Table G.2.33 Water Quality of River Draining to Lake Nakuru

Testing Items / St. No.	Enjoro River	Makalia River	Enderit River	Total
Month. Day	Jun. 9	Jun. 14	Jun. 14	Min ～ Max (Ave)
Time	12 : 00	11 : 40	12 : 00	－
Depth (m)	－	－	－	－
Transpency (m)	－	－	－	－
Color of Water	17	15	17	15 ～ 17 (16)
Temperature (·)	22.1	16.8	16.8	16.8 ～ 22.1 (18.6)
pH	7.85	8.10	7.67	7.67 ～ 8.10 (7.87)
Conductivity (μs/cm)	300	260	330	260 ～ 330 (297)
Turbidity (mg/ℓ)	31	50	94	31 ～ 94 (58)
SS (mg/ℓ)	12	80	180	12 ～ 180 (91)
DO (mg/ℓ)	5.8	6.7	5.6	5.6 ～ 6.7 (6.0)
COD (mg/ℓ)	18	19	25	18 ～ 25 (21)
T-N (mg/ℓ)	7.642	3.109	4.501	3.109 ～ 7.642 (5.084)
K-N (mg/ℓ)	3.45	1.35	2.85	1.35 ～ 3.45 (2.55)
NH_4-N (mg/ℓ)	－	－	－	－
NO_3-N (mg/ℓ)	3.9	1.7	1.5	1.5 ～ 3.9 (2.4)
NO_2-N (mg/ℓ)	0.292	0.059	0.151	0.059 ～ 0.292 (0.167)
T-P (mg/ℓ)	－	－	－	－
PO_4-P (mg/ℓ)	3.45	0.21	0.68	0.21 ～ 3.45 (1.45)

Table G.2.34 Water Quality of Lake Nakuru (1/4)

Testing Items / St. No. S·B	1										Total	
	S	B	S	B	S	B	S	B	S	B	S	B
Month. Day	Jun. 19		July. 3		July. 12		July. 18		July. 23		Min ~ Max (Ave)	Min ~ Max (Ave)
Time	11 : 45		11 : 08		16 : 45		13 : 10		14 : 27		—	—
Depth (m)	2.0		2.0		2.2		2.2		2.1		2.0 ~ 2.2 (2.1)	—
Transpency (m)	0.4		0.4		0.5		0.4		0.4		0.4 ~ 0.5 (0.4)	—
Color of Water	20		21		21		20		> 21		20 ~ > 21 (21)	—
Temperature (°)	25.1	22.1	—	—	—	—	—	—	—	—	—	—
pH	10.39	10.39	—	—	10.37	10.39	10.31	10.35	10.27	10.26	10.27~ 10.39 (10.34)	10.26~ 10.39 (10.35)
Conductivity (μs/cm)	16,960	16,900	17,400	17,400	17,230	17,150	17,740	17,680	17,430	17,400	16,960~17,740 (17,352)	16,900~17,680 (17,306)
Turbidity (mg/ℓ)	—	—	—	—	—	—	—	—	—	—	—	—
SS (mg/ℓ)	69	47	136	77	51	42	66	35	50	45	50 ~136 (74)	35 ~ 77 (49)
DO (mg/ℓ)	11.6	1.9	8.6	1.8	—	—	—	—	—	—	8.6 ~ 11.6 (10.1)	1.8 ~ 1.9 (1.9)
COD (mg/ℓ)	179	192	206	190	206	217	181	184	372	344	179 ~372 (229)	184 ~344 (225)
T-N (mg/ℓ)	34.414	27.840	—	—	—	—	—	—	—	—	—	—
K-N (mg/ℓ)	14.17	10.00	—	—	—	—	—	—	—	—	—	—
NH_4-N (mg/ℓ)	—	—	0.40	0.36	0.03	0.06	0.07	0.02	0.04	0.04	0.03~ 0.40 (0.14)	0.02~ 0.36 (0.12)
NO_3-N (mg/ℓ)	20.2	17.8	11.9	12.9	10.6	10.9	11.5	12.1	12.9	15.4	10.6 ~ 20.2 (13.4)	10.9 ~ 17.8 (13.8)
NO_2-N (mg/ℓ)	0.044	0.040	0.043	0.038	0.028	0.029	0.046	0.031	0.015	0.025	0.015~ 0.046 (0.035)	0.025~ 0.040 (0.033)
T-P (mg/ℓ)	—	—	—	—	2.88	2.40	2.54	3.56	3.99	4.17	2.54~ 3.99 (3.14)	2.40~ 4.17 (3.38)
PO_4-P (mg/ℓ)	1.54	1.72	0.94	1.14	1.80	1.14	1.64	1.02	1.27	1.21	0.94~ 1.80 (1.44)	1.02~ 1.72 (1.25)

Legend S : Surface, B : Bottom

Table G.2.35 Water Quality of Lake Nakuru (2/4)

Testing Items / St. No. S·B	8										Total S	Total B
	S	B	S	B	S	B	S	B	S	B	S	B
Month. Day	Jun. 18		July. 3		July. 7		July. 18		July. 23		Min ～ Max (Ave)	Min ～ Max (Ave)
Time	16 : 00		13 : 56		17 : 18		13 : 40		14 : 55		—	—
Depth (m)	2.2		2.3		2.3		2.3		2.2		2.2 ～ 2.3 (2.3)	—
Transpency (m)	0.4		0.5		0.5		0.4		0.5		0.4 ～ 0.5 (0.5)	—
Color of Water	19		21		21		21		> 21		19 ～ > 21 (21)	—
Temperature (°)	26.4	22.4	—	—	—	—	—	—	—	—	—	—
pH	10.42	10.37	—	—	10.44	10.45	10.39	10.40	10.24	10.23	10.24～ 10.44 (10.37)	10.23～ 10.45 (10.36)
Conductivity (μs/cm)	17,620	17,600	17,750	17,620	17,660	17,450	17,990	17,970	17,840	17,920	17,620～17,990 (17,772)	17,450～17,970 (17,712)
Turbidity (mg/ℓ)	—	—	—	—	—	—	—	—	—	—	—	—
SS (mg/ℓ)	16	16	65	77	53	32	41	25	29	18	16 ～ 65 (41)	16 ～ 77 (34)
DO (mg/ℓ)	9.1	7.9	—	—	—	—	—	—	—	—	—	—
COD (mg/ℓ)	192	191	197	204	211	359	176	146	332	300	192 ～332 (222)	146 ～359 (240)
T-N (mg/ℓ)	33.201	29.339	—	—	—	—	—	—	—	—	—	—
K-N (mg/ℓ)	12.08	10.42	—	—	—	—	—	—	—	—	—	—
NH_4-N (mg/ℓ)	—	—	0.09	0.07	0.05	0.07	0.04	0.03	0.02	0.01	0.02～ 0.09 (0.05)	0.01～ 0.07 (0.05)
NO_3-N (mg/ℓ)	21.1	18.9	13.9	11.9	10.4	10.3	12.0	13.4	10.5	10.5	10.4 ～ 21.1 (13.6)	10.3 ～ 18.9 (13.0)
NO_2-N (mg/ℓ)	0.021	0.019	0.029	0.039	0.032	0.022	0.034	0.030	0.029	0.039	0.021～ 0.034 (0.029)	0.019～ 0.039 (0.030)
T-P (mg/ℓ)	—	—	—	—	3.08	2.82	3.12	3.00	2.45	2.63	2.45～ 3.12 (2.88)	2.63～ 3.00 (2.82)
PO_4-P (mg/ℓ)	1.54	2.10	1.38	1.26	1.28	1.34	1.18	0.92	1.27	1.35	1.18～ 1.54 (1.33)	0.92～ 2.10 (1.39)

Legend S : Surface, B : Bottom

Table G.2.36 Water Quality of Lake Nakuru (3/4)

Testing Items	St. No.	1		2		3		4		5		6		7	
	S·B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Month. Day		Jun. 19		Jun. 19		Jun. 19		Jun. 18		Jun. 18		Jun. 18		Jun. 18	
Time		11 : 45		12 : 30		12 : 15		17 : 05		16 : 55		16 : 40		16 : 25	
Depth	(m)	2.0		2.2		2.0		2.3		2.3		2.3		2.3	
Transpency	(m)	0.4		0.4		0.4		0.3		0.4		0.4		0.5	
Color of Water		20		20		20		20		18		18		19	
Temperature	(·)	25.1	22.1	24.6	20.5	24.2	20.8	24.8	21.7	26.0	21.0	26.2	21.0	26.8	21.8
pH		10.39	10.39	10.40	10.37	10.45	10.36	10.40	10.41	10.34	10.40	10.39	10.41	10.35	10.42
Conductivity	(μs/cm)	16,960	16,900	17,360	17,410	17,530	17,450	17,690	17,660	17,660	17,600	17,640	17,550	17,660	17,580
Turbidity	(mg/ℓ)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SS	(mg/ℓ)	69	47	19	16	19	17	30	20	15	13	13	11	14	13
DO	(mg/ℓ)	11.6	1.9	6.3	1.8	7.3	4.1	13.2	6.1	9.1	4.2	8.3	4.8	8.4	7.2
COD	(mg/ℓ)	179	192	195	195	193	194	197	197	190	189	190	192	193	192
T-N	(mg/ℓ)	34.414	27.840	–	–	–	–	–	–	–	–	–	–	–	–
K-N	(mg/ℓ)	14.17	10.00	–	–	–	–	–	–	–	–	–	–	–	–
NH_4-N	(mg/ℓ)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NO_3-N	(mg/ℓ)	20.2	17.8	20.0	16.7	25.0	18.5	18.3	15.8	15.5	14.6	16.2	14.7	16.5	16.4
NO_2-N	(mg/ℓ)	0.044	0.040	0.024	0.025	0.027	0.025	0.035	0.027	0.025	0.021	0.019	0.017	0.020	0.020
T-P	(mg/ℓ)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PO_4-P	(mg/ℓ)	1.54	1.72	1.52	1.90	1.82	1.90	1.44	2.04	1.64	1.60	1.76	1.52	1.74	1.68

Legend S : Surface, B : Bottom

Table G.2.37 Water Quality of Lake Nakuru (4/4)

Testing Items / St. No. / S·B		8		9		10		11		Total	
		S	B	S	B	S	B	S	B	S	B
Month. Day		Jun. 18		Jun. 18		Jun. 18		Jun. 18		Min ～ Max (Ave)	Min ～ Max (Ave)
Time		16 : 00		15 : 50		15 : 00		15 : 30		—	—
Depth	(m)	2.2		2.1		2.0		2.2		2.0 ～ 2.3 (2.2)	—
Transpency	(m)	0.4		0.2		0.2		0.2		0.2 ～ 0.5 (0.3)	—
Color of Water		19		21		21		21		18 ～ 21 (20)	—
Temperature	(·)	26.4	22.4	26.2	25.1	26.5	21.3	26.3	21.2	24.2 ～ 26.8 (25.7)	20.5 ～ 25.1 (21.7)
pH		10.42	10.37	10.46	10.61	10.44	10.72	10.60	10.52	10.34～ 10.60 (10.42)	10.36～ 10.72 (10.45)
Conductivity	(μs/cm)	17,620	17,600	17,630	17,600	17,760	17,760	17,690	17,570	16,960～17,760 (17,564)	16,900～17,760 (17,516)
Turbidity	(mg/ℓ)	—	—	—	—	—	—	—	—	—	—
SS	(mg/ℓ)	16	16	33	30	20	17	15	12	13 ～ 69 (24)	11 ～ 47 (19)
DO	(mg/ℓ)	9.1	7.9	13.2	13.7	9.8	3.5	10.6	4.8	6.3 ～ 13.2 (9.7)	1.8 ～ 13.7 (5.5)
COD	(mg/ℓ)	192	191	192	188	189	185	193	193	179 ～197 (191)	185 ～197 (192)
T-N	(mg/ℓ)	33.201	29.339	—	—	—	—	—	—	33.201～34.414 (33.808)	27.840～29.339 (28.590)
K-N	(mg/ℓ)	12.08	10.42	—	—	—	—	—	—	12.08～ 14.17 (13.13)	10.00～ 10.42 (10.21)
NH_4-N	(mg/ℓ)	—	—	—	—	—	—	—	—	—	—
NO_3-N	(mg/ℓ)	21.1	18.9	16.6	18.6	17.1	18.7	17.3	16.6	15.5 ～ 25.0 (18.5)	14.6 ～ 18.9 (17.0)
NO_2-N	(mg/ℓ)	0.021	0.019	0.026	0.028	0.021	0.023	0.019	0.020	0.019～ 0.044 (0.026)	0.017～ 0.040 (0.024)
T-P	(mg/ℓ)	—	—	—	—	—	—	—	—	—	—
PO_4-P	(mg/ℓ)	1.54	2.10	1.38	1.22	1.40	1.00	1.28	1.82	1.28～ 1.82 (1.55)	1.00～ 2.10 (1.68)

Legend S : Surface, B : Bottom

Table G.2.38 Proposed Effluent Standards for Nakuru Municipal Sewage Works

A. Total Discharge into Lake Nakuru				
1)	Total BOD_5	not to exceed	800	kg/day
2)	Heavy metals (excl. Zn; Fe)	not to exceed	0.1	mg/l
B. Additional Standards for Discharge Directly into Lake Nakuru (Town Sewage Works)				
1)	BOD_5 at 20 °C (excl. algae)	not to exceed	50	mg/l
2)	COD	"	80	mg/l
3)	Suspended Solids	"	30	mg/l
4)	Free ammonia	"	10	mg/l
5)	Heavy metals total (excl. Zn; Fe)	"	0.1	mg/l
6)	Zinc	"	0.3	mg/l
7)	Cyanide	"	0.05	mg/l
8)	Total phenols	"	0.1	mg/l
9)	Organochlorines total	"	0.001	mg/l
10)	Oil		No trace	
11)	Anionic detergents	not to exceed	0.5	mg/l
12)	Effluent at dilution 1:20 must not be toxic to Tilapia grahami in 48 hours.			
13)	Flow records must be maintained at the inlet and outlet of all sewage works.			
14)	The effluent must be aerated over a cascade before discharge into the lake.			
(Njoro River Sewage Works)				
1)	BOD5 at 20 °C (excl. algae)	not to exceed	30	mg/l
2)	COD	"	50	mg/l
3)	Suspended Solids	"	30	mg/l
4)	Free ammonia	"	5	mg/l
5)	Heavy metals total (excl. Zn; Fe)	"	0.1	mg/l
6)	Zinc	"	0.3	mg/l
7)	Cyanide	"	0.05	mg/l
8)	Total phenols	"	0.1	mg/l
9)	Organochlorines total	"	0.001	mg/l
10)	Oil		No trace	
11)	Anionic detergents	not to exceed	0.5	mg/l
12)	Effluent at dilution 1:10 must not be toxic to Tilapia grahami in 48 hours. Toxicity = a water killing 50% or more of the test animals.			
13)	Flow records must be maintained at the inlet and outlet of all sewage works.			

Data source: MOWD

Table G.3.1 Basic Equations of Water Quality Change Analysis

(1) Diffusion Equation of Phosphorus

a. Photic Zone

$$\frac{\partial (Po \bullet h)}{\partial t} = Lpo - Kz (Po - P'o) + Pr^*p - \beta p \bullet Pp \bullet h - Wp \bullet Po$$

$$\frac{\partial (Pi \bullet h)}{\partial t} = Lpi - Kz (Po - P'o) - Pr^*p + \beta p \bullet Po \bullet h$$

b. Aphotic Zone

$$\frac{\partial (P'o \bullet h')}{\partial t} = Kz (Po - P'o) - \beta' p \bullet P'o \bullet h' + Wp \bullet Po - W'p \bullet P'o$$

$$\frac{\partial (P'i \bullet h')}{\partial t} = Kz (Po - P'o) + \beta' p \bullet P'o \bullet h' + Bpi$$

where,

Lpo, Lpi	:	Inflow load of organic phosphorus and inorganic phosphorus from river (In the case of the proposed reservoir, residual load of outflow load subtracted from inflow load.)
h, h'	=	Water depth of photic zone and aphotic zone
Po, P'o	=	Concentration of organic phosphorus of photic zone and aphotic zone
Pi, P'i	=	Concentration of inorganic phosphorus of photic zone and aphotic zone
Wp, W'p	=	Settling velocity of organic phosphorus of photic zone and aphotic zone
βp, $\beta' p$	:	Decomposed velocity of organic phosphorus of photic zone and aphotic zone
Bpi	:	Dissolved velocity of inorganic phosphorus of photic zone and aphotic zone
Kz	:	Coefficient of vertical mixture between photic and aphotic zones
Pr*p	:	Velocity of change from IP to OP by production

(2) Diffusion Equation of Nitorogen

a. Photic Zone

$$\frac{\partial\,(No \bullet h)}{\partial\, t} = Lno - Kz\,(Po - P'o) + Pr^{*}n - \beta n \bullet No \bullet h - Wn \bullet No$$

$$\frac{\partial\,(Ni \bullet h)}{\partial\, t} = Lni - Kz\,(Po - P'o) - Pr^{*}n + \beta n \bullet No \bullet h$$

b. Aphotic Zone

$$\frac{\partial\,(N'o \bullet h')}{\partial\, t} = Kz\,(Po - P'o) - \beta n \bullet N'o \bullet h' + Wn \bullet No - W'n \bullet N'o$$

$$\frac{\partial\,(N'i \bullet h')}{\partial\, t} = Kz\,(Po - P'o) + \beta'n \bullet N'o \bullet h' + Bni$$

where,

Lno, Lni	:	Inflow load of organic nitrogen and inorganic nitrogen from river (In the case of the proposed reservoir, residual load of outflow load subtracted from inflow load.)
No, N'o	:	Concentration of organic nitrogen of photic zone and aphotic zone
Ni, N'i	:	Concentration of inorganic nitrogen of photic zone and aphotic zone
Wn, W'n	:	Settling velocity of organic nitrogen of photic zone and aphotic zone
βn, $\beta'n$	:	Decomposed velocity of organic nitrogen of photic zone and aphotic zone
Pr*n	:	Velocity of change from I-N to O-N by production
Bni	:	Dissolved velocity of inorganic nitrogen

(3) Diffusion Equation of COD

a. Photic Zone

$$\frac{\partial (S \bullet h)}{\partial t} = Ls - Kz\,(Po - P'o)$$

$$+ Pr^*s - Kt \bullet S \bullet h - Ws \bullet S$$

b. Aphotic Zone

$$\frac{\partial (S' \bullet h')}{\partial t} = Bs + Kz\,(Po - P'o)$$

$$- K't \bullet S' \bullet h' + Ws \bullet S - W's \bullet S'$$

where,

Ls	:	Inflow load of COD from river (In the case of the proposed reservoir, residual load of outflow load subtracted from inflow load.)
S, S'	:	Concentration of COD of photic zone and aphotic zone
Ws, W's	:	Settling velocity of photic zone and aphotic zone
Kt, K't	:	Decomposed velocity of photic zone and aphotic zone
Pr*s	:	Increase velocity of COD of photic zone and aphotic zone by production
Bs	:	Dissolved velocity of COD

(4) Diffusion Equation of DO

a. Photic Zone

$$\frac{\partial (C \bullet h)}{\partial t} = Lc - Kz\,(Po - P'o)$$

$$+ Pr^*C - Ko \bullet (Cs - C) \bullet h - Kt \bullet S \bullet h \bullet \gamma$$

b. Aphotic Zone

$$\frac{\partial (C' \bullet h')}{\partial t} = Kz\,(Po - P'o)$$

$$- Kt \bullet S' \bullet h' \bullet \gamma - Bc$$

where,

Lc	:	Inflow load of DO (In the case of the proposed reservoir, residual load of outflow load subtracted from inflow load.)
C, C'	:	Concentration of DO of photic zone and aphotic zone
Cs	:	Saturated concentration of DO
Ko	:	Coefficient of re-aeration
Pr*C	:	Increase velocity of DO by production
Bc	:	Consumption velocity of DO by bottom sediment

Pr*p, Pr*n, Pr*s, Pr*c are expressed as follows.

$$Pr^*p = \partial \bullet Pr^*s$$

$$Pr^*n = \beta \bullet Pr^*s$$

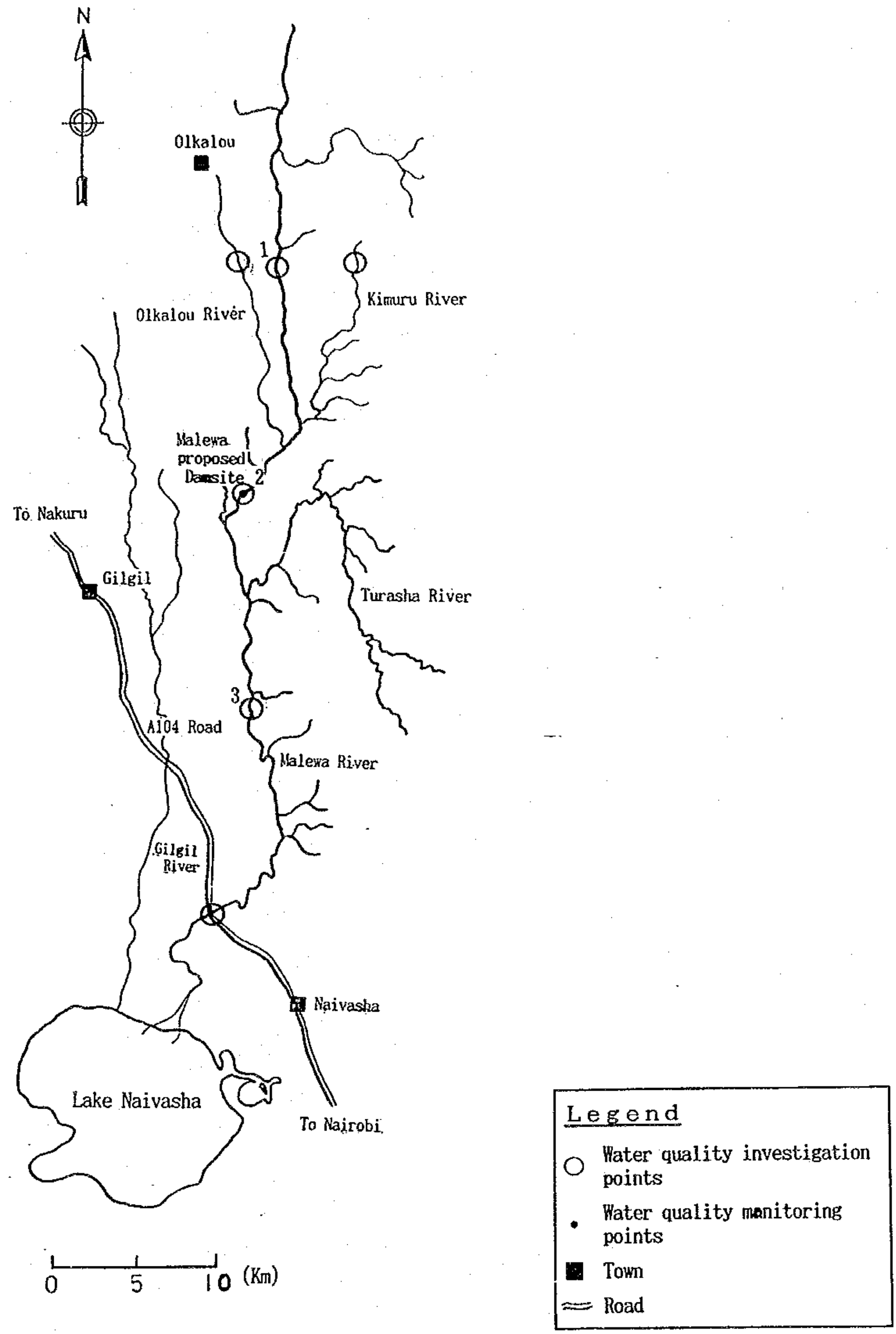
$$Pr^*c = \gamma \bullet Pr^*s$$

$$Pr^*s = \mu \bullet \frac{Pi}{Pi + Kp} \bullet \frac{Ni}{Ni + Kn} \bullet (S - St)$$

∂	:	P/COD ratio of plankton
β	:	N/COD ratio of plankton
γ	:	DO/COD ratio of photosynthesis
μ	:	Production velocity constant
Kp	:	Half saturated constant of phosphorus
Kn	:	Half saturated constant of nitrogen
S	:	Concentration of COD
St	:	Concentration of COD without production

