การทดสอบบดอัดวัสดุ

ชนิดของวัสดุ ดิน โครงการ ส่งเสริมสหกรณ์การเกษตร

ตัวอย่างที่ [illegible] ทดสอบ เปอร์เซ็นต์น้ำ

ปริมาณของตัวอย่าง ลบ.ซม. วันที่ทดสอบ 17 / 12 / 26

ทดสอบครั้งที่		1		2		3		4		5	
น.วัสดุ + ภาชนะ	(กรัม)										
น.ภาชนะ	(กรัม)										
น.วัสดุชื้น	กรัม										
ความแน่นวัสดุชื้น	กรัม/ลบ.ซม										
หมายเลขภาชนะ		126	35	233	89						
น.วัสดุชื้น + ภาชนะ	กรัม	39.68	145.6	125.0	131.63						
น.วัสดุแห้ง + ภาชนะ	กรัม	22.50	27.85	110.08	16.41						
น.น้ำ	กรัม	17.18	17.79	14.92	15.24						
น.ภาชนะ	กรัม	24.55	28.14	24.57	24.67						
น.วัสดุแห้ง	กรัม	97.95	103.71	85.51	91.74						
เปอร์เซ็นต์ความชื้น Water content	%	17.54	17.15	17.45	16.61						
เปอร์เซ็นต์ความชื้นเฉลี่ย Mean Water Content	%	17.35		17.03							
ความแน่นวัสดุแห้ง	กรัม/ลบ.ซม.										

หมายเหตุ

ได้ชำระเงินค่าทดสอบวัสดุครบถ้วนถูกต้องแล้ว
ลงชื่อ [illegible] หัวหน้าโครงการ

ผู้ทดสอบ

วิศวกร/นายช่างผู้ควบคุม

หัวหน้างานวิเคราะห์

21 / ธ.ค. / 26

แบบฟอร์ม วส. 11
ฝ่ายสำรวจออกแบบ
ศูนย์ฯ รพช. นครราชสีมา
23 มี.ค. 27

การทดสอบบดอัดวัสดุ

ชนิดของวัสดุ กิน โครงการ ส่งเสริมสหกรณ์การเกษตร

ตัวอย่างที่ PIL-3-2 ทดสอบ เปอร์เซ็นต์น้ำ

ปริมาณของตัวอย่าง ลบ.ซม. วันที่ทดสอบ 17 / 12 / 2?

ทดสอบครั้งที่	1		2		3		4		5	
น.น.วัสดุ + ภาชนะ (กรัม)										
น.น.ภาชนะ (กรัม)										
น.น.วัสดุชื้น กรัม										
ความแน่นวัสดุชื้น กรัม/ลบ.ซม										
หมายเลขภาชนะ	179	1[illegible]5	39	105						
น.น.วัสดุชื้น + ภาชนะ กรัม	107.1	102.4	122.2	107.69						
น.น.วัสดุแห้ง + ภาชนะ กรัม	95.87	91.75	103.8	96.25						
น.น.น้ำ กรัม	11.23	10.71	13.40	11.44						
น.น.ภาชนะ กรัม	24.72	24.91	24.49	24.38						
น.น.วัสดุแห้ง กรัม	71.15	66.84	84.31	71.87						
เปอร์เซ็นต์ความชื้น *Water Conten* %	15.78	16.02	15.89	15.92						
เปอร์เซ็นต์ความชื้นเฉลี่ย *Mean Water Content.* %	15.90		15.91							
ความแน่นวัสดุแห้ง กรัม/ลบ.ซม.										

หมายเหตุ

ได้ชำระเงินค่าทดสอบวัสดุครบถ้วนถูกต้องแล้
ลงชื่อ หัวหน้าฝ่

ผู้ทดสอบ

วิศวกร/นายช่างผู้ควบคุม

หัวหน้างานวิเคราะห์

21 / 12 / 2?

แบบฟอร์ม วส. 11

ฝ่ายสำรวจออกแบบ

ศูนย์ ฯ รพช. นครราชสีมา

23 มี.ค. 27

การทดสอบบดอัดวัสดุ

ชนิดของวัสดุ ดิน โครงการ [illegible]

ตัวอย่างที่ [illegible] ทดสอบ [illegible]

ปริมาณของตัวอย่าง ลบ.ซม. วันที่ทดสอบ 17 / 12 / 2[illegible]

ทดสอบครั้งที่		1		2		3		4		5	
น้ำหนักวัสดุ + ภาชนะ	(กรัม)										
น้ำหนักภาชนะ	(กรัม)										
น้ำหนักวัสดุชื้น	กรัม										
ความหนาแน่นวัสดุชื้น	กรัม/ลบ.ซม										
หมายเลขภาชนะ		71	63	24	10						
น้ำหนักวัสดุชื้น + ภาชนะ	กรัม	127.40	133.45	136.0[illegible]	126.[illegible]						
น้ำหนักวัสดุแห้ง + ภาชนะ	กรัม	112.36	117.93	120.62	111.0[illegible]						
น้ำหนักน้ำ	กรัม	15.04	15.52	15.38	15.00						
น้ำหนักภาชนะ	กรัม	22.60	24.27	24.57	24.80						
น้ำหนักวัสดุแห้ง	กรัม	87.76	93.66	96.05	86.20						
เปอร์เซ็นต์ความชื้น Water Content	%	17.14	16.57	16.01	17.40						
เปอร์เซ็นต์ความชื้นเฉลี่ย Mean Water Content	%	16.86		16.71							
ความหนาแน่นวัสดุแห้ง	กรัม/ลบ.ซม.										

หมายเหตุ

ได้ชำระเงินค่าทดสอบวัสดุครบถ้วนถูกต้องแล้ว
ลงชื่อ [illegible]

ผู้ทดสอบ

[illegible] วิศวกร/นายช่างผู้ควบคุม

[illegible] หัวหน้างานวิเคราะห์

[illegible]

แบบฟอร์ม วส. 11
ฝ่ายสำรวจออกแบบ
ศูนย์ฯ รพช. นครราชสีมา
23 มี.ค. 27

Determination		Pit - 1		Pit - 2		Pit - 3	
		A	B	C	D	E	F
Specimen	Weight m ; g	676	816	666	746	856	756
	Volume V ; cm^3	314.0	399.0	338.7	375.6	357.1	338.7
Wet density ρ_t, m/V (g/cm^3)		2.153	2.409	1.966	1.986	2.397	2.232
Water contents (%)		23.92	26.58	21.94	17.19	15.91	16.79
Dry density; ρ_d (g/cm^3) $\rho_t/(1+w/100)$		1.737	1.903	1.612	1.695	2.068	1.911
Specific gravity ; Gs		2.501	2.501	2.600	2.600	2.488	2.488
Void ratio ; e $(Gs \cdot \rho_w/\rho_d - 1)$		0.490	0.314	0.613	0.537	0.203	0.302
Degree of saturation ; Sr $Gs \cdot w/e$ (%)		-	-	93	84	-	-

Table. - 12 Field Density Test

Table-13 Suitability or soil for banking and foundation

Symbol	Suitability for banking	Compaction	Dry density (t/m^3)	Permeability cm/sec.	Suitability for foundation	Adjustment for permeability
GW	Very good used for pervious zone of bank or dam	Good by tractor, rubber tired roller, steel wheel roller	2.00 ∿ 2.16	$> 10^{-2}$	Good	Cut off wall required
GP	Good used for pervious zone of bank or dam	Good by tractor, rubber tired roller, steel wheel roller	1.84 ∿ 2.00	$> 10^{-2}$	Good	Cut off wall required
GM	Fair not so suitable as impervious zone, but used for impervious core or blanket	Good by close management, by rubber tired roller, sheeps food roller etc.	1.92 ∿ 2.16	10^{-3} ∿ 10^{-6}	Good	Toe trench required ∿ needless
GC	Barely fair used for impervious core	Fair by rubber tired roller, sheeps foot roller	1.84 ∿ 2.08	10^{-6} ∿ 10^{-8}	Good	Needless
SW	Very good used for pervious zone with slope protection	Good by tractor	1.76 ∿ 2.08	$> 10^{-3}$	Good	Upstream blanket, toe drain or drain well required
SP	Fair used for gentle slope banking	Good by tractor	1.60 ∿ 1.92	$> 10^{-3}$	Good-poor according their density	Upstream blanket, toe drain or drain well required
SM	Barely fair not so suitable for impervious zone, used for impervious core or bank	Good careful operation required. by rubber tired roller, sheeps foot roller	1.72 ∿ 2.00	10^{-3} ∿ 10^{-6}	Good-poor according their density	Upstream blanket, toe drain or drain well required
SC	Barely fair used for impervious core of flood protection bank	Fair by sheeps foot roller, rubber tired roller	1.68 ∿ 2.00	10^{-6} 10^{-8}	Good-poor	Needless
ML	Poor used on proper adjustment	Good - poor careful operation is important. by rubber tired roller, sheeps foot roller	1.52 ∿ 1.92	10^{-3} ∿ 10^{-6}	Very poor in danger of lique faction	Toe drain ∿ needless
CL	Barely fair used for impervious core or blanket	Fair - good by sheeps foot roller, rubber tired roller	1.52 ∿ 1.92	10^{-6} ∿ 10^{-8}	Good-poor	Needless
OL	Unsuitable for banking materials	Fair - poor by sheeps foot roller	1.28 ∿ 1.60	10^{-4} ∿ 10^{-6}	Fair-poor in danger large settlement	Needless
MH	Poor used for core in hydraulic fill but unsuitable for roll fill	Poor - unsuitable by sheeps foot roller	1.12 ∿ 1.52	10^{-4} ∿ 10^{-6}	Poor	Needless
CH	Fair for gentle slope, used for thin core, blanket	Fair - poor by sheeps foot roller	1.20 ∿ 1.68	10^{-5} ∿ 10^{-8}	Fair-poor	Needless
OH	Unsuitable for banking materials	Poor - unsuitable by sheeps foot roller	1.04 ∿ 1.60	10^{-5} ∿ 10^{-8}	Very poor	Needless
Pt	Can't use for construction materials	Practically impossible	-	-	Can't use for foundation	-

Pit-2

Pit-1

Pit-3

Table-14

REPORT OF WATER ANALYSIS BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 11, 1986.
Sampling place	Proposed pigs House 6/12 A
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name	
1. Appearance	Clear
2. Colour	0'
3. Odour	-
4. Turbidity	0'
5. PH value	7.4
6. Electrical conductivity at 20°C, micromhos/cm	270
7. Total solids (ppm)	158
8. Suspended solids (ppm)	22
9. Dissolved solids (ppm)	136
10. Total hardness (ppm as $CaCo_3$)	63
11. Temporary hardness (ppm as $CaCo_3$)	63
12. Permanent hardness (ppm as $CaCo_3$)	0
13. M—Alkalinity (ppm as $CaCo_3$)	46
14. P—Alkalinity (ppm as $CaCo_3$)	0
15. Residual—Alkalinity (ppm as $CaCo_3$)	
16. Chlorides Ion (ppm as Cl^-)	46
17. Sulfates Ion (ppm as SO_4^{-2})	
18. Phosphates Ion (ppm as PO_4^{-3})	
19. Nitrates Ion (ppm as NO_3^-)	None
20. Nitrites Ion (ppm as NO_2^-)	None
21. Ammonium Ion (ppm as NH_4^+)	None
22. Silica (ppm as Sio_2)	
23. Total Iron (ppm)	0.20
24. Total Manganese (ppm)	0.08
25. Residual Chlorine (ppm)	0
26. COD-Mn (ppm)	2

REMARKS.

LABORATORY MANAGER.

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 11, 1986.
Sampling place	Mool River 6/12 B
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name	
1. Appearance	little white mud
2. Colour	0'
3. Odour	-
4. Turbidity	10
5. PH value	7.5
6. Electrical conductivity at 20°C, micromhos/cm	550
7. Total solids (ppm)	338
8. Suspended solids (ppm)	48
9. Dissolved solids (ppm)	290
10. Total hardness (ppm as $CaCo_3$)	94
11. Temporary hardness (ppm as $CaCo_3$)	94
12. Permanent hardness (ppm as $CaCo_3$)	0
13. M-Alkalinity (ppm as $CaCo_3$)	60
14. P-Alkalinity (ppm as $CaCo_3$)	0
15. Residual-Alkalinity (ppm as $CaCo_3$)	
16. Chlorides Ion (ppm as Cl^-)	131
17. Sulfates Ion (ppm as SO_4^{-2})	
18. Phosphates Ion (ppm as PO_4^{-3})	
19. Nitrates Ion (ppm as NO_3^-)	None
20. Nitrites Ion (ppm as NO_2^-)	Detection
21. Ammonium Ion (ppm as NH_4^+)	None
22. Silica (ppm as Sio_2)	
23. Total Iron (ppm)	0.88
24. Total Manganese (ppm)	0.02
25. Residual Chlorine (ppm)	0
26. COD-Mn (ppm)	4

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 11, 1986
Sampling place	Existing Reservoir site 6/12 C
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name		
1. Appearance		little Brow Mud
2. Colour		0'
3. Odour		-
4. Turbidity		40'
5. PH value		7.5
6. Electrical conductivity at 20°C, micromhos/cm		240
7. Total solids	(ppm)	832
8. Suspended solids	(ppm)	564
9. Dissolved solids	(ppm)	268
10. Total hardness	(ppm as $CaCo_3$)	47
11. Temporary hardness	(ppm as $CaCo_3$)	47
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	40
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	
16. Chlorides Ion	(ppm as Cl^-)	50
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	Detection
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	3.20
24. Total Manganese	(ppm)	0.8
25. Residual Chlorine	(ppm)	0
26. COD-Mn	(ppm)	8

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 16, 1986.
Sampling place	Canel North Paddy field ⌀
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name		
1. Appearance		Little brown Mud
2. Colour		
3. Odour		-
4. Turbidity		40
5. PH value		6.4
6. Electrical conductivity at 20°C, micromhos/cm		320
7. Total solids	(ppm)	408
8. Suspended solids	(ppm)	48
9. Dissolved solids	(ppm)	360
10. Total hardness	(ppm as $CaCo_3$)	68
11. Temporary hardness	(ppm as $CaCo_3$)	68
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M-Alkalinity	(ppm as $CaCo_3$)	25
14. P-Alkalinity	(ppm as $CaCo_3$)	0
15. Residual-Alkalinity	(ppm as $CaCo_3$)	-
16. Chlorides Ion	(ppm as Cl^-)	50
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	Detection
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	4.8
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	
26. COD-Mn	(ppm)	8

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 11, 1986.
Sampling place	Existing Well E
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name	
1. Appearance	Clear
2. Colour	0'
3. Odour	-
4. Turbidity	0'
5. PH value	7.1
6. Electrical conductivity at 20°C, micrombos/cm	4200
7. Total solids (ppm)	3148
8. Suspended solids (ppm)	158
9. Dissolved solids (ppm)	2990
10. Total hardness (ppm as $CaCo_3$)	950
11. Temporary hardness (ppm as $CaCo_3$)	950
12. Permanent hardness (ppm as $CaCo_3$)	0
13. M—Alkalinity (ppm as $CaCo_3$)	430
14. P—Alkalinity (ppm as $CaCo_3$)	0
15. Residual—Alkalinity (ppm as $CaCo_3$)	
16. Chlorides Ion (ppm as Cl^-)	820
17. Sulfates Ion (ppm as SO_4^{-2})	
18. Phosphates Ion (ppm as PO_4^{-3})	
19. Nitrates Ion (ppm as NO_3^-)	Detection
20. Nitrites Ion (ppm as NO_2^-)	Detection
21. Ammonium Ion (ppm as NH_4^+)	None
22. Silica (ppm as Sio_2)	
23. Total Iron (ppm)	0.03
24. Total Manganese (ppm)	Trace
25. Residual Chlorine (ppm)	0
26. COD-Mn (ppm)	1/2

REMARKS.

LABORATORY MANAGER.

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 15, 1986.
Sampling place	Ground Water pig hoouse F
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name		
1. Appearance		Clear
2. Colour		0'
3. Odour		-
4. Turbidity		0'
5. PH value		4.6
6. Electrical conductivity at 20°C, micromhos/cm		11,200
7. Total solids	(ppm)	7,392
8. Suspended solids	(ppm)	64
9. Dissolved solids	(ppm)	7,328
10. Total hardness	(ppm as $CaCo_3$)	936
11. Temporary hardness	(ppm as $CaCo_3$)	936
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M—Alkalinity	(ppm as $CaCo_3$)	0
14. P—Alkalinity	(ppm as $CaCo_3$)	0
15. Residual—Alkalinity	(ppm as $CaCo_3$)	
16. Chlorides Ion	(ppm as Cl^-)	3,994
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Slo_2)	
23. Total Iron	(ppm)	0.14
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	
26. COD-Mn	(ppm)	4

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 15, 1986.
Sampling place	Water Sample No. 2 CT
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name		
1. Appearance		Clear
2. Colour		0
3. Odour		-
4. Turbidity		0
5. PH value		7.5
6. Electrical conductivity at 20°C, micromhos/cm		200
7. Total solids	(ppm)	515
8. Suspended solids	(ppm)	120
9. Dissolved solids	(ppm)	395
10. Total hardness	(ppm as $CaCo_3$)	25
11. Temporary hardness	(ppm as $CaCo_3$)	25
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M-Alkalinity	(ppm as $CaCo_3$)	20
14. P-Alkalinity	(ppm as $CaCo_3$)	0
15. Residual-Alkalinity	(ppm as $CaCo_3$)	
16. Chlorides Ion	(ppm as Cl^-)	50
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	Detection
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	0.88
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	
26. COD-Mn	(ppm)	17

REMARKS.

LABORATORY MANAGER

REPORT OF WATER ANALYSIS
BY PHYSICAL AND CHEMICAL EXAMINATIONS

Sampling date	Dec. 16, 1986.
Sampling place	Test Pit No. 3 H
Sample name	

ANALYSIS RESULT (S)

Item \ Sample name		
1. Appearance		Little white Mud
2. Colour		0'
3. Odour		-
4. Turbidity		5'
5. PH value		6.0
6. Electrical conductivity at 20°C, micrombos/cm		1340
7. Total solids	(ppm)	1032
8. Suspended solids	(ppm)	40
9. Dissolved solids	(ppm)	992
10. Total hardness	(ppm as $CaCo_3$)	172
11. Temporary hardness	(ppm as $CaCo_3$)	172
12. Permanent hardness	(ppm as $CaCo_3$)	0
13. M-Alkalinity	(ppm as $CaCo_3$)	8
14. P-Alkalinity	(ppm as $CaCo_3$)	0
15. Residual-Alkalinity	(ppm as $CaCo_3$)	-
16. Chlorides Ion	(ppm as Cl^-)	418
17. Sulfates Ion	(ppm as SO_4^{-2})	
18. Phosphates Ion	(ppm as PO_4^{-3})	
19. Nitrates Ion	(ppm as NO_3^-)	None
20. Nitrites Ion	(ppm as NO_2^-)	None
21. Ammonium Ion	(ppm as NH_4^+)	None
22. Silica	(ppm as Sio_2)	
23. Total Iron	(ppm)	0.3
24. Total Manganese	(ppm)	
25. Residual Chlorine	(ppm)	
26. $COH-M_{II}$	(ppm)	

REMARKS.

LABORATORY MANAGER

บริษัท ครีเอชั่นเซนเตอร์ จำกัด
CREATION CENTER CO., LTD.
199/1-2 ตึกปทุมวัน ถนนพญาไท กรุงเทพฯ 10500
199/1-2 Patumwan Intersection, Phayathai Road, Bangkok.
Tel. 2522310, 2522312, 2522278, 2522268

WATER ANALYSIS

Customer's Name: Nissin Engineering Co., Ltd.

Date: January 5, 1987 Job No.:
Requested By:
Area:
Page No.: 1/2

Sampling Date	H Test Pit	A Pig House	F Ground Water	E Existing Well
1. Color				
2. Turbidity				
3. pH				
4. Conductivity (microsimens/cm)				
5. Total Solids (ppm)				
6. Total Dissolved Solids (ppm)				
7. M-Alkalinity (ppm as CaCO3)				
8. P-Alkalinity (ppm as CaCO3)				
9. Total Hardness (ppm as CaCO3)				
10. Chloride (ppm as Cl)				
11. Total Iron (ppm as Fe)				
12. Phosphate (ppm as PO4)				
13. Silica (ppm as SiO2)				
14. Sulfate (ppm as SO4)				
15. Hydrazine (ppm)				
16. Sodium Sulfite (ppm as SO3)				
17. Ca-Hardness (ppm as CaCO3)	150.0	45.0	950.0	600.0
18. Mg-Hardness (ppm as CaCo3)	36.0	18.7	51.0	146.0
19. Sodium (ppm as CaCO3)	350.0	70.6	4135.9	604.8
20.				
Recommendation: SAR	36.3	12.5	184.9	31.3
EC	1340	270	11,200	4,200

Analyser Name

Authorised Name

บริษัท ครีเอชั่นเซนเตอร์ จำกัด
CREATION CENTER CO., LTD.
199/1-2 ตึกพญาวัน ถนนพญาไท กรุงเทพฯ 10500
199/1-2 Patumwan Intersection, Phayathai Road, Bangkok.
Tel. 2522310, 2522312, 2522276, 2522268

WATER ANALYSIS

Customer's Name:

Nissin Engineering Co., Ltd.

Date: January 5, 1987 Job No.: 005
Requested By:
Area:
Page No.: 2/2

Sampling Date	C Existing Recer	A Sample (NO2)	B Mod River	D Paddy Field
1. Color				
2. Turbidity				
3. pH				
4. Conductivity (microsimens/cm)				
5. Total Solids (ppm)				
6. Total Dissolved Solids (ppm)				
7. M-Alkalinity (ppm as CaCO3)				
8. P-Alkalinity (ppm as CaCO3)				
9. Total Hardness (ppm as CaCO3)				
10. Chloride (ppm as Cl)				
11. Total Iron (ppm as Fe)				
12. Phosphate (ppm as PO4)				
13. Silica (ppm as SiO2)				
14. Sulfate (ppm as SO4)				
15. Hydrazine (ppm)				
16. Sodium Sulfite (ppm as SO3)				
17. Ca-Hardness (ppm as CaCO3)	40.0	65.0	35.0	50.0
18. Mg-Hardness (ppm as CaCO3)	3.2	35.6	1.4	18.3
19. Sodium (ppm as CaCO3)	71.1	161.7	91.2	118.1
20.				
Recommendation: SAR	15.3	22.8	21.4	20.2
EC	240	200	550	320

Analyser Name

Authorised Name

Table-15 WHO Recommended Standard for Drinking - Water 1971

Physical, Chemical and Bacteriological Characteristic		Highest desirable level	Maximum permissable level
pH		7.0 - 8.5	6.5 - 9.2
Colour, Pt-Co Scale	Units	5	50
Turbidity, Silica Scale	mg/l	5	25
Total Solids	mg/l	500	1,500
Hardness (as $CaCO_3$)	mg/l	100	500
Calcium (as Ca)	mg/l	75	200
Magnesium (as Mg)	mg/l	30*	150
Iron (as Fe)	mg/l	0.1	1.0
Manganese (as Mn)	mg/l	0.05	0.5
Copper (as Cu)	mg/l	0.05	1.5
Zinc (as Zn)	mg/l	5	15
Lead (as Pb)	mg/l	-	0.1
Chromium, hexavalent (as Cr)	mg/l	-	0.05
Sulfate (as SO_4)	mg/l	200	400
Chloride (as Cl)	mg/l	200	600
Fluoride (as F)	mg/l	0.6-0.8**	-
Nitrate (as N)	mg/l	-	10
Coliform bacteria	MPN/100 ml	less than 2	-

* Not more than 30 mg/l if there are 250 mg/l of sulfate; if there is less sulfate, magnesium up to 150 mg/l may be allowed.

