FEASIBILITY REPORT

ON THE PUMP IRRIGATION

IN LAMPUNG PROVINCE

NOVEMBER 1971

OVERSEAS TECHNICAL COOPERATION AGENCY

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CHAPTER 1 SUMMARY

1. Outline of Survey

1.1 Indonesia's Request for Japan's Financial Aid

As a result of the financial aid negotiations for 1971/1972 between the governments of Indonesia and Japan, it was agreed that the pump irrigation project in Lampung province will be undertaken by the Japanese government as one of its aid programmes for Indonesia.

One of the major duties, delegated to the survey team was to study the feasibility of the said pump irrigation project.

On its arrival in Indonesia the team was given an explanation on the project at the General Bureau of Agriculture of the Ministry of Agriculture, of which the outline is given in tables shown in Sections 1.4.1 of this capter.

1.2 Summary of Survey Result

For feasibility study of the project, reconnaissances were carried out on the basis of data made available by the Indonesian Ministry of Agriculture. A brief account of the reconnaissance result ~~in~~ is given in the following items.

(1) Lampung Utara

Since Lampung Utara is a mountainous area, the large pump head required calls for an enormous amount of initial capital input. Further, higher cost than in other kabupaten is required for farm-land improvement and irrigation canal construction.

Pump irrigation will therefore yield a small economic effect if implemented in Lampung Utara.

(2) Lampung Tengah

Though Metro and neighbouring district is already covered by the irrigation network completed by the Ministry of Public Works, the deficient discharge of the main irrigation canal and the high land elevation make it impossible to obtain irrigation water from canals. Pump irrigation in this district therefore promises great economic effect.

50% of the 4,000 ha irrigable area in Bangunredjo is covered by alang-alang fields. Implementation of a large-scale pump irrigation is expected to produce high economic effect in this district.

(3) Lampung Selatan

Since Lampung Selatan has a flat topography and also many rain-fed fields despite of deficient drainage facilities, part of the ketjamatan forms a swamp area.

Pump irrigation cannot be expected to display high economic effect in this district unless accompanied by the construction and improvement of drainage facilities.

(4) Study on the 19 places proposed by the General Bureau of Agriculture revealed that high economic effect can be derived from pump irrigation at those places ranked "good" in the List of Feasibility Study (Section 1.4.1). Of the 11 places ranked "good" by the team, those suited for minor pump irrigation are the eight indicated in the following topographic map.

The cost required for the construction and operation of pump irrigation facilities at these places is shown as follows.

a.	Investment Cost	
	Civil Work	625,957,000 (RP)
	Construction Machinery	61,975,000 (RP)
	Consultant Fee	96,715,000 (RP)
	Total	782,647,000 (RP)
b.	Incremental Operating Cost	
		14,622,000 RP/year
c.	Incremental Gross Return	
		148,372,000 RP/year

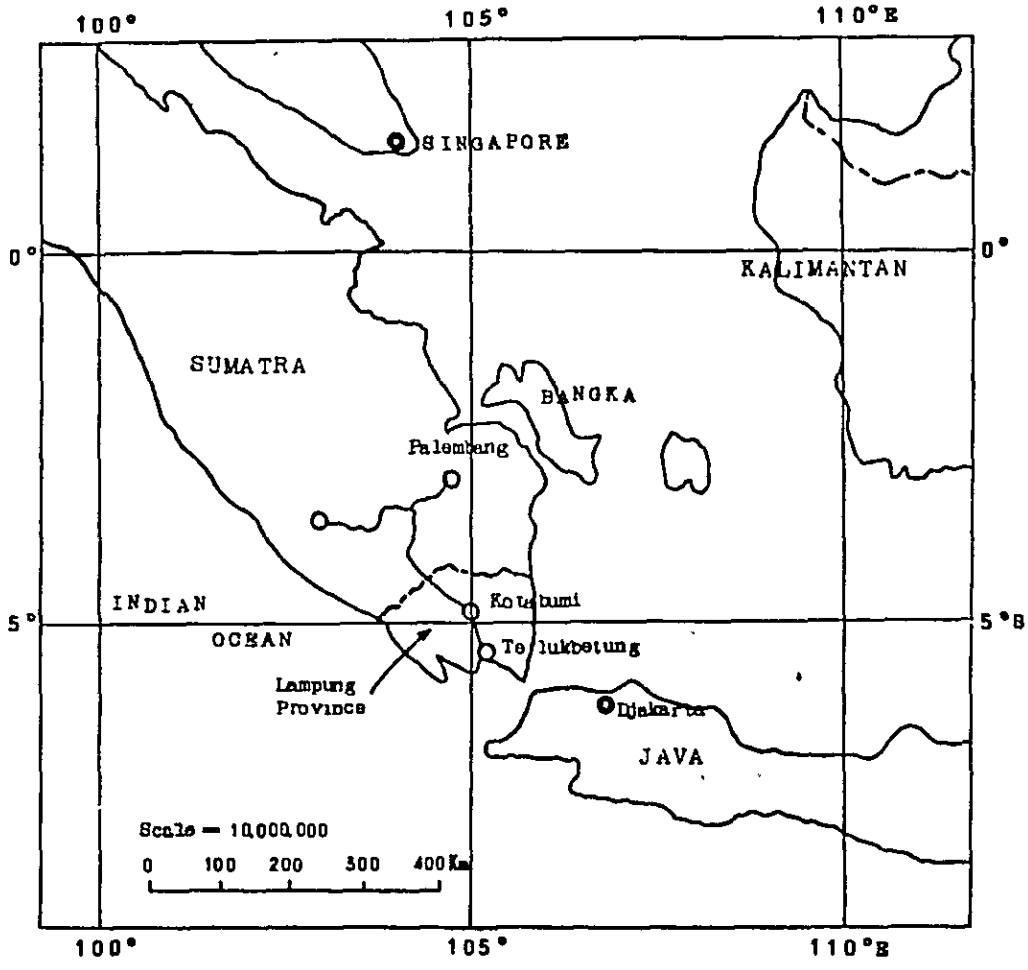
If the pump irrigation scheme at these places is considered as a single project, the internal rate return will be 16.2%.

(5) The project will be put into practice under the direct control of the provincial government of Lampung. It is desirable, however, that the operation of the irrigation system be left to the farmers' organization in two to three years.

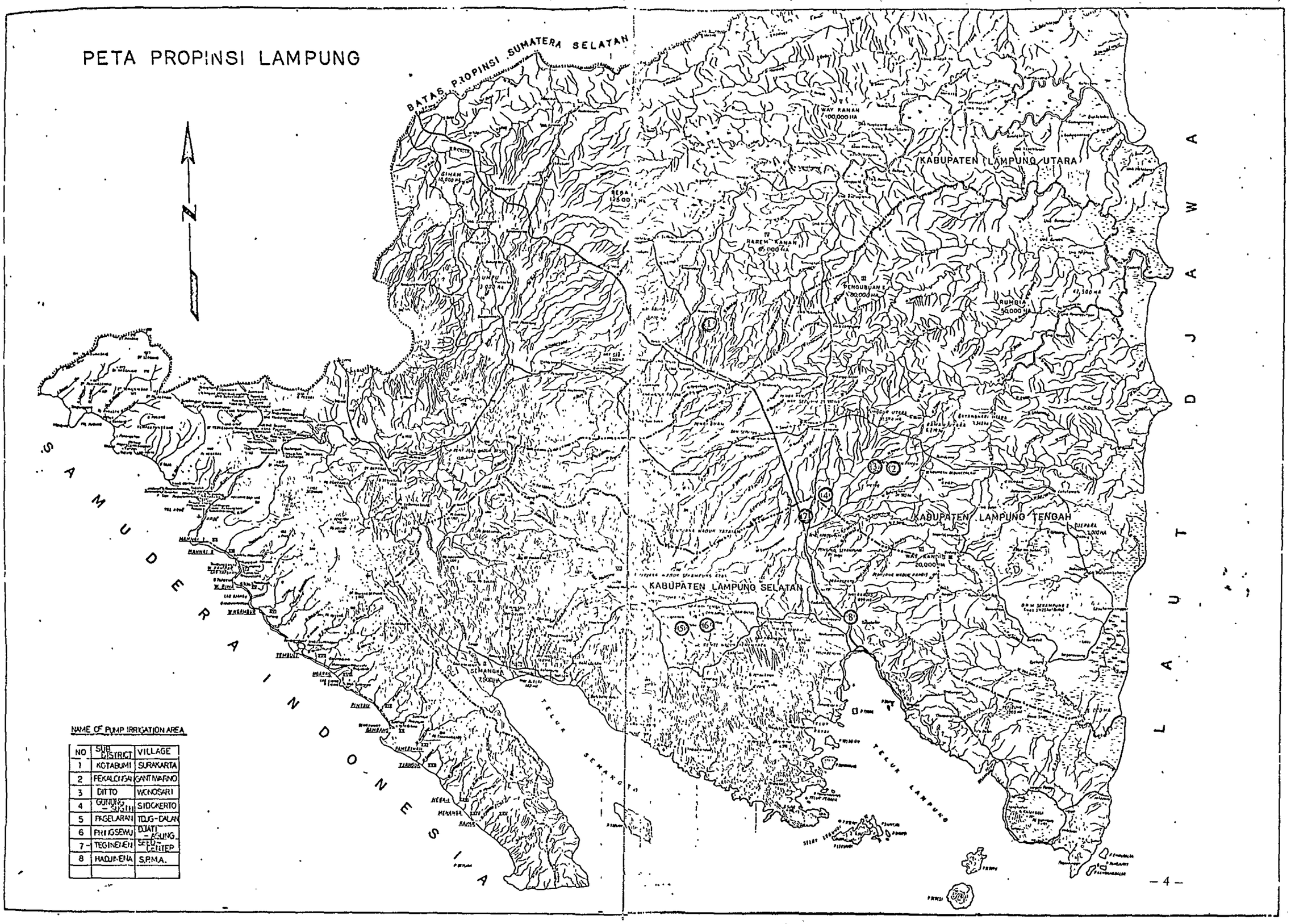
(6) The project should be carried out as part of the Tani Makmur Project particularly in Metro and neighbouring district of Lampung Tengah to promote the farmland improvement, terminal ditch improvement, water management improvement and paddy cultivation as well as to ensure sound development of farmers' organizations on the basis of pump irrigation.

1.3.

LOCATION MAP OF LAMPUNG PROVINCE



PETA PROPINSI LAMPUNG



NAME OF PUMP IRRIGATION AREA

NO	SUB DISTRICT	VILLAGE
1	KOTABUMI	SURAKARTA
2	PEKALONGAN	GANTIMARNO
3	DITTO	WONOSARI
4	GUNUNG SUGIH	SIDOKERTO
5	PAGELARAN	TUJU-DALAN
6	PRINGSEWU	DJATI AGUNG
7	TEGINENEN	SEPU CENTER
8	HADJIMENA	S.P.M.A.

1.4 Outline of Project

1.4.1 List of Feasibility Study for Pump Irrigation Project

List of feasibility study for pumping irrigation project

No.	Kabupaten	Ketjamatan	Village	Irrigation area		Water resource	Droughty water-discharge	Pumping -site	Geographical topography	Decision	Remark	
				Require	Available							
1	North Lampung	Kotabumi	Surakarta	(Ha) 2000	(Ha) 250	River Terusam	(m^3/s) 0.40	2	Quite flate	Good	In rainy season low land rice is possible 2000 ha	①
2		ditto	Termodadi	400	190	River Pangubran	12.00	1	Flat but a little bit undulated	Fair	On the other site of the river D.P.V. project "Way Pangubuan"	
3		Bukit Kemuning	Bukit Kemuning	200	200	Dam Kewairgan	0.20	1	Rocky	Poor	Expensive cost	
4		Sumber Djaja	Baradatu	400	400	River	10.00	1	Hilly	Poor	Intial cost and running cost are expensive	
5			Sumber Djaja (B.P.M.D.)	5	20	River Petai	0.40	1	A little bit undulated	"	Expensive cost	
6	Central Lampung	Pekalongan	Gantiwarno	320	320	River Banut	6.00	3	Flat	Good	Repeating use of water because of lacking in water	②
7		ditto	ditto (Seed center)	25	25	ditto	6.00	1	Flat	Good	Due to poor water management	
8		diito	Wonosari	40	40	River Raman	0.10	1	Flat	Good	High elevation	③
9		Gunung Sugih	Sidokerto	200	300	River Punggur	3.00	1	Falt	Good	High elevation	④
10		Bangunredjo	Tjimarias	500	400	River Prsir	0.60	2	Flat	Good	Large scale irrigation project has efficiently to be applied	
11		ditto	Suwangua	1500	1500	River Wajah	10.00	1	Flat	Fair	Division wear is better than pump irrigation for taking water	

List of feasibility study for pumping irrigation project

	District	Sub switch	Village	Irrigation area		Water resource	Droughty water-discharge	Pumping site	Geographical topography	Desision	Remark	
				Require	Available							
12		Bangunredjo	Sripendowo	750	750	River Tipo	0.12	1	Flat	Good	There are about 4000 ha for irrigation area, but 50% of this area is left as alang-alang	
13		ditto	Poerodad	750	750	River Wajah	10.00	1	Flat	Good		
14		ditto	Sidomuldjo	1500	1500	ditto	10.00	1	Flat	Good	Farmers need water earnestly and then 5 km cannal was completed by farmers *themself*	
15	*South* Lamping	Wonosobo	Sanggi	200	100	River Kaliawi	2.00	1	Hilly	Fair		
16		Pagelaran	Tdjg–Dalan	200	400	River Tebu	2.50	2	Flat	Good	Irrigation and drainage, due to lack of drainage, should be constructed with irrigation facilities	⑤
17		Pringsewu	Djati Agung	200	200	ditto	2.50	2	Flat	Good		⑥
18		Tegineneng	Seed center	63	63	Swarp	0.03	2	Flat	Fair	For secondary crops only	⑦
19		Hadjimena	S.P.M.A.	40	40	River Kandis	0.20	1	Hilly	Fair		⑧

1.4.2 Data and Pump Specification in Respective Districts

Data and pump specification / Districts	Irrigation area (ha)	Irrigation requirement (m^3/s)	Pump-up capacity (m^3/min)	Actual head (m)	Total head (m)	Type of pump	Pipe-diameter (m/m)	Number of pump (Nos)	Output (HP)	Total output (HP)
Surakarta (1st pump station)	500	0.800	57 6	8.10	10.00	Volute pump	350	3	65	195.0
Surakarta (2nd pump station)	500	0.800	57.6	8.10	10.00	"	350	3	65	195.0
Gantiwarno (1st pump station)	270	0.432	31.1	14.00	16.00	Double suction volute pump	300	3	65	195.0
Gantiwarno (2nd pump station)	50	0.080	5.8	16.50	19.00	"	200 x150	1	48.5	48.5
Gantiwarno (Pekalongan)	25	0.040	2.9	10.00	12.50	"	150	1	15.0	15.0
Wonosari	40	0.064	4.6	5.00	6.50	Volute pump	200	1	15.0	15.0
Sidokarto	300	0.480	34.6	9.70	12.00	"	300	3	48.5	145.5
Djati-Agung (1st pump station)	116	0.186	13.4	10.60	13.00	Double suction volute pump	250	2	28.0	56.0
Djati-Agung (2nd pump station)	190	0.304	21.9	12.80	14.50	"	250	3	45.0	135.0
Tdjg-Dalan (1st pump station)	100	0.160	11.5	18.00	20.00	"	200 x150	2	48.5	97.0
Tdjg-Dalan (2nd pump station)	100	0.160	11.5	12.00	14.00	"	200	2	28.0	56.0
Tegineneng (Seed center)	13	0.011	0.8	7.8	9.30	"	80	1	4.0	4.0
	33	0.026	1.9	4.0	5.50	"	125	1	6.0	6.0
Hadjimena (S.P.M.A.)	40	0.064	4.6	7.0	9.00	Volute pump	200	1	15.0	15.0
Total	2,277 ha							26		1,178.8

1.5 Estimates for Construction

1.5.1 Cost of Estimation

Price unit: Rp

District		Whole		Total
		Indonesian	Japan	
Surakarta	[I]	93,961,000	30,682,000	124,643,000
"	[II]	94,038,000	30,682,000	124,720,000
Gantiwarno	[I]	51,683,000	23,728,000	75,411,000
"	[II]	10,088,000	14,083,000	24,171,000
" (Pekalongan)		5,492,000	6,008,000	11,500,000
Wonosari		8,294,000	3,504,000	11,798,000
Sidokerto		60,823,000	17,697,000	78,520,000
Djati-Agung	[I]	24,178,000	8,952,000	33,130,000
"	[II]	37,089,000	14,930,000	52,019,000
Tdjg-Dalan	[I]	21,213,000	8,843,000	30,056,000
"	[II]	20,590,000	11,723,000	32,313,000
Tegineneng	[I]	2,622,000	1,156,000	3,778,000
"	[II]	6,519,000	1,714,000	8,233,000
Hadjmena		8,207,000	5,458,000	13,665,000
Total in $		444,797,000	179,160,000	623,957,000

1.5.2 Estimate for Project Cost

Total Project Cost and Annual Plan Item-Term Table

		Domestic Currency	Foreign Currency	Total (Rp)
Civil-works	1st year			
	2nd year	222,399,000	89,580,000	311,979,000
	3rd year	222,398,000	89,580,000	311,978,000
	Sub-total	444,797,000	431,000 179,160,000	623,957,000
Construction Machinery	1st year			
	2nd year		30,988,000	30,988,000
	3rd year		30,987,000	30,987,000
	Sub-total		149,000 61,975,000	61,975,000
Consultant-fee	1st year	7,895,000	97,499 40,462,000	48,357,000
	2nd year	7,895,000	48,749 20,231,000	28,126,000
	3rd year		48,749 20,232,000	20,232,000
	Sub-total	15,790,000	195,000 80,925,000	96,715,000
Total		460,587,000 Rp	775,000 US$ 322,060,000 Rp	782,647,000 Rp

1.5.3 Running Cost

		HP	Nos	Σ HP	ℓ/Σ HP	ℓ/year	R. Cost	Remark
Surakarta	[I]	65.0	3	195.0	35.1	91,260	2,281,500	
"	[II]	65.0	3	195.0	35.1	"	"	R. cost = $0.18^{ℓ/HP} \times 2{,}600^{hr/year} \times 25^{RP/ℓ}$
Gantiwarno	[I]	65.0	3	195.0	35.1	"	"	
"	[II]	48.5	1	48.5	8.7	22,698	567,450	
Pekalongan		15.0	1	15.0	2.7	7,020	175,500	
Wonosari		15.0	1	15.0	2.7	"	"	
Sidokerto		48.5	3	145.5	26.2	68,094	1,702,350	
Djati-Agung	[I]	28.0	2	56.0	10.1	26,208	655,200	
"	[II]	45.0	3	135.0	24.3	63,180	1,579,500	
Tdjg-Dalan	[I]	48.5	2	97.0	17.5	45,396	1,134,900	
"	[II]	28.0	2	56.0	10.1	26,208	655,200	Operator 7.0 person
Tegineneng	[I]	4.0	1	4.0	0.7	1,872	46,800	Operator 7 persons 10,000 Rp/month/ person 12month x 7 = 840,000 Rp
"	[II]	6.0	1	6.0	1.1	2,808	70,200	
Hadjmena		15.0	1	15.0	2.7	7,020	175,500	
Total							13,782,600	14,622,000 Rp

1.6 Financial Benefit Derivable from Project

Table of benefit calculation

Unit: 1000 Rp

District		Projected	Present	Increase
Surakarta	[I]	27,720	3,775	23,945
"	[II]	"	"	"
Gantiwarno	[I]	22,016	10,208	11,808
"	[II]	"	"	"
Pekalongan		1,720	–	1,720
Wonosari		2,752	984	1,768
Sidokerto		20,640	5,355	15,285
Djati-Agung	[I]	21,052	5,059	15,993
"	[II]	"	"	"
Tdjg-Dalan	[I]	13,760	1,600	12,160
"	[II]	"	"	"
Tegineneng	[I]	814	71	743
"	[II]			
Hadjmena		2,632	1,588	1,044
Total				148,372

1.7 Economic Analysis of Project

The economic effect of the project, as calculated by comparison between the project benefit and the direct project cost, is as tabulated below.

The effect, however, cannot be derived in a year since the project construction is planned to take a period of three years. Further, the calculation was worked out on the assumption that the construction work will be concurrently accompanied by the extension service for encouraging the use of machines and equipment, establishment of a rational irrigation plan, and extension of advanced cultivation techniques.

Calculation of Internal Rate of Return

Unit: 1000 Rp

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	Investment costs	Incremental operating costs	Incremental gross return	Balance (3)-(2)-(1)	Present value of 1 at 16% anual discount	Discounted balance	Present value of 1 at 17% annual discount	Discounted balance
1	48,357			— 48,357	0.862	— 41,683	0.855	— 41,354
2	371,093	3,655	37,093	—337,655	0.743	— 250,877	0.732	— 247,163
3	363,197	7,311	74,186	—296,322	0.641	— 189,942	0.626	— 185,497
4		14,622	148,372	133,750	0.552	73,830	0.535	71,556
5		"	"	"	0.476	63,665	0.458	61,257
6		"	"	"	0.410	54,837	0.370	49,487
7		"	"	"	0.354	47,347	0.335	44,806
8		"	"	"	0.305	40,793	0.295	39,456
9		"	"	"	0.263	35,176	0.245	32,768
10 - 20		"	"	"	1.321	176,683	1.080	144,450
						+ 9,829		— 30,234

The internal rate of return is about 16.2 percent.

CHAPTER II GENERAL DESCRIPTION

1. Introduction — Background and Purpose of Project —

Despite the fact that Indonesia covers as vast an area as 1,900 thousand km², 75% of its total population and 70% of the country's business establishment are concentrated in Java, and this is causing an extreme shortage of foreign exchange reserve which is paid for imported foodstuffs on which the nation is heavily dependent.

Among the many islands of the archipelago, Java records an annual population growth rate of about 2.8% but both the farmland area and employment opportunities of the island are just too deficient to catch up with this rapid population increase.

In an effort to bring solution for these problems, the Indonesian government attaches the greatest importance to the agricultural development scheme to elevate the income level, stabilize the commodity price and increase foreign exchange reserve. The scheme is intended to accelerate agricultural production (particularly rice) so as to raise the rate of self-sufficiency in food, reduce the foreign currency disbursement for import, and increase the foreign currency earnings through expanded export of farm produce.

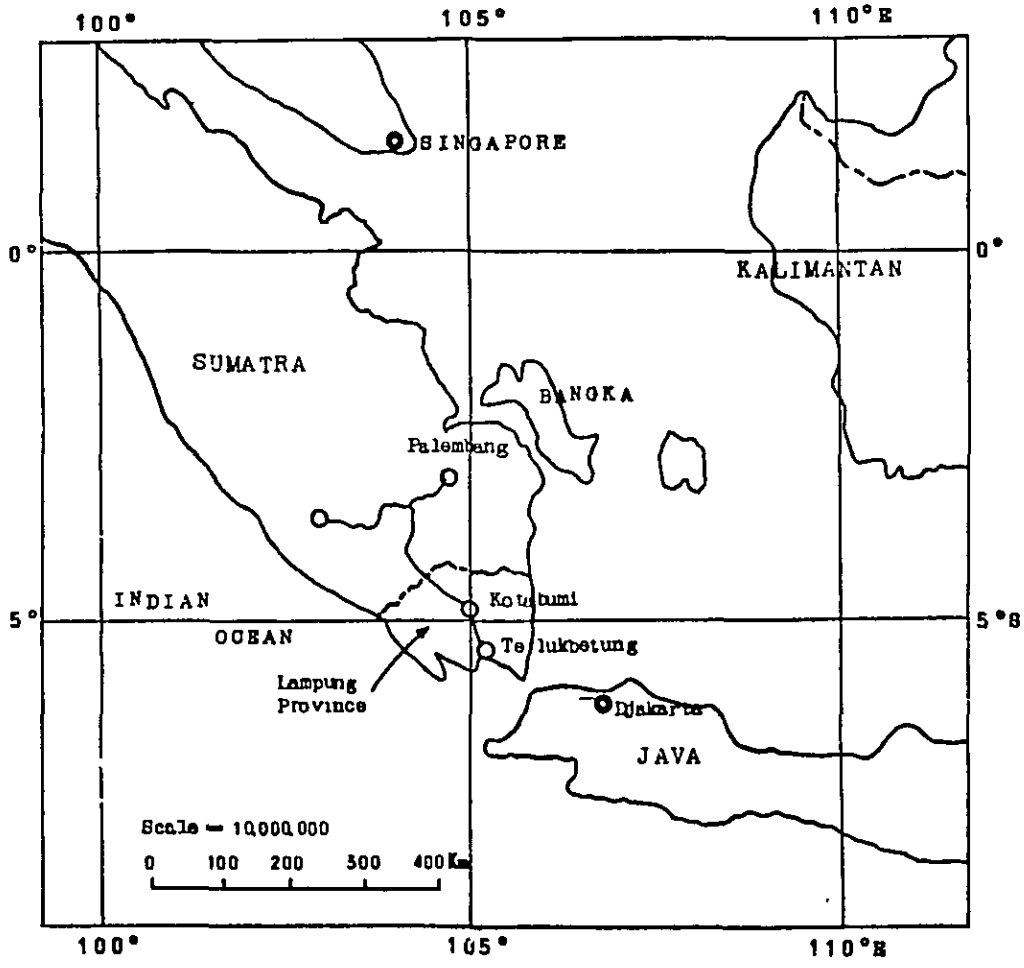
Lampung province was the first project area considered for such agricultural development. Facing Java (Djakarta in particular) across Sunda Channel, the province is very close to the island and at the same time embraces an extensive arable land which promises to become Java's largest food supplying region. The province is also favoured with warm climate and the greater part of its land area has a flat topography with rivers for farmland formation.

Because of the abundance in unreclaimed land area, the province's agricultural development is likely to be little retarded by the prevailing social customs, economic structure or conventional farming practices. In addition, the planned development can be backed up by cheap and abundant labour force of retired soliders and other Javanese settlers.

It is with such favourable background that the Indonesian government mapped out the pump irrigation project for accelerated paddy production and requested Japan's financial aid for its implementation. This resulted in an agreement made by the governments of Indonesia and Japan that Japan would extend financial aid in this project as part of its economic cooperation programmes for Indonesia.

In the following pages, the outcome of feasibility study of the project will be described.

LOCATION MAP OF LAMPUNG PROVINCE



2. Geographical Situation of Project Area

2.1 Location and Geography

As shown in the following location map, the project area is in the southern part of Sumatra, and located in the inland area of Lampung nearest to Java island (particularly Djakarta).

It extends around Lat. 5° S. and Long. 105° E. and covers an area of about 2,300 ha which is composed of a total of eight districts, i.e., one in Lampung Utara, three in Lampung Tengah and four in Lampung Selatan.

