Table 8.11 Disbursement Schedule for Low Grand Falls Scheme

Unit 1,000 US$,1,000 KShs.

Description	Total		1998		1999		2000		2001		2002		2003		2004		2005		2006		2007		2008	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Civil works	146,159.25	3,485,976	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	32,811.36	778,720	18,978.23	399,470	34,422.49	874,314	38,899.56	943,245	21,077.61	490,228	0.00	0
2. Metal work	26,359.81	259,866	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	5,276.97	0	0.00	0	9,234.70	116,940	9,234.70	116,940	2,638.48	25,986
3. Generating equipment	43,213.23	244,035	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	8,642.65	0	0.00	0	4,321.32	24,404	25,927.94	170,825	4,321.32	48,807
4. Transmission line and substation equipment	12,951.14	258,295	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	2,590.23	0	4,532.90	77,488	4,532.90	154,977	1,295.11	25,830
Total(1 to 4)	228,738.46	4,248,172	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	32,811.36	778,720	32,897.85	399,470	37,012.72	874,314	56,988.48	1,162,077	60,773.15	932,970	8,254.91	100,623
5. Land aquisition and compensation	0.00	407,220	0.00	0	0.00	0	0.00	0	0.00	101,805	0.00	203,610	0.00	101,805	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6. Administration expenses	0.00	83,000	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	12,753	0.00	10,650	0.00	14,365	0.00	21,197	0.00	21,074	0.00	2,731
7. Engineering services																								
Detailed design	11,333.00	108,000	0.00	0	0.00	0	2,266.60	21,600	6,799.80	64,800	2,266.60	21,600	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Supervision	18,291.00	174,301	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	2,810.00	26,781	2,398.00	22,848	3,166.00	30,167	4,671.00	44,514	4,644.00	44,255	602.00	5,736
Subtotal	29,624.00	282,301	0.00	0	0.00	0	2,266.60	21,600	6,799.80	64,800	2,266.60	21,600	2,810.00	26,781	2,398.00	22,848	3,166.00	30,167	4,671.00	44,514	4,644.00	44,255	602.00	5,736
Total(1 to 7)	258,362.46	5,020,693	0.00	0	0.00	0	2,266.60	21,600	6,799.80	166,605	2,266.60	225,210	35,621.36	920,059	35,295.85	433,198	40,178.72	918,846	61,659.48	1,227,788	65,417.15	998,299	8,856.91	109,090
8. Physical contingency	21,708.22	463,960	0.00	0	0.00	0	226.66	2,160	679.98	16,661	226.66	22,521	3,562.14	92,006	2,833.60	43,320	3,888.36	91,885	5,261.50	111,837	4,556.94	77,693	472.95	5,827
Total(1 to 8)	280,070.25	5,484,653	0.00	0	0.00	0	2,493.26	23,760	7,479.78	183,266	2,493.26	247,731	39,183.50	1,012,065	38,129.45	476,518	44,067.08	1,010,731	66,920.98	1,339,625	69,974.09	1,075,992	9,329.86	114,967
9. Price escalation	62,849.74	0	0.00	0	0.00	0	149.01	0	780.72	0	660.65	0	6,667.22	0	6,451.46	0	10,058.05	0	16,823.07	0	18,609.27	0	2,649.29	0
Grand total	342,919.99	5,484,653	0.00	0	0.00	0	2,642.27	23,760	8,260.50	183,266	3,153.91	247,731	45,850.72	1,012,065	41,580.91	476,518	54,125.13	1,010,731	83,744.05	1,339,625	88,583.36	1,075,992	11,979.15	114,967

Table 8.12 Disbursement Schedule for Mutonga Scheme

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

Description	Total		2006		2007		2008		2009		2010		2011		2012	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Civil works	63,557.53	1,566,767	0.00	0	0.00	0	21,787.37	502,784	12,361.49	268,000	20,109.77	546,363	9,296.23	249,573	2.67	48
2. Metal work	18,050.16	156,141	0.00	0	0.00	0	3,610.04	0	0.00	0	6,317.56	70,264	6,317.56	70,264	1,805.00	15,613
3. Generating equipment	30,538.08	174,230	0.00	0	0.00	0	6,107.62	0	0.00	0	3,053.81	17,423	18,322.85	121,961	3,053.81	34,846
4. Transmission line and substation equipment	7,228.71	73,312	0.00	0	0.00	0	0.00	0	1,445.74	0	0.00	0	5,060.10	51,318	722.87	21,994
Total(1 to 4)	119,374.48	1,970,450	0.00	0	0.00	0	31,505.03	502,784	13,807.23	268,000	29,481.14	634,050	38,996.74	493,116	5,584.35	72,501
5. Land aquisition and compensation	0.00	89,402	0.00	44,701	0.00	44,701	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6. Administration expenses	0.00	42,083	0.00	0	0.00	0	0.00	11,020	0.00	5,068	0.00	11,130	0.00	12,995	0.00	1,670
7. Engineering services																
Detailed design	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Supervision	10,312.00	98,264	0.00	0	0.00	0	2,429.00	23,143	1,117.00	10,643	2,453.00	23,373	2,864.00	27,289	1,449.00	13,816
Subtotal	10,312.00	98,264	0.00	0	0.00	0	2,429.00	23,143	1,117.00	10,643	2,453.00	23,373	2,864.00	27,289	1,449.00	13,816
Total(1 to 7)	129,686.48	2,200,199	0.00	44,701	0.00	44,701	33,934.03	536,947	14,924.23	283,711	31,934.14	668,553	41,860.74	533,400	7,033.35	88,187
8. Physical contingency	10,177.80	199,836	0.00	4,470	0.00	4,470	2,907.52	53,695	1,420.14	28,371	2,724.85	62,471	2,701.05	41,163	424.24	5,196
Total(1 to 8)	139,864.28	2,400,035	0.00	49,171	0.00	49,171	36,841.55	590,642	16,344.37	312,082	34,658.99	731,024	44,561.79	574,563	7,457.59	93,383
9.Price escalation	50,575.55	0	167.00	0	188.49	0	11,046.59	0	5,659.23	0	13,538.39	0	16,919.37	0	3,056.48	0
Grand total	190,439.83	2,400,035	167.00	49,171	188.49	49,171	47,888.14	590,642	22,003.60	312,082	48,197.38	731,024	61,481.16	574,563	10,514.07	93,383

Table 8.13 Detailed Construction Cost for Low Grand Falls Scheme (1/3)

Description	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
			Unit Price	Amount	Unit Price	Amount
1 Civil Wks						
1.1 Preparatory Works (General item 10%)	L.S.			6,961,393.06		165,993,878
1.2 Diversion Tunnel						
Site clearance	m2	1,600	0.05	80.00	0.80	1,280
Excavation,common	m3	7,960	2.89	23,004.40	51.85	412,726
Excavation,weathered rock	m3	18,570	4.14	76,879.80	72.05	1,337,969
Excavation,rock	m3	1,000	10.16	10,160.00	148.38	148,380
Excavation tunnel	m3	95,250	53.48	5,095,574.40	820.15	78,143,892
Rock bolt	m	18,080	16.41	296,692.80	279.34	5,050,467
Shotcrete for tunnel	m2	13,240	16.13	213,561.20	350.22	5,034,113
Shotcrete for slope protection	m2	2,110	15.22	32,114.20	423.14	892,825
Concrete ,structure	m3	2,240	56.44	126,425.60	2,003.07	4,488,077
Concrete,tunnel	m3	24,050	57.83	1,390,811.50	2,065.19	49,667,820
Concrete ,plug	m3	770	57.83	44,529.10	2,065.19	1,590,196
Form work,structure	m2	3,290	2.60	8,554.00	540.90	1,779,561
Form work,tunnel	m3	770	15.74	12,119.80	65.55	50,474
Reinforcement	ton	430	686.48	295,186.40	19,845.68	8,533,642
Consolidation grout	m	550	86.89	50,396.20	2,004.09	1,162,372
Curtain grout	m	600	108.39	65,034.00	2,475.34	1,485,204
Backfill grout	m3	1,650	60.17	101,085.60	1,479.30	2,485,224
Others (5%)	L.S.			392,110.45		8,113,711
Subtotal				8,234,319.45		170,387,933
1.3 Cofferdam						
Upstream cofferdam						
Site clearance	m2	18,100	0.05	905.00	0.80	14,480
Excavation,common	m3	40,720	3.56	144,963.20	44.39	1,807,561
Excavation,weathered rock	m3	10,180	5.12	52,121.60	74.73	760,751
Excavation,rock	m3	500	10.28	5,140.00	136.10	68,050
Embankment,core	m3	33,640	5.38	180,983.20	96.00	3,229,440
Embankment,filter	m3	21,240	9.50	201,780.00	193.91	4,118,648
Embankment,rock	m3	116,460	9.23	1,074,925.80	129.12	15,037,315
Embankment,riprap	m3	14,440	10.85	156,674.00	245.58	3,546,175
Downstream cofferdam						
Site clearance	m2	3,920	0.05	196.00	0.80	3,136
Excavation,common	m3	11,330	3.56	40,334.80	44.39	502,939
Excavation,weathered rock	m3	2,840	5.12	14,540.80	74.73	212,233
Excavation,rock	m3	500	10.28	5,140.00	136.10	68,050
Embankment core	m3	5,510	5.38	29,643.80	96.00	528,960
Embankment filter	m3	4,180	9.50	39,710.00	193.91	810,544
Embankment,rock	m3	9,930	9.23	91,653.90	129.12	1,282,162
Embankment riprap	m3	3,100	10.85	33,635.00	245.58	761,298
Others(5%)	L.S.			103,617.36		1,637,587
Subtotal				2,175,964.46		34,357,329
1.4 Main Dam						
Reservoir clearance	ha	3,000	450.00	1,350,000.00	8,010.00	24,030,000
Rockfill dam						
Site clearance	m2	181,000	0.05	9,050.00	0.80	144,800
Excavation common	m3	284,640	3.56	1,013,318.40	44.39	12,635,170
Excavation,weathered rock	m3	160,200	5.12	820,224.00	74.73	11,971,746
Excavation rock	m3	32,550	10.28	334,614.00	136.10	4,430,055
Embankment core	m3	597,000	5.38	3,212,344.20	96.00	57,320,640
Embankment,filter	m3	438,660	9.50	4,167,270.00	193.91	85,060,561
Embankment,shell	m3	1,632,420	9.23	15,067,236.60	129.12	210,778,070
Embankment riprap	m3	216,640	10.85	2,350,544.00	245.58	53,202,451
Concrete dam						
Site clearance	m2	44,000	0.05	2,200.00	0.80	35,200
Excavation,common	m3	138,630	3.56	493,522.80	44.39	6,153,786
Excavation,weathered rock	m3	452,100	5.12	2,365,952.00	74.73	34,532,733
Excavation,rock	m3	323,470	10.28	3,325,271.60	136.10	44,024,267
Fill and backfill	m3	24,640	3.46	85,254.40	62.21	1,532,854
Mass concrete(RCC)						
Interior concrete RCC	m3	770,340	51.56	39,718,730.40	1,326.11	1,021,555,577
External concrete and structural concrete	m3	404,330	60.71	24,545,874.30	1,927.40	779,305,642
Reinforcement	ton	670	656.43	439,941.60	19,845.68	13,296,606
Formwork,upstream and downstream	m2	94,750	10.07	954,132.50	293.51	27,810,073
Formwork for structural portion	m2	31,450	2.60	81,770.00	540.90	17,011,305
Formwork for joint portion	m2	62,270	10.07	627,058.90	293.51	18,276,868
Steel plate for joint	m2	36,770	3.31	121,708.70	18.00	661,860
Waterstop,drain pipe,etc for joint	m	1,860	98.92	183,991.20	801.90	1,491,534
Crest bridge, 5.0m wide, 16m long	nos.	6	15,300.00	91,800.00	900,000.00	5,400,000
Crest asphalt pavement	m2	7,320	5.72	41,870.40	117.95	863,394
Drilling and grouting						
Consolidation grout	m	16,200	86.89	1,407,618.00	2,004.09	32,466,258
Curtain grout	m	23,300	108.39	2,525,487.00	2,475.34	57,675,422
Measuring apparatus (1%)	L.S.			1,053,577.85		25,216,669

Table 8.13 Detailed Construction Cost for Low Grand Falls Scheme (2/3)

Description	Unit	Quantity	Foreign Currency (US$) Unit Price	Foreign Currency (US$) Amount	Local Currency (KShs) Unit Price	Local Currency (KShs) Amount
Borrow area						
Clearance	ha	100	450.00	45,000.00	8,010.00	801,000
Spoil overburdem	m3	30,000	2.68	80,400.00	48.22	1,446,600
Quarry site						
Clearance	ha	50	450.00	22,500.00	8,010.00	400,500
Spoil overburdm	m3	15,000	2.95	44,250.00	52.50	787,500
Others (5%)	L.S			5,330,175.64		127,515,957
Subtotal				111,933,688.43		2,677,835,097
1.5 Hip Bucket						
Site clearance	m2	13,760	0.05	688.00	0.80	11,008
Excavation,common	m3	16,530	3.56	58,846.80	44.39	733,767
Excavation,weathered rock	m3	55,090	5.12	282,060.80	73.73	4,116,876
Excavation rock	m3	38,560	10.28	396,396.80	136.10	5,248,016
Others (5%)	L.S.			36,899.62		565,483
Subtotal				774,892.02		10,615,150
1.6 Intake						
Concrete structure	m3	1,880	59.04	110,995.20	2,038.59	3,832,549
Formwork, structure	m2	3,090	2.60	8,034.00	540.90	1,671,381
Reinforcement	ton	60	656.43	41,188.56	19,845.68	1,190,741
Others (5%)	L.S			8,010.90		334,734
Subtotal				168,228.90		7,029,405
1.7 Power Station						
Powerhouse						
Site clearance	m2	20,000	0.05	1,000.00	0.80	16,000
Excavation common	m3	11,620	2.89	33,581.80	51.85	602,497
Excavation,weathered rock	m3	38,720	4.14	160,300.80	72.05	2,789,776
Excavation,rock	m3	27,100	10.16	275,336.00	148.38	4,021,098
Fill and backfill	m3	12,260	3.46	42,419.60	62.21	762,695
Anchor bar	m	50	12.66	633.00	146.21	7,311
Concrete,superstructure	m3	1,680	58.36	98,044.80	2,109.10	3,543,288
Concrete,substructure	m3	12,960	59.04	765,158.40	2,038.59	26,420,126
Secondary concrete around equipment	m3	1,440	58.36	84,038.40	2,109.10	3,037,104
Reinforcement	ton	810	686.48	556,048.80	19,845.68	16,075,001
Formwork, structure	m2	22,000	2.60	57,200.00	540.90	11,899,800
Road pavement	m2	4,480	12.18	54,566.40	233.69	1,046,931
Fence	m	1,120	31.50	35,280.00	1,701.00	1,905,120
Gate	L.S.			3,000.00		162,000
Fanking for powerhouse	m	3,050	11.48	35,014.00	109.35	333,518
Architectural building						
Powerhouse building	L.S			933,075.00		27,130,950
Diesel generator house	L.S			42,705.00		1,241,730
Guard house,dam site	L.S			25,038.00		728,028
Guard house powerhouse	L.S.			25,038.00		728,028
Others (5%)	L.S			51,330.47		1,492,895
Subtotal				3,278,518.47		103,943,895
1.8 Tailrace and Outlet Channel						
Excavation,common	m3	21,340	2.89	61,672.60	51.85	1,106,479
Excavation,weathered rock	m3	71,110	4.14	294,395.40	72.05	5,123,476
Excavation,rock	m3	49,780	10.16	505,764.80	148.38	7,386,356
Fill and backfill	m3	500	3.46	1,730.00	62.21	31,105
Anchor bar	m3	4,340	12.66	54,944.40	146.21	634,551
Concrete,structure	m3	26,500	59.04	1,569,873.60	2,038.59	54,206,108
Formwork,structure	m2	10,270	2.60	26,702.00	540.90	5,555,043
Reinforcement	ton	800	686.48	549,184.00	19,845.68	15,876,544
Others (5%)	L.S.			153,213.34		4,495,983
Subtotal				3,217,480.14		94,415,646
1.9 Switchyard						
Site clearance	m2	8,160	0.05	408.00	0.80	6,528
Excavation,common	m3	8,250	2.89	23,842.50	51.85	427,763
Excavtion weathered rock	m3	27,450	4.14	113,757.20	72.05	1,979,934
Excavation,rock	m3	19,240	10.16	195,478.40	148.38	2,854,831
Fill and backfill	m3	1,900	3.46	3,460.00	62.21	62,210
Concrete,structure	m3	1,100	59.04	64,944.00	2,038.59	2,242,449
Formwork,structure	m2	4,200	2.60	10,920.00	540.90	2,271,780
Reinforcement	ton	35	656.43	24,026.80	19,845.68	694,599
Others (5%)	L.S.			21,842.35		527,005
Subtotal				458,689.25		11,067,093

Table 8.13 Detailed Construction Cost for Low Grand Falls Scheme (3/3)

Description	Unit	Quantity	Foreign Currency (US$) Unit Price	Foreign Currency (US$) Amount	Local Currency (KShs) Unit Price	Local Currency (KShs) Amount
1.10 Access Road and Base Camp						
Access road						
Access road,new permanent road Kiambere to Low Grand Falls	km	52.2	108,900.00	5,684,580.00	2,070,000.00	108,054,000
Bridge construction						
Mussa River bridge, 20m	L.S.			106,200.00		3,438,000
Dhua River bridge, 20m	L.S.			106,200.00		3,438,000
Ngeukya River bridge, 20m	L.S.			50,400.00		1,872,000
Uloni River bridge, 20m	L.S.			50,400.00		1,872,000
Mukindu River bridge,20m	L.S.			50,400.00		1,872,000
Kanyaka River bridge, 40m	L.S.			100,800.00		3,744,000
Konyu River bridge, 100m	L.S.			252,000.00		9,360,000
Kamura River bridge, 80m	L.S.			201,600.00		7,488,000
Kalinge River bridge, 60m	L.S.			151,200.00		5,616,000
Upgrading existing road for construction use	km	20	48,600.00	972,000.00	909,000.00	18,180,000
Base camp construction at Low Grand Falls	L.S.			1,260,000.00		45,360,000
Subtotal				8,955,780.00		210,294,000
Total (Civil Works)				146,189,254.23		3,435,976,430
2 Metal Work						
Diversion tunnel closing gate	ton	280	6,502.50	1,820,700.00	61,965.00	17,350,200
Sand flush gate	ton	960	8,100.00	7,776,000.00	48,600.00	46,656,000
Spillway radial gate,hoist,stoplogs	ton	1,423	6,502.50	9,253,057.50	61,965.00	88,176,195
Intake gate intake trashracks	ton	550	4,500.00	2,662,200.00	43,740.00	25,369,200
Penstock	ton	1,255	3,375.00	4,235,625.00	60,750.00	76,241,250
Powerhouse tailrace gate,hoist	ton	98	6,502.50	637,245.00	61,965.00	6,072,570
Total (Metal Work)				26,384,827.50		259,865,415
3 Generating Equipment						
Turbine	L.S.			14,533,740.00		82,074,600
Generator	L.S.			12,338,910.00		69,680,700
Transformer	L.S.			3,821,850.00		21,582,900
Indoor switchgear	L.S.			7,817,580.00		44,143,600
Ancillary equipment	L.S.			1,671,660.00		9,440,100
Miscellaneous materials	L.S.			2,518,110.00		14,220,000
Transmission line protective relays	L.S.			270,360.00		1,527,300
PLC communication	L.S.			241,020.00		1,360,500
Total (Generating Equipment)				43,213,230.00		244,035,000
4 Transmission Line and Substation						
Transmission line	km	45	92,997.00	4,184,865.00	4,639,761.00	205,789,245
Low Grand Falls outdoor switchgear	L.S.			4,247,370.00		23,935,900
Extension of Kiambere substation	L.S.			4,518,900.00		25,519,500
Totah Transmission Line and Substation)				12,951,135.00		258,294,645
Total (1 to 4)				228,738,446.73		4,248,171,490
5 Land Acquisition and Compensation						
Land acquisition for construction area reservoir area and buffer zone	L.S.			0.00		134,760,000
Compensation for resettlement	L.S.			0.00		137,460,000
Infrastructure	L.S.			0.00		108,000,000
Water supply facilities for resettlement area	L.S.			0.00		27,000,000
Total (Land acquisition and compensation)				0.00		407,220,000
6 Administration Expenses	L.S.			0.00		83,000,000
7 Engineering Services						
Detailed design	L.S.			11,333,000.00		108,000,000
Construction supervision	L.S.			18,291,000.00		174,300,000
Total (Engineering Services)				29,624,000.00		282,300,000
Total (1 to 7)				258,362,446.73		5,020,691,490
8 Physical Contingency	L.S.			21,708,785.05		463,959,396
Total (1 to 8) Excluding price escalation.				280,071,231.78		5,484,650,886
Remarks :						
Engineering services for detail design						
Low Grand Falls : 220 M.M						
Matonga : 180 M.M						
Detail design				11,333,000.00		108,000,000

Table 8.14 Detailed Construction Cost for Mutonga Scheme

Description	Unit	Quantity	Foreign Currency (US$) Unit Price	Foreign Currency (US$) Amount	Local Currency (KShs) Unit Price	Local Currency (KShs) Amount
1 Civil Works						
1.1 Preparatory Works (General Item 10.1)	L.S.			5,777,596.35		142,433,457
1.2 Diversion Tunnel						
Site clearance	m2	2,590	0.05	129.50	0.80	2,072
Excavation common	m3	7,360	2.89	21,359.40	51.85	385,631
Excavation,weathered rock	m3	17,410	4.14	72,077.40	72.05	1,254,331
Excavation,rock	m3	1,000	10.16	10,150.00	148.38	148,380
Excavation tunnel	m3	83,610	53.48	4,471,462.80	820.15	68,572,742
Fill and backfill	m3	3,600	3.46	12,456.00	62.21	223,956
Rock bolt	m	9,270	16.41	152,120.70	279.54	2,589,482
Shotcrete for tunnel	m2	6,660	16.13	107,425.80	380.22	2,532,265
Shotcrete for slope protection	m2	1,300	15.22	16,742.00	423.14	465,454
Concrete structure	m3	3,160	55.44	175,350.40	2,008.07	6,345,501
Concrete tunnel	m3	20,590	57.83	1,208,068.70	2,065.19	43,141,819
Concrete plug	m3	1,620	57.83	93,684.60	2,065.19	3,345,608
Formwork structure	m2	3,180	2.60	8,268.00	540.90	1,720,062
Formwork tunnel	m3	22,510	15.74	359,039.40	65.55	1,475,196
Reinforcement	ton	410	686.48	281,456.50	19,845.68	8,136,729
Consolidation grout	m	216	86.89	18,768.24	2,004.09	432,883
Curtain grout	m	360	108.39	39,020.40	2,475.34	891,122
Backfill grout	m3	840	60.17	50,542.80	1,439.30	1,209,612
Others (5%)	L.S.			355,066.15		7,136,354
Subtotal				7,456,389.09		150,073,428
1.3 Cofferdam						
Upstream cofferdam						
Site clearance	m2	19,300	0.05	965.00	0.80	15,440
Excavation common	m3	50,730	3.56	180,741.20	44.39	2,253,680
Excavation,weathered rock	m3	12,700	5.12	65,024.00	74.73	949,071
Excavation,rock	m3	500	10.28	5,140.00	136.10	68,050
Embankment core	m3	39,259	4.96	194,875.44	68.35	3,471,193
Embankment filter	m3	22,625	9.50	214,937.50	193.91	4,387,214
Embankment rock	m3	108,592	7.58	822,749.36	107.46	11,663,923
Embankment riprap	m3	15,640	9.20	143,888.00	223.92	3,502,109
Downstream cofferdam						
Site clearance	m2	4,200	0.05	210.00	0.80	3,360
Excavation,common	m3	10,440	3.56	37,237.60	44.39	464,319
Excavation,weathered rock	m3	2,620	5.12	13,414.40	74.73	195,793
Excavation rock	m3	500	10.28	5,140.00	136.10	68,050
Embankment core	m3	5,740	4.96	28,470.40	68.35	507,129
Embankment filter	m3	3,740	9.50	35,910.00	193.91	232,950
Embankment rock	m3	7,090	7.58	53,742.20	107.46	761,814
Embankment riprap	m3	2,670	9.20	24,748.00	223.92	602,345
Others(5%)	L.S.			91,359.51		1,482,323
Subtotal				1,915,549.61		31,126,564
1.4 Main Dam						
Reservoir clearance	ha	1,300	450.00	585,000.00	8,010.00	10,413,000
Concrete dam						
Site clearance	m2	24,200	0.05	1,210.00	0.80	19,360
Excavation,common	m3	66,960	3.56	238,377.60	44.39	2,972,354
Excavation,weathered rock	m3	223,150	5.12	1,142,681.60	74.73	16,678,241
Excavation,rock	m3	156,230	10.28	1,606,044.40	136.10	21,262,903
Fill and backfill	m3	27,550	3.46	95,323.00	62.21	1,713,555
Mass concrete (Concrete dam)						
Interior concrete	m3	217,300	63.35	13,722,474.00	1,523.67	331,093,491
External concrete and structural concrete	m3	139,360	69.01	13,658,823.60	1,966.37	390,049,853
Reinforcement	ton	840	686.48	569,778.40	19,845.68	16,471,914
Formwork upstream and downstream	m2	44,170	10.07	444,791.90	293.51	12,964,347
Formwork for joint portion	m2	18,130	10.07	182,569.10	293.51	5,321,336
Formwork for structural portion	m2	5,750	10.07	58,203.60	293.51	1,666,468
Waterstop,drain pipe etc for joint	m	950	74.82	71,079.00	605.70	575,415
Crest bridge, 5.0 m wide and 17.5m long	nos	4	16,200.00	64,800.00	990,000.00	3,960,000
Crest asphalt pavement	m2	5,620	5.72	32,146.40	117.95	662,879
Drilling and grouting						
Consolidation grout	m	7,900	86.89	686,431.00	2,004.09	15,832,311
Curtain grout	m	11,600	108.39	1,257,324.00	2,475.34	28,713,944
Measuring apparatus (1%)	L.S.			344,970.59		8,604,010
Quarry site						
Clearance	ha	50	450.00	22,500.00	8,010.00	400,500
Spoil overburdem	m3	15,000	2.95	44,250.00	52.50	787,500
Others (5%)	L.S.			1,745,434.66		43,509,651
Subtotal				36,654,218.15		913,702,674
1.5 Stilling Basin						
Site clearance	m2	13,300	0.05	665.00	0.80	10,640
Excavation common	m3	36,400	2.89	105,196.00	51.85	1,887,340
Excavation weathered rock	m3	121,320	4.14	502,264.80	72.05	8,741,106
Excavation rock	m3	84,920	10.16	862,787.20	148.38	12,600,430
Fill and backfill	m3	15,620	3.46	54,045.20	62.21	971,720
Concrete,walll in stilling basin	m3	26,260	59.04	1,550,390.40	2,038.59	53,533,373
Concrete stilling basin base	m3	18,900	54.53	1,030,617.00	1,788.90	33,810,210
Formwork structure	m2	12,540	2.60	32,604.00	540.90	6,836,976
Reinforcement	ton	1,200	686.48	823,776.00	19,845.68	23,814,816
Anchor bar, l = 5m	m	10,900	17.16	160,180.00	125.51	1,387,855
Others (5%)	L.S.			257,139.28		7,176,223
Subtotal				5,399,924.88		150,700,690

Table 8.14 Detailed Construction Cost for Mutonga Scheme

Description	Unit	Quantity	Foreign Currency (US$)		Local Currency (KShs)	
			Unit Price	Amount	Unit Price	Amount
1.6 Intake						
Concrete structure	m3	3 220	59 04	190,168 80	2 038 59	6,564,260
Formwork structure	m2	2 000	2 60	5,200 00	540 90	1,081 800
Reinforcement	ton	100	656 48	68,648 00	19 845 68	1,984,568
Others (5%)	L.S			13,197 84		451,531
Subtotal				277,154 64		10,112 159
1.7 Power Station						
Powerhouse						
Site clearance	m2	14,400	0 05	720 00	0 80	11 520
Excavation common	m3	7,940	2 89	22 945 69	51 85	411,689
Excavation,weathered rock	m3	26,450	4 14	109,503 00	72 05	1,905,723
Excavation rock	m3	18,520	10 16	159,163 20	148 38	2,747,958
Fill and backfill	m3	1,490	3.46	5,155.40	62 21	92 693
Anchor bar	m	50	12 66	633 00	146 21	7,311
Concrete superstructure	m3	1,400	58.36	81,704 00	2 109.10	2,952 740
Concrete substructure	m3	19,800	59 04	633,632 00	2 038 59	22,016,772
Secondary concrete around equipment	m3	1 200	58.36	70,032 00	2 109 10	2 530,920
Reinforcement	ton	670	656.48	439,941 60	19,845 68	13,296,636
Formwork structure	m2	20,000	2 60	52,000 00	540.90	10 818,000
Road pavement	m2	3,800	12 18	46 284 00	233 69	888,022
Fence	m	1,120	31 50	35 280 00	1,701 00	1 905,120
Gate, 2 nos.	L S			3 600 00		162,000
Earthing for powerhouse	m	3,050	11 48	35 014 00	109.35	333,518
Architectural building						
Powerhouse building	L S			933 075 00		27,130 950
Diesel generator house	L S			42,705 00		1,241,730
Guard house dam site	L S			25,038 00		728,028
Guard house powerhouse	L S			25,038 00		728 028
Others (5%)	L S.			51,340 47		1,492 855
Subtotal				2 825,205 27		91,402 260 85
1.8 Tailrace and Outlet Channel						
Excavation common	m3	27,130	2 89	78,405.20	51 85	1,406,691
Excavation,weathered rock	m3	93,440	4 14	374,421 60	72 05	6,516,202
Excavation,rock	m3	63,310	10 16	643 229,60	148 38	9,393,938
Fill and backfill	m3	500	3.46	1,730.00	62 21	31,105
Anchor bar	m3	1,100	12 66	13,926.00	146 21	160 831
Concrete structure	m3	4,490	59 04	265,059.60	2 038 59	9,153 269
Formwork structure	m2	3,370	2 60	8,762 00	540.90	1,822 833
Reinforcement	ton	140	656.48	96,107.20	19 845.68	2,778,395
Others (5%)	L S.			74 083 59		1,563,163
Subtotal				1,555,755 29		32 826,427
1.9 Switchyard						
Site clearance	m2	8,150	0 05	408 00	0.80	6,528
Excavation common	m3	8 250	2 89	23,842 50	51 85	427,763
Excavation,weathered rock	m3	27,450	4 14	113,767 20	72 05	1,979,934
Excavation rock	m3	19 240	10 16	195,478 40	148 38	2,854 931
Fill and backfill	m3	1 000	3 46	3,460 00	62 21	62 210
Concrete structure	m3	4 650	59 04	93,416 00	2 038 59	3,363 674
Formwork structure	m2	6,300	2 60	16,350 00	540 90	3,407 670
Reinforcement	ton	35	656.48	24,026 80	19,845.68	694,599
Others (5%)	L S.			23,735 95		639,860
Subtotal				478,517 85		13,437,068
1.10 Access Road and Base Camp						
Access road						
Access road branched from new permanent road to Mutonga dam	km	6.5	109,930 00	707,850 00	2 070 000 00	13,455,000
Base camp construction at Mutonga site	L S.			456 000 00		17,496 000
Subtotal				1,193,850.00		30,951,000
Total (Civil Works)				63 553,521 24		1,566,768,029
2 Metal Work						
Diversion tunnel closing gate	ton	180	6,502 50	1,170,450 00	61,965.00	11,153,700
Sand flush gate	ton	850	8,100 00	6,450,000 00	48,600 00	38,850,000
Spillway radial gate,hoist trashracks	ton	1,260	6,502 50	8,193,150 00	61,965 00	78,075 900
Intake gate trashracks	ton	200	4,590 00	918,000 00	43,740 00	8,748,000
Penstock	ton	245	3,375 00	826 875.00	60,750 00	14,883,750
Powerhouse tailrace gate,hoist	ton	71	6,502 50	461 677 50	61,965 00	4,399,515
Total (Metal Work)				18 050,152 50		156,140 865
3 Generating Equipment						
Turbine	L S.			9,160,380 00		52 215,300
Generator	L S.			7,526 020 00		43,060,500
Transformer	L S.			2 352 120 00		13,578 300
Indoor switchgear	L S.			7,815 840.00		44,567,100
Ancillary equipment	L S.			1,125,150.00		6,414,300
Miscellaneous materials	L S.			1,743 660.00		9,938,700
Transmission line protective relays	L S.			540 810.00		3 082 500
PLC communication	L S			241 020.00		1,373,400
Total (Generating Equipment)				30,538 650 00		174,230 100
4 Transmission Line and Substation						
Transmission line (Tapping-off section)	km	4 5	176 400 00	793,800 00	8 140,500 00	36 632 250
Mutonga outdoor switchgear	L S			6,434,910 00		36 680,400
Total Transmission Line and Substation)				7 228,710 00		73,312,650
Total (1 to 4)				119,374,463.74		1,970 451,643

Table 8.14 Detailed Construction Cost for Mutonga Scheme

	Description	Unit	Quantity	Foreign Currency (US$)		Local Currency (KSh's)	
				Unit Price	Amount	Unit Price	Amount
5	Land Acquisition and Compensation						
	Land acquisition for construction area reservoir area and buffer zone	L.S			0.00		37,280,000
	Compensation for resettlement	L.S.			0.00		25,122,000
	Water supply facilities for resettlement area	L.S			0.00		27,000,000
	Total (land acquisition and compensation)				0.00		89,402,000
6	Administration Expenses	L.S			0.00		42,083,000
7	Engineering Services						
	Detailed design (incl. Low Grand Falls)	L.S			0.00		0
	Construction supervision	L.S			10,312,000.00		98,264,000
	Total (Engineering Services)				10,312,000.00		98,264,000
	Total (1 to 7)				123,656,463.78		2,200,200,643
8	Physical Contingency	L.S.			10,171,729.25		199,835,884
	Total (1 to 8)				139,554,262.99		2,400,036,527

Excluding price escalation.

