No. 8

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

THE MINISTRY OF MAHAWELI DEVELOPMENT

BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

NOVEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of Democratic Socialist Repulibc of Sri Lanka, the Government of Japan decided to conduct a basic design study for the Project on Establishment of Pilot Demonstration Farm in Mahaweli and entrusted the survey to the Japan International Cooperation Agency (J.I.C.A.). The J.I.C.A. sent to Sri Lanka a survey team headed by Mr. Isamu MINAMIYAMA from 25th June to 10th August, 1982.

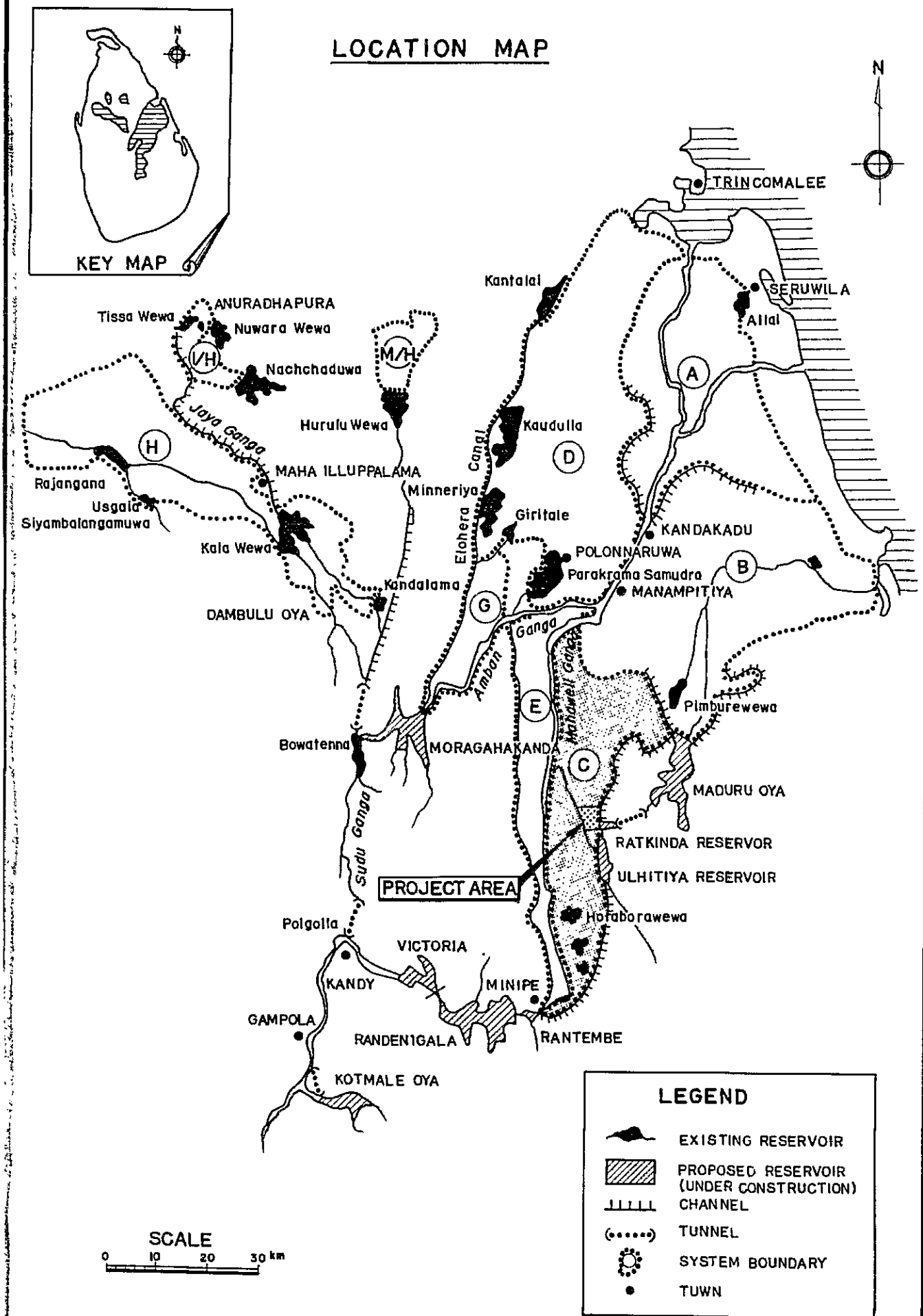
The team had discussions with the officials concerned of the Government of Sri Lanka and conducted a field survey in Mahaweli Project area. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations betwen our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Sri Lanka for their close cooperation extended to the team.

