CHAPTER 3 EXISTING TRANSPORT FACILITIES AND TRAFFIC CONDITIONS

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3.1 Transport Networks and Facilities

3.1.1 Road Network

1) Existing Road Network

The trunk road network in the study area consists of three national roads centering on Mombasa Island: they are A109 to Nairobi in the west, B8 to Malindi in the north and A14 to Tanzania in the south.

The Island is connected to the surrounding mainland by means of roads and ferries: two roads, Makupa Causeway (A109) and Kipevu Causeway (exclusive use for KPA.) lead to Nairobi, and the New Nyali Bridge, which was completed in 1979, leads to Malindi in place of the old Nyali Bridge which is at present being removed. Towards Tanzania two ferries, Likoni and Mtongwe, are functioning. The traffic on the Island is distributed by the regional arterial roads such as Kenyatta, Moi, Digo Ave., etc.

The west Mainland consists of Kipeve, Vikombani, Miritini, etc. (sea port, air port, industrial area and villages). These areas are served by three arterial roads, A109, Magongo road, and the access road to/from the airport.

The North Mainland consists of Mwandoni, Bamburi, Junda, etc. (mostly resorts and villages) These areas are served by three roads (all single carriageways): B8, Old Malindi Road and Old Nyali Link Line.

The South Mainland consists of Likoni and Mtongwe, a resort area on the coastal belt and villages in the hinterland. The road network (all single carriageways) consists of Lunga Lunga Road (A14) as artery and branch roads such as C109 leading to Mtongwe (where villages and the Kenya Navy Base are located) and other service roads for the coastal belt.

The physical features of the associated roads and corridors are shown in Fig. 3.1.1 and Table 3.1.1. Most of the roads on the mombasa Island are 2-lane roads except for some arterial roads.

The characteristics of the project-related roads are summarized in Table 3.1.2.

2) Traffic Problems

(1) Traffic Congestion on Mombasa Island

There are many congested intersections and road sections on Mombasa Island. Heavy traffic congestion occurs in the CBD and at some major district road intersections. These are listed below:

– Digo Road between Kenyatta Ave. and Moi Ave.

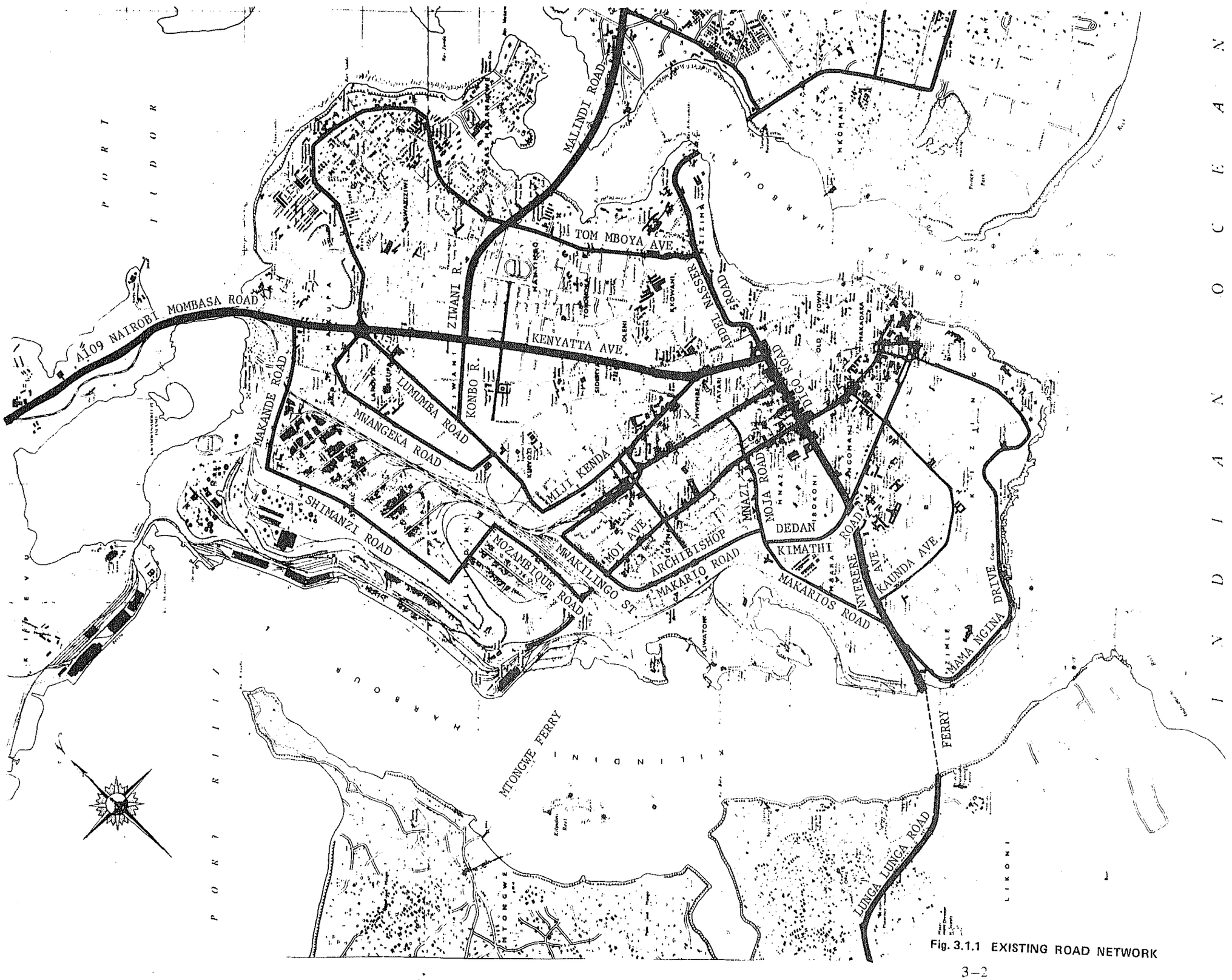


Fig. 3.1.1 EXISTING ROAD NETWORK

Table 3.1.1 INVENTORY OF EXISTING ROADS

Name of Road/Street	Carriageway	Median (m)	Shoulder (m)	Sidewalk	R.O.W. (m)
Kenyatta Ave.	2@ 9.00	3.00	-	4.50	30.00
Nyerere Ave.	2@ 9.00	3.00-8.00	-	4.50	30-32.00
Digo Road	2@ 9.00	3.00-8.00	-	4.50	30-32.00
Abdel Nasser Road	2@ 9.00	3.00	-	4.50	30.00
Moi Ave.	2@ 9.00	3.00-4.50	-	4.50	30.00
Haile Selassie Road	2@ 9.00	3.00	-	4.50	30.00
Tom Mboya Ave.	2@ 7.50	3.50	-	2.00	22.50
Lumumba Road	2@ 7.20	6.60	-	4.50	30.00
Mwakilingo St.	7.20	-	-	-	30.00
Shimanzi Road	7.20	-	-	Partially 4.00	60.00
Makande Road		-	-	-	15-30.00
Mwangeka Road	7.20	-	-	-	15.00
Arch Bishop Makerios Road	6.60	-	-	-	30.00
Mbaraki Road	6.60	-	-	-	30.00
Mnazi Moja Road	6.60	-	-	-	15.00
Dedan Kimathi Road	6.60	-	-	-	30.00
Tangana Road					
Moi-Station	7.20	-	-	-	30.00
Moi-Archbishop Ave.	7.20	-	-	2.60	15.00
Mama Ngina Drive	7.20	-	-	Partially 1.50	24.00
Nairobi-Mombasa (A-109)	2@ 7.00 or 8.00	5.00 -	- -	- -	30.00 30.00
Lunga Lunga Road (A-14)	6.00	-	3.00	-	60.00
Mombasa-Malindi (B-8)	6.00-7.00	-	2.00	-	-

Source: Mombasa Municipality, Road Section

Table 3.1.2 DISTRICT ROADS RELATED TO PROJECT

Name of Road	Number of Lanes	Land Use Along Route	Evaluation of Road Function
Kenyatta Ave.	Divided 4	Mainly commercial	Basically for through traffic but disturbed by the minor street crossings and road side parking.
Moi Ave.	Divided 4	Commercial	Major road connecting east (CBD, Old Town) and west (port/industrial area.)
Nyerere Ave.	Divided 4	Commercial and residential	For through traffic form south (Likoni ferry) and west/north (Kenyatta Ave. and New Nyali Bridge) through CBD
Digo/Abdel Nasser Road	Divided 4	Commercial/ administrative	Most congested major road for local/ through traffic due to the linkage of major roads
Tom Mboya Ave.	Divided 4	Mainly sparsely residential	Major road carrying mainly north-bound traffic and some local traffic
Lumumba Road	Divided 4	Industrial and residential	Major road carrying mainly west-bound traffic and some local traffic
Mbaraki Road	2	Mainly residential	Minor road short cutting to port/industrial area for north/ west-bound traffic
Dedan Kimathi Road	2	Residential/administrative	Minor road, but supplement function of Moi Ave. and serving for south residential area
Archbishop Makerios	2	Residential	Minor road with the combined functions of Mbaraki and Dedan Kimathi Roads
Shimanzi Road	2	Industrial and residential (worker for port)	Supplemental function of Moi Ave and short-cutting to Port/industrial area
Mwangeka Road	2	Industrial/residential	Minor road serving very limited local area adjacent to railway with less through traffic
Tangana Road	2	Residential/commercial	Minor road with major function carrying west/north-bound traffic detouring CBD
Makande Road	2	Industrial/residential	Minor road with major function carrying traffic to port/industrial area

- Kenyatta Ave.
  - Section between Digo Road and Mwembe Tayari Road
  - Intersections with Makande Road, Salim MWA Ngunga Road, Muslim Road and Shibu/Jokad Street
- Moi Ave.
  - Section between Digo Road and Mnazi Moja Road
  - Intersection with Tangana Road
- Abdel Nassir Road between Kenyatta Ave. and Tom Mboya Ave.
- Nkrumah Road between Digo Road and Kaunda Ave.
- Miji Kenda Road

(2) Traffic Accidents

According to the traffic accident record made by the Coast Province Police there were totally 1,219 accidents in 1982 with 709 injuries.

The traffic accidents on the Mombasa Island and its vicinity amounted to 706 cases, which corresponds to 78.2% to the total.

The statistics shows the accidents are caused by: 42.2% by pedestrians, followed by drivers with 30.4% and by location the occurrences are predominately on the district major roads centering around the CBD and on the national roads in the vicinity of the Island, especially on Makupa Causeway, New Nyali Bridge and Lunga Lunga Road near the Likoni Ferry. A considerable number of the accidents are related to the loading/unloading activities to/from Likoni Ferry.

(3) Aspect of Road Network

The existing arterial road network is composed in such a form that all roads concentrate on the CBD and that Nyerere Ave., Digo Road and Abdel Nassir Road receive the traffic coming from Kenyatta Ave., Moi Ave., Haile Selassie Road, Tom Mboya Road, etc. which all link in the form of a comb. Detours for the CBD are poor, and hence through traffic is forced to join the local traffic in the CBD, agravating the traffic congestion.

(4) Aspect of Traffic Management and Road Facilities

- Traffic is a combination of through traffic and local traffic, and there is no provision for frontage roads.
- Free crossing the roads by pedestrians
- Parking along roadsides and medians

- Poor or no terminal facilities for bus and matatu transport, and matatu stop freely on the roads.
- Insufficient capacity of intersections provided with unsuitable road structures (small size, roundabouts, etc.)
- Low maintenance of road surface (many pot holes)

The Mombasa Municipality reports that they have a road budget of 2.16 million shillings annually to maintain 53.4 km of government roads and 97 km of city roads, and that this amount is not sufficient even for the pot hole patch work.

(5) Problems Concerning Bus Terminals

On the Island there are four bus terminals (Likoni Ferry, Kenyatta Ave., Mombasa Station and Bondeni). Some other bus terminals were planned by the municipality in the past.

The bus terminal at Kenyatta Ave., is located between Digo Road and Mwembe Tayari Road. This terminal was planned to be relocated to the northern block of Mombasa Station. However, the plan was abandoned because of budgetary reasons and plans of some new facilities. The existing terminal has insufficient capacity and many buses are forced to wait for passengers at the roadsides.

The Bondeni terminals is a roadside terminal located along Abdel Nasser Road. Traffic congestion is very common here.

A plan for a new terminal is under consideration around the intersection of Kenyatta Ave. with Kombo/Ziwani Road (access road to New Nyali Bridge). However, no definite construction schedule has been proposed yet.

3.1.2 Railway

1) Railway System

The railway network in the study area is very simple: one single track leads towards Nairobi, carrying passengers and goods. Two passenger trains leave the Mombasa Station for Nairobi in the evening, and two passenger trains arrive at the station from Nairobi in the moring, total four passenger trains being handled daily by the Mombasa Station. Two freight lines run between Mombasa Island and west Mainland; they start from the port/industrial area, running on Maupa Causeway and Kipevu Causeway and reach Changemwe where trains are reorganized at the shunting yard and proceed towards Nairobi.

The network of rail freight lines on the Island was completed during the first half of the 1900's, and has provided rail service mainly to Kilindini Harbour and the Port Raitz coastal area. In the industrial area factories and warehouses are provided with rail services, and one rail freight siding extends as far as Mbaraki Berth for Bamburi Cement.

There are two shunting yards (at Changemwe and Mombasa) and one steam-locomotive shed at Mombasa Station. The newly built Changemwe yard handles the collection and distribution of goods, while the Mombasa yard does not function much and is used for the stabling of freight wagons and coaches. The steam-locomotive shed located behind the Mombasa Station does not handle locomotive repairs but does maintenance work on some wagons.

2) Goods Movement by Rail

According to the data from the Kenya Railway, their transportation of goods has stagnated between 2.15 million tons and 2.60 million tons for the past seven years. The recent trend shows a decrease from 2.60 million tons in 1980 to 2.15 million tons in 1982. The movement from the Mombasa area to up-land areas keeps a 60% share of the total tonnage. The number of freight wagons arriving at and departing from, the vicinity of Mombasa amounted to 31,700 units in 1982, out of which about 37 units were handled by the Mombasa Station.

Table 3.1.3 shows the cargo (by transport mode) carried to/from the port area.

Table 3.1.3 PORT CARGO TRANSPORTED BY MODE 1977, 1978, AND 1982

Year		Railway		Road	
		Tonnage	%	Tonnage	%
1977	Import	315,625		911,783	
	Export	296,245		485,195	
	Total	611,870	30.5	1,396,978	69.5
1978	Import	355,900		1,517,077	
	Export	128,305		516,129	
	Total	484,205	19.2	2,033,206	80.8
1982	Import	371,694		881,170	
	Export	115,000		531,087	
	Total	486,694	25.6	1,412,259	74.4

The above table indicates that 70 to 80% of the port cargo depends on the road transport.

3) Problems with Railway Transport

From this discussion it is clear that the utilization of the railway transport is in a decreasing trend and the railway facilities exceed traffic requirements. KPA have many rail freight sidings in their compound, but they are considering removing some siding because of their high maintenance costs and the lack of space for cargo handling. The type of railway cargoes is changed to bulk and containers.

From the above conditions, it can be said that the future railway in the study area will be subject to some change in terms of quantity and quality.

3.1.3 Sea Transport

1) Cargo Handled

The Port of Mombasa is the largest and most developed of the East African ports. Modern ports have been established in Kilindini Harbour, on Mombasa Island Side, and Port Raitz at Kipevu on the West Mainland. Table 3.1.4 shows the record of the cargo handled in the port.

Table 3.1.4 CARGOES DEALT WITH

(Unit: 1,000 D.W.T.)

Cargo Type \ Year	1977	1980	1981
Import & Export			
Dry bulk	853	1,231	1,446
Bulk liquid	3,078	4,066	4,841
Dry general	2,000	2,215	2,129
Total	5,931	7,512	8,436

Source: Annual Bulletin of Port Statistics, 1981

In 1981 the total cargo handled amounted to 8.4 million tons predominately imports at 66.7% and 33.3% export cargoes.

Export commodities are coffee, tea, sisal, soda ash, cement, canned fruit, molasses, hides/skins, and cashewnuts, and imports are crude oil, fertilisers, salt sugar, paper/paper bags, iron/steel works, motor vehicles, farm machinery, wheat and coal in bulk.

The transit cargo shared 4.7% of the total cargo in 1980 and was transported to/from Uganda, Tanzania, Burundi, Ruanda, Sudan, Zaire and Zambia.

2) Port Facilities

Table 3.1.5 shows major facilities of the Port, 1981.

Table 3.1.5 PORT FACILITIES IN 1981

Facilities	Numbers	Total Length (m)	Draft (m)
Deep Water Berths	16	3,044	10
Bulk Oil Jetties	2	-	9.75-13.4
Cased Oil Jetties	1	-	4.3
Container Berths	1	230	-
Bulk Cement Berths	2	315	-
Lighterage and Dhows Wharves	2	412	-

Source: Annual Bulletin of Port Statistics, 1981

3.2 Traffic Survey and Analyses

3.2.1 Traffic Survey

In the middle of April 1983, traffic surveys were conducted to identify the patterns and characteristics of the existing traffic using the Likoni and Mtongwe ferries in particular and to provide a basis for the estimation of future traffic demand in the study area.

Table 3.2.1 shows the dates, hours and sites of the surveys conducted. Fig. 3.2.1 indicates the locations of the traffic surveys. The survey conducted by the Team is listed below:

- Vehicle origin-destination survey and commodity flow
- Person origin-destination survey
- Traffic count survey for vehicles on board
- Traffic count survey for passengers on board
- Vehicle delay (queuing) survey
- Traffic count survey for transit passengers from bus/matatu to ferry
- Traffic count survey for bus/matatu to/from terminals
- Occupancy survey for bus/matatu arrival at terminals
- Traffic direction count survey at intersections
- Traffic direction count survey at road sections

Table 3.2.1 TRAFFIC SURVEY CONDUCTED

Traffic Survey	Date and Time	Survey Site
1. Vehicle O-D Survey and commodity flow	April 11th (Mon) 06:00 - 22:00	Likoni Ferry
2. Person O-D Survey	April 12th (Tue) and 13th (Wed) 06:00 - 22:00	Likoni and Mtongwe Ferry
3. Traffic Count Survey for vehicles on board	April 11th (Mon) 06:00 - 22:00	Likoni Ferry
4. Traffic Count Survey for passengers on board	April 12th (Tue) and 13th (Wed) 06:00 - 22:00	Likoni and Mtongwe Ferry
5. Vehicle Delay Survey (Queuing)	April 13th (Wed) 06:00 - 22:00	Likoni Ferry
6. Traffic Count Survey for transit passengers from bus/matatu to ferry	April 14th (Thu) 06:00 - 22:00	Both Terminals of Likoni Ferry
7. Traffic Count Survey for bus/matatu to/from terminal	April 14th (Thu) 06:00 - 22:00	Both Terminals of Likoni Ferry
8. Occupancy Survey for bus/matatu arrival at terminals	April 14th (Thu) 06:00 - 22:00	Both Terminals of Likoni Ferry
9. Traffic Direction Wise Count Survey at intersections	06:00 - 06:00 April 15th (Fri) " 18th (Mon) 06:00 - 22:00 April 15th (Fri) " 18th (Mon)	 A,B,C and D G E and F H and I
10. Traffic Direction Wise Count Survey at road	06:00 - 06:00 April 19th (Tue) " 20th (Wed) 06:00 - 22:00 April 18th (Mon) " 19th (Tue) " 20th (Wed)	 20 30 1,2,3,4,5,6,7,8,9,10 and 11 12,13,14,15,16,17,18, 19,20,21,22,23,24,25, 26,27 and 28 29,31,32,33,34 and 35

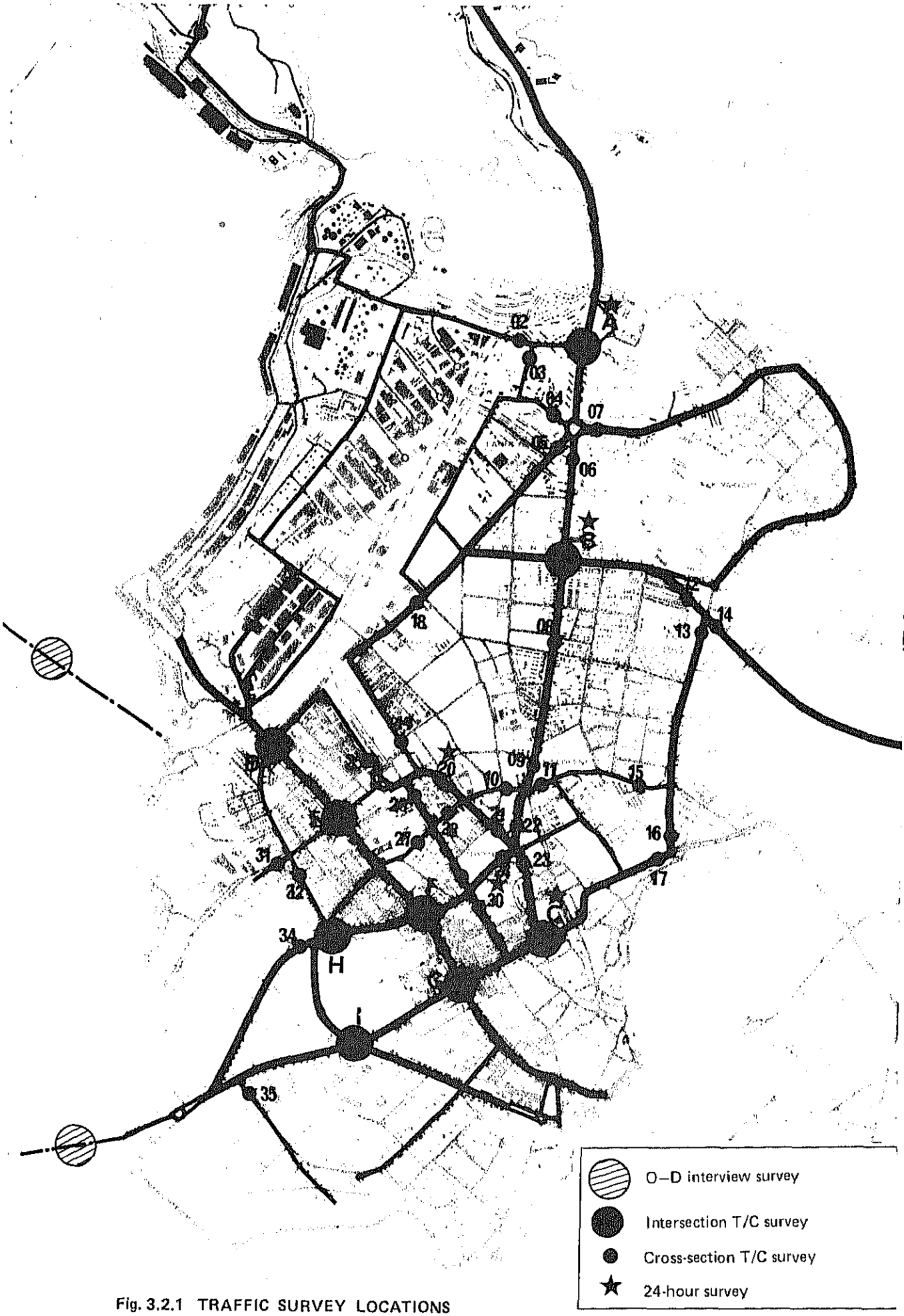


Fig. 3.2.1 TRAFFIC SURVEY LOCATIONS

3.2.2 Existing Traffic of Likoni Ferry

1) General

The Likoni Ferry forms part of the arterial route which connects Mombasa Island and South Mainland as shown in Fig. 3.2.2. The ferry serves for the transportation of vehicles and passengers for the 500m sea channel gap between Mbaraki Berth on the Island and side and Likoni Berth on the Mainland side. At each end of the ferry a bus terminal is provided, and public buses and matatu wait for the passengers using the ferry. Generally the ferry boats do not carry public buses and matatu. Fig. 3.2.3 shows the layout of the two berths of the Likoni Ferry.

In the northern part of South Mainland is the Mtongwe Ferry, but this ferry accommodates mainly local passengers, not competing with the Likoni Ferry.

Existing Likoni Ferry has three boats, with two boats in operation and one on stand-by. The capacity of each boat is as follows:

Safina : 46 P.C.U.'s per trip

Mvita : 32 P.C.U.'s per trip

Michael: 22 P.C.U.'s per trip

Kenya Bus Services Ltd. is entrusted with the ferry operation under a contract with the Mombasa Municipality.

Table 3.2.2 shows the operation schedule of their ferry boats and their average actual operation trips in the past year. Table 3.2.3 shows thier ferry toll system.

The Likoni Ferry is generally in good operation, but the passenger traffic is restricted by the ferry boat capacity and the discontinuity of free traffic flow. The truck traffic is subjected to the following problems:

- All loaded trucks must use Safina only.
- Even empty tracks can not use St. Michael.
- Full trailers, semi-trailers and heavily loaded tracks must wait for high tides, wasting several hours.
- Tank lorrys are permitted to use the ferry only once a day.

2) Hourly Fluctuation of Traffic

The count survey for the traffic using the two ferries was conducted in April 1983. The traffic of passengers and vehicles on the Likoni and Mtongwe Ferries are diagrammed in Fig. 3.2.4. The distribution pattern is characterized by the trip purposes of morning commuting, evening returning and lucnhing at which times the pattern shows three big peaks. This accounts for macroscopic characteristics of land use: workplaces on the island and residence on the mainland, and of local habit of having their lunch at their homes as shown in Fig. 3.2.4.

