Percentage of
Ocupation (%)

FIGURE 1.7-10 – Average Occupancy Rate - Area 05 – Shopping Iguatemi Area

In this part no large variation happened on the permanence average time on morning and afternoon period (FIGURE 1.7-11). The parking time from 0 to 30min totalized in each period around 76.0%, showing the major rotativity among surveyed parts.

FIGURE 1.7-11 – Occupancy Percentage - Area 05– Shopping Iguatemi Area

From the analysis of these five parts surveyed, the average parking time is predominant for one hour, showing potential for the use of restrictive policy for long time parking. This hypothesis is especially for parts located on traditional center (Ver-o-Peso and Downtown) where there is the highest demand, but it is not attended.

1.8. ROAD SYSTEM CHARACTERISTCS

The purpose of the road system assessment is to identify main road physical conditions such as capacity, comfort and security in the RMB - Belem Metropolitan Region. The assessment was realized during July 20th to August 2nd, 2000.

In this survey the following road inventory data is collected: width of sidewalk, number of lanes, traffic signals, traffic signs, lane marking, pavement conditions, median, etc.
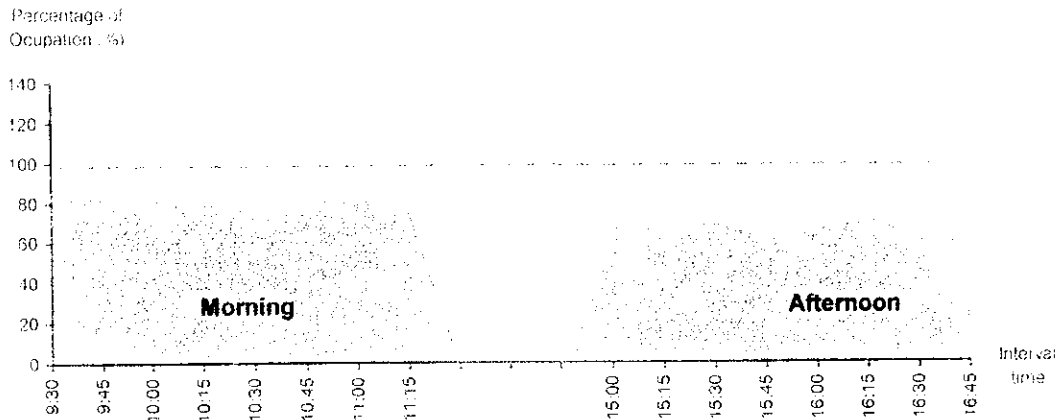
Percentage of
Ocupation (%)

FIGURE 1 7-10 – Average Occupancy Rate - Area 05 – Shopping Iguatemi Area

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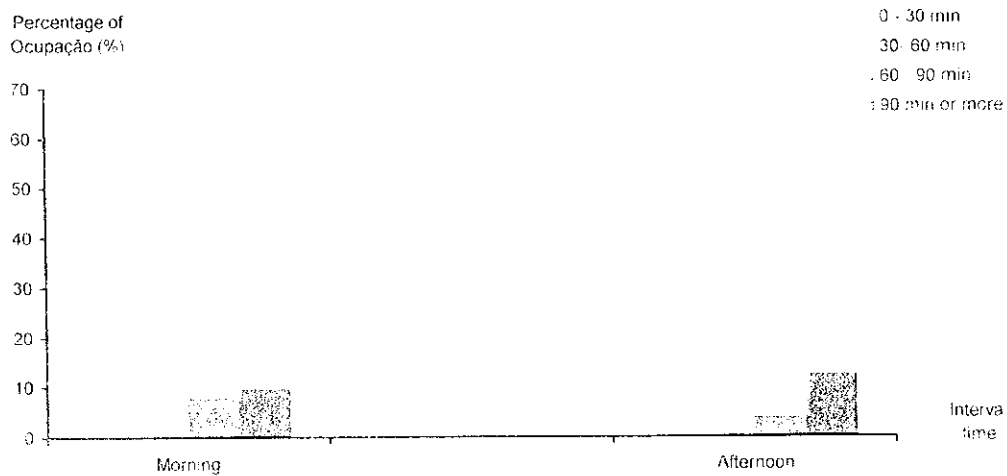

FIGURE 1 7-11 – Occupancy Percentage - Area 05– Shopping Iguatemi Area

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The road conditions were filled on the survey sheet based on the visual inspection by surveyors and photograph. In this survey all the traffic signal conditions was also collected as shown in FIGURES 1.8-1 and 1.8-2 and the information will be utilized on the estimate of road capacity.

The research was done in 47 roads subdivided into 105 sections. The results of the pavement conditions in terms of comfort, security, and driving conditions can be observed in FIGURES 1.8-3, 1.8-4 and ANNEX G – Synthesis of Road Assessment.
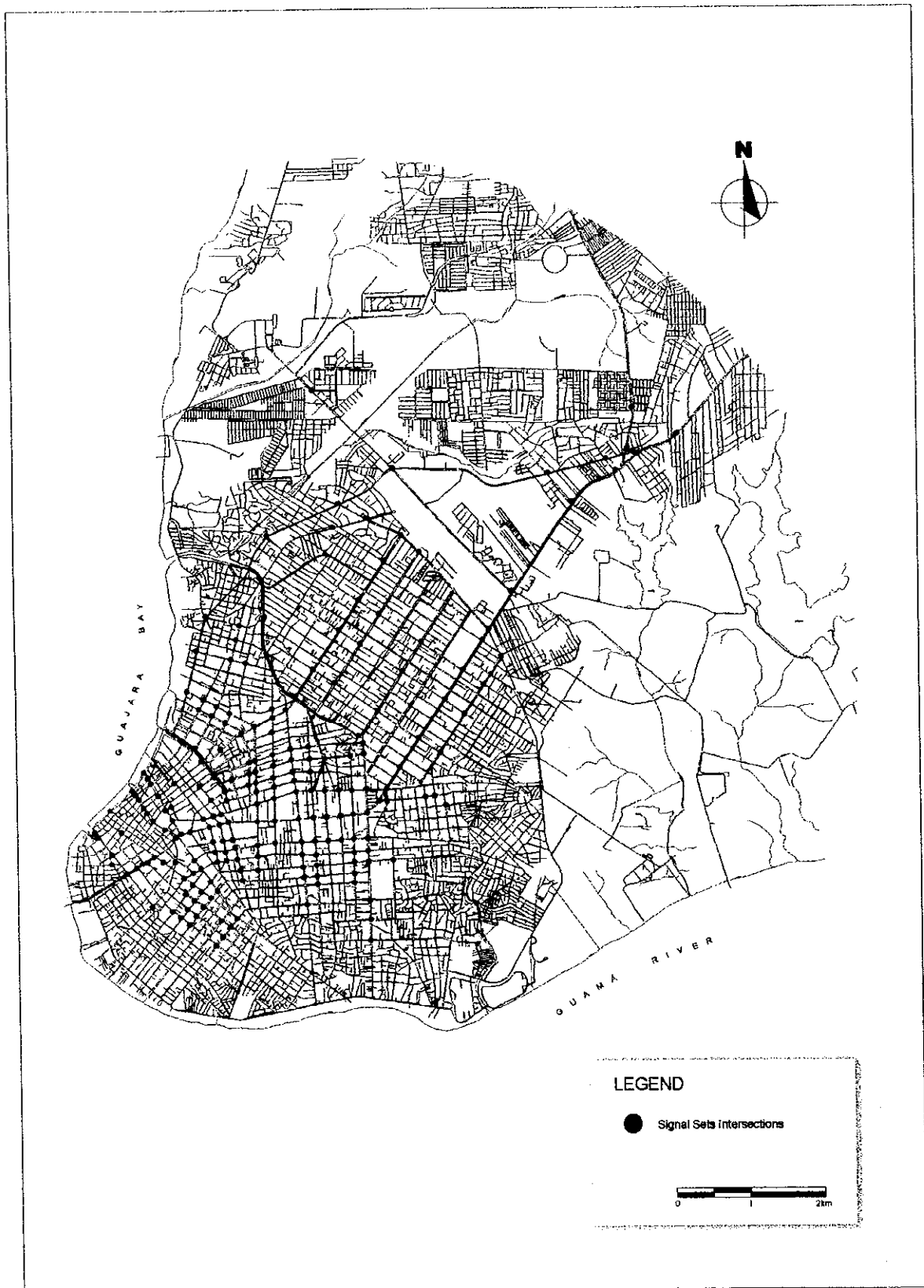
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FIGURE 1.8-1 - Signal Sets Intersections - 1ª. Légua and Surrounding
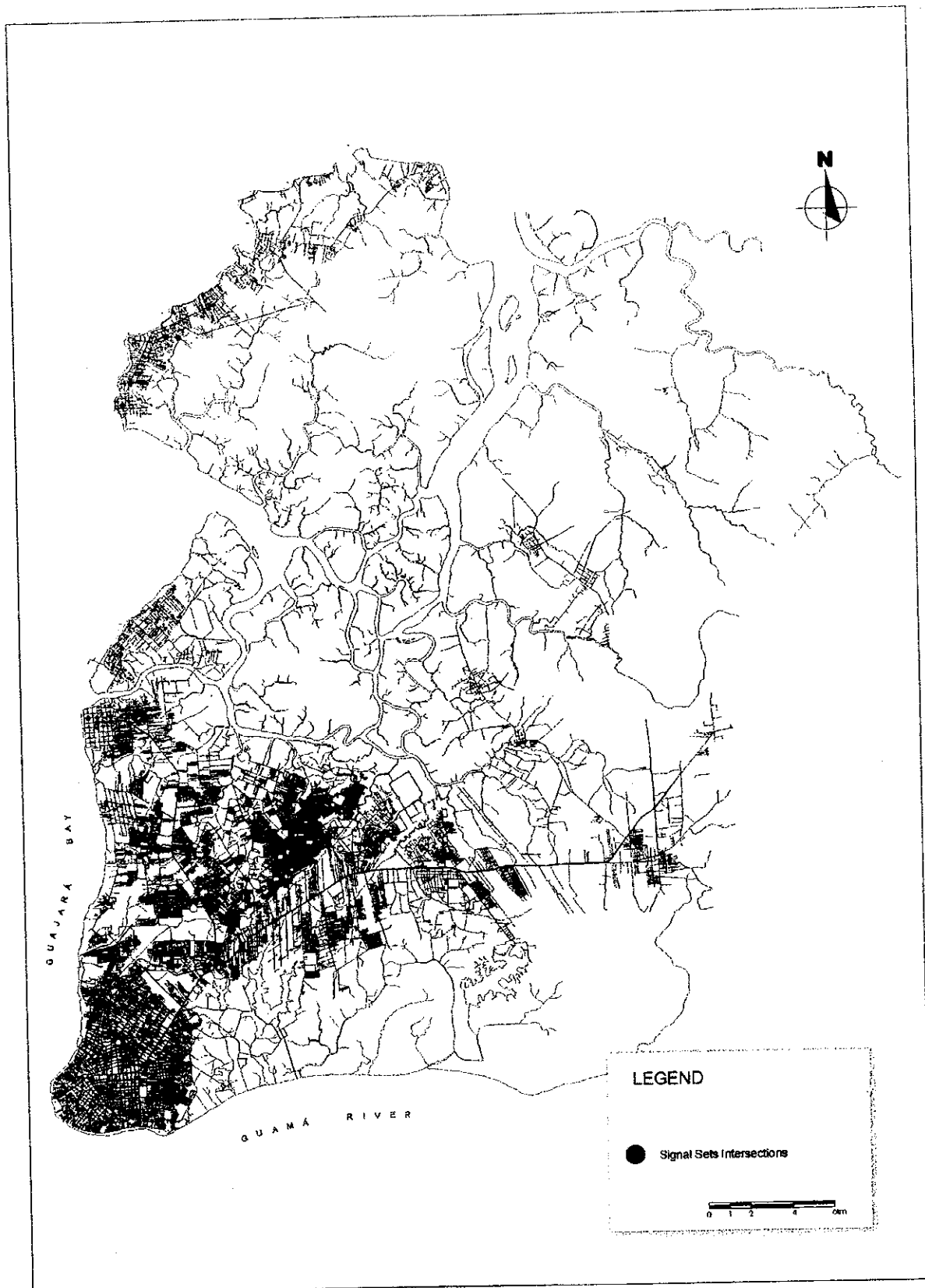
FIGURE 1.8-2 - Signal Sets Intersections - Expansion Area

LEGEND

Number of Lanes

8   4   2

Pavement Conditions

GOOD
REGULAR
BAD
VERY BAD

Sidewalks

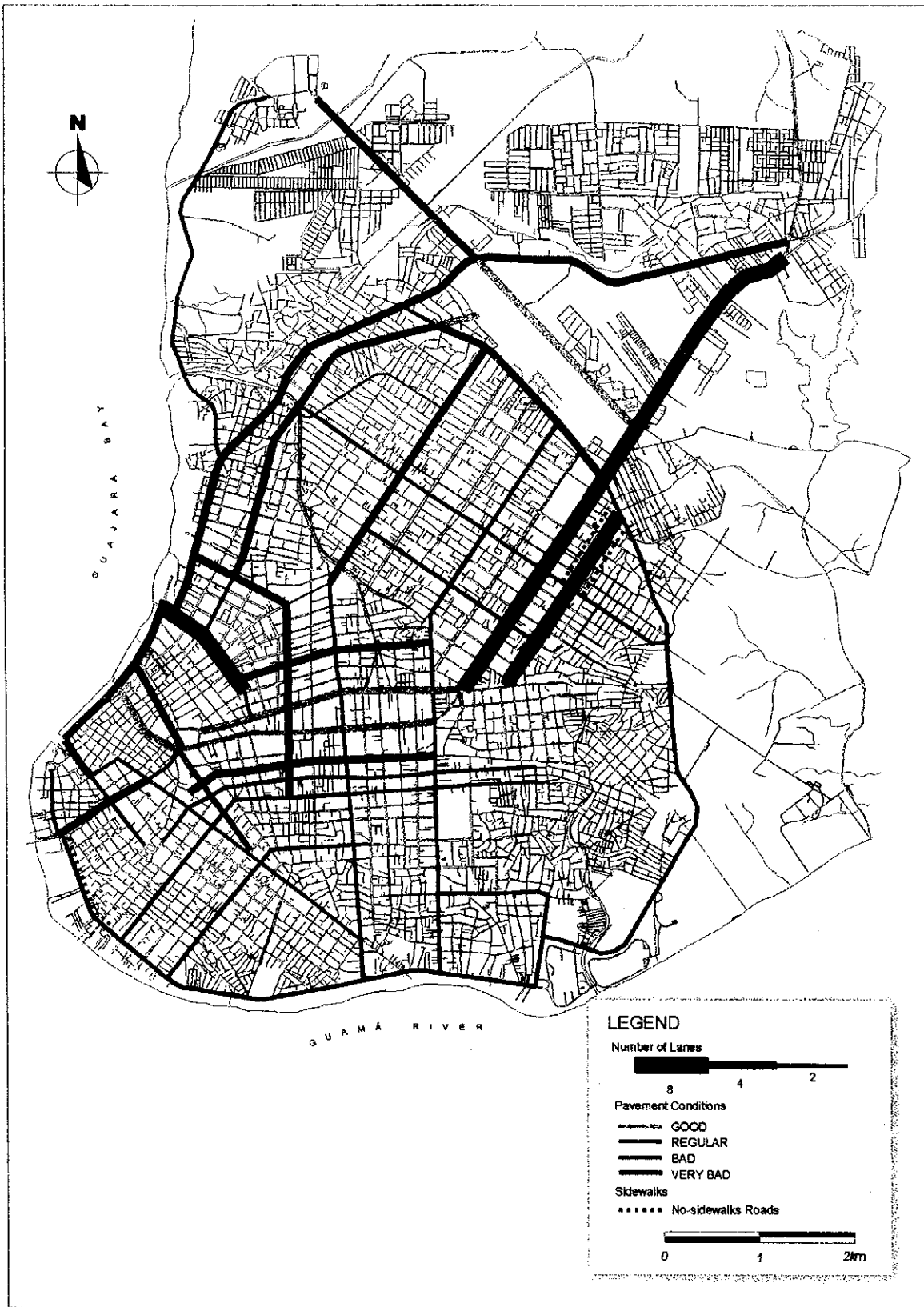• • • • • No-sidewalks Roads

0   1   2km

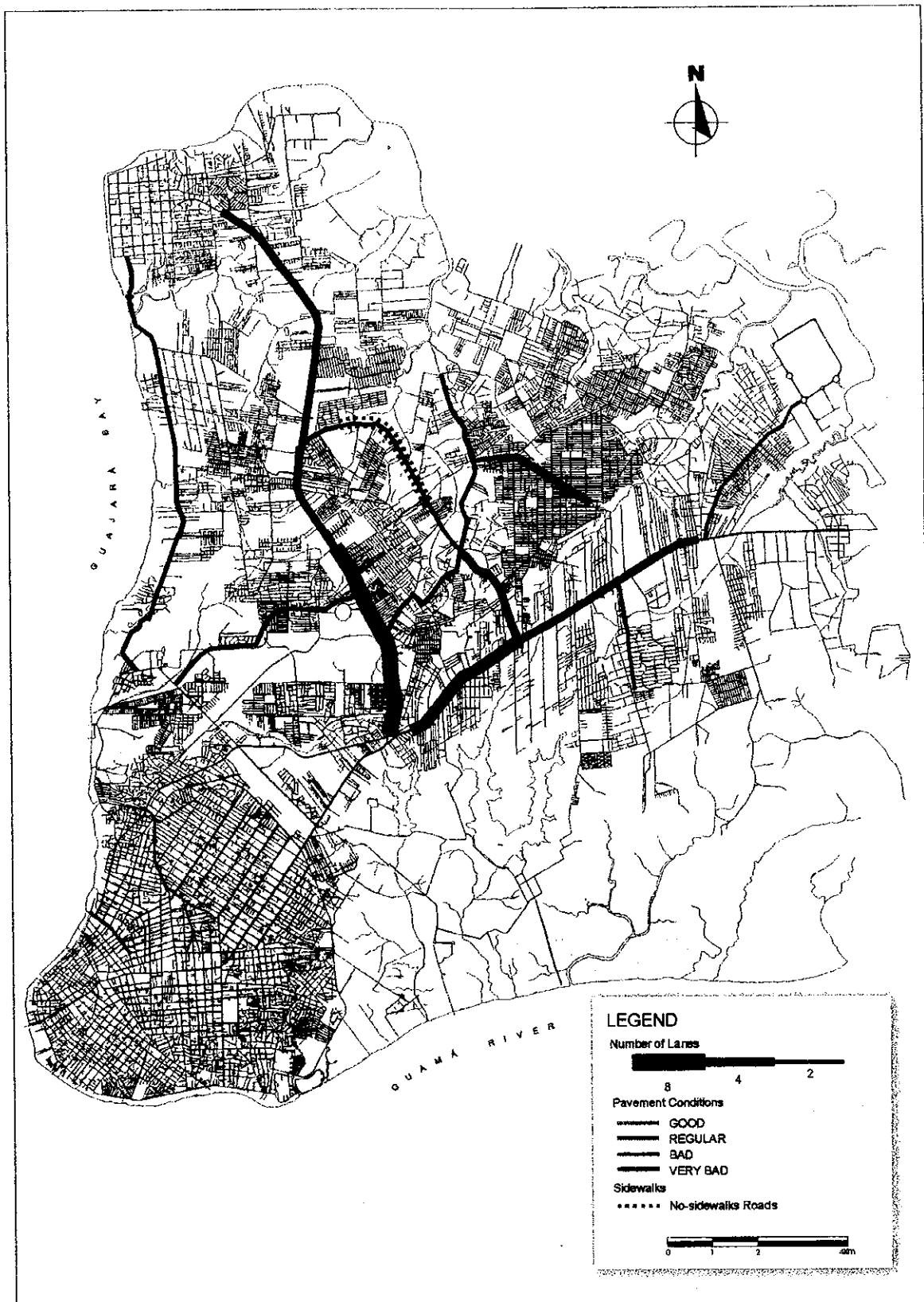FIGURE 1.8-3 - Road Assessment - 1ª. Légua and Surrounding

FIGURE 1.8-4 - Road Assessment - Expansion Area

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According to the results, 55.0% of total surveyed roads present bad conditions in the Expansion Area, while 45.0% are regular quality in 1.a Legua. No roads with excellent pavement conditions are existed. There are few roads without sidewalks. The roads with only two lines are predominant.

