

11.2.2 Implementation Schedule for the Long-term Development Plan

An implementation schedule for the long-term development plan was prepared taking into account the following factors:

- 1) Establishment of road network for well-balanced urban development.
- 2) Engineering requirements from the viewpoint of traffic demands.
- 3) Homogeneous development of Dar es Salaam

The period for the long-term development plan is proposed starting from 2000 up to 2010 for the purpose of the implementation schedule. A summary of the long-term implementation schedule for the development of roads, public transport and traffic management is presented in Table 11.3

A preliminary economic evaluation has been conducted on the basis of the investment program to confirm the economic viability of the proposed road development plan as recommended in the master plan.

Basic assumptions for the evaluation are described below:

- 1) A cost stream has been prepared referring to Table 11.2 and 11.3. Only the economic cost for construction was used for the cost/benefit calculation with the cost for land acquisition and maintenance being excluded.
- 2) The benefits have been calculated from the result of the traffic assignment for 2000 and 2010. The benefits include savings in vehicle operating cost and cost of passenger travel time derived from the proposed projects.
- 3) 15 years of project life is assumed after the opening of the projects.
- 4) 10% of the construction cost of each project is assumed as a residual value at the end of the project life.

Benefits for the year 2000 and 2010 are calculated as follows:

2000 : 16,036 million Tshs/year

2010 : 52,083 million Tshs/year

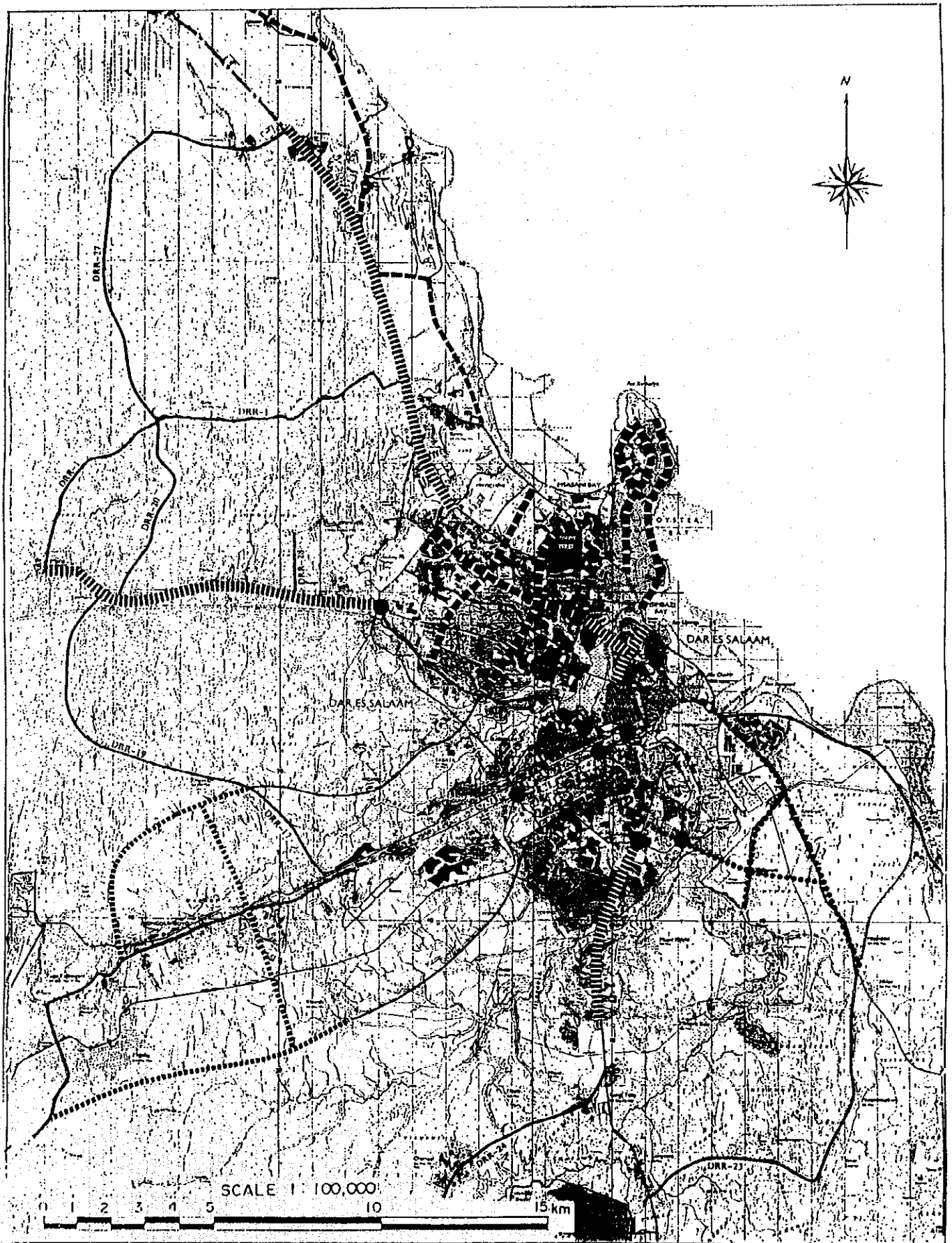
The internal Rate of Return (IRR) amounted to 15.7% based on the above assumptions. Information about the above calculations is attached as Appendix 11.1.

Table 11.1 Concept of Implementation Schedule for Road Development

Road Development Plan and Projects	Project Length	Short Term Plan (-1999)	Long Term Plan (2000-2010)
1. Widening of Arterial Roads in City Center	5.67		
(1) Widening of Inner Ring Road (Old (DTR-17), Kivukoni Front (DTR-32), Sokolas Drive (DTR-8), Gereza (DTR-16) and Bandari Road (DTR-24))	5.43	0	
(2) Construction of New Access between UWT and Gereza Road	0.24		0
2. Widening of Middle Ring Road with Construction of Missing Link (Widening of Morocco (DTR-7), New Kivukoni (DTR-31) and Chama'ombe Road (DTR-21) and Construction of Missing Link between New Kivukoni and Chama'ombe Road)	10.35	0	
3. Widening of Trunk Roads from 2 to 4 lane	68.60		
(1) Widening of New Bagamoyo Road (DTR-3) from Morocco Road Junction upto Sam Nujoma Road Junction	4.40	0	
(2) Widening of New Bagamoyo Road from Sam Nujoma upto Wazo Hill	12.60		0
(3) Widening of Sam Nujoma Road (DTR-5)	3.90		0
(4) Widening of Morogoro Road (DTR-3) from Ubugo upto Mbezi	11.00		0
(5) Widening of Uhuru Road (DTR-9) from Gereza upto 4 lane section	4.00	0	
(6) Widening of United Nations Road (DTR-13)	2.00		0
(7) Widening of Kiwa Road (DTR-4) from Bandari Road Junction upto Nelson Mandela Road	1.90		0
(8) Construction of New Access between United Nations and Morocco Road	3.20	0	
(9) Widening of Kiwa Road (DTR-4) from Nelson Mandela Road upto	5.60		0
4. Strengthening of Road Network in Kigamboni Area including Construction of Bridge Access Harbor	181.50		
(1) Improvement of Kigamboni Ferry Port		0	
(2) Construction of Harbor Bridge with Access Road	2.80		0
(3) Construction of Karasai Bridge with Access Road	5.30		0
(4) Improvement and Rehabilitation of DRR-22 from Kivukoni upto Maazi	43.00	0	
(5) Improvement of DRR-23 from Kogatwezi upto Mlimwema	5.00		0
(6) Improvement of DRR-14 from Kivukoni upto Vihivwazi	6.50		0
(7) Improvement of DRR-29 from Tangi upto Kibata	5.90		0
(8) Rehabilitation of DRR-2 from Mwoogoo upto Goumvi	12.50		0
(9) Rehabilitation of DRR-3 from Chikoniwanga upto Bayuni	43.10		0
(10) Rehabilitation of DRR-4 from Kimbii upto Chikoniwanga	11.50		0
(11) Rehabilitation of DRR-12 from Kimbii upto Sozani	18.00		0
(12) Rehabilitation of 1 lane section of DRR-22	13.40		0
(13) Rehabilitation of DRR-30 from Kibata upto Gezaniwe	14.50		0
5. Construction of Outer Ring Road	23.00	0	
6. Strengthening of Road Network along Pugu Road	41.20		
(1) Construction of South Pugu Road (section-1)	9.00	0	
(2) Construction of South Pugu Road (section-2)	2.50		0
(3) Improvement of North Pugu Road (section-1)	7.50	0	
(4) Construction of North Pugu Road (section-2)	7.50		0
(5) Construction of North south Access	7.70		0
7. Construction and Improvement of Trunk Roads and Collector Roads	61.80		
(1) Overlay of UWT Road	2.00	0	
(2) Overlay of existing 4 lane section of Uhuru Road	1.20	0	
(3) Improvement of Old Kivukoni Road (DTR-29)	6.50	0	
(4) Improvement of Old Kivukoni - Tabata Road	1.50	0	
(5) Improvement of DTR-20 from Morogoro Road upto NIT	1.40		0
(6) Improvement of New Siwaga Road	3.80		0
(7) Improvement of Kibera Road (DTR-26)	2.40		0
(8) Improvement and Construction of Kibera/New Bagamoyo Road	2.60		0
(9) Improvement of DTR-25 between Old Kivukoni/Nelson Mandela Road	1.00		0
(10) Improvement of Mlimwema Access (DTR-36)	1.30		0
(11) Improvement of DTR-38 and Construction of Extension upto Sam Nujoma Road	6.00	0	
(12) Improvement of DTR-32 and Construction of Extension upto Sam Nujoma Road	4.70		0
(13) Improvement of Extension of Old Bagamoyo Road to North	6.70		0
(14) Improvement of Tumbi/Mbambali (DTR-28)	4.70		0
(15) Overlay of Kanyata/Tore Drive (DTR-18)	7.60		0
(16) Improvement and Overlay of Chole Road (DTR-35)	3.00		0
(17) Improvement and Overlay of Hale Selimbi (DTR-27)	5.40		0

Table 11.1 Concept of Implementation Schedule for Road Development

Road Development Plan and Projects	Project Length	Short Term Plan (1999)	Long Term Plan (2000-2010)
8. Rehabilitation of Pavement Condition on Local Roads	39.800		
(1) Improvement of Local Roads in Tembeke Area	13.900	0	
(2) Improvement of Local Roads in Itata Area	10.300	0	
(3) Improvement of Local Roads in Tabata Area	9.200	0	
(4) Improvement of Local Roads in Siza Area	2.200	0	
(5) Improvement of Local Roads in Mwinjijama Area	17.200	0	
9. Reconstruction of Bridge on Trunk Road	0.190	0	
10. Construction of Grade Separated Intersection at major Trunk Road			
(1) Construction of Intersection between Middle Ring Road and Paga Road	1 No.		0
(2) Construction of Intersection between Middle Ring Road and Uvuru Road	1 No.		0
(3) Construction of Intersection between Middle Ring Road and Morogoro Road	1 No.		0
(4) Construction of Intersection between Nelson Mandela Road and Paga Road	1 No.		0
(5) Construction of Intersection between Nelson Mandela Road and Morogoro Road	1 No.		0
(6) Construction of Intersection between Nelson Mandela Road and Kilwa Road	1 No.		0
(7) Construction of Intersection between Msimbazi Road and Paga Road	1 No.		0
(8) Construction of Intersection between Middle Ring Road and Nelson Mandela Road	1 No.		0
(9) Construction of Intersection between Middle Ring Road and Paga Road	1 No.		0
11. Improvement of Trunk and District Road in Rural Area			
(1) Improvement and Rehabilitation of New Bagamoyo Road(DTR-5) outside Wazo Hill	20.50	0	
(2) Overlay of Morogoro Road(DTR-3) outside Mbezi	13.60		0
(3) Rehabilitation of Kawe/Mbezi Road(DRR-1)	16.00		0
(4) Rehabilitation of Paga/Msongola Road(DRR-4)	20.00		0
(5) Rehabilitation of Kawembe/Kisosa(DRR-5)	13.90		0
(6) Rehabilitation of Kitamba/Maoe Mjiji Road(DRR-7)	9.00		0
(7) Rehabilitation of Mikwambe/Gezalo Road(DRR-9)	20.00		0
(8) Improvement of Kandauchi/Boto Road(DRR-10)	11.40		0
(9) Rehabilitation of Msongola/Byasi Road(DRR-11)	16.00		0
(10) Rehabilitation of Paga/Kang'ani Road(DRR-13)	8.30		0
(11) Rehabilitation of Bwani/Mjiji Road(DRR-15)	24.10		0
(12) Rehabilitation of DIA-GMvoto Road(DRR-16)	7.20		0
(13) Rehabilitation of Paga/Tabata Road(DRR-17)	5.00		0
(14) Rehabilitation of Mbezi/Kwembe Road(DRR-18)	8.00		0
(15) Rehabilitation of Tembozi/Kiverezi Road(DRR-19)	9.00		0
(16) Rehabilitation of Tembozi/Goba Road(DRR-20)	5.70		0
(17) Rehabilitation of Goba/Mjiji Road(DRR-21)	8.30		0
(18) Rehabilitation of Kongowe/Munwema Road(DRR-23)	12.60		0
(19) Rehabilitation of Paga/Mbaraka Road(DRR-24)	46.40		0
(20) Rehabilitation of Mbezi/Kwembe Road(DRR-25)	4.50		0
(21) Rehabilitation of Morogoro/Kilwa Road(DRR-26)	2.30		0
(22) Rehabilitation of Wazo Hill/Goba Road(DRR-27)	11.30		0
(23) Rehabilitation of Kiba/Msewa Road(DRR-28)	1.50		0



THE STUDY ON DAR ES SALAAM
ROAD DEVELOPMENT PLAN

Fig. 11.2 Long-term Road
Development Projects

- Widening of Trunk Roads from 2 to 4 lane
- Strengthening of Road Network in Kigamboni Area with Construction of Bridge Access Harbor
- Strengthening of Road Network along Pugu Road
- Construction and Improvement of Trunk Roads and Collector Roads
- Construction of Grade Separated Intersection
- Improvement of Trunk and District Road in Rural Area

Table II.2 (1) Proposed Implementation Program of Short-term Development Plan

(Unit: Million Tsh.)

