Table D-17 TERMS OF LAND CLASSIFICATION AND THEIR SPECIFIC DEGREE FOR RICE CULTURE

Suitability	Suitable				Unsuitable
	Very suitable (I)	Suitable (II)	Moderately (III)	Marginal (IV)	Very marginal (V)
Soil Conditions					
1. Surface Soil Depth (cm) (s)	More than 30 cm	More than 30 cm	15 - 30 cm	Less than 15 cm	Less than 15 cm
2. Effective Soil Depth (cm) (d)	More than 100 cm	50 - 100 cm	25 - 50 cm	15 - 20 cm	Less than 15 cm
3. Gravel Contents in Surface Soil (g)	Less than 20%	20 - 50%	20 - 50%	More than 50%	More than 50%
4. Conditions for tillability (p)					
- Texture of surface soil	Coarse loam	Fine loam	Fine clay	Very fine clayey	Very fine clayey
- Consistence	Friable	Friable	Firm	Very firm	Extremely firm
- Hardness of air-dried soil	Little hard	Hard	Hard	Very hard	Extremely hard
5. Leak of logged water (l)					
- Texture of subsoil	Very fine clayey	Very fine clayey	Fine loam	Coarse loam	Coarse sand
- Drainability	Poorly drainable	Poorly drainable	Moderate drainable	Well drainable	Very well drainable
6. Potential Oxidation Reduction (r)	Weekly hazard	Weekly harzard	Moderately hazard	Strong hazard	Very strong hazard
- Easily decompose - organic matter	Very little	Little	Intermediate	Much	Very much
- Free iron oxides	Very much	Much	Intermediate	Little	Very little
- Permiability (cm/sec.)	Less than 1.4×10^{-4}	1.3 to 5.5×10^{-4}	1.6×10^{-3} to 5.5×10^{-4}	More than 1.6×10^{-3}	More than 1.6×10^{-3}
7. Soil Fertility (f)					
- pH (Soil reaction)	5.5 - 6.5	5.5 - 5.0, 7.0 - 6.5	5.5 - 5.0, 7.0 - 6.5	5.0 - 4.5, 8.5 - 7.0	Less than 4.5, more than 8.5
- CEC (me)	More than 20	20 - 6	Less than 6	Less than 6	Less than 6
- Base saturation (calcium %)	More than 50	50 - 30	Less than 30	Less than 30	Less than 30
- Nutritions of N.P.K.	Much	Intermediate	Little	Very little	Very little
8. Chemical Hazard (c)	Non hazard	Non hazard	Little hazard	Moderately hazard	Strong hazard
- Sulfides (Wt. %)	Less than 0.1%	Less than 0.1%	Less than 0.75%	Less than 0.75%	More than 0.75%
- Salinity (E.Ce.)	Less than 2 ms/cm	Less than 2 ms/cm	Less than 4 ms/cm	Less than 8 ms/cm	More than 8 ms/cm
9. Warkability					
- Bearing capacity of 0.5 kg/cm^2	Within 20 cm soil depth	Within 20 cm soil depth	Within 50 cm soil depth	Within 100 cm soil depth	Below 100 cm soil depth
10. Topography					
- Relief	Flat to nearly flat	Flat to nearly flat	Gently sloped	Undulating	Rolling
11. Peat decomposition classes (y)					
- in subsurface tier (30 - 90 cm) by Post method	More than H8	More than H8	More than H6	Less than H5	Less than H3

Sources: Guide Book of Land Classification, Agricultural and Fishery Ministry, Japan (1979)

Table D-18 LAND SUITABILITY SPECIFICATION FOR JAMAICA
(GENERAL FOR ALL LOCALLY GROWN CROPS EXCLUDING RICE)

Suitability Parameters	Suitable				Unsuitable
	Very Suitable (I)	Suitable (II)	Moderately (III)	Marginal (IV)	Very Marginal (V)
1.1 SOIL TEXTURES (S)					
-Surface soil (1)	Coarse loamy - fine loamy	Fine loamy - fine clayey	Coarse loamy &/or very fine clayey	Sandy &/or Histic Soils very fine clay	Coarse sandy/greater than 60% rock outcrops
-Subsurface soil (2)	Fine loamy - fine clayey	Coarse loamy - fine clayey	Coarse loamy &/or very fine clayey	Sandy &/or Histic Soils very fine clay	Coarse sandy/greater than 60% rock impedance
1.2 EFFECTIVE SOIL DEPTH (D)	Very deep greater than 120 cm	Deep 90 - 120 cm	Moderately Deep 68 - 80 cm	Shallow 30 - 40 (cm)	Very shallow 0 - 20 cm
1.3 GRAVEL CONTENTS IN SURFACE SOIL (G)	Less than 10%	10 - 20%	20 - 30%	40 - 60%	Greater than 60%
1.4 CONSISTENCE (WHEN WET) (P)	Very friable	Friable	Friable to firm	Very firm/loose	Very loose
1.5 WATER LOGGING (W) -Soil drainability (1)	Well drainable	Moderately drainable	Moderately - poorly drainable	Excessively drained & poor drainable	Excessively drained & very poorly drainable
-Seasonal flooding (2)	Non flooding	Non flooding	Short and shallowly flooded	Long & deeply flooded	Permanently & deeply flooded
1.6 SOIL FERTILITY (F) -Soil reaction (pH) (1)	6.5 - 6.8	5.8 - 6.3, 6.9 - 7.5	5.0 - 5.3, 7.6 - 8.0	4.5 - 4.9, 8.1 - 8.5	Less than 4.5/greater than 8.5
-Nutrients status (P,K) (2)	Very high	High	Medium	Low	Very low
-Organic matter (3)	Greater than 5%	3 - 5%	2 - 3%	1 - 2%	0 - 1%
-Cation exchange capacity meq/100 grams (4)	Greater than 40	30 - 40	20 - 30	10 - 20	Less than 10
-Base saturation (5)	Greater than 40%	30 - 40%	20 - 30%	10 - 30%	Less than 10%
1.7 CHEMICALS HAZARD (H)	Negligible 0 - 0.4	Slightly saline 0.4 - 0.8	Moderately saline 0.8 - 1.2	Saline 1.2 - 1.6	Strongly saline greater than 1.6
1.8 MECHANIZATION (M) -Bearing capacity of 0.5kg/cm²	Within 0-20 cm soil depth	Within 20 - 40cm Soil depth	Within 40 - 60 cm depth	Within 60 - 80 cm depth	Greater than 80 cm depth
1.9 TOPOGRAPHY (T) -Relief (1)	Flat	Flat-nearly flat	Gently sloping	Undulating	Rolling-step
-Slope (2)	0 - 2°	2 - 5°	5 - 10°	10 - 20°	Greater than 20°
2.0 CLIMATIC FACTORS (C) -Rainfall average annual (1)	Continuously moist 3,810 -5,080 mm	Weak dry season 2,540 - 3,810 mm	Marked dry season 1,778 - 2,540 mm	Strong dry season 1,270 - 1,778 mm	Very strong dry season Less than 1,270 mm
-Wind velocity (2)	Very weak	weak	Moderately strong	Strong	Very strong
2.1 IRRIGATION POTENTIALS (I) -Water availability (1)	Permanent streams or existing usable wells	Permanent streams or usable wells	Permanent to intermittent streams	Intermittent streams	No streams no potential wells
-Water quality (EC) (mmho/cm) 25°C (2)	Less than 250	250 - 750	750 - 2,000	2,000 - 3,000	Greater than 3,000

Sources: Soil and Land-Use Surveys No.14. Jamaica, Parish of St. Elizabeth, (1961)

Table D-19 LAND CAPABILITY OF SOIL UNITS

Mapping Unit	Map Symbol	Extent Area (ha)	Land Capability Classes		Parent Materials
			For Rice	For Upland Crops	
1	73	23	IIIfl	IIIs	Limestone Soils
1a	73/77	331	IIIfl/IVdl	IIIs/Vse	
2	74	36	IIId	IIIs	
2a	74/77	82	IIId/IVdl	IIIs/Vse	
3	77	35	IVdl	Vse	
3a	77/73	18	IVdl/IIIfl	Vse/Vse	
4	94	46	IIIf	IIIw	
4v	94v	504	IVdg	IVs	
5	150	49	IVlf	IVs	Old Alluvial Soils
5a	150/204	99	IVlf/IIl	IVs/IIws	
6	151	187	IIl	IIw	
6a	151/203	62	IIl/IIp	IIw/IIws	
7	203	1,293	IIp	IIws	
7a	203/151	24	IIp/IIl	IIws/IIw	
8	204	537	IIl	IIws	
8a	204/150	130	Iil/IVlf	IIws/IVs	
9	83	197	IIl	IIs	
10	9	304	IIpl	IIws	Recent Alluvial Soils
10a	9/H1a	86	IIpl/IIIl	IIws/IVsw	
11	109	304	IIpl	IIws	
12	151/94V	48	IIl/IVdg	IIw/IVs	Complex
13	203/94V	67	IIp/IVdg	IIws/IVs	
14	I2	463	IIIpr	IIIw	Inundated Alluvial Soils
15	H1a	2,035	IIIr	IVsw	
16	H1b	1,488	IVbr	IVsw	Peat Soils
16a	H1c	903	Vbr	VIsw	
16b	H1s	1,144	Vbc	VIsw	
	Forest	915	VIII	VIII	
	Total	11,410			

Table D-20 (1/2) DISTRIBUTION OF LAND CAPABILITY (FOR RICE CULTURE)

Segments	Places	Suitable		Marginal	Unsuitable		Sub-Total
		II	III	IV	V	VIII	
Black River right bank	Holland, Lacovia	1,582	0	0	0	0	1,582
	*Y.S.R. lt. bank	0	279	108 1/	110	140	637
	*Y.S.R. rt. bank	0	0	0	276	50	326
	Sub-total	1,582	279	108	386	190	2,545
Black River left bank	Slipe-Cataboo	597	0	142	0	0	739
	Hatfield	304	0	0	0	60	364
	*Frenchman Holiday Pen	0	758	0	0	46	804
	*Styx River	0	0	404 1/	0	7	411
	Sub-total	901	758	546	0	113	2,318
Broad River Basin	Vineyard	195	0	362	0	0	557
	Mountainside	233	472	53	0	0	758
	*Broad River rt. bank	0	891	374 1/	0	22	1,287
	*Broad River lt. bank	0	570	602 1/	0	132	1,304
	Sub-total	428	1,933	1,391	0	154	3,906
Black River Esturay, M.Q.R. right bank	Luana. Baptist	328	46	99	49	0	522
	*Middle Quarters rt. bank	0	0	0	594	70	664
	*Black River Estuary	0	0	0	1,067	388	1,455
	Sub-total	328	46	99	1,710	458	2,641
	Total	3,239	3,016	2,144	2,096	915	11,410

Remarks: * Inundated Area

1/ IV-class of peat soils is included by the suitable land.

Table D-20 (2/2) DISTRIBUTION OF LAND CAPABILITY (FOR UPLAND CROPS)

Segments	Places	Suitable		Marginal	Unsuitable		Sub-Total
		II	III	IV	V	VIII	
Black River right bank	Holland, Lacovia	1,582	0	0	0	0	1,582
	*Y.S.R. lt.bank	0	168	219	110	140	637
	*Y.S.R. rt.bank	0	0	0	276	50	326
	Sub-total	1,582	168	219	386	190	2,545
Black River left bank	Slipe, Cataboo	597	0	142	0	0	739
	Hatfield	304	0	0	0	60	364
	*Frenchman Holiday Pen	0	295	463	0	46	804
	*Styx River	0	0	404	0	7	411
	Sub-total	901	295	1,009	0	113	2,318
Broad River Basin	Vineyard	195	0	362	0	0	557
	Mountainside	233	472	0	53	0	758
	*Broad River rt. Bank	0	0	1,265	0	22	1,287
	*Broad River lt. bank	0	0	1,172	0	132	1,304
	Sub-total	428	472	2,799	53	154	3,906
Black River, M.R.Q. bank	Luana. Baptist	328	46	148	0	0	522
	*M.Q.R. rt. bank	0	0	0	594	70	664
	*Black River Estuary	0	0	0	1,067	388	1,455
	Sub-total	328	46	148	1,661	458	2,641
	Total	3,239	981	4,175	2,100	915	11,410

* Inundated Area

Table D-21 LAND CLASSIFICATION FOR SPECIFIC CROPS IN THE PROJECT AREA

Mapping Unit	Jamaican Map Symbols	Total Hectares	Sugar Cane	Cereal	Legumes	Root Crops	Pasture
1	73	23	$IIIF_1T_2$	$IIIF_1T_2$	IIF_1T_2	$IIIF_1T_2$	$IIIT_2$
2	74	36	$IIIF_1$	$IIIF_1$	$IIIF_1$	$IIIF_1$	IIT_2
3	77	35	$IVDF_{1,2}T_1$	$IVDF_{1,2}T_1$	$IVDF_{1,2}T_1$	$IVDF_{1,2}T_1$	$IVDF_{1,2}T_1$
4	94	46	$IIIF_1P$	$IIIF_1P$	$IIIF_1P$	$IIIF_1P$	IIIP
4v	94v	504	$IVDF_2$	$IVDF_2$	$IVDF_2$	$IVDF_2$	$IIIDF_2$
5	150	49	$IVWF_2S_{1,2}M$	$IVWF_2S_{1,2}M$	$IVWF_2S_{1,2}M$	$IVWF_2S_{1,2}M$	$IVWF_2S_{1,2}M$
6	151	187	IIW_1P	$IIWS_2P$	$IIWS_2P$	$IIWS_2P$	$IIWS_2P$
7	203	1,293	$IIWS_2$	$IIWS_2$	$IIWS_2$	$IIWS_2$	$IIWS_2$
8	204	538	IIS_2W	IIS_2W	IIS_2W	IIS_2W	IIS_2W
9	83	197	IIT_2	IIT_2	IIT_2	IIT_2	IIT_2
10	9	304	$IIIPWS_1$	$IIIPWS_{1,2}$	$IIIPWS_{1,2}$	$IIIPWS_{1,2}$	$IIIPWS_{1,2}$
11	109	304	$IIIW_1S_1$	$IIIWS_1$	$IIIWS_{1,2}$	$IIIW_1S_{1,2}$	$IIIWS_1$