The weal conditions in the current road system come from several factors as lack of management on pavement, inadequated drainage system, lack of construction technology standard, lack of road hierarchy system, and lack of traffic regulation, especially cargo transport in RMB - Belem Metropolitan Area.

1.9. TRANSPORT USERS' OPINION

This survey was carried out together with Person Trip Survey to collect data for the quality of movement from pedestrians, bus users, private vehicle drivers, and bicycle riders. The randomly selected interviewee among family members was surveyed in the opinion survey, in contrary to that all the family members were interviewed in the Person Trip Survey. The questionnaire sheet with only a transport opinion was filled out. The number of collected questionnaires is 6,841 sheets, equivalent to 0.4% of total population.

The questions were divided into four items to identify the transport opinion on trip conditions as showed in FIGURES 1.9-1 to 1.9-10.

Item 1: Walking movement

Question 1.1: What is the biggest problem faced on walking movement?

FIGURE 1.9-1 shows that the problem for the pedestrian security is predominant over other aspects. Its figure reaches 72.1% of the answers of which 35.8% is related to trampling risk (security) and 36.3% robbery and assault risks. Another relevant aspect (21.2%) was the bad sidewalk conditions. According to PDTU/2001 purpose, 57.0% are trampling risk and bad sidewalk conditions.
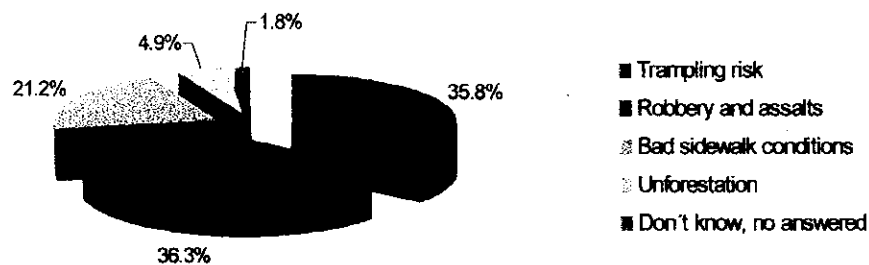
FIGURE 1.9-1 – Trouble on Walking Movement

Item 2: Movement by bus

Question 2.1: User evaluation on bus capacity

In bus users, the "overcrowded" on board is predominant with 40.1% of all the opinion to questions relative to capacity (FIGURE 1.9-2). The opinions for "overcrowded" and "crowd" reach to 65.1%. The data reveals that most of the users are not satisfied with the bus capacity.
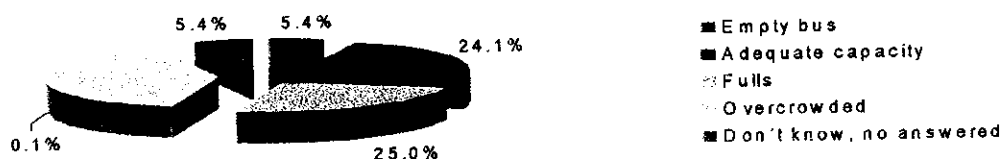
FIGURE 1.9-2 — Bus Capacity Evaluation

Question 2.2: User evaluation on available number of buses for trip/day

The data confirm the same level of dissatisfaction previously mentioned since 65,4% of users regard as small or very small in the number of operated buses. (FIGURE 1.9-3).
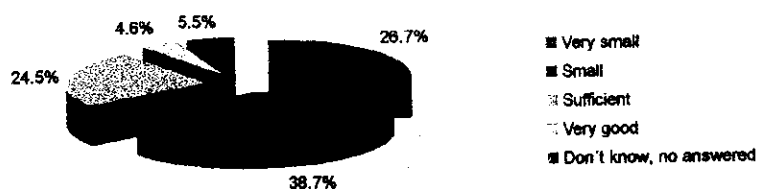
FIGURE 1.9-3 — Evaluation on Buses Number

Question 2.3: If the user give up not making the movement he wishes.

As can be seen in FIGURE 1.9-4, 35.6% of user frequently give up making the desired trips. This ratio shows a large number of potential trips not realized.

6.6%

35.6%

■ Yes
■ No
Don´t know, no answered

57.9%
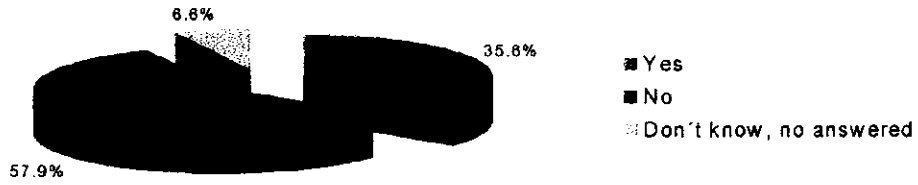
FIGURE 1.9-4 – Evaluation on Buses Movement not performed

Question 2.4: Which reasons make them not take their trips?

FIGURE 1.9-5 shows that the frequent reasons for not performing these movements are distributed equally between 19.9% and 18,7% of the answers as following:
- Necessity to take more than one bus (19.9%);
- Long walking distance (19.2%);
- No security (19.0%); and
- No comfort (18.7%).

The cost of the ticket was considered as a restrictive factor by only 10.7% of users showing that the current operation aspects are more restrictive than the economic one.

12.5%   10.7%

19.9%   18.7%

■ Expensive ticket
■ No comfort
 Unsecurity
 Long distance walking to bus stop
■ Transfer more than one bus
■ Others purposes

19.2%   19.0%
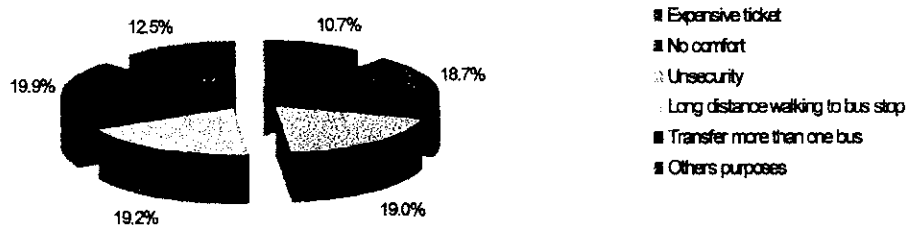
FIGURE 1.9-5 – Reasons for not taking trips by Bus

Question 2.5 What were objects of the movement which were not performed ?

Personal subjects, leisure activities, and shopping are the reasons which hold the biggest number of answers for non-performed movement: 66.0% (FIGURE 1.9-6). The reasons "work" and "business" deserve more detailed analysis for holding 20.8%.
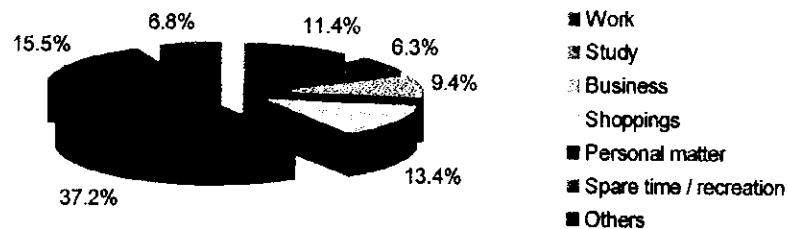
FIGURE 1.9-6 – Evaluation on Reasons for not taking Trips

Item 3: Movement by car

Question 3.1: Would the users avoid taking their cars if the quality of public transport service is improved?

FIGURE 1.9-7 shows that 63.5% of users would use public transport if the services were better.

FIGURE 1.9-7 – Evaluation on Changing from Car to Public Transport

Question 3.2: What are the priorities for public transport improvement?

Among priorities selected for public transport improvement on quality service (FIGURE 1.9-8), the security was the most important, reaching 33.8%. In second rank the quickness with 30.1%. The total of quickness, adequate itinerary and comfort holds 66.1%, showing that the possibility of mode transference depends fundamentally on system improvement.

18.8%   30.1%

17.2%

33.8%

■ Quickness

■ Bus security

Comfort

Itinerary adequade to necessities
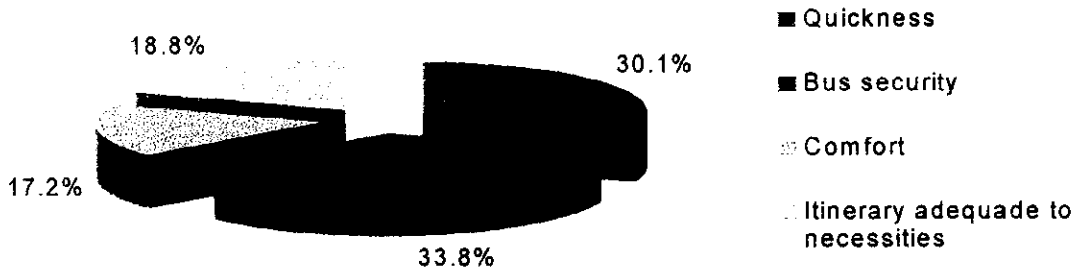
FIGURE 1.9-8 – Evaluation on Priorities for Public Transport Improvement

Question 3.3: What is the biggest problem faced by the user on automobile movement?

FIGURE 1.9-9 considers traffic jam as the most serious problem for automobile movement with 69.7% of the answers. This factor causes trouble not only for the car user but also to other modes. The low percentage of answers for lack of parking area can be interpreted as a reflex of inexistence of policy for restriction to on-street parking.

13.8%

16.5%

89.7%

■ Traffic Jam
■ Lack of Parking Area
□ High cost

FIGURE 1.9-9 – Evaluation on Trouble Faced by Automobile Users

Item 4: Movement by bicycle

Question 4.1: What is the biggest problem faced in riding bicycles?

According to user's opinion (FIGURE 1.9-10) the biggest problem is the lack of security representing 54.7% of the answers while 32.2% points out assaults and robbery. Therefore, the insecurity is the biggest problem holding 86,9%. The lack of parking for bicycle and the traffic insecurity is of 65.7%. Creating bikeroads and/or bikestrip and parking area would stimulate its use. Contrary to what most people think, the heat and the rain are not reasons for not using bicycles in RMB. This is illustrated in 2.2% of the answers.
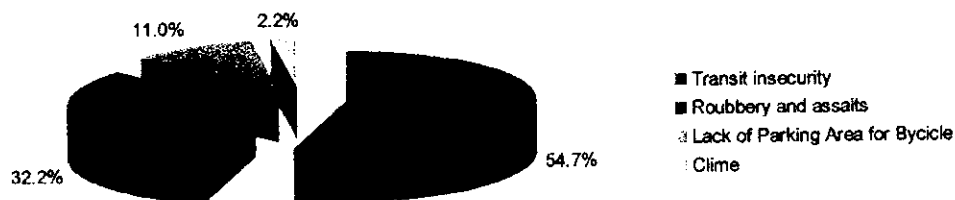
FIGURE 1.9-10 – Evaluation on Trouble Faced by Bicycle Users

1.10. CARGO TRANSPORT

The cargo transport survey was carried out by the Enterprise Syndicate of Cargo Transport of Para - SINDICARPA during December 2000 to January 2001, which made the questionnaire and conducted its distribution and collect. The questionnaire was collected from 27 Enterprise that correspond to 50.0 % of the road cargo moving in RMB. They are located as TABLE 1.10-1 follows:

TABLE 1.10-1 – Enterprise by Macro Zone

Macro zone		Number of Enterprises
Code	Name	
8	Guanabara	5
13	Julia Seffer	7
14	Ananindeua	3
5	Marambaia	3
4	Marco	2
3	Sacramenta	2
10	Pratinha	2
9	Bengui	1
Externa		2

The results are dispersed in some ways, but the more representative are as follows:

The roads utilized by the enterprises to receive and delivery their merchandise coincide with the main traffic corridors in RMB (FIGURE 1.10-1).

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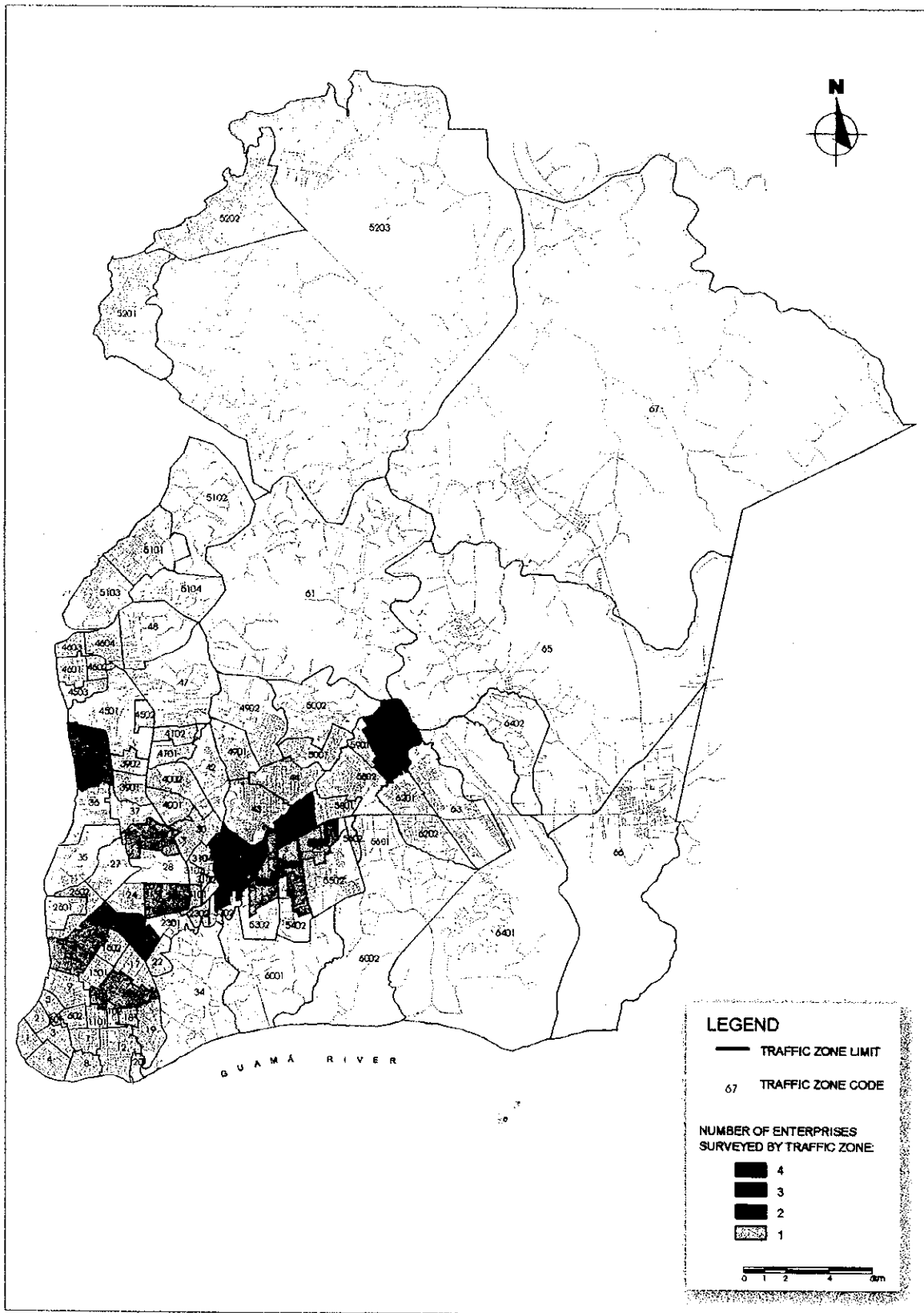
FIGURE 1.10-1 - Spatial Distribution of the Cargo Transport Enterprises