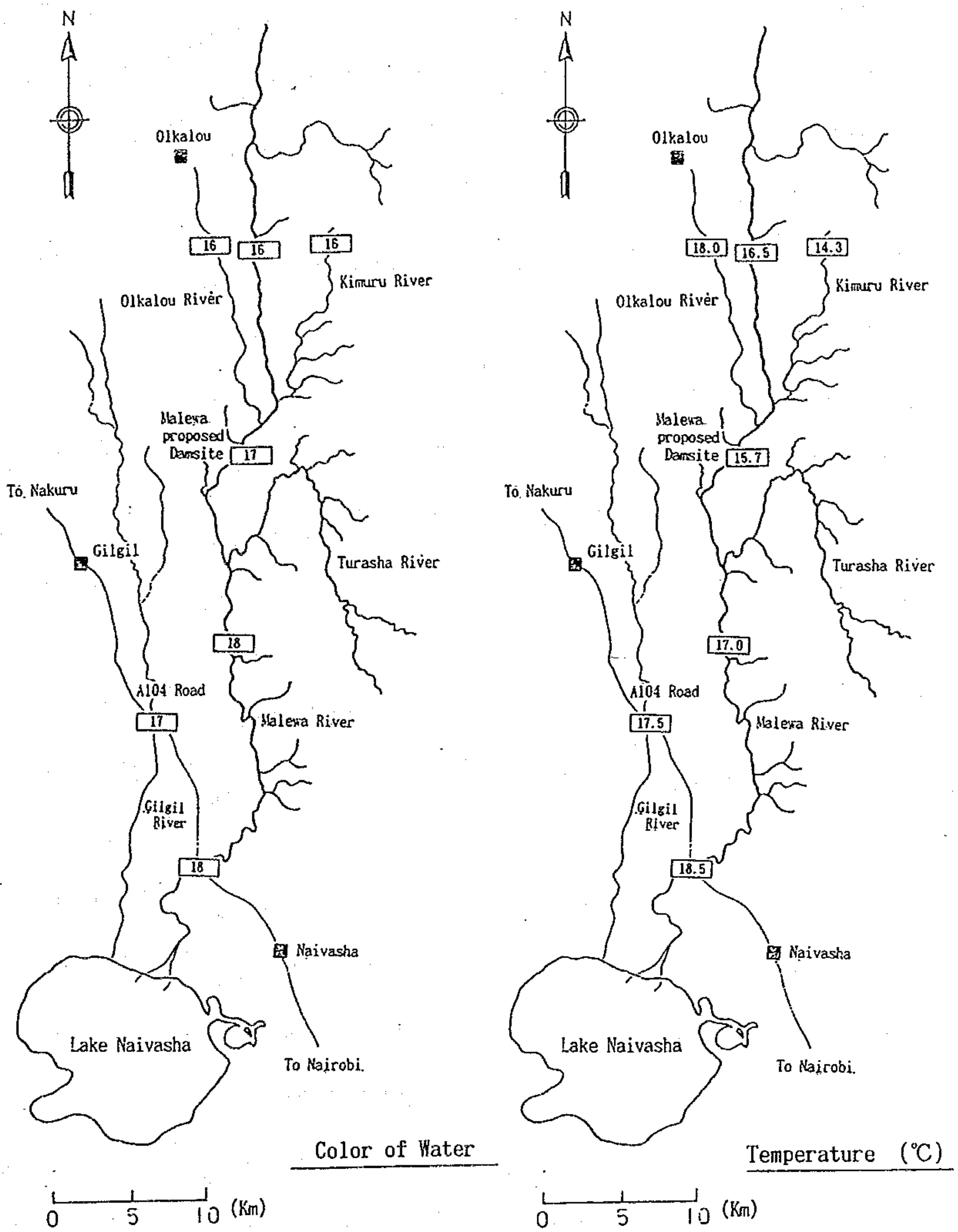
FIGURES

Fig. G.2.1



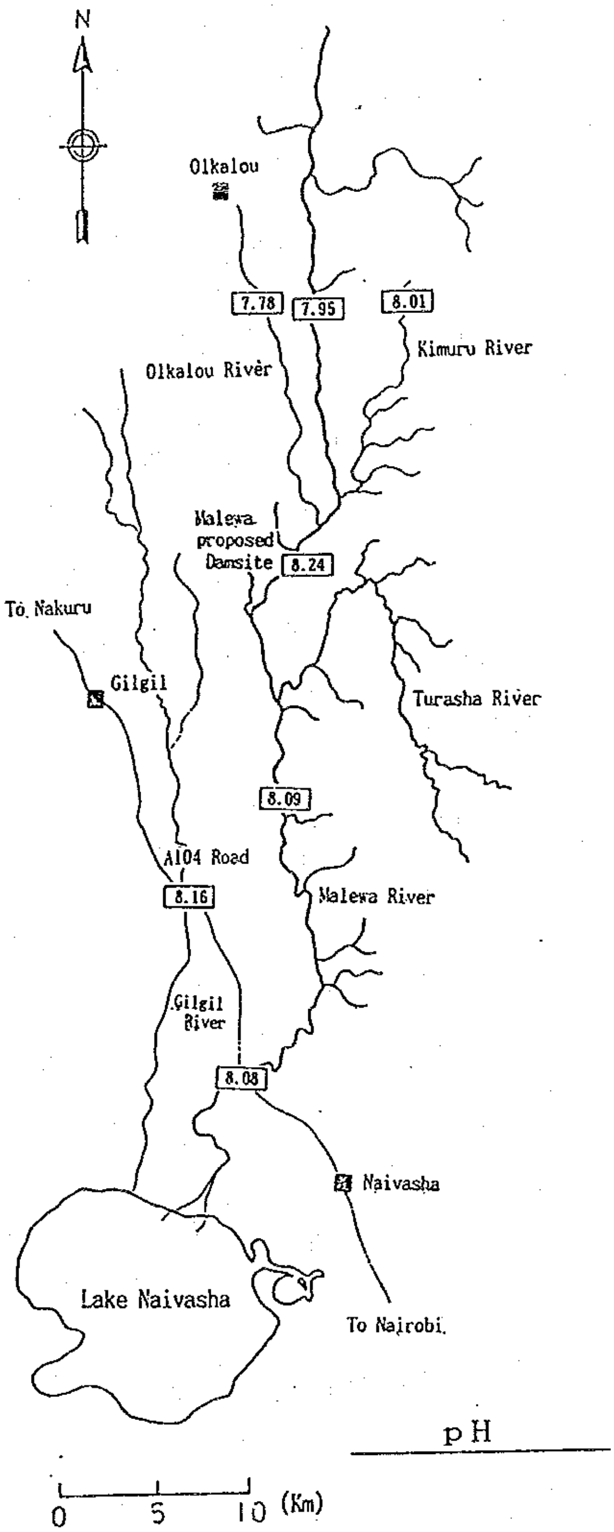
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Location Map of Water Sampling for Water Quality Investigation

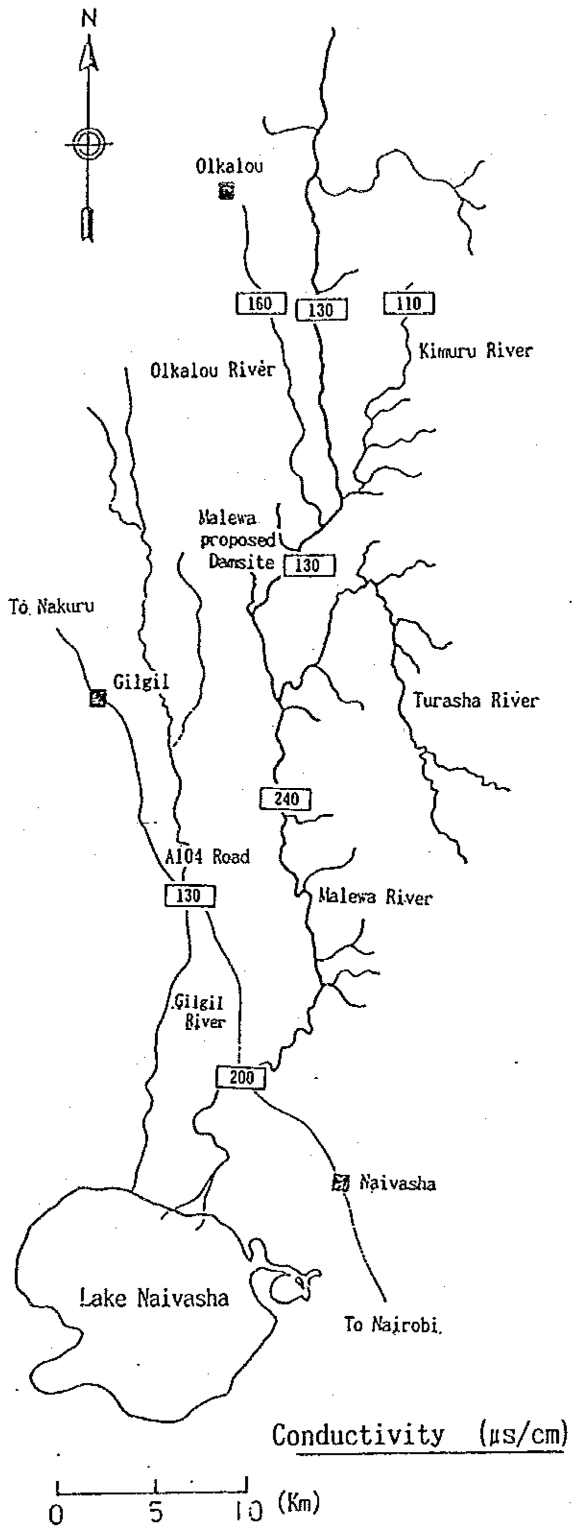
Fig. G.2.2



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal distribution of Water quality in Malewa River Basin (1/7)

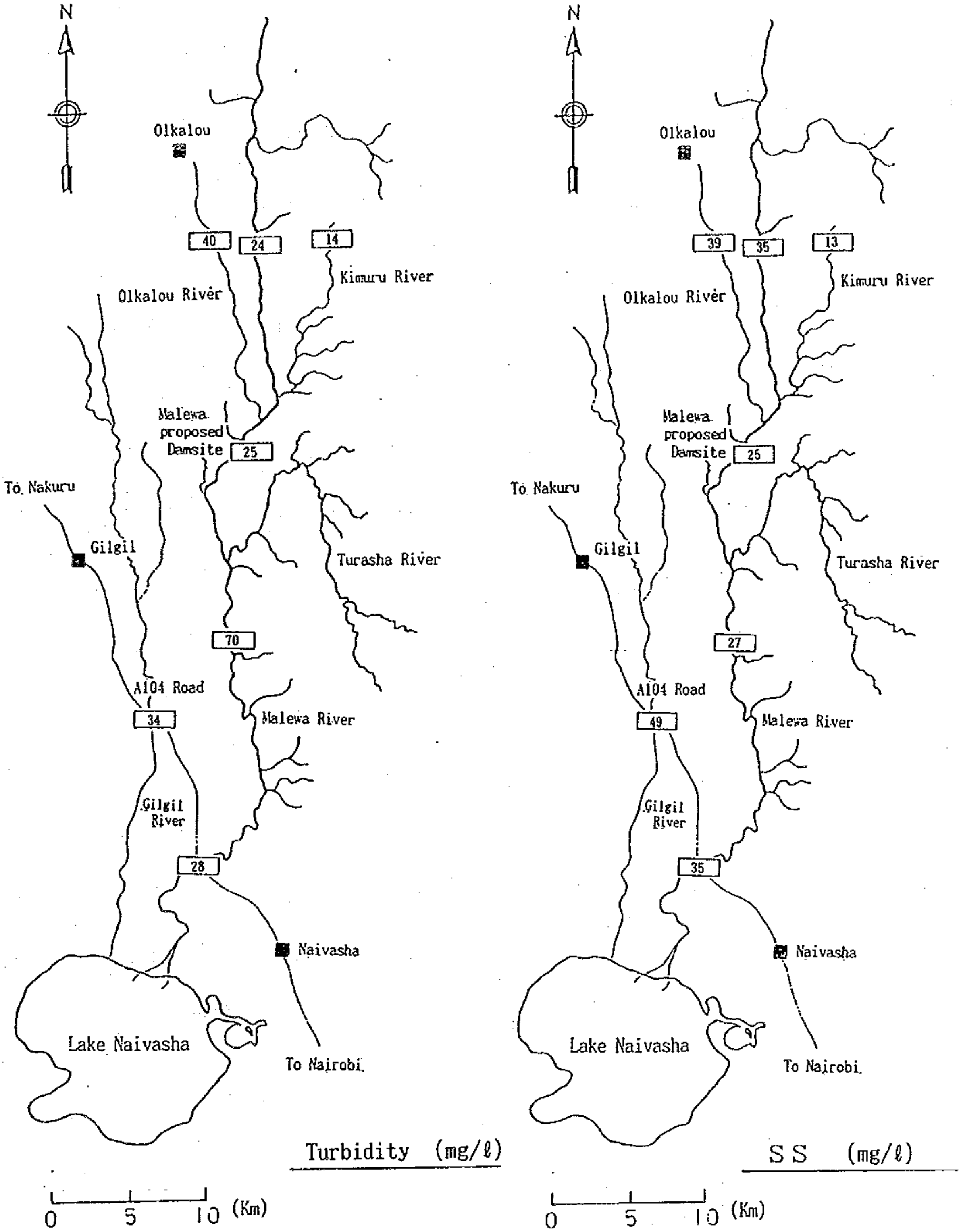
Fig. G.2.3





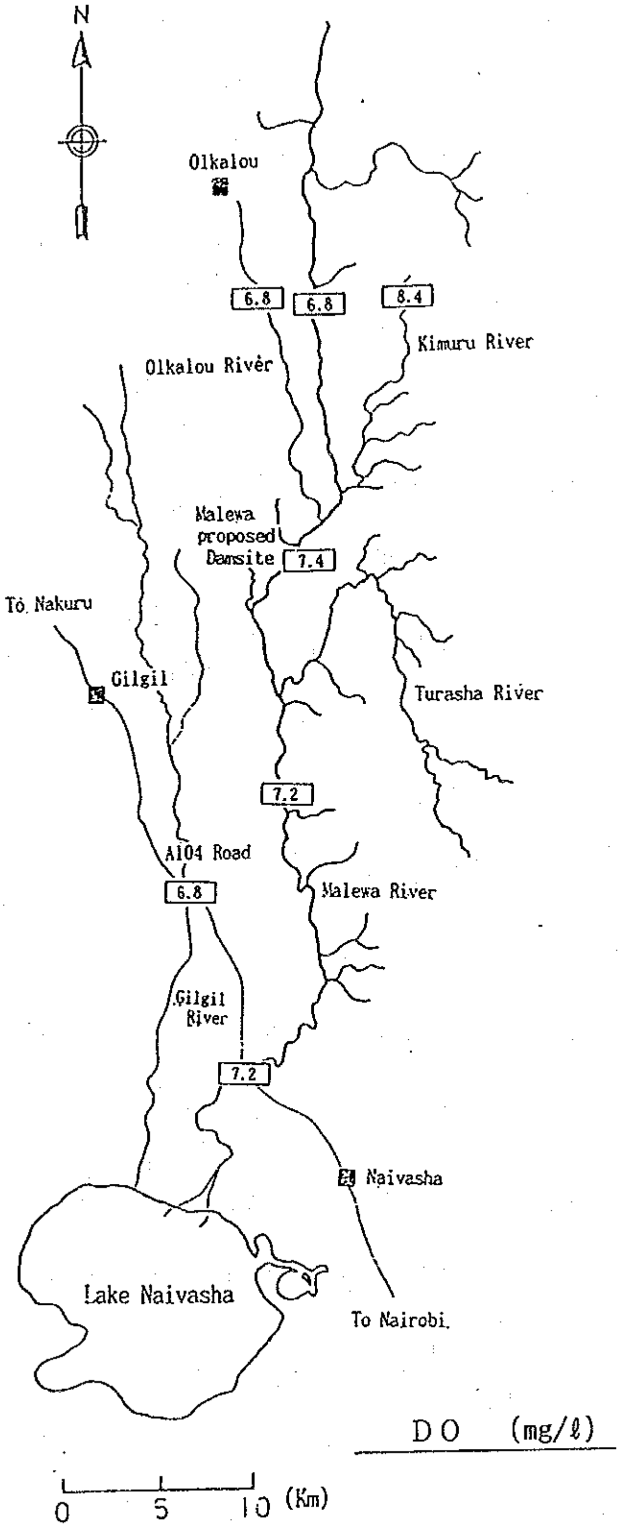
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal distribution of Water quality in Malewa River Basin (2/7)

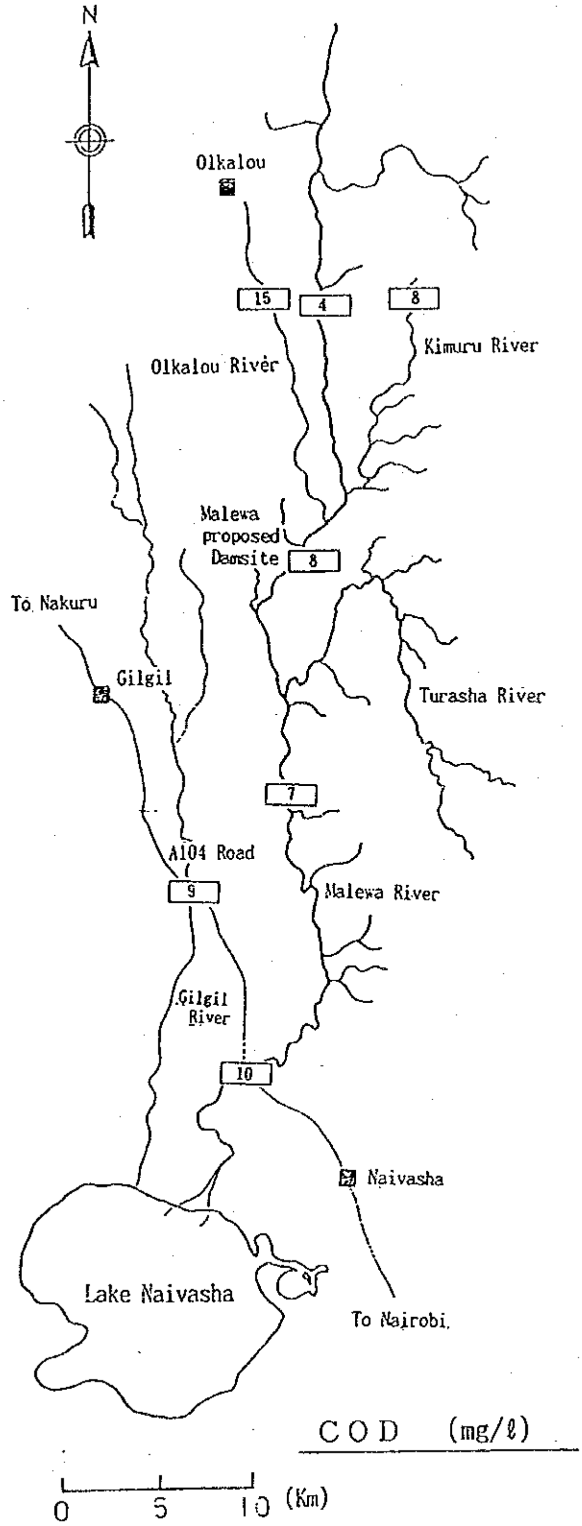
Fig. G.2.4



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal distribution of Water quality in Malewa River Basin (3/7)

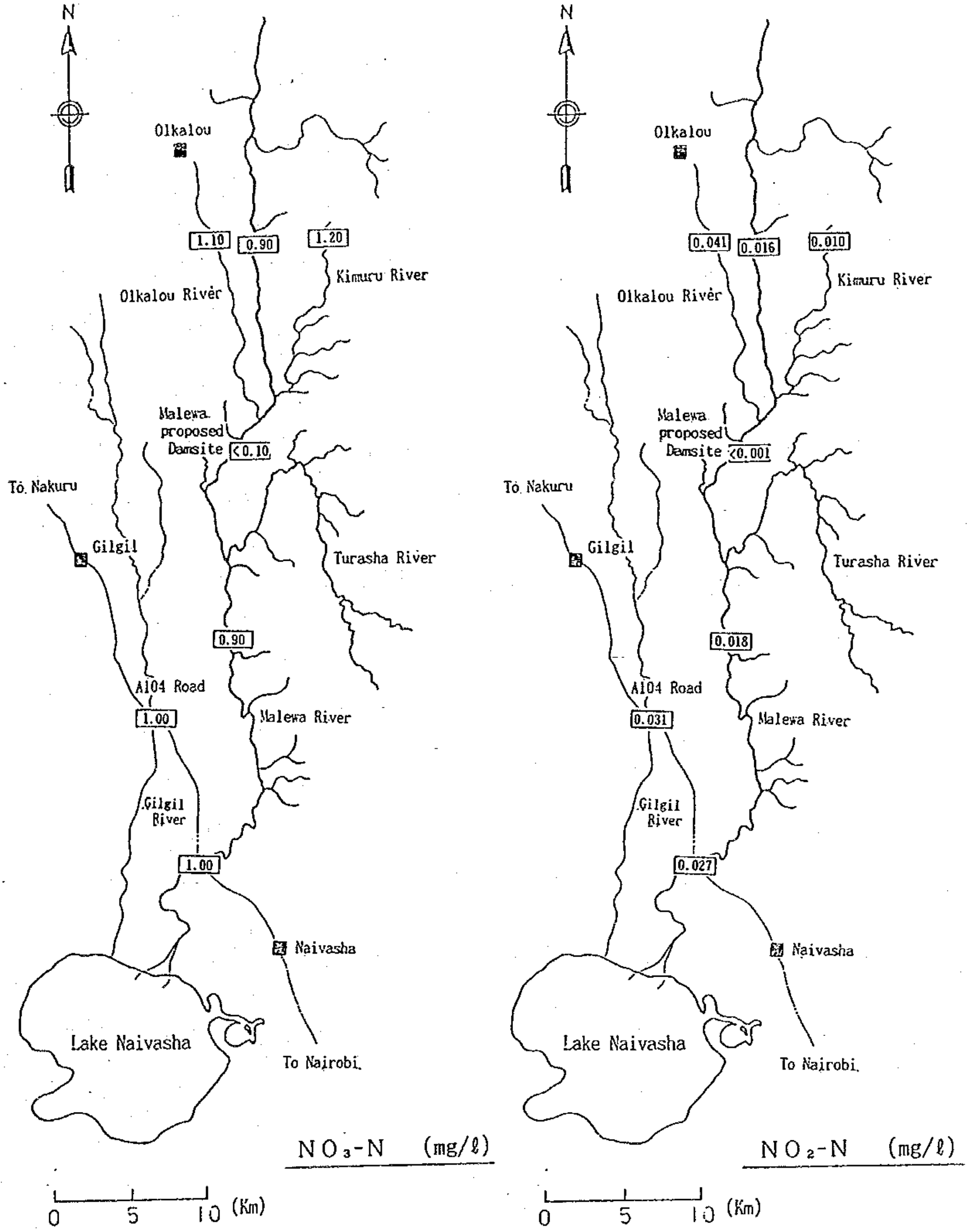
Fig. G.2.5





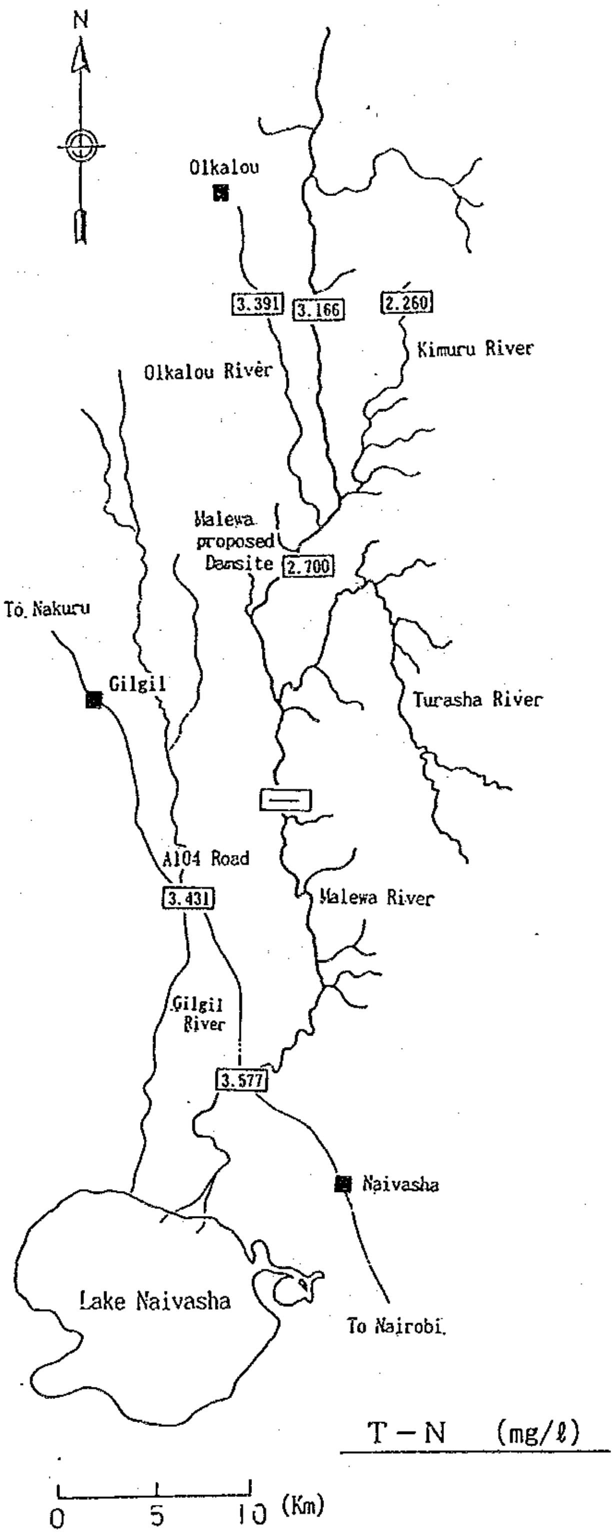
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal distribution of Water quality in Malewa River Basin (4/7)