** Annual average of maximum daily air temperature 26.3 - 32.6°C.

Table - 12 CALCULATION OF EVAPOTRANSPIRATION

(1) Modified Penman Method ($ETo = C \{ W \cdot Rn + (1-W) \cdot f(u) \cdot (ea-ed) \}$)

		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Remarks
I. METEOROLOGICAL DATA														
Air Temperature (°c)		25.0	28.6	30.3	31.4	30.4	29.7	29.3	28.8	28.1	27.4	26.0	24.4	
Relative Humidity (%)		67.0	65.0	65.0	68.0	76.0	76.0	77.0	78.0	83.0	81.0	76.0	68.0	
Wind Velocity (m/s)		1.0	1.0	1.0	1.2	1.1	1.5	1.6	1.5	1.0	1.1	1.3	1.2	
Sun Shine Duration (n/N)		0.81	0.75	0.67	0.67	0.62	0.53	0.47	0.48	0.45	0.62	0.76	0.80	
II. CALCULATION														
ea		31.7	39.2	43.2	46.0	43.4	41.7	40.8	39.6	38.0	36.5	33.6	28.8	
ed=eaxRHmean/100		21.2	25.5	28.1	31.3	33.0	31.7	31.4	30.9	31.5	29.6	25.5	19.9	
(ea-ed)		10.5	13.7	15.1	14.7	10.4	10.0	9.4	8.7	6.5	6.9	8.1	8.9	
u		86.4	86.4	86.4	103.7	95.0	129.6	138.2	129.6	86.4	96.0	112.3	103.7	
f(u)=0.27(1+u/100)		0.50	0.50	0.50	0.55	0.53	0.62	0.64	0.62	0.50	0.53	0.57	0.55	
(1-W)		0.26	0.23	0.22	0.21	0.22	0.22	0.22	0.22	0.23	0.24	0.25	0.27	
W		0.74	0.77	0.78	0.79	0.78	0.78	0.78	0.78	0.77	0.76	0.75	0.73	
Ra		12.2	13.5	14.8	15.7	15.9	15.8	15.8	15.7	15.1	14.0	12.6	11.8	
Rs=(0.25+0.50n/N)Ra		8.0	8.4	8.7	9.0	8.9	8.1	7.8	7.7	7.2	7.8	7.9	7.7	
Rns= (1-α)Rs		6.0	6.3	6.5	6.8	6.7	6.1	5.9	5.8	5.4	5.9	5.9	5.8	
Rnl=f(T)·f(ed)·F(n/N)	f(T)	15.7	16.4	16.8	17.1	16.8	16.6	16.6	16.5	16.3	16.2	15.9	15.5	
	f(ed)	0.14	0.12	0.11	0.09	0.09	0.09	0.09	0.10	0.09	0.10	0.12	0.14	
	f(n/N)	0.83	0.78	0.70	0.69	0.66	0.58	0.54	0.53	0.51	0.66	0.78	0.82	
Rnl		1.8	1.5	1.3	1.1	1.0	0.9	0.8	0.9	0.7	1.1	1.5	1.8	
Rn=Rns-Rnl		4.2	4.8	5.2	5.7	5.7	5.2	5.1	4.9	4.7	4.8	4.4	4.0	
C		1.05	1.06	1.07	1.06	1.07	1.04	1.02	1.03	1.04	1.04	1.04	1.04	
ETo=C{W·Rn+(1-W)·f(u)·(ea-ed)}		4.7	5.6	6.1	6.6	6.1	5.6	5.4	5.2	4.5	4.7	4.6	4.4	

Table-17 CONSTRUCTION SCHEDULE

ITEM	10 20 30 10 20 30 10 20 30 10 20 30 10 20 30 10 20 30
Contact and Report	Contact (30) → Report (10) → Final Inspection Report (10)
Reparation and Finish Work	Reparation (7) → Finish Works (8)
Pond	Excavation (3) → Excavation (40) → Spreading and Compaction (17)
Farm Road	Excavation (3) → Spreading and Compaction (19)
Irrigation Canal	Excavation (7) → Spreading and Compaction (19) → Earth → Earth (4); Conc. Lining (33)
Water Supply Facilities and Regurating Tank	Earth (7) → Conc. Lining (3) → Earth (1); Pump House (6)
Swine Raising Farm	Excavation (3); Spreading Compaction (12) → Excavation (3) → Spreading Compaction (12) → Excavation; Pig House Earth Works (17) → Conc. Lining (10) → Wood Works (26) → Roof Works (15)
Borrow Area	Excavation (13)
Spoil Bank	Spreading and Compaction (17); Spreading, Compaction (9)

Table - 18 BILL OF QUANTITIES No. 1

Item No.	Description	Unit	Quantity	Unit Price	Price	Remarks
I. Swine raising facilities				(฿)	(฿)	
1. Piggery (meat use) Estimated		one house				
1-1. Base						
101	Excavation	cum	26.1	16.8	438	
102	Smoothing face for bed	sqm	108	1.4	151	
103	Plain concrete	cum	14.0	1,232.2	17,250	
104	Hauling L=20 m	"	14.0	15.4	215	
105	Smoothing face for concrete	sqm	108	0.9	97	
106	Curing	"	108	4.9	529	
107	Wooden form	"	9.0	354.2	3,187	
108	Reinf. bar	t	0.24	12,041.0	2,889	
109	Gravel	cum	11.2	220.0	2,464	
110	Compaction for gravel	"	11.2	19.6	219	
111	Plain concrete of pillar base	"	0.2	1,232.2	246	
112	" Hauling	"	0.2	15.4	3	
113	" Wooden form	sqm	4.3	354.2	1,523	
114	Reinf. bar	t	0.02	12,041.0	240	
115	Sub-total				29,451	
1-2. Installation of concrete block						
201	Concrete block	sqm	11.4	165.4	1,885	
202	Sub-total				1,885	

BILL OF QUANTITIES

No. 2

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
1-3. Carpentry						
301	Wooden structure	cum	4.9	12,507	61,284	
302	Sub-total				61,284	
1-4. Roofing						
401	Slate roofing	sqm	103.4	109.0	11,270	
402	Sub-total				11,270	
1-5. Others						
501	Plain concrete (for feed box)	cum	0.6	1,232.2	739	
502	Concrete block (-do-)	pieces	64	3.0	192	
503	Wooden form (-do-)	sqm	5.3	354.2	1,877	
504	Water tank (V=1 kl)	pieces	4	200	800	
505	Vinyl hose	m	8	10	80	
506	Faucet	pieces	4	60	240	
507	Concrete block (Water tank base)	"	40	3	120	
508	Sub-total				4,048	
1-6. Miscellaneous		%	5		5,396	
	Total				113,334	
	Total of 3 houses				340,002	
				round off	340,000	

BILL OF QUANTITIES

No. 3

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
2. Piggery (multiplication use)		Estimated one house				
2-1. Base						
101	Excavation	cum	15.8	16.8	265	
102	Smoothing face for bed	sqm	81	1.4	113	
103	Plain concrete	cum	7.7	1,232.2	9,487	
104	Hauling L=20 m	"	7.7	15.4	118	
105	Smoothing face for concrete	sqm	64.0	0.9	57	
106	Curing	"	64.0	4.9	313	
107	Wooden form	"	4.3	354.2	1,523	
108	Reinf. bar	t	0.14	12,041.0	1,685	
109	Gravel	cum	6.8	220.0	1,496	
110	Compaction for gravel	"	6.8	19.6	133	
111	Plain concrete of pillar base	"	0.2	1,232.2	246	
112	" Hauling	"	0.2	15.4	3	
113	" Wooden form	"	4.3	354.2	1,523	
114	Reinf. bar	t	0.02	12,041.0	240	
115	Sub-total				17,202	
2-2. Installation of concrete block						
201	Concrete block	sqm	15.5	165.4	2,563	
202	Sub-total				2,563	

BILL OF QUANTITIES

No. 4

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
2-3. Carpentry						
301	Wooden structure	cum	2.8	12,507	35,019	
302	Sub-total				35,019	
2-4. Roofing						
401	Slate roofing	sqm	65.6	109.0	7,150	
402	Sub-total				7,150	
2-5. Others						
501	Plain concrete (for feed box)	cum	0.5	1,232.2	616	
502	Concrete block (-do)	pieces	24	3.0	72	
503	Wooden form (-do-)	sqm	4.5	354.2	1,593	
504	Water tank (V=1 kl)	pieces	4	200	800	
505	Vinyl hose	m	8	10	80	
506	Faucet	pieces	4	60	240	
507	Concrete block (Water tank base)	"	40	3	120	
508	Sub-total				3,521	
2-6. Miscellaneous		%	5		3,272	
	Total				68,727	
	Total of 3 houses				206,181	
				round off	206,000	

BILL OF QUANTITIES

No. 5

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
3. Drying facilities						
3-1. Base						
101	Excavation	cum	15.7	16.8	263	
102	Smoothing face for base	sqm	102	1.4	142	
103	Plain concrete	cum	12.2	1,232.2	15,032	
104	-do- Hauling L=20 m	"	12.2	15.4	187	
105	Smoothing face for concrete	sqm	102	0.9	92	
106	Curing	"	102	4.9	499	
107	Wooden form	"	4.6	354.2	1,629	
108	Reinf. bar	t	0.23	12,041.0	2,769	
109	Gravel	cum	10.4	220.0	2,288	
110	Compaction for gravel	"	10.4	19.6	203	
111	Installation of PVC pipe	m	4.4	40.0	176	
112	Sub-total				23,280	
3-2. Miscellaneous		%	5		1,164	
	Total				24,444	
				round off	24,000	

BILL OF QUANTITIES

No. 6

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
4. Compost barnyard						
4-1. Base						
101	Plain concrete	cum	1.2	1,232.2	1,478	
102	-do- Hauling L=20 m	"	1.2	15.4	18	
103	Wooden form	sqm	10.2	354.2	3,612	
104	Reinf. bar	t	0.09	12,041.0	1,083	
105	Gravel	cum	0.4	220.0	88	
106	Compaction for gravel	"	0.4	19.6	7	
107	Sub-total				6,286	
4-2. Carpentry						
201	Wooden structure	cum	10.7	12,507.0	133,824	
202	Sub-total				133,824	
4-3. Roofing						
301	Slate roofing	sqm	286.0	109.0	31,174	
302	Sub-total				31,174	
4-4. Miscellaneous		%	5		8,564	
	Total				179,848	
				round off	179,000	

BILL OF QUANTITIES

No. 7

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
5. Farm machinery shed						
5-1. Base						
101	Excavation	cum	19.3	16.8	324	
102	Smoothing face for bed	sqm	126	1.4	176	
103	Plain concrete	cum	15.1	1,232.2	18.606	
104	-do- Hauling L=20 m	"	15.1	15.4	232	
105	Smoothing face for concrete	sqm	126	0.9	113	
106	Curing	"	126	4.9	617	
107	Wooden form	"	6.4	354.2	2,266	
108	Reinf. bar	t	0.28	12,041.0	3,371	
109	Gravel	cum	12.9	220.0	2,838	
110	Compaction for gravel	"	12.9	19.6	252	
111	Sub-total				28,795	
5-2. Installation of concrete block						
201	Concrete block	sqm	12.0	165.4	1,984	
202	Sub-total				1,984	

BILL OF QUANTITIES

No. 8

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
5-3. Carpentry						
301	Wooden structure	cum	5.4	12,507	67,537	
302	Sub-total				67,537	
5-4. Roofing						
401	Slate roofing	sqm	127.3	109.0	13,875	
402	Slate for wall panel	"	77.8	109.0	8,480	
403	Sub-total				22,355	
5-5. Others						
501	Door	Ls	1		9,000	
502	Hanger door attachment	"	1		5,000	
503	Sub-total				14,000	
5-6. Miscellaneous		%	5		6,733	
	Total				141,404	
				round off	141,000	

BILL OF QUANTITIES

No. 9

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
6. Feed crop processing facilities						
6-1. Base						
101	Excavation	cum	7.9	16.8	132	
102	Smoothing face for bed	sqm	51.0	1.4	71	
103	Plain concrete	cum	6.1	1,232.2	7,516	
104	Reinf. concrete	"	1.6	1,182.9	1,892	
105	-do- Hauling L=20 m	"	7.7	15.4	118	
106	Smoothing face for concrete	sqm	51.0	0.9	45	
107	Curing	"	51.0	4.9	249	
108	Wooden form	"	28.9	354.2	10,236	
109	Reinf. bar	t	0.4	12,041.0	4,816	
110	Gravel	cum	5.3	220.0	1,166	
111	Compaction for gravel	"	5.3	19.6	103	
112	Sub-total				26,344	
6-2. Installation of concrete block						
201	Concrete block	sqm	36.0	165.4	5,954	
202	Sub-total				5,954	
6-3. Carpentry						
301	Wooden structure	cum	3.0	12,507.0	37,521	
302	Sub-total				37,521	

BILL OF QUANTITIES

No. 10

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
6-4. Roofing						
401	Slate roofing	sqm	72.8	109.0	7,935	
402	Sub-total				7,935	
6-5. Others						
501	Window (3,800Wx900H)	Ls	1		5,000	
502	Wooden door	Ls	1		3,000	
503	Sub-total				8,000	
6-6. Miscellaneous		%	5		4,287	
	Total				90,041	
				round off	90,000	

B I L L O F Q U A N T I T I E S

No. 11

Item No.	Description	Unit	Quantity	Unit Price (฿)	P r i c e (฿)	Remarks
7. Urine treatment basin						
7-1. Urine treatment basin						
101	Excavation	cum	65.0	17.6	1,144	
102	Embankment	"	3.5	19.6	68	
103	Lean concrete	"	3.5	956.0	3,346	
104	Gravel	"	4.9	220.0	1,078	
105	- do - Compaction	"	4.9	19.6	96	
106	Reinforced concrete	"	13.8	1,182.9	16,324	
107	Curing	sqm	46.2	4.9	226	
108	Wooden form	"	94.6	354.2	33,507	
109	Reinf. bar	t	0.57	12,041.0	6,863	
110	Sub-total				62,652	
7-2. Others						
201	Wood (basin's cover)	cum	0.4	12,507.0	5,002	
202	Iron sheet	sqm	5.3	109.0	577	
203	Sub-total				5,579	
7-3. Miscellaneous		%	5		3,411	
	Total				71,642	
				round off	71,000	

BILL OF QUANTITIES

No. 12

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
8. Well	(Estimated one place)					
8-1. Well						
101	Excavation	cum	16.3	16.8	273	
102	Concrete pipe	pieces	19	160	3,040	
103	Plain concrete	cum	1.8	1,232.2	2,217	ϕ1,200 mm
104	Gravel	"	1.4	220.0	308	
105	Compaction for gravel	"	1.4	19.6	27	
106	Reinf. car	t	0.04	12,041.0	481	
107	Wooden form	sqm	8.4	354.2	2,975	
108	Gravel (well bottom)	cum	0.3	220.0	66	
109	Sub-total				9,387	
8-2. Others						
201	Wood (Base & tank base)	cum	0.4	12,507	5,002	
202	PVC pipe	m	10.0	40	400	ϕ100 mm
203	Hand pump	set	1	2,500	2,500	
204	Water tank	"	1	2,000	2,000	V = 3.0 kl
205	Iron slate for pipe support	t	0.01	10,500	105	
206	Vinyl hose	m	40	20	800	
207	Sluice valve (ϕ50mm)	piece	1	500	500	
208	Hand pump, pipe setting	set	1		2,000	
209	Sub-total				13,307	

BILL OF QUANTITIES

No. 13

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
8-3.	Miscellaneous	%	5		1,134	
	Total				23,828	
	Total of 2 wells				47,656	
				round off	47,000	

BILL OF QUANTITIES

No. 14

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
9. Drain for urine						
101	Drain	m	110.5	78.2	8,641	
102	Miscellaneous	%	5		432	
	Total				9,073	
10. Installation of fence						
101	Fence	m	200	67.2	13,440	
102	Gate (L=3.0m, H=1.3m)	set	4	1,231.4	4,925	(included setting cost)
103	Miscellaneous	%	5		918	
	Total				19,283	
11. Installation of lighting						
101	Conductor VA 3.2 mm	m	20	3.0	60	
102	- do - VA 2.0 mm	"	300	2.0	600	
103	- do - VA 1.6 mm	"	100	1.3	130	
104	- do - VA 2.0 mm	"	90	2.0	180	Phimai Coop.
105	Fluorescent light (40W)	pieces	22	500	11,000	
106	Switch for light	"	9	30	270	
107	Switch board	piece	1	3,000	3,000	
108	Wiring	set	1	2,000	2,000	
109	Miscellaneous	%	5		862	
	Total				18,102	

BILL OF QUANTITIES

No. 15

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
12. Pump house						
12-1. Pump house 1						
101	Excavation	cum	0.9	16.8	15	
102	Plain concrete	"	2.1	1,232.2	2,587	
103	Concrete block	sqm	7.3	165.4	1,207	
104	Carpentry	cum	0.5	12,507.0	6,253	
105	Slate roofing	sqm	36.0	109.0	3,924	
106	Iron sheet for wall panel	"	1.6	109.0	174	
107	Wooden form	"	3.3	354.2	1,168	
108	Reinf. bar	t	0.04	12,041.0	481	
109	Sub-total				15,809	
12-2. Pump house 2						
201	Excavation	cum	0.5	16.8	8	
202	Plain concrete	"	1.0	1,232.2	1,232	
203	Concrete block	sqm	5.8	165.4	959	
204	Carpentry	cum	0.4	12,507	5,002	
205	Slate roofing	sqm	27.6	109.0	3,008	
206	Iron sheet for wall panel	"	1.6	109.0	174	
207	Wooden form	"	2.5	354.2	885	
208	Reinf. bar	t	0.02	12,041.0	240	
209	Sub-total				11,508	
12-3. Miscellaneous		%	5		1,365	
	Total				28,682	
	Total (9-12)				75,140	
				round off	75,000	

BILL OF QUANTITIES

No. 16

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
II. Concrete works for irrigation facilities						
1. Construction of water supply facilities						
1-1 Earth works						
101	Excavation	cum	33	28.0	924	
102	Embankment (Common soil)	cum	7	28.0	196	
103	Gravel	cum	7	200	1,400	
104	Embankment (Gravel)	cum	7	38.5	269	
105	Loading and Hauling	cum	26	36.1	938	tractor shovel,8t Dump L=500 m
106	Sub-total				3,727	
1-2 Concrete works						
107	Lining concrete	cum	19.7	1,232.2	24,274	
108	Hauling for concrete	cum	19.7	15.4	303	
109	Wooden form of concrete	sqm	53.5	354.2	18,949	
110	Miscellaneous construction works	Ls.	1		2,176	5%
111	Sub-Total				45,702	
2. Construction of canal						
2-1 Earth works						
201	Excavation	cum	762	28.0	21,336	
202	Embankment	cum	87	28.0	2,436	
203	Loading and Haulding	cum	675	36.1	24,367	
204	Sub-Total				48,139	

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
2-2 Concrete works						
205	Lining concrete	cum	287.4	1,232.2	354,134	
206	Plain concrete	cum	2.2	1,105.3	2,431	
207	Wooden form of concrete	sqm	107.9	354.2	38,218	
208	Hauling for concrete	cum	321.5	20.3	6,526	L=40 m
209	RC φ300 m/m	m	19.8	160	3,168	
210	PVC φ50 m/m	m	171.6	125/4m	5,362	
211	Miscellaneous construction works	Ls.			20,491	5 %
212	Sub-Total				430,330	
2-3 Wood						
213	Stop log	cum	1.31	12,507	16,384	
214	Board	cum	0.65	12,507	8,129	
215	Support	cum	0.56	12,507	7,003	
216	Construction and others	Ls.			1,575	5 %
217	Sub-Total				33,091	
3. Construction of regulating tank						
3-1 Earth works						
301	Excavation	cum	2.3	28.0	64	
302	Embankment (Common soil)	cum	0.5	28.0	14	
303	Gravel	cum	1.4	200	280	
304	Embankment (Gravel)	cum	1.4	38.5	53	
305	Loading and Hauling	cum	1.8	36.1	64	
306	Sub-Total				475	

BILL OF QUANTITIES

No. 18

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
3-2	Concrete works					
307	Reinforced concrete	cum	6.2	1,182.9	7,333	
308	Plain concrete	cum	0.5	1,105.3	552	
309	Hauling for concrete	cum	6.7	20.3	136	L=40 m
310	Wooden form of concrete	sqm	54.0	354.2	19,126	
311	Reinforced steel bar	ton	0.35	12,041.0	4,214	
312	vinyl pipe ϕ50 m/m	m	3.3	125/4m	103	
313	vinyl pipe ϕ100 m/m	m	30.0	430/4m	3,225	
314	Miscellaneous of construction works	Ls.			1,734	5 %
315	Sub-Total				36,423	
4.	Construction of spoil bank					
401	Spreading	cum	690	9.4	6,486	
402	Compaction	cum	690	12.4	8,556	
403	Sub-Total				15,042	
5.	Miscellaneous	%	5		30,646	
	Total				643,577	
				round off	643,000	

BILL OF QUANTITIES

No. 19

Item No.	Description	Unit	Quantity	Unit Price	Price	Remarks
III Earth works for irrigation facilities				(฿)	(฿)	
1. Construction of farm pond						
101	Excavation (Top soil)	cum	674	13.6	9,166	
102	Loading and Hauling	cum	674	31.1	20,961	0.5m³Back-hoe,11t Dump,L=500m
103	Excavation (Sand)	cum	5,573	11.4	63,532	
104	Excavation (Common soil)	cum	2,873	15.2	43,669	
105	Spreading	cum	2,463	6.0	14,778	
106	Compaction	cum	2,463	19.1	47,043	
107	Hauling (Pig house)	cum	2,500	17.1	42,750	L = 700 m
108	Hauling (Farm road and canal)	cum	3,483	15.9	55,379	L = 500 m
109	Miscellaneous	%	5		14,863	
110	Sub-Total				312,141	
2. Construction of farm road						
201	Excavation (Top soil)	cum	924	13.6	12,566	
202	Loading and Hauling	cum	924	31.1	28,736	
203	Latelite	cum	420	200	84,000	
204	Gravel	cum	76	220	16,720	
205	Spreading	cum	2,848	6.0	17,088	
206	Compaction	cum	2,772	19.1	52,945	
207	Miscellaneous	%	5		10,602	
208	Sub-Total				222,657	