Short-term Development Plan and Projects	Project Length(km)	1995		1996		1997		1998		1999		Remarks Total
		Construction	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House	
Category A: Road Development Plan												
AS-1 Widening of Arterial Roads in City Center	5.43											0
(1) Widening of Inner Ring Road (Old/DTR-17),Kivukoni Front(DTR-32),Solohwe Drive(DTR-8), Gereza(DTR-16) and Bantari Road (DTR-24)	5.43	3,910										3,910
AS-2 Widening of Middle Ring Road with Construction of Missing Link	10.35		20	4,590		3,200						7,810
(Widening of Morocco (DTR-7),New Ejigoo (DTR-31) and Chang ombe Road(DTR-21)and Construction of Missing Link between New Kijoppo and Chang ombe Road)												0
AS-3 Widening of Trunk Roads from 2 to 4 lane	11.00											0
(1) Widening of New Fugurovo Road(DTR-5) from Morocco Road Junction up to Sani Njuzuu Road Junction	4.40							2,000				4,000
(2) Widening of Uburu Road(DTR-9) from Gereza up to 4 lane section	4.00					900					400	2,900
(3) Widening of Kilwa Road(DTR-4) from Bantari Road Junction up to Nelson Mandela Road	3.30			1,280								2,260
AS-4 Strengthening of Road Network in Kigamboni Area including Construction of Bridge Access Harbor	43.00											0
(1) Improvement of Kigamboni Ferry Port		700		560		2,380		2,580				1,260
(2) Improvement and Rehabilitation of DTR-22 from Kivukoni up to Mizizi	43.00							2,580				7,740
AS-5 Construction of Outer Ring Road	23.00					3,000	70	3,710		3,000		9,780
AS-6 Strengthening of Road Network along Pugu Road	16.50											0
(1) Construction of South Pugu Road(section-1)	9.00							2,900	140	1,450		4,490
(2) Improvement of North Pugu Road (section-1)	7.50					1,950	110	980				3,040
AS-7 Construction and Improvement of Road Network inside Nelson Mandela Road	17.30											0
(1) Overlay of UWT Road	2.00											360
(2) Overlay of existing 4 lane section of Uburu Road	1.30											220
(3) Improvement of Old Kijoppo Road(DTR-29)	6.50			1,070						220		2,670
(4) Improvement of Old Kijoppo - Tabata Road	1.50			400								620
(5) Improvement of DTR-38 and Construction of Extension up to Sani Njuzuu Road	6.10		20	1,030								2,520
AS-8 Rehabilitation of Pavement Condition on Local Roads	59.1											0
(1) Improvement of Local Roads in Tembe Area	13.9			2,090								2,090
(2) Improvement of Local Roads in Ijala Area	10.3					1,550						1,550
(3) Improvement of Local Roads in Tabata Area	9.2										1,300	1,300
(4) Improvement of Local Roads in Sinza Area	9.2			1,300								1,300
(5) Improvement of Local Roads in Mtepyilume Area	17.2							2,500				2,500
Subtotal(1)			20	10,130	100	13,180	180	14,730	140	13,220	400	62,630

Table II.2 (2) Proposed Implementation Program of Short-term Development Plan

(Unit: Million Tsh.)

Short-term Development Plan and Projects	Project Length	1,995		1,996		1,997		1,998		1,999		Remarks	
		Construction	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House	Land/House	Total
AS-9. Reconstruction of Bridges on Trunk Road	0.190								378	377			653
AS-10. Improvement of Important Road in Rural Area	14.1								1,270				0
(1) Improvement and Rehabilitation of New Baguoye Road(DTR-5) outside Wazo-Hill	14.1								1,270				2,940
AS-11. Strengthening of Maintenance Capability													0
Category B: Public Transport Development Plan													0
BS-1. Improvement of Long-distance Bus Services													0
(1) Construction of West-bound Long-distance Bus Terminal		800											800
(2) Shuttle Bus Operation (West-bound Long-distance Bus Terminal)		60											60
BS-2. Improvement of City Bus Services													0
(1) Construction of City Bus Terminals		60											60
(2) Improvement of Construction of Local Bus Stations		105											105
(3) Strengthening of Junction Function (Major)		70											70
Category C: Traffic Management Plan													0
CS-1. Traffic Regulation in City Center													0
CS-2. Reduction of Roadside Parking													0
(1) Construction of Parking Building in City Center 1 Near				1,800						1,200			3,000
CS-3. Streamlining of Pedestrian Flow													0
(1) Introduction of Pedestrian Mall		88											88
(2) Construction of Two Pedestrian Bridges				175									175
CS-4. Improvement of Bottleneck Point													0
(1) Installation of new Traffic Signal		6											6
(2) Improvement of Existing Traffic Signal		6											6
(3) Restructuring of Rotary to at-grade intersection		20											20
(4) Major Improvement of at-grade intersection		189											189
(5) Minor Improvement of at-grade intersection		6											6
Subtotal(2)		1,410	0	1,975	0	1,200	0	1,598	0	1,597	0		7,780
Total		11,920	20	12,105	100	14,280	180	16,248	140	14,817	400		70,410

(Exchange Rate: 1,000US\$=Tshs.490=V110)

Table 11.3(1) Proposed Implementation Programme of Long-Term Development Plan in Dar es Salaam

(Unit : Million TSh.)

Road Development Plan and Projects	Project Length	Long Term Plan(2000-2011)		Total
		Construction	Land/House	
AL-1. Widening of Arterial Roads in City Center				
(1) Construction of New Access between UWT and Gerezaani Road	0.24	140	20	160
AL-2. Widening of Trunk Roads from 2 to 4 lane	37.00			
(1) Widening of New Bagamoyo Road from Sam Nujoma upto Wazo Hill	12.60	9,040		9,040
(2) Widening of Sam Nujoma Road(DTR-5)	3.90	3,140		3,140
(3) Widening of Morogoro Road (DTR-3) from Ubungo upto Mbezi	11.00	10,010	280	10,290
(4) Widening of United Nations Road (DTR-13)	2.00	1,360	50	1,410
(5) Construction of New Access between United Nations and Morocco Road	1.90	2,900	50	2,950
(6) Widening of Kitiwa Road (DTR-4) from Nelson Mandela Road upto	5.60	3,950	30	3,980
AL-3. Strengthening of Road Network in Kigamboni Area including Construction of Bridge Access Harbor	138.50			
(1) Construction of Harbor Bridge with Access Road	2.80	25,470	280	25,750
(2) Construction of Kuruzini Bridge with Access Road	5.30	18,210	130	18,340
(3) Improvement of DRR-23 from Kongwezi upto Mjiwema	5.00	2,050		2,050
(4) Improvement of DRR-14 from Kivukoni upto Vijibweni	6.50	2,670		2,670
(5) Improvement of DRR-22 from Tunzi upto Kibada	5.90	2,420		2,420
(6) Rehabilitation of DRR-2 from Mwongozo upto Gomvu	12.50	750		750
(7) Rehabilitation of DRR-3 from Chekeniwasonga upto Buyuni	43.10	2,590		2,590
(8) Rehabilitation of DRR-8 from Kimbiji upto Chekeniwasonga	11.50	690		690
(9) Rehabilitation of DRR-12 from Kimbiji upto Songani	18.00	1,080		1,080
(10) Rehabilitation of 1 lane section of DRR-22	13.40	800		800
(11) Rehabilitation of DRR-30 from Kibada upto Gezauloe	14.50	870		870
AL-4. Strengthening of Road Network along Pugu Road	24.20			
(1) Construction of South Pugu Road(section-2)	9.00	3,710	140	3,850
(2) Construction of North Pugu Road (section-2)	7.50	3,080		3,080
(3) Construction of North-south Access	7.70	3,410	120	3,530
AL-5. Construction and Improvement of Trunk Roads and Collector Roads	45.60			
(1) Improvement of DTR-20 from Morogoro Road upto NTT	1.40	570		570
(2) Improvement of New Sionza Road	3.80	1,700		1,700
(3) Improvement of Kagera Road (DTR-26)	2.40	1,110		1,110
(4) Improvement and Construction of Kagera/New Bagamoyo Road	3.60	1,040	20	1,060
(5) Improvement of DTR-25 between Old Kigogo/Nelson Mandela Road	1.00	410		410
(6) Improvement of Mikochei Access(DTR-36)	1.30	530		530
(7) Improvement of DTR-39 and Construction of Extension upto Sam Nujoma Road	4.70	1,900	20	1,920
(8) Improvement of Extension of Old Bagamoyo Road to North	6.70	2,750		2,750
(9) Improvement of Temeke/Mbagala(DTR-28)	4.70	1,930		1,930
(10) Overlay of Kenvatta/Toure Drive(DTR-18)	7.60	680		680
(11) Improvement and Overlay of Chole Road(DTR-35)	3.00	1,080		1,080
(12) Improvement and Overlay of Haite Selassie(DTR-27)	5.40	1,350		1,350
Subtotal(1)		113,390	1,140	114,530

Table 11.3(2) Proposed Implementation Programme of Long-Term Development Plan in Dar es Salaam

(Unit: Million Tshs.)

Road Development Plan and Projects	Project Length	Long Term Plan(2000-2011)		Total
		Construction	Land/House	
AL-6. Construction of Grade Separated Intersection at Major Trunk Roads	8 No.			
(1) Construction of Intersection between Middle Ring Road and Pugu Road	1 No.	1,610		1,610
(2) Construction of Intersection between Middle Ring Road and Uhuru Road	1 No.	1,610		1,610
(3) Construction of Intersection between Middle Ring Road and Morogoro Road	1 No.	1,610		1,610
(4) Construction of Intersection between Nelson Mandela Road and Pugu Road	1 No.	1,610		1,610
(5) Construction of Intersection between Nelson Mandela Road and Morogoro Road	1 No.	1,610		1,610
(6) Construction of Intersection between Nelson Mandela Road and Kilwa Road	1 No.	1,610		1,610
(7) Construction of Intersection between Msimbazi Road and Pugu Road	1 No.	1,610		1,610
(8) Construction of Intersection between Middle Ring Road and Nelson Mandela Road	1 No.	1,610		1,610
AL-7. Improvement of Trunk and District Road in Rural Area	280.50			
(1) Overlay of Morogoro Road(DTR-3) outside Mbezi	13.60	1,230		1,230
(2) Rehabilitation of Kawe/Mbezi Road(DRR-1)	16.00	960		960
(3) Rehabilitation of Pugu/Msongolai Road(DRR-4)	20.00	1,200		1,200
(4) Rehabilitation of Bunju-Mbeweni(DRR-5)/Msongolai Road(DRR-5)	6.40	1,730		1,730
(5) Rehabilitation of Kawembe/Kisosa(DRR-6)	13.90	830		830
(6) Rehabilitation of Kibamba/Mageo Mpiji Road(DRR-7)	9.00	540		540
(7) Rehabilitation of Mikuwambe/Gezauloe Road(DRR-9)	20.00	1,200		1,200
(8) Improvement of Kunduchi/Boko Road(DRR-10)	11.40	2,050		2,050
(9) Rehabilitation of Msongola/Byuni Road(DRR-11)	16.00	960		960
(10) Rehabilitation of Pugu/Kaijuni Road(DRR-13)	8.30	500		500
(11) Rehabilitation of Bunju/Mpiji Road(DRR-15)	24.10	1,450		1,450
(12) Rehabilitation of DIA-GMboti Road(DRR-16)	7.20	1,300		1,300
(13) Rehabilitation of Pugu/Tabata Road(DRR-17)	5.00	300		300
(14) Rehabilitation of Mbezi/Kwembe Road(DRR-18)	8.00	480		480
(15) Rehabilitation of Temboni/Kinyerezi Road(DRR-19)	9.00	540		540
(16) Rehabilitation of Temboni/Goba Road(DRR-20)	5.70	340		340
(17) Rehabilitation of Goba/Mojji Road(DRR-21)	8.30	500		500
(18) Rehabilitation of Kongwe/Mjimwera Road(DRR-23)	12.60	2,270		2,270
(19) Rehabilitation of Pugu/Mbagala Road(DRR-24)	46.40	8,350		8,350
(20) Rehabilitation of Mbezi/Kwembe Road(DRR-25)	4.50	270		270
(21) Rehabilitation of Morogoro/Kilvizi Road(DRR-26)	2.30	140		140
(22) Rehabilitation of Wazo Hill/Goba Road(DRR-27)	11.30	680		680
(23) Rehabilitation of Kibo/Msewe Road(DRR-28)	1.5	90		90
Category B : Public Transport Development Plan				
BL-1. Improvement of Long-distance Bus Services				
(1) Improvement of West-bound Long-distance Bus Terminal		450		450
(2) Shuttle Bus Operation (West-bound Long-distance Bus Terminal)		30		30
Category C : Traffic Management Plan				
CL-1. Reduction of Roadside Parking				
(1) Construction of 3 nos. of Parking in City Center		9,000		9,000
CL-2 Streamlining of Pedestrian Flow				
(1) Construction of 2 Pedestrian Bridges		175		175
(2) Improvement of Pedestrian ways		4,725		4,725
Subtotal(2)		55,170	0	55,170
Total		168,660	1,140	169,800

(Exchange Rate : 1.00US\$=Tshs.490=¥110)

11.2.3 Recommended Actions to be taken for Materializing Short-term and Long-term Development Plan

(1) Financial Arrangement for Short-term and Long-term Development Plan

a) Budget Frame and Sector Allocation

Table 11.4 shows the budget allocation, total expenditures and Works Sector (including roads) for fiscal year (FY) 1993/94, FY 1994/95 and FY 1995/96, based on the "Rolling Plan and Forward Budget for Tanzania, 1993/94 - 1995/96". Allocation to Works Sector in each of the above three fiscal years account for 8.1%, 9.6% and 9.3% of the total expenditures respectively, (includes both recurrent and development expenditures).

Table 11.5 indicates the budget projection derived from projected GDP values. The works Sector's share of the total expenditure is fixed at 9.6%. The annual streams of Works Funds are accumulated for the short-term programme (1994 - 1999) and for the long-term programme (2000 - 2010); which show the ceiling amount of funds possible to be allocated for both programme periods.

b) Viability of Project Implementation

The required amount to implement the short-term program is estimated to be Tshs. 70.52 billion. It accounts for 25.7% of the projected amount accumulated during 1994 - 1999 period (Tshs. 274.73 billion). Similarly, the cost estimated for the long-term program (Tshs. 169.74 billion, 2000 - 2010) is equivalent to 24.0% of Tshs. 706.78 billion of the projected amount accumulated during the same period.

