

**THE HASHEMITE KINGDOM OF JORDAN**

**FEASIBILITY STUDY**

**OF**


**RING ROADS CONSTRUCTION PROJECT**

**IN IRBID CITY**

**FINAL REPORT**

FEBRUARY 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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**JAPAN INTERNATIONAL COOPERATION AGENCY**

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International Cooperation Association

International Cooperation Association

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## PREFACE

In response to the request of the Government of the Hashemite Kingdom of Jordan, the Government of Japan decided to conduct a feasibility study on the Ring Roads Construction Project in Irbid City and entrusted the study to the Japan International Cooperation Agency (JICA).

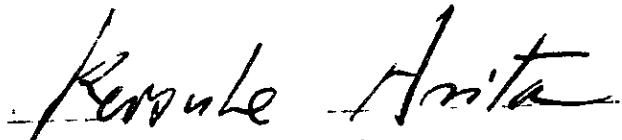
The JICA organized a steering committee for the project chaired by Mr. Kimio Chiba, director of Road Department, Tohoku Regional Construction Bureau, Ministry of Construction, and sent to Jordan a survey team headed by Mr. Giichi Kataoka, Pacific Consultants International in March 1981.

The team discussed the Project with officials concerned of the Government of Jordan and conducted a field survey over a period of eight months. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Hashemite Kingdom of Jordan for their close cooperation extended to the team.

February 1982



Keisuke Arita

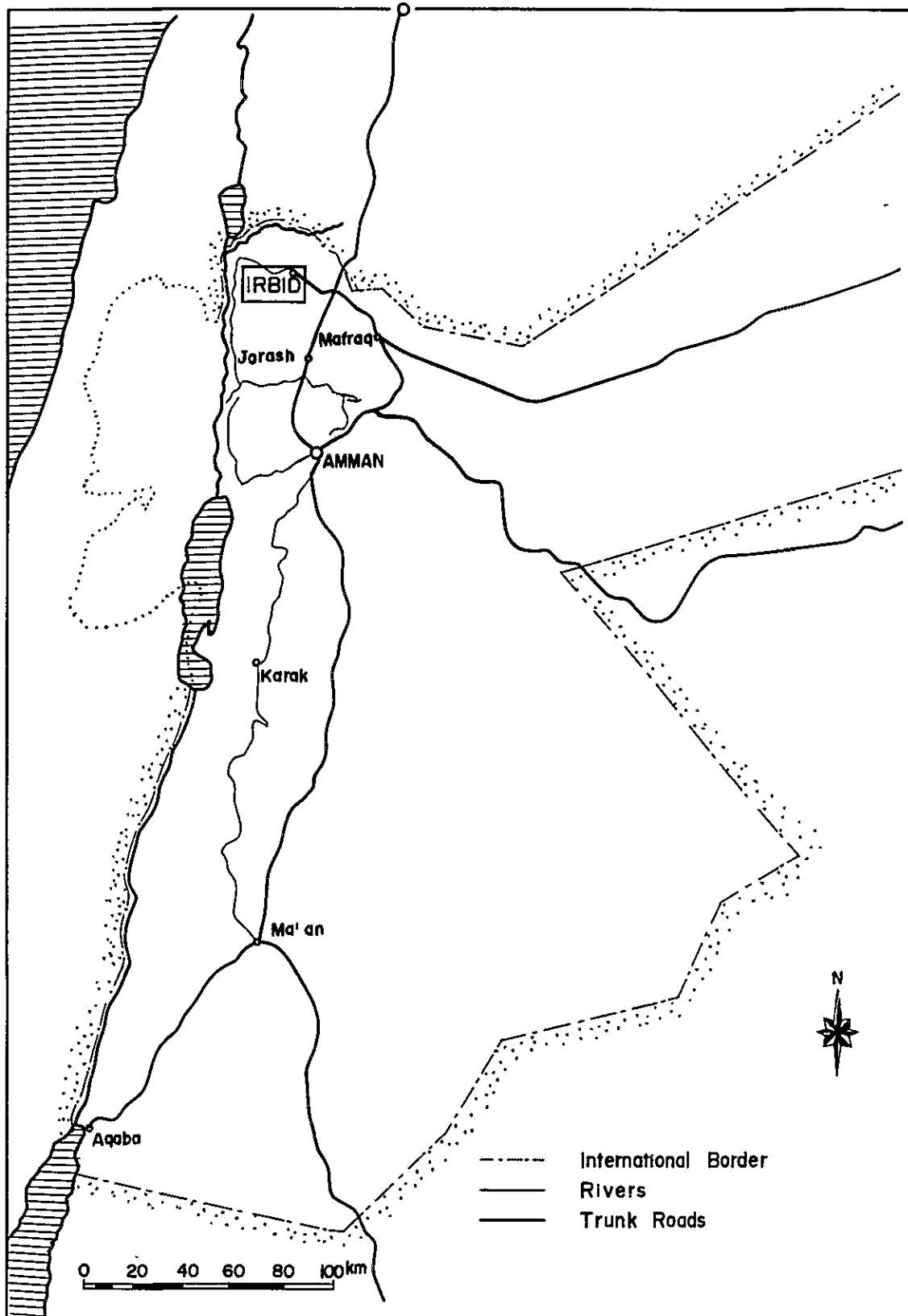
President

Japan International Cooperation Agency



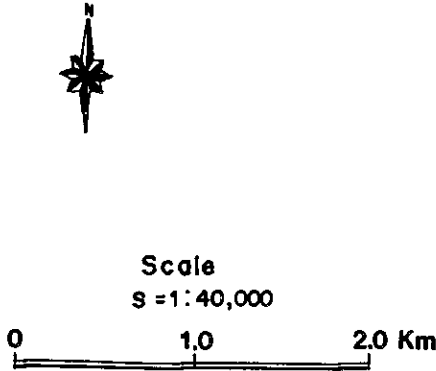
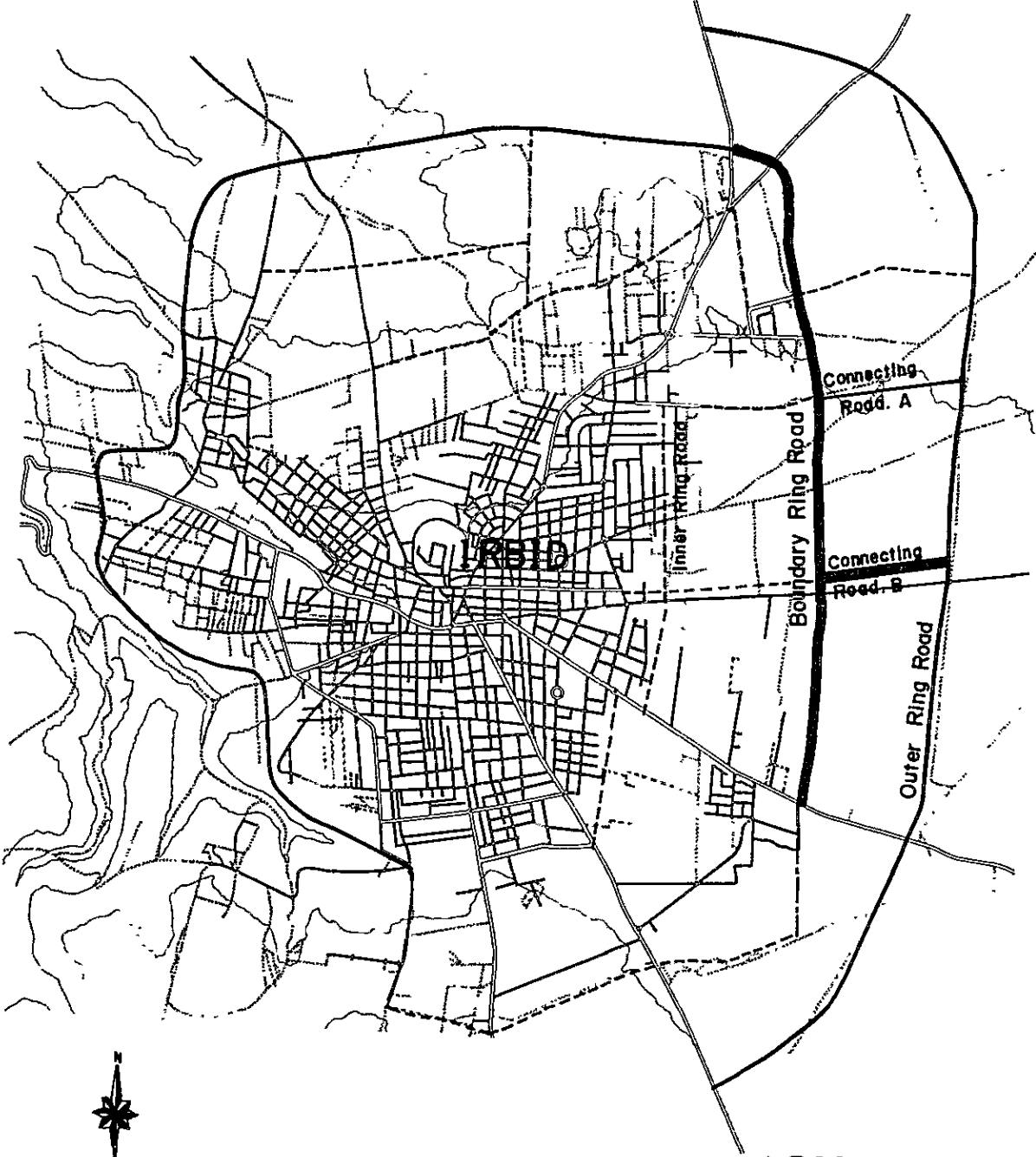


# GENERAL MAP OF JORDAN









# PROJECT LOCATION MAP



## LEGEND

-  4-Lane 2-Way road
-  2-Lane 2-Way road
-  Roads planned by the City
-  Ideal Routes

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abbreviation

IIE	Irbid Industrial Estate
JICA	Japan International Cooperation Agency
MMREA	Ministry of Municipal Rural and Environmental Affairs
MPW	Ministry of Public Works
NPC	National Planning Council
RSS	Royal Scientific Society
IRR	Inner Ring Road
BRR	Boundary Ring Road
ORR	Outer Ring Road
CR	Connecting Road
CR-A	Connecting Road A
CR-B	Connecting Road B
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
NDI	National Disposable Income
JD	Jordan Dinar
OD	Origin Destination
PCU	Passenger Car Unit
NPV	Net Present Value
IRR	Internal Rate of Return
FC	Foreign Currency
LC	Local Currency



## **SUMMARY AND RECOMMENDATIONS**



## **SUMMARY AND RECOMMENDATIONS**

### **1. Necessity and Significance of the Project**

At the present time, Irbid is the largest city in northern Jordan. It is not only the administrative centre of the Irbid Governorate, but also serves as the major centre for diversified economic activities and education.

In Irbid, the most serious traffic problems involve the road network since all the main roads form a radial pattern converging at the city center. Hence intra-city traffic, inter-regional traffic and through traffic all mix together and create congestion. During the next 20 years, the population of Irbid Expanded is expected to increase almost 2.3 times, while total trip ends of cars and trucks are forecast to increase almost 3.2 times. This will put more pressure on the urban center of Irbid which is also the center of the road network. For these reasons and as part of the re-adjustment planning of the agricultural lands to be assigned as residential areas, the road network of the City of Irbid has been under study since 1970 by the Municipality of Irbid.

Consequently, the Ring Road project for the City of Irbid is part of a program of infrastructure improvement for the purpose of promoting development of various urban functions. The project includes construction of a Boundary Ring Road (BRR) and Outer Ring Road (ORR) with average radius of about 2.5 km and of about 3.5 km respectively from the urban center. The Ring Roads extend for a distance of about 24 km (including Connecting Roads of about 2 km) and connect to the existing radial Roads at the periphery of the City of Irbid. The Ring Roads will form the backbone for planning the future City of Irbid, and serve as an arterial street for intra-city and inter-regional traffic and as a by-pass for through traffic.

### **2. Background of the Project**

In 1977, the Hashemite Kingdom of Jordan requested the Japanese Government to cooperate in planning integrated regional development of the northern region of the country centering around Irbid City. The Japanese Government, through Japan International Cooperation Agency

(JICA), dispatched missions to Jordan in 1978 and 1979, and an Integrated Regional Development plan was formulated which recommended three projects: namely, Irbid Industrial Estate, Irbid Ring Roads and Irbid Tourism Project. After performing preliminary feasibility studies of Irbid Industrial Estate and Irbid Ring Roads, this feasibility study of Irbid Ring Roads was started by JICA at the request of the Government of Jordan in order to achieve the following objectives:

- i. To mitigate traffic congestion in the center of Irbid City by diverting traffic to ring roads.
- ii. To contribute to the development of less-developed areas by providing more efficient traffic facilities.
- iii. To prevent disorderly sprawling growth of the urbanized areas by planning the framework for appropriate land use.

### **3. Existing Road Network**

According to the Municipality of Irbid, the total length of roads in the municipality was approximately 130 km as of March 1981, and about 15% of the total road network is unpaved gravel road. Most arterial roads in the City which are part of the national road network are radial roads passing through the centre of Irbid.

These national roads are Route 11 and Route 16 (primary roads) and Route 23 (secondary road).

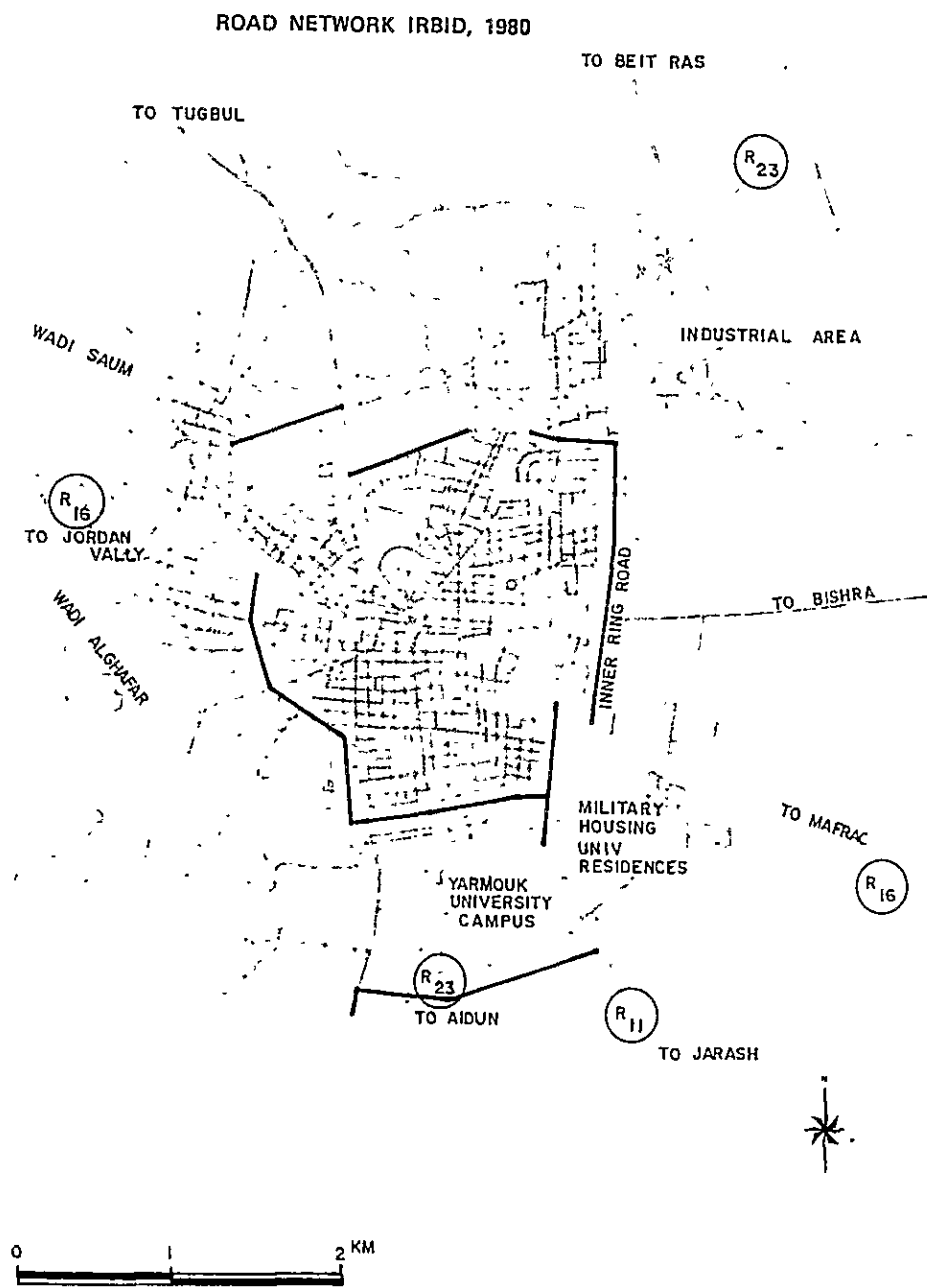
Hashimi Street is Irbid City's broadest street and passes through the centre of the City dividing the City into northern and southern parts.

Other radial roads are Bishra Road, 6 m in width and running parallel to the east and about 50 m south of Hashimi Street, and a road in the northwest running towards Tugbul. All main roads have a right-of-way width of about 20 - 30 m., and their intersections are rotary system type, especially the main intersections.

The Inner Ring Road, located at about 1.0 to 1.5 km from the City centre, has a total length of about 8 kms, of which 4.3 km of the southwest and southern sections is open to traffic; the 2.5 km eastern section is now under construction. However, this eastern section,

planned by the Municipality, does not smoothly link up at the intersection of Route 16 to Mafraq. At present, the Inner Ring Road is not joined at its northwest section, and construction has been stopped, due to an established residential area.

Two small parts of the Boundary Ring Road (500 m in the southern part and 200 m crossing Wadi Saum in the eastern part) are now under construction.



#### 4. Socio-Economic & Land-Use Plan

As one of the bases for planning the road network for Irbid City, a land use plan for the growth of Irbid City and its surrounding areas (called Irbid Expanded) was developed. The land use plan took into consideration the topographic situation of Irbid City (which is physically limited in the west and southwest by steep wadis), the land use regulation plan and development plans of the City, and urban planning concepts.

The frame of future land use in Irbid expanded is summarized by the Table below and by the following Figure which outlines the Growth of the Urban Area. In total, the plan for the year 2000 recommends tripling the used land area to accommodate and redistribute the 2.3-fold increase in population.

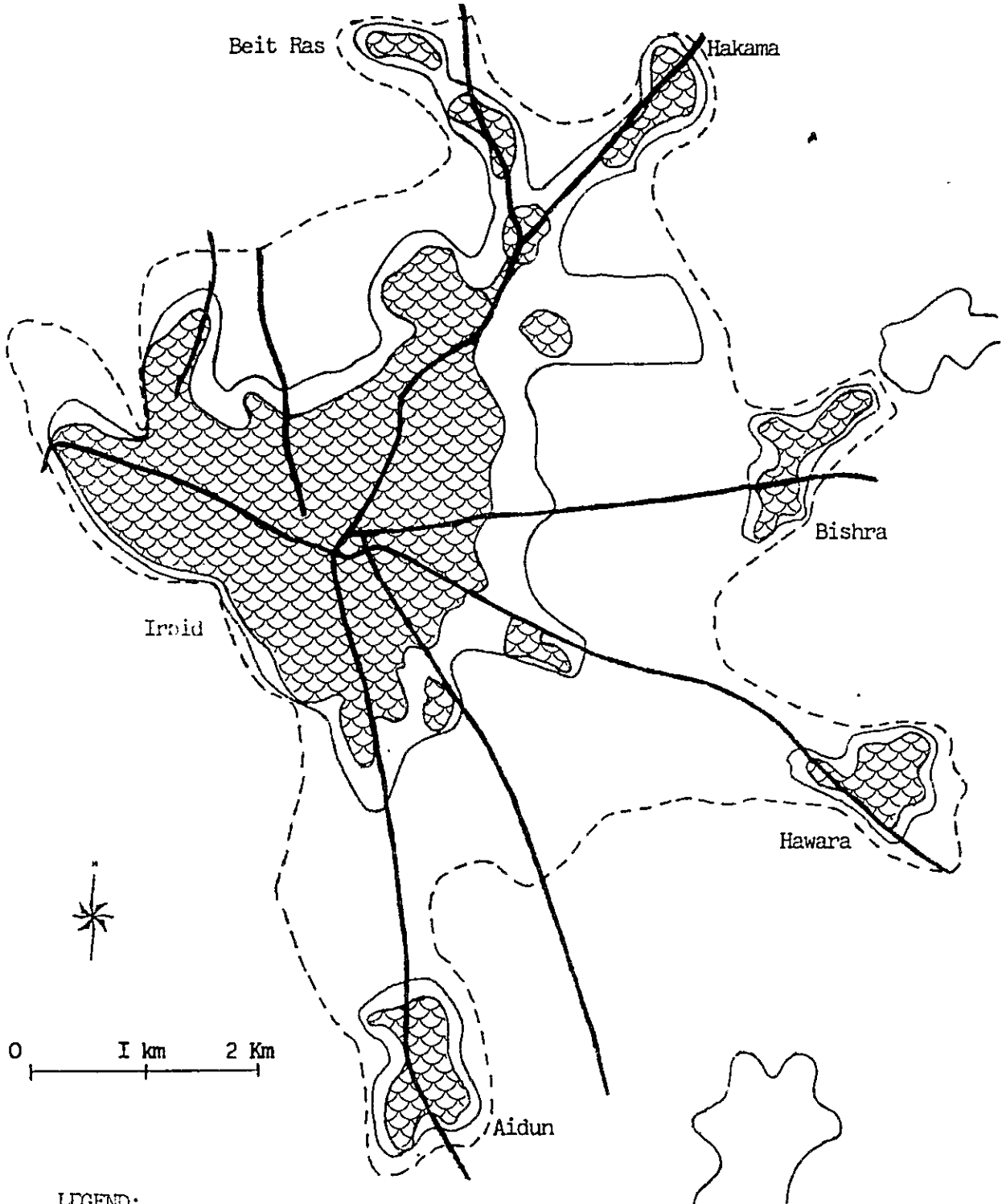
Estimated Frame of Future Land-Use in Irbid Expanded

	1980	1985	2000
Population (1,000 persons)	139	173	322
Population in Residential Area (1,000 persons)	111	138	258
Employed Population (1,000 persons)	27.8 (20%)	38.9 (22.5%)	96.6 (30%)
Sector 11 Population (1,000 persons)	4.2 (15%)	7.0 (18%)	24.2 (25%)
Residential Area (ha) Gross Density	967 (115 persons/ha)	1,247 (111 persons/ha)	2,576 (100 persons/ha)
Commercial & Business Area (ha) gross	139 (10 m <sup>2</sup> /person)	190 (11 m <sup>2</sup> /person)	419 (13 m <sup>2</sup> /person)
Industrial area (ha) Gross Density of workers	42 (100 persons/ha)	73 (96 persons/ha)	284 (85 persons/ha)
Large-scale Green (ha) Gross Area Required	69 (5.0 m <sup>2</sup> person)	111 (6.4 m <sup>2</sup> /person)	354 (11 m <sup>2</sup> /person)
Urban Area (ha) Density (person/ha)	1,217 114	1,654 106	3,637 89

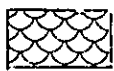
Ref. Table 3-14.



FUTURE URBAN AREA IN IRBID EXPANDED



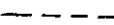
LEGEND:



URBAN AREA 1978



URBAN AREA 1985



URBAN AREA 2000

The recommendations of the land-use plan are outlined below and shown in the following Figure.

Most of the area inside the Inner Ring Road excluding central commercial and business area should be assigned as a mixed area of linear commercial area and residential area.

In Irbid City, the wind blows from the west all through the year, so it is quite reasonable to locate the industrial area at the northeast fringe of the city. Inside the area, a manufacturing distribution center is recommended to be located.

If the industrial area is concentrated in one place, traffic also will be concentrated, so a simple service industry is better located in the existing sub-station area and along Fouara Street.

The existing central market place is very suitable for an agricultural distribution centre, since it is located along the Inner Ring Road, which connects Palestine Road and Baghdad Road.

A large scale green area (Recreation Area) should be located in the northern and eastern boundary areas. The value of recreation areas will be increased as urbanization proceeds and as the standard of living level rises. The hill area of the city centre should be developed as a green park.

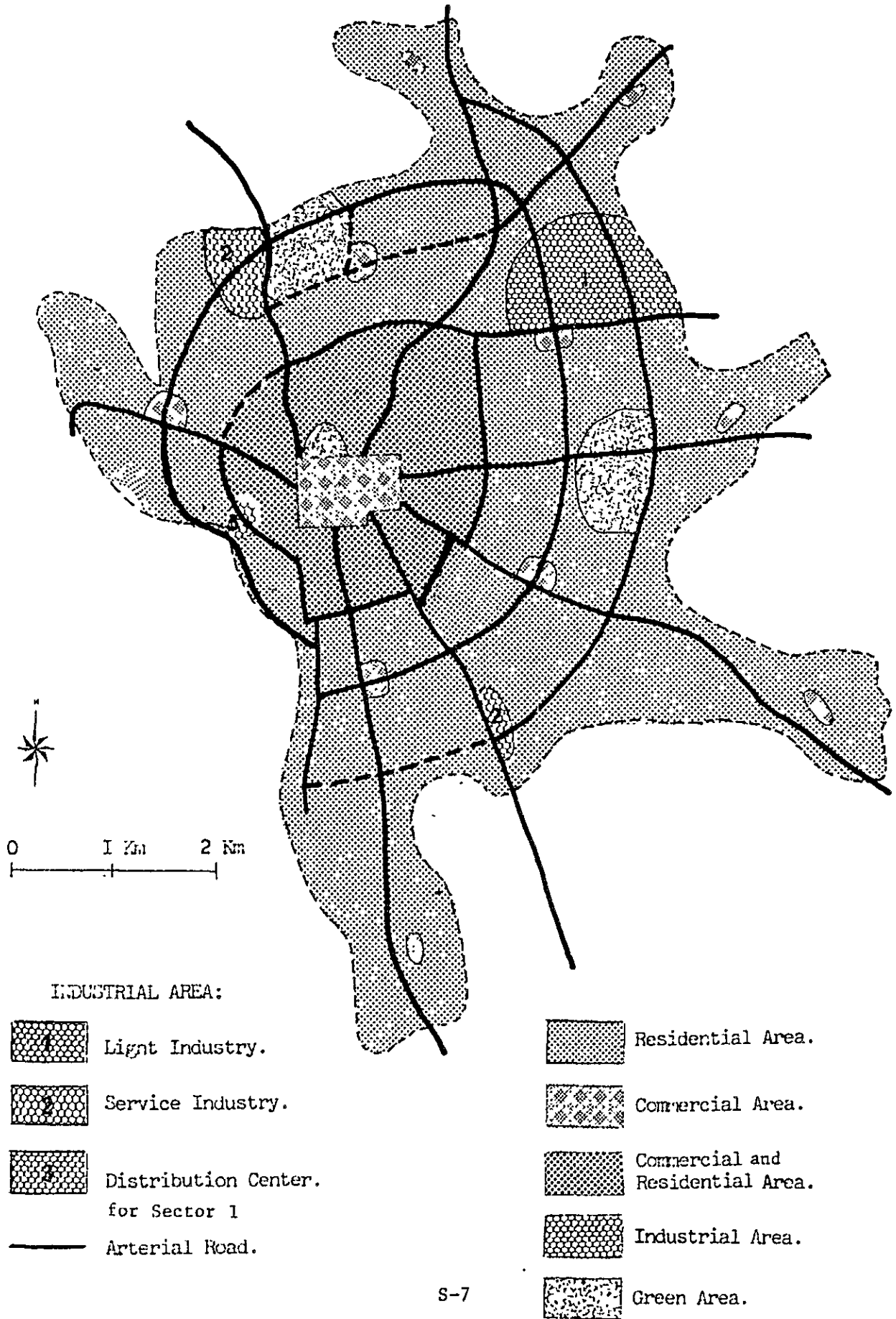
The centers of Residential Areas (commercial areas) should be arranged along the Boundary Ring Road. It is very important to promote district centers in Irbid City, since they are very effective in preventing the concentration of the traffic flow to the city centre.

Since the size of an ideal neighbourhood is approximately 1 km x 1 km, it is desirable to arrange the Boundary Ring Road and Outer Ring Road at 1 km intervals from the Inner Ring Road.

It is very important to improve the Inner Ring Road as a smooth circle, in order to solve the present congestion of traffic in the city centre. After the Inner Ring Road is improved in a smooth circle, it is necessary to prohibit through traffic inside the Inner Ring Road.

After the population of Irbid Expanded exceeds 250,000, a subcentre should be developed and Irbid Expanded should be upgraded to a multi-core city. The desirable position of the sub-center is on Baghdad Street, approximately 6 km from the existing urban centre.

LAND USE PLAN IN IRBID EXPANDED (in 2000)



## 5. Surveyed and Forecast Traffic Situation

The existing traffic situation was determined by an Owner Interview Survey emphasizing traffic within the City Area and a Cordon Line Survey emphasizing traffic entering and leaving the City Area. Using this information together with data regarding the road network, socio-economic characteristics on population, vehicle ownership, etc., simulation of the traffic network by computer was used to assign and forecast attracted and generated trip volumes for the existing traffic situation as of 1981 and traffic in the project target years of 1985 and 2000. In all simulation, vehicles were classified into two types: "cars" (including passenger cars, vans & pick-ups, buses and taxis) and "trucks" (including medium-size trucks, heavy trucks and other vehicles).

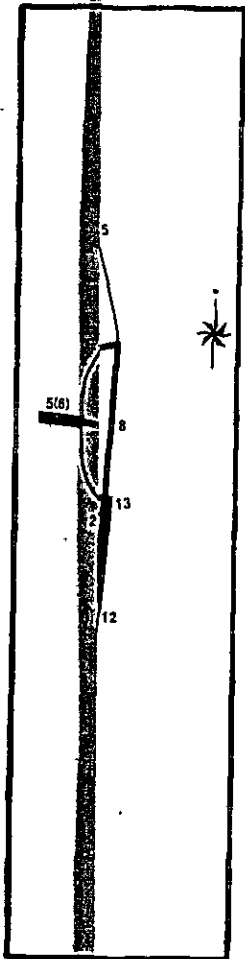
The results which are shown in the Figure and Tables which follow are summarized below.

- The total daily number of trips is 48,634 in 1981. This is forecast to grow 1.3 times by 1985 to 64,331 or 3.2 times by the year 2000 to 154,935.
- The largest part of this traffic is inter-regional (53%) at present, but this is expected to decline (40% in the year 2000).
- The second largest part of the traffic is intra-city (39%) at present, and this is forecast to increase (51% in the year 2000).
- Through traffic presently accounts for 8% of the total and is expected to rise only slightly to 9% in the year 2000.
- The ratio of cars to trucks is 9:1 at present and almost the same in the year 2000.
- The distribution of traffic flows is relatively constant to/from all zones of the city as shown by desire lines.