LEGEND

━━━ Main routes for receiving goods
━━━ Main routes for distribution of goods
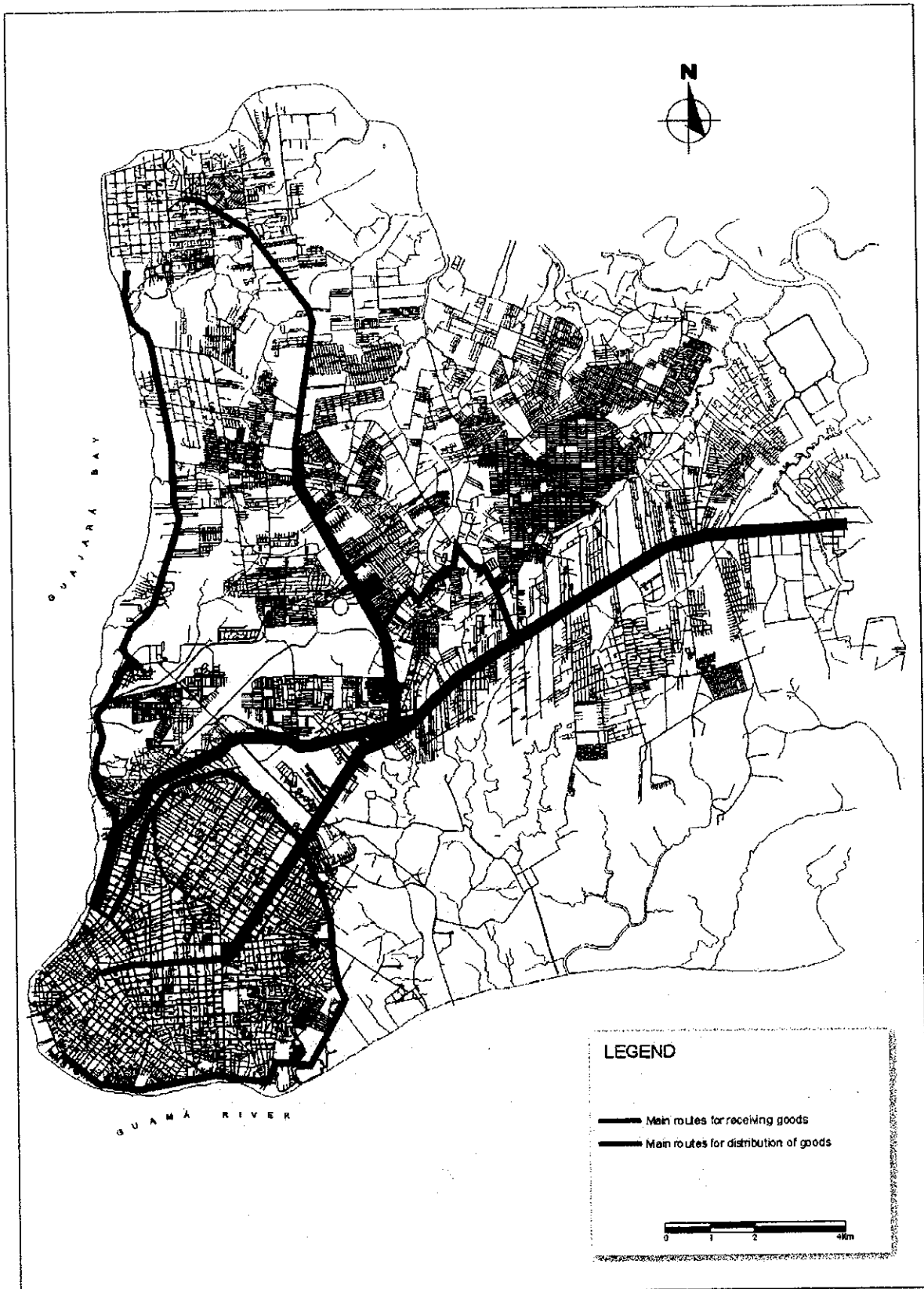
FIGURE 1.10-2 - Main Routes for Cargo Transport

From the surveyed Enterprises, 39% utilize only heavy truck to receive and deliver goods; 17% heavy truck and Semi-heavy truck; and 11% only light truck.

The most utilized mode type for delivery and collection of goods in RMB area are small truck, then light truck and heavy truck.

TABLE 1.10-2, 1.10-3 shows the characteristics of transported goods.

TABLE 1.10-2 – Enterprise Distribution by Segment

Segment	%
Fracionada[1]	74.0
Load[2]	33.0
International	15.0
Multimodal[3]	11.0
Transitário de carga[4]	7.0
Rodoviário	7.0
Fluvial	7.0
Itinerant[5]	4.0
Logística integrada[6]	4.0

Note: [1] Diversified cargo with packaged products
[2]. Cargo with only one product for one client
[3]. Road, fluvial and by air
[4]. Cargo of passage without local delivery
[5]. Cargo of passage with local delivery
[6]. Cargo with delivery to small clients

TABLE 1.10-3 – Enterprise Distribution by Transported Cargo

Type of Cargo	%
Food	48.0
Frozen	4.0
Inflammable	7.0
Household Goods	7.0
Electronics	6.0
Clothing	5.0
Moving	4.0
Several	44.0

The collection and delivery are almost uniformly done on weekday between Monday to Friday. Those activities are less on weekend. The best days are Monday and Tuesday.

TABLE 1.10-4 – Collect Distribution In Week Days

Week Day	Collect %)	Delivery (%)
Sunday	-	0.3
Monday	16.6	20.3
Tuesday	17.1	20.7
Wednesday	18.0	19.6
Thursday	18.4	18.0
Friday	19.5	16.8
Saturday	10.3	4.2

56.0% of the Enterprises deliver to shopping centers.

The main problems for the cargo transport in RMB are:

- There are no specific locations such as truck terminals for collection and delivery in central area;
- There is a restricted time for collection and delivery into central area;
- There is no security – cargo robbery;
- Too many public transport are served in Belém central area; and
- The pavement conditions on the main roads are bad in central area.

The results of the cargo transport survey show that the specific ways are necessary to fix the oneway system with a set of roads and times to access the main roads, and also control and supervise it.

1.11. ENVIRONMENTAL CONDITIONS IN STUDY AREA

1.11.1 NOISE

This set of survey focuses on the noise and vibration levels generated by motorized traffic in Belem. The result is presented in relationship between traffic characteristics (traffic volume and its composition) and the geometric of the road (wide and declivity) against noise and vibration levels.

The survey purposes are:

a) To evaluate the noise and vibration levels in some strategic points in RMB;
b) To compare to the existing noise levels by the Brazilian standard NBR-10151 for the noise;
c) To compare to the Japan resolution published in November 1976, since in Brasil there is no rules for vibration.

The measures were done from 16th to 19th of January 2001, in typical weekdays - Tuesday, Wednesday, Thursday, and Friday - with the average temperature between 28 and 32° C.

The criteria for the measure points are:

- Residential, commercial, and educational areas and hospitals:
a) In order to avoid the interference of noise and vibration not from traffic, measuring points situated away from building areas, industry, airports and other possible sources of noise were selected.
b) Flat areas were selected to calibrate the collected parameters.

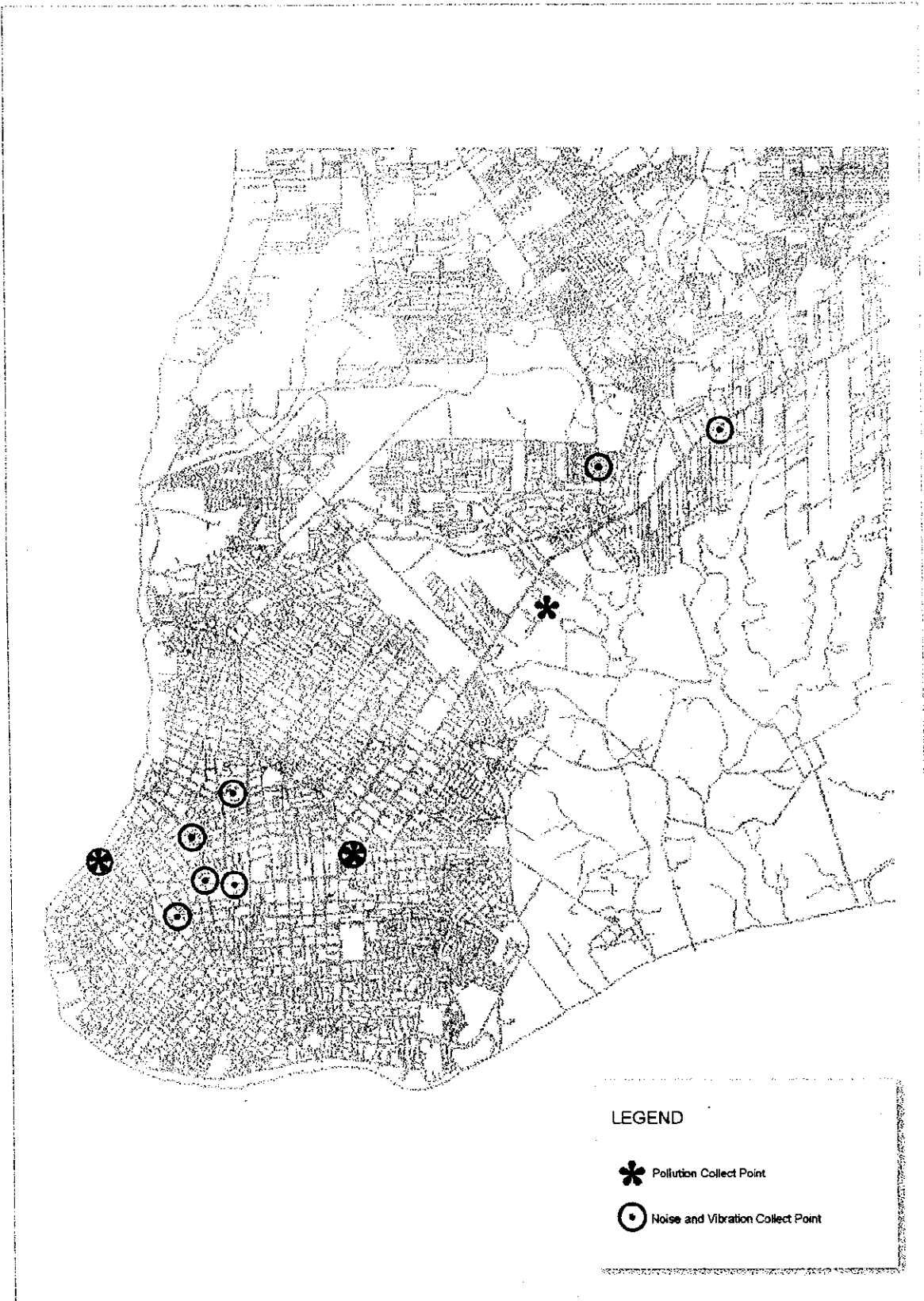TABLE 1.11-1 and in FIGURE 1.11-1 show the measured points in Belem City.

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LEGEND

✱ Pollution Collect Point

⊙ Noise and Vibration Collect Point

FIGURE 1.11-1 - Collect Data Point of Noise, Vibration and Pollution

TABLE 1.11-1 – Noise and Vibration Points

Point	Location	Characteristic	Number of Line	Wide (m)
1	Gentil Bittencourt Ave. (Among Dr. Moraes Street and Serzedelo Correa Ave.)	Commercial and Residential	3	9.40
2	Quintino Bocaiuva Street / Nazare Ave.		3	11.00
3	Generalissimo Deodoro Ave. Bernal do Couto Street	Commercial, educational and Hospital	4	12.00
4	Gov. Jose Malcher Ave. Almirante Barroso Ave.	Commercial	4	12.00
5	Visconde de Souza Franco Ave. Antonio Barreto Street	Commercial e Residential	3	11.00
6	Castilhos França Ave.	Commercial e Residential	3	17.00
7	Nazare Ave. Generalissimo Deodoro Ave.	Commercial	3	12.50
8	BR-316 Road (near Parabor street)	Commercial	3	14.00
9	Augusto Montenegro Road (near WE2 street)	Commercial e Residential	3	12.00

In each selected point the measures were done twice in 15 minutes. The totaled 18 measured data with vehicle traffic volumes by types (light and heavy) is collected.

The vehicles are classified into two types in the traffic volume counting:

a) Light vehicle volume: VL (cars, motorcycles, and vans);
b) Heavy vehicle volume: VP (trucks and buses).

The measurers of Noise Level NL-04 (microphone) and Vibration Level VM-52A (accelerometer), were measured by RION.

The equivalent noise (Leq) and vibration levels represent best measure, since they represent the average levels of sonorous and vibrate energy. The statistic percentage noise levels L10 and L90 represent the level that are up to 10% and 90%, respectively. Lmax is the maximum noise or vibration level reached during the collecting period.

The criteria of measurement is as followings:
a) To set microphone on 1.20 m above from ground level and 1.50 meters away from the curb;
b) To set microphone on a minimum distance of 3.50 meters from a reflective surface (wall);
c) To use wind protected cover on microphone;
d) To measure in the no rainy day; and
e) To set accelerometer near the curb.

TABLE 1.11-2 shows the results obtained from the survey of noise level according to the above methodology.

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TABLE 1.11-2 – Noise Data Collected on the Survey   January/2001

Points	Location	Date	Time	L_{eq} dB-A	L_{max} DB-A	L_{10} dB-A	L_{90} dB-A	Q_T	C (%)
1	Gentil Bittencourt Avenue (between Dr. Moraes Street and Serzedelo Correa Avenue)	16	10:38	79.7	103.2	82.8	66.6	280	29.0
		17	11:25	79.5	97.7	83.0	64.1	293	33.0
2	Quintino Bocaiuva Street / Nazare Avenue	16	11:17	77.3	91.2	80.9	67.9	596	14.0
		18	08:30	77.8	92.5	81.9	64.8	586	15.0
3	Generalissimo Deodoro Avenue / Bernal do Couto Street	17	08:20	73.9	89.5	77.3	65.4	542	7.0
		18	12:00	75.0	87.4	78.5	68.2	659	5.0
4	Gov. Jose Malcher / Almirante Barroso Avenues	17	09:10	79.0	90.6	82.3	73.1	603	23.0
		18	11:20	78.0	89.4	80.7	71.4	577	23.0
5	Visconde Souza Franco Avenue / Antonio Barreto Street	17	10:00	77.0	93.3	81.0	65.3	482	8.0
		17	18:15	76.4	97.1	80.1	64.6	554	11.0
6	Castilhos França Boulevard	17	10:35	76.0	97.9	79.4	66.8	327	32.0
		18	07:30	75.6	88.9	79.4	65.9	239	46.0
7	Nazare/ Generalissimo Deodoro Avenues	17	16:10	75.9	95.3	78.7	69.0	796	13.0
		18	08:00	74.8	90.5	78.2	66.5	583	15.0
8	BR - 316 Road/ Parabor Street	18	09:10	78.7	93.2	81.8	72.3	557	25.0
		19	08:25	79.0	91.9	82.1	72.2	660	20.0
9	Augusto Montenegro Avenue/ WE2 Street	18	09:45	77.3	96.1	80.4	67.2	308	24.0
		19	07:50	79.2	92.5	82.9	64.4	402	20.0

Q_T – total vehicles volume in 15 minutes;
C – traffic composition, per percentage of heavy vehicles;

The result of analysis in TABLE 1.11-3 requests the knowledge of the permitted sonorous pollution levels. These levels are established by Law no 1.065 - May 1996, and fixed according to zone and time by Brazilian Association of Technical Rules - ABNT (NBR-10151).

TABLE 1.11-3– Maximum Levels on Day and Night Period in each Zone

Area	Period	Decibels – dB(A)
Hospital Zone	Day	45
	Night	40
Residential Zone	Day	55
	Night	50
Central Zone (commercial or mixed zone)	Day	65
	Night	60
Industrial Zone	Day	70
	Night	65

dB(A) : sound intensity, measure on curve "A ", defined by NBR- Brazilian Association of Technical Rules – ABNT.

Comparing all the L_{eq} (Table 1.11-2) to the maximum levels employed by Brazilian Rule (Table 1.11-3), all the L_{eq} in all collect points reaches to the maximum levels. These major roads with heavy vehicle volume also present the heavy traffic composition (buses and trucks) where the composition ratio reaches to 30.0% of traffic volume.

On point 1 (e.g. Gentil Bittencourt avenue) with a three - strip - avenue, there is a medium traffic volume on period of 10:38 to 10:53 am (measuring time). The measured noise level is Leq=79,7, relating to the traffic volume which is 19 vehicles per minute with the average heavy vehicle composition ratio of 29%. Comparing to the maximum level 65 dB (A) in the central zone, the noise level in this point exceeds by 14,7 dB(A). A noise level of 79,9 dB(A) has sonorous energy of 28,5 times to the limit 65 dB(A), based on the fact that the relation between sonorous energy and decibel unit is logarithmic.

