9	19.3	22.4
Round Trip Time (minutes)	98	75	52
No. of Routes with Congestion over 1.5 times Seat Capacity	34	17	6
No. of Routes with at least 2 Consecutive Sections with less than 12km/h	46	26	6

Note: Numbers with parenthesis indicate smallest and largest number.

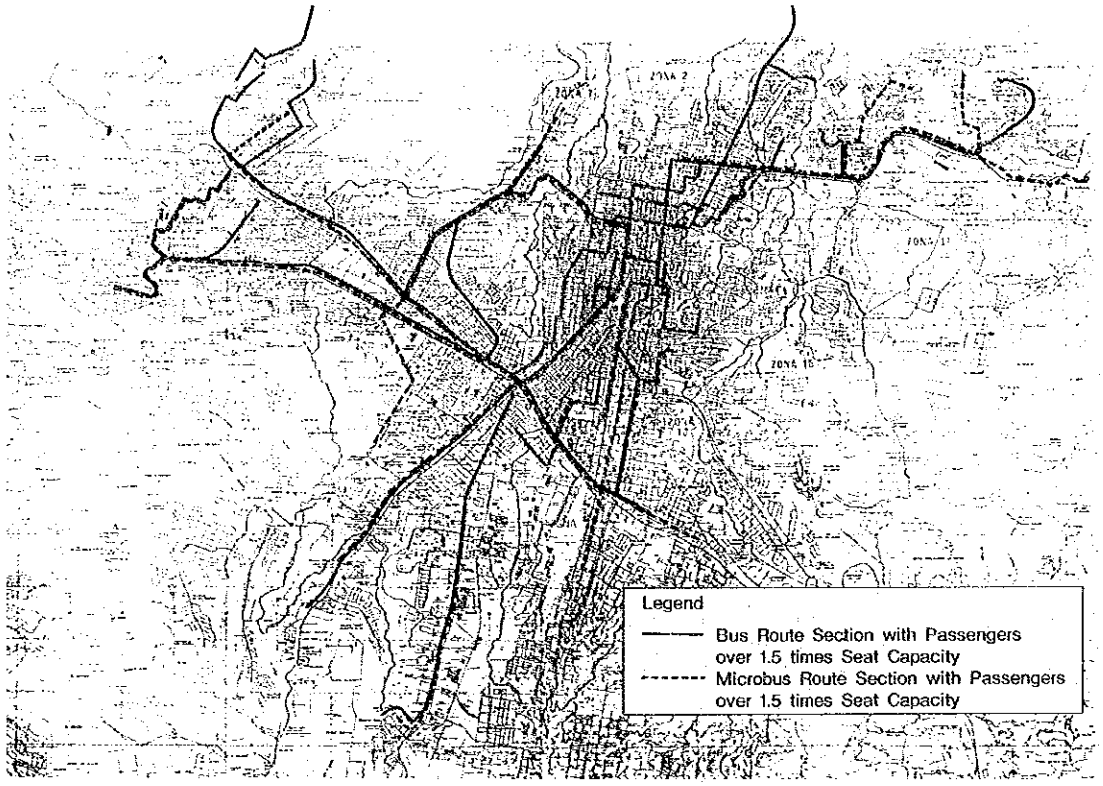

Figure 5.1.7 Heavily Congested Section of Surveyed Route

The average number of bus passengers along a round trip is 129.3 passengers and that of microbuses is 97.5.

5.1.5 Operators' Organizations and Administration

Buses and microbuses are operated by 16 companies and 13 companies respectively.

The average number of operating buses of each organization is 102 and that of microbuses is 92.

Owners of buses or microbuses belong to any one of these organizations and operate their vehicles under the organization's control. The owners are responsible for maintenance of their vehicles. They collect fares, pay to the drivers (and conductors in case of microbuses) and contribute a certain amount to the organization.

Bus drivers, microbus drivers and conductors usually work in 2 shifts. The salaries are paid on a daily basis. The amounts are not proportional to the sales but the drivers and conductors are given a certain number of tickets expected to be sold in a shift.

Within an organization, buses are rotated among different routes every week to maintain fair income distribution among the different buses.

The public transport department of the municipality is in charge of

licensing the bus and microbus operation. It also monitors the operation and grant subsidies provided by the Ministry of Finance.

The urban planning unit of the municipality is responsible for urban planning including public transport planning.

The public service division of the municipality is in charge of constructing public facilities including signs and shelters at bus stops.

5.1.6 Financial Situation

In December 1990, the bus and microbus fare in the daytime on weekdays was increased from Q0.20 to Q0.40 (Q0.20 for students) due to the recent cost increase such as diesel price from Q2.80 to Q5.95. Between April and December 1990, bus operation cost increased by nearly 90% besides the increase of bus prices.

The annual subsidy of Q72 million from Ministry of Finance is distributed to bus and microbus owners. A bus is given approximately Q80 for 10 hours of daily operation. This is nearly equal to Q0.1 per ticket. The subsidy scale of microbuses varies with the size.

As of December 1990, a typical new bus could be purchased by a down payment of Q78,500 and 60 monthly payments of Q2,350. The total loan payment is Q219,500. The daily operation cost is estimated at Q335, of which diesel accounts for 44.5%, drivers' salaries for 17.6%, parts for 12.3% and tires for 8.9%.

Table 5.1.5 Estimation of Bus and Microbus Costs

Urban Buses

April 1990 Case	Daily Q	Annual Q	% to ope. cost
Fixed Cost	54.3	19,814	30.2
Drivers salary	41.1	15,015	22.9
Mechanics salary	2.4	864	1.3
Plate&operat'ncard	0.3	100	0.2
Parking	2.0	720	1.1
Administration	1.2	420	0.6
Tax(923passengers)	7.4	2,695	4.1
Variable cost	125.7	45,883	69.8
Diesel	70.0	25,550	38.9
Oil	5.8	2,114	3.2
Tires	22.3	8,139	12.4
Repair&maintenance	27.6	10,080	15.3
Operation cost	180.0	65,697	100.0
Fare income	184.6	67,379	102.6
Subsidies	96.7	35,307	53.7
Payment for a bus			
Down payment		47,955	73.0
Loan(Q4450.93*36m)	146.3	53,411	81.3

Urban Buses

December 1990 Case	Daily Q	Annual Q	% to ope. cost
Fixed Cost	96.1	35,087	28.7
Drivers salary	59.0	21,534	17.6
Washing	2.5	913	0.7
Administration	19.9	7,250	5.9
Tax(923passengers)	14.8	5,390	4.4
Variable cost	238.5	87,050	71.3
Diesel	148.8	54,294	44.5
Oil	9.1	3,325	2.7
Flat tires repair	0.4	157	0.1
New tires	17.8	6,504	5.3
Recycled tires	11.4	4,161	3.4
Parts	41.1	15,000	12.3
Services	9.9	3,609	3.0
Operation cost	334.6	122,136	100.0
Fare income	369.2	134,758	110.3
Subsidies	96.7	35,307	28.9
Payment for a bus			
Down payment		78,500	64.3
Loan(Q2350.33*60m)	77.3	28,204	23.1

Urban Microbuses

December 1990 Case	Daily Q	Annual Q	% to ope. cost
Fixed Cost	124.3	45,357	36.4
Drivers salary	59.0	21,534	17.3
Assistants salary	29.5	10,767	8.7
Washing	2.5	913	0.7
Administration	19.9	7,250	5.8
Tax(838passengers)	13.4	4,894	3.9
Variable cost	216.7	79,107	63.6
Diesel	130.9	47,779	38.4
Oil	9.1	3,325	2.7
Flat tires repair	0.4	157	0.1
New tires	13.9	5,077	4.1
Recycled tires	11.4	4,161	3.3
Parts	41.1	15,000	12.1
Services	9.9	3,609	2.9
Operation cost	341.0	124,465	100.0
Fare income	335.2	122,348	98.3
Subsidies	69.1	25,221	20.3
Payment for a bus			
Down payment		39,000	31.3
Loan(Q1167.68*60m)	38.4	14,012	11.3

Source : Public Transport Division of Guatemala Municipality

The annual balance before subsidy is a deficit of Q94,100 in the initial year, a deficit of Q15,600 from the second to the fifth year and a gain of

Q12,600 after the loan period. The balance after subsidy is a deficit of Q58,800 in the initial year, a gain of Q19,700 in the loan period and a gain of Q47,900 afterward.

Compared to April 1990, the situation of December 1990 seems to be favorable for bus operators in general terms.

A typical case of microbus operation shows more operation cost than a bus due to the assistants' salaries. The ticket income and subsidy of microbuses are generally less than those of buses. However, they operate for higher fares at night and on weekends without tickets.

It should be noted that the above discussions are general and that the actual profitability varies with routes and changes of financial environments.

5.1.7 Problems and Issues

The following letters in brackets show groups directly concerned with each problem such as (P) for passengers, (O) for operators and (G) for the government.

1) Fleet

Old and poorly maintained buses and microbuses (P)

2) Passengers Service

Congestion in buses in peak hours (P)
Low service level in suburbs and at night (P)
Low operation speeds in peak hours (P,O)
Lack of operation information (P)
Lack of security/safety of buses (P)
Lack of bus stop/terminal facilities and of transfer functions (P)
Not systematic movement of buses and passengers at key bus stops and terminals (P,O)

3) Traffic and Environment

Traffic congestion on roads (O,Other vehicles)
Frequent stops of buses especially in Centro (Other vehicles)
Air pollution by exhaust gas (Environment)

4) Types of Public Transport

No distinct functional difference between buses and microbuses (P,O)
Only one dominant type of urban public transportation (P,O)
No hierarchical structure of public transportation (P,O)

5) Public Measures

Unpaved, narrow or steep roads in suburbs (P,O)
No bus priority measures (O,P)
Insufficient measures to improve service (O,P)
No institutional maintenance system (O)

6) Finance

Fare increase (P)
Cost increase (O)
Subsidies as burden of the central government (G)

7) Organizations

Associations as groups of individual owners (O)
No rigid organization (O)

5.2 Extra-urban Buses

There are 3 types of extra-urban buses operating within the study area. They are buses connecting Guatemala city and the centers of the municipalities, buses connecting Guatemala city and small towns and villages in the municipalities, and buses connecting the centers of municipalities and their neighboring places.

5.2.1 Fleet

The numbers of routes and registered vehicles for intra-departmental transport are as follows.

Table 5.2.1 Number of Routes and Vehicles

Types of Routes	Number of Routes	Number of Buses/Microbuses
Total	92	527
Guatemala City & Municipality Center	17	300
Guatemala City & Small Town/Village	65	200
Municipality Center & Small Town/Village	10	27

5.2.2 Buses Connecting Guatemala City and Municipality Centers

There are 17 routes of extra-urban buses connecting Guatemala city and municipality centers in and around the department of Guatemala. Destinations of 9 routes are the centers of the 9 municipalities in the study area and the remaining 8 destinations are outside the study area. (See Table 5.2.2)

For 14 routes with data, 300 buses with a total of 16300 seats are authorized. Actually, however, some 370 buses with approximately 20200 seats are operating. In some routes such as Villa Nueva and San Juan Sacatepequez routes, operating buses and their seats are much more than those registered. In other routes such as San Pedro Ayampuc and Amatitlan, operating buses and their seats are less than those registered.

On an average, one route has 26.3 operating buses with a total of 1446 seats.

The total number of passengers on one way through the counted 15 routes is approximately 32,200. The total number of the two way passengers is thought to be approximately 64,000. The figure is approximately 4.1% of the total number of passengers of the urban buses (not microbuses) on a week day.

The average occupancy rate is 85.6%.

The daily average travel distance of a bus is 93.3 km.

The average frequency of a route is 1.95 round trips per day. The bus routes in the study area are mostly paved. Exceptions are the 12 km route to Chinautla and a 9 km route section out of the total 27 km route to Fraijanes.

Among major extra-urban bus routes surveyed by the study team in 1990, the Villa Nueva route has 9,656 one way passengers, the San Juan Sacatepequez route has 5,525 and the Villa Canales route including the Petapa route has 4,965. Not like the top 3 routes, the Mixco route carries only 1,542 one way passengers because the urban bus and microbus routes are available to Mixco at cheaper prices.

Table 5.2.2 Extra-urban Buses Connecting Guatemala City and Municipality Centers

Ref No.	Destination	No. of Companies	No. of authorized vehicles	No. of authorized seats	Actual no. of vehicles	Actual no. of seats	No. of passengers	Average occupancy ratio	Average distance /bus (km)	Average frequency /day	Passenger *km/day
1	Mixco	6	15	724	12	668	1,542	0.78	144	3.0	33,924
2	SnLucasSacz	1	1	66	1	66	199	0.86	196	3.5	5,572
3	S.Cat.Pinula	2	2	96	16	834	1,630	0.74	81	2.7	24,450
4	S.JosePinula	9	14	754	29	1,561	3,273	0.87	106	2.4	72,006
5	VillaCanales	7	65	3,613	55	3,170	4,965	0.82	76	1.9	99,300
6	Amatitlan	22	41	2,446	32	1,923	2,935	0.89	95	1.7	82,180
7	Vila Nueva	17	68	3,818	106	5,815	9,656	0.70	74	2.3	154,496
8	SnMig.Petapa										
9	Chinautla										
10	Palencia	7	10	523	11	673	627	0.94	26	1.0	16,302
11	SnPedAyampuc	8	13	634	1	48	37	0.77	44	1.0	814
12	Sn.PedroSac.	3	3	144	2	114	181	0.90	96	2.0	4,344
13	SanJuanSac.	5	57	2,888	81	4,207	5,525	0.97	84	1.4	165,750
14	Sn.Raymundo	2	5	256	8	406	377	0.85	97	1.1	16,588
15	Chuarrancho	2	2	96							
16	Fraijanes	1	4	204	10	540	924	0.98	97	1.8	24,948
17	S.J.delGolfo				4	218	288	0.92	90	1.5	8,640
	Total	92	300	16,262	368	20,243	32,159	11.99	1,306	27.3	709,314
	Average	6.57	21.43	1,161.57	26.29	1,445.93	2,297.07	0.86	93.29	2.0	50,665.29

Note : Sn.Higuel Petapa route is included in Villa Canales route.

Source : Extra-urban Transport Department
Ministry of Communications, Transport and Public Works

5.2.3 Buses Connecting Guatemala City and Small Towns and Villages in Municipalities

188 buses and 2 microbuses are authorized for routes connecting Guatemala city and places other than municipality centers in the department of Guatemala. (See Table 5.2.3)

The total number of companies authorized for each route is 95. This means that each company for a route has 2 buses on average.

The total number of seats is 9573. The average number of seats of a vehicle is 50.4 seats. One company has 100.8 seats on an average.

