Short term varieties, the growing period of which is 90 - 105 days, are chosen for dry season cropping. The harvesting time is scheduled for one month between February and March. The harvesting tools (long edged knife) now in use are not suitable for the short culm variety like CCA. The new tools (top bending sickle) must be introduced and the low cutting method as well.

Paddy fields after dry season harvest will be left fallow under air-drying conditions for about two months (mid-March to mid-May). The cooperative nursery of 50 ha will be prepared, with the utilization of underground water, at the beginning of May.

Fig. 4-3-1 shows a model of Double Cropping Pattern.

4-3-2 Production Scheme

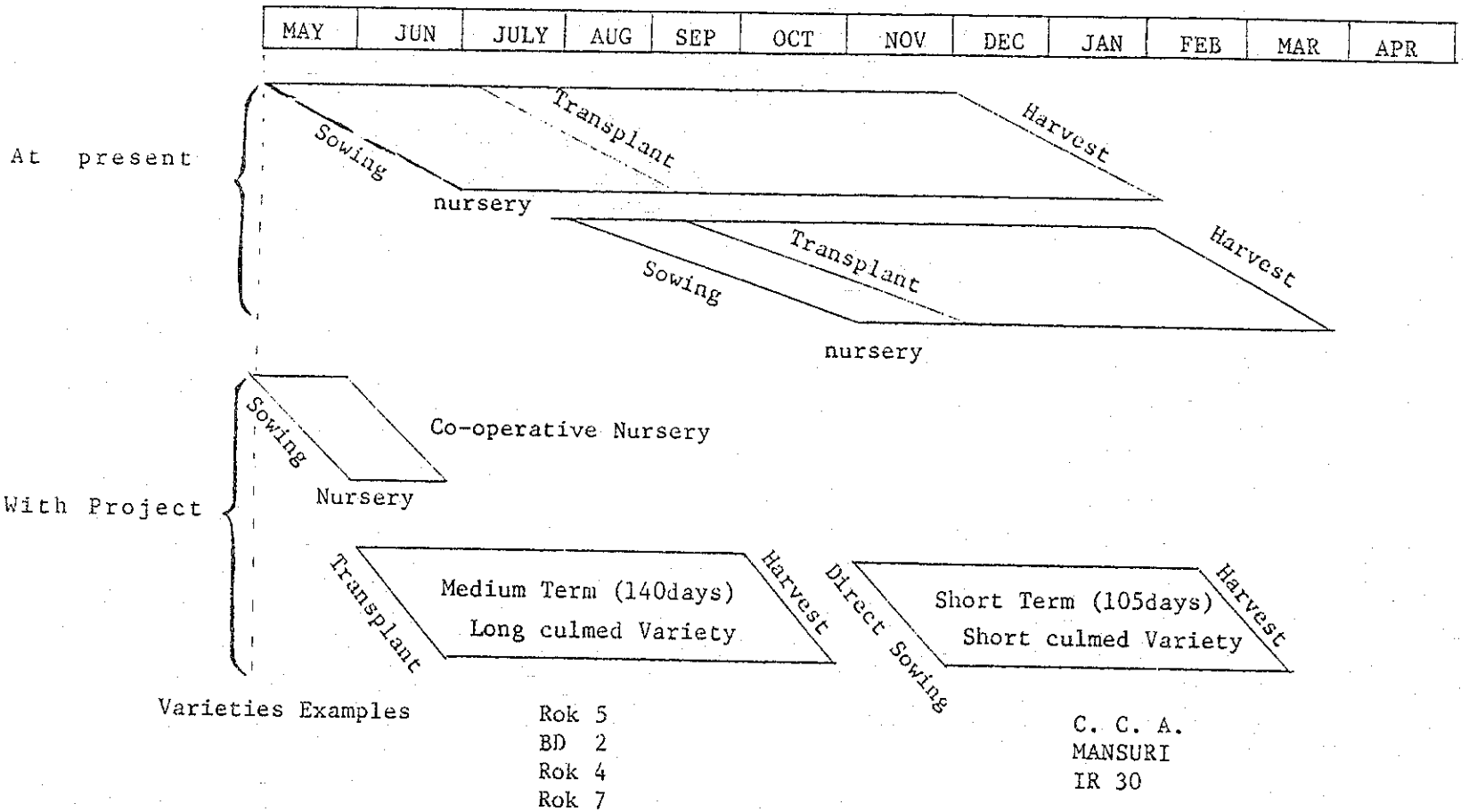
(1) Production

Paddy rice production is calculated from the harvest area and yield per unit area. The planned harvest area is 1,287 ha with an expected yield of 7 ton per year (wet season 3.5 t and dry season 3.5 t)

1,287 ha of harvest area is all the paddy field expected to be obtained from land consolidation. The cropping ratio supposes a 100% yield from each season's cropping. Land consolidation will be carried out in the first five years (1985 - 1989).

The yield mentioned above is a moderate estimate, arrived at by consulting the reports published in Rokupr Rice Research Station and Mange National Farm. Yield increase is closely related to watering and the amount of fertilizer applied.

Fig. 4-3-1 A Model of Double Cropping Pattern



Additional yield beyond that planned may be expected in the latter period with successful water management and extended service techniques.

The project's annual production scheme, to take place over the next 20 years/30 years, is in Table 4-3-2.

(2) Production Cost

The prospective cost per ha with the project will be increased by the cost of new items; mechanical service, fertilizer, water charge, pesticide, credit interest etc. The cost per ha will amount to Le. 338. The cost per yield of one ton of paddy rice will be Le. 110.86, equaling 1.7 times of the present cost.

The new project will need a labour force of about 200 Man Days (M.D.) in each season, although the direct sowing method employed during the dry season can cut about 40 M.D. from the labour force.

Hired labour per ha will increase from 36 M.D. to 88 M.D. The family labour share will decrease from 73.5% to 60.0%.

The estimated production cost for each season is shown as follows in Table 4-3-3.

(3) Developmental Programme

During the construction of the schemed three years from 1985 until 1987, the planned production is the same amount (846 ha of harvest area, 1.9 t/ha unit yield and 1,607 t

Table 4-3-2 Harvest Area, Yield, and Production
(20/30 Year Project)

Year	20 Years of Project after Construction			30 Years of Project with Construction		
	Harvest Area ha	Yield t	Production t	Harvest Area ha	Yield t	Production t
1982	(Basic Year of Project)			846	1.9	1,607
1985						
86	Under Construction			Under Construction		
87						
88	2,574	2.275	5,856	2,574	2.275	5,856
89	2,574	2.8	7,207	2,574	2.8	7,207
90	2,574	3.5	9,009	2,574	3.5	9,009
91	"	"	"	"	"	"
92	"	"	"	"	"	"
93	"	"	"	"	"	"
94	"	"	"	"	"	"
95	"	"	"	"	"	"
96	"	"	"	"	"	"
97	"	"	"	"	"	"
98	"	"	"	"	"	"
99	"	"	"	"	"	"
2000	2,574	4.0	10,296	2,574	4.0	10,296
1	"	"	"	"	"	"
2	"	"	"	"	"	"
3	"	"	"	"	"	"
4	"	"	"	"	"	"
5	"	"	"	"	"	"
6	"	"	"	"	"	"
7	"	"	"	"	"	"
8				"	"	"
9				"	"	"
10				"	"	"
11				"	"	"
12				"	"	"
13				"	"	"
14				"	"	"
			(Without Project)	846 ha	1.9t	1,607t

Tabel 4-3-3 Production Cost

Le. per ha

Cost Items	at Present	with Project	
		Wet Season	Dry Season
Seed	(54k) 20	(28k) 15	(42k) 23
Tools	8	4	4
Mechanical Service	-	38	38
Fertilizer	-	(5 bags) 45	(5 bags) 45
Pesticide	-	2	2
Hired Labour	(36M.D.) 94	(88M.D.)229	(72M.D) 187
Water Charge	-	25	25
Transportation	4	15	15
Credit Interest	-	(4%) 15	(4%) 14
Total Cost	Le. 126	Le. 388	Le. 353

Production Cost per t of Yield

(Le./t)

at Present		66.32
with Project	Rainy season	110.86
	Dry season	98.29

for total production) as the case without project. The same is applied to the unit production cost (Le. 126/ha).

After the construction, harvesting area per year will be enlarged to 2,574 ha with actual area of 1,287 ha of the paddy field, i.e., with the introduction of double cropping system. The yield will increase year by year to reach 3.5 t/ha in 1990.

For the production cost after the construction, the planned costs (Le. 388/ha in wet season and Le. 353/ha in dry season) are applied since 1988 although the yield is still low in 1988 and 1989.

Extension service works should be promoted in the year of 1985 with mechanical services as well as technical services. Both seed center and cooperative nursery are also going to start in the year to ensure the first year's (1988's) paddy cropping. Therefore the cropping credit into farmers are going to start in 1985, too.

4-3-3 Rice Cropping Technique

(1) Improved Varieties

Wet season varieties are mostly local ones of medium term, but there are some long term varieties like CP4. The project adopts medium term varieties for the wet season after careful consideration of the customary practice of farmers in the Project area. Rok 5 is the most popular medium term variety, which is recommended for the mangrove swamp fields by

Rokupr R.R.S. and Port Loko A.O. Rok 5 is the most promising from the point of view of seed supply and having already been partly introduced, though there are also some other recommended varieties of medium term as, for example; BD2, ROK 4, ROK 7.

The Project area will have to be stocked with Rok 5 seeds in Rokupr R.R.S. directly at first, but they will then be able to reproduce seeds by themselves from the next year on.

Self-supplied seeds amounting to 70% of the total stock, must be strictly selected from the yield by the selection machine in the Seed Centre.

C.C.A. is designed to crop for the dry season variety. C.C.A. has been tested over a period of ten years at Mange National Farm and has been spread out in a double rice cropping area of inland swamp.

Harvest operation is expected to improve with the sickle replacing the customary knife, because C.C.A. is of the short culm variety.

WARDA also recommends MANSURI or IR-30 of the short term varieties. It will be important to have aptitude tests on these varieties regarding preparation for pest and disease.

C.C.A. seeds will be taken from good stock at Mange National Farm. But the seeds will still be in need of a little further selection.

New improved varieties, designed to be introduced for double rice cropping, have the following characteristics (Table 4-3-4).

Table 4-3-4 Characteristics of the Varieties

Season / Varieties / Characteristics	Wet Season Varieties				Dry Season Varieties		
	ROK5	BO2	ROK4	ROK7	C.C.A	Mansuri	IR30
Ecology	Mangrove swamp	Mangrove swamp	Mangrove swamp	Inland swamp	Inland swamp	Mangrove swamp	Inland swamp
Duration (Days)	135-145	140	142-145	135-145	100	128	113
Growth Form	Elect	Erect	Erect	Erect	Erect	Erect	Erect
Height (cm)	135	115	135-140	150	80	118	91
Grain Length (mm)	7.87	7.55	7.98	5.30	7.20	8.10	7.90
Grain Width (mm)	2.07	3.43	2.48	2.52	3.00	2.80	3.20
1,000 Grains Weight (g)	29.6	27.5	25.3	21.2	18.0	17.1	20.2
Yield (kg/ha)	3,433-4,251	3,500	3,349	3,739-4,680	4,050	5,500	4,500

(2) Application of chemicals

Fertilizer is effectively applied when the water is well managed. It is sold by the bag of 50 kg for Le. 9 at the Governmental provided price, which is at a ratio of 45% when compared with the price of paddy rice of the same weight. This means that farmers could benefit by fertilizer application even if its price is raised by up to 2.2 times.

The amount of fertilizer to be applied is projected at 250 kg/ha of 20-20-0. This was decided after the discussions in Mange National Farm or in Katonga A.O. The amount to be applied in dry season cropping is planned to be the same quantity as that in wet season. At the Nursery stage in wet season only, fertilizer will be applied at the ratio of 100 kg per 1 ha of seedling bed.

The split application will be divided into three periods - when preparing the field, four and eight (nine) weeks after transplanting (direct sowing). Water in the field while applying fertilizer has to be stopped or to be drained for the fertilizer to be used effectively.

Many kind of pesticides are dealt with at the Agriculture Offices - Marathon, Brastine, Rogo and Sumithion, for example. But their extension to farmers cannot be expected for a while without sprayers.

Therefore it is recommended that the Extension Office organizes a unit of observers and a crop protection team which will protect and control all the Project area when opportune, in conjunction with the farmers.

The pesticide price is Le. 15/Liter (Marathon) which can be applied to about 20 ha of paddy field.

(3) Mechanical cultivation

The type and power of cultivator machines are designed the most fitted to the areal and economical factors. 120 units of 10 H.P. power tillers are schemed to be operated under 5 mechanical staff and 120 operators hired seasonally.

Every 24 units and operators under one staff will be arranged for each farming block consisting of 200 - 250 ha of paddy field (about 100 farmers).

Cultivated area per one machine is schemed 10 ha in one cropping season or 20 ha per year. This means that 1 ha of paddy field is cultivated by 3 machines in a day.

(4) Co-operative nursery

Nursery operation must be confined to the month of May to ensure the time of transplantation can be advanced. Seed selection and taking good care of the seedling bed will bring about good seedlings, which will greatly increase the paddy yield. Those techniques will be evolved by the farmers organization through the Co-operative Nursery planned for May at the beginning of wet season.

All the seedlings for wet season cropping will be bred in the Co-operative Nursery. The plan of operation will be formulated by extension workers. Contact farmers (Key farmers) will operate and manage the nursery farm with the help of officers and farmers.

The Co-operative Nursery will be located near the Seed Centre or Extension Office. Watering will be planned around the use of underground water. The style of nursery is "semi-irrigated nursery" involving a raised narrow bed and watering few times.

Seed selection results in about 70% good seeds. Seed quantity is about 700 kg per one ha of nursery bed. Taking poor seedlings away is always important whilst in the nursery bed stage or even before the transplanting.

In the nursery, 100 kg of fertilizer (20-20-0) will be applied per ha of nursery bed, divided into two periods - when making the bed and 10 days after sowing. Seed disinfection before sowing and pesticide spraying if needed after sowing will be implemented.

(5) Technical extension

The organization of technical extension, the head office of which will belong to the executive Project Office, will have an Extension Office (Techniques and Mechanics), a Seed Centre, and a Co-operative Nursery farm where they can also carry out breeding tests of new varieties.

The Extension Office will engage a staff of 5 technical and 5 mechanical employees. They will set up the cropping schedule and the mechanical arrangements. Each mechanical staff will manage 24 seasonal operators with 24 power tillers and ten sprayers.

It is planned that the Farmers Unit will organize about 100 farmers to every 200 - 250 ha of paddy field. Each block has 10 Contact Farmers (Key Farmers), who will contact both the technical and mechanical staff.

One contact farmer will oversee about ten farmers, manage 1 ha of nursery bed and provide the necessary seedlings for ten farmers holding 20 - 25 ha of paddy field.

The nursery farm will be used as a testing field for double cropping of short varieties. The yield on this farm is planned to be 8 ton/ha per year, just the same as Mange National Farm. The paddy rice will be sold and help toward maintaining the office.

Fig. 4-3-2 shows a Model of Extension System.

4-3-4 Farm Household Income

(1) Farming Scale

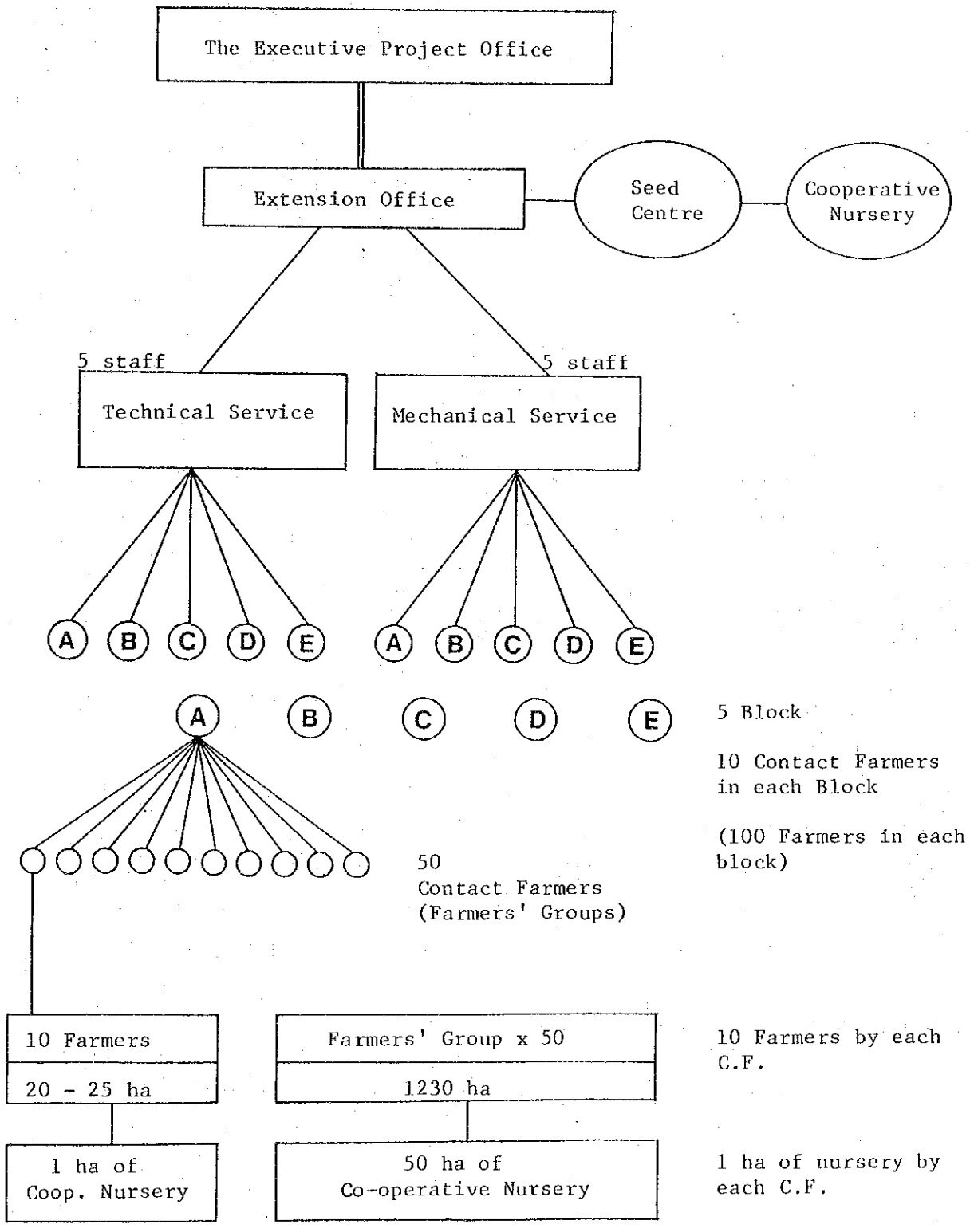
The area of paddy fields in the project area is 1,287 ha. Given the present number of farm households at 630, the average farm size in the project is about 2 ha.

Two hectares is a little larger than the farm size proposed in other agricultural projects in Sierra Leone, but the population in the area will increase not only by births but also by expected remigration from the city. Currently 804 persons are working away from home in contrast with 1069 taxpayers in the villages. The number of members in the farm family is expected to increase and enable larger scale cropping. Even so, it will still be necessary to hire from the outside labour force during harvest time.

(2) Income Level

The estimated income for each household after the project is completed is Le. 3,683 in rice farming and Le. 3,783 in total. This is based on an average farm size of 2 ha. Other crop income and non-agricultural income are separately estimated and shown in the farmers survey.

Fig 4-3-2 A MODEL OF EXTENSION SYSTEM



Rice forming net income will increase 4.76 times, by net production 10,018 kg/4 ha (368.3 bu/10 acre) in comparison with the current production 2,105 kg/1.35 ha (77.3 bu/3.38 acre).

Gross and net income and cost in detail are shown in Table 4-3-5.

After project completion, income of each farm (average 2.0 ha in size) will reach the level of surveyed sample farm households (average 6.2 ha of scale) supposed to rank above common farmers.

4-4 Irrigation and Drainage

4-4-1 Plan of Irrigation

For irrigation development, water needs have been estimated on the basis of crop water requirements, percolation and daily effective rainfall for cultivation of rice. The net irrigation water requirement is estimated in depth on the basis of a 10 day period. By applying the irrigation efficiency estimated at 0.80 for paddy field, the gross water requirement is estimated (Refer to Fig. 4-4-1).

The irrigation efficiency is composed of conveyance, field canal and application efficiency. Taking into consideration that the groundwater is within one metre from the ground level and that drainage re-use can be expected, the irrigation efficiency is estimated.

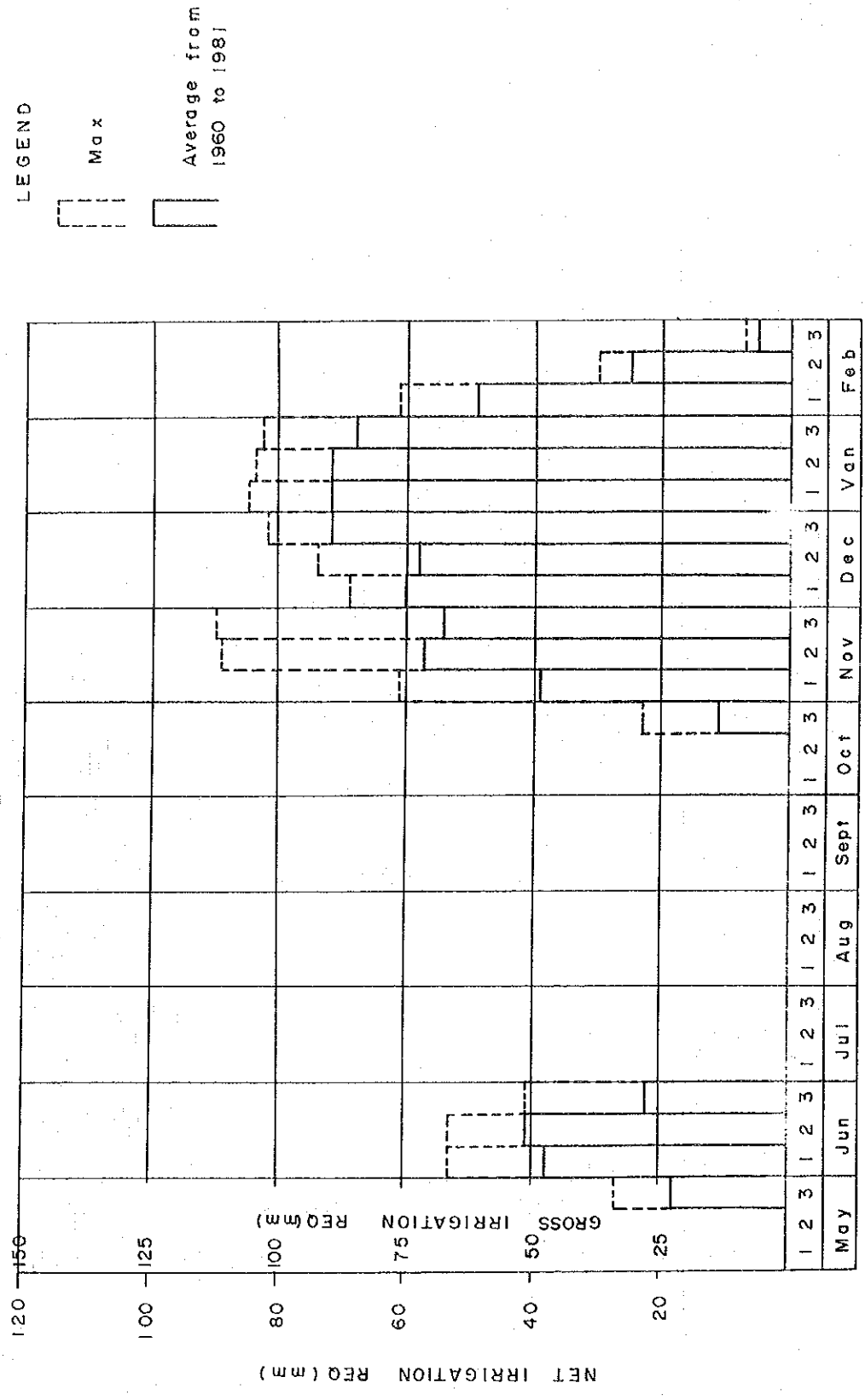
Further, on the basis of maximum daily irrigation for 12 hours, the diversion water requirement has been estimated at 3.0 cubic metres per second at the maximum for the net irrigation area about 1,300 hectares (Refer to Appendix Chapter 9-1-1).

Table 4-3-5 Gross, Net Income and Cost in Each Farm

	At Present			With Project		
	Rice Product	Other Agri.	Non-Agri.	Rice Product	Other Agri.	Non-Agri.
Farm Scale	1.35 ha			2.0 ha		
Cropping	1.35 ha			4.0 ha		
Yield/ha	1.9 t			3.5 t		
Production	2.568 t			14.000 t		
Gross Income	Le. 943.00	Le. 48.00	Le. 69.00	Le. 5,147.00	Le. 48.00	Le. 67.00
Pro. Cost	Le. 170.00	0	Le. 17.00	Le. 1,464.00	0	Le. 17.00
Net Income	Le. 773.00	Le. 48.00	Le. 52.00	Le. 3,683.00	Le. 48.00	Le. 52.00
Total Net Income		Le. 873.00			Le. 3,783.00	

* Paddy rice 1 bu (27.2 kg) = Le. 10.00 (1982, 12)

Fig 4-4-1 10 DAYS IRRIGATION WATER REQUIREMENT



For irrigation in paddy field, water is applied when water depth in the field is less than 50 millimetres in the dry season. In the wet season, irrigation is made supplementally when no rainfall continues. On the contrary, when heavy rainfall takes place, 200 millimetres out of the rainfall depth are to be detained in the field and the excess rainfall is drained.

