APPENDIX-F

AGRO-ECONOMY

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AGRO-ECONOMY

1. PRESENT AGRO-ECONOMIC CONDITION IN THE STUDY AREA

The present agro-economic condition of the study area is discussed concerning 14 Kecamatans listed below.

1. Kasemen	2. Kramatwatu	3. Ciruas	4. Walantaka
5. Kragilan	6. Cikande	7. Pontang	8. Tirtayasa
9. Carenang	10. Pamarayan	11. Cikeusal	12. Cilegon
13. Bojonegara	14. Kopo		

1.1 Land Holding and Farm Household

1.1.1 Land Holding

An average farm size in the study area is very small. According to the 1983 agricultural census, the average farm size is 0.61 ha/household comprising 0.17 ha of irrigated paddy field, 0.22 ha of rainfed paddy field and 0.22 ha of upland field. The distribution of farm household by farm size is shown below.

Farm Size (ha)	Percent Distribution (%)
0 - 0.04	8.3
0.05 - 0.09	4.5
0.10 - 0.24	16.4
0.25 - 0.49	28.5
0.50 - 0.74	17.1
0.75 - 0.99	7.5
1.00 - 1.99	12.8
2.00 - 2.29	3.0
more than 3.00	1.9
	100.0

The maximum frequency occurs in 0.25 to 0.49 ha occupying about 30% of the whole farm households. Farm households holding over 1.0 ha share only 18% of the total.

1.1.2 Farm Household and Tenancy

The total number of farm household in the study area is 106,173 showing 85% of the total households in 1983. The average family size is estimated at 5.0 persons, in which 2 to 2.5 persons can work for agricultural practices.

Tenant farms occupy very small portion (about 3%) of the farm households. However, the existence of many landless laborers, about 22% of the total agriculural households, shows the wide prevalence of latent land tenancy system. Data in Agricultural Extension Office in Kab. Serang say that 43% of land owners lend their land to tenants.

In most cases, land rent is 50% of the farm products subtracted from the harvester's share. Out of the remaining, tenants pay farm input costs such as of fertilizers, insecticide and hired labour costs. Land tax and water charge are paid by landlords.

Favored by the nearness to the largest city and plantation areas, Jakarta and Lamoung, where much employment opportunity exists, many farmers go out of the area to find the additional sources of income during off-farm season such as between transplanting and harvesting seasons of paddy. About 56% of the total population, who seasonally immigrate, goes to Jakarta and 44% to Lampung.

Transmigration to other islands than Java is very small. In 1982, 148 family or 647 persons transmigrated to Sumatra from Kab. Serang. Details of the present land holding of the area are given in Table F-1.

1.2 Market and Price of Farm Products and Inputs

1.2.1 Marketing of Farm Products

Paddy is a main farm product and is self-sufficient in the study area. There are 3 channels of rice marketing for producers (farmers) namely, KUD, broker and miller. The paddy collected by KUD is sold to DOLOG after milling, while paddy collected by broker or miller is transported to rice deficient area such as Jakarta. Rice marketing

route is shown in Fig. F-1. The handling share of surplus paddy by KUD is estimated at 10% (about 40,000 t in paddy rice). Other farm products such as groundnuts, beans, vegetables and fruits are dealt mainly by 10 large dealers, registered in Serang public market, who possess big trucks and also engage in transport business. Transportation cost is around Rp. 100/t/km.

In Kabupaten Serang, there are some agricultural products which are not self-sufficient in the area. According to an interview to officials of Serang public market, red onion, chilly and chicken meat are most deficient as shown below.

Name of farm products	Self-sufficiency (%)	Outside source
Red onion	15	Brebes
Chilly	25	Lampung
Chicken meat	20	Jakarta & Bekasi

Production of paddy rice in the study area is approximately 200,000 t in 1983, in which about 100,000 t are estimated to be consumed locally and the remaining 100,000 t to be exported to outside markets, e.g. Serang city, Jakarta.

Groundnut production in the study area in 1983 is 10,020 t, which is equivalent to 64% of the total production in Keb. Serang. Local consumption is roughly estimated at 3,500 t and surplus 6,500 t is for outside markets.

Red onion production in Kab. Serang is only 1,600 t (1983), covering only 15% of the whole consumption (11,000 t). The balance 9,400 t are brought from Brebes in Central Java, situated 400 km away from Serang city.

Cucumber is the most profitable vegetable in Kab. Serang. The production is 19,000 t (1983) and are consumed in the local market.

1.2.2 Prices of Farm Products

The prices of major farm products at the Serang public market are shown in Table F-2. The wholesale prices of paddy, groundnut and red onion are respectively 150,900 and 750 Rp./kg in 1984 as shown below.

Wholesale Prices of Main Crops (Unit: Rp./kg)

Year	1980	1981	1982	1983	1984
Paddy	120	120	120	120	150
Groundnut	700	700	750	800	900
Red onion	600	600	600	600	750

Consumer prices are mostly in the range of 1.5 to 2.0 times of the producer prices as shown below.

Comparison in Producer/Consumer Price in 1984 (Unit: Rp./kg)

	A: Farm gate price (Producer price)	B: Retail price (Consumer price)	B/A (ratio)
Paddy	100	180	1.8
Groundnut	600	1,200	2.0
Red onion	700	900	1.3

The details are shown in Table F-3.

Although the official producers price of paddy is Rp. 125 kg (1984), actual farm gate price of paddy in the study area is around Rp. 100/kg. This ascribes to an inactivity of KUD, poor road condition and a shortage of transportation means.

It is noteworthy to point out that incentive to paddy production can be given to farmers with improvement of marketing channel of KUD.

1.2.3 Marketing of Agricultural Inputs

Paddy seeds of improved varieties are distributed by KUD, however, only 10% of the farmers purchase the paddy seeds through KUD. Most of the

farmers use the seeds from other farmers or self-supplied ones. As for groundnut, farmers use exchanged seeds from other farmers or self-supplied ones as like the case of paddy. Seeds of vegetables are dealt with by local private dealers.

Most of other agricultural inputs are governed by semi-government corporations such as PT. PUSRI for furtilizers and PT. PERTANI for some farm machinery and agro-chemicals. These inputs are distributed to farmers through KUD, Kios or local private dealers. The retail prices of agro-chemicals through such official route are determined by the government. The prices of major farm inputs through these institutional channels are shown as below.

Official price of agricultural requisits (Nov. 1984 KUD)

	Unit	Rp./Unit	Remarks
Paddy seed	kg	300	Cisadane, IR Varieties
Fertilizers	kg	100	All the same price UREA, TSP, KCL
Agro-chemicals			
Diazinon	lit	1,500	Insectlcide
Sevin	kg	1,500	"
Zink phosphide	kg	6,000	Rodenticide
Klerat	kg	750	"

Agricultural labour charge is from Rp. 1,000 to 1,500 per day provided with meals of about Rp. 750. The total cost ranges from Rp. 1,750 to 2,250 per man-day. In case of small farm households, the agricultural works are covered by their own family labourers except for the land preparation and harvesting. The share of such hired labour is estimated at about 20% of the total labour requirement.

1.3 Agricultural Support Services

1.3.1 Agricultural Extension Service

Kab. Serang has ten agricultural service station (BPP) together with

2 specialists (PPS), 22 middle class experts (PPM) and 107 service workers (PPL). Agricultural support systems for extension service are shown in Fig F-2 and Table F-4.

There are 7 district extension offices (BBP) in the study area. Names of Kecamatans and number of village level extension offices (WKPP) covered by each BBP are shown below.

Agricultural Extension Offices

BPP Office	Covering Kec.	No. of WKPP Covered	No. of Desa Covered
1. Kasemen	Kasemen, Serang	8	29
2. Kramatwatu	Kramatwatu, Taktakan, Waringin Kurung	11	29
3. Cilegon	Cilegon, Bojonegara, Pulomerak	11	51
4. Singamerta	Ciruas, Kragilan, Walantaka	12	38
5. Cikande	Cikande, Carenang	9	29
6. Pamarayan	Pamaraya, Kopo	10	31
7. Tirtayasa	Tirtayasa, Pontang	11	34

Source: Agricultural Office of Kab. Serang, 1983

Agricultural policies and new farming technologies are delivered to common farmers by PPLs through advanced farmer's groups. An advanced farmer's group consists usually of a key farmer, 20 progressive farmers and 60 to 80 common farmers. This farmers group is so called "Kolonpok Tani" and registered in the relevant extension office in the name of the key farmer.

The main activities of the extension service are concerned with technical intensification programs for paddy cropping, business and income programs.

In West Java Province, the intensified paddy cropping by these programs covered as much as 96% of the paddy fields in 1980. The areal coverage of the paddy intensification programs in the study area had

been below 60% until 1981, however, it drastically increased to 86% in 1983 (Table F-5). Recently, Serang agricultural extension office plans to establish demonstration farms for cropping of red onion and chilly.

The agricultural extension services in the study area is much restricted by limited manpower (1,200 ha.PPL), poor road condition and insufficient transportation means i.e. motorcycle for PPL. About 15% of PPLs have purchased motorcycles at their own expenses.

1.3.2 Agricultural Credit

Agricultural credit is provided through the Indonesian People's Bank (BRI) to farmers. There are 2 branch offices and 20 sub-district branch offices (BRI Unit Desa) in the study area.

Three kinds of credit are available; namely, short-term, medium-term and long-term. The BIMAS credit is a short-term credit with an interest of 1%/month and 7 month loan period. The BIMAS loan released and repaid in Kab. Serang from 1976 to 1983 in shown below.

BIMAS Loan Released and Repaid in Kab. Serang

(1976 - 1983)

(Unit: Rp. 10^6)

Year	Loan Released	Loan Repaid	Percentage of Repayment
1976	376	223	59 (%)
1977	786	434	55
1978	681	313	46
1979	549	241	44
1980	664	268	40
1981	828	188	23
1982	1,926	108	6
1983	657	46	7

The average loan amount for farmers was Rp. 28,990/ha in 1982 and Rp. 9,880/ha in 1983 (Table F-5). These amounts are insufficient to cover the standard package of farm input for paddy cropping, such as Rp. 42,000/ha for high-yield variety and Rp. 29,500/ha for local variety (Table F-6).

Inmas credit for individual farmer through KUD was limited to Rp. 20,000/ha. However, Bimas/Inmas credit programs for individual farmers in Kab. Serang are stopped in 1984, because of very low repayment rate. The credits are given to farmer's groups.

1.3.3 Agricultural Cooperatives and Farmers Groups

There were 50 KUD Cooperatives and 83 non-KUD Kios Cooperatives with associated 7,261 and 15,953 members respectively in 1982 in Kab. Serang, which correspond to 5% and 10% of the total farm households there. In general, the activity of KUD is not so high except the following 9 KUDs among the registered 27 KUDs in the study area.

(1)	KUD Kasemen	Kec. Kasemen
(2)	KUD Trumbu	Kec. Kasemen
(3)	KUD Serdang	Kec. Kramat Watu
(4)	KUD Beberan	Kec. Walantaka
(5)	KUD Pematang	Kec. Kragilan
(6)	KUD Kubang Puji	Kec. Pontang
(7)	KUD Tirtayasa Timur	Kec. Tirtayasa
(8)	KUD Pamanuk	Kec. Carenang
(9)	KUD Bojonegara	Kec. Bojonegara

The shares of KUD in major activities are estimated at 10% for sales of seeds, 30% for sales of fertilizer and insecticide, 10% for collection of harvested paddy and 10% for INMAS credit, from information from Department of Cooperative in Kab. Serang.

1.4 Farm Economy

1.4.1 Crops Budget

Present crop budget of paddy, groundnut, red onion, chili, string bean and cucumber are studied to identify their profitability.

Crop production costs are analysed breaking them into several items, namely, farm inputs (seeds, fertilizers and agro-chemicals), labour, interest on credits, tax, water charge etc. as shown in Tables F-8 to F-14. The most important criteria for the profitability of cropping to farmers is a net household income including their own family labour costs. The net household income by each crop cultivation is estimated as:

Rp. 246,080/ha - irrigated paddy, Rp.158,910/ha - rainfed paddy,
Rp. 360,900/ha - irrigated groundnut, Rp.294,900/ha - rainfed groudnut,
Rp.1,814,160/ha - red onion- Rp.672,880/ha - chili
Rp. 139,250/ha - string bean and Rp.836,020/ha - cucumber

The details are shown as follows:

Net Household Income by Crop Cultivation

	3/ Paddy	3/ Grand-nuts	Red onion	Chili	String bean	Cucumber
A.Production cost 1/	397,520	299,900	1,401,840	189,120	230,750	159,980
A = a + b (Rp/ha)	284,690	299,900				
a.Family labour cost 2/	273,600	156,800	416,000	112,000	120,000	96,000
	273,000	156,800				
b.Cash inputs	123,900	143,100	985,840	77,120	110,750	63,980
	111,090	143,100				
B. Yield (Kg/ha)	3,700	840	4,000	1,500	2,500	9,000
	2,700	730				
C. Farm gate price (Rp/kg)	100	600	700	500	100	100
	100	600				
D. Gross production value D=BxC(Rp/ha)	370,000	504,000	2,800,000	750,000	250,000	900,000
	270,000	438,000				
E. Net income value E=D-A (Rp-ha)	-27,520	204,100	1,398,160	560,880	19,250	740,020
	-114,690	138,100				
F.Net Household income F=D-b or E+a (Rp/ha)	246,080	360,900	1,814,160	672,880	139,250	836,020
	158,910	294,900				

Remarks: 1/ Details are shown in Tables F-7 to F-13.

2/ Estimated at 80% of total labour cost.
Unit price is Rp. 2,000/man-day.

3/ Above : Irrigated paddy field.
Below : Rainfed paddy field or Upland.

1.4.2 Farm Household Income and Expenditure

Present typical farm household income and expenditure in the study area is worked out based on an average holding size, cropping pattern, crop budget, non-agricultural income and living costs. The total disposable household income is estimated at Rp. 376,320 as shown below. Living costs are estimated at around Rp. 370,000/household.

Calculation of Disposable Income

(1) Holding Size

Irrigated paddy field	0.17 ha
Rainfed paddy field	0.22 ha
Upland field	0.22 ha
Total:	0.61 ha

(2) Cropping Ratio

Irrigated paddy	162% of irrigated paddy field
Rainfed paddy	107% of rainfed paddy field
Upland crops in irrigated field	11%
Upland crops in rainfed field	6%
Upland crops in Upland	168%

(3) Planted Area

Irrigated paddy	0.28 ha
Rainfed paddy	0.24 ha
Upland crops (irrigated)	0.02 ha
Upland crops (rainfed)	0.38 ha

(4) Net Household income by cropping Rp. 226,320

(5) Non-agricultural disposable income

	Rp. 1,000/man-day x 150 man-days/year	Rp. 150,000
(6)	Total disposable income	Rp. 376,320

2. AGRICULTURAL DEVELOPMENT PLAN

2.1 General

In accordance with the basic concept and detailed plan of agricultural development plan mentioned in Appendix E, Chapter 2, a development plan and its economic consequence are studied from a viewpoint of agro-economy such as marketing of agricultural products and inputs, agricultural support services and economic benefit of the agricultural development plan.

2.2 Marketing of Agricultural Products

2.2.1 Market Prospect of Products

Indonesia has not been self-sufficient in rice and still importing as below.

Rice Import by Indonesia (Unit: 10^3 t)

Year	Volume	Year	Volume
1974	1,132.1	1979	1,922.0
1975	692.6	1980	2,011.7
1976	1,301.2	1981	538.3
1977	1,973.4	1982	309.6
1978	1,841.6	1983	1,168.8

The import will continue as long as the high growth rates of population and of income increase in per capita prevails. The total population in the net beneficial area (37,750 ha) is estimated at 245,000 (650 persons/km^2 x 377.5 km^2) in 1984 and to be projected at 297,320 at the full development stage of the project in 1997 by extrapolating the current population growth rate of 1.5% per annum. In Indonesia, annual average consumption of rice was 132.5 kg per capita in 1981 according to Food Balance Sheet in Indonesia 1981, Central Bureau of Statistics, and had been increased at a growth rate of 2.14% year (Leon A. Mears, 1981) for the period of 1968/69 to 1977/78. Assuming the maximum rice consumption by well-off person at 150 kg/year, the

consumption in the study area is estimated at 150 kg/year for 1997. Rice for feed and waste is estimated at 7.4% of the paddy production and the paddy for seed is calculated at 25 kg/ha. Therefore surplus paddy production in the net beneficial area in 1997 is estimated at about 331,500 t, subtracting self-consumption, feed, waste and seeds from the gross production of 431,150 t. This quantity corresponds to only 19% of the rice import in 1983. Taking the increase of population and rice consumption into consideration, the surplus rice could be consumed in Java Island where rice is most deficient.

Onion of 9,360 t/year produced by the project at the full development stage could substitute onion of about 9,000 t brought in to Serang from Central Java.

Area allocated for palawija cropping in Ciujung area almost corresponds to the existing allocation of 11%. The existing demand for palawija crops in KCC Area, 6% of the area, will be filled by palawija crop planted in non-irrigated areas.

2.2.2 Price of Agricultural Produce and Inputs

For the financial and economic analysis of the project, prices of agricultural produce and inputs are determined. As to the financial analysis, prices are valued at 1984 constant marked prices. The economic prices of rice and fertilizers are derived applying economic parity prices of imported ones.

These are valued at Rp. 218,630/t for rice, Rp. 341,500/t for urea Rp. 263,800/t for TSP and Rp. 177,700/t for KCl. Details are shown in Tables F-14 and F-15. Economic labour charge is valued at 60% (Rp. 1,200/man-day) of the current wage.

2.3 Agricultural Support Services

Agricultural support services such as agricultural extension including agricultural research, agricultural credit, agricultural cooperative and transportation of agricultural produce and input are indispensable for the success of the project. The present agricultural package programs,

BIMAS/INMAS programs for example, have showed outstanding success providing irrigation farmers with fertilizers, insecticides and improved high-yielding seeds through credit. The present agricultural development plan will attain the target crop yields with the recommended farming practices as long as activities of the present agricultural support services will be kept alive in the future. However, there are several points to be improved to accelerate further development of the project.

(1) The present coverage of 2,000 farm households or 1,200 ha of farm land by an extension worker (PPL) is too large. The desirable areal coverage should be 600 - 800 ha per an extension worker. A number of necessary additional extension workers for the project is estimated at 30 persons.

(2) The existing transportation means for an extension worker is very limited. About 15% of the extension workers use motor-cycles. Every extension worker should be equipped with a motor-cycle through Government credit.

(3) Farmers in the study area have not been well organized into groups such as Kotompok Tani through which extension services have been provided to farmers. All the beneficial farmers should be organized into the group.

(4) Technical knowledge on crop husbandry of extension worker (PPL) is not sufficient as in the case of KCl application. The extension office of Kab. Sernag should make manual on crop husbandry for PPLs.

2.4 Irrigation Benefit

2.4.1 Crop Production Cost

Financial crop production costs for paddy, palawija and onion are estimated based on the recommended or projected farming practices for future with- and without-project conditions. For economic analysis, economic crop production costs are also calculated excluding tax and interests from the financial prices. Financial and economic prices are

applied in the financial and economic cost estimations. The total costs are summarized as follows:

Total Production Costs (Unit: Rp./ha)

	Financial		Economic	
	Without-Project	With-Project	Without-Project	With Project
Paddy				
Irrigated	448,260	448,260	358,380	358,380
Rainfed	385,990	-	275,040	-
Palawija				
Irrigated	299,900	299,900	223,490	223,490
Rainfed	299,900	-	223,490	-
Onion				
Irrigated	-	1,545,580	-	1,390,420

Remarks: Palawija is represented by groundnut.

Details are shown in Tables F-16 to F-21.

2.4.2 Irrigation Benefits

Irrigation benefits of this project are derived mainly from the increase in crop production due to the steady supply of irrigation water by the reservoirs. The benefits are defined as a difference in net income between with-project and without-project conditions of the total concerned area of 37,750 ha consisting of 24,200 ha in Ciujung area, 1,430 ha in Cicinta area and 12,120 ha in KCC area.

The construction of the project facilities will be started in 1986 and be completed in 1993. In 1997, after 6 years of a built-up period, crop production will attain the targetted yields.

The irrigation benefit at the full development stage is estimated as

Rp. 7,320 million in financial price and Rp. 33,610 million in economic price. Detailed calculation basis of the benefits are presented in Tables F-22 and F-23.

2.4.3 Farm Economy

The project must secure attractive benefits for farmers involved. Economic viability of the project from farmer's view point is evaluated based on the typical farm budgets. Most of farmers benefitted by the project are paddy farmers, whose landholding is estimated at 0.6 ha on an average. As irrigated paddy fields is a predominant land use in the beneficial area, an irrigated farm is selected as a typical farm. Based on the present and future cropping patterns, the following farm budget is envisaged for the typical farm.

The incremental income of the typical farm is estimated at Rp. 160,400 per year. In cremental income of other type of farmer is larger than that of this typical farm because the typical farm has the least opportunity to increase farm income, already having irrigated fields.

Farm Budget of a Typical Farm (0.6 ha)

	Without-project		With-project	
	Paddy irrigated	Upland crop irrigated	Paddy irrigated	Upland crop irrigated
A. Cropping ratio (%)	162	11	240	10
B. Planted area (ha)	0.97	0.07	1.44	0.06
C. Net disposable income, including family labour cost (Rp/ha)	349,340	378,900	349,340	378,900
D. Total net disposable income (Rp.)	338,860	26,520	503,050	22,730
E. Incremental income (Rp.)		(160,400)		

Remark: Family labour cost spent for farming practices is estimated at 80% of the total labour costs.

Table F-1 HOUSEHOLD DISTRIBUTION BY FARMSIZE AND TENANCY

KECAMATAN	Less than 0.05 (ha)	No. of Farm Households including Tenant Farm								Total	Tenant Farm (house) hold)	Landless Laborer (house hold)	Irri-gated Paddy Fields (ha)	Rainfed Paddy Fields (ha)	Upland Fields (ha)
		0.05-0.09 (ha)	0.10-0.24 (ha)	0.25-0.49 (ha)	0.50-0.74 (ha)	0.75-0.99 (ha)	1.00-1.99 (ha)	2.00-2.29 (ha)	more than 3.00 ha						
1. KASEMEN	750	333	764	1,240	985	485	965	230	167	5,919	83	1,700	2,513	572	948
2. KRAMATWATU	854	577	530	834	764	442	884	182	57	5,127	322	1,378	1,890	292	776
3. CIRUAS	148	87	362	928	719	245	546	97	61	3,193	36	821	1,781	193	131
4. WALANTAKA	441	288	706	974	667	370	648	130	96	4,320	298	1,037	912	778	982
5. KRAGILAN	480	380	845	950	645	275	500	130	50	4,255	175	450	630	882	699
6. CIKANDE	20	65	1,780	4,870	1,870	875	825	200	45	10,550	5	3,320	538	2,746	1,907
7. PONTANG	623	44	436	1,014	1,019	270	720	157	225	4,508	436	2,421	1,548	965	1,253
8. TIRTAYASA	1,438	148	530	1,295	1,158	377	842	235	250	6,273	158	3,381	1,708	1,881	1,540
9. CARENANG	558	343	1,509	2,230	1,284	446	843	171	113	7,497	622	1,960	1,162	2,253	654
10. PAMARAYAN	375	325	1,515	2,110	1,035	390	590	90	100	6,530	25	2,290	307	1,825	1,106
11. CIKEUSAL	675	530	1,175	2,305	1,440	695	980	270	100	8,170	130	1,330	831	1,100	2,715
12. CILEGON	16	37	562	816	557	228	509	201	159	3,085	1,039	133	499	863	1,329
13. BOJONEGARA	206	220	1,583	2,019	1,063	598	955	196	98	6,938	88	2,822	-	1,771	2,496
14. KOPO	320	370	1,295	1,955	970	485	765	160	75	6,395	20	370	28	1,901	1,540
TOTAL:	6,904	3,747	13,592	23,543	14,176	6,181	10,572	2,449	1,596	82,760	3,437	23,413	14,347	18,022	18,076
Percent Distribution (%)	8.3	4.5	16.4	28.5	17.1	7.5	12.8	3.0	1.9	100					

Source : 1983 Agricultural Census of Kabupaten, Serang

Table F-2 WHOLESALE PRICE OF FARM PRODUCTS IN SERANG

(Rp./kg)

	1974	75	76	77	78	79	80	81	82	83	84
1. Paddy	44	58	75	80	80	110	120	120	120	120	150
2. Maize	45	65	85	85	75	175	200	200	200	200	250
3. Cassava	18	23	30	25	25	60	80	80	90	100	80
4. Sweet Potato	20	25	33	25	90	70	95	95	100	100	100
5. Peanuts	285	300	300	400	380	650	700	700	750	800	900
6. Soy bean	120	150	162	160	225	350	400	400	450	500	500
7. Green bean	175	200	250	260	320	450	500	500	550	600	650
8. Avocado	70	80	95	100	150	175	200	250	350	400	350
9. Manggo	65	70	95	150	175	200	250	400	600	750	800
10. Papaya	75	75	75	100	150	175	200	200	225	250	250
11. Banana	75	75	100	125	200	250	300	300	300	300	400
12. Red Onion	140	200	225	275	400	550	600	600	600	600	750
13. Chili	150	200	275	280	325	400	450	450	500	500	600

Source: Agricultural Office of Kabupaten Serang

Table F-3 PRODUCER/RETAIL PRICES OF MAIN CROPS(1984)

(Rp/kg)	Farm Gate Price (Producer Price)	Whole-sale Price	Retail Price (Consumers Price)	Consumers/Retail Price	Remarks
Paddy	100	150	180	1.8	dried paddy
Groundnuts	600	900	1,200	2.0	without shell
Red onion	700	750	900	1.3	fresh
Chili	500	600	800	1.6	fresh
String beans	100	150	200	2.0	fresh
Cucumber	100	150	200	2.0	fresh

Sourse: Agricultural Extension Office, Kab. Serang
Economic Section Kab. Serang
Interview in Field Survey

Table F-4 AGRICULTURAL SUPPORT SERVICE SYSTEMS

	Extensional Service Station (BPP)	Extensional Service Block (WKPP)	Extensional Service Worker (PPL)	Key Farmer (Kontak Tani)	Farmers Group (Kelonpok Tani)	KUD (Registerd)	Non-KUD Kios	Agricultural Bank (BRI)	Water user Association (MITRA CAI)
1. KASNEN	1	4	4	48	48	3	1	2	8
2. KRAMATWATU	1	4	4	50	64	1	2	1	4
3. Ciruas	1	4	4	64	64	2	2	2	9
4. WALANTAKA	-	4	4	62	62	2	1	2	5
5. KRAGILAN	-	4	4	64	64	2	2	2	4
6. CIKANDE	1	5	5	64	64	2	1	1	6
7. PONTANG	-	5	4	75	75	2	3	2	7
8. TIRTAYASA	1	6	5	70	70	2	5	2	8
9. CARENANG	-	4	4	48	48	3	2	1	7
10. PAMARAYAN	-	5	5	80	45	1	-	1	6
11. CIKEUSAL	-	5	5	72	72	3	3	2	4
12. CILEGON	1	4	4	43	43	1	3	1	5
13. BOJONEGARA	-	4	4	48	48	2	1	-	3
14. KOPO	1	5	4	42	80	1	-	1	4
JUMLAH (TOTAL)	7	63	60	830	847	27	26	20	80

Source: LAPORAN TAHUN 1983

(Agricultural Extension Office, Kab. Serang)

Table F-5 AGRICULTURAL CREDIT FOR PADDY IN SERANG

Total Kab. Serang	1980	1981	1982	1983	1971-1983 (Total)
a. Loan total (10^6 Rp.)	692	828	1,925	657	7,536
b. Loan not repaied (10^6 Rp.)	359	603	1,722	609	4,771
c. Repaid proportion $C=\frac{a-b}{a} \times 100$ (%)	48	27	11	7	37
d. Total harvested area of paddy (10^3 ha)	79.9	80.8	76.8	75.7	-
e. Harvest area of paddy loaned	44.0	47.2	66.4	66.5	-
f. Proportion of loaned paddy field (%)	56	58	86	88	-
g. Loan per ha $g = \frac{a}{e} \times 10^2$ Rp.	15,700	17,500	28,990	9,880	-

Source: LAPORAN TAHUN1983
(Agricultural Extension Office, Kab. Serang)

Table F-6 PACKAGE BY BIMAS/INMAS CREDIT IN 1983

	A-type (High Yield Variety)		B-type (Local Variety)	
	Amount	Unit Price	Amount	Unit Price
Paddy Seeds	25 kg/ha	Rp. 250	25 kg/ha	Rp. 250
UREA	200 kg/ha	R. 90	100 kg/ha	Rp. 90
TSP	100 kg/ha	Rp. 90	75 kg/ha	Rp. 90
KCL	50 kg/ha	Rp. 90	50 kg/ha	Rp. 90
Diazinon (Insecticide)	3 lit/ha	Rp.1,250	2 lit/ha	Rp.1,250
Zinc Phosphide (Rodenticide)	0.1 kg/ha	Rp.5,000	0.1 kg/ha	Rp.5,000
Loan Total per Ha (Rp)	Rp.42,000		Rp.29,500	

Source: Agricultural Extension Office
Kab. Serang.

