Table 5.6 A List of the Hydropower Plants in the System

Name of Plant	Commission-ing Year	Installed Capacity (MW)	Maximum Output (MW)	Minimum Output (MW)	Annual Energy (GWh/yr)	
					Firm	Average
(1) Small Hydro	1958	28.3	28.0	16.8	126	153
(2) Masinga	1981	40.0	40.0	26.0	119	166
(3) Kamburu	1976	94.2	84.0	81.5	285	351
(4) Gitaru	1978	145.0	145.0	144.0	562	688
(5) Kindaruma	1968	44.0	44.0	44.0	132	163
(6) Kiambere	1988	144.0	144.0	129.3	626	735
(7) Turkwel	1991	106.0	106.0	99.8	268	372
(8) Sondu/Miriu	1997	60.0	60.0	21.5	188	337
	Total	601.5	591.0	541.4	2118	2628

Note : (1) The data source for the hydropower plants of (1) to (7) is the Feasibility Study for A Geothermal Power Plant at Olkaria North East (Tables 3.5 and 6.2).

Table 5.7 Existing and Committed Thermal Plant

	Name of Plant	Fuel Type	Commissioning Year	Retirement Year	Gross Output (MW)	Sent-out Output (MW)	Heat Rate (Btu/kWh)	Fixed O & M ($/kW/month)	Variable O & M ($/kWh)	Forced Outage Rate (%)	Schedule Maintenance (days)
1	Kipevu Steam										
	Unit Nos.4 and 5	HFO		2004		20.0	15,173	1.43	1.60	25.0	56
	Unit No.6	HFO		2004		25.0	13,255	1.00	1.20	15.0	56
	Unit No.7	HFO		2004		25.0	13,255	1.00	1.20	15.0	56
2	Kipevu G.T.	IDO		2010	30.0	30.0	12,187	1.17	2.27	15.0	28
3	Nairobi South	Gas oil		1994	12.0	12.0	15,697	1.17	2.27	15.0	28
4	Olkaria Geothermal		1985		45.0	44.0	-	1.35	-	5.0	35
5	Diesel Plant at Rabai	HFO	1992		75.0	75.0	9,220	1.20	3.8	6.0	30
6	Olkaria N.E. Geothermal		1993		32.0	31.0	-	1.35	-	5.0	35
			1993		32.0	31.0	-	1.35	-	5.0	35

Data Source: Additional Plant Study in May 1990, Table 2.4 and Feasibility Study for A Geothermal Power Plant at North East Olkaria.

Table 5.8 Thermal Candidates for the Planting-up Study

	Name of Plant	Specific Cost ($/kW)	Total Cost for 1 unit ($ millions)	Economic Life (Years)	Fixed 0 & M ($/kW/year)	Variable 0 & M ($/MWh)	Heat Rate (kJ/kWh)	Phasing of Costs (Percent in year)				Fuel Price		Remarks
								-2	-1	Comm.	1	(US$/MWh)	(US$/bbl)	
1.	Geothermal													
	30 MW	2,139	64.17	25	41.2	-	-	10	70	16	4			
	60 MW	1,862	111.72	25	35.9	-	-	10	70	16	4			
2.	Coal													
	30 MW	1,157	34.71	25	21	1.8	12,050	20	40	35	5	19		44US$/MT
	60 MW	928	55.68	25	21	1.8	12,050	20	40	35	5	19		44US$/MT
3.	Oil													
	30 MW	965	28.95	25	12	1.2	11,900	15	35	45	5	29.3	15.2	US$/bbl(HFO)
	60 MW	771	46.26	25	12	1.2	11,900	15	35	45	5	29.3	15.2	US$/bbl(HFO) (80% of crude)
4.	C.T.													
	30 MW	401	12.03	20	14	2.27	15,000		50	45	5	69	28.5	US$/bbl(G.O)
	60 MW	346	20.76	20	14	2.27	15,000		50	45	5	69	28.5	US$/bbl(G.O) (150% of crude)

Data Source: Feasibility Study for A Geothermal Power Station at North East Olkaria, Table 6.3

Table 5.9 Hydro Candidates for the Planting-up Study

Name of Plant	Type	Installed Capacity, MW	Maximum Output, MW	Firm Capacity, MW	Annual Energy GWh/yr		Total Cost 106US$	Economic Cost 106 US$	Disbursement of Economic Cost, %	Lead Time year
					Firm	Average				
1. Low Grand Falls	Reservoir	120.0	120.0	88.8	402.0	594.0	361.07	291.98	15,25,30,20,10	6
2. Mutonga	Reservoir	60.0	60.0	40.8	202.0	234.0	174.98	144.97	15,35,30,20	6
3. Magwagwa	Reservoir	200.0	200.0	127.0	243.9	553.8	354.11	281.90	15,25,30,20,10	4
		140.0	140.0	88.7	243.9	472.7	303.79	240.35	- do -	
		133.0	133.0	84.8	243.9	493.2	298.64	236.10	- do -	
		120.0	120.0	76.0	243.9	457.0	288.58	227.80	- do -	
		100.0	100.0	63.5	243.9	434.5	269.85	212.36	- do -	
		67.0	67.0	43.6	243.9	345.0	240.45	188.15	- do -	
				(24.2)	(91.2)	(23.4)				

Notes : (1) Annual operation and maintenance cost is assumed to be 1% of total cost.
(2) Figures in the parentheses show the firm-up capacity and energy of the Sondu/Miriu by building the Magwagwa reservoir.
(3) Economic costs for Magwagwa HPP presented above are the allocated cost for Hydropower purpose.

Table 5.10 Cost Allocation of the Magwagwa Project

(Unit : million US$)

	Case-1 (67 MW)		Case-2 (100 MW)		Case-3 (120 MW)		Case-4 (133 MW)		Case-5 (140 MW)		Case-6 (200 MW)	
	(Power)	(Irri.)	(Power)	(Irri.)	(Power)	(Irri.)	(Power)	(Irri.)	(Power)	(Irri.)	(Power)	(Irri.)
Construction Cost (Power plus Irri.)	195.579		219.247		234.426		242.645		246.708		287.688	
Cost with Purpose Excluded	126.293	195.579	127.781	219.247	128.803	234.426	129.314	242.645	129.565	246.708	132.326	287.688
Separable Cost of Purpose	69.286	0	91.466	0	105.623	0	113.331	0	117.143	0	155.362	0
Alternative Cost or Justifiable Expenditure	195.579	27.274	219.247	27.274	234.426	27.274	242.645	27.274	246.708	27.274	287.688	27.274
Remaining Justifiable Expendigure	126.293	27.274	127.781	27.274	128.803	27.274	129.314	27.274	129.565	27.274	132.326	27.274
Percent Distribution	82.2%	17.8%	82.4%	17.6%	82.5%	17.5%	82.6%	17.4%	82.6%	17.4%	82.9%	17.1%
Remaining Joint Cost	103.863	22.430	105.304	22.477	106.295	22.508	106.790	22.523	107.034	22.531	109.713	22.613
Total Allocated Cost	173.149	22.430	196.770	22.477	211.918	22.508	220.121	22.523	224.177	22.531	265.075	22.613
Percent Distribution	88.5%	11.5%	89.7%	10.3%	90.4%	9.6%	90.7%	9.3%	90.9%	9.1%	92.1%	7.9%

Table 5.11 Allocated Economic Cost of the Magwagwa Hydropower Project

(million US$)

Item	(67 MW) Case-1	(100 MW) Case-2	(120 MW) Case-3	(133 MW) Case-4	(140 MW) Case-5	(200 MW) Case-6
1 Preparatory Work	7.636	8.380	8.891	9.146	9.272	10.653
2 Diversion Tunnel	9.992	9.992	9.992	9.992	9.992	9.992
3 Coffer Dam	2.644	2.644	2.644	2.644	2.644	2.644
4 Main Dam	85.208	85.208	85.208	85.208	85.208	85.208
5 Spillway	12.074	12.074	12.074	12.074	12.074	12.074
6 Waterway	24.675	35.204	42.397	45.547	47.210	67.011
7 Surge Tank	4.317	6.309	8.000	9.200	9.750	13.629
8 Open Penstock Line	3.780	4.446	4.850	5.010	5.025	6.600
9 Power House	4.031	4.947	5.400	5.698	5.830	6.988
10 Tailrace	4.900	5.670	6.150	6.450	6.600	7.800
11 Saddle Dam	1.103	1.103	1.103	1.103	1.103	1.103
12 Metal Works	3.692	4.520	4.951	5.214	5.348	6.394
13 GE & SS	17.951	24.430	27.935	30.272	31.440	41.000
14 T/L Line	5.940	5.940	5.940	5.940	5.940	5.940
Total Direct Cost	187.943	210.867	225.535	233.498	237.436	277.036
15 Construction Costs	187.943	210.867	225.535	233.498	237.436	277.036
16 Allocated Cost to Irrigation	22.268	22.306	22.350	22.443	22.364	22.540
17 Allocated Direct Cost to Hydropower	165.675	188.561	203.185	211.055	215.072	254.496
18 E/S & Administration Borne by Hydropower	16.568	18.856	20.319	21.106	21.507	25.450
17 Relocation Cost Borne by Hydropower	26.843	27.230	27.434	27.526	27.583	27.973
18 Physical Contingency Borne by Hydropower	31.363	35.197	37.641	38.953	39.624	46.188
19 Allocated Cost to Hydropower	240.449	269.844	288.579	298.640	303.786	354.107
20 Economic Cost of Relocation	12.559	12.559	12.559	12.559	12.559	12.559
21 Economic Cost of Relocation on Hydropower	11.071	11.230	11.314	11.352	11.376	11.537
22 Economic Cost of Hydropower	188.150	212.357	227.803	236.106	240.348	281.902

* (22) = [(19) - (17)] x 0.829 + (21)

Table 5.12 Energy Balance for the Recommended Planting-up Programme (The Magwagwa in 2003 with 120 MW)

Beginning of Operation	Name	Type	Installed Capacity (MW)	Dependable Peak (MW) 1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Existing	Small Hydro	Hydro	28.00	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80
Existing	Masinga	Hydro	40.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Existing	Kamburu	Hydro	84.00	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50	81.50
Existing	Gitaru	Hydro	145.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00
Existing	Kindaruma	Hydro	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00
Existing	Kiambere	Hydro	144.00	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30	129.30
Commited	Turkwel	Hydro	106.00		99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80	99.80
Existing	Kipevu No. 4 & 5	HFO	20.00	14.30	13.98	13.65	13.33	13.00	12.68	12.35	12.03	11.70	11.38	11.05	10.73	10.40	10.08	Retired						
Existing	Kipevu No. 6	HFO	44.00	17.88	17.47	17.07	16.66	16.25	15.85	15.44	15.04	14.63	14.22	13.82	13.41	13.00	12.60	Retired						
Existing	Kipevu No. 7	HFO	25.00	17.88	17.47	17.07	16.66	16.25	15.85	15.44	15.04	14.63	14.22	13.82	13.41	13.00	12.60	Retired						
Existing	Kipevu G.T.	IDO	30.00	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	Retired
Existing	Nairobi south	Gas oil	12.00	10.64	10.64	10.64	10.64	Retired																
Existing	Olkaria Geo Thermal	Geo	44.00	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78	39.78
Committed	Rabai Diesel	HFO	75.00			66.08	64.76	63.44	62.12	60.80	59.47	58.15	56.83	55.51	54.19	52.87	51.54	50.22	48.90	47.58	46.26	44.94	43.61	42.29
Committed	Olkaria N.E. Geo	Geo	60.00				54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24	54.24
1994	C.T. 02	Gas oil	60.00					53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18
1995	Geo Thermal 02	Geo	60.00						54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25
1997	Sondu/Miriu	Hydro	60.00								35.80	35.80	35.80	35.80	35.80	35.80	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
*	C.T. 01	Gas oil	30.00								26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59	26.59
1998	Geo Thermal 02	Geo	60.00									54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25
1999	C.T. 02	Gas oil	60.00										53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18
2000	Geo Thermal 02	Geo	60.00											54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25
2001	C.T. 02	Gas oil	60.00												53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18	53.18
2002	Geo Thermal 02	Geo	60.00													54.24	54.25	54.25	54.25	54.25	54.25	54.25	54.25	54.25
2003	Magwagwa	Hydro	120.00														76.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00
2004	Coal 03	Coal	90.00															72.82	72.82	72.82	72.82	72.82	72.82	72.82
2005	C.T. 02	Gas oil	60.00																53.18	53.18	53.18	53.18	53.18	53.18
2006	Coal 01	Coal	30.00																	24.27	24.27	24.27	24.27	24.27
*	C.T. 02	Gas oil	60.00																	53.18	53.18	53.18	53.18	53.18
2007	Coal 02	Coal	60.00																		48.55	48.55	48.55	48.55
*	C.T. 01	Gas oil	30.00																		26.59	26.59	26.59	26.59
2008	Coal 02	coal	60.00																			48.55	48.55	48.55
*	C.T. 01	Gas oil	60.00																			53.18	53.18	53.18
2009	Coal 01	Coal	30.00																				48.55	48.55
*	C.T. 02	Gas oil	60.00																				53.18	53.18
2010	Coal 03	Coal	90.00																					72.82
*	C.T. 02	Gas oil	60.00																					53.18
	Total Disbursed Cost			568.67	657.33	732.28	784.06	824.13	875.94	873.47	933.41	985.19	1035.91	1087.71	1138.43	1190.20	1287.95	1324.18	1376.04	1452.17	1525.99	1626.40	1726.80	1824.89
	Forecasted Peak Load			558.00	589.00	620.00	653.00	687.00	724.00	762.00	803.00	746.00	893.00	942.00	994.00	1049.00	1105.00	1163.00	1225.00	1290.00	1358.00	1430.00	1506.00	1586.00
	Power Balance			10.67	78.33	112.28	131.06	137.13	151.94	111.47	130.41	239.19	142.91	145.71	144.43	141.20	182.95	161.18	151.04	162.17	167.99	196.40	220.80	238.89

Table 5.13 Energy Balance for the Recommended Planting-up Programme (The Magwagwa in 2003 with 120 MW)

Beginning of Operation	Name	Type	Installed Capacity (MW)	Firm Energy Output (GWh)																		
				1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Existing	Small Hydro	Hydro	28.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00
Existing	Masinga	Hydro	40.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00	119.00
Existing	Kamburu	Hydro	84.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00	285.00
Existing	Gitaru	Hydro	145.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00	562.00
Existing	Kindaruma	Hydro	44.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00	132.00
Existing	Kiambere	Hydro	144.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00	626.00
Commited	Turkwel	Hydro	106.00		268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00	268.00
Existing	Kipevu No. 4 & 5	HFO	20.00	123.34	120.54	117.73	114.93	112.13	109.32	106.52	103.72	100.92	98.11	95.31	92.51	89.70	86.90	Retired						
Existing	Kipevu No. 6	HFO	44.00	154.18	150.67	147.17	143.66	140.16	136.66	133.15	129.65	126.14	122.64	119.14	115.63	112.13	108.62	Retired						
Existing	Kipevu No. 7	HFO	25.00	154.18	150.67	147.17	143.66	140.16	136.66	133.15	129.65	126.14	122.64	119.14	115.63	112.13	108.62	Retired						
Existing	Kipevu G.T.	IDO	30.00	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	Retired
Existing	Nairobi south	Gas oil	12.00	26.28	26.28	26.28	26.28	Retired																
Existing	Olkaria Geo Thermal	Geo	44.00	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17	366.17
Commited	Rabai Diesel	HFO	75.00			525.60	515.09	504.58	494.06	483.55	473.04	462.53	452.02	441.50	430.99	420.48	409.97	399.46	388.94	378.43	367.92	357.41	346.90	336.38
Commited	Olkaria N.E. Geo	Geo	60.00				499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32
1994	C.T. 02	Gas oil	60.00					131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40
1995	Geo Thermal 02	Geo	60.00						499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32
1997	Sondu/Miriu	Hydro	60.00								188.00	188.00	188.00	188.00	188.00	188.00	279.20	279.20	279.20	279.20	279.20	279.20	279.20	279.20
*	C.T. 01	Gas oil	30.00								65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70	65.70
1998	Geo Thermal 02	Geo	60.00									499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32
1999	C.T. 02	Gas oil	60.00										131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40
2000	Geo Thermal 02	Geo	60.00											499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32
2001	C.T. 02	Gas oil	60.00												131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40	131.40
2002	Geo Thermal 02	Geo	60.00													499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32	499.32
2003	Magwagwa	Hydro	120.00														243.90	243.90	243.90	243.90	243.90	243.90	243.90	243.90
2004	Coal 03	Coal	90.00															630.72	630.72	630.72	630.72	630.72	630.72	630.72
2005	C.T. 02	Gas oil	60.00																131.40	131.40	131.40	131.40	131.40	131.40
2006	Coal 01	Coal	30.00																	210.24	210.24	210.24	210.24	210.24
*	C.T. 02	Gas oil	60.00																	131.40	131.40	131.40	131.40	131.40
2007	Coal 02	Coal	60.00																		420.48	420.48	420.48	420.48
*	C.T. 01	Gas oil	30.00																		65.70	65.70	65.70	65.70
2008	Coal 02	coal	60.00																			420.48	420.48	420.48
*	C.T. 01	Gas oil	60.00																			131.40	131.40	131.40
2009	Coal 01	Coal	30.00																				210.24	210.24
*	C.T. 02	Gas oil	60.00																				131.40	131.40
2010	Coal 03	Coal	90.00																					630.72
*	C.T. 02	Gas oil	60.00																					131.40
	Energy Requirement			2739.85	2998.03	3513.82	3992.81	4077.62	4556.61	4536.28	4769.67	5248.66	5359.74	5838.74	5949.81	6428.81	6743.58	7059.55	7180.53	7511.66	7987.33	8528.70	8859.83	9545.73
	Energy Demand			3306.00	3483.00	3662.00	3852.00	4051.00	4261.00	4484.00	4718.00	4970.00	5242.00	5528.00	5829.00	6142.00	6464.00	6801.00	7157.00	7530.00	7921.00	8333.00	8760.00	9220.00
	Energy Balance			-566.15	-484.97	-148.18	140.81	26.62	295.61	52.28	51.67	278.66	117.74	310.74	120.81	286.81	279.58	258.65	23.53	-18.34	66.33	195.70	99.83	325.73

Table 6.1 Cost Comparison for the Alternatives of Dam Axis

(Unit : US$)

Work Items	Dam Axis-A	Dam Axis-B	Dam Axis-C
Diversion Tunnel	10,256,600	9,687,600	9,159,100
Cofferdam	2,644,100	2,750,600	2,853,810
Main Dam	85,208,450	79,119,575	82,030,100
Spillway	12,073,650	13,728,600	14,248,350
Total	110,182,800	105,286,375	108,291,360
	104.65%	100%	102.85%

Table 6.2 Cost Comparison for the Alternatives of Dam Type

(Unit : US$)

Work Items	Concrete Gravity Dam	Concrete-facing Dam	RCC Dam	Rockfill Dam
Diversion Tunnel	2,620,950	9,687,600	2,620,950	9,850,100
Cofferdam	1,391,100	2,750,600	1,391,100	3,117,600
Main Dam	136,484,550	79,119,575	130,459,950	117,437,400
Spillway	6,627,000	13,728,600	6,627,000	13,728,600
Total	147,123,600	105,286,375	141,099,000	144,133,700
	139.74%	100%	134.01%	136.90%

Table 7.1 Major Construction Equipment (1/3)

Item No.	Description	Specification	Total Required Number
1	Bulldozer with ripper	32 ton	3
2	Bulldozer with ripper	21 ton	3
3	Bulldozer	21 ton	4
4	Bulldozer	11 ton	6
5	Wheel loader	5 m^3	10
6	Tractor shovel	2.3 m^3	12
7	Tractor shovel	1.2 m^3	3
8	Backhoe	0.6 m^3	3
9	Backhoe	0.3 m^3	2
10	Dump truck	32 ton	33
11	Dump truck	11 ton	34
12	Dump truck	8 ton	18
13	Dump truck	4 ton	4
14	Crawler drill	7 m^3/min	2
15	Crawler drill	10 m^3/min	9
16	Crawler drill	15 m^3/min	12
17	Air compressor	10 m^3/min	2
18	Air compressor	13.5 m^3/min	11
19	Air compressor	17 m^3/min	10
20	Vibrating roller	15 ton	2
21	Vibrating roller	10 ton	1
22	Vibrating roller	4 ton	2
23	Vibrating roller	1 ton	2
24	Tire roller	20 ton	1
25	Tamping roller	13.5 ton	2
26	Tractor	15 ton	2
27	Crushing plant	100 ton/hr	2
28	Concrete plant	0.75m^3 x 2	2
29	Concrete plant	1.0 m^3 x 2	1
30	Agitator truck	4.5 m^3	4
31	Agitator truck	3.2 m^3	19
32	Concrete bucket	1.0 m^3	6

Table 7.1 Major Construction Equipment (2/3)

Item No.	Description	Specification	Total Required Number
33	Concrete pump car	60 m^3/hr	5
34	Truck crane	30 ton	2
35	Truck crane	20 ton	2
36	Crawler crane	30 ton	1
37	Motor grader	3.7 m	1
38	Water sprinkler	5.5 klit	2
39	Trailer	20 ton	2
40	Rammer	80 kg	10
41	Compactor	100 kg	10
42	Concrete vibrator	55 mm	20
43	Boring machine	5.5 kW	14
44	Grout pump	7.5 kW	19
45	Grout pump	11 kW	10
46	Grout pump, low pressure	11 kW	3
47	Grout mixer	200 lit x 2	19
48	Grout mixer	300 lit x 2	4
49	Reinforcement trolley		1
50	Transfer trolley, reinforcement		1
51	Slipforming equipment	15 m wide	1
52	Slipforming equipment	7.5 m wide	1
53	Transfer trolley, slipform		1
54	Winch with 8 ton truck	22 kw	1
55	Ancillary trolley		2
56	Winch with 6 ton truck	22 kw	2
57	Truck, flat body	11 ton	2
58	Distributor	1000 lit	1
59	Drill jumbo, 7 boom-drifter		4
60	Drill jumbo, 9 boom-drifter		2
61	Drill jumbo, 7 boom-drifter, Truck		1
62	Muck loader	0.4 m^3	8
63	Muck loader, slide	0.6 m^3	6
64	Muck car	6 m^3	32
65	Battery locomotive	10 ton	8
66	Air compressor	22 m^3/min	12

Table 7.1 Major Construction Equipment (3/3)

Item No.	Description	Specification	Total Required Number
67	Vent fan	300 m^3/min	48
68	Vent fan	100 m^3/min	14
69	Leg hammer	2.7 m^3/min	20
70	Pick hammer	7 kg	30
71	Jack hammer	2.4 m^3/min	20
72	Stopper drill	2.7 m^3/min	4
73	Raise climber		1
74	Shotcrete spray gun		8
75	Presscrete	6 m^3	8
76	Battery locomotive	8 ton	8
77	Concrete vibrator	55 mm	50
78	Form vibrator	0.2 kW	40
79	Full-circular sliding form with needle beam, 5.4 m dia.	10.5 m	4
80	Arch sliding form, 6 m dia.	10.5 m	2
81	Muck loader, inclined	0.2 m^3	1
82	Side-dump tractor shovel	1.4 m^3	1
83	Muck car	3 m^3	2
84	Winch	100 kW	1
85	Winch	200 kW	1
86	Agitator car	3 m^3	2
87	Concrete pump	45 m^3/h	1
88	Overhead crane	10 ton	1

Table 7.2 Laboour Cost (Labour Wage)

Description	Unit	Foreign Currency (US$)	Local Currency (KShs.)
Foremen, foreign	M.D.	215	—
Foremen	M.D.	—	190
Mechanic	M.D.	—	190
Electrician	M.D.	—	190
Operator	M.D.	—	180
Assistant operator	M.D.	—	120
Driver	M.D.	—	160
Rigger	M.D.	—	140
Carpenter	M.D.	—	150
Formworker	M.D.	—	150
Concrete worker	M.D.	—	110
Driller	M.D.	—	150
Tunnel worker	M.D.	—	160
Mason	M.D.	—	150
Powderman	M.D.	—	160
Reinforcing worker	M.D.	—	150
Boring worker	M.D.	—	160
Grout worker	M.D.	—	160
Pavement worker	M.D.	—	120
Skilled worker	M.D.	—	150
Semi skilled worker	M.D.	—	120
Common labour	M.D.	—	90

Note: M.D. means man-day.

