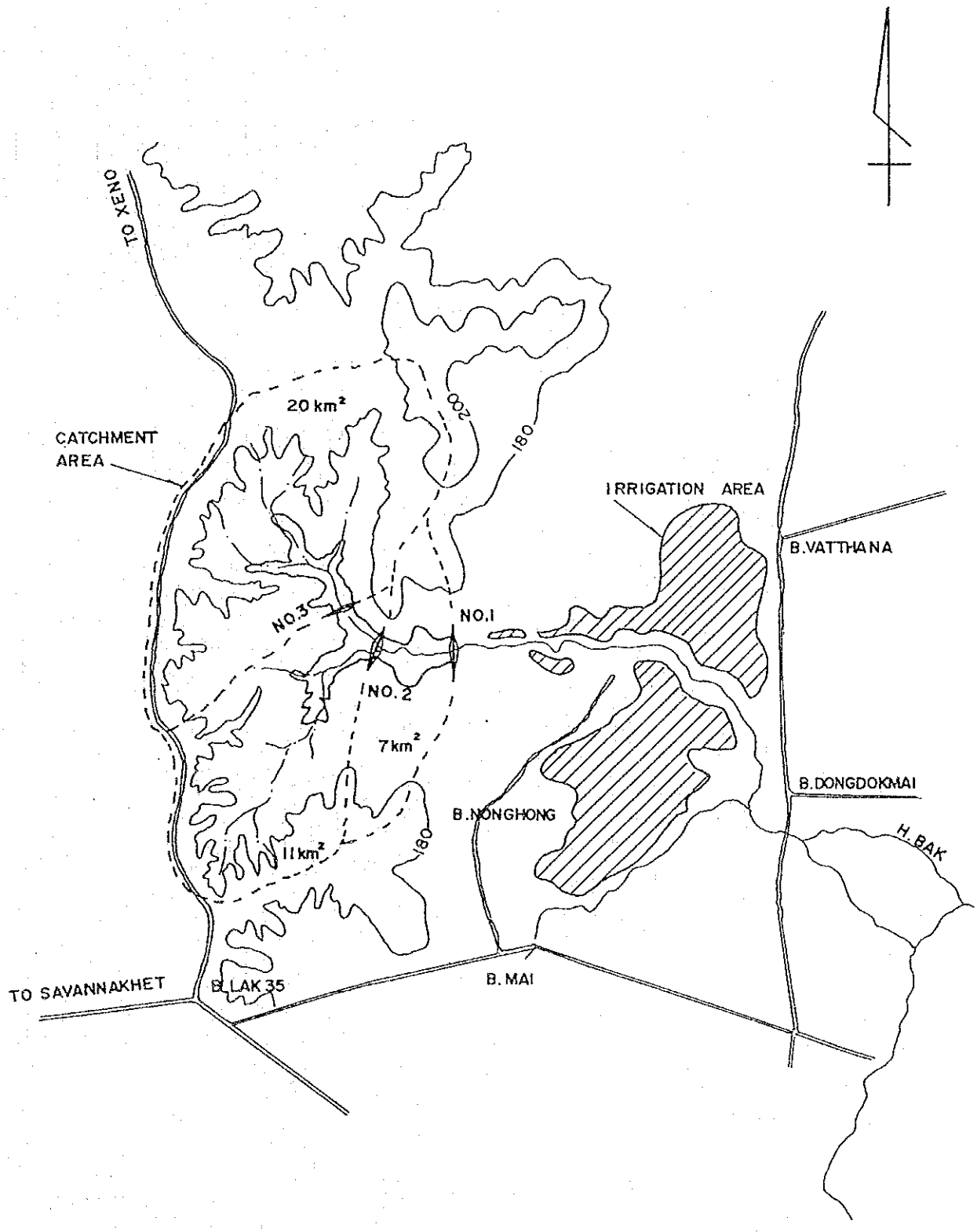

Fig. Ⅷ - 2 Dam Site Selection

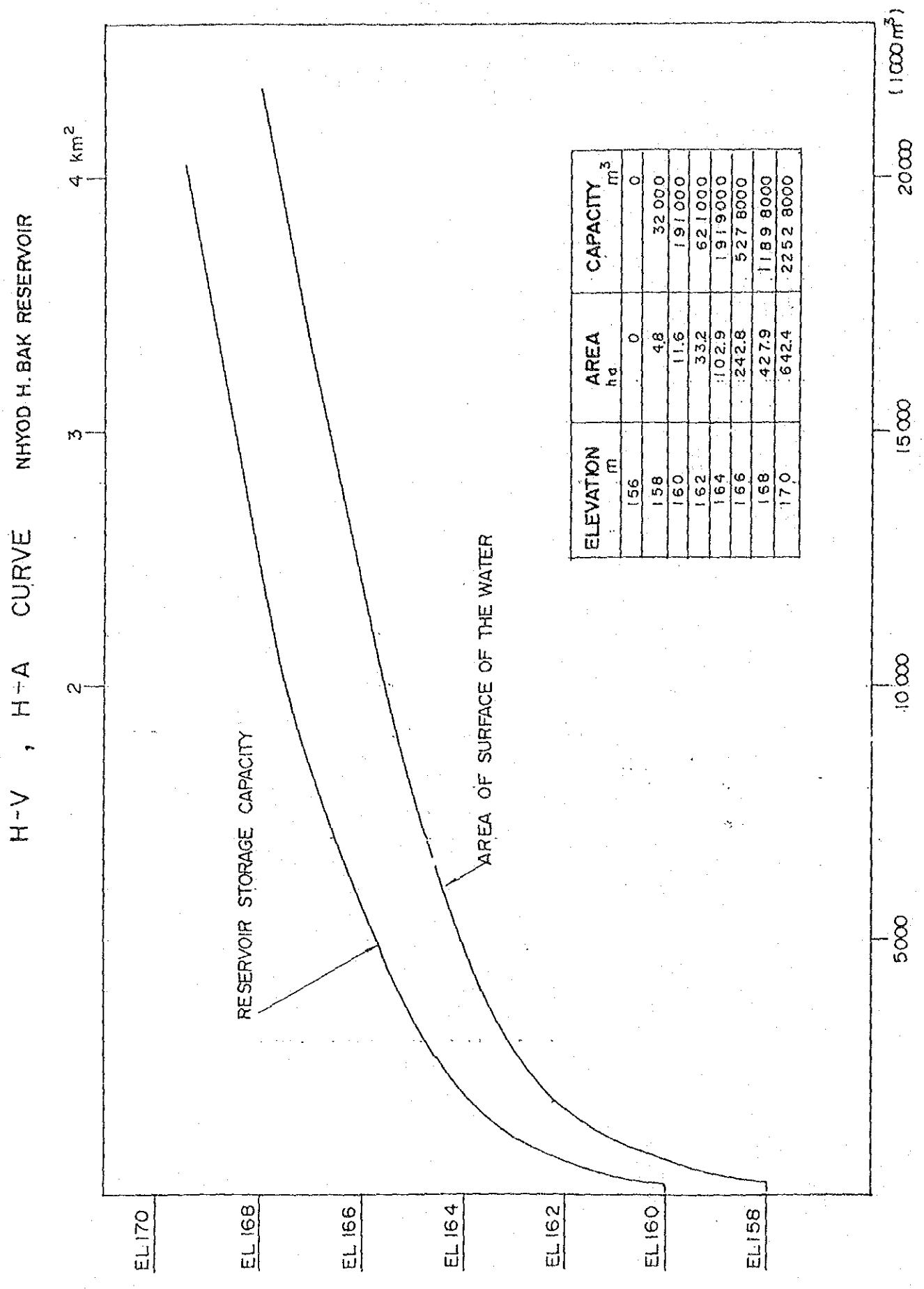

Fig. Ⅷ - 3 H - V, H - A Curve (Nhyod H. Bak Reservoir)

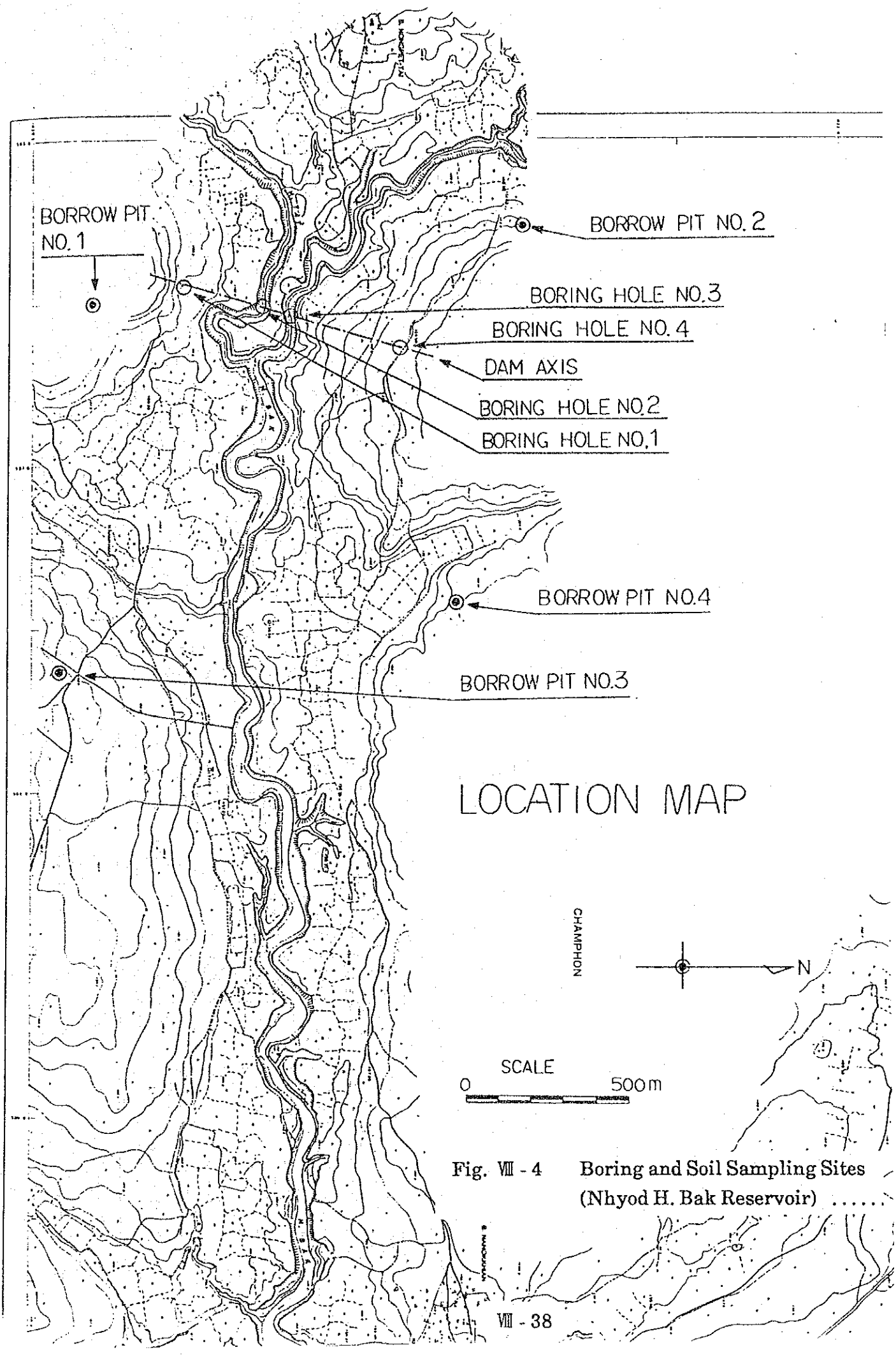

Fig. Ⅷ - 4 Boring and Soil Sampling Sites (Nhyod H. Bak Reservoir) .....

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SUB SOIL INVESTIGATION	BORING LOG	REPORTING SHEET

PROJECT : THE INTEGRATED AGRICULTURAL DEVELOPMENT IN SAVANNAKHET PROVINCE ASTM METHOD D 1586 FOR S.P.T

BORING Nº 1, 85 meter far from point Nº 0,00 PENETRATION TEST

DATE OCTOBER, 2, 1991

NAME OF ENGINEER
Mr souvannarath

SCALE	ELEVATION	DEPTH	LAYER THICKNESS	OBSERVATION RECORD			DEPTH	QU	NUMBER OF	N - VALUE	CONSISTENCY
				SYMBOL	NAME OF SOIL	COLOR OF SOIL			BLOW PER 30cm	10 20 30 40 50 60 70 80	
m	m	m	m				m	kg/cm²			
1	2	3	4	5	6	7	8	9	10	11	12
		0,20	0,20		Sandy clay						
1							0,90	0,96	9		Soft
2							2,10	1,60	15		Stiff
3							3,30	1,45	14		Stiff
4							4,20	2,24	21		Very stiff
5			10,90		Sandy clay loam + gravel	Yellowish brown	5,10	2,78	26		Very stiff
6							5,70	6,20	58		Hard
7							6,60	8,02	75		Very hard
8							7,80	3,63	34		Very stiff
9							8,70	2,78	26		Very stiff
10							9,60	3,95	37		Hard
		11,10					10,50	5,77	54		Hard
							11,10	8,02	75		Very hard

.REMARKS

N: BLOWS PER FT (140 Lb HAMMER 30" DROP 20 D. SAMPLER)

QU: UNCONFINED COMPRESSIVE STRENGTH (kg / cm²)

VIENTIANE, DATE ..NOVEMBER., 11, 1991.....

DIRECTOR

Fig. Ⅷ - 5 Boring Log (Nhyod H. Bak, No.1)

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SUB SOIL INVESTIGATION	BORING LOG	REPORTING SHEET

PROJECT : THE INTEGRATED AGRICULTUPAL DEVELOPMENT IN SAVANNAKHET PROVINCE. A S T M METHOD D 1586 FOR S.P.T
BORING Nº 2 .(Houei. Tat) PENETRATION TEST
DATE September 29 ,1991...
NAME OF ENGINEER
Mr. souvannarath .....

SCALE	ELEVATION	DEPTH	LAYER THICKNESS	OBSERVATION RECORD			DEPTH	QU	NUMBER OF	N - VALUE	CONSISTENCY
				SYMBOL	NAME OF SOIL	COLOR OF SOIL			BLOW PER 30cm	10 20 30 40 50 60 70 80	
m	m	m	m				m	kg/cm²			
1	2	3	4	5	6	7	8	9	10	11	12
1		1.07	1.07		Sandy gravel-laterite	Strong brown	0.90	0.74	7		Soft
2		2.10	1.03		Sandy loam	Dark yellowish brown	2.10	-	3		Very soft
3		3.25	1.15		Loamy sand+gravel	Black	3.30	1.17	11		Stiff
4		4.50	1.25		Sandy gravel	Very dark grayish brown	4.50	1.49	14		Stiff
5			2.46		Loamy sand+gravel	Very dark grayish brown	5.10	1.39	13		Stiff
6							6.00	-	1		Very soft
7		6.96									
		7.12	0.16		Slate	Dark grayish brown	7.12	8.02	75°/6cm		Very dense
8											
9											
10											

.REMARKS

N: BLOWS PER FT (140 Lb HAMMER ,30" DROP.2 0 .O. SAMPLER)

QU: UNCONFINED COMPRESSIVE STRENGTH (kg / cm²)

VIENTIANE. DATE ..NOVEMBER ,11 ,1991.....

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Fig. Ⅷ - 6 Boring Log (Nhyod H. Bak, No.2)

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SUB SOIL INVESTIGATION	BORING LOG	REPORTING SHEET

PROJECT : THE INTEGRATED AGRICULTURAL DEVELOPMENT IN SAVANNAKHET PROVINCE A S T M METHOD D 1586 FOR S.P.T

BORING Nº 3 (Houei bak).

PENETRATION TEST

DATE october 3,1991

NAME OF ENGINEER
Mr.souvannarath

SCALE	ELEVATION	DEPTH	LAYER THICKNESS	OBSERVATION RECORD			DEPTH	QU	NUMBER OF BLOW PER 30cm	N - VALUE	CONSISTENCY
				SYMBOL	NAME OF SOIL	COLOR OF SOIL					
m	m	m	m				m	kg/cm²		10 20 30 40 50 60 70 80	
1	2	3	4	5	6	7	8	9	10	11	12
1		1,45	1,45		Loamy sand	Very pale brown	0,90	1,07	10		Soft
2			1,55		Sandy loam	Brownish yellow	2,10	5,88	55		Hard
3		3,00					3,30	2,67	25		Very stiff
4			2,10		Loamy sand	Gray					
5		5,10					4,80	7,49	70		Hard
6			3,10		Sandy loam	Dark gray	6,30	3,21	30		Very stiff
7											
8		8,20					7,80	1,28	12		Stiff
9			3,20		Shale	Black	9,30	3,21	30		Very stiff
10							10,80	1,28	12		Stiff

REMARKS

N: BLOWS PER FT (140 Lb HAMMER , 30" DROP, 2" O.D. SAMPLER)

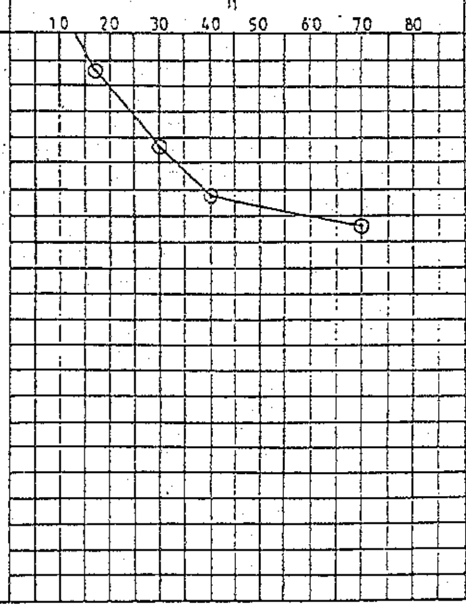
QU: UNCONFINED COMPRESSIVE STRENGTH (kg / cm²)

VIENTIANE, DATE ..NOVEMBER..11..1991.....

DIRECTOR

Fig. Ⅷ - 7 Boring Log (Nhyod H. Bak, No.3-1/2, 2/2)

1	2	3	4	5	6	7	8	9	10	11	12
		11,40									
			2,93		Sandy loam + gravel	Dark grayish brown	11,70	1,81	17		Stiff
							13,20	3,21	30		Very stiff
		14,33					14,10	4,28	40		Hard
		15,00	0,67		Sand stone	Dark red	14,70	8,02	75		



.REMARKS:

.N : BLOWS PER FT (140 Lb HAMMER 30" DROP 2" O.D SAMPLER)

.QU : UNCONFINED COMPRESSIVE STRENGTH (kg/cm^2)

VIENTIANE;
DIRECTOR
SIVISAY NGEUN

Fig. Ⅷ - 7 Boring Log (Nhyod H. Bak, No.3-1/2, 2/2)

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SUB SOIL INVESTIGATION	BORING LOG	REPORTING SHEET

PROJECT : THE INTEGRATED AGRICULTURAL DEVELOPMENT IN SAVANNAKHET PROVINCE A S T M METHOD D 1586 FOR S.P.T

BORING Nº 4 , 240 meter far from pain 800

PENETRATION TEST

DATE October 8 - 10 1991
NAME OF ENGINEER
Mr Souvannarath .....

SCALE	ELEVATION	DEPTH	LAYER THICKNESS	OBSERVATION RECORD			DEPTH	QU	NUMBER OF	N - VALUE	CONSISTENCY
				SYMBOL	NAME OF SOIL	COLOR OF SOIL			BLOW PER 30cm	10 20 30 40 50 60 70 80	
m	m	m	m				m	kg/cm²			
1	2	3	4	5	6	7	8	9	10	11	12
			1,10		Sandy clay loam	light reddish brown	0,30	-	3		Very soft
1		1,10					1,20	1,28	12		Stiff
			0,75		Sandy clay loam + gravel	Reddish yello					
2		1,85					2,10	1,49	14		Stiff
			2,62		Clay	Reddish yello					
3							3,00	1,49	14		Stiff
4							3,90	1,71	16		Stiff
		4,47									
5			1,77		Sandy loam	Stong brown	5,10	2,78	26		Very stiff
6		6,24					6,30	2,35	22		Very stiff
			0,69		Loamy sand	Pink					
7		6,93					7,20	2,35	22		Very stiff
			0,92		Sandy clay loam + gravel	Light gray					
8		7,85					8,40	3,95	37		Hard
			1,15		Sandy clay loam	Light gray					
9		9,00					9,30	4,28	40		Hard
			1,20		Sandy clay loam + gravel	Yellow					
10		10,20					10,20	8,02	75		Very hard

.REMARKS

N : BLOWS PER FT (140 Lb HAMMER 30" DROP 2,0 O.SAMPLER)

QU: UNCONFINED COMPRESSIVE STRENGTH (kg / cm²)

VIENTIANE. DATE .NOVEMBER. 11 1991 .....

DIRECTOR .