Table 9.2.1 Disbursement Schedule of Construction Cost

(US$1,000)

A. Low Grand Falls Scheme

Cost component	Construction cost: Low Grand Falls Scheme												Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
1. Civil works	0	0	0	47,232	26,376	50,613	56,367	30,156	0					210,744
2. Metal work	0	0	0	0	5,277	0	11,400	11,400	3,120					31,197
3. Generating equipment	0	0	0	0	8,643	0	4,773	29,091	5,225					47,732
4. Transmission line & substation equipment	0	0	0	0	0	2,590	5,968	7,403	1,773					17,734
5. Sub-total (1 + 4)	0	0	0	47,232	40,295	53,204	78,508	78,050	10,118					307,408
6. Land aquisition & compensation	0	1,885	3,771	1,885	0	0	0	0	0					7,541
7. Administration expenses	0	0	0	236	201	266	393	390	51					1,537
8. Engineering services	2,667	8,000	2,667	3,306	2,821	3,725	5,495	5,464	708					34,852
9. Detailed dsign	2,667	8,000	2,667	0	0	0	0		0					13,333
10. Supervision	0	0	0	3,306	2,821	3,725	5,495	5,464	708					21,519
11. Sub-total (5 + 8)	2,667	9,885	6,437	52,659	43,318	57,194	84,396	83,904	10,877					351,338
12. Physical contingency	267	989	644	5,266	3,636	5,590	7,333	5,996	582					30,301
13. Sub-total ((11 + 12)	2,933	10,874	7,081	57,925	46,954	62,784	91,729	89,900	11,459					381,639
14. Price escalation	149	781	661	6,667	6,451	10,058	16,823	18,609	2,649					62,849
15. Total financial cost (Incl. price escalation)	3,082	11,654	7,742	64,593	53,405	72,842	108,552	108,509	14,108					444,488
16. Total financial cost (Excl. price escalation)	2,933	10,874	7,081	57,925	46,954	62,784	91,729	89,900	11,459					381,639
17. Total economic cost (Excl. price escalation)	2,611	9,677	6,302	51,554	41,789	55,878	81,639	80,011	10,198					339,659

B. Mutonga Scheme

Cost component	Mutonga							Total
	2006	2007	2008	2009	2010	2011	2012	
1. Civil works	0	0	31,098	17,324	30,228	13,918	4	92,572
2. Metal work	0	0	3,610	0	7,619	7,619	2,094	20,942
3. Generating equipment	0	0	6,108	0	3,376	20,581	3,699	33,765
4. Transmission line & substation equipment	0	0	0	1,446	0	6,010	1,130	8,586
5. Sub-total (1 + 4)	0	0	40,816	18,770	41,223	48,129	6,927	155,864
6. Land aquisition & compensation	828	828	0	0	0	0	0	1,656
7. Administration expenses	0	0	204	94	206	241	35	779
8. Engineering services	0	0	2,858	1,314	2,886	3,369	1,705	12,132
9. Detailed dsign	0	0	0	0	0	0	0	0
10. Supervision	0	0	2,858	1,314	2,886	3,369	1,705	12,132
11. Sub-total (5 + 8)	828	828	43,877	20,178	44,315	51,739	8,666	170,431
12. Physical contingency	83	83	3,902	1,946	3,882	3,463	520	13,878
13. Sub-total ((11 + 12)	911	911	47,779	22,124	48,196	55,202	9,187	184,309
14. Price escalation	167	188	11,047	5,659	13,538	16,919	3,056	50,576
15. Total financial cost (Incl. price escalation)	1,078	1,099	58,826	27,783	61,735	72,121	12,243	234,885
16. Total financial cost (Excl. price escalation)	911	911	47,779	22,124	48,196	55,202	9,187	184,309
17. Total economic cost (Excl. price escalation)	810	810	42,524	19,690	42,895	49,130	8,176	164,035

Table 9.2.2 Cash Flow of Economic Evaluation

(US$1,000)

Year in order	Year	Economic cost				Total	Economic benefit						Total of benefit	Cash balance
		Low Grand Falls S.		Mutonga Scheme			Low Grand Falls Scheme			Mutonga scheme				
		Construction cost	O M and replacement cost	Construction cost	O M and replacement cost		Power value	Energy value	O M cost	Power value	Energy value	O M cost		
1	2000	2,611				2,611							0	-2,611
2	2001	9,677				9,677							0	-9,677
3	2002	6,302				6,302							0	-6,302
4	2003	51,554				51,554							0	-51,554
5	2004	41,789				41,789							0	-41,789
6	2005	55,878				55,878	0						0	-55,878
7	2006	81,639		810		82,449	37,533						37,533	-44,916
8	2007	80,011		810		80,821	62,555						62,555	-18,266
9	2008	10,198	906	42,524		53,628	25,022	25,204	1,230				51,456	-2,172
10	2009		1,811	19,690		21,501	0	50,408	2,459	0			52,867	31,366
11	2010		1,811	42,895		44,706	0	50,408	2,459	16,246			69,113	24,406
12	2011		1,811	49,130		50,941	0	50,408	2,459	27,076			79,943	29,002
13	2012		1,811	8,176	478	10,466	0	50,408	2,459	10,830	11,880	532	76,109	65,644
14	2013		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
15	2014		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
16	2015		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
17	2016		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
18	2017		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
19	2018		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
20	2019		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
21	2020		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
22	2021		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
23	2022		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
24	2023		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
25	2024		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
26	2025		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
27	2026		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
28	2027		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
29	2028		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
30	2029		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
31	2030		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
32	2031		1,811		956	2,768	33,780	50,408	2,459	0	23,759	1,064	111,470	108,703
33	2032		1,811		956	2,768	56,300	50,408	2,459	0	23,759	1,064	133,990	131,222
34	2033		1,811		956	2,768	22,520	50,408	2,459	0	23,759	1,064	100,210	97,443
35	2034		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
36	2035		1,811		956	2,768	0	50,408	2,459	14,621	23,759	1,064	92,312	89,544
37	2036		1,811		956	2,768	0	50,408	2,459	24,368	23,759	1,064	102,059	99,291
38	2037		1,811		956	2,768	0	50,408	2,459	9,747	23,759	1,064	87,438	84,670
39	2038		44,293		956	45,249	0	50,408	2,459	0	23,759	1,064	77,691	32,441
40	2039		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
41	2040		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
42	2041		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
43	2042		1,811		31,007	32,819	0	50,408	2,459	0	23,759	1,064	77,691	44,872
44	2043		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
45	2044		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
46	2045		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
47	2046		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
48	2047		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
49	2048		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
50	2049		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
51	2050		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
52	2051		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
53	2052		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
54	2053		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
55	2054		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
56	2055		1,811		956	2,768	0	50,408	2,459	0	23,759	1,064	77,691	74,923
57	2056		1,811		956	2,768	33,780	50,408	2,459	0	23,759	1,064	111,470	108,703
58	2057		1,926		956	2,882	56,300	50,408	2,459	0	23,759	1,064	133,990	131,108
Total		339,659	132,265	164,035	73,563	709,521	327,789	2,495,196	121,729	102,889	1,081,035	48,431	4,177,068	3,467,547
In the condition of discount rate at 12 %:														
Present value.						229,837							286,710	56,873
Internal rate of return (EIRR).														14.98%
B C														1.25

Table 9.2.3 Cash Flow of Economic Evaluation in the Case of Artificial Flood Release

(US$1,000)

Year in order	Year	Economic cost: Low Grand Falls S. Construction cost	Low Grand Falls S. O/M and replacement cost	Mutonga Scheme Construction cost	Mutonga Scheme O/M and replacement cost	Total	Economic benefit: Low Grand Falls Scheme Power value	Energy value	O/M cost	LGF + Mutonga Power value	Energy value	O/M cost	Total of benefit	Cash balance
1	2000	2,611				2,611							0	-2,611
2	2001	9,677				9,677							0	-9,677
3	2002	6,302				6,302							0	-6,302
4	2003	51,554				51,554							0	-51,554
5	2004	41,789				41,789							0	-41,789
6	2005	55,878				55,878	0						0	-55,878
7	2006	81,639		810		82,449	21,638						21,638	-60,811
8	2007	80,011		810		80,821	36,063						36,063	-44,758
9	2008	10,198	963	47,309		58,470	14,425	18,803	709				33,937	-24,533
10	2009		1,926	21,932		23,858	0	37,606	1,418	0			39,024	15,166
11	2010		1,926	47,721		49,647	0	37,606	1,418	16,552			55,556	5,939
12	2011		1,926	54,581		56,507	0	37,606	1,418	27,604			66,627	10,120
13	2012		1,926	7,722	509	10,157	0	37,606	1,418	11,031	11,905	540	62,510	52,354
14	2013		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
15	2014		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
16	2015		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
17	2016		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
18	2017		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
19	2018		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
20	2019		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
21	2020		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
22	2021		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
23	2022		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
24	2023		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
25	2024		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
26	2025		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
27	2026		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
28	2027		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
29	2028		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
30	2029		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
31	2030		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
32	2031		1,926		1,017	2,943	19,474	37,606	1,418	0	23,810	1,081	83,388	80,445
33	2032		1,926		1,017	2,943	32,456	37,606	1,418	0	23,810	1,081	96,371	93,427
34	2033		1,926		1,017	2,943	12,983	37,606	1,418	0	23,810	1,081	76,897	73,953
35	2034		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
36	2035		1,926		1,017	2,943	0	37,606	1,418	14,912	23,810	1,081	78,827	75,883
37	2036		1,926		1,017	2,943	0	37,606	1,418	24,843	23,810	1,081	88,757	85,814
38	2037		1,926		1,017	2,943	0	37,606	1,418	9,937	23,810	1,081	73,852	70,908
39	2038		49,123		1,017	50,145	0	37,606	1,418	0	23,810	1,081	63,914	13,769
40	2039		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
41	2040		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
42	2041		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
43	2042		1,926		34,406	36,333	0	37,606	1,418	0	23,810	1,081	63,914	27,582
44	2043		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
45	2044		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
46	2045		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
47	2046		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
48	2047		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
49	2048		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
50	2049		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
51	2050		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
52	2051		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
53	2052		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
54	2053		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
55	2054		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
56	2055		1,926		1,017	2,943	0	37,606	1,418	0	23,810	1,081	63,914	60,971
57	2056		1,926		1,017	2,943	19,474	37,606	1,418	0	23,810	1,081	83,388	80,445
58	2057		1,926		1,017	2,943	32,456	37,606	1,418	0	23,810	1,081	96,371	93,427
Total		339,659	142,543	180,885	79,673	742,760	188,968	1,861,497	70,176	104,900	1,083,355	49,166	3,358,061	2,615,301
In the condition of discount rate at 12 %:														
Present value:						235,535							220,282	-15,253
Internal rate of return (EIRR):														11.23%
B/C														0.94

Table 9.2.4 Seasonal Power Generation (1)

(Unit : MW)

	Masinga (Rule 3, Qfirm=70)				Kamburu				Gitaru				Kindaruma				Kiambere (Rule 1, Qfirm=90)			
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1966	37.58	38.81	32.61	31.78	58.73	78.56	54.36	68.14	116.09	135.47	110.31	127.84	31.23	42.27	28.41	36.23	135.92	149.24	118.98	140.77
1967	30.15	35.26	36.64	39.71	52.99	73.83	68.36	81.61	99.94	128.99	133.35	135.47	27.76	40.07	35.89	43.65	119.53	149.11	146.26	149.24
1968	38.76	39.95	38.92	38.32	66.25	82.36	71.24	77.84	129.71	135.47	134.35	135.47	35.15	44.82	37.40	41.99	146.37	149.24	147.13	149.24
1969	38.88	33.14	29.64	29.13	67.81	59.25	51.28	53.65	135.47	120.43	103.42	108.89	35.69	31.24	26.66	28.30	146.82	134.84	117.76	121.30
1970	27.13	35.65	33.64	30.07	52.96	76.92	59.74	55.05	103.08	135.47	121.80	111.43	27.76	40.80	31.40	28.90	117.85	149.24	132.32	127.66
1971	23.98	25.51	26.07	23.92	44.70	62.44	52.11	48.75	92.37	124.81	105.32	97.66	23.64	33.48	27.21	25.97	117.06	141.06	119.77	129.63
1972	20.67	20.66	20.06	23.72	48.29	58.95	49.30	71.41	97.06	119.97	98.93	134.08	25.09	31.31	25.56	38.09	117.77	133.86	118.04	139.15
1973	25.09	25.40	24.52	23.64	52.81	61.88	52.60	57.76	122.87	125.42	106.43	115.63	27.68	32.66	27.42	30.42	125.97	135.58	119.65	128.79
1974	19.25	22.35	24.58	24.29	52.18	57.99	55.38	49.89	105.24	118.48	112.86	100.41	27.32	30.87	29.08	26.08	117.97	137.41	126.08	118.29
1975	23.15	25.45	27.06	29.22	48.75	62.72	52.21	50.93	92.99	124.57	105.56	102.62	25.36	33.26	27.26	26.74	116.06	130.21	120.16	119.47
1976	32.19	28.32	28.89	31.18	52.23	55.45	48.00	53.46	93.13	113.03	96.29	108.46	27.35	29.37	24.84	28.14	117.88	127.52	117.14	117.31
1977	31.73	39.70	36.15	39.14	61.08	82.29	58.05	74.90	98.63	135.47	118.09	134.42	32.18	44.30	30.52	40.03	128.00	149.24	130.99	147.33
1978	39.62	39.74	35.93	36.73	77.08	76.19	58.51	66.98	134.85	133.66	119.03	131.16	41.62	41.07	30.70	35.30	149.24	146.59	129.69	142.94
1979	38.75	39.95	38.62	32.78	61.90	82.36	63.48	62.16	130.49	135.47	129.38	125.36	32.82	44.82	33.48	33.28	143.68	149.24	142.81	143.80
1980	32.10	27.29	26.49	25.74	69.12	75.19	46.71	53.01	96.66	133.84	94.50	107.24	36.59	39.95	24.35	28.10	139.95	149.24	117.01	117.60
1981	24.17	38.90	38.42	32.29	49.16	82.36	65.69	56.35	96.01	135.47	128.68	114.39	25.82	44.82	34.58	29.94	117.45	149.24	140.61	137.47
1982	32.82	36.87	39.27	39.95	53.41	75.39	64.66	81.89	96.26	132.21	129.80	135.47	28.08	40.92	34.02	44.37	122.37	149.24	142.45	149.24
1983	38.48	39.72	39.29	33.12	59.60	79.07	63.38	56.81	128.06	135.47	127.72	115.43	31.46	42.98	33.36	29.92	134.77	149.24	139.27	131.10
1984	36.29	25.38	21.41	25.30	57.13	47.09	43.38	58.02	123.85	95.03	89.27	118.08	30.17	24.67	22.94	31.09	131.61	120.59	113.56	117.73
1985	28.53	39.70	38.96	32.98	51.71	79.68	62.50	57.30	97.46	135.47	127.62	116.26	27.24	43.18	32.93	30.31	123.84	149.24	138.82	136.65
1986	36.72	39.81	39.20	32.67	55.66	78.91	62.77	59.44	117.28	135.47	125.24	120.22	29.31	42.78	33.02	31.72	126.73	149.24	137.05	134.77
1987	37.16	32.47	34.29	32.61	57.03	58.79	55.43	51.32	123.14	119.89	113.02	105.11	30.01	31.40	29.11	27.16	127.25	139.82	123.41	125.97
1988	35.92	39.95	38.37	39.95	54.99	82.36	66.13	82.36	112.65	135.47	132.21	135.47	28.92	44.82	34.76	44.82	118.39	149.24	144.84	149.24
1989	39.95	39.95	39.51	39.95	82.04	82.36	73.66	82.15	135.47	135.47	135.47	135.47	44.19	44.82	39.17	44.36	149.24	149.24	149.09	149.24
1990	39.44	39.95	35.03	36.65	73.33	82.36	57.75	71.33	135.47	135.47	118.10	135.47	39.29	44.82	30.40	37.85	148.06	149.24	128.93	149.24
Avg.	32.34	33.99	32.94	32.19	58.44	71.79	58.27	63.30	112.57	128.64	116.67	120.30	30.87	38.62	30.58	33.71	129.59	143.44	130.47	134.93
Ratio	0.246	0.259	0.251	0.245	0.232	0.285	0.231	0.251	0.235	0.269	0.244	0.252	0.231	0.289	0.229	0.252	0.241	0.266	0.242	0.251

Table 9.2.4 Seasonal Power Generation (2)

(Unit : MW)

	Mutonga (Rule 1,Qfirm=80)				Low Grand Falls (Rule 1,Qfirm=100)				Low Grand Falls (Rule 1,Qfirm=110)				High Grand Falls (Rule 1,Qfirm=120)				Turkwell			
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1966	41.51	55.35	33.03	50.17	81.31	108.87	65.25	94.82	81.79	109.03	65.42	95.60	104.28	139.09	97.41	117.51	49.82	49.60	49.91	50.43
1967	33.22	56.17	44.11	59.19	65.25	115.67	81.90	115.67	65.40	115.67	82.49	115.67	97.45	140.07	103.91	149.07	49.52	49.30	88.46	94.15
1968	51.59	59.19	47.00	55.56	102.10	115.67	90.27	109.53	102.40	115.67	90.84	109.77	129.26	149.07	115.40	137.80	50.36	58.45	73.09	50.30
1969	51.44	48.26	33.56	38.38	104.32	100.93	66.10	74.12	104.68	101.27	66.35	75.02	131.72	131.04	97.54	97.06	49.73	49.36	49.56	49.61
1970	33.92	56.04	36.37	37.26	65.83	108.71	67.57	70.90	65.97	108.96	68.04	71.42	96.78	138.99	97.64	97.26	48.83	48.35	49.24	50.03
1971	31.86	50.56	33.43	40.48	65.08	99.63	64.87	73.53	65.52	100.02	65.03	74.55	96.48	101.81	97.37	96.86	49.21	48.79	49.68	66.36
1972	32.58	40.37	32.27	43.91	64.63	74.92	64.58	89.76	64.69	75.96	64.72	89.93	96.41	96.15	95.61	96.09	50.04	49.46	50.01	50.31
1973	36.68	40.77	32.04	41.35	72.99	74.19	64.00	64.32	73.17	74.99	64.06	65.19	96.94	96.66	95.70	95.02	49.81	48.84	49.06	49.38
1974	31.98	47.37	35.62	37.72	64.20	88.40	68.12	70.43	64.27	89.46	68.40	71.31	94.23	95.33	95.09	94.44	48.59	47.81	48.41	48.45
1975	31.83	41.82	32.59	36.63	64.34	75.31	64.28	64.33	64.39	76.04	64.36	64.50	93.78	93.90	93.05	92.28	47.28	46.41	47.86	49.44
1976	31.02	38.02	31.89	36.73	63.81	64.12	63.41	62.87	64.05	64.44	63.84	63.43	91.32	90.74	89.70	88.69	48.80	48.20	48.68	48.54
1977	38.20	59.19	36.28	51.96	64.26	115.67	70.56	100.36	67.54	115.67	71.10	100.55	88.56	125.83	97.86	131.89	47.59	47.84	49.33	81.83
1978	55.76	55.00	36.50	51.19	111.52	109.79	70.90	105.38	111.65	109.93	71.44	105.75	143.00	140.28	97.90	129.24	54.93	58.14	88.27	50.97
1979	53.73	59.19	42.21	49.08	111.26	115.67	81.36	96.40	111.52	115.67	81.95	96.78	142.59	149.07	104.21	122.05	58.79	59.10	57.16	49.63
1980	48.48	55.46	32.48	43.30	98.50	110.81	65.86	90.49	98.86	111.04	66.16	91.02	125.68	142.34	97.54	103.54	48.39	48.64	48.57	47.61
1981	35.96	59.19	41.78	45.96	76.08	115.67	84.75	95.84	76.58	115.67	85.31	96.36	99.12	149.07	108.95	118.45	47.33	80.81	99.19	50.01
1982	34.17	59.19	40.88	59.19	69.72	115.67	88.83	115.67	70.22	115.67	89.39	115.67	97.82	146.96	113.23	149.07	48.78	49.67	50.10	61.21
1983	38.36	59.19	38.59	42.50	82.99	115.67	77.19	86.44	83.52	115.67	77.73	86.98	107.21	149.07	102.83	104.91	49.62	49.36	85.46	72.15
1984	37.62	33.42	30.61	47.98	74.69	67.95	63.49	97.17	75.18	68.15	63.61	97.98	101.01	97.40	95.97	100.38	49.49	48.54	47.85	47.16
1985	36.70	59.19	38.99	43.80	75.04	115.67	79.54	89.63	75.57	115.67	80.11	90.16	98.32	149.07	103.53	111.09	46.19	47.53	47.85	47.03
1986	35.18	59.19	38.17	48.86	70.84	115.67	77.20	96.85	71.37	115.67	77.70	97.22	98.06	149.07	104.28	127.09	45.76	46.92	48.01	47.24
1987	36.04	46.13	33.56	37.80	75.72	98.19	66.20	74.59	76.18	98.49	66.50	75.41	103.63	121.16	97.55	97.08	45.98	46.92	47.70	47.11
1988	33.47	59.19	41.31	59.19	66.23	115.67	82.46	115.67	66.65	115.67	83.05	115.67	96.80	149.07	104.59	149.07	46.06	47.39	78.55	67.93
1989	57.52	59.19	47.31	59.19	112.50	115.67	93.78	115.67	112.65	115.67	94.22	115.67	144.12	149.07	119.31	149.07	49.42	49.09	49.31	49.72
1990	55.72	59.19	38.25	58.55	111.83	115.67	80.56	114.87	111.99	115.67	81.11	115.00	143.11	149.07	104.73	128.37	50.13	93.26	103.16	85.64
Avg.	40.18	52.63	37.15	47.04	80.60	102.80	73.72	91.41	81.03	103.03	74.12	91.87	108.71	129.57	101.24	115.33	49.22	52.71	60.18	56.49
Ratio	0.227	0.297	0.210	0.266	0.231	0.295	0.212	0.262	0.231	0.294	0.212	0.262	0.239	0.285	0.223	0.254	0.225	0.241	0.275	0.258

Table 9.2.4 Seasonal Power Generation (3)

(Unit : MW

Miriu

	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1966	24.97	49.11	40.10	26.96
1967	5.27	43.31	48.03	34.85
1968	32.32	50.96	50.96	38.68
1969	44.45	41.17	30.46	13.63
1970	34.11	50.96	50.96	34.78
1971	9.08	39.11	50.96	29.64
1972	11.67	34.90	46.08	43.26
1973	41.24	37.87	48.29	36.39
1974	6.54	50.96	50.96	33.02
1975	5.93	45.25	50.96	40.27
1976	8.21	31.02	50.96	19.21
1977	22.78	50.96	50.96	45.80
1978	44.09	50.96	50.96	47.00
1979	43.83	50.96	49.99	14.92
1980	7.27	40.96	46.87	17.45
1981	10.34	49.15	50.96	33.25
1982	5.55	35.68	50.51	50.13
1983	20.60	41.98	50.96	45.08
1984	13.56	16.70	32.86	30.40
1985	12.79	50.96	50.96	27.99
1986	9.44	40.06	41.79	22.47
1987	17.10	45.99	37.87	35.57
1988	22.06	50.96	50.96	43.79
1989	18.67	50.96	48.59	50.75
1990	45.55	50.96	47.45	34.32
Avg.	20.70	44.07	47.22	33.99
Ratio	0.142	0.302	0.323	0.233

Table 9.2.5 List of the Hydropower Plants

Name	Status	Commissioning Year	Retirement Year	Installed Capacity (MW)	Firm Output (MW)	Annual Average Energy (GWh/y)	Forced Outage Rate (%)	Schedule Maintenance (week)
Small Hydro	Existing	1952	2002	28.3	28.3	153.0	2.0	2
Masinga	Existing	1981	2031	40.0	17.7	248.0	2.0	2
Kambru	Existing	1975	2025	84.0	29.3	475.9	2.0	2
Gitaru	Existing	1978	2028	145.0	64.8	961.8	2.0	2
Gitaru 3rd Unit	Committed	1999	2049	72.5	72.5	46.0	2.0	2
Kindaruma	Existing	1968	2018	44.0	16.1	253.2	2.0	2
Kiambere	Existing	1988	2038	140.0	134.4	1004.6	2.0	2
Low Grand Falls	Proposed	2008	2058	140.0	135.3	715.5	2.0	2
Mutonga	Proposed	2012	2062	60.0	58.1	337.5	2.0	2
Turkwel	Existing	1991	2041	106.0	88.7	372.0	2.0	2
Sondu/Miriu	Committed	2002	2052	60.0	59.4	337.0	2.0	2
(Import)	Existing	-	-	30.0	30.0	144.0	-	-
Total				949.8	734.5	5048.4		

Table 9.2.6 List of the Existing and Committed Thermal Plants

Name	Status	Commissioning Year	Retirement Year	Installed Capacity (MW)	Firm Output (MW)	Annual Average Energy (GWh/y)	Forced Outage Rate (%)	Schedule Maintenance (week)	Fuel Type	Fuel Cost (US$/BTU)	Heat Rate (BTU/KWh)	Fixed O&M Cost ($/KW-y)	Variable O&M Cost ($/MWH)
Kipevu NO.6	Existing	1992	2001	25.0	25.0	-	0.15	11	RES	2.313	16115	32.0	3.2
Kipevu NO.7	Existing	1992	2004	30.0	30.0	-	0.15	11	RES	2.313	16115	32.0	3.2
Kipevu CT	Existing	1992	2010	31.0	31.0	-	0.15	3	IDO	3.220	16115	21.0	6.9
NAIROBI CT	Existing	1992	2003	13.5	13.5	-	0.15	3	AGO	5.452	14361	14.5	5.3
Stop-gap 1x44.5	Committed	1997	2004	44.5	44.5	-	0.05	4	RES	2.313	8341	16.0	9.0
Stop-gap 1x43	Committed	1997	2004	43.0	43.0	-	0.06	4	RES	2.313	8341	16.0	9.0
Kipevu I	Committed	1999	2014	75.0	75.0	-	0.06	4	RES	2.313	8341	16.0	9.0
Kipevu II	Committed	1999	2014	75.0	75.0	-	0.06	4	RES	2.313	8341	16.0	9.0
LS DIESEL 1x50	Committed	2000	2020	50.0	50.0	-	0.05	4	HFO	2.026	7868	16.0	4.5
OLKARIA	Existing	1985	2010	45.0	45.0	392.8	0.05	4	-	-	-	-	6.4
OLKARIA II	Committed	2001	2026	64.0	61.4	472.0	0.05	4	-	-	-	-	6.4
OLKARIA III	Committed	2002	2027	64.0	61.4	472.0	0.05	4	-	-	-	-	6.4