The data shows that the noise levels are up to the expected even if the measures are done in the month during the school vacation Figure 1.11-2. Most of the educational facilities that are near the streets and avenues suffer from the dispersion of sonorous energy by larger noise impact from traffic.
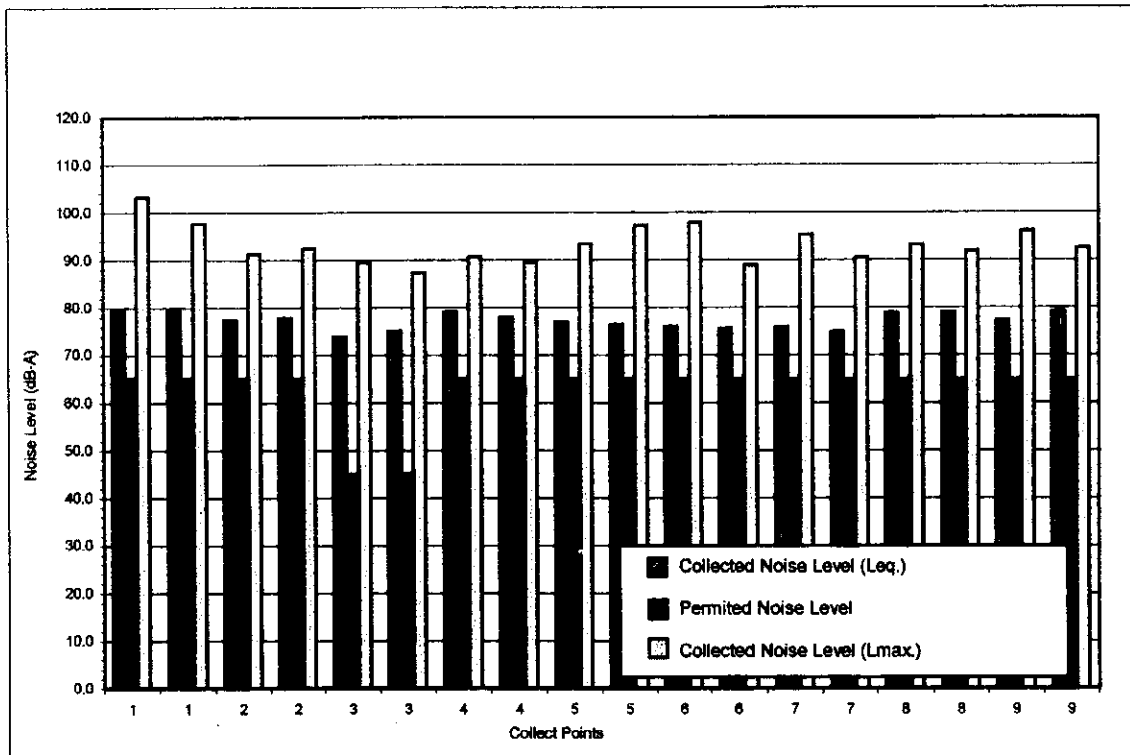

FIGURE 1.11-2: Noise Level Collected vs. Permitted

TABLE 1.11-4 - Data from Vibration Collect   January/2001

Points	Location	Day	Time	Axle X (dB)				Axle Y (dB)				Axle Z (dB)			
				Leq	Lmax	L10	L90	Leq	Lmax	L10	L90	Leq	Lmax	L10	L90
1	Gentil Bittencourt Avenue	16	10:38	24.5	34.7	27.5	19.7	25.9	38.3	28.8	20.6	39.7	53.1	43.0	32.3
		17	11:25	24.4	34.4	27.5	19.5	26.3	38.4	29.0	20.8	39.6	52.7	42.8	31.5
2	Quintino Bocaiuva Street/ Nazare Avenue	16	11:17	23.5	44.6	25.6	18.1	31.9	59.5	27.7	18.7	34.9	52.5	37.8	27.3
		18	08:30	22.1	36.3	25.4	16.2	22.2	36.3	25.7	15.7	35.9	51.4	39.1	26.5
3	Generalissimo Deodoro Ave. /Bernal do Couto Street	17	08:20	17.6	27.4	19.6	15.0	18.2	30.2	20.6	15.0	33.0	43.2	36.2	26.2
		18	12:00	21.8	45.3	22.7	15.7	20.2	30.2	22.5	16.7	33.9	44.5	36.8	28.7
4	Jose Malcher Gov. / Almt. Barroso Avenues	17	09:10	24.4	33.1	27.1	19.6	24.6	33.7	27.2	19.9	36.6	46.9	39.0	30.5
		18	11:20	22.1	31.7	25.0	17.7	23.1	30.7	25.7	18.5	35.6	44.6	38.7	29.7
5	Visconde Souza Franco Avenue / Antonio Barreto St.	17	10:00	31.6	46.2	36.1	21.5	34.0	51.8	37.8	22.4	51.7	71.3	55.4	33.7
		17	16:15	29.3	41.2	33.6	21.1	34.3	51.7	38.5	21.6	51.4	70.7	55.8	33.3
6	Castilhos França Boulevard	17	10:35	22.7	32.3	26.0	17.4	24.4	37.1	27.2	19.4	47.2	59.1	51.3	35.5
		18	07:30	22.6	32.6	26.2	16.0	24.4	36.8	27.5	18.3	47.2	60.8	51.4	32.8
7	Nazare / Generalissimo Deodoro Avenues	17	16:10	19.6	29.0	22.5	15.7	20.6	30.8	23.2	16.9	34.4	46.0	38.7	27.2
		18	08:00	19.3	26.5	21.3	15.7	20.0	32.0	23.3	16.7	34.0	48.1	38.4	27.6
8	BR - 316 Road / Parabor Street	18	09:10	20.3	29.8	22.8	16.6	23.0	32.7	26.2	18.1	36.1	48.3	39.9	29.5
		19	08:25	21.1	27.8	23.3	18.3	22.9	32.4	25.8	19.0	34.9	44.9	38.2	29.5
9	Augusto Montenegro Road / WE2 Street	18	09:45	24.6	40.2	28.2	16.8	26.5	39.4	30.2	17.9	42.8	58.8	46.6	30.3
		19	07:50	19.0	25.6	42.2	29.0	15.4	26.0	42.5	29.5	15.7	40.8	54.5	44.9

In order to measure and evaluate the vibration levels, it is necessary to have the ordinate data because the vibration can happen in different directions. For that, three axles were defined to measure the vibration levels:

a) Vibration axle X: parallel to road;
b) Vibration axle Y: perpendicular to road;
c) Vibration axle Z: vertical.

Since in Brazil there is no rule for vibration level limits, the rule from Japan was taken.

TABLE 1.11-5 – Maximum Levels of Vibration

Area	Period	Decibels – dB(A)
Residential zone or that need silence	Diurnal	65
	Nocturnal	60
Commercial zone, industrial or mixed	Diurnal	70
	Nocturnal	65

Comparing and analyzing the Tables 1.11-4 and 1.11-5, that the data referred to equivalent vibration does not exceed the values foreseen, especially on axles X and Y, where levels are much lower than that of the rule.

There are situations where the vibration level is over the limit fixed by the Japan rule in the crossing point between Doca Souza Franco and Antonio Barreto Ave. In this case the maximum level on axle Z is 71,3dB, which doesn't mean a serious problem. The L10 level shows that in 10% of the measuring time duration, the vibration level is over 55,4 dB.

In contrary to what was observed in the noise measures, the vibration levels do not reach the degree that could damage the human health. It is lower than the limits established by rule.

Because few samples were taken, of which it was possible to evaluate how much such noise and vibration levels can affect the life quality in Belem. The results show the necessity of a long time monitoring program to mitigate the pollution for noise and vibration.

1.11.2 RELEASE LEVEL OF PARTICLE MATERIAL

The survey focuses on measure of the emitted particle material level in Belem Metropolitan Region in order to identify its concentration level beside roads in comparison to the maximum levels of Brazilian rules.

The urban traffic characteristics influence the physical-chemical atmospheric characteristics by emission gas and polluted material (MP) from vehicles.

The inhalant particles (polluted material less then 10 μm (microns)) are harmful to the human health. However it is important to identify the concentration of these particles in the air to prevent public health.

The particle material is one of the elements emitted from vehicles under Brazilian Law according to the Resolution CONAMA n° 003 of June 28th 1990. It presents with three indicators: Total Dust in Suspension (PTS), Inhalant Particles (PI), and Smoke. The substances are solids or liquids, and visible or not. These particles can be carried by air through the long distance between the pollution origin and residences or areas.

The article 1 in the Resolution CONAMA n° 003 of June 28th 1990 set Primary and Secondary Patterns of Air Quality:

a) Primary Patterns: are the pollutant concentrations when they are over the recommendation level which affects the human health;
b) Secondary Patterns: are the pollutant concentrations that cause the minimum damage to residents as well as to fauna, flora, and natural environment.

As for primary and secondary patterns, the resolution considers the maximum concentration of inhalant particles of 150μg/m3 in air for a period of 24 hours. Above this level, it is harmful to the welfare of the population.

For illustration, see TABLE 1.11-6.

TABLE 1.11-6: National Patterns of Air Quality

POLLUTANT	Sample Time	Primary μ g/m³	Secondary μ g/m³	Measure Methods
Inhalant	24 hours*	150	150	Inertial Parting
Particles	MAA	50	50	or Filtering

(*) Not allowed to be exceeded once a year.
MAA: annual average arithmetic

Besides the specific method for this resolution and the ABNT-Brazilian Association of Technician Rules-NBR 13412, the Sample of Large Volume - AGV MP 10 was used in this study together with the inertial parting of the MP10 particles. This method also attends to specifications of US EPA-Agency of Protection and Development of United States, and CONAMA-National Concierge of Environment in consideration of a national and international reference method.

The equipment MP10 was installed according to the criterion of measures recommended by US EPA in which the equipment is at least 20.0m away from trees and buildings, left in the air, and at a minimum distance of 2.0m above the ground.

Three locations were selected for the measures, taking into account the traffic volume and its composition:

a) COHAB: which is in a residential area beside the environmental park of Utinga, is characterized by the following traffic conditions: low traffic volume and low ratio of large vehicle composition. The equipment was set at parking lots.
b) Praça dos Estivadores (Boulevard Castilhos França): is characterized by traffic conditions with higher ratio of heavy vehicle composition. Its figures are approximately 15,000 vehicles/day with 45% of heavy vehicles.
c) São Braz (Av. Almirante Barroso / Av. Governador Jose Malcher): is characterized by heavy traffic flows as an important major bus corridor. The traffic volume is approximately 45,000 vehicles/day with 26.0% of heavy vehicles.

To analyze the pollutant concentration, the following examination is carried out in laboratory:

According to the examination manual, the fiber filters were dried and its weigh was measured to conduct next search.

After installing the samplers in the selected three locations, the collecting of the particles was done by equipment with a diameter less than 10 μm during 24 continuos hours. A sampler unit was used in distinct days to conduct the collection in the three locations. The information such as average temperature, precipitation, and arterial differential pressure between the atmosphere and the equipment was collected in those locations.

After the collection of particles, the weighs of filters were measured again to determine the volume of float material in the air obtained from sample mass. Based on the information for the difference of mass and real outflow, it was possible to estimate the particles in total air volume. Finally the pollutant concentration in unit of μg/m3 could be defined. We can figure out the concentration following the equation 01 recommended by US EPA.

$$MP_{10} = 10^6 \left(\frac{Mf - Mi}{Vp} \right)$$

(Equation 01)

Where,

MP10 = concentration of total particles in suspension, $\mu g/m^3$

Mf = final weight of filter, g

Mi = initial weight of filter, g

Vp = total volume of air sampled for pattern conditions, m^3

10^6 = conversion factor $\mu g / g$

FIGURE 1.11-1 and TABLE 1.11-7 shows the result of the three selected points.

TABLE 1.11-7: Result of Pollution Collect

Local	Date	Rain (min)	P(initial) (g)	P(final) (g)	P(sample) (g)	Qp (m^3/min)	Vp (m^3)	Concentration ($\mu g/m^3$)
COHAB	24/01/01	0	2.6711	2.7045	0.0334	1.134	1,638.5	20.38
COHAB	26/01/01	0	2.7154	2.7518	0.0364	1.131	1,626.1	22.39
COHAB	25/01/01	0	2.6707	2.7130	0.0423	1.131	1,670.1	25.33
COHAB	23/01/01	20	2.6973	2.7396	0.0423	1.133	1,630.9	25.94
COHAB	29/01/01	0	2.7263	2.7713	0.0450	1.131	1,628.1	27.64
COHAB	13/12/00	120	2.7886	2.8375	0.0489	1.126	1,621.0	30.17
COHAB	11/12/00	35	2.7824	2.8380	0.0556	1.128	1,623.8	34.24
COHAB	* 27/01/01	0	2.7400	2.8001	0.0601	1.131	1,626.7	36.95
COHAB	* 28/01/01	0	2.7141	2.7828	0.0687	1.130	1,626.7	42.23
P. Estiv.	* 20/01/01	445	2.7326	2.7658	0.0332	1.129	1,614.4	20.56
P. Estiv.	* 21/01/01	20	2.7475	2.7951	0.0476	1.116	1,606.0	29.64
P. Estiv.	* 17/12/00	50	2.6783	2.7391	0.0608	1.115	1,604.6	37.89
P. Estiv.	18/12/00	475	2.7458	2.8078	0.0620	1.115	1,605.3	38.62
P. Estiv.	19/01/01	105	2.7244	2.7913	0.0669	1.123	1,617.4	41.36
P. Estiv.	19/12/00	45	2.7799	2.8463	0.0664	1.111	1,599.6	41.51
P. Estiv.	22/01/01	0	2.7284	2.8018	0.0734	1.113	1,602.4	45.81
P. Estiv.	18/01/01	80	2.7186	2.8008	0.0822	1.120	1,612.4	50.98
Sao Braz	* 16/12/00	340	2.7192	2.7931	0.0739	1.124	1,618.1	45.67
Sao Braz	* 14/01/01	55	2.7753	2.8509	0.0756	1.113	1,602.4	47.18
Sao Braz	15/01/01	35	2.7713	2.8522	0.0809	1.111	1,598.9	50.60
Sao Braz	15/12/00	330	2.6748	2.7575	0.0827	1.108	1,595.3	51.84
Sao Braz	14/12/00	130	2.7660	2.8503	0.0843	1.106	1,592.4	52.94
Sao Braz	16/01/01	70	2.7633	2.8509	0.0876	1.103	1,580.9	55.41
Sao Braz	17/01/01	10	2.7134	2.8032	0.0898	1.106	1,592.4	56.39

(*): Collect done on weekends;

P(initial): Gross initial weight of dry filter (g);
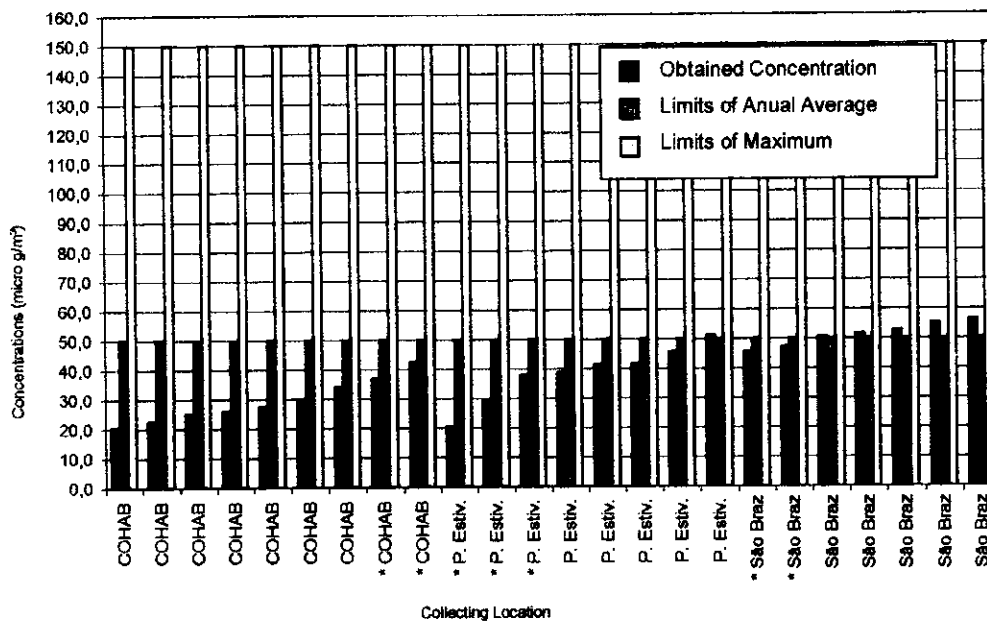
P(final): Gross final weight of dry filter (g), after the collect;

P(sample): Weight of collected sample (g);

Qp: Average air outflow sample in normal conditions of temperature and pressure (m^3/min);

Vp: Total volume of sample air in normal conditions of temperature and pressure (m^3);

Concentration: Concentration of pollutant material per cubic meter of sample air ($\mu g/m^3$).

(*): Collected data in the weekends.

FIGURE 1.11-3: Pollutant Concentration Levels

The pollutant concentration levels varied between 20,38 (COHAB/PA) and 56.39 µg/m3 (Sao Braz). This means that the concentration does not exceed the permitted maximum limits. Since the collected data is measured in the rainy season when there is daily precipitation, the concentration level in Sao Braz area will be close to the limits permitted in the annual average. The results are not satisfactory because in this season the concentration levels are the lowest of the year.

Comparing the results obtained from the CONAMA resolution (Table 1.11-6), it is observed that part of the collected data is already up to or over the limit for the annual averages of concentrations. If the value in the season of lower levels of concentration exceeds the limit of the annual average, probably we will find values over the limit of the rules (50 µg/m^3) in case the collect is done in different season. The measurement was done during a vacation season where the traffic volume is lower than in others. However, it is important to have global traffic monitoring system to evaluate the particle pollutant in RMB - Belem Metropolitan Area.

The result table shows that the concentration of the pollutant material is larger in areas with heavy traffic volume. The traffic volume at intersection between Almirante Barroso and Governador Jose Malcher Ave. (Sao Braz) stands out at 11,000 heavy vehicle/day. Traffic jam to cause a great volume of pollutants occurs in this area. This fact can be confirmed by the two lowest concentrations in this location during the weekends (16/12/00 and 14/01/01).