3. Natural Conditions

3.1 Climate

The project area enjoys a relatively mild and warm climate and free from any typhoons. The temperature is virtually free from fluctuation throughout the year, showing a daytime highest value of 32 – 34°C and a night time lowest value of 22 – 24°C all the year round. The temperature difference between days and nights is approximately 10°C. Thus, the temperature is quite suited for the growth of crops.

Rainfall and the number of rainy days are as shown in the following graph.

Monthly rainfall rises beyond the 200 mm level from November to April, and declines to about 80 mm in the dry season which lasts from July to September.

It is known that the average annual rainfall and average annual number of rainy days at different places of the project area are as follows.

Kotabumi:	2,480 mm, 134 days
Gunung Sugih:	2,570 mm, 129 days
Metro:	1,980 mm, 118 days.

The rainfall distribution shown in the following graph represents average values. It appears, however, that the project is not totally exempt from drought damages and floods as evidenced, for instance, at Kotabumi where hardly any rainfall was observed during the May–October period of 1967. In the same period, the entire Lampung province was afflicted with drought.

3.2 Soil

On the west costs side of the province, the Barisang range stretches in the north-south direction with volcanos, and on the east coast side extends a plain embracing a swamp area, with undulating hilly area found in between. The soil is composed chiefly of weathered basalt and tuff. Rivers rise in the mountainous district, flow through the undulating hilly area in the east-west direction, and then through the flat area until they empty into the sea. Since the project area is in the tropical zone

rich in rainfall, the soil is subjected to the eluviation of basic matters and to the development into acid soil, laterite and podsol. Volcanic ash produced by the past eruptions could not be observed during the survey.

There are many plantations of perenial crops such as rubber, coffee and pepper in the northern mountainous and hilly area. In the central undulating highland area, oil palm and ordinary upland crops are cultivated in addition to perenial crops and there are also found paddy fields in the irrigated area, but the greater part of this highland area is still occupied by alang-alang fields. In the eastern part of the province, many swamps are found, and in the south a substantially extensive paddy field area. The soil is composed of laterite, podsol and alluvial soil which are intricately mixed and distributed.

The following table shows the result of soil analysis conducted in Indonesia on specimens sampled in the project area. As is clear in the table, loam, clay loam and clay soil are widely distributed and there are three major groups of soil colour, i.e., reddish brown, dark brown and greyish yellow.

In view of the soil acidification which cannot be avoided in an area like Lampung which is in the tropical zone with abundant rainfall and yet has a dry season, pH (H_2O) and pH (KCl) of soil specimens were studied and a soil buffer curve was also prepared to estimate the lime requirement for acid soil nutralization.

This study disclosed that some of the soil in the project area is highly acid with pH (KCl) standing at 4.0, and that application of 1 ton of $CaCO_3$ per ha will be required to rectify this value to pH (KCl) = 6.0 and an average of 0.6 tons or more of $CaCO_3$ per ha to rectify to pH (KCl) = 5.0. The study also revealed that the soil of the alang-alang fields in Bungun Redjd calls for particularly heavy application of lime. As to the crop resistance to strong soil acidity, paddy and upland paddy display the mightiest resistance (pH 5.0 or more), followed by maize, sweet potatoes and tobacco (pH 5.5 or more), with soybeans and groundnuts known to be very vulnerable (pH 6.0 or more).

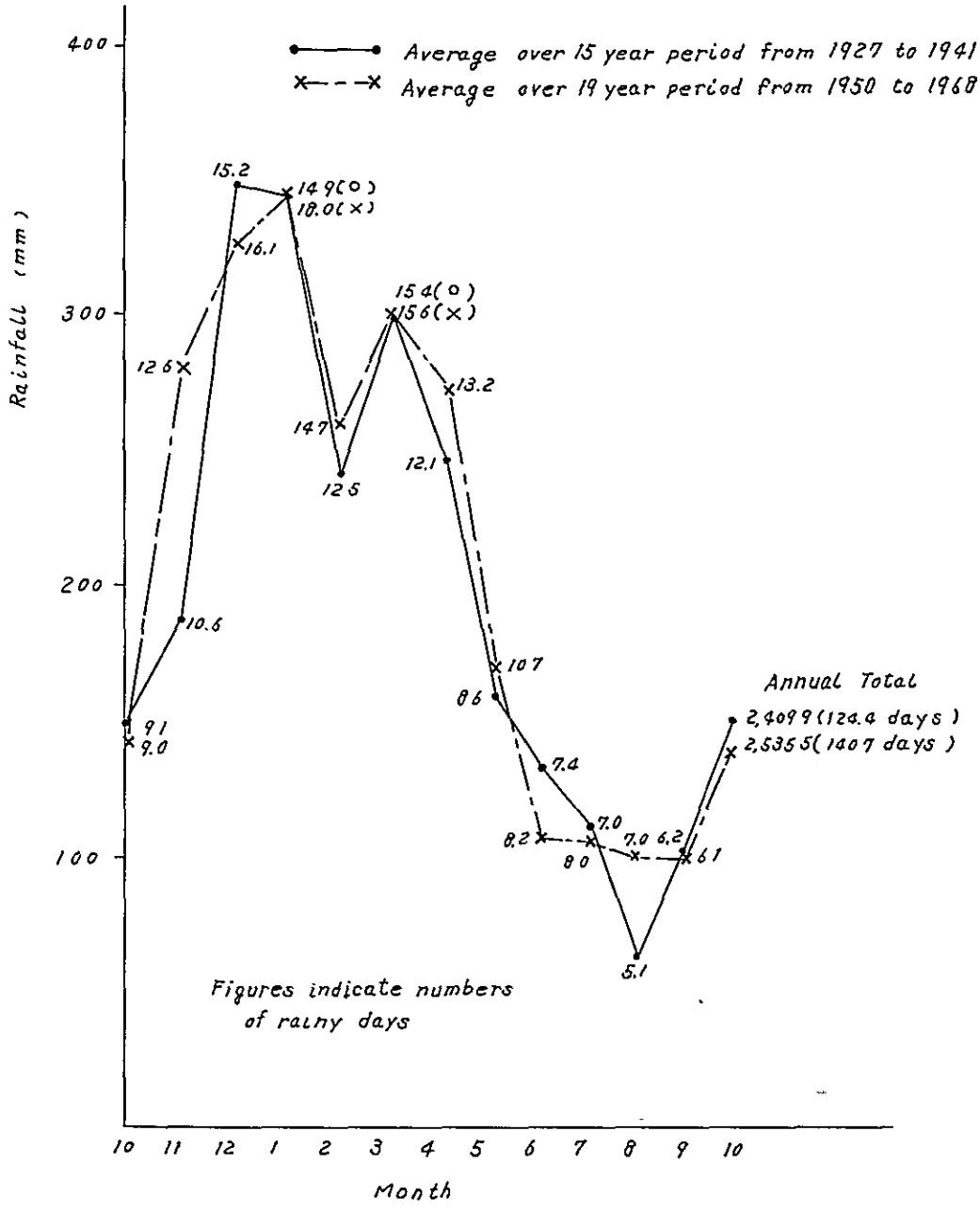
To cultivate crops in the project area, it is considered essential to rectify the acidity of soil, su pplement the eluviated basic matters, and apply lots of phosphorus fertilizer. It may be added that some people entertain the opinion that the base exchange capacity should be increased by the application of organic matters such as green manure.

The lateric soil contains inert ferric oxide. When this soil is used for paddy cultivation, the ferric oxide will be reduced to ferrous oxide so that the increased activated iron content becomes bonded with phosphoric acid and decrease the effect of phosphorus fertilizer.

Heavy dosage of lime application within a short period may not be possible for financial reasons. It will be necessary, therefore, to develop cheap lime fertilizer and apply it constantly even in small dosage so as to minimize the extraction of land fertility by rainfalls and crop cultivation.

River water was sampled and its pH value was tested. Though all the rivers presented a weak acidity, they proved suited for irrigation.

Monthly Rainfall and Number of Monthly Rainy Days at Kotabumi



Test Data of Soils and Water Quality (September 4 – September 14, 1971)

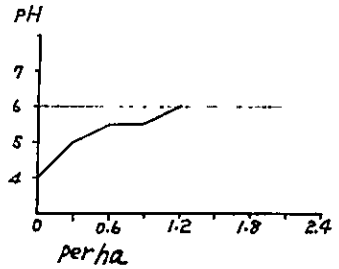
Survey District		Sampled Place	Horizon	Soil Texture	Soil colour		pH		Lime * Requirement (ton/ha)		Vegetation and others
					No.	Colour	KCℓ	H_2O			
Lampung Utara											
SURAKARTO											W. TERUSAN (pH = 6.0)**
	1	Vicinity of pumping station II	0–10	CL	7.5 YR 4/4	Brown	4.0	5.0	0.3	1.2	Plant roots are found in the surface soil near the river and at the foot of hills.
			10–30	CL	5 YR 4/8	Reddish Brown	4.0	5.0	–	–	
	2	Vicinity of pumping station III	0–5	SiC	10 YR 2/2	Blackish Brown	5.3	6.0	0	0.6	
			5–25	C	7.5 YR 4/6	Brown	4.0	5.3	0.9	1.5	
GEOHNG PAKUAN											Tributary of the Niki
	3	Vicinity of pump site	0–10	C	7.5 YR 2/3	Very Dark Brown	5.5	6.0	0	–	Hill composed of soils of aggregate structure containing no boulders.
SUMBER DJAJA											W. PETAY (pH = 6.5)
	4	Paddy field along the petay	0–30	SiL	2.5 YR 7/4	Light Yellow	4.5	6.0	0.6	1.2	Farmland in clearings in forest land.
	5	Area opposite to the paddy field along the petay	0–25	CL	75 YR 3/3	Dark Brown	4.0	5.0	0.6	71.5	Hill alang-alang field containing humic soil.
			25–50	C	5 YR 5/8	Right Reddish Brown	4.0	5.5	0.6	71.5	
Lampung Tengah											W. WATA (pH = 6.5)
	6	Vicinity of pumping station IV	0–10	C	7.5 YR 3/4	Dark Brown	4.0	5.3	1.8	2.1	Flat fallowed farmland and alang-alang field, soil along the waja has aggregete structure.
			10–30	Sic	7.5 YR 4/4	Brown	4.0	5.5	1.8	2.4	
	7	Maize field at the foot of the mountain near pumping station II	0–15	SL	75 YR 2/2	Blackish Brown	5.3	6.0	0	–	Sloping area contains humic soil; flat area used for cassava cultivation.
	8	Vicinity of pumping station I	0–20	CL	7.5 YR 3/4	Dark Brown	5.0	5.5	0	0.3	

* $CaCO_3$ requirement in tons per ha of soil to rectify its pH (KCℓ) to 5.0 and 6.0 at a depth of 10 cm.

** Water source of pump irrigation; figure in parentheses indicates pH value.

Survey District	Sampled Place		Horizon	Soil Texture	Soil colour		pH		Lime Requirement (ton/ha)		Vegetation and others
					No	Colour	KCℓ	H_2O			
DJERARA											W. DJEPARA (pH = 6.6) W. ANDAK (pH = 6.0)
	9	Lanned spillway site 2 km from Lake Djepara	0–20	L	2.5 Y 3/1	Blackish Brown	4.5				Tobacco is grown in the flat top area of hill, with a black pan of bassalt not totally weathered extending.
			20–100	C	10 R 3/4	Dark Red					
	10	Area along the Djepara		CL	2.5 Y 6/2	Greyish Yellow	5.5				Swamp area.
SIDOKERTO											W. PUNGGUR (pH = 6.0)
	11	100m from pumping station	5–15	CL	2.5 YR 3/6	Dark Reddish Brown	4.3	5.3	0.5	0.45	Hilly and covered by alang-alang fields.
	12	500m downsteam of sampled place No. 11	0–15	C	5 YR 3/6	Dark Reddish Brown	5.0	5.5	0	0.6	Cassava field found in hilly area.
	13	Paddy field along the Punggur	0–20	SiC	2.5 YR 7/5	Light Yellow	4.0	5.5	0.9	1.5	
	14	Pumping station II	0–5	CL	7.5 YR 2/3	Very Dark Brown	4.5	5.5	0.3	1.5	Banana plantation.
			5–15	SiC	5 YR 3/3	Dark Reddish Brown	4.3	5.5	–	–	
TEGINENENG											
	15	Maize field of Seed Center	0–10	CL	5 YR 3/6	Dark Reddish Brown	5.0	6.0	0	0.6	Land has a mild slope and is composed of humic soil.
			10–30	C	5 Y 2/2	Olive Black	5.5	6.0	0	0.45	
	16	100m from paddy field of Seed Center	0–30	C	2.5Y 4/1	Yellowish Gray	5.5	6.0	0	1.2	Many rice straws are found and the small of H_2S is detected (2nd crop.)
GUTIWARTO											W. BUNUT (pH = 6.5)
	17	Paddy field of agricultural school located 500m from pumping station	0–10	C	10 YR 3/4	Dark Brown	5.0	5.5	0	0.9	Flat area is covered by alang-alang fields.
			10–25	SiC	75 YR 3/4	Dark Brown	5.0	5.8	0	0.9	
	18	Center of terraced paddy field about 2 km from sampled place No. 17	0–30	C	10 YR 5/4	Dark Yellowish Brown	5.0	–	0	1.2	Paddy fields(2nd crop.)found inflat area.

Survey District	Sampled Place		Horizon	Soil Texture	Soil colour		pH		Lime Requirement (ton/ha)	Vegetation and others
					No.	Colour	KCℓ	H_2O		
Lampung Selatan										
PR.SEWU										W. TEBU (pH = 6.6)
	19	Cassava field near pumping station	0–20	SiC	5 YR 3/2	Very Dark Reddish Brown	5.0	5.8	0 –	Land has a slope containing the humas.
	20	South of Djatcagun, 1 km from sampled place No. 18	0–20	SiC	10 YR 3/2	Blackish Brown	5.5	6.0	0 –	– ditto –
	21	500m from sampled place No. 19	0–10	C	7.5 YR 2/2	Blackish Brown	5.2	6.0	0 0.15	Flat land resting field alang-alang.
PAGELARAN										W. TEBU (pH =)
	22	T.D.J. DALAN	10–25	SiC	7.5 YR 4/3	Brown	4.5	5.5	0.15 0.9	Flat area embraces fallowed paddy fields (where rain water is logged and cannot be drained).



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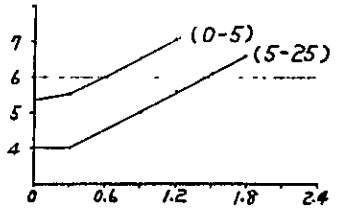

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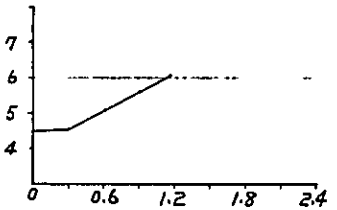

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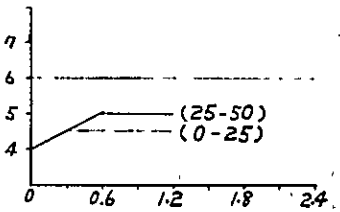

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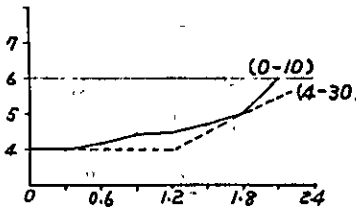

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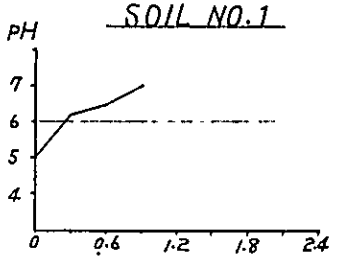

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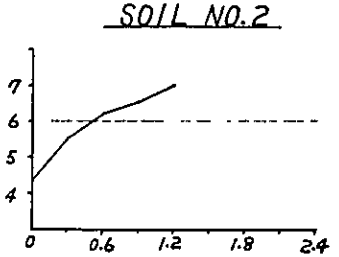

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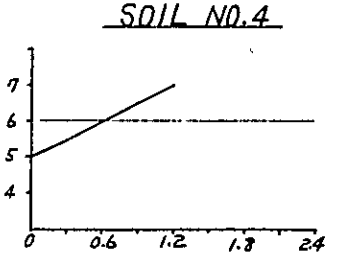

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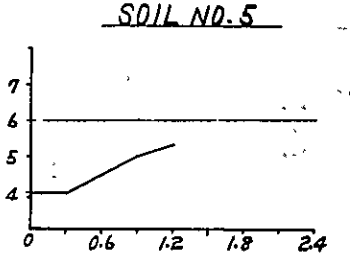

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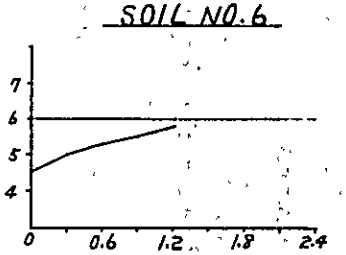

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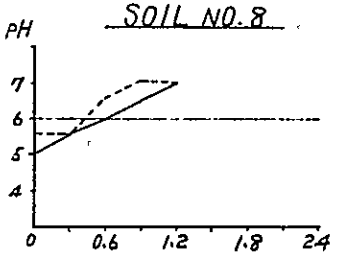

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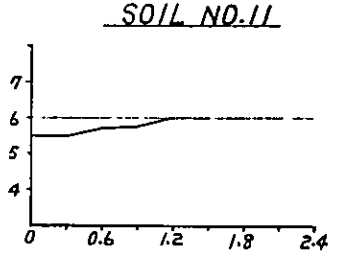

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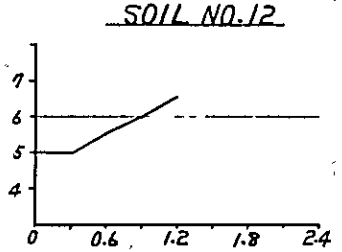

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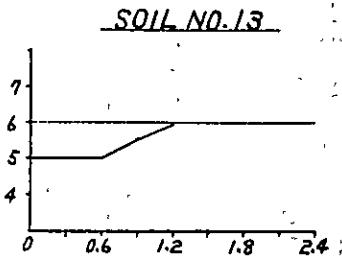

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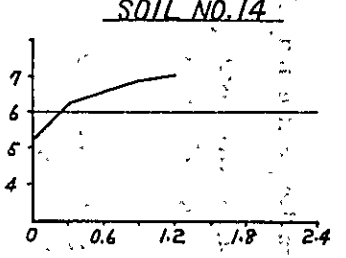

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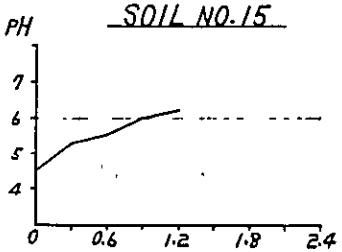


SOIL NO.22

Buffer Curves of Respective Soil Specimens

3.3 River Discharge in Respective Irrigation Districts

The monthly average river discharge in dry season was estimated on the basis of the observation in this time (Sep. 1971) and partial observation for river discharge among 1917 to 1959.

The river discharge in wet season is estimated by only specific discharge because it is prentiful as water resource.

The river discharge in respective districts is as follows. In this table the upper figures show the discharge in dry season and the lower ones show the discharge in wet season.

Ketjamatan	Districts	River	Specific Discharge	Catchment Area	Discharge	Discharge by Observation	Design Discharge
			$m^3/100\ km^2$	km^2	m^3/s	m^3/s	m^3/s
Kotabumi	Surakarto	Terusan	0.22	183.4	0.40	0.40	0.40
			6.01	"	"	11.00	11.00
Pekalongan	Gantiwarno	Bunut	1.12	45.5	0.50	5.5	5.00
			3.70	"	1.68	6.68	6.68
"	Wonosari	Raman	0.22			D.P.U. Reservoir	0.10
			2.66				1.00
Gunung-Sugih	Sidokerto	Punggur	0.52	28.0	0.15	1.40	1.40
			5.02	"	1.40	15.40	15.40
Pringsewu	Djati-Agung	Tebu	1.12	284.5	3.20	2.50	2.50
			6.01	"	17.10	–	17.10
Pagelaran	Tdjg-dalan	Tebu	1.12	"	3.20	2.50	2.50
			6.01	"	17.10	–	17.10
Natar	Tegineneng Seed-Center	Swamp				0.03	0.03
						0.09	0.09
Tandjung-Karang	Hadjimena S.P.M.A.	Kandis	1.12	30.0	0.33	0.20	0.20
			3.70	30.0	1.11	–	1.11

Table

Stream Flow Data – Lampung Province

(Cubic meters per second)

	Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average Runoff (cms)	Annual Volume (mcm)
Way Sekampung (Agroguruh)															
2155 sq. km.	1937				151.5	107.0	108.0	52.3	41.5	37.5	55.2	36.8	69.8		
	1938	131.0	106.0	90.6	76.8	50.8	62.6	33.4	27.5	20.8	15.6	26.9	47.4	57.4	1310
	1939	111.0	98.1	80.8	70.1	43.7	28.1	35.2	30.3	25.4	28.2	26.1	86.6	55.2	1740
	1940	125.0	(76.9)	82.8	124.0	56.0	50.2	38.7	24.5	17.4	14.3	7.5	50.0	55.6	1750
		5.68	4.35	3.93	4.9	3.0	2.89	1.85	1.43	1.17	1.31	1.13	2.36		
Way Sekampung (Negeridjemantan)															
2508 sq. km	1940	–	–	–	–	80.3	70.8	54.6	30.2	20.1	14.5	9.7	–	–	
						3.2	2.82	2.18	1.20	0.80	0.58	0.39			
Way Belok															
797 sq. km.	1939	28.7	49.7	24.2	14.4	5.7	3.8	7.5	6.7	5.9	6.4	7.5	5.7	13.9	438
	1940	–	27.6	25.2	42.0	12.4	12.3	6.8	4.0	2.5	1.3	2.2	10.0	–	
		3.60	4.85	3.1	3.54	1.14	1.01	0.90	0.67	0.53	0.48	0.61	0.98		
Way Seputih															
500 sq. km.	1937									10.3	10.2	5.2	20.7		
	1938	45.1	37.8	27.1	25.6	17.6	17.8	8.2	4.9	3.4	2.2	5.2	15.1	17.5	551
	1939	40.5	38.2	29.2	22.4	16.6	12.9	11.3	9.0	5.4	6.3	7.1	16.5	17.9	563
	1940	28.2	27.4	24.0	27.4	25.5	16.8	19.8	7.2	3.3	2.2	3.7	14.6	16.7	526
		7.59	6.89	5.35	5.03		3.17	2.62	1.41	1.12	1.05	1.06	3.35		
Way Teboe															
294 sq. km.	1940	13.5	12.4	10.3	16.1	5.9	5.7	3.9	1.2	1.6	0.5	1.0	6.0	6.5	205
		4.59	4.22	3.50	5.48	2.01	1.94	1.33	0.41	0.54	0.17	0.34	2.04		

	Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average Runoff (cms)	Annual Volume (mcm)
Way Pengubuan															
180 sq. km.	1937										2.9	1.4	7.5	–	
	1938	16.5	16.3	10.3	10.9	8.8	8.8	2.8	2.3	1.3	0.9	2.6	6.8	7.4	233
	1939	21.6	16.8	10.8	11.9	9.3	7.2	6.8	4.9	2.5	3.0	3.8	9.4	9.0	284
	1940	16.1	16.6	15.6	14.6	9.1	8.4	10.8	3.4	2.0	1.5	2.0	6.8	8.8	277
		10.04	9.21	6.79	6.93	5.04	4 52	3.78	1.96	1.07	1.16	1.36	4.24		
Way Sukadana															
148. sq. km.	1939									0.43	0.49	0.54	7.21		
	1940	10.50	8.73	8.90	9.73	2.42	1.26	0.72	0.52	0.35	0.28	0.27	2.34	3.8	120
		7.09	5.93	6.01	6.57	1.64	0.85	0.49	0.35	0.26	0.26	0.28	3.23		
Way Djepara															
130 sq. km.	1938							2.6	2.0	1.5	1.4	2.1	3.8		
	1939	4.9	6.3	7.4	3.7	2.9	2.9	3.2	2.5	1.5	1.4	1.4	5.4	3.7	117
	1940	(7.5)	5.7	5.5	7.4	6.3	5.4	(3.1)	2.6	(1.6)	1.1	(1.0)	2.0	4.1	129
		4.77	4.62	4.96	4.27	3.54	3.19	2.28	1.82	1.18	1.00	1.15	2.87		
Way Batang Hari															
110 sq. km.	1939	9.7	6.1	5.6	8 0	4.2	3.2	4.6	0.7	0.4	0.5	1.5	8.0	4.4	139
	1940	14.0	9.9	11.0	10.9	2.7	5.2	2.0	0.6	0.4	0.3	2.4	15.0	6.2	195
		10.77	7.27	7.55	8.59	3.14	3.82	3.00	0.59	0.36	0.36	1.77	10.45		
Way Raman															
45 sq. km.	1939	6.7	3.6	1.4	3.2	1.6	0.2	1.3	0.4	0.1	0.4	3.3	10.2	2.7	85
	1940	17.3	6.2	7.6	6.2	0.8	0.6	0.3	0.1	0.1	0.2	5.6	14.9	5.0	157
		26.67	10.89	10.00	10.44	2.67	0.89	1.78	0.56	0.22	0.67	9.89	27.89		

4. Income Increase by Project Implementation

4.1 Annual Balance Sheet Estimates for Standard Farm Households

(1) Agricultural Production

The per ha yield of food crops obtained at the agricultural improvement and extension office in respective districts is as shown below.

Food Crops	Yield per Ha (in Padi)
Paddy (wet season)	2.5 tons
Upland paddy (wet season)	0.9 tons
Paddy (dry season)	1.7 tons
Maize	0.9 tons
Cassava	9.2 tons

Yield of Paddy after Completion of Project:

Irrigation facilities are already established in and around Metro, and farmers using fertilizers produce an average yield of 3.7 tons in the wet season and 3.08 tons in the dry season.

The minimum paddy production target attainable when the irrigation facilities are developed and field condition improved is therefore set at an annual average of 4.0 tons in padi, with the wet season crop estimated to reach an average of 4.2 tons and the dry season crop 3.8 tons.

(2) Production Cost

Paddy production cost required at present is as follows.

Fertilizers	Rp 3,800
Agro-chemicals	1,500
Sprayer	600
Seeds	1,000
Labour Cost	
Male – 70 labourers @ Rp 150	10,500
Female – 50 " " " 70	3,500
Equipment and Materials	2,900
Total	Rp23,800/ha

The production cost after the project completion will be as follows.