Table 7.3 Construction Material Cost

Description	Unit	Foreign Currency (US$)	Local Currency (KShs.)
Gasoline	litre	0.38	5.10
Light oil	litre	0.35	2.64
Lubricant	litre	2.02	7.53
Grease	kg	3.67	22.10
Heavy oil	litre	0.33	0.68
Portland cement	ton	53.51	1,152.30
Bitumen 80/100	kg	0.31	0.99
Bitumen MC30	litre	0.51	2.94
Emulsion	litre	0.39	2.28
Reinforcement	ton	418.26	8,584.00
Annealed wire	kg	0.99	20.30
H-shape steel	ton	642.86	0.00
Channel steel	ton	565.22	11,600.00
Steel plate	ton	565.22	11,600.00
Nail	kg	0.57	11.60
Dynamite	kg	5.22	73.28
ANFO	kg	0.70	0.80
Detonator	No	2.88	40.40
Timber, plank	m^3	0.00	5,120.00
Timber, square	m^3	0.00	6,182.00
Timber, log	m^3	0.00	5,120.00
Plywood	m^3	416.09	12,850.00
Bit, 65 mm	No	196.43	297.56
Rod	No	275.00	416.59
Sleeve	No	70.71	107.12
Shank rod	No	204.29	309.47
Bit, 36 mm	No	47.14	71.42
Taper rod, 2 m	No	70.71	107.12
Taper rod, 1.5 m	No	58.14	88.08
Insert bit, 36 mm, 1.7 m	No	102.93	155.92
Air entrain agent	kg	1.41	14.08
Water reduced agent	kg	2.36	23.47
Metal form, 300*1500	No	19.25	191.68
Metal form, 150*1500	No	15.32	152.57
Metal form, 100*1500	No	12.96	129.10
Pipe support	m	19.25	191.68
Portal frame	No	28.13	280.09
Metal bit	No	27.11	41.06
Diamond bit	carat	78.57	119.03
Boring rod, 40 mm	No	86.43	130.93
Scaffolding pipe	m	2.36	23.47
Air bubble agent	kg	5.50	54.77
Lozenge shape net	m^2	3.77	37.55
Waterstop, 200 mm	m	9.43	14.28
Waterstop, 300 mm	m	16.50	25.00
Jont filler, 20 mm	m^2	12.57	19.04
PVC pipe, 75 mm	m	4.56	45.38
Rock bolt	m	6.29	9.52
Wire mesh	m^2	1.96	19.56

Table 7.4 Equipment Cost (1/2)

Description	Unit	Foreign Currency (US$)	Local Currency (KShs.)
Bulldozer, 32 t	Hr	47.6	277.0
Bulldozer, 21 t	Hr	33.5	195.0
Bulldozer, 11 t	Hr	16.7	98.0
Bulldozer w/ripper, 32 t	Hr	52.9	319.0
Tractor, 15 t	Hr	19.8	116.0
Backhoe, 0.6 m^3	Hr	19.7	115.0
Backhoe, 0.2 m^3	Hr	10.1	57.0
Wheel loader, 5 m^3	Hr	68.3	399.0
Tractor shovel, 2.2 m^3	Hr	25.0	146.0
Tractor shovel, 1.2 m^3	Hr	13.4	75.0
Dump truck, 32 t	Hr	47.7	269.0
Dump truck, 11 t	Hr	11.4	64.0
Dump, truck, 8 t	Hr	8.0	45.0
Truck crane, 20 t	Hr	28.0	141.0
Truck crane, 30 t	Hr	41.1	208.0
Crawler drill, 10 m^3/min	Hr	18.4	95.0
Crawler drill, 15 m^3/min	Hr	20.7	107.0
Jack hammer, 20 kg	Day	6.2	20.0
Leg hammer, 30 kg	Day	8.3	26.0
Pick hammer, 7 kg	Day	1.1	4.0
Motor grader, 3.7 m	Hr	18.0	101.0
Tire roller, 20 t	Hr	11.6	59.0
Tamping roller, 13 t	Hr	15.0	76.0
Vibrating roller, 1 t	Hr	4.3	20.0
Vibrating roller, 4 t	Hr	9.1	51.0
Vibrating roller, 8-10 t	Hr	26.2	145.0
Vibrating roller, 15 t	Hr	40.5	224.0
Rammer, tamper, 90 kg	Day	6.3	27.0
Concrete plant, 0.75 m^3*2	Hr	75.0	388.0
Concrete plant, 1.0 m^3*2	Hr	87.1	451.0
Agitator truck, 3.2 m^3	Hr	12.2	72.0
Agitator truck, 4.4 m^3	Hr	14.6	82.0
Concrete pump, 45 m^3/hr	Hr	32.2	181.0
Air compressor, 7 m^3/min	Hr	83.8	423.0
Air compressor, 13.5 m^3/min	Hr	93.7	473.0
Air compressor, 17 m^3/min	Hr	95.2	481.0
Diesel generator, 100 kVA	Day	24.7	114.0
Diesel generator, 125 kVA	Day	32.9	152.0
Diesel generator, 250 kVA	Day	38.9	289.0
Concrete bucket, 1 m^3	Day	15.0	71.0
Concrete vibrator	Day	4.7	18.0
Form vibrator, 0.2 kW	Day	1.2	5.0
Concrete spray gun, 5 m^3/hr	Hr	8.1	40.0
Water sprinkler, 5.5 kl	Hr	7.6	43.0
Raise climber	m	166.0	859.0
Boring machine, 5.5 kW	Day	33.3	168.0
Boring machine, 11 kW	Day	62.3	314.0
Grout pump, 7.5 kW	Day	28.7	149.0
Grout pump, 11 kW	Day	35.8	185.0

Table 7.4 Equipment Cost (2/2)

Description	Unit	Foreign Currency (US$)	Local Currency (KShs.)
Grout mixer, 200*2, 2.2 kW	Day	14.8	77.0
Grout mixer, 300*2, 3.7 kW	Day	17.3	90.0
Drifter	Day	8.5	27.0
Leg drill,	Day	8.3	26.0
Guide shell	Day	16.6	52.0
Muck loader, side, 0.6 m^3	Hr	42.6	227.0
Vent fan, 3 kW	Day	2.4	11.0
Air compressor, 27 m^3/min^3	Hr	11.0	53.0
Muck loader, 0.4 m^3	Hr	36.6	194.0
Train loader	Day	68.5	371.0
Muck car, 6 m^3	Day	26.2	142.0
Muck car, 3 m^3	Day	18.5	100.0
Battery locomotive, 10 t	Hr	57.5	393.0
Battery locomotive, 8 t	Hr	41.1	281.0
Vent fan, 150 m^3/min	Day	14.7	66.0
Air compressor, 12 m^3/min	Hr	5.3	25.0
Air compressor, 16 m^3/min	Hr	8.6	41.0
Spray machine, 5-10 m^3/hr	Hr	28.0	145.0
Concrete placer, 3 m^3	Hr	26.2	125.0
Concrete placer, 6 m^3	Hr	40.9	195.0
Air compressor, 22 m^3/min	Hr	11.0	53.0
Muck car, 6 m^3	Day	26.2	142.0
Stoper drill, 2.7 m^3/min	Day	12.3	39.0
Jaw crusher, 25 t/hr	Hr	19.3	115.0
Impact crusher, 20 t/hr	Hr	8.9	53.0
Cone crusher, 20 t/hr	Hr	22.3	132.0
Rod mill, 20 t/hr	Hr	25.7	133.0
Screen, 20/5 mm	Hr	5.5	35.0
Classifier	Hr	5.6	32.0
Screen, 40 mm	Hr	4.1	26.0
Jaw crusher, 100 /hr	Hr	29.7	176.0
Screen, 100 mm	Hr	4.9	31.0
Impact crusher, 100 t/hr	Hr	26.8	159.0
Cone crusher, 50 t/hr	Hr	34.2	203.0
Screen, 40/20 mm	Hr	5.7	36.0
Screen, 5 mm	Hr	4.9	31.0
Muck loader, inclined 0.2 m^3	Hr	33.1	176.0
Muck car, 3 m^3	Day	18.5	100.0
Winch, 100 kW	Day	259.4	1,668.0
Winch, 200 kW	Day	503.6	3,237.0
Agitator car, 3 m^3	Hr	21.6	103.0

Table 7.5 Land Acquisition and Compensation

	Description	Amount (1,000 KShs)
1.	Reservoir	
	(a) Farm land	635,000
	(b) Schools and health facilities	5,000
	Subtotal	640,000
2.	Transmission line	4,000
3.	Road	160,000
	Total	804,000

Note: Detailed discussions on land acquisition are referred to in Appendix VI, Social Environmental Aspect.

Table 7.6 Construction Cost

Description	Foreign Currency (1,000 US$)	Local Currency (1,000 KShs.)	Total (1,000 KShs.)
1. Preparatory works	11,473.31	123,432	387,318
2. Civil works	114,733.12	1,234,319	3,873,181
3. Metal works	3,109.33	18,799	90,314
4. Generating equipment	36,727.63	80,259	924,994
5. Transmission line and substation equipment	10,955.85	85,904	337,889
Total (1 to 5)	176,999.24	1,542,713	5,613,696
6. Land aquisition and compensation	0.00	804,000	804,000
7. Administration expenses	0.00	28,068	28,068
8. Engineering services	21,477.00	63,048	557,019
Total (1 to 8)	198,476.24	2,437,829	7,002,783
9. Physical contingency	17,307.98	154,135	552,219
Total (1 to 9)	215,784.22	2,591,964	7,555,001
10. Price escalation	41,662.07	2,964,499	3,922,727
Grand total	257,446.29	5,556,463	11,477,728

Table 7.7 Detailed Construction Cost (1/3)

	Description	Foreign Currency (1,000 US$)	Local Currency (1,000 KShs.)	Total (1,000 KShs)
1.	Preparatory works	11,473.31	123,432	387,318
2.	Civil works			
2.1	Diversion tunnel	4,331.62	52,915	152,542
2.2	Cofferdam	2,089.89	16,139	64,206
2.3	Main dam	46,479.53	419,115	1,488,144
2.4	Saddle dam	2,465.56	21,549	78,257
2.5	Spillway	9,942.62	100,412	329,092
2.6	River outlet	198.37	3,230	7,793
2.7	Waterway			
	Intake & intake tunnel	2,175.53	26,697	76,734
	Headrace tunnel	21,836.98	266,493	768,744
	Intake gate shaft	720.98	10,609	27,192
	Surge tank	3,154.84	38,745	111,306
	Work adits	1,320.73	17,105	47,482
	Penstock	506.49	6,931	18,580
	Tailrace tunnel	6,216.33	75,149	218,125
	Subtotal (2.7)	35,931.88	441,729	1,268,162
2.8	Power station			
	Access tunnel	2,811.44	36,205	100,868
	Cable tunnel	274.76	3,455	9,774
	Underground powerhouse	2,772.58	41,819	105,588
	Gate chamber	75.22	1,180	2,910
	Tailrace surge tank	775.97	10,070	27,917
	Outdoor switchyard	289.40	4,227	10,883
	Subtotal (2.8)	6,999.37	96,956	257,942
2.9	Outlet channel	1,257.78	11,818	40,747
2.10	Architectural building	1,936.50	29,736	74,276
2.11	Access road	1,400.00	14,720	46,920
2.12	Base camp	1,700.00	26,000	65,100
	Total (2)	114,733.12	1,234,319	3,873,181

Table 7.7 Detailed Construction Cost (2/3)

Description	Foreign Currency (1,000 US$)	Local Currency (1,000 KShs.)	Total (1,000 KShs)
3. Metal works			
Diversion gate	189.32	1,050	5,404
River outlet valve	658.93	1,108	16,263
River outlet trashracks	37.50	287	1,150
Intake trashracks	97.50	747	2,990
Intake gate	566.53	2,970	16,000
Drain valve	214.83	332	5,273
Steel penstock	1,140.00	11,232	37,452
Draft tube gate	141.36	790	4,041
Tailrace gate	63.36	283	1,740
Total (3)	3,109.33	18,799	90,314
4. Generating equipment			
Turbines	9,363.90	19,880	235,250
Generators	8,916.70	23,664	228,748
Transformers	2,603.48	3,927	63,807
Switchgear & control equipment	5,199.20	14,278	133,860
Supervisory equipment	5,978.00	9,016	146,510
Ancillary equipment	1,265.04	2,540	31,636
Miscellaneous equipment	1,659.31	3,872	42,036
Transmission line protective relays	585.00	1,035	14,490
PLC communication	1,157.00	2,047	28,658
Total (4)	36,727.63	80,259	924,994

Table 7.7 Detailed Construction Cost (3/3)

Description	Foreign Currency (1,000 US$)	Local Currency (1,000 KShs.)	Total (1,000 KShs)
5. Transmission line and substation equipment			
5.1 Transmission line			
Magwagwa-Sondu/Miriu	924.30	9,650	30,909
Magwagwa-Chemosit	948.60	14,812	36,630
Magwagwa-Muhoroni	1,324.10	19,079	49,533
Muhoroni-Lessos	2,416.60	34,825	90,407
Subtotal (5.1)	5,613.60	78,366	207,479
5.2 Substation equipment			
Chemosit substation	1,507.75	2,122	36,800
Muhoroni substation	2,554.25	3,582	62,330
Lessos substation	1,280.25	1,834	31,280
Subtotal (5.2)	5,342.25	7,538	130,410
Total (5)	10,955.85	85,904	337,889
Total (1 to 5)	176,999.24	1,542,713	5,613,695
6. Land aquisition and compensation	0.00	804,000	804,000
7. Administration expenses	0.00	28,068	28,068
8. Engineering services			
8.1 Detailed design	6,955.00	4,105	164,070
8.2 Construction supervision	14,522.00	58,943	392,949
Total (8)	21,477.00	63,048	557,019
Total (1 to 8)	198,476.24	2,437,829	7,002,782
9. Physical contingency	17,307.98	154,135	552,219
Total (1 to 9)	215,784.22	2,591,964	7,555,001
10. Price escalation	41,662.07	2,964,499	3,922,727
Grand total	257,446.29	5,556,463	11,477,728

Table 7.8 Disbursement Schedule

Unit : 1,000US$
1,000KSh.

Work Items	Construction Cost		1992		1993		1994		1995		1996	
	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)
1. Preparatory works	11,473.31	123,432	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2. Civil works	114,733.12	1,234,319	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
3. Metal works	3,109.33	18,799	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
4. Generating equipment	36,727.63	80,259	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
5. Transmission line and substation equipment	10,955.85	85,904	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Total of (1 - 5)	176,999.24	1,542,713	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6. Land acquisition and compensation	0.00	804,000	0.00	0	0.00	0	0.00	0	0.00	321,600	0.00	482,400
7. Administration expenses	0.00	28,068	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
8. Engineering services	21,477.00	63,048	696.00	411	3,477.00	2,052	2,782.00	1,642	0.00	0	0.00	0
1) Detailed design	6,955.00	4,105	696.00	411	3,477.00	2,052	2,782.00	1,642	0.00	0	0.00	0
2) Supervision	14,522.00	58,943	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Total of (1 - 8)	198,476.24	2,437,829	696.00	411	3,477.00	2,052	2,782.00	1,642	0.00	321,600	0.00	482,400
9. Physical contingency	17,307.98	154,135	69.60	41	347.70	205	278.20	164	0.00	0	0.00	0
10% of (1+2+7+8)	14,768.34	144,887	69.60	41	347.70	205	278.20	164	0.00	0	0.00	0
5% of (3+4+5)	2,539.64	9,248	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Total of (1 - 9)	215,784.22	2,591,964	765.60	452	3,824.70	2,257	3,060.20	1,806	0.00	321,600	0.00	482,400
10. Price escalation	41,662.07	2,964,499	23.12	70	194.29	611	219.72	718	0.00	172,796	0.00	333,338
Grand Total	257,446.29	5,556,463	788.72	522	4,018.99	2,868	3,279.92	2,524	0.00	494,396	0.00	815,738

Work Items	1997		1998		1999		2000		2001		2002	
	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)	FC (US$)	LC (KSh.)
1. Preparatory works	7,342.92	78,996	4,130.39	44,436	0.00	0	0.00	0	0.00	0	0.00	0
2. Civil works	13,112.16	144,158	13,483.39	161,954	31,691.27	287,531	34,469.32	339,102	18,749.73	257,375	3,027.25	44,199
3. Metal works	0.00	0	0.00	0	621.87	0	0.00	0	2,176.53	13,159	310.93	5,640
4. Generating equipment	0.00	0	0.00	0	6,274.93	0	3,672.77	16,052	21,501.28	40,129	5,278.65	24,078
5. Transmission line and substation equipment	0.00	0	0.00	0	1,544.52	0	1,627.26	15,673	5,648.54	41,444	2,135.53	28,787
Total of (1 - 5)	20,455.08	223,154	17,613.78	206,390	40,332.59	287,531	39,769.35	370,827	48,076.08	352,107	10,752.36	102,704
		[0.1236]		[0.1089]		[0.2165]		[0.2290]		[0.2597]		[0.0823]
6. Land acquisition and compensation	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
7. Administration expenses	0.00	3,469	0.00	3,057	0.00	6,077	0.00	6,427	0.00	7,289	0.00	1,749
8. Engineering services	1,794.92	7,286	1,581.44	6,419	3,144.01	12,761	3,325.54	13,498	3,771.37	15,307	904.72	3,672
1) Detailed design	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2) Supervision	1,794.92	7,286	1,581.44	6,419	3,144.01	12,761	3,325.54	13,498	3,771.37	15,307	904.72	3,672
Total of (1 - 8)	22,250.00	233,909	19,195.22	215,866	43,476.60	306,369	43,094.89	390,752	51,847.45	374,703	11,657.08	108,125
9. Physical contingency	2,225.00	23,391	1,919.52	21,587	3,925.59	30,637	4,044.49	37,489	3,718.43	32,734	779.45	7,887
10% of (1+2+7+8)	2,225.00	23,391	1,919.52	21,587	3,503.53	30,637	3,779.49	35,903	2,252.11	27,997	393.20	4,962
5% of (3+4+5)	0.00	0	0.00	0	422.07	0	265.00	1,586	1,466.32	4,737	386.26	2,925
Total of (1 - 9)	24,475.00	257,300	21,114.74	237,453	47,402.19	337,006	47,139.38	428,241	55,565.88	407,437	12,436.53	116,012
10. Price escalation	3,362.86	221,304	3,382.58	248,423	8,693.56	421,527	9,757.85	631,998	12,846.83	702,177	3,181.26	231,537
Grand Total	27,837.86	478,604	24,497.32	485,876	56,095.75	758,533	56,897.23	1,060,239	68,412.71	1,109,614	15,617.79	347,549

Table 7.9 Breakdown of Construction Cost (1/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
1.	Preparatory works (General)	L.S.			11,473,312		123,431,957
2.	Civil works						
2.1	Diversion tunnel						
	Site clerance	m2	9,700	0.04	388	0.36	3,492
	Excavation,common	m3	25,300	2.73	69,069	22.01	556,853
	Excavation,weathered rock	m3	19,700	3.90	76,830	30.53	601,441
	Excavation,rock	m3	7,100	9.47	67,237	68.76	488,196
	Excavation,tunnel	m3	38,800	51.81	2,010,228	684.47	26,557,436
	Fill and backfill	m3	6,400	2.93	18,752	23.92	153,088
	Steel support	ton	75	1384.54	103,841	3138.57	235,393
	Rock bolt	m	11,100	20.11	223,221	126.67	1,406,037
	Anchor bar	m	1,600	8.93	14,288	65.95	105,520
	Shotcrete for tunnel	m2	5,400	16.50	89,100	135.01	729,054
	Shotcrete for slope protect	m2	120	12.73	1,528	155.45	18,654
	Concrete,structure	m3	2,300	49.51	113,873	680.33	1,564,759
	Concrete,tunnel	m3	8,900	54.05	481,045	763.10	6,791,590
	Concrete,plug	m3	2,500	54.05	135,125	763.10	1,907,750
	Formwork,structure	m2	3,100	2.17	6,727	328.06	1,016,986
	Formwork,tunnel	m2	27,200	14.01	381,072	94.29	2,564,688
	Reinforcement	ton	130	590.75	76,798	14768.73	1,919,935
	Consolidation grout	m	2,600	72.11	187,486	1064.73	2,768,298
	Curtain gruot	m	500	115.18	57,590	1733.77	866,885
	Backfill grout	m3	160	69.73	11,157	868.56	138,970
	Others(5%)	L.S.			206,268		2,519,751
	Subtotal of item 2.1				4,331,621		52,914,775
2.2	Cofferdam						
	Site clearance	m2	19,000	0.04	760	0.36	6,840
	Excavation,common	m3	69,000	2.41	166,290	19.33	1,333,770
	Excavation,weathered rock	m3	24,000	3.51	84,240	27.45	658,800
	Excavation,rock	m3	0	9.01	0	65.07	0
	Embankment,core	m3	22,900	4.75	108,775	37.48	858,292
	Embankment,filter	m3	7,600	11.08	84,208	93.19	708,244
	Embankment,randam,stockpile	m3	0	3.68	0	25.86	0
	Embankment,rock	m3	178,600	7.67	1,369,862	52.38	9,355,068
	Embankment,riprap	m3	15,500	11.37	176,235	158.05	2,449,775
	Others(5%)	L.S.			99,519		768,539
	Subtotal of item 2.2				2,089,889		16,139,328

Table 7.9 Breakdown of Construction Cost (2/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.3	Main dam						
	Site clearance	m2	148,000	0.04	5,920	0.36	53,280
	Excavation,common	m3	593,000	3.34	1,980,620	19.48	11,551,640
	Excavation,weathered rock	m3	57,000	4.79	273,030	32.48	1,851,360
	Excavation,rock	m3	0	9.41	0	64.70	0
	Excavation,trench,toe slab	m3	43,100	10.28	443,068	198.25	8,544,575
	Embankment,rock from quarry	m3	3,611,000	7.27	26,251,970	49.79	179,791,690
	Embankment,rock,stockpile	m3	300,000	4.13	1,239,000	28.63	8,589,000
	Embankment,transition	m3	143,600	8.77	1,259,372	92.04	13,216,944
	Embankment,riprap	m3	51,200	10.96	561,152	155.46	7,959,552
	Impervious fill	m3	68,600	4.36	299,096	34.47	2,364,642
	Fill and backfill	m3	232,000	2.93	679,760	23.92	5,549,440
	Concrete,structure	m3	2,700	50.05	135,135	703.36	1,899,072
	Pad concrete	m3	400	76.66	30,664	1529.96	611,984
	Concrete facing,toe slab	m3	3,300	51.35	169,455	710.46	2,344,518
	Conc.facing,filler/main slabs	m3	34,100	84.04	2,865,764	897.25	30,596,225
	Slope protect for transition	m2	71,800	3.41	244,838	26.44	1,898,392
	Formwork,structure,parapet	m2	5,200	2.17	11,284	328.06	1,705,912
	Formwork,toe slab	m2	5,300	2.17	11,501	328.06	1,738,718
	Reinforcement,structure	ton	90	562.62	50,636	14065.45	1,265,891
	Reinforcement,concrete facing	ton	3,740	590.75	2,209,405	14768.73	55,235,050
	Waterstop,PVC	m	2,400	25.49	61,176	77.17	185,208
	Waterstop,copper	m	7,800	89.49	698,022	205.83	1,605,474
	Anchor bar for toe slab	m	14,000	9.99	139,860	87.14	1,219,960
	Consolidation grout	m	2,800	55.38	155,064	690.04	1,932,112
	Curtain grout	m	41,200	92.44	3,808,528	1252.06	51,584,872
	Road pavement	m2	6,300	11.56	72,828	83.81	528,003
	Measuring apparatus(1%)	L.S.			436,571		3,938,235
	Quarry site,site clearance	m2	150,000	0.04	6,000	0.36	54,000
	Quarry site,spoil overburden	m3	75,000	2.22	166,500	17.89	1,341,750
	Others(5%)	L.S.			2,213,311		19,957,875
	Subtotal of item 2.3				46,479,530		419,115,374
2.4	Saddle dam						
	Site clearance	m2	125,900	0.04	5,036	0.36	45,324
	Excavation,common	m3	128,100	3.43	439,383	27.61	3,536,841
	Excavation,weathered rock	m3	14,300	4.70	67,210	37.06	529,958
	Excavation,rock	m3	0	10.36	0	75.98	0
	Embankment,impervious fill	m3	379,900	3.60	1,367,640	28.55	10,846,145
	Embankment,filter	m3	2,700	11.08	29,916	93.19	251,613
	Embankment,riprap	m3	27,300	11.37	310,401	158.05	4,314,765
	Fill and backfill	m3	6,500	2.93	19,045	23.92	155,480
	Road pavement	m2	4,500	11.56	52,020	83.81	377,145
	Borrow area,site clearance	m2	50,000	0.04	2,000	0.36	18,000
	Borrow area,spoil overburden	m3	25,000	2.22	55,500	17.89	447,250
	Others(5%)	L.S.			117,408		1,026,126
	Subtotal of item 2.4				2,465,559		21,548,647

Table 7.9 Breakdown of Construction Cost (3/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.5	Spillway						
	Site clearance	m2	80,000	0.04	3,200	0.36	28,800
	Excavation,common	m3	431,400	3.74	1,613,436	22.02	9,499,428
	Excavation,weathered rock	m3	229,100	5.25	1,202,775	35.39	8,107,849
	Excavation,rock	m3	322,200	10.99	3,540,978	74.16	23,894,352
	Fill and backfill	m3	3,500	2.93	10,255	23.92	83,720
	Concrete,structure	m3	44,500	50.38	2,241,910	685.88	30,521,660
	Backfill concrete	m3	1,800	48.56	87,408	673.23	1,211,814
	Formwork,structure	m2	23,000	2.17	49,910	328.06	7,545,380
	Reinforcement	ton	850	562.62	478,227	14065.45	11,955,633
	Consolidation grout	m	1,400	55.38	77,532	690.04	966,056
	Anchor bar	m	4,200	8.93	37,506	65.95	276,990
	Shotcrete for slope protect	m2	9,900	12.73	126,027	155.45	1,538,955
	Others(5%)	L.S.			473,458		4,781,532
	Subtotal of item 2.5				9,942,622		100,412,168
2.6	River outlet						
	Excavation,tunnel,chamber	m3	550	57.18	31,449	820.37	451,204
	Backfill in tunnel	m3	2,800	11.78	32,984	233.91	654,948
	Steel support	ton	10	1384.54	13,845	3138.57	31,386
	Rock bolt	m	350	20.11	7,039	126.67	44,335
	Anchor bar	m	300	8.93	2,679	65.95	19,785
	Shotcrete for tunnel	m2	250	16.50	4,125	135.01	33,753
	Concrete,structure	m3	420	50.96	21,403	710.40	298,368
	Concrete,tunnel,chamber	m3	210	59.46	12,487	839.41	176,276
	Concrete,plug	m3	500	54.05	27,025	763.10	381,550
	Formwork,structure	m2	1,300	2.17	2,821	328.06	426,478
	Formwork,tunnel	m2	400	11.82	4,728	150.70	60,280
	Reinforcement	ton	15	590.75	8,861	14768.73	221,531
	Consolidation grout	m	160	72.11	11,538	1064.73	170,357
	Backfill grout	m3	20	69.73	1,395	868.56	17,371
	Shotcrete for slope	m2	200	12.73	2,546	155.45	31,090
	Concrete removal	m3	70	57.18	4,003	820.37	57,426
	Others(5%)	L.S.			9,446		153,807
	Subtotal of item 2.6				198,373		3,229,943

Table 7.9 Breakdown of Construction Cost (4/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.7	Waterway						
2.7.1	Intake and intake tunnel						
	Site clearance	m2	1,500	0.04	60	0.36	540
	Excavation,common	m3	4,700	2.73	12,831	22.01	103,447
	Excavation,weathered rock	m3	9,400	3.90	36,660	30.53	286,982
	Excavation,rock	m3	5,300	9.47	50,191	68.76	364,428
	Excavation,tunnel	m3	16,600	54.77	909,182	660.19	10,959,154
	Fill and backfill	m3	18,800	2.93	55,084	23.92	449,696
	Steel support	ton	90	1384.54	124,609	3138.57	282,471
	Rock bolt	m	0	20.11	0	126.67	0
	Shotcrete for tunnel	m2	0	16.50	0	135.01	0
	Concrete,structure	m3	1,600	49.51	79,216	680.33	1,088,528
	Concrete,tunnel	m3	5,100	63.75	325,125	828.16	4,223,616
	Reinforcement	ton	100	590.75	59,075	14768.73	1,476,873
	Formwork,structure	m2	2,100	2.17	4,557	328.06	688,926
	Formwork,tunnel	m2	9,400	11.00	103,400	104.38	981,172
	Anchor bar	m	670	8.93	5,983	65.95	44,187
	Shotcrete for slope protect	m2	500	12.73	6,365	155.45	77,725
	Consolidation grout	m	4,000	72.11	288,440	1064.73	4,258,920
	Curtain grout	m	0	115.18	0	1733.77	0
	Backfill grout	m3	160	69.73	11,157	868.56	138,970
	Others(5%)	L.S.			103,597		1,271,282
	Subtotal of item 2.7.1				2,175,531		26,696,916
2.7.2	Headrace tunnel						
	Excavation,tunnel	m3	208,700	54.77	11,430,499	660.19	137,781,653
	Steel support	ton	350	1384.54	484,589	3138.57	1,098,500
	Rock bolt	m	22,200	20.11	446,442	126.67	2,812,074
	Shotcrete for tunnel	m2	13,500	16.50	222,750	135.01	1,822,635
	Concrete,tunnel	m3	55,500	63.75	3,538,125	828.16	45,962,880
	Formwork,tunnel	m2	120,500	11.00	1,325,500	104.38	12,577,790
	Reinforcement	ton	430	590.75	254,023	14768.73	6,350,554
	Consolidation grout	m	38,400	72.11	2,769,024	1064.73	40,885,632
	Curtain grout	m	1,500	115.18	172,770	1733.77	2,600,655
	Backfill grout	m3	2,200	69.73	153,406	868.56	1,910,832
	Others(5%)	L.S.			1,039,856		12,690,160
	Subtotal of item 2.7.2				21,836,984		266,493,365