BILL OF QUANTITIES

No. 20

Item No.	Description	Unit	Quantity	Unit Price (₱)	Price (₱)	Remarks
3. Construction of canal						
301	Excavation (Top soil)	cum	1,078	13.6	14,660	
302	Loading and Hauling	cum	1,078	31.1	33,525	
303	Spreading	cum	2,783	6.0	16,698	
304	Compaction	cum	2,783	19.1	53,155	
305	Miscellaneous	%	5		5,901	
306	Sub-total				123,939	
4. Construction of river water supply facilities						
401	Excavation	cum	665	15.2	10,108	
402	Excavation (Soft soil)	cum	665	11.4	7,581	
403	Hauling	cum	665	15.9	10,573	L = 500 m
404	Spreading	cum	665	6.0	3,990	
405	compaction	cum	665	8.0	5,320	
406	Miscellaneous	%	5		1,878	
407	Sub-Total				39,450	
5. Construction of swine raising farm						
501	Excavation (Top soil)	cum	900	13.6	12,240	
502	Spreading	cum	4,000	6.0	24,000	
503	Compaction (11t Bull)	cum	3,500	8.0	28,000	
504	Compaction (Roller)	cum	500	19.1	9,550	
505	Miscellaneous	%	5		3,689	
506	Sub-Total				77,479	

BILL OF QUANTITIES

No. 21

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
6. Construction of borrow area						
601	Excavation	cum	211	13.6	2,869	
602	Loading and Hauling	cum	211	32.9	6,941	0.5m³Back-hoe, 8t Dump, L=800m
603	Excavation (Common soil)	cum	2,152	15.2	32,710	
604	Hauling (Swine raising farm)	cum	500	18.9	9,450	L= 1,000 m
605	Hauling (Canal)	cum	1,652	15.9	26,266	L= 500 m
606	Miscellaneous	%	5		3,911	
607	Sub-Total				82,147	
7. Construction of spoil bank						
701	Spreading	cum	2,887	6.0	17,322	
702	Compaction	cum	2,887	8.0	23,096	
703	Miscellaneous	%	5		2,020	
704	Sub-Total				42,438	

BILL OF QUANTITIES

No. 1

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
1.	Installation of Electric pole (h=12 m)					
1	Tangent structure 0°- 5°	set	7	1,584	11,088	
2	Small angle structure 5°- 30°	set	19	2,613	49,647	
3	Dead end structure	set	2	2,217	4,434	
4	Arm installation (1800 mm)	set	1	2,272	2,272	
5	Concrete slab (0.35 x 0.35 x 4.5 m)	set	10	1,034	10,340	
6	Sub-Total				77,781	
2.	Installation of Conductor (High tension)					
1	Conductor(ACSR 50 mm²)	km	4.23	6,138	25,963	
2	Sub-Total				25,963	

B I L L O F Q U A N T I T I E S

No. 2

Item No.	Description	Unit	Quantity	Unit Price (฿)	P r i c e (฿)	Remarks
3.	Installation of Electric pole (h=9 m)					
1	Dead end structure	set	1	2,217	2,217	
2	Rack, Secondary 2 x 200 mm	set	1	136	136	
3	Side Guy	set	1	1,012	1,012	
4	Sub-Total				3,365	
4.	Installation of Conductor (Low tension)					
1	Conductor, AL, Bare 35 mm^2	m	20	2.75	55	
2	Cable, AL, Compact standard 35 mm^2	m	20	2.75	55	
3	Sub-Total				110	

BILL OF QUANTITIES

No. 3

Item No.	Description	Unit	Quantity	Unit Price (฿)	Price (฿)	Remarks
5.	Installation of Transformer					
1	Transformer	set	1	6,666	6,666	
2	Sub-Total				6,666	
	Total				113,885 113,000	

Table-19 LIST OF LABOUR WAGES

(as Nokorn Ratchasima)

No.	I t e m	Pedium (ß/day)
1.	Commom labour	70
2.	Foreman, earth work	180
3.	Foreman, concrete work	215
4.	Foreman, other civil work	215
5.	Foreman, mechanical work	215
6.	Foreman, Electrical work	215
7.	Foreman, steel work	180
8.	Technician, capenter	180
9.	Technician, Electrician	180
10.	Technician, steel worker	180
11.	Techinician, form worker	180
12.	Technician, concrete worker	180
13.	Technician, mechanical	180
14.	Technician, mason	180
15.	Operator, bulldozer	180
16.	Operator, backhoe	180
17.	Operator, loader	180
18.	Operator, tamping roller	180
19.	Operator, other light equipment	145
20.	Driver, dump truck	145
21.	Driver, truck	145
22.	Driver, light vehicles	120

Table-20 LIST OF MATERIAL COST

No.	I t e m	Unit	Unit Cost (₱)
1.	Portland cement	t	80
2.	Concrete admixture, AE & others	kg	45
3.	Reinforcing steel bar, deformed, SD 30	t	9,800
4.	Reinforcing steel bar, round, SR 24	t	9,800
5.	Wire for binding reinforcing steel bar, ϕ180mm	t	14,000
6.	Aggregate for concrete, coarse (gravel)	m^3	220
7.	Aggregate for concrete, fine (sand)	m^3	150
8.	Laterite	m^3	140
9.	Wooden material for wooden form	m^3	7,000
10.	Wooden material for house	m^3	10,000
11.	Metal form	m^2	460
12.	Reinforced concrete pipe ϕ150 mm (L=1.0m)	m	80
13.	Reinforced concrete pipe ϕ200 mm (")	m	95
14.	Reinforced concrete pipe ϕ300 mm (")	m	160
15.	Reinforced concrete pipe ϕ400 mm (")	m	245
16.	Reinforced concrete pipe ϕ500 mm (")	m	300
17.	Reinforced concrete pipe ϕ600 mm (")	m	350
18.	Reinforced concrete pipe ϕ800 mm (")	m	600
19.	Reinforced concrete pipe ϕ1,000 mm (")	m	840
20.	Reinforced concrete pipe ϕ1,200 mm (")	m	1,200
21.	Reinforced concrete pipe ϕ1,500 mm (")	m	2,200
22.	Structure steel	t	10,500
23.	Nail	t	12,500
24.	Water-stop, PVC, 230 x 6 mm	m	160
25.	Water-stop, PVC, 300 x 7 mm	m	225
26.	PVC pipe, ϕ20 mm x 4.0 m class 8.5 not for high pressior	pec.	36
27.	PVC pipe, ϕ25 mm	"	48
28.	PVC pipe, ϕ30 mm	"	60
29.	PVC pipe, ϕ40 mm	"	78
30.	PVC pipe, ϕ50 mm	"	125
31.	PVC pipe, ϕ75 mm	"	262
32.	PVC pipe, ϕ100 mm	"	430

LIST OF MATERIAL COST

No.	I t e m	Unit	Unit Cost (ß)
33.	PVC pipe, ϕ150 mm	pec.	920
34.	PVC pipe, ϕ200 mm	"	1,720
35.	PVC pipe, ϕ300 mm	"	3,360
36.	Sod	m^2	20
37.	Fence mech wire	m^2	58
38.	Fuel, diesel oil	lit	6.5
39.	Fuel, gasoline, regular	"	9.1
40.	Stone for masonry work	m^3	210
41.	Elastic filler 0.02 x 1.20 x 2.40 m	pc	1,730
42.	Elastic filler 0.01 x 1.20 x 2.40 m	"	920
43.	Steel pipe L=6.0m ϕ1/2" (BS-S)	"	45
44.	Steel pipe L=6.0m ϕ3/4" (")	"	70
45.	Steel pipe L=6.0m ϕ1" (")	"	100
46.	Steel pipe L=6.0m ϕ1 1/4(")	"	135
47.	Steel pipe L=6.0m ϕ1 1/2(")	"	160
48.	Steel pipe L=6.0m ϕ2" (")	"	194
49.	Steel pipe L=6.0m ϕ2 1/2 (")	"	262
50.	Steel pipe L=6.0m ϕ3" (")	"	386
51.	Steel pipe L=6.0m ϕ4" (")	"	540
52.	Steel pipe L=6.0m ϕ5" (")	"	1,025
53.	Steel pipe L=6.0m ϕ6" (")	"	1,160
54.	Welding bar ϕ2.6 mm	kg	23
55.	Welding bar ϕ3.2 mm	kg	23
56.	Welding bar ϕ4.0 mm	kg	23
57.	Electric power	kwH	2.8
58.	Concrete block (400x200x70)	pec	2
59.	Concrete clock (400x200x90)	pec	3
60.	Slate (500x1200, t=4mm)	pec	34
61.	Galvanized iron sheet (665x2130, t=0.2mm)	m^2 pec	57 80
62.	Wire netting (50mm, ϕ2mm, h=120cm)	m	35
63.	Wire netting (50mm, ϕ1mm, h=90cm)	m	35
64.	Concrete pipe (no joint) L=0.5 m, ϕ900	pec	100

LIST OF MATERIAL COST

No.	I t e m	Unit	Unit Cost (₱)
65.	Concrete pipe (no joint) L=0.5 m, ϕ1,000	pec	120
66.	Concrete pipe (no joint) L=0.5 m, ϕ1,200	pec	160
67.	Concrete pipe (no joint) L=0.4 m, ϕ1,500	pec	200
68.	Asbestos pipe ϕ100, L=1.0 m	m	12
69.	Asbestos pipe ϕ150, L=1.0 m	m	25
70.	Asbestos pipe ϕ200, L=1.0 m	m	35
71.	Asbestos pipe ϕ250, L=1.0 m	m	50
72.	Asbestos pipe ϕ300, L=1.0 m	m	60
73.	Asbestos pipe ϕ400, L=1.0 m	m	80
74.	Asbestos pipe ϕ500, L=1.0 m	m	100
75.	Asbestos pipe ϕ600, L=1.0 m	m	140
76.	Asbestos pipe ϕ800, L=1.0 m	m	300
77.	Asbestos pipe ϕ1,000, L=1.0 m	m	400
78.	Asbestos pipe ϕ100, L=3.0 m	m	15
79.	Asbestos pipe ϕ150, L=3.0 m	m	25
80.	Asbestos pipe ϕ200, L=3.0 m	m	35
81.	Concrete pole for fence 4"x4" L=1.0 m	pec	40
82.	Concrete pole for fence 4"x4" L=1.5 m	pec	60
83.	Concrete pole for fence 4"x4" L=2.0 m	pec	80
84.	Concrete pole for fence 4"x4" L=2.5 m	pec	100
85.	Concrete pole for fence 4"x4" L=3.0 m	pec	120
86.	Concrete pole for fence 5"x5" L=1.0 m	pec	60
87.	Concrete pole for fence 5"x5" L=1.5 m	pec	90
88.	Concrete pole for fence 5"x5" L=2.0 m	pec	120
89.	Concrete pole for fence 5"x5" L=2.5 m	pec	150
90.	Concrete pole for fence 5"x5" L=3.0 m	pec	180
91.	Concrete pole for fence 5"x5" L=3.5 m	pec	210
92.	Concrete pole for fence 6"x6" L=1.0 m	pec	70
93.	Concrete pole for fence 6"x6" L=1.5 m	pec	105
94.	Concrete pole for fence 6"x6" L=2.0 m	pec	140
95.	Concrete pole for fence 6"x6" L=2.5 m	pec	175
96.	Concrete pole for fence 6"x6" L=3.0 m	pec	210
97.	Concrete pole for fence 6"x6" L=3.5 m	pec	245

LIST OF MATERIAL COST

No.	I t e m	Unit	Unit Cost (฿)
98.	Water tank (Concrete) V=2,000 lit	pec	450
99.	Faucet for drinking water of livestock	pec	60

Table - 21 LIST OF UNIT COST BY MANPOWER

No.	I t e m	Unit	Unit Cost (baht)
MP-1	Excavation by Manpower		
	Sand	m^3	16.8
	Common Soil	m^3	28.0
	Gravel	m^3	38.5
MP-2	Hauling by Manpower		
	L = 20 m	m^3	15.4
	L = 40 m	m^3	20.3
	L = 60 m	m^3	23.8
	L = 80 m	m^3	28.0
	L =100 m	m^3	29.4
	L =120 m	m^3	30.1
MP-3	Compacting		
MP-3-1	Compacting by Manpower	m^3	19.6
MP-3-2	Compacting by Compactor	m^3	14.6
MP-4	Smoothing of face excavated or filled up	m^2	1.4
MP-5	Concrete		
MP-5-1	Plain concrete	m^3	1,105.3
MP-5-2	Reinforced concrete	m^3	1,182.9
MP-5-3	Lean concrete	m^3	956.0
MP-5-4	Lining concrete	m^3	1,232.2
MP-6	Mortar (C:S = 1:3)	m^3	1,305.1
MP-7	Wooden form of concrete	m^2	354.2
MP-8	Processing and assembling of reinforcing steel bar	ton	12,041.0
MP-9	Sod facing	m^2	44.8
MP-10	Wooden scaffolding	m^3	140.1
MP-11	Drainage by pump	day	314.5

No.	I t e m	Unit	Unit Cost (baht)
MP-12	Smoothing face of concrete	m^2	0.9
MP-13	Curing for concrete	m^2	4.9
MP-14	Installation of concrete block	m^2	165.4
MP-15	Roofing slate	m^2	109.0
MP-16	Roofing iron sheet	m^2	109.0
MP-17	Wooden structure for house	m^3	12,507.0
MP-18	Installation of fence	m	67.2
MP-19	Drain for urine	m	78.2
MP-20	Installation of gate fence	place	1,231.4

Table UNIT COST FOR ELECTRIC FACILITIES

No.	I t e m	Unit	Unit Cost(฿)
E-1	Installation of Electric Pole (h=12 m) (High tension, Tangent structure 0°-5°)	place	1,584
E-2	Installation of Electric Pole (h=12 m) (High tension, Small angle structure 5°-30°)	"	2,613
E-3	Installation of Electric Pole (h=12 m) (High tension, Angle structue 30°-60°)	"	2,613
E-4	Installation of Electric Pole (h=9 m) (Low tension, Tangent structure 0°-5°)	"	1,331
E-5	Installation of Electric Pole (h=9 m) (Low tension, Angle structure 5°-60°)	"	2,244
E-6	Dead end structure	set	2,217
E-7	Arm Installation (1,800 mm)	"	2,272
E-8	Concrete slab (0.35x0.35x4.5 m)	10 sets	1,034
E-9	Conductor (Conductor and Messenger Wire) ACSR 50 mm^2	km	6,138
E-10	Conductor (Conductor and Messenger wire) AL, Bare 35 mm^2	20 m	55
E-11	Cable (Cable and Messenger wire) AL, Compact, Standard 35 mm^2	20 m	55
E-12	Rack, Secondary 2 x 200 mm	set	136
E-13	Side Guy	"	1,012
E-14	Installation of Transformer 50 KVA	"	6,666

Table-22 LIST OF UNIT COST BY USING CONSTRUCTION EQUIPMENTS

No.	Item	Unit	Unit Cost (₱)	
			CPD	Contractor
EQ-1	Excavation by Bull-dozer (11 ton)			
	Sand	m^3	11.4	17.6
	Common soil	m^3	13.6	21.1
	Gravel and weathered rock	m^3	19.4	30.2
EQ-2	Excavation by Bull-dozer (21 ton)			
	Sand	m^3	15.9	15.9
	Common soil	m^3	19.0	19.0
	Gravel and weathered rock	m^3	27.2	27.2
EQ-3	Excavation by Back-hoe Shovel (0.5 m^3)			
	Sand	m^3	11.4	17.1
	Common soil	m^3	15.2	22.8
	Gravel and weathered rock	m^3	18.2	27.4
EQ-4	Excavation by Back-hoe Shovel (0.7 m^3)			
	Sand	m^3	17.6	17.6
	Common soil	m^3	23.5	23.5
	Gravel and weathered rock	m^3	28.2	28.1
EQ-5	Loading by Tractor Shovel			
	Sand	m^3	13.1	13.1
	Common soil	m^3	15.3	15.3
	Gravel and weathered rock	m^3	18.4	18.3
EQ-6	Hauling by Dump Truck (8 ton)			
	Sand	m^3	0.0057L+12.1	0.0076L+15.9
	Common soil	m^3	0.0061L+12.8	0.0080L+16.8
	Gravel and weathered rock	m^3	0.0064L+13.5	0.0085L+17.8

No.	Item	Unit	Unit Cost (₱)	
			CPD	Contractor
EQ-7	Hauling by Dump Truck (11 ton)			
	Sand	m^3	0.0055L+11.5	0.0072L+15.1
	Common soil	m^3	0.0058L+12.2	0.0076L+16.0
	Gravel and weathered rock	m^3	0.0061L+12.9	0.0080L+16.9
EQ-8	Spreading by Bull-dozer (11 ton)			
	Sand	m^3	6.0	9.4
	Common soil	m^3	6.0	9.4
	Gravel and weathered rock	m^3	6.0	9.4
EQ-9	Compaction by Tire Roller (11 - 20 t)	m^3	5.2	5.2
EQ-10	Compaction by Vibration Roller (3 - 5 t)	m^3	19.1	18.3
EQ-11	Compaction by Bull-dozer (11 t)	m^3	8.0	12.4
EQ-12	Excavation by Dragline (1.2 m^3)			
	Sand	m^3	31.8	31.7
	Common soil	m^3	34.7	34.6
	Gravel and weathered rock	m^3	38.1	38.1

LIST OF OPERATION COST

No.	Item	Unit	Unit Cost (Baht) CPD	CONTRACTOR
OP-1	11 ton Bulldozer	day	3,021.6	4,686.0
OP-2	21 ton Bulldozer	day	9,298.9	9,277.9
OP-3	0.50 m^3 Backhoe Shovel	day	3,129.7	4,701.1
OP-4	0.70 m^3 Backhoe Shovel	day	6,791.0	6,770.0
OP-5	1.2 m^3 Tractor Shovel	day	4,527.6	4,506.6
OP-6	8 ton Dump Truck	day	2,041.7	2,692.3
OP-7	11 ton Dump Truck	day	2,690.5	3,517.4
OP-8	Tire Roller (11 - 20 ton)	day	3,049.0	3,028.0
OP-9	Vibration Roller (3 - 5 ton)	day	2,055.1	1,977.3
OP-10	Dragline (1.2 m^3)	day	14,976.4	14,955.4

HOURLY PRODUCTION

1. Bull-dozer

(1) For excavation

Spec.	Work Item	f	q	E	Cm	Q (m^3/hr)
11 ton	Excavation					
Eq1-1	Sand	1.00	1.34	0.6	1.27	38.0
Eq1-2	Common soil	1.00	1.34	0.5	1.27	31.7
Eq1-3	Gravel or weathered rock	1.00	1.34	0.35	1.27	22.2
21 ton	Excavation					
Eq2-1	Sand	1.00	2.95	0.6	1.27	83.6
Eq2-2	Common soil	1.00	2.95	0.5	1.27	69.9
Eq2-3	Gravel or weathered rock	1.00	2.95	0.35	1.27	48.8

(2) For spreading

Spec.	Work Item	thickness (cm)	E	D	Q (m^3/hr)
11 ton	Spreading				
Eq8-1	Sand	25	0.70	0.20	71.4
Eq8-2	Common soil	25	0.70	0.20	71.4
Eq8-3	Gravel or weathered rock	25	0.70	0.20	71.4

2. Back-hoe Shovel

Spec.	Material	q	f	E	Cm	Q (m^3/hr)
Eq3-1	Sand	0.45	1.00	0.80	33	39.3
Eq3-2	Common soil	0.45	1.00	0.60	33	29.5
Eq3-3	Gravel or weathered rock	0.45	1.00	0.50	33	24.5
Eq4-1	Sand	0.63	1.00	0.80	33	55.0
Eq4-2	Common soil	0.63	1.00	0.60	33	41.2
Eq4-3	Gravel or weathered rock	0.63	1.00	0.50	33	34.4

3. Tractor Shovel

Spec.		Material	q	f	E	Cm	Q (m^3/hr)
Eq5-1	1.2m^3	Sand	0.88	1.00	0.70	45	49.3
Eq5-2		Common soil	0.88	1.00	0.60	45	42.2
Eq5-3		Gravel or weathered rock	0.88	1.00	0.50	45	35.2

4. Dump Truck

Spec.		Material	q	f	E	Cm
Eq6-1	8 ton	Sand	4.71	1.00	0.90	0.005L+10.5
Eq6-2		Common soil	4.44	1.00	0.90	0.005L+10.5
Eq6-3		Gravel or weathered rock	4.21	1.00	0.90	0.005L+10.5
Eq7-1	11 ton	Sand	6.47	1.00	0.90	0.005L+10.5
Eq7-2		Common soil	6.11	1.00	0.90	0.005L+10.5
Eq7-3		Gravel or weathered rock	5.79	1.00	0.90	0.005L+10.5

5. Compacting Equipment

Spec.		V	W	D	E	N	Q (m^3/hr)	Q (m^3/day)
Eq9	Tire roller for road (8 - 20 ton)	4,200	1.80	0.2	0.55	10	83.2	-
Eq10	Vibration roller (3 - 5 ton)	1,000	0.7	0.2	0.55	5	15.4	-
Eq11	Bull dozer (11 ton)	3,500	0.7	0.2	0.55	5	54.0	-

6. Dragline

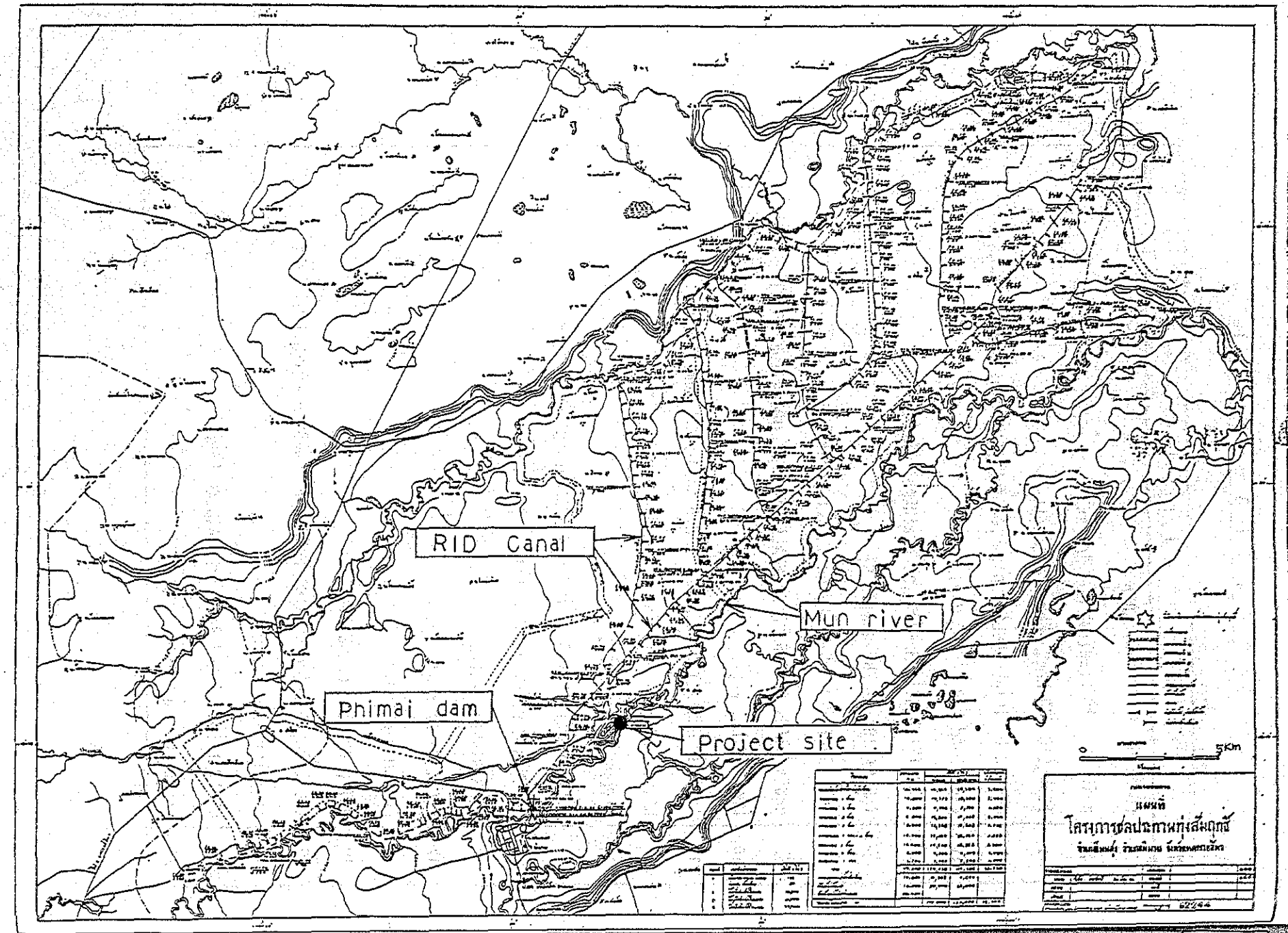
Spec.			f	q	E	Cm	Q (m^3/day)
Eq12-1	1.2 m^3	Sand	1.00	1.06	0.6	34	67.3
Eq12-2		Common soil	1.00	1.06	0.55	34	61.7
Eq12-3		Gravel or weathered rock	1.00	1.06	0.5	34	56.1

