Table A.VI-5(3) CONVERTED OD TRIPS ON THE BYPASS (LINK-3) IN 2000

TYPE OF VEHICLE: TOTAL

	ZONE No	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
		←								NAIROBI CITY										→
NAIROBI CITY	1	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	259 (24.0)	289 (88.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	4	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	5	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	6	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	162 (20.0)	42 (24.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	7	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	206 (20.0)	77 (24.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	8	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	739 (65.0)	55 (88.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	9	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	10	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	11	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	107 (20.1)	215 (20.0)	265 (64.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1162 (48.8)	0 (0.0)	0 (0.0)
	12	0 (0.0)	477 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	195 (56.2)	7 (87.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	823 (88.5)	0 (0.0)	0 (0.0)
	13	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	14	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	15	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	16	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	17	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	639 (48.0)	498 (88.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	18	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	19	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	35 (89.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
OUTSIDE NAIROBI	20	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	100 (24.1)	43 (87.8)	25 (73.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	21	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	22	259 (39.7)	56 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	22 (88.0)	420※ (100.0)	8※ (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	872※ (100.0)	0 (0.0)	0 (0.0)
	23	254 (39.6)	110 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	81 (89.0)	383※ (100.0)	21※ (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	370※ (100.0)	0 (0.0)	0 (0.0)
	24	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	25	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	26	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	28	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	78 (40.0)	74 (88.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	29	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	30	448 (39.6)	75 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	62 (88.6)	641※ (100.0)	134※ (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	322※ (100.0)	0 (0.0)	0 (0.0)
	31	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	TOTAL	961 (39.6)	718 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	272 (37.8)	1854 (62.2)	435 (75.0)	0 (0.0)	0 (0.0)	2185 (36.4)	1113 (68.6)	25 (73.5)	0 (0.0)	0 (0.0)	0 (0.0)	3549 (72.8)	0 (0.0)	0 (0.0)

Table A.VI-5(3) CONVERTED OD TRIPS ON THE BYPASS (LINK-3) IN 2000

TYPE OF VEHICLE: TOTAL

ZONE NO	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(28)	(29)	(30)	(31)	TOTAL
NAIROBI CITY												
1	0	0	422	253	0	0	0	0	821	0	0	1472
	(0.0)	(0.0)	(58.7)	(58.7)	(0.0)	(0.0)	(0.0)	(0.0)	(14.0)	(0.0)		(65.3)
2	0	0	133	64	0	0	0	0	152	0		897
	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)		(51.1)
3	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
4	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
5	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
6	0	0	64	13	0	0	0	0	28	0		309
	(0.0)	(0.0)	(58.2)	(22.8)	(0.0)	(0.0)	(0.0)	(0.0)	(16.4)	(0.0)		(23.4)
7	0	0	302※	251※	0	0	0	0	545※	0		1387
	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)		(56.3)
8	0	0	122※	100※	0	0	0	0	14※	0		1030
	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)		(71.8)
9	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
10	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
11	56	0	0	0	0	0	0	50	7	0		1862
	(39.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(39.7)	(41.2)	(0.0)		(38.6)
12	0	0	0	0	0	0	0	42	14	0		1558
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(89.4)	(87.5)	(0.0)		(85.4)
13	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
14	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
15	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
16	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
17	0	0	278※	229※	0	0	0	0	57※	0		1701
	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)		(69.2)
18	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
19	0	0	0	0	0	0	0	0	0	0		35
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(89.7)
OUTSIDE NAIROBI												
20	0	0	0	0	0	0	0	0	0	0		168
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(33.7)
21	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
22	0	0	0	0	0	0	0	86※	0※	0		1723
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(0.0)		(81.3)
23	0	0	0	0	0	0	0	40※	31※	0		1290
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)		(76.5)
24	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
25	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
26	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
28	0	0	41※	73※	0	0	0	0	446※	0		712
	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)		(85.0)
29	0	0	11※	0※	0	0	0	0	66※	0		79
	(0.0)	(0.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)		(97.5)
30	0	0	0	0	0	0	0	343※	76※	0		2101
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(0.0)		(72.3)
31	0	0	0	0	0	0	0	0	0	0		0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		(0.0)
TOTAL	56	0	1373	959	0	0	0	561	128	2129	0	16318
	(34.1)	(0.0)	(80.0)	(82.4)	(0.0)	(0.0)	(0.0)	(87.4)	(91.4)	(83.1)	(0.0)	(63.4)

LEGEND

UPPER : NO. OF CONVERTED OD TRIPS

(LOWER) : % OF CONVERSION RATE

※ : CONVERTED TRIPS FROM A104

Table A.VI-5(4) CONVERTED OD TRIPS ON THE BYPASS (LINK-4) IN 2000

TYPE OF VEHICLE: TOTAL

	ZONE No	NAIROBI CITY (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
NAIROBI CITY	1	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	289 (88.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	63 (34.6)	8 (30.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	4	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	25 (64.1)	4 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	5	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	6	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	162 (20.0)	42 (24.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	7	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	206 (20.0)	77 (23.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	8	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	142 (65.0)	52 (38.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	9	0 (0.0)	0 (0.0)	106 (33.5)	64 (64.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	353 (48.1)	97 (88.2)	21 (75.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	10	4 (0.0)	0 (0.0)	4 (33.3)	6 (60.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	77 (59.7)	12 (92.3)	2 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	11	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	107 (20.0)	215 (20.0)	265 (64.8)	348 (47.9)	147 (59.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1162 (44.8)	0 (0.0)	0 (0.0)
	12	477 (0.0)	0 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	195 (56.2)	7 (87.5)	236 (88.4)	12 (85.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	823 (88.5)	0 (0.0)	0 (0.0)
	13	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	30 (88.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	14	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	15	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	16	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	17	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	533 (47.5)	488 (88.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	18	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	19	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	35 (89.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
OUTSIDE NAIROBI	20	0 (0.0)	0 (0.0)	30 (31.9)	17 (65.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	164 (39.5)	43 (87.8)	25 (73.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	21	0 (0.0)	0 (0.0)	45 (36.4)	14 (63.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	587 (72.6)	111 (88.8)	5 (71.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	22	259 (39.7)	56 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	22 (88.0)	420※ (100.0)	8※ (100.0)	9 (100.0)	7 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	872※ (100.0)	0 (0.0)	0 (0.0)
	23	254 (39.6)	110 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	84 (88.0)	383※ (100.0)	21※ (100.0)	83 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	370※ (100.0)	0 (0.0)	0 (0.0)
	24	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	25	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	26	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	28	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	78 (40.2)	74 (88.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	29	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	30	448 (39.6)	75 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	62 (88.6)	641※ (100.0)	134※ (100.0)	16 (100.0)	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	322※ (100.0)	0 (0.0)	0 (0.0)
	31	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	TOTAL	961 (39.6)	718 (100.0)	183 (67.8)	101 (63.9)	0 (0.0)	272 (37.8)	1854 (64.7)	435 (75.0)	760 (62.6)	181 (62.4)	3101 (46.0)	1333 (71.3)	53 (73.6)	0 (0.0)	0 (0.0)	0 (0.0)	3549 (72.8)	0 (0.0)	0 (0.0)

Table A.VI-5(4) CONVERTED OD TRIPS ON THE BYPASS (LINK-4) IN 2000

TYPE OF VEHICLE: TOTAL

	ZONE No	OUTSIDE NAIROBI (20)	(21)	(22)	(23)	(24)	(25)	(26)	(28)	(29)	(30)	(31)	TOTAL
NAIROBI CITY	1	0	0	422	239	0	0	0	0	0	821	0	1482
		(0.0)	(0.0)	(56.7)	(38.7)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(74.0)	(0.0)	(66.8)
	2	0	0	133	64	0	0	0	0	0	152	0	638
		(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(44.4)
	3	0	34	0	0	0	0	0	0	0	0	0	105
		(0.0)	(37.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(70.5)
	4	0	10	0	0	0	0	0	0	0	0	0	39
		(0.0)	(62.5)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(63.9)
	5	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	6	0	0	64	13	0	0	0	0	0	28	0	309
		(0.0)	(0.0)	(58.2)	(22.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(16.4)	(0.0)	(23.4)
	7	0	0	302※	251※	0	0	0	0	0	545※	0	1381
		(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(56.3)
	8	0	0	122※	100※	0	0	0	0	0	14※	0	1030
		(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(71.8)
	9	0	0	5	0	8	0	0	0	0	0	0	654
		(0.0)	(0.0)	(100.0)	(0.0)	(66.7)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(57.0)
	10	0	0	0	0	0	0	0	0	0	0	0	101
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(62.7)
	11	65	469	0	0	0	0	0	50	7	0	0	2835
		(39.6)	(72.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(39.7)	(41.2)	(0.0)	(0.0)	(44.8)
	12	0	0	0	0	0	0	0	0	0	0	0	1750
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(71.2)
	13	0	0	0	0	0	0	0	0	0	0	0	30
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(88.2)
	14	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	15	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	16	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	17	0	0	278※	229※	0	0	0	0	57※	0	0	1695
		(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(0.0)	(68.9)
	18	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	19	0	0	0	0	0	0	0	0	0	0	0	35
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(89.7)
OUTSIDE NAIROBI	20	0	0	10	20	0	0	0	0	0	0	0	309
		(0.0)	(0.0)	(76.9)	(71.4)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(50.5)
	21	0	0	24	19	0	0	0	0	0	0	0	903
		(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(73.1)
	22	10	32	0	0	0	0	0	86※	0※	0	0	1781
		(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(0.0)	(0.0)	(81.8)
	23	3	22	0	0	0	0	0	40※	2※	0	0	1319
		(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(93.2)
	24	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	25	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	26	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	28	0	0	41※	73※	0	0	0	0	0	446※	0	712
		(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(85.0)
	29	0	0	11※	0※	0	0	0	0	0	66※	0	79
		(0.0)	(0.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.0)	(97.5)
	30	0	7	0	0	0	0	0	343※	76※	0	0	2127
		(0.0)	(100.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(100.0)	(0.0)	(0.0)	(72.6)
	31	0	0	0	0	0	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	TOTAL	78	574	1412	1008	8	0	0	519	85	2129	0	19314
		(44.1)	(74.9)	(80.3)	(83.2)	(66.7)	(0.0)	(0.0)	(87.2)	(68.5)	(83.1)	(0.0)	(64.2)

LEGEND
UPPER : NO. OF CONVERTED OD TRIPS
(LOWER) : % OF CONVERSION RATE
※ : CONVERTED TRIPS FROM A104

Table A.VI-5(5) Future OD Table by Aggregated Zone in 2000

TYPE OF VEHICLE: TOTAL

		NAIROBI CITY																	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	17)	(18)	(19)
NAIROBI CITY	1	275	1965	168	26	62	558	3907	851	241	34	3351	1792	11	68	782	757	2009	236	38
	2	3134	1168	516	185	540	249	2435	1329	431	40	1079	327	21	0	319	1004	2236	314	7
	3	306	508	159	50	6	136	1070	230	182	26	1422	1130	0	6	184	226	590	72	14
	4	24	185	22	0	0	21	620	48	39	6	236	307	0	0	137	155	300	49	0
	5	48	403	48	5	20	57	327	58	33	0	371	84	0	9	296	158	431	48	0
	6	1003	489	108	52	27	360	529	144	86	0	808	175	3	0	323	444	319	137	0
	7	2779	1533	804	198	176	346	2786	644	549	9	1031	322	6	18	178	786	383	247	24
	8	1728	1104	504	85	230	396	1690	880	54	9	1137	62	0	0	225	669	378	212	7
	9	811	482	316	100	26	111	496	399	878	92	734	110	28	0	102	589	705	184	11
	10	85	152	12	10	0	0	159	0	89	12	129	13	3	0	0	8	0	2	0
	11	3227	948	1172	299	175	533	1076	409	726	247	1233	267	30	0	168	1316	2380	413	0
	12	1903	477	1224	444	105	92	347	8	267	14	331	353	106	0	174	571	930	178	7
	13	20	14	12	4	7	0	17	0	34	0	26	72	2	0	17	41	106	12	0
	14	162	44	6	0	14	10	33	0	0	0	37	8	9	0	0	161	0	52	0
	15	913	293	152	53	230	153	417	263	91	0	198	251	0	0	49	791	507	250	0
	16	693	1069	348	107	102	430	1394	839	119	70	1289	277	14	25	775	3212	3540	767	0
	17	2024	1337	764	239	271	169	981	1048	267	4	1332	563	9	0	225	2467	14	773	0
	18	215	336	112	32	31	131	435	265	38	22	406	87	4	7	247	1008	1112	316	0
	19	67	45	8	0	15	5	14	0	17	5	5	39	0	0	0	0	0	0	0
OUTSIDE NAIROBI	20	613	384	94	26	34	109	276	10	104	0	415	49	34	0	11	82	137	27	4
	21	767	256	118	22	17	80	212	5	213	4	954	125	7	0	0	232	327	72	0
	22	653	56	202	23	115	25	420	8	9	7	59	0	0	0	57	97	872	30	0
	23	641	110	110	110	174	91	383	21	33	0	51	41	0	0	23	253	370	80	0
	24	517	59	116	53	98	45	190	124	0	0	185	91	7	11	10	204	227	65	0
	25	506	91	36	53	85	41	236	78	0	0	55	18	5	0	0	547	30	172	0
	26	752	195	106	129	115	55	844	66	14	32	372	110	0	0	8	194	303	61	0
	28	1189	248	142	90	32	314	692	168	14	0	194	84	17	3	99	432	302	136	0
	29	186	30	12	6	19	105	52	0	0	0	4	0	0	0	55	69	0	22	0
	30	1132	75	36	65	59	70	641	134	16	3	33	17	0	3	39	146	322	44	0
	31	1064	266	98	53	190	249	604	2	0	0	54	52	0	0	5	188	56	60	0
	TOTAL	27437	14322	7684	2519	2975	4941	23283	8031	4544	636	17531	6826	316	150	4508	16807	18886	5031	112

Table A.VI-5(5) Future OD Table by Aggregated Zone in 2000

TYPE OF VEHICLE: TOTAL

		← OUTSIDE NAIROBI →											
		(20)	(21)	(22)	(23)	(24)	(25)	(26)	(28)	(29)	(30)	(31)	TOTAL
← NAIROBI CITY →	1	254	367	719	390	342	315	649	943	235	1110	870	23325
	2	279	135	133	64	86	33	151	336	41	152	229	16973
	3	54	90	202	64	72	46	110	82	40	156	76	7468
	4	7	16	70	63	47	104	113	101	18	130	134	2952
	5	18	32	44	36	48	66	116	112	9	138	191	3206
	6	71	67	110	57	65	56	92	157	28	171	270	6151
	7	80	62	302	251	98	140	258	300	39	545	412	15306
	8	73	140	122	100	56	95	226	26	0	14	0	10222
	9	45	60	5	0	12	0	38	14	3	5	44	6400
	10	0	0	0	0	0	0	0	6	0	0	0	680
	11	164	644	0	8	35	70	68	126	17	39	106	15896
	12	29	41	18	43	82	5	70	47	16	32	36	7950
	13	0	0	6	35	131	0	24	0	0	88	0	668
	14	0	0	0	7	0	33	0	0	0	10	0	586
	15	23	6	0	35	5	0	0	16	0	38	22	4756
	16	93	52	195	243	137	48	119	203	15	167	166	16508
	17	46	74	278	229	185	48	130	17	8	57	97	13656
	18	29	16	60	78	42	14	36	63	5	54	53	5254
	19	5	0	0	0	0	0	0	0	0	0	0	225
← OUTSIDE NAIROBI →	20	1	23	13	28	2	0	20	11	1	0	13	2521
	21	3	34	24	19	16	15	21	6	2	9	32	3592
	22	10	32	0	8	79	23	12	86	0	0	31	2914
	23	3	22	0	10	0	0	39	40	31	12	0	2648
	24	8	5	49	17	16	6	11	39	16	14	7	2190
	25	0	0	0	0	0	0	14	9	0	0	10	1986
	26	0	9	47	28	0	0	0	141	10	13	0	3604
	28	7	0	41	73	21	15	59	28	12	446	145	5003
	29	6	2	11	0	5	0	13	0	14	66	53	730
	30	14	7	0	0	6	8	57	343	76	24	14	3384
	31	21	8	0	9	0	0	37	136	29	37	17	3235
	TOTAL	1343	1944	2449	1895	1588	1140	2483	3388	665	3527	3028	189989

Table A.VI-5(6) Aggregated Zone

Aggregated Zone No.	Original Zone No.	
1	1	Nairobi City
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	
11	11	
12	12	
13	13	
14	14	
15	15	
16	16	
17	17	
18	18	
19	19	
20	20	Outside Nairobi
21	21	
22	22	
23	23	
24	24	
25	25	
26	26	
28	101-106, 112,113	
29	123	
30	119,121,122, 124,126-128, 130-141	
31	107-111, 114-118,120, 125,129	

Appendix VII.5

Geological, Soil and Material Survey.

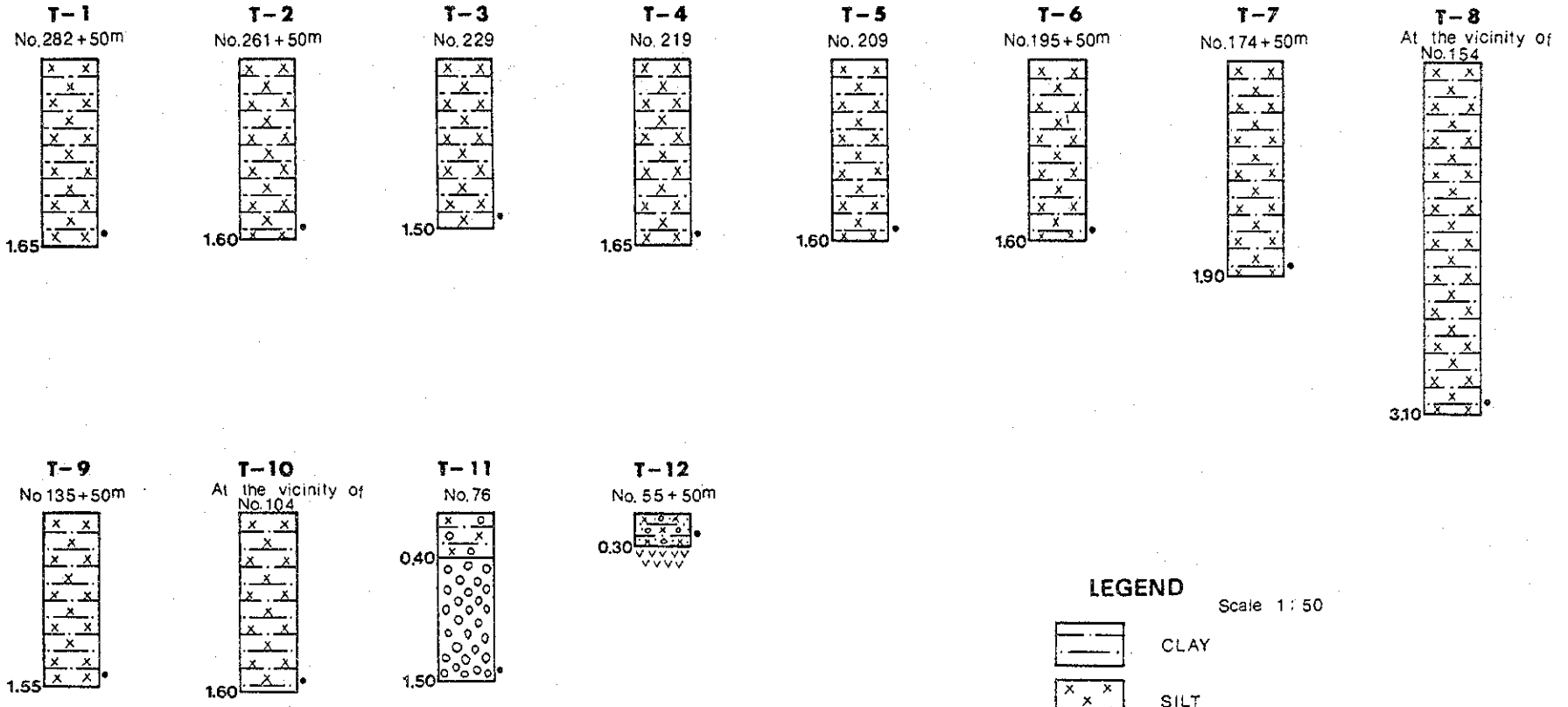


Fig. A-VII-5.1

TEST PIT RESULTS (1)
(ALIGNMENT)

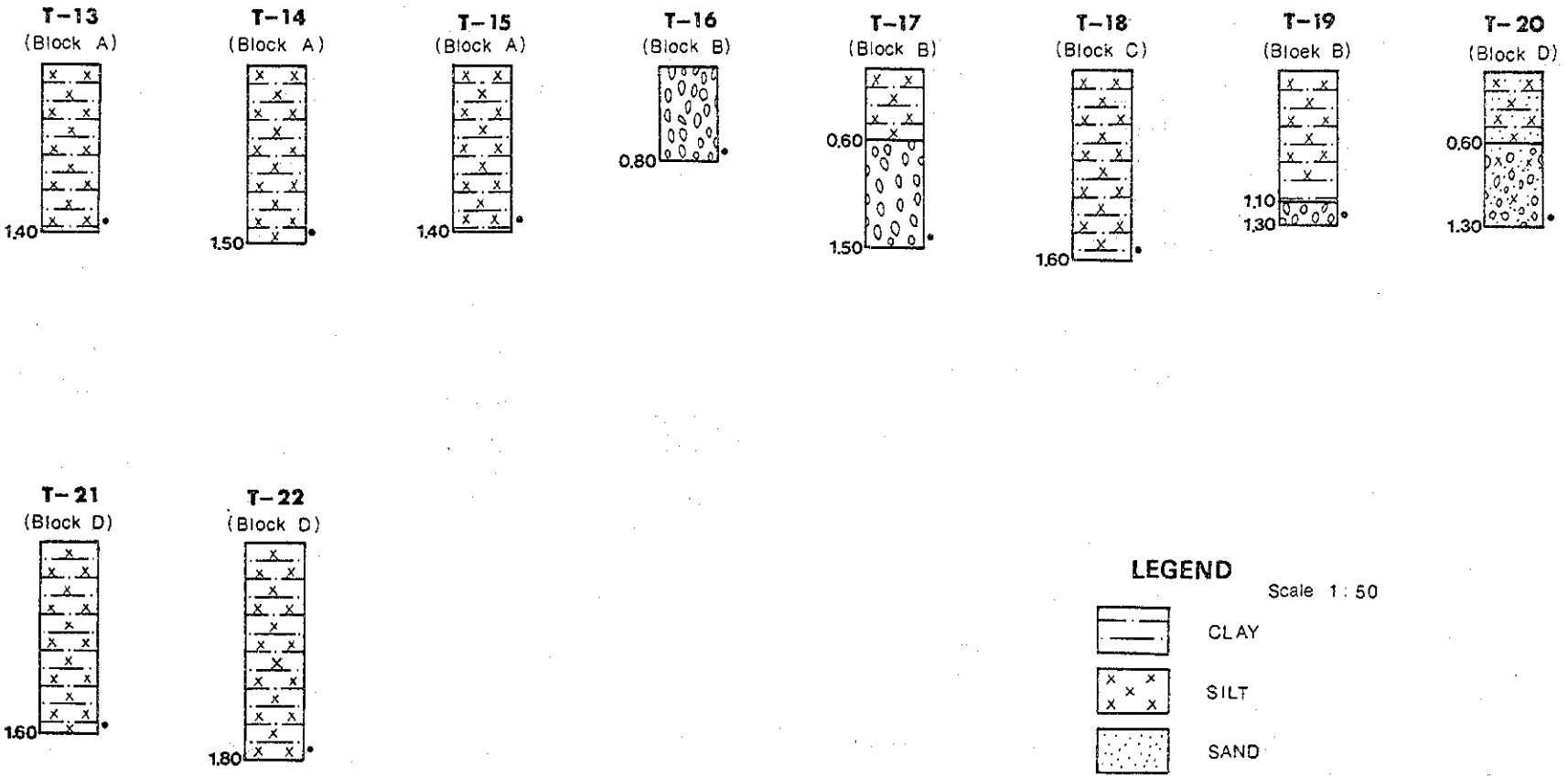


Fig. A-VII-5.2

TEST PIT RESULTS (2)
(BORROW SITE)