Table 7.9 Breakdown of Construction Cost (5/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.7.3	Intake gate shaft						
	Site clearance	m2	500	0.04	20	0.36	180
	Excavation,common	m3	1,000	3.08	3,080	24.82	24,820
	Excavation,weathered rock	m3	1,300	4.31	5,603	33.90	44,070
	Excavation,rock	m3	1,000	9.92	9,920	72.38	72,380
	Excavation,shaft	m3	3,900	65.34	254,826	865.10	3,373,890
	Excavation,tunnel	m3	1,200	54.77	65,724	660.19	792,228
	Fill and backfill	m3	0	2.93	0	23.92	0
	Steel support	ton	20	1384.54	27,691	3138.57	62,771
	Rock bolt	m	750	20.11	15,083	126.67	95,003
	Shotcrete for shaft,tunnel	m2	450	16.50	7,425	135.01	60,755
	Concrete,structure	m3	400	49.51	19,804	680.33	272,132
	Concrete,shaft	m3	2,200	53.36	117,392	735.78	1,618,716
	Concrete,tunnel	m3	650	63.75	41,438	828.16	538,304
	Formwork,structure	m2	400	2.17	868	328.06	131,224
	Formwork,shaft	m2	2,200	2.60	5,720	379.98	835,956
	Formwork,tunnel	m2	600	11.82	7,092	150.70	90,420
	Reinforcement	ton	100	590.75	59,075	14768.73	1,476,873
	Consolidation grout	m	450	72.11	32,450	1064.73	479,129
	Backfill grout	m3	30	69.73	2,092	868.56	26,057
	Anchor bar	m	700	8.93	6,251	65.95	46,165
	Shotcrete for slope protect	m2	400	12.73	5,092	155.45	62,180
	Others(5%)	L.S.			34,332		505,163
	Subtotal of item 2.7.3				720,976		10,608,414
2.7.4	Surge tank						
	Site clearance	m2	2,300	0.04	92	0.36	828
	Excavation,common	m3	1,200	3.77	4,524	30.32	36,384
	Excavation,weathered rock	m3	5,300	5.11	27,083	40.39	214,067
	Excavation,rock	m3	11,600	10.81	125,396	79.59	923,244
	Excavation,shaft	m3	30,400	60.46	1,837,984	679.25	20,649,200
	Excavation,tunnel	m3	1,900	54.77	104,063	660.19	1,254,361
	Fill and backfill	m3	100	2.93	293	23.92	2,392
	Steel support	ton	60	1384.54	83,072	3138.57	188,314
	Rock bolt	m	3,800	20.11	76,418	126.67	481,346
	Shotcrete for shaft,tunnel	m2	2,150	16.50	35,475	135.01	290,272
	Concrete,structure	m3	150	50.82	7,623	690.09	103,514
	Concrete,shaft	m3	6,400	54.66	349,824	745.54	4,771,456
	Concrete,tunnel	m3	160	63.75	10,200	828.16	132,506
	Plug concrete	m3	1,300	54.05	70,265	763.10	992,030
	Formwork,structure	m2	300	2.17	651	328.06	98,418
	Formwork,shaft	m2	5,300	2.60	13,780	379.98	2,013,894
	Formwork,tunnel	m2	100	11.82	1,182	150.70	15,070
	Reinforcement	ton	160	590.75	94,520	14768.73	2,362,997
	Consolidation grout	m	2,150	72.11	155,037	1064.73	2,289,170
	Backfill grout	m3	10	69.73	697	868.56	8,686
	Anchor bar	m	150	8.93	1,340	65.95	9,893
	Shotcrete for slope protect	m2	400	12.73	5,092	155.45	62,180
	Others(5%)	L.S.			150,231		1,845,011
	Subtotal of item 2.7.4				3,154,841		38,745,230

Table 7.9 Breakdown of Construction Cost (6/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.7.5	Work adits						
	Site clearance	m2	400	0.04	16	0.36	144
	Excavation,common	m3	2,300	3.08	7,084	24.82	57,086
	Excavation,weathered rock	m3	1,400	4.31	6,034	33.90	47,460
	Excavation,rock	m3	900	9.92	8,928	72.38	65,142
	Excavation,tunnel	m3	7,100	51.81	367,851	684.47	4,859,737
	Excavation,inclined tunnel	m3	3,500	57.48	201,180	756.99	2,649,465
	Fill and backfill	m3	1,400	2.93	4,102	23.92	33,488
	Steel support	ton	20	1384.54	27,691	3138.57	62,771
	Rock bolt	m	3,900	20.11	78,429	126.67	494,013
	Shotcrete for tunnel	m2	2,340	16.50	38,610	135.01	315,923
	Concrete,structure	m3	900	50.16	45,144	685.40	616,860
	Concrete,tunnel	m3	1,530	57.66	88,220	774.89	1,185,582
	Concrete,inclined tunnel	m3	1,570	63.75	100,088	828.16	1,300,211
	Concree,plug	m3	1,800	54.05	97,290	763.10	1,373,580
	Formwork,structure	m2	1,100	2.17	2,387	328.06	360,866
	Formwork,tunnel	m2	4,600	11.82	54,372	150.70	693,220
	Formwork,inclined tunnel	m2	1,200	11.82	14,184	150.70	180,840
	Reinforcement	ton	50	590.75	29,538	14768.73	738,437
	Consolidation grout	m	1,100	72.11	79,321	1064.73	1,171,203
	Backfill grout	m3	50	69.73	3,487	868.56	43,428
	Anchor bar	m	150	8.93	1,340	65.95	9,893
	Shotcrete for slope protect	m2	200	12.73	2,546	155.45	31,090
	Others(5%)	L.S.			62,892		814,522
	Subtotal of item 2.7.5				1,320,732		17,104,961
2.7.6	Penstock						
	Excavation,shaft	m3	2,800	67.12	187,936	925.41	2,591,148
	Excavation,tunnel	m3	760	55.88	42,469	766.81	582,776
	Shotcrete	m2	900	16.50	14,850	135.01	121,509
	Rock bolt	m	1,300	20.11	26,143	126.67	164,671
	Steel support	ton	15	1384.54	20,768	3138.57	47,079
	Concrete,tunnel	m3	250	54.05	13,513	763.10	190,775
	Backfill concrete,shaft	m3	1,150	59.46	68,379	839.41	965,322
	Backfill concrete,tunnel	m3	400	59.46	23,784	839.41	335,764
	Slab concrete,tunnel	m3	40	54.05	2,162	763.10	30,524
	Formwork,tunnel	m2	250	11.82	2,955	150.70	37,675
	Reinforcement	ton	60	590.75	35,445	14768.73	886,124
	Consolidation grout	m	600	72.11	43,266	1064.73	638,838
	Backfill grout	m3	10	69.73	697	868.56	8,686
	Others(5%)	L.S.			24,118		330,044
	Subtotal of item 2.7.6				506,485		6,930,934

Table 7.9 Breakdown of Construction Cost (7/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.7.7	Tailrace tunnel						
	Site clearance	m2	400	0.04	16	0.36	144
	Excavation,common	m3	800	3.08	2,464	24.82	19,856
	Excavation,weathered rock	m3	2,600	4.31	11,206	53.90	140,140
	Excavation,rock	m3	4,600	9.92	45,632	72.38	332,948
	Excavation,tunnel	m3	57,800	54.77	3,165,706	660.19	38,158,982
	Steel support	ton	160	1384.54	221,526	3138.57	502,171
	Rock bolt	m	4,500	20.11	90,495	126.67	570,015
	Shotcrete for tunnel	m2	2,900	16.50	47,850	135.01	391,529
	Concrete,structure	m3	700	50.16	35,112	685.40	479,780
	Concrete,tunnel	m3	16,100	63.08	1,015,588	822.20	13,237,420
	Formwork,structure	m2	550	2.17	1,194	328.06	180,433
	Formwork,tunnel	m2	32,500	11.00	357,500	104.38	3,392,350
	Reinforcement	ton	100	590.75	59,075	14768.73	1,476,873
	Consolidation grout	m	11,400	72.11	822,054	1064.73	12,137,922
	Backfill grout	m3	600	69.73	41,838	868.56	521,136
	Anchor bar	m	200	8.93	1,786	65.95	13,190
	Shotcrete,slope protection	m2	100	12.73	1,273	155.45	15,545
	Others(5%)	L.S.			296,016		3,578,522
	Subtotal of item 2.7.7				6,216,331		75,148,956
	Subtotal of item 2.7				35,931,880		441,728,775
2.8	Power station						
2.8.1	Access tunnel						
	Site clearance	m2	600	0.04	24	0.36	216
	Excavation,common	m3	500	3.08	1,540	24.82	12,410
	Excavation,weathered rock	m3	700	4.31	3,017	33.90	23,730
	Excavation,rock	m3	800	9.92	7,936	72.38	57,904
	Excavation,tunnel	m3	41,000	56.99	2,336,590	752.92	30,869,720
	Steel support	ton	35	1384.54	48,459	3138.57	109,850
	Rockbolt	m	3,000	20.11	60,330	126.67	380,010
	Shotcrete for tunnel	m2	2,400	16.50	39,600	135.01	324,024
	Concrete,structure	m3	200	50.16	10,032	685.40	137,080
	Concrete,tunnel	m3	1,450	59.46	86,217	839.41	1,217,145
	Formwork,structure	m2	400	2.17	868	328.06	131,224
	Formwork,tunnel	m2	2,600	14.01	36,426	94.29	245,154
	Reinforcement	ton	50	590.75	29,538	14768.73	738,437
	Consolidation grout	m	180	72.11	12,980	1064.73	191,651
	Backfill grout	m3	20	69.73	1,395	868.56	17,371
	Anchor bar	m	150	8.93	1,340	65.95	9,893
	Shotcrete,slope protection	m2	100	12.73	1,273	155.45	15,545
	Others(5%)	L.S.			133,878		1,724,068
	Subtotal of item 2.8.1				2,811,441		36,205,431

Table 7.9 Breakdown of Construction Cost (8/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.8.2	Cable tunnel						
	Site clearance	m2	250	0.04	10	0.36	90
	Excavation,common	m3	300	3.08	924	24.82	7,446
	Excavation,weathered rock	m3	500	4.31	2,155	33.90	16,950
	Excavation,rock	m3	400	9.92	3,968	72.38	28,952
	Excavation,tunnel	m3	3,000	57.48	172,440	756.99	2,270,970
	Steel support	ton	10	1384.54	13,845	3138.57	31,386
	Rockbolt	m	300	20.11	6,033	126.67	38,001
	Shotcrete for tunnel	m2	1,100	16.50	18,150	135.01	148,511
	Concrete,structure	m3	150	50.16	7,524	685.40	102,810
	Concrete,tunnel	m3	230	63.75	14,663	828.16	190,477
	Formwork,structure	m2	300	2.17	651	328.06	98,418
	Formwork,tunnel	m2	550	11.82	6,501	150.70	82,885
	Reinforcement	ton	10	590.75	5,908	14768.73	147,687
	Consolidation grout	m	100	72.11	7,211	1064.73	106,473
	Backfill grout	m3	10	69.73	697	868.56	8,686
	Anchor bar	m	40	8.93	357	65.95	2,638
	Shotcrete,slope protection	m2	50	12.73	637	155.45	7,773
	Others(5%)	L.S.			13,084		164,508
	Subtotal of item 2.8.2				274,757		3,454,659
2.8.3	Underground powerhouse						
	Excavation,underground	m3	34,000	36.06	1,226,040	407.38	13,850,920
	Shotcrete	m2	4,800	16.50	79,200	135.01	648,048
	Rock bolt	m	6,000	22.12	132,720	139.34	836,040
	PC anchor	m	6,400	35.01	224,064	208.34	1,333,376
	Concrete,underground	m3	9,700	56.75	550,475	801.26	7,772,222
	Second stage concrete	m3	2,700	56.75	153,225	801.26	2,163,402
	Formwork,underground	m2	23,200	2.17	50,344	328.06	7,610,992
	Reinforcement	ton	380	590.75	224,485	14768.73	5,612,117
	Others(5%)	L.S.			132,028		1,991,356
	Subtotal of item 2.8.3				2,772,581		41,818,473
2.8.4	Gate chamber						
	Excavation,tunnel	m3	200	55.88	11,176	766.81	153,362
	Excavation,shaft	m3	120	111.52	13,382	2424.33	290,920
	Steel support	ton	5	1384.54	6,923	3138.57	15,693
	Rock bolt	m	150	20.11	3,017	126.67	19,001
	Shotcrete for tunnel	m2	200	16.50	3,300	135.01	27,002
	Concrete,tunnel	m3	70	59.46	4,162	839.41	58,759
	Concrete,shaft	m3	60	59.46	3,568	839.41	50,365
	Formwork,tunnel	m2	250	11.82	2,955	150.70	37,675
	Formwork,shaft	m2	300	2.60	780	379.98	113,994
	Reinforcement	ton	5	590.75	2,954	14768.73	73,844
	Consolidation grout	m	250	72.11	18,028	1064.73	266,183
	Backfill grout	m3	20	69.73	1,395	868.56	17,371
	Others(5%)	L.S.			3,582		56,208
	Subtotal of item 2.8.4				75,220		1,180,375

Table 7.9 Breakdown of Construction Cost (9/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.8.5	Tailrace surge tank						
	Excavation,underground	m3	10,300	56.62	583,186	678.53	6,988,859
	Steel support	ton	6	1384.54	8,307	3138.57	18,831
	Rock bolt	m	50	20.11	1,006	126.67	6,334
	Shotcrete for tunnel	m2	1,000	16.50	16,500	135.01	135,010
	Concrete,underground	m3	1,600	59.46	95,136	839.41	1,343,056
	Formwork,underground	m2	1,000	2.60	2,600	379.98	379,980
	Reinforcement	ton	40	590.75	23,630	14768.73	590,749
	Consolidation grout	m	120	72.11	8,653	1064.73	127,768
	Others(5%)	L.S.			36,951		479,529
	Subtotal of item 2.8.5				775,969		10,070,116
2.8.6	Outdoor switchyard						
	Site clearance	m2	11,500	0.04	460	0.36	4,140
	Excavation,common	m3	7,500	2.41	18,075	19.33	144,975
	Excavation,weathered rock	m3	16,500	3.51	57,915	27.45	452,925
	Excavation,rock	m3	6,000	9.01	54,060	65.07	390,420
	Embankment	m3	2,400	3.60	8,640	28.55	68,520
	Fill and backfill	m3	700	2.93	2,051	23.92	16,744
	Rockbolt	m	200	20.11	4,022	126.67	25,334
	Anchor bar	m	300	8.93	2,679	65.95	19,785
	Concrete,structure	m3	1,400	48.56	67,984	673.23	942,522
	Formwork,structure	m2	2,500	2.17	5,425	328.06	820,150
	Reinforcement	ton	30	562.62	16,879	14065.45	421,964
	Shotcrete for slope protect	m2	250	12.73	3,183	155.45	38,863
	Wet rubble masonry	m2	300	17.38	5,214	324.86	97,458
	Gravel bedding	m3	450	11.78	5,301	233.91	105,260
	Road pavement	m2	400	11.56	4,624	83.81	33,524
	Fence	m	500	35.03	17,515	812.10	406,050
	Gate	L.S.			1,590		36,900
	Others(5%)	L.S.			13,781		201,277
	Subtotal of item 2.8.6				289,397		4,226,809
	Subtotal of item 2.8				6,999,365		96,955,864
2.9	Outlet channel						
	Site clearance	m2	19,000	0.04	760	0.36	6,840
	Excavation,common	m3	35,600	2.41	85,796	19.33	688,148
	Excavation,weathered rock	m3	47,200	3.51	165,672	27.45	1,295,640
	Excavation,rock	m3	78,700	9.01	709,087	65.07	5,121,009
	Fill and backfill	m3	7,000	2.93	20,510	23.92	167,440
	Concrete,structure	m3	1,400	50.00	70,000	703.30	984,620
	Formwork,structure	m2	800	2.17	1,736	328.06	262,448
	Reinforcement	ton	50	562.62	28,131	14065.45	703,273
	Shotcrete for slope protect	m2	1,000	12.73	12,730	155.45	155,450
	Wet rubble masonry	m2	3,000	17.34	52,020	324.86	974,580
	Anchor bar	m	2,100	8.93	18,753	65.95	138,495
	Fence	m	1400	23.35	32,690	541.40	757,960
	Others(5%)	L.S.			59,894		562,795
	Subtotal of item 2.9				1,257,779		11,818,698

Table 7.9 Breakdown of Construction Cost (10/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
2.10	Architectural building						
	Powerhouse	m2	1,200	700.00	840,000	10700.00	12,840,000
	Diesel generator house	m2	100	440.00	44,000	7000.00	700,000
	Guard house,dam site	m2	100	650.00	65,000	10000.00	1,000,000
	Guard house,powerhouse	m2	120	650.00	78,000	10000.00	1,200,000
	Intake gate shaft house	m2	80	400.00	32,000	6200.00	496,000
	Control house	m2	1,350	650.00	877,500	10000.00	13,500,000
	Subtotal of item 2.10				1,936,500		29,736,000
2.11	Access road						
	Access to main dam	m	3,000	170.00	510,000	1980.00	5,940,000
	Access to powerhouse	m	200	170.00	34,000	1980.00	396,000
	Access to surge tank	m	800	170.00	136,000	1980.00	1,584,000
	Improvement of existing road	m	8,000	90.00	720,000	850.00	6,800,000
	Subtotal of item 2.11				1,400,000		14,720,000
2.12	Base camp	L.S.			1,700,000		26,000,000
	Total (2)				114,733,118		1,234,319,573
3.	Metal works						
	Diversion gate	L.S.			189,321		1,050,000
	River outlet valve	L.S.			658,929		1,108,000
	River outlet trashracks	L.S.			37,500		287,000
	Intake trashracks	L.S.			97,500		747,000
	Intake gate	L.S.			566,536		2,970,000
	Drain valve(headrace tunnel)	L.S.			214,829		332,000
	Steel penstock	L.S.			1,140,000		11,232,000
	Draft tube gate	L.S.			141,357		790,000
	Tailrace gate	L.S.			63,357		283,000
	Total (3)				3,109,329		18,799,000
4.	Generating equipment						
	Turbines	L.S.			9,363,900		19,880,280
	Generators	L.S.			8,916,700		23,663,550
	Transformers	L.S.			2,603,480		3,926,560
	Switchgear & control equipment	L.S.			5,199,200		14,278,400
	Supervisory equipment	L.S.			5,978,000		9,016,000
	Ancillary equipment	L.S.			1,265,040		2,540,120
	Miscellaneous materials	L.S.			1,659,312		3,871,728
	Transmission line protective relays	L.S.			585,000		1,035,000
	PLC communication	L.S.			1,157,000		2,047,000
	Total (4)				36,727,632		80,258,638

Table 7.9 Breakdown of Construction Cost (11/11)

Item No.	Work	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
				Unit Price	Amount	Unit Price	Amount
5	Transmission line and Substation equipment						
5.1	Transmission line						
	Magwagwa-Sondu/Miriu	L.S.			924,300		9,650,500
	Magwagwa-Chemosit	L.S.			948,600		14,811,700
	Magwagwa-Muhoroni	L.S.			1,324,100		19,078,800
	Muhoroni-Lessos	L.S.			2,416,600		34,825,000
	Subtotal of item 5.1				5,613,600		78,366,000
5.2	Substation equipment						
	Chemosit substation	L.S.			1,507,750		2,121,750
	Muhoroni substation	L.S.			2,554,250		3,582,250
	Lessos substation	L.S.			1,280,250		1,834,250
	Subtotal of item 5.2				5,342,250		7,538,250
	Total (5)				10,955,850		85,904,250
	Total(1 to 5)				176,999,241		1,542,713,418
6.	Land aquisition and compensation	L.S.			0		804,000,000
7.	Administration expenses	L.S.			0		28,068,000
8.	Engineering services						
8.1	Detailed design	L.S.			6,955,000		4,105,000
8.2	Construction supervision	L.S.			14,522,000		58,943,000
	Total (8)				21,477,000		63,048,000
	Total(1 to 8)				198,476,241		2,437,829,418
9.	Physical contengency	L.S.			17,307,980		154,135,000
	Total(1 to 9)				215,784,221		2,591,964,418
10.	Price escalation	L.S.			41,662,070		2,964,499,000
	Grand Total				257,446,291		5,556,463,418

Table 8.1 Cash Flow for Economic Evaluation

Unit : million US$

No.	Year	Capital Cost			OM cost			Total	Benefit			Total	SONDU B-C	MAGWA B-C	KANO B-C	S+M B-C	M+K B-C	S+M+K B-C
		SONDU	MAGWA	KANO	SONDU	MAGWA	KANO		SONDU	MAGWA	KANO							
0	1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1993	14.70	3.25	0	0	0	0	17.95	0	0	0	0.00	-14.70	-3.25	0.00	-17.95	-3.25	-17.95
2	1994	34.30	2.6	0	0	0	0	36.90	0	0	0	0.00	-34.30	-2.60	0.00	-36.90	-2.60	-36.90
3	1995	39.20	11.59	0.00	0	0	0	50.79	0	0	0	0.00	-39.20	-11.59	0.00	-50.79	-11.59	-50.79
4	1996	9.80	17.39	0.00	0	0	0	27.19	0	0	0	0.00	-9.80	-17.39	0.00	-27.19	-17.39	-27.19
5	1997		29.56	5.75	0.98	0	0.00	36.29	16.01	0.00	0.00	16.01	15.03	-29.56	-5.75	-14.53	-35.31	-20.28
6	1998		26.06	13.42	0.98	0	0.00	40.46	16.01	0.00	0.00	16.01	15.03	-26.06	-13.42	-11.03	-39.48	-24.45
7	1999		51.44	28.76	0.98	0	0.00	81.18	16.01	0.00	0.00	16.01	15.03	-51.44	-28.76	-36.41	-80.20	-65.16
8	2000		54.51	38.34	0.98	0.00	0.00	93.83	16.01	0.00	0.00	16.01	15.03	-54.51	-38.34	-39.48	-92.85	-77.82
9	2001		60.75	38.34	0.98	0.00	0.00	100.07	16.01	0.00	8.43	24.44	15.03	-60.75	-29.91	-45.72	-90.67	-75.63
10	2002		14.49	38.34	0.98	0.00	1.20	55.01	16.01	0.00	16.85	32.86	15.03	-14.49	-22.69	0.54	-37.18	-22.15
11	2003			28.76	0.98	3.28	2.40	35.41	16.01	61.71	25.28	103.00	15.03	58.43	-5.88	73.46	52.55	67.59
12	2004				0.98	3.28	3.59	7.85	16.01	61.71	33.70	111.42	15.03	58.43	30.11	73.46	88.54	103.57
13	2005				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
14	2006				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
15	2007				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
16	2008				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
17	2009				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
18	2010				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
19	2011				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
20	2012				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
21	2013				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
22	2014				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
23	2015				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
24	2016				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
25	2017				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
26	2018				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
27	2019				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
28	2020				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
29	2021				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
30	2022				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
31	2023				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
32	2024				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
33	2025				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
34	2026				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
35	2027				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
36	2028				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
37	2029				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
38	2030				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
39	2031				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
40	2032				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
41	2033				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
42	2034				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
43	2035				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
44	2036				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
45	2037				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
46	2038				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
47	2039		6.31		0.98	3.28	4.79	15.36	16.01	61.71	33.70	111.42	15.03	52.12	28.91	67.15	81.03	96.06
48	2040		3.96		0.98	3.28	4.79	13.01	16.01	61.71	33.70	111.42	15.03	54.47	28.91	69.50	83.38	98.41
49	2041		21.91		0.98	3.28	4.79	30.96	16.01	61.71	33.70	111.42	15.03	36.52	28.91	51.55	65.43	80.46
50	2042		5.77		0.98	3.28	4.79	14.82	16.01	61.71	33.70	111.42	15.03	52.66	28.91	67.69	81.57	96.60
51	2043				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37
52	2044				0.98	3.28	4.79	9.05	16.01	61.71	33.70	111.42	15.03	58.43	28.91	73.46	87.34	102.37

Table 8.2 Financial Cash Flow

Unit : million US$

No.	Year	CAPITAL COST	O & M COST	INCREMENT REVENUE (*)	NET FINANCIAL REVENUE
1	1992	0.79			-0.79
2	1993	3.92			-3.92
3	1994	3.14			-3.14
4	1995	13.98			-13.98
5	1996	20.97			-20.97
6	1997	35.67			-35.67
7	1998	31.43			-31.43
8	1999	62.05			-62.05
9	2000	65.76			-65.76
10	2001	73.29			-73.29
11	2002	17.48			-17.48
12	2003		4.99	40.16	35.17
13	2004		4.99	40.16	35.17
14	2005		4.99	40.16	35.17
15	2006		4.99	40.16	35.17
16	2007		4.99	40.16	35.17
17	2008		4.99	40.16	35.17
18	2009		4.99	40.16	35.17
19	2010		4.99	40.16	35.17
20	2011		4.99	40.16	35.17
21	2012		4.99	40.16	35.17
22	2013		4.99	40.16	35.17
23	2014		4.99	40.16	35.17
24	2015		4.99	40.16	35.17
25	2016		4.99	40.16	35.17
26	2017		4.99	40.16	35.17
27	2018		4.99	40.16	35.17
28	2019		4.99	40.16	35.17
29	2020		4.99	40.16	35.17
30	2021		4.99	40.16	35.17
31	2022		4.99	40.16	35.17
32	2023		4.99	40.16	35.17
33	2024		4.99	40.16	35.17
34	2025		4.99	40.16	35.17
35	2026		4.99	40.16	35.17
36	2027		4.99	40.16	35.17
37	2028		4.99	40.16	35.17
38	2029		4.99	40.16	35.17
39	2030		4.99	40.16	35.17
40	2031		4.99	40.16	35.17
41	2032		4.99	40.16	35.17
42	2033		4.99	40.16	35.17
43	2034		4.99	40.16	35.17
44	2035		4.99	40.16	35.17
45	2036		4.99	40.16	35.17
46	2037		4.99	40.16	35.17
47	2038		4.99	40.16	35.17
48	2039	7.60	4.99	40.16	27.57
49	2040	4.77	4.99	40.16	30.40
50	2041	26.40	4.99	40.16	8.77
51	2042	6.95	4.99	40.16	28.22
52	2043		4.99	40.16	35.17
53	2044		4.99	40.16	35.17
54	2045		4.99	40.16	35.17
55	2046		4.99	40.16	35.17
56	2047		4.99	40.16	35.17
57	2048		4.99	40.16	35.17
58	2049		4.99	40.16	35.17
59	2050		4.99	40.16	35.17
60	2051		4.99	40.16	35.17
61	2052		4.99	40.16	35.17

