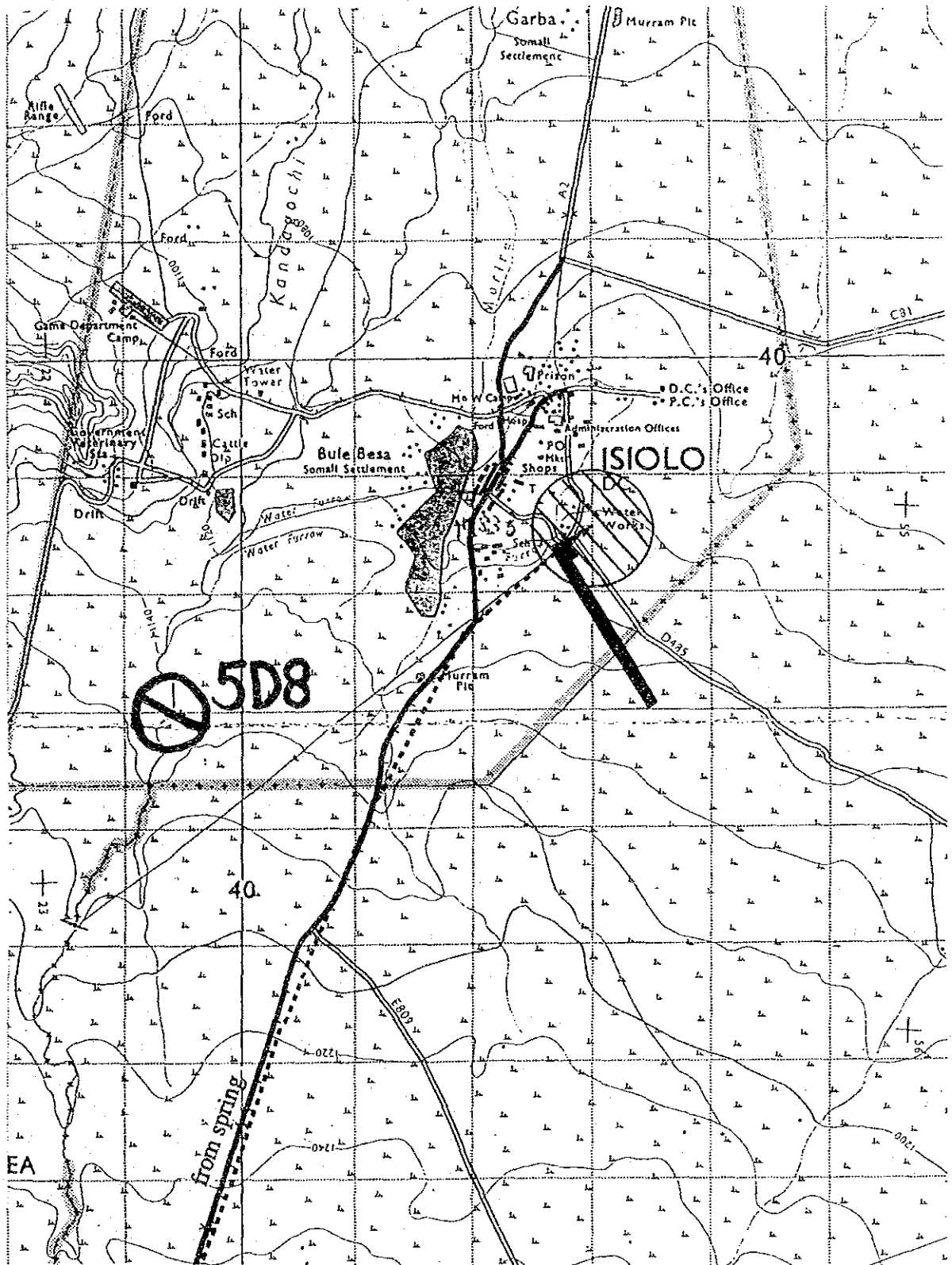
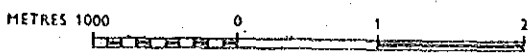


a	b	c	d	e	f	g	h	i
2						National Water Master Plan		
3			URBAN WATER SUPPLY					Jul-92
4	Code No. 420		U- 41			Rate		25.2
5	-----							
6	Name of Urban:		Isiolo		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):				421.1	Central		
9	District:		Isiolo	Locataion :				
10	Map ( 1/50,000 ):		108/1	Coordinates X:		37°35'	Y:	N 00°21'
11	Sub-basin Code:		SDA	Elevation (EL. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Isiolo River			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		1250		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		15,900	49,200	88,100	
22	Residential Demand		(m3/d)		1,970	6,230	11,398	
23	Non-residential Demand		(m3/d)		330	1,018	1,824	
24	Livestock Demand		(m3/d)		551	1,993	5,234	
25	Industrial Demand		(m3/d)		172	318	458	
26	Total Demand		(m3/d)		3,023	9,559	18,914	
27	Area Served ( estimated net )		(ha)		119	367	658	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Boreholes + Spring			River No:		
31	Raw Water System:		H (m)=	0 L (m)=		1,245,000	14,000	
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		1,772.6	6,536.3	9,355.0	17,663.9
37	Source Works		(US\$'000)		3,501.9	12,902.9	18,463.8	34,868.6
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		5,168.6	19,218.9	28,256.4	52,643.9
40	Treatment		(US\$'000)		578.3	1,032.2	1,151.7	2,762.2
41	Storage		(US\$'000)		98.6	281.5	402.9	783.0
42	Distribution		(US\$'000)		949.9	1,989.5	2,324.0	5,263.4
43	Miscellaneous (20%)		(US\$'000)		2,059.5	7,085.0	10,119.8	19,264.2
44	Admi. & Engineering		(US\$'000)		1,235.7	4,251.0	6,071.9	11,558.5
45	Contingency		(US\$'000)		2,718.5	9,352.2	13,358.1	25,428.8
46	Total Cost		(US\$'000)		16,310.9	56,113.0	80,148.7	152,572.6
47	Cost per Capita		(US\$/c)		1,025.8	1,685.1	2,060.4	
48	Cost per ha		(US\$/ha)		137,365.7	225,641.0	275,896.1	
49	Cost per m3		(US\$/m3)		9.2	8.6	8.6	8.6
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		815.5	2,805.7	4,007.4	
53	Capital Costs		(US\$'000)		1,680.0	5,779.6	8,255.3	
54	Total Annual Cost		(US\$'000)		2,495.6	8,585.3	12,262.8	
55	Unit Cost per m3		(US\$/m3)		3.9	3.6	3.6	
56	-----							
57	Remarks:	Groundwater will be exploited to a maximum extent. As an alternative, water conveyance from the Meru						
58		system or from 2 springs which are located 14 km south at Isiolo town is considered. In this study, it was						
59		planned that the urban centre will depend on boreholes as well as springs, assuming a half of the demand						
60		is supplied by boreholes.						
61								
62								
63	-----							



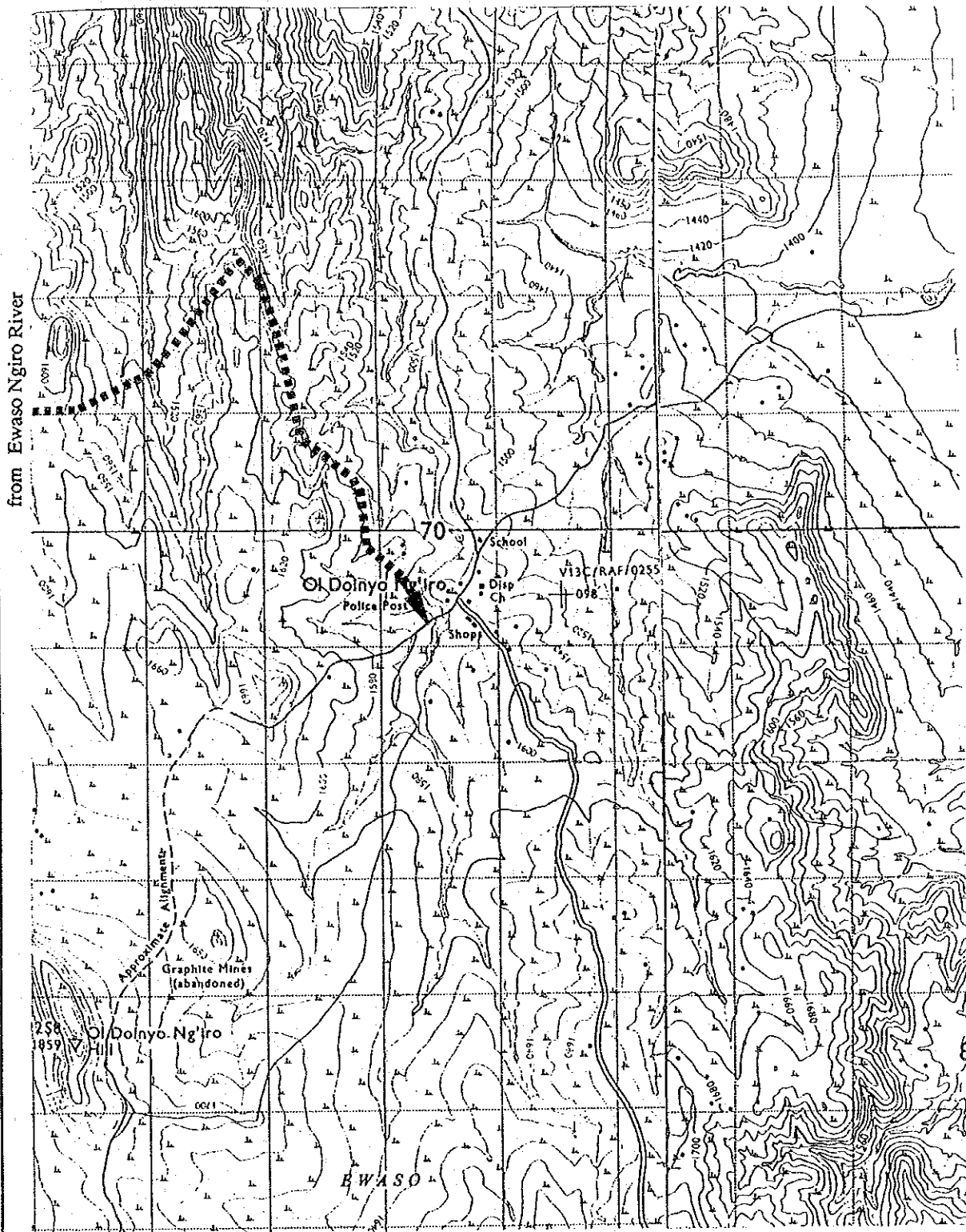
U- 41 Isiolo

421.1 108/1



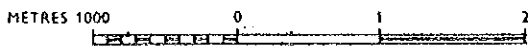
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 420		U- 42			Rate		25.2	
5	-----								
6	Name of Urban:		Ol Doinyo Ng'iro		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):					421.2	Oldonyonyiro		
9	District:	Isiolo	Locataion :				36°59'	Y: N 00°38'	
10	Map ( 1/50,000 ):	92/4	Coordinates X:						
11	Sub-basin Code:	5DD	Elevation (El. m):						
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Sub-surface dam				River No		
15	Raw Water System:		H (m)=		L (m)=				
16	Treatment:				Capacity (m <sup>3</sup> /d)				
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)	4,400		11,000	17,600		
22	Residential Demand		(m <sup>3</sup> /d)	545		1,393	2,277		
23	Non-residential Demand		(m <sup>3</sup> /d)	91		227	363		
24	Livestock Demand		(m <sup>3</sup> /d)	152		444	1,041		
25	Industrial Demand		(m <sup>3</sup> /d)	0		0	0		
26	Total Demand		(m <sup>3</sup> /d)	788		2,064	3,681		
27	Area Served ( estimated net )		(ha)	33		82	131		
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Ewaso Ngiro River				River No:		
31	Raw Water System:		H (m)=	100	L (m)=		17,000		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m <sup>3</sup> /d)	788.1		1,275.3	1,617.1	3,681.0	
37	Source Works		(US\$'000)	8.9		12.7	15.2	36.7	
38	Pump Cost		(US\$'000)	3.9		4.7	5.4	14.0	
39	Raw Water Main		(US\$'000)	774.2		841.4	882.2	2,497.8	
40	Treatment		(US\$'000)	373.8		486.8	551.6	1,412.1	
41	Storage		(US\$'000)	64.4		83.6	94.3	242.3	
42	Distribution		(US\$'000)	262.9		394.3	394.3	1,051.5	
43	Miscellaneous (20%)		(US\$'000)	297.6		364.7	388.6	1,050.9	
44	Admi. & Engineering		(US\$'000)	178.6		218.8	233.2	630.5	
45	Contingency		(US\$'000)	392.8		481.4	512.9	1,387.2	
46	Total Cost		(US\$'000)	2,356.9		2,888.5	3,077.6	8,323.0	
47	Cost per Capita		(US\$/c)	535.7		437.7	466.3		
48	Cost per ha		(US\$/ha)	71,727.5		58,605.0	62,440.7		
49	Cost per m <sup>3</sup>		(US\$/m <sup>3</sup> )	3.0		2.3	1.9	2.3	
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)	117.8		144.4	153.9		
53	Capital Costs		(US\$'000)	242.8		297.5	317.0		
54	Total Annual Cost		(US\$'000)	360.6		441.9	470.9		
55	Unit Cost per m <sup>3</sup>		(US\$/m <sup>3</sup> )	1.3		0.9	0.8		
56	-----								
57	Remarks:	Pumping from Ewaso Ngiro is relatively costly. Maximum development of groundwater							
58		and subsurface resources should be searched.							
59									
60									
61									
62									
63	-----								



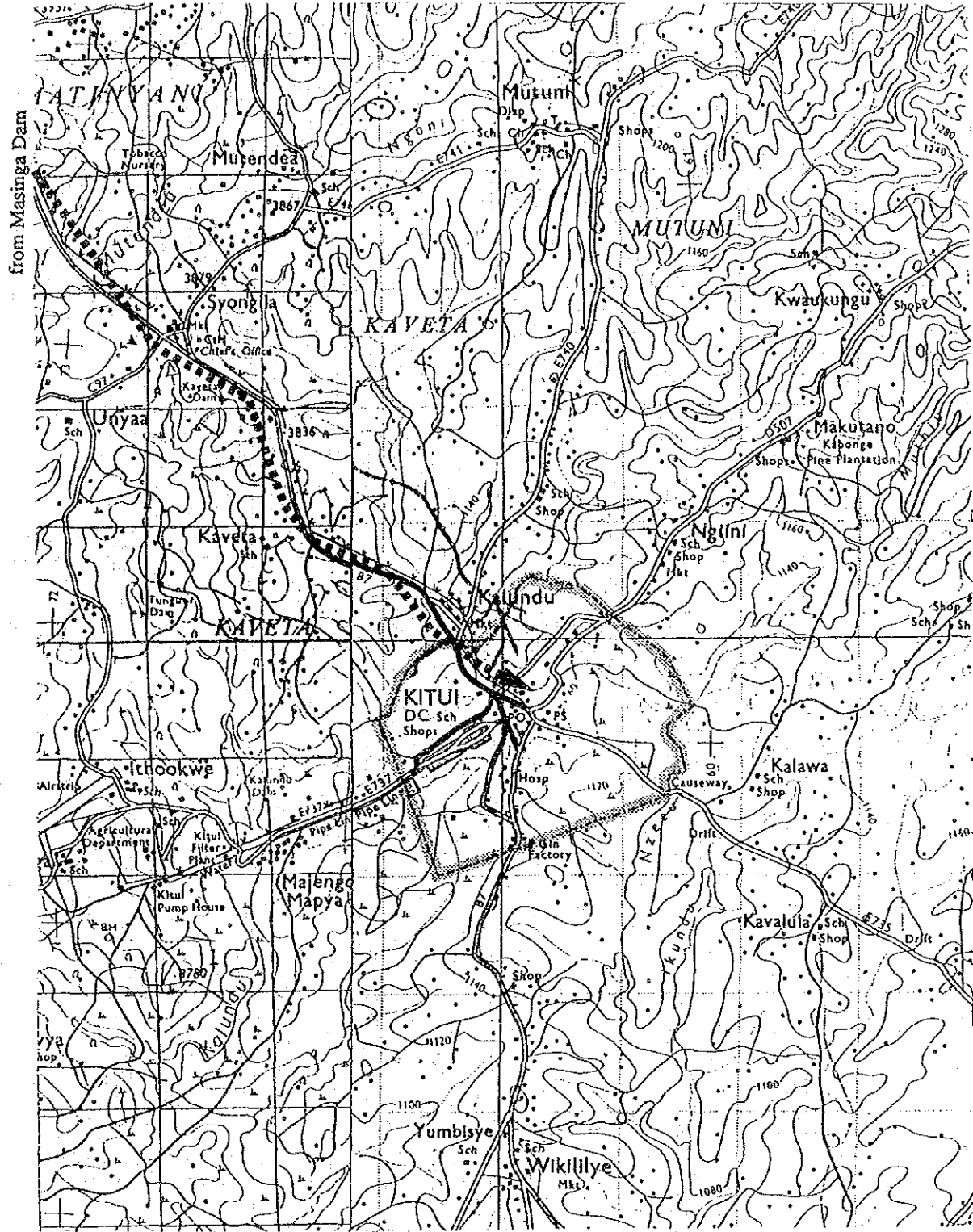
U- 42 Ol Doinyo Ng'iro

421.2 93/3



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

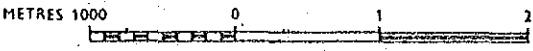
a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 430		U- 43			Rate		25.2	
5	-----								
6	Name of Urban:		Kitui			LGL Notice No:			
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Kitui	Locataion :		431.4 Changwithya			
10	Map ( 1/50,000 ):		151/3	Coordinates X:		38°01'	Y:	S 01°22'	
11	Sub-basin Code:		4HA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Boreholes			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		1180			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			9,300	24,400	40,800	
22	Residential Demand		(m3/d)			1,152	3,090	5,279	
23	Non-residential Demand		(m3/d)			193	504	845	
24	Livestock Demand		(m3/d)			27	67	108	
25	Industrial Demand		(m3/d)			188	356	527	
26	Total Demand		(m3/d)			1,560	4,017	6,759	
27	Area Served ( estimated net )		(ha)			69	182	305	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Masinga Dam			River No:			
31	Raw Water System:		H (m)=	0 L (m)=		9,800			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			380.0	2,456.6	2,741.9	5,578.5
37	Source Works		(US\$'000)			5.1	20.8	22.6	48.5
38	Pump Cost		(US\$'000)			0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)			404.6	559.1	574.7	1,538.5
40	Treatment		(US\$'000)			245.7	680.6	717.4	1,643.7
41	Storage		(US\$'000)			41.8	114.3	119.6	275.8
42	Distribution		(US\$'000)			555.6	902.1	979.8	2,437.5
43	Miscellaneous (20%)		(US\$'000)			250.6	455.4	482.8	1,188.8
44	Admi. & Engineering		(US\$'000)			150.3	273.2	289.7	713.3
45	Contingency		(US\$'000)			330.8	601.1	637.3	1,569.2
46	Total Cost		(US\$'000)			1,984.5	3,606.7	3,824.0	9,415.2
47	Cost per Capita		(US\$/c)			213.4	238.9	233.2	
48	Cost per ha		(US\$/ha)			28,573.9	31,983.9	31,222.8	
49	Cost per m3		(US\$/m3)			5.2	1.5	1.4	1.7
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			99.2	180.3	191.2	
53	Capital Costs		(US\$'000)			204.4	371.5	393.9	
54	Total Annual Cost		(US\$'000)			303.6	551.8	585.1	
55	Unit Cost per m3		(US\$/m3)			2.2	0.6	0.6	
56	-----								
57	Remarks:								
58									
59									
60									
61									
62									
63	-----								