The results show the necessity of long term monitoring of the inhalant particles together with a vehicle inspection program. It would be possible to obtain information for the cycle and temporal pollution structure to evaluate all air quality parameters for the annual average concentration of the National Legislation. This convenient analysis would be used to support the environmental conservation management.
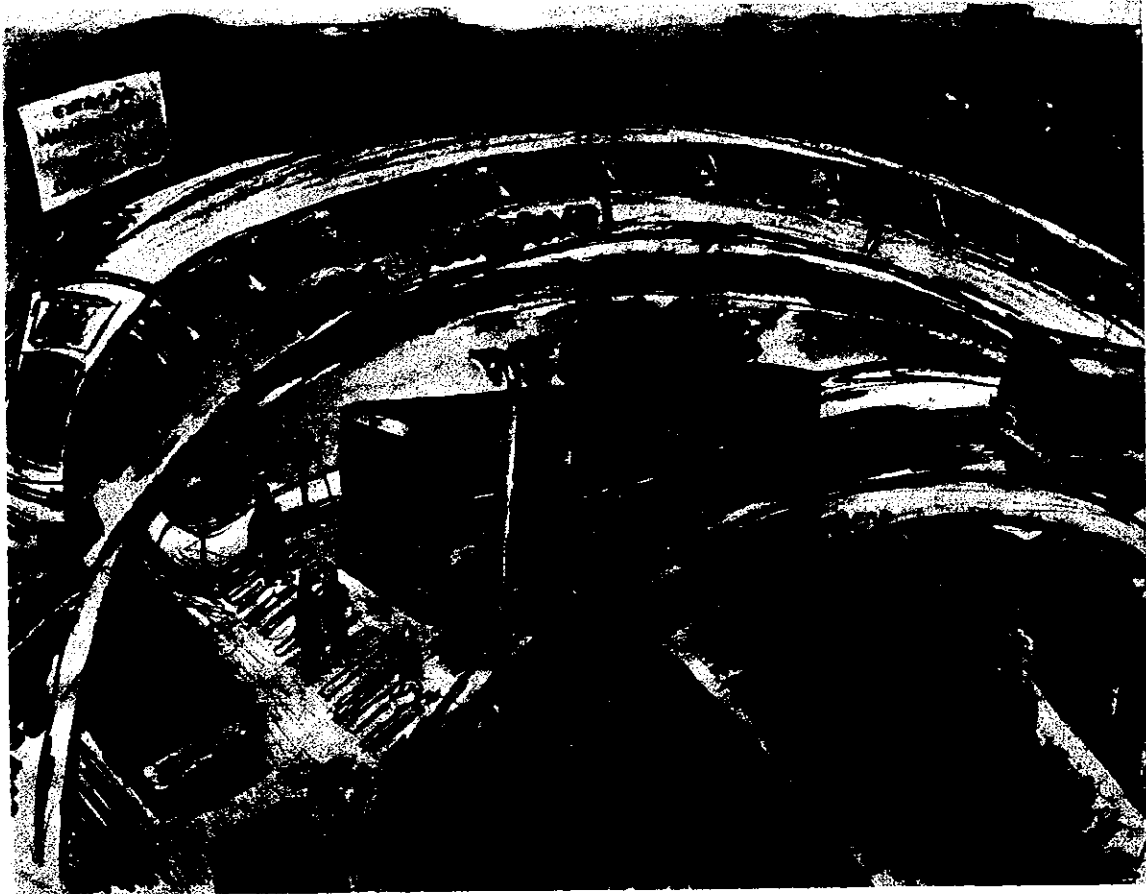
Author: Josué Anselmo Rente
Title: Belém Transporte do Futuro
School: Cidade de Emaús – 8th Degree
Classification: 2nd

CHAPTER 2
SOCIOECONOMIC STRUCTURE AND TENDENCIES OF DEVELOPMENT OF METROPOLITAN AREA

2.1. SCENARIOS OF REGIONAL AND NATIONAL DEVELOPMENT

The main factors that influence the economic performance in the RMB-Belem Metropolitan Area for next 20 years are the followings:

1) Evolution of the national and state economy

The economic performance of the RMB-Belem Metropolitan Area is affected not only by the behavior of the Brazilian economy as a whole but also by that of the economy in the rest of the Para State. These parts of the State present a great demand for products and services, especially in regional area and sub-regional area.

During the second half in the 1980s, the Para economy achieved a more rapid rate of economic growth by mainly operation or development of great mining and metallurgical projects (bauxite, iron, manganese and gold exploration and production of primary aluminum), as well as the implementation of the first phase of the Tucurui hydroelectric plant. According to the studies and Statistic data of SEPLAN/PA-Executive Secretary of Planning General Coordination and IBGE-Institute of Brazilian Geography, the average annual growth rate of GDP in Para State (Gross Domestic Product) between 1985 and 1990 was 8.03%, in contrast to the average of 1.88% in the Whole State, implying a higher participation of the Para-GDP in the national economy. The figure of percentage increased from 1.44% to 1.94%. In the beginning of the 90s, the situation was inverted: the Para GDP falls 1.43% per year against 3.11% of the whole country, what reduced to its participation of 1.72% with the lower and stable growth of production process, besides increasing a environmental concern for the use of Amazon natural resources.

The economic development of both Brazil and Para State in the period of years 2000-2020 refers to the study on "World, National Scenarios and of Amazon – 1998-2020", studied by Eletronorte: electronic company in Para. The outline of study in the Amazon area delineated four alternative scenarios is illustrated in FIGURE 2.1-1. The future development of the Para economy in this Study accepted the analyses and conclusions presented by the Eletronorte's Study. The axis Araguaia-Tocantins where area presents intense dynamism of economic development in the RMB is referred to the Study. The four mentioned-alternatives are as the followings:
a) "Sustainable development": compatibility among economic growth, social and space distribution of the income and reduced environmental impacts. Its dynamism is based on micro-electronics products, computer science and telephony (Manaus), besides energy, bioindustry (use of the extraordinary biodiversity of the area), ecological tourism and sustainable exploration of natural resources. Strong regional articulation;

b) "Regional development and life quality": its dynamism been divided between modern activities and traditional segments. This scenery also foresees positive results in the economic, social and environmental fields, but without the same intensity of the prior scenery;

c) "Growth and environmental degradation": increase for minielectronics products (Manaus), beside activities as metal-mechanics, production of grains, agropasture, agroindustry, wood processing, and tourism. Small reduction in the poverty indexes, nevertheless the growth of the economy and intense environmental degradation;

d) "Stagnation and poverty": the regional economy stays stagnated, presenting its main activity as the export of raw materials or semi-elaborated products. Increase of the poverty levels and medium environmental impact, due to the stagnation. Desarticulation of the region.

Update of Master Plan for Urban Transport in the Metropolitan Area of Belém - PDTU/2001

5. AMAZONIA INTEGRATION AXIS
Highway and energetic infra-slucture of economic integration of Axis Araguaia-Tocantins,Madeira-Amazonas and Oeste.
Interligation Inter-regional North-Northeast through Transamazônica Highway (Humaitá-Altamira) and North, Center-West through Sartarém-Curabá Highway and transferency of eletric energy big blocks direding to Northeast and Center-South of the country, from Belo Monte Hydroeletricon Xingu River and Ilaituba on Tapajós River.

6. PAN-AMAZONICOS NORTH AXIS
Highways and energetic infra-structure axis (generations and transition of hydro and termoeletricity) integrating influency areas of Manaus and Boa Vista with Venezuela and Guianas and Macapá with Guianas.

7. ARAGUAIA-TOCANTINS AXIS
Multimodal transport axis - hydroroads, ports, railroads and highways - and energetic infra-structure (eletric energy generation and transmission) and comunication, including 10% of national territory. Rowing of grains and also for exportation, through Itaqui Port on Maranhão and/or Belém with Tucurui dike conclusion.

4. PAN-AMAZONIC WEST AXIS
Highway and energetic infra-strudure of Amazonia ntegration with Andinos coutnes, through Peru railroads and also exportation grains by Pacific ports.

2. WEST AXIS
Highway and energetic infra-structure (natural gas, petrol, thermal and hydroeletricity) including Rondónia state and the Center-West of Mato Grosso. Rowing of grain production and bovine products from Cuiabá-Porto Velho Highway and Madeira Hydromoed, in direction to tacoatiara port.

3. MADEIRA-AMAZONAS AXIS
Transports multimodal axis -hydroroads, ports, railroads and highways - and energetic infra-structure (natural gas, petrol, thermal and hydroeletnicity) including Amazonas and Acre states. Grains production flow and bovine productions of west to north and also to export, througu tacoatiara, on Amazonas.

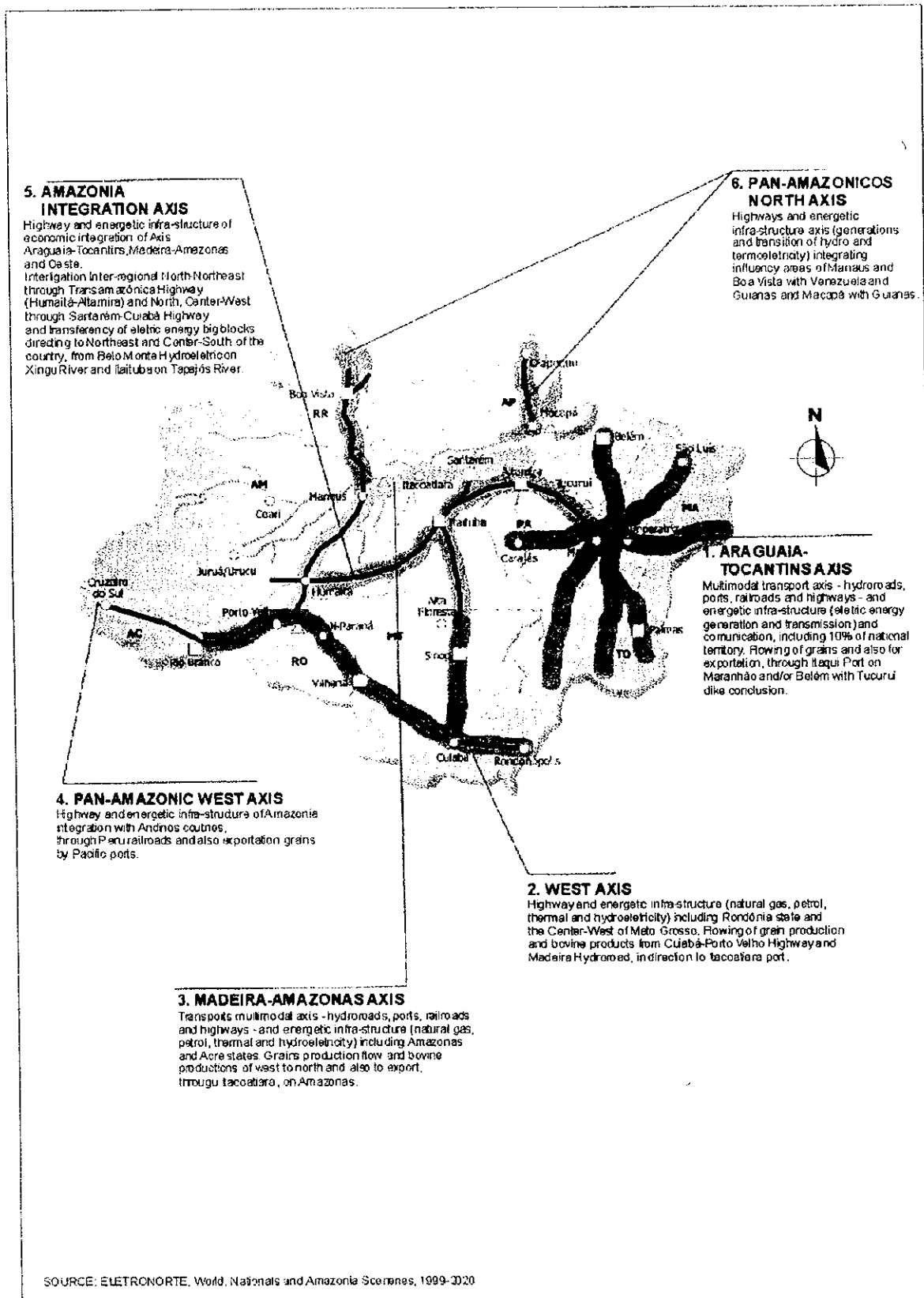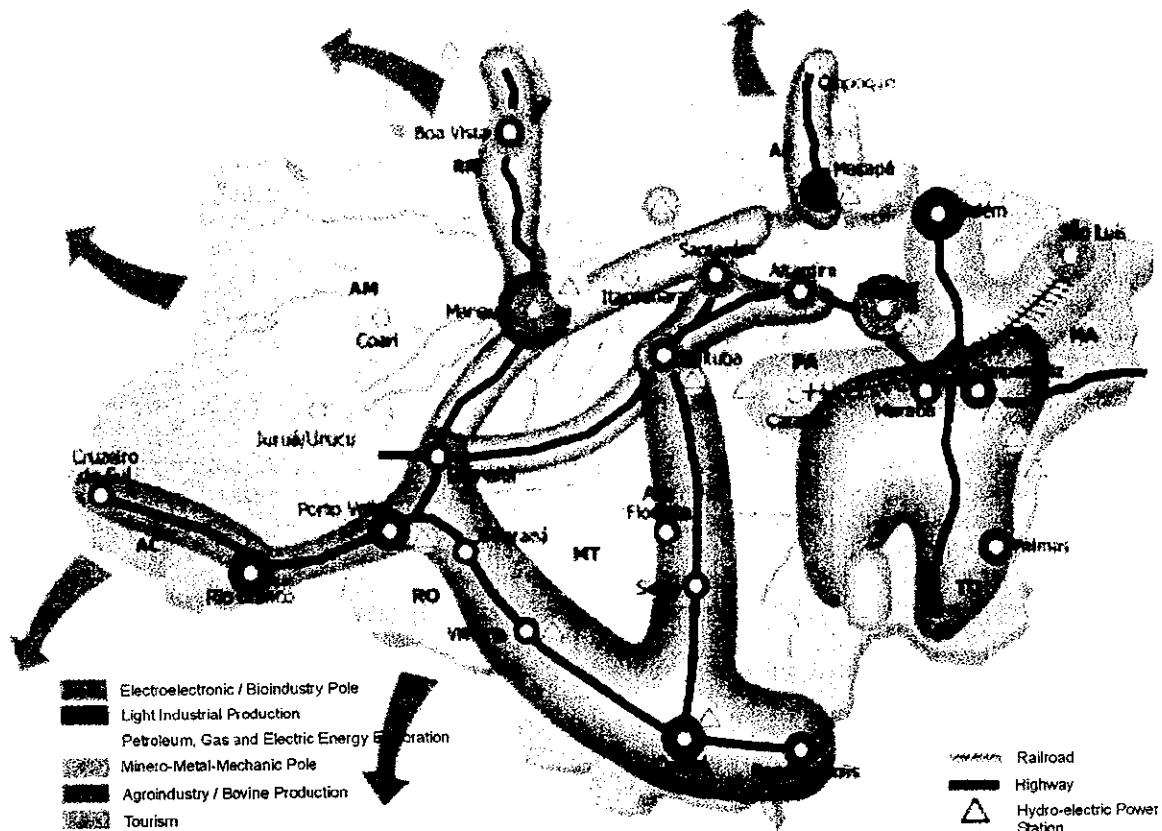SOURCE: ELETRONORTE, World, Nationals and Amazonia Scenenes, 1999-2020

FIGURE 2.1-1 - Dynamism Factors of Amazonic Economy

According to the same study, the period of 2000-2020 would not be characterized by just one scenario, but by a sequence of them. The "most probable situation" in the area starts with the scenario of "stagnation and poverty" (current situation). Its situation should be persisted until 2002. From year 2002, the reorganization of the productive structure will gradually progress, so that the economic activities may win competitiveness and expand under a condition by increasing environmental restrictions. On that condition, the period 2003-2010 will be characterized as a "growth and modernization period". On the other hand, the 2011-2020 marks the scenario of consolidation of which growth is compatible with the environmental conservation. Its dynamism will be based on the biodiversity and the ecological tourism. Therefore, the significant reduction of the poverty levels will be realized. FIGURE 2.1.2 shows the scenario of prosperity and conservation of Amazonia forecast. It deals with an optimistic expectation for the future of Amazon.

Electroelectronic / Bioindustry Pole
Light Industrial Production
Petroleum, Gas and Electric Energy Generation
Minero-Metal-Mechanic Pole
Agroindustry / Bovine Production
Tourism

Railroad
Highway
Hydro-electric Power Station

Source: ELETRONORTE

FIGURE 2.1.2 - Scenario of prosperity and conservation forecast to Amazonia - 2020

2) The Role of RMB-Belem Metropolitan Area as a pole of tertiary industry in the region and the state

The tertiary sector of economy constituted by such as commercial activities and services is the more important in RMB-Belem Metropolitan Area. According to the UNDP/98-National Survey per Household Sample data, it occupies about 80.2 % of total employment.

Most of the customers of the tertiary industry are outside of the RMB-Belem Metropolitan Area such as the remaining of Para State and neighboring states. Especially there is strong influence to regional or sub-regional area (specialized clinics, third degree education, technical consultant, technological information, trade of products of high value added, etc., besides administrative activities of the federal and state public segment in the area).

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Those functions are the results of a long historical process of development in the Amazon urban area, where Belem urban area presents an important role of economic activities, taking advantage of the privileged location of the urban nucleus. The urban nucleus became a convergence point of many transport routes and of the road network system. Therefore, the convergence of a major transport axis provides the better accessibility from the surrounding state.

The maintenance possibilities or even the amplification of that function depend on some factors:

a) The easy access to RMB-Belem Metropolitan Area concerning people and companies. In fact, the recovery of the highways and Alça Viaria project start up, as well as the reactivation/growth of Area aerial transport lines connected to Belem are crucial factors;

b) The competition with other cities such as Manaus and Sao Luis;

c) The evolution for service demand in ambit area, which depends on the growth of the portion of the Para economy located outside the RMB-Belem Metropolitan Area, among other factors; and

d) The volume of the area commercial flows passing by the RMB-Belém-Metropolitan Area and nearby areas. In this case, it is of great importance to resume the construction of Tucurui locks, which will promote a new dynamism for the port of Villa do Conde located in its proximity's.

