

THE UNITED REPUBLIC OF TANZANIA

THE FEASIBILITY STUDY
ON
ROAD IMPROVEMENT AND MAINTENANCE
IN
DAR ES SALAAM

FINAL REPORT

MAIN REPORT

JULY, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

THE FEASIBILITY STUDY ON ROAD IMPROVEMENT
AND MAINTENANCE IN DAR ES SALAAM

FINAL REPORT
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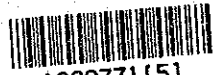
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国際協力事業団

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PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Japanese Government decided to conduct a Feasibility Study on Road Improvement and Maintenance in Dar es Salaam and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the United Republic of Tanzania a survey team headed by Mr. H. Ito, Japan Engineering Consultants Co., Ltd., composed of members from Japan Engineering Consultants Co., Ltd. and Nippon Koei Co., Ltd., three times from March, 1989, to March, 1990.

The team held discussions with the officials concerned of the Government of the United Republic of Tanzania, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

July, 1990



Kensuke Yanagiya

President

Japan International Cooperation Agency

FINAL REPORT
FOR
THE FEASIBILITY STUDY
ON
ROAD IMPROVEMENT AND MAINTENANCE
IN DAR ES SALAAM

SUMMARY OF CONTENTS

Preface

Project Location Map

A. Conclusion and Recommendations

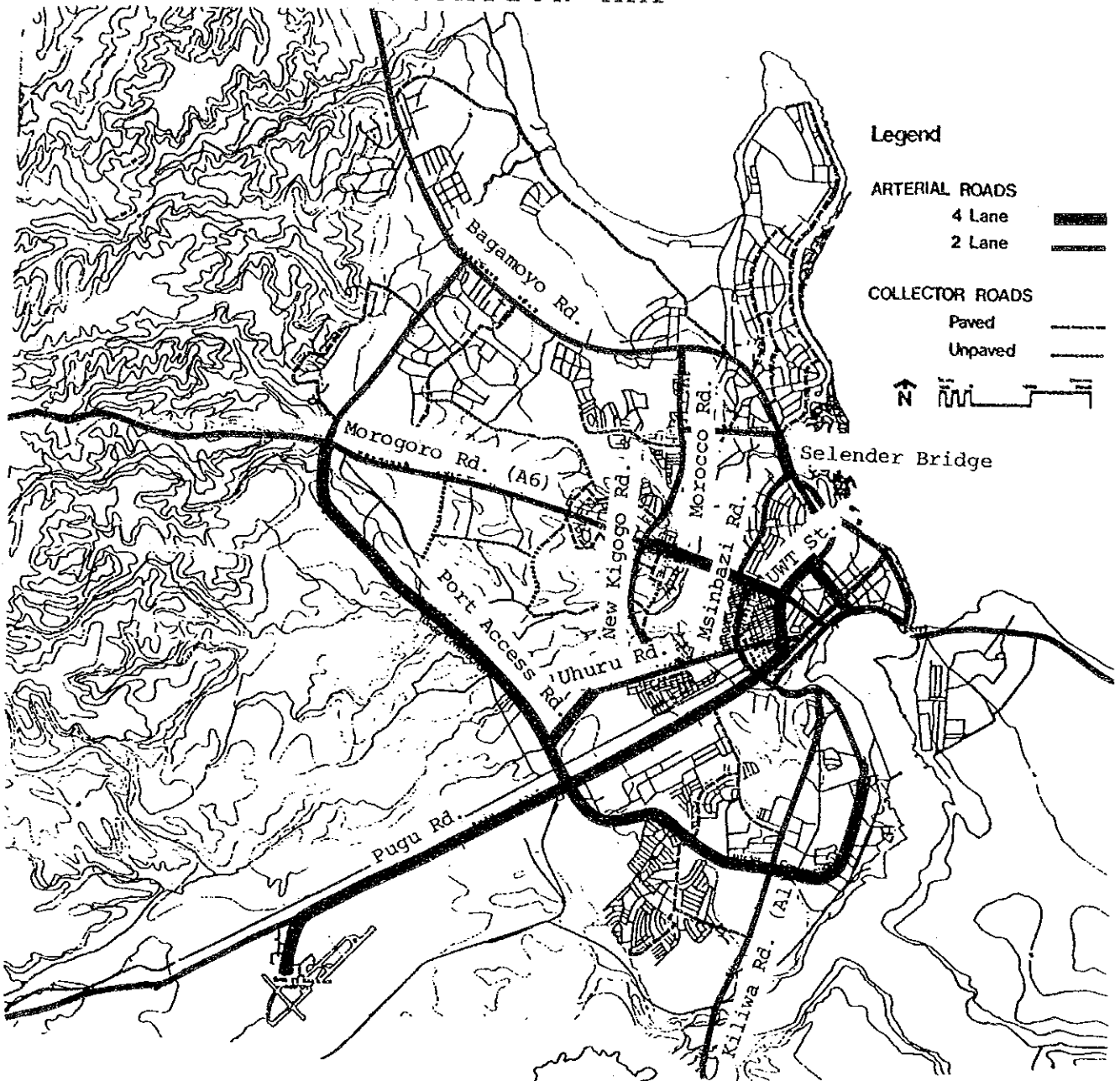
B. Summary of the Study

CHAPTER 1	INTRODUCTION
CHAPTER 2	OUTLINE OF THE STUDY AND ANALYSIS
CHAPTER 3	TRAFFIC SURVEY AND ANALYSIS
CHAPTER 4	FUTURE FRAMEWORK
CHAPTER 5	TRAFFIC DEMAND FORECAST
CHAPTER 6	IDENTIFICATION OF ROAD NETWORK
CHAPTER 7	ENGINEERING SURVEYS AND ANALYSIS
CHAPTER 8	EXISTING ROAD MAINTENANCE SYSTEM AND OPERATION
CHAPTER 9	IMPROVEMENT OF ROAD MAINTENANCE SYSTEM
CHAPTER 10	IDENTIFICATION OF NECESSARY IMPROVEMENT
CHAPTER 11	FORMULATION OF IMPLEMENTATION PLAN AND SELECTION OF HIGH PRIORITY PROJECTS
CHAPTER 12	PRELIMINARY ENGINEERING DESIGN FOR HIGH PRIORITY PROJECTS
CHAPTER 13	CONSTRUCTION PLAN AND COST ESTIMATE
CHAPTER 14	ECONOMIC EVALUATION
CHAPTER 15	CONCLUSION AND RECOMMENDATIONS

Composition of Final Report

- Summary Report
- Main Report
- Appendices
- Drawings

LOCATION MAP



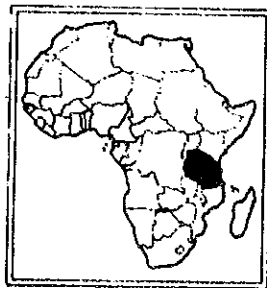
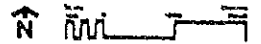
Legend

ARTERIAL ROADS

- 4 Lane
- 2 Lane

COLLECTOR ROADS

- Paved
- Unpaved



THE FEASIBILITY STUDY
ON
ROAD IMPROVEMENT AND MAINTENANCE
IN
DAR ES SALAAM

SUMMARY

**Summary of the Feasibility Study
on
Road Improvement and Maintenance
in Dar es Salaam**

A. Conclusion and RecommendationsS- 1

B. Summary of the Study

Chapter 1	Introduction	S-12
Chapter 2	Outline of the Study Area	S-13
Chapter 3	Traffic Survey and Analysis	S-16
Chapter 4	Future Framework	S-19
Chapter 5	Traffic Demand Forecast	S-21
Chapter 6	Identification of Road Network	S-27
Chapter 7	Engineering Survey and Analysis	S-30
Chapter 8	Existing Road Maintenance and Operation Systems	S-35
Chapter 9	Improvement of Road Maintenance System	S-38
Chapter 10	Identification of Necessary Improvement	S-43
Chapter 11	Formulation of Implementation Plan and Selection of High Priority Projects	S-44
Chapter 12	Preliminary Engineering Design for High Priority Projects	S-54
Chapter 13	Construction Plan and Cost Estimate	S-63
Chapter 14	Economic Evaluation	S-71

A. CONCLUSION AND RECOMMENDATIONS

The following are the conclusion and recommendations made by the Study Team on the basis of the results of the feasibility study for the "Road Improvement and Maintenance in Dar es Salaam":

A-1 CONCLUSION

A-1-1: High Priority Projects to be Implemented in the Short-term Plan

The Study Team concluded that the following improvement measures shall be implemented in the Short-term Plan (1990 - 1994) from the view points of engineering, socio-economy and policy of the Tanzanian Government.

High Priority Projects to be Implemented in the Short-term Plan	Project Length	Estimated Cost
Category A: Improvement of Road Structures	(km)	(TshxM)
(1) Widening and Improvement of Upanga and New Bagamoyo Roads	9.8	890
(2) Widening of Morogoro Road	5.7	810
(3) Chan'gombe Area Roads	19.2	510
(4) Kariakoo Area Roads	31.6	900
(5) Mwinjuma Area Roads	16.9	450
(6) Central Area Roads	20.0	440
Total	104.1	4,000
Category B: Urgent Repair of Pot-holes for the Selected Roads	Total	190
Category C: Improvement of Maintenance System		
(1) Establishment of New Main Depot	1 no.	170
(2) Procurement of Equipment	Sum	110
(3) Technical Assistance/Training	T/A	-
Total		280
Detailed Design/Preparation of Bidding Documents	Total	100
Grand Total		4,570

Exchange Rate: US\$1.0=Tsh.144=¥144 (As of Nov. 1989)

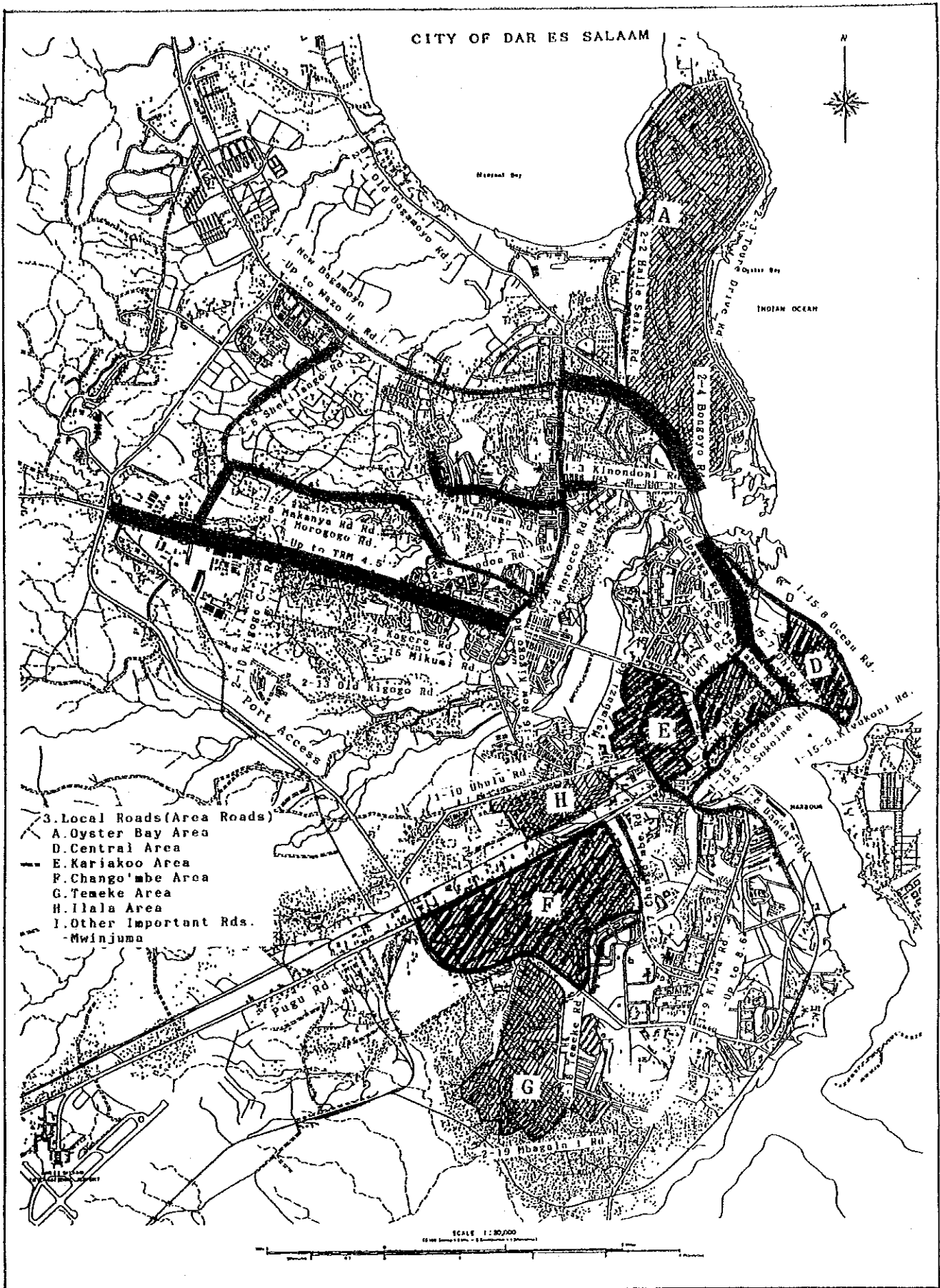
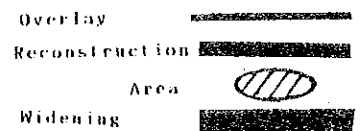


Fig. S. A. 1 High Priority Projects of Short Term Plan



A-1-2: Project Implementaion Programme (Short-term Plan)

The tentative implementation programme of the Short-term Plan with cost disbursement schedule was prepared by the Study Team as shown below taking into consideration possibility of financial arrangement of the Tanzanian government.