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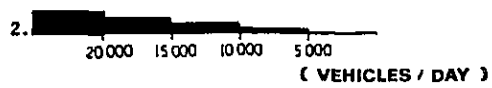
### RESULT OF TRAFFIC ASSIGNMENT

2000 ( WITHOUT )



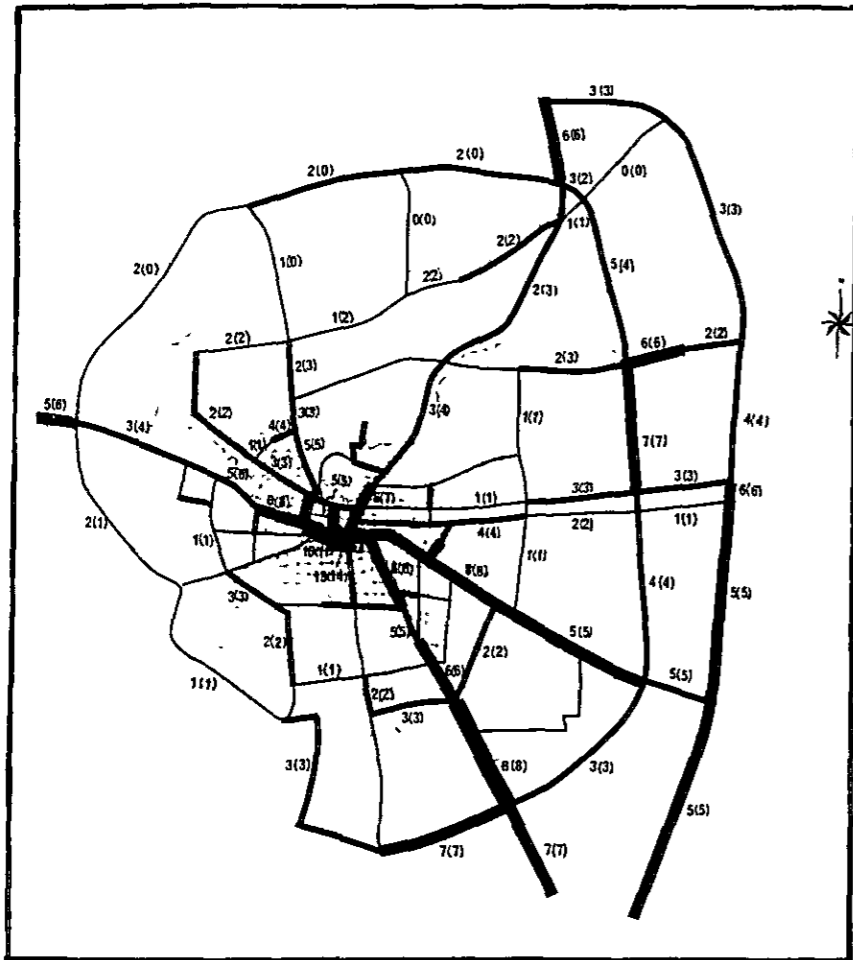
#### LEGEND :

1. RING ROAD TRAFFIC VOLUME ( 1000 VEHICLES / DAY )



3. PROPOSED RING ROAD

RESULT OF TRAFFIC ASSIGNMENT ( 1985 )



LEGEND ;

- 1. RING ROAD TRAFFIC VOLUME ( 1000 VEHICLES / DAY )
- 2. [Scale bar: 10000, 8000, 5000, 2000] ( VEHICLES / DAY )
- 3. [Symbol] ALTERNATIVE ( 2 )
- 4. [Symbol] ALTERNATIVE ( 1 )

RESULT OF TRAFFIC ASSIGNMENT

2000 ( WITH )

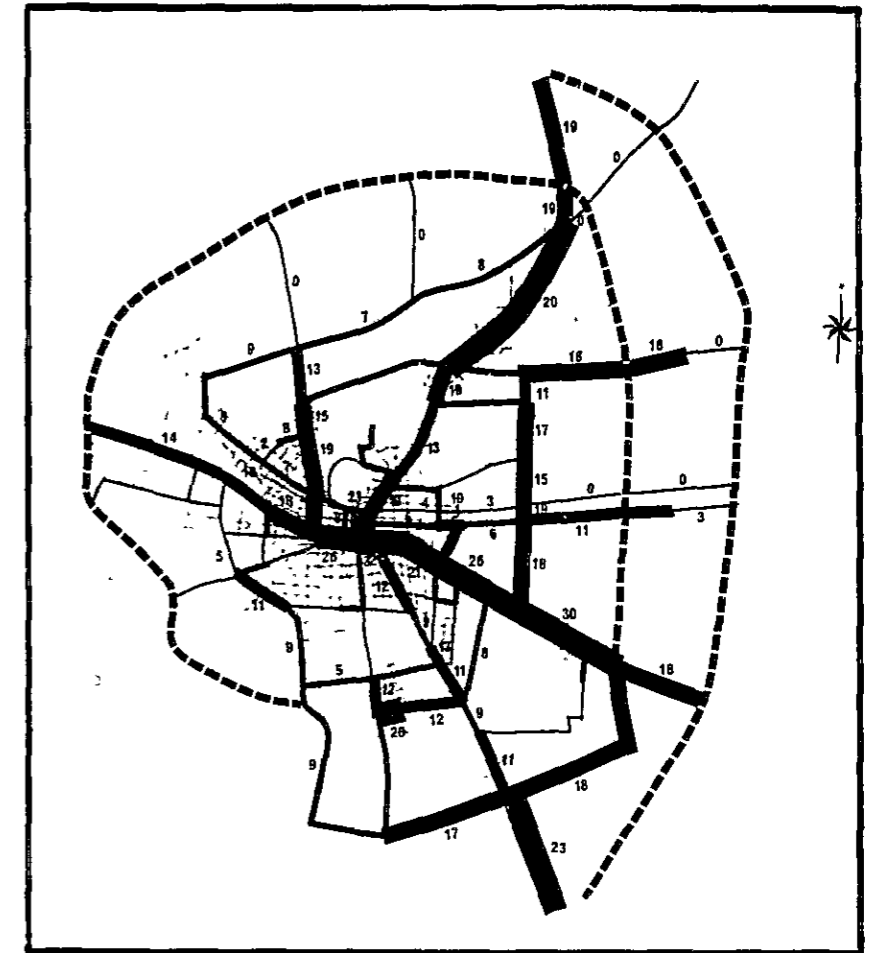


LEGEND ;

- 1. RING ROAD TRAFFIC VOLUME ( 1000 VEHICLES / DAY )
- 2. [Scale bar: 20000, 15000, 10000, 5000] ( VEHICLES / DAY )

RESULT OF TRAFFIC ASSIGNMENT

2000 ( WITHOUT )



LEGEND ;

- 1. RING ROAD TRAFFIC VOLUME ( 1000 VEHICLES / DAY )
- 2. [Scale bar: 20000, 15000, 10000, 5000] ( VEHICLES / DAY )
- 3. [Symbol] PROPOSED RING ROAD



Surveyed and Forecasted Daily Traffic Volume and Composition  
Vehicle (1981, 1985, 2000)

(Unit: % trips/day)

		Intra-city	Inter-regional	Through traffic	Total
1981	Car	37.6	45.9	6.2	89.2
	Truck	1.5	6.8	2.1	10.4
	Total	39.1	52.7	8.3	100.0

1985	Car	44.0	37.0	8.7	89.6
	Truck	2.8	5.2	2.4	10.4
	Total	46.8	42.2	11.1	100.0

2000	Car	48.0	36.1	7.5	91.6
	Truck	2.9	4.1	1.4	8.4
	Total	50.9	40.2	8.9	100.0

Growth Index of Daily Traffic Volume

(Base Year 1981 = 1.0)

		Intra-city	Inter-regional	Through traffic	Total
1985	Car	1.5	1.1	1.9	1.3
	Truck	2.5	1.0	1.5	1.3
	Total	1.6	1.1	1.8	1.3

2000	Car	4.1	2.5	3.9	3.3
	Truck	6.3	1.9	2.2	2.6
	Total	4.2	2.4	3.4	3.2



## 6. Preliminary Design of the Project Roads

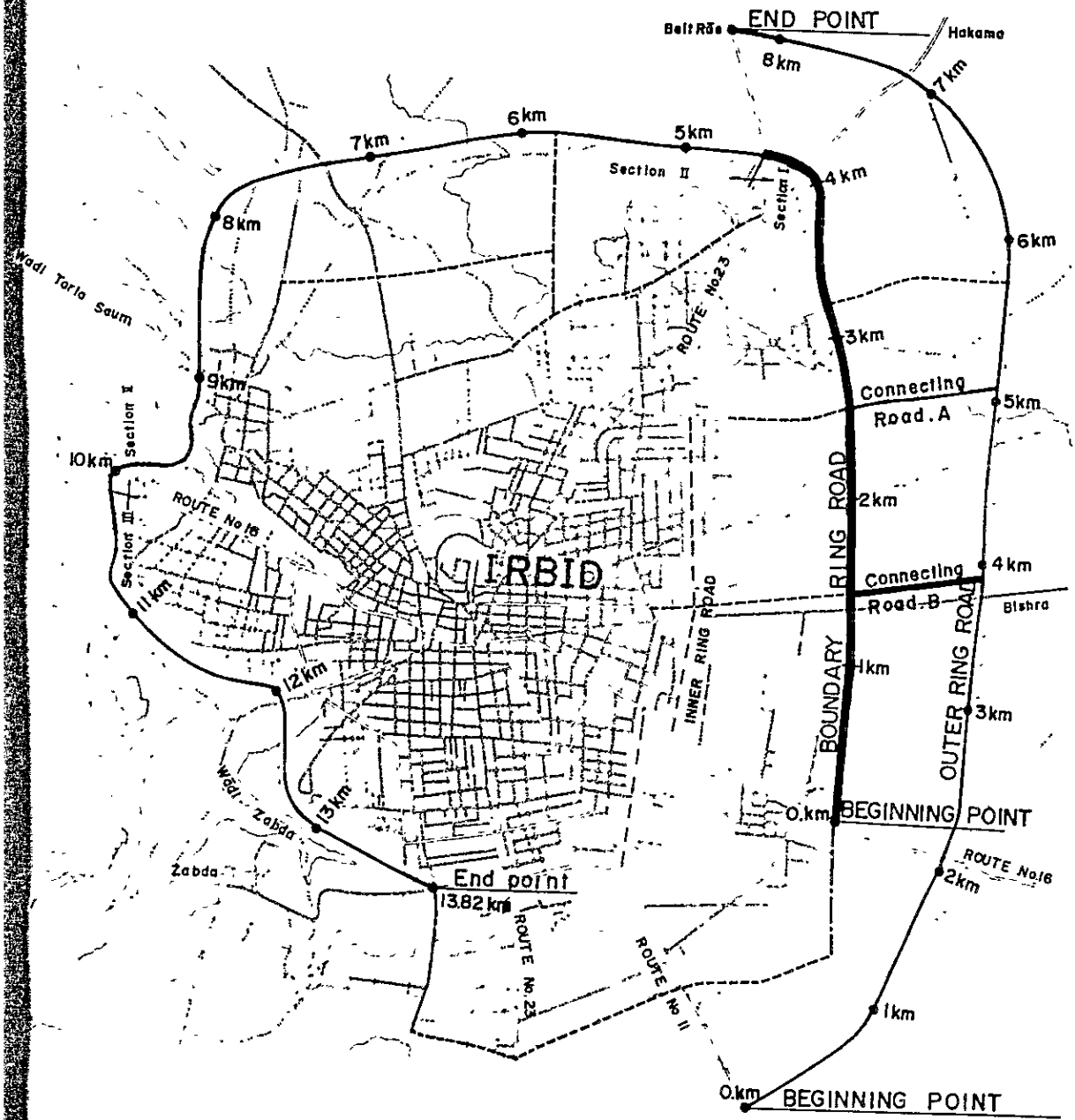
The routing of the Boundary Ring Road (BRR) is based on the plan by the Irbid Municipality for the Adjustment of Land for Residential Use. Separated by a distance of about 1 km, the Outer Ring Road (ORR) runs almost parallel to Section 1 of the BRR around the eastern outskirts of the city. Connecting Road-A (CR-A) has been planned to extend a road now proposed by the City Municipality and Connecting Road-B (CR-B) has been planned to extend a road now under construction. CR-A is close to an industrial area and CR-B runs closely parallel to Bishra Street. The total length of the route is approximately 24 km with breakdown of Sections as follows:

Route Section	Length (km (%))		Construction Area (m <sup>2</sup> )	Over-lay Area (m <sup>2</sup> )
BRR - Section 1	4.4	(18.4)	66,000	45,980
Section 2	5.78	(24.1)	115,600 (21.7)	76,300 (21.4)
Section 3	3.64	(15.2)	72,800 (13.7)	48,800 (13.5)
(Subtotal BRR)	(13.82)	(57.7)	(320,400) (60.3)	(216,260) (20.7)
Outer Ring Road	8.34	(34.8)	166,800 (31.4)	110,000 (30.9)
Connecting Road-A	0.95	( 4.0)	19,000 ( 3.6)	12,500 ( 3.5)
Connecting Road-B	0.85	( 3.5)	25,500 ( 4.8)	17,800 ( 5.0)
Total	23.96	(100.0)	531,700 (100.0)	356,560 (100.0)

The features and location of the Sections of the BRR are as follows:

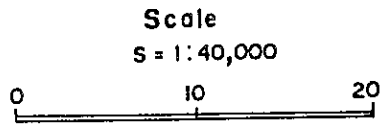
BRR Section	Starting Point (distance from BP)	Ending Point (distance from BP)	Topography	Land-Use
1	Baghdad St. (0.0)	Beit Ras St. (4.4)	Flat	Agriculture
2	Beit Ras St. (4.4)	Palestine St. (10.18)	Hilly/Rolling	Agri., olive orchards, residential
3	Palestine St. (10.18)	Bab Al-Wadd St. (13.82)	Mountainous Wadi Slopes	Scattered houses

## LOCATION OF THE PROJECT ROADS



### LEGEND

- 4-Lane 2-Way road
- 2-Lane 2-Way road
- Roads Planned by the City
- Ideal Routes



Based on the most appropriate routes, a detailed horizontal alignment study was made. A general description of the route of each road segment is outlined below:

#### BRR Alignment

The BRR begins from Route No. 16. The alignment for the BRR was designed taking into account control points such as the community and terrain etc..

From the Beginning Point up to the 7 km point, the route alignment traces the route of the Irbid City Road. For the rest of the extension, because of the mountainous terrain, the alignment was determined to minimize earth works.

Four at-grade intersections with signals are planned at the junctions with existing roads. Five culverts are also planned: 4 to cross the valley, and 1 for an existing road.

#### ORR Alignment

The route for the ORR was determined so as to run parallel with the BRR. In the main, this route traces the route of the City Road planned by Irbid.

Two at-grade intersections with signals are to be provided.

Basic requirements controlling the engineering aspects of the vertical alignment study were as follows:

- In the Flat and Rolling area, the finished level of the roadway will be maintained 0.2 - 0.6 m above the natural ground as far as possible taking into consideration the land-use after development
- A minimum gradient of 0.3% will be adopted for roadway surface drainage
- Flatter vertical gradients and a larger length of vertical curve will be adopted near the intersections as much as possible
- In the mountainous area, vertical alignment was determined to minimize earth works
- The minimum vertical clearance for grade separation structures will be minimum 5.0 m.
- A combination of horizontal and vertical alignments will be considered

- A maximum gradient of 6.0% will be adopted in consideration of heavy trucks

In addition to the basic requirements mentioned above, the following primary control points for BRR and ORR were considered for the determination of vertical alignment.

- Seven at-grade intersections to be provided as listed below:

Signals for traffic control shall be set up at all intersections except No. 3 where the volume of traffic does not justify signalization.

<u>No.</u>	<u>Intersection with BRR</u>
1	Baghdad St. (Rt-16)
2	Bishra St.
3	Hakama St.
4	Beit Ras St. (Rt-23)
5	Palestine St. (RT-16)
	<u>Intersection with ORR</u>
6	Jarash St. (Rt. 11)
7	Baghdad St. (Rt. 16)

- Grade-separation structures to be provided at:

Sta. 8 + 820 (Existing road south of Factory)

- Four Wadis to be considered at:

Sta. 7 + 700

Sta. 8 + 830

Sta. 9 + 480

Sta.12 + 120

Preliminary engineering study was carried out to develop roadway designs that would permit estimates of principal quantities for construction with an accuracy of  $\pm 20\%$  of the final quantities. The recommended design criteria for the Ring Roads are listed in the Table below:

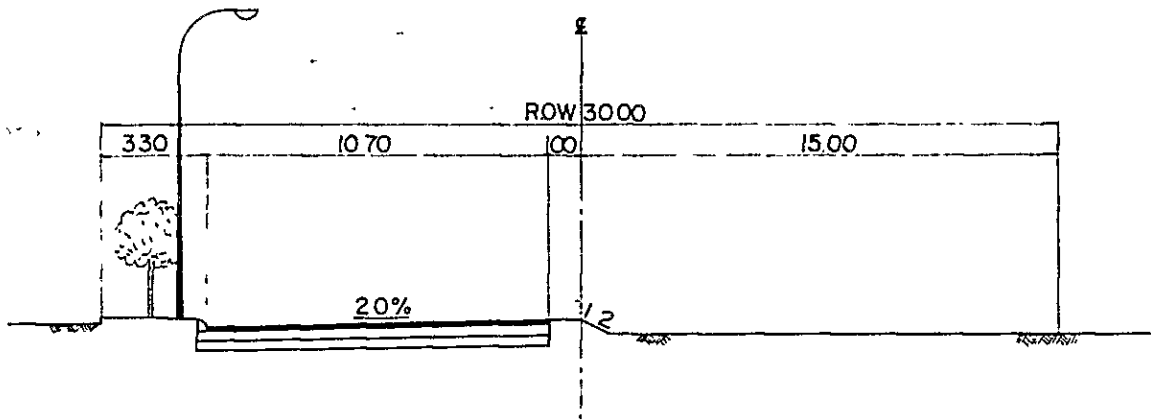
Design Element Unit	BRR-Sec.1	BRR-Sec.2		BRR-Sec.3	ORR	
	(B.P.4.3 km)	(4.3~7.2 km)	(7.2~10.2 km)	(10.2~E.P)	CR-A	CR-B
Design Speed km/h	80	80	80	60	80	80
R.O.W. m	30	30	20 (MIN)	20 (MIN)	30	30
Lane Width m	3.6	3.6	3.6	3.6	3.6	3.6
Lane Number lane	4	2	2	2	2	4
Mediam Width m	2.5	0	0	0	0	2.5
Shoulder Width						
(Left) m	0.5	3.0	3.0	3.0	3.0	0.5
(Right) m	3.0	3.0	3.0	3.0	3.0	3.0
Sidewalk m	3.3	3.4	3.4	0	3.4	3.3

Based on the above design criteria, typical cross sections for the Ring Roads were drawn as shown in the following Figures.

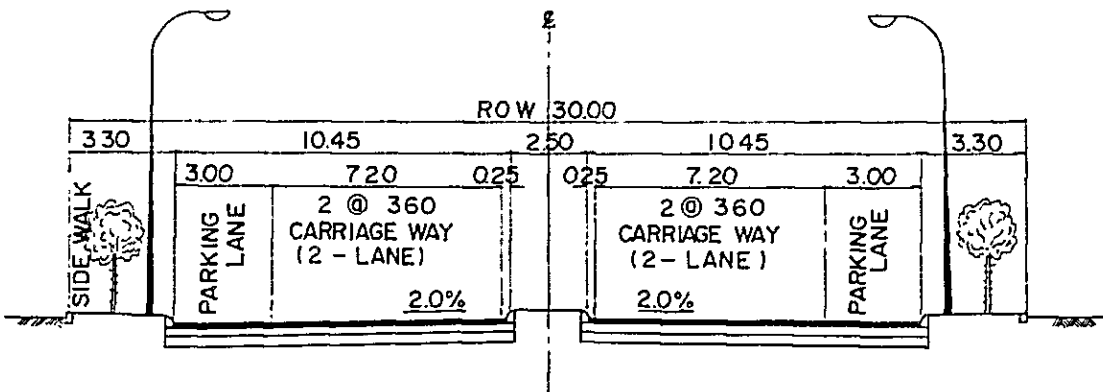
## TYPICAL CROSS SECTION OF RING ROAD IN IRBID CITY

BOUNDARY RING ROAD SECTION I  
( BAGHDAD STREET TO BEIT RAS STREET )

STAGE - I

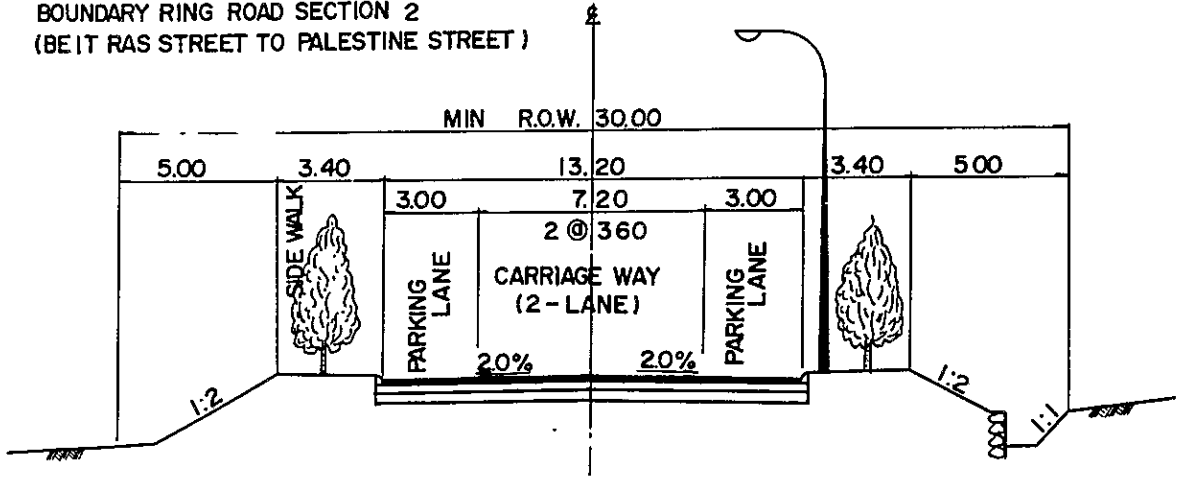


BOUNDARY RING ROAD SECTION I  
STAGE - 2 AND  
CONNECTING ROAD - B

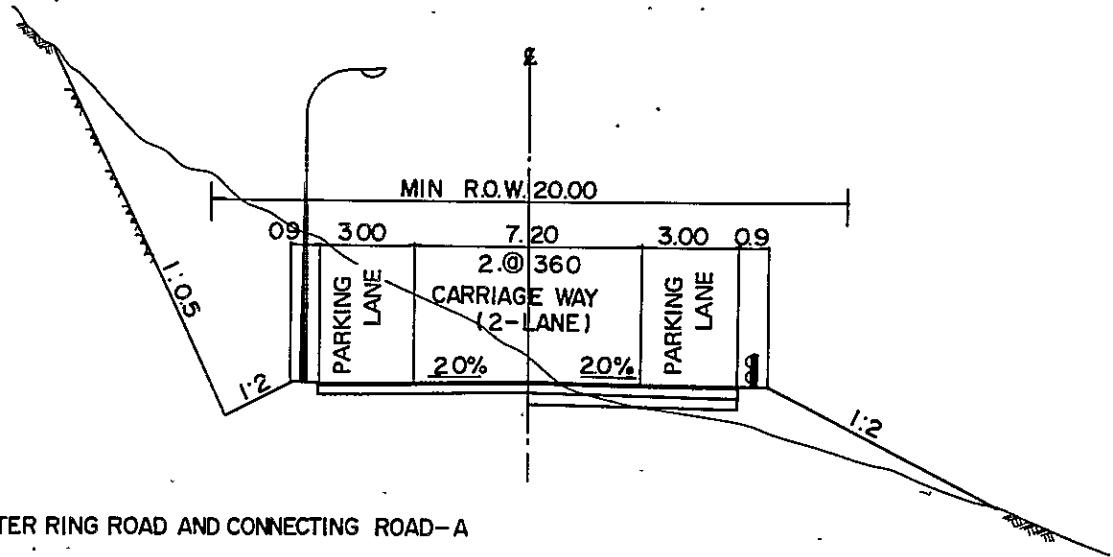


CONTINUE

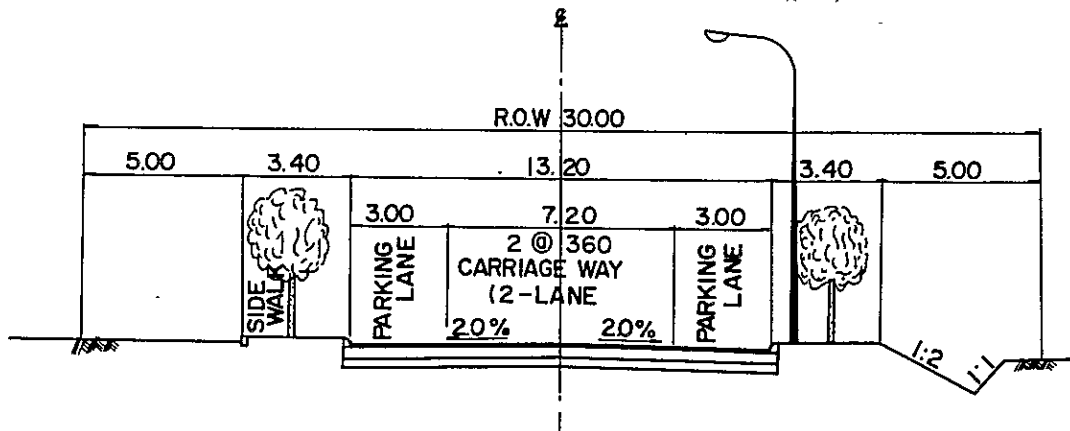
BOUNDARY RING ROAD SECTION 2  
(BE IT RAS STREET TO PALESTINE STREET)



BOUNDARY RING ROAD SECTION 3  
(PALESTINE STREET TO BAB AL-WADD STREET)



OUTER RING ROAD AND CONNECTING ROAD-A



## 7. Staged Construction

Since the construction of the Ring Roads requires a large investment and in order to obtain maximum economic benefits a staging of construction is adopted. The eastern part of the Boundary Ring Road (Section 1) and Outer Ring Road have priority to be constructed in an early stage taking into consideration the large traffic demand due to planned the industrial estate, truck terminal and housing project in the eastern part of Irbid City.

On the other hand, in order to mitigate the traffic congestion on Route 16 in the center of Irbid City, the construction of the northern part of the BRR (Section 2) and the southern part (Section 3) is necessary, although Section 3 is the more important of the two.

Consequently, two alternative construction completion schedules were proposed for BRR Section 2 as follows:

Alternative I - BRR Section 2 in 1985

Alternative II - BRR Section 2 in 1990

For all other sections of the ring roads, only one construction completion schedule is proposed; namely:

1985 - BRR Section 1 (Stage 1 : Two lanes)

BRR Section 3 (Two lanes)

Outer Ring Road (Two lanes)

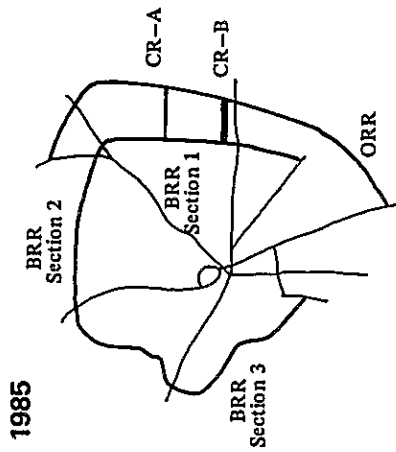
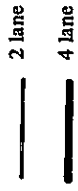
Connecting Road - A (Two lanes)

Connecting Road - B (Four lanes)

1995 - BRR Section 1 (Stage 2: widening to four lanes)



**STAGED CONSTRUCTION**

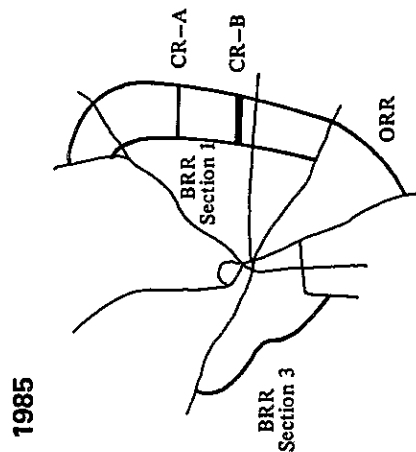
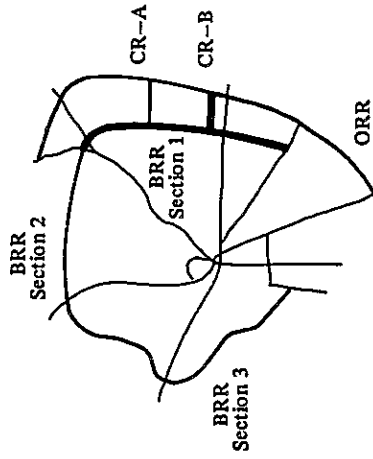


**Alternative I**

**1990**

Same as 1985

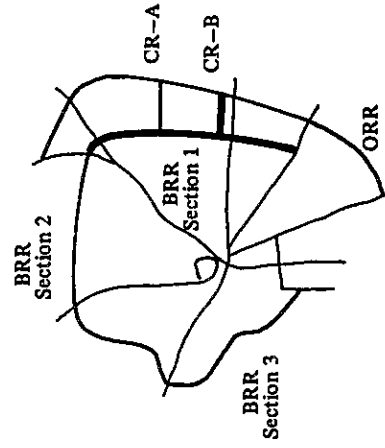
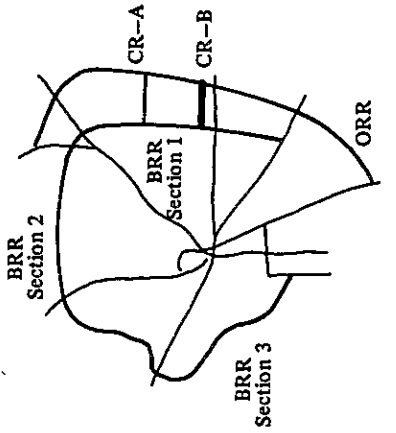
**1995**



**Alternative II**

**1990**

**1995**



## 8. Project Costs

The unit price of each work item was obtained by accumulating the labour cost, equipment cost, material cost, in Sept. 1981 in Northern Jordan, and informed opinions on various specific items secured in interviews with individual Ministry of Public Works' engineers and local contractors. The results were checked against recent actual figures for the construction work in Jordan.

Although the design of the pavement is for a target of 20 years, to prevent excessive thickness and to reduce initial investment cost, construction will be staged so that the initial thickness meets traffic requirements of the first 10 years. Subsequently, it will be overlaid to meet future requirements.

In order to estimate the actual economic cost of the project to the Jordan, duties were deducted from the estimated financial costs and the results were used in the benefit cost analysis.

Total project cost in financial and economic terms for the major expense categories of construction, land acquisition, compensation, contingencies and engineering supervision and also project costs for each road segment are listed in tables which follow.

Total Project Cost by Major Expense Category

( Unit : JD (%) )

	Financial Cost			Economic Cost
	Total	L.C	F.C	
Total Construction Cost	4,338,666 (57.4)	2,028,549	2,310,117	3,886,617 (56.9)
Land Acquisition	1,598,300 (21.1)	1,598,300	-	1,470,436 (21.5)
Compensation	544,500 ( 7.2)	410,700	133,800	599,940 ( 7.3)
Contingencies	648,147 ( 8.6)	403,755	244,392	585,999 ( 8.6)
Engineering Supervisor	433,867 ( 5.7)	202,855	231,012	388,862 ( 5.7)
Total Project Amount	7,563,489 (100.0)	4,644,159	2,919,321	6,834,854 (100.0)

Note: L.C : Local Currency      F.C : Foreign Currency

1 JD ÷ 2,941 US\$

Total Project Cost by Route Section  
(Financial Basis)

( Unit : JD (%) )

Route Section	Total Construction Cost		
	Total	L.C	F.C
BRR-Section 1 (Stage-1)	790,602 (10.5)	511,649	278,953
Section 1 (Stage-2)	690,517 ( 9.1)	466,173	224,344
Section 2	1,915,764 (25.3)	1,146,283	769,481
Section 3	1,742,144 (23.1)	1,160,909	581,235
(Subtotal BRR)	(5,139,027) (68.0)	(3,285,014)	(1,854,013)
Outer Ring Road	1,507,963 (19.9)	905,394	602,569
Connecting Road-A	124,097 ( 1.6)	62,894	61,203
Connecting Road-B	233,943 ( 3.1)	158,642	75,301
Asphalt-Concrete Over-lay	558,454 ( 7.4)	232,214	326,240
Total	7,563,480 (100.0)	4,644,158	2,919,321

Note: L.C : Local Currency  
F.C : Foreign Currency  
1 JD = 2,941 US\$

Ref. Tables 9.6 ~ 9.14

### 9. Project Benefits

When the ring roads are completed ("with project"), vehicles will be able to travel faster, and therefore, vehicle operating costs and travel time will decrease, in comparison with the do-nothing situation (i.e. "without project"). Project benefits were calculated from the cost savings, realized "with project". Quantified Project benefits were calculated for the two alternative cases of the ring roads project in terms of total vehicle movement (Vehicle-km and Vehicle-hrs), vehicle operating costs and time cost.

