4.4. Irrigation Scheme

4.4. Irrigation Scheme

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4.4.1. Determination of Suction Water Level for Pump

The highest and lowest water level of the river at the proposed pumping site are the most important factors in designing a pumping station. These water levels at the Kaeng Khoi pumping station have been determined based upon the observation records of the Pasak river at S2 gauging station and Rama VI barrage since no observation has been made at the proposed site.

The proposed pumping station is located about 54 km upstream of Rama VI barrage and three kilometer upstream of S2 gauging station along the Pasak river.

According to the observation records during 30 years from 1951 to 1980 at S2 gauging station, the highest water level at the station within the said period was given by 21.11 m in MSL. The water level at the Rama VI barrage correspond to S2 highest water level was about 11.90 m in MSL. The design highest water level at the proposed site can be obtained by about 21.63 m in MSL in adopting the proportional allotment method.

On the other hand, the lowest water level at the proposed site usally occur during the dry season except the case when the gate at Rama VI was opened, because the runoff discharge during the said period is rather small and the inflow discharge from Chainat-Pasak canal to Pasak river also decreases. According to the study on the availability of water resources, the runoff of Pasak river during the dry season is about 10 to 20 percent of Chainat-Pasak canal intake discharge. Therefore, water level of the Pasak during the dry season would be affected by the inflow discharge from the Chainat-Pasak canal and the irrigated area for the dry season.

The mean water level observed in the specific months from March to May at Rama VI and S2 station are tabulated for the last ten years in Table A.4.4-1 and A.4.4-2. From Table A.4.4-1, the mean water level at both Rama VI and S2 station are summarized as follows;

Item	Month	S2 Station m	Rama VI m	Difference m
Highest	March	7.72	7.61	0.11
	April	7.73	7.60	0.13
	May	7.81	7.60	0.21
	Mean	7.75	7.60	0.15
Lowest	March	7.25	5.76	1.49
	April	7.17	5.91	1.26
	May	7.23	6.19	1.04
	Mean	7.21	5.95	1.30
Mean	March	7.61	7.18	0.43
	April	7.58	7.26	0.32
	May	7.64	7.34	0.30
	Mean	7.61	7.26	0.35

The lowest water level at Rama VI occurred by around MSL 6.00 m in 1980. This low water level can be judged that the intake discharge at Manorom and irrigated area in the dry season are quite small compared with ordinary crop years as showed in Table 3-4 and 4-3.

On the other hand, the different heads of the said station in the dry season are usually quite small. Accordingly, the design low water level at the proposed site should be adopted by the same water level as that at Rama VI and the water level was selected by about MSL 6.30 m for the second lowest water level, which was discussed already. Therefore, the design low water level in suction pit at the proposed pumping station was decided by MSL 6.00 m taking into consideration the head losses of about 0.30 m in terms of several factors including screen loss.

4.4.2. Selection of Pump Type

In general, pumps are classified into the horizontal and vertical types. A study on the pump performance when the cavitation phenomena takes place if the site has a big difference between the low water level of the related river and the ground level of the site.

At the proposed site, the difference between the highest water level of 21.63 m and the lowest one of 6.00 m stands more than 15 m, therefore, it is clear that the cavitation will take place if a pump of the horizontal type is used. The impeller of a vertical type pump is submerged, resulting in a low frequency of the cavitation phenomena as well as in a small setting area of pumps. Furthermore, the vertical type is advantageous in installing the prime mover at a high elevation where a site has a high flood level as this site.

Mechanically a mixed flow pump is recommendable to cope with widely varying pump heads both in wet and dry seasons.

Aparting from the above-mentioned, it might be necessary to study a possibility to install an inclined type pump at the site, which has both the merits and demerits of the said two types, since many of this type have been used in Thailand although their bore diameter is small.

Since the Project requires pumps of about 1,000 mm in bore diameter, the inclined type pump will be disadvantageous in the following aspects:

(1) The setting angle of pump will be about 30°, resulting in a column line heavier two times longer and one and a half times than that of a vertical type pump.

(2) For operation and maintenance, specially in repairing, large temporary works and heavy equipment of a big capacity are required, accordingly.

(3) In case of an inclined type pump of a large bore diameter and of a large capacity, a great thrust caused by hydraulic power is indispensable resulting in a complicated structure of the thrust bearing.

Based on the above-mentioned comparison of merits and demerits of each type of pumps inclusive of the economic study, which are shown in Table A.4.4.-3, a mixed flow pump of the vertical shaft type is recommended for the Project. Typical drawing of the inclined type are illustrated in Figure A.4.4-2 and A.4.4-3.

4.4.3. Determination of Pump Unit

RID has 40 to 50 pumping stations equipped with about 150 units of pump in total under its jurisdiction. The majority of existing pumps of RID is of the vertical type so that they can cope with a large difference between the high and low water levels. The maximum bore diameter of them is 36" (900 mm) the maximum capacity 2.25 cu.m/sec, and the maximum output of a prime mover is 450 Hp.