The average route length is 30.6 km, of which 22.6 km or 74.1% is paved and 7.9 km or 25.9% is not paved.

There are some 65 destinations. One destination has 2.9 buses on an average.

The following can be noted as the major characteristics of this category of routes.

i Bus companies are small scale individual companies.

ii Each route has small service capacity, reflecting the destinations' population.

iii Frequencies are generally low.

According to a survey by the urban planning unit of Guatemala Municipality on July 19 and 20, 1990, routes to Peronia and San Cristobal in Mixco Municipality have a two-way total of 12,335 passengers. The southern areas in Mixco Municipality is a newly growing housing areas.

Table 5.2.3 Extra-urban Buses Connecting Guatemala City and Small Towns/Villages in Municipalities

Ref. No.	Destination	No. of authorized companies	No. of authorized vehicles		No. of authorized seats		Distance	
			Buses	Microbuses	Buses	Microbuses	Paved	Unpaved
1	MIXCO							
1.1	SnJoseComunidad	1	2		96		19	
1.2	Las Terrazas	1	1		36		26	
1.3	Ciudad Peronia	1	2		126		15	
4	SAN JOSE PINULA							
4.1	Sta Rita	7	1		54		22	8
4.2	Sta Rita		1		60		22	8
4.3	Sta Rita		3		156		22	8
4.4	Sta Rita		3		178		22	8
4.5	Sta Rita		1		54		22	8
4.6	Sta Rita		1		54		22	8
4.7	Sta Rita		1		50		22	8
4.8	Aldea LasMonas	1	3		152		33	
4.9	Cienaga Grande	1	1		66		18	4
5	VILLA CANALES							
5.1	AldeaLosPuntos	1	7		388		52	
5.2	Bal.Los Orantes	2	1		54		25	2
5.3	Bal.Los Orantes		1		48		25	2
5.4	Aldea El Tablon	2	2		110		25	2
5.5	SnJose ElTablon		2		105		25	2
5.6	Aldea ElDurazno	1	2		100		20	5
5.7	Ald BocaDelMonte	1	2		102		13	
5.8	CaseriaElZapote	1	1		48		20	4
6	AMATITLAN							
6.1	AldSnJoseCalder	1	7		388		37	8
6.2	Ald Patrocinio	1	2		109		37	12
6.3	Ald Las Trojas	1	1		48		28	4
7	VILLA NUEVA							
7.1	Aldea El Carmen	2	1		50		5	13
7.2	Aldea El Carmen		1		50		5	13
7.3	Aldea Ramirez	4	8		406		16	3
7.4	Aldea Ramirez		1		60		16	3
7.5	Aldea Ramirez		1		46		16	3
7.6	Aldea Ramirez		1		66		16	3
7.7	VilClubElDorado	1	1		36		12	
7.8	Valle Dorado	1	1		40		12	
7.9	Barcenas	2	5		266		16	3
7.10	Barcenas		1		46		16	3
7.11	CaserElCalvario	1	5		48		16	15
7.12	Villalobos	1	1		48		13	
8	SAN MIGUEL PETAPA							
8.1	Sta Ines Petapa	8	2		96		23	
8.2	Sta Ines Petapa		3		171		23	
8.3	Sta Ines Petapa		1		60		23	
8.4	Sta Ines Petapa		1		50		23	
8.5	Sta Ines Petapa		1		66		23	
8.6	Sta Ines Petapa		2		102		23	
8.7	Sta Ines Petapa		1		45		23	
8.8	Sta Ines Petapa		1		48		23	
8.9	Granja Gerona	1	1		50		20	
9	CHIRAUTLA							
9.1	SnAntoLasFlores	2	4		194			12
9.2	SnAntoLasFlores		1		60			12
9.3	Bacojito	1	1		45		28	12
9.4	AldeaFrexSabana	1		2		48		13
10	PALENCIA							
10.1	Ald Plan Grande	1	1		48		19	25
10.2	Ald Los Mixcos	3	1		48		19	11
10.3	Ald Los Mixcos		2		108		19	11
10.4	Ald Los Mixcos		2		104		19	11
10.5	Aldea SnGuayabo	1	1		58		19	13
10.6	Ald El Matillo	1	1		49		19	27
10.7	Los Tecomates	3	1		68		22	14
10.8	Los Tecomates		1		54		22	14
10.9	Los Tecomates		1		66		22	14
10.10	Santur	2	2		102		19	18
10.11	Santur		1		48		17	16
12	SAN PEDRO AYAMPUC							
12.1	Aldea Chillani	1	2		102		16	10
12.2	SnJose LaOrtega	1	2		98		24	9
12.3	Ald BuenaVista	1	1		48		24	1
13	SAN JUAN SACATEPEQUEZ							
13.1	Ald CiudQuetzal	3	1		46		18	7
13.2	Ald CiudQuetzal		2		96		18	7
13.2	Ald CiudQuetzal		2		120		16	7
13.4	Aldea Sacsuy	1	1		54		17	7
13.5	Realguitz	1	1		54		33	11
13.6	Ald Sajcavilla	2	1		69		24	7
13.7	Ald Sajcavilla		5		260		24	7
13.8	Los Cuates	1	5		196		37	10
13.9	Estan la Virgen	1	5		196		37	10
13.10	Sabanas	1	1		48		37	11
13.11	Aldea Pachun	1	5		196		37	14
13.12	Caserio Cuenich	1	1		48		37	3
13.13	Caser Patzanes	1	1		48		37	7
13.14	Fca Rodefuentes	1	1		49		16	18
13.15	Caser de Sacsuy	1	1		156		37	21
13.16	Ald de Carranza	1	3		145		16	4
13.17	Montufar	1	1		50		42	10
13.18	Fca El Pilar	1	2		102		30	5
13.19	Caser El Pilar	1	1		48		30	5
13.20	Comunidad Zet	1	1		50		38	4
13.21	Estancia Grande	1	1		54		37	15
13.22	Caserio Ajute	1	1		48		37	8
14	SAN RAYMUNDO							
14.1	Llano DiaVirgen	1	4		210		44	4
14.2	Aldea El Zarzal	1	5		196		44	5
15	CHURRACHCO							
15.1	Canton LaCumbre	1	1		40			42
16	FRAIJANES							
16.1	Ald El Cerrito	2	2		96		17	15
16.2	Ald El Cerrito		1		48		19	15
16.3	GranjPenal Pavon	2	1		72		21	
16.4	GranjPenal Pavon		6		302		21	
17	SAN JOSE DEL GOLFO							
17.1	El Carrizal	1	3		143		19	15
17.2	SnAnton ElAngel	1	1		49		19	27
17.3	Lova Tendida	1	4		218		19	27
17.4	Aldea Chulena	1	4		218		19	18
	Total	95	166	2	9,533	48	2,158	751
	Average	1.68	1.48	0.02	188.35	0.42	22.63	7.93

Source : Extra-urban Transport Department
Ministry of Communications, Transport and Public Works

5.2.4 Buses Connecting Centers of Municipalities and Neighboring Places

7 municipality centers in the department of Guatemala have local bus services to neighboring places. 5 of them are in the study area, namely Mixco, Santa Catarina Pinula, Villa Canales, Amatitlan and Villa Nueva.

Table 5.2.4 Extra-urban Buses Connecting Centers of Municipalities and Neighboring Places

Ref No.	Route Origin / Destination	No. of authorized companies	No. of authorized vehicles		No. of authorized seats		Distance (km)	
			Buses	Microbuses	Buses	Microbuses	Paved	Unpaved
1	MIXCO							
1.1	C.Satelite	1	2		97		3	3
3	SANTA CATARINA PINULA							
3.1	Aldea El Pilar	4	1		48		3	
3.2	Aldea El Pilar		2		114		3	
3.3	Aldea El Pilar		1		66		3	
3.4	Aldea El Pilar		1		60		3	
5	VILLA CANALES							
5.1	Sta Elena Barillas	1		1		24	15	
6	AMATITLAN							
6.1	Aldea Laguna Seca	1		1		21		8
6.2	Aldea El Tacaton	1	1		54		15	
6.3	Aldea Los Trojes	1		1		21		4
6.4	Aldea El Durazno	1		1		21		8
7	VILLA NUEVA							
7.1	Aldea Ramirez	6		2		46		3
7.2	Aldea Ramirez			2		40		3
7.3	Aldea Ramirez			2		40		3
7.4	Aldea Ramirez			2		40		3
7.5	Aldea Ramirez			2		42		3
7.6	Aldea Ramirez			2		40		3
13	SAN JUAN SACATEPEQUEZ							
13.1	Pachali	2	1		25		7	
13.2	Pachali		1		60		7	
14	SAN RAYMUNDO							
14.1	San Pedro Sac.	1	1		48		21	
	Total	19	11	16	572	335	80	41
	Average	1.00	0.58	0.84	30.11	17.63	4.21	2.16

Source : Extra-urban transport Department
Ministry of Communications, Transport and Public Works

In the department, there are 11 buses and 16 microbuses authorized to operate between municipality centers and neighboring places. They are operated by 19 companies. One company on an average has 1.4 vehicles or 47.7 seats.

The total capacity is 907 seats.

The average route length is 6.4 km, of which 4.2 km or 66.1% is paved and 2.2 km or 33.9% is not paved.

In this category, the operation scale is small as in the second case. The number of microbuses is more than that of buses. The share of paved routes is relatively low.

5.2.5 Routes and Terminals of Extra-urban Buses

Major extra-urban bus routes are CA 9 North, National Route 5, CA 1 West, CA 9 South, CA 1 East and Departmental Road 1.

Major terminals of extra-urban buses in Guatemala City are Zone 4 Terminal, Zone 6 Terminal and scattered terminals in Zone 1.

Most extra-urban bus terminals are located in Zone 1 such as in front of the FEGUA station and north or west side of the national theater. The zone 6 market is also an important extra-urban terminal mainly towards eastern peripheries of the city and/or along CA9 north. Many of the terminals do not have any special facilities for buses except for open space on the streets.

However, zone 4 terminal, by-far the largest extra-urban bus terminal, is equipped with 86 passenger bus bays and some 13 bays for cargo handling. The terminal is located together with the market in an enclosed area.

The 86 bus bays are arranged in 4 rows according to the destinations, namely Department of Guatemala, eastwards, westwards and southwards/southeastwards in the country. At the cargo bays, not only trucks and pickups but also urban microbuses and extra-urban buses mainly for cargo operate.

International bus terminals are located at Zone 1, Zone 6 and Zone 9. They have off-street park space, passengers facilities and offices.

According to a survey conducted by the extra-urban bus department, 981 buses (68.8%) departed from zone 4 terminal, 21 buses (1.5%) from the zone 6 terminal and 423 buses (29.7%) from other various terminals.

The shares of zone 4 terminal is largest except for the CA9North route. 96.7% of the buses along the route left from other terminals including the zone 6 terminal, which is mostly used by the CA 9 North routes.

Bus terminals at municipality centers are typically located at the centro of each municipality together with a park, a church, a market and the municipality office.

Extra-urban buses collect additional passengers after leaving the terminals at some key locations such as Avenida Bolivar and Trebol.

On the way to terminals in Guatemala city, many passengers get off the buses at their convenient locations before the terminals.

Based on various surveys, the flow of extra-urban buses can be roughly estimated. Among the major corridors, CA9South and CA1West have the heaviest flow, most of which is for Zone 4 Terminal and/or terminals in Zone 1.

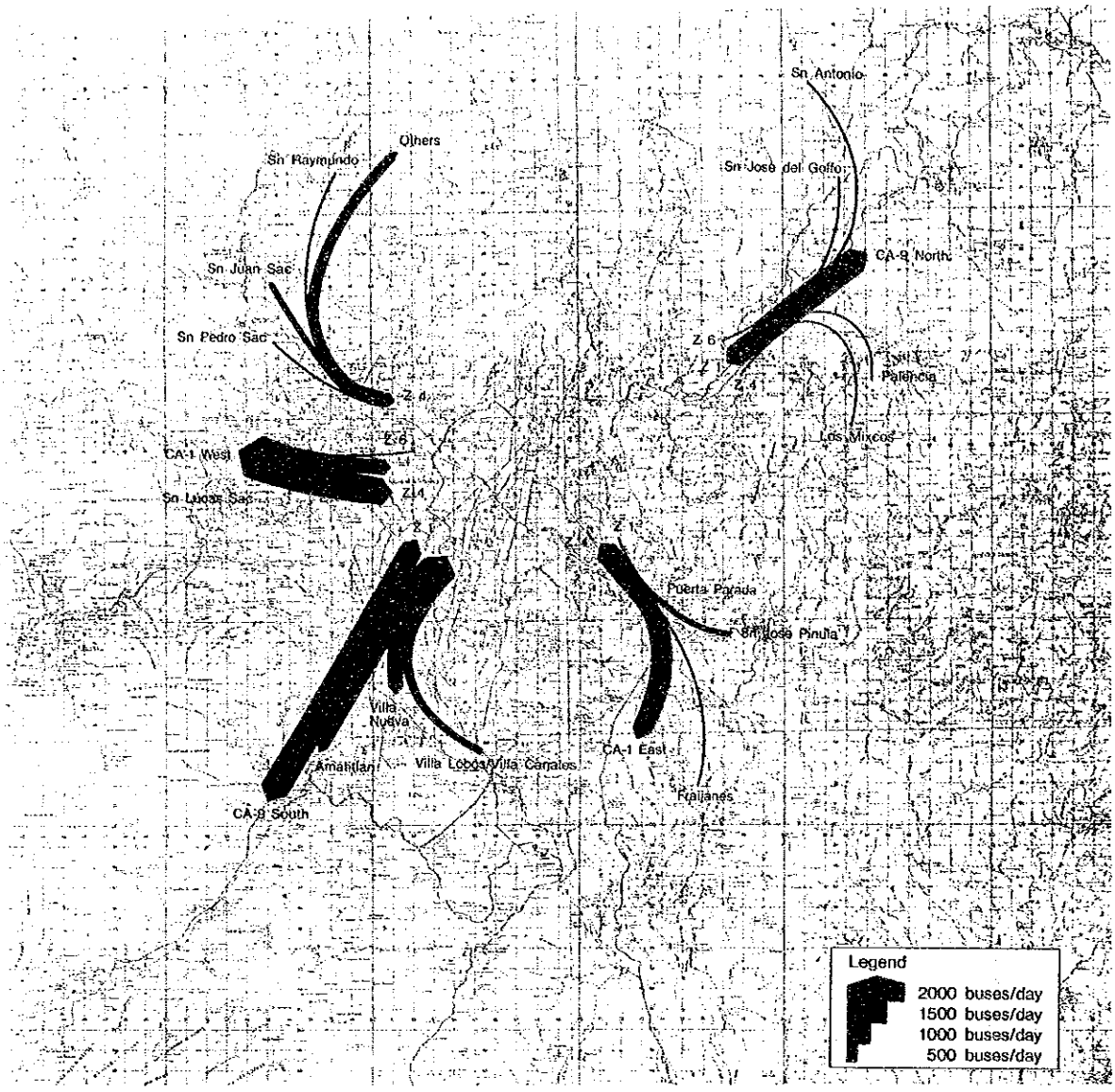

Figure 5.2.1 Estimated Flow of Extra-urban Buses

5.2.6 CENMA (Central de Mayoreo) Project

The zone 4 market has both wholesalers and retailers together with an extra-urban bus terminal. Both market functions are mixed and sprawl to surrounding areas. In order to solve the problems from an urban planning point of view, the wholesalers are planned to relocate to a location some 6 km south of Trebol on a branch road from CA 9 South.