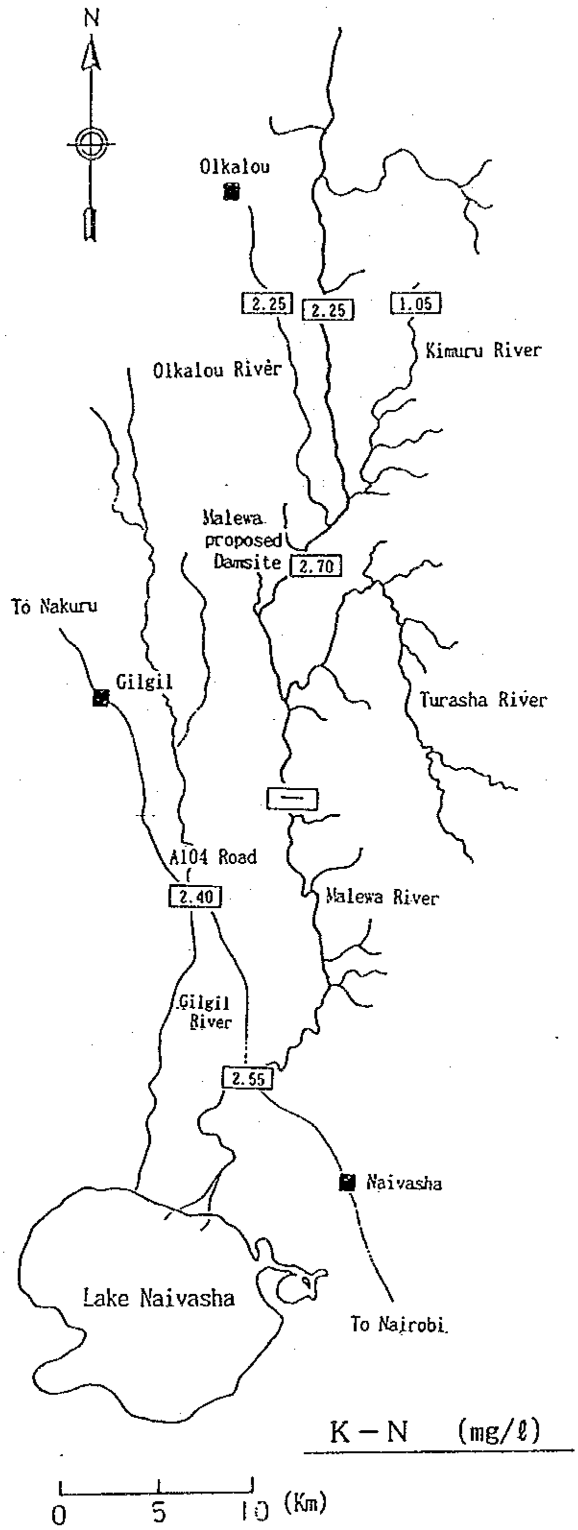
Fig. G.2.6



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal distribution of Water quality in Malewa River Basin (5/7)

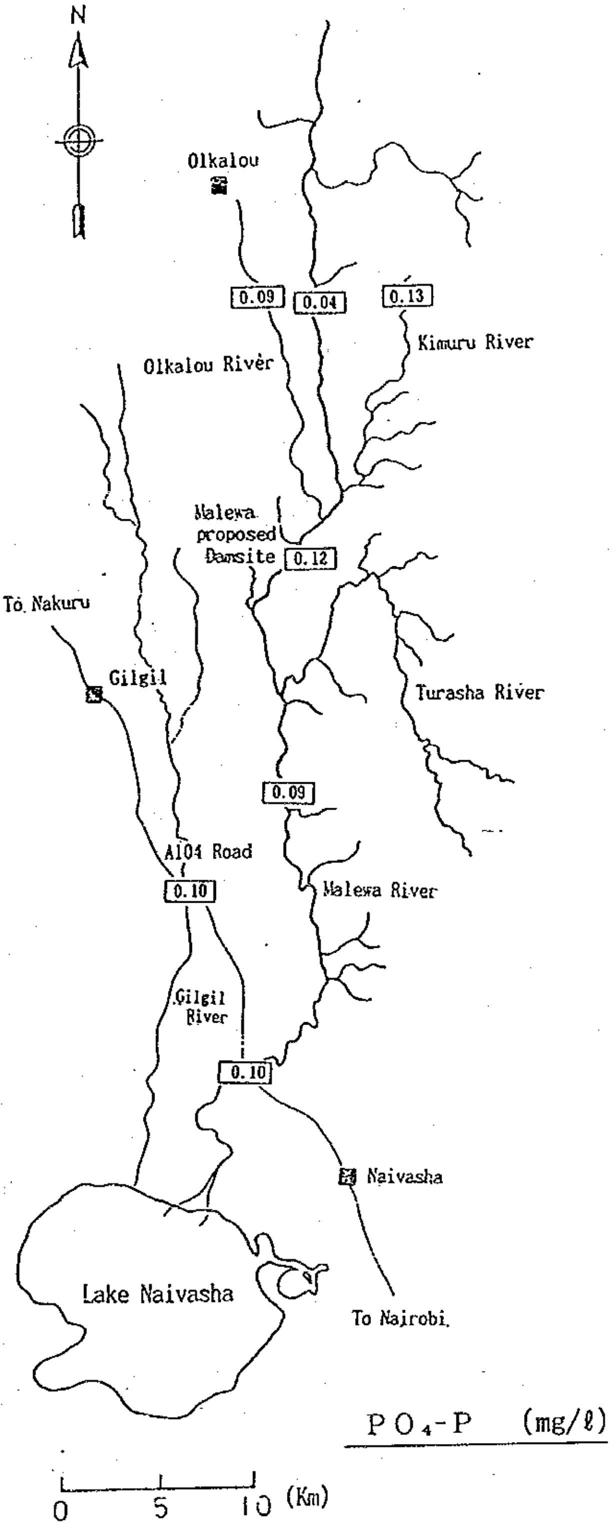
Fig. G.2.7





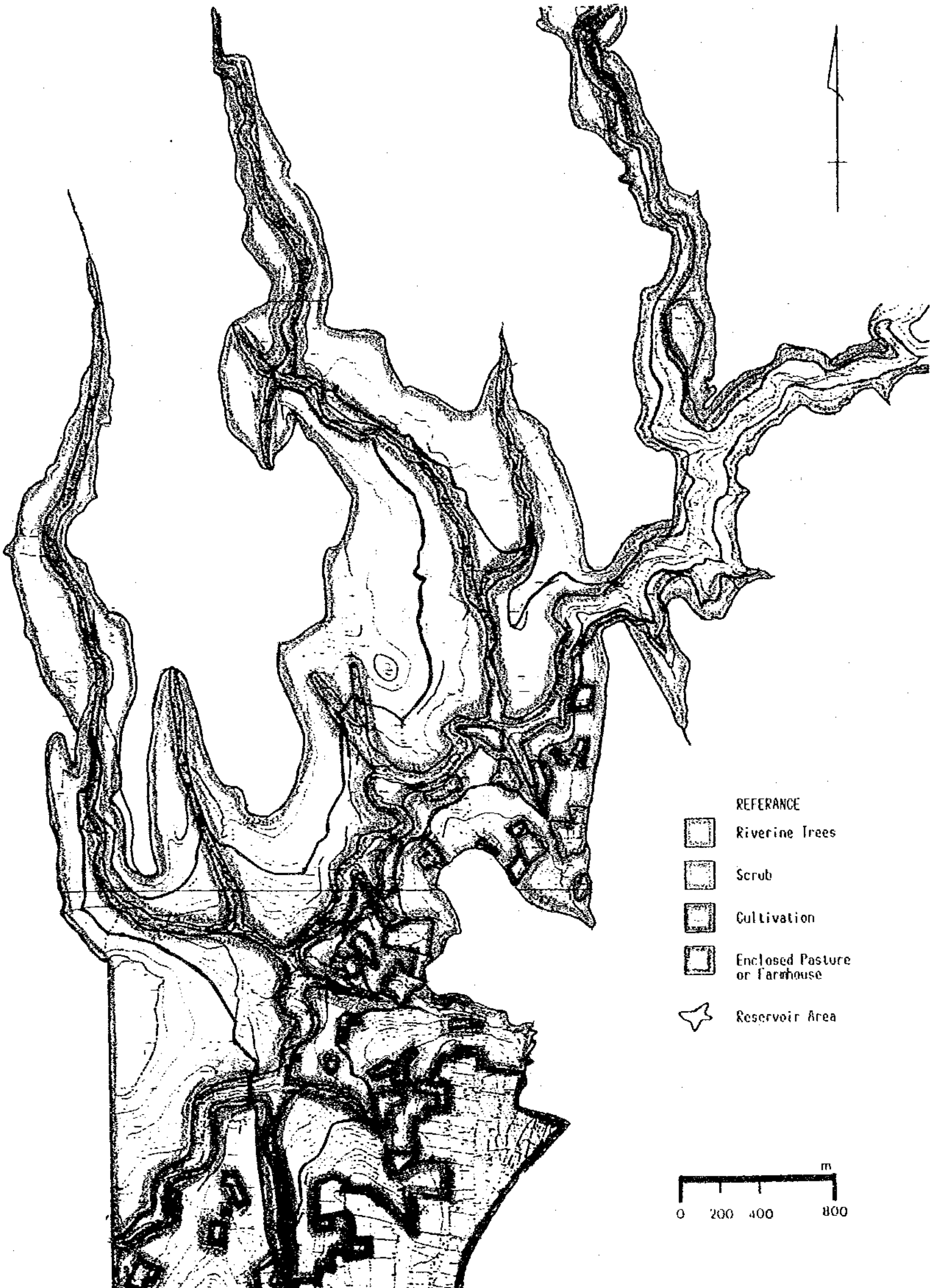
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal distribution of Water quality in Malewa River Basin (6/7)

Fig. G.2.8



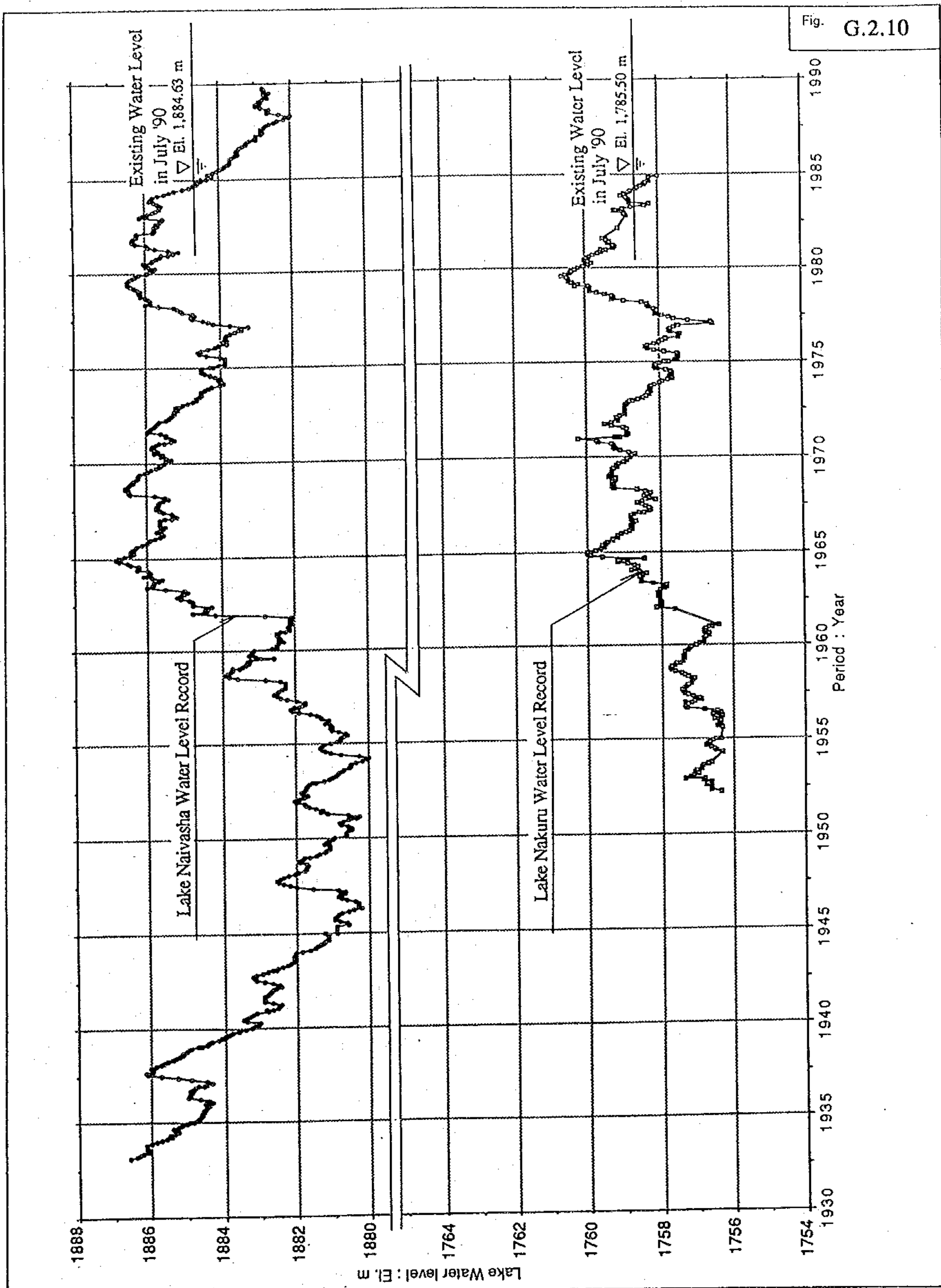
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Horizontal Distribution of Water quality in Malewa River Basin (7/7)

Fig. G.2.9



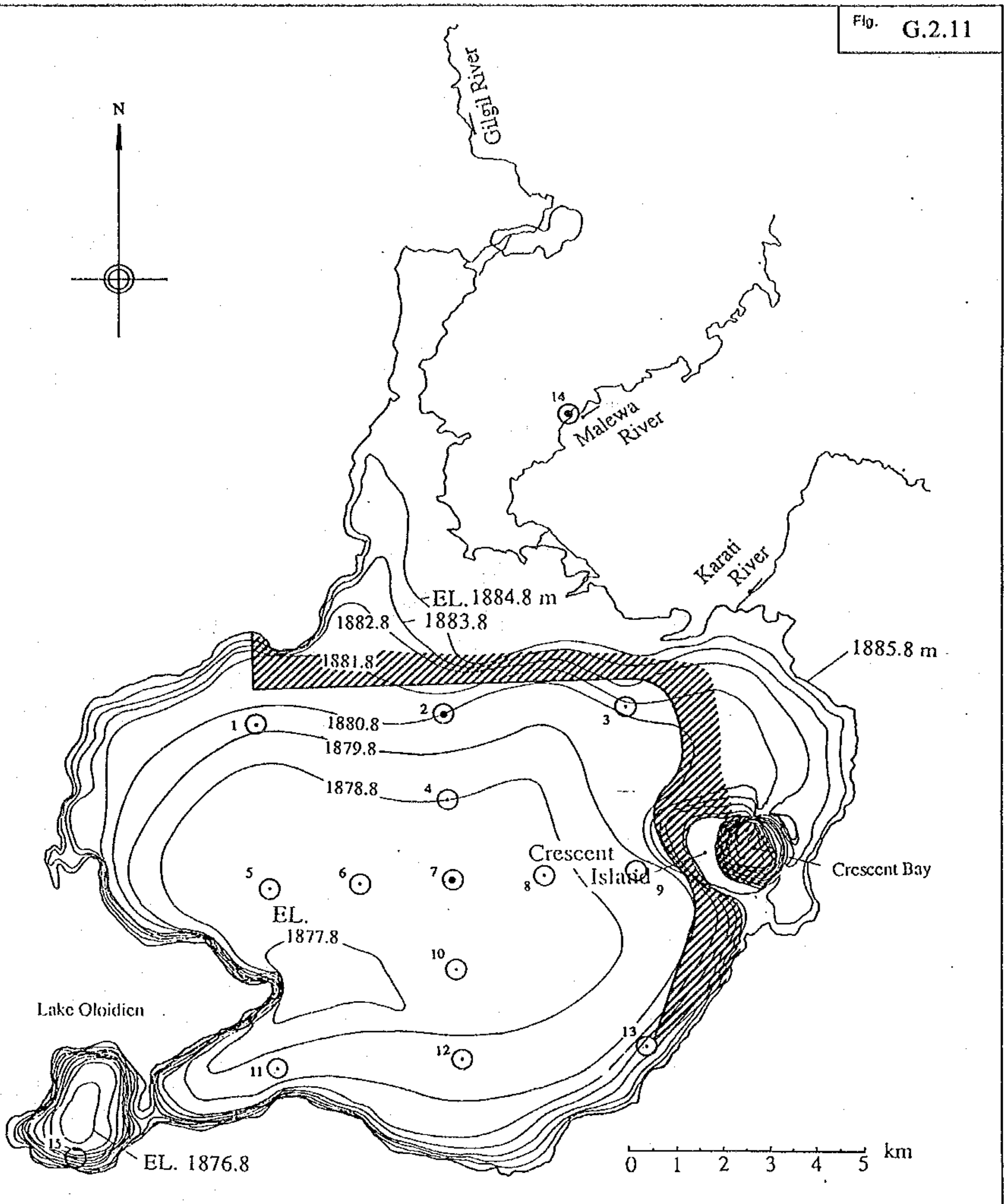
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Land Use in Malewa River Basin

Fig. G.2.10



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Recorded Water Level Fluctuations of Lake Naivasha and Lake Nakuru

Fig. G.2.11

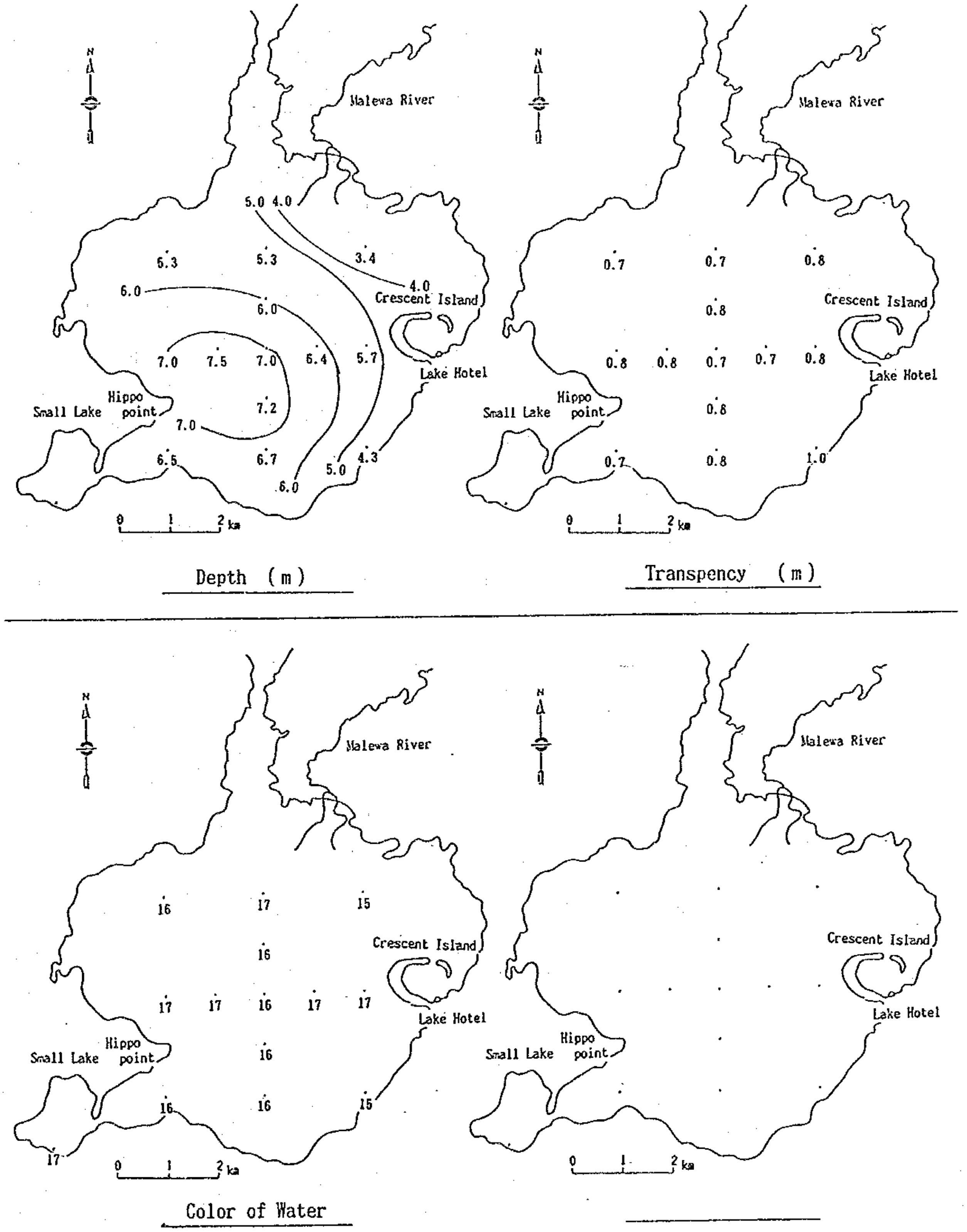


Legend

- ○ Water quality survey sampling points
- • Water quality monitor and plankton sampling points
- ▨ Aquatic plant survey

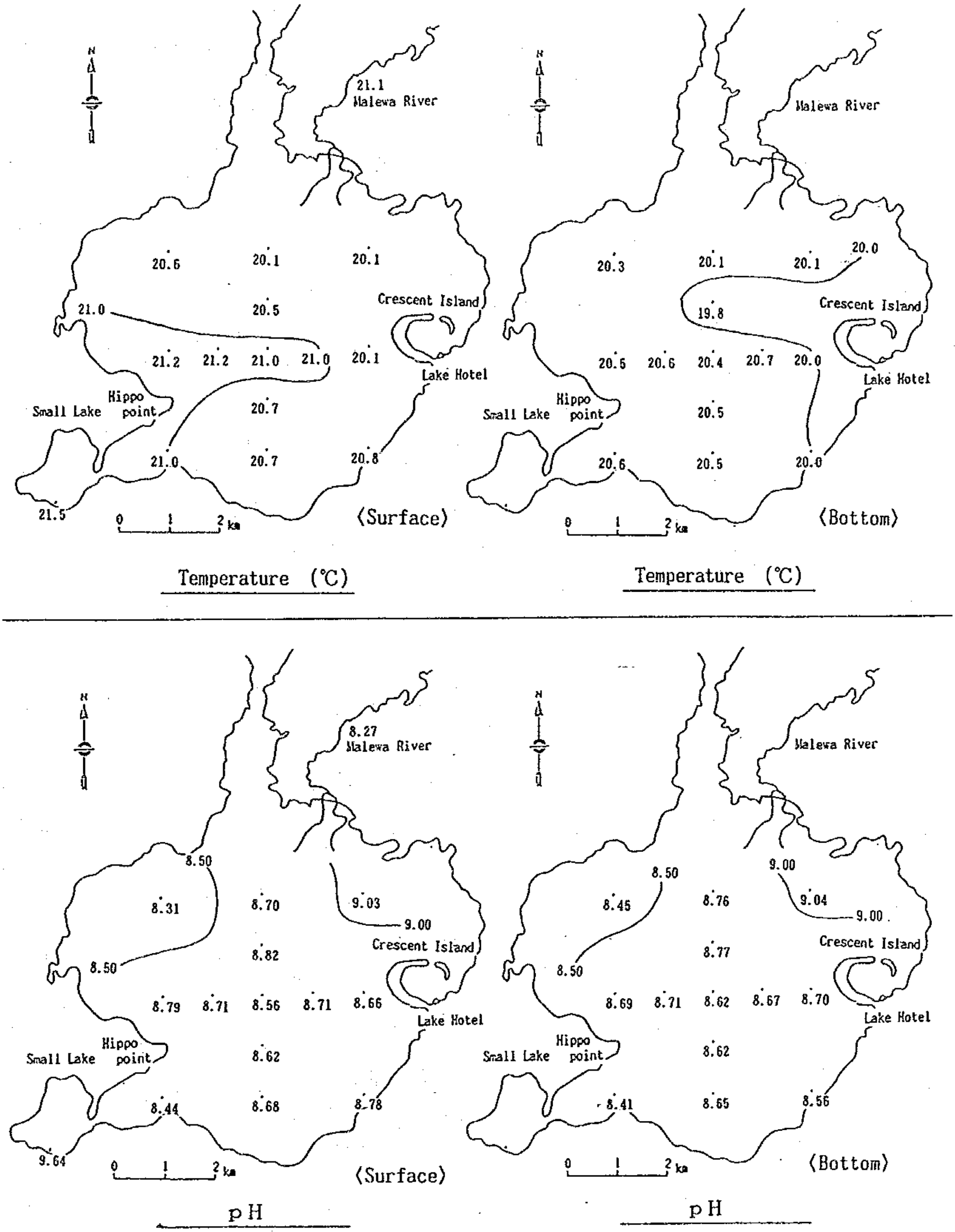
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Topography and Water Sampling Points in Lake Naivasha