Fertilizers	Rp 6,500
Agro-chemicals	2,400
Sprayer	600
Seeds	1,000

Labour Cost	5,100
Charges for Hiring Tiller	3,000
Other Equipment and Materials	3,000
Total	Rp 21,600/ha

4.2 Table of benefit calcuration

Table of Benefit Calcuration

Unit: 1000 Rp

District		Projected	Present	Increase
Surakarta	[I]	27,720	3,775	23,945
"	[II]	"	"	"
Gantiwarno	[I]	22,016	10,208	11,808
"	[II]	"	"	"
Pekalongan		1,720	–	1,720
Wonosari		2,752	984	1,768
Sidokerto		20,640	5,355	15,285
Djati-Agung	[I]	21,052	5,059	15,993
"	[II]	"	"	"
Tdjg-Dalan	[I]	13,760	1,600	12,160
"	[II]	"	"	"
Tegineneng	[I]	814	71	743
"	[II]			
Hadjmena		2,632	1,588	1,044
Total				148,372

Net Value of Crop Production at Farm

Surakarta [I]

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				5,850,000
2. Less cost of production				
a. Low land 1st crop				
b. Lowland 2nd crop				
c. Upland crop	250	5,300	1,325,000	2,075,000
d. Corn	250	3,000	750,000	
3. Net value				3,775,000
(Projected)				
1. Gross value of crop production				47,600,000
2. Less cost of production				
a. Lowland 1st crop	500	21,600	10,800,000	19,880,000
b. Lowland 2nd crop	100	"	2,160,000	
c. Upland crop	400	17,300	6,920,000	
3. Net value				27,720,000

Item	Gross value	Production Cost	Net value
Projected	47,600,000	19,880,000	27,720,000
Present	5,850,000	2,075,000	3,775,000
Increase	41,750,000	17,805,000	23,945,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)					
Lowland 2nd crop (non-irrigated)					
Upland crop	250	0.9	225.0	14,000	3,150,000
Corn or cassava	250	0.9	225.0	12,000	2,700,000
Total					5,850,000
(Projected)					
Lowland 1st crop (irrigated)	500	4.0	20,000	14,000	28,000,000
Lowland 2nd crop (irrigated)	100	4.0	400.0	"	5,600,000
Upland crop	400	2.5	1,000.0	"	14,000,000
Total					47,600,000
Increase					41,750,000

Surakarta [I]

Net Value of Crop Production at Farm

Gantiwarno [I, II]

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				12,864,000
2. Less cost of production				
a. Lowland 1st crop				
b. Lowland 2nd crop				
c. Upland crop	320.0	5,300	1,696,000	2,656,000
d. Corn or cassava	320.0	3,000	960,000	
3. Net value				10,208,000
(Projected)				
1. Gross value of crop production				35,840,000
2. Less cost of production				
a. Lowland 1st crop	320.0	21,600	6,912,000	13,824,000
b. Lowland 2nd crop	320.0	21,600	"	
3. Net value				22,016,000

Item	Gross value	Production cost	Net value
Projected	35,840,000	13,824,000	22,016,000
Present	12,864,000	2,656,000	10,208,000
Increase	22,976,000	11,168,000	11,808,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)					
Lowland 2nd crop (non-irrigated)					
Upland crop	320.0	0.9	288.0	14,000	4,032,000
Corn or cassava	320.0	9.2	2,944.0	3,000	8,832,000
Total					12,864,000
(Projected)					
Lowland 1st crop (irrigated)	320.0	4.0	1,280.0	14,000	17,920,000
Lowland 2nd crop (irrigated)	320.0	4.0	"	"	"
Upland crop					
Total					35,840,000
Increase					22,976,000

Gantwarno [I, II]

Net Value of Crop Production at Farm

Pekalongan

	Area	Cost of production (per ha)	Cost of production	Total value
		ha	Rp	Rp
(Present)				
1. Gross value of crop production				
2. Less cost of production				
a. Lowland 1st crop				
b. Lowland 2nd crop				
c. Upland crop				
d. Corn				
3. Net value				
(Projected)				
1. Gross value of crop production				2,800,000
2. Less cost of production				
a. Lowland 1st crop	25.0	21,600	540,000	1,080,000
b. Lowland 2nd crop	25.0	"	"	
3. Net value				1,720,000

Item	Gross value	Production cost	Net value
Projected	2,800,000	1,080,000	1,720,000
Present	–	–	–
Increase			1,720,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)	–			18,000	
Lowland 2nd crop (non-irrigated)	–			"	
Upland crop	–			"	
Corn or cassava	–			3,000	
Total					
(Projected)					
Lowland 1st crop (irrigated)	25.0	4.0	100,000	14,000	1,400,000
Lowland 2nd crop (irrigated)	25.0	4.0	"	"	"
Total					2,800,000
Increase					

Pekalongan

Net Value of Crop Production at Farm

Wonosari

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				1,104,000
2. Less cost of production				
a. Lowland 1st crop				
b. Lowland 2nd crop				
c. Upland crop				
d. Corn or cassava	40.0	3,000	120,000	120,000
3. Net value				984,000
(Projected)				
1. Gross value of crop production				4,480,000
2. Less cost of production				
a. Lowland 1st crop	40.0	21,600	864,000	1,718,000
b. Lowland 2nd crop	40.0	"	864,000	
3. Net value				2,752,000

Item	Gross value	Production cost	Net value
Projected	4,480,000	1,728,000	2,752,000
Present	1,104,000	120,000	984,000
Increase	3,376,000	1,608,000	1,768,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)					
Lowland 2nd crop (non-irrigated)					
Upland crop					
Corn or cassava	40.0	0.9 9.2	368.0	3,000	1,104,000
Total					1,104,000
(Projected)					
Lowland 1st crop (irrigated)	40.0	4.0	160.0	14.000	2,240,000
Lowland 2nd crop (irrigated)	40.0	4.0	"	"	2.240,000
Total					4,480,000
Increase					3,376,000

Wonosari

Net Value of Crop Production at Farm Sidekarto

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				7,726,000
2. Less cost of production				
a. Lowland 1st crop	20.0	23,800	476,000	2,371,000
b. Lowland 2nd crop	15.0	23,800	357,000	
c. Upland crop	100.0	9,300	530,000	
d. Corn or cassava	106.0 230.0	3,000	1,008,000	
3. Net value				5,355,000
(Projected)				
1. Gross value of crop production				33,600,000
2. Loss cost of production				
a. Lowland 1st crop	300.0	21,600	6,480,000	12,960,000
b. Lowland 2nd crop	300.0	"	6,480,000	
3. Net value				20,640,000

Item	Gross value	Production cost	Net value
Projected	33,600,000	12,960,000	20,640,000
Present	7,726,000	2,371,000	5,355,000
Increase	25,874,000	10,589,000	15,285,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)	20.0	2.5	50.0	14,000	700,000
Lowland 2nd crop (non-irrigated)	15.0	1.7	25.5	"	357,000
Upland crop	100.0	0.9	90.0	"	1,260,000
Corn or cassava	230.0 106.0	0.9 9.2	207.0 975.2	12,000 3,000	2,484,000 2,925,000
Total					7,726,000
(Projected)					
Lowland 1st crop (irrigated)	300.0	4.0	1,200.0	14,000	16,800,000
Lowland 2nd crop (irrigated)	300.0	4.0	"	"	16,800,000
Total					33,600,000
Increase					25,874,000

Sidokarto

Net Value of Crop Production at Farm

Djati-Agung [I, II]

	Area	Cost of production (per ha)	Cost of production	Total value
	Ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				10,724,200
2. Less cost of production				
a. Lowland 1st crop	203.0	23,800	4,831,400	5,665,000
b. Lowland 2nd crop				
c. Upland crop	112.0	5,300	593,600	
d. Corn	80.0	3,000	240,000	
3. Net value				5,059,200
(Projected)				
1. Gross value of crop production				34,272,000
2. Less cost of production				
a. Lowland 1st crop	306.0	21,600	6,609,600	13,219,200
b. Lowland 2nd crop	306.0	"	6,609,600	
3. Net value				21,052,800

Item	Gross value	Production cost	Net value
Projected	34,272,000	13,219,200	21,052,800
Present	10,724,200	5,665,000	5,059,200
Increase	23,547,800	7,554,200	15,993,600

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)	203.0	2.5	507.5	14,000	7,105,000
Lowland 2nd crop (non-irrigated)					
Upland crop	112.0	0.9	100.8	"	1,411,200
Corn or casava	80.0	9.2	736.0	3,000	2,208,000
Total					10,724,200
(Projected)					
Lowland 1st crop (irrigated)	306.0	4.0	1,224.0	14,000	17,136,000
Lowland 2nd crop (irrigated)	306.0	4.0	"	"	17,136,000
Total					34,272,000
Increase					23,547,800

Djati-Agung [I, II]

Net Value of Crop Production at Farm

Tdjg-Dalan [I, II]

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				4,760,000
2. Less cost of production				
a. Lowland 1st crop	200.0	15,800	3,160,000	3,160,000
b. Lowland 2nd crop				
c. Upland crop				
d. Corn				
3. Net value				1,600,000
(Projected)				
1. Gross value of crop production				22,400,000
2. Loss cost of production				
a. Lowland 1st crop	200.0	21,600	4,320,000	8,640,000
b. Lowland 2nd crop	200.0	"	4,320,000	
3. Net value				13,760,000

Item	Gross value	Production cost	Net value
Projected	22,400,000	8,640,000	13,760,000
Present	4,760,000	3,160,000	1,600,000
Increase	17,640,000	5,480,000	12,160,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)					
Lowland 2nd crop (non-irrigated)	200.0	1.7	340.0	14,000	4,760,000
Upland crop					
Corn or cassava				-	
Total					4,760,000
(Projected)					
Lowland 1st crop (irrigated)	200.0	4.0	800.0	14,000	11,200,000
Lowland 2nd crop (irrigated)	200.0	4.0	800.0	"	11,200,000
Total					22,400,000
Increase					17,640,000

Tdjg-Dalan [I, II]

Net Value of Crop Production at Farm

[I, II]

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				140,400
2. Less cost of production				
a. Lowland 1st crop				
b. Lowland 2nd crop				
c. Upland crop	13.0	5,300	68,900	68,900
d. Corn				
3. Net value				71,500
(Projected)				
1. Gross value of crop production				1,610,000
2. Less cost of production				
a. Lowland 1st crop				
b. Lowland 2nd crop				
c. Upland crop	46.0	17,300	795,800	795,800
3. Net value				814,200

Item	Gross value	Production cost	Net value
Projected	1,610,000	795,800	814,200
Present	140,400	68,900	71,500
Increase	1,469,600	726,900	742,700

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit Price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)					
Lowland 2nd crop (non-irrigated)					
Upland crop					
Corn or cassava	13.0	0.9	11.7	12,000	140,400
Total					140,400
(Projected)					
Lowland 1st crop (irrigated)					
Lowland 2nd crop (irrigated)					
Upland crop	46.0	2.5	115.0	14,000	1,610,000
Total					1,610,000
Increase					1,469,600

Tegineneng [I, II]

Net Value of Crop Production at Farm

S.P.M.A. Hadjimena

	Area	Cost of production (per ha)	Cost of production	Total value
	ha	Rp	Rp	Rp
(Present)				
1. Gross value of crop production				2,040,000
2. Less cost of production				
a. Lowland 1st crop				
b. Lowland 2nd crop				
c. Upland crop	40.0	5,300	212,000	452,000
d. Corn	80.0	3,000	240,000	
3. Net value				1,588,000
(Projected)				
1. Gross value of crop production				4,480,000
2. Less cost of production				
a. Lowland 1st crop	40.0	23,100	924,000	1,848,000
b. Lowland 2nd crop	40.0	23,100	924,000	
3. Net value				2,632,000

Item	Gross value	Production cost	Net value
Projected	4,480,000	1,848,000	2,632,000
Present	2,040,000	452,000	1,588,000
Increase	2,440,000	1,396,000	1,044,000

Volume and Gross Value of Crop Production at Farm within the Project Area, 1970

	Area-harvested	Yield per hectare (t)	Production (t)	Unit price (Rp)	Value (Rp)
(Present)					
Lowland 1st crop (non-irrigated)					
Lowland 2nd crop (non-irrigated)					
Upland crop	40.0	0.9	36.0	14,000	504,000
Corn or cassava	40.0 40.0	0.9 9.2	36.0 368.0	12,000 3,000	432,000 1,104,000
Total					2,040,000
(Projected)					
Lowland 1st crop (irrigated)	40.0	4.0	160.0	14,000	2,240,000
Lowland 2nd crop (irrigated)	40.0	4.0	160.0	"	"
Total					4,480,000
Increase					2,440,000

S.P.M.A. Hadjimena

5. Irrigation Facilities Plan

5.1 Water Requirement

The unit water requirement during the puddling period of paddy fields ranges from 1.2 ℓ/ha/s to 1.7 ℓ/ha/s in Indonesia.

Though loam, clayey loam and clayey soil are mixed and widely distributed in all the pump irrigation project districts, the reddish brown clayey loam covers a relatively large part of the project area.

Hence, the unit water requirement during the puddling period including the conveyance loss through canals and turnouts is set at 1.6 ℓ/ha/s.

For reference's sake, the unit water requirement during the puddling period adopted in other irrigation project districts of the country is shown below.

	Water requirement
Central Java Tadjium district, Banjumas	1.67 ℓ/ha/s
West Java Tjihea district	1.20 "
Lampung Pengubuan district, Lampung Utara	1.60 "
" " " "	1.30 "

The above value of 1.6 ℓ/ha/s is adopted for the dry season cropping, and this is adopted for the wet season cropping as well.

Water Requirement in Each Project Area

District	River	River discharge m^3/s	Irrigation area ha	Water requirement m^3/s	Remarks
Surakarta	Terusan	0.40	200	0.320	Calculated on the basis of a unit requirement of 1.6ℓ/ha/sec.
		11.00	1000	1.600	
Gantiwarno	Bunut	5.00	345	0.552	
		6.68	"	"	
Wonosari	Raman	0.10	40	0.064	
		1.00	"	"	
Sidokerto	Punggur	1.40	300	0.480	
		15.40	"	"	
Djati-Agung	Tebu	2.50	306	0.490	
		17.10	"	"	
Tdjg-dalan	Tebu	2.50	200	0.320	
		17.10	"	"	
Tegineneng seed center	Swamp	0.03	46	0.037	Field irrigation district (½ water requirement)
		0.09	"	"	
Hadjimena S.P.M.A.	Kandis	0.20	40	0.064	
		1.11	"	"	

The upper figures indicate the values in the dry season and the lower figures those in the wet season.

Pumping Station:

1. Maximum Pump Capacity

Assuming that the pump will be operated for 20 hours to give it proper maintenance care, the pump capacity required in respective project districts will be as shown in the following table.

2. Pipe Bore and Quantity of Pumps

The pipe bore and quantity of pumps were determined with the following factors taken into consideration.

(a) Acreage of irrigation area.
(b) Variation of water requirement by paddy cropping season.
(c) Risk diversification against pump failures.
(d) Economic aspect involving the cost of installation and power.
(e) Interchangeability of parts by installation of pumps of a single type having an identical pipe bore.

3. Type of Pumps

Horizontal mixed flow volute pump and double suction volute pump are economically suited by reason of the required pump capacity, total head and suction head.

Data and Pump Specification in Respective Districts

Data and pump specification / Districts	Irrigation area (ha)	Irrigation requirement (m^3/s)	Pump-up capacity (m^3/min)	Actual head (m)	Total head (m)	Type of pump	Pipe-diameter (m/m)	Number of pump (Nos)	Output (HP)	Total output (HP)
Surakarta (1st pump station)	500	0.800	57.6	8.10	10.00	Volute pump	350	3	65	195.0
" (2nd pump station)	500	0,800	57.6	8.10	10.00	"	350	3	65	195.0
Gantiwarno (1st pump station)	270	0.432	31.1	14.00	16.00	Double suction volute pump	300	3	65	195.0
" (2nd pump station)	50	0.080	5.8	16.50	19.00	"	200 x 150	1	48.5	48.5
" (Pekalongan)	25	0.040	2.9	10.00	12.50	"	150	1	15.0	15.0
Wonosari	40	0.064	4.6	5.00	6.50	Volute pump	200	1	15.0	15.0
Sidokarto	300	0.480	34.6	9.70	12.00	"	300	3	48.5	45.5
Djati-Agung (1st pump station)	116	0.186	13.4	10.60	13.00	Double suction volute pump	250	2	28.0	56.0
" (2nd pump station)	190	0.304	21.9	12.80	14.50	"	250	3	45.0	135.0
Tdjg-dalan (1st pump station)	100	0.160	11.5	18.00	20.00	"	200 x 150	2	48.5	99.0
" (2nd pump station)	100	0.160	11.5	12.00	14.00	"	200	2	28.0	56.0
Tegineneng (Seed center)	13	0.011	0.8	7.8	9.30	"	80	1	4.0	4.0
	33	0.026	1.9	4.0	5.50	"	125	1	6.0	6.0
Hedjimena (S.P.M.A.)	40	0.064	4.6	7.0	9.00	Volute pump	200	1	15.0	15.0
Total	2,377 ha							26		1,180.0

Conveyance Loss Through Hedrace

(See the following table of hydraulic calculation worked out by an electronic computer)

	Irrigation area (ha)	Water requirement (m^3/s)	Design discharge (m^3/s)	Canal bed width (m)	Canal height (m)	Water depth (m)	Velocity (m/s)	Canal gradient	Canal length (m)	Head loss (m)
Surakarta (1st pump station)	500	0.800	0.960	0.80	1.00	0.80	0.561	$\frac{1}{2100}$	4,650	3.10
" (2nd pump station)	"	"	"	"	1.00	"	"	"	4,500	3.00
Gantiwarno (1st pump station)	270	0.432	0.518	0.50	0.60	0.40	0.51	$\frac{1}{2000}$	1,830	0.91
" (2nd pump station)	50	0.080	0.096	0.30	0.30	0.10	0.37	$\frac{1}{4000}$	500	0.125
" (Pekalongan)	25	0.040	0.048	"	"	"	"	"	–	–
Wonosari	40	0.064	0.077	"	"	"	"	"	400	0.10
Sidokarto	300	0.480	0.576	0.70	0.80	0.60	0.35	"	2,700	0.68
Djati-Agung (1st pump station)	116	0.186	0.223	0.30	0.40	0.20	0.37	"	473	0.12
" (2nd pump station)	190	0.304	0.365	0.50	0.40	0.60	0.40	"	3.550	0.89
Tdjg-Dalan (1st pump station)	100	0.160	0.192	0.30	0.40	0.20	0.37	"	2,150	0.54
" (2nd pump station)	100	"	"	"	"	"	"	"	2,550	0.64
Tegineneng. (1st pump station)	13	0.011	0.013	0.30	0.30	0.10	0.37	"	–	–
" (2nd pump station)	33	0.026	0.031	"	"	"	"	"	–	–
Hadjimena S.P.M.A.	40	0.064	0.077	"	"	"	"	"	–	–
Total	2,277									

** HYDRAULIC CALCULATION **

CONDITION OF CALCULATION

CANAL TYPE TRAPEZOIDAL EARTH CANAL

VELOCITY CAN BE GET BY MANNIG'S FORMULA.

COEFFICIENT OF ROUGHNESS N=0.03

SIDE SLOPE OF CANAL 1/M=1/1.5

THE MEANINGS OF SIGN IN THE FOLLOWING TABLE ARE AS FOLLOWS.

CANAL WIDTH MEANS WIDTH OF CANAL BED.

A MEANS CROSS-SECTIONAL AREA OF FLOW.

P MEANS WETTED PERIMETER.

R MEANS HYDRAURIC RADIUS.

V MEANS VELOCITY.

Q MEANS DISCHARGE.

NOTICE THE FOLLOWING VALUES WERE CALCULATED BY USING ELECTRONIC COMPUTER.

CANAL WIDTH		0.30			0.40			0.50			0.60			0.70	
WATER DEPTH		0.20	0.25	0.30	0.30	0.35	0.40	0.40	0.45	0.50	0.50	0.55	0.60	0.60	0.65	0.70
A		0.600	0.675	0.750	0.850	0.925	1.000	1.100	1.175	1.250	1.350	1.425	1.500	1.600	1.675	1.750
P		1.021	1.201	1.382	1.482	1.662	1.842	1.942	2.123	2.303	2.403	2.583	2.764	2.864	3.044	3.224
R		0.588	0.562	0.543	0.574	0.557	0.543	0.566	0.554	0.543	0.562	0.552	0.543	0.559	0.550	0.543
I=1/ 500	V	1.046	1.015	0.992	1.029	1.009	0.992	1.020	1.005	0.992	1.015	1.003	0.992	1.011	1.001	0.992
	Q	0.627	0.685	0.744	0.875	0.933	0.992	1.122	1.181	1.240	1.370	1.429	1.488	1.618	1.677	1.736
I=1/ 600	V	0.955	0.927	0.905	0.939	0.921	0.905	0.931	0.917	0.905	0.927	0.915	0.905	0.923	0.914	0.905
	Q	0.573	0.625	0.679	0.799	0.852	0.905	1.025	1.078	1.132	1.251	1.304	1.358	1.477	1.531	1.585
I=1/ 700	V	0.884	0.858	0.838	0.870	0.852	0.838	0.862	0.849	0.838	0.858	0.847	0.838	0.855	0.846	0.838
	Q	0.530	0.579	0.629	0.739	0.788	0.838	0.949	0.998	1.048	1.158	1.208	1.257	1.367	1.417	1.467
I=1/ 800	V	0.827	0.802	0.784	0.814	0.797	0.784	0.807	0.795	0.784	0.802	0.793	0.784	0.799	0.791	0.784
	Q	0.496	0.542	0.588	0.692	0.738	0.784	0.887	0.934	0.980	1.083	1.130	1.176	1.279	1.326	1.372
I=1/ 900	V	0.779	0.757	0.739	0.767	0.752	0.739	0.761	0.749	0.739	0.757	0.747	0.739	0.754	0.746	0.739
	Q	0.468	0.511	0.554	0.652	0.695	0.739	0.837	0.880	0.924	1.021	1.065	1.109	1.206	1.250	1.294
I=1/1000	V	0.739	0.718	0.701	0.728	0.713	0.701	0.722	0.711	0.701	0.718	0.709	0.701	0.715	0.708	0.701
	Q	0.444	0.484	0.526	0.619	0.660	0.701	0.794	0.835	0.877	0.969	1.010	1.052	1.144	1.186	1.227
I=1/1100	V	0.705	0.684	0.669	0.694	0.680	0.669	0.688	0.678	0.669	0.684	0.676	0.669	0.682	0.675	0.669
	Q	0.423	0.462	0.502	0.590	0.629	0.669	0.757	0.796	0.836	0.924	0.963	1.003	1.091	1.130	1.170
I=1/1200	V	0.675	0.655	0.640	0.664	0.651	0.640	0.659	0.649	0.640	0.655	0.647	0.640	0.653	0.646	0.640
	Q	0.405	0.442	0.480	0.565	0.602	0.640	0.725	0.762	0.800	0.884	0.922	0.960	1.044	1.082	1.120
I=1/1300	V	0.649	0.629	0.615	0.638	0.626	0.615	0.633	0.623	0.615	0.629	0.622	0.615	0.627	0.621	0.615
	Q	0.389	0.425	0.461	0.543	0.579	0.615	0.696	0.732	0.769	0.850	0.886	0.923	1.003	1.040	1.077
I=1/1400	V	0.625	0.607	0.593	0.615	0.603	0.593	0.610	0.601	0.593	0.607	0.599	0.593	0.604	0.598	0.593
	Q	0.375	0.409	0.445	0.523	0.558	0.593	0.671	0.706	0.741	0.819	0.854	0.889	0.967	1.002	1.037
I=1/1500	V	0.604	0.586	0.573	0.594	0.582	0.573	0.589	0.580	0.573	0.586	0.579	0.573	0.584	0.578	0.573
	Q	0.362	0.396	0.430	0.505	0.539	0.573	0.648	0.682	0.716	0.791	0.825	0.859	0.934	0.968	1.002
I=1/1600	V	0.585	0.567	0.554	0.575	0.564	0.554	0.570	0.562	0.554	0.567	0.561	0.554	0.565	0.560	0.554
	Q	0.351	0.383	0.416	0.489	0.522	0.554	0.627	0.660	0.693	0.766	0.799	0.832	0.905	0.937	0.970
I=1/1700	V	0.567	0.550	0.538	0.558	0.547	0.538	0.553	0.545	0.538	0.550	0.544	0.538	0.548	0.543	0.538
	Q	0.340	0.372	0.403	0.474	0.506	0.538	0.609	0.640	0.672	0.743	0.775	0.807	0.877	0.909	0.941
I=1/1800	V	0.551	0.535	0.523	0.542	0.532	0.523	0.538	0.530	0.523	0.535	0.528	0.523	0.533	0.528	0.523
	Q	0.331	0.361	0.392	0.461	0.492	0.523	0.592	0.622	0.653	0.722	0.753	0.784	0.853	0.884	0.915
I=1/1900	V	0.536	0.521	0.509	0.528	0.517	0.509	0.523	0.516	0.509	0.521	0.514	0.509	0.519	0.514	0.509
	Q	0.322	0.351	0.382	0.449	0.479	0.509	0.576	0.606	0.636	0.703	0.733	0.763	0.830	0.860	0.890
I=1/2000	V	0.523	0.507	0.496	0.515	0.504	0.496	0.510	0.502	0.496	0.507	0.501	0.496	0.506	0.501	0.496
	Q	0.314	0.343	0.372	0.437	0.466	0.496	0.561	0.590	0.620	0.685	0.714	0.744	0.809	0.838	0.868
I=1/2100	V	0.510	0.495	0.484	0.502	0.492	0.484	0.498	0.490	0.484	0.495	0.489	0.484	0.493	0.488	0.484
	Q	0.306	0.334	0.363	0.427	0.455	0.484	0.548	0.576	0.605	0.669	0.697	0.726	0.790	0.818	0.847
I=1/2200	V	0.499	0.484	0.473	0.491	0.481	0.473	0.486	0.479	0.473	0.484	0.478	0.473	0.482	0.477	0.473
	Q	0.299	0.327	0.355	0.417	0.445	0.473	0.535	0.563	0.591	0.653	0.681	0.709	0.771	0.799	0.828

