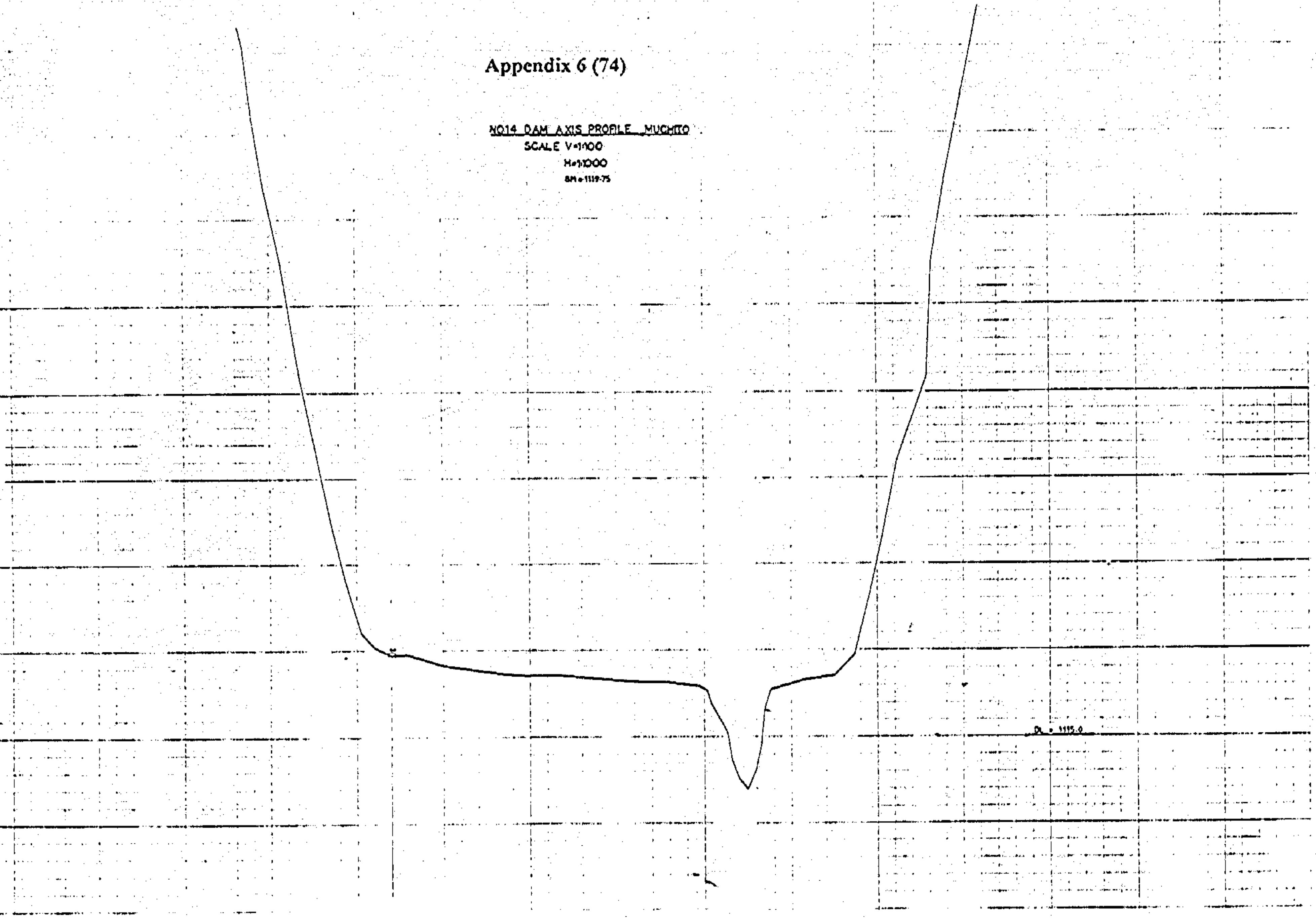
Appendix 6 (73)

DAM AXIS PROFILE DATA.

STATION : No. 14 MUCHITO (LEFT)

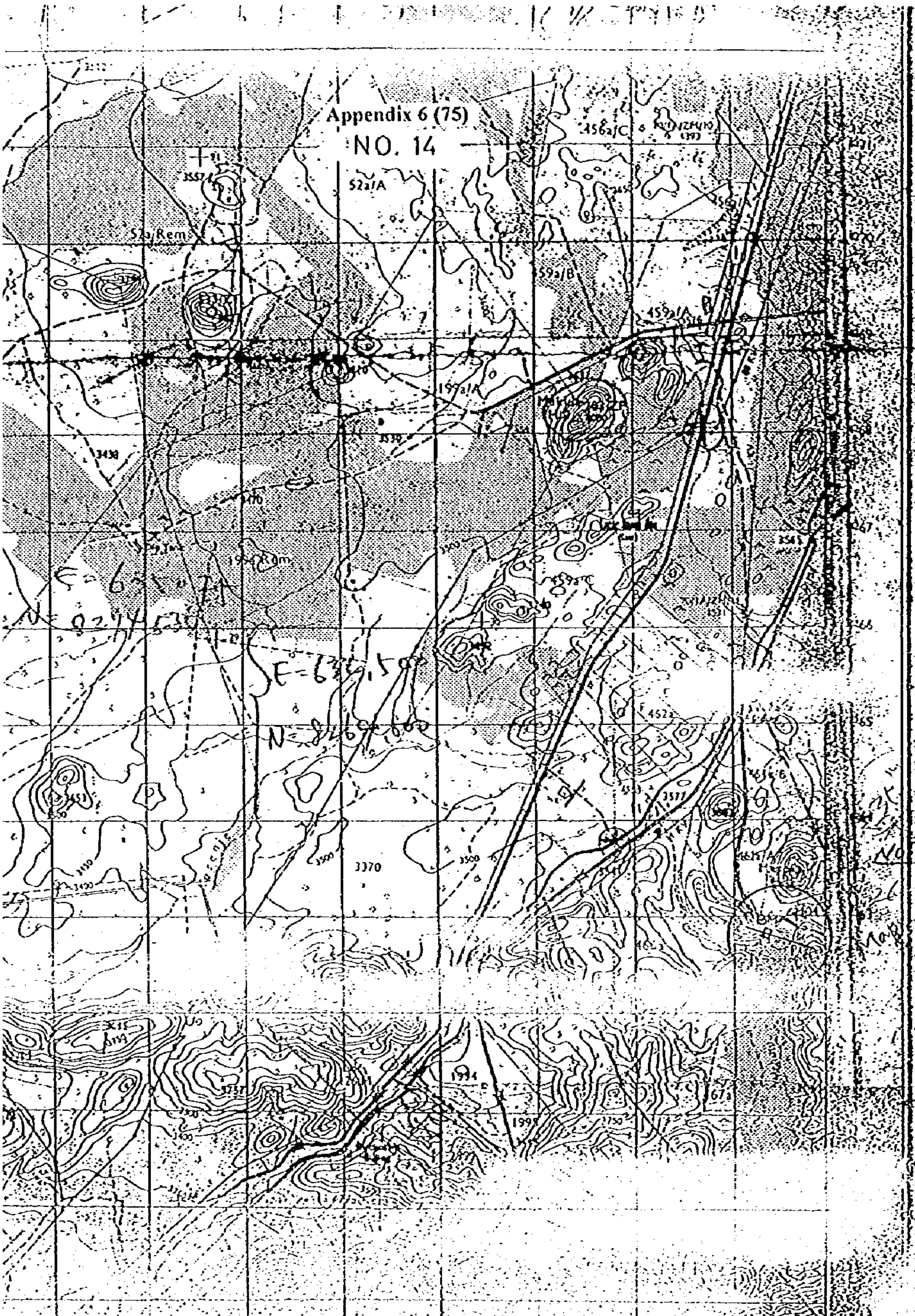
No.	D	H	Remark	No.	D	H	Remark
BM.	0	1119.75					
1	8.93	1120.12					
2	17.25	1121.03					
3	26.46	1123.99					
4	34.88	1127.35					
5	43.43	1131.41					
6	53.54	1136.20					
7	64.51	1141.72					
8	73.02	1146.69					
9	79.55	1150.93					
10	86.60	1155.04					
11	88.58	1156.25					

Appendix 6 (74)



Appendix 6 (75)

NO. 14



Appendix 6 (76)

DAM AXIS PROFILE DATA.

STATION : No. 15 KANAKANTAPA (RIGHT BANK)

No.	D	H	Remark	No.	D	H	Remark
BM.	0	1109.00					
1	17.58	1115.57					
2	35.17	1115.86					
3	53.12	1118.67					
4	69.07	1121.43					
5	86.59	1124.39					
TP. 1	103.04	1126.20					
1	122.94	1128.40					
2	142.71	1130.09					
3	161.50	1131.67					
4	181.21	1133.74					
5	194.95	1135.30					
6	212.57	1137.23					
7	231.64	1139.27					
TP. 2	247.84	1140.38					
1	266.32	1141.41					
2	284.75	1142.16					
3	303.67	1142.60					
4	321.14	1142.99					
5	338.08	1143.17					
TP. 3	355.16	1143.50					
1	374.75	1143.98					
2	391.80	1144.80					
3	406.79	1145.53					

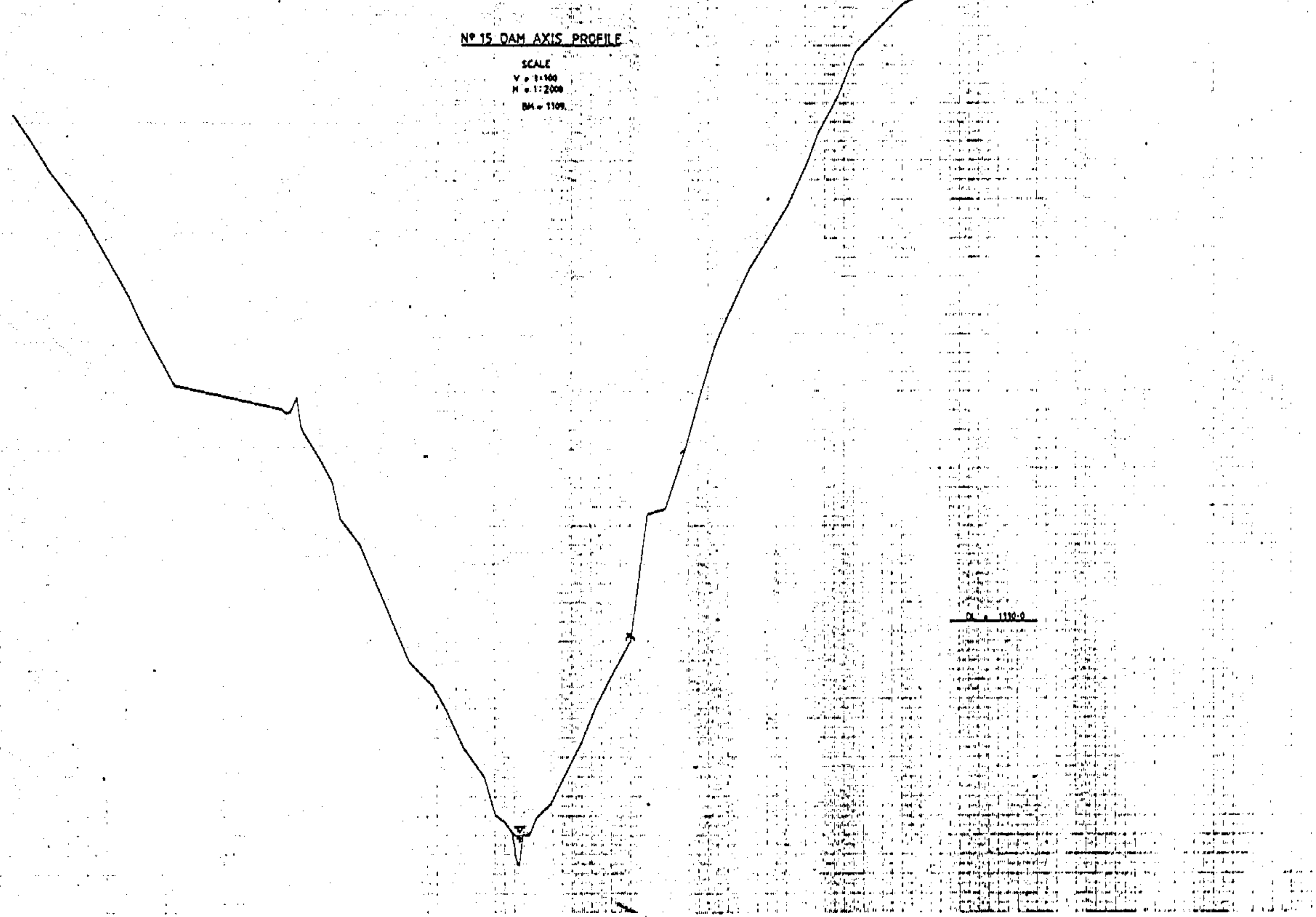
Appendix 6 (77)

DAM AXIS PROFILE DATA.

STATION : No. 15 KANAKANTAPA. (LEFT BANK)

No.	D	H	Remark	No.	D	H	Remark
BM.	0	1109.00		BM.	332.85	1118.68	
1	5.96	1108.53	Center of Road	1	337.57	1119.96	
2	21.13	1107.03	W=2.5M.	2	338.94	1120.28	
3	37.09	1105.39		3	344.19	1121.74	Ant Hill
4	52.00	1103.65		4	349.39	1120.95	
5	67.17	1102.04		5	353.22	1120.88	
6	73.30	1101.48	Farm	6	359.27	1121.13	
7	83.85	1100.59	Farm	7	469.21	1122.30	
8	97.94	1099.94		8	486.60	1123.85	
				9	504.20	1125.56	
TP. 1	105.91	1099.17		10	518.62	1127.03	
1	110.07	1099.20	Water Surface	11	535.62	1128.66	
2	113.07	1097.25		12	549.95	1129.96	
3	114.68	1096.00		13	566.13	1131.35	
4	116.00	1096.00		14	582.76	1132.40	
5	117.78	1099.19	Water Surface	15	600.86	1133.60	
6	120.95	1099.20		16	618.50	1135.08	
7	130.05	1099.77		17	635.75	1136.52	
8	139.69	1100.79					
9	151.60	1101.99					
10	160.72	1102.65	Center of Road				
11	172.73	1103.46	W=2.5M.				
12	184.97	1104.78					
13	196.12	1105.95					
14	206.91	1106.71					
15	219.89	1107.52					
16	229.77	1107.92					
17	245.73	1109.88					
TP. 2	254.59	1110.95					
1	266.17	1112.37					
2	279.02	1114.00					
3	291.26	1115.36					
4	307.39	1117.24					

Appendix 6 (78)




NO.15
SOLI LOCAL FOREST
Sandifolo
No. 75
KANAKANTAPA SOUTH
LOCAL FOREST
No.9191
Kanakantapa
SOLI
LOCAL FOREST
No 75
8320
8319
8318
8317
8316
8315

Appendix 6 (80)

DAM AXIS PROFILE DATA.

STATION : No. 16 CHONGWE. (REGHT)

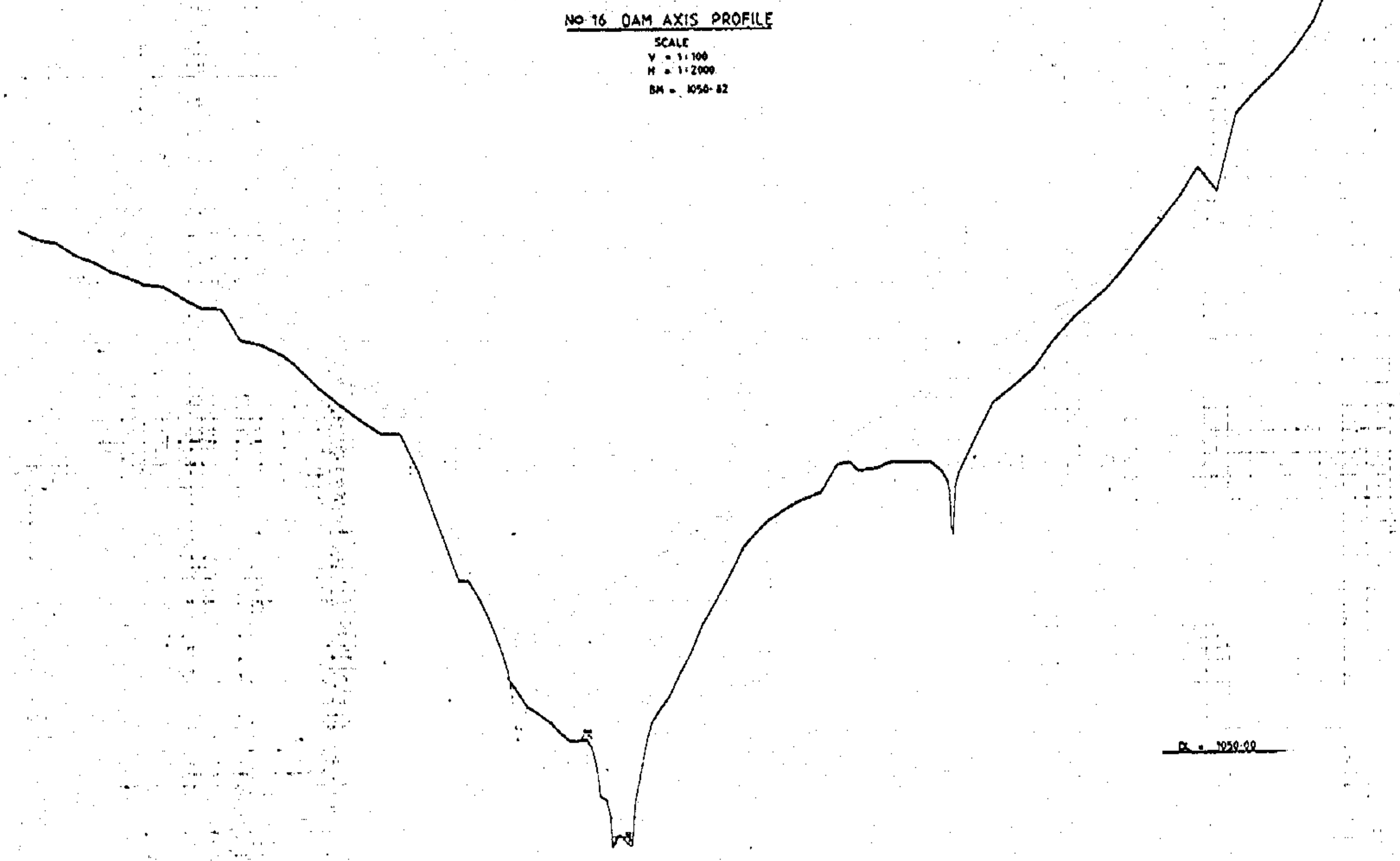
No.	D	H	Remark	No.	D	H	Remark
BM.	0	1050.823		36	320.26	1059.60	
1	4.70	1050.50		37	322.84	1061.73	
2	8.91	1049.58		38	325.81	1062.33	
3	11.00	1048.38		39	341.49	1063.94	
4	17.69	1048.28		40	356.74	1065.35	
5	19.98	1047.49	Water Surface.	41	373.86	1066.04	
6	21.31	1046.17		42	391.54	1066.80	
7	26.87	1046.45		43	408.91	1068.00	
8	39.84	1046.22		44	427.97	1069.07	
9	42.29	1048.21		45	440.21	1069.61	
10	52.48	1050.82		46	454.92	1070.27	
11	57.29	1051.51		47	473.27	1071.28	
12	63.68	1052.02		48	488.43	1072.18	
13	73.43	1052.68		49	502.73	1073.12	
14	82.90	1053.61		50	520.09	1074.29	
15	93.12	1054.64		51	536.85	1075.48	
16	102.31	1055.72		52	553.28	1074.48	
17	113.71	1056.67		53	569.98	1077.89	
18	128.97	1058.13		54	586.57	1078.70	
19	138.86	1059.18		55	603.90	1079.51	
20	149.49	1059.71		56	620.89	1080.56	
21	160.56	1060.30		58	638.42	1081.83	
22	168.54	1060.55		59	657.29	1084.15	
23	174.36	1060.76		60	670.71	1085.42	
24	187.43	1061.15		61	680.18	1085.54	
25	206.46	1061.51		62	693.94	1085.61	
26	220.43	1062.71					
27	231.81	1062.82					
28	238.84	1062.48					
29	255.94	1062.53					
30	267.10	1062.82					
31	300.89	1062.79					
32	309.05	1062.38					
33	315.49	1061.97					
34	316.97	1061.56					
35	318.84	1059.91					

Appendix 6 (81)

DAM AXIS PROFILE DATA.