If the ring roads are constructed, vehicles which would otherwise pass through the center of the city will travel along the ring roads because vehicles can be driven faster. Therefore, vehicle-km in the "with project" case is more than the "without project" case in 1985 (except Alternative II where the Ring Road is not fully operational until 1990) and 2000.

On the other hand, vehicle operating costs in the "with project" case are less than the "without project" case because vehicles can be driven faster due to the decrease of congestion in the center of the city. Vehicle operating costs become higher as the speed goes down; however, since vehicles can be driven faster in the "with project" case compared

to the "without project" case, time cost is reduced by construction of the ring roads. As shown in the following table, operating costs saving are estimated at about JD 1,500 per day in 1985 and JD 4,000 per day in 2000.

In addition, time savings are estimated at about JD 500 per day in 1985 and JD 5,000 per day in 2000.

Since the ring roads will be constructed by the end of 1985, project benefits will be obtained starting from 1985. Assuming the project life to be 25 years, total undiscounted project benefits were estimated at about JD 62 million.

Net Vehicle Movements and Cost Savings <sup>1/</sup>

	1985		2000
	Alternative I	Alternative II	
Vehicle-Km per day <sup>2/</sup>	-3,498	36	-36,571
Vehicle-Hr per day <sup>3/</sup>	4,419	4,158	45,085
Operating Costs Saving (JD per day)	1,464	1,457	4,029
Time Cost Saving (JD per day)	517	487	5,275

Ref. Table 5.19

Notes: <sup>1/</sup> Net total = "Without Project" minus "With Project"

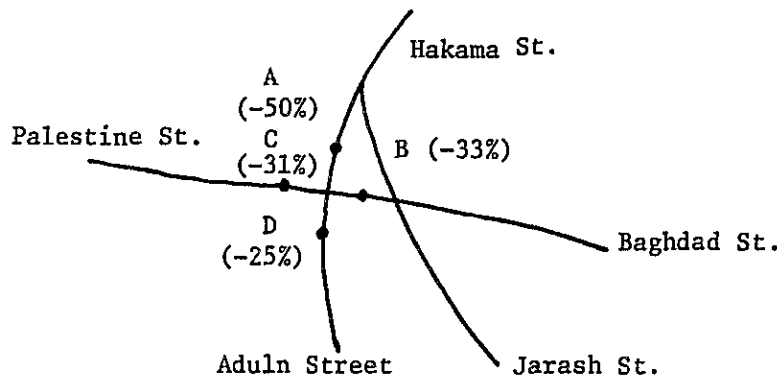
<sup>2/</sup> Cars and trucks

<sup>3/</sup> Cars only

In addition, because of the ring roads, traffic can easily be detoured away from the city center and the traffic congestion in the urban center will be reduced as shown in the Figure of Traffic Assignment Results. At the same time, the environment of the urban center will be improved with the reduction of noise and air pollution. It is forecast that as of the year 2000, the traffic volume of arterial roads in the

urban center will be reduced 25 - 50% with this project compared to "without project" as measured by the decrease in traffic volume around the cross point of Palestine St. and Baghdad St. as shown below. Thus it can be considered that the effect of the Ring Road will be very strongly-felt for the road network system in Irbid.

Effect of Project to Release Traffic Congestion as of the year 2000.



Ref. Table 10.1

Note: ( ) show decrease in traffic volume "with project"

Other Non-quantified Project Benefits include the following:

- For the area along the ring road which will be developed as a residential area, the ring roads will be important as the arterial roads inside the residential district. The Boundary and Outer Ring Roads will become the arterial road of approximately 780 ha and 430 ha of residential area, respectively. This is the largest benefit independent of growth in the volume of traffic.
- Since residential area will be established along the ring roads, the urban areas inside the inner city having a high population density will decrease.
- District Centers (commercial areas) developed beside intersections of the Boundary Ring Road and the existing radial arterial road will be very effective in preventing a concentration in the traffic flow to the urban centers.
- Access to the industrial area will become easier and the absolute value of the Industrial land will increase. The truck terminal, which is planned to be located along the Outer Ring Road inside the industrial area will function effectively with the ring road.

## 10. Project Evaluation

Economic cost and benefits of the project were discounted at the rate of 10 percent (the discount rate suggested by the Ministry of Public Works) for the two alternatives. The results presented in the Table below indicate that both alternatives are economically feasible since benefits are expected to be twice the amount of costs (Alternative I B/C = 2.23 and Alternative II B/C = 2.42) and since the Internal Rates of Return are almost twice the discount rate (Alternative I IRR = 18.1% and Alternative II IRR = 19.7). Although total project costs are about 6 percent less in the case of Alternative I, Alternative II was selected as being more recommendable in terms of return on investment.

### Summary of Economic Analysis (Discounted at 10% using 1981 Prices)

(Unit: 1000 JD)

	<u>Alternative I</u>	<u>Alternative II</u>
Total Discounted Costs	4,977	4,563
Total Discounted Benefits	11,082	11,044
Net Present Value (B-C)	6,105	6,481
Cost-Benefit Ratio (B/C)	2.23	2.42
Internal Rate of Return (IRR)	18.1%	19.7%

A comparison was made of the Cost-Benefit Ratios, in Alternative II for each section of the ring roads as shown in the Table below in order to examine the importance of each section based on the estimated vehicle-km by section. The results reconfirm the recommendation to delay the construction of BRR Section 2 by 5 years in order to reduce costs since its B/C ratio is low. Although BRR Section 3 also has low B/C ratio, its construction is not delayed since its function to reduce through traffic in the road network is felt to be more significant.

Cost-Benefit Ratios by Section  
(Discounted at 10% using 1981 prices, 1000 JD)

	Costs (1000 JD)	Benefits (1000 JD)	B/C
BRR Section 1 (including CR-A)	1,007	3,718	3.69
BRR Section 2	1,006	1,633	1.62
BRR Section 3	1,260	955	0.76
ORR (including CR-B)	1,290	4,738	3.67
Total	4,563	11,044	2.42

Other considerations which support the selection of Alternative II are as follows:

- Alternative I is a little more effective than alternative II from the viewpoint of reducing traffic congestion faster and improving the urban environment.
- On the other hand, in Alternative I, investment will be concentrated in one period, and accordingly, land prices will increase in one period. The negative impact of Alternative I will be larger than that of Alternative II.
- Furthermore, since the investment period of Alternative II is longer than that of Alternative I, it can be financed a little more easily.

## 11. Implementation Schedule

The implementation schedule for the recommended Alternative II is shown in the Table below. Some of the noteworthy schedule details are as follows:

- The detailed design including a review of the Feasibility Study will commence in the beginning of 1982 and, consequently, tender documents for construction are to be prepared.
- Modification of the land readjustment plan to match with the proposed Ring Roads should be urgently started.
- Land acquisition and compensation will commence in the beginning of 1982.
- When land acquisition and compensation are completed, the contract for construction can be approved and awarded.
- Mobilization for construction can begin after the contract has been awarded.
- Widening Boundary Ring Road Section 1 to four lanes should be completed by the end of 1995.
- Over-lay of asphalt surface should be performed after 10 years of road use.

### Executing Agency for Construction

The Municipality of Irbid is the agency responsible for the execution for road construction. The necessary land acquisition and compensation for the land and property within the proposed right-of-way should be undertaken prior to the start of construction by this agency.

Other concerned government agencies are the Ministry of Municipal, Rural and Environmental Affairs, the Ministry of Public Works and the Ministry of Finance.

The proposed project organization structure for execution of the Ring Roads is shown in the following Figure.



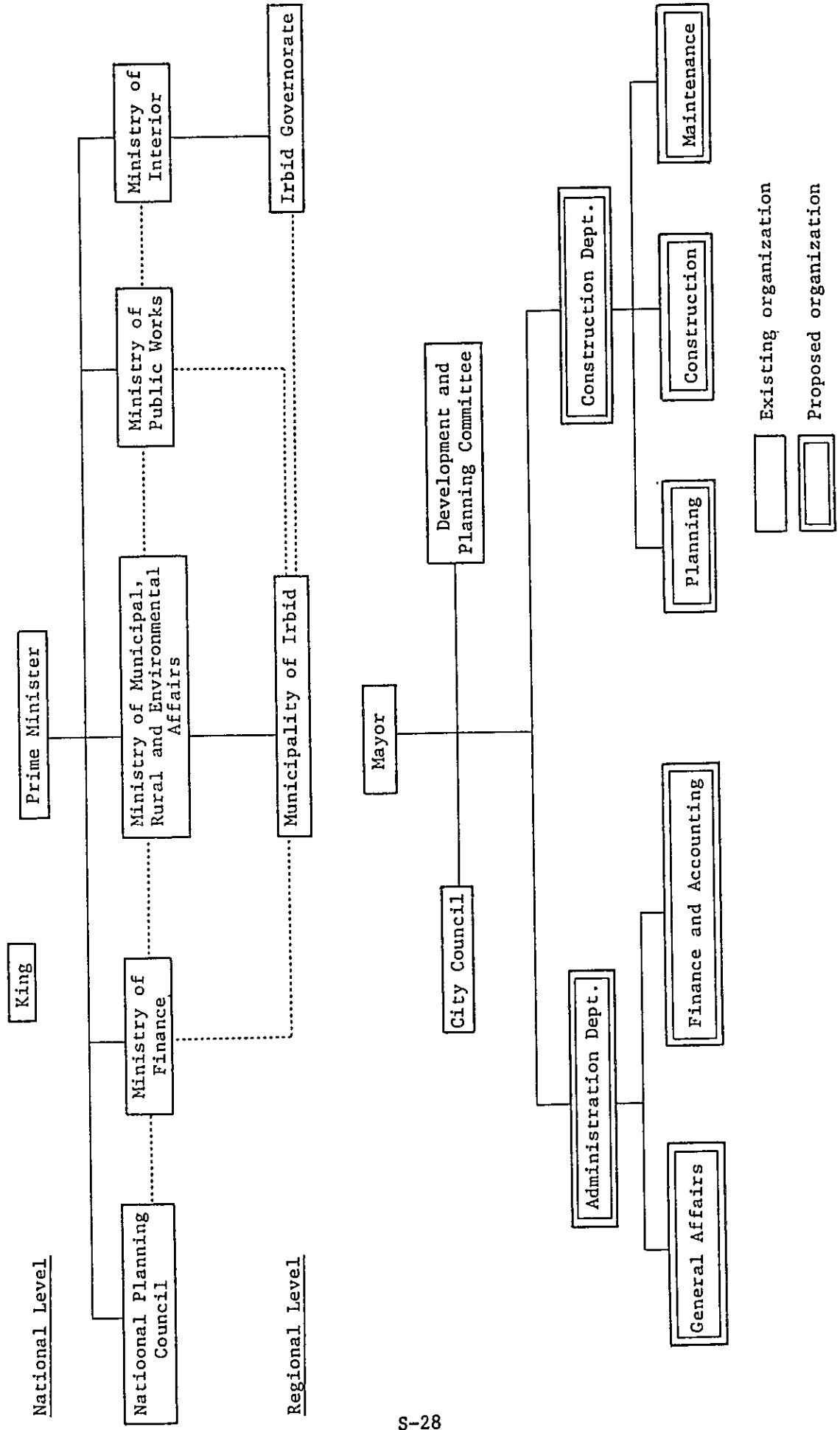
Implementation and Investment Schedule (Alternative I)

Item	Year	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	10	Total						
Detailed Design and Tender																																					
	Land Acquisition and Compensation																																				
	Construction																																				
Overlay of Asphalt Surface																																					
Maintenance																																					
Engineering, Supervision and Administration																																					
Land Acquisition and Compensation																																					
Construction																																					
Overlay of Asphalt Surface																																					
Maintenance																																					
Total																																					

Implementation and Investment Schedule (Alternative II)

Item	Year	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	10	Total							
Detailed Design and Tender																																						
	Land Acquisition and Compensation																																					
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Land Acquisition and Compensation																																						
Construction																																						
Overlay of Asphalt Surface																																						
Maintenance																																						
Total																																						

Organization Structure



## 12. Conclusion and Recommendations

In conclusion, the ring roads are very important for the urban function of Irbid City. Characteristics of soil at the site are acceptable and soil materials can be compacted with optimum water content by drying during road construction. There are no complicated structures. Technically, there are no problems.

Jordanian contractors should be able to execute the ring roads without any difficulty. Construction materials such as aggregates, cement, asphalt and steel bars are all locally available in acceptable quality and in sufficient quantities.

Of the two alternatives, Alternative II is more recommendable. The project is not very sensitive to cost increases since it was calculated that a 10 percent increase in costs only decrease IRR by about one percent. Even in the case where cost increases to 110% and the time saving benefit is excluded (ie, benefits are reduced about 58%), the project is still feasible since IRR is reduced to 12%.

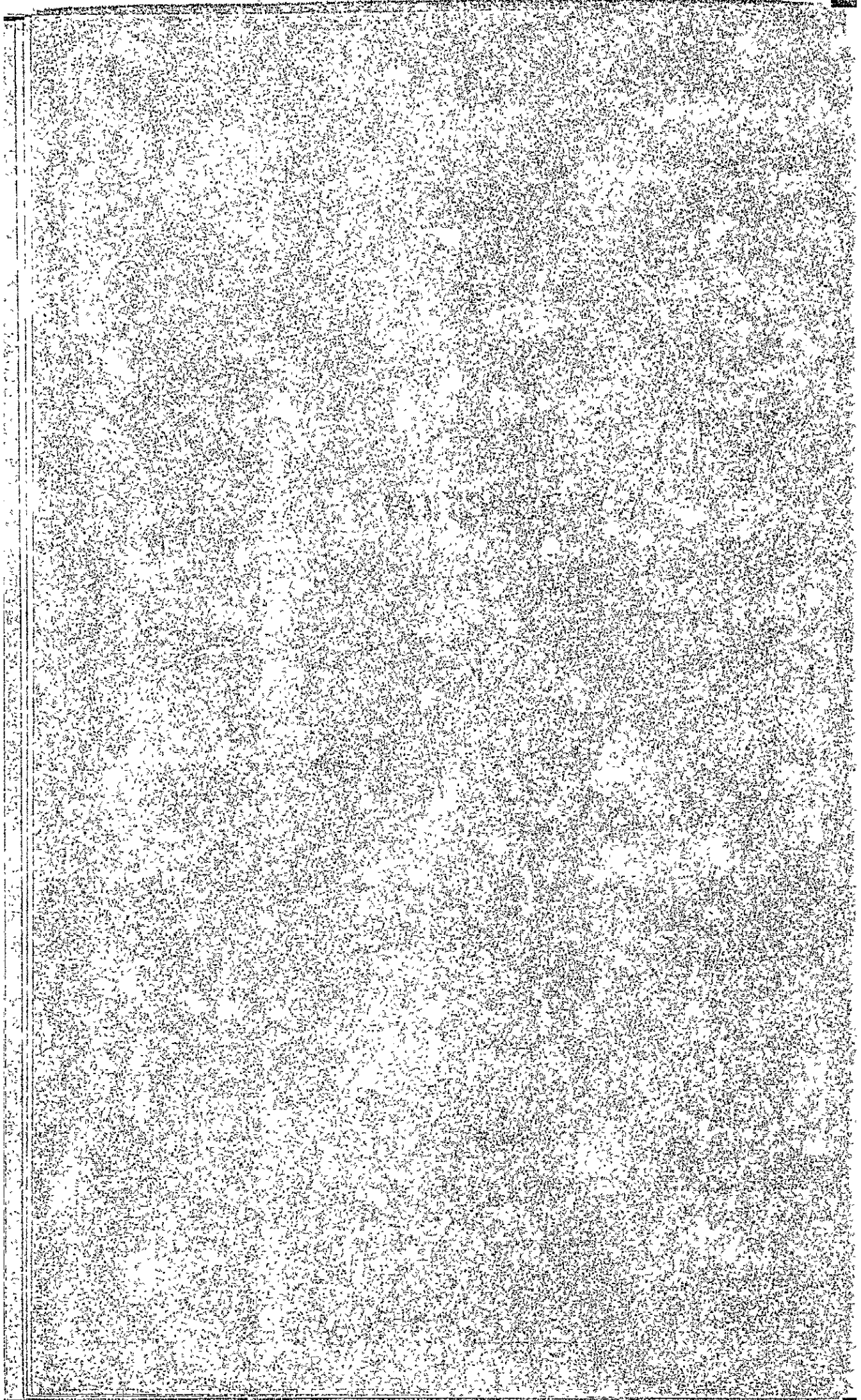
Hence, the project is considered to be technically and economically feasible.

- The section of the Boundary Ring Road between its intersections with Bab Al-Wadd Street and Baghdad Street, and the roads from the urban center joining Connecting Roads A and B are not included in this project since they are planned to be constructed by Irbid Municipality. However, since the roads planned in this project will be completed by 1985, interfacing city roads should be completed before 1985.
- The design standard of a part of the Boundary Ring Road which Irbid Municipality will plan should be equal to that of the project Roads. Reference to the future traffic volume and vehicle composition in the Study should be made.

- The Ring Roads have a large effect on reducing the traffic volume in the center area of Irbid City. However, certain fundamental traffic related problems still remain, such as traffic safety, vehicle parking, pedestrian ways so on. Therefore, in order to solve the overall traffic problems, it will be necessary to make up a master transportation plan in Irbid. This master plan should include traffic control and regulation plan, intersections improvement plan, public transportation network plan, parking area plan etc.
- At the present time, a readjustment plan on most of the land for the proposed roads has been carried out by Irbid Municipality, accordingly, it is necessary to urgently modify the readjustment plan to match with the proposed Ring Roads.
- The budget for the construction of Ring Roads is insufficient. Consequently, strong financial support by the Government of Jordan and loans from foreign countries are needed and should be arranged as soon as the project is approved. It is necessary to establish appropriate organization in Irbid municipality for execution of the Ring Roads.



# **INTRODUCTION**



## INTRODUCTION

### 1. Background of the Project

The Hashemite Kingdom of Jordan requested the Japanese Government to cooperate in planning integrated regional development of the northern region of the country centering around Irbid city, the biggest city in Northern Jordan, located about 75 km north of Amman, the capital of Jordan. The Japanese Government, having accepted the request from the Hashemite Kingdom of Jordan, gave Japan International Cooperation Agency (JICA) instructions to take necessary action to help implement the integrated regional development. As a result, JICA dispatched two survey teams in 1978 and 1979 in succession to collect the necessary first-hand information required to plan the integrated regional development. In March 1980 the survey team finished its final report, which is concerned mainly with the following three projects:

A. Irbid Industrial Estate

B. Irbid Ring Roads

C. Irbid Tourism Project

The preliminary feasibility studies of Projects A and B, "Irbid Industrial Estate", and "Irbid Ring Road," were finished within the framework of the field surveys mentioned above, and the final feasibility study was completed for Project A, "Irbid Industrial Estate". With this advance made in the project planning process, the Japanese Government was again requested to cooperate in the feasibility study of the Ring Roads Construction Project in Irbid City, and, having accepted again the request from Jordan, decided to dispatch a preliminary survey team there in December 1980. This Japanese survey team conducted a field survey in Irbid city and vicinity from December 2 to 19, 1980 to collect first-hand information in the district considered.

Irbid is the largest city in Northern Jordan and is, so to speak, the hub of the traffic network there. It has a population of about 113,000 (1979 census) and has been undergoing remarkable growth in



population, urbanization and motorization.

In about 1970, the Irbid city authorities started to plan the construction of ring roads (inner, boundary and outer ring roads) in the city and vicinity as a part of city planning. The Inner Ring Road and part of the Boundary Ring Road are already under construction. The planning of the remaining portion of the Boundary Ring Road and the Outer Ring Road was considered within the framework of the integrated regional development study of Northern Jordan, and finally, the comprehensive feasibility study of the Ring Roads under discussion was undertaken by JICA.

## **2. Survey Purpose and Information Sought**

The survey team was dispatched to Jordan to accomplish the following objectives in accordance with the scope of work agreed to between the Jordanian and Japanese governments for the purpose of building new ring roads in Irbid city.

The main purpose of this project is as follows:

- i. To mitigate traffic congestion in the center of the city by diverting traffic to the Ring Roads.
- ii. To contribute to the development of less-developed areas by providing more efficient traffic facilities.
- iii. To prevent disorderly sprawling of the urbanized areas by indicating the framework of appropriate land use.

The feasibility study encompassed the following activities:

- i. Field reconnaissance
- ii. Economic study of the area concerned
- iii. Traffic study
- iv. Hydrological study
- v. Soil investigation
- vi. Selection of alternatives
- vii. Surveying
- viii. Preliminary engineering design

- ix. Study of road construction materials and labor force
- x. Estimation of construction, maintenance, and vehicle operation costs
- xi. Project evaluation

### 3. Survey

JICA started by dispatching the Chairman and a member of the Supervisory Committee and an advance survey team to Jordan on March 17, 1981, and they promptly started the discussion of the inception report and the collection and analysis of first-hand information.

On May 1, 1981, a second survey team (charged with the tasks of road planning, traffic survey, soil survey, and surveying) arrived in Jordan and set to work on the detailed field survey.

On May 15, 1981, Progress Report I was submitted to the Regional Planning Dept. to keep them informed of the progress of the work performed by the Japanese survey teams.

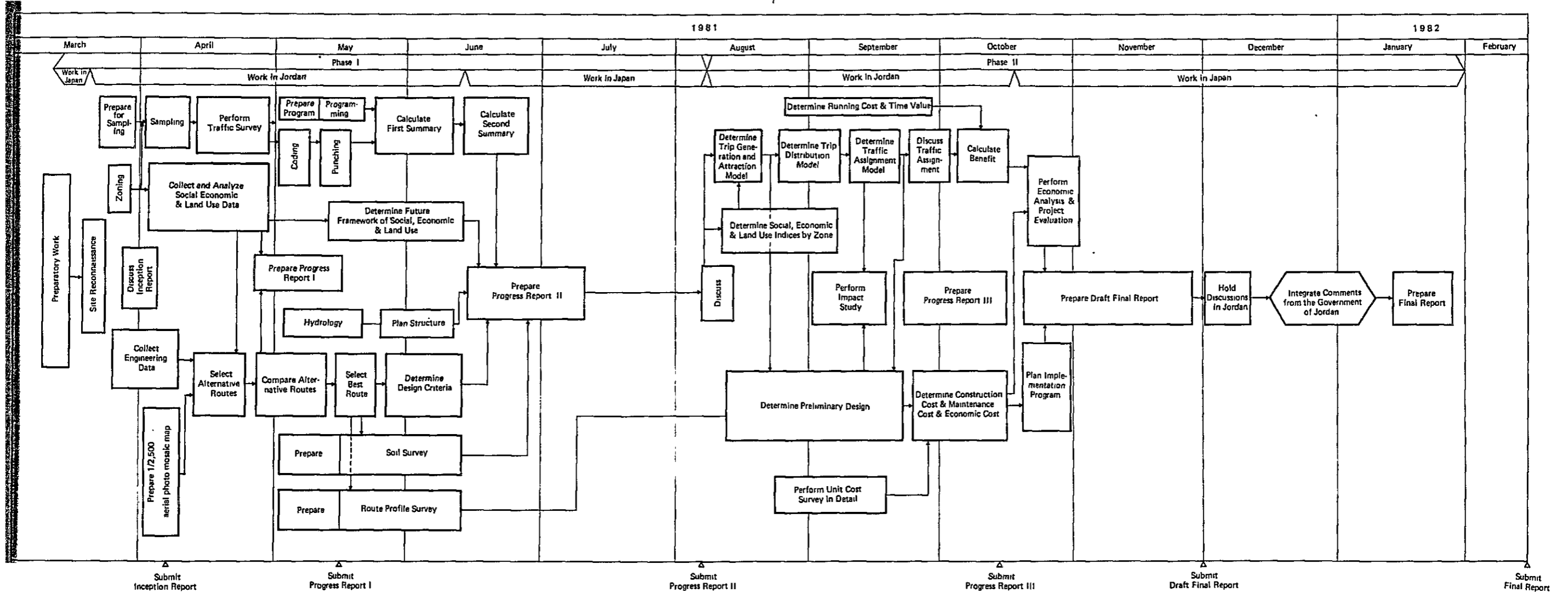
On June 16, 1981, the survey teams completed first phase field work and returned to Japan. Back in Japan the survey teams analyzed the information collected in Jordan and summarized the results of analysis as Progress Report II.

On August 7, 1981 an advance survey team was dispatched to Jordan to undertake a second phase of the feasibility study. On that occasion, Progress Report II was submitted to the R.P.D., and, making use of data derived from the socio-economic studies as well as traffic, engineering and other surveys undertaken in the first phase of the feasibility study, the survey team entered the advanced stage of planning; they engaged in future traffic forecasting, determination of an optimum route, estimation of construction costs, and cost-benefit analysis.

On August 22, 1981, a second survey team left Japan for Jordan to reinforce the advance survey team.

On October 18, 1981, Progress Report III was submitted to the R.P.D., and on completion of their mission on October 21 the Japanese survey teams left Jordan for Japan.

## Work Flow of Feasibility Study





Back in Japan, the Japanese survey teams entered the final stage of planning, engaging in the economic evaluation and project implementation planning, making use of the information collected in Jordan and data provided through analysis of that information, and incorporated their findings and recommendations in this Draft Final Report.

JICA dispatched the Chairman and a member of the Supervisory Committee to Jordan on December 2, 1981 to make the presentation of the Draft Final Report to the Jordanian authorities and discuss it with them.

#### 4. Organization for Study

The members of Supervisory Committee and Survey team for Ring Road Construction Project in Irbid City are as follows:

##### Supervisory Committee

Chairman	Mr. Kimio Chiba	Director of Raods of North-East Construction Dept. Ministry of Construction
Member	Mr. Osamu Hidaki	Assistant Section Chief of National Express Highway Section Ministry of Construction
Member	Mr. Kenzo Kikuchi	Deputy Head of Tokyo Bay Crossing Bridge and Tunnel Research Office  Japan Highway Public Corporation
Member	Mr. Makoto Misawa	Assistant Section Chief of Ministen's Secretariate Policy Sect. Ministry of Construction

##### Survey Team (Pacific Consultant International)

Team Leader	Mr. Giichi Kataoka	General
Team member	Mr. Hironobu Sakai	City Planning, Impact Study
"	Mr. Shigeru Okutsu	Transportation Planning
"	Mr. Hiromi Hidaka	Traffic and Economic Analysis
"	Mr. Kazuhisa Kai	System Engineering

Team member	Mr. Torao Tokozumi	Road Planning
"	Mr. Chiharu Fukuda	Road Planning
"	Mr. Akira Maki	Soil and Materials Investigation
"	Mr. Shuji Miura	Surveying
<u>JICA</u>	Mr. Junichi Inoue	Coordinator
"	Mr. Go Nishibe	Coordinator

## 5. Acknowledgements

Throughout the survey periods, the Japanese survey teams were fortunate to have excellent cooperation and assistance, as well as valuable advice and suggestions from various organizations, public and private alike, as well as the government agencies concerned, of the Hashemite Kingdom of Jordan. Without such cooperation and assistance the field surveys and other activities of the Japanese survey teams could not have been performed so efficiently and successfully.

Although we can only make mention of the main organizations and personnel in and out the central and local governments, many other individuals and organizations cooperated with us. We extend our sincere thanks to them all.

### Ministry of Municipal and Rural Affairs (MMRA)

Mr. Awad al Tell                      Under Secretary of MMRA

### Regional Planning Department of MMRA

Dr. Sufyan A. Tell	Director
*Mr. Taher M. Faroun	Geographer
*Mr. Yaser M. Najjar	Economic Geography Researcher
*Mr. Muhammed M. Qudeh	Civil Engineer
*Mr. Khalaf M. Kailani	Geographer
*Mr. Ahamad M. Rusan	Sociologist
*Mr. Khairi M. Khateb	Geographer
*Mr. Khaled S. Tanawrah	Civil Engineer

\* Indicates counterparts of the Survey Team.

### Municipality of Irbid

Dr. Adaul R. Tubeishat	Mayor
Mr. Muhamad A. Tell	Chief of Regulation Dept.
Mr. Muhamad S. Dalgamoni	Chief of Public Works Dept.

Ministry of Public Works

Mr. Gorge Haddad	Chief of Study Dept.
Mr. Sameer Kakish	Highway Engineer
Mr. Moataz A. Balbisi	Director of Irbid Office
Mr. Ghazi Jodeh	Civil Engineer of Irbid Office

Royal Scientific Society

Dr. Monther Salah	Director of Computer Center
Dr. Yousef A. Nusseir	Acting Director of Computer Center
Dr. Ruhi Sharif	Director of Building Materials Research Center
Dr. Izzed D. Katekhda	Director of Laboratories

Jordan Geographic Center

Colonel R. Mejal	Director
Major G. Asa'ad.	Acting Director

Car Registration Department

Mr. Kazins Soub	Director
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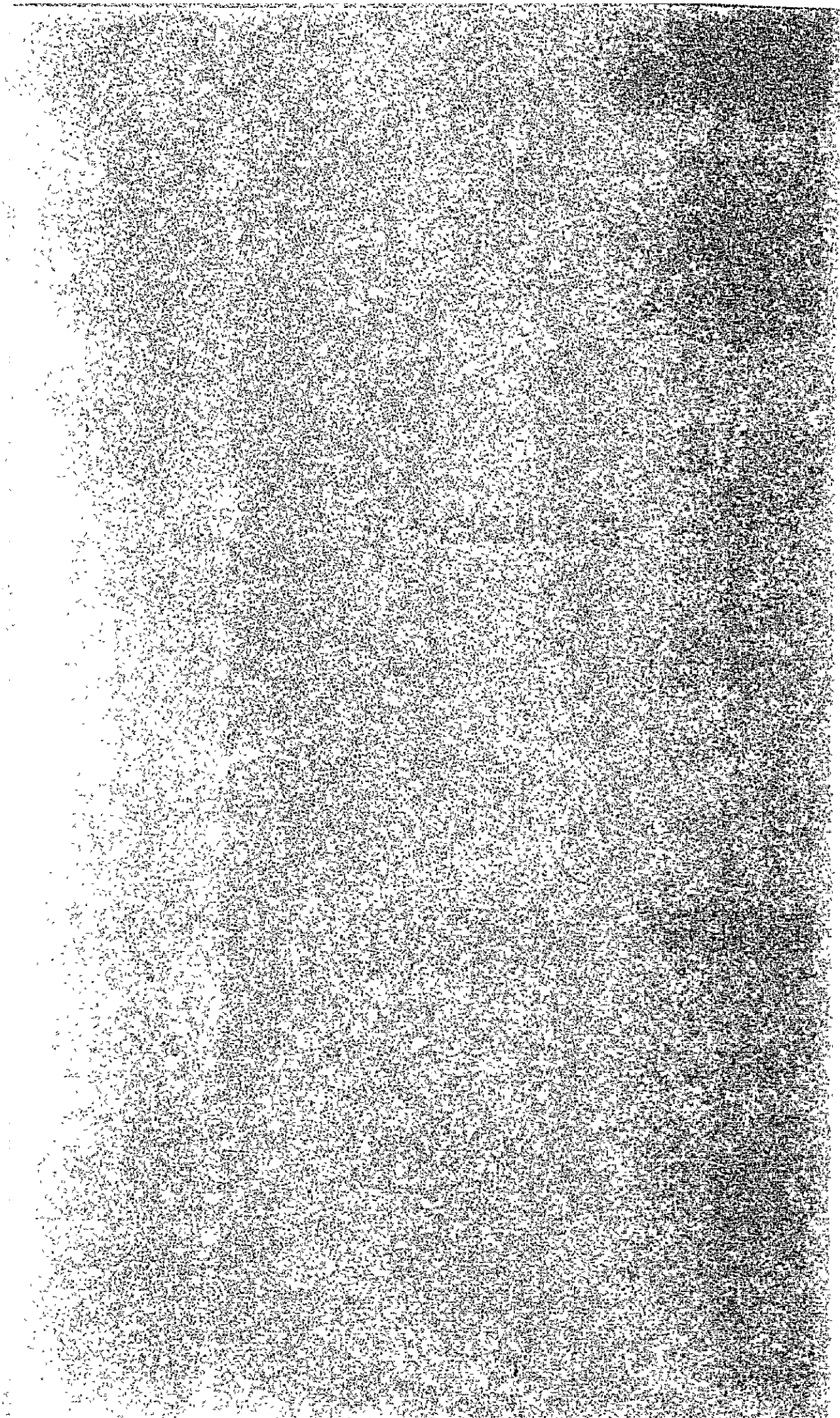
Public Security Directorate

Colonel Sabri Mohammad
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# **PLANNING STUDY**



## CHAPTER 1 PRESENT SOCIAL, ECONOMIC AND LAND USE CONDITIONS

### 1.1 Conditions of the Study Area

#### (1) Physical Features

Irbid City is situated in the northern region of Jordan, approximately north 32.6° in latitude and east 35.8° of Greenwich in longitude.