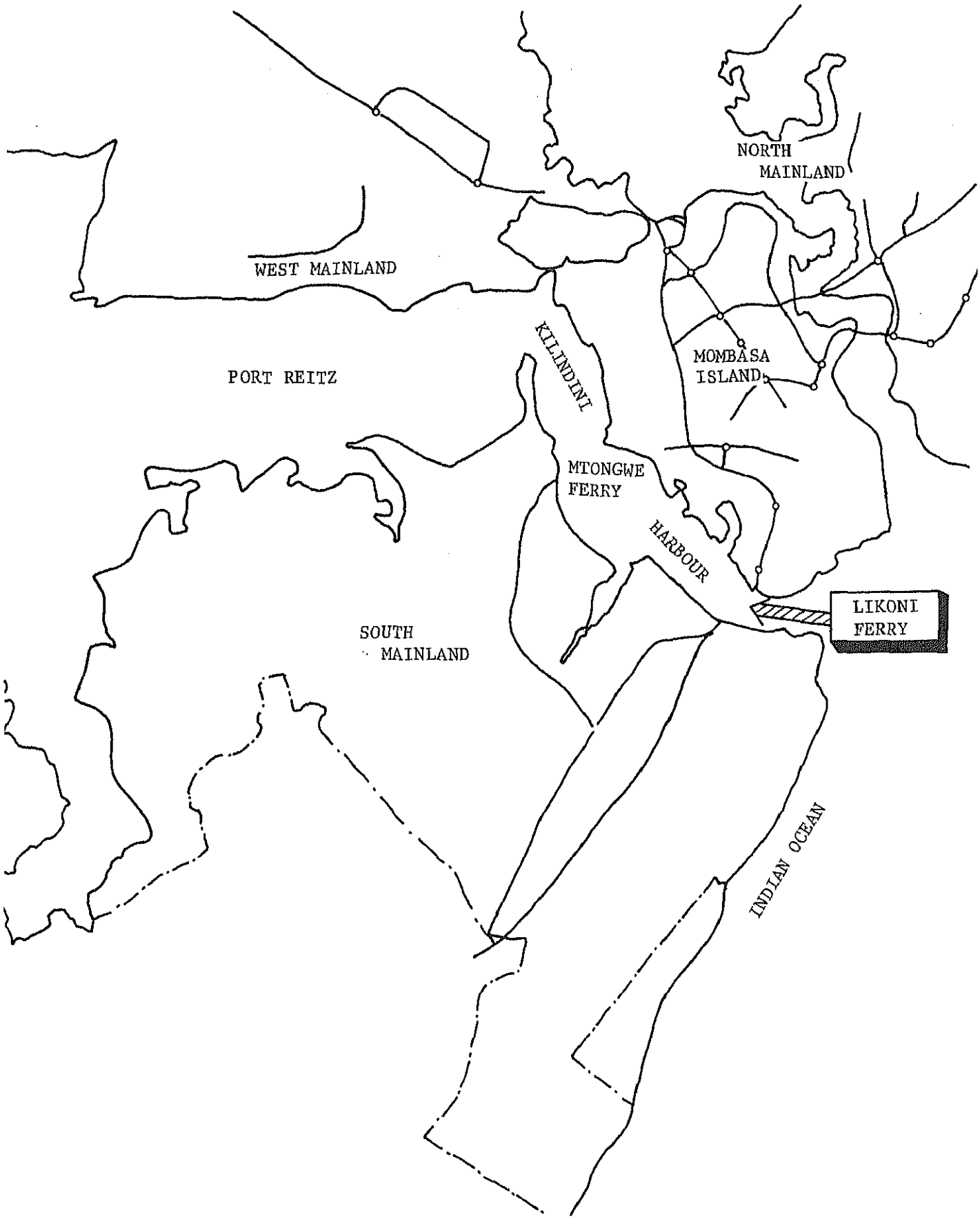


Fig. 3.2.2 LOCATION MPA OF LIKONI FERRY

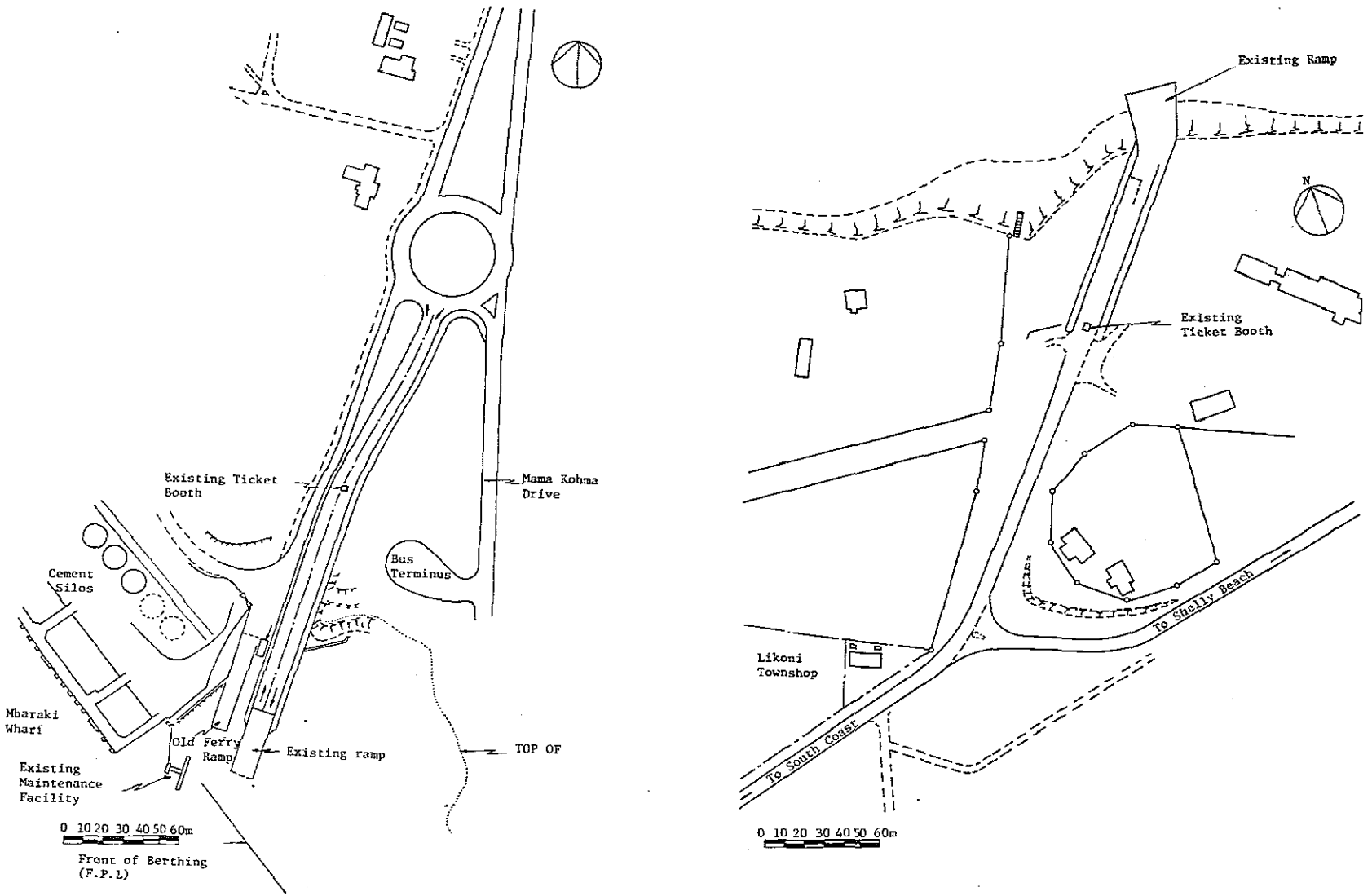


Fig. 3.2.3 EXISTING LIKONI FERRY TERMINAL

MBARAKI TERMINAL LIKONI TERMINAL

Table 3.2.2 OPERATION TRIPS OF FERRY BOATS: SCHEDULED AND ACTUAL AVERAGE

(Unit: Trips)

Time Band	No. of Scheduled Operation Trips		No. of Average Actual Operation Trips	
	Safina	Mvita	Safina	Mvita
0 - 1	-	2	-	2
1 - 2	-	2	-	2
2 - 3	-	2	-	2
3 - 4	-	2	-	2
4 - 5	-	6	-	4
5 - 6	6	-	4	-
6 - 7	6	6	4	6
7 - 8	6	6	6	4
8 - 9	6	-	6	4
9 - 10	6	6	6	4
10 - 11	6	6	6	4
11 - 12	6	-	4	4
12 - 13	6	6	6	4
13 - 14	6	6	6	4
14 - 15	6	-	4	4
15 - 16	6	6	6	4
16 - 17	6	-	6	-
17 - 18	6	6	4	5
18 - 19	6	6	6	4
19 - 20	6	-	6	4
20 - 21	-	6	-	4
21 - 22	-	6	-	6
22 - 23	-	6	-	4
23 - 24	-	6	-	4
Total	90	92	80	85

Table 3.2.3 FERRY TOLL

(Applied from July 19th, 1981)

Key No.		Length upto (m)	Toll (Shs)	Key No.		Length upto (m)	Toll (Shs)
1	Car Single	3.5	6.00	25	Truck & Bus	9.5	45.00
2	Car Single	4.5	8.00	26		10.00	48.50
3	Car Single & L/L, R/R	6.0	10.00	27		10.00	52.00
				28		11.50	55.50
4	Car Double	3.5	12.00	29		11.50	59.00
5	Car Double	4.5	16.00	30		12.00	62.50
6	Car Double & L/L, R/R	6.0	20.00	31		12.50	66.00
7	Car Towing	3.5	12.00	32	Surcharge	Loaded Tipper	10.00
8	Car Towing	4.5	16.00	33	Petrol		60.00
9	Car Towing	6.0	20.00	34	Tanker		80.00
10	Car Off Peak RTN.	3.5	11.00	35	D/Unit & SPL Petrol Ferry		160.00
11	Car Off Peak RTN	4.5	14.00	36	Loaded Traffic		250.00
12	Car Off Peak RTN.	6.0	18.00	37	Normal Load		450.00
13	Kombi Single Kombi Double	5.0	13.50	38	2-Wheeled		1.00
14	Kombi Double	5.0	27.00				

The 16 hour count survey between 06:00 and 22:00 shows: the peak falls on 11:00 and 12:00 for the vehicular traffic from Mbaraki to Likoni, while for the one from Likoni to Mbaraki it falls on 07:00 – 08:00, and for the total traffic of the two directions the peak falls on 11:00 – 12:00 with the percentages to the total being 11.7%, 11.6% and 9.7%, respectively.

3) Crossing Time by Vehicles

The total crossing time of vehicles through the Likoni Ferry consists of the following elements:

– Average queuing time consisting of queuing (waiting) time and loading time.

– Crossing time, and

– Unloading time

The survey for the ferry crossing time was conducted on April 13th, 1983.

Table 3.2.4 shows the average queuing time of vehicles by time band and by ferry berth of the Likoni Ferry, and Table 3.2.5 shows the average queuing time at the same ferry by type of vehicle resulting from the above survey. Tables 3.2.6 thru 3.2.9 show the traffic volumes counted by time band, by vehicle type and direction.

The minimum crossing time by the ferry boats was measured at 3 minutes while the maximum at 9 minutes, and the average is estimated at 4.5 minutes. The minimum unloading time by vehicles was measured at 2 minutes.

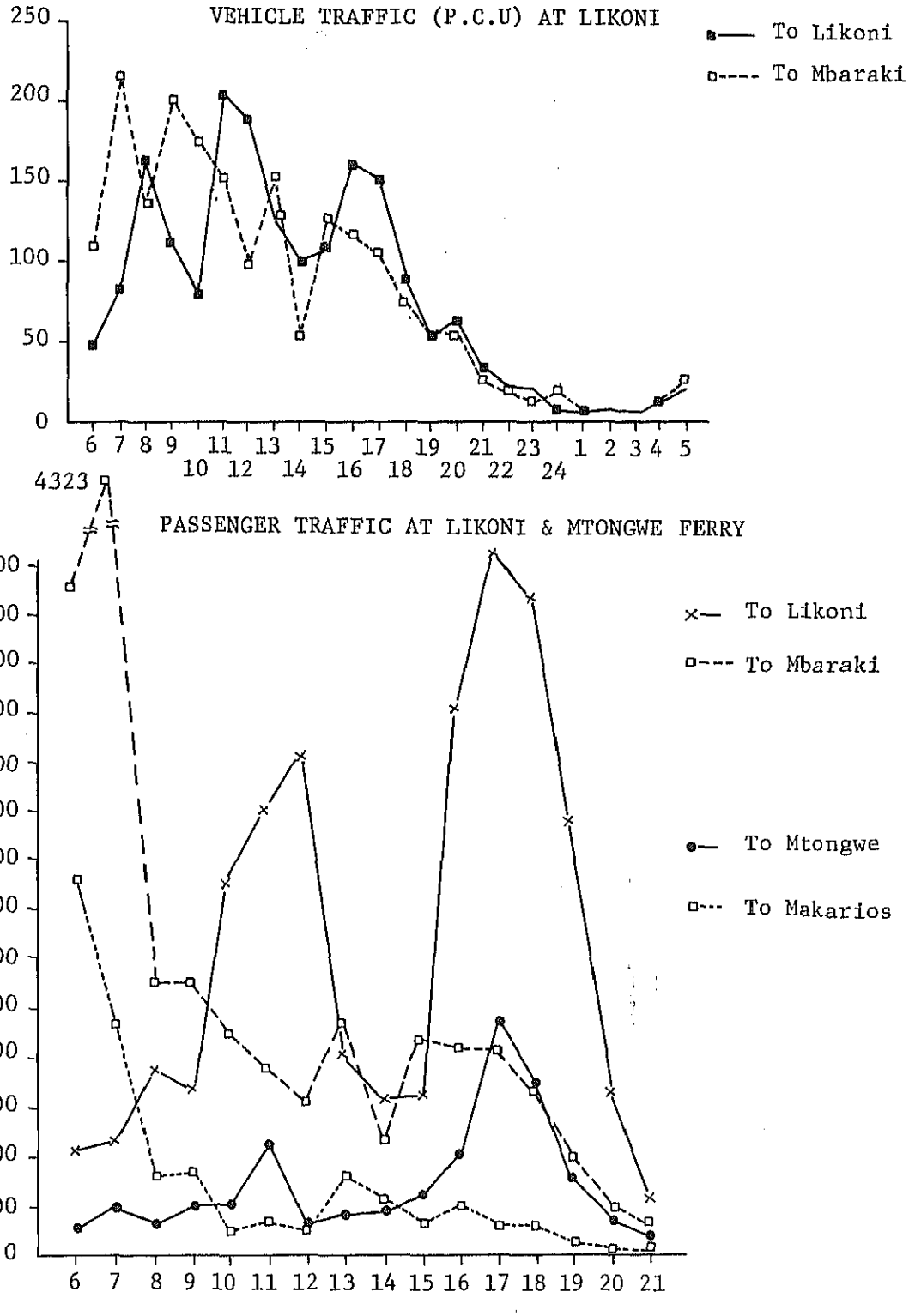
4) Traffic through the Ferry

According to the statistics supplied by Kenya Bus Service Lgd. (K.B.S.), the trends of vehicles and passengers carried by the ferry are as tabulated in Table 3.2.10, and Table 3.2.11. In the above volumes military service transports were not counted.

The record shows that in 1982 the ferry carried 758,000 vehicles with the daily average of 2,600 P.C.U. The composition of cars (including cars and kombis) and trucks (including heavy commercial vehilces and pickups) was 61.2% and 38.8%, respectively. It can be considered that the higher stare of cars on the ferry shows a constraint on the truck traffic because of the high tariff to the loaded goods levied to the trucks, access gradient, water tide, etc.

The annual average growth rates of vehicles and pedestrians during the past 11 years were 3.8% and 7.0%, respectively. The former shows a little higher rate than 3.3% which is the growth rate in population in Mombasa during 1969 – 1979 period, while the latter an almost equal rate to 6.9% which is the growth rate in population in South Mainland during the same period.

This shows that there is a strong co-relation between the increase in population by the housing development in South Mainland and the increase in ferry passengers.



NOTE: Vehicle - By traffic counts survey

Passengers - By traffic counts survey for boarding passengers.

Fig. 3.2.4 HOURLY FLUCTUATIONS OF FERRY TRAFFIC BY DIRECTION (LIKONI AND MTONGWE)

Table 3.2.4 AVERAGE QUEUING TIME: BY TIME BAND AND FERRY BERTH OF LIKONI FERRY

Survey Date: 15 April, '83

	LIKONI BERTH			MBARAKI BERTH		
	No. of Ferry Service	No. of Vehicle (P.C.U.)	Queuing Time (min)	No. of Ferry Service	No. of Vehicle (P.C.U.)	Queuing Time (min)
6 - 7	4	36.0	6.6	5	45.5	6.4
7 - 8	5	89.5	5.1	6	73.0	7.2
8 - 9	4	129.0	12.1	2	63.0	10.8
9 - 10	5	122.0	10.5	3	84.5	14.3
10 - 11	4	97.0	9.9	4	100.5	9.1
11 - 12	6	107.0	10.2	6	130.0	7.6
12 - 13	5	75.5	7.8	5	120.0	6.9
13 - 14	4	49.0	7.2	4	83.0	10.8
14 - 15	4	113.5	12.7	3	88.0	11.9
15 - 16	-	-	-	4	81.0	7.2
16 - 17	(2)	-	-	4	85.5	7.3
17 - 18	4	97.0	7.2	5	115.0	9.0
18 - 19	2	61.0	13.2	2	58.0	13.2
19 - 20	3	83.5	15.7	2	37.0	15.0
20 - 21	3	36.5	10.4	3	37.0	10.8
21 - 22	4	30.5	12.1	3	29.0	11.9
Total	-	-	(10.2)	61	1,230.0	(9.7)

Table 3.2.5 AVERAGE QUEUING TIME AT LIKONI FERRY BY TYPE OF VEHICLE

(Survey Date: 13th April, 1983)

(Unit : Minutes)

	Car & Taxi	Light Goods Vehicles				Medium G.V.		Heavy Goods Vehicle	Total
		Pick up	Land Rover	P.S.V.	Matatu	Truck	Bus		
LIKONI	10.0	10.2	12.2	10.3	12.0	10.6	9.3	7.0	10.2
MBARAKI	9.6	10.2	10.2	9.9	7.7	9.7	7.1	12.0	9.7

Table 3.2.6 PASSENGERS AND VEHICLES CARRIED ON LIKONI FERRY: DURING 06:00 – 22:00, FROM MBARAKI TO LIKONI

	Pedestrian	Cyclist	Motor Cyclist	Hard cart	Car & Taxi	Light Goods Vehicles				Medium G.V.		Heavy Goods Vihicles
						Pick Up	Land Rover	P.S.V.	Matatu	Truck	Bus	
6 - 7	422	17	1	3	6	3	0	6	0	7	2	0
7 - 8	466	16	0	3	12	7	2	2	3	19	0	0
8 - 9	752	16	4	2	25	19	6	19	3	28	5	0
9 - 10	678	15	7	5	28	16	3	4	3	18	0	0
10 - 11	1,506	23	5	3	16	9	6	7	1	10	0	0
11 - 12	1,817	46	7	2	52	23	1	18	5	28	1	0
12 - 13	2,044	43	13	5	48	34	4	19	8	14	4	0
13 - 14	817	23	5	1	24	8	1	7	2	20	10	0
14 - 15	608	19	7	0	34	8	4	1	1	15	0	0
15 - 16	629	18	3	3	33	13	6	4	1	16	0	0
16 - 17	2,216	29	13	2	56	20	9	6	4	14	1	2
17 - 18	2,876	34	11	1	70	12	7	12	0	9	2	0
18 - 19	2,693	37	19	0	40	3	3	8	3	2	0	0
19 - 20	1,763	17	9	0	28	5	2	4	0	0	0	0
20 - 21	630	14	10	0	27	5	1	4	5	2	2	0
21 - 22	202	5	3	0	15	7	0	5	1	0	0	0
Total	20,119	373	117	30	514	192	61	126	40	202	27	2

Table 3.2.7 PASSENGERS AND VEHICLES CARRIED ON LIKONI FERRY: DURING 06:00 – 22:00, FROM LIKONI TO MBARAKI

	Pedestrian	Cyclist	Motor Cyclist	Hand cart	Car & Taxi	Light Goods Vehicles				Medium G.V.		Heavy Goods Vehicles
						Pick Up	Land Rover	P.S.V.	Matatu	Truck	Bus	
6 - 7	2,726	104	19	2	11	5	13	0	3	6	0	0
7 - 8	4,323	146	39	2	42	13	4	4	15	16	2	0
8 - 9	1,113	24	8	1	44	14	8	8	9	13	2	0
9 - 10	1,166	31	12	2	67	28	5	17	9	20	0	0
10 - 11	893	19	6	0	57	32	9	12	7	16	2	0
11 - 12	752	17	5	5	47	23	10	5	4	18	2	0
12 - 13	604	12	1	1	27	14	2	5	0	17	0	0
13 - 14	924	47	8	8	35	21	2	3	1	24	0	0
14 - 15	449	27	6	5	13	9	0	2	1	4	0	0
15 - 16	875	4	4	0	35	20	6	2	5	21	1	0
16 - 17	822	14	4	0	37	23	4	1	10	13	0	0
17 - 18	811	7	6	2	23	21	1	2	4	18	1	0
18 - 19	654	4	1	0	29	11	0	8	3	6	1	1
19 - 20	398	0	3	0	27	11	1	4	2	0	5	0
20 - 21	196	4	5	0	24	11	1	0	2	0	6	0
21 - 22	100	2	1	1	14	4	0	0	3	0	1	0
Total	16,806	462	128	29	532	260	66	73	78	192	23	1

Table 3.2.8 VEHICLES CARRIED ON LIKONI FERRY: DURING 22:00 – 06:00 FROM MBARAKI TO LIKONI

	Car & Taxi	Light Goods Vehicle				Medium G.V.		Heavy Goods Vehicles
		Pick up	Land Rover	P.S.V.	Matatu	Truck	Bus	
(A)								
6 - 22	514	192	61	126	40	202	27	2
22 - 23	15	3	2	1	0	0	0	0
23 - 24	14	3	2	2	0	0	0	0
0 - 1	7	0	0	0	0	0	0	0
1 - 2	5	1	0	0	0	0	0	0
2 - 3	6	2	0	0	0	0	0	0
3 - 4	2	3	0	0	0	0	0	0
4 - 5	4	0	0	4	0	0	1	0
5 - 6	1	0	0	6	0	0	7	0
(B)								
22 - 6	54	12	4	13	0	0	8	0
(C)								
24 hours	568	204	65	139	40	202	35	2
(C)/(A)	1.1051	1.0625	1.0656	1.1032	1.0000	1.0000	1.2963	1.0000

Table 3.2.9 VEHICLES CARRIED ON LIKONI FERRY: DURING 22:00 – 06:00 FROM LIKONI TO MBARAKI

	Car & Taxi	Light Goods Vehicle				Medium G.V.		Heavy Goods Vehicles
		Pick up	Land Rover	P.S.V.	Matatu	Truck	Bus	
(A)								
6 - 22	532	270	66	73	78	192	23	1
22 - 23	13	2	1	3	0	0	0	0
23 - 24	9	1	0	1	1	0	0	0
0 - 1	7	3	0	2	6	0	0	0
1 - 2	2	1	1	2	1	0	0	0
2 - 3	2	0	0	0	0	0	0	0
3 - 4	1	0	0	2	0	0	0	0
4 - 5	2	5	0	1	2	0	1	0
5 - 6	5	5	1	4	1	2	2	0
(B)								
22 - 6	41	17	3	15	11	2	3	0
(C)								
24 hours	573	277	69	88	89	194	26	1
(C)/(A)	1.0771	1.0654	1.0455	1.2055	1.1410	1.0104	1.1304	1.0000

Table 3.2.10 TRAFFIC ON LIKONI FERRY, 1972 – 1082

(Unit: 1,000)

Year	Cars & Kombis	Heavy Commercial vehicles & pickups	Total of vehicles	Traffic volumes in P.C.U.	Daily average traffic	Pedestrians (persons)	Daily average pedestrians (persons)
1972	333	198	531	650	1.8	6,816	18.7
1973	330	214	544	672	1.8	7,398	20.3
1974	349	234	583	723	2.0	8,116	22.2
1975	360	264	624	782	2.1	-	-
1976	357	243	600	746	2.1	10,999	30.1
1977	422	229	677	788	2.2	11,104	30.4
1978	444	255	699	852	2.3	12,096	33.1
1979	487	275	762	927	2.5	-	-
1980	517	301	818	999	2.7	11,049	30.3
1981	506	306	812	996	2.7	12,956	35.5
1982	464	294	758	934	2.6	17,885	49.0

Source: K.B.S. (MSA)

Table 3.2.11 MONTHLY TRAFFIC CARRIED BY LIKONI FERRY, 1982

Month	H.C.V.-PICK-UPS	KOMBIS - CARS
January	25,751	45,777
February	24,796	41,456
March	27,146	39,528
April	25,053	39,097
May	20,568	34,271
June	23,859	33,272
July	21,829	36,573
August	25,262	40,649
September	24,376	34,747
October	24,809	36,725
November	25,359	37,220
December	26,082	45,344
Total	294,890	464,659

Source: K.B.S (MBA)

5) Estimated Present Traffic Volume on Likoni Ferry

The traffic count suervey was conducted by the study team in April 1983. Tables 3.2.6 and 3.2.7 show the traffic volumes of passengers and vehicles carried by the Likoni Ferry during the time period of 06:00 – 22:00 from Mbaraki to Likoni and from Likoni to Mbaraki, respectively. Tables 3.2.8 and 3.2.9 show the vehicular traffic carried by the same ferry during the time period of 22:00 – 06:00 from Mbaraki to Likoni and from Likoni to Mbaraki, respectively.

The result of the survey was studied for conversion to the average daily traffic (ADT) by comparison with the adjustment coefficients examined by MOTC for their traffic survey in 1982 between two points in the vicinity of Mombasa. The comparison shows that the count result is almost equal to the average.

Therefore, the traffic volumes resulting from the traffic count survey are determined to be used for ADT. However, consideration is given to the increase in traffic during the four months from December 1982 to March 1983, and this increase rate is estimated at 21.95%.

The present traffic volumes are 2,572 vehilces, 1,138 units of cyclists, motor-cyclists and hand-carts, totalling 3,804 P.C.U. In addition, the pedestrian traffic is 36,925 persons. The above figures are tubulated below.

Table 3.2.13 TOTAL TRAFFIC VOLUME AT LIKONI FERRY

Traffic	Traffic counts	P.C.U.	Total (P.C.U.)
Vehicles	2,572	3,235	3,804
Cyclists, Motor-cyclists and Hand-carts	1,138	569	
Pedestrians	36,925	-	-

3.2.3 Zonal Traffic Analysis

1) Zones for Traffic Analysis and OD Traffic Table for 1983

The study area is divided into the following zones for the traffic analysis:

(1) Mombasa Island

– Town Centre

This is the centre of the commercial/business functions of the Coast Province. The zone is to be surrounded by the proposed Inner Ring Road.