Fig. A-VII-5.3

GEOLOGICAL SECTION (1)

(A104 ROAD TO MOMBASA)

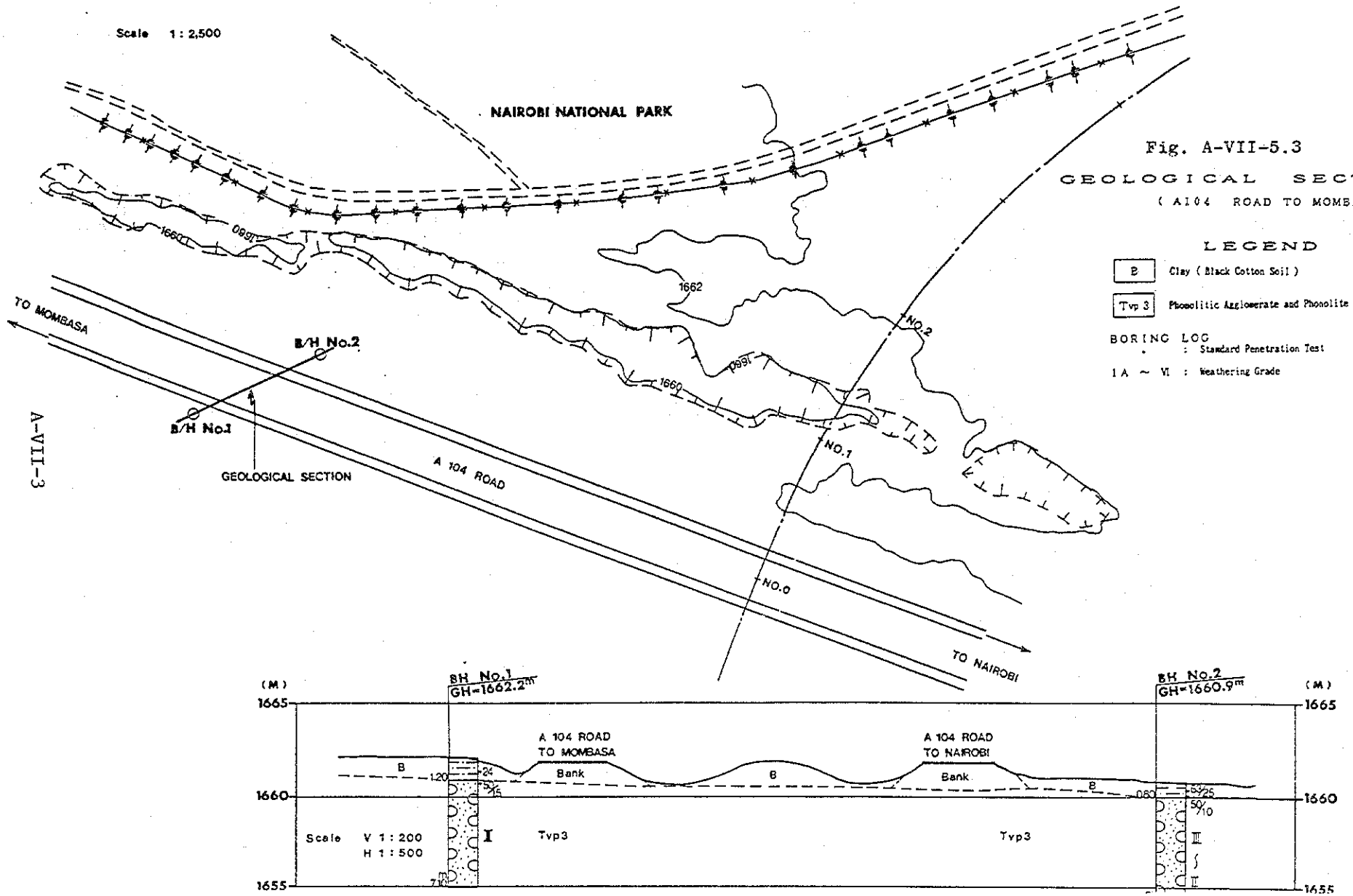
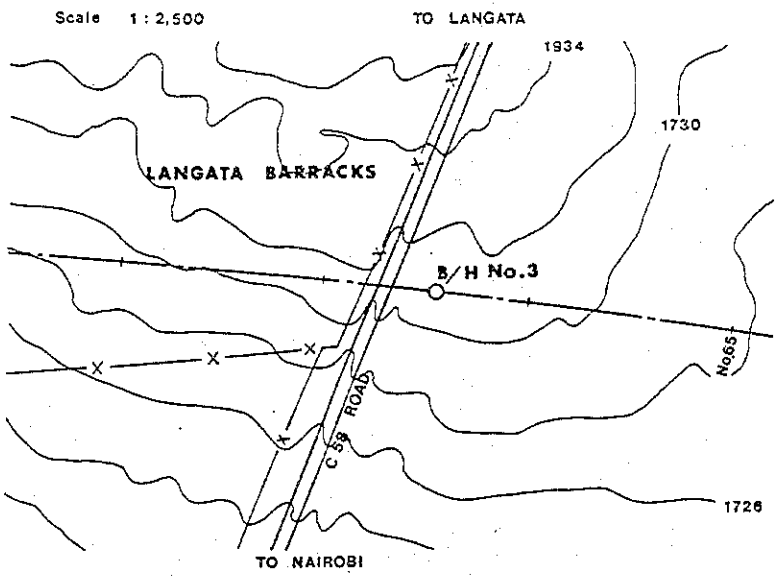


Fig. A-VII-5.4

GEOLOGICAL SECTION (2)

(C58 ROAD)



LEGEND

S	Soil and High Weathered Rock
Tvt 2	Trachyte

BORING LOG

• : Standard Penetration Test

I A ~ VI : Weathering Grade

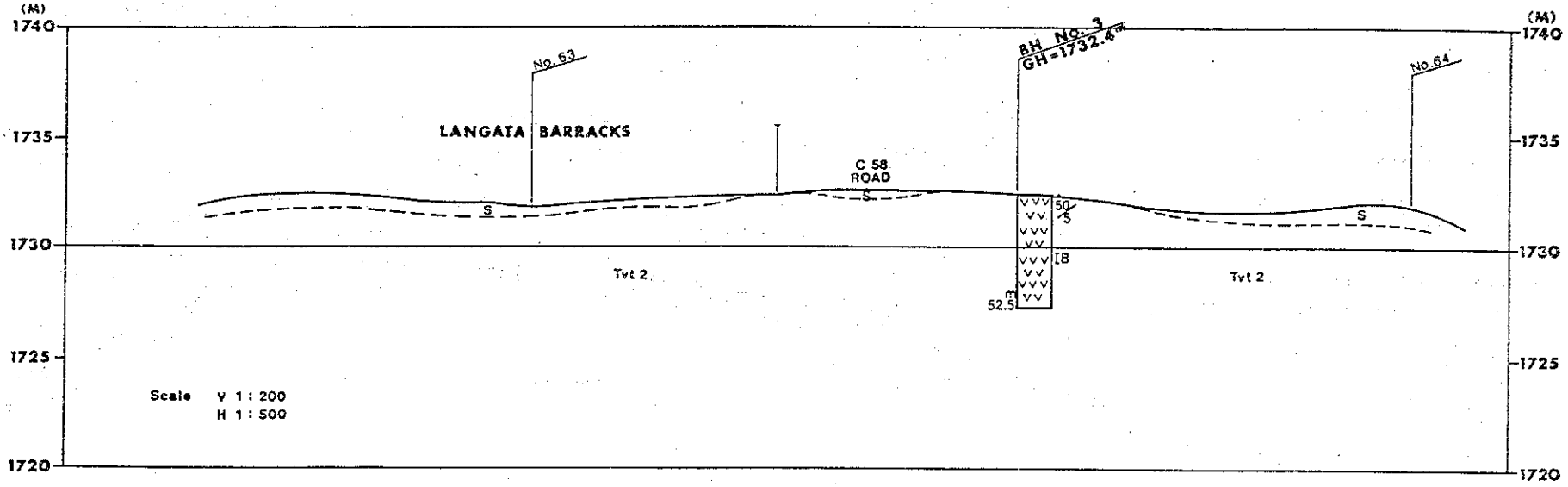
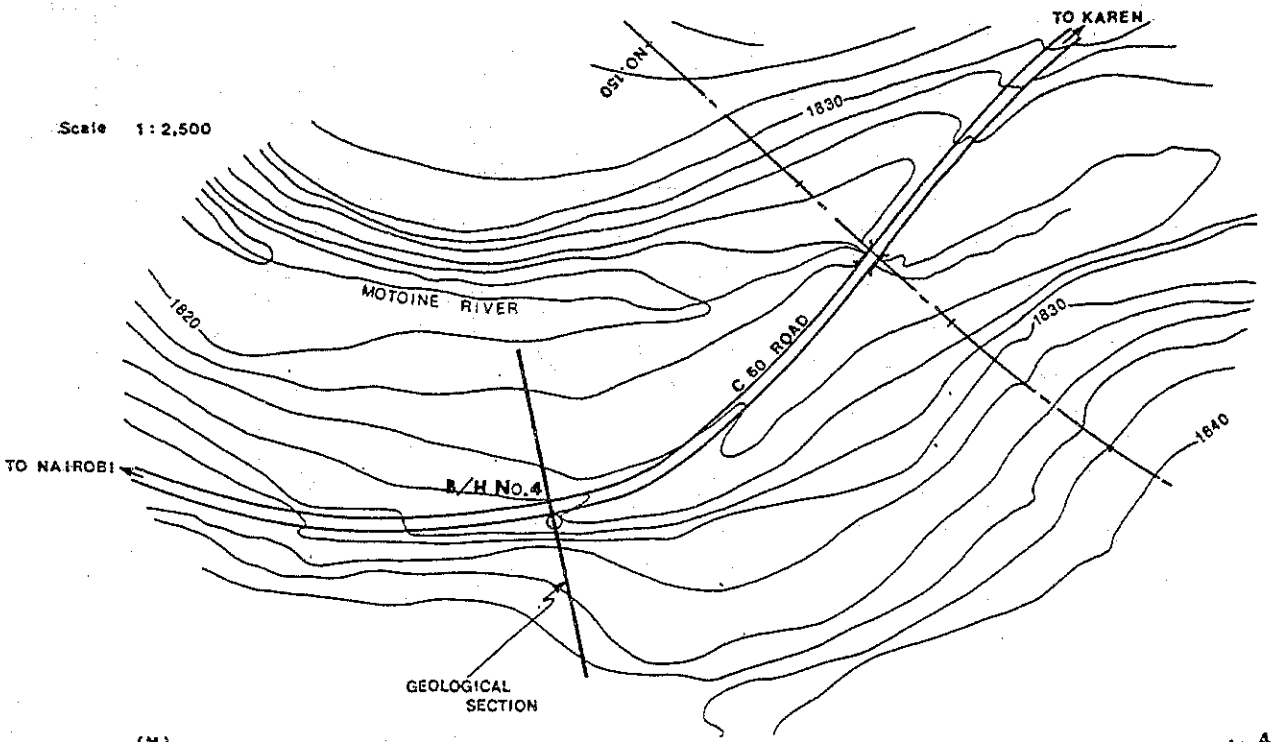


Fig. A-VII-5.5

GEOLOGICAL SECTION (3)
(C60 ROAD)



LEGEND

S	Soil and High Weathered Rock
Tvtf2	Pyroclastic Tuff

BORING LOG
• : Standard Penetration Test
I A ~ VI : Weathering Grade

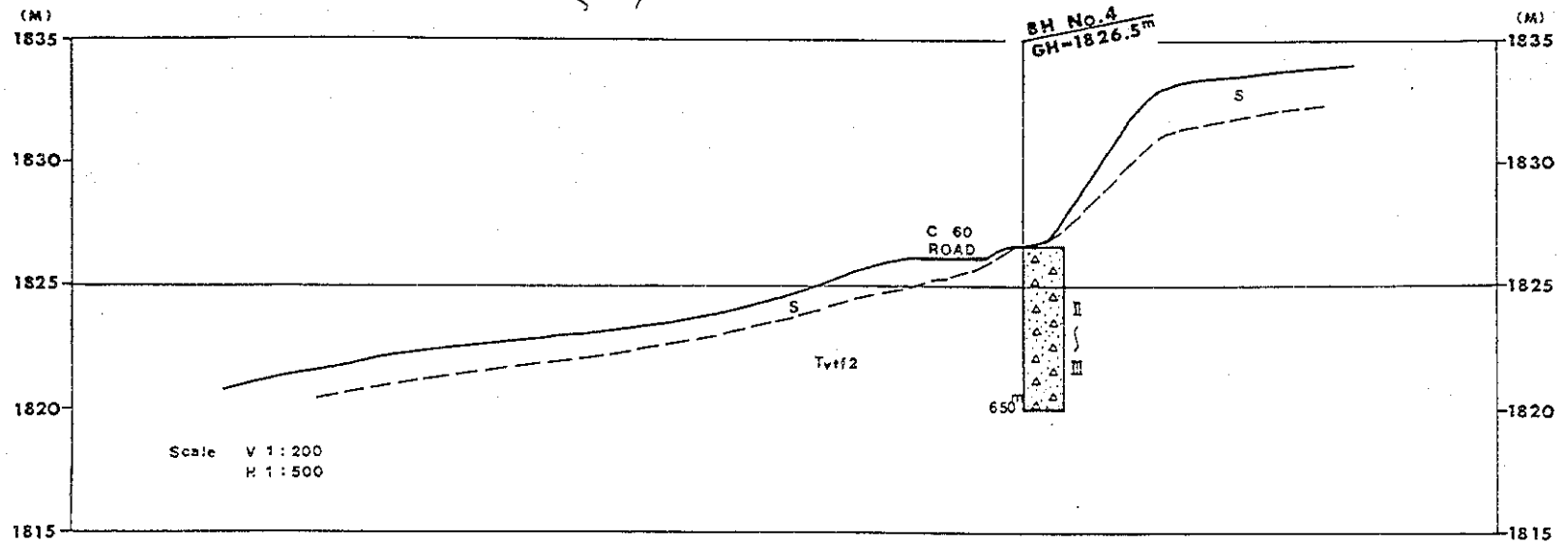
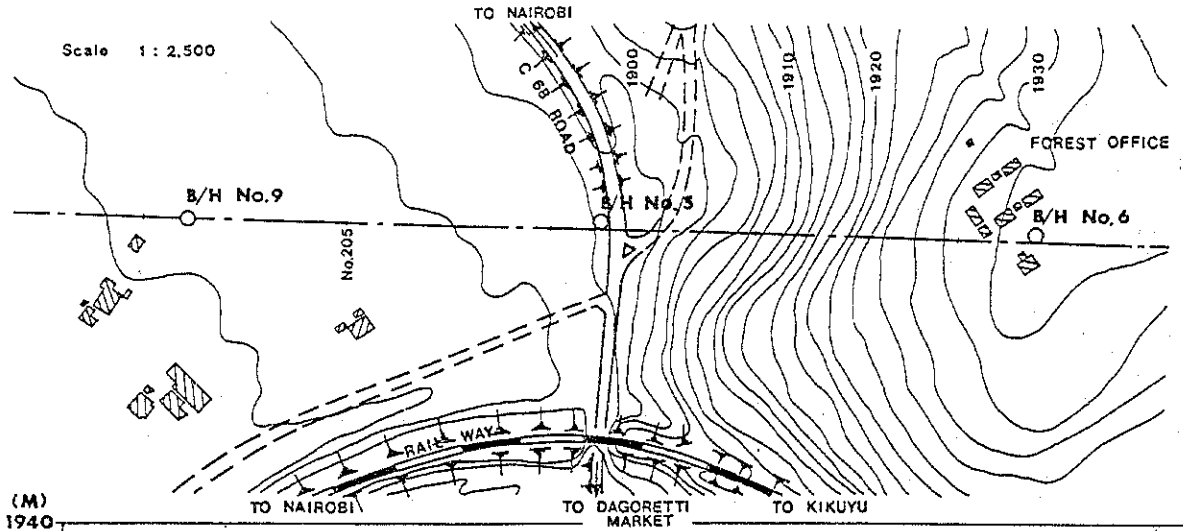


Fig. A-VII-5.6

GEOLOGICAL SECTION (4)

(C63 ROAD)



LEGEND

A	Clay, Peat, Sand, Gravel etc.
S	Soil and High Weathered Rock
Ptbl	Trachyte Lava
Tvtf2	Pyroclastic Tuff

BORING LOG
: Standard Penetration Test
IA ~ VI : Weathering Grade

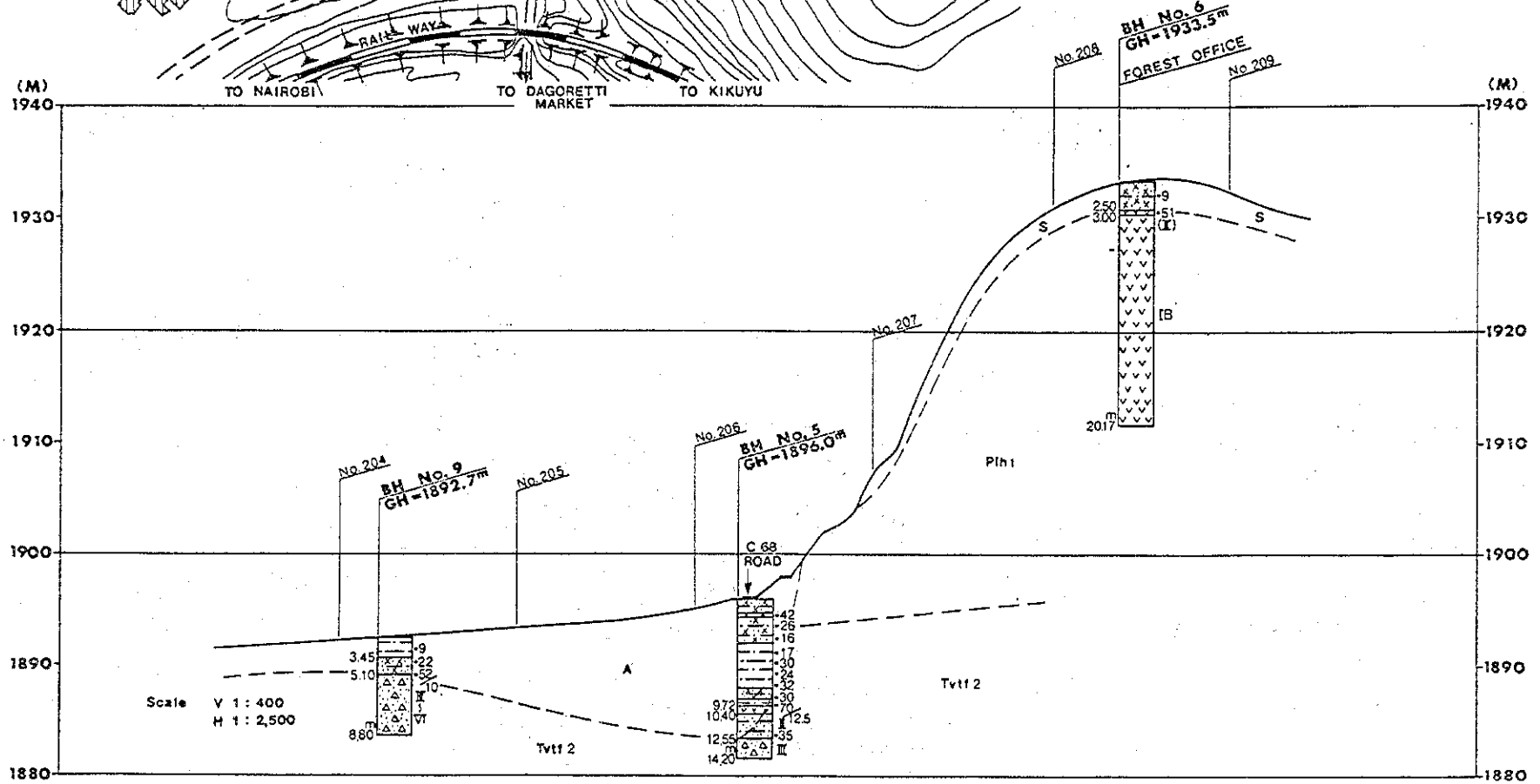
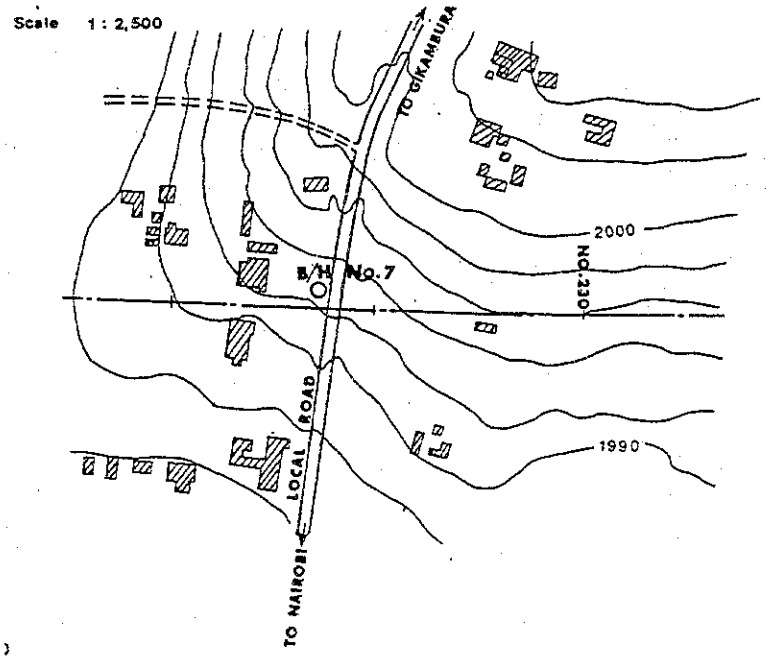