Wadi El-Ghafar passes by the western side of the City and forms a rather deep valley. The other areas are almost flat, and as a whole the land gradually declines to the north.

The level of the centre of the City is approximately 570 m above sea level.

The valley that Wadi El-Ghafar forms prevents the development of the western side of the City. The urban area of the City spreads in northern, eastern and southern directions.

#### (2) Climate

Irbid City is located in the far north of Jordan, therefore, the climate in summer is mild. Moreover, the City is surrounded by a mountain range in the north and west. Accordingly, the climate in winter is also mild.

Average temperature ranges from 8.5°C (January) to 25°C (August) throughout the year. In summer, relative humidity decreases to 50-60% and it becomes dry, while in winter relative humidity increases to 70%. It can be said that the climate of the City is mild and comfortable.

The rainy season is from December to March in winter. The rainfall of each month is between 80 mm and 110 mm.

The dominant wind direction is westerly throughout the year.

Table 1.1 Climate of Irbid City  
(Irbid Nursery 1966 - 1975)

Month	Temperature Mean Monthly (°C)	Relative Humidity Monthly Average (%)	Rainfall Mean Monthly (mm)	Dominant Wind Direction
1	8.5	72	110.9	West
2	9.6	68	88.0	West
3	12.2	66	83.9	West
4	16.1	57	29.0	West
5	20.3	49	6.6	West
6	23.4	50	0.1	West
7	24.7	55	Tr	West
8	25.0	59	0.0	West
9	23.7	58	0.9	West
10	20.7	54	13.5	West
11	15.2	60	44.6	West
12	10.0	68	85.6	West
Whole Year	17.5	59.7	463.1	West

Source : Meteorological Directorate Statistics Division

## 1.2 Administrative and Regional Zoning

### (1) Administrative Zoning

The East Bank of Jordan is divided into five governorates: Amman, Irbid, Balqa, Karak and Ma'an.

Each governorate is administratively divided into Lewaa, Kadaa and Nahiya, respectively in descending order.

The administrative zoning of Irbid Governorate is shown in Figure 1.2.

### (2) Regional Zoning

Regional zoning is used for the purpose of planning in Jordan and is based on administrative zoning, but differs in terms ranks.

Irbid Governorate is divided into six districts: Irbid, Jarash, Mafraq, Rumtha, Ajlun and Al-Aghwar Shamalia.

Irbid District is further divided into five sub-districts: Irbid, Al Taybe, Northern Mazar, Al Kourah and Bani Kennanah. Irbid sub-district is composed of Irbid City and 51 villages scattered around it.

It is forecast that by the year 2000, the urban area of Irbid City will spread to surrounding villages across the boundary of Irbid City.

The area where building can freely spread is called Irbid Expanded in Phase II study by the Japanese Regional Planning Team.

Irbid Expanded is composed of Irbid City, Hawara, Aidun, Bishra, Beit Ras and Hakama.

Irbid City is zoned, as shown in Figure 1.5.

FIG. 1.1 GOVERNORATES IN JORDAN: ADMINISTRATIVE MAP

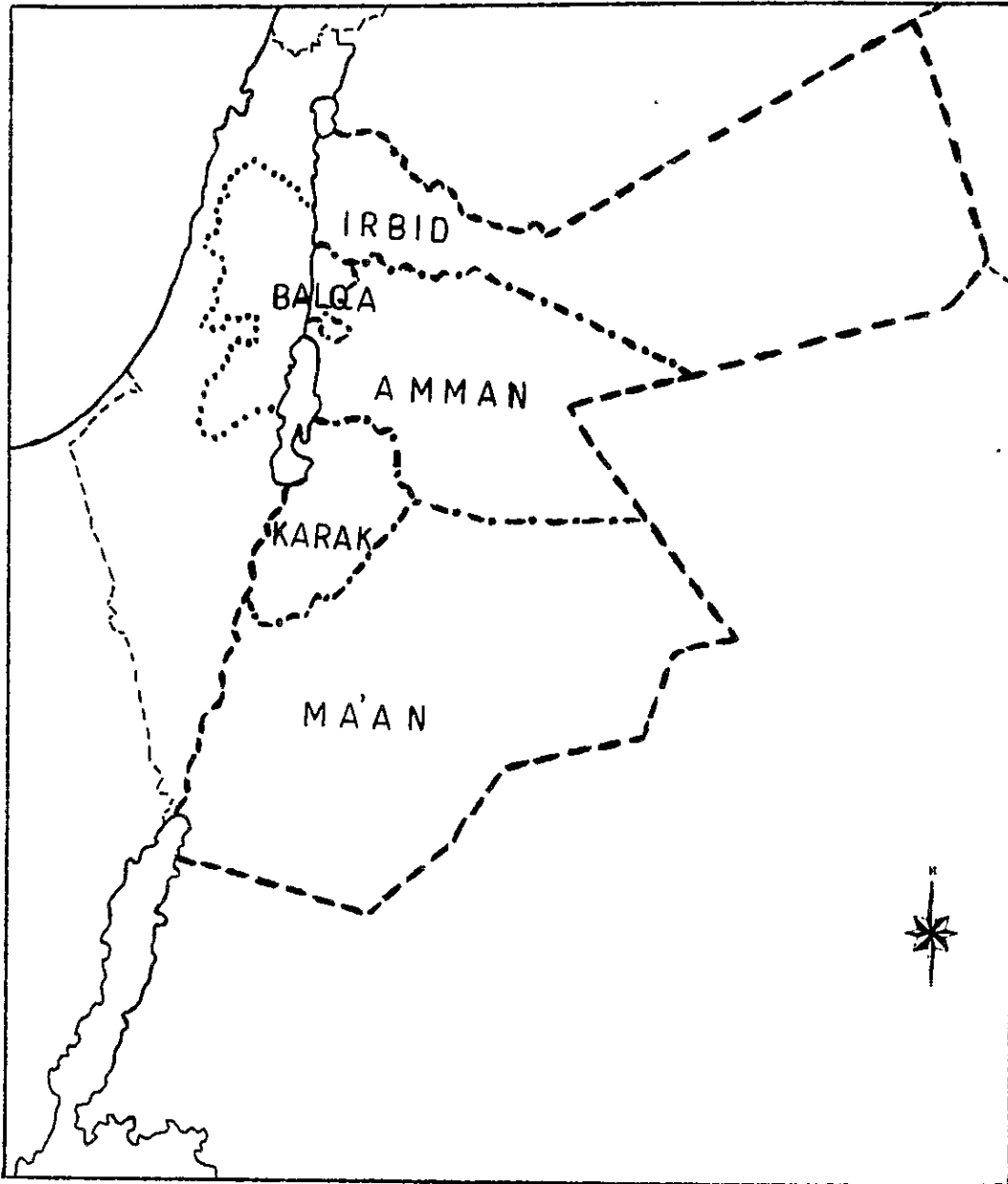
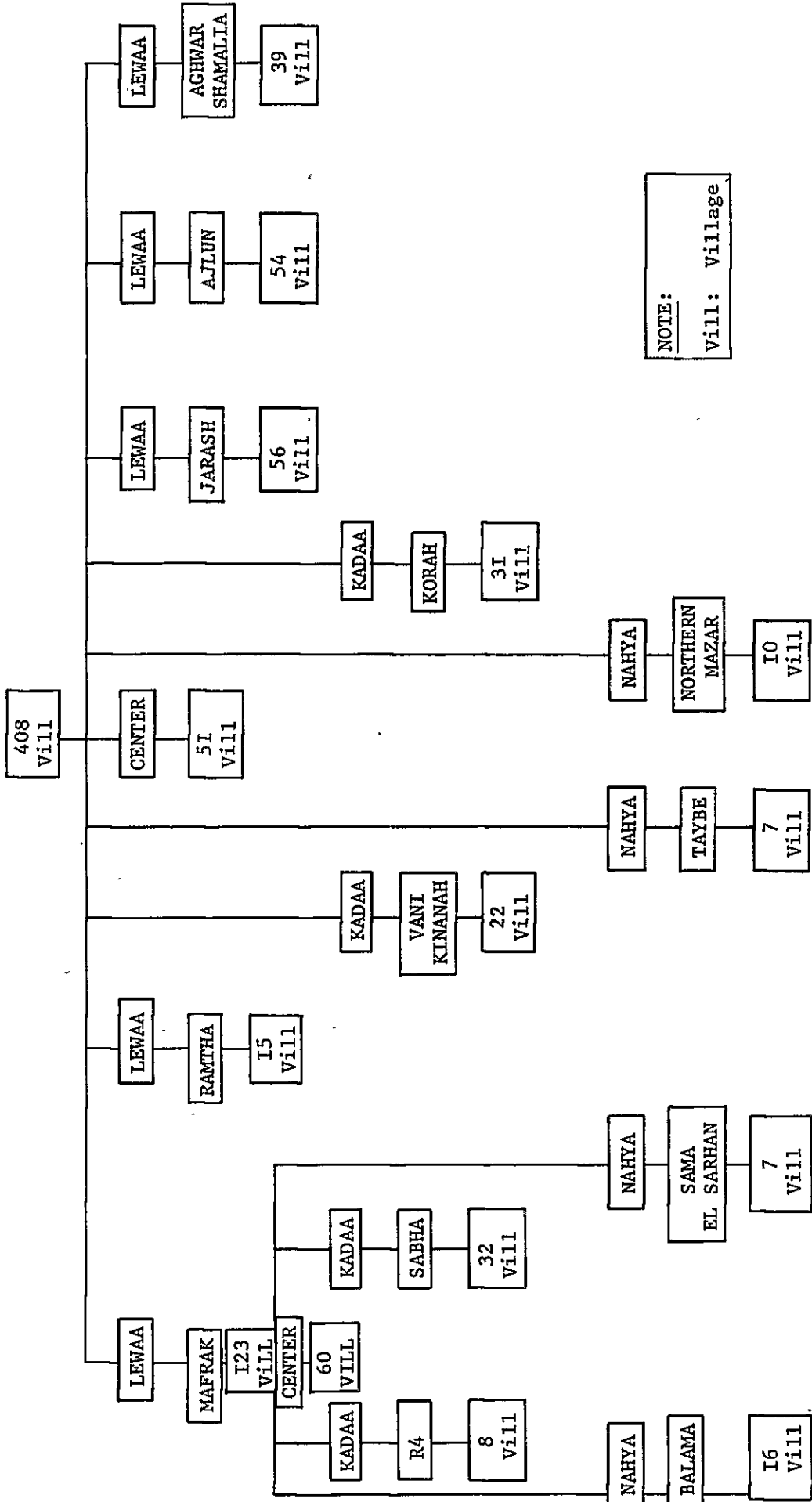


Fig. 1.2 ADMINISTRATIVE ZONING OF IRBID GOVERNORATE



NOTE:  
Vill: Village

Source: Irbid Governorate

Fig. 1.3 REGIONAL ZONING OF IRBID GOVERNORATE

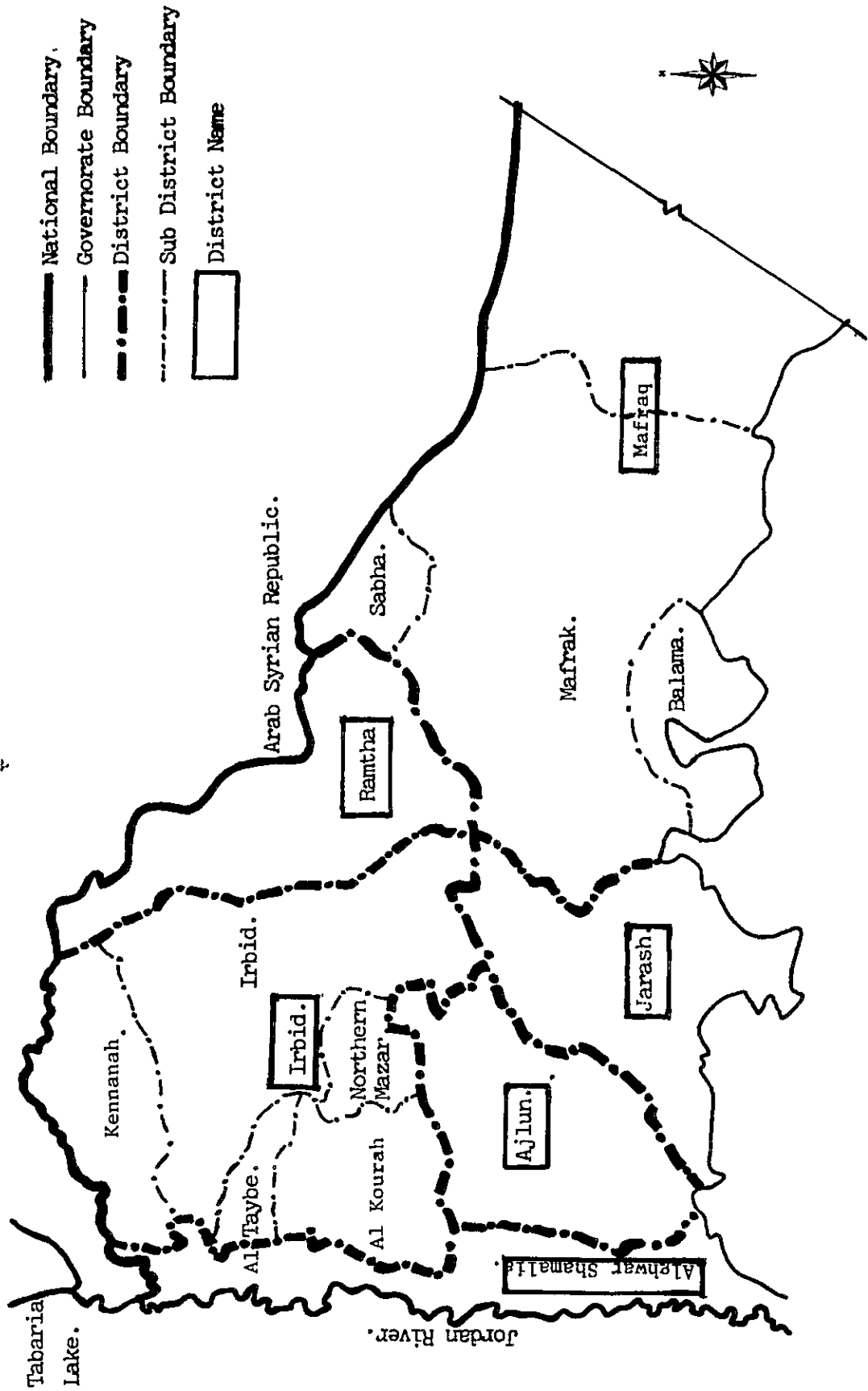




FIG. 1.4 IRBID EXPANDED

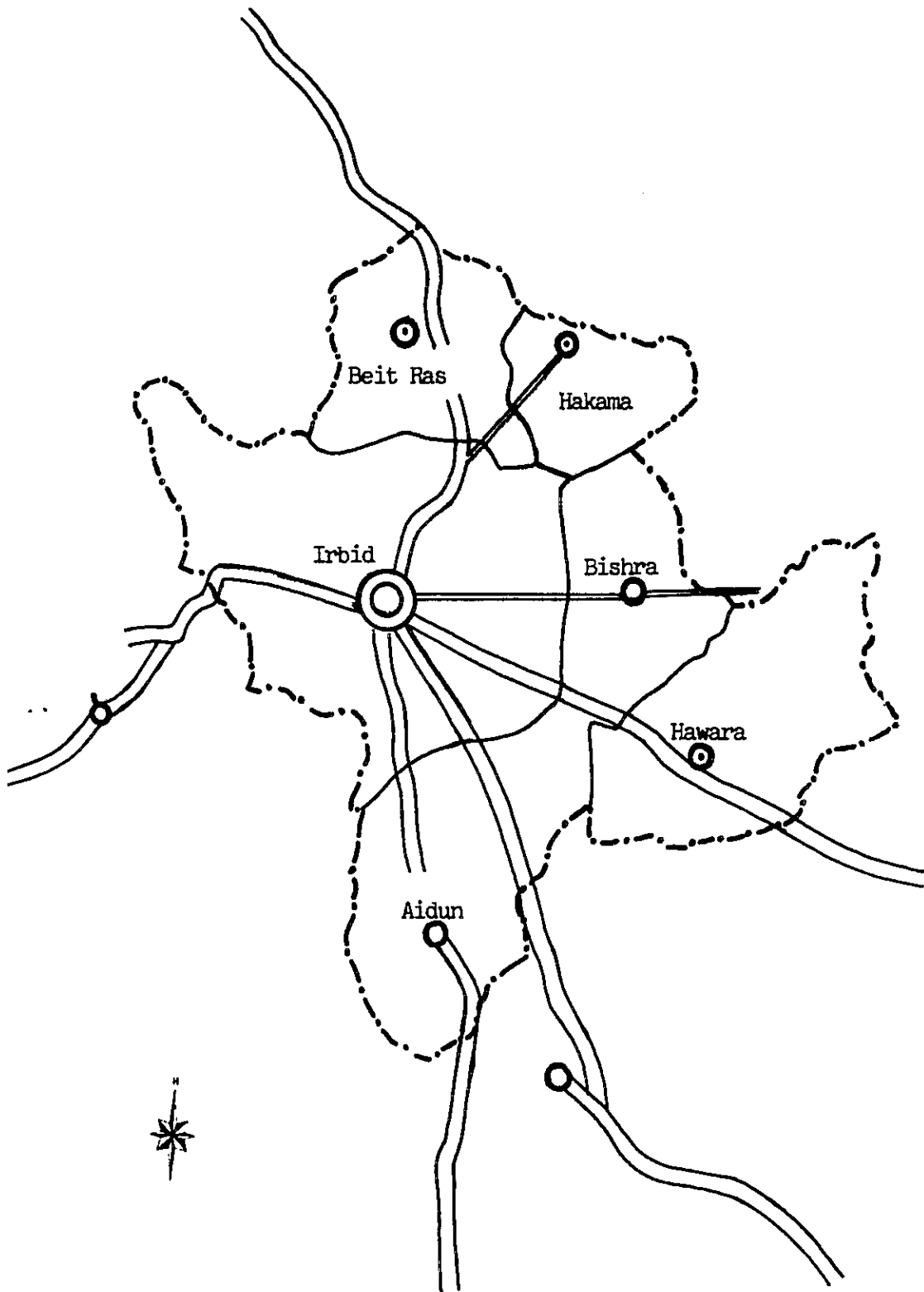
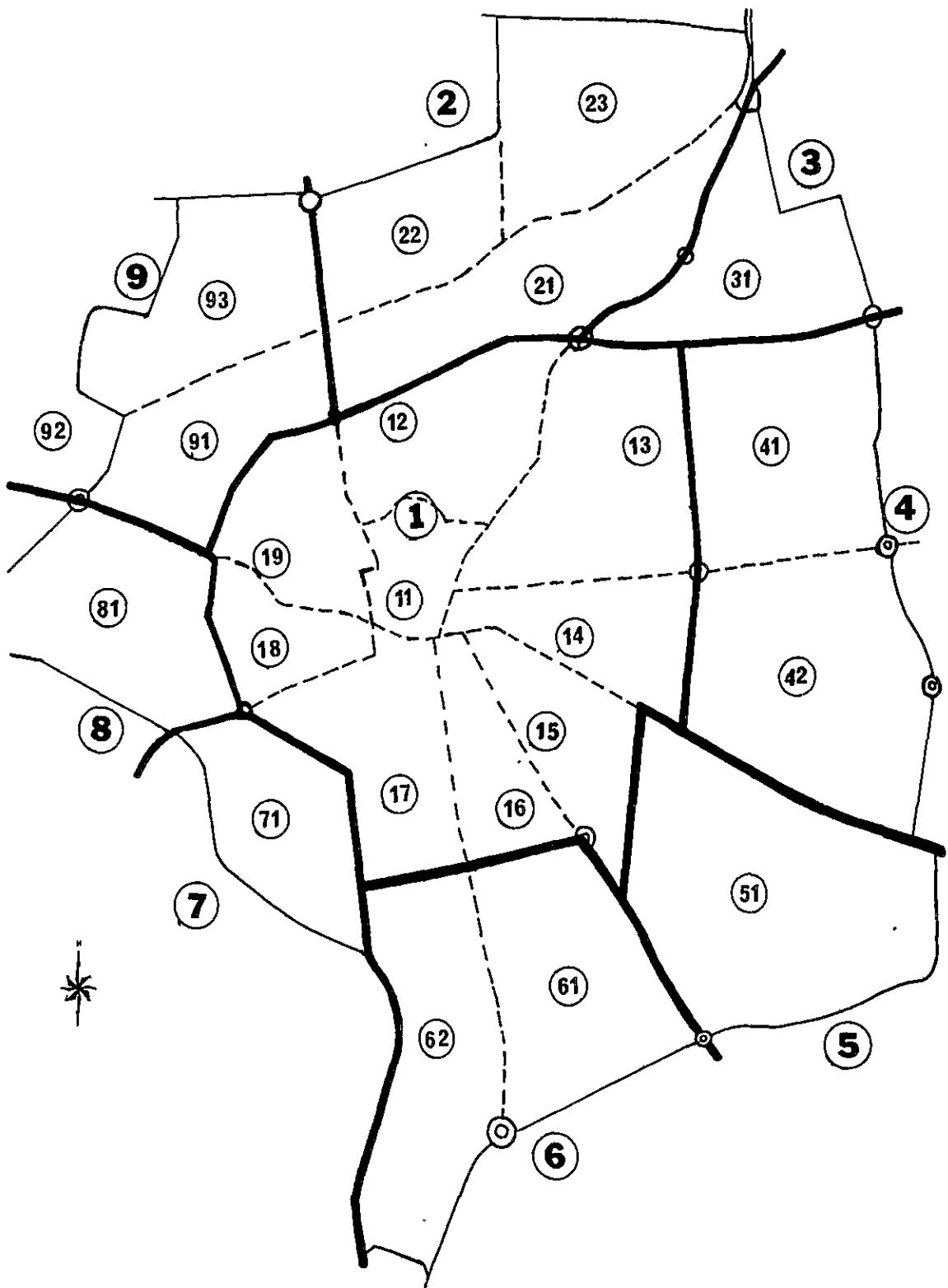


FIG. 15 IRBID CITY ZONING MAP



### 1.3 Population and the Employed Population

#### (1) Population

The first population census was carried out in 1961 and the second one in 1979. The census results indicate that the population of the East Bank has increased from 900,000 in 1961 to 2,150,000 in 1979.

Approximately 470,000 refugees migrated to the East Bank from the West Bank in 1969 as a result of the 1967 war.

The population increase of Amman Governorate was the highest and next to it, that of Irbid Governorate. Most of the 1969 refugees went into the Amman Governorate.

The population of Irbid Expanded increased from 53,000 in 1961 to 133,000 in 1979. During the same period, the population of Irbid City increased from 45,000 in 1961 to 113,000 in 1979.

With reference to estimations of natural population growth rates (Table 3.1), the population of the East Bank in the past twenty years was estimated as shown in Table 1.7. The population of Irbid Governorate was also estimated assuming migration at the rate of -0.1%.

Table 1.2 Population of Each Governorate in the East Bank

Governorate	Population 1961 (person)	Population 1979 (person)	Average Annual Growth Rate (%)
Amman	443,618	1187,750	5.6
Irbid	273,976	611,658	4.6
Others (Subtotal)	193,182	352,865	3.4
[Balqa]	79,057	151,382	
Karak	67,211	126,082	
Ma'an	46,914	75,401	
East Bank	900,776	2152,273	5.0

Source : Statistical Yearbook 1979

Table 1.3 Population of Each District in Irbid Governorate

District	Population 1961 (person)	Population 1979 (person)	Average Annual Growth Rate (%)
Irbid	132,497	324,291	5.1
Others (Subtotal)	141,479	287,367	4.0
Jarash	23,377	66,835	
Mafraq	25,314	73,241	
Rumtha	19,175	47,980	
Ajlun	26,093	54,907	
Alghwar Shamalia	29,357	44,404	
Scattered Tent Dwellers	18,163	-	
Irbid Region	273,976	611,658	4.6

Source : Statistical Yearbook 1979

Table 1.4 Population of Each Sub-District in Irbid District

Sub-District	Population 1961 (person)	Population 1979 (person)	Average Annual Growth Rate (%)
Irbid	74,050	219,807	6.2
Others (Subtotal)	58,447	104,484	3.3
Altaybe	12,519	13,858	
Northern Mazar	7,040	20,851	
Alkoura	23,955	40,000	
Bani Kennanah	14,926	29,775	
Irbid District	132,497	324,291	5.1

Source : Statistical Year 1979  
Preliminary Results of Population Census 1979

Table 1.5 Population of City and Villages in Irbid Expanded

City and Villages	Population 1961 (person)	Population 1979 (person)	Average Annual Growth Rate (%)
Irbid City	44,685	112,969	5.3
Hawara	2,342	5,043	4.4
Aidun	1,700	4,697	5.8
Bishra	1,560	3,992	5.4
Beit Ras	1,280	4,630	7.4
Hakama	699	2,208	6.6
Irbid Expanded	52,266	133,539	5.3

Source : Population Census 1961  
Preliminary Result of Population Census 1979

Table 1.6 Population of the Major Cities in Jordan

City	Population 1961 (person)	Population 1979 (person)	Average Annual Growth Rate (%)
Amman	246,475	648,587	5.6
Zarqa	96,080	215,687	4.6
Irbid	44,685	112,969	5.3
Ruseifah	6,200	49,622	12.2
Baqa'a		45,291	
Salt	16,176	32,866	4.0
Madaba	11,224	28,509	5.3
Ramtha	10,791	27,292	5.3
Aqaba	8,835	26,986	6.4
Wadi Seer		24,497	

Source : Department of Statistics

Table 1.7 Population of the East Bank

Year	Yearbook <sup>1/</sup>		Adjusted Figures <sup>2/</sup>	
	Population (thousand persons)	Average Annual Growth Rate (%)	Population (thousand persons)	Average Annual Growth Rate (%)
1961	901	3.3	901	3.1
1962	932		929	
1963	962		958	
1964	992		987	
1965	1024	3.2	1018	3.2
1966	1066		1051	
1967	1094		1084	
1968	1126		1119	
1969	1600	4.3	1551	3.2
1970	1668		1601	
1971	1723		1653	
1972	1774	3.2	1708	3.3
1973	1831		1764	
1974	1890		1822	
1975	1952		1883	
1976	2018	4.4	1947	3.4
1977	2127		2013	
1978	2218		2081	
1979	2152		2152	
1980			2225	3.4
1981			2301	

Notes: <sup>1/</sup> Source Statistical year book 1979  
<sup>2/</sup> Adjusted figures by study team

Table 1.8 Population of Irbid Governorate

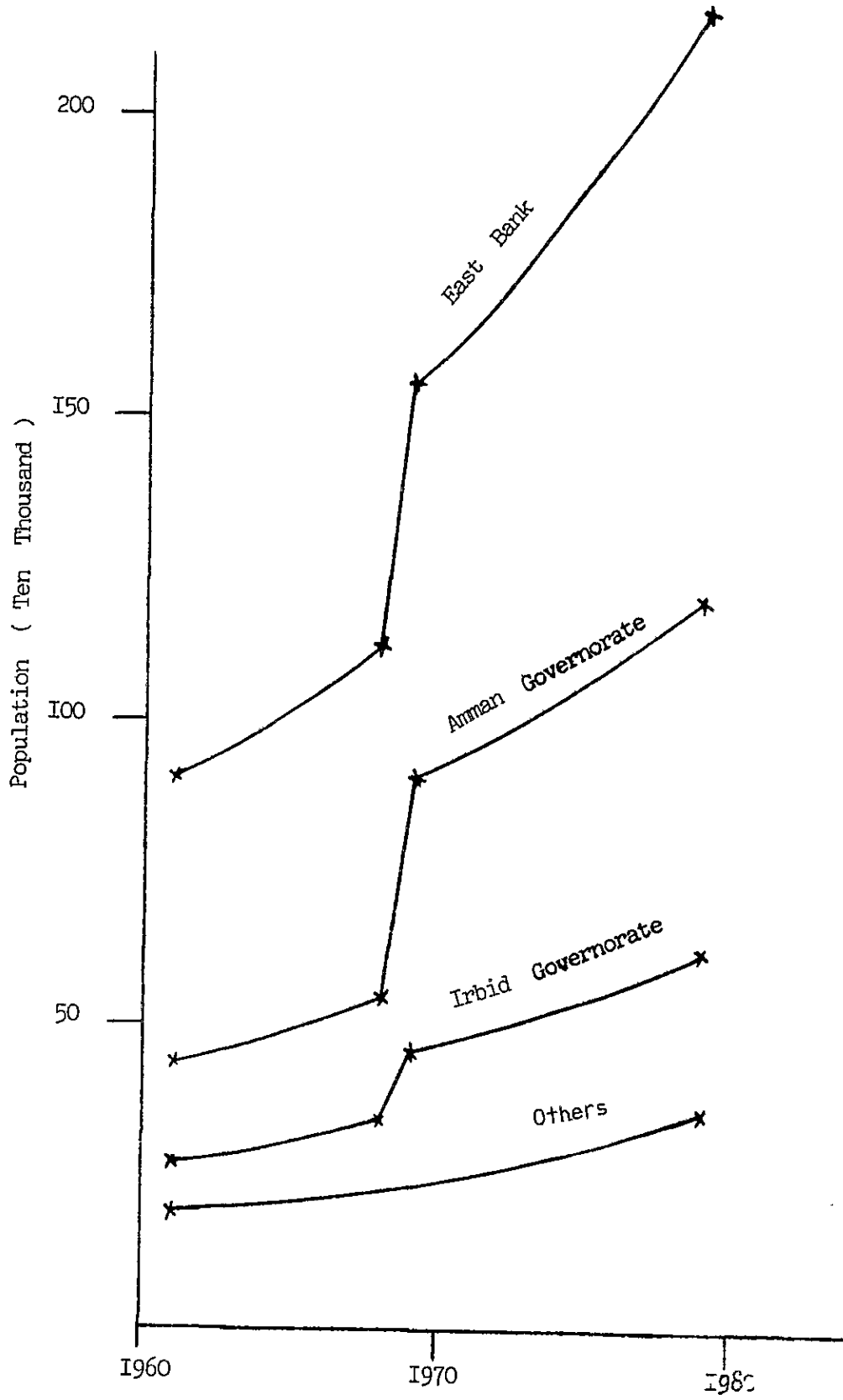
Year	Yearbook <sup>1/</sup>		Adjusted Figures <sup>2/</sup>	
	Population (thousand persons)	Annual Growth Rate (%)	Population (thousand persons)	Annual Growth Rate (%)
1961	274	3.2	274	3.1 - 0.1 <sup>3/</sup> = 3.0
1962	272		282	
1963	284		291	
1964	297	3.3	299	3.2 - 0.1 = 3.1
1965	311		308	
1966	326		318	
1967	334	4.2	328	3.1
1968	343		338	
1969	457		445	
1970	476	3.4	459	3.3 - 0.1 = 3.2
1971	491		474	
1972	506		489	
1973	522	3.2	504	3.4 - 0.1 = 3.3
1974	539		521	
1975	564		537	
1976	582	3.2	555	3.4 - 0.1 = 3.3
1977	600		573	
1978	619		592	
1979	612	3.3	612	3.3
1980			632	
1981			653	

Notes: <sup>1</sup> Assuming migration is - 0.1%

<sup>2</sup> Source: Statistical yearbook 1979

<sup>3</sup> Adjusted figures by study team

FIG. 1.6 POPULATION OF EAST BANK AND EACH GOVERNORATE





(2) Employed Population

Table 1.9 shows the labour force by Sector. Approximately 19% of the population in the East Bank and Irbid Governorate are employed.