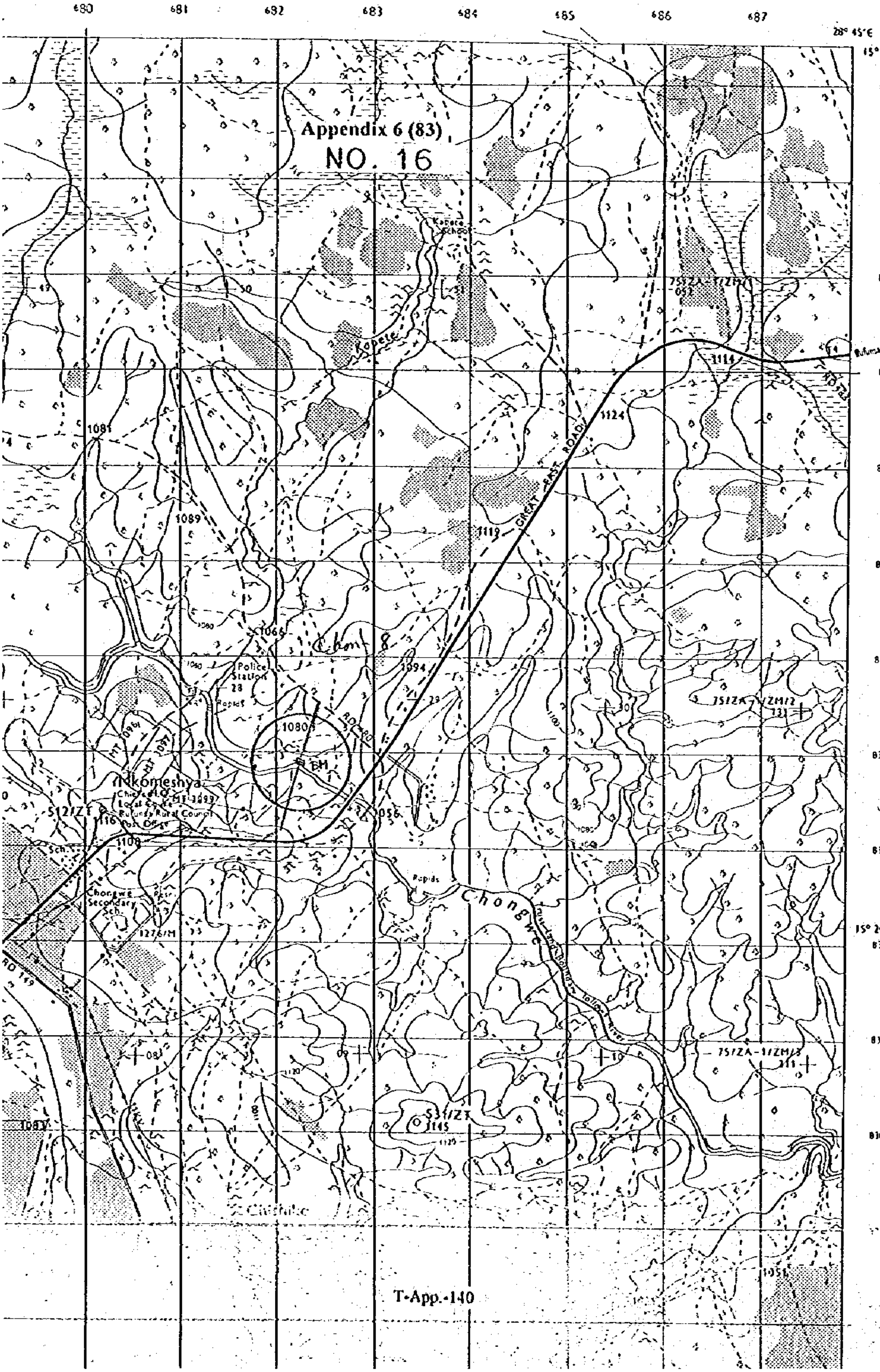
STATION : No. 16 CHONGWE.				(LEFT)			
No.	D	H	Remark	No.	D	H	Remark
BM	0	1050.823		36	454.71	1072.77	
1	8.39	1050.76		37	472.20	1072.88	
2	13.96	1050.73		38	487.33	1073.28	
3	22.55	1051.07		39			
4	31.69	1051.49					
5	41.34	1051.90					
6	51.69	1052.25					
7	60.02	1050.82					
8	67.64	1053.67			JICA BM.	1118.198	
9	75.84	1054.97				-67.375	BAROMETER
10	84.07	1056.11			No.16 BM.	1050.823	
11	92.14	1056.94					
12	101.23	1057.71					
13	109.81	1058.12					
14	117.61	1058.98					
15	125.54	1060.09					
16	130.72	1060.76					
17	143.49	1062.57					
18	159.81	1064.27					
19	175.78	1064.27					
20	193.90	1064.89					
21	211.75	1065.53					
22	230.48	1066.36					
23	250.84	1067.41					
24	259.22	1067.70					
25	277.09	1068.16					
26	296.19	1068.39					
27	312.77	1069.72					
28	329.33	1069.79					
29	345.41	1070.25					
30	361.84	1070.74					
31	377.92	1070.86					
32	393.26	1071.19					
33	407.83	1071.43					
34	422.87	1071.86					
35	437.74	1072.15					

Appendix 6 (82)



Appendix 6 (83)

NO. 16



DAM AXIS PROFILE DATA.

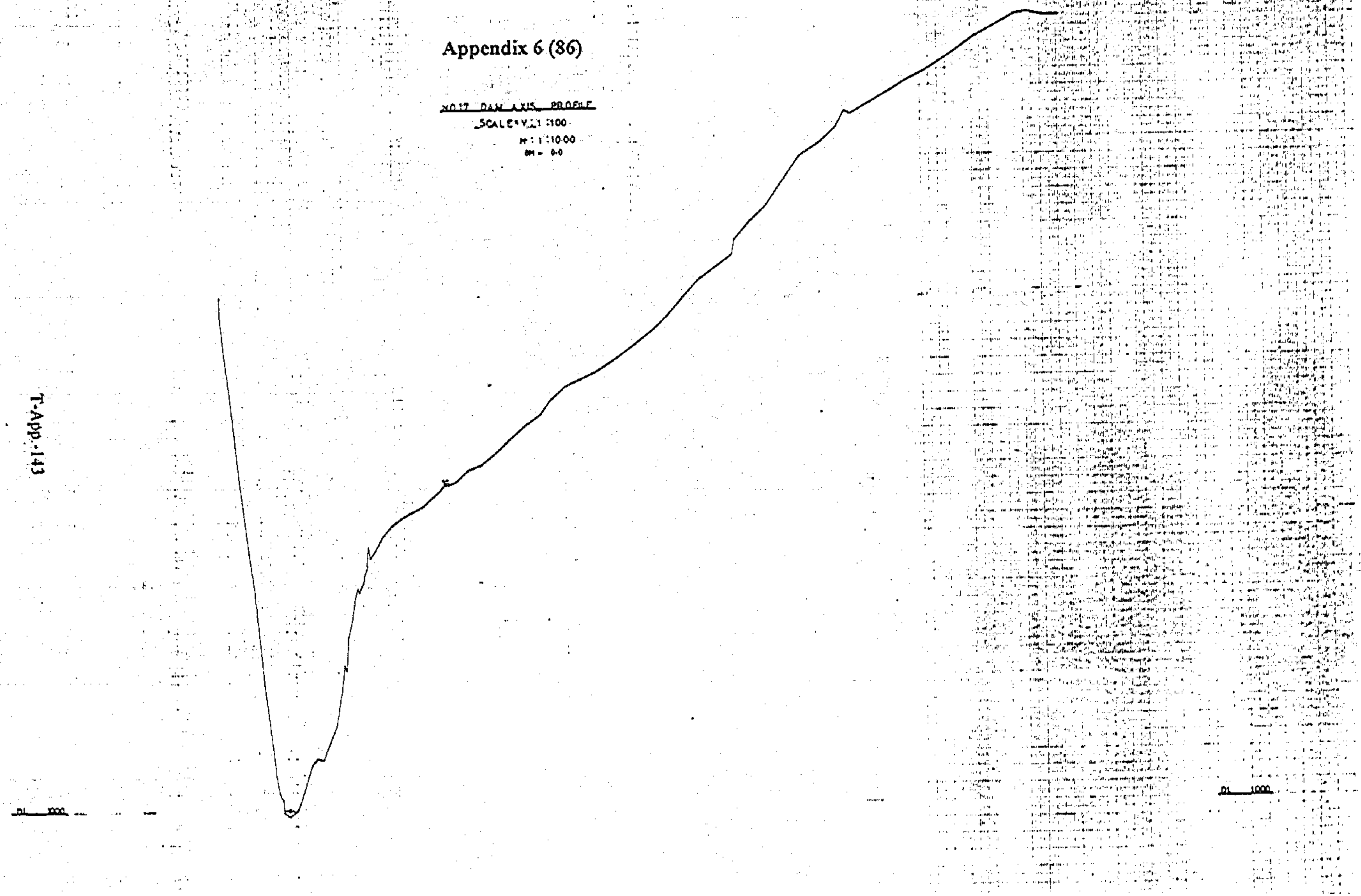
STATION : No. 17 MWAPULA.					(RIGHT)		
No.	D	H	Remark	No.	D	H	Remark
BM.	0	1018.95		8	272.22	1042.36	
1	5.74	1019.19		9	284.40	1042.92	
2	13.87	1019.71		10	299.03	1043.92	
3	21.55	1020.24		11	312.61	1044.87	
4	30.09	1020.97		12	328.04	1045.83	
5	37.97	1021.61		13	336.22	1046.26	
6	46.55	1022.39					
7	55.26	1023.07		TP 3.	0	0	
8	62.61	1023.98		1	343.46	1046.37	
9	70.20	1024.68		2	352.03	1046.11	
10	79.80	1025.13		3	361.21	1046.16	
11	89.94	1025.58					
12	101.18	1026.35					
13	113.70	1027.22					
TP 1.	0	0					
1	123.67	1028.03					
2	130.42	1028.71					
3	139.81	1029.73					
4	149.02	1030.89					
5	159.88	1032.30					
6	170.31	1033.25					
7	179.34	1034.22					
8	189.01	1035.11					
9	198.83	1036.56					
10	210.87	1038.08					
11	221.47	1038.86					
TP 2.	0	0					
1	221.47	1038.86					
2	227.08	1039.36					
3	230.46	1039.71					
4	235.84	1040.62					
5	239.03	1040.48					
6	249.21	1041.07					
7	260.91	1041.71					

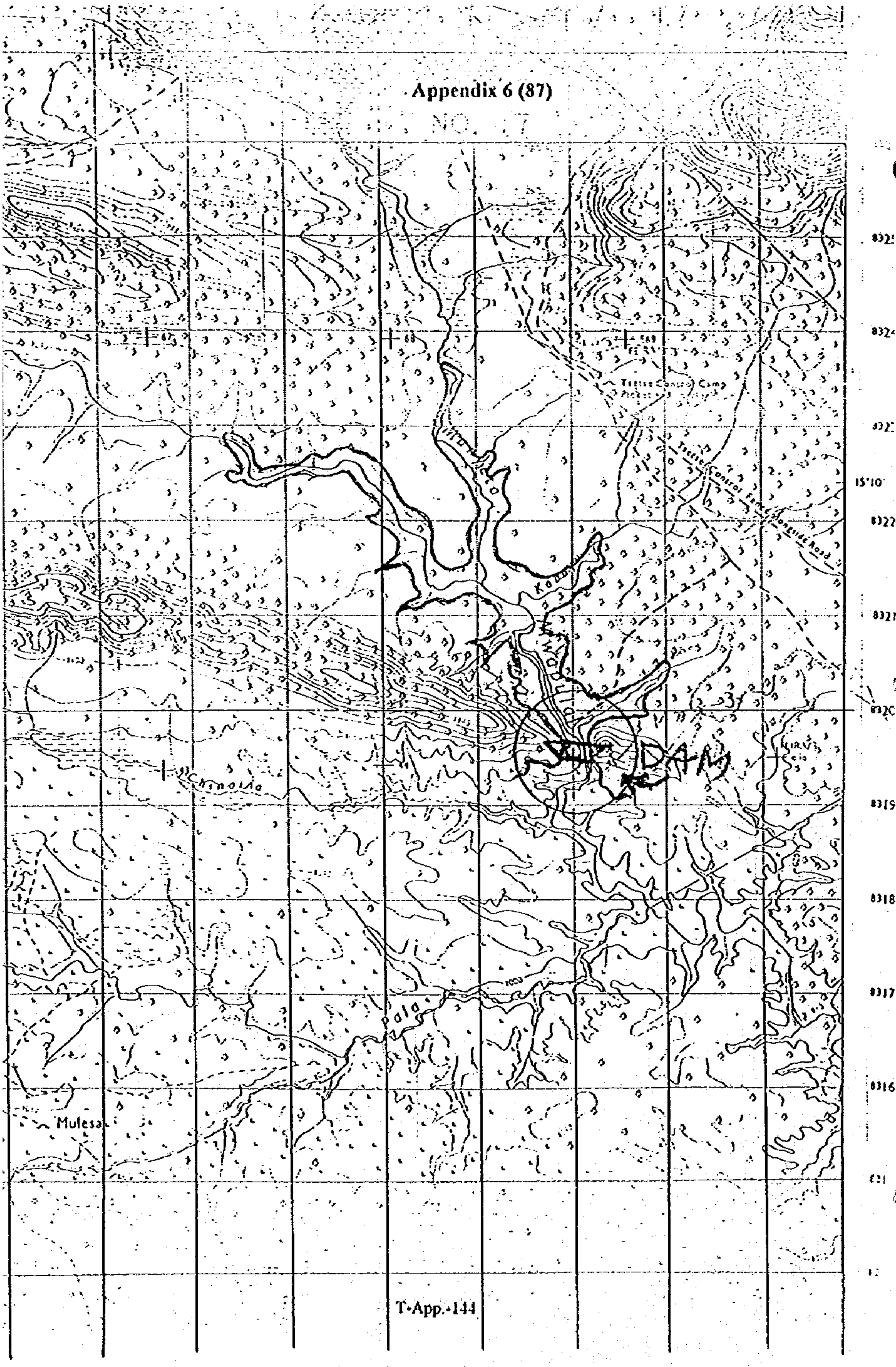
Appendix 6 (85)

DAM AXIS PROFILE DATA.

STATION : No. 17 MWAPULA.				(LEFT)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0		10	78.40	1002.94	
1	1.58	1018.87		11	81.57	1002.57	
2	4.19	1018.56		12	84.99	1001.42	
3	7.87	1018.27		13	88.16	1000.38	
4	13.91	1017.70		14	91.61	999.53	Water Surface.
5	20.81	1017.32		15	94.26	999.44	
6	26.65	1017.06		16	96.41	999.33	
7	32.77	1016.65		17	97.57	999.87	
8	37.69	1016.05		18	98.16	1000.53	
9	42.74	1015.11		19	100.17	1000.91	
				20	102.13	1002.18	
TP 1.	0	0					
1	45.92	1014.74		TP 3.	0	0	
2	45.94	1015.15	Stone Edge.	1	103.85	1003.34	
3	46.34	1015.43	Stone Edge.	2	105.84	1004.92	
4	46.76	1014.21		3	109.51	1008.07	
5	49.00	1013.65		4	114.21	1013.12	
6	49.75	1013.19					
7	51.36	1013.00		TP 4.	0	0	
8	52.15	1012.68		1	116.42	1014.85	
9	52.23	1012.97	Stone Edge Start.	2	121.61	1018.89	
10	54.42	1012.42	Stone.	3	124.29	1021.30	
11	56.35	1011.16	Stone.	4	127.82	1024.46	
12	59.06	1010.01	Stone.	5	130.30	1026.86	
13	59.91	1008.82	Stone.	6	132.39	1029.12	
				7	133.75	1030.20	
TP 2.	0	0					
1	61.00	1008.41	Stone End.				
2	61.15	1007.83					
3	63.09	1006.79					
4	64.47	1006.47					
5	65.40	1005.85					
6	66.79	1004.85					
7	69.35	1004.19					
8	71.78	1003.55					
9	74.55	1002.85					

Appendix 6 (86)




Tsetse Control Camp
Tsetse Control Fence alongside Road
DAM
Chinoila
Mulesa
8325
8324
8322
8321
8320
8319
8318
8317
8316
15°10'

Appendix 6 (88)

DAM AXIS PROFILE DATA.

STATION : No. 18 LUNDAZI				(RIGHT)			
No.	D	H	Remark	No.	D	H	Remark
BM	0	1021.00		5	78.86	1010.05	
1	2.48	1021.45		6	79.87	1010.14	
2	8.05	1022.61		7	82.53	1010.05	
3	11.12	1023.90		8	83.47	1010.06	
4	16.13	1024.69		9	84.29	1010.42	
5	20.57	1024.33		10	84.84	1011.16	
6	22.71	1024.16		11	85.77	1011.81	
				12	88.27	1012.20	
TP. 1	0	0		13	90.78	1012.39	
1	22.71	1017.82		14	100.59	1013.21	
2	24.52	1017.10		15	101.84	1014.14	
3	28.27	1015.84		16	109.26	1014.74	
4	30.80	1015.05		17	114.37	1015.81	
5	39.20	1014.27		18	118.07	1017.86	
6	46.31	1013.48		19	122.21	1019.95	
				20	124.31	1021.35	
TP. 2	0	0		21	130.08	1026.09	
1	48.37	1013.09		22	135.18	1028.30	
2	56.03	1010.98		23	139.23	1029.77	
3	56.16	1010.06		24	144.06	1032.01	
4	57.50	1009.52		25	147.97	1033.88	
5	58.97	1009.44		26	151.27	1035.91	
6	60.34	1009.52		27	154.69	1037.51	
7	61.71	1009.60		28	160.02	1041.21	
8	63.87	1009.75		29	164.23	1042.46	Top of the
9	64.65	1009.86					Mountain
10	64.99	1010.66	Water Surface.				
11	67.42	1010.89					
12	69.50	1010.70					
13	70.75	1011.10					
TP. 3	0	0					
1	73.99	1010.69	Water Surface.				
2	74.03	1010.51					
3	75.87	1010.52					
4	77.33	1010.24					

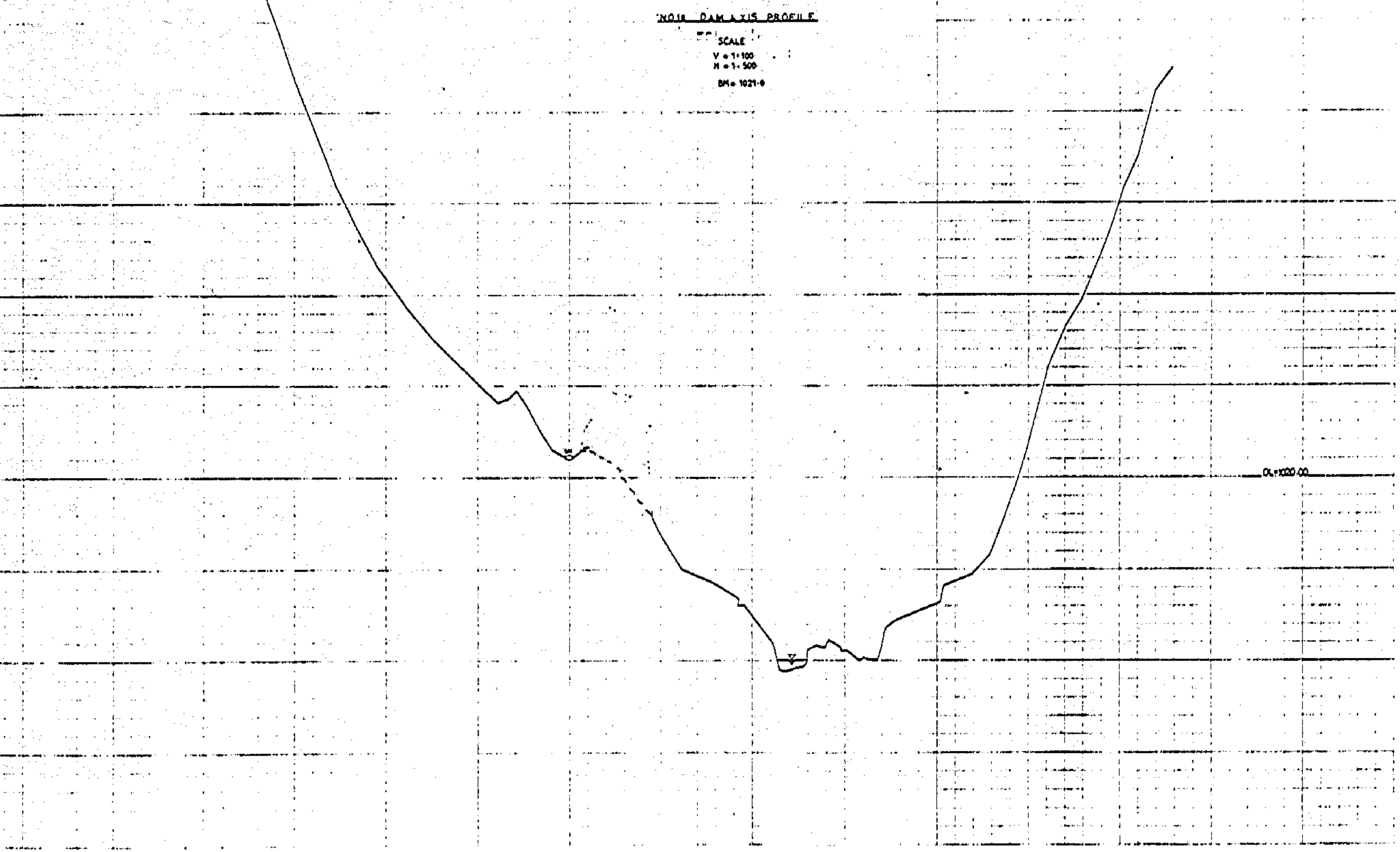
Appendix 6 (89)

DAM AXIS PROFILE DATA.