– Port/Industrial ARea

This is the zone consisting of the Kilindini Port in the west of the Island and of the industrial/warehousing area in the west side of the railway line.

– Island North

This zone is in the north of the Town Centre and most of it is used for residential purpose.

– Island South

This zone is covered with residential areas with public facilities, having the best environment in the Island.

(2) Likoni (South Mainland)

This zone consists of three areas: Likoni East, Likoni West and Mtongwe.

Mtongwe is the area having the most developed residential areas in the past ten years in the Mombasa District.

(3) Kwale (South Mainland)

Kwale District is located to the South of Likoni, connected with A14 Road. This district consists of two areas: Central Kwale and Southern Kwale which both belong to the coastal strip, and another two areas: Kubo and Hinterland Kwale which both from a hinterland. Hinterland Kwale is divided into two: north and south. The coastal strip is expected to be developed for future tourism.

(4) Kisauni (North Mainland)

This is the zone which includes Kisauni Area of Mombasa District and two districts, Kilifi and Lamu Tana River of the Coast Province which are served by B8 Road, and North Eastern Province. Kisauni has the most developed tourism facilities, and the coastal strip covering Lamu plays an important role in the tourism sector.

(5) Changemwe (West Mainland)

Changamwe has major transportation facilities such as airport complex, port area, industrial area, shunting yard of the railway, etc.

(6) A109 Road is the important arterial road connecting Mombasa Island with Highland of the hinterland. The area related to this road includes Taita District, part of Kilifi and part of Kwale. This zone includes the other provinces that are not described above.

Figs. 3.2.5, 3.2.6 and 3.2.7 show zoning maps of Mombasa Island, the surrounding areas of the Island and Kwale District, respectively.

Based on the above zones the 1983 Origin-Destination traffic matrix is estimated, and is shown in Table 3.2.13.

2) Present Pattern of Vehicular Traffic

The pattern of the daily traffic volume of 3,804 P.C.U. using the Likoni Ferry in 1983 is diagrammed in Fig. 3.2.8 and short distance vehicle traffic is predominant.

The traffic having its destination as the Island is 2,868 P.C.U., 75.4% to the total traffic. The breakdown of the traffic is as follows:

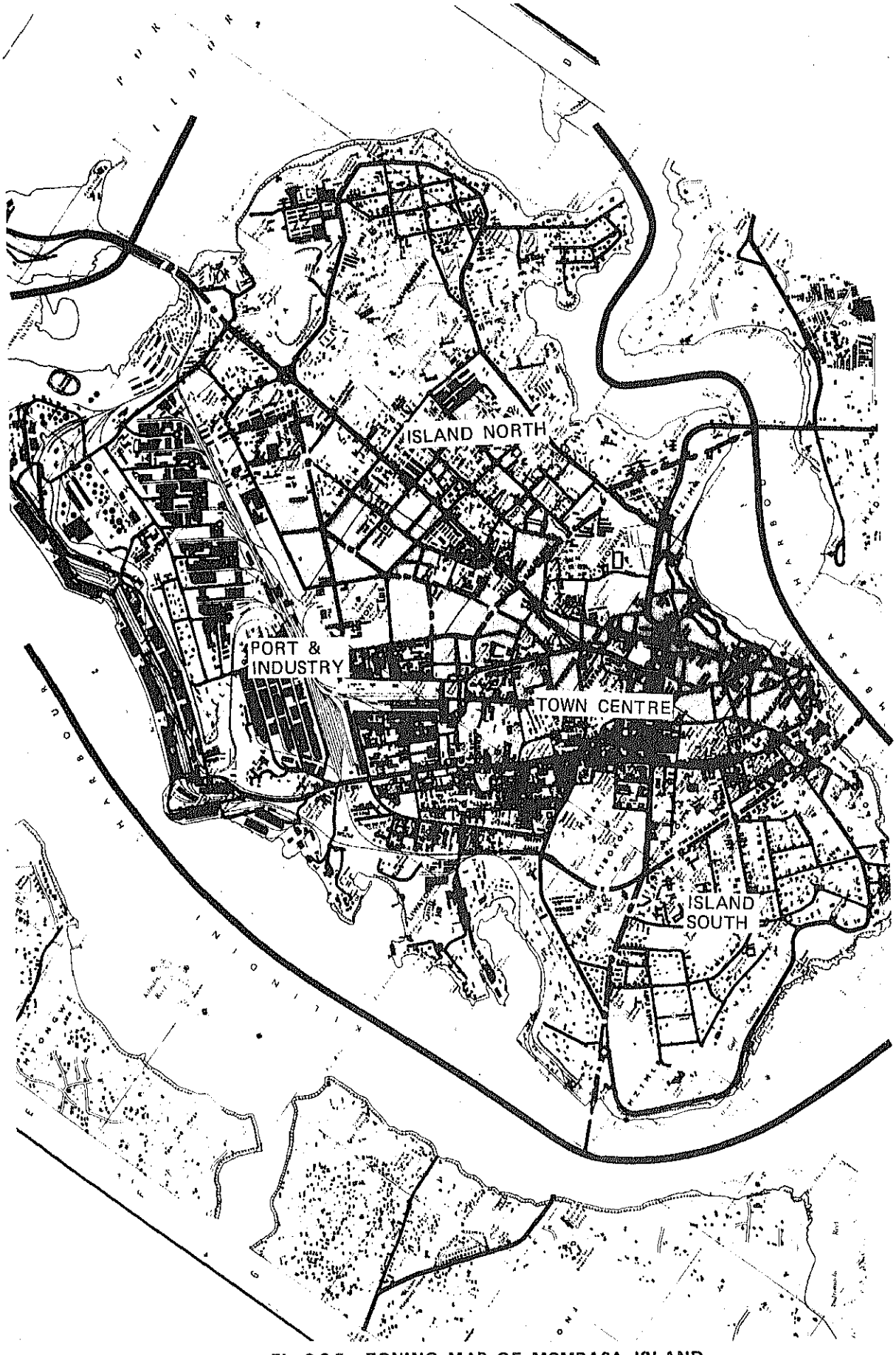


Fig. 3.2.5 ZONING MAP OF MOMBASA ISLAND

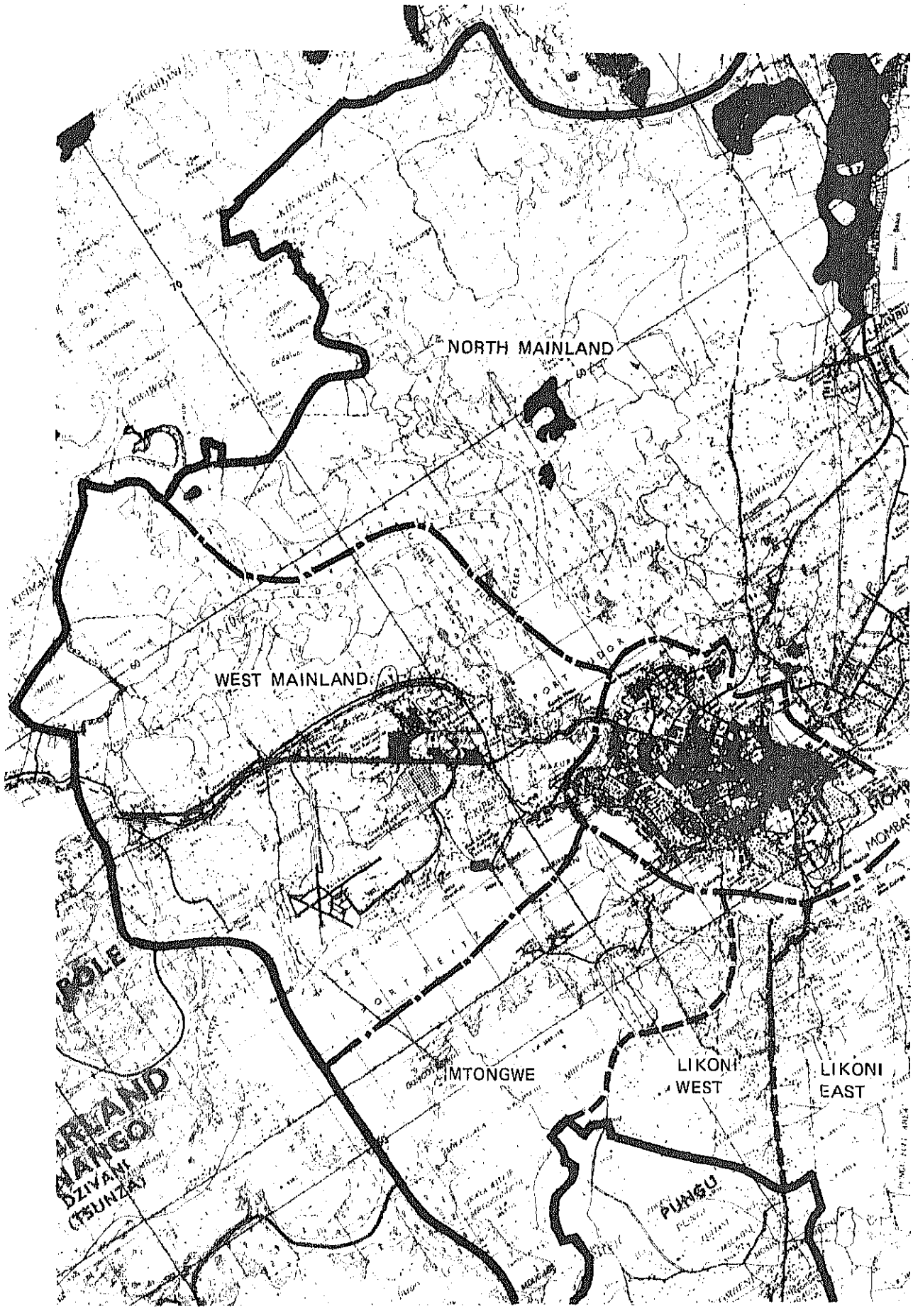


Fig. 3.2.6 ZONING MAP OF SURROUNDING AREAS OF MOMBASA ISLAND

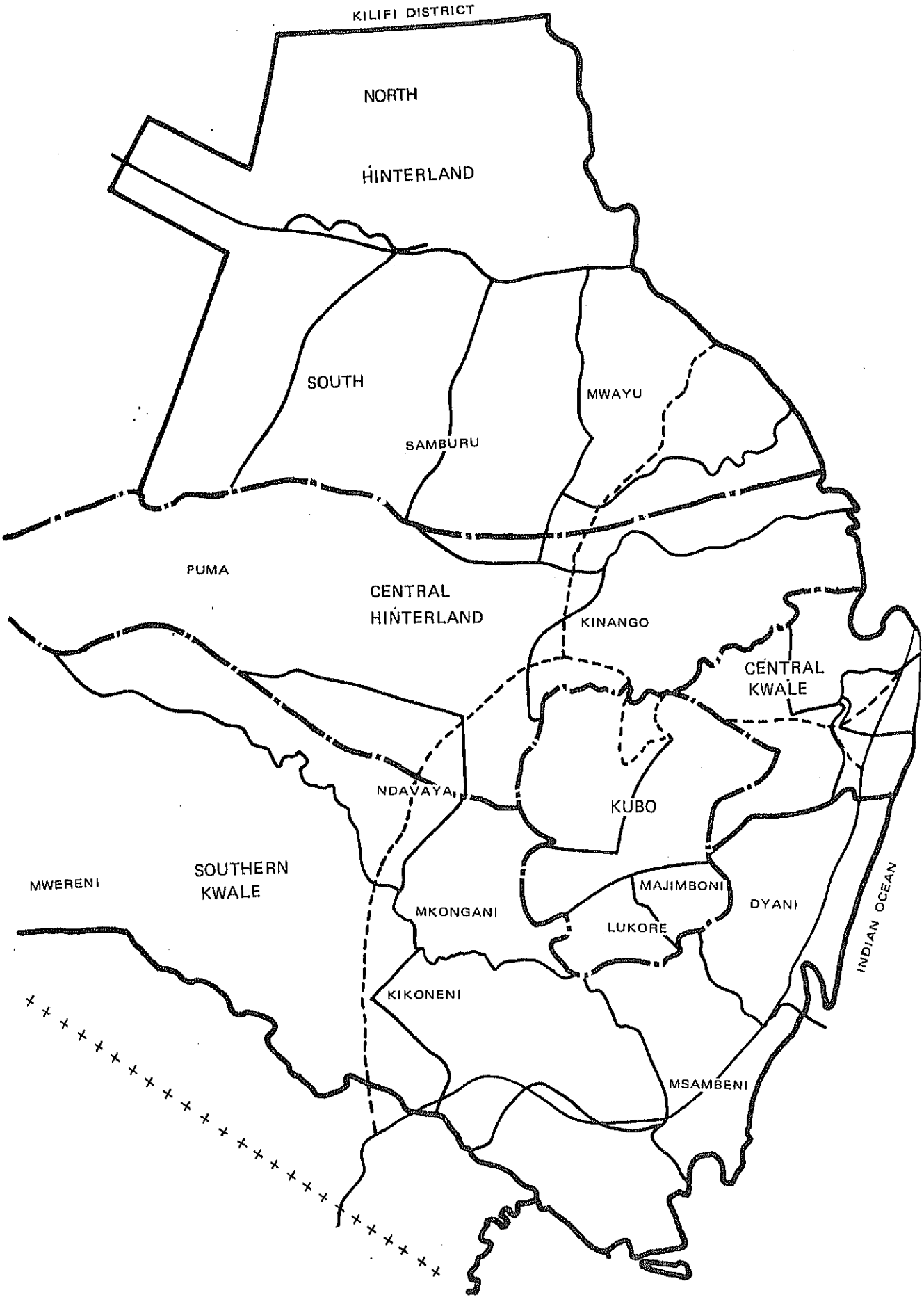


Fig. 3.2.7 ZONING MAP OF KWALE DISTRICT

Table 3.2.13 ORIGIN-DISTINATION TABLE OF TRAFFIC, 1983

	Island North	Island South	Port/ Indus-trial	Town centre	West Main-land	North Main-land	Kilifi	Coast	Others	Exter-nal	Total
Likoni East	73	21	162	320	54	64	15	4	19	0	732
Likoni West	23	5	43	81	17	14	1	1	7	0	192
Mtongwe	25	8	53	96	16	29	13	0	2	0	242
Sub-total of above Likoni	121	34	258	497	87	108	29	5	28	0	1,166
Central Kwale	125	43	320	327	148	115	36	10	14	0	1,138
Kubo	0	0	4	15	2	0	0	0	0	0	21
Central Hinterland	5	0	6	8	5	0	0	0	0	0	24
South Kwale	101	35	280	465	101	66	23	6	81	2	1,160
South Hinterland	0	0	0	3	0	0	0	0	0	0	3
Sub-total of above Kwale	231	78	610	818	231	181	59	16	95	2	2,346
Total	352	112	868	1,315	352	289	88	21	123	2	3,512

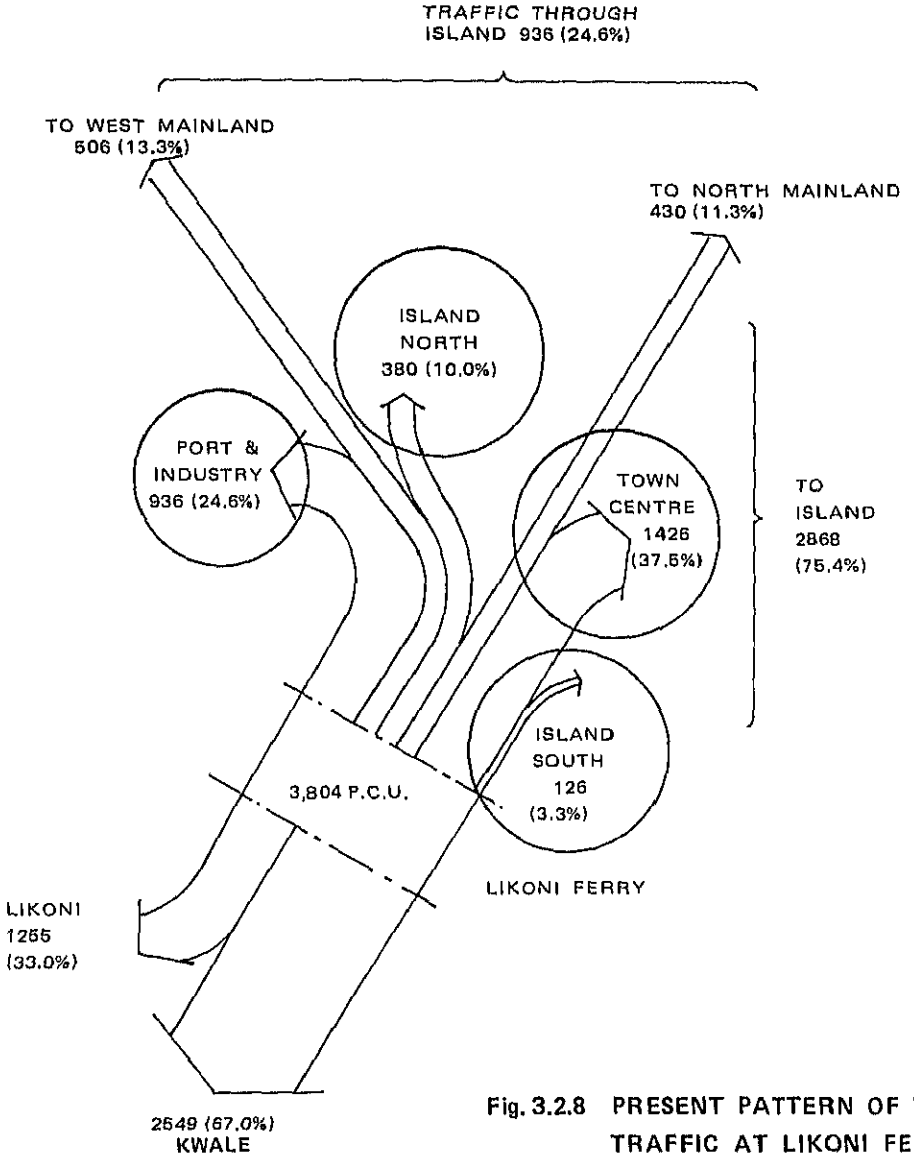


Fig. 3.2.8 PRESENT PATTERN OF VEHICULAR TRAFFIC AT LIKONI FERRY, 1983

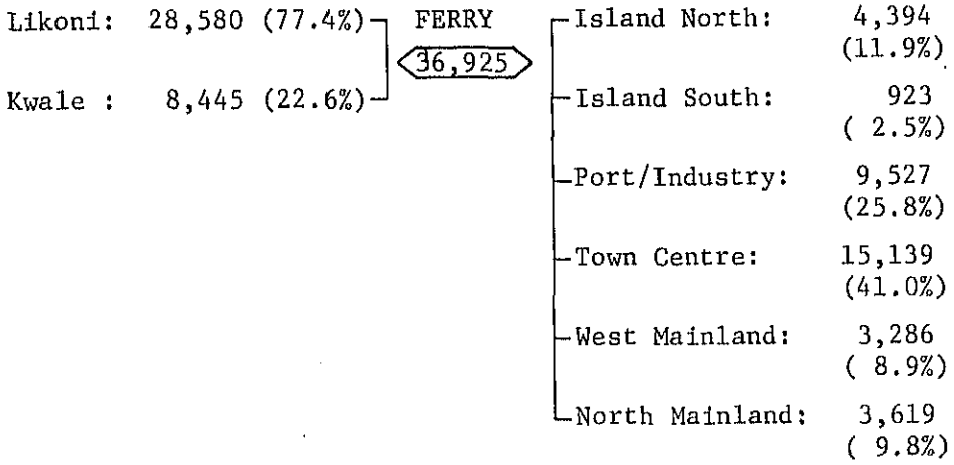
Town Centre	1,426 P.C.U.	(37.5%)
Port/Industrial	936	(24.6%)
Island North	380	(10.0%)
Island South	126	(3.3%)
Total	2,868	(75.4%)

The traffic running through the Island is 936 P.C.U. with 24.6%: 430 P.C.U. (11.3%) for North Mainland and 506 U.C.U. (13.3%) for West Mainland. The traffic towards South Mainland consists of 1,255 P.C.U. (67.0%) to Kwale.

Fig. 3.2.9 shows the existing traffic flow on Mombasa island based on the traffic direction count survey conducted in April, 1983. Digo Road accommodates approximately 36,000 P.C.U./day.

3) Present Pattern of Passenger Traffic

The daily passenger traffic using the Likoni ferry in 1983 is 36,925 persons and its traffic patern shown below:



The trips originating from and destinating to the Island occupy 81.2% to the total, which is a little bigger than the percentage of the vehicular traffic, but it can be said that both patterns are similar. However the passenger traffic in the Likoni side is divided to 77.4% for Likoni and 22.6% for Kwale, the pattern of which is different from the vehicular traffic.

From the above it can be said that the vehicular traffic has a strong inter-city artery function while the passenger traffic a strong intra-city artery function.

4) Traffic to/from Bus Terminal Attached to Ferry

The traffic reaching and leaving the bus terminals on both ferry terminals is illustrated below:

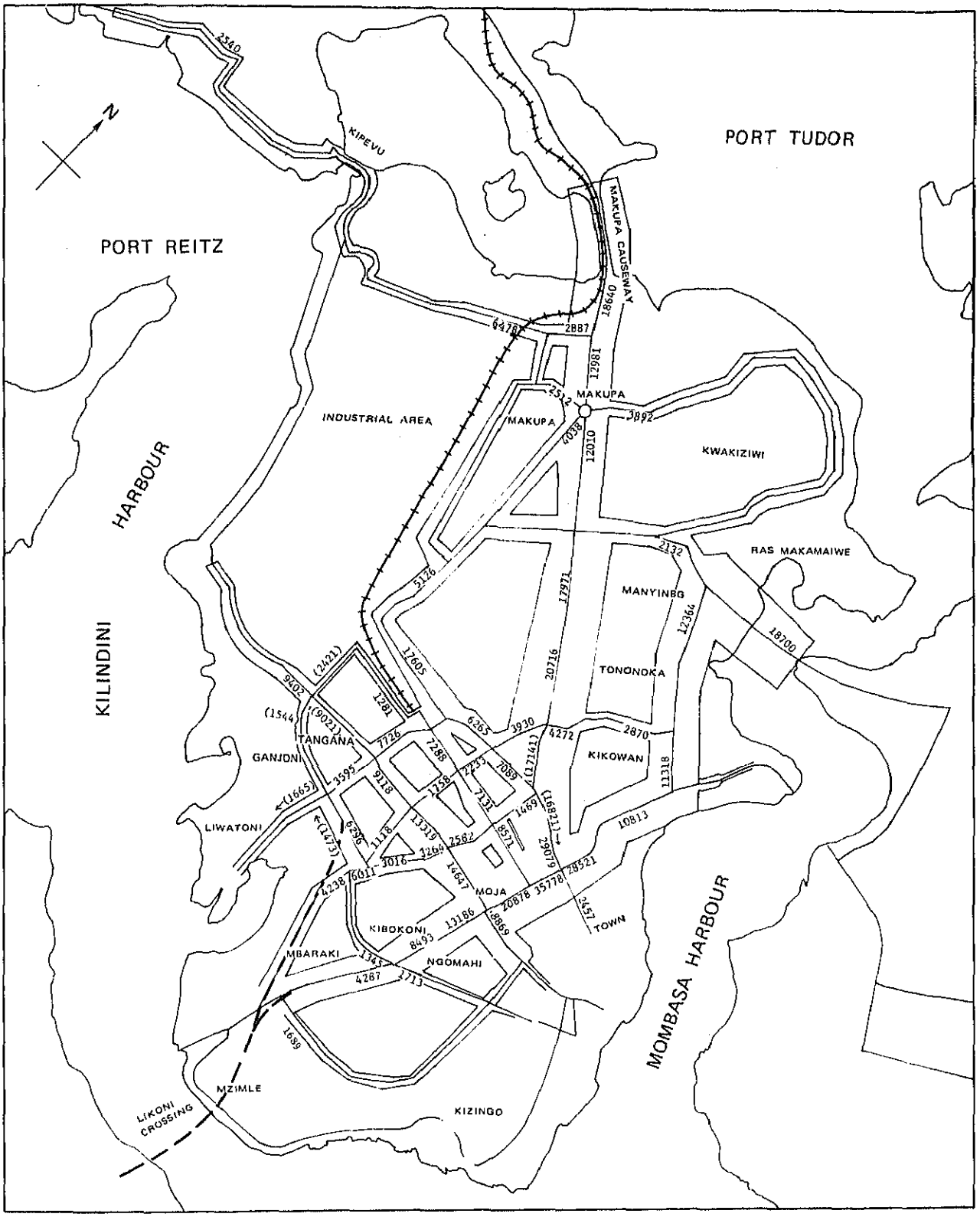
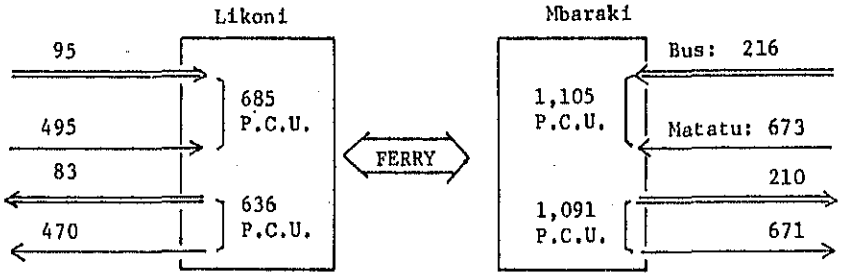


Fig. 3.2.9 PRESENT TRAFFIC FLOW ON MOMBASA ISLAND, 1983

(Unit : PCU)

(The traffic was surveyed between 06:00 and 22:00).



The bus and matatu traffic to/from the Mbaraki terminal is greater than that of the Likoni bus terminal, with 1,105 P.C.U. arriving and 1,099 P.C.U. leaving, totalling 2,196 P.C.U.

The number of passengers carried by buses and matatsu terminating at Mbaraki and Likoni bus terminals are 12,481 persons and 7,637 persons, respectively, 95% of which are the passengers carried by the ferry.