Fig. G.2.12



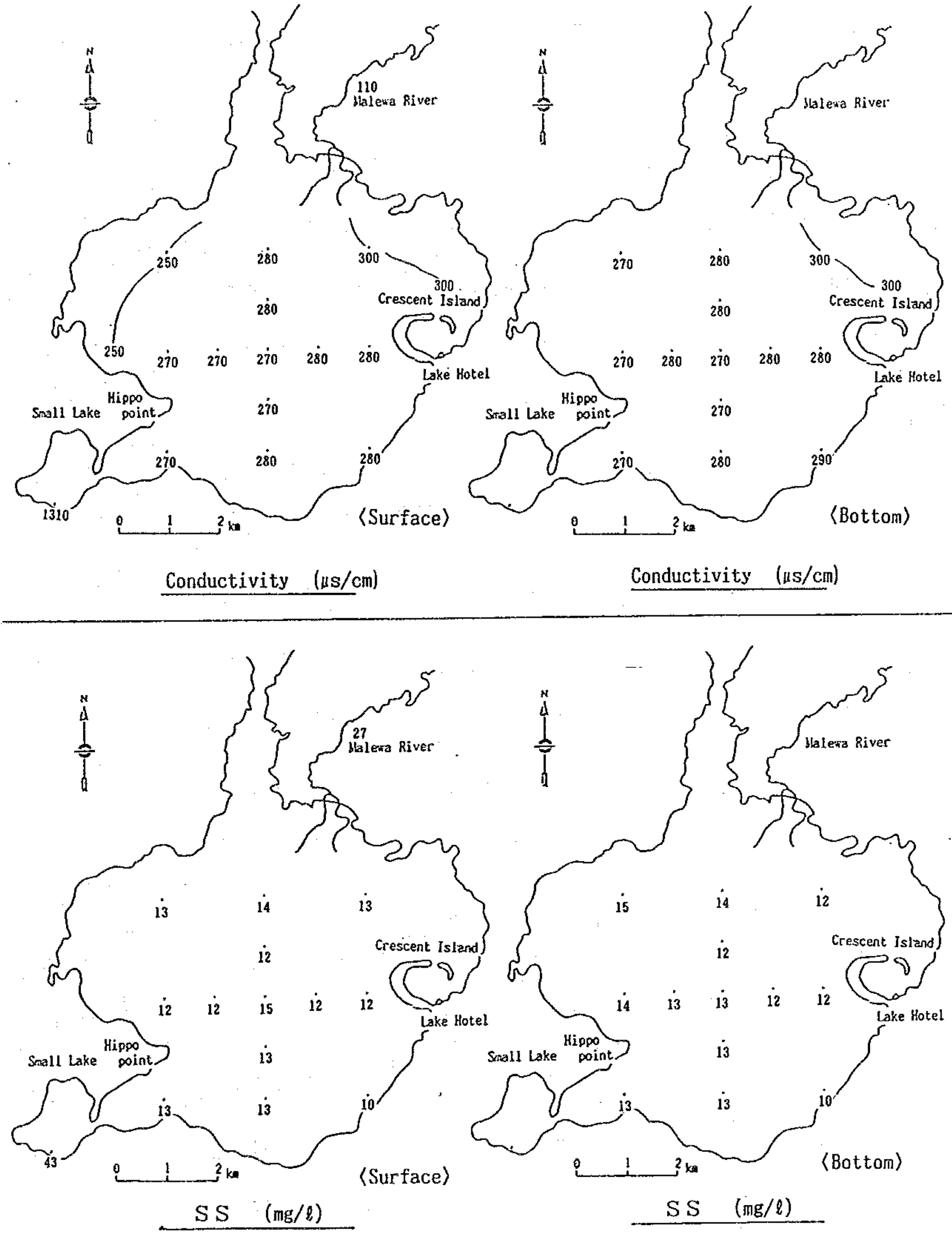
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE (1/6) Horizontal distribution of Water quality in Lake Naivasha

Fig. G.2.13



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE (2/6) Horizontal distribution of Water quality in Lake Naivasha

Fig. G.2.14



THE REPUBLIC OF KENYA

MINISTRY OF WATER DEVELOPMENT

NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION

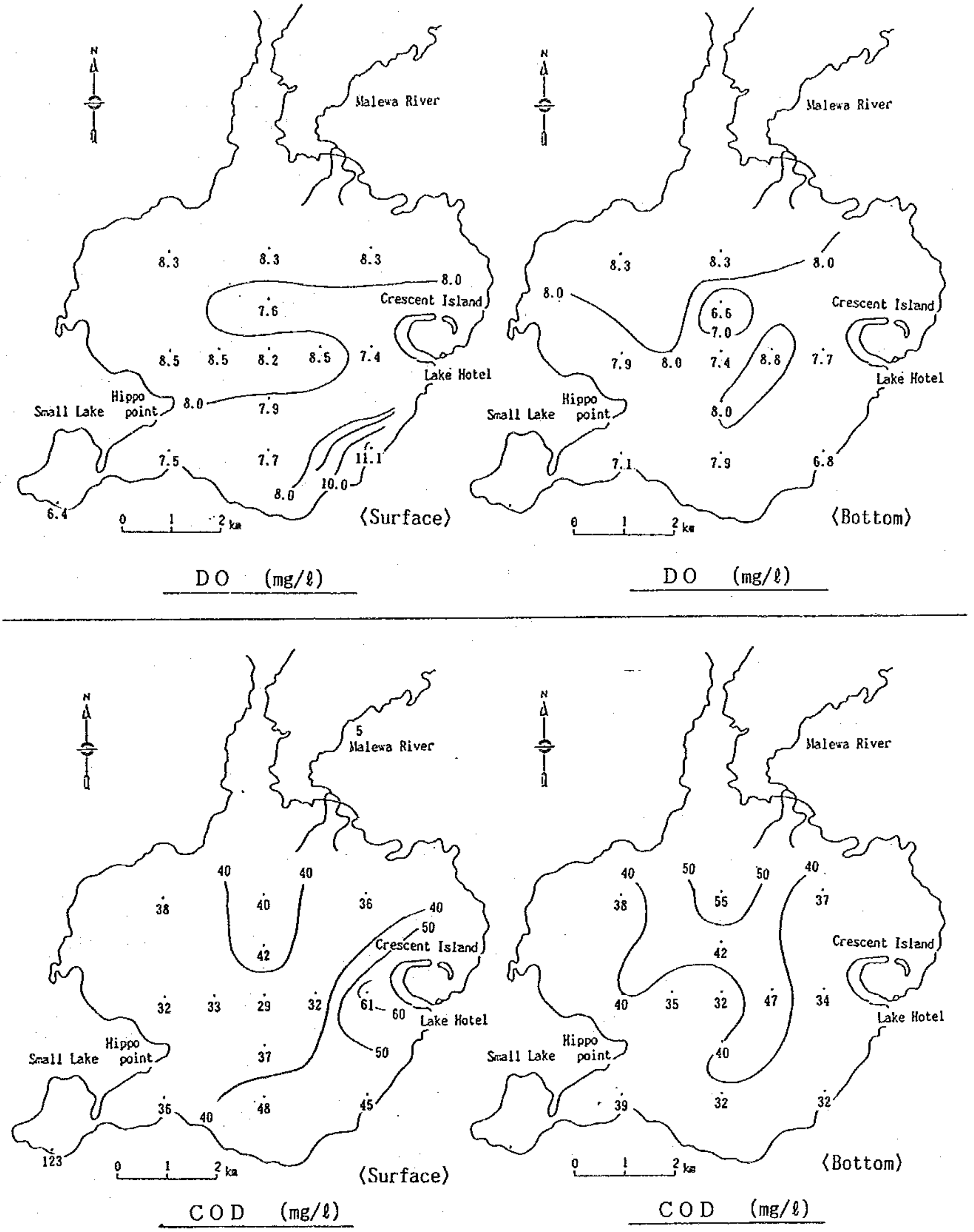
THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE (3/6)

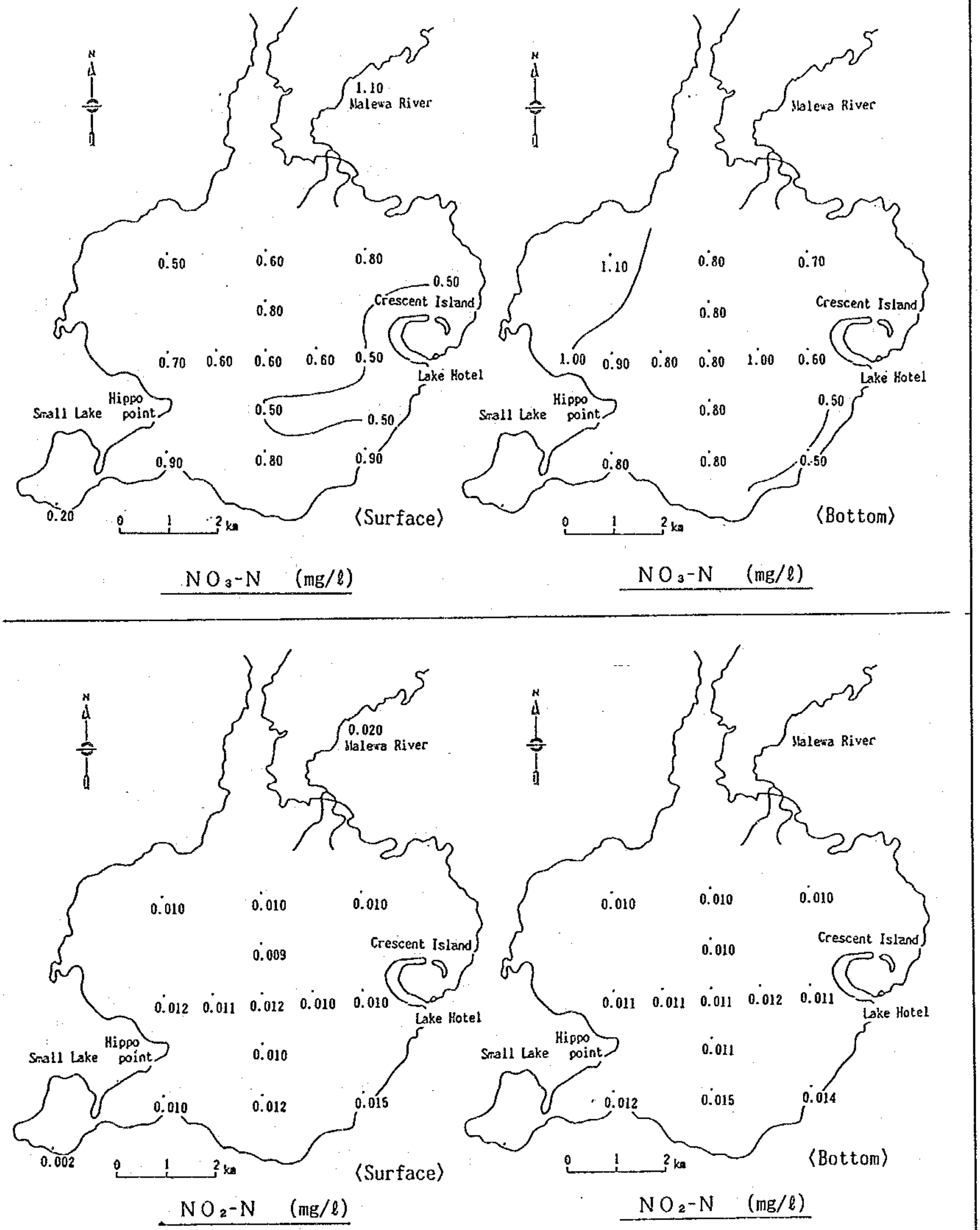
Horizontal distribution of Water quality in Lake Naivasha

Fig. G.2.15



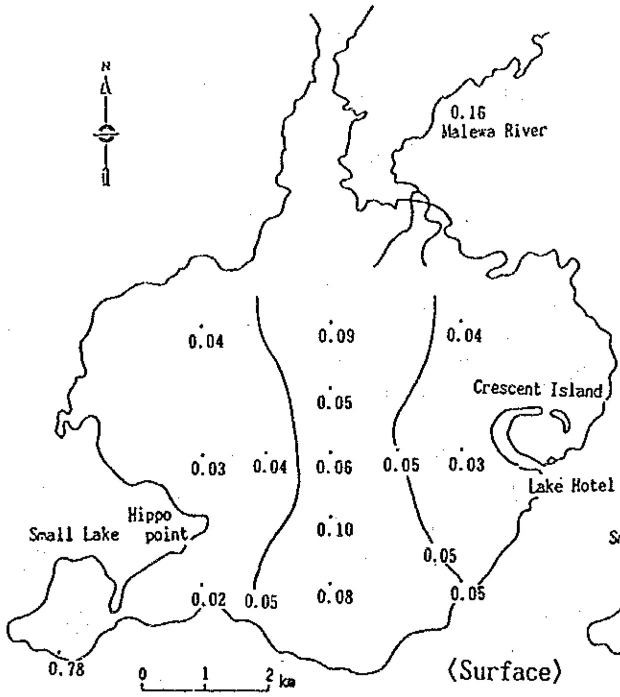
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE (4/6) Horizontal distribution of Water quality in Lake Naivasha

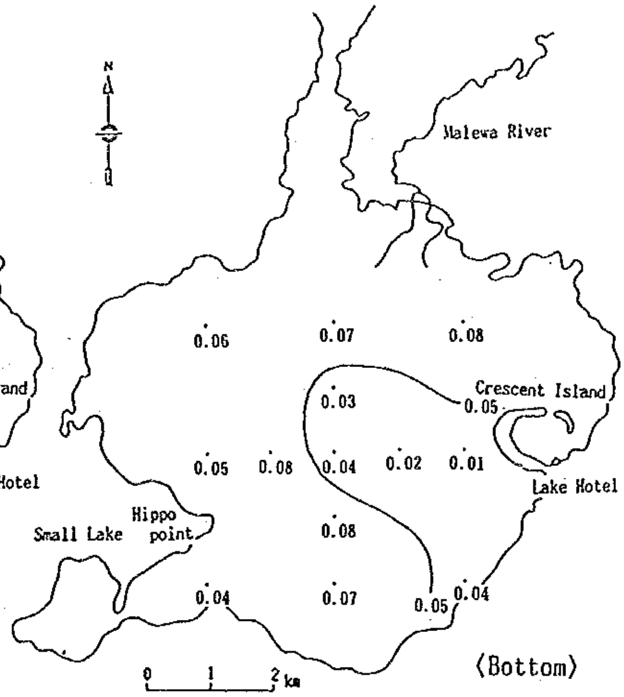
Fig. G.2.16



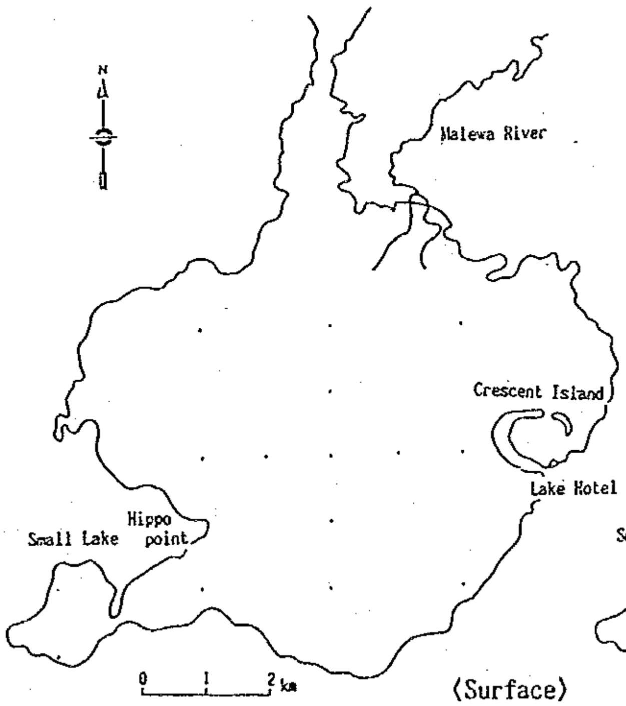
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE (5/6) Horizontal distribution of Water quality in Lake Naivasha

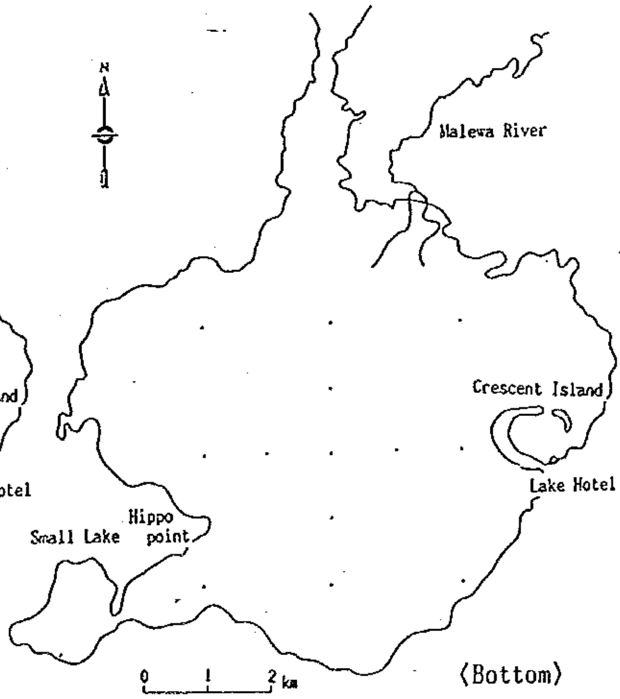
Fig. G.2.17





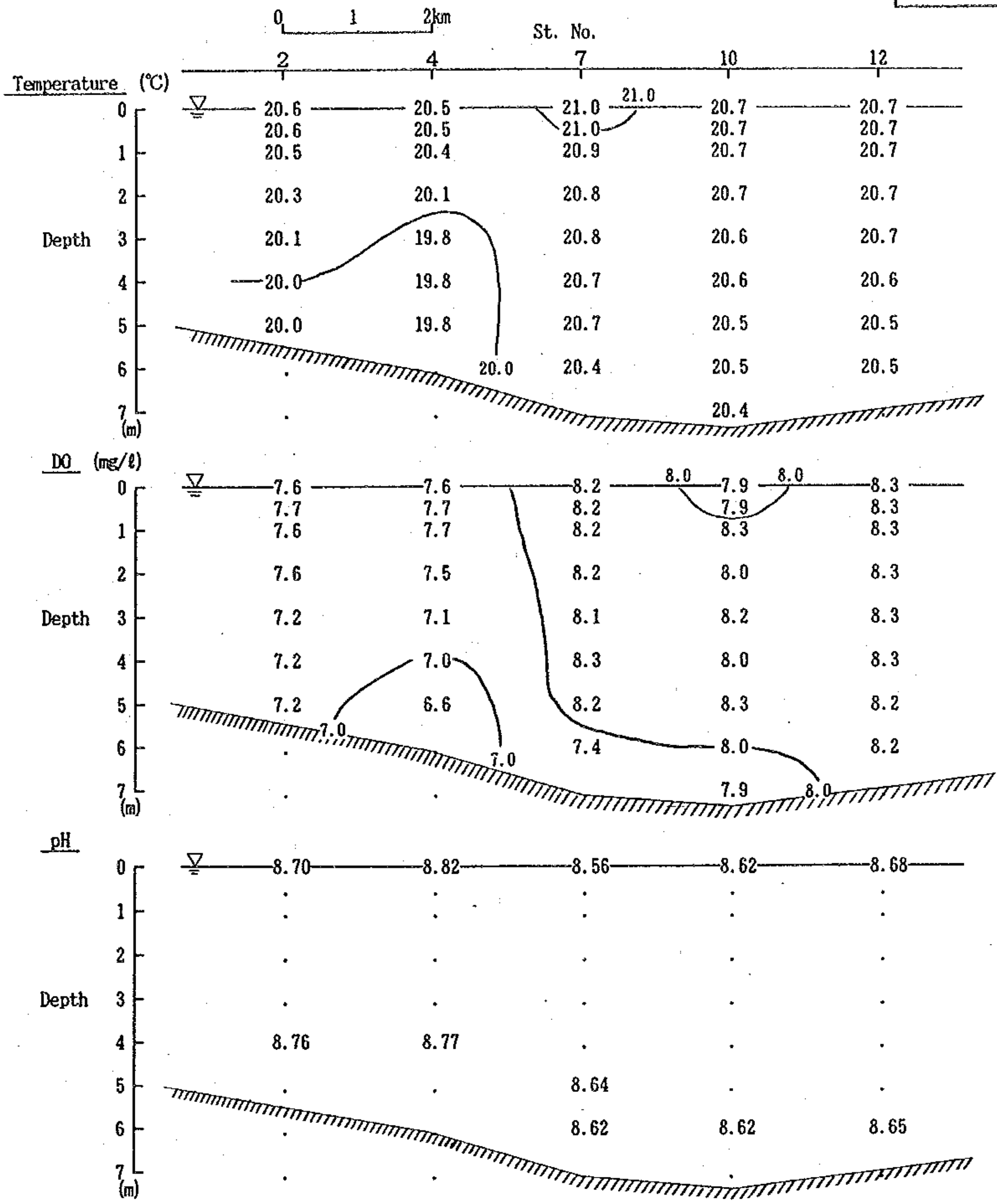
PO_4-P (mg/ℓ) PO_4-P (mg/ℓ)

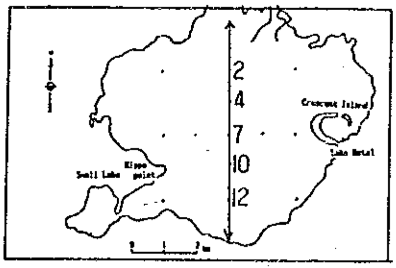




THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE (6/6) Horizontal distribution of Water quality in Lake Naivasha

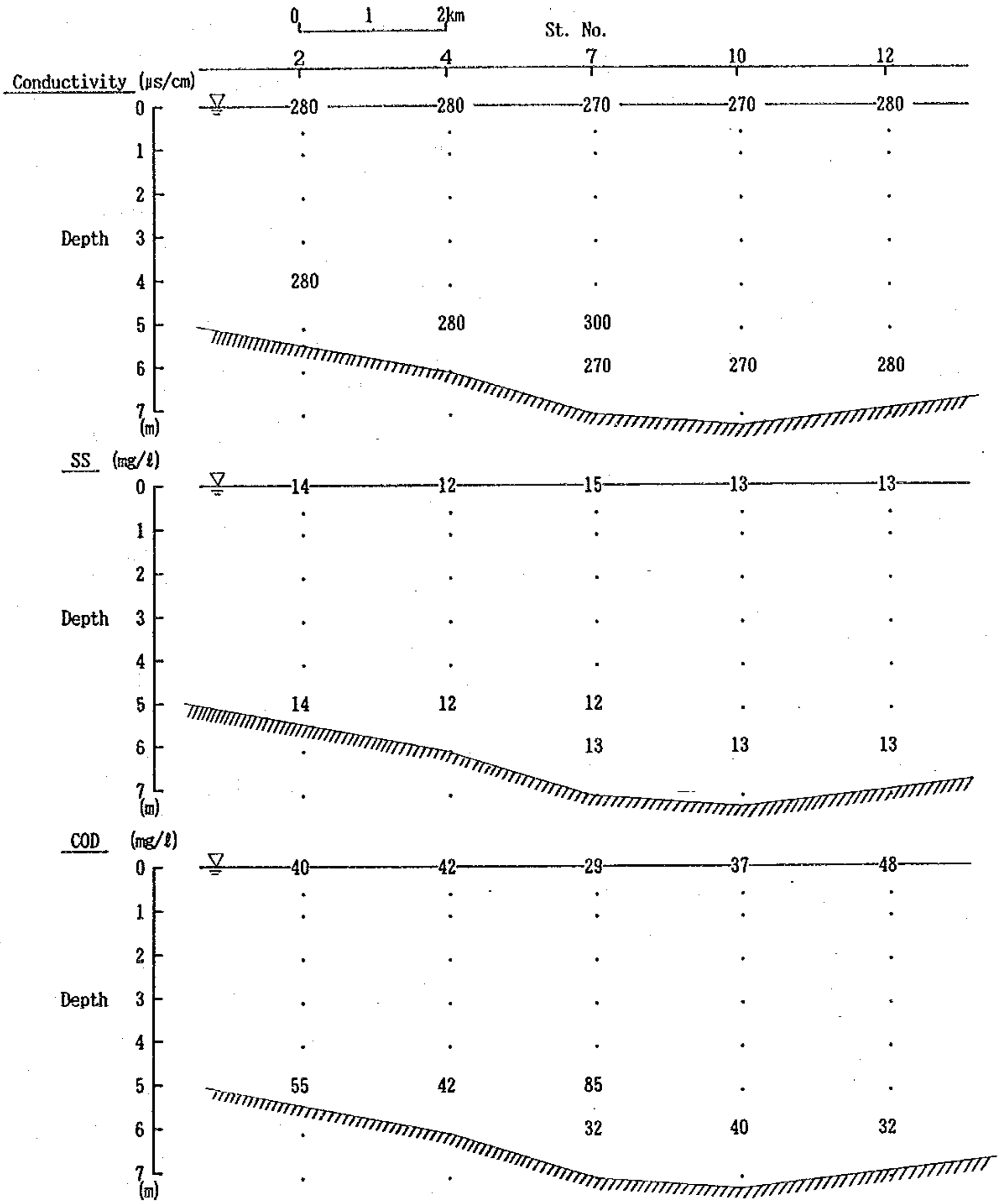
Fig. G.2.18

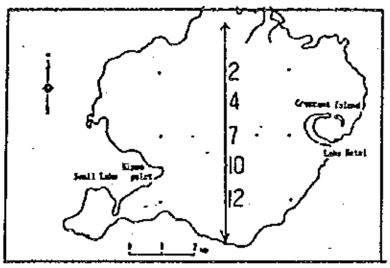




THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Water quality in a Vertical section of Lake Naivasha (1/6)