STATION : No. 18 LUNDAZI (LEFT)

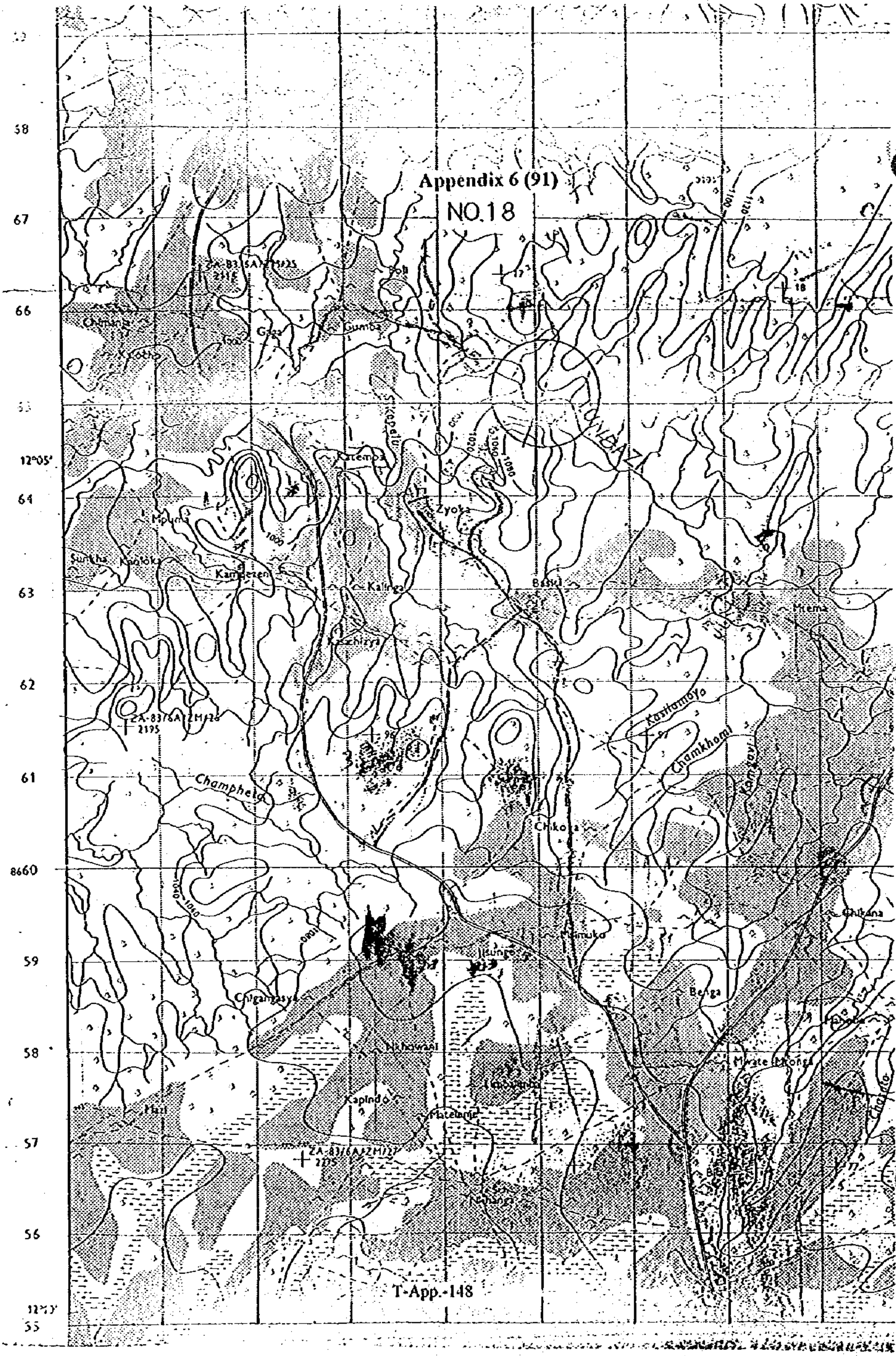
No.	D	H	Remark	No.	D	H	Remark
BM	0	1021.00					
1	4.48	1021.45					
2	8.18	1022.61					
3	11.58	1023.90					
4	14.26	1024.69					
5	16.61	1024.33					
6	19.80	1024.16					
7	23.44	1024.84					
8	28.77	1025.95					
9	36.61	1027.50					
10	43.69	1029.24					
11	52.35	1031.73					
12	57.16	1033.48					
13	63.71	1036.00					
14	68.85	1038.65					
15	74.45	1041.61					
16	79.44	1044.52					
TP 1.	0	0					
1	82.18	1046.09					
2	86.12	1048.70					
3	89.65	1051.05					
4	91.95	1052.23					
5	96.18	1054.83					
6	97.61	1055.04					

Appendix 6 (90)



Appendix 6 (91)

NO.18



DAM AXIS PROFILE DATA.

STATION : No. 19 LUKUSASHI			(RIGHT)				
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0					
1	5.47	-2.46					
2	10.51	-5.43					
3	16.93	-7.87					
4	26.84	-12.47					
5	40.07	-17.85					
6	55.16	-24.05					
TP. 1	0	0					
1	64.64	-27.50					
2	71.12	-30.59					
3	80.28	-31.34					
4	82.63	-32.38					
5	82.73	-32.69	Water Surface.				
6	82.87	-33.37					
7	83.73	-33.74					
8	86.23	-33.69					
9	90.23	-33.60					
10	94.23	-33.63					
11	96.03	-33.25					
12	96.89	-32.69	Water Surface.				
13	97.97	-31.30					
14	104.59	-29.53					
15	111.65	-27.51					
16	117.64	-24.15					
TP. 2	0	0					
1	127.80	-23.02					
2	140.66	-18.50					
3	149.21	-14.26					
4	159.69	-7.98					
5	173.07	0.70					
6	177.74	3.29					
7	184.85	7.80					

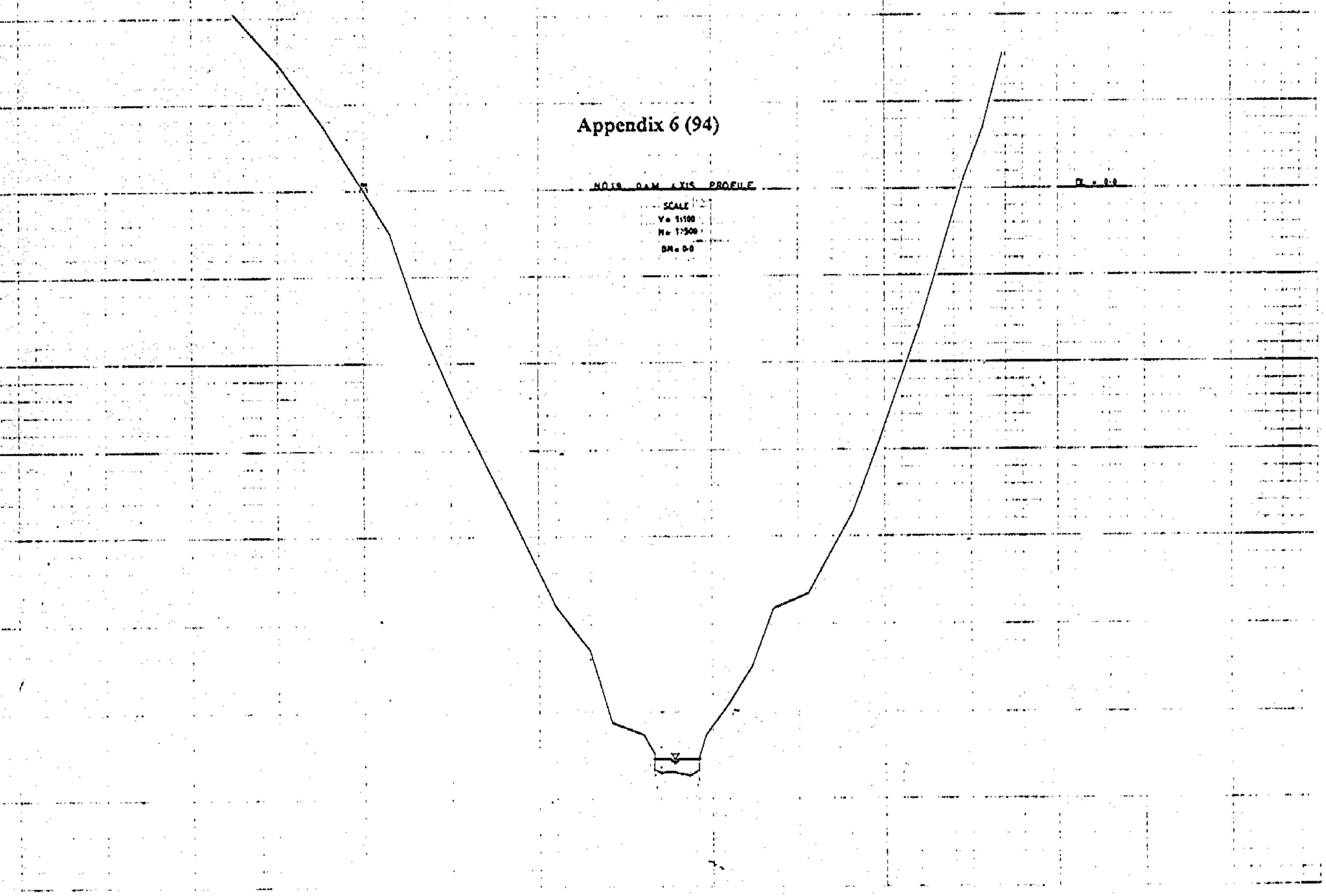
Appendix 6 (93)

DAM AXIS PROFILE DATA.

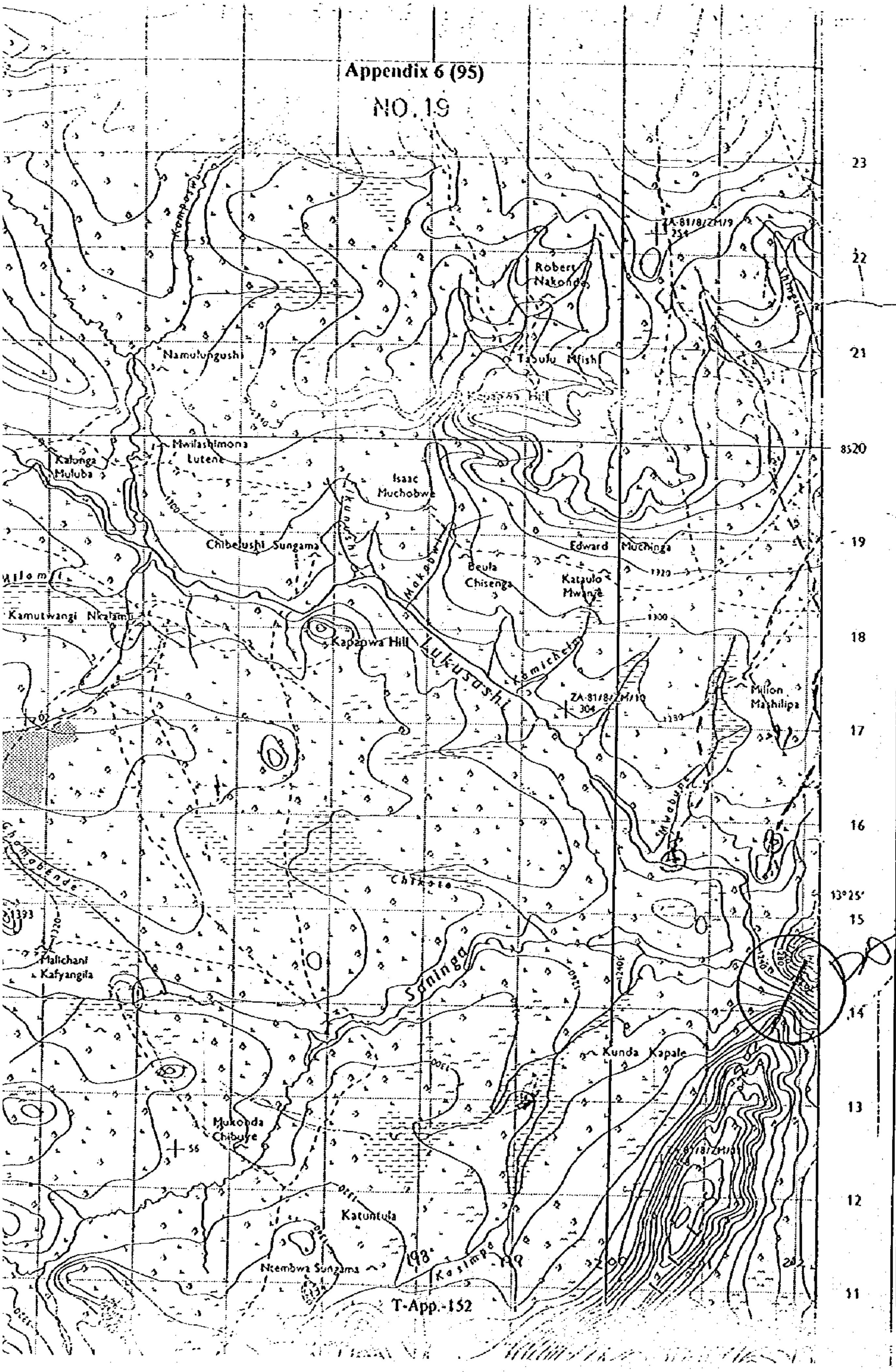
STATION : No. 19 LUKUSASHI. (LEFT)

No.	D	H	Remark	No.	D	H	Remark
BM	0	0					
1	12.82	3.78					
2	25.22	7.39					
3	33.17	10.16					

Appendix 6 (94)



NO. 19


Kompowu
ZA-81/8/ZM/9
Robert Nakonde
Namulungushi
Tabulu Mfishi
Kapapwa Hill
Mwilashimona Lutene
Kalonga Muluba
Isaac Muchobwe
Chibelushi Sungama
Edward Muchinga
Beula Chisenga
Kataulo Mwanze
Makobwe
Kamutwangi Nkalamu
Kapapwa Hill
Lukusushi
ZA-81/8/ZM/10
Milion Mashilipa
Chomabende
Chikoto
Malichani Kafyangila
Saninga
Kunda Kapale
Mukonda Chibuye
Katuntula
Ntembwa Sungama
Kasimpa
1320
1300
1393
23
22
21
8520
19
18
17
16
13°25'
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12
11

Appendix 6 (96)

DAM AXIS PROFILE DATA.

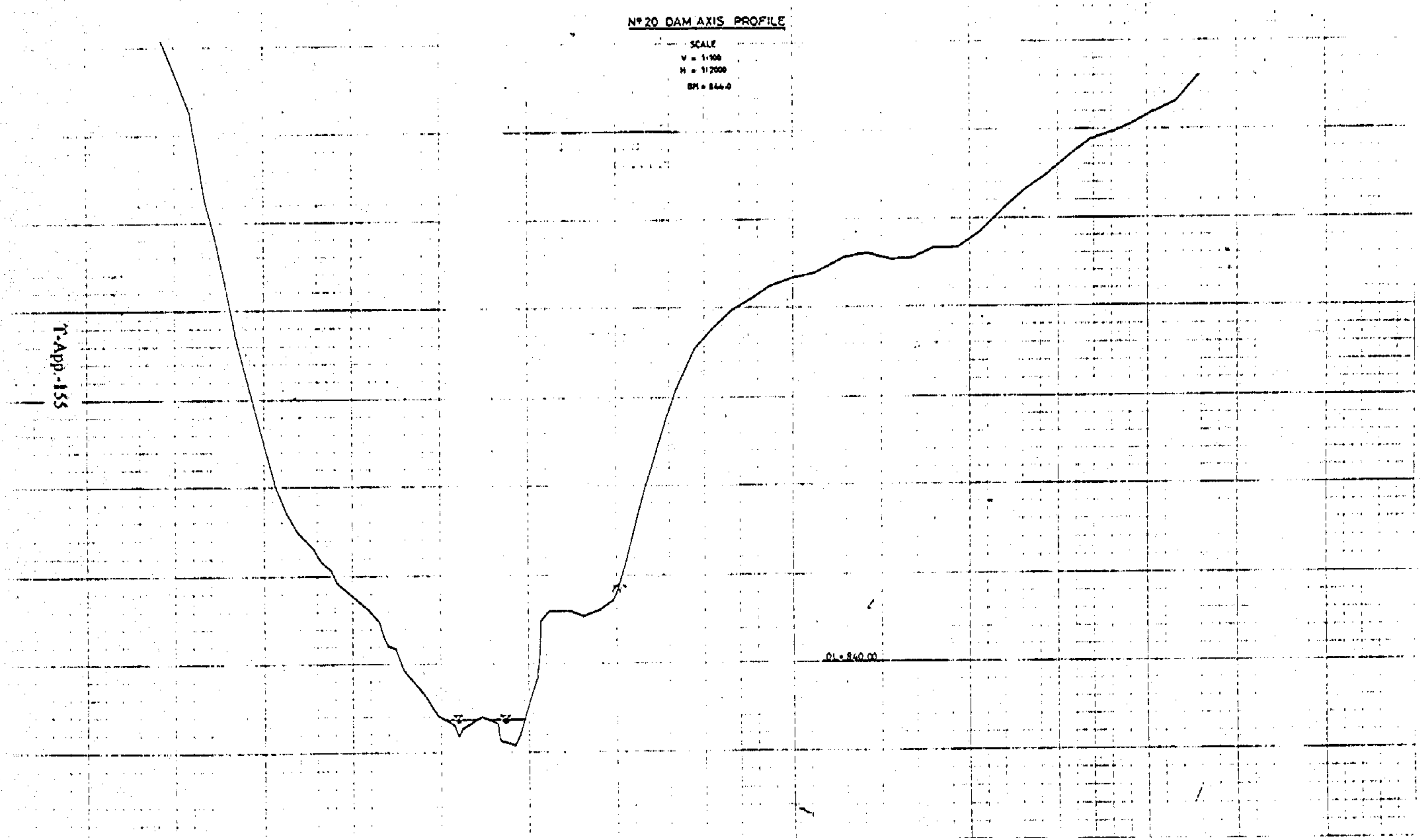
STATION : No. 20 CHIPARAMBA				(RIGHT)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	844.00			280.19	869.77	
	4.70	845.60			290.94	870.35	
	8.48	847.21			304.37	870.97	
	12.81	848.75			315.82	871.50	
	17.88	850.42			328.02	871.89	
	22.63	852.09					
	27.83	853.73					
	33.90	855.42					
	39.86	856.72					
TP. 1	0	0					
	45.54	857.69					
	53.98	858.79					
	64.63	859.78					
	76.64	860.51					
	88.12	861.20					
	99.84	861.64					
	112.06	861.93					
	124.56	862.54					
	129.29	865.83					
TP. 2	0	0					
	135.75	864.25					
	141.67	863.02					
	153.70	862.71					
	166.54	862.71					
	178.99	862.82					
	192.91	863.33					
	206.33	864.34					
TP. 3	0	0					
	219.56	865.60					
	230.30	866.51					
	242.70	867.45					
	255.10	868.42					
	267.15	869.28					

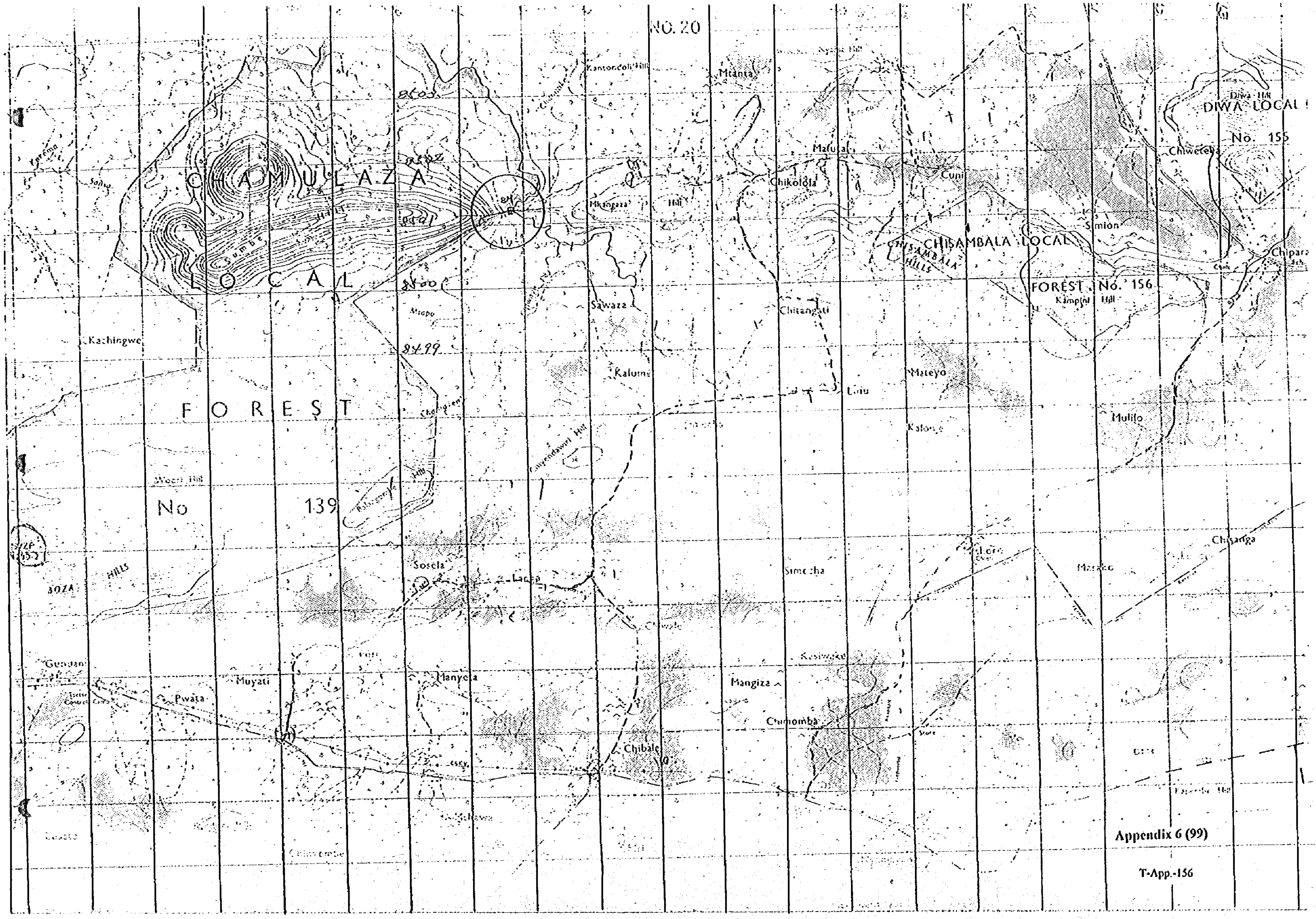
Appendix 6 (97)

DAM AXIS PROFILE DATA.