from Masinga Dam

U- 43 Kitui

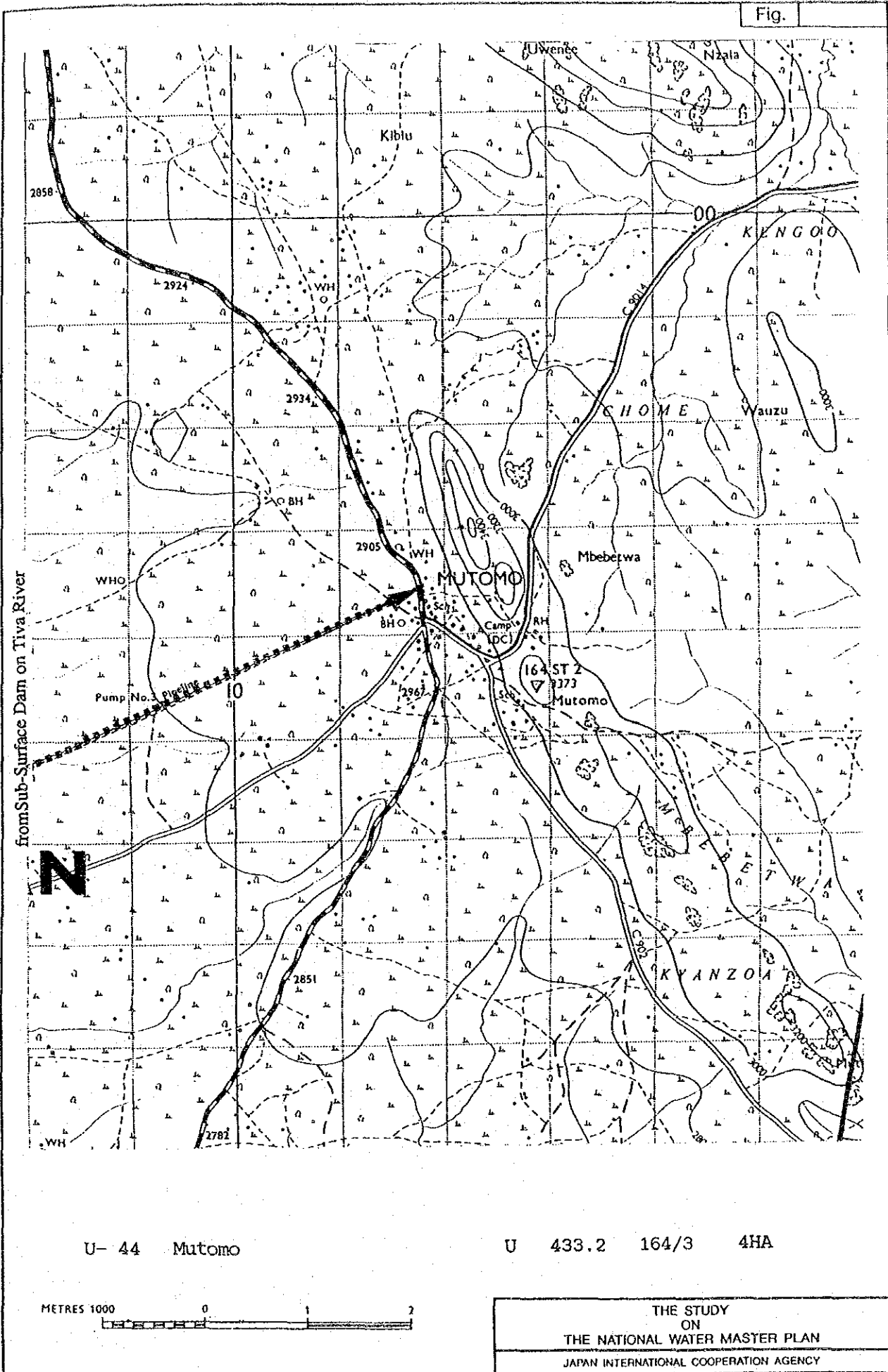
U 431.4 151/3 4HA



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

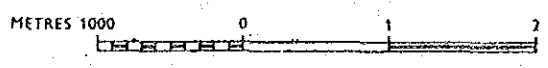
a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Jul-92	
4	Code No. 430		U- 44			Rate		25.2	
5	-----								
6	Name of Urban:		Mutomo		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Kitui	Locataion :	433.2	Mutomo			
10	Map ( 1/50,000 ) :		164/3	Coordinates X:		38°11'	Y:	S 01°51'	
11	Sub-basin Code:		4HA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Boreholes			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		310			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population			(no)	700	1,200	1,600		
22	Residential Demand			(m3/d)	87	152	207		
23	Non-residential Demand			(m3/d)	0	23	31		
24	Livestock Demand			(m3/d)	0	3	4		
25	Industrial Demand			(m3/d)	0	0	0		
26	Total Demand			(m3/d)	87	178	242		
27	Area Served ( estimated net )			(ha)	5	9	12		
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Sub-Surface dam on Tiva river			River No:			
31	Raw Water System:		H (m)=	110	L (m)=	16,000			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity			(m3/d)	0.0	0.0	0.0	0.0	0.0
37	Source Works			(US\$'000)	0.0	0.0	0.0	0.0	0.0
38	Pump Cost			(US\$'000)	0.0	0.0	0.0	0.0	0.0
39	Raw Water Main			(US\$'000)	0.0	0.0	0.0	0.0	0.0
40	Treatment			(US\$'000)	0.0	0.0	0.0	0.0	0.0
41	Storage			(US\$'000)	0.0	0.0	0.0	0.0	0.0
42	Distribution			(US\$'000)	0.0	0.0	0.0	0.0	0.0
43	Miscellaneous (20%)			(US\$'000)	0.0	0.0	0.0	0.0	0.0
44	Admi. & Engineering			(US\$'000)	0.0	0.0	0.0	0.0	0.0
45	Contingency			(US\$'000)	0.0	0.0	0.0	0.0	0.0
46	Total Cost			(US\$'000)	0.0	0.0	0.0	0.0	0.0
47	Cost per Capita			(US\$/c)	0.0	0.0	0.0	0.0	
48	Cost per ha			(US\$/ha)	0.0	0.0	0.0	0.0	
49	Cost per m3			(US\$/m3)	0.0	0.0	0.0	0.0	0.0
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)	0.0	0.0	0.0	0.0	0.0
53	Capital Costs			(US\$'000)	0.0	0.0	0.0	0.0	0.0
54	Total Annual Cost			(US\$'000)	0.0	0.0	0.0	0.0	0.0
55	Unit Cost per m3			(US\$/m3)	0.0	0.0	0.0	0.0	0.0
56	-----								
57	Remarks:	It appears that present supply capacity could meet the demand up to year 2010. In case supply shortage							
58		occurs, a possible solution may be pumping up from a subsurface dam to be constructed on the Tiva river.							
59		Rehabilitation works would be required for the present water supply system.							
60									
61									
62									
63	-----								

Fig.



U- 44 Mutomo

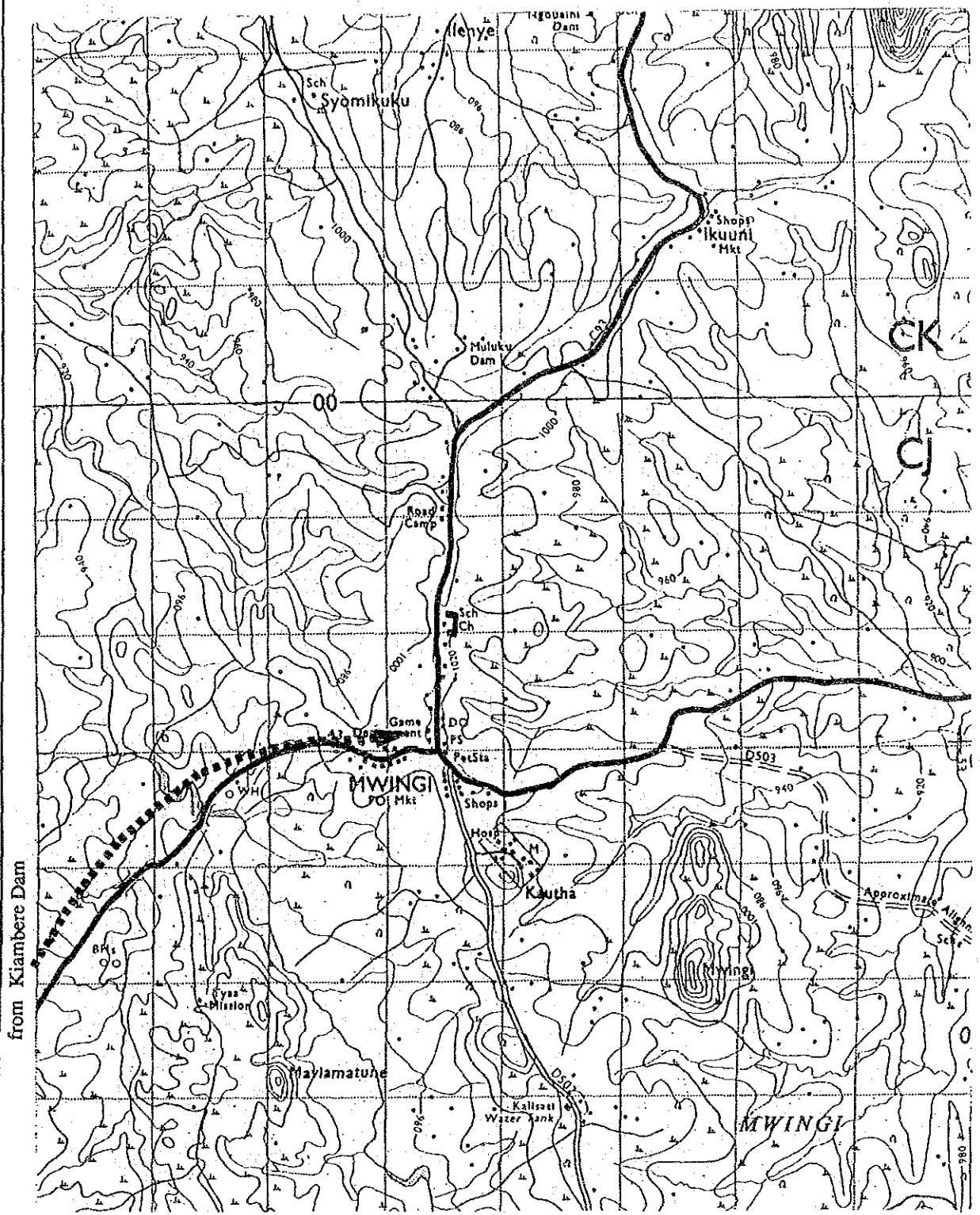
U 433.2 164/3 4HA



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

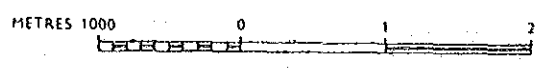


a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 430		U- 45			Rate		25.2	
5	-----								
6	Name of Urban:		Mwingi			LGL Notice No:			
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Kitui	Locataion :		434.4 Mwingi			
10	Map ( 1/50,000 ) :		137/3	Coordinates X:		38°03'	Y:	S 00°55'	
11	Sub-basin Code:		4ED	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Shallow wells			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		50			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			7,300	19,200	32,000	
22	Residential Demand		(m3/d)			904	2,431	4,140	
23	Non-residential Demand		(m3/d)			151	396	663	
24	Livestock Demand		(m3/d)			21	52	85	
25	Industrial Demand		(m3/d)			0	0	0	
26	Total Demand		(m3/d)			1,076	2,879	4,888	
27	Area Served ( estimated net )		(ha)			55	143	239	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Kiambere Dam				River No:		
31	Raw Water System:		H (m)=	290 L (m)=			40,500		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			1,026.3	1,802.9	2,008.8	4,838.0
37	Source Works		(US\$'000)			10.8	16.5	17.9	45.1
38	Pump Cost		(US\$'000)			10.8	14.4	15.9	41.1
39	Raw Water Main		(US\$'000)			1,926.6	2,151.1	2,203.5	6,281.1
40	Treatment		(US\$'000)			432.7	583.3	616.2	1,632.2
41	Storage		(US\$'000)			74.5	99.4	104.5	278.5
42	Distribution		(US\$'000)			436.1	710.9	764.7	1,911.8
43	Miscellaneous (20%)		(US\$'000)			578.3	715.1	744.5	2,038.0
44	Admi. & Engineering		(US\$'000)			347.0	429.1	446.7	1,222.8
45	Contingency		(US\$'000)			763.4	944.0	982.8	2,690.1
46	Total Cost		(US\$'000)			4,580.1	5,663.8	5,896.8	16,140.7
47	Cost per Capita		(US\$/c)			627.4	475.9	460.7	
48	Cost per ha		(US\$/ha)			84,014.7	63,731.9	61,688.4	
49	Cost per m3		(US\$/m3)			4.5	3.1	2.9	3.3
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			229.0	283.2	294.8	
53	Capital Costs		(US\$'000)			471.8	583.4	607.4	
54	Total Annual Cost		(US\$'000)			700.8	866.6	902.2	
55	Unit Cost per m3		(US\$/m3)			1.9	1.3	1.2	
56	-----								
57	Remarks:		Water transfer by pipeline from existing Kiambere dam.						
58									
59									
60									
61									
62									
63	-----								