The funds required for the Second Integrated Roads Project (IRP-II) are shown in Table 11.6. From FY 1994/95 to FY 1998/9, the total amount of US\$902.3 million is expected to be allocated to IRP-II, which is scheduled to be completed in the year 2000. This amount is equivalent to Tshs. 442,127 million (exchange rate: US\$1 = Tshs. 490) showing 61% increase to the cost for short-term program accounts for 16.0% of total IRP-II requirements. In considering GRP proportion of Dar es Salaam Region (around 16%), the cost ratio for IRP-II implementation is quite acceptable in the context of resources allocation.

After the year 2000, implementation of extended IRP (IRP-III up to 2005 and IRP-IV up to 2010); will be expectable. The funds required for IRP-III and -IV might grow against the Works Funds in the budget. If 61% increase (same as in short-term program) is applied, the cost of long-term program might occupy 14.9% of the total IRP requirements. For the same reason as in short-term program, the cost of long-term program is justified in the context of resources allocation.

c) **Budgeting Arrangements**

As shown in Table 11.6, of the whole IRP-II, 72.7% of total funds come from external sources (loans or grants from donor countries, that are mostly for development expenditures). The "Rolling Plan and Forward Budget for Tanzania, 1993/94 - 1995/96" also shows that 72.3% of 1993/94 MWTC allocation for Works Sector is financed by foreign sources. These figures indicate that almost 72.5% of Works Funds should be arranged from external sources.

For the implementation of the Master Plan, the same kind of budgeting arrangements is required as for IRP-II. In the Master Plan, short-term program is to be incorporated with IRP-II while long-term program will be part of IRP-III and -IV. Of the total requirements, 70 to 80% of project costs should be covered by external resources (loans or grants). Especially, new development projects require such arrangements of financing. Taking into account past allocation of resources, financial supporting is definitely needed by international donor organization; however, some projects might require local funding sources due to their nature, function and jurisdiction. As such, it is clear that the Master Plan requires both external and domestic sources of financing.

d) **Financing Sources of the Proposed Projects**

According to magnitude or importance of the projects (both functionally and technically), financing sources are classified. In view of financial situation of the government, external resources are required to finance most of the projects. As mentioned in the previous section, over 70% of the total requirements are expected to come from outside the country. Grant-in-aid is the most preferable financing form; however, the upper limit of grants, as observed from past performance, amount to about Tshs. 6,500 - 7,000 million per year.

Table 11.4 Total Government Expenditure and Works Allocation

Item	Unit: Million Tshs. (at current prices)		
	FY 1993/94	FY 1994/95	FY 1995/96
Total Budget (Expenditures)	428,750	443,992	441,490
Works (Roads)	34,609 (8.1)	42,826 (9.6)	41,121 (9.3)
- Recurrent	5,671 (1.3)	6,398 (1.4)	6,597 (1.5)
- Development	28,938 (6.8)	36,433 (8.2)	34,523 (7.8)

Remarks: (): Percentage contribution to the total budget (%).

Source: Planning Commission "Rolling Plan and Forward Budget for Tanzania, 1993/94 - 1995/96".

Table 11.5 Budget Projection

Item	Unit: Million Tshs. (at 1993 constant prices)		
	1993	2000	2010
1. GDP	987,718	1,299,768	1,923,974
2. Total Budget	414,841	545,902	808,069
3. Works Fund	39,825	52,407	77,575

Remarks: (1) Total Budget = 42% of GDP.

(2) Works Fund = 9.6% of Total Budget.

(3) Accumulated Works Fund (excluding 1993 value):

1994 - 1999 : 274,725

2000 - 2010 : 706,778

Table 11.6 Funding Requirement IRP-II

Item	Unit: Million US\$					
	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
1. Development						
- Government	9.0	10.2	17.1	18.7	17.8	9.2
- Donors	81.0	92.2	153.7	168.2	160.2	82.6
2. Recurrent (Government)	22.5	28.0	35.0	35.0	36.4	38.0
Total	112.5	130.4	205.8	221.9	214.4	129.8

Source: MWCT, "Presentation on the Second Integrated Roads Project", June 1993.

In this consequence, the most functional and urgent projects are expected to be of a grant aid type. Others are to be financed mostly by foreign loans. Local funds are also allocated to some portion.

List of Projects and Financing Sources
Short-term Programme

Unit: Million Tshs.

	Project Name/Amount	
Grant Projects:	AS-1-(1): Widening of Inner Ring Road (3,910)	
	AS-2: Widening of Middle Ring Road with Construction of Missing Link (7,790)	
	AS-3: Widening of Trunk Roads from 2 to 4-lanes (8,770) -New Bagamoyo Road from Morocco Rd to Sam Nujoma Rd. Uhuru Road from Gerezani Rd. to 4-lane section of Uhuru Rd. -Kilwa Road from Bandari Rd. to Nelson Mandela Rd.	
	BS-1: Construction of West-bound Long-distance Bus Terminal with Shuttle Bus Operation (860)	
	BS-2: Improvement of City Bus Services (235)	
	CS-3: Streamlining of Pedestrian Flow (263) - Introduction of Pedestrian Mall - Construction of Two Pedestrian Bridge	
	CS-4 Improvement of Bottleneck Points (227) - Installation of new Traffic Signals - Improvement of Existing Traffic Signals - Reconstruction of Rotary to At-grade Intersections - Major Improvement of At-grade Intersections - Minor Improvement of At grade Intersections	
	<hr/>	
		Sub-total: 21,055 (31.3 %)
	Loan Projects:	AS-4: Strengthening of Road Network in Kigamboni Area (9,000) - Improvement of Kigamboni Ferry Port - Improvement and Rehabilitation of DRR-22
AS-5: Construction of Outer Ring Road (9,710)		
AS-6: Strengthening of Road Network along Pugu Road (7,280) - Construction of South Pugu Road (Section-1) - Improvement of North Pugu Road (Section-1)		

- AS-7: Construction and Improvement Road Network inside Nelson Mandela Road (6,350)
- Overlay of UWT Road
 - Overlay of Existing 4-lane Section of Uhuru Road
 - Improvement of Old Kigogo Road
 - Improvement of Old Kigogo Road-Tabata Road
 - Improvement of DTR-38 and extension to Sam Nujoma Rd.
- AS-9: Reconstruction of Bridges on Trunk Roads (655)
- AS-10: Improvement of Important Roads in Rural Areas (2,540)
- Improvement of New Bagamoyo Road beyond Wazo Hill
-
- Sub-total: 35,595 (50.5%)

- Local Financing
- AS-7: Rehabilitation of Pavement Condition on Local Roads (8,980)
- Local Roads in Temeke, Ilala, Tabata, Sinza and Mwinjuma areas
- CS-2: Construction of Parking Building in City Center (1 Nos.) (3,000)
- Other: Land/house Acquisition (840)
-
- Sub-total: 12,820 (18.2%)
- Total requirement for short-term Programme: 70,520 (100.0%)
- (* Exchange Rates: US\$1.00 = Tsh. 490 = ₴110)

Long-term Programme

		Unit: Million Tshs
		Project Name/Amount
External Sources	AL-2-(1)-(6):	Widening of Trunk Roads from 2 to 4 lane (30,400)
		- New Bagamoyo Road from San Nujoma Rd. up to Wazo Hill
		- Sam Nujoma Road (DTR-5)
		- Morogoro Road (DTR-3) from Ubungo up to Mbezi
		- United Nations Road (DTR-13)
		- Kilwa Road (DTR-4) beyond Nelson Mandela Rd.
		- Construction of New Access between United Nations Rd. and Morocco Rd.
	AL-3-(1)-(11):	Strengthening of road Network in Kigamboni Area with Construction of Bridges across Harbor (57,600)
		- Construction of Harbor Bridge with Access Road
		- Construction of Kurasini Bridge with Access Road
		- Improvement and Rehabilitation of DRR-2, 3, 8, 12,14, 22, 23, 29 and 30
	AL-4-(1)-(3):	Strengthening of Road Network along Pugu Road (10,200)
		- Construction of South Pugu Rd. (section-2), North Pugu Rd. (section-2) and North south Access
	AL-5-(1)-(12):	Construction and Improvement of Trunk Roads and Collector Roads (15,050)

	AL-6-(1)-(9):	Construction of 8 Nos. of Grade Separated Intersections at major trunk roads (12,880)
	BL-1-(1)-(2):	Improvement of South-bound Long-distance Bus Terminal with Shuttle Bud Operation (480)
	CL-2-(1)-(2):	Streamlining of Pedestrian Flow (4,900)
		<hr/> Sub-total: 131,510 (77.5%)
Local Financing	AL-1-(1):	Construction of New Access between UWT and Genezani Road (140)
	AL-7-(1)-(22):	Improvement of Trunk and District Roads in Rural Area (27,900)
	CL-1-(1)-(2):	Construction of 3 Nos. of Parking Buildings (9,000)
	Other:	Land/house acquisition (1,1400)
		<hr/> Sub-total: 38,180 (22.5%)
		Total requirement for Long-term programme: 169,740 (100.0%)
		(* Exchange Rates: US\$1.00 = Tsh. 490 = ¥110)

(2) Land/house Acquisition Program

The problem of land and house compensation and acquisition sometimes becomes a critical issue for implementing the road development projects, especially in the urban areas.

The estimated land/house acquisition cost required for implementing the short-term plan and long-term plan are shown in Table 11.2 and Table 11.3, respectively. The following action programs for land/house acquisition are recommended in order to materialize the road development plan.

a) Inner Ring Road

The Inner Ring Road is planned to be 4 lanes in the short-term taking into consideration the traffic demand. Since the Inner Ring Road will play an important role for the urban road network in the city center, the proposed width of right of way should be reserved.

Ohio Street, Gerezani Road and Bandari Road are important links of the Inner ring Road and it is considered that no additional right-to-way might be required for the widening with exception of the end section of Ohio Street near the harbor.

Widening of Sokoine Drive, one of the important links of the Inner Ring Road, might be possible with some land and building acquisition/ compensation.

The land and building acquisition can be commenced soon after confirming the financial source according to the alignment of the Inner Ring Road proposed in the succeeding feasibility study.

b) Middle Ring Road

The Middle Ring Road is planned to be 4 lanes in the short-term taking into consideration the traffic demand as well as a very important role for the urban road network in the city.

Sufficient width of right-of-way should be required soon after confirming the financial source according to the alignment of the Middle Ring Road proposed in the succeeding feasibility study.

c) Trunk Roads to be Widened from 2 to 4 Lane.

Trunk roads to be widened from 2 to 4 lane in the short-term will play important role for urban road network in the city. As such, necessary width of right-of-way for these trunk roads should be identified as soon as possible by a feasibility study required and the land should be either safeguarded or acquired.

The alignment for the widening of Sam Nujoma Road and Morogoro Road from Ubungo intersection have already been identified in the feasibility study of Sixth Highway Project for Morogoro Road and Sam Nujoma Road. Therefore, the Tanzanian government should commence the land/house acquisition along the proposed roads.

d) Outer Ring Road and Other Roads to be Newly Constructed/widened in the Short-term

Outer Ring Road and other roads to be newly constructed/widened in the short-term will require identification of these proposed alignments. So, construction of these roads may be deferred until development takes place.

The land required for this road development should be controlled by the Tanzanian government until development takes place.

(3) Operation and Maintenance of Long-distance Bus Terminals

The proposed bus terminals are expected to be constructed with grant aid funds. The implementation agency for the construction of the terminals is recommended to be Dar es Salaam City Council (DCC) and the property itself will belong to DCC.

It is recommended that a proper governing body be established for the responsible operation and maintenance of the completed terminals. The body should include representatives from both DCC and the beneficiaries (bus operators utilizing the terminals). The association which will be part private and part public in nature will delegate the responsibilities for operation and maintenance after construction.

Utilization fees should be collected by the body from bus operators to meet facility services, i.e., (cleanup, water supply, power, etc.). Amount of fees should be set forth by mutual agreement between the body and the beneficiaries. Part of the utilization fees will need to be saved for future functional expansion of the terminals. Individual bus operators will keep their independent roles in terms of bus operation.

(4) Legal and Administrative Measures for Parking Facilities

The proposed multi-story parking garage is expected to be financed by local funds with Government subsidies. Operation of the garage should be undertaken by the private sector. A parking fee will be assessed for users.

If roadside parking is permitted as is presently practiced, utilization of the parking garage will be low level. To avoid this trend, it will be required to take strong measures to reduce roadside parking. The levying of roadside parking fees by the DCC is most recommendable. Parking fees along roadsides should be assessed at a higher rate than that for the parking garage, as an incentive for parking garage usage. Collection of the roadside parking fees will need to be carried out by DCC personnel. In view of the potential revenue source, collected roadside parking fees will greatly enhance the city's (DCC) financial situation enabling it to continue to enforce the parking fee assessment.

Other measures for reducing roadside parking will be the revision of the Building Code. By appropriate revisions, a certain amount of provided parking should be designated or reserved for that new building's use. The DCC should also be responsible for enforcing the revised Building Code.

11.3 High Priority Projects for Feasibility Study

High priority projects has been selected among the road development projects proposed for the short-term plan and a feasibility study on those high priority projects will be conducted in phase 2 of this Study in order to confirm the technical and economical viability of the projects.

Evaluation of high priority projects were made based on the following factors:

- 1) Enhancement and improvement of urban traffic efficiency
- 2) Promotion and stimulation of potential suburban development
- 3) Prevention of haphazard urban sprawl
- 4) Required funds for construction
- 5) Improvement of accessibility to public transport services
- 6) Ease of construction in terms of land/house aquisition and needed local funds
- 7) Necessity of high construction technology
- 8) Urgency of the project from the viewpoint of safety
- 9) Contribution to non-mortorized transport
- 10) Improvement of roadside environment

Evaluation was conducted for each road development project proposed in the short-term plan as shown in Table 11.7. As a result, the following projects have been selected as high priority projects to be conducted in the subsequent phase 2 of this Study.