Table 9.2.7 List of the Alternative Thermal Plants

Name	Operating Life (Year)	Installed Capacity (MW)	Firm Output (MW)	Annual Average Energy (GWh/y)	Forced Outage Rate (%)	Schedule Maintenance (week)	Fuel Type	Fuel Cost (US$/BTU)	Heat Rate (BTU/KWh)	Fixed O&M Cost ($/KW-y)	Variable O&M Cost ($/MWH)	Installation Cost ($/KW)
Geothermal 2x32	25	64	61.4	472	0.05	4	-	-	-		6.4	1883
LS DIESEL 1x50	20	50.0	50.0	-	0.05	4	HFO	2.026	7868	16.0	4.5	1050
MS DIESEL 1x60	15.0	60.0	60.0	-	0.06	4	LRFO	2.313	8341	16.0	9.0	805

Table 9.2.8 Expansion Plan Proposed by Planting-up Study

YEAR	Hydro (MW)	Geo-THRM (MW)	LS Diesel (MW)	MS Diesel (MW)	Stop-Gap (MW)
1995		2x32			
1996					
1997					1x11.5 1x13
1998					
1999	1x72.5(Gi 3rd)			6x12.5 6x12.5	
2000			1x50		
2001		2x32(Olk II)			
2002	2x30(Miriu)	2x32(Olk III)			
2003					
2004			3x50		-1x11.5 -1x13
2005			1x50		
2006			2x50		
2007			2x50		
2008	1x140(LGF)				
2009			1x50		
2010			4x50		
2011			2x50		
2012	1x60(Muto)		1x50		
2013		2x32	1x50		
2014			6x50		
2015			3x50		
2016			4x50		
2017			3x50		
2018			4x50		
2019		4x32	1x50		

Table 9.2.9 Power Balance of Planting-up Study

Beginning of Operation	Name	Type	Installed Capacity (MW)	Installed Capacity (MW)																						
				1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Existing	Kiyeun #1,6	THERM	25.0	25.0	25.0	25.0	25.0	25.0	25.0																		
Existing	Kiyeun #2,7	THERM	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0																
Existing	Kiyeun #3	THERM	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9										
Existing	Sagami #1	THERM	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0																
Committed	Sagami #4,5	THERM	44.5			44.5	44.5	44.5	44.5	44.5	44.5																
Committed	Sagami #3,4,6	THERM	43.0			43.0	43.0	43.0	43.0	43.0	43.0																
Committed	Kiyeun #5	THERM	75.0					75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0					
Committed	Kiyeun #6	THERM	75.0					75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0					
Committed	LS DIESEL 1x50	THERM	50.0						50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Existing	OLARIA	GEO-THERM	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0								
Committed	OLARIA II	GEO-THERM	61.4							61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
Committed	OLARIA III	GEO-THERM	61.4								61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
Existing	SMALL HYDRO	HYDR	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3																	
Existing	MASPSA	HYDR	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Existing	KAMBUSU	HYDR	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
Existing	GITARU	HYDR	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0
Committed	Gita 3rd	HYDR	72.5					72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
Existing	KINDARUMA	HYDR	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	
Existing	KIAMBERE	HYDR	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0
Proposed	Mutonga	HYDR	60.0																		60.0	60.0	60.0	60.0	60.0	60.0	60.0
Proposed	Ina G/F	HYDR	140.0														140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0
Existing	TURASH	HYDR	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0
Committed	MIRIU	HYDR	60.0								60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Existing	Import	HYDR	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
1995	GEO-THM 2x32	GEO-THERM	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
2013	GEO THM 2x32	GEO-THERM	61.4																			61.4	61.4	61.4	61.4	61.4	61.4
2019	GEO-THM 2x32	GEO-THERM	61.4																								61.4
2001	LS DIESEL 1x50	THERM	50.0										50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2001	LS DIESEL 1x50	THERM	50.0										50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2001	LS DIESEL 1x50	THERM	50.0										50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2005	LS DIESEL 1x50	THERM	50.0											50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2006	LS DIESEL 1x50	THERM	50.0												50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2006	LS DIESEL 1x50	THERM	50.0												50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2007	LS DIESEL 1x50	THERM	50.0													50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2005	LS DIESEL 1x50	THERM	50.0													50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2009	LS DIESEL 1x50	THERM	50.0															50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2010	LS DIESEL 1x50	THERM	50.0																50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2010	LS DIESEL 1x50	THERM	50.0																50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2010	LS DIESEL 1x50	THERM	50.0																50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2010	LS DIESEL 1x50	THERM	50.0																50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
2012	LS DIESEL 1x50	THERM	50.0																		50.0	50.0	50.0	50.0	50.0	50.0	50.0
2013	LS DIESEL 1x50	THERM	50.0																			50.0	50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																				50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																				50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																				50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																				50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																				50.0	50.0	50.0	50.0	50.0
2011	LS DIESEL 1x50	THERM	50.0																					50.0	50.0	50.0	50.0
2015	LS DIESEL 1x50	THERM	50.0																					50.0	50.0	50.0	50.0
2015	LS DIESEL 1x50	THERM	50.0																					50.0	50.0	50.0	50.0
2015	LS DIESEL 1x50	THERM	50.0																						50.0	50.0	50.0
2016	LS DIESEL 1x50	THERM	50.0																						50.0	50.0	50.0
2016	LS DIESEL 1x50	THERM	50.0																						50.0	50.0	50.0
2016	LS DIESEL 1x50	THERM	50.0																						50.0	50.0	50.0
2017	LS DIESEL 1x50	THERM	50.0																							50.0	50.0
2017	LS DIESEL 1x50	THERM	50.0																							50.0	50.0
2017	LS DIESEL 1x50	THERM	50.0																							50.0	50.0
2018	LS DIESEL 1x50	THERM	50.0																								50.0
2018	LS DIESEL 1x50	THERM	50.0																								50.0
2018	LS DIESEL 1x50	THERM	50.0																								50.0
2018	LS DIESEL 1x50	THERM	50.0																								50.0
2019	LS DIESEL 1x50	THERM	50.0																								
Total Installed Capacity (MW)				811.6	811.6	902.1	902.1	1124.6	1174.6	1211.0	1301.1	1291.1	1331.6	1381.6	1481.6	1581.6	1721.6	1771.6	1896.7	1996.7	2105.7	2217.1	2367.1	2517.1	2717.1	2867.1	3023.1	3195.9
Forecasted Peak Load (MW)				670.0	720.0	762.0	812.0	866.0	921.0	981.0	1013.0	1109.0	1179.0	1251.0	1330.0	1411.0	1499.0	1589.0	1698.0	1789.0	1896.0	2012.0	2132.0	2262.0	2396.0	2541.0	2699.0	2852.0
Power Balance (MW)				141.6	91.6	140.1	90.1	258.6	253.6	230.0	261.1	185.1	152.6	130.6	151.6	170.6	222.6	182.6	207.7	206.7	209.7	205.1	235.1	255.1	322.1	326.1	324.1	343.9

Table 9.2.10 Energy Balance of Planting-up Study

Beginning of Operation	Name	Type	Installed Capacity (MW)	Energy Generated (GWh) 1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Existing	Kipevu Mk.6	THERM	25.0	47.1	81.7	2.6	65.2	0.3	0.2																		
Existing	Kipevu Mk.7	THERM	25.0	1.3	66.8	1.5	15.0	0.3	0.2	0.2	0.1	0.6															
Existing	Kipevu GT	THERM	30.9	1.1	17.5	1.2	5.0	0.5	0.4	0.2	0.2	0.3	4.2	2.7	1.9	1.5	0.1	1.4									
Existing	KAMORI GT	THERM	10.6	0.4	0.8	0.3	1.0	0.2	0.1	0.1	0.1																
Committed	SIOEG IX11.5	THERM	11.5			218.1	312.5	310.9	310.9	310.9	278.3	316.6															
Committed	SIOEG IX13.0	THERM	13.6			110.6	221.7	289.5	295.7	265.9	193.7	275.8															
Committed	Kipevu I	THERM	75.0					256.6	278.5	189.3	67.3	200.3	261.6	368.0	158.9	88.1	80.8	149.3	17.6	21.3	20.3	25.6					
Committed	Kipevu II	THERM	75.0					1.7	2.2	2.5	0.9	23.8	13.7	50.6	20.1	12.1	3.9	11.2	1.4	5.9	6.3	8.4					
Committed	LS DIESEL IX50	THERM	50.0						383.0	383.0	361.0	383.0	325.5	345.0	261.7	153.8	115.6	186.1	108.1	82.1	106.1	81.1	3.2	2.9	0.7	1.1	1.8	1.8
Existing	OLKARIA	GEO-THERM	45.0	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7									
Committed	OLKARIA IE	GEO-THERM	64.1							470.1	470.1	470.1	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4
Committed	OLKARIA III	GEO-THERM	64.1								470.1	470.1	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4
Existing	SAMUEL HV160	HYDR	28.3	152.8	152.8	152.8	152.8	152.8	119.8	119.8																	
Existing	MASINGA	HYDR	40.0	218.0	218.0	218.0	218.0	218.0	213.0	213.0	213.0	213.0	210.6	210.6	210.6	210.6	210.6	210.6	238.1	238.1	238.1	238.1	238.1	233.1	233.1	233.1	233.1	233.1
Existing	KAMBURU	HYDR	94.6	175.9	175.9	175.9	175.9	175.9	166.1	166.1	166.1	166.1	161.6	161.6	161.6	161.6	161.6	161.6	456.9	456.9	456.9	456.9	456.9	196.9	417.3	417.3	417.3	417.3	417.3
Existing	GITARU	HYDR	145.0	961.8	961.8	961.8	961.8	961.8	912.6	912.6	912.6	912.6	912.6	932.9	932.9	932.9	932.9	932.9	923.3	923.3	923.3	923.3	923.3	901.1	901.1	901.1	901.1	901.1
Committed	Gitaru 3rd	HYDR	72.5					46.0	45.1	45.1	45.1	45.1	45.1	44.6	44.6	44.6	44.6	44.6	44.2	44.2	44.2	44.2	44.2	43.2	43.2	43.2	43.2	43.2
Existing	KINDARUMA	HYDR	44.0	253.2	253.2	253.2	253.2	253.2	248.1	248.1	248.1	248.1	248.1	245.6	245.6	245.6	245.6	245.6	243.1	243.1	243.1	243.1	243.1	238.0	238.0	238.0	238.0	
Existing	KEAMBERE	HYDR	148.0	1001.6	1001.6	1001.6	1001.6	1001.6	984.5	984.5	984.5	984.5	981.5	974.5	974.5	974.5	974.5	974.5	964.4	964.4	964.4	964.4	964.4	944.3	944.3	944.3	944.3	944.3
Proposed	Mutonga	HYDR	60.0																		324.0	324.0	324.0	317.3	317.3	317.3	317.3	317.3
Proposed	Ien G-E	HYDR	140.0														690.8	690.8	683.7	683.7	683.7	683.7	683.7	669.5	669.5	669.5	669.5	669.5
Existing	TURKWEL	HYDR	106.0	371.6	371.6	371.6	371.6	371.6	361.2	361.2	361.2	361.2	361.2	360.5	360.5	360.5	360.5	360.5	356.8	356.8	356.8	356.8	356.8	349.3	349.3	349.3	349.3	349.3
Committed	MERIU	HYDR	60.0								330.3	330.3	330.3	326.9	326.9	326.9	326.9	326.9	323.5	323.5	323.5	323.5	323.5	316.8	316.8	316.8	316.8	316.8
Existing	Ingurt	HYDR	30.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0
1995	GTO-THM 2x32	GEO-THERM	61.1	316.6	309.2	161.8	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4	470.4
2013	GTO THM 2x32	GEO-THERM	61.1																			470.4	470.4	470.4	470.4	470.4	470.4	470.4
2019	GTO THM 2x32	GEO-THERM	61.1																									470.4
2019	GTO-THM 2x32	GEO-THERM	61.1																									470.4
2001	LS DIESEL IX50	THERM	50.0										383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2001	LS DIESEL IX50	THERM	50.0										383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2001	LS DIESEL IX50	THERM	50.0										316.6	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2006	LS DIESEL IX50	THERM	50.0											350.7	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2006	LS DIESEL IX50	THERM	50.0												317.9	378.4	361.4	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2006	LS DIESEL IX50	THERM	50.0												341.8	318.8	339.0	364.0	353.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2007	LS DIESEL IX50	THERM	50.0													311.5	299.3	343.1	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2007	LS DIESEL IX50	THERM	50.0													300.9	231.5	330.6	375.1	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2008	LS DIESEL IX50	THERM	50.0															245.0	315.1	380.7	383.0	383.0	383.0	383.0	383.0	383.0	383.0	383.0
2010	LS DIESEL IX50	THERM	50.0																338.7	317.1	357.8	358.8	383.0	383.0	383.0	383.0	383.0	383.0
2010	LS DIESEL IX50	THERM	50.0																287.0	313.5	315.0	316.6	370.7	383.0	383.0	383.0	383.0	383.0
2010	LS DIESEL IX50	THERM	50.0																221.7	327.9	339.6	343.4	318.8	383.0	383.0	383.0	383.0	382.8
2010	LS DIESEL IX50	THERM	50.0																110.7	231.6	283.7	309.3	316.2	375.4	383.0	383.0	383.0	357.9
2011	LS DIESEL IX50	THERM	50.0																	192.2	226.7	240.4	311.0	318.5	383.0	383.0	383.0	312.0
2011	LS DIESEL IX50	THERM	50.0																	137.1	197.1	227.7	265.3	316.0	358.5	383.0	383.0	329.1
2012	LS DIESEL IX50	THERM	50.0																		131.4	161.4	251.6	307.7	318.5	374.9	383.0	321.3
2013	LS DIESEL IX50	THERM	50.0																			131.9	215.6	289.7	313.2	350.7	383.0	314.9
2014	LS DIESEL IX50	THERM	50.0																				163.9	254.0	322.5	343.5	368.5	299.2
2014	LS DIESEL IX50	THERM	50.0																				133.0	220.5	279.0	303.3	310.4	283.1
2011	LS DIESEL IX50	THERM	50.0																				86.2	181.1	256.3	310.0	312.5	271.9
2011	LS DIESEL IX50	THERM	50.0																				31.4	139.8	220.9	278.5	322.4	260.5
2014	LS DIESEL IX50	THERM	50.0																				13.3	109.6	198.5	256.4	307.9	248.9
2011	LS DIESEL IX50	THERM	50.0																				7.3	55.3	144.3	227.8	288.5	235.1
2015	LS DIESEL IX50	THERM	50.0																					26.2	116.7	205.6	266.0	221.0
2015	LS DIESEL IX50	THERM	50.0																					11.9	80.3	181.7	247.4	201.4
2015	LS DIESEL IX50	THERM	50.0																					6.5	43.8	127.3	231.7	185.8
2016	LS DIESEL IX50	THERM	50.0																						21.6	101.2	207.9	150.2
2016	LS DIESEL IX50	THERM	50.0																						11.2	64.7	178.5	128.1
2016	LS DIESEL IX50	THERM	50.0																						6.2	42.8	135.3	114.6
2016	LS DIESEL IX50	THERM	50.0																						2.8	22.0	115.7	96.2
2017	LS DIESEL IX50	THERM	50.0																							11.9	98.2	63.1
2017	LS DIESEL IX50	THERM	50.0																							7.0	55.3	52.0
2017	LS DIESEL IX50	THERM	50.0																							3.5	42.7	41.9
2018	LS DIESEL IX50	THERM	50.0																								23.3	26.5
2018	LS DIESEL IX50	THERM	50.0																								12.9	15.5
2018	LS DIESEL IX50	THERM	50.0																								7.9	10.6
2018	LS DIESEL IX50	THERM	50.0																								4.3	6.8
2019	LS DIESEL IX50	THERM	50.0																									3.9
	Energy Generated (GWh)			4123.4	4535.6	4182.7	5018.4	5363.0	5704.0	6055.3	6428.7	6823.5	7241.7	7683.1	8152.7	8647.8	9171.5	9723.6	10308.6	10925.6	11577.2	12265.4	12991.1	13762.6	14575.5	15433.4	16339.6	16310.4
	Energy Demand (GWh)			4122.0	4327.0	4511.0	4786.0	5054.0	5365.0	5706.0	6058.0	6431.0	6826.0	7245.0	7688.0	8156.0	8651.0	9174.0	9727.0	10311.0	10928.0	11580.0	12269.0	12997.0	13765.0	14577.0	15435.0	16312.0
	Energy Balance (GWh)			201.4	208.6	241.7	262.4	309.0	339.0	349.3	370.7	392.5	415.7	438.1	464.7	491.8	520.5	549.6	581.6	614.6	649.2	685.4	725.1	765.6	810.5	856.4	904.6	-1.6

Table 9.3.1 Disbursement Schedule of Financial Construction Cost Including Price Escalation

Escalation rate per annum for FC: 2.00%
Escalation rate per annum for LC: 2.00%
(US$1,000)

A. Low Grand Falls Scheme

Cost component	Construction cost Low Grand Falls Scheme													Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1010	2011	2012	
1. Year after base year	3	4	5	6	7	8	9	10	11	12	13	14	15	
2. Connstruction cost for FC	2,493	7,480	2,493	39,184	38,129	44,067	66,921	69,974	9,330					280,071
3. Construction cost for FC incl. escalation	2,620	8,017	2,726	43,694	43,368	51,127	79,194	84,459	11,487					326,692
4. Construction cost for LC in Kshs.1,000	23,760	183,266	247,731	1,012,065	476,518	1,010,731	1,339,625	1,075,992	114,967					5,484,655
5. Construction cost for LC in US$1,000	440	3,394	4,588	18,742	8,824	18,717	24,808	19,926	2,129					101,568
6. Construction cost for LC incl. escalation	462	3,637	5,016	20,899	10,037	21,716	29,358	24,050	2,621					117,796
7. Total financial cost (3+6)	3,082	11,654	7,742	64,593	53,405	72,843	108,552	108,509	14,108					444,488

B. Mutonga Scheme

Cost component	Construction cost Mutonga Scheme													Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1010	2011	2012	
1. Connstruction cost for FC							0	0	36,842	16,344	34,659	44,562	7,458	139,864
2. Construction cost for FC incl. escalation							0	0	45,359	20,525	44,395	58,220	9,939	178,438
3. Construction cost for LC in Kshs.1,000							49,171	49,171	590,642	312,082	731,024	574,563	93,383	2,400,036
4. Construction cost for LC in US$1,000							911	911	10,938	5,779	13,537	10,640	1,729	44,445
5. Construction cost for LC incl. escalation							1,078	1,099	13,467	7,258	17,340	13,901	2,304	56,447
6 Total financial cost (2+5)							1,078	1,099	58,826	27,783	61,735	72,121	12,243	234,885

Source : JICA Study Team.
(Note) Exchange rate : US$ 1.00 = KSh.54 = Japanese Yen 120, as of June 1997.

Table 9.3.2 Parameters for Financial Analysis

Item	Unit	Value		
		Low Grand Falls	Mutonga	Full operation (After 2013)
OM Cost				
Total financial construction cost	US$1,000	444,488	234,885	679,373
Cost for civil, metal & transmission line	US$1,000	259,675	122,100	381,775
OM cost for civil, metal & transmission line	US$1,000	1,298	611	1,909
(0.5% of construction cost for civil, metal & transmission line)				
OM cost for generating equipment	US$1,000	737	464	1,201
(5.5 US$/kW for Low Grand Falls & 8.0 US$/kW for Mutonga)				
OM cost	US$1,000	2,035	1,075	3,110
Subtransmission and Distribution Cost				
Assumed subtransmission and distribution cost in 1997	US$/KWh	0.0175	0.0175	
(70% of construction cost for transmission line/kWh/year)				
Assumed subtransmission and distribution cost in 2008	US$/KWh	0.03	0.03	
Annual subtransmission and distribution cost in 2008	US$1,000	18,018	8,492	26,510
Electricity Tariff				
Average electricity tariff in 1999	Ksh./KWh	6.720	6.720	6.720
esimated electricity tariff in 2008	Ksh./KWh	10.420	10.420	10.420
Estimation of Annual Revenue				0
Annual generated energy	GWh	715	337	1,052
Transmission and distribution loss	%	16.00%	16.00%	16.00%
Energy received at customers	GWh	600.60	283.08	883.68
Annual revenue in Ksh.	Ksh.million	6,258	2,950	9,208
Exchange rate as of June 1997	Ksh./US$	54.0	54.0	54.0
Annual revenue in US$ in 2008	US$1,000	115,894	54,624	170,518

Table 9.3.3 Cash Flow of Financial Evaluation

(US$1,000)

Year in order	Year	Financial cost				Subtransmission and Distribution Cost	Total	Benefit	Cash balance
		Low Grand Falls Scheme		Mutonga Scheme					
		Cost. cost	OMR	Cost cost	OMR				
1	2000	3,082					3,082	0	-3,082
2	2001	11,654					11,654	0	-11,654
3	2002	7,742					7,742	0	-7,742
4	2003	64,593					64,593	0	-64,593
5	2004	53,405					53,405	0	-53,405
6	2005	72,842					72,842	0	-72,842
7	2006	108,552		1,078			109,630	0	-109,630
8	2007	108,509		1,099			109,608	0	-109,608
9	2008	14,108	1,018	58,826		9,009	82,961	57,947	-25,014
10	2009		2,035	27,783		18,018	47,836	115,894	68,058
11	2010		2,035	61,735		18,018	81,788	115,894	34,106
12	2011		2,035	72,121		18,018	92,174	115,894	23,720
13	2012		2,035	12,243	538	22,261	37,080	143,206	106,126
14	2013		2,035		1,075	26,510	29,620	170,518	140,898
15	2014		2,035		1,075	26,510	29,620	170,518	140,898
16	2015		2,035		1,075	26,510	29,620	170,518	140,898
17	2016		2,035		1,075	26,510	29,620	170,518	140,898
18	2017		2,035		1,075	26,510	29,620	170,518	140,898
19	2018		2,035		1,075	26,510	29,620	170,518	140,898
20	2019		2,035		1,075	26,510	29,620	170,518	140,898
21	2020		2,035		1,075	26,510	29,620	170,518	140,898
22	2021		2,035		1,075	26,510	29,620	170,518	140,898
23	2022		2,035		1,075	26,510	29,620	170,518	140,898
24	2023		2,035		1,075	26,510	29,620	170,518	140,898
25	2024		2,035		1,075	26,510	29,620	170,518	140,898
26	2025		2,035		1,075	26,510	29,620	170,518	140,898
27	2026		2,035		1,075	26,510	29,620	170,518	140,898
28	2027		2,035		1,075	26,510	29,620	170,518	140,898
29	2028		2,035		1,075	26,510	29,620	170,518	140,898
30	2029		2,035		1,075	26,510	29,620	170,518	140,898
31	2030		2,035		1,075	26,510	29,620	170,518	140,898
32	2031		2,035		1,075	26,510	29,620	170,518	140,898
33	2032		2,035		1,075	26,510	29,620	170,518	140,898
34	2033		2,035		1,075	26,510	29,620	170,518	140,898
35	2034		2,035		1,075	26,510	29,620	170,518	140,898
36	2035		2,035		1,075	26,510	29,620	170,518	140,898
37	2036		2,035		1,075	26,510	29,620	170,518	140,898
38	2037		2,035		1,075	26,510	29,620	170,518	140,898
39	2038		49,767		1,075	26,510	77,352	170,518	93,166
40	2039		2,035		1,075	26,510	29,620	170,518	140,898
41	2040		2,035		1,075	26,510	29,620	170,518	140,898
42	2041		2,035		1,075	26,510	29,620	170,518	140,898
43	2042		2,035		34,840	26,510	63,385	170,518	107,134
44	2043		2,035		1,075	26,510	29,620	170,518	140,898
45	2044		2,035		1,075	26,510	29,620	170,518	140,898
46	2045		2,035		1,075	26,510	29,620	170,518	140,898
47	2046		2,035		1,075	26,510	29,620	170,518	140,898
48	2047		2,035		1,075	26,510	29,620	170,518	140,898
49	2048		2,035		1,075	26,510	29,620	170,518	140,898
50	2049		2,035		1,075	26,510	29,620	170,518	140,898
51	2050		2,035		1,075	26,510	29,620	170,518	140,898
52	2051		2,035		1,075	26,510	29,620	170,518	140,898
53	2052		2,035		1,075	26,510	29,620	170,518	140,898
54	2053		2,035		1,075	26,510	29,620	170,518	140,898
55	2054		2,035		1,075	26,510	29,620	170,518	140,898
56	2055		2,035		1,075	26,510	29,620	170,518	140,898
57	2056		2,035		1,075	26,510	29,620	170,518	140,898
58	2057		2,035		1,075	26,510	29,620	170,518	140,898
Total		444,487	148,465	234,885	82,678	1,278,277	2,188,792	8,222,145	6,033,353

In the condition of discount rate at 12 %

Tariff applied : KShs 10.42/kWh as of 2008 resulted from 1999 tariff provided by KPC applying an annual price escalation of 5%.

Cost : Included the price escalation of 2% per annum since 1997.