U- 45 Mwingi

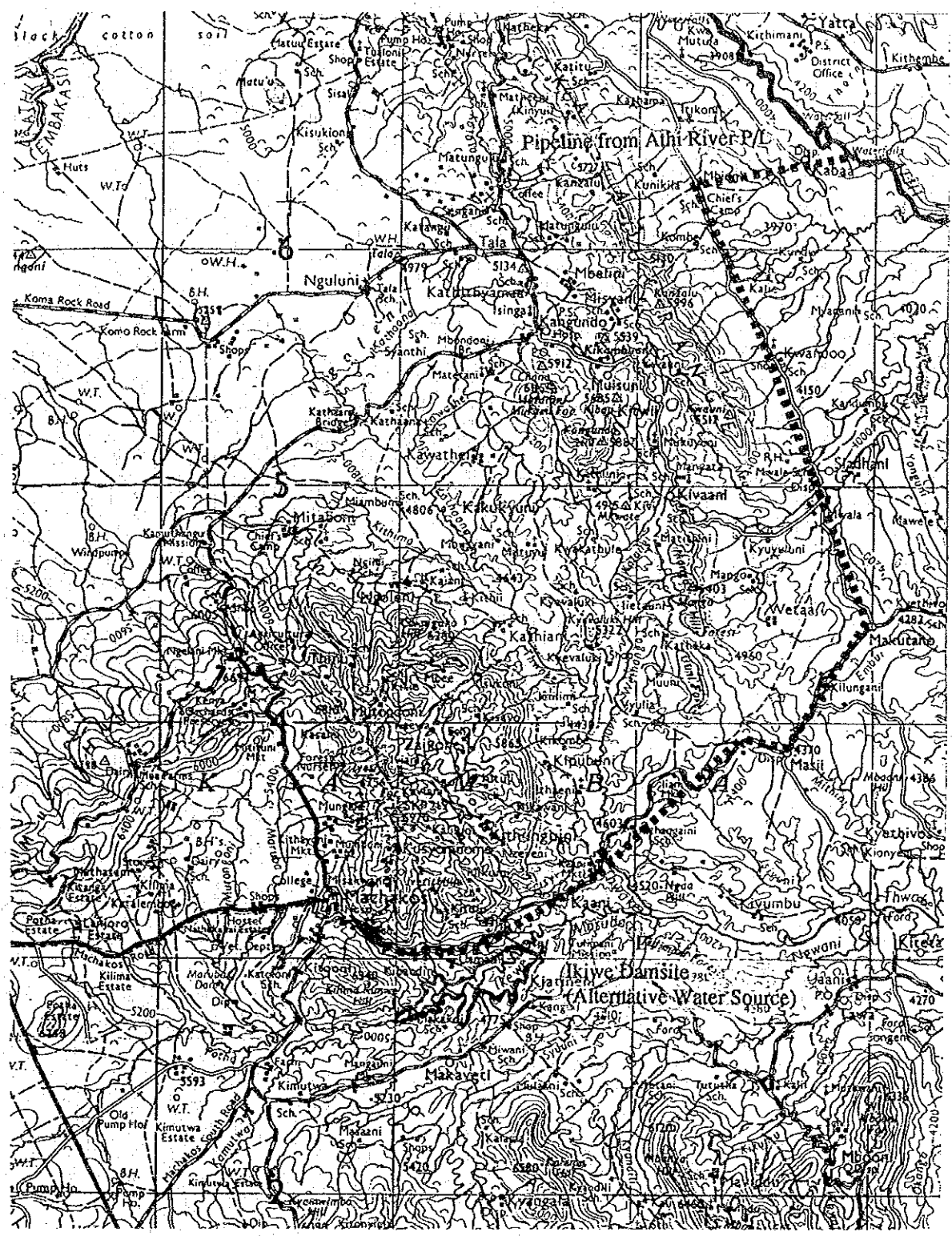
U 434.4 137/3 4ED



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

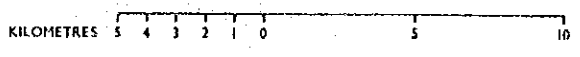
a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 440		U- 46			Rate		Jul-92 25.2
5	-----							
6	Name of Urban:		Machakos		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):				441.1	Muvuti		
9	District:		Machakos	Locataion :				
10	Map ( 1/50,000 ) :		161/4	Coordinates X:		37°14'	Y:	S 01°32'
11	Sub-basin Code:		3EA	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Mamba Dam			River No		
15	Raw Water System:		H (m)=		L (m)=			
16	Treatment:			Capacity (m3/d)		2660		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		91,100	214,500	356,400	
22	Residential Demand		(m3/d)		11,285	27,161	46,109	
23	Non-residential Demand		(m3/d)		1,888	4,444	7,386	
24	Livestock Demand		(m3/d)		156	348	581	
25	Industrial Demand		(m3/d)		980	1,797	2,555	14294
26	Total Demand		(m3/d)		14,309	33,750	56,631	
27	Area Served ( estimated net )		(ha)		680	1,602	2,662	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Athi River P/L			River No:		
31	Raw Water System:		H (m)=		600	L (m)=		56,700
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		11,649.0	19,441.1	22,881.2	53,971.3
37	Source Works		(US\$'000)		66.8	98.0	110.8	275.5
38	Pump Cost		(US\$'000)		136.7	219.0	257.6	613.3
39	Raw Water Main		(US\$'000)		5,355.6	6,707.6	7,252.6	19,315.8
40	Treatment		(US\$'000)		1,185.3	1,978.1	2,328.2	5,491.6
41	Storage		(US\$'000)		501.7	837.3	985.4	2,324.4
42	Distribution		(US\$'000)		5,442.6	7,372.4	8,477.6	21,292.6
43	Miscellaneous (20%)		(US\$'000)		2,537.7	3,442.5	3,882.4	9,862.6
44	Admi. & Engineering		(US\$'000)		1,522.6	2,065.5	2,329.5	5,917.6
45	Contingency		(US\$'000)		3,349.8	4,544.1	5,124.8	13,018.7
46	Total Cost		(US\$'000)		20,098.9	27,264.4	30,748.8	78,112.1
47	Cost per Capita		(US\$/c)		220.6	220.9	216.7	
48	Cost per ha		(US\$/ha)		29,542.8	29,585.5	29,016.5	
49	Cost per m3		(US\$/m3)		1.7	1.4	1.3	1.4
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		1,004.9	1,363.2	1,537.4	
53	Capital Costs		(US\$'000)		2,070.2	2,808.2	3,167.1	
54	Total Annual Cost		(US\$'000)		3,075.1	4,171.5	4,704.6	
55	Unit Cost per m3		(US\$/m3)		0.7	0.6	0.6	
56	-----							
57	Remarks:	Water transfer by pipeline from Athi river (water abstraction at Kabaa). Alternative source will be either						
58		Ikiwe dam (see attached figure) or a sand dam on the Thwake river.						
59								
60								
61								
62								
63	-----							

Fig.



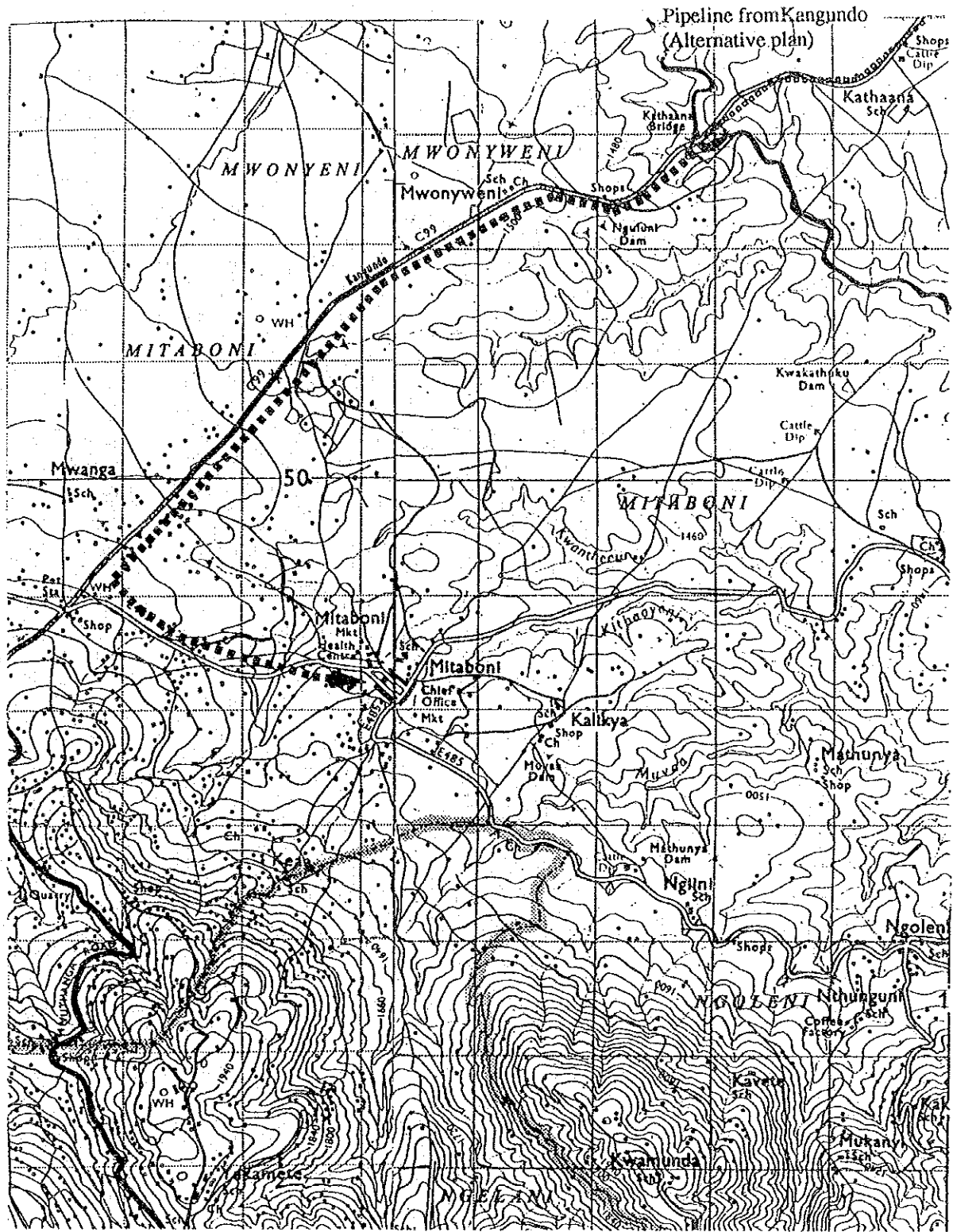
U- 46 Machakos &

G 441.1 161/4 3EA

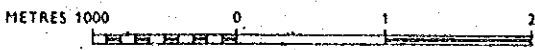


THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 440		U- 47			Rate		Jul-92 25.2
5	-----							
6	Name of Urban:		Mitaboni		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:	Machakos	Locataion :		441.2	Mitaboni		
10	Map ( 1/50,000 ) :	149/3, 4	Coordinates X:		37°15'		Y:	S 01°22'
11	Sub-basin Code:	4AC	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Spring, Self-help			River No		
15	Raw Water System:		H (m)=		L (m)=			
16	Treatment:				Capacity (m3/d)			
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		29,400	68,800	114,000	
22	Residential Demand		(m3/d)		3,642	8,712	14,749	
23	Non-residential Demand		(m3/d)		597	1,424	2,361	
24	Livestock Demand		(m3/d)		49	112	186	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		4,288	10,248	17,296	
27	Area Served ( estimated net )		(ha)		220	514	851	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Kaathana River			River No:		
31	Raw Water System:		H (m)=		130	L (m)=		9,900
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		4,287.9	5,959.9	7,048.0	17,295.8
37	Source Works		(US\$'000)		31.5	40.4	45.8	117.7
38	Pump Cost		(US\$'000)		11.8	15.1	17.4	44.4
39	Raw Water Main		(US\$'000)		657.1	729.2	772.4	2,158.6
40	Treatment		(US\$'000)		877.0	998.7	1,059.0	2,934.6
41	Storage		(US\$'000)		184.7	256.7	303.5	744.9
42	Distribution		(US\$'000)		1,756.5	2,353.9	2,700.4	6,810.8
43	Miscellaneous (20%)		(US\$'000)		703.7	878.8	979.7	2,562.2
44	Admi. & Engineering		(US\$'000)		422.2	527.3	587.8	1,537.3
45	Contingency		(US\$'000)		928.9	1,160.0	1,293.2	3,382.1
46	Total Cost		(US\$'000)		5,573.4	6,960.0	7,759.1	20,292.5
47	Cost per Capita		(US\$/c)		189.6	176.7	171.7	
48	Cost per ha		(US\$/ha)		25,384.6	23,654.5	22,986.5	
49	Cost per m3		(US\$/m3)		1.3	1.2	1.1	1.2
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		278.7	348.0	388.0	
53	Capital Costs		(US\$'000)		574.1	716.9	799.2	
54	Total Annual Cost		(US\$'000)		852.7	1,064.9	1,187.1	
55	Unit Cost per m3		(US\$/m3)		0.5	0.5	0.5	
56	-----							
57	Remarks:	In case the Kaathana river water is not sufficient, water would be supplemented from Kangundo system						
58		in the north. There are some potential dam sites near to the area (Maruba, Mivwongoni).						
59								
60								
61								
62								
63	-----							

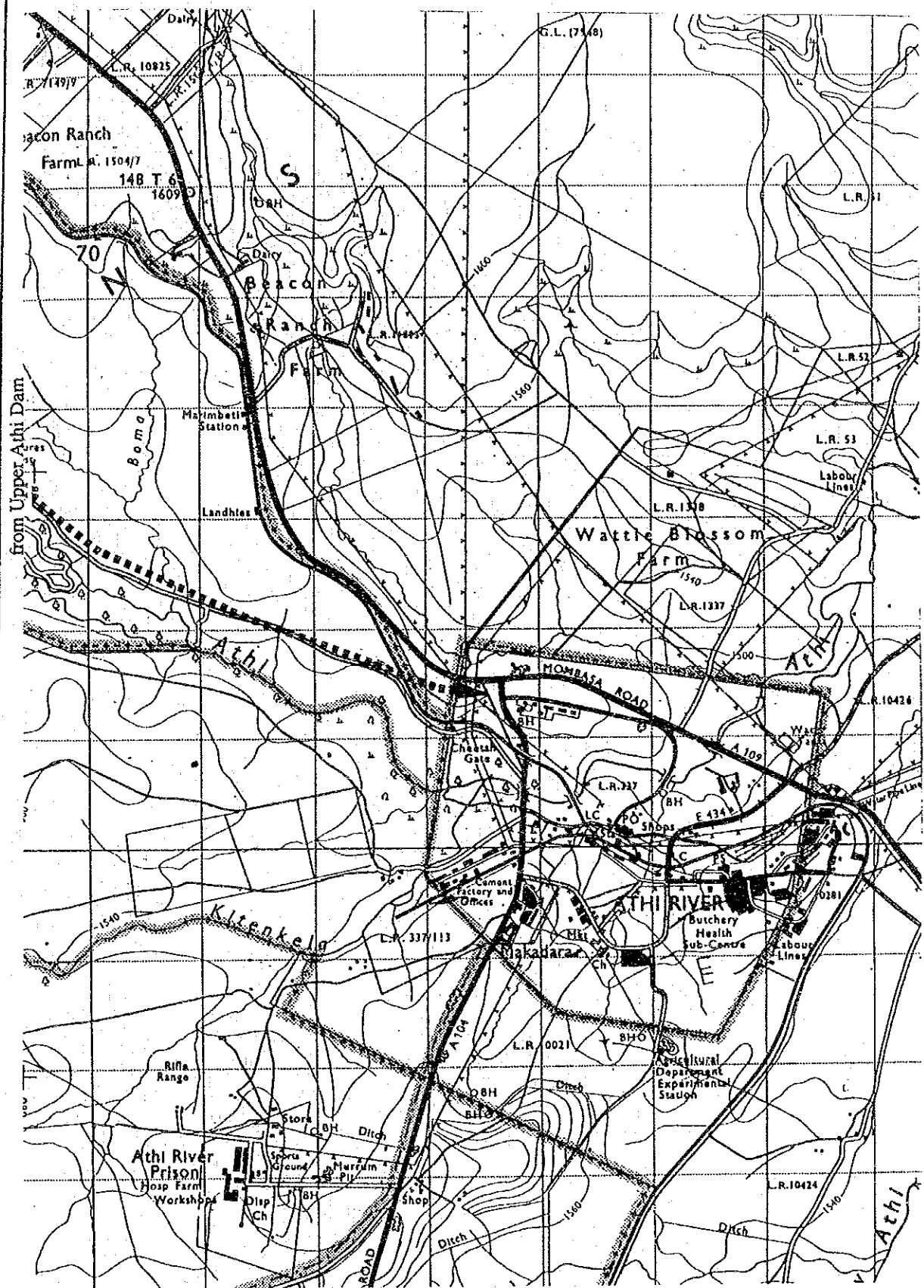


U- 47 Mitaboni + a part of Machakos 441.2 162/2



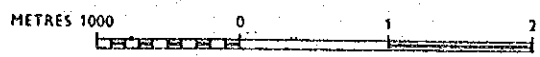
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							Feb-92
4	Code No. 440	U- 48				Rate		25.2
5	-----							
6	Name of Urban:	Athi River	LGL Notice No:					
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:	Machakos	Locataion :	442.3	Settlement Area			
10	Map ( 1/50,000 ) :	148/4	Coordinates X:		37°02'		Y:	S 01°31'
11	Sub-basin Code:	3AB	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:	Nol-Turesh P/L				River No		
15	Raw Water System:	H (m)=	L (m)=					
16	Treatment:	Capacity (m3/d)			6400			
17	Distribution System:							
18	-----							
19				1990	2000	2010		
20	-----							
21	Projected Population	(no)	25,100	59,100	98,200			
22	Residential Demand	(m3/d)	3,109	7,484	12,705			
23	Non-residential Demand	(m3/d)	520	1,224	2,035			
24	Livestock Demand	(m3/d)	43	96	161			
25	Industrial Demand	(m3/d)	1,219	2,103	2,748			
26	Total Demand	(m3/d)	4,891	10,907	17,649			
27	Area Served ( estimated net )	(ha)	187	441	733			
28	-----							
29	Future Development Plan							
30	Raw Water Source:	Upper Athi Dam				River No:		
31	Raw Water System:	H (m)=	0	L (m)=	9,900			
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost		1990	2000	2010		Total	
36	Incremental Capacity	(m3/d)	0.0	4,506.5	6,742.1		11,248.6	
37	Source Works	(US\$'000)	0.0	32.7	44.3		77.0	
38	Pump Cost	(US\$'000)	0.0	0.0	0.0		0.0	
39	Raw Water Main	(US\$'000)	0.0	667.0	760.5		1,427.5	
40	Treatment	(US\$'000)	0.0	895.3	1,043.3		1,938.6	
41	Storage	(US\$'000)	0.0	194.1	290.4		484.4	
42	Distribution	(US\$'000)	0.0	2,031.3	2,336.0		4,367.3	
43	Miscellaneous (20%)	(US\$'000)	0.0	764.1	894.9		1,659.0	
44	Admi. & Engineering	(US\$'000)	0.0	458.5	536.9		995.4	
45	Contingency	(US\$'000)	0.0	1,008.6	1,181.2		2,189.8	
46	Total Cost	(US\$'000)	0.0	6,051.6	7,087.4		13,139.0	
47	Cost per Capita	(US\$/e)	0.0	178.0	181.3			
48	Cost per ha	(US\$/ha)	0.0	23,833.7	24,272.1			
49	Cost per m3	(US\$/m3)	0.0	1.3	1.1		1.2	
50	-----							
51	Present Value of Water at DF=10 %		1990	2000	2010		Total	
52	Direct O & M Costs	(US\$'000)	0.0	302.6	354.4			
53	Capital Costs	(US\$'000)	0.0	623.3	730.0			
54	Total Annual Cost	(US\$'000)	0.0	925.9	1,084.4			
55	Unit Cost per m3	(US\$/m3)	0.0	0.6	0.4			
56	-----							
57	Remarks: Source works cost does not include the cost of Upper Athi dam, which should be added separately							
58	(see Sectoral Report M).							
59								
60								
61								
62								
63	-----							