Fig. Ⅷ - 8 Boring Log (Nhyod H. Bak, No.4)

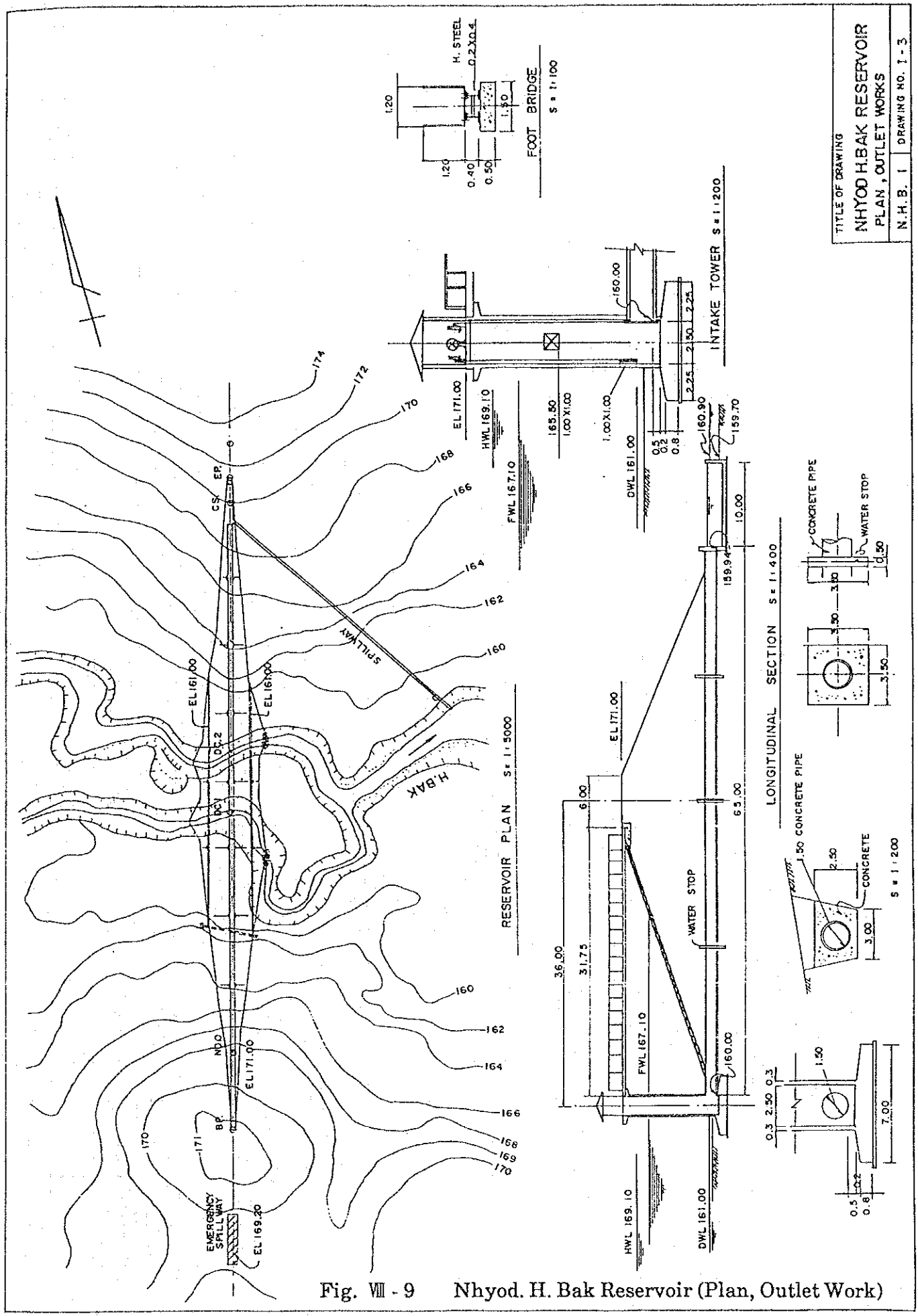

Fig. Ⅷ - 9 Nhyod. H. Bak Reservoir (Plan, Outlet Work)

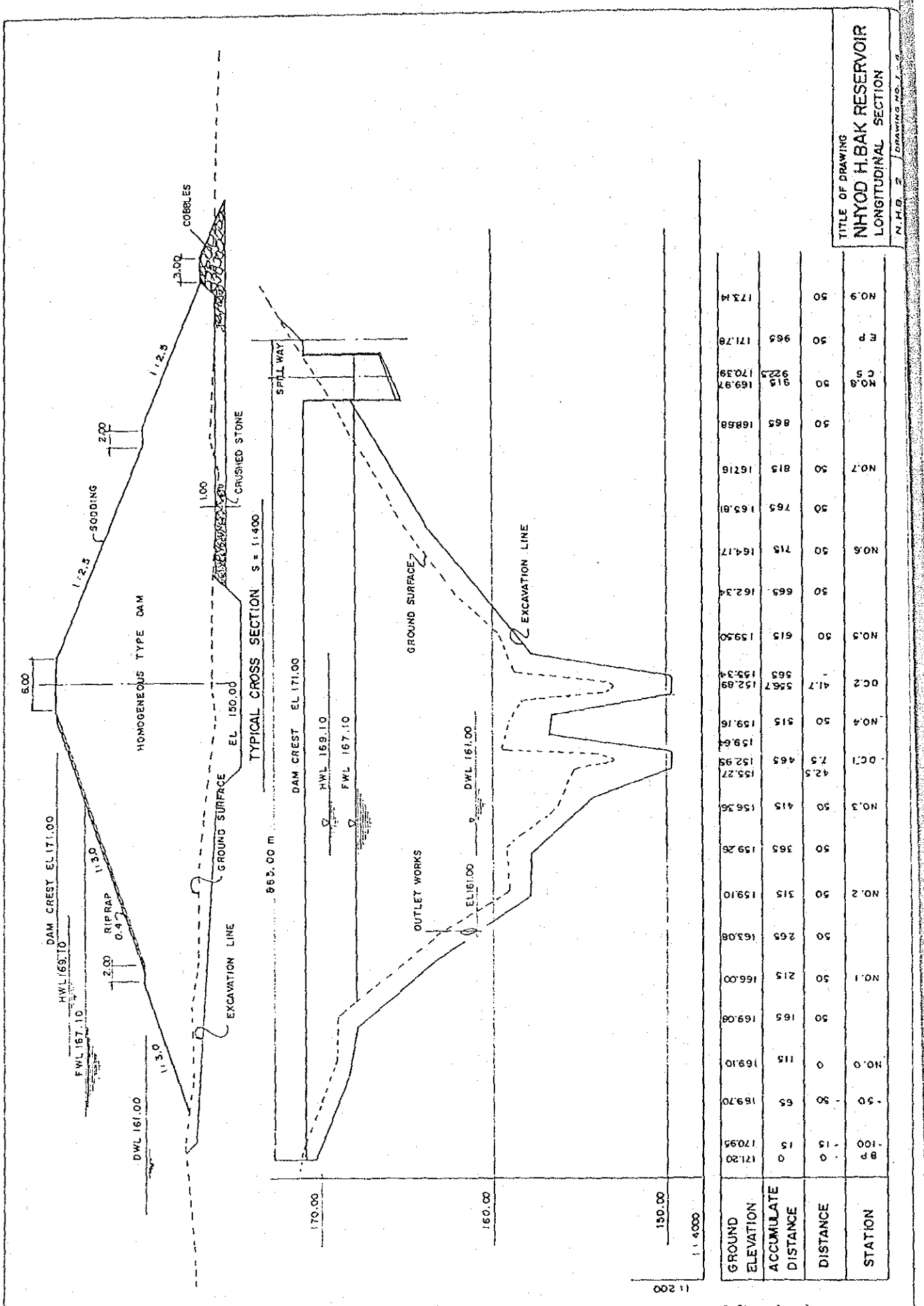

Fig. Ⅷ - 10 Nhyod. H. Bak Reservoir (Longitudinal Section)

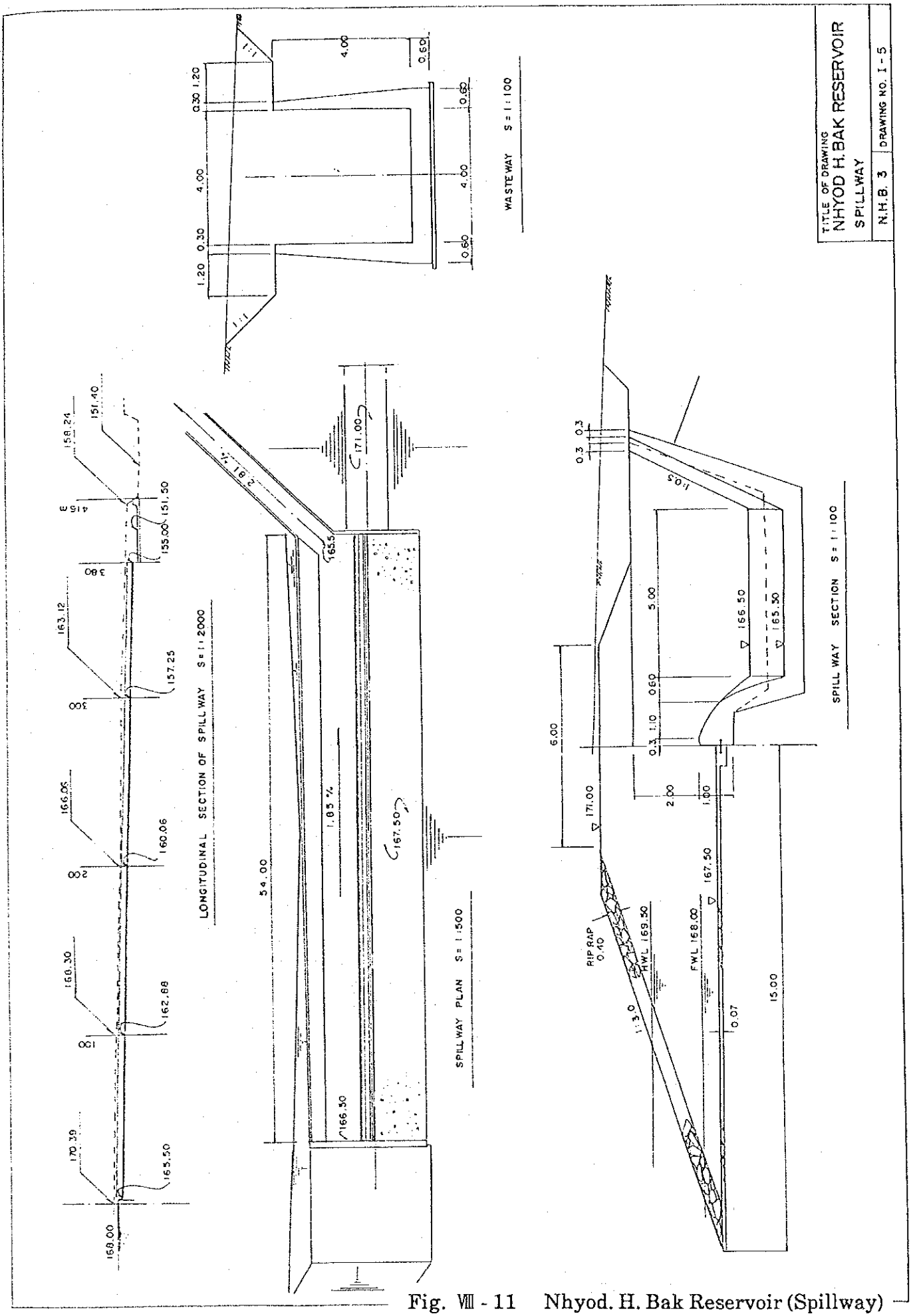

Fig. Ⅷ - 11 Nhyod. H. Bak Reservoir (Spillway)

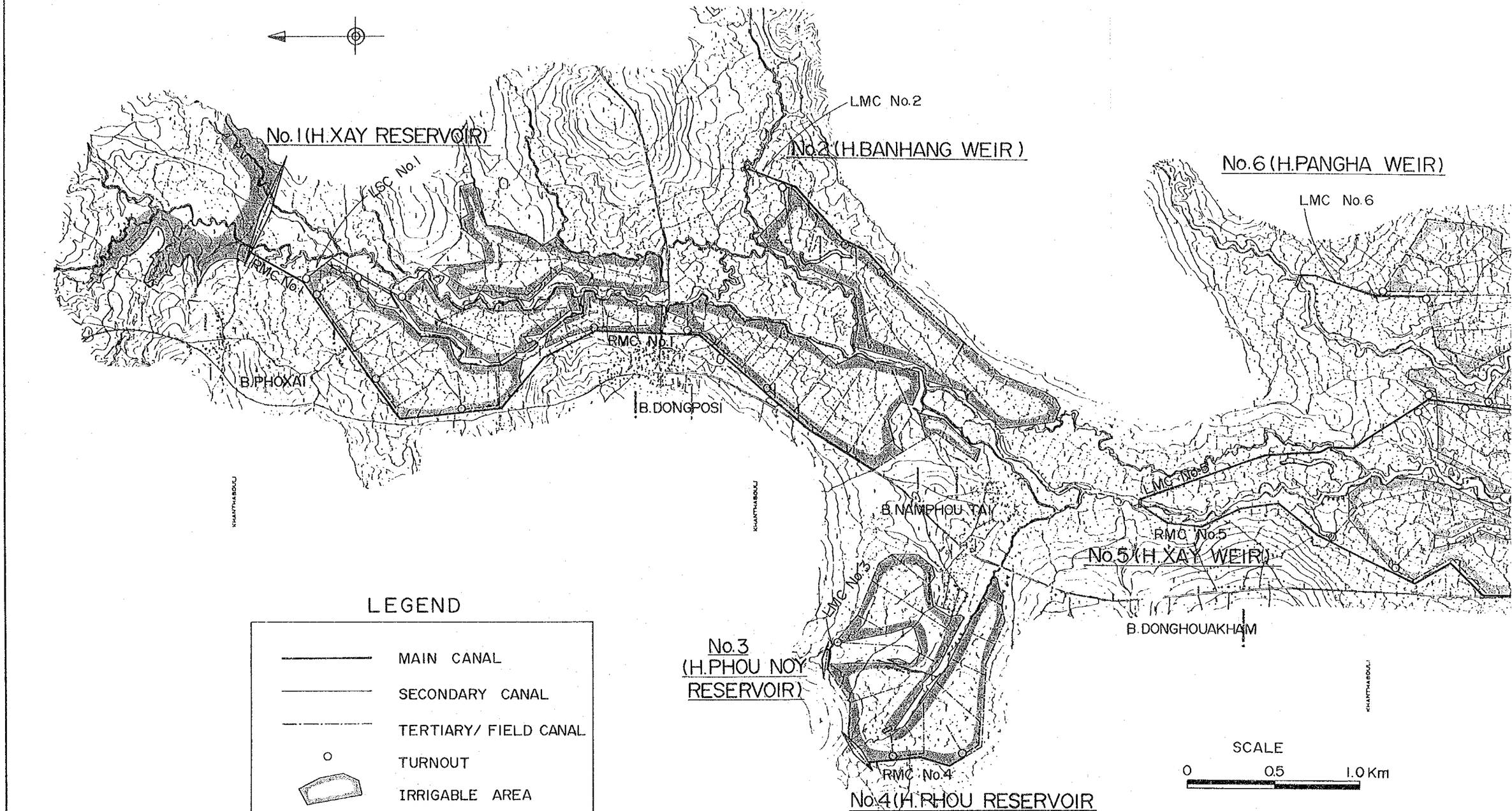
No.1 (H.XAY RESERVOIR)
LSC No.1
RMC No.1
B.PHOXAI
B.DONGPOSI
RMC No.1
L.MC No.2
No.2 (H.BANHANG WEIR)
No.6 (H.PANGHA WEIR)
L.MC No.6
L.MC No.5
B.NAMPHOU TAI
RMC No.5
No.5 (H.XAY WEIR)
L.MC No.3
B.DONGHOUAKHAM
No.3
(H.PHOU NOY
RESERVOIR)
RMC No.4
No.4 (H.PHOU RESERVOIR
KHANTHABOULI
KHANTHABOULI
LEGEND
MAIN CANAL
SECONDARY CANAL
TERTIARY/ FIELD CANAL
TURNOUT
IRRIGABLE AREA
RESERVOIR / DAM
WEIR
SCALE
0
0.5
1.0 Km

Fig. VIII -

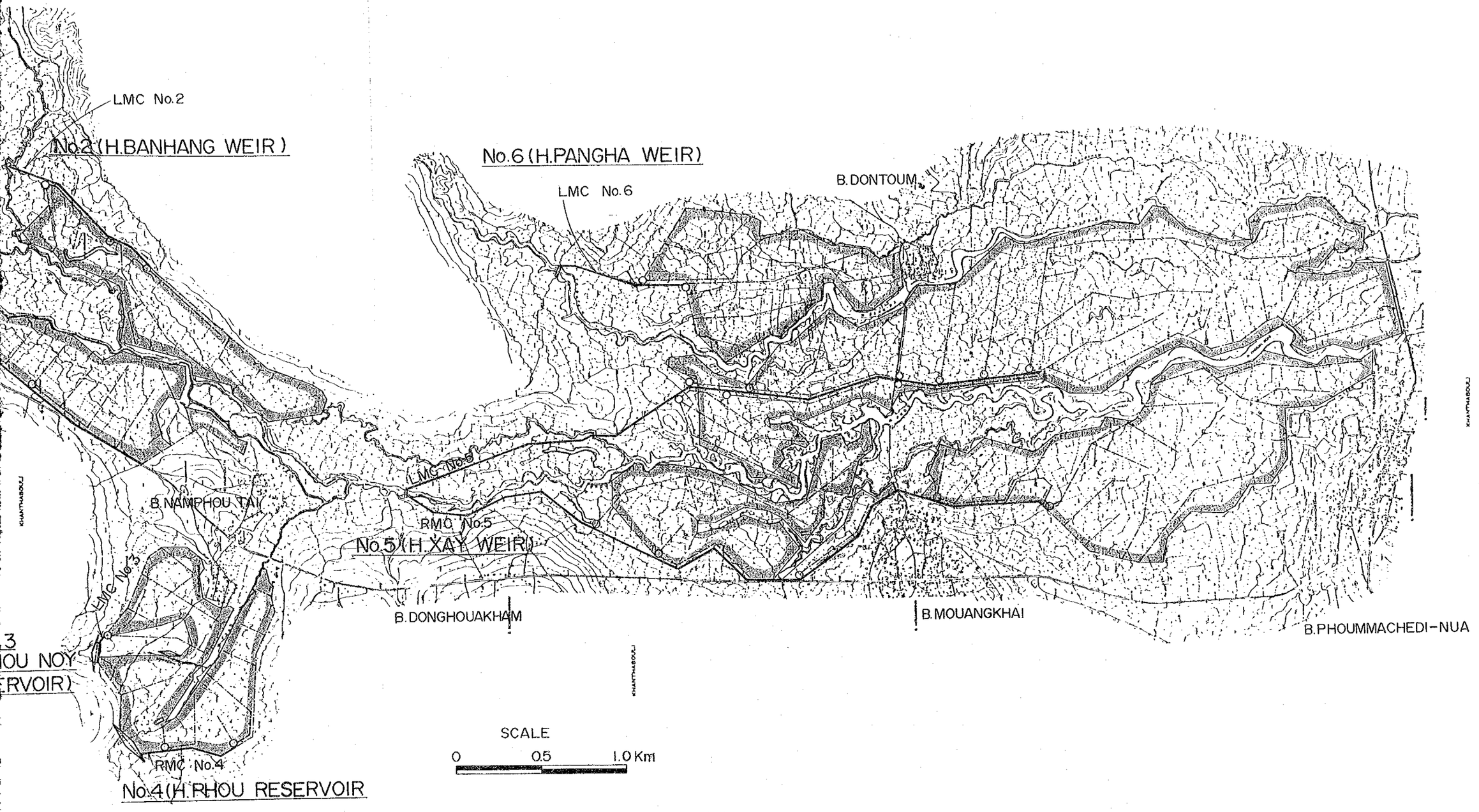

Fig. Ⅷ - 12 General Layout of Irrigation & Drainage Facilities (Namphou Irrigation Area)

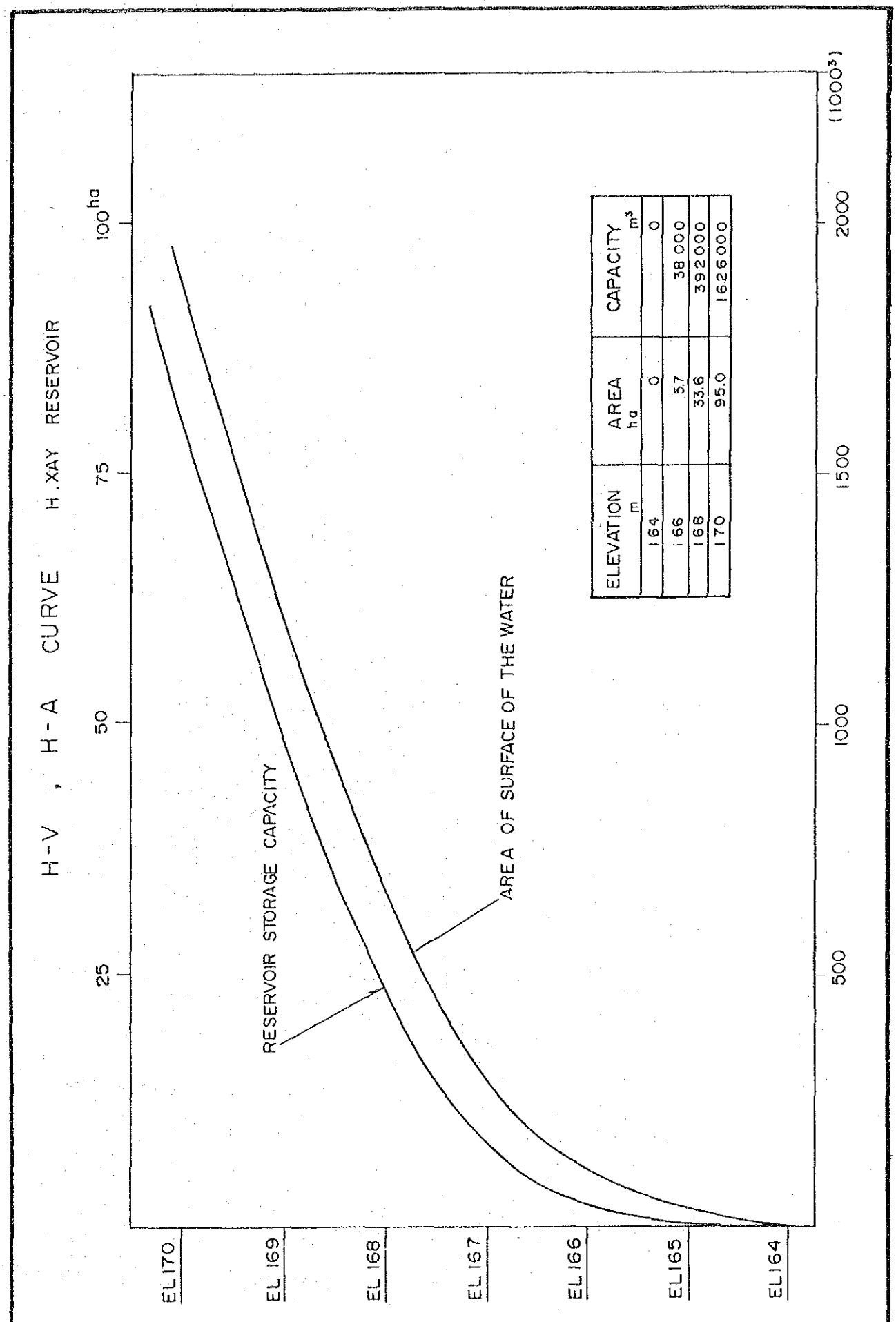

Fig. Ⅷ - 13 H - V, H - A Curve (H. Xay Reservoir)