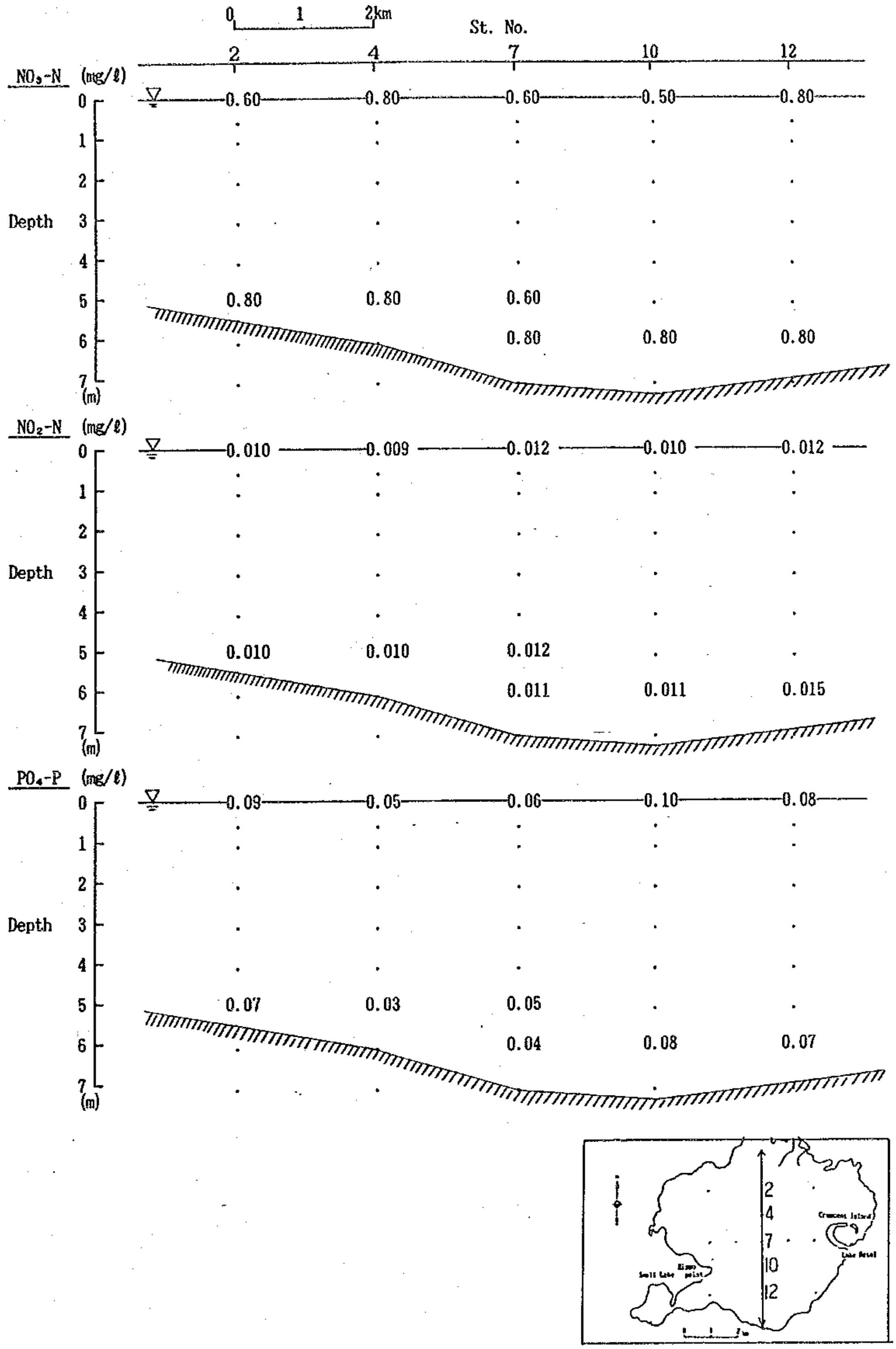
Fig. G.2.19





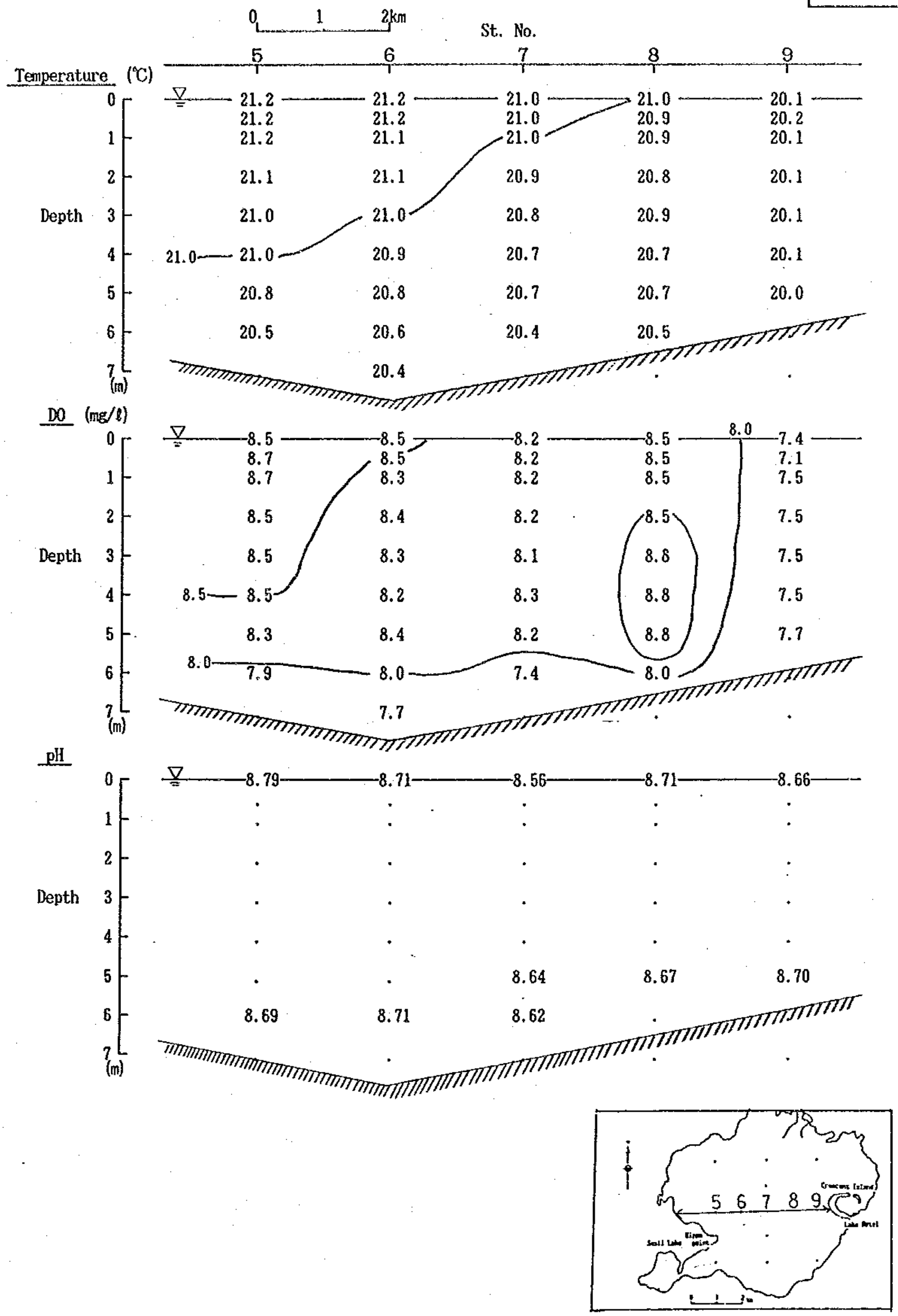
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Water quality in a Vertical section of Lake Naivasha (2/6)

Fig. G.2.20



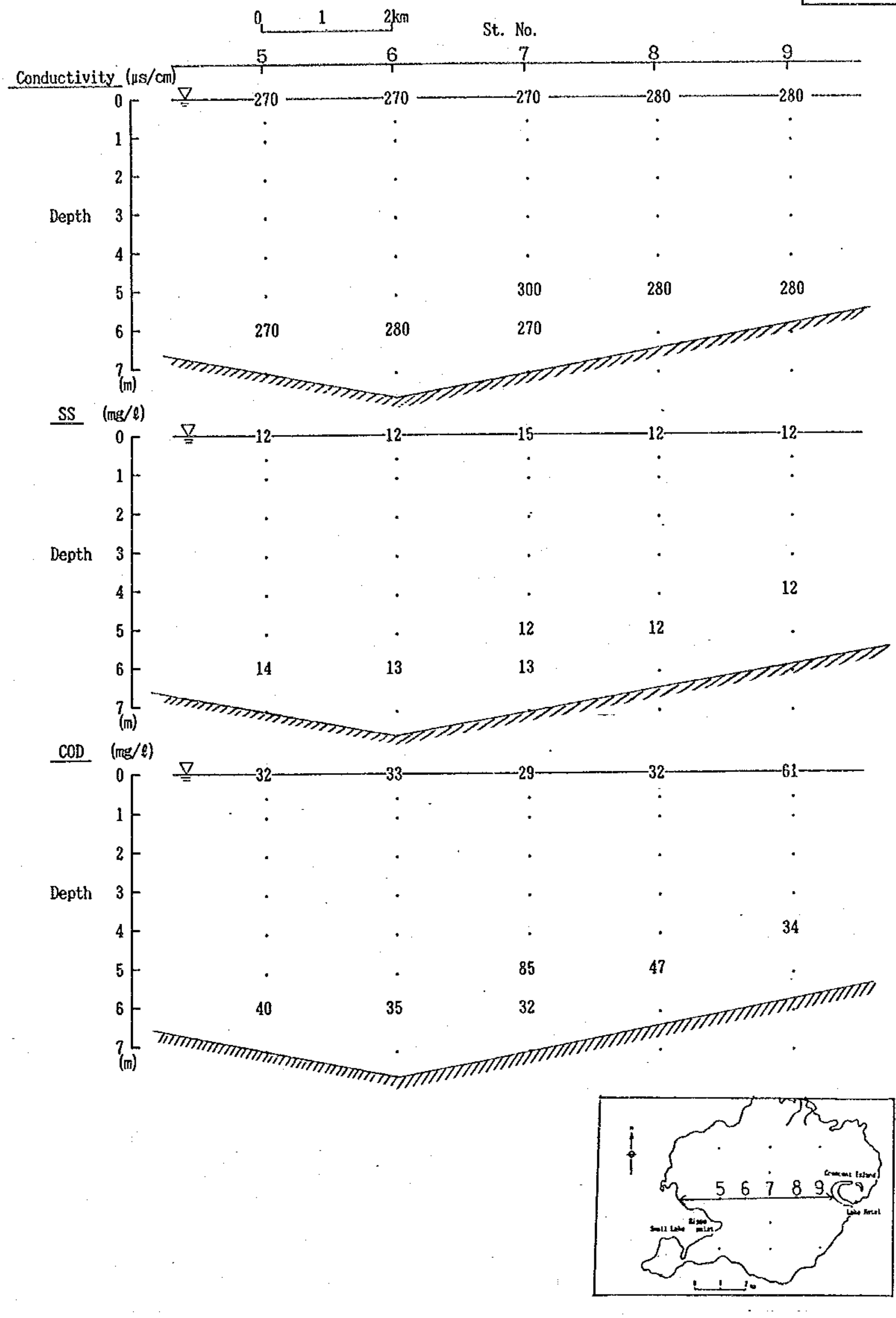
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	***THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION*** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Water quality in a Vertical section of Lake Naivasha (3/6)

Fig. G.2.21



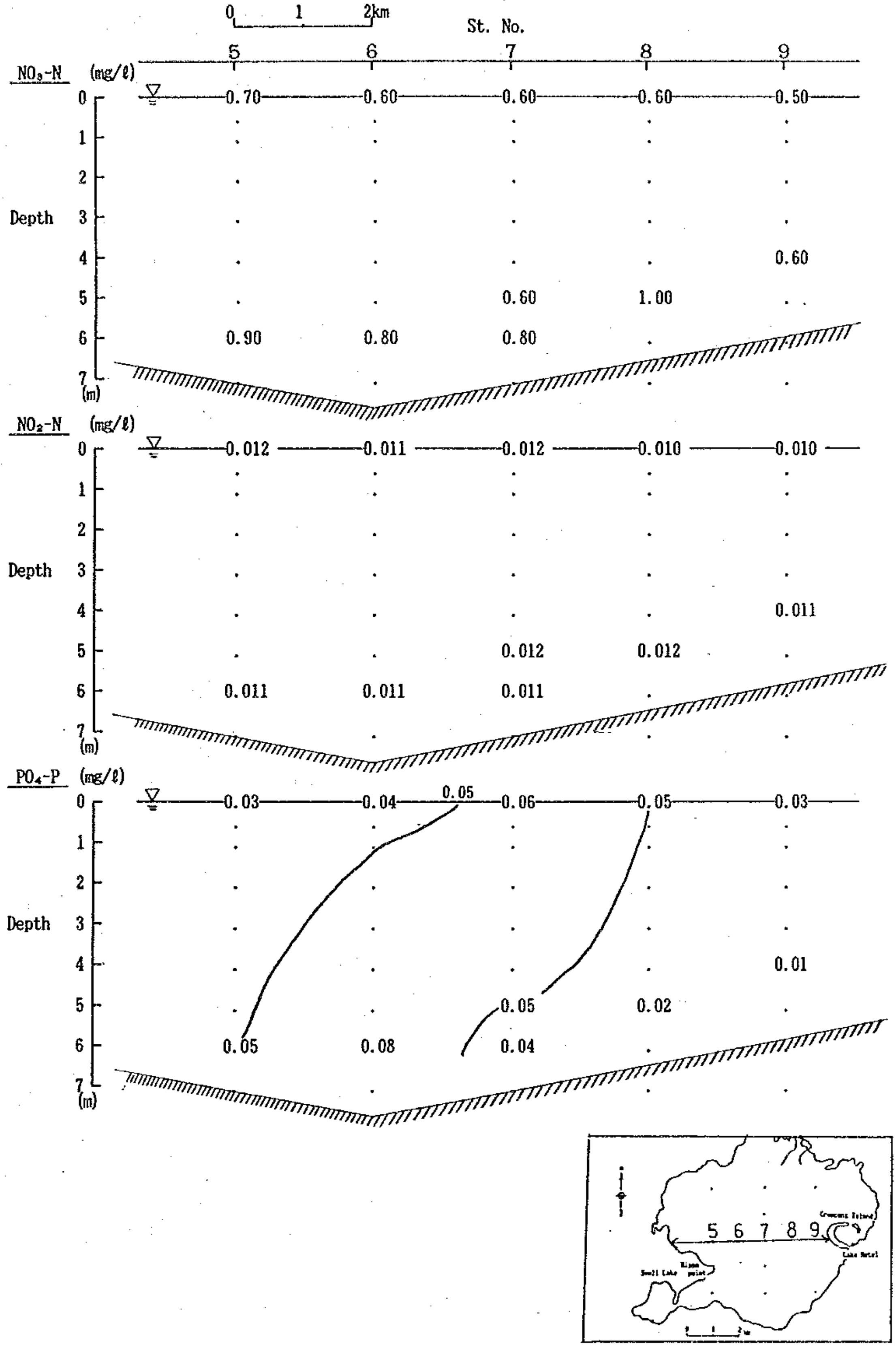
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Water quality in a Vertical section of Lake Naivasha (4/6)

Fig. G.2.22



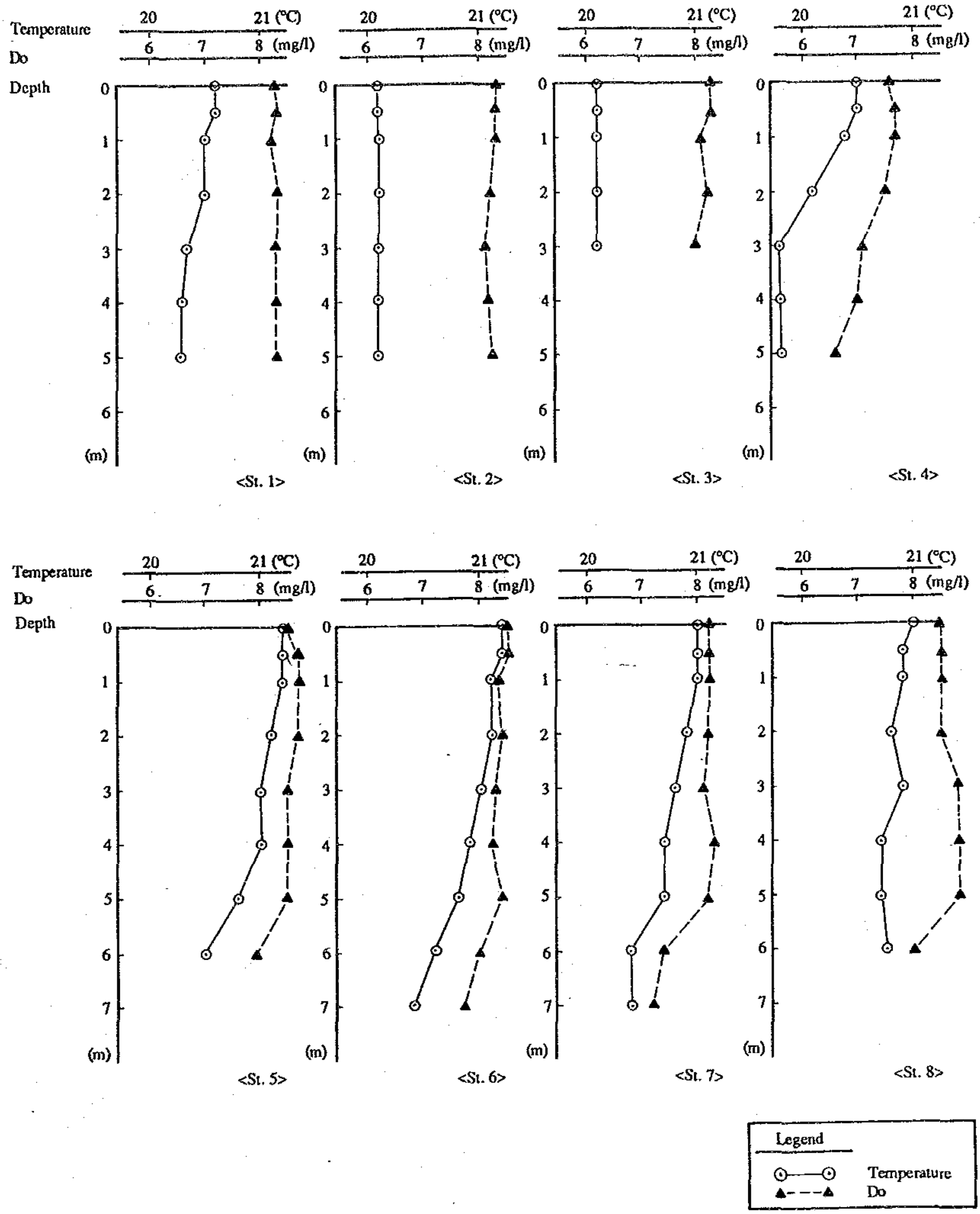
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Water quality in a Vertical section of Lake Naivasha (5/6)

Fig. G.2.23



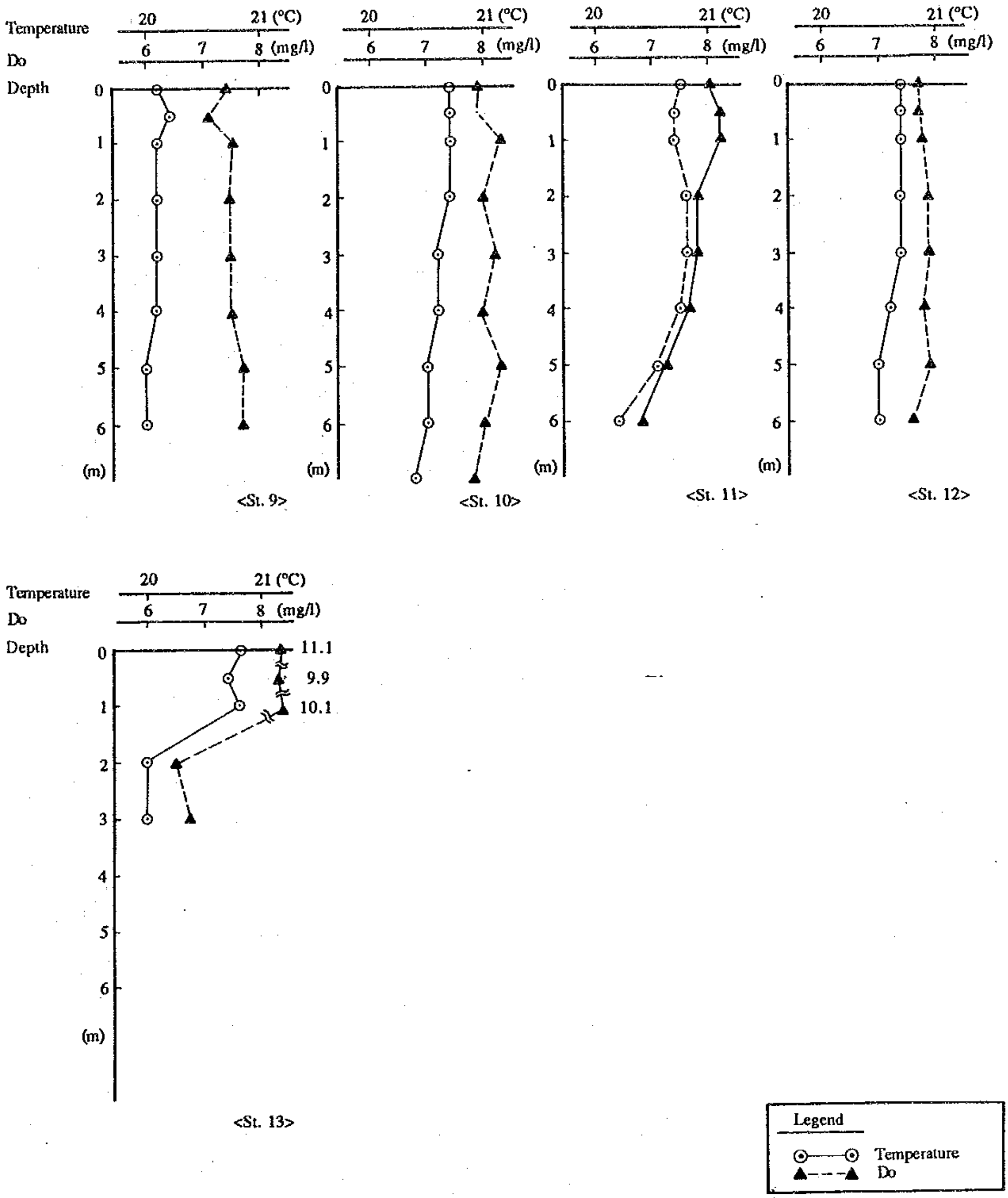
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Water quality in a Vertical section of Lake Naivasha (6/6)