Judging from the existing pumps of RID, it might be desirable to use in the Project a pump smaller than 1,000 mm in bore diameter.

The irrigation water requirement in the Project is 17.62 cu.m/sec at maximum. The water requirement seasonally varies depending upon the growing stages of crops and the distribution of effective rainfalls.

Hourly and unit control of pumps to be operated are made to meet the varying water requirement. On the other hand, the combination of pumps with the same bore diameter and prime movers of the same output is desirable for easy operation and maintenance of pumps and easy utilization of spare parts in common.

Under the circumstances, a comprehensive study on the three cases of six units, seven units and eight units has been conducted from the view points of pumping plant, construction cost of the pumping station and operation and maintenance cost. Table A.4.4-4 shows results of the comparative study. Based on the study seven units of pump with the bore diameter of 1,000 mm with a motor of 560 kw are proposed for the pumping station. Figure A.4.4-2 shows the estimated pump performance curve.

Table A.4.4-1 Difference Water Level between Rama VI and S2 Station

(Unit: m)

Year	March			April			May		
	S2	Rama VI	Diff.	S2	Rama VI	Diff.	S2	Rama VI	Diff.
1972	7.69	N.A.	-	7.69	7.58	0.11	7.62	7.51	0.11
1973	7.61	7.49	0.12	7.62	7.50	0.12	7.66	7.51	0.15
1974	7.67	7.52	0.15	7.59	7.44	0.15	7.81	7.55	0.26
1975	7.72	7.61	0.11	7.70	7.58	0.12	7.69	7.53	0.16
1976	7.70	7.57	0.13	7.73	7.60	0.13	7.80	7.58	0.22
1977	7.65	7.57	0.08	N.A.	7.46	-	N.A.	7.60	-
1978	N.A.	7.45	-	N.A.	7.53	-	N.A.	7.36	-
1979	N.A.	7.35	-	N.A.	7.38	-	N.A.	7.43	-
1980	N.A.	5.76	-	7.17	5.91	1.26	7.23	6.19	1.04
1981	7.25	6.30	0.95	N.A.	6.60	-	N.A.	7.14	-
Highest	7.72	7.61		7.73	7.60		7.81	7.60	
Lowest	7.25	5.76		7.17	5.91		7.23	6.19	
Mean	7.61	7.18		7.58	7.26		7.64	7.34	

Table A.4.4-2 Water Level Records at Rama VI Barrage and S2 Station

Year	Decade	Rama VI Barrage			S2 Gauging Station		
		March	April	May	March	April	May
1972	1st	N.A.	7.59	7.53	7.69	7.70	7.66
	2nd	N.A.	7.58	7.56	7.69	7.70	7.66
	3rd	N.A.	7.57	7.43	7.69	7.68	7.55
	Mean	N.A.	7.58	7.51	7.69	7.69	7.62
1973	1st	7.46	7.49	7.51	7.58	7.61	7.67
	2nd	7.50	7.51	7.51	7.62	N.A.	7.65
	3rd	7.50	7.51	7.50	7.62	7.63	7.67
	Mean	7.49	7.50	7.51	7.61	7.62	7.66
1974	1st	7.47	7.50	7.51	7.69	7.62	N.A.
	2nd	7.62	7.44	7.61	7.75	7.60	7.85
	3rd	7.47	7.38	7.55	7.56	7.54	7.96
	Mean	7.52	7.44	7.55	7.67	7.59	7.81
1975	1st	7.60	7.58	7.53	7.72	7.70	7.68
	2nd	7.59	7.58	7.51	7.72	7.69	7.65
	3rd	7.65	7.58	7.54	7.73	7.71	7.74
	Mean	7.61	7.58	7.53	7.72	7.70	7.69
1976	1st	7.46	7.65	7.67	7.59	7.78	7.83
	2nd	7.62	7.58	7.41	7.74	7.69	7.63
	3rd	7.63	7.58	7.66	7.76	7.71	7.94
	Mean	7.57	7.60	7.58	7.70	7.73	7.80
1977	1st	7.55	7.51	7.62	7.67	N.A.	N.A.
	2nd	7.53	7.34	7.61	7.64	N.A.	N.A.
	3rd	7.54	7.63	7.58	7.65	N.A.	N.A.
	Mean	7.54	7.46	7.60	7.65	-	-
1978	1st	7.49	7.44	7.52	N.A.	N.A.	N.A.
	2nd	7.39	7.62	7.31	N.A.	N.A.	N.A.
	3rd	7.48	7.52	7.25	N.A.	N.A.	N.A.
	Mean	7.45	7.53	7.36	-	-	-
1979	1st	7.46	7.35	7.34	N.A.	N.A.	N.A.
	2nd	7.23	7.56	7.44	N.A.	N.A.	N.A.
	3rd	7.35	7.22	7.51	N.A.	N.A.	N.A.
	Mean	7.35	7.38	7.43	-	-	-
1980	1st	5.64	5.95	5.82	N.A.	7.21*	7.19*
	2nd	5.85	5.83	5.91	N.A.	7.13	7.26
	3rd	5.79	5.94	6.84	N.A.	7.18	7.23
	Mean	5.76	5.91	6.19	-	7.17	7.23
1981	1st	6.20	6.38	7.05	7.41*	N.A.	N.A.
	2nd	6.53	6.66	7.01	7.21	N.A.	N.A.
	3rd	6.47	6.75	7.36	7.12	N.A.	N.A.
	Mean	6.30	6.60	7.14	7.25	-	-