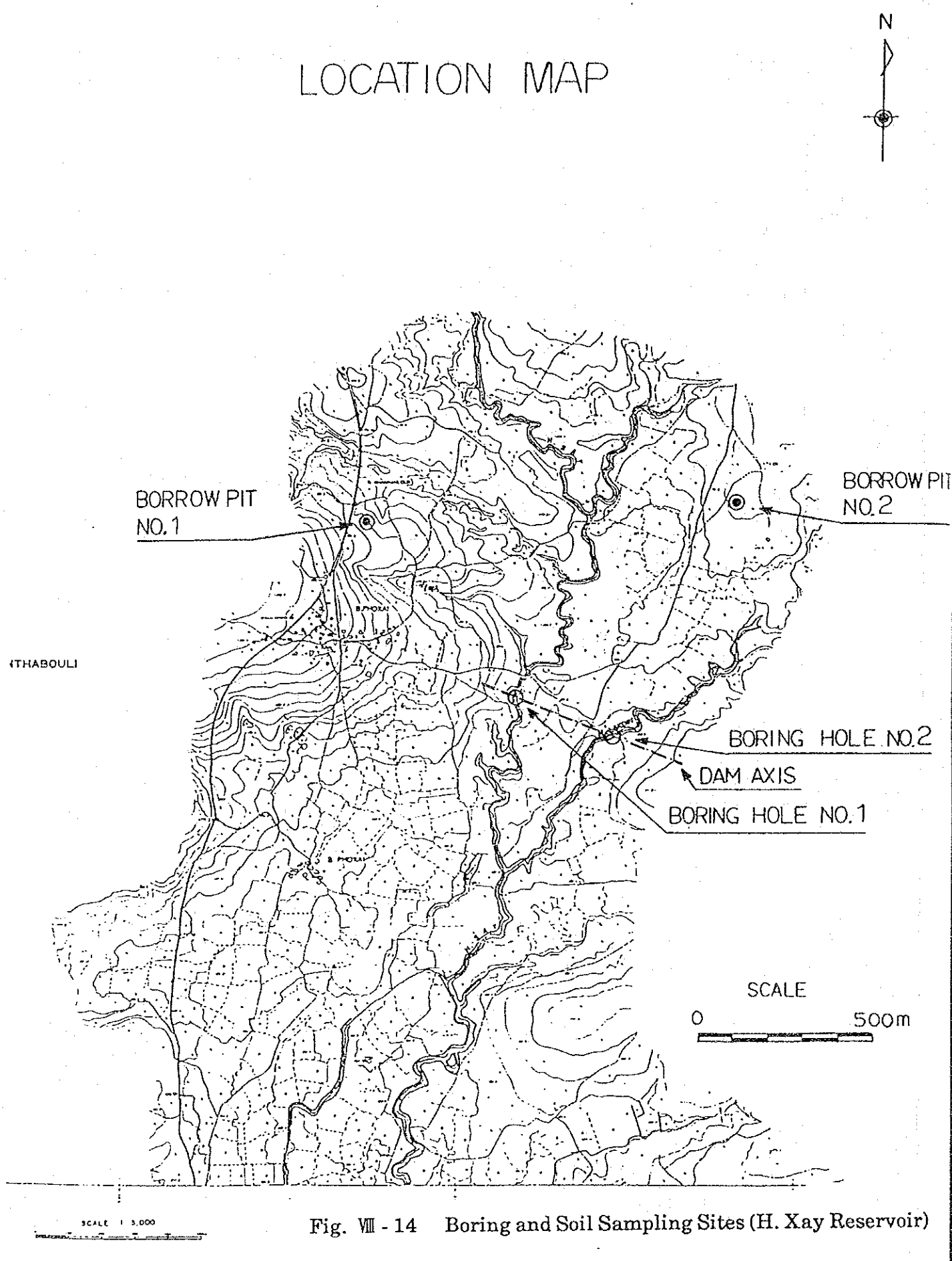

Fig. Ⅷ - 14 Boring and Soil Sampling Sites (H. Xay Reservoir)

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SUB SOIL INVESTIGATION	BORING LOG	REPORTING SHEET

PROJECT : THE INTEGRATED AGRICULTURAL DEVELOPMENT IN SAVANNAKHET PROVINCE A S T M METHOD D 1586 FOR S.P.T

BORING Nº 1 (H. Xay dam)

PENETRATION TEST

DATE September, 22-23, 1991
NAME OF ENGINEER
Mr. Souvannarath .....

SCALE	ELEVATION	DEPTH	LAYER THICKNESS	OBSERVATION RECORD			DEPTH	QU	NUMBER OF BLOW PER 30cm	N - VALUE	CONSISTENCY
				SYMBOL	NAME OF SOIL	COLOR OF SOIL		kg/cm²		10 20 30 40 50 60 70 80	
m	m	m	m				m				
1	2 ▼ 163.30	3	4	5	6	7	8	9	10	11	12
1	161.95	1.35	1.35		Sandy gravel	Strong brown	0.30 0.90	— —	5 2		Very soft Very soft
2	161.05	2.25	0.90		Clay loam + Gravel	Dark red	1.80 2.10 2.25	0.85 2.67 8.02	8 25 75"/15cm		Soff Very stiff Very dense
3			1.80		Sandstone	Dark reddish brown			—		
4	159.25	4.05							—		

REMARKS :

N : BLOWS PER FT (140 Lb. HAMMER 30" DROP. 2" OD. SAMPLER)

QU : UNCONFINED COMPRESSIVE STRENGTH (kg / cm²)

VIENTIANE, DATE ...OCTOBER, 22, 1991.....

DIRECTOR

SIVISAY NGEUN

Fig. VIII - 15 Boring Log (H. Xay Reservoir No.1)

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SUB SOIL INVESTIGATION | BORING LOG | REPORTING SHEET

PROJECT : THE INTEGRATED AGRICULTURAL DEVELOPMENT IN SAVANNAKHET PROVINCE A S T M METHOD D 1586 FOR S.P.T

BORING Nº 2 (N. Lakdin)

PENETRATION TEST

DATE September 19-21, 1991

NAME OF ENGINEER
Mr. Souvannarath

SCALE	ELEVATION	DEPTH	LAYER THICKNESS	OBSERVATION RECORD: SYMBOL	NAME OF SOIL	COLOR OF SOIL	DEPTH	QU	NUMBER OF BLOW PER 30cm	N - VALUE (10 20 30 40 50 60 70 80)	CONSISTENCY
m	m	m	m				m	kg/cm²			
1	2	3	4	5	6	7	8	9	10	ft	12
	▼ 164.10										
1			1.45		Sand	Dark brown	0.30	—	3		Very soft
	162.65	1.45					1.20	—	2		Very soft
2			0.75		Sandy loam	Reddish yellow	1.80	8.02	75		Very hard
	161.90	2.20					2.36	8.56	80 /16cm		Very dense
3									—		
4			4.10		Sandstone	Dark reddish brown			—		
6									—		
	157.80	6.30							—		

REMARKS :

N : BLOWS PER FT (140 Lb HAMMER 30" DROP 2" OD. SAMPLER)

QU : UNCONFINED COMPRESSIVE STRENGTH (kg / cm²)

VIENTIANE. DATE : OCTOBER 22, 1991

DIRECTOR

Fig. Ⅷ - 16 Boring Log (H. Xay Reservoir No.2)

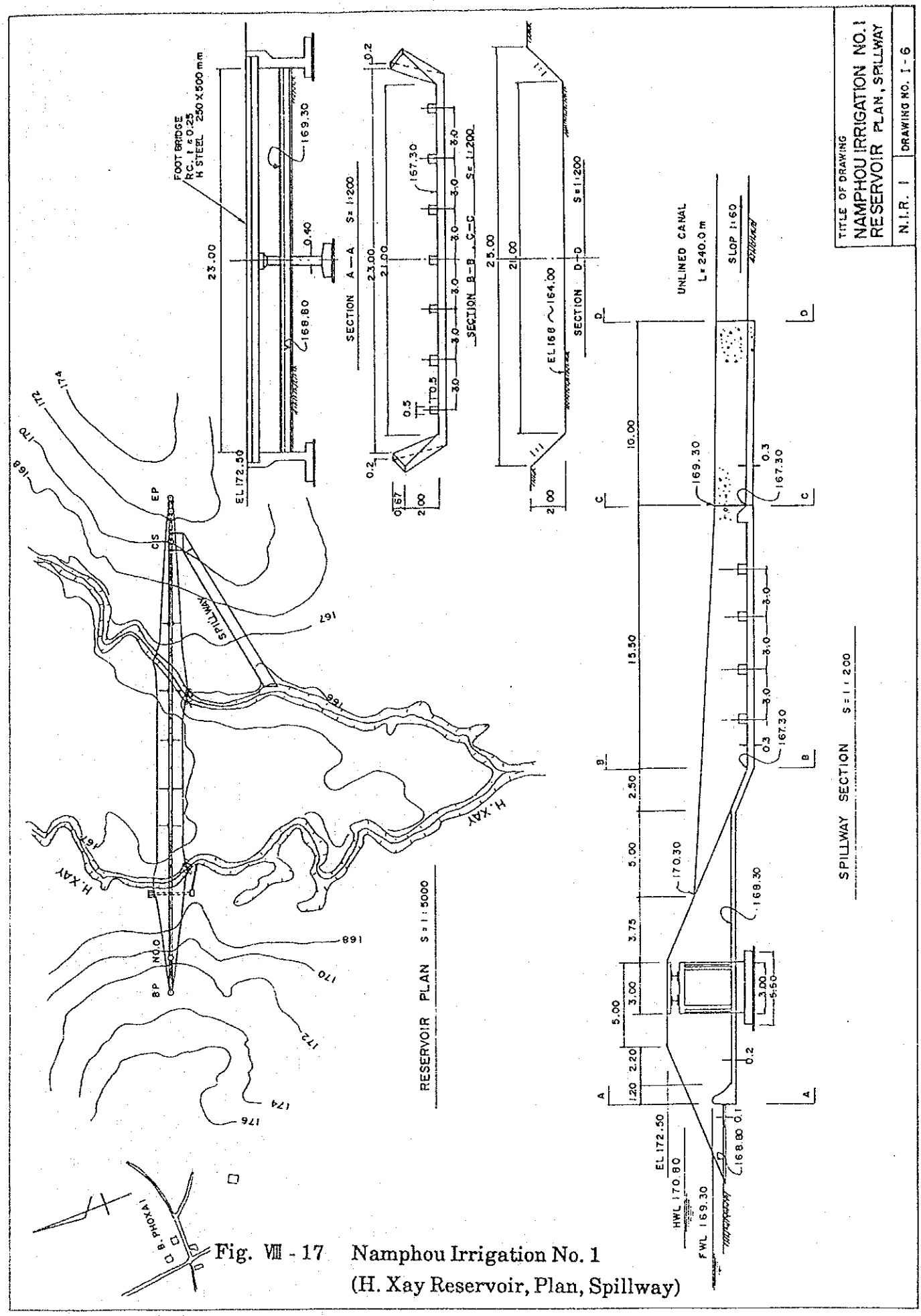


Fig. Ⅷ - 17 Namphou Irrigation No. 1
(H. Xay Reservoir, Plan, Spillway)

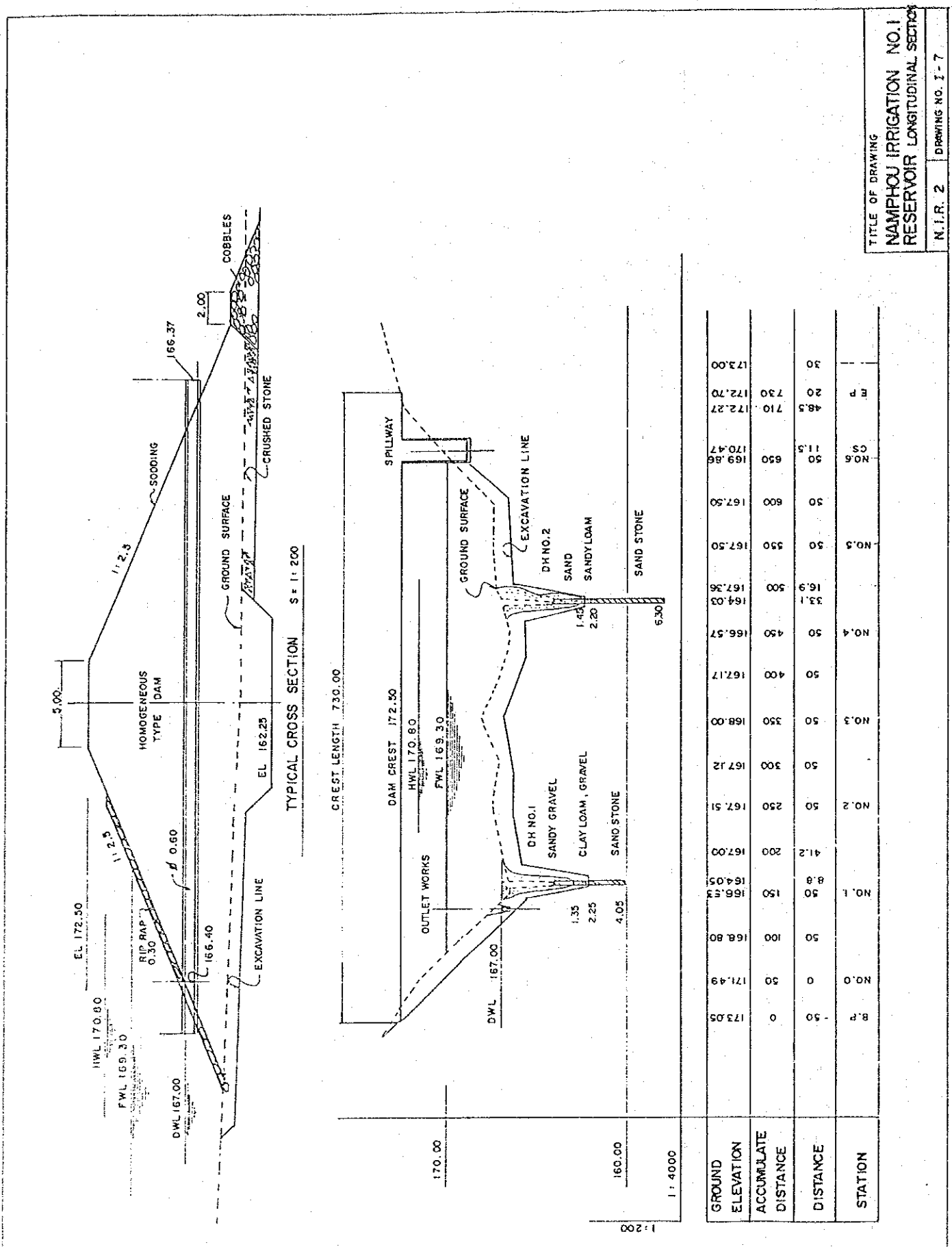


Fig. Ⅷ - 18 Namphou Irrigation No. 1
(H. Xay Reservoir, Longitudinal Section)

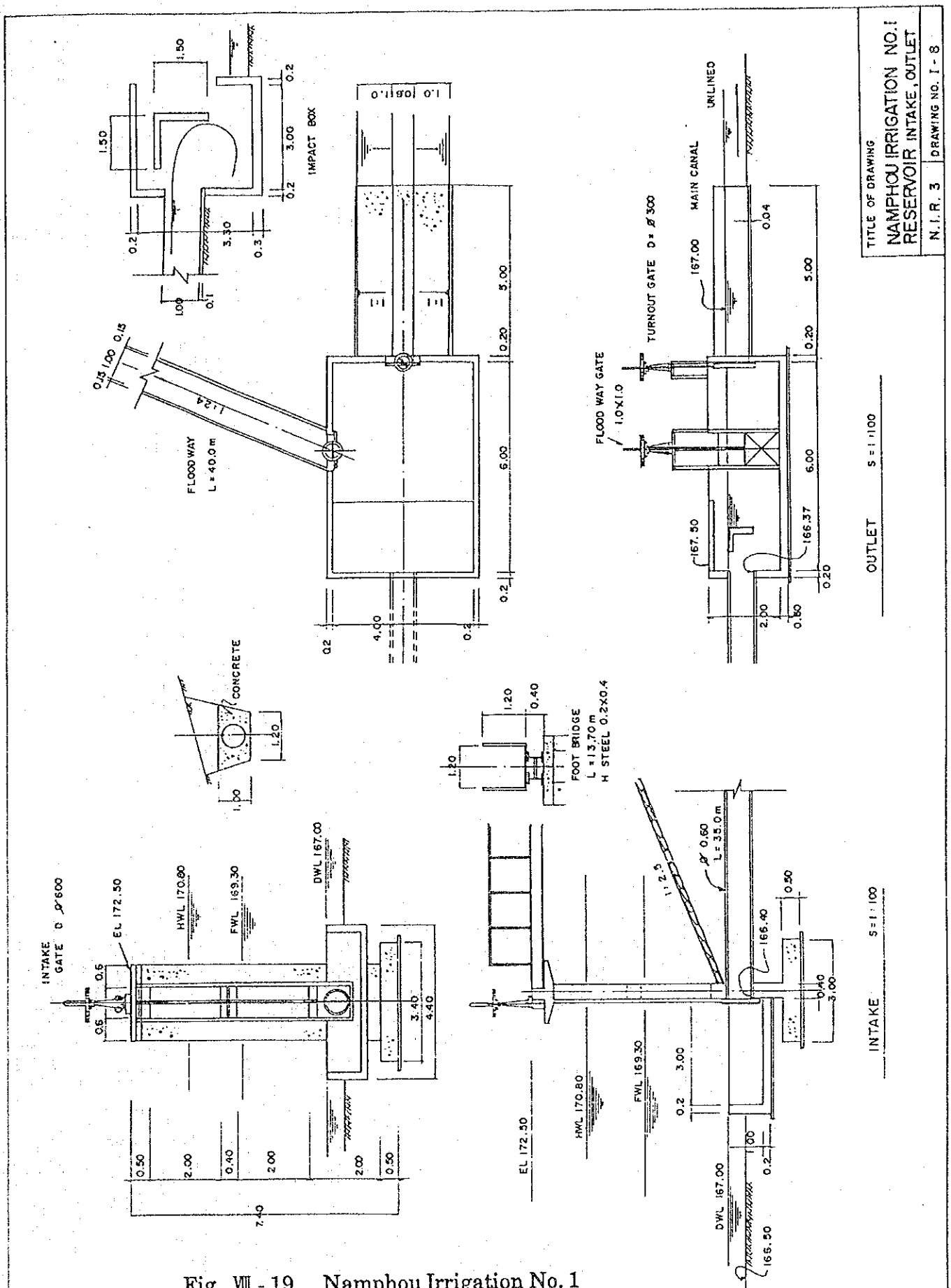


Fig. Ⅷ - 19 Namphou Irrigation No. 1
(H. Xay Reservoir, Intake, Outlet)

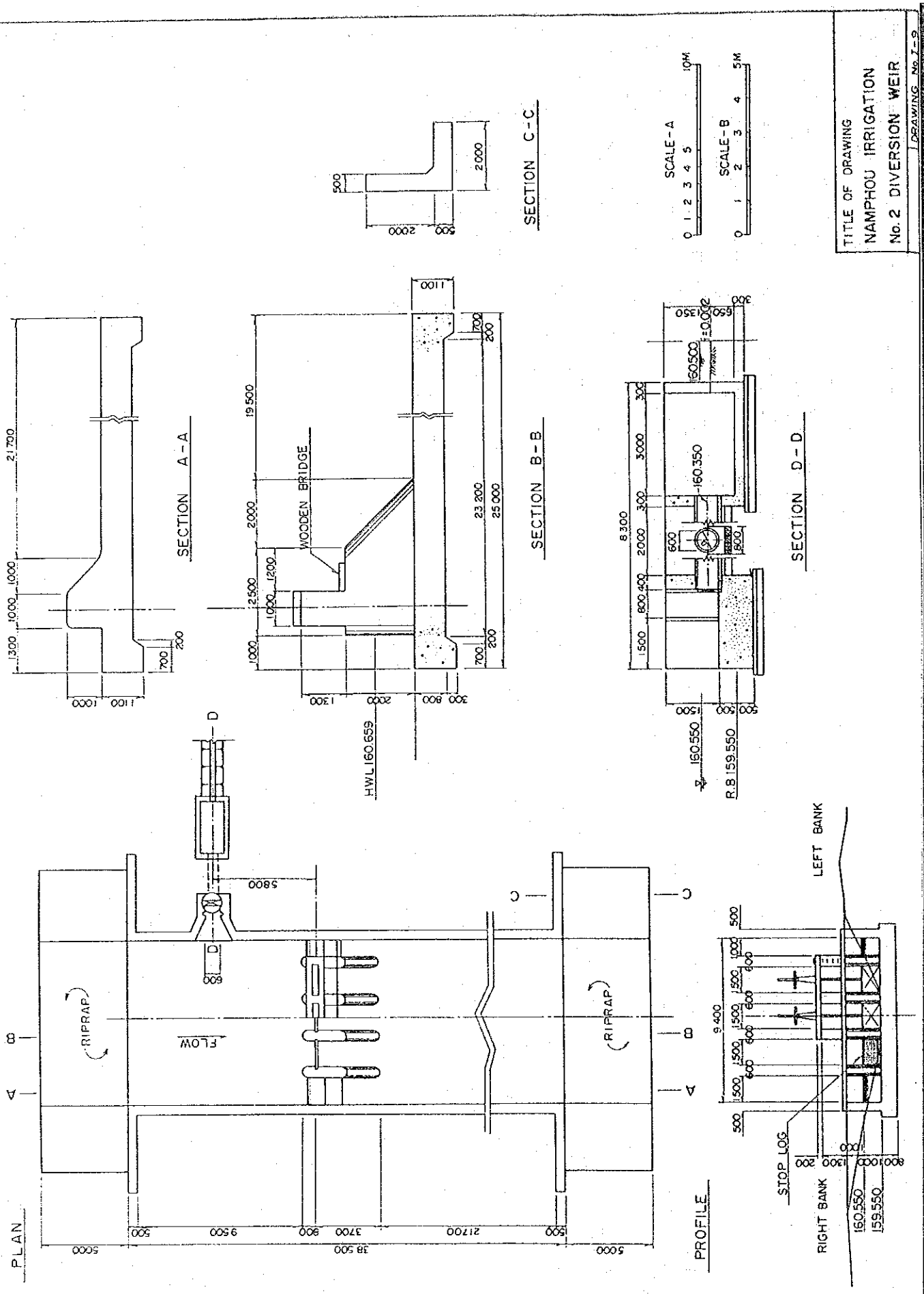


Fig. Ⅷ - 20 Namphou Irrigation No. 2 (H. Banhang Weir)