Fig. G.2.24



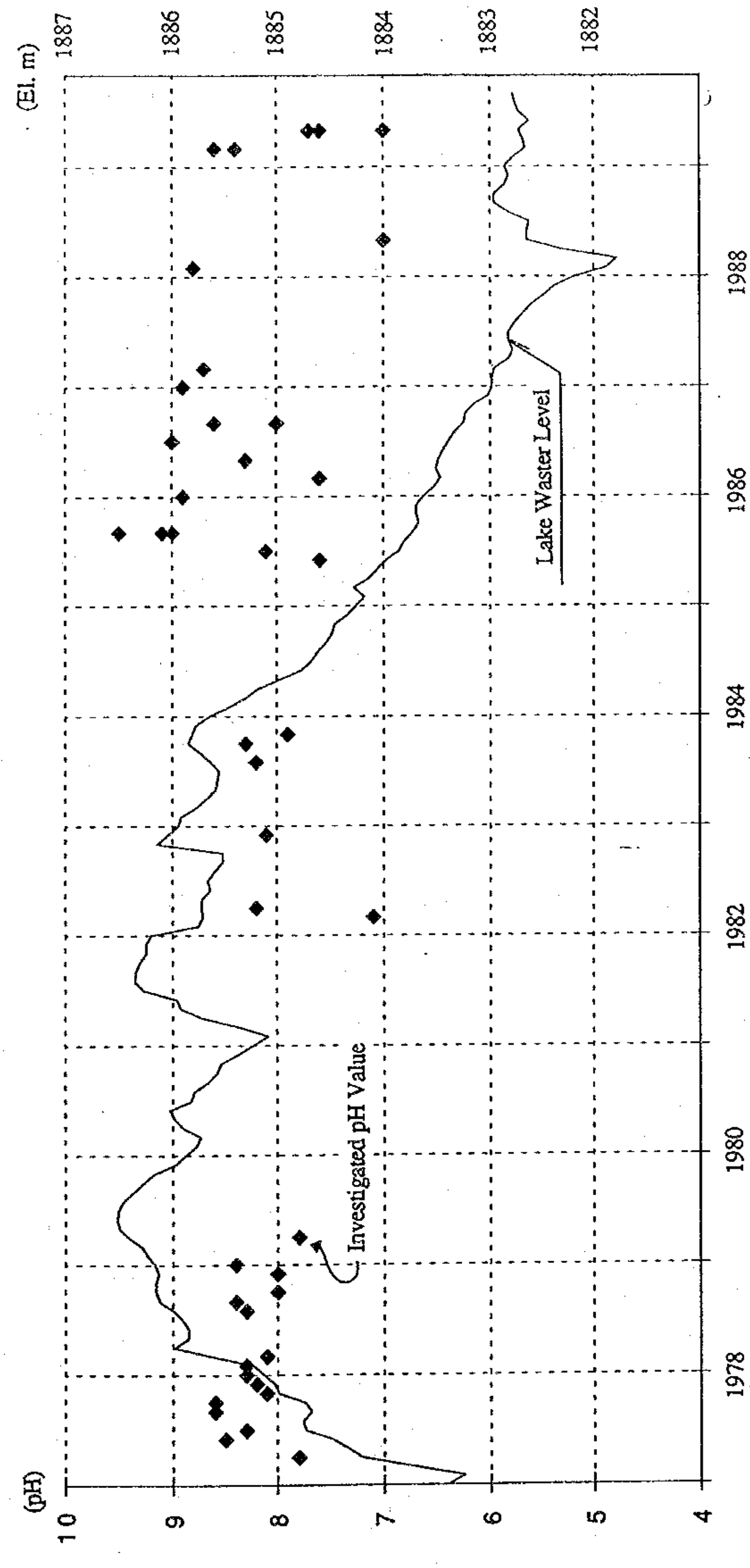
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Vertical distribution of Water quality in Lake Naivasha (1/2)

Fig. G.2.25



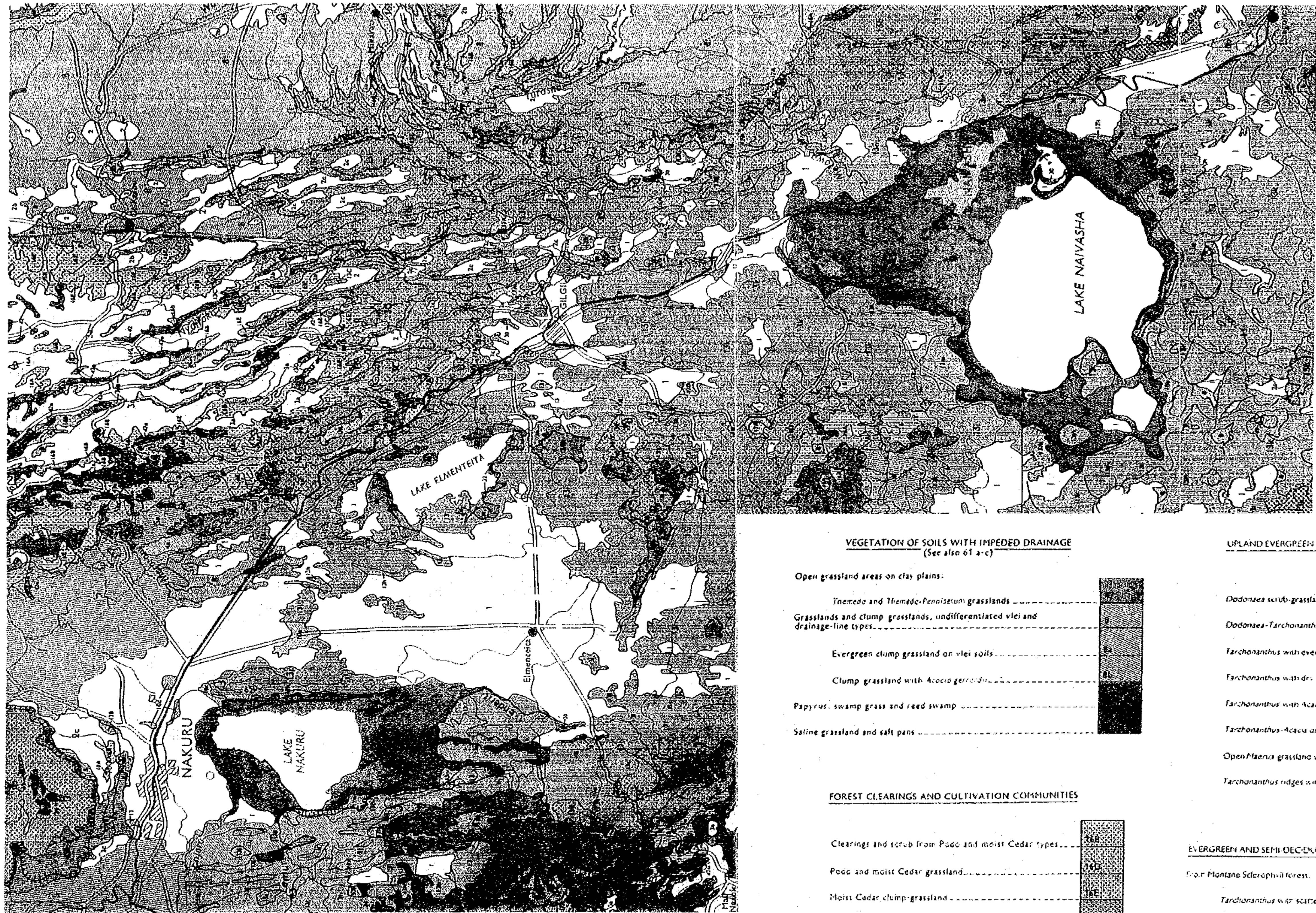
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Vertical distribution of Water quality in Lake Naivasha (2/2)

Fig. G:2.26



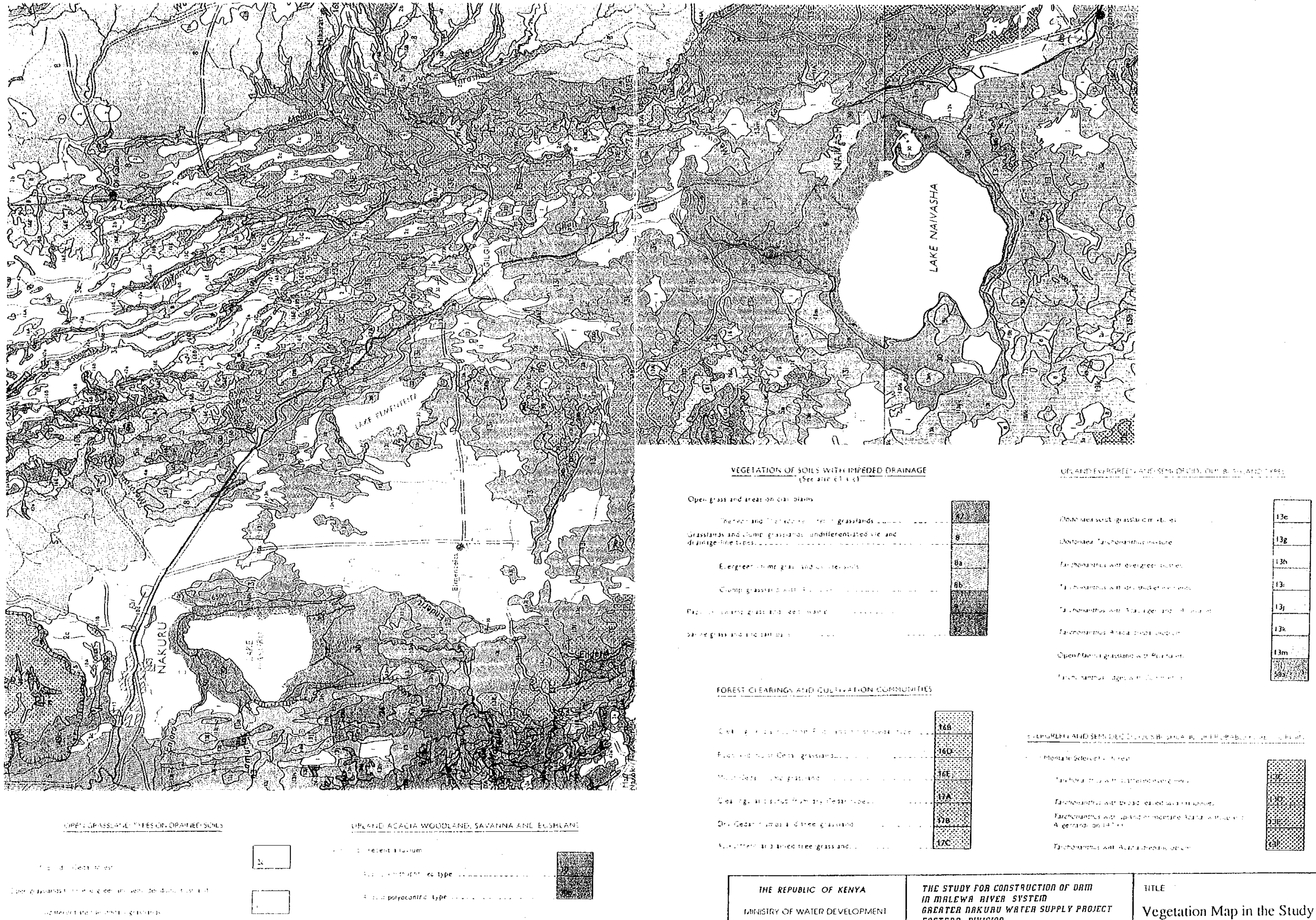
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Historical Record pH and Water Level in Lake Naivasha

Fig. G.2.27



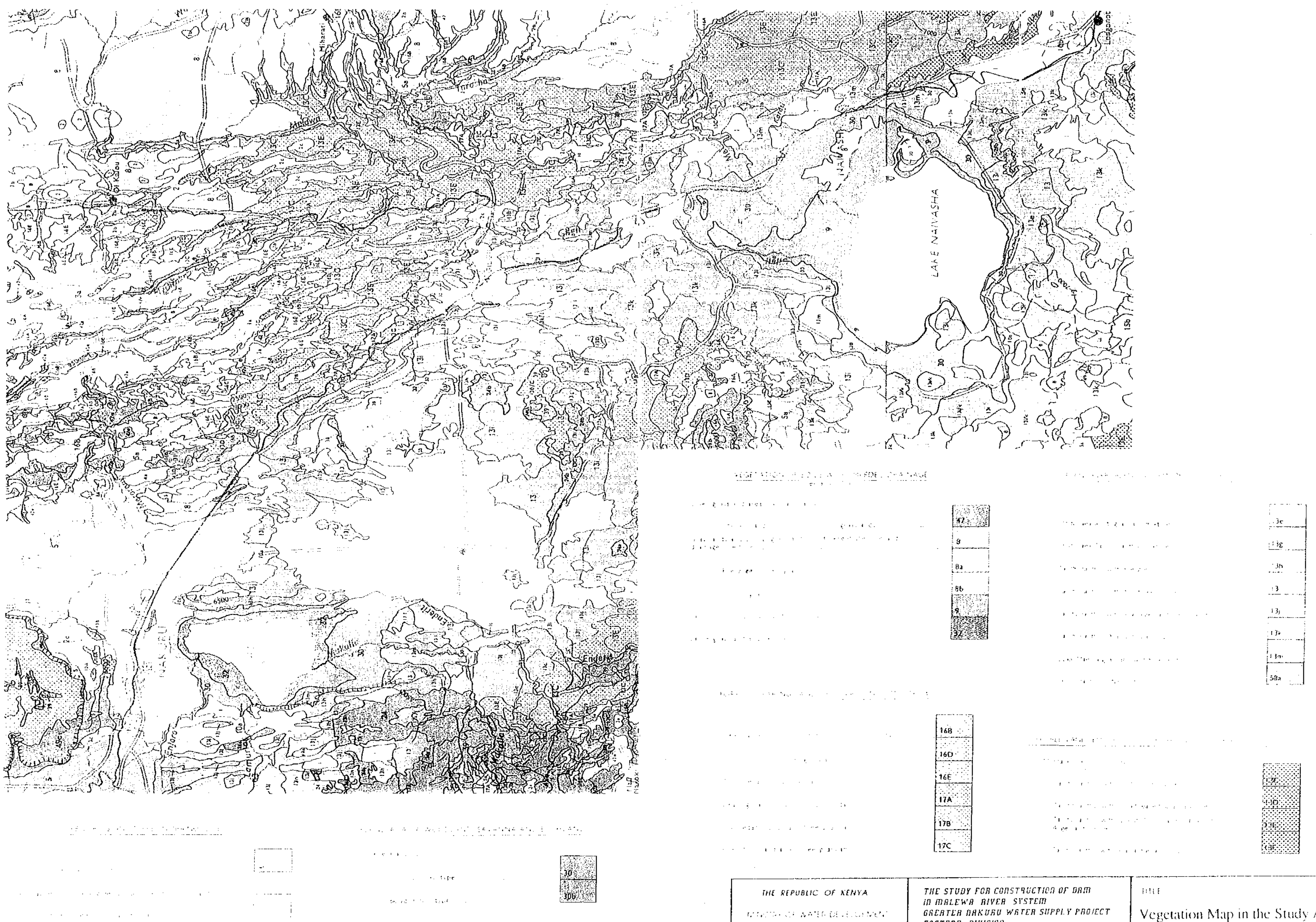
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Vegetation Map in the Study Area

Fig. G.2.27



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Vegetation Map in the Study Area

Fig. G.2.27



THE REPUBLIC OF KENYA

MINISTRY OF WATER DEVELOPMENT

NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION

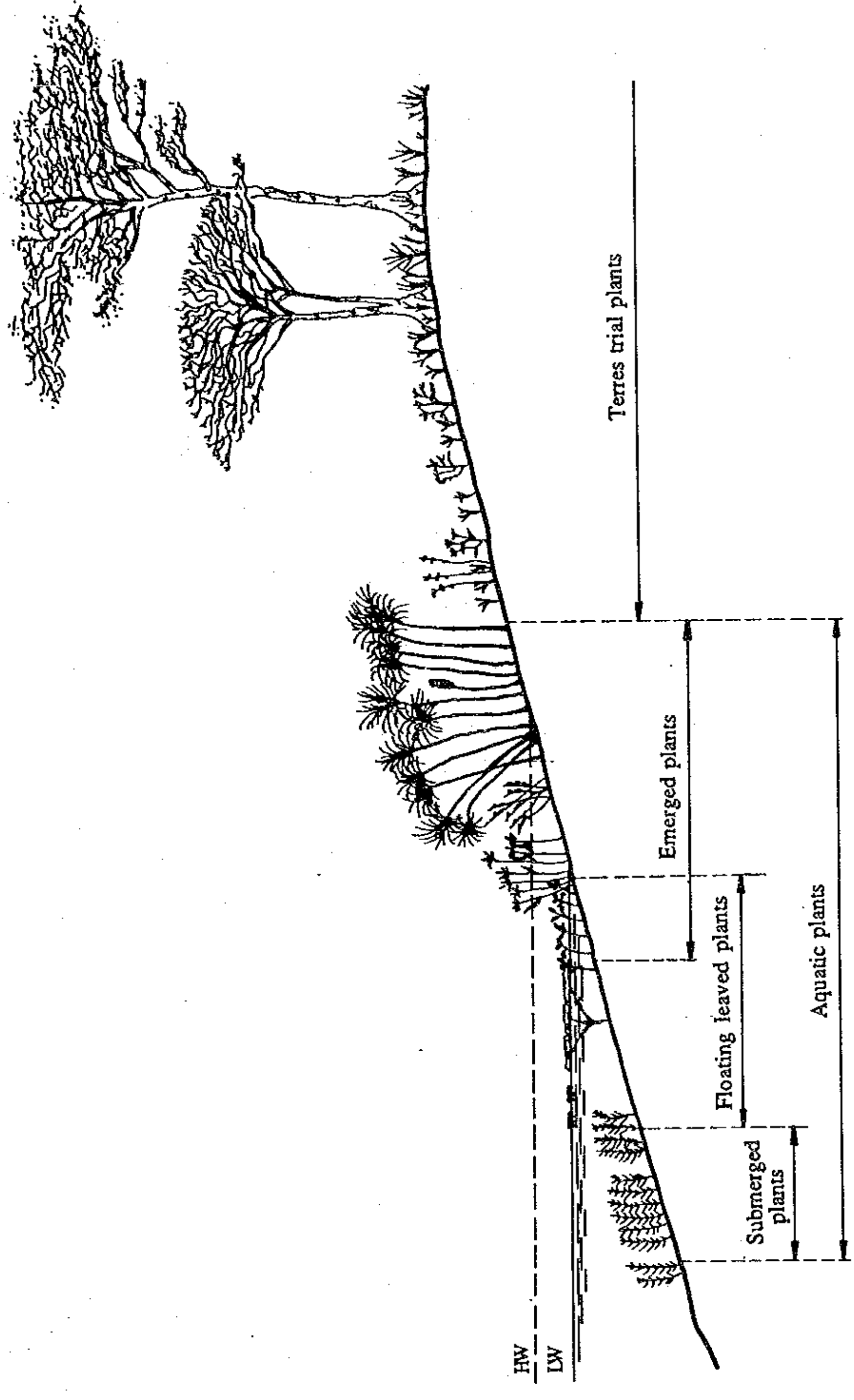
THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM
GREATER NAKURU WATER SUPPLY PROJECT
EASTERN DIVISION

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE

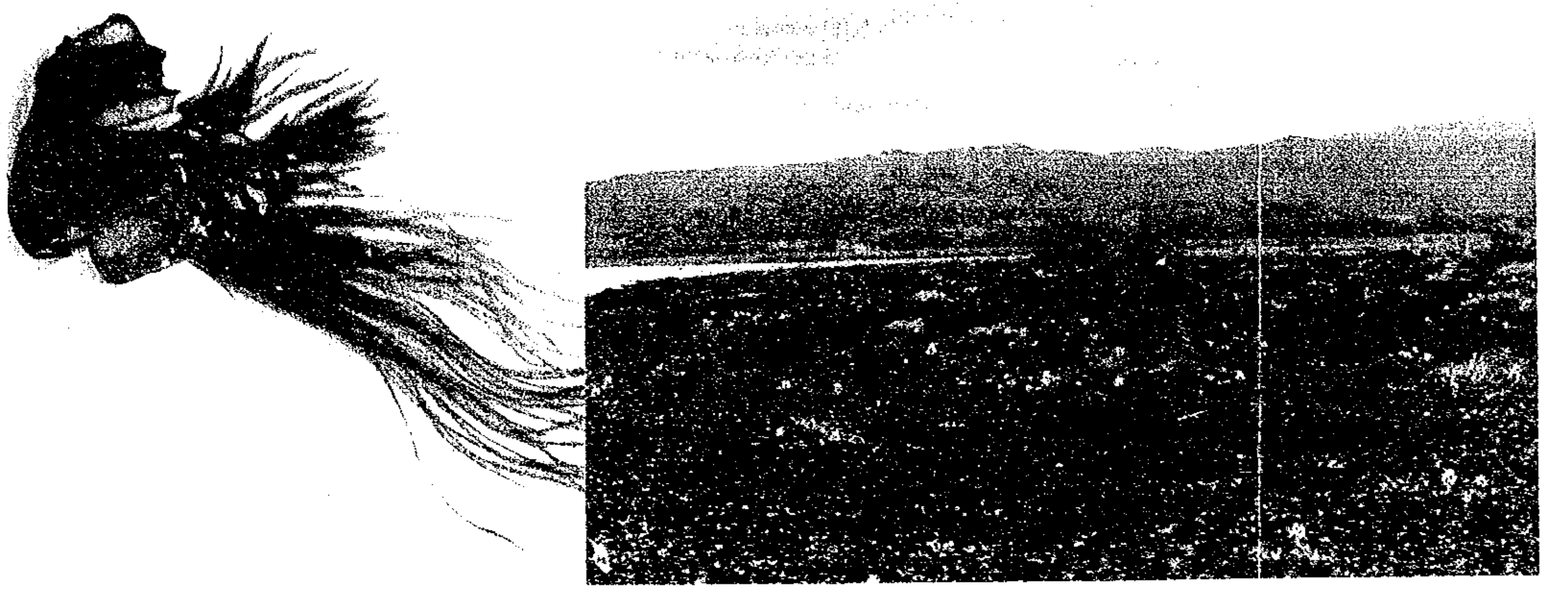
Vegetation Map in the Study Area

Fig. G.2.28



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Aquatic Plant in Lake Naivasha

Fig. G.2.29



Salvinia molesta

Cyperus papyrus

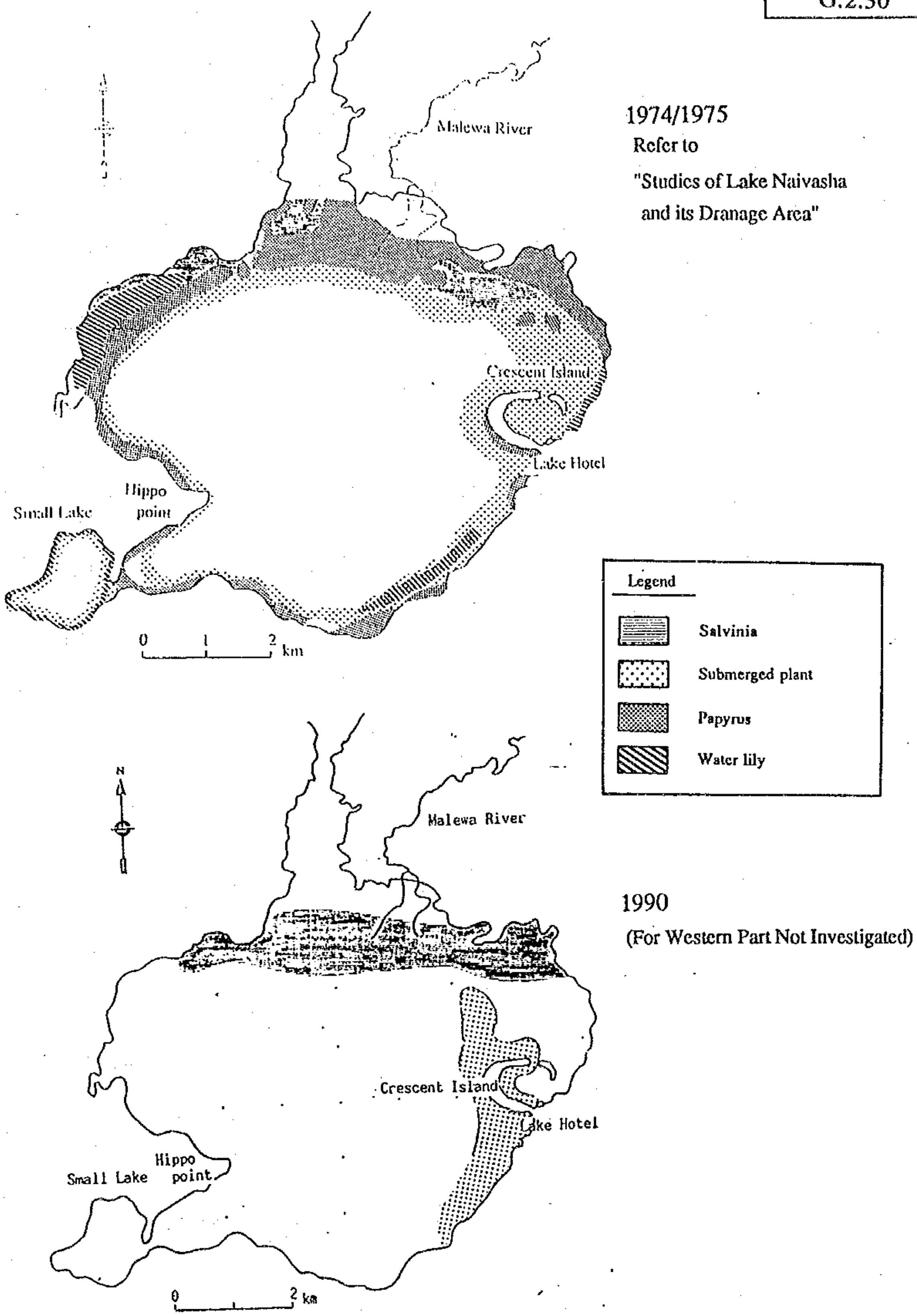
Nymphaea sp.