During July, August, September and early October, no irrigation but drainage is necessary.

For irrigation of the study area, three water sources are studied, namely water of the Little Scarcies river, the Makemba North Swamp and groundwater. Out of those water sources, the water of the Little Scarcies river is selected as the logical choice. The Little Scarcies river generally has a monthly mean discharge of more than 20 m^3/sec in January and February. Since the maximum design discharge is estimated at 3.0 m^3/sec, the Little Scarcies water is sufficient to meet the design discharge.

From the intake structure at Rhombe, irrigation water is carried through the water supply channel, of which a cross section is shown in Fig. 4-4-2. At the pumping station (See Fig. 4-4-3) installed on each polder, the water is pumped up to the level of the distribution canal, through which the water is conveyed to each plot.

Fig. 4-4-2 CROSS SECTION OF WATER SUPPLY CHANNEL

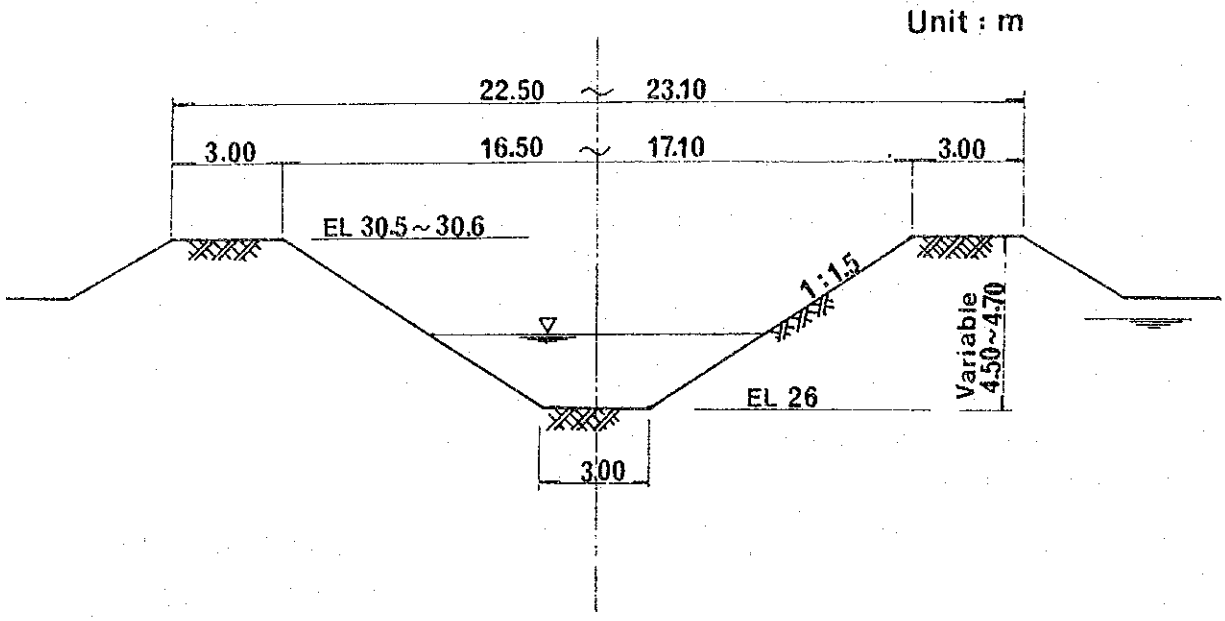
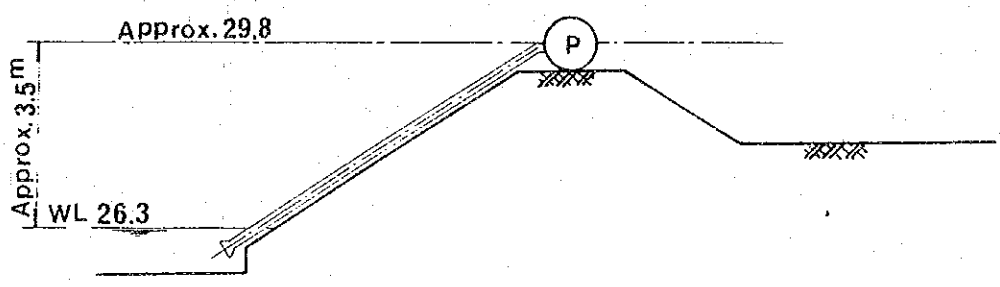


Fig. 4-4-3 PUMPING STATION



4-4-2 Plan of Drainage

The unit drainage requirement is calculated based on the provable rainfall. Drain period is assumed in accordance with the allowable flooding depth and time.

The flooding water will not intrude into the polder because of bunds and miter gates to be constructed at each polder.

Referring to Table 4-2-5 (Appendix), water levels at Konta for minimum low tide and maximum low tide for the month of September (1960 to 1962) are 28.41 m and 29.5 m with respect to the Storey datum.

Therefore, drainage by gravity through miter gates cannot be expected during this period at certain places which make up about 13% of the total project area. To resolve this limited problem, irrigation pumps could possibly serve as dainage aids.

The unit drainage requirement in the paddy fields is calculated in accordance with the following formula.

$$R = \frac{I - D}{T}$$

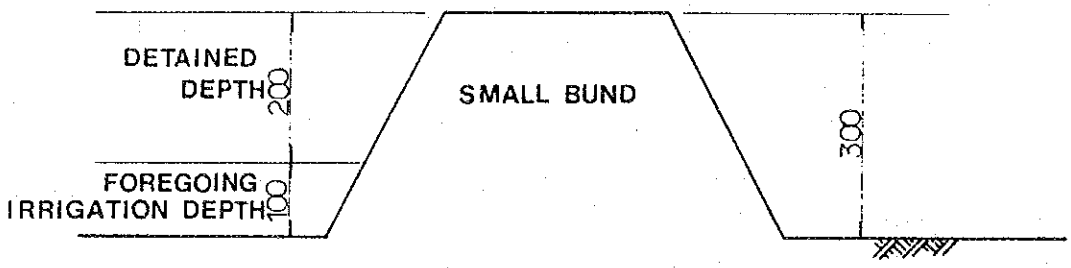
where, R: unit drainage requirement (mm/day)
I: design rainfall (mm)
T: drainage period (day)
D: detained depth (mm)

Design rainfall (I) is defined as a maximum of 3 days' consecutive rainfall for the return period of 5 years. According to the MRT report (page I.32), it is estimated to be 252 millimetres from the 36 years' rainfall data at Rokupr, by applying the Weibull formula.

Drainage period (T) is assumed to be three days, and the detained depth (D) of 200 millimetres is proposed

(Refer to Fig. 4-4-4). Accordingly, the unit drainage requirement in the paddy field is estimated at 17.3 millimetres per day, or 2 liters per second per hectare.

Fig 4-4-4 ILLUSTRATING DETAINED WATER IN ONE PLOT



4-4-3 List of facilities

The following facilities are proposed.

(1)	Small polders	16
(2)	Water supply channel	L = 13,250 m
(3)	Miter gate (Rhombe, 3.0 m x 2.25 m x 2)	1 each
(4)	Miter gate (Makasa, 3.0 m x 4.0 m x 2)	1 each
(5)	Siphon 2 m x 1.5 m Average length 43.5 m	4 each
(6)	Siphon ø800 Average length 57.3 m	4 each
(7)	Facilities for land consolidation	
1)	Pump station for irrigation and drainage Q = 7.0 m^3/min x 2	16 each
2)	Miter gate 1.5 m x 1.0 m	32 each
3)	Swing gate 0.8 m x 0.8 m	32 each
4)	Circular slide gate ø1,000	16 each
5)	Distribution channel	96,000 m
6)	Drain channel	136,000 m
7)	Wooden bridge W = 3.0 m Average length 32.2 m	18 each
(8)	Trunk road	
1)	Embankment W = 6.0 m	7,770 m
2)	Cutting W = 6.0 m	5,080 m
(9)	Bridge W = 6.0 m concrete slab made	
1)	Bridge W = 6.0 m L = 50 m	1 each
2)	Bridge W = 6.0 m L = 30 m	2 each
3)	Bridge W = 6.0 m L = 15 m	3 each

4-5 Land Consolidation and Farm Road Planning

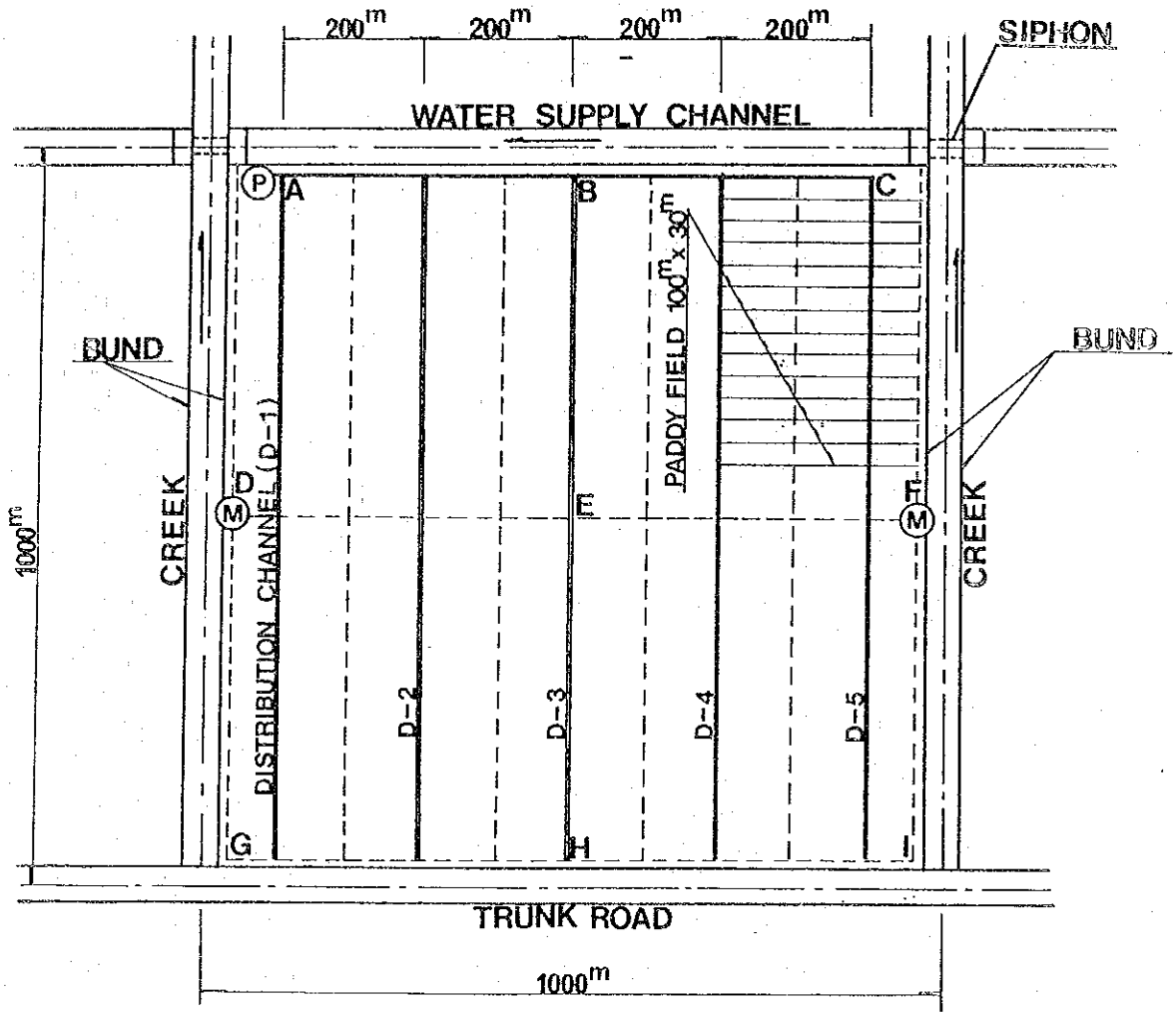
4-5-1 Land Consolidation Planning

(1) General

The 100 ha standard polder is being considered for use in the land consolidation plan.

The model is illustrated below.

Fig. 4-5-1 Land Consolidation Plan



(2) Distribution channel

1) Main channel A-B (See Fig. 4-5-1).

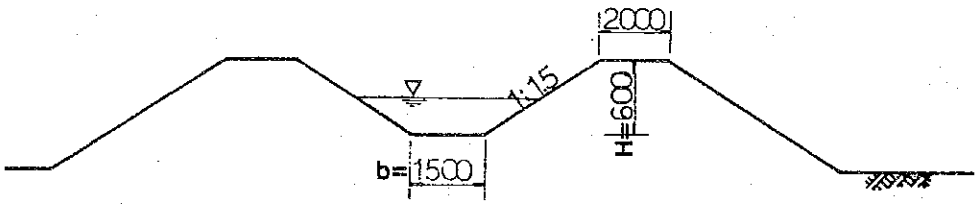
$Q = 0.23\ m^3/S$ (This is calculated from irrigation requirement)

$n = 0.027$

$I = 0.00075$ (Elevation of A is 29.5 m and that of B is 29.13 m)

The following channel section is assumed;

Fig 4-5-2 DISTRIBUTION CHANNEL



$$K_1 = \frac{Q.n}{I^{1/2}\ b^{8/3}} = \frac{0.23 \times 0.027}{0.027386 \times 2.9484} = 0.080$$

$$\frac{H}{b} = 0.22 \qquad \therefore\ H = 0.33\ m \text{ (water depth)}$$

Therefore, the height of the channel is determined at 0.60 m, including a 0.27 m freeboard.

2) Main channel B-C

Assume b = 0.8;

K_1 = 0.172 H = 0.26

$V = \frac{1}{n} \times R^{2/3} \times I^{1/2} = 0.32$ m/S

Therefore the height of channel is determined at 0.60 m, including a 0.28 m freeboard.

3) Distribution channel (D-1, D-2, D-3, D-4)

Assume b = 0.4;

K_1 = 0.3946 H = 0.2

Therefore the height of channel is designed to be 0.5 m.

4) Distribution channel (D-5)

Assume b = 0.5;

K_1 = 0.3005

H = 0.215

Therefore the height of channel is designed to be 0.5 m.

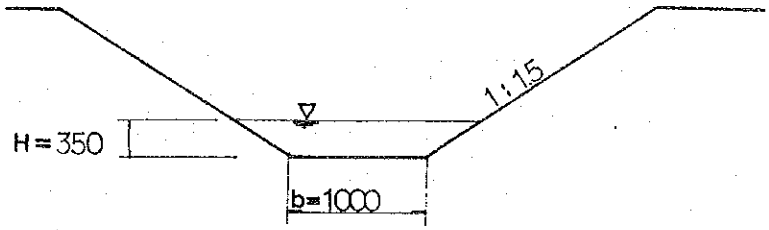
(3) Drain channel

Irrigation pumps can be also used as a drain purpose. The capacity of pump is 0.23 m^3/s. Accordingly the main drain channel (channel A-D) should have the same capacity. The elevation at point D is 27.0 m and that of A is 26.5 m. (See Fig. 4-5-1)

Assume b=1.0m ; I=0.001

k=0.20 $\frac{H}{b}$=0.35 ∴ H=0.35m

Fig 4-5-3 PROPOSED SECTION OF DRAIN



Therefore the section of drain channel between A-D-E-F is proposed to the same as the above illustrated one (Refer to Fig. 4-5-3)

Bottom width b of other feeder drains is proposed to be 0.5 m.

(4) Miter gate and swing gate

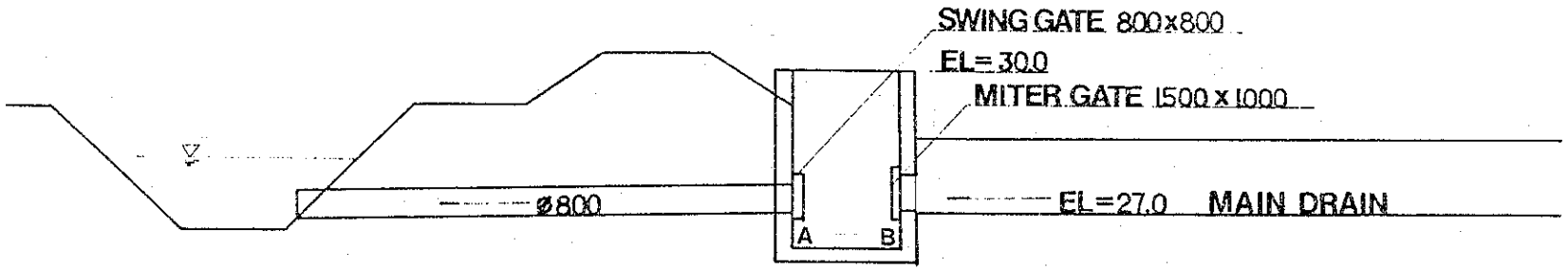
1) Wet season

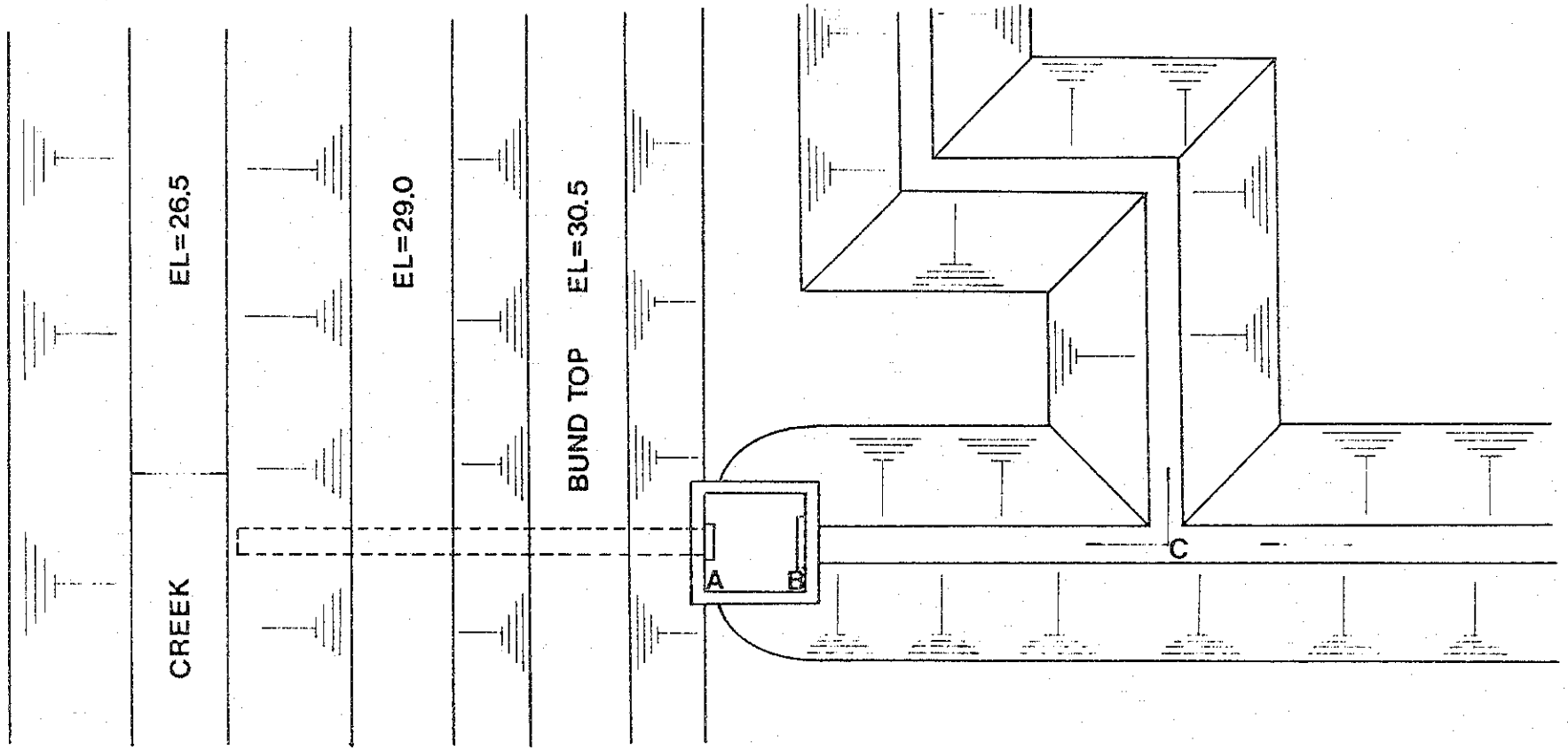
Drain from the polder will be made during the time of the creek's lower water level. Swing gate A will be fixed in the open position and miter gate B will be operated automatically by the pressure of the water (See Fig. 4-5-4).

Referring to Table 4-2-5 of the Appendix, it is clear that even at the time of lowest tide the water level of the creek is so high (28.7 m, Storey datum) that drain through the miter gate is not possible.

This being the case, the excess water is conveyed to point A and drained through the slide gate into the water supply channel.

Fig 4-5-4 MITER AND SWING GATE



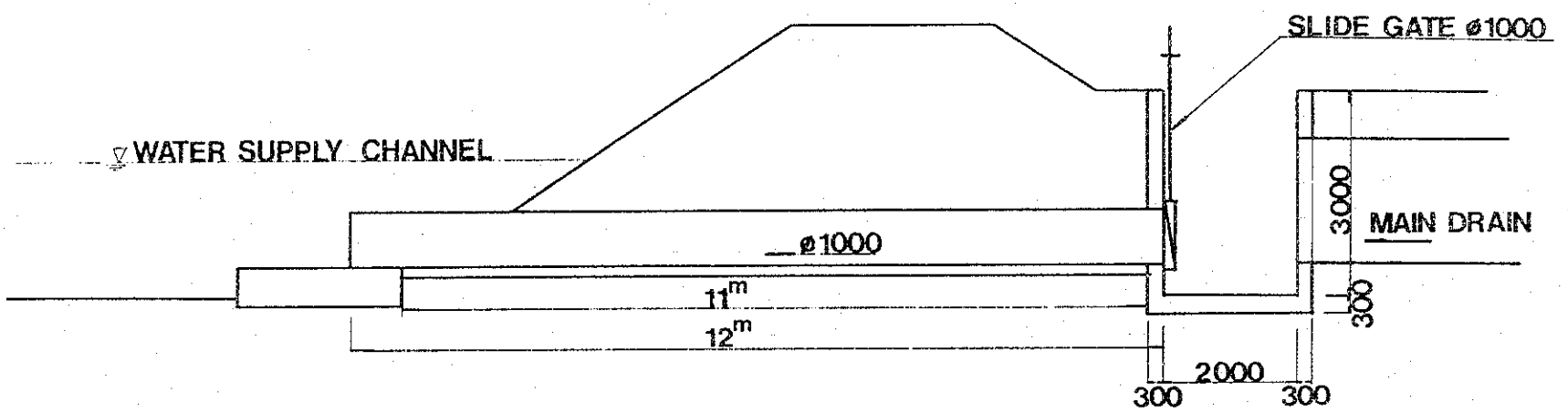


This slide gate is operated manually (See Fig. 4-5-5).

2) Dry season

There are many days when the electric conductivity of creek water is below 2,000 μs/cm, even in the dry season. In this case swing gate A is operated and miter gate B is opened and fixed. At the time of high tide, creek water is introduced to the paddy field through the drain channel and is used as irrigation water.

Fig 4-5-5 SLIDE GATE



4-5-2 Farm road planning

The purpose of the farm roads planned is to provide easy access for farming activities as well as for operating and maintaining irrigation and drainage facilities. The farm roads are classified into three categories, trunk roads, branch roads and feeder roads, according to their purpose.

Presently, under the swampy environment of the project area, waterborne transportation by traditional boats has been developed and is the only means of transport available.

A specific problem in the project area is that the cost required for embankment construction is considerably high in this type of swampy area.

For this reason, considerations are given to minimize the volume of embankment. Accordingly the width of the banks and canal embankments, on which the branch roads are to be constructed, is minimized.

On the other hand, the creeks among these polders will be much improved for the waterborne transports from polders to the trunk roads. The width of these creeks is designed to be 15 m with a depth of 2 m.

Therefore, the branch and feeder roads to be constructed within each polder will play only a supplementary function of transportation in the project area.

The trunk roads are designed to combine the project area with the national road between Port Loko and Lungi which is extended to Freetown. The alignment and standard cross section of the trunk roads are shown in Fig. 4-5-6 and 4-5-7.