Improvement Measures	Short-term Plan				
	1990	1991	1992	1993	1994
Detailed Design/Tendering	(100)				
Category A: Road Improvement					
(1) Widening of Upanga and New Bagamoyo Roads (9.8km)	(420)	(470)			
(2) Widening of Morogoro Road (5.7km)		(350)	(460)		
(3) Chan'gombe Area Roads (19.2km)		(510)			
(4) Kariakoo Area Roads (31.6km)			(900)		
(5) Mwinjuma Area Roads (16.9km)				(450)	
(6) Central Area Roads (20.0km)	(440)				
Sub-total	860	1330	1360	450	-
Category B: Urgent Repair of Pot-holes for the Selected Roads	190				
Sub-total	190	-	-	-	-
Category C: Improvement of Maintenance System					
(1) Establishment of New Main Depot	(170)				
(2) Procurement of Equipment	(50)	(60)			
(3) Technical Assistance/Training					
Sub-total	220	60	-	-	-
Annual Fund Required (Total 4,570 M)	1370	1390	1360	450	-

Exchange Rate: US\$1.0=Tsh.144=¥144 as of November, 1989.

A-1-3: Summary of the Project Cost

The project cost was calculated on the basis of work quantities and the unit prices obtained through the preliminary engineering design.

Summary of the Project Cost

Items	Foreign Component (Tsh.M)	Local Component (Tsh.M)	Total Amount (Tsh.M)
A. Construction Cost	2,356	1,408	3,764
B. Physical Contingences	221	135	356
C. Engineering	360	90	450
Sub-total (A+B+C)	2,937	1,633	4,570
D. Relocation Cost	70	50	120
E. Administration Cost	-	23	23
F. Land Compensation Cost	-	30	30
Sub-total (D+E+F)	70	103	173
Total (A to F)	3,007	1,736	4,743

Note 1: Exchange rate: US\$1.0= Tsh.144= ¥144 (As of Nov. 1989)

A-1-4 Disbursement Schedule

As shown in the above table, the government of Tanzania shall arrange the following amount of funds annually to implement the projects in the Short-term Plan:

Phase 1 (1990);	Tsh. 1,370 million
Phase 2 (1991);	Tsh. 1,390 million
Phase 3 (1992);	Tsh. 1,360 million
Phase 4 (1993);	Tsh. 450 million
Total	Tsh. 4,570 million

A-1-5: Economic Feasibility and Expected Social Impacts

(1) Economic Feasibility

It is concluded that the Project is technically and economically feasible with very high economic indicators as shown below:

Benefit/Cost	= 2.46
Net Present Value	= 4,900 M.Tsh.
Internal Rate of Return(IRR)	= 25.1%

(2) Direct Benefits

Direct benefits summing up the savings in vehicle operating cost and time cost are expected to be large. An annual benefit derived from the project in 2000 is estimated to be Tsh. 2,000 million and total amount over 15 years after completion of the project would be Tsh. 27,000 million.

(3) Socio-economic Impacts Expected

In addition to the above direct benefits, the Project is expected to bring about great indirect effects on the surrounding areas of the project as follows:

- Acceleration of land-use development on the surrounding areas of New Bagamoyo and Morogoro Roads.
- Promotion of intensive land-use in Kariakoo, Chang'ombe, Central and Mwinjuma areas where they are specialized in commercial, industry, business and residential uses respectively.
- Realization of functional hierarchy among roads, that is, New Bagamoyo road functioning as arterial road, Morogoro road as inter-regional arterial road and area road as feeder road.
- Enhancement of urban amenity by separating pedestrians from vehicles and decrease of traffic accidents.
- Stimulation of regional economy by strengthening of inter-

sector economic activities as well as by that of inter-region.

- Incentive role for the succeeding road development Projects, such as improvement of intersections and traffic signals on the roads in downtown areas of the city.

(4) People and Area Affected by the Project

The Project will exert an influence on a large majority of people and area in Dar es Salaam as shown below:

- Total number of population that will benefit directly from the Project is estimated to be 540,000 people or 40% of the whole population of Dar es Salaam City (1.3 million).
- Total number of population that will benefit indirectly from the Project would be estimated to be 880,000 people or 65 % of the city population.
- Area that will benefit from the project would cover the whole urbanized areas of Dar es Salaam City.

A-1-6: Projects to be Implemented in Middle and Long-term Plans

The improvement measures to be implemented in the Middle-term and Long-term Plans were summarized as shown below:

(1) Middle-term Plan : 1995 - 1999

- Overlay and reconstruction of the following four(4) Area Roads and two(2) Arterial Roads:

* Ilala Area Roads	13,1 km
* Oyster Bay Area Roads	27.7 km
* Kigogo Area Roads	15.8 km
* Temeke Area Roads	17.2 km
* Kilwa Road	8.6 km
* Morogoro Road	4.5 km
(Port Access - TRM 4.5km)	
Total	86.9 km

- Widening of Central Ring Road consisting of:

* Ohio Drive	1.0 km
* Sokoine Drive	0.8 km
* Gerezani Street	1.2 km
* Bandari Street	2.2 km
Total	5.2 km

(2) Long-term Plan : 2000 - 2005

- Improvement of Middle Ring Road including;
 - * Widening of Morocco, New Kigogo and Chang'ombe roads from 2 to 4 lanes, 10.8 km
 - * Improvement of intersections by grade separation at Morogoro and Uhuru intersections
 - * Construction of missing link by elevated structure in between New Kigogo and Chang'ombe roads, 1.0 km, with grade separated intersection at Pugu Road
 - * Extension of Chang'ombe road up to Port Access, 2.5 km

- Improvement of the following intersections by grade separation;
 - * Intersection of Port Access/Pugu Road
 - * Intersection of Pugu Road/Msimbazi Road

A-2 RECOMMENDATIONS

A-2-1 Implementation of Mwinjuma Area Road Projects by Direct Labour of DCC

Total amount required for the implementation of the high priority projects selected in the Short-term Plan amounts to Tsh. 4,570 million, which seems to be large compared to the annual budget of Tanzanian government.

Therefore if the Tanzanian Government shall be faced with difficulty in financial arrangement, it is recommended to implement the Mwinjuma area roads (Lot No. A-5) by the direct force of the government using the road maintenance depot and equipment to be provided under the Category C of this Project.

In order to implement the project by direct labour of DCC smoothly and efficiently, the government of Tanzania might be required to make the following arrangement:

(1) Allocation of Sufficient Local Funds

The total amount required for the implementation of Mwinjuma Area Road Project by direct labour is estimated to be Tsh. 270 million approx. An annual cost to be disbursed for the project is estimated as shown below:

<u>Year</u>	<u>Annual Disbursement</u>
1991	Tsh. 162 million
1992	<u>Tsh. 108 million</u>
Total	Tsh. 270 million

(Tsh. 1.0= ¥ 1.0 as of Nov. 1989)

(2) Establishment of Project Office and Working Units

DCC shall establish the project office and working units in charge of the project under the direct supervision of City Engineer. Since DCC may not have a sufficient staff of technicians, operators, mechanics and administrators required for organizing the working units, it is suggested to recruit these staff from MOCW, TRM and other agencies.

(3) Equipment to be used for Mwinjuma Area Road Project

It is therefore recommended to revise the type and number of equipment to be provided under Category C of this Study to meet the requirement of overlay and reconstruction of pavement

(4) Early Commencement of Mwinjuma Area Road

DCC may be able to start the construction of Mwinjuma Area Road after finishing the arrangement of project office and working units.

A-2-2 Necessity on Continuous Investment on Road Maintenance

The Dar es Salaam City is served by 1,150 km of the existing road network system consisting 150 km long of arterial road, 65 km of collector road and 935 km of local road.

In order to maintain the road network in DCC properly and timely, the government should invest Tsh. 21 million of road maintenance cost annually.

A-2-3 Improvement of Traffic Management System of the Central Area in Dar es Salaam.

In order to solve the traffic problems in the Central Area of Dar es Salaam, an improvement on traffic management system is essential. Following systems should be studied as soon as possible:

a) Improvement of Road System

- Promotion of Functional Hierarchy on road network
- Widening and formation of the Central Ring road
- Improvement of congested roundabout to signal control

b) Improvement of Traffic Control System

- Introduction of One-way control
- Strengthening of road side parking control
- Review and improvement of road closure

c) Improvement of Parking System

- Improvement of Off-street parking lots in and around the central commercial and business area
- Review and improvement of existing facilities and collection system of charge for road parking

d) Improvement of Public Transport System

- Improvement of existing bus terminals and stops with improvement of major bus route on the Central Ring road
- Relocation and Strengthening of the local bus terminal
- Introduction of bus exclusive or priority lane

A-2-4 Improvement of Middle Ring Road in the Long-term Plan

In order to solve the problems of traffic congestion in Dar es Salaam, the strengthening of Middle Ring Road is essential for the city. The Study Team strongly recommends the improvement of Middle Ring Road as shown in Fig. S.A.2.

The improvement plan proposed by the Study Team is:

- to widen Morocco, New Kigogo and Chang'ombe roads,
- to construct the missing link in between New Kigogo and Chang'ombe, and
- to extend Chang'ombe road up to Port Access.

Since the Middle Ring Road plays a vital role in the road network of Dar es Salaam City, the government is advised to commence the feasibility study at an early stage.