Persicaria sp.

Najas sp.

THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Photograph of Macrophytes in Lake Naivasha

Fig. G.2.30

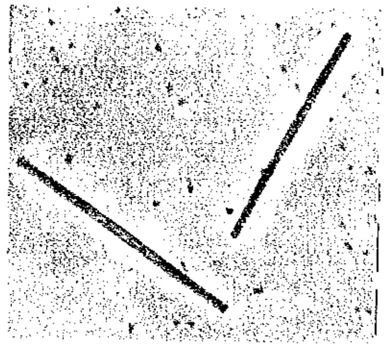


THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Distribution of Macrophytes in Lake Naivasha

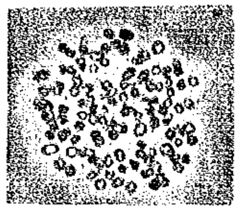
G.2.31

Lake Naivasha

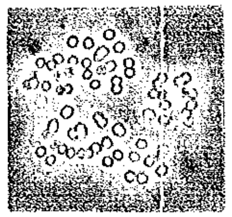
PhytoPlankton



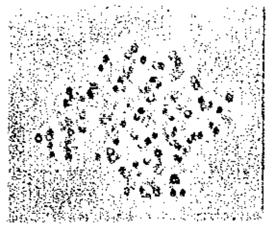
Synedra sp.A x 480



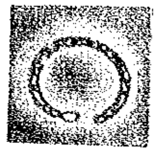
Microcystic aeruginosa x 480



Aphanocapusa sp.B x 480

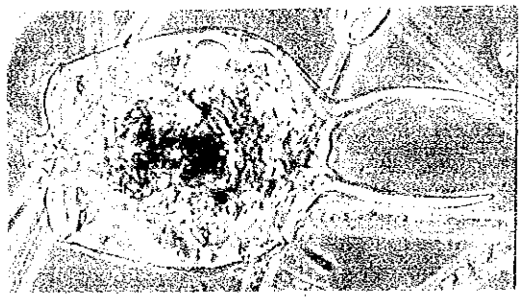


Aphanocapusa sp.A x 480

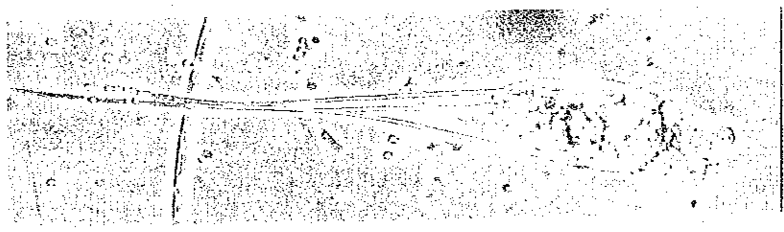


Cylindrospermopsis raciborskii x 480

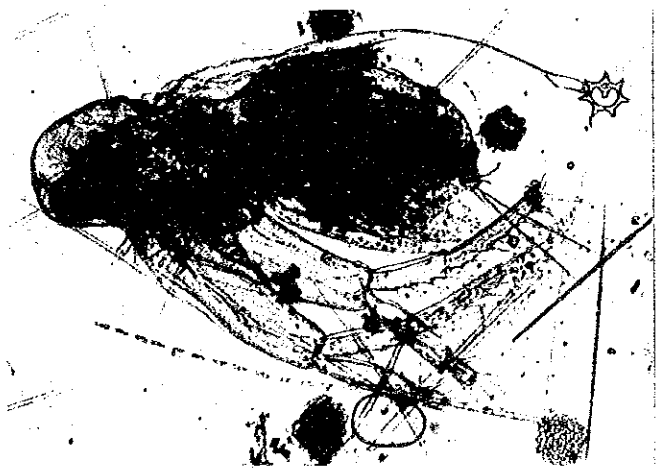
Zooplankton



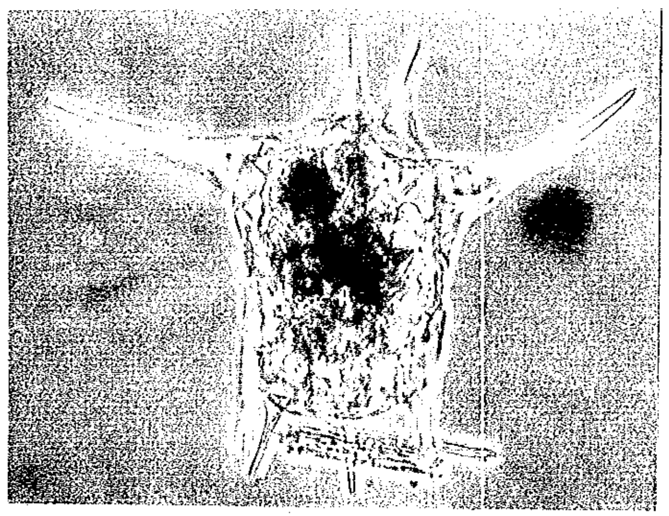
Brachionus caudatus x 240



Filinia sp. x 240



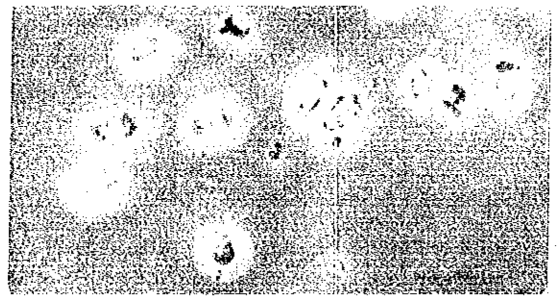
Diaphanosoma sp. x 100



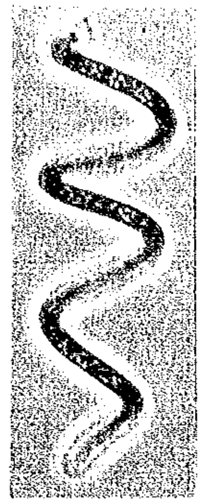
Brachionus calyciflorus x 240

Lake Nakuru

PhytoPlankton

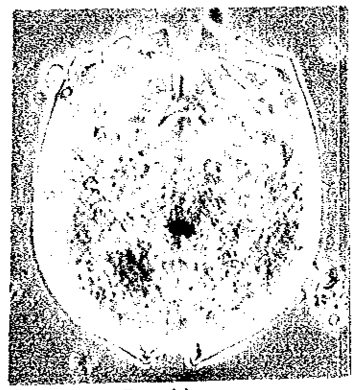


Cryptomonadales x 480

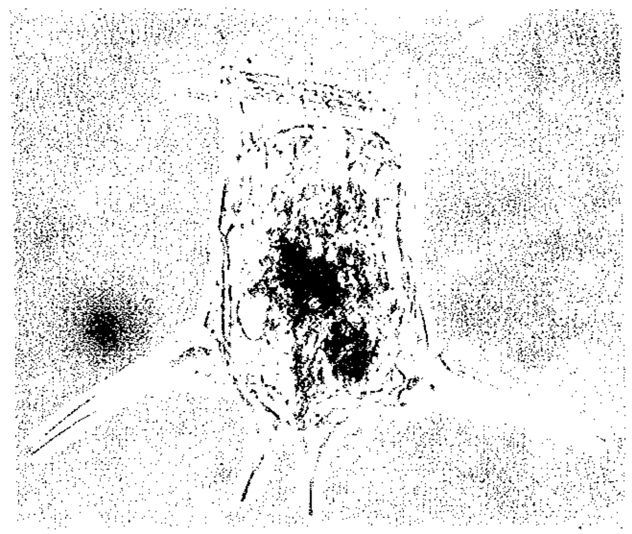


Spirulina platensis x 480

Zooplankton



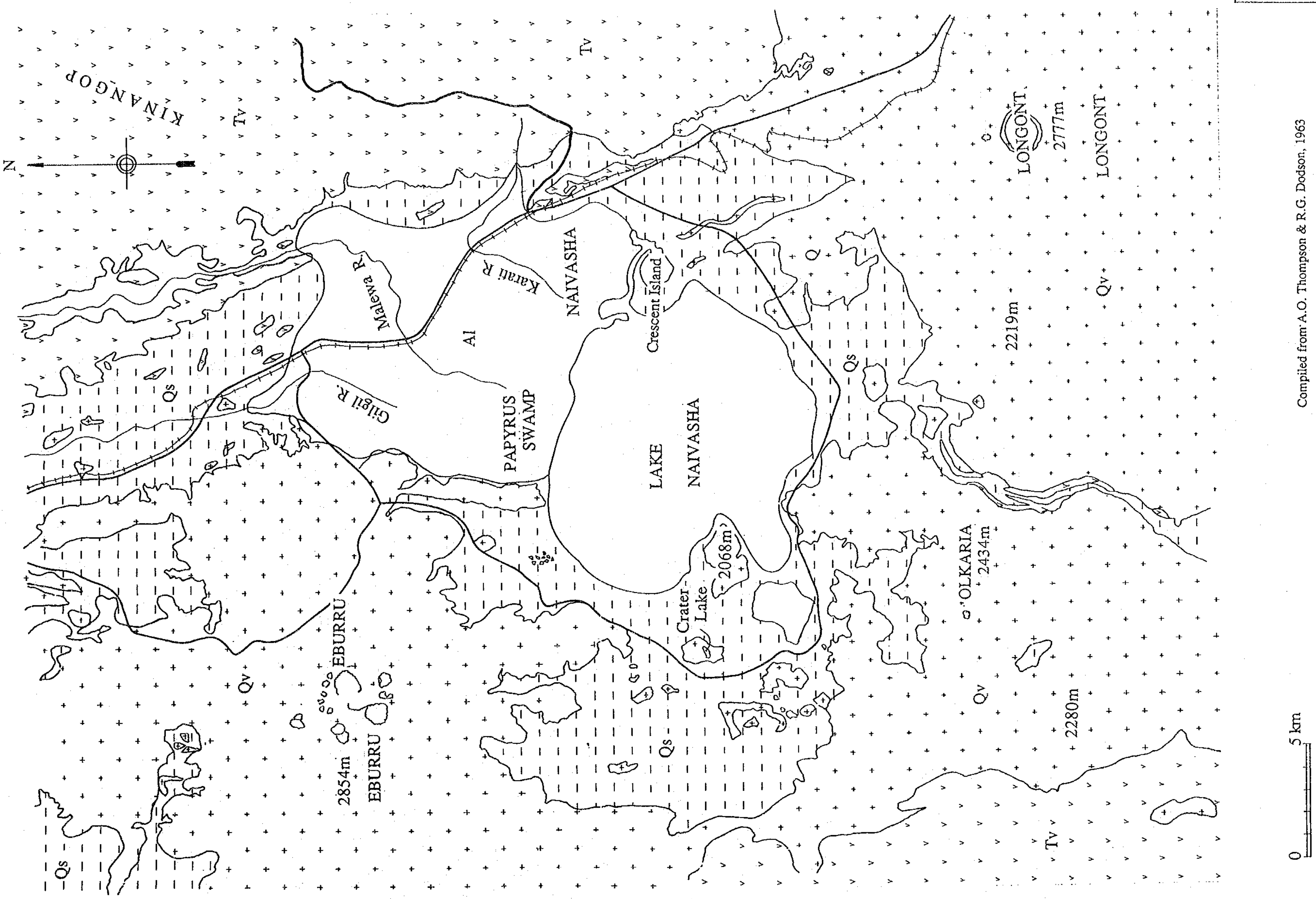
Brachionus sp. x 240



Brachionus calyciflorus x 240

THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Photograph of Plankton

Fig. G.2.32



Al	Alluvium
Qs	Quaternary Lake Sediments
Qv	Quaternary Volcanic & Pyroclastic rocks
Tv	Tertiary Volcanic & Pyroclastic rocks
(line)	Boundry of Rock Facies
(hatched line)	Railway
(line)	Main Road

THE REPUBLIC OF KENYA

MINISTRY OF WATER DEVELOPMENT

NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION

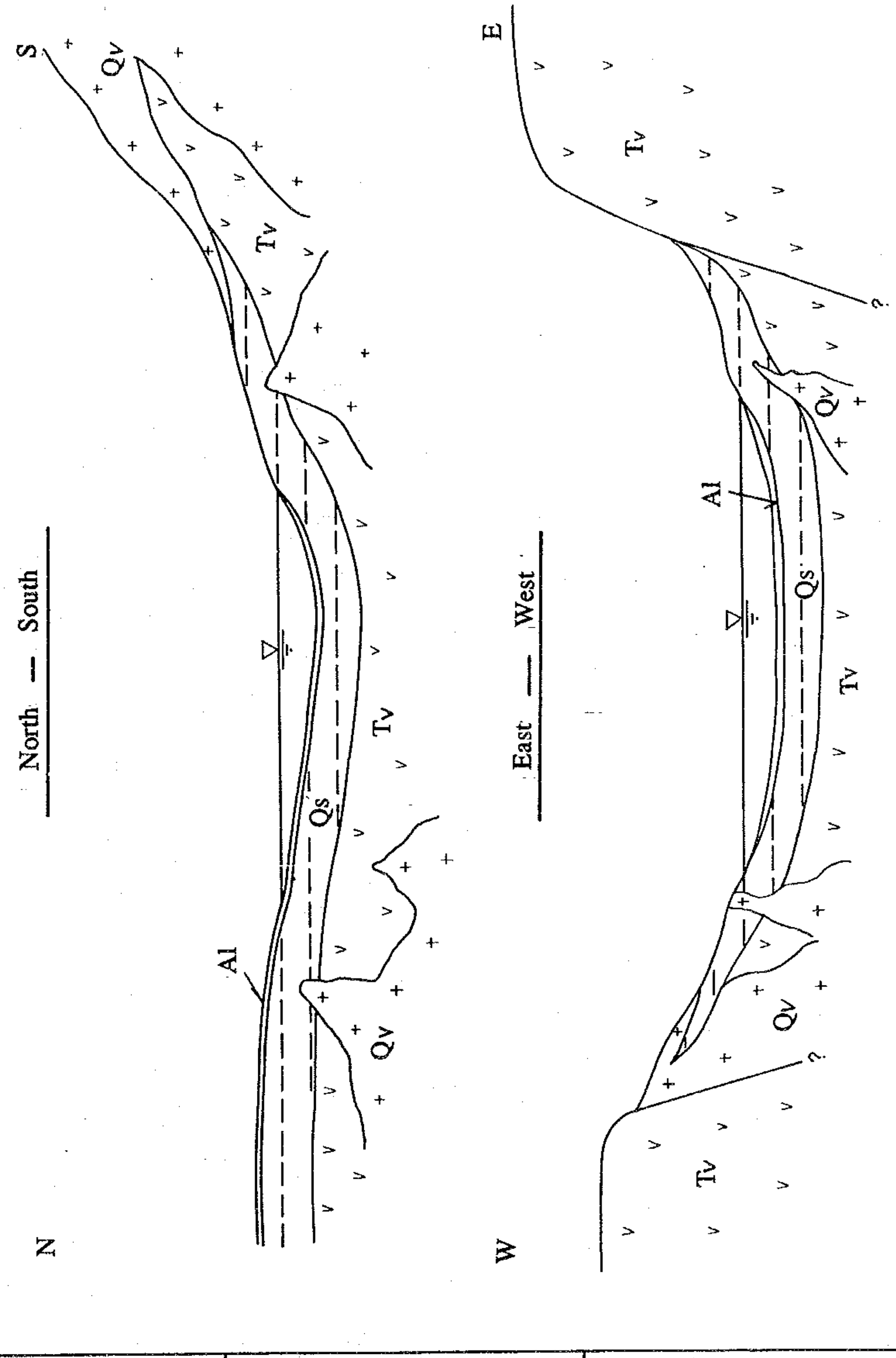
THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE

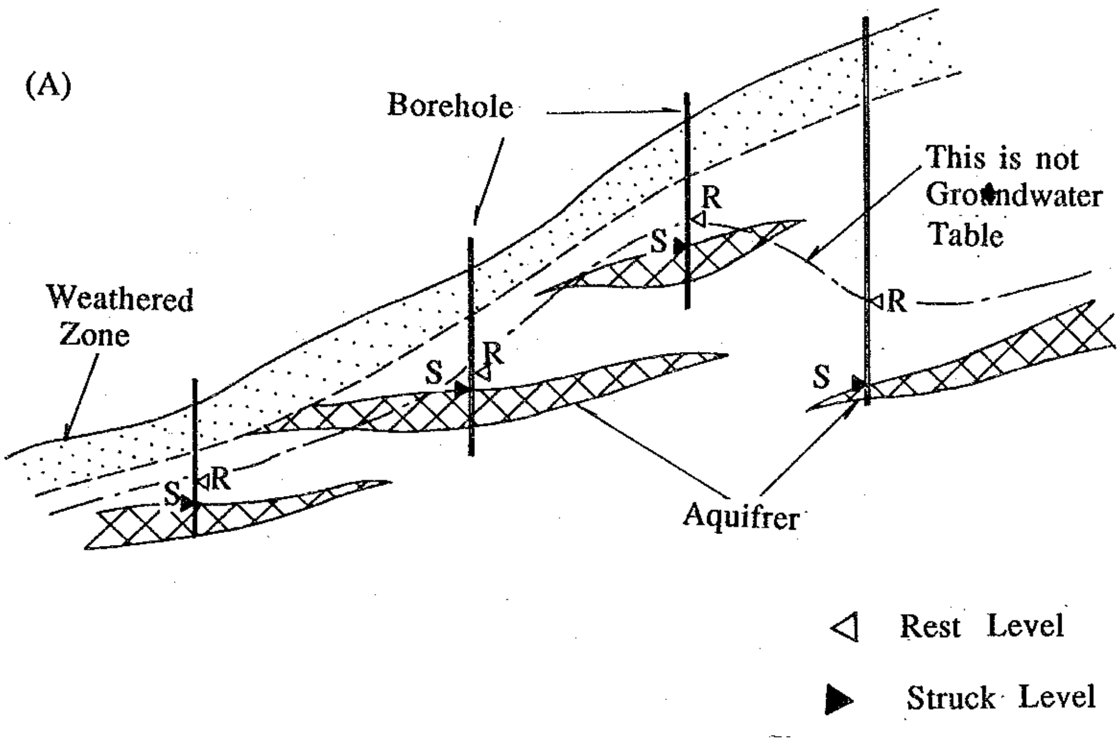
Compiled Geological Map

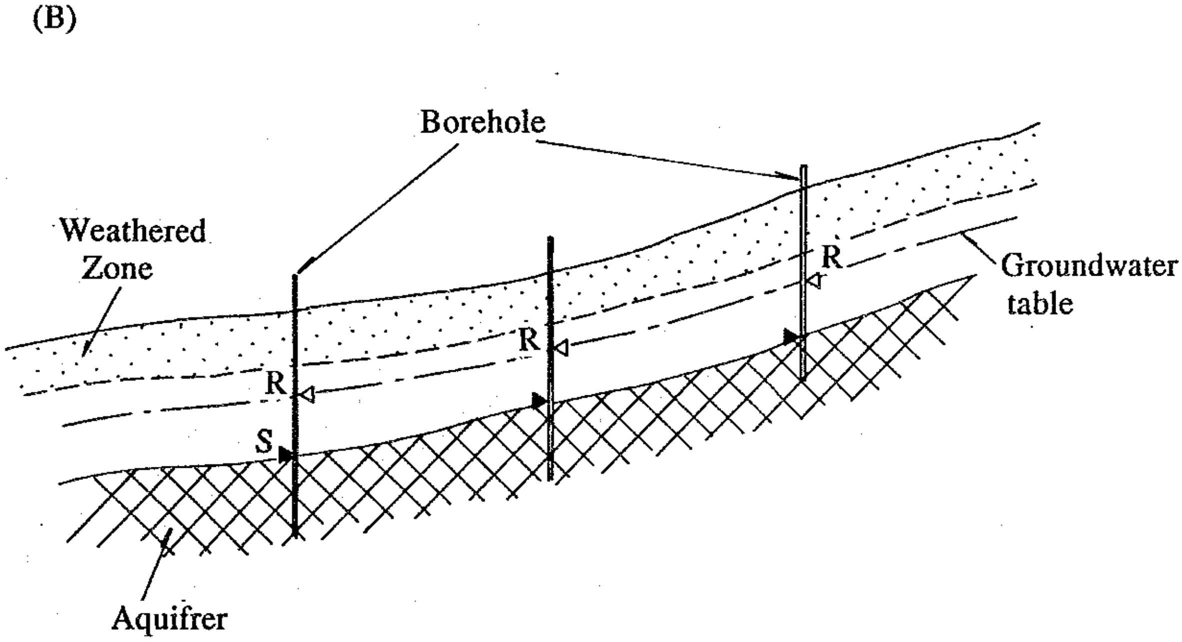
Fig. G.2.33



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Typical Geological Profile of Lake Naivasha

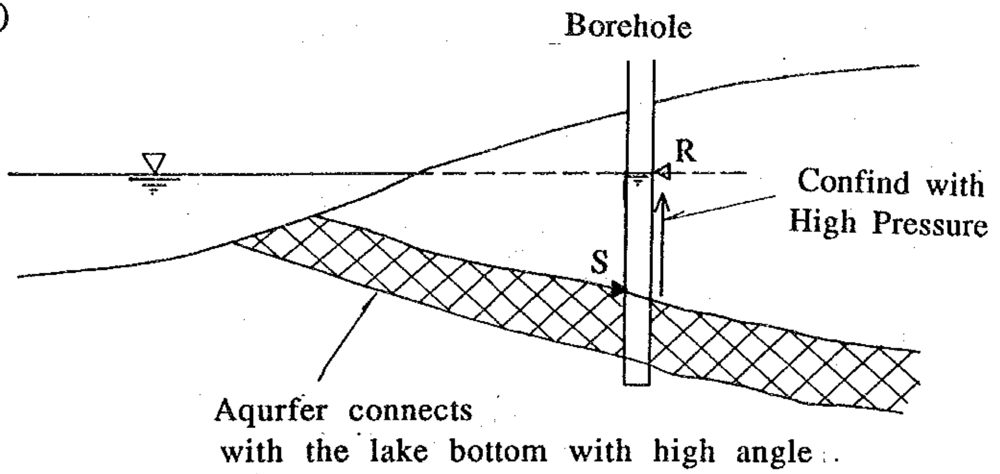
Fig. G.2.34



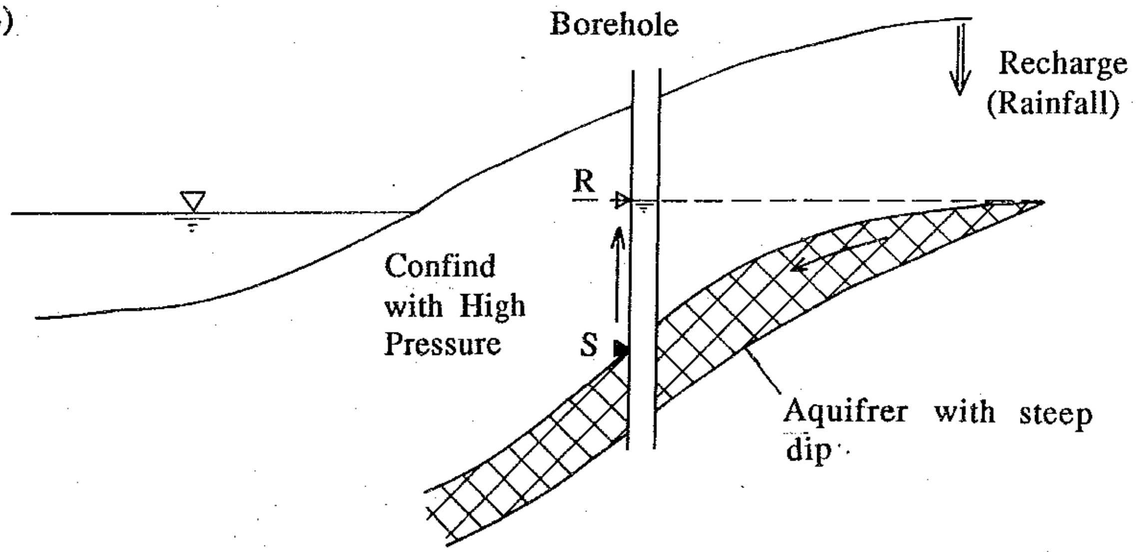


THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Conceptual Relation between Groundwater Aquifer and Lake Naivasha (1/3)