Internal rate of return (FIRR). 15.10%

Table 9.3.4 Loan Repayability Analysis for Mutonga/Grand Falls Hydropower Project

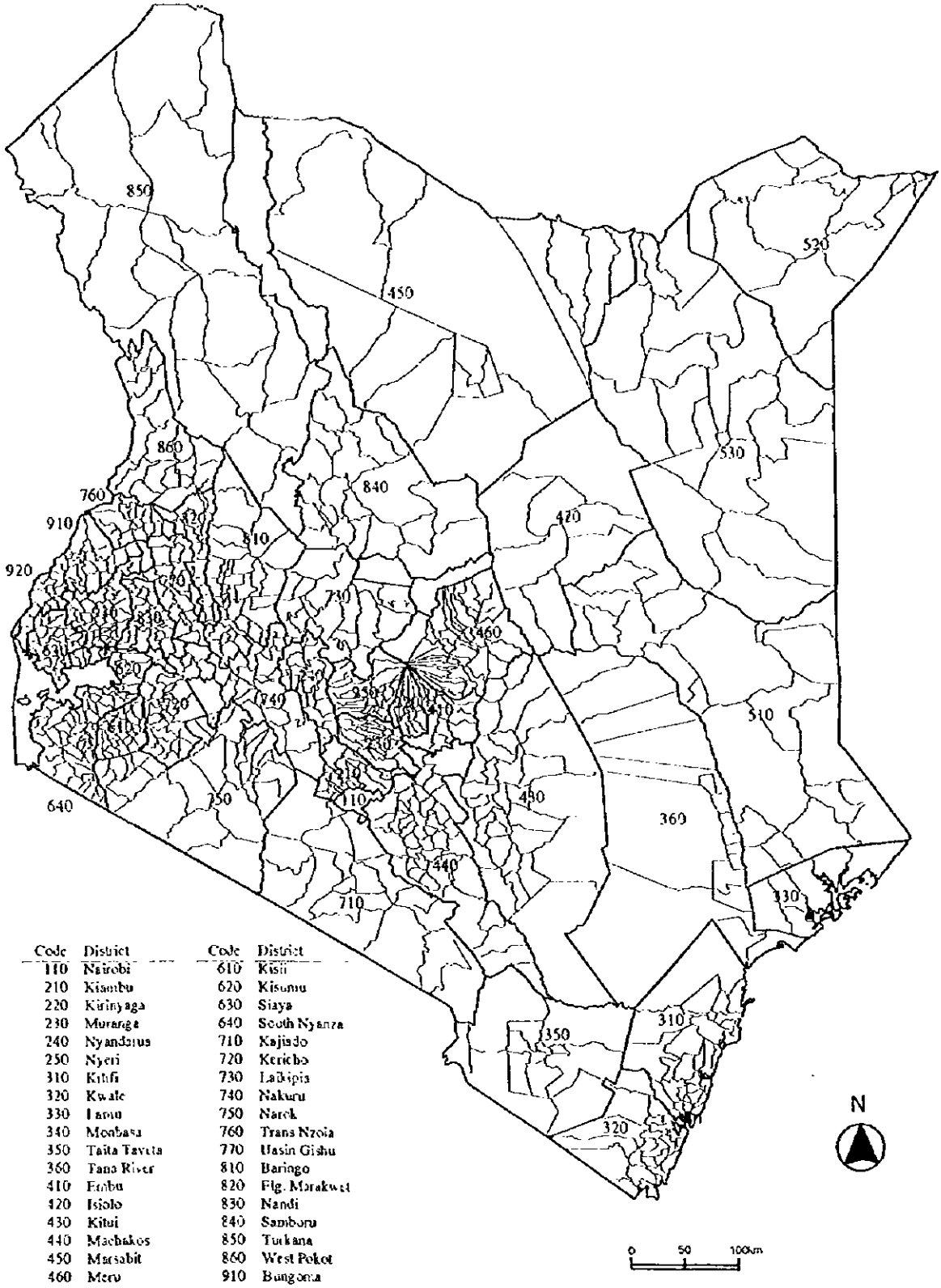
Interest rate of Loan: 2.30%
Capital recovery factor: 0.06294
(US$1,000)

Year in order	Year	Initial Investment Cost		Loan Disburse-ment		Expenditure (Incl. Loan Disbursement)							Revenue						Cash balance	Accumulated cash balance
						Repayment							Amount to be expended by the Government							
						Low Grand Falls			Mutonga			Grand total	Low Grand Falls Scheme	Mutonga Scheme	O/M cost (LGF)	O/M cost (MTG)	Subtrans. and Distrn. Cost	Total out flow	Accumu-lated total outflow	Annual revenue	Accumu-lated total revenue		
		(LGF)	(MTG)	(LGF)	(MTG)	Interest	Principal	Total	Interest	Principal	Total											
1	2000	3,082		2,620	0	0	0	0				0	462	0	0	0		462	462	0	0	-462	-462
2	2001	11,654		9,906	0	0	0	0				0	1,748	0	0	0		1,748	2,210	0	0	-1,748	-2,210
3	2002	7,742		6,581	0	0	0	0				0	1,161	0	0	0		1,161	3,372	0	0	-1,161	-3,372
4	2003	64,593		54,904	0	0	0	0				0	9,689	0	0	0		9,689	13,061	0	0	-9,689	-13,061
5	2004	53,405		45,394	0	0	0	0				0	8,011	0	0	0		8,011	21,071	0	0	-8,011	-21,071
6	2005	72,842		61,916	0	0	0	0				0	10,926	0	0	0		10,926	31,998	0	0	-10,926	-31,998
7	2006	108,552	1078	92,269	916	0	0	0				0	16,283	162	0	0		16,445	48,442	0	0	-16,445	-48,442
8	2007	108,509	1,099	92,233	934	0	0	0				0	16,276	165	0	0		16,441	64,883	0	0	-16,441	-64,883
9	2008	14,108	58,826	11,992	50,002	0	0	0				0	2,116	8,824	1,018	0	9,009	20,967	85,851	57,947	57,947	36,980	-27,904
10	2009		27,783	0	23,616	0	0	0				0	0	4,167	2,035	0	18,018	24,220	110,071	115,894	173,841	91,674	63,770
11	2010		61,735	0	52,475	10,754	15,090	25,845				25,845		9,260	2,035	0	18,018	55,158	165,229	115,894	289,735	60,736	124,506
12	2011		72,121	0	61,303	10,407	15,438	25,845				25,845		10,818	2,035	0	18,018	56,716	221,945	115,894	405,629	59,178	183,684
13	2012		12,243	0	10,407	10,052	15,793	25,845				25,845		1,836	2,035	558	22,264	52,518	274,464	143,206	548,835	90,688	274,371
14	2013					9,689	16,156	25,845				25,845		0	2,035	1,075	26,510	55,465	329,929	170,518	719,353	115,053	389,424
15	2014					9,317	16,527	25,845				25,845			2,035	1,075	26,510	55,465	385,394	170,518	889,871	115,053	504,477
16	2015					8,937	16,908	25,845				25,845			2,035	1,075	26,510	55,465	440,859	170,518	1,060,389	115,053	619,530
17	2016					8,548	17,296	25,845	6,107	7,974	14,081	39,926			2,035	1,075	26,510	69,546	510,406	170,518	1,230,907	100,972	720,501
18	2017					8,151	17,694	25,845	5,923	8,158	14,081	39,926			2,035	1,075	26,510	69,546	579,952	170,518	1,401,425	100,972	821,473
19	2018					7,744	18,101	25,845	5,736	8,345	14,081	39,926			2,035	1,075	26,510	69,546	649,498	170,518	1,571,943	100,972	922,445
20	2019					7,327	18,518	25,845	5,544	8,537	14,081	39,926			2,035	1,075	26,510	69,546	719,044	170,518	1,742,461	100,972	1,023,417
21	2020					6,901	18,943	25,845	5,347	8,734	14,081	39,926			2,035	1,075	26,510	69,546	788,590	170,518	1,912,979	100,972	1,124,389
22	2021					6,466	19,379	25,845	5,146	8,935	14,081	39,926			2,035	1,075	26,510	69,546	858,137	170,518	2,083,497	100,972	1,225,360
23	2022					6,020	19,825	25,845	4,941	9,140	14,081	39,926			2,035	1,075	26,510	69,546	927,683	170,518	2,254,015	100,972	1,326,332
24	2023					5,564	20,281	25,845	4,731	9,350	14,081	39,926			2,035	1,075	26,510	69,546	997,229	170,518	2,424,533	100,972	1,427,304
25	2024					5,098	20,747	25,845	4,516	9,565	14,081	39,926			2,035	1,075	26,510	69,546	1,066,775	170,518	2,595,051	100,972	1,528,276
26	2025					4,620	21,224	25,845	4,296	9,785	14,081	39,926			2,035	1,075	26,510	69,546	1,136,322	170,518	2,765,569	100,972	1,629,247
27	2026					4,132	21,713	25,845	4,071	10,010	14,081	39,926			2,035	1,075	26,510	69,546	1,205,868	170,518	2,936,087	100,972	1,730,219
28	2027					3,633	22,212	25,845	3,840	10,241	14,081	39,926			2,035	1,075	26,510	69,546	1,275,414	170,518	3,106,605	100,972	1,831,191
29	2028					3,122	22,723	25,845	3,605	10,476	14,081	39,926			2,035	1,075	26,510	69,546	1,344,960	170,518	3,277,123	100,972	1,932,163
30	2029					2,599	23,246	25,845	3,364	10,717	14,081	39,926			2,035	1,075	26,510	69,546	1,414,507	170,518	3,447,641	100,972	2,033,134
31	2030								3,117	10,964	14,081	14,081			2,035	1,075	26,510	43,701	1,458,208	170,518	3,618,159	126,817	2,159,951
32	2031								2,865	11,216	14,081	14,081			2,035	1,075	26,510	43,701	1,501,909	170,518	3,788,677	126,817	2,286,768
33	2032								2,607	11,474	14,081	14,081			2,035	1,075	26,510	43,701	1,545,611	170,518	3,959,195	126,817	2,413,584
34	2033								2,343	11,738	14,081	14,081			2,035	1,075	26,510	43,701	1,589,312	170,518	4,129,713	126,817	2,540,401
35	2034								2,073	12,008	14,081	14,081			2,035	1,075	26,510	43,701	1,633,014	170,518	4,300,231	126,817	2,667,217
36	2035								1,797	12,284	14,081	14,081			2,035	1,075	26,510	43,701	1,676,715	170,518	4,470,749	126,817	2,794,034
37	2036														2,035	1,075	26,510	29,620	1,706,335	170,518	4,641,267	140,898	2,934,932
38	2037														2,035	1,075	26,510	29,620	1,735,956	170,518	4,811,785	140,898	3,075,829
39	2038														40,707	1,075	26,510	77,292	1,813,248	170,518	4,982,303	93,226	3,169,055
40	2039														2,035	1,075	26,510	29,620	1,842,869	170,518	5,152,821	140,898	3,309,952
	Total	444,487	234,885	377,814	199,652	139,083	377,814	516,897	81,968	199,652	281,620	798,517	66,673	35,233	111,775	29,563	801,108	1,842,869		5,152,821		3,309,952	

Figures

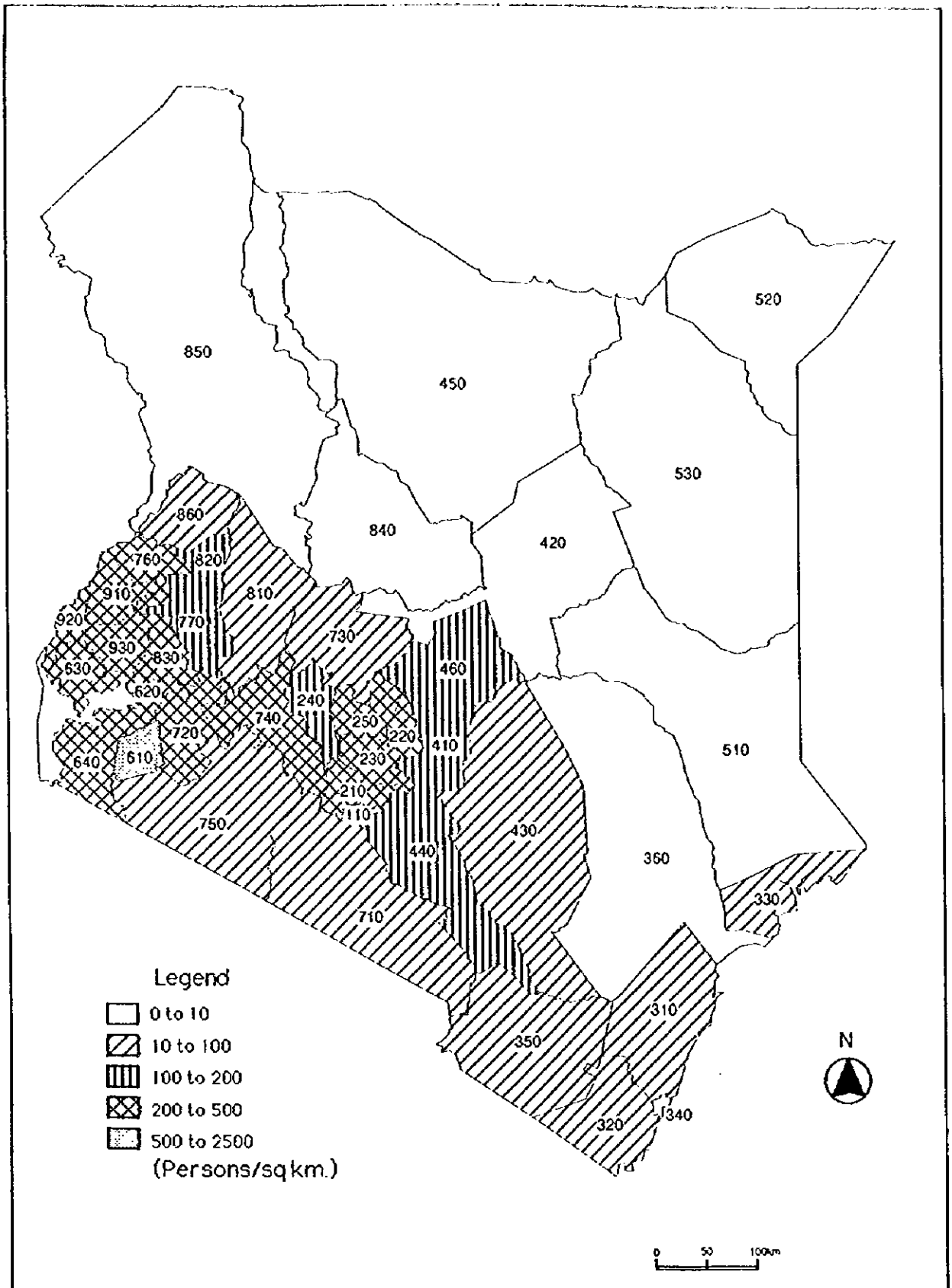
JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Overall Flow of Study	Fig. No. 1.1

JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Overall Flow of Study	Fig. No. 1.1

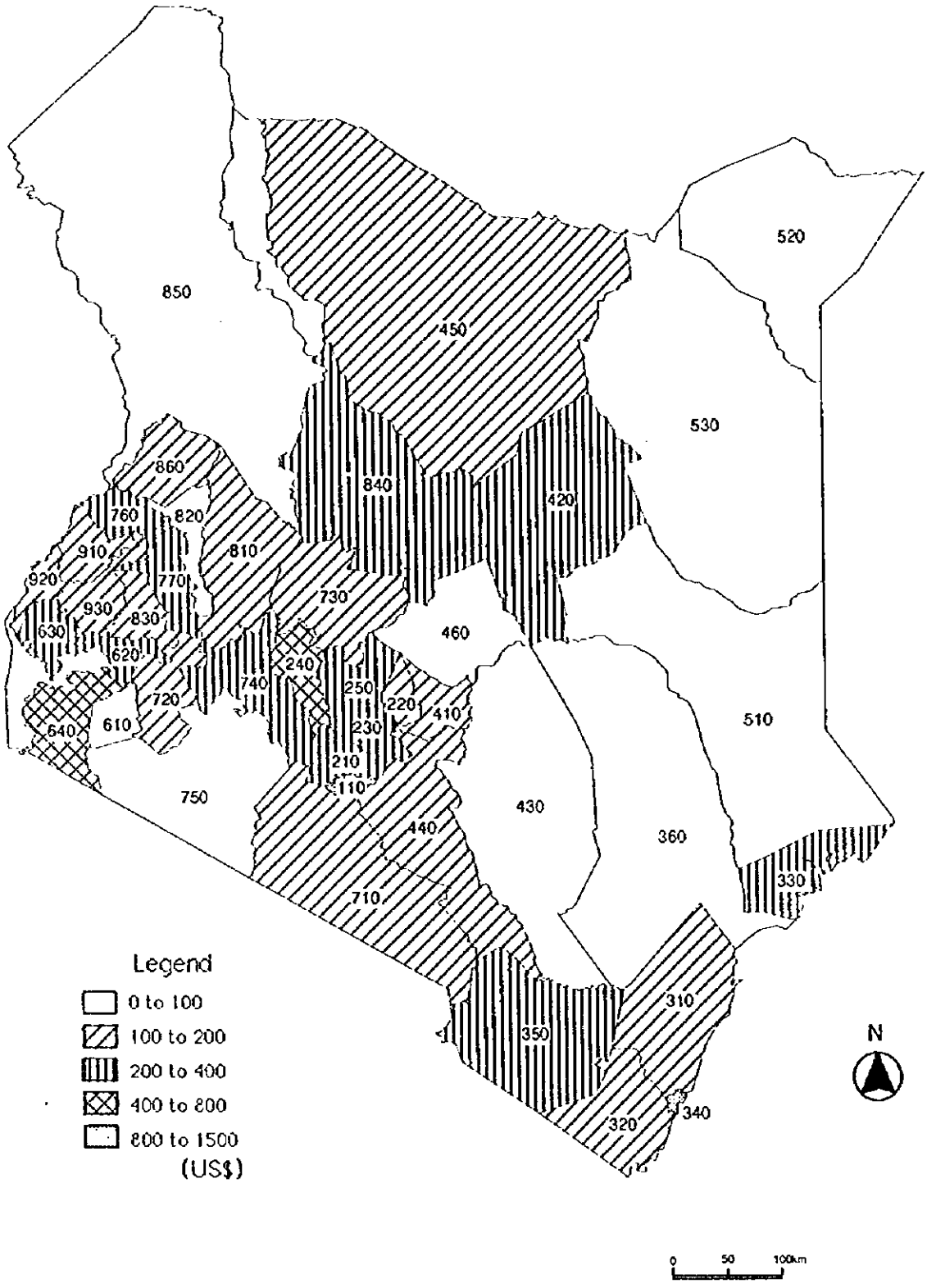


Code	District	Code	District
110	Nairobi	610	Kisii
210	Kiambu	620	Kisumu
220	Kirinyaga	630	Siaya
230	Muranga	640	South Nyanza
240	Nyandarua	710	Kajiado
250	Nyeri	720	Kericho
310	Kitui	730	Laikipia
320	Kwale	740	Nakuru
330	Lamu	750	Narok
340	Mombasa	760	Trans Nzoia
350	Taita Taveta	770	Uasin Gishu
360	Tana River	810	Baringo
410	Embu	820	Elg. Marakwet
420	Isiolo	830	Nandi
430	Kitui	840	Samburu
440	Machakos	850	Turkana
450	Marsabit	860	West Pokot
460	Meru	910	Bungoma
510	Garissa	920	Busia
520	Mandera	930	Kakamega
530	Wajir		

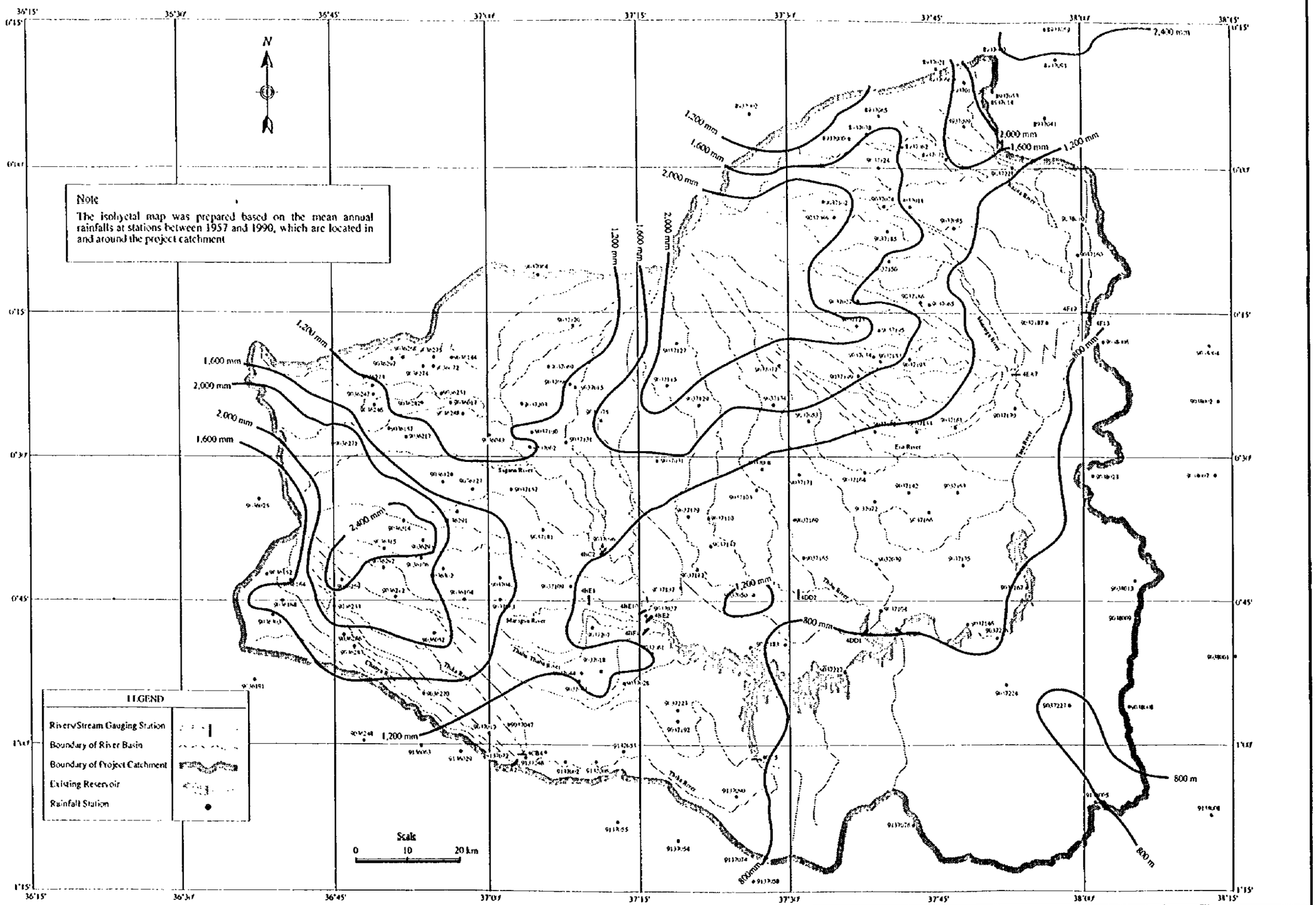
JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Administry Boundary Map : 1986	Fig. No. 2.1.1



JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Population Density by District : 1990	Fig. No. 2.1.2



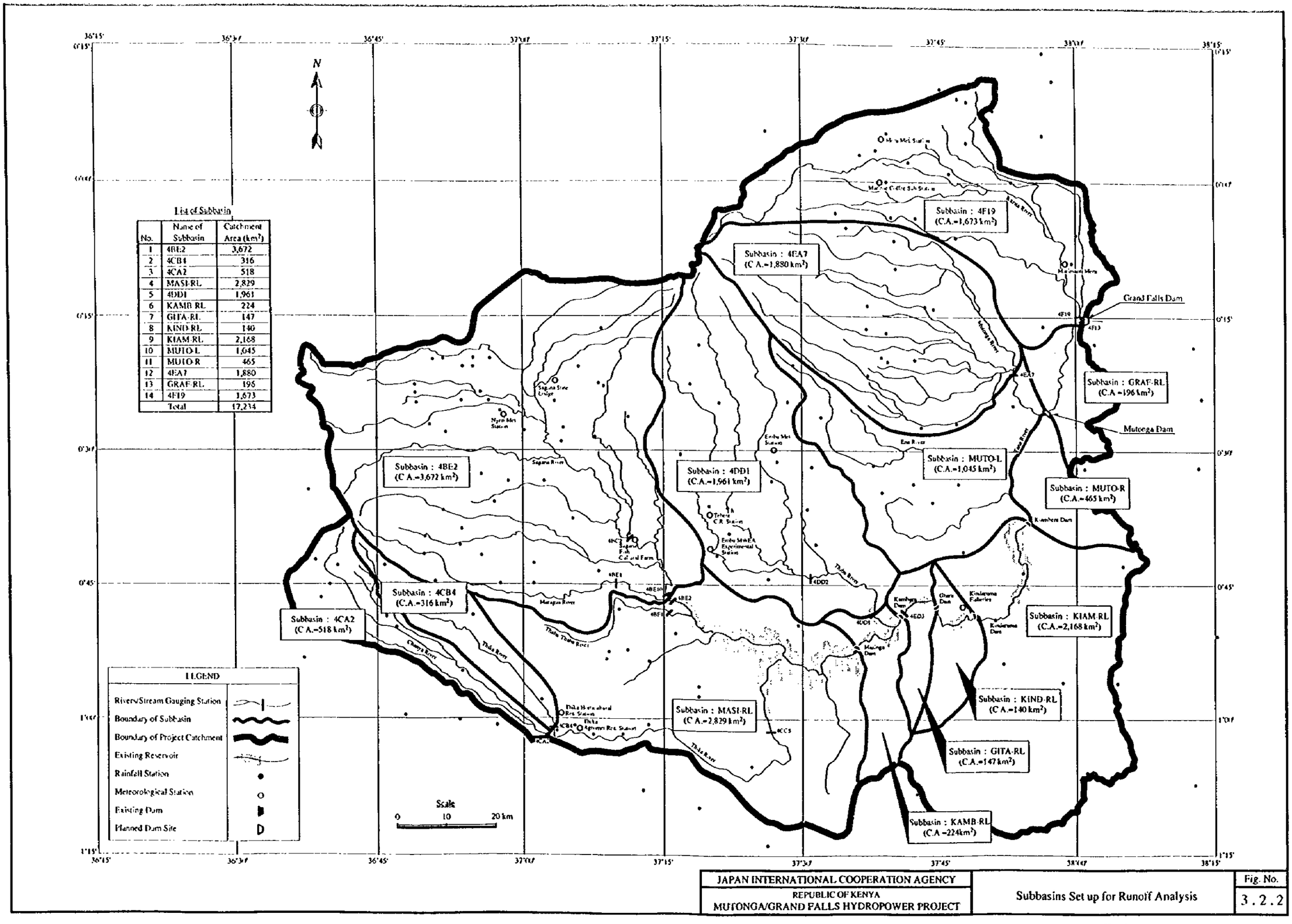
JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	GRDP Per Capita by District : 1989	Fig. No. 2.1.3



JAPAN INTERNATIONAL COOPERATION AGENCY	Isohyetal Map for Project Catchment	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.1

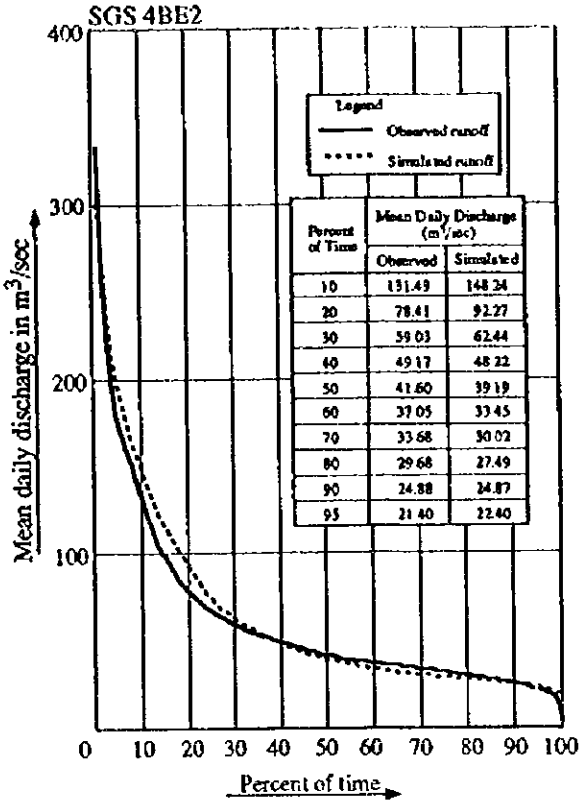
List of Subbasin

No.	Name of Subbasin	Catchment Area (km²)
1	4BE2	3,672
2	4CB4	316
3	4CA2	518
4	MASI-RL	2,829
5	4DD1	1,961
6	KAMB-RL	224
7	GITA-RL	147
8	KIND-RL	140
9	KIAM-RL	2,168
10	MUTO-L	1,045
11	MUTO-R	465
12	4EA7	1,880
13	GRAF-RL	196
14	4F19	1,673
	Total	17,234



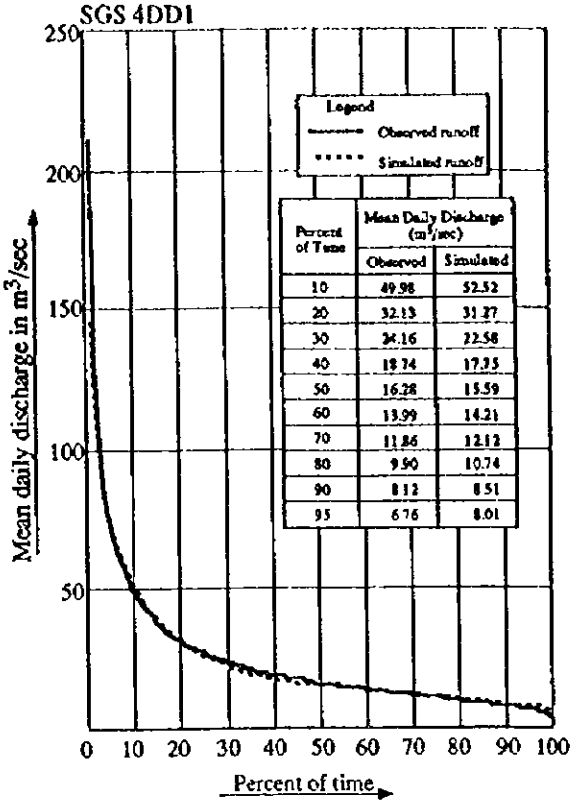
JAPAN INTERNATIONAL COOPERATION AGENCY	Subbasins Set up for Runoff Analysis	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.2

SGS 4BE2



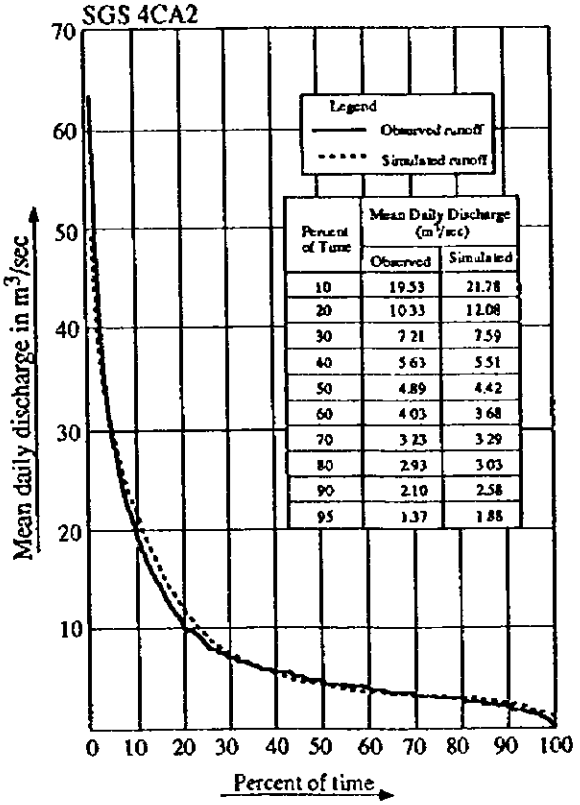
Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	131.49	148.24
20	78.41	92.27
30	59.03	62.44
40	49.17	48.22
50	41.60	39.19
60	37.05	33.45
70	33.68	30.02
80	29.68	27.49
90	24.88	24.87
95	21.40	22.40

SGS 4DD1



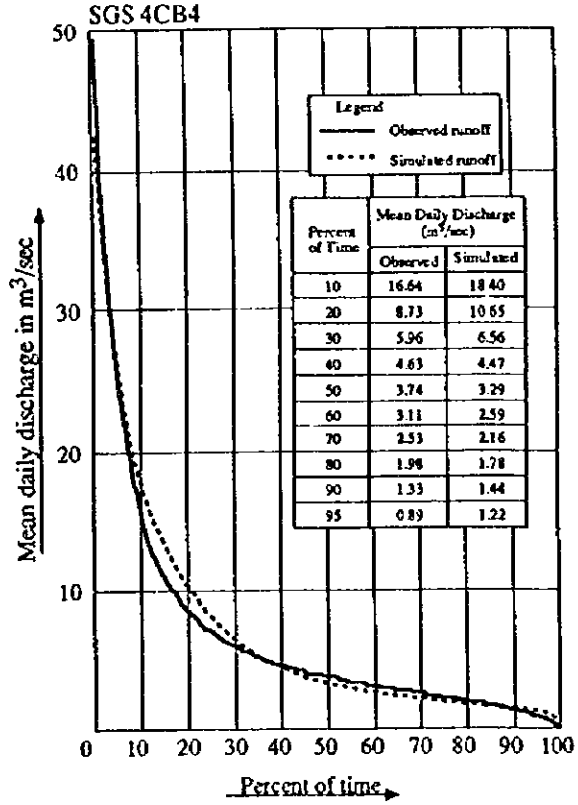
Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	49.98	52.52
20	32.13	31.27
30	24.16	22.58
40	18.74	17.35
50	16.28	15.59
60	13.99	14.21
70	11.86	12.12
80	9.90	10.74
90	8.12	8.51
95	6.76	8.01