This project called CENMA is under construction. According to the project, the zone 4 market will be improved as retail market only when the wholesalers relocate.

The project includes a new bus stop in the new market but it does not include relocation of the extra-urban bus terminal.

5.2.7 Administration and Tariff

Extra-urban buses and international buses are operated by private entrepreneurs under the supervision of the extra-urban bus department of the Ministry of Communications, Transport and Public Works.

The tariff scales of extra-urban buses were changed in November 1990 due to the cost increase.

	on paved roads	on unpaved roads
Before November 1990	Q0.0335/paxkm	Q0.0489/paxkm
After November 1990	Q0.0526/paxkm	Q0.0768/paxkm

Subsidies are not given to extra-urban buses. Extension of urban buses and microbuses outside the city boundary can cause unfair competition between extra-urban buses without subsidies and urban buses and microbuses with subsidies.

The municipality's office in the zone 4 terminal is supervising use of the terminal by extra-urban bus operators.

5.2.8 Problems and Issues

(1) Operation

1) Routes from suburban municipality centers to Guatemala City have congestion and low speed sections. (See Figures 5.2.2 and 5.2.3)

2) Routes between Guatemala City and local places other than municipality centers and routes between municipality centers and local places have generally low level of services

3) Functional linkage between extra-urban and urban bus routes and operation is yet to be improved.

4) There are unpaved routes mostly in suburbs

5) Most operators are small scale owners. Some operators have to compete with subsidized urban buses along some common routes.

6) Due to insufficient staff of the extra-urban bus department of MOCTPW, the extra-urban bus operation is not fully controlled by the department.

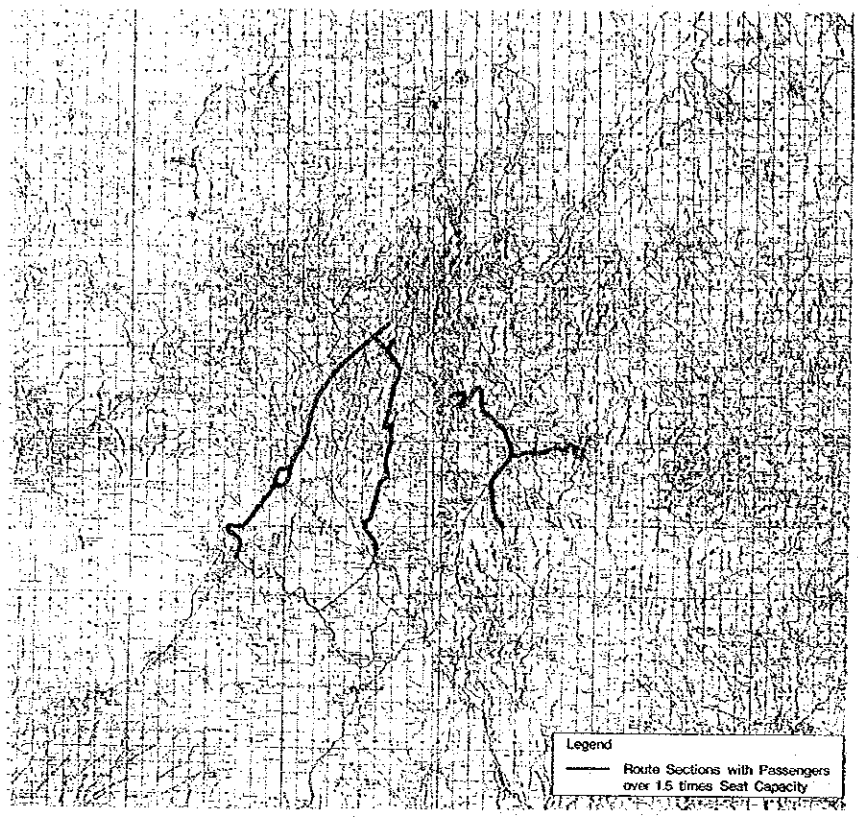

Figure 5.2.2 Heavily Congested Sections of Surveyed Extra-urban Buses

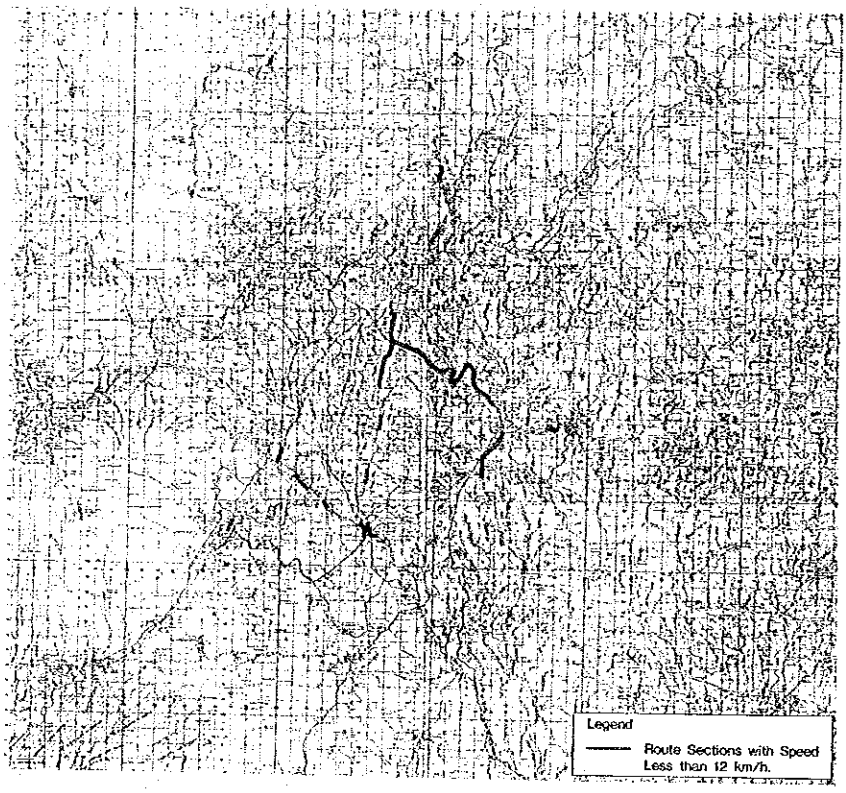

Figure 5.2.3 Low Speed Sections of Surveyed Extra-urban Buses

(2) Terminals and Stops

1) Zone 4 Terminal

Zone 4 terminal and its neighboring areas are congested with extra-urban buses and the passengers as well as whole sale and retail market activities sprawled beyond the compound. Considerable amount of the cargoes are carried by extra-urban buses. Major roads approaching the terminal have heavy traffic.

2) CENMA Project

Because a large share of the cargoes are now and at least in near future carried by buses, reorganization of extra and urban bus network has to take the project into consideration.

3) Zone 6 Terminal

Zone 6 Terminal does not have sufficient facilities.

4) Terminals in Zone 1

On-street terminals scattered in Zone 1 are without sufficient facilities and functional network.

5) Extra-urban bus terminals in municipalities

Bus terminals are located at centers of municipalities without sufficient facilities.

6) Extra-urban bus stops

The stops are usually with no facilities as in case of urban bus stops.

(3) Key Issues of Extra-urban Buses

1) Routing to meet new urban growth in suburban areas and coordination among different types of bus routes

2) Establishing transfer facilities and services considering the urban development pattern

5.3 Taxis

5.3.1 Fleet

There are 1428 registered taxis in the study area including 1230 in Guatemala City.

According to a sample survey of 356 taxis, the average production year is 1972.

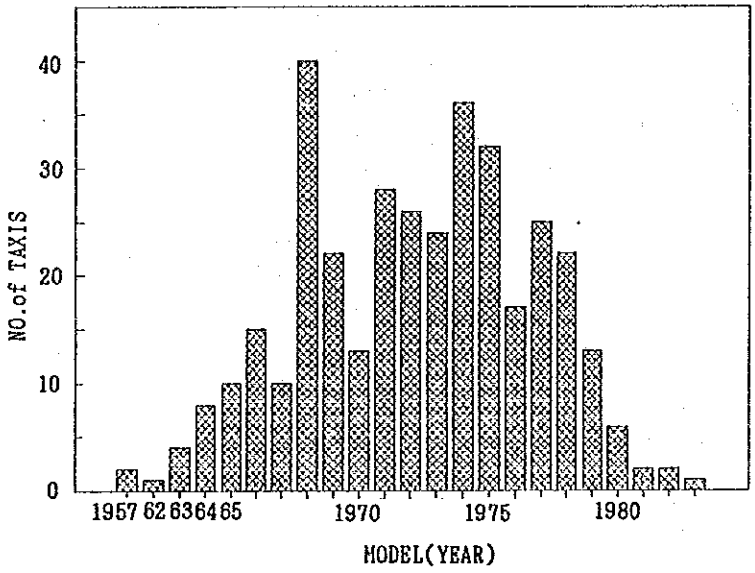

Figure 5.3.1 Production Years of Samples of Taxis

5.3.2 Operation

Every taxi is assigned to a taxi depot. Taxis wait at the depots for passengers coming there. In some cases, depots have a telephone shared by the taxi drivers and they are called by it also.

Taxis can park at the depots and operate for 24 hours.

Picking up passengers on streets is permitted by not customary. There is also no custom of sharing taxis.

There is no clear fare system. The fares are decided by negotiation between the passengers and the drivers except that fares from the airport to common places such as the Centro or major hotels are fixed.

The daily number of trips of a taxi is typically less than 5.

5.3.3 Registration

In order to operate a taxi, the owner of a car has to apply to the transit department of the national police with data of the car and the driver. For

new applications, the car must not be older than a 1970 model, though some already registered cars are older. No special license is required to be taxi driver. The ordinary car license called "B" is enough for application.

Applications are accepted if there is available depots space for the taxi. Currently, however, registration of taxis is suspended because the transit department is reorganizing the registration and numbering system.

When the new system is established, the consulting chart of taxis will decide whether new registration at certain locations is accepted or not, considering the space and demand-supply factors.

A taxi pays Q3.00 tax every year to the national police and Q10.00 every month to the municipality.

5.3.4 Operators' Organizations and Administration

Taxis are owned by private owners and operated by their drivers who may be the owners themselves. Cooperatives of taxis are organized. On the government side, the consulting chart of taxis is the policy making body of taxis. The chart members are the transit department of the national police, the municipality, the social security office and the extra-urban bus department and the highway department of the Ministry of Communications, Transport and Public Works.

5.3.5 Problems and Issues

Taxis in the metropolis are generally inactive. The following factors are regarded to be the major causes.

1) High fares and lack of standardized fares
2) Old cars and image of lack of security
3) No custom of picking up passengers on streets
4) No custom of sharing taxis
5) High operation cost due to old and large cars

5.4 Railways

5.4.1 Operation and Facilities

The national railways are mainly for inter-regional cargo transportation connecting Guatemala City, major ports on the Pacific and Atlantic Oceans and the borders on Mexico, Honduras and El Salvador. They are used as urban passenger transport only when the urban buses are on strike.

Stations in Guatemala city are La Ermita, Gerona, the central station, La Terminal and Pamplona.

The passenger trains leave the central station for north and south on Tuesdays, Thursdays and Saturdays and return on Wednesdays, Fridays and Sundays.

The average operating speed is 15 km per hour.

In 1989, the railways transported 456,000 metric tons of cargo and 329,000 passengers. The performance is in a declining trend.

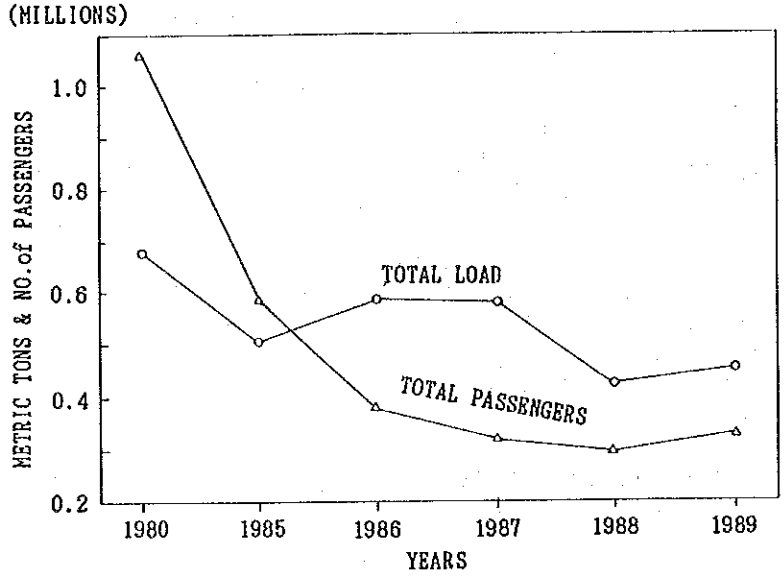

Figure 5.4.1 Cargo and Passenger Volume of FEGUA in Recent Years

The rolling stock consists of 30 locomotives (10 units of series 1000, 13 units of series 900, 1 unit of series 600, 1 unit of series 800 and 5 units of series 700). They are 1982, 1960 and 1950 models. Approximately 50% of the trains are operating.

5.4.2 Organization

The railways in Guatemala are operated by a semi-independent public organization called FEGUA (Ferrocarriles de Guatemala). FEGUA has 1500 employees as of June 1990 and is under indirect control of Ministry of Communica-

tions, Transport and Public Works. The general manager of FEGUA reports to the president of Guatemala.

5.4.3 Financial Situation

The fares of FEGUA are low compared to buses.

The annual earnings in 1989 were Q237,000 from passengers and Q9,674,000 from cargo totaling Q9,911,000.

FEGUA suffers continuous deficit and receives subsidies from Ministry of Finance. In 1990, the deficit before the subsidy was Q5,689,000 and the subsidy amounted to Q5,080,000.

5.4.4 Problems and Issues

Problems and issues of FEGUA from a view point of public transport development in the study area are as follows. Some of these problems make it difficult to utilize the railways for urban service.