Fig.A-VII-5.7

GEOLOGICAL SECTION (5)

(LOCAL ROAD OF THOGOTO)



LEGEND

S	Soil and High Weathered Rock
Plhl	Trachyte Lava

BORING LOG

• : Standard Penetration Test

IA ~ VI : Weathering Grade

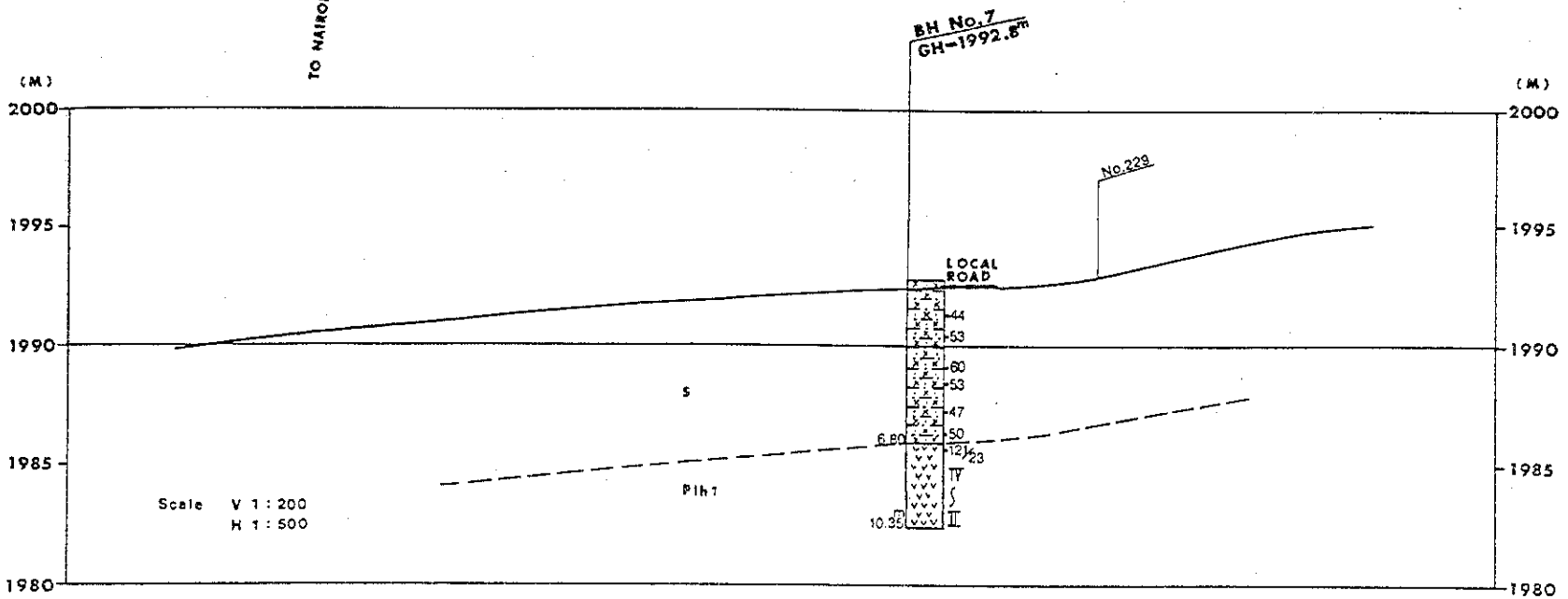
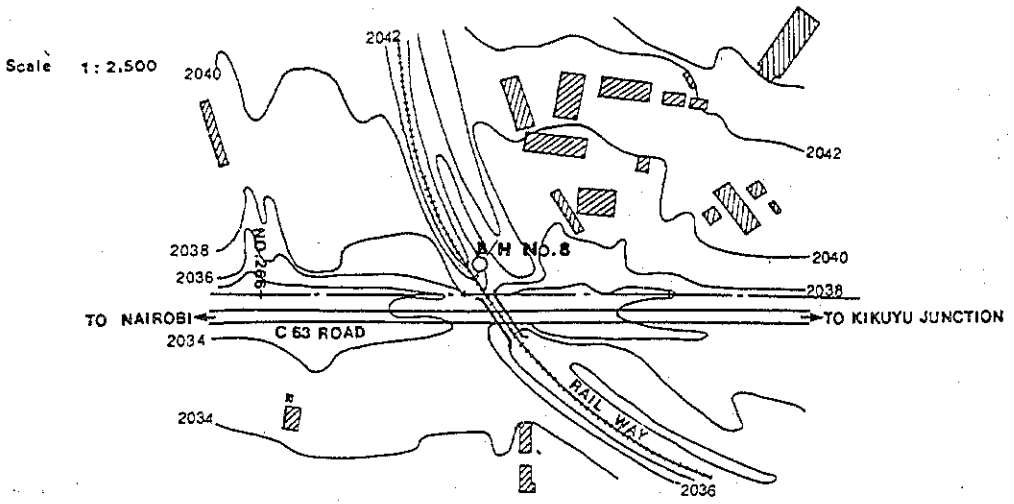


Fig.A-VII-5.8

GEOLOGICAL SECTION (6)

(RAILWAY AT THE VICINITY OF KIKUYU)



LEGEND

S : Soil and High Weathered Rock

BORING LOG

• : Standard Penetration Test

I A ~ VI : Weathering Grade

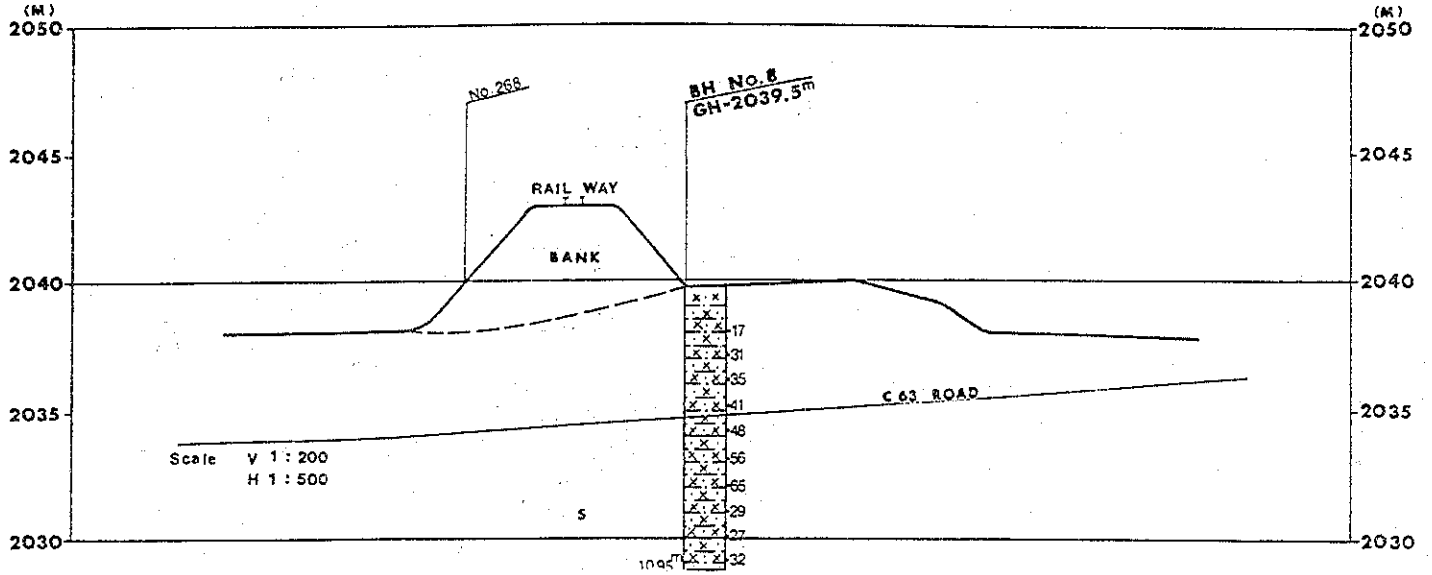
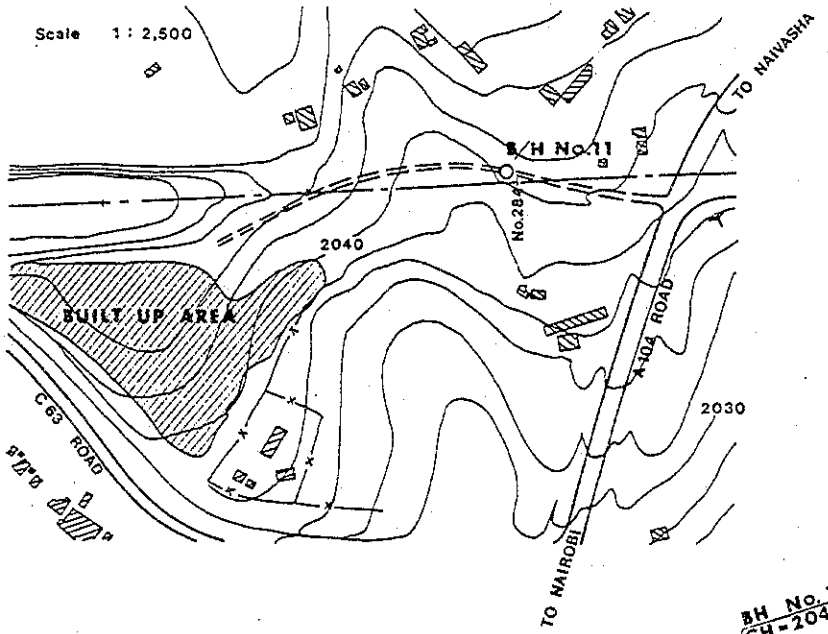


Fig.A-VII-5.9

GEOLOGICAL SECTION (7)

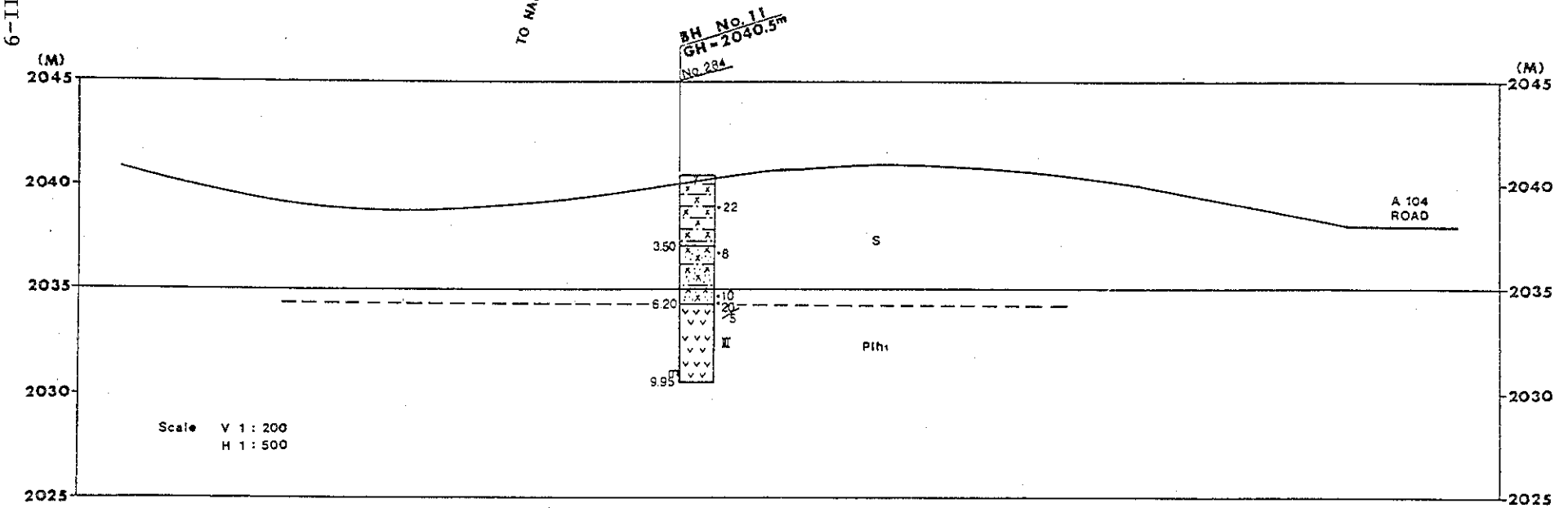
(A104 ROAD TO NAIVASHA)



LEGEND

S	Soil and High Weathered Rock
Pibl	Trachyte Lava

BORING LOG
• : Standard Penetration Test
IA ~ VI : Weathering Grade



Appendix VIII. Preliminary Design

Appendix VIII.1

Principle of Junction Design

1.1 Road Classification and Control of Access

Road classification of the Bypass is A class.
According to the Road Design Manual of Kenya, the level of Access control for A class road is recomended Full access control as desirable case and Partial access control as reduced case. The detail description of Access control is shown as in below:

Full access control - means that the authority to control access is exercised to give preference to through traffic by providing access connections with selected public roads only and by prohibiting direct private access connections.

Partial access control - means that the authority to control access is exercised to give preference to through traffic to a degree in that, in addition to access connections with selected public roads, there may be (some) private access connections.

For giving preference to through traffic on the Bypass, Selected public roads which are the classified roads are considered to provide access connection with the Bypass by Junctions. (see Table VIII-1-1)

1.2 Principle of Junction Type

At-grade Junction

The basic layout for at-grade junction is the T-junction with the major road traffic having priority over the minor road traffic. Crossroads, although not recommended, may also be used but only on single carriageway roads where traffic flows are very low and where site conditions will not permit the use of staggered T-junctions.

Therefore staggered T-junctions will be recommendable for the minor junctions which is a junction with minor classified road. The minimum distance between consecutive junctions shall preferably be equal to (10 x V_D) meters where V_D is the major road design speed in Km/h. Thus the V_D of the Bypass is 70 to 100 km/h, the calculated distance is 700 m to 1,000 m length.

Roundabout Junction

Generally, roundabouts should not be introduced on rural roads. However, close to built-up areas where the through road may crossed by local roads carrying heavy traffic, the use of roundabouts may be considered. For traffic safety, Roundabouts should not be introduced on rural roads where the design speeds of adjacent sections are 80 km/h or greater.

Thus Roundabouts may be introduced if the design speeds of the adjacent sections are:-

a) less than 60 km/h, or
b) less than 80 km/h and the roundabout and approach roads are provided with overhead lighting.

The capacity calculation formula is referred from the Road Design Manual of Kenya for each weaving sections on Conventional Roundabout.

The formula is:-

$$QP = 240\ W\ \frac{(1 + e/w)}{1 + w/L}$$

where QP : Weaving capacity (vehicles/hrs)

e : Average Width of entries to weaving sections in meters.

w : Width of weaving section in meters

L : Length of weaving section in meters

and 0.85QP: Weaving Traffic Volume (W.T.V.)

Therefore

$$L > \frac{w \times W.T.V.}{0.85 \times 240W\ (1 + e/w) - W.T.V.}$$

For the estimation of W.T.V., the estimated future AADT should be transferred by the peak hour traffic rate as 10% and by the increasing rate of traffic as 4% par annum from year 2000 to 2006.

The calculation of the peak flow rate are ossumed that peak flows are greater than 1.5 times the average daytime hourly flows and the 24 hr/12 hr flow rates are 1.25.

$$\text{The peak flow rate} = \frac{\text{Peak flow}}{\text{AADT}} = \frac{1.5 \times \text{AADT}/1.25 \times 12}{\text{AADT}} = 10\ \%$$

Therefore W.T.V. = AADT at weaving section x 10% x 1.04^6

= AADT at weaving section x 0.126^5

Grade Separated Junction

Conditions where the use of grade separation is warranted are usually as follows:-

a) An at-grade junction has insufficient capacity.
b) The scheme is justified economically from the saving in delay to traffic and accidents.
c) Grade separation is cheaper on account of topography or on grounds that expensive sites can be avoided by it.
d) For operational reasons.
e) Where roads cross motorways.

The design speed for the through traffic movement shall never be less than 20 km/h lower than the average design speed for the Bypass and crossing road. The recommended design speed for slip roads is 50 km/h.

The types of grade separated junctions for the Bypass can be classified into two categories as follows.

a) Junctions with minor roads
   Diamond junction and half-cloverleaf junction are the most popular junction with minor roads and both transfer the major traffic conflicts to the minor road.
   Diamond junction is the most basical type and requires the least land acquisition.
   An alternative design is the half-cloverleaf junction. The half-cloverleaf junction has the advantage that it can often meet difficult site conditions. The slip roads can be placed on the opposite hand if it is necessary to minimise right turn cutting movements on the minor road.

b) Junction with major roads

Cloverleaf junction and Directional junction are suitable. Cloverleaf junction requires only one bridge but occupies a large area. Directional junction requires more than two bridges usually.

The selection of junction type should be carefully considered of traffic movement, site conditions and construction cost.

Table VIII-1-1 Classification of Junctions

Junction Name	Connecting Road				Junction		
	Road No., Road Name	Existing/ Future No. of lane	Terrain	Design speed	Classification	Design speed	
						Through road	/ slip road
				km/h			
Mombasa Road J.	A104 Mombasa Rd.	4/-	Level	100-120	Grade Separated Junction with major road	70-100	50
Uhuru Monument J.	C58 Langata Rd.	2/4	Rolling	60-90	Grade Separated Junction with minor road or Roundabout Junction	50-80 60	40-50 -
Ngong Road J.	C60 Ngong Rd.	2/2	Rolling	60-90	Grade Separated Junction with minor road	50-80	40-50
Dagoretti Forest J.	C63 Dagoretti Rd.	2/2	Rolling	60-90	Grade Separated Junction with minor road	50-80	40-50
Thogoto J.	D411 Thogoto Rd.	2/2	Rolling	50-80	At-grade Junction	40-70	-
Ondiri J.	C63/E422	2/2	Rolling	60-90	Grade Separated Junction with minor road	50-80	30-40
Kikuyu J.	A104 Naivasha Rd.	2/4	Rolling	70-100	Grade Separated Junction with major road	60-80	50
-	Unclassified road	-	-	-	no access conection	-	-

Appendix VIII.2. Rough Estimate of Additional Construction Cost of Mombasa Junction Layout.

Additional construction costs for construction of ramps are estimated as follows.

(1) Layout A

		Unit	Quantity	Unit Price (K.Shs)	Amount (K.Shs)
a)	Site Clearing and Top Soil Stripping				
	Removal of top soil	m^3	634.0	15.00	9,510
	Sub-Total				9,510
b)	Earthwork				
	Excavation, Unsuitable Soil	m^3	2,000	15.00	40,500
	Sub-grade Preparation	m^2	3,170	2.90	9,193
	Slope Protection	m^2	2,163	11.20	25,307
	Borrow Filling	m^3	4,118	64.60	266,023
	Sub-Total				341,023
c)	Pavement work				
	Crusher-run Sub-base Course	m^3	472.5	377.60	178,416
	Cement Stabilized base Course	m^3	540.0	462.20	249,588
	Bitument Emulsion Prime Coat	l	3,240	9.6	31,104
	Asphalt Concrete	m^3	270	1.500	405,000
	Sub-Total				864,108
d)	Road Furniture				
	Guardrails	m	450	680.	273,600
	Concrete Kerb	m	1,150	44.4	51,060
	Sub-Total				324,660
	Total			K.Shs	1,539,301

(2) Layout B

	Unit	Quantity	Unit Price (K.Shs)	Amount (K.Shs)
a) Site Clearing and Top Soil Stripping				
Removal of top soil	m^3	3,072	15.00	46,080
Sub-Total				46,080
b) Earthwork				
Excavation, Unsuitable Soil	m^3	15,600	15.00	234,000
Sub-grade Preparation	m^2	13,121	2.90	38,051
Slope Protection	m^2	11,444	11.70	133,895
Borrow Filling	m^3	31,079	65.00	2,020,135
Sub-Total				2,426,081
c) Pavement work				
Crusher-run Sub-base	m^3	1,491	377.6	563,001
Cement Stabilized Material	m^3	1,704	462.2	787,589
Bitumen Emulsion Prime Coat	l	8,519	9.6	81,782
Asphalt Concrete	m^3	852	1,500	1,278,000
Sub-Total				2,710,372
d) Road Furniture				
Guard rails	m	2,165	680.	1,316,320
Concrete Kerb	m	2,490	44.4	110,556
Sub-Total				1,426,876

e) Bridge construction

Bridge Construction Cost was roughly estimated by multiplying unit price per square meter with additional bridge area.

$$8,302,387 \text{ K.Shs} \times \frac{3,5 \times 72.0}{25,2 \times 72.0} = 1,153,109 \text{ K.Shs.}$$

Sub-Total = 1,153,109 K.Shs.

Total K.Shs 7,762,518 K.Shs.

Table A-VIII-3 (1)

Temperature & Wind Speed

STATION NUMBER 91.36/168

ALTITUDE 5327 FEET 1624 METERS

STATION NAME NAIROBI (J.K.A.)