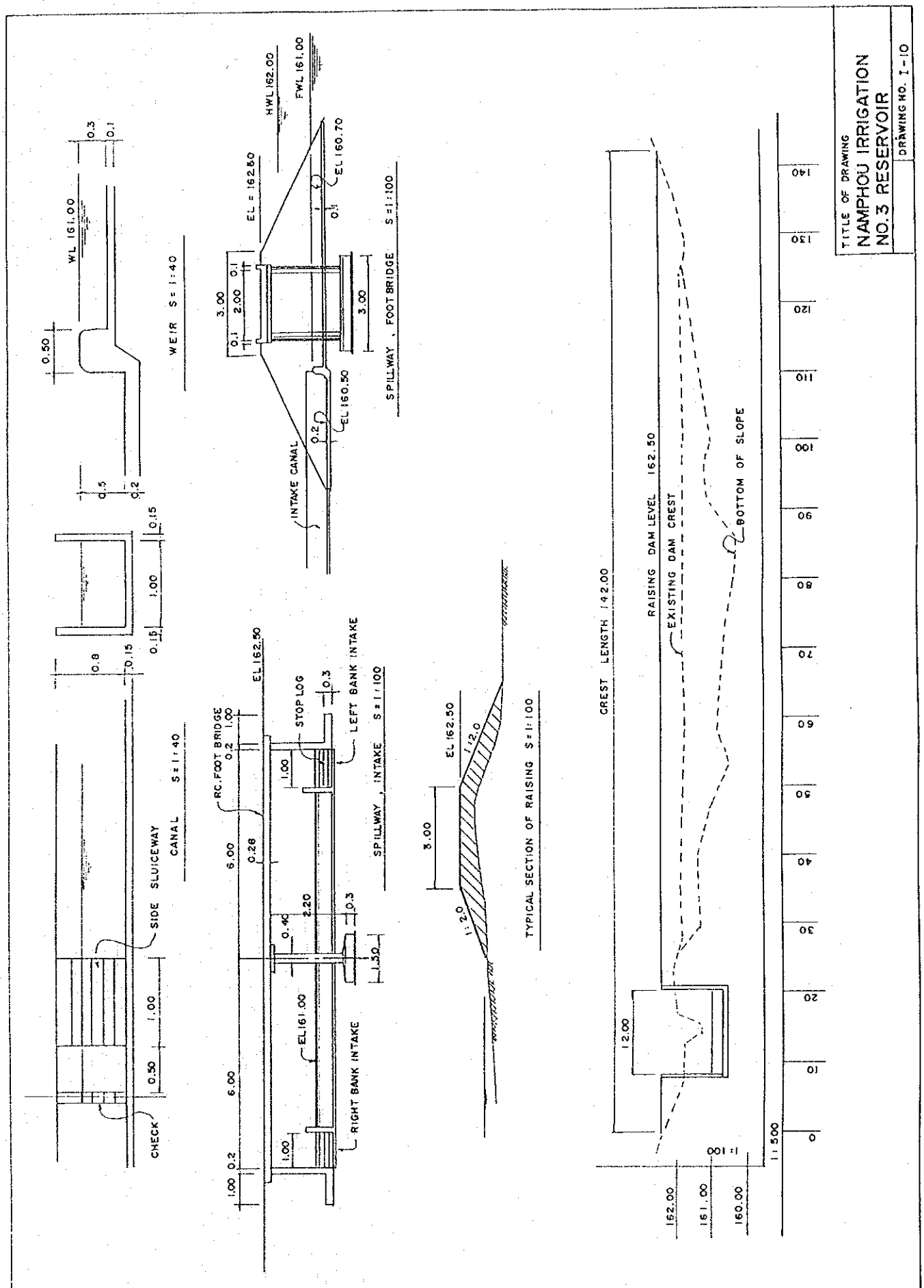


Fig. Ⅷ - 21 Namphou Irrigation No. 3 (H. Phou Noy Reservoir)

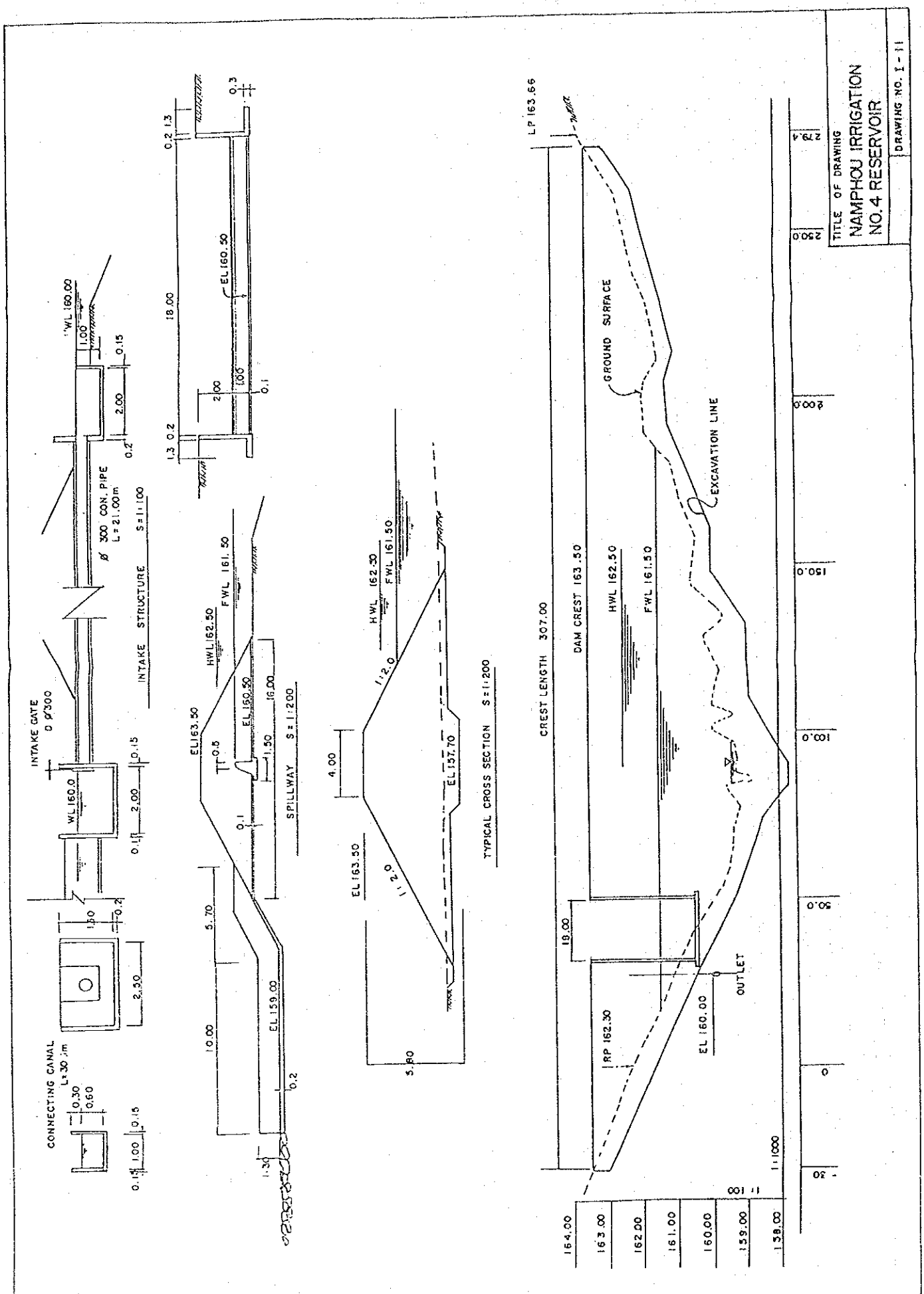


Fig. Ⅷ - 22 Namphou Irrigation No. 4 (H. Phou Reservoir)

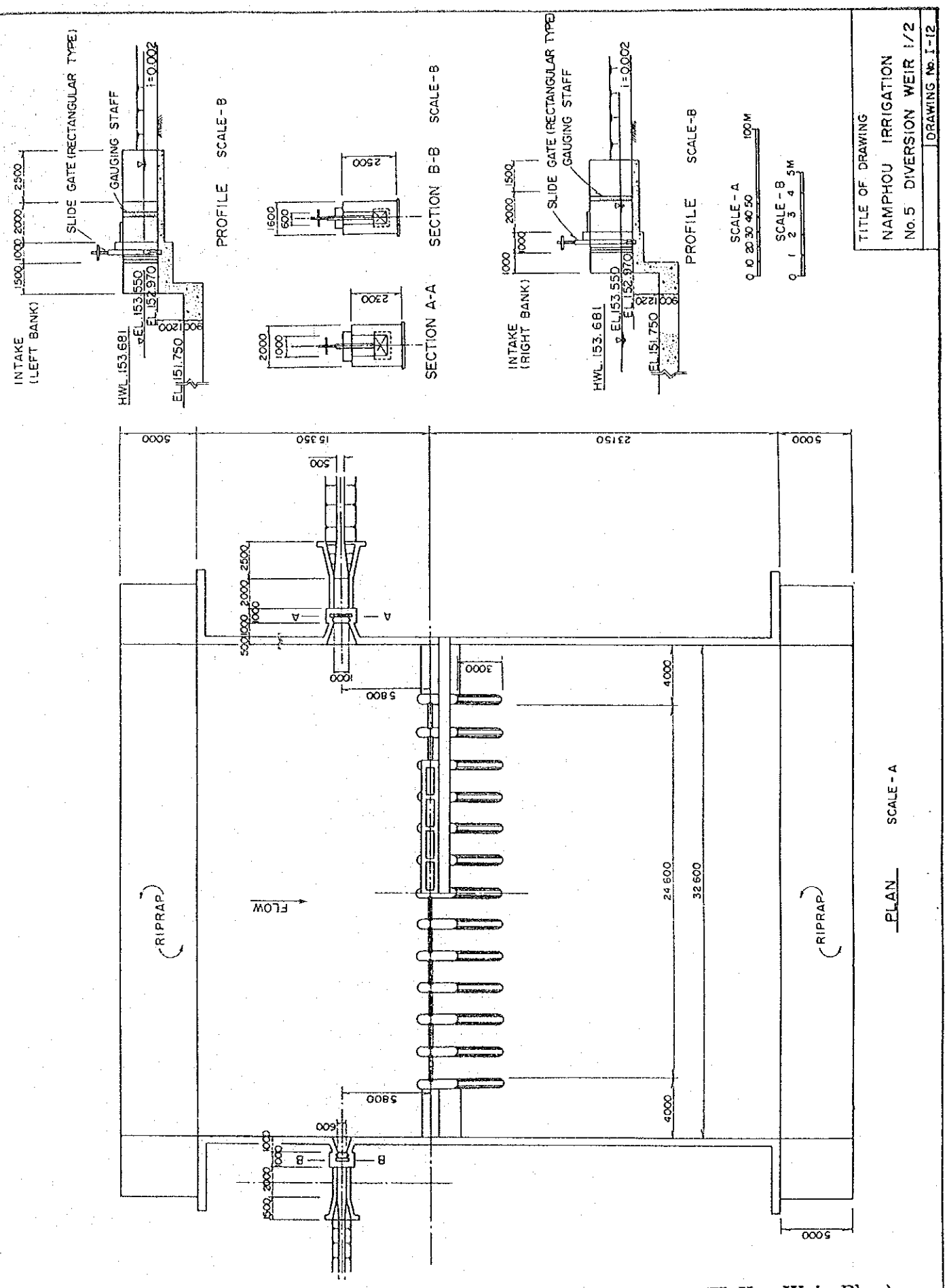


Fig. Ⅷ - 23 Namphou Irrigation No. 5 (H. Xay Weir, Plan)

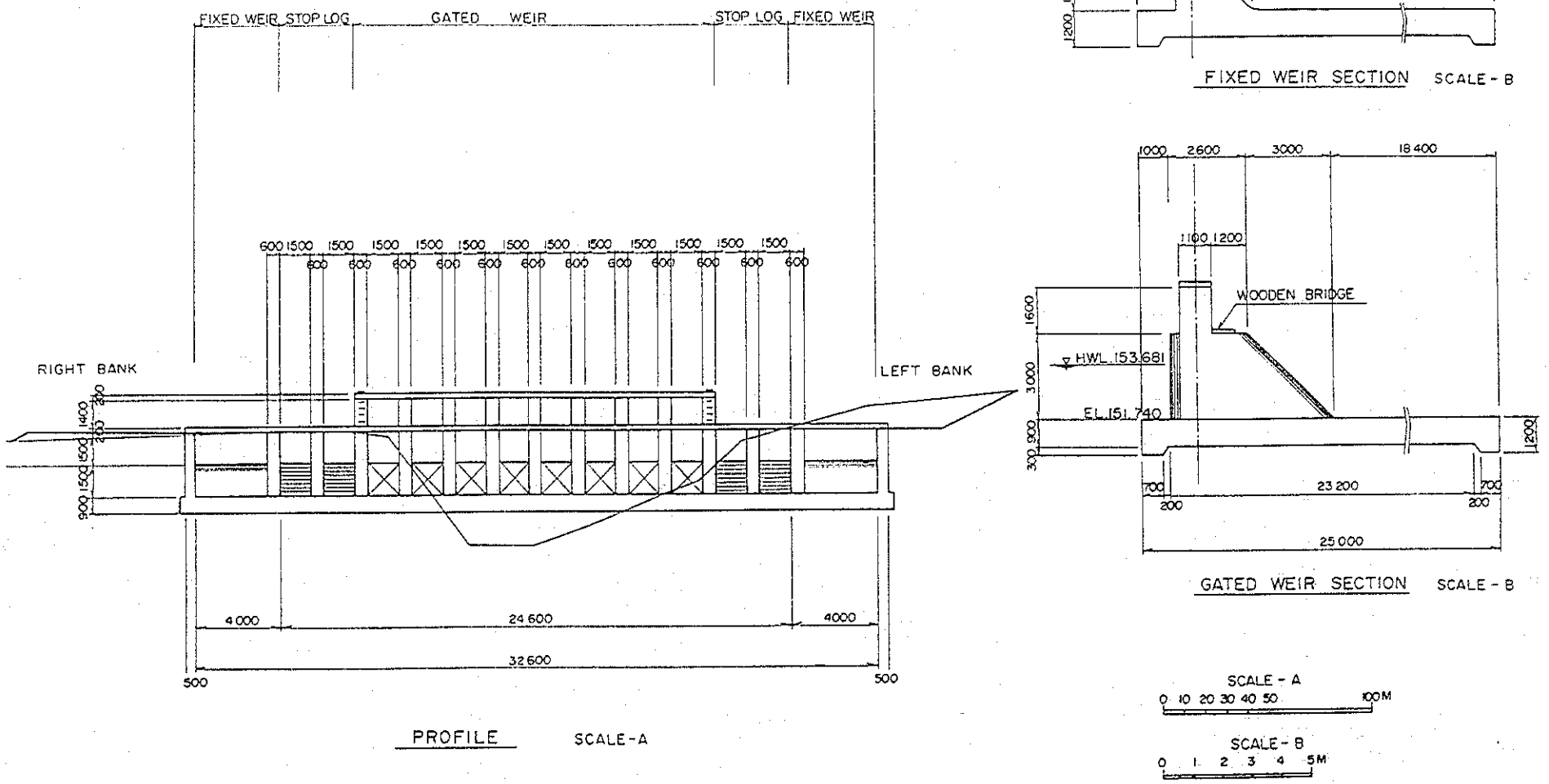


Fig. VIII - 24 Namphou Irrigation No. 5
(H. Xay Weir, Profile, Section)

TITLE OF DRAWING
NAMPHOU IRRIGATION
No. 5 DIVERSION WEIR 2/2
DRAWING No. 1-13

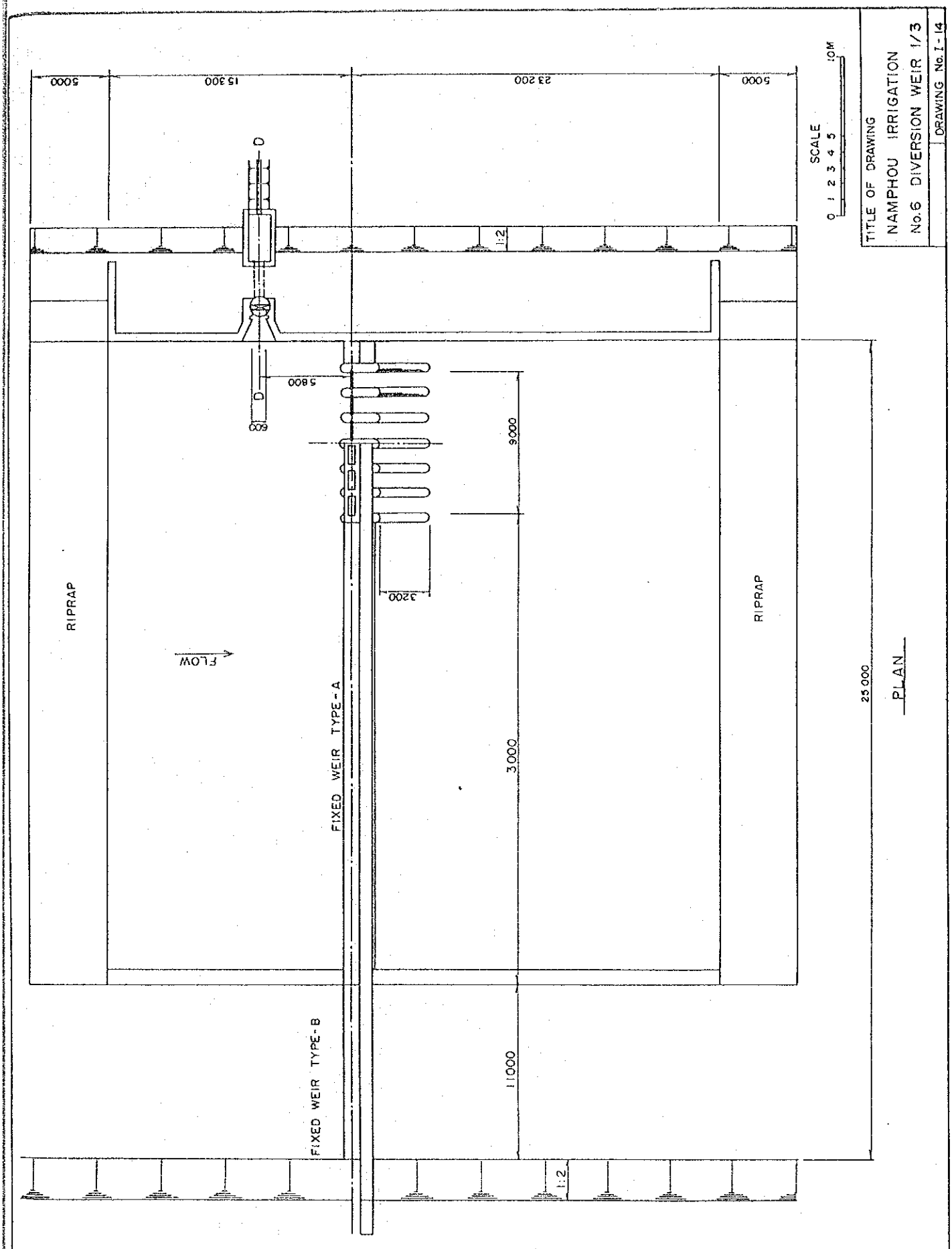


Fig. Ⅷ - 25 Namphou Irrigation No. 6 (H. Pangha Weir, Plan)

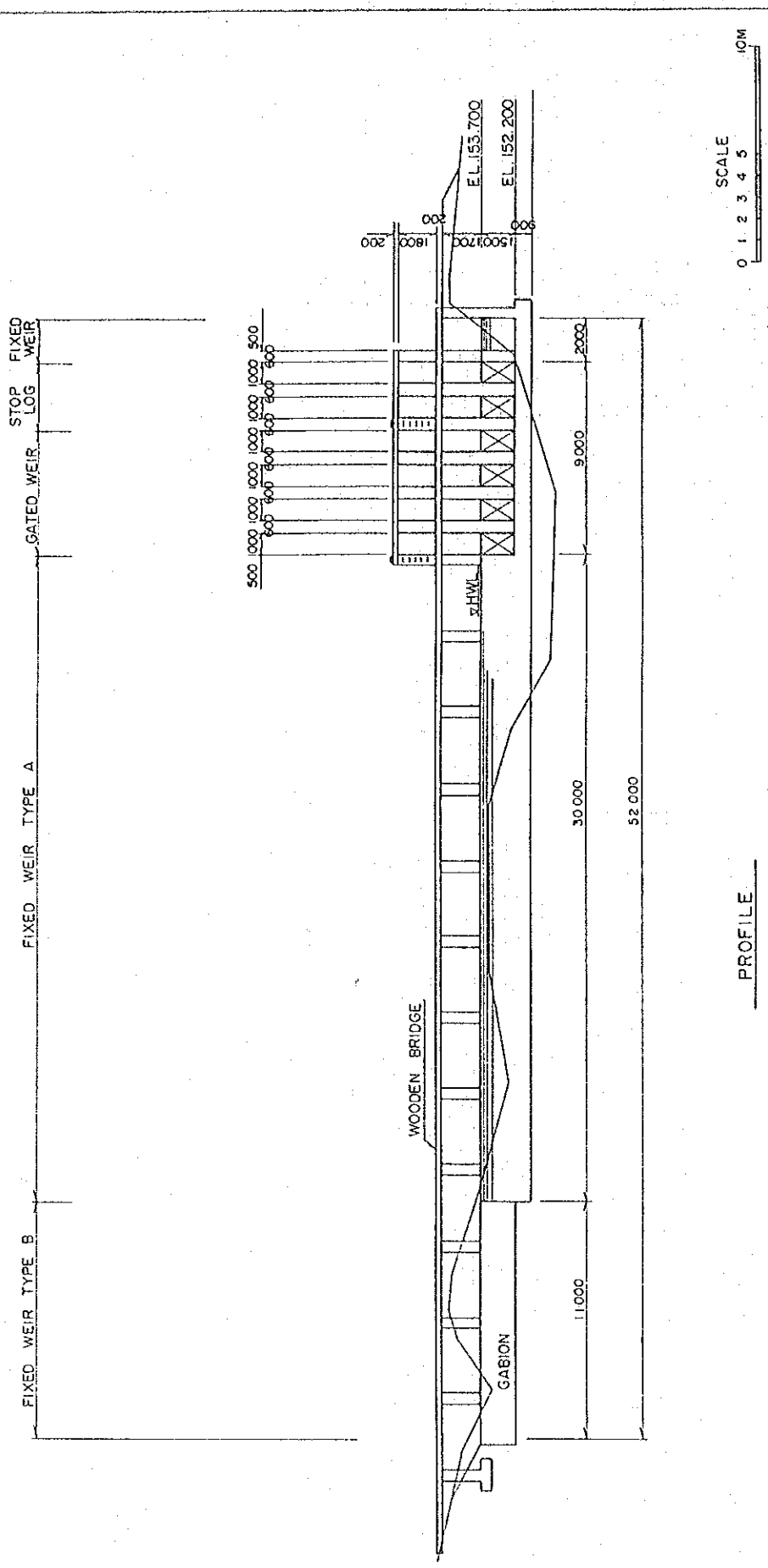


Fig. Ⅷ - 26 Namphou Irrigation No. 6 (H. Pangha Weir, Profile)