* The figures of April and May, 1980 and March, 1981 are indicated at S9 gauging station.

N.A. means not available data.

Table A.4.4-3 Comparison of Vertical and Inclined Type Pump

Item	Vertical type			Inclined type		
	Spec	Unit	Cost (1,000฿)	Spec	Unit	Cost (1,000฿)
1. Pumping Plant						
(1) Pump & accessories	ø1,000 m/m L = 18 m	7	21,370	ø1,000 m/m L = 33 m	7	31,290
(2) Motor & accessories	560 KW	7	6,860	590 KW	7	7,860
(3) Power boards		1	3,960		1	4,360
(4) Transformer	5,000 KVA	1	5,410	5,500 KVA	1	5,710
(5) Valves (Butterfly & Check)	1,350 m/m	2	3,520	1,350 m/m	2	3,500
(6) Delivery pipe	24 m		7,420	24 m		7,420
(7) Crane	15 ton	1	970	-		-
(8) Cable		1	1,225		1	1,350
(9) Installation wiring & transmission		1	5,250		1	8,290
Sub-total			55,965			69,780
2. Pumping Station			22,660			14,474
3. Electricity Charge			5,670			5,973
Total			84,295			90,227

Table A.4.4-4 Cost Comparison on Pumping Station by Each Number of Pump

Item	6 units		7 units		8 units	
	Spec	Cost (1,000฿)	Spec	Cost (1,000฿)	Spec	Cost (1,000฿)
1. Pumping Plant						
(1) Pump & accessories	ø1,100 m/m	23,370	ø1,000 m/m	21,370	ø900 m/m	21,210
(2) Motor & accessories	650 KW	6,860	560 KW	6,860	490 KW	6,500
(3) Power boards		3,600		3,960		4,530
(4) Transformers		5,410		5,410		5,410
(5) Valves (Butterfly & Check)		3,840		3,500		3,580
(6) Delivery Pipe	24 m	8,160		7,420		7,300
(7) Crane	16 t	1,480	15 t	970	15 t	970
(8) Cable		1,230		1,225		1,290
(9) Installation Wiring & transmission		5,650		5,250		5,400
Sub-total		59,600		55,965		56,190
2. Pumping Station	320 m^2	20,660	350 m^2	22,600	370 m^2	23,890
3. Electricity Charge		5,642		5,670		5,671
Total		85,902		84,235		85,751
%		102		100		102

Table A.4.4-5 Hydraulic Computation of Main and Major Lateral Irrigation Canals

Main Canal (1)

STATION NO	DISCHARGE (m³/s)	LENGTH (m)	WORKS	SLOPE	HEAD LOSS ΔH (m)	ENERGY HEAD LEVEL	VELOCITY HEAD (m)	WATER SURFACE LEVEL	WATER DEPTH (m)	INVERT LEVEL
0						22.4	0.04	22.0	2.44	19.56
	17.62	100	Open channel (A-type)	1/10000	0.01					
0+100			(1L) Turn-out			22.03	0.04	21.99	2.44	19.55
	17.62	775	Open channel (A-type)	1/10000	0.08					
0+875			(2L) Turn-out			21.95	0.04	21.91	2.44	19.47
	17.62	3,045	Open channel (A-type)	1/10000	0.30					
3+920						21.65	0.04	21.61	2.44	19.17
3+920			(3L) Turn-out			21.65	0.03	21.62	2.33	19.29
	14.96	5,965	Open channel (B-type)	1/10000	0.60					
9+885						21.05	0.03	21.02	2.33	18.69
	14.96	30	Hin Khao Riv. Syphon	-	0.11					
9+915						20.94	0.03	20.91	2.33	18.58
	14.96	485	Open channel (B-type)	1/10000	0.05					
10+400						20.89	0.03	20.86	2.33	18.53
10+400			(4L) Turn-out			20.89	0.03	20.86	2.12	18.74
	11.37	1,750		1/10000	0.17					
12+150			(5L) Turn-out			20.72	0.03	20.69	2.12	18.57
	11.37	1,090		1/10000	0.11					
13+240						20.61	0.03	20.58	2.12	18.46
	11.37	30	Bong Riv. Syphon	-	0.11					
13+270						20.50	0.03	20.47	2.12	18.35
	11.37	730	Open channel (C-type)	1/10000	0.07					
14+000						20.43	0.03	20.40	2.12	18.28
	11.37	80	National road No.1 Syphon	-	0.14					
14+080						20.29	0.03	20.26	2.12	18.14
	11.37	670	Open channel (C-type)	1/10000	0.07					
14+750						20.22	0.03	20.19	2.12	18.07
14+750			(6L) Turn-out			20.22	0.02	20.20	1.77	18.43
	6.51	1,800	Open channel (D-type)	1/10000	0.18					
16+550			(7L) Turn-out			20.04	0.02	20.02	1.77	18.25
	6.51	1,400	Open channel (D-type)	1/10000	0.14					