1) Route (See Figure 5.4.2)

- Sharp curves and steep slopes due to the topographic conditions
- Not many connected towns in the study area
- Many at-grade crossings

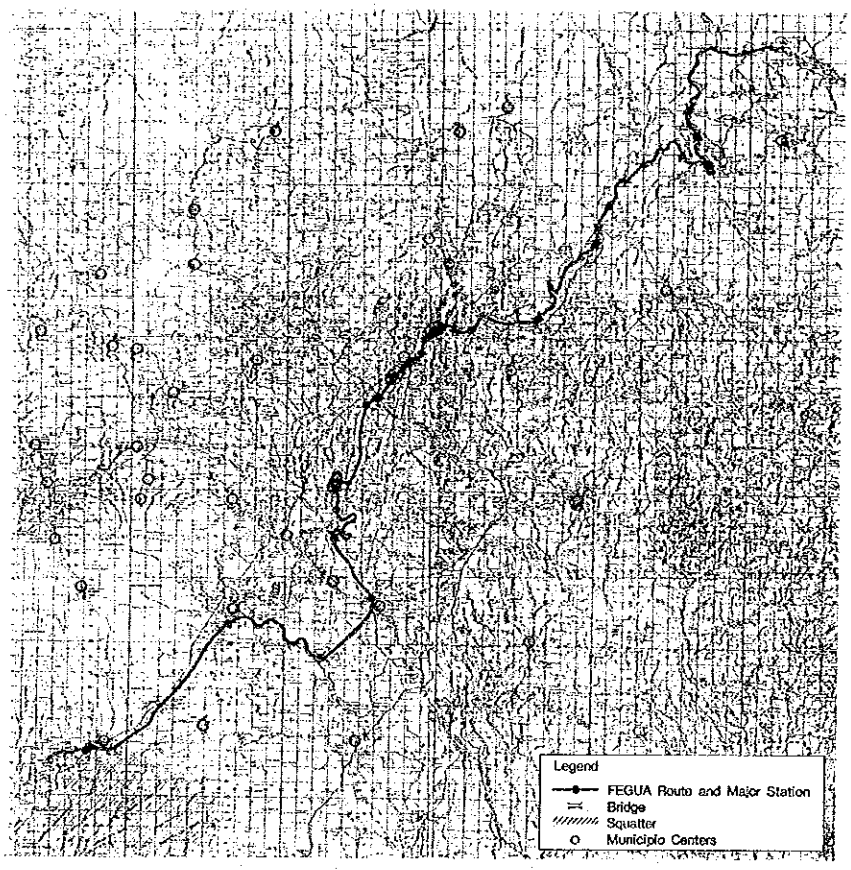

Figure 5.4.2 FEGUA Route

2) Right of Way (Width = 30m)

- Existence of estimated 1550 families of squatters
- Other natural and man-made constraints
- Bridges

3) Finance

- Large continuous deficit

4) Facilities and Equipment

- Narrow (3 feet) gauge single railway in bad conditions
- Old facilities and equipment with poor maintenance

5) Institution

- Insufficient institutional capability
- Possibility of partial or total privatization

6. TRAFFIC MANAGEMENT

6.1 Traffic Management Conditions

6.1.1 Traffic Signals

The installation, operation and maintenance of traffic signals in the Study Area is basically the responsibility of the National Police, Traffic Department (hereinafter referred as NPTD).

(1) Number of Signalized Intersections

There are 268 signalized intersections in the Study Area at present. These intersections are located only in the area within about a 6 km radius of the Municipality of Guatemala as shown in Figure 6.1.1.

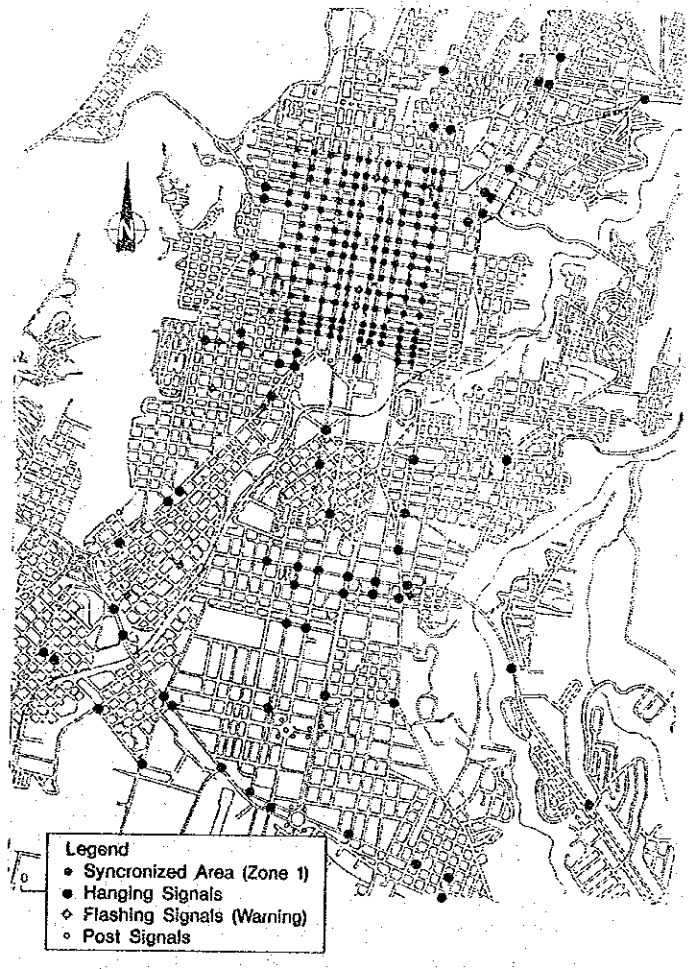

Figure 6.1.1 Signalized Intersections in Guatemala City

Of those signalized intersections, coordinated traffic signals are installed at 165 intersections located in the central area of Zona 1, as shown in Figure 6.1.2. Those coordinated signals are controlled by the central

controller installed at the National Police Headquarters in Zona 1. At other intersections, independent control signals are installed. (See Table 6.1.1)

Traffic signals in the Study Area are the pedestal type, the suspension type or the overhung type. However, all traffic signals controlled under the central control system in Zona 1 are the pedestal type.

Two types of traffic signals are installed in the Study Area, i.e. an ordinary type and a flashing signal. The red flashing signals are installed at some intersections to call the drivers attention to the intersection.

Table 6.1.1 Number of Traffic Signal

Signal Type	Number
- Centrally Controlled signals (Coordinated signal)	161
- Centrally controlled flashing signal	4
- Independent pretimed signal	
* Suspension type	75
* Overhung type	3
* Pedestal type	15
- Independent flashing signal	10
T O T A L	268

(2) Placement of Signals

Current placement of traffic signals are prescribed in "Manual Centroaméricano de Dispositivos para el Control del Tránsito en Calles y Carreteras (Central American Manual of Mechanisms to Control the Traffic in Streets and Highways)" (hereinafter referred as Central American Traffic Manual), established in 1975. This manual is widely utilized in Central American countries (Guatemala, El Salvador, Costa Rica, Honduras and Nicaragua).

Several placement methods for traffic signal are described in this Manual. According to this manual, NPTD installed traffic signals according to the following criteria:

- Pedestal type

  The primary signal is placed at the right-hand nearside of each approach, while the secondary signal is placed either at the left-hand nearside or the left-hand far-side of each approach.

- Suspension type

  The primary signal is placed at the center of an intersection facing each approach.

- Overhung type

This type of signal was recently introduced in Guatemala and were installed along CA-1 Oriente (18 Calle Zona 10). In this type, the primary signal is placed at the right-hand far-side of each approach and an supplemental display is attached on the supporting pole of the primary signal.

In addition to the signal display for vehicular traffic, signal displays for crossing pedestrians are installed at some signalized intersections, where volume of crossing pedestrians are heavy. However, most of those signal displays for crossing pedestrians are not functioning at present. Hence, pedestrians are required to pay attention for the vehicle flow when they cross the carriageway at these intersections.

(3) Control System

Every traffic signal controller installed in the Study Area operates with a single program pretimed signal and it is impossible to change the phasing pattern and cycle length according to the traffic condition at the site, unless the pattern is changed by maintenance.

1) Centrally Controlled System

The coordinated signals installed in Zona 1 are controlled by the center controller. The function of this controller, however, is limited only to switching signals on/off and to monitoring the break down of signal equipment. Since every signal under this central controller is the single pattern pretimed signal, it is impossible to change the signal phasing or the cycle length from this central controller.

2) Independent Signal

Independent signals other than the coordinated signal system are controlled by an individual controller installed at each intersection. Those individual controllers are only able to control several signal displays at each intersection. In addition, every independent signal is the single program pretimed signal.

(4) Operation of Traffic Signals

Most of traffic signals in the Study Area are operated only between 6:00 and 21:00 - 21:30, except intersections where signal control during the night period are requisite. Hence, most traffic signals in the Study Area are turned off manually around 21:00 to 21:30. In case of the coordinated signal system in Zona 1, the central controller can turn off every signal under its control at the same time.

(5) Signal Equipments

Most of signal equipment used in the Study Area were made by EAGLE (U.S.A.), while some of them were made in Mexico. Basically, lenses with 21cm diameter are used for signal displays, while 30cm diameter lenses are also used only for red light at some intersection. Generally speaking, brightness of signal lights were observed to be insufficient and the visibility of traffic signals for drivers is not so good.

(6) Comparison of Traffic Condition and Signal Phasing

Every traffic signal functioning in the Study Area is the single program pretimed signal, hence, it is impossible to change the signal phasing and cycle length according to the variation of traffic volume. The phasing and the cycle length of most of the signalized intersections in the Study Area are presented in a technical report "Intersection Survey", together with the results of intersection inventory survey.

(7) Maintenance of Signal Equipment and Systems

The maintenance of signal equipments and systems installed in the Study Area is carried out only by NPTD. However, the number of staff this task is limited to only 22 personnel and there is no traffic engineer. Hence, maintenance works are generally limited to the repair of broken signal equipment.

(8) Other Conditions at Signalized Intersection

At present, the proper maintenance of pavement markings are not carried out. As a result, pavement markings related to intersections, such as lane line markings, stop lines and crosswalk markings are almost non-existent at most intersections in the Study Area.

Also, the number of traffic signs installed in the Study Area is limited. At signalized intersections, regulatory signs, such as "Left Turn Prohibition" are seldom installed.

6.1.2 Traffic Signs and Pavement Markings

(1) Manual of Traffic Signs and Pavement Markings

The Central American Traffic Manual, as described in the previous section, is basically adopted as the standard for planning, design and installation of traffic signs and pavement markings. In this manual, detail descriptions of types, sizes and installation locations and methods for traffic signals, traffic signs and pavement markings are presented. However, this manual has not been reviewed for quite some time, since 1975.

Together with the Central American Traffic Manual, "Manual de Senalami-

ento para el Control del Transito en el Distrito Federal" (System of Signs for the Traffic Control in the Federal District Manual) issued by the Mexican Departamento del Distrito Federal Secretaría de Obras y Servicios COVITUR in 1983 is also widely used in Guatemala as a reference manual at present.

In both manuals, symbols, colors and design of traffic signs and pavement markings are almost same, except some wordings. Hence, some modifications are made for the Mexican Manual in Guatemala.

(2) Condition of Traffic Signs

1) General

Three kinds of traffic signs, i.e. regulatory signs, warning signs and guidance signs, are installed in the Study Area at present.

PNTD has the responsibility for installation and maintenance of regulatory signs and a part of warning signs in the whole country.

The Municipality of Guatemala, however, has the responsibility for installation of regulatory, warning and guidance signs in new high way projects and some guidance and warning signs on road under its jurisdiction if the Municipal Budget permits. CAMINOS has the same responsibility for roads and highways under its jurisdiction.

In addition, due to inadequate budget allocations for installation of traffic signs, even regulatory and warning signs, private companies have recently donated traffic signs. In these cases, billboards of the company are attached above the traffic signs. This situation reduces the visibility of traffic signs.

2) Materials and Size of Traffic Signs

Each agency produces all traffic signs in its factory. So far, only ordinary paints are used for productions of traffic signs. Hence, there is no reflective capability of traffic signs during the night.

Sizes of traffic sign boards are unified according to the above mentioned manuals. However, sizes of some traffic signs seems to be rather small at certain locations, where the visibility of traffic signs is obstructed by the surrounding environment, such as billboards of private companies.

3) Regulatory Signs

Drivers are obliged to comply regulatory signs are the most important traffic signs compared with other kinds of traffic signs, since only these types of signs contain obligation to control traffic

movements.

However, due to lack of proper maintenance of traffic signs, colors of some traffic signs have faded. As a result of low visibility, drivers may confuse the meaning of traffic signs, since differences between regulatory signs for prohibition and permission are red diagonal lines only.

The number of installed regulatory signs in the Study Area is considered to be insufficient from the traffic engineering point of view. Insufficient traffic signs often causes difficulty in traffic law enforcement, since regulations are not clear to drivers.

4) Warning Signs and Guidance Signs

In the Study Area, many roads have been converted into one-way roads for quite a long length. These one-way roads include not only narrow roads with 1 or 2 lanes, but also wider roads with 4 to 6 lanes. Medians have not even been demolished along some of wider roads. Hence, vehicles make turns at intersections must change lanes in advance in order to avoid confusion at intersections.

However, due to lack of sufficient warning signs and guidance signs, many drivers tend to change lanes very close to an intersection. Hence, confusion of traffic flows is often observed along one-way roads with a wide carriageway.

(3) Condition of Pavement Markings

There are two kinds of pavement markings, i.e. regulatory markings and indication markings. PNTD has full responsibility for the installation and the maintenance of both kinds of pavement markings. At present, the installation and the maintenance of pavement markings are carried out by their 3 personnel.

Ordinary cold paints are used for pavement markings and reflectorized glass beads are not mixed with paints. These traffic paints can last for 4 to 5 months only and repainting is required at least twice a year. However, due to the economic recession in Guatemala, no budget has been allocated for maintenance of pavement markings. As a result, most pavement markings in the Study Area are no longer visible.

In addition to the present situation of pavement markings, it should be noted that pavement markings for crossing pedestrians are seldom provided. This causes random crossings of carriageways by pedestrians, which may cause traffic accidents between vehicles and pedestrians.

Other than traffic paints, reflective buttons (raised pavement markers)

are installed on certain roads to supplement lane line markings. These reflective buttons function well at night for the visual guidance of drivers.

6.1.3 Traffic Safety

(1) Traffic Accident Investigation and Traffic Law Enforcement

In the Guatemala Metropolitan Area, seven (7) police stations (corps) are in charge of traffic accident investigations and traffic law enforcements. The results of traffic accident investigations have been recorded in the daily investigation report in each police station. These police stations are supposed to send a compiled accident record to the NPTD, however, this data has not been sent to NPTD for the last few years.