FIRR : 11.14%

*) The average tariff as of November, 1990 is US$0.060/KWh

Table 8.3 Loan Repayability

(Unit : million US$)

Year	FOREIGN LOAN: Loan Disbursement Capital	IDC*	Cumulative Debt	Repayment: Interest	Principal	Total	EXPENDITURE BY GOVERNMENT: Capital Costs	OMR* Costs	TOTAL EXPENDITURE	ANNUAL REVENUE	SURPLUS OR DEFICIT	CUMULATIVE SURPLUS (DEFICIT)
1	0.81	0.02	0.83				0.01		0.01	0.00	-0.01	-0.01
2	4.09	0.12	5.04				0.04		0.04	0.00	-0.04	-0.05
3	3.35	0.21	8.60				0.04		0.04	0.00	-0.04	-0.09
4	0.00	0.22	8.82				21.50		21.50	0.00	-21.50	-21.59
5	0.00	0.22	9.04				35.50		35.50	0.00	-35.50	-57.09
6	41.65	1.28	51.97				7.00		7.00	0.00	-7.00	-64.09
7	38.51	2.29	92.77				7.11		7.11	0.00	-7.11	-71.20
8	77.97	4.32	175.06				11.09		11.09	0.00	-11.09	-82.29
9	87.49	6.64	269.19				15.51		15.51	0.00	-15.51	-97.80
10	100.43	9.35	378.98				16.23		16.23	0.00	-16.23	-114.03
11	25.65	10.24	414.87	10.37	16.24	26.61	5.08		31.70	0.00	-31.70	-145.73
12			398.63	9.97	16.65	26.61		4.99	31.60	40.16	8.56	-137.17
13			381.98	9.55	17.06	26.61		4.99	31.60	40.16	8.56	-128.61
14			364.92	9.12	17.49	26.61		4.99	31.60	40.16	8.56	-120.05
15			247.43	8.69	17.93	26.61		4.99	31.60	40.16	8.56	-111.49
16			329.50	8.24	18.37	26.61		4.99	31.60	40.16	8.56	-102.93
17			311.12	7.78	18.83	26.61		4.99	31.60	40.16	8.56	-94.37
18			202.20	7.31	19.31	26.61		4.99	31.60	40.16	8.56	-85.81
19			272.98	6.82	19.79	26.61		4.99	31.60	40.16	8.56	-77.25
20			253.20	6.33	20.28	26.61		4.99	31.60	40.16	8.56	-68.69
21			232.91	5.82	20.79	26.61		4.99	31.60	40.16	8.56	-60.13
22			212.12	5.30	21.31	26.61		4.99	31.60	40.16	8.56	-51.57
23			190.82	4.77	21.84	26.61		4.99	31.60	40.16	8.56	-43.01
24			168.97	4.22	22.39	26.61		4.99	31.60	40.16	8.56	-34.45
25			146.58	3.66	22.95	26.61		4.99	31.60	40.16	8.56	-25.89
26			123.64	3.09	23.52	26.61		4.99	31.60	40.16	8.56	-17.33
27			100.12	2.50	24.11	26.61		4.99	31.60	40.16	8.56	-8.77
28			76.01	1.90	24.71	26.61		4.99	31.60	40.16	8.56	-0.21
29			51.29	1.28	25.33	26.61		4.99	31.60	40.16	8.56	8.35
30			25.96	0.65	25.96	26.61		4.99	31.60	40.16	8.56	16.91
31			0.00					4.99	4.99	40.16	35.17	52.08
32								4.99	4.99	40.16	35.17	87.25
33								4.99	4.99	40.16	35.17	122.42
34								4.99	4.99	40.16	35.17	157.59
35								4.99	4.99	40.16	35.17	192.76
36								4.99	4.99	40.16	35.17	227.93
37								4.99	4.99	40.16	35.17	263.10
38								4.99	4.99	40.16	35.17	298.27
39								4.99	4.99	40.16	35.17	333.44
40								4.99	4.99	40.16	35.17	368.61
41								4.99	4.99	40.16	35.17	403.78
42								4.99	4.99	40.16	35.17	438.95
43								4.99	4.99	40.16	35.17	474.12
44								4.99	4.99	40.16	35.17	509.29
45								4.99	4.99	40.16	35.17	544.46
46								4.99	4.99	40.16	35.17	579.63
47								4.99	4.99	40.16	35.17	614.80
48								12.59	12.59	40.16	27.57	642.37
49								9.76	9.76	40.16	30.40	672.77
50								31.39	31.39	40.16	8.77	681.54
51								11.94	11.94	40.16	28.22	709.76
52								4.99	4.99	40.16	35.17	744.93
53								4.99	4.99	40.16	35.17	780.10
54								4.99	4.99	40.16	35.17	815.27
55								4.99	4.99	40.16	35.17	850.44
56								4.99	4.99	40.16	35.17	885.61
57								4.99	4.99	40.16	35.17	920.78
58								4.99	4.99	40.16	35.17	955.95
59								4.99	4.99	40.16	35.17	991.12
60								4.99	4.99	40.16	35.17	1,026.29
61								4.99	4.99	40.16	35.17	1,061.46

Notes: * Interest during construction
** O & M cost and Replacement cost

Figures

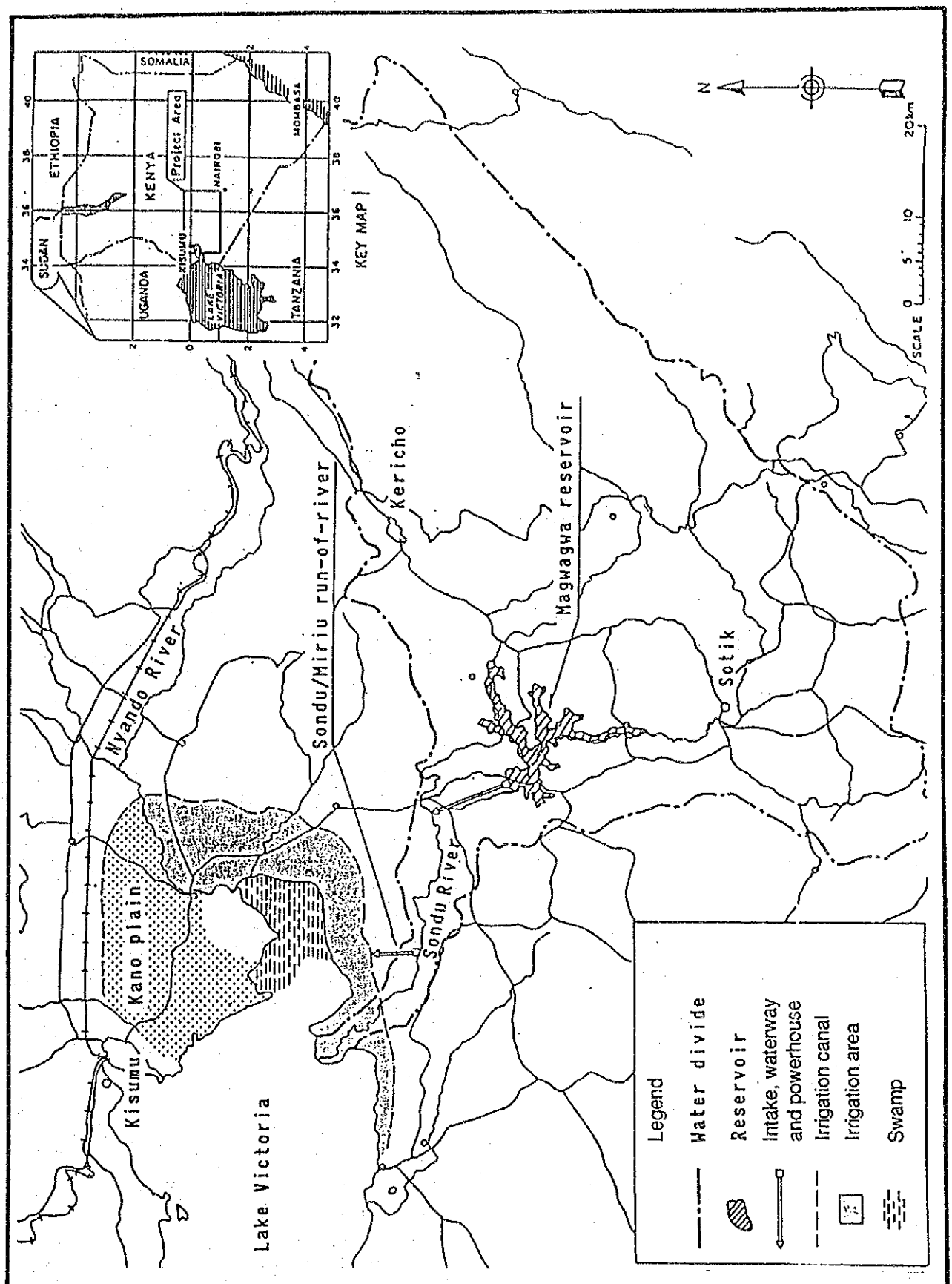

Figure 1.1 Location of the Project

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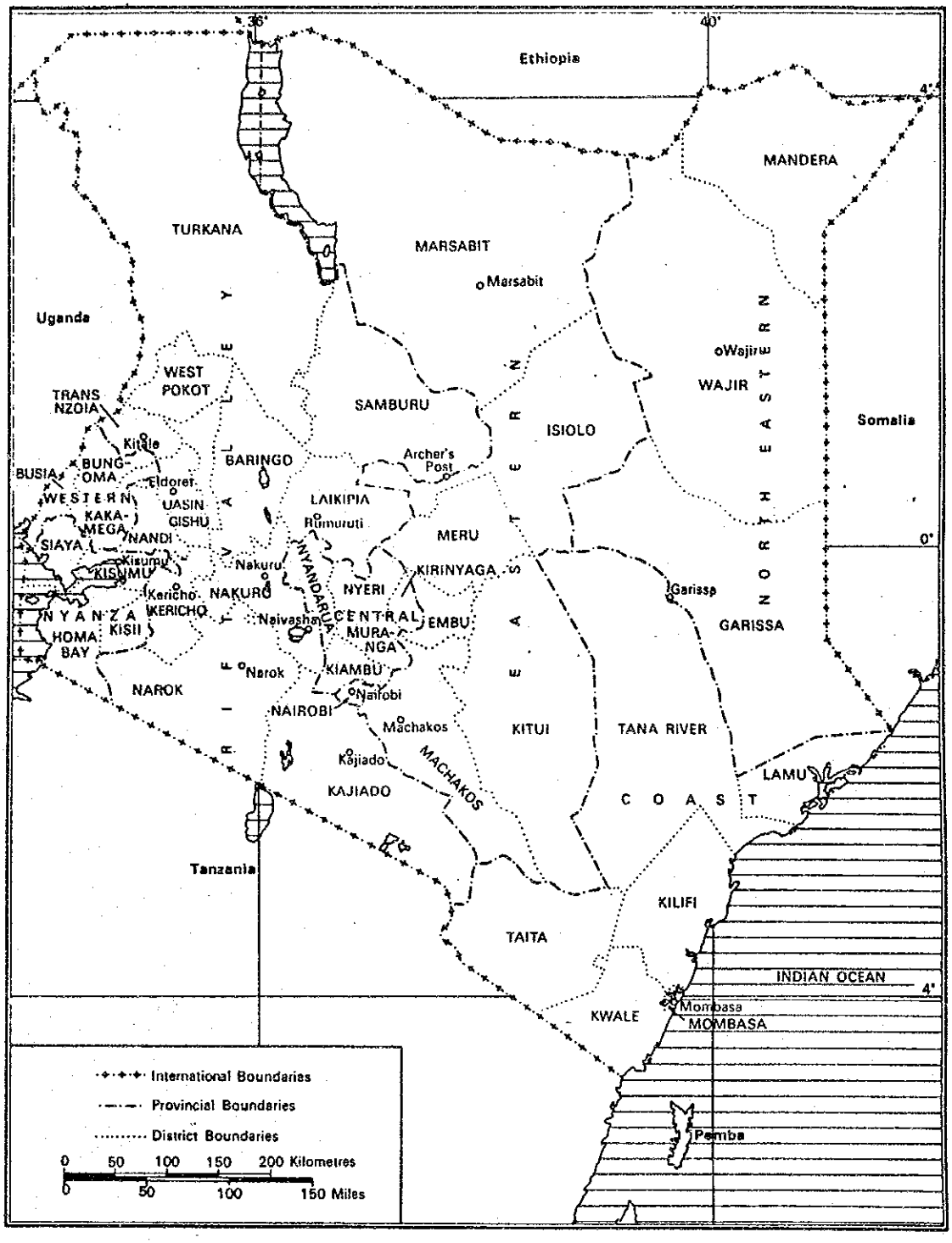

Figure 2.1 Administrative Boundaries in Kenya

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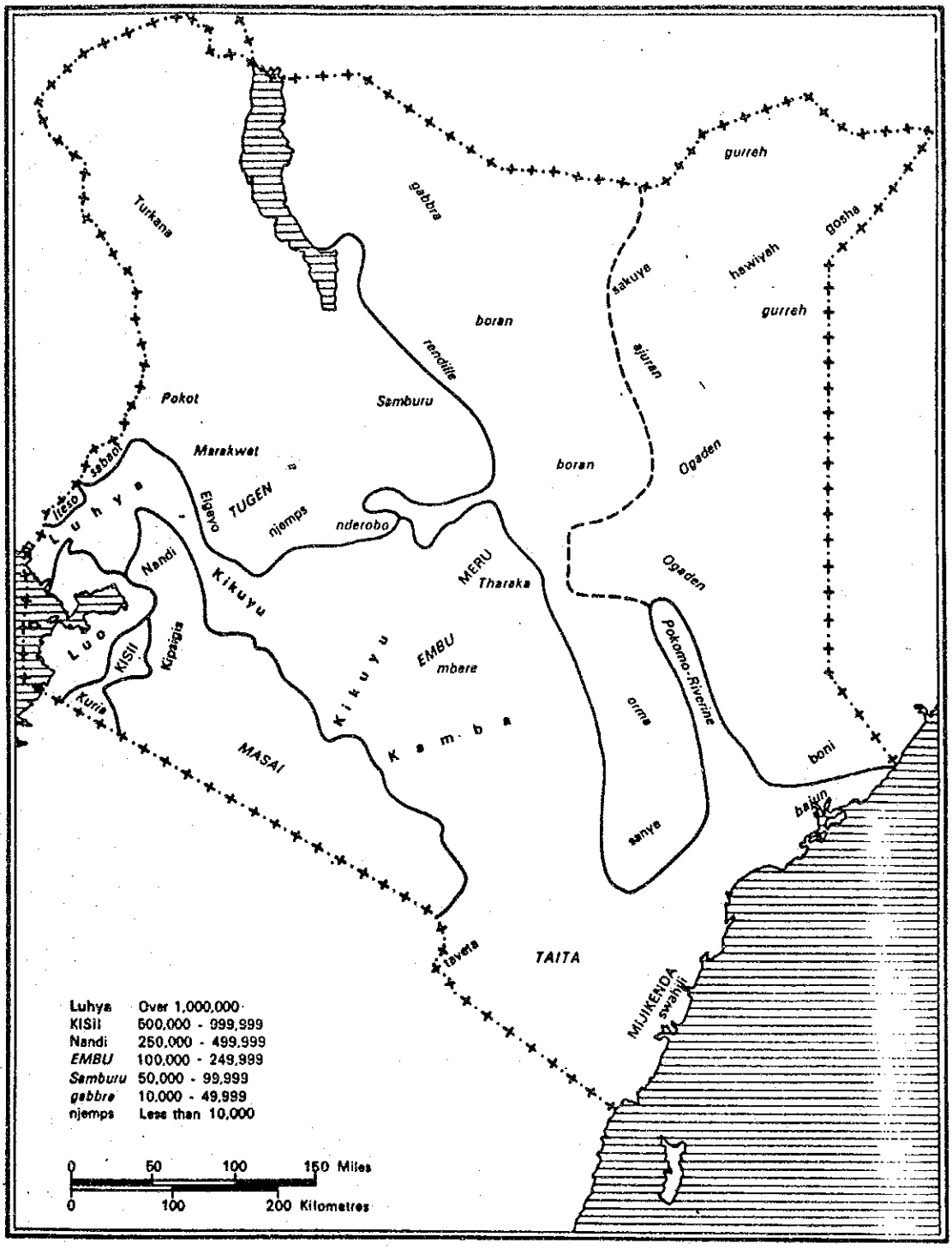

Figure 2.2 Tribal Distribution in Kenya

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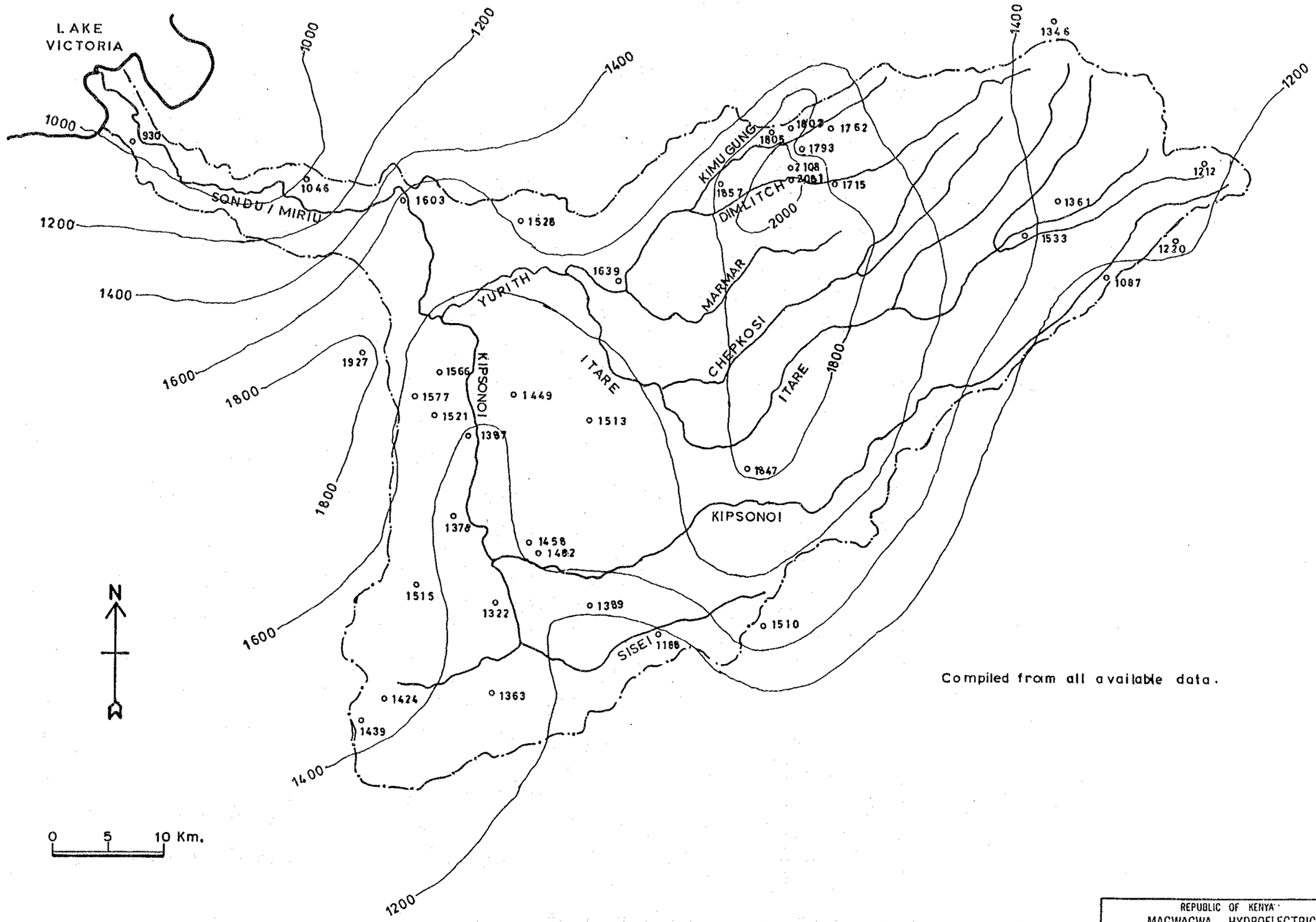

Compiled from all available data.

Figure 3.1 Isohyetal Map of Mean Annual Rainfall in the Sondu River Basin

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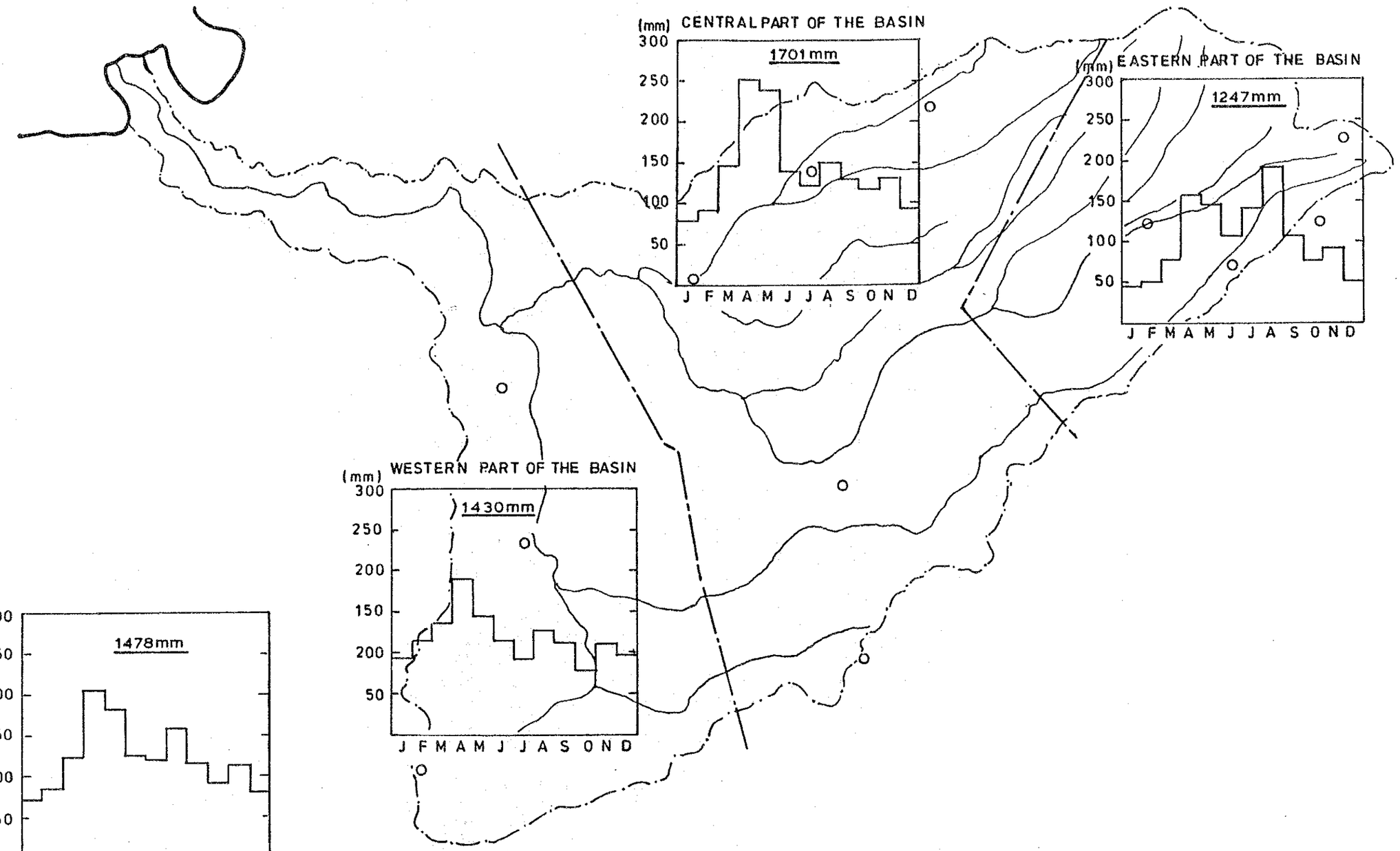