Table-23 List of Equipment

I t e m s	Quantities	Remarks
1. Pump facilities		
Volute pump	3 sets	ϕ80mm, 3.7 kw
Sluice valve	5 sets	ϕ80, 100mm
Foot valve	3 sets	ϕ100mm
Check valve	3 sets	ϕ80mm
Steel pipe and others	60 m	ϕ150mm
- do -	70 m	ϕ100mm
Float switch	1 pc.	
Control panel	2 Ls.	
2. Electric facilities		
Concrete pole	28 poles	H=12 m (for High tension)
- do -	1 poles	H= 9 m (for Low tension)
Conductor	3ϕx1.41 km	50 sqm (for High tension)
- do -	1ϕx20 m	35 sqm (for Low tension)
Transformer, attachment	1 set	22KV - 380/220V
Appertenant parts	1 set	Guy wire, Arm Anchor slab

FIGURES

F I G U R E S L I S T


RID Canal
Mun river
Phimai dam
Project site
5Km

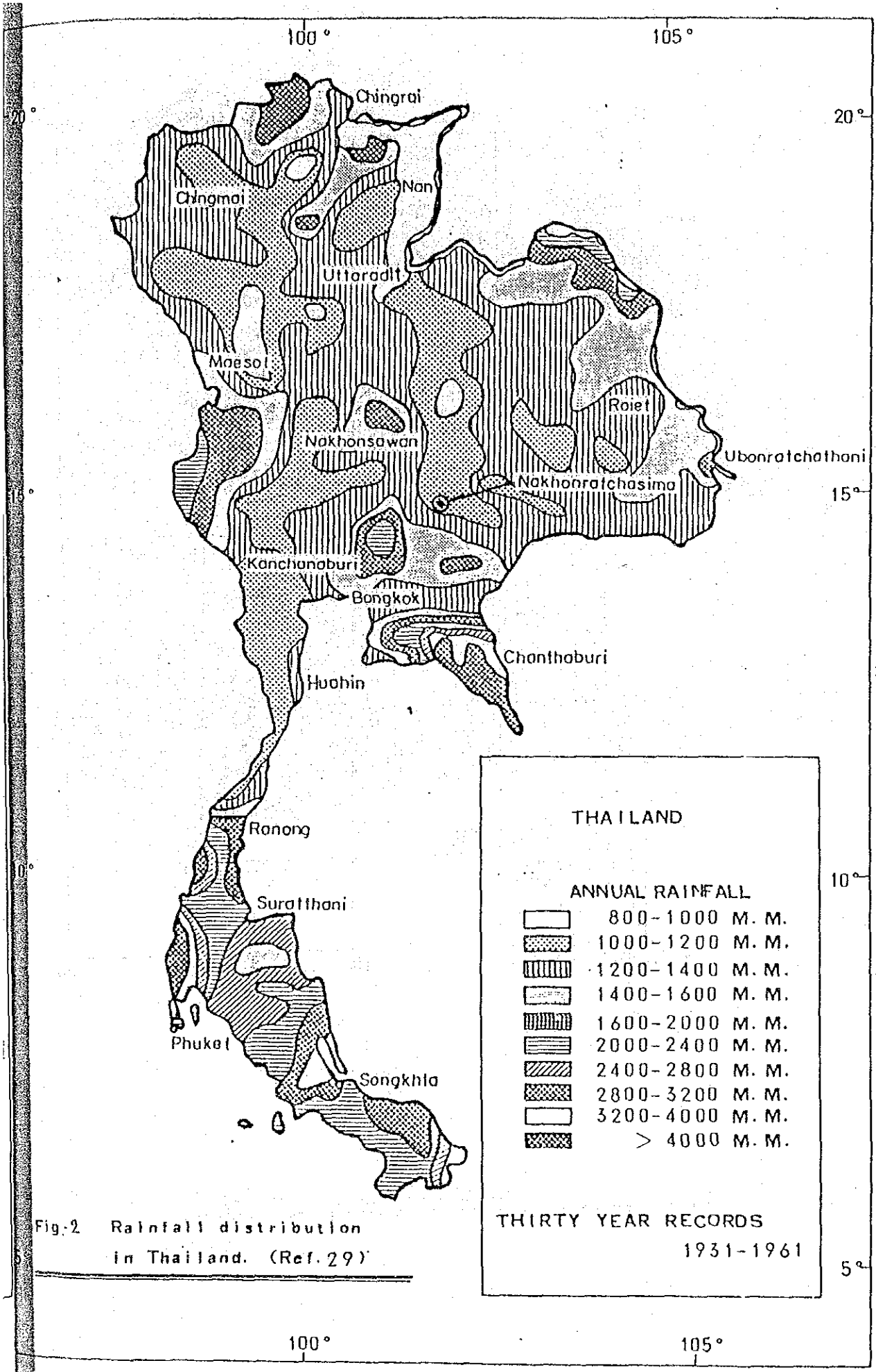


Fig.2 Rainfall distribution in Thailand. (Ref. 29)

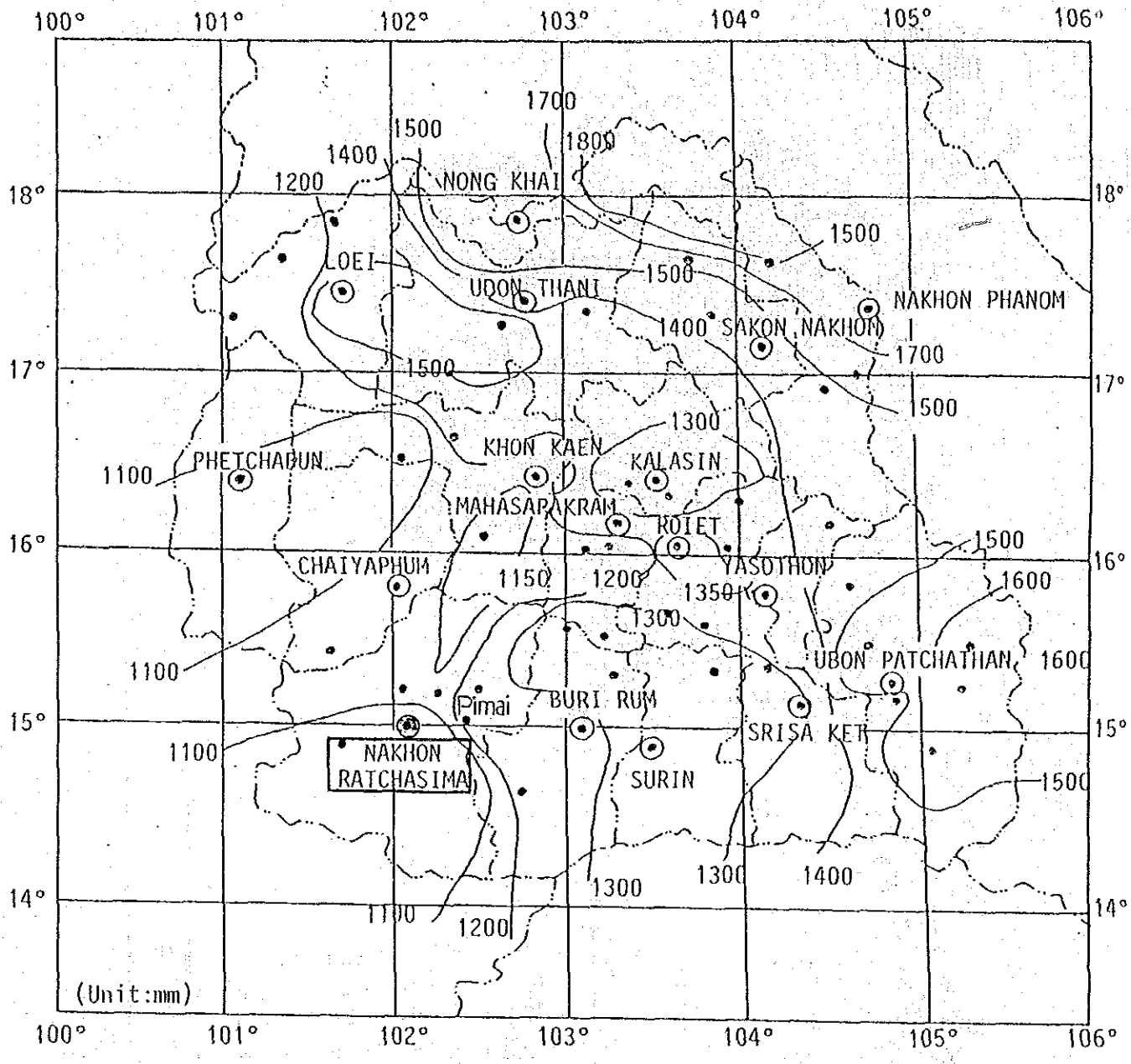


Fig.3 Isohyets for Mean Annual Rainfall (Ref. 1)

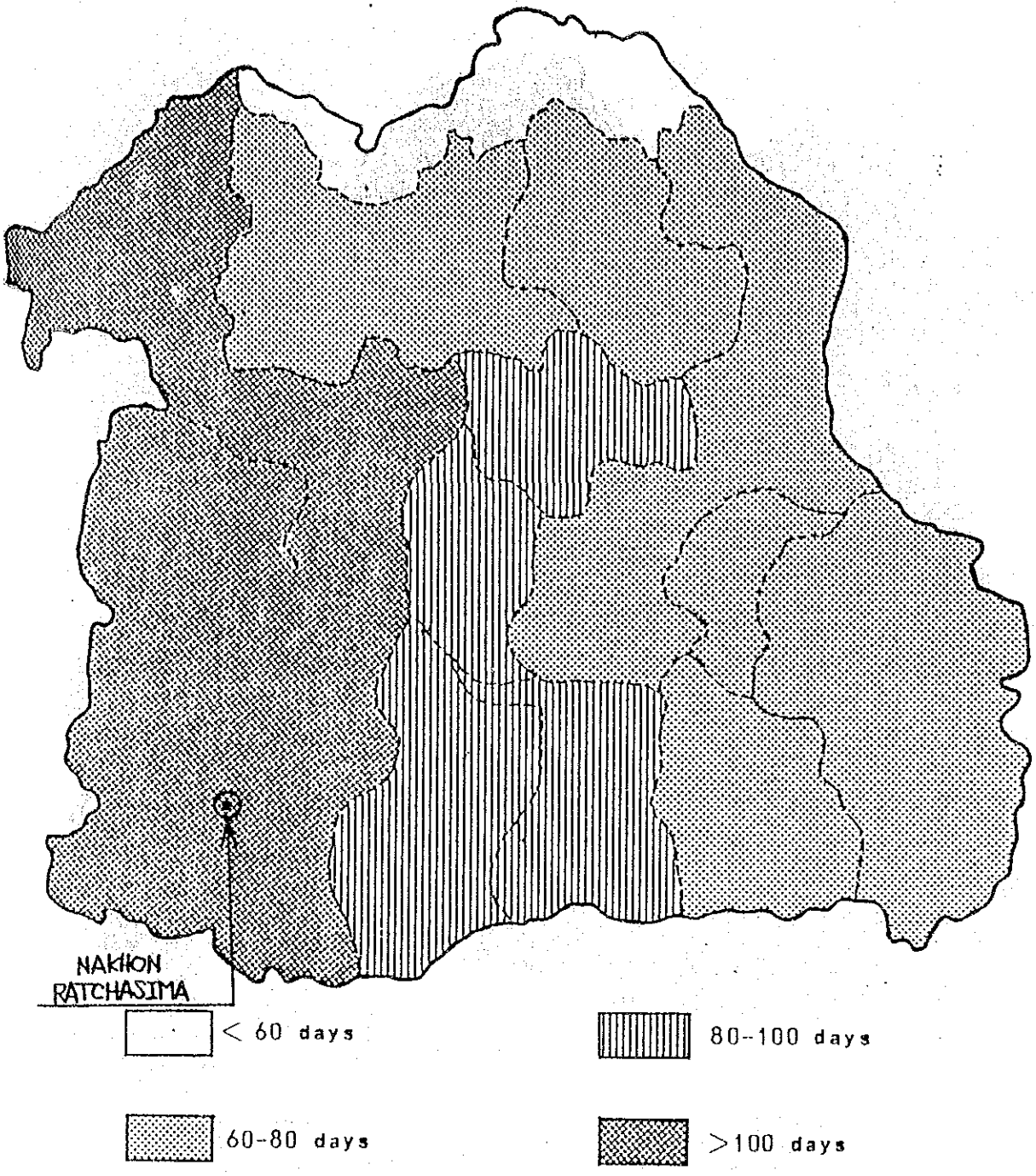


Fig. 4 Number of total drought days (calculated for paddy) for the period of May to October (Ref. 13, Original source: ESCAP 1974).

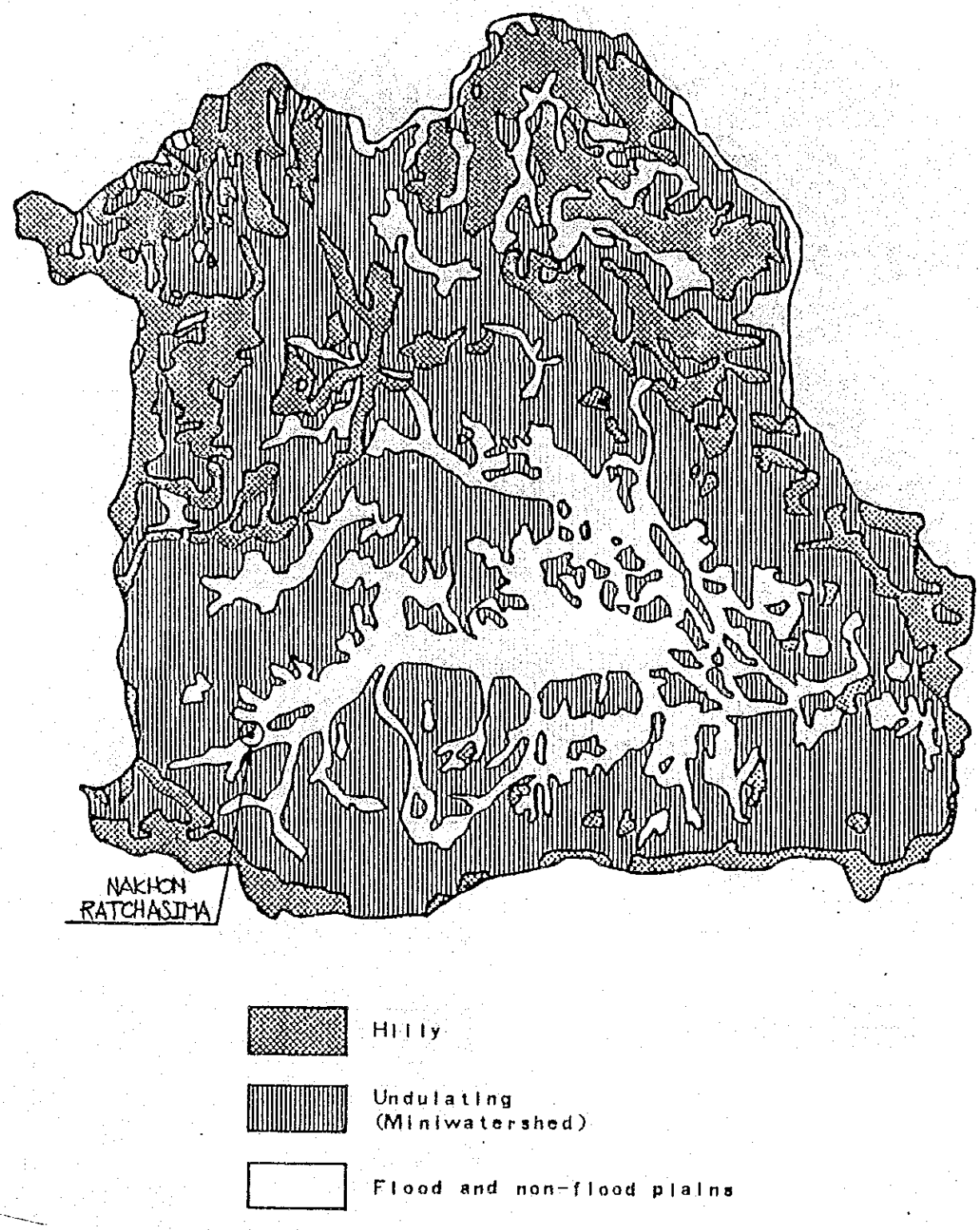


Fig - 5 Land form map of the Northeast (Ref. 13 Original source; Department of Land Development, 1972).

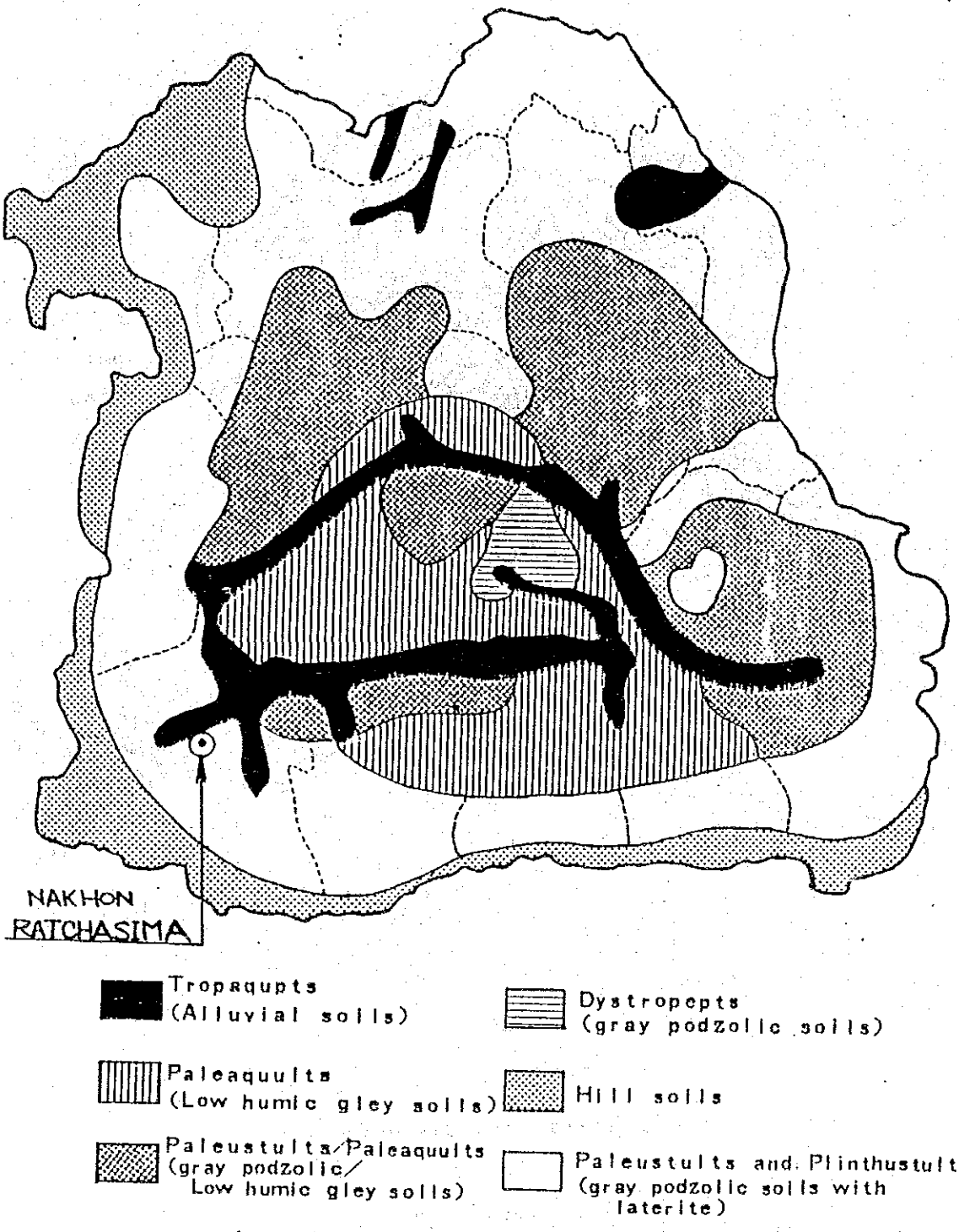


Fig - 6 Simplified soil map of Northeast Thailand (Ref. 13)
Original source: Dept. of Land Development, 1979).