Table A.4.4-5 Hydraulic Computation of Main and Major Lateral Irrigation Canals

Main Canal (2)

STATION NO	DISCHARGE (m³/s)	LENGTH (m)	WORKS	SLOPE	HEAD LOSS ΔH (m)	ENERGY HEAD LEVEL	VELOCITY HEAD (m)	WATER SURFACE LEVEL	WATER DEPTH (m)	INVERT LEVEL
17+950			(8L) Turn-out			19.90	0.02	19.88	1.77	18.11
	6.51	180	Open channel (D-type)	1/10000	0.02					
18+130						19.88	0.02	19.86	1.77	18.09
	6.51	30	Yang Riv. Syphon	-	0.10					
18+160						19.78	0.02	19.76	1.77	17.99
	6.51	1,040	Open channel (D-type)	1/10000	0.10					
19+200			(9L) Turn-out			19.68	0.02	19.66	1.77	17.89
	6.51	1,900	Open channel (D-type)	1/10000	0.19					
21+100						19.49	0.02	19.47	1.77	17.70
21+100			(10L) Turn-out			19.49	0.01	19.48	1.30	18.18
	2.59	730	Open channel (E-type)	1/10000	0.07					
21+830						19.42	0.01	19.41	1.30	18.11
	2.59	30	San chao Riv. Syphon	-	0.11					
21+860						19.31	0.01	19.30	1.30	18.00
	2.59	2,440	Open channel (E-type)	1/10000	0.24					
24+300			(11L) Turn-out			19.07	0.01	19.01	1.30	17.76
	1.20	80	National road No.3034 Syphon	-	0.11					
24+380						18.96	0.02	18.94	0.84	18.10
24+380	1.20	-	Drop		(1.00)	17.96	0.02	17.94	0.84	17.10
	1.20	1,020	Open channel (F-type)	1/5000	0.20					
25+400						17.76	0.02	17.74	0.84	16.90
25+400	1.20		Drop		(1.00)	16.76	0.02	16.74	0.84	15.90
	1.20	1,100	Open channel (F-type)	1/5000	0.22					
26+500						16.54	0.02	16.52	0.84	15.68
26+500	1.20		Drop		(1.50)	15.04	0.02	15.02	0.84	14.18
	1.20	750	Open channel (F-type)	1/5000	0.15					
27+250						14.89	0.02	14.87	0.84	14.03
27+250			(12L) Turn-out			14.89	0.01	14.88	0.89	13.99
	0.84	2,750	Open channel (G-type)	1/5000	0.55					
30+000						14.34	0.01	14.33	0.89	13.44
	0.84	30	Nam Phu Riv. Syphon	-	0.03					

Table A.4.4-5 Hydraulic Computation of Main and Major Lateral Irrigation Canals

Main Canal (3)

STATION NO	DISCHARGE (m^3/s)	LENGTH (m)	WORKS	SLOPE	HEAD LOSS ΔH (m)	ENERGY HEAD LEVEL	VELOCITY HEAD (m)	WATER SURFACE LEVEL	WATER DEPTH (m)	INVERT LEVEL
30+030						14.31	0.01	14.30	0.89	13.41
	0.84	470	Open channel (G-type)	1/5000	0.09					
30+500						14.22	0.01	14.21	0.89	13.32
30+500	0.84		Drop		(2.00)	12.22	0.01	12.21	0.89	11.32
	0.84	500	Open channel (G-type)	1/5000	0.10					
31+000						12.12	0.01	12.11	0.89	11.22
31+000	0.84		Drop		(1.00)	11.12	0.01	11.11	0.89	10.22
	0.84	4,300	Open channel (G-type)	1/5000	0.86					
35+300						10.26	0.01	10.25	0.89	9.36
		50	Waste way with check gate							
35+350										