At present, traffic law enforcement is carried out mainly by traffic policemen in each police station. Enforcement, however, is limited to traffic violations related to obstruction of traffic flows, such as parking offenses. On the other hand, traffic violations which may directly cause severe traffic accidents are seldom enforced. These violations include speeding, reckless driving and drunken driving.

(2) Number of Traffic Accidents and Casualties

In order to grasp the situation regarding traffic accidents in the Study Area, the Study Team collected traffic accident data of Guatemala Department based on daily investigation report of each police station. Table 6.1.2 summarizes the number of traffic accidents and casualties recorded in 1989 by police station.

Table 6.1.2 Number of Traffic Accidents and Casualties in Guatemala Department in 1989

Police Corps	Accidents	Fatalities	Injuries	Casualties
First Corps	858	12	618	630
Second Corps	855	24	662	686
Third Corps	1,487	67	1,047	1,114
Fourth Corps	158	46	282	328
Fifth Corps	476	44	487	531
Sixth Corps	466	60	279	339
Seventh Corps	199	3	128	131
Total	4,449	256	3,503	3,759

Source : Allied Operation Center, National Police

The Faculty of Engineering, University of San Carlos conducted a study on traffic accidents in Guatemala City. The title of this study is "Evaluación de los Accidentes de Tránsito en la Ciudad de Guatemala Durante el Período 1976-1985".

Based on the report of this study, the past trend of traffic accidents in Guatemala City is summarized in Table 6.1.3.

Table 6.1.3 Past Trend of Traffic Accident

Year / Area	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1989
Guatemala City											
Accident	4,337	4,355	4,465	4,671	4,672	3,690	3,599	4,273	3,249	2,849	n.a.
Fatality	119	259	265	246	292	222	225	141	145	145	n.a.
Injury	2,977	3,704	4,782	3,949	4,774	3,825	3,323	2,188	1,890	1,916	n.a.
Casualties	3,096	3,963	5,074	4,195	5,066	4,047	3,548	2,329	2,035	2,061	n.a.
Guatemala Department											
Accident	4,338	4,656	4,792	4,975	4,905	3,893	3,764	4,467	3,249	3,064	4,449
Whole Country											
Accident	5,163	5,544	6,336	7,160	6,440	5,179	4,878	5,869	4,599	4,451	n.a.

Source : Evaluación de los Accidentes de Tránsito en la Ciudad de Guatemala Durante el Periodo 1976-1985, University of San Carlos

Each year, about 70% of total accidents in the whole country are recorded in Guatemala City. After 1980, the number of recorded traffic accidents and casualties in Guatemala City appeared to decrease significantly, however, the number increased again in 1989. The reasons of this fluctuation are not clear, however, one of the reasons is considered to be the incomplete reporting of traffic accident cases from each police stations to the National Police Headquarters, except for the 1989 data.

The following Table 6.1.4 shows the type of victims in traffic accidents. It is clear from this table that pedestrians from the highest share of traffic accidents victims, with 60 to 70% of total fatalities and 40 to 60% of total injuries. The share of drivers and passengers are almost the same.

Table 6.1.4 Type of Victims by Traffic Accidents

Year	No. of Fatalities				No. of Injuries			
	Total	Driver	Pedestrian	Passenger	Total	Driver	Pedestrian	Passenger
1976	119	13	99	7	2,977	629	1,978	378
1977	259	56	176	33	3,704	964	1,996	744
1978	256	68	156	47	4,782	1,039	2,422	1,321
1979	246	52	148	46	3,949	932	1,805	1,126
1980	292	31	199	62	4,774	1,520	2,114	1,140
1981	222	46	150	26	3,825	1,091	2,021	713
1982	225	35	141	49	3,323	805	1,900	618
1983	141	28	95	18	2,188	383	1,517	280
1984	145	33	92	20	1,890	413	1,083	394
1985	145	33	82	30	1,916	524	871	521

Source : Evaluación de los Accidentes de Tránsito en la Ciudad de Guatemala Durante el Periodo 1976-1985, University of San Carlos

(3) Comparison of Traffic Accident Indicators

To understand the traffic accident situation in Guatemala, a comparison of traffic accident indicators in 1989 with some other countries was made. It should be noted that the number of traffic accidents and fatalities in Guatemala are estimated based on data of Guatemala Department. Tables 6.1.5 and 6.1.6 show the comparison of traffic accident indicators.

Table 6.1.5 Comparison of Traffic Accident Indicators (Nation Level)

Country	No. of Accident	No. of Fatality	Population (100,000)	No. of Registered Vehicle (10,000)	Rate of Motorization*	Fatality Rate 1**	Fatality Rate 2***
Japan	614,481	10,344	1,229	5,253	42.7	8.42	1.97
U.S.A.	2,335,434	46,385	2,445	17,904	73.2	18.97	2.59
G. Britain	231,830	5,050	554	2,116	38.2	9.12	2.39
Guatemala	6,228	338	89	19	2.2	3.80	17.79

Note * : No. of vehicles per 100 population.
** : No. of fatalities per 100,000 population.
*** : No. of fatalities per 10,000 vehicles.
Source : World Road Statistics (1984 - 1989) - Other than Guatemala data
Allied Operation Center, National Police -- Guatemala data

It is clear from this table that the number of fatalities per 10,000 vehicles in the whole country is much worse than other countries. This means that even though the rate of motorization in Guatemala is still low, the potential danger from traffic accident is already high.

Table 6.1.6 Comparison of Traffic Accident Indicators (City Level)

City	No. of Accident	No. of Fatality	Population (100,000)	No. of Registered Vehicle (10,000)	Rate of Motorization*	Fatality Rate 1**	Fatality Rate 2***
Tokyo****	35,296	390	118	375	31.8	3.30	1.04
Guatemala Department	4,449	256	9.79	15.4	15.7	26.15	16.62

Note * : No. of vehicles per 100 population.
** : No. of fatalities per 100,000 population.
*** : No. of fatalities per 10,000 vehicles.
**** : 1985 figures.
Source : National Police Agency, Japan -- Tokyo data
Allied Operation Center, National Police -- Guatemala data

The situation of traffic accidents in Guatemala Department is much worse. Hence measures to prevent traffic accidents, especially in Guatemala Depart-

ment, are considered to be necessary as soon as possible.

(4) Identification of Hazardous Road Sections

Based on the 1989 traffic accident data in Guatemala Department, traffic accident locations are illustrated in Figure 6.1.2.

Based on this figure, the Study Team identified hazardous road sections from consideration of the number of accidents. Those hazardous road sections are as follows:

These hazardous road sections are as follows.

1) Central Area of the City

- Calle Martí, Zonas 2 & 6
- 6a. & 7a. Avenida, Zonas 1 & 4
- 1a. & 2a. Calles, Zona 9
- 12 Calle, Zona 9
- 2a. Calle, Zona 15

2) Other areas

- 13 Avenida, Zona 19 (Florida)
- Western part of Calzada San Juan Sacatepéquez, Zona 7
- Western part of Calzada Roosevelt, Zonas 7 & 11
- Southern part of Boul. Aguilar Batres, Zona 11
- 19a & 20a Calles, Zona 10
- Approach roads to El Trébol and Anillo Periférico

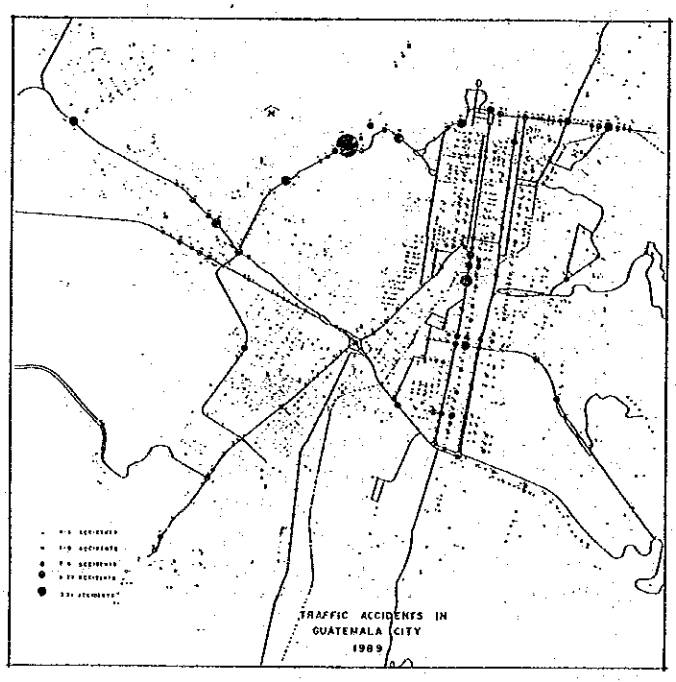

Figure 6.1.2 Traffic Accidents in Guatemala City (1989)

6.1.4 Parking Conditions

In the Study, the parking survey was conducted in Zonas 1, 4, 9 and 10, because these places are densely developed with commercial and business activities. Therefore parking has become one of the most serious issues.

(1) Parking Capacity and Location

The parking capacity in Central Urban Area is approximately 40,000, including on-street and off-street parking spaces, excluding illegal parking. Among them, the capacity of off-street parking spaces is approximately 22,000 (55%)as shown in Table 6.1.7.

The capacity of public parking (public off-street parking and parking meters) is approximately 24,000 in total.

Table 6.1.7 Capacity of Parking

ZONE	TRAFFIC ZONE	OFF-STREET PARKING(PARKING LOT)			PARKING METER③	FREE PARKING④	PUBLIC PARKING②+③	CAPACITY ①+②+③+④	ILLIGAL PARKING	ACTUAL CAPACITY
		PRIVATE①	PUBLIC②	SUBTOTAL						
1	1	3,087	2,800	5,887	1,128	882	3,928	7,897	234	8,131
	2	1,804	1,391	3,195	528	607	1,919	4,330	189	4,519
	3	299	90	389	0	1,732	90	2,121	0	2,121
	4	256	180	436	34	1,653	214	2,123	6	2,129
	SUBTOTAL	5,446	4,461	9,907	1,690	4,874	6,151	16,471	429	16,900
4	8	1,787	1,543	3,330	224	1,292	1,767	4,846	519	5,365
9	18	2,970	849	3,819	0	1,508	849	5,327	376	5,703
	19	1,763	75	1,838	142	1,357	217	3,337	232	3,569
	SUBTOTAL	4,733	924	5,657	142	2,865	1,066	8,664	608	9,272
10	20	2,230	392	2,622	0	4,146	392	6,768	0	6,768
	21	590	35	625	0	2,387	35	3,012	0	3,012
	SUBTOTAL	2,820	427	3,247	0	6,533	427	9,780	0	9,780
TOTAL		14,786	7,355	22,141	2,056	15,564	9,411	39,761	1,556	41,317

The number of parking lots is approximately 1,300 and the average capacity is 17.3as indicated in Table 6.1.8.

Table 6.1.8 Number of Parking Lots

ZONE	TRAFFIC ZONE	PARKING LOT		
		PRIVATE	PUBLIC	SUBTOTAL
1	1	142	65	207
	2	72	23	95
	3	15	3	18
	4	8	70	78
	SUBTOTAL	237	161	398
4	8	88	102	190
9	18	172	13	185
	19	142	16	158
	SUBTOTAL	314	29	343
10	20	210	12	222
	21	123	1	124
	SUBTOTAL	333	13	346
TOTAL		972	305	1,277

The location of public and private parking lots and parking meter are shown in Interim Report. Most public parking are located in Zonas 1 and 4, which are commercial and business areas, and are distributed in the center of

the Zonas.

(2) Parking Control

On the main Avenidas, which run north to south, parking is prohibited and many Calles, which run east to west in Zona 1 facilitate parking meters.

Many illegal parking are found in Zonas 4 and 9, which amounted 500 to 600, and a lot of illegal parking on parking meters are also found in Zona 1.

The parking meters have been controlled by the Municipality since 1961. In Zone 1, there are about 1,700 meters. The parking rate is Q0.05 per 30 minutes and maximum parking time is 2 hours with Q0.20. Even though the charge is cheap, there are many cars of no payment. About 20 controllers are checking the parking meters. The fine is the amount to be paid for parking. The condition of maintenance is bad due to old mechanism and no parts.

(3) Parking Demand

From the person trip survey, parking demand by zone, by purpose, by type and by time was analyzed as shown in Fig.6.1.3 to Fig.6.1.4.

The parking demand was about 123,300 cars per day in Central Urban Area, and about 58,700 cars in Zona 1, 16,500 cars in Zona 4, 21,500 cars in Zona 9 and 26,600 cars in Zona 10. As to parking demand by purpose, "to work" and "to school" are 73,724 forming as large as 60%. Parking was concentrated during 7 a.m. to 9 a.m. The hourly peak was about 35,000 cars between 9 a.m. to 9 a.m. in Central Urban Area and the peak ratio was about 28.5%. As to parking demand by parking type, free parking formed large part. Free off- street parking formed 60.7% and free on-street parking 29.6%.