Table F-7 PRESENT PRODUCTION COST OF PADDY IN IRRIGATED PADDY FIELD

(Rp/ha)

Items	Unit Price	Amount	Cost
1. Materials			
Seeds (Self-provided)	Rp. 100/kg	25 kg	2,500
Fertilizers			
Urea	Rp. 100/kg	124 kg	12,400
TSP	Rp. 100/kg	73 kg	7,300
Agro-Chemicals			
Insecticide	Rp.1,500/lit	2 lit	3,000
Rodenticide	Rp.6,000/kg	0.17 kg	1,020
Sub-Total:			26,220
2. Labour /1			
Nursery Preparation		10 man-days	
Land Preparation		60 man-days	
Transplanting		23 man-days	
Weeding		23 man-days	
Harvesting		15 man-days	
Post-Harvest		15 man-days	
Other (chemical application, water management)		25 man-days	
Sub-Total:	Rp.2,000/man-day	171 man-days	342,000
3. Miscellaneous Costs /2 (5% of the above costs)			18,410
4. Credit Interest (26,220 x 0.01 x 7)			1,840
5. Tax and Water Charge			9,000
TotalL			397,470

Remarks: /1 : Family labour 80% : Hired labour 20%
/2 : Bags, mats, tools etc.

Source: Agricultural Extension Office, Kab. Serang.
Production Cost Survey in Kec. Kr. Watu, 1984

Table F-8 PRESENT PRODUCTION COST OF PADDY IN RAINFED PADDY FIELD

(Rp/ha)

Items	Unit Price	Amount	Cost
1. Materials			
Seeds (Self-provided)	Rep. 100/kg	25 kg	2,500
Fertilizers			
Urea	Rp. 100/kg	80 kg	8,000
TSP	Rp. 100/kg	70 kg	7,000
Agro-Chemicals			
Insecticide	Rp.1,500/lit	1 lit	1,500
Rodenticide	Rp.6,000/kg	0.04 kg	240
Sub-Total:			19,240
2. Labour /1			
Nursery Preparation		10 man-days	
Land Preparation		60 man-days	
Transplanting		23 man-days	
Weeding		23 man-days	
Harvesting		15 man-days	
Post-Harvest		15 man-days	
Other (chemical application water management)		25 man-days	
Sub-Total:	Rp.2,000/man-day	171 man-days	342,000
3. Miscellaeous Costs /2 (5% of the above costs)			18,060
4. Credit Interest (19,240 x 0.01 x 7)			1,350
5. Tax			4,000
Total			384,650

Remarks: /1 : Family labour 80% : Hired labour 20%
/2 : Bags, mats, tools etc.

Source: Agricultural Extension Office, Kab. Serang and Interview in Cikande.

Table F-9 PRESENT PRODUCTION COST OF GROUNDNUTS

(Rp/ha)

	Items	Unit Price	Amount	Cost
1.	Materials			
	Seeds (Self-provided)	Rp. 600/kg	130 kg	72,000
	Fertilizers			
	Urea	Rp. 100/kg	25 kg	2,500
	TSP	Rp. 100/kg	50 kg	5,000
	Agro-chemicals	Rp.1,500/lit	1 lit	1,500
	Sub Total:			81,000
2.	Labour	Rp.2,000/man-day	98 man-days	19,6000
3.	Miscellaneous Costs (5% of the above)			13,850
4.	Credit Interest (81,000 x 0.01 x 5)			4,050
5.	Tax			5,000
	Total			299,900

Remarks: Figures are estimated making use of the following sources.

1. Central Bureau of Statistics, Cost Structure of Paddy and other food crop farmers, 1980 and
2. Agricultural office of Kabupaten Serang, Monograph of Kabupaten Serang, 1973 and 1978

Table F-10 PRESENT PRODUCTION COST OF RED ONION

(Rp/ha)

Items	Unit Price	Amount	Cost
1. Materials			
Seeds	Rp.1,500/kg	500 kg	750,000
Fertilizers			
Urea	Rp. 100/kg	50 kg	5,000
TSP	Rp. 100/kg	100 kg	10,000
Agro-Chemicals			
Insecticide	Rp.1,500	3 lt	4,500
Rodenticide	Rp.6,000	2 kg	12,000
Sub-Total:			781,500
2. Labour	Rp.2,000/man-day	260 man-days	520,000
3. Miscellaneous Costs (5% of the above)			65,080
4. Credit Interest			31,730
5. Tax			4,000
Total:			1,401,840

Source: Based on Hearing Survey in BPP Kec. Kr. Watu.

Table F-11 PRESENT PRODUCTION COST OF CHILI

(Rp/ha)

	Items	Unit Price	Amount	Cost
1.	Materials			
	Seeds	Rp. 800/kg	10 kg	8,000
	Fertilizers			
	Urea	Rp. 100/kg	50 kg	5,000
	TSP	Rp. 100/kg	100 kg	10,000
	Agro-chemicals	Rp.1,500/lit	2 lit	3,000
	Sub-total:			26,000
2.	Labour	Rp.2,000/man-day	70 man-days	140,000
3.	Miscellaneous Costs (5% of the above)			8,300
4.	Credit Interest (26,000 x 0.01 x 7)			1,820
5.	Tax			13,000
	TOTAL:			189,120

Source: Baced on Hearing survey
in BPP Kec. Cikande

Table F-12 PRESENT PRODUCTION COST OF STRING BEANS

(Rp/ha)

	Items	Unite Price	Amount	Cost
1.	Materials			
	Seeds	Rp.5,000/kg	8 kg	40,000
	Fertilizers			
	Urea	Rp. 100/kg	25 kg	2,500
	TSP	Rp. 100/kg	50 kg	5,000
	Agro-chemicals	Rp.1,500/lit	5 lit	7,500
	Bamboo (3 years renew)	Rp. 40	640	8,530
	Sub-total			63,530
2.	Labour	Rp.2,000/man-day	75 man-days	150,000
3.	Miscellaneous Costs (5% of the above)			10,680
4.	Credit Interest (63,530 x 0.01 x 4)			2,540
5.	Tax			4,000
	TOTAL:			230,750

Source: Baced on survey
in BPP Kec. Chikande

Table F-13 PRESENT PRODUCTION COST OF CUCUMBER

(Rp/ha)

	Items	Unit Price	Amount	Cost
1.	Materials			
	Seeds	Rp.10,000/kg	1.25 kg	12,500
	Fertilizers			
	Urea	Rp. 100/kg	25 kg	2,500
	TSP	Rp. 100/kg	50 kg	5,000
	Agro-chmicals	Rp. 1,500/lit	5 lit	7,500
	Sub-total			27,500
2.	Labour	Rp.2,000/man-day	60 man-days	120,000
3.	Miscellaneous Cost (5% of the above)			7,380
4.	Credit Interest (27,500 x 0.01 x 4)			1,100
5.	Tax			4,000
	TOTAL:			159,980

Source: Baced on survey
in BPP Kec. Cikande

Table F-14 CALCULATION OF ECONOMIC PRICE OF PADDY IN 1984 VALUE

	Unit	1995
F.O.B Price of rice at Bangkok, 5% broken /1	$/ton	339
Quality Admustment (10% discount)	$/ton	305
Freight and Insurance, Bangkok - Jakarta	$/ton	30
Port Handling, Storage and Transport to wholesaler /3	Rp/ton	9,000
Transport and Handling Costs, Mills-wholesaler /2	Rp/ton	7,000
Ex-mill price of rice in Project Area (1 $ = 1050 Rp)	Rp/ton	353,750
Conversion of milled rice to dry paddy (68%)	Rp/ton	240,550
Losses of Weight in Storage and Processing (5%)	Rp/ton	12,030
Milling Cost of Paddy	Rp/ton	10,200
Value of By-product per ton of paddy	Rp/ton	2,040
Transport Cost, Mills-Farm (20km)	Rp/ton	2,000
Farm Gate Price of Paddy	Rp/ton	218,360

Remarks: /1 : IBRD 1984, commodity prices and price projection

/2 : 70 km x Rp.100/km. ton

/3 : Port handling and storage cost : Rp.7,000/ton

transport cost to wholesaler 20 km x Rp.100/km. ton

Table F-15 CALCULATION OF ECONOMIC PRICES OF FERTILIZERS IN 1984 VALUE

	Unit	1995
1. Urea (46% N)		
F.O.B. price in Europe	$/ton	270
Freight and Insurance, Europe-Jakarta	$/ton	40
Port Handling and Storage Costs	Rp/ton	9,000
Transport Cost, Jakarta-Project Area	Rp/ton	7,000
Farm Gate Price	Rp/ton	341,500
2. TSP (46% P_2O_5)		
F.O.B. price in Gulf Ports	$/ton	176
Freight and Insurance, Gulf Port-Jakarta	$/ton	60
Port Handling and Storage Cost	Rp/ton	9,000
Transport Cost, Jakarta-Project Area	Rp/ton	7,000
Farm Gate Price	Rp/ton	263,800
3. Potassium Chloride (60% K_2O)		
F.O.B. price in Van Couver	$/ton	104
Freight and Insurance, Van Couver - Jakarta	$/ton	50
Port Handling and Storange Costs	Rp/ton	9,000
Transport Cost, Jakarta-Project Area	Rp/ton	7,000
Farm Gate Price	Rp/ton	177,700

Remark: F.O.B. prices are from IBRD data, commodity prices and price projection, 1984.

Table F-16 FINANCIAL PRODUCTION COSTS OF PADDY IN WITHOUT/WITH PROJECT CONDITIONS

(Rp/ha)

Items	Unit Price	Without-Project (Rainfed Paddy)		Without-Project (Irrigated Paddy)		With-Project (Irrigated Paddy)	
		Amount	Cost	Amount	Cost	Amount	Cost
1. Materials							
Seeds	Rp. 100/kg Rp. 170/kg /1	25 kg	2,500	25 kg	4,250	25 kg	4,250
Fertilizers							
UREA	Rp. 100/kg	87 kg	8,700	200 kg	20,000	200 kg	20,000
TSP	Rp. 100/kg	75 kg	7,500	100 kg	10,000	100 kg	10,000
KCL	Rp. 100/kg	-		50 kg	5,000	50 kg	5,000
Agro-chemicals							
Insecticide	Rp.1,500/lit	1 lit	1,500	2 lit	3,000	2 lit	3,000
Rodenticide	Rp.6,000/kg	0.04 kg	240	0.2 kg	1,200	0.2 kg	1,200
Sub-total			20,440		43,450		43,450
2. Labour (man-day)							
Nursery Preparation		10		10		10	
Land Preparation		60		60		60	
Transplanting		23		23		23	
Weeding		23		23		23	
Harvesting		15		20		20	
Post-Harvest		15		20		20	
Other		25		30		30	
Sub-total	Rp.2,000/man-day	171	342,000	186	372,000	186	372,000
3. Miscellaneous Cost 2/			18,120		20,770		20,770
4. Credit Interest (1 x 0.01 x 7)			1,430		3,040		3,040
5. Tax and Water charge			4,000		9,000		9,000
TOTAL:			385,990		448,260		448,260

Remarks: /1: Irrigated Paddy, Purchase of certified seeds every 3 years
/2: Bags, mats, tools, etc.

Table F-17 FINANCIAL PRODUCTION COST OF GROUND-NUTS IN WITHOUT/WITH-PROJECT CONDITIONS

(Rp/ha)

	Items	Unit Price	Amount	Cost
1.	Materials			
	Seed (Self-provided)	Rp. 600/kg	120 kg	72,000
	Fertilizers			
	Urea	Rp. 100/kg	25 kg	2,500
	TSP	Rp. 100/kg	50 kg	5,000
	Agro-chemicals	Rp.1,500/lit	1 lit	1,500
	Sub-total			81,000
2.	Labour	Rp.2,000/man-day	98 man-days	196,000
3.	Miscellaneous Costs (5% of the above)			13,850
4.	Credit Interest (81,000 x 0.01 x 5)			4,050
5.	Tax			5,000
	TOTAL:			299,900

Table F-18 FINANCIAL PRODUCTION COSTS OF RED ONION, WITH-PROJECT CONDITION

(Rp/ha)

Items	Unit Price	Amount	Cost
1. Materials			
Bulb Sets	Rp.1,500/kg	600 kg	900,000
Fertilizers			
Urea	Rp. 100/kg	150 kg	15,000
TSP	Rp. 100/kg	200 kg	20,000
KCL	Rp. 100/kg	100 kg	10,000
Agro-chemicals			
Insecticide	Rp.1,500/lit	3 lit	4,500
Rodenticide	Rp.6,000/kg	3 kg	18,000
Sub-total			967,500
2. Labour	Rp.2,000/man-day	230 man-days	460,000
3. Miscellaneous Costs (5% of the above)			71,380
4. Credit Interest (967,500 x 0.01 x 4)			38,700
5. Tax and Water Charge			8,000
TOTAL:			1,545,580

Table F-19 ECONOMIC PRODUCTION COSTS OF PADDY IN WITHOUT/WITH PROJECT CONDITIONS

(Rp/ha)

Items	Unit Price	Without Project (Rainfed Paddy)		Without Project (Irrigated Paddy)		With Project (Irrigated Paddy)	
		Amount	Cost	Amount	Cost	Amount	Cost
1. Materials							
Seeds	Pp. 218/kg	25 kg	5,450	25 kg	5,450	25 kg	5,450
Fertilizers							
UREA	Rp. 342/kg	87 kg	29,750	200 kg	68,400	200 kg	68,400
TSP	Rp. 264/kg	75 kg	19,800	100 kg	26,400	100 kg	26,400
KCO	Rp. 178/kg	-		50 kg	8,900	50 kg	8,900
Agro-chemicals							
Insecticide	Rp.1,500/lit	1 lit	1,500	2 lit	3,000	2 lit	3,000
Rodenticide	Rp.6,000/kg	0.04 kg	240	0.02 kg	1,200	0.02 kg	1,200
Sub-total			56,740		113,350		113,350
2. Labour (man-day)							
Nursery Preparation		10		10		10	
Land Preparation		60		60		60	
Trans planting		23		23		23	
Weeding		23		23		23	
Harvesting		15		20		20	
Post Harvest		15		20		20	
Other		25		30		30	
Sub-total	Rp.1,200/man-day	171	205,200	186	223,200	186	223,200
3. Miscellaneous Cost 1/			13,100		16,830		16,830
4. Water Charge					5,000		5,000
TOTAL:			275,040		358,380		358,380

Remarks; 1/: Bags, mats, tools, etc.

Table F-20 ECONOMIC PRODUCTION COSTS OF GROUNDNUTS IN WITHOUT/WITH-PROJECT CONDITIONS

(Rp/ha)

Items	Unit Price	Amount	Cost
1. Materials			
Seed	Rp. 600/kg	120 kg	72,000
Fertilizers			
Urea	Rp. 342/kg	25 kg	8,550
TSP	Rp. 264/kg	50 kg	13,200
Agro-chemicals	Rp.1,500/lit	1 lit	1,500
Sub-total			95,250
2. Labour	Rp.1,200/man-day	98 man-days	117,600
3. Miscellaneous Costs (5% of the above)			10,640
TOTAL:			223,490

Table F-21 ECONOMIC PRODUCTION COST OF RED ONION, WITH-PROJECT CONDITION

(Rp/ha)

Items	Unit Price	Amount	Cost
1. Materials			
Bulb Sets	Rp.1,500/kg	600 kg	900,000
Fertilizers			
Urea	Rp. 342/kg	150 kg	51,300
TSP	Rp. 264/kg	100 kg	52,800
KCL	Rp. 178/kg	100 kg	17,800
Agro-chemicals			
Insecticide	Rp.1,500/lit	3 lit	4,500
Rodenticide	Rp.6,000/kg	3 kg	18,000
Sub-total			1,044,400
2. Labour	Rp.1,200/man-day	230 man-days	276,000
3. Miscellaneous Costs (5% of the above)			66,020
4. Water Charge			4,000
TOTAL:			1,390,420

Table F-22 IRRIGATION BENEFITS AT THE FULL DEVELOPMENT STAGE

(FINANCIAL ANALYSIS)

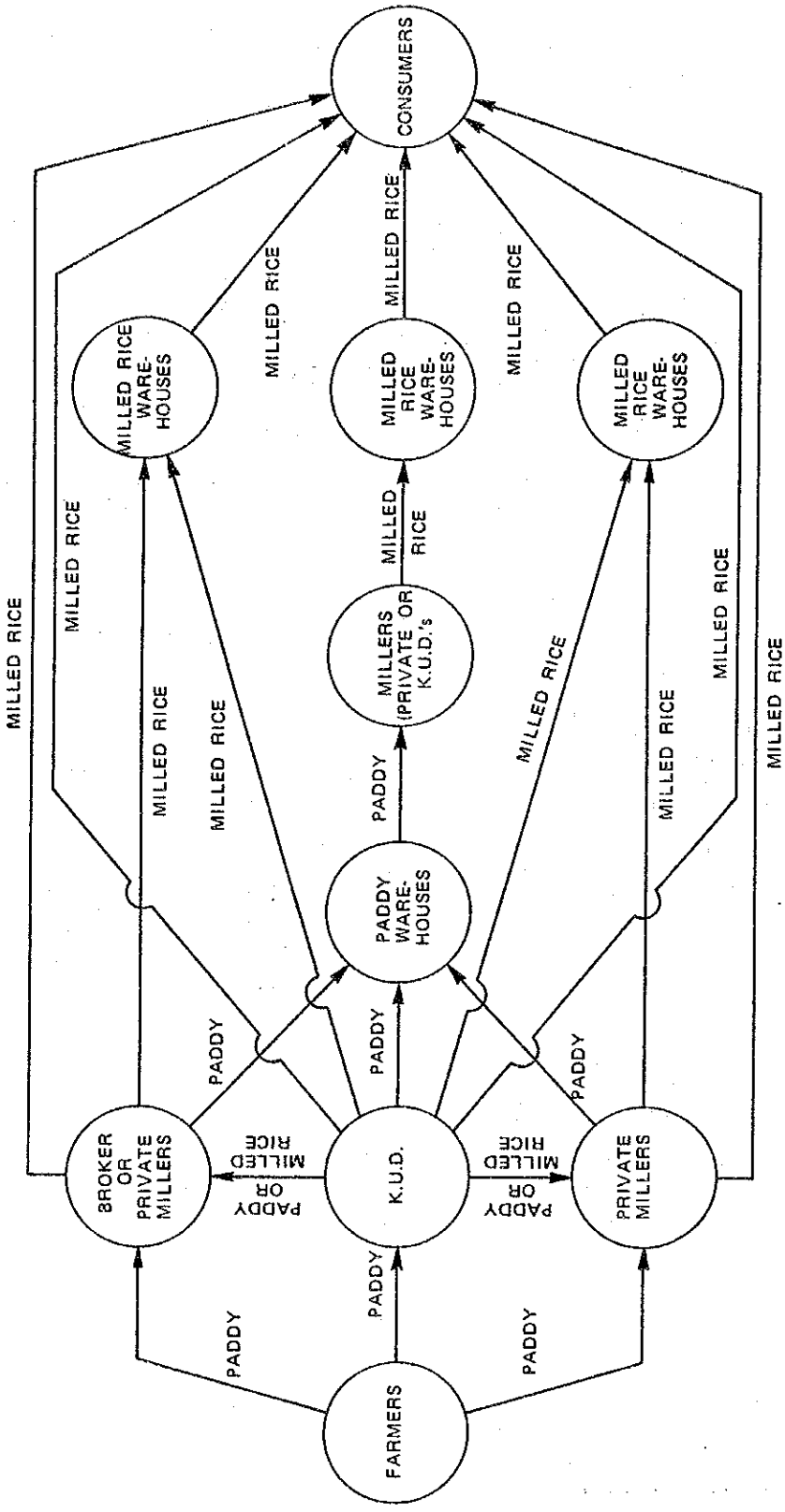
	Without-project				With-project		
	Paddy		Upland Crops		Paddy	Upland Crops	Onion
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Irrigated	Irrigated
A. Ciujung Area							
Planted area (ha)	39,200	-	2,660	-	58,080	2,420	-
Unit Yield (ton/ha)	5.0	-	0.87	-	5.0	0.87	-
Prices (Rp/ton)	100,000	-	600,000	-	100,000	600,000	-
Production Cost (Rp/ha)	448,260	-	299,900	-	448,260	299,900	-
Net Income (Million Rp)	2,030	-	590	-	3,010	540	
Project benefit (Million Rp)			(930)				
B K C C Area							
Planted area (ha0	480	10,980	-	1,510	24,720	-	1,030
Unit yield (ton/ha)	5.0	2.9	-	0.76	5.2	-	8.0
Prices (Rp/ton)	100,000	100,000	-	600,000	100,000	-	700,000
Production cost (Rp/ha)	448,260	385,990	-	299,900	448,260	-	1,545,580
Net Income (Million Rp)	450	-1,050	-	340	1,280	-	4,180
Project benefit (Million Rp)			(5,720)				
C Cicinta Area							
Planted area (ha)	1,530	-	-	-	3,430	-	140
Unit yield (ton/ha)	5.0	-	-	-	5.0	-	8.0
Prices (Rp/ton)	100,000	-	-	-	100,000	-	700,000
Production cost (Rp/ha)	448,260	-	-	-	448,260	-	1,545,580
Net Income (Million Rp)	80	-	-	-	180	-	570
Project benefit (Million Rp)			(670)				
D Total Project Benefits			(7,320)				

Table F-23 IRRIGATION BENEFITS AT THE FULL DEVELOPMENT STAGE

(ECONOMIC ANALYSIS)

	Without-project				With-project		
	Paddy		Upland Crops		Paddy	Upland Crops	Onion
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Irrigated	Irrigated
A. Ciujung Area							
Planted area(ha)	39,200	-	2,660	-	58,080	2,420	-
Unit yield (ton/ha)	5.0	-	0.87	-	5.0	0.87	-
Prices (Rp/ton)	218,360	-	600,000	-	218,360	600,000	-
Production cost (Rp/ha)	358,380	-	223,490	-	358,380	223,490	-
Net Income (Million Rp)	28,750	-	790	-	42,600	720	-
Project benefit (Million Rp)			(13,780)				
B. K C C Area							
Planted area (ha)	480	10,980	-	1,510	24,720	-	1,030
Unit Yield (ton/ha)	5.0	2.9	-	0.76	5.0	-	8.0
Prices (Rp/ton)	218,360	218,360	-	600,000	218,360	-	700,000
Production cost (Rp/ha)	358,380	275,040	-	223,490	358,380	-	1,390,420
Net Income (Million Rp)	350	3,930	-	350	18,130	-	4,340
Project benefit (Million Rp)			(17,840)				
C. Cicinta Area							
Planted area (ha)	1,530	-	-	-	3,430	-	140
Unit yield (ton/ha)	5.0	-	-	-	5.0	-	8.0
Prices (Rp/ton)	218,360	-	-	-	218,360	-	700,000
Production cost (Rp/ha)	358,380	-	-	-	358,380	-	1,390,420
Net Income (Million Rp)	1,120	-	-	-	2,520	-	590
Project benefit (Million Rp)			(1,990)				
D. Total Project Benefits (Million Rp)			(33,610)				

Fig.F-1



Source: Domestic Rice Procurement of BULOG in Collaboration with KUD (National Logistics Agency, BULOG, 1980)

MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT

Paddy and Rice Marketing Channel

JAPAN INTERNATIONAL COOPERATION AGENCY

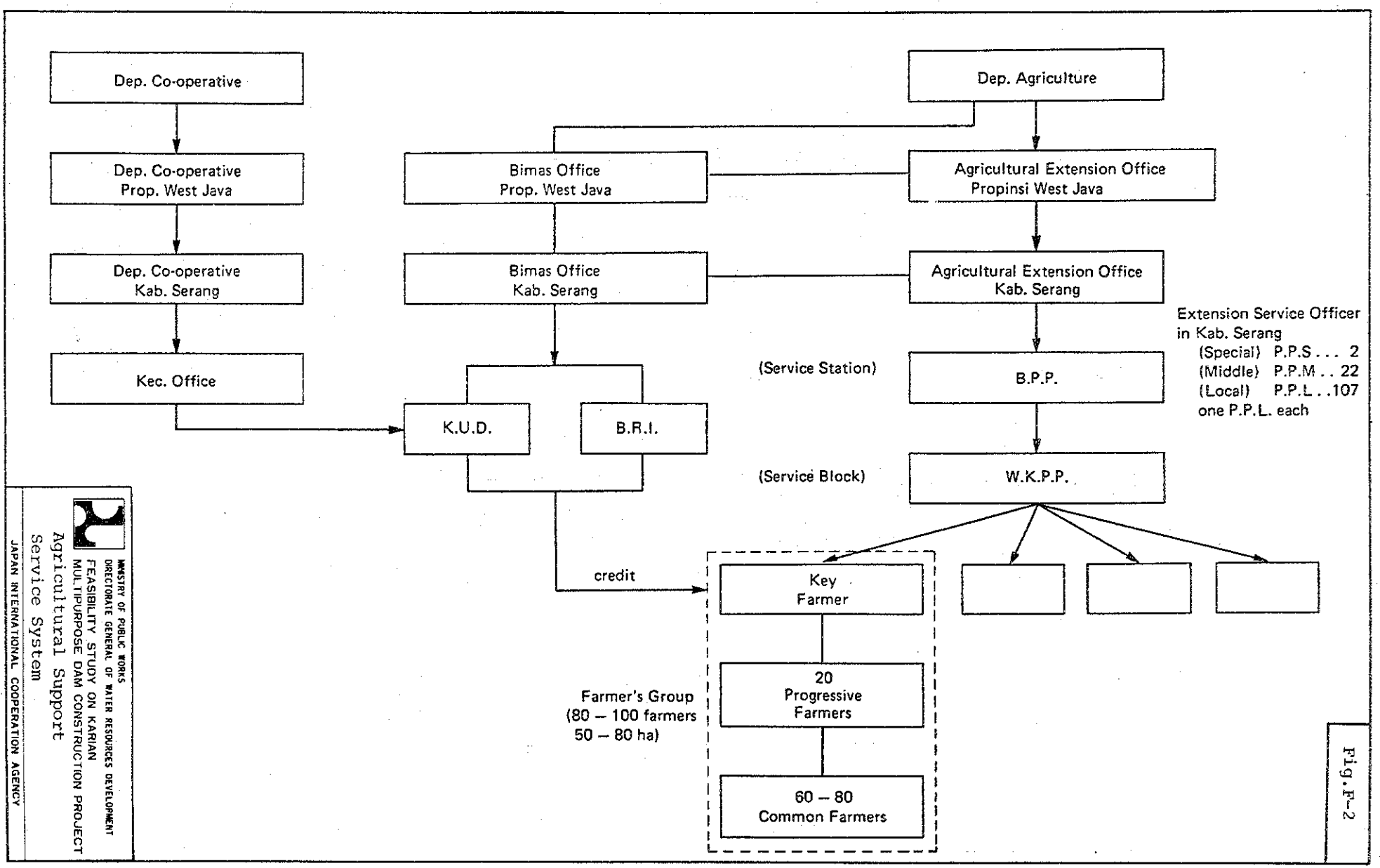

Dep. Co-operative
Dep. Co-operative Prop. West Java
Dep. Co-operative Kab. Serang
Kec. Office
Dep. Agriculture
Bimas Office Prop. West Java
Agricultural Extension Office Propinsi West Java
Bimas Office Kab. Serang
Agricultural Extension Office Kab. Serang
(Service Station)
B.P.P.
K.U.D.
B.R.I.
(Service Block)
W.K.P.P.
Extension Service Officer in Kab. Serang
(Special) P.P.S . . . 2
(Middle) P.P.M . . 22
(Local) P.P.L . .107
one P.P.L. each
credit
Key Farmer
20 Progressive Farmers
60 – 80 Common Farmers
Farmer's Group
(80 – 100 farmers
50 – 80 ha)
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT
Agricultural Support Service System
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.F-2

APPENDIX-G

IRRIGATION AND DRAINAGE

APPENDIX - G

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IRRIGATION AND DRAINAGE

1. DELINEATION OF K-C-C IRRIGATION SCHEME AREA

1.1 General

For the delination of irrigable area in the Kopo-Cikande-Carenang area (K-C-C area), field reconnaissance was made, and various data on natural resources and interrelated land data have been collected mainly in the area surrounded by the Cidurian river on the north, by the Rangkasbitung - Kopo road on the south, by the Cibeureum river on the east and by the Right Primary Canal of the Ciujung Irrigation Scheme on the west. In addition, the information given in the aerial photos (1:20,000) and maps (1:5,000 and 1:50,000), such as topography, vegetation conditions and present land use conditions were fully taken into consideration.