Table A.4.4-5 Hydraulic Computation of Main and Major Lateral Irrigation Canals

- 3L -

STATION NO	DISCHARGE (m³/s)	LENGTH (m)	WORKS	SLOPE	HEAD LOSS ΔH (m)	ENERGY HEAD LEVEL	VELOCITY HEAD (m)	WATER SURFACE LEVEL	WATER DEPTH (m)	INVERT LEVEL
0						21.12	0.01	21.11	1.15	19.96
	2.12	1,800	Open channel (E-type)	1/10000	0.18					
1+800						20.94	0.01	20.93	1.15	19.78
	2.12	2,400	Open channel (E-type)	1/10000	0.24					
4+200						20.70	0.01	20.69	1.15	19.54
4+200	2.12		Drop		(1.00)	19.70	0.01	19.69	1.15	18.54
	2.12	900	Open channel (E-type)	1/10000	0.09					
5+100						19.61	0.01	19.60	1.15	18.45
			(1R-3L) Turn-out			19.61	0.01	19.60	0.93	18.67
	1.00	1,500	Open channel (G-type)	1/5000	0.30					
6+600			(2R-3L), (2L-3L) Turn-out			19.31	0.01	19.30	0.93	18.37
	1.00	1,000	Open channel (G-type)	1/5000	0.20					
7+600						19.11	0.01	19.10	0.93	18.17
7+600	1.00		Drop		(1.30)	17.81	0.01	17.80	0.93	16.87
	1.00	3,000	Open channel (G-type)	1/5000	0.60					
10+600						17.21	0.01	17.20	0.93	16.27

Table A.4.4-5 Hydraulic Computation of Main and Major Lateral Irrigation Canals

- 4L -

STATION NO	DISCHARGE (m³/s)	LENGTH (m)	WORKS	SLOPE	HEAD LOSS ΔH (m)	ENERGY HEAD LEVEL	VELOCITY HEAD (m)	WATER SURFACE LEVEL	WATER DEPTH (m)	INVERT LEVEL
0						20.52	0.02	20.50	1.12	19.38
	2.82	500	Open channel (E-type)	1/5000	0.10					
0+500						20.42	0.02	20.40	1.12	19.28
0+500	2.82		Drop (F = 1.5)		(1.50)	18.92	0.02	18.90	1.12	17.78
	2.82	500	Open channel (E-type)	1/5000	0.10					
1+000						18.82	0.02	18.80	1.12	17.68
1+000	2.82		Drop (F = 1.5)		(1.50)	17.32	0.02	17.30	1.12	16.18
	2.82	435	Open channel (E-type)	1/5000	0.09					
1+435						17.23	0.02	17.21	1.12	16.09
	2.82	30	Hac Riv. Syphon	-	0.08					
1+465						17.15	0.02	17.13	1.12	16.01
	2.82	1,485	Open channel (E-type)	1/5000	0.30					
2+950						16.85	0.02	16.83	1.12	15.71
2+950			(1L-4L) Turn-out			16.85	0.02	16.83	1.02	15.81
	1.92	1,750	Open channel (F-type)	1/5000	0.35					
4+700						16.50	0.02	16.48	1.02	15.46
4+700	1.92		Drop (F = 1.00)		(1.00)	15.50	0.02	15.48	1.02	14.46
		340	Open channel (F-type)	1/5000	0.07					
5+040						15.43	0.02	15.41	1.02	14.39
		80	National road No.1 Syphon	-	0.11					
5+120						15.32	0.02	15.30	1.02	14.28
		30	Open channel (F-type)	1/5000	0.01					
5+150			(2L-4L) Turn-out			15.31	0.02	15.29	1.02	14.27
		2,035	Open channel (F-type)	1/5000	0.41					
7+185						14.90	0.02	14.88	1.02	13.86
		30	Drainage canal No.5 Syphon	-	0.08					
7+215						14.82	0.02	14.80	1.02	13.78
		4,485	Open channel (F-type)	1/5000	0.90					
11+700			(1R-4L) Turn-out			13.92	0.02	13.90	1.02	12.88
		1,300	Open channel (F-type)	1/5000	0.26					
13+000						13.66	0.02	13.64	1.02	12.62