STATION : No. 20 CHIPARAMBA				(LEFT)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	844.00		29	129.57	841.04	
1	1.82	843.55	Farm BP.	30	132.70	841.74	
2	9.60	843.07		31	133.87	842.45	
3	19.39	842.79		32	140.51	843.06	
4	32.11	842.98		33	149.34	843.80	
5	38.04	843.04	Farm EP.	34	159.18	844.65	
				35	162.08	845.28	
TP. 1	0	0					
1	41.90	842.73					
2	43.06	842.53		TP. 2	0	0	
3	44.03	840.61		1	168.32	845.77	
4	45.59	839.24		2	172.19	846.36	
5	47.64	838.58		3	176.74	847.58	
6	50.44	837.66		4	181.03	847.52	
7	54.62	836.87	Water Surface.	5	187.84	848.48	
8	54.89	835.94		6	193.47	850.10	
9	57.52	835.47		7	198.17	851.67	
10	59.44	835.43		8	204.28	853.94	
11	61.39	835.36		9	209.06	855.98	
12	64.06	835.13		10	216.08	858.65	
13	66.56	835.65		11	222.66	861.52	
14	67.22	836.51		12	228.32	864.10	
15	68.07	836.63					
16	71.41	837.00		TP. 3	0	0	
17	77.47	836.96		1	232.87	866.32	
18	88.08	836.36		2	237.09	868.65	
19	90.50	835.86		3	242.96	871.38	
20	92.73	836.43		4	250.62	875.32	
21	96.95	836.84					
22	99.55	836.68					
23	101.94	836.87	Water Surface.				
24	105.20	837.48					
25	109.02	838.13					
26	114.64	838.92					
27	121.04	839.72					
28	126.42	840.89					

Appendix 6 (98)





Appendix 6 (99)

T-App.-156

Appendix 6 (100)

DAM AXIS PROFILE DATA.

STATION : No. 21 KATETE				(RIGHT BANK)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	1115.60	Tree				
	5.13	1116.60	Road BP.				
	11.13	1116.60	Road EP.				
	12.00	1117.89	Tree				
	17.00	1120.00	Tree				

Appendix 6 (101)

DAM AXIS PROFILE DATA.

STATION : No. 21 KATETE					(LEFT)		
No.	D	H	Remark	No.	D	H	Remark
BM.	0	1115.60		12	303.52	1090.41	
1	14.71	1110.09		13	312.56	1090.37	
2	18.24	1110.40	Road Starts.	14	324.63	1091.62	
3	24.88	1110.79	Road Ends.	15	336.11	1092.94	
4	29.03	1110.61		16	344.08	1093.85	Farm Starts.
5	38.79	1112.57		17	355.35	1094.82	
				18	370.24	1096.21	
TP. 1	38.79	1112.57					
1	45.53	1109.56		TP. 3	370.24	1096.21	
2	54.32	1107.95		1	373.65	1096.26	
3	66.89	1106.31		2	375.40	1095.76	Depression(Hole
4	77.21	1105.03		3	378.65	1095.28	staarts)
5	96.53	1102.94	Farm Starts.	4	382.89	1095.58	Depre. Ends(Hole)
6	112.03	1101.52		5	384.60	1097.06	
7	128.52	1100.20		6	400.65	1097.99	
8	149.38	1098.57	farm Ends.	7	419.22	1099.08	
9	161.11	1097.59		8	438.31	1100.32	
10	176.25	1096.36		9	456.55	1101.52	
11	190.11	1094.87		10	487.09	1102.91	
12	206.02	1092.67		11	498.65	1103.96	
13	217.75	1091.58		12	517.60	1104.76	
14	230.95	1090.39		13	532.66	1105.27	
15	234.92	1089.48		14	547.28	1105.87	
TP. 2	234.92	1089.48					
1	237.49	1088.60					
2	240.70	1088.12	River Starts(dry)				
3	247.44	1087.90					
4	250.96	1087.87					
5	255.04	1087.80					
6	258.54	1087.83					
7	263.09	1087.97					
8	266.88	1088.29	River Ends(dry)				
9	274.87	1090.34					
10	287.07	1090.63					
11	296.10	1090.31					

Appendix 6 (102)

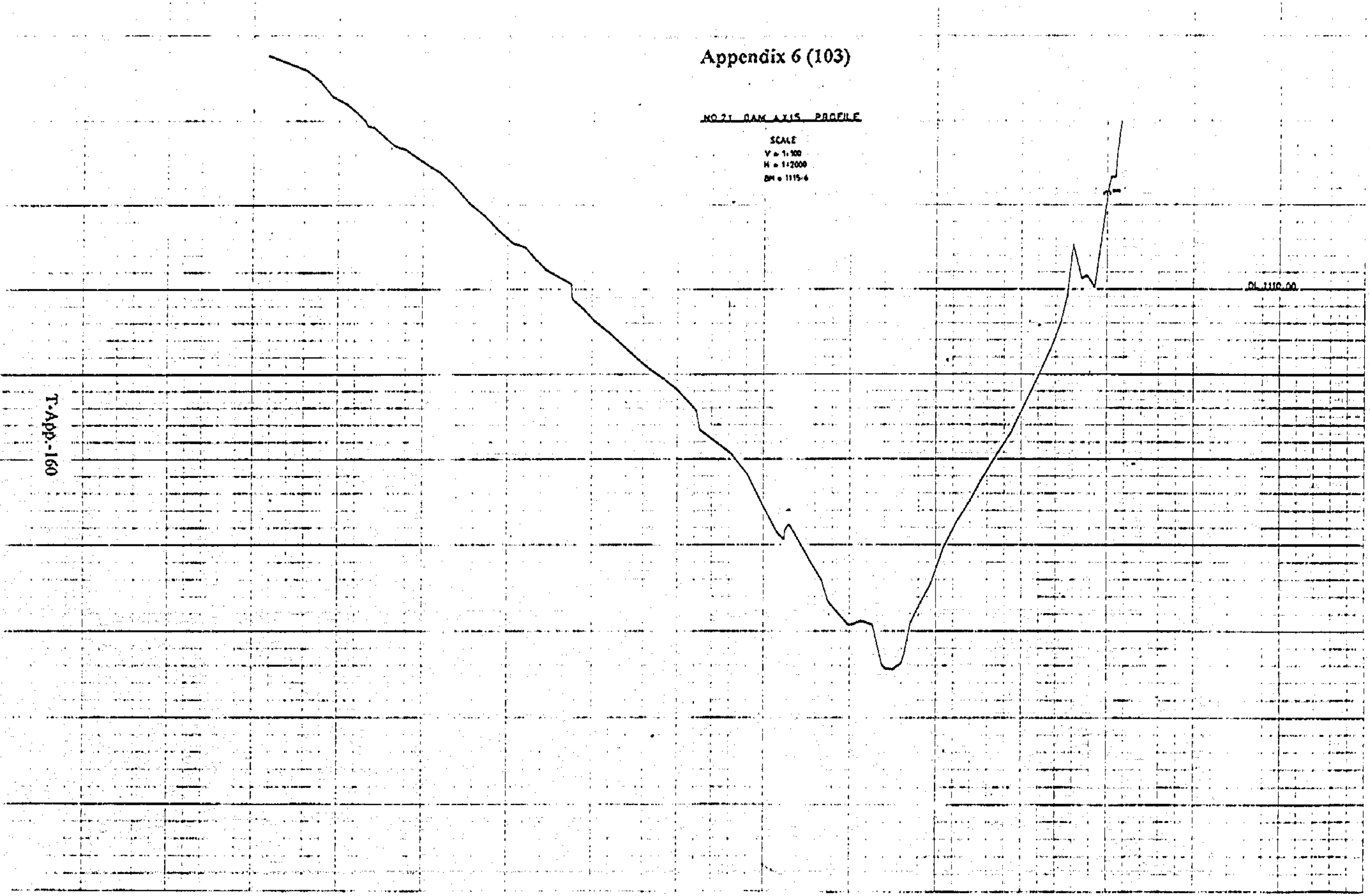
DAM AXIS PROFILE DATA.

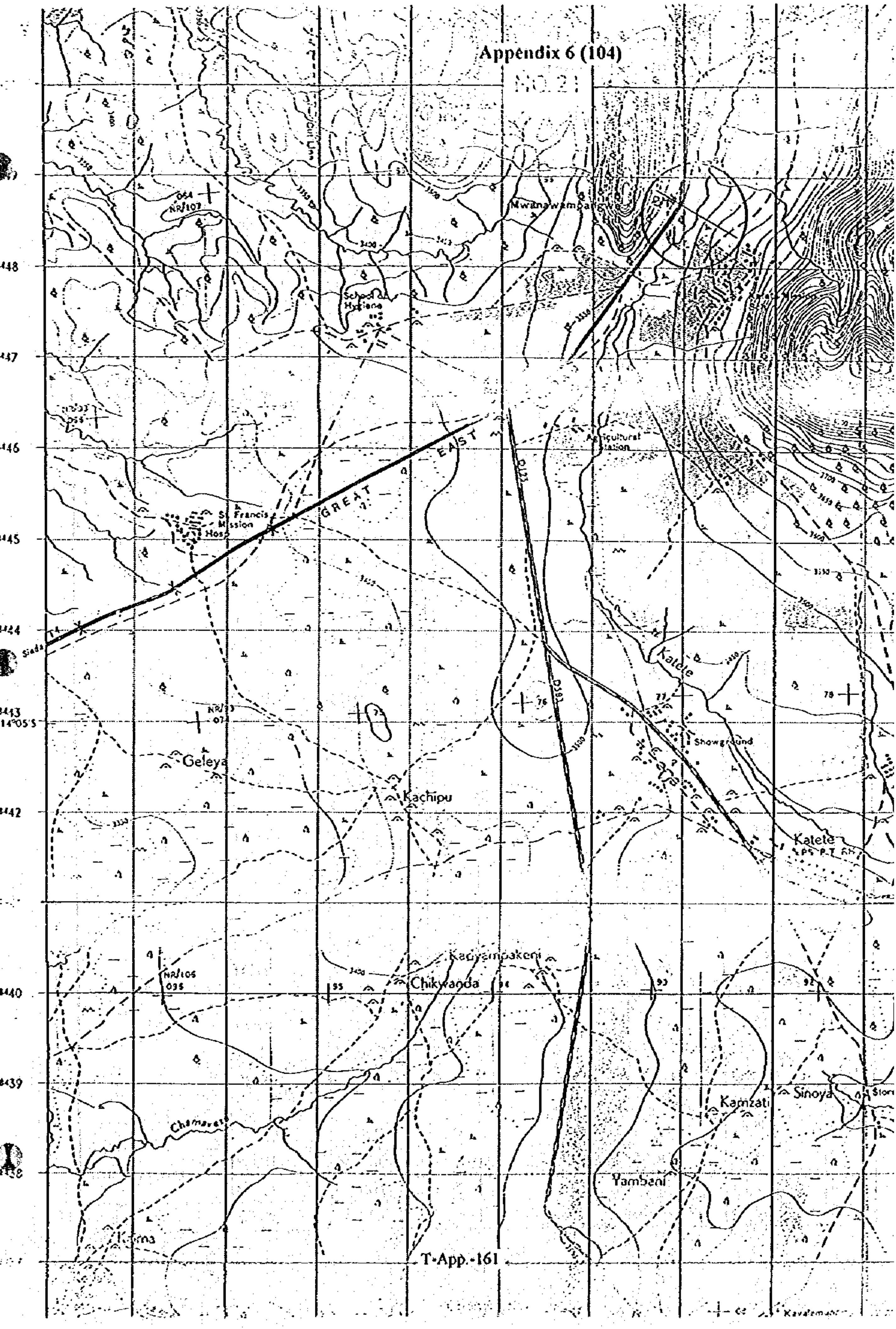
STATION : No. 21 KATETE				(LEFT)			
No.	D	H	Remark	No.	D	H	Remark
TP. 4	547.28	1105.87					
1	562.08	1106.56					
2	579.14	1107.36					
3	596.74	1108.12					
4	609.91	1108.67					
5	624.52	1109.42					
6	624.89	1110.37					
7	654.26	1111.10	Farm Ends.				
8	667.73	1111.70	Farm Starts.				
9	679.61	1112.39					
10	694.46	1112.71					
11	710.07	1113.42					
12	728.57	1114.37					
13	744.94	1115.03					
14	760.03	1115.76					
15	770.10	1116.37					
16	780.44	1116.85	Farm End.				
17	791.27	1117.22					
TP. 5	791.27	1117.22					
1	804.97	1117.69					
2	820.22	1118.27					
3	832.83	1118.51					
4	845.35	1119.03					
5	859.43	1119.63	Road Begins Width				
6	866.13	1119.76	(3.0m)				
7	868.94	1120.03					
8	872.40	1120.11					
TP. 6	872.40	1120.11					
1	879.81	1120.52					
2	892.78	1120.96	Farm Starts.				
3	907.47	1121.42					
4	922.51	1122.27					
5	937.92	1123.05					
6	953.23	1123.70					

Appendix 6 (103)

NO.21 DAM AXIS PROFILE

SCALE
V = 1:100
H = 1:2000
BM = 1115.6




Mwanawambang
Kazai Mission
School &
Hygiene
Agricultural
Station
GREAT EAST
St Francis
Mission
Hosp
D133
D181
Katete
Showground
Geleya
Kachipu
Katete
Kadyampakeni
Chikwanda
Chamavera
Kamzati
Sinoya
Yambani
NR/107
NR/105
8448
8447
8446
8445
8444
8443
14°05'S
8442
8440
8439
3550
3400
3350
3500

Appendix 6 (105)

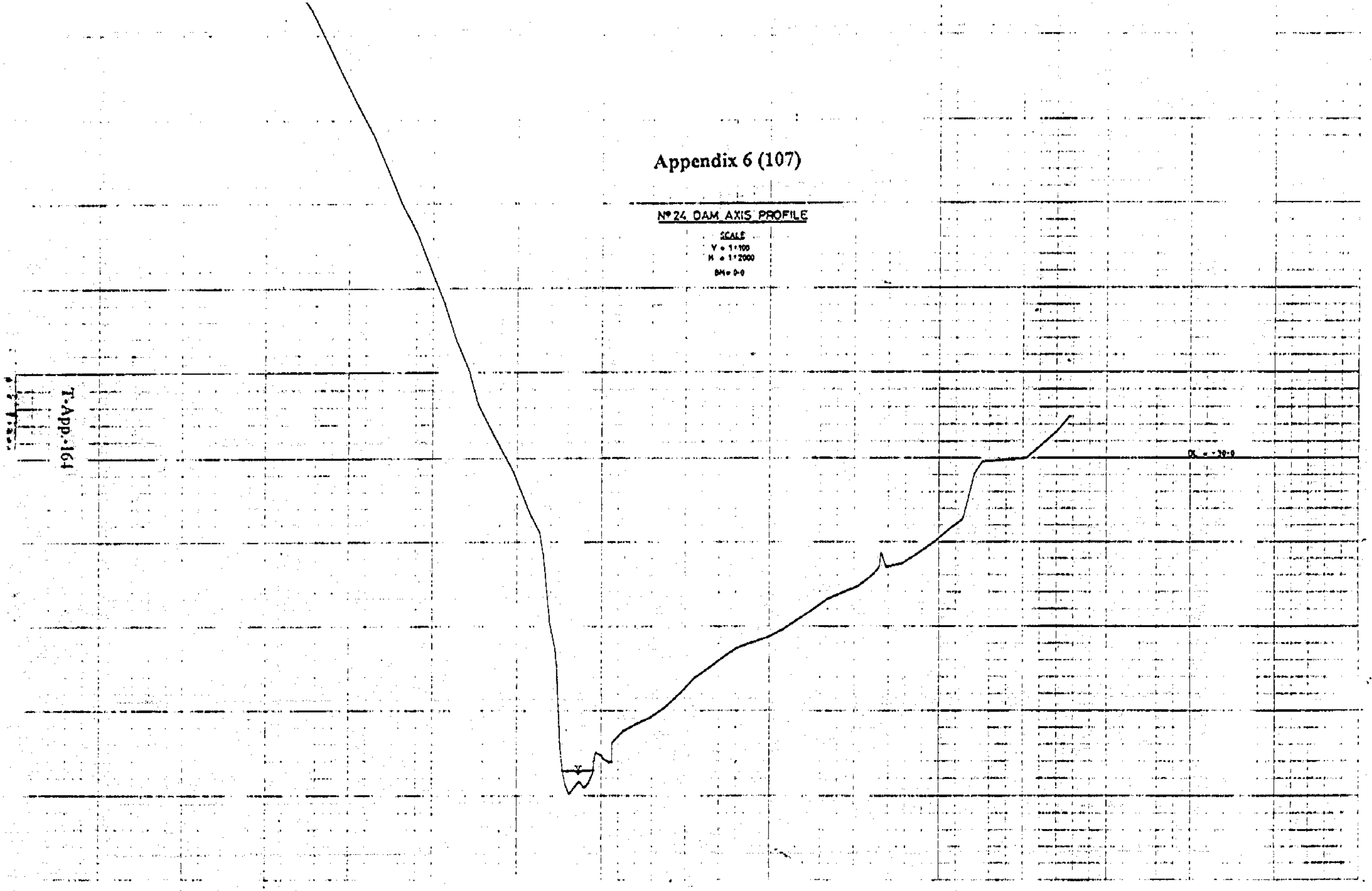
DAM AXIS PROFILE DATA.

STATION : No. 24 MUSONDA FALLS.				(RIGHT)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0		6	367.12	-49.61	
1	5.44	-0.34		7	373.99	-49.23	
2	19.99	-1.31		8	379.02	-49.91	
3	36.99	-2.33		9	384.79	-50.34	
4	54.03	-3.49		10	389.69	-50.04	
5	73.02	-5.47		11	389.84	-48.65	Water Surface.
6	92.95	-7.41		12	390.07	-48.14	
7	111.46	-9.41		13	394.74	-47.55	
8	130.24	-11.09					
				TP 4.	0	0	
TP 1.	0	0		1	400.12	-47.70	
1	145.89	-12.92		2	401.63	-47.93	
2	163.22	-14.99		3	411.51	-48.13	
3	180.92	-16.79		4	412.45	-46.90	
4	197.42	-18.90		5	426.45	-46.28	
5	213.04	-20.80		6	442.15	-45.87	
6	228.63	-23.15		7	459.08	-45.40	
7	242.75	-24.85		8	475.24	-44.79	
8	254.80	-26.86		9	493.41	-43.95	
9	260.55	-27.38		10	511.63	-43.03	
10	278.53	6.94		11	530.19	-42.42	
11	296.68	-30.84		12	548.84	-41.71	
12	315.11	-33.29		13	559.42	-41.31	
13	327.44	-34.41					
				TP 5.	0	0	
TP 2.	0	0		1	578.99	-40.90	
1	330.73	-35.81		2	597.19	-40.65	
2	339.30	-39.89		3	614.46	-40.27	
3	345.30	-41.72		4	630.78	-39.77	
				5	649.74	-39.12	
TP 3.	0	0		6	668.50	-38.39	
1	346.87	-42.37					
2	350.90	-47.24		TP 6.	0	0	
3	354.14	-48.65	Water Surface.	1	687.36	-38.08	
4	357.22	-49.39		2	705.73	-37.68	
5	362.98	-49.96		3	722.62	-36.97	

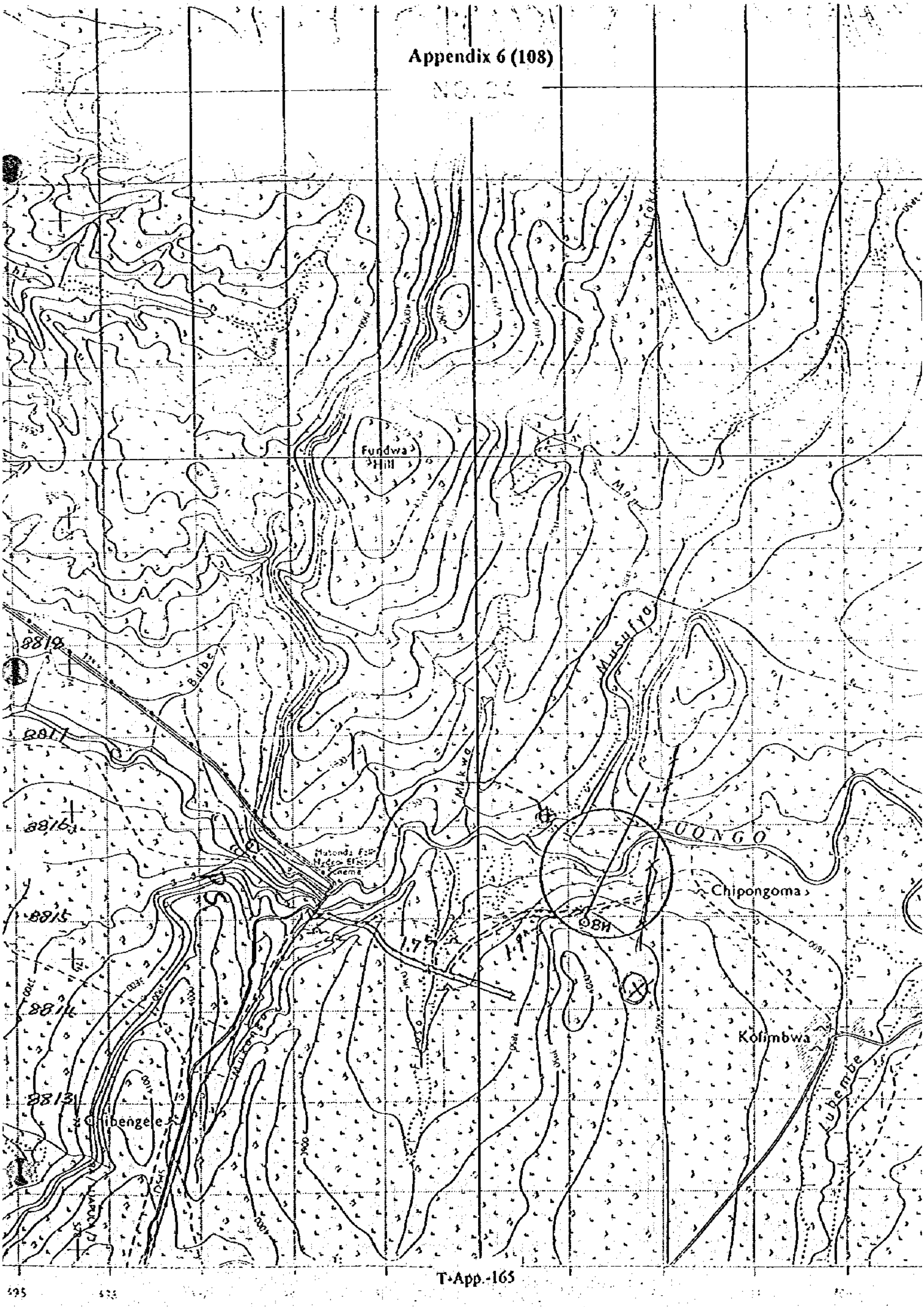
DAM AXIS PROFILE DATA.