U- 48 Athi River &

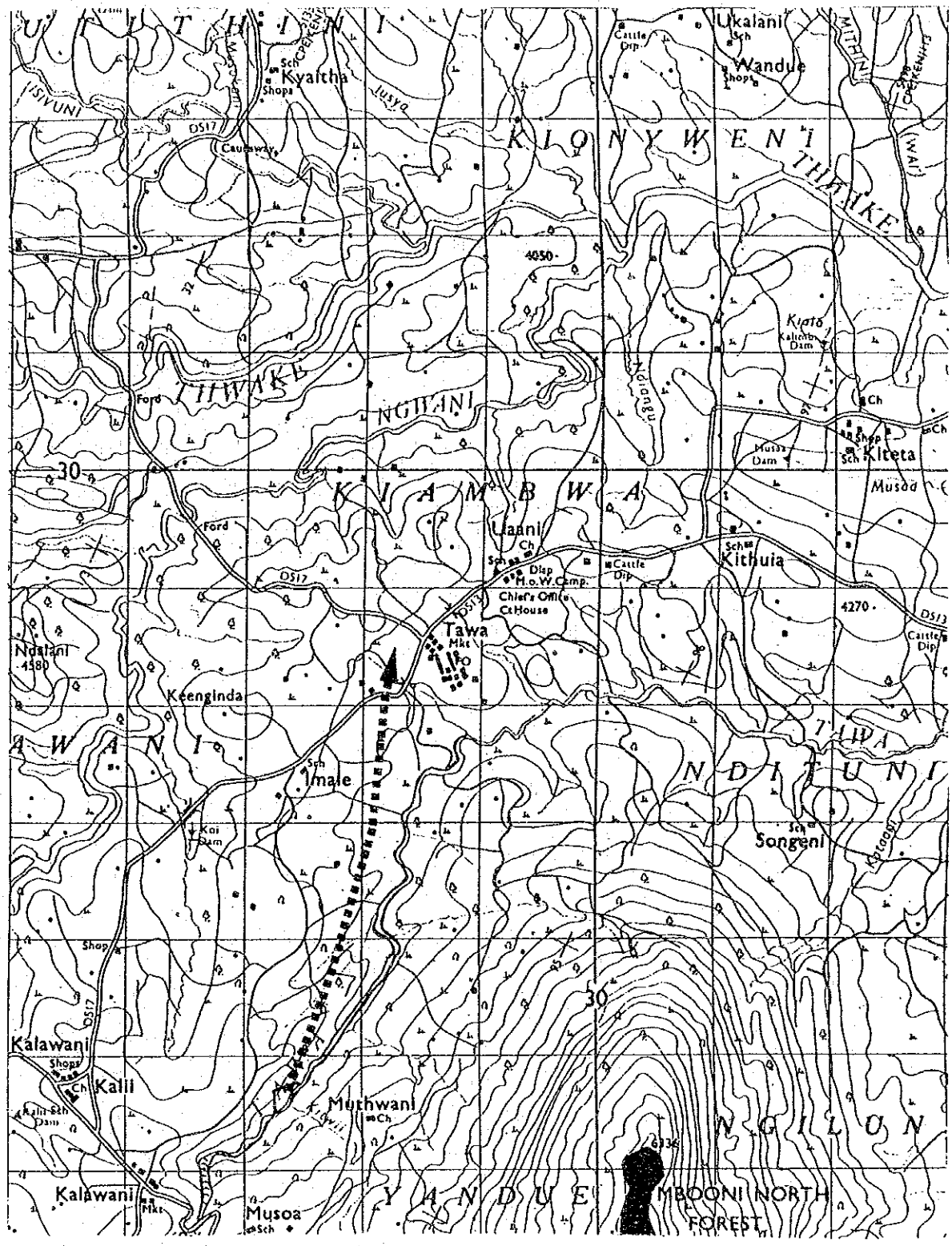
U 442.3 148/4 3AB



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

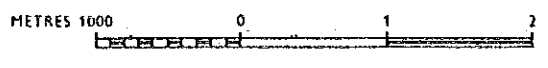


a	b	c	d	e	f	g	h	i
2						National Water Master Plan		
3					URBAN WATER SUPPLY			Jul-92
4	Code No. 440		U- 49			Rate		25.2
5	-----							
6	Name of Urban:		Uaani/Tawa		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:		Machakos	Locataion :	444.3	Kiteta		
10	Map ( 1/50,000 ) :		162/2	Coordinates X:		37°28'	Y:	S 01°33'
11	Sub-basin Code:		3EB	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Boreholes and Dam			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		4		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		300	500	700	
22	Residential Demand		(m3/d)		37	63	91	
23	Non-residential Demand		(m3/d)		0	10	13	
24	Livestock Demand		(m3/d)		0	1	1	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		37	74	105	
27	Area Served ( estimated net )		(ha)		2	4	5	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Tawa river			River No:		
31	Raw Water System:		H (m)=	0 L (m)=		4,100		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		33.2	70.3	30.3	133.7
37	Source Works		(US\$'000)		0.8	1.4	0.8	3.0
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		143.1	147.9	142.6	433.5
40	Treatment		(US\$'000)		54.6	87.8	51.5	193.9
41	Storage		(US\$'000)		8.4	14.0	7.9	21.5
42	Distribution		(US\$'000)		17.9	11.9	11.9	41.8
43	Miscellaneous (20%)		(US\$'000)		45.0	52.6	42.9	140.5
44	Admi. & Engineering		(US\$'000)		27.0	31.6	25.8	84.3
45	Contingency		(US\$'000)		59.3	69.5	56.7	185.5
46	Total Cost		(US\$'000)		356.1	416.8	340.1	1,112.9
47	Cost per Capita		(US\$/c)		1,187.0	2,083.8	1,700.3	
48	Cost per ha		(US\$/ha)		158,944.9	279,036.1	227,680.3	
49	Cost per m3		(US\$/m3)		10.7	5.9	11.2	8.3
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		17.8	20.8	17.0	
53	Capital Costs		(US\$'000)		36.7	42.9	35.0	
54	Total Annual Cost		(US\$'000)		54.5	63.8	52.0	
55	Unit Cost per m3		(US\$/m3)		4.5	2.5	4.7	
56	-----							
57	Remarks:	In case the river water is not sufficient in the dry season, the construction of a small dam or a subsurface dam						
58		may be required.						
59								
60								
61								
62								
63	-----							



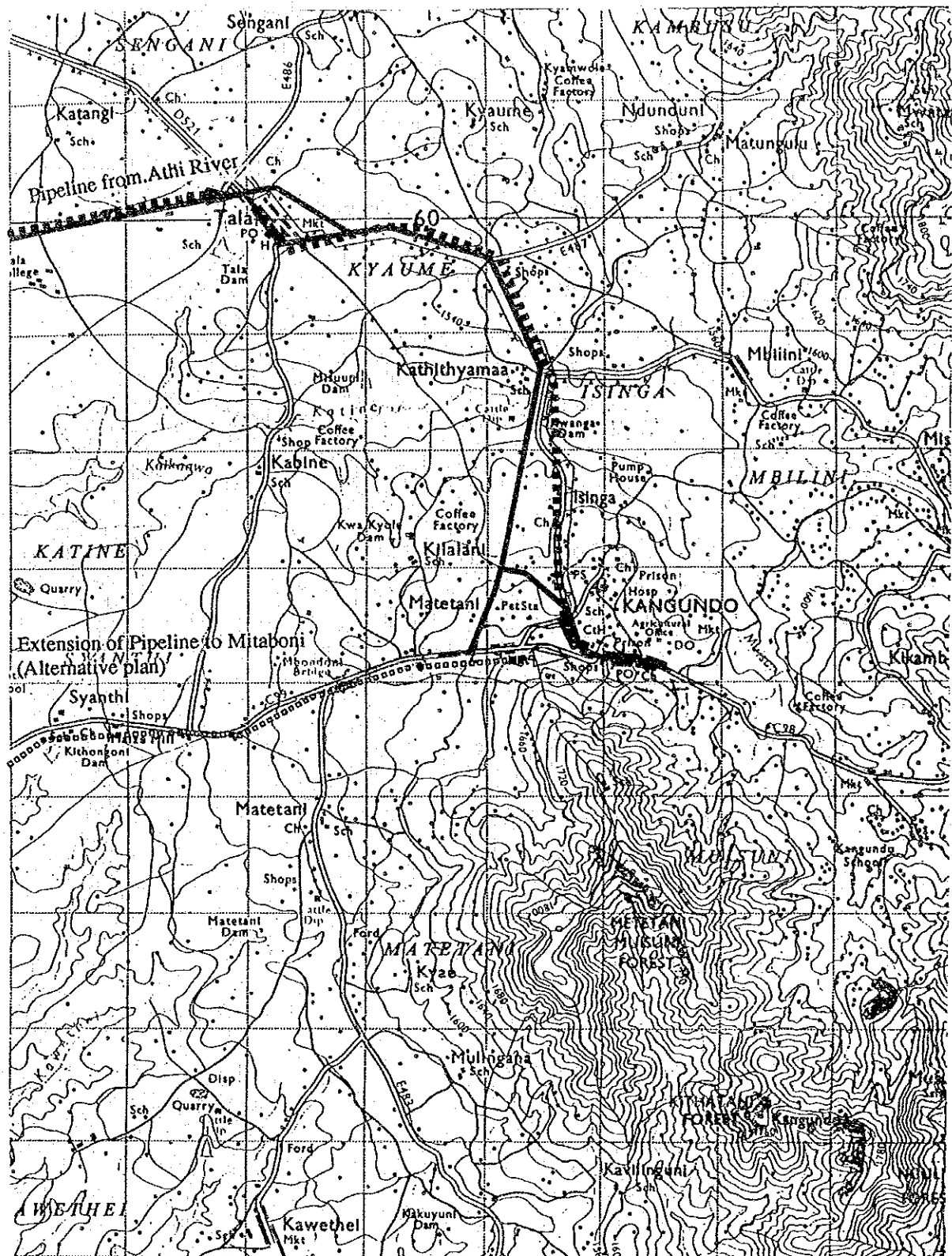
U- 49 Uaani/Tawa

R. 444.3 162/2 3EB



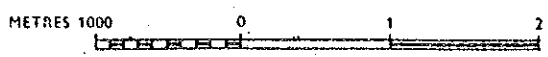
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 440		U- 50			Rate		Feb-92 25.2
5	-----							
6	Name of Urban:		Kangundo		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:		Machakos	Locataion :	445.1	Kangundo		
10	Map ( 1/50,000 ) :		149/4	Coordinates X:		37°22'	Y:	S 01°22'
11	Sub-basin Code:		3EA	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Boreholes			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		72		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		11,200	26,400	43,900	
22	Residential Demand		(m3/d)		1,387	3,343	5,680	
23	Non-residential Demand		(m3/d)		232	546	908	
24	Livestock Demand		(m3/d)		19	43	72	
25	Industrial Demand		(m3/d)		57	105	152	
26	Total Demand		(m3/d)		1,695	4,037	6,812	
27	Area Served ( estimated net )		(ha)		84	197	328	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Pipeline from Athi River			River No:		
31	Raw Water System:		H (m)=	170	L (m)=	44,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		1,623.4	2,341.5	2,774.7	6,739.6
37	Source Works		(US\$'000)		15.2	20.0	22.8	58.0
38	Pump Cost		(US\$'000)		9.1	11.3	12.7	33.1
39	Raw Water Main		(US\$'000)		2,285.2	2,481.3	2,588.2	7,354.7
40	Treatment		(US\$'000)		552.7	664.9	721.5	1,939.1
41	Storage		(US\$'000)		94.5	112.0	120.2	326.6
42	Distribution		(US\$'000)		669.1	908.1	1,045.5	2,622.7
43	Miscellaneous (20%)		(US\$'000)		725.2	839.5	902.2	2,466.8
44	Admi. & Engineering		(US\$'000)		435.1	503.7	541.3	1,480.1
45	Contingency		(US\$'000)		957.2	1,108.2	1,190.9	3,256.2
46	Total Cost		(US\$'000)		5,743.2	6,649.0	7,145.2	19,537.4
47	Cost per Capita		(US\$/c)		512.8	437.4	408.3	
48	Cost per ha		(US\$/ha)		68,664.9	58,574.8	54,673.6	
49	Cost per m3		(US\$/m3)		3.5	2.8	2.6	2.9
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		287.2	332.4	357.3	
53	Capital Costs		(US\$'000)		591.5	684.8	736.0	
54	Total Annual Cost		(US\$'000)		878.7	1,017.3	1,093.2	
55	Unit Cost per m3		(US\$/m3)		1.5	1.2	1.1	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



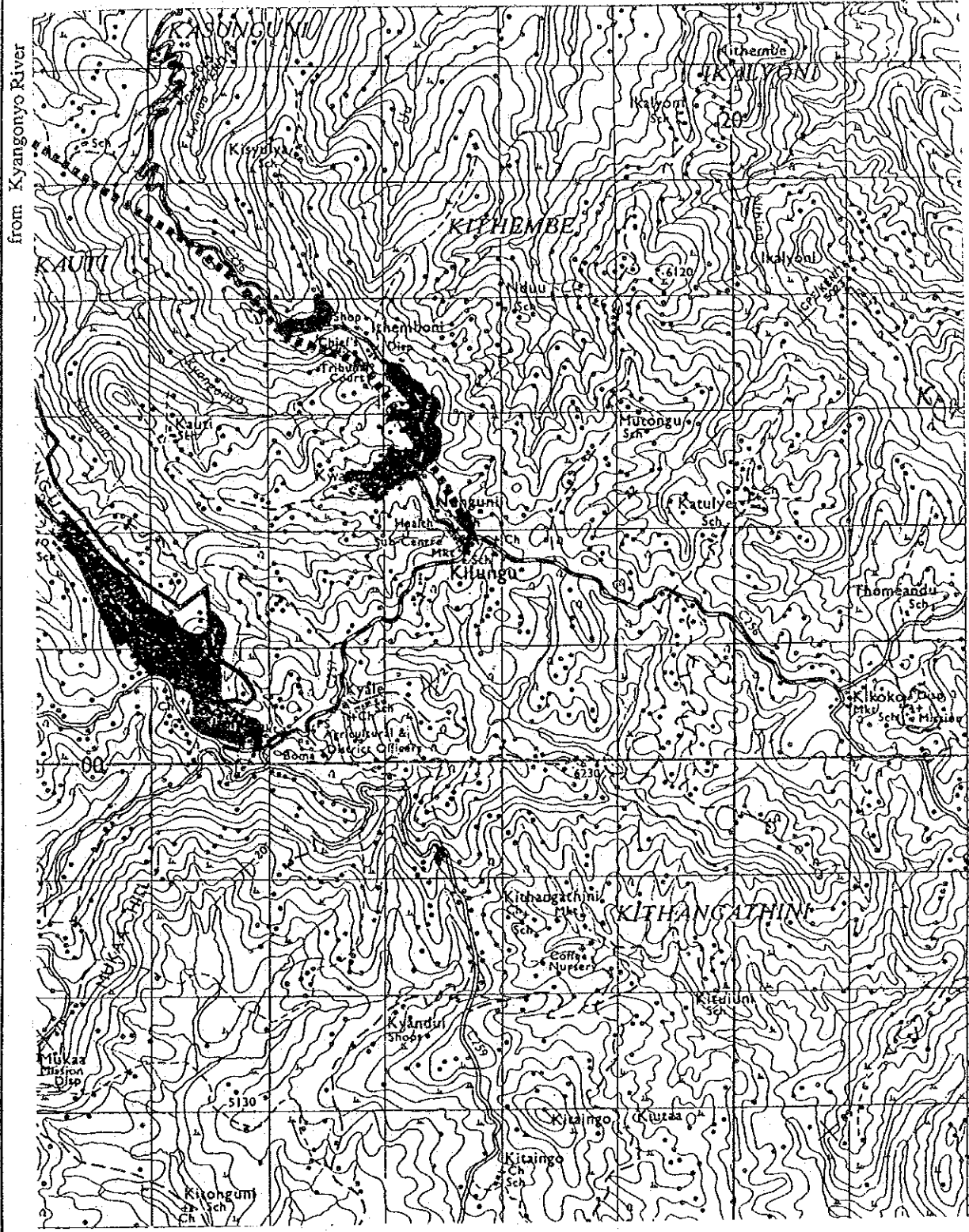
U- 50 Kangundo

U 445.1 149/4 3EA



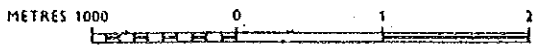
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 440		U- 51			Rate		25.2	
5	-----								
6	Name of Urban:		Nunguni		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Machakos	Locataion :		447.4 Kilungu			
10	Map ( 1/50,000 ) :		162/4	Coordinates X:		37°22'	Y:	S 01°50'	
11	Sub-basin Code:		3FA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Spring				River No		
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)			45		
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population			(no)		500	800	1,000	
22	Residential Demand			(m3/d)		62	101	129	
23	Non-residential Demand			(m3/d)		0	15	20	
24	Livestock Demand			(m3/d)		0	1	2	
25	Industrial Demand			(m3/d)		0	0	0	
26	Total Demand			(m3/d)		62	117	151	
27	Area Served ( estimated net )			(ha)		4	6	7	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Kyangonyo river				River No:		
31	Raw Water System:		H (m)=	440 L (m)=			6,200		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity			(m3/d)		16.9	72.3	34.1	123.3
37	Source Works			(US\$'000)		0.5	1.5	0.8	2.8
38	Pump Cost			(US\$'000)		0.0	11.2	11.2	22.4
39	Raw Water Main			(US\$'000)		211.8	224.0	216.5	652.3
40	Treatment			(US\$'000)		35.5	89.3	55.6	180.4
41	Storage			(US\$'000)		5.3	14.3	8.6	28.1
42	Distribution			(US\$'000)		29.9	17.9	11.9	59.7
43	Miscellaneous (20%)			(US\$'000)		56.6	71.6	60.9	189.2
44	Admi. & Engineering			(US\$'000)		34.0	43.0	36.6	113.5
45	Contingency			(US\$'000)		74.7	94.6	80.4	249.7
46	Total Cost			(US\$'000)		448.2	567.4	482.6	1,498.2
47	Cost per Capita			(US\$/c)		896.4	1,891.4	2,412.8	
48	Cost per ha			(US\$/ha)		120,034.0	253,264.5	323,091.0	
49	Cost per m3			(US\$/m3)		26.5	7.8	14.2	12.1
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)		22.4	28.4	24.1	
53	Capital Costs			(US\$'000)		46.2	58.4	49.7	
54	Total Annual Cost			(US\$'000)		68.6	86.8	73.8	
55	Unit Cost per m3			(US\$/m3)		11.1	3.3	5.9	
56	-----								
57	Remarks:	Alternatively, water source may be small streams downstream from the Kilungu forest area							
58		with construction of a small dam.							
59									
60									
61									
62									
63	-----								