5) Access Means of Ferry Passengers

The arrival and departing means of the ferry passengers was examined, and the result is shown in Fig. 3.2.10. The means are divided into "Walking" and "Other means" which includes bicycle, motorcycle, bus, matatu, car, etc.

The number of passengers who access to the Likoni berth on foot is 7,815 which is 46.5% and those who leave the other berth on foot 2,672 persons corresponding to 16.9%. The number of passengers originating from the Likoni zone on foot occupied more than half, 57.5% while the passenger originating from the Kwale zone on foot is as low as 6 to 10.7%.

The number of passengers who access to the Mbaraki berth on foot is 4,969 or 24.7% and those who leave the opposite berth is 6,840 persons or 34.0%.

The Likoni zone has recently developed several residential areas and the origin and destination count gave a total of 28,580 passengers or 77.4%. This can account for the many walkers to and from the Likoni berth.

From the above analysis, the number of ferry passengers who come to the Likoni berth and leave the Mbaraki berth on foot is 2,672 and the one in the opposite direction is 4,969, totalling 7,641 which corresponds to 20.7% of the total ferry passengers.

6) Present Traffic Potential

According to the result of the traffic survey conducted as part of this study, the daily traffic volume of Likoni Crossing was 3,804 PCU in 1983. This figure reflects the volume of traffic actually handled by the ferry under heavy existing constraints such as the capacities of ferry vessels, the lack of continuous mass transportation service at both ferry

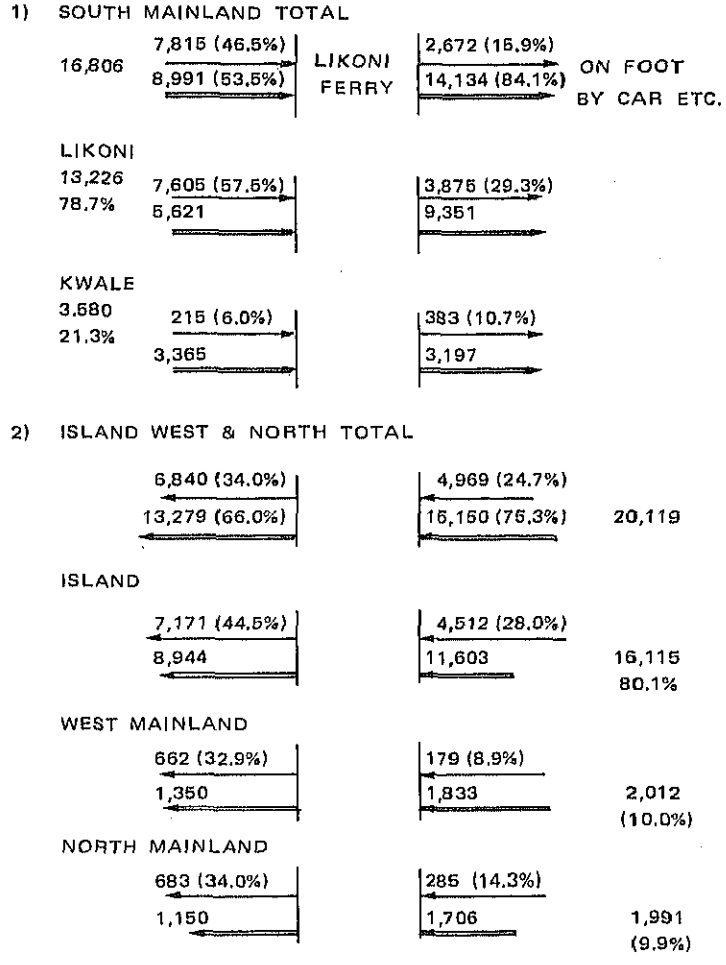


Fig. 3.2.10 ARIVAL AND DEPARTING MEANS OF LIKONI FERRY PASSENGER

terminals. In estimating the future traffic volume, the effects of such constraints require to be duly considered in order to obtain a realistic forecast of future situations free of such constraints.

Removal of such constraints is assumed to increase to bus and matatu trips and pedestrian trips consisting of long distance walkers between Kwale and North/West Mainland, which in total amounts to an increase of 1,817 PCU on top of the current traffic volume as of 1983.

In addition, a substantial increase in freight traffic will also undoubtedly occur with the removal of the existing traffic constraints which involve restrictions on the crossing of freight vehicles by ferry vessel and vehicle type, by tide condition, and by nature of freight carried.

It can therefore be concluded that the existing traffic potential of Likoni Crossing is at least 5,621 PCU, even disregarding the effect of existing constraints on crossing by freight vehicles.

CHAPTER 4 DEVELOPMENT PLANS

CHAPTER 4 DEVELOPMENT PLANS

4.1 Previous Development Plans

Several studies have been previously conducted for the development of the Mombasa area. Summaries of the major studies concerning transportation are introduced below.

1) Mombasa Master Plan (1963)

(1) Trunk Road System

Fig. 4.1.1 shows the trunk road system in and around Mombasa. Three intercity roads, from the island to West, North and South Mainlands, are shown. Some major roads on the island serves city centre, industrial and port area, and administrative and commercial area. These roads are Jome Kenyatta, Moi, Lumumba and Dedan Kimathi Avenues.

(2) Outer Ring Road

As well as providing linkage between north and south mainlands, part of the route from the Kisauni Bridge to Likoni Ferry would form the western section of an outer ring road around the central area. The remainder of this would be formed by the continuation of Tom Mboya Avenue intersecting with Abdel Nasser Road, thence eastwards through the northern areas of Old Town, dropping to the level of the coral ledge and swinging westward to pick-up with Dedan Kimathi Avenue at Treasury Square (Administrative and civic centre) and continuing to an intersection with the western section of the ring at Nyerere Avenue.

(3) Inner Ring Road

The central core would be enclosed by an inner ring road which runs from the intersection of Nyerere Avenue and Moi Avenue; along the latter to the intersection with Tangana Road thence along Tangana and Parsee Roads to the intersection of Jomo Kenyatta Avenue. From the latter, along Maalim Juma Mohamed Road and back to Pigo Road.

2) Mombasa Draft Physical Development Plan (1971)

The long term development plan is shown in Fig. 4.1.2. Future population estimated on the bases of the 1962 census and 1969 census. The key figure is the population growth rate of 4.7% for the total which includes a 7.5% growth rate for the African population and 3.0% for the Kenyan non-African population. Thence, Mombasa Municipality forecast a population of 1,000,000 sometime between 1990 and 2000. Therefore, Mombasa area must be planned in the context of a wider region with the population of about 2,000,000. The models of ideal distribution of 1,000,000 people in Mombasa is shown in the report, but regardless of the future of Mombasa Harbour.

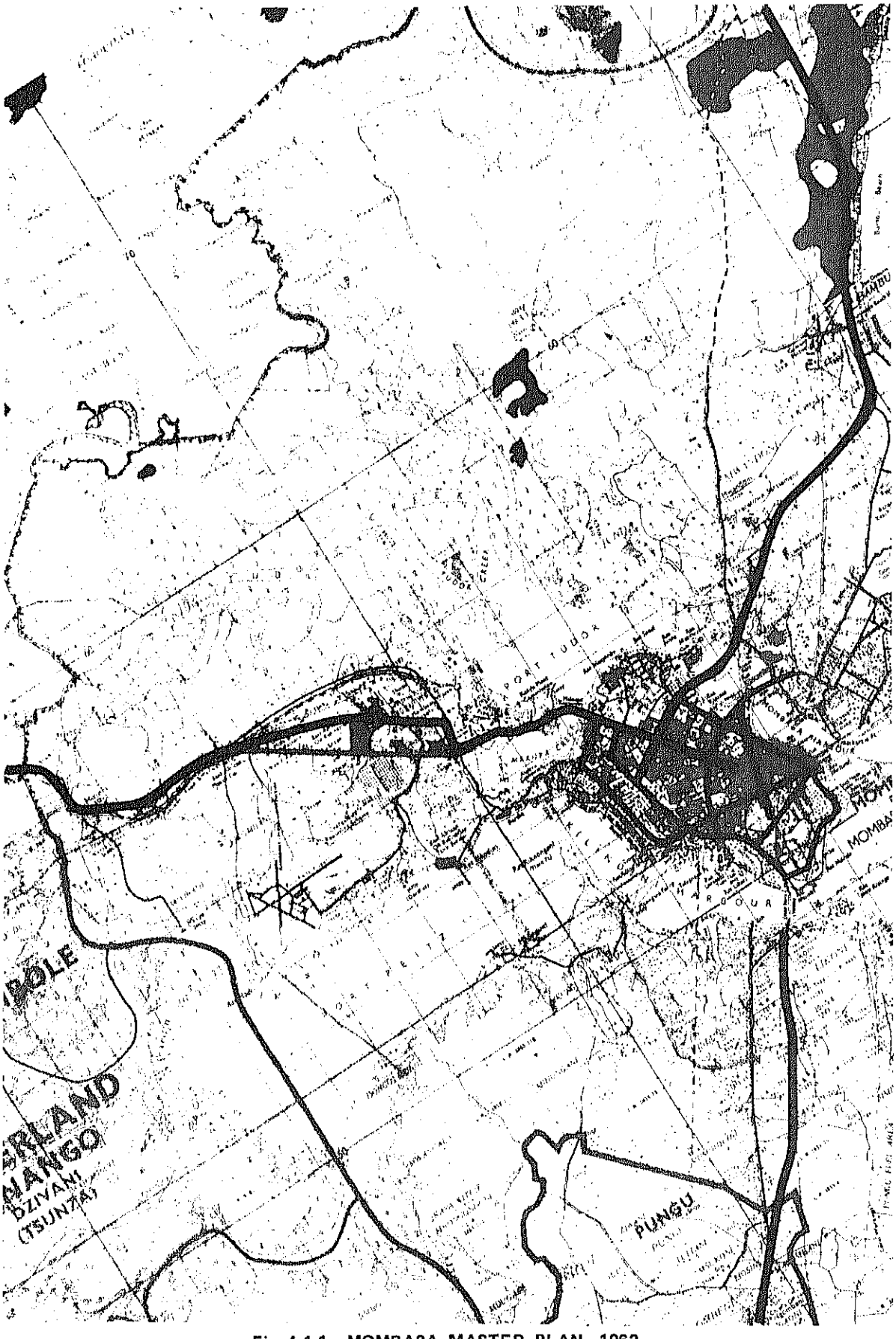


Fig. 4.1.1 MOMBASA MASTER PLAN, 1962

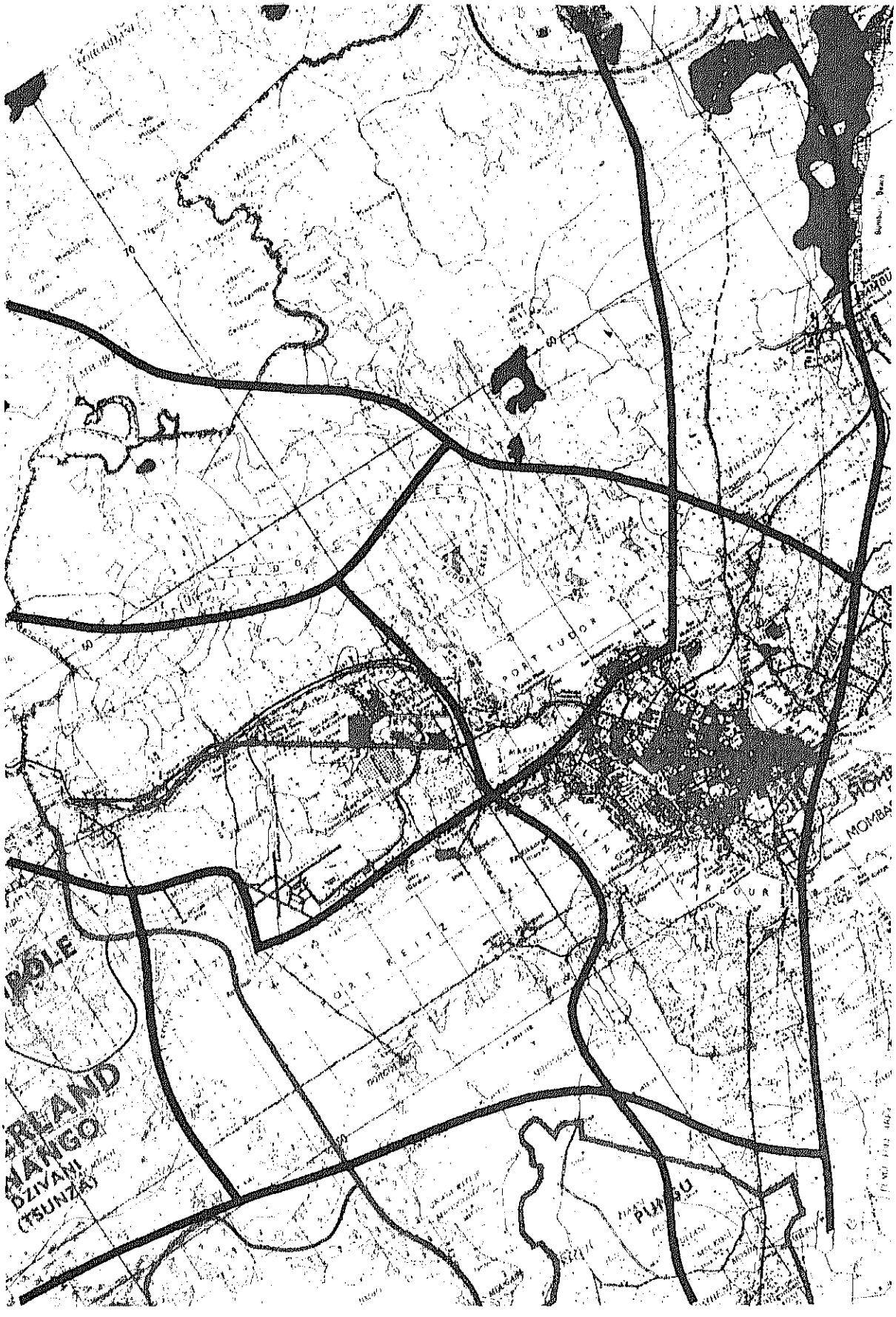


Fig. 4.1.2 MOMBASA DRAFT PHYSICAL DEVELOPMENT PLAN, 1971

(1) Direct transportation links between work places and residential areas

At present most of the traffic between the mainland areas must pass through the central area. Therefore, direct transportation links between the mainland areas are essential for the future road network.

(2) Transportation by-passes

A disperal policy would be required, in which major transportation routes by-pass the island and possibly the west mainland as well.

Such main roads and by-passes can help the shifting of development away from critical areas. These are listed below.

west – south : Kipevu-Ras Kikaangoni Bridge or Ferry

west – north : New Kipevu Causeway and Tudor Junda Bridge

north – south: Likoni Bridge and Fort Jesus Bridge.

3) *Mombasa Transportation Study (1972)*

The recommended 1996 road system is shown in Fig. 4.1.3.

(1) The Prime Objectives

The study evaluated alternative strategies for the development of a main road network for Mombasa and recommended the optimal system for the time when Mombasa will have a population of 1,000,000 persons.

(2) The Basis of the Study

Mombasa Draft Physical Development Plan (1971) is the basis of the Study.

(3) Alternative Systems

The following major facilities were found to be needed to carry the unrestrained 1996 traffic demand.

Crossing to the South Mainland

1. A bridge at Likoni
2. A causeway to Ras Hodi

Crossing to the North Mainland

1. The Kisauni Bridge (Planned for completion in 1976)
2. A bridge at Ras Saadi

Fig. 4.1.3 MOMBASA TRANSPORTATION STUDY, 1972 (1) RECOMMENDED 1996 ROAD SYSTEM

Major routes on the island

1. A North-South route from Makupa to Likoni
2. An East-west route from the Kisauni bridge to the North-south route.

(4) The Recommended 1996 Road Plan (Mombasa island in Fig. 4.1.4)

It was recommended that the 1996 road plan should be based on the minimum system 1A/1B.

The four periods were set to indicate the major construction items to be executed in each period.

CROSSING

- Kisauni Bridge
- Ras Hodi Causeway
- Second Kipevu Causeway
- Widening of ferry ramps at Likoni
- Ferry ramps for vehicular ferry service to Mtongwe

ISLAND

- North – South Route (1st stage)
- East – West Route (1st stage)
- CBD Ring Road
- Bridge over the railway tracks behind Central Railway Station
- Link Shimanzi Road to Kilindini Road
- Widen Ziwani Road and Tom Mboya Avenue to dual carriageway
- All remaining district distributors to dual carriageway

MAINLANDS

- Airport access road from the east
- Airport access road from the north
- Changewe by-pass
- Road along north shore of Port Reitz from Kipevu to Ras Hodi Causeway
- Trunk road on west side of airport from Kwa Jomvu to Ras Hodi

CAUSEWAY

- Trunk road between Miritini and Mazeras on new alignment
- Improve road around Tudor Creek

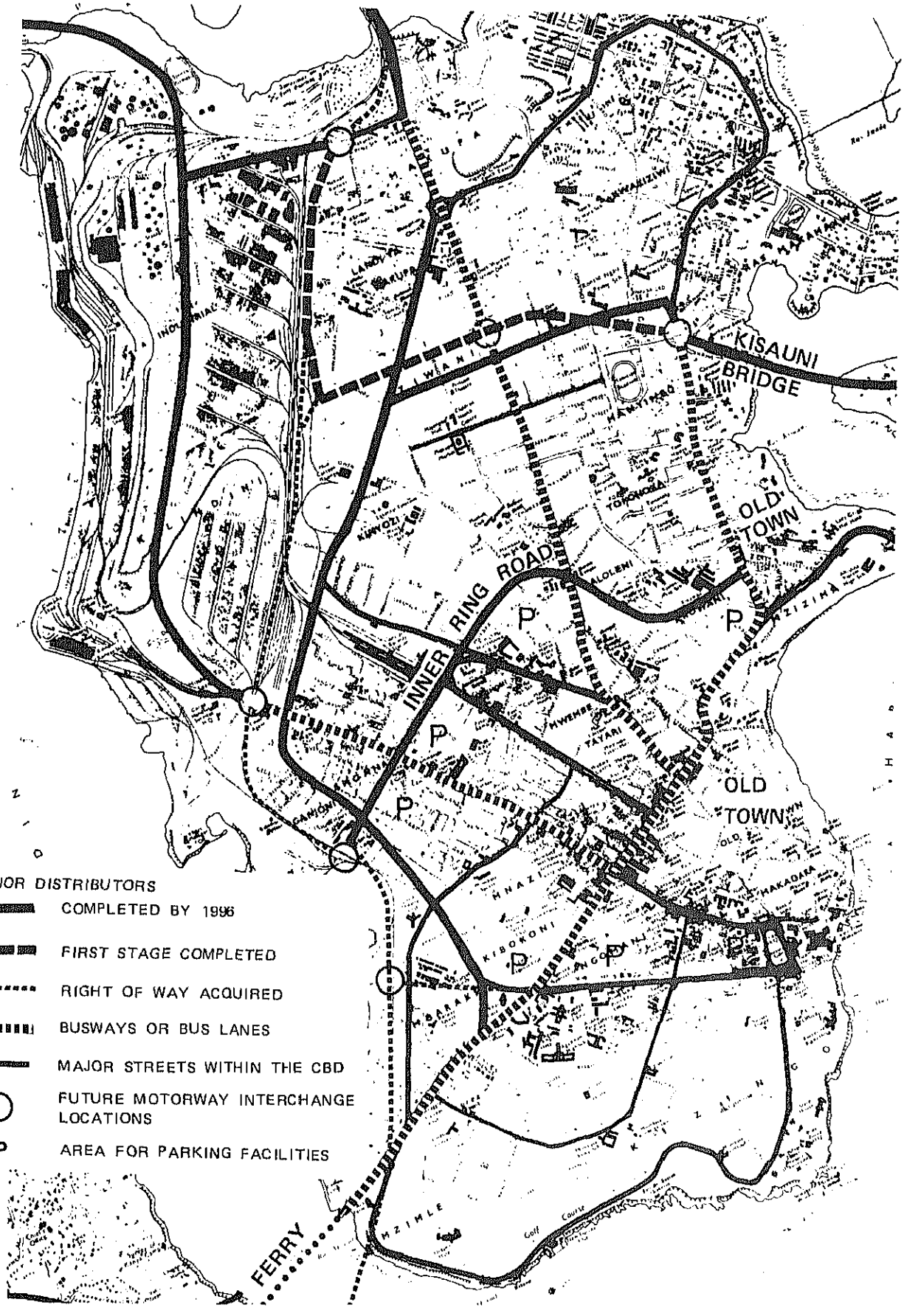


Fig. 4.1.4 MOMBASA TRANSPORTATION STUDY, 1972 (2) RECOMMENDED 1966 ROAD SYSTEM

– Trunk road from Kisauni Bridge to Mtwapa Creek

– Trunk road from Likoni Ferry to Waa

– District distributors within development areas

1st Period (beginning of 1974 to mid-1981)

Short-term improvements recommended in Volume 2

– Kisauni Bridge (planned for completion in early 1976)

– Airport access road from the east

– Ziwani Road and Tom Mboya Avenue widened to dual carriageway

– Bridge over the railway tracks behind Central Railway Station

– Ras Hodi Causeway (first stage with two lanes) and access roads

– Airport access road from the north

2nd Period (mid-1981 to the end of 1988)

– CBD ring road widened to dual carriageway

– Trunk road from Kisauni Bridge through Nayli District

– Trunk road from Likoni Ferry to Waa

– Extension of Shimanzi Road to Kipevu and link to Kilindini Road

– Trunk road between Miritini and Mazeras on new alignment

– Road along north shore of Port Reitz from Kipevu to Ras Hodi

– All remaining Island district distributors widened to dual carriageway

– Changamwe by-pass

3rd Period (beginning of 1989 to mid-1996)

– Widen Ras Hodi Causeway to four lanes

– Improve road around Tudor Creek

– Trunk road from Ras Hodi to Kwa Jomvu

– East-west route on Island (1st stage)

– Northern section of North-South Route on Island (1st stage)

– Trunk road on north mainland extended through Bamburi District to Mtwapa Creek

– Ferry ramps for vehicular ferry service to Mtongwe

4th Period (after mid-1996)

– Complete East-West Route on Island

– Likoni Bridge

– Complete North-South Route on Island

– Widen Makupa Causeway

4) Mombasa Structure Plan (1975)

Future road network is shown in Fig. 4.1.5 and 4.1.6.

(1) Planning area

Mombasa consists of the island and 7 planning areas with their town centres as follows:

Mombasa Island	
North mainland:	Bamburi, Nyali
West mainland:	Changamwe, Miritini, Mazeras
South mainland:	Likoni, Ngombeni

(2) Future population

The distribution of the population was estimated in Table 4.1.1., and illustrated in Fig. 4.1.7.

The total population in the structure plan was 990,000.

(3) Crossing to the south mainland

The crossing point is likely to be decided from the view point of the effective land use in the south mainland. The proposed crossing route was located at Telegraph Point, the north of Mueza Creek.