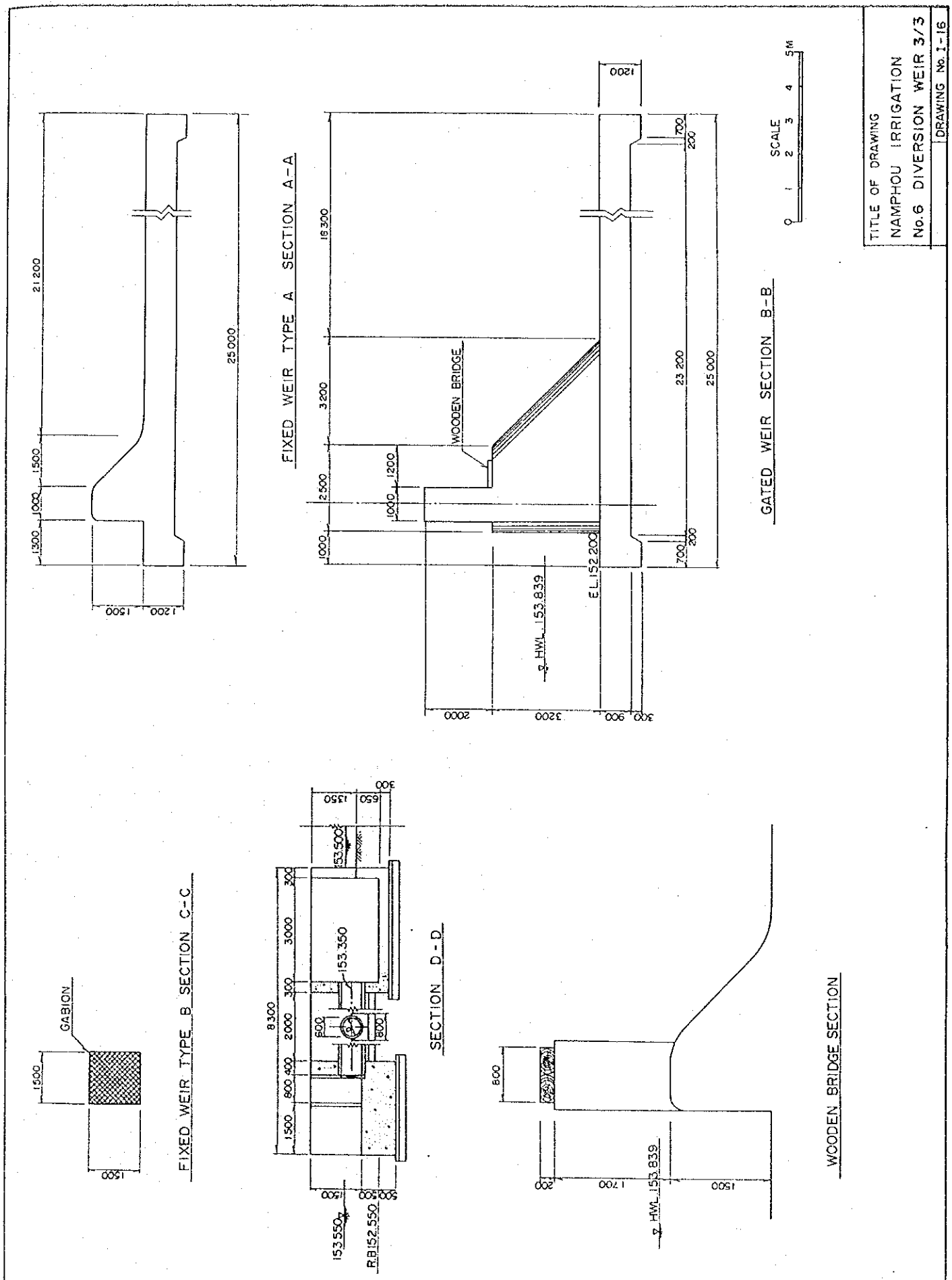


Fig. Ⅷ - 27 Namphou Irrigation No. 6 (H Pangha Weir, Section)

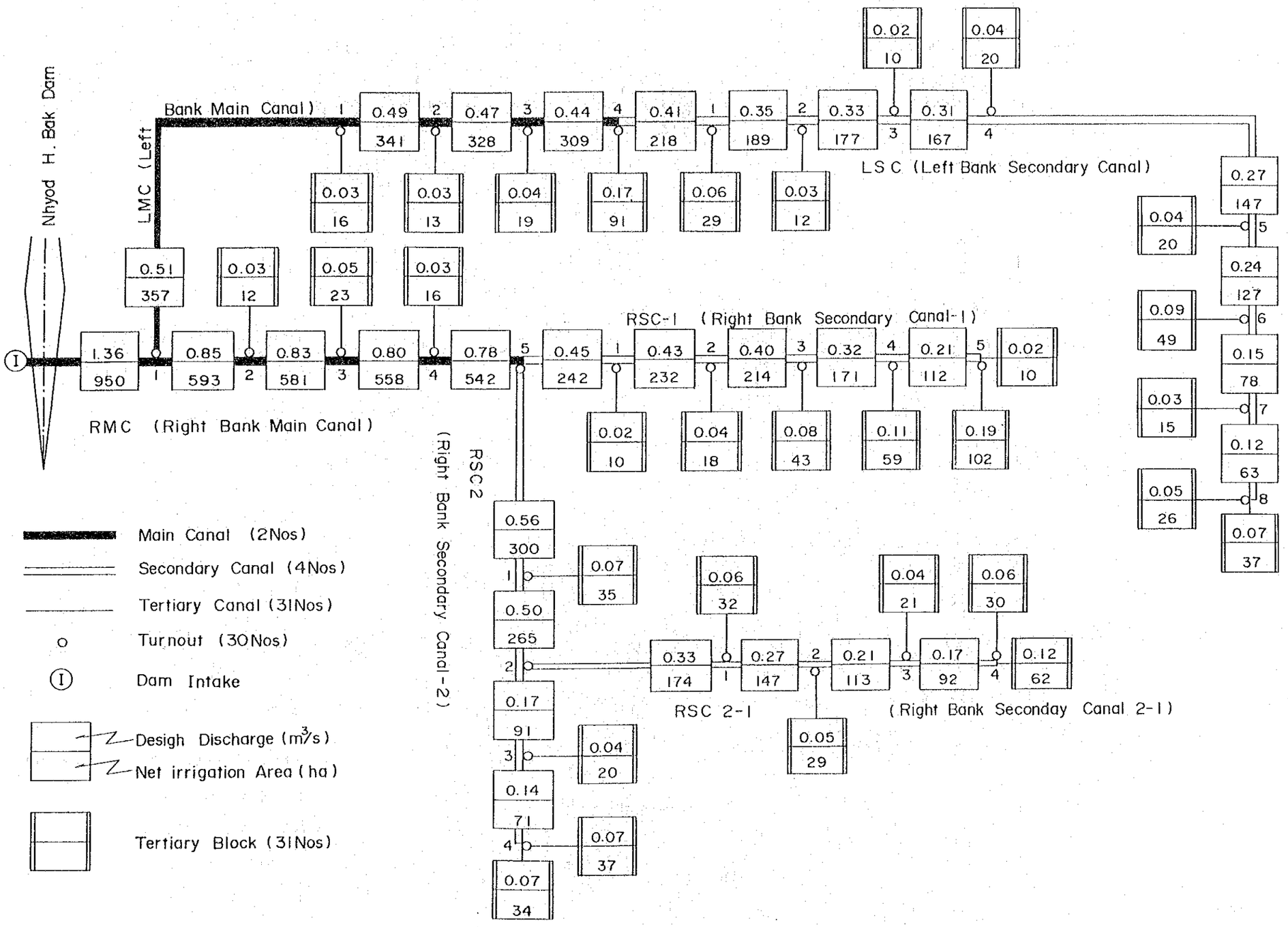


Fig. Ⅷ - 28 Irrigation Flow Diagram (Nhyod H. Bak)

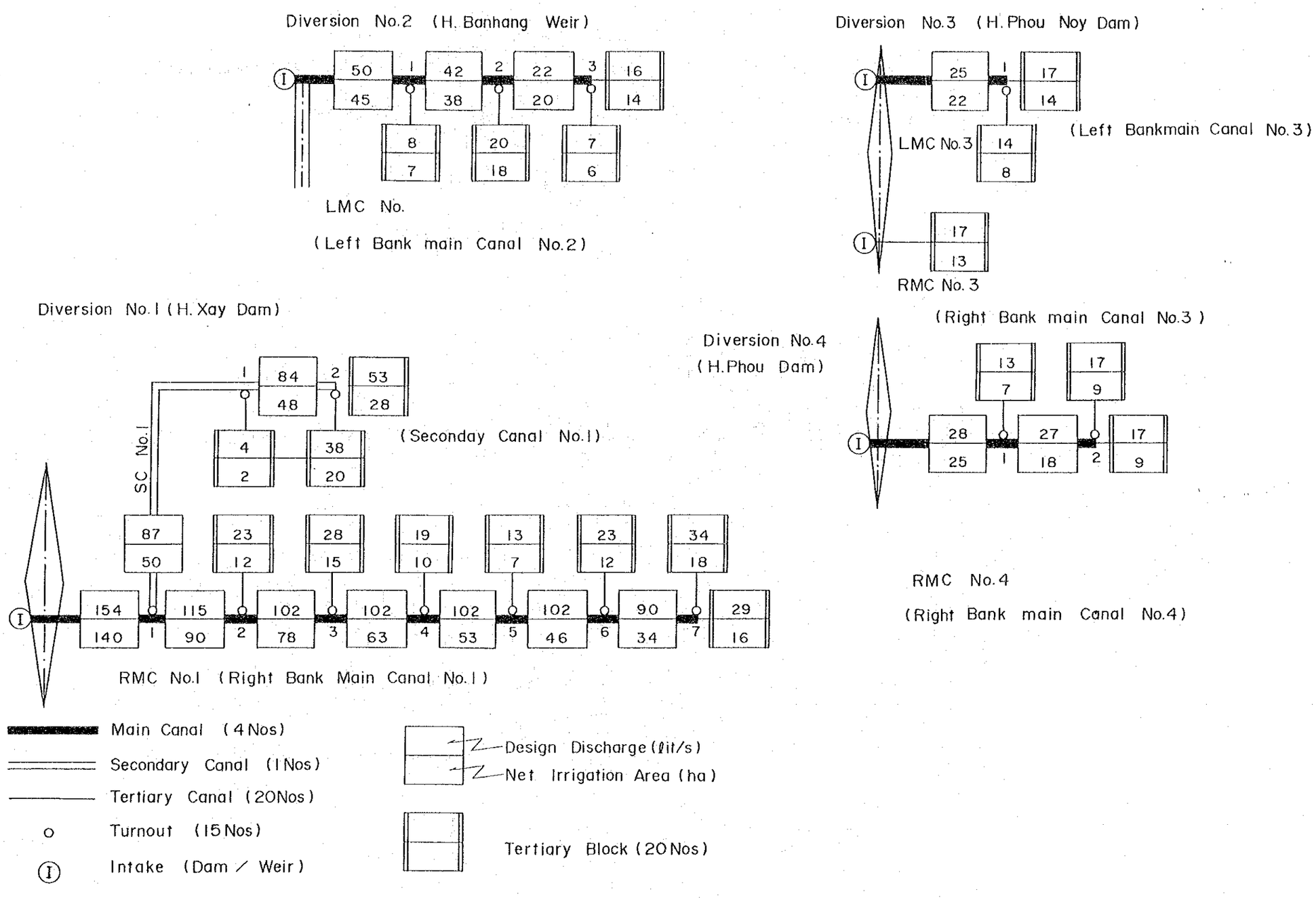


Fig. Ⅷ - 29 Irrigation Flow Diagram (Namphou, 2/2)

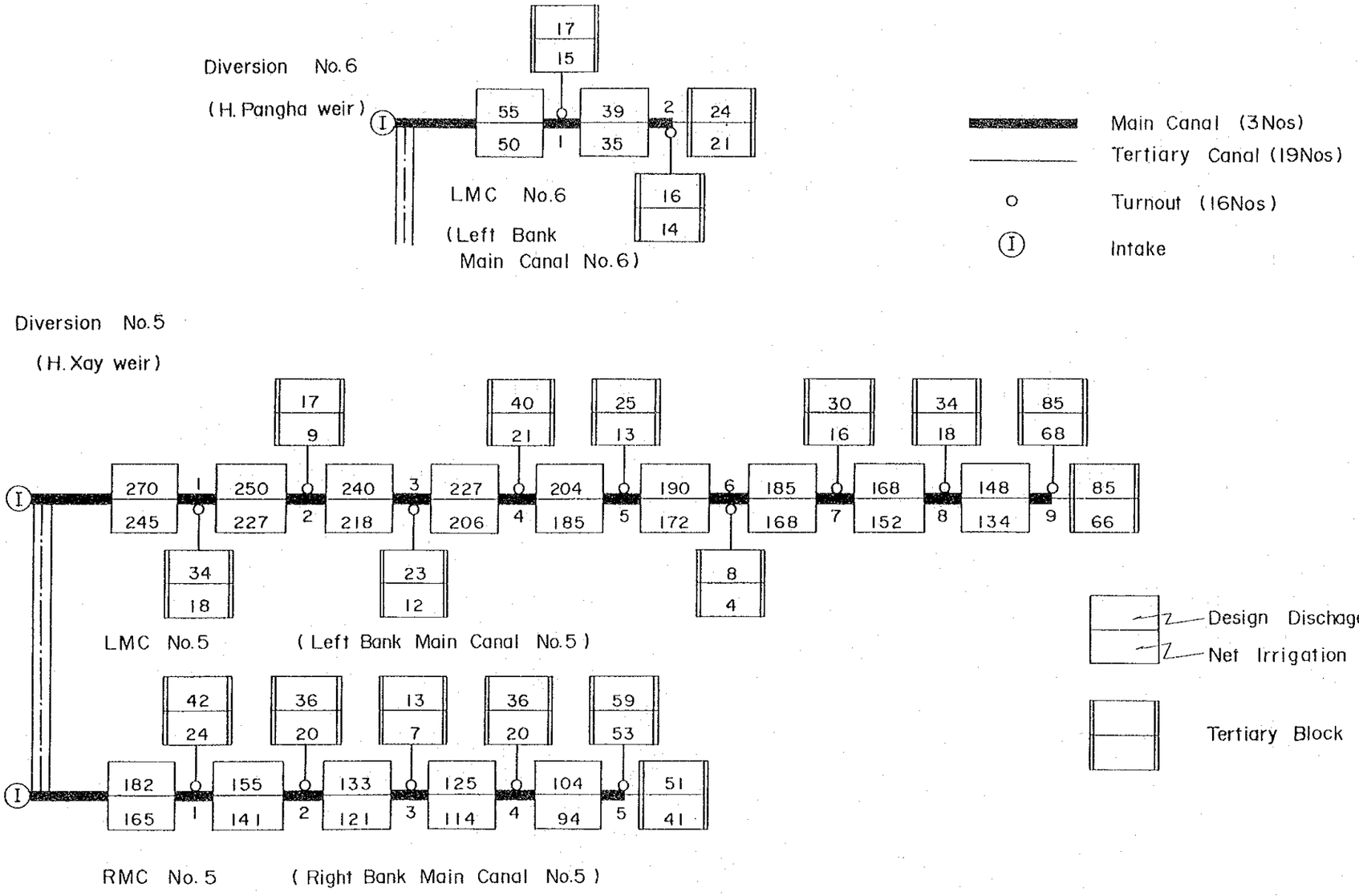
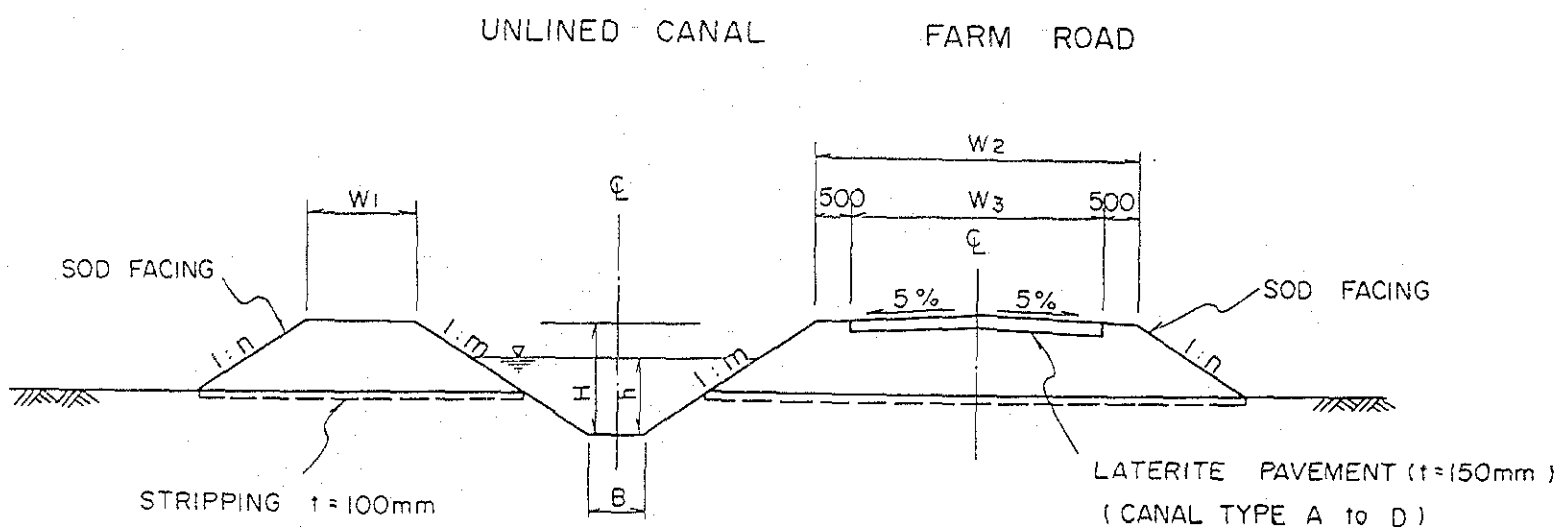


Fig. Ⅷ - 30 Irrigation Flow Diagram (Namphou, 2/2)



DIMENSION

UNIT : mm

CANAL TYPE	B	H	h max	W1	W2	W3	m	n
A	800	1,600	1,300	1,500	4,500	3,500	1.5	1.5~2.0
B	600	1,300	1,000	1,500	4,500	3,500	1.5	1.5~2.0
C	500	1,100	800	1,500	4,500	3,500	1.5	1.5~2.0
D	400	900	600	1,000	4,500	3,500	1.5	1.5~2.0
E	400	800	600	400	3,000	—	1.0	1.5
F	300	600	400	400	3,000	—	1.0	1.5
G	300	500	300	300	3,000	—	1.0	1.5
H	200	350	300	300	800	—	1.0	1.5
I	200	300	250	300	600	—	1.0	1.5
J	100	200	180	200	300	—	1.0	1.5

SCALE

0 1 2 3m

FIG. TYPICAL CROSS SECTIONS OF CANALS AND FARM ROADS

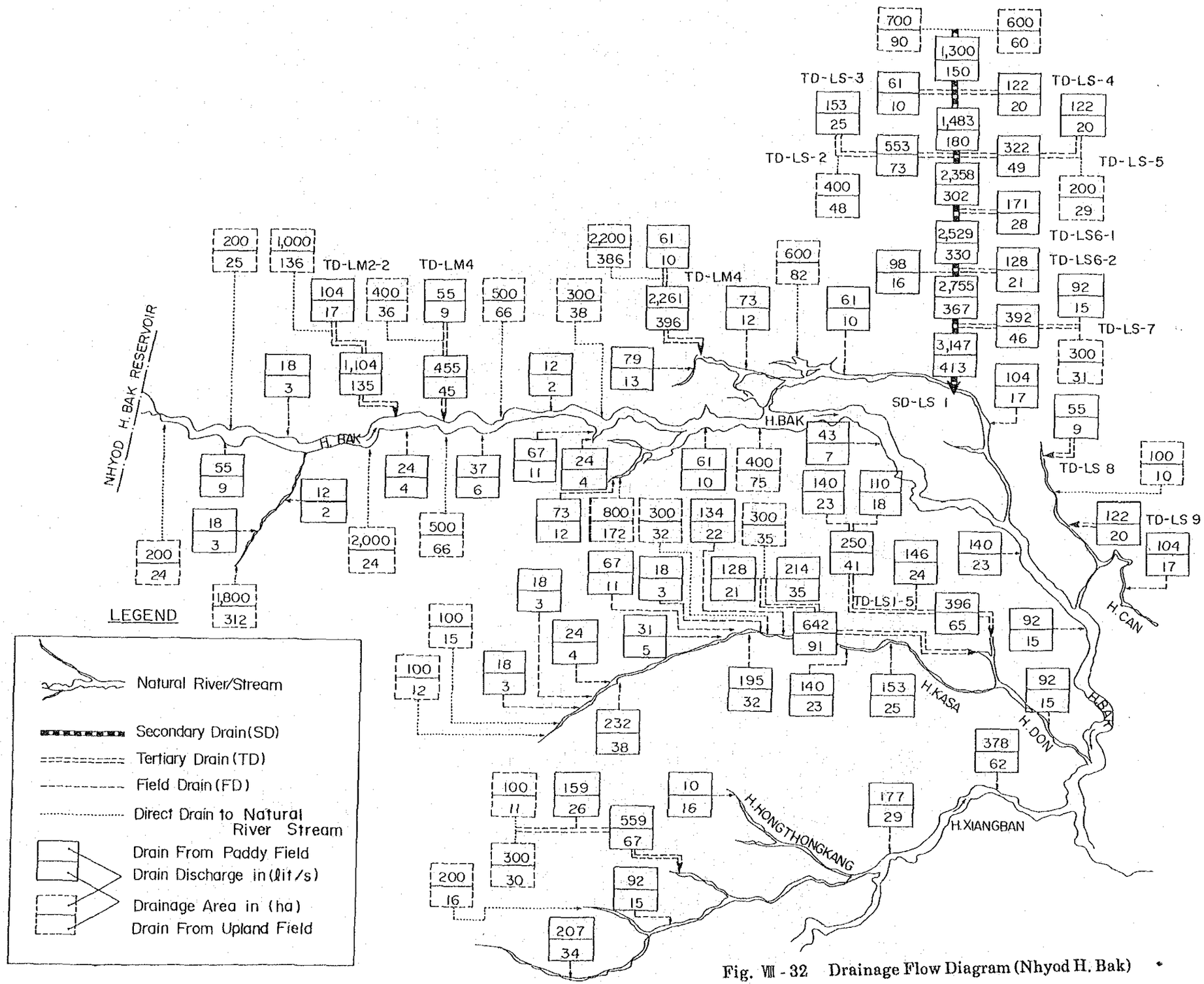


Fig. Ⅷ - 32 Drainage Flow Diagram (Nhyod H. Bak)