Table D-22 DISTRIBUTION OF SOIL UNITS IN PROJECT AREA

Soil Sub Group	Soil Mapping Unit	Map Symbol	Soil Series (Soil Phase)	Project Area	Area to be Developed			
					Holland	Black River	Broad River	
						Left	Right	Left
Typic Eutrorthox	1	73	Chudleigh clay loam	23	0	0	0	0
〃	9	83	Anglesey clay loam	197	0	0	0	0
〃 -Lithic Ustorthents	1a	73/77*	〃 -Bonnygate clay loam	331	0	0	0	0
Udic Haplustalfs	2	74	Lucky Hill clay loam	36	0	0	0	0
〃 -Lithic Ustorthents	2a	74/77	〃 -Bonnygate clay loam	82	0	0	0	0
Lithic Ustorthents	3	77	Bonnygate clay loam	35	0	0	0	0
〃 -Typic Eutrorthox	3a	77/73	〃 -Chudleigh clay loam	18	0	0	0	0
Typic Quartzipsamments	5	150	Hodges sand	49	0	0	0	0
〃 -Typic Chromusterts	5a	150/204	〃 -Fourpath sandy loam	99	0	0	0	0
Typic Chromusterts	6	151	Cashew clay loam	187	0	22	0	0
〃	6a	151/203	〃 -Fourpath clay	62	0	0	0	0
〃 -Typic Chromuderts	12	151/94v	Cashew clay loam - Carron Hall clay	48	0	0	0	0
〃	7	203	Fourpath clay	1,293	107	124	0	0
〃	7a	203/151	〃 -Cashew clay loam	24	0	0	0	0
〃	13	203/94v	Fourpath - Carron Hall clay extremely rocky	67	0	0	0	0
〃	8	204	Fourpath sandy loam	537	0	0	0	0
〃 -Typic Quartzipsamments	8a	204/150	〃 -Hodges sand	130	0	0	0	0
〃	11	109	Holland clay	304	204	0	0	0
〃	4	94	Carron Hall clay loam - extremely rocky	46	0	0	0	0
〃	4v	94v	Carron Hall clay loam	504	0	0	0	0
Aquic Halpludolls	10	9	Wellen clay	304	170	0	0	0
〃 -Hemic Troposaprists	10a	9/Hla	〃 -Broad River Peat	86	86	0	0	0
Aeric Tropaquepts	14	I2	Black River clay	463	51	200	0	0
Hemic Troposaprists	15	Hla	Broad River peat	2,035	62	450	604	467
Hydric Tropohemists	16	Hlb	Morass Peat - high decomposition phase	1,488	0	298	396	533
Hydric Tropofibrists	16a	Hlc	〃 -low decomposition phase	903	0	0	0	0
Typic Sulfihemists	16b	Hls	〃 -sulfidic phase	1,144	0	0	0	0
	Forest			915	0	106	0	0
	Town			40	0	0	0	0
			Total	11,450	680	1,200	1,000	1,000

*73/77 : This symbol shows the complex soil type. The area occupies two third by the former(73)and one third by the latter(77).

Table D-23 DISTRIBUTION OF LAND CAPABILITY CLASSES FOR RICE CULTURE IN PROJECT AREA

(Unit: ha)

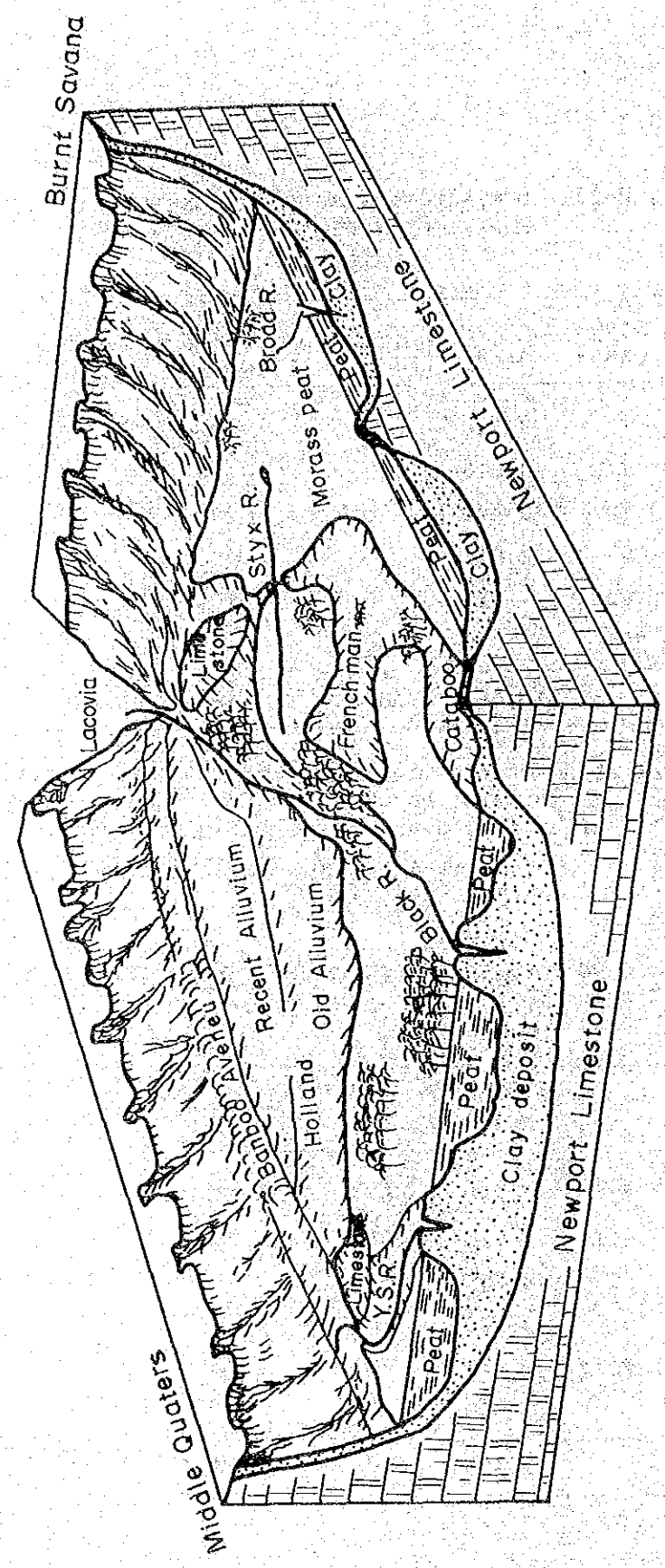
Land Capability	Land Class	Project Area	Area to be Developed				Total
			Holland Estate	Black River Left	Broad River Right	Broad River Left	
Suitable	II	3,240	567	146	0	0	713
"	III	3,016	113	650	604	467	1,834
Marginal	IV	2,144	0	298	396	533	1,227
Unsuitable	V	2,095	0	0	0	0	0
" (Forest)	VIII	915	0	106 1/	0	0	106
Town		40	0	0	0	0	0
Total		11,450	680	1,200	1,000	1,000	3,880

Remarks: 1/: Land of this forest consists of mainly mineral soils. Land class therefore would be changed to class III/IV after drainage improvement and clearing.

Table D-24 DISTRIBUTION OF LAND CAPABILITY CLASSES FOR UPLAND CROPS IN PROJECT AREA

(Unit: ha)

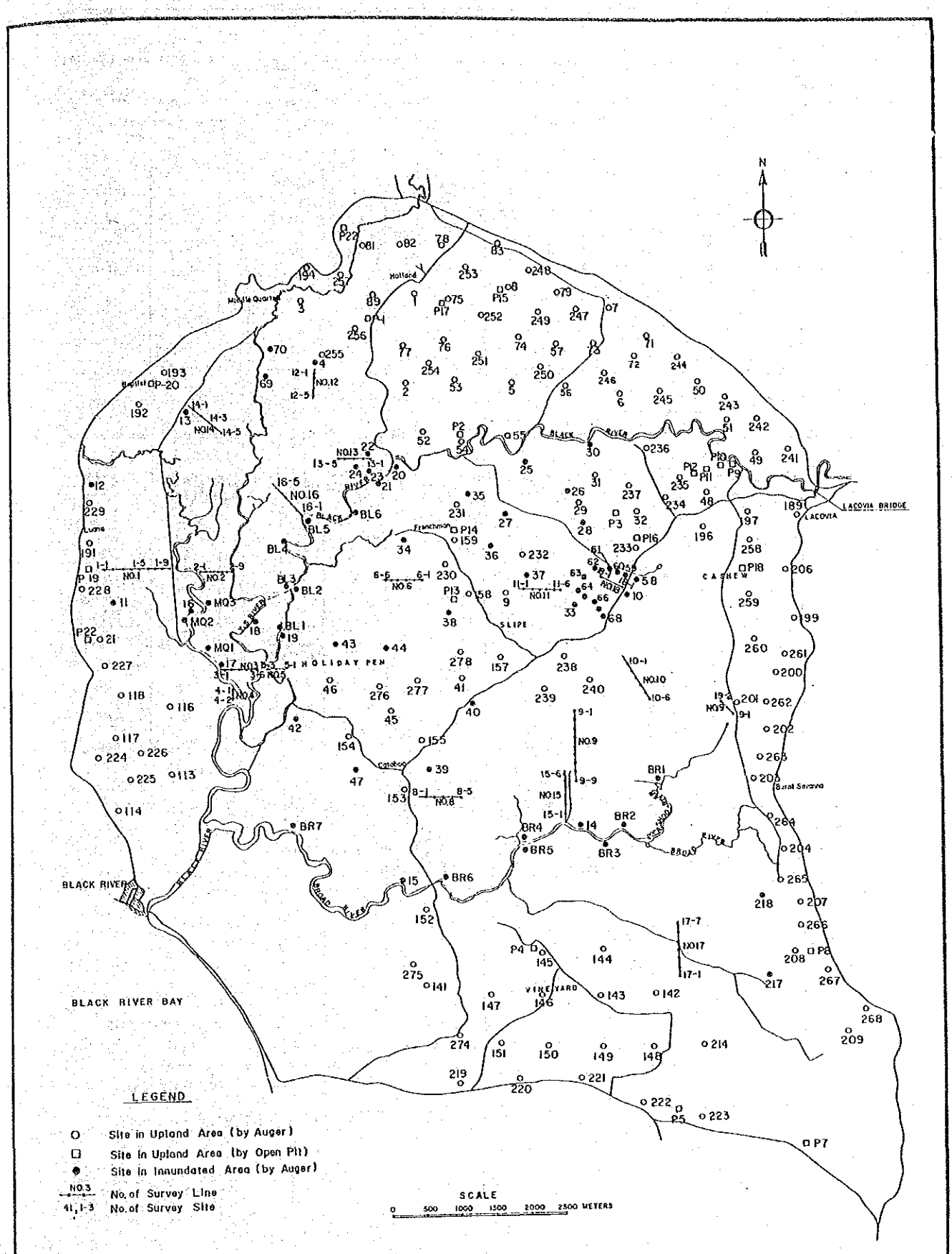
Land Capability	Land Class	Project Area	Area to be Developed				Total
			Holland	Black River Left	Broad River Right	Broad River Left	
Suitable	II	3,240	567	146	0	0	713
"	III	920	51	200	0	0	251
Marginal	IV	4,235	62	450	604	467	1,583
Unsuitable	V	2,100	0	298	396	533	1,227
" (Forest)	VIII	915	0	106	0	0	106
Town		40	0	0	0	0	0
Total		11,450	680	1,200	1,000	1,000	3,880



BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-1 LANDSCAPE OF LOWER MORASS

JAPAN INTERNATIONAL COOPERATION AGENCY

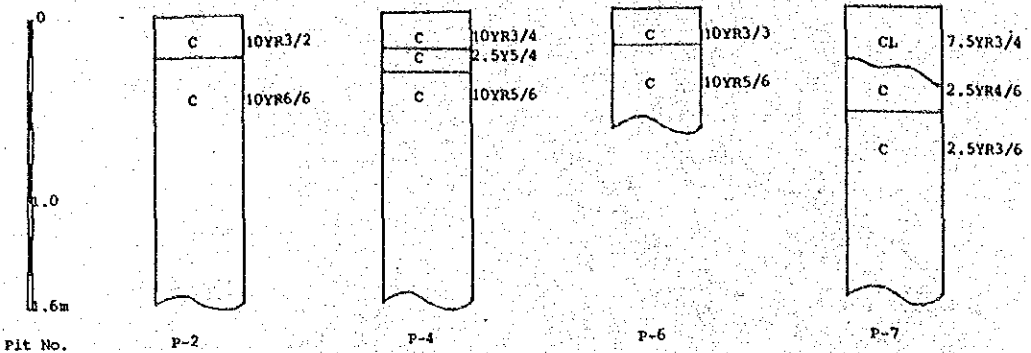


BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-2 SOIL SURVEY SITES IN THE PROJECT AREA