CANAL WIDTH			0.80			0.90			1.00			1.10			1.20	
WATER DEPTH		0.70	0.75	0.80	0.80	0.85	0.90	0.90	0.95	1.00	1.00	1.05	1.10	1.10	1.15	1.20
A		1.850	1.925	2.000	2.100	2.175	2.250	2.350	2.425	2.500	2.600	2.675	2.750	2.850	2.925	3.000
P		3.324	3.504	3.685	3.785	3.965	4.145	4.245	4.426	4.606	4.706	4.886	5.067	5.167	5.347	5.527
R		0.557	0.549	0.543	0.555	0.549	0.543	0.554	0.548	0.543	0.552	0.547	0.543	0.552	0.547	0.543
I=1/ 500	V	1.009	1.000	0.992	1.007	0.999	0.992	1.005	0.998	0.992	1.004	0.998	0.992	1.003	0.997	0.992
	Q	1.866	1.925	1.984	2.114	2.173	2.232	2.362	2.421	2.480	2.610	2.669	2.728	2.858	2.917	2.976
I=1/ 600	V	0.921	0.913	0.905	0.919	0.912	0.905	0.917	0.911	0.905	0.916	0.911	0.905	0.915	0.910	0.905
	Q	1.703	1.757	1.811	1.930	1.983	2.037	2.156	2.210	2.264	2.382	2.436	2.490	2.609	2.662	2.716
I=1/ 700	V	0.852	0.845	0.838	0.851	0.844	0.838	0.849	0.844	0.838	0.848	0.843	0.838	0.847	0.843	0.838
	Q	1.577	1.627	1.677	1.786	1.836	1.886	1.996	2.046	2.096	2.206	2.255	2.305	2.415	2.465	2.515
I=1/ 800	V	0.797	0.790	0.784	0.796	0.790	0.784	0.795	0.789	0.784	0.794	0.789	0.784	0.793	0.788	0.784
	Q	1.475	1.522	1.568	1.671	1.718	1.764	1.867	1.914	1.960	2.063	2.110	2.156	2.259	2.306	2.353
I=1/ 900	V	0.752	0.745	0.739	0.750	0.745	0.739	0.749	0.744	0.739	0.748	0.744	0.739	0.747	0.743	0.739
	Q	1.391	1.435	1.479	1.576	1.619	1.663	1.760	1.804	1.848	1.945	1.989	2.033	2.130	2.174	2.218
I=1/1000	V	0.713	0.707	0.701	0.712	0.706	0.701	0.711	0.706	0.701	0.710	0.705	0.701	0.709	0.705	0.701
	Q	1.319	1.361	1.403	1.495	1.536	1.578	1.670	1.712	1.753	1.845	1.887	1.929	2.021	2.062	2.104
I=1/1100	V	0.680	0.674	0.669	0.679	0.673	0.669	0.678	0.673	0.669	0.677	0.673	0.669	0.676	0.672	0.669
	Q	1.258	1.298	1.337	1.425	1.465	1.505	1.592	1.632	1.672	1.759	1.799	1.839	1.927	1.966	2.006
I=1/1200	V	0.651	0.645	0.640	0.650	0.645	0.640	0.649	0.644	0.640	0.648	0.644	0.640	0.647	0.644	0.640
	Q	1.204	1.242	1.281	1.364	1.402	1.441	1.524	1.562	1.601	1.685	1.723	1.761	1.845	1.883	1.921
I=1/1300	V	0.626	0.620	0.615	0.624	0.620	0.615	0.623	0.619	0.615	0.622	0.619	0.615	0.622	0.618	0.615
	Q	1.157	1.194	1.230	1.311	1.347	1.384	1.465	1.501	1.538	1.618	1.655	1.692	1.772	1.809	1.845
I=1/1400	V	0.603	0.598	0.593	0.602	0.597	0.593	0.601	0.597	0.593	0.600	0.596	0.593	0.599	0.596	0.593
	Q	1.115	1.150	1.186	1.263	1.298	1.334	1.411	1.447	1.482	1.560	1.595	1.630	1.708	1.743	1.778
I=1/1500	V	0.582	0.577	0.573	0.581	0.577	0.573	0.580	0.576	0.573	0.579	0.576	0.573	0.579	0.576	0.573
	Q	1.077	1.111	1.145	1.220	1.254	1.289	1.364	1.398	1.432	1.507	1.541	1.575	1.650	1.684	1.718
I=1/1600	V	0.564	0.559	0.554	0.563	0.558	0.554	0.562	0.558	0.554	0.561	0.558	0.554	0.561	0.557	0.554
	Q	1.043	1.076	1.109	1.182	1.215	1.248	1.320	1.353	1.386	1.459	1.492	1.525	1.597	1.630	1.663
I=1/1700	V	0.547	0.542	0.538	0.546	0.542	0.538	0.545	0.541	0.538	0.544	0.541	0.538	0.544	0.541	0.538
	Q	1.012	1.044	1.076	1.146	1.178	1.210	1.281	1.313	1.345	1.415	1.447	1.479	1.550	1.582	1.614
I=1/1800	V	0.532	0.527	0.523	0.531	0.526	0.523	0.530	0.526	0.523	0.529	0.526	0.523	0.528	0.526	0.523
	Q	0.983	1.014	1.046	1.114	1.145	1.176	1.245	1.276	1.307	1.375	1.406	1.438	1.506	1.537	1.568
I=1/1900	V	0.517	0.513	0.509	0.516	0.512	0.509	0.516	0.512	0.509	0.515	0.512	0.509	0.514	0.512	0.509
	Q	0.957	0.987	1.018	1.084	1.115	1.145	1.212	1.242	1.272	1.339	1.369	1.399	1.466	1.496	1.527
I=1/2000	V	0.504	0.500	0.496	0.503	0.499	0.496	0.502	0.499	0.496	0.502	0.499	0.496	0.501	0.499	0.496
	Q	0.933	0.962	0.992	1.057	1.086	1.116	1.181	1.210	1.240	1.305	1.334	1.364	1.429	1.458	1.488
I=1/2100	V	0.492	0.488	0.484	0.491	0.487	0.484	0.490	0.487	0.484	0.490	0.487	0.484	0.489	0.487	0.484
	Q	0.910	0.939	0.968	1.031	1.060	1.089	1.152	1.181	1.210	1.273	1.302	1.331	1.394	1.423	1.452
I=1/2200	V	0.481	0.477	0.473	0.480	0.476	0.473	0.479	0.476	0.473	0.478	0.476	0.473	0.478	0.475	0.473
	Q	0.890	0.918	0.946	1.008	1.036	1.064	1.126	1.154	1.182	1.244	1.272	1.300	1.362	1.390	1.419

CANAL WIDTH			0.80			0.90			1.00			1.10			1.20	
WATER DEPTH		0.70	0.75	0.80	0.80	0.85	0.90	0.90	0.95	1.00	1.00	1.05	1.10	1.10	1.15	1.20
A		1.850	1.925	2.000	2.100	2.175	2.250	2.350	2.425	2.500	2.600	2.675	2.750	2.850	2.925	3.000
P		3.324	3.504	3.685	3.785	3.965	4.145	4.245	4.426	4.606	4.706	4.886	5.067	5.167	5.347	5.527
R		0.557	0.549	0.543	0.555	0.549	0.543	0.554	0.548	0.543	0.552	0.547	0.543	0.552	0.547	0.543
I=1/2300	V	0.470	0.466	0.462	0.469	0.466	0.462	0.469	0.465	0.462	0.468	0.465	0.462	0.467	0.465	0.462
	Q	0.870	0.897	0.925	0.986	1.013	1.041	1.101	1.129	1.156	1.217	1.244	1.272	1.332	1.360	1.387
I=1/2400	V	0.460	0.456	0.453	0.459	0.456	0.453	0.459	0.456	0.453	0.458	0.455	0.453	0.458	0.455	0.453
	Q	0.852	0.878	0.905	0.965	0.992	1.019	1.078	1.105	1.132	1.191	1.218	1.245	1.304	1.331	1.358
I=1/2500	V	0.451	0.447	0.444	0.450	0.447	0.444	0.449	0.446	0.444	0.449	0.446	0.444	0.448	0.446	0.444
	Q	0.834	0.861	0.887	0.945	0.972	0.998	1.056	1.083	1.109	1.167	1.193	1.220	1.278	1.304	1.331
I=1/2600	V	0.442	0.438	0.435	0.441	0.438	0.435	0.441	0.438	0.435	0.440	0.437	0.435	0.440	0.437	0.435
	Q	0.818	0.844	0.870	0.927	0.953	0.979	1.036	1.062	1.087	1.144	1.170	1.196	1.253	1.279	1.305
I=1/2700	V	0.434	0.430	0.427	0.433	0.430	0.427	0.432	0.430	0.427	0.432	0.429	0.427	0.431	0.429	0.427
	Q	0.803	0.828	0.854	0.910	0.935	0.960	1.016	1.042	1.067	1.123	1.148	1.174	1.230	1.255	1.281
I=1/2800	V	0.426	0.423	0.419	0.425	0.422	0.419	0.425	0.422	0.419	0.424	0.422	0.419	0.424	0.421	0.419
	Q	0.788	0.813	0.838	0.893	0.918	0.943	0.998	1.023	1.048	1.103	1.128	1.153	1.208	1.232	1.257
I=1/2900	V	0.419	0.415	0.412	0.418	0.415	0.412	0.417	0.414	0.412	0.417	0.414	0.412	0.416	0.414	0.412
	Q	0.775	0.799	0.824	0.878	0.902	0.927	0.981	1.005	1.030	1.084	1.108	1.133	1.187	1.211	1.236
I=1/3000	V	0.412	0.408	0.405	0.411	0.408	0.405	0.410	0.408	0.405	0.410	0.407	0.405	0.409	0.407	0.405
	Q	0.762	0.786	0.810	0.863	0.887	0.911	0.964	0.988	1.012	1.065	1.089	1.114	1.167	1.191	1.215
I=1/3100	V	0.405	0.402	0.398	0.404	0.401	0.398	0.404	0.401	0.398	0.403	0.401	0.398	0.403	0.400	0.398
	Q	0.749	0.773	0.797	0.849	0.873	0.896	0.948	0.972	0.996	1.048	1.072	1.095	1.148	1.171	1.195
I=1/3200	V	0.399	0.395	0.392	0.398	0.395	0.392	0.397	0.395	0.392	0.397	0.394	0.392	0.396	0.394	0.392
	Q	0.738	0.761	0.784	0.836	0.859	0.882	0.934	0.957	0.980	1.032	1.055	1.078	1.130	1.153	1.176
I=1/3300	V	0.393	0.389	0.386	0.392	0.389	0.386	0.391	0.389	0.386	0.391	0.388	0.386	0.390	0.388	0.386
	Q	0.726	0.749	0.772	0.823	0.846	0.869	0.919	0.942	0.965	1.016	1.039	1.062	1.112	1.135	1.158
I=1/3400	V	0.387	0.383	0.380	0.386	0.383	0.380	0.385	0.383	0.380	0.385	0.383	0.380	0.385	0.382	0.380
	Q	0.716	0.738	0.761	0.811	0.833	0.856	0.906	0.928	0.951	1.001	1.023	1.046	1.096	1.118	1.141
I=1/3500	V	0.381	0.378	0.375	0.380	0.378	0.375	0.380	0.377	0.375	0.379	0.377	0.375	0.379	0.377	0.375
	Q	0.705	0.727	0.750	0.799	0.821	0.844	0.893	0.915	0.937	0.986	1.009	1.031	1.080	1.102	1.125
I=1/3600	V	0.376	0.373	0.370	0.375	0.372	0.370	0.375	0.372	0.370	0.374	0.372	0.370	0.374	0.372	0.370
	Q	0.695	0.717	0.739	0.788	0.810	0.832	0.880	0.902	0.924	0.973	0.995	1.017	1.065	1.087	1.109
I=1/3700	V	0.371	0.368	0.365	0.370	0.367	0.365	0.369	0.367	0.365	0.369	0.367	0.365	0.369	0.367	0.365
	Q	0.686	0.708	0.729	0.777	0.799	0.820	0.868	0.890	0.912	0.959	0.981	1.003	1.050	1.072	1.094
I=1/3800	V	0.366	0.363	0.360	0.365	0.362	0.360	0.365	0.362	0.360	0.364	0.362	0.360	0.364	0.362	0.360
	Q	0.677	0.698	0.720	0.767	0.788	0.810	0.857	0.878	0.900	0.947	0.968	0.989	1.037	1.058	1.079
I=1/3900	V	0.361	0.358	0.355	0.360	0.358	0.355	0.360	0.357	0.355	0.359	0.357	0.355	0.359	0.357	0.355
	Q	0.668	0.689	0.710	0.757	0.778	0.799	0.846	0.867	0.888	0.934	0.956	0.977	1.023	1.044	1.065
I=1/4000	V	0.357	0.353	0.351	0.356	0.353	0.351	0.355	0.353	0.351	0.355	0.353	0.351	0.354	0.353	0.351
	Q	0.660	0.680	0.701	0.747	0.768	0.789	0.835	0.856	0.877	0.923	0.943	0.964	1.010	1.031	1.052

CANAL WIDTH			0.30			0.40			0.50			0.60			0.70	
WATER DEPTH		0.20	0.25	0.30	0.30	0.35	0.40	0.40	0.45	0.50	0.50	0.55	0.60	0.60	0.65	0.70
A		0.600	0.675	0.750	0.850	0.925	1.000	1.100	1.175	1.250	1.350	1.425	1.500	1.600	1.675	1.750
P		1.021	1.201	1.382	1.482	1.662	1.842	1.942	2.123	2.303	2.403	2.583	2.764	2.864	3.044	3.224
R		0.588	0.562	0.543	0.574	0.557	0.543	0.566	0.554	0.543	0.562	0.552	0.543	0.559	0.550	0.543
I=1/2300	V	0.488	0.473	0.462	0.480	0.470	0.462	0.476	0.469	0.462	0.473	0.467	0.462	0.472	0.467	0.462
	Q	0.293	0.319	0.347	0.408	0.435	0.462	0.523	0.551	0.578	0.639	0.666	0.694	0.754	0.782	0.809
I=1/2400	V	0.477	0.463	0.453	0.470	0.460	0.453	0.466	0.459	0.453	0.463	0.458	0.453	0.462	0.457	0.453
	Q	0.286	0.313	0.340	0.399	0.426	0.453	0.512	0.539	0.566	0.625	0.652	0.679	0.739	0.765	0.792
I=1/2500	V	0.468	0.454	0.444	0.460	0.451	0.444	0.456	0.449	0.444	0.454	0.448	0.444	0.452	0.448	0.444
	Q	0.281	0.306	0.333	0.391	0.417	0.444	0.502	0.528	0.554	0.613	0.639	0.665	0.724	0.750	0.776
I=1/2600	V	0.459	0.445	0.435	0.451	0.442	0.435	0.447	0.441	0.435	0.445	0.440	0.435	0.443	0.439	0.435
	Q	0.275	0.300	0.326	0.384	0.409	0.435	0.492	0.518	0.544	0.601	0.627	0.652	0.710	0.735	0.761
I=1/2700	V	0.450	0.437	0.427	0.443	0.434	0.427	0.439	0.432	0.427	0.437	0.431	0.427	0.435	0.431	0.427
	Q	0.270	0.295	0.320	0.376	0.401	0.427	0.483	0.508	0.534	0.590	0.615	0.640	0.696	0.722	0.747
I=1/2800	V	0.442	0.429	0.419	0.435	0.426	0.419	0.431	0.425	0.419	0.429	0.424	0.419	0.427	0.423	0.419
	Q	0.265	0.290	0.314	0.370	0.394	0.419	0.474	0.499	0.524	0.579	0.604	0.629	0.684	0.709	0.734
I=1/2900	V	0.434	0.421	0.412	0.427	0.419	0.412	0.424	0.417	0.412	0.421	0.416	0.412	0.420	0.416	0.412
	Q	0.261	0.284	0.309	0.363	0.387	0.412	0.466	0.490	0.515	0.569	0.593	0.618	0.672	0.696	0.721
I=1/3000	V	0.427	0.414	0.405	0.420	0.412	0.405	0.417	0.410	0.405	0.414	0.409	0.405	0.413	0.409	0.405
	Q	0.256	0.280	0.304	0.357	0.381	0.405	0.458	0.482	0.506	0.559	0.583	0.607	0.661	0.685	0.709
I=1/3100	V	0.420	0.408	0.398	0.413	0.405	0.398	0.410	0.404	0.398	0.408	0.403	0.398	0.406	0.402	0.398
	Q	0.252	0.275	0.299	0.351	0.375	0.398	0.451	0.474	0.498	0.550	0.574	0.598	0.650	0.673	0.697
I=1/3200	V	0.413	0.401	0.392	0.407	0.399	0.392	0.403	0.397	0.392	0.401	0.396	0.392	0.400	0.396	0.392
	Q	0.248	0.271	0.294	0.346	0.369	0.392	0.444	0.467	0.490	0.542	0.565	0.588	0.640	0.663	0.686
I=1/3300	V	0.407	0.395	0.386	0.401	0.393	0.386	0.397	0.391	0.386	0.395	0.390	0.386	0.394	0.390	0.386
	Q	0.244	0.267	0.290	0.341	0.363	0.386	0.437	0.460	0.483	0.533	0.556	0.579	0.630	0.653	0.676
I=1/3400	V	0.401	0.389	0.380	0.395	0.387	0.380	0.391	0.385	0.380	0.389	0.385	0.380	0.388	0.384	0.380
	Q	0.241	0.263	0.285	0.335	0.358	0.380	0.430	0.453	0.475	0.525	0.548	0.571	0.620	0.643	0.666
I=1/3500	V	0.395	0.384	0.375	0.389	0.381	0.375	0.386	0.380	0.375	0.384	0.379	0.375	0.382	0.378	0.375
	Q	0.237	0.259	0.281	0.331	0.353	0.375	0.424	0.446	0.469	0.518	0.540	0.562	0.612	0.634	0.656
I=1/3600	V	0.390	0.378	0.370	0.384	0.376	0.370	0.380	0.375	0.370	0.378	0.374	0.370	0.377	0.373	0.370
	Q	0.234	0.255	0.277	0.326	0.348	0.370	0.418	0.440	0.462	0.511	0.532	0.554	0.603	0.625	0.647
I=1/3700	V	0.384	0.373	0.365	0.378	0.371	0.365	0.375	0.369	0.365	0.373	0.369	0.365	0.372	0.368	0.365
	Q	0.231	0.252	0.273	0.322	0.343	0.365	0.413	0.434	0.456	0.504	0.525	0.547	0.595	0.616	0.638
I=1/3800	V	0.379	0.368	0.360	0.373	0.366	0.360	0.370	0.365	0.360	0.368	0.364	0.360	0.367	0.363	0.360
	Q	0.228	0.249	0.270	0.317	0.338	0.360	0.407	0.428	0.450	0.497	0.518	0.540	0.587	0.608	0.630
I=1/3900	V	0.374	0.363	0.355	0.368	0.361	0.355	0.365	0.360	0.355	0.363	0.359	0.355	0.362	0.358	0.355
	Q	0.225	0.245	0.266	0.313	0.334	0.355	0.402	0.423	0.444	0.491	0.512	0.533	0.579	0.600	0.622
I=1/4000	V	0.370	0.359	0.351	0.364	0.357	0.351	0.361	0.355	0.351	0.359	0.354	0.351	0.358	0.354	0.351
	Q	0.222	0.242	0.263	0.309	0.330	0.351	0.397	0.417	0.438	0.484	0.505	0.526	0.572	0.593	0.614

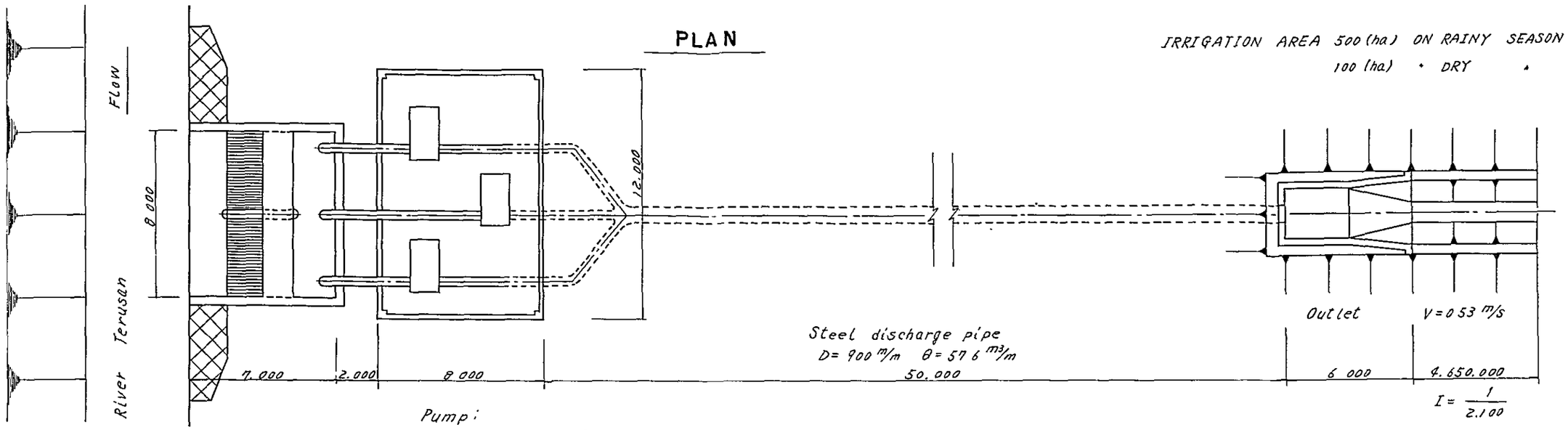
5.2 Plan for Pump Station Facilities

Pump station in respective districts are so designed as illustrated in the following drawings. The design height of pump station was determined by adding a free board of about 50 cm to the flood discharge in the wet season which was obtained by interviews conducted in each district.

GENERAL PLAN OF PUMP STATION IN SURAKARTA (I) DISTRICT

SCALE 1 : 200

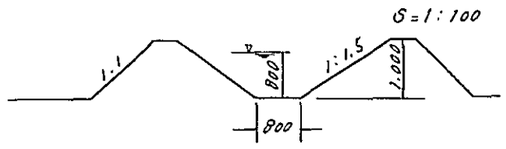
PLAN



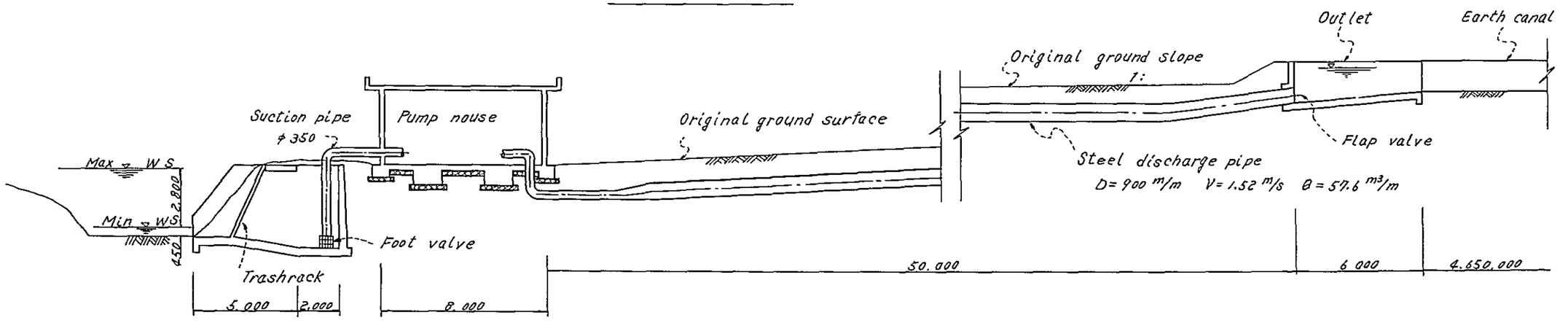
IRRIGATION AREA 500 (ha) ON RAINY SEASON
100 (ha) • DRY •

Pump :
Horizontal shaft mixed flow
volute pumps
φ 350 m/m x 19.2 m3/m x 10.0 m x 3 nos
Engine diesel 65 HP

Earth Canal Section



PROFILE

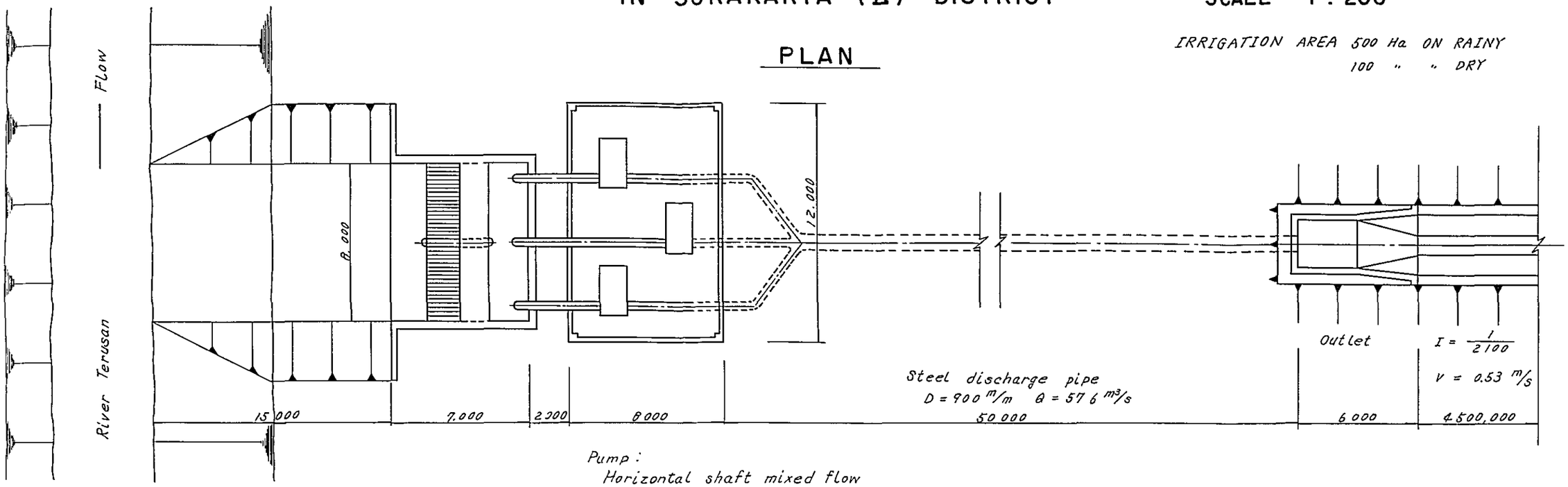


GENERAL PLAN OF PUMP STATION IN SURAKARTA (II) DISTRICT

SCALE 1 : 200

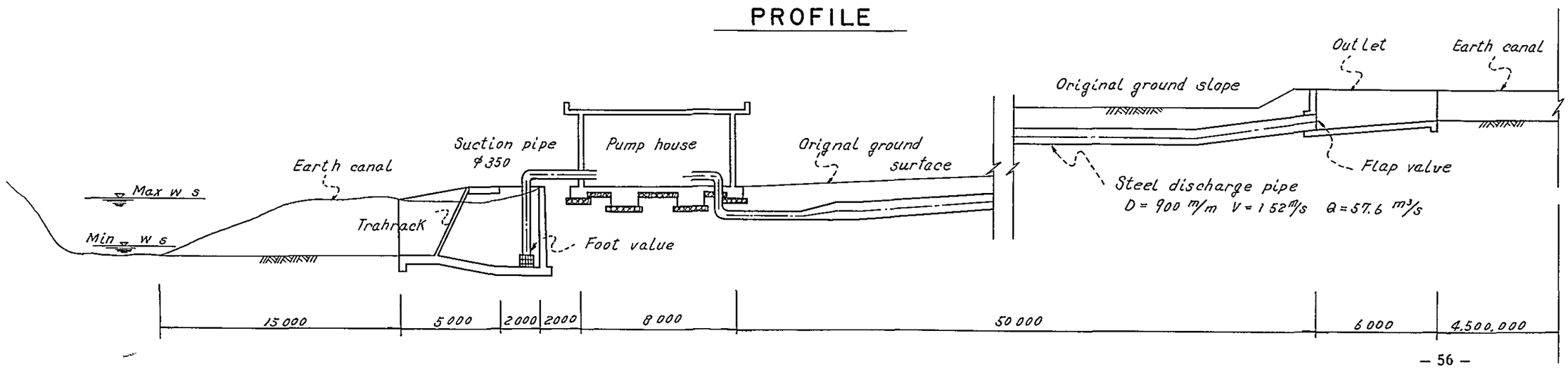
IRRIGATION AREA 500 Ha ON RAINY
100 " " DRY