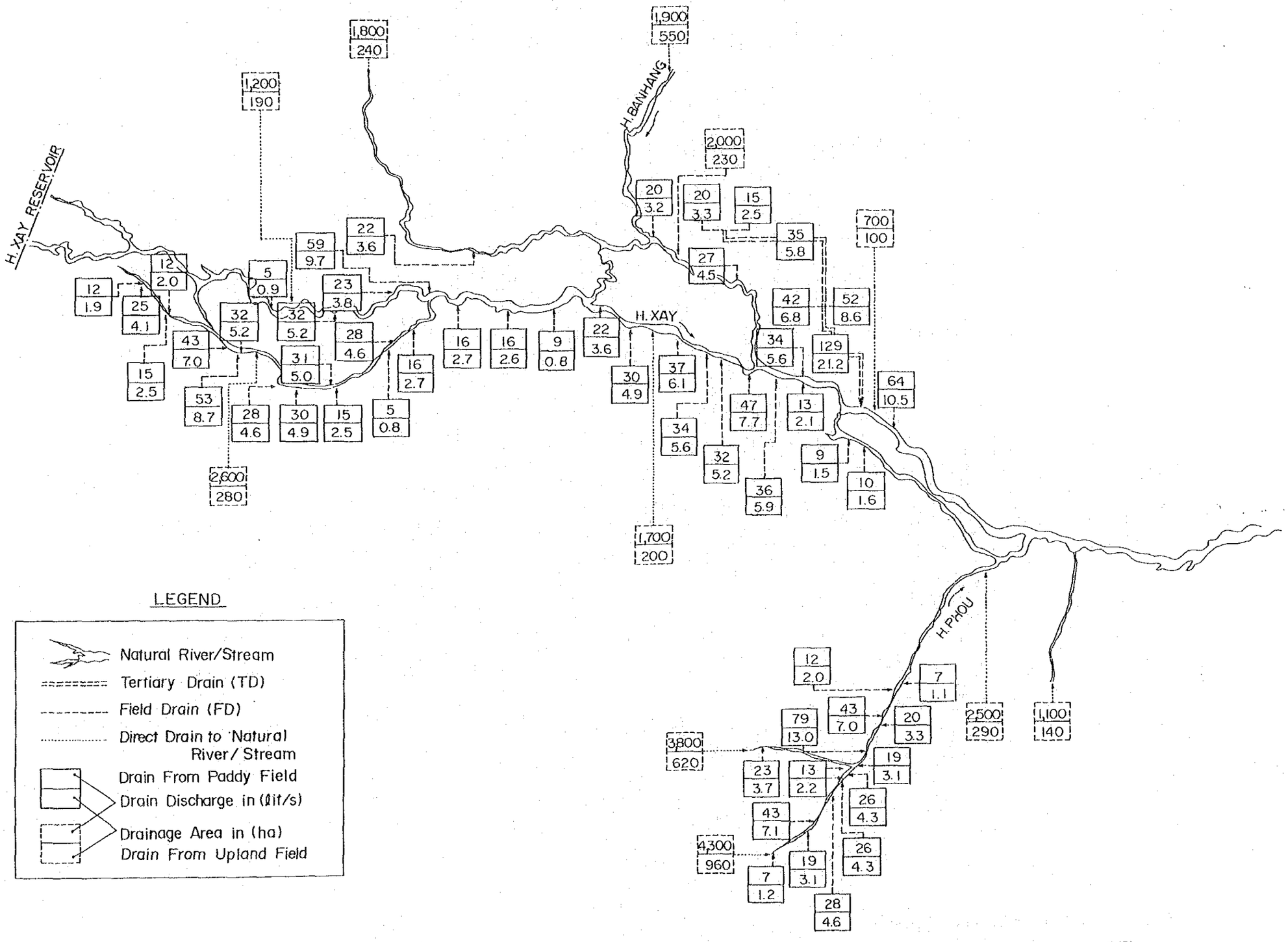


Fig. Ⅷ - 33 Drainage Flow Diagram (Namphou, 1/2)

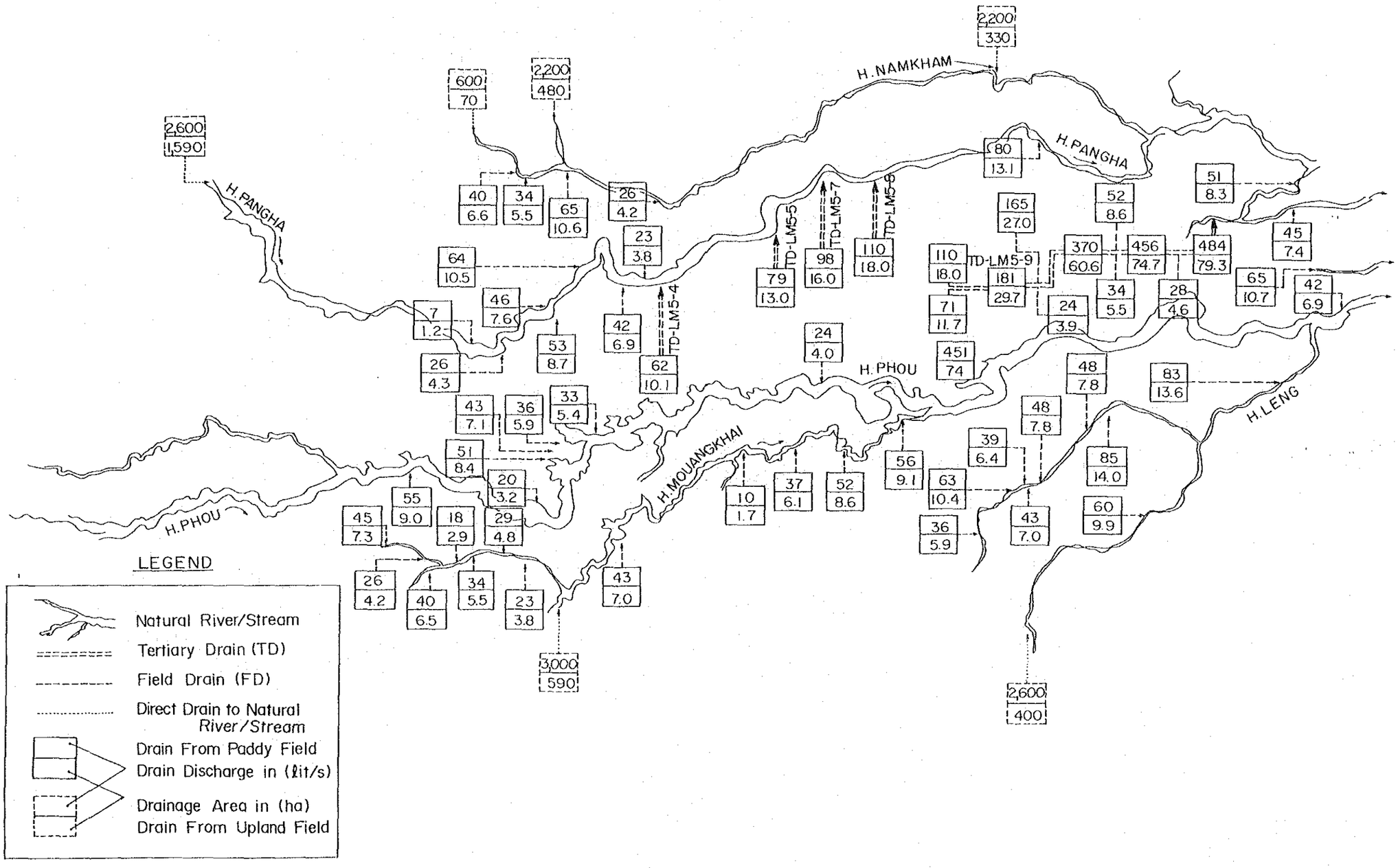
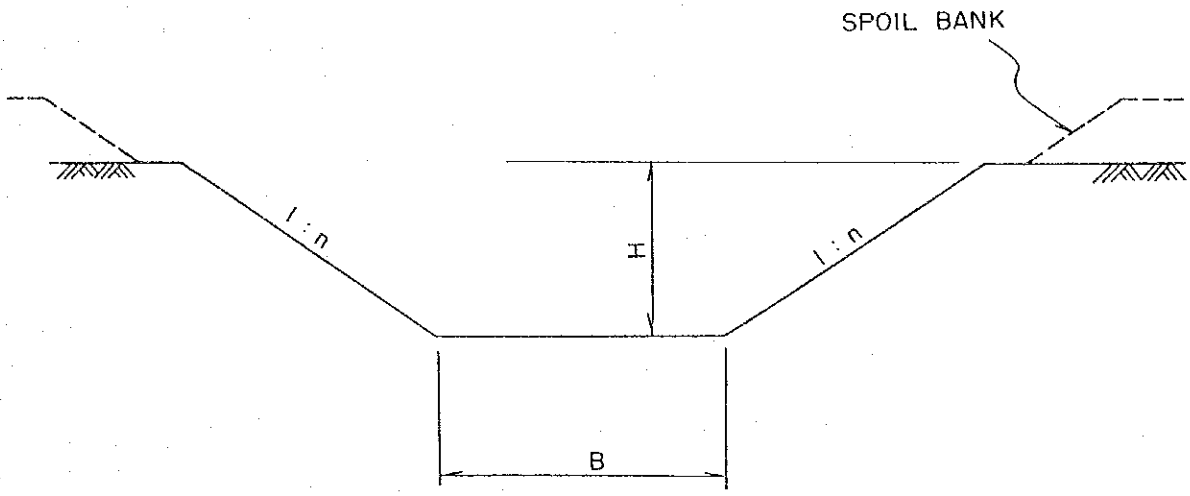


Fig. Ⅷ - 34 Drainage Flow Diagram (Namphou, 2/2)



DIMENSIONS

UNIT : mm

TYPE	B	H	n
A	2,000	1,200	1.5
B	1,000	800	1.5
C	700	600	1.0
D	200	150	1.0

Fig. Ⅷ - 35 Typical Cross Section of Drains

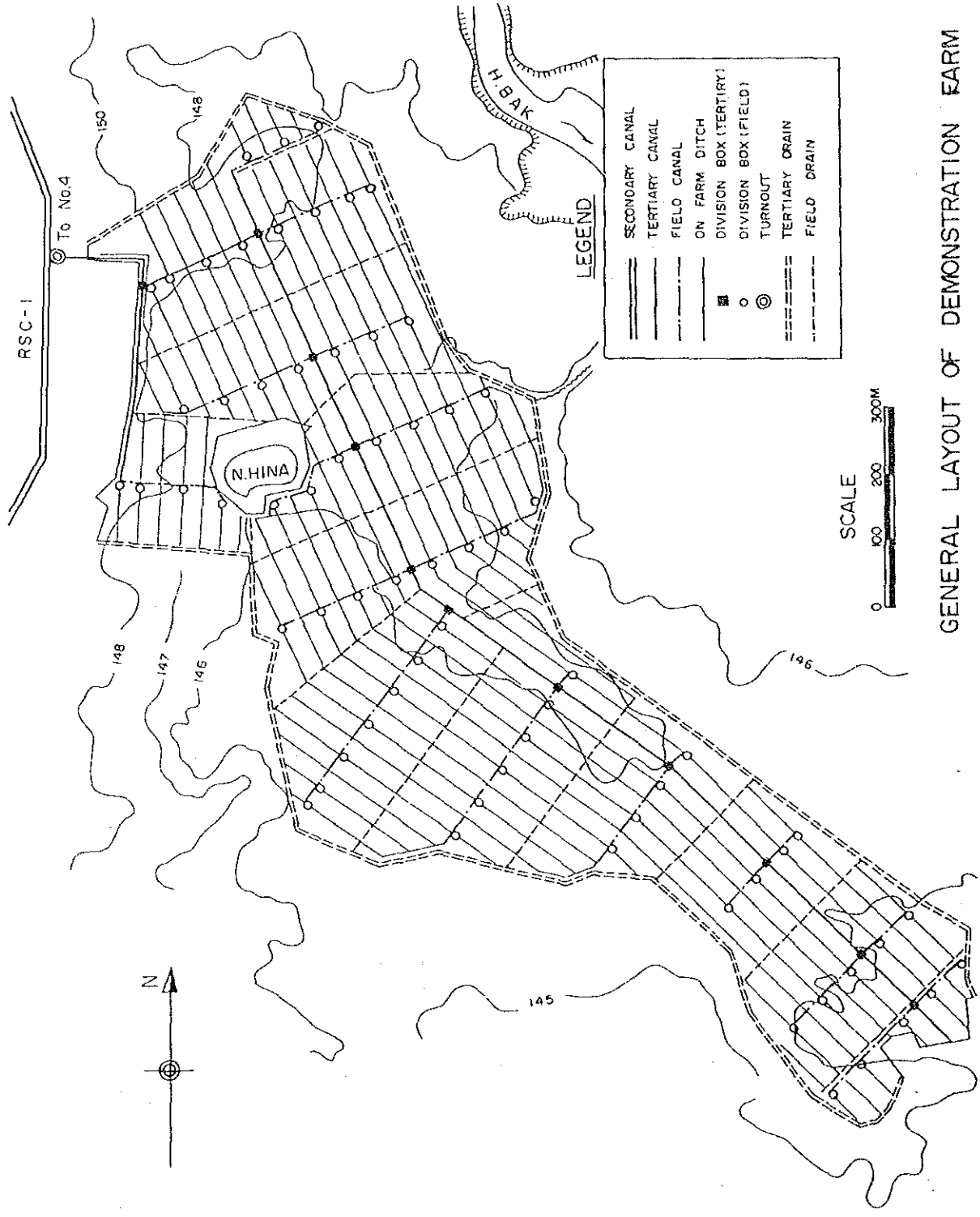


Fig. Ⅷ - 36 General Layout of Demonstration Farm

ANNEX IX

CONSTRUCTION PLAN AND COST ESTIMATE

ANNEX IX

CONSTRUCTION PLAN AND COST ESTIMATE

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1. Construction Plan

1.1 Construction Work

The civil works to be constructed under the Project are broadly divided into three (3) categories, namely irrigation and drainage facilities, rural infrastructures and project office/supporting center. The irrigation and drainage facilities are further divided into two portions according to the two (2) proposed irrigation areas, namely Nhyod H. Bak irrigation area and Namphou irrigation area. Main work for each category are as follows:

(1) Irrigation and drainage facilities

a. Nyod H. Bak
- N.H. Bak reservoir
- Main canals
- Secondary canals
- Tertiary canals
- Field canals
- Secondary drains
- Tertiary drains
- Field drains
- Demonstration farm

b. Namphou
- No. 1 (Xay reservoir)
- No. 2 (Banhang weir)
- No. 3 (Phou Noy reservoir)
- No. 4 (Phou reservoir)
- No. 5 (Xay weir)
- No. 6 (Pangha weir)
- Main canals
- Secondary canal
- Tertiary canals
- Field canals

- Tertiary drains
- Field drains

(2) Rural infrastructures
- Rehabilitation of village road
- Rural water supply

(3) Project office/Supporting center
- B. Lak 35 center office
- Demonstration office

1.2 Construction Schedule

The construction schedule of the Project is prepared as shown in Fig. IX - 1 on the following conditions:

i) All the construction works will be executed by qualified international contractor(s) selected through international competitive tendering.

ii) Since the construction work includes a large volume of earth work, the mechanized construction method will be employed.

iii) Major construction equipment and machinery needed for the work such as bulldozers (21t, 15t), backhoes (0.6m^3, 0.3m^3), wheel loaders (1.3m^3, 1.0m^3), tire rollers (8t), road rollers (10t), motor graders (3.1m), dump trucks (11t, 8t), truck cranes (20t), water tankers (5m^3), etc. are mostly available in Lao PDR.

iv) Earth work for main irrigation and drainage facilities will be concentrated in the dry season.

v) Competent foreign consultant(s) will be engaged in detailed design, preparation of tender documents, technical guidance for prequalification and tendering works, and supervision of the construction works.

vi) Acquisition of lands necessary for the construction work will be made by the Project office.

vii) Equipment and machinery necessary for supervision of the construction works and for operation and maintenance of the Project facilities, as well as for the demonstration farm will be procured by the Project office.

vi) Annual workable days for construction works are estimated at 272 days excluding suspension days due to rainfall, national holidays and Sundays as shown in Table IX - 1.

As shown in Fig. IX - 1, after the pre-construction work, such as detailed design and tendering are completed in the first year, the construction work will commence in February of the second year and end in February of the 4th year, taking a period of two (2) years. Consequently, the irrigation of the entire Project area will commence from the rainy season of the 4th year.

1.3 Construction

(1) Major irrigation and drainage facilities

Construction of the dams and weirs will be mainly executed during the dry season when water flow of the rivers is small. A temporary closing dike will be firstly constructed and, this will be immediately followed by foundation excavation and concreting for sub-structure or embankment for dam.

Earth work for dams (embankment and compaction) will be carried out with heavy equipment such as bulldozers, motorgraders, tire rollers, tamping rollers, road rollers, wheel loaders, dump trucks, backhoes, etc. Earth work for the main and secondary canals will be carried out mainly with such heavy equipment as backhoes and bulldozers. The trimming of canal side slopes will be made by manual labor or trimming machine. The compaction for canal embankment will be made with tamping roller after conditioning the fill materials to achieve the required moisture content.

The embankment materials will be obtained from suitable excavated materials in canals and drains, and/or extracted from borrow pits.

Concrete for such large structures as spillways of dam, and weirs will be produced in a central batching and mixing plant and transported with agitators, while that for small structures will be produced through potable concrete mixers to be installed at construction sites of respective structures.

Earth work for on-farm canals and drains will be made through both construction machineries and manual labor.

(2) Rural infrastructures

The existing road will be rehabilitated as a village road with road construction equipment such as bulldozers, motorgraders, and road rollers. Dug-well will be constructed by manpower.

(3) Borrow-pit and concrete aggregates

Proposed borrow-pits for both dams are located at about 500 to 1500m from the proposed sites, shown in Fig. Ⅷ - 4 and 14. Concrete aggregates, i.e. sand and gravel will be obtained from the Mekong river, 4 km north from Savannakhet and located about 45 km east from the Project area.

Work quantities of the major construction works are presented in Table Ⅸ-2, 3, 4 and 5.

1.4 Operation and Maintenance

All the facilities constructed under the Project will be owned by the Government of Lao PDR. The operation and maintenance of the main irrigation and drainage facilities, village roads, and farm tractors for the demonstration farm will be carried out by the Project office, while that of the on-farm facilities will be entrusted to farmers concerned.

2. Cost Estimate

2.1 General

The costs for the implementation of the Project are estimated on the following assumptions:

i) The exchange rate as of November 1991 used in the estimate was US$1.0 = Kip 700 = Yen 130.

ii) All the construction works will be carried out by contractor(s) selected through international tendering. Most of the construction machinery and equipment needed for the construction works will be available in Lao PDR.

iii) Taxes on construction materials, machinery and equipment to be imported from abroad are exempted.

iv) Unit costs of respective works are estimated at price and wage levels prevailing in Savannakhet. The unit costs are divided into the foreign currency portion and local currency portion based on the following classification:

Local currency portion
- Labor force
- Wooden materials
- Sand and gravel
- Inland transportation
- Administration expenses

Foreign currency portion
- Reinforcing bar
- Depreciation of construction and machinery
- Steel gates
- Structural steel
- Cement
- Fuel

- International transportation
- General expenses and profits for foreign contractor(s)
- Expenses and fees of engineering services by foreign consultant(s)

v) Physical contingency is taken as 10% of direct construction cost

vi) Rice contingency is estimated based on a price escalation rate of 1% per annum for the foreign currency equivalent.

2.2 Cost Estimate

(1) Construction cost and annual disbursement schedule

The total construction cost for the Project is estimated to be equivalent to US$15.0 million, (US$12.4 million of foreign currency portion and local currency portion equivalent to US$2.6 million), as summarized in Table IX-6. The annual disbursement schedule is worked out based on the construction schedule shown in Table IX-7.

The procurement cost of O & M equipment, the prices of basic materials and labor wages used in the estimate and unit prices for major work items are shown in Tables IX-8, 9 and 10.

(2) Operation and maintenance costs

Operation and maintenance costs at the full operation stage of the Project is estimated to be US$, as shown in Table IX-11.

(3) Replacement cost of the Project facilities

O & M equipment and steel gates of intake facilities of dam and turnouts of canals will have to be periodically replaced. Their span of usefulness and replacement cost are given in Table IX-12.