SGS 4CA2



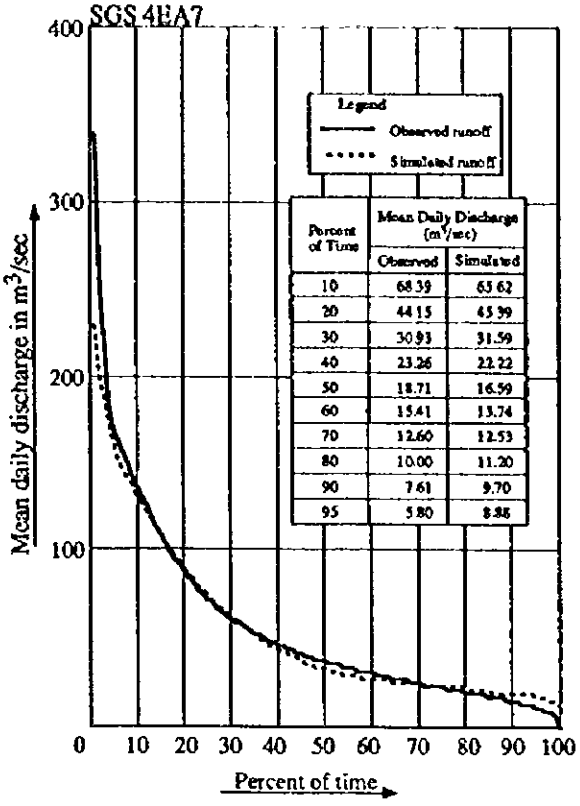
Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	19.53	21.78
20	10.33	12.08
30	7.21	7.59
40	5.63	5.51
50	4.89	4.42
60	4.03	3.68
70	3.23	3.29
80	2.93	3.03
90	2.10	2.58
95	1.37	1.88

SGS 4CB4

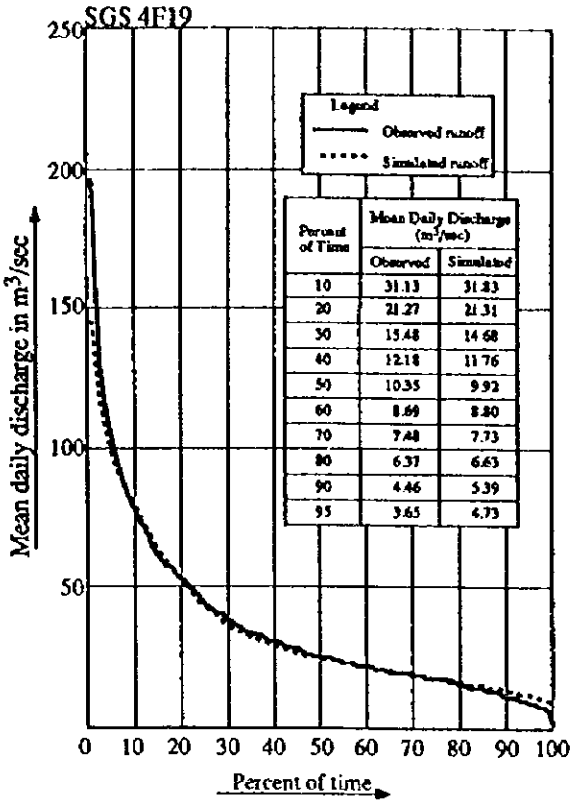


Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	16.64	18.40
20	8.73	10.65
30	5.96	6.56
40	4.63	4.47
50	3.74	3.29
60	3.11	2.59
70	2.53	2.16
80	1.98	1.78
90	1.33	1.44
95	0.89	1.22

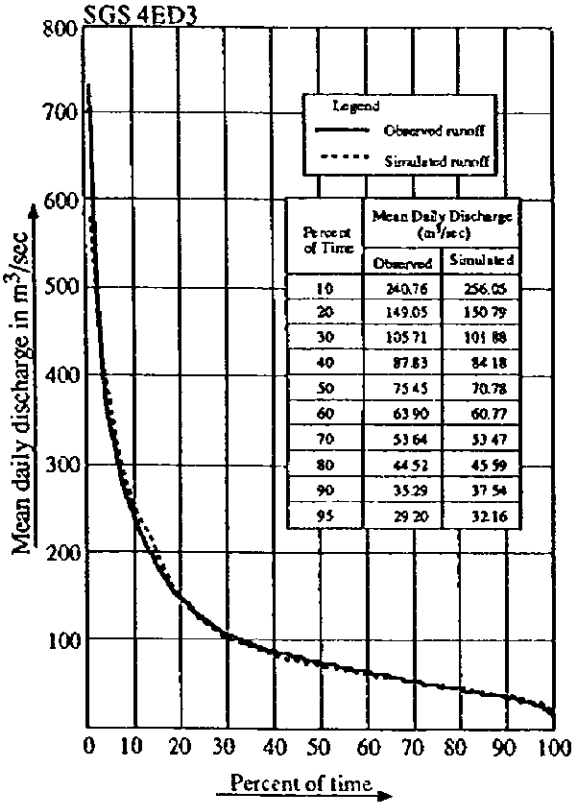
JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Flow Duration Curves Worked out Based on Mean Daily Discharges Observed and Simulated (1/2)	Fig. No.
REPUBLIC OF KENYA		3.2.3
MUTONGA/GRAND FALLS HYDROPOWER PROJECT		



Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	68.39	65.62
20	44.15	45.39
30	30.93	31.59
40	23.26	22.22
50	18.71	16.59
60	15.41	13.74
70	12.60	12.53
80	10.00	11.20
90	7.61	9.70
95	5.80	8.88

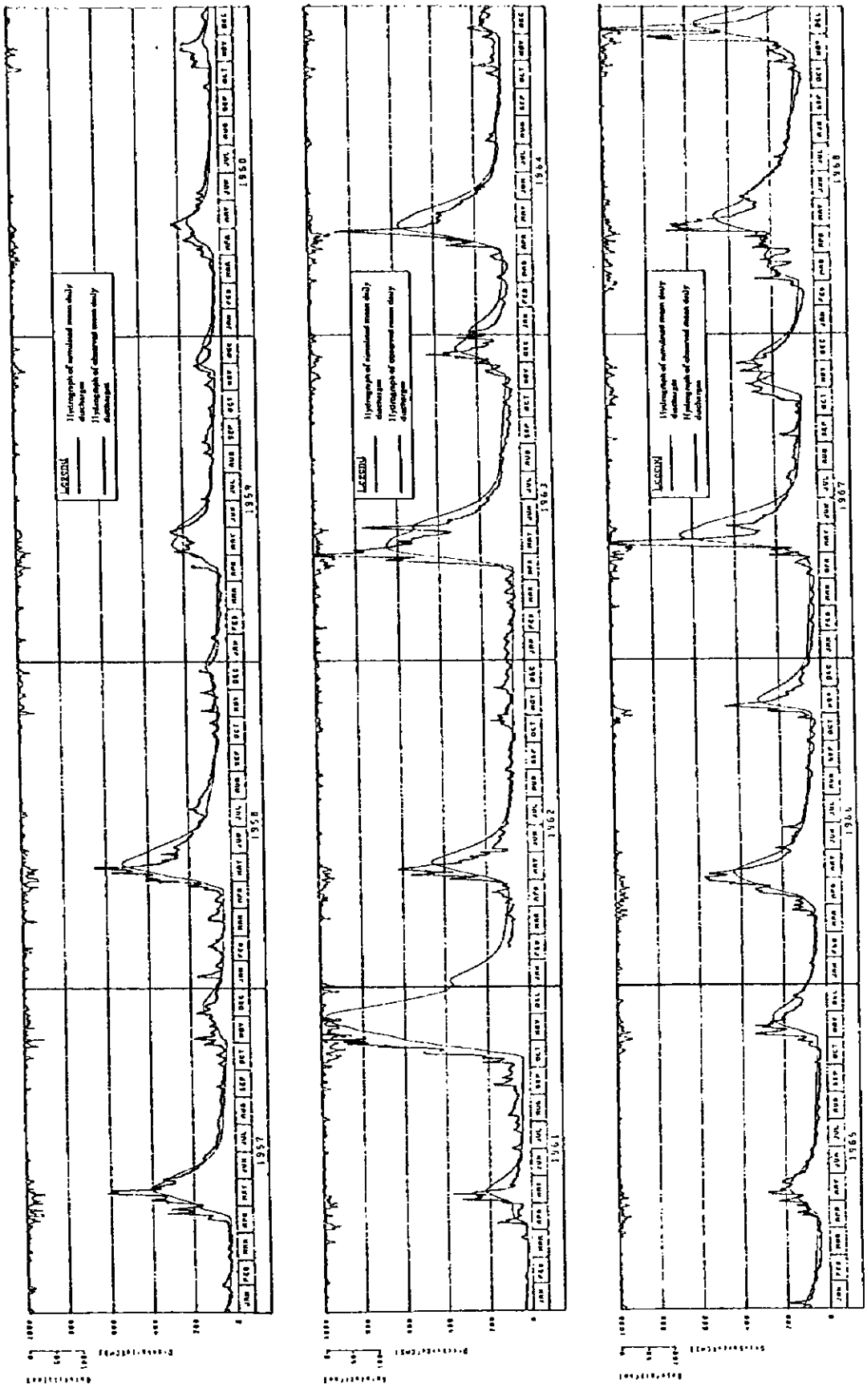


Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	31.13	31.83
20	21.27	21.31
30	15.48	14.68
40	12.18	11.76
50	10.35	9.92
60	8.69	8.80
70	7.48	7.73
80	6.37	6.63
90	4.46	5.39
95	3.65	4.73

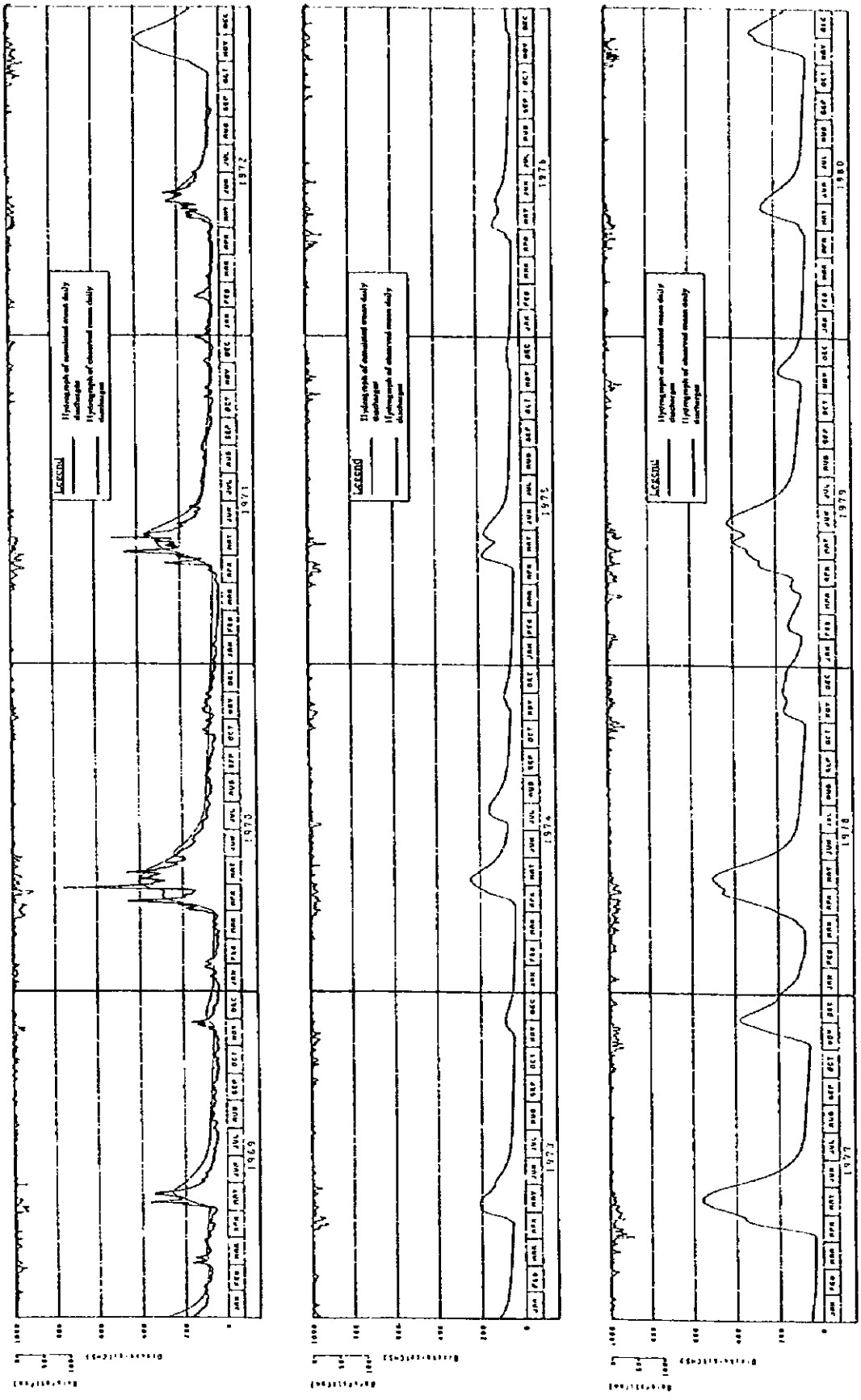


Percent of Time	Mean Daily Discharge (m³/sec)	
	Observed	Simulated
10	240.76	256.05
20	149.05	150.79
30	105.71	101.88
40	87.83	84.18
50	75.45	70.78
60	63.90	60.77
70	53.64	53.47
80	44.52	45.59
90	35.29	37.54
95	29.20	32.16

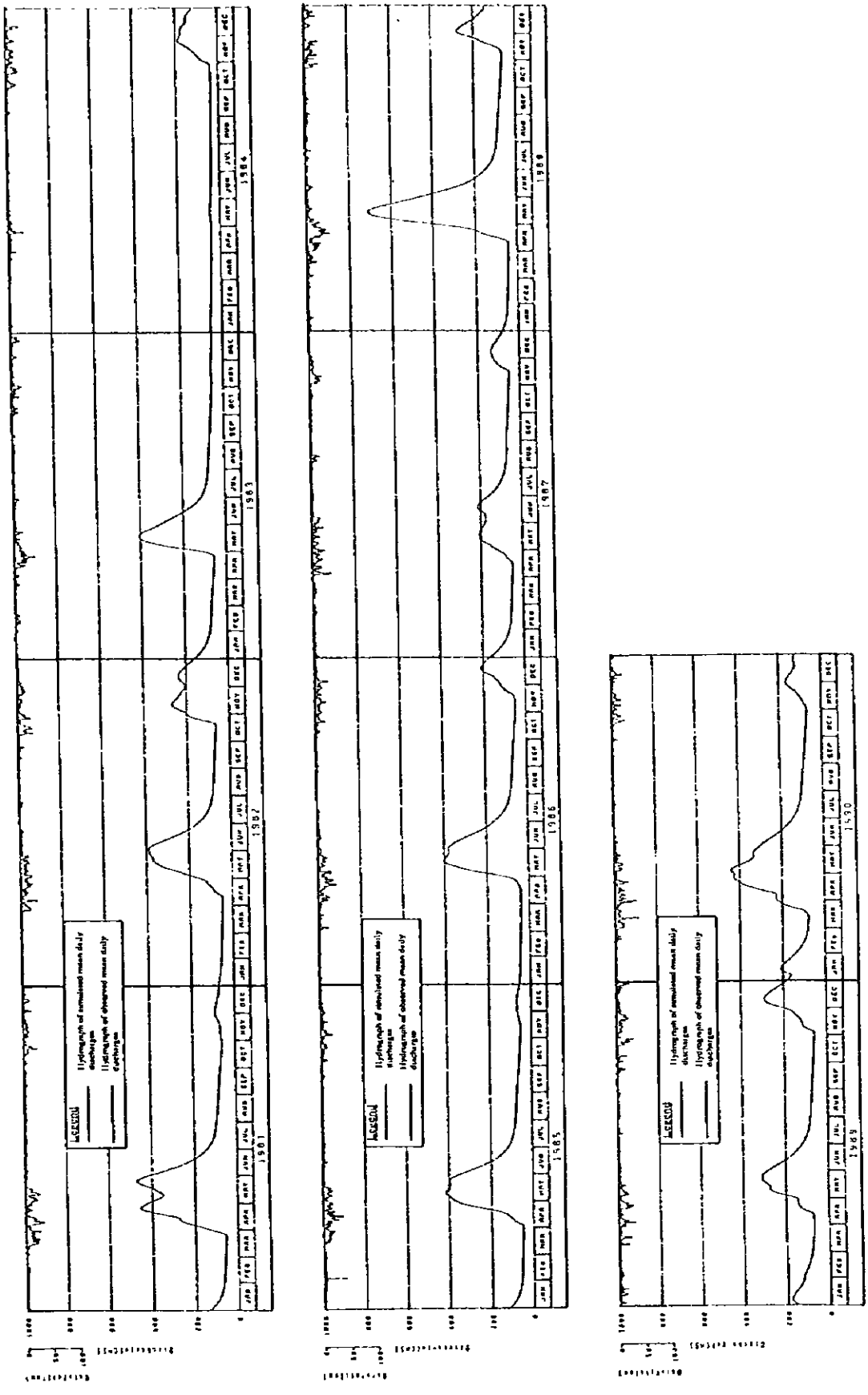
JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Flow Duration Curves Worked out Based on Mean Daily Discharges Observed and Simulated (2/2)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.3



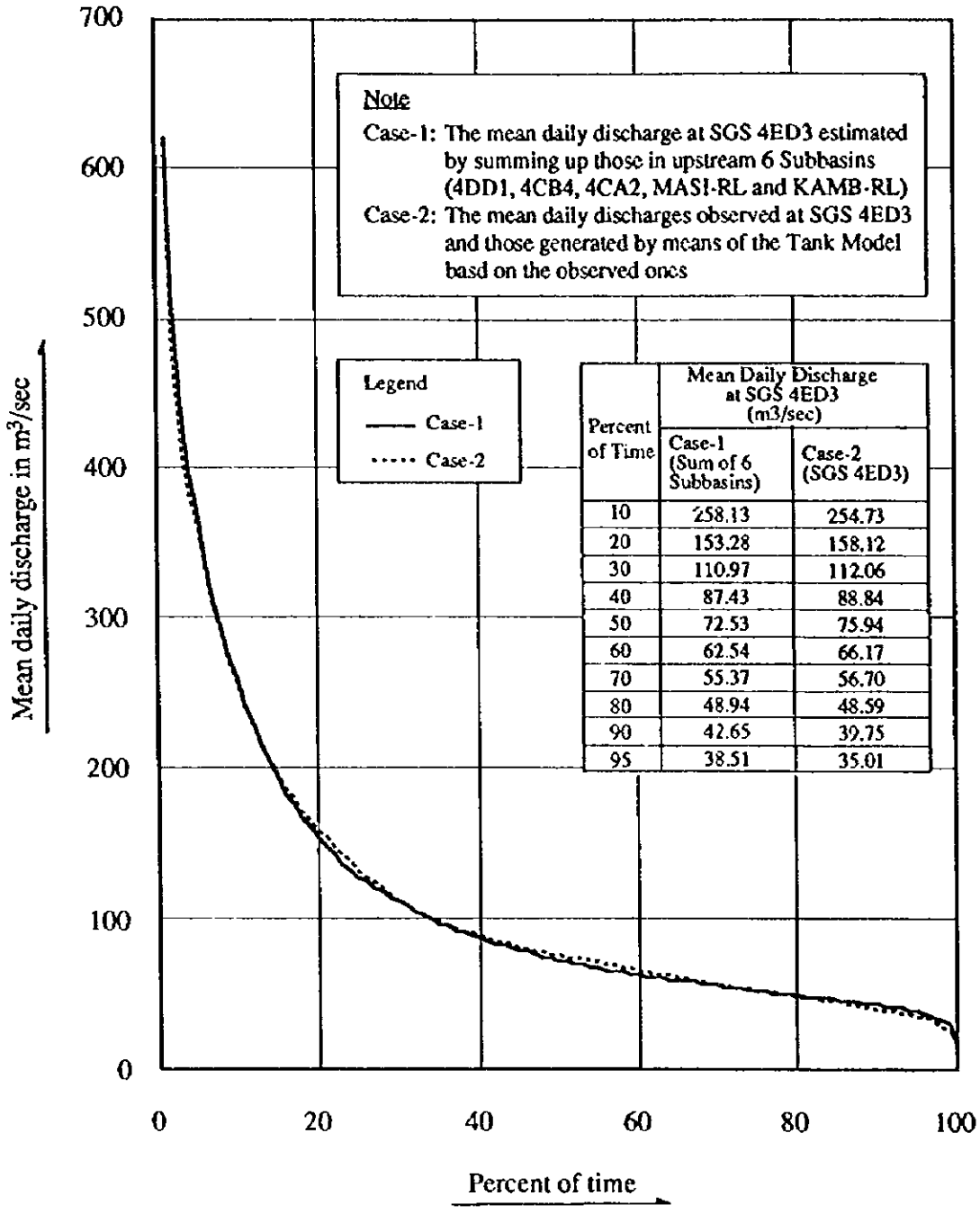
JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Hydrographs of Mean Daily Discharges at SGS 4ED3, Worked out by Means of Different Methods (1/3)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.4



JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Hydrographs of Mean Daily Discharges at SGS 4ED3, Worked out by Means of Different Methods (2/3)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.4

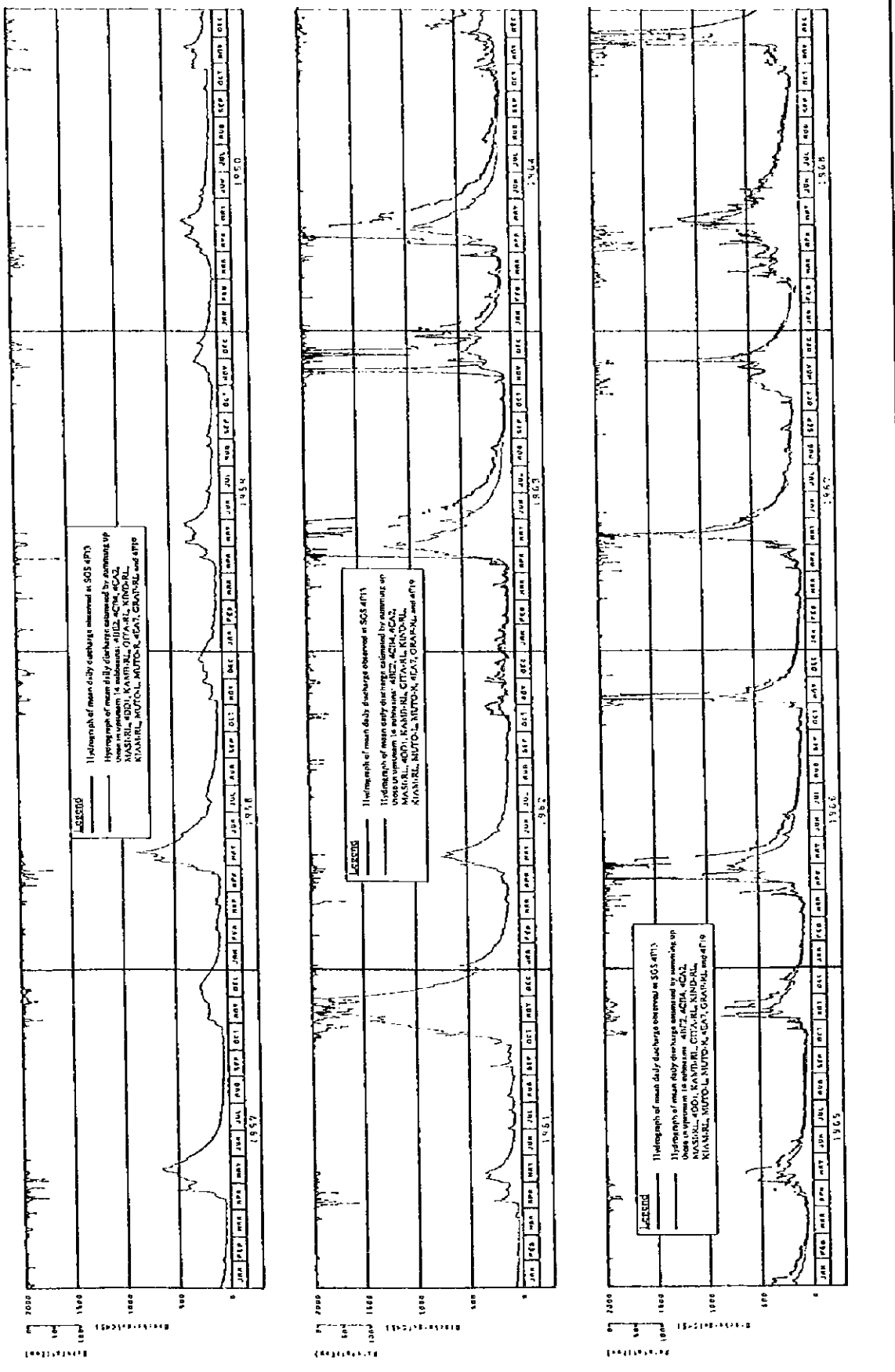


JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Hydrographs of Mean Daily Discharges at SGS 4ED3, Worked out by Means of Different Methods (3/3)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.4

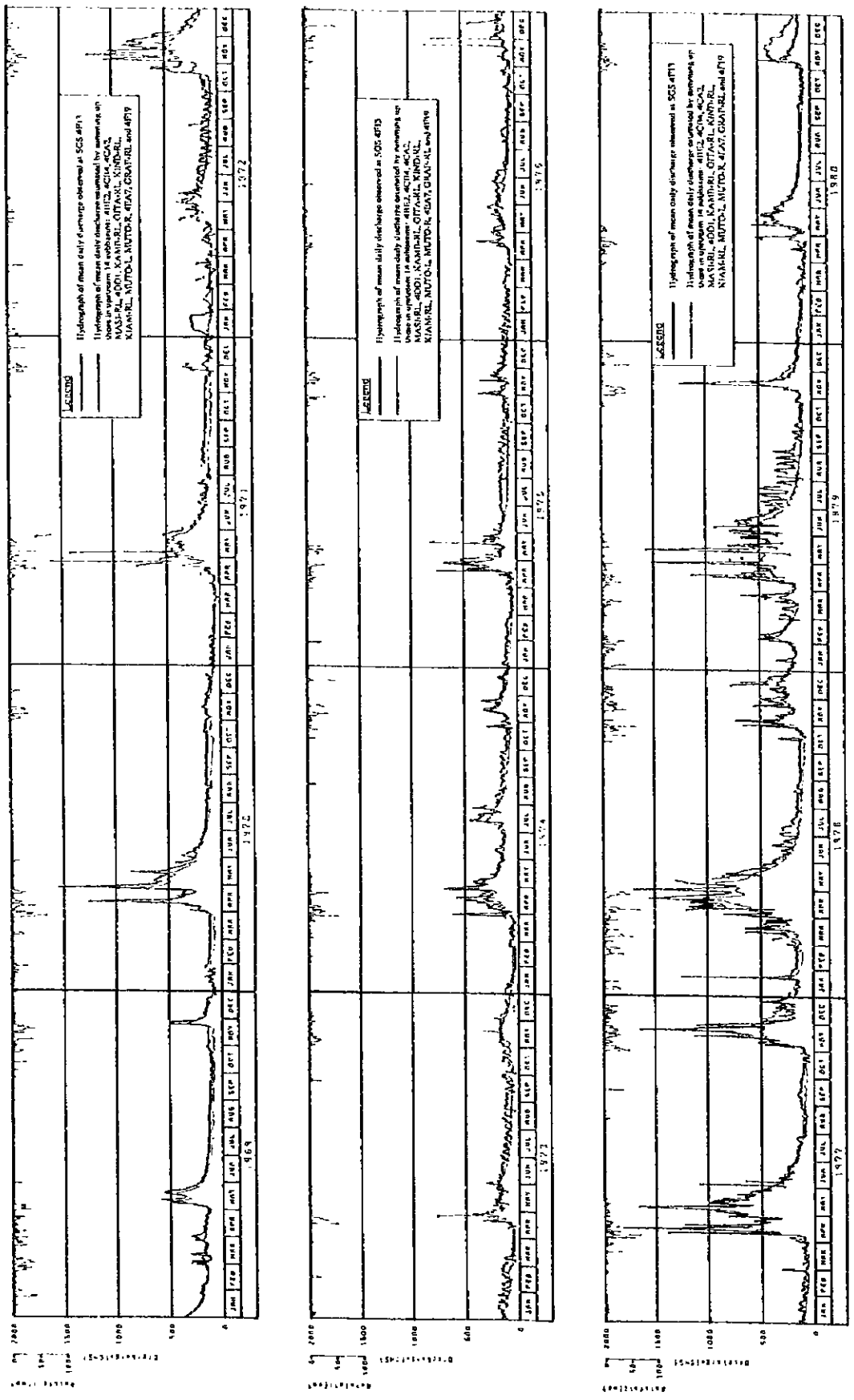


Percent of Time	Mean Daily Discharge at SGS 4ED3 (m3/sec)	
	Case-1 (Sum of 6 Subbasins)	Case-2 (SGS 4ED3)
10	258.13	254.73
20	153.28	158.12
30	110.97	112.06
40	87.43	88.84
50	72.53	75.94
60	62.54	66.17
70	55.37	56.70
80	48.94	48.59
90	42.65	39.75
95	38.51	35.01