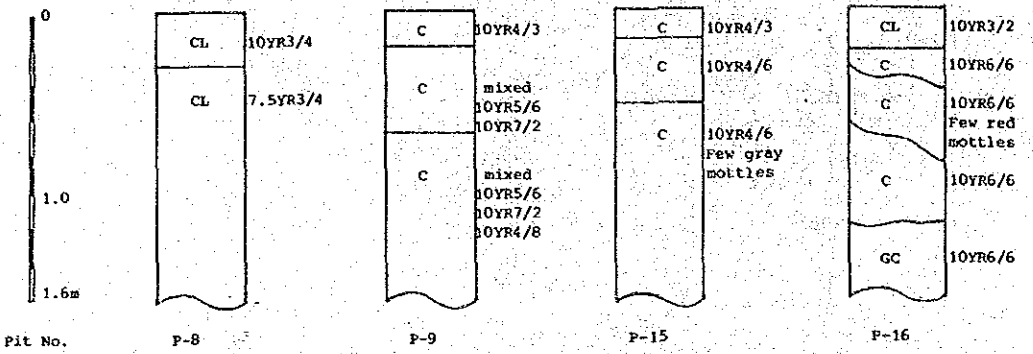
JAPAN INTERNATIONAL COOPERATION AGENCY

Soil name :	WALLENS clay #9	CARRON HALL clay #94	CARRON HALL clay extremely rocky complex #94V	LUCKY HILL clay loam #74
Location :	Holland Estate	Vineyard	Vineyard	Exeter
Land form :	Lower part of nealy level plain	Flat	Flat hills over limestone	Foot slope of hills
Land use :	Suger cane	Pasture	Pasture	Mixed cultivation



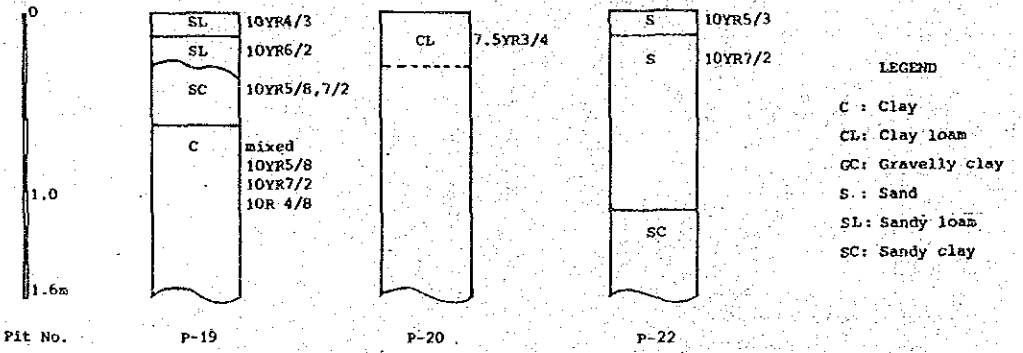
Pit No. P-2 P-4 P-6 P-7

Soil name :	CRUDLEIGH clay loam #73	FOUR PATH clay #203	HOLLAND clay #109	CASHEW clay loam #151
Location :	Irlington	Hatfield	Holland Estate	Hatfield
Land form :	Side slope of hills	Elevated part of nealy level plain	Lower slope of nealy level plain	Lower part of the Plain near swamp
Land use :	Pasture	Pasture/acasia	Suger cane	Pasture/acasia



Pit No. P-8 P-9 P-15 P-16

Soil name :	FOUR PATH sandy loam #204	ANGLESEY clay loam #83	BODGES sand #150
Location :	Luana	Baptist	Luana
Land form :	Gently undulating Plain	Lower slope towards Swamp	Very gently undulating Plain
Land use :	Pasture/mixed trees	Pasture	Pasture



Pit No. P-19 P-20 P-22

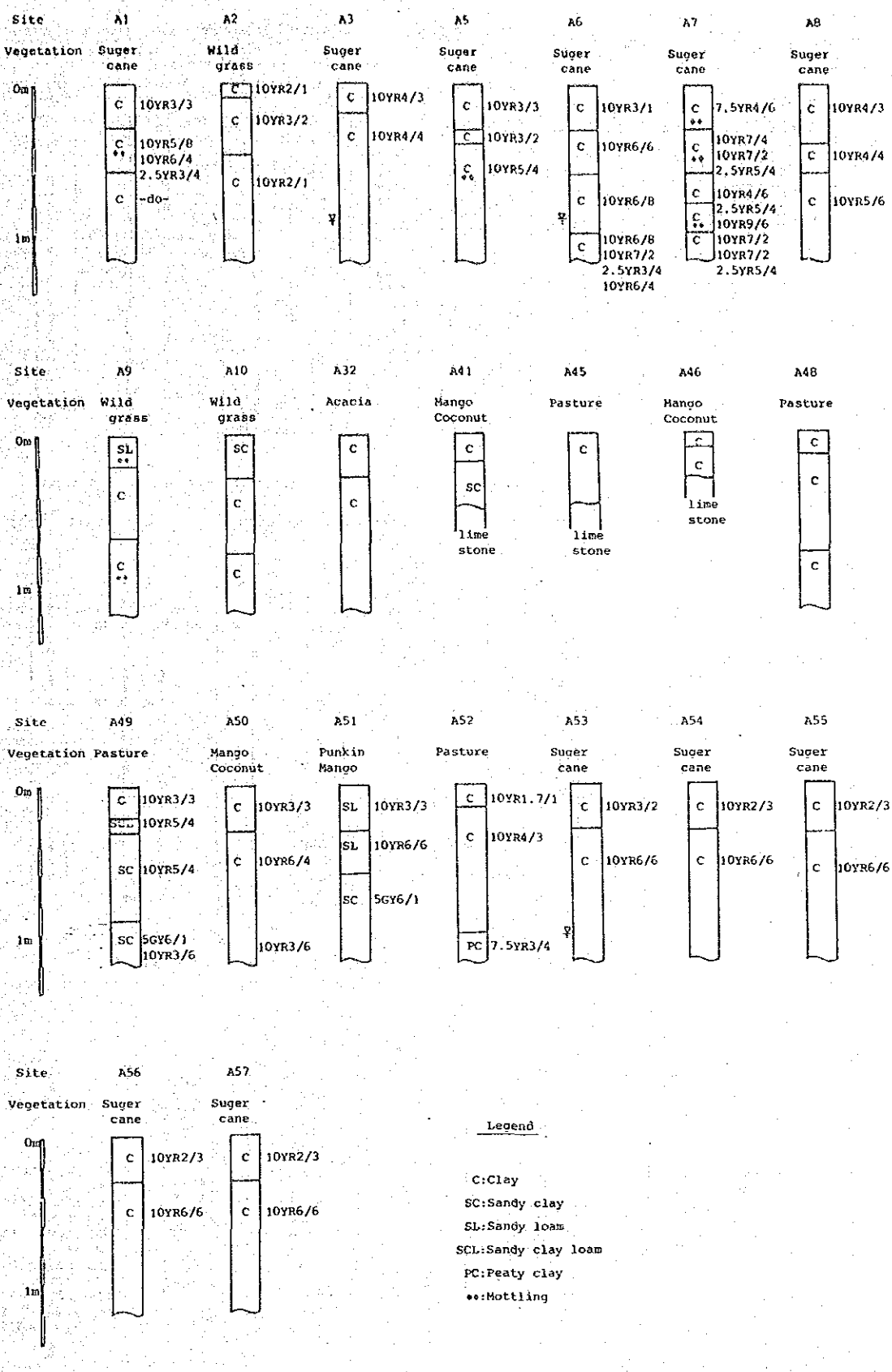
LEGEND

C : Clay
CL: Clay loam
GC: Gravelly clay
S. : Sand
SL: Sandy loam
SC: Sandy clay

BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-3 SOIL PROFILE (OPEN PIT) DIAGRAM IN UPLAND AREA

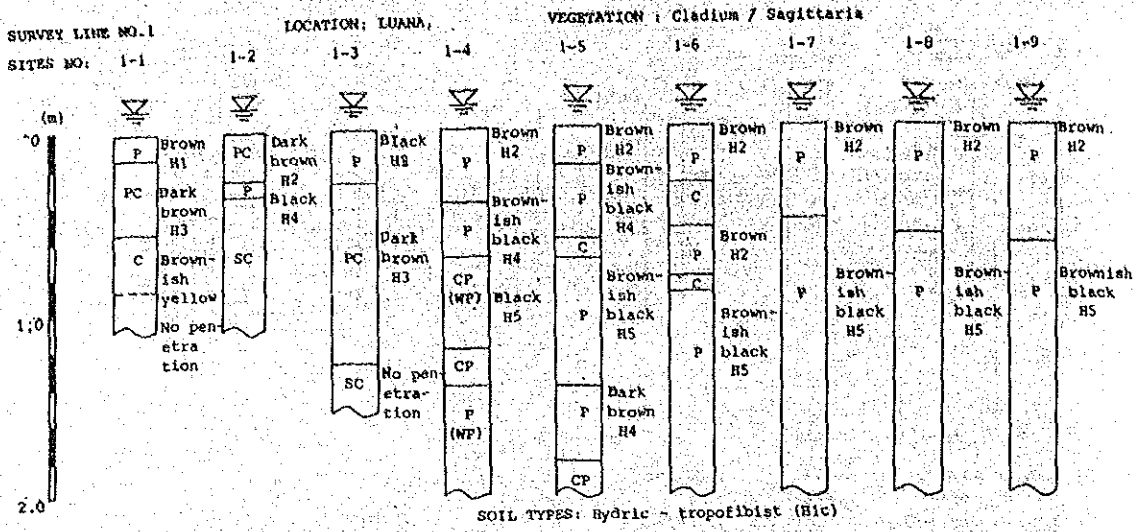
JAPAN INTERNATIONAL COOPERATION AGENCY

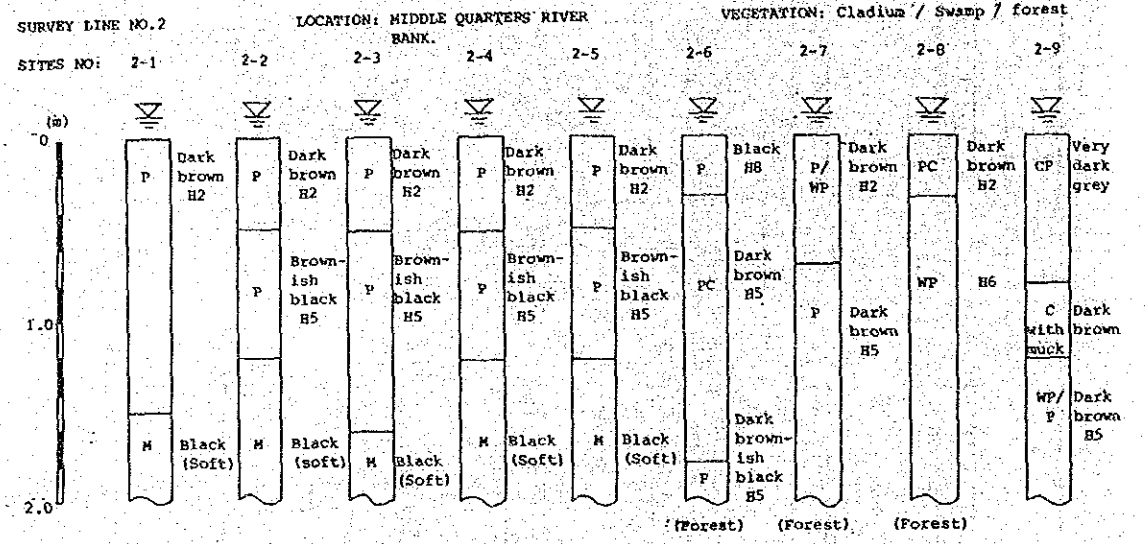


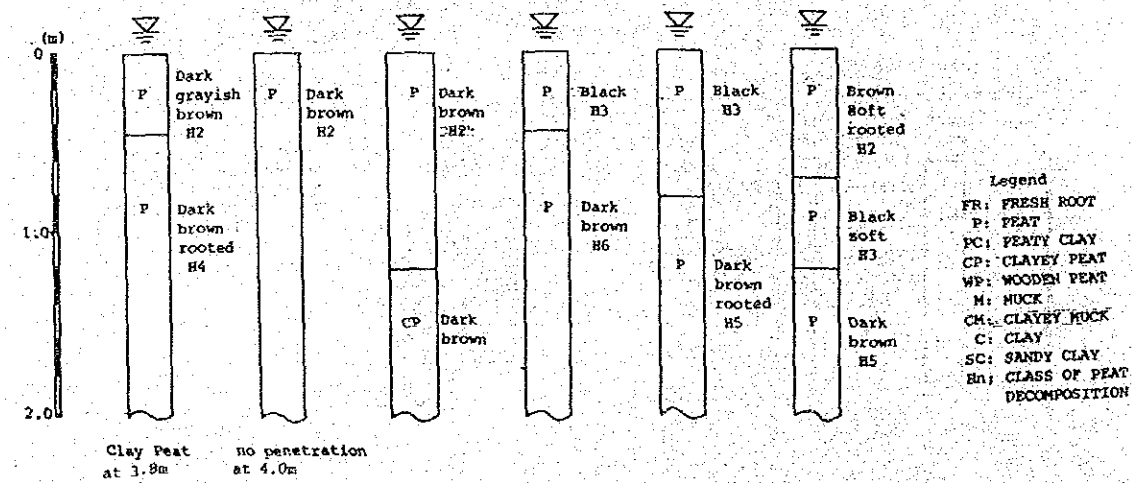
BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-4 SOIL COLUMN DIAGRAM IN UPLAND AREA