Further details of these farm roads are summarized as below:

Fig 4-5-6 PLAN OF TRUNK ROAD

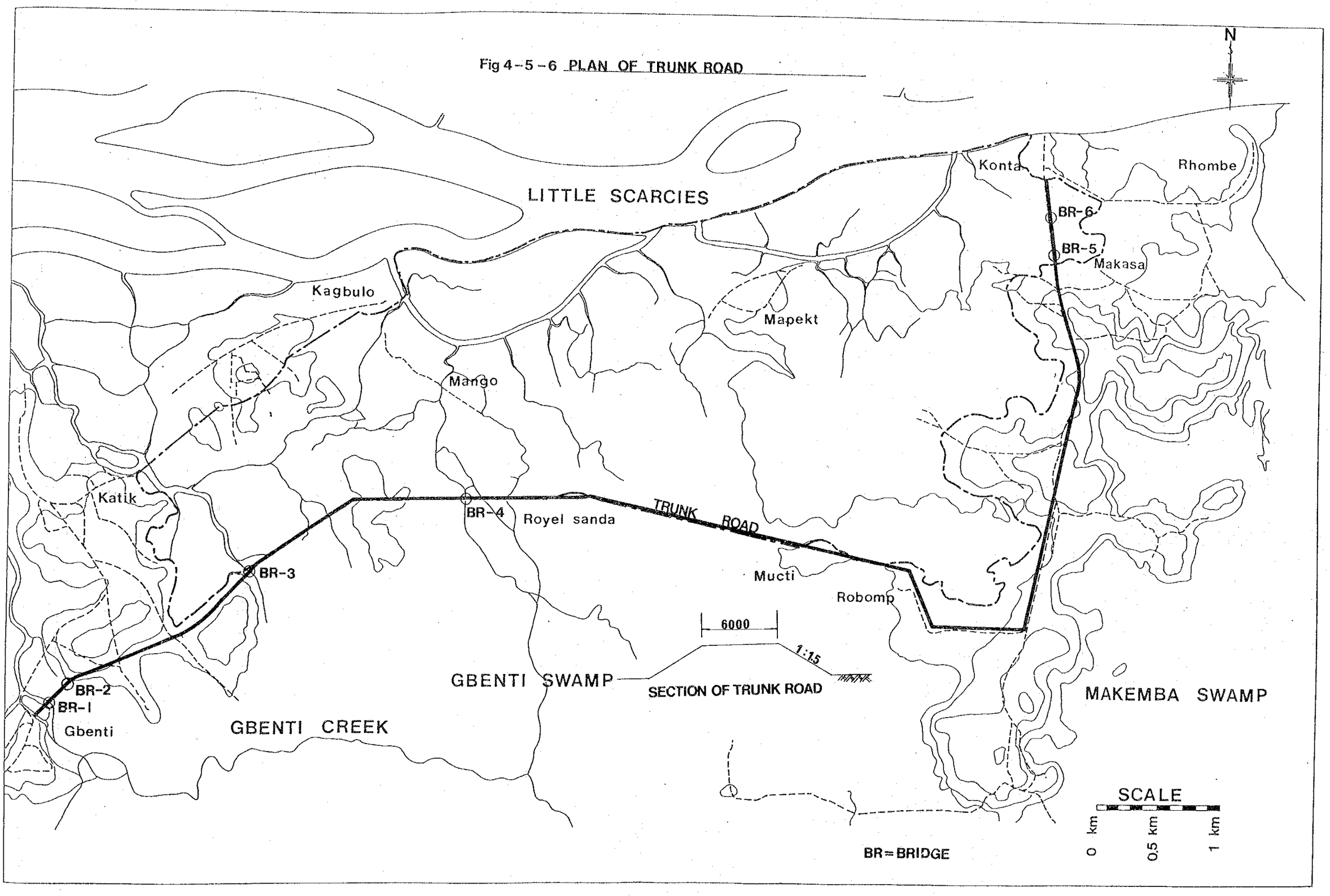
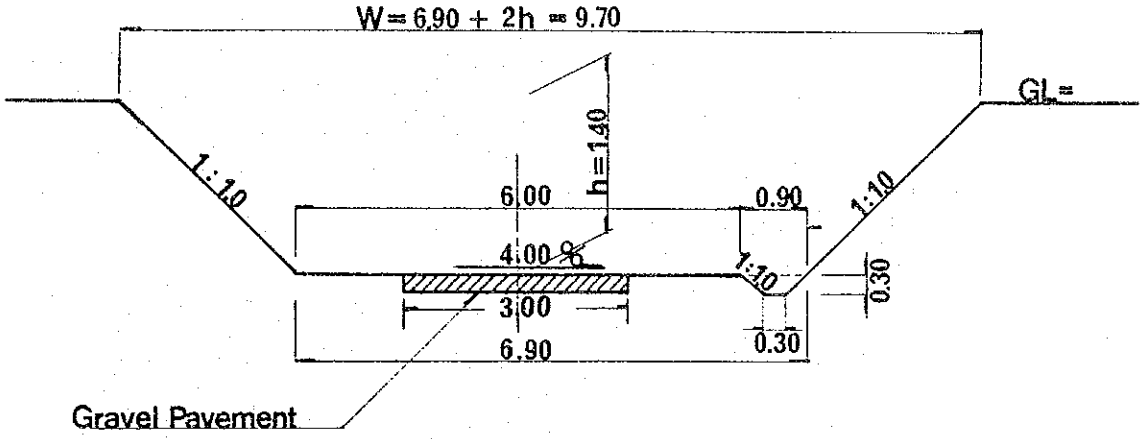


Fig 4－5－7 TRUNK ROAD STANDARD SECTION



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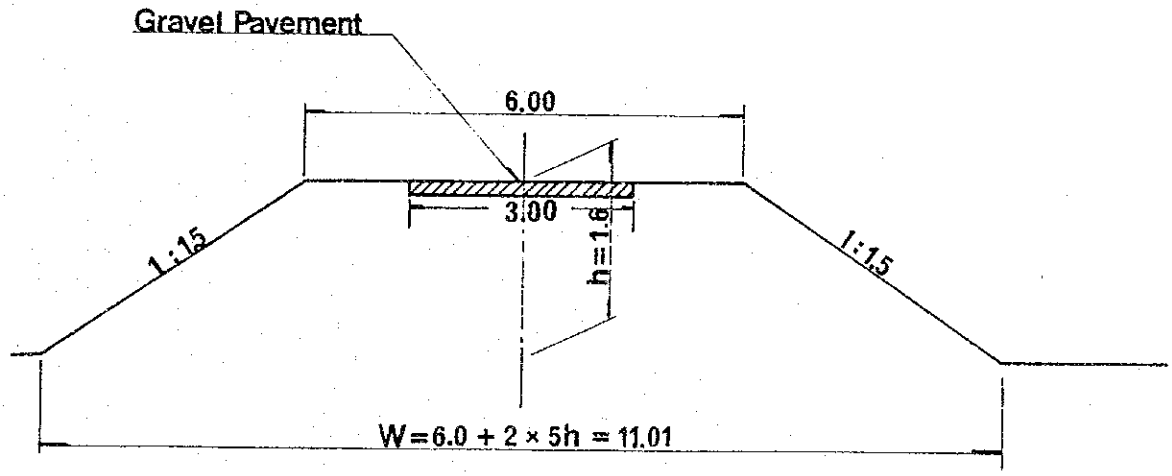


Section of Embankment

Table 4-5-1 Principal Dimension

	Trunk Road	Branch Road	Feeder Road
Total width (m)	6.0 m	3.0 m	2.0 m
Effective width (m)	5.0	2.0	1.4
Length (km)	13.0	56.0	192.0
Density of Road (m/ha)	7.5	35.0	120.0

CHAPTER 5 IMPLEMENTATION PROGRAM

CHAPTER 5 IMPLEMENTATION PROGRAM

5-1 Construction Plan and Schedule

The implementation program is divided into two stages; preparation of tender documents and construction of works.

Preparation of Tender Documents includes;

(1) Necessary additional surveys

(2) Determination of Location and Dimension of Facilities

(3) Detailed Design Drawing

(4) Design Calculation and Design Notes

(5) Technical Specifications and Bill of Quantities

(6) Contract Forms for Tender, Bid Bond, Agreement and Performance Bond

For this purpose nine months will be required before the tendering to determine the contractor which will require 6 months.

After 15 months from the commencement of the detailed design stage, the construction will be started and will be completed after 29 months (See Fig. 5-1-1).

5-2 Construction Cost and Operation/Maintenance Cost

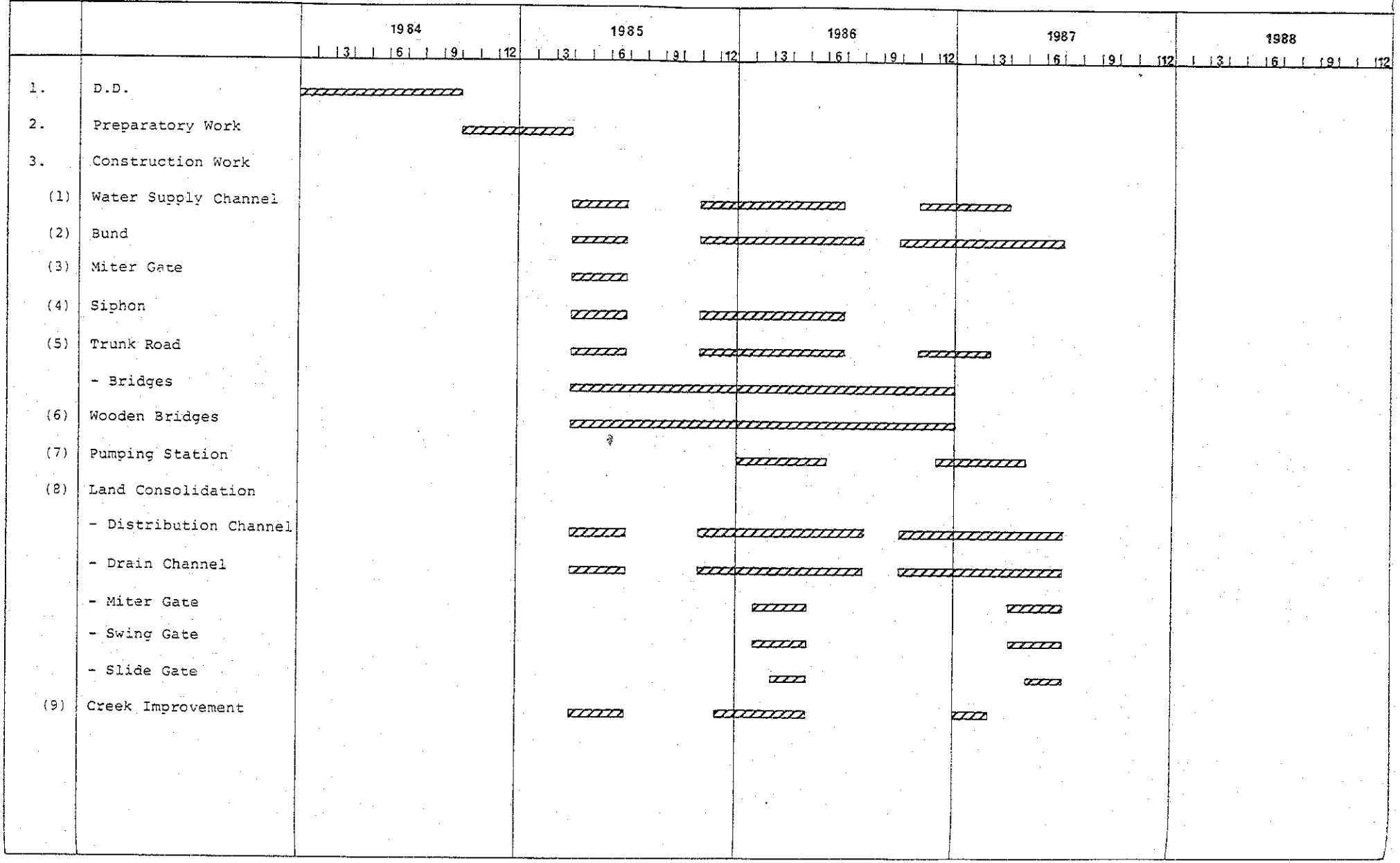
5-2-1 Construction cost

As shown in Table 5-2-1, the total construction cost is estimated at Le. 28,156,000, Le. 23,361,000 of which will be incurred by foreign expenses and the remaining Le. 4,795,000 will be the portion incurred by local expenses.

The above estimate is based on the following.

(1) Unit cost applied for the labour cost and

Fig 5-1-1 CONSTRUCTION SCHEDULE OF THE PROJECT



material cost is the actual cost in Sierra Leone at 1983 prices.

(2) Unit costs for material and machinery which are not available at Sierra Leone are estimated based on the actual cost for these in Japan at 1983 prices.

(3) Exchange rate between Japanese yen and Sierra Leone Leone is estimated as below:

Le. 2.40 = US$1.0
¥235.0 = US$1.0

(4) Overhead cost includes administration cost, project facilities and the engineering service cost.

About 28% of the construction cost is equivalent to the overhead cost of this project.

(5) Contingency consists of the physical contingency and price contingency. The physical contingency is estimated at 10% of the construction cost and overhead cost. The price contingency is estimated for each currency, foreign and local currencies in a percentage of the construction cost, overhead cost and physical contingency. The percentage of physical contingency and price contingency is estimated at 10% and 15% respectively.

(6) The project cost consists of the construction cost, overhead cost and contingencies.

Table 5-2-1 INVESTMENT COST OF PROJECT

	Work Item	F/C	L/C	Total
1.	Preparatory Work	-	20,000	20,000
2.	Water Supply Channel	Le. 731,000	Le. 465,000	Le. 1,196,000
3.	Bund	Le. 2,278,000	Le. 978,000	Le. 3,256,000
4.	Siphon	Le. 443,000	Le. 210,000	Le. 653,000
5.	Miter Gate	Le. 54,000	Le. 8,000	Le. 62,000
6.	Land Consolidation	Le. 3,393,000	Le. 194,000	Le. 3,587,000
7.	Pump Station	Le. 1,577,000	Le. 82,000	Le. 1,659,000
8.	Creek Improvement	Le. 181,000	Le. 5,000	Le. 186,000
9.	Trunk Road and Bridges	Le. 2,451,000	Le. 329,000	Le. 2,780,000
10.	Farm Road Bridges	Le. 1,538,000	Le. 68,000	Le. 1,606,000
	Sub-Total	Le.12,646,000 (US$5,269,166)	Le, 2,359,000 (US$982,916)	Le.15,005,000 (US$6,252,082)
11.	Project Facilities	-	Le. 197,000	Le. 197,000
12.	Administration Cost	-	Le. 277,000	Le. 277,000
13.	Consulting Services	Le. 3,641,000	Le. 117,000	Le. 3,758,000
14.	Overseas Training	Le. 106,000	-	Le. 106,000
	Sub-Total	Le.16,393,000 (US$6,830,415)	Le. 2,950,000 (US$1,229,165)	Le.19,343,000 (US$8,059,580)
15.	Physical Contingency	Le. 1,639,000	Le. 295,000	Le. 1,934,000
	Total	Le.18,032,000 (US$7,513,332)	Le. 3,245,000 (US$1,352,081)	Le.21,277,000 (US$8,865,413)
16.	Price Escalation	Le. 5,483,000	Le. 1,550,000	Le. 7,033,000
	Grand Total	Le.23,515,000 (US$9,798,000)	Le. 4,795,000 (US$1,998,000)	Le.28,310,000 (US$11,796,000)

5-2-2 Operation & maintenance cost

Operation and maintenance cost of the project is estimated based on the fixed percentage of the construction cost of the facility. The fixed percentage of the operation and maintenance cost of the classified facility is summarized as shown in Table 5-2-2.

Table 5-2-2 Basic Ratio of Operation and Maintenance Cost

Item	% (Year)	Durable Years
Water Supply Channel	0.5	20
Pump Station	L.S.	20
Bund, Road and Concrete Bridges	0.1	50
Gate and Project Facilities	0.5	30
Siphon	0.5	40
Wooden Bridge	0.5	10

Based on the above fixed percentage of the operation and maintenance cost, necessary operation and maintenance cost of the project is estimated at Le. 1.789,000 for 30 years of the project life. Details of the estimated operation and maintenance cost of each major facility of the project are summarized as shown in Table 5-2-3.

Table 5-2-3 Operation and Maintenance Cost

Unit: Le. 1,000

Item	Cost	Remarks
1. Water Supply Channel	124	For 30 years
2. Pump Station	20	"
3. Bund, Road and Concrete Bridges	181	"
4. Gate and Project Facilities	39	"
5. Siphon	57	"
6. Wooden Bridges	240	"
7. Personnel Expenses	817	"
8. Running Cost	311	"
Total	1,789	For 30 years

5-3 The Project Executing Agency, Management Organization and Farmers Organization

The direct objective of the project is to provide the designated area with polders, irrigation and drainage facilities so that the potential of the land is increased to allow the farmers to cultivate the paddy twice a year. Currently, the funds that have been allocated for this project cover only the construction costs and administration costs which will occur throughout the construction period. Without funding for the executing agency, project management organization, and a farmers organization, however, the likelihood of successful completion of the project as well as an increase in crop production, is limited. The Government of Sierra Leone is urged to outlay the money for the above-mentioned organizations in addition to the local construction and administrative costs. Recommendations concerning these organizations are as follows:

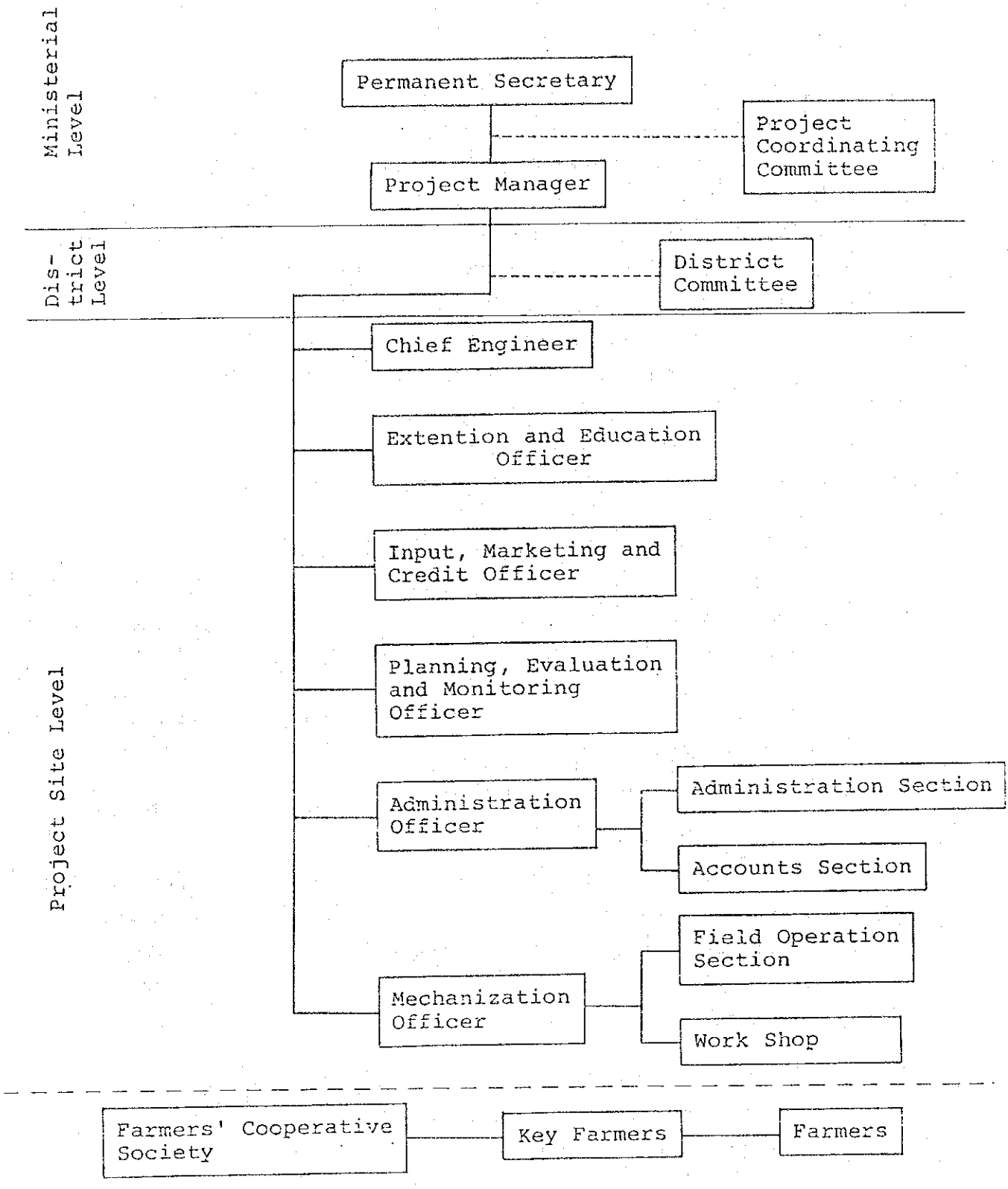
The chart of the project management organization is given in Fig. 5-3-1.

The Ministry of Agriculture and Forestry (MAF) should be the executing agency for project implementation. The organizational arrangement should be designed to integrate with the existing administrative structure of the MAF and further to strengthen it.

(1) Ministerial Level:

Overall coordination and management of project implementation will rest with the project manager who is directly responsible to the permanent secretary of the MAF. In other word, the organization formed under him is structually independent from the other departments of the

Fig. 5-3-1 PROJECT MANAGEMENT ORGANIZATION



MAF, so responsibility as well as authority of implementing the project lies solely on the project manager.

A project coordinating committee should be formed if there is a consensus that such a committee will serve to facilitate coordination at the inter-ministerial level.

The ministries represented to the committee besides MAF would be finance, economic planning and cooperative. Agencies such as SLPMB and Sierra Leone Cooperative Union may be invited to the committee. The committee would be entrusted the tasks of approving the budget and work programmes, reviewing them, while checking the actual work done as well as expenditure.

(2) Regional Level:

At the regional level, regional committee would be established. Its function is to bring the members the situation of the project up to date and get their review. The member consists of the officers of regional level of the ministries and other agencies concerned, some of which are mentioned above.

According to a proposal for restructuring the MAF made by a world bank mission in 1981, establishment of the regional headquarter is proposed; this regional committee is ranked parallel to it. The presence of this committee is to facilitate the implementation of project by giving the staffs of regional level of other organizations concerned a sense of involvement to the project.

(3) Project Site Level:

1) Chief Engineer:

The office of chief engineer would supervise construction work with consultant engineers at the time of implementation period; when the work is completed, its duty would be to repair and to maintain the whole structure of irrigation and drainage facilities as well as to supervise the control of irrigation water according to the schedule made by the extention officer. Taking the critical moment when the salt water intrusion takes place at the time of high tide in the dry season into account, the close coordination between this office and that of extention officer is crucial. Regular checking of salinity level of the river water falls also on the responsibility of this office.

2) Extention and Education Officer:

This office would prepare the basic schedule for double crop paddy cultivation. It has a wide range of responsibility, from water management to technical transfer, especially to the farmers. Close contacts with the farmers as well as other offices are essential. The project office has to win the farmers' confidence by all means, and timing of information on salinity intrusion and of input have direct effect on the farm output which concerns all the farmers most. Extention effort is discussed in Chapter four (see Fig. 4-3-2).

3) Input, Marketing and Credit Officer:

This office has overall responsibility to the organizations concerned. The input section has an administrative channel to the Sierra Leone Co-operative Union and Government Seed Multiplication Farm; marketing section to SLPMB and credit section to some of the agricultural financing agencies explained in Fig. 2-3-1. On the other end, the office has to make a daily supervision on the farmers' cooperative society in its keeping the records of the incoming input goods, of their storage and distribution, and of book keeping. Considering the low level of administrative capability of farmers' cooperative, at least at the initial stage, actual handling of money and its book keeping for input credit including the collection of water charges should be conducted by this office.

4) Planning, Evaluation and Monitoring Office:

In order to grasp the basic socio-economic life of the farmers in the project area, this office would have to conduct a socio-economic survey of the project area as the base-line data while the construction work is at its detail design stage, then it would have to collect further informations periodically for the evaluation of the project, besides the daily contact with the farmers and the staffs of the project office. It goes without saying that the accuracy of the information furnished by this office are vital for the success of the project.

5) Administration Officer:

Administration section of this office would oversees the general administration aspect of the office activity such as scheduling and checking of daily programmes of office staffs and office vehicles, controling inventory of stores and taking care of public relations.

The account section is to establish the accounting system which is valid both within the project office and to the banks which financed the project. All the purchases of the goods and services by the project office are to be done through this office, which controls the flow according to the budget. This office would get also the copy of the credit records and grasp the credit balance to the farmers with an intention to secure the capital for the credit for the next crop season.

6) Mechanization Officer:

The field operation section of the office would prepare schedule for land preparation and harvesting, according to the cropping schedule made by the extension officer. This section also controls the tractor drivers. Responsibility of maintenance and repair of farm roads and project office buildings comes under this section.

The mechanical section would conduct the maintenance work of pumps, tractors, vehicles and other equipments. It is also responsible for keeping the logbooks of drivers and the inventory of the spare parts, fuel and

lubricants for the analysis of efficiency of farm mechanization and for the timely renewal of the materials and supply of fuel.