Table 4.1.1 MOMBASA STRUCTURE PLAN (PLANNED POPULATION)

	Planning area	Planned population	1979 Census
North	BAMBURI	90,000	
	NYALI	155,000	80,299
		(245,000)	
West	CHANGAMWE	85,000	
	MIRITINI	75,000	
	MAZERAS	87,500	
		(247,500)	82,353
South	LIKONI	130,000	
	NGOMBENI	187,500	
		(317,500)	40,148
Island	ISLAND	180,000	138,312
TOTAL		990,000	341,148

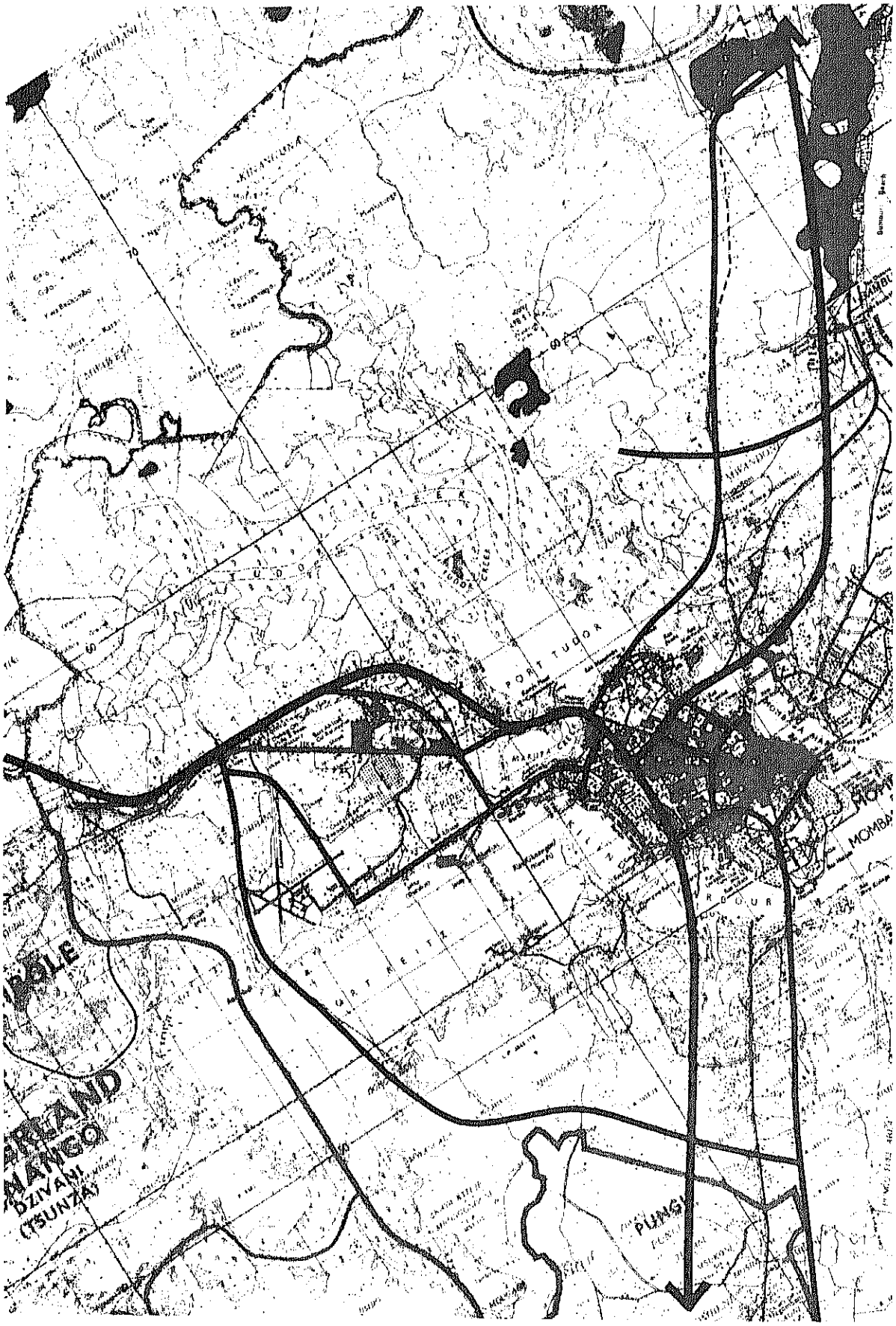


Fig. 4.1.5 MOMBASA STRUCTURE PLAN DRAFT, 1975 (1)

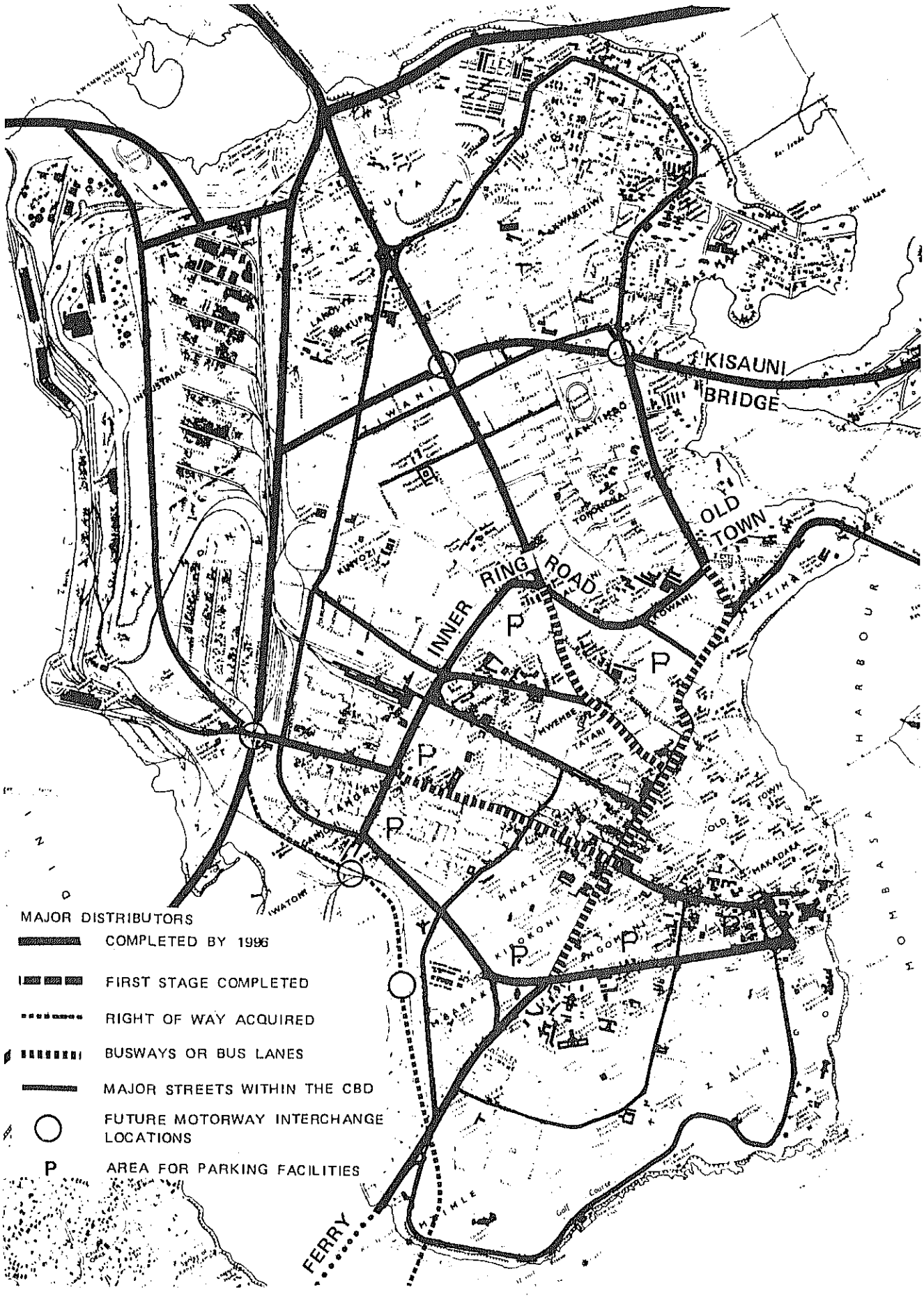


Fig. 4.1.6 MOMBASA STRUCTURE PLAN DRAFT, 1975 (2)

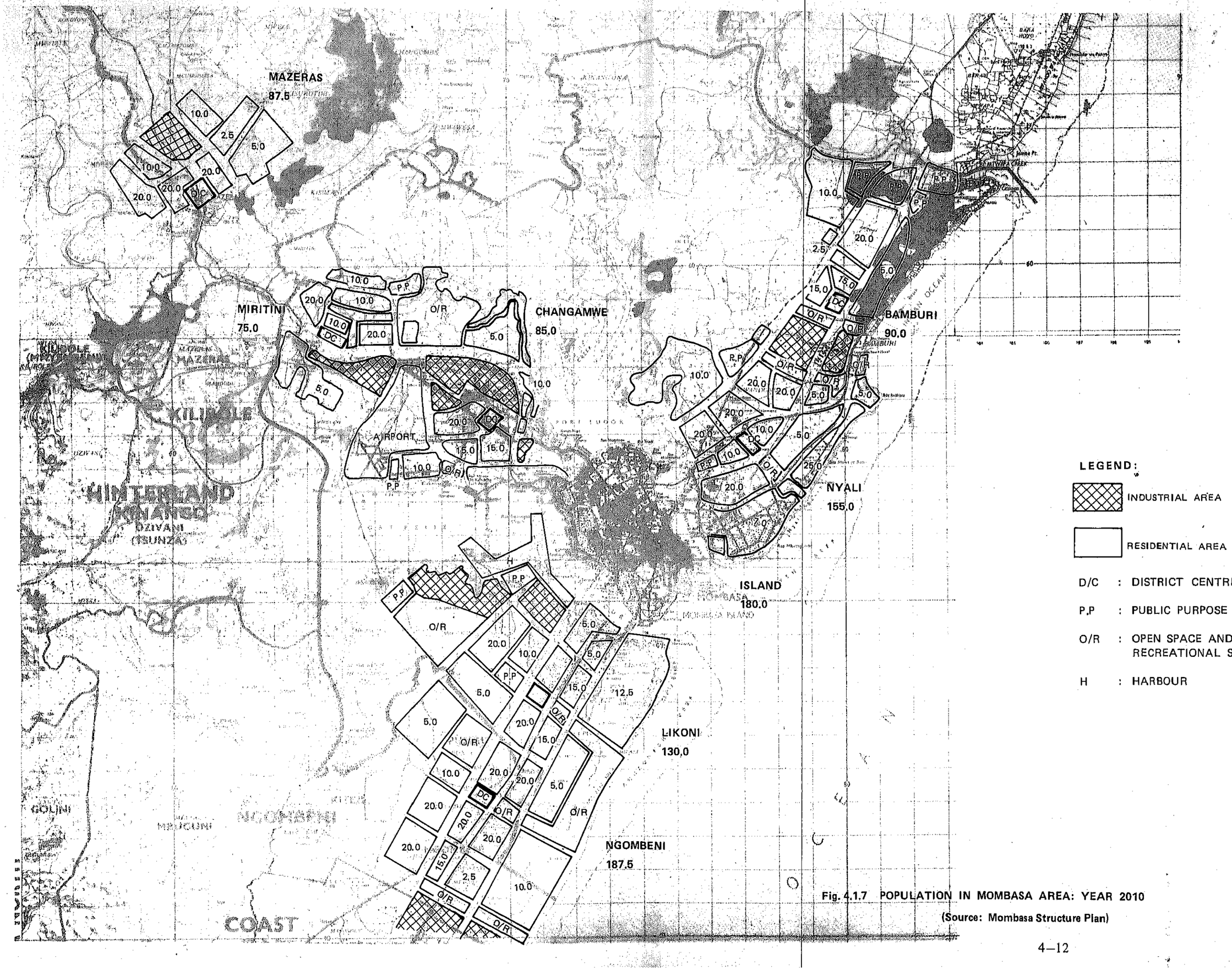


Fig. 4.1.7 POPULATION IN MOMBASA AREA: YEAR 2010

(Source: Mombasa Structure Plan)

5) East African Port Development Study (1977)

Future road network in the study is shown in Fig. 4.1.8 and 4.1.9.

(1) Future port development

From the south mainland at Dongo Kundu up to the naval jetty at Mkunguni is a possible site for future deep water berths. The hinterland of the port is a possible area for long term development of port related industries.

(2) Kilindini Harbour Crossing

The Port Master Plan selected the crossing of Kilindini Harbour to the south mainland at Telegraph Point instead of Likoni. The crossing route at Telegraph Point is the result of a study carried out by the Ministry of Lands and Settlement, and the crossing route at Likoni is the recommendation of the Mombasa Transportation Study for the Ministry of Works (MTS)

(3) Port Reitz Crossing

The crossing at Ras Hodi to Dongo Kundu is shown likely to have the biggest impact on the Port. The Port Master Plan has an alternative crossing to the Ras Hodi via Tsunza.

6) Evaluation of Past Development Plans

Past development recommendations here reviewed for progress and summarized below:

(1) Past Development in the Area

Some developments recommended in the Mombasa Structure Plan (1975) and other studies are underway, especially in the West and North Mainland as follows:

Changamwe (West Mainland)

- Industrial area development
- New by-pass of A109
- Mombasa Airport extension

North Mainland

- Bamburi cement factory, but not the whole industrial area
- New Malindi Road (B8) and New Nyali bridge
- Resort and housing development along the coastal belt

South Mainland

- Resort and housing development along the coastal belt
- Hinterland housing development in Likoni area
- Dongo Kundu area (Port and industrial development) under study by KPA

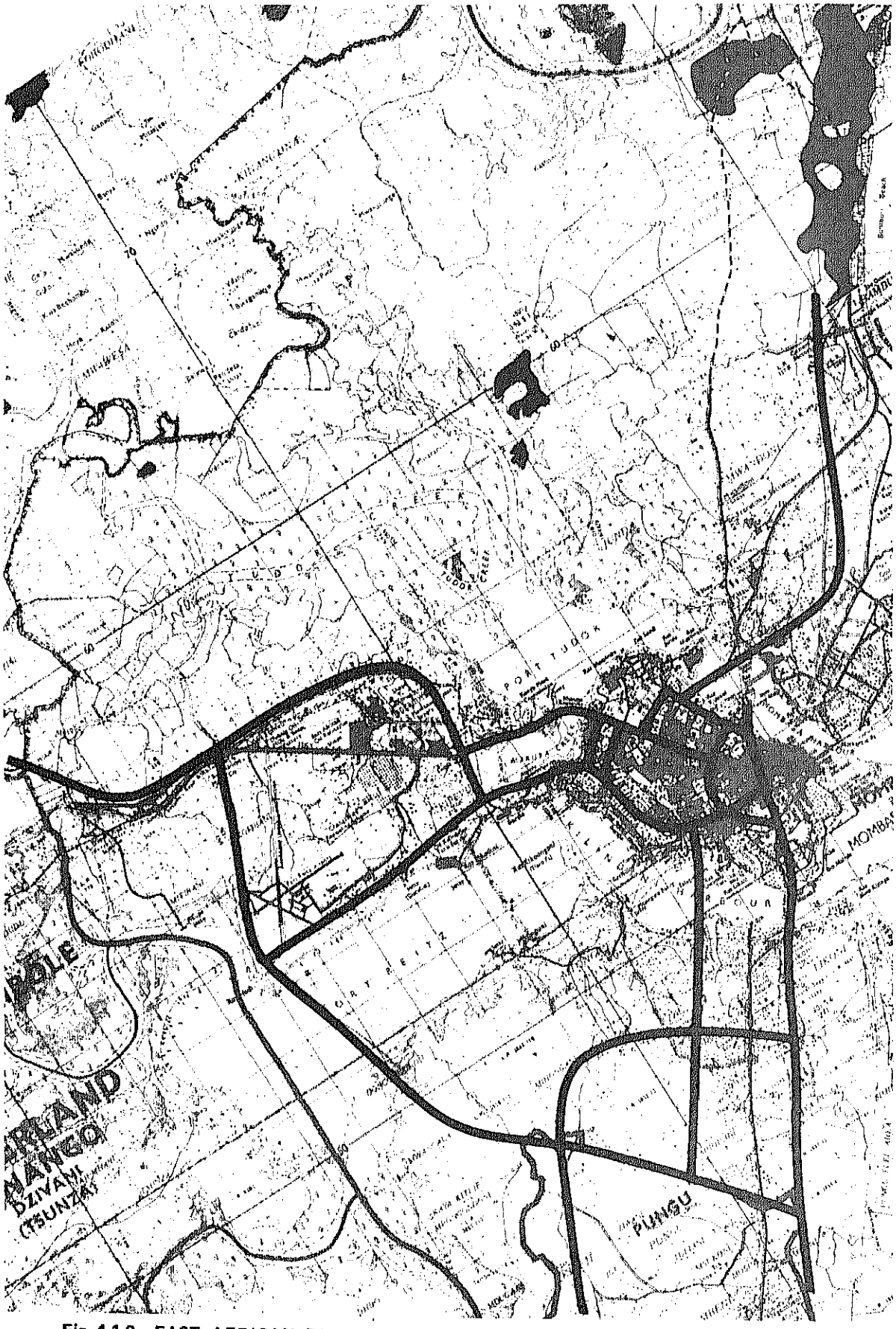


Fig. 4.1.8 EAST AFRICAN PORT DEVELOPMENT STUDY (1) (PORT MASTERPLAN TO YEAR 2000, 1977)

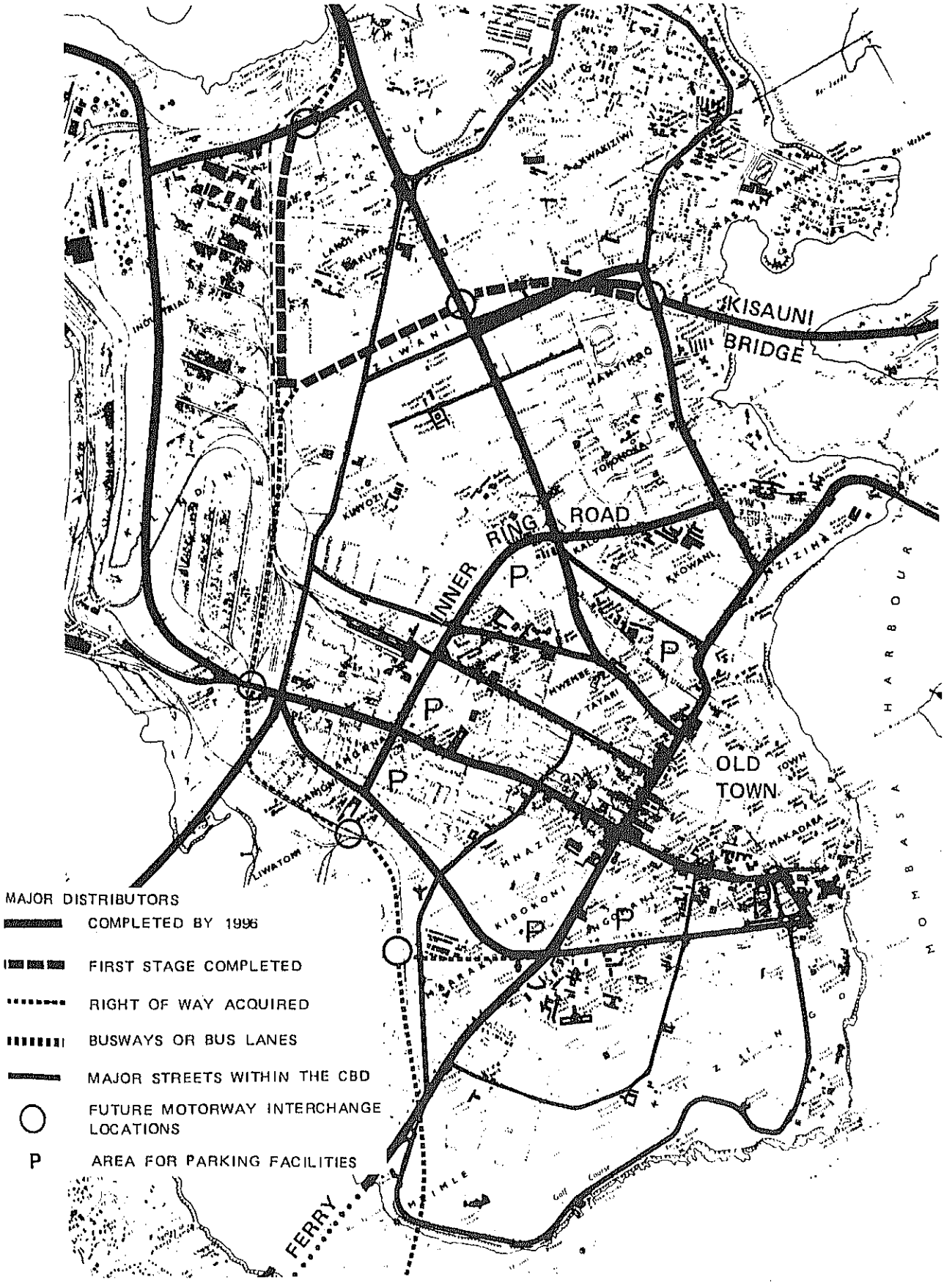


Fig. 4.1.9 EAST AFRICAN PORT DEVELOPMENT STUDY (2) (PORT MASTERPLAN TO YEAR 2000, 1977)

In connection with industries, Mombasa shares approximately 20% in industrial establishment, GDP and earnings of Kenya in 1979. Transportation/Communication and manufacturing sectors are significant in industrial earnings with a high of 45% and 20% in the respective sectors of Kenya.

(2) Population Growth

The population in the South Mainland marked at the highest growth among three mainlands over the period of 1969 ∿ 1979 as shown below:

Population Growth (1969 – 1979)			Growth Rate
South Mainland	:	1.91	6.7%
West Mainland	:	1.79	5.0
North Mainland	:	1.63	6.0

The Mombasa Draft Physical Development Plan (1971) recommended that the future population would be one million sometime between 1990 and 2000.

The total growth rate of Mombasa area was 3.3% between 1969–1979 as shown in Table 2.2.3.

If this growth rate continues, a population of one million will be realized around the year 2010.

(3) Trunk Road System

The Ras Hodi Causeway recommended in several master plans is evaluated to be a by-pass of Mombasa Metropolitan area and a trunk road as the direct goods transportation corridor to Nairobi and the upland regions from Dongo Kundu area, instead of passing through the busy area on the island.

The Likoni ferry currently carries commuting traffic of approximately 3,800 vehicles and 37,000 pedestrians from Kwale, Likoni, Mtongwe, etc to the island. Upon the completion of the bridge crossing this function will be enhanced not only from the existing areas, but also much wider area including the costal belt.

4.2 Existing Transport Plans

4.2.1 Existing and Previous Road Plans

1) Mombasa Municipality Plan

The Mombasa City has some improvement plans for the existing roads as listed below:

– Mozambique Road:	24 ft wide paved carriageway from existing earth road
– Archbishop Makarios Road:	dual carriageway (same width as Moi Ave.) from existing single carriageway
– Mbaraki/Mnazi Moja Roads:	4 cm thick asphalt on the existing thin seal coat which has been extensively damaged by heavy vehicles.
– Moi Ave.:	construction tender including 2 cm thick overlay and smooth road surfacing, has been awarded and the construction is scheduled to start after the rainy season in 1983.

The plans listed above have no precise schedules due to the budget constraint except for the improvement of Moi Ave. Moreover the road reserve of 50 m width for a existing narrow road from Likoni ferry intersection to the south inland area was made many years ago.

2) KPA Plan

Widening of the existing Kipevu Road to a dual carriageway road is proposed due to the increasing container traffic demend and the poor road structure (narrow and steep gradient). However, no definite construction schedule has been made.

KPA has plans to construct a new road linking, Shimanzi Road with Moi Avi. The proposed Road is expected to provide smooth traffic in the port/industrial area. In this plan provision of a bus and matatu terminal as well as a new port gate is included. The construction is scheduled to start at the end of 1983.

3) MOTC Plan

The Provincial Planning Officer, Ministry of Economic Planning and Development had reserved the width of 60 m for the expansion of the existing Lunga Lunga Road in about 1968.

4.2.2 Existing Port Projects

The development plan of the Mombasa Port was established in 1977 as "Kenya Port in EAST AFRICAN PORTS DEVELOPMENT STUDY" by IBRD fund.

In this section the current situation of the port such as the development progress, the current plan of KPA, etc., is described refering to the original recommendations which was made in the study.

1) Island Side

(1) Mbaraki Waterfront

One additional berth will be constructed for soda ash beyond 1984/1988 plan.

(2) AMGECO/SECO

The existing facilities will be maintained.

(3) Liwatoni Fishery Quay

The existing facilities will be maintained, although the fish products have declined recently. Therefore, the leisure facilities, K-Boat and a marine club, will be maintained.

(4) North Lighter Quay

There are no redevelopment plans at this moment and lighter traffic will be treated as now.

(5) Ras Kilindini

The existing conditions will be maintained for the mean time due to the existing of the facilities and dredging for the waterfront.

(6) Kilindini Berth (No. 1-5)

KPA has a scheme involving the re-arrangement of existing railway lines and removal of miscellaneous storage in order to save the railway maintenance cost and to produce open storage space.

No precise plans have been made. The residential area and some industries located behind those berths will be maintained.

(7) Shimanzi Oil Terminal/Cased Oil Jetty

There is no improvement plan and these facilities will be maintained.

2) West Mainland (Kipevu Area)

(1) KPA office building and Kipevu Power Station will be maintained.

(2) Kipevu Oil Terminal

The extension work is almost completed by the Canadian Government..

(3) KeN-ReN Fertilizer Factory (behind berth No. 16–18)

The site, after the bankruptcy of the factory, was proposed to be used for container yeards by KPA. The government has yet to approve the KPA proposal. KPA is examining suitable sites.

(4) Railway extension to the west

The railway extension plan was proposed by the Study (1977), which would be located to the south of Mombasa Airport. Recently the area has been developed for residential purpose and is too narrow for the large scale developments. Therefore the plan will be concerned as Long Term.

3) Port Reitz (South Side, Dongo Kundu Area)

The KPA proposes to commission a master plan study of land use and development programme for Mombasa Port. Land area measuring 3005 acres has been acquired by the KPA for harbour development, warehousing and port oriented industries.

This area borders a waterfront capable of producing 6000 – 7000 ft of quay length. The scope of the study includes financial and economic evaluation of transport network system as well as the optimum land use, layout of the waterfront facilities. The project was already contracted with a American Consulting firm and be under a 9 months study period.

4) Port Kilindini (South Mainland)

(1) KPA has no intention to develop the coastal area between Ras Kikanngoni and Mtongwe Navy Jetty.

(2) Navy Jetty-Ras Bofu

These are no plans for this area except a scheme for Mombasa World Trade Centre, which was studied by Kohli Jackson International in 1982 as a feasibility study. The study was stopped due to an alternative location in Nairobi.

(3) Ras Bofu-Eastern Coast

There are no development plans for the area and also no plan for a 700 m wide strip reservation from the coast, which was proposed by the Study (1977).

5) Manda Bay

(1) Manda Bay Port development plan was proposed by Sauti Consultants in early 1970. The proposal was not accepted by the Government due to critical engineering questions.

(2) The government has requested some Consultants to present their proposal (titled "Second Port of Kenya") for the location selection and facilities plan in 1982. The government has not issued yet the Notice to Proceed.

(3) Manda Bay is still one of the major alternative locations for the second port.

4.3 Planning Aspects Related to the Project Road

4.3.1 Development of Fixed Crossings

Because of the accumulation of central public facilities such as CBD, schools, hospital, etc. on Mombasa Island, the ferries between the Island and the surrounding Mainlands have been converted to fixed crossings as the Municipality expands, as follows:

Makupa Ferry → Makupa Causeway

Nyali Ferry → Old Nyali Bridge → New Nyali Bridge

Likoni Ferry → a proposed fixed crossing

The three trunk road connections from the town centre towards respective mainlands are being completed by the means of the fixed crossing and the third connection is at present proposed.

Mombasa, northwards – B8:	National Trunk Road
Mombasa, westwards – A109:	International Trunk Road
Mombasa, southwards – A14:	International Trunk Road

It is now a transition period when the functions of the trunk road system and the street system are being separated. Fig. 4.3.1 illustrates the transition of the major road system.

4.3.2 Functional Consideration of Likoni Crossing

1) Island Side

The road network should be established in comformity to the planning policies of the Mombasa Structure Plan.

The traffic concentration on the town centre should be dispersed by the proposed Inner Ring Road.