JAPAN INTERNATIONAL COOPERATION AGENCY







BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-5 (5/1) SOIL PROFILE DIAGRAM OF PEAT SOILS

JAPAN INTERNATIONAL COOPERATION AGENCY

SURVEY LINE NO.4 LOCATION: MIDDLE QUARTER RIVER BANK,
VEGETATION: Cladium/Sagittaria

SITES NO: 4-1 4-2

(m) 0 1.0 2.0

4-1: P Brownish black H3; P Black H5

4-2: P Brownish black H3; C Olive brown

SURVEY LINE NO.5 LOCATION: HOLIDAY PEN
VEGETATION: Swamp forest

SITES NO: 5-1 5-2 5-3

(m) 0 1.0 2.0

5-1: C Grayish brown; C/P Black H2; P/WP Brownish black soft H4; P Black H5; WP Dark Brown H5

5-2: P Brownish black H2; WP Dark brown rooted H3; P Brownish black H4

5-3: P Brownish black H2; P Black H5

SURVEY LINE NO.6 LOCATION: FRENCHMANS VEGETATION: Cladium / conocarpus

SITES NO: 6-1 6-2 6-3 6-4 6-5 6-6

(m) 0 1.0 2.0

6-1: CP Black; SC Dark grayish yellow

6-2: P Brownish black H6; P Brownish black; P Brownish black H6

6-3: P Brownish black H6; P Brownish black H8

Clay at 3.50 m

6-4: P Brownish black H6; P Brownish black H7

Clay at 2.0 m

6-5: P Brownish black H6; P Brownish black H7

Clay at 4.0 m

6-6: P Brownish black H6; CP Black; WP/P Dark brown H6

Clay at 4.5 m

SOIL TYPES: Hemic-troposaprist (Hia)

SURVEY LINE NO. 8 LOCATION: CATABOO VEGETATION: Typha Hummok

SITES NO: 8-1 8-2 8-3 8-4 8-5

(m) 0 1.0 2.0

8-1: P Brownish black H4; C Olive brown

8-2: P Dark brown H2; P Brownish black H5; P Black H6; P Brownish black H5

Clay at 2.80 m

8-3: P Dark brown H2; P Black H6; P (WP) Brownish black H5

Clay at 3.50 m

8-4: P Dark brown H2; P Black H6; P (WP) Brownish black H5

Clay at 2.90 m

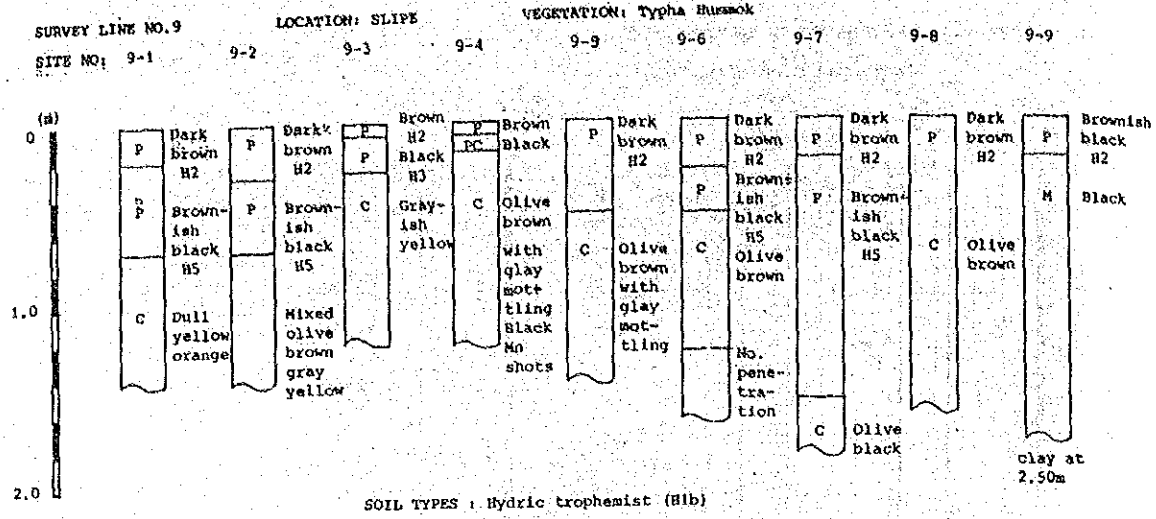
8-5: P Dark brown H2; P Brownish black to black H5; P (WP) Brownish black H5

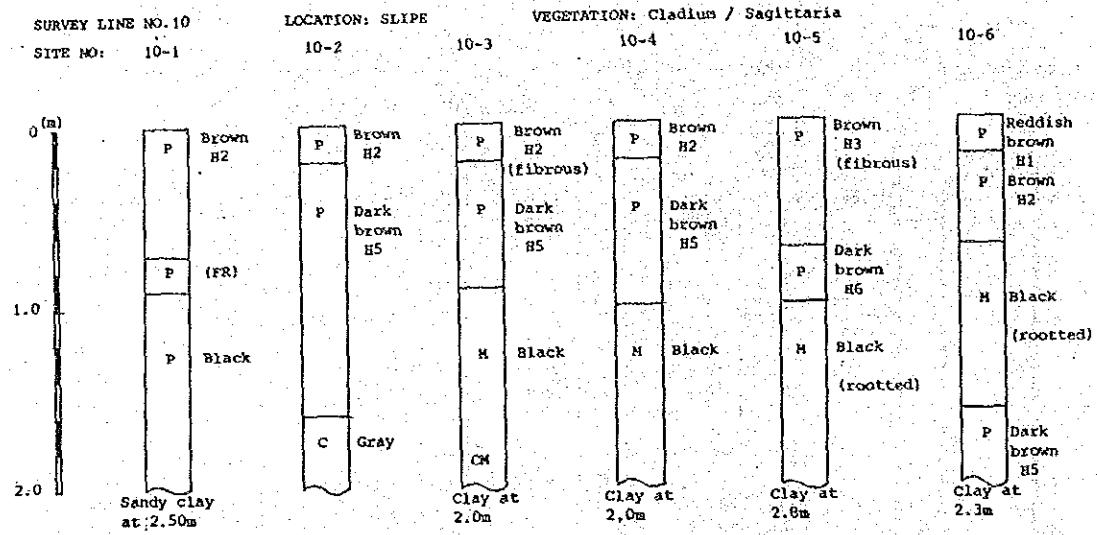
Clay at 2.50 m

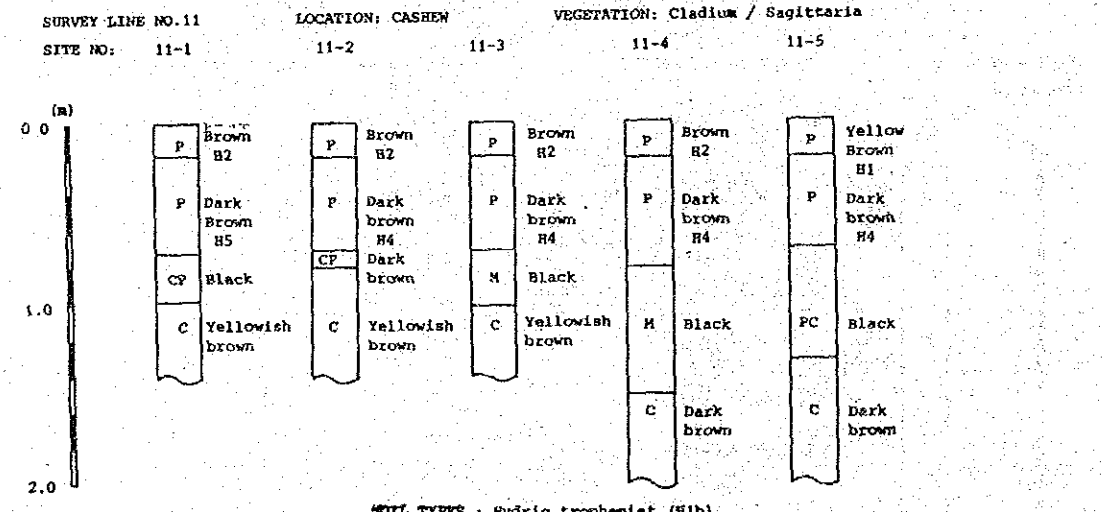
BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-5 (5/2) SOIL PROFILE DIAGRAM OF PEAT SOILS

JAPAN INTERNATIONAL COOPERATION AGENCY







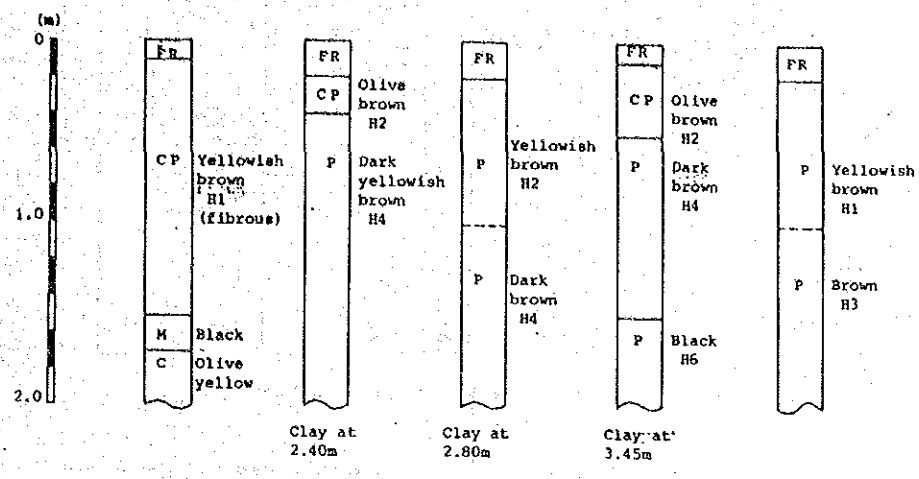
BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-5 (5/3) SOIL PROFILE DIAGRAM OF PEAT SOILS

JAPAN INTERNATIONAL COOPERATION AGENCY

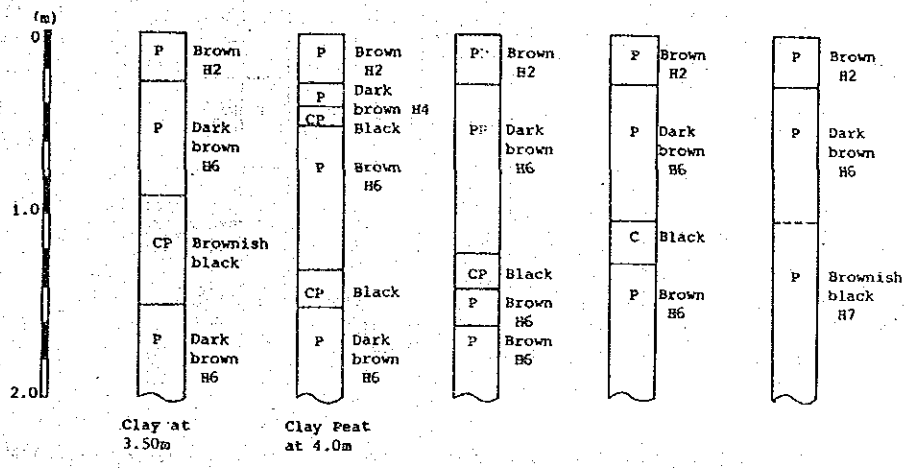
SURVEY LINE NO: 12 LOCATION : Y.S. RIVER BANK VEGETATION : Typha Hummok

SYTES NO: 12-1 12-2 12-3 12-4 12-5



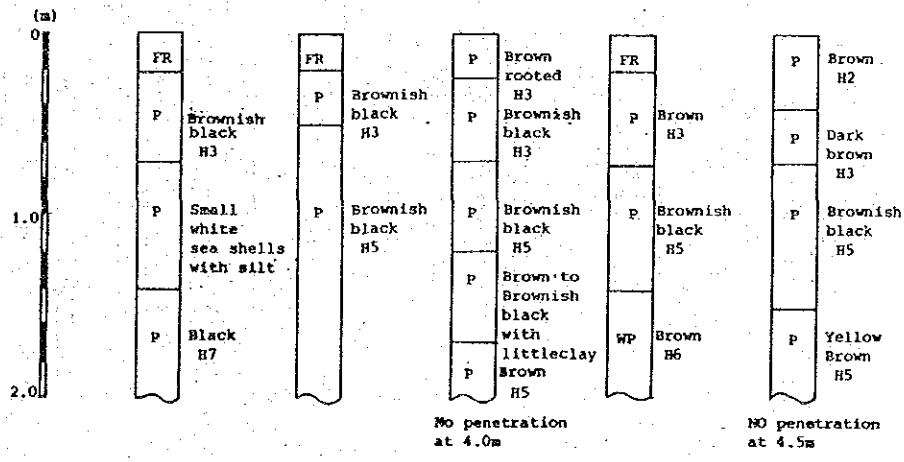
SURVEY LINE NO:13 LOCATION : HOLLAND VEGETATION : Typha Hummok