PLAN



Pump :
Horizontal shaft mixed flow
volute pumps
ϕ 350 m/m x 19.2 m³/m x 10.0 m x 3
Engine diesel 65HP

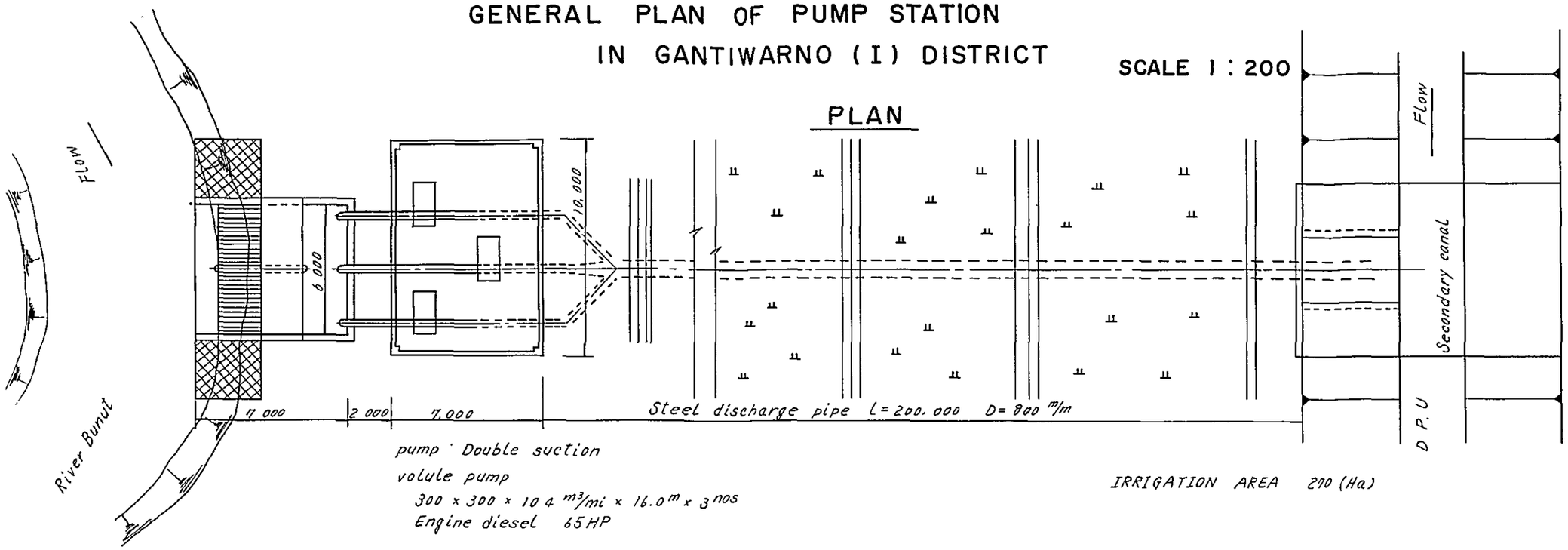
PROFILE



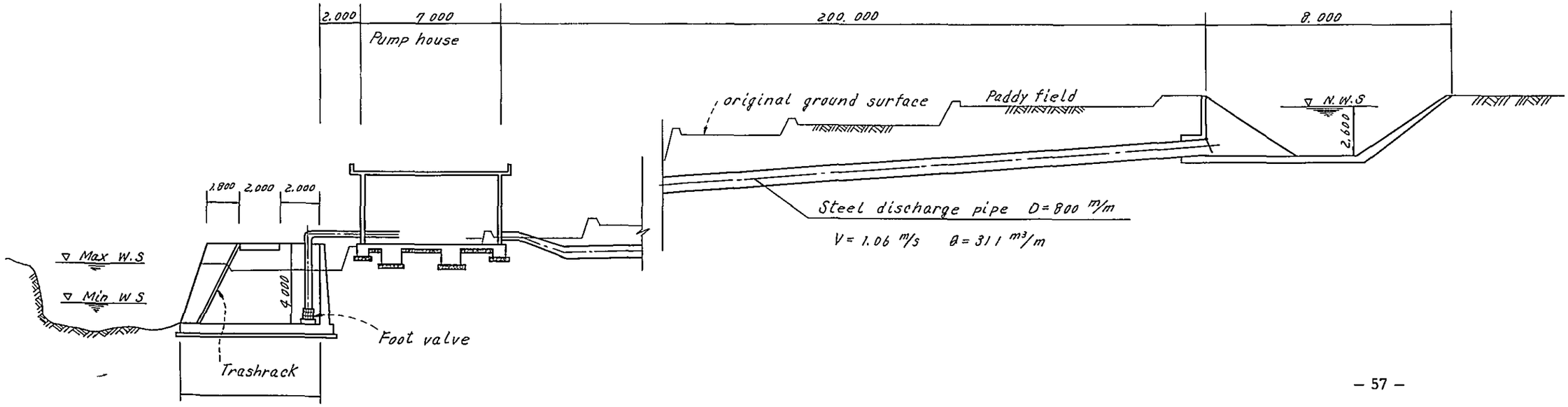
GENERAL PLAN OF PUMP STATION IN GANTIWARNO (I) DISTRICT

SCALE 1 : 200

PLAN



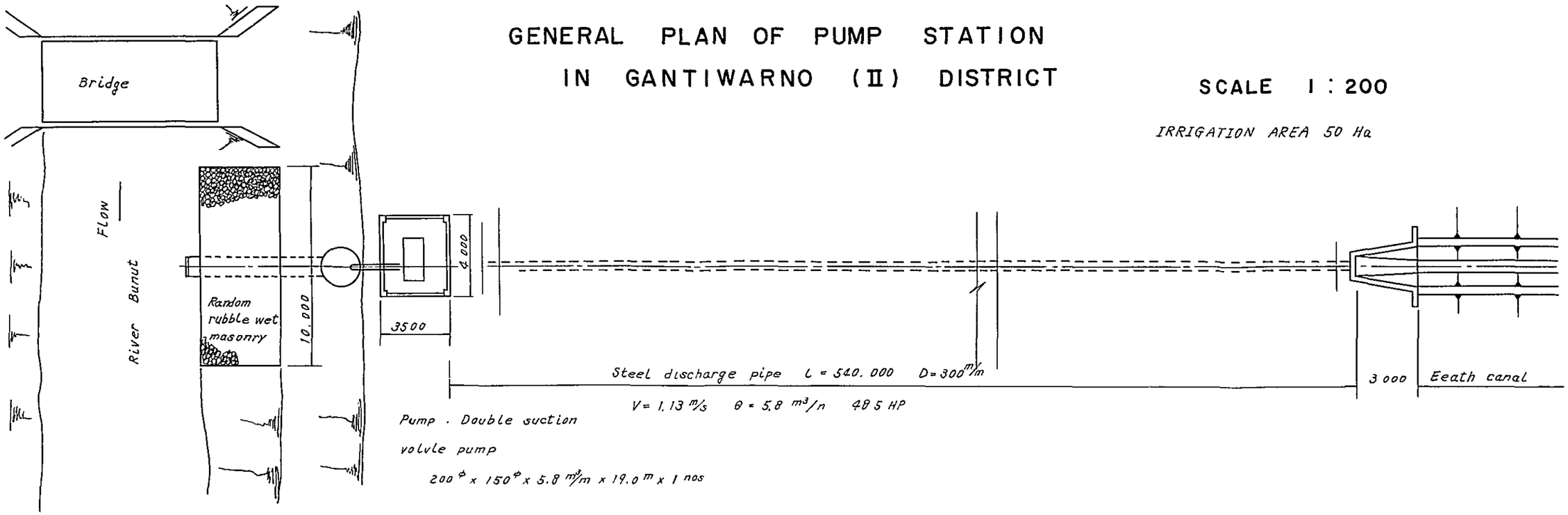
ELEVATION

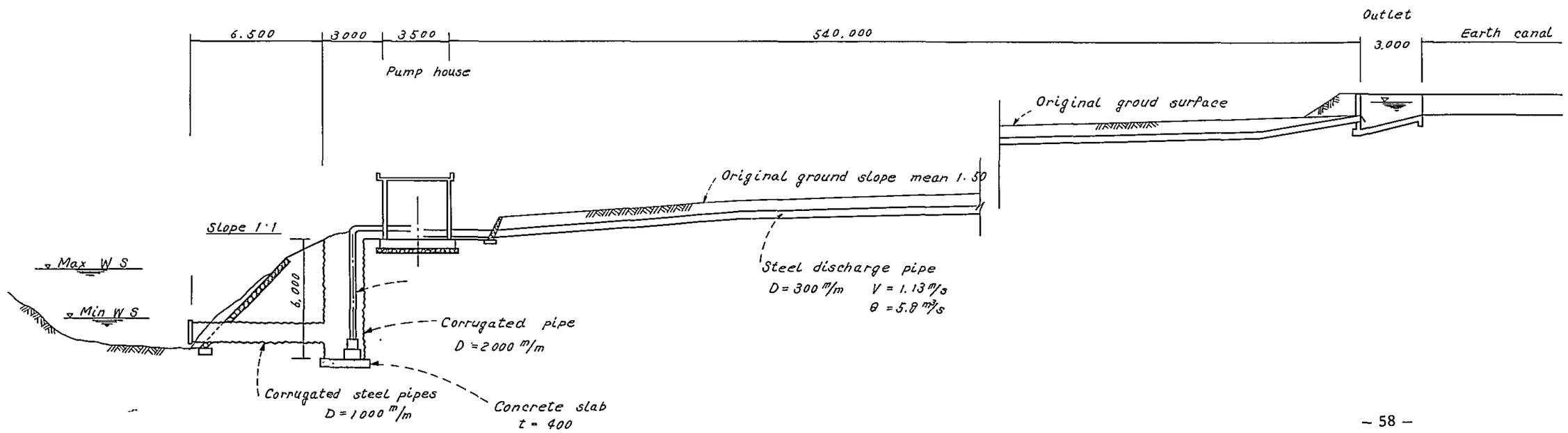


GENERAL PLAN OF PUMP STATION IN GANTIWARNO (II) DISTRICT

SCALE 1 : 200

IRRIGATION AREA 50 Ha



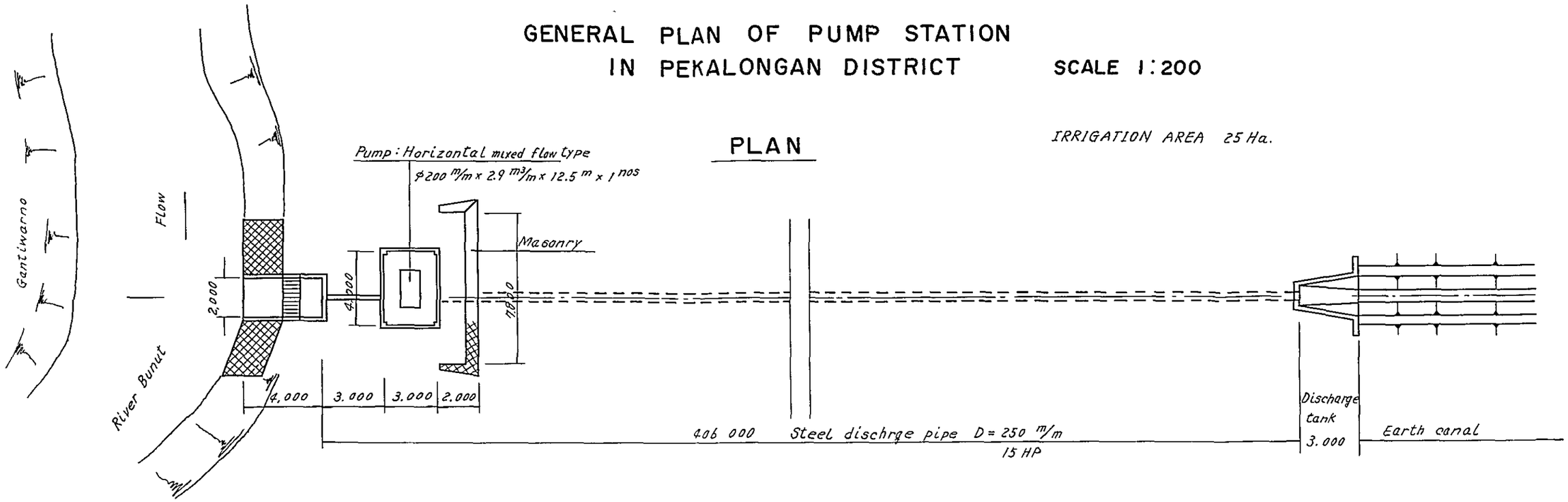


GENERAL PLAN OF PUMP STATION IN PEKALONGAN DISTRICT

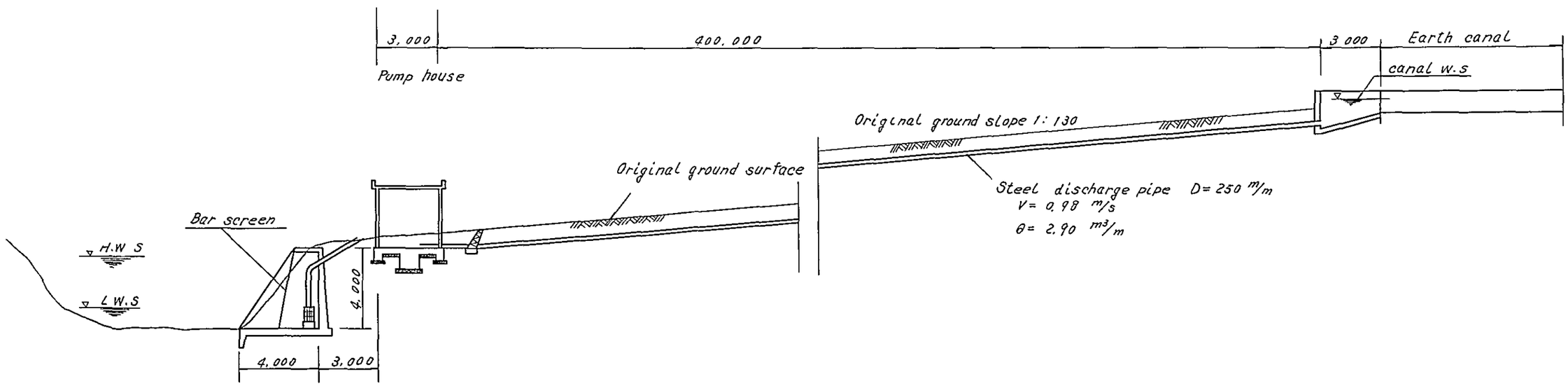
SCALE 1:200

PLAN

IRRIGATION AREA 25 Ha.



PROFIL

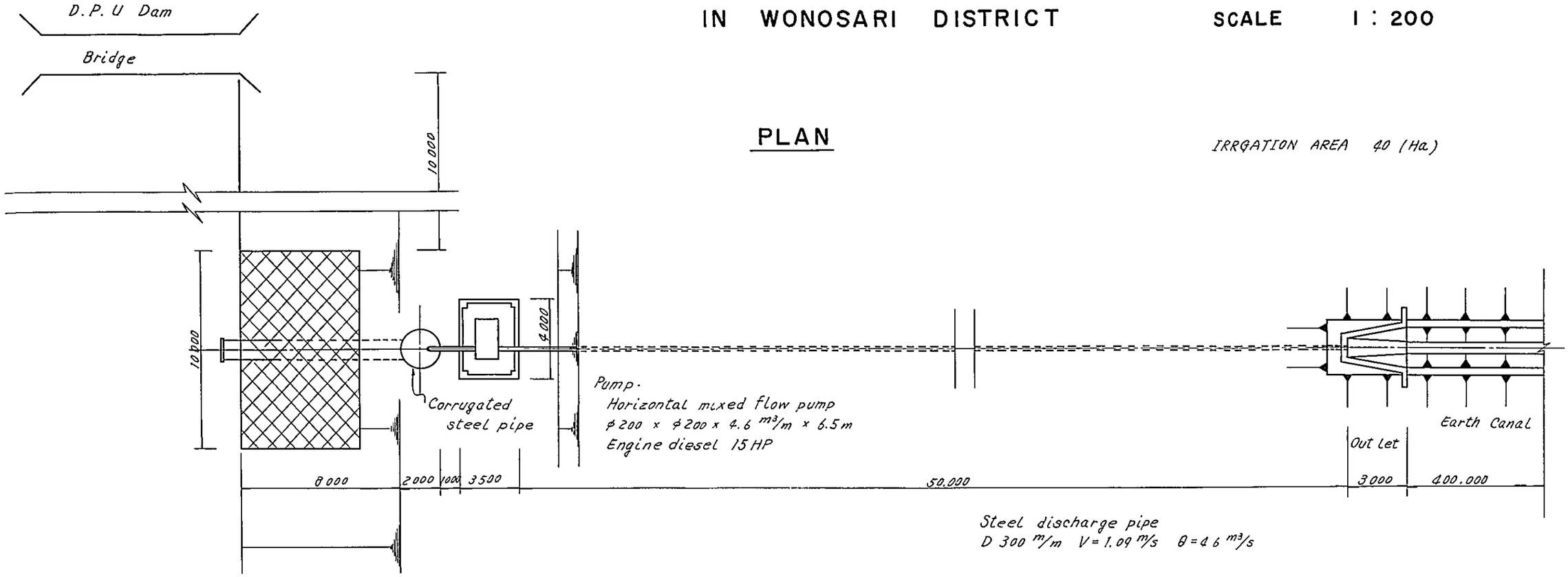


GENERAL PLAN OF PUMP STATION IN WONOSARI DISTRICT

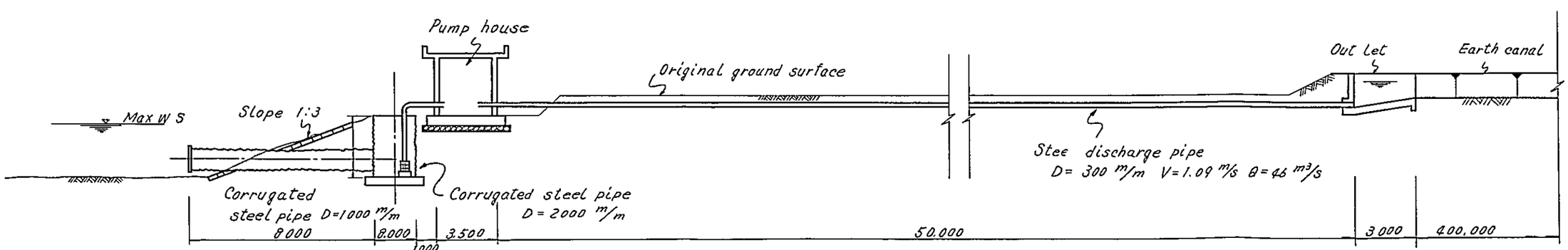
SCALE 1 : 200

PLAN

IRRGATION AREA 40 (Ha)



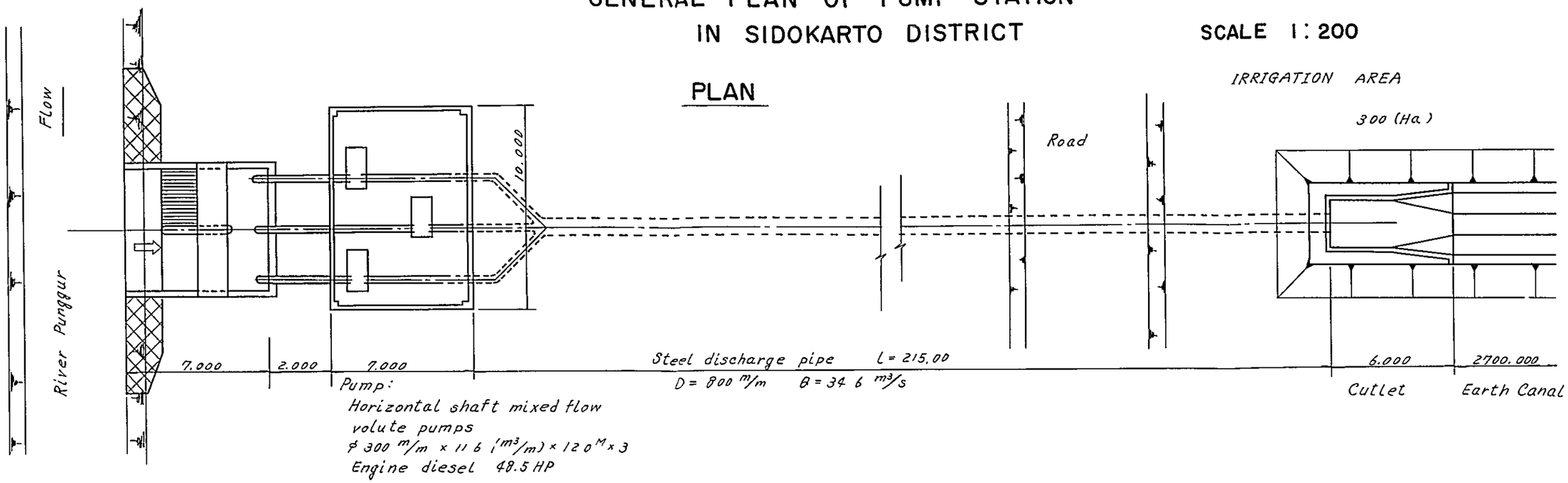
PROFILE



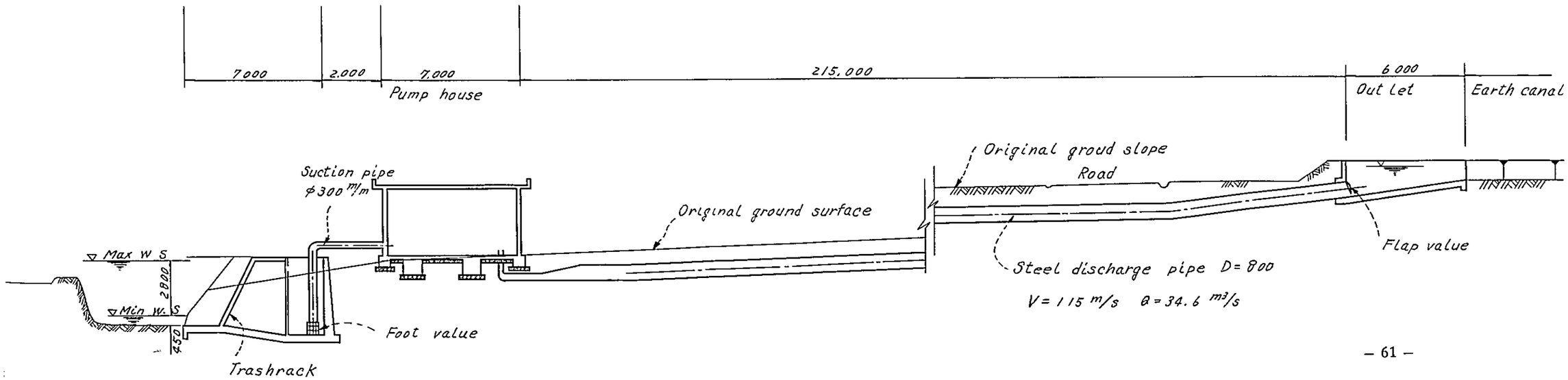
GENERAL PLAN OF PUMP STATION IN SIDOKARTO DISTRICT

SCALE 1 : 200

PLAN



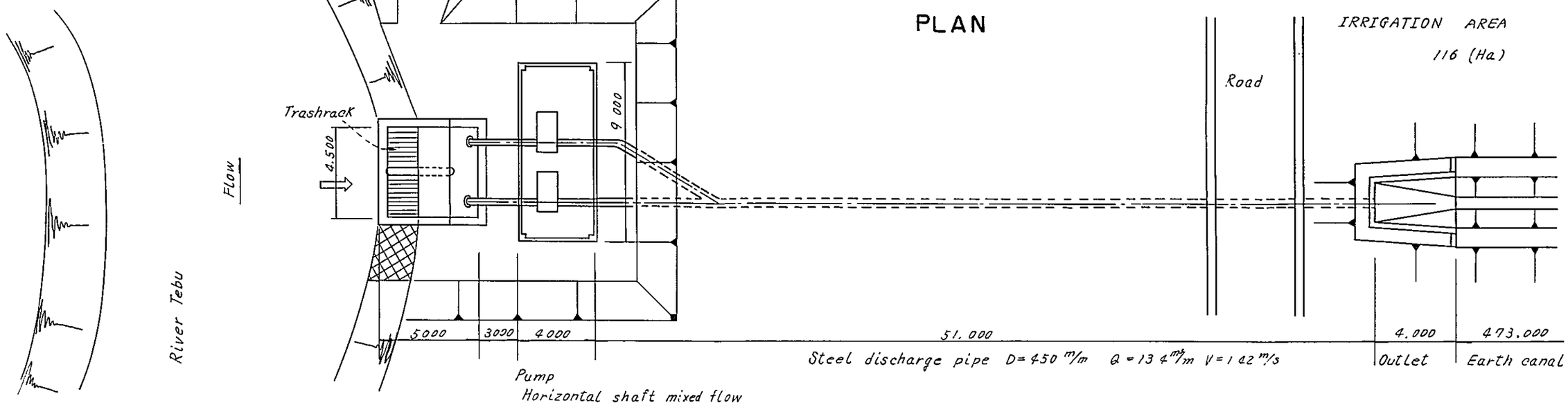
PROFILE



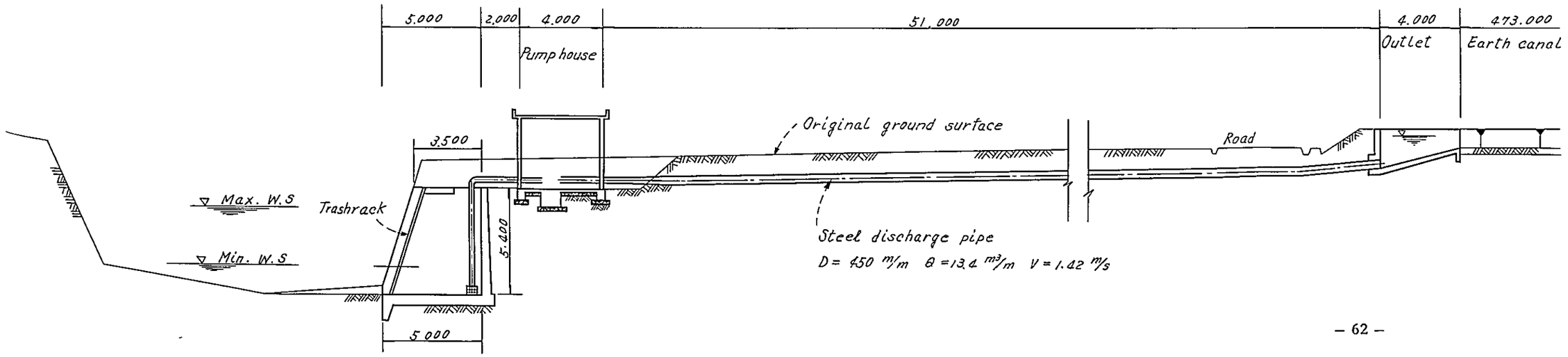
GENERAL PLAN OF PUMP STATION
IN DJATI – AGUNG (I) DISTRICT