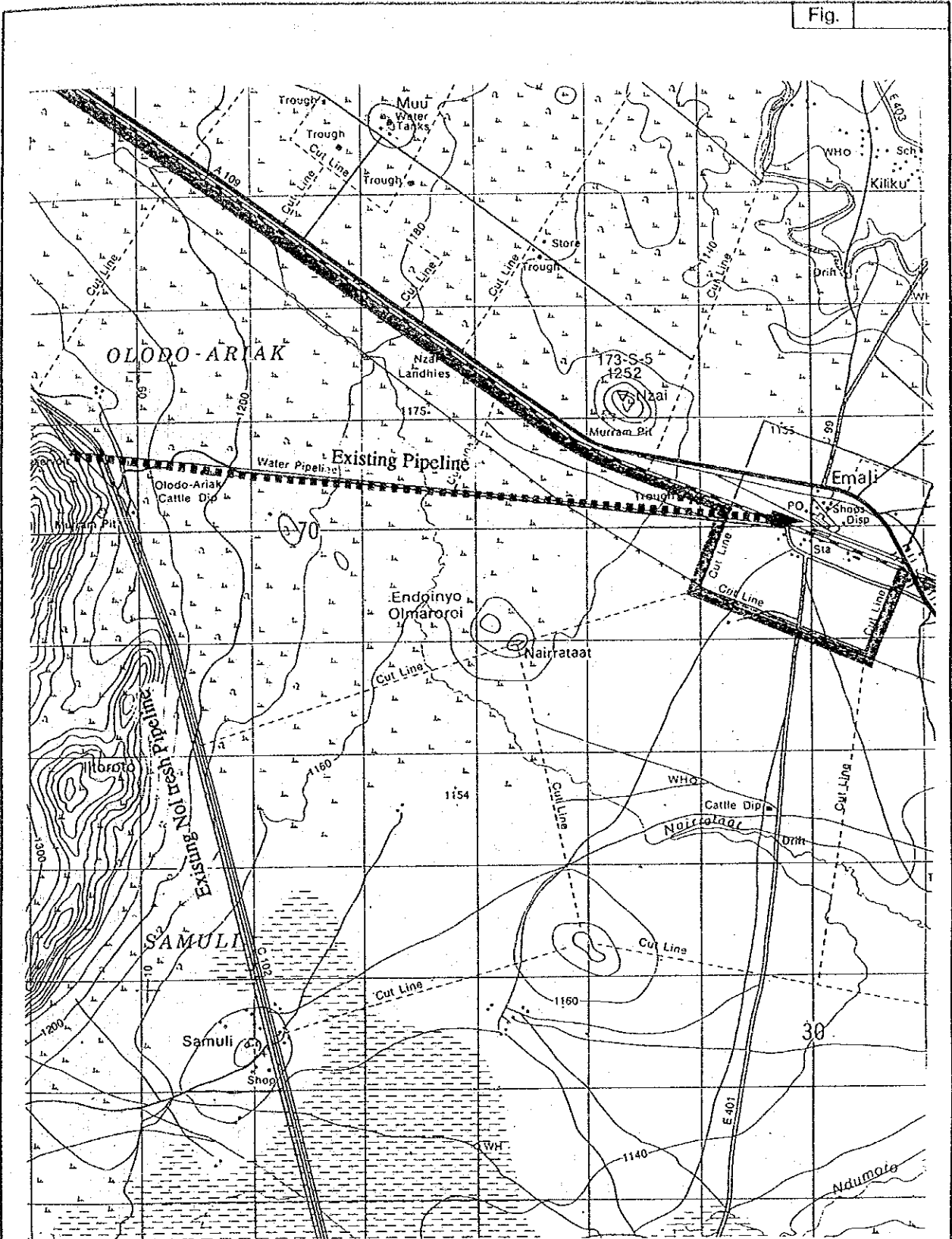
U- 51 Nunguni

U 447.4 162/4 3FA



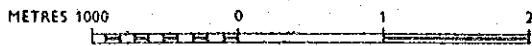
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 440		U- 52			Rate		25.2	
5	-----								
6	Name of Urban:		Emali			LGL Notice No:			
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Machakos	Locataion :		448.3 Nzaui			
10	Map ( 1/50,000 ) :		173/2	Coordinates X:		37°29'	Y:	S 02°05'	
11	Sub-basin Code:		3FA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		No1 Tresh P/L				River No		
15	Raw Water System:		H (m)=		L (m)=				
16	Treatment:				Capacity (m3/d)				
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			400	600	800	
22	Residential Demand		(m3/d)			50	76	104	
23	Non-residential Demand		(m3/d)			0	12	16	
24	Livestock Demand		(m3/d)			0	1	1	
25	Industrial Demand		(m3/d)			0	0	0	
26	Total Demand		(m3/d)			50	89	121	
27	Area Served ( estimated net )		(ha)			3	4	6	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		No1 Tresh P/L				River No:		
31	Raw Water System:		H (m)=		150 L (m)=		7,000		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			49.6	89.0	31.5	170.0
37	Source Works		(US\$'000)			1.1	1.7	0.8	3.6
38	Pump Cost		(US\$'000)			0.0	3.9	3.8	7.7
39	Raw Water Main		(US\$'000)			248.3	255.9	243.8	747.9
40	Treatment		(US\$'000)			70.4	101.7	52.9	225.0
41	Storage		(US\$'000)			11.1	16.4	8.1	35.6
42	Distribution		(US\$'000)			23.9	11.9	11.9	47.8
43	Miscellaneous (20%)		(US\$'000)			71.0	78.3	64.3	213.5
44	Admi. & Engineering		(US\$'000)			42.6	47.0	38.6	128.1
45	Contingency		(US\$'000)			93.7	103.4	84.8	281.8
46	Total Cost		(US\$'000)			562.0	620.2	508.9	1,691.1
47	Cost per Capita		(US\$/c)			1,404.9	3,100.9	2,544.7	
48	Cost per ha		(US\$/ha)			188,123.1	415,228.3	340,744.6	
49	Cost per m3		(US\$/m3)			11.3	7.0	16.1	9.9
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			28.1	31.0	25.4	
53	Capital Costs		(US\$'000)			57.9	63.9	52.4	
54	Total Annual Cost		(US\$'000)			86.0	94.9	77.9	
55	Unit Cost per m3		(US\$/m3)			4.8	2.9	6.8	
56	-----								
57	Remarks:		Augmentation of supply from No1 Tresh pipeline.						
58									
59									
60									
61									
62									
63	-----								



U- 52 Emali

R 448.3 173/2 3FA

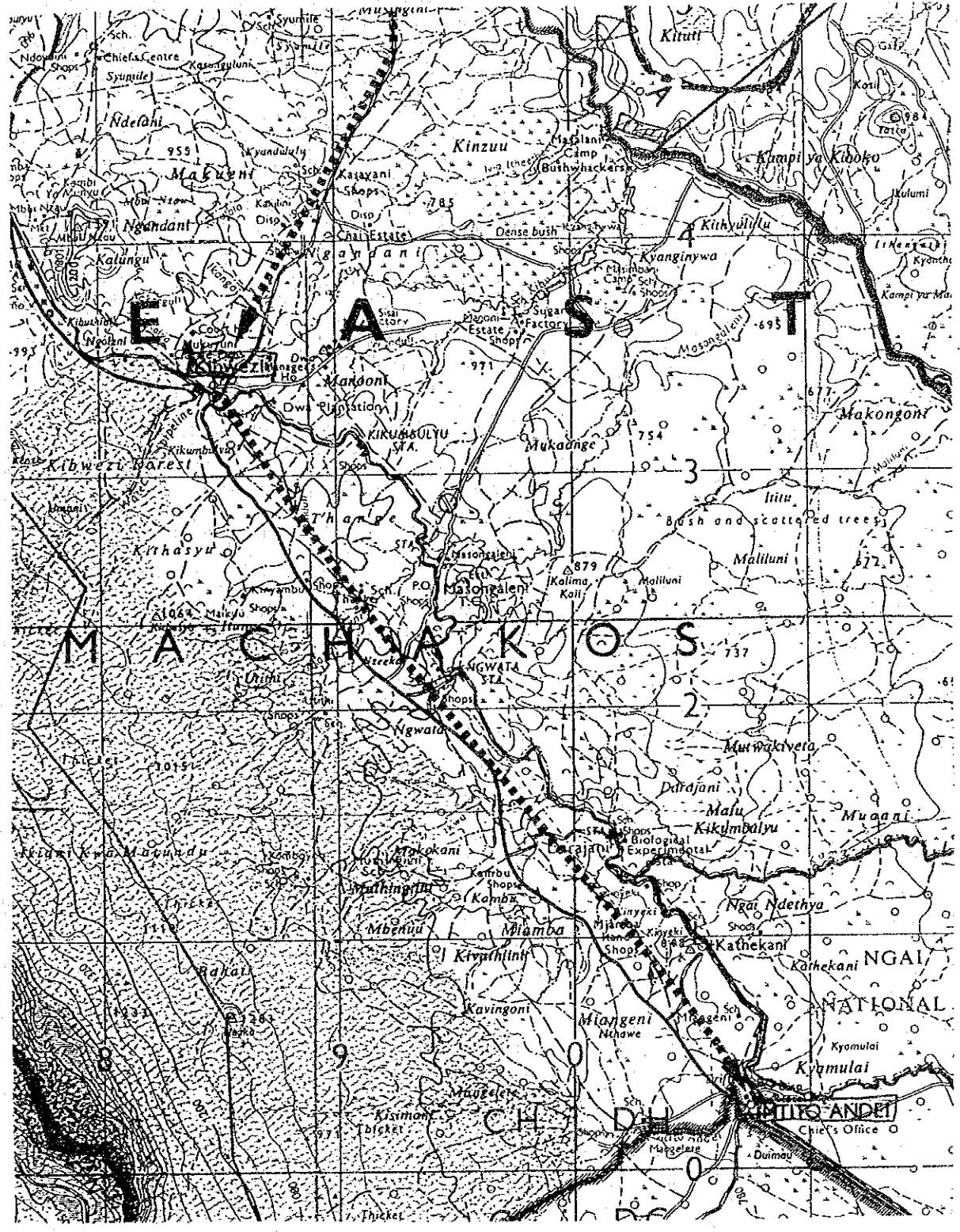


THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY



a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 440	U- 53				Rate		Jul-92 25.2
5	-----							
6	Name of Urban:	Muito Andei&Kibwezi		LGL Notice No:				
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:	Machakos	Locataion :	449.4 Muito Andei				
10	Map ( 1/50,000 ) :	183/1	Coordinates X:	38°11'				Y: S 02°42'
11	Sub-basin Code:	3FB	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:	Not-Turesh P/L + Umani springs			River No			
15	Raw Water System:	H (m)=	L (m)=					
16	Treatment:	Capacity (m3/d)						
17	Distribution System:							
18	-----							
19				1990	2000	2010		
20	-----							
21	Projected Population	(no)		3,800	8,500	13,500		
22	Residential Demand	(m3/d)		471	1,076	1,747		
23	Non-residential Demand	(m3/d)		79	174	280		
24	Livestock Demand	(m3/d)		7	14	22		
25	Industrial Demand	(m3/d)		0	0	0		
26	Total Demand	(m3/d)		557	1,264	2,049		
27	Area Served ( estimated net )	(ha)		28	63	101		
28	-----							
29	Future Development Plan							
30	Raw Water Source:	Pipeline from Athi river			River No:			
31	Raw Water System:	H (m)=	70 L (m)=		77,000			
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost			1990	2000	2010	Total	
36	Incremental Capacity	(m3/d)		556.7	707.6	784.3	2,048.6	
37	Source Works	(US\$'000)		6.8	8.2	8.8	23.8	
38	Pump Cost	(US\$'000)		2.5	2.8	2.9	8.2	
39	Raw Water Main	(US\$'000)		3,333.7	3,449.2	3,503.8	10,286.7	
40	Treatment	(US\$'000)		306.8	351.8	372.8	1,031.4	
41	Storage	(US\$'000)		52.7	60.5	64.2	177.4	
42	Distribution	(US\$'000)		227.0	280.8	298.7	806.5	
43	Miscellaneous (20%)	(US\$'000)		785.9	830.7	850.2	2,466.8	
44	Admi. & Engineering	(US\$'000)		471.5	498.4	510.1	1,480.1	
45	Contingency	(US\$'000)		1,037.4	1,096.5	1,122.3	3,256.2	
46	Total Cost	(US\$'000)		6,224.3	6,578.9	6,734.0	19,537.2	
47	Cost per Capita	(US\$/c)		1,638.0	1,399.8	1,346.8		
48	Cost per ha	(US\$/ha)		219,335.3	187,435.2	180,342.8		
49	Cost per m3	(US\$/m3)		11.2	9.3	8.6	9.5	
50	-----							
51	Present Value of Water at DF=10 %			1990	2000	2010	Total	
52	Direct O & M Costs	(US\$'000)		311.2	328.9	336.7		
53	Capital Costs	(US\$'000)		641.1	677.6	693.6		
54	Total Annual Cost	(US\$'000)		952.3	1,006.6	1,030.3		
55	Unit Cost per m3	(US\$/m3)		4.7	3.9	3.6		
56	-----							
57	Remarks:	Water is abstracted from Athi river by pumping (at Kailembwa).						
58		Alternatively source of water for Muito Andei may be the Muito Andei river.						
59								
60								
61								
62								
63	-----							

### Pipeline from Athi River



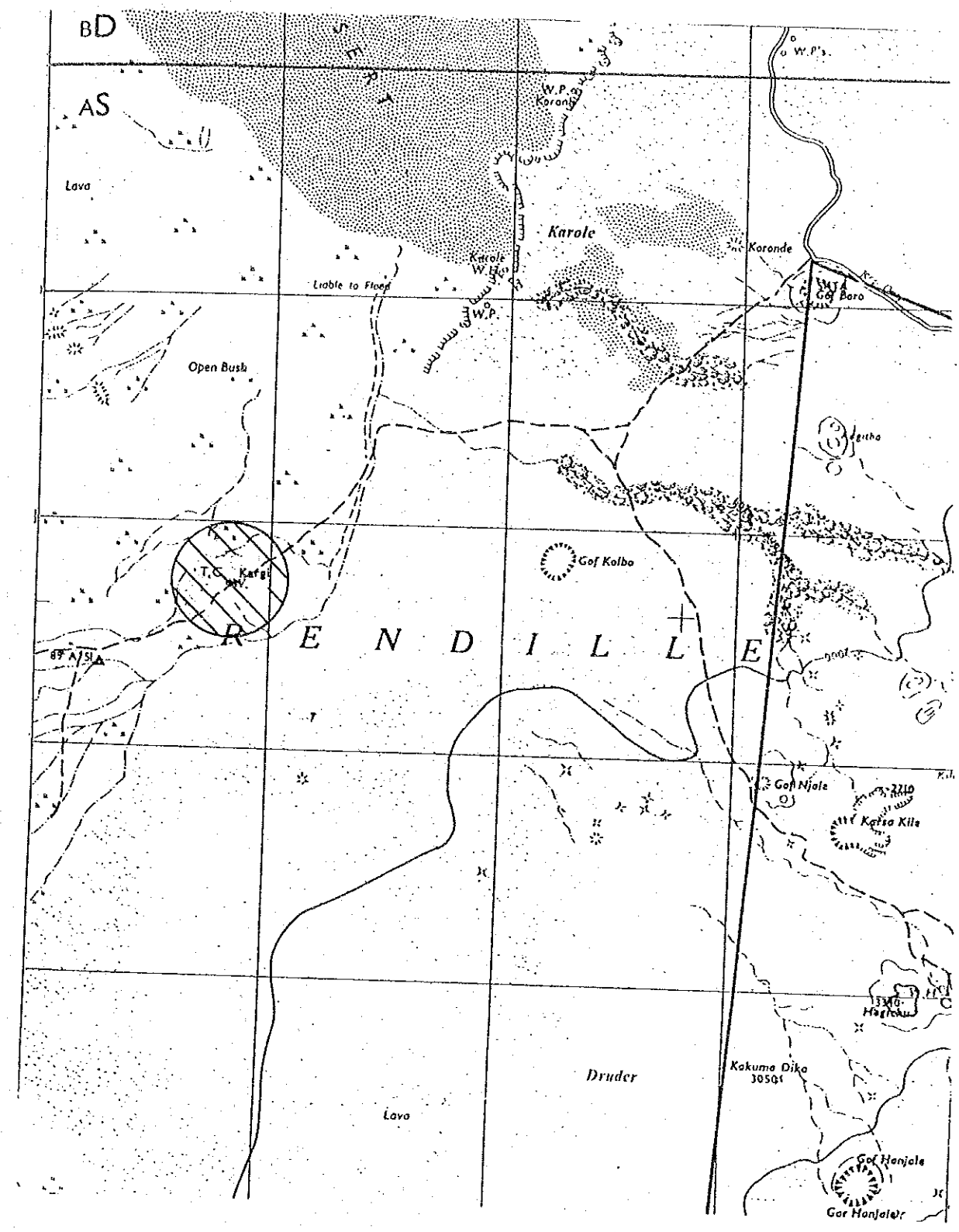
U- 53 Mtito Andei+Kibwezi

R 449.4 183/1 3FB



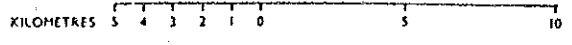
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 450		U- 54			Rate		Jul-92 25.2
5	-----							
6	Name of Urban:		Kargi		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:		Marsabit	Locataion :	452.2	Kargi		
10	Map ( 1/50,000 ):		NA-37-6	Coordinates X:		37°20'	Y:	N 02°31'
11	Sub-basin Code:		5J	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Boreholes			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		50		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		4,300	10,500	16,600	
22	Residential Demand		(m3/d)		533	1,330	2,148	
23	Non-residential Demand		(m3/d)		89	217	343	
24	Livestock Demand		(m3/d)		142	363	799	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		764	1,910	3,290	
27	Area Served ( estimated net )		(ha)		32	78	124	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Boreholes + Subsurface Dam			River No:		
31	Raw Water System:		H (m)=	0 L (m)=		756,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		713.7	1,145.9	1,380.1	3,239.6
37	Source Works		(US\$'000)		2,908.9	4,670.7	5,625.1	13,204.7
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		5,957.0	9,815.6	11,962.3	27,734.9
40	Treatment		(US\$'000)		0.0	0.0	0.0	0.0
41	Storage		(US\$'000)		60.8	79.1	87.1	227.0
42	Distribution		(US\$'000)		256.9	370.4	364.4	991.7
43	Miscellaneous (20%)		(US\$'000)		1,836.7	2,987.2	3,607.8	8,431.7
44	Admi. & Engineering		(US\$'000)		1,102.0	1,792.3	2,164.7	5,059.0
45	Contingency		(US\$'000)		2,424.5	3,943.0	4,762.3	11,129.8
46	Total Cost		(US\$'000)		14,546.8	23,658.3	28,573.7	66,778.8
47	Cost per Capita		(US\$/e)		3,383.0	3,815.9	4,684.2	
48	Cost per ha		(US\$/ha)		453,000.5	510,964.1	627,241.2	
49	Cost per m3		(US\$/m3)		20.4	20.6	20.7	20.6
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		727.3	1,182.9	1,428.7	
53	Capital Costs		(US\$'000)		1,498.3	2,436.8	2,943.1	
54	Total Annual Cost		(US\$'000)		2,225.7	3,619.7	4,371.8	
55	Unit Cost per m3		(US\$/m3)		8.5	8.7	8.7	
56	-----							
57	Remarks: Cost was tentatively estimated for the case of borehole development.							
58	Maximum development of subsurface dam should be surveyed.							
59								
60								
61								
62								
63	-----							