SYTES NO: 13-1 13-2 13-3 13-4 13-5



SURVEY LINE NO: 14 LOCATION : BAPTIST VEGETATION : Thick Cladium

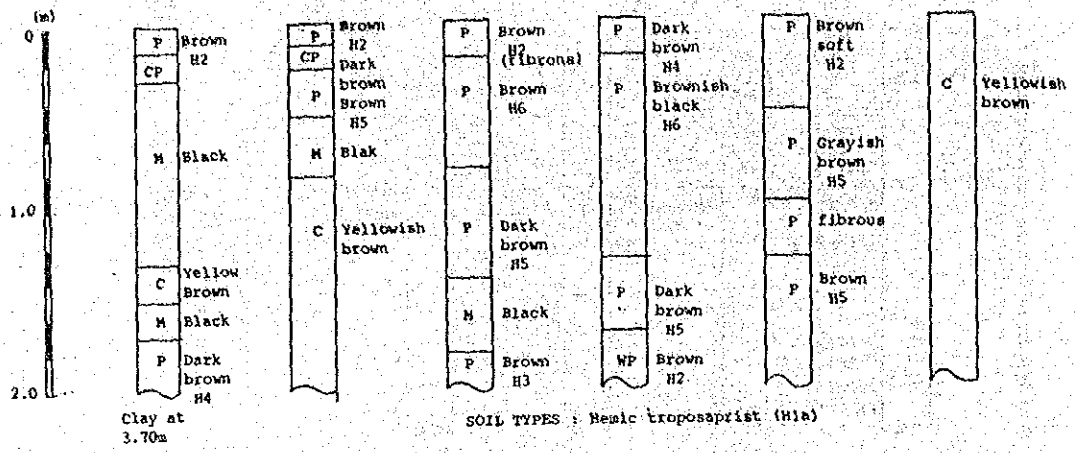
SYTES NO: 14-1 14-2 14-3 14-4 14-5

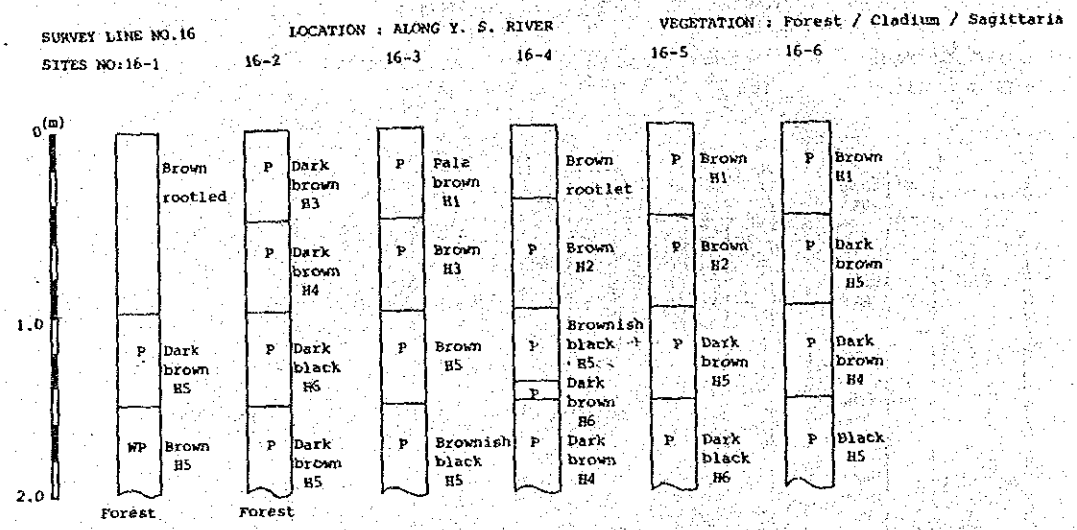


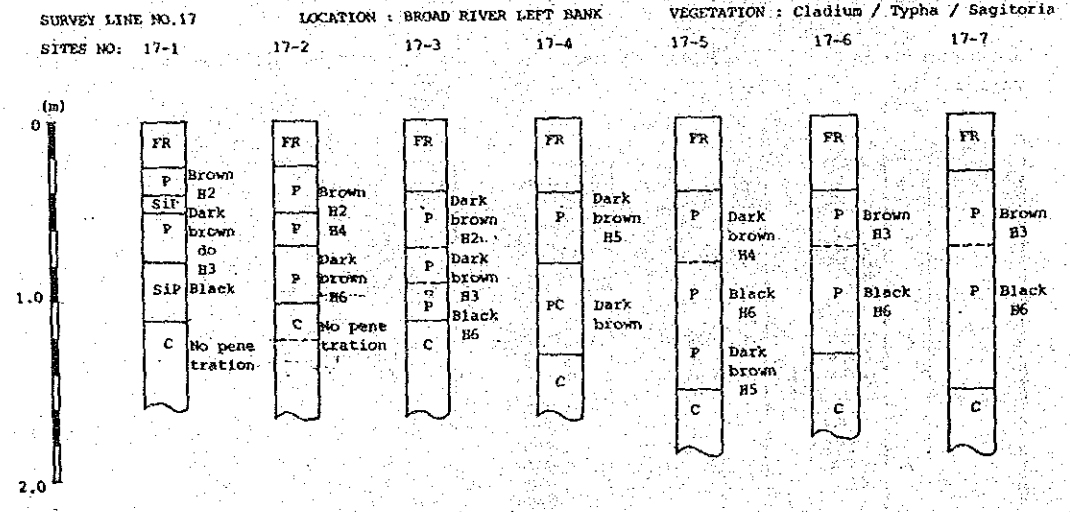
BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-5 (5/4) SOIL PROFILE DIAGRAM OF PEAT SOILS

JAPAN INTERNATIONAL COOPERATION AGENCY



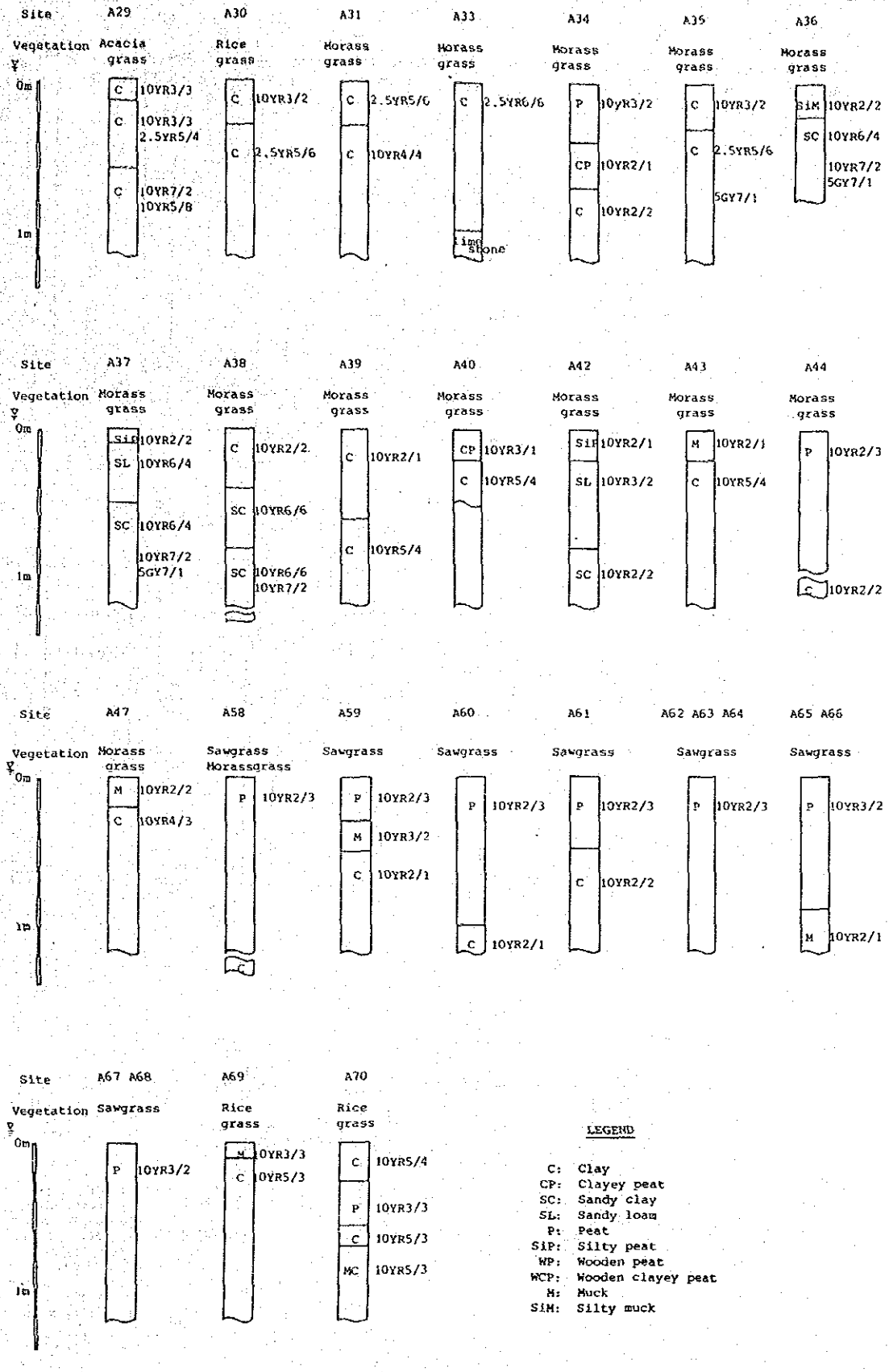




BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-5 (5/5) SOIL PROFILE DIAGRAM OF PEAT SOILS

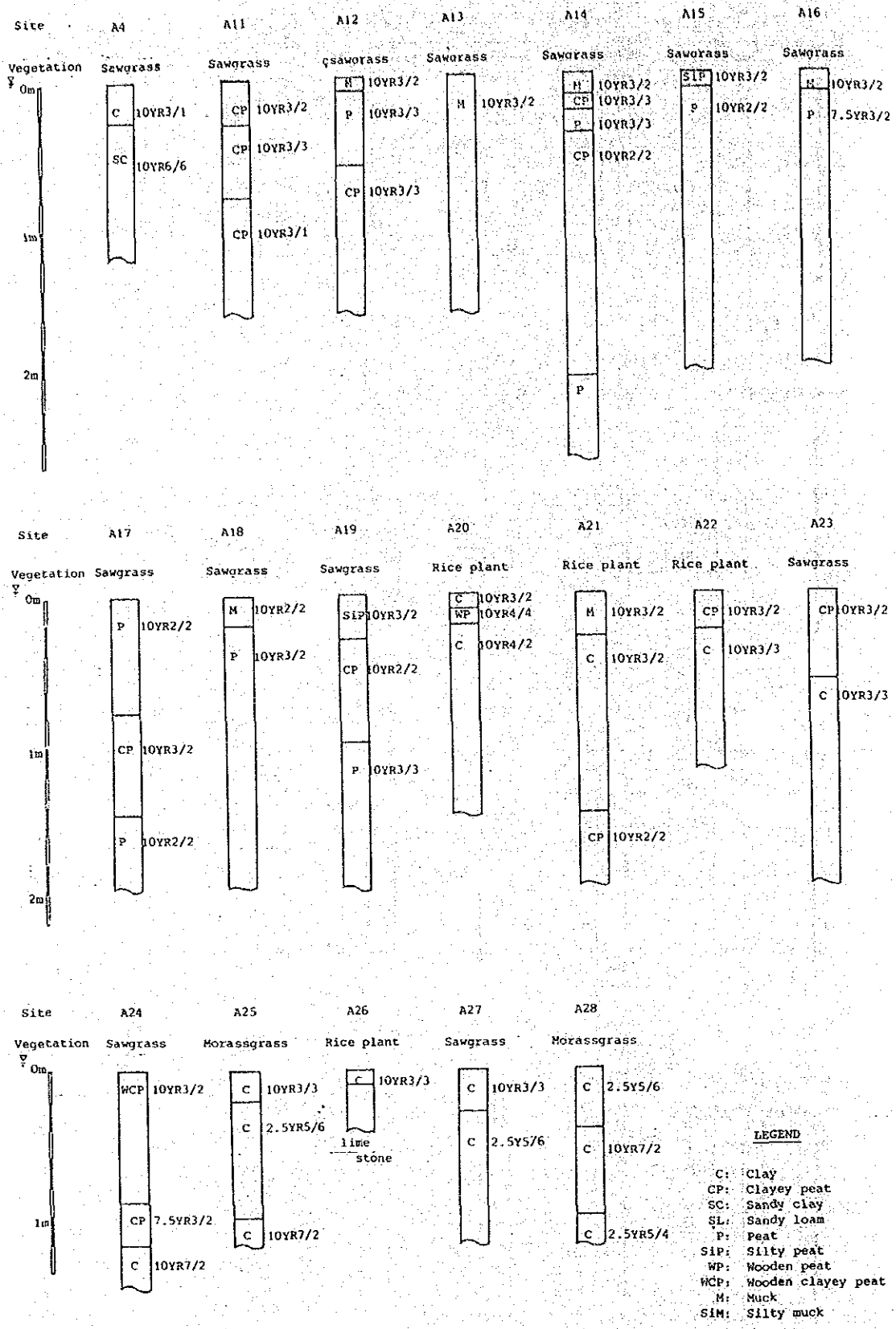
JAPAN INTERNATIONAL COOPERATION AGENCY



BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-6 (6/1) SOIL COLUMN DIAGRAM IN INUNDATED AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