A-2-5 Improvement of Major Intersections in the Long-term Plan

In addition to the improvement of Middle Ring Road, the following two intersections should be improved by grade separation:

- | | |
|-------------------------------|--------------|
| (1) Pugu Road/Port Access Rd. | Diamond type |
| (2) Pugu Road/Msinbazi Rd. | Diamond type |

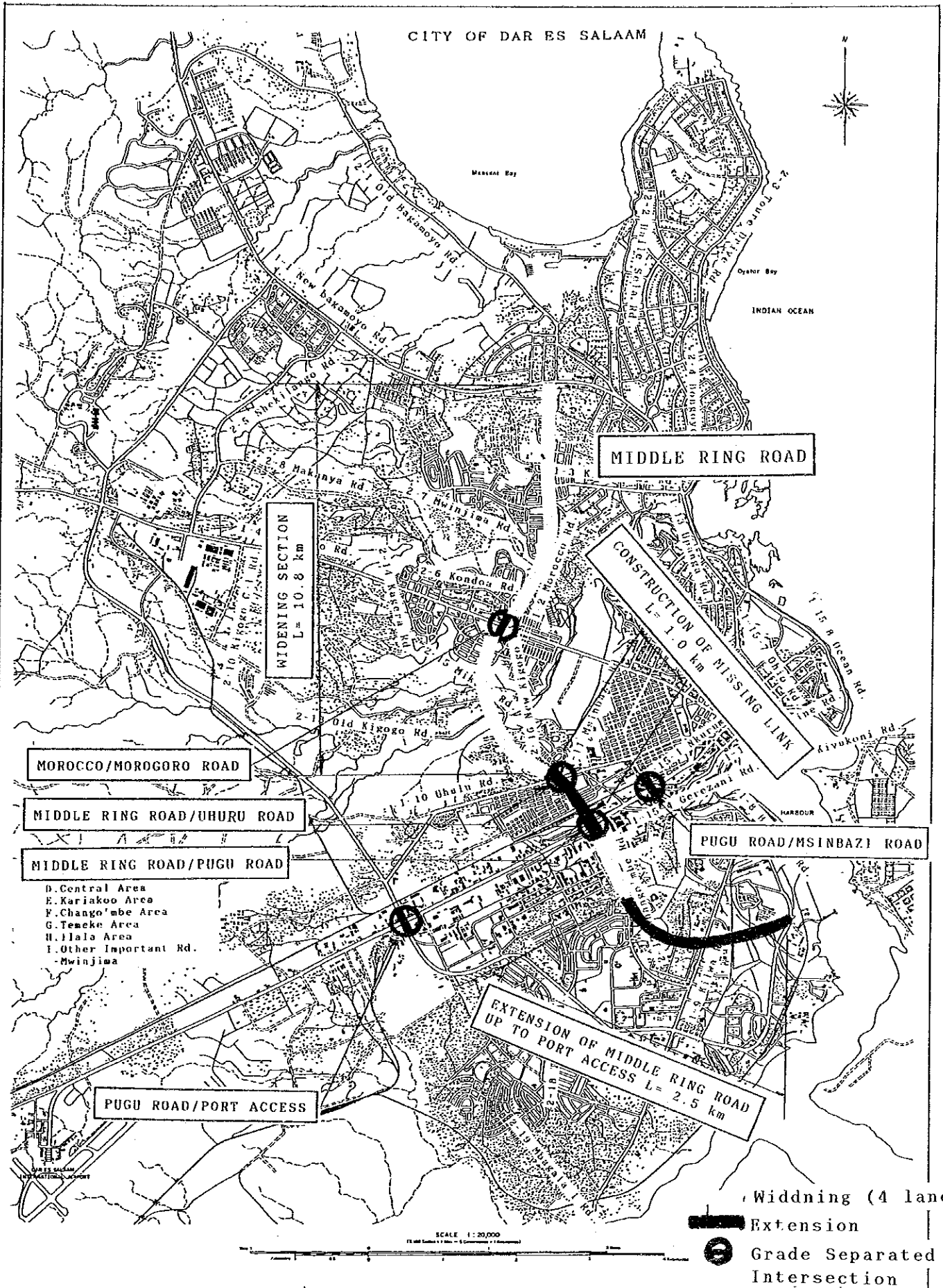


Fig.S.A.2 Proposed Improvement Plan of Middle Ring Road and Intersections in Long-Term Plan

B. SUMMARY OF THE STUDY

This summary contains the major findings and results of the Study obtained by the JICA Study Team who carried out their works during the period from March, 1989 to July, 1990.

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Recognizing the urgent need for improvement and rehabilitation of the city roads in Dar es Salaam, the Government of the United Republic of Tanzania requested the Government of Japan to provide technical assistance for the feasibility study on those city roads which have seriously deteriorated due to long absence of road maintenance.

In response to this request, the Government of Japan decided to carry out the Feasibility Study on Road Improvement and Maintenance in Dar es Salaam (hereinafter referred to as "the Study")

1.2 Objectives of the Study

The objectives of the Study is:

- to identify the existing problems and issues on the city roads including the road maintenance and operation systems through the field surveys and analysis and identify the necessary improvement measures to be conducted in the Short, Middle and Long-term Plans.
- to carry out the supplementary field surveys and preliminary design for the high priority projects selected to be implemented in the Short-term Plan and confirm their engineering and economic feasibility.

CHAPTER 2 OUTLINE OF THE STUDY AREA

2.1. Characteristic of the Study Area

Dar es Salaam is the former capital city of Tanzania and is the country's principal center of administration, social and economic activities. It lies on the coastal plain with the Indian Ocean to the East and Pugu Hills to the West.

The Study area covers the whole city of Dar es Salaam having 1.390 sq.km, with the biggest population of 1.36 million in 1988.

2.2 Socio-economic Situation

(1) Administrative Areas

The Study Area is divided into 3 administrative districts which consist of 52 wards in total as follows:

- Temeke District : 16 wards
- Kinondoni District : 18 wards
- Ilala District : 18 wards

(2) Population and Employment

The population of Dar es Salaam was 356,286 in 1967, 843,090 in 1978 and 1,360,850 in 1988 and shows that the growth rate of the Dar es Salaam has been decreasing from the rate of 7.8 % during 1967 to '78 to the rate of 4.8 % during 1978 to '88, because of the establishment of the Dar es Salaam Master Plan and the introduction of the decentralization of the industry.

Total number of employment of Dar es Salaam is assumed 231,000 in 1988 approximately and increased about 3.92 times from 1966, while the employment/population ratio was 18% in 1988 steadily.

(3) Land-use Pattern

Present Land-use pattern of Dar es Salaam consists of one city center with a radial road network.

Some extension of surrounding urban area, such as extension of Planned Residential area along Bagamoyo road, Kilwa road and at Tabata area, extension of Unplanned Residential area

along Morogoro road, Pugu road and Kilwa road and extension of Industrial area along Bagamoyo road, Port Access road, Pugu road and some at Kinondoni area, are remarkably realized.

(4) Gross Regional Product

The Gross Domestic Products (GDP) data of Tanzania are only available for the analysis of the Gross Regional Products and the GDP of Tanzania was 198.1 billion shillings and per capita GDP was about 8,800 shillings in 1987.

A high annual growth rate of 3.9% was counted in 1986, while the growth rate to 1988 is forecasted at about 4.0%. These figures of the annual economic growth rate during 1984 and 1987 were just higher than the population growth rate of 2.8% per annum.

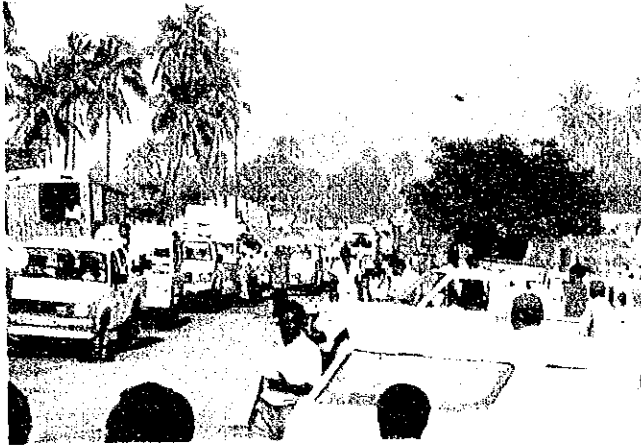
(5) Transport Facilities

The Transport Facilities of Dar es Salaam consist of the following:

- Dar es Salaam International Airport has a 3000m long and 60m wide runway, new passenger terminal facilities, and has an additional cross runway of 1000m long and 30m wide.
- The facilities of Dar es Salaam Port comprise of container, deep-sea general cargo, deep-sea oil products berth and other coastal facilities and these deep-sea facilities are relatively modern.
- The two railway lines namely the Central line served by Tanzania Railway Corporation (TRC) and Tanzania-Zambia line served by Tanzania Zambia Railway Authority (TAZARA). The two railway line serve to haul much passenger and freight traffic to and from the city, but the trends of the passenger and freight haulage of TRC and TAZARA are decreasing.
- Public bus transportation within Dar es Salaam is undertaken by the company of UDA (Shirika la Usafiri Dar es Salaam) with 59 bus routes planning to link various sections of the City, but it is very congested owing to the lack of bus operations.

TRAFFIC CONDITIONS

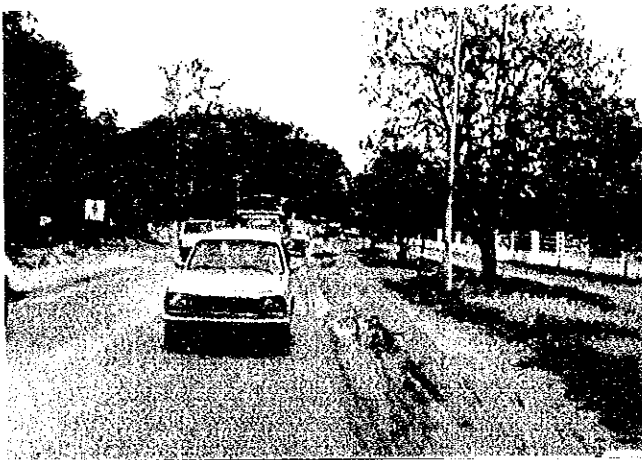
Morogoro Road



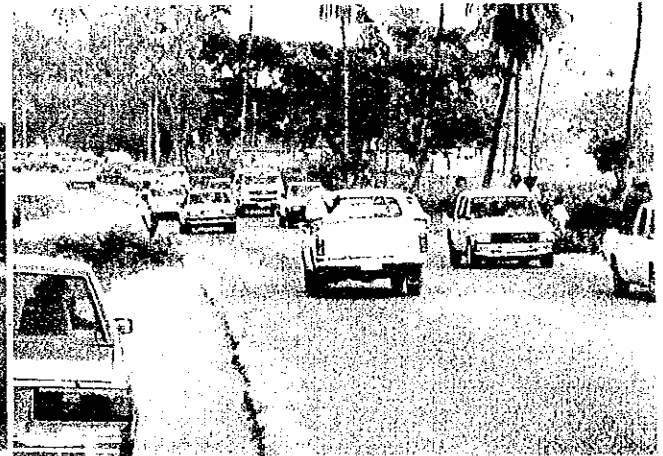
Morogoro Road at Manzese



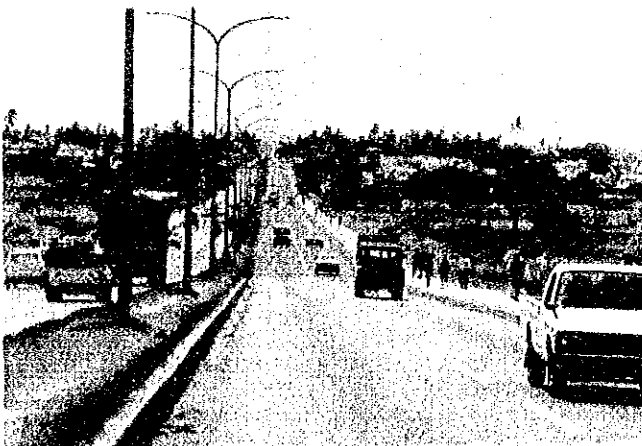
Upanga Road



New Bagamoyo Road



Morogoro Road (completed section)



Selender Bridge (completed)



CHAPTER 3 TRAFFIC SURVEY AND ANALYSIS

3.1 Traffic Survey Conducted

In order to realize the existing traffic problems, three kinds of Traffic Survey, Origin Destination (O-D) Survey, Traffic Count Survey and Running Speed Survey, were conducted on most of the main roads in Dar es Salaam.

3.2 Results of Traffic Survey

The existing Average Daily Traffic (ADT) in passenger car unit (p.c.u.) were calculated after adjustment of daily and weekly traffic variations.