U- 54 Kargi

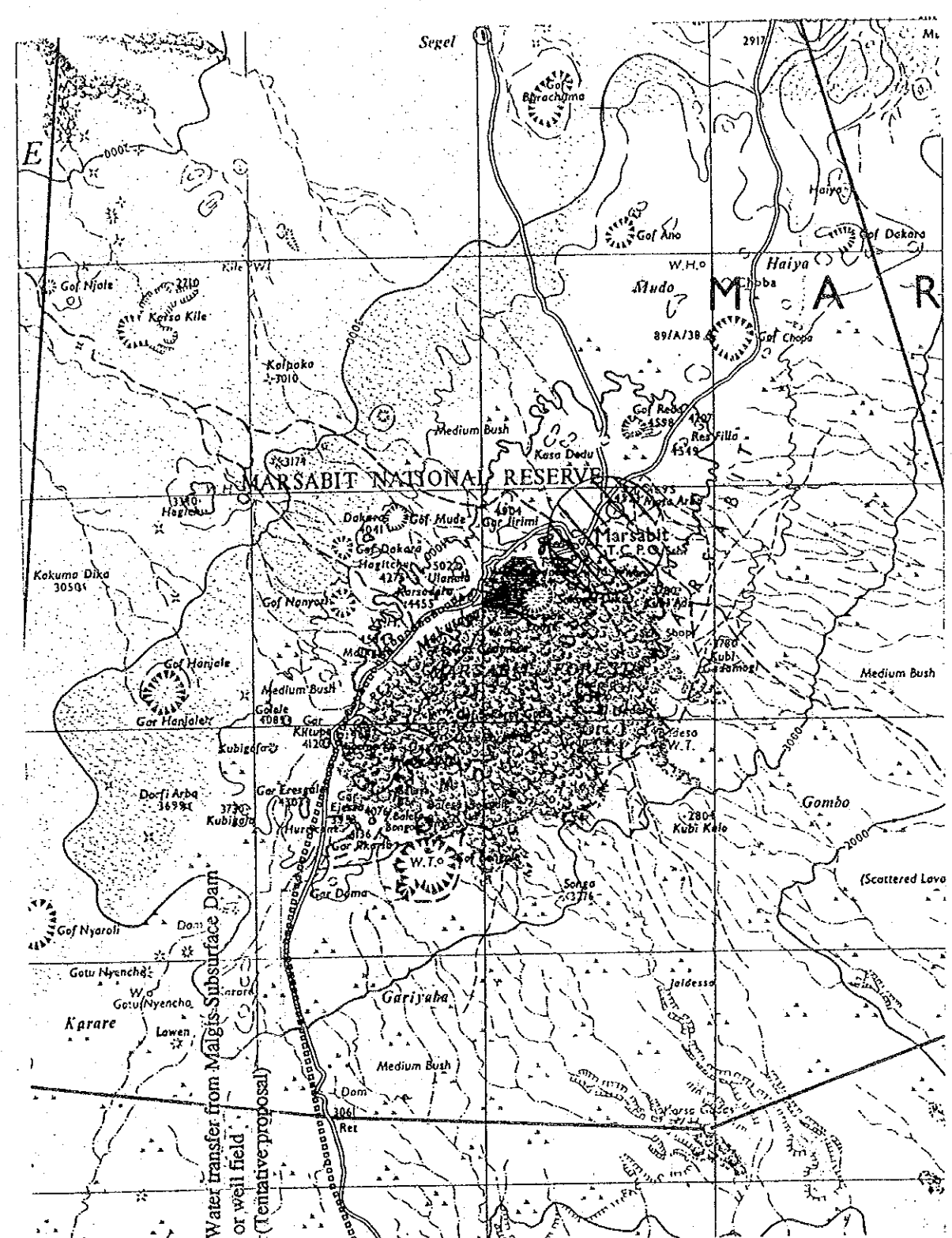
452.2 NA-37-6 5J



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

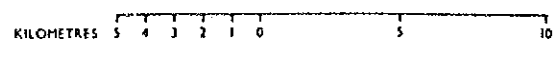
a	b	c	d	e	f	g	h	i
2						National Water Master Plan		
3			URBAN WATER SUPPLY					Jul-92
4	Code No. 450		U- 55			Rate		25.2
5	-----							
6	Name of Urban:		Marsabit		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:		Marsabit	Locataion :	454.1	Mountain		
10	Map ( 1/50,000 ) :		NA-37-6	Coordinates X:		37°58'	Y:	N 02°18'
11	Sub-basin Code:		5EC	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Small river(Bakuli spring)			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		300		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		11,100	27,100	42,700	
22	Residential Demand		(m3/d)		1,375	3,432	5,524	
23	Non-residential Demand		(m3/d)		230	560	885	
24	Livestock Demand		(m3/d)		368	937	2,062	
25	Industrial Demand		(m3/d)		228	421	607	
26	Total Demand		(m3/d)		2,201	5,350	9,078	
27	Area Served ( estimated net )		(ha)		83	202	319	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Boreholes +Small dams/Sub-surface dam/Spring					
31	Raw Water System:		H (m)=	0 L (m)=		1,739,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		1,901.0	3,148.5	3,728.8	8,778.3
37	Source Works		(US\$'000)		8,262.9	13,685.3	16,207.5	38,155.7
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		14,312.9	24,765.3	29,833.3	68,911.5
40	Treatment		(US\$'000)		599.3	765.3	825.8	2,190.4
41	Storage		(US\$'000)		101.9	135.6	160.6	398.1
42	Distribution		(US\$'000)		663.2	955.9	932.0	2,551.1
43	Miscellaneous (20%)		(US\$'000)		4,788.0	8,061.5	9,591.8	22,441.4
44	Admi. & Engineering		(US\$'000)		2,872.8	4,836.9	5,755.1	13,464.8
45	Contingency		(US\$'000)		6,320.2	10,641.2	12,661.2	29,622.6
46	Total Cost		(US\$'000)		37,921.3	63,847.0	75,967.3	177,735.6
47	Cost per Capita		(US\$/c)		3,416.3	3,990.4	4,869.7	
48	Cost per ha		(US\$/ha)		457,465.6	534,342.1	652,079.7	
49	Cost per m3		(US\$/m3)		19.9	20.3	20.4	20.2
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		1,896.1	3,192.4	3,798.4	
53	Capital Costs		(US\$'000)		3,905.9	6,576.2	7,824.6	
54	Total Annual Cost		(US\$'000)		5,802.0	9,768.6	11,623.0	
55	Unit Cost per m3		(US\$/m3)		8.4	8.5	8.5	
56	-----							
57	Remarks:	Cost was tentatively estimated for the case of borehole development. Maximum development of small dams						
58		within Marsabit hill area and subsurface dams at the hill foot area should be surveyed. The last alternative						
59		solution may be water transfer from Malgis subsurface dam or potential well field near Laisamis.						
60								
61								
62								
63	-----							

Fig.



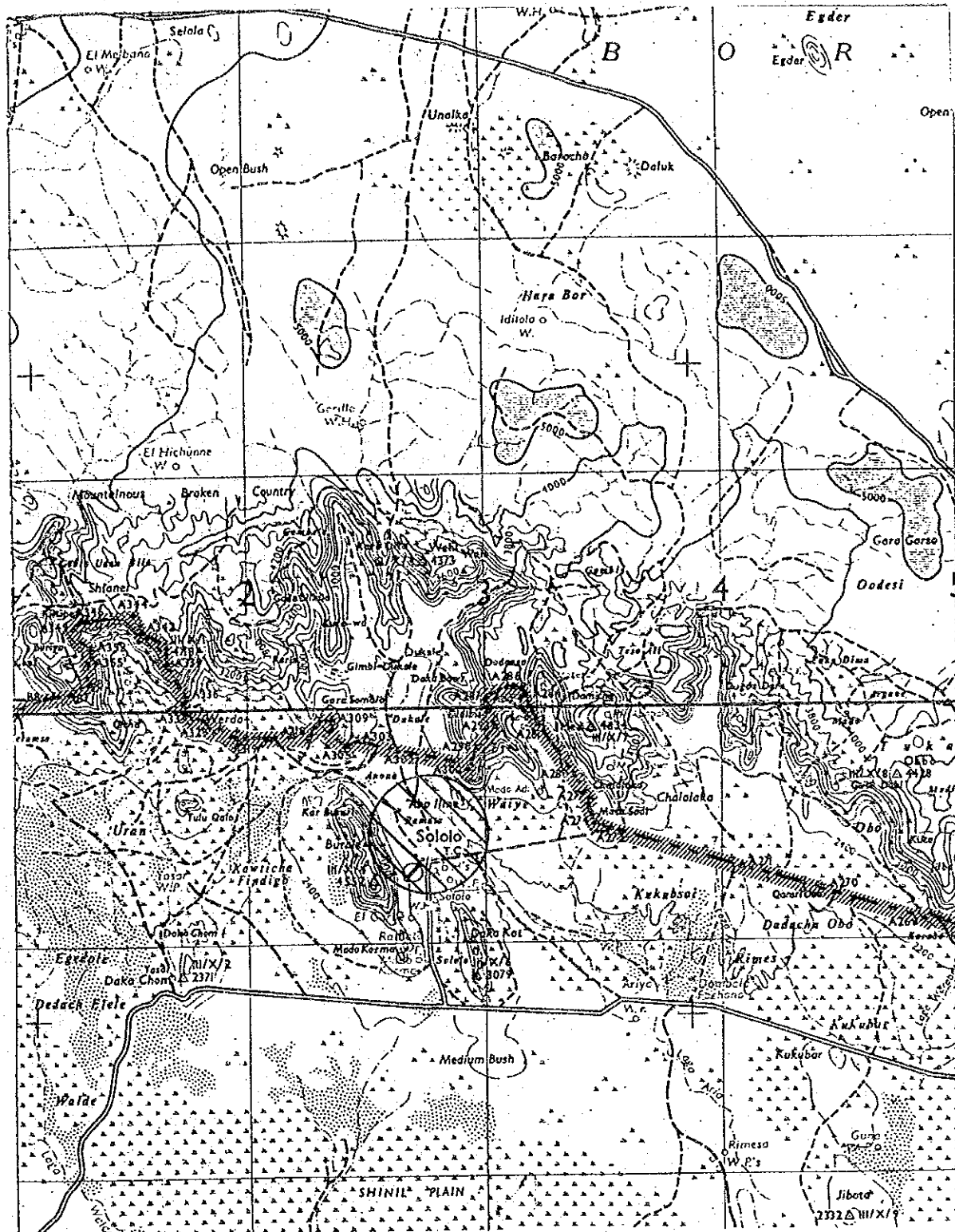
U- 55 Marsabit

U 454.1 NA-37-6 5EC



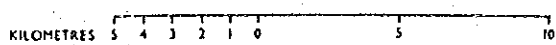
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 450	U- 56				Rate		Jul-92 25.2
5	-----							
6	Name of Urban:	Sololo			LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:	Marsabit	Locataion :	455.2	Sololo			
10	Map ( 1/50,000 ) :	NA-37-2	Coordinates X:			38°39'	Y:	N 03°34'
11	Sub-basin Code:	5EB	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:	Boreholes				River No		
15	Raw Water System:	H (m)=		L (m)=				
16	Treatment:		Capacity (m3/d)			20		
17	Distribution System:							
18	-----							
19						1990	2000	2010
20	-----							
21	Projected Population		(no)	3,700		9,100	14,300	
22	Residential Demand		(m3/d)	458		1,152	1,850	
23	Non-residential Demand		(m3/d)	77		187	295	
24	Livestock Demand		(m3/d)	123		313	687	
25	Industrial Demand		(m3/d)	0		0	0	
26	Total Demand		(m3/d)	658		1,652	2,832	
27	Area Served ( estimated net )		(ha)	28		68	107	
28	-----							
29	Future Development Plan							
30	Raw Water Source:	Boreholes				River No:		
31	Raw Water System:	H (m)=		0 L (m)=		726,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost			1990		2000	2010	Total
36	Incremental Capacity		(m3/d)	638.3		994.0	1,179.8	2,812.1
37	Source Works		(US\$'000)	2,832.6		4,410.6	5,235.1	12,478.3
38	Pump Cost		(US\$'000)	0.0		0.0	0.0	0.0
39	Raw Water Main		(US\$'000)	5,863.6		9,340.7	11,200.4	26,404.7
40	Treatment		(US\$'000)	0.0		0.0	0.0	0.0
41	Storage		(US\$'000)	57.1		73.2	80.3	210.6
42	Distribution		(US\$'000)	221.1		322.6	310.7	854.3
43	Miscellaneous (20%)		(US\$'000)	1,794.9		2,829.4	3,365.3	7,989.6
44	Admi. & Engineering		(US\$'000)	1,076.9		1,697.6	2,019.2	4,793.7
45	Contingency		(US\$'000)	2,369.2		3,734.8	4,442.2	10,546.2
46	Total Cost		(US\$'000)	14,215.3		22,409.0	26,653.1	63,277.4
47	Cost per Capita		(US\$/c)	3,842.0		4,149.8	5,125.6	
48	Cost per ha		(US\$/ha)	514,461.7		555,682.4	686,346.3	
49	Cost per m3		(US\$/m3)	22.3		22.5	22.6	22.5
50	-----							
51	Present Value of Water at DF=10 %			1990		2000	2010	Total
52	Direct O & M Costs		(US\$'000)	710.8		1,120.4	1,332.7	
53	Capital Costs		(US\$'000)	1,464.2		2,308.1	2,745.3	
54	Total Annual Cost		(US\$'000)	2,174.9		3,428.6	4,077.9	
55	Unit Cost per m3		(US\$/m3)	9.3		9.5	9.5	
56	-----							
57	Remarks:	In addition to boreholes, construction of subsurface dams should be searched						
58		to exploit subsurface water yielded from Mega escarpment area in Ethiopia.						
59		Rock catchment can be also considered.						
60								
61								
62								
63	-----							



U- 56 Sololo

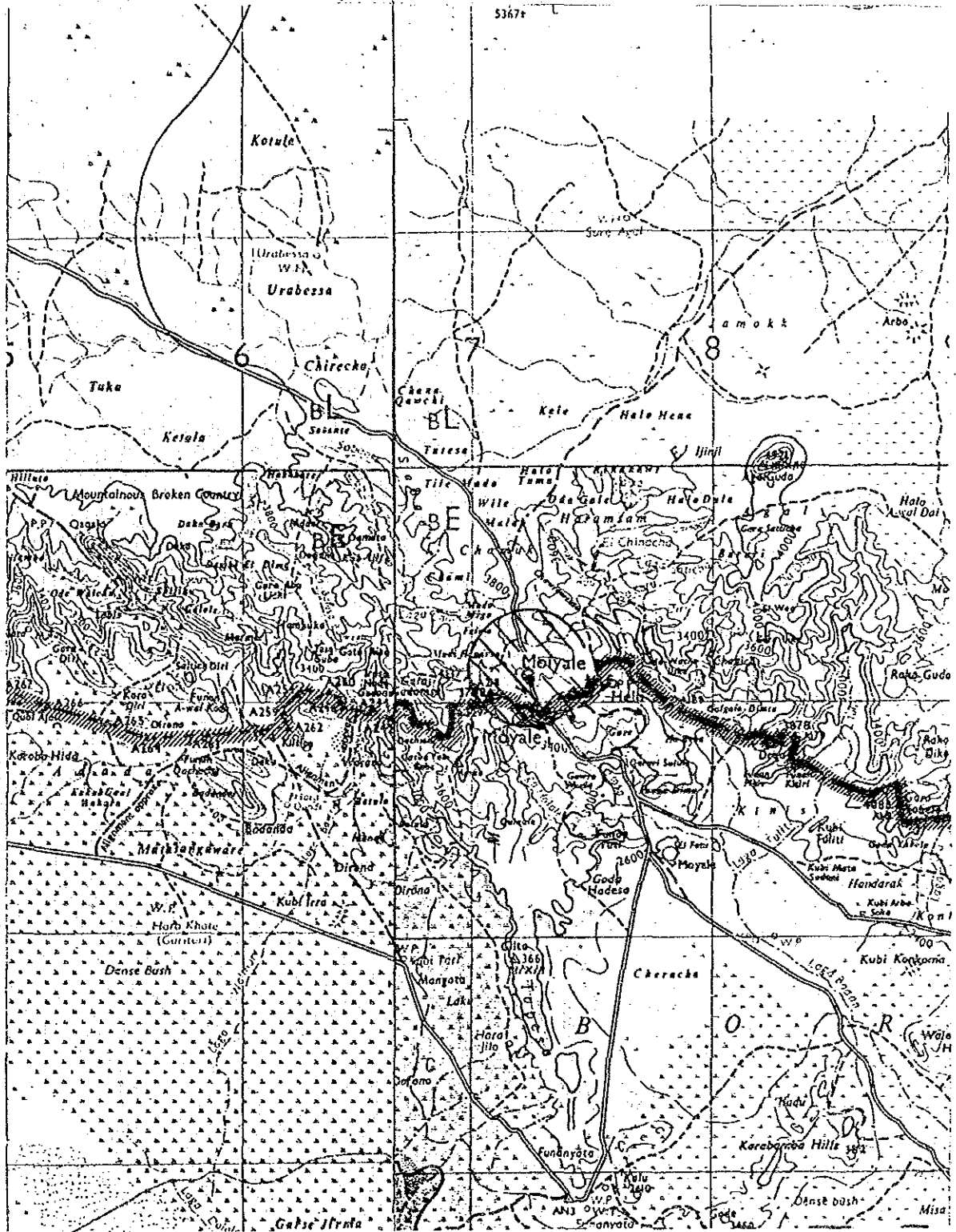
455.2 NA-37-2 5EB



THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY



a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Jul-92
4	Code No.	450	U- 57			Rate		25.2
5	-----							
6	Name of Urban:		Moyale		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):				456.1	Moyale		
9	District:		Marsabit	Locataion :				
10	Map ( 1/50,000 ) :		NA-37-3	Coordinates X:		39°02'	Y:	N 03°30'
11	Sub-basin Code:		5EA	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Moyale Dam			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		450		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		6,800	16,600	26,200	
22	Residential Demand		(m3/d)		842	2,102	3,390	
23	Non-residential Demand		(m3/d)		141	343	542	
24	Livestock Demand		(m3/d)		225	574	1,263	
25	Industrial Demand		(m3/d)		285	529	761	
26	Total Demand		(m3/d)		1,493	3,548	5,956	
27	Area Served ( estimated net )		(ha)		51	124	196	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Borcholes + Small Dam			River No:		
31	Raw Water System:		H (m)=	0 L (m)=		608,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		1,043.4	2,054.6	2,407.7	5,505.6
37	Source Works		(US\$'000)		3,093.9	6,092.7	7,139.6	16,326.2
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		4,205.7	8,676.3	10,301.5	23,183.5
40	Treatment		(US\$'000)		436.6	623.2	674.0	1,733.8
41	Storage		(US\$'000)		75.2	105.6	113.3	148.6
42	Distribution		(US\$'000)		406.3	585.5	573.5	1,565.3
43	Miscellaneous (20%)		(US\$'000)		1,643.5	3,216.7	3,760.4	8,620.6
44	Admi. & Engineering		(US\$'000)		986.1	1,930.0	2,256.2	5,172.4
45	Contingency		(US\$'000)		2,169.5	4,246.0	4,963.7	11,379.2
46	Total Cost		(US\$'000)		13,016.9	25,476.0	29,782.2	68,275.0
47	Cost per Capita		(US\$/c)		1,914.2	2,599.6	3,102.3	
48	Cost per ha		(US\$/ha)		256,328.0	348,099.7	415,416.6	
49	Cost per m3		(US\$/m3)		12.5	12.4	12.4	12.4
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		650.8	1,273.8	1,489.1	
53	Capital Costs		(US\$'000)		1,340.7	2,624.0	3,067.6	
54	Total Annual Cost		(US\$'000)		1,991.6	3,897.8	4,556.7	
55	Unit Cost per m3		(US\$/m3)		5.2	5.2	5.2	
56	-----							
57	Remarks:	In addition to borcholes, maximum development of small dams (surface water) and subsurface dams						
58		(subsurface water from Mega escarpment area in Ethiopia) should be pursued.						
59								
60								
61								
62								
63	-----							