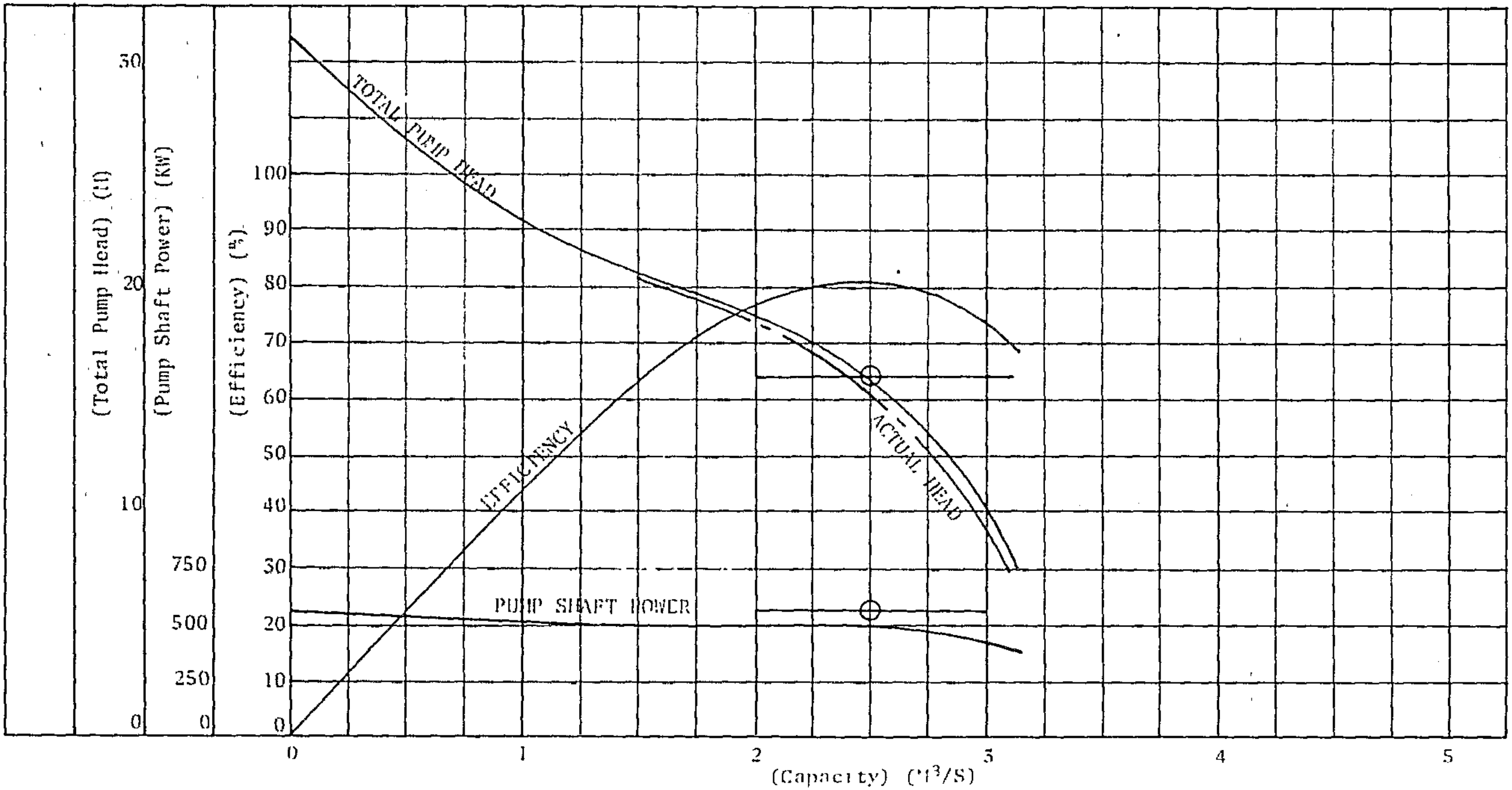
Table A.4.4-5 Hydraulic Computation of Main and Major Lateral Irrigation Canals

- 6L -

STATION NO	DISCHARGE (m^3/s)	LENGTH (m)	WORKS	SLOPE	HEAD LOSS ΔH (m)	ENERGY HEAD LEVEL	VELOCITY HEAD (m)	WATER SURFACE LEVEL	WATER DEPTH (m)	INVERT LEVEL
0						20.20	0.03	20.17	1.31	18.86
	3.89	500	Open channel (E-type)	1/5000	0.10					
0+500						20.10	0.03	20.07	1.31	18.76
0+500	3.89		Drop (F = 1.0)		(1.00)	19.10	0.03	19.07	1.31	17.76
	3.89	500	Open channel (E-type)	1/5000	0.10					
1+000						19.00	0.03	18.97	1.31	17.66
1+000	3.89		Drop (F = 1.3)		(1.30)	17.70	0.03	17.67	1.31	16.36
	3.89	500	Open channel (E-type)	1/5000	0.10					
1+500						17.60	0.03	17.57	1.31	16.26
1+500	3.89		Drop (F = 1.3)		(1.30)	16.30	0.03	16.27	1.31	14.96
	3.89	800	Open channel (E-type)	1/5000	0.16					
2+300						16.14	0.03	16.11	1.31	14.80
2+300	3.89		Drop (F = 1.5)		(1.50)	14.64	0.03	14.61	1.31	13.30
	3.89	400	Open channel (E-type)	1/5000	0.08					
2+700			(1L-6L) Turn-out			14.56	0.03	14.53	1.31	13.22
	3.89	400	Open channel (E-type)	1/5000	0.08					
3+100			(2L-6L) Turn-out			14.48	0.03	14.45	1.31	13.14
	3.89	1,300	Open channel (E-type)	1/5000	0.26					
4+400			(3L-6L) Turn-out			14.22	0.03	14.19	1.31	12.88
	3.89	930	Open channel (E-type)	1/5000	0.19					
5+330			(4L-6L) Turn-out			14.03	0.03	14.00	1.31	12.69
	3.89	2,120	Open channel (E-type)	1/5000	0.42					
7+450						13.61	0.03	13.58	1.31	12.27
7+450			Waste way			13.61	0.02	13.59	0.97	12.62
	1.73	4,450	Open channel (F-type)	1/5000	0.89					
11+900			(1R-6L) Turn-out			12.72	0.02	12.70	0.97	11.73
	1.73	1,650	Open channel (F-type)	1/5000	0.33					
13+550						12.39	0.02	12.37	0.97	11.40
	1.73	1,450	Open channel (F-type)	1/5000	0.29					
15+000						12.10	0.02	12.08	0.97	11.11