SCALE 1 : 200

PLAN



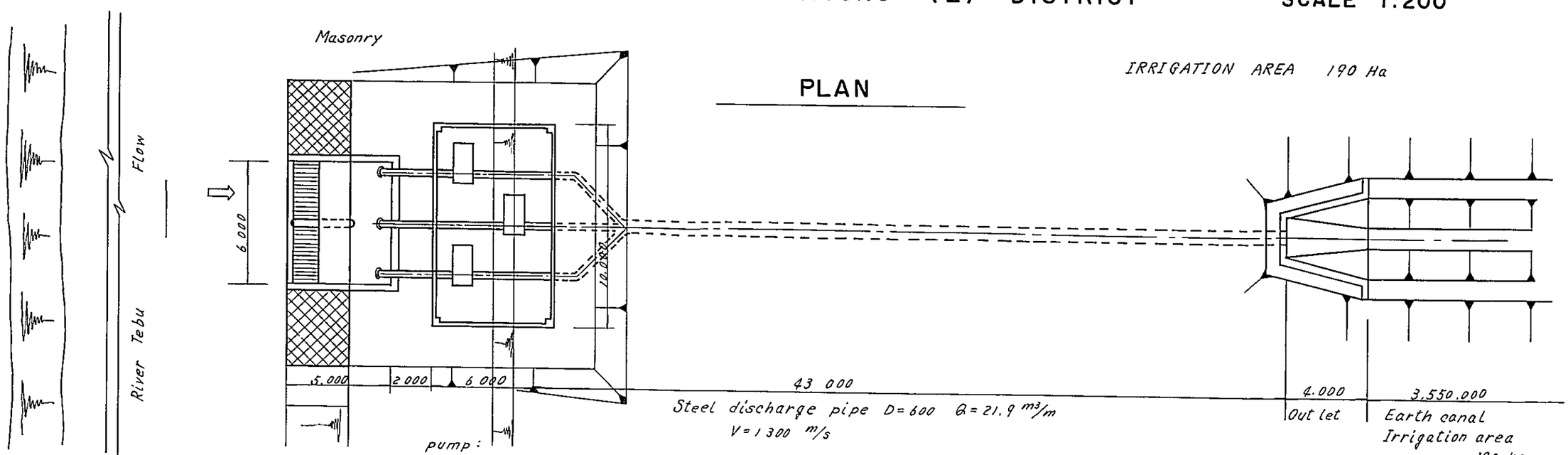
PROFILE



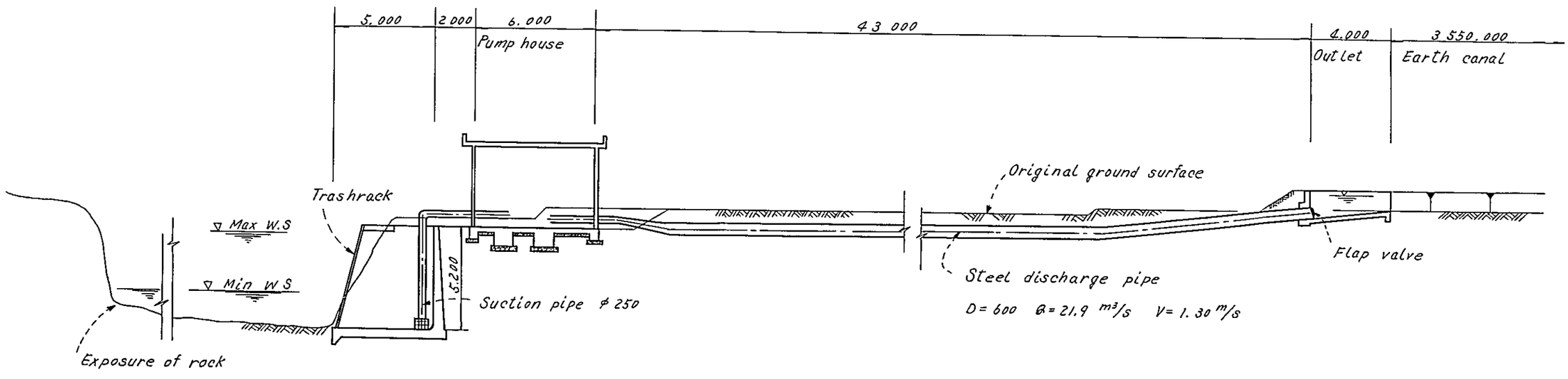
GENERAL PLAN OF PUMP STATION IN DJATI - AGUNG (II) DISTRICT

SCALE 1:200

PLAN

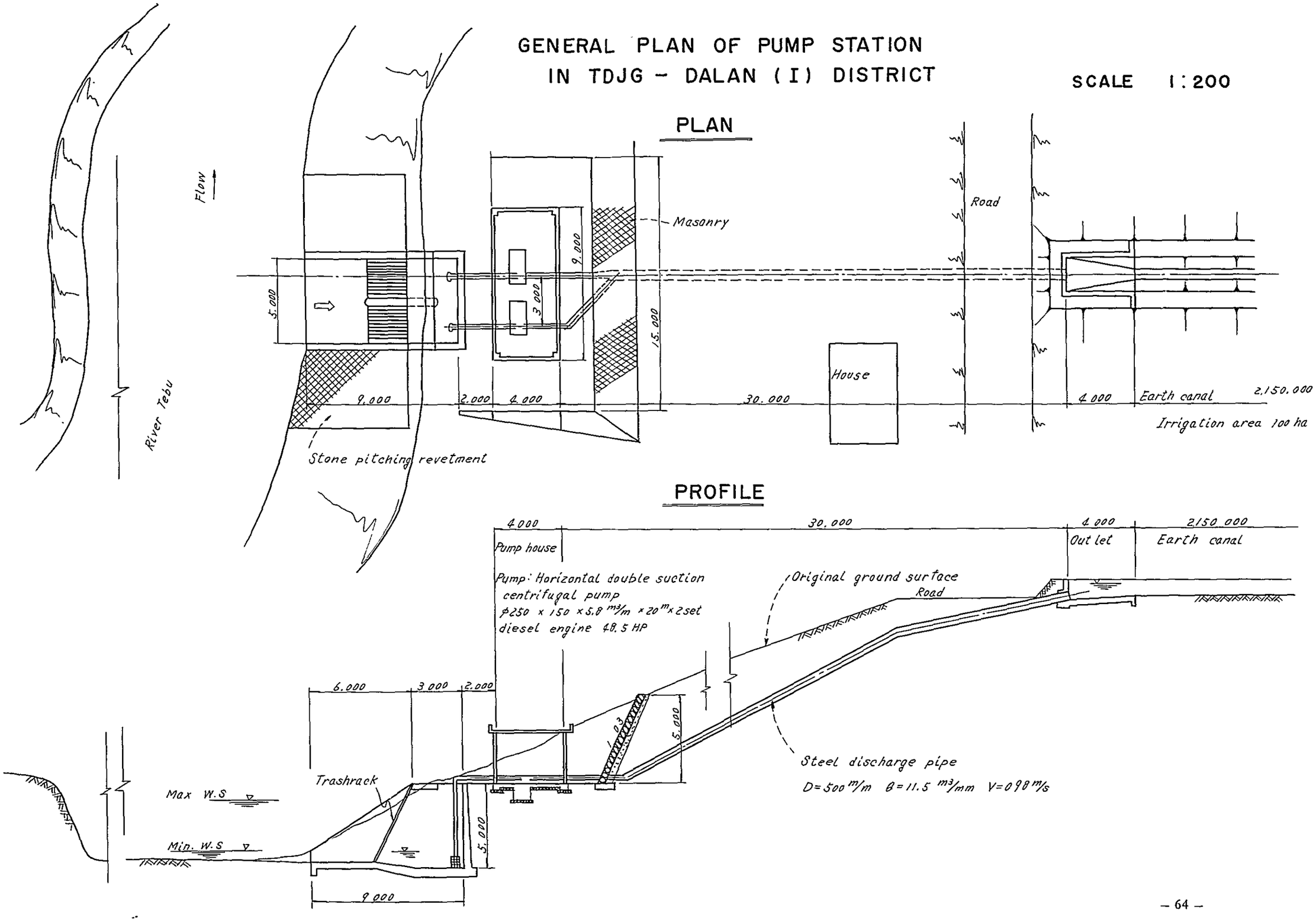


PROFILE



GENERAL PLAN OF PUMP STATION IN TDJG - DALAN (I) DISTRICT

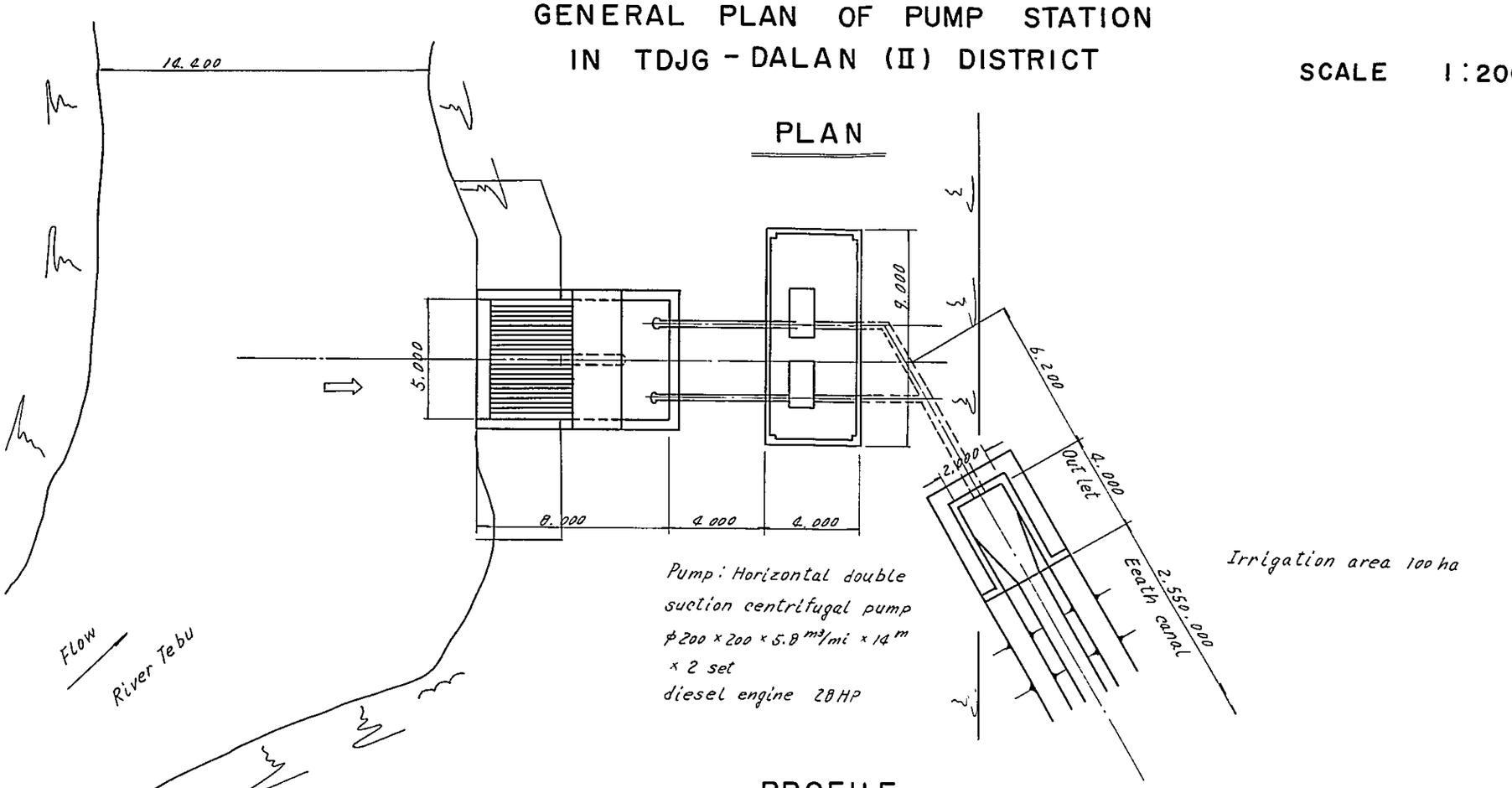
SCALE 1 : 200



GENERAL PLAN OF PUMP STATION IN TDJG - DALAN (II) DISTRICT

SCALE 1 : 200

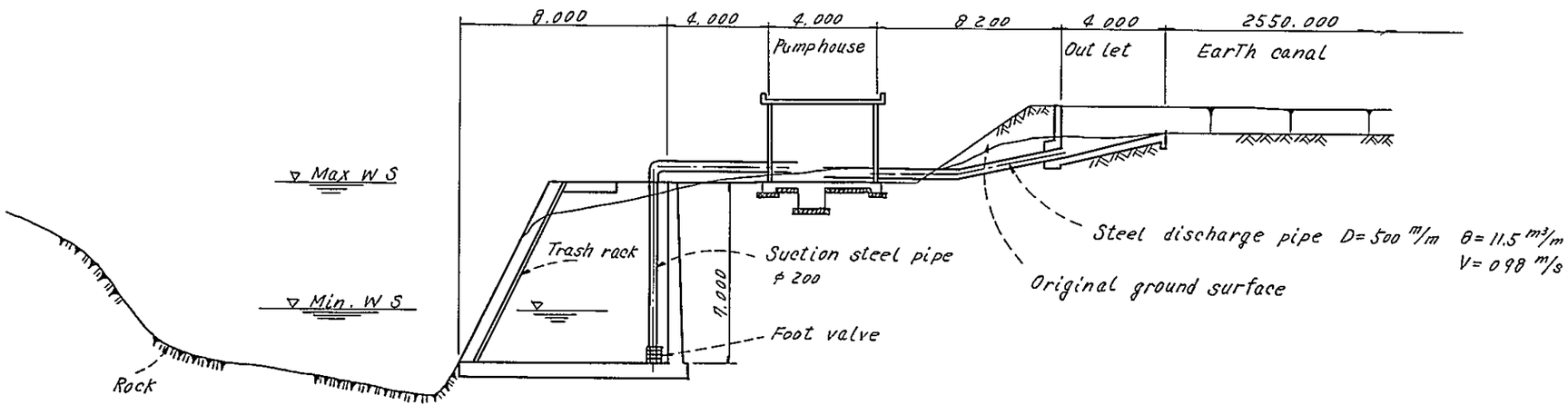
PLAN



Pump : Horizontal double suction centrifugal pump
ϕ 200 × 200 × 5.8 m^3/mi × 14 ^{m}
× 2 set
diesel engine 28 HP

Irrigation area 100 ha

PROFILE

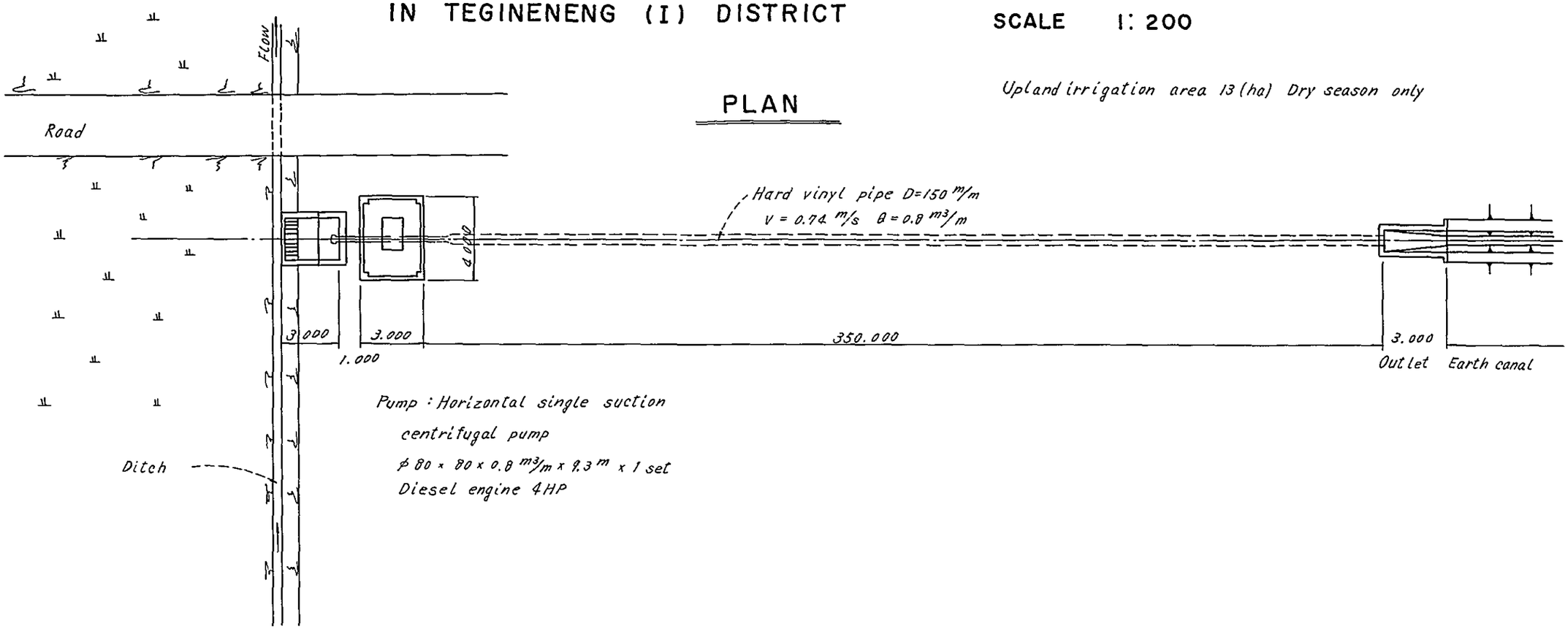


GENERAL PLAN OF PUMP STATION IN TEGINENENG (I) DISTRICT

SCALE 1: 200

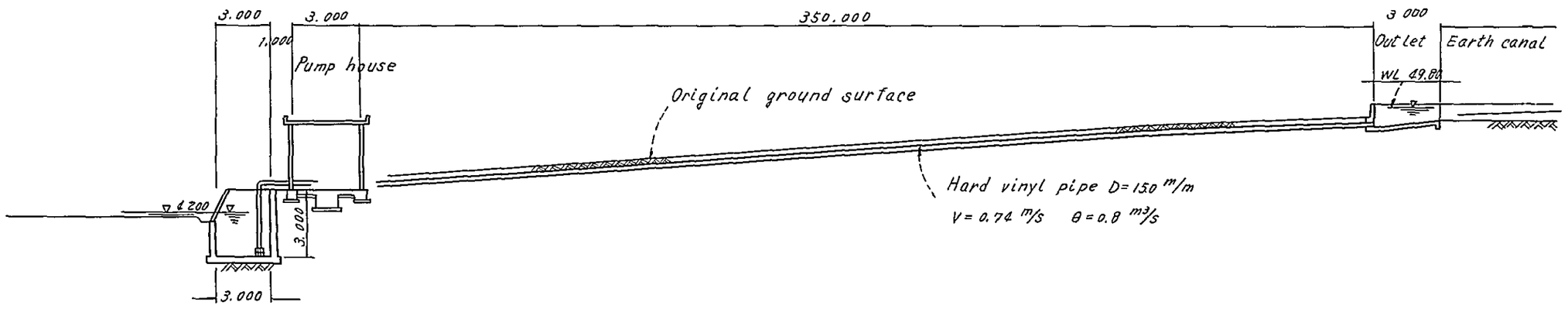
Upland irrigation area 13 (ha) Dry season only

PLAN



Pump : Horizontal single suction centrifugal pump
ϕ 80 × 80 × 0.8 m3/m × 9.3 m × 1 set
Diesel engine 4HP

PROFILE

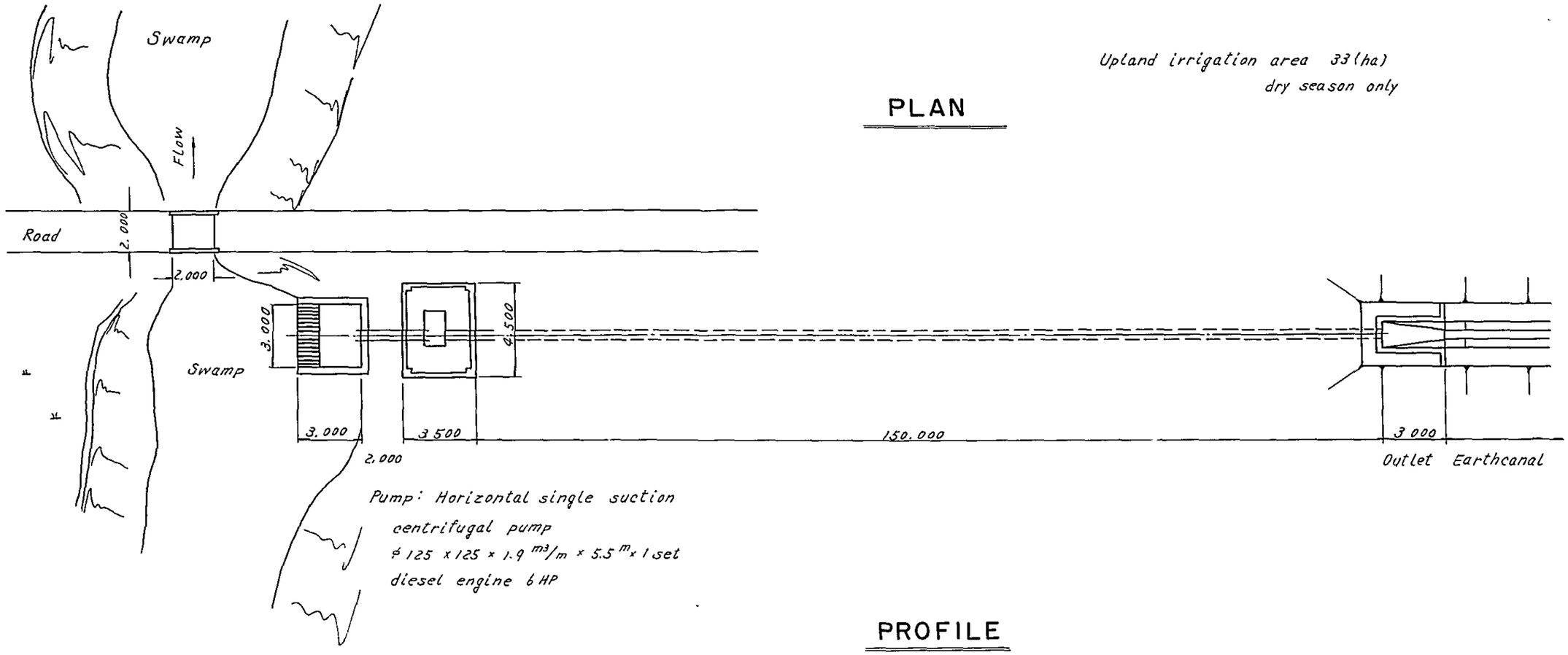


GENERAL PLAN OF PUMP STATION IN TEGINENENG (II) DISTRICT

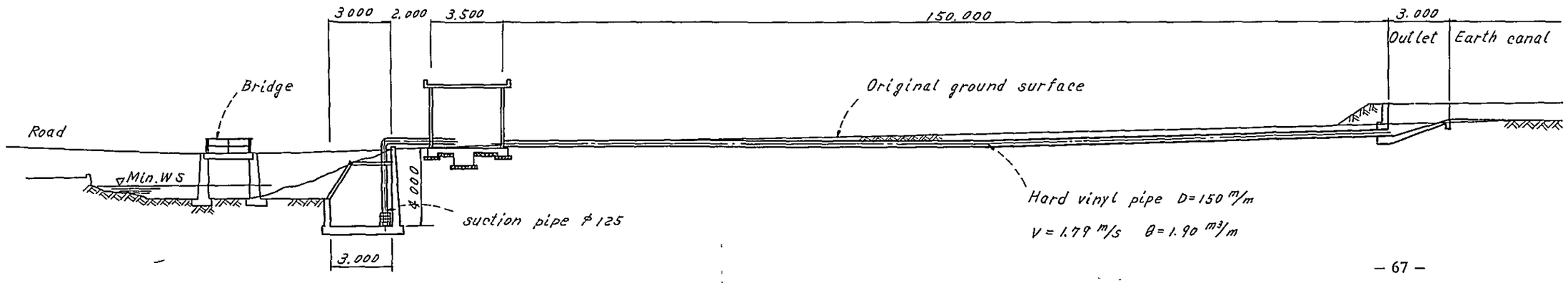
SCALE 1 : 200

Upland irrigation area 33(ha)
dry season only

PLAN



PROFILE

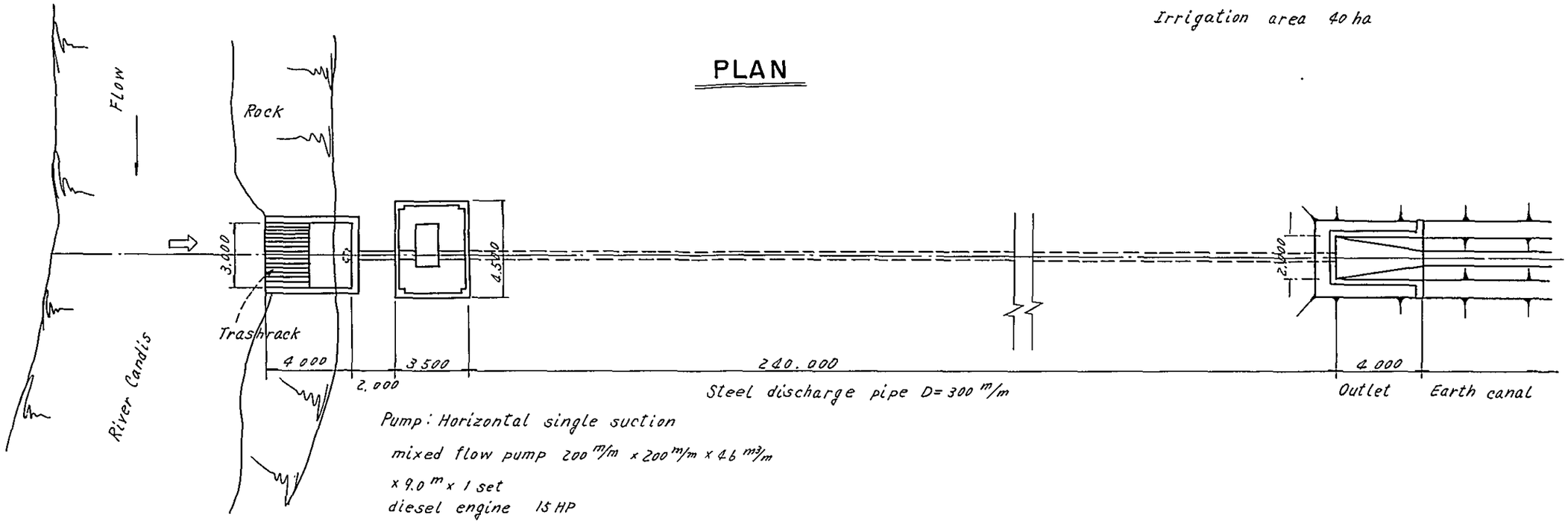


GENERAL PLAN OF PUMP STATION IN S.P.M.A HADJIMENA DISTRICT

SCALE 1 : 200

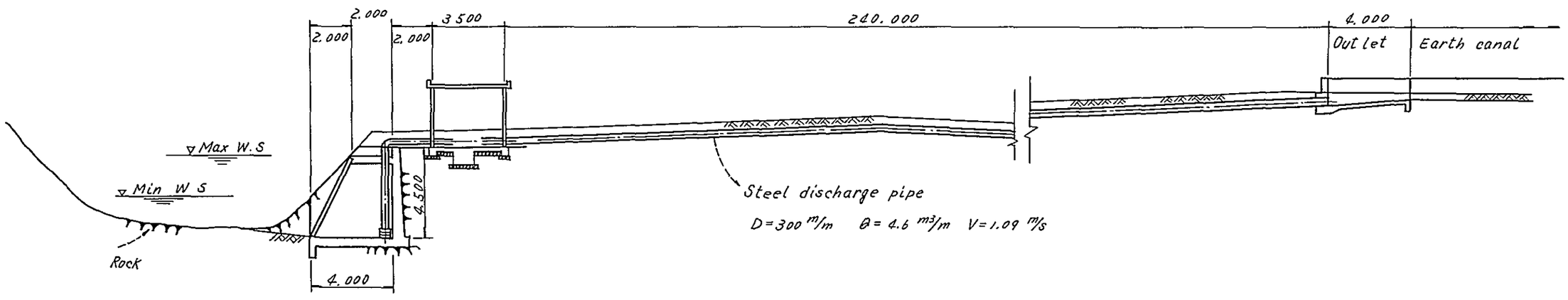
Irrigation area 40 ha

PLAN



Pump : Horizontal single suction
mixed flow pump 200 m/m x 200 m/m x 4.6 m³/m
x 9.0 m x 1 set
diesel engine 15 HP