STATION : No. 24 MUSONDA FALLS.				(RIGHT)			
No.	D	H	Remark	No.	D	H	Remark
4	729.29	-36.51	Ant Hill				
5	731.82	-35.34	Ant Hill				
6	733.43	-35.70					
TP 7.	0	0					
1	736.94	-36.21	Ant Hill Finish.				
2	756.33	-36.05					
3	774.83	-35.44					
4	794.03	-34.78					
5	810.44	-34.10					
6	827.92	-33.37					
7	842.38	-32.63					
8	851.45	-31.57					
TP 8.	0	0					
1	903.04	-29.32					
2	938.78	-27.76					
3	955.61	-26.87					

Appendix 6 (107)



NO. 24


Fundwa Hill
Musufya
Mukwa
UONGO
Chipongoma
Kolimbwa
Lubembe
Chibengele
Bube
Mutonda Falls Hydro Elec. Scheme
8810
8811
8816
8815
8814
8813

Appendix 6 (109)

DAM AXIS PROFILE DATA.

STATION : No. 25 CHISHIMBA FALLS				(RIGHT)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0		26	252.70	1.25	Farm End.
1	1.43	-0.10	Road Start.	27	264.12	1.60	
2	4.00	-0.17	Road End.	28	272.82	2.18	
3	15.10	-0.48		29	283.55	2.59	
4	31.04	-0.54		30	294.65	2.72	
5	45.31	-0.28	Rock Area.	31	303.14	2.96	
6	55.19	-0.34		32	322.64	3.51	
7	65.31	-0.50		33	341.14	4.03	
8	73.67	-1.64		34	357.84	4.50	
				35	373.64	4.94	
TP 1.	0	0		36	391.44	5.43	
1	78.18	-2.92		37	409.44	5.934	
2	87.43	-3.52					
3	96.38	-3.66					
4	96.69	-3.79					
5	96.71	-3.79	Water Surface				
6	99.71	-4.24					
7	102.71	-4.39					
8	105.71	-4.66					
9	108.71	-4.69					
10	111.71	-4.84					
11	114.71	-4.81					
12	116.71	-5.01					
13	119.71	-4.68					
14	122.71	-4.12					
15	124.64	-3.81	Water Surface.				
16	124.63	-3.81					
17	124.87	-3.63					
18	131.39	-3.27					
19	144.18	-2.63					
20	162.48	-1.76					
21	180.31	-0.88	Farm Start.				
22	198.27	0.06					
23	216.69	0.54					
24	226.23	0.64					
25	243.36	1.10					

Appendix 6 (110)

DAM AXIS PROFILE DATA.

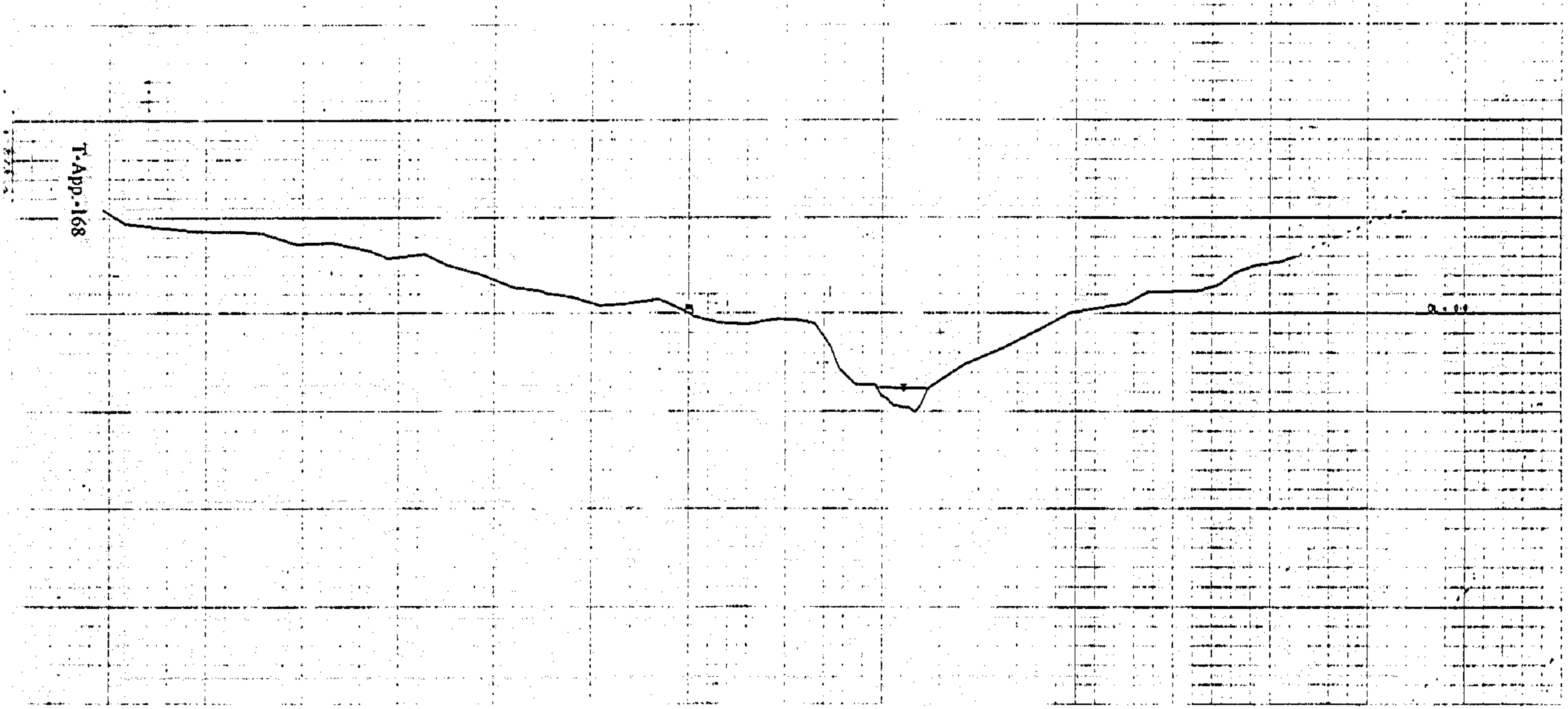
STATION : No. 25 CHISHIMBA FALLS.			(LEFT)				
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0					
1	3.53	0.21	Farm Start.				
2	15.62	0.71					
3	30.95	0.54					
4	46.04	0.39					
5	60.79	0.88					
6	71.68	1.04	Farm End.				
7	78.38	1.20					
8	88.93	1.28	Rock Area.				
9	106.74	2.00	Rock Area.				
10	123.60	2.53	Rock Area.				
11	136.46	3.10	Rock Area.				
12	148.20	3.29	Rock Area.				
13	156.05	2.88	Rock Area.				
TP. 1	0	0					
1	166.44	3.34					
2	185.05	3.71					
3	203.40	3.63					
4	221.28	4.20					
5	237.22	4.34					
6	255.95	4.33					
7	274.34	4.54					
8	292.41	4.69					
9	307.90	5.66					

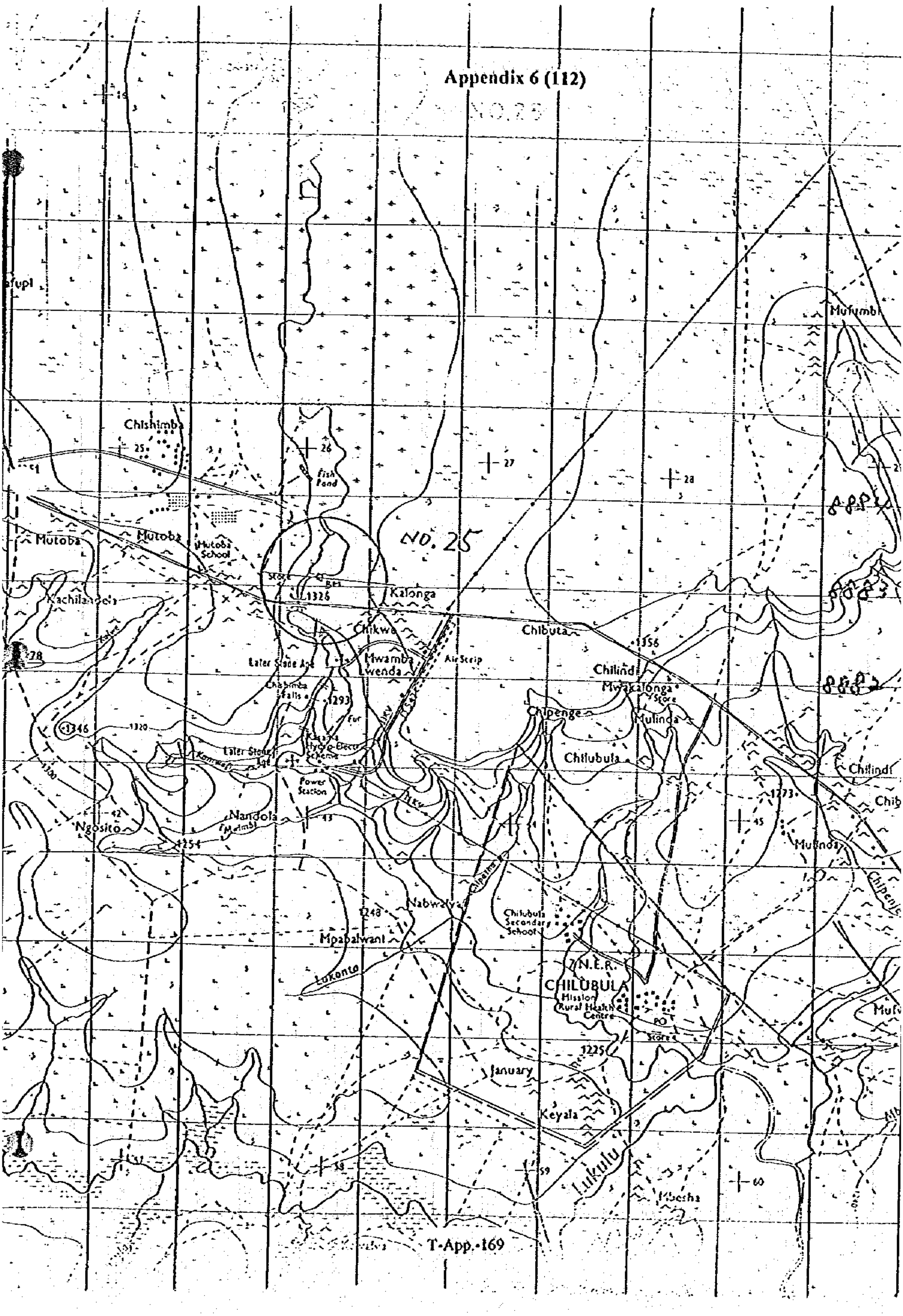
Appendix 6 (111)

NO.75 DAM AXIS PROFILE

SCALE: V = 1:100
H = 1:1000

BM = 0.0




Mufumbi
Chishimba
Fish Pond
NO. 25
Mutoba
Mutoba
Mutoba School
Kachilandela
1326
Kalonga
Chikwa
Chibuta
1356
Later Stone Age
Mwamba Lwenda
Air Strip
Chilindi
Mwakalonga
Store
Chishimba Falls
1293
1346
1320
Chipenge
Mulinda
Later Stone Age
Kasama Hydro-Electric Scheme
Chilubula
Chilindi
Power Station
1273
Nandola
Ngosito
1254
Mulinda
1248
Nabwalya
Chilubula Secondary School
Mpabalwani
Lukonto
N.E.R.
CHILUBULA
Mission
Rural Health Centre
PO
Store
1225
January
Keyala
Lukulu
Mbesha

Appendix 6 (113)

DAM AXIS PROFILE DATA.

STATION : No. 26 BWENGWA				(RIGHT)			
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0					
1	3.83	-0.74					
2	10.24	-1.98	Road Starts.				
3	19.09	-2.25	Road End.				
4	21.58	-2.78					
5	35.04	-4.83					
6	48.50	-6.60					
7	65.03	-8.13					
8	75.89	-9.16					
9	89.16	-9.92					
TP 1	0	0					
1	108.21	-11.33					
2	115.23	-13.00	River Starts				
3	116.12	-13.14					
4	119.74	-12.13	Rock.(stone)				
5	121.03	-12.02	Rock.(stone)				
6	121.80	-12.60	Rock.(stone)				
7	122.90	-12.72	Rock.(stone)				
8	125.38	-13.09	On the Sand.				
9	128.90	-13.12					
10	139.22	-13.90					
11	144.95	-13.65					
12	158.95	-13.72	Rock Area.				
13	169.54	-13.82	Rock Area.				
14	176.97	-13.13	River End.				
15	183.90	-10.60					
16	193.86	-3.99					
17	201.50	-0.25					
18	209.37	1.87					
19	226.27	4.10					
20	242.17	6.46					
21	259.56	7.55					
22	276.47	9.24					
23	287.76	9.78					
24	291.31	9.96					

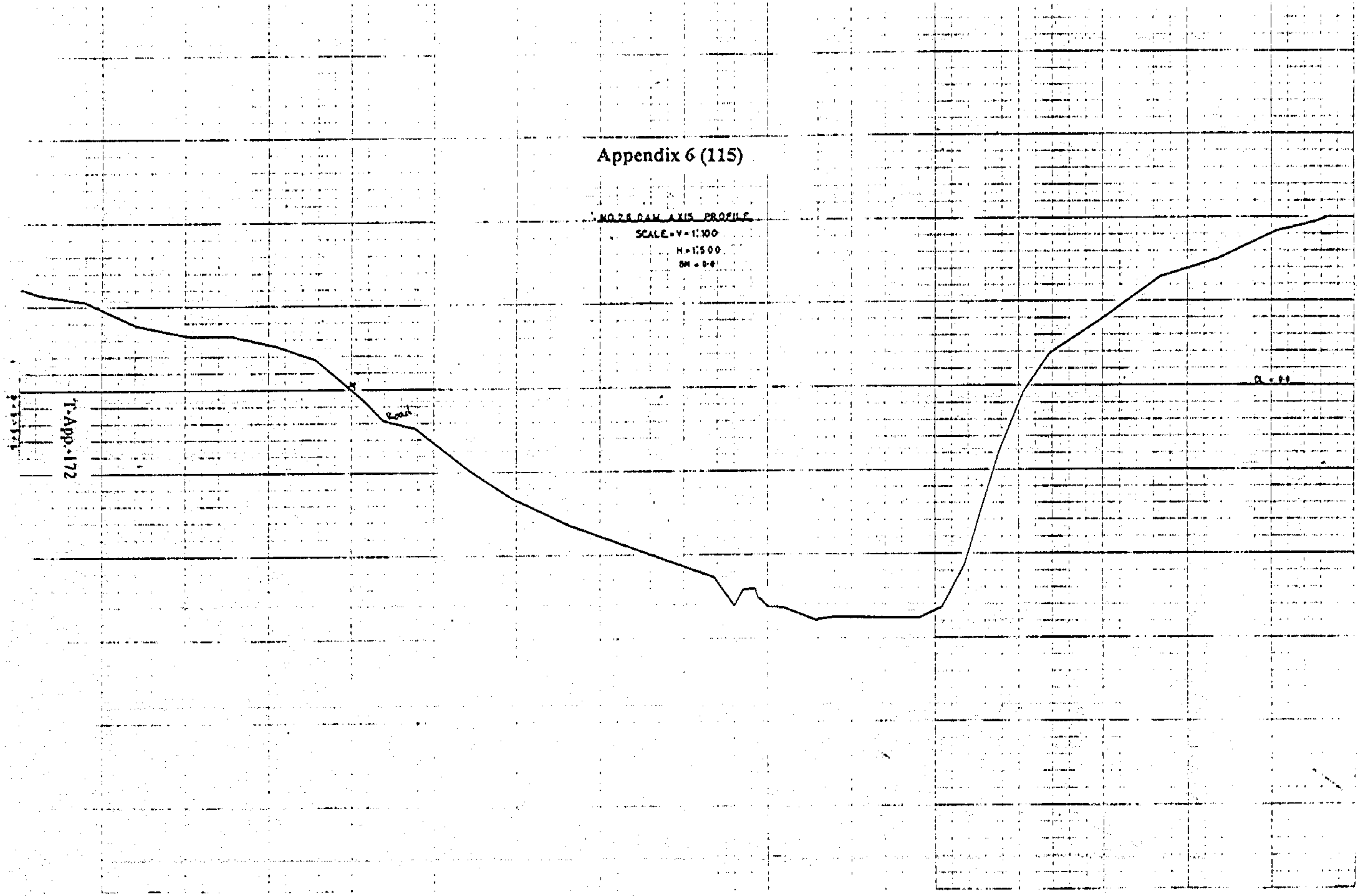
Appendix 6 (114)

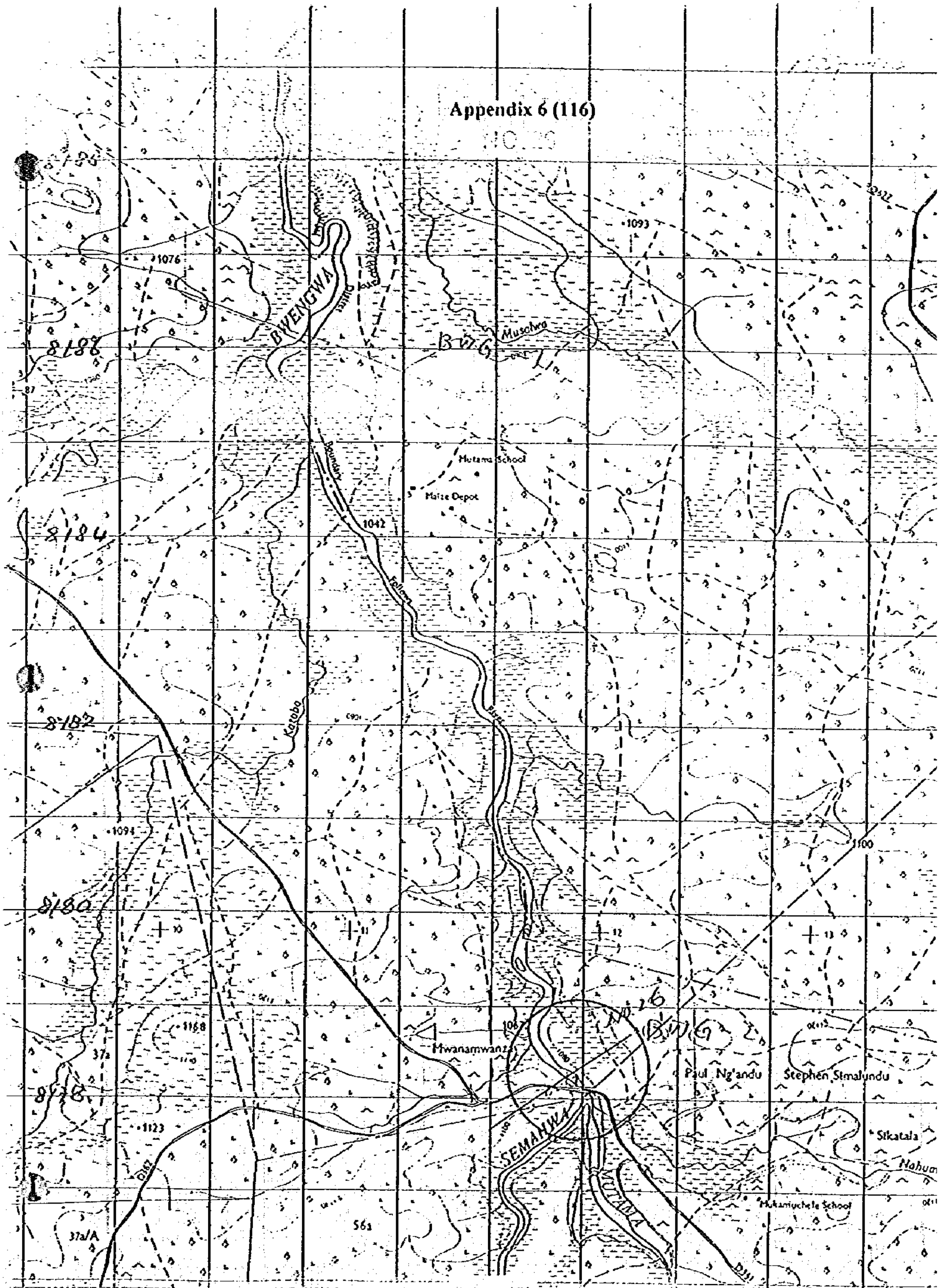
DAM AXIS PROFILE DATA.

STATION : No. 26 BWENGWA (LEFT)

No.	D	H	Remark	No.	D	H	Remark
BM.	0	0					
1	10.89	+1.79					
2	23.58	+2.59					
3	36.96	+3.24					
4	48.15	+3.16					
5	64.97	+3.94					
6	80.37	+5.25					
7	93.52	+5.73					
8	105.54	+6.32					

Appendix 6 (115)




BWENGWA
Musolwa
1076
1093
Mutama School
Maize Depot
1042
1094
1100
Mwanamwanza
1168
1123
SEMAHWA
Paul Ng'andu
Stephen Simalundu
Sikatala
Mukamuchele School
563
37a
37a/A
8188
8184
8182
8180
8178

Appendix 6 (117)

DAM AXIS PROFILE DATA.