According to other data, Table 1.10 shows the labour force in Irbid Governorate by sector.

There is no precise data concerning the labour force in Irbid Expanded or Irbid City.

The unemployment ratio was 2.15% in the East Bank and 1.74% in Irbid Governorate in the year 1974, according to the Multi-Purpose Household Sample Survey of 1975.

(3) Number of Pupiles

School enrollment ratio in the East Bank is approximately 88% in primary and middle schools, 57% in high schools and 12% in the universities.

The educational level is comparatively high, so the East Bank has suitable conditions to supply the labour force for industrialization.

Table 1.9 Distribution of the Labour Force in the East Bank and Irbid Governorate by Sector, 1975

(Unit : 1.000 persons)

	Population	Employment	Employment by Sector		
			Primary	Secondary	Tertiary
East Bank	1,952 (100)	374(100) (19.2)	125(33.4)	33(8.8)	216(57.8)
Irbid Gov.	564 (100)	107(100) (18.9)	68(63.6)	3(2.8)	36(33.6)

Sources : Labour Force Census, 1975

Notes : ( ) Percent

In this classification, Tertiary includes public administration, community services, armed forces, public security and civil defence.

Table 1.10 Employment in Irbid Governorate by Industrial Sector, 1975

	Industry	Male	Female	Total	%
I	Agriculture	43,812	24,630	68,442	77.0
II	Mining and Manufacturing	1,015	262	1,277	2.9
	Construction	1,285	1	1,286	
III	Transportation	2,352	16	2,368	20.1
	Commerce	4,477	18	4,495	
	Public Utilities	298	0	298	
	Bank and Insurance	210	15	225	
	Community Services & General Administration	7,505	2,950	10,455	
	Total Employment	60,954	27,892	88,846	

Source : Human Resources Committee for the Irbid Region Planning Study of the Government of Jordan

Table 1.11 School Enrollment Ratio (%) 1974

Age	East Bank	Irbid Governorate
6 - 9	83.9	83.9
10 - 14	92.3	90.3
15 - 19	57.2	51.3
20 - 24	12.3	10.1
Total (6-24)	70.8	68.4

Source : Multi-purpose Household Sample Survey 1974

## 1.4 Economic Activities

After the 1967 war between Jordan and Israel, the GDP per capita and per capita disposable income declined; however, since 1975 these figures again have been increasing.

The Jordanian Government did not officially publish data showing the economic level by governorate.

Accordingly, the Japanese Regional Planning Team made Table 1.13 to show the difference in economic levels between governorates.

The ratios of contribution to the GDP is 64% in Amman, 21% in Irbid and 15% for the remaining governorates.

Concerning the income per family, Amman Governorate has the largest, Irbid Governorate the second largest and the remaining governorates thereafter with the lowest income levels. The income per family in Irbid Governorate and the remaining governorates is below the national average and that is why the migration of those governorates is minus.

Table 1.14 shows the trend in share of GDP for each industrial sector. While the share of Sector I is almost constant, the share of Sector II is gradually increasing.

The share of GDP for each industrial sector by governorate is shown in Table 1.15.

In Irbid Governorate, the share of Sector I is 19.7%, Sector II's share is 10.0% and Sector III's share is 70.3%.

The share of Irbid Governorate relative to the national total for Sector I is 43.6%. Irbid Governorate is the main production area for industrial Sector I.

The share of Amman Governorate relative to the national total for Sector II is 71.1%, and therefore it is clear that this industry is concentrated in Amman Governorate.

Table 1.12 GDP and Disposable Income Per Capita (East Bank)

GDP at Factor Cost Current Price (Mil.JD)	National Disposable Income Current Price (Mil.JD)	Cost of Living Index	GDP at 1975 Constant Price (Mil.JD)	National Disposable Income at 1975 Constant Price (Mil.JD)	Population (Thousand Persons)	GDP per capita at 1975 Constant Price (JD)	Per Capita Disposable Income Constant Price (JD)
1967 115.6	190.1	52.1	221.9	364.9	1084	204.7	337
1968 138.2	213.3	51.9	266.3	411.0	1119	238.0	367
1969 162.5	237.1	56.0	290.2	423.4	1551	187.1	273
1970 154.7	220.0 <sup>1/</sup>	59.8	258.7	367.9	1601	161.6	230
1971 166.0	228.1	62.4	266.0	365.5	1653	160.9	221
1972 182.8	281.2	67.3	271.6	417.8	1708	159.0	245
1973 188.9	297.8	74.4	253.9	400.3	1764	143.9	227
1974 242.4	357.5	89.3	271.4	400.3	1822	149.0	220
1975 269.4	473.3	100	269.4	473.3	1883	143.1	251
1976 358.5	659.0	111.5	321.5	591.0	1947	165.1	304
1977 403.3	778.3	127.7	315.8	609.5	2013	156.9	303
1978 480.6	846.3	136.6	351.8	619.5	2081	169.1	298
1979 542.0		156.0	347.4		2152	161.4	
1980		173.3					
1981 Feb.		192.5					

Notes: <sup>1/</sup> Data in Amman

Source: The cost of Living Index, Feb. 1981

FIG. 1.7 GDP AND DISPOSABLE INCOME PER CAPITA

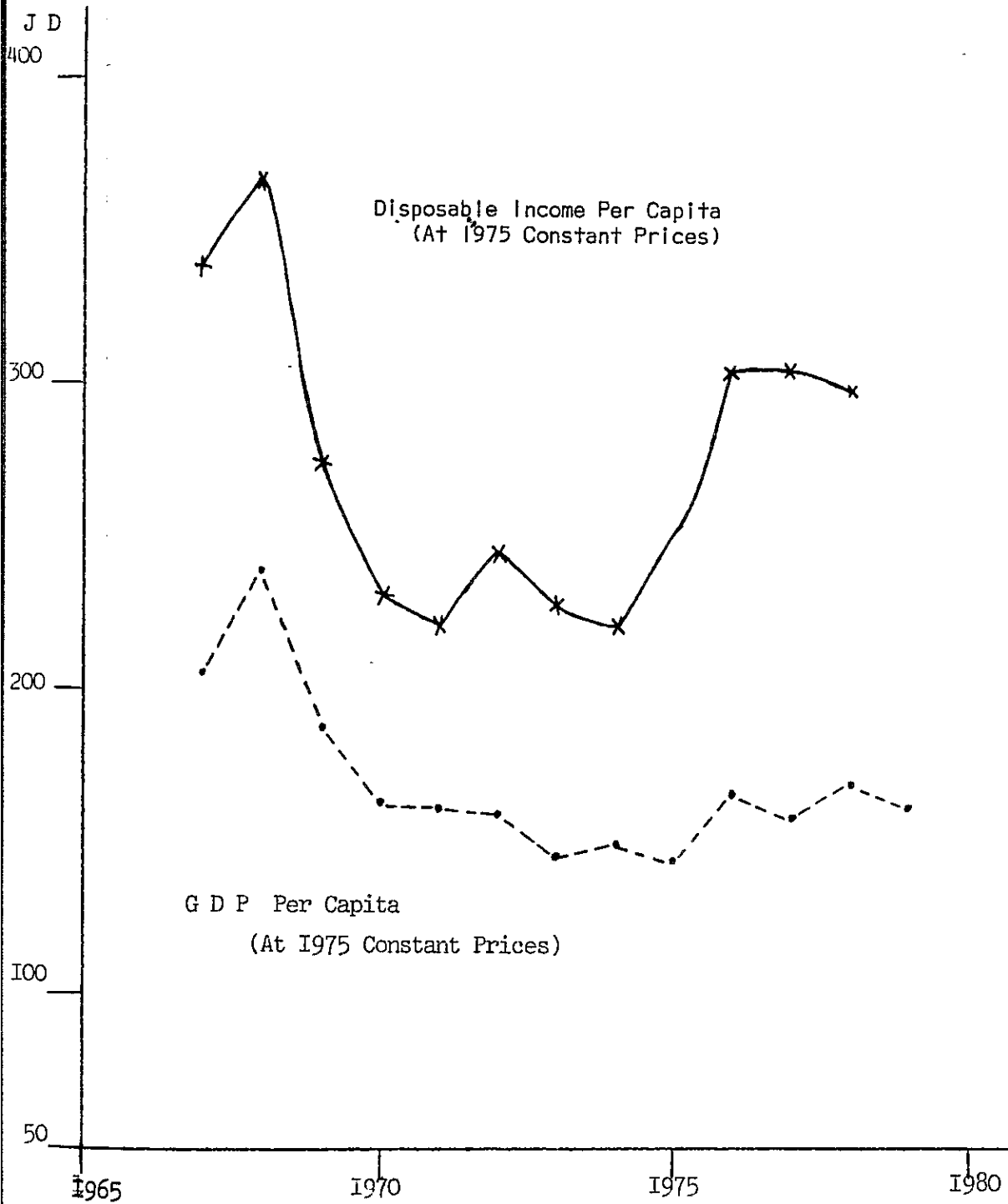


Table 1.13 GRDP and Household Income by Governorate,  
East Bank, 1977

Indicator (Unit)	Governorate					
	East Bank	Irbid	Amman	Balqa	Karak	Ma'an
GRDP at Market Price (1977) <u>1/</u> (JD mio) (%)	471 100	99 21	299 64	24 6	31 7	12 2
Population (1977) <u>2/</u> (1.000P.)	2.127	600	1,219	138	114	56
Per Capita GRDP at M.P. (1977) (JD) (%)	221 100	165 75	245 111	174 79	272 123	214 97
Total Family Income (1973) <u>3/</u> (JD mio)	194	49	125	9	6	5
No. of Household (1973) <u>4/</u> (1.000HH)	292.6	84.5	163.1	19.2	15.5	10.3
HH Income (1973) (JD) (%)	663 100.0	580 87.5	766 115.5	469 70.7	387 58.4	485 73.2

Notes : 1/ Source : Study Team's estimation

2/ Source : Unpublished memo from the Department of Statistics

3/ This includes income in kind.

Source : Estimated by the Study Team based on Economics Department RSS, Income Distribution Study 1973, unpublished memo

4/ Source : Estimated by the Study Team assuming the same family size for all governorates, the size of which is assumed to be 6.33 persons per household

Source: Integrated Regional Development Study of Northern Jordan. Final Report, Volume 2

Table 1.14 Share of GDP by Industry

(%)

	Sector I	Sector II	Sector III
1973	9.3	19.3	71.4
1974	12.5	23.6	63.9
1975	9.7	23.3	67.0
1976	10.8	23.6	65.4
1977	10.5	24.5	65.0
1978	10.8	25.3	63.9

Source : Fifteenth Annual Report 1978

Central Bank of Jordan

Table 1.15 Distribution of GDP at Factor Cost by Governorate 1977

(Unit : JD.000 at current price)

	East Bank	Irbid	Amman	Balqa	Karak	Ma'an
Primary	41.700	18.200	9.200	8.500	5.200	600
Industry	100%	43.6%	22.1%	20.4%	12.5%	1.4%
Secondary	10.5%	19.7%	3.9%	30.6%	18.1%	3.3%
Industry	97.000	9.200	69.000	6.200	10.600	2.000
Industry	100%	9.5%	71.1%	6.4%	10.9%	2.1%
Tertiary	24.5%	10.0	29.3%	22.3%	36.8%	17.7%
Industry	257.200	64.800	157.600	13.100	13.000	8.700
Industry	100%	25.2%	61.3%	5.1%	5.1%	3.4%
Industry	65.0%	70.3%	66.8%	47.1%	45.1%	77.0%
TOTAL	395.900	92.200	235.800	27.800	28.800	11.300
	100%	23.3%	59.6%	7.0%	7.3%	2.9%
	100%	100%	100%	100%	100%	100%

- Notes :
1. Primary Industry Agriculture, Forestry & Fishery
  2. Secondary Industry-Mining Manufacturing & Construction
  3. Tertiary Industry -Electricity, Water Supply, Transport, Wholesale, Retail Trade, Banking & Finance, Ownership of Dwellings, Public Administration & Defence & Civil Service

Source : Integrated Regional Development Study of Northern Jordan, Final Report, Volume 4



## 1.5 Existing Situation of Car Ownership

The rate of car ownership (number of cars per thousand persons) in the East Bank has been steadily increasing since 1970.

The average annual growth rate for car ownership during 1970 - 1975 was 12.9% and during 1975 - 1980, 19.4%.

The number of trucks has also been conspicuously increasing since 1975. This means that the economy for Sectors I and II is active.

The rate of car ownership in various countries is shown in Fig. 1.8. It is also clear from the figure that recent increase of car ownership in Jordan is remarkable.

Table 1.19 shows car ownership by governorate. The number of cars per 1,000 persons in 1979 was as follows: 85 vehicles in Amman, 22 vehicles in Irbid and 5 vehicles in the remaining governorates. The difference in car ownership between governorates is remarkable.

In 1980, there were 16,600 cars in Irbid Governorate and 4,400 cars in Irbid City.

The relation between NDI per capita and rate of vehicle ownership in the East Bank is shown in Table 1.20. The rate of car ownership has steadily increased even when economic activities were slow.

The rate of car ownership by zone in Irbid City is shown in Fig. 1.10. In general the rate of the southeast side of the City is higher. It is clear that higher income class people live in southeast side of the City.

Table 1.16 Number of Vehicles in Use (East Bank)

	<sup>1/</sup> Passenger Vehicles Number	Average Annual Growth Rate (%)	Goods Vehicles Number	Average Annual Growth Rate (%)	<sup>2/</sup> Other Vehicles Number	Total Vehicles Number	(%)	Population (Thousand Persons)	Number of Vehicles per Thousand persons	(%)
1970	14495		5436		2039	21970		1601	13.7	
1971	15251		5763		2168	23182		1653	14.0	
1972	18764	18.5	5556	9.0	2378	26698	16.5	1708	15.6	12.9
1973	21845		5777		3192	30814		1764	17.5	
1974	26886		6470		3875	37131		1822	20.4	
1975	33856		8378		4999	47233		1883	25.1	
1976	42366		12493		5591	60455		1947	31.1	
1977	56767		16419		6307	79493		2013	39.5	
1978	70222	23.3	19133	28.7	7139	97402	23.4	2081	46.8	19.4
1979	83603		24484		8188	116275		2152	54.0	
1980	96521		29554		9242	135317		2225	60.8	

Source : Licencing Authority, Amman

Notes: <sup>1/</sup> Includes passenger cars, taxis and buses

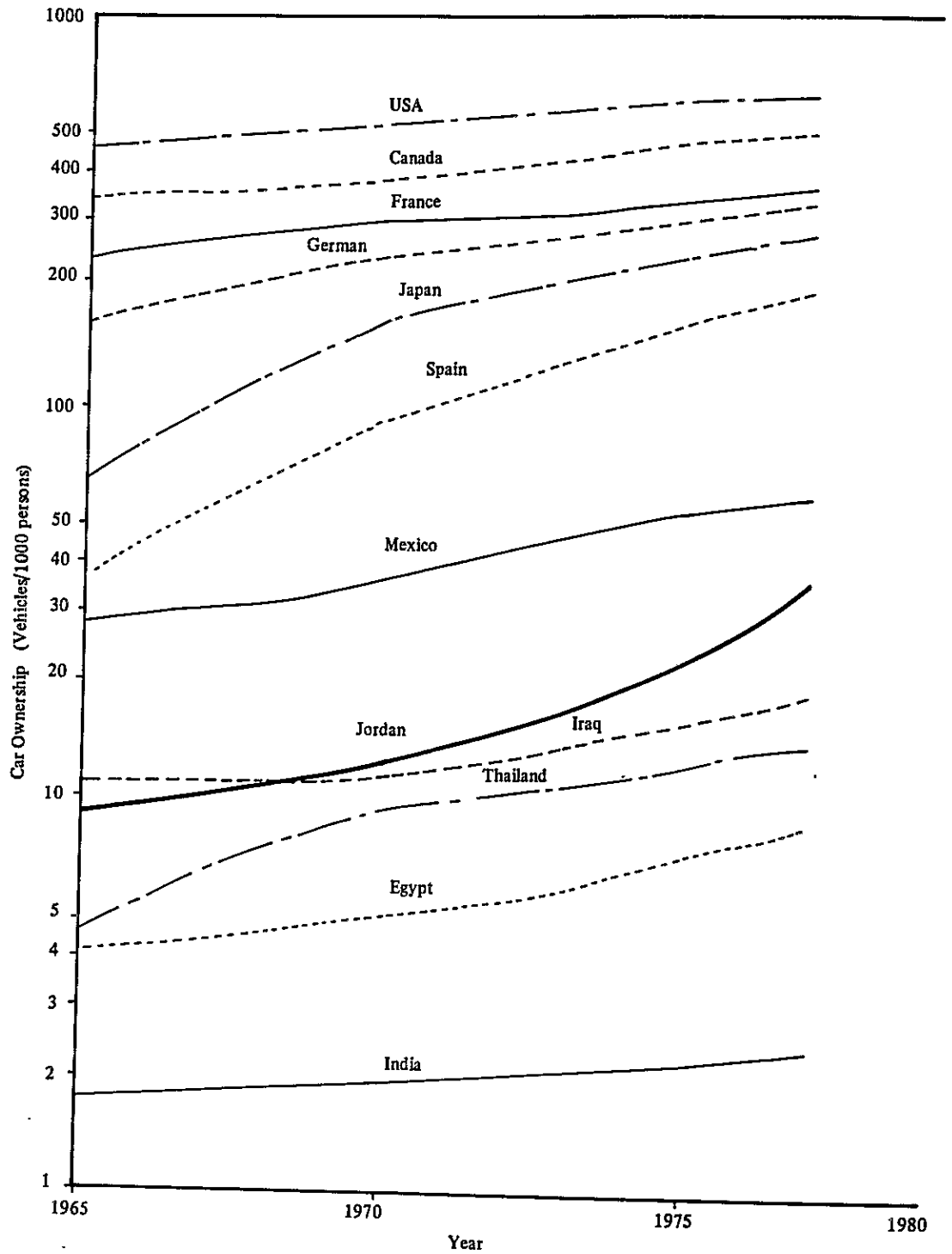
<sup>2/</sup> Includes tractors, motorcycles and construction vehicles

Table 1.17 Number of Vehicles in Use (Irbid Governorate)

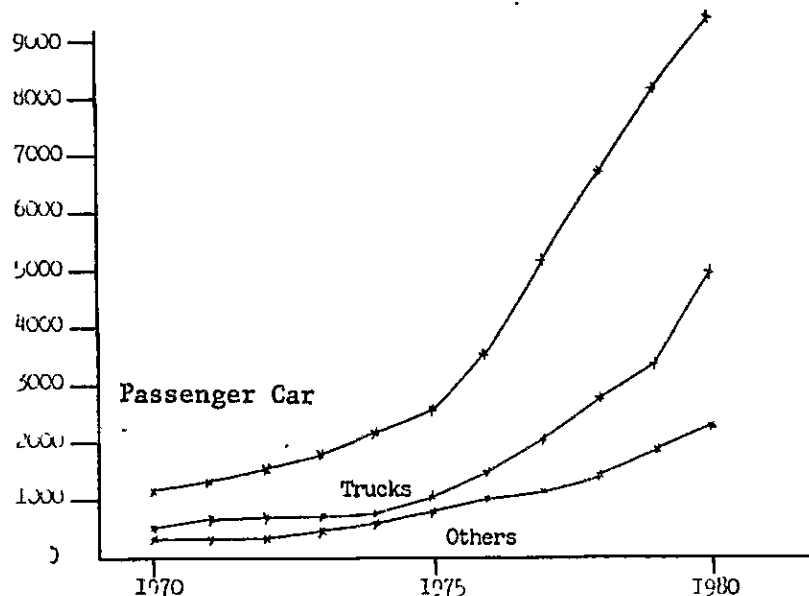
	Passenger Vehicles Number	Avg. Annual Growth Rate (%)	Goods Vehicles Number	(%)	Other Vehicles Number	(%)	Total Vehicle Number	(%)	Population	Number of Vehicles per thousand Population	(%)
1970	1165		574		381		2140		459	4.7	
1971	1316		716		387		2419		474	5.1	
1972	1540	17.3	710	12.7	351	15.6	2601	15.8	489	5.3	12.0
1973	1746		738		494		2978		504	5.9	
1974	2109		710		657		3476		521	6.7	
1975	2590		1081		788		4459		537	8.3	
1976	2713		1538		1025		5276		555	9.5	
1977	5231	29.4	2092	35.7	1150	23.2	8473	30.1	573	14.8	35.9
1978	6716		2792		1413		10921		592	18.4	
1979	8155		3391		1852		13398		612	21.9	
1980	9410		4967		2240		16617		632	26.3	

Source : Licencing Authority, Amman

**FIG. 1.8 RATE OF CAR OWNERSHIP IN VARIOUS COUNTRIES**



**FIG. 1.9 NUMBER OF VEHICLES IN USE IN IRBID GOVERNORATE**



**Table 1.18 Trend of Car Ownership by Governorate**

Year	Amman Governorate		Irbid Governorate		Remaining Governorates	
	No. of Vehicles	Annual Growth Rate (%)	No. of Vehicles	Annual Growth Rate (%)	No. of Vehicles	Annual Growth Rate (%)
1970	19965	16.5	2140	15.8	-	39.5
1971	21760		2419		-	
1972	23994		2601		-	
1973	27546		2978		-	
1974	33645		3476		-	
1975	42784	4459	-			
1976	54311	22.2	5276	30.1	51	
1977	70265		8473		755	
1978	85450		10921		1031	
1979	101118		13398		1761	
1980	116705		16617		1995	

Source : Licencing Authority, Amman

Table 1.19 Car Ownership of Each Governorate (1979)

Governorate	Number of Vehicles in Use	Population (thousand persons)	Number of Vehicles per thousand population
Amman	101118	1188	85.1
Irbid	13398	612	21.9
Others (Sub-total)	1761	353	5.0
Balqa	661	151	4.4
Karak	343	126	2.7
Ma'an	757	75	10.1
East Bank	116277	2152	54.0

Source : Licencing Atuthority, Amman

Table 1.20 NDI per Capita and Rate of Car Ownership (East Bank)

Year	1/ NDI per Capita (at 1975 Price)		2/ Number of Vehicles /1,000 persons
	JD	US\$	
1970	230	676	12.4
1971	221	650	12.7
1972	245	721	14.2
1973	227	668	15.7
1974	220	647	18.3
1975	251	738	22.4
1976	304	894	28.2
1977	303	891	36.4
1978	298	876	42.9
1979			50.2
1980			56.7

Notes: 1/ NDI = National Disposable Income

2/ Tractors, motorcycles and construction vehicles are not included.

1JD ÷ 2.94 US\$

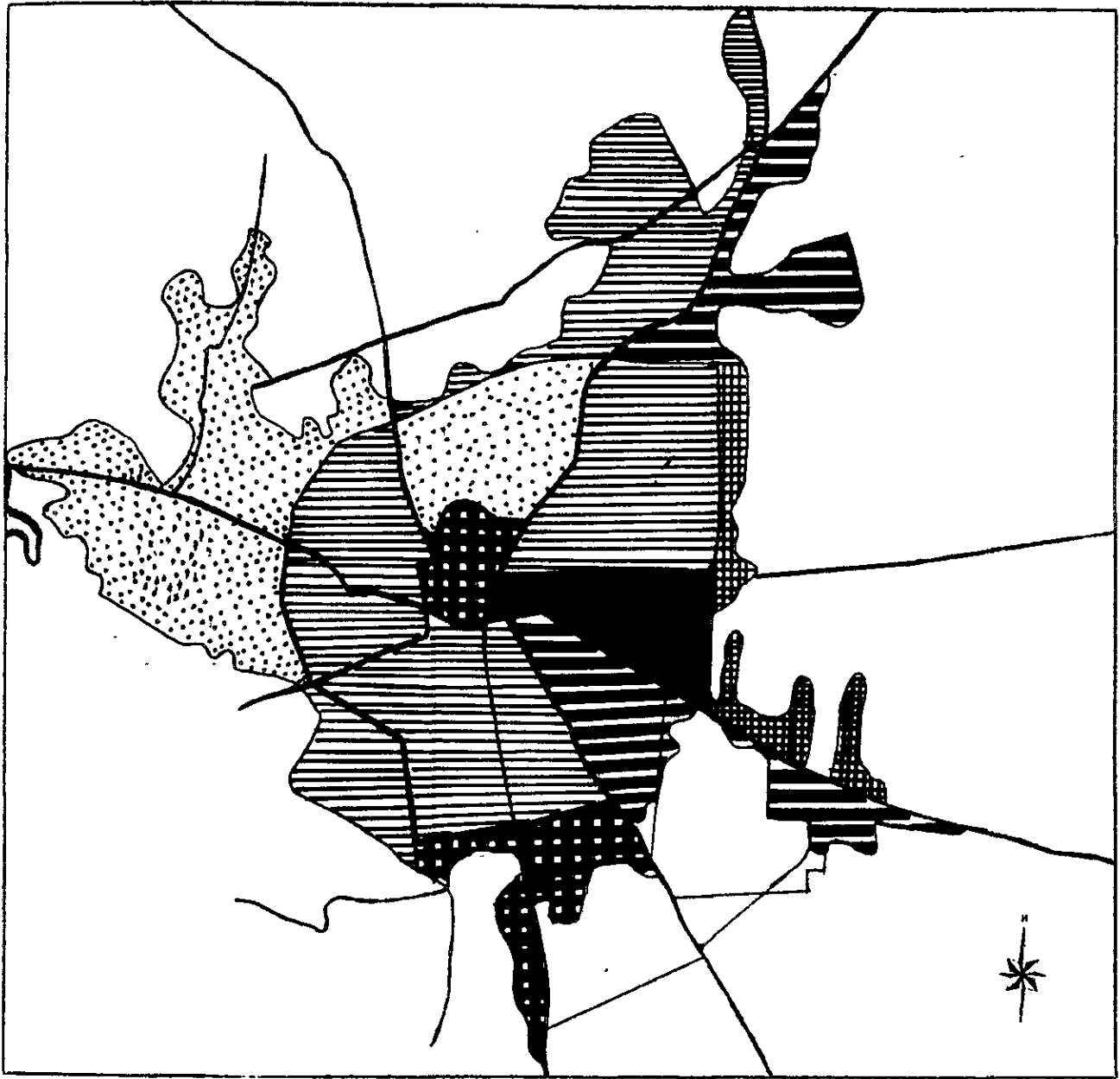
Table 1-21 Rate of Car Ownership By Zone  
(In Irbid City)

Zone (Unit)	Number of Cars (Cars)	Population in 1979 (Persons)	Number of Cars/thousand Persons
11	420	3,021	139.0
12	379	24,597	15.4
13	391	14,017	27.9
14	507	2,630	192.8
15	171	1,753	97.5
16	140	3,651	38.3
17	444	13,340	33.3
18	258	5,724	45.1
19	491	10,813	45.4
21,22,23	282	7,986	35.3
31	165	1,992	82.8
41,42	36	637	56.5
51	69	775	89.0
61,62	245	2,060	118.9
71	43	1,352	31.8
81	145	9,564	15.2
91,92,93	182	9,057	20.1
Irbid City	4,368	112,969	38.7

Source : Study Team



FIG. 1.10 PER CAPITA RATE OF CAR OWNERSHIP BY ZONE IN IRBID CITY



NUMBER OF CARS/ONE THOUSAND PERSONS



0 - 25



25 - 50



50 - 75



75 - 100



100 - 150



150 - 200

## 1.6 Existing Land Use Situation

According to aerial photographs taken in 1978, the recent urban area in Irbid Expanded is shown in Figure 1.11.

The urban area of Irbid City is 883 ha and that of its surrounding area is 271 ha.

Using the 1979 population census results, the population density of the urban area are obtained as follows: In Irbid City approximately 128 persons/ha, in the surrounding villages 76 persons/ha and that of the whole urban area in Irbid Expanded is approximately 116 persons/ha.

For reference, the population density of the urban area of Irbid City in 1967 was estimated to be 200 persons/ha.

Present land use in Irbid City is shown in Figure 1.12.

The commercial area is situated in the centre part and along the radial arterial road. High fashion shops are located mainly in Wassfi Eltell Street.

At the north-east border of the City, a development of the industrial area is planned. There is a sub-station on the south-east border of the City. Manual industry is scattered in the center area and along Hakama Street.

The hilly area in the city centre is the only open space in the urban area.

The remaining area is almost all residential area.

The population density in Irbid City by zones, based on the 1979 population census, is shown in Table 1.23. The density of the refugee area (unit 12) is the highest, 365 persons/ha. Generally speaking, density is not so high as that in Asia. From the density map of Figure 1.13, it is clear that the north west side of the City generally has a higher density than the south east side.

High class residential area spreads from the centre in a south-east-erly direction.

The location of primary schools are shown in Figure 1.14. The schools are not so regularly arranged, as one school per neighbourhood. Bus and taxi terminals and market centre (i.e. the traffic nodes) are shown in Figure 1.15.

Figure 1.16 shows the City planning map of Irbid City, in which the land use zoning regulations were decided; this data also appears in Table 1.24. It is pointed out that the minimum plot of land in residential areas is too large. These zoning regulations are going to be changed soon.

Public housing development has been carried out by the Housing Corporation. In the next Five Year Plan, commencing this year (1981 - 1985), it is planned to build a total of 3,500 housing units in Irbid Governorate (i.e., construction of 700 units every year, of which 400-500 units will be built in Irbid City). The site of this housing project is not yet decided. It is expected to be along the Outer Ring Road.

The housing development details prepared by the Housing Corporation for Irbid City and the surrounding areas is shown in Table 1.25.

The gross density of developed residential areas is about 130 persons/ha in the low-rise terraced houses and 250 persons/ha in the apartment blocks with three storeys.

The Japanese Regional Planning Team has calculated that the density of workers in the existing industrial area is approximately 150 workers/ha (1979).