LATITUDE 01° 19'S LONGITUDE 36°

MONTH	ATMOSPHERIC PRESSURE (1959 - 80)		TEMPERATURE (1959 - 80)									WIND SPEED 1959 -80	
			MEANS			EXTREMES		DRY BULB		DEW POINT		0600 GMT	1200 GMT
	0600 GMT	1200 GMT	MAX.	MIN.	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	knots	knots
	mb.	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C		
January	840.3	836.7	26.6	11.9	14.7	32.2	4.7	18.3	25.5	13.7	11.4	7	12
February	840.0	836.3	27.7	12.4	15.3	31.4	5.6	18.6	26.6	14.1	11.1	6	12
March	840.0	836.5	27.6	13.2	14.4	32.1	6.3	18.6	26.4	15.1	11.7	6	13
April	840.2	837.0	26.0	14.5	11.5	31.5	8.9	18.2	24.7	15.8	13.9	6	11
May	841.2	838.2	24.6	13.5	11.1	28.8	6.3	17.4	23.4	14.9	14.1	5	8
June	842.2	839.4	23.6	11.5	12.1	28.9	6.1	15.7	22.5	13.2	12.5	5	7
July	842.4	839.8	22.5	10.7	11.8	28.1	4.6	14.8	21.4	12.2	11.5	5	6
August	842.2	839.2	23.1	10.8	12.3	29.1	4.4	15.0	21.9	12.1	11.5	5	7
September	842.0	838.2	25.6	11.0	14.6	31.1	4.2	16.2	24.4	12.6	11.0	4	8
October	841.5	837.4	26.7	12.6	14.1	30.5	5.0	18.0	25.5	13.7	11.0	5	10
November	840.9	837.1	25.2	13.3	11.9	30.2	5.8	17.7	23.8	15.0	13.1	7	11
December	840.5	836.9	25.5	12.7	12.8	29.6	7.0	18.1	24.4	14.6	12.6	8	13
Year	841.1	837.7	25.4	12.3	13.1	32.2	4.2	17.2	24.2	13.9	12.1	6	10

AUTHORITY: CLIMATE SECTION

METEOROLOGICAL DEPARTMENT

OF M.O.T.C

Table A-VIII-3 (2)

Temperature & Wind Speed

STATION NUMBER 9136/130

STATION NAME NAIROBI WILSON AIRPORT MET. STATION.

ALTITUDE 5525 FEET 1683 METERS

LATITUDE 01° 19'S LONGITUDE 36° 49'E

MONTH	ATMOSPHERIC PRESSURE (1965 - 80)		TEMPERATURE (1961 - 80)									WIND SPEED 1961 -80	
			MEANS			EXTREMES		DRY BULB		DEW POINT			
	0600 GMT	1200 GMT	MAX.	MIN.	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	knots	knots
January	834.9	831.4	26.2	12.9	13.3	31.1	7.2	18.3	25.2	13.0	10.1	8	12
February	834.6	831.1	27.1	13.3	13.8	30.5	7.7	18.6	25.9	13.4	10.0	7	12
March	834.7	831.2	27.1	14.4	12.7	31.5	9.1	18.4	25.7	14.6	10.9	7	13
April	834.8	831.7	25.4	15.0	10.4	30.0	10.4	17.9	24.0	15.4	13.4	6	11
May	835.9	833.1	23.8	14.0	9.8	28.1	8.0	17.1	22.6	14.6	13.8	5	8
June	836.7	834.3	22.8	12.0	10.8	28.0	5.2	15.5	21.6	12.9	12.2	4	7
July	837.0	834.6	22.0	11.3	10.7	27.9	5.4	14.5	20.8	11.9	11.1	5	7
August	836.8	834.0	22.7	11.3	11.4	28.8	5.9	14.6	21.4	11.8	10.7	4	8
September	836.6	833.1	25.2	11.8	13.4	31.1	5.9	15.8	24.2	12.3	9.9	5	9
October	836.1	832.2	26.2	13.6	12.6	29.9	6.9	17.4	25.0	13.4	10.2	6	10
November	835.4	831.9	24.5	14.3	10.2	28.8	9.4	17.3	23.1	14.5	12.6	8	12
December	835.0	831.7	24.8	13.8	11.0	28.7	8.4	17.9	24.2	14.0	11.6	8	12
Year	835.7	832.5	24.8	13.1	11.7	31.5	5.2	16.9	23.6	13.5	11.4	6	10

AUTHORITY: CLIMATE SECTION

METEOROLOGICAL DEPARTMENT

OF M.O.T.C

Table A-VIII-3 (3)

Temperature & Wind Speed

STATION NAME NAIROBI (D. CORNER). STATION NUMBER 91:36/164

LATITUDE 01° 18'S LONGITUDE 36° 45'E ALTITUDE 5900 FEET 1798 METERS

MONTH	ATMOSPHERIC PRESSURE (1955 - 80)		TEMPERATURE (1955 - 80)								
			MEANS			EXTREMES		DRY BULB		DEW POINT	
	0600 GMT	1200 GMT	MAX.	MIN.	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	mb.	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C
January	823.0	819.4	24.5	11.5	13.0	29.7	3.3	17.2	23.7	12.8	11.2
February	822.5	819.2	25.6	11.6	14.0	29.7	4.7	17.7	24.7	12.8	10.5
March	822.6	819.3	25.6	13.1	12.5	30.6	6.7	17.4	24.7	14.0	11.3
April	822.7	819.7	24.1	14.0	10.1	28.8	7.8	17.0	23.0	14.7	13.4
May	823.9	821.1	22.6	13.2	9.4	27.1	7.2	16.2	21.5	13.9	13.6
June	824.5	822.1	21.5	11.0	10.5	26.8	4.4	14.6	20.6	12.2	12.1
July	824.7	822.4	20.6	10.1	10.5	25.8	2.5	13.5	19.6	11.3	11.4
August	824.5	821.9	21.4	10.2	11.2	27.9	2.9	13.7	20.3	11.3	11.0
September	824.2	821.1	23.7	10.5	13.2	29.1	3.9	14.8	22.7	11.8	10.5
October	825.9	820.3	24.7	12.5	12.2	28.3	5.0	16.4	23.7	12.9	10.7
November	823.3	820.0	23.1	13.1	10.0	27.8	6.7	16.3	22.0	13.9	12.7
December	822.9	819.7	23.4	12.6	10.8	27.4	5.3	16.9	22.6	13.4	12.2
Year	823.5	820.5	23.4	11.9	11.5	30.6	2.5	15.9	22.4	12.9	11.7

WIND SPEED 1955-80	
0600 GMT	1200 GMT
knots	knots
7	11
6	11
6	11
5	9
4	6
3	6
3	6
3	7
5	8
6	9
7	10
7	11
5	9

AUTHORITY: CLIMATE SECTION
METEOROLOGICAL DEPARTMENT
OF M.O.T.C

Table A-VIII-3 (4)

Temperature & Wind Speed

STATION NAME MUGUGA K.A.R.I. STATION NUMBER 91036/121

LATITUDE 01° 13'S LONGITUDE 36° 38'E ALTITUDE 6875 FEET 2096 METERS

MONTH	Atmospheric Pressure		Temperature 1953-80										WIND SPEED	
			MEANS			EXTREMES		DRY BULB		DEW POINT				
	0600 GMT	1200 GMT	MAX.	MIN.	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT
	mb.	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C		knots	knots
January			22.4	11.1	11.3	26.9	5.6	15.9	21.3	11.2	10.1			
February			23.2	11.5	11.7	27.4	6.4	16.2	21.9	11.5	9.7			
March			23.2	12.2	11.0	27.5	7.3	16.1	22.2	12.5	10.7			
April			21.6	12.5	9.1	26.6	9.5	15.2	20.5	13.3	12.4			
May			19.9	11.6	8.3	23.7	5.6	14.4	18.8	12.8	12.9			
June			18.9	9.8	9.1	23.5	3.9	13.0	17.9	11.3	11.3			
July			18.2	8.9	9.3	23.9	1.9	11.9	17.1	10.3	10.6			
August			18.8	9.0	9.8	26.0	2.8	12.1	17.7	10.6	10.4			
September			21.0	9.4	11.6	25.9	3.0	13.5	19.8	10.7	9.7			
October			22.1	11.0	11.1	26.4	5.8	14.7	20.7	11.7	9.7			
November			20.7	11.7	9.0	25.9	6.8	14.8	19.5	12.5	11.6			
December			21.3	11.3	10.0	25.4	4.5	15.5	20.0	11.9	11.5			
Year			20.9	10.8	10.1	27.5	1.9	14.4	19.8	11.7	10.9			

AUTHORITY: CLIMATE SECTION

METEOROLOGICAL DEPARTMENT

OF M.O.T.C

Table A-VIII-3 (5)

Precipitation

AUTHORITY: DATA OF RAINFALL
CLIMATE SECTION
METEOROLOGICAL DEPARTMENT
OF M.O.T.C

(1) . WILSON AIRPORT

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	AVER-AGE
Jan.	3.3	22.4	-	-	-	3.4	2.5	1.3	7.1	0	17.9	7.2
Feb.	17.9	35.7	-	-	0	2.0	14.1	127.9	1.7	93.3	0	32.5
Mar.	26.5	6.7	-	-	49.6	104.0	27.6	42.9	5.8	91.3	67.7	46.9
Apr.	106.1	436.4	-	-	97.9	324.4	195.8	136.2	87.4	171.8	297.3	105.9
May.	65.3	313.5	-	-	448.1	148.8	164.4	35.5	2.9	76.9	289.5	171.6
Jun.	38.2	68.7	-	-	18.8	32.0	10.5	29.6	5.0	36.3	16.6	28.4
July	9.6	34.3	-	-	1.5	9.1	13.2	22.5	12.4	50.7	0.8	17.1
Aug.	11.7	92.3	-	-	8.0	30.8	2.7	29.4	22.9	2.5	1.3	22.4
Sep.	52.8	17.9	-	-	5.7	45.1	15.5	2.5	15.4	23.4	1.0	19.9
Oct.	18.1	18.3	-	-	17.6	43.0	178.7	61.2	140.0	14.0	33.5	57.0
Nov.	84.8	-	-	-	200.3	39.2	198.1	19.8	129.0	67.8	164.7	113.0
Dec.	97.9	-	-	-	28.1	56.1	209.9	228.8	90.9	104.5	-	116.6
TOTAL	532.1	1046.2	-	-	875.6	837.9	1033.0	737.6	520.5	732.5	879.3	838.5
MONTHS	12	10			11	12	12	12	12	12	11	12

Table A-VIII-3 (6)

Precipitation

(11) DAGORETTI

AUTHORITY:
CLIMATE SECTION
METEOROLOGICAL DEPARTMENT
OF M.O.T.C

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	AVE-RAGE
Jan.	23.0	28.3	139.6	59.8	79.1	14.5	0	5.2	5.2	0.1	12.5	33.4
Feb.	42.1	74.8	33.1	163.6	26.1	5.7	18.8	187.9	0.6	93.0	0	58.7
Mar.	30.4	34.7	273.0	144.1	37.5	117.5	60.5	72.1	6.3	133.7	79.4	89.9
Apr.	-	485.9	195.7	128.0	105.1	541.2	219.5	178.9	81.5	212.7	233.6	238.2
May.	-	314.8	91.6	180.5	413.7	244.9	211.5	38.2	3.4	93.0	251.3	184.3
June	34.4	41.4	7.4	27.8	26.6	11.3	38.4	13.1	5.7	21.2	23.2	22.8
July	17.7	50.8	10.4	42.4	1.7	9.9	27.3	16.3	6.5	27.3	0.8	19.2
Aug.	17.7	50.6	63.4	10.8	16.2	40.4	8.2	28.7	7.0	5.2	3.1	22.8
Sep.	60.7	23.7	15.1	52.4	24.8	37.9	34.7	2.7	30.3	15.9	0.5	27.2
Oct.	13.1	44.5	134.0	19.7	30.1	42.2	150.0	53.7	126.7	34.4	21.9	60.9
Nov.	135.6	76.9	101.1	93.8	249.8	17.9	221.3	24.6	135.4	108.7	189.9	123.2
Dec.	86.4	113.5	112.1	73.6	31.3	33.3	167.4	329.5	77.6	80.3	-	110.5
TOTAL	461.1	1339.9	1176.5	996.5	1047.0	1116.7	1157.6	951.1	486.2	825.5	816.2	991.1
MONTHS	10	12	12	12	12	12	12	12	12	12	11	12

Table A-VIII-6 (1) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
1.	General	L.S.			0		12,908,800		3,227,200		16,136,000
2.	Construction Section I										
2.1	Site clearing and top-soil stripping										
	Clearing and Grubbing	ha.	37.5	2,060.00	77,250	60.00	2,250	130.00	4,875	2,250.00	84,375
	Removal of topsoil	m^3	75,000	10.00	750,000	2.20	165,000	2.80	210,000	15.00	1,125,000
	Sub-total				827,250		167,250		214,875		1,209,375
2.2	Earthwork										
	Excavation,Unsuitable -Soil	m^3	36,150	10.00	361,500	2.20	79,530	2.80	101,220	15.00	542,250
	Cross Filling (side-borrow)	m^3	9,810	16.30	159,903	4.00	39,240	4.60	45,126	24.90	244,269
	Cutting and Filling-upto 1000m	m^3	25,750	32.80	844,600	4.70	121,025	9.50	244,625	47.00	1,210,250
	Borrow Filling, 7000m	m^3	289,510	43.90	12,709,489	8.20	2,373,982	12.90	3,734,679	65.00	18,818,150
	Sub-grade preparation	m^2	209,100	1.90	397,290	0.50	104,550	0.50	104,550	2.90	606,390
	Filling around pipe-culvert	m^3	910	43.60	39,676	8.20	7,462	12.80	11,648	64.60	58,786
	Slope protection, Cutting slope	m^2	21,690	-	-	6.50	140,985	0.40	8,676	6.90	149,661
	Slope protection, -embankment slope	m^2	51,000	3.30	168,300	7.10	362,100	1.30	66,300	11.70	596,700
	Sub-Total				14,680,758		3,228,874		4,316,824		22,226,456
2.3	Pavement work										
	Crusher-run Sub-base -Course	m^3	24,190	262.30	6,345,037	40.40	977,276	74.90	1,811,831	377.60	9,134,144
	Cement Stabilized-base Course	m^3	21,990	315.90	6,946,641	58.20	1,279,818	88.10	1,937,319	462.20	10,163,778
	Bitumen Emulsion Prime-Coat	lit	131,940	7.00	923,580	1.20	158,328	1.40	184,716	9.60	1,266,624
	Asphalt Concrete - Surface Course	m^3	10,990	1,104.20	12,135,158	145.20	1,595,748	250.60	2,754,094	1,500.00	16,485,000
	Sub-Total				26,350,416		4,011,170		6,687,960		37,049,546

Table A-VIII-6 (2) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
2.4	Drainage work										
	Concrete pipe,600mm	m	640	40.90	26,176	610.10	390,464	106.30	68,032	757.30	484,672
	Concrete drain pit, 0.8m x 0.8m	no.	96	1950.00	187,200	2260.00	216,960	730.00	70,080	4940.00	474,240
	Concrete pipe,900mm	m	190	52.80	10,032	1164.50	221,255	198.20	37,658	1415.50	268,945
	Inlet and Outlet - Structure	no.	16	15,170.00	242,720	34,470.00	551,520	8,350.00	133,600	57,990.00	927,840
	Sub-Total				466,128		1,380,199		309,370		2,155,697
2.5	Road Furniture										
	Standard regulatory-Signs	no.	6		0	1600.00	9,600	272.00	1,632	1872.00	11,232
	Standard Warning Signs	no.	4		0	1200.00	4,800	204.00	816	1404.00	5,616
	Standard Mandatory - Signs	no .	8		0	1200.00	9,600	204.00	1,632	1404.00	11,232
	Standard Hazard Signs	no.	8		0	1100.00	8,800	187.00	1,496	1287.00	10,296
	Permanent Informal Signs	no.	16		0	3000.00	48,000	510.00	8,160	3510.00	56,160
	Guardrails	m	4,330	400.00	1,732,000	80.00	346,400	188.00	814,040	608.00	2,892,440
	Road Marking Lines	m	35,860	9.30	333,498	0.60	21,516	5.10	182,886	15.00	537,900
	Planting	m^2	38,750	3.30	127,875	7.10	275,125	1.30	50,375	11.70	453,375
	Concrete Kerb	m	29,230		0	38.00	1,110,740	6.40	187,072	44.40	1,297,812
	Sub-Total				2,193,373		1,834,581		1,248,109		5,276,063
2.6	Bridge Construction										
	Excavation, Common	m^3	1,770	24.40	43,188	3.70	6,549	6.90	12,213	35.00	61,950
	Excavation, Rock	m^3	370	74.20	27,454	10.80	3,996	25.00	9,250	110.00	40,700
	Backfill	m^3	3,440	32.80	112,832	4.70	16,168	9.50	32,680	47.00	161,680

Table A-VIII-6 (3) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
	Concrete, Slab	m^3	1,150	810.20	931,730	295.70	340,055	225.10	258,865	1331.00	1,530,650
	Concrete, Abutment- and Pier	m^3	920	691.40	636,088	291.60	268,272	197.10	181,332	1180.10	1,085,692
	Formwork, Slab	m^2	4,250	34.70	147,475	120.20	510,850	25.60	108,800	180.50	767,125
	Formwork, Abutment and- Pier	m^2	1,290	34.70	44,763	120.20	155,058	25.60	33,024	180.50	232,845
	Reinforcement	kg	161,640	6.30	1,018,332	4.20	678,888	1.70	274,788	12.20	1,972,008
	Expansion Joint	m	50	4100.00	205,000	205.00	10,250	1927.00	96,350	6,232.00	311,600
	Handrail	m	216	2900.00	626,400	145.00	31,320	1363.00	294,408	4,408.00	952,128
	Rubber Shoe, 250 x 300mm	no.	72	500.00	36,000	25.00	1,800	235.00	16,920	760.00	54,720
	Asphalt Pavement, t = 50mm	m^2	1,620	55.20	89,424	7.30	11,826	12.50	20,250	75.00	121,500
	Supporting	m^3	11,730	21.20	248,676	11.60	136,068	11.10	130,203	43.90	514,947
	Scaffolding	m^2	1,120	1.40	1,568	27.50	30,800	3.40	3,808	32.30	36,176
	Joint Filler	m^2	18	113.50	2,043	7.30	132	53.30	959	174.10	3,134
	Masonry	m^2	990	183.90	182,061	99.60	98,604	56.50	55,935	340.00	336,600
	Concrete, Masonry Foundation	m^3	110	637.00	70,070	269.10	29,601	175.10	19,261	1081.20	118,932
	Sub-Total				4,423,104		2,330,237		1,549,046		8,302,387
	TOTAL (2)				48,941,029		12,952,311		14,326,184		76,219,524
3.	Construction Section II										
3.1	Site Clearing and Top-Soil Stripping										
	Clearing and Grubbing	ha	42.3	4,350.00	184,005	990.00	41,877	1240.00	52,452	6580.00	278,334
	Removal of Topsoil	m^3	84,600	10.00	846,000	2.20	186,120	2.80	236,880	15.00	1,269,000
	Sub-Total				1,030,005		227,997		289,332		1,547,334

Table A-VIII-6 (4) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
3.2	Earthwork										
	Excavation, Surplus Material, Common	m^3	43,180	10.00	431,800	2.20	94,996	2.80	120,904	15.00	647,700
	Cross Filling,(Side-Borrow)	m^3	58,230	16.30	949,149	4.00	232,920	4.60	267,858	24.90	1,449,927
	Cutting and Filling-upto 1000m	m^3	157,500	32.80	5,166,000	4.70	740,250	9.50	1,496,250	47.00	7,402,500
	Cutting and Filling-2000m	m^3	155,780	39.10	6,090,998	7.40	1,152,772	11.50	1,791,470	58.00	9,035,240
	Sub-grade Preparation	m^2	268,700	1.90	510,530	0.50	134,350	0.50	134,350	2.90	779,230
	Filling around pipe-Culvert	m^3	2,590	43.60	112,924	8.20	21,238	12.80	33,152	64.60	167,314
	Slope protection,-Cutting Slope	m^2	75,570		-	6.50	491,205	0.40	30,228	6.90	521,433
	Slope protection,-Embankment Slope	m^2	48,860	3.30	161,238	7.10	346,906	1.30	63,518	11.70	571,662
	Sub-Total				13,422,639		3,214,637		3,937,730		20,575,006
3.3	Pavement Work										
	Crusher-run Sub-base-Course	m^3	33,910	262.30	8,894,593	40.40	1,369,964	74.90	2,539,859	377.60	12,804,416
	Cement Stabilzed Base-Course	m^3	25,690	315.90	8,115,471	58.20	1,495,158	88.10	2,263,289	462.20	11,873,918
	Bitumen Emulsion Prime-Coat	Lit	154,130	7.00	1,078,910	1.20	184,956	1.40	215,782	9.60	1,479,648
	Asphalt Concrete Sur-Face Course	m^3	12,840	1,104.20	14,177,928	145.20	1,864,368	250.60	3,217,704	1500.00	19,260,000
	Sub-Total				32,266,902		4,914,446		8,236,634		45,417,982
3.4	Drainage Work										
	Concrete Pipe,600mm	m	880	40.90	35,992	610.10	536,888	106.30	93,544	757.30	666,424
	Concrete Drain Pit, -0.8m x 0.8m	no.	132	1950.00	257,400	2260.00	298,320	730.00	96,360	4940.00	652,080
	Concrete Pipe,900mm	m	530	52.80	27,984	1,164.50	617,185	198.20	105,046	1,415.50	750,215
	Inlet and Outlet Structure	no.	28	15,170.00	424,760	34,470.00	965,160	8,350.00	233,800	57,990.00	1,623,720
	Drain Ditch,Masonry	m	1,250	91.80	114,750	37.90	47,375	26.20	32,750	155.90	194,875
	Sub-Total				860,886		2,464,928		561,500		3,887,314

Table A-VIII-6 (5) Detailed Construction Cost

Unit : Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
3.5	Road Furniture										
	Standard Regulatory -Signs	no.	6		0	1600.00	9,600	272.00	1,632	1872.00	11,232
	Standard Warning Signs	no.	2		0	1200.00	2,400	204.00	408	1404.00	2,808
	Standard Mandatory Signs	no.	4		0	1200.00	4,800	204.00	816	1404.00	5,616
	Standard Hazard Signs	no.	10		0	1100.00	11,000	187.00	1,870	1287.00	12,870
	Permanent Informatory Signs	no.	8		0	3000.00	24,000	510.00	4,080	3510.00	28,080
	Guardrails	m	3,590	400.00	1,436,000	80.00	287,200	188.00	674,920	668.00	2,398,120
	Road Marking Lines	m	44,960	9.30	418,128	0.60	26,976	5.10	229,296	15.00	674,400
	Planting	m^2	57,450	3.30	189,585	7.10	407,895	1.30	74,685	11.70	672,165
	Concrete Kerb	m	36,300		-	38.00	1,379,400	6.40	232,320	44.40	1,611,720
	Sub- Total				2,043,713		2,153,271		1,220,027		5,417,011
3.6	Box Culvert Construction										
	Excavation, Common	m^3	160	24.40	3,904	3.70	597	6.90	1,104	35.00	5,600
	Excavation, Rock	m^3	250	74.20	18,550	10.80	2,700	25.00	6,250	110.00	27,500
	Backfill	m^3	780	32.80	25,584	4.70	3,666	9.50	7,410	47.00	36,660
	Concrete, Culvert	m^3	610	746.40	455,304	314.00	191,540	208.60	127,246	1269.00	774,090
	Concrete ,Bedding	m^3	46	637.00	29,302	269.10	12,378	175.10	8,055	1081.20	49,735
	Formwork	m^2	1,730	34.70	60,031	120.20	207,946	25.60	44,288	180.50	312,265
	Reinforcement	kg	51,620	6.30	325,206	4.20	216,804	1.70	87,754	12.20	629,764
	Supporting	m^3	680	21.20	14,416	11.60	7,888	11.10	7,548	43.90	29,852
	Scaffolding	m^2	770	1.40	1,078	27.50	21,175	3.40	2,618	32.30	24,871
	Joint Filler	m^2	36	113.50	4,086	7.30	263	53.30	1,919	174.10	6,268
	Water Stop	m	78	124.40	9,703	10.80	843	58.40	4,555	193.60	15,101
	Sub-Total				947,164		665,795		298,747		1,911,706