That represents an important change in the conception of the Araguaia-Tocantins Navigation that is expressed in the initial version of the Avança Brasil Program[1]. There are exciting perspectives for the development of agroindustry axis in relatively closed places like Paragominas.

3) Presence of RMB- Belem Metropolitan Area in the national/Areaal tourism circuits

The Amazon is recognized as one of the areas of the planet with the greatest potential for the ecological tourism, which should constitute one of the focuses of the area economy dynamism, as it was seen previously. In order to develop such a potential, it is necessary, among other requirements, the existence of infrastructures and support services to the tourist (ports, airports, highways, hotels and others), not just in the final destination (the tourist attraction), as well as in the nucleus of area influence which have capacity to receive and to host great contingents of travelers, while waiting the trip to the final destination (mainly a small town in the countryside). The expanding and the reforms of the Val-de-Cães airport constitutes important step to improve the performance of the RMB- Belem Metropolitan Area concerning its function of support to those tourists that go to the countryside of the State for ecological tourism activities.

Besides this role, it is important to analyze the possibilities of the own RMB in offering of attractiveness. It is undeniable that in the recent years that significant investment spending has been both in projects of urban conservation and recovery of the patrimony. Besides the infrastructure already installed and of the existent attractiveness for the conventional modes of tourism, the RMB-Belem Metropolitan Area possesses expressive territorial area with not so deep altered environments, and is appropriate for the practice of the ecological tourism. The creation of the Environmental Park of Pirelli will represent initiative of great importance for such purpose.

4) Investment capacity of the private segment

Any growth possibility necessarily depends on the capacity of the private section to make productive investments. In that sense, it is decisive the behavior of the national macroeconomics variables, in particular, the interest rates, which depends on a great complexity of factors. In the local ambit, the maintenance/increment of fiscal incentives and funds such as the FNO-Constitutional Found of North Finance is important.

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[1] The original conception of hydroroad Araguaia-Tocantins previous the locks conclusion of Tocantins River that is fundamental to viability the cargo's flow through port of Villa do Conde would be realized only in a second phase.

The optimistic perspectives delineated on the scenarios for Amazon envisages a slow, but persistent elevation, in the capacity of investment of the private segment of RMB- Belem Metropolitan Area.

5) Capacity of investment of the public segment

If can be seen a clear lost of the government's power on the behavior of macroeconomics variables, consequences of increasing commercial and financial flows due to the globalization; the participation of the State in the determination of the microeconomics conditions (including transport infrastructure and communications, professional education, support services to the production, research and development of products and processes, political stability, and others) coincides with the so called "systemic competitiveness"of Michel Porter. In that context, the capacity of the state and municipal governments' investment spending becomes a factor of great relevance.

At the present time, the finances of the State government and local governments of the RMB- Belem Metropolitan Area (the largest one) do not present serious problems. The approval of the Lei de Responsabilidade Fiscal (Fiscal Responsibility Law) along with the favorable expectations for the evolution of the Para economy mentioned above, would rebound favorably in the finances of those two government spheres and, therefore, in their capacity to promote investments spending that should increase the "systemic competitiveness" of the area.

6) Growth and diversification of the existent industrial park

The transformation industry in the RMB- Belem Metropolitan Area is characterized by enterprises of small and medium scale, acting both in the internal and external markets. The main branches are the food production and wood processing. The largest industrial concentrations are located in the Arthur Bernardes highway, in the industrial districts of Icoaraci and Ananindeua.

During the 90s, the segment faced several difficulties. The reduction from 10.3% to 7.9% in its employment contingent in the period 1988-98 is an indicator of that direction, according to UNDP data. More recently, a tendency of recovery is observed once the favorable numbers of the balance among employees (formal job) admitted and dismissed, supplied by the Ministry of the Work. In 1997 it was announced a debit of 275 jobs, and a worsened situation in the following year with the liquid loss of 1,400 jobs. In 1999, however, there was a positive balance of 50 jobs, number enlarged significantly along the first five months of the year 2000, with a liquid gain of 1.476 jobs.

For the consistent reversion of the adverse scenery, it is necessary not only the retaking of the growth of both Brazil and Para economies and of the own local consuming market, but also that the existing industrial park pass through a modernization of productive processes and its diversification, with the output of new products. In this case, one of the possibilities is the tightening of the relations between the private segment and the local institutions of research and development, through the amplification of the experiences comprising the model of technological parks. The bio-industry is pointed out as one of the most promising segments, as it is seen in the area scenarios. Such guideline comes to the encounter of the efforts of the State Government with the purpose of intensifying the industrial upgrade in several branches, increasing the aggregation of value to local raw materials. In that context, many of the new enterprises resulting from this upgrading process may be located in the RMB- Belem Metropolitan Area.

7) Administrative articulation among RMB- Belem Metropolitan Area municipalities

The adoption of articulate actions among the component RMB- Belem Metropolitan Area municipalities in the comprising a metropolitan development master plan, of which PDTU-The Masterplan Study on Urban Transport in Belem can be considered as a fundamental component, represents something very important in the sense of coordinating the actions of the state and local spheres, avoiding gaps, dispersion and effort overlapping.

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2.2. TENDENCIES OF DEVELOPMENT ON ECONOMICS ACTIVITIES

This section presents the information for land use, demography and socioeconomics on Study area. The Impacts of projects proposed by government in Belem Metropolitan Area also discussed in the section. Finally, the conclusions at the Seminar held on August 29 are presented. This Seminar had participants from government and state staffs, academic community, the executive project groups and representatives of JICA-Japan International Cooperation Agency. Main tendency of the economic development such as economic growth by macro-zone was identified for the next 20 years.

2.2.1 LAND USE

1) Land Use 1990

The land use map elaborated in the PDTU-1991 is showed, which divide into 7 different categories of land use in the study area in 1991 (FIGURE 2.2-1):

- Consolidated Urban Zones;
- Urban Zones in Formation;
- Trades Zones ;
- Industrials Zones ;
- Institutional Zones ;
- Residential planned Zones; and
- Rural Zones.

In this map, the consolidated urban zones are the great predominance on 1.a Legua, and the major commercial area is in the traditional Central Area, and areas along the main corridors;

The hinterland of the $1.^a$ Legua expands with the Institutional Zones. The outside area of the Institutional Zone is followed by two main expansion axes; the Augusto Montenegro Road which extends to Icoaraci District (Consolidated Zones) and BR – 316 connected to Ananindeua Industrial District. These areas are accentuated with Icoaraci and the Ananindeua Industrial District. The industrial areas are between Val-de-Caes International Airport and Icoaraci along Arthur Bernardes Road. These areas are still the only remarkable industrial area on RMB- Belem Metropolitan Area. Other relevant Industrial zones in this RMB mix with many residential blocks where integration is difficult caused by dispersion between them.

The rural areas are also relevant because they used to be represented by two big areas on Cidade Nova north until Maguari River and at south the BR-316 road until Guama River. These areas have been compressed with the urban occupation as follows on FIGURE 2.2-1.

2) Intensity of Tertiaries Uses 1996

Elaborated from dates of population account done by IBGE 1996, this map shows whose census sectors with high percentage[2] of services and trade uses (FIGURE 2.2-2).

The map shows clearly the high concentration of tertiary uses on traditional and central area and surroundings, and the presence of some sub-centers as second level as Sao Braz, Entroncamento, Icoaraci, Ananindeua and Marituba, besides presence of third sector stratum along the main transport axis as BR-316 Road, Augusto Montenegro Road, Magalhães Barata, Nazare, Senador Lemos Ave. and Padre Eutíquio St, accentuating expansion tendency of theses activities on traffic corridors.

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[2] The percentile refers to occurrence numbers of tertiaries uses by census sector relates to the occurrence total of RMB uses.

3) Urban Occupation – 1977 and 1996

This map was done in 1977 Aero Photogrametrical Inventory and Satellite Image in 1996, shows spots on area in both moments, allowing the consistent analyze about RMB-Belem Metropolitan Area urban occupation on last 20 years (FIGURE 2.2-3).

Comparing both spots (1977 and 1996) detach high increase in Ananindeua Municipality on Cidade Nova, and its surrounding areas and south of BR-316 Road. In Belem the Caratateua Island, Augusto Montenegro Road, and surrounding areas and next to Icoaraci District, shown high difference between the occupation spots in 1977 and 1966.

The 1996 spot reveal that no exist at this moment much free spaces on continental areas over Belem and Ananindeua Municipalities, pointing to tendency for new regional location.

4) Belem Municipality Urbanistic Legislation

This is presented by two maps, Land Use Zoning, and Maximum Utilization[3] Coefficient extracted from Urbanistic Control Complementary Land–LCCU, to identify the potential construction use on Belem Municipality (FIGURE 2.2-4).

Referring to land use the Historical Center and surroundings has a specific law in which preservation of patrimonial architecture is the main conditioning factor.

The central large peak[4] which covers from Historical Center to Entroncamento, furthermore Augusto Montenegro Road until the river front of Icoaraci, is characterized by zones of mixed use presenting a major potential to commercial and service uses. The main road axis of the municipality is located in these zones

The industrial zones appear only on Icoaraci Industrial District and Arthur Bernardes Road. These areas appeared to be used for industrial activities at survey in 1990, showing timid increase in Belem.

The environment preservation zones deserve special attention for its dimension of surrounding area to Bolonha and Água Preta lakes from BR-316 Road until Guama River. Farther, it is included Belem Municipality Ecological Park besides Medici I and II residential area and environmental Preservation Zone on Paracuri area on Icoaraci south. These areas already partially occupied by residents although there was no previous plan for occupation.

The 2nd map of this series identifies the maximum coefficient of utilization with average from 1.4 to 3.8. The highest coefficient shows the major potential for construction which is located in two blocks. The first one with 3.8 value on Marco and Pedreira district and the second with 3.3 value on Historical Center and surrounding area including part of Batista Campos, Nazare and Umarizal district. The coefficient 2.5 appears on Entroncamento, along Augusto Montenegro Road and Icoaraci Center. In this map note that the areas with better substructure has highest coefficient. Among climatic aspects the direction (east, northeast) and intensity predominant winds are relevant factors on zone coefficient distribution.

Among climatic aspects the direction (east, northeast) and intensity of wind flow are important factors on zone coefficient distribution.

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[3] Utilization Coefficient is defined on LCCU by " relation between sum of constructed areas and that of total land area where building exists".

[4] High altitude area, Belem water division, has the corridor as central axis formed by Nazaré, Magalhães Barata and Almirante Barroso Avenues.
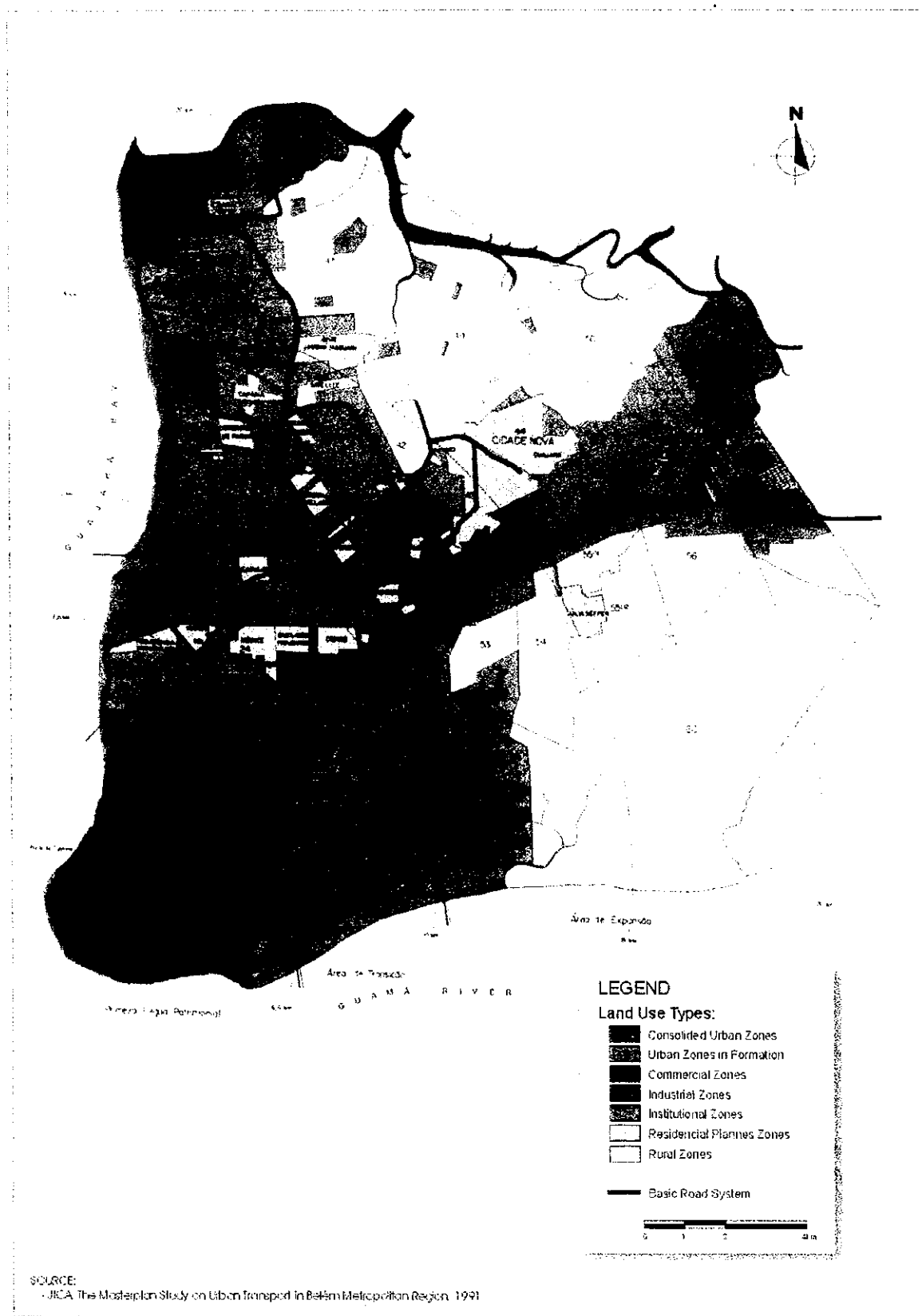
93

Update of Master Plan for Urban Transport in the Metropolitan Area of Belém - PDTU/2001

LEGEND
Land Use Types:

- Consolided Urban Zones
- Urban Zones in Formation
- Commercial Zones
- Industrial Zones
- Institutional Zones
- Residencial Plannes Zones
- Rural Zones

— Basic Road System

SOURCE:
- JICA The Masterplan Study on Urban Transport in Belém Metropolitan Region 1991

FIGURE 2.2-1 - Land Use - 1990

LEGEND
Tertiary Use by Census Department

- 0 – 0,111
- 0,112 – 0,250
- 0,251 – 1,280
- 1,281 – 3,500

NOTE: Percentage corresponding to a tertiary Use by Census Department to the RMB Gross.

SOURCE:
- IBGE, Demographic Census 1996

FIGURE 2.2-2 - Tertiaries Use Intensity - 1996
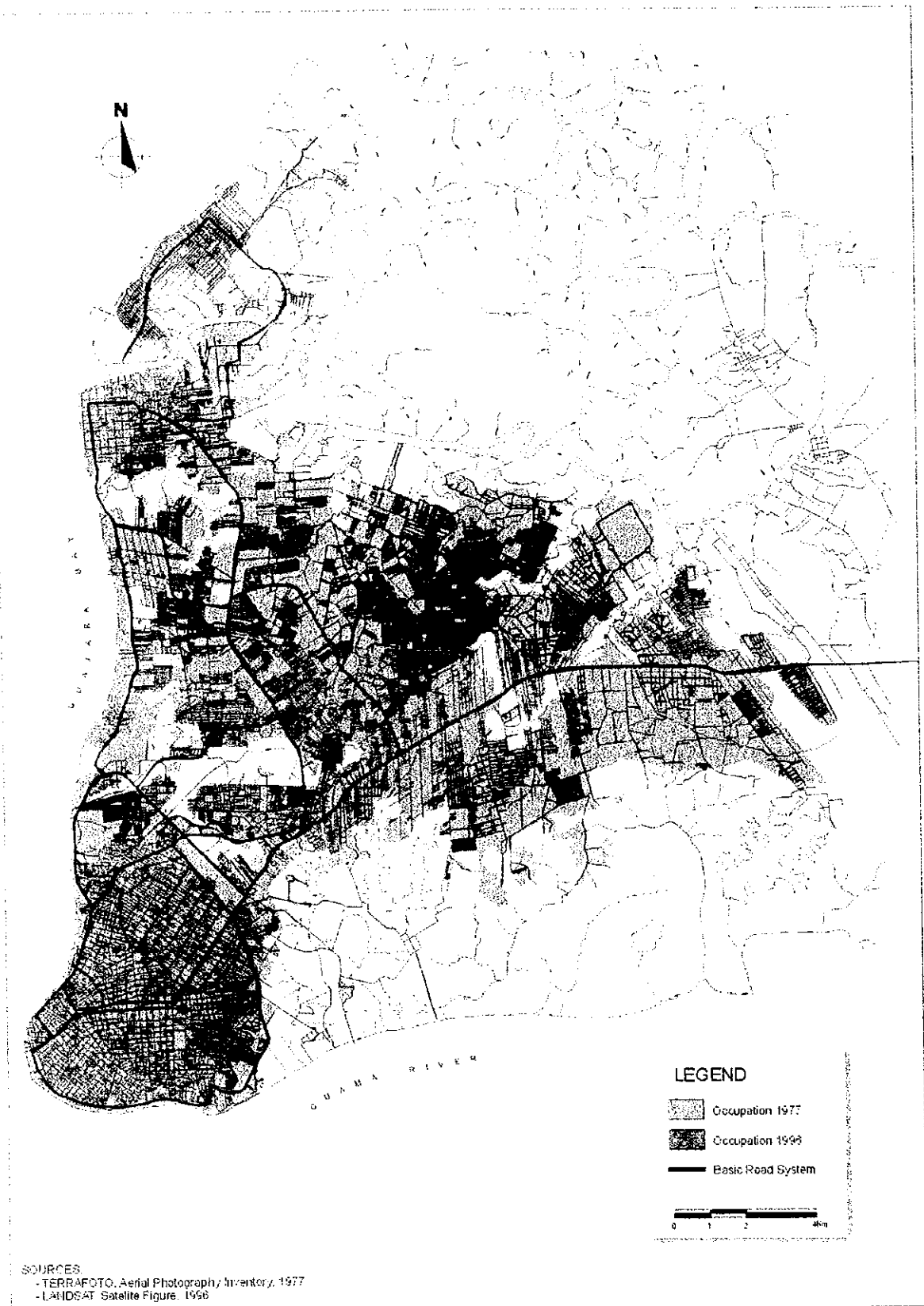
FIGURE 2.2-3 - Urban Occupation - 1977 and 1996