STATION : No. 27 KALOMO.							(RIGHT)
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0		11	457.24	20.09	
1	7.44	0.34		12	472.72	20.12	
2	24.77	1.36		13	488.04	20.16	
3	43.45	3.33					
4	60.66	4.15					
5	76.17	5.32					
6	92.29	6.20					
7	107.54	7.15					
8	126.01	8.57					
9	142.35	9.57					
10	159.47	10.59					
11	176.61	11.67					
12	192.42	12.63					
13	206.96	13.28					
14	214.35	13.77					
15	233.01	15.06					
TP 1.	0	0					
1	249.58	16.20					
2	266.54	16.87					
3	284.44	17.65					
4	292.39	18.02					
5	296.73	18.54	Ant Hill Finished				
6	303.38	20.27	Ant Hill				
TP 2.	0	0					
1	308.76	19.15	Ant Hill Finished				
2	325.24	18.88					
3	342.18	19.26					
4	358.72	19.62					
5	374.47	20.10					
6	383.22	20.01					
7	393.24	19.93					
8	410.24	20.01					
9	427.66	20.05					
10	442.07	20.07					

Appendix 6 (118)

DAM AXIS PROFILE DATA.

STATION : No. 27 KALOMO.						(LEFT)	
No.	D	H	Remark	No.	D	H	Remark
BM.	0	0		10	347.90	8.39	
1	16.06	-1.27		11	365.66	9.40	
2	18.63	-2.95	River Starts (dry)	12	382.43	10.49	
3	21.82	-2.32		13	399.30	11.67	
4	26.99	-2.05		14	416.09	12.34	
5	27.99	-3.03		15	433.04	12.94	
6	36.19	-1.89		16	450.25	13.59	
7	39.93	-3.73		17	468.23	14.74	
8	47.35	-3.91					
9	48.64	-2.76		TP 2.	0	0	
10	52.20	-3.60		1	482.13	14.99	
11	66.34	-3.65	End of the River	2	499.29	15.56	
12	69.55	-1.20		3	516.49	16.27	
13	85.52	0.55		4	532.97	17.13	
14	104.32	2.27		5	546.56	17.83	
15	108.06	3.31		6	564.65	18.86	
16	110.79	2.80		7	580.93	20.00	
17	127.36	3.51		8	598.62	20.00	
18	143.89	4.65		9	617.58	20.38	
19	162.90	5.70					
20	179.16	6.39					
21	196.26	6.81					
22	200.71	6.87					
23	216.90	7.40					
24	218.90	7.33					
TP 1.	0	0					
1	236.07	7.23					
2	253.31	6.94					
3	270.21	6.49					
4	287.29	6.32	Stream Starts				
5	305.05	6.31					
6	306.51	5.69					
7	312.46	5.91					
8	314.46	6.86	Stream Ends				
9	331.66	7.55					

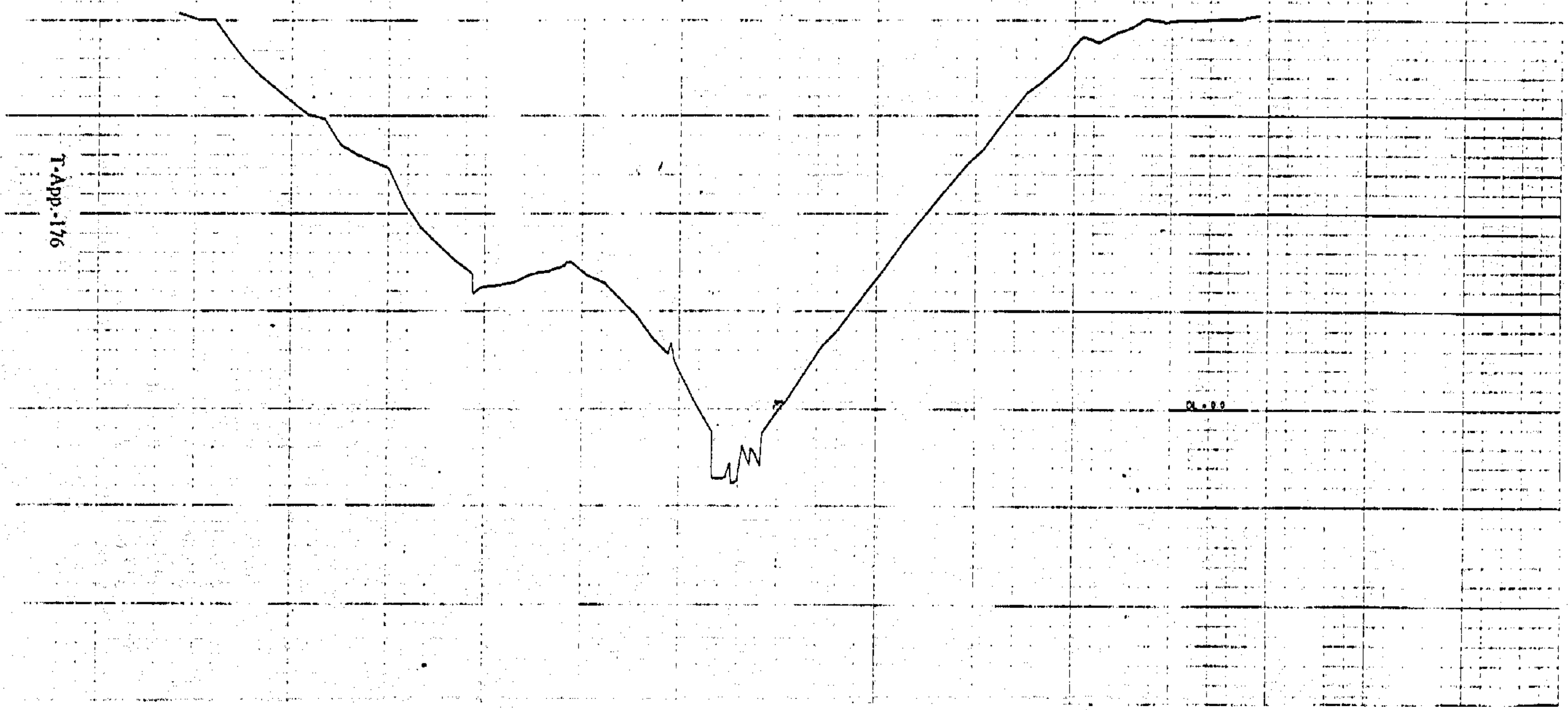
Appendix 6 (119)

NO 27 DAM AXIS PROFILE

SCALE= V: 1:100

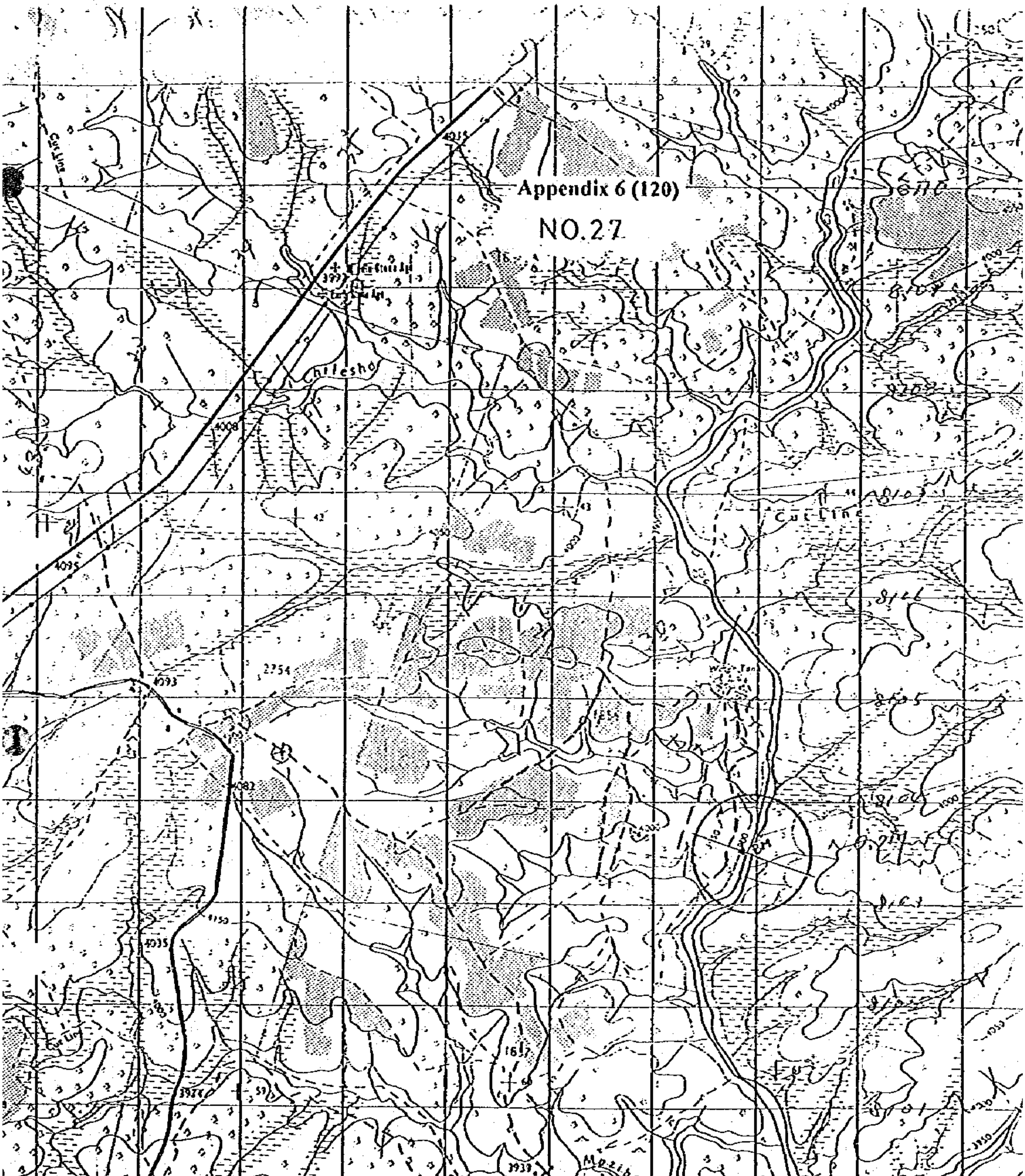
H: 1:2000

BM = 0.0



Appendix 6 (120)

NO.27



JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF ZAMBIA
MINISTRY OF ENERGY AND WATER DEVELOPMENT

THE STUDY

ON

THE NATIONAL WATER RESOURCES MASTER PLAN

IN

THE REPUBLIC OF ZAMBIA

FINAL REPORT

SUPPORTING REPORT [U]

GROUNDWATER MONITORING

OCTOBER, 1995

YACHIYO ENGINEERING CO., LTD.
(YEC)

THE STUDY ON NATIONAL WATER RESOURCES MASTER PLAN IN THE REPUBLIC OF ZAMBIA

SUPPORTING REPORT (U) GROUNDWATER MONITORING

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CHAPTER 1 INTRODUCTION

1.1 Scope

This report summarises groundwater monitoring. Groundwater monitoring is divided into two parts, one is nation-wide groundwater level observation, the other is groundwater monitoring in the four main cities, Lusaka, Ndola, Kabwe, Mongu. All the results are mentioned in this report.

1.2 Contents of the report

The contents of the report are as follows:
Chapter 1 comprises an introduction.
Chapter 2 describes nation-wide groundwater level observation.
Chapter 3 describes groundwater monitoring in Lusaka, Ndola, Kabwe, Mongu.
Chapter 4 describes recommendation for groudwater monitoring.

CHAPTER 2 NATION-WIDE GROUNDWATER LEVEL OBSERVATION

2.1 Purpose of observation

The purpose of nation-wide groundwater level observation is to obtain groundwater development potential in the whole of Zambia. Groundwater development potential is a part of the groundwater storage in aquifers. Groundwater storage in aquifers consists of two parts, namely, groundwater storage of shallow aquifers which is provided by rainfall and renewed every year, and groundwater storage of deep aquifers which is almost constant every year. This concept is shown in Figure 2-1.

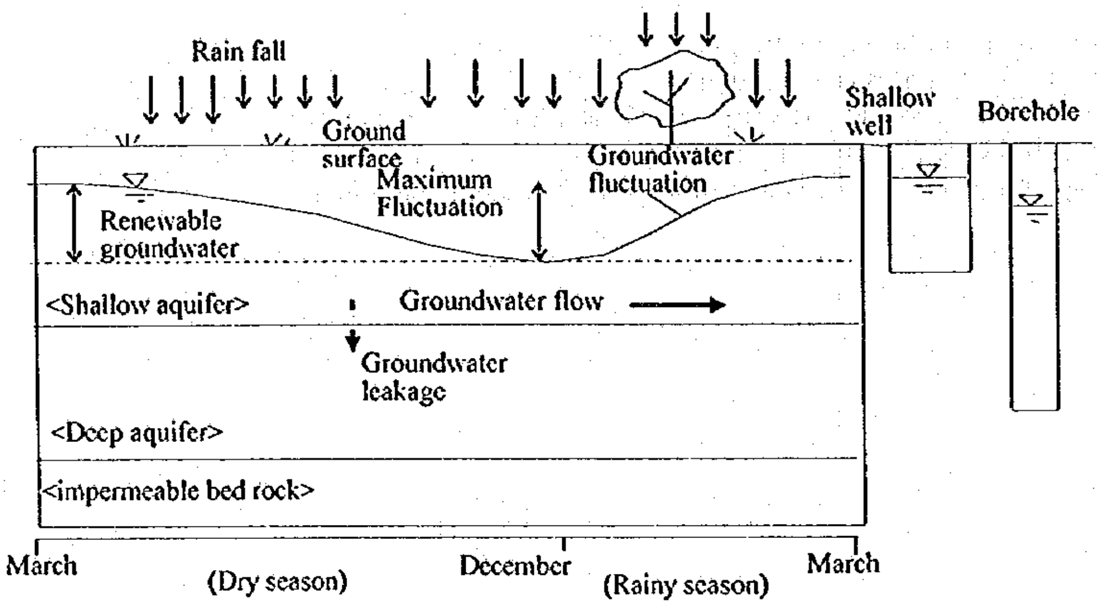


Figure 2-1 Concept of Renewable Groundwater

It is desirable to regard the renewable groundwater storage as groundwater development potential in terms of sustainable groundwater use. Rainfall which infiltrates into the ground in the rainy season reaches the groundwater table and causes the groundwater table to rise. But at the same time some groundwater runs off into rivers as baseflow. In the dry season, there is not rainfall and groundwater table falls only to run off into rivers as baseflow.

Total groundwater storage in aquifers which is stored in aquifers in rainy season is theoretically equal to the total groundwater run off into rivers in the dry season and it is also equal to renewable groundwater. These relations are shown in Figure 2-1.

As shown in Figure 2-1, it is necessary to measure maximum groundwater fluctuation for estimating renewable groundwater volume. For this purpose, nation-wide groundwater observation was carried out.

2.2 Method of observation

(1) Observation point

Observation points were selected so that the observation network might cover the whole country and the distribution of groundwater level fluctuation might be obtained with reliable accuracy. 169 observation points were finally selected over the whole country.

(2) Observation period

Observation period is 8 months, namely, May, June, July ,September, October, December 1994 and February, March 1995. Purpose of the survey was to obtain the maximum groundwater fluctuation over one year. Groundwater level is usually lowest between February and May, highest between September and December. Therefore, these months were included in the observation period.

Table 2-1 Observation Period

Year	1994									1995			
Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Observation		-----	-----	-----		-----	-----	-----			-----	-----	

Note; ---- Observation Period

(3) Type of observation well

Shallow wells are more suitable as observation wells than boreholes, because the groundwater level in shallow wells is more sensitive to precipitation and much easier to measure.

The condition for choosing observation wells were as follows:

- Not to dry up even in the wet season
- To be easy to access by vehicle
- To be adequately used and maintained

According to the conditions mentioned above, 2 wells were selected at each point. Location of observation points is shown in Figure 2-3. Representative groundwater fluctuation at each point was obtained from the results of two wells.

(4) Record Card

Record card shown in Figure 2-2 was made for every observation well. The detailed information on observation wells was recorded in the record cards.

2.3 Outline of Observation Wells

The total number of 312 shallow wells (169 points) for rural water supply along main roads were selected as observation wells based on the conditions mentioned above. Figure 2-3 shows the approximate location of these points. Site name, location, elevation, grid reference, scale of well, aquifer, etc. are attached at Appendices The total number of observation points and wells by Province are shown in Table 2-2.

RECORD CARD

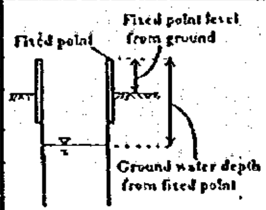
No______

observer ______________ Date of observation ______________________

Province __________ district name __________ village name __________

Name of site	Well catalogue No.
	Geological survey No.

Owner	Map grid ref.
Occupier	Status
(Ground level m)	Aquifer
Fixed point level from ground m	
Ground water depth from fixed point m	
(Date)	



Construction: Method Date

Depth bmt	Dia.	Linings (below well top) From	To	Dia.	Type

Abstraction rates (state units) Type of pump

PWL Chem./bact. anal. YES/NO

Summary of geological section	Thickness	Depth

Remarks (condition of the current use of the well, etc.)

Diagram of the well structure indicating diameter, depth, length of well liner, etc.	Sketch of observation well indicating appropriate fixed point to measure	Plane figure around well to distinguish later

Figure 2-2 Record Card

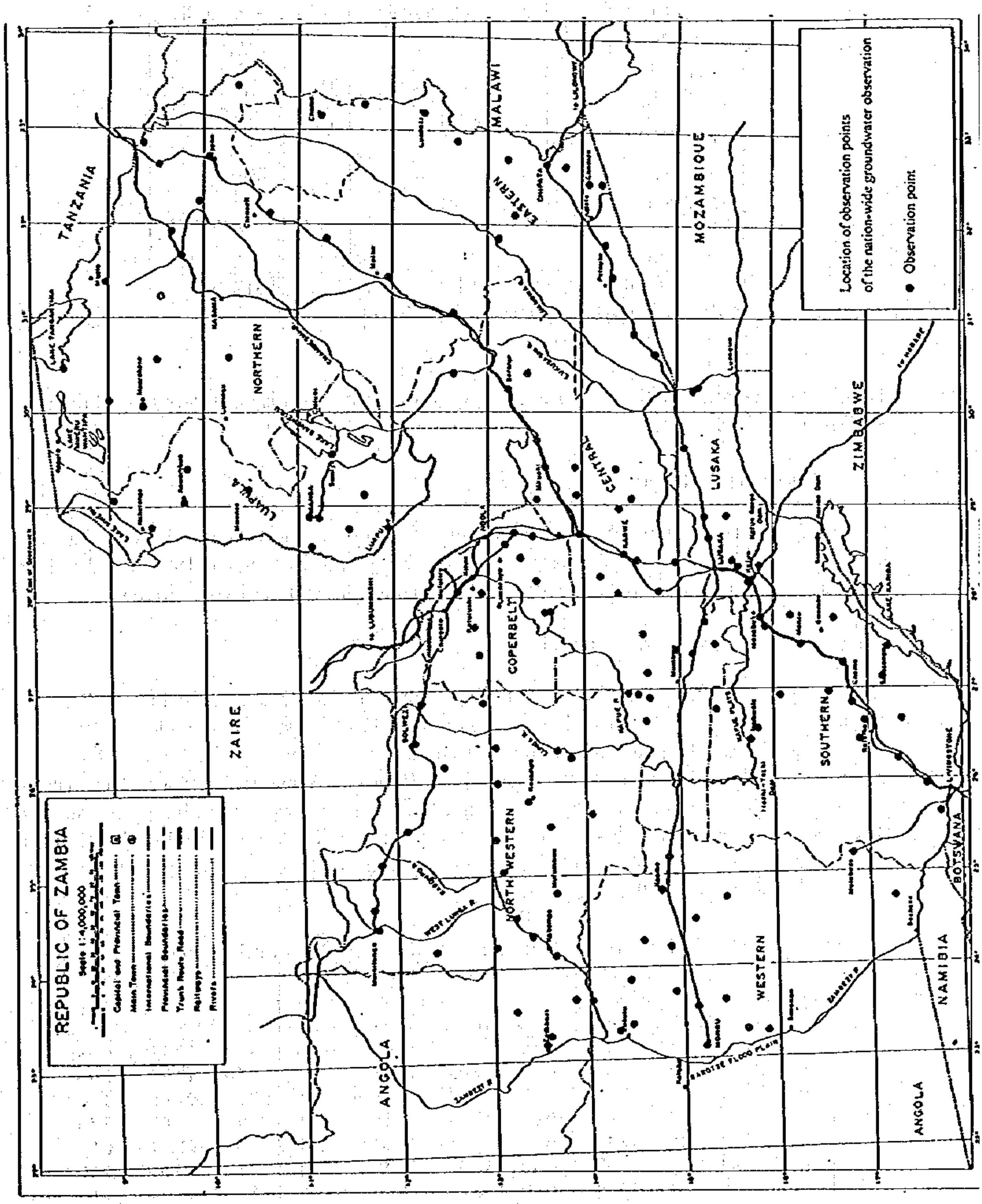


Figure 2-3 Location of Observation Point

Table 2-2 Number of Observation Points

Province	Number of observation points	Number of observation wells
Central	30	57
Copperbelt	14	27
Eastern	15	30
Luapula	14	27
Lusaka	10	20
Northwestern	26	49
Northern	21	35
Southern	20	37
Western	19	30
Total	169	312

* Each point has 2 observation wells in principle

Depth of observation wells range from 5m to 28 m. That depth is considered usual depth of shallow wells in Zambia.

2.4 Observation Results

Table 2-3, Figure 2-4 and 2-5, show the results of the observations. Table 2-4 and Figure 2-6 show groundwater level difference between May and November 1994 by Province. Characteristics of groundwater fluctuation by province are summarised as follows :

2.4.1 Average Groundwater Level

Average groundwater levels are different in each province as shown in Figure 2-4. The groundwater levels are lower in Northern Province, Northwestern and Southern Province. The average groundwater level in these provinces during the dry season was 10 - 11m below the surface. The groundwater level is shallower in Western province. The average groundwater level in Western province during the dry season was 5.5m below the surface. The average groundwater levels during the dry season in Copperbelt, Lusaka, Central, Eastern and Luapula Province were between the groundwater level in two groups described above. They averaged 7- 9m below surface.