Table A-VIII-6 (6) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
3.7	Bridge Construction										
	Excavation, Rock	m^3	480	74.20	35,616	10.80	5,184	25.00	12,000	110.00	52,800
	BackFill	m^3	1,310	32.80	42,968	4.70	6,157	9.50	12,445	47.00	61,570
	Concrete, Slab	m^3	410	810.20	332,182	295.70	121,237	225.10	92,291	1331.00	545,710
	Concrete, Abutment - and Pier	m^3	730	691.40	504,722	291.60	212,868	197.10	143,883	1180.10	861,437
	Formwork, Slab	m^2	1,550	34.70	53,785	120.20	186,310	25.60	39,680	180.50	279,775
	Formwork, Abutment - and Pier	m^2	860	34.70	29,842	120.20	103,372	25.60	22,016	180.50	155,230
	Reinforcement	kg	77,040	6.30	485,352	4.20	323,568	1.70	130,968	12.20	939,888
	Expansion Joint	m	45	4100.00	184,500	205.00	9,225	1927.00	86,715	6232.00	280,440
	Handrial	m	99	2900.00	287,100	145.00	14,355	1363.00	134,937	4408.00	436,392
	Rubber Shoe,250 x 300mm	no.	30	500.00	15,000	25.00	750	235.00	7,050	760.00	22,800
	Asphalt Pavement - t = 50mm	m^2	630	55.20	34,776	7.30	4,599	12.50	7,875	75.00	47,250
	Supporting	m^3	4,130	21.20	87,556	11.60	47,908	11.10	45,843	43.90	181,307
	Scaffolding	m^2	840	1.40	1,176	27.50	23,100	3.40	2,856	32.30	27,132
	Joint Filler	m^2	16	113.50	1,816	7.30	117	53.30	853	174.10	2,786
	Masonry	m^2	150	183.90	27,585	99.60	14,940	56.50	8,475	340.00	51,000
	Concrete, Masonry-Foundation	m^3	38	637.00	24,206	269.10	10,226	175.10	6,654	1081.20	41,086
	Sub-Total				2,148,182		1,083,916		754,541		3,986,639
	TOTAL (3)				52,719,491		14,724,990		15,298,511		82,742,992
4.	Construction Section III										
4.1	Site Clearing and Top-Soil Stripping										
	Clearing and Grubbing	ha	18.5	2,060.00	38,110	60.00	1,110	130.00	2,405	2250.00	41,625
	Removal of Top-Soil	m^3	37,000	10.00	370,000	2.20	81,400	2.80	103,600	15.00	555,000
	Sub-Total				408,110		82,510		106,005		596,625

Table A-VIII-6 (7) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
4.2	Earthwork										
	Excavation, Surplus-Material, Common	m^3	50,330	10.00	503,300	2.20	110,726	2.80	140,924	15.00	754,950
	Cross Filling (Side-Borrow)	m^3	27,450	16.30	447,435	4.00	109,800	4.60	126,270	24.90	683,505
	Cutting and Filling-upto 1000m	m^3	137,950	32.80	4,524,760	4.70	648,365	9.50	1,310,525	47.00	6,483,650
	Sub-Grade Preparation	m^2	93,300	1.90	177,270	0.50	46,650	0.50	46,650	2.90	270,570
	Filling around Pipe-Culvert	m^3	1,430	43.60	62,348	8.20	11,726	12.80	18,304	64.60	92,373
	Slope Protection,-Cutting Slope	m^2	40,930		-	6.50	266,045	0.40	16,372	6.90	282,417
	Slope Protection,-Embankment Slope	m^2	31,370	3.30	103,521	7.10	222,727	1.30	40,781	11.70	367,029
	Sub-Total				5,818,634		1,416,039		1,699,826		8,934,499
4.3	Pavement Work										
	Crusher-run Subbase-Course.	m^3	21,750	262.30	5,705,025	40.40	878,700	74.90	1,629,075	377.60	8,212,800
	Cement Stabilized - Base Course	m^3	15,430	315.90	4,874,337	58.20	898,026	88.10	1,359,383	462.20	7,131,746
	Bitumen Emulsion Prime-Coat	Lit	92,570	7.00	647,990	1.20	111,084	1.40	129,598	9.60	888,672
	Asphalt Concrete Surface Course	m^3	7,710	1,104.20	8,513,382	145.20	1,119,492	250.60	1,932,126	1500.00	11,565,000
	Sub-Total				19,740,734		3,007,302		5,050,182		27,798,218

Table A-VIII-6 (8) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
4.4	Drainage Work										
	Concrete Pipe,600mm	m	540	40.90	22,086	610.10	329,454	106.30	57,402	757.30	408,942
	Concrete Drain Pit-0.8 x 0.8m	no.	81	1,950.00	157,950	2260.00	183,060	730.00	59,130	4940.00	400,140
	Concrete Pipe,900mm	m	290	52.80	15,312	1164.50	337,705	198.20	57,478	1415.50	410,495
	Inlet and Outlet-Structure	no.	20	15,170.00	303,400	34,470.00	689,400	8,350.00	167,000	57,990.00	1,159,800
	Drain Ditch, Masonry	m	800	91.80	73,440	37.90	30,320	26.20	20,960	155.90	124,720
	Sub-Total				572,188		1,569,939		361,970		2,504,097
4.5	Road Furniture										
	Standard Regulatory-Signs	no.	6		0	1600.00	9,600	272.00	1,632	1872.00	11,232
	Standard Warning-Signs	no.	2		0	1200.00	2,400	204.00	408	1,404.00	2,808
	Standard Mandatory-Signs	no	4		0	1200.00	4,800	204.00	816	1,404.00	5,616
	Standard Hazard Signs	no.	6		0	1100.00	6,600	187.00	1,122	1,287.00	7,722
	Permanent Informatory-Signs	no.	8		0	3000.00	24,000	510.00	4,080	3510.00	28,080
	Guardrails	m	600	400.00	240,000	80.00	48,000	188.00	112,800	668.00	400,800
	Road Marking Lines	m	27,300	9.30	253,890	0.60	16,380	5.10	139,230	15.00	409,500
	Planting	m^2	18,550	3.30	61,215	7.10	131,705	1.30	24,115	11.70	217,035
	Concrete Kerb	m	22,000		-	38.00	836,000	6.40	140,800	44.40	976,800
	Sub-Total				555,105		1,079,485		425,003		2,059,593
4.6	Box Culvert Construction										
	Excavation, Common	m^3	1,270	24.40	30,988	3.70	4,699	6.90	8,763	35.00	44,450

Table A-VIII-6 (9) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
	Backfill	m^3	3,250	32.80	106,600	4.70	15,275	9.50	30,875	47.00	152,750
	Concrete,Culvert	m^3	1,970	746.40	1,470,408	314.00	618,580	208.60	410,942	1,269.00	2,499,930
	Concrete,Bedding	m^3	80	637.00	50,960	269.10	21,528	175.10	14,008	1,081.20	86,496
	Formwork	m^2	3,310	34.70	114,857	120.20	397,862	25.60	84,736	180.50	597,455
	Reinforcement	kg	171,620	6.30	1,081,206	4.20	720,804	1.70	291,754	12.20	2,093,764
	Asphalt Pavement-t = 50mm	m^2	370	55.20	20,424	7.30	2,701	12.50	4,625	75.00	27,750
	Supporting	m^3	2,240	21.20	47,488	11.60	25,984	11.10	24,864	43.90	98,336
	Scaffolding	m^2	1,810	1.40	2,534	27.50	49,775	3.40	6,154	32.30	58,463
	Joint Filler	m^2	59	113.50	6,696	7.30	431	53.30	3,145	174.10	10,272
	Masonry	m^2	100	183.90	18,390	99.60	9,960	56.50	5,650	340.00	34,000
	Concrete, Masonry-Foundation	m	340	637.00	216,580	269.10	91,494	175.10	59,534	1,081.20	367,608
	Waterstop	m	90	124.40	11,196	10.80	972	58.40	5,256	193.60	17,424
	Sub-Total				3,178,327		1,960,065		950,306		6,088,698
	TOTAL (4)				30,273,098		9,115,340		8,593,292		47,981,730
5.	Construction Section IV										
5.1	Site Clearing and Top-Soil Stripping										
	Clearing and Grubbing	ha.	31.6	2060.00	65,096	60.00	1,896	130.00	4,108	2250.00	71,100
	Removal of Topsoil	m^3	63,160	10.00	631,600	2.20	138,952	2.80	176,848	15.00	947,400
	Sub-Total				696,696		140,848		180,956		1,018,500
5.2	Earthwork										
	Cross Filling (Side-Borrow)	m^3	34,200	16.30	557,460	4.00	136,800	4.60	157,320	24.90	851,580
	Cutting and Filling-Rock, upto 1000m	m^3	78,000	83.40	6,505,200	13.00	1,014,000	27.60	2,152,800	124.00	9,672,000

Table A-VIII-6 (10) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
	Cutting and Filling-Weathered Rock upto-1000m	m^3	78,000	46.50	3,627,000	10.20	795,600	13.30	1,037,400	70.00	5,460,000
	Cutting and Filling-Soil upto 1000m	m^3	162,110	32.80	5,317,208	4.70	761,917	9.50	1,540,045	47.00	7,619,170
	Cutting and Filling-Rock, 2000m	m^3	42,400	89.90	3,811,760	14.30	606,320	30.80	1,305,920	135.00	5,724,000
	Cutting and Filling-Weathered Rock,2000m	m^3	42,400	53.20	2,255,680	11.50	487,600	15.30	648,720	80.00	3,392,000
	Cutting and Filling-Soil, 2000m	m^3	83,400	39.10	3,260,940	7.40	617,160	11.50	959,100	58.00	4,837,200
	Sub-Grade Preparation	m^2	220,530	1.90	419,007	0.50	110,265	0.50	110,265	2.90	639,537
	Filling around Pipe-Culvert	m^3	1,280	43.60	55,808	8.20	10,496	12.80	16,384	64.60	82,688
	Slope Protection,-Cutting Slope	m^2	52,710		0	6.50	342,615	0.40	21,084	6.90	363,699
	Slope Protection-Embankment Slope	m^2	73,930	3.30	243,969	7.10	524,903	1.30	96,109	11.70	864,981
	Sub-Total				26,054,032		5,407,676		8,045,147		39,506,855
5.3	Pavement Work										
	Crusher-run Subbase-Course	m^3	35,210	262.30	9,235,583	40.40	1,422,484	74.90	2,637,229	377.60	13,295,296
	Cement Stablilized-Base Course	m^3	24,980	315.90	7,891,182	58.20	1,453,836	88.10	2,200,738	462.20	11,545,756
	Bitumen Emulsion-Prime Coat	Lit	149,850	7.00	1,048,950	1.20	179,820	1.40	209,790	9.60	1,438,560
	Asphalt Concrete-Surface Course	m^3	12,490	1,104.20	13,791,458	145.20	1,813,548	250.60	3,129,994	1500.00	18,735,000
	Sub-Total				31,967,173		4,869,688		8,177,751		45,014,612

Table A-VIII-6 (11) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
5.4	Drainage Work										
	Concrete Pipe,600mm	m	960	40.90	39,264	610.10	585,696	106.30	102,048	757.30	727,008
	Concrete Drain Pit, 0.8 x 0.8m	no.	144	1950.00	280,800	2260.00	325,440	730.00	105,120	4940.00	711,360
	Concrete Pipe,900mm	m	260	52.80	13,728	1164.50	302,770	198.20	51,532	1,415.50	368,030
	Inlet and Outlet - Structure	no.	20	15,170.00	303,400	34,470.00	689,400	8,350.00	167,000	57,990.00	1,159,800
	Drain Ditch,Masonry	m	2,900	91.80	266,220	37.90	109,910	26.20	75,980	155.90	452,110
	Sub-Total				903,412		2,013,216		501,680		3,418,308
5.5	Road Furniture										
	Standard Regulatory Signs	no.	6		0	1600.00	9,600	272.00	1,632	1872.00	11,232
	Standard Warning-Signs	no.	8		0	1200.00	9,600	204.00	1,632	1404.00	11,232
	Standard Mandatory Signs	no.	16		0	1200.00	19,200	204.00	3,264	1404.00	22,464
	Standard Hazard Signs	no.	10		0	1100.00	11,000	187.00	1,870	1,287.00	12,870
	Permanent Informatory-Signs	no.	32		0	3000.00	96,000	510.00	16,320	3,510.00	112,320
	Guardrails	m	2,870	400.00	1,148,000	80.00	229,600	188.00	539,560	668.00	1,917,160
	Road Marking Lines	m	44,640	9.30	415,152	0.60	26,784	5.10	227,664	15.00	669,600
	Planting	m^2	25,550	3.30	84,315	7.10	181,405	1.30	33,215	11.70	298,935
	Concrete Kerb	m	37,340		0	38.00	1,418,920	6.40	238,976	44.40	1,657,896
	Sub-Total				1,647,467		2,002,109		1,064,133		4,713,709
5.6	Box Culvert Construction										
	Excavation, Common	m^3	4,690	24.40	114,436	3.70	17,353	6.90	32,361	35.00	164,150
	Backfill	m^3	7,450	32.80	244,360	4.70	35,015	9.50	70,775	47.00	350,150
	Concrete Culvert	m^3	6,740	746.40	5,030,736	314.00	2,116,360	208.60	1,405,964	1,269.00	8,553,060
	Concrete Bedding	m^3	210	637.00	133,770	269.10	56,511	175.10	36,771	1,081.20	227,052

Table A-VIII-6 (12) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
5.6	Box Culvert Construction										
	Formwork	m^2	9,170	34.70	318,199	120.20	1,102,234	25.60	234,752	180.50	1,655,185
	Reinforcement	kg	581,920	6.30	3,666,096	4.20	2,444,064	1.70	989,264	12.20	7,099,424
	Supporting	m^3	7,860	21.20	166,632	11.60	91,176	11.10	87,246	43.90	345,054
	Scaffolding	m^2	3,630	1.40	5,082	27.50	99,825	3.40	12,342	32.30	117,249
	Joint Filler	m^2	190	113.50	21,565	7.30	1,387	53.30	10,127	174.10	33,079
	Masonry	m^2	420	183.90	77,238	99.60	41,832	56.50	23,730	340.00	142,800
	Concrete,Masonry-Foundation	m^3	150	637.00	95,550	269.10	40,365	175.10	26,265	1081.20	162,180
	Waterstop	m	290	124.40	36,076	10.80	3,132	58.40	16,936	193.60	56,144
	Sub-Total				9,909,740		6,049,254		2,946,533		18,905,527
5.7	Bridge Construction										
	Excavation, Common	m^3	3,840	24.40	93,696	3.70	14,208	6.90	26,496	35.00	134,400
	Backfill	m^3	2,070	32.80	67,896	4.70	9,729	9.50	19,665	47.00	97,290
	Concrete, Slab	m^3	41	810.20	33,218	295.70	12,124	225.10	9,229	1,331.00	54,571
	Concrete,Abutment and-Pier	m^3	380	691.40	262,732	291.60	110,808	197.10	74,898	1180.10	448,438
	Formwork Slab	m^2	210	34.70	7,287	120.20	25,242	25.60	5,376	180.50	37,905
	Formwork, Abutment-and Pipe	m^2	760	34.70	26,372	120.20	91,352	25.60	19,456	180.50	137,180
	Sturctural Steel	Ton	7	7800.00	54,600	6600.00	46,200	2,040.00	14,280	16,440.00	115,080
	Reinforcement	kg	24,470	6.30	154,161	4.20	102,774	1.70	41,599	12.20	298,534
	Expansion Joint	m	14	4100.00	57,400	205.00	2,870	1927.00	26,978	6232.00	87,248

Table A-VIII-6 (13) Detailed Construction Cost

Unit: Kshs.

Item No.	Work	Unit	Quantity	Foreign Currency		Local Currency		Import Duty & Tax		Total	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
	Steel Shoe	no.	4	12,000.00	48,000	600.00	2,400	5,640.00	22,560	18,240.00	72,960
	Supporting	m^3	640	21.20	13,568	11.60	7,424	11.10	7,104	43.90	28,096
	Scaffolding	m^2	680	1.40	952	27.50	18,700	3.40	2,312	32.30	21,964
	Slope Protection	m^2	300		-	6.50	1,950	0.40	120	6.90	2,070
	Temporary Steel-Support	Ton	117	3,900.00	456,300	9,300.00	1,088,100	1,020.00	119,340	14,220.00	1,663,740
	Sub-Total				1,276,182		1,533,881		389,413		3,199,476
	TOTAL (5)				72,454,702		22,016,672		21,305,613		115,776,987
	TOTAL (1-5)				204,388,320		71,718,113		62,750,800		338,857,233

Appendix IX

Economic Assessment

Appendix IV-1 Calculation of Vehicle Operation Cost

(1) Fuel Cost

a) Passenger Vehicle

$$F1 = 0.1773\ S + 51.03$$

whereas,

C1	:	by cc/km
S	:	speed by sec./km
0.1773 and 51.03	:	the structural parameters, calculated by Japan's Science/Police Research Institute, and adopted in the Study.

$$C1 = \frac{\text{economic cost of fuel / litre} \times F1}{1{,}000}$$

b) Light passenger/ commodity vehicle

$$F2 = 0.2441\ S + 80.32$$

$$C2 = \frac{\text{economic cost of fuel / litre} \times F2}{1{,}000}$$

c) Bus

$$F3 = 1.006\ S + 176.90$$

$$C3 = \frac{\text{economic cost of fuel / litre} \times F3}{1{,}000}$$

d) Medium commodity vehicle

$$F4 = 1.006\ S + 176.90$$

$$C4 = \frac{\text{economic cost of fuel / litre} \times F4}{1{,}000}$$

e) Heavy commodity vehicle

$$F5 = 1.0833\ S + 179.49$$

$$C5 = \frac{\text{economic cost of fuel / litre x F5}}{1{,}000}$$

Table A-IX-1

Fuel Cost per Km by Speed

Unit: Cent

Type of Vehicle	Km/hr							
	10	20	30	40	50	60	70	80
Passenger Vehicle F1	39	28	24	23	22	21	20	20
Light Commodity Vehicle F2	57	42	37	35	33	32	31	31
Bus F3	144	96	79	71	67	63	61	59
Medium Commodity Vehicles F4	144	96	79	71	67	63	61	59
Heavy Commodity Vehicle F5	152	100	83	74	69	65	63	61

Remarks : Fuel Cost 3.3746 Shill./1000 CC, Regular for F1, F2
Fuel Cost 2.6675 Shill./1000 CC, Diesel for F3,F4,F5

(2) Lubricating Oil

Lubricating oil cost, C2 is calculated with the fuel. lubricating oil cost ratios, based on the figures of Japan's Ministry of Transport, Automobile Department, 1979.

a) Passenger vehicle 0.046
b) Light commodity vehicle 0.063
c) Bus 0.069

d) Medium commodity vehicle 0.052

e) Heavy commodity vehicle 0.052

Table A-IX-2

Lubricating Oil Cost

Unit : Cent

Type of Vehicle	Km/hr							
	10	20	30	40	50	60	70	80
Passenger Vehicle	2	1	1	1	1	1	1	1
L.P.&.C.V	3	2	2	2	2	2	1	1
Bus	10	7	6	5	5	5	4	4
M.C.V.	8	5	4	4	4	3	3	3
H.C.V.	8	5	4	4	4	3	3	3

(3) Tyre Cost

$$C3 = \frac{\text{economic cost of tyre x number of tyres}}{\text{average mileage/tyre x adjustment factor}}$$

Table A-IX-3

Tyre Cost

Item	(1) Economic Cost of Tyre, Shill.	(2) No. of Tyre	(1)x(2) = (3) Shill.	(4) Average Mileage of Tyre	(5) Adjustment Factor	(4)x(5) = (6) Km	(3) / (6) Cent
Passenger Vehicle	591	4	2,364	30,000	0.76	22,800	10
Light C. Vehicle	11,224	4	4,896	30,000	0.76	22,800	22
Bus	4,554	6	27,324	60,000	0.76	45,600	60
Medium C. Vehicle	5,658	6	33,948	60,000	0.76	45,600	74
Heavy C. Vehicle	5,658	6	33,948	60,000	0.76	45,600	74

Remarks : Adjustment factor of 0.76 is estimated by road survey of Kenya's road maintenance level, referring to the figure of Japan's Ministry of Construction Department of road, 1981.

(4) Maintenance Cost

Maintenance Cost is calculated as follow in general.

$$C4 = a1 \times \frac{a2}{b}$$

whereas,
- a1 : periodical check
- a2 : repair cost
- b : adjustment factor

Although, periodical check is not compulsory in Kenya, thus a_1 is not assessible.

Therefore, following maintenance costs were estimated through the interviews in the Study.

a) Passenger vehicle
by Toyota Automobile Corporation, Kenya, date

average repair times : 10 times
average repair cost : 1500 shilling
average mileage of surveyed vehicle : 10,000 km
Then, 10 x 1500 ÷ 10,000 = 1.5 Shill/Km

b) Light commodity vehicle
adopted the figure of (a)

c) Bus
by the Kenya Bus Service data, estimated by labour cost for repair and spare parts cost, dividing by number of buses and average mileage

d) Medium commodity vehicle and
e) Heavy commodity vehicle
by the data of Truck Forwarder Association calculated, based on total running cost 18.2 Shill. using the ratio 2.34 Shill/Km

Table A-IX-4

Maintenance Cost

Unit: Cent

Passenger Vehicle	Light P.C. Vehicle	Bus	Medium C. Vehicle	Heavy C. Vehilce
150	150	165	234	234

(5) Depreciation Cost

Formula to calculate is as follow in general.

$$C5 = \frac{0.9 \text{ (economic cost of vehicle - economic cost of tyre)}}{\text{lifetime mileage x adjustment factor}}$$

whereas, 0.9 : depreciation ratio

adjustment factor, adopted 0.76

See Remarks of tyre cost.