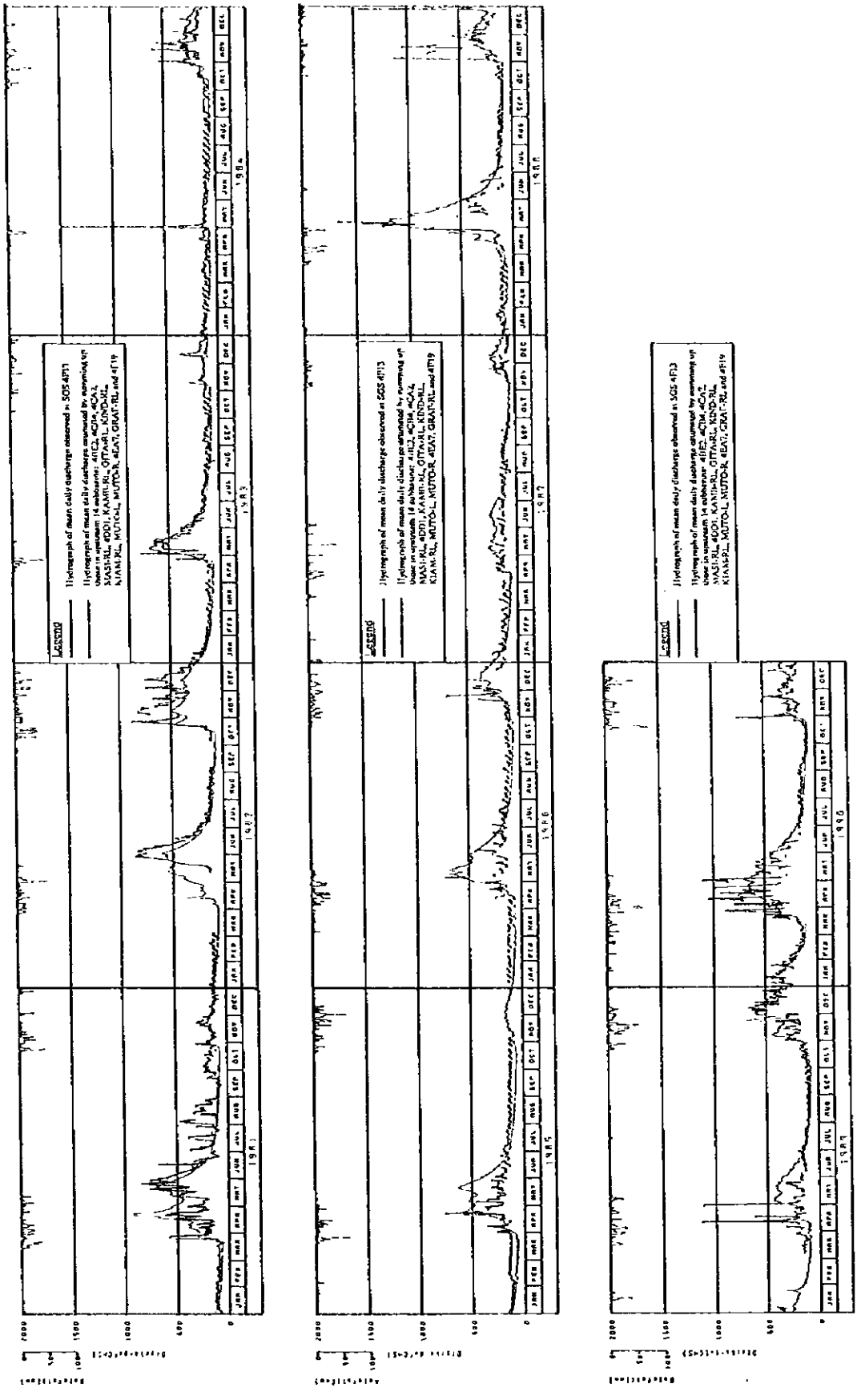
JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Flow Duration Curves of Mean Daily Discharges at SGS 4ED3, Worked out by Means of Different Two Methods	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.5



JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Flow Duration Curves at SGS 4F13, Worked out Based on Mean Daily Discharges Observed and Estimated by Summing up Those in Upstream 14 Subbasins (1/3)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.6

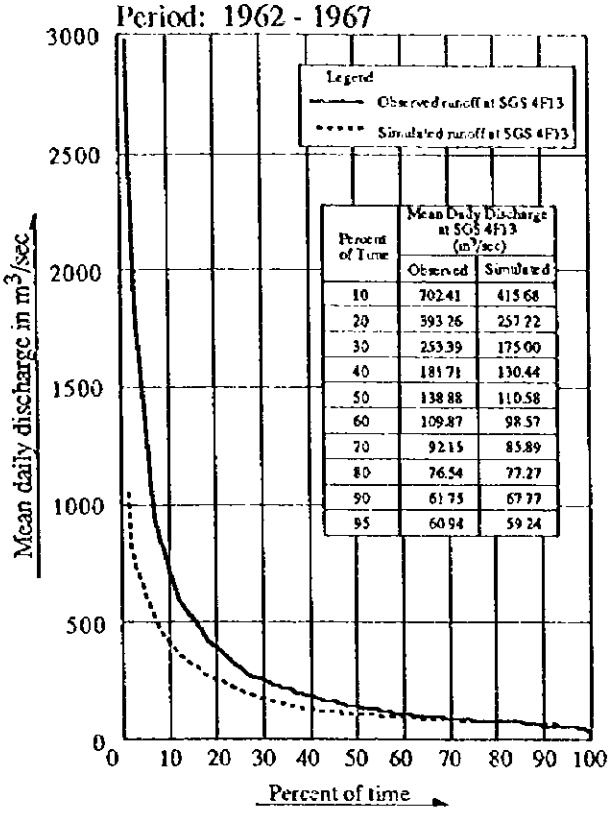


JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Flow Duration Curves at SGS 4F13, Worked out Based on Mean Daily Discharges Observed and Estimated by Summing up Those in Upstream 14 Subbasins (2/3)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.6



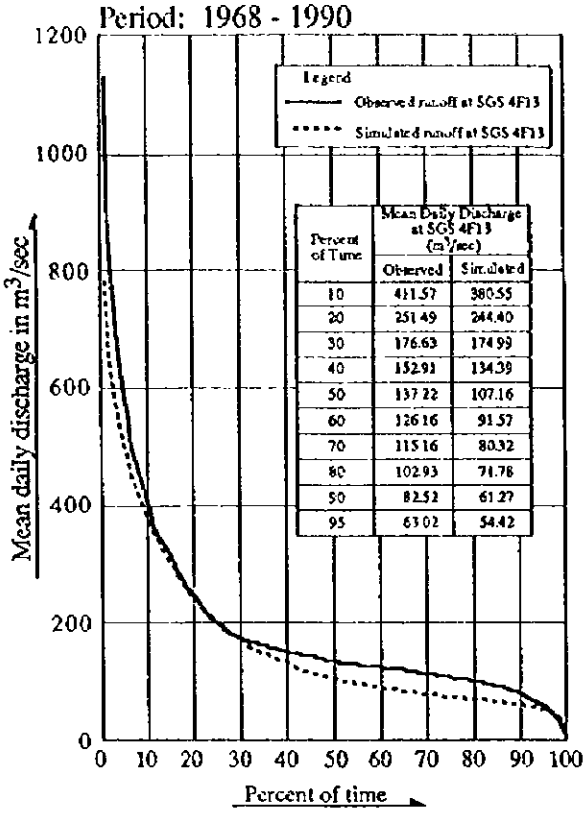
JAPAN INTERNATIONAL COOPERATION AGENCY	Comparison of Flow Duration Curves at SGS 4F13, Worked out Based on Mean Daily Discharges Observed and Estimated by Summing up Those in Upstream 14 Subbasins (3/3)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.6

Period: 1962 - 1967



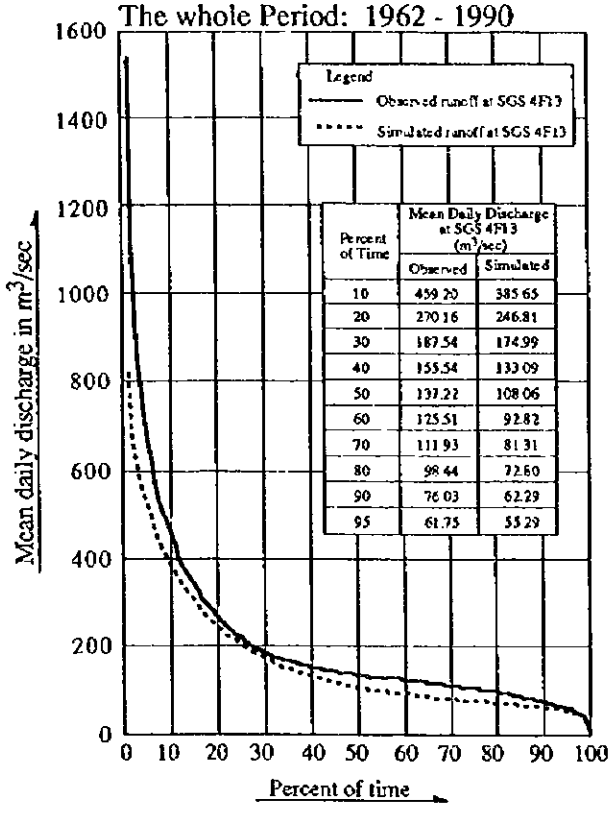
Percent of Time	Mean Daily Discharge at SGS 4F13 (m³/sec)	
	Observed	Simulated
10	702.41	415.68
20	393.26	257.22
30	253.39	175.00
40	181.71	130.44
50	138.88	110.58
60	109.87	98.57
70	92.15	85.89
80	76.54	77.27
90	61.75	67.77
95	60.94	59.24

Period: 1968 - 1990



Percent of Time	Mean Daily Discharge at SGS 4F13 (m³/sec)	
	Observed	Simulated
10	411.57	380.55
20	251.49	244.40
30	176.63	174.99
40	152.91	134.39
50	137.22	107.16
60	126.16	91.57
70	115.16	80.32
80	102.93	71.78
90	82.52	61.27
95	63.02	54.42

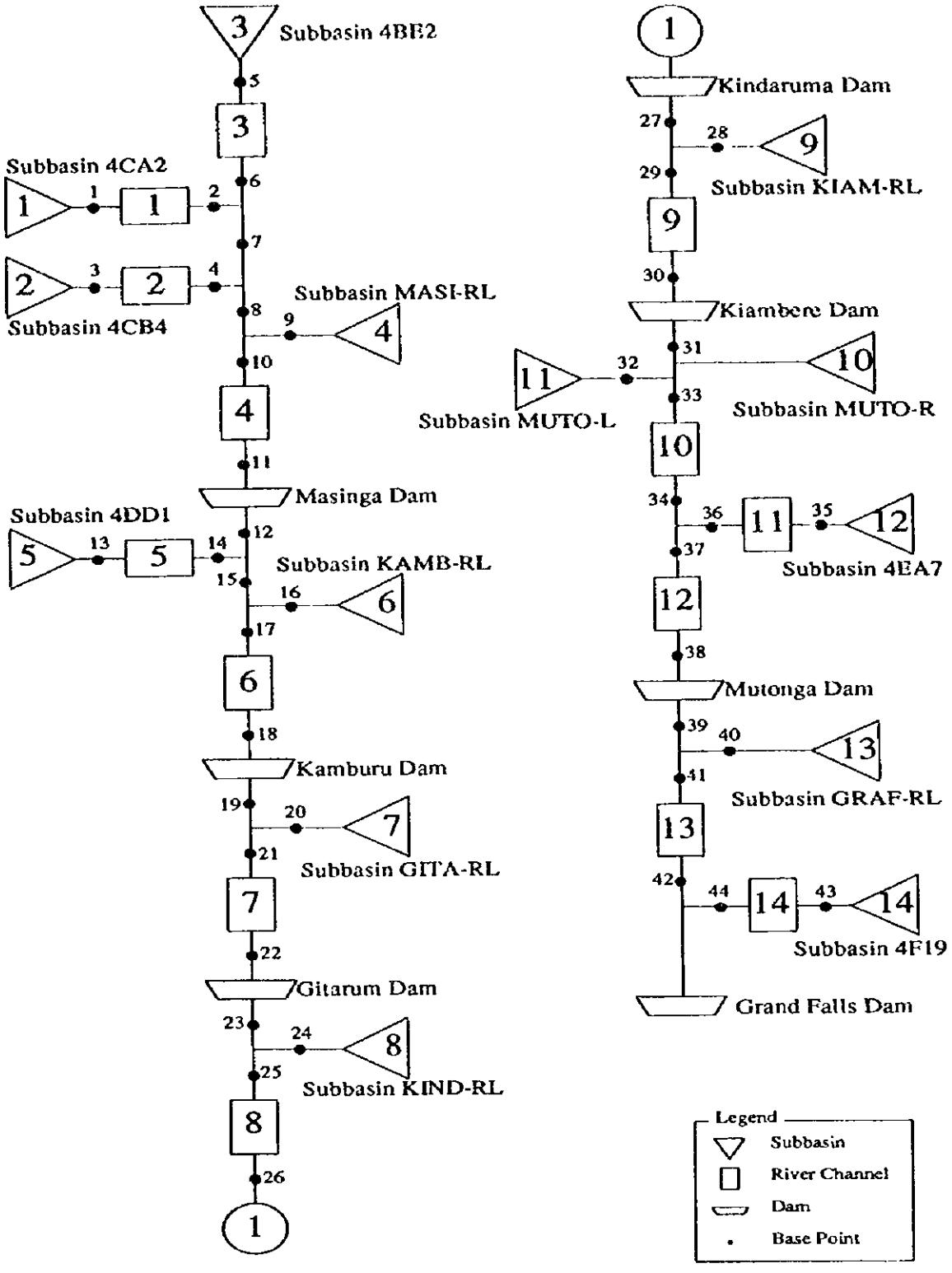
The whole Period: 1962 - 1990



Percent of Time	Mean Daily Discharge at SGS 4F13 (m³/sec)	
	Observed	Simulated
10	459.20	385.65
20	270.16	246.81
30	187.54	174.99
40	155.54	133.09
50	137.22	108.06
60	125.51	92.82
70	111.93	81.31
80	98.44	72.60
90	76.03	62.29
95	61.75	55.29

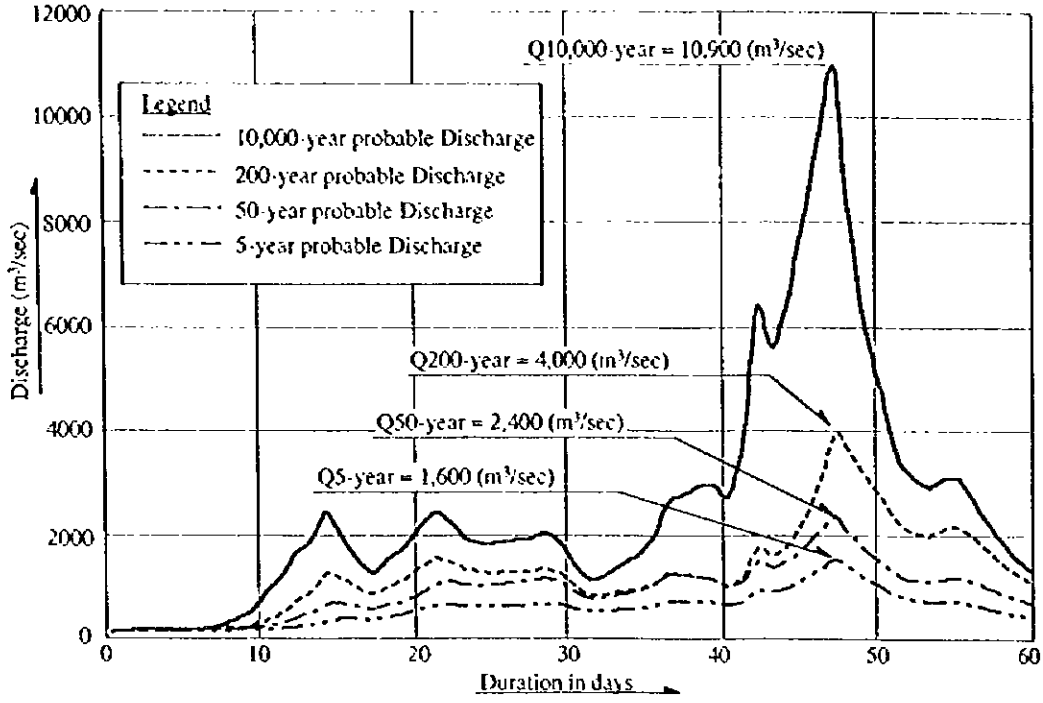
Note
The "Simulated" and "Simulated runoff" are the mean daily discharges derived by summing up those in the upstream 14 subbasins, which were estimated by means of the Tank Model Method.

JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Comparison of Flow Duration Curves at SGS 4F13, Worked out Based on Mean Daily Discharges Observed and Estimated by Summing up those in Upstream 14 Subbasins	Fig. No. 3.2.7

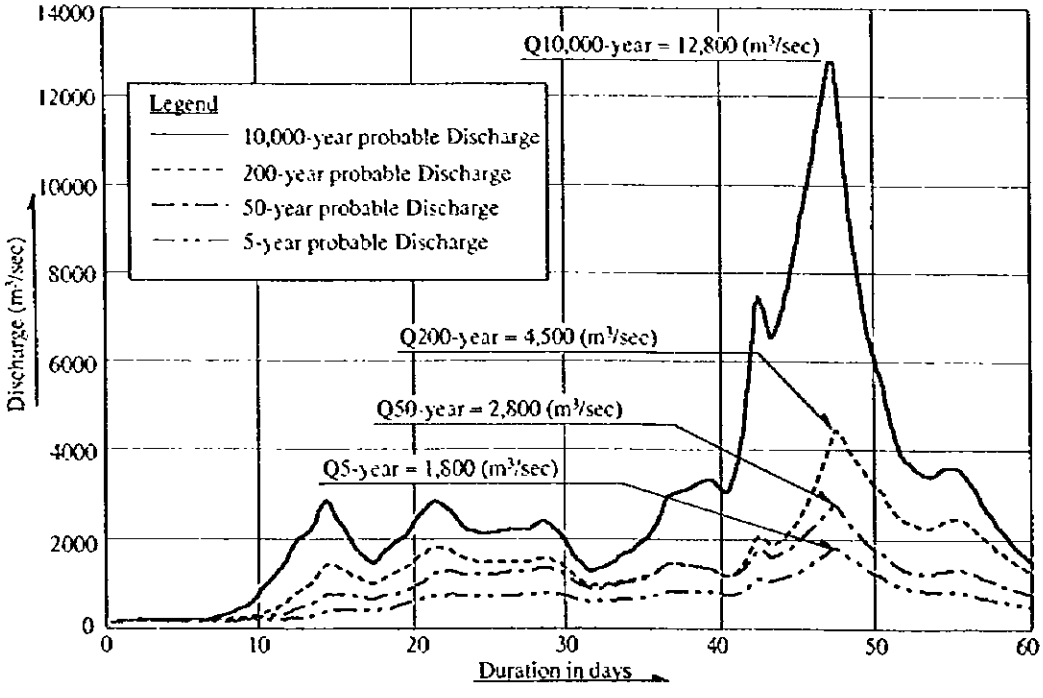


Note
The locations of subbasins are shown in Fig. B3.1

JAPAN INTERNATIONAL COOPERATION AGENCY	Simulation Model for Project Catchment, Used for Storage Function Model	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.8

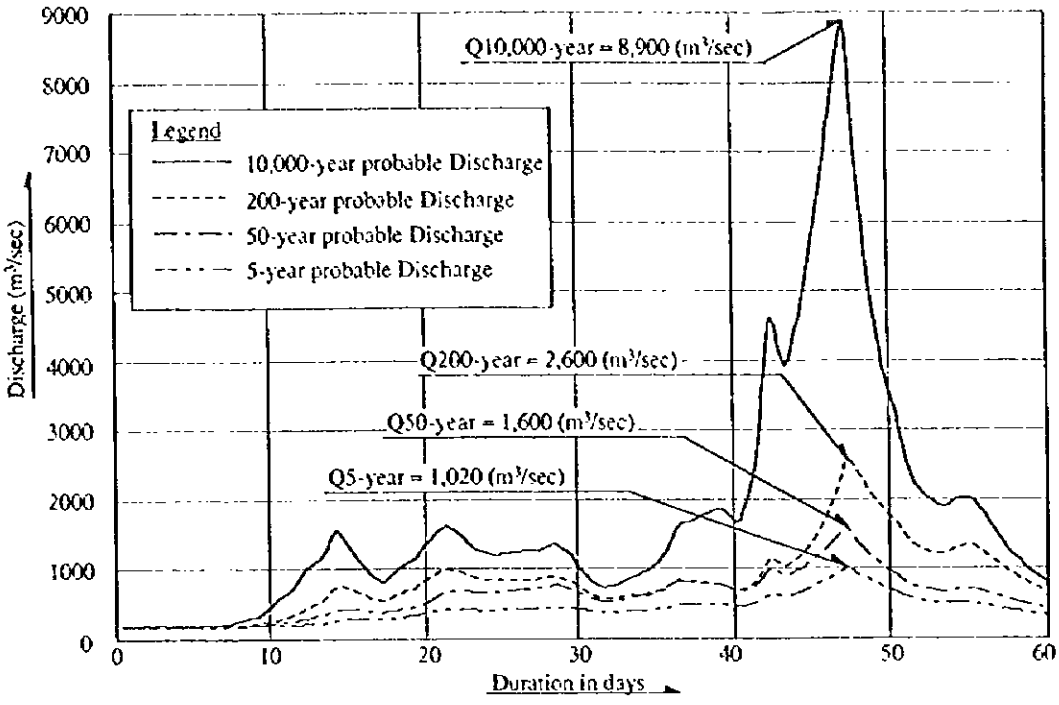


Hydrographs of Probable Floods at Mutonga Dam Site

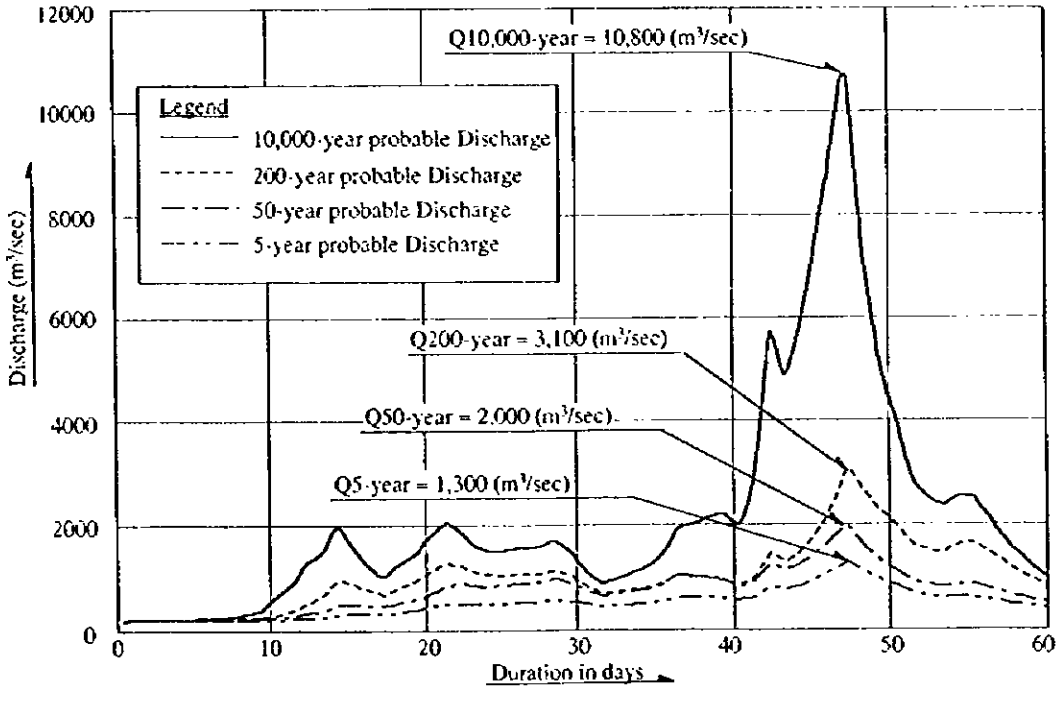


Hydrographs of Probable Floods at Grand Falls Site

JAPAN INTERNATIONAL COOPERATION AGENCY	Estimated Flood Hydrographs at Mutonga and Grand Falls Dam Site (on the without upstream Reservoirs Condition)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.9