Table S.3.1 Summary of Existing ADT and Congestion Ratio on the Classified Road

Road Class	Lane No.	ADT(1000pcu/day)			Congestion rate(per day)		
		Max.	Min.	Ave.	Max.	Min.	Ave.
Arterial	4	42.6	8.2	22.4	0.8	0.1	0.4
	2	25.6	7.6	15.5	1.9	0.3	1.1
Collector	2	17.1	2.5	8.1	1.2	0.2	0.7

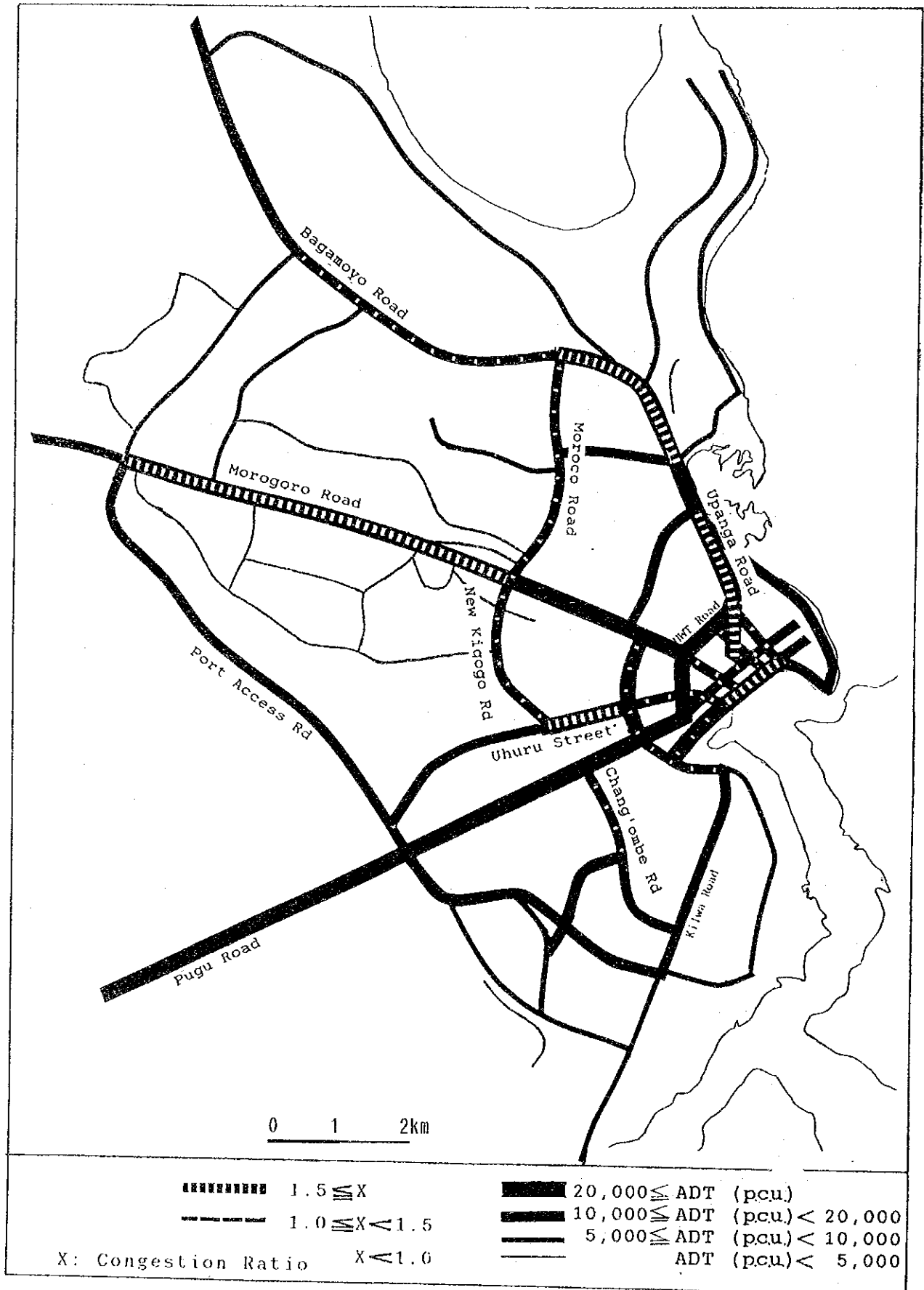
Fig. S.3.1 shows that the radial arterial roads, such as Bagamoyo road, Morogoro road, Pugu road, Uhuru street, and some streets in the city-center are having more than 20,000 p.c.u./day traffic and there are chronically congested roads with a congestion ratio of more than 1.5 on Bagamoyo road, Upanga road, Morogoro road, Uhuru street and Sokoine Drive.

3.3 Analysis of Existing Traffic Problems

The following are the traffic problems identified and their improvement methods obtained from the traffic survey:

- Congestion on the arterial road: Widening of arterial roads and establishment of Middle Ring Road;
- Congestion in the city center: Improvement of intersections;
- Traffic restriction by road surface condition: Improvement of Road Surface condition;
- Lack of proper bus-stop: Provision of bus-bays on congested roads and;
- Lack of Traffic data: formation of Traffic Monitoring System

Fig. S-3-1 Present Traffic Volume and Congestion Ratio



CAUSE OF TRAFFIC CONGESTION

Peak-hour Traffic on Morogoro Road



Roundabout



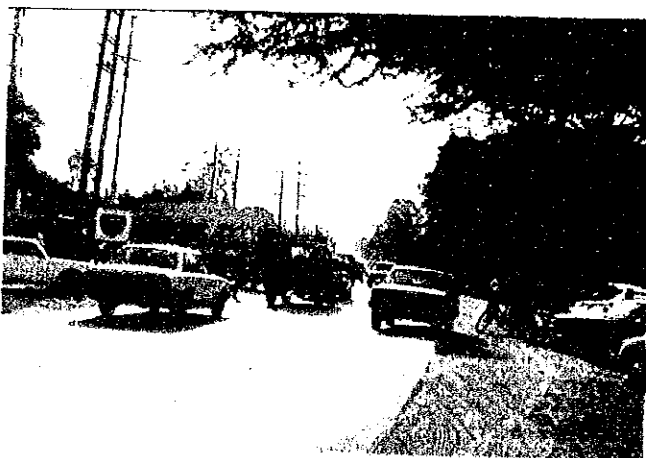
Lack of Bus-bay



Pavement Deterioration



No proper Signal Control



Poor Drainage System



CHAPTER 4 FUTURE FRAMEWORK

In order to estimate the future traffic volume on the road network of Dar es Salaam, the existing socio-economic data and information have been analysed and three authorized plans, namely the Economic Recovery Programme, the Dar es Salaam Master Plan, and the City Council Integrated Programme, were also reviewed.

4.1 Population and Employment Projection

Referring to the projection of population and employment in the Master Plan, the difference between the projection of the Master Plan and the assumption of the updated trends in the Study is very small. Therefore, the target future in 1999 on the Master Plan will be considerable as the future population and employment in 2000 for the Study. (see Table S.4.1)

Future distribution of population and employment have been established to the traffic zone in accordance with the basic concept of population distribution in the Master Plan.

4.2 Transport Projection

As a result of long range analysis, the growth rate of total daily traffic on the Inner Cordon-Line was 1.9% per annum between 1982 and 1989 while the growth rate of real GDP and population of Dar es Salaam was 2.0% per annum between 1977 and 1987 and 4.8% per annum between 1978 and 1988 respectively. (see Table S.4.2)

Considering the recent progress of economic recovery and the future growth rate of population of Dar es Salaam, the future economic growth by 2000 will be assumed as about 4% per annum in accordance with the projection of GDP growth rate of 4-5% per annum by 1993 in the New Five Year Development Plan.

Thus the average growth rate of Traffic on the Cordon-line will be around 4% per annum for total traffic, 4% for car and light goods vehicle, 10% for bus and 2% per annum for trucks respectively.

Table S 4.1 Future Population and Employment of Dar es Salaam

unit : 1000 people

	<u>the Master Plan</u>		<u>the Study</u>	
	1978	1999	1988	2000
Population	843.1	2,461.0	1,360.9	2,461.0
		(5.2%) ^{1/}		(5.0%) ^{1/}
Employment	129.1	418.3	231.3	418.3
-Manufacturing	37.4	148.2	64.8	148.2
-Commerce	14.0	71.0	37.0	71.0
-Public Service & Utilities	33.0	82.8	74.2	82.8
-Transport & Communications	26.0	78.1	26.3	78.1
-Constructions	16.0	32.6	6.9	32.6
-Mining	0.1	0.1	0.6	0.1
-Agriculture	2.6	5.5	1.6	5.5

^{1/} The figures in parentheses show the average annual growth rate.

Table S.4.2 Comparison of Traffic Growth and socio-economic Growth

Item	<u>Present</u>		<u>Future</u>	
	Average Growth Rate	Period	Average Growth Rate	Period
	(%)		(%)	
<u>12hrs Traffic</u> Car & <u>on the Inner</u> Light goods	1.4		4	
<u>Cordon line</u> Bus	11.0	1982-89	10	1989-2000
Truck	-1.1		2	
<u>Total</u>	<u>1.9</u>		<u>4.3</u>	
<u>Motor Vehicles on Roads</u>	-0.7	1980-87		
	(3.6)	(1984-87)		
<u>Population</u> Dar es Salaam	4.8	1978-88	5.0	1988-2000
Tanzania	2.8	1978-88		
<u>GDP</u> Tanzania	2.0	1977-87		
	(3.5)	(1984-87)	4	1989-2000

CHAPTER 5 TRAFFIC DEMAND FORECAST

5.1 General

This chapter includes the forecast of future (the year 2000) traffic demand based on the traffic survey data conducted on May, 1989 and the recommendation for the proposed future road network for the city of Dar es Salaam.

5.2 Result of Traffic Forecast

5.2.1 Traffic Generation and Attraction

The future traffic generation and attraction volume in the city of Dar es Salaam was estimated as 415,963 trip-ends/day in 2000 from the existing value of 268,687 trip-ends/day in 1989 and its growth rate was 1.55 times. The zones having considerable generation and attraction volume of more than 20,000 trip-ends/day in future are the City Center, Keko, Msasani, Kariakoo, and Ubungo areas.

5.2.2 Traffic Distribution

The traffic movement in Dar es Salaam tends to be concentrated in the City Center. At present, the concentration ratio to the City Center of all traffic trips are 19.5%, and in future it is estimated at 15.3%. But a ratio of a trip between the city and out of the city to the total trips in future will be only 1.1% almost same as the existing figure.

5.2.3 Traffic Assignment

The forecast of future traffic demand on the existing road network estimated by the traffic assignment method is shown in Fig. S-5-1.

In order to solve the existing traffic congestion and to prepare for the future traffic increase, future road network has been established and the forecast of future traffic demand on the future road network is shown in Fig. S-5-2.

As shown in Table S-5-1 and Fig. S-5-2, if proposed future road network will be constructed for the future traffic demand, almost of road links will be less than 1.0 of congestion

ratio as a level of smooth traffic condition.

Table S-5-1 Comparison of Future Traffic Conditions

<u>Road Network</u>	<u>Ave. Congestion Ratio</u>	<u>Ave. Velocity</u>
Existing Network	1.045	33.8(Km/hr)
Proposed Network	0.669	50.3

5.3 Proposed Future Road Network

Based on the analysis of future traffic increase and consideration from the view point of construction of future road network, a proposed widening of arterial roads from 2 to 4 lane divided into three stages such as Short, Middle and Long-term plan is listed in Table S-5-2 and illustrated in Fig. S-5-3.

Referring to Table S-5-2, it is proposed that Widening of the radial road network system for the Short-Term Plan, Widening of the Central Area Roads with the introduction of Traffic Control Devices within the new Central Ring Road connecting with UWT Road for the Middle-Term Plan and the establishment of new Middle Ring Road by the construction of missing links between New Kigogo Road and Port Access Road (Nelson Mandela Road) for Long-Term Plan.

And it is also proposed that an introduction of Grade Separated Intersection will be considered for the Long-Term Plan on the following important intersections crossing between dual carriageway road of which the future traffic volume will be over the traffic capacity of signal controlled intersection.