LEGEND
Land Use

- MIXED-USE ZONE
- SERVICES ZONE
- HABITATIONAL ZONE
- INDUSTRIAL ZONE
- PRESERVATION ZONE
- HISTORICAL CENTRAL AND SURROUND

LEGEND

Greatest Utilization
Coeficient

- 1.4
- 1.8
- 2.0
- 2.5
- 3.3
- 3.8
- HISTORICAL CENTRAL AND SURROUND

Corridors

COMERCIAL AND SERVICES

- TYPE 1
- TYPE 2
- TYPE 3

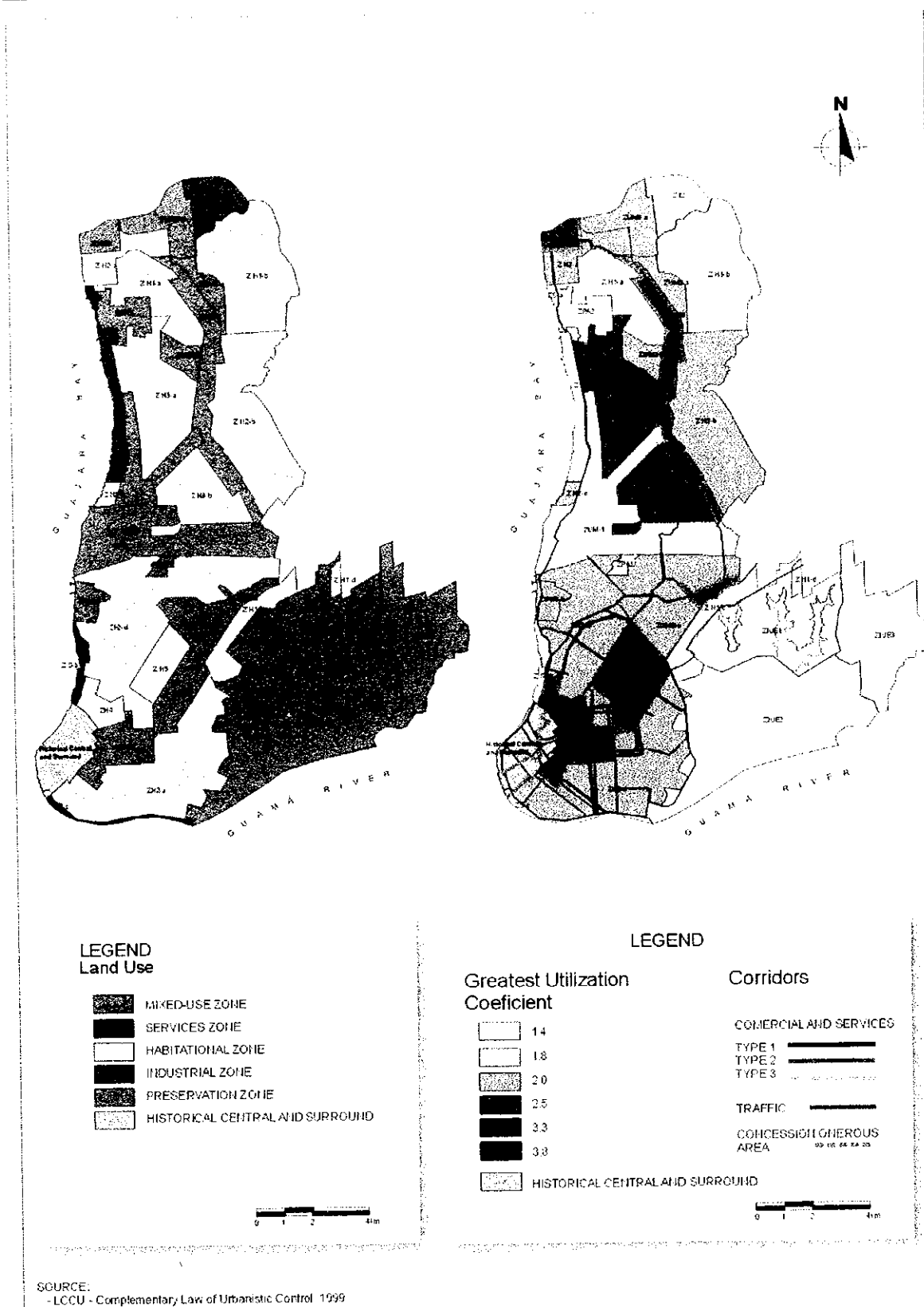TRAFFIC

CONCESSION ONEROUS
AREA

FIGURE 2.2-4 - Complementary Law of Urbanistic Control (LCCU)

2.2.2 SOCIOECONOMIC AND DEMOGRAPHY

Items presented on three maps are as follows:

1) Gross Population Density 1996
FIGURE 2.2-5 shows the gross population density in the unit of population/ha based on the population census by IBGE –1996 with classification of six stratums.

As can be seen, the highest density areas with 300 or more persons/ha are Terra Firme, Guama, Condor, Jurunas, and Sacramenta district. These density are mainly caused by the "intensive form of residential occupation of land"[5], meanwhile on the Central Peak where industry is more advanced, the gross density falls to between 60 to 119.99 persons/ha.

The Consolidated Urban Zones in Icoaraci and Cidade Nova residential area and along Augusto Montenegro and BR-316 Roads are higher density at 199.99 persons/ha or more. Some areas with large land spaces with 29.99 persons/ha or low indicate the potential of increase in the density in future.

2) Average Monthly Income per Capita

Develop with Census 1991 (IBGE) dates, the average income per capita is shows in 6 stratums from R$0,00 to R$149.99 until R$1.000,00 or more (FIGURE 2.2-6)

In this map the highest income concentration is on Nazare, part of Batista Campos and Comercio districts, the lower stratum in lowland and the intermediate stratum in Almirante Barroso Avenue and Reduto, Umarizal and part of Telegrafo districts. In the expansion area the stratum of the lowest income is predominant with exception of some residential area.

Observe that the areas with more income concentration are attracting tertiary activity.

3) Macro Zone Employment Distribution

Based on Person Trip Survey 2000 dates, note the existing spatial distribution work primary, secondary and tertiary per macro zone (FIGURE 2.2-7) and their quantities (ANNEX H – Socioeconomic Dates Table per TZ – 2000/2010/2020).

The FIGURE 2.2-7 reveals the high tertiary employment predominance totaling 91.0%, reaffirming the tertiary segment as the base to sustain the economy of the RMB- Belem Metropolitan Area.

In the macrozone analysis of tertiary segment, the Central Area hold major percentage with 25.75% of total, followed by Marco, Sacramenta and Guamá district. They show a big employment concentration on 1.ª Legua (31.92. %). In the Expansion Area, the macro zone Marambaia located on Entroncamento sub-central stand out. Cidade Nova appears with higher figure than traditional centers located on Ananindeua and Icoaraci macro zone.

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[5] COHAB/PA, UNAMA. Lifting Indicators of Quality, 2000
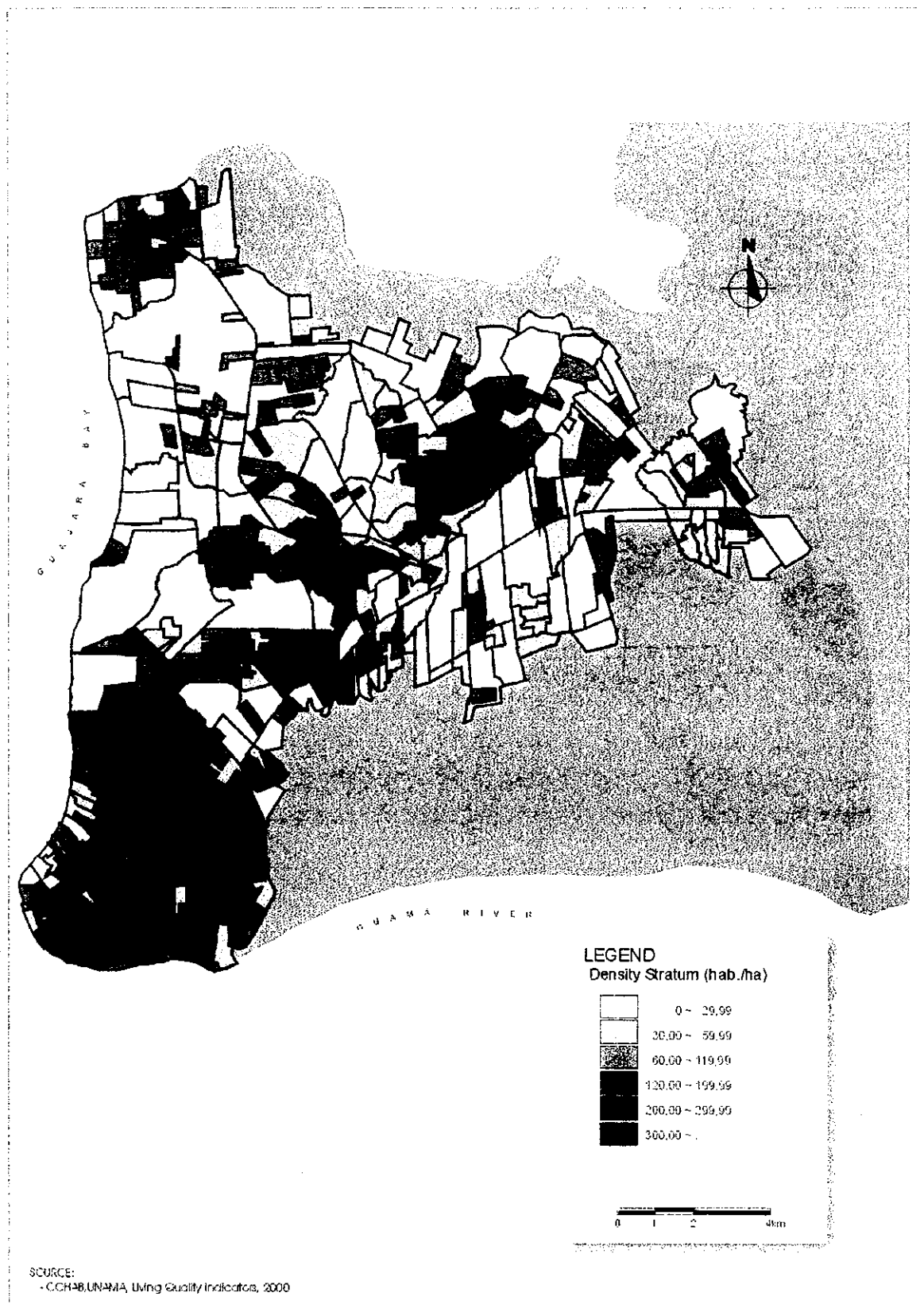
LEGEND
Density Stratum (hab./ha)

0 ~ 29,99
20,00 ~ 59,99
60,00 ~ 119,99
120,00 ~ 199,99
200,00 ~ 299,99
300,00 ~ .

SOURCE:
- CCHAB,UNAMA, Living Quality Indicators, 2000

FIGURE 2.2-5 - Gross Population Density - 1996

99

LEGEND
Average Monthly Income Stratum
per Capita in R$ (Dec/1991)

	0 – 149.99
	150.00 – 299.99
	300.00 – 499.99
	500.00 – 749.99
	750.00 – 999.99
	1 000.00 –

SOURCE:
- COHAB UNAMA, Living Quality Indicators, 2000
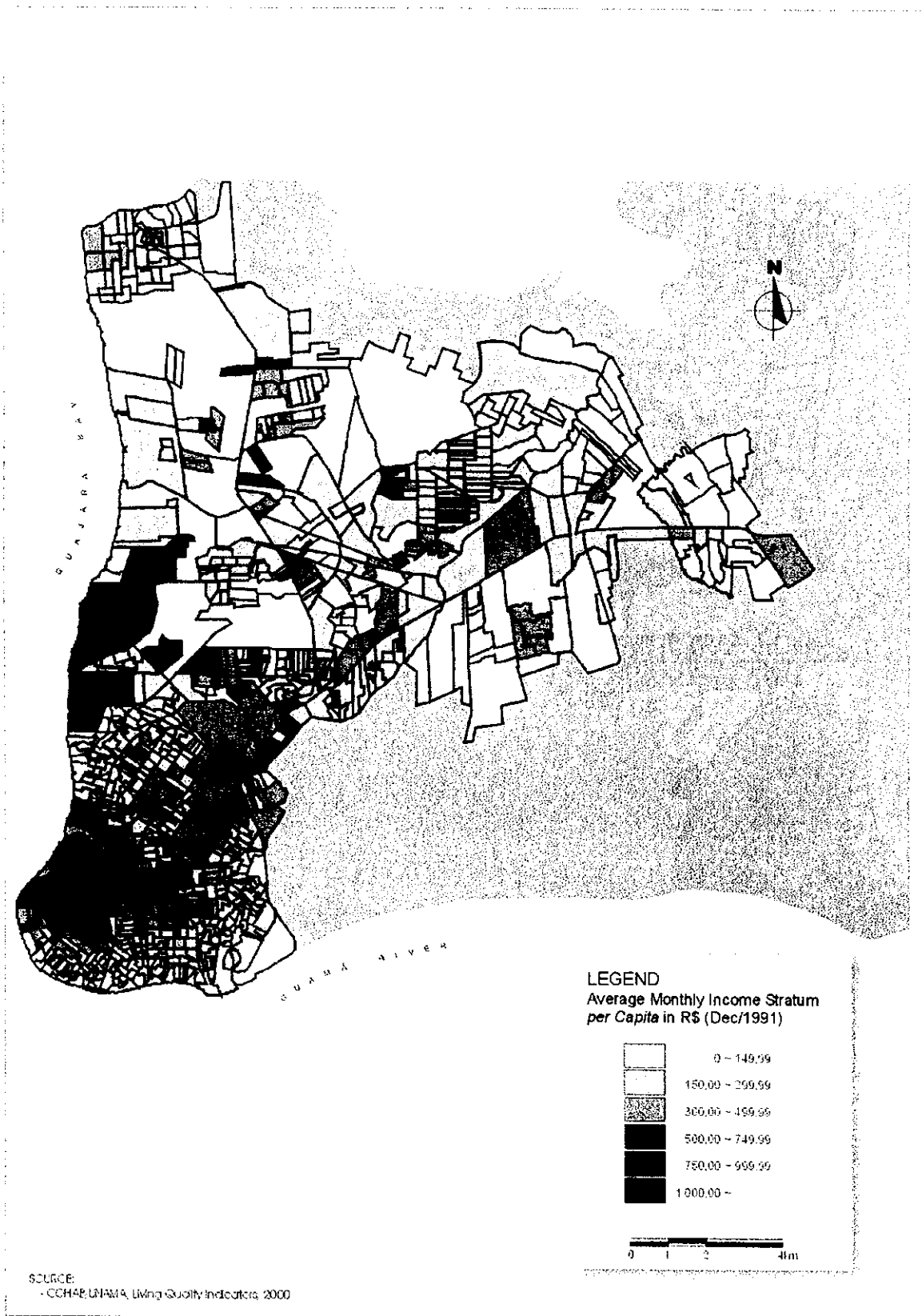
FIGURE 2.2-6 - Average Monthly Income *per Capita*