Table 2-3 Groundwater Level at the Highest and Lowest

Province	May, 1994 (GL-m)			October, 1994 (GL-m)			March, 1995 (GL-m)		
	Average	Lowest	Highest	Average	Lowest	Highest	Average	Lowest	Highest
Lusaka	5.17	17.10	0.50	7.44	19.63	0.77	6.90	17.17	0.79
Copperbelt	4.90	8.85	0.95	7.03	12.71	2.87	6.20	12.75	2.20
Central	5.17	20.64	0.73	7.81	20.98	2.32	7.23	21.05	1.06
Northwestern	8.87	21.60	0.00	10.48	23.18	5.12	6.10	22.07	3.15
Western	3.19	9.11	0.00	5.71	28.74	0.98	5.59	28.79	0.78
Southern	8.12	20.30	0.90	10.39	20.40	2.20	9.92	20.65	1.90
Luapula	6.33	13.74	0.00	8.88	18.20	3.00	5.25	18.30	1.05
Northern	10.29	18.61	3.47	11.30	19.25	3.88	7.81	17.67	1.04
Eastern	5.28	8.20	2.30	8.48	14.80	7.90	5.51	10.60	3.40

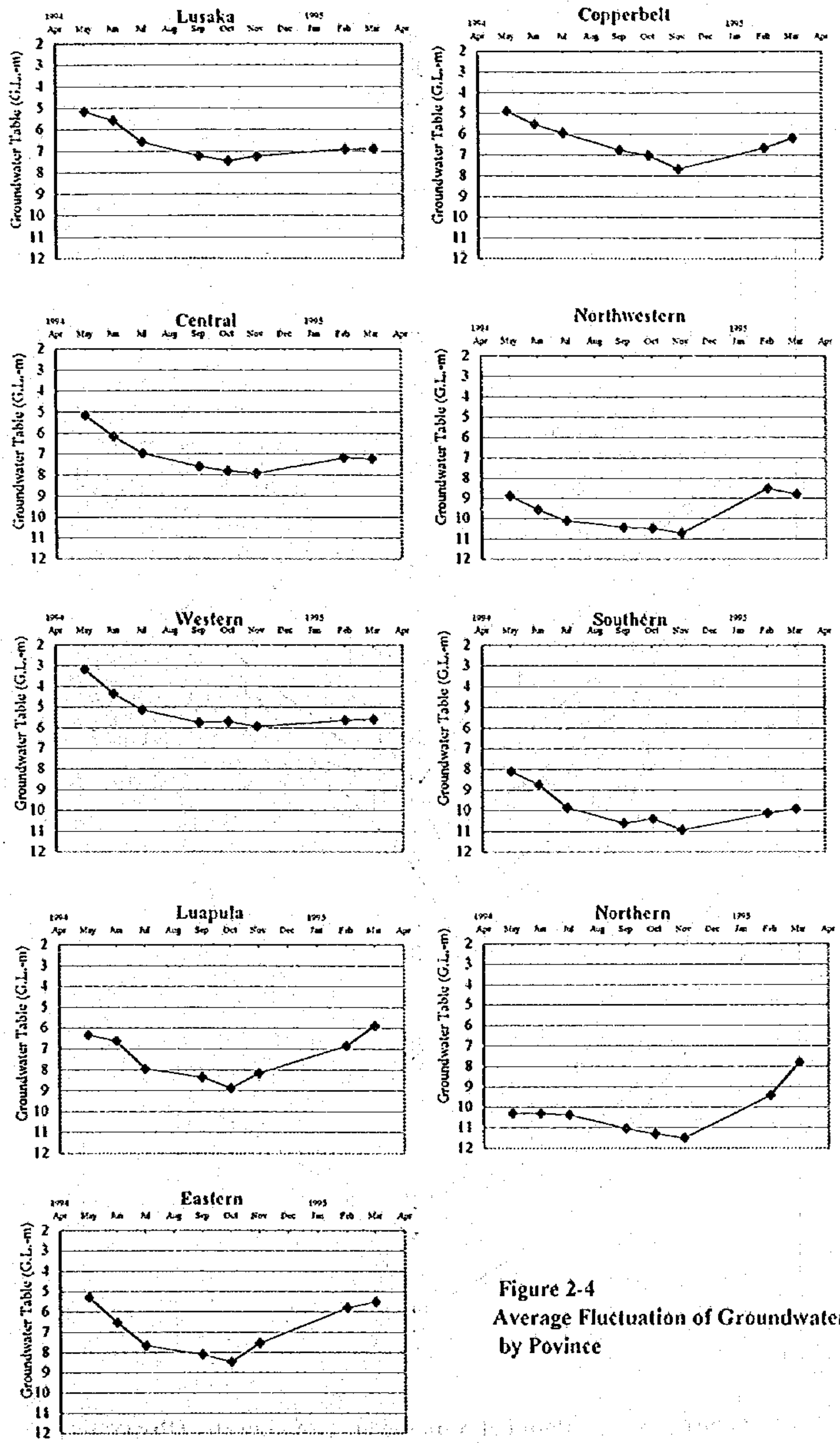


Figure 2-4
Average Fluctuation of Groundwater by Povince

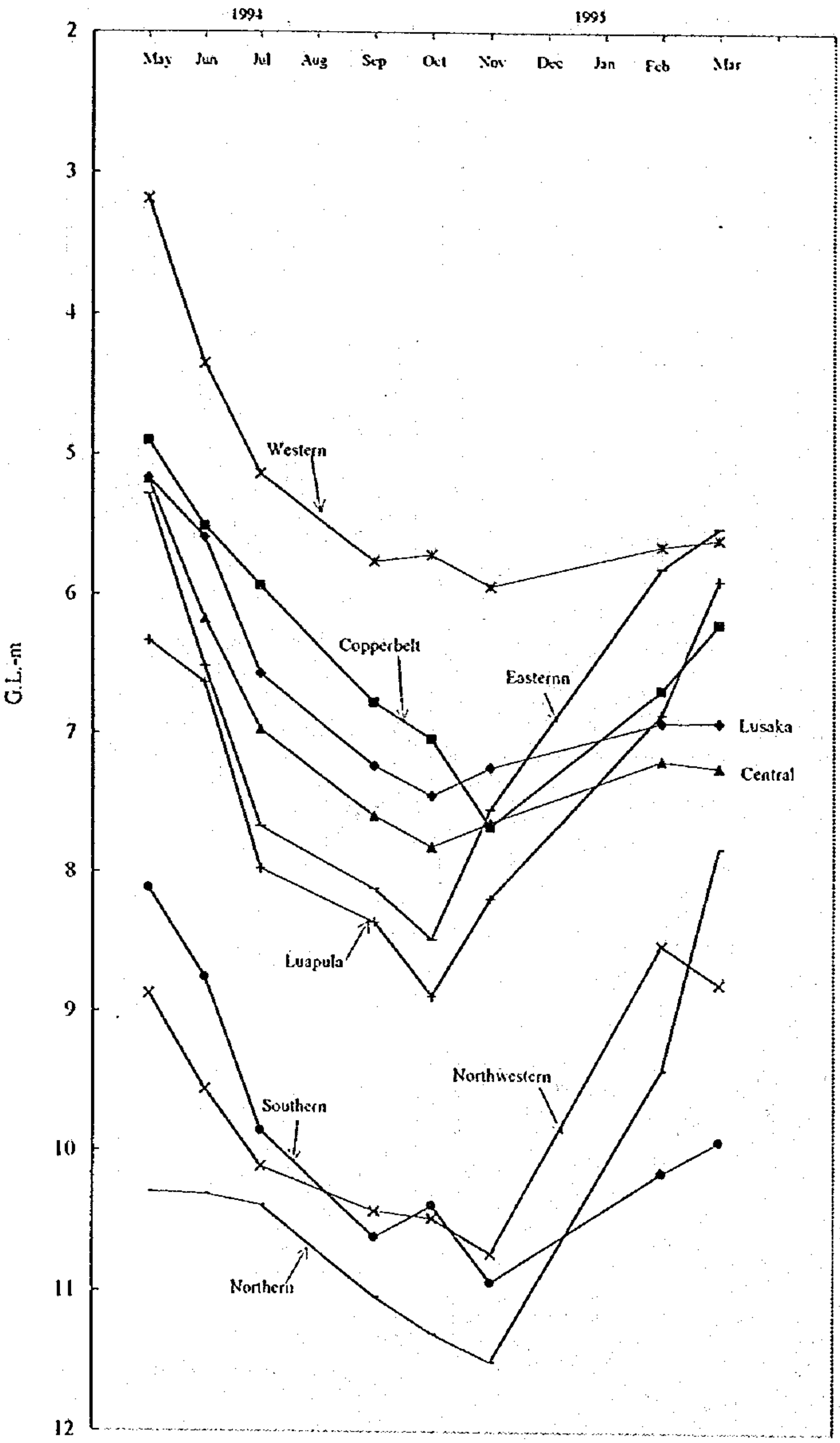


Figure 2-5 Result of Nation-wide Groundwater Observation

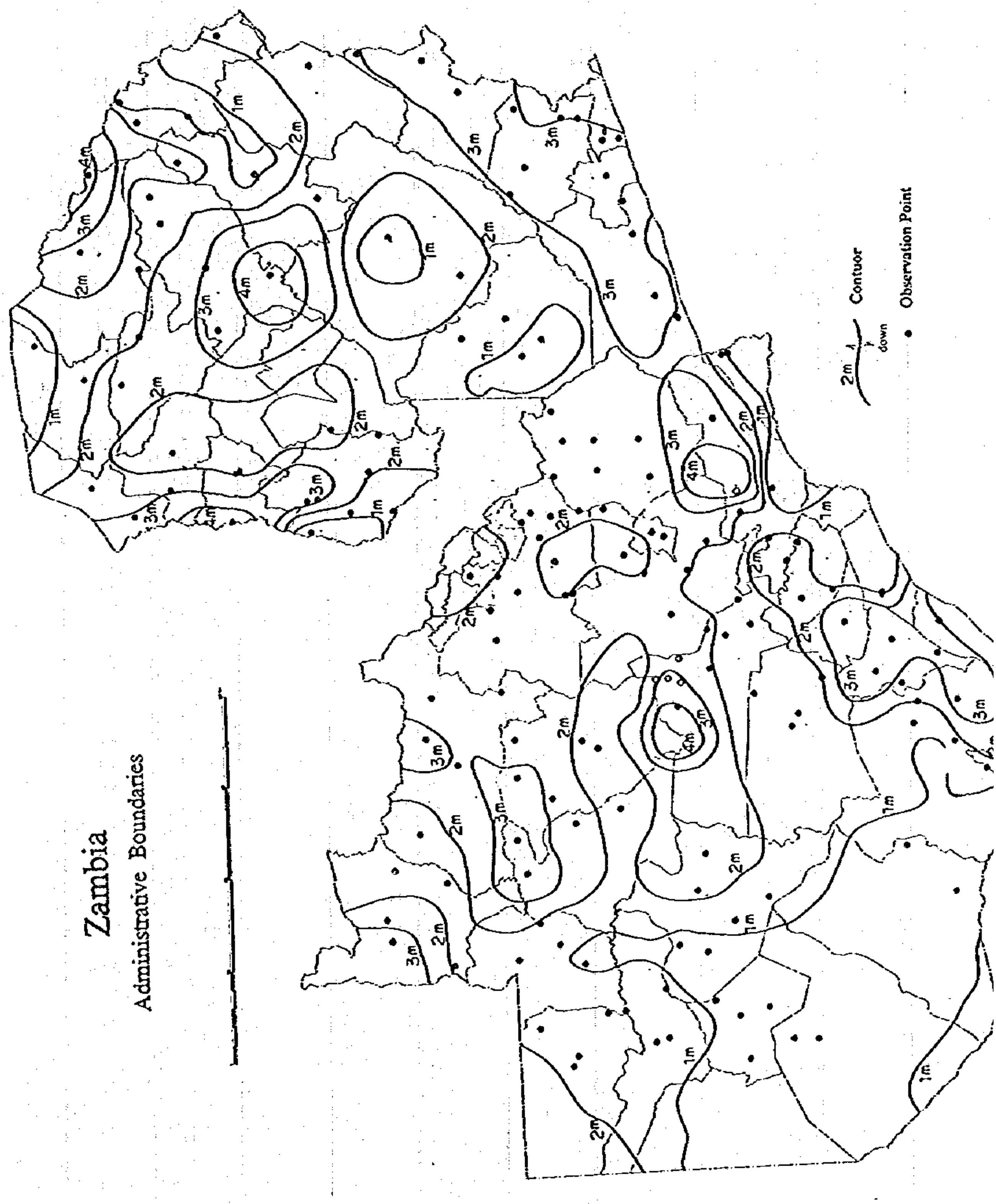


Figure 2-6 Contour Map of Maximum Groundwater Fluctuation

Table 2-4 Maximum Groundwater Fluctuation by District

Province	District	Distribution Area of Maximum Fluctuation (km					Total Area	Average
		0-1(m)	1-2(m)	2-3(m)	3-4(m)	4-5(m)	(km2)	dh (m)
Lusaka	Lusaka-Urban		353	88			441	1.7
	Lusaka-Rural	2,663	3,804	4,327	4,565	2,425	17,783	2.5
	Luangwa	2,331	1,376	153			3,859	0.9
Copperbelt	Ndola-Urban		240	754			993	2.3
	Ndola-Rural			20,096	3,328		23,423	2.6
	Chililabombwe		704	302			1,005	1.8
	Chingola		1,081	665			1,747	1.9
	Mufulira		1,273				1,273	1.5
	Kalulushi		673	462			1,135	1.9
	Kitwe		751				751	1.5
	Luanshya		114	759			873	2.4
Central	Kabwe-Urban			1,355	175		1,530	2.6
	Kabwe-Rural		1,868	19,024	3,933	590	25,415	2.6
	Mumbwa		473	14,598	4,019	2,482	21,572	2.9
	Mkushi			18,558	3,132	705	22,395	2.7
	Serenje		6,571	17,001			23,572	2.2
Northwestern	Solwezi		4,069	20,507	5,546		30,122	2.5
	Mwinilunga		9,123	5,381	6,390		20,894	2.4
	Zambezi		9,235	9,511			18,746	2.0
	Kabompo	1,204	12,299	1,032			14,535	1.5
	Mfumbwe		8,893	6,308	3,878		19,078	2.2
	Kasempa		7,988	9,334	3,448	1,135	21,905	2.4
Western	Mongu	9,567	504				10,071	0.6
	Lukulu	2,583	11,813	1,244			15,639	1.4
	Kalabo	15,164	1,983	83			17,230	0.6
	Kaoma	5,442	11,093	6,488			23,024	1.5
	Senanga	28,786	3,071				31,857	0.6
	Sesheke	26,355	3,168				29,522	0.6
Southern	Livingstone	200	761	80			1,041	1.4
	Namwala		19,268	1,839	40		21,147	1.6
	Mazabuka		3,312	3,312			6,625	2.0
	Monze		586	1,591	2,679		4,856	2.9
	Choma			1,208	5,799		7,008	3.3
	Kalomo	10,819	11,067	6,483	3,056		31,425	1.6
	Siavonga	321	2,207				2,529	1.4
	Gwembe		2,947	761	570		4,279	1.9
	Sinazongwe			1,458	2,248		3,706	3.1
Luapula	Mansa	2,206	4,090	7,077	2,619		15,991	2.1
	Nchelenge	85	930	2,791	1,381		5,188	2.6
	Kawambwa		5,432	2,189	1,054	365	9,040	2.1
	Mwense		2,219	1,972	1,438	1,027	6,656	2.7
	Samfya		4,014	4,403			8,417	2.0
Northern	Kasama		5,422	6,901	5,135	2,999	20,457	2.8
	Kaputa	3,469	4,047	2,891			10,407	1.4
	Mbala	602	8,014	5,606	2,408	527	17,156	2.2
	Mporokoso		2,029	9,228	676		11,933	2.4
	Luwingu		3,404	2,648	2,017	756	8,825	2.5
	Chilubi		807	2,346	1,393	110	4,656	2.7
	Isoka	3,535	4,589	3,671	1,836	136	13,767	1.8
	Chinsali	1,344	5,725	5,074	2,515	781	15,440	2.2
	Mpika	3,603	18,053	16,232	2,124	493	40,505	2.0
Eastern	Chipata			2,776	9,413		12,189	3.3
	Chama	1,298	5,799	10,706			17,803	2.0
	Lundazi			4,589	9,098		13,687	3.2
	Chadiza			850	1,652		2,502	3.2
	Katete				3,842		3,842	3.5
	Petauke			7,072	12,052		19,123	3.1
Total		125,525	218,533	270,553	112,469	13,511	740,590	2.1

The difference between the highest and the lowest groundwater levels are shown in Table 2-4 and Figure 2-6. As shown in Table2-4, the difference in groundwater levels between May and October 1994 is greatest in Eastern Province followed Central, Western, Luapula Provinces. The groundwater level difference is smaller in Northern Province and Northwestern Province. However, the groundwater levels differences between October 1994 and March 1995 are completely different from those between May and October 1994. Moreover, the differences by province are greater between October 1994 and March 1995 than between May and October 1994. The groundwater table falls during the dry season (May. to Oct.) and the difference is considered to be almost the same every year. On the other hand, the groundwater table rises during the rainy (Dec. to Apr.) season and the difference is considered to be dependent on precipitation. If the groundwater level difference during the dry season is much greater than that during the rainy season in some provinces, draught is forecast in these provinces.

Table 2-5 Average Groundwater Level Difference

Province	Average Groundwater Level Difference (m)	
	May - Oct, 1994	Oct - Mar, 1995
Lusaka	2.27	0.54
Copperbelt	2.13	0.83
Central	2.64	0.58
Northwestern	1.61	4.38
Western	2.52	0.11
Southern	2.27	0.47
Luapula	2.55	3.63
Northern	1.01	3.49
Eastern	3.19	2.96
Average	2.24	1.89

(Note) Values shown in this Table is simple average of observed results. Therefore, the values differ from those shown in Table 2-4.

2.4.2 Relationship between Groundwater Level Fluctuation and Elevation

The relationship between groundwater level fluctuation and elevation is shown in Figure 2-7. This Figure shows the relationship between decline of the groundwater level during May and November and the elevation of the groundwater table. The relationship is not clear from Figure 2-7.

2.4.3 Relationship between Groundwater Level Fluctuation and Lithology

The relationship between groundwater level fluctuation and aquifer lithology is shown in Figure 2-8. There is a little difference in the seasonal groundwater level draw-down by lithology, however, the differences are not so clear. Although, it seems that the groundwater level decline in the Kalahari sand area is lower than in other areas.