Fig. A.4.4-1 Prospected Performance Curve of the Pump

Project	Kaeng Khoi-Ban Mo Pumping Irrigation Project				Service	Irrigation	
Model	1000 M/M Vertical Mixed Flow Pump	Requirements	$2.5M^3/S$	15.8^M	593^{RPM}	560^{KW}	



KAENG KHOI PUMPING STATION (ALTERNATIVE PLAN)

PLANE

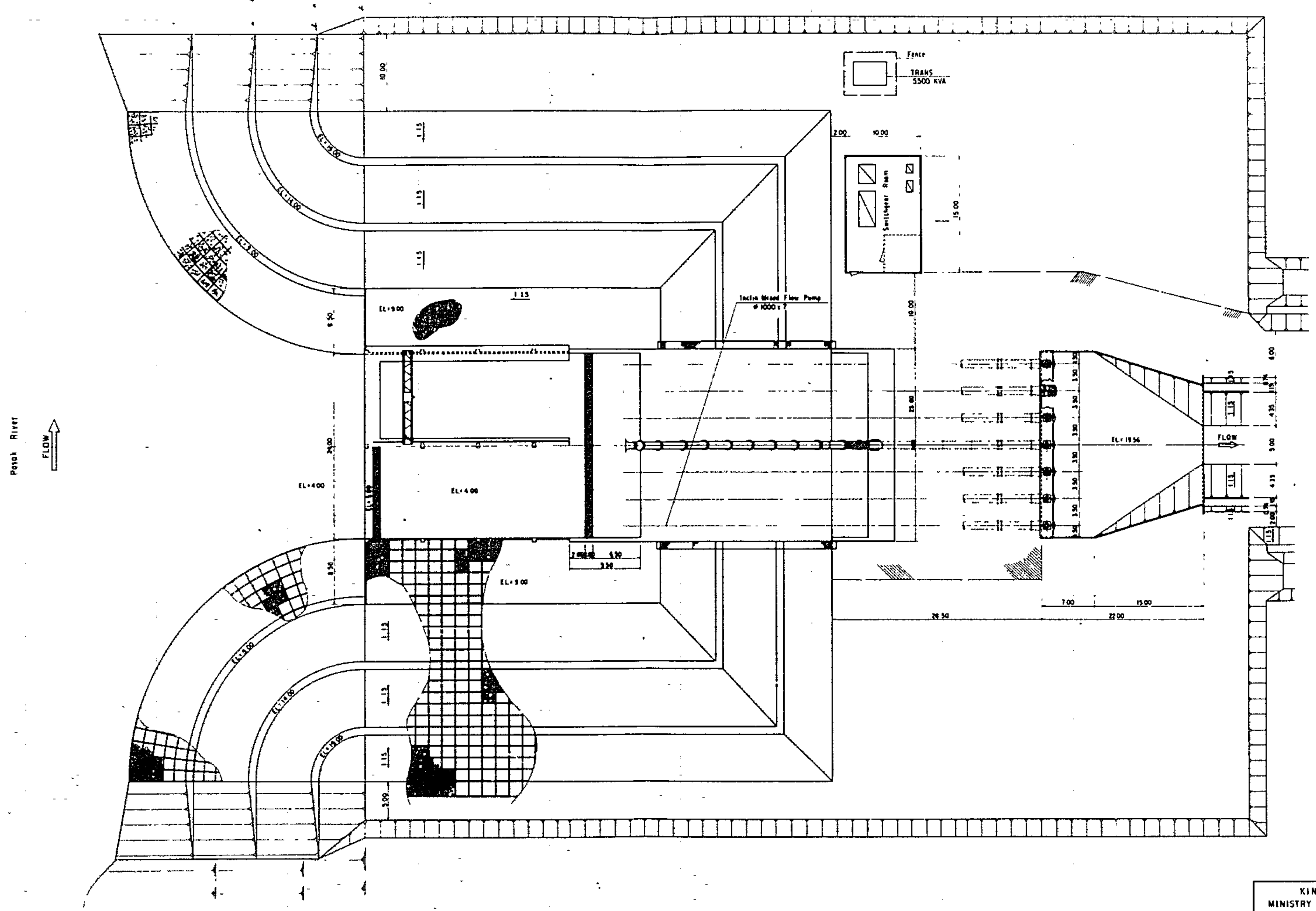


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Fig A.4.4-2

KAENG KHOI PUMPING STATION (ALTERNATIVE PLAN)