Figure 3.2 Monthly Rainfall Patterns at the Rain Gauges in the Sondu River Basin

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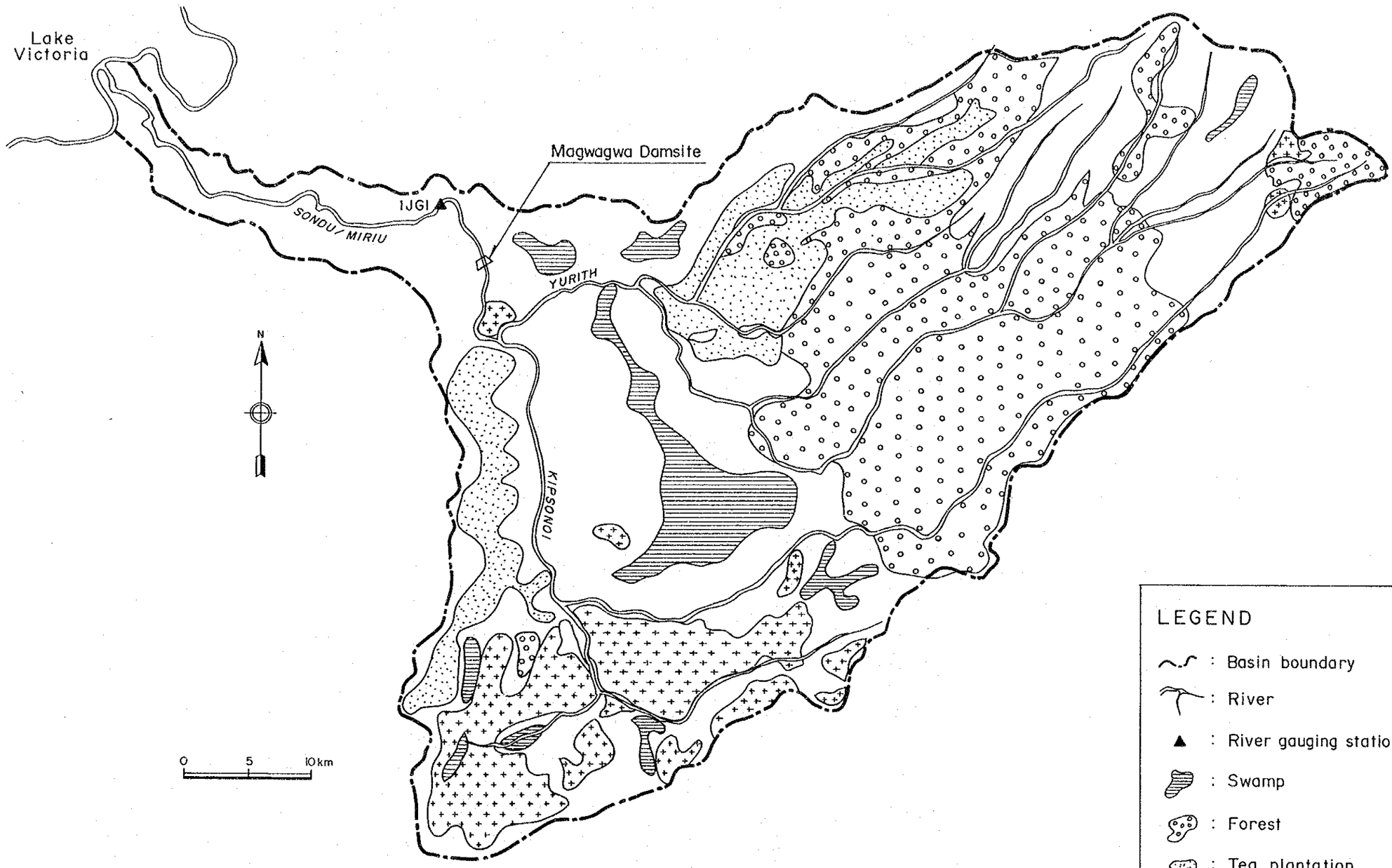

Figure 3.3 Land Distribution of the Sondu River Basin

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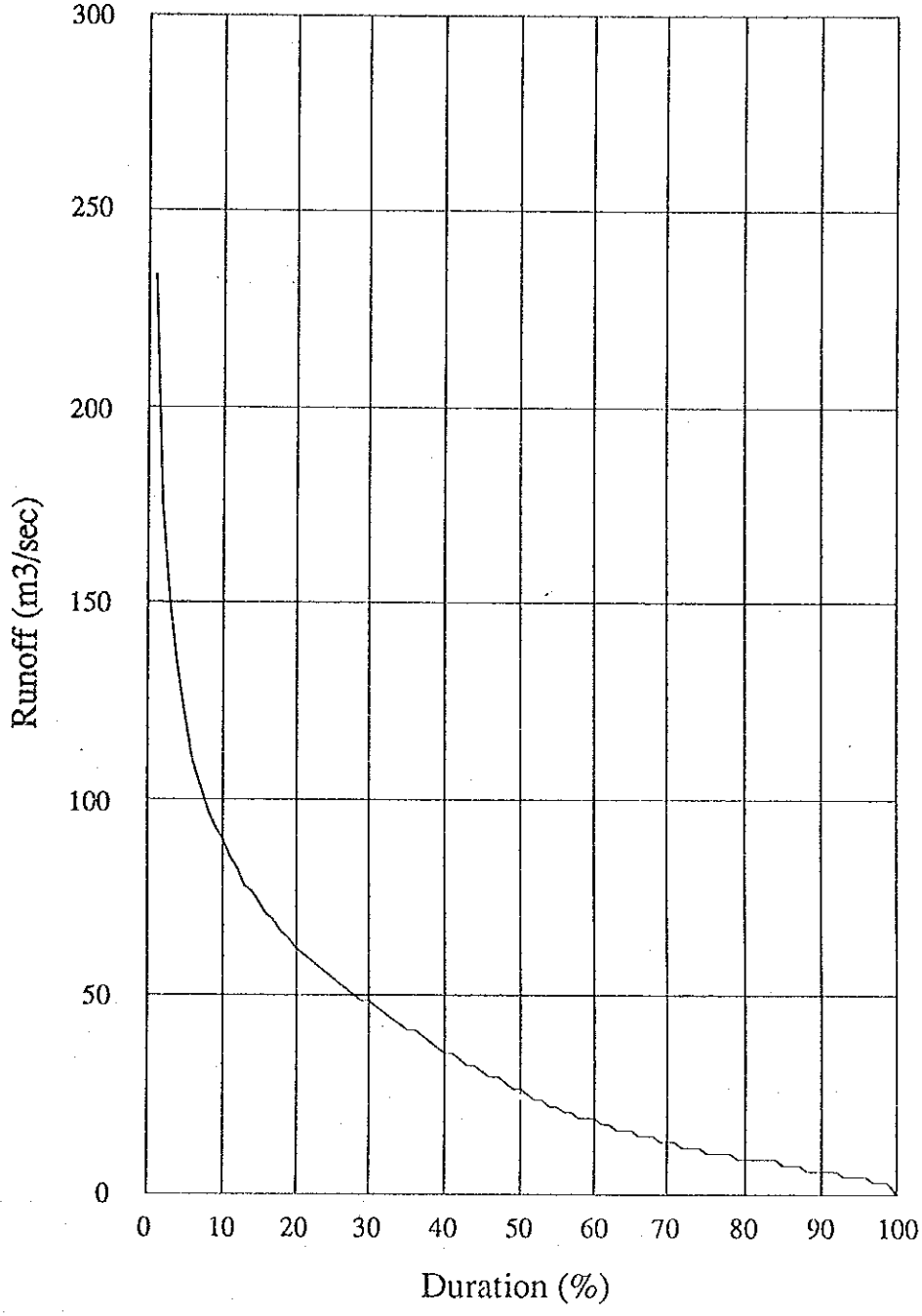

Figure 3.4 Flow Duration Curve at the 1JG1 Station by the Series Method

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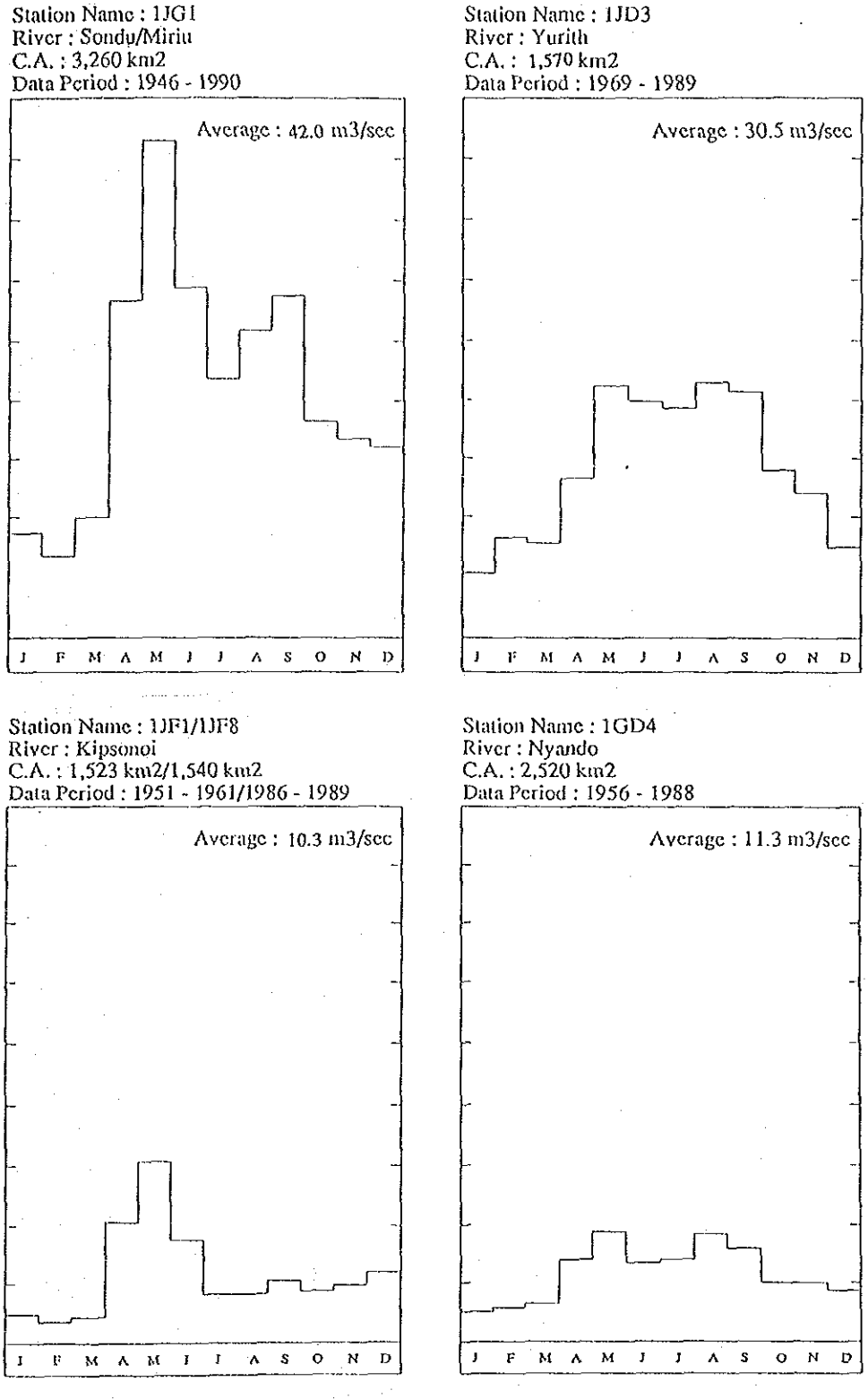

Figure 3.5 Monthly Runoff Patterns at the Stream Gauges in the Sondu River Basin

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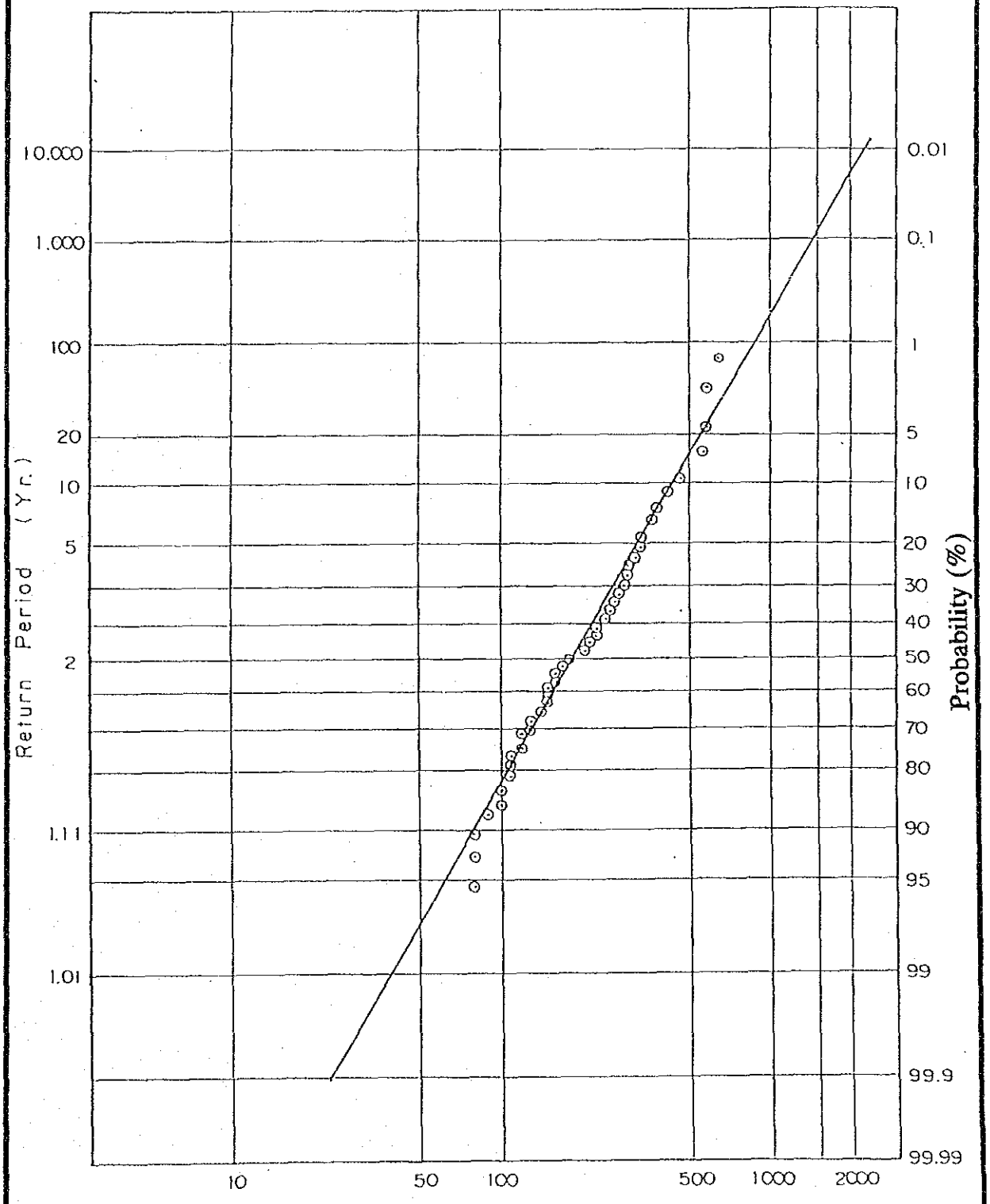

Figure 3.6 Frequency Curve for Annual Maximum Peak Discharge at the 1JG1 Station

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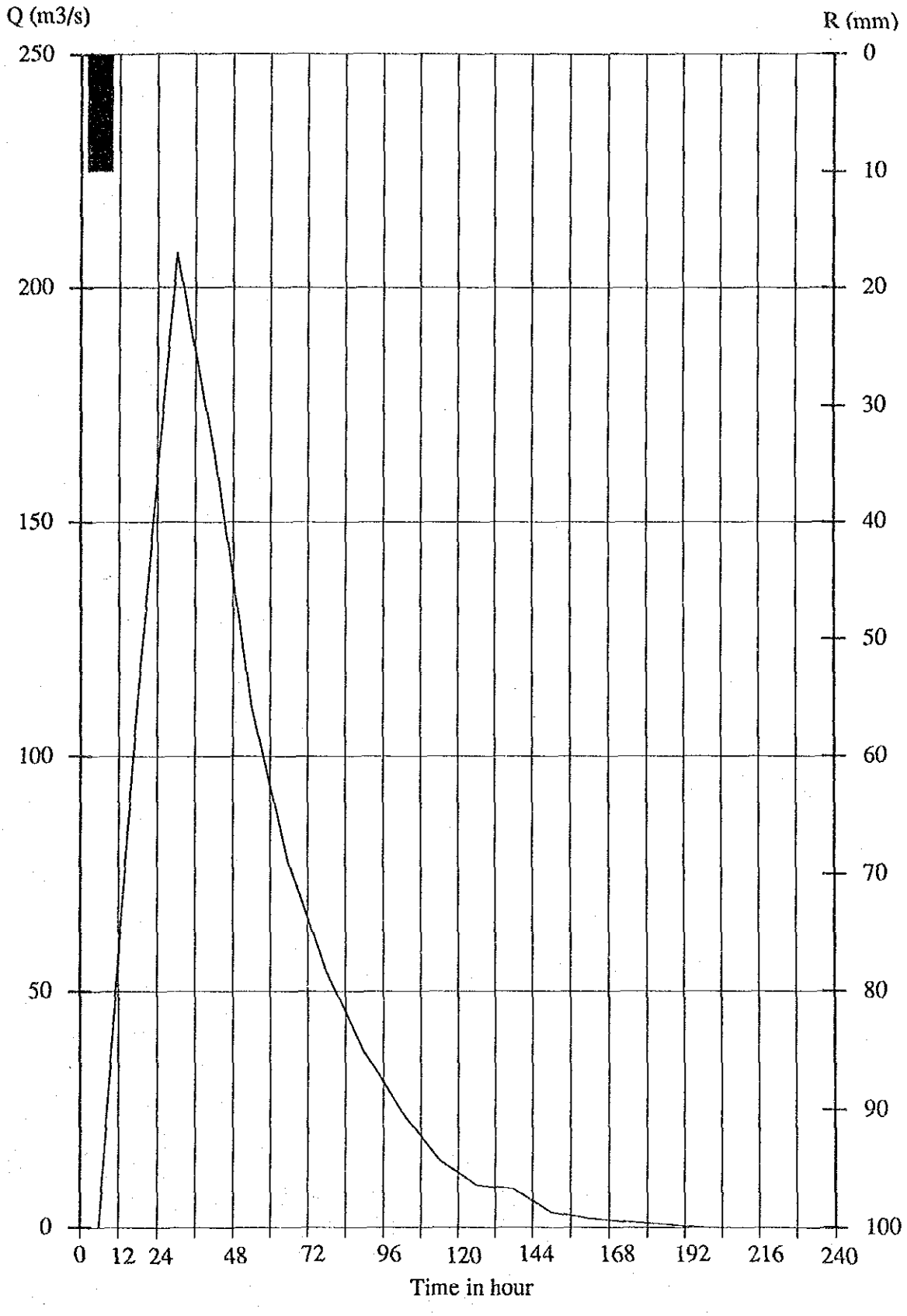

Figure 3.7 Unit Hydrograph for the Proposed Magwagwa Damsite

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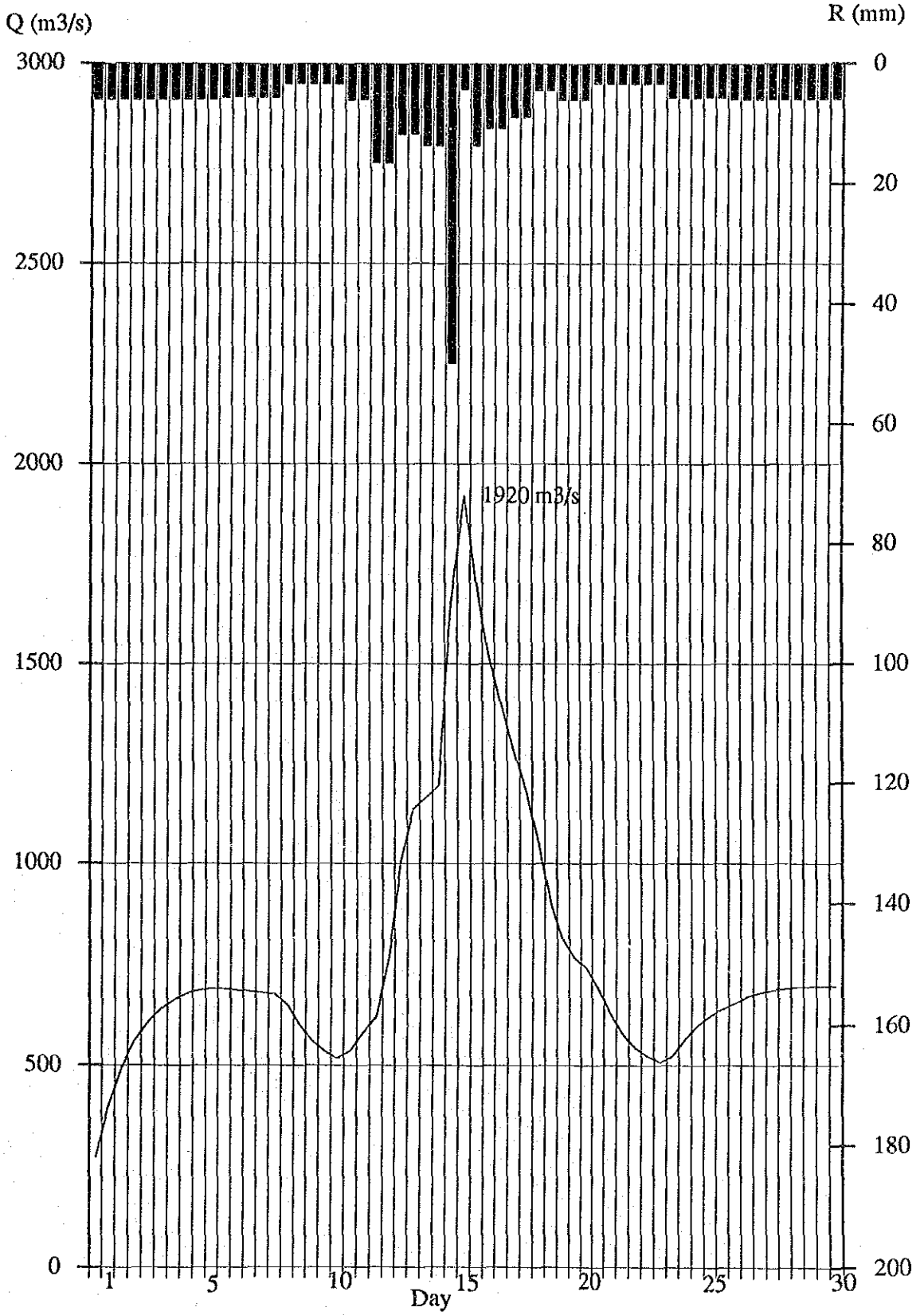

Figure 3.8 P.M.F. Hydrograph for the Proposed Magwagwa Damsite

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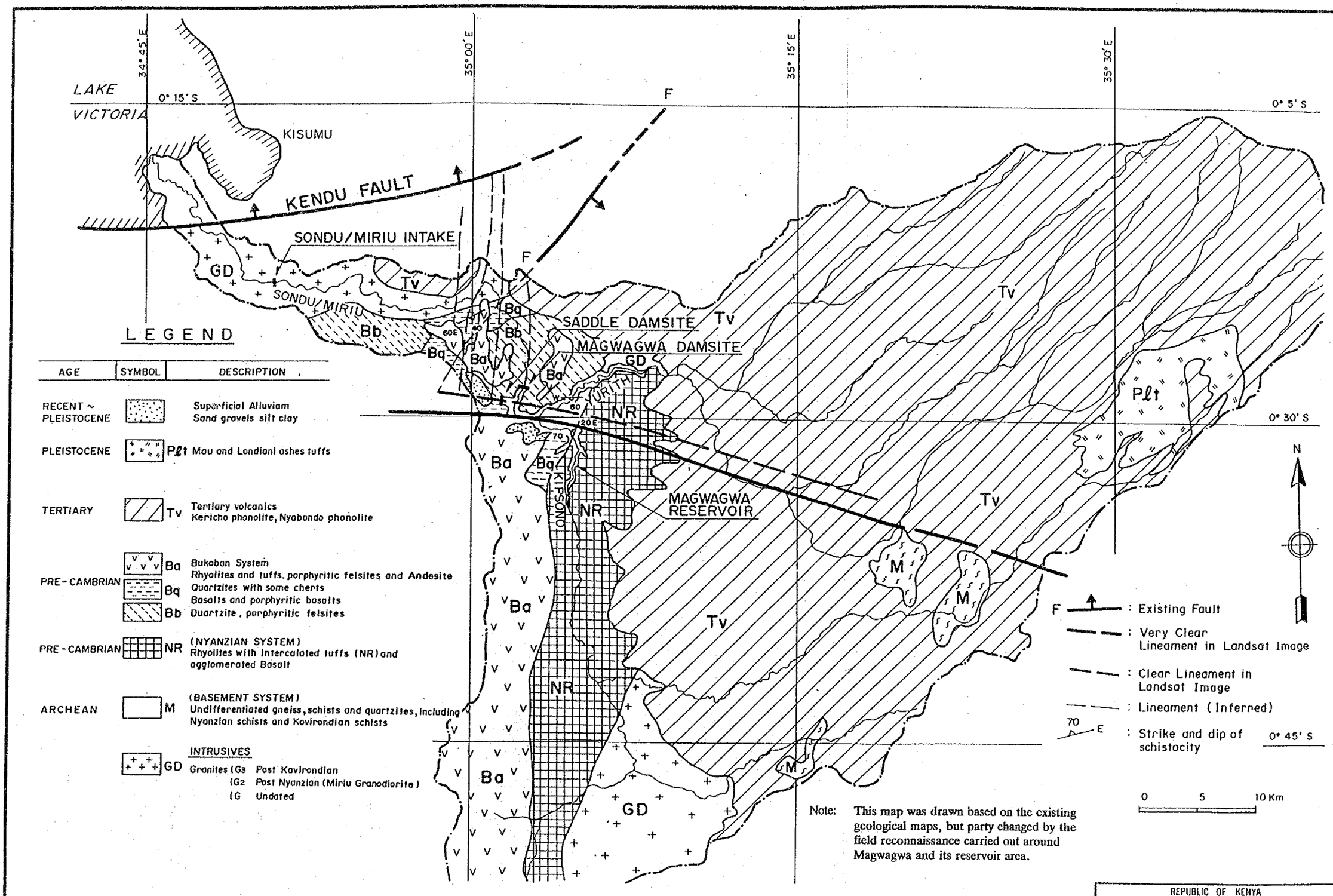