- Intersection of Pugu Road and Port Access Road
- Intersection of Pugu Road and New Middle Ring Road
- Intersection of Pugu Road and Msimbazi Road
- Intersection of New Middle Ring Road and Morogoro Road
- Intersection of New Middle Ring Road and Uhuru Road

Table S-5-2 Proposed Future Road Network to be Widened from 2 lane to 4 lane

Implementation Plan		Road Name
Short-Term: Plan	<u>Strengthening of the radial road network system in Dar es Salaam</u>	<ul style="list-style-type: none"> - Upanga Rd. (from UWT St. to U.N. Rd.) - Bagamoyo Rd. (from Selender Bri. to Morocco Rd.) - Morogoro Rd. (from Morocco Rd. to Port Access) - Uhuru Rd. (from Msimbazi Sr. to Nursery School)
Middle-Term: Plan	<u>Strengthening of the Central Area Roads for the formation of Central Ring Road</u>	<ul style="list-style-type: none"> - Sokoine Drive (from Post Office to Gerezani St.) - Gerezani St. (from Pugu Rd. to Sokoine Drive) - Bandari St. (from Gerezani St. to Port Access) - Ohio St. (from Upanga Rd. to Sokoine Drive)
Long-Term: Plan	<u>Strengthening of a Middle Ring road by construction of missing link between New Kigogo and Chango'mbe road by widening from 2 lane to 4 lane</u>	<ul style="list-style-type: none"> - Morocco Rd. - New Kigogo Rd. up to Uhuru Road with Widening - Chang'ombe Rd. (from Pugu Rd. to Port Access) - Bagamoyo Rd. (from Morocco Rd. to Mpakani Rd.) <div style="display: flex; align-items: center; margin-left: 200px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; width: 200px; height: 60px; margin-right: 10px;"></div> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 10px;">Construction</div> <div style="margin-bottom: 10px;">of Middle Ring</div> <div>Road</div> </div> </div>

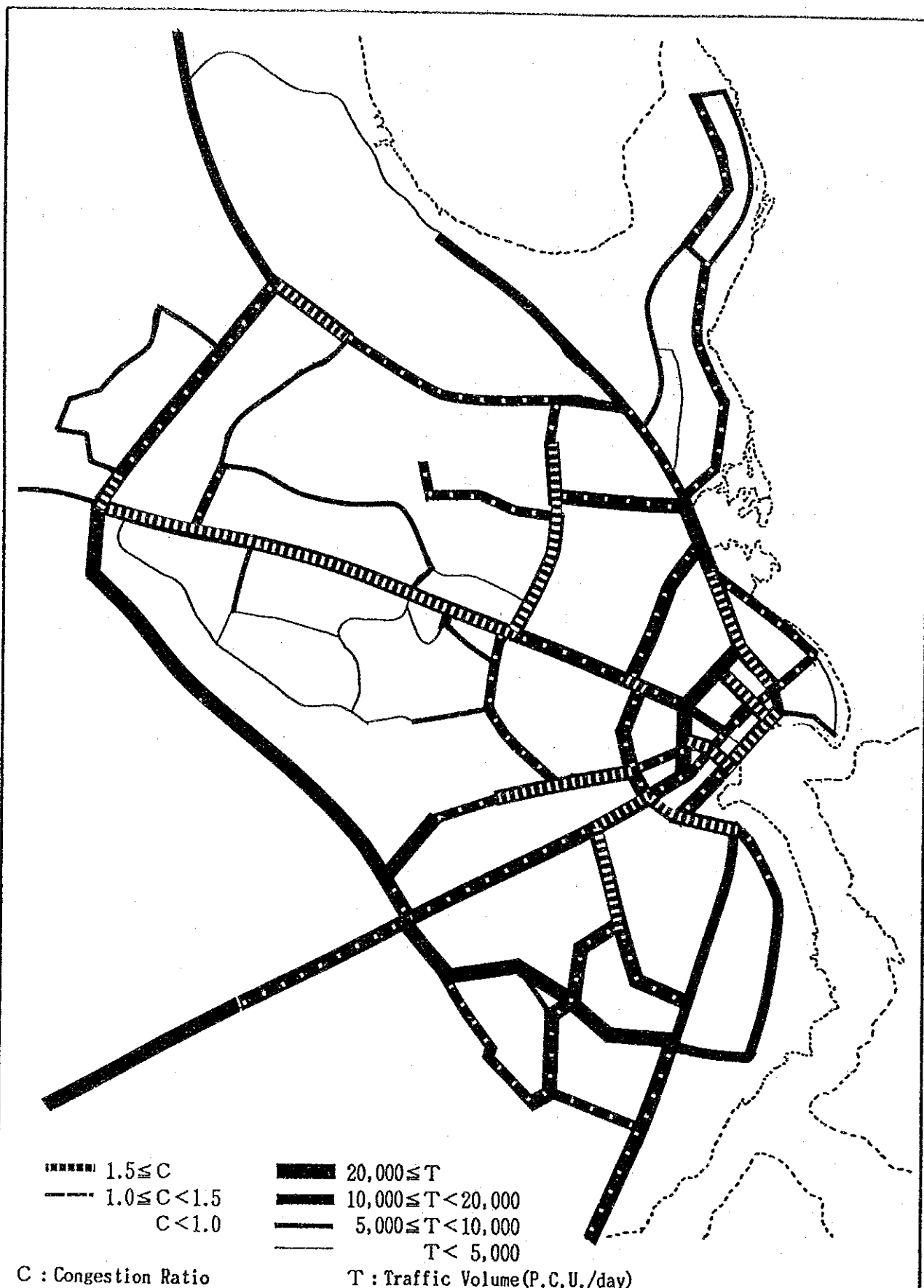


Fig S-5-1 Future Traffic Assignment on the Present Road Network

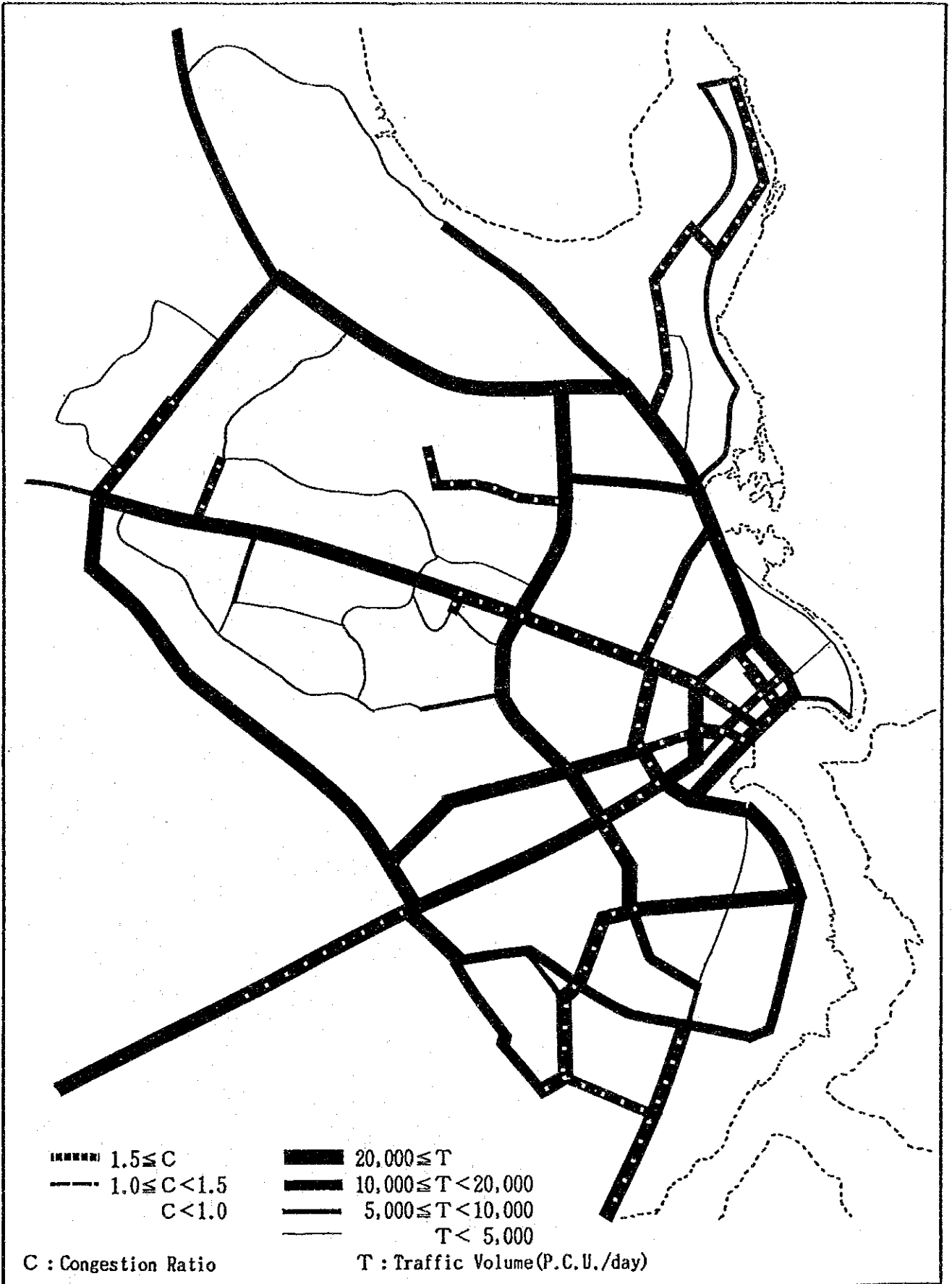
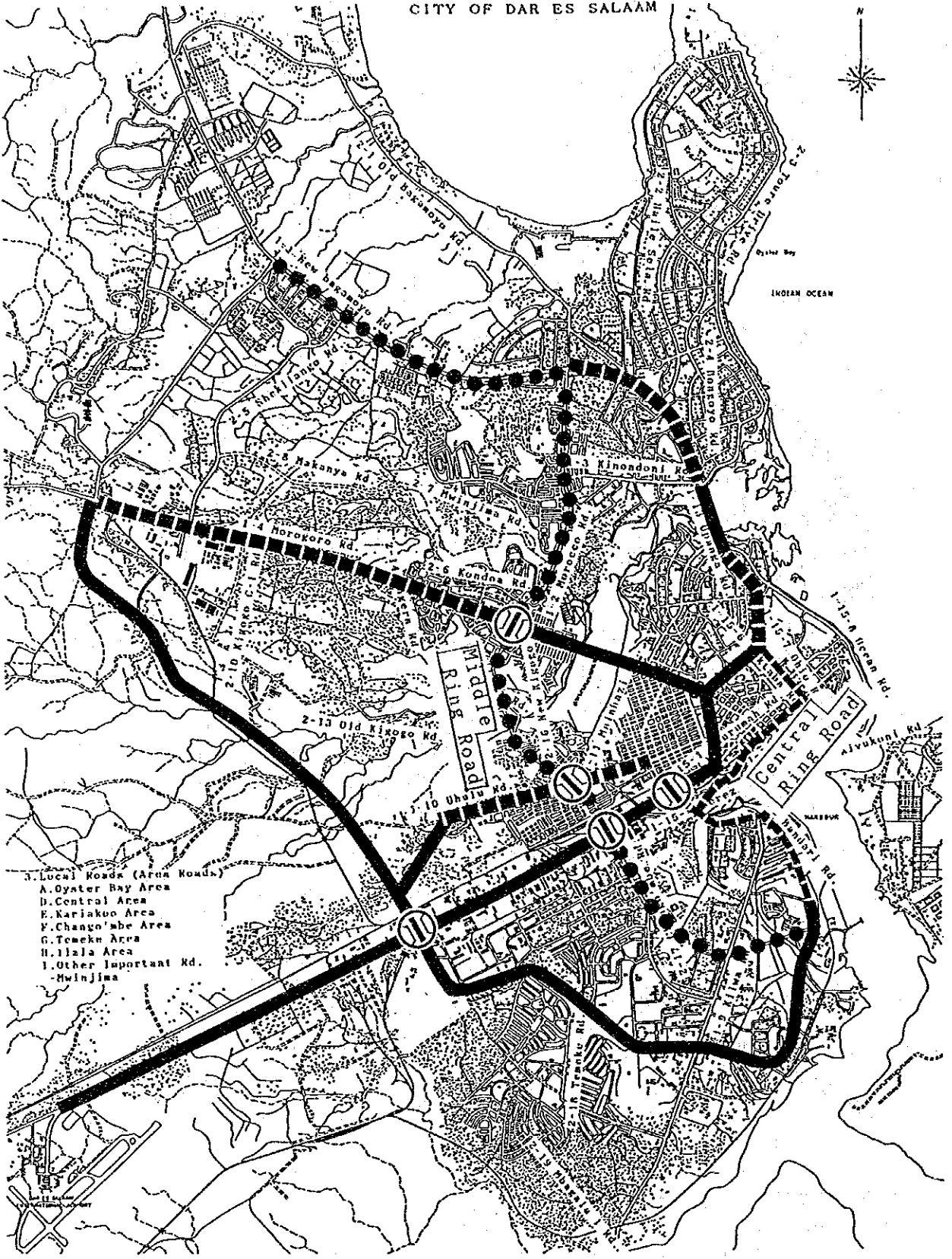


Fig S-5-2 Future Traffic Assignment on the Proposed Road Network

CITY OF DAR ES SALAAM



- 3. Local Roads (Area Roads)
- A. Oyster Bay Area
- D. Central Area
- E. Kariakoo Area
- F. Chaago'she Area
- G. Temeko Area
- H. Ilala Area
- I. Other Important Rd. - Mwinjima

SCALE 1:20,000






-  Present 4 lane
-  Short Term 4 lane
-  Middle Term 4 lane
-  Long Term 4 lane
-  Grade Separation in Long-Term

Fig.S-5-3 Proposed Future Road Network

CHAPTER 6 IDENTIFICATION OF ROAD NETWORK

6.1 Existing Road in Dar es Salaam

The city of Dar es Salaam is served by 1,150 km approx. of the existing roads network system of a hierarchy of arterial, collector and local roads as shown in Fig. S.6.1 and in Table S.6.1.