SIDE-VIEW

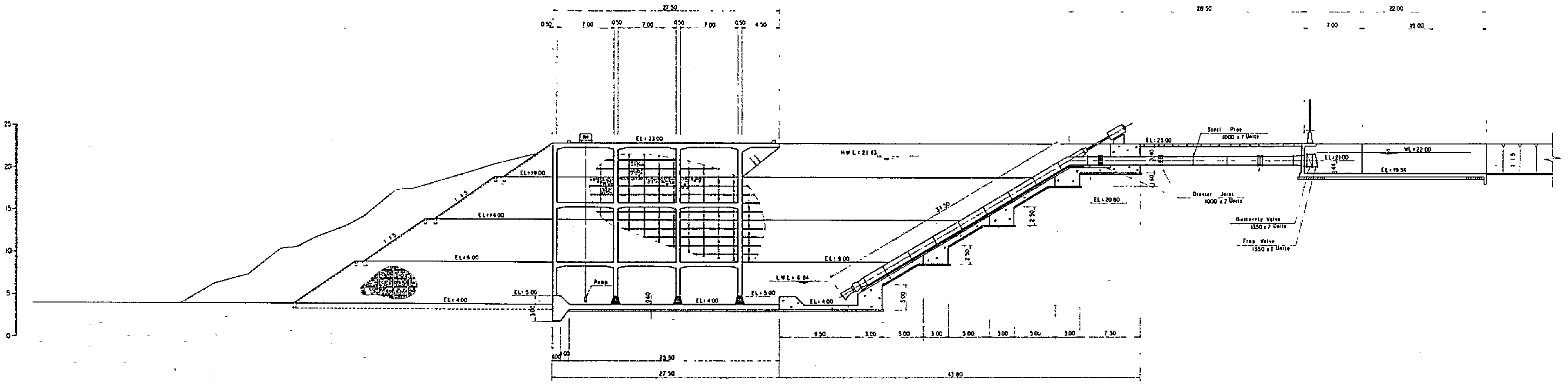

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Fig A.4.4-3

4.5. Drainage Scheme

4.5. Drainage Scheme

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4.5. Drainage Scheme

4.5.1. Basic Concept of Drainage Scheme

The service areas of the Project are mostly paddy fields. Furthermore, about 60% of farm lands extending from the northern boundary of the Project Area, that is, the drainage areas of small streams running into the Project Area, consists of paddy fields, and the rest upland fields and plantations. The mountainous or hilly water source areas are extremely small. The land slope of paddy fields ranges from 1/200 to 1/250 in the above-mentioned drainage areas where the plot-to-plot irrigation to flow down excess rainy water in a farm plot to the neighboring downstream farm plot is practised. The land slope in upland fields ranges from 1/80 to 1/150.

The probability of consecutive rainfalls is computed based on the daily rainfall data (1952 - 1980) at Saraburi,as a representative station of the Project Area, and shown below.

Return Period	Consecutive Rainfall			
Year	2 days	3 days	4 days	5 days
3	128.3	144.2	160.2	176.5
5	145.7	163.6	181.2	197.8
10	168.5	189.2	207.6	223.6
20	191.0	215.1	232.8	247.3
50	221.6	250.5	265.6	277.0

The daily rainfall data indicate that the three to four days consecutive rainfall frequently appears in the Area in comparison with the others mostly after the middle of September. Paddy is in the maximum tillering stage around the end of September, and the flood damage on paddy yield is comparatively small since paddy has grown up high.

Taking into consideration the above-mentioned topographic conditions and rainfall distribution, the following drainage modulus is determined.

i) The four days consecutive rainfall with the probability of one to fifth is employed as the design rainfall.

ii) The permissible depth of water in paddy fields is determined at 100 mm, and a consecutive rainfall over 100 mm shall be drained.

iii) As regards the daily distribution of the four days consecutive rainfall with 1/5 year probability, a rain pattern in which the peak appears in an early time in the raining period is employed, in consideration of safety, as shown below:

Table A.4.5-1 Distribution of 4 days Consecutive Rainfall

(Unit: mm)

Year	1st	2nd	3rd	4th	Total
1953	15.3	60.4	22.7	1.9	100.3
1970	31.4	91.5	27.8	7.9	158.6
1971	22.3	58.4	42.5	53.7	176.9
1972	26.1	64.8	61.9	10.6	163.4
Total	95.1	275.1	154.9	74.1	599.2
Ratio	16	46	26	12	100
Distributed Rainfall *	29.0	83.4	47.1	21.7	181.2

* Daily rainfalls are computed as follows:
D.R= 181.2mm x daily distribution ratio