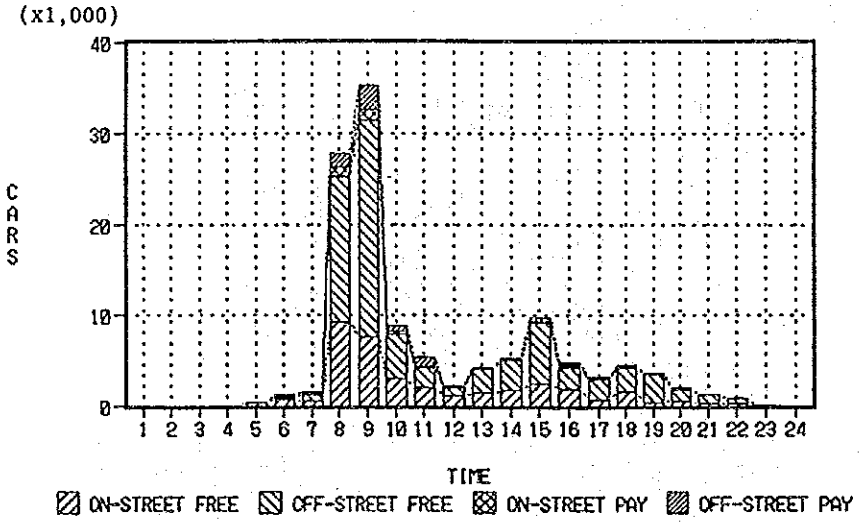

Figure 6.1.3 Parking Demand by Type of Parking by Time

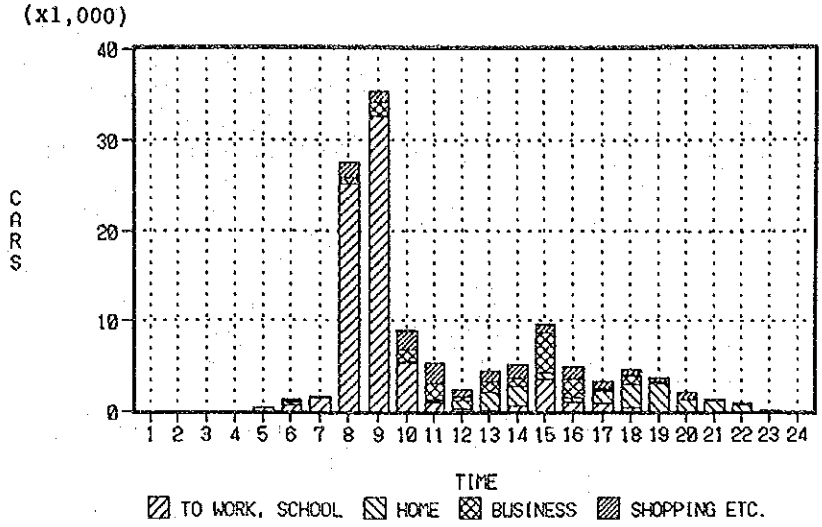

Figure 6.1.4 Parking Demand by Purpose by Time

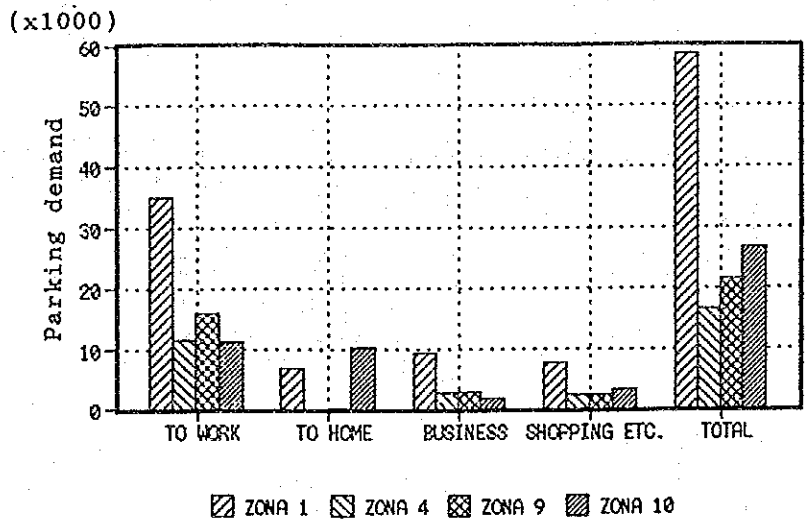

Figure 6.1.5 Parking Demand by Purpose by Zone

(4) Characteristics of Parking

From the parking survey, Characteristics of parking is as follows:

Zona 1

- The total parking demand was about 59,000 cars.
- "To work or to school" formed about 60%, and was concentrated from 7:00 to 9:00 a.m.
- The peak of "business" was 2,289 cars from 2:00 to 3:00 p.m.
- The peak of "shopping, etc." was 1,218 cars from 10:00 to 11:00 a.m.

- The hourly peak was about 16,700 cars and the peak ratio was 28.3%.

Zona 4

- The total parking demand was about 17,000 cars.
- "To work or to school" formed about 70% and concentrated from 8:00 to 9:00 a.m.
- The minor peak (206) of "shopping, etc." between 5:00 to 6:00 a.m. is considered for the market next to the bus terminal.
- The peak of "business" was 764 cars from 3:00 to 4:00 p.m.

Zona 9

- The total parking demand was about 22,000 cars.
- "To work or to school" formed approximately 74%, and was concentrated from 8:00 to 9:00 a.m. (8,827).
- The peak of "business" was 764 cars from 3:00 to 4:00 p.m.

Zona 10

- The total parking demand was about 27,000 cars.
- "To work or to school" formed approximately 43% and was concentrated from 8:00 to 9:00 a.m.
- The peak of "business" was 599 cars from 2:00 to 3:00 p.m.
- The peak of "shopping, etc." was 720 cars from 3:00 to 4:00 p.m.

Parking Duration

Average on-street parking time is 50 to 90 minutes and long time parking (more than 140 minutes) formed 10 to 20%. Average off-street parking time is varies 1 to 6 hours place by place.

Turn-over Ratio

Turn-over ratio is 7 to 8 for on-street parking and less than 0.7 to 4.3 for off-street parking.

Average Parking Ratio

$$\text{Average parking ratio} = \frac{\text{(Accumulative no. of Parking Cars)}}{\text{(Capacity) x (No. of survey)}}$$

The average parking ratio shows the degree of utilization of parking capacity. The average parking ratio is 0.2 to 0.6 for off-street parking and approximately 1.0 for busy on-street parking.

(5) Regulation for Obligatory Parking Space

Building license is necessary for construction of buildings according to the regulation. During the procedure of the license, parking spaces are required based on the type of the building. This criteria have not been legalized.

The new construction regulation which covers the parking criteria of

building is being prepared the schedule of enforcement has not been decided. The criteria is shown in Table 6.1.9.

As development in urban area advances, parking demand will increase. On-street parking is limited, so increased parking demand should be solved by each development. The regulation to force to prepare parking spaces in new construction should be indispensable.

Table 6.1.9 Regulation of Obligatory Parking for New Building

Item	Regulation
Housing - Detached House	0 - 150m2 1 lot 150 - 300 1 lot 300 - 2 lots
- Apartment House	- 60m2 1 lot (Unit area) 60 - 150 1.5 lot 150 - 2 lots
Business and Commercial Building	30% of rentable area/12.5 lot
Institutional Building	40% of usable area/12.5 lot
Warehouse	1 lot per 250m2
Hotel, Inn	Less than 20 rooms: 1 lot per 4 rooms More than 21 rooms: 5 lots plus 1 lot per 8 rooms
Apartment-hotel	1 lot per 4 units
Hospital, Health center	1 lot per single room or 1 lot per 4 beds
School, Orphanage	1 lot per classroom
Convention center, Sports center	1m2 per person or 0.5m2 per person plus annex parking
Church, Religious building	1 lot per 25 people or 1 lot per 50 people with permission
Factory	1 lot per 100m2 or 1 lot per 200m2 according to requirement of industry

Source: Regulacion de Constuccion Urbana Capitulo 17, Articulo 84 to 90

6.1.5 Others

(1) One-way Traffic System

The one-way traffic regulation is an effective traffic management measure to ease traffic congestion and to prevent some types of traffic accidents, such as a head-on collisions.

The history of the one-way traffic system in the Study Area is rather old and it was introduced about 30 years ago. Since then, the one-way traffic system has been expanding not only in the central area of the city but also at the suburban areas. At the same time, not only narrow roads but also some wide roads have been converted to the one-way operation.

The present one-way system in the central area of the city is illustrated in Figure 6.1.6. The present one-way system has not been changed since 1976, with few exceptions, hence it is very familiar to drivers in the Study Area.

As a result of the nature of one-way traffic systems, travel distances become longer compared with a two-way system. Under the recent oil crisis, a study to review the present one-way traffic system is underway by the Guatemalan Government from the point of view of energy conservation. In addition, the Municipality has revised the one-way traffic system in some areas in order to ease traffic congestion at certain roads/intersections.

In the Study Area, some wider roads with medians, such as 6a and 7a Avenidas in Zona 9, are also operating as one-way roads. On these roads, confusion in traffic flows caused by vehicles weaving from one side of the carriageway to the other are observed.

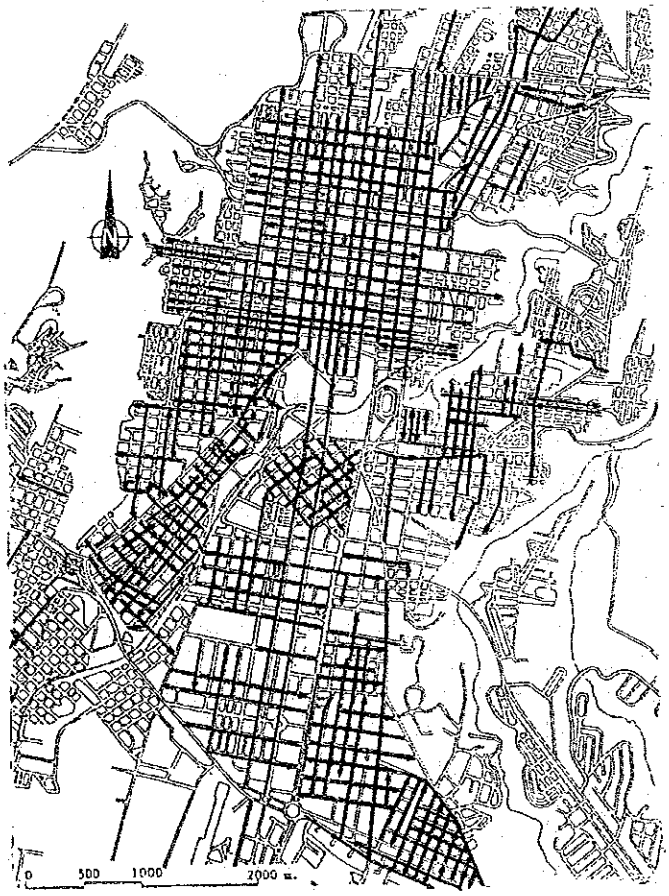

Figure 6.1.6 One-way Traffic System in Guatemala

(2) Driving License System

1) Agency Issuing Driving License

As with vehicle registration, NPTD has full responsibility for

issuing driving licenses and licenses are issued only at NPTD in the National Police Headquarters in Guatemala City. The driving licensing procedure has not been computerized so far, and 86 police officers handle every task manually.

2) Examination

A person who applies for a driving license should pass a theoretical, a medical and a practical examinations held at NPTD. The theoretical examination is designed to check the knowledge of the traffic law and traffic signs/road markings by applicants. If applicants pass the examinations, they are required to pay tax and obligatory insurance in order to obtain a driving license.

3) Validity of Driving License

The validity of a driving license is 1 to 3 years depending on drivers. For the renewal of a driving license, only submission of an application form is required without further examination, unless a driving license is canceled by the court.

4) Type of Driving License

There are the following 5 types of driving license.

- Class "A": Professional license valid for driving of trucks more than 3.5 ton of cargo weight and commercial buses.
- Class "B": Professional license valid for driving of trucks less than 3.5 ton of cargo weight and taxis.
- Heavy Machinery: Professional license valid for driving of heavy machineries.
- Class "C": Ordinary license valid for driving of private vehicles.
- Motorcycle: Ordinary license valid for driving of motorcycles.

5) Suspension and Cancellation of License

For a driver who violates the traffic regulations, penalties include fines and suspension or cancellation of licenses. The penalty is judged in court for each offense and it varies from a simple fine to cancellation of a license. In addition, if a driver violates traffic regulations 3 times within a year, his/her driving license is automatically canceled. After the cancellation of a license, he/she may be able to apply for a new license after 1 to 3 years according to the judgment.

(3) Vehicle Inspection

As a part of the vehicle registration procedure, described in Section, a vehicle inspection is also supposed to be carried out every 5 years. However, due to lack of facilities and personnel, only a simple inspection, such as to check the body color and engine number, are carried out. Inspections for the important mechanical, such as brakes and engines, are not conducted.

6.2 Problems of Traffic Management

Based on above mentioned analysis, the problems regarding traffic management conditions in the Study Area are summarized in Table 6.2.1.

Table 6.2.1 Summary of Traffic Management Problems

Item	Present Condition	Problems
1. Traffic Signal		
*Placement of signal	- Nearside installation for pedestal type signal	- Lower visibility of signal display from drivers
*Control system	- Single program pretimed control - Coordinated system in Zona 1	- Cannot cope with traffic fluctuation - Cannot amend phasing and cycle length easily
*Signal equipment	- 21cm lenses for display - Insufficient reflection in lighting source	- Lower visibility,
*Signal operation	- Turn off most of signals between 21:00 - 6:00	- Potential danger of accident due to unclear priority of crossing
	- No functioning of pedestrian signal	- Potential danger for crossing pedestrians
*Other condition	- Unclear lane line, stop line and crosswalk markings - No installation of important regulatory signs	- Confusion of traffic flows adjacent to intersections - Random crossing of carriageway by pedestrians - Cannot see a signal display from vehicles stopping on first or second line of queue
*Maintenance	- Limited number of personnel - No traffic engineer	- Difficulty of proper and quick maintenance
2. Traffic Sign and Pavement Marking		
*Regulatory Traffic Signs	- Usage of ordinary paints - Insufficient installation - Obstacles for visibility - Improper maintenance	- Invisible during night - Confusion of drivers - Misunderstanding by drivers
*Warning and Guidance Signs	- Insufficient installation	- Confusion of traffic flow
*Pavement Markings	- Usage of ordinary paints - Improper maintenance - Disappearance of markings - No provision of crosswalk markings	- Invisible during night - Confusion of traffic flows - Potential danger for crossing pedestrians
3. Traffic Safety		
*Accident Investigation	- Carried out by each police station - Records were not sent to NPTD for last few years	- No statistical record is available at HDQ - Identification of hazardous locations is impossible
*Traffic Law Enforcement	- Limited to violations for obstruction of traffic flow - Insufficient number of traffic policemen for enforcement duty	- Violations may cause severe accidents are not enforced - Insufficient traffic law enforcement
*Hazardous Road Section	- Insufficient installation of traffic safety devices	- Concentration of traffic accidents at certain road sections
4. One-way Traffic System		
*Wide one-way road	- One-way street with median	- Confusion of traffic flows by weaving
5. Vehicle Inspection		
*No Proper inspection	- Inspection only for body color and engine number	- Mechanical problems are not inspected

PART II FORECAST AND PLAN

7. URBAN DEVELOPMENT PLAN

7.1 Socio-Economic Framework

At this stage, it is very difficult to develop a forecast for Guatemala's economy in the future. However, considering the recent indications toward recovery (the GDP growth rate for 1989 was 4% and is estimated at 3.5% for 1990) and the future population increase, particularly the increase in economically active population, there will be a gradual increase in the growth of the national economy, estimated at 3.5% - 4% during the 1990-1995. It is anticipated that it will expand at an average rate of 4% after 1995.

The role of the Study Area will be fulfilled by driving the national economy through the secondary and tertiary sectors. It is anticipated that the growth rate for the GRP will continue its increase from 4% in 1990 to 4.5% in 1995, and expand at an average annual growth rate of 4.5% after 1995.

Thus, the per capita GRP for the residents by the year 2010 will be 1.43 times that of 1990, and expressed in terms of 1990 US dollars, will rise from $2,000 to $2,900.