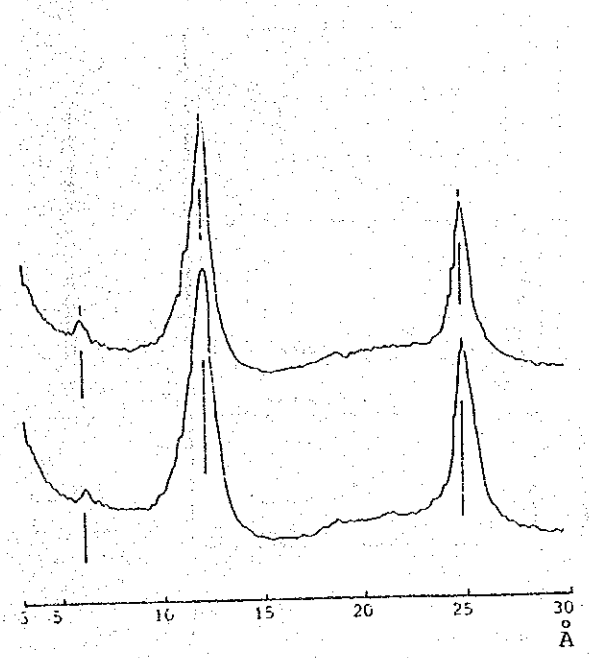


BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

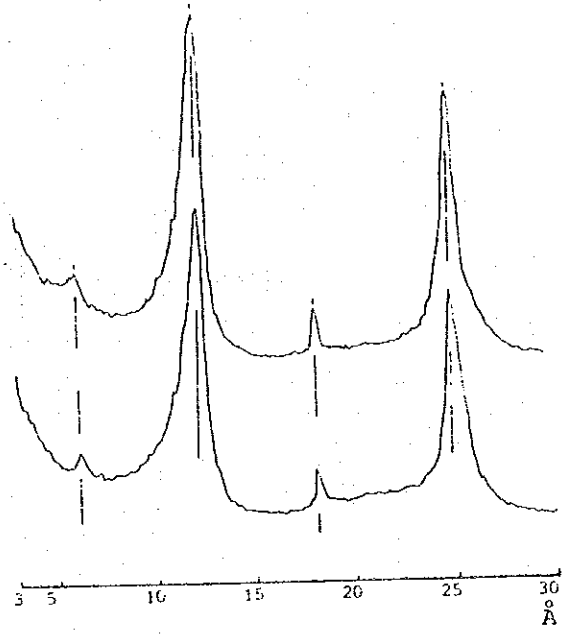
Fig. D-6 (6/2) SOIL COLUMN DIAGRAM IN INUNDATED AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

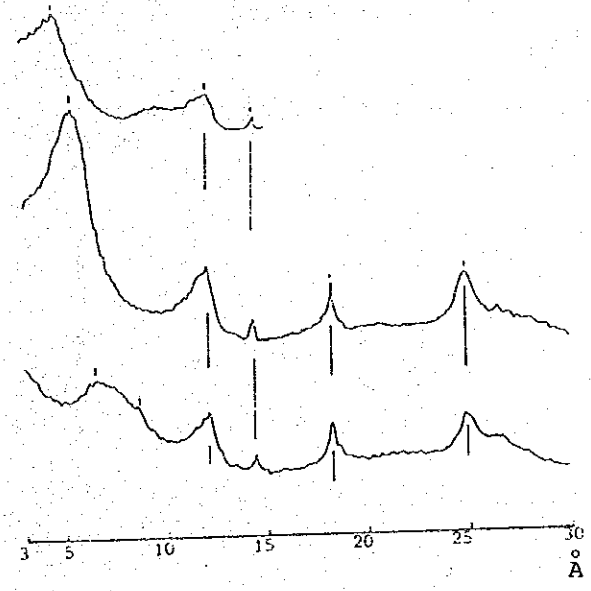
Four Path clay (#203)



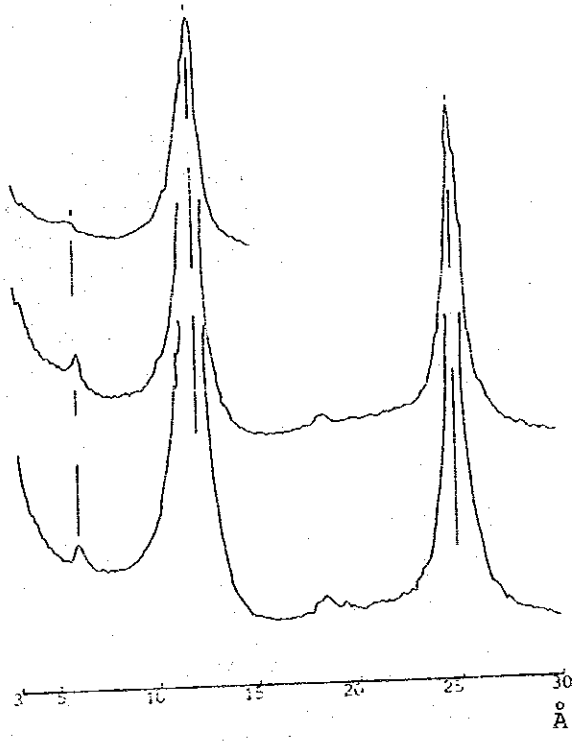
Four Path sandy loam (#204)



Wallerns clay (#9)



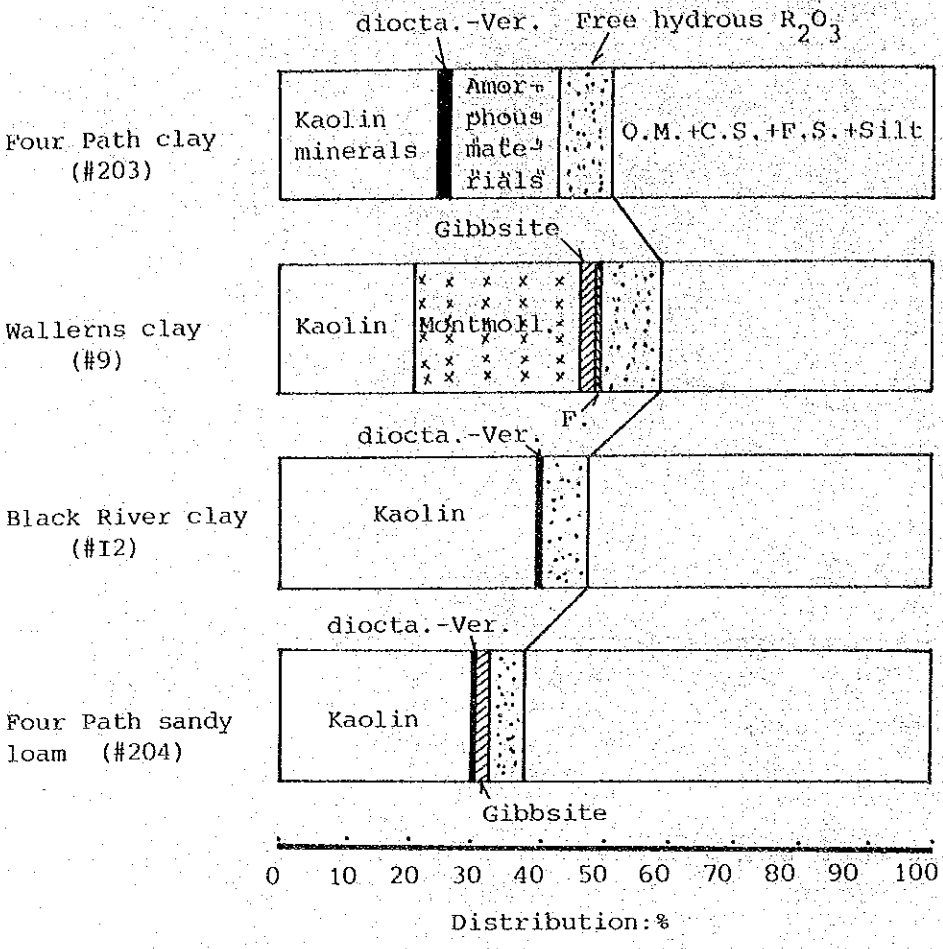
Black River clay (#I2)



BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-7 X-RAY DIFFRACTION PATTERNS

JAPAN INTERNATIONAL COOPERATION AGENCY



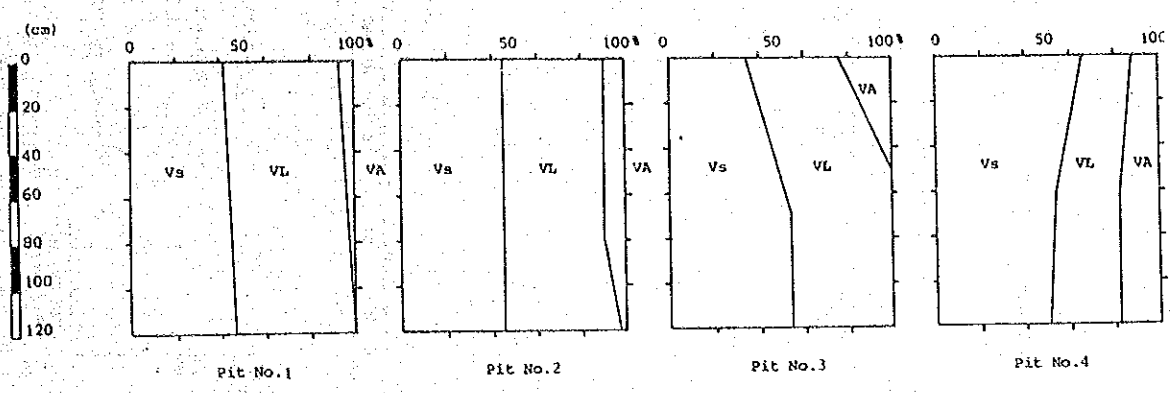
Notes: diocta.-Ver.=dioctahedral vermicullite
O.M.=organic matter
F.S.=fine sand
Free hydrous R_2O_3=free hydrous sesquioxides
F.=feldspars
Montmoll.=montomorillonite
C.S.=coarse sand

BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

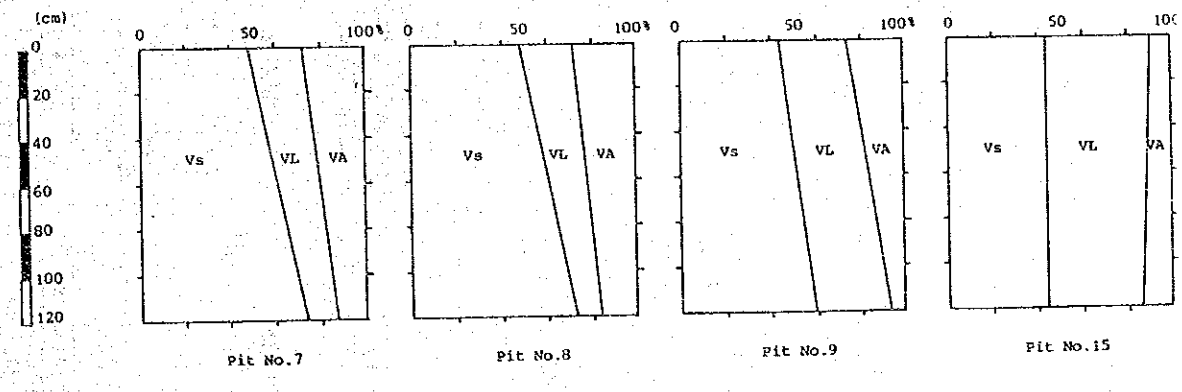
Fig. D-8 CLAY MINERAL COMPOSITION OF TYPICAL SOILS IN THE PROJECT AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

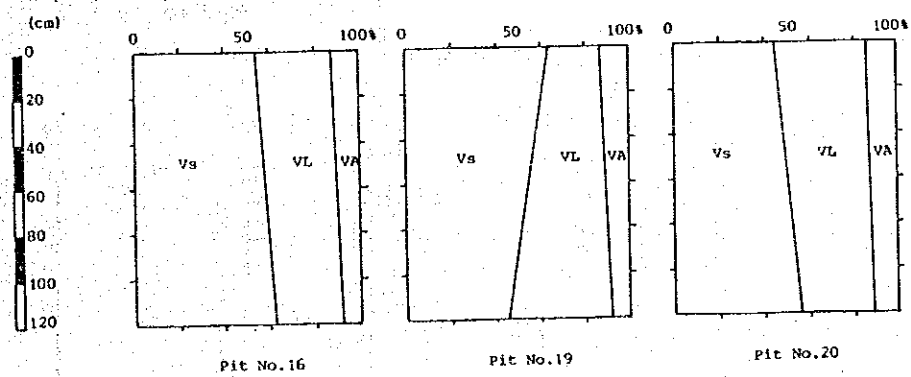
LOCATION :	HOLLAND ESTATE	HOLLAND ESTATE ,	HATFIELD	VINEYARD
SOIL TYPES :	FOUR PATH Clay (#203)	WALLEN Clay (#9)	FOUR PATH Clay (#203)	CARRON HALL Clay (#9
BULK DENSITY :	1.30	1.40	1.10	1.55



LOCATION :	EXETER PORT	CASHEW	HATFIELD	HOLLAND ESTATE
SOIL TYPES :	LUCKY HILL Clay loam (#74)	CHUDLEIGH Clay loam (#73)	FOUR PATH Clay (#203)	HOLLAND Clay (#109)
BULK DENSITY :	1.46	1.37	1.28	1.23



LOCATION :	HATFIELD	LUANA	BAPTIST
SOIL TYPES :	CASHEW Clay loam (#151)	FOUR PATH Sady loam (#204)	ANGLESLEY Clay loam (#83)
BULK DENSITY :	1.44	1.51	1.31