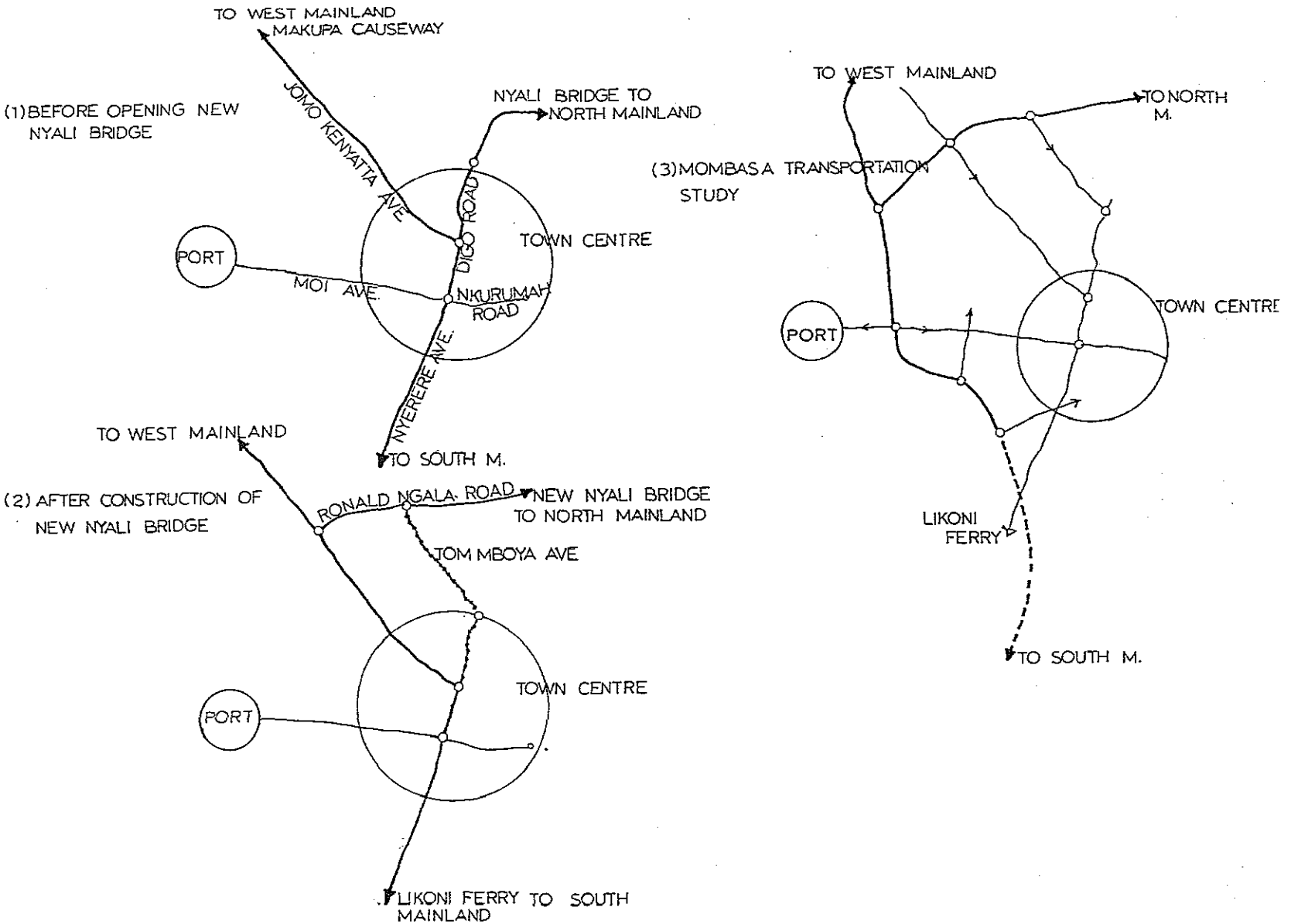


Fig. 4.3.1 ROAD NETWORK DEVELOPING PROCESS

The trunk roads should be linked by intersecting mutually outside the Inner Ring Road.

The two greatest traffic generation-attraction areas are the town centre and the port/ industrial area. Therefore it is not desirable to distribute the traffic from the port/ industrial area to the town centre and vice versa. The favorable location for the traffic distribution for both areas is at intermediate points.

The major streets and junctions that can distribute the traffic from the trunk roads to respective destinations must be sufficient in number and function to operate the network.

Through these points emphasis should be put on the recommendations by the Mombasa Transportation Study.

2) South Mainland Side

South Mainland has a high potential for port and industrial development. An arterial road which can serve South Mainland should also link West Mainland. It is as proposed in Ras Hodi Causeway Project (a by-pass of Mombasa city) by the Mombasa Transportation Study.

The Likoni crossing will support the above industrial development of South Mainland, but not fulfill the alternative function of the proposed Ras Hodi Causeway.

The Likoni ferry currently carried approximately 3,800 vehicles and 37,000 passengers per day between the island and the South Mainland.

As part of an international/national trunk road the Project road will serve a much bigger area and enhance the regional development in compliance with the decentralization policy recommended in the Mombasa Structure Plan, and not merely service the port and industrial development area in Dongo Kundu as in the case of Ras Hodi causeway.

CHAPTER 5 TRAFFIC DEMAND FORECAST

CHAPTER 5 TRAFFIC DEMAND FORECAST

5.1 Traffic Forecast

5.1.1 Forecast Model

To forecast the future traffic demand of Likoni Crossing, it is necessary that present and future socio-economic conditions be compared and future change in traffic volume and pattern be analysed. For this purpose, data of present regional population, road system and traffic are available, while future population and distribution can be estimated based on the Mombasa Structure Plan. The gravity model is applied in making the traffic demand forecast in this study. From the result of the origin-destination (OD) survey, the present OD traffic pairs using the Likoni ferry are obtained. Based on the OD pairs the present traffic flows in Mombasa Island are estimated by use of the gravity model.

The gravity model consists of population and time distance as in the following formula:

$$T_{ij} = a\, P_i * P_j / D^2_{ij}$$

where: T_{ij} : traffic volume between i and j zones
P_i, P_j: population in i and j zones
D_{ij}: time distance between i and j zones

Coefficient of each zone pair is calculated by using the data analyzed as in the following table:

Zone from Likoni, Kwale	Traffic share (%)	Total Present Traffic Potential	Estimated Present Traffic Volume	Time Distance (min)	Population in 1979	Gravity Coefficient
Island North	10.83		609	35.5	51,536	45.3272
Island South	3.43		193	29.5	9,038	56.5629
Port/Industry	26.54		1,492	31.0	29,958	145.674
Town Centre	40.27	5,621	2,263	30.5	47,780	134.104
West Mainland	10.55		593	50.5	82,353	55.8934
North Mainland and Kilifi	8.38		471	136.5	511,285	52.2427
Total	100		5,621			

Fig. 5.1.1 is a conceptual diagram of the arterial road network loaded with key data required for traffic analysis. Fig. 5.1.2 illustrates the major traffic flows estimated using the above data.

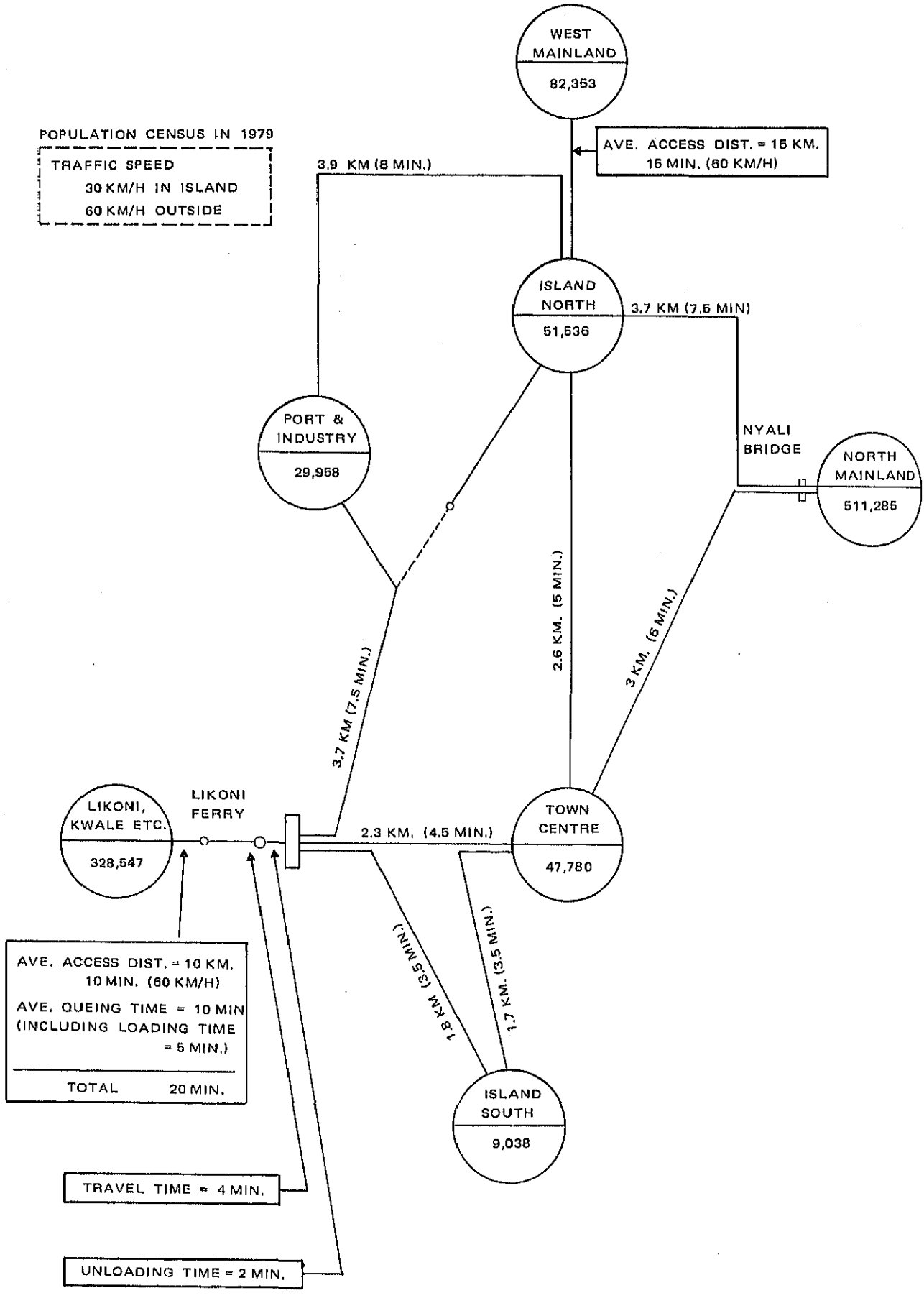


Fig. 5.1.1 PRESENT ROAD NETWORK AND POPULATION

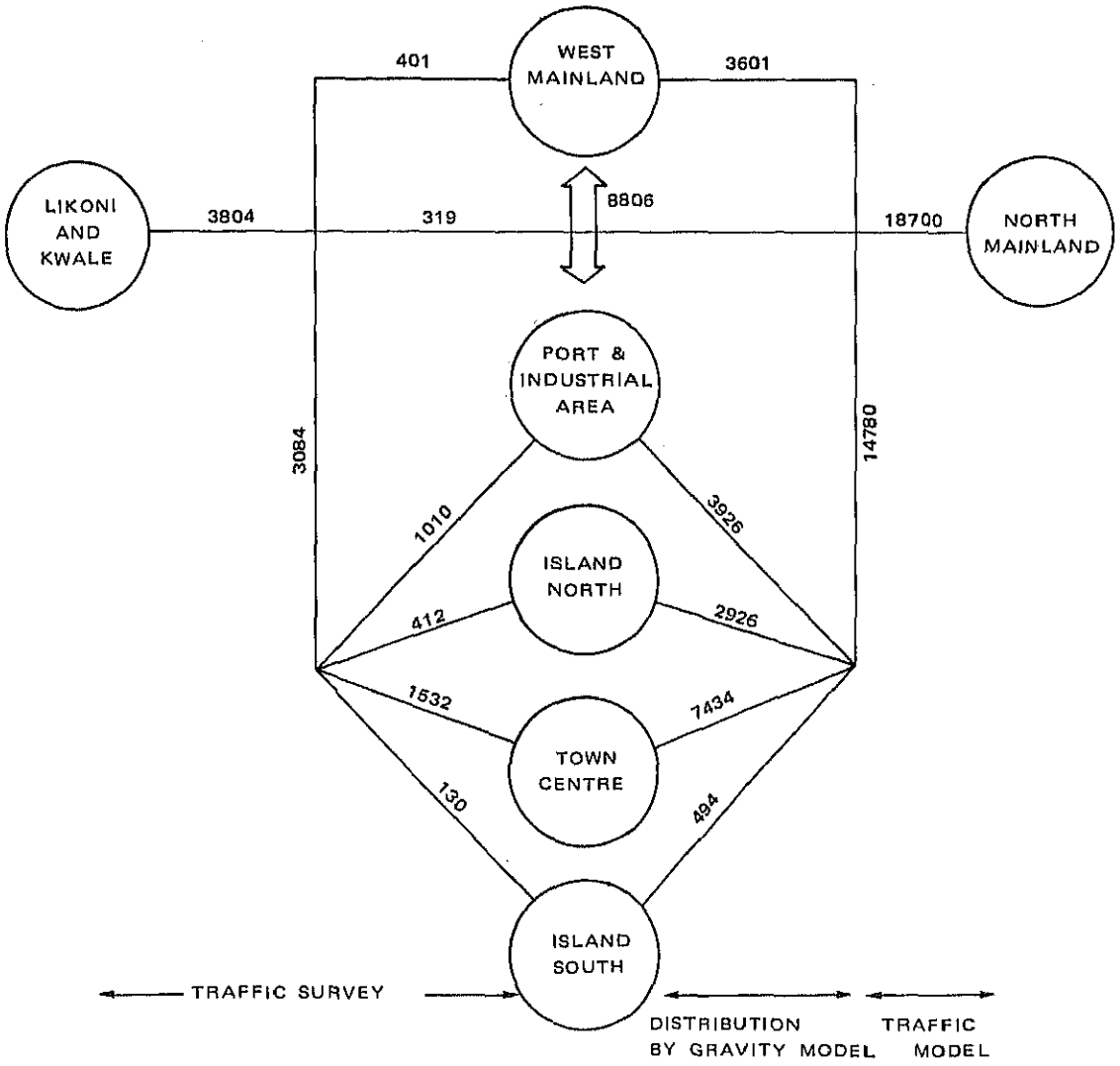


Fig. 5.1.2 ESTIMATED PRESENT TRAFFIC FLOW

5.1.2 Population Forecast

The future population is estimated using the Mombasa Structure Plan which targets a future population of 1,000,000 in year 2000 and applies a decentralization planning policy.

Under the present world-wide economic situation and considering the growth trend in the past (refer to Table 2.2.3), modernization of Mombasa is expected to be slow for the time being, so that it is only in 2010 when the population of the Mombasa Metropolitan Area will reach 1,000,000. In this case the annual growth rate of population is estimated at 3.4%.

Table 5.1.1 shows the population distribution by division in 1969, 1979 and 2010.

Table 5.1.1 ESTIMATED POPULATION ON STUDY AREA FOR 1969, 1979 AND 2010

Year / Division	1969	1979	2010	Remarks Town Centre
Island	116,420	138,321	180,000	
Likoni East	4,368	9,165	57,500	
Likoni West	7,895	16,836	70,000	
Mtongwe	8,735	14,183	10,000	
Likoni (South)	20,998	40,184	137,500	Likoni
Changamwe (W. Mainland)	50,548	82,353	160,000	Changamwe & Miritini
Kisauni (N. Mainland)	44,874	80,299	245,000	Nyali & Bamburi
Mombasa	247,073	341,148	722,500	
Kwale				
Central Waa	6,161	9,049	30,000	Ngombeni
Ngombeni	9,406	13,380	150,000	
Kwale				
Hinterland Kilibole	11,884	16,794	70,000	Mazeras
Kilifi				
Southern Rabai	14,652	20,987	17,500	
Others	-	-	-	By trend

5.1.3 Future Traffic Volumes by Target Year

Assuming that the proposed fixed crossing to be open to traffic in 1990, the future traffic volumes are estimated by target year as follows:

1) Traffic using Ferry in 1990

The traffic across the ferry in 1990 is estimated at 4,939 P.C.U. based on the traffic volume of 3,804 P.C.U. surveyed in 1983 using an annual growth rate of 3.8%.

2) Traffic using Fixed Crossing in 1990

The present traffic potential in 1983 is estimated at 5,621 P.C.U., and the forecast basic traffic volume in 1990 using the growth rate 3.8% is 7,298 P.C.U. Considering the induced traffic by freedom from waiting for the ferry as analysed in Appendix A, and the induced rate is estimated at 20.8% of the above traffic volume, the crossing traffic in 1990 with the proposed fixed crossing is expected to amount to 8,816 P.C.U.

3) Traffic using Fixed Crossing in 2010

The traffic in 2010 accommodated by the fixed crossing is calculated at 28,460 P.C.U. by adding the induced traffic (20.8%) to the basic traffic volume of 23,560 P.C.U. forecast based on the model.

The annual growth rate between 1990 and 2010 is calculated at 6% from 8,816 P.C.U in 1990 and to 28,460 P.C.U in 2010 as shown in Fig. 5.1.3.

4) Evaluation of Future Traffic Growth Rate

The future population in Mombasa Metropolitan area will reach one million in year 2010. Based on this assumption the traffic growth rate of the project road is estimated to be 6%. This figure is evaluated from the following considerations.

- Development potential of the South Mainland
- Traffic growth trend
- Economic growth in Kenya

(1) Development Potential of the South Mainland

KPA has under study the development of port and industrial areas in the Dongo kundu area (South Mainland) according to recommendations made by the East African Port Development Study (1977).

Mombasa Structure Plan (1975) recommended that higher population growth would be expected in the South Mainland compared to the North and West Mainland. It is evaluated that the future development potential in the South Mainland is also likely to be high from political standpoints as discribed in Chapter 4.

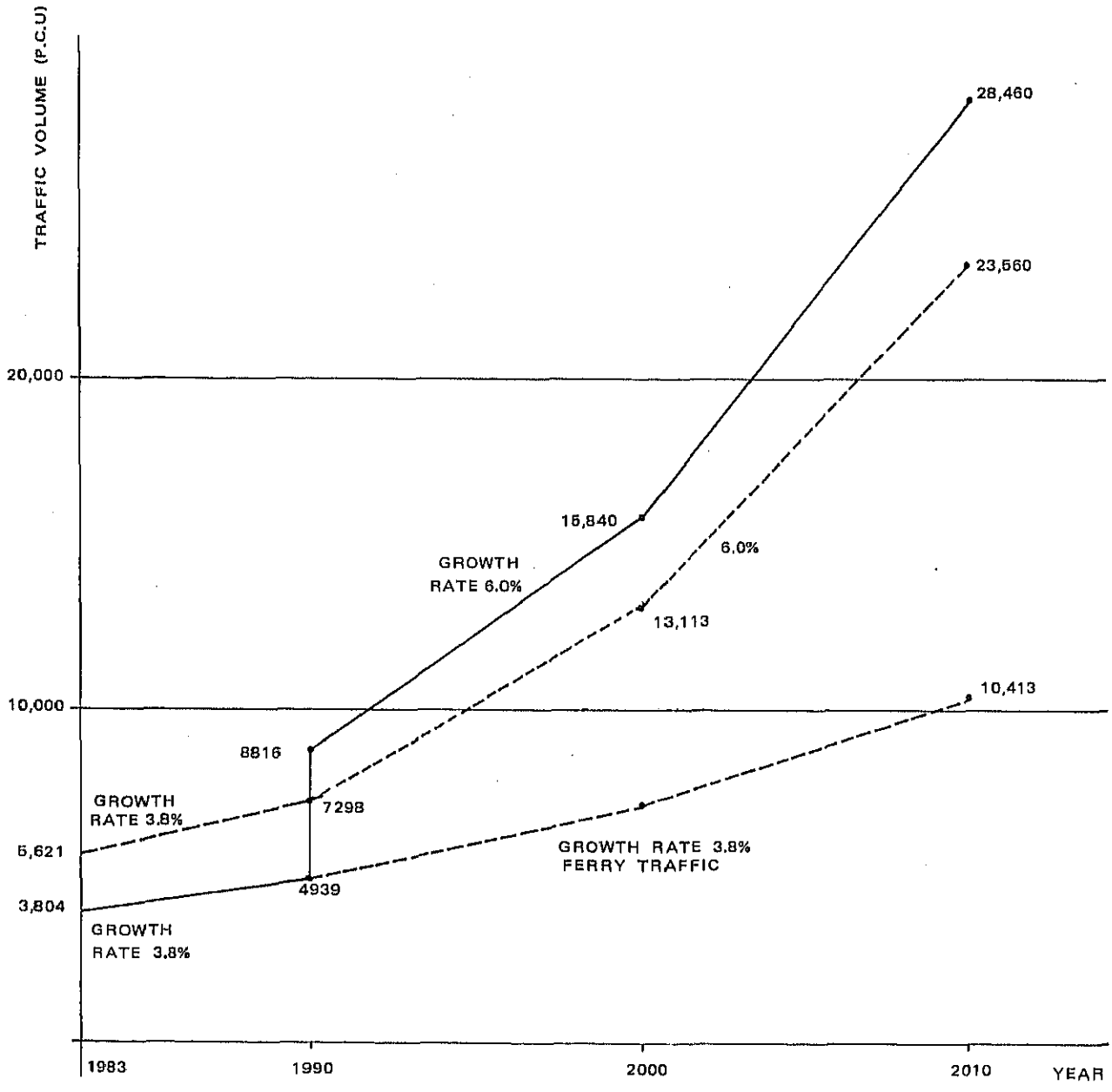


Fig. 5.1.3 TRAFFIC DEMAND OF LIKONI CROSSING (THROUGH TRAFFIC)

Furthermore the resort development potential has a higher evaluation than that of the North Mainland.

(2) Traffic Growth Trend

The past traffic growth rate on Lunga Lunga Road and Likoni Ferry were surveyed and found to be in the range of 4.1% to 6.5%. Especially in the recent years the rate shows a higher value of 5.5% to 6.5% on the existing trunk road and the existing ferry (KBS) as shown in Table 5.1.2.

Table 5.1.2 TRAFFIC GROWTH TREND RELATED LIKONI CROSSING

Location	Years	Annual Growth Rates %					Total
		C.	L.G.	M.G.	H.G.	B.	
A14/2	1970–77	3.8	8.8	10.3	3.9	10.8	4.1
	1977–81	6.0	9.7	5.1	-ve	-ve	5.5
A14/5	1970–77	6.2	8.8	6.3	3.3	9.4	4.6
	1977–81	4.2	8.4	5.5	-ve	-ve	6.3
KBS	1968–1980	7.1	–	–	6.6	–	6.5

(3) Traffic Growth in relation with GDP

The traffic growth generally exceeds a country's GDP.

– Relation with total GDP in Kenya

The elasticity of traffic growth against GDP in Kenya is estimated to be 1.4 over the past 16 years, 1964–1980.

A: Economic growth (GDP Growth): Average annual rate 5.6% [2)]

B: Traffic growth: Average annual rate 7.9% [2)]

The elasticity between two growth rates is B/A = 1.4.

– Relation with GDP in Mombasa area

If the economic growth in the Mombasa area is the same as the economic growth in Kenya. The elasticity of the Likoni ferry is estimated as 1.2 over the past 12 years, 1968–1980.

a. Economic growth (estimation): Average annual growth rate 5.3% [2)]

b. Traffic growth of the ferry: Average annual growth rate 6.5% [1)]

The growth rate of vehicle traffic is estimated to be much higher rate than the economic growth rate.

In the fifth five year plan the annual average national GDP after 1983 is forecast to be 5%. Considering the study area as the leading area in the Kenyan economy, the economic

growth in the study area is not expected to have a lower value than the average GDP in Kenya. Therefore the traffic growth of the project crossing is estimated to be 6 ∿ 7% annually.

As a result the traffic growth rate of 6% can be resonable value.

Source: 1) A Feasibility Study Report on the Likoni Ferry Crossing, MOTC, March 1982
2) Kenya 1981, 1982 Year Book
3) Fifth Development Plan, 1983–1988

5.1.4 Future Traffic Flows

Fig. 5.1.4 illustrates the forecast future traffic flows in the year 2010, and Table 5.1.3 shows the OD matrix table for the basic traffic in the same year. Estimated traffic volumes by type of vehicles in 1983 and 2010 are tabulated in Table 5.1.4. The above OD table indicates that the share of traffic volume of Likoni zone representing South Mainland will amount to 41.9% in 2010 while its present share accounts for 33.0% of the total traffic volume. This can be considered appropriate with potential developments of port, industry, housing, etc. in South Mainland.