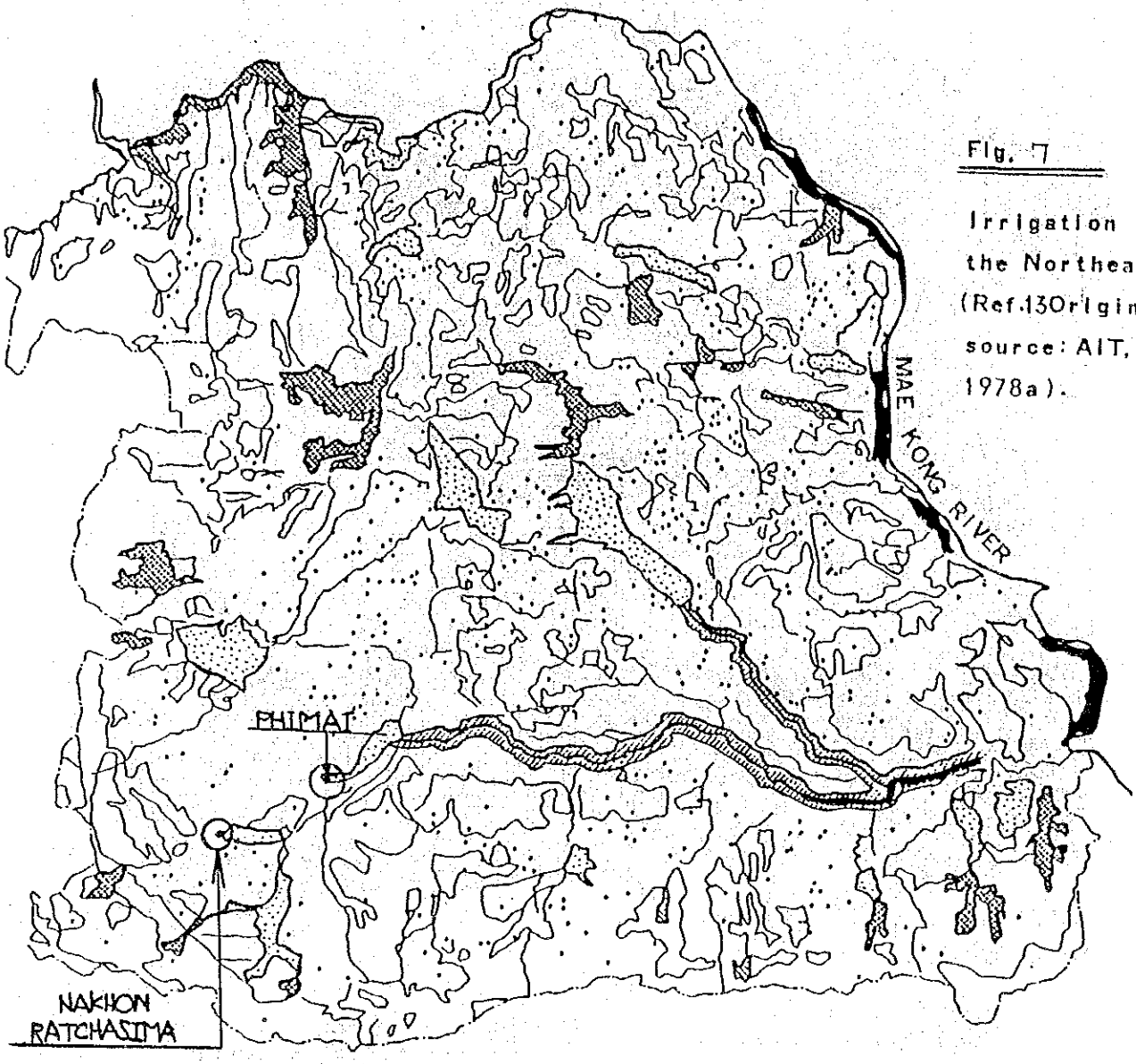


Fig. 7

Irrigation in the Northeast (Ref.13Original source: AIT, 1978a).

- Small tanks (completed and planned)
- Dry season
- Wet season

} Pump irrigation (existing and potential)

- Reservoir
- Irrigated area

} Irrigation from large reservoir (existing and potential)

Fig - 8

Soil Salinity Distribution in the Northeast

(Provided by : Land Development Department)

LEGEND

Mapping unit	Description	Area Rai	Area %
1	Severely salt-affected area	1,476,762	1.40
2	Moderately salt-affected area	3,690,349	3.50
3	Slightly salt-affected area	12,645,735	11.98
4	Potential salt source area	19,423,774	18.41
5	Non-salt-affected area	67,400,262	63.86
6	Reservoir	897,080	0.85
	Total	105,533,962	100.00

INDEX MAP

CONVENTIONAL SYMBOLS

- Changwat
- Amphoe
- Road
- Railroad
- International Boundary
- Changwat Boundary
- River , Khlong
- Water, Dam

Phimai

Nakhon Ratchasima

SCALE = 5,000,000

SOIL SURVEY DIVISION BANGKOK ,1978

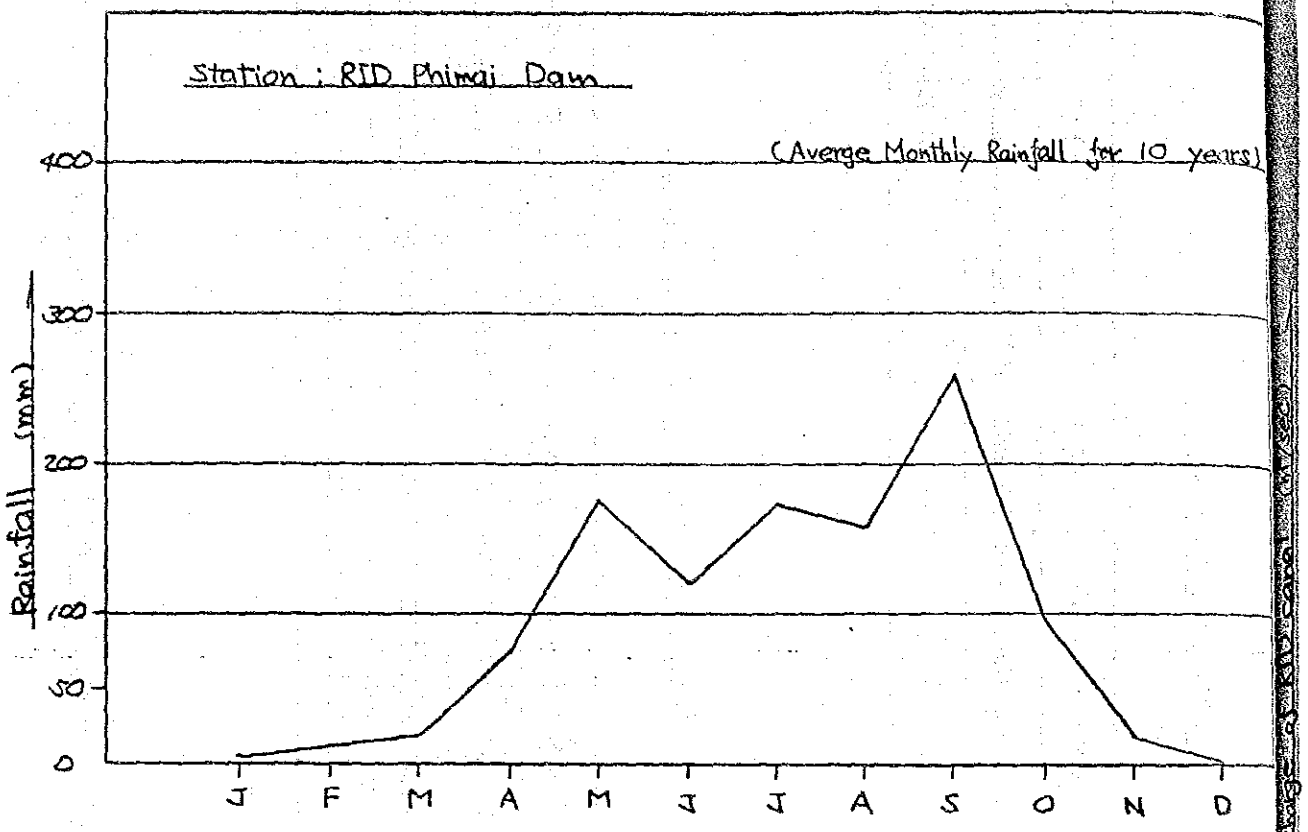
Observation period of rainfall (daily)

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
RID Gate Station	Apr.									Nov.
Phimai Cooperative									July	

Observation period of Gate operation by RID

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Water level of Gate-upstream										
Discharge of Mun river										
Discharge of RID Canal										

Fig - 9 Observation period of rainfall and Gate operation at Mun river



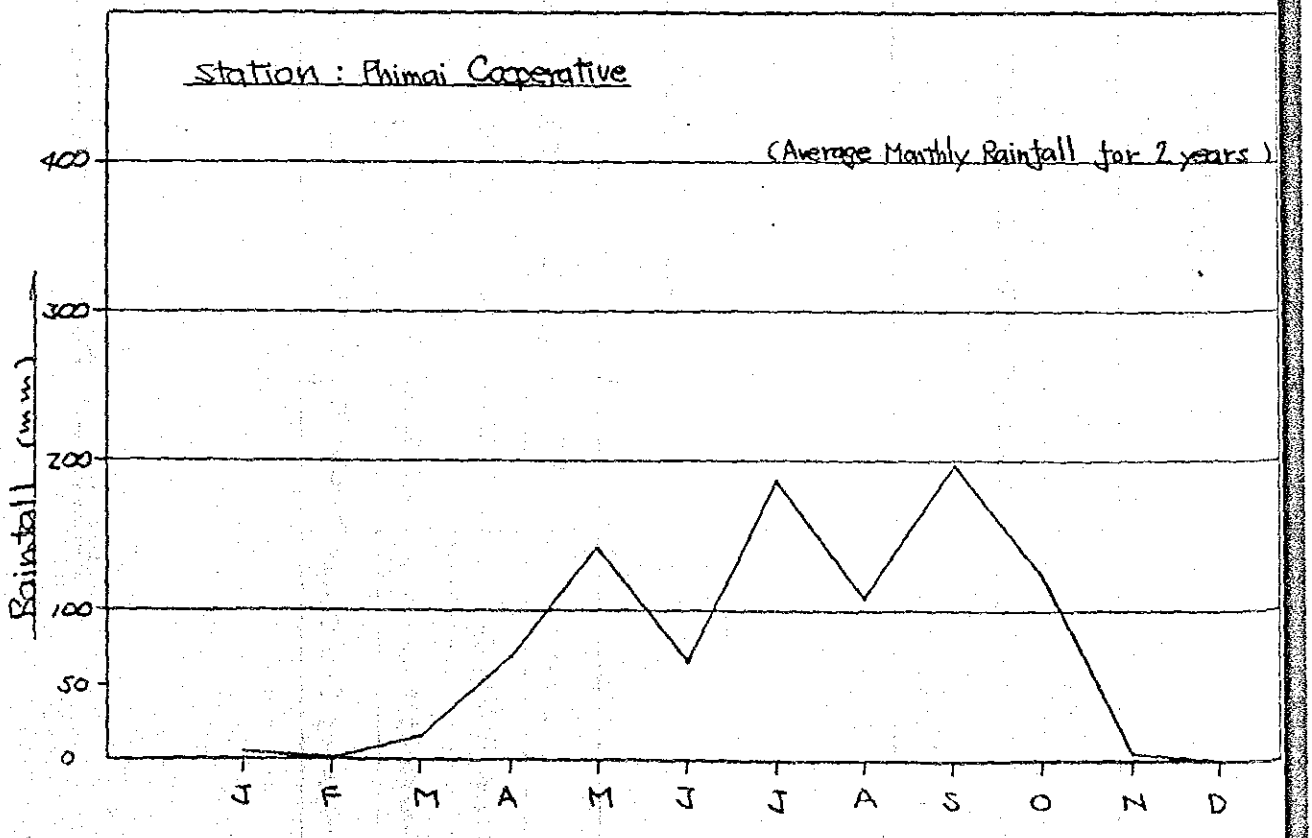


Fig - 10 Monthly Rainfall

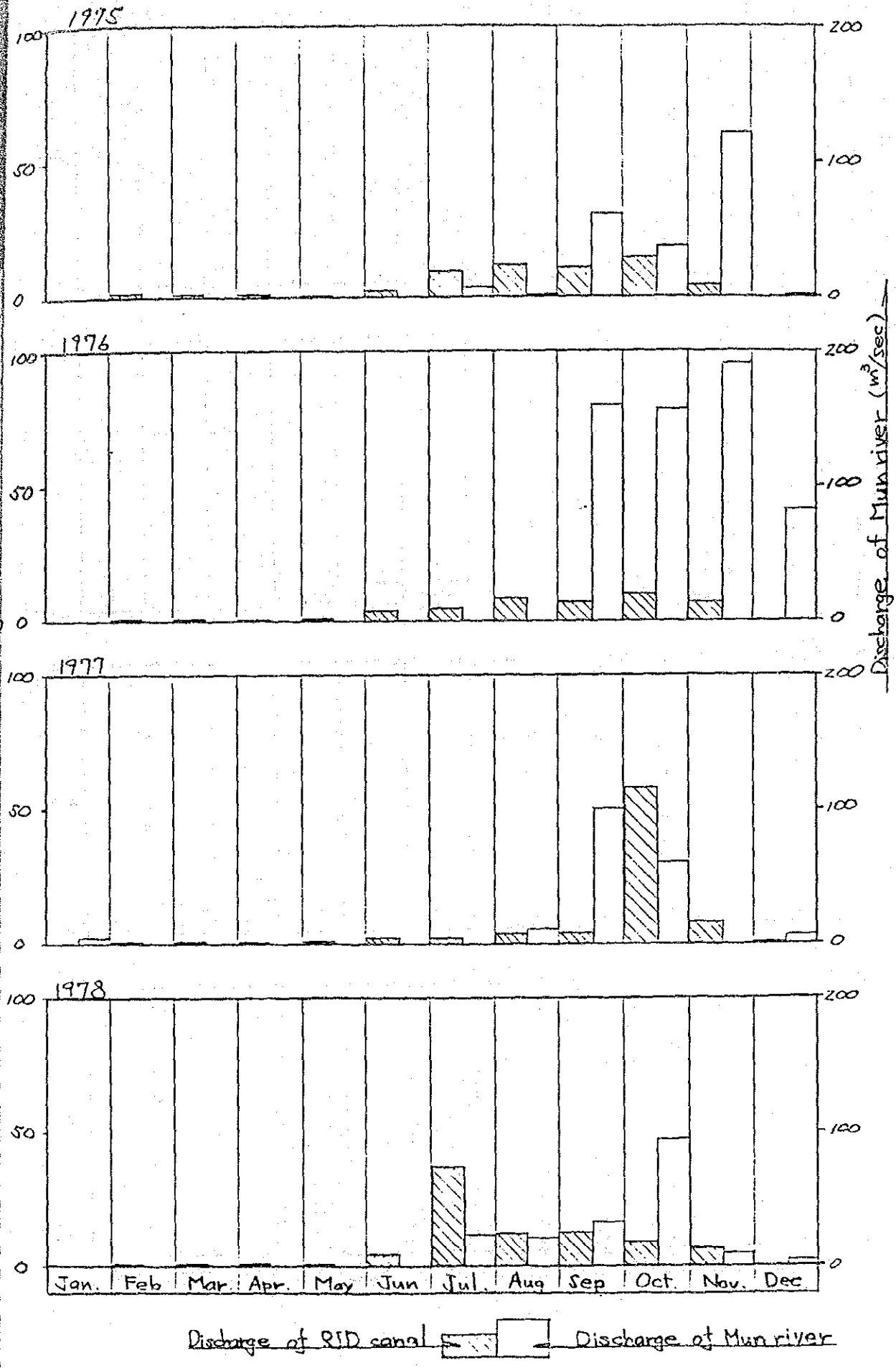
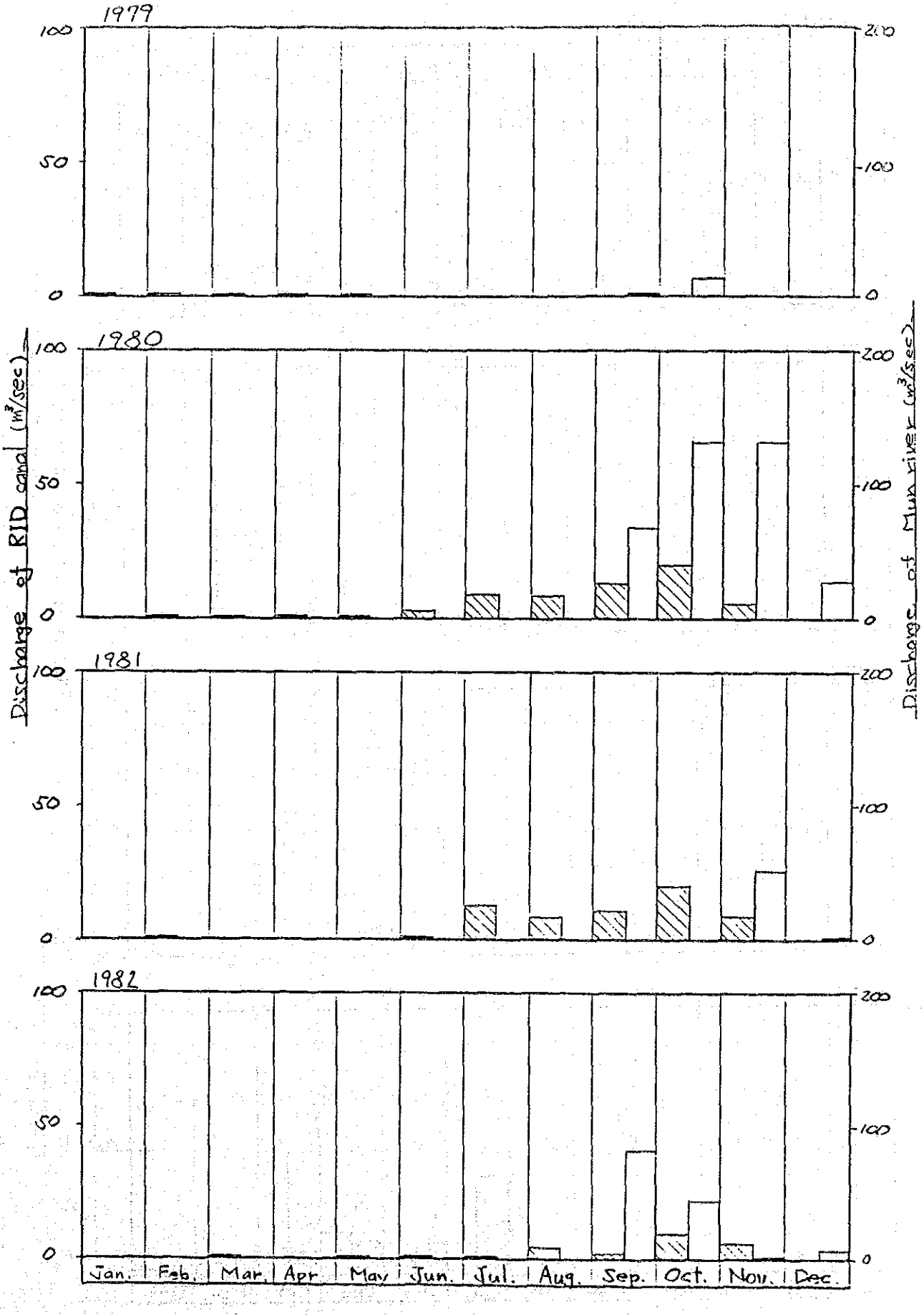
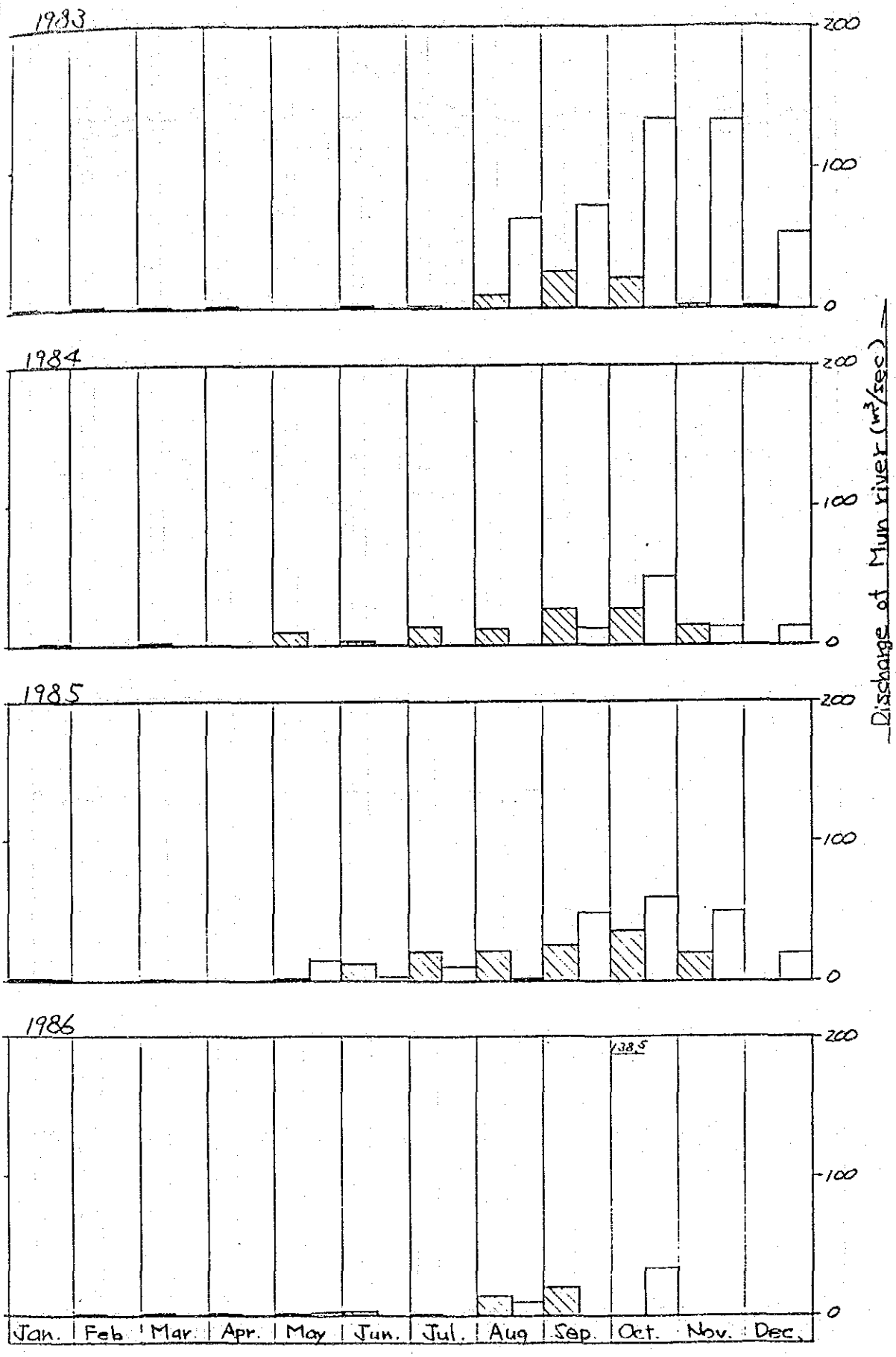


Fig-11 Average monthly discharge at RID Canal and Mun River


1979
1980
1981
1982
100
50
0
200
100
0
Discharge of RID canal (m³/sec)
Discharge of Mun river (m³/sec)
Jan.
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.