Table A-IX-5

Depreciation Cost

Item	(1) Economic Cost of Vehicle Shill.	(2) Economic Cost of Tyre Shill.	Depreciation Ratio	((1) - (2)) x 0.9 = (3) Shill.	(4) Life time Mileage Km	(4) x 0.76 [1] = (5) Km	(3)/(5) Cent
Passenger Vehicle	143,000	2,364	0.9	126,572	200,000	152,000	83
Light P.& C.Vehicle	142,000	4,896	0.9	123,394	240,000	187,400	68
Bus	689,380	27,324	0.9	595,850	720,000	547,200	109
Medium C. Vehicle	449,171	33,948	0.9	373,701	420.000	319 ,200	117
Heavy C. Vehicle	527,250	33,448	0.9	443,972	420,000	319,200	139

[1] : 0.76, Adjustment factor

(6) Personnel Cost

The cost of driver, attendant and turn boy for transport business, not included in V.O.C. of passenger vehicle

Based on Government Law

62.60 Shill. per driver
29.90 Shill. per turn boy

a) Light passenger and commodity vehicle and
b) Bus

$62.6 \div 8 \text{ hours} \div 60 \text{ km/hr} = 13.04 \fallingdotseq 13$

c) Medium commodity vehicle and
d) Heavy commodity vehicle

$(62.60 + 29.90) \div (8 \times 0.8 \times 50) = 28.9 \fallingdotseq 29$ Cent

whereas, 8 : working hours
0.8 : working ratio
50 : average running speed

Table A-IX-6

V.O.C. by Type of Vehicle and by Speed

Unit: Cent

Item	Km/hr							
	10	20	30	40	50	60	70	80
Passenger Vehicle	284	273	269	267	266	266	265	265
Light P.&.C Vehicle	304	303	298	295	294	292	292	291
Bus	516	465	448	439	434	430	428	426
Medium C. Vehicle	606	555	539	530	524	521	519	517
Heavy C. Vehicle	636	582	563	554	549	545	542	541

Table A-IX-7

Adjustment Factor by Slope

Unit %

	Degree				
Km/hr	1°	2°	3°	4°	5°
10	2.5	9.6	15.0	20.6	26.4
20	2.5	9.6	15.0	20.6	26.4
30	5.6	13.6	18.0	24.7	31.8
40	5.6	13.6	18.0	24.7	31.8
50	5.0	11.3	17.0	23.2	29.8
60	4.4	10.7	16.0	21.9	28.2
70	4.5	11.2	15.7	21.4	27.4
80	4.5	11.2	15.7	21.4	27.4

Remarks : calculated, based on the Table of AASHTO, with passenger vehicle extraporation for 4° and 5°.

Table will be used for all type of vehicles in the Study, confirming viability by

"Vehicle Operating Cost, fuel consumption and pavement type and factors", U.S. National Technical Information source, 1982.

2.5 means that V.O.C. is
2.5% higher than the V.O.C. of flat road.

In order to calculate the above V.O.C., characteristics of representative vehicle and economic cost of transport materials were surveyed beforehand.

Characteristics of representative vehicle were tabulated, based on the information through the interviews, specifications of selected vehicle and statistical data after having selected representative vehicles, considering the best seller among the types of vehicle.

Economic cost of transport materials was prepared, based on financial cost through the interview with makers and personnels concerned .

It is the official taxation in Kenya, related to the matters concerned that 17% of sales tax and 35% of import custom duty on imported components, due to knock down assembling togetherwith domestic parts are legalized

Table A-IX-8

Characteristics of Representative Vehicle

Description	Type of Vehicle				
	Passenger Vehicle	Light Passenger and Commodity Vehicle	Bus	Medium Commodity Vehicle	Heavy Commodity Vehicle
Marker	Toyota	Toyota	Isuzu	Isuzu	Nissan
Name of Vehicle	Collolla	Hilux	DQR 610	TXD	CPB12
Gross Vehicle Weight (Ton)	1.4	2.5	16.0	12.3	14.2
Loading (person)	5		62		
Capacity (Ton)		1.5		7	10
Number of Axles	2	2	2	2	2
Number of Tyres	4	4	6	6	6
Fuel	Regular	Regular	Diesel	Diesel	Diesel
Piston Displacement (cc)	1,295	1,626	13,741	5,785	7,412
Average Annual Kilometerage (Km)	25,000	30,000	80,000	60,000	60,000
Average (Year) Life Time	8	8	9	7	7
Life Time (Km)	200,000	240,000	720,000	420,000	420,000

Table A-IX-9

Economic Cost of Transport Materials

Unit: Shill. January, 1987 Price

Description	Financial Cost	Import Custom Duty	Sales Tax	Economic Cost
Vehicle				
Passenger Vehicle Collolla	229,000	19,000	67,000	143,000
Light Commodity Vehicle Hilux	205,000	28,000	34,850	142,150
Bus,DQR 610	1,073,750	225,488	158,882	689,380
Medium Commodity Vehicle,TXD	618,450	91,999	77,280	449,171
Heavy Commodity Vehicle,CPB 12	673,750	79,750	86,750	527,250
Fuel (Litre)				
Regular	7.64	0.6534	3.612	3.3746
Diesel	5.3	0.4354	2.197	2.6675
Lubricating Oil (Liter)	23.0	6.04	1.75	15.21
Tyre (Piece)				
165 x 13 (Collolla)	712	n.a	121	591
175 x 14 (Hilux)	1.475	n.a	251	1,224
1,000 x 20 (DQR 610)	5.487	n.a	933	4,554
1,100 x 20 (TXD)	6.817	n.a	1,159	5,658
1,100 x 20 (CPB 12)	6.817	n.a	1,159	5,658

Appendix IX-2 Detailed Procedure of Benefit Calculation

(1) The benefit of required time differential on A104.

a) 1991 year

- $P.V._{1991}$ = 59.09 cent x 1.8 x 365 $\sum T_{pi} \cdot d_{pi}$
- Bus_{1991} = 12.71 cent x 55.8 x 365 $\sum T_{bi} \cdot d_{bi}$
- $Matatu_{1991}$ = 12.71 cent x 22.5 x 365 $\sum T_{mi} \cdot d_{mi}$

whereas, T_{pi}, T_{bi}, T_{mi} (AADT)

Link No.		P.V.	Bus	Matatu
2	S.→N.W.	9,547	174	638
	N.W.→S.	9,562	205	638
3	S.→N.W.	11,134	570	638
	N.W.→S.	11,530	407	638

d_{pi}, d_{bi}, d_{mi} (min.)

Link No.		P.V.	Bus	Matatu
2	S.→N.W.	0.3	0.4	0.4
	N.W.→S.	0.2	0.3	0.3
3	S.→N.W.	0.7	1.1	1.1
	N.W.→S.	0.7	1.1	1.1

Therefore,

$P.V._{1991}$ = 59.09 cent x 1.8 x 365 × (9,547 x 0.3 + 9,562 x 0.2 + 11,134 x 0.7 + 11,530 x 0.7) = 8,018,392 Shill.

Bus_{1991} = 12.71 cent x 55.8 x 365 × (174 x 0.4 + 205 x 0.3 + 570 x 1.1 + 407 x 1.1) = 3,121,389 Shill.

$Matatu_{1991}$ = 12.71 cent x 22.5 x 365 × (638 x 0.4 + 638 x 0.3 + 638 x 1.1 + 638 x 1.1) = 1,724,581 Shill.

b) 2000 year

- $P.V._{2000}$ = 59.09 cent x 1.8 x 365 $\sum T_{pi} \cdot d_{pi}$
- Bus_{2000} = 12.71 cent x 55.8 x 365 $\sum T_{bi} \cdot d_{bi}$
- $Matatu_{2000}$ = 12.71 cent x 22.5 x 365 $\sum T_{mi} \cdot d_{mi}$

whereas, T_{pi}, T_{bi}, T_{mi} (AADT)

Link No.		P.V.	Bus	Matatu
1	S. → N.W.	5,620	313	808
	N.W. → S.	6,571	299	538
2	S. → N.W.	8,328	181	638
	N.W. → S.	8,714	222	638
4	S. → N.W.	11,838	553	638
	N.W. → S.	11,274	524	638

, d_{pi}, d_{bi}, d_{mi} (min.)

Link No.		P.V.	Bus	Matatu
1	S. → N.W.	1.8	2.9	2.0
	N.W. → S.	1.2	1.8	1.8
2	S. → N.W.	0.7	1.4	1.4
	N.W. → S.	0.4	0.7	0.7
4	S. → N.W.	0.3	0.6	0.6
	N.W. → S.	0.1	0.2	0.2

Therefore,

$P.V._{2000}$ = 59.09 cent x 1.8 x 365 × (5,620 x 1.8 + 6,571 x 1.2 + 8,328 x 0.7 + 8,714 x 0.4 + 11,838 x 0.3 + 11,274 x 0.1)

= 12,421,063 Shill.

Bus_{2000} = 12.71 cent x 55.8 + 365 × (313 x 2.9 + 299 x 1.8 + 181 x 1.4 + 222 x 0.7 + 553 x 0.6 + 524 x 0.2)
= 6,700,192 Shill.

$Matatu_{2000}$ = 12.71 cent x 22.5 x 365 × (808 x 2.9 + 538 x 1.8 + 638 x 1.4 + 638 x 0.7 + 638 x 0.6 + 638 x 0.2)
= 5,387,932 Shill.

(2) The Benefit of Converted Traffic from A104

a) 1991 year

$$- V.O.C._{1991}^{A104} = 365 \sum T_{ij} \cdot d_j \cdot V.O.C._i$$

whereas, T_{ij}

	P.V.	L.V.	Bus	M.V.	H.V.	(AADT)
S. → N.W.	623	743	15	269	406	
N.W. → S.						

, Total V.O.C. (1 link → 9 link)

	P.V.	L.V.	Bus	M.V	H.V.	(cent)
S. → N.W.	7,908	9,808	14,172	17,678	18,563	
N.W. → S.	7,498	9,218	13,169	16,507	17,261	

Therefore

$V.O.C._{1991}^{A104}$ (S. → N.W.) = 365 x (623 x 7,908 + 743 x 9,808 + 15 x 14,172 + 269 x 17,678 + 406 x 18,563)
= 90,230,154 Shill.

$V.O.C._{1991}^{A104}$ (N.W. → S.) = 365 x (623 x 7,498 + 743 x 9,218 + 15 x 13,169 + 269 x 16,507 + 406 x 17,261)
= 84,513,560 Shill.

Total V.O.C. on A104 in 1991 year

		1 (3.6)	2 (1.4)	3 (1.4)	4 (0.9)	5 (1.7)	6 (1.1)	7 (2.0)	8 (6.2)	9 (7.6)	
P.V.	S. — N.W.	(3.6 x 290) +	(1.4 x 290) +	(1.4 x 291) +	(0.9 x 331) +	(1.7 x 331) +	(1.1 x 290) +	(2.0 x 331) +	(6.2 x 305) +	(7.6 x 305) =	7,908
		1,044	406	407.4	297.9	562.9	319	662	1,891	2,318	
	N.W. — S.	(3.6 x 289) +	(1.4 x 290) +	(1.4 x 291) +	(0.9 x 289) +	(1.7 x 289) +	(1.1 x 289) +	(2.0 x 289) +	(6.2 x 289) +	(7.6 x 289) =	7,497.5
		1,040.4	406	407.4	268.2	491.3	317.9	578	1,791.8	2,196.4	
L.V.	S. — N.W.	(3.6 x 356) +	(1.4 x 357) +	(1.4 x 361) +	(0.9 x 416) +	(1.7 x 416) +	(1.1 x 356) +	(2.0 x 416) +	(6.2 x 378) +	(7.6 x 378) =	9,808.4
		1,281.6	499.8	505.4	374.4	707.2	391.6	832	2,343.6	2,872.8	
	N.W. — S.	(3.6 x 353) +	(1.4 x 356) +	(1.4 x 361) +	(0.9 x 369) +	(1.7 x 369) +	(1.1 x 353) +	(2.0 x 369) +	(6.2 x 352) +	(7.6 x 352) =	9,217.9
		1,270.8	498.4	505.4	332.1	627.3	388.3	738	2,182.4	2,675.2	
Bus	S. — N.W.	(3.6 x 512) +	(1.4 x 518) +	(1.4 x 529) +	(0.9 x 601) +	(1.7 x 601) +	(1.1 x 512) +	(2.0 x 601) +	(6.2 x 546) +	(7.6 x 546) =	14,171.6
		1,843.2	725.2	740.6	540.9	1,021.7	563.2	1,202	3,385.2	4,149.6	
	N.W. — S.	(3.6 x 507) +	(1.4 x 512) +	(1.4 x 529) +	(0.9 x 507) +	(1.7 x 507) +	(1.1 x 507) +	(2.0 x 507) +	(6.2 x 507) +	(7.6 x 507) =	13,169.1
		1,825.2	716.8	740.6	456.3	861.9	557.7	1,014	3,143.4	3,853.2	
M.V.	S. — N.W.	(3.6 x 639) +	(1.4 x 647) +	(1.4 x 658) +	(0.9 x 747) +	(1.7 x 747) +	(1.1 x 639) +	(2.0 x 747) +	(6.2 x 682) +	(7.6 x 682) =	17,678.1
		2,300.4	905.8	921.2	672.3	1,269.9	702.9	1,494	4,228.4	5,187.2	
	N.W. — S.	(3.6 x 636) +	(1.4 x 639) +	(1.4 x 658) +	(0.9 x 636) +	(1.7 x 636) +	(1.1 x 636) +	(2.0 x 636) +	(6.2 x 636) +	(7.6 x 636) =	16,507.4
		2,289.6	894.6	921.2	572.4	1,181.2	699.6	1,272	3,943.2	4,833.6	
H.V.	S. — N.W.	(3.6 x 670) +	(1.4 x 676) +	(1.4 x 687) +	(0.9 x 781) +	(1.7 x 781) +	(1.1 x 670) +	(2.0 x 781) +	(6.2 x 714) +	(7.6 x 714) =	18,563
		2,412	946.4	961.8	702.9	1,327.7	737	1,562	4,426.8	5,436.4	
	N.W. — S.	(3.6 x 665) +	(1.4 x 670) +	(1.4 x 687) +	(0.9 x 665) +	(1.7 x 665) +	(1.1 x 665) +	(2.0 x 665) +	(6.2 x 665) +	(7.6 x 665) =	17,261.3
		2,394	936	961.8	598.5	1,130.5	731.5	1,330	4,123	5,054	

$$V.O.C._{1991}^{Bypass} = 365 \sum T_{ij}.d_i.V.O.C._i$$

whereas, Total V.O.C.

	P.V. (70k/m)	29.22 km	x 265 cent	= 7,849
	L.V. (60k/m)	"	x 292	= 8,649
S. → N.W.	Bus (")	"	x 430	= 12,737
	M.V. (")	"	x 521	= 15,432
	H.V. (")	"	x 545	= 16,143
	P.V. (80k/m)	29.22 km	x 265 cent	= 7,849
	L.V. (70k/m)	"	x 292	= 8,649
N.W. → S.	Bus (")	"	x 428	= 12,677
	M.V. (")	"	x 519	= 15,373
	H.V. (")	"	x 542	= 16,054

Therefore,

$V.O.C._{1991}^{Bypass}$ (S. → N.W.) = 365 x (623 x 7,849 + 743 x 8,649 + 15 x 12,737 + 269 x 15,432 + 406 x 16,143)
= 81,074,202 Shill.

$V.O.C._{1991}^{Bypass}$ (N.W. → S.) = 365 x (623 x 7,849 + 743 x 8,649 + 15 x 12,677 + 269 x 15,373 + 406 x 16,054)
= 80,878,635 Shill

- $Time\ Benefit_{1991}$

$$P.V._{1991} = 59.09 \text{ cent} \times 1.8 \times 365 \sum T_p.d_p$$

whereas, d_p

		A104		Bypass	
P.V.	S. → N.W.	29.8 min.	-	25.39	= 4.41
	N.W. → S.	23.3	-	22.22	= 1.08

		A104		Bypass	
Bus	S. → N.W.	36.7 min.	-	29.62	= 7.08
	N.W. → S.	27.6	-	25.39	= 2.21

Therefore,

$P.V._{1991}$ = 59.09 x 1.8 x 365 x 4.41 x 623 = 1,066,710 Shill.

(S. → N.W.)

$P.V._{1991}$ = 59.09 x 1.8 x 365 x 1.08 x 623 = 261,050 Shill.

(N.W. → S.)

Bus_{1991} = 12.71 x 55.8 x 365 x 7.08 x 15 = 274,955 Shill.

(S. → N.W.)

Bus_{1991} = 12.71 x 55.8 x 365 x 2.21 x 15 = 85,848 Shill.

(N.W. → S.)

b) 2000 year

$$V.O.C._{2000}^{A104} = 365 \sum T_{ij} \cdot d_i \cdot V.O.C._i$$

whereas, T_{ij}

	P.V.	L.V.	Bus	M.V.	H.V.	(AADT)
S. → N.W.	1,065cent	1,266	16	296	499	
N.W. → S.						

, Total V.O.C. (link 1 → 9)

	P.V.	L.V.	Bus	M.V.	H.V.
S. ⟶ N.W.	10,206 cent	9,743	14,304	17,802	18,802
N.W. ⟶ S.	7,497	9,187	13,213	16,581	17,338

Therefore,

$V.O.C._{2000}^{A104}$ (S. ⟶ N.W.) = 365 x (1,065 x 10,206 + 1,266 x 9,743 + 16 x 14,304 + 296 x 17,802 + 499 x 18,802)
= 139,004,045 Shill.

$V.O.C._{2000}^{A104}$ (N.W. ⟶ S.) = 365 x (1,065 x 7,494 + 1,266 x 9,187 + 16 x 13,213 + 296 x 16,581 + 499 x 17,338)
= 121,886,640 Shill.

$V.O.C._{2000}^{Bypass} = 365 \sum T_{ij} \cdot d_i \cdot V.O.C._i$

whereas, total V.O.C. at Bypass in 2000 year as same as 1991 year, listed in page 17.

Therefore,

$V.O.C._{2000}^{Bypass}$ = 365 x (7,849 x 1,065 + 8,649 x 1,266 + 12,737 x 16 + 15,432 x 296 + 16,143 x 499)
= 109,997,276 Shill.

$V.O.C._{2000}^{Bypass}$ = 365 x (7,849 x 1,065 + 8,649 x 1,266 + 12,677 x 16 + 15,373 x 296 + 16,054 x 499)
= 109,764,917 Shill.

- $Time\ Benefit_{2000}$
- $P.V._{2000} = 59.09 \times 1.8 \times 365 \sum T_p \cdot d_p$
- $Bus_{2000} = 12.71 \times 55.8 \times 365 \sum T_b \cdot d_b$

whereas, d_p

Total V.O.C. on A104 in 2000 year

		1 (3.6)	2 (1.4)	3 (1.4)	4 (0.9)	5 (1.7)	6 (1.1)	7 (2.0)	8 (6.2)	9 (7.6)	
P.V.	S. — N.W.	(3.6 x 291)	+ (1.4 x 293)	+ (1.4 x 293)	+ (0.9 x 334)	+ (1.7 x 334)	+ (1.1 x 290)	+ (2.0 x 331)	+ (6.2 x 305)	+ (7.6 x 305)	= 10,206.4
		1,047.6	410.2	410.2	300.6	567.8	319	662	1,891	4,598	
	N.W. — S.	(3.6 x 290)	+ (1.4 x 291)	+ (1.4 x 291)	+ (0.9 x 290)	+ (1.7 x 290)	+ (1.1 x 289)	+ (2.0 x 289)	+ (6.2 x 289)	+ (7.6 x 289)	= 7,496.9
		1,044	407.4	407.4	261	493	317.9	578	1,791.8	2,196.4	
L.V.	S. — N.W.	(3.6 x 361)	+ (1.4 x 367)	+ (1.4 x 367)	+ (0.9 x 402)	+ (1.7 x 402)	+ (1.1 x 356)	+ (2.0 x 416)	+ (6.2 x 373)	+ (7.6 x 373)	= 9,743.4
		1,299.6	513.8	513.8	683.4	683.4	391.6	832	2,312.6	2,834.8	
	N.W. — S.	(3.6 x 357)	+ (1.4 x 361)	+ (1.4 x 361)	+ (0.9 x 356)	+ (1.7 x 356)	+ (1.1 x 353)	+ (2.0 x 353)	+ (6.2 x 353)	+ (7.6 x 353)	= 9,187.3
		1,285.2	505.4	505.4	605.2	605.2	388.3	706	2,188.6	2,682.8	
Bus	S. — N.W.	(3.6 x 529)	+ (1.4 x 549)	+ (1.4 x 549)	+ (0.9 x 601)	+ (1.7 x 601)	+ (1.1 x 512)	+ (2.0 x 601)	+ (6.2 x 546)	+ (7.6 x 546)	= 14,304.2
		1,904.4	768.6	768.6	1,021.7	1,021.7	563.2	1,202	3,385.2	4,149.6	
	N.W. — S	(3.6 x 518)	+ (1.4 x 529)	+ (1.4 x 529)	+ (0.9 x 512)	+ (1.7 x 512)	+ (1.1 x 507)	+ (2.0 x 505)	+ (6.2 x 505)	+ (7.6 x 505)	= 13,213.9
		1,864.8	740.6	740.6	870.4	870.4	557.7	1,010	3,131	3,385	
M.V.	S. — N.W.	(3.6 x 658)	+ (1.4 x 677)	+ (1.4 x 677)	+ (0.9 x 742)	+ (1.7 x 742)	+ (1.1 x 639)	+ (2.0 x 747)	+ (6.2 x 682)	+ (7.6 x 682)	= 17,802.1
		2,368.8	947.8	947.8	1,261.4	1,261.4	702.9	1,494	4,228.4	5,183.2	
	N.W. — S.	(3.6 x 647)	+ (1.4 x 658)	+ (1.4 x 658)	+ (0.9 x 639)	+ (1.7 x 639)	+ (1.1 x 636)	+ (2.0 x 636)	+ (6.2 x 636)	+ (7.6 x 636)	= 16,581.4
		2,329.2	921.2	921.2	1,086.3	1,086.3	699.6	1,272	3,943.2	4,833.6	
H.V.	S. — N.W.	(3.6 x 687)	+ (1.4 x 710)	+ (1.4 x 710)	+ (0.9 x 777)	+ (1.7 x 777)	+ (1.1 x 670)	+ (2.0 x 781)	+ (6.2 x 714)	+ (7.6 x 714)	= 18,801.9
		1,321.2	994	994	1,320.9	1,320.9	337	1,562	4,426.8	5,426.4	
	N.W. — S	(3.6 x 676)	+ (1.4 x 687)	+ (1.4 x 687)	+ (0.9 x 670)	+ (1.7 x 670)	+ (1.1 x 665)	+ (2.0 x 665)	+ (6.2 x 665)	+ (7.6 x 665)	= 17,337.7
		2,433.6	961.8	961.8	1,139	1,139	731.5	1,330	4,123	5,054	

		A104		Bypass	
d_p	S. → N.W.	33.5 min.	-	25.39	= 8.11
	N.W. → S.	25.5	-	22.22	= 3.28
d_b	S. → N.W.	43.1	-	29.62	= 13.48
	N.W. → S.	31.0	-	25.39	= 5.61

Therefore,

$P.V._{2000}$ = 59.09 x 1.8 x 365 x 8.11 x 1,065 = 3,343,035 Shill.
(S.→ N.W.)