7) Staffing of the Office and Training of the Office Staffs:

Ideally, the offices mentioned above would be entrusted to the experienced hands. If they are not found among the staffs of MAF, the project could do with some expatriates at the initial stage of the project implementation with an appropriate on-the-job training programmes for the successors from MAF. To find a source or two of fund for the payment to the expatriates is most difficult part of it. One of the feasible way of finding it is to make use of technical corporation aid scheme of any donor country which consists of grant element. For the Sierra Leonian, it would be wise to avoid as far as possible to recruit from outside MAF, which in turn will create a special pay scale. Motivation ought not be stirred by the monetary incentive but rather through ideological approach toward the national integration. There have been some examples that as soon as inflow of fund to the project from the donor organization stops, the function of the project office will deteriorate. Given the autonomy, the maximum effort for self-reliance in the part of the project office would be encouraged.

At the same time the increase of the workload should be minimized, and the grade of administrative efficiency be raised with appropriate staff training

programmes so that the existing man power of the ministry can handle the work. Experiences of existing IADPs in Sierra Leone have given valuable examples of how this can be achieved.

Since education of the small farmers is crucial to project success, other field officers besides the field engineer, such as officers for extension and education, for inputs, credit and marketing, for mechanization, for monitoring and evaluation, and for administration and accounts should be appointed as soon as the schedule for civil work is prepared. Likewise, the formation of the farmers cooperation should commence along with these appointments.

5-4 Complementary Services

(1) Credit for Input and Small Equipment:

The necessary initial capital to start the credit scheme for inputs and small equipments should be arranged through the network of agricultural finance institutions (see Fig. 2-1-1). If we take an example of the case with IADP loan scheme for the swamp rice development project in the eastern region, which is shown in App. Table 1-1-11, where each farmer of 1.2 ha holding will get about 60 Leons seasonal loan with 10% interest deducted, this project office should have about 65,000 Leons for 1,070 farmers as the initial fund. Then 45 Leons per farmer for the purchase of small implements, which comes about 55,000 Leon in total with 10% annual interest included.

The responsibility of repayment rests on the farmers' union of the project area. Repayment of the loan in kind would be handled by the SLPMB through the project office.

(2) Processing:

So far, parboiling is done by individual farmers and husking is done by some small rice mills located in and around the project area. Though the machines are conventional and the scale is very small, the private rice mill will safely handle any amount of rice produced from the project area. Their number will increase according to the amount of the rice production. If the government initiative is shown in this area of activity, and sets up a medium scale rice mill, it will be well and good.

(3) Storage:

Either the project office might provide a storage in its office premises or SLPMB depo for the project might, but these storage facilities are for the rice sold or as repayment of loans in kind. So it would be a good idea to give loan to the farmers to encourage them to buy improved small storage bin or box to keep their crop free from damage caused by insects or rodents, so that they can sell rice in the period of short supply.

(4) Marketing:

This comes under the responsibility of SLPMB. There are also marketing network of private rice merchants who act at the same time as money lenders, in which price varies according to the demand of the market. If the farmers' cooperative

of the project area is able to function as a strong selling agent with its own marketing strategy, it can save the commission to initiate afterwards some useful processing industry of its own.

5-5 Engineering Services and Training

An experienced expatriate consulting firm will be engaged to assist the M.A.F. of Sierra Leone and other agencies responsible for project implementation.

The expatriate consultants will work in association with the local consultants. The local consuntants will be employed by the Sierra Leone Government to carry out survey, investigation and preliminary design work prior to the expatriate consultants' arrival. The expatriate consultants will be supported by local consultants in preparing work programmes, detailed design and contract documents. In supervision of the Project Works including agricultural development, the expatriate consultants complemented by the local consultants will provide assistance to the Government staff for effective implementation of the Project.

Though the Sierra Leone Government has already undertaken some of irrigation project, its experience on pumping station, water management and institutional aspects is limited. So it is necessary for the Sierra Leone Government to draw up a programme of overseas training for 3 technical staffs who are directly related to the Project implementation for about three months each to visit an advanced country with experiences in improved irrigation engineering, water management, and institutional development, in addition to the on-the-job training provided by the consultants. In this connection, an amount of Le. 106,000 of foreign currency is provided in the estimate.

CHAPTER 6 A REVIEW OF MRT REPORT

CHAPTER 6 A REVIEW OF MRT REPORT

6-1 General

Rhombe Swamp Engineering Feasibility Study was carried out by MRT Consulting Engineers Ltd. under assignment by the Overseas Development Administration, Foreign and Commonwealth Office, London.

The field study started in September 1970 and ended in February 1972. The report was submitted in August 1972.

The objective was to find out the engineering feasibilities and overall effect concerning the agriculture development of the Rhombe swamp area. In the report, Rhombe Swamp is sub-divided into six sub-areas, and 19 combinations of the sub-areas including total area, are selected to find out the most feasible project scale where irrigation and drainage system can be laid out to the best effect.

The chosen project is the combination of sub-areas, Makemba-North, Gbenti-South and Gbenti River mouth (Net cultivable area ca. 4,400 ha) with pumping irrigation and gravity drainage. The project is selected mainly because the unit construction cost is the cheapest. A future stage-wise construction programme incorporating the sub-areas which are omitted from the combination, i.e., Rhombe (the name of the sub-area), Makemba-South, Gbenti-North, is not elaborated in the report except an estimate of construction cost for the total area.

In the following sections we tried to review its contents. As the title of the report suggests, its range of study is limited to the engineering aspect of the project. Such topics as agricultural

potential or soil quality are discussed cursorily. Neither is the economic analysis of the swamp development carried out.

The basic difference of attitude towards the project concept and its formulation is that the MRT Report has tried to identify the optimum combination of sub-areas of the total Rhombe Swamp, whereas in this study, the target project area is primarily Gbenti-North sub-area, though this project itself is regarded as the first phase of the development plan for the entire Rhombe Swamp area. Moreover the sub-area which this study is taking up is not included in the combination of sub-areas which the MRT Report has chosen, because the area is a riverline land and is hydrologically rather independent from the rest of the area. Such is the case, there is few common spheres on which we can set an axis of comparison.

Various climatic and hydrological data continuously taken during MRT's two year period of study are very useful for our follow-up study.

By finding delicate hydrological equilibrium which is familiar to the rivermouth area under monsoon climate, choice of the water intake site and the choice of the rice variety with the introduction of suitable cropping pattern are the factors which make a breakthrough in the realization of the project.

We take this opportunity to express our appreciation to MRT consulting engineers for their valuable information which we were able to use for comparison with our own.

6-2 Soil and Vegetation

According to MRT report, "These soils are known as acid sulphate or cat clays. Reclamation is possible by leaching of excess acid with sea water".

As described in the main report, it is recommended to leach excess acid with fresh water.

6-3 Water Quality

6-3-1 The Swamp

MRT mentioned characteristics of swamp water quality as follows.

(1) Water quality was slightly acidic. The acidity level became higher due to humic acid in the dry season. Subsequently, the water took on a brownish colour.

(2) Electrical conductivity did not exceed 60 μS/cm and swamp water was almost pure.

The above-mentioned matters were also confirmed by this study. Furthermore, MRT mentioned the salinity of the swamps and assumed that the swamp water was hardly affected by sea water intrusion, due to poor the drainage system in the swamps.

6-3-2 The Little Scarcies River

The MRT summarized water quality fluctuation in relation to tidal change as follows.

(1) The inflow of sea water into the Little Scarcies was a typical "plug type" sea water intrusion,

and there was complete mixing between sea water and river water.

(2) The sea water plug receded leaving a pond of fresh water in the river at low tide. After long periods of low flow, the water upstream of the mouth of Gbenti Creek became brackish at low tide.

(3) The water quality in the Little Scarcies was affected by both the tide level and the river flow. When the flow in the river is below 700 cusecs, the sea water intrusion depends solely on the tide level. This is observed between March and May. When the flow rises above 700 cusecs, the sea water intrusion depends on both tide level and river flow. There is limited intrusion into the river during spring tides for flows above 5,000 cusecs, but as the flow rises to 30,000 cusecs, no intrusion occurs. Based on these observations, MRT made charts relating the salinity, the tide level and the river flow and estimated the salinity.

The above mentioned (1) and (2) were observed in this study. As the relation charts in the above (Para. 3) were made from limited available data no longer relevant, it is necessary to carry out a further detailed study over a longer period to enable the relation charts to cover accurately all conditions.

6-4 Water Quality Design Criteria

6-4-1 River water

MRT adopted 2,250 μS/cm in electrical conductivity as the standard for the irrigation water and decided a safe yield, based on certain assumptions, for pumping under a scheme which was to pump up water between Katoma and Sirian. According to this, intermittent pumping will have to be practiced at Katoma at the time of high spring tide and the mean pumping rate should not be more than 200 cusecs. It is unlikely that the water quality at Sirian will be affected by pumping rates less than 300 cusecs. Basic data for the above estimation were obtained when the maximum sea water intrusion occurred in the river at high spring tide. It is considered that this overestimates the safety for the pumping rate and it has not been taken into consideration that as the dry season progresses the salinity level rises. It is therefore considered that an effective usage of flow in the Little Scarcies is limited.

6-4-2 Swamp water

MRT concluded that the swamp water was not available as an irrigation water resource due to the small amount of water storage and high acidity.

However, the swamp water is considered to be a suitable water resource for irrigation usage for the following reasons.

(1) Water quality in the swamp is hardly affected by sea water intrusion.

(2) Water storage should increase on completion of drainage system.

6-4-3 Groundwater

MRT recommended an irrigation method by utilizing groundwater according to results of three exploratory borings, particle size analysis and infiltration tests. However, it is not recommended for the following reasons.

(1) Survey covering an aquifer distribution system is insufficient.

(2) MRT applied value in laboratory for permeability of aquifer may not be accurate. This permeability has to be determined by a pumping test in situe.

(3) An examination of water balance is indispensable to decide the safe yield of groundwater. This has not been sufficiently examined.

6-5 Cropping Pattern

The MRT report proposes two rice crops, a dry season crop between December and April, and a wet season one between July and November in the paddy field. In this cropping pattern the duration period from transplanting to harvesting is proposed to be 100 days or so.

It is supposed that they presumed to adopt the 120 or 130 days short term varieties, which were very few in Sierra Leone at that time.

The MRT report had often drawn attention to Mange Farm. But it was in early 1972 that the short term variety of CCA arrived from the Peoples' Republic of China and testing commenced at Mange Farm.

Even now most farmers like cropping long term varieties because of high yield involving no manuring. The

report doesn't suggest applying any fertilizers and it is very difficult for the farmers to apply fertilizers with a constantly fluctuating water depth.

Another puzzling aspect of this crop calender is that it supposes the same irrigation plan will suffice for both the wet season and the dry season.

Even though in the wet season we cannot dry out the paddy fields because of the quantity of rainfall, we suppose that it's more beneficial for the yield and the watering cost to irrigate intermittently in the dry season.

6-6 Irrigation

In Appendix V of the MRT report, it is assumed in Section V-3 that ground water loss + Open Surface Evaporation = Pan evaporation during the dry season. The amount of irrigation water needed for the project is estimatied by taking the values of Open Surface evaporation which are multiplied by the factors of 1.0, 1.4 and 1.8. Insufficient explanations on the determination of these factors are given in the report. Even if these factors are taken as factors like crop coefficient, there is the question that the difference of the factors to be applied to each month is too large, resulting in the inaccurate estimation of required irrigation water.

The period of time planned for cultivation of dry season crops, which should elapse before the period of restricted water use, has been overestimated in the MRT report, resulting in a worsening situation regarding both the quantity and quality of irrigation water. With this in mind further study on the cropping pattern is desirable.

For calculating the water balance, it is assumed in Section V-3 that 4 inches depth (or 10 cm) is to be maintained during the growing season. This assumption seems to be less realistic and advantageous than allowing for some variation in water depth.

CHAPTER 7 RELATION TO THE OVERALL DEVELOPMENT PLAN

CHAPTER 7 RELATIONS TO THE OVERALL DEVELOPMENT PLAN

7-1 The Overall Plan

7-1-1 Development Area

The following areas are taken into consideration for the overall plan.

Rhombe	300 ha
Gbenti South	2,672 "
Gbenti Mouth	644 "
Makemba North	1,604 "
Makemba South	2,524 "
Total	7,744 "
Gbenti North	1,585 "
Grand total	9,329 "

7-1-2 The Overall Plan

The following plans are to be proposed:

a. The Gbenti Creek shall be improved to enlarge the capacity of drainage.

b. Miter gates to prevent the intrusion of tidal water shall be built at the Gbenti, the Katik, the Mango and the Rhombe Creek, and also at Katoma.

c. The swamp area shall be divided into small areas of approximately 100 ha, a pump station for irrigation and drainage to be built in each area.

d. A driving channel from Katoma on the Little Scarcies River shall be installed employing the same measures as were taken in the Gbenti North Development Project.

e. The channel shall not be connected with the current creeks, so that siphons should be used at the intersection points.

f. As a traffic plan, roads which will be constructed in the Gbenti North Development Project shall be extended to Robis to connect with the national highway of Port Loko - Lungi Line (See Fig. 7-1-1).

7-1-3 Construction Cost and Quantities

(1)	Prepartory Work	L.S.	Le. 100
(2)	Driving channel	L = 60 km	Le. 6,682
(3)	Drain channel	L = 66 km	Le. 6,647
(4)	Miter gate to control water	5 each	Le. 465
(5)	Polder Average area Bund length	100 ha x 77 190 km	Le. 13,919
(6)	Improvement of existing creek	13 km	Le. 345
(7)	Bridge Concrete slab type	L = 60 m x 1 W = 6.0 m	Le. 401
(8)	Wooden bridge	W = 3.0 m L = 3.5 m x 85	Le. 6,686
(9)	Siphon 2.5 m x 2.0 m	L = 50 m x 21	Le. 1,701
(10)	Trunk road Embankment Cutting	1,000 m 11,000 m	Le. 554
(11)	Land consolidation		
	1) Distribution channel	462 km	Le. 25,241
	2) Drain channel	655 km	
	3) Pump station Q = 14 m^3/min.	x 77	
	4) Miter gate	77 sets	
(12)	Cost for Gbenti North		Le. 15,005
	Sub total		Le. 77,746
(13)	Others		Le. 10,801
(14)	Price Escalation		Le. 55,598
	Total		Le. 144,145

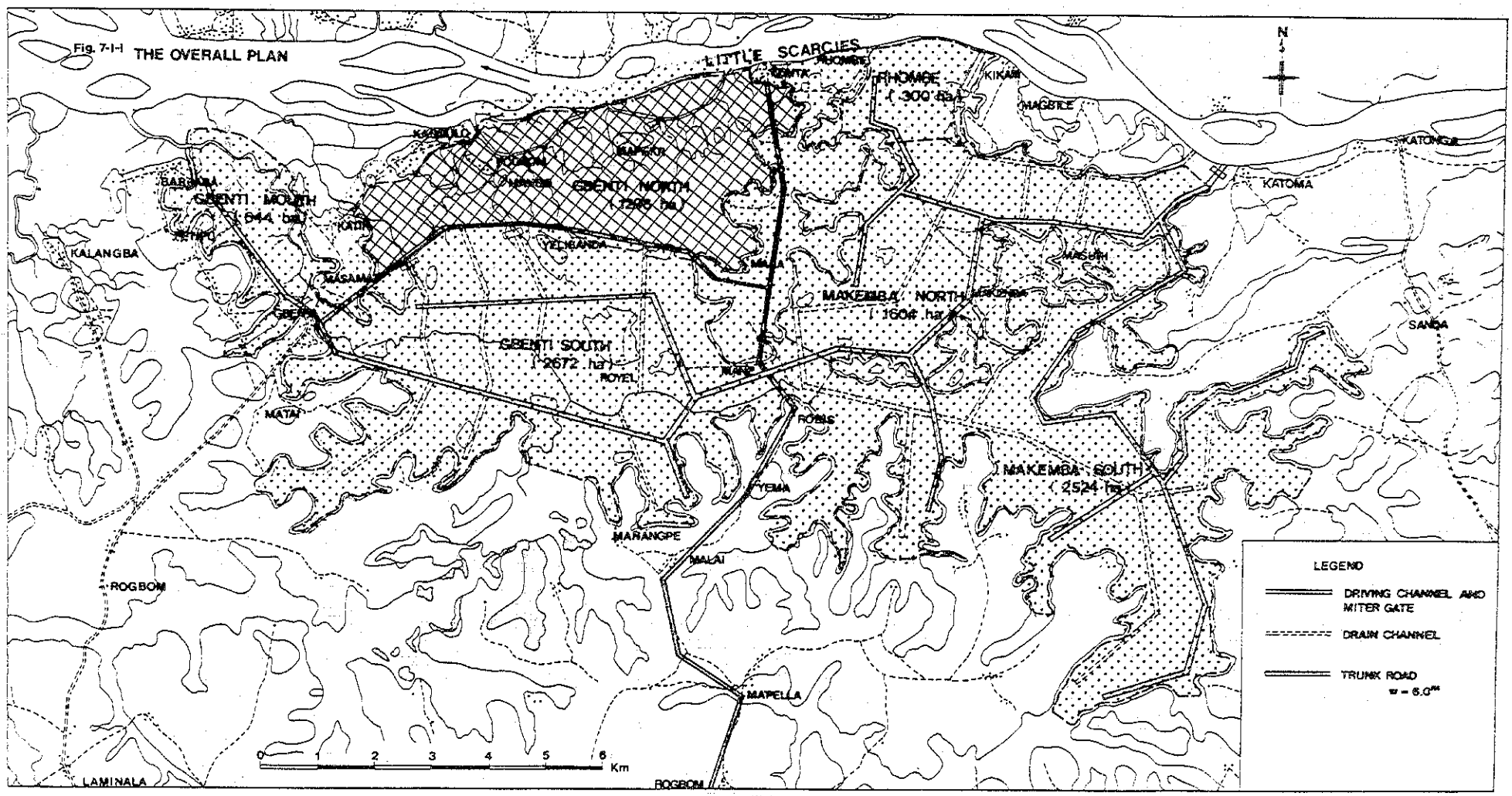


Fig. 7-1-1 THE OVERALL PLAN
LITTLE SCARCIES
RHOMBE
(300 ha)
KIKAM
MAGBILE
KATONGA
KATOMA
GBENTI NORTH
(1295 ha)
GBENTI SOUTH
(2672 ha)
MAKEMBA NORTH
(1604 ha)
MAKEMBA SOUTH
(2524 ha)
SANDA
KALANGBA
ROYEL
ROBIS
YEMA
MARANGPE
MALAI
ROGBOM
MAPELLA
LAMINALA
0 1 2 3 4 5 6 Km
N
LEGEND
DRIVING CHANNEL AND MITER GATE
DRAIN CHANNEL
TRUNK ROAD
w = 6.0m

7-1-4 Economic Rate of Return

Using an approximate estimate of the construction cost and of net benefit out of agriculture production, the Economic Internal Rate of Return (EIRR) was calculated. EIRR of the project for the total area of Rhombe swamp is estimated to be about 17%. In addition to the assumption made for the project we are dealing with, the following assumptions were made.

(1) The present cultivated area is thirty percent of the total area.
(2) In fully developed stage, eighty percent of the total area will be under paddy.
(3) Though no detailed plan for the idea of stage construction is established, the area which we are dealing with will be developed first so that the benefit will be realized from the fifth year while the rest of the total area is under construction.

The relationship between the development of a part of the Rhombe swamp area and that of the total area is discussed in Chapter 8, section 5.

7-2 Relations between Gbenti North Project and the Overall Plan.

7-2-1 Characteristics of Gbenti North Development.

- Small scale polder plan is adopted.
- This development does not harm the current of the creeks in the swamp. Accordingly, this works advantageously for drainage and the traffic of boats on the creeks does not have to be changed.
- Water from a river is used for irrigation, which stems from one of the most natural ideas.
- Although irrigation and drainage are performed by pumping, the scale of the facilities is small to make the maintenance easy.

7-2-2 Relation to the Overall Plan

The development schemes used for this site can be applied to the overall project. The Gbenti North Development should form a good example for the development of the entire area.

It is recommended that water for irrigation should be taken in at Katoma in the general plan for the entire area. In the Gbenti North Development, which can be said to be a scaled-down development of the overall project, not one facility shall be constructed that will prove useless for adoption in later plans.

It can also be said that the traffic network system in the region will be ideally completed when the roads planned in the Gbenti North Development are connected with the roads to be planned in the overall project so that Konta, Mane and Robis are connected with the national highway of Port Loko - Lungi Line.

CHAPTER 8 THE PROJECT JUSTIFICATION

CHAPTER 8 THE PROJECT JUSTIFICATION

8-1 Benefits

The project would directly benefit the small farmers in the project area, who are supporting the household members of some seven thousand. When the project is implemented in the entire project area, the farmers will be able to have two crops of paddy a year, and after 1990, with application of double cropping techniques, the average yield of paddy would rise to 3.5 ton/ha per crop compared with 1.9 ton/ha at present.

With proper education and extention programme for the farmers, a yield of 4.0 ton/ha is within reach, but this benefit would come from extension service effort for which this project does not allocate any funds.

Even without the provision of proper post harvest facilities such as efficient mills and rodent and insect-free storages, the paddy can be sold easily. The farmers can expect an increase of more than 3,000 Leones per household per year in 1982 price.

With the intensification of cultivation, and the maintenance of polders, employment, either self or hired, will also increase.

The area would be connected to Port Loko - Lungi Road, one of the main grids of the road network via the Gbenti - Loko Masama Junction feeder road. This would result in a decrease of transport cost.

8-2 Economic Justification

Alternative IV, explained in Chapter 8 of Appendix, was selected as the most suitable plan for the

development of Rhombe swamp from the analysis of the construction cost as well as operation and maintenance cost, so the economic justification is made for the plan IV only.

The Economic Internal Rate of Return (EIRR) was estimated to be 11.4% over an economic life of 30 years, which includes one year preparatory period and the following three year construction. The table for estimating EIRR is shown in Appendix 11 Table 11-1-5. The major assumptions on which the calculation have been made are explained in App. Chapter 11, Section 1.

A sensibility analysis was carried out by examining the two major factors which influence the EIRR. They are (1) a delay in construction period and (2) a net decrease in benefit. The cases of a one year delay in construction period and a 10% net decrease in benefit are shown in the form of a 2 dimensional matrix in Table 8-2-1

Table 8-2-1 Sensibility Analysis

(EIRR in %)

Delay in construction period / Decrease in net benefit	Basic Case	+ 1 Year
Basic case	11.4	10.3
+10%	10.2	9.3

The relationship between the Net Present Value (NPV) and the discount rate for the chosen cases in sensibility analysis is shown in App. Fig. 11-1-1.

There are some other risks worth mentioning besides the above mentioned two factors.

Possible meteorological risks are excess rainfall and prolonged drought. The height of the bunds which protect the project area and the capacity of the pumps are enough to counter the excess rainfall of up to a 100-year return period. The ill-effect of drought can also be minimized by the introduction of new cropping patterns, which do not need to rely on the minimum run-off from the river in March.

Technology involved in the physical structure of the project is conventional. Miter gates, siphons and ordinary pumps raise little difficulty in handling. Proper timing in operation, according to the tidal change which influences the salinity of river water at the critical time of water in-take in the dry season, needs to be exercised.

The Little Scarcies originates from woodland savanna zone, flows through derived savanna zone and grasslands till it reaches Mange. If there is not much change in vegetation in both types of the savanna and no agriculture development scheme for the dry season in the grassland, the quantity of water run-off in the dry season will not alter much.

The lower reach of the river below Mange goes through the mangrove swamps and inland swamps, where double cropping of paddy will be introduced in the future. At present, there is only one pumping station at the right bank of the river and manual watering of miscellaneous cash crops such as beans, eggplants, maize, water melons etc. on the slope of both banks.

When this project succeeds in double cropping of paddy, the system will be introduced throught Rhombe swamp. Then, the double cropping system will be introduced to both the left and right banks of the river. At that time, a Co-operatives' union for the use of water of the Little Scarcies and the right of water use

will have to be established, and the plan to build a multi-purpose dam above Mange can be realized.

Identification of family holdings and proper reallocation of paddy field after the area is consolidated is another process crucial to the success of the project. Careful arrangement and scheduling to reach the consensus of all parties concerned (family heads, tribal authorities and the government) on the redistribution, will be essential.

As the country has been importing rice in the order of fifty thousand tons every year, an increase of five thousand tons of domestic rice would be welcome. As the price will be competitive with other domestic rice prices, marketing won't cause any problem. As the project area is connected to Gbenti by road, transport to Freetown would become cheaper and faster.

Being near to Freetown and Pepel, a port with loading facilities to Marampa iron ore mines, life in the project area has become based on a monetary economy and people are well versed in handling money.

If the technology involved is within the reach of the farmers, which is the case with this project, any change which promises them an increase of tangible income would give them an incentive to grow more and improve their lives.

8-3 Financial Analysis

The Financial Internal Rate of Return (FIRR) to all resources engaged was estimated to be 11.5% over a project life of 30 years, which includes one year preparatory period and the following three year construction period. The table for estimating FIRR is shown in Table 11-2-1 of Appendix. The major assumptions on which calculation has been made are explained in the following and in Appendix.

An analysis of the farm economy reveals that the individual farmers with 11 household members can save and generate the recurring fund for the farm input within two years of transitional phase of the project, wherefrom they don't need to pay any input credit interest. They have enough income not only to pay water charges which will cover the operational cost of the project, to pay full amount of the purchase of machinery service, fertilizer and pesticide, which enables the government to get rid of the expenditure for subsidies, but also to be afford to pay the income tax of 20% of the gross agricultural income.