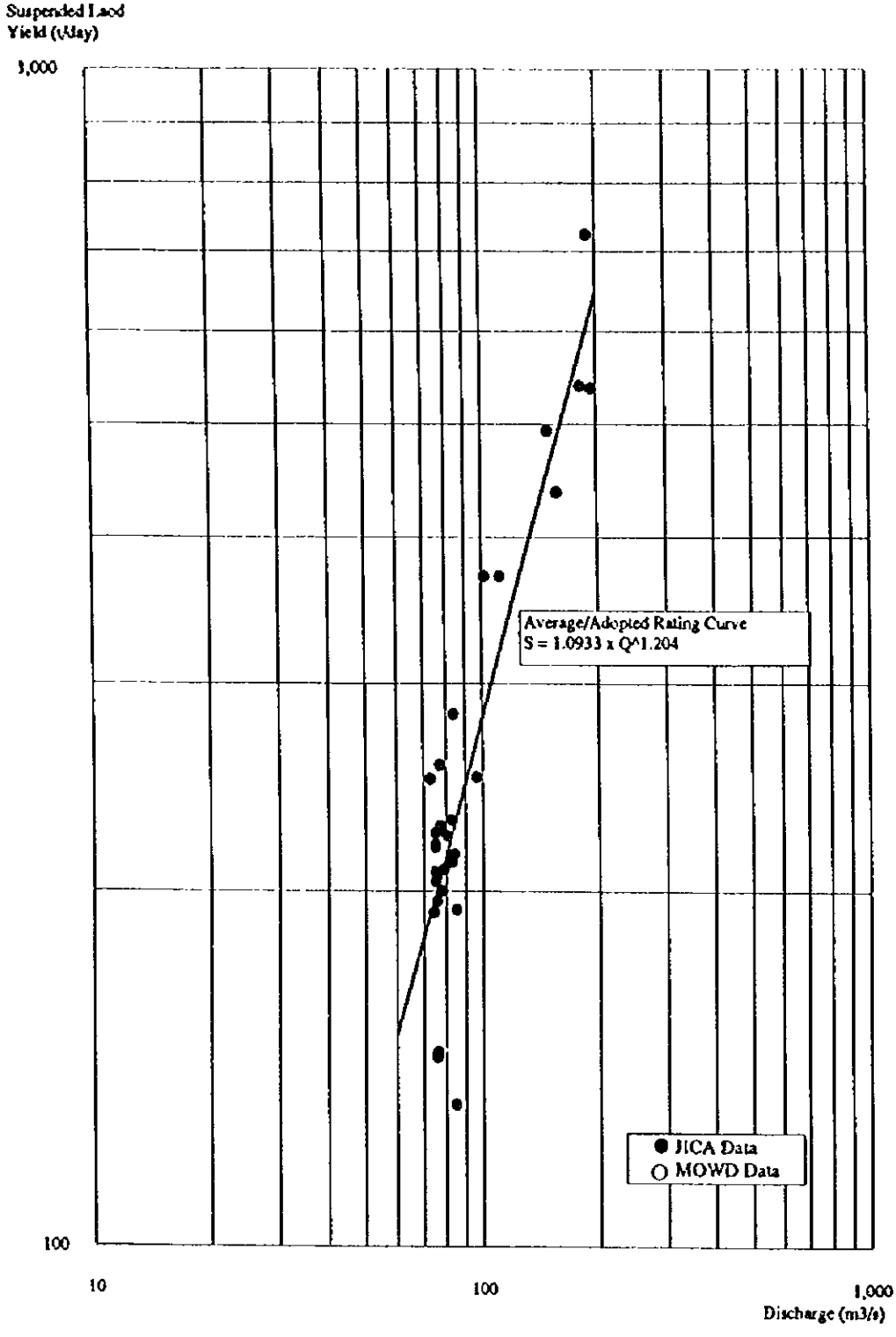


Hydrographs of Probable Floods at Mutonga Dam Site

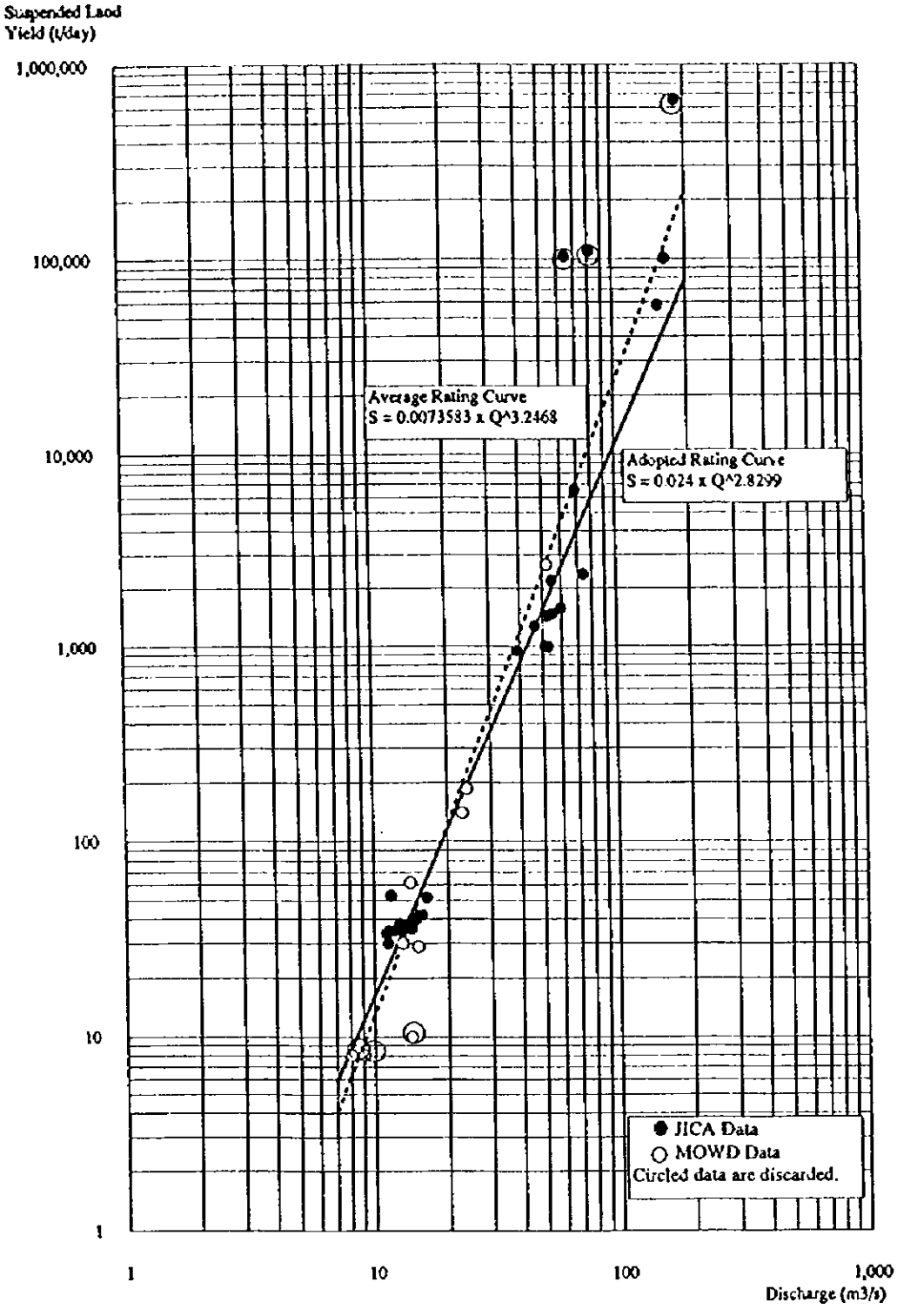


Hydrographs of Probable Floods at Grand Falls Site

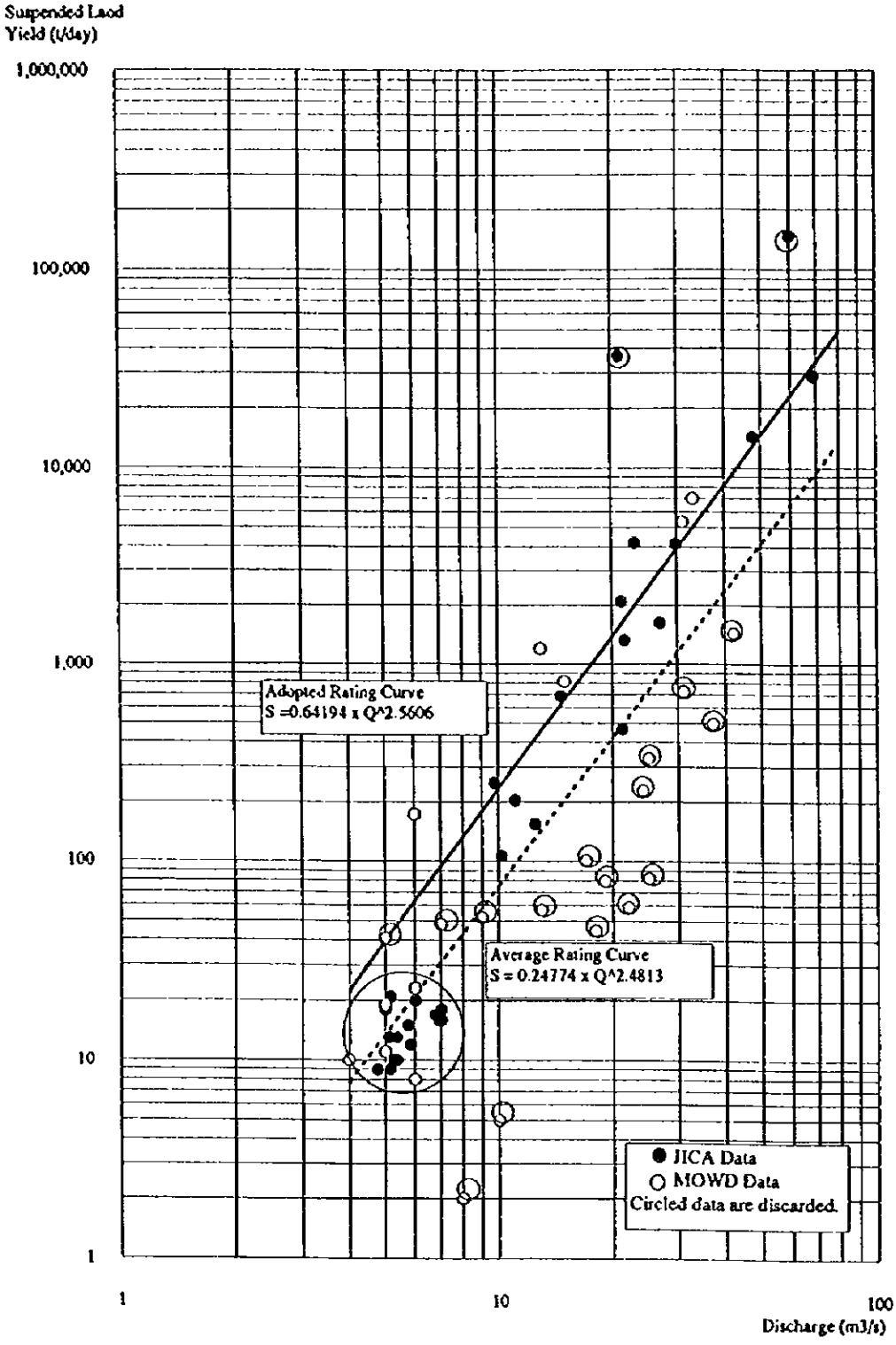
JAPAN INTERNATIONAL COOPERATION AGENCY	Estimated Flood Hydrographs at Mutonga and Grand Falls Dam Site (on the with upstream Reservoirs Condition)	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.2.10



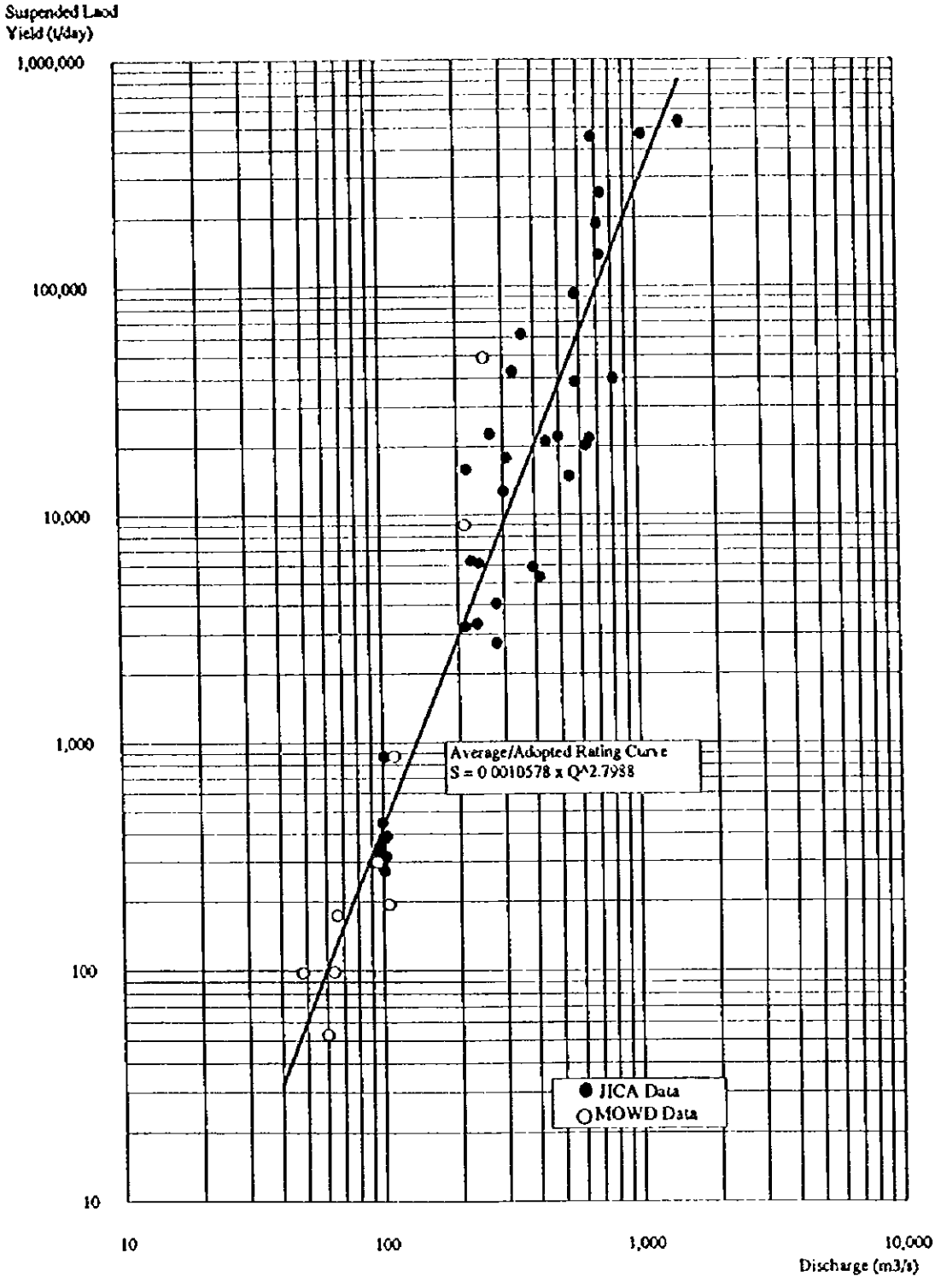
JAPAN INTERNATIONAL COOPERATION AGENC REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Suspended Load Density Curve at the Kiambere Dam downstream point	Fig. No. 3.2.11



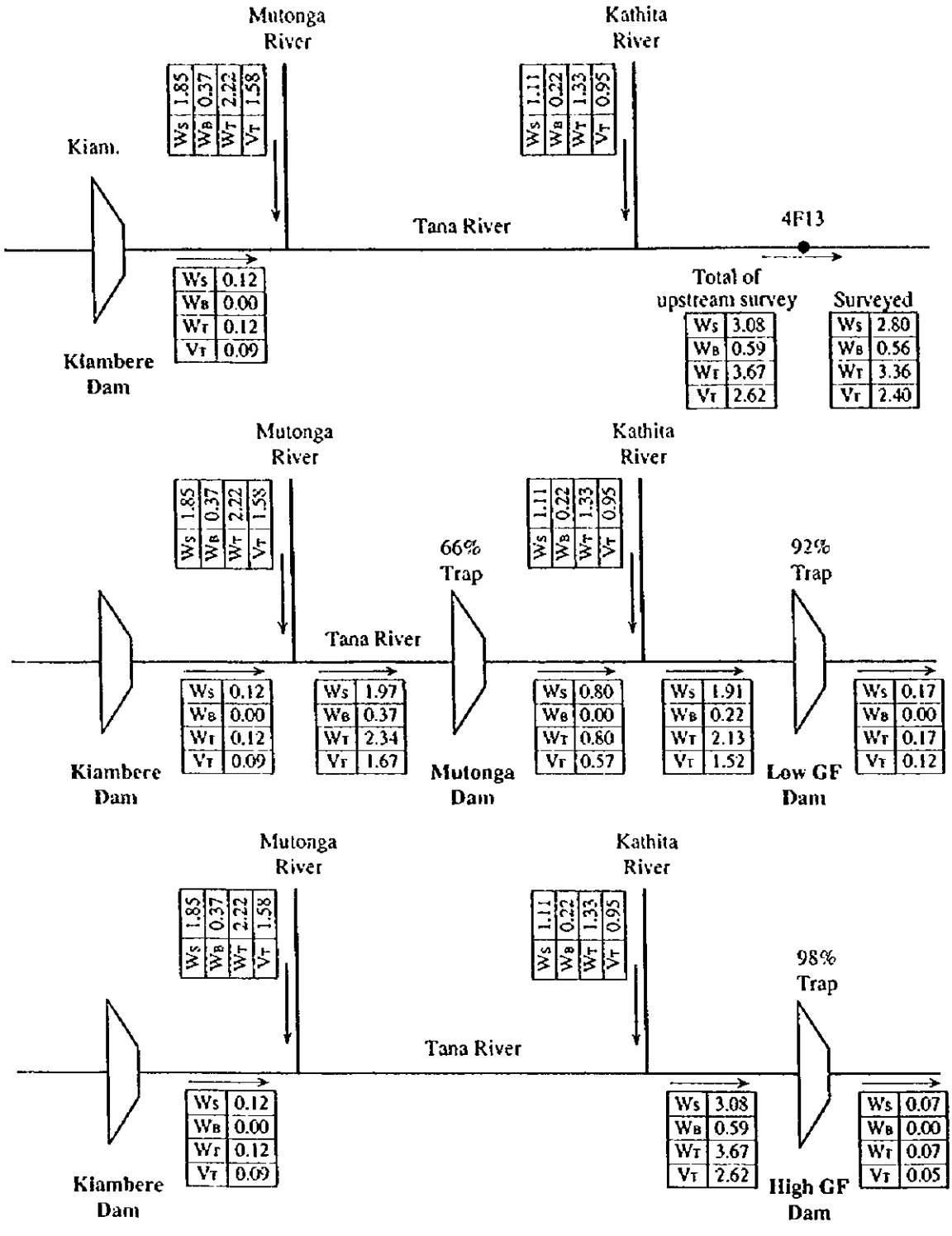
JAPAN INTERNATIONAL COOPERATION AGENC REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Suspended Load Density Curve at SGS 4EA7 of Mutonga River	Fig. No. 3.2.12



JAPAN INTERNATIONAL COOPERATION AGENC REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Suspended Load Density Curve at SGS 4F19 of Kathita River	Fig. No. 3.2.13

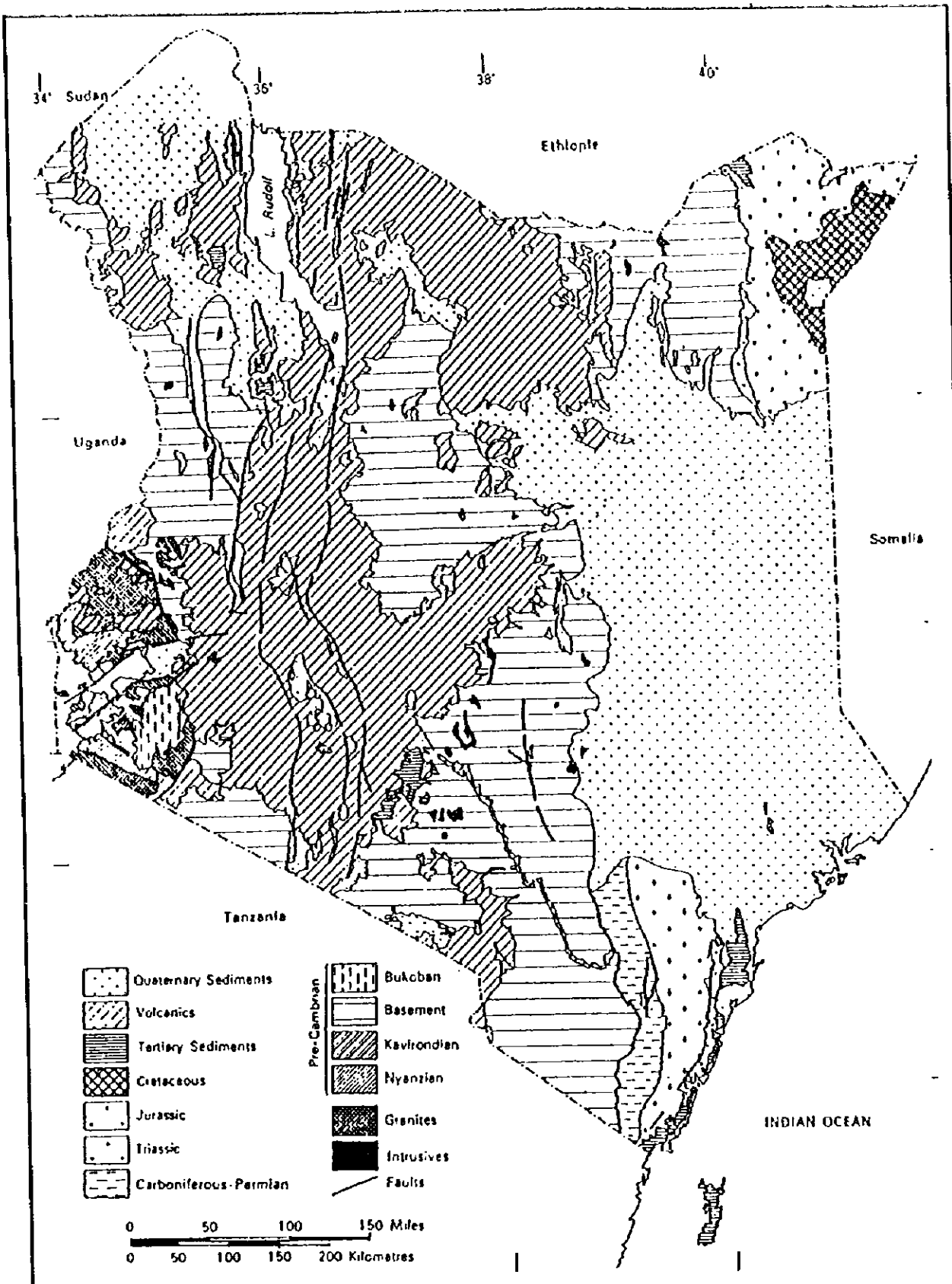


JAPAN INTERNATIONAL COOPERATION AGENC REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Suspended Load Density Curve at SGS 4F13 of Grand Falls	Fig. No. 3.2.14



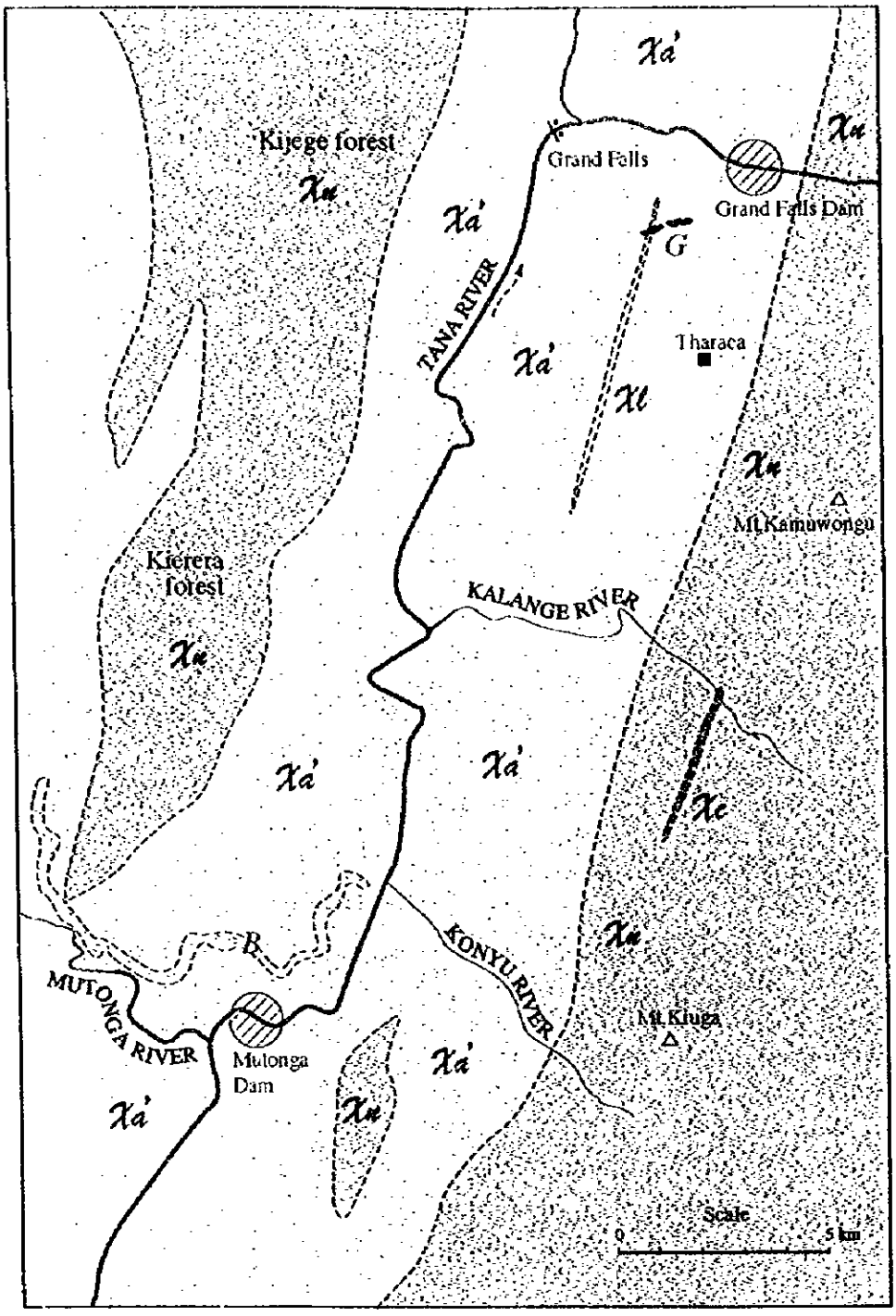
Legend :
WS : Weight of Suspended Load (10^6ton/year)
WB : Weight of Bed Load (10^6ton/year)
WT : Weight of Sediment Load (10^6ton/year)
VT : Volume of Sediment Load ($10^6 m^3$/year)

JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Estimate of Annual Sediment Transportation	Fig. No. 3 . 2 . 15



Source: Mines and Geological Department(1967)

JAPAN INTERNATIONAL COOPERATION AGENCY	Geology of Kenya	Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT		3.3.1



From
* Geology of the North Kitui Area. Geological Survey of Kenya. Report No.33, 1/125,000.
* A Geological Reconnaissance of the country between Embu and Meru. Geological Survey of Kenya Report No.17, 1/125,000.

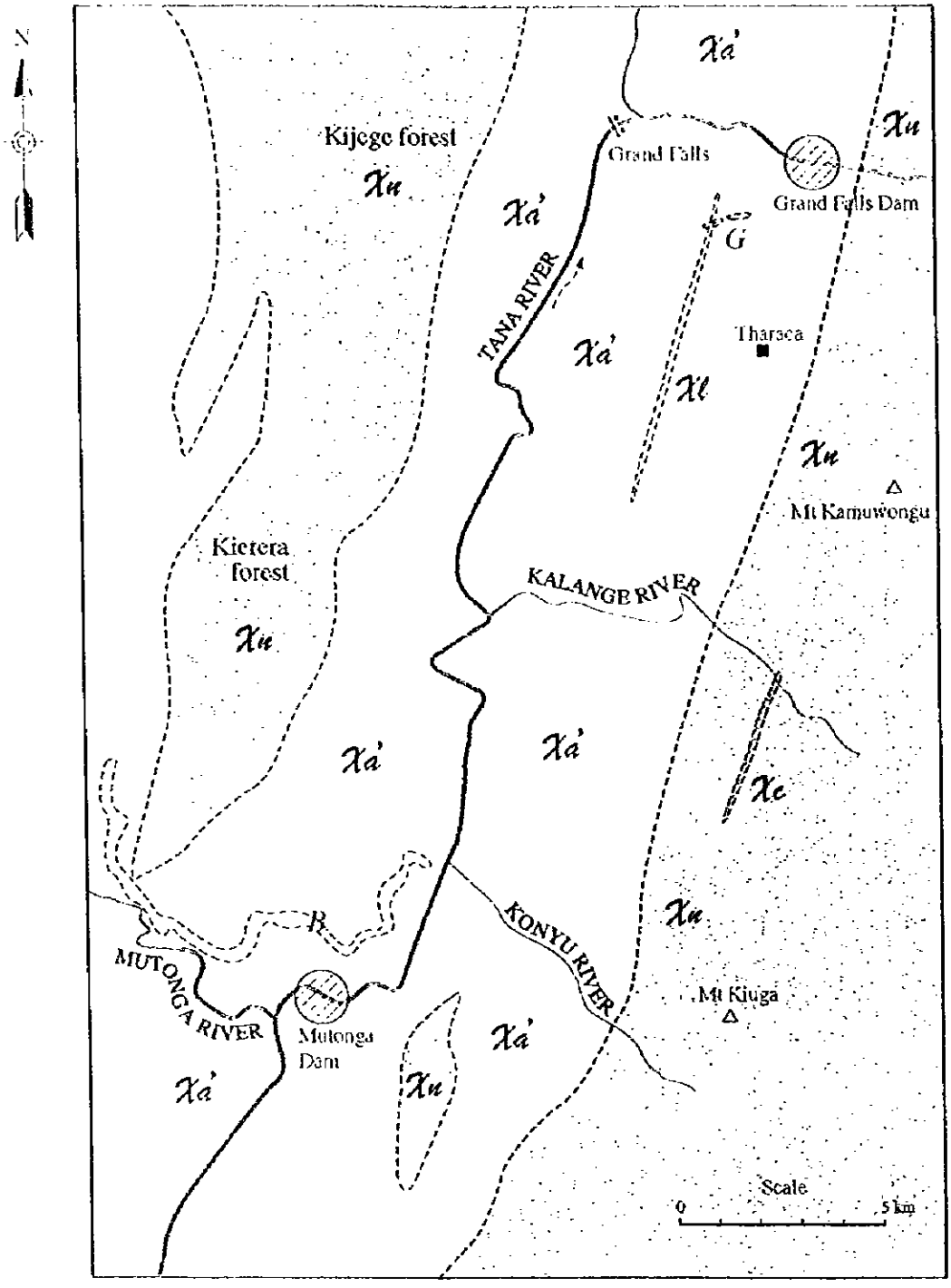
LEGEND

- B : Basalt (Pleistocene?)
- : Granite (Archaean?)
- : Granitic gneiss
- : Semi-pelitic gneiss
- : Crystaline limestone
- : Calc-silicate gneiss

(Kenya Basement System (Archaean))

- Geological boundary

JAPAN INTERNATIONAL COOPERATION AGENCY		Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Geology of the Reservoir Area	3.3.2



From * Geology of the North Kitui Area
Geological Survey of Kenya
Report No.33, 1/125,000.
* A Geological Reconnaissance of the country between Embu and Meru
Geological Survey of Kenya
Report No.17, 1/125,000.