PROFILE



6. Estimate for Project Cost

6.1 Estimate for Project Cost

Total Project Cost and Annual Plan Item Term Table

		Domestic currency	Foreign currency	Total (Rp)
Civil - works	1st year			
	2nd year	222,399,000	89,580,000	311,979,000
	3rd year	222,398,000	89,580,000	311,978,000
	Sub-total	444,797,000	431,000 179,160,000	623,957,000
Construction machinery	1st year			
	2nd year		30,988,000	30,988,000
	3rd year		30,987,000	30,987,000
	Sub-total		149,000 61,975,000	61,975,000
Consultant-fee	1st year	7,895,000	97,499 40,462,000	48,357,000
	2nd year	7,895,000	48,749 20,231,000	28,126,000
	3rd year		48,749 20,232,000	20,232,000
	Sub-total	15,790,000	195,000 80,925,000	96,715,000
Total		460,587,000 Rp	775,000 US$ 322,060,000 Rp	782,647,000 Rp

6.2 Cost of Estimation

Cost of Estimate

Price unit: Rp

District		Whole		Total
		Indonesian	Japan	
Surakarta	[I]	93,961,000	30,682,000	124,643,000
"	[II]	94,038,000	30,682,000	124,720,000
Gantiwarno	[I]	51,683,000	23,728,000	75,411,000
"	[II]	10,088,000	14,083,000	24,171,000
" (Pekalongan)		5,492,000	6,008,000	11,500,000
Wonosari		8,294,000	3,504,000	11,798,000
Sidokarto		60,823,000	17,697,000	78,520,000
Djati-Agung	[I]	24,178,000	8,952,000	33,130,000
"	[II]	37,089,000	14,930,000	52,019,000
Tdjg-Dalan	[I]	21,213,000	8,843,000	30,056,000
"	[II]	20,590,000	11,723,000	32,313,000
Tegineneng	[I]	2,622,000	1,156,000	3,778,000
"	[II]	6,519,000	1,714,000	8,233,000
Hadjmena		8,207,000	5,458,000	13,665,000
Total in $		444,797,000 (1,071,000)	179,160,000 (431,000)	623,957,000 (1,502,000)

Surakarta [1] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	12	m	15,200	182,400			182,400	
Subtotal				182,400			182,400	
(2) Intake								
Excavation	200.0	m^3	60	12,000			12,000	
"	200.0	"	225	45,000			45,000	Loose rock
Backfill	100.0	"	30	3,000			3,000	
Reinf conc	79.5	"	5,700	453,150	3,750	298,125	751,275	
Form	231.8	m^2	200	46,360			46,360	
Masonry	40.5	m^2	4,350	176,175			176,175	
Trashrack	30.4	"			36,000	1,094,400	1,094,400	4.0 x 7.6
Subtotal				735,685		1,392,525	2,128,210	
(3) Building construction								
a. Bacement								
Plain conc	44.8	m^3	5,200	232,960			232,960	
Gravel	14.4	"	700	10,080			10,080	0.15 x 12 x 8
Form	104.0	m^2	200	20,800			20,800	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
b. Floor space	96.0	m^2	12,500	1,200,000			1,200,000	
Sub-total				1,463,840			1,463,840	
(4) Mechanical equipment								
Pumps	3.0	Set			3,847,000	11,541,000	11,541,000	
Discharge pipe	1.0	Nos				352,000	352,000	
Sub-total						11,893,000	11,893,000	
(5) Discharge pipe								
Steel pipe	45.0	m			47,500	2,137,500	2,137,500	900ϕ
Sub-total						2,137,500	2,137,500	
(6) Outlet								
Remf conc	9.4	m^3	5,700	53,580	3,750	35,250	88,830	
Form	36.9	m^2	200	7,380			7,380	
Embankment	9.1	m^3	30	273			273	
Sub-total				61,233		37,250	96,483	
I-B Irrigation distribution								
Main canal	4,650	m	109	506,850			506,850	
Calvert	2				11,400	22,800	22,800	
Turnout	2		8,100	16,200	3,700	7,400	23,600	
Sub-total				523,050		30,200	553,250	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I-C Discharge system								
Main canal								
Sub-total								
II Landleveling	500.0	ha	118,240	90,620,000	30,249	15,124,500	105,744,500	
Sub-total				90,620,000		15,124,500	105,744,500	
III Operation management								
Office building	30	m^2	12,500	375,000			375,000	
Motorcycle	1.0	nos			70,000	70,000	70,000	
Sub-total				375,000		70,000	445,000	
Total construction cost				93,961,208 (226,413)		30,682,975 (73,935)	124,644,183 (300,348)	( ) in US$

Surakarta [II] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	12	m	15,200	182,400			182,400	
Sub-total				182,400			182,400	
(2) Intake								
Excavation	200.0	m^3	60	12,000			12,000	C.F. Surakarta (I)
"	612 5	"	225	137,813			137,813	" ½ x (8.00+14.00) x 15.00 x 2.50 = loose rock
Backfill	100.0	"	30	3,000			3,000	C.F. Surakarta (I)
Reinf conc	79 5	"	5,700	453,150	3,750	298,125	751,275	"
Form	231.8	m^2	200	46,360			46,360	"
Masonry	40.5	"	4,380	177,390			177,390	"
Trashrack	30.4	"			36,000	1,094,400	1,094,400	4.0 x 7.6
Sub-total				829,713		1,392,525	2,222,238	
(3) Building construction								
a. Bacement								
Plain conc	44.8		5,200	232,960			232,960	C.F. Surakarta (I)
Gravel	14.4	m^3	700	10,080			10,080	" 0.15 x 12 x 8 =
Form	104.0		200	20,800			20,800	C.F. Surakarta (I)

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
b. Floor space	96.0	m^2	12,500	1,200,000			1,200,000	C.F. Surakarta (I)
Sub-total				1,463,840			1,463,840	
(4) Mechanical equipment								
Pumps	3.0	set			3,847,000	11,541,000	11,541,000	
Discharge pipe	1.0	nos				352,000	352,000	
Sub-total						11,893,000	11,893,000	
(5) Discharge pipe								
Steel pipe	45.0	m			47,500	2,137,500	2,137,500	900ϕ
Sub-total						2,137,500	2,137,500	
(6) Outlet								
Reinf conc	9.4	m^3	5,700	53,580	3,750	35,250	88,830	C.F. Surakarta (I)
Form	36.9	m^2	200	7,380			7,380	"
Embankment	9.1	m^3	30	273			273	"
Sub-total				61,233		35,250	96,483	
I-B Irrigation distribution								
Main canal	4,500	m	109	490,500			490,500	
Culvert	2				11,400	22,800	22,800	
Turnout	2		8,100	16,200	3,700	7,400	23,600	
Sub-total				506,700		30,200	536,900	
I-C Discharge system								
Main canal								

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
II Landleveling	500.0	ha	181,240	90,620,000	30,249	15,124,500	105,744,500	
Sub-total				90,620,000		15,124,500	105,744,500	
III Operation management								
Office building	30	m^2	12,500	375,000			375,000	
Motorcycle	1.0	nos			70,000	70,000	70,000	
Sub-total				375,000		70,000	445,000	
Total construction cost				94,038,886 (226,600)		30,682,975 (73,935)	124,721,861 (300,535)	( ) in US$

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) *Temporary works*								
Cofferdam	23	m	15,200	349,600			349,600	
Sub-total				349,600			349,600	
(2) Intake								
Excavation	267 8	m^3	60	16,068			16,068	
Backfill	82.3	"	30	2,469			2,469	
Reinf conc	66.2	"	5,700	377,340	3,750	248,250	625,590	
Form	211.0	m^2	200	42,200			42,200	
Random rubble wet *masonry*	17.5	"	4,380	76,650			76,650	
Trashrack	24 0	"			36,000	864,000	864,000	6.00 x 4 00
Sub-total				514,727		1,112,250	1,626,977	
(3) Building construction								*cf sidokarto*
a. Bacement								
Plain conc	25 7	m^3	5,200	133,640			133,640	
Gravel	17.6	"	700	12,320			12,320	
Form	30.4	m^2	200	6,080			6,080	
b. Floor space	70.0	"	12,500	875,000			875,000	
Sub-total				1,027,040			1,027,040	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Mechanical equipment								
Pumps	3.0	set			3,420,000	10,260,000	10,260,000	
Discharge-pipe	1.0	nos				264,000	264,000	
Sub-total						10,524,000	10,524,000	
(5) Discharge-pipe								
Steel pipe	196.0	m			18,700	3,665,200	3,665,200	800ϕ
Excavation	313	m^3	60	18,780			18,780	1.6x 1.0x 196.0 = Include backfill
Sub-total				18,780		3,665,200	3,683,980	
(6) Outlet								
Reinf conc	38.6	m^3	5,700	220,020	3,750	144,750	364,770	
Form	99.0	m^2	200	19,800			19,800	
Sub-total				239,820		144,750	384,570	
I-B Irrigation distribution								
Mail canal	1,830	m	109	199,470			199,470	
Culvert	3.0	nos			11,400	34,200	34,200	
Turnout	3.0	nos	8,100	24,300	3,700	11,100	35,400	
Sub-total				223,770		45,300	269,070	
I-C Discharge-system								
Main canal	–	m						
Culvert	–	nos						
Sub-total								

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
II Operation management								
Office building	30	m^2	12,500	375,000			375,000	
Motorcycle	1 0	nos			70,000	70,000	70,000	
Sub-total				375,000		70,000	445,000	
III Land-leveling	270.0	ha	181,240	48,934,800	30,249	8,167,230	57,102,030	Original ground slope 0°00'
Sub-total				48,934,800		8,167,230	57,102,030	
Total construction cost				51,683,537 (124,539)		23,728,730 (57,178)	75,412,267 (181,717)	( ) in US$

Gantiwarno [II] Pumping station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	16	m	15,200	243,200			243,200	
Sub-total				243,200			243,200	
(2) Intake								
Excavation	120.0	m^3	60	7,200			7,200	½× 10.00× 4.00× 6.00=
Backfill	25.0	"	30	750			750	
Masonry	65.0	m^2	4,350	282,750			282,750	
Plain conc	2.0	m^3	5,200	10,400			10,400	2/4× 2 5^2× 0.40 =
Corrugated pipe	6.0	m			46,110	276,660	276,660	2000ϕ
"	6 5	m			11,140	72,410	72,410	1000ϕ
Sub-total				301,100		349,070	650,170	
(3) Building construction								
a Bacement								
Plain conc	9.0	m^3	5,200	46,800			46,800	4.00×4.50×0.50 =
Form	8.5	"	200	1,700			1,700	(4.00+4.50)×0.50×2 =
Gravel	4 5	"	700	3,150			3,150	4.50× 5.00×0.20 =
b. Floor space	14.0	m^2	12,500	175,000			175,000	
Sub-total				226,650			226,650	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Mechanical equipment								
Pumps	1 0	set			2,037,000	2,037,000	2,037,000	
Sub-total						2,037,000	2,037,000	
(5) Discharge pipe								
Steel pipe	540	m			18,700	10,098,000	10,098,000	D = 300 m/m
Sub-total						10,098,000	10,098,000	
(6) Outlet								
Reinf conc	1.6	m^3	5,700	9,120	3,750	6,000	15,120	[(0 15+0.25)x½+0.50x1.00+½ (1.50+1.00)x3.00] x 0.3 ≈
Form	19.8	m^2	200	3,960			3,960	[1 50x1.00+½ (1.50+100) x 2 x 3.0x0.30x3.00] x 2 =
Embankment	6 0	m^3	30	180			180	0.75x(3.00x2+2.00)x1.00
Sub-total				13,260		6,000	19,260	
I-B Irrigation distribution								
Main canal	500.0	m	109	54,500			54,500	
Culvert	1.0	nos			11,400	11,400	11,400	
Sub-total				54,500		11,400	65,900	
II Landleveling	50.0	ha	181,240	9,062,000	30,249	1,512,450	10,574,450	Original ground slope 1°00′
Sub-total				9,062,000		1,512,450	10,574,450	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
III Operation management								
Office building	15	m^2	12,500	187,500			187,500	
Motorcycle	1.0	nos			70,000	70,000	70,000	
Sub-total				187,500		70,000	257,500	
Total construction cost				10,088,210 (24,308)		14,083,920 (33,937)	24,172,130 (58,246)	( ) in US$

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Coferdam	16.0	m	15,200	243,200			243,200	
Sub-total				243,200			243,200	
(2) Intake								
Excavation	104.0	m^3	60	6,240			6,240	
Backfill	70.4	"	30	2,112			2,112	
Reinf conc	12.8	"	5,700	72,960	3,750	48,000	120,096	
Form	56.2	m^2	200	11,240			11,240	
Random rubble wet masonry	45.3	"	4,380	198,414			198,414	11.8 x 1.3 = 15.3 5 0 x 3.0 x 2 = 30 0 m^2
Transhrack	8.0	"			36,000	288,000	288,000	4 0 x 2.0 = 8.0 m^2
Gravel	2 3	m^3	700	1,610			1,610	5.0x 3.0 x 0.15 = 2 25
Sub-total				292,576		336,000	628,576	
(3) Building construction								
a. Bacement								
Plain conc	7.5	m^3	5,200	39,000			39,000	
Gravel	1.8	"	700	1,260			1,260	
Form	17.2	m^2	200	3,440			3,440	
b. Floor spere	12.0	"	12,500	150,000			150,000	
Sub-total				193,700			193,700	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Mechanical equipment								
Pumps	1.0	set				477,000	477,000	
Sub-total						477,000	477,000	
(5) Discharge pipe								
Steel pipe	400.0	m			10,800	4,320,000	4,320,000	250ϕ
Sub-total						4,320,000	4,320,000	
(6) Outlet								
Reinf conc	6.9	m^3	5,700	39,330	3,750	25,875	65,205	
Form	26.5	m^2	200	5,300			5,300	
Embankment		m^3	30					
Sub-total			44,630		25,875	25,875	70,505	
I-B Irrigation distribution								
Main canal	–	m						
Syphon	1 0	nos			23,600	23,600	23,600	
Sub-total						23,600	23,600	
I-C Discharge system								
Main canal	–	m						
II Landlevelling	25	ha	181,240	4,531,000	30,249	756,225	5,287,225	Original ground slope 1°00'
Sub-total				4,531,000		756,225	5,287,225	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
III Operation management								
Office building	15	m^2	12,500	187,500			187,500	
Motorcycle	1 0	nos				70,000	70,000	
Sub-total				187,500		70,000	257,500	
Total construction cost				5,492,606 (13,235)		6,008,700 (14,479)	11,501,306 (27,714)	( ) in US$

Wonosari pumping station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I. Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	16	m	15,200	243,200			243,200	
Sub-total				243,200			243,200	
(2) Intake								
Excavation	80 0	m^3	60	4,800			4,800	½ x 10.00x 4.00x 4.00
Backfill	65.0	"	30	1,950			1,950	
Masonry	75.0	m^2	4,350	326,250			326,250	7.50x 10.00
Plain conc	2.0	m^3	5,200	10,400			10,400	$\pi/4 \times 2.50^2 \times 0.40$
Corrugated pipe	3.0	m			46,110	138,330	138,330	2000ϕ
"	8.0	"			11,400	91,200	91,200	1000ϕ
Sub-total				343,400		229,530	572,930	
(3) Building construction								
a Bacement								
Plain conc	9 0	m^3	5,200	46,800			46,800	4.00x 4.50x 0.50
Form	8.5	m^2	200	1,700			1,700	(4.00+4.50) x 0.50 x 2
Gravel	4.5	m^3	700	3,150			3,150	4.50x 5 00x 2
b. Floor space	4.0	m^2	12,500	175,000			175,000	
Sub-total				226,650			226,650	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) *Equipment*								
Pumps	1.0	set			1,043,000	1,043,000	1,043,000	
Sub-total						1,043,000	1,043,000	
(5) Discharge pipe								
Steel pipe	50.0	m			18,700	935,000	935,000	D = 300 m/m
Sub-total						935,000	935,000	
(6) *Outlet*								
Reinf conc	1.6	m^3	5,700	9,120	3,750	6,000	15,120	[(0.15+0.25) x ½ +1.50 x 1.00 + ½ (1.50+1.00) x 3.00] x 0.30 =
Form	19.8	"	200	3,960			3,960	[1.50 x 1.00 + ½ (1.50+1.00) x 2 x 3.00 + 0.30 x 3.00] x 2 =
Embankment	6 0	"	30	180			180	0.75 x (3.00x2+2.00) x 1.00
Sub-total				13,260		6,000	19,260	
I-B *Irrigation distribution*								
Main canal	400.0	m	109	43,600			43,600	
Culvert	1.0	nos			11,400	11,400	11,400	
Sub-total				43,600		11,400	55,000	
II Landlevelling	40.0	ha	181,240	7,249,600	30,249	1,209,960	8,459,560	
Sub-total				7,249,600		1,209,960	8,459,560	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
III Operation management								
Office building	14	m^2	12,500	175,000			175,000	
Motorcycle	1	nos			70,000	70,000	70,000	
Sub-total				175,000		70,000	245,000	
Total construction cost				8,294,710 (19,987)		3,504,890 (8,446)	11,799,600 (28,433)	( ) in US$

Sidokarto Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil work								
I-A Pumping station								
(1) Temporary works								
Cofferdam	21.0	m	15,200	319,200			319,200	
Sub-total				319,200			319,200	
(2) Intake								
Excavation	297.5	m^3	60	17,850			17,850	
Backfill	141.5	"	30	4,245			4,245	
Reinf conc	48 7	"	5,700	277,590			277,590	
Form	165.4	m^2	200	33,080			33,080	
Random rubble wet masonry	22.5	"	4,380	98,550			98,550	4 50x 2.50x 2
Transhrack	24.0	"			36,000	864,000	864,000	
Sub-total				431,315		864,000	1,295,315	
(3) Building construction								
a. Basement								
Plain conc	16 1	m^3	5,200	83,720			83,720	
Gravel	7 2	"	700	5,040			5,040	
Form	39.4	m^2	200	7,880			7,880	
b. Floor space	70.0	"	12,500	875,000			875,000	
Sub-total				971,640			971,640	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Mechanical equipment								
Pumps	3 0	set			2,427,000	7,281,000	7,281,000	
Discharge pipe	1.0	nos				264,000	264,000	
Sub-total						7,545,000	7,545,000	
(5) Discharge pipe								
Excavation	–	m^3	60					
Steel pipe	212	m	18,700	3,964,400			3,964,400	800φ
Sub-total				3,964,400			3,964,400	
(6) Outlet								
Reinf conc	11.5	m^3	5,700	65,550	3,750	43,125	108,675	
Form	49.5	m^2	200	9,900			9,900	
Excavation	57.6	m^3	60	3,456			3,456	
Embankment	25 5	"	30	765			765	
Sub-total				79,671		43,125	122,796	
I-B Irrigation distribution								
Main canal	2,700	m	109	294,300			294,300	
Culvert	2.0	nos			11,400	22,800	22,800	
Turnout	2.0	nos	8,100	16,200	3,700	7,400	23,600	
Sub-total				310,500		30,200	340,700	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I-C Discharge system								
Main canal	–	m						
Culvert	–	nos						
II *Land levelling*	300	ha	181,240	54,372,000	30,249	9,074,700	63,446,700	Original ground slope 0°30'
Sub-total				54,372,000		9,074,700	63,446,700	
III Operation management								
Office building	30	m^2	12,500	375,000			375,000	
Motorcycle	2 0	nos			70,000	140,000	140,000	
Sub-total				375,000		140,000	515,000	
Total consutruction cost				*60,823,726* (146,563)		*17,697,025* (42,643)	*78,520,751* (189,206)	( ) in US$

Djati-Agung [1] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	18	m	15,200	273,600			273,600	
Sub-total				273,600			273,600	
(2) Intake								
Excavation	273	m^3	60	16,380			16,380	
"	156	"	225	35,100			35,100	Loose rock
Backfill	87	"	30	2,610			2,610	(6.0+3.5+5.0)x 6.0x 1.0 = 87
Gravel	–	"	700				–	
Reinf conc	171	"	5,700	974,700	3,750	641,250	1,615,950	
Form	82.2	"	200	16,440			16,440	
Random rubble wet masonry	36.0	m^2	4,380	157,680			157,680	
Transhrack	18.0	"			36,000	648,000	648,000	4.0 x 4.5 = 18.0
Sub-total				1,202,910		1,289,250	2,492,160	
(3) Building construction								
a. Bacement								
Plain conc	15.8	m^3	5,200	82,160			82,160	
Gravel	5.4	"	700	3,780			3,780	4.0x 9.0x 0.15 = 5.4
Form	18.2	m^2	200	3,640			3,640	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
b. Floor space	36.0	m^2	12,500	450,000			450,000	
Sub-total				539,580			539,580	
(4) Mechanical equipment								
Pumps	2.0	set			1,974,000	3,948,000	3,948,000	
Discharge pipe	1.0	nos				70,000	70,000	Includ pipe jint
Sub-total						4,018,000	4,018,000	
(5) Discharge pipe								
Steel pipes	45.0	m	18,700	841,500			841,500	450ϕ
Sub-total				841,500			841,500	
(6) Outlet								
Reinf conc	8.5	m^3	5,700	48,450	3,750	31,875	80,325	
Form	35.2	m^2	200	7,040			7,040	
Excavation	5.0	m^3	60	300			300	
Embankment	12 5	"	30	375			375	
Sub-total				56,165		31,875	88,040	
I-B Irrigation distribution								
Main canal	473	m	109	51,557			51,557	
Culvert	2.0	nos			11,400	22,800	22,800	
Sub-total				51,557		22,800	74,357	
I-C Drainage system								
Main canal	30.7	m	49	1,504			1,504	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
Culvert	1.0	nos			11,400	11,400	11,400	
Sub-total				1,504		11,400	12,904	
II Land levelling	116	ha	181,240	21,023,840	30,249	3,508,884	28,420,000	Original ground lope 0°30'
Sub-total				21,023,840		3,508,884		
III Operation maintenance								
Office building	15	m^2	12,500	187,500			187,500	
Motorcycles	1.0	set				70,000	70,000	
Sub-total				187,500		70,000	257,500	
Total construction cost				24,178,156 (58,261)		8,952,209 (21,572)	33,130,365 (79,833)	( ) in US$

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
1 Civil works								
I-A Pumping station								
(1) Temporary works								
Coffordam	30	m	15,200	456,000			456,000	
Sub-total				456,000			456,000	
(2) Intake								
Excavation	155	m^3	60	9,300			9,300	
"	108	"	225	24,300			24,300	Loose rock
Backfill	87	"	30	2,610			2,610	(6.0+3.5+5.0)x 6.0x 1.0 =
Reinf conc	62.3	"	5,700	355,110	3,750	233,625	588,735	
Form	168.0	m^2	200	33,600			33,600	
Random rubble wet masonry	48.0	"	4,380	210,240			210,240	
Trashrack	29.7	"			36,000	1,069,200	1,069,200	5.4 x 5.5 = 29.7
Sub-total				635,160		1,302,825	1,937,985	
(3) Building construction								
a. *Bacement*								
Plain conc	16.3	m^3	5,200	84,760			84,760	
Gravel	9.0	"	700	6,300			6,300	10.0x 6.0x 0.15 = 9.0
Form	34.4	m^2	200	6,880			6,880	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
b. Floor space	60 0	m^2	12,500	750,000			750,000	
Sub-total				847,940			847,940	
(4) Mechanical equipment								
Pumps	3.0	set			2,220,000	6,660,000	6,660,000	
Discharge pipe	1.0	nos				148,000	148,000	
Sub-total						6,808,000	6,808,000	
(5) Discharge pipe								
Steel pipe	39.0	m			24,600	959,400	959,400	600ϕ
Sub-total						959,400	959,400	
(6) Outlet								
Reinf conc	8.5	m^3	57,000	48,450	37,50	31,875	80,325	
Form	32.5	m^2	200	6,500			6,500	
Excavation	5.0	m^3	60	300			300	
Embankment	12.5	"	30	375			375	
Sub-total				55,625			87,500	
I-B Irrigation distribution								
Main canal	3,550	m	109	386,950			386,950	
Culvert	1.0	nos			11,400	11,400	11,400	
Sub-total				386,950		11,400	398,350	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
IC Drainage system								
Mail canal	1,730	m	49	84,770			84,770	
Sub-total				84,770			87,770	
II Land levelling	190	ha	181,240	34,435,600	30,249	5,747,310	40,182,910	Original ground slope 0°30'
Sub-total			181,240	34,435,600	30,249	5,747,310	40,182,910	
III Operation maintenance								
Office building	15	m^2	12,500	187,500			187,500	
Motorcycle	1.0	set				70,000	70,000	
Sub-total				187,500		70,000	257,500	
Total construction cost				37,089,545 (89,372)		14,930,810 (35,978)	52,020,355 (125,350)	( ) in US$