The assumptions made in this section is not an optimum combination of various factors involved but an example to show the viability of the project.

We assume that seventy percent of the project cost would be financed by the African Development Fund (AfDF), twenty percent by the African Development Bank (AfDB) and the remaining ten percent of the cost by the Government of Sierra Leone. Disbursement schedule is shown in Table 11-2-3 of Appendix.

We also assume that the interest rate of the loan from the AfDF is set to be 0.75% per annum to the amount disbursed or outstanding and that the interest rate of the loan from the AfDB is 3% per annum.

In the case of the loan from the AfDF, repayment of the principal would start from the 11th year. From the 11th to the 20th, 1% of the principal would be repaid yearly and from the 21st onward 3%. Repayment of the loan from the AfDB would also start from the 11th year, and 5% of the principal would be repaid for the following twenty years. Loan disbursement and repayment schedule is shown in Table 11-2-4 of Appendix.

The major assumptions for the government profit and loss statement, the government cash flow statement and the government balance sheet are explained in Appendix 11, and figures are given through project life in the Tables 11-2-5, 11-2-6 and 11-2-7 of Appendix.

The amount of capital investment for this project, 415 thousand Leones for the first year, and around 800 thousand Leones for the second through the fourth year, average at 700 thousand Leones per annum which is 12.6% of the domestic portion of development funds estimated for the year 1982/1983 allocated to the MAF. The government financial statements shown in the three forms in the Tables 11-2-5, 11-2-6 and 11-2-7 disclose that the critical year for the financial burden is the sixth year, when it accumulates in the order of four million Leones, but it soon decreases and after the 11th year, the cash flow position is always in the black except in the two occasions when the replacements of the components of the facilities are done. The project would show the profit from the 24th year onward. So with this projection in mind, the government would demonstrate its financial commitment to the project in order to guarantee the smooth operation of the project.

8-4 Scoio-Economic Aspects

According to the plan of farm economy discussed in Chapter 4, Section 3, the farmers and their families who are now living in and around the project area (about 640 households) will receive all the benefits of the increase of productivity of land by cultivating two ha of paddy field a household on average compared to the 1.35 ha (approx.) presently under cultivation. But, if instead of two ha, a 1.2 ha plot is distributed to each household, as is the case with the Integrated Agriculture Development Projects in the Eastern and Southern Provinces, 440 new households (about 4,400 people) would be accommodated in the area. They will be able to lead a fairly comfortable life with the stable income from the double crop paddy cultivation.

This arrangement would be more in line with the government policy for attaining social equality.

The road connection to the existing feeder road would have tremendous impact on the socio-economic aspect of the village life. Though, in the economic justification, only the benefit derived from economization of transport cost of rice from the project area to Freetown due to the change of the means and routes is enumerated, there are many other direct benefits to the inhabitants of the area, of seven thousand at present, of more than eleven thousand in future, by securing access to the three towns, Freetown, Port Loko and Pepel all the year round.

The area from which the benefits, direct or indirect, come, does not remain in the transportation of commodity but extends further into the field of public health. The project area will attract people, which will in turn accumulate more potential to develop the adjacent swamp area.

8-5 The Project Appraisal

The analysis so far made has shown that this project for the agricultural development of Gbenti North subdivision of Rhombe Swamp itself is feasible.

Though the size of the project is small, 0.3% of the total area under rice in 1979/1980, and the yield from the area would amount to 1.6% of the total national production achieved in that year, when double cropping as proposed in this project is successfully established, it will give rise to further development over the entire area.

The implementation of this project can be said to have two aspects. One, regarding the project as a first phase or pilot project, is the expansion of the scheme to include the total area of Rhombe Swamp, as discussed in Chapter 7 (7-2-2), and then its further extension to the country's other swamps.

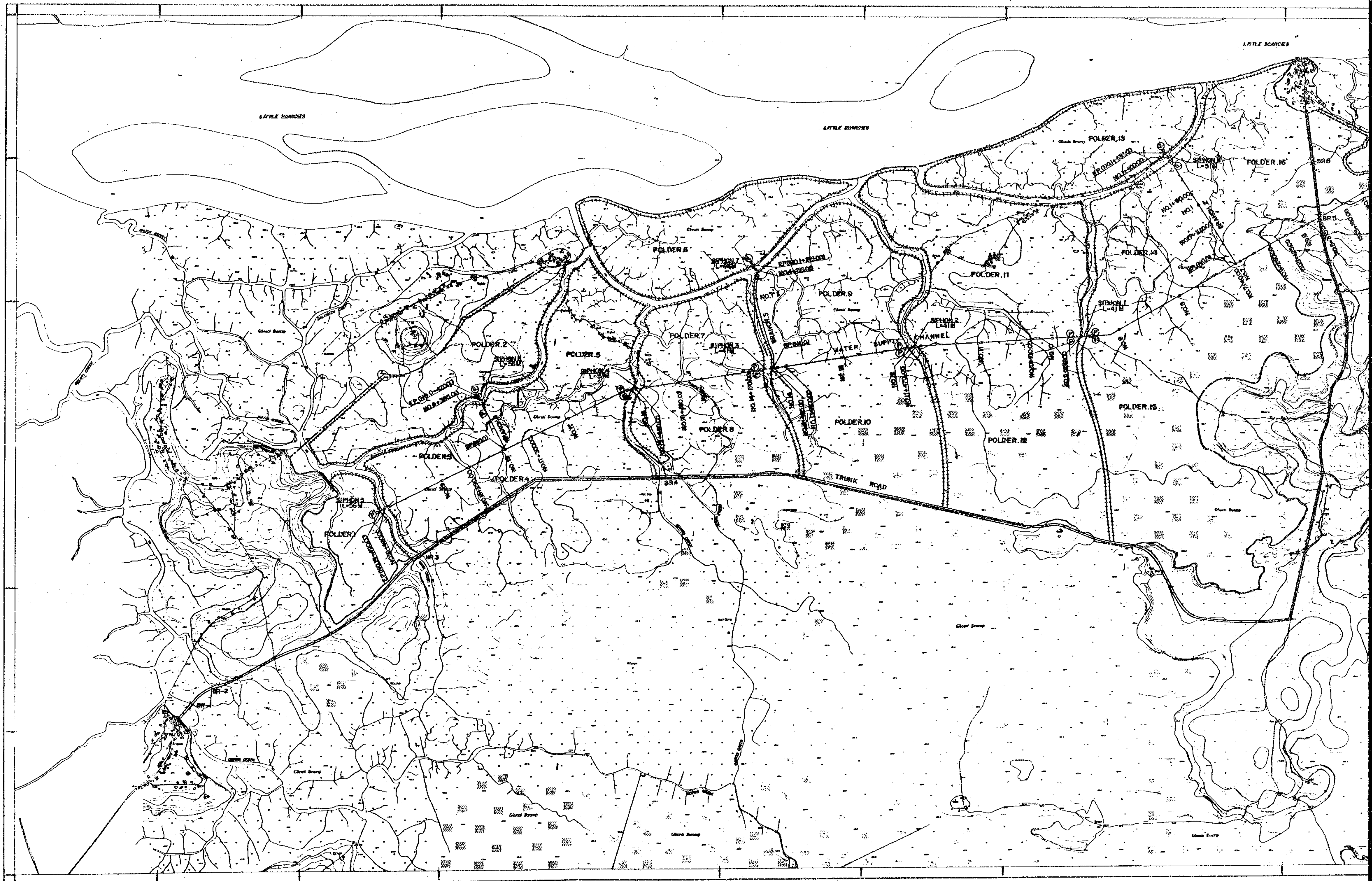
The second aspect, a focus on the integration of this project with other projects such as the one for extension and training, by which an increase in productivity could be expected, the one for the introduction of work-oxen, by which input cost would be minimized considerably, or the one for the improvement of storage facilities and mills. If even one of the above-mentioned integration scheme plans is realized, then a proportionate increase in economic profit will result. For example, the farmers could ensure rice is stored well so it can be sold during wet season at a higher price. Farmers in the project area can be contract farmers to a seed farm to produce higher quality rice seeds, which will fetch a higher price than normal rice cultivated for consumption.

These benefits can only affect farmers outside the project area when the first aspect of the plan is successfully implemented.

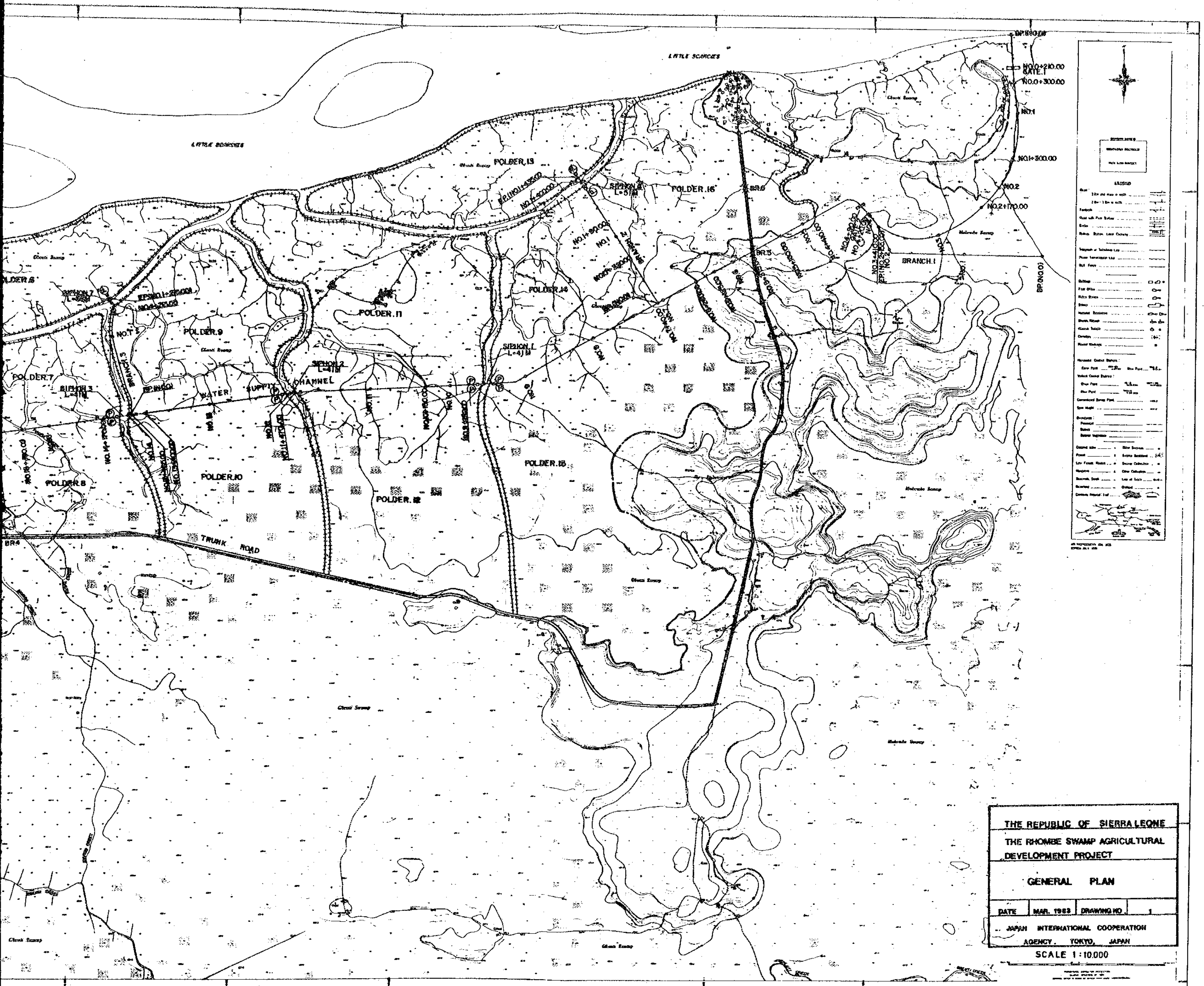
DRAWING

DRAWING LIST

1. GENERAL PLAN
2. TYPICAL SECTION OF BAND
3. WATER SUPPLY CHANNEL LONGITUDINAL SECTION
4. SIPHON
5. MITER GATE
6. MITER GATE, SWING GATE & SLIDE GATE
7. PUMP STATION AT MAKASA
8. PUMP STATION AT EACH POLDER
9. WOODEN BRIDGE
10. LAND CONSOLIDATION PLAN
11. LONGITUDINAL SECTION OF TRUNK ROAD (1)
12. LONGITUDINAL SECTION OF TRUNK ROAD (2)
13. LONGITUDINAL SECTION OF TRUNK ROAD (3)
14. BRIDGE TYPE - A
15. BRIDGE TYPE - B
16. BRIDGE TYPE - C

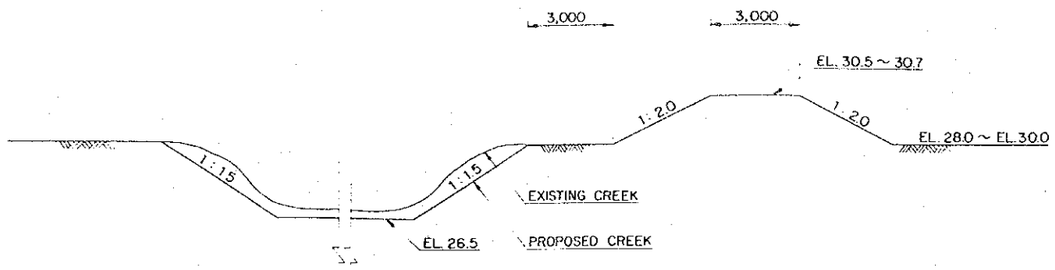


LITTLE SCARCIES
LITTLE SCARCIES
LITTLE SCARCIES
POLDER.1
POLDER.2
POLDER.3
POLDER.4
POLDER.5
POLDER.6
POLDER.7
POLDER.8
POLDER.9
POLDER.10
POLDER.11
POLDER.12
POLDER.13
POLDER.14
POLDER.15
POLDER.16
WATER
SUPPLY
CHANNEL
TRUNK
ROAD
BR.3
BR.4
BR.5
BR-2

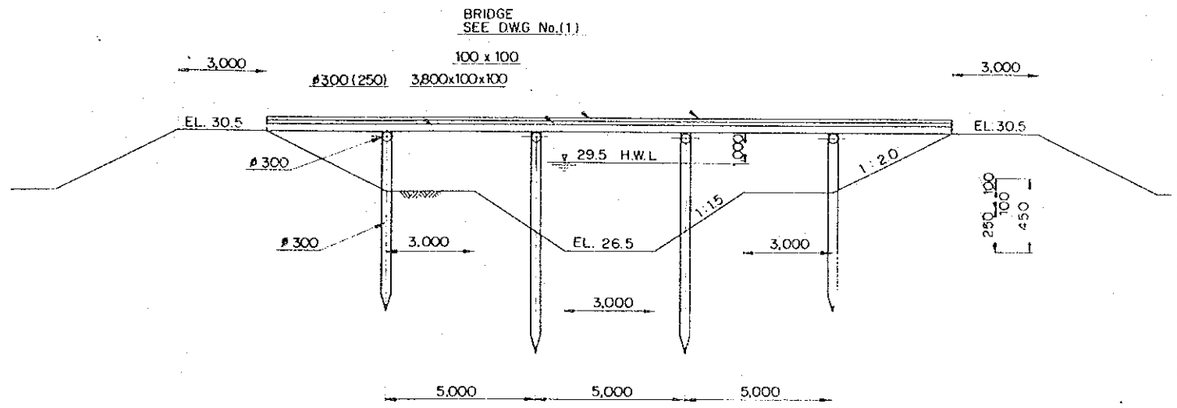


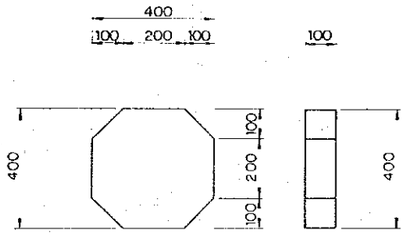
LITTLE SCARCIES
POLDER.13
POLDER.16
POLDER.14
POLDER.11
POLDER.9
POLDER.7
POLDER.8
POLDER.10
POLDER.12
POLDER.15
SIPHON.1
SIPHON.2
SIPHON.3
SIPHON.7
BRANCH.1
BRANCH.3
WATER SUPPLY CHANNEL
TRUNK ROAD
GATE.1
NO.0+210.00
NO.0+300.00
NO.1
NO.1+300.00
NO.2
NO.2+170.00
BR.3
BR.4
BR.5
BR.6
LEGEND
THE REPUBLIC OF SIERRA LEONE
THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT
GENERAL PLAN
DATE
MAR. 1983
DRAWING NO.
1
JAPAN INTERNATIONAL COOPERATION AGENCY. TOKYO, JAPAN
SCALE 1 : 10.000

TYPICAL SECTION OF BUND AND EXISTING CREEK S = 1/100

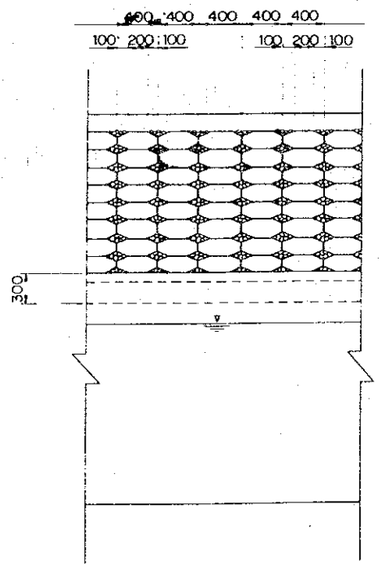


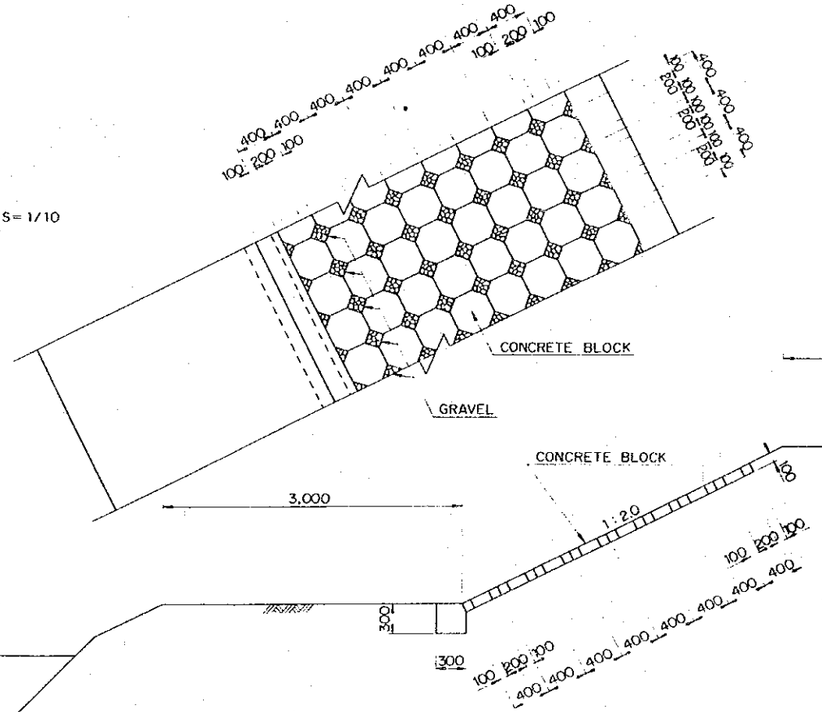
TYPICAL SECTION OF PROPOSED CREEK AND WOODEN BRIDGE S = 1/100



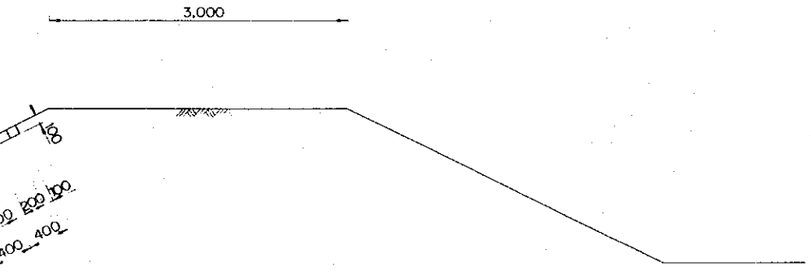


DETAIL OF CONCRETE BLOCK S = 1/10





PROTECTION OF BUND SLOPE S = 1/30



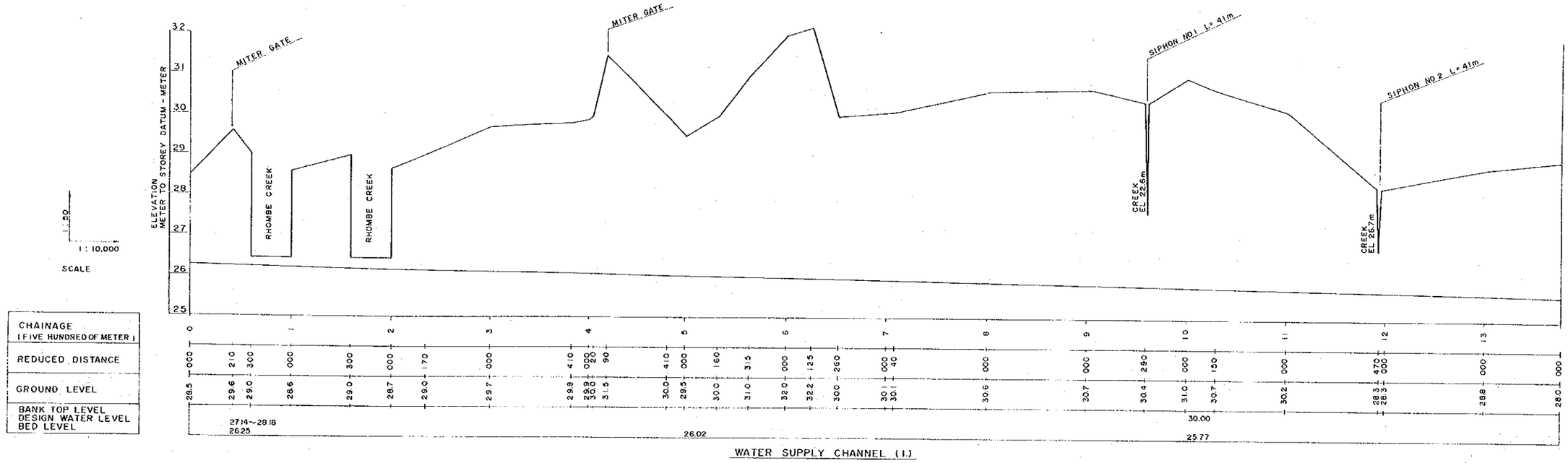
THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

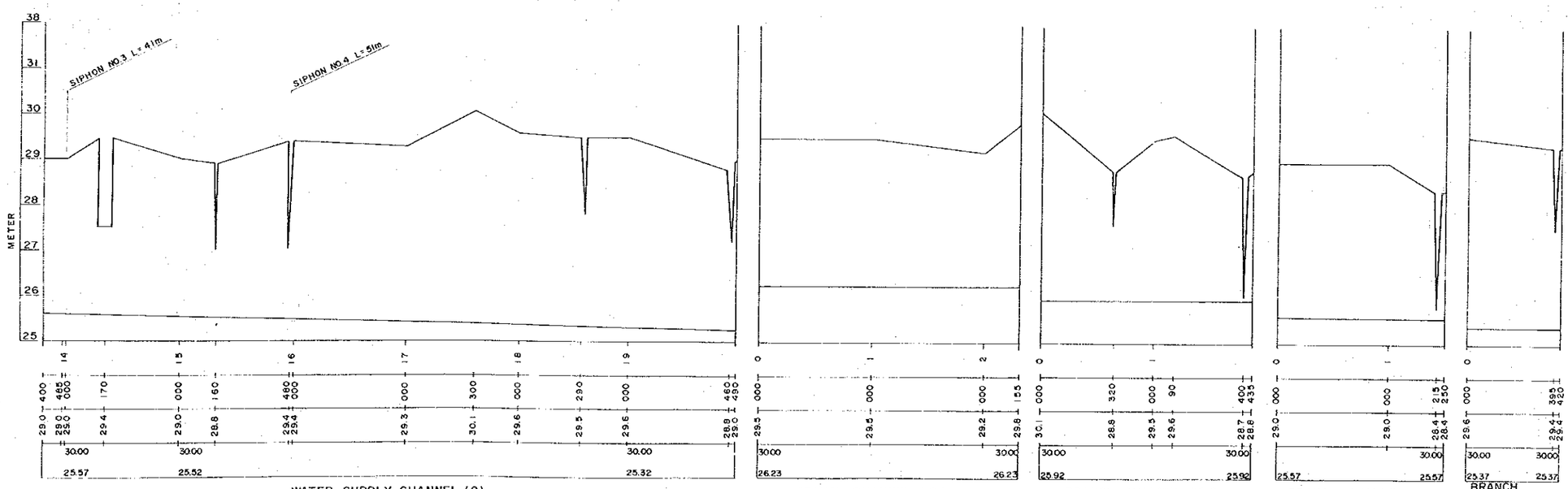
TYPICAL SECTION OF BAND

DATE	MAR. 1983	DRAWING NO.	2

JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO JAPAN



WATER SUPPLY CHANNEL (1)