1.2 Factors to be Considered in Delineation

1.2.1 Land Capability

The total area surveyed is graded into four classes of land capability which is evaluated in terms of thickness of top soil, effective soil depth, gravel content in top soil, easiness of plowing, permeability under submerged condition, wetness of land, inherent fertility, content of available nutrient, degree of hazard, frequency of hazard, land slope and erodability. The following table shows the area extent of each class in land capability (APPENDIX-D).

Capability Class	Area (ha)
I	8,360
II	12,220
III	1,250
IV	40
Total	21,870

In the above areas, the lands graded in Class - I, II and III are taken as an irrigable area, and the lands graded in Class - IV are deleted from the irrigable area because of their unsuitability for irrigated farming.

1.2.2 Area Distibution by Elevation

The K-C-C area lies on the elevations between 0 m and 55 m having an average ground slope of 1/655 northward, but its area distribution is not proportionate to the elevation : lower altitude occupies more area as shown below.

Elevation (m)	Accumulated Area (ha)	Difference (ha)
0	0	0 (0 %)
5	2,590	2,590 (14.3%)
10	4,780	2,190 (12.1%)
15	7,180	2,400 (13.2%)
20	10,400	2,920 (16.1%)
25	13,610	3,510 (19.3%)
30	15,690	2,080 (11.5%)
35	16,910	1,220 (6.7%)
40	17,460	550 (3.0%)
45	17,730	270 (1.5%)
50	17,950	220 (1.2%)
55	18,150	200 (1.1%)

The above table shows that the area increase above EL. 35 m is only 1,240 ha (gross) in total (740 ha in net), and it would not be economical to include these high lands in the irrigable area, because the irrigation of these lands would require a much raised canal system as well as diversion works resulting in unreasonably high construction cost. Thus, the maximum gross irrigable area would be 12,760 ha (10,300 ha in net) after deducting 1,930 ha of village areas, 930 ha of forest and plantation areas, 770 ha of military area and 520 ha/1 of swamp areas from 16,910 ha lying below EL. 35.0 m.

1.2.3 Water Resources and Water Demands

The Project intends to supply irrigation water to the three scheme areas; the Ciujung, Cicinta and K-C-C areas, in addition to supply of municipal water to the major towns in the Project area and industrial water to the Cilegon area. The water resources of these water demands will depend on three rivers; the Ciujung, Cibeureum and Cicinta. The runoffs of these rivers particularly in the dry season are limited as compared with the above-mentioned water demands. The water resources endowed in these rivers would therefore be exploited through construction of storage dams. For the exploitation of such water resources, it is proposed to construct two dams; the Karian dam on the Ciberang river (a tributary of the Ciujung river) and the Cilawang dam on the Cibeureum river. The water thus exploited on two rivers is planned to be used combinedly for the following demands respectively.

i) Supplementary water supply to the Ciujung Irrigation Scheme area of 24,200 ha at the cropping intensity of 250%.

ii) Supplementary water supply to the Cicinta Irrigation Scheme area of 1,430 ha at the cropping intensity of 250%.

/1: Total swamp area is measured to be 840 ha under the present conditions, but 320 ha out of this is expected to be improved by the drainage improvement and can be included in the irrigable area.

iii) Water supply to the K-C-C Irrigation Scheme area of 10,300 ha at the cropping intensity of 250%.

iv) Municipal water supply of 0.62 m^3/sec to major towns (IKKs) in the Project area.

v) Industrial water supply of 1.15 m^3/sec to Cilegon area.

In order to check whether or not the exploited water resources can suffice the above-mentioned water demands, the water balance studies are made between the various combinations of the storage capacities of the Karian and Cilawang reservoirs and the water demands. As the result, it is clarified that the water resources exploited in the following manner can most economically suffice the above-mentioned water demands (Ref. APPENDIX-J).

(1)	Cropping intensity:	250% for all the scheme areas
(2)	Irrigable area :	
	- Ciujung Scheme area	24,200 ha
	- Cicinta Scheme area	1,430 ha
	- K-C-C Scheme area	10,300 ha
(3)	Dam height	
	- Karian	60.5 m
	- Cilawang	36.0 m
(4)	Reservoir capacity (net)/1	
	- Karian	219.3 MCM
	- Cilawang	62.0 MCM
(5)	Flow capacity of tunnel	
	- Karian-Cibeureum	8.0 m^3/sec
	- Cilawang-Cicinta	2.7 m^3/sec

/1: The discharge of the Cicinta river is counted in the water balance study.

1.3 Area to be Developed under the Project

From the results of overall studies mentioned above, it is concluded that the K-C-C irrigation development area would be 10,300 ha, in which an intensive cultivation will be practiced by introducing the cropping pattern with an intensity of 250%.

2. IRRIGATION WATER REQUIREMENTS

2.1 General

For the use of water balance study between the irrigation demands and river discharges of the Ciberang and Cibeureum rivers for the optimization of development scale, irrigation water requirements are calculated for the cropping pattern with a cropping intensity of 250%. The calculation is made on 10-day basis for 12 years from 1972 to 1983 and the results thus calculated are used for the water balance calculation at the Karian and Cilawang dam sites. In order to determine the design capacity of the irrigation canal system, the unit design irrigation water requirement is also calculated against the effective rainfall with an 80% probability of exceedence of the drought year.

In the calculation of water requirements, the report on "Computation of Irrigation Water Requirement for Wet Sawah Padi, PROSIDA/NEDECO 1973" and other past study results for the irrigation projects in the Banten area are fully referred to. In order to facilitate the calculation of irrigation water requirements, some field measurements of canal conveyance losses and percolation rates in paddy fields have been conducted in the project area during the present survey period.

2.2 Consumptive Use of Water (CU)

The consumptive use of water is calculated by the following formula:

$$CU = ETp \times kc$$

Where, ETp: potential evapotranspiration

kc : crop coefficient

The ETp is defined as "the rate of evapotranspiration from an extensive surface of 7 to 15 cm tall, green grass cover of uniform height, actively growing, completely shading the ground and not short of water". In the study, the ETp is calculated using the Penman Formula modified by PROSIDA. Since the meteorological data required for the calculation are available only at the Serang Meteorological Station in the project area, the ETp calculated using these data (1972 - 1983) is applied to the calculation of CU for the three scheme areas, i.e. Ciujung, Cicinta and K-C-C areas. The following table shows the calculated ETp.

(Unit: mm/day)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
3.7	4.1	4.3	4.4	4.3	4.1	4.3	4.6	4.9	4.7	4.4	4.1

The kc is employed to relate the ETp to the consumptive use of water. Values of crop coefficients vary with the crop characteristics, time of planting and/or sowing and climatic conditions. For the calculation of consumptive use of water for both local and high-yield varieties of paddy, the kc-values recommended by PROSIDA in its report on "Computation of Irrigation Water Requirement for Wet Sawah Padi, PROSIDA/NEDECO 1973" are used after plotting on graph papers for their convenient use. As for the kc-values for vegetable and palawija, the kc-values shown in "FAO Irrigation and Drainage Paper 24" are used in the calculation, because those values are not available in the PROSIDA report (Ref. Fig. G-1).

2.3 Unit Irrigation Water Requirement for Water Balance Study

(1) Equations

The unit irrigation water requirement to be used for the water balance study is calculated for every 10-day period employing the following equations.

(For paddy)

$$IWD = (CU + PL + NW + PW - ER) / Ei$$

(For upland crop)

$$IWS = (CU + FA - ER) / Ei$$

Where, IWD, IWS ; unit irrigation water requirement,
CU ; consumptive use of water,
PL ; percolation loss in paddy field,
NW ; nursery water requirement,
PW ; puddling water requirement,
ER ; effective rainfall,
FA ; farm application losses,
Ei ; combined irrigation efficiency.

(2) Percolation loss in paddy field

In order to know the percolation losses in paddy fields, field measurements have been conducted at nine plots of paddy fields selected in the project area; six in the K-C-C area, one in the Ciujung area and two in Cicinta area, all of which are located in lowland and being planted with paddy. The following table shows the measured results.

Location	Date of Measurement	Percolation Loss (mm/day)
Kamp. Sebe (Cicinta)	Aug.31, 1984	1.29
Kamp. Pasirjambe (Ciujung)	Sep. 1, 1984	0.86
Kamp. Parigi (K-C-C)	Sep. 4, 1984	0.15*
Kamp. Cidahu (Cicinta)	" "	0.65
Kamp. Laes (K-C-C)	Sep.11, 1984	1.12
Kamp. Junti (K-C-C)	" "	1.37
Kamp. Penebong (K-C-C)	Sep.12, 1984	1.01
Kamp. Kamrang (K-C-C)	" "	0.96
Kamp. Cakung (K-C-C)	Sep.13, 1984	0.28*
Average		1.04

Note *; These figures are deleted when the assessment is made because of their inaccuracy.

From the above measured results, it may be concluded that the percolation loss in lowland is about 1 mm/day in the dry season. In the calculation of water requirements, however, double of the above-measured results; 2 mm/day, is counted for lowland in the dry season taking into account some measurement losses and some allowances. The percolation losses in the rainy season is deemed to be a half of that in the dry season; 1 mm/day. On the other hand, the percolation losses for elevated paddy fields are deemed to be double of those in lowland paddy fields.

The above description is recapitulated below.

	Percolation Rate (mm/day)	
	Dry Season	Rainy Season
Elevated paddy field	4	2
Lowland paddy field	2	1

(3) Nursery water requirement

The nursery water requirement is estimated for the following assumptions.

(a) Area required for nursery bed : 1/20 of main field

(b) Nursery period : 20 days

(c) Water required for 20 days,

- Preparation of nursery bed	150 mm
- Evapotranspiration, 5 mm/day	100 mm
- Percolation loss, 2 mm/day	40 mm
Total	290 mm

(4) Puddling water requirement

In order to know the actual puddling water requirement under the present farming practices in the area, a field measurement was conducted on September 13, 1984 in the Ciselaraja Irrigation Scheme area, of which soil characteristics are deemed to be similar to those of the K-C-C area.

A plot of paddy field with an area of 1,010 m^2 was selected for the measurement. As the result, 214 mm was obtained. The puddling water requirement thus measured was compared with the value obtained through theoretical calculation as follows:

(a) Formula

$$PW = DS + WS + E + PL - ER$$

Where, PW : puddling water requirement,
DS : required water depth above soil surface after puddling,
WS : difference in soil moisture contents before and after puddling,
E : evaporation from water surface in puddled field,
PL : percolation loss in puddled field,
ER : effective rainfall.

(b) Assumptions:

i) Water depth above soil after puddling is 30 mm.

ii) Porosity is 50% in both surface soil (20 cm depth) and sub-soil (20 cm depth).

iii) Vapor phase in soils after puddling is 5%.

iv) Soil moisture before irrigation is assumed to be 15% (in volume) in the dry season and 35% in the rainy season.

v) Effective rainfall for 10 days during the puddling period is obtained to be 10 mm in the dry season and 32 mm in the rainy season.

Thus, the puddling water requirement is obtained as follows:

- dry season ; 195 mm
- rainy season ; 86 mm

Referring to both measured and calculated results mentioned above, 210 mm for the dry season and 90 mm for the rainy season are adopted in the calculation of water requirements.

(5) Effective rainfall

The effective rainfall is estimated using the "Effective Rainfall Chart" developed based on the results obtained through the daily balance calculation made for the Komering-I Irrigation Project/1 (Fig. G-2). In the estimation, the rainfall data at the Serang meteorological station are used for all the Ciujung, K-C-C and Cicinta areas, because long-term and reliable data are available only at this station in the Project area.

(6) Farm application losses

Farm application losses in upland crop irrigation include deep percolation, surface runoff, etc. Taking into account the soil characteristics, topography, climate, irrigation practices and experience, etc., the application efficiency is assumed to be 80% of (CU - ER) on an avarage.

(7) Combined irrigation efficiency

The combined irrigation efficiency is the product of canal operation efficiency and canal conveyance efficiency, and expressed by the following equation:

$$Ei = (1 - OL) \times (1 - CL)$$

Where, OL : ratio of operation loss to net irrigation water requirement,

CL : ratio of canal conveyance loss to net irrigation water requirement.

/1: Feasibility Study on the Komering-I Irrigation Development Project in the Upper Komering River, JICA, 1981.

The operation loss is defined as the irrigation water wasted due to improper canal gate operations and unskilled water management in field. According to the actually measured results in the irrigated paddy fields in Lampung province/1, the total operation loss would be 50 to 100% of net irrigation water requirement. Even after the canal operation practices and water management are improved through appropriate guidance to farmers, a certain amount of irrigation water; in the order of 10 - 30% of net irrigation water requirement, would be wasted. Considering these facts, the operation loss of 20% is taken in the calculation; 80% in efficiency.

The canal conveyance loss would be caused by seepage through the water perimeter of canal and evaporation from the canal water surface. In order to know the actual canal conveyance losses, the field measurements are conducted by the Team expert at four places; RH-9 canal in the Ciujung scheme area, main canal of the Cicinta scheme area, tertiary canal in the Ciselaraja scheme area and Koper village where pump irrigation is practiced. In addition to the above field measurements, the results of field measurements conducted by D.P.M.A. in the Ciujung Scheme area/2 are collected from the Serang Irrigation Section. Based on these data, the relationship between the flow velocity in canal and canal conveyance loss expressed in cubic meter per second per unit wetted area of canal ($m^3/sec/m^2$) is calculated and plotted on a section paper as shown in Fig. G-3. Using the relationship thus obtained, the average canal conveyance loss in the proposed canal system is obtained in the following manner.

/1: "Water Requirement on New Paddy Field", J. Inoue, Lampung Provincial Public Works, 1981.

/2: Laporan "Penelitian Besarnya Kehilangan Air Irigasi Pada Jaringan Utama di Daerah Pengairan Ciujung Sub-PROSIDA Ciujung Serang", D.P.M.A., 1978.

(a) Assumption

	Average Length (m)	Mean Discharge (m^3/sec)	Mean Velocity (m/sec)
- Main canal	15,000	12	0.61
- Secondary canal	3,600	1.2	0.42
- Tertiary canal	800	0.08	0.28
- Quaternary canal	150	0.01	0.22

(b) Calculation of efficiency

	Wetted Area (m^2)	Unit Conveyance Loss (m^3/sec/m^2)	Total Loss (m^3/sec)	Loss in Percent (%)	Efficiency (%)
- Main canal	180,000	2.2×10^{-6}	0.3960	3.3	96.7
- Secondary canal	16,920	3.7×10^{-6}	0.0626	5.2	94.8
- Tertiary canal	1,120	8.0×10^{-6}	0.0090	11.2	88.8
- Quaternary canal	90	13.3×10^{-6}	0.0012	12.0	88.0
- Overall efficiency					71.6%

From the above calculation, the canal conveyance efficiency is taken to be 70% after deducting some miscellaneous losses from 71.6%.

The canal operation efficiency and conveyance efficiency mentioned above make a combined irrigation efficiency of 56%.

(8) Calculated results

Following the above-mentioned calculation procedure, the unit water requirement is calculated for the cropping pattern with a cropping intensity of 250% (Fig. G-4), and the water demands are obtained by multiplying the unit water requirement by the irrigation area as shown in Table G-1 through Table G-3. The water demands thus calculated will be used for the water balance study at the Karian and Cilawang reservoirs to examine the optimum scale of water resources development.

2.4 Unit Design Irrigation Water Requirement

The unit design water requirement is calculated for the recommended cropping pattern with the cropping intensity of 250% for all the three irrigation schemes. According to the calculated result of the water requirement for water balance study, the peak irrigation water demand concentrates in the period from May to August. Therefore, the unit design irrigation requirement is examined only for this period. For the calculation of the water requirement, rainfalls are summed up for 4 months from May to August for each year, and then 4-month rainfall with a 80% probability of exceedence of drought year is obtained to be 155 mm at the Serang meteorological station. Based on the probable rainfall thus obtained, the basic year for the calculation of the unit design irrigation water requirement is selected to be 1975 at the Serang station. The monthly distribution of rainfall in the basic year is as follows:

(Unit; mm)

Station	May	Jun	Jul	Aug	Total
Serang (1975)	40	18	61	33	152

Based on the above rainfall, the effective rainfall is estimated using the "Effective Rainfall Chart" mentioned above and then, the unit design irrigation water requirement is calculated to be 1.60 lit/sec/ha for all the scheme areas.

2.5 Design Water Requirements

(1) Design diversion requirements

The design diversion requirements are defined as the peak diversion discharge, which is obtained by multiplying the above unit design irrigation water requirement by total irrigation area. The design diversion requirements thus calculated for the respective scheme areas are as shown below.

Scheme	Irrigation Area	Design Diversion Requirement
Ciujung	24,200 ha	38.72 m^3/sec
Cicinta	1,430 ha	2.29 m^3/sec
K-C-C	10,300 ha	16.48 m^3/sec

(2) Design discharge for headreach, main and secondery canals

Based on the unit design irrigation water requirement calculated in Section 2.4 hereof, the design discharges for the headreach, main canal and the secondary canals are obtained as shown in Fig. G-5.

(3) The design discharge for tertiary and quaternary canals

The design discharges for the tertiary and quaternary canals are calculated by using the following formula derived from the Tegal Curve.

$$Q = 5.32 \times q \times A^{2/3}$$

Where, Q : design discharge (lit/sec),

q : unit design irrigation water requirement (lit/sec/ha)
= 1.60 lit/sec/ha,

A : command area (ha).

3. DRAINAGE WATER REQUIREMENTS IN K-C-C AREA

3.1 Standard for Drainage Plan

Northern half of the K-C-C area extends over low-lying and flat plain and suffers from maldrainage in every rainy season. If the lands are not drained well within a feasible range, the productivity will not go up even after the provision of well-designed irrigation facilities.

From the past experiments and observations in Japan/1 on the relation between the yields and reduction rates of paddy and depth and duration of submergence at different growing stages of paddy, the following considerations could be made:

(a) The submergence at the growing stage of young panicle formation gives the serious damage to paddy. The damage due to submergence at the stage of maturing is insignificant.

(b) The duration of submergence within 1 - 3 days is not significant, but damage of paddy remarkably increases, if the submergence lasts for more than 3 days.

(c) When a part of leaves still remains above water surface, the damage to paddy is not serious as compared with the case that the leaves are completely submerged.

Taking into account the above considerations, the following design standard will be applied for the drainage plan in the K-C-C area.

(1) The allowable depth submergence in paddy fields should be less than 30 cm, and its duration should not exceed 3 days.

(2) The submergence more than 30 cm in depth should not last for more than 24 hours.

/1: These are presented in "Hand Book on Estimating Yield Reduction Rates of Summer Crop due to Various Causes" published by the Ministry of Agriculture, Forestry and Fisheries of Japn In 1975.

3.2 Drainage Requirement

In general, the criteria for the calculation of unit drainage requirement defines the rainfall intensity with a certain probability and a drain period necessary for removal of excess water to an allowable extent. In this study, the drainage requirements are estimated on the basis of following assumptions and procedures:

(1) The design rainfall is estimated based on the following Indonesian criteria mentioned in the comment on the Interim Report;

   (a) three-day consecutive rainfall in 1/5 exceedance probability for the design of main and secondary drains,

   (b) three-day consecutive rainfall in 1/20 exceedance probability for the design of drainage structures,

   (c) two-day consecutive rainfall in 1/25 exceedance probability for the design of tertiary drains.

(2) In the Project area, long term and reliable daily rainfall data are available only at the Serang meteorological station, and therefore, the design rainfall is estimated based on the data at this station. The design rainfalls thus estimated are as follows:

   - three-day consecutive rainfall in 1/5 probability; 150 mm
   - three-day consecutive rainfall in 1/20 probability; 191 mm
   - two-day consecutive rainfall in 1/25 probability; 183 mm

(3) The design rainfalls obtained in the above are distributed to each day as follows, based on the average distribution pattern of rainfall at Serang;

	3-day rainfall in 1/5 probability		3-day rainfall in 1/20 probability		2-day rainfall in 1/25 probability	
Day	Distribution rate	Distributed rainfall	Distribution rate	Distributed rainfall	Distribution rate	Distributed rainfall
1st day	30.1%	45 mm	30.1%	58 mm	47.2%	86 mm
2nd day	27.9%	42 mm	27.9%	53 mm	52.8%	97 mm
3rd day	42.0%	63 mm	42.0%	80 mm	-	-

(4) Relationship between rainfall and runoff distribution is assumed as follows:

Relationship between Cumulative Rainfall and Total Runoff

Cummulative Rainfall	Runoff Coefficient
less than 10 mm	0
10 - 30 mm	0.1
30 - 50 mm	0.3
50 - 100 mm	0.5
100 - 300 mm	0.8

Relation between Rainfall and Runoff Distribution

Rainfall	1st day	2nd day	3rd day	4th day
less than 30 mm	100%	-	-	-
30 - 50 mm	70%	30%	-	-
50 - 100 mm	60%	30%	10%	-
more than 100 mm	50%	30%	15%	5%

(5) Based on the above assumptions, the drainage requirements are calculated as follows:

Drainage Requirement for Main and Seconday Drains

Design Rainfall (mm)	Cumulative Rainfall (mm)	Runoff Coefficient	Runoff (mm) 1st day	2nd day	3rd day	4th day	5th day
45	45	0.3	9.5	4.0	-	-	-
42	87	0.5	-	14.7	6.3	-	-
63	150	0.8	-	-	30.2	15.1	5.0
Total (mm)			9.5	18.7	36.5	15.1	5.0
(lit/sec/ha)			1.1	2.2	4.2	1.7	0.6

Drainage Requirement for Drainage Structures

Design Rainfall (mm)	Cumulative Rainfall (mm)	Runoff Coefficient	Runoff (mm) 1st day	2nd day	3rd day	4th day	5th day
58	58	0.5	17.4	8.7	2.9	-	-
53	111	0.8	-	25.4	12.7	4.2	-
80	191	0.8	-	-	38.4	19.2	6.4
Total (mm)			17.4	34.1	54.0	23.4	6.4
(lit/sec/ha)			2.0	3.9	6.3	2.7	0.7

Drainage Requirement for Tertiary Drains

Design Rainfall (mm)	Cumulative Rainfall (mm)	Runoff Coefficient	Runoff (mm) 1st day	2nd day	3rd day	4th day
86	86	0.5	25.8	12.9	4.3	-
97	183	0.8	-	46.6	23.3	7.8
Total (mm)			25.8	59.5	27.6	7.8
	(lit/sec/ha)		3.0	6.9	3.2	0.9

From the above calculation, the unit design drainage requirements are determined to be 4.2 lit/sec/ha for the main and secondary drains, 6.3 lit/sec/ha for the drainage structures, and 6.9 lit/sec/ha for the tertiary drains, all of which are defined as the peak requirement in the above calculation. Based on these unit design drainage requirements, the design discharges for the respective drains are calculated as shown in Fig. G-6.

4. ALTERNATIVE STUDY ON DIVERSION WORKS

4.1 General

In the feasibility study conducted by JICA in 1983, a diversion dam was proposed on the Cibeureum river near Gadeg village to take water for the irrigation of 3,500 ha in the southern half of K-C-C area under the run-off-river type system. In the present study, however, it is proposed to develop 10,300 ha of whole K-C-C area as one package by augmenting the river discharge particularly in the dry season through construction of a storage dam (Cilawang dam) on the upstream reach of the Cibeureum river and a trans-basin tunnel between the Karian reservoir and the Cibeureum river. This alteration of development plan would require restudy on the diversion method of irrigation water.

4.2 Alternative Cases

A series of desk study and field reconnaissance had been made, using the 1/5,000 map, to find out the possible sites for the construction of diversion works and concluded that the following three alternative cases should further be examined from the technical and economic viewpoints and the most attractive method should be selected among the three cases (Fig. G-7).

Alternative-1 : Construction of a diversion dam at the Gadeg site following the recommendation made in the feasibility study conducted by JICA in 1983.

Alternative-2 : Construction of a diversion weir at the Gadeg site applying the Coupure system, which was proposed and designed by a local consultant in 1983.

Alternative-3 : Construction of a diversion weir at the Buyut site; 3-km upstream of the Gadeg site, applying the Coupure system.

The advantages and disadvantages of each alternative case are compared as follows:

(1) Alternative-3 site provides more narrow river width and higher topography than those of the others, which would result in less embankment volume for the construction of river closure dam.

(2) Rock foundation is observed at 3.0 - 3.5 m below the river bed at the dam site of Alternative-1, 5.0 - 6.0 m below ground surface along the diversion channel of Alternative-2 and 2.0 - 3.0 m below ground surface along the diversion channel of Alternative-3.

(3) The hydrological conditions are almost the same at all the sites.

(4) A long and deep-cut head reach; 2.0 km in length and 20 m in the deepest cutting, is required in case of Alternative-3, while Alternative-1 and 2 require only 0.4 km and 0.2 km in total length respectively and their cutting depths are 18 m and 7 m in the deepest portion respectively.

(5) In both cases of Alternative-1 and 2, 83 houses, 15 ha of paddy fields and 18 ha of dry lands will be submerged due to construciton of diversion works, which may induce social problems to the area.

(6) Alternative-1 requires more cost for the provision of access.

(7) In Alternative-1, a gated spillway, which will also have a function of maintaining the reservoir water level at the designed one, will be constructed 650-m away from the intake due to topographical reason. This configuration would give some difficulties for a compatible operation between these two structures.

The above-mentioned advantages and disadvantages should be taken into consideration, when the comparative study is made.

4.3 Basic Design Conditions

For the purpose of cost comparison among the alternative cases of the diversion works, preliminary design is made for each alternative case based on the following basic design conditions.

(a) Design intake discharge: The sum of peak diversion requirements of 16.48 m^3/sec calculated in Chapter 2 hereof is taken as a design intake discharge.

(b) Design intake water level : The design intake water level should be high enough to irrigate the K-C-C area, of which highest elevation is EL. 35 m as concluded in Chapter 1 hereof.

(c) Design flood discharge: The flood with a 100-year return period is taken as the design flood discharge. The earth dam designed for the above design flood discharge should, however, stand against the regulated probable maximum flood (PMF) of 1,200 m^3/sec.

(d) Design flood water level : The design flood water level should preferably be lower than the elevation of riparian house yards, farmlands and bridges in the upstream reaches from the diversion works.