Fig. 1.11 URBAN AREAS OF IRBID EXPANDED (IN 1978)

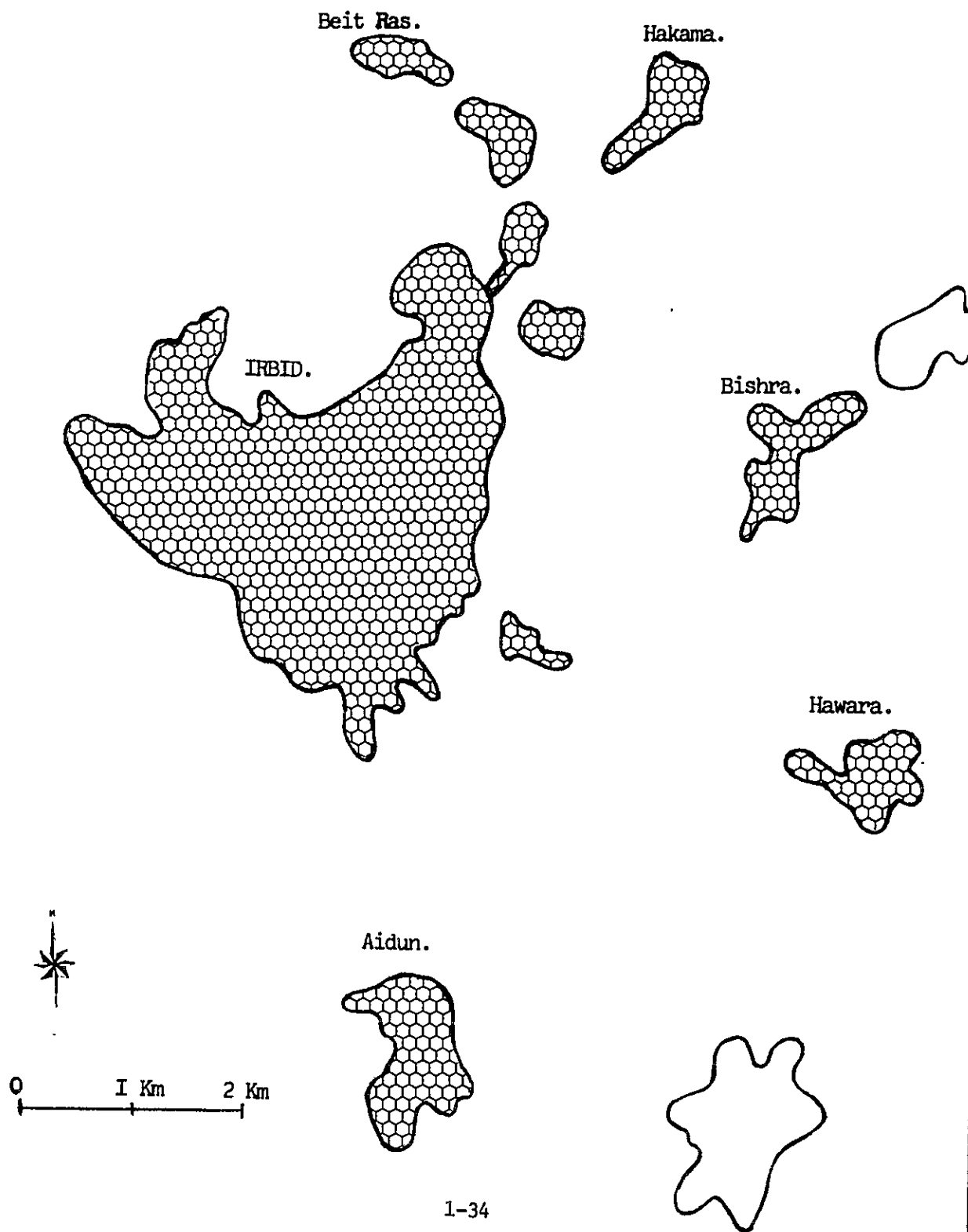
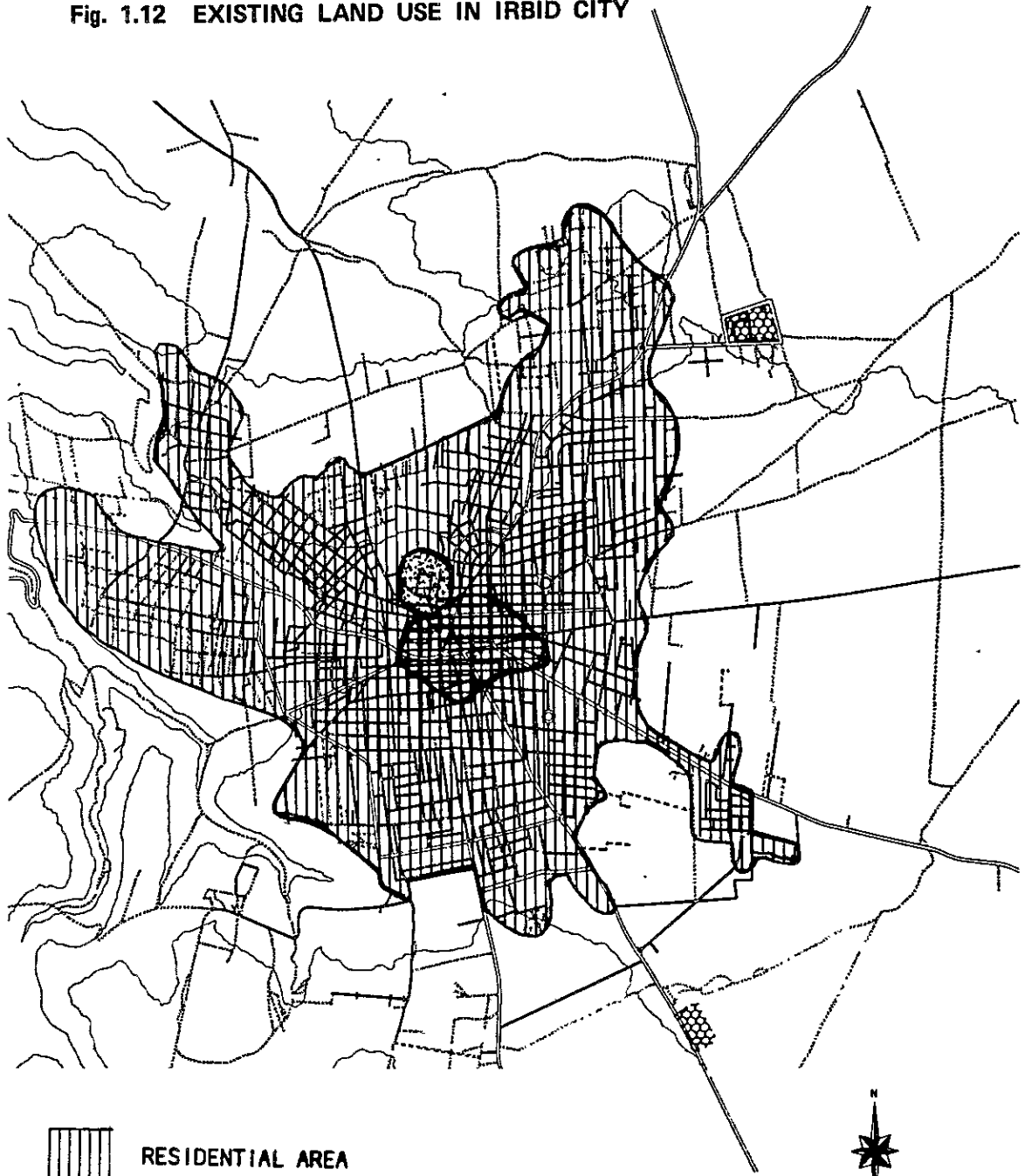


Table 1.22 Population Density of Urban Areas

(Irbid Expanded)

City Village	Urban Area in 1978 (ha)	Population in 1979 (persons)	Density (person/ha)
Irbid- Albarha	877.3	112,969	128.8
Other (Sub- total)	270.8	20,570	76.0
Beit Ras	48.5	4,630	95.5
Hakama	39.4	2,208	56.0
Bishra	56.3	3,992	70.9
Hawara	46.9	5,043	107.5
Aidun	79.7	4,697	58.9
Total Irbid Expanded	1148.1	133,539	116.3

**Fig. 1.12 EXISTING LAND USE IN IRBID CITY**







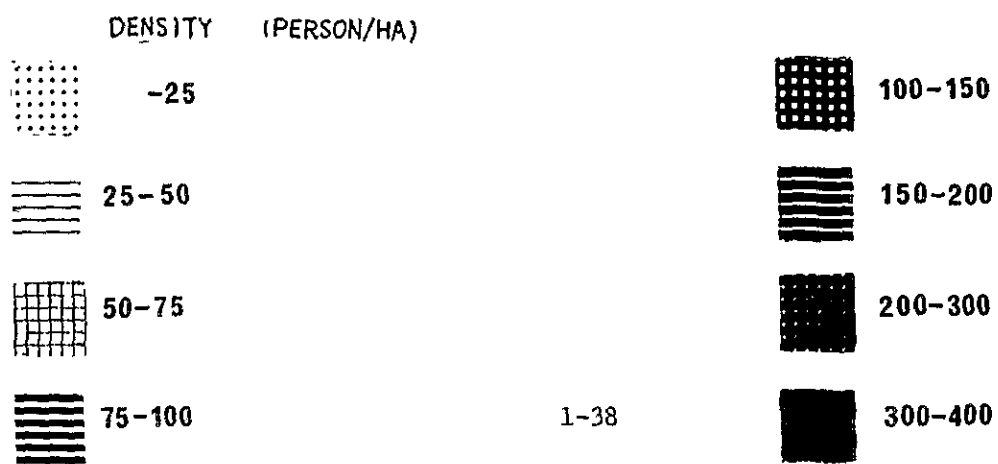
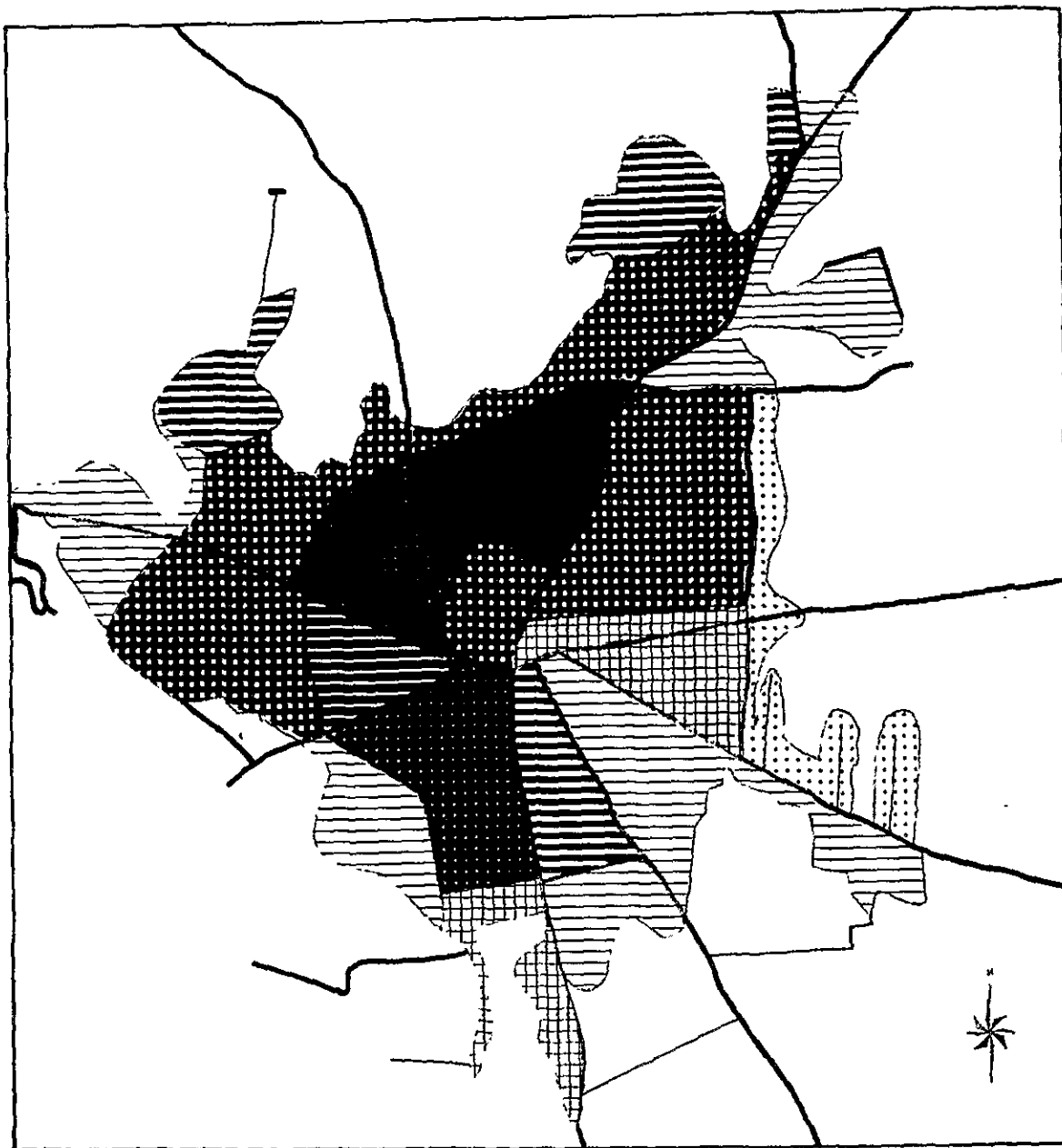
-  RESIDENTIAL AREA
-  COMMERCIAL AREA
-  INDUSTRIAL AREA
-  GREEN AREA

Table 1.23 Population Density of Urban Area  
(Irbid City)

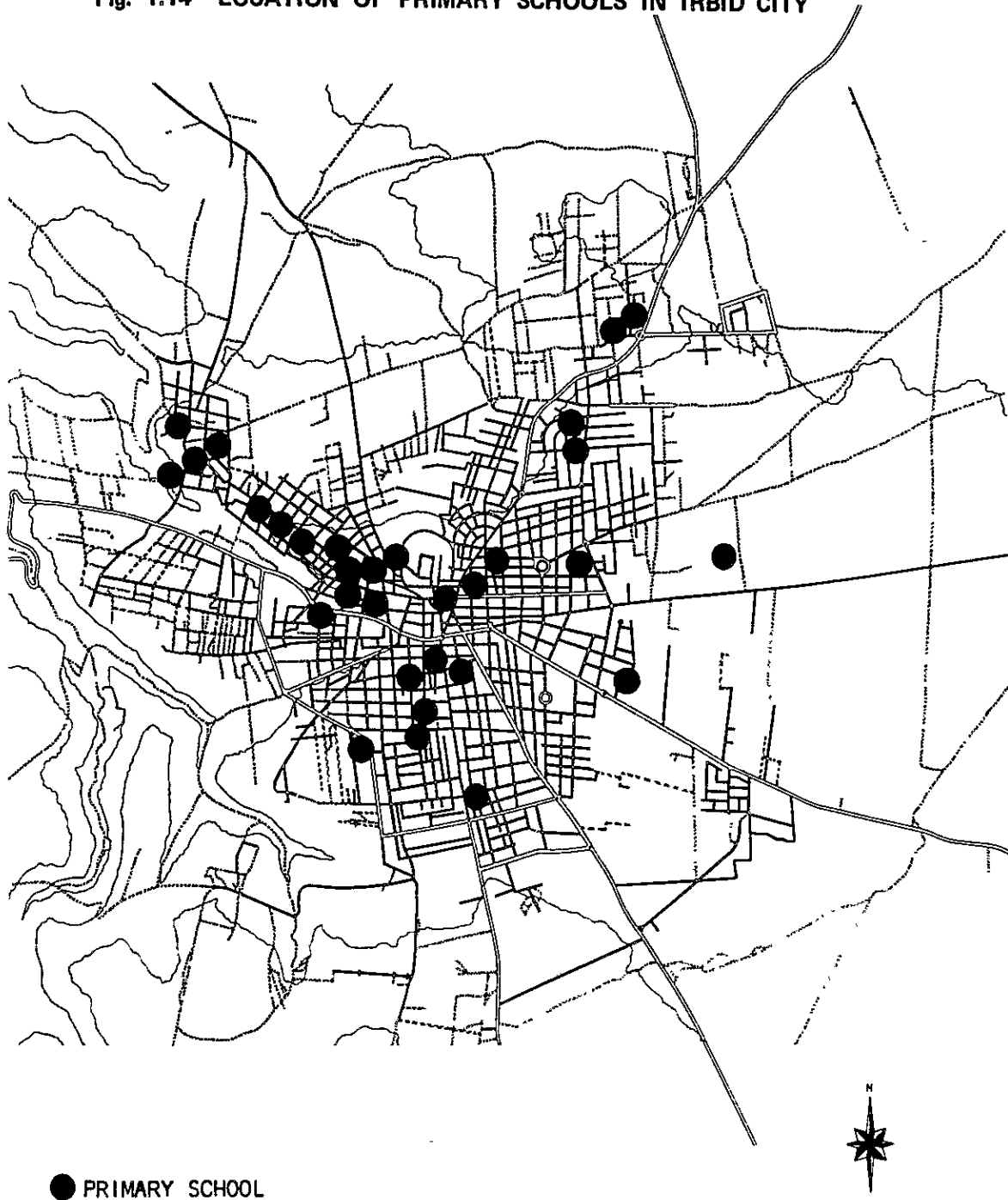
Zone (unit)	Urban Area in 1979 (ha)	Population (persons)	Density (persons/ha)
11	24.3	3,021	124.6
12	67.3	24,579	365.2
13	98.6	14,017	142.1
14	47.3	2,630	55.6
15	43.3	1,753	40.4
16	48.4	3,651	75.4
17	66.5	13,340	200.4
18	28.9	5,724	198.2
19	44.6	10,813	242.2
21	47.3	4,875	103.0
22	0.0	72	-
23	36.0	3,039	84.5
31	42.2	1,992	47.2
41	12.7	234	18.5
42	20.2	403	19.9
51	22.4	775	34.5
61	26.1	731	28.0
62	18.0	1,329	73.9
71	33.5	1,352	40.3
81	64.0	9,564	149.5
91	45.1	5,926	131.4
92	17.1	512	29.9
93	28.9	2,619	90.7
<b>Total Irbid City</b>	<b>882.7</b>	<b>112,969</b>	<b>128.0</b>

Fig. 1.13 POPULATION DESNSITY IN IRBID CITY.

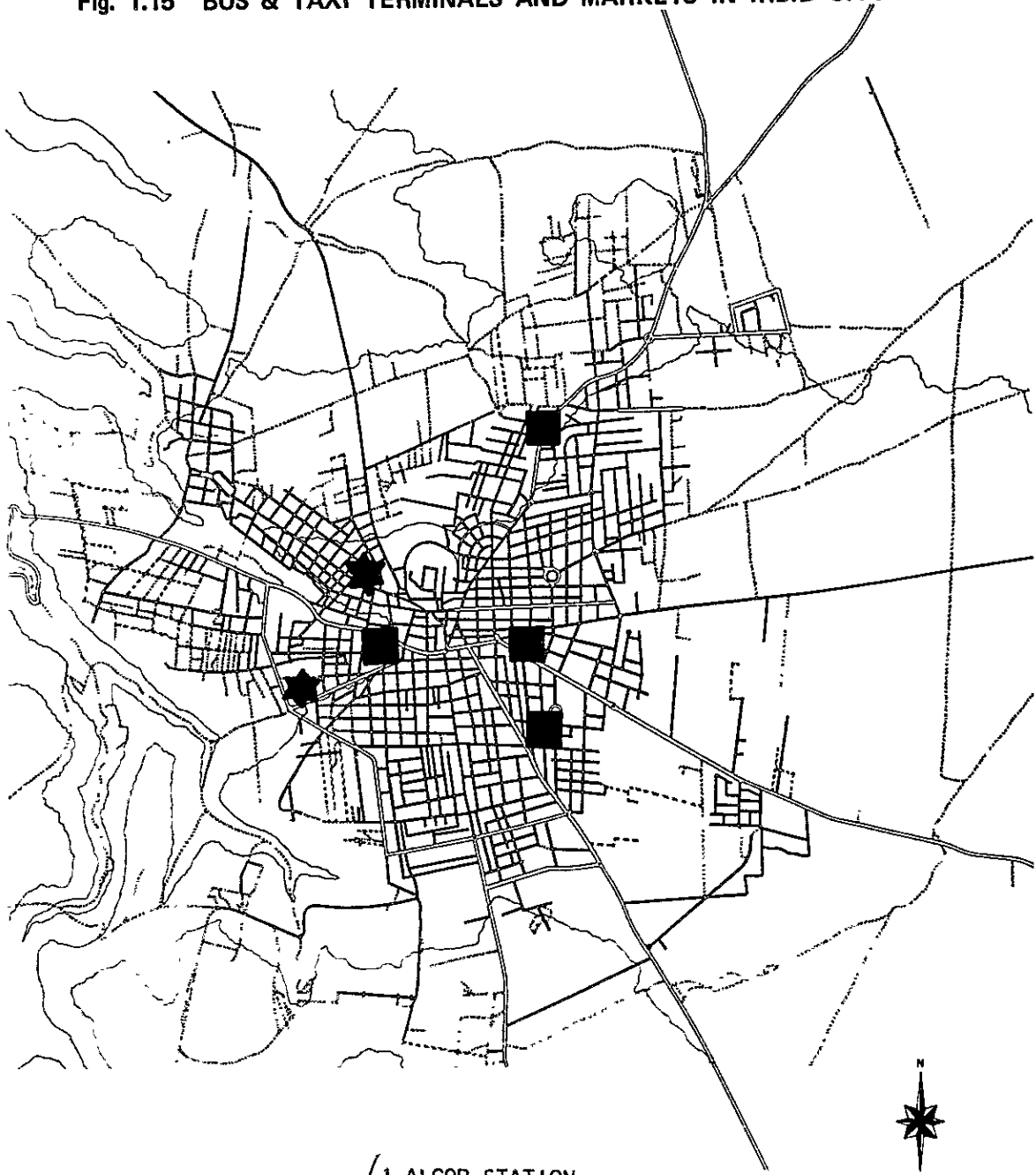




**Fig. 1.14 LOCATION OF PRIMARY SCHOOLS IN IRBID CITY**



**Fig. 1.15 BUS & TAXI TERMINALS AND MARKETS IN IRBID CITY**



- BUS & TAXI TERMINAL
  - 1. ALGOR STATION
  - 2. NORTH STATION
  - 3. BISHRA STATION
  - 4. AL SHEIKH KHALIL STATION
  
- ★ MARKET
  - a. CENTRAL MARKET
  - b. WESTERN MARKET

Fig. 1.16 URBAN PLANNING MAP OF IRBID CITY

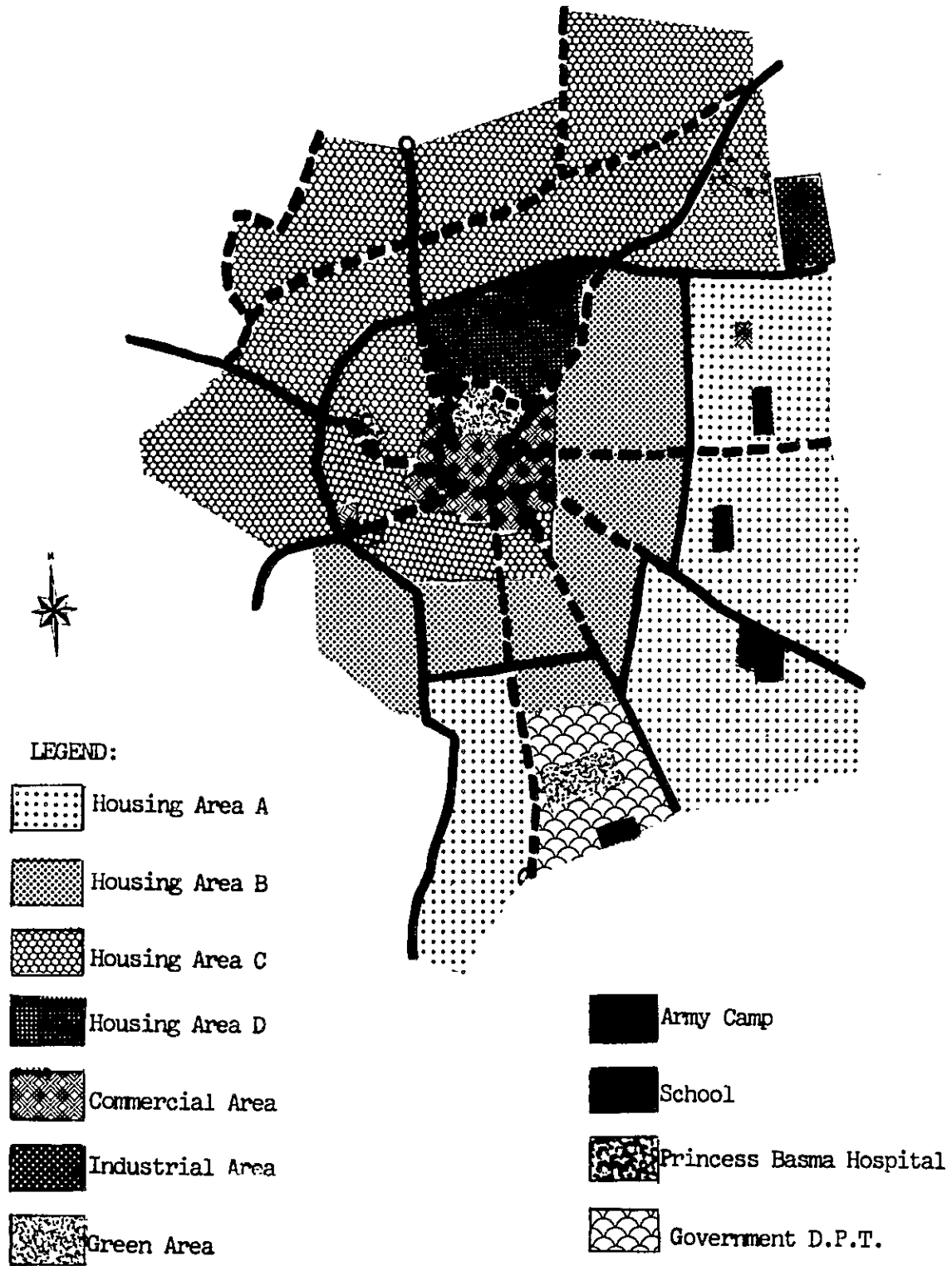


Table 1.24 Land Use Zoning Regulation in Irbid City

	Residential Area				Commercial Area $\perp$	Public Building	Light Industry Area	Service Industry Area
	A	B	C	D				
Minimum size of Land (m <sup>2</sup> )	1000	750	500	250	100	1000	1000	400
Minimum width of land (m)	25	20	15	15	10	25	25	18
Allowed coverage of building (%)	30	35	40	45	60	30	75	50
Maximum height of building (m)	8.5	8.5	8.5	8.5	13	18	19	16
Set Back Front	5	4	3	3	0	5	4	3
Side	4	3	2.5	2	0	6	4	3
Back	5	4	3	2.5	3	7	5	4

Notes:  $\perp$  In case of Linear Commercial Area : Depth from the street 12 m.

Table 1.25 Housing Project in Irbid City and Surrounding Area

Name of Project	Land Area (ha)	Number of Houses (unit)	Type & Size	Gross <sup>1/</sup> Density (person/ha)
Zabda Housing Project	9.5	392	3 stories A 121m <sup>2</sup> Flat B 108m <sup>2</sup> 3 Type C 121m <sup>2</sup>	247
Old Irbid Housing Project	2.5	98	3 stories A 73.5m <sup>2</sup> Flat B 54 m <sup>2</sup> 3 Type C 53 m <sup>2</sup>	294
Rumtha Housing Project	2.0	44	1 storey Terrace 90.3m <sup>2</sup> 1 Type	132
New Irbid Housing Project	3.1	126	3 stories Flat 121 m <sup>2</sup> 1 Type	244

Source: Housing Cooperation

Notes: <sup>1/</sup>assuming one family is composed of 6 members



## CHAPTER 2 PRESENT TRAFFIC CHARACTERISTICS OF IRBID

### 2.1 General

The traffic characteristics of IRBID have been analyzed based on the results of traffic surveys which were carried out by the study team.

The following traffic characteristics were studied:

	<u>Section</u>
Vehicle ownership	2.2
Vehicle Use by Owners in Irbid	2.3
Inter-Regional Traffic	2.4
Movement of Vehicles	2.5
Traffic Accident	2.6

Sections 2.2 and 2.3 were analyzed based on the results of Car-owner Interview Survey which was carried out on the car-owners in IRBID CITY. Section 2.4 was analyzed based on the results of the Cardon Line Survey. Section 2.5 was analyzed based on the Origin-Destination Table estimated from the combined results of above two traffic surveys.

The details of each survey are described in Technical Supporting Report (1).

#### 2.1.1 Traffic Survey

##### (1) The Purpose of the Traffic Survey

In order to analyze vehicle movements in Irbid, it was necessary to ascertain the origin and destination of each vehicle trip.

When detailed information about vehicle movements was obtained, the existing road network could be analyzed to meet the traffic demand. In the study area, that is the Irbid City area, such an origin-destination survey was never before carried out.

In Irbid, the most serious traffic problems involve the traffic flow and road network toward the city center since all the main roads form a radial pattern. Therefore, around the center of city, the intra-city traffic and inter-regional traffic mix and create congestion.

The Ring Road Project is affected by inner-city traffic problems and studies must be made which cover the close relation between

Ring Road and inner city traffic. The function of the Ring Road is affected by road network planning involving the center area in Irbid.

Roadside interview surveys cannot cover information regarding inner city traffic movement. To get information on traffic movements inside the City trip movements for car owners must be studied for a whole day.

Furthermore, in the near future, when the traffic study of inner city in Irbid is carried out, the results of car owner interview survey will be available for that study and the planning concerned.

These are the main reasons that the car owner interview survey was adopted as the most suitable method for this study.

## (2) Outline of Traffic Survey

The traffic survey consists of three survey parts:

- 1) Car Owner Interview Survey
- 2) Cordon Line Survey
- 3) Screen Line Survey

In regard to the purpose of this survey, traffic movements of inner city areas were investigated by 1) Car Owner Interview Survey. Entering/departing trips from Irbid City area were studied by 2) Cordon Line Survey. 3) Screen Line Survey aimed to examine the results of above two surveys.

The Car Owner Interview Survey was conducted to interview individual car owners. Interviewees, car owners, were selected from the registration list of car owners in the Irbid City area. This registration list was compiled from the original registration files of car owners in Irbid Region at the Lisence Authority in Irbid.

The Cordon Line Survey was conducted to interview drivers at the roadside. The vehicle which ran through the survey points were stopped by policemen and signalled to go to the roadside. Then, every driver was interviewed.

Screen Line Survey was conducted to count the traffic volume at a selected roadside in order to examine the estimated O D table.



### 2.1.2 Car Owner Interview Survey

The Car Owner Interview Survey aimed to determine the vehicle movement and the characteristics of the car owners. Therefore, interviewers recorded the whole day's movement (24 hours) of each sampled vehicle.

General flow-chart of Owner Interview Survey is shown in the Figure 2.1. Also, the schedule of the traffic survey which was carried out is shown in Figure 2.2.

#### (1) Number of Registered Cars in Irbid

The up-to-date number of registered cars in Irbid City Area had not been known before the sampling was done. There were statistics of registered cars only for the total Irbid Region.

Total number of registered cars was approximately 4,364 vehicles (excluding taxis and buses) in Irbid City.

Private passenger cars totalled 3,294 vehicles, which was 75.4% of the total registered vehicles.