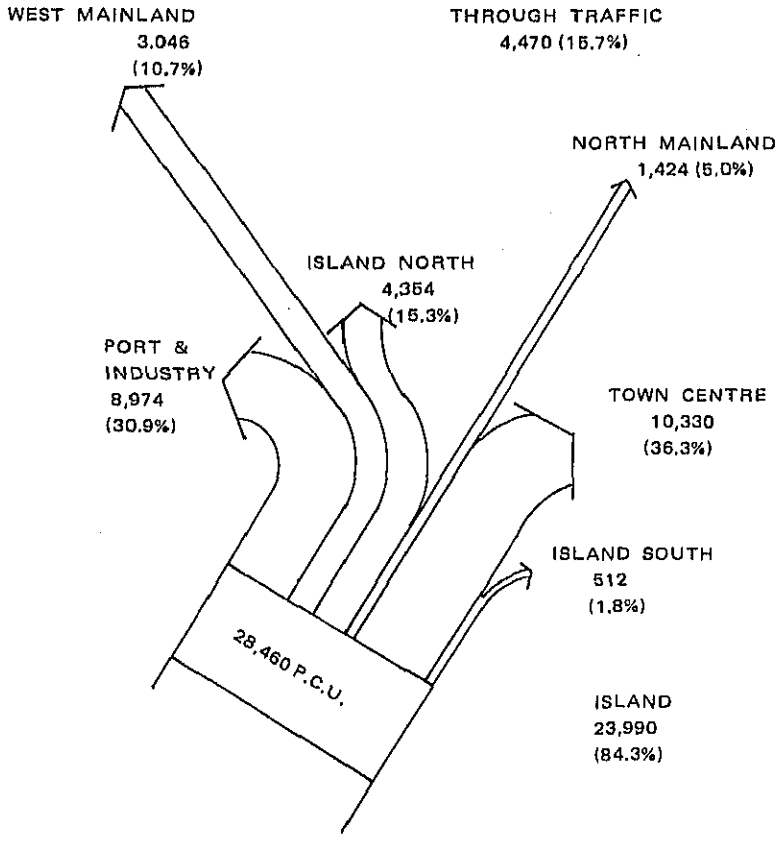


Fig. 5.1.4 FUTURE TRAFFIC FLOW IN 2010

Table 5.1.3 ORIGIN-DESTINATION TABLE FOR 2010 (BASIC TRAFFIC)

*** FEASIBILITY STUDY ON LIKONICROSSING CONSTRUCTION PROJECT *** PAGE =187

****
* O-ZONE X D-ZONE *
****

<< 2010 YEAR --DEVELOPED (TOTAL) UNIT: P.C.U. >>

	TUDOR ESTATE	TUDOR FOUR	TONOKOKA	BONDENI	MAKADARA	MAJI WA KALE	MAJENGO	MWEMBE TAYARI	MWEMBE CENTRE	KINGO RANI	SHIMANZI	GANJONI
TUDOR ESTATE	0	0	0	0	0	0	0	0	0	0	0	0
TUDOR FOUR	0	0	0	0	0	0	0	0	0	0	0	0
TONONOKA	0	0	0	0	0	0	0	0	0	0	0	0
BONDENI	0	0	0	0	0	0	0	0	0	0	0	0
MAKADARA	0	0	0	0	0	0	0	0	0	0	0	0
MAJI WA KALE	0	0	0	0	0	0	0	0	0	0	0	0
MAJENGO	0	0	0	0	0	0	0	0	0	0	0	0
MWEMBE TAYARI	0	0	0	0	0	0	0	0	0	0	0	0
MWEMBE CENTRE	0	0	0	0	0	0	0	0	0	0	0	0
KINGORANI	0	0	0	0	0	0	0	0	0	0	0	0
SHIMANZI	0	0	0	0	0	0	0	0	0	0	0	0
GANJONI	0	0	0	0	0	0	0	0	0	0	0	0
GANJONI CENTRE	0	0	0	0	0	0	0	0	0	0	0	0
KINZINGO	0	0	0	0	0	0	0	0	0	0	0	0
KINZINGO CENTRE	0	0	0	0	0	0	0	0	0	0	0	0
LIKONI EAST	204	56	22	249	283	149	362	192	1381	14	583	474
LIKONI WEST	11	9	59	68	108	16	108	29	353	13	104	187
MTONGWE	115	25	77	29	181	59	529	109	1187	25	587	798
CENTRAL KWALE	206	47	206	133	447	256	687	204	1272	106	1401	615
KUBO	0	0	0	11	0	0	0	14	93	0	0	14
CENTRAL HITHER	20	5	5	5	11	0	0	0	20	0	25	13
SOUTHERN KWALE	169	77	140	147	513	181	547	280	2126	178	848	689
NORTHERN HITHER	0	0	0	0	0	0	0	0	0	0	0	0
WEST MAINLAND	0	0	0	0	0	0	0	0	0	0	0	0
NORTH MAINLAND	0	0	0	0	0	0	0	0	0	0	0	0
KILIFI	0	0	0	0	0	0	0	0	0	0	0	0
COAST	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	0	0	0	0	0	0	0	0	0	0	0	0
EXTERNAL	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	725	219	509	642	1543	661	2233	828	6432	336	3548	2790

Table 5.1.4 (Continued)

*** FEASIBILITY STUDY ON LIKONICROSSING CONSTRUCTION PROJECT *** PAGE =188

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* O-ZONE X D-ZONE *
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<< 2010 YEAR --DEVELOPED (TOTAL) UNIT: P.C.U. >>

	GANJONI CENTRE	KINZINGO	KINZINGO CENTRE	LIKONI EAST	LIKONI WEST	MTONGWE	CENTRAL KWALE	KUBO	CENTRAL HITHER	SOUTHERN KWALE	NORTHERN HITHER	NORTH MAINLAND
TUDOR ESTATE	0	0	0	204	11	115	206	0	20	169	0	0
TUDOR FOUR	0	0	0	56	9	25	47	0	5	77	0	0
TONONOKA	0	0	0	22	59	77	206	0	5	140	0	0
BONDENI	0	0	0	249	68	29	133	11	5	147	0	0
MAKADARA	0	0	0	283	108	181	447	0	11	513	0	0
MAJI WA KALE	0	0	0	149	16	59	256	0	0	181	0	0
MAJENGO	0	0	0	362	108	529	687	0	0	547	0	0
MWEMBE TAYARI	0	0	0	192	29	109	204	14	0	280	0	0
MWEMBE CENTRE	0	0	0	1381	353	1187	1272	93	20	2126	0	0
KINGORANI	0	0	0	14	13	25	106	0	0	178	0	0
SHIMANZI	0	0	0	583	104	587	1401	0	25	848	0	0
GANJONI	0	0	0	474	187	798	615	14	13	689	0	0
GANJONI CENTRE	0	0	0	158	25	11	172	0	11	246	0	0
KINZINGO	0	0	0	147	29	108	300	0	0	246	0	0
KINZINGO CENTRE	0	0	0	34	0	0	25	0	0	48	0	0
LIKONI EAST	158	147	34	0	0	0	0	0	0	0	56	378
LIKONI WEST	25	29	0	0	0	0	0	0	0	0	48	118
MTONGWE	11	108	0	0	0	0	0	0	0	0	74	344
CENTRAL KWALE	172	300	25	0	0	0	0	0	0	0	118	1031
KUBO	0	0	0	0	0	0	0	0	0	0	0	9
CENTRAL HITHER	11	0	0	0	0	0	0	0	0	0	0	34
SOUTHERN KWALE	246	246	48	0	0	0	0	0	0	0	68	721
NORTHERN HITHER	0	0	0	56	48	74	118	0	0	68	0	0
WEST MAINLAND	0	0	0	378	118	344	1031	9	34	721	0	0
NORTH MAINLAND	0	0	0	416	99	319	642	0	0	416	0	0
KILIFI	0	0	0	95	5	86	208	0	0	136	0	0
COAST	0	0	0	20	5	0	54	0	0	36	0	0
OTHER	0	0	0	133	48	29	99	0	0	574	0	0
EXTERNAL	0	0	0	0	0	0	0	0	0	14	0	0
TOTAL	623	830	107	5406	1442	4692	8229	141	149	8400	364	2635

Table 5.1.3 (Continued)

*** FEASIBILITY STUDY ON LIKONICROSSING CONSTRUCTION PROJECT *** PAGE =189

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* O-ZONE X D-ZONE *
****

<< 2010 YEAR --DEVELOPED (TOTAL) UNIT: P.C.U. >>

	WEST MAINLAND	KILIFI	COAST	OTHER EXTERNAL		TOTAL
TUDOR ESTATE	0	0	0	0	0	725
TUDOR FOUR	0	0	0	0	0	219
TONONOKA	0	0	0	0	0	509
BONDENI	0	0	0	0	0	642
MAKADARA	0	0	0	0	0	1543
MAJI WA KALE	0	0	0	0	0	661
MAJENGO	0	0	0	0	0	2233
MWEMBE TAYARI	0	0	0	0	0	828
MWEMBE CENTRE	0	0	0	0	0	6432
KINGORANI	0	0	0	0	0	336
SHIMANZI	0	0	0	0	0	3548
GANJONI	0	0	0	0	0	2790
GANJONI CENTRE	0	0	0	0	0	623
KINZINGO	0	0	0	0	0	830
KINZINGO CENTRE	0	0	0	0	0	107
LIKONI EAST	416	95	20	133	0	5406
LIKONI WEST	99	5	5	48	0	1442
MTONGWE	319	86	0	29	0	4692
CENTRAL KWALE	642	208	54	99	0	8229
KUBO	0	0	0	0	0	141
CENTRAL HITHER	0	0	0	0	0	149
SOUTHERN KWALE	416	136	36	574	14	8400
NORTHERN HITHER	0	0	0	0	0	364
WEST MAINLAND	0	0	0	0	0	2635
NORTH MAINLAND	0	0	0	0	0	1892
KILIFI	0	0	0	0	0	530
COAST	0	0	0	0	0	115
OTHER	0	0	0	0	0	883
EXTERNAL	0	0	0	0	0	14
TOTAL	1892	530	115	883	14	56918

5.1.5 Future Constitution of Traffic by Vehicle Type

The future constitution of traffic across Likoni Crossing by vehicle type is estimated as follows:

Based on the present constitution of vehicle type, the present share of buses is computed as 31.9%. This value is assumed here to be unchanged in future.

The present shares of other vehicle types in four categories; car/taxi, L.G, M.G and H.G, are obtained by working out the ratios of averaged value by category on three routes loading from Likoni ferry to Mombasa Island. These three routes include Likoni ferry, Nyali bridge and Makupa Causeway.

The future constitution of vehicle types is computed by first subtracting buses from the future traffic volume (in PCU) and then allot the remainder into the other four categories proportionally to their respective present shares. The constituent of L.G category is further breakdown in proportion of the present constituting ratio at Likoni ferry.

The future constitution of traffic by vehicle types in number of vehicles is then obtained by converting from the PCU. The result is as shown in Table 5.1.4.

Table 5.1.4 ESTIMATED TRAFFIC VOLUMES BY VEHICLE TYPE, 1983 AND 2010

	1983			2010	
	Traffic Counts (Vehicles)	Potential of Traffic (P.C.U.)	Reference	Estimated Ratio (P.C.U.)	Traffic Volume (Vehicles)
Car & Taxi	1,141	1,269		27.6%	7,855
Pick-up	481	535	37.0%	7.7	2,191
Land Rover	134	149	10.3	2.1	598
P.S.V.	227	253	17.5 } 100%	3.6	1,025
Matatu	129	508	35.2	7.3	2,078
Truck	396	1,102		16.3	1,856
			Bus Ratio		(4,639)
Bus	61	1,793	31.9%	31.9	4,539
Heavy Goods Vehicle	3	12		3.5	(9,078) 285
					(996)
Total	2,572	5,621		100.0%	20,427
					(28,460)

( ) = P.C.U.

5.2 Traffic Assignment

Traffic assignments are worked out for years 1990, 2000 and 2010 as illustrated in Fig. 5.2.1. The major link network is prepared based on the traffic assignment obtained as a result of traffic survey of the existing road network as shown in Fig. 5.2.2. Each link with node-pair is examined for its capacity (mainly for the number of lanes) as shown in Table 5.2.1.

The assigned traffic volume on each link is examined by simulation based on the Q-V (traffic volume vs. vehicle running speed) curves as shown in Fig. 5.2.3. The assigned traffic volumes thus obtained for years 1990, 2000 and 2010 are shown in Figs. 5.2.4 thru 5.2.12, respectively. Two cases of crossing traffic assignment, with and without improvement of existing roads on Mombasa Island, are shown in Fig. 5.2.4 through 5.2.9. Fig. 5.2.10 through 5.2.12 show the combined traffic with the crossing traffic and the assigned traffic to the existing road network on Mombasa Island.

Fig. 5.2.1 TRAFFIC ASSIGNEMENT FLOW

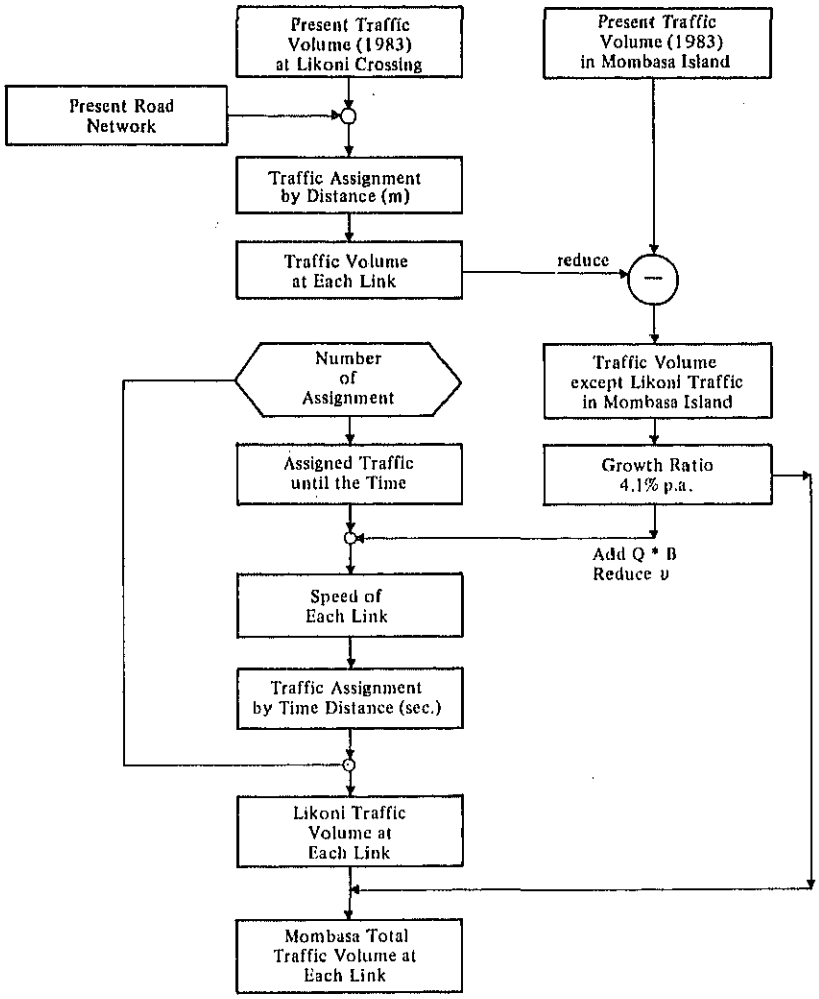

Fig. 5.2.2 LINK NETWORK DIAGRAM FOR TRAFFIC ASSIGNMENT

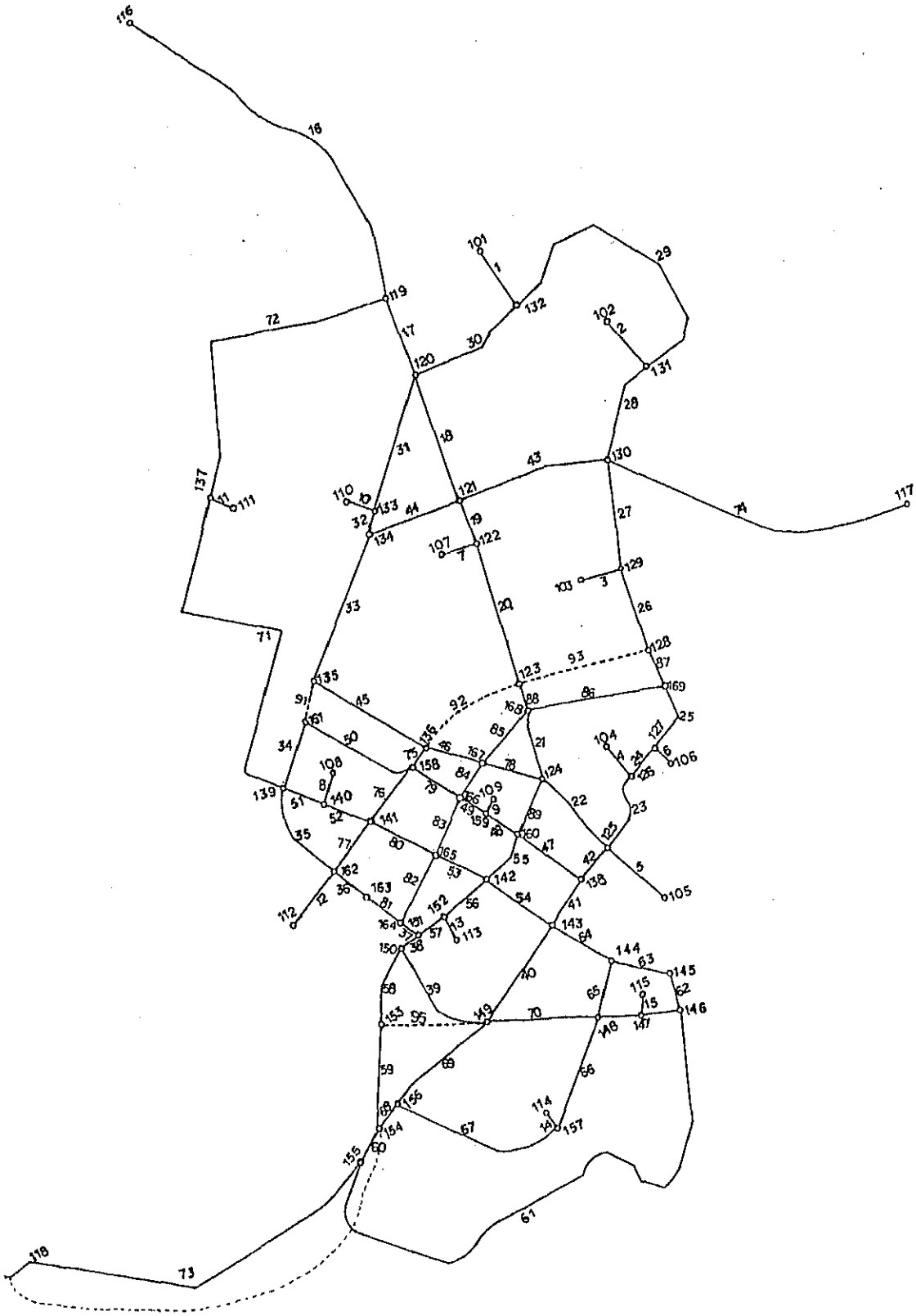

Table 5.2.1 LINK CONDITIONS

LINK	NODE-PAIR	DISTANCE (M)	KIND	LINK	NODE-PAIR	DISTANCE (M)	KIND
1	101-132	323	2	51	139-140	239	4
2	102-131	309	2	52	140-141	239	4
3	103-129	211	2	53	142-165	324	4
4	104-126	211	2	54	142-143	408	4
5	105-125	394	2	55	142-160	281	2
6	106-127	126	2	56	142-152	352	2
7	107-122	183	2	57	151-152	140	2
8	108-140	169	2	58	150-153	352	2
9	109-159	98	2	59	153-154	507	2
10	110-133	154	2	60	154-155	211	4
11	111-137	126	2	61	146-155	2859	2
12	112-162	352	2	62	145-146	197	2
13	113-152	140	2	63	144-145	281	2
14	114-157	98	2	64	143-144	366	4
15	115-147	112	2	65	144-148	295	2
16	116-119	2112	4	66	148-157	563	2
17	119-120	408	4	67	156-157	985	2
18	120-121	676	4	68	154-156	140	4
19	121-122	225	4	69	149-156	633	4
20	122-123	774	4	70	148-149	577	2
21	124-168	338	4	71	137-139	2056	2
22	124-125	492	4	72	119-137	1690	2
23	125-126	422	4	73	118-154	2112	4
24	126-127	169	4	74	117-130	1690	4
25	127-169	507	4	75	136-158	126	2
26	128-129	422	4	76	141-158	352	2
27	129-130	591	4	77	141-162	309	2
28	170-131	582	2	78	124-167	366	4
29	131-132	1619	2	79	158-166	282	4
30	120-132	633	2	80	141-165	380	4
31	120-133	704	4	81	163-164	323	2
32	133-134	140	4	82	164-165	380	2
33	134-135	845	4	83	165-166	338	2
34	139-161	352	2	84	166-167	225	2
35	139-162	563	2	85	167-168	352	2
36	162-163	225	2	86	168-169	789	2
37	151-164	70	2	87	128-169	56	4
38	150-151	112	2	88	123-168	183	4
39	149-150	633	2	89	124-160	324	2
40	143-149	591	4	90	130-170	407	2
41	138-143	281	4	91	135-161	211	4
42	125-138	211	4	95	149-153	464	4
43	121-170	438	4	96	147-143	234	2
44	121-134	492	4	97	146-147	234	2
45	135-136	647	2				
46	136-167	268	4				
47	138-160	394	4				
48	159-160	211	4				
49	166-159	141	4				
50	158-161	633	2				

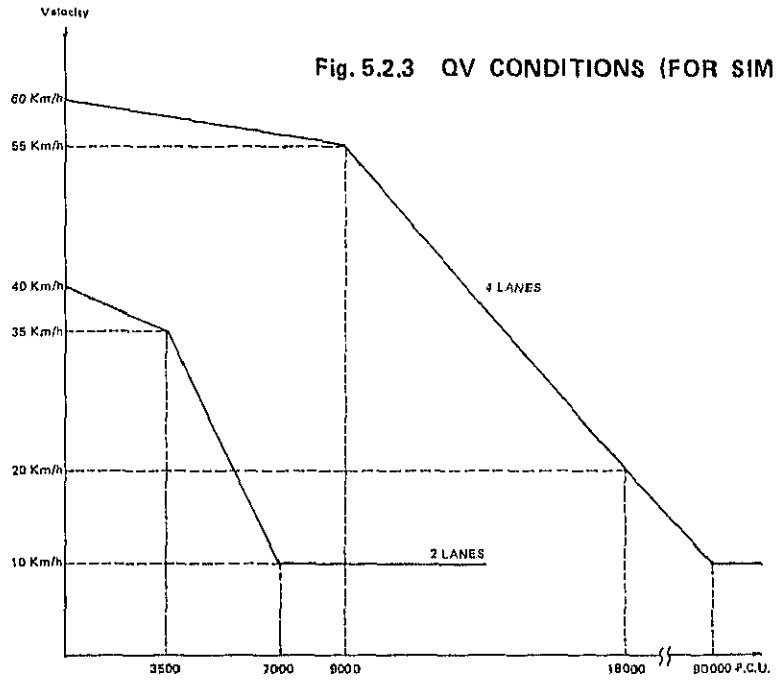

Fig. 5.2.3 QV CONDITIONS (FOR SIMULATION)

Fig. 5.2.4 FUTURE CROSSING TRAFFIC (PCU), 1990
(WITHOUT IMPROVEMENT OF EXISTING ROADS)

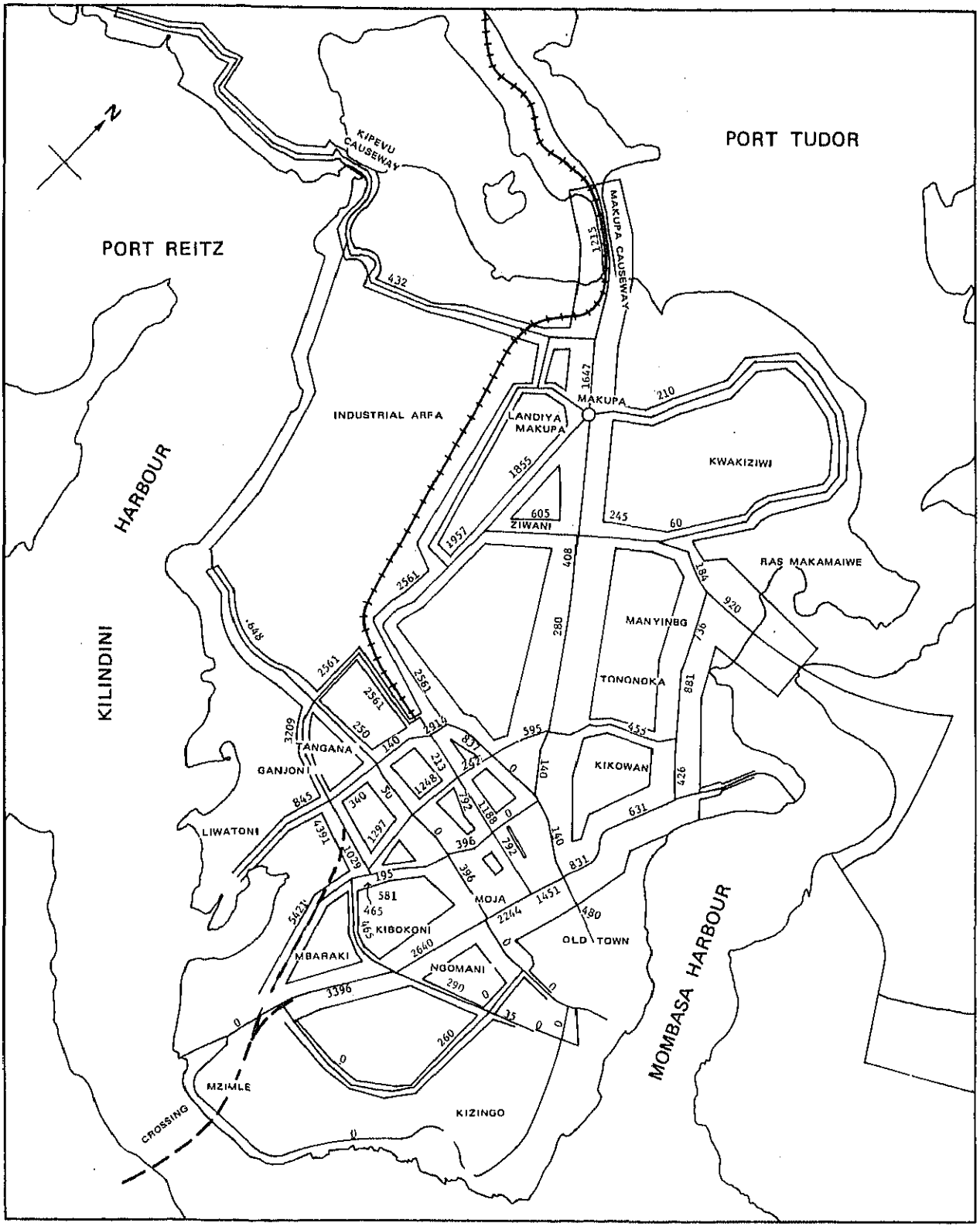

Fig. 5.2.5 FUTURE CROSSING TRAFFIC (PCU), 2000
(WITHOUT IMPORVEMENT OF EXISTING ROADS)