4.4 Design of Alternatives

4.4.1 Alternative-1

In the feasibility study conducted by JICA in 1983, a diversion dam was proposed near Gadeg village to maintain the intake water level high enough for the irrigation of K-C-C area. The dam site is located about 6-km upstream from the head of irrigable area, where the catchment area is 117 km^2 and its flood discharge at the proposed dam site is estimated at 460 m^3/sec in a 100-year return period and 1,200 m^3/sec of the regulated PMF. The river bed elevation is about 26.0 m above mean sea level. Rock foundation is observed at 3.0 - 3.5 m below the river bed.

The original design made in the feasibility study conducted by JICA in 1983 is modified for the purpose of comparative study mainly because of change in the hydrological conditions caused by the construction of the Cilawang dam and change in irrigation demand. The following table shows the salient features of diversion works (Fig. G-8).

- Design flood discharge	460 m^3/sec
- PMF (regulated)	1,200 m^3/sec
- Design high water level	EL. 44.5 m
- Dam	
- type	Homogeneous earthfill
- crest elevation	EL. 45.9 m
- height	21.9 m
- crest length	145 m
- Spillway	
- type	Gated overflow 2 ways
- crest elevation	EL. 33.9 m
- width	11.5 m x 2 bays
- gate type	Roller gate
- gate size (B x H x Nos.)	11.5 m x 4.1 m x 2
- Intake	
- design discharge	16.48 m^3/sec
- design intake water level	EL. 37.9 m
- width	10.0 m
- gate type	Steel slide gate
- Nos. of gate	4
- Head reach	
- design capacity	16.48 m^3/sec
- type	Trapezoidal earth canal
- width of canal bottom	6.0 m

- inside slope	1 : 1.1 for rock portion
	1 : 1.5 for earth portion
- length	430 m

4.4.2 Alternative-2

This alternative case was originally proposed and designed by a local consultant in 1983 under the contract with the Directorate General of Water Resources Development (DGWRD). The site was selected at almost the same location as that of Alternative-1. The river course at the site is shaped with a large meander which gives an advantage for the construction of diversion weir, if the Coupure system is applied. The hydrological conditions are the same as those of Alternative-1 site. The river bed elevation is about EL. 26.0 m at the head of diversion channel and EL. 25.0 m at the tail of diversion channel. Rock foundation mainly consisting of tuffaceous sandstone is observed at 6 - 10 m below the ground surface along the route of diversion channel.

A review on the original design made by the local consultant indicates the necessity of the modification on this design because of change in the hydrological conditions caused by the construction of the Cilawang dam and change in irrigation demand. When the modification was made, the selection on the type of diversion weir was also made between the movable weir (gated weir) and fixed weir with a sluice gate. As the result, the movable weir was finally selected, because the fixed weir would raise the water surface in the upstream reach for about 3 m due to backwater affection at the design flood time and 10 m at the PMF time. This would require the higher dam and sub-dam for river closure, resulting in higher construction cost than the case of movable weir by about Rp.400 x 10^6.

The following table shows the salient features of the diversion works (Fig. G-9).

- Design flood discharge	460 m^3/sec
- PMF (regulated)	1,200 m^3/sec
- River closure dam	
- type	Homegeneous earthfill
- crest elevation	EL. 44.85 m
- height	21.85 m
- crest length	170.0 m
- Diversion channel	
- design capacity	1,200 m^3/sec
- type	Trapezoidal earth canal
- width of canal bottom	25.0 m
- inside slope	1 : 1.0 for rock portion
	1 : 1.5 for earth portion
- length	420.0 m
- Diversion weir	
- type	Movable
- crest elevation	EL. 33.85 m
- gate type	Roller gate
- gate size (B x H x Nos.)	11.5 m x 4.1 m x 2
- Intake	
- design discharge	16.48 m^3/sec
- design intake water level	EL. 37.85 m
- width	10.0 m
- gate type	Steel slide gate
- nos. of gate	4
- Head reach	
- design capacity	16.48 m^3/sec
- type	Trapezoidal earth canal
- width of canal bottom	6.0 m
- inside slope	1 : 1.5
- length	220 m

4.4.3 Alternative-3

This alternative site is located near Buyut village; 3-km upstream of Alternative-1 and 2 sites. The river course near this alternative site largely meanders and provides a convenience for the construction of diversion weir under the Coupure system. The catchment area is 115.5 km^2 at the weir site and its flood discharge is 455 m^3/sec in a 100-year return period. The regulated PMF is estimated to be 1,200 m^3/sec. The river bed elevation is about EL. 28.0 m at the head of diversion channel. Rock foundation mainly consisting of tuffaceous sandstone is found at 2.0 m below the river bed at the river closure dam and 2.0 - 3.0 m below the ground surface along the route of diversion channel.

Taking into account the above natural conditions and basic design conditions mentioned in Sub-Chapter 4.3 hereof, the diversion weir and its relevant facilities are designed on a preliminary basis. For this alternative also, the gated diversion weir is adopted from the same reason as that for Alternative-2. The following table shows the salient features of diversion weir and its relevant facilities (Fig. G-10).

- Design flood discharge	455 m^3/sec
- PMF	1,200 m^3/sec
- River closure dam	
- type	Homogeneous earthfill
- crest elevation	EL. 46.0 m
- height	19.0 m
- crest length	150 m
- Diversion channel	
- design capacity	1,200 m^3/sec
- type	Trapezoidal earth canal
- width of canal bottom	25.0 m
- inside slope	1 : 1.0 for rock portion
	1 : 1.5 for earth portion
- length	258.0 m

- Diversion weir
  - type — Movable weir
  - crest elevation — EL. 34.0 m
  - gate type — Roller gate
  - gate size (B x H x Nos.) — 11.5 m x 4.1 m x 2 Nos.
- Intake
  - design discharge — 16.48 m^3/sec
  - design intake water level — EL. 38.0 m
  - width — 10 m
  - gate type — Steel slide gate
  - nos. of gate — 4 Nos.
- Head reach
  - design capacity — 16.48 m^3/sec
  - type — Trapezoidal concrete lining canal
  - width of canal bottom — 6.0 m for earth portion
  - inside slope — 1 : 1.5 for earth portion
  - length — 2.080 m

4.5 Cost Comparison

Based on the above preliminary designs, the construction cost estimates are made for the respective cases and summarized below (Table G-4 through Table G-6).

(Unit; Rp.10^6)

Alternative Case	Construction Cost
1	4,618
2	4,092
3	3,938

4.6 Conclusion

From the above comparative study, it can be concluded that there is no significant difference in the construction costs between Alternative-2 and 3, and both are given equal priority from the economical viewpoint. However, if it is considered that Alternative-2 would bring about social problems to the riparian villages due to the submergence of houses and farm lands to be caused by the construction of diversion weir under Alternative-2, the first priority would be given to Alternative-3.

5. ASSESSMENT OF PRIMARY CANAL CAPACITIES IN CIUJUNG SCHEME AREA

5.1 General

The Ciujung Irrigation Scheme, 24,200 ha, was completed in 1918. Since the completion, the facilities have effectively been used, but its performance has not been satisfactory because of water shortage in the Ciujung river particularly in the dry season. According to the estimation of irrigated area based on the discharge data collected at the Pamarayan intake gates, the irrigated area in the dry season has been limited to 13,000 - 17,000 ha averaging 14,800 ha in the recent 5 years.

Other limiting factors to the full irrigation development in this scheme area are insufficient discharge capacities of the existing Right and Left Primary Canals. The shortage of these canal capacities would become more serious, when the recommended cropping patterns with an intensity of 250% is introduced to the scheme area and when, particularly for the Left Primary Canal, the canal is used for the conveyance of industrial water to the Cilegon area. In this context, the assesment of the primary canal capacities in the Ciujung Irrigation Scheme area is made in the following chapter.

5.2 Assessment of Existing Capacities of Primary Canals

The existing canal capacities of three primary canals, Right, Left and Central Primay Canals, are assessed based on the designed canal sections and gradient given by the Serang Irrigation Section and the assessed canal capacities in the respcetive reaches of the canals are shown in Table G-7 through Table G-9. These tables show that both Right and Left Primary Canals have less capacities than the required even under the present cropping pattern almost throughout the canal reaches, while the Central Primary Canal has the capacity more than enough in every reach of the canal.

5.3 Improvement Plan of Primary Canals

The assessment of the required capacities of the three primary canals are made for the future irrigation water demands under the recommended cropping pattern of 250% intensity and the industrial water supply as shown in the said Table G-7 through Table G-8. The assessed results and the improvement plan for each primary canal are briefed below.

(1) Right Primary Canal

In most parts of the canal reaches, the present canal capacity would not be enough, when the recommended cropping pattern is introduced to the scheme area. In order to find the most economical way for increasing the canal capacity up to the required, the cost comparative study is made for various cases of concrete lining, raising of canal banks and their combined method. Before the cost comparative study is made, the canal capacity is checked for the following four conceivable cases:

Case - 1 : concrete lining on the existing canal section throughout the length

Case - 2 : raise of canal banks for 10 cm and concrete lining on the canal section thus modified throughout the length

Case - 3 : raise of canal banks for 20 cm throughout the length and concrete lining for 5.4 km where the capacity is not enough even after raising the canal banks

Case - 4 : raise of canal banks for 30 cm/1 throughout the length and concrete lining for 4.0 km where the capacity is not enough even after raising the canal banks

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/1 : The raising height of the canal banks is limited to 30 cm judging from the design high water level and intake capacity at the Pamarayan diversion weir and the flow capacities of the canal related structures.

Among the above four cases, the cost comparative study is made only for the case - 3 and 4, because the canal capacities in the case - 1 and 2 can not suffice the requirements. The following table shows the construction cost for the case - 3 and 4.

Study Case	Cost ($Rp\ 10^6$)
3	289.0
4	328.0

From the above cost comparative study, it can be concluded that the most economical way for increasing the canal capacity is to raise the canal banks for 20 cm and to provide concrete lining for 5.4 km in total length where the canal capacity is not enough even after raising the canal banks.

(2) Left Primary Canal

The present canal capacity would not be sufficient in all the portions of canal reachs for introducing the recommended cropping pattern to the scheme area. Moreover, when the canal is used also for the conveyance of M & I water supply of 1.47 m^3/sec to the Cilegon area, the capacity would be far less than the required. In order to cope with the increased demands, the canal capacity will have to be increased by providing the concrete lining or by raising the canal banks. Before the detriled cost comparative study is made, 14 cases are compared for their construction costs on the preliminary basis, and the following four cases are selected for the detailed comparative study.

Case - 1 : concrete lining on the existing canal section throughout the length and installation of 12.7-km D.C.I. pipes for the M & I water supply from BPB - 29 (34-km point) of the canal to the Krenceng reservoir.

Case - 2 : raise of canal banks for 10 cm throughout the length, concrete lining for 41.8 km where the capacity is not enough even after raising the canal banks, and installation of 9.4-km D.C.I. pipes for M & I water supply from BPB - 31(37.3-km point) of the canal to Krenceng reservoir.

Case - 3 : raise of canal banks for 20 cm throughout the length, concrete lining for 39.4 km where the capacity is not enough even after raising the canal banks, and installation of 9.4-km D.C.I. pipes for M & I water supply from BPB - 31 (37.3-km point) of the canal to the Krenceng reservoir.

Case - 4 : raise of canal banks for 30 cm throughout the length, concrete lining for 9.8 km where the capacity is not enough even after raising the canal banks, and installation of 4.9-km D.C.I. pipes for M & I water supply from BPB - 36 (41.8-km point) of the canal to the Krenceng reservoir.

The following table shows the construction costs of the respective cases.

Study Case	Cost (Rp 10^6)
1	11,508
2	8,062
3	8,237
4	3,159

The above comparative study shows that the most economical way for increasing the canal capacity up to the required would be to raise the canal banks for 30 cm throughout the length and to provide concrete lining for 9.8 km where the capacity is not enough even after raising the canal banks. In this case, the M & I water will be pumped up at BPB - 36 (41.8-km point) of the canal and conveyed to the Krenceng reservoir through 4.9-km long pipelines.

Table G-1 WATER DEMAND FOR CIUJUNG SCHEME

Area = 24,200 ha

(unit : m^3/s)

		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
JAN	1	6.05	8.95	0.00	7.02	8.47	13.07	16.94	1.45	14.52	7.50	9.44	8.95
	2	0.00	17.67	18.15	15.00	7.02	3.15	19.12	0.00	0.00	13.07	0.00	23.47
	3	21.05	1.21	21.05	11.13	1.69	10.16	0.73	15.73	20.09	6.53	12.10	3.63
FEB	1	27.35	0.00	21.54	20.57	17.91	18.88	13.07	21.54	16.46	13.07	7.02	15.00
	2	11.37	14.04	0.00	1.45	17.42	4.36	23.96	20.57	0.00	6.29	15.73	17.67
	3	10.16	12.34	11.13	11.13	3.63	1.21	0.48	0.73	3.15	8.23	6.53	3.63
MAR	1	7.02	7.02	9.20	20.57	7.99	8.95	17.67	10.89	17.67	14.52	17.18	15.25
	2	21.54	21.78	23.47	21.54	20.09	20.33	14.76	20.57	20.57	17.67	18.63	23.47
	3	24.44	24.44	22.51	20.33	24.68	24.44	20.33	25.41	21.78	26.38	22.26	19.60
APR	1	20.57	20.57	16.21	17.91	25.65	25.17	19.84	26.38	26.62	19.36	23.72	22.26
	2	29.28	26.14	23.72	28.56	19.84	22.75	29.04	22.99	26.38	24.93	26.62	26.38
	3	30.01	25.41	33.88	29.52	23.23	22.02	19.60	20.33	13.55	27.83	19.12	13.55
MAY	1	28.80	32.43	34.85	35.82	37.99	26.38	36.30	30.73	25.65	26.38	37.03	37.03
	2	25.41	35.09	24.20	38.72	30.98	38.72	36.06	30.73	36.30	32.67	42.11	30.73
	3	38.48	27.10	35.33	36.30	41.87	27.10	41.87	29.28	30.49	30.98	14.28	39.45
JUN	1	25.89	21.78	29.28	24.44	29.28	6.05	22.75	28.31	22.26	28.31	22.75	15.73
	2	24.68	20.09	20.57	24.44	21.78	15.73	15.73	21.30	6.53	14.52	24.44	24.68
	3	21.30	16.46	0.73	20.81	21.30	20.57	7.99	21.30	20.81	17.67	20.81	20.81
JUL	1	25.89	24.44	12.10	23.23	23.23	25.89	21.05	18.15	22.51	22.26	25.89	14.04
	2	33.15	21.78	29.77	24.93	33.40	33.40	24.20	25.65	30.73	25.17	28.31	24.68
	3	39.20	26.14	31.22	34.85	38.96	36.06	30.25	38.96	27.35	22.75	32.19	37.27
AUG	1	38.48	21.78	37.75	37.27	32.91	39.20	35.09	32.91	29.28	38.48	36.54	36.78
	2	30.25	22.75	30.49	30.01	28.80	33.15	18.39	25.65	13.79	8.47	31.94	29.28
	3	26.86	20.09	25.41	21.05	24.20	27.59	15.73	20.81	26.86	22.26	26.86	26.86
SEP	1	20.81	18.39	13.79	15.00	19.84	20.57	11.86	12.83	16.21	18.15	20.81	20.57
	2	18.39	18.39	7.74	16.70	18.88	15.00	10.89	18.15	16.70	9.20	18.39	18.39
	3	15.97	6.78	8.47	15.25	12.58	16.21	13.55	5.32	4.84	9.68	15.97	15.49
OCT	1	18.15	14.28	12.58	13.55	11.37	18.15	12.83	14.04	15.25	10.41	18.63	14.76
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOV	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02
	3	14.76	13.07	15.97	16.70	16.70	16.46	16.21	16.46	16.46	15.49	15.25	14.28
DEC	1	18.39	20.81	13.07	19.84	23.47	19.84	22.02	15.73	20.09	20.81	20.09	21.05
	2	23.96	19.60	29.04	23.47	14.04	13.55	12.83	21.30	21.54	28.07	27.10	22.75
	3	19.60	21.78	27.83	6.05	16.46	22.75	16.70	22.26	8.71	6.05	12.10	15.25

Table G-2 WATER DEMAND FOR CICINTA SCHEME

Area = 1,430 ha

(unit : m^3/s)

		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
JAN	1	0.36	0.53	0.00	0.41	0.50	0.77	1.00	0.09	0.86	0.44	0.56	0.53
	2	0.00	1.04	1.07	0.89	0.41	0.19	1.13	0.00	0.00	0.77	0.00	1.39
	3	1.24	0.07	1.24	0.66	0.10	0.60	0.04	0.93	1.19	0.39	0.72	0.21
FEB	1	1.62	0.00	1.27	1.22	1.06	1.12	0.77	1.27	0.97	0.77	0.41	0.89
	2	0.67	0.83	0.00	0.09	1.03	0.26	1.42	1.22	0.00	0.37	0.93	1.04
	3	0.60	0.73	0.66	0.66	0.21	0.07	0.03	0.04	0.19	0.49	0.39	0.21
MAR	1	0.41	0.41	0.54	1.22	0.47	0.53	1.04	0.64	1.04	0.86	1.02	0.90
	2	1.27	1.29	1.39	1.27	1.19	1.20	0.87	1.22	1.22	1.04	1.10	1.39
	3	1.44	1.44	1.33	1.20	1.46	1.44	1.20	1.50	1.29	1.56	1.32	1.16
APR	1	1.22	1.22	0.96	1.06	1.52	1.49	1.17	1.56	1.57	1.14	1.40	1.32
	2	1.73	1.54	1.40	1.69	1.17	1.34	1.72	1.36	1.56	1.47	1.57	1.56
	3	1.77	1.50	2.00	1.74	1.37	1.30	1.16	1.20	0.80	1.64	1.13	0.80
MAY	1	1.70	1.92	2.06	2.12	2.25	1.56	2.15	1.82	1.52	1.56	2.19	2.19
	2	1.50	2.07	1.43	2.29	1.83	2.29	2.13	1.82	2.15	1.93	2.49	1.82
	3	2.27	1.60	2.09	2.15	2.47	1.60	2.47	1.78	1.80	1.83	0.84	2.33
JUN	1	1.53	1.29	1.73	1.44	1.73	0.36	1.34	1.67	1.32	1.67	1.34	0.93
	2	1.46	1.19	1.22	1.44	1.29	0.93	0.93	1.26	0.39	0.86	1.44	1.46
	3	1.26	0.97	0.20	1.23	1.26	1.22	0.47	1.26	1.23	1.04	1.23	1.23
JUL	1	1.53	1.44	0.72	1.37	1.37	1.53	1.24	1.07	1.34	1.33	1.53	0.83
	2	1.97	1.29	1.77	1.47	1.97	1.97	1.43	1.52	1.83	1.49	1.69	1.46
	3	2.35	1.54	1.87	2.10	2.35	2.15	1.82	2.33	1.62	1.34	1.93	2.23
AUG	1	2.32	1.29	2.26	2.25	1.87	2.32	2.10	1.99	1.76	2.32	2.19	2.22
	2	1.82	1.39	1.84	1.82	1.66	1.96	1.12	1.54	0.82	0.50	1.93	1.77
	3	1.63	1.23	1.53	1.27	1.40	1.63	0.97	1.27	1.63	1.34	1.63	1.63
SEP	1	1.26	1.12	0.84	0.92	1.26	1.20	0.73	0.79	0.99	1.10	1.26	1.24
	2	1.12	1.12	0.46	1.02	1.12	0.90	0.67	1.10	1.02	0.59	1.12	1.12
	3	0.96	0.40	0.50	0.93	0.76	0.96	0.83	0.31	0.39	0.59	0.96	0.94
OCT	1	1.07	0.86	0.74	0.80	0.67	0.94	0.77	0.83	0.90	0.61	1.12	0.89
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOV	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
	3	0.87	0.77	0.94	0.99	0.99	0.97	0.96	0.97	0.97	0.92	0.90	0.84
DEC	1	1.09	1.23	0.77	1.17	1.39	0.89	1.30	0.93	1.19	1.23	1.19	1.24
	2	1.42	1.16	1.72	1.39	0.83	0.80	0.76	1.26	1.27	1.66	1.60	1.34
	3	1.16	1.29	1.64	0.36	0.97	1.34	0.99	1.32	0.51	0.36	0.72	0.90

Table G-3 WATER DEMAND FOR K-C-C SCHEME

Area = 10,300 ha

(Unit : m^3/s)

		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
JAN	1	2.58	3.81	0.00	2.99	3.61	5.56	7.21	0.62	6.18	3.19	4.02	3.81
	2	0.00	7.52	7.73	6.39	2.99	1.34	8.14	0.00	0.00	5.56	0.00	9.99
	3	8.96	0.52	8.96	4.74	0.72	4.33	0.31	6.70	8.55	2.78	5.15	1.55
FEB	1	11.64	0.00	9.17	8.76	7.62	8.03	5.56	9.17	7.00	5.56	2.99	6.39
	2	4.84	5.97	0.00	0.62	7.42	1.85	10.20	8.76	0.00	2.68	6.70	7.52
	3	4.33	5.25	4.74	4.74	1.55	0.52	0.21	0.31	1.34	3.50	2.78	1.55
MAR	1	2.99	2.99	3.91	8.76	3.40	3.81	7.52	4.64	7.52	6.18	7.31	6.49
	2	9.17	9.27	9.99	9.17	8.55	8.65	6.28	8.76	8.76	7.52	7.93	9.99
	3	10.40	10.40	9.58	8.65	10.51	10.40	8.65	10.82	9.27	11.23	9.48	8.34
APR	1	8.76	8.76	6.90	7.62	10.92	10.71	8.45	11.23	11.33	8.24	10.09	9.48
	2	12.46	11.12	10.09	12.15	8.45	9.68	12.36	9.79	11.23	10.61	11.33	11.23
	3	12.77	10.82	14.42	12.57	9.89	9.37	8.34	8.65	5.77	11.85	8.14	5.77
MAY	1	12.26	13.80	14.83	15.24	16.17	11.23	15.45	13.08	10.92	11.23	15.76	15.76
	2	10.82	14.94	10.30	16.48	13.18	16.48	15.35	13.08	15.45	13.91	17.92	13.08
	3	16.38	11.54	15.04	15.45	17.82	11.54	17.82	12.46	12.98	13.18	6.08	16.79
JUN	1	11.02	9.27	12.46	10.40	12.46	2.58	9.68	12.05	9.48	12.05	9.68	6.70
	2	10.51	8.55	8.76	10.40	9.27	6.70	6.70	9.06	2.78	6.18	10.40	10.51
	3	9.06	7.00	1.44	8.86	9.06	8.76	3.40	9.06	8.86	7.52	8.86	8.86
JUL	1	11.02	10.40	5.15	9.89	9.89	11.02	8.96	7.73	9.68	9.58	11.02	5.97
	2	14.21	9.27	12.77	10.61	14.21	14.21	10.30	10.92	13.18	10.71	12.15	10.51
	3	16.89	11.12	13.49	15.14	16.89	15.45	13.08	16.79	11.64	9.68	13.91	16.07
AUG	1	16.69	9.27	16.27	16.17	13.49	16.69	15.14	14.32	12.67	16.69	15.76	15.97
	2	13.08	9.99	13.29	13.08	11.95	14.11	8.03	11.12	5.87	3.61	13.91	12.77
	3	11.74	8.86	11.02	9.17	10.09	11.74	7.00	9.17	11.74	9.68	11.74	11.74
SEP	1	9.06	8.03	6.08	6.59	9.06	8.65	5.25	5.67	7.11	7.93	9.06	8.96
	2	8.03	8.03	3.30	7.31	8.03	6.49	4.84	7.93	7.31	4.22	8.03	8.03
	3	6.90	2.88	3.61	6.70	5.46	6.90	5.97	2.27	2.06	4.22	6.90	6.80
OCT	1	7.73	6.18	5.36	5.77	4.84	6.80	5.56	5.97	6.49	4.43	8.03	6.39
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOV	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
	3	6.28	5.56	6.80	7.11	7.11	7.00	6.90	7.00	7.00	6.59	6.49	6.08
DEC	1	7.83	8.86	5.56	8.45	9.99	6.39	9.37	6.70	8.55	8.86	8.55	8.96
	2	10.20	8.34	12.36	9.99	5.97	5.77	5.46	9.06	9.17	11.95	11.54	9.68
	3	8.34	9.27	11.85	2.58	7.00	9.68	7.11	9.48	3.71	2.58	5.15	6.49

Table G-4 CONSTRUCTION COST FOR ALTERNATIVE-1

Work Items	Unit	Q'ty	Cost (Rp. 10^6)
1. Diversion Dam			3,877
1.1 Preparatory Works		L.S.	352.3
1.2 Diversion Dam			496.2
1.2.1 Stripping	m^3	15,000	14.7
1.2.2 Excavation	m^3	30,000	97.1
1.2.3 Embankment	m^3	104,000	254.7
1.2.4 Gravel metalling	m^2	1,600	8.5
1.2.5 Dry stone pitching	m^2	3,800	45.9
1.2.6 Curtain grouting	m	640	30.2
1.2.7 Miscellaneous works		L.S.	45.1
1.3 Spillway			2,238.3
1.3.1 Stripping	m^3	12,500	12.2
1.3.2 Excavation	m^3	135,000	392.3
1.3.3 Backfill	m^3	5,700	10.2
1.3.4 Concrete works	m^3	6,900	1,115.8
1.3.5 Wet stone masonry	m^2	3,200	84.3
1.3.6 Roller gate 11.5 m x 4.1 m x 2 nos.	ton	60	420.0
1.3.7 Miscellaneous works		L.S.	203.5
1.4 Intake Structure			769.1
1.4.1 Stripping	m^3	3,300	3.2
1.4.2 Excavation	m^3	34,500	100.4
1.4.3 Backfill	m^3	4,700	8.4
1.4.4 Concrete works	m^3	3,100	490.0
1.4.5 Wet stone masonry	m^2	1,200	31.6
1.4.6 Slide gate 2.5 m x 2.5 m	ton	10	65.6
1.4.7 Miscellaneous works		L.S.	69.9
1.5 Operation Road			21.1
1.5.1 Stripping	m^3	1,700	1.7
1.5.2 Excavation	m^3	2,100	5.8
1.5.3 Gravel metalling	m^2	2,200	11.7
1.5.4 Miscellaneous works		L.S.	1.9
2. Head Reach and Inspection Road			255.0
2.1 Preparatory Works		L.S.	22.9
2.2 Head Reach			216.6
2.2.1 Stripping	m^3	2,000	2.0
2.2.2 Excavation	m^3	61,000	173.5
2.2.3 Embankment	m^3	3,000	2.7
2.2.4 Related structures	nos	2	18.7
2.2.5 Miscellaneous works		L.S.	19.7
2.3 Inspection Road			15.5
2.3.1 Stripping	m^3	700	0.7
2.3.2 Embankment	m^3	1,300	1.2
2.3.3 Gravel metalling	m^2	2,300	12.2
2.3.4 Miscellaneous works		L.S.	1.4
3. Compensation Cost		L.S.	486.0
Total			4,618