Figure 3.9 Regional Geology in the Sondu River Basin

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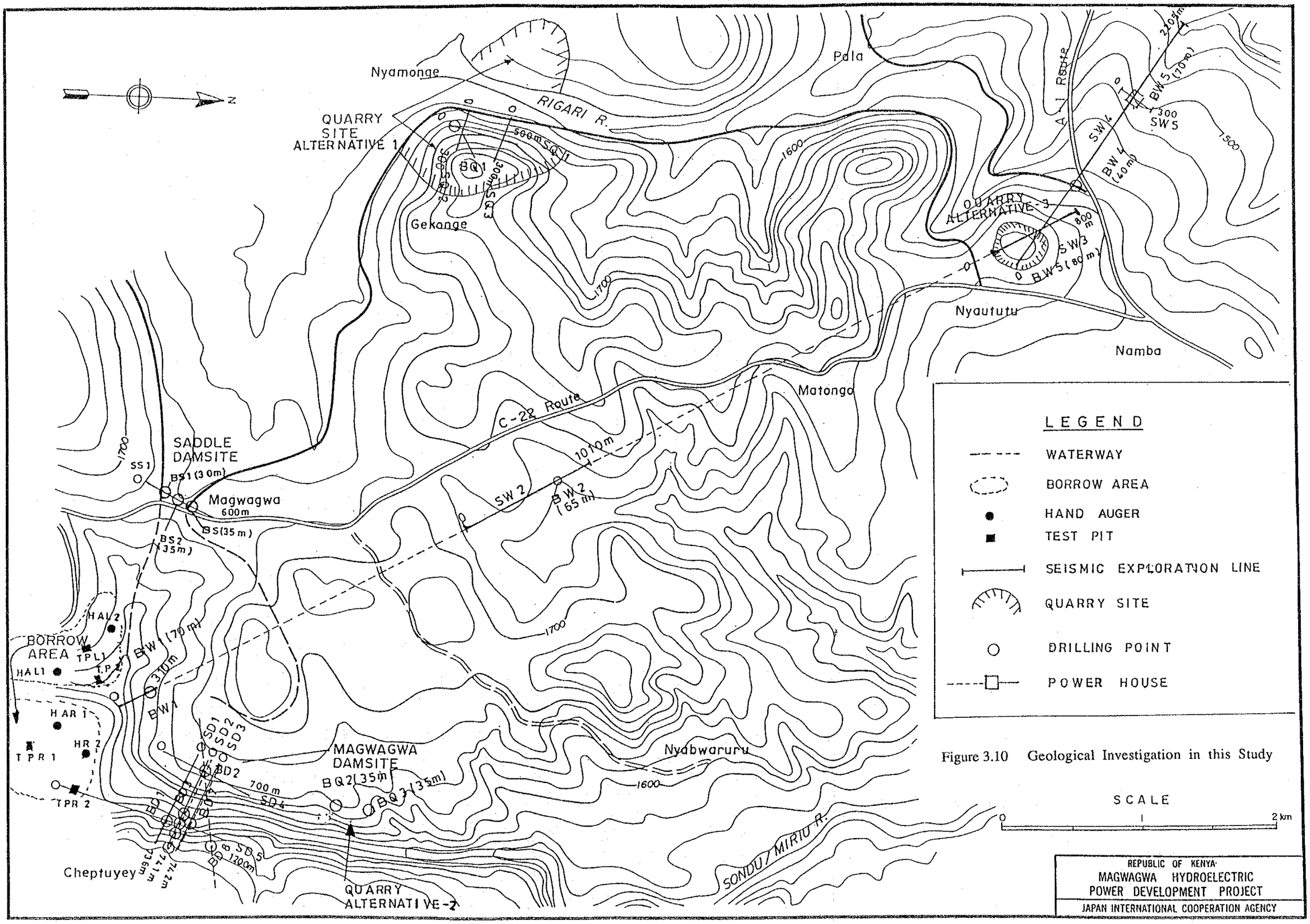
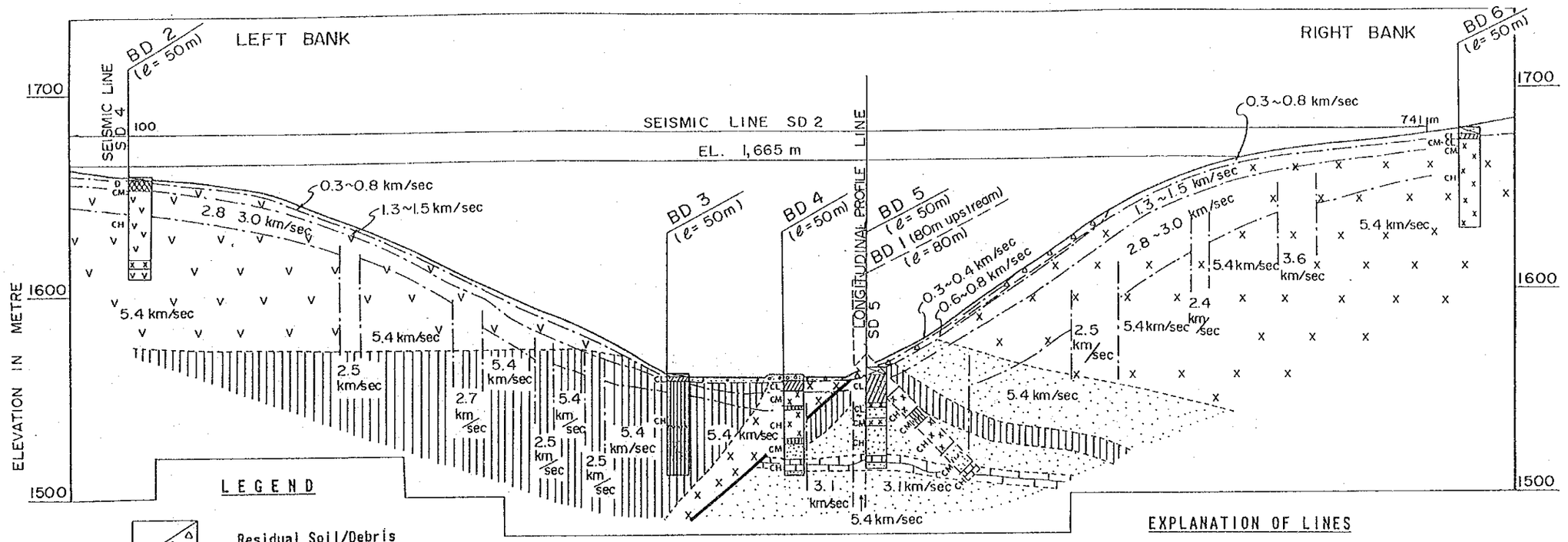


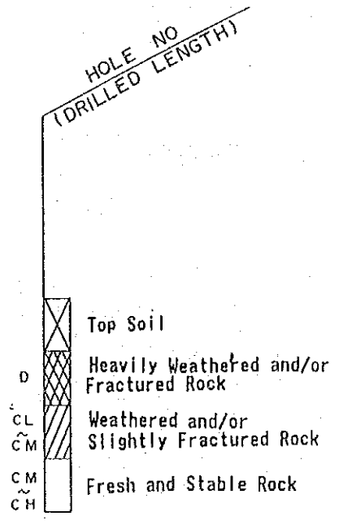
Figure 3.10 Geological Investigation in this Study



LEGEND

- Residual Soil/Debris
- River Deposits of Silty Sand With Gravel
- Porphyritic Andesite in Bukoban System
- Felsitic Andesite in Bukoban System
- Andesitic Dolerite in Bukoban System
- Sedimentary Rocks mainly Composed of Quartzite in Bukoban System
- Sedimentary Rocks mainly Composed of Shale in Bukoban System
- Sedimentary Rocks mainly Composed of Sandstone in Bukoban System
- Sedimentary Rocks mainly Composed of Limestone in Bukoban System

BORING LOGS



EXPLANATION OF LINES

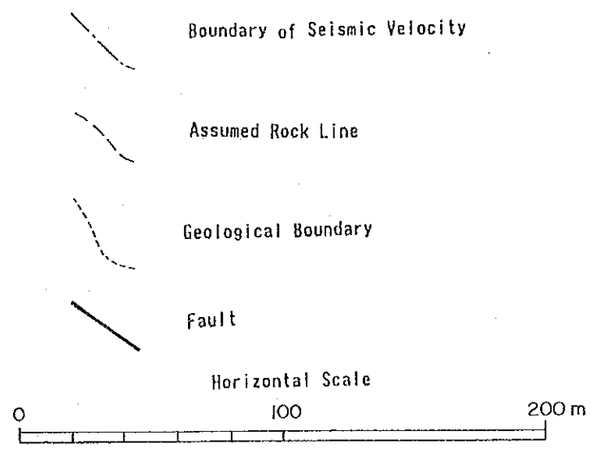


Figure 3.11 Geological Profile along the Dam Axis Alternative-A

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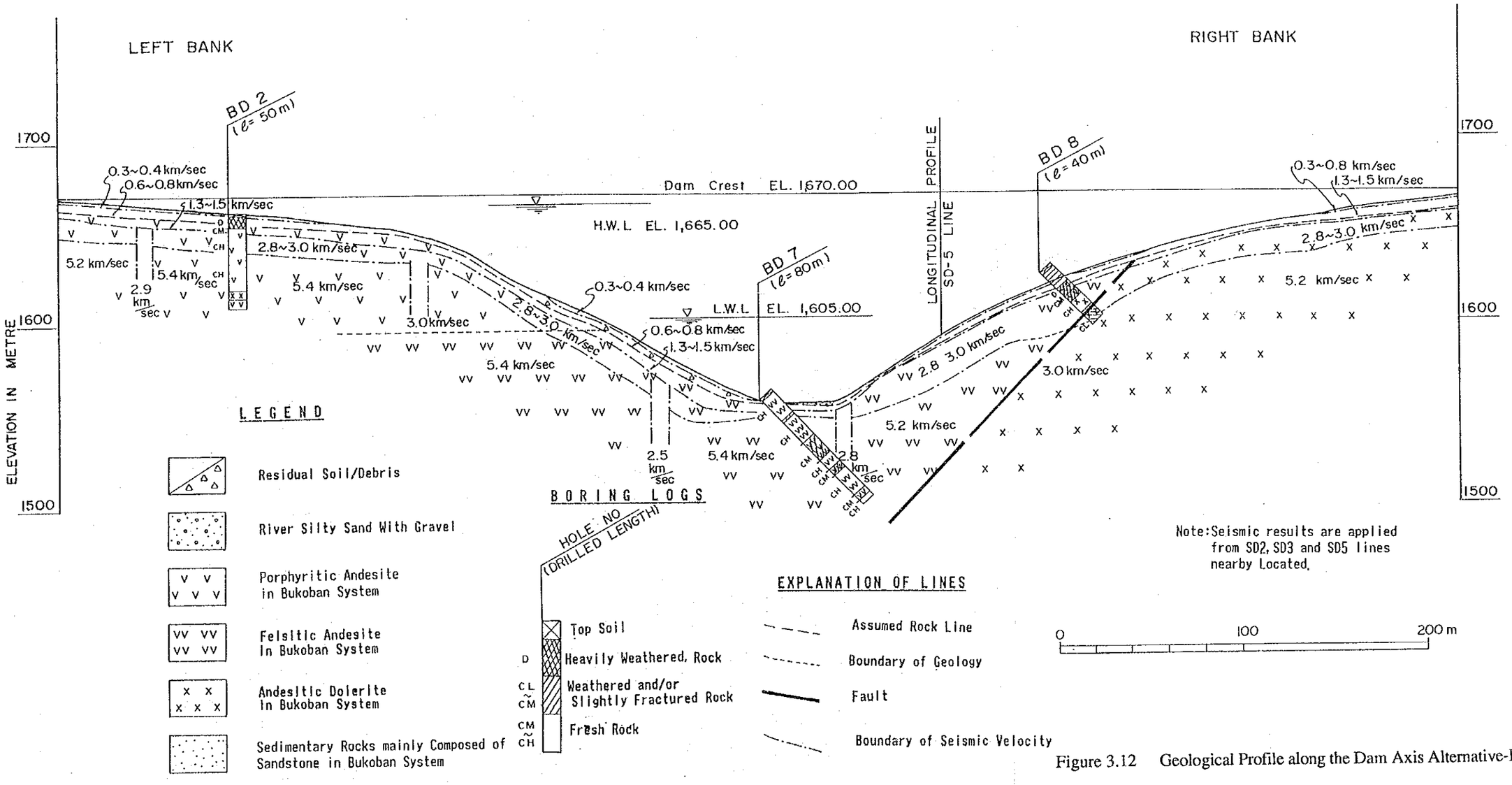

Figure 3.12 Geological Profile along the Dam Axis Alternative-B

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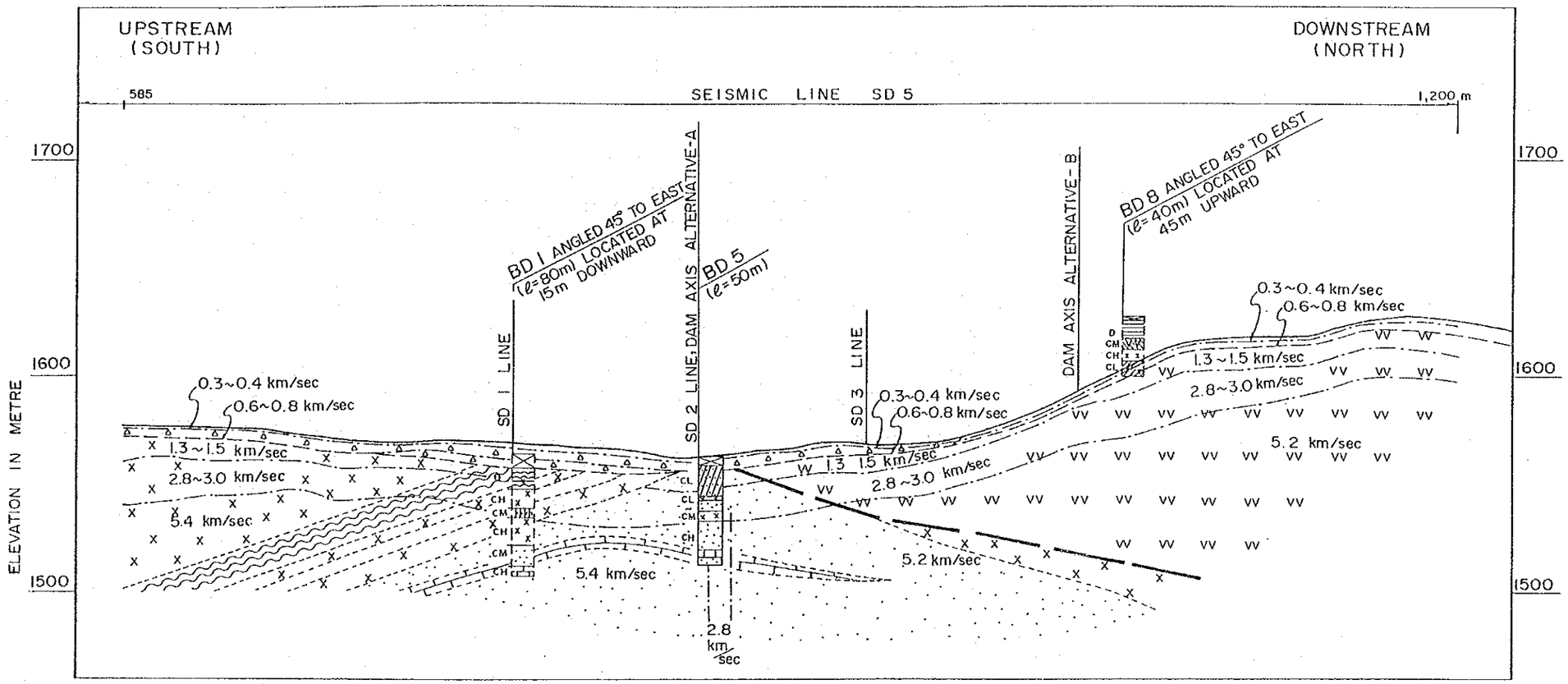

LEGEND

- Residual Soil/Debris
- Felsitic Andesite in Bukoban System
- Andesitic Dolerite in Bukoban System
- Sedimentary Rocks mainly Composed of Shale in Bukoban System
- Sedimentary Rocks mainly Composed of Quartzite in Bukoban System
- Sedimentary Rocks mainly Composed of Sandstone in Bukoban System
- Sedimentary Rocks mainly Composed of Limestone in Bukoban System
- Boundary of Seismic Velocity
- Assumed Rock Line
- Geological Boundary
- Fault

Horizontal Scale
0 100 200 m

Figure 3.13 Longitudinal Geological Profile along Seismic Line SD-5 at the Magwagwa Damsite

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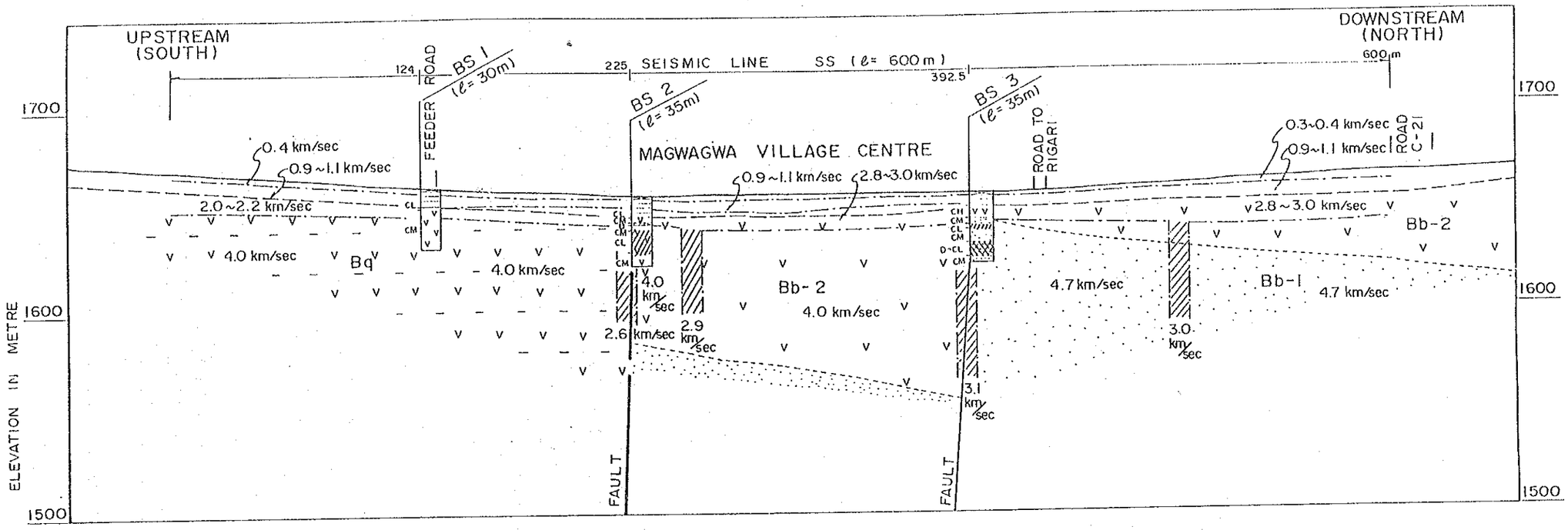

LEGEND

- Residual Soil with Gravels
- Bb 2 — Andesite in Bukoban System
- Bb 1 — Sandstone in Bukoban System
- Bq — Andesite in Quartzite Zone in Bukoban System
- Assumed Rock Line
- Geological Boundary
- Boundary of Seismic Velocity
- Fault
- Main Fault

HORIZONTAL SCALE

0 — 100 — 200 m

EXPLANATION OF LOGS

HOLE NO. (DRILLED LENGTH)

- Top Soil
- D — Heavily Weathered/Fractured Rock
- CL — Weathered/Fractured Rock
- CM — Andesite
- CM — Sandstone

Figure 3.14 Geological Profile of Seismic Line S.S at the Saddle Damsite

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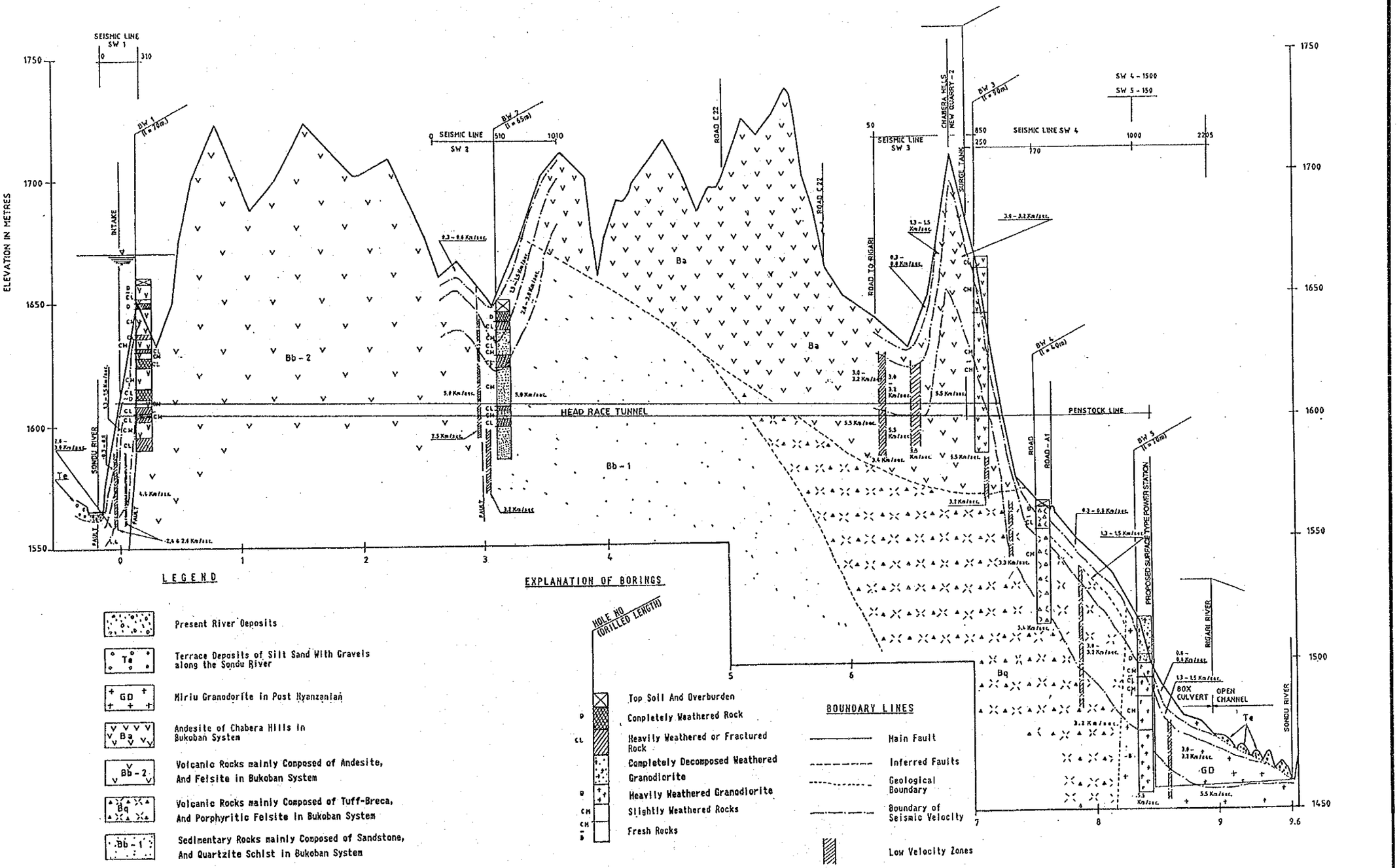

Figure 3.15 Geological Profile along the Waterway

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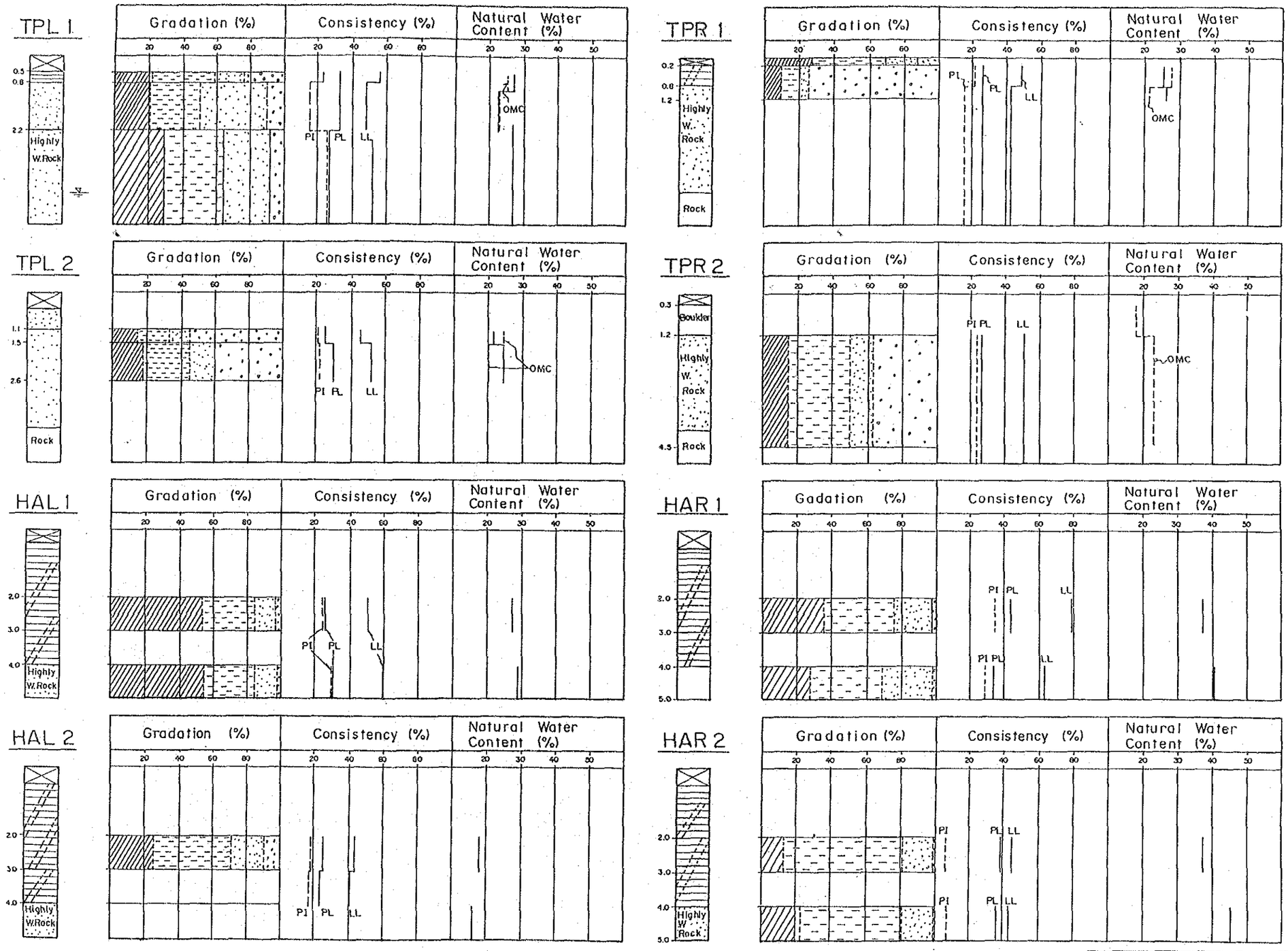