WATER SUPPLY CHANNEL (2)

BRANCH CHANNEL NO.1

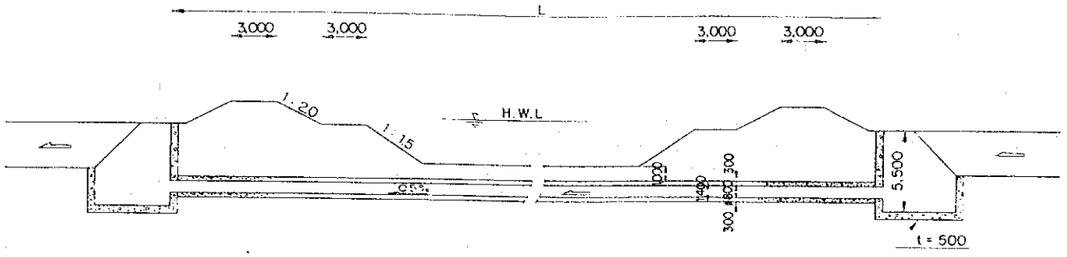
BRANCH CHANNEL NO.2

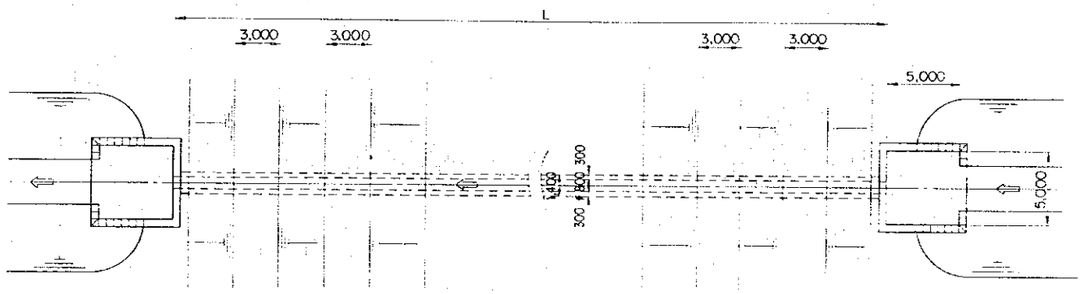
BRANCH CHANNEL NO.3

BRANCH CHANNEL NO.4

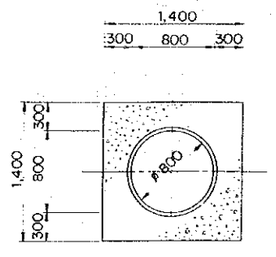
THE REPUBLIC OF SIERRA LEONE	
THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT	
WATER SUPPLY CHANNEL LONGITUDINAL SECTION	
DATE	MAR. 1983 / DRAWING NO. 3
JAPAN INTERNATIONAL COOPERATION AGENCY. TOKYO, JAPAN	

SIPHON No.5 ~ No.8 S = 1/200



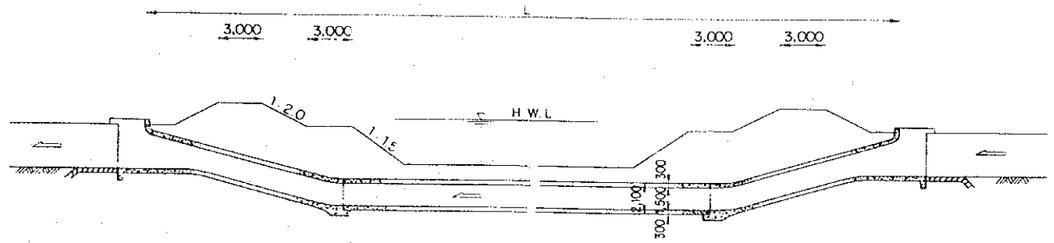


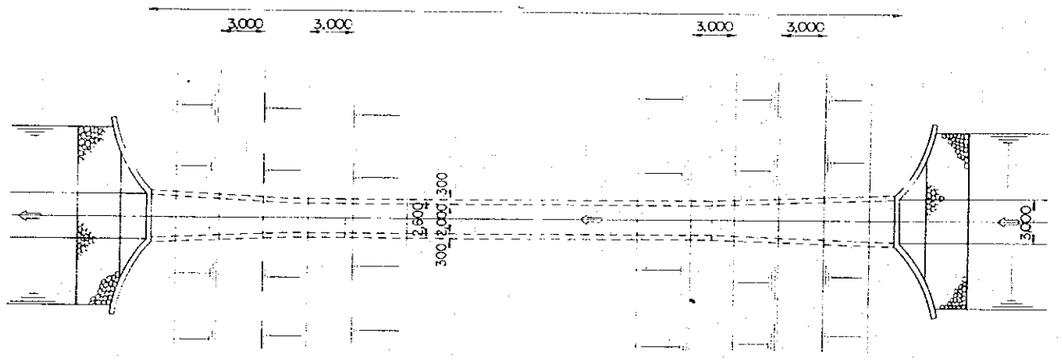
SECTION S = 1/30



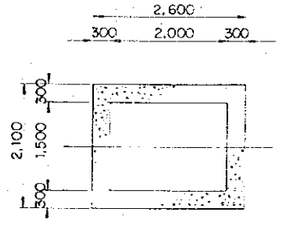
SIPHON	L : LENGTH
No. 5	56.0 m
No. 6	51.0 m
No. 7	66.0 m
No 8	56.0 m

SIPHON No.1 ~ No.4 S = 1/200





SECTION S = 1/50



SIPHON	L : LENGTH
No. 1	41.0 m
No. 2	41.0 m
No. 3	41.0 m
No 4	51.0 m

THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

SIPHON

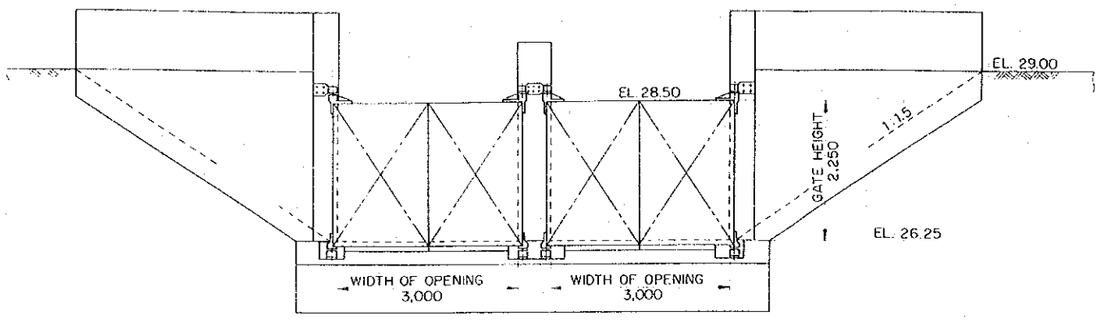
DATE	MAR. 1983	DRAWING NO.	4

JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO, JAPAN

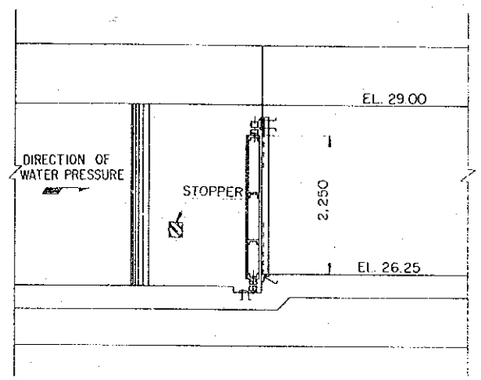
MITER GATE AT RHOMBE S= 1/50

FRONT VIEW (3.0M x 2.25M x 2)

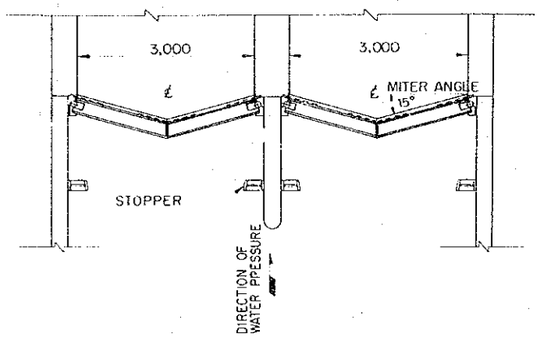
TYPE STEEL (SUS 304) MITER GATE



SECTION



PLAN

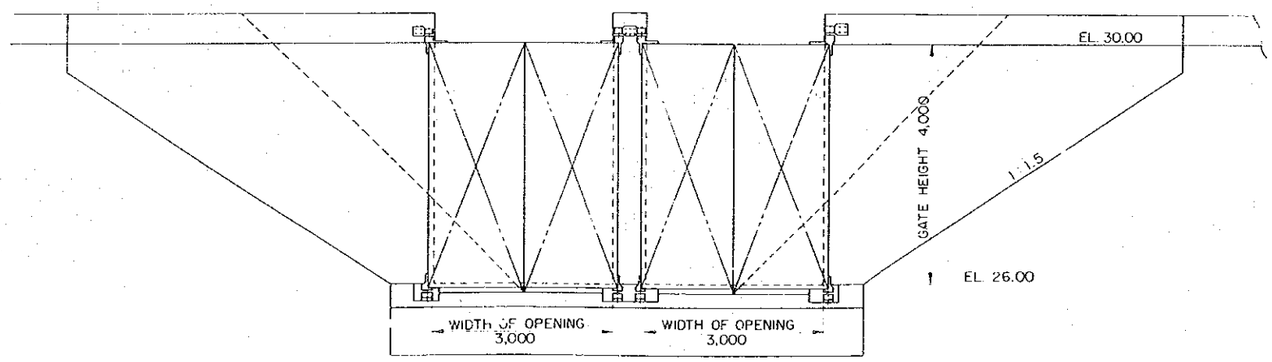


NOTE : SAME PLAN AT RHOMBE AND MAKASA

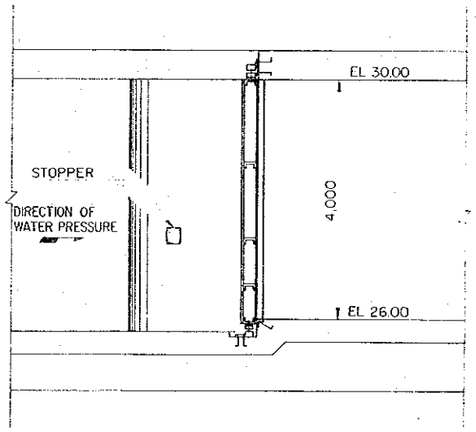
MITER GATE AT MAKASA S= 1/50

FRONT VIEW (3.0M x 4.0M x 2)

TYPE STEEL (SUS 304) MITER GATE



SECTION



THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

MITER GATE

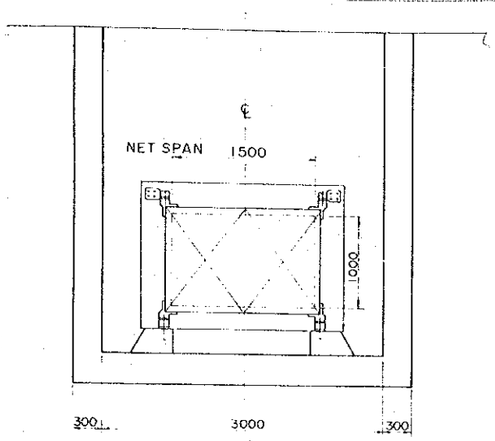
DATE	MAR. 1983	DRAWING NO.	5

JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO JAPAN

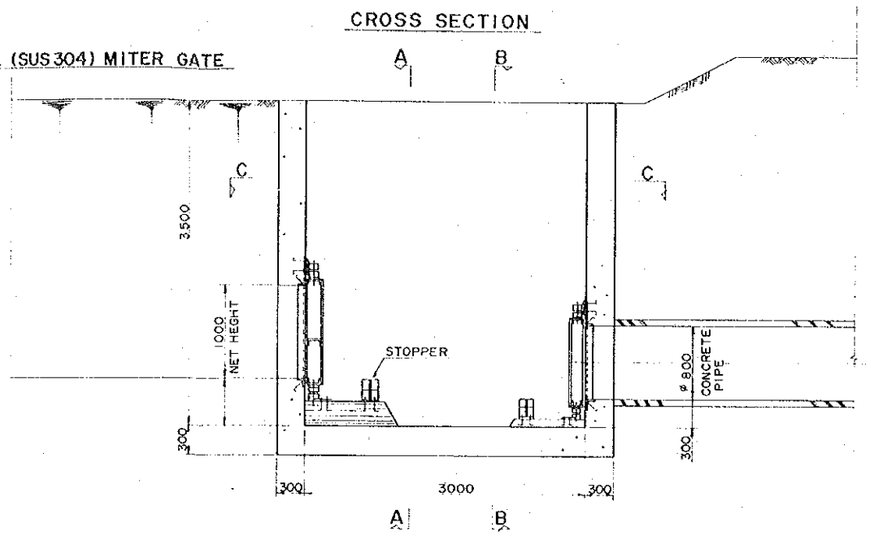
GATE FOR DRAINAGE S=1/30

SECTION A-A (1.50M x 1.00M x 32)

TYPE OF GATE: STEEL (SUS304) MITER GATE



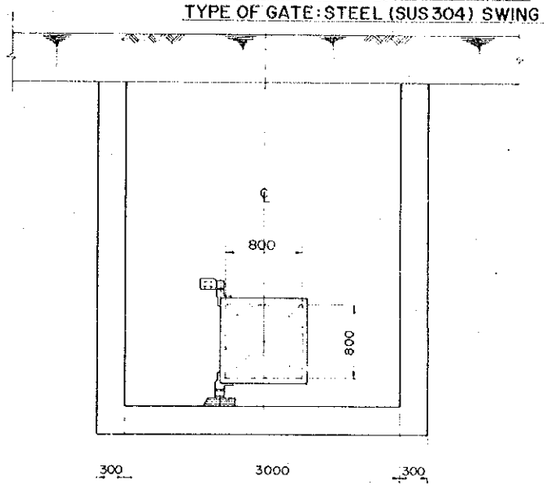
CROSS SECTION



GATE FOR IRRIGATION S=1/30

SECTION B-B (0.80M x 0.80M x 32)

TYPE OF GATE: STEEL (SUS304) SWING GATE

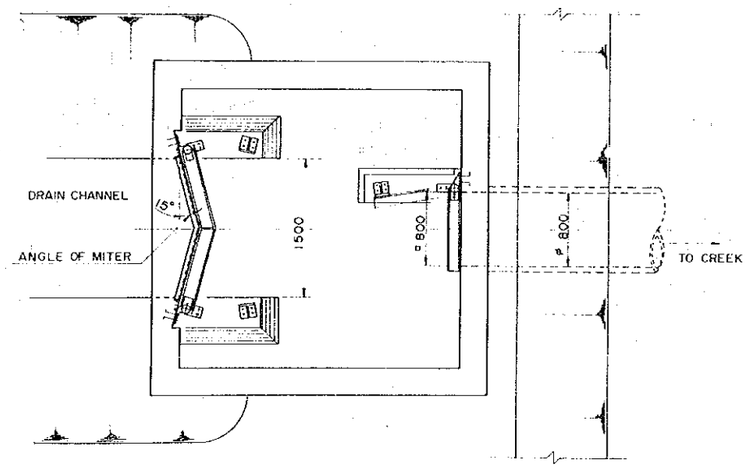


CIRCULAR SLIDE GATE S=1/30

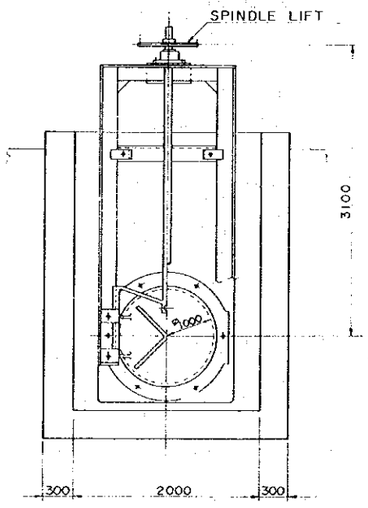
(ø1000 x 16)

TYPE OF GATE: CAST IRON (FC20) CIRCULAR GATE

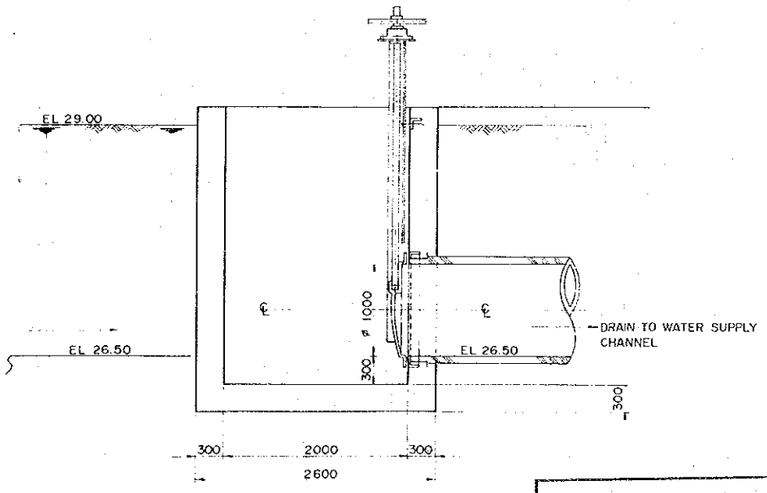
SECTION C-C



FRONT VIEW



SECTION



THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

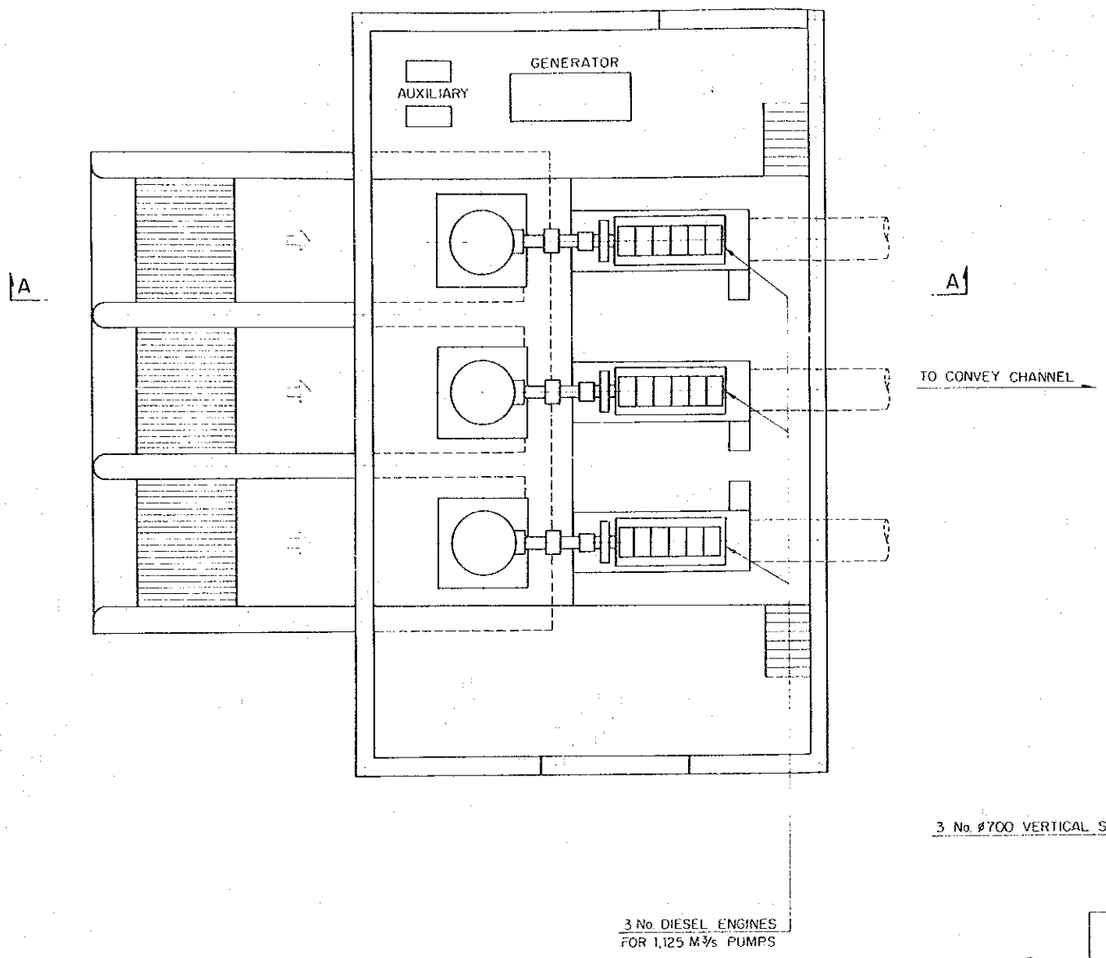
MITER GATE, SWING GATE, & SLIDE GATE

DATE	MAR. 1993	DRAWING NO.	6

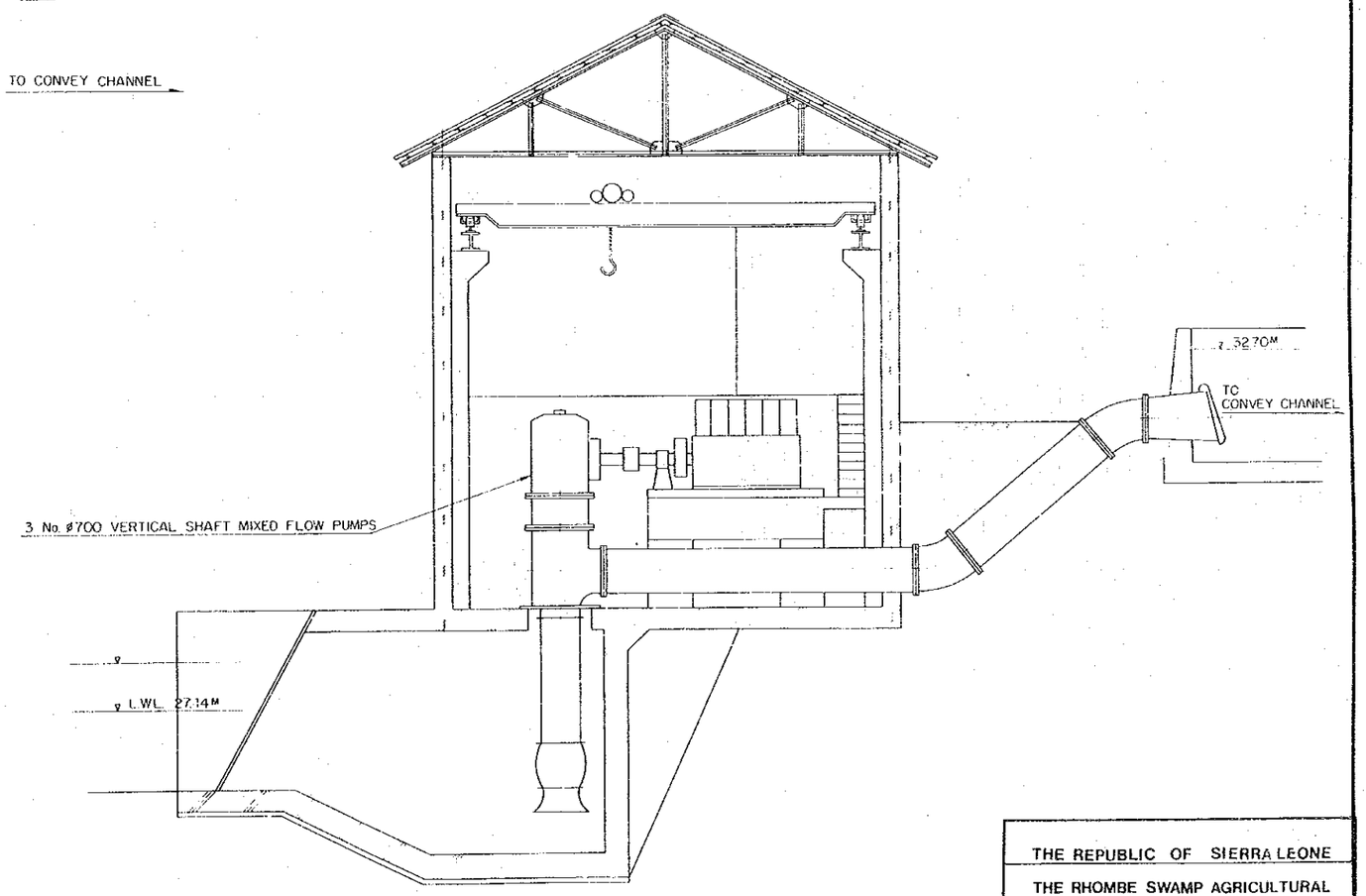
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO, JAPAN