Location of the proposed high priority projects are presented in Fig 11.3 and summarized below:

- (1) **Package AS-1: Widening of Arterial Roads in Central Area including the following works:**
 - (AS-1-1) Widening of Ohio, Sokoine, Gerezani and Bandari s from 2 to 4 lanes including reconstruction of Gerezani Bridge with 4 lanes (Total Length=5.43 km)
 - (AS-1-2) Reconstruction of city bus terminal located near the park along Sokoine Drive (0.32 km²)
 - (AS-1-3) Construction of seaside promenade with car parking lots (Promenade W=10, L=500 m)

(2) **Package AS-2: Widening of Middle Ring Road with Construction of Missing Link including:**

(AS-2-1) Widening of the Middle Ring Road from 2 to 4 lanes including the provision of sidewalks on both sides
(4 lanes, L=9.60km)

(AS-2-2) Construction of missing link between New Kigogo and Chang'ombe Road
(4 lanes, L=0.75km)

(AS-2-3) Construction of bus station for changing at every important intersections with radial trunk roads (8 places)

(3) **Package AS-3: Widening of Radial Trunk Roads from 2 lane to 4 lane including:**

(AS-3-1) Widening of New Bagamoyo Road from Morocco Road Junction up to Mpakani Road Junction(4 lanes, L=4.40km)

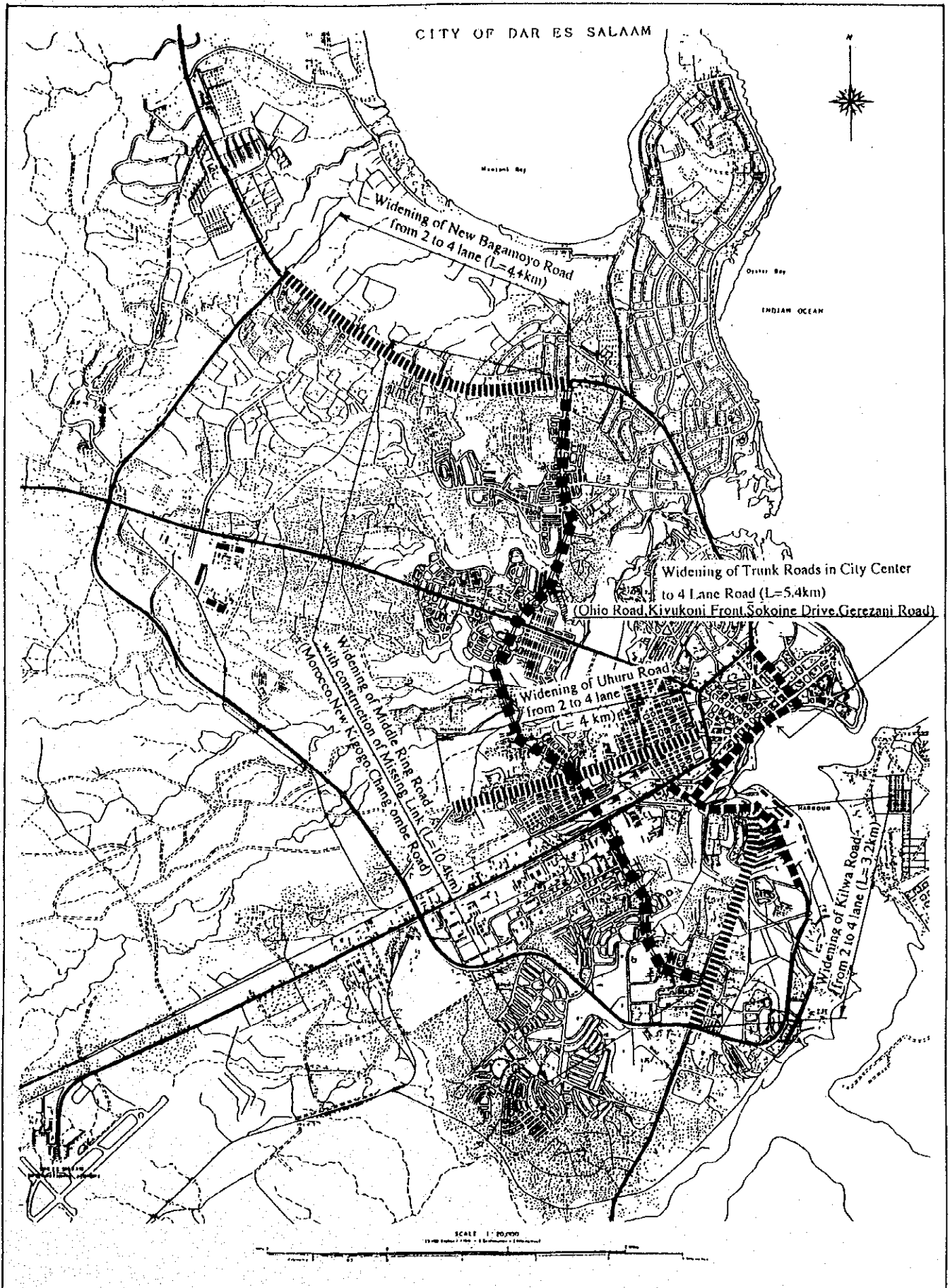
(AS-2-2) Widening of Uhuru Road from Gerezani up to the 4-lane section
(4 lanes, L=4.40km)

(AS-2-3) Widening of Kilwa Road from Bandari Road up to Mandela Road
(4 lanes, L=3.20km)

Table 11.7 Selection of High Priority Projects to be Conducted for Feasibility Study

Evaluated Items	Road Development Projects Proposed in the Short-term Plan							
	AS-1 Widening of Arterial Roads in City Center	AS-2 Widening of Middle Ring Road and Construction of Missing Link	AS-3 Widening of Trunk Road from 2 to 4 lane	AS-4 Strengthening of Road Network in Kigamboni Areas	AS-5 Construction of Outer Ring Road	AS-6 Strengthening of Road Network Along Pugu Road	AS-7 Const. And Improv. Of Important Roads in Rural Areas	AS-8 Reconstruction of Bridges
1. Enhancement and Improvement of Urban Traffic Efficiency	A	A	A	C	B	C	C	C
2. Promotion and Simulation of Potential Suburban Development	B	A	A	A	A	A	A	C
3. Prevention of Haphazard Urban Sprawl	B	A	B	A	A	A	A	C
4. Required Fund for Construction	B	C	C	B	C	B	A	B
5. Improvement of Accessibility to the Public Transport Service	A	A	A	B	A	A	C	C
6. Ease of Construction in Terms of Land Acquisition and Needed Local Funds	C	C	A	B	B	B	B	A
7. Necessity of High Construction Technology	A	A	A	B	B	B	C	A
8. Urgency of the Project from the View point of Safety	B	B	C	C	C	C	C	A
9. Contribution to Non-Mortorized Transport	A	A	A	B	B	B	C	A
10. Improvement of Road side Environment	B	A	B	B	A	B	A	C
Total Score	23	25	24	20	22	21	19	19
Priority	3	1	2	6	4	5	7	7
RECOMMENDED HIGH PRIORITY PROJECTS TO BE CONDUCTED FOR FEASIBILITY STUDY	0	0	0					

Rating: A=3
B=2
C=1



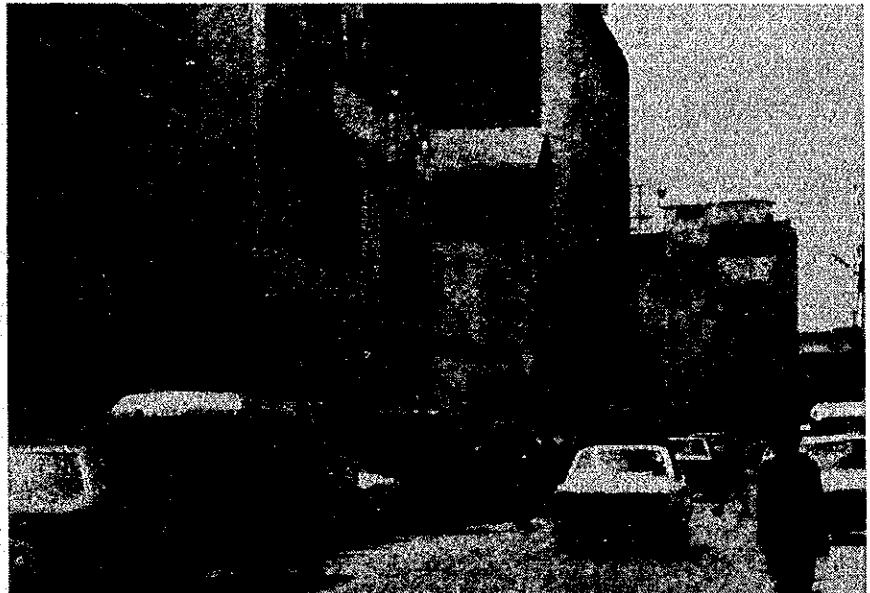
THE STUDY ON DAR ES SALAAM
ROAD DEVELOPMENT PLAN

Fig. 11.3 High Priority Projects
to be followed by Feasibility Study

- ▬▬▬▬▬** Package AS-1 Widening of Arterial Roads in City Center (L=5.4km)
- ▬▬▬▬** Package AS-2 Widening of Middle Ring Road with Construction of Missing Link (L=10.4km)
- ▬▬▬▬▬▬▬▬** Package AS-3 Widening of Radial Trunk Roads from 2 to 4 lane (L=11.6km)

PART B : FEASIBILITY STUDY

CHAPTER 12 INTRODUCTION



Chapter 12 INTRODUCTION

12.1 General

As stated in the Master Plan Study (Part A of this Study), high priority projects were selected among the road development plans proposed for the short-term plan (target year 2000). The selection of these high priority projects was made taking into consideration the following factors:

- 1) Enhancement and improvement of urban traffic efficiency
- 2) Promotion and stimulation of potential sub-urban development
- 3) Prevention of haphazard urban sprawl
- 4) Required funds for construction
- 5) Improvement of accessibility to public transport services
- 6) Ease of construction and use of local funds in terms of land/house acquisition
- 7) Necessity of high construction technology
- 8) Urgency of the project from the viewpoint of safety
- 9) Contribution to non-motorized transport systems
- 10) Improvement of environment along the Proposed Project roads.

The high priority projects consist of three categories; namely, road development plan, traffic management plan and public transport plan as outlined below:

- (1) **Road Development Plan**
 - Package AS-1 : Widening of Arterial Roads in Central Area
 - Package AS-2 : Widening of Middle Ring Road with construction of Missing Link
 - Package AS-3 : Widening of Radial Trunk Roads
- (2) **Traffic Management Development Plan**
 - Structure for Public Parking
 - Improvement of Intersections at Bottleneck Points
 - Traffic Regulation in the City Center
- (3) **Public Transport Development Plan**
 - Construction of New Bus Terminal with Shuttle Bus Operation
 - Strengthening of Central Bus Terminal

- Improvement of Major Bus Terminals at Major Intersections

A Feasibility Study for the development of the projects was conducted during June - November 1994 in accordance with the Scope of Works mutually agreed by the Tanzanian Government and the Japanese Government on May 30, 1994. All findings and issues of it have been compiled in Chapter 12 through Chapter 20 herein and are presented as **Part B: Feasibility Study for High Priority Projects**.

12.2 Subject Roads for the Feasibility Study

As discussed in Section 11.3, Chapter 11, Part A: Master Plan Study, the Feasibility Study was to be conducted for the following three packages of the high priority road projects.

- (1) Package 1 : Widening of Arterial Roads in Central Area including the following works:
 - (a) Widening of Ohio, Kivukoni, Sokoine, Gerezani and Bandari Roads from 2 to 4 lanes which includes reconstruction of Gerezani Bridge with 4 lanes (total length of about 5.4 km).
 - (b) Reconstruction of the city bus terminal located near the park on Sokoine Drive.
 - (c) Construction of a seaside promenade with parking lots for ferry users.
- (2) Package 2 : Widening of Middle Ring Road with Construction of Missing Link to include:
 - (a) Widening of Middle Ring Road from 2 to 4 lanes with sidewalks on both sides (total length of about 9.6 km).
 - (b) Construction of the Missing Link between New Kigogo Road and Chan'gombe Road (total length of about 0.75 km).
 - (c) Construction of a bus station at each important intersections.

(3) Package 3 : Widening of Radial Trunk Roads

- (a) Widening of New Bagamoyo Road from the Morocco Road Junction up to the Mpakani Road Junction (total length of about 4.4 km).**
- (b) Widening of Uhuru Road from the UWT Road up to the Mandela Road (total length of about 4.8 km).**
- (c) Widening of Kilwa Road from Bandari Road up to the Mandela Road Junction (total length of about 3.2 km).**

CHAPTER 13 BASIC DESIGN STANDARDS AND RIGHT-OF-WAY



CHAPTER 13 BASIC DESIGN STANDARDS AND RIGHT-OF-WAY

13.1 General

In this chapter, the basic engineering aspects including design standards and standard cross-sections to be applied for the proposed roads have been studied. The basic plan for the right-of-way (ROW) was also studied taking into consideration the present ROW strip as well as the land-use situation along the proposed roads.

13.2 Design Standards

13.2.1 Functional Classification of the Proposed Roads

The functional classification of each proposed road has been studied referring to the "Draft Road Manual" prepared by the former Ministry of Communications and Works (presently the Ministry of Works, Communications and Transport) as well as the existing road conditions and land-use pattern along the road.

All proposed roads can be classified into the category of "Trunk Roads" taking into consideration the following items:

- 1) They will form a part of the primary road network system in Dar es Salaam city.
- 2) They will be widened to four lanes based on approved design standards.
- 3) They will carry a large traffic volume in the future.

13.2.2 Design Speed

Design speed is a fundamental factor for road design and is directly related to the geometric elements of the road design including carriageway width, horizontal and vertical alignments, etc.

The design speed to be applied for each proposed road was established taking into account the road classification, traffic volume, terrain condition and land-use situation along the proposed roads as shown in Table 13.1.

The project design life to be used for the economic evaluation is assumed to be 15 years after completion of the Project.