Table S.6.1 Existing Classified Roads

<u>Classification</u>	<u>Total Length(km)</u>	
1. Arterial Roads	<u>148</u>	(13%)
4-lanes paved roads	35	
2-lanes paved roads	113	
2. Collector Roads	<u>65</u>	(6%)
2-lanes paved roads	52	
2-lanes unpaved roads	13	
3. Local Roads	<u>933</u>	(81%)
2-lane paved roads	251	
Minor unpaved roads	682	
<u>Total</u>	<u>1,146</u>	(100%)
Paved roads	451	(39%)
Unpaved roads	695	(61%)

6.2 Priority Roads Proposed by DCC

Priority Roads Proposed by DCC are presented in Table S.6.2.

6.3 Road Subject to the Study

Roads subject to the Study cover all arterial and collector roads in the city and important local roads in 8 areas proposed by DCC as shown below:

-All arterial roads	(23 routes)	148.5km
-All collector roads	(21 routes)	65.5km
-Important local roads	(128 routes)	91.2km
	Total	305.2km

Table S.6.2 Priority Roads Proposed by DCC

No.	Name of Roads	Length Measured by St.Tm.	Length Estimated by DCC	Road Classification
<u>Group 1: Arterial and Collector Roads</u>				
1.	Old Bagamoyo Road	8.2	(8.4)	Collector road
2.	Old Kigogo Road	6.8	(6.0)	Collector road
3	Shekilango Road	3.8	(4.4)	Collector road
4	Morocco Road through Kigogo to Uhuru Road	6.2	(6.8)	Arterial road
5	Kinondoni Street	0.7	(0.7)	Arterial road
6	Morogoro Road incl. 4.5 km of TRM	9.5	(8.0)	Arterial road
7	Uhuru Road	2.8	(2.3)	Arterial road
8	Gerezani St.(1.2km) incl. Bandari Road(2.2km) & Kilwa Raod(8.6km)	12.0	(12.0)	Arterial road
9	Chang'ombe Roads incl. Temeke Road(1.9km) & Mbagala I Road (1.4km)	7.9	(8.0)	Collector road
Total of Group 1 :		<u>57.9 km</u>	<u>(56.6 km)</u>	
<u>Group 2: Area Roads</u>				
A	Oyster Bay Residential Area Streets	19.5	(19.0)	Incl. 3 collec. roads.(12.1km)
B	Mwinjuma Road	2.4	(2.4)	Collector road
C	Magomeni Area Streets	3.2	(3.2)	2 collec. roads
D	Central Area Streets	17.5	(16.9)	Incl. 5 arterial roads.(7.2km)
E	Kariakoo Commercial Area Streets	31.6	(31.4)	
F	Chang'ombe Area Streets	14.6	(14.6)	
G	Temeke Area Streets incl. Mbagala II (2.0km)	13.9	(13.0)	
H	Ilala Commercial and Residential Area Streets.	10.3	(10.3)	
Total of Group 2 :		<u>113.0 km</u>	<u>(110.8 km)</u>	
Grand Total :		<u>170.9 km</u>	<u>(167.4 km)</u>	

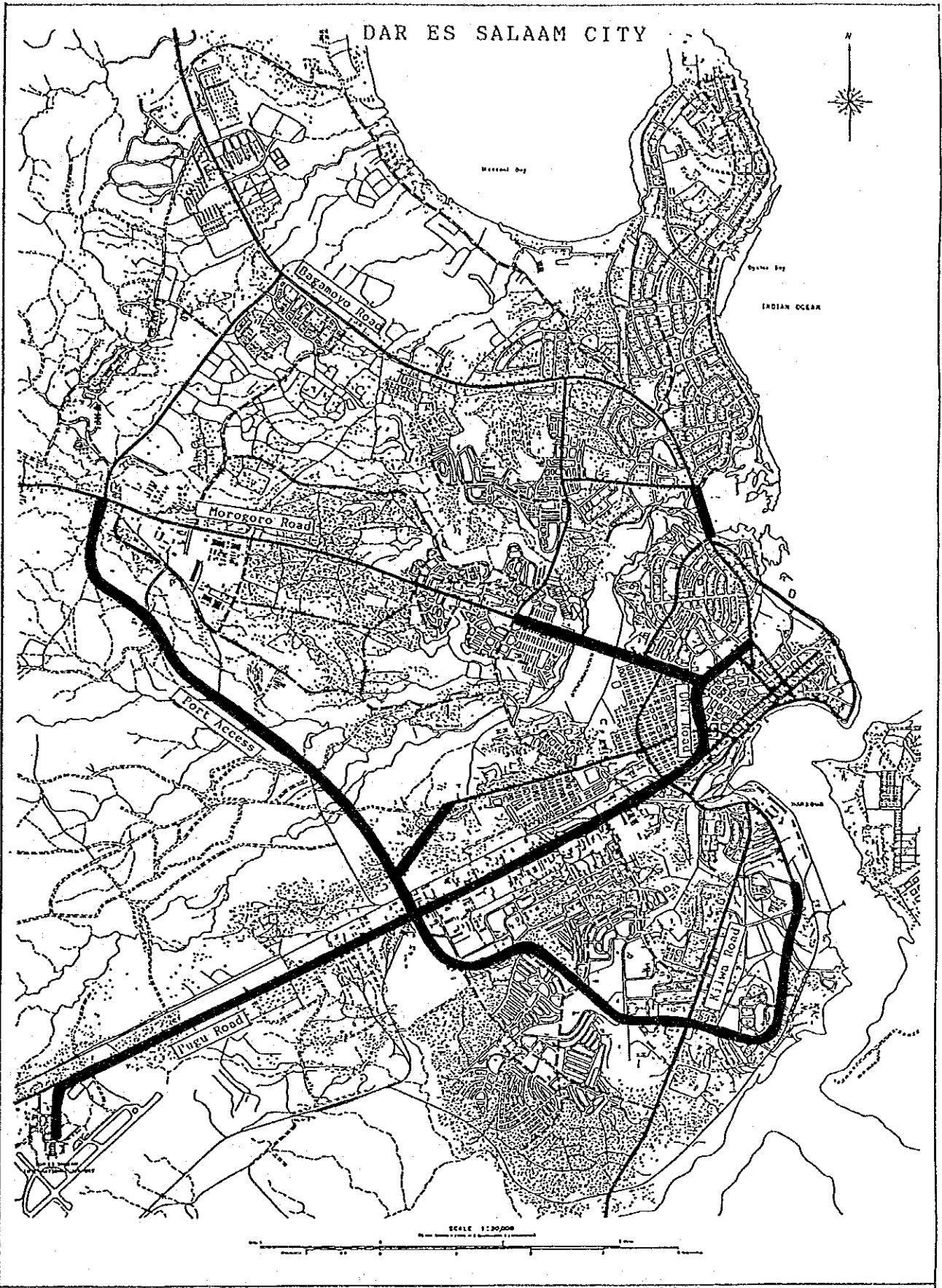


Fig.S-6-1 Existing Classified Road System in Dar es Salaam

- Arterial Roads
- 4 lanes paved roads:
- 2 lanes paved roads:
- Collector Roads
- 2 Lanes paved roads:
- 2 Lanes unpaved roads:
- Local Roads
- Key plan not applicable

CHAPTER 7 ENGINEERING SURVEY AND ANALYSIS

7.1 Road Inventory Survey

A road inventory survey was conducted on the roads subject to the study with a total length of 305.2km. The beginning and ending points of each road, classification, width of carriageway and shoulder, horizontal and vertical alignment, pavement condition drainage and bridge structures, and land-use pattern along roadside were recorded.

7.2 Drainage Survey

The drainage system of the roads located in the urban areas are composed of lined channel and underground piped drainage structures. This drainage system, however, is not working well due to poor maintenance which have caused damage on road pavement seriously. Improvements of storm drainage system are also needed urgently to dissolve the floodings.

7.3 Pavement Condition Survey

The pavements of existing roads were inspected by means of Present Serviceability Index (PSI). The survey revealed that almost 80 % of roads in the City have deteriorated to the level where overlay or reconstruction measures are required.

Fig.S.7.1 shows the existing pavement conditions classified into the level of countermeasures required. The summary of road conditions by countermeasures are summarized in Table S.7.1 below:

Table S.7.1 Road Section by Countermeasures

<u>Roads Subject to the Study</u>	<u>Total Length</u>	<u>PSI than 2.5 Maintenance</u>	<u>2.5 Overlay</u>	<u>1.5 PSI less than Reconstruction</u>
Arterial Roads	148.5	52.5	81.3	14.7
Collector Road	65.5	11.6	22.3	31.6
Local Road	91.2	0.0	32.3	58.9
Total	305.2 km (100.0%)	64.1 km (21.0%)	135.9 km (44.5%)	105.2 km (34.5%)

7.4 Traffic Condition of Intersections

The intersections controlled by roundabout seemed to be overloaded. The following two (2) roundabouts might be improved to signal controlled intersections to meet the traffic during peak flow:

- Tanganyika Motors Roundabout at Upanga, and
- Uhuru Roundabout at Msimbazi Road.

7.5 Bus Bay Facilities

Bus services is the major transport means of the people in Dar es Salaam. Their operations however frequently hinder traffic flows due to the lack of bus bays and the inappropriate location of bus stops. In order to improve the traffic condition in the City, bus bays should be provided sufficiently, especially on the following roads:

- Uhuru Road, Morogoro Road, Morocco Road, and New Bagamoyo Road.

7.6 Roads Selected for Implementation Plan

The roads to be studied for subsequent implementation plan were selected by the Study Team taking into account the following factors:

- Deterioration of pavement reached to the level below PSI 2.5 where roads require overlay or reconstruction,
- Congestion of the roads reached to the level above C.R.1.5 where roads require widening from 2 to 4 lanes, and
- Priority given by DCC

Based on the above, 116.6 km over 35 arterial and collector roads, and 88.7 km over 126 routes of local roads in 8 areas are selected by the Study Team as shown below and presented in Fig.S.7.2.