(A)



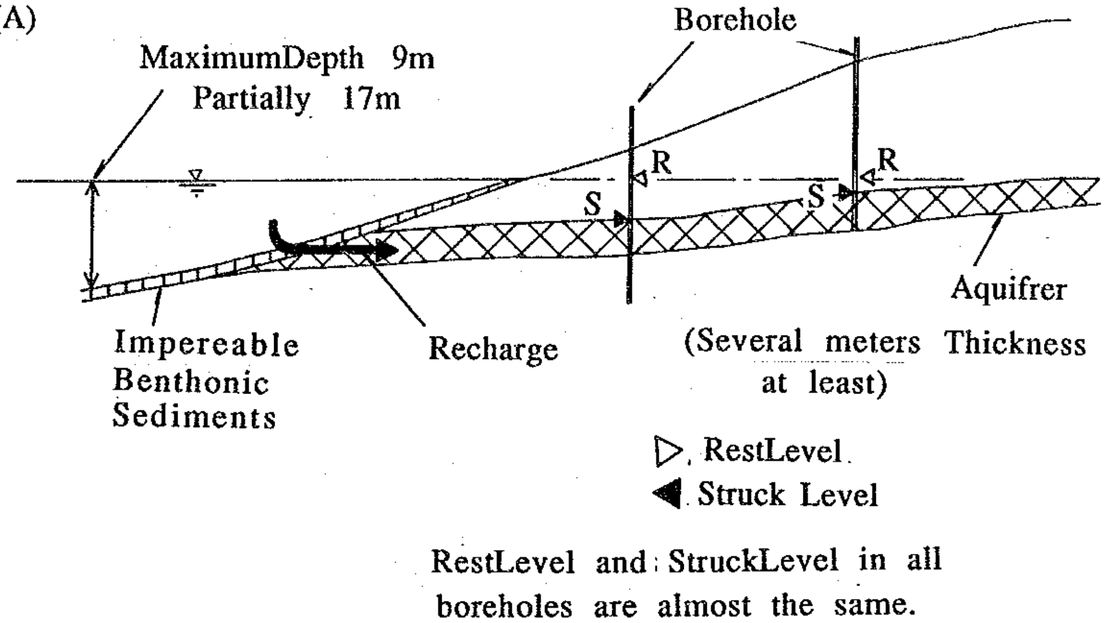
(B)



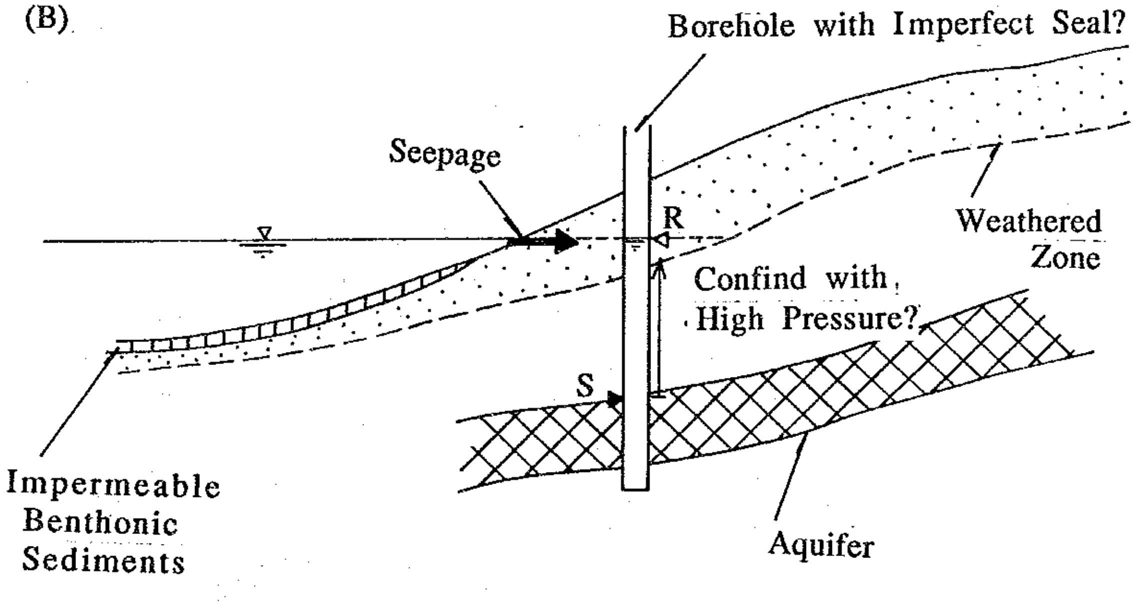
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Conceptual Relation between Groundwater Aquifer and Lake Naivasha (2/3)

Fig. G.2.36

(A)

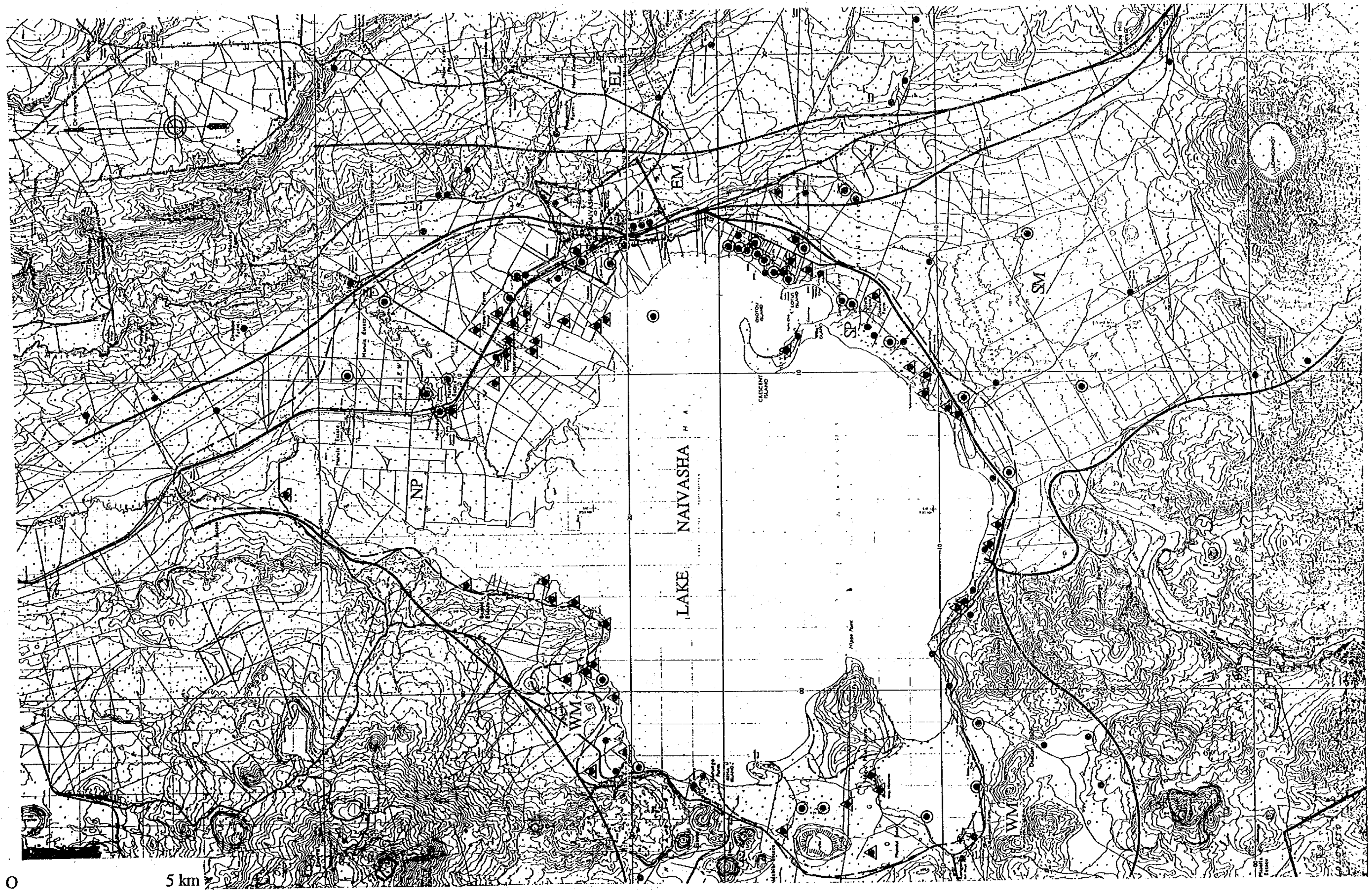


(B)



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Conceptual Relation between Groundwater Aquifer and Lake Naivasha (3/3)

Fig. G.2.37



O 5 km

• Borenole

◉ it's water level is the same to lake level with high pressure (>10 m head)

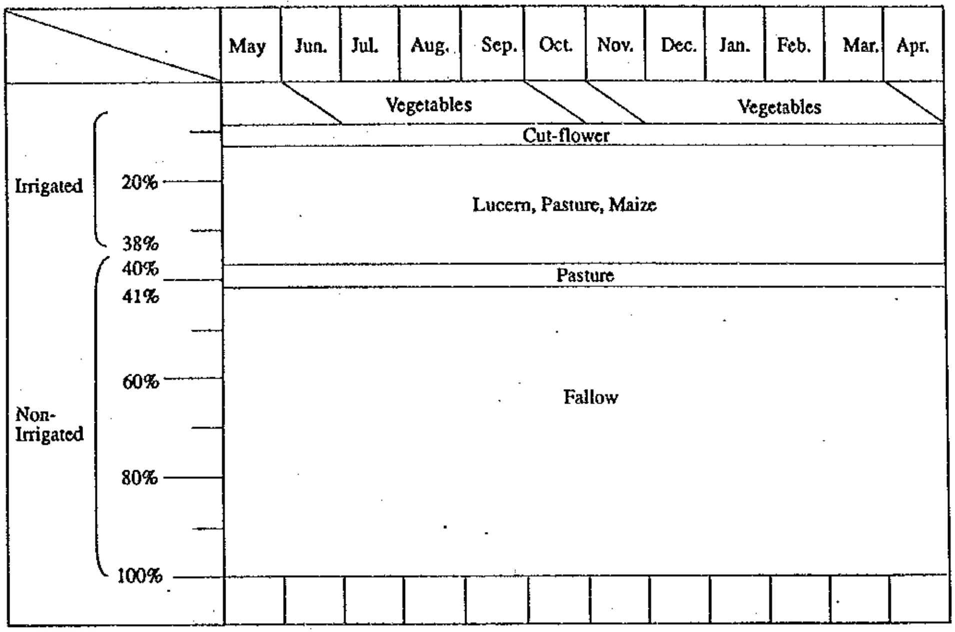
▲ it's waster level is the same to lake level with low pressure

Boundary of Estimated Area Where Lake Water Seeps into Bereholes

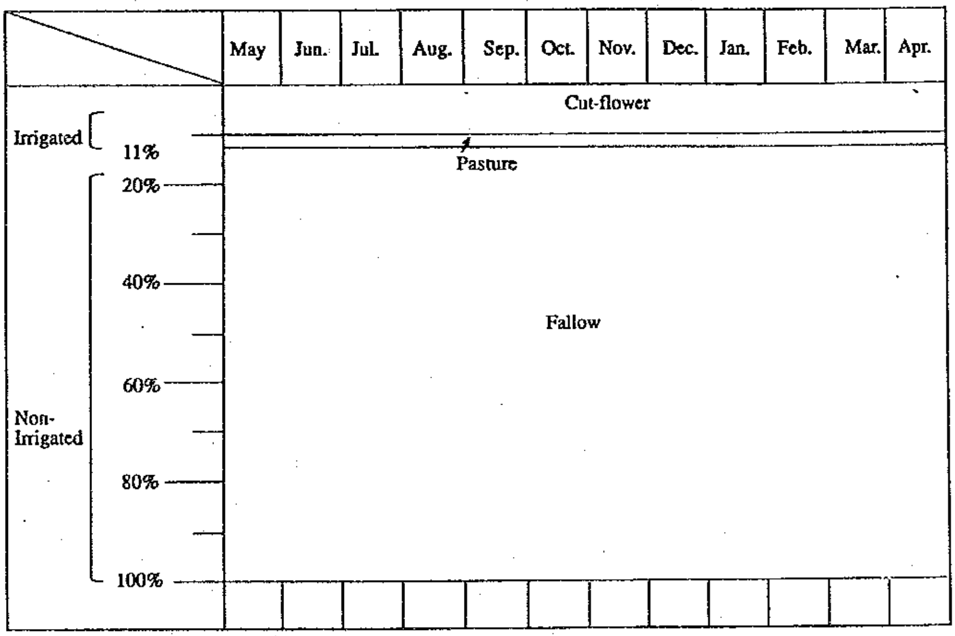
NP/EM Boundary of Classified Location

THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Location Map of Existing Boreholes

Cropped Area in North Side of Lake Naivasha



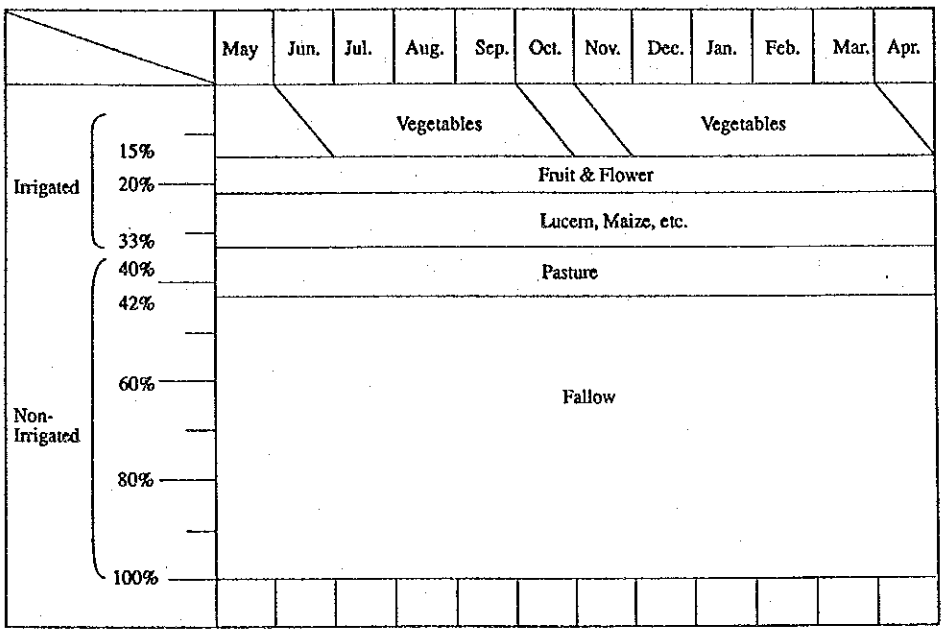
Cropped Area in South Side of Lake Naivasha



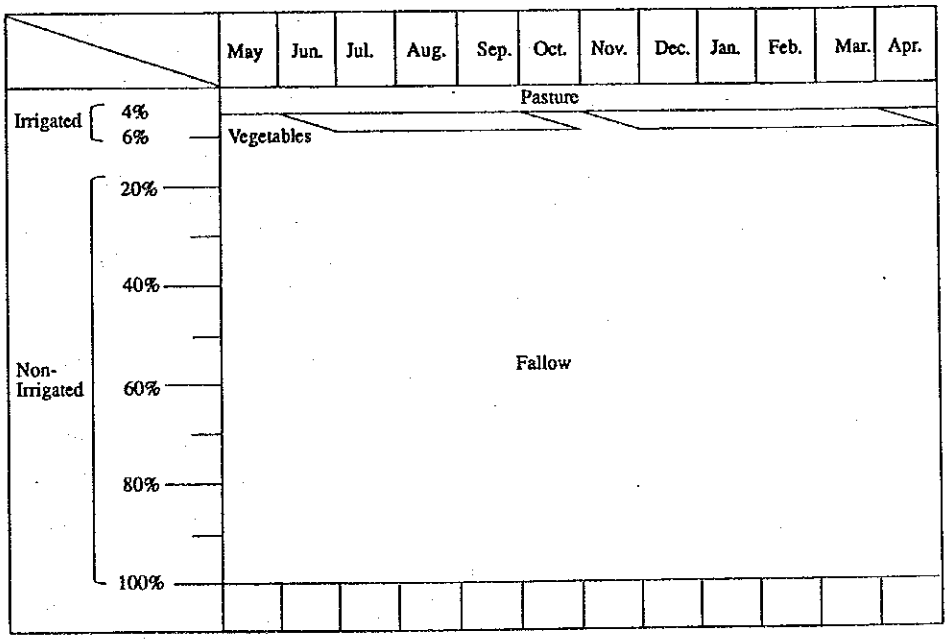
THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	*THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Cropping Pattern around Lake Naivasha(1/2)

Fig. G.2.39

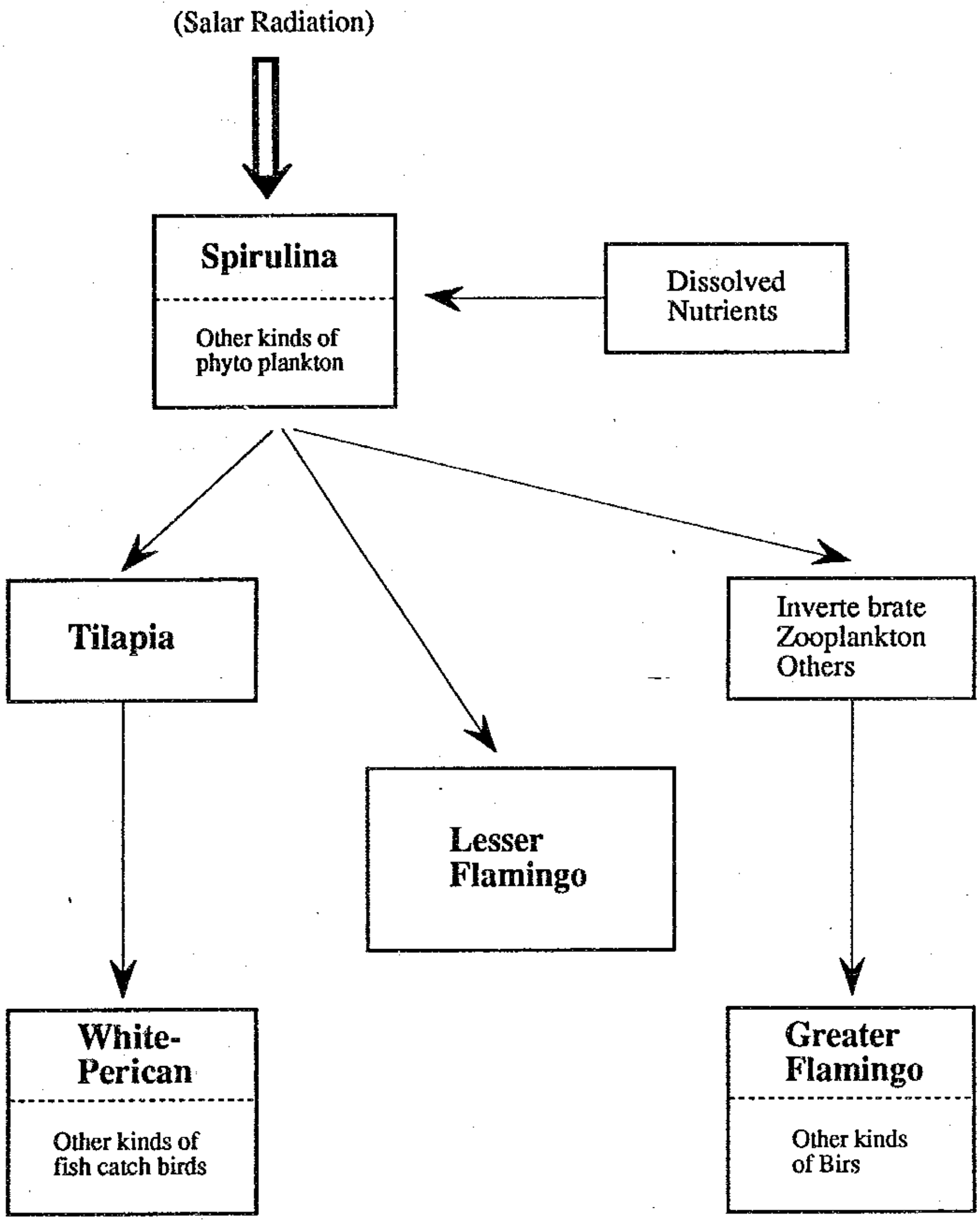
Cropped Area in East Side of Lake Naivasha



Cropped Area in West Side of Lake Naivasha

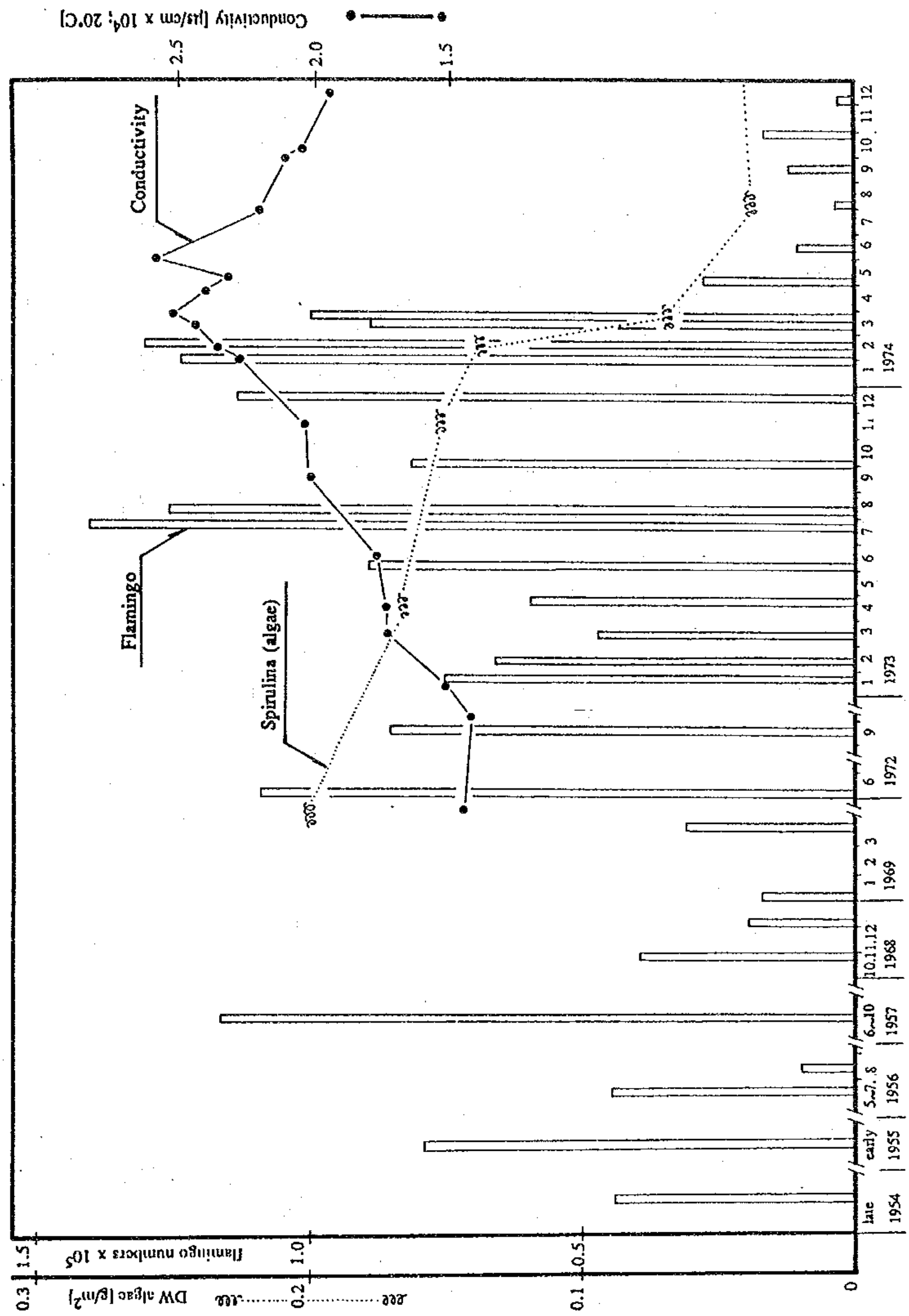


THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Cropping Pattern around Lake Naivasha(2/2)



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Food chain in Lake Nakuru

Fig. G.2.41



THE REPUBLIC OF KENYA MINISTRY OF WATER DEVELOPMENT NATIONAL WATER CONSERVATION AND PIPELINE CORPORATION	THE STUDY FOR CONSTRUCTION OF DAM IN MALEWA RIVER SYSTEM GREATER NAKURU WATER SUPPLY PROJECT EASTERN DIVISION JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Historical Record Flamingo Population and Spirulina Amount and Conductivity in Lake Nakuru