Table G-5 CONSTRUCTION COST FOR ALTERNATIVE-2

Work Items	Unit	Q'ty	Cost (Rp. 10^6)
1. Diversion Works			3,532
1.1 Preparatory Works		L.S.	321
1.2 River Closure Dam			447.5
1.2.1 Stripping	m^3	20,000	19.5
1.2.2 Excavation	m^3	33,000	106.8
1.2.3 Embankment	m^3	164,500	186.2
1.2.4 Gravel metalling	m^2	1,900	10.1
1.2.5 Dry stone pitching	m^2	3,800	45.9
1.2.6 Curtain grouting		810	38.3
1.2.7 Miscellaneous works		L.S.	40.7
1.3 Diversion Channel and Weir			2,462.6
1.3.1 Stripping	m^3	13,000	12.7
1.3.2 Excavation	m^3	277,300	845.4
1.3.3 Backfill	m^3	1,700	3.1
1.3.4 Concrete works	m^3	5,700	902.1
1.3.5 Wet stone masonry	m^2	2,100	55.4
1.3.6 Roller gate 11.5 m x 4.1 m x 2 nos.	ton	60	420.0
1.3.7 Miscellaneous works		L.S.	223.9
1.4 Intake Structure			300.9
1.4.1 Stripping	m^3	1,300	1.3
1.4.2 Excavation	m^3	8,800	26.8
1.4.3 Backfill	m^3	200	0.4
1.4.4 Concrete works	m^3	1,000	168.9
1.4.5 Wet stone masonry	m^2	400	10.5
1.4.6 Slide gate 2.5 m x 2.5 m	ton	10	65.6
1.4.7 Miscellaneous works		L.S.	27.4
2. Head Reach and Inspection Road			74
2.1 Preparatory Works		L.S.	6.7
2.2 Head Reach			59.2
2.2.1 Stripping	m^3	2,000	2.0
2.2.2 Excavation	m^3	15,200	42.2
2.2.3 Embankment	m^3	3,800	3.8
2.2.4 Related structure	nos	1	5.8
2.2.5 Miscellaneous works		L.S.	5.4
2.3 Inspection Road			8.1
2.3.1 Stripping	m^3	400	0.4
2.3.2 Embankment	m^3	700	0.6
2.3.3 Gravel metalling	m^2	1,200	6.4
2.3.4 Miscellaneous works		L.S.	0.7
3. Compensation Cost		L.S.	486
Total			4,092

Table G-6 CONSTRUCTION COST FOR ALTERNATIVE-3

Work		Unit	Q'ty	Cost (Rp. 10^6)
1. Diversion Works				3,047
1.1	Preparatory Works		L.S.	276.9
1.2	River Closure Dam			187.6
1.2.1	Stripping	m^3	3,700	3.6
1.2.2	Excavation	m^3	10,000	32.4
1.2.3	Embankment	m^3	53,000	80.0
1.2.4	Gravel metalling	m^2	1,700	9.0
1.2.5	Dry stone pitching	m^2	1,800	21.8
1.2.6	Curtain grouting		500	23.7
1.2.7	Miscellaneous works		L.S.	17.1
1.3	Diversion Channel and Weir			2,233.4
1.3.1	Stripping	m^3	20,000	19.6
1.3.2	Excavation	m^3	192,000	612.4
1.3.3	Backfill	m^3	2,100	3.8
1.3.4	Concrete works	m^3	5,800	919.2
1.3.5	Wet stone masonry	m^2	2,100	55.3
1.3.6	Roller gate 11.5 m x 4.1 m x 2 nos	ton	60	420.0
1.3.7	Miscellaneous works		L.S.	203.1
1.4	Intake Structure			349.1
1.4.1	Stripping	m^3	1,500	1.5
1.4.2	Excavation	m^3	22,000	70.3
1.4.3	Backfill	m^3	250	0.5
1.4.4	Concrete works	m^3	1,000	168.9
1.4.5	Wet stone masonry	m^2	400	10.6
1.4.6	Slide gate 2.5 m x 2.5 m	ton	10	65.6
1.4.7	Miscellaneous works		L.S.	31.7
2. Head Reach and Inspection Road				891
2.1	Preparatory Works		L.S.	81.3
2.2	Head Reach			736.7
2.2.1	Stripping	m^3	8,000	7.8
2.2.2	Excavation	m^3	158,000	444.2
2.2.3	Embankment	m^3	29,000	25.6
2.2.4	Concrete lining	m^3	2,400	144.4
2.2.5	Related structures	nos	8	47.7
2.2.6	Miscellaneous works		L.S.	67.0
2.3	Inspection Road			73.0
2.3.1	Stripping	m^3	3,300	3.2
2.3.2	Embankment	m^3	6,100	5.4
2.3.3	Gravel metalling	m^2	10,900	57.8
2.2.4	Miscellaneous works		L.S.	6.6
3. Compensation Cost			L.S.	0
Total				3,938

Table G - 7 DISCHARGE CAPACITY OF CIUJUNG RIGHT PRIMARY CANAL (1/2)

(In case of earth canal)

(Unit: m^3/sec)

Station No.	Accumulated Distance	Irrigation Area	Present Irrigation Demand	Future Irrigation Demand	Canal Capacity				Balance in Present Condition	Balance between Canal Capacity and Future Irrigation Demand			
					Existing	+10 cm	+20 cm	+30 cm		Existing	+10 cm	+20 cm	+30 cm
	(km)	(ha)	(1)	(2)	(3)	(4)	(5)	(6)	(3)-(1)	(3)-(2)	(4)-(2)	(5)-(2)	(6)-(2)
0		5,600	8.06	8.96	9.64	11.10	12.67	14.33	+1.58	+0.68	+2.14	+3.71	+5.37
BPT 1	0.90	5,600	8.06	8.96	9.64	11.10	12.67	14.33	+1.58	+0.68	+2.14	+3.71	+5.37
2	6.31	4,281	6.16	6.85	5.95	6.86	7.83	8.86	-0.21	-0.90	+0.01	+0.98	+2.01
3	7.66	4,082	5.88	6.53	6.08	7.01	7.99	9.05	+0.20	-0.45	+0.48	+1.46	+2.52
4	9.46	3,869	5.57	6.19	5.91	6.81	7.78	8.81	+0.34	-0.28	+0.62	+1.59	+2.62
5	11.06	3,572	5.14	5.72	5.21	6.02	6.88	7.80	+0.07	-0.51	+0.30	+1.16	+2.08
6	12.73	3,658	5.12	5.69	5.55	6.40	7.31	8.28	+0.43	-0.14	+0.71	+1.62	+2.59
7	14.35	3,512	5.06	5.62	5.40	6.24	7.14	8.10	+0.34	-0.22	+0.62	+1.52	+2.48
8	14.58	3,458	4.98	5.53	4.36	5.02	5.73	6.49	-0.62	-1.17	-0.51	+0.20	+0.96
9	15.86	3,281	4.72	5.25	4.11	4.79	5.53	6.32	-0.61	-1.14	-0.46	+0.28	+1.07
10	19.07	2,929	4.22	4.69	6.97	8.12	9.37	10.70	+2.75	+2.28	+3.43	+4.68	+6.01
11	19.29	2,741	3.95	4.39	4.00	4.67	5.38	6.15	+0.05	-0.39	+0.28	+0.99	+1.76
12	20.72	2,741	3.95	4.39	2.08	2.46	2.87	3.31	-1.87	-2.31	-1.93	-1.52	-1.08
13	21.46	2,715	3.91	4.34	2.08	2.46	2.87	3.31	-1.83	-2.26	-1.88	-1.47	-1.03
14	22.36	2,599	3.74	4.16	3.55	4.14	4.78	5.46	-0.19	-0.61	-0.02	+0.62	+1.30
15	23.76	2,019	2.91	3.23	2.08	2.46	2.87	3.31	-0.84	-1.15	-0.77	-0.36	+0.08
16	26.54	1,559	2.24	2.49	2.17	2.64	3.16	3.72	-0.07	-0.32	+0.15	+0.67	+1.23
17	27.59	1,289	1.86	2.06	1.49	1.82	2.18	2.58	-0.37	-0.57	-0.24	+0.12	+0.52
18	29.40	1,087	1.57	1.74	0.80	0.99	1.20	1.44	-0.77	-0.94	-0.75	-0.54	-0.30
19 (EP)	31.07	663	0.95	1.06	0.80	1.02	1.27	1.55	-0.15	-0.26	-0.04	+0.21	+0.49

Table G - 7 DISCHARGE CAPACITY OF CIUJUNG RIGHT PRIMARY CANAL (2/2)

(In case of concrete lining)

(Unit: m^3/sec)

Station No.	Accumulated Distance	Irrigation Area	Present Irrigation Demand	Future Irrigation Demand	Canal Capacity				Balance in Present Condition	Balance between Canal Capacity and Future Irrigation Demand			
					Existing	+10 cm	+20 cm	+30 cm		Existing	+10 cm	+20 cm	+30 cm
	(km)	(ha)	(1)	(2)	(3)	(4)	(5)	(6)	(3)-(1)	(3)-(2)	(4)-(2)	(5)-(2)	(6)-(2)
0		5,600	8.06	8.96	14.46	16.65	19.00	21.49	+1.58	+5.50	+7.69	+10.04	+12.53
BPT 1	0.90	5,600	8.06	8.96	14.46	16.65	19.00	21.49	+1.58	+5.50	+7.69	+10.04	+12.53
2	6.31	4,281	6.16	6.85	8.93	10.29	11.74	13.29	-0.21	+2.08	+3.44	+ 4.89	+ 6.44
3	7.66	4,082	5.88	6.53	9.12	10.51	11.99	13.57	+0.20	+2.59	+3.98	+ 5.46	+ 7.04
4	9.46	3,869	5.57	6.19	8.86	10.22	11.67	13.21	+0.34	+2.67	+4.03	+ 5.48	+ 7.02
5	11.06	3,572	5.14	5.72	7.82	9.03	10.32	11.70	+0.07	+2.10	+3.31	+ 4.60	+ 5.98
6	12.73	3,658	5.12	5.69	8.32	9.60	10.96	12.42	+0.43	+2.63	+3.91	+ 5.27	+ 6.73
7	14.35	3,512	5.06	5.62	8.10	9.36	10.71	12.15	+0.34	+2.48	+3.74	+ 5.09	+ 6.53
8	14.58	3,458	4.98	5.53	6.54	7.53	8.60	9.73	-0.62	+1.01	+2.00	+ 3.07	+ 4.20
9	15.86	3,281	4.72	5.25	6.16	7.19	8.29	9.48	-0.61	+0.91	+1.94	+ 3.04	+ 4.23
10	19.07	2,929	4.22	4.69	10.45	12.19	14.05	16.05	+2.75	+5.76	+7.50	+ 9.36	+11.36
11	19.29	2,741	3.95	4.39	6.00	7.00	8.08	9.22	+0.05	+1.61	+2.61	+ 3.69	+ 4.83
12	20.72	2,741	3.95	4.39	3.46	4.09	4.78	5.52	-1.87	-0.93	-0.30	+ 0.39	+ 1.13
13	21.46	2,715	3.91	4.34	3.46	4.09	4.78	5.52	-1.83	-0.88	-0.25	+ 0.44	+ 1.18
14	22.36	2,599	3.74	4.16	5.92	6.91	7.97	9.10	-0.19	+1.76	+2.75	+ 3.81	+ 4.94
15	23.76	2,019	2.91	3.23	3.46	4.09	4.78	5.52	-0.84	+0.23	+0.86	+ 1.55	+ 2.29
16	26.54	1,559	2.24	2.49	3.61	4.40	5.26	6.21	-0.07	+1.12	+1.91	+ 2.77	+ 3.72
17	27.59	1,289	1.86	2.06	2.48	3.03	3.63	4.30	-0.37	+0.42	+0.97	+ 1.57	+ 2.24
18	29.40	1,087	1.57	1.74	1.33	1.65	2.00	2.39	-0.77	-0.41	-0.09	+ 0.26	+ 0.65
19 (EP)	31.07	663	0.95	1.06	1.34	1.70	2.12	2.59	-0.15	+0.28	+0.64	+ 1.06	+ 1.53

Table G - 8 DISCHARGE CAPACITY OF CIUJUNG LEFT PRIMARY CANAL (1/2)
(In case of earth canal)

(Unit: m^3/sec)

Station No.	Accumulated Distance	Irrigation Area	Present Irrigation Demand	Future Irrigation Demand	Future M & I Demand	Future Total Demand	Canal Capacity				Balance in Present Condition	Balance between Canal Capacity and Future Total Demand			
							Existing	+10 cm	+20 cm	+30 cm		Existing	+10 cm	+20 cm	+30 cm
	(km)	(ha)	(1)	(2)	(3)	(4)=(2)+(3)	(5)	(6)	(7)	(8)	(5)-(1)	(5)-(4)	(6)-(4)	(7)-(4)	(8)-(4)
0	0	18,597	26.78	29.76	1.47	31.23	24.61	26.68	28.85	31.11	-2.17	-6.62	-4.55	-2.38	-0.12
BPB 1	0.33	18,597	26.78	29.76	1.47	31.23	24.61	26.68	28.85	31.11	-2.17	-6.62	-4.55	-2.38	-0.12
2	3.03	18,537	26.69	29.66	1.47	31.13	24.61	26.68	28.85	31.11	-2.08	-6.52	-4.45	-2.28	-0.02
3	3.27	18,467	26.59	29.55	1.47	31.02	24.61	26.68	28.85	31.11	-1.98	-6.41	-4.34	-2.17	+0.19
4	4.21	18,428	26.54	29.48	1.47	30.95	24.61	26.68	28.85	31.11	-1.93	-6.34	-4.27	-2.10	+0.16
5	4.43	18,419	26.52	29.47	1.47	30.94	24.61	26.68	28.85	31.11	-1.91	-6.33	-4.26	-2.09	+0.17
6	4.69	18,304	26.36	29.29	1.47	30.76	24.61	26.68	28.85	31.11	-1.75	-6.15	-4.08	-1.91	+0.35
7	5.64	18,253	26.28	29.20	1.47	30.67	24.61	26.68	28.85	31.11	-1.67	-6.06	-3.99	-1.82	+0.44
8	5.69	18,216	26.23	29.15	1.47	30.62	24.61	26.68	28.85	31.11	-1.62	-6.01	-3.94	-1.77	+0.49
9	5.79	18,216	26.23	29.15	1.47	30.62	24.61	26.68	28.85	31.11	-1.62	-6.01	-3.94	-1.77	+0.49
10	7.76	18,164	26.16	29.06	1.47	30.53	24.61	26.68	28.85	31.11	-1.55	-5.92	-3.85	-1.68	+0.58
11	7.99	18,140	26.12	29.02	1.47	30.49	24.61	26.68	28.85	31.11	-1.51	-5.88	-3.81	-1.64	+0.62
12	8.96	18,140	26.12	29.02	1.47	30.49	24.61	26.68	28.85	31.11	-1.51	-5.88	-3.81	-1.64	+0.62
13	14.25	17,726	25.53	28.36	1.44	29.80	24.61	26.68	28.85	31.11	-0.92	-5.19	-3.12	-0.95	+1.31
14	14.33	11,830	17.04	18.93	1.42	20.35	16.35	17.53	18.76	20.03	-0.69	-4.00	-2.82	-1.59	-0.32
15	15.09	11,759	16.93	18.81	1.42	20.23	16.35	17.53	18.76	20.03	-0.58	-3.88	-2.70	-1.47	-0.20
16	16.95	11,541	16.62	18.47	1.42	19.89	16.35	17.53	18.76	20.03	-0.27	-3.54	-2.36	-1.13	+0.14
17	17.55	10,072	14.50	16.12	1.41	17.53	13.60	14.67	15.78	16.93	-0.90	-3.93	-2.86	-1.75	-0.60
18	18.57	9,853	14.19	15.76	1.41	17.17	13.60	14.67	15.78	16.93	-0.59	-3.57	-2.50	-1.39	-0.24
19	21.08	7,556	10.88	12.09	1.39	13.48	10.34	11.32	12.36	13.46	-0.54	-3.15	-2.16	-1.12	-0.02
20	21.99	6,648	9.57	10.64	1.39	12.03	9.24	10.29	11.39	12.56	-0.33	-2.79	-1.74	-0.64	+0.53
21	24.73	6,046	8.71	9.67	1.39	11.06	8.34	9.35	10.43	11.57	-0.37	-2.72	-1.71	-0.63	+0.51
22	25.77	5,745	8.27	9.19	1.39	10.58	8.34	9.35	10.43	11.57	+0.07	-2.24	-1.23	-0.15	+0.99
23	27.63	4,573	6.59	7.32	1.39	8.71	6.53	7.34	8.19	9.11	-0.06	-2.18	-1.37	-0.52	+0.40
24	28.84	4,183	6.02	6.69	1.39	8.08	5.72	6.40	7.11	7.87	-0.30	-2.36	-1.68	-0.97	-0.21
25	29.14	3,760	5.41	6.02	1.39	7.41	5.72	6.40	7.11	7.87	+0.31	-1.69	-1.01	-0.30	+0.46
26	30.30	3,723	5.36	5.96	1.39	7.35	5.72	6.40	7.11	7.87	+0.36	-1.63	-0.95	-0.24	+0.52
27	32.29	3,625	5.22	5.80	1.37	7.17	4.83	5.50	6.21	6.98	-0.39	-2.34	-1.67	-0.96	-0.19
28	32.43	3,536	5.09	5.66	1.37	7.03	4.71	5.45	6.24	7.09	-0.38	-2.32	-1.58	-0.79	+0.06
29	34.02	2,918	4.20	4.67	1.37	6.04	3.89	4.54	5.23	5.98	-0.31	-2.15	-1.50	-0.81	-0.06
30	37.05	2,614	3.76	4.18	1.37	5.55	3.48	4.01	4.57	5.18	-0.28	-2.07	-1.54	-0.98	-0.37
31	37.28	2,584	3.72	4.13	1.37	5.50	3.48	4.01	4.57	5.18	-0.24	-2.02	-1.49	-0.93	-0.32
32	37.82	1,937	2.79	3.10	1.37	4.47	1.77	2.11	2.47	2.86	-1.02	-2.70	-2.36	-2.00	-1.61
33	39.44	1,854	2.67	2.97	1.37	4.34	1.77	2.11	2.47	2.86	-0.90	-2.57	-2.23	-1.87	-1.48
34	39.73	1,275	1.84	2.04	1.37	3.41	1.47	1.77	2.11	2.47	-0.37	-1.94	-1.64	-1.30	-0.94
35	41.44	963	1.39	1.54	1.37	2.91	1.15	1.39	1.67	1.96	-0.24	-1.76	-1.52	-1.24	-0.95
36	41.81	665	0.96	1.06	1.37	2.43	0.80	0.99	1.21	1.45	-0.16	-1.64	-1.44	-1.22	-0.98
37	43.72	610	0.88	0.98	1.37	2.35	0.75	0.96	1.21	1.49	-0.13	-1.60	-1.39	-1.14	-0.86
38	44.13	567	0.82	0.91	1.37	2.28	0.70	0.92	1.18	1.48	-0.12	-1.59	-1.36	-1.10	-0.80
39 (EP)	44.83	487	0.70	0.78	1.37	2.15	0.61	0.85	1.13	1.45	-0.09	-1.54	-1.30	-1.02	-0.70

Table G - 8 DISCHARGE CAPACITY OF CIUJUNG LEFT PRIMARY CANAL (2/2)
(In case of concrete lining)

(Unit: m^3/sec)

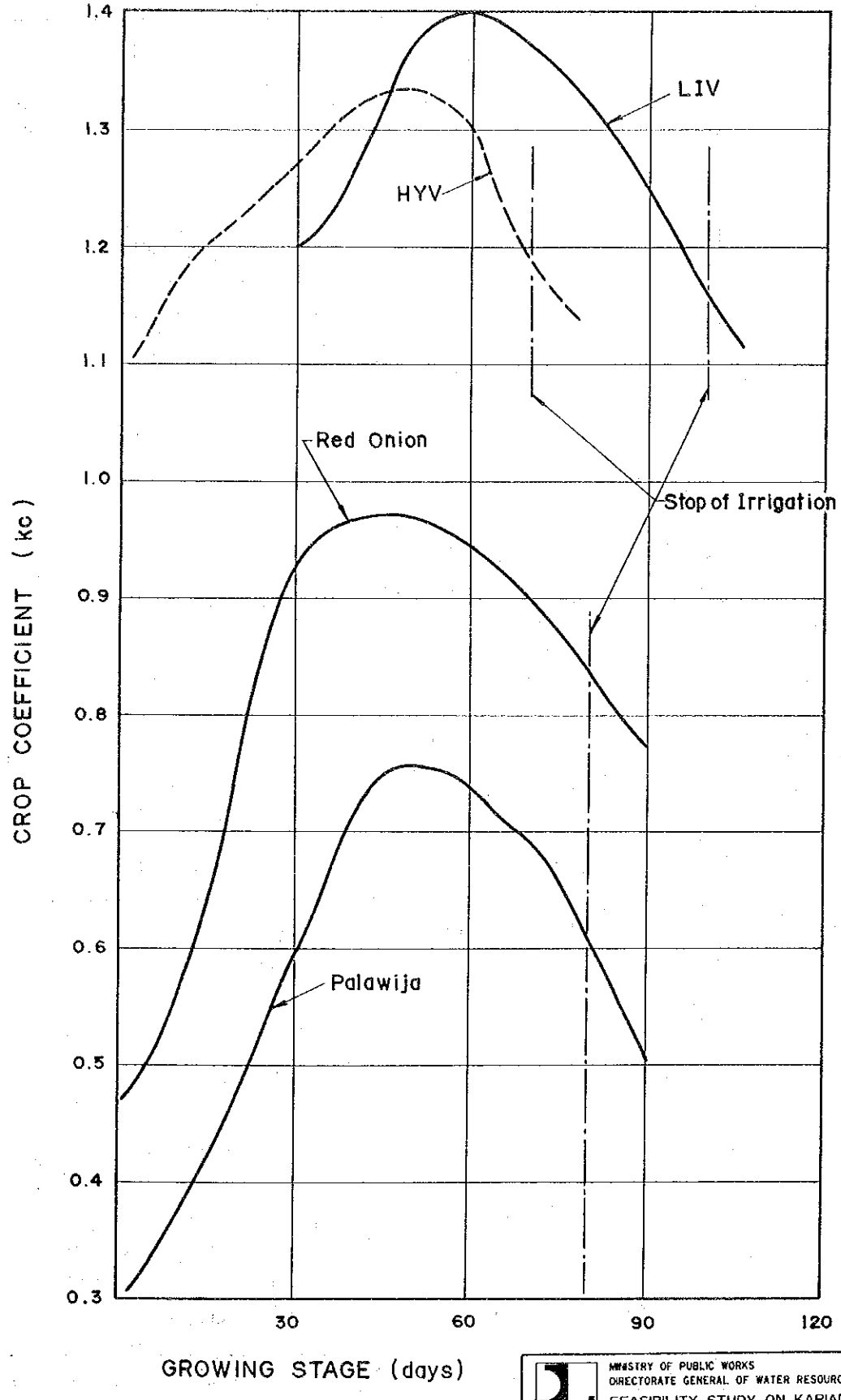
Station No.	Accumulated Distance	Irrigation Area	Present Irrigation Demand	Future Irrigation Demand	Future M & I Demand	Future Total Demand	Canal Capacity				Balance in Present Condition	Balance between Canal Capacity and Future Total Demand			
							Existing	+10 cm	+20 cm	+30 cm		Existing	+10 cm	+20 cm	+30 cm
	(km)	(ha)	(1)	(2)	(3)	(4)=(2)+(3)	(5)	(6)	(7)	(8)	(5)-(1)	(5)-(4)	(6)-(4)	(7)-(4)	(8)-(4)
0	0	18,597	26.78	29.76	1.47	31.23	36.92	40.03	43.28	46.67	-2.17	+8.69	+8.80	+12.05	+15.44
BPB 1	0.33	18,597	26.78	29.76	1.47	31.23	36.92	40.03	43.28	46.67	-2.17	+5.69	+8.80	+12.05	+15.44
2	3.03	18,537	26.69	29.66	1.47	31.13	36.92	40.03	43.28	46.67	-2.08	+5.79	+8.90	+12.15	+15.54
3	3.27	18,467	26.59	29.55	1.47	31.02	36.92	40.03	43.28	46.67	-1.98	+5.90	+9.01	+12.26	+15.65
4	4.21	18,428	26.54	29.48	1.47	30.95	36.92	40.03	43.28	46.67	-1.93	+5.97	+9.08	+12.33	+15.72
5	4.43	18,419	26.52	29.47	1.47	30.94	36.92	40.03	43.28	46.67	-1.91	+5.98	+9.09	+12.34	+15.73
6	4.69	18,304	26.36	29.29	1.47	30.76	36.92	40.03	43.28	46.67	-1.75	+6.16	+9.27	+12.52	+15.91
7	5.64	18,253	26.28	29.20	1.47	30.67	36.92	40.03	43.28	46.67	-1.67	+6.25	+9.36	+12.61	+16.00
8	5.69	18,216	26.23	29.15	1.47	30.62	36.92	40.03	43.28	46.67	-1.62	+6.30	+9.41	+12.66	+16.05
9	5.79	18,216	26.23	29.15	1.47	30.62	36.92	40.03	43.28	46.67	-1.62	+6.30	+9.41	+12.66	+16.05
10	7.76	18,164	26.16	29.06	1.47	30.53	36.92	40.03	43.28	46.67	-1.55	+6.39	+9.50	+12.75	+16.14
11	7.99	18,140	26.12	29.02	1.47	30.49	36.92	40.03	43.28	46.67	-1.51	+6.43	+9.54	+12.79	+16.18
12	8.96	18,140	26.12	29.02	1.47	30.49	36.92	40.03	43.28	46.67	-1.51	+6.43	+9.54	+12.79	+16.18
13	14.25	17,726	25.53	28.36	1.44	29.80	36.92	40.03	43.28	46.67	-0.92	+7.12	+10.23	+13.48	+16.87
14	14.33	11,830	17.04	18.93	1.42	20.35	24.52	26.29	28.13	30.05	-0.69	+4.17	+5.94	+7.78	+9.70
15	15.09	11,759	16.93	18.81	1.42	20.23	24.52	26.29	28.13	30.05	-0.58	+4.29	+6.06	+7.90	+9.82
16	16.95	11,541	16.62	18.47	1.42	19.89	24.52	26.29	28.13	30.05	-0.27	+4.63	+6.40	+8.24	+10.16
17	17.55	10,072	14.50	16.12	1.41	17.53	20.40	22.00	23.66	25.40	-0.90	+2.87	+4.47	+6.13	+7.87
18	18.57	9,853	14.19	15.76	1.41	17.17	20.40	22.00	23.66	25.40	-0.59	+3.23	+4.83	+6.49	+8.23
19	21.08	7,556	10.88	12.09	1.39	13.48	15.50	16.99	18.55	20.19	-0.54	+2.02	+3.51	+5.07	+6.71
20	21.99	6,648	9.57	10.64	1.39	12.03	13.87	15.43	17.09	18.85	-0.33	+1.84	+3.40	+5.06	+6.82
21	24.73	6,046	8.71	9.67	1.39	11.06	12.50	14.03	15.65	17.36	-0.37	+1.44	+2.97	+4.59	+6.30
22	25.77	5,745	8.27	9.19	1.39	10.58	12.50	14.03	15.65	17.36	+0.07	+1.92	+3.45	+5.07	+6.78
23	27.63	4,573	6.59	7.32	1.39	8.71	9.80	11.01	12.29	13.66	-0.06	+1.09	+2.30	+3.58	+4.95
24	28.84	4,183	6.02	6.69	1.39	8.08	8.58	9.59	10.67	11.81	-0.30	+0.50	+1.51	+2.59	+3.73
25	29.14	3,760	5.41	6.02	1.39	7.41	8.58	9.59	10.67	11.81	+0.31	+1.17	+2.18	+3.26	+4.40
26	30.30	3,723	5.36	5.96	1.39	7.35	8.58	9.59	10.67	11.81	+0.36	+1.23	+2.24	+3.32	+4.46
27	32.29	3,625	5.22	5.80	1.37	7.17	7.24	8.24	9.32	10.46	-0.39	+0.07	+1.07	+2.15	+3.29
28	32.43	3,536	5.09	5.66	1.37	7.03	7.06	8.17	9.36	10.64	-0.38	+0.03	+1.14	+2.33	+3.61
29	34.02	2,918	4.20	4.67	1.37	6.04	5.84	6.80	7.85	8.97	-0.31	-0.20	+0.76	+1.81	+2.93
30	37.05	2,614	3.76	4.18	1.37	5.55	5.21	6.01	6.86	7.77	-0.28	-0.34	+0.46	+1.31	+2.22
31	37.28	2,584	3.72	4.13	1.37	5.50	5.21	6.01	6.86	7.77	-0.24	-0.29	+0.51	+1.36	+2.27
32	37.82	1,937	2.79	3.10	1.37	4.47	2.95	3.51	4.12	4.77	-1.02	-1.52	-0.96	-0.35	+0.30
33	39.44	1,854	2.67	2.97	1.37	4.34	2.95	3.51	4.12	4.77	-0.90	-1.39	-0.83	-0.22	+0.43
34	39.73	1,275	1.84	2.04	1.37	3.41	2.44	2.95	3.51	4.12	-0.37	-0.97	-0.46	+0.10	+0.71
35	41.44	963	1.39	1.54	1.37	2.91	1.91	2.32	2.78	3.27	-0.24	-1.00	-0.59	-0.13	+0.36
36	41.81	665	0.96	1.06	1.37	2.43	1.32	1.65	2.01	2.41	-0.16	-1.11	-0.78	-0.42	-0.02
37	43.72	610	0.88	0.98	1.37	2.35	1.25	1.61	2.02	2.48	-0.13	-1.10	-0.74	-0.33	+0.13
38	44.13	567	0.82	0.91	1.37	2.28	1.16	1.53	1.97	2.46	-0.12	-1.12	-0.75	-0.31	+0.18
39 (EP)	44.83	487	0.70	0.78	1.37	2.15	1.02	1.42	1.88	2.41	-0.09	-1.13	-0.73	-0.27	+0.26