Table 13.1 Proposed Design Speeds

Proposed Road	MWCT's Classification	Terrain Condition	Land-use Situation	Expected Function	Traffic Vol. in 1994 (ADT)	Proposed Design Speed (km/hr)
Package 1						
- Ohio Street	Trunk Road	Flat	CBD area	Arterial Road	11,800	40
- Kivukoni Front	Trunk Road	Flat	CBD area	Arterial Road	7,600	40
- Sokoine Drive	Trunk Road	Flat	CBD area	Arterial Road	19,000	40
- Gerezani Street	Trunk Road	Flat	CBD area	Arterial Road	15,300	40
- Bandari Street	Trunk Road	Flat	CBD area	Arterial Road	11,800	40
Package 2						
- Morocco Road	Trunk Road	Flat	Urban Area	Main Collector	19,600	60
- New Kigogo Road	Trunk Road	Flat	Urban Area	Main Collector	14,700	60
- Chang'ombe Road	Trunk Road	Flat	Urban Area	Main Collector	11,600	60
- Missing Link	Trunk Road	Flat	Urban Area	Main Collector	11,600	60
Package 3						
- New Bagamoyo Rd	Trunk Road	Flat	Sub-urban area	National Road	19,600	80
- Uhuru Road	Trunk Road	Flat	Urban Area	Main Collector	18,100	40
- Kilwa Road	Trunk Road	Flat	Sub-urban area	National Road	12,000	60

CBD: Central Business District

13.2.3 Basic Design Standards

The design standards are determined considering the design speed, land-use situation along the proposed road, the characteristics of traffic movement and anticipated future traffic demands. The proposed main design elements such as number of lanes, carriageway width, type and dimension of shoulder/median strip, sidewalks, bicycle lane, bus lane, etc. were studied and are summarized as shown in Table 13.2.

(1) Carriageway

The carriageway width is determined depending upon the type, volume and speed of the traffic it will carry and the ROW situation alongside the road.

Since each of the proposed roads is expected to function as a trunk road carrying heavy traffic travelling at a high speed, the lane width was determined to be 3.75 m (in principle) including a 0.50 m wide verge which is in accordance with the Draft Road Manual.

However, the proposed arterial roads running through the city center area were recommended to have a 3.50 m wide lane including a 0.50 m wide verge due to the tight ROW situation along the road.

(2) **Median Strip**

A 7.0 m to 10.0 m wide median strip is provided for the roads located outside of the urban area, wherever it is possible. The median strip would be utilized for the expansion of the road capacity in the future by introduction of an exclusive bus lane.

On the other hand, a 1.0 m wide median strip is recommended for the roads located in the urban area because of the tight and limited ROW strip along the road.

(3) **Sidewalks**

Greater widths may be necessary where pedestrian movement is heavy or additional space is required for underground utilities.

Sidewalks to be located where kiosks exist or are planned should be at least 4.0 m wide, while a minimum of 5.0 m is desirable for the business areas in the town center.

At points of possible congestion such as bus stops and the entrances to large shops and public buildings, it may be necessary to widen the sidewalks by setting back the frontage line or arcade buildings.

(4) **Cycle Lane**

Bicycle tracks should normally be provided on both sides of the road and designed for two-way traffic. It should desirably be separated from the carriageway and from the footway by a verge about 0.3 m wide. The standard width for a bicycle lane is 3.0 m and the minimum is 2.0 m.

The combined use of sidewalks and bicycle lanes by pedestrians and cyclists should be considered for the roads where the ROW is limited.

(5) Vertical Clearance

The free height from the top of the pavement to the underside of bridges, as specified in Draft Road Manual, should be greater or equal to 4.5 m. The Study Team, however, recommends to apply 4.7 m for the free height which includes an allowance of 20 cm taking into account the placing of additional overlay as well as the introduction of large-sized vehicles in future.

Table 13.2 Proposed Basic Design Standards

Proposed Roads	Design Speed (km/hr)	Number of Lane	Type of Road	Carriageway Width (m)	Median Strip (m)	Type of Surface	Pedestrian Sidewalk (m)	Cycle Lane (m)	Applicability of Bus Lane	
									Priority use	Exclusive use
1 Package 1: Arterial Roads in the City Center										
- Ohio Street	40	Dual 2-lane	A	Dual 2x3.5	1.0	Paved	2.0 - 3.0	Combined	Applicable	
- Kivukoni Front	40	Dual 2-lane	A	Dual 2x3.5	1.0	Paved	2.0 - 3.0	Combined	Applicable	
- Sokoine Drive	40	Dual 2-lane	A	Dual 2x3.5	1.0	Paved	2.0 - 3.0	Combined	Applicable	
Seaside Promenade						Paved	5.0 - 8.0	Combined		
- Gerezani Street	40	Dual 2-lane	A	Dual 2x3.75	1.0	Paved	2.0 - 3.0	Combined	Applicable	
- Bandari Road	40	Dual 2-lane	A	Dual 2x3.75	1.0	Paved	2.0 - 3.0	Combined	Applicable	
2 Package 2: Middle Ring Road										
- Morocco Road	60	Dual 2-lane	A	Dual 2x3.75	7.0 - 10.0	Paved	2.0 - 5.0	2.0 - 3.0	Applicable	Applicable
- New Kigogo Road	60	Dual 2-lane	A	Dual 2x3.75	7.0 - 10.0	Paved	2.0 - 5.0	2.0 - 3.0	Applicable	Applicable
- Chang'ombe Road	60	Dual 2-lane	A	Dual 2x3.75	1.0	Paved	2.0 - 3.0	2.0 - 3.0	Applicable	
- Missing Link	60	Dual 2-lane	A	Dual 2x3.75	1.0	Paved	2.0 - 3.0	Combined	Applicable	
3 Package 3: Radial Trunk Road										
- New Bagamoyo Road	80	Dual 2-lane	A & B	Dual 2x3.75	3.0 - 7.0	Paved	2.0 - 5.0	2.0 - 3.0	Applicable	Applicable
- Uhuru Road(UWT - Mzimbazi Rd) *	40	Dual 2-lane	A	2 x 2x3.50	-	Paved	2.5	Combined	Applicable	
Uhuru Road(Msimbazi Rd - Mandela Rd)	40	Dual 2-lane	A	Dual 2x3.75	1.0	Paved	2.0 - 5.0	Combined	Applicable	
- Kilwa Road	60	Dual 2-lane	B	Dual 2x3.75	7.0 - 10.0	Paved	2.0 - 5.0	2.0 - 3.0	Applicable	Applicable

Notes:

* Oneway system is introduced.

Type A: Road without shoulder (city road type)

Type B: Road with shoulder (rural road type)

Combined: Use for both pedestrians and cyclists

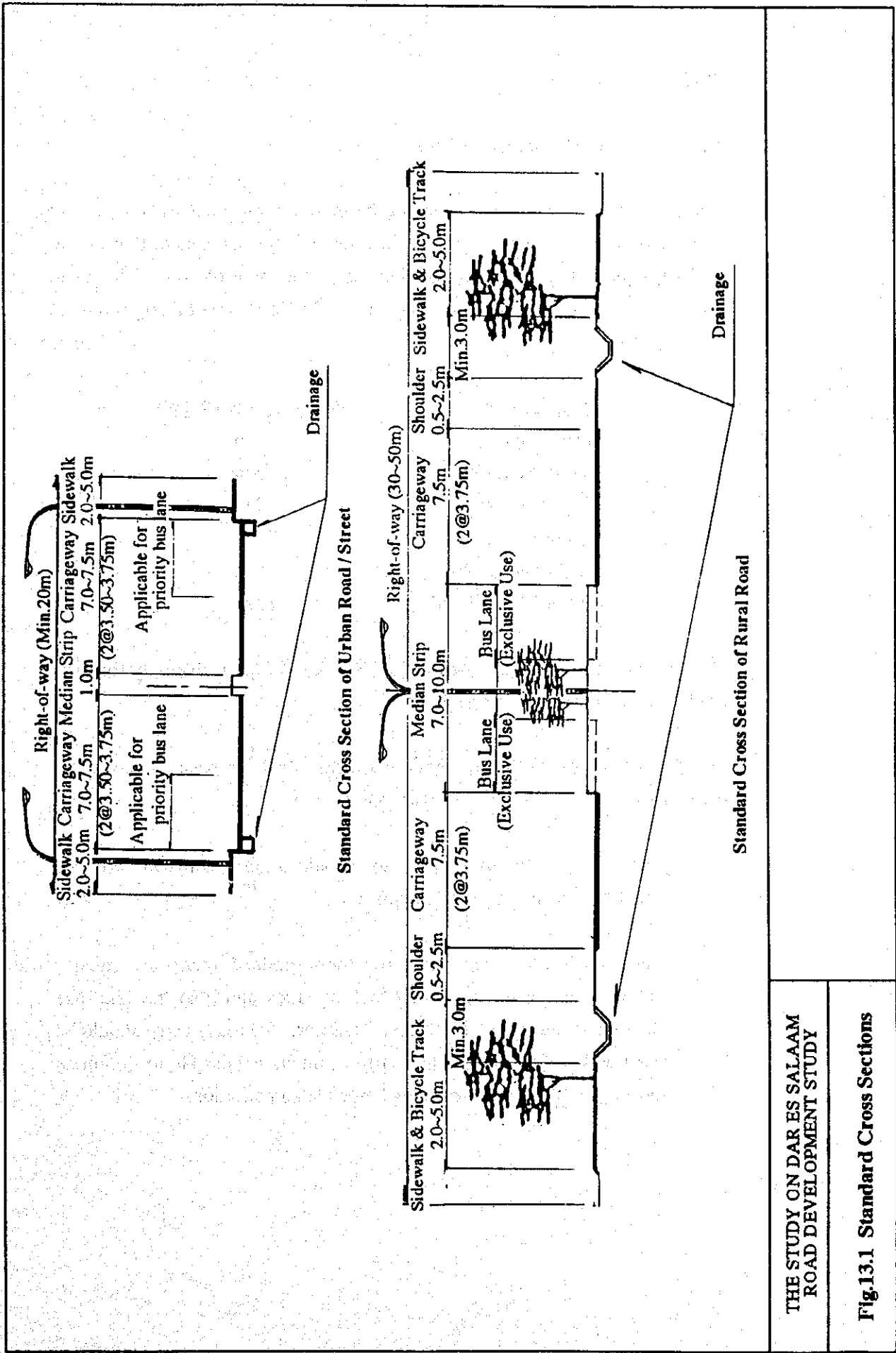
13.3 Standard Cross-sections

The Draft Road Manual prepared by the Ministry of Works, Communications and Transport (MWCT) is applicable only for rural trunk roads (not for urban roads). Therefore, standard cross-sections to be applied for the proposed roads have been established by the Study Team based on Japanese Road Standards as well as British Road Standards.

The width of the carriageway will depend largely on the type, traffic volume and speed of the traffic it will carry. A standard cross-section to be applied for each proposed road has been established taking into consideration the following conditions:

- 1) Sidewalk and bicycle lanes should be provided on each side of the road wherever it is possible.
- 2) Proposed roads should have a dual carriageways of four lanes with each of the dual carriageways being separated by a median strip.
- 3) The minimum width of a traffic lane should be 3.5 m, including a verge of 0.5 m.
- 4) The possibility of either a priority use bus lane or an exclusive use bus lane should be considered during the design in order to allow for future development of the public transport system.
- 5) A utility space below the sidewalks should be provided during the design.
- 6) Tree planting should be considered along the median strips and sidewalks, wherever it is reasonably possible as this will reduce the glare from bright lights of oncoming traffic as well as improve the road side environment.

Road cross-sections established by the Study Team are broadly divided into two types: namely, urban street type with sidewalks and rural road type with shoulders as shown in Fig 13.1. However, this will depend on the land-use situation, function of the road and right-of-way situation.



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Fig.13.1 Standard Cross Sections

13.4 Right-of-Way Plan

13.4.1 Basic Concept for Right-of-Way Plan

The right-of-way acquisition is one of the more complicated aspects of road construction in urban areas due to the location of large numbers of houses and buildings that are usually encroaching inside the right-of-way. The basic standard for width of right-of-way specified in MWCT's Draft Design Manual is as follows:

<u>Road Class</u>	<u>Right-of-way (ROW)</u>
Trunk Road	45 m
Local Main Road	45 m
Regional Road	30 m
District Road	20 m
Major Feeder Road	15 m
Minor Feeder Road	10 m

The Manual states the above standard ROW width is applicable only for rural roads, and not for urban city roads.

For the purpose of the Study, the Team established the basic concepts for planning of the right-of-way design as follows:

- 1) The ROW for the proposed roads should be in accordance with the MWCT's standard wherever applicable.
- 2) The improvement measures for the proposed roads are mostly widening of an existing road to four lanes and also the land-use situation is fairly well developed. Therefore, the road design should be done within the present ROW strip as much as possible to minimize the additional land/house acquisition and compensation.

13.4.2 Right-of-Way Situation along the Proposed Roads

The present ROW situations along the proposed roads have been investigated and are summarized as follows:

(1) **Proposed Roads in Package 1 : Widening of Arterial Roads in the City's Central Area**

(a) **Ohio Street**

This road is in a business area with a road reserve ranging from 20 m - 25 m. A few meters of additional land acquisition might be possible.

(b) **Kivukoni Front**

The present road reserve is only about 20 m; however, widening of the road up to Express Ferry Terminal might be possible by means of land reclamation along seaside.

As far as land reclamation along the seaside (Kivukoni Front) and the environmental aspects are concerned, the Ministry of Lands, Housing and Urban Development; Ministry of Tourism, Natural Resources and Environment and the National Environmental Management Council should be contacted/consulted to obtain their guidance regarding environmental impact assessment (EIA). This should be done before implementation of the Project.

(c) **Sokoine Drive**

In the section between the Express Ferry Terminal and the DSM Railway Station, a few numbers of antiquated buildings are located close to the road which should be preserved in accordance with the national preservation policy. Widening of the ROW might be possible though if the space in front of the Ferry Terminal can be utilized by provision of a retaining structure.

(d) **Gerezani Road**

The road is running along the railway station and has a ROW of about 20 m. Widening might be possible by utilizing the open space on the

slope between the existing road and the harbor yard. It turns right at the roundabout with Bandari Road and runs up to Pugu Road with a ROW width of about 15 m.

Land acquisition (minimum of 10 m) and house compensation might be necessary for widening of the existing road in this section since the road is passing through an area where factory buildings are already developed along the road.

(e) **Bandari Road**

Bandari Road, starting from the roundabout at Gerezani Road, crosses over a railway by the 30 m long Gerezani Bridge and descends up to the B.P. Depot. The widening of the existing road in this section could be done on the left-hand side in parallel with the existing road by utilizing a part of Tanzania Harbor Authority's (THA) yard, for which permission will be required from THA.