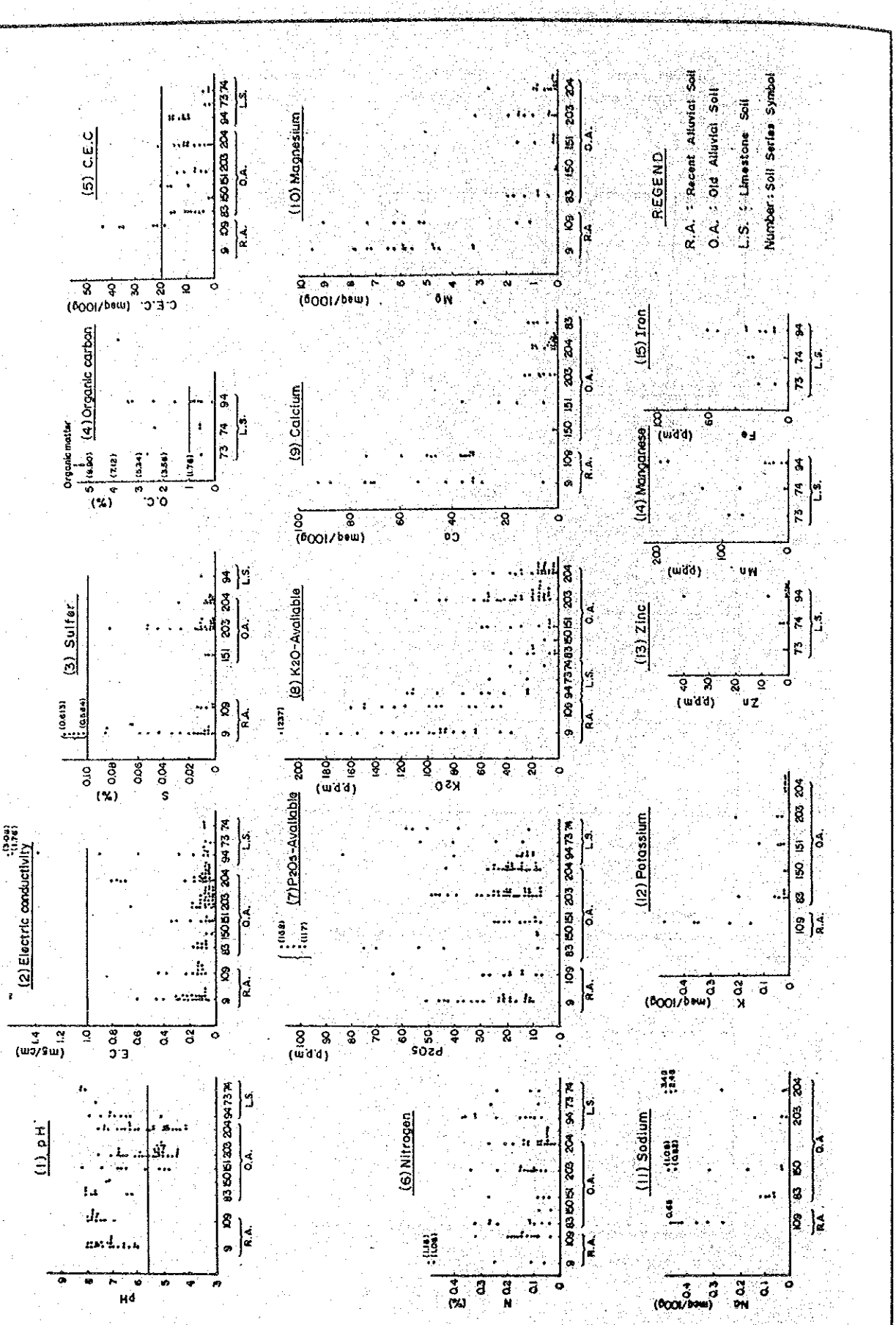
LEGEND

Vs : SOLID PHASE
VL : LIQUID PHASE
VA : AIR PHASE

BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-9 SOIL THREE PHASES IN UPLAND AREA

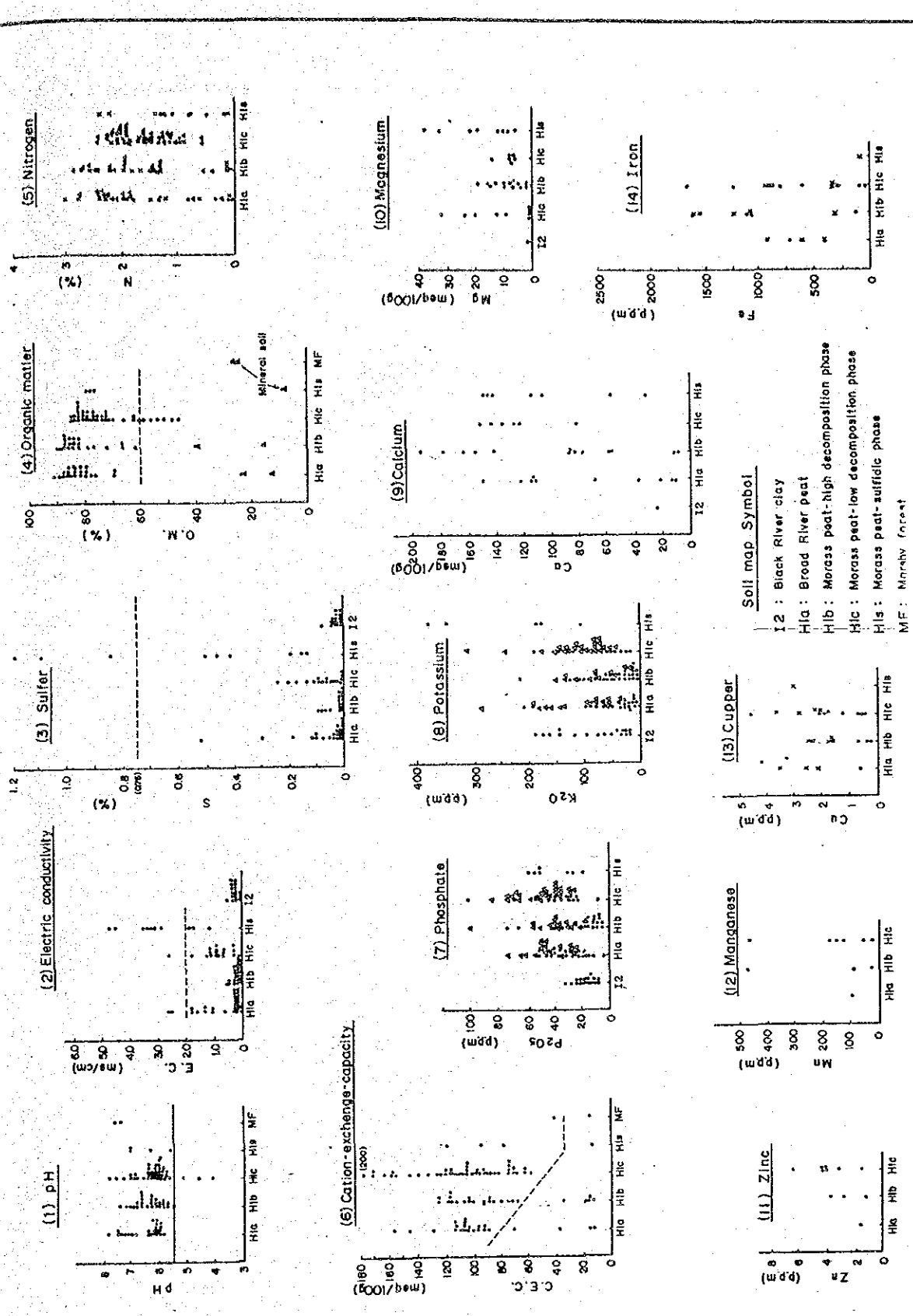
JAPAN INTERNATIONAL COOPERATION AGENCY



BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-10 CHEMICAL PROPERTIES OF MINERAL SOILS

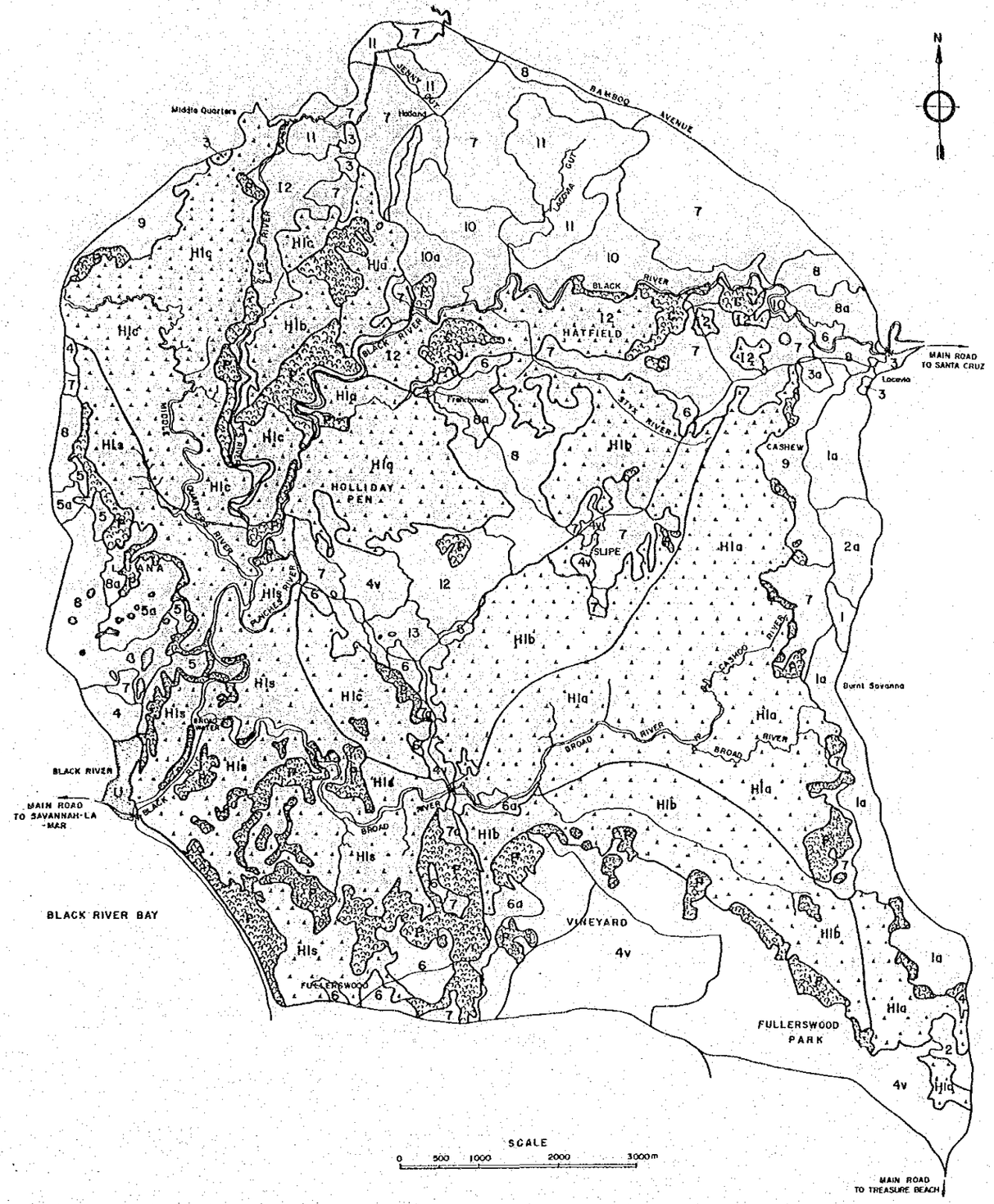
JAPAN INTERNATIONAL COOPERATION AGENCY



BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-11 CHEMICAL PROPERTIES OF PEAT SOILS

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

	SOIL BOUNDARY		POND
	ROAD		BRIDGE
	RIVER	U	URBAN AREA
12	SOIL TYPE	C	MARSHY FOREST - CLAY
	SWAMP	P	MARSHY FOREST - PEAT

SOILS LEGEND

UPLAND SOIL

A. HILLS

I. LIMESTONE SOIL

1	Chudleigh clay loam	73	3	Bonnygate stony clay loam	77
1a	Chudleigh clay loam-Bonnygate stony clay loam complex	73/77	3a	Bonnygate stony clay loam-Chudleigh clay loam complex	77/73
2	Lucky Hill clay loam	74	4v	Carron Hall clay loam-extremely rocky complex.	94v
2a	Lucky Hill clay loam-Bonnygate stony clay loam complex	74/77	4	Carron Hall clay	94

B. ALLUVIAL PLAIN

II. OLD ALLUVIAL SOIL

5	Hodges sand	150	7a	Fourpath clay-Cashew clay loam complex	203/151
5a	Hodges sand-Fourpath sandy loam complex.	150/204	8	Fourpath sandy loam	204
6	Cashew clay loam.	151	8a	Fourpath sandy loam-Hodges sand complex.	204/150
6a	Cashew clay loam-Fourpath clay loam.	151/203	9	Anglesey clay loam.	83
7	Fourpath clay	203			

III. RECENT ALLUVIAL SOIL

10	Wallen clay.	9
10a	Wallen clay-Broad River Peat complex.	9/Hla
11	Holland clay.	109

C. ALLUVIAL PLAIN/FLAT HILLS

IV. OLD ALLUVIAL/LIMESTONE SOIL

12	Cashew clay loam-Carron Hall clay extremely rocky complex.	151/94v
13	Fourpath-Carron Hall clay extremely rocky complex.	203/94v