November , 1982

Keisuke Arita
President
Japan International Cooperation Agency


LOCATION MAP
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ABBREVIATIONS

1.	Length	mm	:	millimeter
		cm	:	centimeter
		m	:	meter
		km	:	kilometer
2.	Area	m^2	:	square meter
		km^2	:	square kilometer
		ha	:	hectare
3.	Volume	ℓ	:	liter
		m^3	:	cubic meter
4.	Weight	g	:	gram
		kg	:	Kilogram
		ton(t)	:	ton (=1,000 kgs)
		Gal.	:	gallon (=4.546ℓ) [Great Britain]
5.	Time	sec(s)	:	second
		hr	:	hour
6.	Other measures	%	:	percent
		HP	:	horsepower
		°C	:	centigrade
		mm/day	:	millimeter per day
		m/sec	:	meter per second
		m^3/sec	:	cubic meter per second
		m^3/ha	:	cubic meter per hectare
		ℓ/sec/ha	:	liter per second per hectare
		t/ha	:	ton per hectare
		M.D.	:	man day
		MW	:	megawatt
7.	Currency	Rs.	:	Sri Lanka Rupee
		¥	:	Japanese Yen
8.	Other abbreviations			
		UNDP	:	United Nations Development Programme
		FAO	:	Food and Agriculture Organization of the United Nations
		U.K.	:	United Kingdom
		OECF	:	Overseas Economic Cooperation Fund
		MASL	:	Mahaweli Authority of Sri Lanka
		GOSL	:	Government of Sri Lanka
		MMD	:	Ministry of Mahaweli Development
		USDA	:	United States, Department of Agriculture
		USBR	:	United States, Department of Interior Bureau of Reclamation
		GOJ	:	Government of Japan
		JICA	:	Japan International Cooperation Agency

SUMMARY

This report presents the results of the basic design study on the pilot demonstration farm for the on-farm development in System C under the Accelerated Mahaweli Development Programme.

The Government of Sri Lanka has laid great emphasis on creating increase opportunities in rural employment, generating hydro-power to meet the requirements of industry and rural electrification, and increase in food production over a wide range of crops to improve the balance of payment for agricultural imports.

The Government has formulated the Accelerated Programme which involved the construction of five reservoir headworks and the associated downstream development of 140,000 ha in 1977. Then, the Government revised the Programme in 1978 and confined it to four reservoir projects-viz : Kotmale, Victoria, Maduru Oya and Randenigala, and the development of System C and the left bank of System B covering about 60,000 ha.

The construction of System C including Minipe Anicut, R.B. Canal, and Ulhitiya and Ratkinda reservoirs started in 1980 with the financial assistance from the World Bank, Japan and Kuwait. The construction of the Minipe Anicut and the R.B. Transbasin Canal would be completed in early 1983 and the Ulhitiya and the Ratkinda reservoirs have been implemented. The irrigation development and settlement in Zone 2 (3,500 ha) are being progressing smoothly. The works on the canal construction of the Main Canal and Branch Canals in Zones 3 to 6 will commence soon.