The section between the B.P. Depot and the junction of Kilwa Road might not be difficult since the present ROW strip is sufficient enough for a 4-lane road. However, the ROW situation in the section from the Kilwa Road Junction up to Nelson Manderu Road is a bit tight and the minimum width of the present ROW strip is 20 m since buildings are located at both sides along the road. The road design should be carried out to minimize any adverse effects on these buildings.

(2) **Proposed Roads in Package 2: Widening of Middle Ring Roads**

(a) **Morocco Road**

The existing ROW strip of Morocco Road ranges from 40 m to 50 m, with the exception of the section near Kinondoni Junction up to the Mwinijuma Road Junction where the existing ROW is only 25.0 m wide. Presently, there are many houses and kiosks illegally located inside the ROW strip which must be demolished before the implementation of the Project.

(b) **New Kigogo Road**

The present ROW width is ranging from 30 m to 45 m. The 30 m wide ROW strip is along the section from the Morogoro Road Junction up to the Old Kigogo Road Junction, while the remaining section up to Uhuru Road has a 45 m wide ROW strip.

(c) Chang'ombe Road

The Chang'ombe Road is running in an area where factory buildings are located on both sides. The ROW strip ranges only from about 20 m to 25 m. Additional land and house acquisition might be difficult because there are so many buildings already located along the road.

(3) Package 3: Widening of Radial Trunk Roads

(a) New Bagamoyo Road

The section between the Morocco Road Junction up to 1.30 km on the New Bagamoyo Road has only a 30 m wide ROW and this might not be enough for widening to a 4-lane road. However, there is a proposal to widen the ROW strip to 50 m according to a drawing prepared by the Ministry of Lands, Housing and Urban Development.

The section up to the Mpakani Road Junction has a 45 m to 60 m ROW strip which might be sufficient enough for widening of the present road.

(b) Uhuru Road

The ROW situation along Uhuru Road is a bit tight and difficult since the road passes through an area which is densely developed as a business area.

The section in the Kariakoo area from the Msimbazi Street Roundabout up to Lumumba Street/Uhuru Junction might be difficult for widening to four lanes because the narrow street has only a 15 m wide ROW and there are multi-storey buildings located at both sides. The remaining section has a 25 m to 30 m wide ROW so that widening to four lanes might be possible.

(c) **Kilwa Road**

The ROW strip along the Kilwa Road is sufficient, ranging from 40 m to 45 m with the exception of the stretch near the Police Training College where the ROW width is only 25 m to 30 m.

13.4.3 Proposed Right-of-way Standard

The standard ROW specified in MWCT Road Design Manual shall be applied only to the rural roads or roads which run in the non-urbanized areas. As for the urban streets, the boundary line along the road or buildings located on both sides of the street should be identified as the limits of the ROW strip unless the ROW limits are already clearly specified in the ROW map.

A standard ROW width to be applied for each proposed road has been reviewed by the Study Team taking into consideration the road classification, future development plan (staged construction), present right-of-way strip and land-use situation, difficulty of demolishing houses encroached on the road, house acquisition and compensation costs, valuable monuments and antiquated buildings which are to be preserved, etc.,

The results of this review are presented in Table 13.3. As can be seen, the JICA Study Team has recommended to apply a minimum ROW width for particular sections where the land-use situation seems to be extremely tight and difficult.

13.4.4 ROW Area at the Major Intersections

The intersections between Morogoro/Morocco Roads, Uhuru/New Kigogo Roads and Pugu/Chan'gombe Roads are planned to be of a grade-separated type in the long-term to cope up with the increase of traffic demands. The ROW area for those intersections should therefore be reserved in sufficient widths for future development plans having grade separations.

Widening of the ROW strip is necessary at the above intersections.

ROW area for those intersections should therefore be reserved in sufficient widths for future development plans having grade separations.

Widening of the ROW strip is necessary at the above intersections.

Table 13.3 Proposed Right-of-Way Standards

Proposed Road	MWCT's Classification	Present Pattern of ROW	Land-use Situation	Proposed Lane Nos.	Standard ROW Width (m)	Minimum ROW Width* (m)
Package 1						
- Ohio Street	Trunk Road	Urban Street	CBD area	4	Not specified	20
- Kivukoni Road	Trunk Road	Urban Street	CBD area	4	Not specified	20
- Sokoine Drive	Trunk Road	Urban Street	CBD area	4	Not specified	20
- Gerezani Street	Trunk Road	Urban Street	CBD area	4	Not specified	20
- Bandari Street	Trunk Road	Urban Street	CBD area	4	Not specified	20
Package 2						
- Morocco Road	Trunk Road	Rural Road	Urban Area	4	45	30
- New Kigogo Road	Trunk Road	Rural Road	Urban Area	4	45	30
- Chang'ombe Road	Trunk Road	Rural Road	Urban Area	4	30	25
- Missing Link	Trunk Road	Rural Road	Urban Area	4	30	25
Package 3						
- New Bagamoyo Rd	Trunk Road	Rural Road	Sub-urban area	4	45	30
- Uhuru Road	Trunk Road	Rural Road	Sub-urban area	4	45	25
- Kilwa Road	Trunk Road	Rural Road	Urban Area	4	30	25

CBD: Central Business District

Note *: Recommended by the Study Team

CHAPTER 14 ENGINEERING SURVEY AND ANALYSIS



CHAPTER 14 ENGINEERING SURVEY AND ANALYSIS

14.1 General

This chapter describes the results of engineering survey and analysis that were made for the purpose of acquiring necessary information/data required for the preliminary design. The engineering survey was composed of the following items as discussed in the succeeding Sections:

- 1) Geological Investigation including subsoil investigations at the proposed bridge sites and shore protection site.
- 2) Materials investigation including the subsoil and pavement structure on the high priority project roads as well as the investigation of borrow pit areas, quarry sites and materials for structure.
- 3) Hydrological study and analysis.
- 4) Topographical survey including supplemental plane surveying at proposed bridge sites and the shore protection site.

14.2 Geological Investigation

14.2.1 Purpose of the Investigation

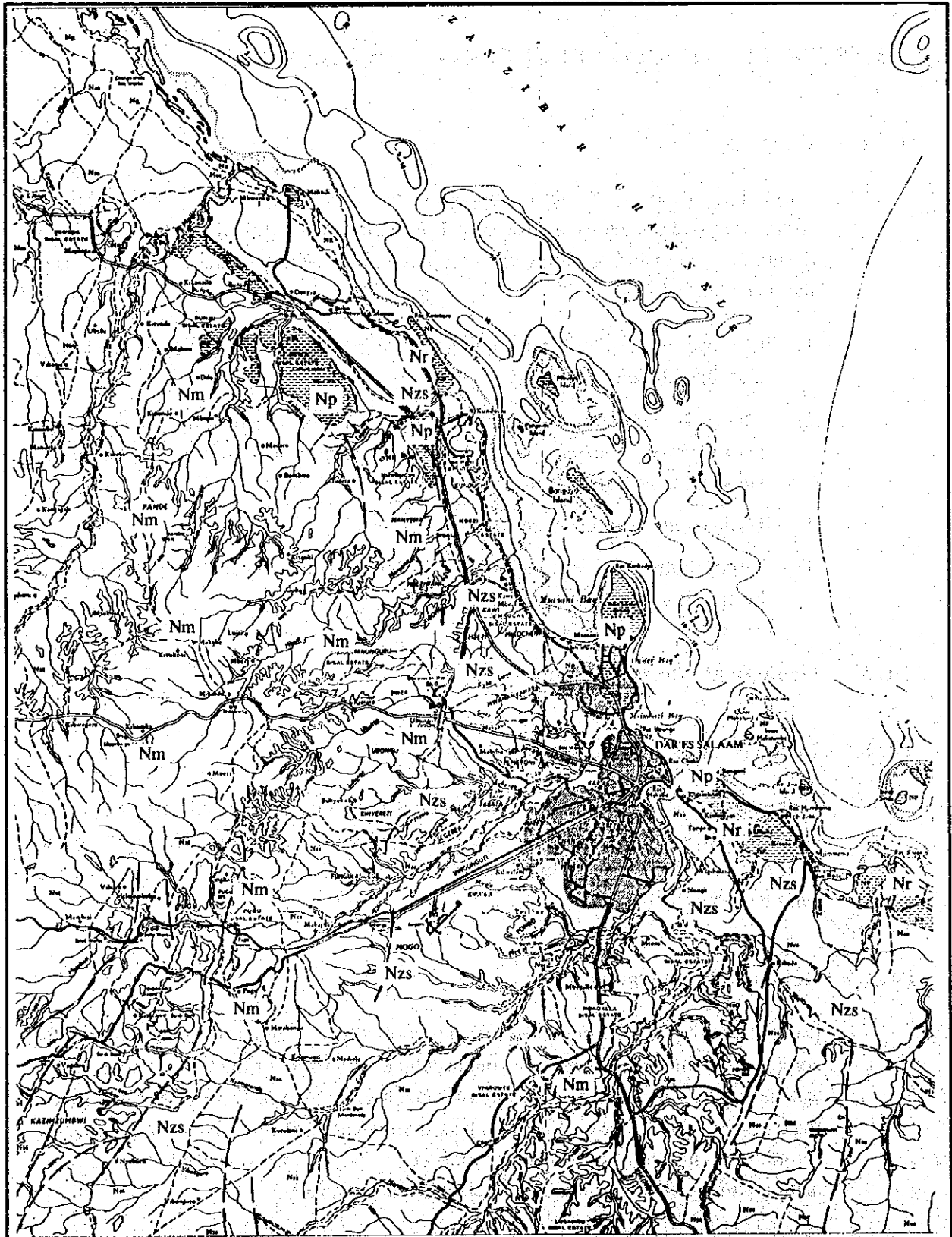
The geological investigation was conducted to clarify the subsoil strata and characteristics at the proposed bridge sites and shore protection site based on the results of test boring including standard penetration tests and laboratory tests for samples from the boreholes.

14.2.2 Geological Characteristics

Dar es Salaam lies eastern in the eastern part of Tanzania along the coastal area. It is composed mainly of geologically young sedimentary rocks of the Cainozoic (Tertiary to Quarternary) age as shown in Fig 14.1 Geological Map of Dar es Salaam. These rocks are found at Wazo Hills which is the raised coral reef. This rocks are also found at Kunduchi and Mjimwema. This rocks are quarried for cement manufacturing, lime burning, building stone and aggregate.

The quarternary deposits are alluvial and largely derived from the Usagaran system. They are mainly fine to medium grained sand (superficial deposits) and sandy clay. In some places there are bands of red and greenish clay.

At several localities, the clay bound sands are overlain by raised reef limestone. A relatively deep borehole drilled at Dar es Salaam passed through the following beds:



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Fig. 14.1

Geological Map of Dar es Salaam

- Nm : White -buff Sands
- Nzs : Sands, sand dunes and beach deposits
- Np : Reef limestones
- Nr : Tidal mangrove swamps

- Yellow surface sand
- White sand and sandy clay: 5m - 28m
- Upper marine beds: 44m - brackish water marls
- Lower marine beds: 60m - 162m

These rocks appear to be of considerable thickness; the underlying mesozoic rocks, if present, must be of considerable depth in the Dar es Salaam area. The nearest precambrian gneiss lie at 64 km.

Fault

Much of the faulting and uplift appears to have taken place in recent geological times and is possibly still occurring. Fault positions have been deduced from prominent scarp features on aerial photographs. The block faulting which exist in the western part of Dar es Salaam have slight westerly tilts and have linear features paralleling the present coastline. This rock faulting does not extent to the Project area.

Superficial Sands

The superficial sands of the flat, low-lying coastal plain represent re-distributed outwash material from the fault blocks. Near the coast they consist of marine sands and silts that are rich in shell fragments while along the Msimbazi River they overlies clay bound sands. The superficial sands regarded as recent deposits since boreholes in Dar es Salaam have shown them to overlay gray clays, which in turn overlay coral limestone at depth of 9 - 11m below the surface.

14.2.3 Soil Investigation at Proposed Structures

(1) Investigation Procedure

The test boring were performed using drilling machine of hydraulic-driven rotary type at one or two location(s) for each proposed site. The boreholes were drilled to a depth of 20.0m.

Standard Penetration Test were performed at one-meter depth intervals in each borehole. Disturbed samples were also taken at one-meter intervals in each borehole.

The samples were tested according to AASHTO or ASTM Methods at the Central Materials Laboratory. Following are the types of tests which were carried out:

- Bulk Density
- Sieve Analysis
- Atterberg Limits
- Moisture Content

(2) Location of the Soil Investigation

The proposed sites where the test borings were performed:

Proposed Bridge Sites (6 sites)

- Two railway crossings along Bandari Road
- Two river crossings along New Kigogo Road
- One river crossing along Morocco Road
- One grade separation with railway at Ilala District

Proposed Shore Protection Site (1 site)

- The site next to ferry port along Sokoine Drive.

The proposed sites were numbered and named as shown in Figure 14.2. The detailed location of borehole at each proposed site is also shown in Appendix- 14.1.

(3) Investigation Results

The investigation results for each proposed site as shown in Fig. 14.2 are illustrated in Appendix-14.2 (1) to Appendix-14.2 (7) respectively.