Fig. 2.1 General Survey Flow-Chart

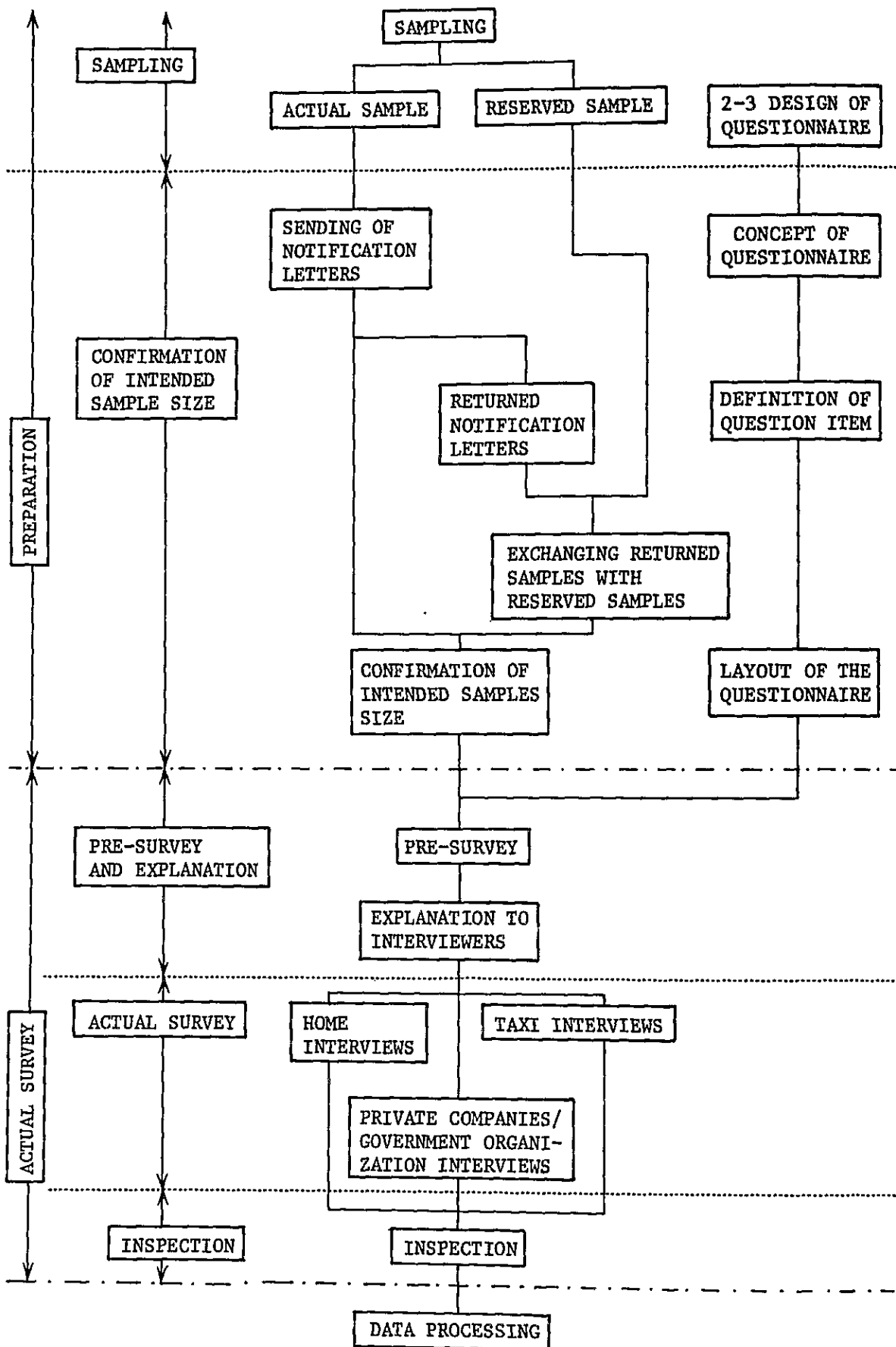


Fig. 2.2 Traffic Survey Schedule

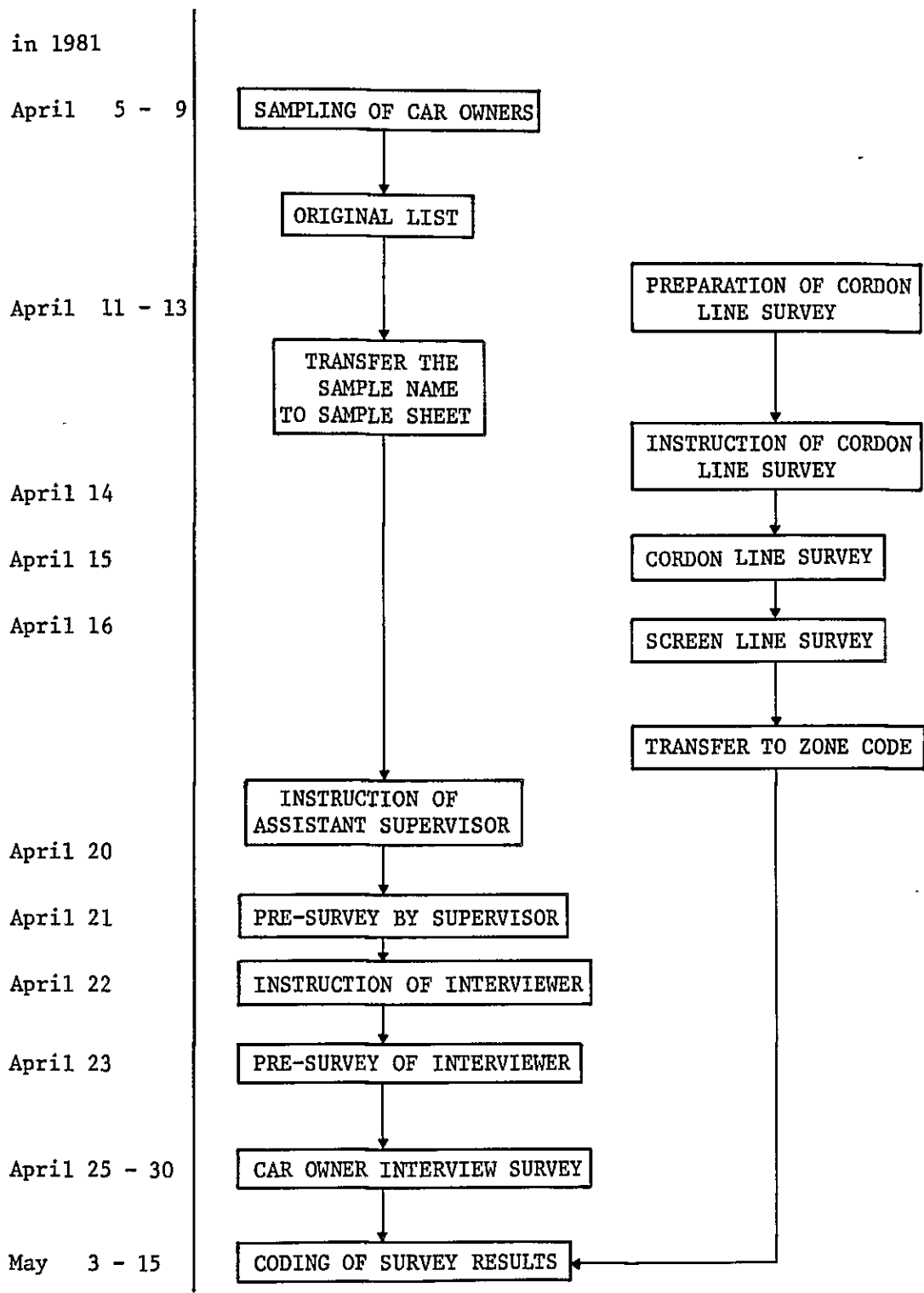


Table 2.1 The Number of Registered Vehicles

Zone	1 Private Cars	3 Van Pickup	4 Truck Trailer	7 Others	Total	(%)
1	349	42	27	2	420	9.6
2	213	114	38	14	379	8.7
3	307	53	26	5	391	9.0
4	432	53	18	4	507	11.6
5	142	15	11	3	171	4.1
6	110	18	12	-	140	2.9
7	339	67	25	13	444	10.3
8	191	40	19	8	258	5.9
9	377	61	41	12	491	11.1
<b>Sub-Total</b>	<b>2,460</b>	<b>463</b>	<b>217</b>	<b>61</b>	<b>3,201</b>	<b>73.2</b>
10	158	67	31	26	282	6.5
11	119	32	8	6	165	3.8
12	30	4	2	-	36	0.8
13	57	9	1	2	69	1.7
14	221	17	5	2	245	5.4
15	31	5	6	1	43	1.1
16	91	36	11	7	145	3.3
17	125	39	14	4	182	4.2
<b>Sub-Total</b>	<b>832</b>	<b>209</b>	<b>78</b>	<b>48</b>	<b>1,167</b>	<b>26.8</b>
<b>Total</b>	<b>3,292</b>	<b>672</b>	<b>295</b>	<b>109</b>	<b>4,364</b>	<b>100.0</b>

Source: Estimation by Study Team

(2) Sampling

The planned sampling rate was 30 percent of the total vehicle-owners in Irbid City. The final sampling rate was 29.7%.

Table 2.2 Sampling Results

Total Vehicle Owner	4,364
Sampled Owner	1,300
Total Reserve Samples	449
Reserve Samples Used	258

### 2.1.3 Cordon Line Survey

#### (1) Survey Procedure

This survey was one part of the traffic O-D survey. The objective of this survey was to obtain information on the traffic passing through the study area. With this data the volume and characteristics of the traffic were determined. In addition to this, the number of vehicles and the nature of trips made between the Study Area and the External Area were also determined.

#### (2) Survey Method

This survey consisted of two parts:

- a) Interviewing
- b) Traffic counting

Vehicles entering the Study Area were interviewed and vehicles passing the border of the Study Area were counted. These vehicles consisted of cars, vans, medium lorries, heavy lorries, taxis, buses, and others. The interviews were conducted from 7:00 a.m. to 7:00 p.m.

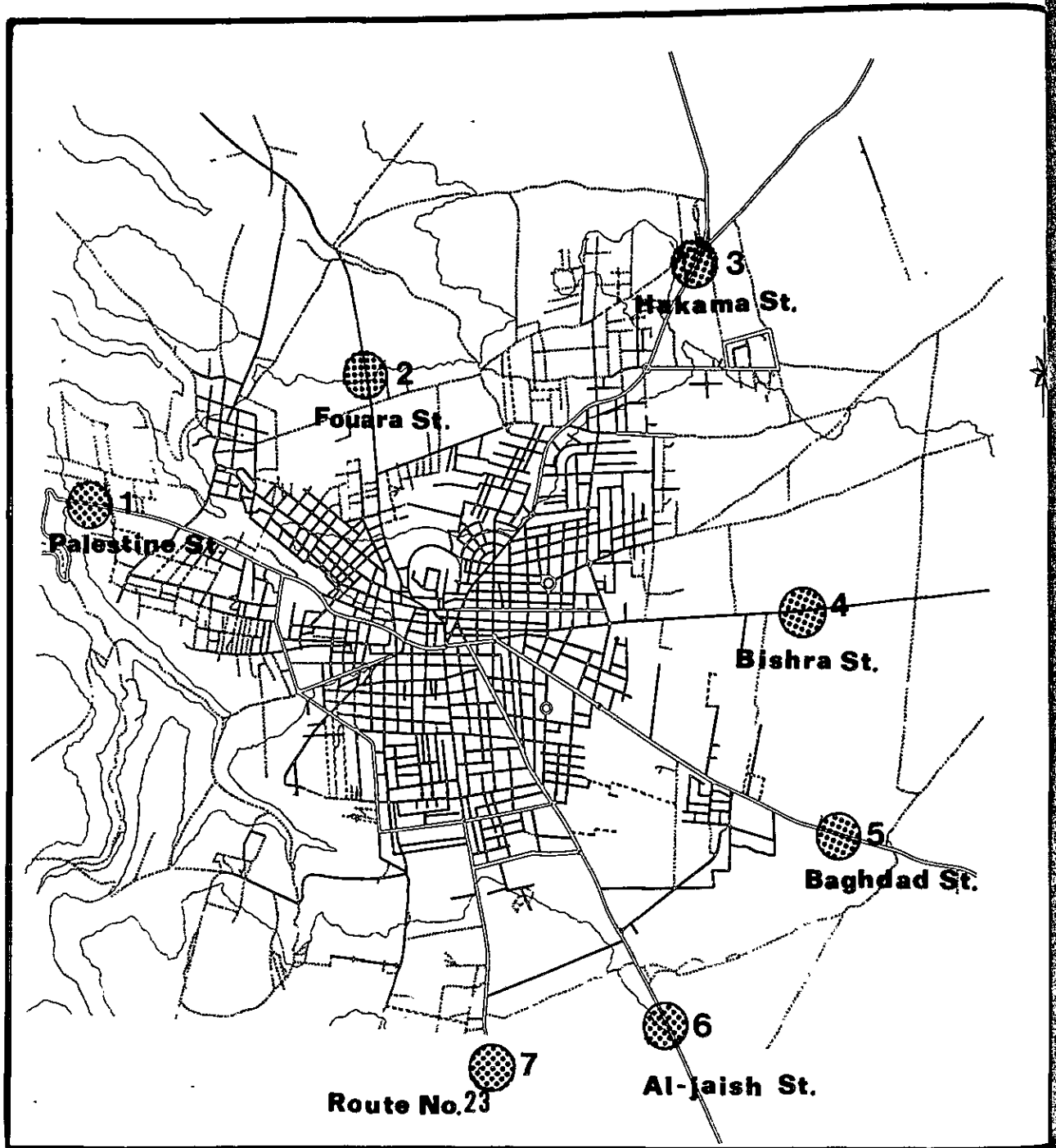
#### (3) Stations

The following stations were selected at the crossing points of the border and the trunk roads. These 7 stations are shown in Table 2.3 and Figure 2.3.

Table 2.3 Survey Station

Station No.	Station Name	Interviewers
1	Palestine St.	26 persons
2	Fouara St.	5
3	Hakama St.	26
4	Bishra St.	5
5	Baghdad St.	28
6	Al Jarash St.	28
7	Ajuln St.	22

Fig. 2.3 SURVEY STATIONS

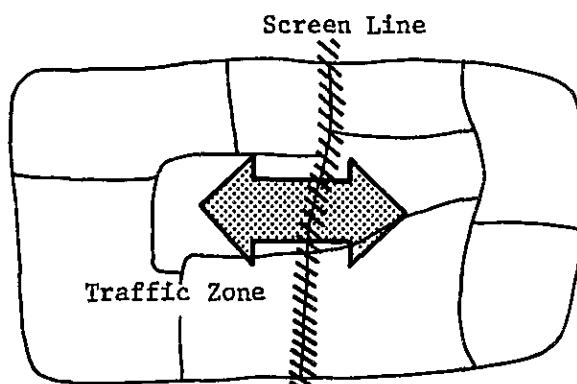


#### 2.1.4 Screen Line Survey

##### (1) Objectives and Outline

The objective of this survey were to estimate the traffic volume of road-users using a selected road. The results of this screen-line survey were used for control and correction of traffic movements obtained from the origin-destination survey. It was necessary to examine the traffic movements estimated from the home-interviews survey for a selected number of samples of the actual traffic volumes that were obtained from this survey.

Fig. 2.4 Out-Line of Screen Line



In most cases, natural barriers such as rivers, hills, sea etc. were used to denote the screen-line due to the ease with which the volume of traffic between the zones can be noted.

For the reasons mentioned above, the screen lines were selected at the center of the Irbid City separating Irbid into 2 regions: Western region and Eastern region.

There was no proper natural barrier in Irbid to serve as a boundary.

This survey involves vehicles of all categories that use roads, except motorcycles and bicycles.

##### (2) Survey Procedure

The Screen Line survey was carried out on 16th April, from 7:00 a.m. to 7:00 p.m. Two survey points were chosen, both of them being located along the street that passes through the city.

One survey point was set at the junction of Palestine St. and Baghdad St. The other survey point was set at Hashim St. About 10,000 vehicles passed through each point during the whole period, and about 900 vehicles consistently passed through each point every hour.

Half of the passing vehicles were passenger cars, while taxis constituted about 20 percent. From this it becomes clear that the passing vehicles were composed of 70 passenger cars, 20 taxi and 10 lorries.

### 2.1.5 Zoning

Irbid City Area was divided into 17 zones. Irbid Region outside the City Area was divided to 12 zones. Other regions in Jordan were combined into 7 zones. Neighbouring countries were represented by 5 zones. The total number of zones was 41. Details are shown in Figures 2.5 ~ 2.7 and Table 2.4.

Fig. 2.5 Zoning of Irbid City Area

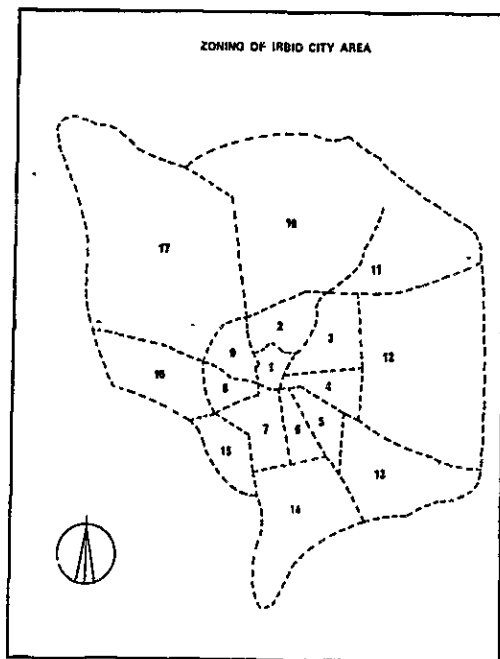


Fig. 2.6 Zoning of Irbid Region

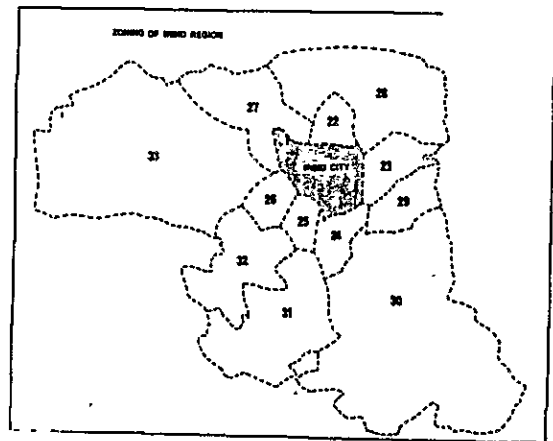




FIG. 2.7 ZONE MAP

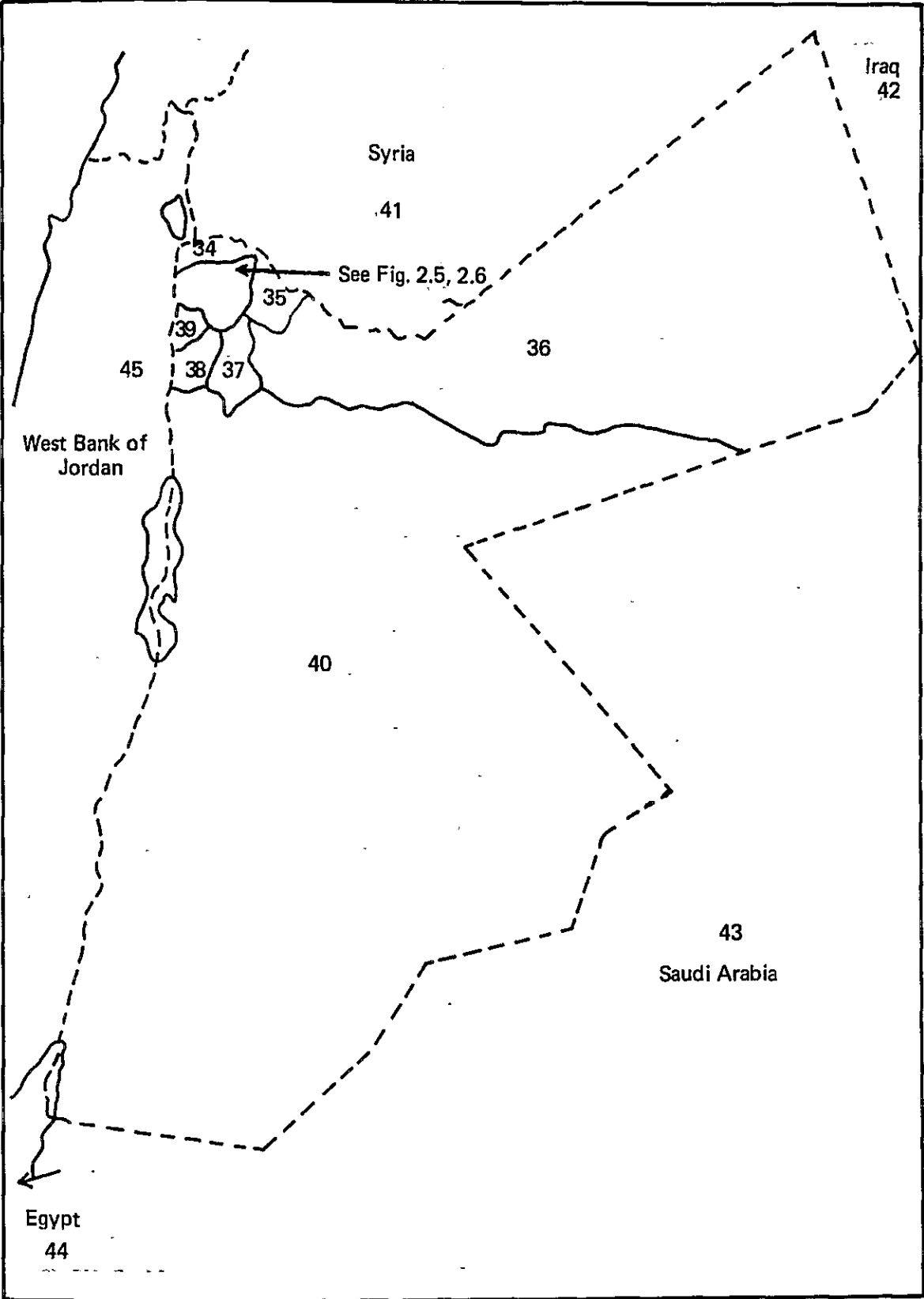


Table 2.4 Zone Code Table for Irbid City

Zone	Street Name				
1	Al-Jami'	Al-Walid	Al-Mutanabi		
	Abu Al-Kassim	Al-Shabi	Ali Khulki		
2	Al-Jeel	Al-Hussein	Hikeen	Al-Sharah	
	Al-Mukhayam	Al-Khulood	Hunain		
	Ali-Al-Keilani	Al-Jegazir	Al-Mudafar		
	Antarah Ibn Shaddad	Hassan Kamel	Al-Sabah		
	Sayyid Darweesh	Al-Hassad			
3	Al-Afaghani	Al-Assifah	Al-Urb	Al-Betra	
	Al-Hussein	Al-Nahus	Al-Dustoor	Al-Mutanabi	
	King Ali	Sa'ad Zaghlool	Al-Istiklal		
	Mahmoud Rasheed	Al-Akkad	Al-Khawarismi		
	Al-Jazairi	Rahooob	Al-Huriyyah	Al-Andlus	
	Ba'labak	Jarash	Adnan Al-Maliky	Zenubia	
	Abd-Al-Salam Arif				
4	Al-Khitabi	Al-Shaheed Wasfi	Al-Tel	Bishra	
	Al-Nahas	Al-Dustoor	Al-Hussein	Hananu	
	Al-Asimah	Al-Kawakibi	Yousuf Al-Adum		
	Abd Al-Kareem	Al Khitabi			
5	Al-Ghafiky	Al-Karmah	Al-Feda	Al-Aqsa	
	Salah Al-Deen	Al-Magri	Al-Umah Al-Arbia		
	Al-Khansa	Huda Sharawi			
6	Al-Amin	Al-Jegair	Al-Kahirah		
7	King Faisal The First		Abu-Baker	Uthman	
	Muawiyah	Salah Eddeen	Ali Bin Abi Talib		
	Al-Inshirah	Al A dad	Kuraysh	Al-Zehra	
	Ahma I Basha	Al-Jezzar	Al-Ahram	Boor Said	
	Shafeek Irsheidat				
8	King Fayssal The First	Al-Mu'tez	Al-Tai		
	Al-Arous	Al-Nasser	Maysaloon	Al-Furat	
	Kutaiban	Al-Jerrah			
9	Yatrib	Khalid Ibn El-Walid	Al-Barha		
	Prince Hassan	Prince Muhammad	Al-Ra Zi		
	Loghman	Al-Hajadge	Al-Samual	Al-Nessr	
	Prince Shaker				
10	Al-Anssar	Abd Al-Mutalib	Al-Yarmouk		
	Omar Ibn Ab I EL Aziz		Al-Hijrah	Adleel	
	Al-Assi	Kilio Petra	Al-Leetani	Beirut	
	Mecca	Halab	Yassein	Al-Maghib	Tunis

Table 2.4 Continued

Zone	Street Name			
10	Al-Hussein Baradu Tarig Bin Ziad Amr Ibn El-Ass Al-Sayyidah Zainab Al-Jihad Firas Abu Firas Al-Hamadani Ibn Al-Mukrfa' Al-Abbas	Al-Khurtoum Ibn Khaldoun Al-Tawrah Al-Arabia Al-Mahd Abu Hurairah Al-Kindi Hassan Ibn Tabit Al-Kawal Abd Al-Ruhman Ibn Awf	Deir Yassein Dirar Ibn Al-Azwar Al-Mubadi Al-Azhar Al-Jahidh Jobran Khaleel Jobran Abd Al-Kadir Jameelah Merj Ibn Amir Al-Shodili	Babil Al-Faruyduk
11	Hnaina Yaghoot El-Hamawi	Al-Yaziji El-Hamawi	Deir Yassein Al-Neel	Al-Firdous Yafa
12	Fayyez Al-Ghaul Al-Mukhtar Al-Thakafi Jineen Bishra Al-Alamein Ajloun Al-Thahir Beibeirs Kasser Hisham Izz Al-Deen Al-Kassam Al-Karamah Al-Mujib Ibn Al-Nudeem Lahour Kufor Al-Duwar Kar Kook Al-Marwah Yazzeid Ibn Abi Sifyan Izz Al-Deen Al-Kassam	Abd Al-Rahim Mahmoud Jamal Abd Al-Nasser Al-Kastal Al-Adrsuya Amouriah Abd Al-Malik Abn Marwan Abu-Dabi Suleimman Al-Kanuni Al-Imum Mulik Karatshi Al-Madain Al-Mukreezi Nablu Kutheir Izzah Al-Karkh Al-Mahalu Al-Kobra Muslimah Ibn Abd Al Malik Al-Akkad	Abu-Kier Amr Bin Kalthoum Mohammud Ali Ajlouni Al-Ikhlis Al-Ikhlis Al-Mu'tusim Ma'ad Naoor Al-Kassam Abd Al-Rahim Mahmud Maskat Abd Al Malik	Kusai Ibn Kilab Al-Ikhlis Al-Ikhlis Ma'ad Marakish
13	Safei Al-Dein Al-Hilli Al-Suqour Turfah Ibn Al-Abid Sultan Saliem Al-Awal Baghddad Zamzam Al-Skakini Shouna Al-Udba' Al-Sadd Samahk Al-Ressalah	Al-Hilli Toal Karm Al-Abid Al-Awal Zeid bin ummyyah Zubeidh Al. Taffie lah Safad Shieraz Al-Shoubak Al-Thauri Al-Saloum Al-Zabadani	Tanta Tubrug Al-Ta'ef Zeid Ibn Harithah Al-Zakazeek Saker Kurraysh Sharief Al Radi Shafa Amro Al-Samira Summer Kund Al-Sharikah	Tabareih Zerka
14	Al-Habbaniyah Al-Hussari Al-Ikhlis Ibn Hurikal	Hems Al-Jeizah Al-Imam Al-Hellah	Hadramoot Al-Houlah Jabel Al-Mukabir Al-Ramlah	

Table 2.4 Continued

Zone	Street Name			
14	Um Dorman Dimyatt Al-Zarzour Abd Al-Kadir Al-Salt	Al-Khuzumuh Al-Nuqab Ra's Al-Khaymah Tarablis Sad Al-Muqarin	Al-Rikah Denshway Daura Abu Thar Al-Ghaffary	Dyar Baker
15	Bab Al-Wad Jabel Tariq Bi'r Al-Saba' Ibrahim Ibn Tokan Talemsan Al-Balsam Yausuf Ibn Tashfeem Be'r Al-Sabi' Jabel Al-Sheikh Al-Jaleel Firas El-Ajlouni Al-Balsum Al-Basri	Al-Jalil Jabel Al-Sheikh Muhammad Ali Jemah Ta's Al-Basri Ibrahim Ibn Tokan Muhammad Ali Genah Jabel Tarig Bub Al-Wad Ta'z Ibn Batotah Beit Ras	Al-Jaberti Al-Akram Yousuf Ibn Tashfeen Ibn Batotah Talemsan Ibrahim Ibn Tokan Muhammad Ali Genah Jabel Tarig Bub Al-Wad Ta'z Ibn Batotah King Fayssal The Second King Fayssal The Se	Kutaibah Beit Ras Al-Jeberti Al-Ahram Bani Ghazi King Fayssal The Second King Fayssal The Se
16	Antakya Agadeer Aminak Bint Wabb Ja'far Al-Bermaki Bandouge	Ja'fer Al-Tayyar Rowad	Al-Ukhuwan Al-Ansari Al-Idreesi Al-Bokhari	Borkah Izm-er
17	Khalid Ibn Al-Walid Al-Hussein Al-Fayhu Al-Amanah Al-Kisai Al-Tabari Abd Allah Bin Masoud Sharhabeel Bin Hassnah Tabouk Al-Falah	Sana'a King Ghazi Ma'ath Ibn Jabal Al-Ittihad Al-Asmai Al-Jawhari Hami Al-Urabi Ibn El-Amid Abd Allah Ibn Al-Zubeir	Al-Urdon Sharhabeel Hasnah Al-Khaleel Prince Shoker Abu Mousa El-Asha'ri Marj Rahit King Ghazi Jarrer Al-Awzai May Ziadah	Uhud

Table 2.5 Zoning of Irbid Region

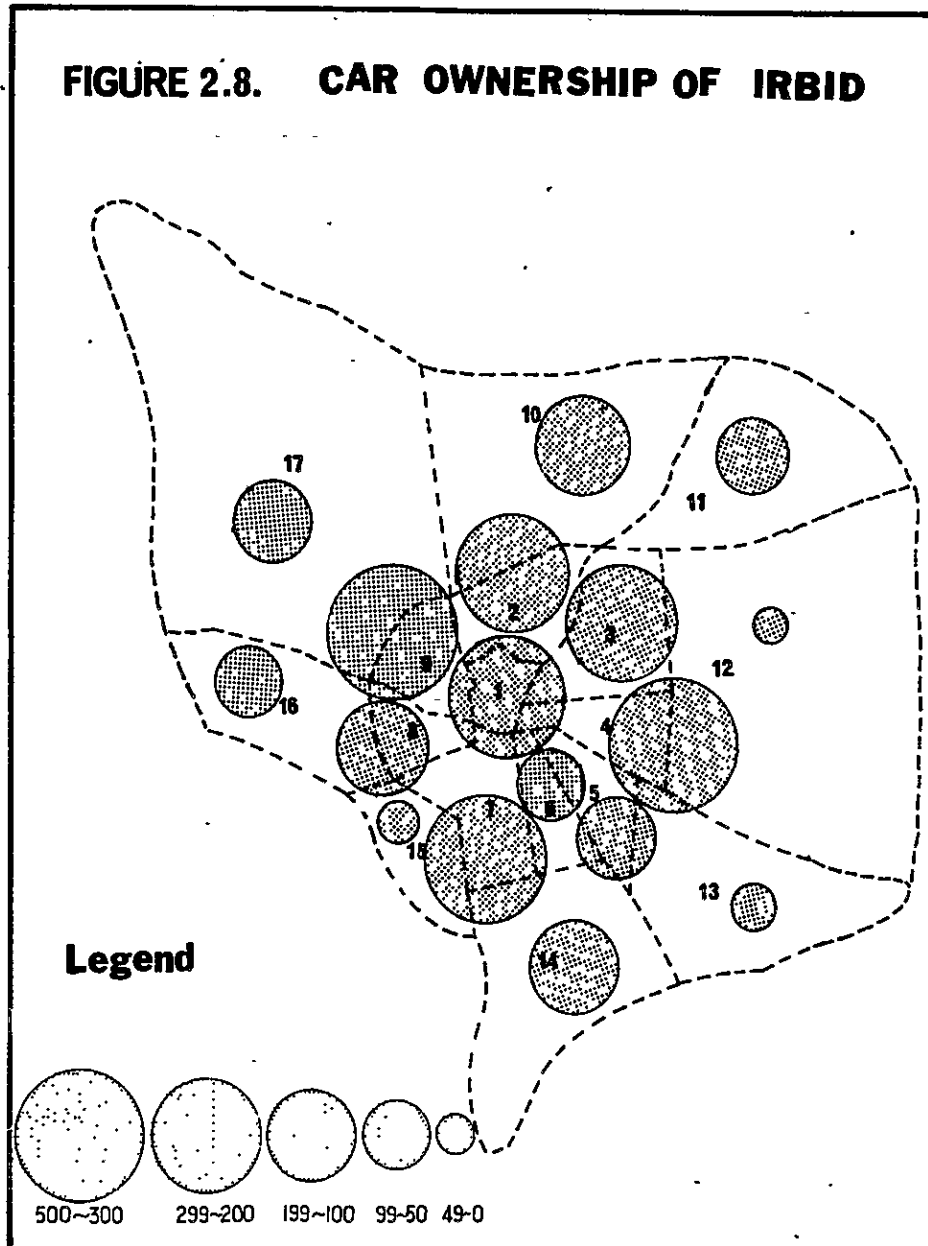
Zone No.	Zone Coverage				
22	Beit Ras				
23	Bishra	Sal			
24	Aidun				
25	Natifa	Zabda			
26	Kufr Yuba				
27	Fau'ara Tuqbul	Hawar	Is'ara	Li Barz	Saum
28	Abu el Lauqas El Qisfa Moru	'Al'al Hakama Sama	El Khureiba Harima Ezrit	El Mughaiyir Kharja	Kufr Tayiz
29	Hawara				
30	En Nu'eiyma Tumeira	Es Sarih Shatana	Husn	Kabar	Kitim
31	El Mazar Zubiya	Juhfiya Samad	Habaka	Haufa	Rihaba
32	Beit Yafa	Deir Yusuf	Ham	'Inba	Kufr Kifiya
33	Dauqara Katr Asad Makhraba Zabda	Deires Si'na Kufr Rahta Mandah Zahar	Dumeim Kufr Ano Qam Samma	Jijjin Likhraj Seidur Haufa	Jumha Taiyiba

Table 2.6 Zoning of Other Region

Zone No.	Zone Converage
34	The region of northern bordor (ex. Bani-Kinana etc.)
35	Ramtha, Musheirifa, Hausha, Buweida Bureiqu Eb-Turra
36	Ma fraq, Aidun, Rihab, El Huseinivat
37	Jarash, Balila, Kufrkhal, Reimun, El Majdal, El Masbaba
38	Ajlun, Samta, Rasun, Baun, Anjara
39	El-Ashrafiyeh, Es Samt, Sammu judeita, Deir Abu Said
40	Amman, Southern part of Jordan
41	Syria
42	Iraq
43	Saudi Arabia
44	Egypt
45	West Bank of Jordan

## 2.2 Vehicle Ownership

Based on the data obtained by the study Team as shown in Table 2.1, the total number of registered vehicles in Irbid City as of 1981 is 4,364. Of these registrations, 3,197 (73%) are concentrated inside the Inner Ring Road (Zones 1-9).