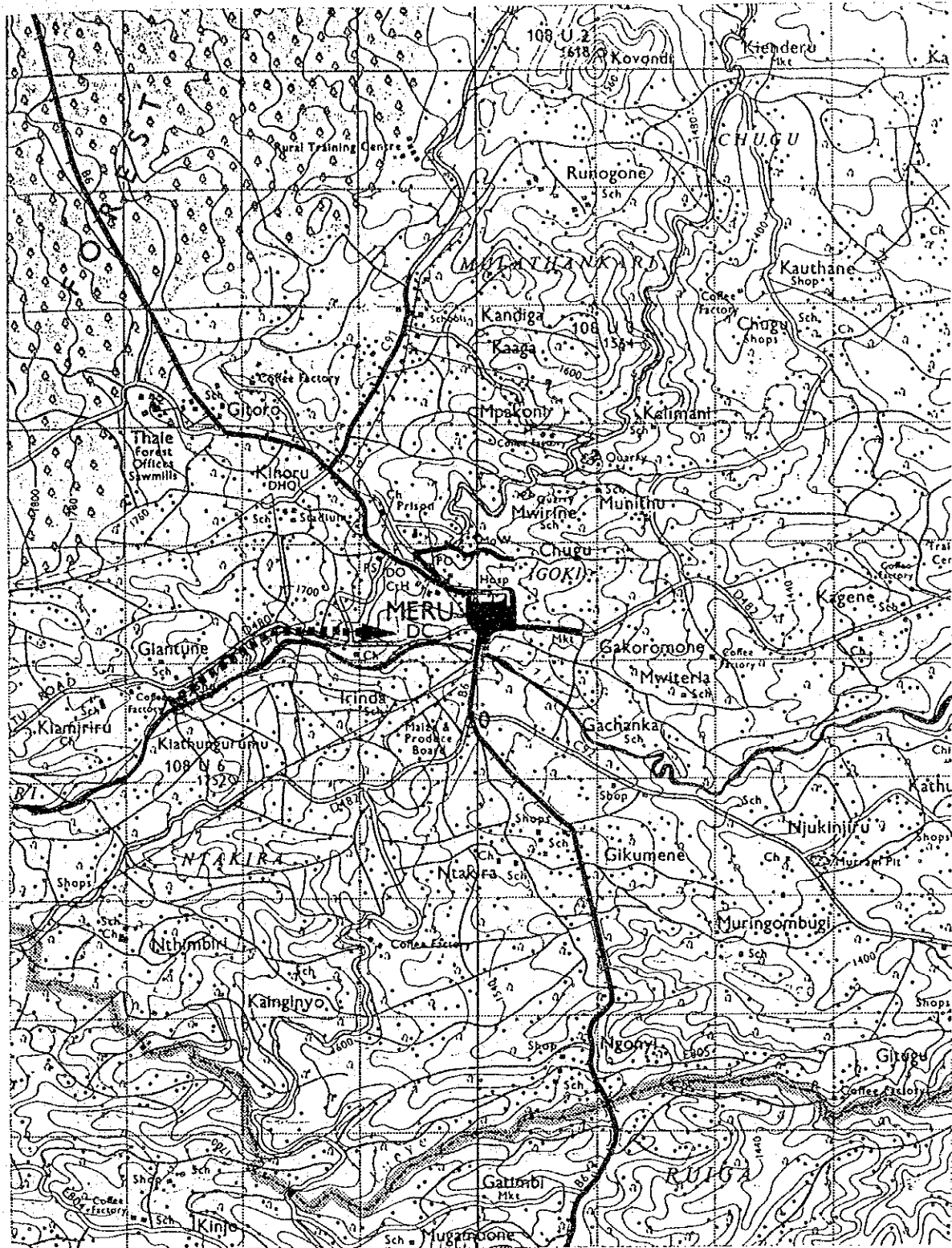
U- 57 Moyale

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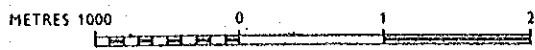
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2					National Water Master Plan				
3			URBAN WATER SUPPLY					Jul-92	
4	Code No. 460		U- 58			Rate		25.2	
5	-----								
6	Name of Urban:		Meru		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Meru	Locataion :		461.4 Ntima			
10	Map ( 1/50,000 ):		108/3	Coordinates X:		37°39'	Y:	N 00°03'	
11	Sub-basin Code:		4FA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Kazita R.Gatobora St			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		2980			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population			(no)		78,900	192,900	319,900	
22	Residential Demand			(m3/d)		9,774	24,426	41,387	
23	Non-residential Demand			(m3/d)		1,635	3,997	6,628	
24	Livestock Demand			(m3/d)		220	521	884	
25	Industrial Demand			(m3/d)		1,580	2,919	4,194	
26	Total Demand			(m3/d)		13,209	31,863	53,093	
27	Area Served ( estimated net )			(ha)		589	1,441	2,389	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Kathita river			River No:			
31	Raw Water System:		H (m)=	0 L (m)=		2,200			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity			(m3/d)		10,228.7	18,654.2	21,230.1	50,113.1
37	Source Works			(US\$'000)		60.5	95.0	104.7	260.3
38	Pump Cost			(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main			(US\$'000)		197.2	255.3	271.4	723.9
40	Treatment			(US\$'000)		1,177.1	1,898.1	2,160.2	5,235.3
41	Storage			(US\$'000)		440.5	803.4	914.3	2,158.2
42	Distribution			(US\$'000)		4,713.8	6,810.8	7,587.4	19,112.0
43	Miscellaneous (20%)			(US\$'000)		1,317.8	1,972.5	2,207.6	5,497.9
44	Admi. & Engineering			(US\$'000)		790.7	1,183.5	1,324.6	3,298.8
45	Contingency			(US\$'000)		1,739.5	2,603.7	2,914.0	7,257.3
46	Total Cost			(US\$'000)		10,437.2	15,622.2	17,484.2	43,543.6
47	Cost per Capita			(US\$/c)		132.3	137.0	137.7	
48	Cost per ha			(US\$/ha)		17,713.6	18,350.0	18,434.9	
49	Cost per m3			(US\$/m3)		1.0	0.8	0.8	0.9
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)		521.9	781.1	874.2	
53	Capital Costs			(US\$'000)		1,075.0	1,609.1	1,800.9	
54	Total Annual Cost			(US\$'000)		1,596.9	2,390.2	2,675.1	
55	Unit Cost per m3			(US\$/m3)		0.4	0.4	0.3	
56	-----								
57	Remarks:	Expansion of treatment works and rehabilitation of distribution lines are necessary to accommodate							
58		additionalwater from Kathita intake.							
59									
60									
61									
62									
63	-----								



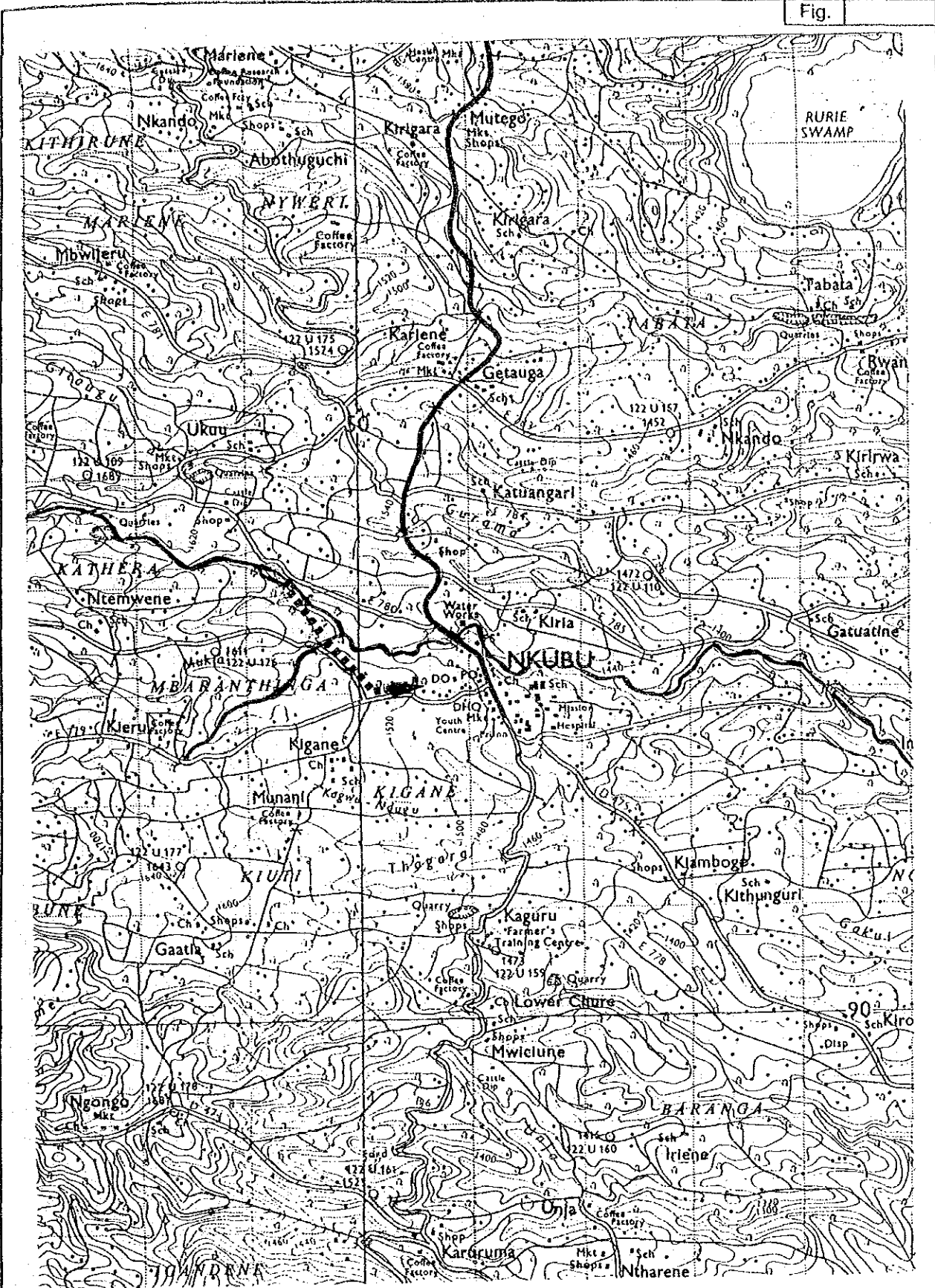
U- 58 Meru

G 461.4 108/3 4FA



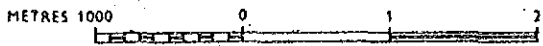
<p>THE STUDY ON THE NATIONAL WATER MASTER PLAN JAPAN INTERNATIONAL COOPERATION AGENCY</p>
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a	b	c	d	e	f	g	h	i
2						National Water Master Plan		
3			URBAN WATER SUPPLY					Feb-92
4	Code No. 460		U- 59			Rtae		25.2
5	-----							
6	Name of Urban:		Nkubu		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:		Meru	Locataion :	463.1	Nkuene		
10	Map ( 1/50,000 ) :		122/1	Coordinates X:		37°40'	Y:	S 00°03'
11	Sub-basin Code:		4FA	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Thingithu R.			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		300		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population			(no)	5,000	12,300	20,300	
22	Residential Demand			(m3/d)	619	1,557	2,626	
23	Non-residential Demand			(m3/d)	104	253	420	
24	Livestock Demand			(m3/d)	14	33	56	
25	Industrial Demand			(m3/d)	0	0	0	
26	Total Demand			(m3/d)	737	1,843	3,102	
27	Area Served ( estimated net )			(ha)	37	92	152	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Thingithu River			River No:		
31	Raw Water System:		H (m)=	0 L (m)=		2,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity			(m3/d)	437.4	1,106.1	1,258.8	2,802.3
37	Source Works			(US\$'000)	5.7	11.4	12.6	29.7
38	Pump Cost			(US\$'000)	0.0	0.0	0.0	0.0
39	Raw Water Main			(US\$'000)	84.0	96.4	98.7	279.1
40	Treatment			(US\$'000)	266.8	450.7	483.3	1,200.8
41	Storage			(US\$'000)	45.6	77.6	83.1	206.2
42	Distribution			(US\$'000)	298.7	436.1	477.9	1,212.8
43	Miscellaneous (20%)			(US\$'000)	140.1	214.5	231.1	585.7
44	Admi. & Enginccring			(US\$'000)	84.1	128.7	138.7	351.4
45	Contingency			(US\$'000)	185.0	283.1	305.1	773.1
46	Total Cost			(US\$'000)	1,109.9	1,698.5	1,830.5	4,638.9
47	Cost per Capita			(US\$/c)	222.0	232.7	228.8	
48	Cost per ha			(US\$/ha)	29,724.8	31,155.4	30,639.4	
49	Cost per m3			(US\$/m3)	2.5	1.5	1.5	1.7
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)	55.5	84.9	91.5	
53	Capital Costs			(US\$'000)	114.3	174.9	188.5	
54	Total Annual Cost			(US\$'000)	169.8	259.9	280.1	
55	Unit Cost per m3			(US\$/m3)	1.1	0.6	0.6	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



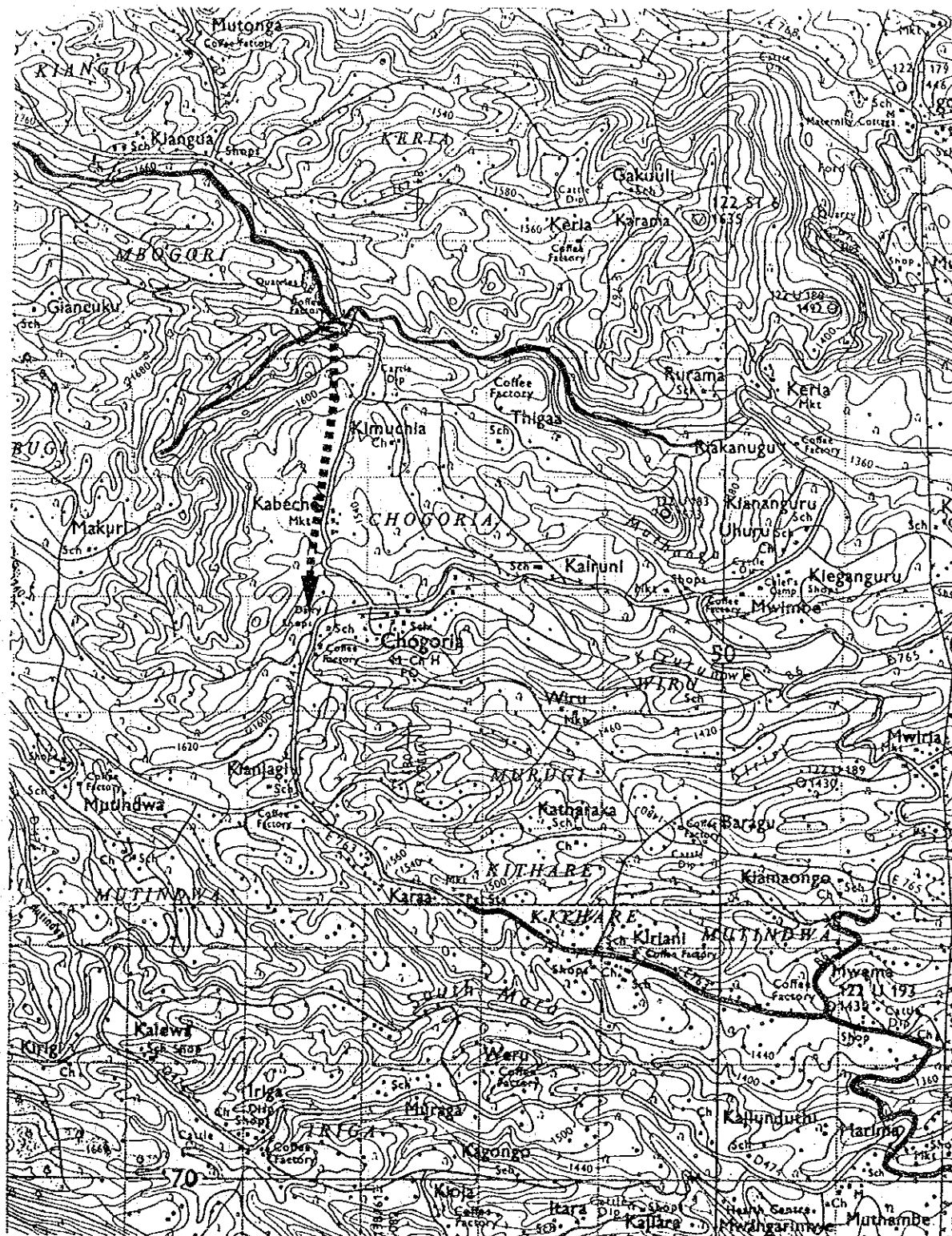
U- 59 Nkubu

U 463.1 122/1 4FA




THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 460	U- 60				Rate		Jul-92 25.2
5	-----							
6	Name of Urban:	Chogoria			LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:	Meru	Locataion :	464.1	Chogoria			
10	Map ( 1/50,000 ):	'122/1	Coordinates X:		37°38'		Y:	S 00°13'
11	Sub-basin Code:	4EB	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:	Mutonga River			River No			
15	Raw Water System:	H (m)=	L (m)=					
16	Treatment:		Capacity (m3/d)					
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)	1,300	2,200	2,900		
22	Residential Demand		(m3/d)	161	279	375		
23	Non-residential Demand		(m3/d)	0	44	60		
24	Livestock Demand		(m3/d)	0	6	8		
25	Industrial Demand		(m3/d)	0	0	0		
26	Total Demand		(m3/d)	161	329	443		
27	Area Served ( estimated net )		(ha)	10	16	22		
28	-----							
29	Future Development Plan							
30	Raw Water Source:	North Mara River			River No:			
31	Raw Water System:	H (m)=	50 L (m)=		2,800			
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost			1990	2000	2010	Total	
36	Incremental Capacity		(m3/d)	161.0	328.6	114.6	604.2	
37	Source Works		(US\$'000)	2.7	4.6	2.1	9.4	
38	Pump Cost		(US\$'000)	0.0	1.7	1.5	3.2	
39	Raw Water Main		(US\$'000)	106.6	113.8	104.0	324.3	
40	Treatment		(US\$'000)	146.6	225.4	119.0	491.0	
41	Storage		(US\$'000)	24.3	38.3	19.5	82.0	
42	Distribution		(US\$'000)	77.7	53.8	41.8	173.3	
43	Miscellaneous (20%)		(US\$'000)	71.6	87.5	57.6	216.6	
44	Admi. & Engineering		(US\$'000)	42.9	52.5	34.5	130.0	
45	Contingency		(US\$'000)	94.5	115.5	76.0	286.0	
46	Total Cost		(US\$'000)	566.9	693.0	455.9	1,715.7	
47	Cost per Capita		(US\$/c)	436.0	770.0	651.3		
48	Cost per ha		(US\$/ha)	58,388.4	103,103.3	87,208.8		
49	Cost per m3		(US\$/m3)	3.5	2.1	4.0	2.8	
50	-----							
51	Present Value of Water at DF=10 %			1990	2000	2010	Total	
52	Direct O & M Costs		(US\$'000)	28.3	34.6	22.8		
53	Capital Costs		(US\$'000)	58.4	71.4	47.0		
54	Total Annual Cost		(US\$'000)	86.7	106.0	69.8		
55	Unit Cost per m3		(US\$/m3)	1.5	0.9	1.7		
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