In response to the requeest of the Government of Sri Lanka to establish a pilot demonstration farm under the Grant Aid Programme of Japan, the Japan International Cooperation Agency (JICA), the executive agency of the Government of Japan, carried out the basic design study on the establishment of the said farm in collaboration with the Government of Sri Lanka from June 1982 to Septemeber 1982.

The proposed project area for the pilot demonstration farm is located in the entire lands of Block 302 (about 1,300 ha in gross) within Zone 3 of System C. The project area is of rather undulating topography and is covered with mostly grass and partly of forest. The elevation of the area ranges from 80 to 100 m in mean sea level.

The climate in the project area is tropical. The average rainfall varies between 1,700 mm and 2,300 mm per annum of which about 75% fall during the Maha season from October to February. The mean maximum temperature and mean minimum temperature range from 28°C to 34°C and 20°C to 24°C respectively.

The soils in the project area comprise the Reddish Brown Earths (RBEs). The soils have rather deep to moderately deep effective soil depth and are low in plant nutrient. Most of the soils are suitable for both paddy and upland crops cultivation.

In Zones 1 to 2 in System C, the following cropping pattern is predominant at present:

i) Double crops of rice in the irrigated rice field.

ii) Single crop of rice in the Maha season in the rain-fed lands.

iii) Single crop of upland crops in the Maha season in the rainfed lands.

In the project area, very limited upland crops such as maize, sesame, cassava and cowpea are cultivated as shifting culture in the chena area.

A few amounts of fertilizers and agro-chemicals are applied for only rice cultivation in System C at present. The present yield of rice in Zones 1 to 2 ranges from 1.8 t/ha to 3.7 t/ha (paddy) depending on irrigation water availability and rainfall distribution. Yields of upland crops are generally low and fluctuate largely depending on the rainfall distribution.

Since the irrigation water availability in Sri Lanka is limited and the water consumption by rice is excessive, minimizing water losses and maximizing water use through the introduction of new techniques on land development and the development of irrigation facilities are of paramount importance. In the irrigation development of System C, where new farmer settlers will be introduced into the reclaimed land, the establishment of a pilot demonstration farm is very essential for the successful implementation of System C.

The cropping pattern proposed in the project area is firstly determined for double crops of rice a year in due consideration of climatological and soil conditions and familiarity of farming practices by settlers. Upland crops for diversification would be also introduced into the area to examine those feasibility and to carry out various agronomic tests.

The yeild of crops is expected to increase substantially with the introduction of improved irrigation farming practices and proper water management. At the full development stage, the anticipated yield of rice would be about 5.0 t/ha and 4.5 t/ha (paddy) in the Maha season and the Yala season respectively.

The consumptive use by crops is estimated by the empirical formula of the modified Penman method. Diversion irrigation requirements are estimated taking the canal conveyance and operation efficiencies of 66% into account. Peak diversion requirements for rice cultivation at the head of the minor branch canal, distributary canal and field canal are then calculated to be 2.7 ℓ/sec/ha, 2.4 ℓ/sec/ha and 2.0 ℓ/sec/ha respectively.

Drainage requirements in the project area are estimated taking into account of 1 in 5 years probability of rainfall at Horabora Wewa. Thus the design drainage requirements are estimated to be 15 ℓ/sec/ha for wetland rice and 25 ℓ/sec/ha for contour bunded upland crops respectively.

The net irrigable area in Block 302 would be 673 ha for which about 1.8 m^3/sec of irrigation water would be supplied at the maximum. In order to develop the above irrigation area the following irrigation and drainage facilities including O&M road as well as land clearing are required.