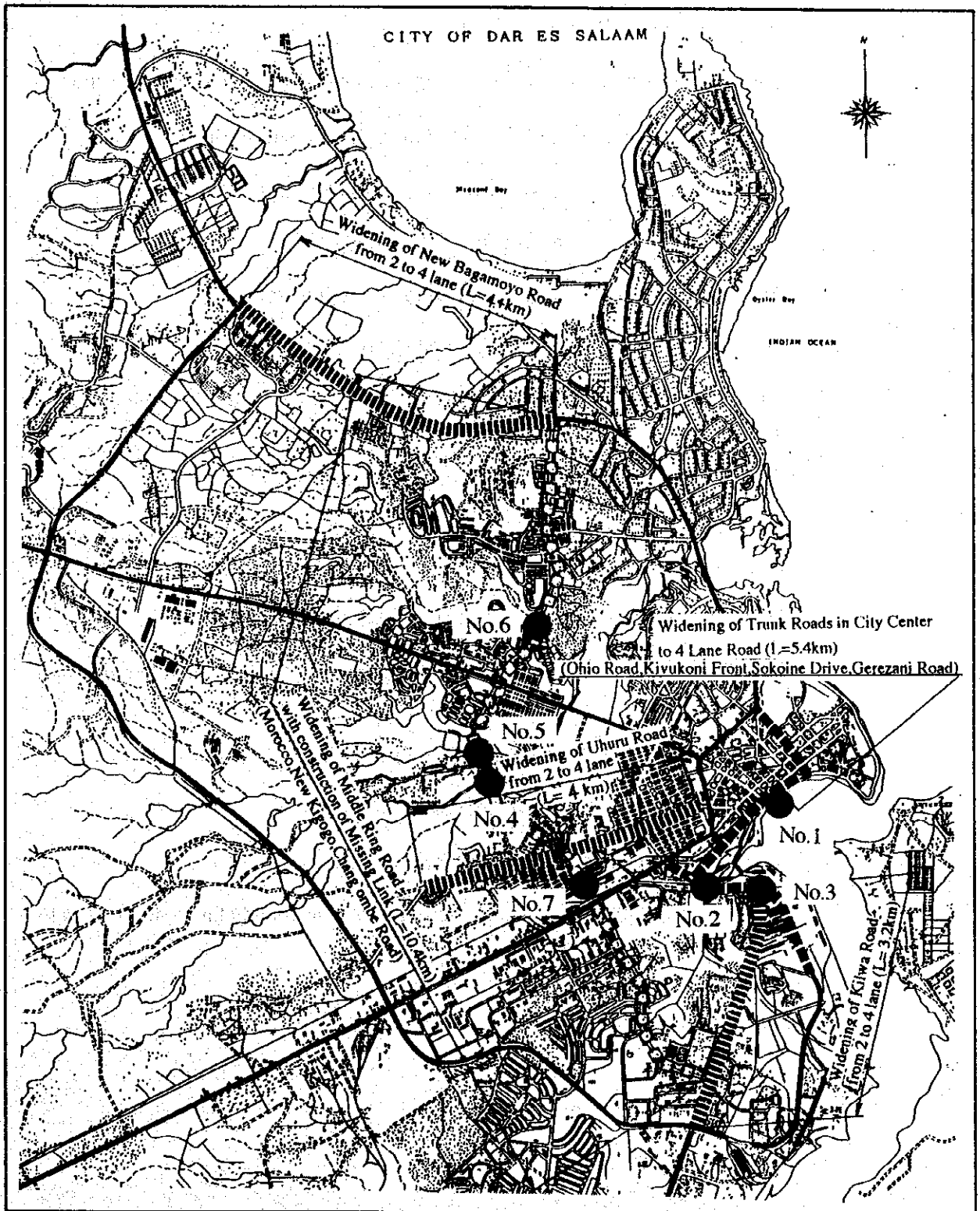
The figure shows the following items:

- Soil Classification (by USCS from the results of sieve analyses and Atterberg Limits)
- N-values (from the results of Standard Penetration Test)
- Water Table
- Bulk Density
- Moisture Content

As shown in these figures, most of the layers in the boreholes were composed of medium dense sand except for location No. 6 where very loose soil was found. The maximum size of the particles was 4.76mm and the portion passing BS Sieve No. 200 (0.075mm) for most of the samples is less than 50%.

The soils at all sites are of low to medium plasticity with low to medium potential of volume change indicating that swelling and shrinkage of soils is not critical. Most of samples were found to have moisture contents of between 10% and 20% except at Location No. 6 and No. 4 where high moisture contents were recorded. Also, most of the samples fall under SC group while a few others fall under SW-SM group.

The detailed test results are also attached in Appendix-14.3.



<p>THE STUDY ON DAR ES SALAAM ROAD DEVELOPMENT PLAN</p>	<table border="0"> <tr> <td>No.1 : Sokoine Seashore</td> <td>2 Boreholes</td> </tr> <tr> <td>No.2 : Gerezani Bridge</td> <td>2 Boreholes</td> </tr> <tr> <td>No.3 : Bandari Bridge</td> <td>2 Boreholes</td> </tr> <tr> <td>No.4 : First Msimbazi C-Box</td> <td>1 Borehole</td> </tr> <tr> <td>No.5 : Second Ubungo C-Box</td> <td>2 Boreholes</td> </tr> <tr> <td>No.6 : Sinza C-Box</td> <td>2 Boreholes</td> </tr> <tr> <td>No.7 : Ilala Bridge</td> <td>1 Borehole</td> </tr> </table>	No.1 : Sokoine Seashore	2 Boreholes	No.2 : Gerezani Bridge	2 Boreholes	No.3 : Bandari Bridge	2 Boreholes	No.4 : First Msimbazi C-Box	1 Borehole	No.5 : Second Ubungo C-Box	2 Boreholes	No.6 : Sinza C-Box	2 Boreholes	No.7 : Ilala Bridge	1 Borehole
No.1 : Sokoine Seashore	2 Boreholes														
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No.4 : First Msimbazi C-Box	1 Borehole														
No.5 : Second Ubungo C-Box	2 Boreholes														
No.6 : Sinza C-Box	2 Boreholes														
No.7 : Ilala Bridge	1 Borehole														
<p>Fig. 14.2 Location of Soil Investigation</p>															

14.2.4 Evaluation of Foundations

The following types of piling foundations are recommended at each proposed site:

- 1) Location No. 1 (Kivukoni Front Seashore) : End Bearing Piles
Hard ground (limestone) was found at a depth of 13 m to 14 m.
- 2) Location No. 2 (Gerezani Bridge) : Friction Piles
Any bearing layer 30 was not found up to a depth of 20 m.
- 3) Location No. 3 (Bandari Bridge) : End Bearing Piles
The hard strata having N-value of more than 50 was found at a depth of 5 m to 6 m.
- 4) Location No. 4 (First Msimbazi C-Box) : Friction Piles
The dense sand strata having N-value of more than 30 was found at a depth of 17 m to 20 m.
- 5) Location No. 5 (Second Ubungo C-Box): Friction Piles
The dense sand strata having N-value of more than 30 was found at a depth of 16 m to 20 m.
- 6) Location No. 6 (Sinza C-Box) : Friction Piles
No bearing layer was found up to a depth of 20 m.
- 7) Location No. 7 (Ilala Bridge) : End Bearing Piles
The hard strata having N-value of more than 50 was found at a depth of 13 m to 14 m.

14.3 Materials Investigation

14.3.1 Purpose of the Investigation

The materials investigation was:

- To clarify the suitability as subgrade material of the existing subsoil on the high priority project roads based on the laboratory test results of samples taken at several test pits.
- To identify borrow pit areas from which can be taken suitable subgrade materials by means of checking several potential areas around the project roads.

- To identify quarry sites from which can be taken suitable coarse and fine aggregates by checking several potential sites around the project roads.
- To identify availability and quality of materials.

14.3.2 Subsoil Conditions on High Priority Project Roads

(1) Investigation Procedure

The test pits were dug having a 1.0m width, 1.0m length and 1.5m depth along the project roads. Two disturbed samples were taken at each selected test pit.

The samples were tested according to AASHTO or ASTM methods at the Central Materials Laboratory. The following types of tests were carried out:

- Specific Gravity
- Sieve Analysis
- Atterberg Limits
- Moisture Content
- Compaction
- CBR Value

At the same time, the investigation of pavement structure was conducted at each selected test pit with the following process being used:

- 1) Measure the thickness of existing base and surface course.
- 2) Determine the appropriate conversion factor at each layer.
- 3) Determine the effective thickness of each layer

(2) Location of the Investigation

28-test pits were selected at 1.0 km intervals along the project roads for the investigation. In this Study, the investigations were conducted at 18-pits out of 28 pits in total, and the investigation results in the previous study entitled "The Feasibility Study on Road Improvement and Maintenance in Dar es Salaam" were used at the remaining 10 pits.

The locations are shown in Appendix-14.4.

(3) Investigation Results

The investigation results for each "Package" (refer to chapter 11) are shown in Table 14.1.

The table shows the following items:

- Soil classification by the AASHTO Method and Group Index at each test pit based on the results of Sieve Analyses and Atterberg Limit.
- CBR Value (4-days soak) at each test pit.

The materials taken from pit No. 1, No. 9, No. 12 and No. 14 show uniformly graded sand. The rest show poorly graded sand or sand-clay. The samples collected from pit No. 1 to No. 9 and No. 11 to No. 14 were non-plastic.

The specific gravity of the soil particles range between 2.5 and 2.6 while the natural moisture content for the samples range between 1.9% and 23%. A high moisture content were observed for all soils collected along Morocco and New Bagamoyo Roads. The maximum dry densities of these samples are shown to range between 1.50 t/m³ and 1.93 t/m³ with optimum moisture content ranging between 7% and 14%. The results of CBR test were ranging between 2% and 17%.

The detailed test results are attached in Appendix-14.5.

Table 14.1 Investigation Results of Subsoil Condition

(a) For Package 1

Name of Project Roads	Test - pit No.	Soil Classification	Group Index	CBR Value	Remarks
Ohio Road Kivukoni Front Sokoine Drive Gerezani Road	II - 1 - 1 *	A-2-4	0	10%	Previous Study result
	No.1	-1	A-3	0	7
		-2	A-3	0	10
	No.2	-1	A-3	0	5
-2		A-3	0	6	
Bandari Road	No.3	-1	A-2-4	0	17
		-2	A-2-4	0	12
	8.1*	A-1-b	0	16	Previous Study result
	No.4	-1	A-1-b	0	5
		-2	A-1-b	0	7

- Test pits marked with *are the ones which were conducted in the previous study entitled "The Feasibility Study on Road Improvement and Maintenance in Dar es Salaam" JICA, 1991.

(b) For Package 2

Name of Project Roads	Test Pit No.	Soil Classification	Group Index	CBR Value	Remarks	
Chang'ombe Road	No.5	-1	A-1-b	0	12%	
		-2	A-1-b	0	16	
	II-F-13 *		A-3	0	7	Previous study result
	No.6	-1	A-1-b	0	8	
		-2	A-3	0	7	
	No.7	-1	A-1-b	0	11	
	-2	A-1-b	0	8		
New Kigogo Road	No.8	-1	A-3	0	4	
		-2	A-3	0	5	
	4.1*		A-2-6	0	21	Previous study result
	No.9	-1	A-1-b	0	10	
		-2	A-1-b	0	12	
Morocco Road	4.2*		A-1-a	0	7	Previous study result
	4.3*		A-3	0	7	Previous study result
	No.10	-1	A-7	6.1	2	
		-2	A-7	7.3	5	

(c) For Package 3

Name of Project Roads	Test Pit No.	Soil Classification	Group Index	CBR Value	Remarks	
Kilwa Road	No.11	-1	A-2-4	0	10%	
		-2	A-3	0	7	
	No.12	-1	A-3	0	7	
		-2	A-3	0	3	
	8.2*		A-1-b	0	15	Previous study result
Uhuru Road	No.13	-1	A-1-b	0	9	
		-2	A-1-b	0	6	
	7*		A-1-b	0	14	Previous study result
	No.14	-1	A-1-b	0	4	
		-2	A-1-b	0	5	
	No.15	-1	A-2-6	0	3	
	-2	A-2-6	0	3		
New Bagamoyo Road	No.16	-1	A-2-6	0	3	
		-2	A-2-6	0	3	
	II.1.3*		A-2-6	1.2	5	Previous study result
	No.17	-1	A-2-6	0	9	
		-2	A-2-4	0	10	
	No.18	-1	A-2-6	0	2	
		-2	A-2-6	0	3	
II.1.4*		A-2-6	0	8	Previous study result	

(4) Effective Thickness of Project roads

The existing effective thickness of each project road was estimated as shown in Table 14.2 for use in consideration of overlaying. The detailed investigation results are also shown in Appendix 14.6.

Table 14.2 Effective Thickness of Project Roads

Project Roads	Effective Thickness		
	Surface Course	Base Course	Total
Ohio/Kivukoni/Sokoine	7cm	11cm	18cm
Gerezani	7cm	7cm	14cm
Bandari	4cm	7cm	11cm
Chang'ombe	4cm	10cm	14cm
New Kigogo	5cm	4cm	9cm
Morocco	7cm	7cm	14cm
Kilwa	5cm	6cm	11cm
Uhuru	5cm	10cm	15cm
New Bagamoyo	7cm	7cm	14cm

14.3.3 Potential Borrow-pit Areas

The following borrow pit areas around the project roads were investigated on the basis of interviews with the MWCT and other concerned organizations.

- 1) Along Old Bagamoyo Road
 - Kunduchi Hill (Bunju, Mbezi Tegeta)
 - Kunduchi MECCO Quarry crusher-run fines.
- 2) Along Morogoro Road
 - Kibangu
 - Kimara Mafuloni
 - Kimara Korogwe
- 3) Along Pugu Road
 - Ukonga (Kitunda)
 - Pugu
- 4) Along Kilwa Road
 - Mwandege
 - Chamazi

The potentiality of these borrow pit areas was determined based on the estimated deposited amount, the quality, the accessibility and the workability at site. Refer to Table 14.3 for details.

Table 14.3 Determination of Potentiality for Borrow-pit Areas

Borrow-pit Area	Estimated Deposit	Quality (Soil classification)	Accessibility	Workability	Potentiality
Kunduchi Hill	Assumed to be limited	Excellent (A-1-b)	Good	Good	Insufficient
Kunduchi crusher run fines	Limited	Excellent (A-1-b)	Good	Good	Insufficient
Kibangu	Limited	Good (A-2-4,6,7)	Good	To be issued	Insufficient
Kimara Mafuloni	sufficient	Good (A-2-6)	To be improved	Good	Fair
Kimara Korogwe	Limited	Good (A-2-7)	Good	Good	Insufficient
Ukongu (Kitunda)	Sufficient	Excellent (A-3)	To be improved	Good	Fair
Pugu	Sufficient	Excellent (A-3)	Fair	Good	Sufficient
Mwandege	Limited	Good (A-2-6)	Good	Good	Insufficient
Chamazi	Sufficient	Excellent (A-3)	Fair	Good	Sufficient

14.3.4 Potential Quarry Sites for Aggregate

In the previous study (The Feasibility Study on Road Improvement and Maintenance in Dar es Salaam), Kunduchi Area Quarries, Msolwa Quarry and Mikese Quarries were investigated. This has revealed that the quarries have the following technical and/or operational difficulties as follows:

Kunduchi Area Quarries

These quarries have been utilized because of being the nearest and sole site for several construction projects in Dar es Salaam Area. As a result, the material deposit are no longer sufficient and they will obviously be exhausted in several years.