Table G - 9 DISCHARGE CAPACITY OF CIUJUNG CENTRAL PRIMARY CANAL

(Unit: m^3/sec)

Station No.		Accumulated Distance	Irrigation Area	Present Irrigation Demand	Future Irrigation Demand	Existing Canal Capacity	Balance in Present Condition	Balance between Canal Capacity and Future Demand
		(km)	(ha)	(1)	(2)	(3)	(3)-(1)	(3)-(2)
	0	0	5,896	7.08	8.31	13.57	+6.49	+5.26
BPU	1	2.62	5,896	7.08	8.31	13.57	+6.49	+5.26
	2	5.09	5,735	6.88	8.09	12.73	+5.85	+4.64
	3	8.57	5,350	6.42	7.54	12.09	+5.67	+4.55
	4	12.12	3,275	3.93	4.62	5.27	+1.34	+0.65
	5	12.40	3,074	3.69	4.33	5.27	+1.58	+0.94
	6	13.41	2,306	2.77	3.25	4.38	+1.61	+1.13
	7 (EP)	16.16	1,894	2.27	2.67	4.38	+2.11	+1.71

Fig. G-1



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MULTIPURPOSE DAM CONSTRUCTION PROJECT

Crop Coefficient (kc)

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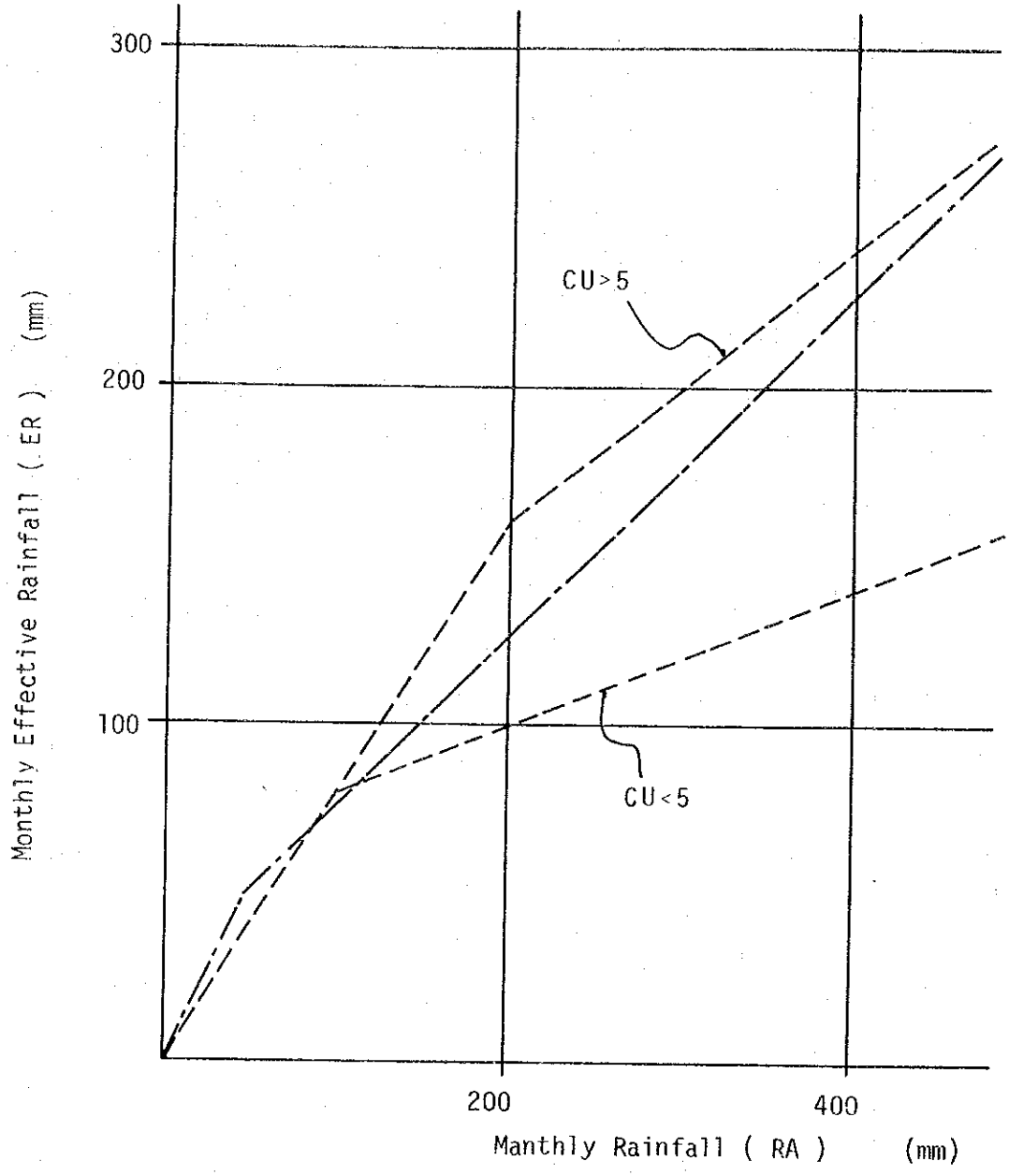
Fig. G-2



Remarks :---------- Paddy

$$CU < 5 \quad ER = \begin{cases} RA \times 0.8 & (RA < 100) \\ (RA - 100) \times 0.2 + 80 & (RA > 100) \end{cases}$$

$$CU > 5 \quad ER = \begin{cases} RA \times 0.8 & (RA < 200) \\ (RA - 200) \times 0.4 + 160 & (RA > 200) \end{cases}$$

——·——·—— Palawija

$$ER = \begin{cases} RA & (RA < 50) \\ (RA - 50) \times 0.5 + 50 & (RA > 50) \end{cases}$$

where,CU means Consumptive Use(mm/day).

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Effective Rainfall Chart

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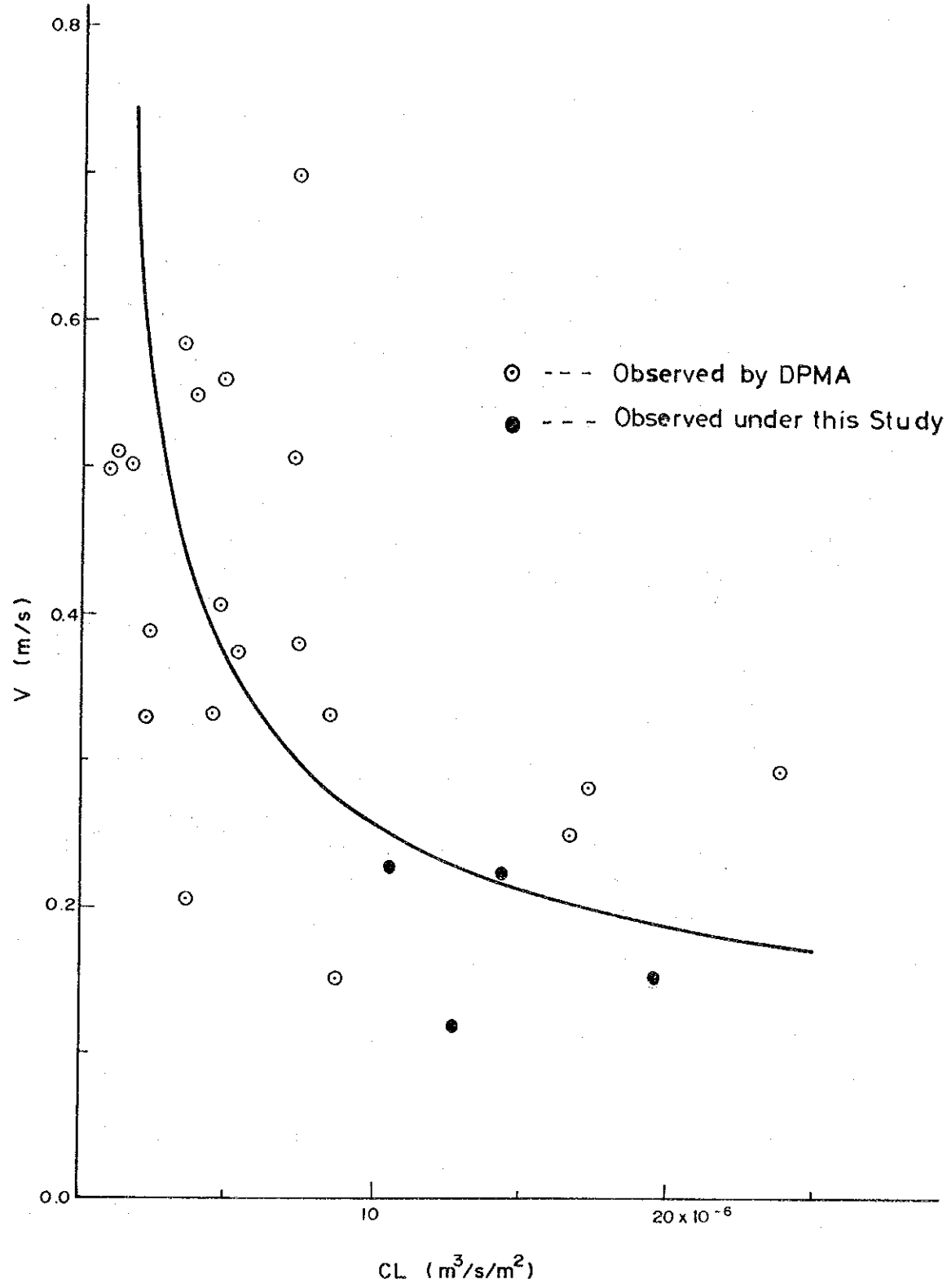
Fig. G-3



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FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Relationship between Canal Flow Velocity and Conveyance Loss

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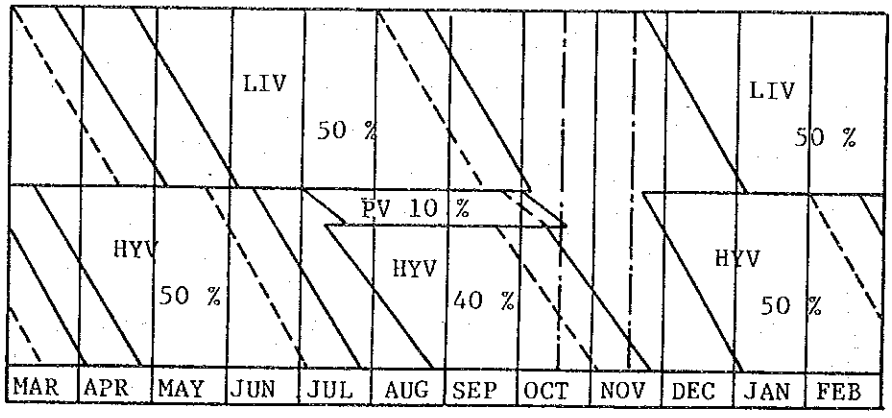
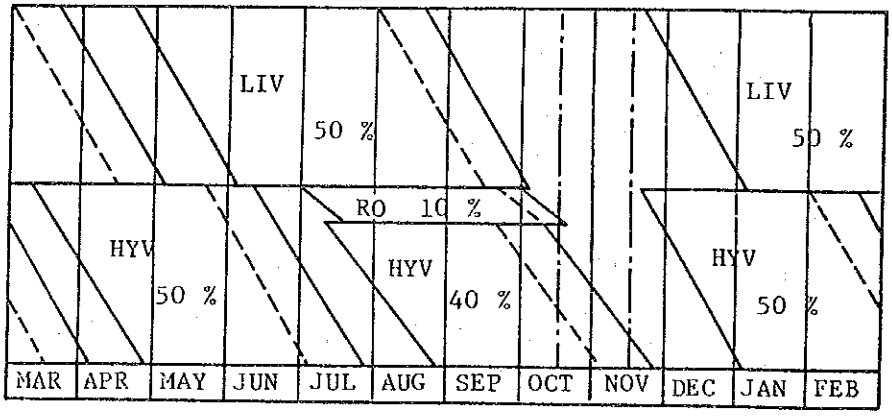
Fig. G-4

CIUJUNG IRRIGATION SCHEME



K-C-C & CICINTA IRRIGATION SCHEME



Remarks LIV:Locally Improved Variety (Paddy)

HYV:High-Yielding Variety (Paddy)

PV :Palawija or Vegetables

RO :Red Onion

Canal Maintenance Period : middle of Oct.- middle of Nov.

Note : These patterns show the growing period in main fields excluding nursery period. Dotted lines express stoppage of irrigation.

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Proposed Cropping Pattern

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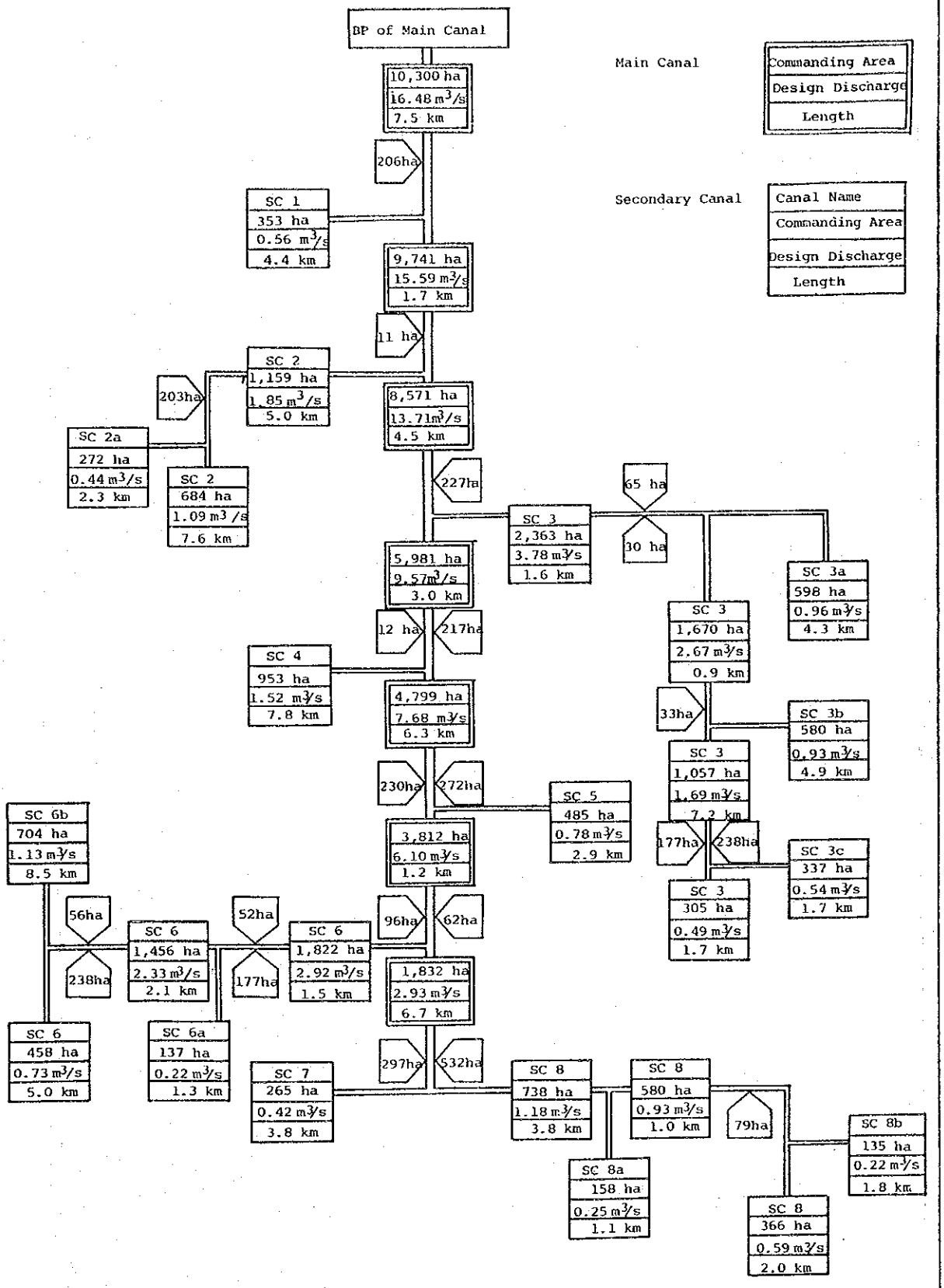
Fig. G-5



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MULTIPURPOSE DAM CONSTRUCTION PROJECT

Irrigation Diagram

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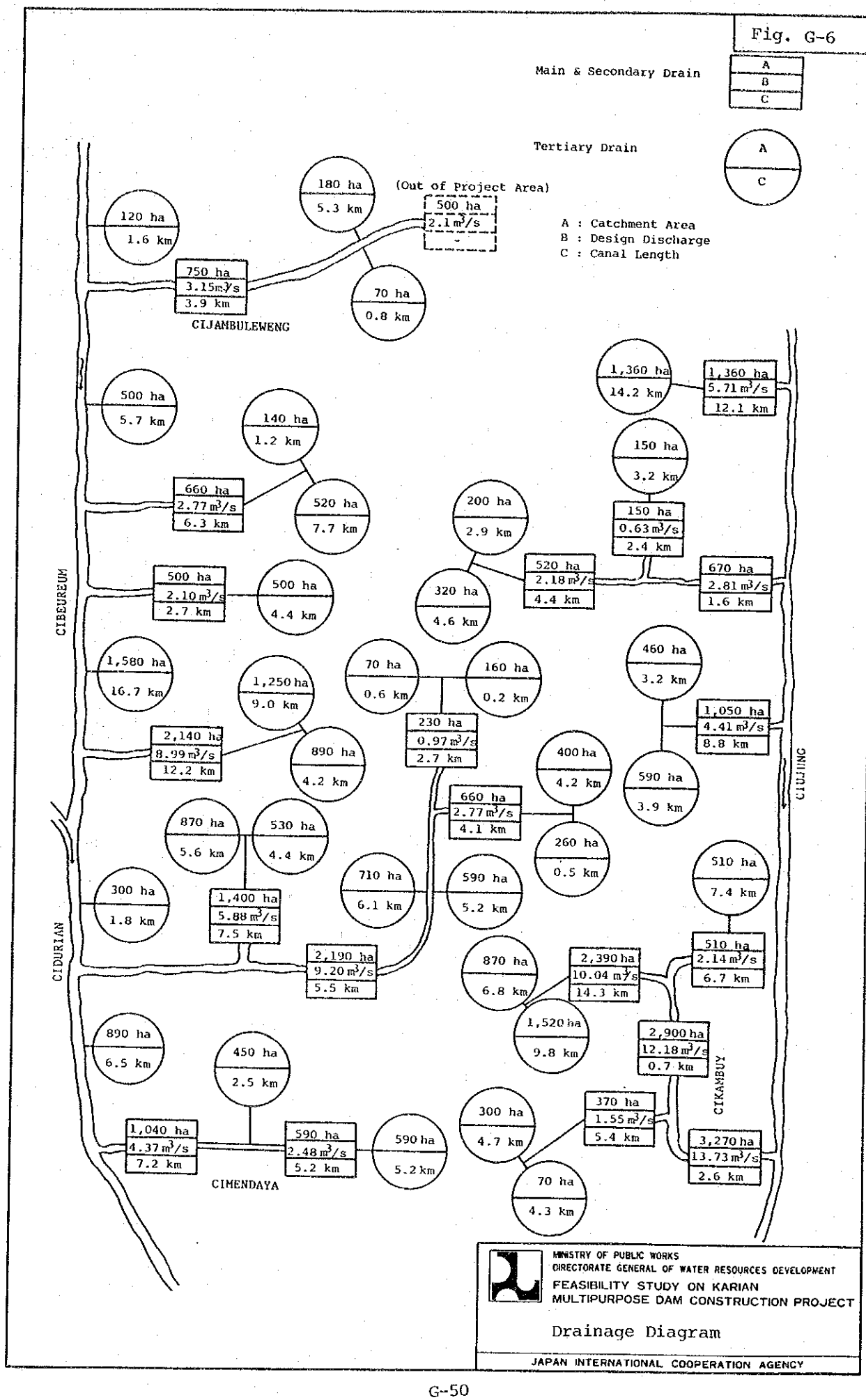
Fig. G-6



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FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Drainage Diagram

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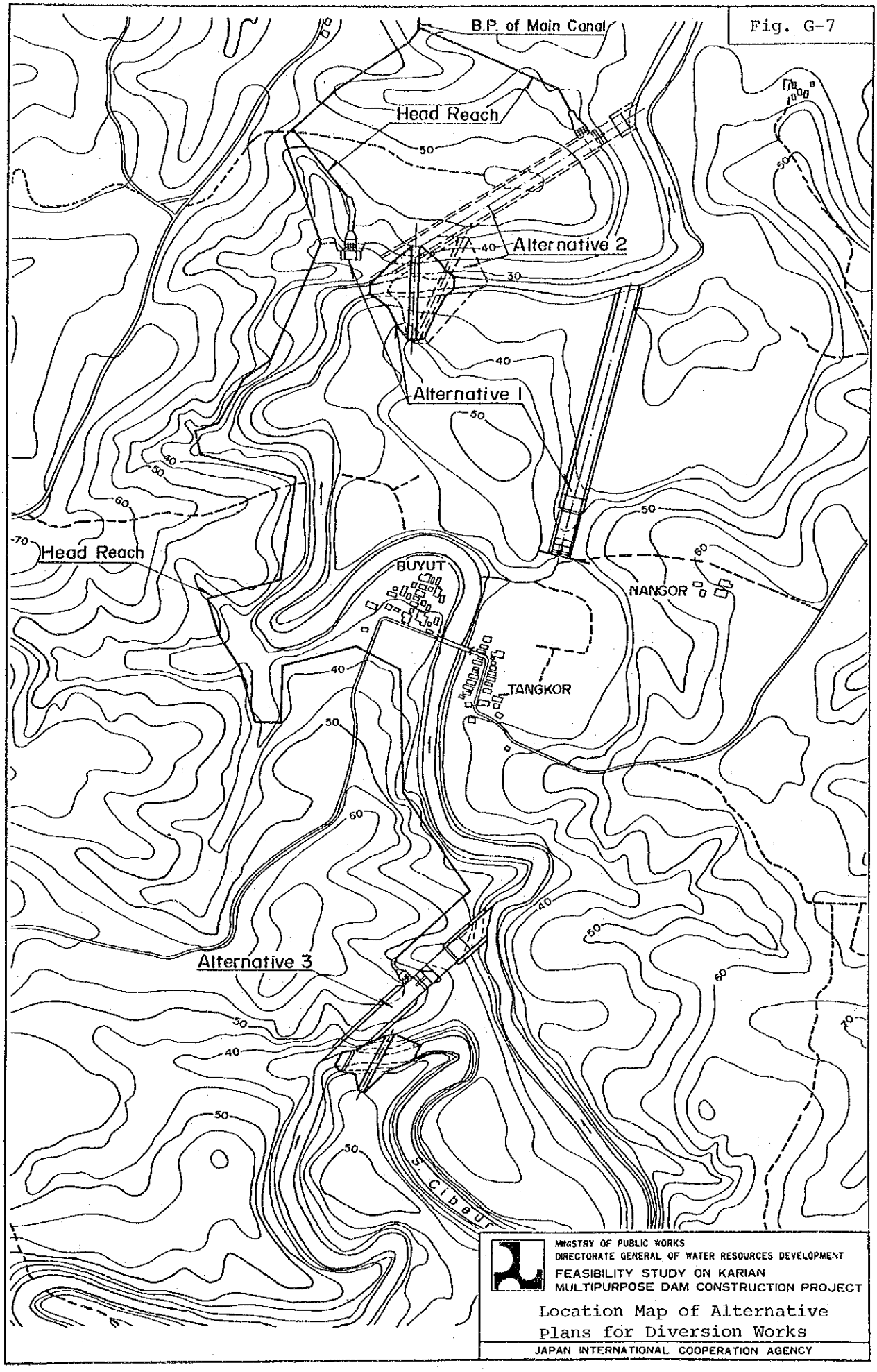
Fig. G-7



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Location Map of Alternative plans for Diversion Works

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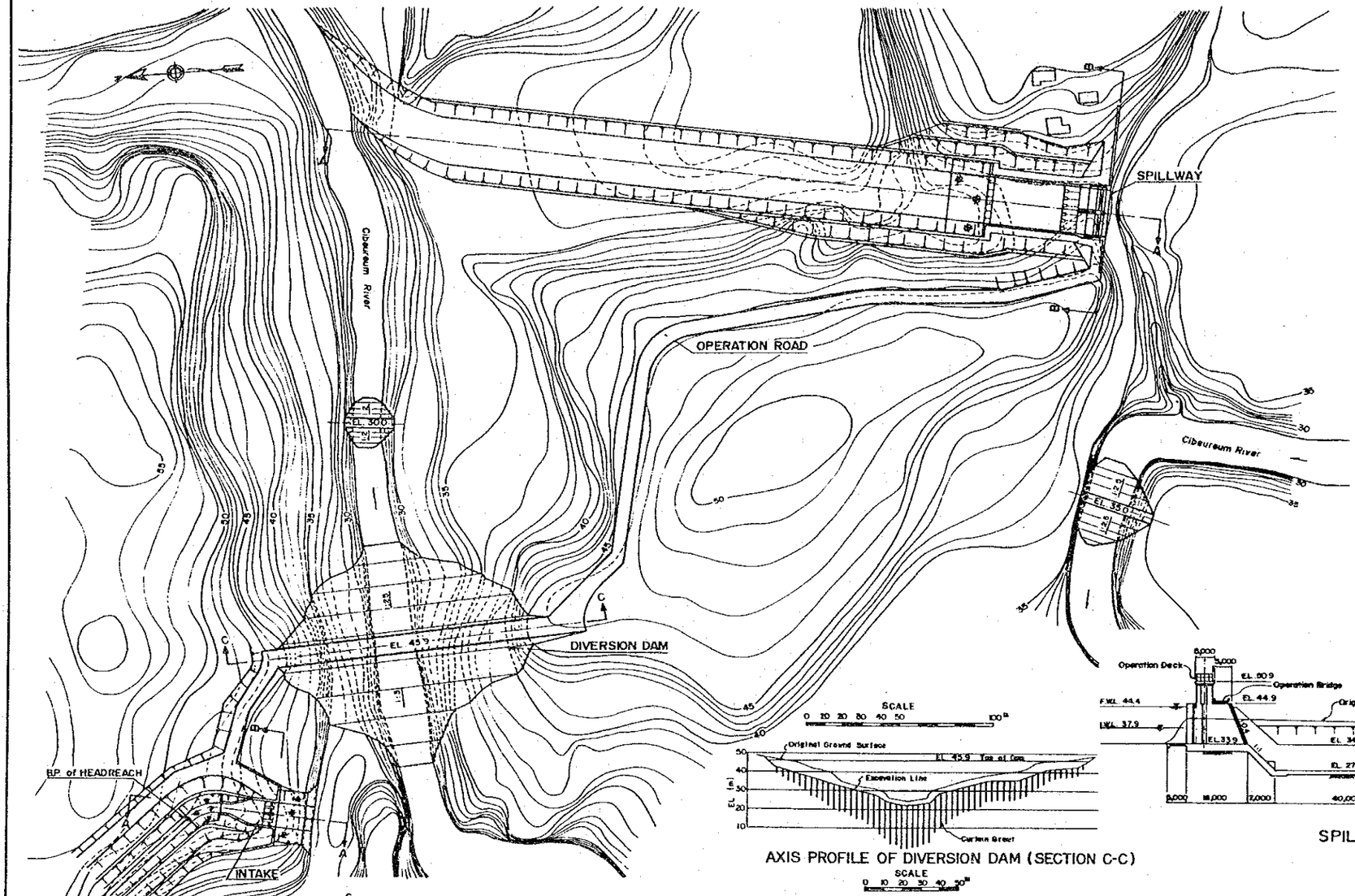
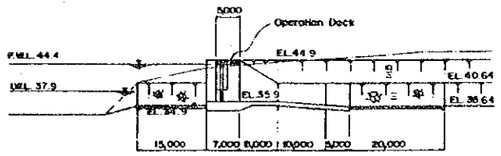
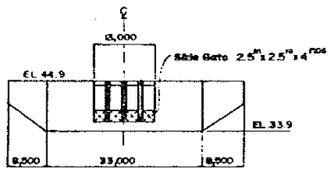