Table 7.1.1 Economic Development Estimation for the Study Area

Item	1990	2010	2010/1990
GRP (million quetzal[1)])	1,827	4,355	2.35
GRP Per Capita (US dollar[2)])	2,018	2,889	1.43

Note: 1) In 1958 constant prices
2) In 1990 prices

Corresponding with the increase in population of Guatemala Department, the Study Area population will rise from a 91.7% share of the Departments' population to 94.6% by the year 2010, at which time it is estimated to reach 3 million, 1.67 times the current scale. The rate of population growth will gradually decline, but will still keep average 2.6% annual growth over the next 20 year period.

Table 7.1.2 Future Population in the Study Area

Item	1990	2010	2010/1990
Population (thousand persons)	1,801	3,000	1.67
Share in Department (%)	91.7	94.6	

Corresponding to the economic growth and population increase noted above, the working population will also increase. In order for there to be an increase in the employment rate, it is necessary for the rate of increase of the number of those employed to be higher than the rate of increase of the labor

force. Meanwhile, an increase in labor productivity is necessary to elevate the employee's real income. The future rate of increase in the labor force is estimated at average 2.9% annually.

Taking these factors into consideration, and thus presuming that the economic growth rate of 4.5% will be composed of an approximately 1% rise in labor productivity and a 3.5% increase in employment, an estimate can be made of the number of persons employed by sector.

Table 7.1.3 Future Employment by Sector

Sector	1990	2010	2010/1990
Primary	16(2.5)	12(1.0)	0.75
Secondary	150(23.5)	318(25.5)	2.12
Tertiary	471(74.0)	916(73.5)	1.94
Total	637(100.0)	1,246(100.0)	1.96

7.2 Urban Development Patterns

7.2.1 Habitable Lands and Present Uses

In the Study Area of 93,725.5 hectare (ha.) as a whole, lands with a gradient of more than 30% (mainly forests) cover an area of 45,973 ha. The rest, with an area of 47,752 ha. are classified as follows: built-up areas, 17,314 ha.; semi-built-up areas, 7,939.5 ha.; farmland, 17,302.8 ha.; forests, 3,343 ha. and waters, 1,352.5 ha. The semi-built-up areas are subdivision sites under construction or partly completed and rural communities.

The lands appropriate to urban uses are considered to be an area of 46,399.5 ha., excluding the waters from the above-mentioned lands with a slope of less than 30%. The lands convertible to new urban areas in future are present farmland and forests, an area which amounts to 21,145.8 ha. altogether.

Table 7.2.1 Habitable Lands and Present Uses

Unit: ha.

Category	Area
Habitable lands (slope<30%, no waters)	46,399.5
Present urban area	25,253.7
Built-up area	17,314.2
Semi-built-up area	7,939.5
Future urbanizable area	21,145.8
Farming land	17,802.8
Forest	3,343.0
Non-habitable lands (slope>30%, waters)	47,326.0
Total	93,725.5

7.2.2 Rough Estimation of Land Requirement

(1) Residential Area

At present, 1.8 million people live in the built-up and semi-built-up areas, comprising an area of 25,300 ha. altogether. (Population density is 71 persons/ha.). In the future, this present urban area will have a population of 2.35 million (population density: 94 persons/ha.), according to a projection based on the recent population changes by zone. Therefore, new residential areas are required for 650 thousand persons; that is about 6,500 ha., supposing the average population density to be about 100 persons/ha.

(2) Industrial Area

The area of industrial uses measured on the existing land use map of 1:50,000 is 1,130 ha., and the number of employed persons in the manufacturing sector is estimated at 118 thousand from the P.T. Survey results. There are a considerable number of traffic zones in which no industrial areas can be found on the land use map, although industrial employment exists according to the P.T. Survey. This is because small-scale industries are dispersed throughout

the areas where the other uses are dominant.

In Zona 12 (Traffic Zone 25), a typical industrial area, the ratio of industrial employment to the area of factory sites is 150m²/person. Supposing that this value is an average unit land area for the visible industrial area, about 75 thousand persons (64% of the total industrial employment) are working in the visible industrial areas, and about 43 thousand persons (36%) in small-scale factories located in the other land use categories. The increase in the industrial employment between 1990 and 2010 is estimated at 134 thousand. Assuming that 94 thousand persons (70% of the total increase) will work in the visible large industrial sites, newly required industrial areas will be about 1,400 ha.

(3) Commercial Area (Including Institutional Area)

The increase in the tertiary sector employment between 1990 and 2010 is estimated at 437 thousand. At present, the relationship between the number of employed persons in the tertiary sector and the total floor area of the buildings used for the tertiary sector activities (shops, offices, warehouses, institutional facilities, apartment houses with shops and offices, and shop-houses) is 16.6m²/person in the Centro (Zona 1). It is assumed that the unit floor area needed for the increased persons is 20m²/person, a little larger than the present one, taking into consideration that the present unit floor in a new commercial district (Zona 9, Traffic Zone 18) is 22.7m²/person. Applying this unit floor area, the total additional floor area demand is calculated to be about 870 ha. Supposing that about half of this demand will be absorbed in the existing urban areas and new residential and industrial areas, about 440 ha. will be required.

The average floor area ratio of the above-mentioned buildings in Zona 1 is 91.9%. It is assumed that the average floor area ratio of new commercial/institutional cores is 80%, considering that in future more parking and open spaces will be required for these facilities. Applying this floor area ratio, the land requirement is calculated to be about 550 ha.

7.2.3 Basic Conditions for Formation of Urban Development Patterns

Based on the distribution of habitable lands and the land requirement as described above, alternative future urban development patterns of the Study Area are prepared in consideration of the following conditions:

a) In the central part of the built-up area (Zona 1, 4, 8, and 9, hereinafter referred to as the Central District), population is decreasing and a transition process from the residential to the commercial area is taking place. These changes are undeniable.

b) The functions of Guatemala as the center of the Central America (political, economical and social) and their support services as well as the functions of the national capital will continue to be located in the Central District.

c) It is important to consider the economic behavior of the private sector and the possibility of the public investment, for there is no land use master plan nor land use regulations in Guatemala.

d) Due to the frequency/possibility of earthquake, a vast extension of high-rise and high-density urban spaces should be avoided as much as possible and it is necessary to increase alternative traffic routes for evacuation.

e) Concentration of job opportunities in the Central District and disorderly expansion of residential areas in the suburbs should be restrained as much as possible and efforts should be made to shorten the distance between the place of work and the place of residence.

f) There should be some consideration for laying a foundation and giving elasticity for the ultra long-term development of the area after 2010.

g) The opinions of the local administrative officers and planners should be respected.

7.2.4 Urban Development Pattern Alternatives

If no land use master plan will be prepared and no development control or planned development are expected, the following will occur:

a) Various types of disorderly subdivisions will be developed in Mixco, where urbanization trend has been rapid, as well as in Villa Nueva and Petapa. On the other hand, development in the eastern part of the Study Area will be delayed.

b) As the provision of urban infrastructure such as utilities and roads will not be able to catch up with the rapid urbanization, low quality residential areas will extend and worsening of living environment will be accelerated.

c) Although some commercial/service facilities and factories will be located along the trunk roads, most of job opportunities will continue to concentrate in the Central District.

d) The commuting distance will become longer, and the traffic congestion on the radial roads will be aggravated.

In order to prevent these problems from occurring, it is necessary to prepare an urban development master plan, which is intended to realize an appropriate urban form with a desirable distribution pattern of socio-economic functions, supported by the provision of urban infrastructure. In relation to the urban form and the function distribution, two alternative patterns can be proposed.

One is to bring up several new towns in the suburbs for the supply of job opportunities --the Polycentric Pattern. The other is to locate residential areas and places of work along selected transportation axes extending from the Central District to suburban areas --the Corridor Pattern.

(1) Polycentric Pattern

Urbanization toward Mixco, which has been very rapid and caused heavy traffic congestions in peak hours of morning and evening, shall be restricted

as much as possible. Planned residential areas shall be located in Villa Nueva, Petapa, Villa Canales, Sta. Catarina Pinula (including a part of Fraijanes) and Zonas 16, 17 and 24 of Guatemala City. In these new residential areas as well as in Mixco, location of economic activities to provide job opportunities shall be promoted in order to develop these areas as new towns where one's residence and place of work are near each other (See Figure 7.2.1).

Population and employment distribution are shown in Table 7.2.2. Concentration rates for Central Guatemala shall be restricted to less than 30% of population and to less than 50% of employment, and the rest shall be distributed to the new towns in the suburbs.

Table 7.2.2 Future Distribution of Population and Employment in Polycentric Pattern

Unit: 1,000 persons

Zone Group	Population	(%)	Employment	(%)
Central Guatemala[1)]	892	(29.7)	597	(48.7)
East Guatemala[2)]	460	(15.3)	126	(10.3)
Mixco	512	(17.1)	125	(10.2)
Villa Nueva[3)]	565	(18.8)	178	(14.5)
Petapa[4)]	343	(11.5)	106	(8.7)
Sta. Catarina Pinula[5)]	228	(7.6)	93	(7.6)
Total	3,000	(100.0)	1,225	(100.0)

Note: 1) Including Chinautla
2) Zona 16, 17, 18, 24 and 25
3) Including Amatitlan
4) Including Villa Canales
5) Including San Jose Pinula and Fraijanes

(2) Corridor Pattern

The strong urbanization pressure towards Mixco shall be accepted to a considerable degree, and to cope with an increasing traffic demand, roads and public transport axes shall be constructed as required. In addition, from the Central District to the eastern part of Villa Nueva and Petapa a new urban corridor shall be formed. Commercial, business and institutional functions shall be induced to locate along the transport axes constituting the urban corridors, and industrial activities along the other trunk roads. Industrial areas in Zona 12 shall be converted to commercial/institutional uses (See Figure 7.7.2).

As shown in Table 7.2.3, population and employment are remarkably concentrated in Central Guatemala and Mixco in comparison to Polycentric Pattern.

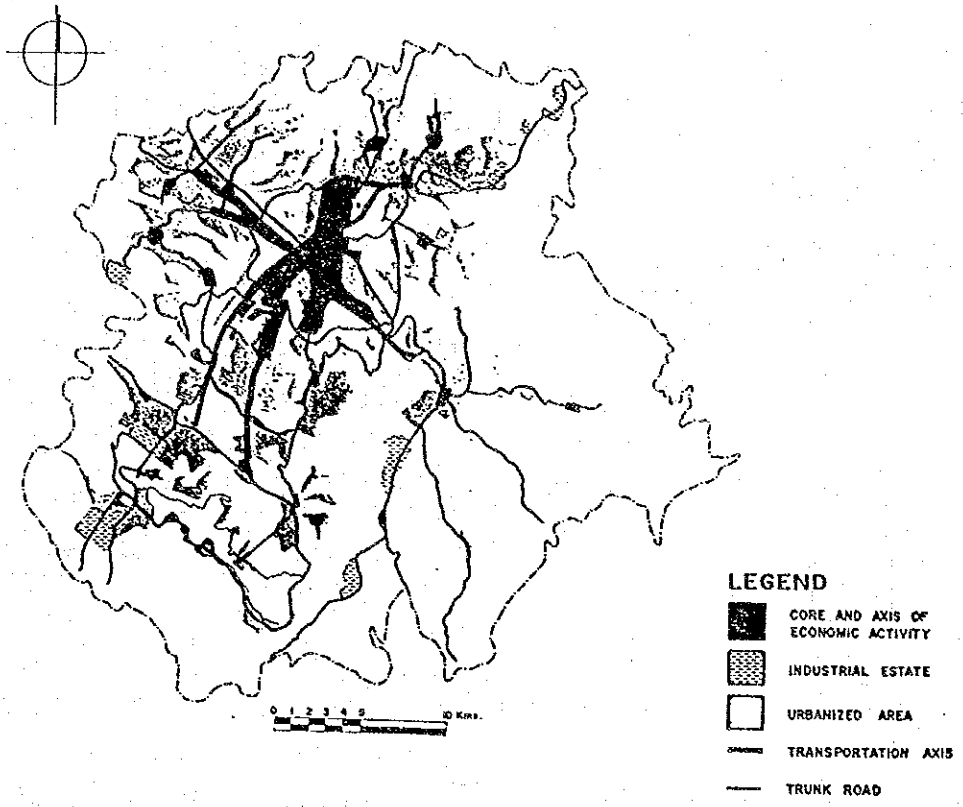

Figure 7.2.1 Urban Development Pattern (Corridor Pattern)

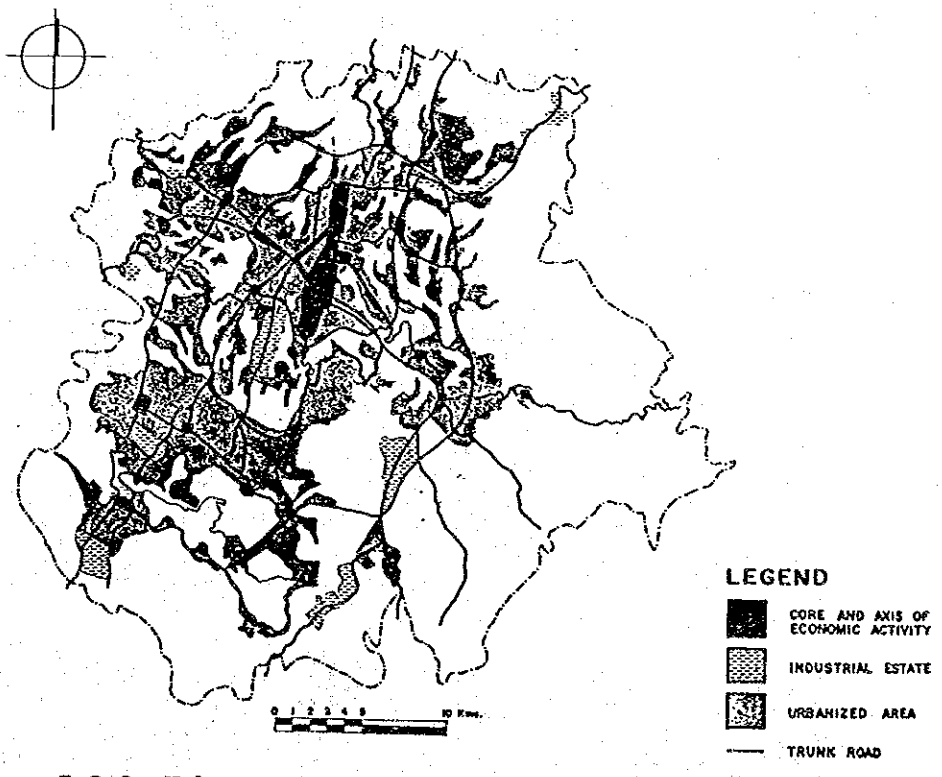

Figure 7.2.2 Urban Development Pattern (Polycentric Pattern)

Table 7.2.3 Future Distribution of Population and Employment in Corridor Pattern

Unit : 1,000 persons

Zone Group	Population	(%)	Employment	(%)
Central Guatemala	1,059	(35.3)	749	(61.1)
East Guatemala	405	(13.5)	94	(7.7)
Mixco	637	(21.2)	128	(10.4)
Villa Nueva	468	(15.6)	132	(10.8)
Petapa	278	(9.3)	73	(6.0)
Sta. Catarina Pinula	153	(5.1)	49	(4.0)
Total	3,000	(100.0)	1,225	(100.0)

Note: Zone grouping is the same as Table 7.2.2.