1983
1984
1985
1986
200
100
0
138.5
Jan.
Feb
Mar.
Apr.
May
Jun.
Jul.
Aug
Sep.
Oct.
Nov.
Dec.
Discharge of Mun river (m³/sec)

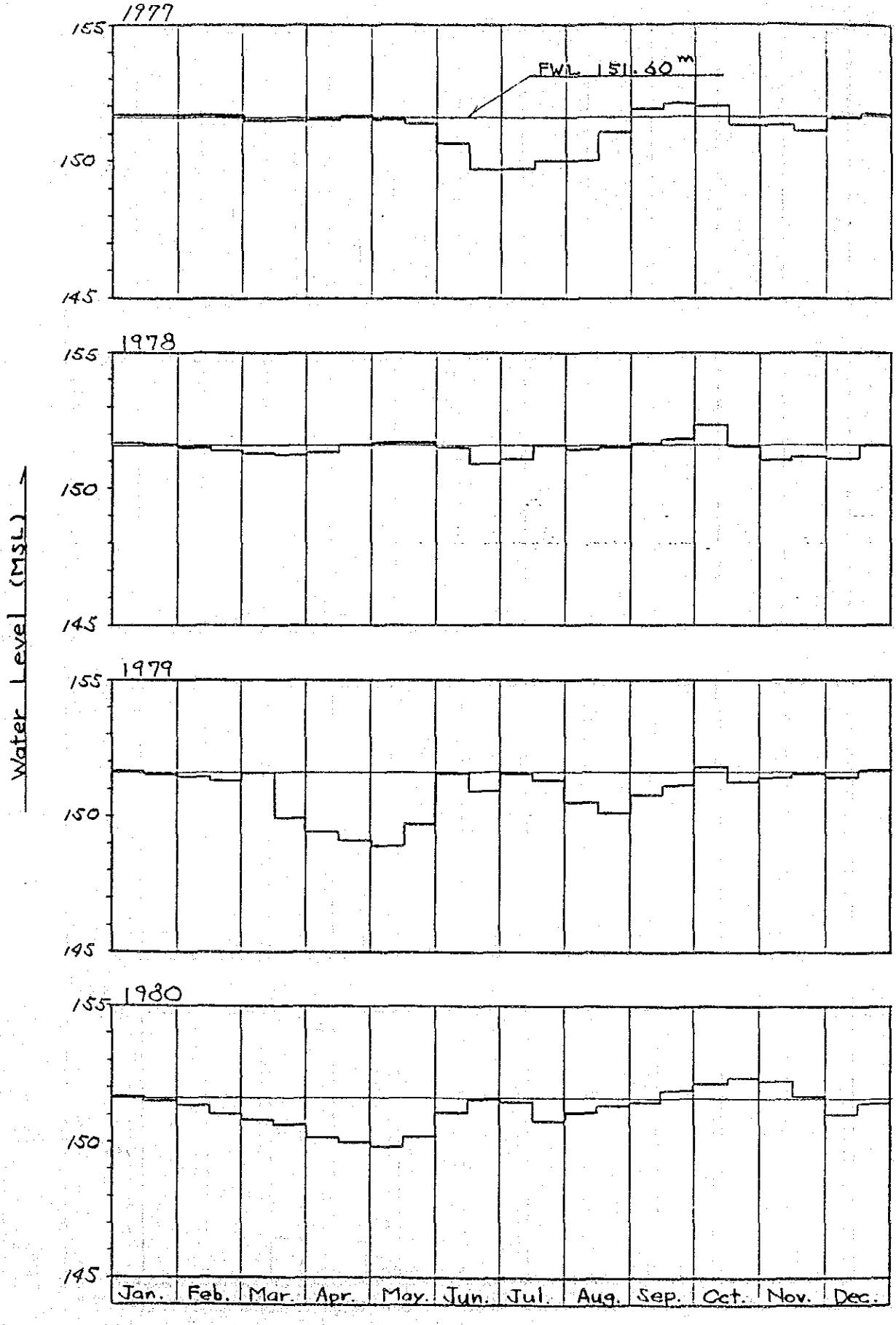
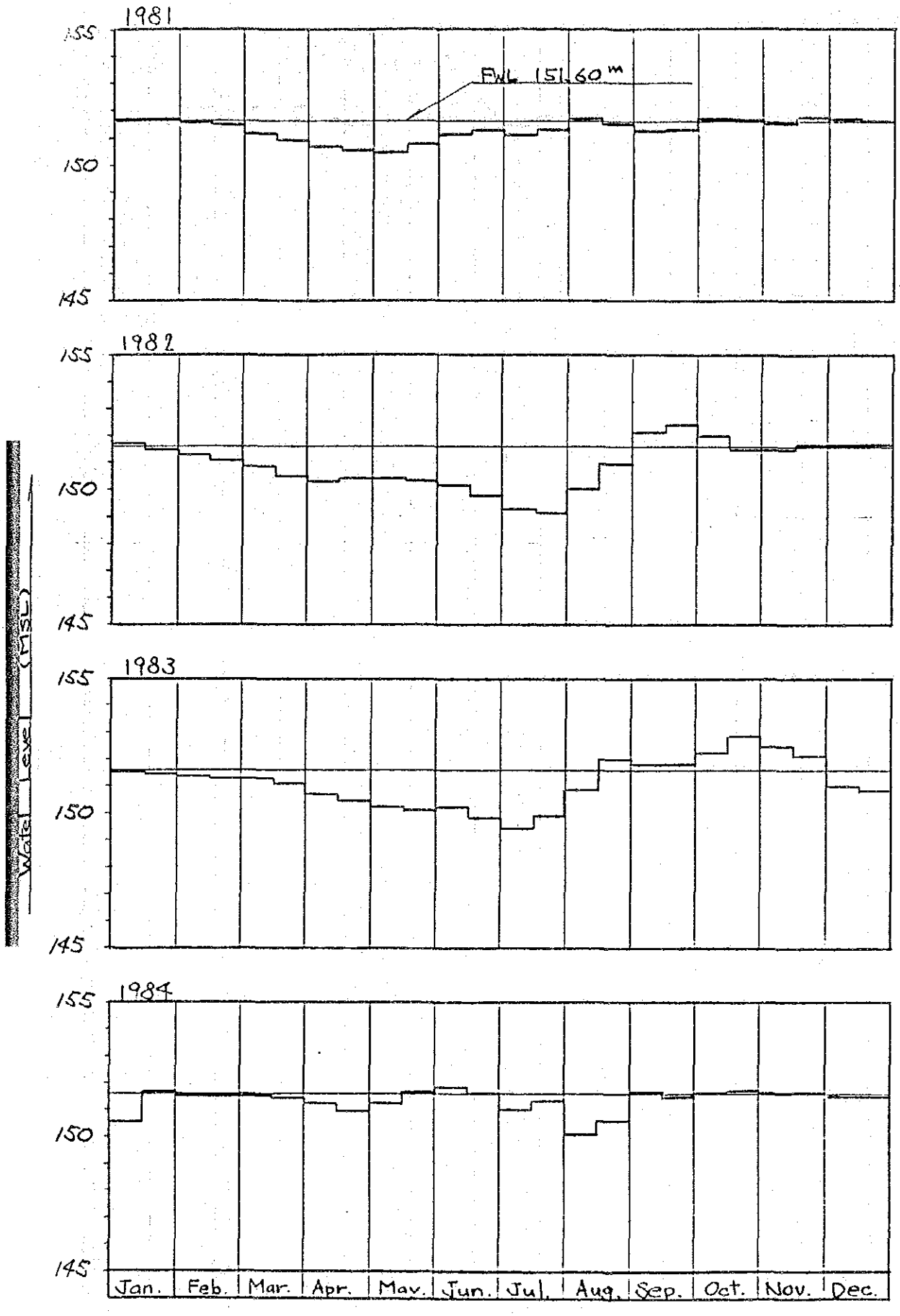
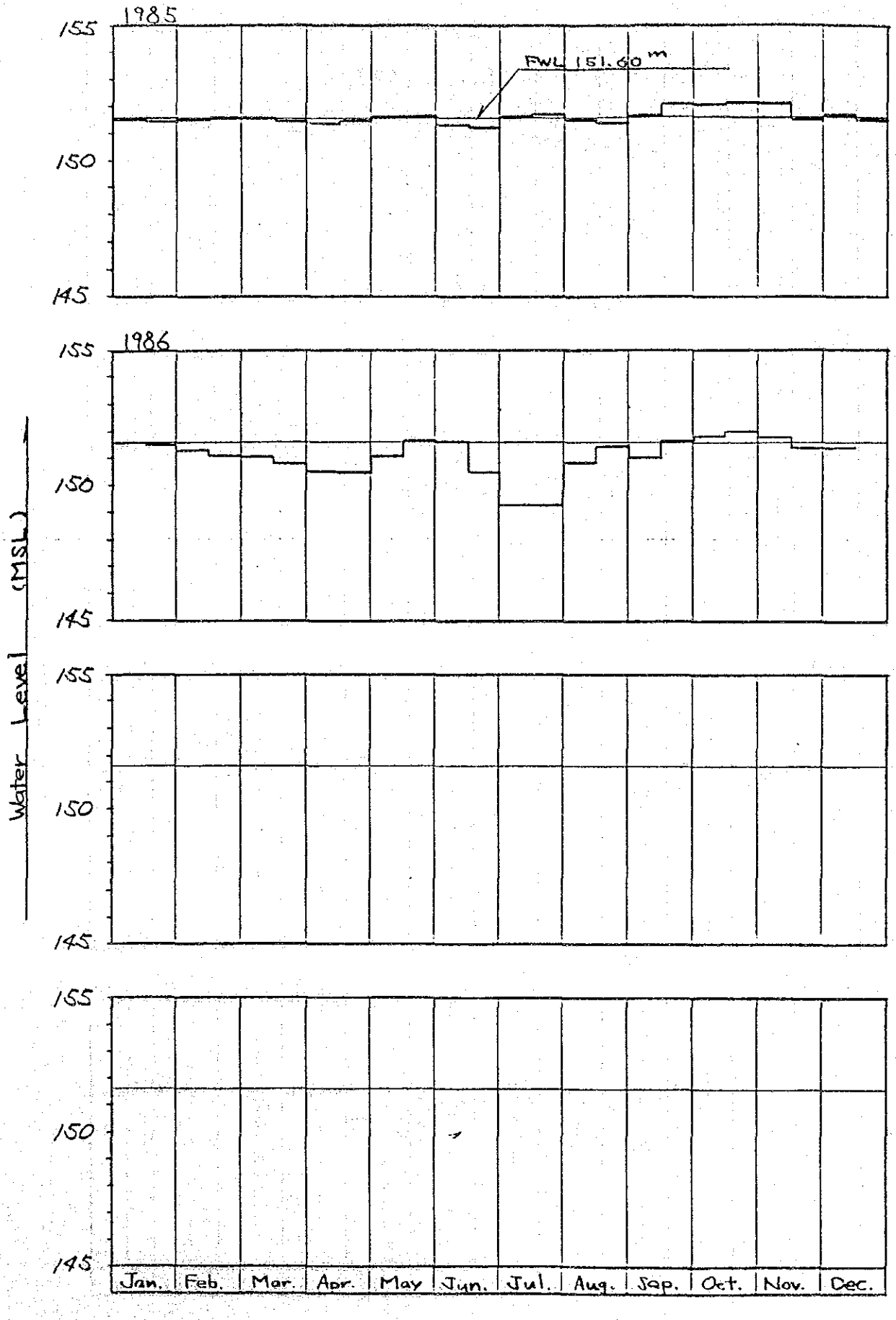


Fig - 12 Water level at Upstream at Phimai Dam


1981
155
150
145
FWL 151.60 m
1982
155
150
145
1983
155
150
145
1984
155
150
145
Water Level (MSL)
Jan.
Feb.
Mar.
Apr.
May.
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.


1985
FWL 151.60 m
155
150
145
1986
155
150
145
155
150
145
155
150
145
Water Level (MSL)
Jan.
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.

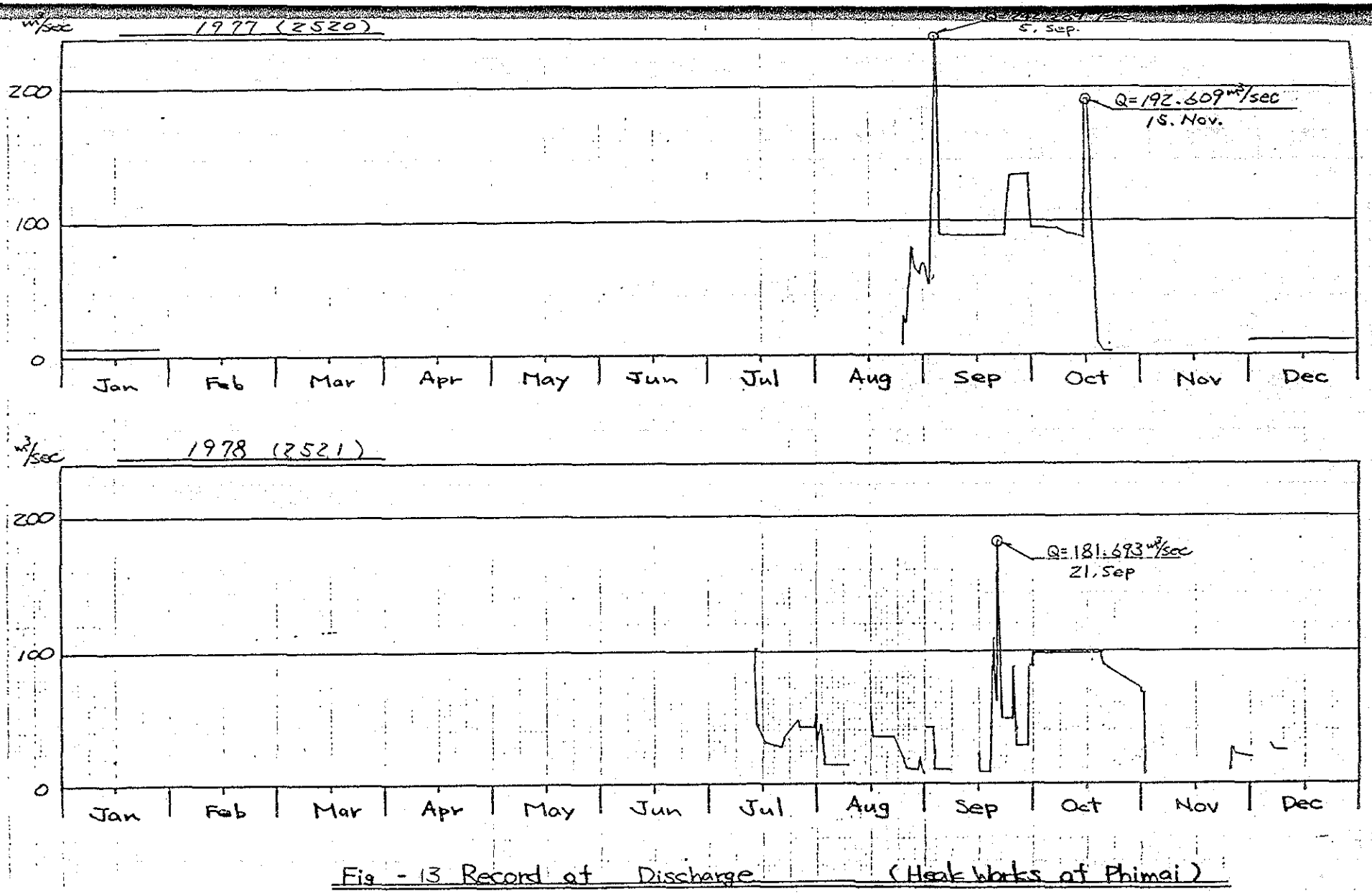
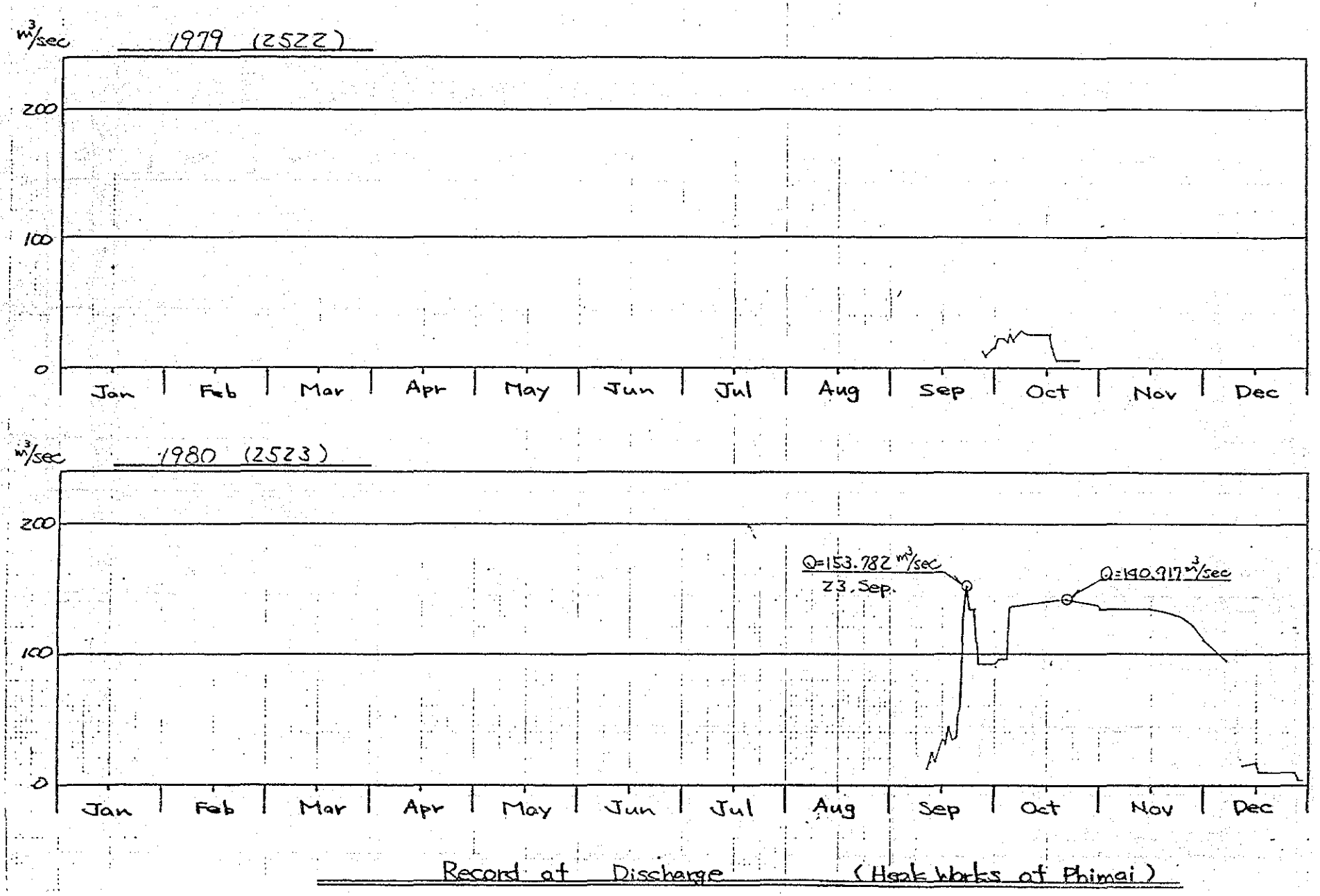
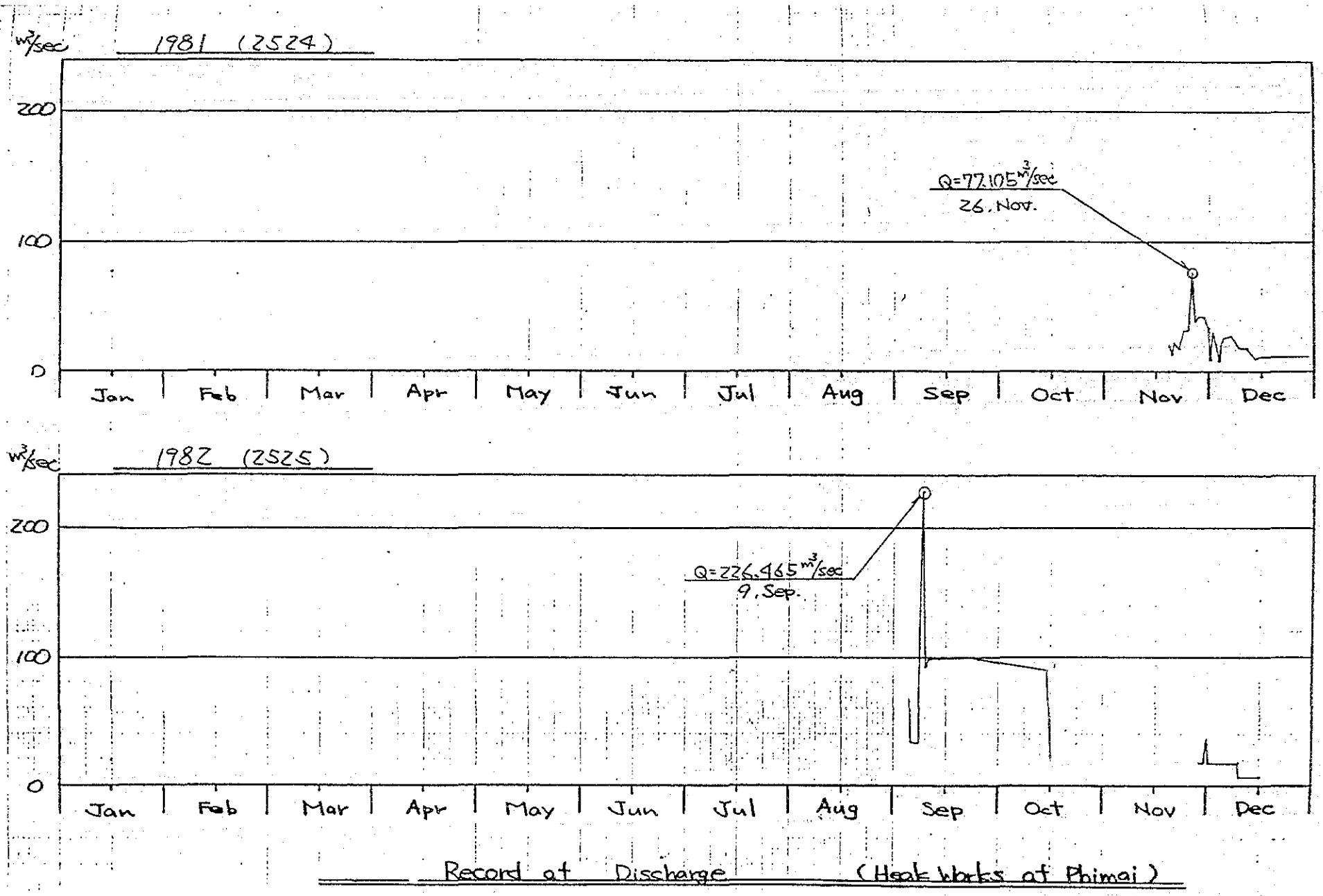