$P.V._{2000}$ = 59.09 x 1.8 x 365 x 3.28 x 1,065 = 1,360,538 Shill.
(N.W.→ S.)

Bus_{2000} = 12.71 x 55.8 x 365 x 13.48 x 16 = 558,304 Shill
(S.→N.W.)

Bus_{2000} = 12.71 x 55.8 x 365 x 5.61 x 16 = 232,432 Shill.
(N.W.→ S.)

Appendix X

Appendix X-1

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON NAIROBI BYPASS CONSTRUCTION PROJECT
IN
THE REPUBLIC OF KENYA
AGREED UPON BETWEEN
THE MINISTRY OF TRANSPORT & COMMUNICATIONS
AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

NAIROBI 4th July, 1986

Mr. W. P. WAMBURA
Permanent Secretary

Ministry of Transport and
Communications (MOTC)

Mr. Toshiaki TACHIMORI
Leader of the Preliminary
Study Team
The Japan International
Cooperation Agency (JICA)

Mr. J. W. NJOROGE
for: Permanent Secretary
Ministry of Finance

Mr. Akira TAKAHASHI
Resident Representative
JICA, Nairobi Office

I. INTRODUCTION

In response to the request of the Government of the Republic of Kenya (hereinafter referred to as "Kenya"), the Government of Japan decided to conduct the Feasibility Study on Nairobi Bypass Construction Project in the Republic of Kenya (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programme of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government of Kenya.

The present document sets forth the scope of work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The Objective of the Study is to carry out a feasibility study on Nairobi Bypass Construction Project in Kenya.

III STUDY AREA

The Study area will cover the city of Nairobi and its environs.

IV. SCOPE OF THE STUDY

In order to achieve the objectives mentioned above the Study shall cover the following items.

1. Socio-Economic Surveys

(1). Data collection and interview with Government Department and concerning agencies for necessary items of the Study
(2). Field survey of existing land-use planning, existing city planning, existing road facilities, existing public transport network, present state of traffic conditions etc.
(3). Socio-economic activities forecast.

2. Traffic Surveys

(1). Traffic counts on selected roads
(2). Origin-destination surveys on selected roads
(3). Determining the existing, diverted, generated, and developmental traffic
(4). Other traffic studies to determine the existing trafffic patterns and to establish traffic desire lines
(5). Future traffic demand forecast.

3. Engineering Studys

(1). Identification of a most preferred alignment
(2). Soil and geological survey
(3). Hydrological Survey
(4). Materials survey
(5). Ground Survey
(6). Meteorological information
(7). Preliminary design
(8). Estimation of bills of quantities
(9). Estimation of Land acquisition cost, construction cost, and maintenance cost over the roads design life
(10). Possibilities of phased stage construction.

4. Economic Analysis

(1). Estimation of benefits
(2). Net Present value for the project
(3). Internal Rate of Return
(4). Benefit/Cost Ratio
(5). Sensitivity analysis

5. Project Evaluation and Recommendation

(1). Project evaluation
(2). Recommendation

V. STUDY SCHEDULE

The Study will generally be carried out in accordance with the attached tentative schedule.

VI. REPORTS

JICA will prepare and submit the following reports in English to the Government of Kenya.

1. Inception Report

   Twenty (20) copies at the beginning of field survey.

2. Progress Report

   Twenty (20) copies within six (6) months after commencement of the Study.

3. Interim Report

   Twenty (20) copies within ten(10) months after commencement of the Study.

4. Draft Final Report

   Twenty (20) copies within thirteen (13) months after commencement of the Study.

5. Final Report

   Fifty (50) copies within two (2) months after receiving the written comments on the Draft Final Report from the Government of Kenya. The comments made by the authorities concerned of Kenya, shall be submitted to JICA within three(3) weeks after explanation of the Draft Final Report.

VII. UNDERTAKING OF THE GOVERNMENT OF KENYA

1. To facilitate smooth conduct of the Study, the Government of Kenya shall take necessary measures;
   (1) to secure the safety of the Study team,
   (2) to permit the members of the Japanese Study team to enter, leave and sojourn in Kenya for the duration of their assignment therein, and exempt them from alien registration requirement (and consular fees),
   (3) to exempt the members of the Japanese Study team from taxes, duties and other charges on surveying and office equipment, machinery such as level, transit, typewriter, photo-copying machine, personal computer etc. and other materials brought into Kenya for the implementation of the study,
   (4) to exempt the members of the Japanese Study team from income tax and other charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Japanese Study team for their services in connection with the implementation of the study,
   (5) to provide necessary facilities to the Japanese Study team for remittance as well as utilization of the funds introduced into Kenya from Japan in connection with the implementation of the Study,
   (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
   (7) to secure permission for the Japanese Study team to take all data and documents (including photographs) to Japan, for analysis during the implementation of the Study,
   (8) to provide medical services as needed. Its expenses will be chargeable on the members of the Japanese Study team.

2. The Government of Kenya shall bear claims, if any arises against members of the Japanese Study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese Study team.

3. Ministry of Transport & Communications, (hereinafter referred to as "MOTC"), shall act as counterpart agency to the Japanese Study team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. MOTC shall, at its own expense, provide the Japanese study team with the followings, in cooperation with other organizations concerned;
   (1). available data and information related to the Study,
   (2). counterpart pesonnel,
   (3). suitable office space with necessary equipment in Nairobi,
   (4) credentials or identification cards.

VIII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall, take the following measures;

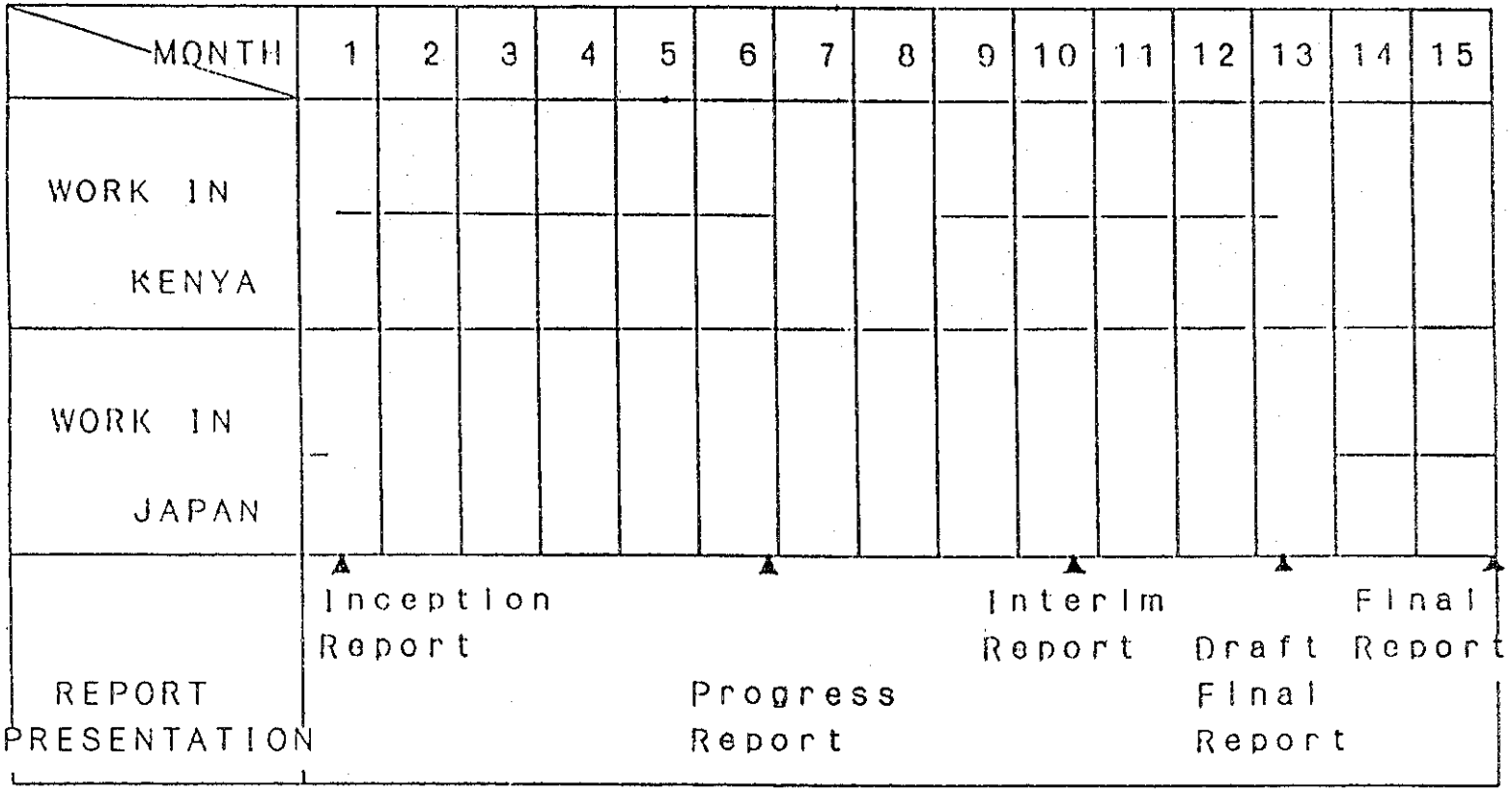
1. to dispatch, at its own expense, study team to Kenya,
2. to pursue technology transfer to the Kenya counterpart personnel in the course of the Study,
3. to provide the equipment and machinery for the implementation of the Study, which will remain the property of JICA unless otherwise agreed upon.

IX.

JICA and MOTC shall consult with each other in respect of any matter that is not agreed upon in this document and may arise from or in connection with the Study.

ATTACHMENT

Tentative Schedule



Appendix X-2

MINUTES OF MEETING
ON
SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
THE NAIROBI BYPASS CONSTRUCTION PROJECT
IN
THE REPUBLIC OF KENYA

NAIROBI, JULY 4, 1986

MR. W. P. WAMBURA
Permanent Secretary

Ministry of Transport and
Communications (MOTC)

MR. TOSHIAKI TACHIMORI
Leader of Japanese
Preliminary Study Team,
The Japan International
Cooperation Agency (JICA)

MR. AKIRA TAKAHASHI
Resident Representative
JICA, Nairobi Office

MINUTES OF MEETING

The Japanese Preliminary Survey Team (hereinafter referred to as "the Team") sent by the Japan International Cooperation Agency headed by Mr. T. Tachimori visited the Republic of Kenya from June 24 to July 7, 1986 for the purpose of getting mutual agreement on the Scope of Work for the Feasibility Study on the Nairobi Bypass Construction Project in the city of Nairobi and its environs (hereinafter referred to as "the Study").

The Team had a series of discussions with representatives from the Ministry of Transport and Communications (hereinafter referred to as "MOTC") and the Ministries concerned, and carried out field inspection in the study area.

Through those discussions, both sides agreed on the Scope of Work attached in Annex I.

Members' attendance lists of both sides are attached in Annex II.

The main items of mutual understanding in addition to the Scope of Work are as follows:-

I. NAIROBI BYPASS

Nairobi Bypass in the Study refers to the route passing through the southern part of the city of Nairobi.

II. UNDERTAKING OF THE GOVERNMENT OF KENYA

To facilitate smooth conduct of the Study, the Government of Kenya shall take the following necessary measures;

(1) Topographical Maps

- to provide topographical maps in the scale 1:2,500 by the middle of October, 1986.

(2) During the Traffic Survey

- to provide approximately 20 members of Traffic Survey Team organized by MOTC and arrange vehicles to transport the traffic surveyors to survey points within the city of Nairobi and its environs
- to make special arrangements with Police Department and appropriate Departments for the smooth implementation of the Traffic Survey including notification to the public

(3) During the Field Technical Survey

- to recommend the Japanese Study Team a local consulting engineer who can conduct survey works at reasonable cost
- to make arrangements for soil and material tests in the Materials Department of MOTC or approved commercial materials laboratories.

(4) Office of the Study Team

- to provide one office by the middle of October in the building of MOTC with the following equipment and service:
  - tables and chairs
  - 1 secretary
  - 1 telephone

(5) Counterpart Personnel

- to act as counterpart agency to the Japanese Study Team and organize a steering commitee which consists of governmental and non-governmental organizations related to the Study, such as Ministry of Finance, the City Council of Nairobi etc..

(6) Referring to VII. I. (3) in the Scope of Work

The said equipment etc. are foreseen necessary by the Team for the implementation of the Study. However, these may be changed owing to circumstances of the Japanese Study Team. Final list of the said equipment etc. shall be submitted to the Ministry of Finance through MOTC at the time when the Japanese Study Team presents the Inception Report to the Government of Kenya.

A N N E X II

MEMBER'S ATTENDANCE LIST

KENYAN SIDE

W P Wambura		Permanent Secretary, MOT&C
J K Kirika		Engineer-In-Chief, MoT&C
S M Kiguru		Chief Engineer(Roads & Aerodromes) MoT&C
S N Otonglo		Chief Superintending Engineer(D) MoT&C
J M Wanyoike		Senior Superintending Engineer(D) MoT&C
G N Muthigani		Superintending Engineer(D), MoT&C
K Tada		Bridges Engineer, MoT&C

JAPANESE SIDE

T Tachimori	Leader, Preliminary Study Team Japan International Cooperation Agency(JICA)
M Ikeda	Member of Team, JICA
T Tsuchishir	Member of Team, JICA
Y Kawamura	Member of Team, JICA
H Mochizuki	Member of Team, JICA
O Nakano	First Secretary, Embassy of Japan - Nairobi
A Takahashi	Resident Representative JICA, Nairobi Office
S Kaiho	Assistant Resident Representative JICA, Nairobi Office

Appendix X-3

MINUTES OF MEETING
ON
THE INCEPTION REPORT
FOR
FEASIBILITY STUDY
ON
THE NAIROBI BY-PASS CONSTRUCTION PROJECT
IN
THE REPUBLIC OF KENYA

7TH NOVEMBER, 1986

S.N. OTONGLO
Ag. Chief Engineer
(Road & Aerodromes)
Ministry of Transport
and Communication(MOTC)

HIROKAZU ITOH
Project Manager
Feasibility Study Team
for the Nairobi By-pass
Construction Project, JICA

TOSHIAKI TACHIMORI
Leader
Advisory Committee
for the Nairobi By-pass
Construction Project, JICA

The JICA study Team for Nairobi By-pass Construction Project together with the members of the JICA Advisory committee had some discussion with representatives from the Ministry of Transport and Communications (hereinafter referred to as "MOTC") on the Inception Report on November 4, 1986 at the office of MOTC.

The main items that were agreed upon by both sides are as follows:

a) Based on the results of the above discussion, the contents of the Inception Report are accepted by the Steering Committee.

b) The contents of the "Undertaking of the Government of Kenya" as described in Annex II are agreed by the Steering Committee.

The attendance list at the meeting is as in Annex I, and the Undertaking of the Government of Kenya is as in Annex II and the Steering Committee is as in Annex III.

Annex I

ATTENDANCE LIST

Kenyan Side

Ministry of Transport & Communication

1.	S.N. Otonglo	Ag. Chief Engineer (Roads & Aerodromes), MOTC
2.	J.M. Wanyoike	Senior Superintending Engineer, MOTC
3.	G.M. Muthigani	Superintending Engineer, MOTC
4.	K. Tada	Bridges Engineer, MOTC

Japanese Side

J I C A Advisory Committee

1.	Toshiaki Tachimori	Advisory Committee (Leader)
2.	Hidenori Yoshikane	Advisory Committee
3.	Hidetsugu Mochizuki	Coodinator

Nairobi By-pass Study Team (NBST)

1.	Horokazu Itoh	NBST (Project Manager)
2.	Katsunobu Furukawa	NBST
3.	Tsuyoshi Takahashi	NBST
4.	Hisashi Mutoh	NBST
5.	Shoichiro Hiraki	NBST

JICA Nairobi Office

1.	Akira Takahashi	Resident Representative
2.	Seiji Kaiho	Assistant Resident Representative

Annex II

UNDERTAKING OF GOVERNMENT OF KENYA

To facilitate smooth conduct of the Study, the Government of Kenya shall take the following necessary measures:

(1) Topographical Maps

- to provide topogrpahical maps in the scale of 1:2,500 (to inform the date of delivery by 15th November)

(2) During the Traffic Survey

- to provide 20 members of traffic survey team organized by MOTC

- to make arrangement 10 members of assistant surveyor of traffic survey team (with JICA's own expense).

- to make arrangement 1 Landrover by MOTC and 2 light ban by JICA to transport the traffic surveyors to survey points within the city of Nairobi and its environs.

- to make special arrangement with Police Department and appropriate Departments for the smooth implementation of the Trafffic Survey including notification to the public.

(3) During Field Technical Survey

- to recommend the study team a local consulting engineer who can conduct topographical survey in detail at bridges, culverts and intersections sites with road and railway.

- to make arrangements for soil and material tests in the Material Department of MOTC or approved commercial materials laboratories.

(4) Office of the Study Team

- to provide one office by the early November in the building of MOTC with the following equipment and service:

  a. 5-tables and chairs
  b. 1-secretary
  c. 1-telephone
  d. One office with furniture for 10 members of traffic surveyor to make calculation of the traffic data.

(5) Counterpart personnel

To give the names of counterpart, nominated assistant engineer, by the 15th November to work with the Study Team.

(6) Contact officer

To nominate the following personnels of MOTC to act as Study Team's contact officers.

a. Coodinating engineer	G.N. Muthigani
b. Traffic technical expert	Ochieng
c. Economic expert	Wakori
d. Highway technical expert	Gitonga
e. Structure technical expert	Muraguri
f. Soil & material technical expert	Mugambi

Annex III

STEERING COMMITTEE

1. Ministry of Transport and Communications
2. Ministry of Finance
3. City Council of Nairobi
4. Embassy of Japan, Kenya
5. Japan International Cooperation Agency

Appendix X-4

MINUTES OF MEETING

ON

THE PROGRESS REPORT

FOR

THE FEASIBILITY STUDY

ON

THE NAIROBI BYPASS CONSTRUCTION PROJECT

IN

THE REPUBLIC OF KENYA

NAIROBI 20TH MARCH, 1987

.....

S.N. OTONGLO
Chief Engineer
(Roads & Aerodromes)
Ministry of Transport and
Communications (M.O.T. & C.)

.....

HIROKAZU ITOH
Project Manager
Feasibility Study Team
for the Nairobi By-pass
Construction Project
The Japan International
Cooperation Agency (JICA)

.....

YUSO KAWAMURA

Member
Advisory Committee
for the Feasibility Study
on the Nairobi By-pass Construction
Project (JICA)

FEASIBILITY STUDY ON THE
NAIROBI BYPASS CONSTRUCTION PROJECT

The JICA Feasibility Study Team for the Nairobi By-pass Construction Project together with the members of the JICA Advisory Committee held a series of discussions with members of the steering committee, from M.O.T.& C. and the Nairobi City Commission, N.C.C. on the Progress Report of the above subject on 19th March, 1987 at the offices of M.O.T. & C.

The following items were agreed upon by both sides:-

a) The various chapters in the progress report were highlighted by Mr. Itoh and it was agreed that after the members have read through the report and made their comments, the comments will be forwarded to JICA by middle of May, 1987.

b) Chapter 8 of the progress report had been revised but the revised version was not available in the meeting. This revised version of chapter 8 will be bound in the report by Monday 23/3/1987.

c) Questions were raised on the present traffic congestion rates, and the PCU conversion rates for Matatus. Committee members were of the opinion that the congestion rates should be related to the hourly peak traffic volume which is more relevant to the urban set up rather than on AADT. The PCU conversion rate for Matatus should be higher than the one used in the analysis taking into consideration the Matatu driving patterns. This rate has been agreed with M.O.T. & C. Traffic Engineering Unit as 1.5 instead of 1.0.

Full explanation on the congestion rates will be given during the next meeting.

d) The section of road linking Nairobi's Industrial Area with Mombasa road is an important component of the Bypass. The meeting affirmed that the Kenya Government will take up the construction of the link at the time the Bypass is constructed.

The attendance list for both sides is as attached in Annex 1.

Annex I

ATTENDANCE LIST

Kenyan Side

1.	S. N. Otonglo	Chief Engineer (Roads & Aerodromes) M.O.T. & C.
2.	J. M. Wanyoike	Ag. Chief Superintending Engineer (Desig M.O.T. & C.
3.	G. N. Muthigani	Superintending Engineer (Design) M.O.T. & C.
4.	K. Tada	Bridges Engineer M.O.T. & C.
5.	J. P. Muraguri	Bridges Engineer M.O.T. & C.
6.	D. W. Mugambi	Engineer (Materials Branch) M.O.T. & C.
7.	A. Gitonga	Engineer (Design) M.O.T. & C.
8.	P. M. K. Kiiyukia	Survey Section M.O.T. & C.
9.	M. E. Agalochieng'	Senior Superintendent Traffic Unit M.O.T.& C.
10.	D. W. Njora	Deputy City Engineer N.C.C.
11.	S. Gichohi	City Engineer's N.C.C.
12.	S. Mindri	Asst. Engineer (Design) M.O.T. & C. Counter part
13.	H. O. Moranga	Asst. Engineer (Design) M.O.T. & C. Counter part
14	P. O. Oloo	Asst. Engineer (Design) M.O.T. & C. Counter part.

Japanese Side

JICA Advisory Committee

1. Yuso Kawamura
2. Hidenori Yoshikane

JICA Nairobi Office

1.	Seiji Kaiho	Assistant Resident Representative

Feasibility Study Team for the Nairobi By-pass Construction Project

1.	Hirokazu Itoh	Project Manager
2.	Ko Kuwata	Highway Engineer - Member

Appendix X-5

MINUTES OF STEERING COMMITTEE MEETINGS

ON

THE INTERIM REPORT

FOR

THE FEASIBILITY STUDY

ON

THE NAIROBI BYPASS CONSTRUCTION PROJECT

IN

THE REPUBLIC OF KENYA

NAIROBI 31ST AUGUST, 1987

ENG J M WANYOIKE
for: ENG S N OTONGLO
Chief Engineer
(Roads & Aerodromes)
Ministry of Transport and
Communications (M.O.T. & C.)