Roads Selected for Implementation Plan

Arterial/collector roads:	116.6 km over 35 routes
Local roads in 8 areas :	88.7 km over 126 routes
Total	205.3 km over 161 routes

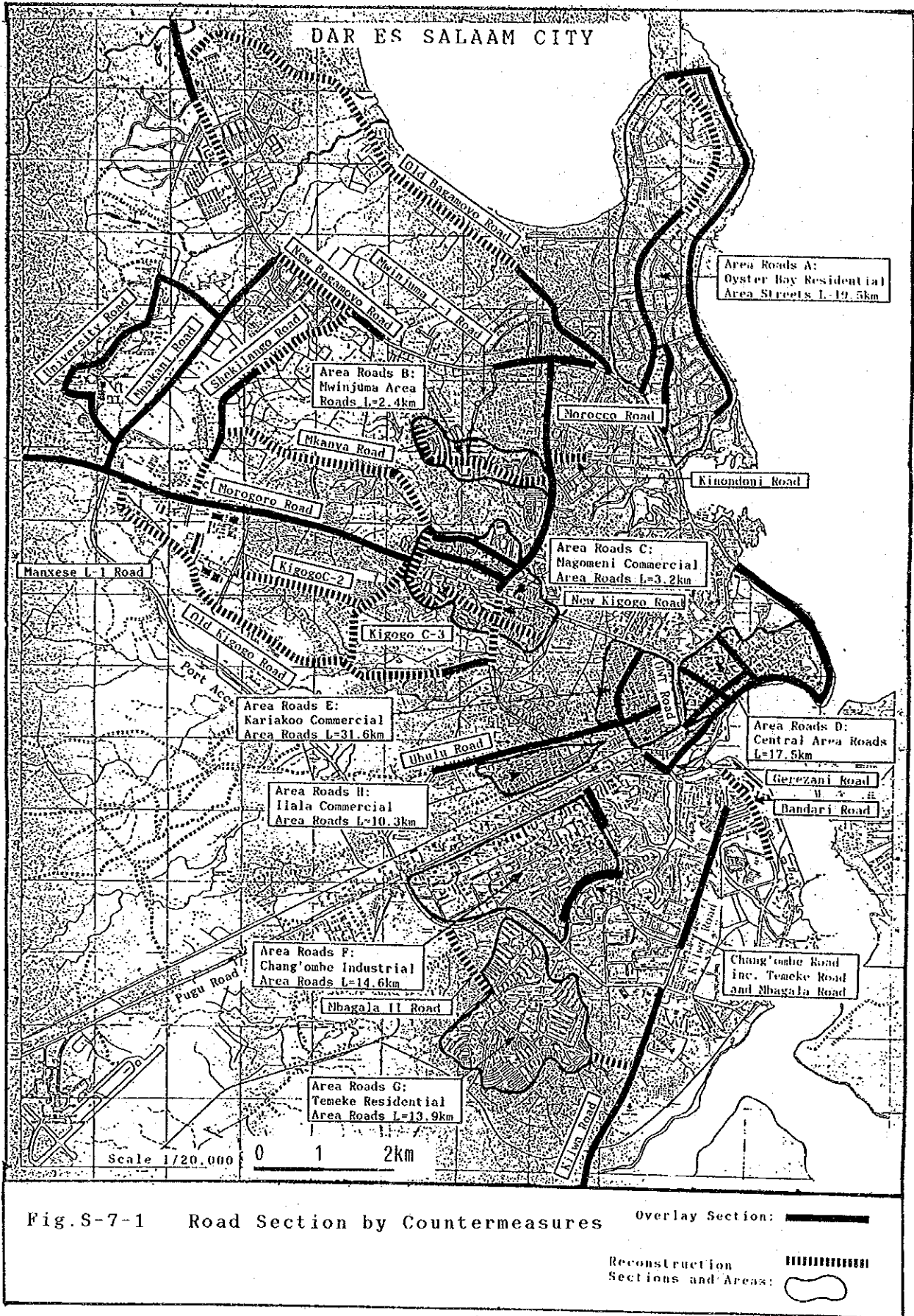


Fig.S-7-1 Road Section by Countermeasures

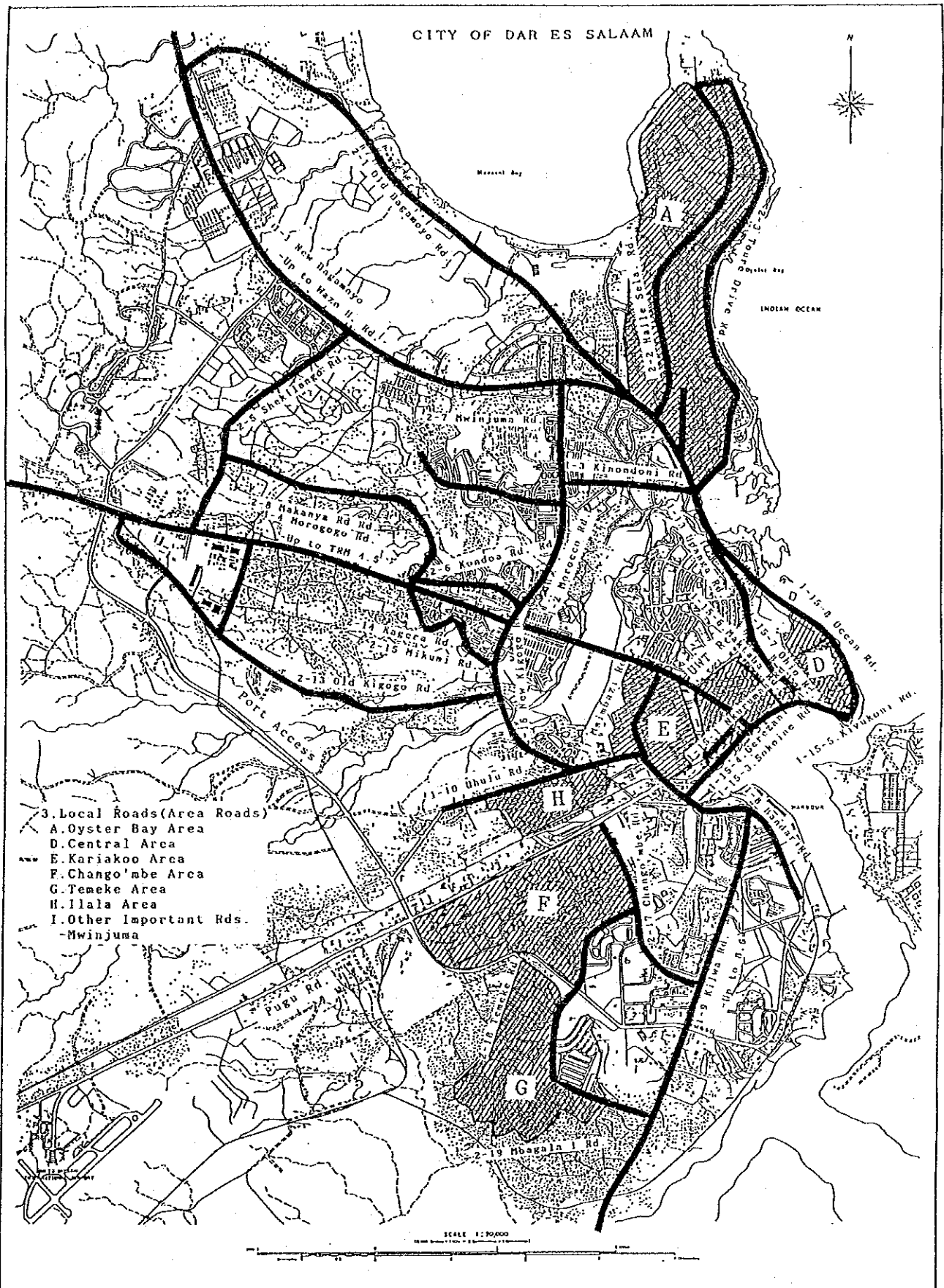


Fig.S-7-2 Roads Selected For Further Study(205Km)

Arterial/Collector Roads:

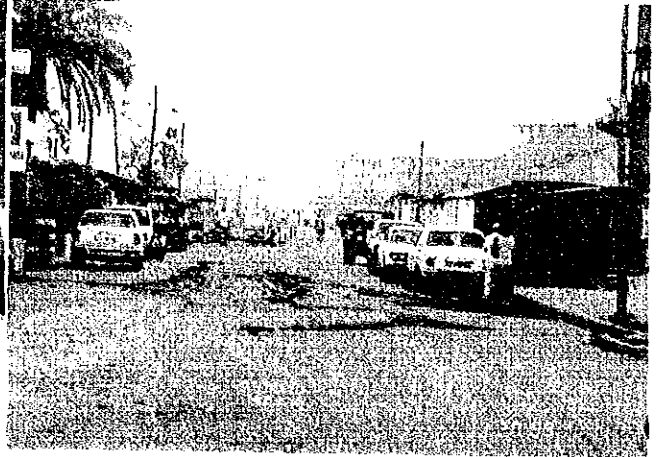
Local Roads (Area Roads) / Other Important Roads:

EXISTING PAVEMENT CONDITIONS

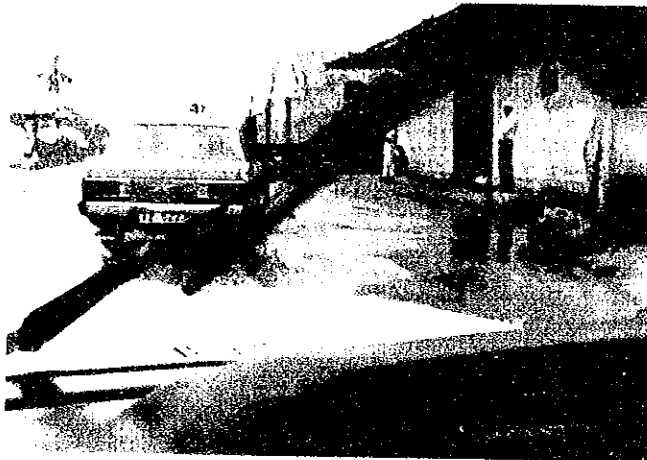
Central Area



Kariakoo Area



Chango'mbe Area



Mwinjuma Area



Morogoro Road



New Bagamoyo Road



CHAPTER 8: EXISTING ROAD MAINTENANCE AND OPERATION SYSTEM

8.1 Present Maintenance system

The survey revealed that the existing roads in Dar es Salaam have deteriorated mainly due to insufficient funds for road maintenance and inadequate road maintenance organization as shown below:

(1) Maintenance Expenditures

Present roads in the City have seriously deteriorated to the level far beyond routine maintenance due to inadequacy of funds in the past few years.

Road maintenance outlays spent by DCC over the past five years were only Tsh. 30 to 40 million per year which seems to be too small to maintain the whole city roads with a total length of 1,150 km in good conditions, if compared with other countries.

(2) Main and Site Depots

According to the organization chart, main depot is under Mechanical Workshop Section but not Road Section in Engineering Department of DCC. As the result, road maintenance works seems to have not been done well due to the complicated organization and communication.

The four site depot allocated in each district in DSM have no adequate equipment/vehicles for maintenance to cover the road in each district.

In order to improve maintenance activities, the Study Team recommends the establishment of a road maintenance depot under the direct control of the Road Section of the Engineering Department of DCC.

8.2 Maintenance Activity

The excessive damage of pavement in the City has been caused due to not only shortage of funds but also to the lack of concrete plan and programme for road maintenance in Dar es

Salaam.

It is recommended to establish a road maintenance unit in Engineering Department of DCC to prepare concrete action programmes and basic maintenance manuals including data on road inventory, traffic count data, design standard, etc.

It is also recommended that the DCC establish a monitoring system in Road Section to get the information on road conditions daily or weekly so as to enable the maintenance unit to carry out prompt repair of pavement.

8.3 Road Maintenance Equipment

As the results of survey, most of the equipment used for road maintenance are defective due to being old modelled, poor maintenance for equipment and shortage of spare-parts.

Since the present workshop in the main depot is responsible not only for road equipment but also for all equipment belonging to DCC, capability of maintenance or repair for these equipment seems to be overloaded.

In order to maintain these equipment properly in good conditions, it is necessary to establish a new road maintenance depot with a well-equipped workshop as soon as possible.

PRESENT ROAD MAINTENANCE

No Maintenance



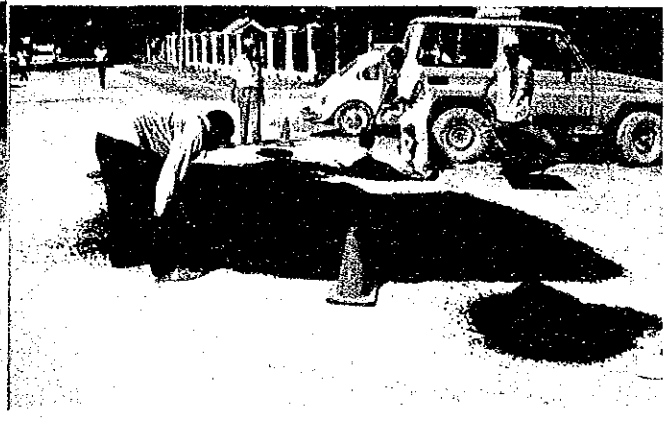
Poor Drainage



Pot-holes



Unsatisfactory Maintenance



Existing Condition of Central Work-shop



Existing Condition of Site Depot



CHAPTER 9 IMPROVEMENT OF ROAD MAINTENANCE SYSTEM

9.1 Proposed Maintenance Activities

In order to prepare the maintenance programmes and manuals, road maintenance activities should be defined as follows:

- Routine Maintenance: Required continuously on every road as road furniture installation, bush clearing, ditch cleaning, gravel patching, dragging, pot-hole patching and grading.
- Periodic Maintenance: Regravelling, repairing rut dragging, repairing edges, resealing cracks and surface dressing.
- Urgent Maintenance: Needed to deal with emergencies and problem calling for immediate action when a road is blocked.