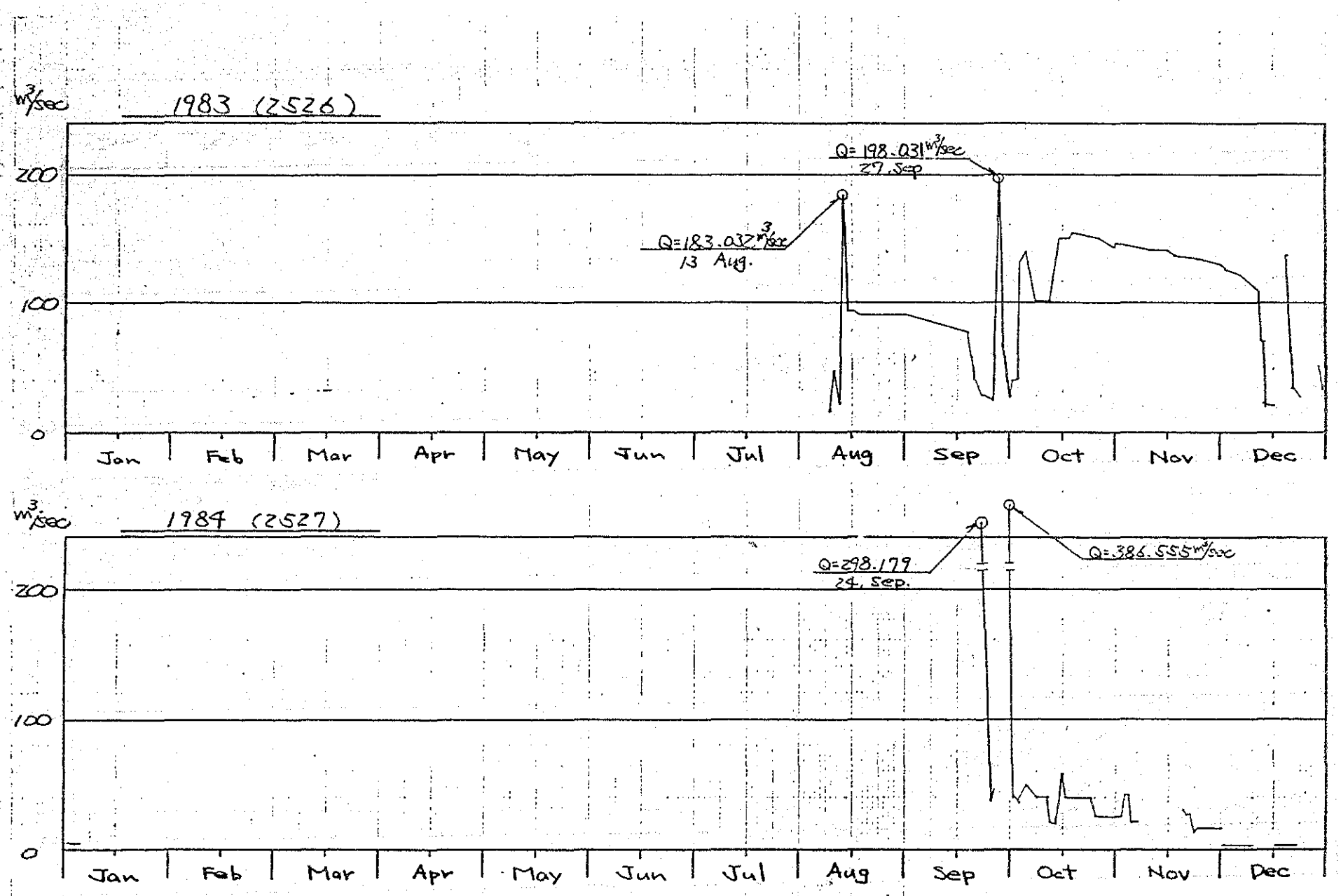
Fig - 13 Record of Discharge (Heak Works at Phimai)



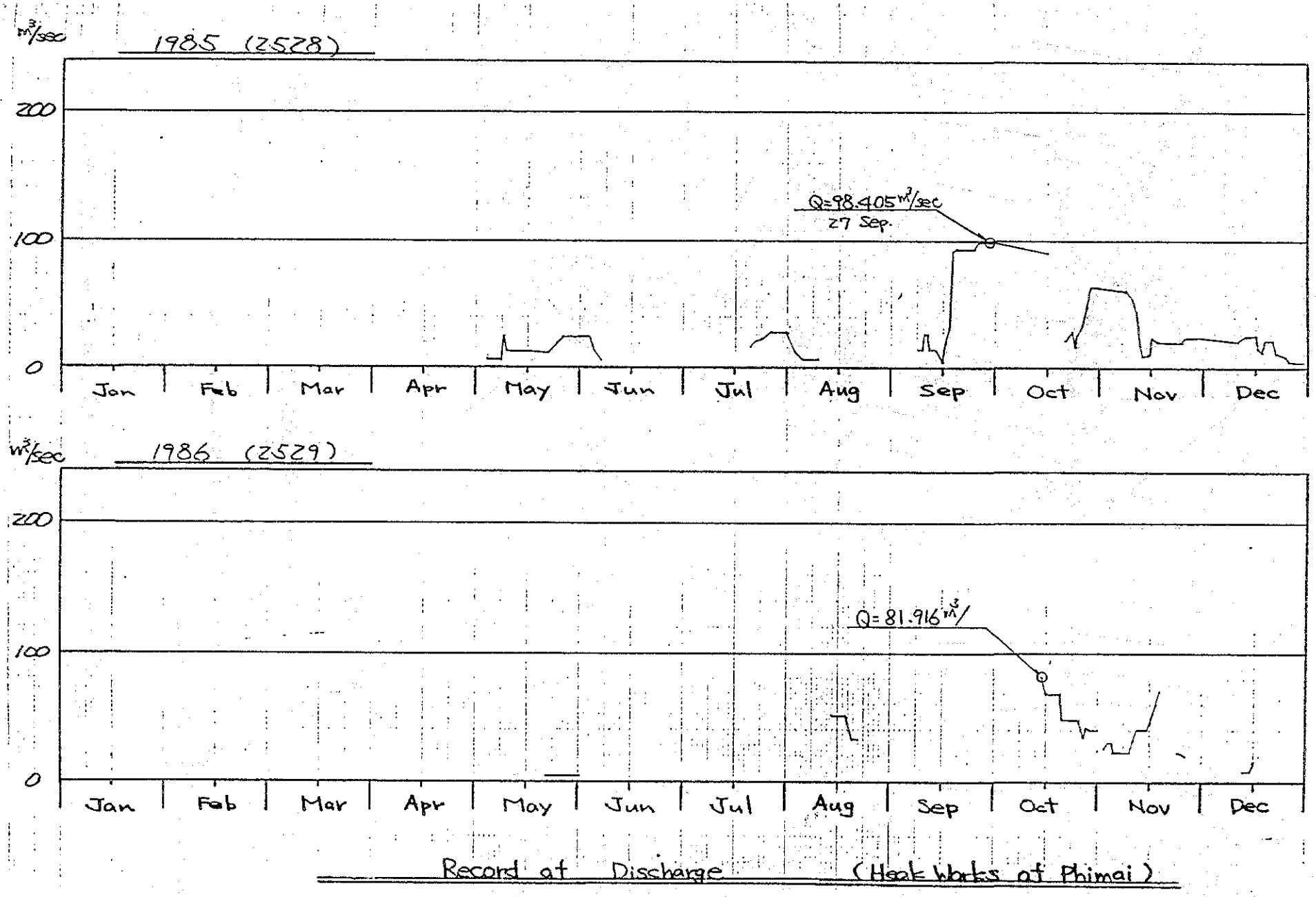
Record at Discharge (Hook Works at Phimai)



Record at Discharge (Heak Works at Phimai)



Record of Discharge (Hoabinhbo at Phimai)



Record at Discharge (Hoak Works at Phimai)