Tdjg-Dalan [1] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	30	m	15,200	456,000			456,000	
Sub-total				456,000			456,000	
(2) Intake								
Excavation	274	m^3	60	16,440			16,440	
"	337	"	225	75,825			75,825	Loose rock
Backfill	60	"	30	1,800			1,800	(3.0x 2+6.0)x 5.0x 1.0 = 60
Reinf conc	88.4	m^3	5,700	503,880	3,750	331,500	835,380	
Form	278.5	m^2	200	55,700			55,700	
Stone pitching revetment	72.0	"	4,380	315,360			315,360	
Trashrack	22.5	m^2			36,000	810,000	810,000	5.0x4.5 = 22.5
Sub-total				969,005		1,141,500	2,110,505	
(3) Building construction								
a. Bacement								
Plain conc	15.8	m^3	5,200	82,160			82,160	
Gravel	5.4	"	700	3,780			3,780	
Form	18.2	m^2	200	3,640			3,640	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
b. Floor space	36.0	m^2	12,500	450,000			450,000	
Sub-total				539,580			539,580	
(4) Mechanical equipment								
Pumps	2.0	set				3,948,000	3,948,000	
Discharge pipe	1.0	nos				70,000	70,000	
Sub-total						4,018,000	4,018,000	
(5) Discharge pipe								
Steel pipe	28.0	m			18,700	523,600	523,600	D = 500 m/m
Excavation	71.5	m^3	60	4,290			4,290	Loose rock
Random rubble wet masonry	121.9	m^2	4,380	533,922			533,922	
Sub-total				538,212		523,600	1,061,812	
(6) Outlet								
Reinf conc	8.5	m^3	5,700	48,450	3,750	31,875	80,325	
Form	32.5	m^2	200	6,500			6,500	
Embankment	12.5	m^3	30	375			375	
Sub-total				55,325		31,875	87,200	
I-B Irrigation distribution								
Main canal	2,150	m	109	234,350			234,350	
Culvert	1.0	nos			11,400	11,400	11,400	
Turnout	3.0	nos	8,100	24,300	3,700	11,100	35,400	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I-C Drainage system								
Main canal	1,680	m	51	85,680			85,680	
Culvert	1.0	nos			11,400	11,400	11,400	
Sub-total				344,330		33,900	378,230	
II Land levelling	100	ha	181,240	18,124,000	30,249	3,024,900	21,148,900	Original ground slope 0°00'
Sub-total			181,240	18,124,000	30,249	3,024,900	21,148,900	
III Operation management								
Office building	15	m^2	12,500	187,500			187,500	
Motorcycle	1.0	nos				70,000	70,000	
Sub-total				187,500		70,000	257,500	
Total construction cost				21,213,952 (51,118)		8,843,775 (21,310)	30,057,727 (72,428)	( ) in US$

Tdjg-Dalan [II] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	24	m	15,200	364,800			364,800	
Sub-total				364,800			364,800	
(2) Intake								
Excavation	184	m^3	60	11,040			11,040	367.5× ½ = 184
"	184	"	225	41,400			41,400	(9.0+6.0)×½×7.0+6.0×7.0×1.0 =
Backfill	95	"	30	2,850			2,850	
Reinf conc	101.7	"	5,700	579,690	3,750	381,375	961,065	
Form	240	m^2	200	48,000			48,000	
Random rubble wet masonry	70	"	4,380	306,600			306,600	
Transrack	36	"			36,000	1,296,000	1,296,000	8.0 ×4.5 = 360
Sub-total				989,580		1,677,375	2,666,955	
(3) Building construction								cf Djats-Agung [I]
a. Bacement								
Plain conc	15.8	m^3	5,200	82,160			82,160	
Gravel	5.4	"	700	3,780			3,780	
Form	18.2	m^2	200	3,640			3,640	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
b. Floor space	36.0	m^2	12,500	450,000			450,000	
Sub-total				539,580			539,580	
(4) Mechanical equipment								
Pumps	2.0	set			3,320,000	6,640,000	6,640,000	
Discharge pipe		nos				148,000	148,000	
Sub-total						6,788,000	6,788,000	
(5) Discharge pipe								
Steel pipe	4.0	m			18,700	74,800	74,800	D = 500 m/m
Sub-total						74,800	74,800	
(6) Outlet								
Reinf conc	8.5	m^3	5,700	48,450	3,750	31,875	80,325	
Form	35.2	m^2	200	7,040			7,040	
Excavation	5.0	m^3	60	300			300	
Embankment	12.5	"	30	375			375	
Sub-total				56,165	•	31,875	88,040	
I-B Irrigation distribution								
Main canal	2,550	m	109	277,950			277,950	
Culvert	4				11,400	45,600	45,600	
Turn-out	3		8,100	24,300	3,700	11,100	35,400	
Sub-total				302,250		56,700	358,950	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I-C Discharge system								
Main canal	5.30	m	51	27,030			27,030	
Sub-total				27,030			27,030	
II Land levelling	100	ha	181,240	18,124,000	30,249	3,024,900	21,148,900	Original ground slope $0^{\circ}00'$
Sub-total			181,240	18,124,000	30,249	3,024,900	21,148,900	
III Operation maintenance								
Office building	15	m^2	12,500	187,500			187,500	
Motorcycle	1.0	nos				70,000	70,000	
Sub-total				187,500		70,000	257,500	
Total construction cost				20,590,905 (49,617)		11,723,650 (28,250)	32,314,555 (77,867)	( ) in US$

Tegineneng [I] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Intake								
Excavation	81	m^3	60	4,860			4,860	
Backfill	18	"	30	540			540	
Reinf conc	11.0	"	5,700	62,700	3,750	41,250	103,950	
Form	40.0	m^2	200	8,000			8,000	
Transhrack	2.8	"			36,000	100,800	100,800	
Sub-total				76,100		142,050	218,150	
(2) Building construction								
a. Bacement								
Plain conc	3.6	m^3	5,200	18,720			18,720	
Gravel	1.8	"	700	1,260			1,260	
Form	14.4	m^2	200	2,880			2,880	
b. Floor space	12.0	"	12,500	150,000			150,000	
Sub-total				171,780			171,780	
(3) Mechanical								
Pumps	1.0	set				261,000	261,000	
Sub-total						261,000	261,000	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Discharge pipe								
Vinyl chloride pipe	350	m			1,000	350,000	350,000	150ϕ
Sub-total						350,000	350,000	
(5) Outlet								
Reinf conc	2.6	m^3	5,700	14,820	3,750	9,750	24,570	
Form	13.4	m^2	200	2,680			2,680	
Embankment	5 0	m^3	30	150			150	
Sub-total				17,650		9,750	27,400	
II Land levelling	13	ha	181,240	2,356,120	30,249	393,237	2,749,357	Original ground slope 0°00'
				2,622,				
Total construction cost				2,622,730 (6,320)		1,156,037 (2,785)	3,778,767 (9,105)	( ) in US$

Tegineneng [II] Pumping Station

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Cofferdam	10	m	15,200	152,000			152,000	
Sub-total				152,000			152,000	
(2) Intake								
Excavation	144	m^3	60	8,640			8,640	
Backfill	80	"	30	2,400			2,400	
Reinf conc	18.1	"	5,700	103,170	3,750	67,875	171,045	
Form	69.0	m^2	200	13,800			13,800	
Transhrack	6.0	"			36,000	216,000	216,000	
Sub-total				128,010		283,875	411,885	
(3) Building construction								
a. Bacement								
Plain conc	4.2	m^3	5,200	21,840			21,840	
Gravel	2.3	"	700	1,610			1,610	
Form	16.0	m^2	200	3,200			3,200	
b. Floor space	16.0	"	12,500	200,000			200,000	
Sub-total				226,650			226,650	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Mechanical equipment								
Pumps	1.0	set				264,000	264,000	
Sub-total						264,000	264,000	
(5) Discharge pipe								
Vinyl chloride pipe	150.0	m			1,000	150,000	150,000	150ϕ
Sub-total						150,000	150,000	
(6) Outlet								
Reinf conc	4.8	m^3	5,700	27,360	3,750	18,000	45,360	
Form	22.0	m^2	200	4,400			4,400	
Embankment	12.0	m^3	30	360			360	
Sub-total				32,120		18,000	50,120	
II Land levelling	33.0	ha	181,240	5,980,920	30,249	998,217	6,979,137	Original ground slope 0°00'
Total construction cost				6,519,700 (15,710)		1,714,092 (4,130)	8,233,792 (19,840)	( ) in US$

S.P.M.A. Hadjimena Pumping Station

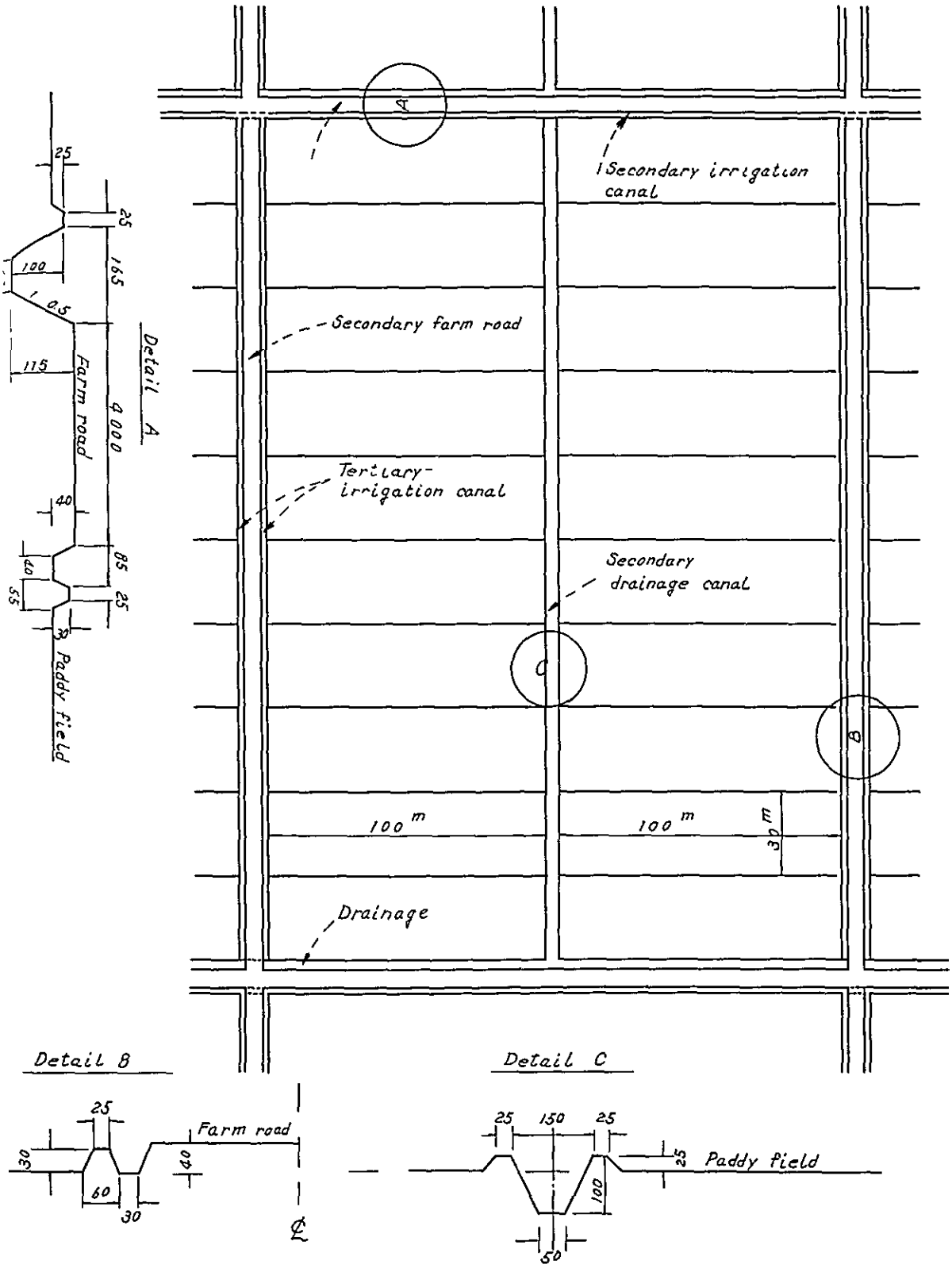
Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
I Civil works								
I-A Pumping station								
(1) Temporary works								
Coffer dam	14	m	15,200	212,800			212,800	
Sub-total				212,800			212,800	
(2) Intake								
Excavation	54	m^3	60	3,240			3,240	
"	81	"	225	18,225			18,225	1.5 x 1.5 Rp = 225 loose rock
Reinf conc	24.2	m^3	5,700	137,940	3,750	90,750	228,690	
Form	58	"	200	11,600			11,600	
Transhrack	13.5	m^2			36,000	486,000	486,000	3.0x 4.5 =
Sub-total				171,005		576,750	747,755	
(3) Building construction								
a. Basement								
Plain conc	4 2	m^3	5,200	21,840			21,840	
Gravel	2.4	"	700	1,680			1,680	
Form	15.0	m^2	200	3,000			3,000	
b. Floor space	16	"	12 500	200,000			200,000	
Sub-total				226,520			226,520	

Description of Item	Quantity	Unit	Domestic currency		Foreign currency		Total cost (Rp)	Remarks
			Rate (Rp)	Cost (Rp)	Rate (Rp)	Cost (Rp)		
(4) Mechanical equipment								
Pumps	1.0	set				1,043,000	1,043,000	
Sub-total						1,043,000	1,043,000	
(5) Discharge pipe								
Steel pipe	240.0	m	1,200	288,000	10,800	2,592,000	2,880,000	300ϕ
Sub-total				288,000		2,592,000	2,880,000	
(6) Outlet								
Reinf conc	6.7	m^3	5,700	38,190	3,750	25,125	63,315	
Form	32.5	m^2	200	6,500			6,500	
Embankment	12.5	m^3	30	375	–		375	
Sub-total				45,065		25,125	70,190	
I-B Irrigation distribution								
Main canal	300	m	49	14,700			14,700	
Culvert	1.0	nos			11,400	11,400	11,400	
Sub-total				14,700		11,400	26,100	
II Land levelling	40	ha	181,240	7,249,600	30,249	1,209,960	8,459,560	Original ground slope $1^{\circ}00'$
Total construction cost				8,207,690 (19,778)		5,458,235 (13,152)	13,665,925 (32,930)	( ) in US$

Land leveling 1 ha / Original ground slope: 1:0.006

Description of Item	Quantity	Unit	Domestic currency	Foreign currency	Total cost		Remarks
			Unit price	Unit price	D.C.	F.C.	
Surface soil removing	9,512	m^3	45		428,040		Hauling distance 20m 0.30 person/m^3 Hauling distance 50m 0.37 person/m^3 0.27
Cut and bank soil	4,500	m^3	55		247,500		
Surface soil back filling	9,512	m^3	40		380,480		
Border	2,000	m	2		4,000		
Secondary irrigation canal	416	m	105		43,680		
Secondary drainage canal	305	m	49		14,945		
Tertiary irrigation canal	610	m	51		31,110		
Turn-out	2	nos		11,800		23,600	
Corrugated pipe 1100ϕ	3	nos		44,500		133,500	
" " 300ϕ	3	nos		11,600		34,800	
Total					1,149,755	191,900	
			$\frac{1,149,755 \text{ or } 191,900 \times 1000}{208 \times 305} =$		181,240 Rp/ha	30,249 Rp/ha	
			$\frac{1,341,655 \times 10,000}{2.08 \times 305} =$				211,484 Rp/ha

Plan of Field Block Formation



6.3 Estimate of construction machinery and consultant-fee

Cost of Major Construction Machinery

Name of construction machinery	Nos	Unit cost	Cost
Bulldozer (5 t)	2	7,260,000	14,520,000
Backhoe (0.6 m^3)	2	11,477,000	22,954,000
Tractor shovel (1.2 m^3)	2	5,661,000	11,322,000
Concreat vibrator	3	143,000	429,000
Belt conveyor	5	191,000	955,000
Dump track (2t)	7	1,685,000	11,795,000
Total			61,975,000 Rp (149,000 $)

Consulting Service:

(1) Description of Consulting Service

For the purpose of implementing the pump irrigation project, consultants experienced in agricultural development, particularly those experienced in Indonesia's agricultural development projects, should be selected.

The consulting service can be divided into the following three parts.

The first part is for surveying and preparation of accurate maps covering project districts.

The second part involves the design of pump irrigation facilities and preparation of tender documents, establishment of the pump station operation and management plan, and design of roads and buildings appurtenent to pump irrigation facilities. It also includes the survey on the existing state of agriculture and detailed study of the benefit derivable from the project.

The third part covers the extension of assistance to the Indonesian government at time of selecting pump station facilities by tender and also the construction supervision and administration of foundations and buildings of machines and equipment. The third part should also be included the technical guidance on pump station operation and management which is to be provided to Indonesian engineers.

1. Agricultural Irrigation engineer (leader)

An agricultural engineer experienced in the design and execution of land use projects and pump irrigation, and registered as qualified surveyor and engineer.

2. Surveying engineer

An engineer having the qualifications for an assistant or higher level surveying engineer and capable of providing Indonesian engineers with guidance on surveying techniques.

3. Pump station designer

An agricultural engineer experienced in the planning and design of pump irrigation projects.

4. Soil expert

An expert specialized in soil analysis and scientific judgement of land productivity, and well acquainted with the soils in Southeast Asia.

5. Hydrologist

An agricultural engineer capable of consolidating and analyzing astronomical and hydrological data and preparing, in Indonesia, basic data required for an overall development project. He is therefore required to know both Indonesian and Dutch.

6. Agricultural economist

An expert with noticeable achievements and long experience in agricultural economy in Southeast Asia who can provide surfficient and good advices to the Indonesian government on the future operation and management of pump irrigation.

7. Agronomist

An expert having deep knowledges and experience about crops in Southeast Asia. He is required to give technical advices to the Indonesian government on the cultivation techniques, fertilizers and fertilizers.

(Construction administration)

8. Agricultural Irrigation engineer

An engineer whose qualifications are equal to those of the leader mentioned in Item 1.

9. Civil engineer

An engineer having the qualifications specified in Item 3 and experienced in the engineering work and preparation of working drawings.

10. Construction machinery expert

An expert capable of giving guidance and instructions to Indonesian engineers and operators on the operation, repair and management of construction machines and equipment.

11. Pump expert

An expert well experienced in the installation, operation and repair of pumps and capable of providing technical guidance to Indonesian engineers and operators.

Breakdown of Cost of Technical Assistance

(1) Personnel Cost

Assignment	Man-Month	Wages per Man-Month	Amounts	No. of Trips
		US$	US$	
(Surveying)				
Agri. Irrigation Engineer (Leader)	3	1,500	4,500	1
Surveying engineer	6	1,000	6,000	1
(Preparation of Final Design)				
Agri. irrigation engineer (Leader)	5 + (1)	1,500	9,000	–
Designer for pump station	7 + (1)	1,100	8,800	1
Soil expert	1.0	1,100	1,100	1
Hydrologist	1.0	1,100	1,100	1
Agricultural economist	2 + (1)	1,500	4,500	1
Agronomist	1	1,200	1,200	1
(Construction Management)				
Agri. irrigation engineer (Leader)	10	1,500	15,000	2
Civil engineer	6	1,100	6,600	2
Expert for construction machinery	3	1,100	3,300	1
Expert for pumps and accessories	4	1,100	4,400	1
Total	49 + (3)		65,500	13

(2) Overhead Cost

65,500 x 100% = 65,500

(3) Technical Cost

[(1) + (2)] x 25% = 32,750

(4) Staying Expenses

49 man-months x 30 days x Rp 6,225 = 9,150,750 (Rp)

(5) Travelling and Communication Expenses in Indonesia

20 months x Rp 332,000 = 6,640,000 (Rp)

(6) Travelling Expenses to and from Indonesia

	13 return trips x 625.4	= 8,130	
Travelling allowance	13 persons x 200	= 2,600	13,330
Freight of personal belongings	13 peices x 200	= 2,600	

(7) Printing and Binding Expenses of the Report

50 copies x 100 = 5,000

(8) *Contingencies*

7.5% = 13,656

Hence, foreign currency requirement = 195,736 ≒ US$195,000
local currency requirement = 15,790,750 ≒ Rp 15,790,000

——— Works to be completed in Indonesia
- - - - - Works to be carried out in Japan

Schedule of Design Execution and Construction Management of Pump Irrigation Project in Lampung Province

Item	1 Month	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total No. of Month Required
<Surveying>																									
Design (Leader)	———	———	———																						3.0
Surveying	———	———	———	———	———	———																			6.0
<Preparation of Final Design>																									
Design (Leader)				———	———	———	———	———	- - -																5.0 (1)
Design of Pump Station				———	———	———	———	———	———	———	- - -														7.0 (1)
Soil					———																				10
Hydrology				———																					10
Agricultural Economy						———	———	- - -																	20 (1)
Agronomy					———																				1.0
<Construction Management>																									
Management (Leader)												———	———	———	———	———	———	———	———						10 0
												———	———	———											* 1974/1975
Design												———	———	———											6.0
												———	———	———											* 1974/1975
Construction Machinery														———	———	———									3.0
Pumps and Accessories															———	———	———	———							4
																									490 (3)

7. Maintenance and Management Cost

Running Cost

		Hp	Nos	ΣHP	ℓ/ΣHP	ℓ/year	R. Cost	Remark
Surakarta	[I]	65.0	3	195.0	35.1	91,260	2,281,500	
"	[II]	65.0	3	195.0	35.1	91,260	2,281,500	R. cost =
Gantiwarno	[I]	65.0	3	195.0	35.1	91,260	2,281,500	0.18ℓ/HP×2,600 hr/year × 25 Rp/ℓ
"	[II]	48.5	1	48.5	8.7	22,698	567,450	
Pekalongan		15.0	1	15.0	2.7	7,020	175,500	
Wonosari		15.0	1	15.0	2.7	7,020	175,500	
Sidokarto		48.5	3	145.5	26.2	68,094	1,702,350	
Djati-Agung	[I]	28.0	2	56.0	10.1	26,208	655,200	
"	[II]	45.0	3	135.0	24.3	63,180	1,579,500	
Tdjg-Dalan	[I]	48.5	2	97.0	17.5	45,396	1,134,900	
"	[II]	28.0	2	56.0	10.1	26,208	655,200	Operator 7.0 person
Tegineneng	[I]	4.0	1	4.0	0.7	1,872	46,800	10,000 Rp x 12 month x 7 person month
"	[II]	6.0	1	6.0	1.1	2,808	70,200	= 840,000 Rp
Hadjmena		15.0	1	15.0	2.7	7,020	175,500	
Total							13,782,600	14,622,000 Rp

8. Economic Analysis of Project

The economic effect of the project, as calculated by comparison between the project benefit and the direct project cost, is as tabulated below.

The effect, however, cannot be derived in a year since the project construction is planned to take a period of three years. Further, the calculation was worked out on the assumption that the construction work will be concurrently accompanied by the extension service for encouraging the use of machines and equipment, establishment of a rational irrigation plan, and extension of advanced cultivation techniques.

Calculation of Internal Rate of Return

Unit: *1000 Rp*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	Investment costs	Incremental operating costs	Incremental gross return	Balance (3)-(2)-(1)	Present value of 1	Discounted balance	Present value of 1	Discounted balance
					at 16% annual discount		at 17% annual discount	
1	48,357			– 48,357	0.826	– 41,683	0.855	– 41,354
2	371,093	3,655	37,093	– 337,655	0.743	– 250,877	0.732	– 247,163
3	363,197	7,311	74,186	– 296,322	0.641	– 189,942	0.626	– 185,497
4		14,622	148,372	133,750	0.552	73,830	0.535	71,556
5		14,622	148,372	133,750	0.476	63,665	0.458	61,257
6		14,622	148,372	133,750	0.410	54,837	0.370	49,487
7		14,622	148,372	133,750	0.354	47,347	0.335	44,806
8		14,622	148,372	133,750	0.305	40,793	0.295	39,456
9		14,622	148,372	133,750	0.263	35,176	0.245	32,768
10 – 20		14,622	148,372	133,750	1.321	176,683	1,080	144,450
						+ 9,829		– 30,234

The internal rate of return is about 16.2 percent.

Benefit – Cost Rate

The discount rate for calculating the current cost of investment and benefit shall be determined to consider the condition of loan in Yen, the loan interest for development investment; etc.

Where this rate is assumed to be 10%, the calculation will be made to use following formula:

(Unit: 1,000 Rp)

$A = V/U$

A: Net benefit rate

V: Current cost of total benefit

$$V = \frac{Qt}{(1+i)\,t} \qquad Qt = t \text{ yearly}$$

Qt = benefit in t yearly ($t = 1, 2, 3, \ldots n$)

U: current cost of total investment amount

$$U = \frac{Ct}{(1+i)\ t} \qquad Ct = \text{investment in t yearly} \quad (t = 1, 2, \ldots n)$$

B/C rate obtained by the following calculation is 1.36.

Benefit – Cost Rate

	Investment cost			Net benefit	Current cost calculate coefficiency	Current amount	
	Investment amount	Maintenance and management cost	Total		Discount rate 10%	Investment cost	Net benefit
1	48,357		48,357		0.909	43,956	
2	371,093	3,655	374,748	37,093	0.826	309,541	30,638
3	363,197	7,311	370,508	74,186.	0.751	278,251	55,713
4	–	14,622	14,622	148,372	0.683	9,986	101,338
5	–	"	"	"	⎤	⎤	⎤
6	–	"	"	"	5,345	78,154	793,048
.	.	.	.	.	⎥	⎥	⎥
.	.	.	.	.	⎥	⎥	⎥
.	.	.	.	.	⎦	⎦	⎦
20	–	14,564	14,564	148,372			
Total	782,647					719,888	980,737

$$A = \frac{980{,}737}{719{,}888} = 1.36$$