LEGEND

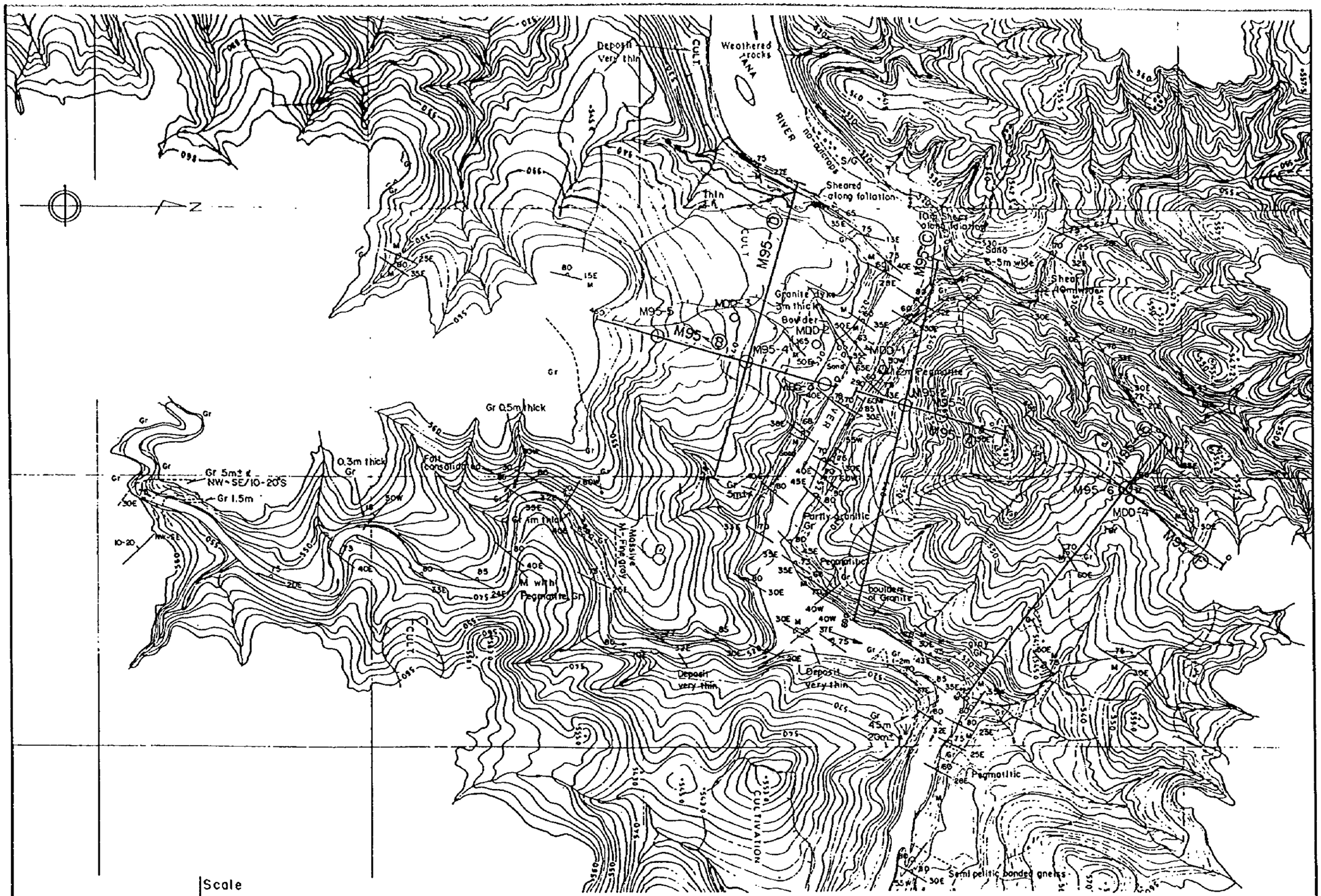
- B : Basalt (Pleistocene?)
- G : Granite (Archaean?)
- Xu : Granitic gneiss
- Xa' : Semi-pelitic gneiss
- Xl : Crystaline limestone
- Xc : Calc-silicate gneiss

(Kenya Basement System (Archaean))

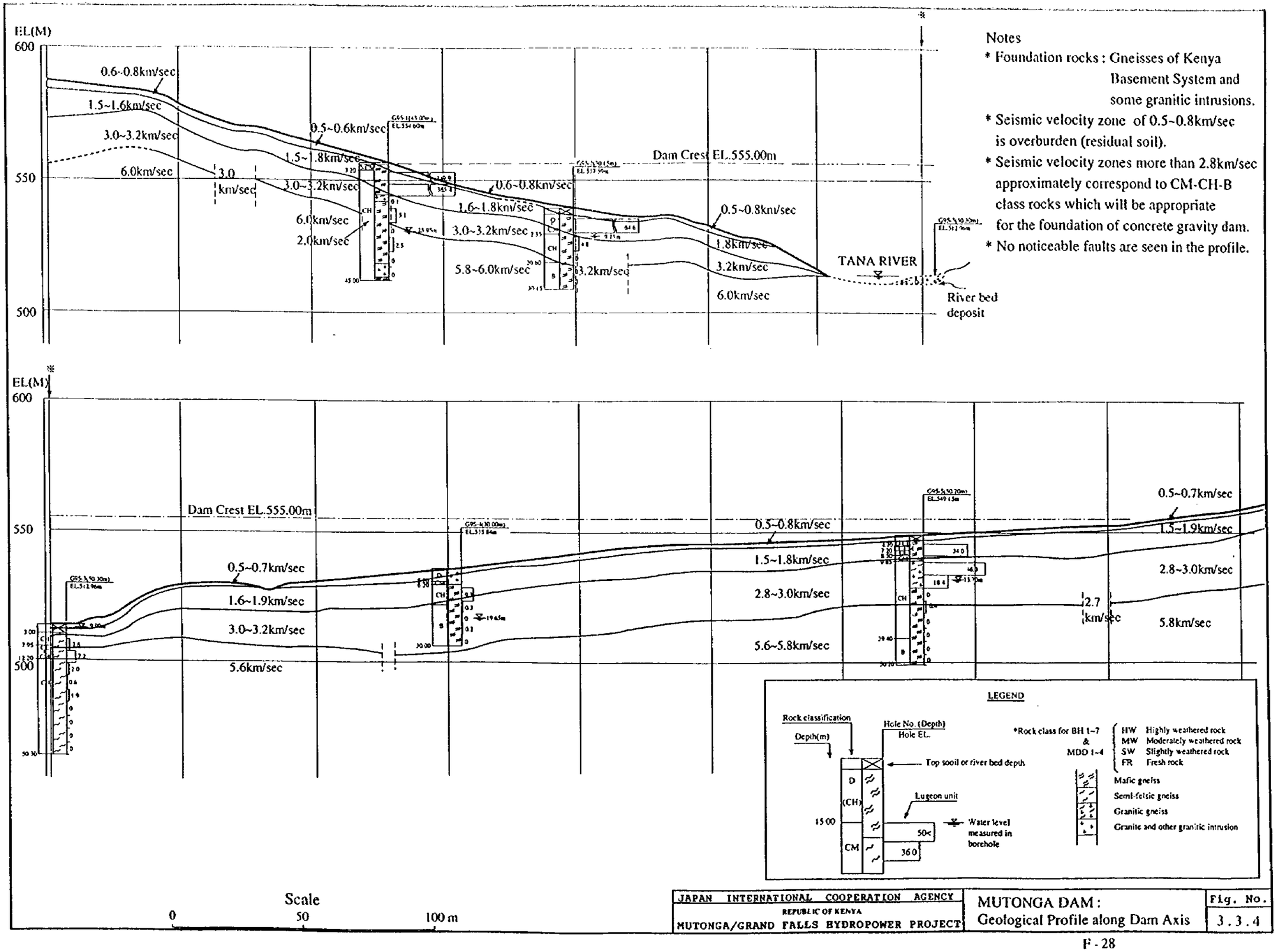
Geological boundary

JAPAN INTERNATIONAL COOPERATION AGENCY		Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Geology of the Reservoir Area	3.3.2

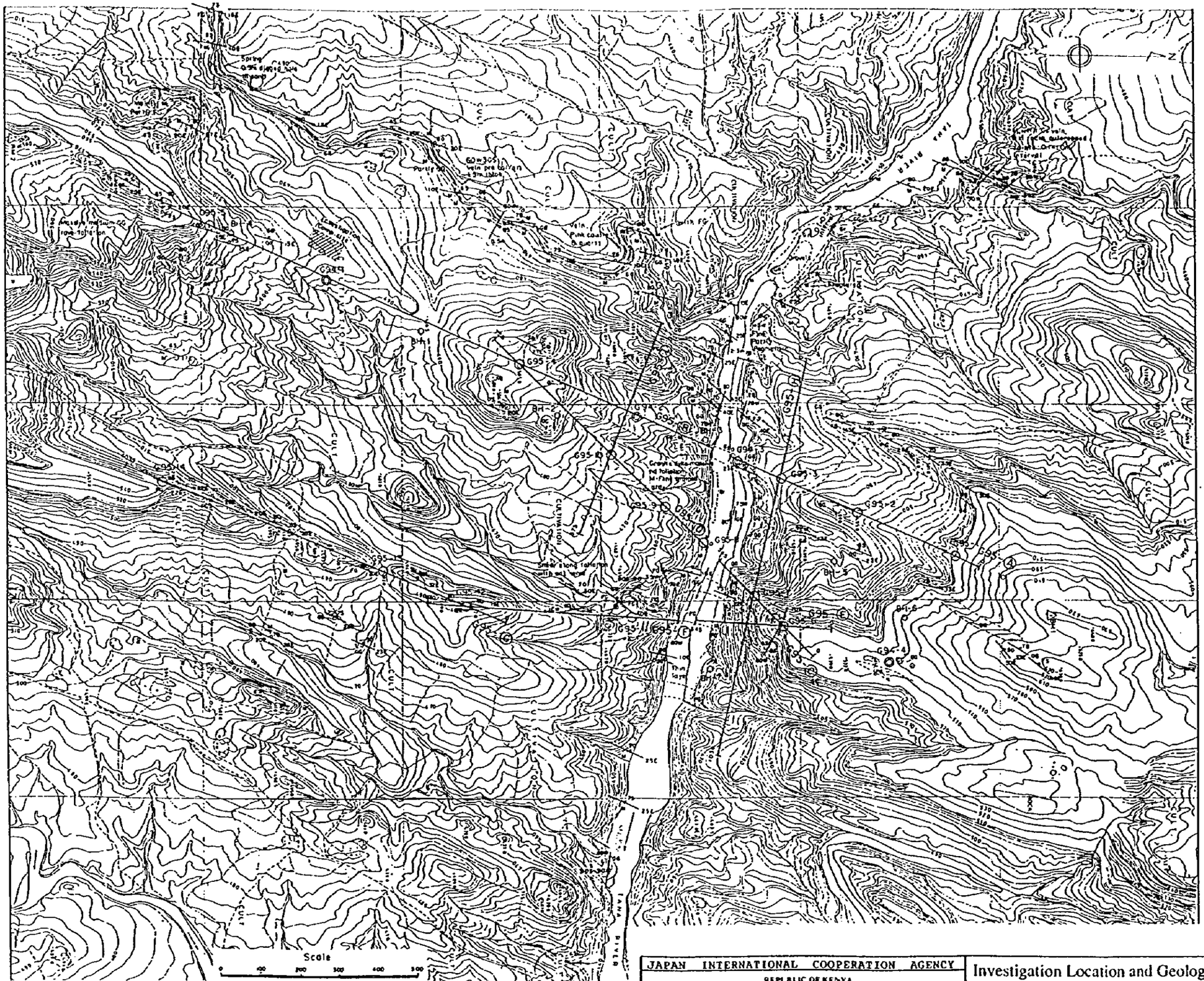
:



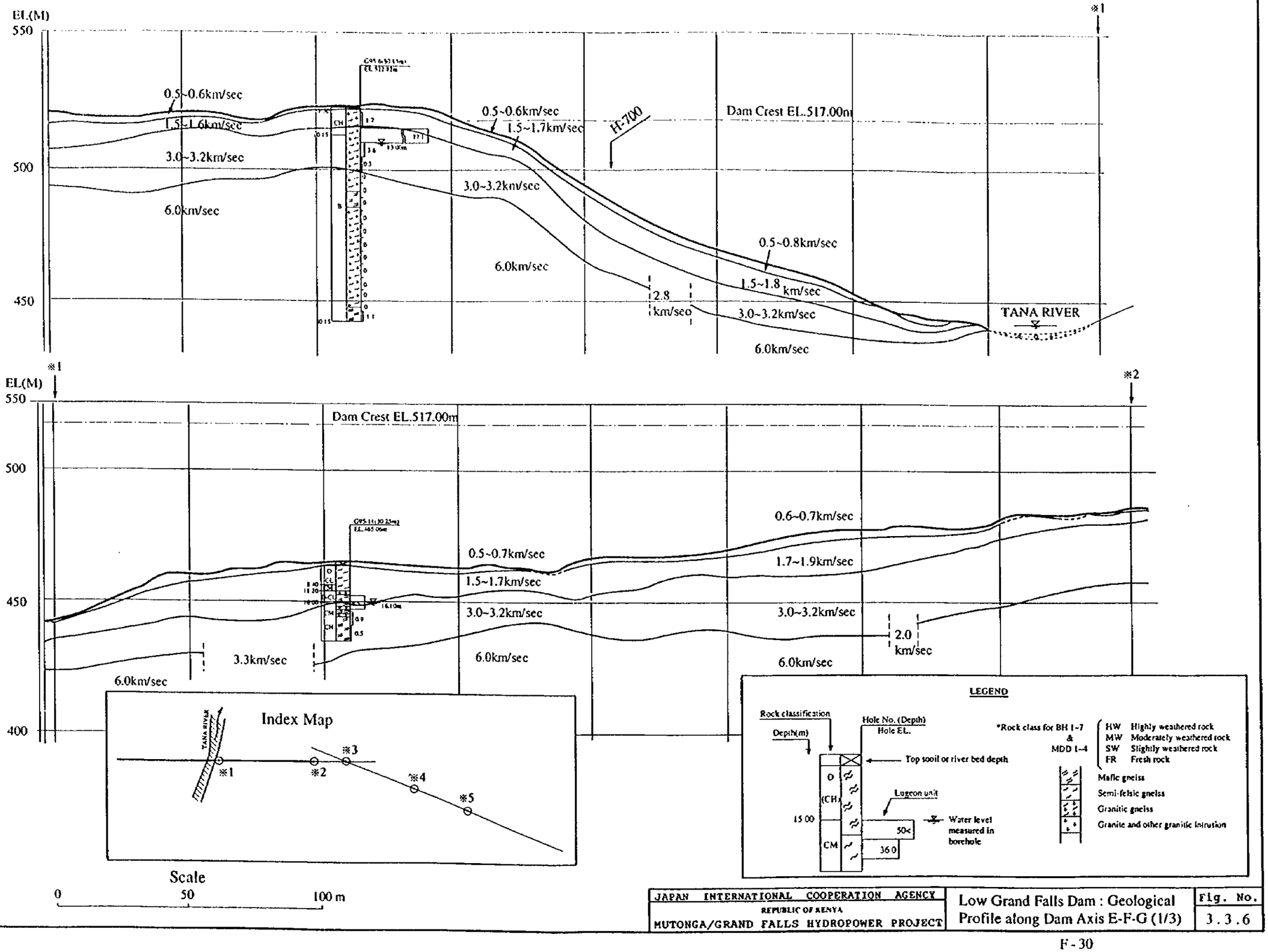
JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Investigation Location and Geological Map for Mutonga Project	Fig. No. 3.3.3



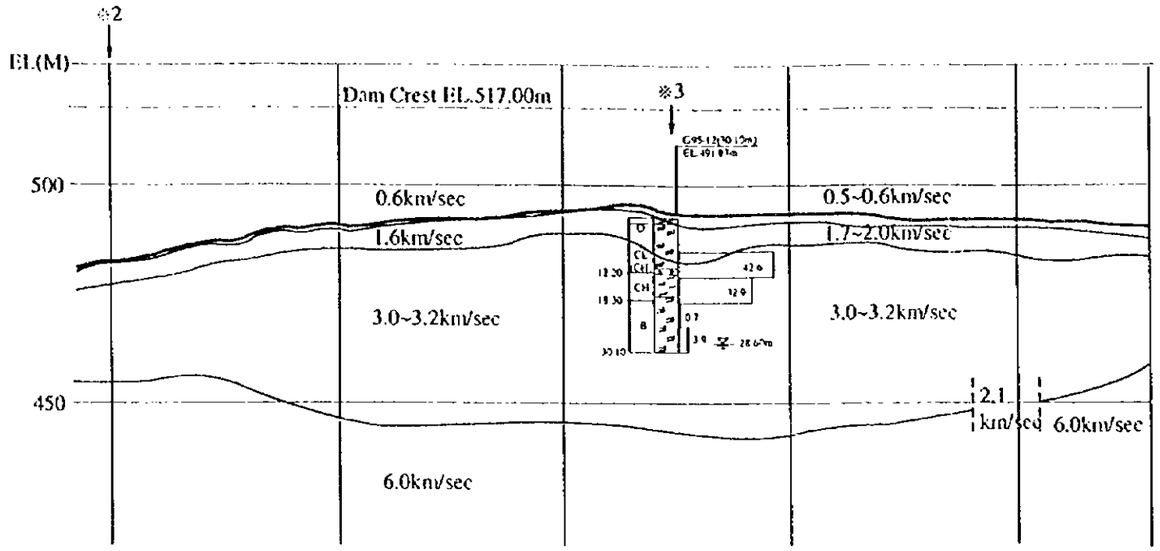
JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	MUTONGA DAM : Geological Profile along Dam Axis	Fig. No. 3.3.4



JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Investigation Location and Geological Map for Low Grand Falls Project	Fig. No. 3.3.5

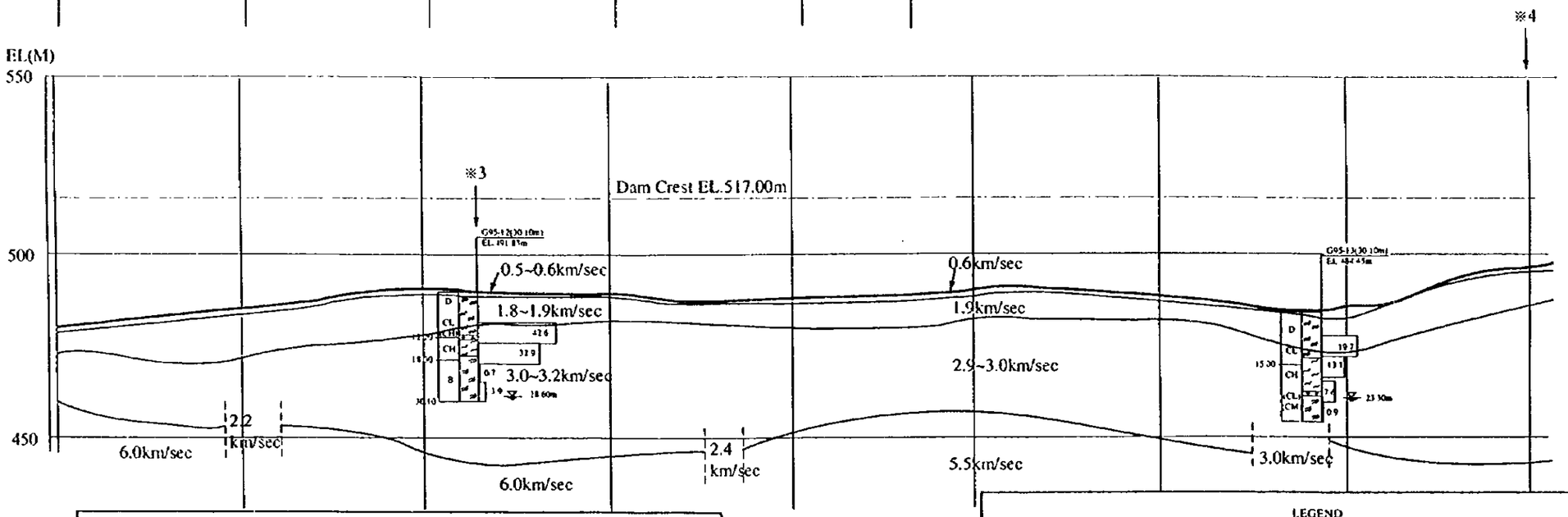


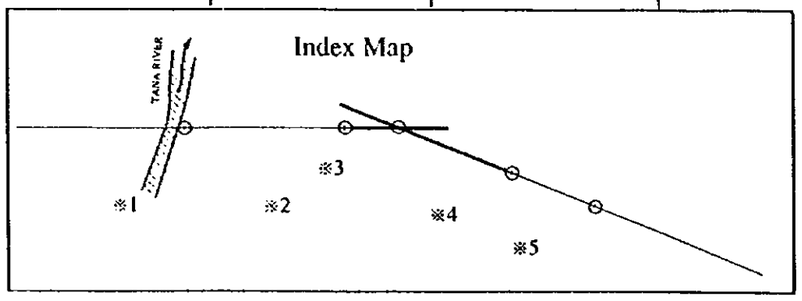
JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Low Grand Falls Dam : Geological Profile along Dam Axis E-F-G (1/3)	Fig. No. 3.3.6



Notes for Dam axis E-F-G

* Foundation rocks : Gneisses of Kenyan Basement System and some granitic intrusions.
* Seismic velocity zone of 0.5~0.8km/sec is overburden (residual soil).
* Seismic velocity zones more than 2.8km/sec approximately correspond to CM-CH-B class rocks which will be appropriate for the foundation of core zone (rock fill section), and for the foundation of concrete gravity dam.
* No noticeable faults are seen in the profile along dam axis E-F-G.





Scale
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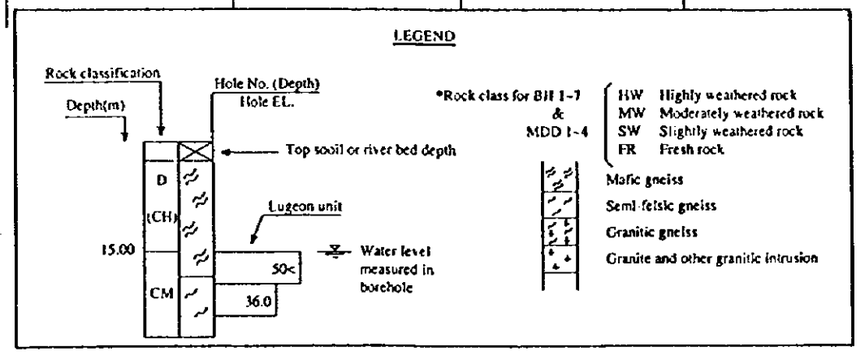
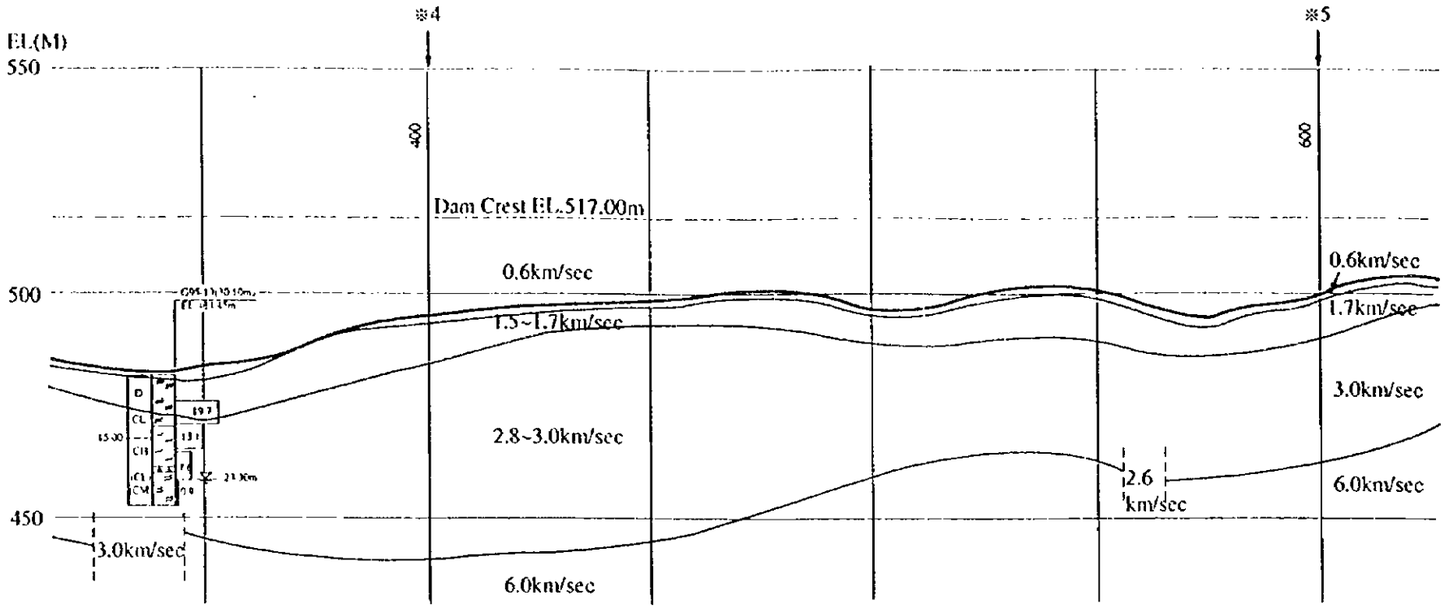
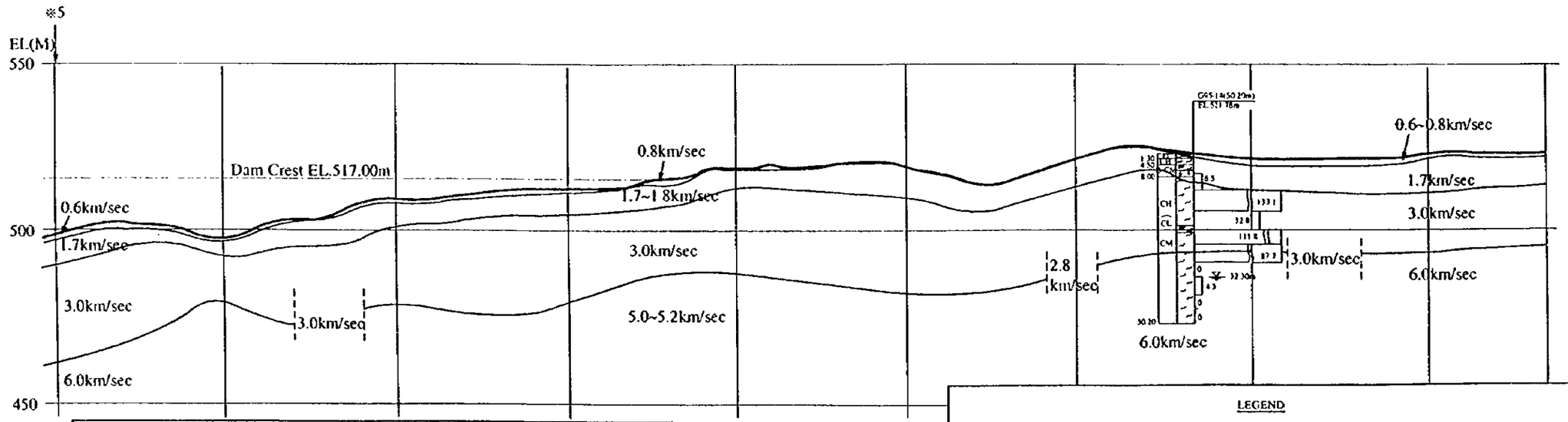
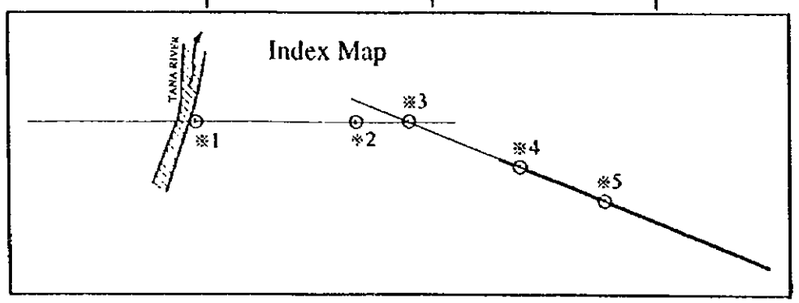
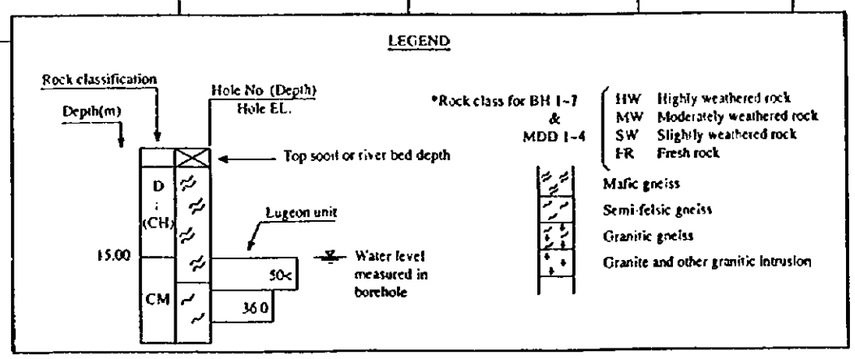


JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Low Grand Falls Dam : Geological Profile along Dam Axis E-F-G (2/3)	Fig. No. 3.3.6

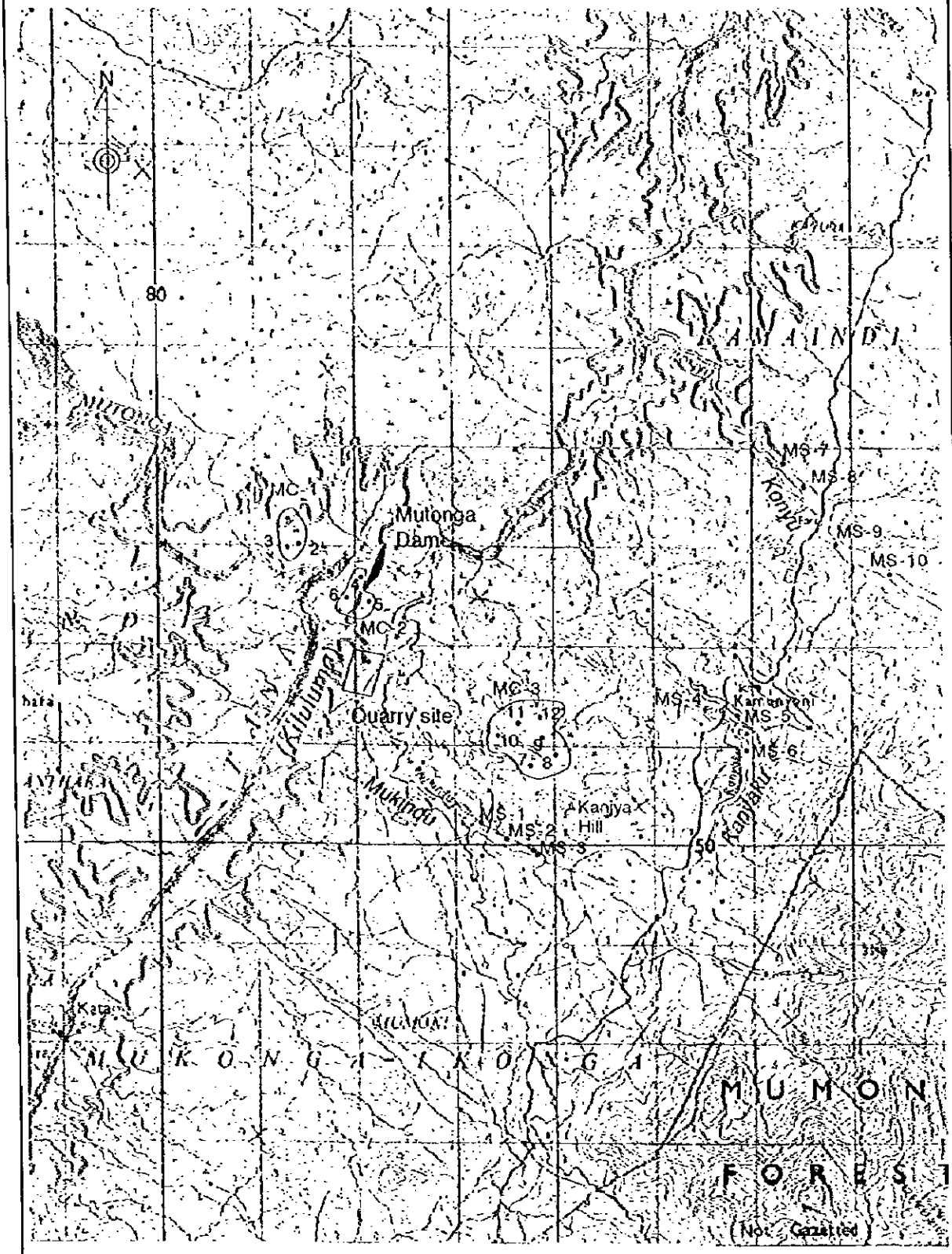








JAPAN INTERNATIONAL COOPERATION AGENCY REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Low Grand Falls Dam : Geological Profile along Dam Axis E-F-G (3/3)	Fig. No. 3.3.6



JAPAN INTERNATIONAL COOPERATION AGENCY		Fig. No.
REPUBLIC OF KENYA MUTONGA/GRAND FALLS HYDROPOWER PROJECT	Mutonga Dam Site	3.4.1