Table IX - 1 Work Day for Construction Work

1. Conditions for work day estimate

(1)	Daily rainfall (mm)	0-10	10-30	30-50	50 <
(2)	Time needed for suspension (day)	0	0.5	1.0	2.0

2. Estimate of work days (reference year of 1987)

	Month/	J	F	M	A	M	J	J	A	S	O	N	D
(1)	Rainfall days (day/month)												
	10-30 mm	–	–	–	1	2	4	6	4	5	1	–	–
	30-- 50	–	–	–	–	2	1	2	1	2	–	–	–
	50 mm <	–	–	–	–	–	1	2	1	1	–	–	–
(2)	Time length to be suspended	–	–	–	0.5	3	5	9	5	6.5	0.5	–	–
(3)	Sundays & national holidays	6	4	7	7	6	5	4	6	4	4	5	5
	Total days : (2) + (3)	6	4	7	8	9	10	13	11	11	5	5	5
3.	Work days	25	25	24	22	22	20	18	20	19	26	25	26

= 272 days

Table Ⅸ-2 Work Quantity of Irrigation and Drainage Facilities (1/2)

Items	Embank-ment (m^3)	Back-fill (m^3)	Excava-tion (m^3)	Strop-ping (m^3)	Sod Facing (m^2)	Laterite Pavement (m^3)	Land Level-ing (ha)
(Ⅰ)N.H. Bak Irrigation							
1. N.H. Bak Reservoir							
- Dam	321,700	0	72,300	0	19,100	0	0
- Intake/Spillway	0	0	1,100	0	0	0	0
2. Main Canals	154,100	1,500	61,300	15,600	64,300	5,600	0
3. Secondary Canals	281,400	200	34,800	15,800	69,600	5,100	0
4. Tertiary Canals	22,000	170	1,200	9,200	0	0	0
5. Field Canals	19,000	100	1,000	11,400	0	0	0
6. Secondary Drains	0	40	10,000	0	0	0	0
7. Tertiary Drains	0	30	27,900	0	0	0	0
8. Field Drains	0	0	3,100	0	0	0	0
9. Demonstration Farm	0	0	0	0	0	0	50
(Ⅱ)Namphou Irrigation							
1. No. 1 (H.Xay Reservoir)							
- Dam	83,100	0	22,100	0	8,500	0	0
- Intake/Spillway	0	30	11,700	0	0	0	0
2. No. 2 (Banhang Weir)	0	530	1,500	0	0	0	0
3. No. 3 (Phou Noy	800	0	200	0	200	0	0
Reservoir)	9,300	0	2,500	0	600	0	0
4. No. 4 (Phou Reservoir)	0	1,410	5,000	0	0	0	0
5. No. 5 (Xay Weir)	0	1,510	4,400	0	0	0	0
6. No. 6 (Pangha Weir)	46,900	220	47,400	12,000	45,200	1,100	0
7. Main canals	4,800	10	600	600	2,800	0	0
8. Secondary Canals	10,300	100	800	5,000	0	0	0
9. Tertiary Canals	10,900	60	600	6,500	0	0	0
10. Field Canals	0	20	3,400	0	0	0	0
11. Tertiary Drains	0	0	1,700	0	0	0	0
12. Field Drains							

Table IX-3 Work Quantity of Irrigation and Drainage Facilities (2/2)

Items	Concrete (1:2:4) (m^3)	Concrete (1:3:6) (m^3)	Form (m^2)	Rein-force-ment bar (ton)	Gate (set)	Concrete (D<0.8m) (m)	Pipe (D>0.8m) (ha)
(I) N.H. Bak Irrigation							
1. N.H. Bak Reservoir							
- Dam	0	0	0	0	0	0	0
- Intake/Spillway	1,700	280	2,300	43	3	0	70
2. Main Canals	580	200	1,900	36	9	30	940
3. Secondary Canals	500	100	2,100	25	21	70	280
4. Tertiary Canals	450	80	2,700	27	0	810	0
5. Field Canals	290	100	1,300	19	0	480	0
6. Secondary Drains	100	20	300	4	0	0	40
7. Tertiary Drains	120	20	500	4	0	0	50
8. Field Drains	0	0	0	0	0	0	0
9. Demonstration Farm	0	0	0	0	0	0	0
(II) Namphou Irrigation							
1. No. 1 (H.Xay Reservoir)							
- Dam	0	0	0	0	0	0	0
- Intake/Spillway	520	260	900	28	3	40	0
2. No. 2 (Banhang Weir)	520	40	600	32	4	0	0
3. No. 3 (Phou Noy Reservoir)	40	10	0	2	0	0	0
4. No. 4 (Phou Reservoir)	180	60	500	10	1	20	0
5. No. 5 (Xay Weir)	1,400	70	1,300	84	14	0	0
6. No. 6 (Pangha Weir)	870	90	1,100	52	7	0	0
7. Main canals	400	80	1,800	22	29	140	270
8. Secondary Canals	30	10	100	2	2	10	10
9. Tertiary Canals	240	40	1,500	14	0	420	20
10. Field Canals	170	60	800	12	0	290	0
11. Tertiary Drains	110	10	800	7	0	60	0
12. Field Drains	0	0	0	0	0	0	0

TABLE Ⅸ-4 Work Quantity of Rural Infrastructures

(Ⅰ) Rehabilitation of village road

	Items	Unit	Q'ty 1)	Q'ty 2)	Q'ty 3)	Total Q'ty
1.	Grading	m^2	8,300	113,000	31,000	152,300
2.	Disposal	m^3	6,200	9,430	5,620	21,250
3.	Embankment	m^3	36,400	50,700	16,500	103,600
4.	Side ditch	m	20,100	28,000	10,000	58,100
5.	Concrete Pipe (D=600mmx)	m	160	200	40	400
6.	Excavation	m^3	2,500	1,140	1,800	5,440
7.	Concrete (1:2:4)	m^3	120	212	301	633
8.	Concrete (1:3:6)	m^3	60	0	0	60
9.	Reinforcing Bar	ton	0	11	15	32
10.	Form	m^2	300	810	1,200	2,310
11.	Riprap	m^3	212	0	0	212
12.	Gravel/cobble for base	m^3	80	28	48	156
13.	Backfill	m^3	1,200	0	0	1,200
14.	H-steel (350×700)	m	0	0	63	63
15.	Removal/installation	site	0	3	5	8

Note: 1) Route A, L=10.4 Km including a submergible bridge construction
2) Route B, L=14.2 Km including the rehabilitation of 3 bridges
3) Route C, L=5.0 Km including the rehabilitation of 5 bridges

(Ⅱ) Rural water supply

	Items	Unit	Q'ty 1)	Q'ty 2)	Total Q'ty
1.	Excavation	m^3	180	60	240
2.	Concrete Pipe (D=1000 mm)	m	90	30	120
3.	Disposal	m^3	180	60	240
4.	Gravel/sand	m^3	120	40	160
5.	concrete (1:2:4)	m^3	23	80	30
6.	submergible pump	LS	9	1	10
7.	Hand-pump	set	9	1	10

Note: 1) H. Bak area, nine (9) wells
2) Namphou area, one (1) well

Table IX-5 Work Quantity of Project Office/Supporting Center

Items	Unit	Quantity
(I) B. Lak 35 Supporting Center Office		
1. Clearing for the center area	ha	2.25
2. Grading for the center area	ha	2.25
3. Concrete (1:2:4)	m^3	5,800
4. Office	m^2	250
5. Store house	m^2	475
6. Garage	m^2	150
7. Market house	m^2	875
8. Rice-mill house	m^2	100
9. Well (water supply in the center)	LS	1
10. Rice-mill (1.5 t/h, 15 Kw)	set	1
11. Fish nursery	m^2	120
(II) Demonstration Farm Office		
1. Office	m^2	100
2. Store house	m^2	100
3. Garage	m2	100

Table IX-6 Summary of Construction Cost

(Unit : '000$)

Items	Foreign Currency	Local Currency	Total Cost
1. Land acquisition	0	226	226
2. Preparatory work	139	24	163
3. Irrigation and drainage facilities			
(1) N.H. Bak			
a. N.H. Bak Reservoir			
- Dam	1,823	250	2,073
- Intake/Spillway	320	88	408
b. Main Canals	1,058	106	1,164
c. Secondary Canals	1,071	95	1,166
d. Tertiary Canals	203	83	286
e. Field Canals	108	45	153
f. Secondary Drain	48	11	59
g. Tertiary Drains	95	18	113
h. Field Drains	7	1	8
i. Demonstration Farm	36	3	39
(2) Namphou Irrigation			
a. No. 1 (H.Xay Reservoir)			
- Dam	522	103	625
- Intake/Spillway	145	33	178
b. No. 2 (Banhang Weir)	131	31	162
c. No. 3 (Phou Noy Reservoir)	12	1	13
d. No. 4 (Phou Reservoir)	86	18	104
e. No. 5 (Xay Weir)	371	68	439
f. No. 6 (Pangha Weir)	238	61	299
g. Main canals	480	71	551
h. Secondary Canals	32	5	37
i. Tertiary Canals	95	31	126
j. Field Canals	64	28	92
k. Tertiary Drains	25	16	41
l. Field Drains	3	1	4
(Sub-total : 2+3)	7,112	1,191	8,303
4. Rural infrastructures			
(1) Rehabilitation of village road	846	466	1,312
(2) Rural water supply	110	58	168
(Sub-total: 4)	956	524	1,480
5. Project office/Supporting center			
(1) B.Lak 35 center office	504	228	732
(2) Demonstration farm office	61	31	92
6. Equipment			
(1) O & M equipment	1,288	0	1,288
(2) Equipment for center office	190	0	190
(3) Equipment for demonstration farm	206	0	206
7. Engineering services	1,123	177	1,300
8. Contingencies			
(1) Physical contingency	863	220	1,083
(2) Price contingency	114	24	138
Total	12,417	2,621	15,038

Table IX-7 Disbursement Schedule of Construction Cost (1/2)

(Unit : '000$)

Items	Total		1st Year		2nd Year		3rd Year		4th Year	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Land acquisition	0	226	0	226	0	0	0	0	0	0
2. Preparatory work	139	24	0	0	139	24	0	0	0	0
3. Irrigation and drainage facilities										
(1) N.H. Bak										
a. N.H. Bak Reservior										
- Dam	1,823	250	0	0	912	125	11	125	125	0
- Intake/Spillway	320	88	0	0	256	70	64	18	18	0
b. Main Canals	1,058	106	0	0	264	26	794	80	80	0
c. Secondary Canals	1,071	95	0	0	179	16	892	79	79	0
d. Tertiary Canals	203	83	0	0	0	0	102	42	42	41
e. Field Canals	108	45	0	0	0	0	54	23	23	22
f. Secondary Drain	48	11	0	0	0	0	24	6	6	5
g. Tertiary Drains	95	18	0	0	0	0	48	9	9	9
h. Field Drains	7	1	0	0	0	0	4	0	0	1
i. Demonstration Farm	36	3	0	0	0	0	18	2	2	1
(2) Namphou Irrigation										
a. No. 1 (H.Xay Reservoir)										
- Dam	522	103	0	0	522	103	0	0	0	0
- Intake/Spillway	145	33	0	0	145	33	0	0	0	0
b. No. 2 (Banhang Weir)	131	31	0	0	131	31	0	0	0	0
c. No. 3 (Phou Noy Reservoir)	12	1	0	0	6	1	6	0	0	0
d. No. 4 (Phou Reservoir)	86	18	0	0	43	9	43	9	0	0
e. No. 5 (Xay Weir)	371	68	0	0	371	68	0	0	0	0
f. No. 6 (Pangha Weir)	238	61	0	0	0	0	238	61	0	0
g. Main canals	480	71	0	0	160	24	320	47	0	0
h. Secondary Canal	32	5	0	0	11	2	21	3	0	0
i. Tertiary Canals	95	31	0	0	0	0	48	16	47	15
j. Field Canals	64	28	0	0	0	0	32	14	32	14
k. Tertiary Drains	25	16	0	0	0	0	13	8	12	8
l. Field Drains	3	1	0	0	0	0	2	1	1	0
4. Rural infrastructures										
(1) Rehabilitation of village road	846	466	0	0	282	156	282	155	282	155
(2) Rural water supply	110	58	0	0	0	0	73	39	37	19
5. Project office/Supporting center										
(1) B.Lak 35 center office	584	228	0	0	360	163	144	65	0	0
(2) Demonstration farm office	61	31	0	0	0	0	41	21	20	10

Table Ⅸ-7 Disbursement Schedule of Construction Cost (2/2)

(Unit : '000$)

Items	Total		1st Year		2nd Year		3rd Year		4th Year	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
6. Equipment										
(1) O & M equipment	1,288	0	0	0	0	0	1,288	0	0	0
(2) Equipment for center office	190	0	0	0	0	0	190	0	0	0
(3) Equipment for demonstration farm	206	0	0	0	0	0	206	0	0	0
7. Engineering services	1,288	177	219	35	438	69	350	55	116	18
8. Contingencies										
(1) Physical contingency	863	220	0	23	478	85	417	82	68	30
(2) Price contingency	114	24	2	3	42	9	62	9	8	3
Total	12,417	2,621	221	287	4,639	1,014	6.687	969	878	351

Table Ⅸ-8 Cost of O & M Equipment

Items	Unit	Q'ty	Unit Price ('000$)	Total Cost ('000$)
(Ⅰ) O & M Equipment				
1. Bulldozer, 130 HP	Nos.	1	169	169
2. Wheel loader, 110 HP	Nos.	1	132	132
3. Backhoe, 0.5 m^3	Nos.	2	162	300
4. Motor grader, 135 HP	Nos.	2	115	230
5. Road roller, 85	Nos.	1	100	100
6. Dump truck, 85	Nos.	3	51	153
7. Water tanker, 6m^3	Nos.	1	45	45
8. Pick-up, 25	Nos.	1	17	17
9. Spare parts	LS	1		118
10. Radio Station		1	24	24
		(Sub-total)		1,288
(Ⅱ) Equipment for B. Lak 35 Center Office				
1. Cargo truck, 45	Nos.	3	31	93
2. Pick-up, 25	Nos.	1	17	17
3. Motor cycle, 150cc	Nos.	2	2	4
4. Generator, 45 KVA	Nos.	1	18	18
5. generator, 15 KVA	Nos.	1	10	10
6. Training equipment	LS	1		15
7. Office equipment	LS	1		6
8. Spare parts	LS	1		27
		(Sub-total)		190
(Ⅲ) Equipment for Demonstration Farm Office	Nos.	3	31	93
1. Farm tractor, 35 HP with attachments	Nos.	1	62	62
2. Mobile workshop	Nos.	2	1	2
3. Motor cycle, 100cc	LS	1		8
4. Meteorological equipment	LS	1		8
5. Training equipment	LS	1		2
6. Office equipment	LS	1		32
7. Spare parts				
		(Sub-total)		205
Total				1,684

Table Ⅸ-9 Price List of Basic Materials and Labor Wages

Items	Unit	Price (US$)
Ⅰ. Materials		
	m^3	13.0
1. Gravel	m^3	8.9
2. Sand	ton	180.0
3. Cement	m^3	210.0
4. Timber for form work	ton	607.5
5. Reinforcing bar		
Ⅱ. Fuel		
	lit.	0.45
1. Gasoline	lit.	1.29
2. Lubricating oil	lit.	0.39
3. Diesel engine oil		
Ⅲ. Labor		
1. Common laborer	man-day	1.9
2. Skilled laborer	man-day	2.4
3. Concrete Worker	man-day	3.6
4. Carpenter	man-day	3.1
5. Welder	man-day	3.1
6. Heavy equipment operator	man-day	3.6
7. Driver	man-day	2.4

Table IX-10 Unit Price for Major Work Items

Work Items	Unit	Foreign Currency	Local Currency	Total
1. Stripping	m^3	0.93	0.01	0.94
2. Excavation				
- Excavation	m^3	1.23	0.04	1.27
- Excavation/disposal (L=30m)	m^3	1.60	0.04	1.64
- Excavation/disposal (L=1Km)	m^3	2.45	0.17	2.62
3. Embankment				
- W/Excavated Materials (L=30m)	m^3	2.01	0.05	2.06
- W/excavation in borrow pit (L=30m)	m^3	2.15	0.04	2.19
- W/excavation in borrow pit (L=2Km)	m^3	4.75	0.21	4.95
4. Backfill	m^3	1.33	0.16	1.50
5. Sod facing	m^3	1.39	0.07	1.46
6. Laterite pavement	m^3	4.67	0.09	4.76
7. Riprap	m^3	26.08	23.19	49.27
8. Concrete (1:2:4)	m^3	118.89	16.28	135.17
9. Concrete (1:3:6)	m^3	88.73	16.06	104.79
10. Form	m^3	1.30	18.88	20.18
11. Reinforcement bar	ton	898.19	51.54	949.74
12. Concrete pipe				
- Diameter = 300 mm	m	30.37	5.84	36.21
- Diameter = 400 mm	m	41.69	7.53	49.22
- Diameter = 600 mm	m	57.67	11.71	69.39
- Diameter = 800 mm	m	78.68	15.79	94.47
- Diameter = 1000 mm	m	99.63	19.87	119.50
- Diameter = 1500 mm	m	158.92	30.85	189.77
13. Slide gate				
- 300 mm × 300 mm	set	409	8	417
- 500 mm × 500 mm	set	433	21	454
- 700 mm × 1000 mm	set	1,247	35	1,282
- 1000 mm × 1000 mm	set	3,645	84	3,729
- 1000 mm × 1500 mm	set	7,796	190	7,986
- 1500 mm × 1500 mm	set	11,600	381	11,981

Table IX-11 Annual Operation & Maintenance Cost

Items	Cost (US$)
1. Salaries and Wages	
- Staff Salaries	2,160
- Labor Wages	1,290
2. Operation Cost	
- Fuel	6,370
3. Maintenance cost	24,000
Total	33,820

Table IX-12 Replacement Cost and Span of Use

Items	Span of Use	Replacement Cost (US$'000)
1. Equipment O & M	10	345
2. Gates	25	245
3. Pump	20	29
4. Equipment for Center	10	197
5. Building in Center	25	383

Fig. IX-1 Project Implementation Schedule

Works	1st Year			2nd Year			3rd Year			4th Year		
	J	J	D	J	J	D	J	J	D	J	J	D
(I) Pre-construction Work												
1. Detailed Design and Preparation of Tender Document		———										
2. Prequalification and Tendering												
(1) Prequalification	*											
(2) Construction Work Tendering				*								
(3) Equipment Tendering				*								
3. Building of Project Office				—								
Construction Works												
(II) Irrigation and drainage facilities												
1. Mobilization, Preparatory Works				———								
2. N.H. Bak												
(1) N.H. Bak Reservoir						———						
- Dam				———			—					
- Intake/Spillway												
(2) Main Canals						———						
(3) Secondary Canals						———						
(4) Tertiary Canals									———			
(5) Field Canals									———			
(6) Secondary Drains									———			
(7) Tertiary Drains									———			
(8) Field Drains									———			
(9) Demonstration Farm												
3. Namphou												
(1) No. 1 (H.Xay Reservoir)												
- Dam				———		———						
- Intake/Spillway				———								
(2) No. 2 (Banhang Weir)						—						
(3) No. 3 (Phou Noy Reservoir)						———						
(4) No. 4 (Phou Reservoir)						———						
(5) No. 5 (Xay Weir)						—						
(6) No. 6 (Pangha Weir)						—						
(7) Main canals						———						
(8) Secondary Canals						———						
(9) Tertiary Canals									———			
(10) Field Canals									———			
(11) Tertiary Drains									———			
(12) Field Drains									———			
(III) Rural Infrastructures												
(1) Rehabilitation of village road				———			———			———		
(2) Rural water supply												
(V) Supporting Center												
1. B.Lak 35 center office				———			———					
2. Demonstration farm office								———				

ANNEX X

PROJECT EVALUATION

ANNEX X

PROJECT EVALUATION

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ANNEX X PROJECT EVALUATION

1. General

The Project aims to enhance the living standards of beneficiaries in the south western part of Savannakhet Province and to rectify regional income disparities in the Lao PDR.

To achieve the above objectives, the Project emphasizes the irrigation development plan, accompanied by three other plans; agricultural supporting center, rural road, rural water supply plan.

The Project is one of the important regional development plans related to the main governmental development policies delineated as follows :

- To increase agricultural productivity
- To magnify opportunities for the unemployed and under-employed
- To correct economic growth disparities among rural area residents.

Project evaluation was carried out in order to ascertain the feasibility of the Project from the viewpoint of national, private, and socio-economic aspects.

1.1 Evaluation Methology

Project evaluation was carried out through the economic and financial analysis of project cost, operation and maintenance costs, and benefits.

The economic analysis will be made to ascertain Project desirability in terms of its contribution to the economic and social welfare of the country as a whole.

1) Economic evaluation is made by estimating the Economic Internal Rate of Return (EIRR) with the cost-benefit analysis of the Project. The cost-benefit analysis of projects were made according to the following steps:

- Identification of Project costs and benefits :
- Valuation of costs and benefits in terms of economic prices; and
- Present value comparisons of costs and benefits, sensitivity analysis and selection of projects based on derived economic feasibility indicators.

2) The financial analyses dealt with :

- Farm income analysis including the analysis of farm enterprise income and net farm income; and

- Farm budgets for financial resources.

Furthermore, the impact of the Project on farm budget and their capacity to pay for irrigation water charges are analyzed in the farm budget assessment.

3) In addition to the direct benefits, intangible socio-economic impacts resulting from Project implementation are briefly studied to evaluate social feasibility, at the same time, the existence of any social constraints concerning the implementation of the project were studied, too.

1.2 Basic Assumption

Project evaluation was carried out on the following assumptions :

1) The Project implementation period is about three years from 1993 to 1995.

2) The economic span of the Project is 50 years after construction.

3) The current prices are expressed in constant prices as of October of 1991.

4) The exchange rate of Lao Kip to US. Dollar is 700 kips which is equivalent to US$ 1. (700k = 1 US$)

5) The construction cost for the agricultural supporting center, rural roads, rural water supply facilities, and purchase cost of the farm machinery for the proposed demonstration field are excluded from the initial capital cost for the project evaluation, because they can be regarded as social investments that are not directly related to the increment of agricultural productivity.

6) The operation/maintenance costs of the agricultural supporting center are excluded from the O/M cost of the Project, that is, the objective cost of the economic/financial analysis to evaluate the Project, because it is proposed to be managed separately by the farmers' association which is organized individually from the irrigation beneficiaries association.

7) Furthermore, O/M costs for the rural road and rural water supply facilities are excluded from the O/M costs of the Project, because they shall be entrusted to the users union.

2. Economic Evaluation

2.1 General

In the economic evaluation, all the Project costs and benefits are presented in economic prices which reflect the value of the country as a whole. Generally, the direct costs and benefits are valued in terms of respective opportunity cost or shadow prices.

Economic prices for inputs and outputs of the Project were valuated based on the following criteria :

(1) Direct transfer of payments such as taxes and subsidies, were eliminated wherever they could be isolated, since the transfer of payments are payment that merely represent the transfer of claims to real resources from a farmer or organization to another.

(2) Shadow price of foreign exchange was derived at 720 kips, equivalent to US$ 1, based on the latest foreign exchange rate at the official and black market.

(3) Economic prices of traded goods and services are to be based on border prices. Border prices of farm inputs and outputs were estimated based on the World Bank's projections of international market prices for the year 2,000. The World Bank forecasted prices and the 1985 constant prices were adjusted to the 1991 constant prices by multiplying the factor of 1.4869 derived from the MUV index. Additional domestic charge at the border is added to the price, and the savable cost by import substitution and additional cost for export expansion are deducted in order to estimate the import and export parity price at the farm gate in the Project area.

(4) Domestic currency values were converted to the economic price by the Standard Conversion Factors (SCF) in order to adjust the distortion on domestic prices as a result of national trade policies such as tariff and subsidy. A standard conversion factor of 0.970 was used, it was estimated based on the official foreign exchange rate as of October 1991, that is, US$1 = k700. The shadow exchange rate is US$1 = k720.

(5) Economic value of unskilled labor wage was valuated by the shadow wage. The shadow price rate of labor was estimated at 0.36, which is derived from the ratio of weighted average of farm labor cost (Refer. Table X-5). Wage rate in the cost includes a premium to attract laborers and other expenditures.

2.2 Economic Cost

The Financial Project cost was converted into the Economic Project cost in accordance with the following procedures:

- The cost for rural road and water supply developments, and purchase of farm machinery for the demonstration field block were excluded from the capital cost;

- Contingency for price escalation was deduced from the financial cost;

- All the costs were divided into the foreign currency portion and local currency portion;

- Unskilled labor cost was converted into opportunity cost;

- Whole local currency portion was converted into economic price by multiplying SCF of 0.97.

The total construction cost for the proposed Project is estimated at US$15,038 thousand.