Msolwa Quarry

The deposit of aggregates which have suitable quality for pavement material have become exhausted during recent years.

Mikese Quarries

Since the aggregates taken from these quarries have long and flat shapes and because the L.A.A or Aggregate Impact Values are slightly below the standard, it is required to take appropriate technical countermeasures if this aggregate is to be used for pavement material, especially in the surface course.

Accordingly, the following other quarry sites were investigated:

- Melela
- Kitumbi
- Lugoba (Mindutriani)
- Kigamboni (Mjimwema)
- Mpiji

The potentiality of each quarry site was determined from the viewpoint of hauling distance, estimated deposit, quality, accessibility and workability at the site. (Refer to Table 14.4).

Table 14.4 Determination of Potential Quarry Sites

Quarry Site	Melela	Kitumbi	Lugoba (Mindutriani)	Kigamboni (Mjimwema)	Mpiji
Approximate Hauling Distance and Condition/1	230 km	226 km	128 km (Fair)	42 km (Appropriate)	38 km (Appropriate)
Estimated Deposit	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
Quality /2	Good for Coarse aggregate for base	Excellent for Coarse aggregate for surface	Excellent for Coarse aggregate for surface	Good for Coarse aggregate for base	Good for Fine aggregate
Accessibility	Good	Good	Good	To be improved	Good
Workability	Good	Good	Good	Good	Good
Potentiality	Dist. too far	Dist. too far	Adequate	Fair	Adequate

Note: /1 Distance from Ubungo Junction

/2 Evaluation from the results of laboratory tests (refer to Appendix - 14.7)

14.3.5 Investigation of Materials for Structure

The following main materials will be utilized for the proposed reinforced concrete structures:

- 1) Concrete Mixture
- 2) Reinforcing Bar
- 3) Structural Steel

Concrete Mixture

The mixture for reinforced concrete structure which has a required strength of up to 240 kg/cm² is available using domestic cement and aggregate. The compressive strength testing apparatus for checking the quality is available in the Central Materials Laboratory of MWCT and the University of Dar es Salaam.

Reinforcing Bar

Local made round bars product are available, while the deformed bars which conformed to ASTM standards are imported. The tensile tests for confirming the steel's quality can be performed at the University of Dar es Salaam.

Structural Steel

Out of several types of structural steel, steel channels, H-beams and I-beams which conform to DIN (German Standards) are manufactured in Tanzania, but the sizes are quite limited. Other types of steel will have to be imported from abroad.

14.3.6 Evaluation of Aggregate and Materials

(1) Subsoil Conditions on High Priority Project Roads

The existing subsoil along the high priority project roads was concluded to be suitable for subgrade materials except for the following sections (refer to Appendix-14.8).

- 1) The section from the intersection with New Bagamoyo Road to a point 1.0 km along Morocco Road (L = 1.0 km).

Here, soils were classified to Category A-7, which is poor for subgrade. Also, the CBR value taken from samples at the test pit there were was very low (2%).

- 2) The section from the intersection with Morocco Road to a point 1.0 km along the New Bagamoyo Road (L = 1.0 km)

The CBR values taken from both samples at the test pit were low (3%).

- 3) The section between the 2.8 km point and the 3.8 km point along the New Bagamoyo Road (L = 1.0 km)

The CBR values taken from both samples at the test pit were very low (2 to 3%).

- 4) The section from 2.8 km point to the 4.8 km point along the Uhuru Road (L = 2.0 km).

The CBR values taken from both samples at the test pit were low (3%).

Appropriate improvement measures including use of suitable borrow materials will be required at the above sections.

The design CBR values for the pavement thickness design were estimated according to the method in "Manual for Asphalt Pavement, 1989" published by Japan Road Association as follows:

-6% : Ohio – Gerezani, Bandari, Morocco, Missing Link, Chang'ombe and New Bagamoyo Roads

-4% : New Kigogo, Uhuru and Kilwa Roads

The above results are also illustrated in Appendix-14.8, with the determination process being indicated in Appendix 14.9.

(2) Potential Borrow pit Areas

Since Pugu and Chamazi borrow pit areas both have non-plastic fine sand suitable for subgrade and have sufficient estimated deposits, they are recommendable to be used.

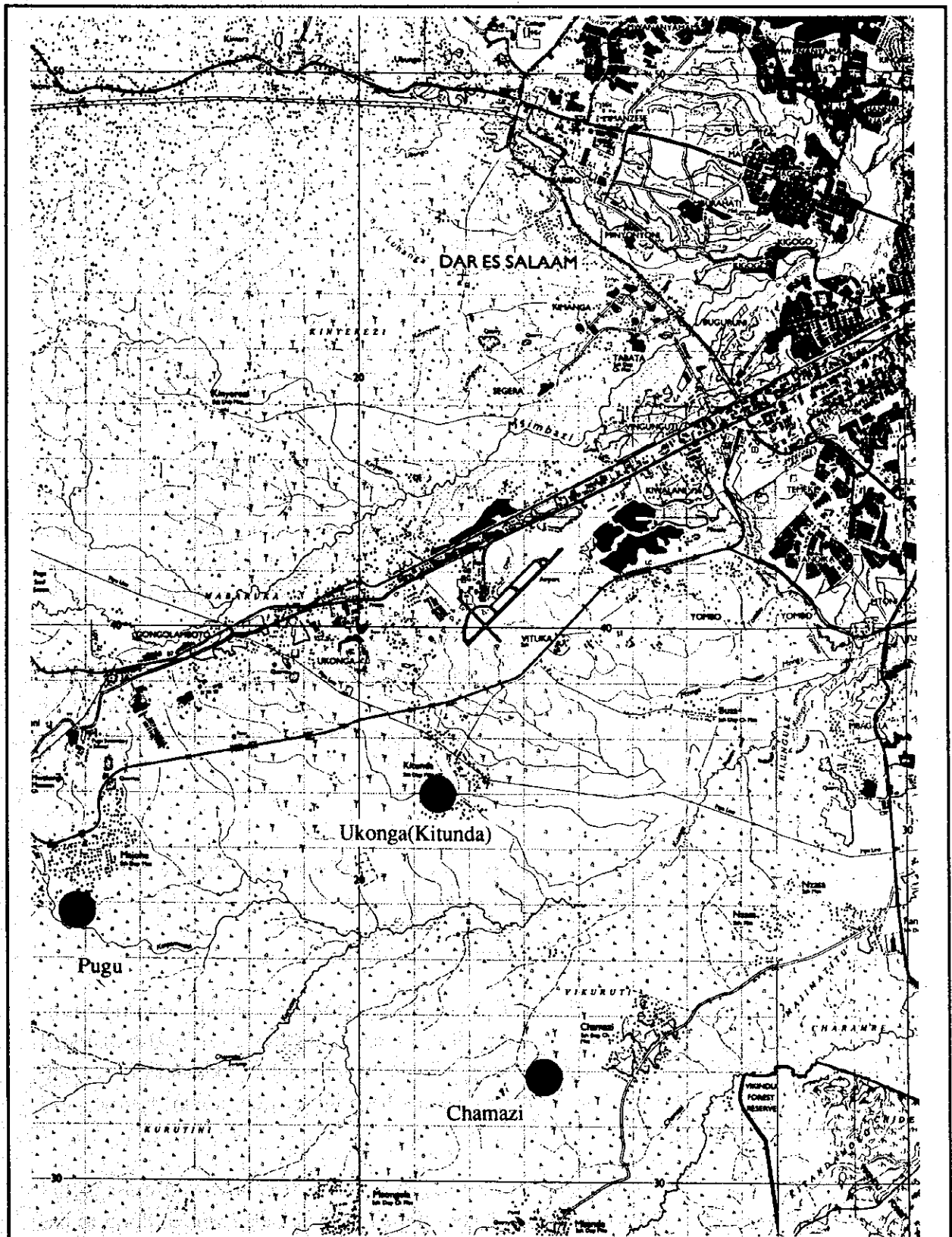
Although the access road needs to be improved, Ukonga (Kitunda) borrow pit has conditions similar to the above areas from the viewpoint of estimated amounts of deposit and the quality. As such, it is considered as a secondary potential area.

The location of these borrow pit areas are shown in Figure 14.3.

(3) Potential Quarry Sites for Aggregate

Coarse Aggregate for Surface Course

Although the hauling distance is comparatively far from Dar es Salaam, Lugoba (Mindutmani) quarry site has sufficient amounts of deposit and suitable coarse aggregate for surface course. It is therefore recommendable as a quarry site (see Fig. 14.4).



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Potential Borrow-pit Areas

Fig. 14.3
Location of
Potential Borrow-pit Areas

Coarse Aggregate for Base Course

Some stabilization method should be applied for the aggregates from Kigamboni (Mjimwena) quarry that are to be used for the base cause (see Fig. 14.4). It is considered as a secondary source from the following viewpoints:

- Although the material in Kigamboni quarry has a coral stone similar to the Kunduchi quarry, the quality is slightly lower, especially in water absorption (approximately 2% against 1% in Kunduchi) and the overburden layer is less than at the Kunduchi quarry (approximately 4 m against 6 m at Kunduchi).
- Considering the recent remarkable increase of demand for construction materials in the Dar es Salaam Region, the Kigamboni quarry will also be in the same situation as Kunduchi in the near future.
- The predominance of young sedimentary material around Dar es Salaam means that suitable quarry sites are relatively scarce. The type of rock existing near Dar es Salaam, is coral stone. There are massive deposits along the shores of Dar es Salaam but the raised coral reef is the one mined for construction. Such massive deposits of coral can vary in quality within the same quarry which is why they are not very suitable for use as construction material.
- These materials are mined at Kunduchi and Kigamboni near Mjimwema in Dar es Salaam. Large areas around Dar es Salaam are covered by superficial deposit such as sandy clay, such materials being impossible to find in areas other than at the abovementioned Kunduchi and Kigamboni.

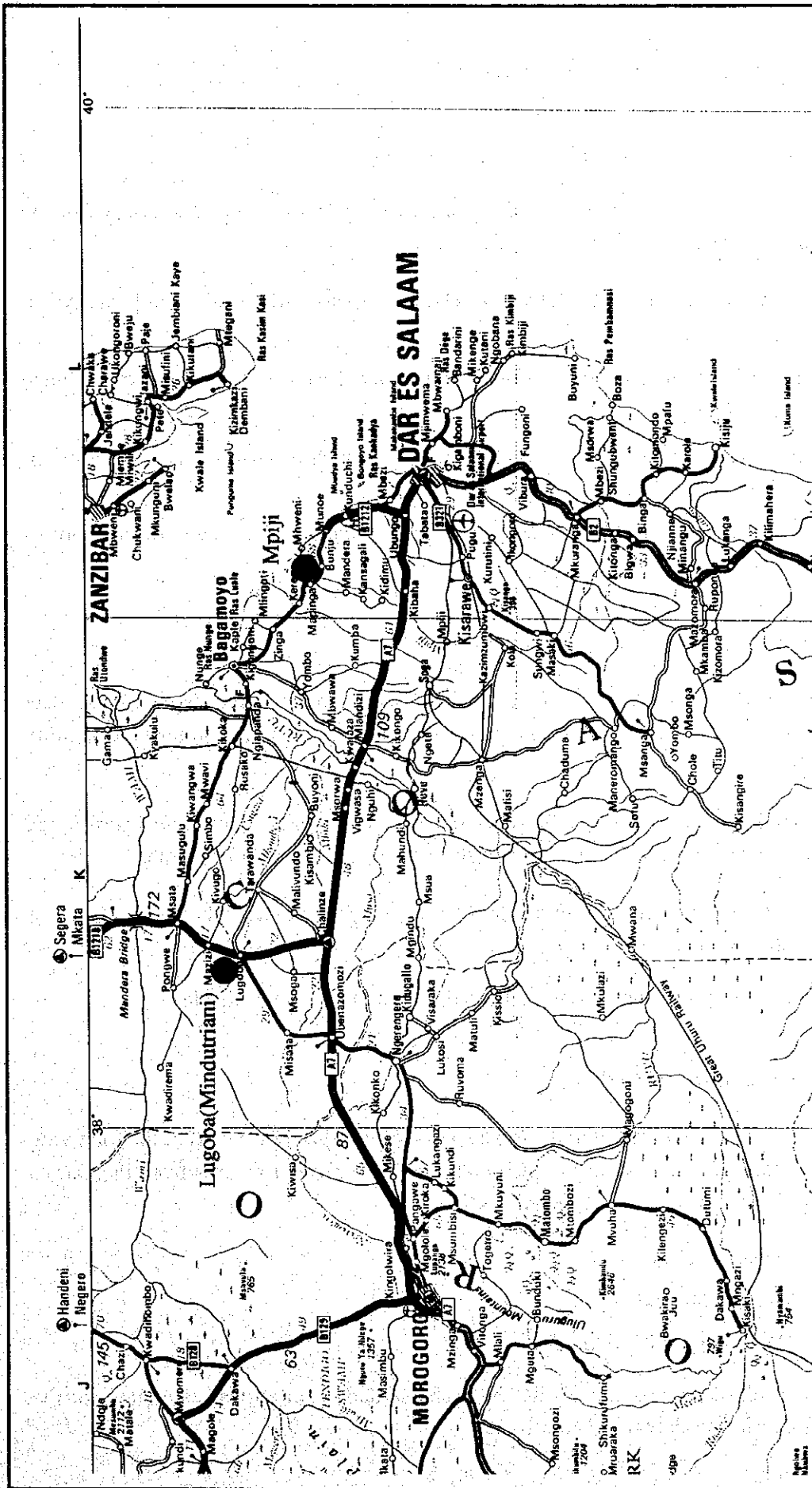
Fine Aggregate

Fine aggregates suitable for both asphalt mixtures and structural concrete can be taken in Mpiji quarry as shown in Table 14.4.

(4) Materials for Reinforce Concrete Structures

As stated in Section 14.3.5, a reinforced concrete structure could be considered for the existing situation. However, any structure using prestressed or post-tensioned concrete would require careful consideration including prior checking of the strength for trial mixing, since such concrete has not been utilized on previous projects in Tanzania.

The deformed reinforcement bars for use in concrete structures and most of the structural steel should be imported from abroad to ensure they will conform to the designated standard.



● Potential Quarry Sites

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Fig. 14.4

Location of Potential Quarry Sites