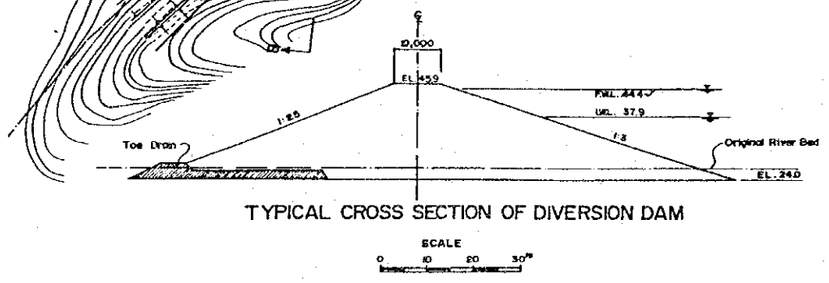
INTAKE SECTION A-A

SCALE
0 10 20 30m



INTAKE SECTION B-B

SCALE
0 10 20 30m

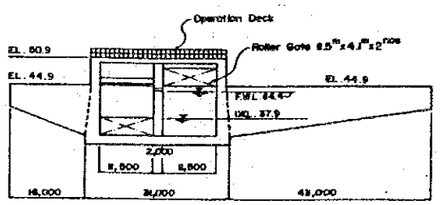


TYPICAL CROSS SECTION OF DIVERSION DAM

SCALE
0 10 20 30m

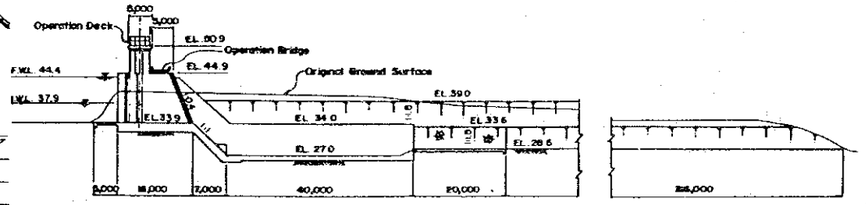
AXIS PROFILE OF DIVERSION DAM (SECTION C-C)

SCALE
0 10 20 30 40 50m



SPILLWAY SECTION B-B

SCALE
0 10 20 30m



SPILLWAY SECTION A-A

SCALE
0 10 20 30m

REMARKS
F.W.L. : Flood Water Level by PMF.
I.W.L. : Intake Water Level

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Diversion Dam(Alternative-1)

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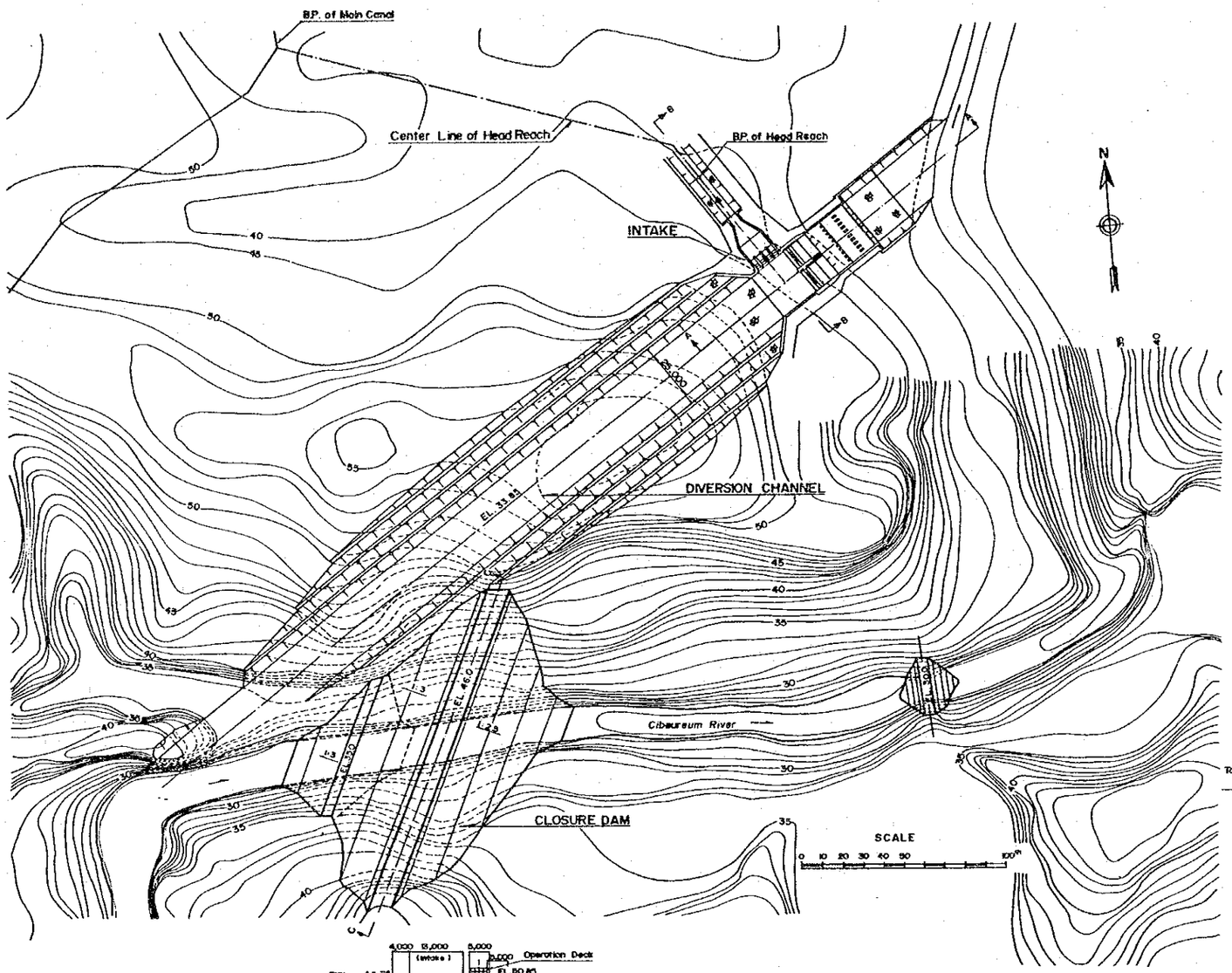
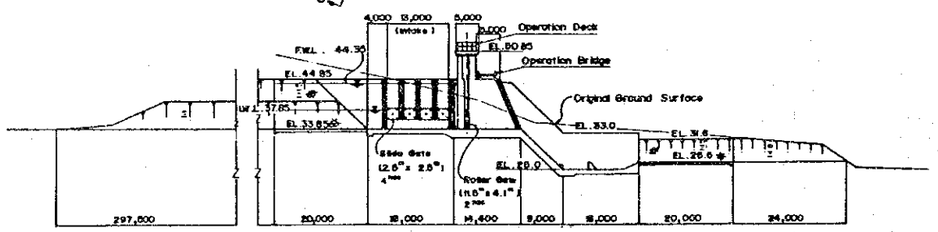
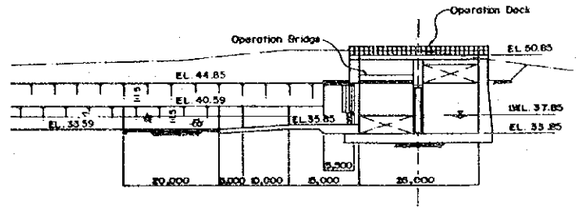




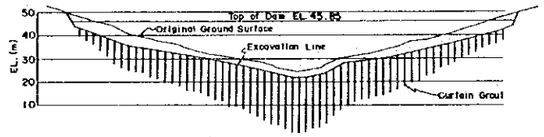
SECTION A-A

SCALE 0 10 20 30m



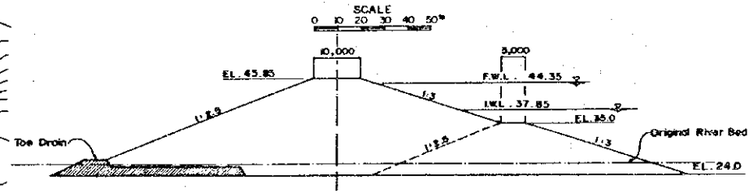
SECTION B-B

SCALE 0 10 20 30m



AXIS PROFILE OF CLOSURE DAM (SECTION C-C)

SCALE 0 10 20 30 40 50m



TYPICAL CROSS SECTION OF CLOSURE DAM

SCALE 0 10 20 30m

REMARKS

F.W.L. : Flood Water Level by P.M.F
I.W.L. : Intake Water Level

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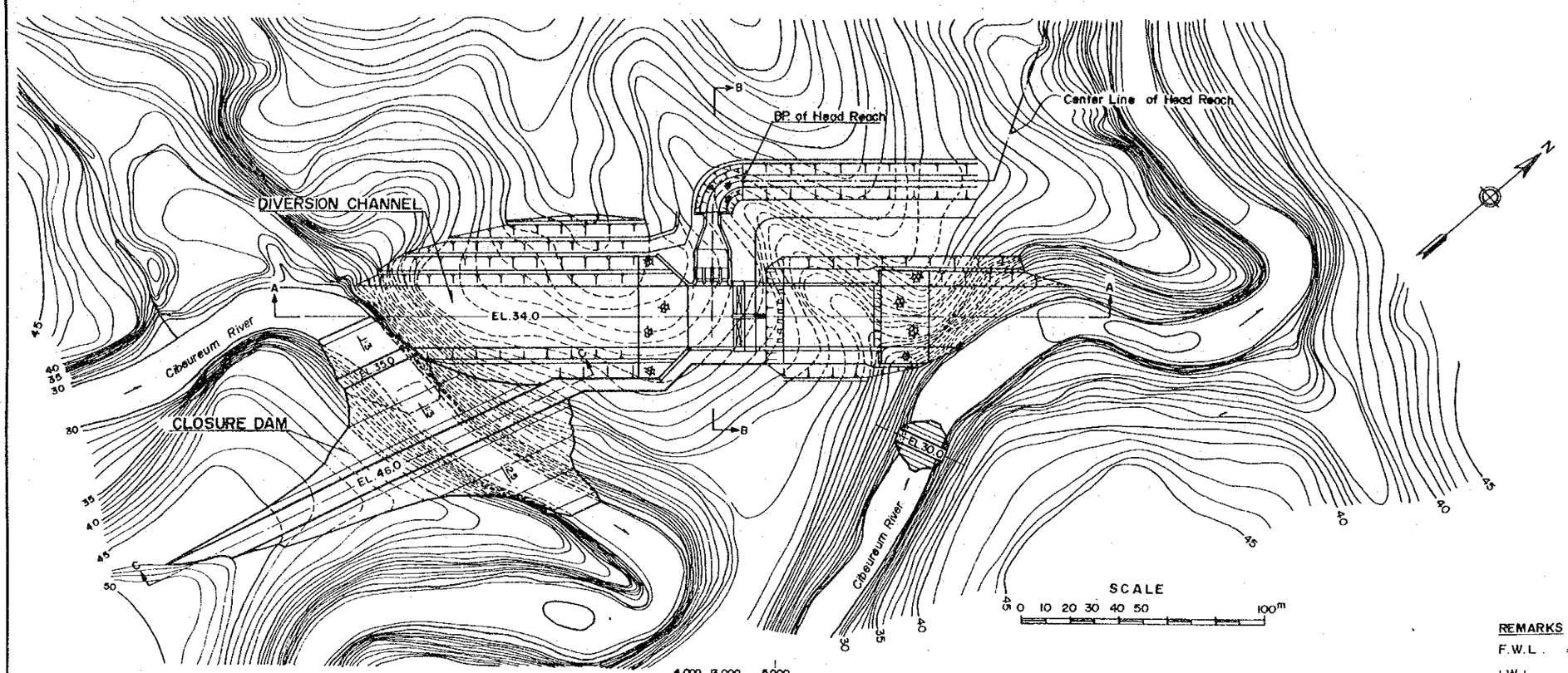
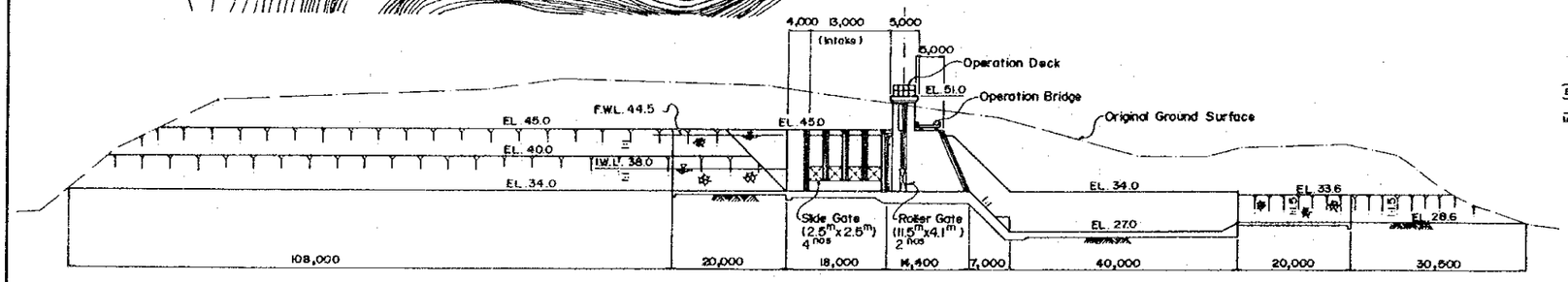
Diversion Works(Alternative-2)

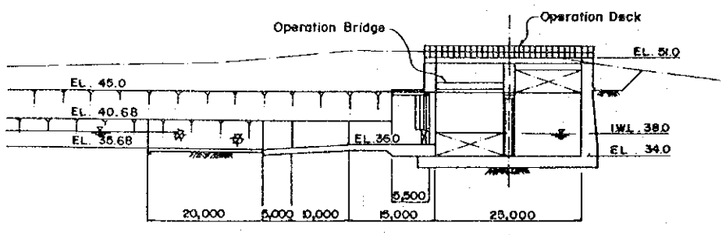
JAPAN INTERNATIONAL COOPERATION AGENCY





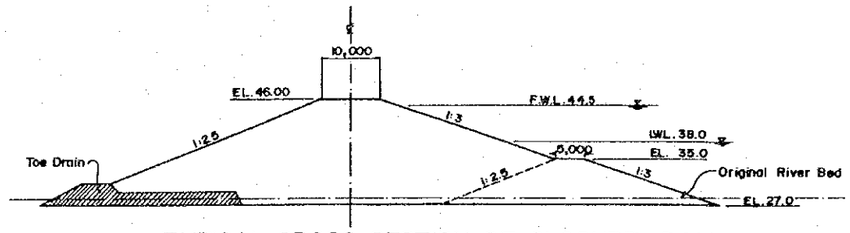
SECTION A–A

SCALE
0 10 20 30m



SECTION B–B

SCALE
0 10 20 30m



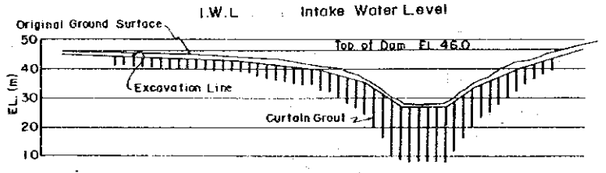
TYPICAL CROSS SECTION OF CLOSURE DAM

SCALE
0 10 20 30m

REMARKS

F.W.L. : Flood Water Level by P.M.F

I.W.L. : Intake Water Level



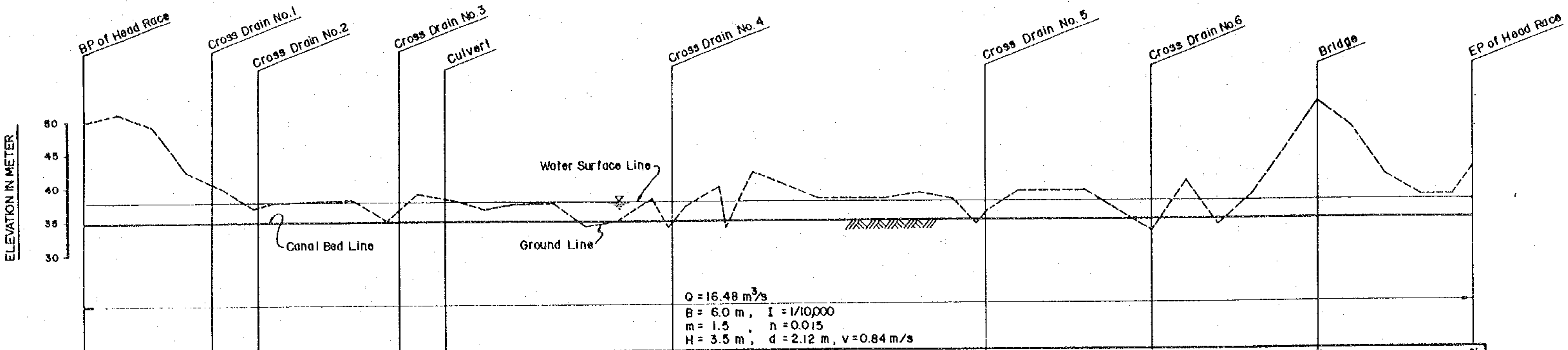
AXIS PROFILE OF CLOSURE DAM (SECTION C-C)

SCALE
0 10 20 30 40 50m

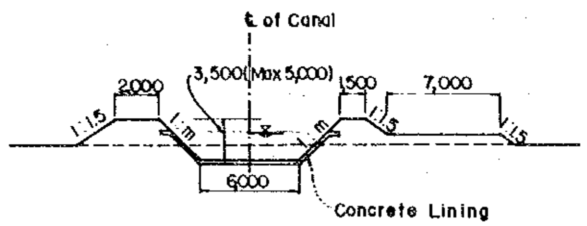
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Diversion Works (Alternative-3)

JAPAN INTERNATIONAL COOPERATION AGENCY



STATION	DISTANCE	REDUCED DISTANCE	GROUND SURFACE ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVATION
NO. 0	0.00	0.00	50.00	37.80	35.68
	50.00	50.00	51.20		
NO. 1	50.00	100.00	49.20		
	50.00	150.00	42.50		
+ 90	40.00	190.00		37.781	35.661
NO. 2	50.00	200.00	40.00		
	50.00	250.00	37.00		
+ 60	10.00	260.00		37.774	35.654
NO. 3	50.00	300.00	38.00		
	50.00	350.00	38.00		
NO. 4	50.00	400.00	38.00		
	50.00	450.00	35.00		
+ 70	20.00	470.00		37.753	35.633
NO. 5	50.00	500.00	39.00		
+ 40	40.00	540.00		37.746	35.626
	50.00	550.00	38.00		
NO. 6	50.00	600.00	36.70		
	50.00	650.00	37.50		
NO. 7	50.00	700.00	37.50		
	50.00	750.00	34.00		
NO. 8	50.00	800.00	35.00		
	50.00	850.00	38.00		
	25.00	875.00	34.00		
+ 80		880.00		37.712	35.592
NO. 9	25.00	900.00	37.00		
	50.00	950.00	40.00		
	10.00	960.00	34.00		
NO. 10	40.00	1,000.00	42.00		
	50.00	1,050.00	40.00		
NO. 11	50.00	1,100.00	38.00		
	50.00	1,150.00	38.00		
NO. 12	50.00	1,200.00	38.00		
	50.00	1,250.00	38.80		
NO. 13	50.00	1,300.00	38.00		
	35.00	1,335.00	34.00		
+ 50	15.00	1,350.00	36.00	37.665	35.545
NO. 14	50.00	1,400.00	39.00		
	50.00	1,450.00	39.00		
NO. 15	50.00	1,500.00	39.00		
	50.00	1,550.00	36.00		
NO. 16	50.00	1,600.00	33.00	37.640	35.52
	50.00	1,650.00	40.50		
NO. 17	50.00	1,700.00	34.00		
	50.00	1,750.00	38.00		
NO. 18	50.00	1,800.00	45.00		
+ 50	50.00	1,850.00	52.00	37.615	35.495
NO. 19	50.00	1,900.00	48.00		
	50.00	1,950.00	41.00		
NO. 20	50.00	2,000.00	38.00		
	50.00	2,050.00	38.00		
+ 80	30.00	2,080.00	42.10	37.592	35.472



LEGEND

Q : Design Discharge (m^3/s)
I : Hydraulic Gradient
B : Canal Base Width (m)
m : Canal Side Slope
n : Manning Coefficient
H : Canal Height (m)
d : Water Depth (m)
v : Velocity (m/s)

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DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
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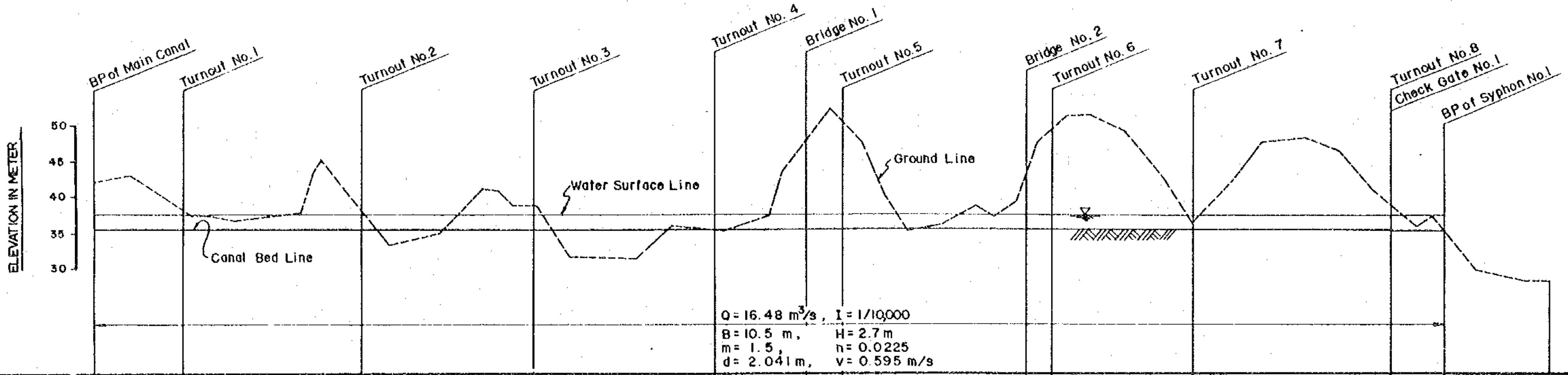
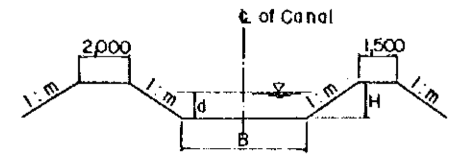
Head Reach Profile

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.G-12

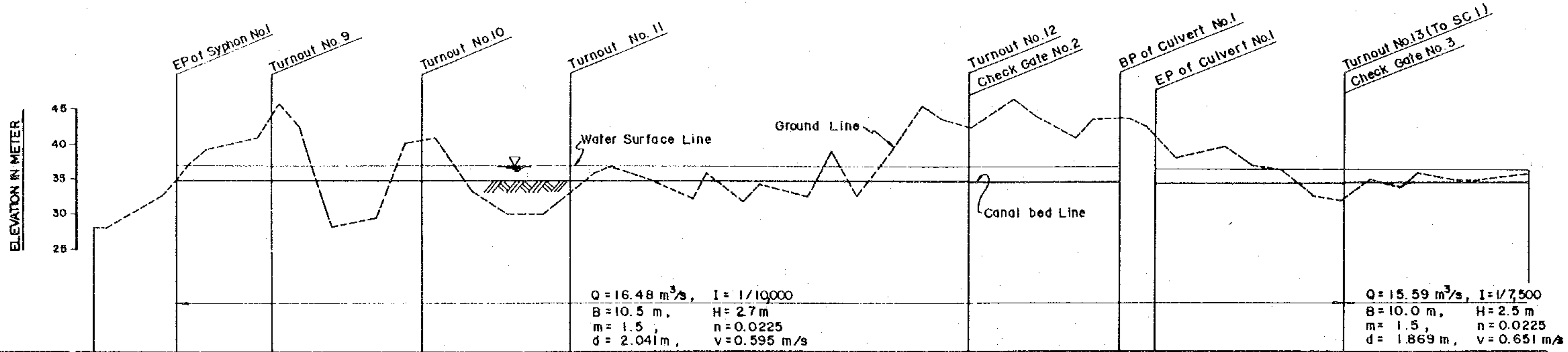


STATION	DISTANCE	REDUCED DISTANCE	GROUND SURFACE ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVATION
NO. 0	0.00	0.00	42.106	37.546	35.505
	91.98	91.98	43.245		
NO.2 + 40	148.02	240.00	37.975	37.522	35.481
	11.79	251.79			
	138.00	389.79	36.945		
NO. 5	110.21	500.00			
	73.79	573.79	37.852		
	55.00	628.79	45.118		
NO.7 + 40	111.21	740.00		37.472	35.431
	72.79	812.79	33.463		
	141.97	954.76	35.279		
NO. 10	45.24	1,000.00			
	72.48	1,072.48	41.394		
	87.90	1,160.38	38.982		
NO.12 + 20	59.62	1,220.00	38.856	37.424	35.383
	10.37	1,230.37			
	85.49	1,315.86	31.766		
NO. 15	188.00	1,503.86	31.688		
	93.64	1,597.50	36.046		
NO. 17 + 20	122.50	1,720.00		37.374	35.333
	21.50	1,741.50	35.382		
	129.95	1,871.45	37.406		
	36.50	1,907.95	43.782		
NO.19 + 70	62.05	1,970.00		37.349	35.308
NO. 20	30.00	2,000.00			
	37.28	2,037.28	52.126		
+ 70	32.72	2,070.00		37.339	35.298
	177.03	2,247.03	35.380		
	98.00	2,345.03	36.243		
	79.98	2,425.01	38.656		
	60.99	2,486.00	37.262		
NO. 25	14.00	2,500.00			
	41.99	2,541.99	39.448		
+ 70	28.01	2,570.00		37.289	35.248
	29.93	2,599.93	47.628		
NO.26 + 40	40.07	2,640.00		37.282	35.241
	29.74	2,669.74	51.182		
	76.99	2,746.73	51.413		
	97.82	2,844.55	48.834		
NO. 30	155.45	3,000.00			
+ 30	30.00	3,030.00	36.390	37.243	35.202
	189.81	3,219.81	47.635		
	115.99	3,335.80	48.052		
	91.99	3,427.79	46.385		
NO. 35	72.21	3,500.00			
+ 70	70.00	3,570.00		37.189 / 37.139	35.148 / 35.098
	67.26	3,637.26	35.807		
	35.88	3,673.14	37.224		
NO.37 + 10	36.86	3,710.00		37.125	35.094
	94.70	3,804.70	29.662		
	123.99	3,928.69	28.307		
NO. 40	180.00	4,000.00			