The transfer expenditure, construction cost for the non-productive scheme, and price contingency were deducted from the financial project cost.

The costs were classified into the local currency portion and foreign currency portion, the local currency portion of the deducted financial project cost was converted to the economic value by multiplying it by the standard conversion factor.

The standard conversion factor was derived at 0.970, the correlation ratio of the official rate to black market rate on the foreign exchange. It was applied in consideration of the latest stable national economic conditions, especially the trend of traded goods and domestic goods in Lao.

Consequently, the project construction cost given is shown in Table X-1. The derived economic cost is US$ 11,763 thousand.

The proposed operation and maintenance cost per year reaches US$33.8 thousand on the financial base and US$33.4 thousand on the economic base.

Replacement of O/M equipments are US$1,625 thousand on the financial base, and US$ 1,623 thousand on the economic base. (ref. Table X-4)

On the assumption that the Project will commence in 1993, the disbursement of project cost is tabulated in Table X-3.

2.3 Economic Benefit

2.3.1 Identification of Benefit

When the project was evaluated, only agricultural benefits to be acquired from the irrigation development were analysed and valuated.

The agricultural benefits were evaluated as the net incremental income.

The benefit will come out immediately after the implementation of the Project. The benefit is expected to increase and fully attain its target level at the development stage. (Table X-9)

The increase in agricultural production mainly results from :

- introduction of irrigation farming for the wet season crops
- irrigation water supply for the dry season crops

2.3.2 Economic price for agricultural outputs and inputs

The production of rice and peanut through irrigation farming is proposed in the project. From this, rice shall be produced for importation and peanut for exportation.

Therefore, the economic price of rice was based on import parity prices and that of peanut, on export parity prices.

Farm inputs such as fertilizer and agricultural chemicals are wholly imported from abroad and their prices are, therefore, based on import parity prices.

Details of the derivation of import and export parity prices are presented in Table X-12,~15.

2.3.3 Net agricultural production value

The benefits were estimated as the difference of annual net crop production value with and without project conditions.

Net agricultural production values were estimated by deducting production costs from gross production values. Economic production costs for proposed crops are given in Table X-7. Details of estimation of net economic production value are given in Table X-8 and the result is summarized as follows:

(Unit: US$.000)

Crop	Without Project	With Project	Increment
Paddy	361.31	1,406.65	1,044.9
Peanut	0.04	150.98	151.0
Total	361.35	1,557.63	1,195.90

2.3.4 Result of Economic Evaluation (Economic Internal Rate of Return)

1) The cost and benefit during the span of the Project is shown in Table X-16,

The economic internal rate of return is calculated at 8.05%. The net present value is at a discount rate of 8 %, 54,699 in US$.

2) Sensitivity Analysis

In order to evaluate the soundness of the Project to the possible changes in the economic condition in future, the sensitivity analyses were made for the following case in terms of EIRR.

Case I The Project costs increase by 10% due to unforeseen geological and topographical conditions, and increase in material costs.

Case II The project benefits decrease by 10% due to unexpected decrease in the world price of the crop, or decrease in crop yields.

The effects of these changes on EIRR and NPU are summarized below:

Case	EIRR (%)	NPV (US$)
Case I	7.45	699,335 (Discount rate 7%)
Case II	7.38	533,117 (Discount rate 7%)

3. Financial Analysis

3.1 General

The financial analyses were carried out firstly as farm income analysis, including the analysis of farm enterprise income and net farm income, in order to evaluate the financial viability of the Project from the farmers' economic point of view.

In addition to the above, the capital cost, operation/maintenance costs, membership dues and charges, and financial statements (income statement, cash flow statement, balance sheet) were analysed in order to examine the financial viability of the Project from the standpoint of the farmers' organization who would operate the irrigation system, as well as the farm households who will be the beneficiaries of the Project.

3.2 Farm Income Analyses

Farm income analysis were made to determine the incremental returns that the farm households may be expected to generate as a result of the incremental inputs that they would be bound to put.

The analyses were made according to the following procedure :

- profitability of individual farm enterprise
- farm enterprise gross value of production
- farm enterprise cost of production

Net farm income is the difference between gross value of production and cost of production.

The farm budget analyses were made according to 3 different farming scales and the results are presented in Table X-17. As shown in Table X-18, the farm income and farmer's disposable income are expected to increase significantly under the Project.

The future annual disposable income is estimated to be 29 to 1000 times larger than the present one. Thus, the standard of living of the farmers in the Project area will be evidently changed by the implementation of the Project.

3.3 Payability of Irrigation Water Charges

Generally, the irrigation water charge is imposed to the water users who shall benefit from the irrigation water supply, and the water charges thus collected is spent for the payment of O/M expenditures and for the repayment of the capital cost of the Project.

If the farmers could not pay the water charge, all the costs of the Project will have to be shouldered by the government, and such expenditures will become a heavy burden to the Government.

Therefore, the farmer's capacity to pay the irrigation water charges was examined in connection with the amount of their incremental disposable income resulting from the introduction of irrigated farming by the Project.

The annual O/M cost required for the Project is estimated at US$33.819, which is equivalent to about US$12.81 per hectare, about 2.2% of the gross agricultural production value.

This corresponds to about 3.5% of the payability of 1.5 ha scale farmers.

In consideration of the above and with regard to similar projects at home and abroad, water charge for the Project is proposed to be about 8% of the incremental disposable income of 1.5 ha scale farmers. The following table presents the estimated incremental disposable income.

Incremental Disposable Income US$/1.5ha	Annual Water Charge	
	Per farm (US$)	per ha (US$)
821.885	63.6	28.5

Based on the above unit charge, total amount of water charge to be collected from all the farmers in the Project area is estimated at US$75,240 per annum, an amount enough to cover the estimated annual operation, maintenance and replacement cost of the Project. Since it is considered impractical to include the allowances of amortization of the investment cost and payment of interest in the water charges, the Government will have to cover them.

3.4 Financial cost

The financial cost was estimated on the basis of the current market price as of October 1991 under the condition of the exchange rate of US$1.00 = kip 700.

The financial cost evaluated is US$12,117 thousand for capital cost, US$33,819 for annual operation cost, and US$345,000 and US$245,000 respectively for every ten years and 25 years of equipment replacement.

In estimation of the financial construction cost, the physical contingency of 8% and the price contingency of 1% per annum for both foreign and local currency portions in consideration of the foreign currency portion, is included in the estimate based on the forecast of the Manufacturing Unit Value by the World Bank. The local currency is expressed in US$ assuming that price change will be absorbed into the fluctuation of the exchange rate. The estimated cost and disbursement schedule are presented in Table X-1, and X-3, 4.

3.5 Repayment of Project Cost

The capital cost required for the implementation of the proposed Project were arranged under the following conditions :

1) Capital cost, exclusive of the land acquisition cost, is financed by grant aids of foreign governments;

2) Land acquisition cost in the Project is financed by the Government without repayment.

3.6 Financial Inflow and Outflow

The financial inflow and outflow of the executing organization are estimated assuming that the organization has an independent budget. The inflow is from the irrigation water charge collected from the Project beneficiaries. The outflow consists of all the financial costs of the Project including the O/M cost and replacement cost of the equipment.

Estimated financial cash flow is presented in Table X-19.

4. Justification

The results of the economic and financial analyses on the cost and benefit for the proposed Project are summarized below.

		Economic Value	Financial Value
Gross Production (ton)	Paddy	8,825	8,825
	Peanut	1,237.5	2,237.5
Gross Production Values (US$)		2,248,170	1,564,584
Gross Production Cost (US$)		690,930	901,665
Net Production Values (US$)		1,557,240	662,929
Benefit (US$)		1,195,893	667,135
Internal Rate of Return (%)		8.05	4.6

Farm Budget (Financial base US$) Farm size		Without Project	With Project	Increasing Rate
1.0 ha	Gross income	205.2	604.89	2.95
	Disposable income	11.9	353.2	29.0
1.5 ha	Gross income	267,335	1,171.282	4.40
	Disposable income	9.385	821.851	85.7
2.0 ha	Gross income	340.22	1,536.132	4.5
	Disposable income	-1.36	1,076.966	1,007.0

Based on the above, the following justifies the project.

- Economic Internal Rate of Return is lower than ten (10)%. It is impossible to say that the Project is economically feasible in view of the national economy,

- On the other hand, it may be safe to say that the Project is desirable to the local farmers from the economic point of view. Because, as shown in Table 17, the disposable income of the different farming enterprises will certainly increase to about 20 to 1000 times compared with the present one due to the increase in the yield of crops per ha and cropping intensity as a result of

irrigation farming. Therefore, it is not too much to say that the immediate implementation of the project should be furthered.

5. Socio-Economic Impact

5.1 In addition to the direct benefits from the increase of the agricultural productivity stipulated in the economic evaluation, the following various favourable but intangible benefits are envisioned from the implementation of the Project.

1) Socioeconomical Impact on a Nationwide Scale

Paddy production will be increased to about 8825 tons per annum from 2780 tons. Out of the increased production, it is expected that marketable rice would be about 5595 tons after deducting local consumptions. It would also reduce the annual amount of imported rice. Therefore, the Project will contribute in the improvement of the national economy through:

- Self-sufficiency in food production
- Minimization of the use of foreign currencies.

2) Impact on the Project Area

a) Continued employment opportunities, as project construction and O/M shall require 300,000 man-days. Local employment opportunities will be increased by the implementation of the Project and a favorable impact will be given to the national economy through multiplication effect. Furthermore, employees will be able to gain experience, technical know-how, and skillfulness in various working fields. These accumulations could be applied to other future development projects in the country.

b) The local standard of living will be improved with the increase and stabilization of household income, improved quality of farm produce and market expansion through the introduction of fresh and various

farm produce throughout the year as a result of the introduction of irrigation farming.

c) Improvement and encouragement of cultivation techniques and farm management through the extension of modern farming practice in the demonstration farm.

d) Acceleration of farmer's activity with the establishment of the irrigators' association which shall be managed by farmers themselves.

e) Promotion of rural development projects as a result of developed standard of living and increased status.

2. As previously mentioned, the Project is proposed as an integrated rural development project encompassing rural road improvement, water supply, and agricultural center schemes along with the irrigation/agricultural development plan.

The Project shall be implemented as a multiple-structured project, and the following various socio-economic impacts are expected to be realized through it.

1) Expansion of radius of interaction and close communication ties among the villagers of the area through the improvement of rural roads, especially in the rainy season, and will contribute to brisking up economic activities in the rural area.

2) Improvement of the locals' public health and living environment through stable water supply.

6. Environmental Impact

1) The Project proposes the construction of the N.H. Bak Dam and H. Xay Dam, reservoirs, water conveyance canals, O/M road for the irrigation

canal, and various related works. The N.H. Bak Dam reservoir capacity and major features are as shown below.

Designed Capacity

Full Water Level Design
- Normal
- Flood

Designed Reservoir Area at Full Water Level
- Paddy
- Upland
- Bush
- Forest
- Residential
- Others

- Total

Designed
- Inflow
- outflow

The construction of the N.H. Bak Dam is considered to bring about various effects on the natural and social environment, both in the Project area and its surrounding area as delinated below.

(1) Favorable Effects

- new recreation area in form of artificial lakes
- stabilization of residents water supply on the shore of the reservoir
- creation of fish culture in reservoir
- flood peak control downstream

(2) Adverse Effects

- noise from machinery and blasting works during the construction period

- possible pollution from excavation and washing of materials

- promotion of soil erosion and denuding of vegetation cover

- submerging of residences, cultivated land and roads

- migration of some residents

- obstruction of road network

- submerging of expensive tropical trees such as ebony, red sandalwood, and teak, etc.

- drastic decrease in domestic water supply of the residents of the downstream area of the dam.

2) Socioeconomic Impact of Dam Construction

(1) One village with 45 households and 224 inhabitants which are located within the area shall be affected by the design flood water level (EL.170m) and accordingly they will be submerged by dam construction.

(2) Including river course, about 470 ha of land will be submerged. It is composed of a flatland along meandering rivers which is gently sloped toward the river course. It consists of a natural forest with scattered expensive tropical trees such as ebony, red sandalwood, and teak, etc., and arable lands with 100 ha of paddy.

The lowland and tropical trees are valuable to the locals and their destruction shall be a great financial loss to the farmers.

(3) The present road density of the proposed watershed area is high, however, there is only one road passable for small vehicles. The remaining roads are footpaths following natural topographic counter, while rivers are generally forded on foot. The locals either walk or ride carabaos (water buffalo).

With the construction of the dam, fording of river on foot will become impossible and inter-village crossing shall take longer than usual.

Table X - 1 Financial and Economic Construction Cost

(Unit : US$.000)

Items	Financial Construction Cost			Economic Construction Cost		
	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total
1. Land Acquisition	0	226	226		220	220
2. Preparatory Works	139	24	163	139	14.5	153.5
3. Irrigation/Drainage Works						
1) N.H. Bak Scheme						
- N.H. Bak Dam	2,143	338	2,481	2,143	279.32	2,422.30
- Main/second canals	2,129	201	2,330	2,129	168.23	2,297.2
- Tertiary/onfarm canals	497	161	658	497	135.63	632.6
2) Namphou Scheme						
- H Xay Dam	667	136	803	667	108.2	775.2
- Phou Dam/Weirs	838	179	1,017	838	158.3	996.3
- Canal Works	699	152	851	699	127.7	822.7
Sub Total	6,973	1,167	8,140	6,973	973.38	7,946.3
4. O/M equipments/Facilities	1,288	—	1,288	1,288	—	1,288
5. Engineering services	1,123	177	1,300	1,123	161	1,284
Sub Total (1~5)	9,523	1,594	11,117	9,523	1,368.9	10,891.9
6. Contingency						
- Physical Contingency	762	127	889	762	109	871
- Price	95	16	111	—	—	—
Total	10,380	1,737	12,117	10,285	1,478	11,763

Table X-2 Annual Disbursement Schedule of Economic Construction Cost

Table X-2 Annual Disbursement Schedule of Economic Construction Cost

(Unit : US$.000)

Items / Economic Cost	1st Year		2nd Year		3rd Year		4th Year		Total	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Land Acquisitions	—	220								220
2. Preparatory Works			139	14.5					139	14.5
3. Irrigation Development										
- N.H. Bak Scheme			1,611	197.0	2,911	356.0	247	30.1	4,769	583
- Namphou Scheme			1,389	246	723	128.4	92	16	2,204	390.4
4. O/M Equipments/Facilities			—				1,288	—	1,288	—
5. Engineering Service	219	32	438	63.0	350	50.	116	16	1,123	161
Sub total	219	252	3,577	520.5	3,984	534.4	1,743	62	9,523	1,369
6. Physical Contingency	18	20	286	42.0	319	43.0	139	3.7	762	109
Total	237	272	3,863	562.5	4,303	577.4	1,882	65.7	10,285	1,478

Table X-3

Annual Disbursement Schedule of Financial Construction Cost

(Unit : US$.000)

Items / Financial Cost	1st Year		2nd Year		3rd Year		4th Year		Total	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Land Acquisitions		226								226
2. Preparatory Works			139	24					139	24
3. Irrigation Development										
- N.H. Bak Scheme			1,611	237	2,911	384	247	79	4,769	700
- Namphou Scheme			1,389	271	723	159	92	37	2,204	467
4. O/M Equipments							1,288	—	1,288	—
5. Engineering Services	219	35	438	69	350	55	116	18	1,123	177
Sub total	219	261	3,577	601	3,984	598	1,743	134	9,523	1,594
6. Physical Contingency	18	21	286	48	319	47	139	11	762	127
7. Price Contingency	2.2	2.6	35.8	6.0	39.8	6.0	17.4	1.3	95.0	17
Total	239.2	284.6	3,989.8	655	4,342.8	652	1,899.4	146.3	1,0380	1,738

Table X - 4 Financial/Economical Operation and Maintenance Cost

(Unit : US$.000)

Year	Order	Financial Cost							Economic Cost						
		Annual O/M Cost			Replacement Cost			Total	Annual O/M Cost			Replacement Cost			Total
		F.C.	L.C.	Total	F.C.	L.C.	Total		F.C.	L.C.	Total	F.C.	L.C.	Total	
1992	1	Construction													
3	2														
4	3														
5	4	16,600	13,046	29,646				29,646	16,600	12,655	29,255				29,255
6	5	16,600	13,046	29,646				29,646	16,600	12,655	29,255				29,255
7	6	16,600	13,046	29,646				29,646	16,600	12,655	29,255				29,255
8	7	18,984	13,046	32,030				32,030	18,984	12,655	31,639				31,639
9	9	18,984	13,046	32,030				32,030	18,984	12,655	31,639				31,639
2000	9	18,984	13,046	32,030				32,030	18,984	12,655	31,639				31,639
2001	10	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
2	11	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
3	12	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
14	13	20,773	13,046	33,819	345,000		345,000	378,819	20,773	12,655	33,427	345,000	—	345,000	378,427
15	14	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
⟨															
14	22	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
15	23	20,773	13,046	33,819	345,000		345,000	378,819	20,773	12,655	33,427	345,000	—	345,000	378,427
⟨															
20	28	20,773	13,046	33,819	239,000	6,000	245,000	278,819	20,773	12,655	33,427	239,000	4,080	243,080	276,507
21	29	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
⟨															
23	32	20,773	13,046	33,819				33,819	20,773	12,655	33,427				33,427
24	33	20,773	13,046	33,819	345,000		345,000	378,819	20,773	12,655	33,427	345,000		345,000	378,427
	43	20,733	13,046	33,819	345,000		345,000	378,819	20,733	12,655	33,427	345,000		345,000	378,427

Table X - 5 Estimation of Economic Wage Rate

Month	Percent of Potential Full Employment %		Weight of Labor Requirement		Ecoomic Wage Rate Kip/Manday (Weighted)	
	WOP	WP	WOP	WP	WOP	WP
Jan.	—	14.0	—	4.52	—	270
Feb.	—	26.8	—	8.65	—	340
Mar.	—	7.2	—	2.32	—	240
Apr.	7.0	21.8	4.44	7.03	250	355
May	34.0	52.0	21.57	16.77	440	570
Jun.	14.0	13.2	8.89	4.26	300	300
Jul.	6.1	61.0	3.87	19.68	245	630
Aug.	6.8	7.0	4.31	2.26	250	250
Sep.	7.3	7.3	4.36	2.35	255	255
Oct.	20.4	20.4	12.95	6.58	345	345
Nov.	41.8	41.8	26.52	13.48	500	500
Dec.	20.2	37.5	12.82	12.10	345	465
Total	157.6	310.0	100.0	100.0		

1) Average Economic Wage rate Kip 386.2 462.5
Weighted Average
US$ 1 : k 720 US$ 0.55 0.65

2) Financial Wage rate Rainy Season K700
Dry Season K500

3) Opportunity labor cost of each month is estimated as the sum of weighted rate and additional charges such as services, transport, and expenditures were added.

4) Shadow price rate of employed unskilled labor for the construction works is estimated as follows:

$$\frac{462.5}{7300\ \text{Lia}} = 0.36$$

La : Labor wage for the construction works 1300 kips

Table X - 6 Economical Production Cost of Crops Under With and Without Project Conditions

Table X-6

(Unit : US$.000)

Description	Rainy Season Paddy						Dry Season Paddy			Peanut					
	Without Project			With Project			With Project			Without Project Rainy Season			With Project Dry Season		
	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha
1. Farm Imput: Seed	55 kg	0.131	7.21	40 kg	0.16	6.04	40 kg	0.16	6.40	75 kg	0.354	24.78	60 kg	0.354	21.24
Fertilizer: Urea	5 kg	0.252	1.26	100 kg	0.252	25.20	100 kg	0.252	25.20	—	—	—	50 kg	0.252	12.60
DAP	25 kg	0.259	6.48	150 kg	0.259	37.54	200 kg	0.259	51.80	25 kg	0.259	6.48	150 kg	2.59	38.86
Composed	5 kg	0.485	0.24	1000 kg	0.0485	48.50	500 kg	0.0485	24.25	—	—	—	1000 kg	0.0485	48.50
Chemical Insecticide	5 kg	2.315	11.58	10 kg (Diajinon)	2.485	24.85	5 kg	2.485	12.43	5 kg	2.315	11.58	10 kg	2.485	24.85
Animal/Machinery	15 days	2.078	31.18		2.078	31.05	16 days	2.078	33.26	—	—	—	—	—	—
2. Labor Cost: Family	135 days	0.55	74.25	123.0	10.65	79.95	140 dyas	0.465	65.10	84 days	0.55	46.20	94 days	0.465	43.71
Hired	10 days	0.55	5.50	30.0	0.65	19.50	17 days	0.465	7.90	10 days	0.55	5.50	10 days	0.465	4.65
Sub Total			137.70			272.63			226.34			95.54			194.40
3. Others: Equipments			6.30			13.37			11.66			4.46			9.6
Total ($/ha)			144.00			286.0			238.0			99.0			204

Table X - 7 Financial Production Cost of Crops Under With and Without Project Conditions

Table X-7

(Unit : US$.000)

Description	Rainy Season Paddy						Dry Season Paddy			Peanut					
	Without Project			With Project			With Project			Without Project Rainy Season			With Project Dry Season		
	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha	Q/ha	US$	US$/ha
1. Farm Imput: Seed	55 kg	0.10	5.5	40 kg	0.132	5.28	40 kg	0.132	5.28	75 kg	0.357	26.78	60 kg	0.357	21.42
Fertilizer: Urea	5 kg	0.32	1.6	100 kg	0.32	32.00	100 kg	0.32	32.00	—	—	—	50 kg	0.32	16.00
DAP	25 kg	0.291	7.29	150 kg	0.291	43.71	200 kg	0.291	58.20	25 kg	0.291	7.28	150 kg	0.291	43.65
Composed	5 kg	0.05	0.25	1000 kg	0.05	50.00	500 kg	0.050	25.00	—	—	—	1000 kg	0.05	50.00
Chemical Insecticide	5 kg (Seven)	2.571	12.86	10 kg (Diajinon)	2.75	27.50	5 kg	2.75	13.75	5 kg (Seven)	2.571	12.86	10 kg	2.75	27.50
Animal/Machinery	15 days	2.143	32.14	15 days	2.143	32.14	16 days	2.143	34.28	—	—	—	—	—	—
2. Labor Cost: Family	135 days	1.00	135.00	123 days	1.00	123.00	140 days	1.00	140.00	84 days	1.0	84.0	94 days	1.0	94.00
Hired	10 days	1.00	10.00	30 days	1.00	30.00	17 days	1.00	17.00	10 days	1.0	10.0	10 days	1.0	10.00
Sub Total			204.64			343.63			325.51			140.92			262.57
3. Others: Equipments	50 % of Sub Total		10.36			17.37			16.45			7.08			13.43
Total (US$/ha)			215.00			361.0			342.0			148.00			276.00