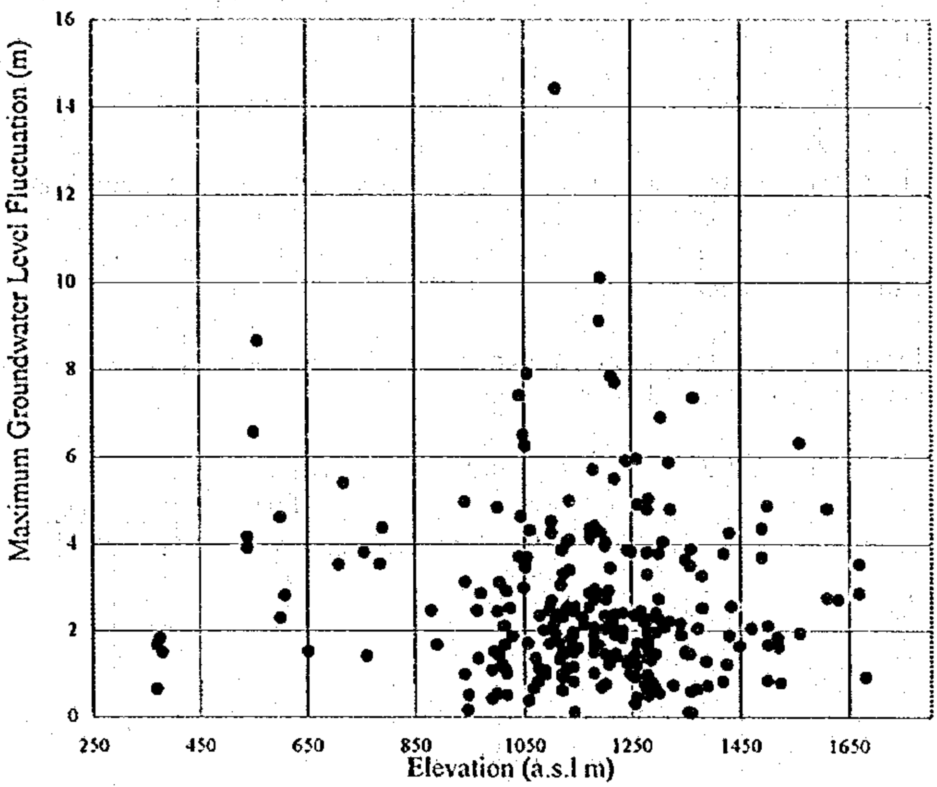


Figure 2-7 Relation between Elevation and Groundwater Level Fluctuation

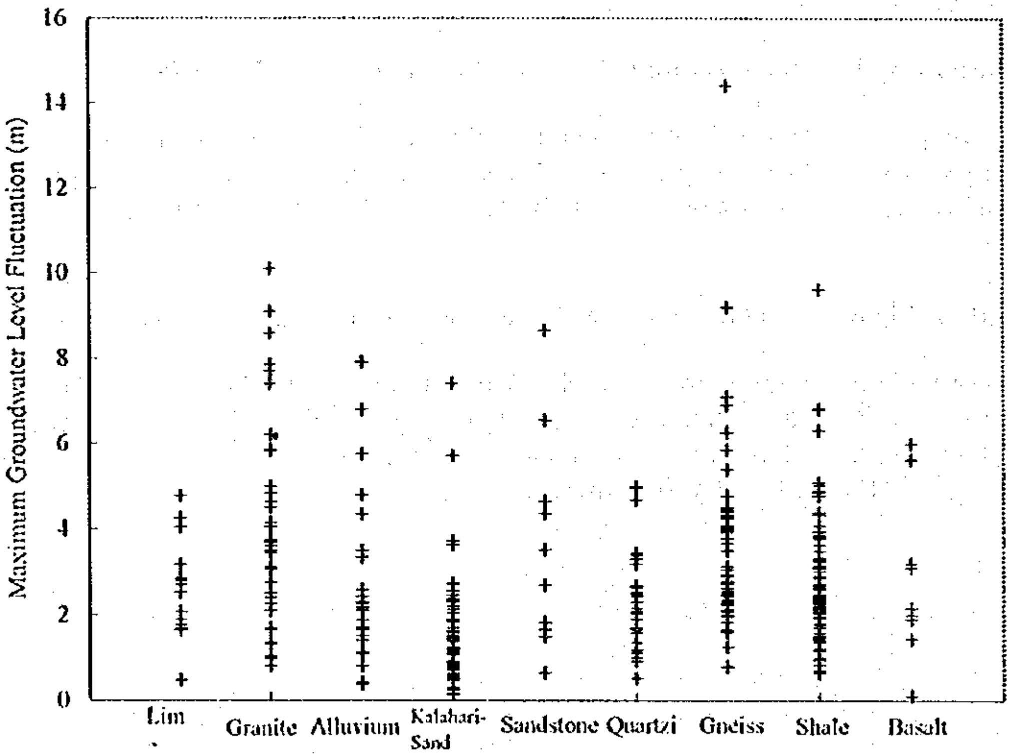


Figure 2-8 Maximum Groundwater Level Fluctuation by Lithology

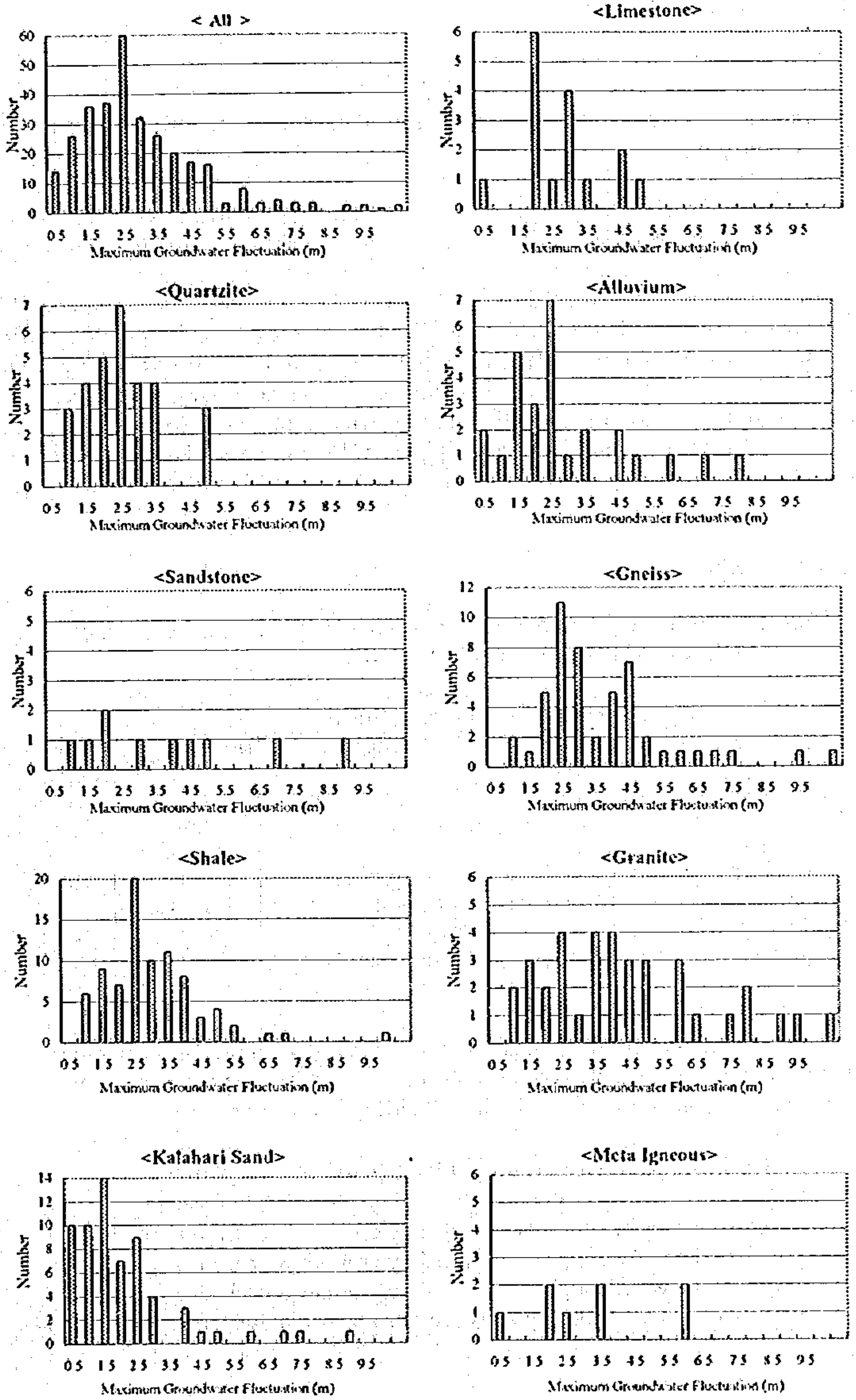


Figure 2-9 Histogram of Maximum Groundwater Level Fluctuation by Lithology

CHAPTER 3 GROUNDWATER MONITORING IN LUSAKA, NDOLA, KABWE, MONGU

3.1 Purpose of monitoring

This monitoring was carried out to obtain fundamental data about groundwater table decline caused by over pumping.

Recently a groundwater table decline in large cities has been reported. Especially in Lusaka, it is said that the trend of groundwater decline is remarkable and existing water supply facilities will be damaged in the near feature. Groundwater table decline is caused by over pumping. It is generally recognised that groundwater table starts declining when pumping rate exceeds rainfall recharge into groundwater. Groundwater level monitoring was carried out in this Master Plan to confirm the fact, because there was little evidence of groundwater level decline. Other than Lusaka, a large quantity of groundwater are being pumped for water supply in Nodal, Kabwe, Mongu. Groundwater table in these cities is also forecast to decline as in Lusaka. Over pumping causes collapse of the ground surface near boreholes. Actually in Kabwe well field, several collapses occurred and some boreholes were abandoned.

3.2 Monitoring Site

Seven monitoring points in 4 cities were selected as shown in Table 3-1. Location of monitoring sites are shown in Figures 3-1 and 3-2.

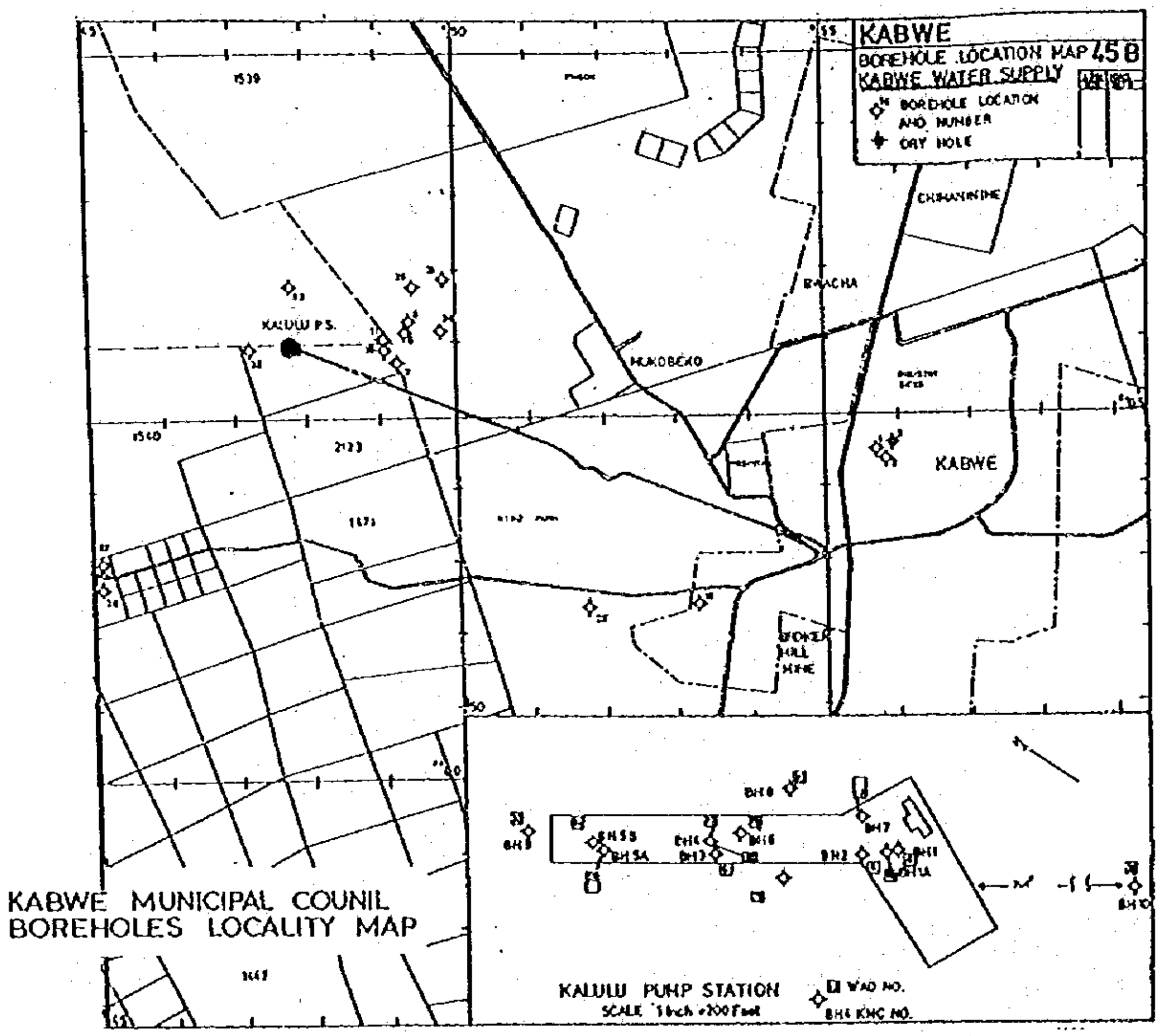
Table 3-1 Monitoring Stations

No.	City	Name of site	Depth of borehole	Ownership	Date of starting monitoring	Elevation of casing top
1	Lusaka	Mass Media	65m	Lusaka Water and Sewerage Company / DWA	12, Aug.	1265.0m
2	Lusaka	Mumbwa Road	39m		11, Aug.	1285.0m
3	Lusaka	Shaft No.5	75m		15, Aug.	1274.4m
4	Kabwe	Kalulu PS	100m	Kabwe Municipal Council	22, July	1187.9m
5	Ndola	Misundu St .1	80m	Ndola City Council / DWA	17, Aug.	1252.8m
6	Ndola	Misundu St .2	80m		23, Aug.	1247.0m
7	Mongu	Br No.5	82m	Mongu District Council / DWA	29, Jun.	1022.1m

These 4 cities are far more dependent on groundwater for water supply than any other cities and reduction of water supply is serious if groundwater decline occurs. Current groundwater use for public water supply in these 4 cities is as follows:

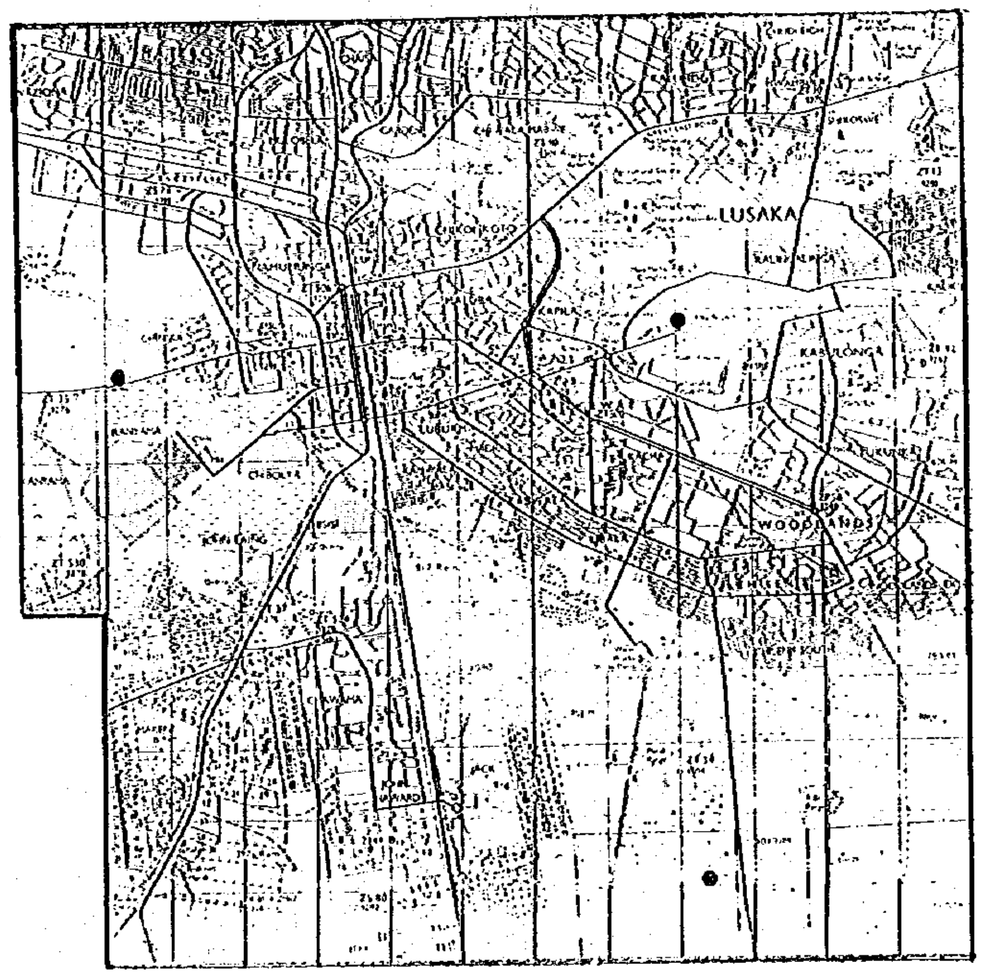
Table 3-2 Current Groundwater Use in the Four Cities

Area	Current Groundwater Use for Public Water Supply
Lusaka	-40% of the water supply is provided by groundwater from about 40 wells
Ndola	-52% of the water supply is provided by groundwater from 3 well fields
Kabwe	-75% of the water supply is provided by groundwater from 2 well fields
Mongu	-100% of groundwater supply is provided by groundwater from 9 boreholes



KABWE Scale 1: 100,000

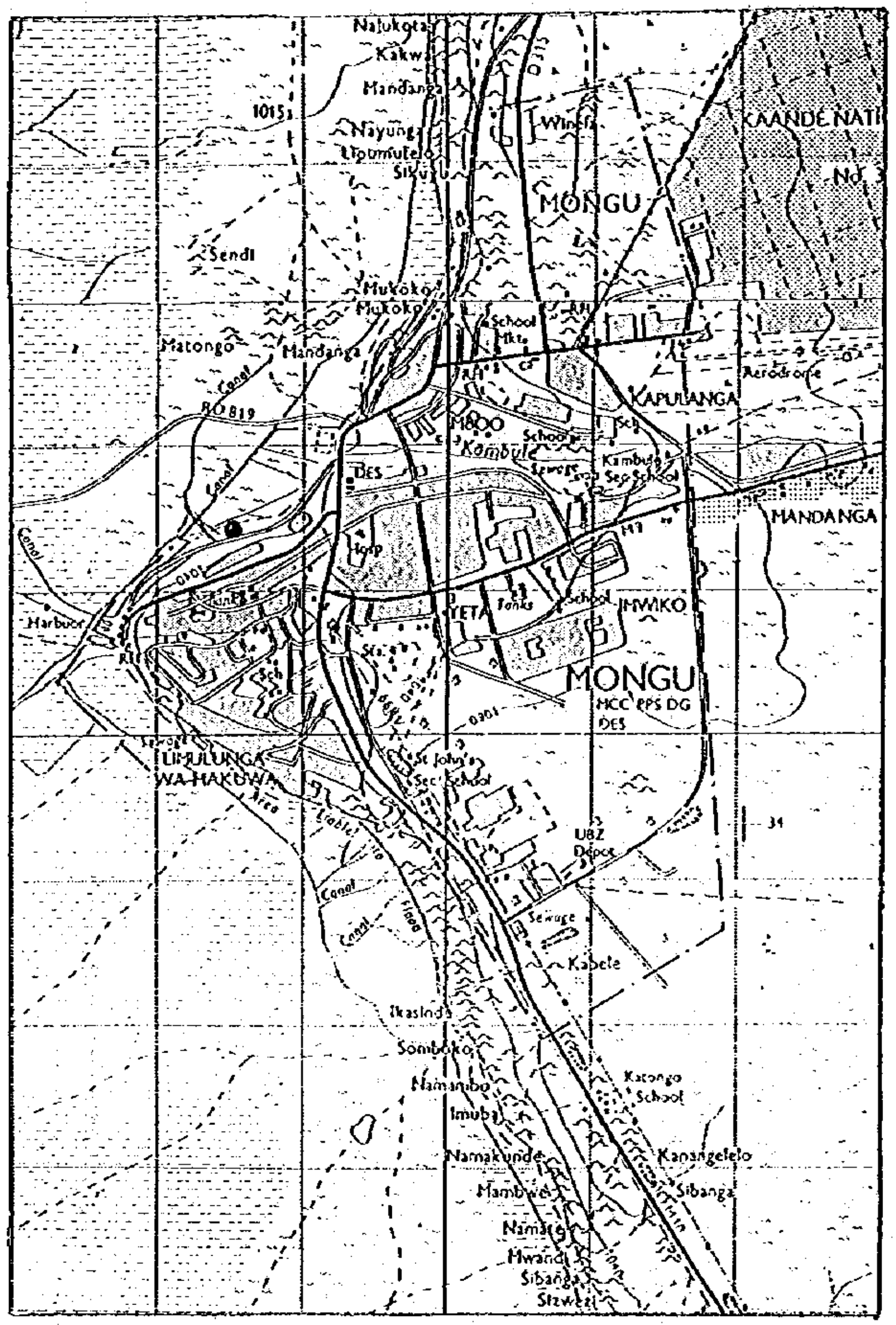
● Monitoring well



LUSAKA Scale 1: 100,000

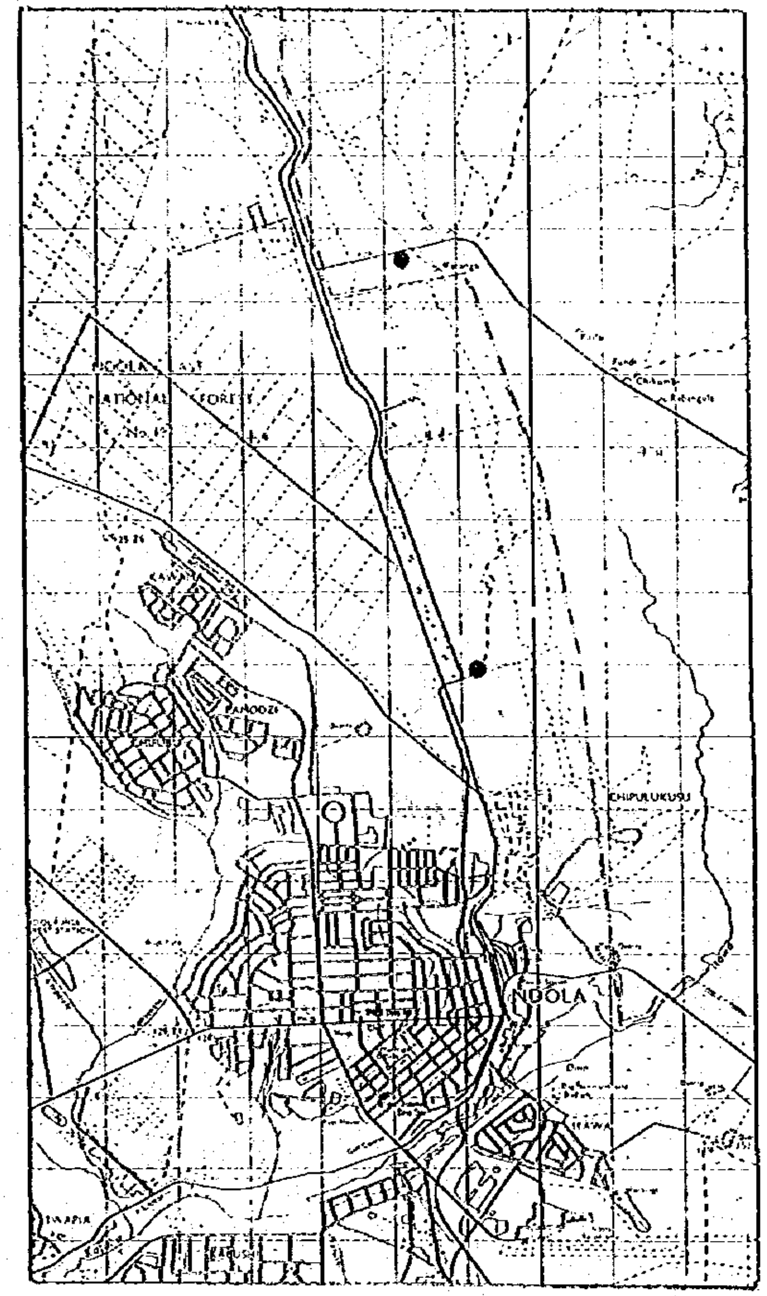
● Monitoring well

Figure 3-1 Location of Monitoring Well (1)



MONGU Scale 1: 50,000

● Monitoring well



NDOLA Scale 1: 100,000

● Monitoring well

Figure 3-2 Location of Monitoring Well (2)