PUMP STATION AT MAKASA

P L A N S=1/50



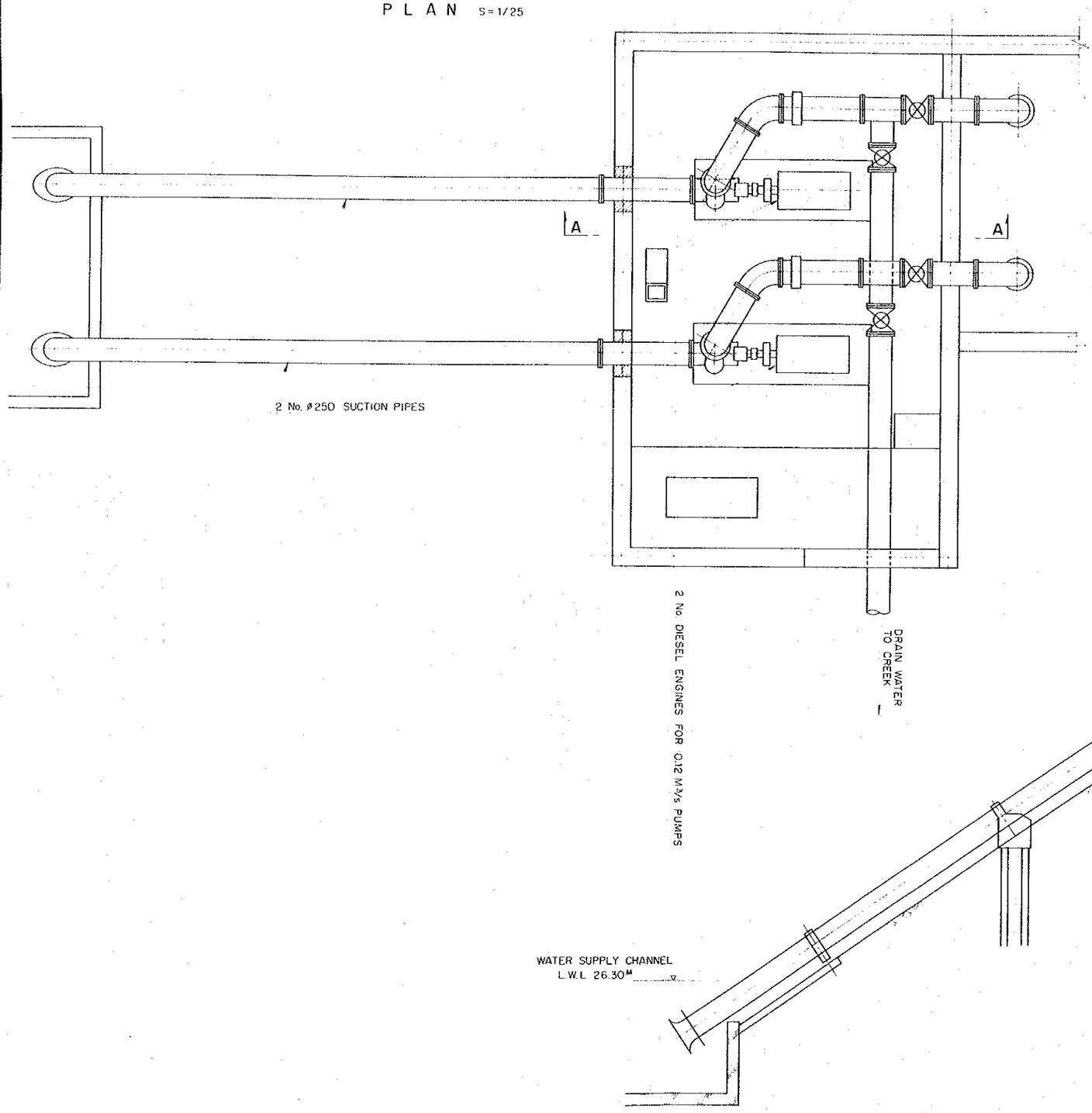
SECTION A — A S=1/50



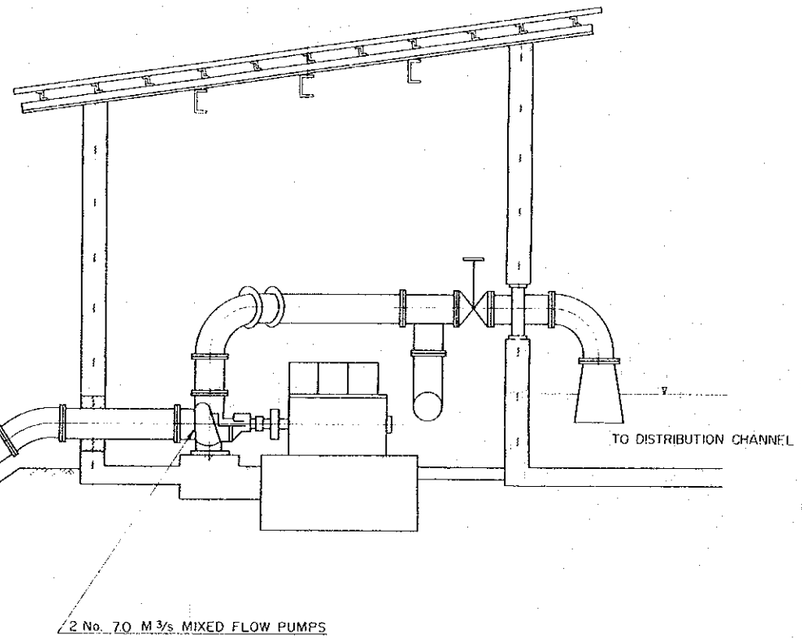
THE REPUBLIC OF SIERRA LEONE	
THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT	
PUMP STATION AT MAKASA	
DATE	MAR. 1983
DRAWING NO.	7
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO, JAPAN	

PUMP STATION AT EACH POLDER

PLAN S=1/25

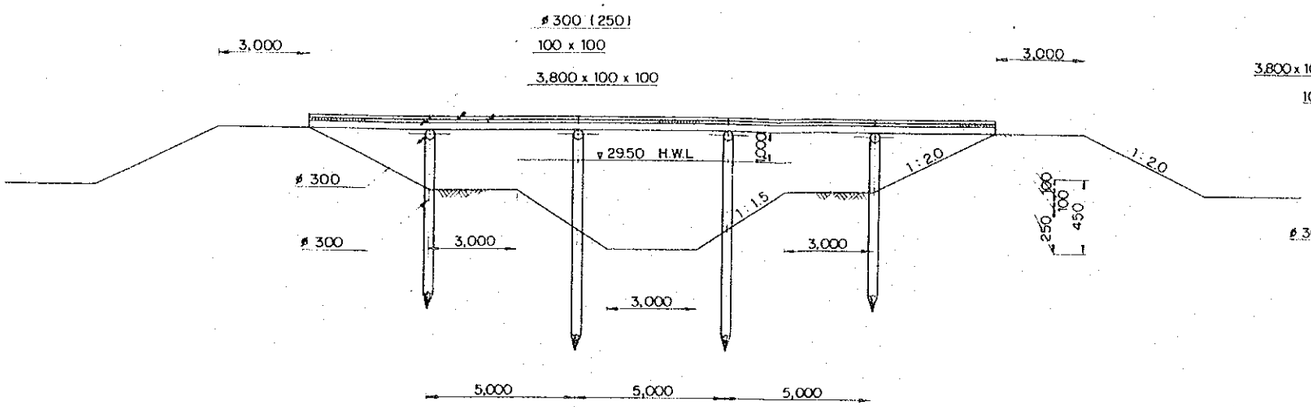


SECTION A – A S=1/25

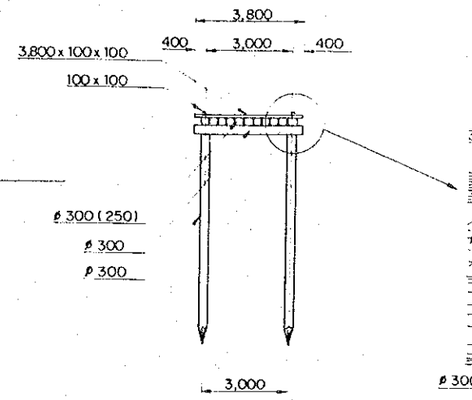


THE REPUBLIC OF SIERRA LEONE			
THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT			
PUMP STATION AT EACH POLDER			
DATE	MAR. 1983	DRAWING NO.	8
JAPAN INTERNATIONAL COOPERATION AGENCY. TOKYO, JAPAN			

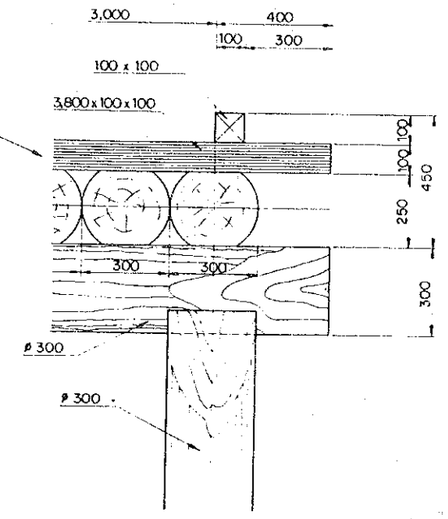
SECTION OF WOODEN BRIDGE S=1/100



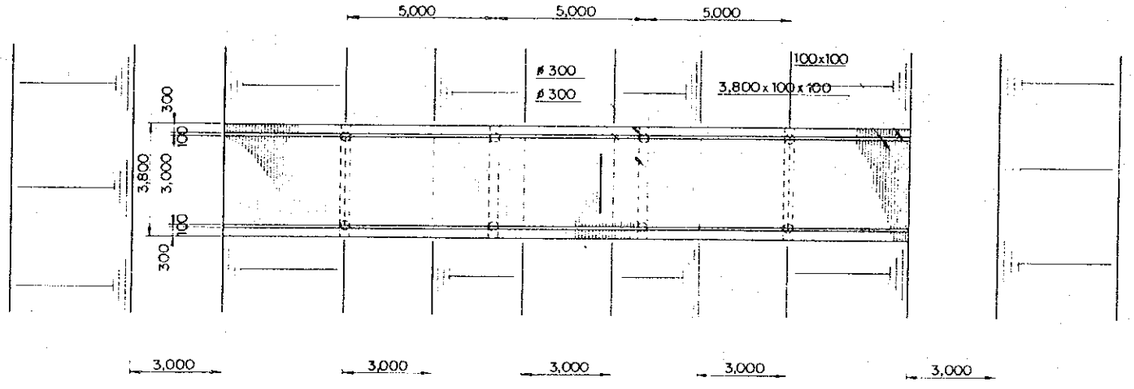
CROSS SECTION S=1/100



DETAIL S=1/10



PLAN S=1/100



THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

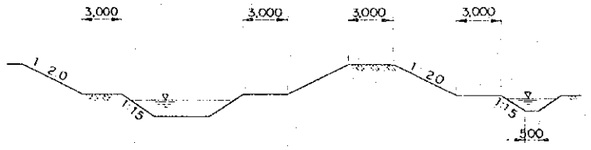
WOODEN BRIDGE

DATE	MAR. 1983	DRAWING NO.	9

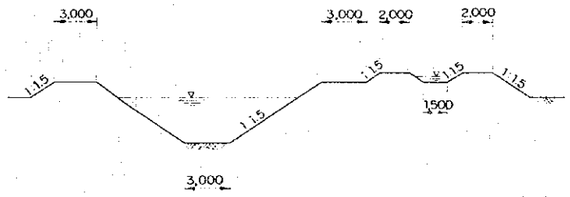
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO, JAPAN

LAND CONSOLIDATION PLAN NO SCALE

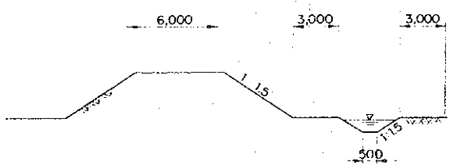
SECTION A – A S = 1/200

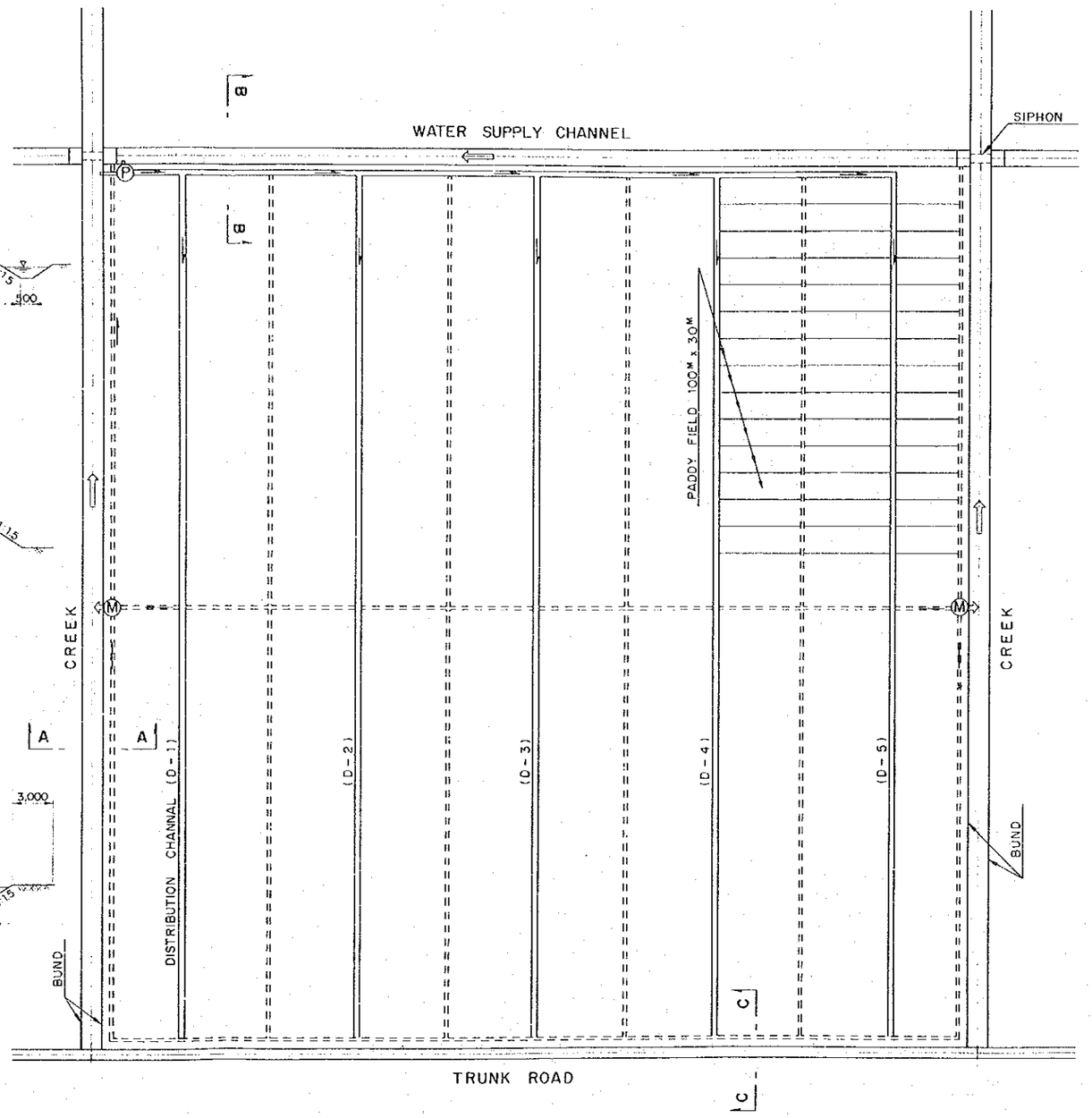


SECTION B – B S = 1/200



SECTION C – C S = 1/200





LEGEND

- DISTRIBUTION CHANNEL
- DRAIN CHANNEL
- (P) PUMP STATION
- (M) MITER GATE
- 100M / 30M — ONE PLOT OF PADDY FIELD

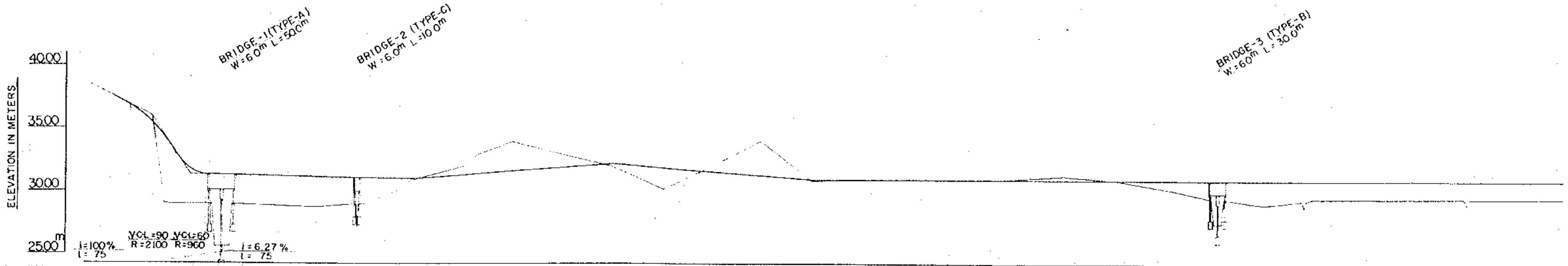
THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

LAND CONSOLIDATION PLAN

DATE	MAR. 1983	DRAWING NO.	10

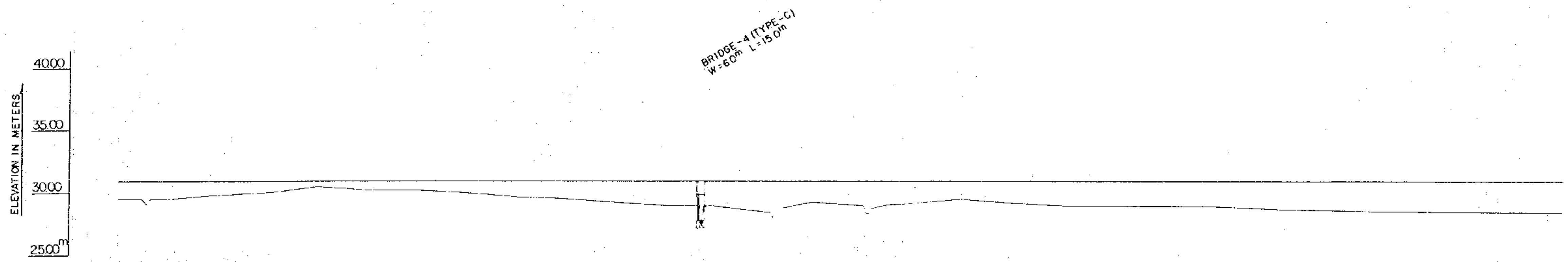
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO, JAPAN



GRADE: 37.50 — 36.00 — 31.30 — LEVEL l=150 — 31.30 — i=0.10% l=300 — 31.00 — i=0.30% l=400 — 32.20 — i=0.30% l=400 — 31.00 — LEVEL

STATION	PROPOSED SURFACE ELEVATION	GROUND SURFACE ELEVATION	REDUCED DISTANCE	DISTANCE
NO. 0	37.50	37.5	0	0
+75	35.52	36.0	75	75
NO. 1	34.34	29.0	100	25
+90	31.30	29.0	190	[illegible]
+95	31.30	25.6	195	5
NO. 2	31.30	25.5	200	5
+25	31.30	25.6	225	[illegible]
+30	31.30	29.0	230	5
NO. 3	31.30	28.9	300	70
NO. 4	31.16	28.7	400	100
+78	31.10	29.0	478	78
+88	31.08	29.0	488	10
NO. 5	31.08	29.0	500	12
+60	31.03	30.0	560	60
NO. 6	31.00	31.0	600	40
NO. 7	31.30	32.0	700	100
+30	31.39	33.0	730	30
NO. 8	31.60	33.9	800	70
NO. 9	31.90	33.0	900	100
NO. 10	32.20	32.0	1 000	100
NO. 11	31.90	30.5	1 100	100
NO. 12	31.60	32.3	1 200	100
NO. 13	31.30	34.0	1 300	100
NO. 14	31.00	30.8	1 400	100
NO. 15	31.00	31.0	1 500	100
NO. 16	31.00	31.0	1 600	100
NO. 17	31.00	30.9	1 700	100
NO. 18	31.00	31.0	1 800	100
NO. 19	31.00	31.2	1 900	100
NO. 20	31.00	31.0	2 000	100
NO. 21	31.00	30.3	2 100	100
+45	31.00	30.0	2 145	45
+93	31.00	29.5	2 193	38
NO. 22	31.00	27.5	2 200	7
+23	31.00	29.5	2 223	23
NO. 23	31.00	29.0	2 300	77
+75	31.00	29.3	2 375	75
+85	31.00	29.3	2 385	10
NO. 24	31.00	29.5	2 400	15
NO. 25	31.00	29.5	2 500	100
NO. 26	31.00	29.5	2 600	100
NO. 27	31.00	29.5	2 700	100
+12	31.00	29.5	2 712	12
NO. 28	31.00	29.5	2 800	88
NO. 29	31.00	29.5	2 900	100

HORIZONTAL CURVE

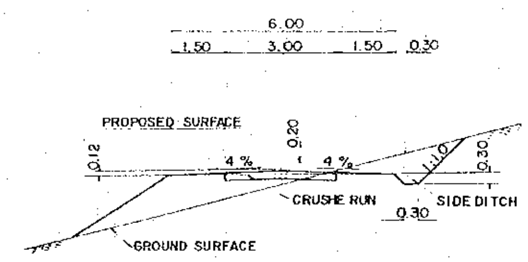


GRADE: LEVEL l=6 150

STATION	PROPOSED SURFACE ELEVATION	GROUND SURFACE ELEVATION	REDUCED DISTANCE	DISTANCE
NO. 29	31.00	29.5	2 900	100
+45	31.00	29.5	2 945	45
+65	31.00	29.5	2 965	20
NO. 30	31.00	29.5	3 000	35
NO. 31	31.00	29.8	3 100	100
NO. 32	31.00	30.0	3 200	100
NO. 33	31.00	30.5	3 300	100
NO. 34	31.00	30.2	3 400	100
NO. 35	31.00	30.2	3 500	100
NO. 36	31.00	30.0	3 600	100
NO. 37	31.00	29.7	3 700	100
NO. 38	31.00	29.5	3 800	100
NO. 39	31.00	29.3	3 900	100
NO. 40	31.00	29.0	4 000	100
+68	31.00	29.0	4 068	68
+83	31.00	29.0	4 083	15
NO. 41	31.00	29.0	4 100	17
NO. 42	31.00	28.5	4 200	100
+16	31.00	28.5	4 216	16
+30	31.00	28.5	4 230	14
+40	31.00	29.0	4 240	10
NO. 43	31.00	29.3	4 300	60
NO. 44	31.00	29.0	4 400	100
+12	31.00	28.8	4 412	12
+35	31.00	29.0	4 435	23
NO. 45	31.00	29.2	4 500	65
NO. 46	31.00	29.5	4 600	100
NO. 47	31.00	29.2	4 700	100
NO. 48	31.00	29.0	4 800	100
NO. 49	31.00	29.0	4 900	100
NO. 50	31.00	29.0	5 000	100
NO. 51	31.00	29.0	5 100	100
NO. 52	31.00	28.8	5 200	100
NO. 53	31.00	28.7	5 300	100
NO. 54	31.00	28.6	5 400	100
NO. 55	31.00	28.5	5 500	100
NO. 56	31.00	28.5	5 600	100
NO. 57	31.00	28.4	5 700	100
NO. 58	31.00	28.3	5 800	100

HORIZONTAL CURVE

TYPICAL CROSS SECTION



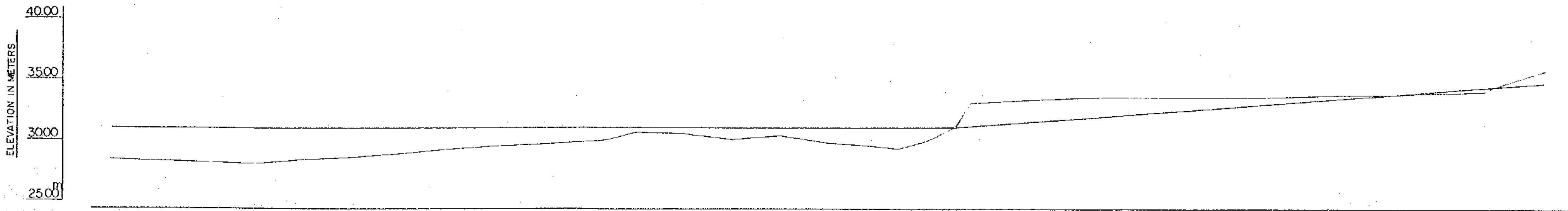
THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

LONDITUDINAL SECTION OF TRUNK ROAD (1)