LEGEND

- Q : Design Discharge (m³/s)
- I : Hydraulic Gradient
- B : Canal Base Width (m)
- m : Canal Side Slope
- n : Manning Coefficient
- H : Canal Height (m)
- d : Water Depth (m)
- v : Velocity (m/s)



STATION	DISTANCE	REDUCED DISTANCE	GROUND SURFACE ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVATION
NO. 40	180.00	4,000.00			
	36.68	4,036.68	28.076		
	154.98	4,191.66	32.799		
NO. 42 + 30	38.34	4,230.00		36.698	34.657
	83.07	4,313.07	39.410		
	145.98	4,459.05	40.778		
NO. 45	40.95	4,500.00		36.671	34.630
	21.43	4,521.43	45.773		
	51.86	4,573.29	42.467		
	97.24	4,670.53	28.169		
	123.98	4,794.51	29.604		
	81.54	4,876.05	40.156		
NO.49 + 20	43.95	4,920.00		36.629	34.588
	38.04	4,958.04	40.848		
NO. 50	41.96	5,000.00			
	63.51	5,063.51	33.228		
	103.96	5,167.47	35.000		
	100.03	5,267.50	35.000		
NO.53 + 40	72.50	5,340.00		36.587	34.546
	61.48	5,401.48	35.629		
	49.93	5,451.41	36.758		
NO. 55	48.59	5,500.00			
	187.28	5,687.28	32.142		
	37.06	5,724.34	35.829		
	104.83	5,829.17	31.631		
	43.15	5,872.32	34.277		
NO. 60	127.68	6,000.00	32.492		
	70.21	6,070.21	38.989		
	71.21	6,141.42	32.513		
	180.08	6,321.50	45.231		
NO.64 + 50	128.50	6,450.00	42.044	36.476 / 36.426	34.435 / 34.385
NO. 65	50.00	6,500.00			
	74.22	6,574.22	46.162		
	170.86	6,745.08	40.716		
	51.73	6,796.81	43.243		
NO.68 + 70	73.19	6,870.00	43.391	36.384	34.343
	21.79	6,891.79			
	55.59	6,947.38	42.342		
NO.69 + 70	22.62	6,970.00		36.184	34.143
NO. 70	30.00	7,000.00			
	23.14	7,023.14	37.890		
	138.96	7,162.10	39.573		
	80.00	7,242.10	36.616		
	76.00	7,318.10	36.079		
	83.92	7,402.02	32.497		
NO.74 + 90	87.98	7,490.00	31.745	36.132 / 36.078	34.091 / 34.209
NO. 75	10.00	7,500.00			
	59.83	7,559.83	34.742		
	86.98	7,646.81	33.598		
	43.85	7,690.66	35.839		
	108.00	7,798.66	34.778		
NO. 80	201.34	8,000.00		36.010	34.141

MINISTRY OF PUBLIC WORKS
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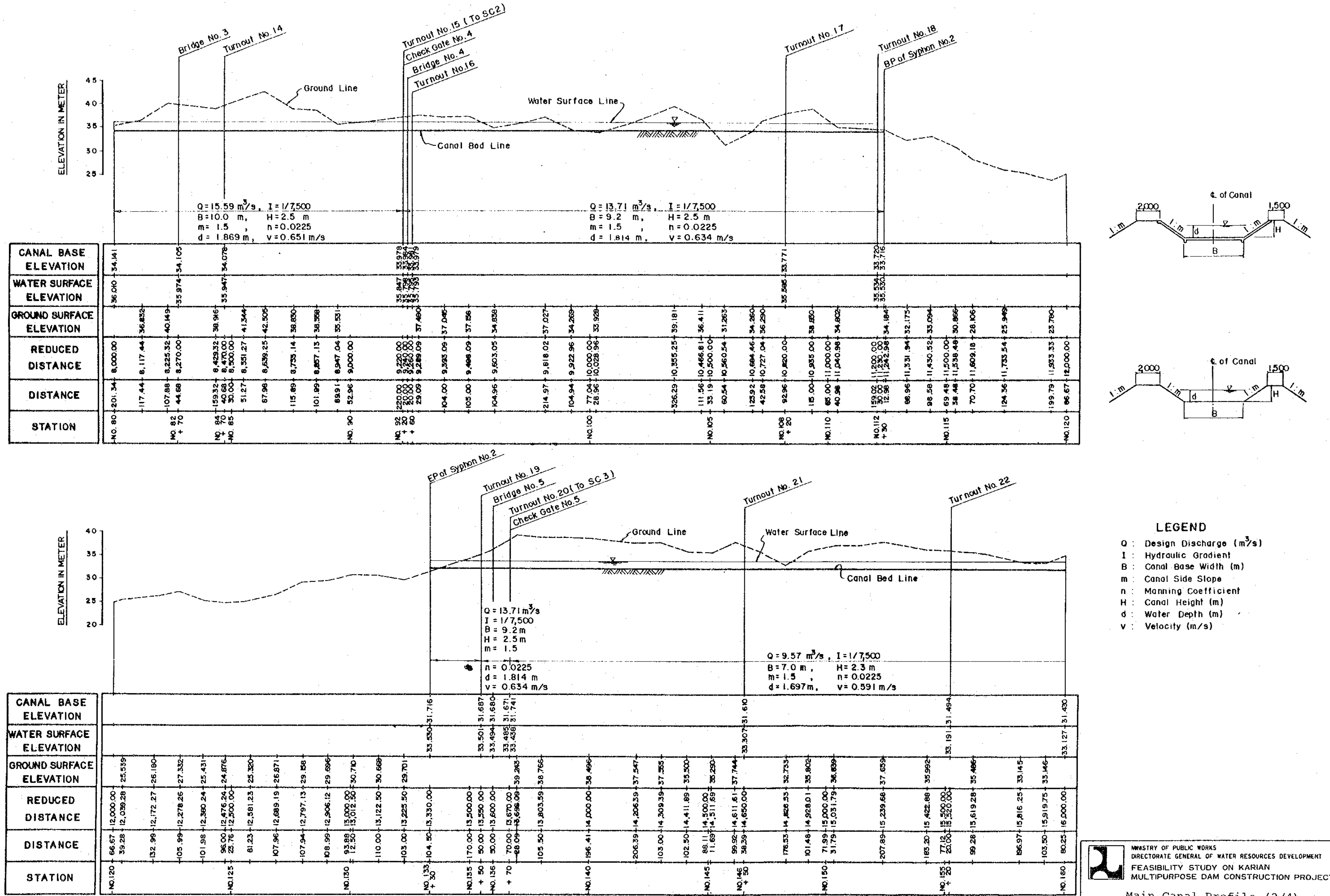
Main Canal Profile (1/4)

JAPAN INTERNATIONAL COOPERATION AGENCY

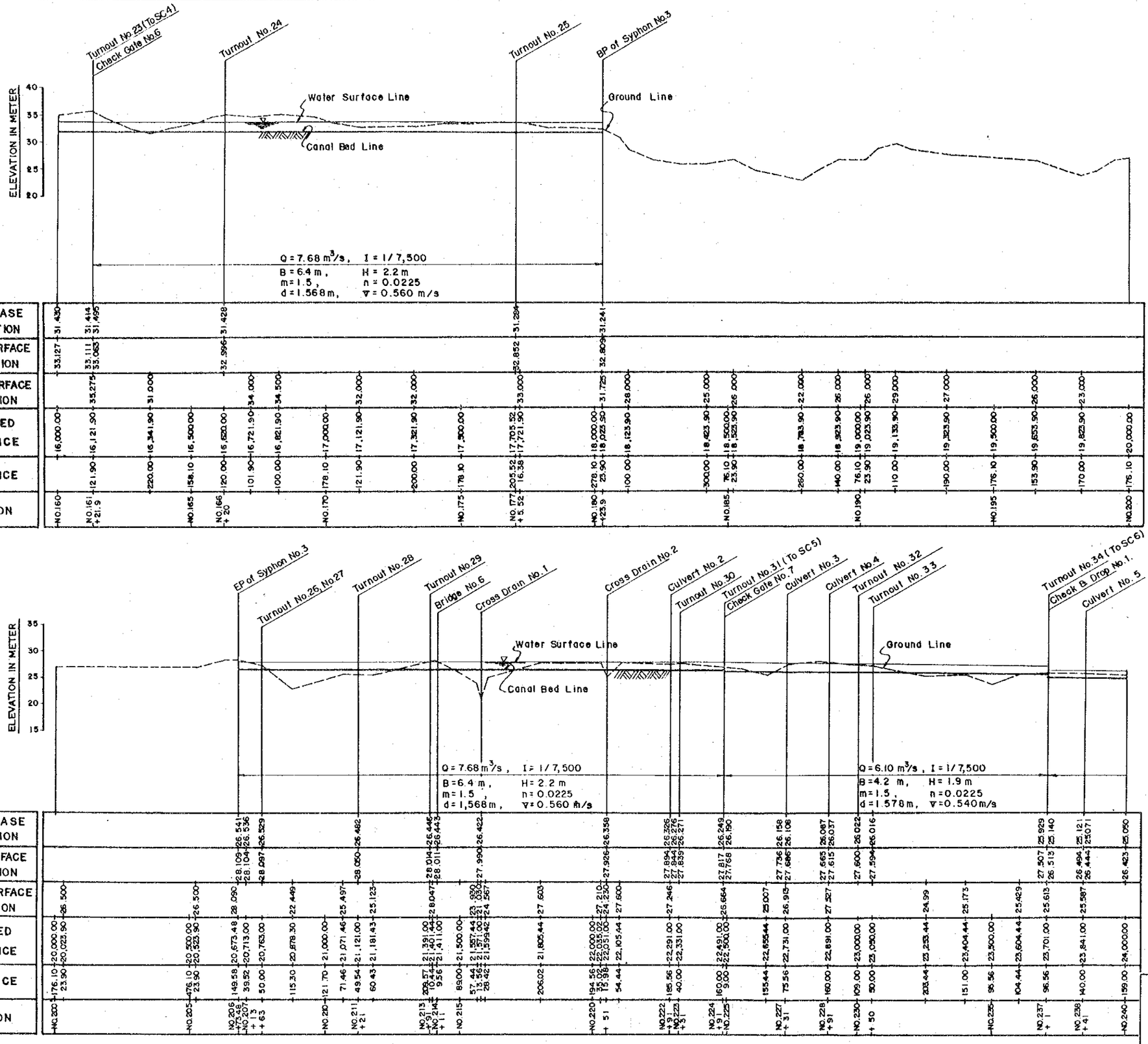
Fig.G-13

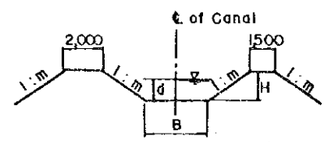


MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT

Main Canal Profile (2/4)

JAPAN INTERNATIONAL COOPERATION AGENCY





LEGEND

- Q : Design Discharge (m^3/s)
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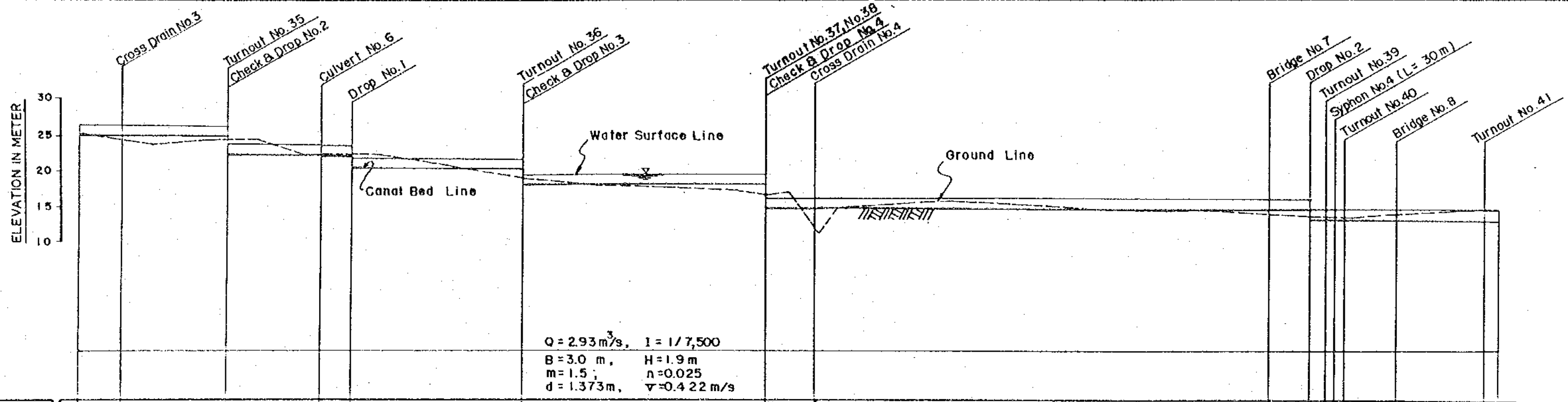
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

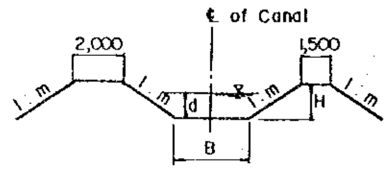
Main Canal Profile (3/4)

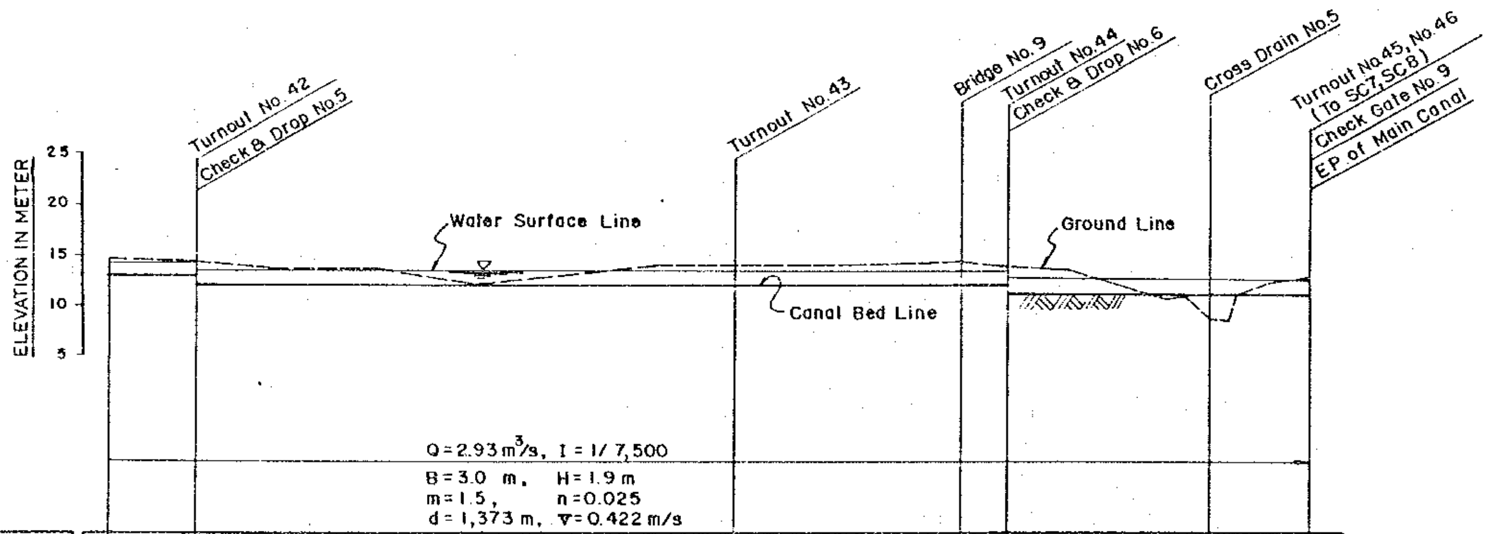
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.G-15



REDUCED DISTANCE	CANAL BASE ELEVATION	WATER SURFACE ELEVATION	GROUND SURFACE ELEVATION	DISTANCE	STATION
24,000.00	25.050	26.423		159.00	NO.240
24,121.00	25.034	26.407		121.00	NO.241 +21
24,204.44			23.843	83.44	
24,421.00	24.994 / 22.494	26.367 / 23.867	24.596	216.56	NO.244 +21
24,500.00				79.00	NO.245
24,632.44			22.359	132.44	
24,681.00	22.459 / 22.409	23.832 / 23.782	22.359	48.56	NO.246 +81
24,771.00	22.397 / 19.997	23.770 / 21.370	22.359	90.00	NO.247 +71
24,852.44			22.070	81.44	
25,000.00				147.56	NO.250
25,052.44			20.392	52.44	
25,251.00	19.933 / 17.933	21.306 / 19.306	18.596	198.56	NO.252 +51
25,452.44			17.547	201.44	
25,500.00				47.56	NO.255
25,652.44			17.423	152.44	
25,932.44	17.842 / 14.842	19.215 / 16.215	16.209	280.00	NO.259 +32.44
26,000.00				67.56	NO.260
26,071.00	14.824	16.197	10.760	71.00	+71
26,082.44				11.44	
26,134.44			14.420	52.00	
26,391.00			15.274	256.56	
26,482.44			15.478	71.44	
26,500.00				37.56	NO.265
26,662.44			14.950	162.44	
26,862.44			14.326	200.00	
27,000.00				137.56	NO.270
27,162.44			14.282	162.44	
27,351.00	14.653	16.026		188.56	NO.273 +51
27,362.44			13.767	11.44	
27,471.00	14.637 / 13.137	16.010 / 14.510	13.484	108.56	NO.274 +71
27,500.00	13.132	14.505		29.00	NO.275
27,511.00	13.128	14.501		11.00	+11
27,541.00	13.028	14.401		30.00	+41
27,571.00	13.024	14.397		30.00	+71
27,588.44			13.169	17.44	
27,711.00	13.005	14.378		122.56	NO.277 +11
27,961.00	12.972	14.345		250.00	NO.279 +61
27,972.44			14.606	11.44	
28,000.00	12.967	14.340		27.56	NO.280





REDUCED DISTANCE	CANAL BASE ELEVATION	WATER SURFACE ELEVATION	GROUND SURFACE ELEVATION	DISTANCE	STATION
28,000.00	12.967	14.340		27.56	NO.280
28,171.00	12.944 / 12.044	14.317 / 13.417	14.269	171.00	NO.281 +71
28,322.44			13.688	151.44	
28,500.00				177.56	NO.285
28,722.44			11.939	222.44	
29,000.00				277.56	NO.290
29,221.00	11.904	13.277		221.00	NO.292 +21
29,272.44			13.884	51.44	
29,500.00				227.56	NO.295
29,661.00	11.845	13.218		161.00	NO.296 +61
29,664.44			14.197	3.44	
29,751.00	11.833 / 11.033	13.206 / 12.406	13.767	86.56	NO.297 +51
30,000.00				249.00	NO.300
30,064.44			10.375	64.44	
30,103.88			11.170	39.44	
30,141.00	10.981	12.354	8.840	37.12	NO.301 +41
30,182.75			8.330	41.75	
30,264.44			12.030	81.69	
30,341.00	10.754	12.327	12.604	76.56	NO.303 +41

LEGEND

- Q : Design Discharge (m^3/s)
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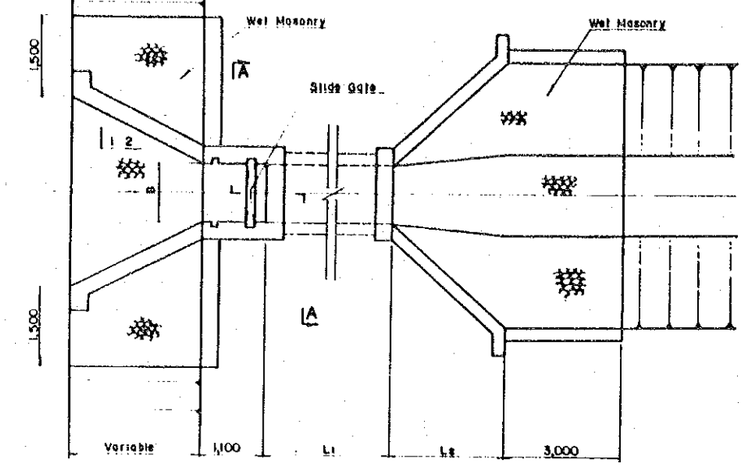
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT

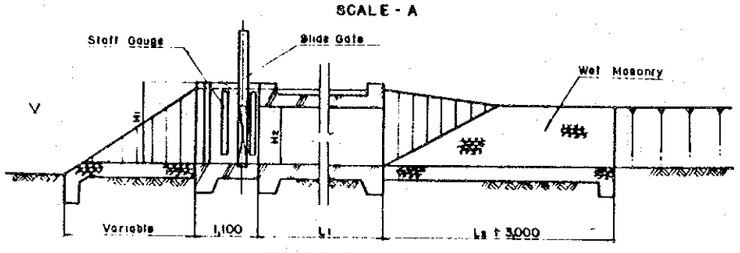
Main Canal Profile (4/4)

JAPAN INTERNATIONAL COOPERATION AGENCY

TURNOUT TYPE - A



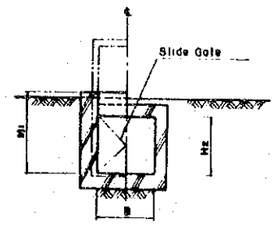
PLAN
SCALE - A



PROFILE
SCALE - A

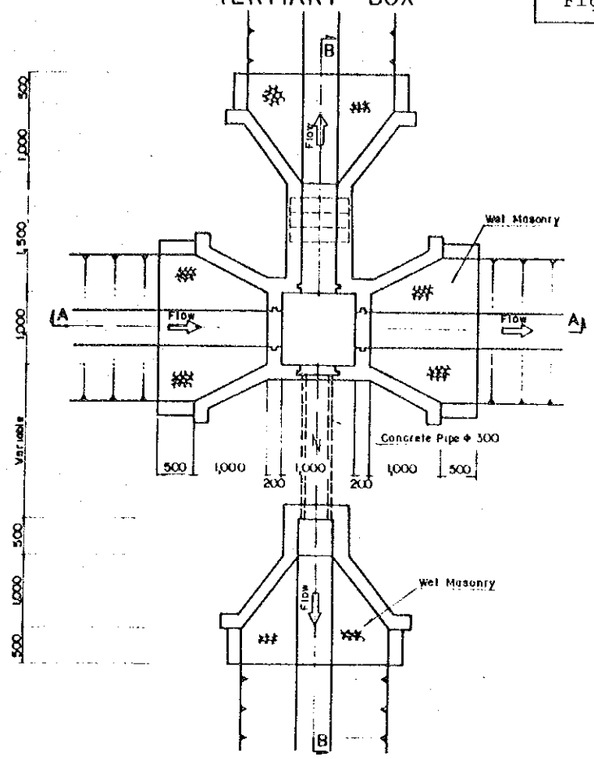
DIMENSIONS OF TURNOUTS
TYPE - A

Discharge (m³/s)	L1	L2	B	H1	H2	Gate
3.78	20,000	4,000	2,000	3,000	2,200	2.0x2.0
2.92	27,000	"	"	2,500	1,800	2.0x1.8
2.50~2.00	20,000	"	1,500	"	"	1.5x1.8
2.00~1.50	27,000 20,000	"	"	2,200	1,500	1.5x1.5
1.50~1.00	27,000 20,000 6,000 1,000	3,000	1,300	2,000	1,300	1.3x1.3
1.00~0.80	27,000 20,000 6,000 1,000	"	1,100	1,800	1,100	1.1x1.1
0.80~0.60	27,000 20,000 6,000 1,000	"	1,000	1,700	1,000	1.0x1.0



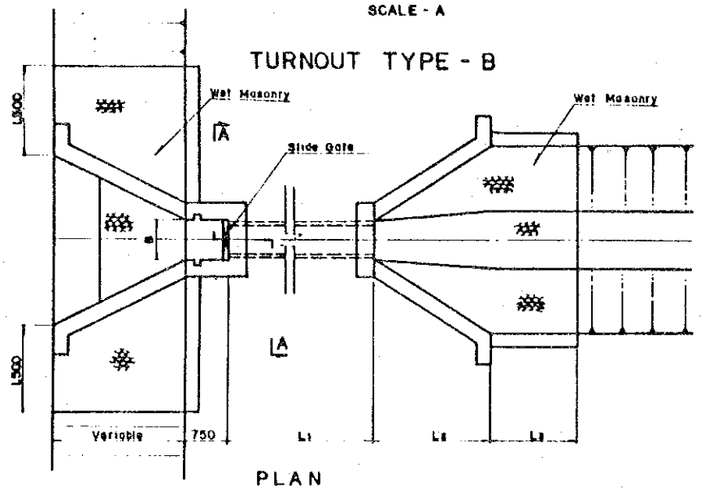
SECTION A-A
SCALE - A

TERTIARY BOX

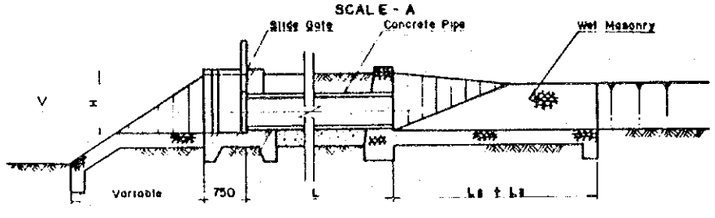


PLAN
SCALE - B

TURNOUT TYPE - B



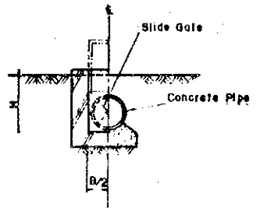
PLAN
SCALE - A



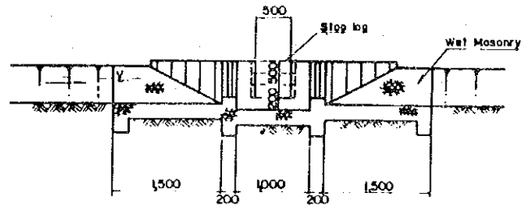
PROFILE
SCALE - A

DIMENSIONS OF TURNOUTS
TYPE - B

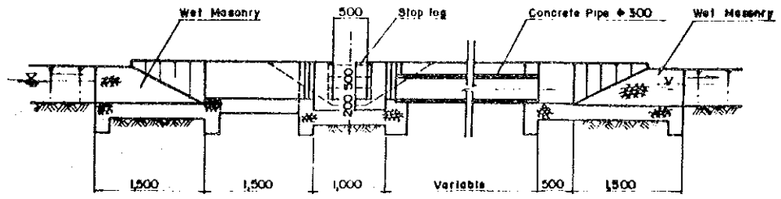
Discharge (m³/s)	L1	L2	L3	B	H	Pipe ϕ	Gate
0.60~0.40	27,000 20,000 6,000 1,000	3,000	3,000	1,100	1,800	ϕ 900	ϕ 900
0.40~0.20	27,000 20,000 6,000 1,000	"	"	900	1,600	ϕ 700	ϕ 700
0.20~0.10	27,000 20,000 6,000 1,000	"	"	700	1,400	ϕ 500	ϕ 500
0.10~0.05	27,000 20,000 6,000 1,000	2,000	2,000	600	1,300	ϕ 400	ϕ 400
0.05~	27,000 20,000 6,000 1,000	"	"	500	1,200	ϕ 300	ϕ 300



SECTION A-A
SCALE - A



SECTION A-A
SCALE - B



SECTION B-B
SCALE - B

SCALE - A
0 5 10m

SCALE - B
0 1 2 3 4 5m

MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Turnout & Tertiary Box

JAPAN INTERNATIONAL COOPERATION AGENCY