Figure 3.16 Physical Properties of Soil in the Borrow Areas

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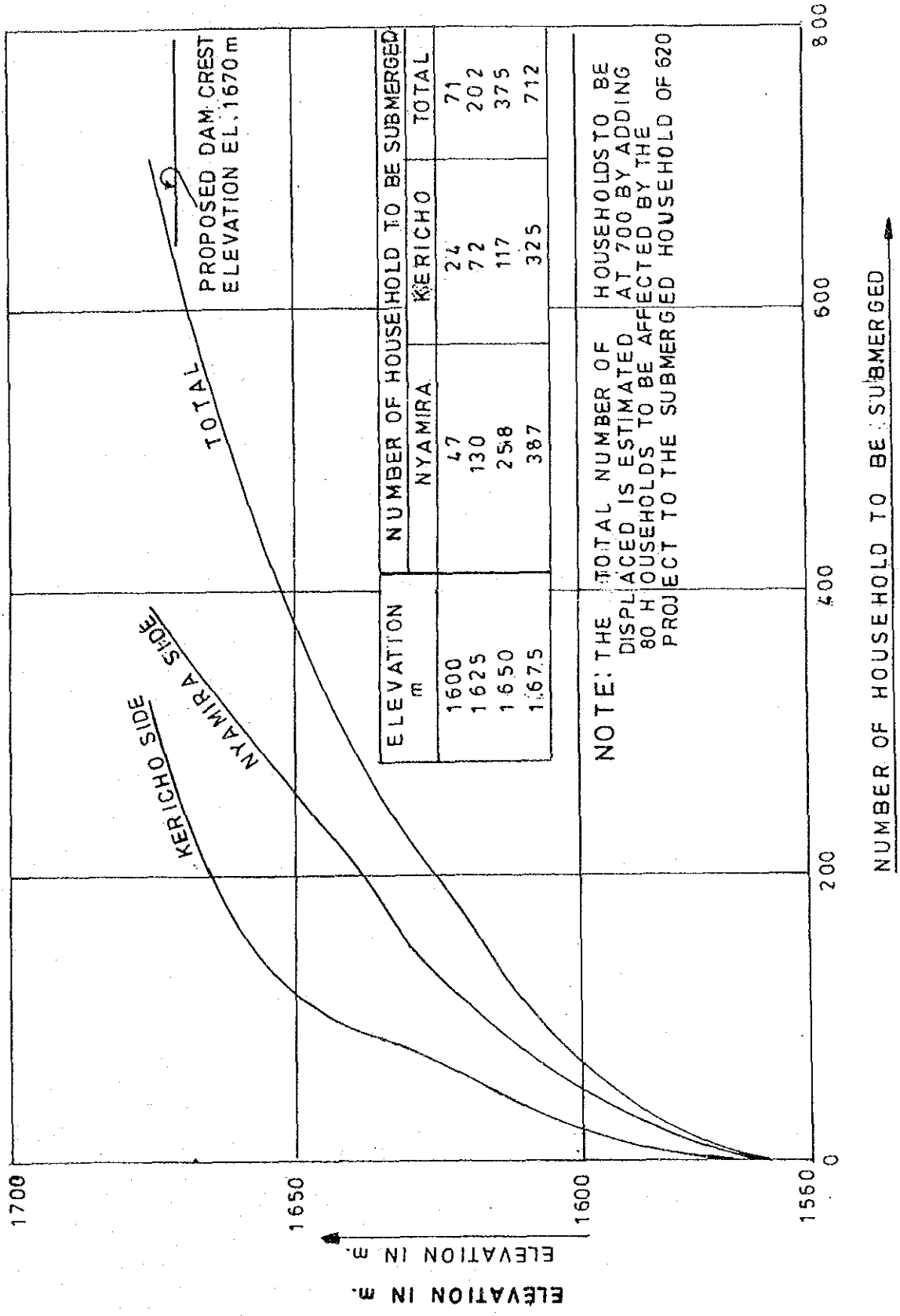

Figure 3.17 Number of Households in the Reservoir

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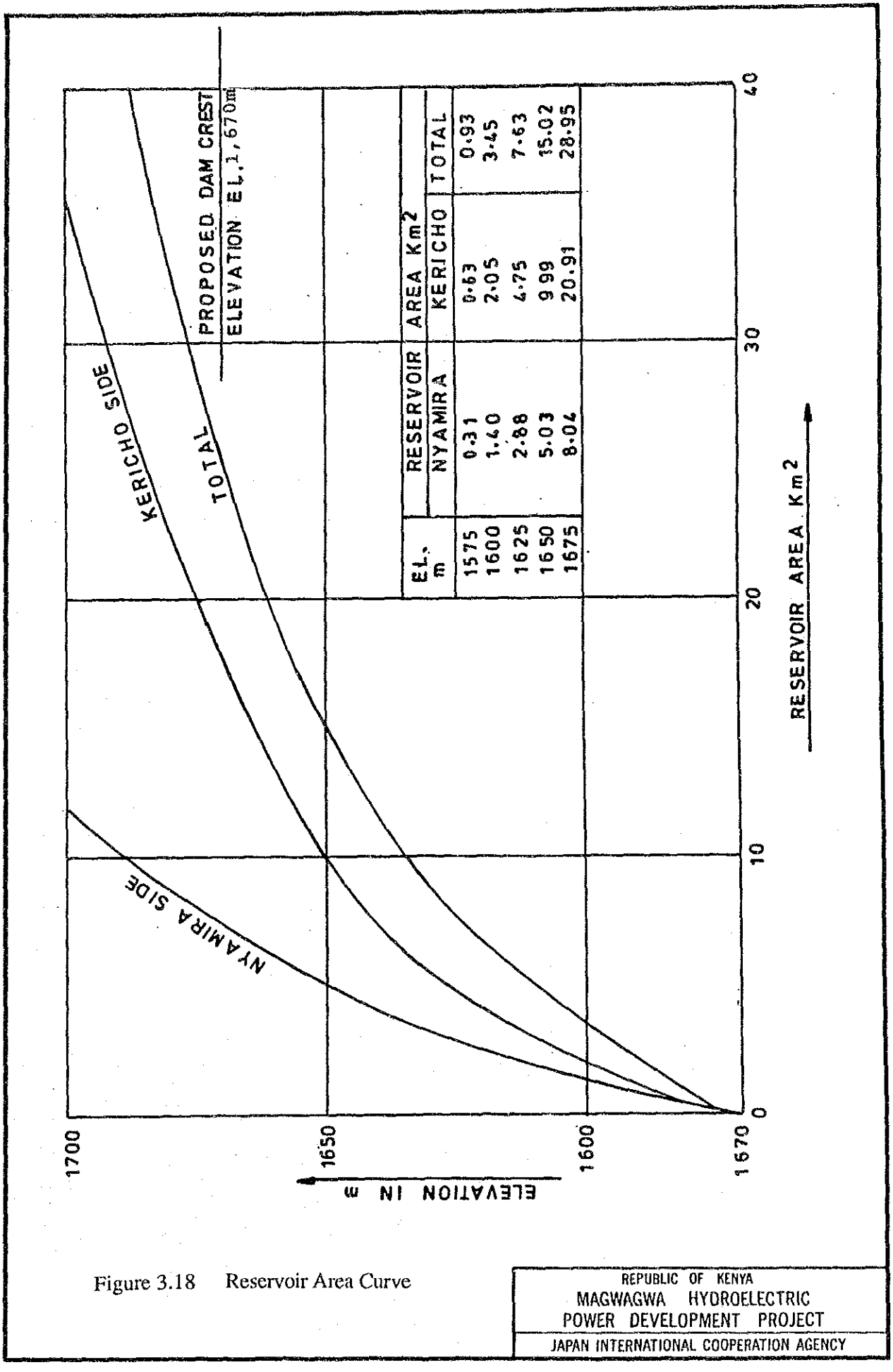

Figure 3.18 Reservoir Area Curve

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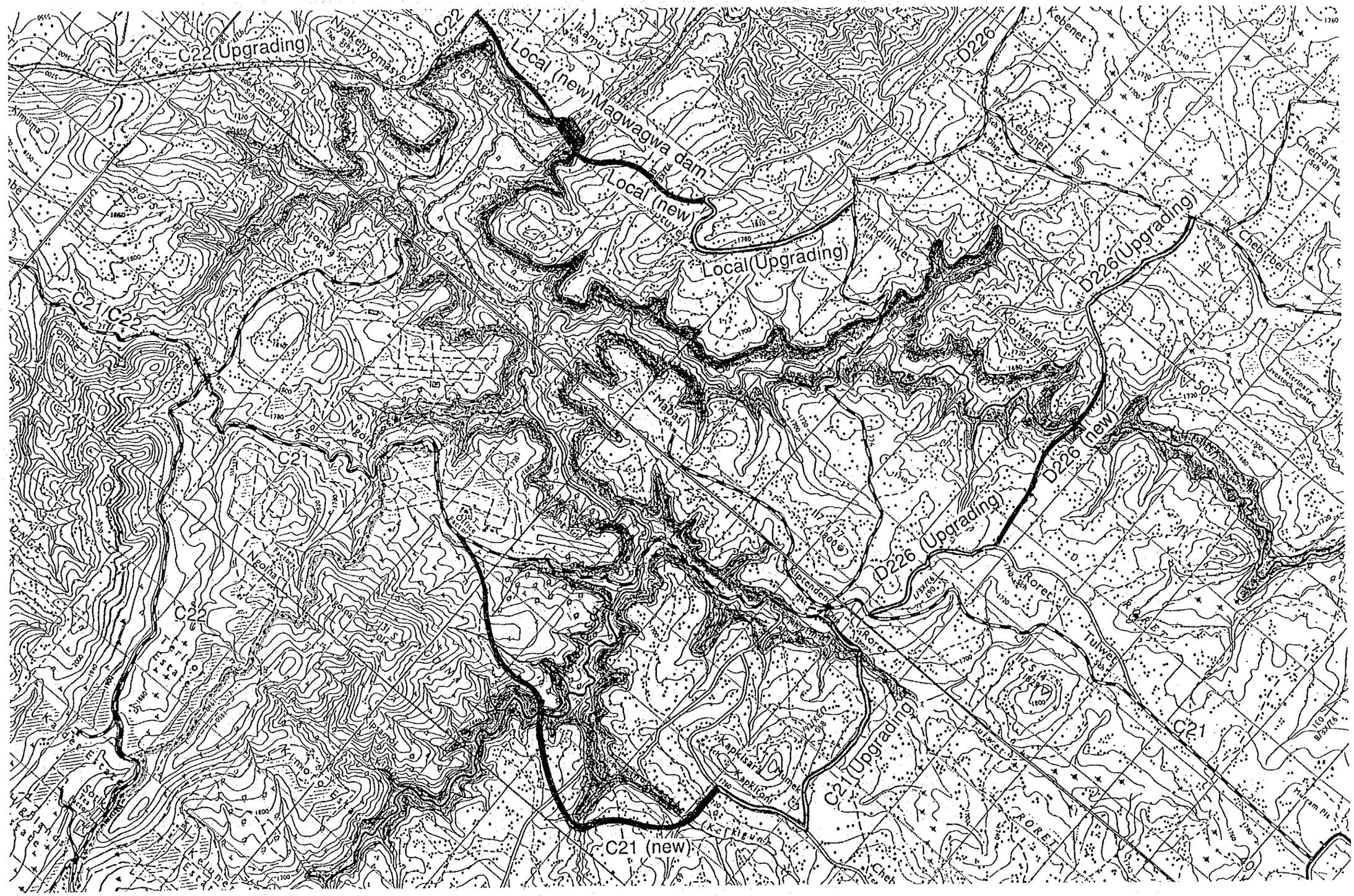

Figure 3.19 Relocation Roads in and around the Reservoir Area

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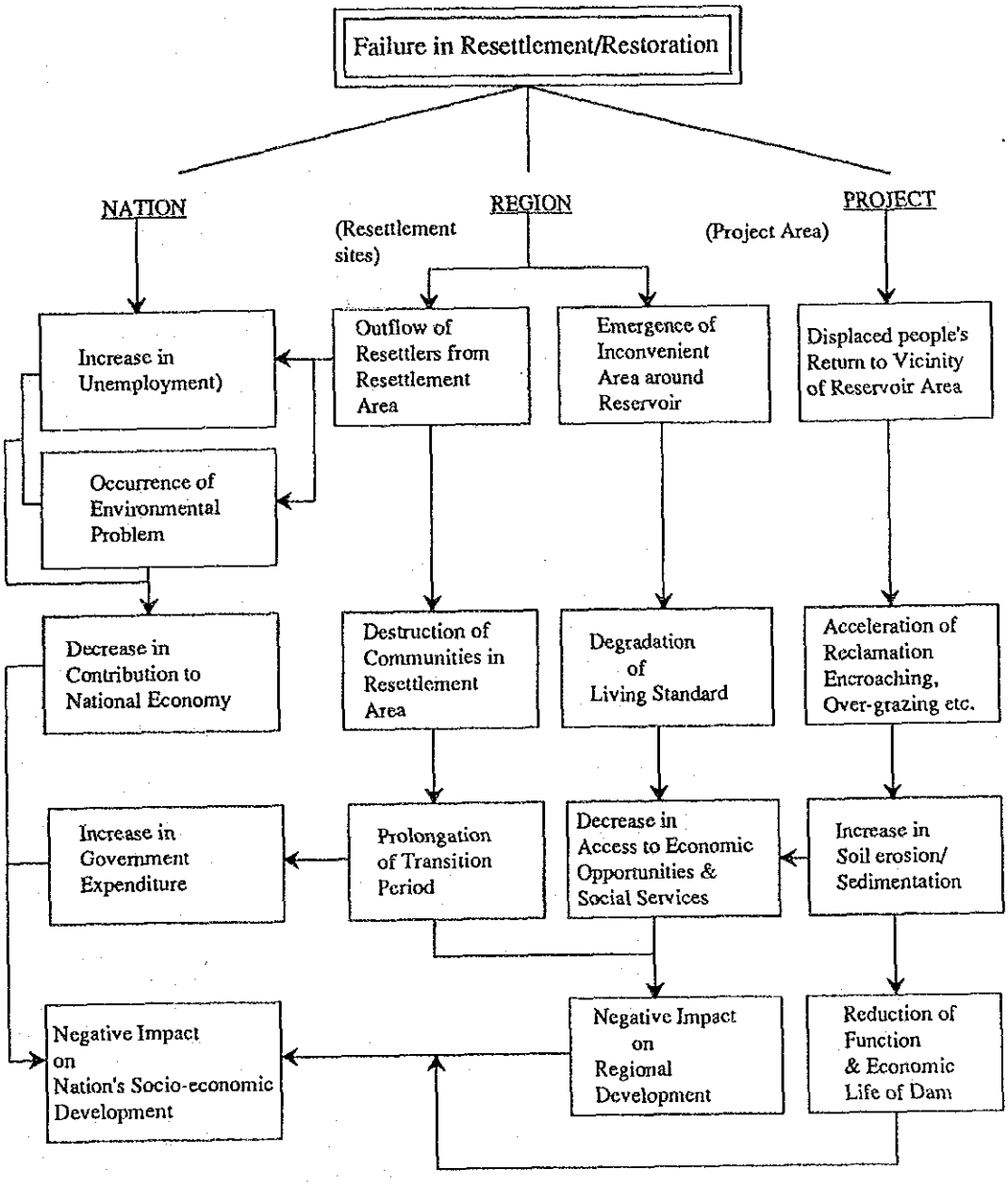

Figure 3.20 Possible Impacts of Failure in Resettlement and Restoration in the Project Area

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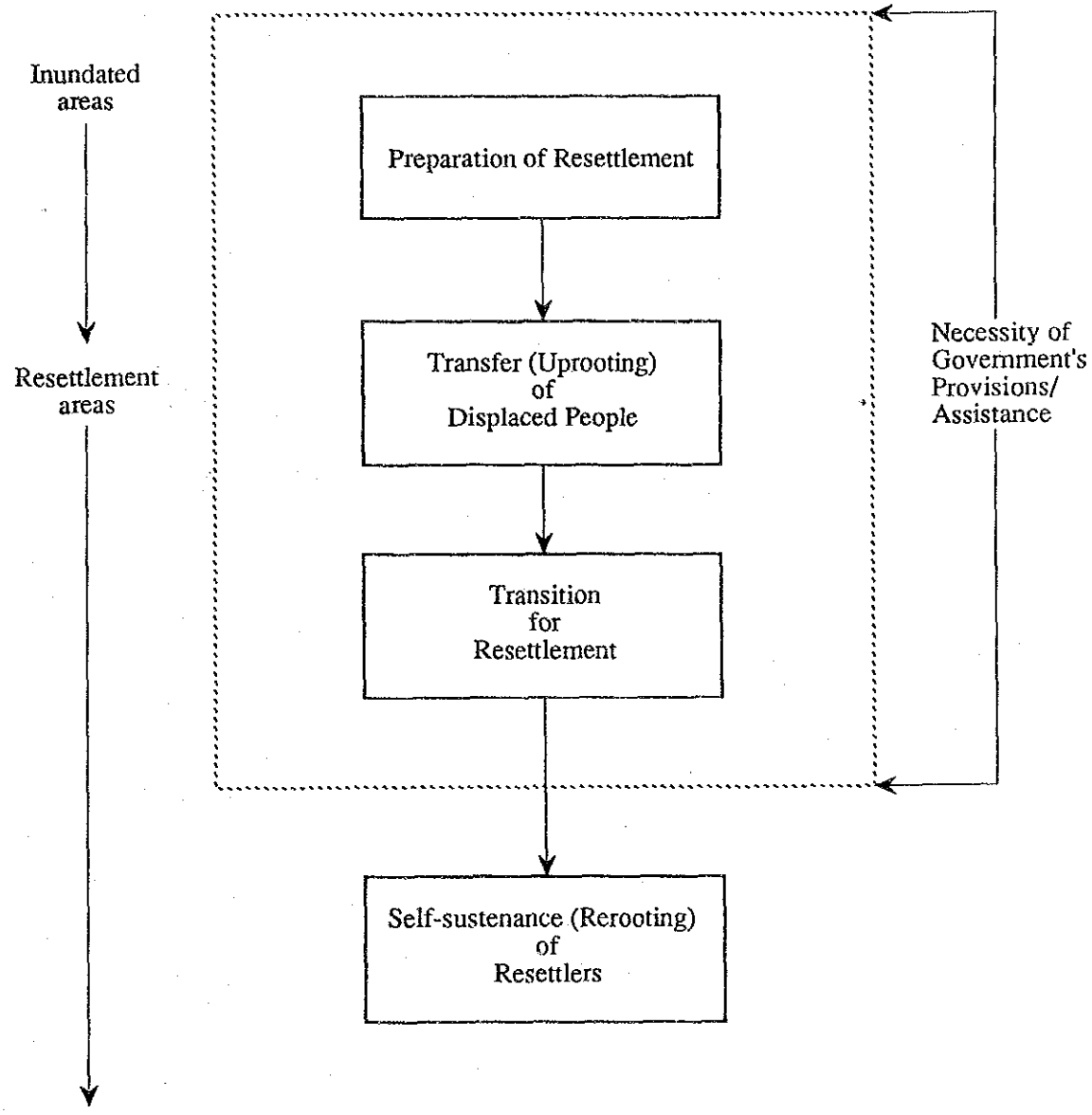

Figure 3.21 Phases of Involuntary Resettlement

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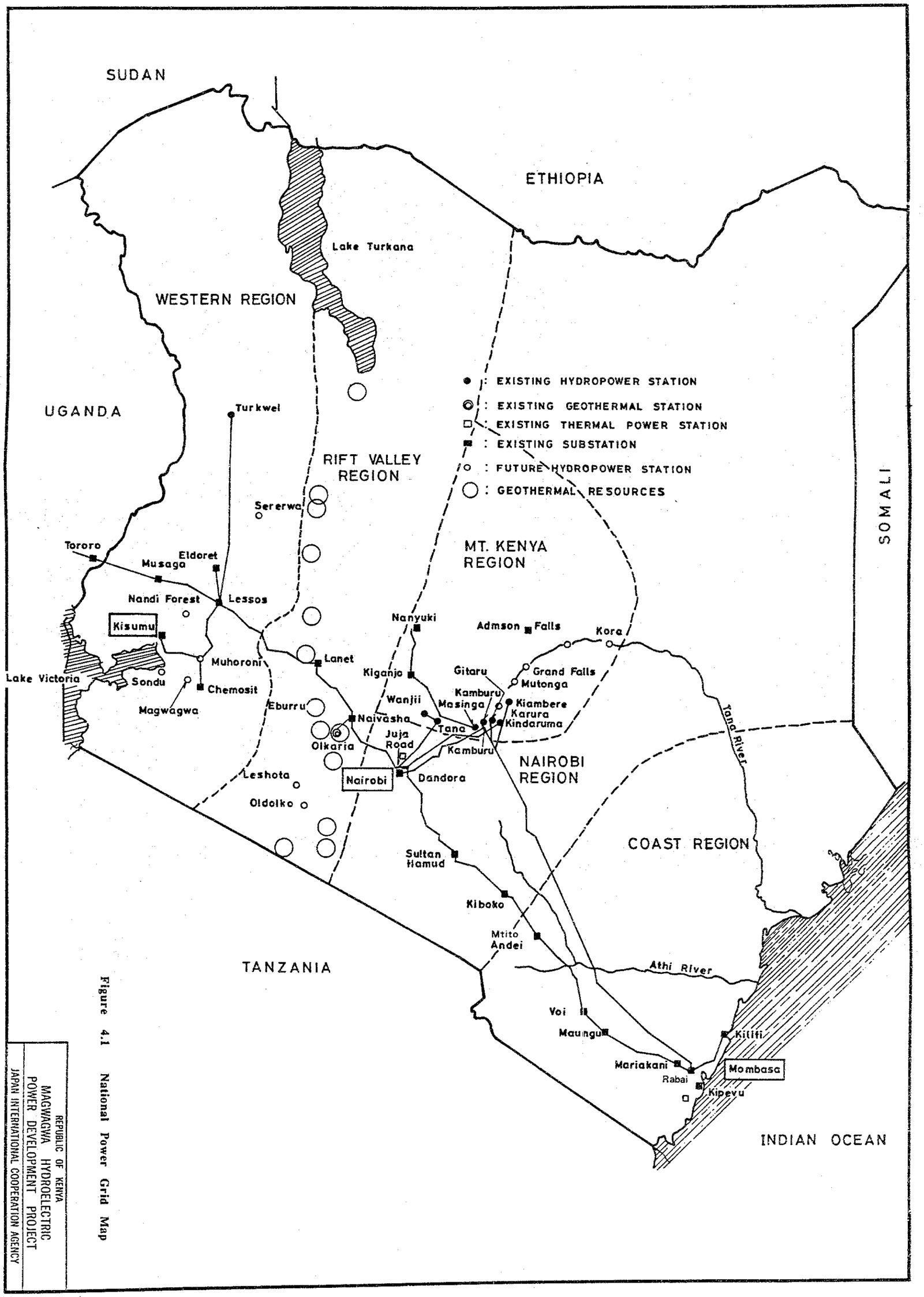

Figure 4.1 National Power Grid Map

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JAPAN INTERNATIONAL COOPERATION AGENCY