100

Mosqueiro

Outeiro

Ilhas

Marituba/Benevides
Santa Bárbara

Icoaraci

Cidade Nova

Pratinha

Ananindeua

Bengui

Aeroporto

Guanabara

Júlia Seffer

Marambaia

Sacramenta

Aurá

Marco

Embrapa

Centro

Guamá

LEGEND

150.000
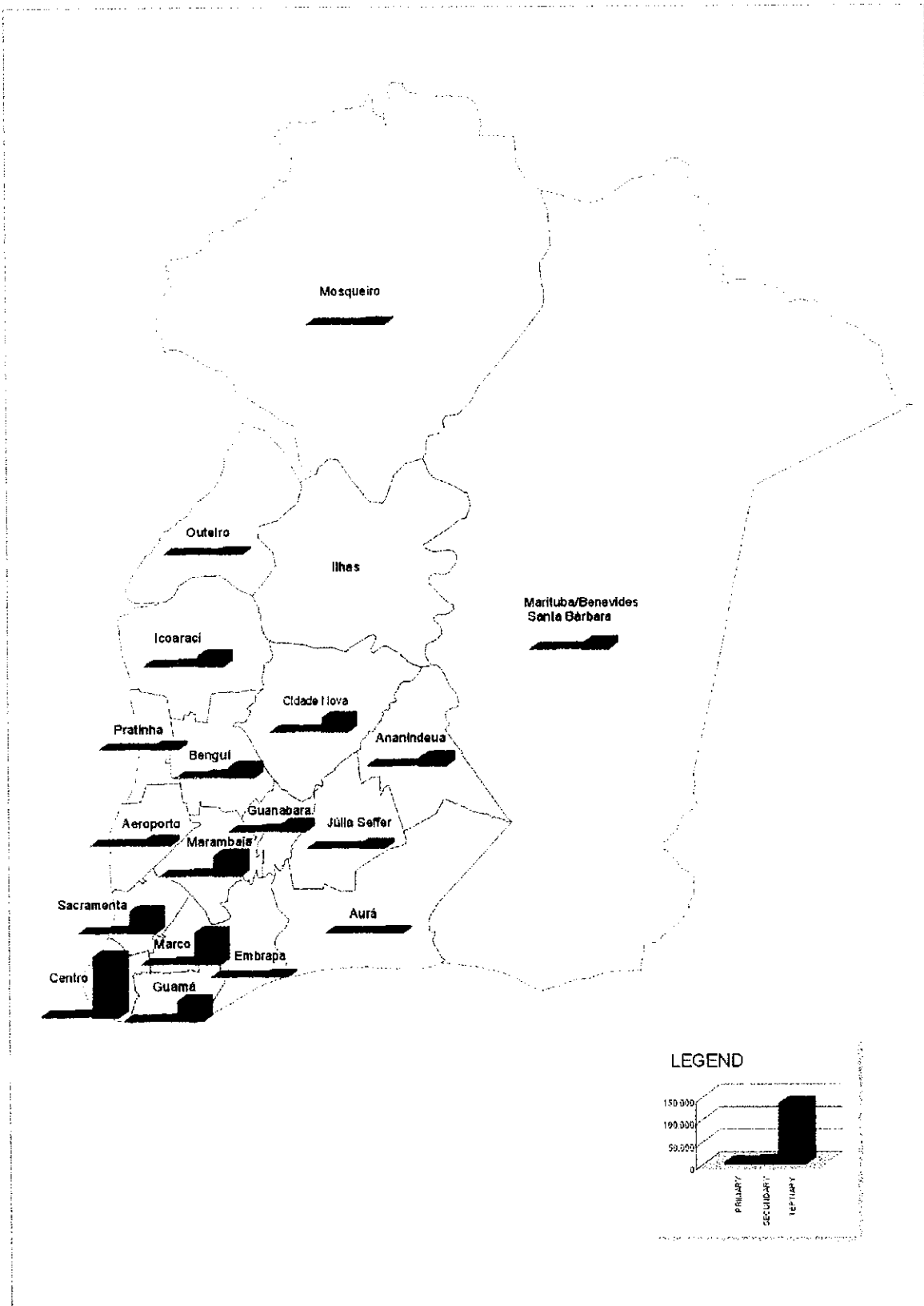100.000
50.000
0

PRIMARY
SECUNDARY
TERTIARY

FIGURE 2.2-7 - Employment Distribution per Macrozones - 2000

101

2.2.3 IMPACT OF PROJECTS

FIGURE 2.2-8 summaries the major projects to be executed partially or totally by government in RMB- Belem Metropolitan Area during the next 5 years.

The projects on the map are classified into three categories:
- Road projects;
- Drainage projects; and
- Great urban equipment's and Historical Center redevelopment projects.

Construction of Independencia Avenue and extension of the 1.º de Dezembro Avenue are planned as alternative for Almirante Barroso Avenue that already exceeds the road capacity against traffic in the peak hours. The Alça Viaria project is planned as new vector to RMB expansion. On the other hand, Liberdade Avenue requires special attention because this road passes through the Belem Environment Protection Area.

The project on "Una Basin Macrodrainage" which covers approximately 3,664.1 hectare in Belem Municipality, equivalent to 60.0% of the total urban area benefits approximately 86,000 families[6]. Together with the construction of sanitation rectification, canal opening, water distribution, draining sanitary and drainage network; this area will be improved with approximately 70km of asphalt surface road, on which it is possible to consolidate traffic corridors and fortify the existing alteration of occupation patterns in the area. Tucunduba Basin will take the same impact but low scale as that of the project area because of the project dimensions.

Some big urban equipment projects as Events Center, Sarah Kubitscheck Hospital, amplification of the Val-de-Caes International Airport and Historical Center revitalization as Feliz Lusitania 2 e 3 and BID Monumenta, will certainly cause impact over surrounding area, changing or intensifying existing uses. They will be formed as generators of new traffic poles.

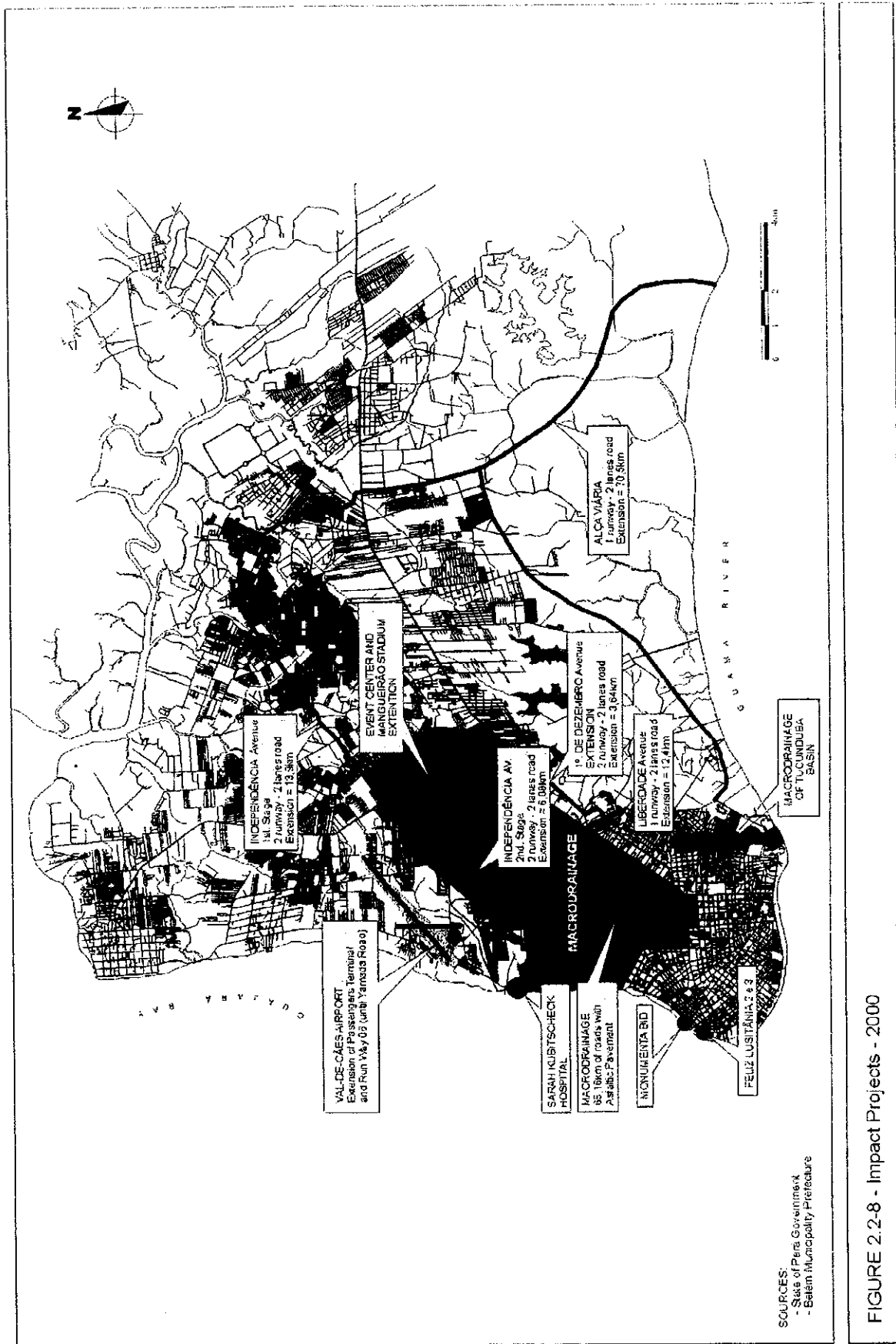[6] PROJETO UNA, Local Technique Visit Report, 1999

FIGURE 2.2-8 - Impact Projects - 2000

SOURCES:
- State of Pará Government
- Belém Municipality Prefecture

2.2.4 SPATIAL TENDENCIES OF ECONOMIC DEVELOPMENT

The comprehensive urban development plans in the Study area does not exist now. Therefore, the specific seminar was held in August 29th, 2000 to identify the spatial tendencies for economic development, occupation and land use allocation. The participants of the Seminar are from the Government , academic community, production sector, the study team and JICA representatives. (FIGURE 2.2-9).

FIGURE 2.2-9 – Scene of Tendencies of Development Seminar

The following items of questions had been analyzed and discussed with the seminar participants:

a) How much RMB-Belem Metropolitan Area would take advantage of the favorable scenario of the Area considering presented future conditions and other factors worth for considering;

b) Perspectives of RMB commercial, service and industrial activities increase;

c) Perspectives of RMB commercial, service and industrial activities increase per segment;

d) Areas that would present tendency of commercial, service and industrial activities increase;

e) Perspectives of Belem traditional center activities increase;

f) Perspectives of Belem traditional center functions requalification;

g) Perspectives of location of pole-making-activities (shopping centers, supermarkets, provisioning centers, department stores, etc);

h) Perspectives of establishment of big industry that causes impacts on utilization and occupation of land and transport demand;

i) Perspectives of establishment of big educational facilities in areas with high population increase; and perspectives of constructing horizontal condominiums, apartment houses for medium and low income households and plots in residential areas where building blocks are concentrated.

The perspectives of localization permanence and/or transference of the existing industries (industry districts, Bernardo Sayao Ave., Arthur Bernardes and BR-316 roads) in the RMB-Belem Metropolitan Area had been discussed. This is because some projects such as transfer of Belém port to Conde Villa and Belem-Barcarena Alça Viaria project have a big impact in the RMB.

TABLES 2.2-1 to 2.2-5 show the results discussed by working groups in which the tendency of each economic factor by the integrated zones is assessed.

- Accentuated increasing ↑
- Moderate increasing ↗
- Existing tendency support →
- Moderate reduction ↘
- Accentuated reduction ↓

TABLE 2.2-1 – Demography Behaviour Tendency per Miniregion and Work Group

Group	1.ª Legua	Transition	Icoaraci / Outeiro	Utinga / Aurá	Ananindeua	Mosqueiro / Ilhas	Marituba / Benevides/ Sta. Bárbara
1	↘	↑	↑Paracuri Outeiro	Alça Rodov. ↗ Abacatal	↑	Plot/ Households↑ Construction↗ Population→	↑
2	→	↗	↑	→	↑	↗	↑
3	Centro ↘ Guamá→ Marco↗ Sacramenta↑	Marambaia↑ Airport→ Benguí↑ Pratinha↗	↗	Utinga→ Aurá↗	↑	→	Marituba / Benevides↗ Local Reality
4	→	↗	↑	↗No protection instruments	↑	↗Impacts of Alça Viária	↑

TABLE 2.2-2 – Industrial Sector Behaviour Tendency by Miniregion and Work Group

Group	1.a Legua	Transition	Icoaraci / Outeiro	Utinga / Aurá	Ananindeua	Mosqueiro / Ilhas	Marituba / Benevides/ Sta. Bárbara
1	↓	↘	→	→	↗	→	→
2	↘	→	↗	↘	↗	→	↗
3	↓	Marambaia→ Airport→ Benguí→ Pratinha↘	Icoaraci↗ (-) Outeiro→	→	↗ (+)	→	↗ Agroindustry Furniture Industry
4	↓	↘	↗	→	↑	→	↗

TABLE 2.2-3 – Behavior Commercial Sector Tendency per Miniregion and Work Group

Group	1.ª Legua	Transition	Icoaraci / Outeiro	Utinga / Aurá	Ananindeua	Mosqueiro / Ilhas	Marituba / Benevides/ Sta. Bárbara
1	1ª Légua↗ Trade. Center.↓	Caráter↗ Local	↗	↗	↑	→	↗
2	↗	↗	↗	→	↑	→	↗
3	↑	Marambaia↑ Airport→ Benguí↗ Pratinha→ ↗LOCALIZED	Icoaraci↗(-) Outeiro→	Utinga↗(-) Aurá↑	↑	Islands→ Mosqueiro↗(-)	↗ Proportional to demographic increasing
4	↑	↗	↗	→ Environmental Park	↑	↗	↗ Pirelli Park

TABLE 2.2-4 – Average Household Income Behavior Tendency by Miniregion and Work Group

Group	1.a Legua	Transition	Icoaraci / Outeiro	Utinga / Aurá	Ananindeua	Mosqueiro / Ilhas	Marituba / Benevides/ Sta. Bárbara
1	↗	↗	↗	↗	↗	→	↘
2	↗	↗	↗	→	↗	↗	↗
3	Center↗ Guamá↗ Marco↑ Sacramenta↑	↗	↗(-)	↗(-)	↑	Island→ Mosqueiro↗(-)	↗
4	↑	↗	→	→	↗	→	→

TABLE 2.2-5 Number of Admissions School Offer Behavior Tendencies by Miniregion and Work Group

Group	1.a Legua	Transition	Icoaraci / Outeiro	Utinga / Aurá	Ananindeua	Mosqueiro / Ilhas	Marituba / Benevides/ Sta. Bárbara
1	↗	↗ Fundamental Education	↗ Fundamental Education	↗ Fundamental Education	↗	→	↗ Fundamental Education
2	↗ ↗private ↓public	↗	↗	→	↗	→	→
3	↗	↗(-) informal occupation areas	↗	→	↑	→	↗
4	↑	↗	↗	→	↑	→	↗

The future socioeconomic frame in RMB is estimated based on these Tables.

LEGEND
MINIREGIONS

URBAN AREA
TRANSITION
ICOARACI / OUTEIRO
UTINGA / AURÁ
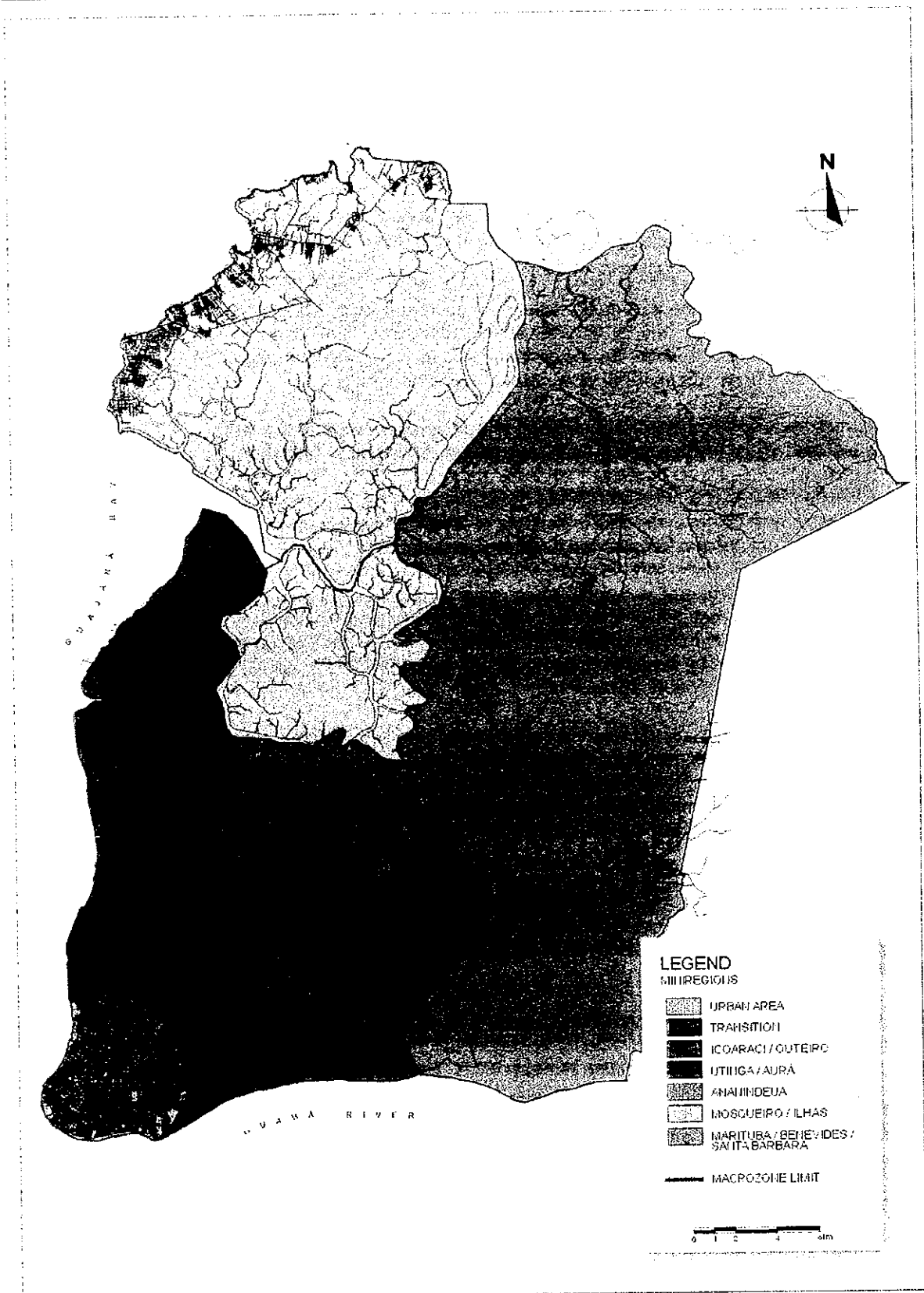ANANINDEUA
MOSQUEIRO / ILHAS
MARITUBA / BENEVIDES / SANTA BARBARA

MACROZONE LIMIT

FIGURE 2.2-10 - Division of Study Area in Miniregions