INUNDATED SOIL

D. ALLUVIAL SWAMP

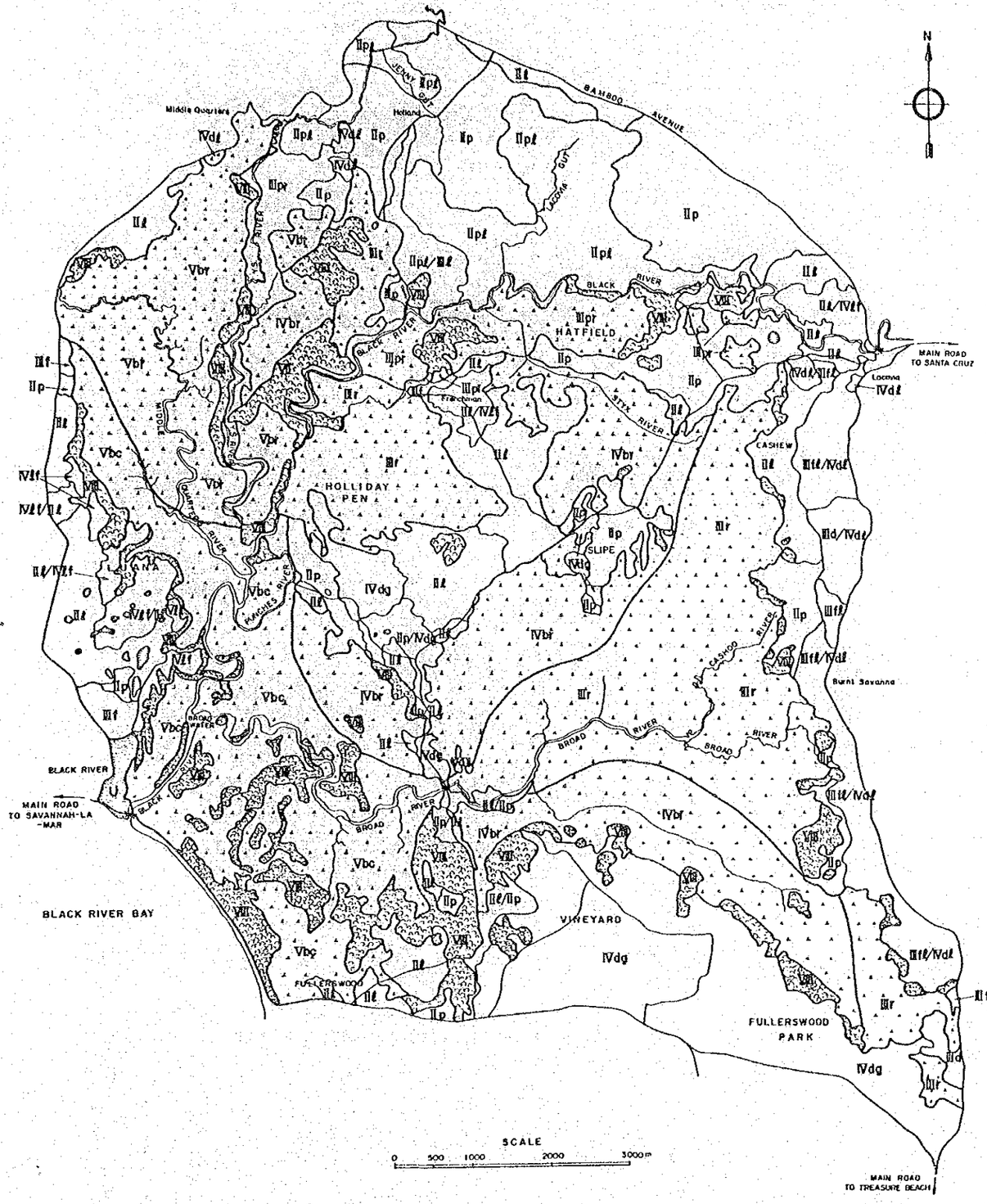
V. RECENT ALLUVIAL SOIL

14	Black River clay.	12
15	Broad River peat.	Hla
16	Morass Peat-high decomposition phase.	Hlb
16a	Morass Peat-low decomposition phase.	Hlc
16b	Morass Peat-sulfidic phase	Hls

BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-12 SOIL MAP

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

- SOIL BOUNDARY
- ROAD
- RIVER
- MANGROVE / FOREST
- SWAMP
- POND
- BRIDGE
- U — URBAN AREA
- IIIrp — LAND CAPABILITY CLASSES FOR RICE

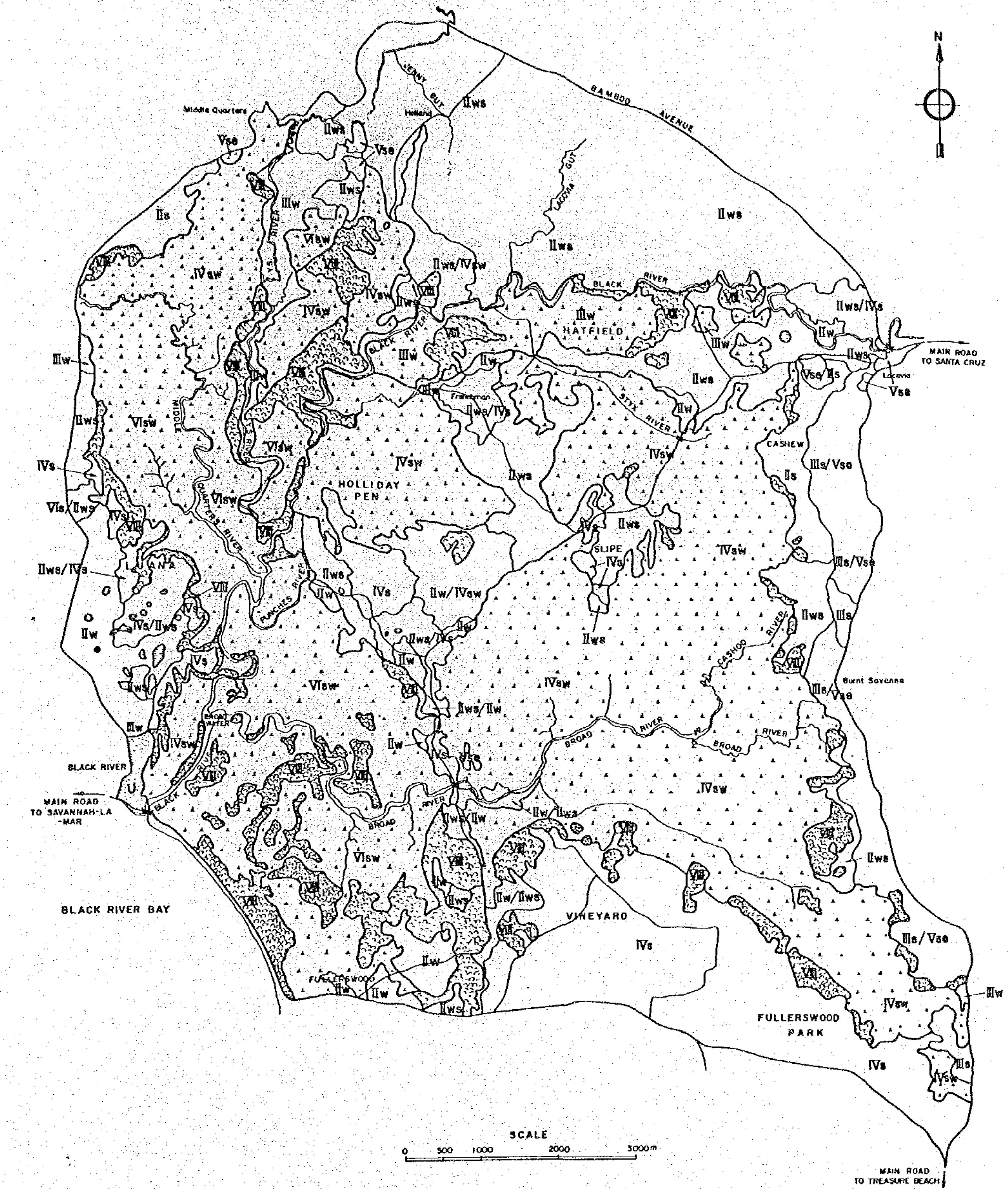
LAND CAPABILITY CLASSES FOR RICE CULTURE

- IIℓ — Land suitable for cultivation with moderate limitation. Leaking of logged water is the main limitation to its use.
- IIp — Land suitable for cultivation with moderate limitation. Difficult proughing of soil is the main limitation to its use.
- IIpℓ — Land suitable for ultivation with moderate limitation. Leaking and difficult plowing of soil are the chief limitation to its use.
- IIId — *Land suitable for cultivation with strong limitation, imposed by* shallow effective soil depth.
- IIIf — Land suitable for cultivation with strong limitation, imposed by adverse soil fertility.
- IIIℓℓ — Land suitable for cultivation with strong limitations, imposed by poor soil fertility and leaking of logged water.
- IIIpr — Land suitable for cultivation with strong limitations, imposed by ploughing and oxi-reduction of soil.
- IVdℓ — Land marginal for cultivation due to shallow soil depth and extreme leaking of logged water.
- IVdg — Land marginal for cultivation due to shallow soil depth and gravel soil.
- IVℓf — Land marginal for cultivation due to extreme leaking of logged water and low soil fertility.
- IVbr — Land marginal for cultivation due to extremely low bearing capacity and strong oxi-reduction of soil.
- Vbf — Land not suitable for cultivation due to extremely low bearing capacity and strong oxi-reduction of soil.
- Vbc — *Land not suitable for cultivation due to extremely low bearing* capacity and chemical hazards of soils.
- VII — Land not suitable for agriculture due to marshy forest.

BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig.D-13 LAND CAPABILITY MAP FOR RICE CULTURE

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

- SOIL BOUNDARY
- ROAD
- RIVER
- MANGROVE / FOREST
- SWAMP
- POND
- BRIDGE
- U URBAN AREA
- IIw LAND CAPABILITY CLASSES FOR UPLAND CROPS

LAND CAPABILITY CLASSES FOR UPLAND CROPS

IIw	*Land suitable for cultivation with moderate limitations.* Naturally wet land of which drainage is the main limiting factor to its use.
IIs	Land suitable for cultivation with moderate limitations. Soil fertility or other factors are the main limitation to its use.
IIws	Land suitable for cultivation with moderate limitations, imposed by drainage and soil factors.
IIIs	Land suitable for cultivation with strong limitations. Naturally wet *land needing much attention to drainage.*
IIIs	Land suitable for cultivation with strong limitations, imposed by adverse soil factors.
IVs	Land marginal for cultivation due to adverse soil factors.
IVsw	Land marginal for cultivation due to adverse soil factors and poor drainage.
Vse	Land not suitable for cultivation due to extremely low soil fertility and erosion hazards.
VIsw	Land not suitable for cultivation due to extremely adverse soil factors and drainage hazards.
VII	Land not suitable for agriculture due to marshy forest.

BLACK RIVER LOWER MORASS AGRICULTURAL DEVELOPMENT PROJECT

Fig. D-14 LAND CAPABILITY MAP FOR UPLAND CROPS

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX E

SOIL MECHANICS

ANNEX E

SOIL MECHANICS

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ANNEX E

SOIL MECHANICS

1. INTRODUCTION

Field investigation on foundation conditions of the major structures, the construction, materials survey at the quarry sites and borrow pit areas were conducted in two stages, the first survey from the end of June to the end of July in 1984 and the second survey from September to October in 1984. The major work items carried out are shown below.

1) Foundation investigation at major structure sites

   i) core sampling by drilling work,
   ii) standard penetration test at the clay layer and boring stratum,
   iii) cone penetration test,
   iv) permeability test at the site,
   v) vane shear test, and
   vi) laboratory tests in Jamaica

2) Construction material survey

   i) site investigation of borrow pit for embankment materials and quarry site for concrete materials, and
   ii) laboratory tests of embankment materials and concrete materials in Jamaica.

Conclusion

1) The typical soil profile of the project area consists of peat, clayey soil and decomposed limestone in that order from the ground surface. Because of the small bearing capacity of the peat layer the staged construction method is proposed for the construction of the polder dike on the peat ground. Furthermore, it is necessary to allow enough time for the ground consolidation at each construction site.

2) The embankment on the thick peat layer requires large amount of materials for settlement and needs longer construction period. Therefore the development of the thick peat area will be uneconomical. In this study, areas where the thickness of peat is more than 4 meters are to be excluded from the development area.

3) The peat layer can hardly support concrete structures due to its low bearing capacity. Therefore important structures like a pump station will not be constructed on the peat soil. But small structures such as division boxes will be provided on the peat, for which the wooden ladder foundation type is proposed to support small structures.

On the other hand,clayey soil distributed in the upland area has a relatively strong bearing capacity to support concrete structures with shallow foundation.

4) The permeability of peat and clay is so small that the volume of seepage from the outside of the polder dike through to inside project area is expected to be small. Seepage through the underlying decomposed limestone is calculated to be 0.6 l/sec per one kilometer of the dike. This volume is insignificant when comparing with the capacity of the pumps proposed to drain the excessive rainfall and can be ignored.

5) Materials excavated from the drain canal which are mainly peat will be utilized in the construction of the embankment of the polder dikes as well as in roads construction.

6) The slope of the drain canal will be damaged by the excavation of the canal in a short time. Therefore the speed of staged construction for polder dike will be sychronized with that of the excavation of the drain canal. The excavation and embankment are to be made simultaneously by allowing sufficient time for the works.

7) When the peat land is drained it is transformed into a sub-aerial oxygen-rich environment and it is consumed by aerobic microfouna. It is proposed, however, to use the peat soils for paddy cultivation in this project. The soils remain flooded for a long period resulting in a lower rate of decomposition of soils. The oxidation may also be reduced by keeping the peat soils flooded when not being cultivated and by adding the residual rice straws to the surface of the paddy fields.