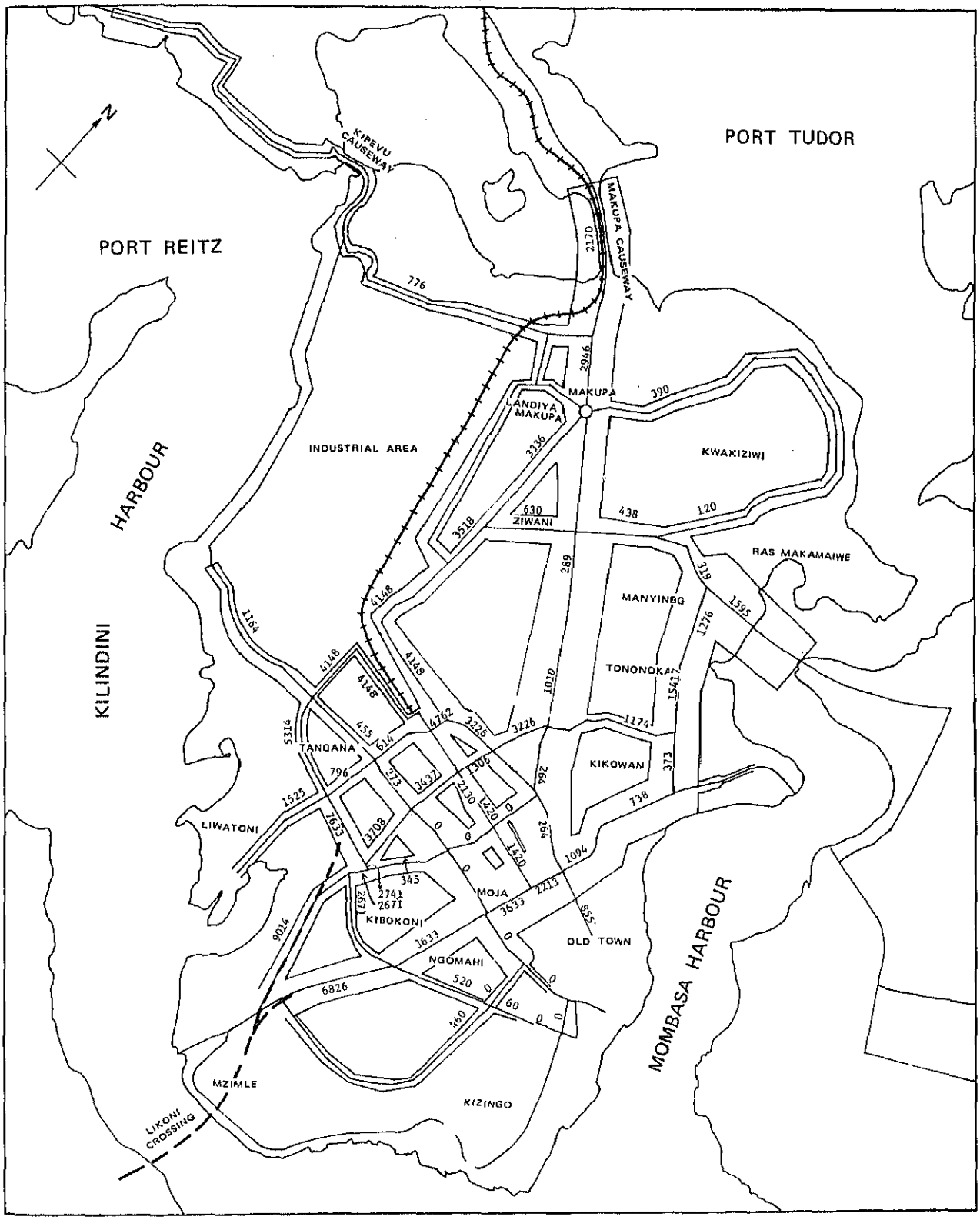

Fig. 5.2.6 FUTURE CROSSING TRAFFIC (PCU), 2010
(WITHOUT IMPROVEMENT OF EXISTING ROADS)

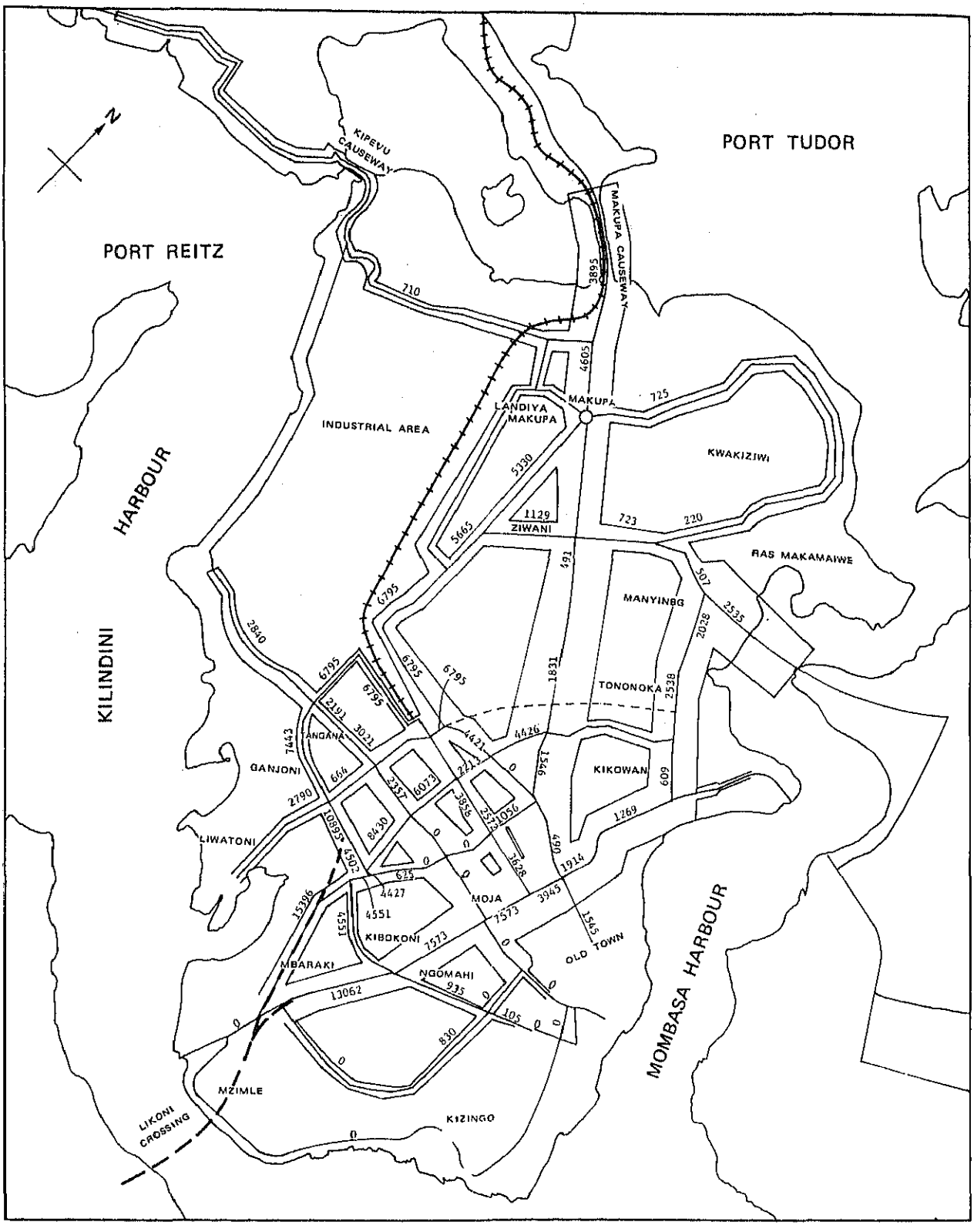

Fig. 5.2.7 FUTURE CROSSING TRAFFIC (PCU), 1990
(WITH IMPROVEMENT OF EXISTING ROADS)

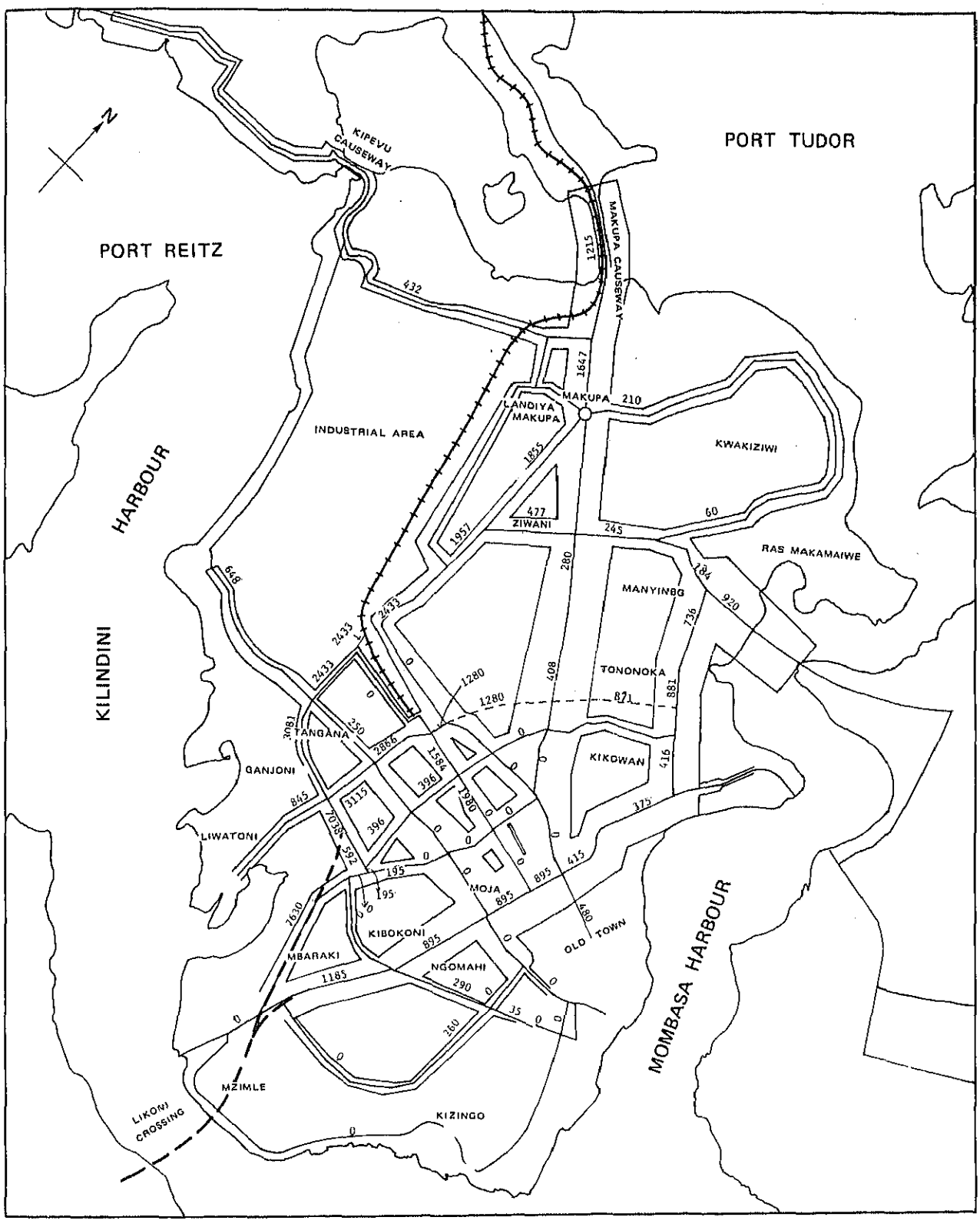

Fig. 5.2.8 FUTURE CROSSING TRAFFIC (PCU), 2000
(WITH IMPROVEMENT OF EXISTING ROADS)

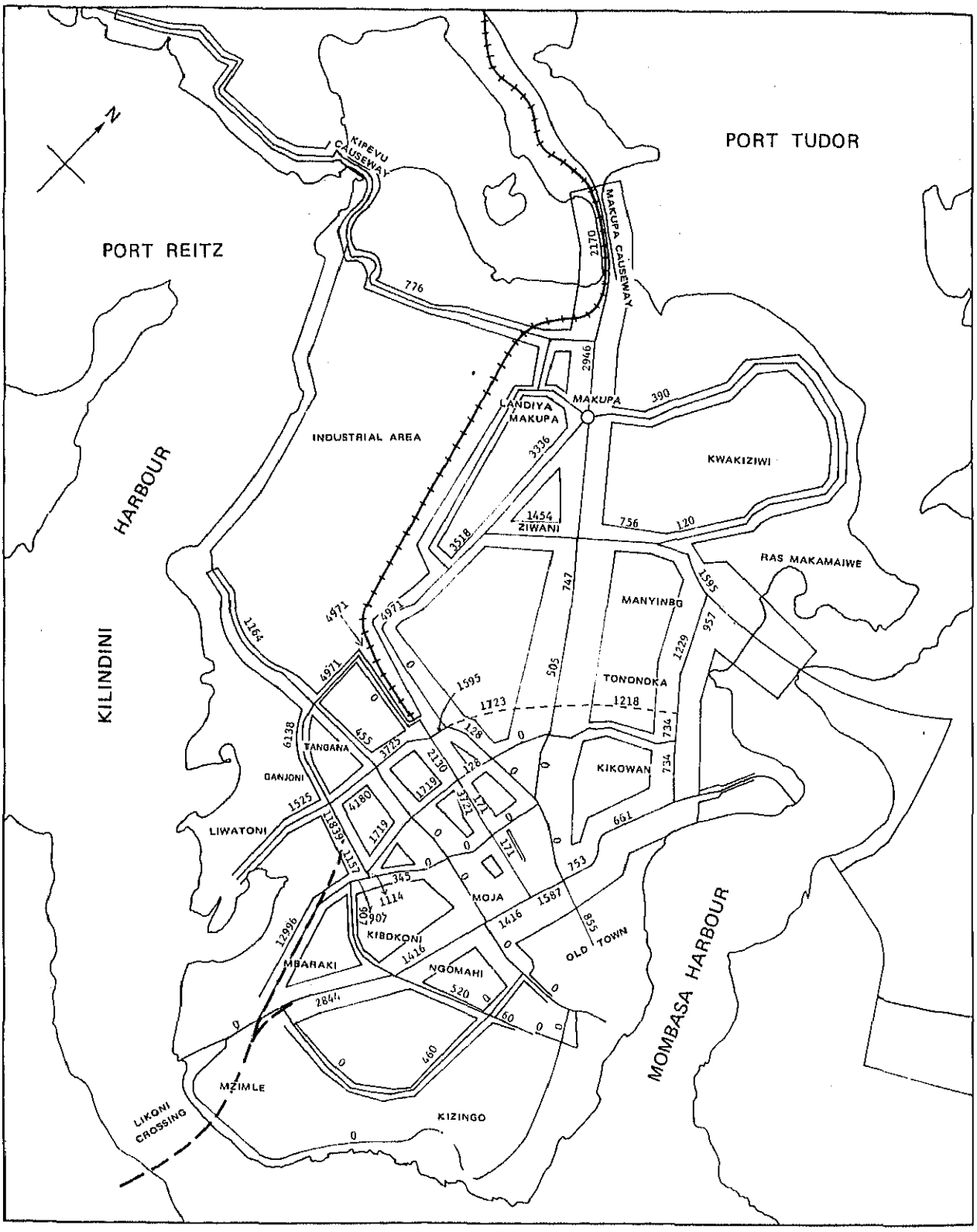

Fig. 5.2.9 FUTURE CROSSING TRAFFIC (PCU), 2010
(WITH IMPROVEMENT OF EXISTING ROADS)

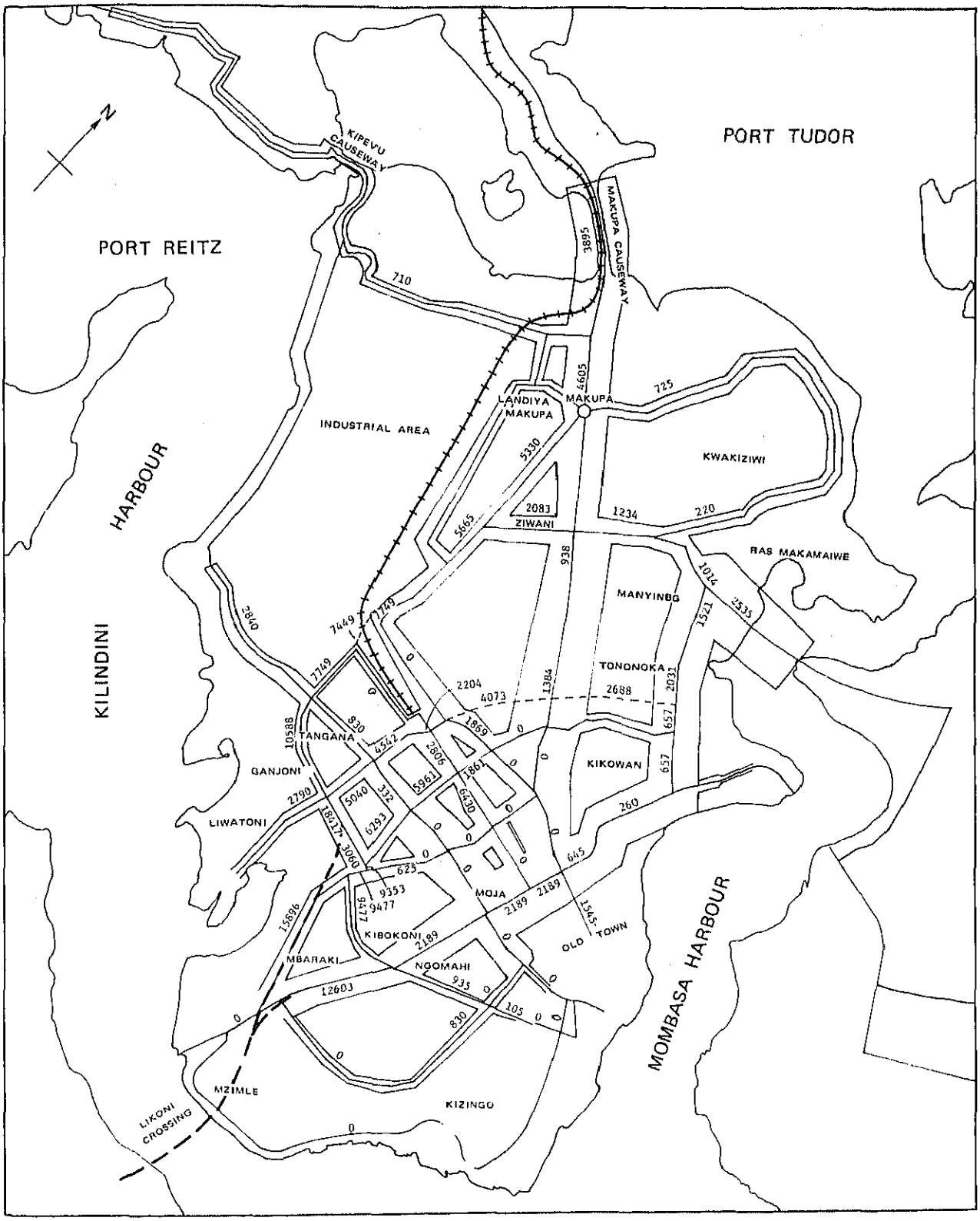

Fig. 5.2.10 TRAFFIC ASSIGNEMNT OF MOMBASA ISLAND, 1990
(WITHOUT IMPROVEMENT OF EXISTING ROADS)

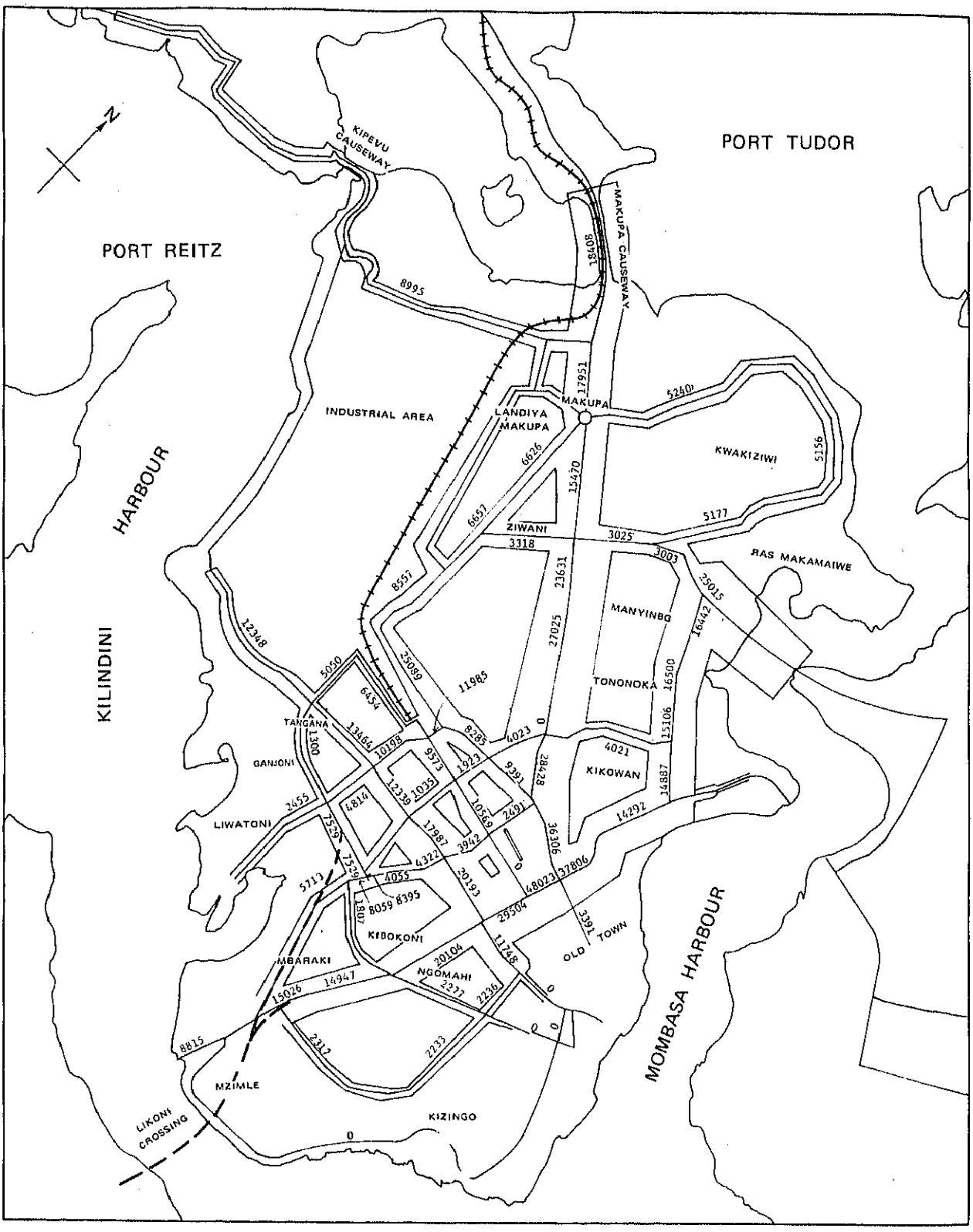

Fig. 5.2.11 TRAFFIC ASSIGNEMNT ON MOMBASA ISLAND, 2000
(WITHOUT IMPROVEMENT OF EXISTING ROADS)

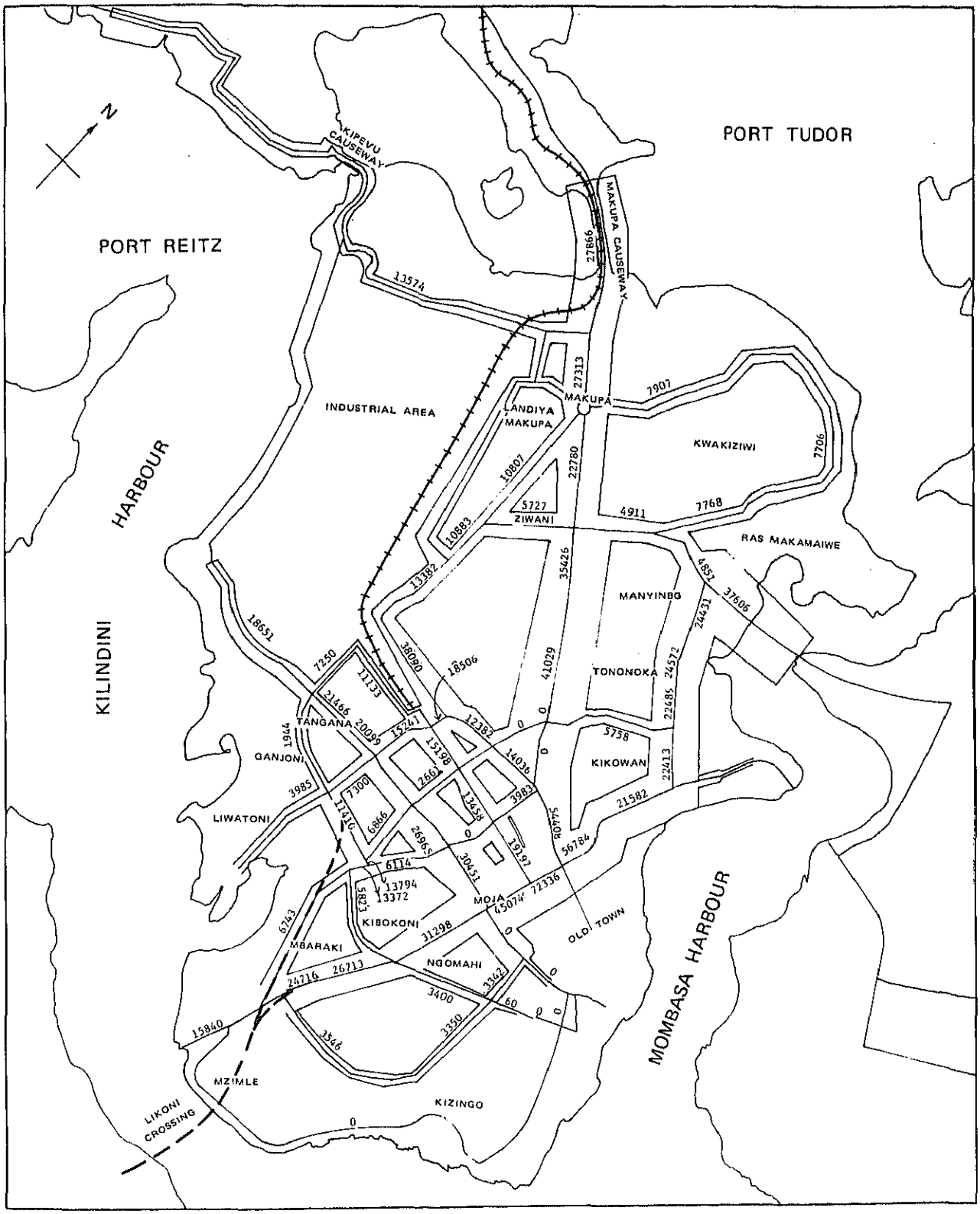

Fig. 5.2.12 TRAFFIC ASSIGNMENT ON MOMBASA ISLAND, 2010
(WITHOUT IMPROVEMENT OF EXISTING ROADS)