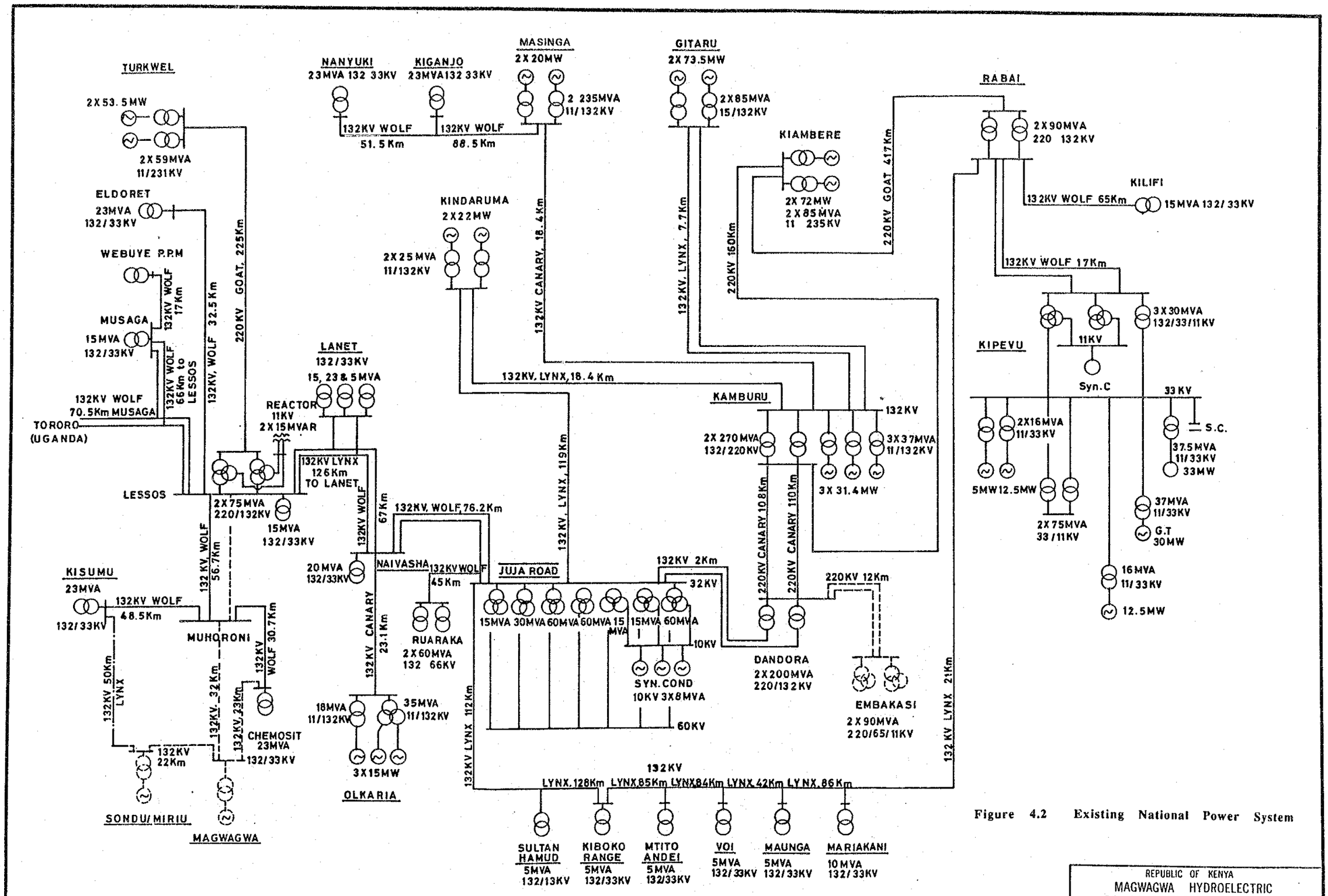

Figure 4.2 Existing National Power System

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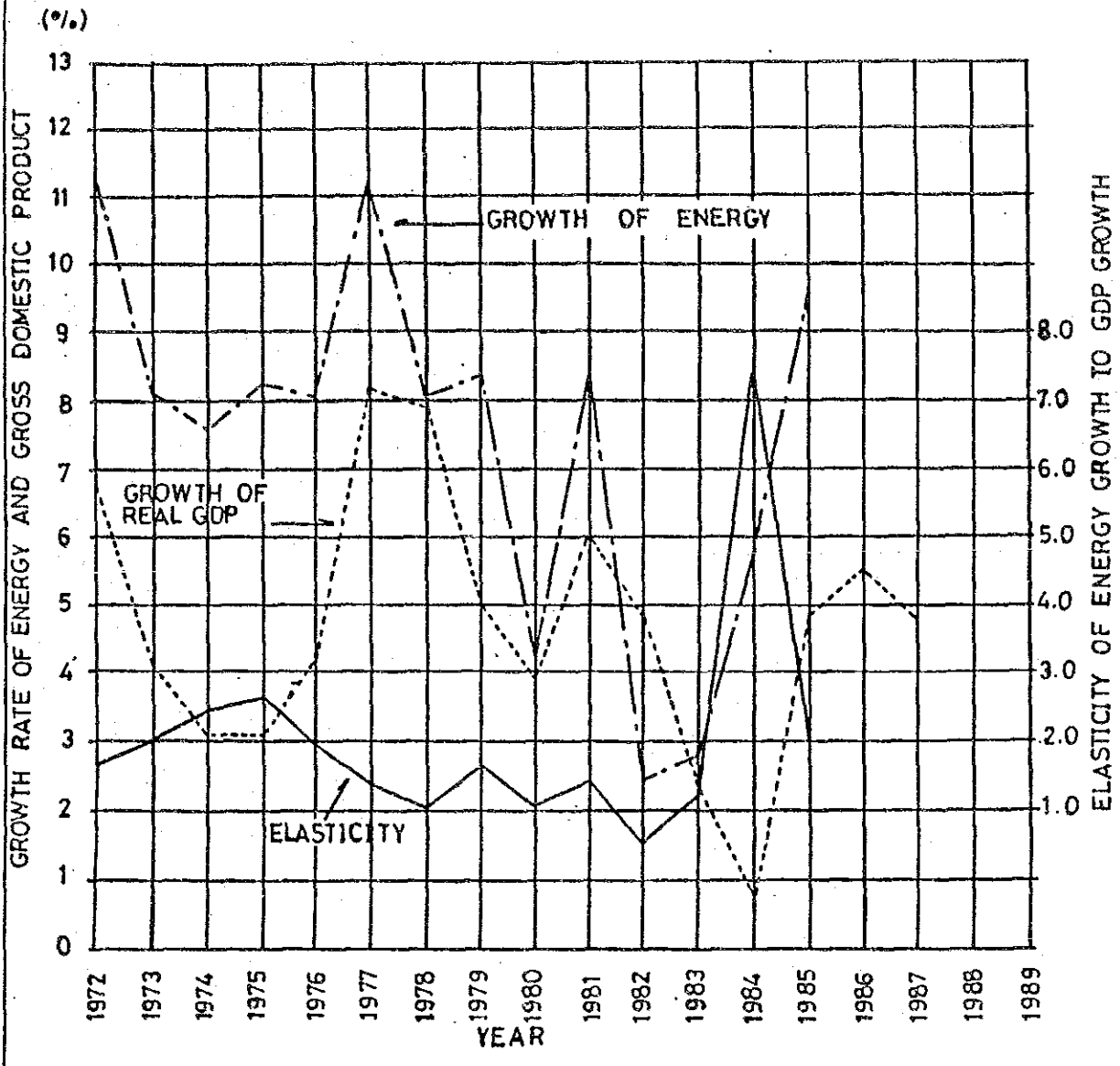

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
GROWTH OF ENERGY (%)	11.2	8.2	7.6	8.3	8.1	11.2	8.1	8.4	4.2	8.5	2.4	2.8	5.9	9.5	–	–	10.4	–
GROWTH OF * REAL GDP (%)	6.8	4.1	3.1	3.1	4.2	8.2	7.9	5.0	3.9	6.0	4.8	2.3	0.8	4.8	5.5	5.7	–	–
ELASTICITY	1.65	2.00	2.45	2.68	1.93	1.37	1.03	1.68	1.08	1.42	0.50	1.22	7.38	1.99	–	–	–	–

* Source : National Development Plan for 1989 - 1993

Figure 4.3 National Energy Growth & Elasticity to GDP

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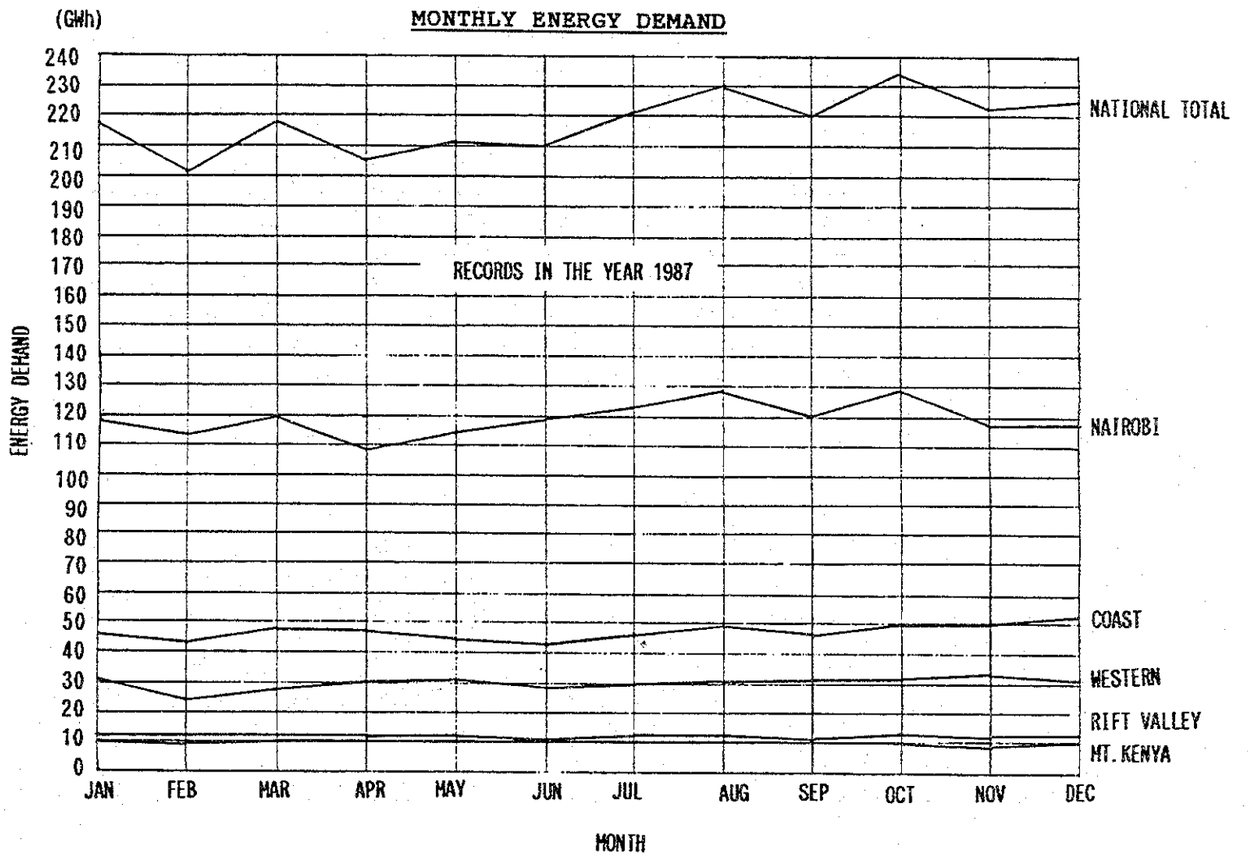

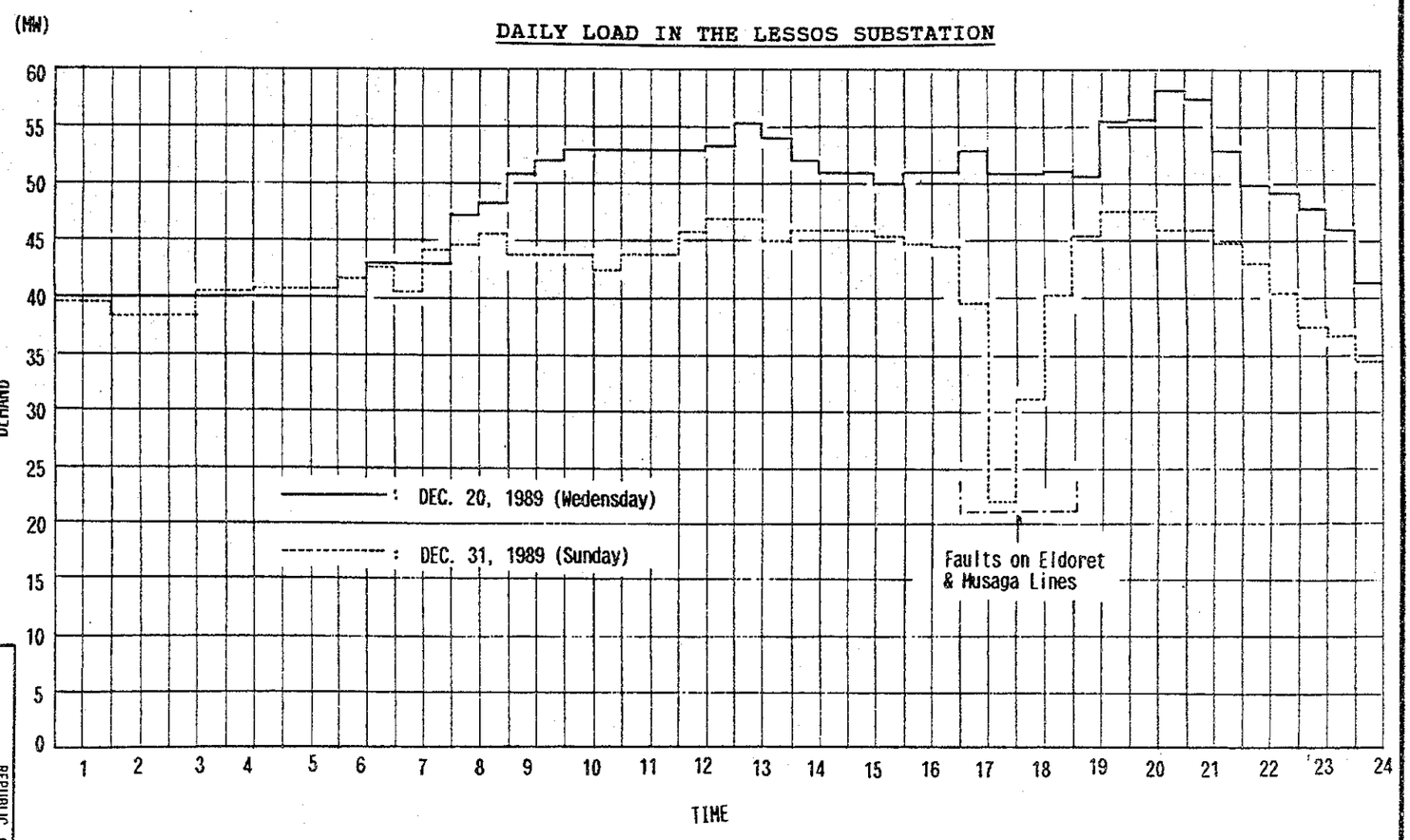

Figure 4.4 Load Patterns

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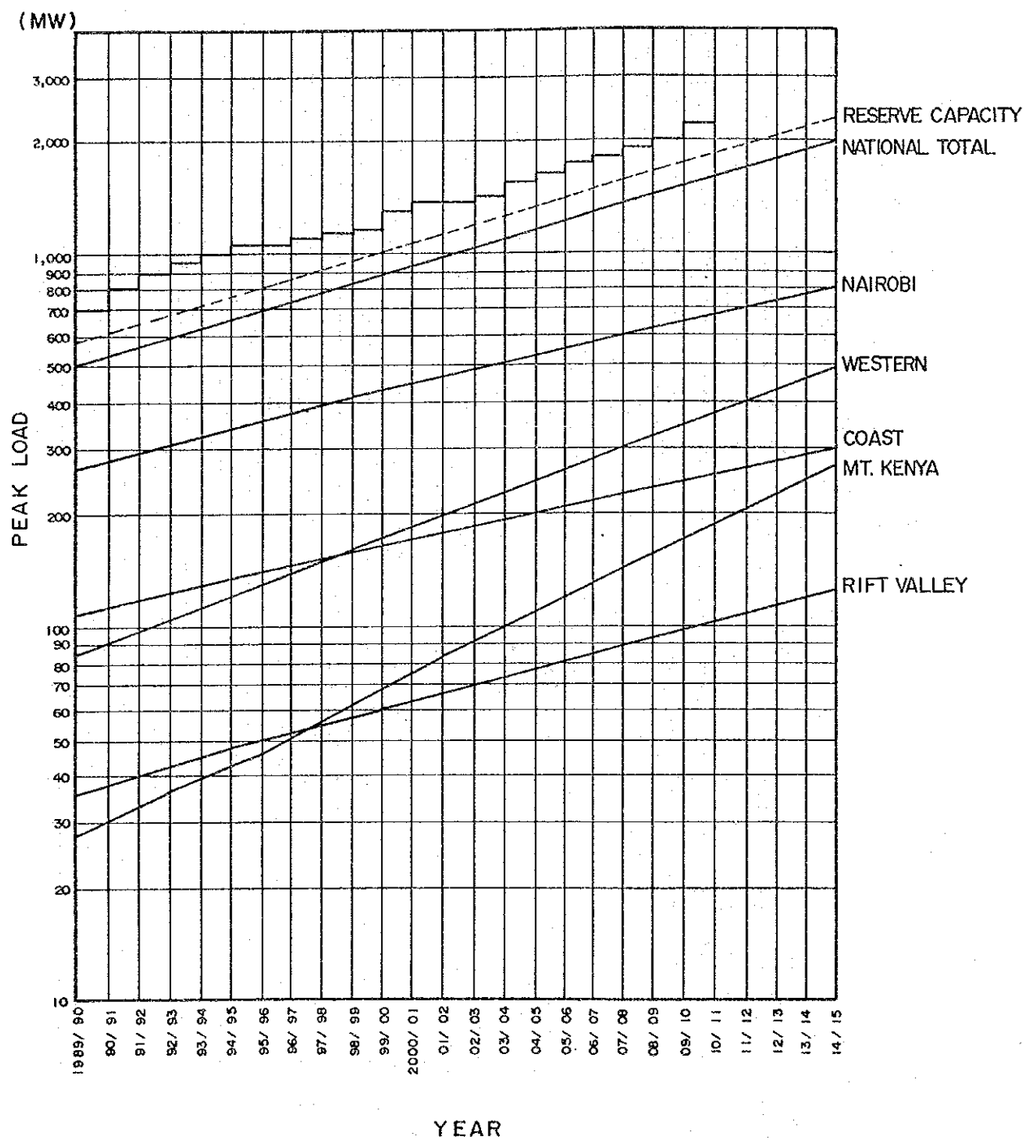

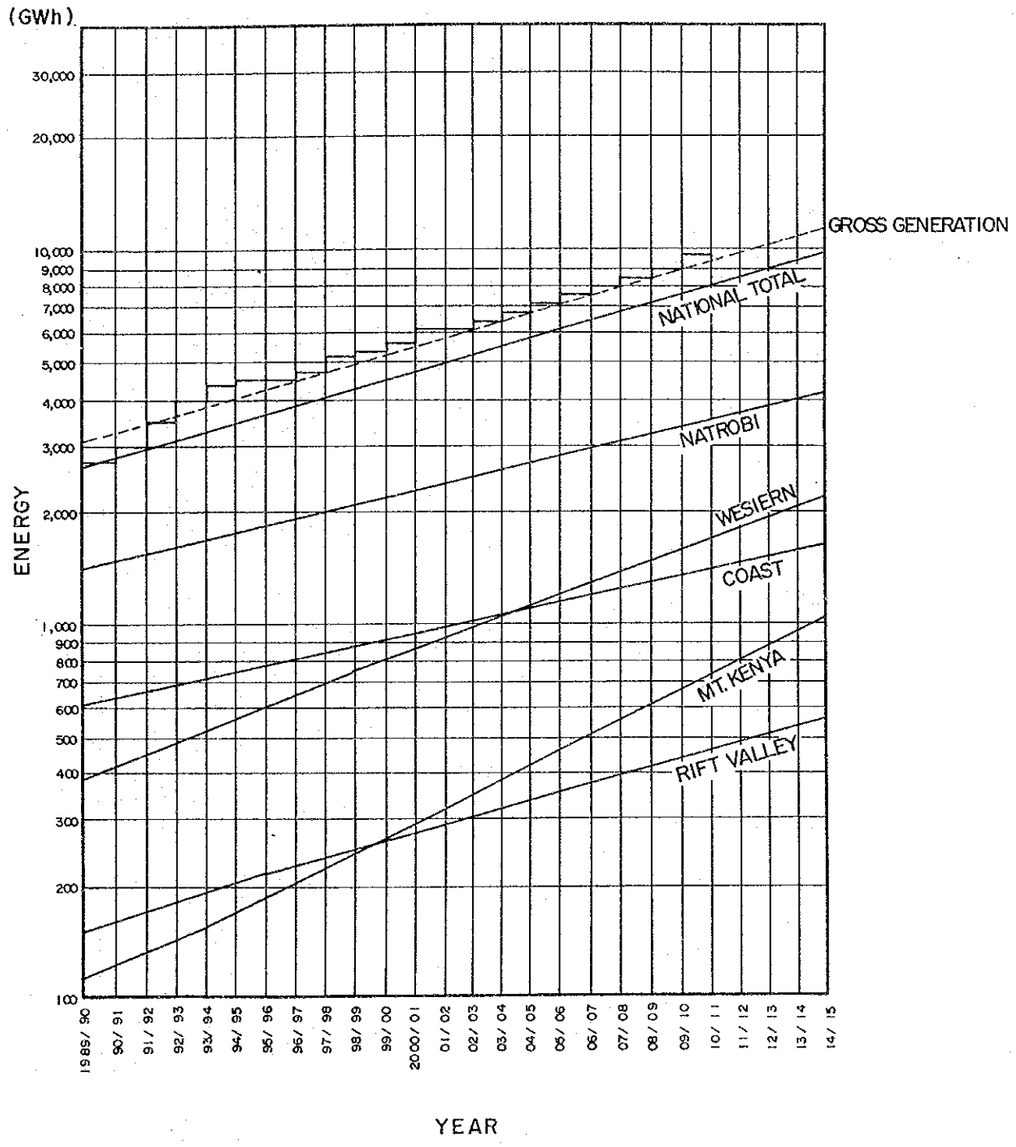

Figure 4.5 Demand Forecast (Mediam)

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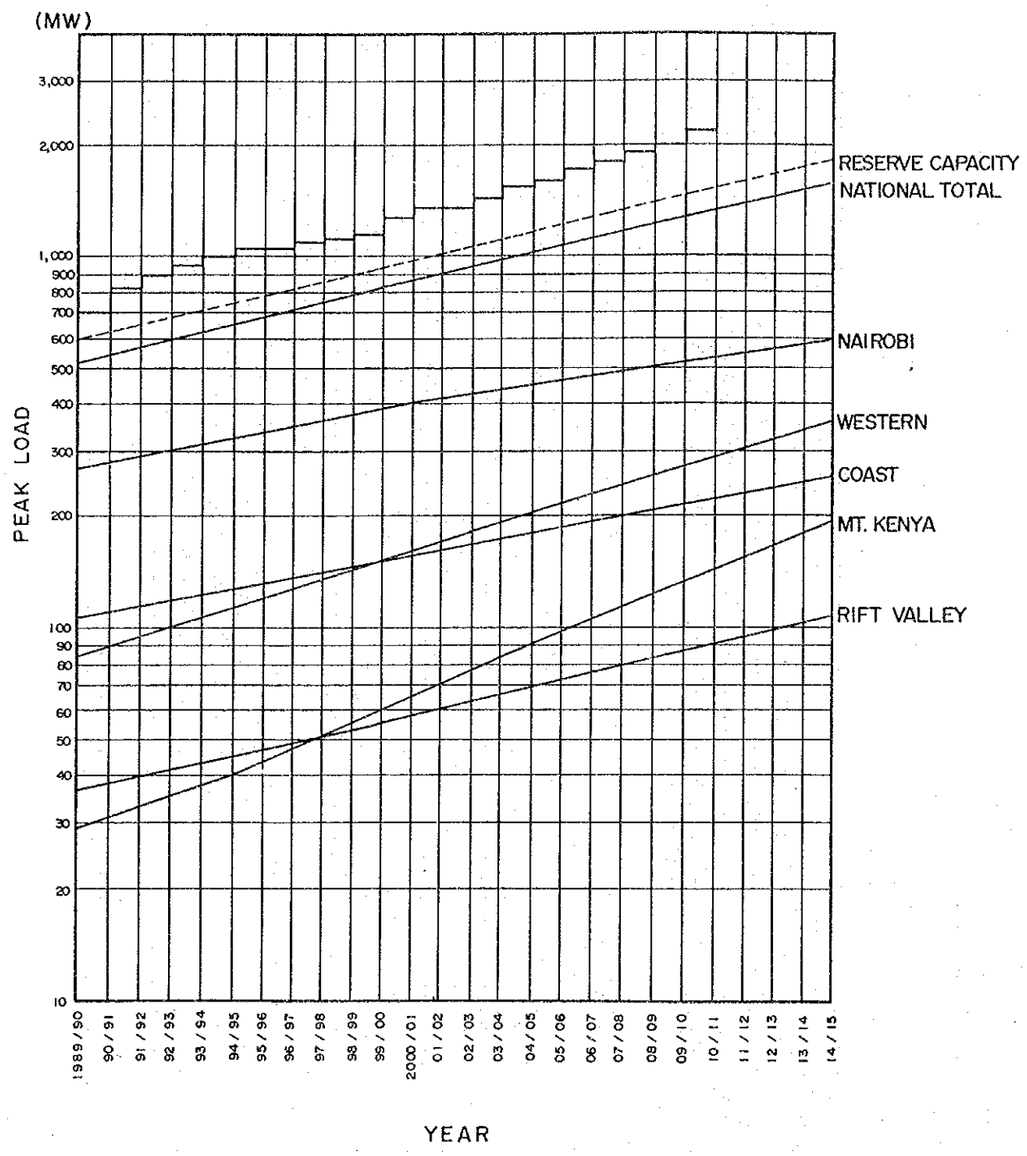

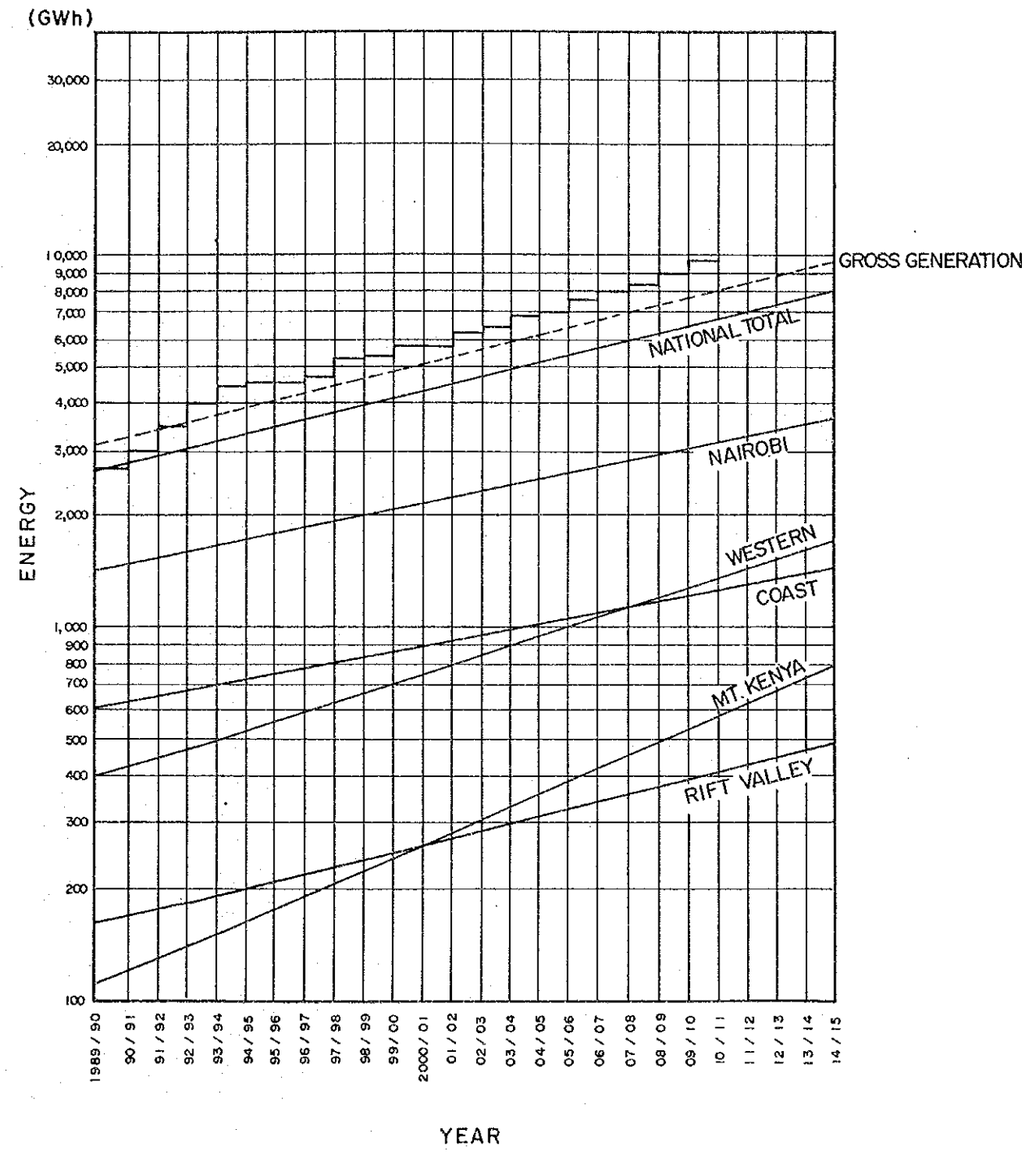

Figure 4.6 Demand Forecast (Low)

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