U- 60 Chogoria

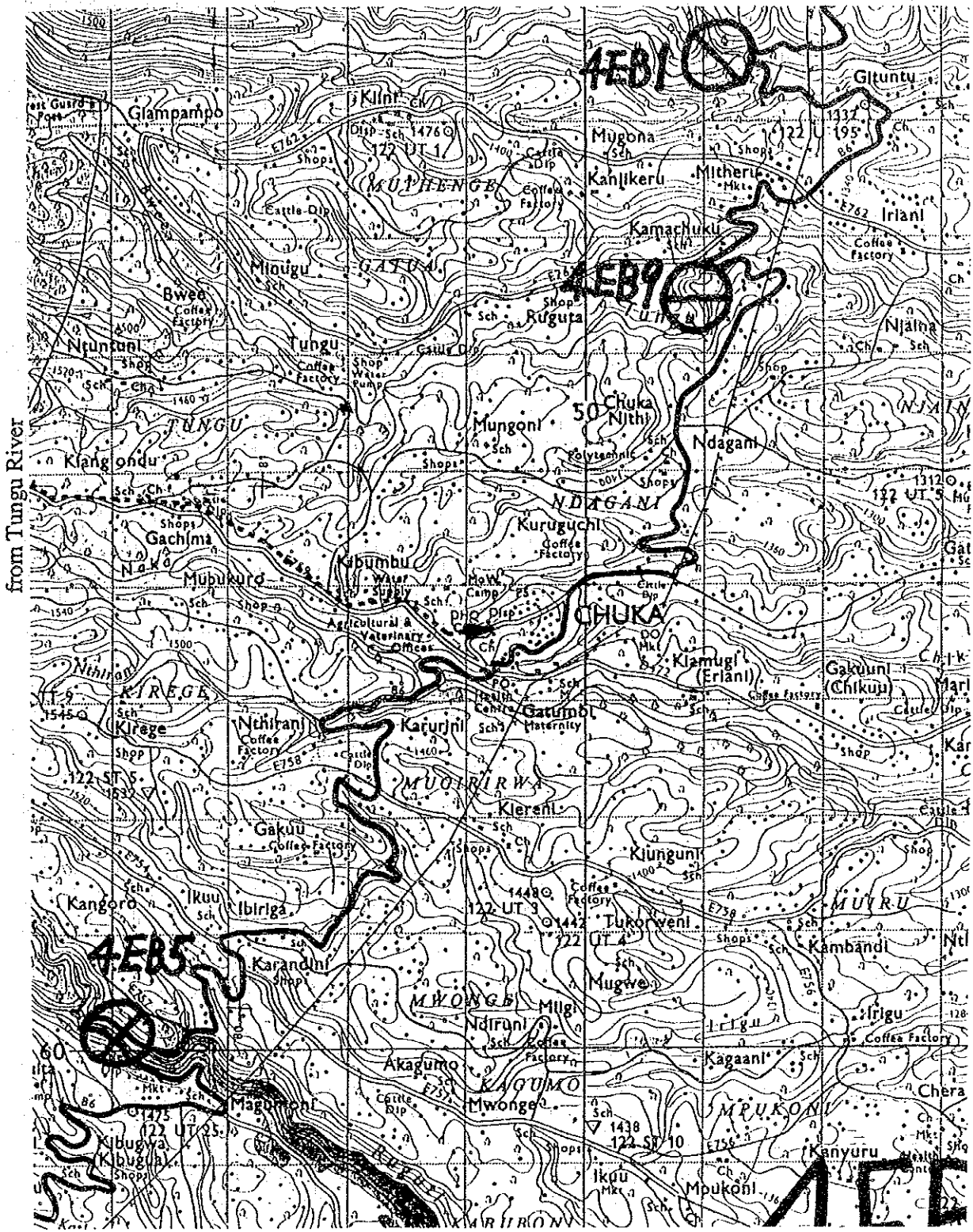
U 464.1 122/1 4EB

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THE STUDY  
 ON  
 THE NATIONAL WATER MASTER PLAN  
 JAPAN INTERNATIONAL COOPERATION AGENCY



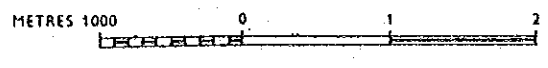
a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							Jul-92
4	Code No. 460		U- 61			Rate		25.2
5	-----							
6	Name of Urban:	Chuka		LGL Notice No:				
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:	Meru	Locataion :	464.3 Karingani				
10	Map ( 1/50,000 ) :	122/3	Coordinates X:	37°39'				Y: S 00°19'
11	Sub-basin Code:	4EB	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:	Tungu River		River No				
15	Raw Water System:	H (m)=	L (m)=					
16	Treatment:	Capacity (m3/d)		400				
17	Distribution System:							
18	-----							
19				1990	2000	2010		
20	-----							
21	Projected Population	(no)		4,000	8,300	12,400		
22	Residential Demand	(m3/d)		496	1,051	1,604		
23	Non-residential Demand	(m3/d)		83	171	256		
24	Livestock Demand	(m3/d)		11	22	34		
25	Industrial Demand	(m3/d)		0	0	0		
26	Total Demand	(m3/d)		590	1,244	1,894		
27	Area Served ( estimated net )	(ha)		30	62	93		
28	-----							
29	Future Development Plan							
30	Raw Water Source:	Tungu river		River No:				
31	Raw Water System:	H (m)=	0 L (m)=	7,000				
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost			1990	2000	2010	Total	
36	Incremental Capacity	(m3/d)		189.5	654.5	650.3	1,494.3	
37	Source Works	(US\$'000)		3.0	7.7	7.7	18.4	
38	Pump Cost	(US\$'000)		0.0	0.0	0.0	0.0	
39	Raw Water Main	(US\$'000)		269.9	310.0	309.7	889.6	
40	Treatment	(US\$'000)		161.9	336.6	335.3	833.8	
41	Storage	(US\$'000)		27.0	57.9	57.7	142.6	
42	Distribution	(US\$'000)		239.0	256.9	244.9	740.8	
43	Miscellaneous (20%)	(US\$'000)		140.2	193.8	191.1	525.0	
44	Admi. & Engineering	(US\$'000)		84.1	116.3	114.6	315.0	
45	Contingency	(US\$'000)		185.0	255.8	252.2	693.1	
46	Total Cost	(US\$'000)		1,110.2	1,535.0	1,513.2	4,158.3	
47	Cost per Capita	(US\$/c)		277.5	357.0	369.1		
48	Cost per ha	(US\$/ha)		37,164.4	47,799.9	49,421.3		
49	Cost per m3	(US\$/m3)		5.9	2.3	2.3	2.8	
50	-----							
51	Present Value of Water at DF=10 %			1990	2000	2010	Total	
52	Direct O & M Costs	(US\$'000)		55.5	76.7	75.7		
53	Capital Costs	(US\$'000)		114.3	158.1	155.9		
54	Total Annual Cost	(US\$'000)		169.9	234.8	231.5		
55	Unit Cost per m3	(US\$/m3)		2.5	1.0	1.0		
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



from Tuguru River

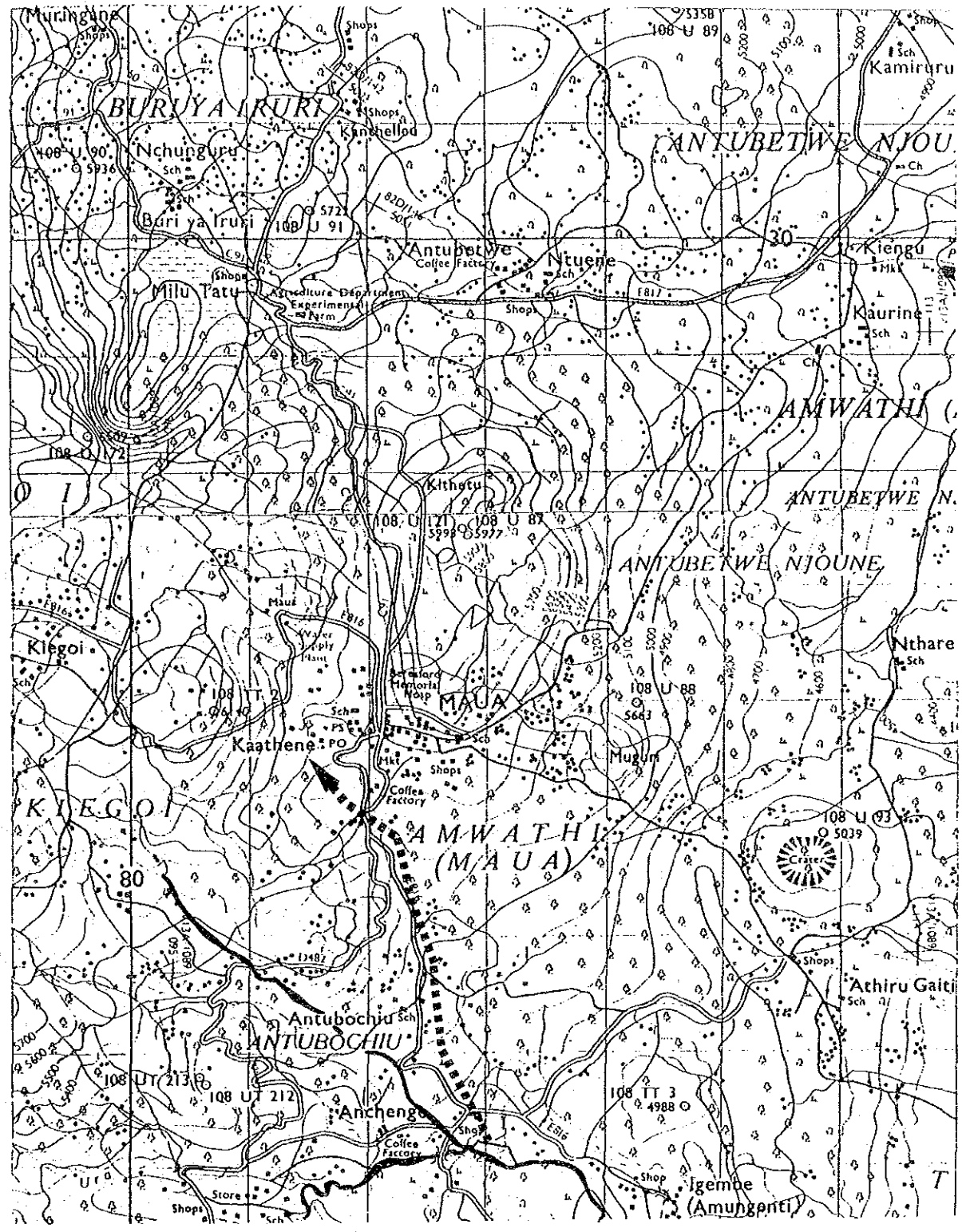
U- 61 Chuka

U 464.3 122/3 4EB



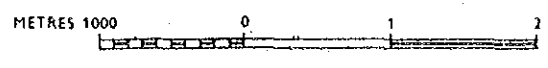
THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No. 460		U- 62			Rate		25.2
5	-----							
6	Name of Urban:		Maua		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 ( guess ):							
9	District:		Mera	Locataion :	467.2	Maua		
10	Map ( 1/50,000 ) :		108/4	Coordinates X:		37°57'	Y:	N 00°14'
11	Sub-basin Code:		4FB	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Mboone Stream			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		170		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		4,000	8,300	12,400	
22	Residential Demand		(m3/d)		496	1,051	1,604	
23	Non-residential Demand		(m3/d)		83	171	256	
24	Livestock Demand		(m3/d)		11	22	34	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		590	1,244	1,894	
27	Area Served ( estimated net )		(ha)		30	62	93	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Ura river			River No:		
31	Raw Water System:		H (m)=	250	L (m)=	4,100		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		419.5	654.5	650.3	1,724.3
37	Source Works		(US\$'000)		5.5	7.7	7.7	20.9
38	Pump Cost		(US\$'000)		8.3	9.9	9.9	28.2
39	Raw Water Main		(US\$'000)		171.2	181.6	181.4	534.2
40	Treatment		(US\$'000)		260.3	336.6	335.3	932.2
41	Storage		(US\$'000)		44.4	57.9	57.7	160.0
42	Distribution		(US\$'000)		239.0	256.9	244.9	740.8
43	Miscellaneous (20%)		(US\$'000)		145.8	170.1	167.4	483.3
44	Admi. & Engineering		(US\$'000)		87.5	102.1	100.4	290.0
45	Contingency		(US\$'000)		192.4	224.5	221.0	637.9
46	Total Cost		(US\$'000)		1,154.5	1,347.3	1,325.7	3,827.4
47	Cost per Capita		(US\$/c)		288.6	313.3	323.3	
48	Cost per ha		(US\$/ha)		38,647.1	41,954.9	43,297.4	
49	Cost per m3		(US\$/m3)		2.8	2.1	2.0	2.2
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		57.7	67.4	66.3	
53	Capital Costs		(US\$'000)		118.9	138.8	136.5	
54	Total Annual Cost		(US\$'000)		176.6	206.1	202.8	
55	Unit Cost per m3		(US\$/m3)		1.2	0.9	0.9	
56	-----							
57	Remarks:	Tentatively pump-up from Ura river is assumed above. Further study is needed to seek						
58		a less costly water source in the Nyambeni forest area.						
59								
60								
61								
62								
63	-----							



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THE STUDY  
ON  
THE NATIONAL WATER MASTER PLAN  
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2	National Water Master Plan								
3	URBAN WATER SUPPLY							Jul-92	
4	Code No. 510		U- 63			Rate		25.2	
5	-----								
6	Name of Urban:		Mudo Gashe		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 ( guess ):								
9	District:		Garissa	Locataion :		513.1 Madogashe			
10	Map ( 1/50,000 ):		NA-37-15	Coordinates X:		39°10'	Y:	N 00°44'	
11	Sub-basin Code:		5FA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Spring			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		69			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			2,200	4,700	6,700	
22	Residential Demand		(m3/d)			273	595	867	
23	Non-residential Demand		(m3/d)			46	97	138	
24	Livestock Demand		(m3/d)			40	81	136	
25	Industrial Demand		(m3/d)			0	0	0	
26	Total Demand		(m3/d)			359	773	1,141	
27	Area Served ( estimated net )		(ha)			16	35	50	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Boreholes + Subsurface Dam			River No:			
31	Raw Water System:		H (m)=	0 L (m)=		207,000			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			289.5	414.6	367.7	1,071.8
37	Source Works		(US\$'000)			1,260.1	1,804.5	1,600.2	4,664.9
38	Pump Cost		(US\$'000)			0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)			1,929.8	2,798.1	2,470.5	7,198.4
40	Treatment		(US\$'000)			0.0	0.0	0.0	0.0
41	Storage		(US\$'000)			35.4	44.1	41.0	120.5
42	Distribution		(US\$'000)			131.4	149.4	119.5	400.3
43	Miscellaneous (20%)		(US\$'000)			671.3	959.2	846.2	2,476.8
44	Admi. & Engineering		(US\$'000)			402.8	575.5	507.7	1,486.1
45	Contingency		(US\$'000)			886.2	1,266.2	1,117.0	3,269.4
46	Total Cost		(US\$'000)			5,317.1	7,597.1	6,702.2	19,616.4
47	Cost per Capita		(US\$/c)			2,416.9	3,038.8	3,351.1	
48	Cost per ha		(US\$/ha)			323,629.7	406,916.9	448,733.4	
49	Cost per m3		(US\$/m3)			18.4	18.3	18.2	18.3
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			265.9	379.9	335.1	
53	Capital Costs		(US\$'000)			547.7	782.5	690.3	
54	Total Annual Cost		(US\$'000)			813.5	1,162.4	1,025.4	
55	Unit Cost per m3		(US\$/m3)			7.7	7.7	7.6	
56	-----								
57	Remarks:	Development of boreholes was tentatively assumed in the above cost estimate. However, the first							
58		approach should be to study the development potential of subsurface dams on the Galana Gof.							
59		Demand exceeding subsurface dam yield will be met by borehole yield.							
60									
61									
62									
63	-----								