7.2.5 Evaluation of Urban Development Patterns

Comparing the two alternatives of urban development pattern, Polycentric and Corridor --quantitatively for traffic aspects and qualitatively for other ones-- the followings can be pointed out:

a) The number of trips attracted to the Central District will be smaller in the Polycentric Pattern, so the traffic burden there will be a little lighter.

b) Traffic volume for Mixco will be very large in the Corridor Pattern, resulting a heavy burden of construction of transportation facilities. In the other directions, traffic volumes in the Polycentric Pattern are a little larger but not significant.

c) Judging from these traffic volumes by direction, the necessity of introducing a public transport axis will be high in the direction of Mixco and the south in the Corridor Pattern, and in the south in the Polycentric Pattern.

d) The number of trips in the direction of ring will be larger in the Polycentric Pattern, showing a higher necessity of ring road construction.

e) The number of inner trips within suburban zones will be larger in the Polycentric Pattern, showing a higher necessity of local road network improvement.

f) Both total vehicle kilometers and total vehicle hours are greater in the Polycentric Pattern, because the ratio of trips between zones a long distance from each other is larger in this pattern.

g) Accessibility to the place of work in the suburbs is higher in Polycentric Pattern.

h) It is desirable to make efforts to locate job opportunities as well as residential areas in the new towns proposed in the Polycentric Pattern, but it is not easy to induce the private economic activities, especially the tertiary sector, to locate in the suburban

areas.

i) A huge amount of public investment will be required for the provision of urban infrastructure in the new towns and the construction of ring roads in the Polycentric Pattern, while a heavy investment burden for the improvement and construction of the transportation facilities toward Mixco will be charged on the public and private sectors in the Corridor Pattern.

j) Flexibility in an earthquake disaster is considered to be comparatively higher in Polycentric Pattern.

In short, it is difficult to determine which pattern is desirable. And it is impossible to make some remarkably different urban development patterns, judging from the distribution of habitable lands, the existing urban structure and the recent urbanization trend. Therefore, a medium type of urban development pattern, the Corridor/ Polycentric Pattern, is proposed in the Study, and an urban development plan is prepared to make the most of advantages in each pattern.

Table 7.2.4 Comparison of Urban Development Patterns

Item	Polycentric Pattern	Corridor Pattern
Trips attracted to Central District (Zona 1, 4, 8, and 9)	569,000 (PT/D)	578,000 (PT/D)
Traffic volume by direction for Mixco for Villa Nueva and Petapa for Sta. Catarina Pinula for Zonas 17 and 18	 689,400 (PT/D) 1,197,000 (PT/D) 276,400 (PT/D) 494,400 (PT/D)	 851,800 (PT/D) 1,135,000 (PT/D) 221,000 (PT/D) 426,400 (PT/D)
Necessity of introducing mass transit	Higher in the south direction	Higher in the direction of Mixco and south
Trips between suburban zones Trips within suburban zones	More More	Fewer Fewer
Total vehicle kms. Total vehicle hours	554,000 (kms) 151,600 (Hours)	452,100 (kms) 117,700 (Hours)
Accessibility to place of work (ratio of employed persons work place basis to residence basis)	0.750	0.621
Inducement of activities	Comparatively hard	Comparatively easy
Investment cost	Expensive for infrastructure of new towns and ring roads	Expensive for transport axes, higher land cost
Flexibility to earthquake	Comparatively higher	Comparatively lower

Note: PT/D: Person Trip per Day

7.3 Land Use Plan

7.3.1 Basic Considerations for Planning

According to results of the study conducted in the previous section, the future urban pattern of the Study Area is aimed to be the Polycentric/Corridor Pattern. In addition, in developing the land use plan, following points are taken into consideration:

a) Existing urban areas (built-up areas and semi-built-up areas), except population-decreasing zones, will strengthen their land use intensity in every use category, by filling up vacant lots and by rebuilding dilapidated and lower structures.

b) The population-decreasing zones are in a process of conversion from existing mixed or residential use to commercial use and will become an overall commercial area in the future.

c) Authorized and scheduled projects like BANVI's housing projects are adopted in the plan, and the treatment of projects at the stage of idea is determined through discussions with the Guatemala side.

d) About 60% of the existing farmland and forests, 10,000 ha. and 2,000 ha. respectively, is set as an aim of conservation.

e) It is assumed that the residential area includes the lands used for neighborhood commercial/service facilities, small-scale institutional facilities, small-scale factories and small parks.

f) From the standpoint of making much of realism and feasibility, future urbanized areas tend to be widely formed in the western and southwestern parts of the Study Area, but a balanced urban form should be pursued by developing as much as possible the lands located in the eastern and southeastern parts, although there exist some topographical restrictions.

7.3.2 Residential Area

New residential areas of 6,370 ha. are planned for 639 thousand increased population which cannot be absorbed in the existing urban areas.

According to the characteristics of zones, the average population densities of the new residential areas are assumed as shown below: (some differences allowable)

Central Guatemala and Zona 18	150 persons/ha.
General suburban zones	100 persons/ha.
Higher class residential zones	70 persons/ha.

About one third of the whole (nearly 2,000 ha.) is located from Villa Nueva to Amatitlan, about 400 ha. in Central Guatemala and around 1,000 ha. in every other zone group.

The average population density of East Guatemala is 120 persons/ha, but

there are various types of residential areas such as Zona 16 mainly for upper classes (average population density, 80 persons/ha), Zona 18 with a high population density (160 persons/ha) and Zonas 17 and 24 of typical suburban zones (100 persons/ha).

Mixco and Villa Nueva include some upper class residential areas, but for the most part general suburban zones. Petapa/Villa Canales will be a typical suburban residential area. From Sta. Catarina Pinula to Fraijanes and to San Jose Pinula a residential area for higher classes will form.

Table 7.3.1 Location of New Residential Area

Zone group	Area (ha.)	(%)	Average population density (persons/ha.)
Central Guatemala	417.3	(6.5)	150.0
East Guatemala	1,000.0	(15.7)	120.0
Mixco	850.0	(13.3)	92.9
Villa Nueva	1,952.5	(30.7)	94.5
Petapa	1,000.0	(15.7)	100.0
Sta. Catarina Pinula	1,150.0	(18.1)	80.4
Total	6,369.8	(100.0)	100.2

Note: Zone grouping is the same as Table 7.2.2

7.3.3 Industrial Area

New industrial areas are located in habitable lands along the regional trunk roads. Of 1,400 ha. as a whole, a little more than one third, 500 ha., will be developed along CA-9 in Villa Nueva/Amatitlan for contributing to increase job opportunities.

Moreover, 250 ha. will be developed along CA-9 in Zonas 17 and 18, 300 ha. altogether along CA-1 and Department Route 10, and 250 ha. along CA-1 in Fraijanes. In Mixco, 50 ha. industrial developments are planned along CA-1 and Calzada San Juan Sacatepéquez respectively.

Table 7.3.2 Location of New Industrial Area

Unit : ha.

Zone group	Area	(%)	
Central Guatemala	---	(--)	
East Guatemala	250.0	(17.9)	
Mixco	100.0	(7.1)	
Villa Nueva	500.0	(35.7)	
Petapa	300.0	(21.4)	(Villa Canales)
Sta. Catarina Pinula	250.0	(17.9)	(Fraijanes)
Total	1,400.0	(100.0)	

Note: Zone grouping is the same as Table 7.2.2

7.3.4 Commercial/Institutional Core

The area of required land for future commercial/institutional cores is estimated at 550 ha., of which 160 ha. is considered to be formed by land use conversion from residential or mixed to commercial/institutional in the present urban areas.

The new commercial/institutional cores of 390 ha. altogether are located all around, especially in Sta. Catarina Pinula/Fraijanes, where high-income class residents are expected to increase and there is no commercial accumulation. Several cores are located along CA-1 and near the intersections with planned ring roads (about 90 ha. altogether), and in Traffic Zone 45 of Villa Nueva a new town center of about 40 ha. will be developed.

7.3.5 Conclusion

The urban areas planned for 2010 total to 33,400 ha., of which 8,200 ha. are newly developed areas. The urban areas will occupy 72% of the whole habitable land. (See Figure 7.3.1)

Table 7.3.3 Location of New Commercial/Institutional Core

Unit: ha.

Zone group	Area	(%)
Central Guatemala	40.0	(10.3)
East Guatemala	70.0	(17.9)
Mixco	60.0	(15.4)
Villa Nueva	80.0	(20.5)
Petapa	50.0	(12.8)
Sta. Catarina Pinula	90.0	(23.1)
Total	390.0	(100.0)

Note: Zone grouping is the same as Table 7.2.2

About one third of the new urban areas will be formed in Villa Nueva, where residential and industrial areas will increase remarkably. The rest will be distributed almost evenly to East Guatemala, Mixco, Petapa, and Sta. Catarina Pinula.

Non-urban areas will cover 13,000 ha.: farmland, 10,700 ha. and forests, 2,300 ha. As seen in Table 7.3.4, large farmland are found in Villa Nueva, Petapa and Sta. Catarina Pinula, but the real jurisdictions are Amatitlan, Villa Canales and San Jose Pinula, respectively. And although some farmland are listed in Central Guatemala, these exist in Chinautla.

Table 7.3.4 Summary of Land Use Plan

Unit: ha.

Zone Group	Urban area			Non urban area			Habitable land total
	Existing urban area	New urban area	Sub total	Farmland	Forest	Sub total	
Central Guatemala	7,466.1	457.3	7,923.4	155.0	329.0	484.0	8,407.4
East Guatemala	2,522.8	1,320.0	3,842.8	620.0	341.5	961.5	4,804.3
Mixco	4,539.8	1,010.0	5,549.8	122.5	625.5	748.0	6,297.8
Villa Nueva	4,632.5	2,532.5	7,165.0	1,297.5	302.5	1,600.0	8,765.0
Petapa	3,437.5	1,350.0	4,787.5	2,920.0	440.0	3,360.0	8,147.5
Sta. Catarina Pinula	2,655.0	1,490.0	4,145.0	5,607.5	225.0	5,832.5	9,977.5
Total	25,253.7	8,159.8	33,413.5	10,722.5	2,263.5	12,986.0	46,399.5

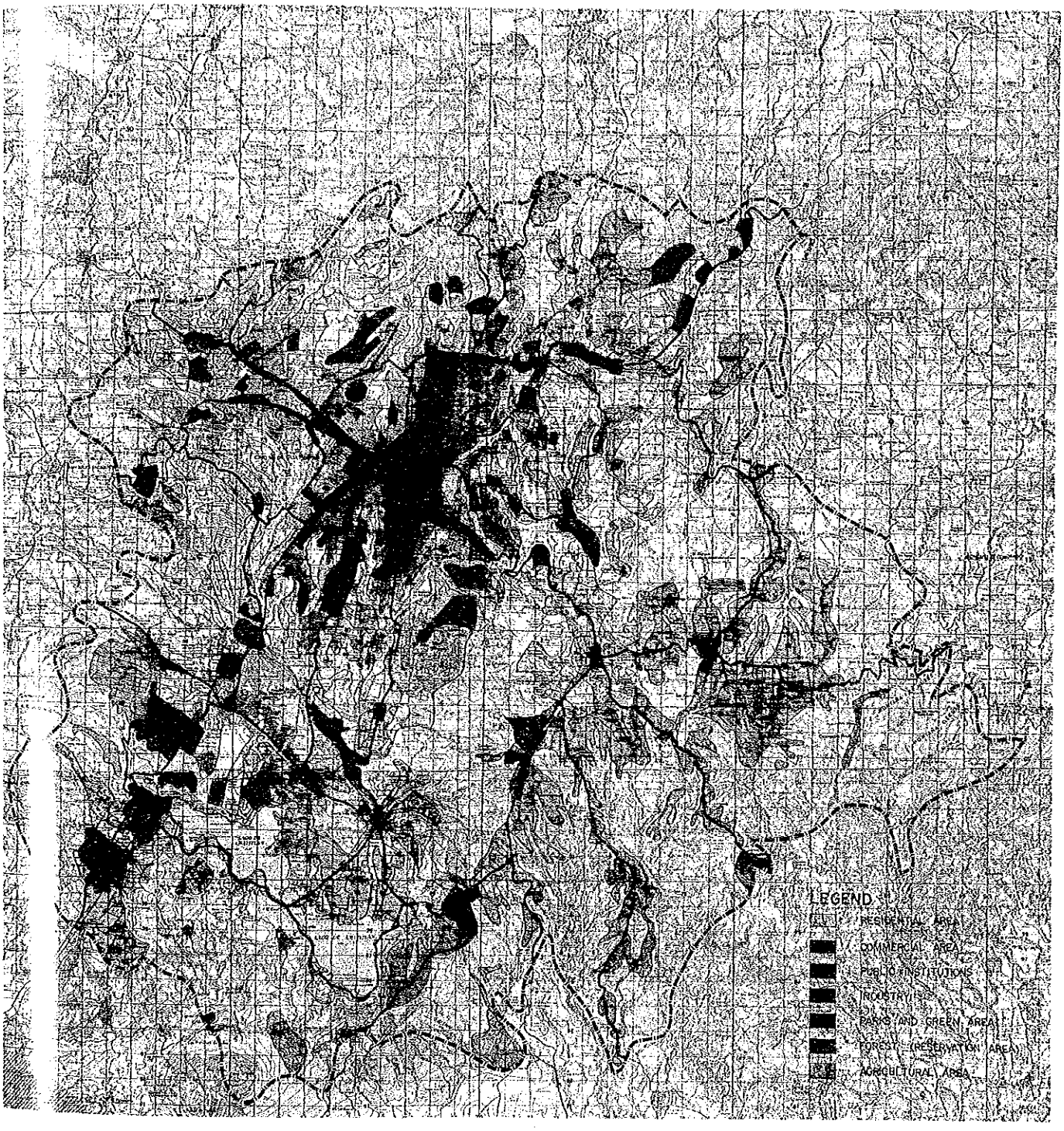

Figure 7.3.1 Future Land Use in 2010