HIROKAZU ITOH
Project Manager
Feasibility Study Team
for the Nairobi Bypass
Construction Project
The Japan International
Cooperation Agency (JICA)

YUSO KAWAMURA
Member
Advisory Committee
for the Feasibility Study
on the Nairobi Bypass Construction
Project (JICA)

The JICA Feasibility Study Team for the Nairobi Bypass Construction Project with the members of the JICA Advisory Committee held a meeting with the members of the Steering Committee from M.O.T&C. and the Nairobi City Commission, during the presentation of the Interim Report on the above project by the Study Team on 27th August,1987 at the office s of M.O.T.&C.

1. The meeting was opened with an address from the Chairman expressing deep appreciation by the Kenya side for the cooperation extended by the Japanese Government in undertaking the Feasibility Study for the Nairobi Bypass Construction Project. He also welcomed members of the JICA Advisory Committee.

2. Mr. Kawamura, on behalf of the JICA Advisory Committee, expressed sincere gratitude to the Kenya side for the close cooperation extended to the Study Team and hoped that the study findings, results and recommendations would be helpful in the implementation of the Project.

3. Twenty copies of the Interim Report were submitted and presented by the Study Team. The leader of the Study Team pointed out that the submisssion schedule for the reports had been changed. The Draft Final Report would be submitted by middle of November, 1987 and the Final Report would be submitted by middle of February, 1988 instead of December, 1987.

4. The Chairman pointed out that the reports should have been forwarded to the steering committee at least 2 weeks prior to the meeting to give the steering committee members enough time to study the documents. In this case, the documents were being circulated to the members during the meeting. It was therefore agreed that detailed comments would be forwarded in 2 weeks time, by the members of the Steering Committee.

5. The study team leader presented the report to the committee highlighting the various topics contained in it. During the presentation the members of the committee raised comments on some aspects of the report.

   These included the traffic analysis, materials investigation: alignment soil testing, and pavement design.

   Several omissions were also noted. These were :

   (a) The priced bill of quantities

   (b) Calculation of direct and indirect benefits and

   (c) The maintenance cost

   The Study Team in consultation with the JICA Advisory Committee presented a memorandum to the steering committee meeting 28th August, 1987 (see Annex 1). The committee accepted the measures proposed in the memorandum.

   An attendance list for the meeting on 27th August, 1987 is shown on Annex II.

Annex I

Memorandum on the Presentation of Interim Report on Feasibility study for Nairobi Bypass.

The study team proposes to undertake the following measures to facilitate the feasibility study:-

1. Preparation of a Revised Interim Report to be submitted at the end of September, 1987. The revised report shall include among others:-

   (a) Items which were to be incorporated in the Interim Report such as

      (i) Priced bill of quantities

      (ii) Maintenance cost

      (iii) Calculation of direct and indirect benefits

   (b) Items which were to be included in the draft Final Report

      (i) Estimation of Economic cost

      (ii) Analysis of economic evaluation (B/C, N.P.V, IRR and sensitivity Analysis)

   (c) Future study schedule.

2. Relevant comments on the Interim Report shall be submitted by M.O.T.&C to the Study Team within two weeks from 27th August, 1987 and shall be incorporated either in the Revised Interim Report or the Draft Final Report where appropriate.

3. A meeting of the steering Committee shall be held to discuss the Revised Interim Report at the beginning of October, 1987.

ATTENDANCE LIST

ANNEX 11

Kenyan Side

1.	J. M. Wanyoike (Chairman)	Ag. Chief Superintending Engineer (Design), M.O.T.&C
2.	G. N. Muthigani	Superintending Engineer (Design) M.O.T&C.
3.	K. Tada	Bridges Engineer, M.O.T.&C
4.	P. M. Wakori	Superintending Engineer (Planning M.O.T.&C
5.	M. E. Agalochieng	Officer-In-Charge Traffic Engineer Unit (Planning) M.O.T.&C
6.	S. M. Ngare	Superintending Engineer (Design) M.O.T.&C
7.	D. M. Mugambi	Engineer (Materials Branch) M.O.T.&C.
8.	B. M. Njoroge	Bridges Engineer, M.O.T.&C.
9.	E. R. Waithaka	Nairobi City Commission
10.	S. Gichohi	Nairobi City Commission
11.	P. K. Kiiyukia	Senior Supt. Surveyor

Japanese Side

JICA Advisory Committee

1.	Y. Kawamura	
2.	M. Ikeda	
3.	T. Nakano	

JICA Nairobi Office

1.	A.Takahashi	Resident Representative
2.	S. Kaiho	Assistant Resident Representati

JICA Feasibility Study Team

1.	H. Itoh	Project Manager
2.	K. Kuwata	Highway Engineer
3.	Y. Higashi	Structure Engineer
4.	K. Furukawa	Economist
5.	T. Kozawa	Construction Planning and Cost Estimate

Appendix X-6 MINISTRY OF TRANSPORT AND COMMUNICATIONS

Telephone: Nairobi [illegible]
Telegraphic Address: "Stevone"
If calling or telephoning ask for
.....
When replying please quote
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and date

ROADS AND AERODROMES DEPARTMENT
P.O. Box 52692
NAIROBI
15th October 87

The Chief Engineer (Planning)
M.O.T. & C.
Nairobi.

Attention Mr. Wakori

The Chief Materials Engineer
P.O. Box 11873,
Nairobi.

Attention Mr. Bikeri

The City Engineer
Nairobi City Commission
P.O. Box 30075
Nairobi.

Attention Mr. Waithaka

The Senior Supt. Engineer (Bridges)
M.O.T. & C. Hq.,
Nairobi.

Attention Mr. Tada & Mr. Njoroge

The Senior Supt. Engineer (Survey)
M.O.T.C. Hq.,
Nairobi.

The Study Team Leader
Nairobi By-Pass Road Feasibility Study Project
Nairobi.

Mr. Kaiho
JICA
P.O. Box 50572
Nairobi.

MINUTES OF STEERING COMMITTEE MEETING ON REVISED INTERIM REPORT ON FEASIBILITY STUDY FOR NAIROBI BY-PASS ROAD HELD ON 14TH OCTOBER, 1987 IN ENGINEERS REGISTRATION BOARDROOM, M.O.T.C. HQ.,

Please find enclosed the minutes of the above referred meeting for your perusal and retention.

(Eng. S. N. Otonglo)
CHIEF ENGINEER (ROADS & AERO)

Encl.

MINUTES OF THE STEERING COMMETTEE MEETING ON REVISED INTERIM REPORT ON FEASIBILITY STUDY FOR NAIROBI BY-PASS ROAD HELD ON 14TH 1987 IN ENGINEERS REGISTRATION BOARDROOM MOTC, HQ.

PRESENT

1.	J.M. Wanyoike	-	M.O.T.C. - Chairman
2.	H. Ito	-	Study Team
3.	K. Kuwata	-	" "
4.	K. Furukawa	-	" "
5.	R. Tamaishi	-	OECF, Nairobi
6.	K. Tada	-	M.O.T.C.
7.	H. Bikeri	-	M.O.T.C.
8.	S. Kaiho	-	JICA, Kenya
9.	B. M. Njoroge	-	M.O.T.C.
10.	P.K. Kiiyukia	-	M.O.T.C.
11.	P.M. Wakori	-	M.O.T.C.
12.	E.R. Waithaka	-	Nairobi City Commission
13.	S. M. Ngare	-	M.O.T.C. - Taking Minutes.

INTRODUCTION

The Chairman opened the meeting at 9.07 a.m. and started by welcoming the participants and outlining the purpose of the meeting. The participants were then requested to introduce themselves.

After introduction, the Chairman highlighted in detail the comments on Revised Interim Report and in particular thanked the Study Team for producing a definetely better report than the previous one. However, he pointed out that there is scope for further editing before the Draft Final Report is presented. He also pointed out that the traffic assignment has been done using shortest travel distance method as requested in the previous meeting but has been included in the Appendix instead of the main report. He hoped that this will be done in Draft Final Report. He then called upon the Study Team Leader to present the Interim Report.

The Study Team Leader outlined the report and especially highlighted on the economic assessment of the feasibility study. He indicated that the economic analysis might not be carried out exhaustively because of time constraints.

The Chairman then invited comments from participants and there were dealt as follows:

1. ECONOMIC ANALYSIS

It was noted that the Study Team has used 10% as the opportunity cost of capital in Kenya whereas this Ministry has adopted 12%. It is quite apparent that lowering the opportunity cost will have the effect of making the project viable.

The Study Team has assessed the economic costs at 65% of financial costs, and they consider this figure to be conservative since such items as shadow pricing was not taken into account. Mr. Wakori indicated that this Ministry uses approximately 80% of financial costs and can show the Study Team how they arrive at such figure.

The Study Team wanted the discussion on economic analysis to be deferred until at Draft Final Stage since they are revising it. The JICA representative indicated that there are some streams of benefits which were not included in the report. The Chairman pointed out all those benefits should have been indicated earlier since the documents have been circulated for all members to comment, and therefore the participants do not expect an unusual new changes in the evaluation of economic analysis.

After discussion, it was resolved that the Study Team will undertake the following measures:-

(i) Discount the streams of cost and benefits at 12% in addition to the discounting of the same at their calculated opportunity cost of capital of 10%.

(ii) Indicate the three decision criteria, namely, the Internal Rate of Return, the Benefit/cost ratio and the Net Present Value.

(iii) Include the economic analysis in the Draft Final.

2. MATERIAL INVESTIGATIONS

The Materials Engineer said that the traffic analysis for pavement design has now been amended. However, the soil site investigations should have been carried out exhaustively especially on the first 6 km. The Study Team assumed that from Mombasa Junction to Uhuru Monument Junction, the alignment soil consists of black cotton for about 1.0 metre depth whereas this should be supported by facts.

The JICA representative indicated that the work requested by Materials Branch to be done is extra work. However, the Chairman pointed out that this was not extra work since the inception report did not explicitly indicate where the trial pits should be dug.

It was resolved that the Study Team will incorporate all the comments from Material Branch as indicated through our letter Ref. No. R5054/P124 of 14th September, 1987 in the Draft Final Report.

3. MOMBASA ROAD LAYOUT JUNCTION

It was noted that the proposed junction at Mombasa Road does not provide for all manouvres required by vehicles. This was pointed out in the Report but has not been incorporated in the Revised Interim Report. The Study Team indicated that traffic demand forecasts did not warrant ramps for the manourvres indicated. The City Commission representative observed that the area to the North of Mombasa Road has been earmarked for residential development and construction of 80 medium class estates has already commenced and are due for occupation in early next year. Therefore the traffic demand forecast cannot be assessed at nearly zero.

The Study Team in consultation with City Commission undertook to consider the junction layout so that all manouvres required by the vehicles are taken into account.

The City Commission representative informed the meeting that a junction has been proposed at around South C to the By-pass by Physical Planners to take care of traffic to be generated by South C estate. After discussion, it was decided that it should not be included in the By-Pass project but can be looked on its own merit when the development of South C takes place fully.

4. ANY OTHER BUSINESS

The schedule allows for about 12 days between this meeting and submission of Draft Final and Mr. Ngare wanted to know if this period is adequate for the Study Team to incorporate all the comments in the Draft Final. The Study Team indicated that the schedule should remain the same since they will be able to do all the work requested within the time limit.

The Chairman stressed the importance of punctuality and hoped that the participants will observe the times set for the meetings strictly.

There being no other business, the meeting ended at 11.00 a.m.

CHAIRMAN ..... SECRETARY .....

DATE ..... 5/12/87 ..... 19 ...

Appendix X-7

19th October,1987.

Ref: No. JICA 87-8

Eng. S. N. Otonglo,
Chief Engineer (Road & Aerodrome),
M.O.T.C. Hq.,
NAIROBI.

MEMORANDUM FOR THE STEERING COMMITTEE MEETING ON REVISED INTERIM REPORT ON FEASIBILITY STUDY FOR NAIROBI BY-PASS ROAD HELD ON 14TH OCTOBER 1987 IN ENGINEERS REGISTRATION BOARDROOM MOTC, HQ..

In connection with the discussion of the captioned Steering Committee Meeting, I am pleased to mention our way for disposal of the comments by the members of the committee as follows:-

1. ECONOMIC ANALYSIS.

1). As for the comment of the ratio between financial cost and economic cost. About 80% in Kenya should be compared with the rate of 76.6%, which can be given as follows.

Economic initial capital investment cost, 395,596 x 10^3 Shill. in the Table IX-1-1, page IX-5 / financial capital investment cost, 516,463 x 10^3 Shill. = 76.6%.

395,596 x 10^3 Shill. is used for economic evaluation. Additional minor difference is supposed to come out by the deduction of Tax and Duty.

Besides, 65.5% is calculated, based on the assumption described in (4) Exemption of Price Escalation in page IX-3.

2). As for the conversion rate from financial to economic term of maintenance cost

Economist for the Study team has followed the conventional methodology, which is fully admitted in transport economics.

Differential of strictly calculated figure to that of conventional way is neglible difference and/or admittable error.

3). The Study Team will undertake the following measures:-

(i). Discount the streams of cost and benefits at 12% in addition to the discounting of the same at their calculated opportunity cost of capital of 10%.

(ii). Indicate the three decision criteria, namely, the Internal Rate of Return, the Benefit/Cost Ratio and the Net Present Value.

(iii). Include the economic analysis in the Draft Final.

2. MATERIAL INVESTIGATION.

With two numbers of mechanical boring made at Mombasa Junction beginning site on the first 6 km, and with reference material as a geological map it is acceptable in general to estimate the formation of the ground. However, over the 6 km long auger boring would be made with adequate intervals in order to confirm the layers of the ground, of which results would be refered to MOTC.

3. MOMBASA ROAD LAYOUT JUNCTION.

In accordance with the results of the traffic study by the Study Team, it is presented that very small number of traffic will move by the junction between Nairobi City and the Industrail Area.

However, as Nairobi City Commission strongly requested another layout of the junction to serve traffics of full direction, after discussion with M.O.T.C., N.C.C. and the consultants two layouts (shown in Fig. VII-1-4 A and Fig. VIII-1-4 B) were planned as reference. And additional construction costs of them were roughly estimated and are shown in Appendix VIII.1.

H.ITO
The Study Team Leader
Nairobi By-pass Road Feasibility Study Project
Nairobi.

c.c. Mr. J.M. Wanyoike
Chief Supt. Engineer (Design) MOTC.

Mr. Wakori
The Chief Engineer (Planning) MOTC.

Mr. Bikeri
The Chief Materials Engineer, P.O. Box 11873, Nairobi.

Mr. Waithaka
The City Engineer (Nairobi City Commission) P.O.Box 30075 NRB.

Mr. Tada & Mr. Njoroge
The Senior Supt. Engineer (Bridges)MOTC Hq.,

The Senior Supt. Engineer (Survey)
MOTC Hq.,

The Resident Representative JICA Nairobi

File.

Appendix X-8

MINUTES OF STEERING COMMITTEE MEETING

ON

THE DRAFT FINAL REPORT

FOR

THE FEASIBILITY STUDY

ON

THE NAIROBI BYPASS CONSTRUCTION PROJECT

IN

THE REPUBLIC OF KENYA

ENG. J. M. WANYOIKE
Ag: Chief Supt. Engineer
for: ENG. S. N. OTONGLO
(Roads & Aerodromes)
Ministry of Transport and
Communications (M.O.T. & C.)

HIROKAZU ITOH
Project Manager
Feasibility Study Team for
the Nairobi Bypass Construction
Project
The Japan International
Cooperation Agency (JICA)

TOSHIAKI TACHIMORI
Leader
Advisory Committee
for the Feasibility Study
on the Nairobi Bypass Construction
Project JICA

NAIROBI 10TH NOVEMBER, 1987

FEASIBILITY STUDY ON THE NAIROBI BYPASS

CONSTRUCTION PROJECT

The JICA Feasibility Study Team for the Nairobi Bypass Construction Project with the members of the JICA Advisory Committee held a meeting with the members of the Steering Committee from M.O.T. & C. and the Nairobi City Commission during the presentation of the Draft Final Report on the above refered subject by the Study Team on 9th November, 1987 at the offices of M.O.T. & C. The Minutes of the meeting are as follows:-

1. The meeting was opened with an address from the Chairman expressing deep appreciation by the Kenya side for the cooperation extended by the Japanese Government in undertaking the Feasibility Study for the Nairobi Bypass Construction Project. He also welcomed members of the JICA Advisory Committee.

2. Mr. Tachimori, on behalf of the JICA Advisory Committee, expressed sincere gratitude to the Kenya side for the close cooperation extended to the Study Team and hoped that the Study findings, results and recommendations would be helpful in the implementation of the Project.

3. The Project Manager of the Study Team presented the Report to the Steering Committee highlighting the salient points contained therein.

4. During the meeting, a variety of comments and opinions were raised for which major points were summarised as follows:-

   (i) Although the Report has been accepted in principle, a further clarification on the details of traffic assignment and resultant economic analysis shall be necessary. The clarifications shall be channelled through JICA Kenya Office.

   (ii) The present layout of Mombasa Junction proposed by the Study Team was accepted. Additional construction costs of alternatives of the Mombasa Juncation as requested by the Nairobi City Commission which have already been shown in Appendix of the Draft Final Report shall be indicated in the Final Main Report but shall not be included in total construction cost and in the economic assessment of the project. This point will be stated in the Final Main Report.

   (iii) Official comments on the Draft Final Report from the Government of Kenya should be submitted to JICA within three weeks from 9th November, 1987 (by the end of November) as stipulated in the Scope of Work for the Project. The comments shall be incorporated in the Final Report to be submitted in February, 1988.

An attendance list for the meeting is shown on Annex I.

ATTENDANCE LIST

ANNEX I.

Kenyan Side

1.	J. M. Wanyoike (Chairman)	Ag. Chief Superintending Engineer (Design), M.O.T. & C.
2.	S. M. Ngare	Superintending Engineer (Design), M.O.T. & C.
3.	K. Tada	Bridges Engineer, M.O.T. & C.
4.	M. E. Agalochieng	Officer-In-Charge Traffic Engineer Unit (Planning) M.O.T. & C.
5.	D. M. Mugambi	Senior Superintending Engineer (Materials Branch) M.O. T. & C.
6.	A. Gitonga	Superintending Engineer, M.O.T. & C.
7.	B. M. Njoroge	Bridges Engineer, M.O.T. & C.
8.	P. K. Kiiyukia	Senior Superintending Surveyor M.O.T. & C.
9.	E. R. Waithaka	Nairobi City Commission

Japanese Side

JICA Advisory Committee

1.	T. Tachimori	Leader
2.	Y. Kawamura	Member
3.	N. Horiguchi	JICA HDQ.

JICA Kenya Office

1.	S. Kaiho	Assistant Resident Representative

JICA Feasibility Study Team

1.	H. Itoh	Project Manager
2.	K. Kuwata	Highway Engineer
3.	K. Furukawa	Economist

OECF Nairobi Office

1.	R. Tamaishi	Representative

Appendix X-9

MINISTRY OF TRANSPORT AND COMMUNICATIONS

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When replying please quote
Ref. No. R.7305/P.124
and date

ROADS AND AERODROMES DEPARTMENT
P.O. Box 52692
NAIROBI

18th November 19 87

SD 4495 2/3

The Study Team Leader,
Nairobi By-Pass Feasibility Study Project

Thro'

Resident Representative
JICA
P.O. Box 50572
Nairobi.

Dear Sir,

DRAFT FINAL REPORT FOR FEASIBILITY STUDY ON THE NAIROBI BY-PASS ROAD PROJECT

I refer to a meeting held on 9th November, 1987 at M.O.T.C. Hqs. for the discussion of the above referred report. The following are our comments:-

1. The report still needs editing. It seems that Revised Interim Report was not edited as requested at the Steering Committee meeting on 14th October, 1987. In this regard, there is little difference between the Draft Final Report and the Revised Interim Report. It is hoped that more editing will be done for the Final Report.

2. It was quite apparent at the said meeting that the outstanding issues in the report concerns traffic and economic analysis. In this connection, the following points were noted:-

   (a) On page IV-11 of the Draft Final Report (Summary), there is a table showing future AADT on the various alternatives of the by-pass. However, there is no mention of the alternative chosen. Furthermore, there appears to be no correlation between this Table and Table IV-3-3 on page IV-12 which shows future traffic of the bypass by link. While future traffic on page IV-11 ranges from 9,000 to 22,000, future traffic on page IV-12 ranges from 9,433 to 25,594.

   (b) It is not explicitly stated in the report the total traffic used in the calculation of benefits. However, it was said that the traffic on page IV-12 is the one that was used in the calculation of benefits. Two questions arise from this:-

(i) Why was the traffic on page IV-11 not used?

(ii) Why is there so much of a discrepancy between the traffic on page IV-12 of the Summary report and the IV-13 of the main report? Through traffic plus the diverted traffic from Zones inside Nairobi comprise only a small portion of the traffic used in the calculation. It was obvious that traffic induced from other roads other than A104 has been considered. This traffic is far in excess of the traffic diverted from A104. It was not explained why this is so. Furthermore, what are the results of the traffic survey with respect to the proportion of traffic expected to be induced from these other roads?

(c) The report states that traffic on A104 that has its origin or destination outside Nairobi is considered as through traffic. This was pointed out at the meeting that it is not practical at all. Trip purpose should be considered before such trips are considered to be through traffic. Nairobi as such is well placed for accommodation, shopping etc. and cannot be easily by-passed A factor not equal to unity should have been established to convert through traffic to bypass traffic.

(d) The Interim Report rightly considered the benefits due to induced traffic at 50% of the benefits due to normal traffic. However, in the Draft Final Report the benefits has been escalated to 100% without indicating any reasons thereof.

(e) In the economic analysis, it is apparent that time savings were considered. Time savings usually become important if they exceed 30 minutes. It is, however, difficult to see how differentials in time between the bypass and A104 can be of this magnitude given the differentials in lengths. In fact differentials in time as shown on Table IX-2-4 on page IX-23 of main report appear negligible in view of the fact that the saved time cannot be put into any significant use.

(f) In general, the traffic assignment approach and the resultant economic analysis needs to be re-examined.

(g) It is hoped that the comments will be incorporated in the Final Report.

Yours faithfully,

(Eng. S. N. Otonglo)
CHIEF ENGINEER (ROADS & AERO.)
for: PERMANENT SECRETARY.