9.2 Proposed Organization of Road Maintenance System

The road maintenance system proposed by the Study Team consists in the establishment of a new Maintenance Unit, Main Road Depot and 4 Site Depots under the Road Section of DCC as shown in Fig.S.9.1.

Each organization should have the following responsibilities:

(1) Road Maintenance Unit

- to evaluate existing road features for prompt repairing.
- to prepare road maintenance programmes and other technical requirements.

(2) Main Road Depot

- to carry out Routine Maintenance for all city roads.
- to prepare future improvement works of overlay and reconstruction of pavement.
- to train mechanics, operators and other technical staffs.
- to train administrative and supervisory staffs for maintenance works.

Detailed organization chart of main road depot is shown in Fig. S.9.2. The staff required for new main depot may not be sufficient in DCC so that some of them should be recruited from other government agencies.

It is also recommended that the maintenance works should be done in collaboration with MOCW for the first few years after opening the main depot to cope with the insufficient engineering staff.

(3) Site Depots

- to perform road monitoring.
- to perform maintenance under the supervision of main depot.
- to store equipment, material and staff for routine maintenance.

9.3 Improvement Measures Required

Improvement plan on road maintenance system proposed in the above consists of improvement measures classified into three (3) items as shown below:

(1) Establishment of Road Maintenance Depots

- Main Depot:

Main depot should firstly be established with facilities of administrative office, workshop, store room, training room, equipment depot, parking lot, washing yard, etc.

- 4 nos. of Site Depots:

Site depots should be rebuilt at a later stage when a qualified staff including engineers, administrators, operators, etc. are brought up through the operation of the main depot.

(2) Procurement of Plant and Equipment

Plant and equipment should be determined taking into account the maintenance works to be done in accordance with the programme as well as the work volume per day.

- Procurement of equipment required for routine maintenance:

The Study Team suggests that equipment to be used for daily or routine maintenance should firstly be procured taking into account the existing technical level of maintenance.

- Procurement of equipment required for periodic and major improvement works

Heavy equipment to be used for overlay and reconstruction of the pavement, such as crushing plants, asphalt finisher, bulldozer, etc should be procured at a later stage when the road maintenance team is organized substantially.

(3) Technical Assistance and Training

- Technical Assistance

In order to operate the maintenance depots smoothly, it is recommended to recruit some technical experts from abroad until the new organization functions well.

- Training for mechanics and operators:

Training of technicians, operators and mechanics should be done through on-the-job training of improvement works in cooperation with the international contractor assigned to the Project.

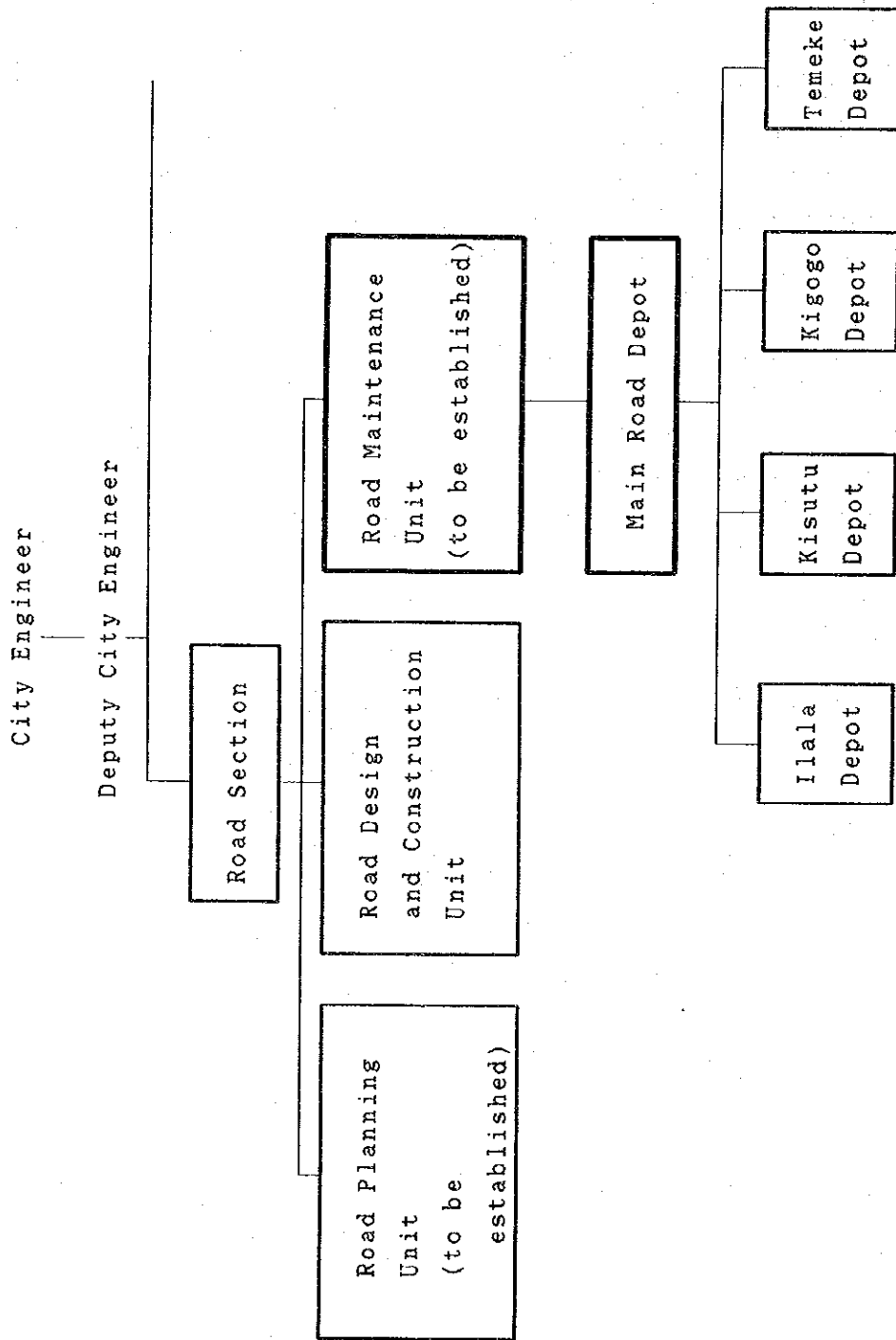


Fig.S.9.1 Proposed Road Maintenance System

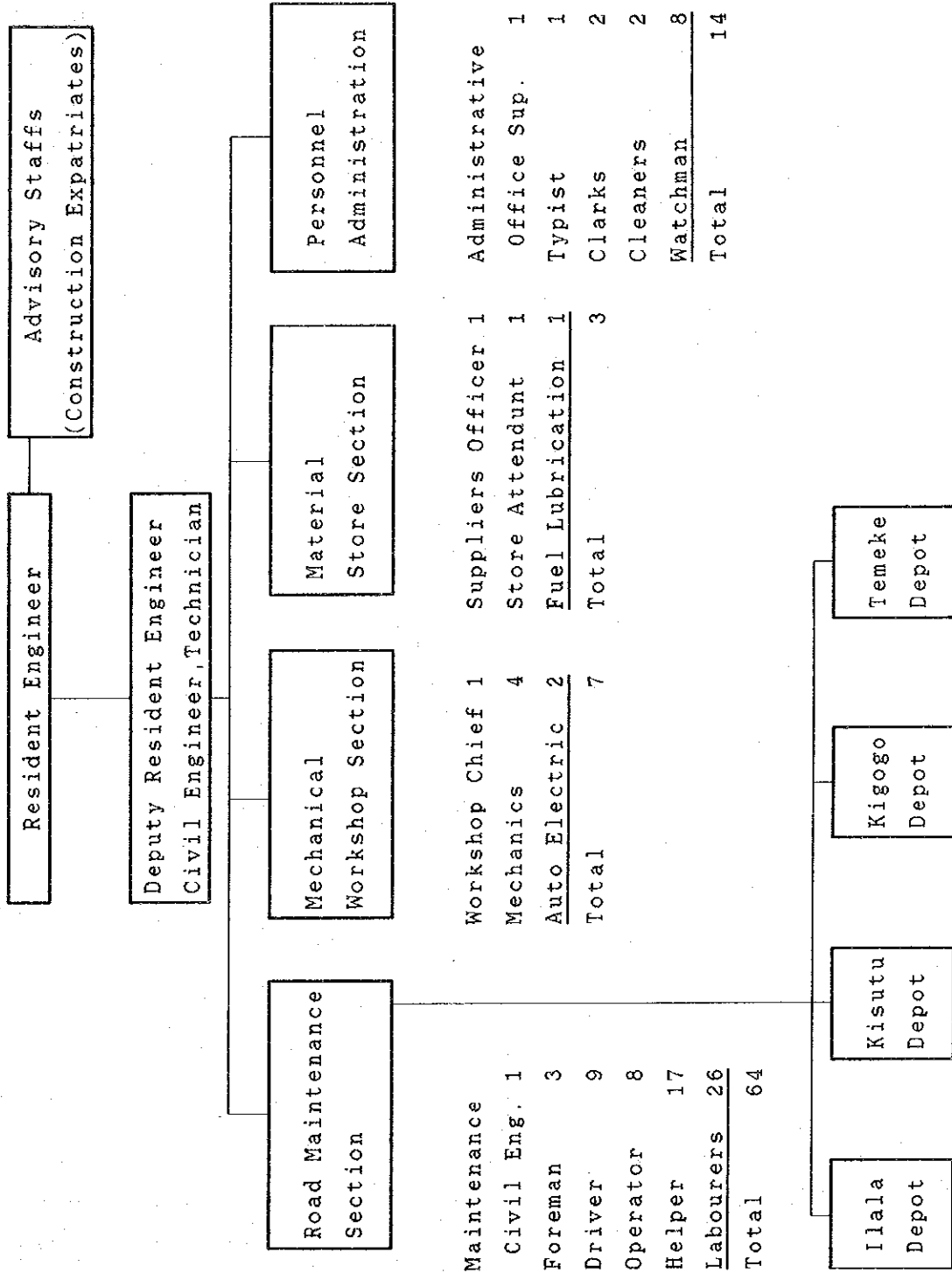


Fig. S. 9.2 Organization Chart of the Proposed Main Depot

CHAPTER 10 IDENTIFICATION OF NECESSARY IMPROVEMENT

10.1 Identification of Necessary Improvements

The necessary improvements dealt with in this Study are composed of three categories with sub-work items as follows:

(1) Category A: Improvement of Road Structures

- A-1; Overlay of pavement
- A-2; Reconstruction of pavement
- A-3; Widening from 2 to 4 lanes
- A-4; Rehabilitation/Improvement of Drainage Structures
- A-5; Provision of Bus Bays
- A-6; Improvement of Intersections

Proposed improvement measures to be applied for each road were determined as shown in Table S.10.1.

(2) Category B: Urgent Repair of Pot-holes

- B-1; Urgent repair of pot-holes

The proposed urgent repair of pot holes shall cover whole important city roads with a estimated length of 205 km.

(3) Category C: Improvement of Road Maintenance System

- C-1; Construction of Road Maintenance Depots
- C-2; Provision of Road Maintenance Equipment
- C-3; Technical Assistant and Training Programme

Necessary improvement measures for each sub-items are as shown in Table S.10.2.

10.2 Preliminary Engineering Plan

Study on preliminary engineering plan was made to estimate approx. project costs required for evaluation of the project viability as well as the possibility of project implementation. Study was made assuming the typical cross sections and layout plan.