As shown in Table 2.7, almost all passenger car (99%) are privately owned and 94% of total are owned by individuals rather than companies. Although companies owned only 5% of the total number of vehicles, their ownership of vans (18.3%), buses (100%) and trucks (13.2%) was higher.

Table 2.7 Ownership by Type of Vehicle and Class of Owner

Veh (% of total by type)

Owner- ship Type	Indivi- dual	Company	Govern- ment	Unknown	Total	%
Car (1)	3233(98.1)	42( 1.3)	14	5	3294	75.5
Van (2)	534(80.4)	122(18.3)	3	5	664	15.2
Bus (5)	0( - )	5(100 )	0	0	5	0.1
1+2+5	3767	169	17	10	3963	90.8
M Lorry(3)	164	23	0	0	187	4.3
H Lorry(4)	174	20	8	0	202	4.6
Other(6)	2	10	0	0	12	0.3
3+4+6	340(84.8)	53(13.2)	8	0	401	9.2
Total	4107	222	25	10	4364	100
%	94.1	5.1	0.6	0.2	100	

Source: Estimation by Study Team

The length of vehicle ownership as shown in Table 2.8 reflects the increasing growth rate of passenger cars. About 47% of the cars and vans were registered within the last 2 years (1979-81). On the other hand, within the last 2 years only 35% of medium-size trucks and 25% of the heavy trucks were registered. Buses were all purchased 3-5 years ago (1977-8).



Table 2.8 Period of Vehicle Ownership

Period Type	1 ~ 2 years	3 ~ 4 years	Over 5 years	Unknown	Total
Car (1)	1543 (46.9)	1021 (31.0)	715 (21.7)	14	3293
Van (2)	317 (47.7)	218 (32.8)	129 (19.4)	0	664
Bus (5)	0	5 (100)	0	0	5
1 + 2 + 5	1860	1244	844	14	3962
M Lorry (3)	66 (35.3)	53 (28.3)	68 (36.4)	0	187
H Lorry (4)	51 (25.3)	106 (52.7)	44 (21.9)	0	201
Other (6)	2	0	10	0	12
3 + 4 + 6	119 (29.8)	159 (39.8)	122 (30.5)	0	400
Total	1979 (45.4)	1403 (32.2)	966 (22.1)	14	4362

Source : Estimation by Study team

The characteristics of registered vehicle owners by age and occupation are shown in Table 2.9. The largest groups comprising more than 50% of the total were professionals (31%) and sales people (25%) in terms of occupations and persons in their thirties (38%) and forties (26%) in terms of age.

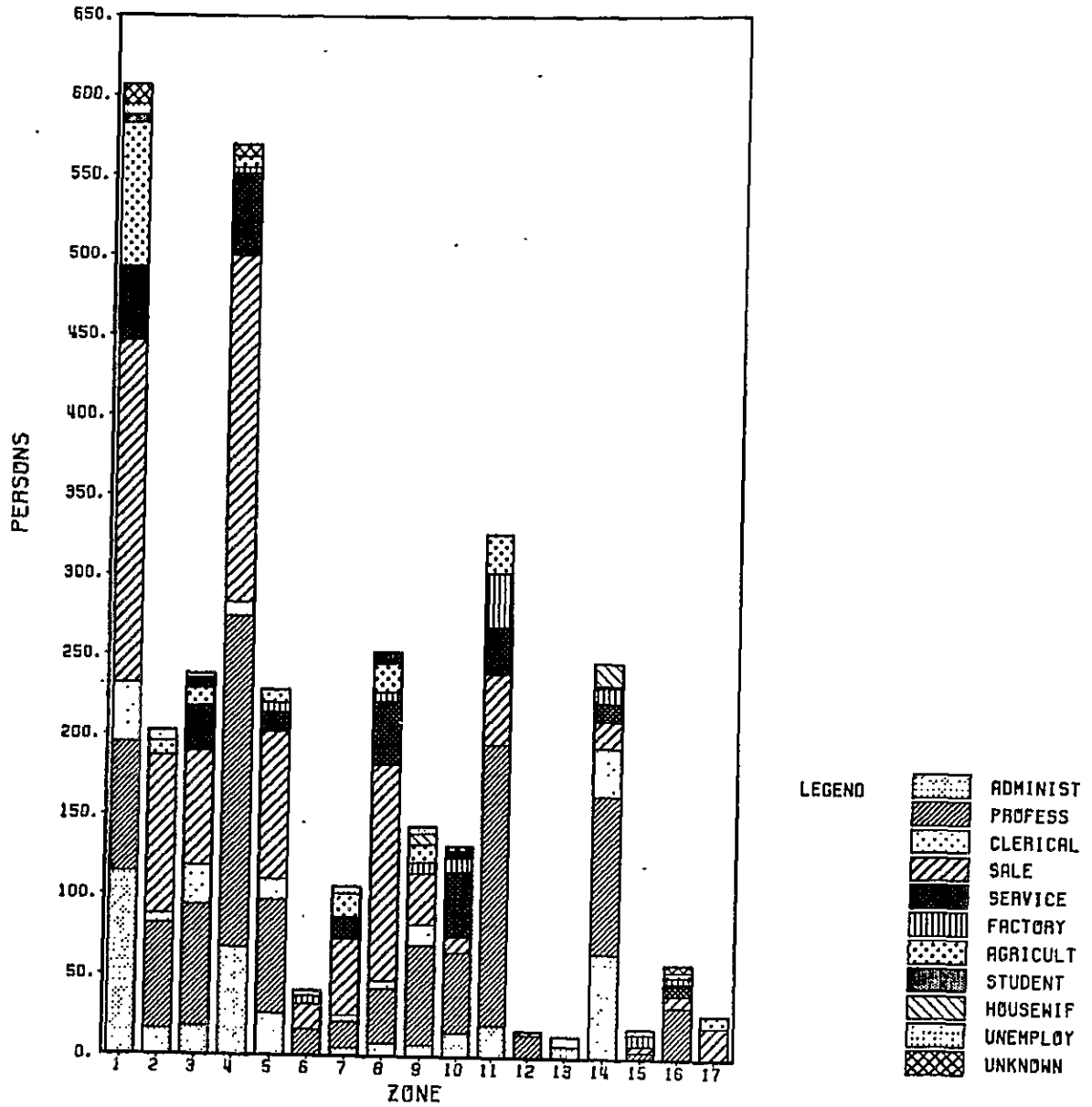
Table 2.9 Occupation and Age of Vehicle Owners

Age Occupation	Below 19	20-29	30-39	40-49	50 -	Un- known	Total	%
Administration	7	97	164	150	77	7	502	11.5
Professional	0	197	674	318	169	7	1365	31.3
Clerical	0	29	77	37	33	0	176	4.0
Sales	0	178	405	309	185	26	1103	25.3
Service	0	48	112	109	64	22	355	8.1
Factory	7	9	61	53	8	1	139	3.2
Agriculture	0	127	78	57	57	3	322	7.4
Student	0	16	36	25	42	0	119	2.7
Housewife	0	38	0	0	0	0	38	0.9
Unemployed	0	13	32	8	4	0	57	1.3
Unknown	5	25	28	53	64	10	185	4.3
Total	19	777	1667	1119	703	76	4361	100.0
%	0.4	17.8	38.2	25.4	16.1	1.8	100.0	

Source : Estimation by Study Team

It is obvious from the Fig. 2.9 that the zones which located in the center area of IRBID had the most large number of work places.

Fig. 2.9 Work Place of Vehicle Owner



By size of work place, 61% of the owners worked in small establishments with 1-4 persons, 23% in medium-size establishments with 5-49 workers, and most of the know balance (7%) in large establishments with over 100 workers.

Table 2.10 Occupation - Size of Employment

Employment Occupation	1-4	5-9	10-19	20-49	50-99	100 -	Un- known	Total
Administ	125	46	95	114	32	68	22	502
Profess	818	76	130	90	19	155	77	1365
Clerical	53	15	9	65	9	20	4	175
Sale	928	88	22	17	6	0	42	1103
Service	234	12	30	11	6	41	23	357
Factory	51	22	26	1	0	11	29	140
Agricult	198	34	34	35	0	7	14	322
Student	79	24	15	0	0	0	0	118
Housewif	11	0	0	0	0	7	20	38
Unemploy	27	0	0	0	0	4	27	58
Unknown	124	0	0	0	0	10	52	186
Total	2648	317	361	333	72	323	310	4364
%	(60.7)	(7.3)	(8.3)	(7.6)	(1.6)	(7.4)	(7.1)	(100)

Source : Estimation by Study Team

Table 2.11 Type of Vehicle - Occupation

Occupation Type	Administ	Profess	Clerical	Sale	Service	Factory	Agricult	Student	Housewif	Unemploy	Unknown	Total
Car (1)	469	1115	160	879	188	87	94	90	34	51	131	3295
Van (2)	22	159	15	149	117	32	101	27	4	7	30	663
Bus (5)	0	0	0	5	0	0	0	0	0	0	0	5
1 + 2 + 5	491	1274	175	1033	305	116	195	117	38	58	161	3963
M Lorry(3)	0	15	0	23	30	15	96	2	0	0	7	188
H Lorry(4)	11	74	0	46	23	8	31	0	0	0	9	202
Other (6)	0	2	0	0	0	0	0	0	0	0	10	12
3 + 4 + 6	11	91	0	69	53	23	127	2	0	0	26	402
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Total	502	1365	175	1102	358	139	322	119	38	58	187	4365
%	11.5	31.3	4.0	25.2	8.2	3.2	7.4	2.7	0.9	1.3	4.3	100

Source : Estimation by Study Team

### 2.3 Vehicle Use by Owners in Irbid

The data regarding intra-city traffic is based on the home interview survey which documented about 19,100 trips made within and to and from the Irbid City area.

As shown in the following Table 2.12 and Figure 2.10, trip purposes in Irbid were divided into 8 categories with over 72% made for the purpose of going to work and returning home as shown below.

Table 2.12 Percentage of Trip Purpose

Trip Purpose	%
To Work	37.0
Home	35.1
Business	8.0
Shopping	7.4
School	4.6
Socializing	3.6
For Food	2.7
Others + Unknown	1.6

Source : Study Team

FIG. 2.10 TRIP PURPOSES BY VEHICLE TYPE

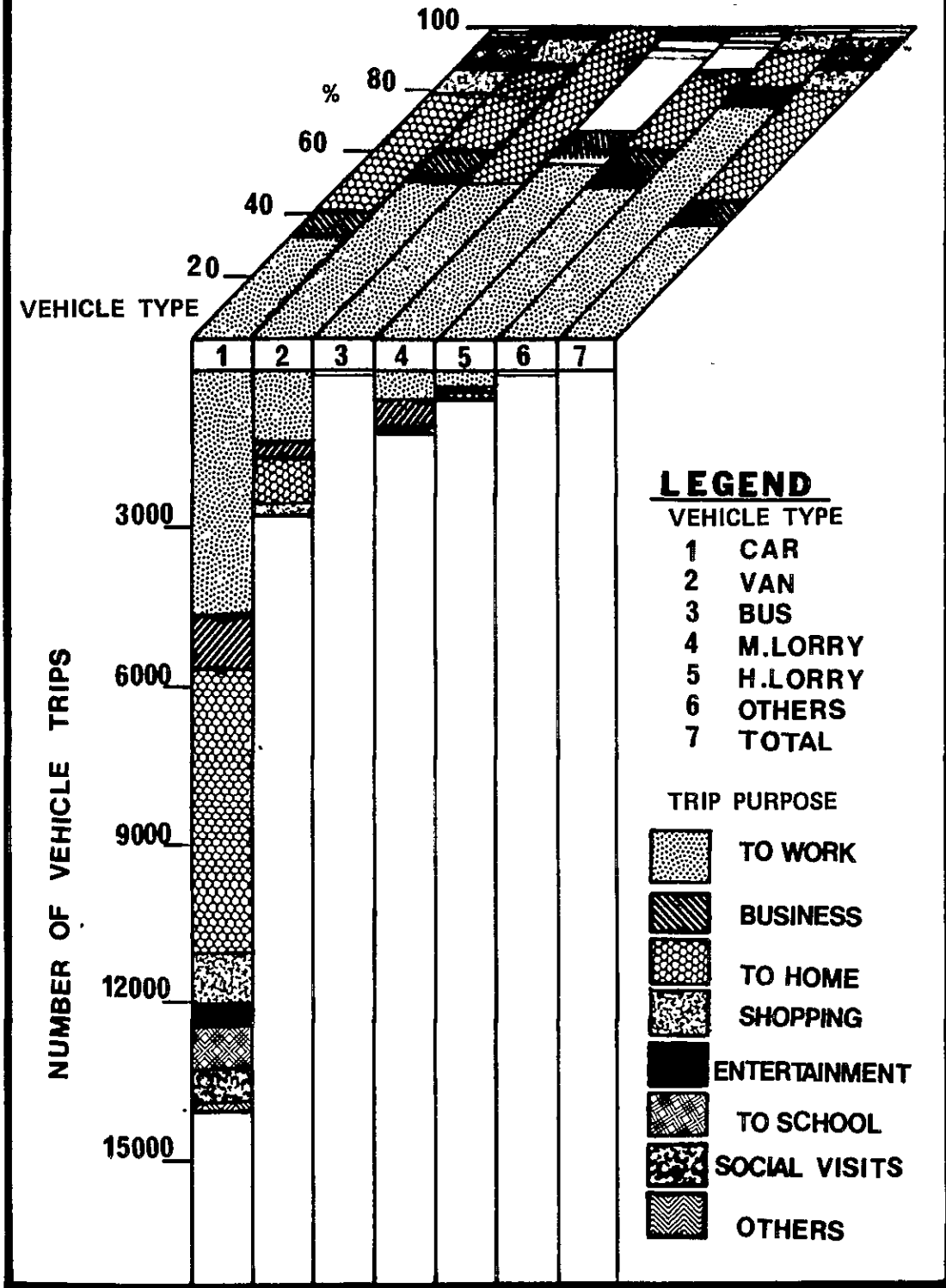


Table 2.13 Origin - Trip Purpose

PURPOSE	TO WORK	JUSTNESS	HOME SHOPPING FOR FOOD	SCHOOL	SOCIAL	OTHERS	UNKNOWN	TOTAL
ZONE								
1	620	167	194	97	119	65	19	2162
2	468	48	47	19	40	37	6	771
3	599	101	49	56	73	68	11	1348
4	584	124	159	65	96	57	47	2145
5	296	48	57	10	47	35	9	868
6	263	25	29	23	17	26	0	450
7	557	137	86	47	98	87	22	1206
8	406	96	117	13	53	20	19	1173
9	754	114	145	61	41	73	6	1583
10	401	73	198	14	33	21	3	834
11	289	94	103	18	21	31	9	1101
12	162	19	2	11	21	0	0	222
13	41	26	0	0	19	6	0	171
14	411	90	84	45	96	25	4	1296
15	65	19	38	15	19	19	11	270
16	219	31	37	16	23	3	0	464
17	154	43	45	25	14	46	16	403
99	68	35	163	7	18	11	4	336
UNKNOWN	797	235	105	5	23	65	10	2294
TOTAL	7062	1527	1418	517	871	688	212	19097

Source: Estimation by Study Team

Table 2.14 Destination - Trip Purpose

PURPOSE	TO WORK	JUSTNESS	HOME SHOPPING FOR FOOD	SCHOOL	SOCIAL	OTHERS	UNKNOWN	TOTAL
ZONE								
1	793	186	418	27	78	12	35	2195
2	202	53	44	4	13	16	7	755
3	432	32	104	42	99	36	9	1335
4	990	136	259	105	44	69	10	2148
5	402	40	35	36	60	14	4	879
6	63	30	233	16	39	25	0	458
7	146	57	30	33	61	40	11	1176
8	520	60	337	7	29	45	13	1154
9	306	77	81	7	152	91	17	1557
10	231	57	51	12	14	16	2	793
11	655	154	204	0	14	23	27	1108
12	21	0	31	0	19	19	0	219
13	29	4	5	0	18	6	0	167
14	496	162	32	64	174	31	0	1263
15	47	3	5	8	11	2	19	268
16	159	17	225	8	8	0	0	470
17	64	12	276	0	25	0	0	389
99	120	35	29	33	19	7	8	334
UNKNOWN	1382	382	105	96	48	209	14	2424
TOTAL	7058	1524	6713	519	870	688	212	19092

Source: Estimation by Study Team

The average mileage per day by type of vehicle is given below in descending order.

Table 2.15 Average Mileage by Type

<u>Type of Vehicle</u>	<u>Average Mileage</u>
H. Lorry	241.7 (Km)
M. Lorry	146.8
Van	75.2
Bus	62.8
Others	55.0
Car	55.0

Table 2.16 Average Mileage per Day by Vehicle Type

(Unit: Vehicles)

Mileage Type	0	1-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-150	150-200	200-250	250-300	300-(km)	Total
Car (1)	30	480	851	548	392	300	156	99	113	33	100	91	57	28	5	10	3293
Van (2)	9	82	95	72	45	58	28	24	56	3	50	68	57	3	3	10	663
Bus (5)	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	5
1+2+5	39	562	946	620	437	358	189	123	169	36	150	159	114	31	8	20	3961
M Lorry (3)	0	15	0	19	7	3	9	9	0	0	19	9	55	19	19	5	188
H Lorry (4)	0	0	0	0	0	11	2	9	9	0	3	36	63	0	23	45	201
Other (6)	0	0	0	0	0	10	0	0	2	0	0	0	0	0	0	0	12
3+4+6	0	15	0	19	7	24	11	18	11	0	22	45	118	19	42	50	401
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	39	577	946	639	444	382	200	141	180	36	172	204	232	50	50	70	4362

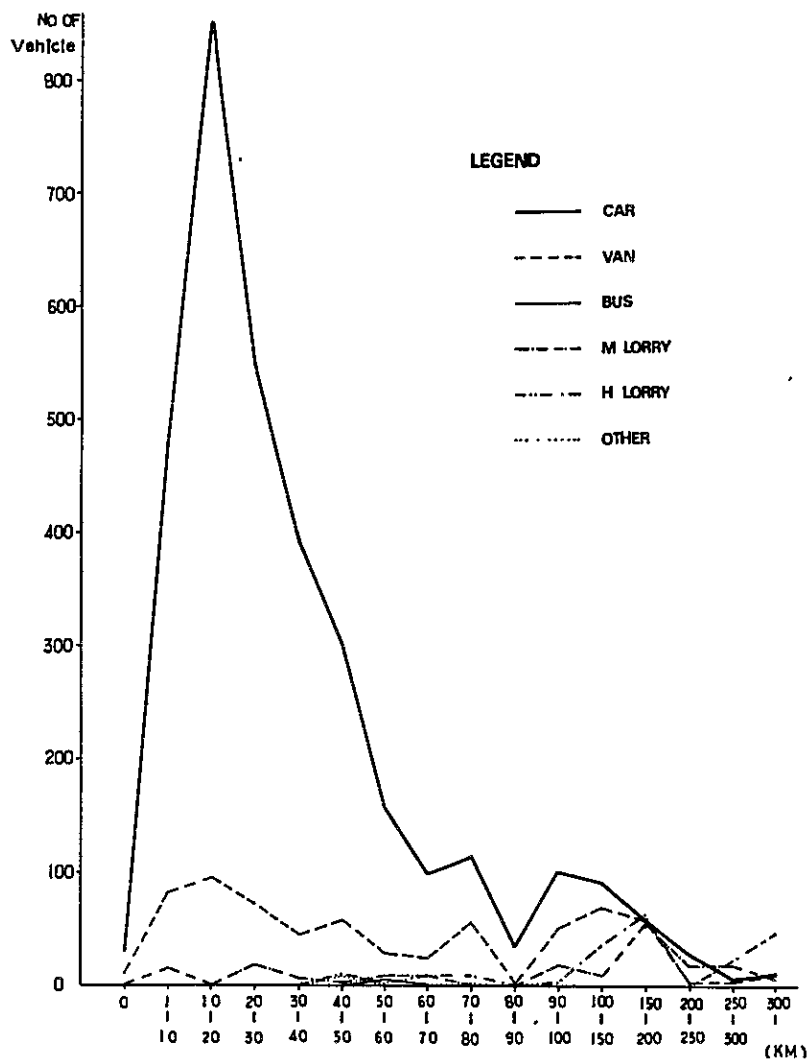
Source : Estimation by Study Team

Table 2.17 Averager Mileage by Occupation

<u>Owner's Occupation</u>	<u>Average Mileage/day</u>
Agricultural	110.6 (km)
Service	71.6
Administrative	64.9
Student	62.3
Professional	56.9
Sales	52.9
Factory	49.3
Clerical	44.0
Housewife	33.5
Unemployed	15.7
Unknown	55.0
Total	60.5

The average trip distance in terms of owners occupation is shown below. Although agricultural and service workers travel the greatest distances per day, in terms of number of vehicles owned, their component of the traffic volume is small, Professionals, sales workers and administrative personnel on the other hand own 68% of the vehicles.

FIG 2-11 AVERAGE MILEAGE PER DAY BY VEHICLE TYPE



As shown in Table 2.18, the highest peak period of the day is between 7:00 and 8:00 am which accounts for 12.6% of the daily number of trips. The evening peak period is a little more spread out from 14:00 - 15:00 pm and accounts for 8.6% of the daily number of trips.

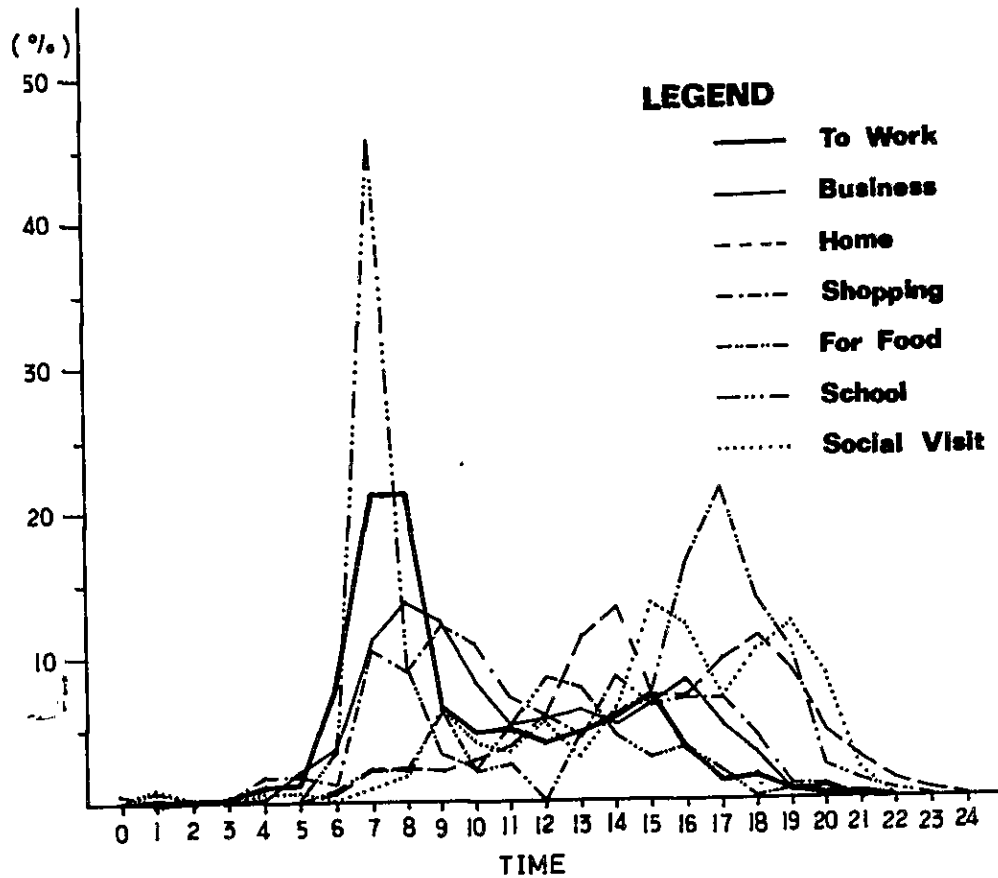


Table 2.18 Daily Traffic Time Cycles

Purpose Time	* DEPARTURE TIME -- PURPOSE *										(No. of trips)	
	To Work	Business	Home	Shopping	For Food	School	Social	Others	Unknown	Total	%	
0:00 -	0	0	11	3	3	0	0	0	0	17		
1:00 -	0	6	4	3	0	7	5	0	0	25		
2:00 -	4	0	0	0	0	0	0	0	0	4		
3:00 -	20	0	0	0	0	0	0	5	0	25		
4:00 -	69	4	5	24	0	0	4	6	0	112		
5:00 -	122	32	13	26	0	0	4	0	0	197		
6:00 -	571	57	40	18	4	31	0	7	0	728		
7:00 -	Δ1502	172	154	148	11	Δ396	7	13	7	2410		
8:00 -	1512	Δ211	159	128	11	79	12	18	8	2138	Δ 12.6	
9:00 -	484	190	157	Δ170	31	30	45	9	0	1116	11.2	
10:00 -	335	128	197	154	11	19	29	16	9	898	5.6	
11:00 -	352	80	264	102	13	46	25	3	0	885	4.7	
12:00 -	292	89	410	84	0	74	38	11	9	1007	46	
13:00 -	329	98	765	62	24	67	21	15	5	1386	5.3	
14:00 -	416	82	Δ900	120	31	39	44	11	8	1651	7.3	
15:00 -	514	104	496	90	38	26	93	33	8	1402	Δ 8.6	
16:00 -	250	125	477	97	84	31	83	4	9	1160	7.3	
17:00 -	89	78	660	97	111	18	49	23	14	1139	6.1	
18:00 -	103	51	754	62	72	2	71	4	5	1124	6.0	
19:00 -	37	8	593	14	53	5	84	17	3	814	5.9	
20:00 -	20	11	311	13	12	1	59	11	3	441	4.3	
21:00 -	23	0	196	0	7	0	14	4	0	244	2.0	
22:00 -	2	0	92	0	3	0	0	0	0	97	1.3	
23:00 -	0	0	37	0	0	0	0	0	0	37		
24:00 -	0	0	0	0	0	0	0	0	0	0		
Unknown	12	0	17	0	0	0	0	0	0	29		
Total	7058	1526	6712	1415	519	871	687	210	88	19086		

Source : Estimation by Study Team

FIG. 2.12 DEPARTURE TIME OF TRIPS



Majority of Travelling vehicles were only the driver without passengers, that was 69% of the total vehicle Trips. Only 7% drove the car or van with more than 3 persons.

Table 2.19 Number of Passengers\*

(Unit: Trip)

Passenger Type	1	2	3	4	5	6-	Unknown (Persons)	Total	Average (No. of Passengers)
Car (1)	10333	1974	973	477	349	193	274	14573	1.52
Van (2)	1641	808	264	26	23	40	77	2879	1.60
1 + 2	11974	2782	1237	503	372	233	351	17452	1.53
M Lorry (3)	686	204	61	0	0	15	44	1010	1.37
H Lorry (4)	343	176	9	0	7	10	2	547	1.52
Other (6)	62	0	0	10	0	0	0	72	1.42
3 + 4 + 6	1091	380	70	10	7	25	46	1629	1.42
Unknown	0	0	0	0	0	0	0	0	-
<b>Total</b>	<b>13065</b>	<b>3162</b>	<b>1307</b>	<b>513</b>	<b>379</b>	<b>258</b>	<b>397</b>	<b>19081</b>	<b>1.52</b>

\* Note: Excluding bus passengers.

Source : Estimation by Study Team

Loading condition of trucks as shown in Table 2.20 indicates that 85% of the total capacity is being used with a large part of the total (75%) in full vehicles.

Table 2.20 Commodity - Loading

Loading Commodity	Full	Full 3/4	Full 1/2	Full 1/4	Less 1/4	Empty	Unknown	Total
No Lugg.	90	61	30	117	72	13	335	718
Agricul.	7	0	4	52	34	0	39	136
Timber	15	0	9	37	30	5	88	184
Minerale	11	6	13	14	9	0	52	105
Metal	3	1135	34	23	27	0	87	1309
Light	0	569	7	14	0	0	383	973
Chemical	0	0	0	0	0	0	30	30
Unknown	0	54	0	0	0	0	0	0
Total	126	1825	97	257	172	18	1014	3455
% (excluding unknown)	5.2	74.8	4.0	10.5	7.0	0.7	-	100
Weighted %	1.3	74.8	3.0	5.3	0.9	-	-	85.3

Source : Estimation by Study Team

The average number of trips by passenger cars was 4.4 trips per day; vans, 4.3 trips per day; medium lorries, 5.4 trips; and heavy lorries, 2.7 trips per day.