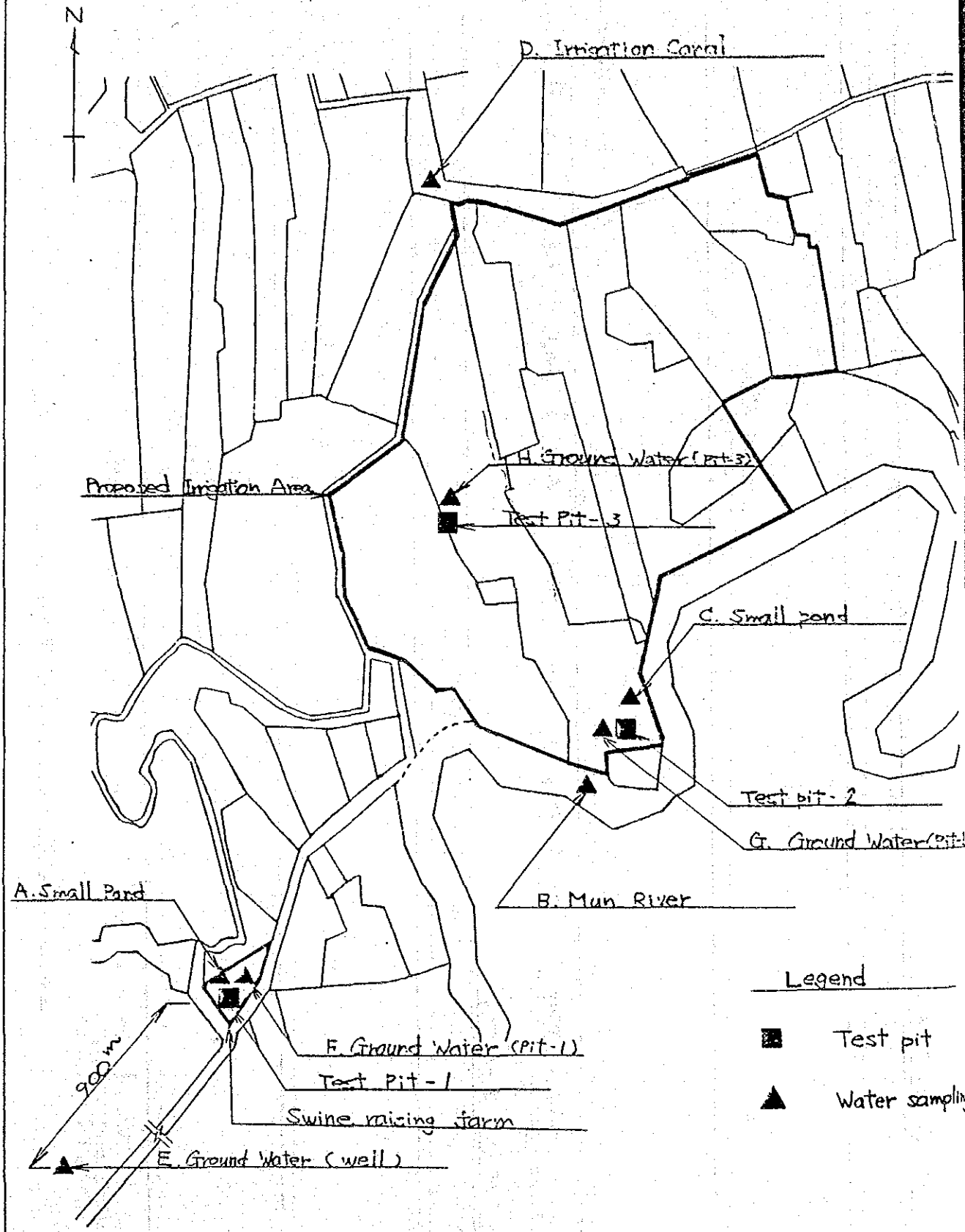


Fig-14 Location of Test pits and Water sampling

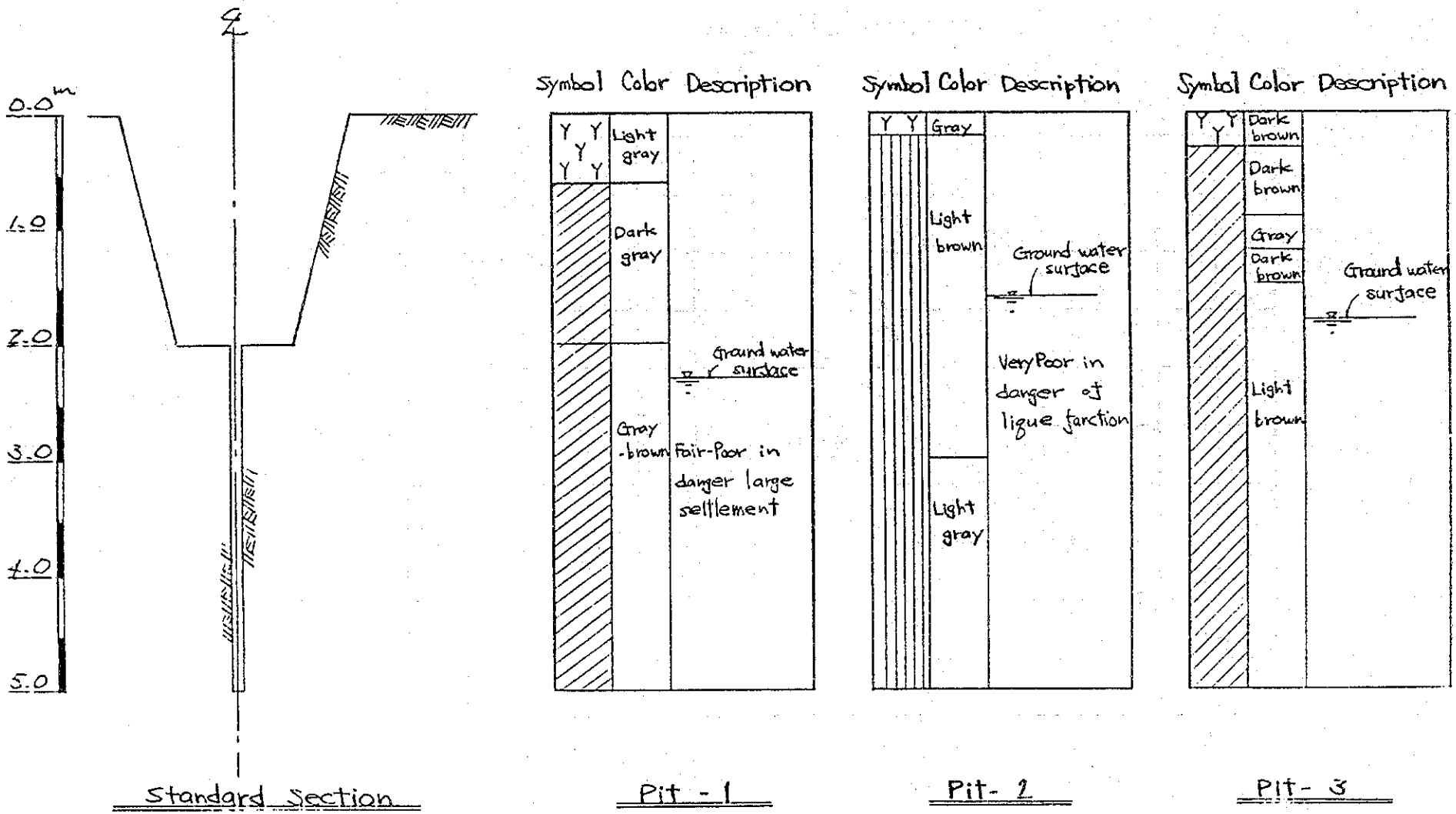


Fig -15 Columar section of Test pits

Consistency Index

Pit - 1 $I_c = 0.9$

Pit - 3 $I_c = 1.3$

Liquidity Index

Pit - 1 $I_L = 0.1$

Pit - 3 $I_L = -0.3$

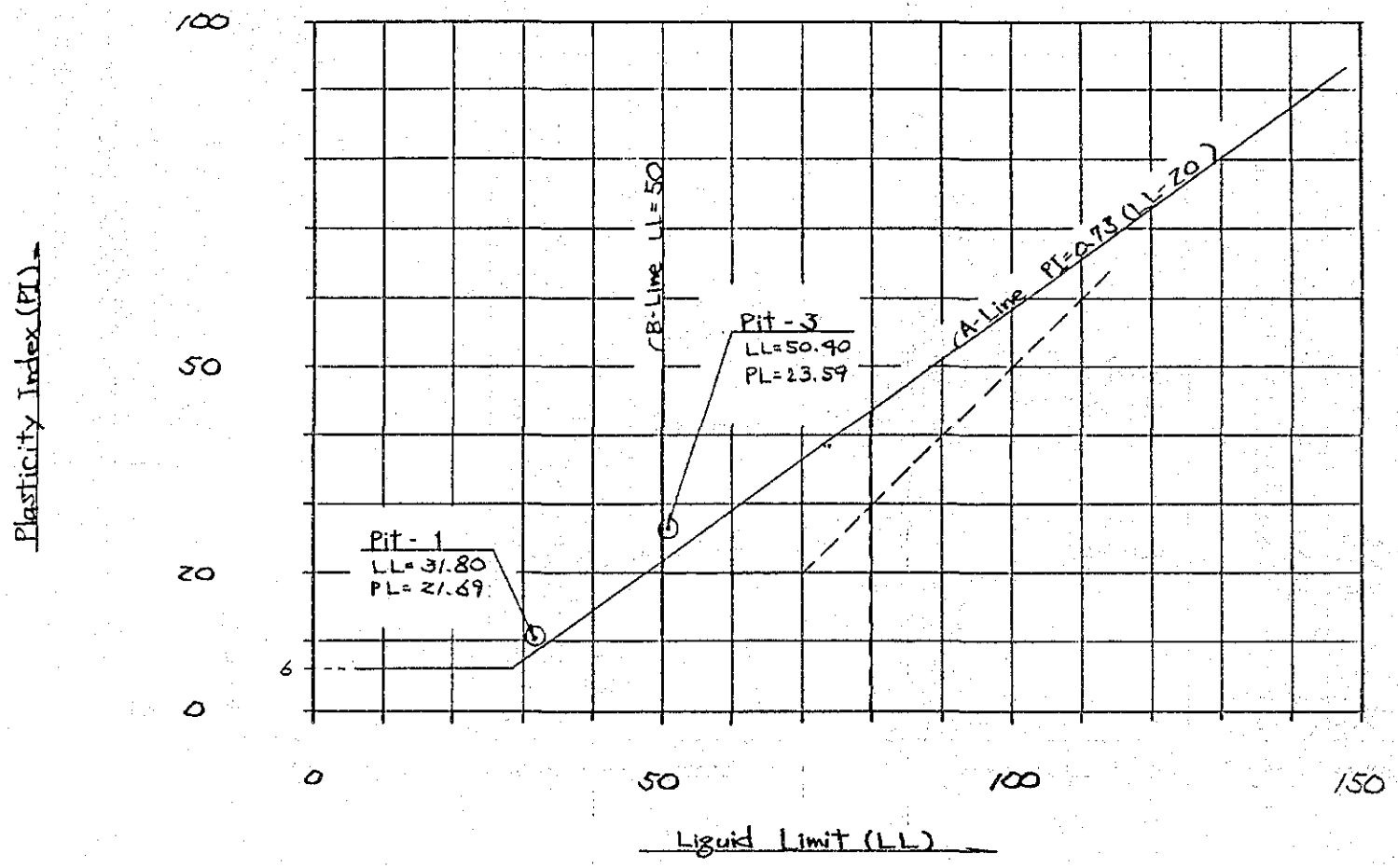


Fig-16 Consistency Limits

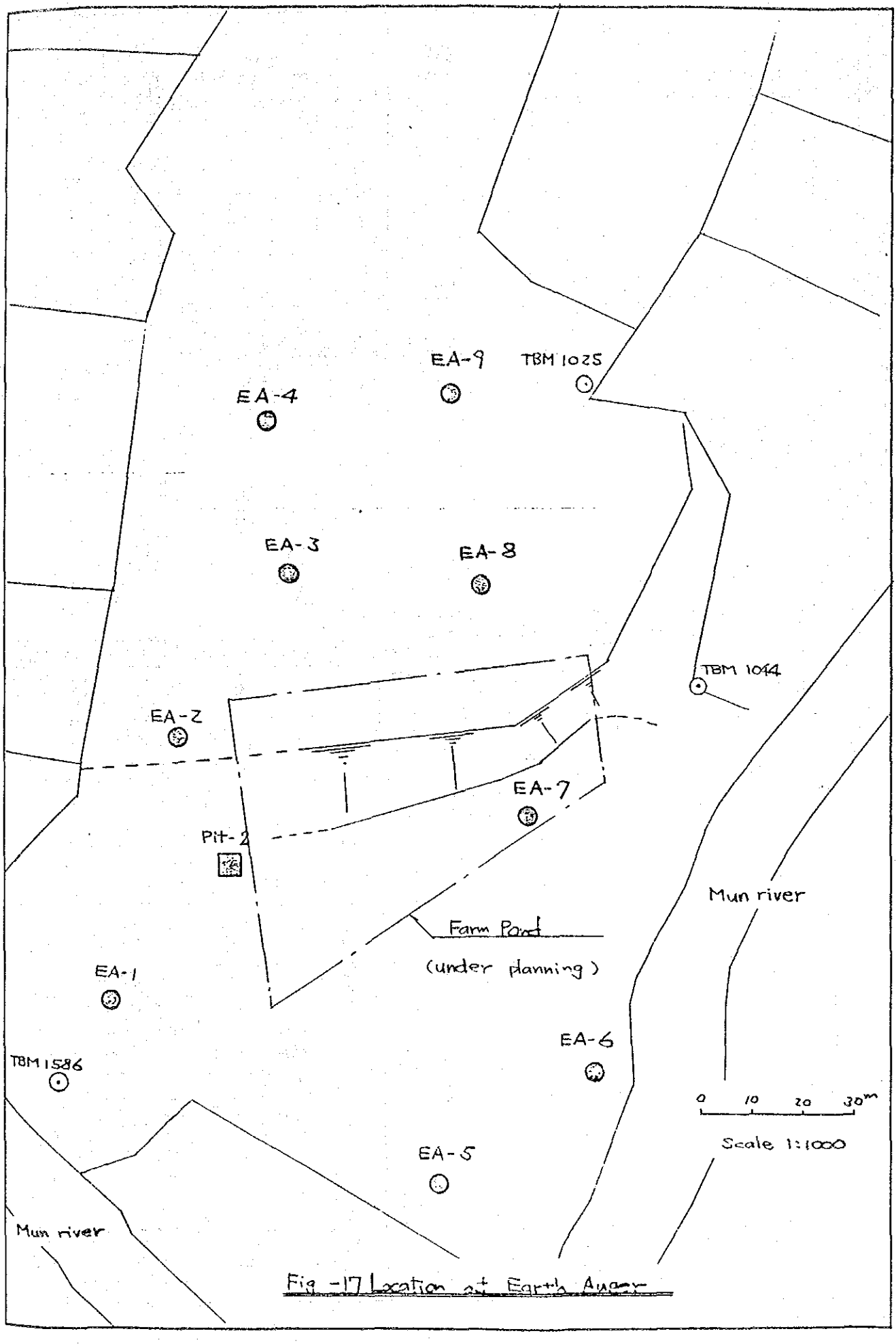


Fig -17 Location of Earth Auger

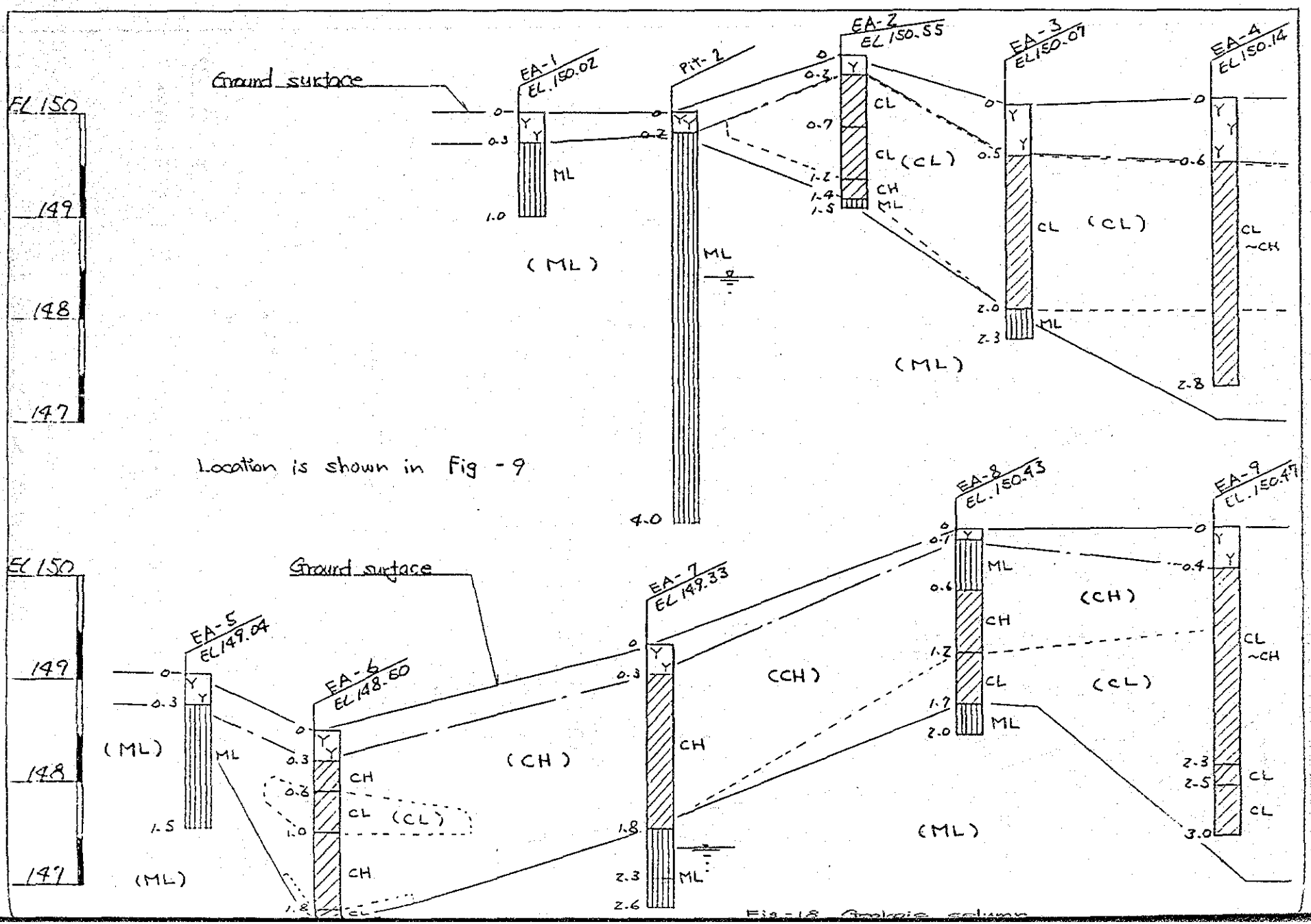
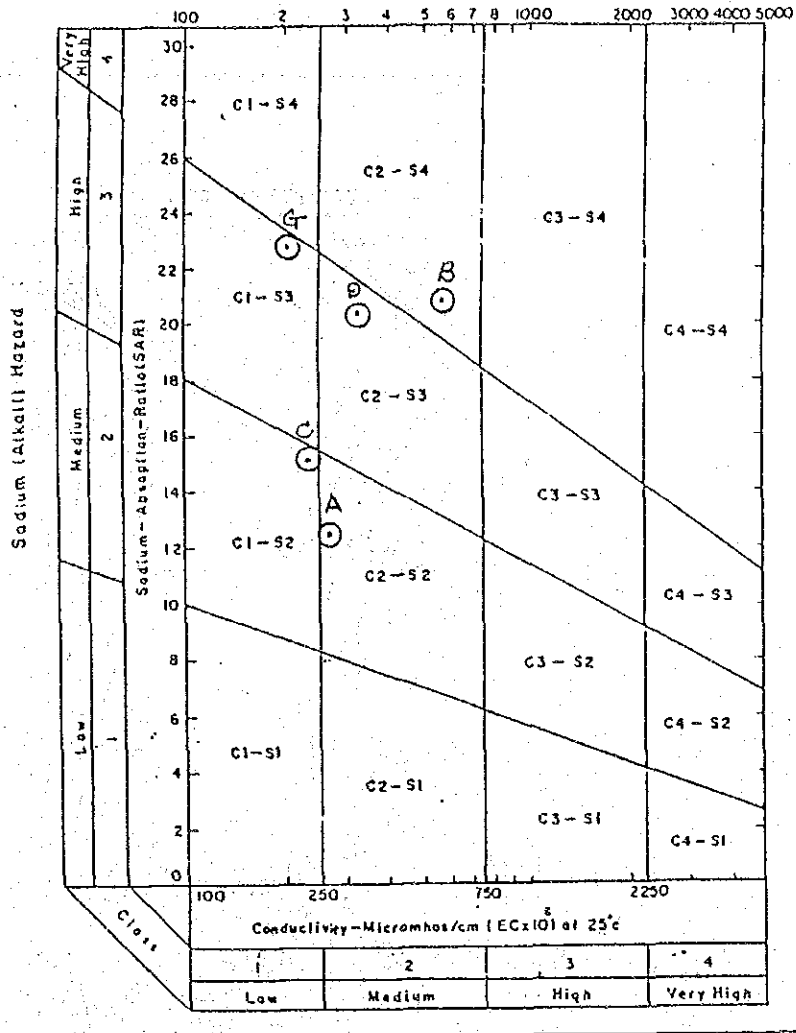


Fig - 8 Geologic column

Fig.19 WATER QUALITY CLASSIFICATION



H ⊙ EC : 1340 SAR : 36.3

F ⊙ EC : 11,200 SAR : 184.9

E ⊙ EC : 4200 SAR : 21.3

Low sodium water can be used for irrigation in almost all soils with little danger of the development of harmful levels of exchangeable sodium. However, sodium sensitive crops such as stonefruit trees and avocados may accumulate injurious concentrations of sodium.	C_1	Low salinity water can be used for irrigation with most crops on most soils with little likelihood, that soil salinity will develop. Some leaching is required but this occurs under normal irrigation practices, except in soils of extremely low permeability.
Medium water will present an appreciable sodium hazard in fine textured soils having high cation exchange capacity, especially under low leaching conditions unless gypsum is present in the soil. This water may be used on coarse textured or organic soils with good permeability.	C_2	Medium salinity water can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.
High sodium water may produce harmful levels of exchangeable sodium in most soils, and will require special soils management; good drainage, high leaching, and organic matter conditions. Gypsiferous soils may not develop harmful levels of exchangeable sodium from such waters. Chemical amendments may be required for replacement of exchangeable sodium, except that amendments may not be feasible in the case of waters of very high salinity.	C_3	High salinity water cannot be used on soils with restricted drainage, even with adequate drainage, special treatment for salinity control may be required, and plants with good salt tolerance should be selected.
Very high sodium water is generally unsatisfactory for irrigation pruposes, except at low and perhaps medium salinity where the solution of calcium from the soil or used of gypsum or other amendments may make the use of these waters feasible.	C_4	Very high salinity water is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special cercumstances. The soils must be permeable, drainage condition must be adequate, irrigation water must be applied in excess to provide consierable leaching and very salt-tolerance crops should be selected.

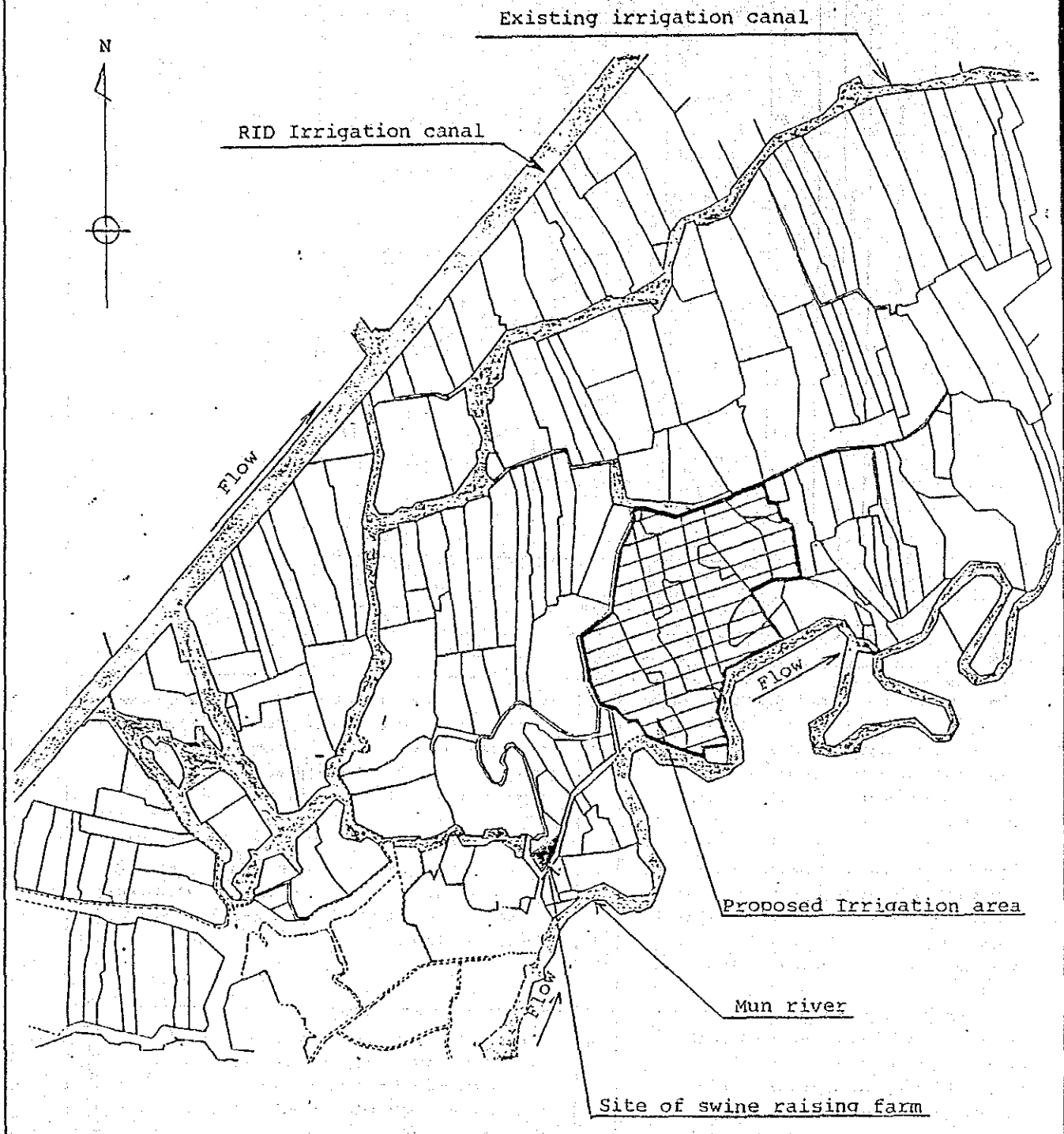
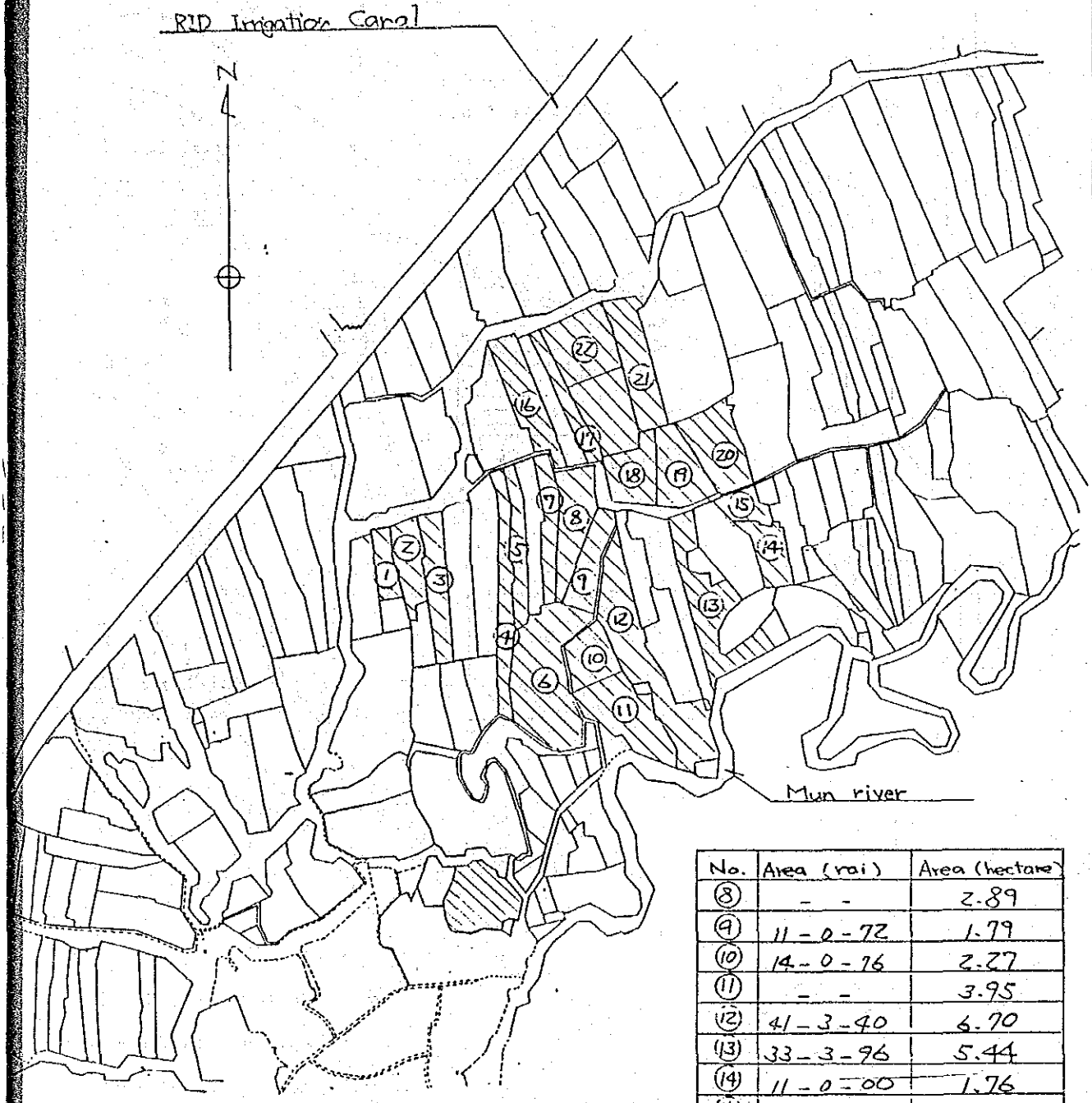


Fig.20 Location of swine raising farm and Proposed Irrigation area



No.	Area (rai)	Area (hectare)
①	12 - 1 - 64	1.99
②	12 - 0 - 60	1.94
③	16 - 0 - 60	2.58
④	- -	2.80
⑤	- -	2.20
⑥	- -	6.95
⑦	11 - 1 - 56	1.82

No.	Area (rai)	Area (hectare)
⑧	- -	2.89
⑨	11 - 0 - 72	1.79
⑩	14 - 0 - 76	2.27
⑪	- -	3.95
⑫	41 - 3 - 40	6.70
⑬	33 - 3 - 96	5.44
⑭	11 - 0 - 00	1.76
⑮	- -	1.16
⑯	20 - 0 - 52	3.22
⑰	- -	1.68
⑱	15 - 3 - 88	2.56
⑲	17 - 3 - 24	2.85
⑳	22 - 3 - 88	3.68
㉑	- -	3.42
㉒	22 - 3 - 08	3.64
Total		62.29

Fig -21 Area for Model Group

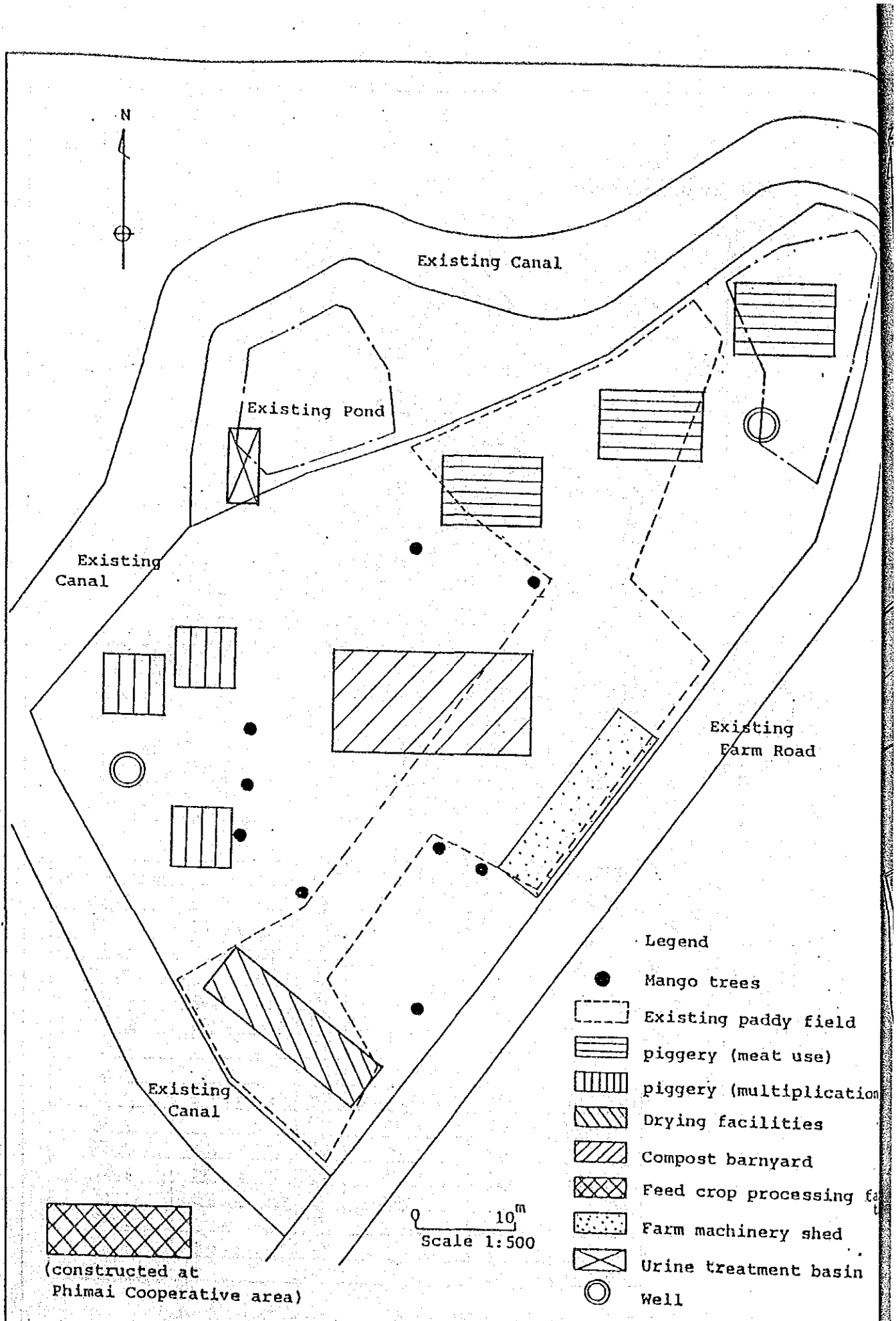
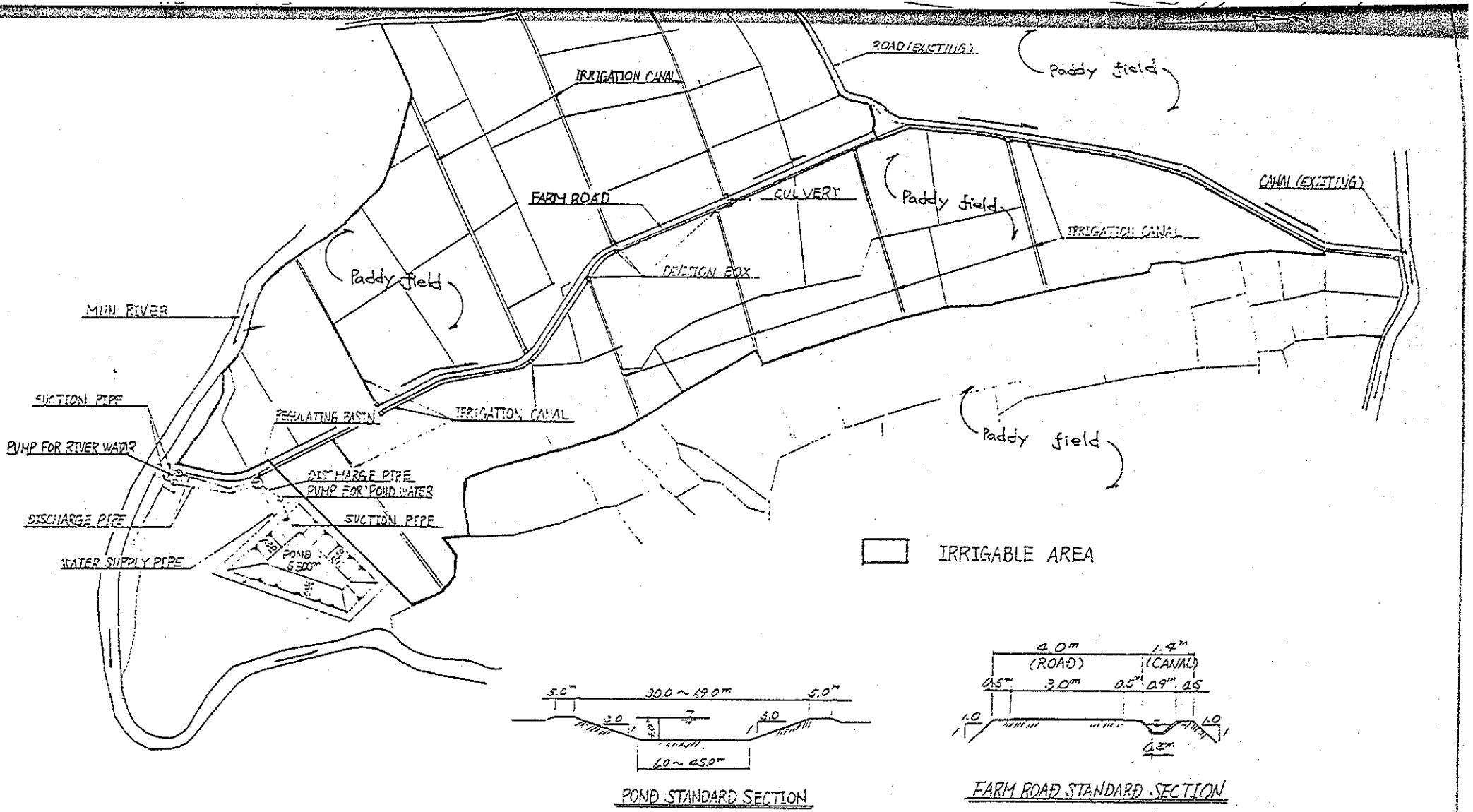


Fig.22 General Layout map at Swine raising farm



POND STANDARD SECTION

FARM ROAD STANDARD SECTION

Fig - 23 LAYOUT OF IRRIGATION SYSTEM