DATE	MAR. 1983	DRAWING NO.	11

JAPAN INTERNATIONAL COOPERATION AGENCY. TOKYO, JAPAN

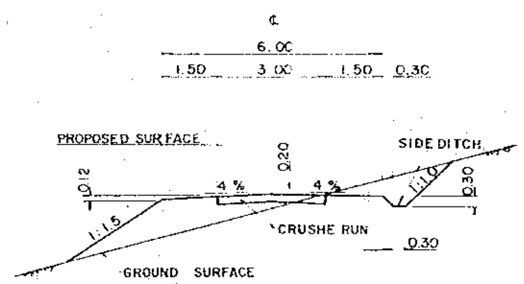


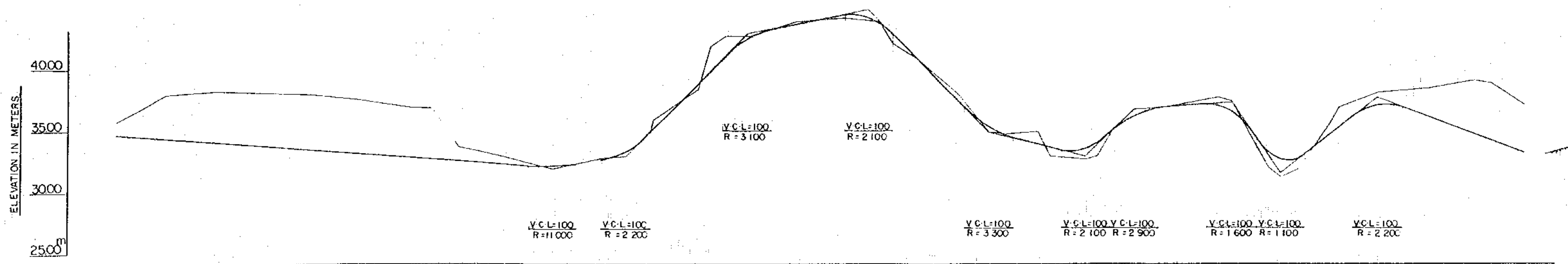
STATION	DISTANCE	REDUCED DISTANCE	GROUND SURFACE ELEVATION	PROPOSED SURFACE ELEVATION
NO. 58	100	5 800	28.3	31.00
NO. 59	100	5 900	28.2	31.00
NO. 60	100	6 000	28.1	31.00
NO. 61	100	6 100	28.0	31.00
NO. 62	100	6 200	28.3	31.00
NO. 63	100	6 300	28.5	31.00
NO. 64	100	6 400	28.8	31.00
NO. 65	100	6 500	29.2	31.00
NO. 66	100	6 600	29.4	31.00
NO. 67	100	6 700	29.6	31.00
NO. 68	100	6 800	29.8	31.00
+ 40	40	6 840	30.0	31.00
NO. 69	60	6 900	30.6	31.00
NO. 70	100	7 000	30.5	31.00
NO. 71	100	7 100	30.0	31.00
NO. 72	100	7 200	30.3	31.00
NO. 73	100	7 300	29.7	31.00
NO. 74	100	7 400	29.4	31.00
+ 50	50	7 450	29.2	31.00
NO. 75	50	7 500	29.7	31.00
+ 22	22	7 522	30.0	31.00
+ 70	48	7 570	31.0	31.00 / 31.06
NO. 76	30	7 600	33.0	31.15
NO. 77	100	7 700	33.2	31.45
NO. 78	100	7 800	33.4	31.75
NO. 79	100	7 900	33.5	32.06
NO. 80	100	8 000	33.5	32.36
NO. 81	100	8 100	33.5	32.66
NO. 82	100	8 200	33.5	32.96
NO. 83	100	8 300	33.6	33.26
NO. 84	100	8 400	33.7	33.56
NO. 85	100	8 500	33.8	33.85
NO. 86	100	8 600	33.9	34.15
+ 75	75	8 675	34.0	34.38
NO. 87	25	8 700	34.5	34.45
NO. 88	100	8 800	35.8	34.75

GRADE: 31.00 — i = 0.30% l = 1250 — 34.75

HORIZONTAL CURVE: (blank)

TYPICAL CROSS SECTION





STATION	DISTANCE	REDUCED DISTANCE	GROUND SURFACE ELEVATION	PROPOSED SURFACE ELEVATION
NO. 88	100	8 800	35.8	34.75
+ 57	57	8 857	37.0	34.58
NO. 89	43	8 900	38.0	34.45
NO. 90	100	9 000	38.3	34.15
NO. 91	100	9 100	38.2	33.85
NO. 92	100	9 200	38.1	33.55
NO. 93	100	9 300	37.7	33.25
NO. 94	100	9 400	37.1	32.95
+ 45	45	9 445	37.0	32.82
+ 95	55	9 500	33.8	32.66
NO. 96	100	9 600	33.0	32.36
NO. 97	100	9 700	32.0	32.17
NO. 98	100	9 800	32.3	32.69
+ 50	50	9 850	33.0	33.42
NO. 99	50	9 900	35.0	35.00
+ 10	10	9 910	36.0	35.40
+ 45	35	9 945	37.0	36.80
NO. 100	55	10 000	38.5	39.00
+ 28	28	10 028	42.0	40.12
+ 65	27	10 055	42.8	41.20
NO. 101	45	10 100	42.8	42.60
NO. 102	100	10 200	43.3	43.80
NO. 103	100	10 300	44.3	44.60
+ 75	72	10 375	44.0	43.85
NO. 104	25	10 400	42.2	43.00
+ 50	50	10 450	41.0	41.00
NO. 105	50	10 500	39.3	39.00
+ 40	40	10 540	38.0	37.40
NO. 106	60	10 600	35.0	35.38
+ 30	30	10 630	34.8	34.84
NO. 107	70	10 700	35.0	34.00
+ 25	25	10 725	33.0	33.75
NO. 108	75	10 800	32.7	33.60
+ 25	25	10 825	33.0	34.10
+ 55	30	10 855	35.0	35.09
NO. 109	45	10 900	36.8	36.36
NO. 110	100	11 000	37.2	37.10
+ 70	70	11 070	37.8	37.19
NO. 111	30	11 100	37.5	36.64
+ 60	60	11 160	32.0	33.96
NO. 112	40	11 200	31.2	32.71
+ 40	40	11 240	32.0	32.88
NO. 113	60	11 300	35.5	34.67
+ 20	20	11 320	37.0	35.29
NO. 114	80	11 400	38.2	37.18
NO. 115	100	11 500	38.5	36.25
NO. 116	100	11 600	39.2	34.75
+ 30	30	11 630	39.0	34.30
NO. 117	70	11 700	37.2	33.25

GRADE: 34.75 — i = 0.30% l = 900 — 32.05 — i = 0.63% l = 150 — 33.00 — i = 4.00% l = 250 — 43.00 — i = 0.80% l = 250 — 45.00 — i = 4.00% l = 250 — 35.00 — i = 1.00% l = 200 — 33.00 — i = [illegible] l = 100 — 36.80 — i = 0.30% l = 200 — 37.40 — i = [illegible] l = 100 — 31.60 — i = 3.08% l = 200 — 37.75 — i = 1.50% l = 450

HORIZONTAL CURVE: (blank)

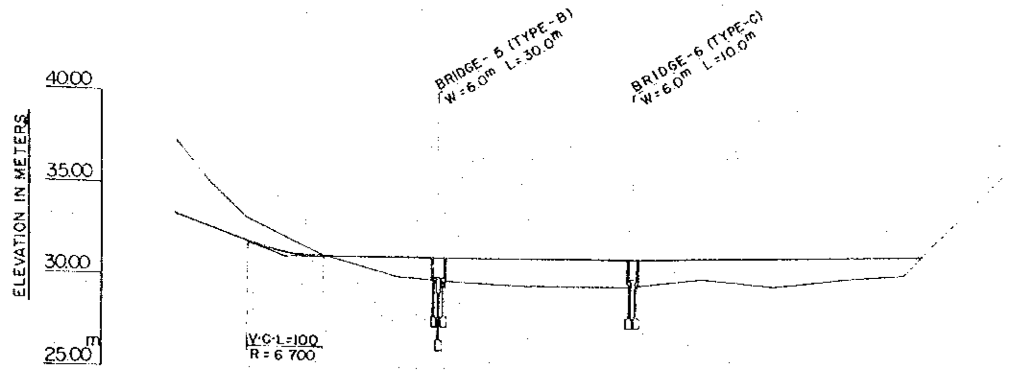
THE REPUBLIC OF SIERRA LEONE

THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

LONGITUDINAL SECTION OF TRUNK ROAD (2)

DATE	MAR. 1983	DRAWING NO.	12

JAPAN INTERNATIONAL COOPERATION AGENCY. TOKYO, JAPAN



GRADE	i=1.50% l=450			31.00	LEVEL l=1700											31.00
PROPOSED SURFACE ELEVATION	33.25	32.58	31.75	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00
GROUND SURFACE ELEVATION	37.2	35.0	33.0	31.1	29.9	29.6	29.5	29.5	29.5	28.0	29.5	29.9	29.5	29.8	30.0	30.9
REDUCED DISTANCE	11 700	11 745	11 800	11 900	12 000	12 100	12 200	12 300	12 305	12 305	12 315	12 400	12 500	12 600	12 660	12 700
DISTANCE	70	45	55	100	100	100	100	100	5	5	5	85	100	100	60	40
STATION	NO117	+45	NO118	NO119	NO120	NO121	NO122	NO123	+5	+10	+15	NO124	NO125	NO126	+60	NO127
HORIZONTAL CURVE																

ELEVATION IN METERS

GRADE	
PROPOSED SURFACE ELEVATION	
GROUND SURFACE ELEVATION	
REDUCED DISTANCE	
DISTANCE	
STATION	
HORIZONTAL CURVE	

THE REPUBLIC OF SIERRA LEONE

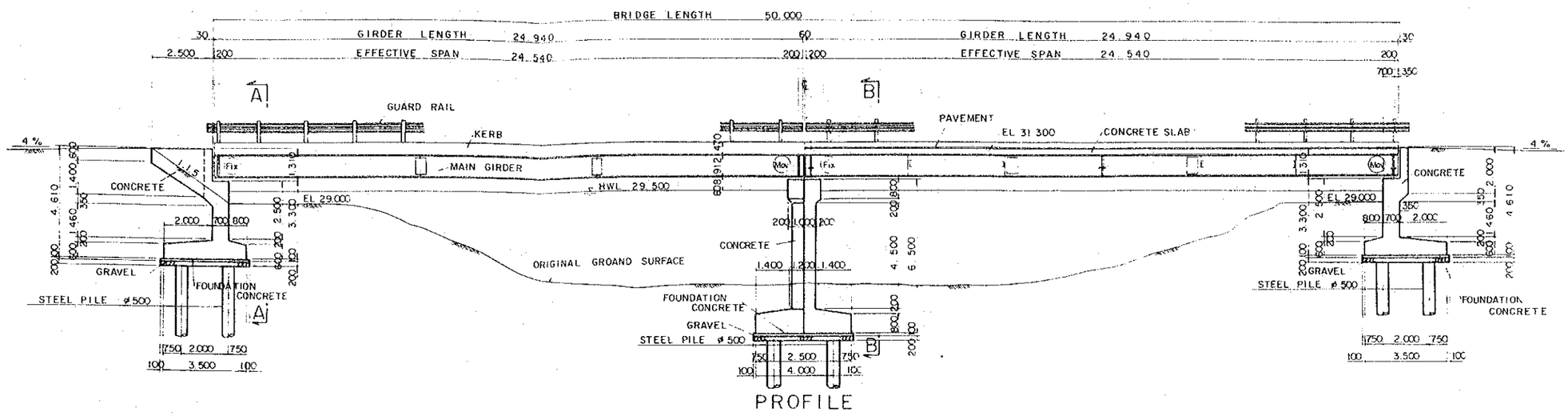
THE RHOMBE SWAMP AGRICULTURAL DEVELOPMENT PROJECT

L NDITUDINAL SECTION OF TRUNK ROAD (3)

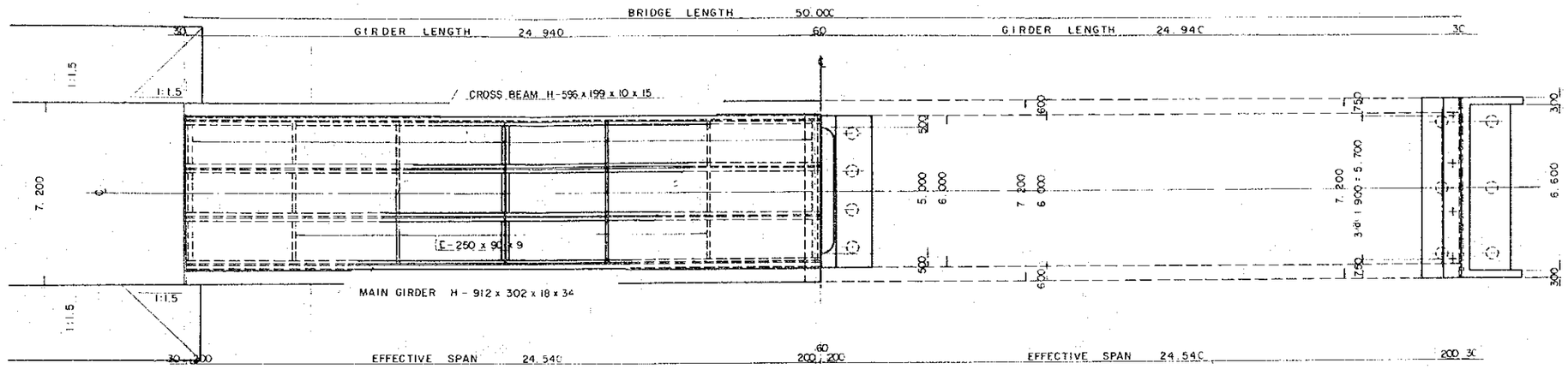
DATE	MAR. 1983	DRAWING NO.	13

JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO, JAPAN

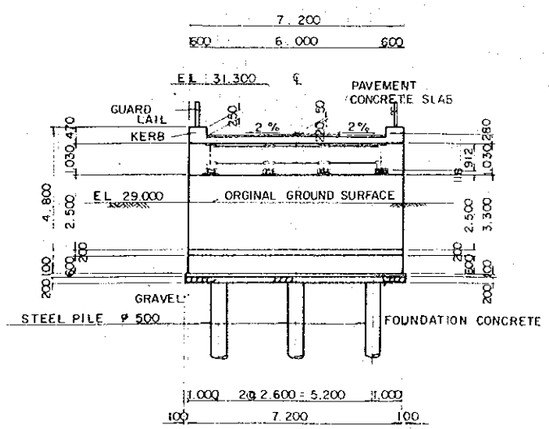
TYPE - A



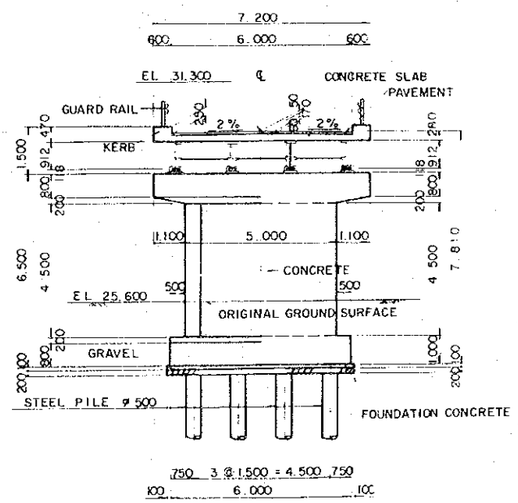
PROFILE



PLAN



SECTION A-A



SECTION B-B

SCALE 0 10m

DESIGIN CRITERIA

TYPE	SIMPLE COMPOSITE GIRDER
BRIDGE LENGTH	50m 000
GIRDER LENGTH	24m 940 x 2
EFFECTIVE SPAN	24m 540 x 2
BRIDGE WIDTH	7m 200
EFFECTIVE WIDTH	6m 000
LIVE LOAD	TL - 20
BRIDGE SURFACE GRADE	2 %
SKEW ANGLE	90°00'00"
GIRDER HEIGHT	0m 912

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BRIDGE TYPE — A

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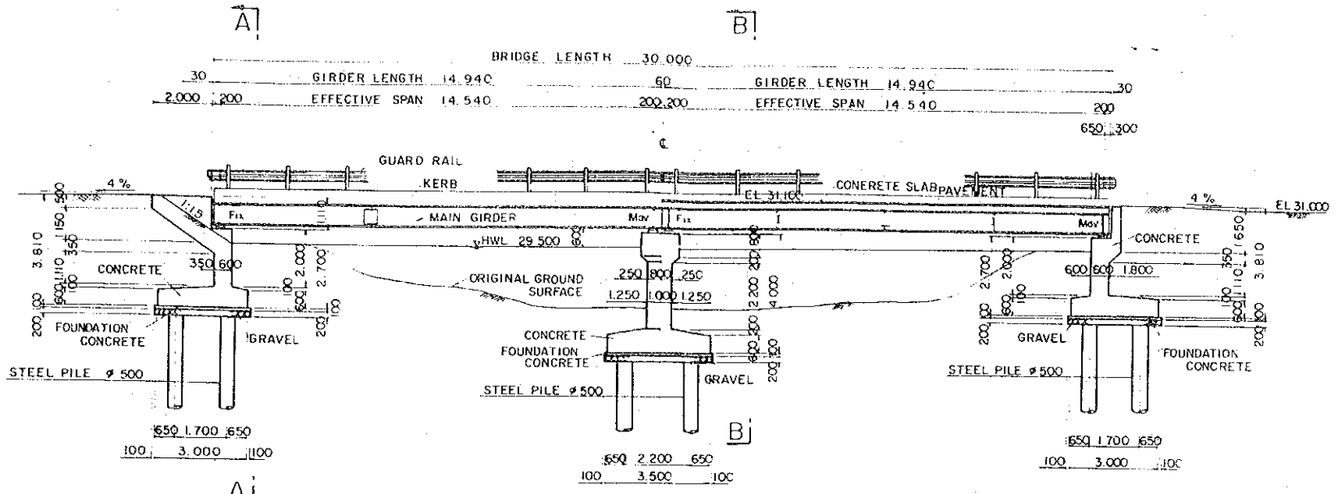
TYPE - B



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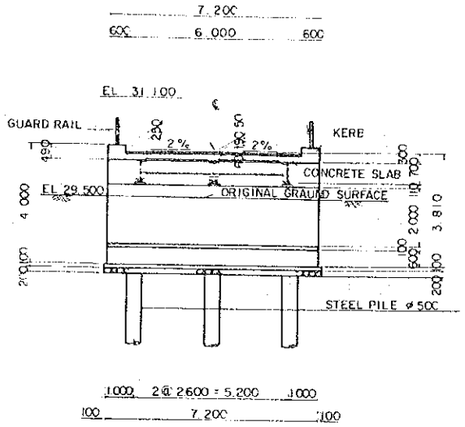
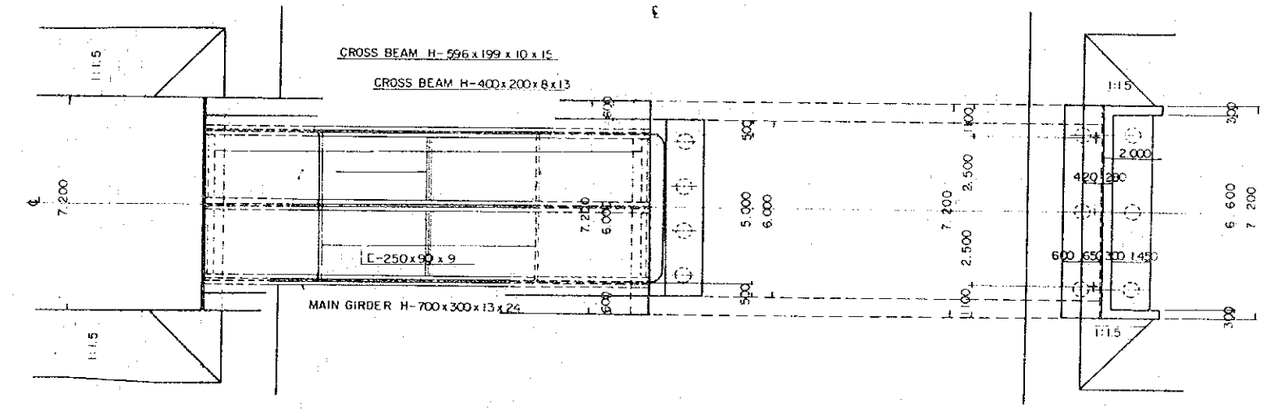


SECTION A-A



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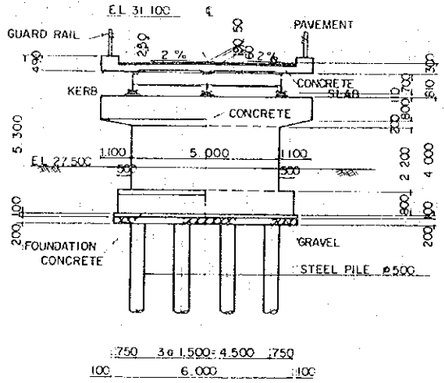

SECTION B-B

SCALE

0 10m

DESIGN CRITERIA

TYPE	SIMPLE COMPOSITE GIRDOR
BRIDGE LENGTH	30m000
GIRDER LENGTH	14m940 x 2
EFFECTIVE SPAN	14m540 x 2
BRIDGE WIDTH	7m200
EFFECTIVE WIDTH	6m000
LIVE LOAD	TL-20
BRIDGE SURFACE GRADE	2 %
SKEW ANGLE	90°00'00"
GIRDER HEIGHT	0m700

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BRIDGE TYPE – B

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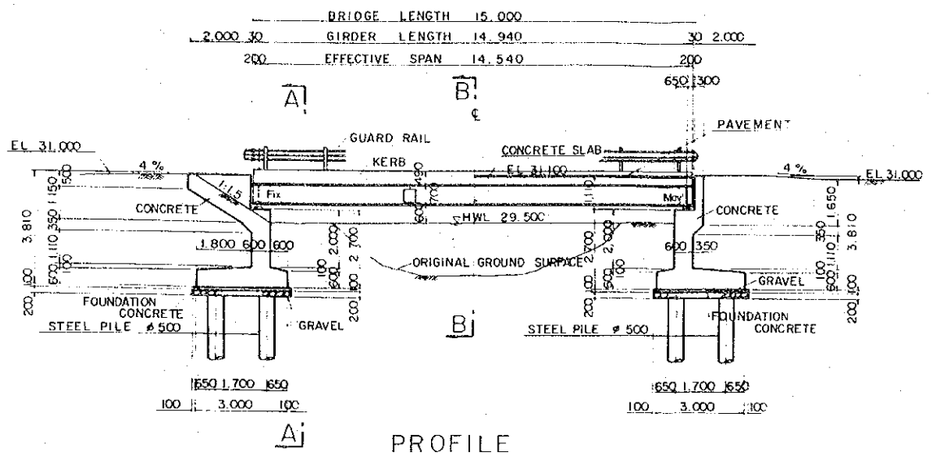
TYPE - C



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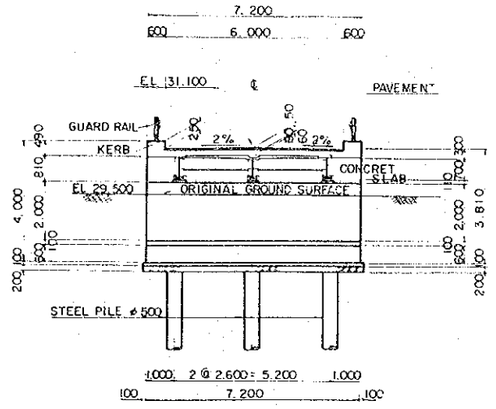
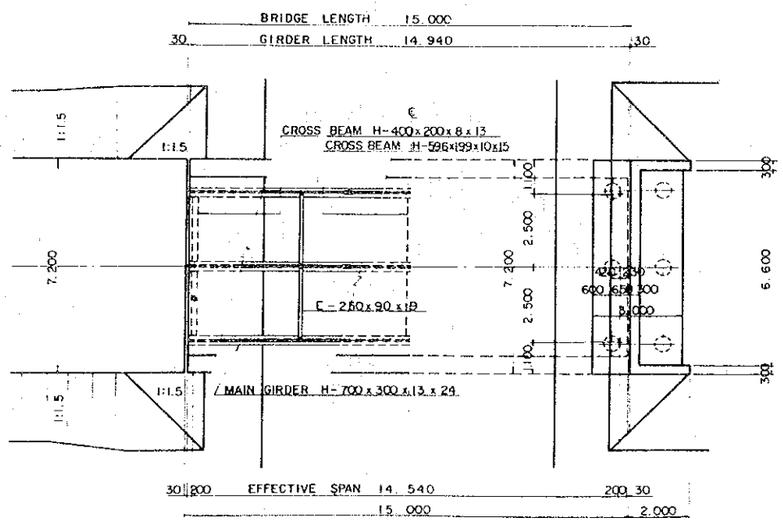


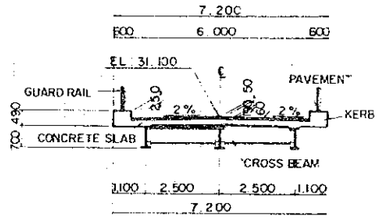
SECTION A-A

DESIGN CRITERIA

TYPE	SIMPLE COMPOSITE GIRDER
BRIDGE LENGTH	15m 000
GIRDER LENGTH	14m 940
EFFECTIVE SPAN	14m 540
BRIDGE WIDTH	7m 200
EFFECTIVE WIDTH	6m 000
LIVE LOAD	T L - 20
BRIDGE SURFACE GRADE	2 %
SKEW ANGLE	90° 00' 00"
GIRDER HEIGHT	0m 700



PLAN



SECTION B-B

SCALE
0 10m

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BRIDGE TYPE – C	
DATE	MAR. 1983
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