(1) Local budget portion

	Q'ty
Land clearing	930 ha
Regulating tanks	3 Nos

(2) Japanese grant aid portion

	Canal (km)	Structure (Nos)
a) Irrigation canals		
Minor branch canal	1.7	13
Distributary canals	19.9	226
Field canals	45.8	1,640
b) Drainage canals		
Secondary drain	23.8	
Field drain	20.6	230
c) Land levelling	673 ha	
d) Construction office	300 m^2	

Before the commencement of the construction works of the project facilities, the field survey including final canal alignment, plot demarcation and grid surveys, detail design and preparation of tender documents for civil works are to be carried out within the apportioned time. The time required for the construction of the civil works would be about 12 months including preparatory works. The construction works will be made on contract basis through competitive bidding in accordance with the procurement procedure of the GOJ.

After the successful implementation of the project, the demonstration of improved irrigation farming practices and the training of the Government staff and farmers in water management will be thoroughly conducted. The following specific benefits and effects in addition to the direct economic benefits are expected to the entire System C through the above activities.

- Minimizing water losses through proper water management including rotation irrigation practices,
- Efficient farming practices and saving farm inputs through land consolidation,
- Determination of the most adaptable and beneficial cropping patterns as well as introduction of adaptable varieties of crops,
- Distribution of seeds of recommended varieties multiplied,
- Maximizing crop production through introduction of above farming activities,
- Minimizing operation and maintenance costs of irrigation and drainage system,
- Extension of appropriate pre-cast concrete structures for on-farm development resulting in the saving in costs and construction time.

For the successful completion of the project the GOSL is requested to carry out the following activities.

- To provide counterparts personnel for the detail design survey and during construction stage;
- To furnish additional data required for detail design and preparation of tender documents;
- To carry out the field survey including final canal alignment, plot demarcation and grid survey in the irrigable lands.

In view of the facts that the implementation of the project would provide certain direct and intangible benefits and effects as well as serve as a guide on the development of the entire System C, and that the scale of the project would be attractive on its construction time and costs required, it is recommended to implement the project as soon as possible under the Grant Aid Programme of the Government of Japan in order to maximize its benefits and effects.

1. INTRODUCTION

1-1 Project History

The Democratic Socialist Republic of Sri Lanka (Sri Lanka) can be divided into two climatic zones: the wet zone extending in the south-western part of the island, and the dry zone covering the remaining area of the northern and eastern lowlands. The average rainfall varies from 1,300 mm in the dry zone to 3,900 mm in the wet zone. The dry zone suffers from drought during the south-west monsoon. The Government of Sri Lanka (the Government) is putting great emphasis on the agricultural development in the dry zone.

The Mahaweli River Basin Development Project is the largest national project to be implemented by the Government as the preferencial project. The Master Plan prepared by UNDP/FAO during 1965 to 1968 covered the study of an area of about 360,000 ha of which about 270,000 ha were to be newly developed for irrigation and to generated hydropower with capacity of about 500 MW. The implementation of the plan started in 1970, and the Polgola-Bowatenna Complex included in the first phase has been completed.

In 1977, the Government of Sri Lanka decided to accelerate the implementation of the project with the primary objectives to increase rural employment opportunities and to stimulate the economic development by attaining self-sufficiency in food, to improve the balance of payments through export promotion and also to generate hydroelectric power. The System C development, which has been given the highest priority in the Accelerated Mahaweli Development Programme, is presently being executed and irrigation water would be delivered to about 68,000 ha.

The Feasibility Study on the System C development started in 1978 and the preparation of the detailed design was completed in 1981 under the U.K. technical assistance. Meanwhile, the construction of the Minipe Anicut intake facility, Right Bank Transbasin Canal and Ratkinda Dam as well as Ulhitiya Dam commenced in 1980 with the finance provided by the International Development Association (IDA). The Ulhitiya dam

was completed in the beginning of 1982. The System C area is divided into 6 zones of which Zones 3 to 6 are under construction as the Japanese Government financed project.

Subsequently, on-farm development in Zone 3 of System C was started in mid 1982. The establishment of a pilot demonstration farm in Block 302 were emphasized as there are urgent needs to demonstrate new techniques of land consolidation for maximizing water use, minimizing water losses through surface runoff, percolation and seepage. The other aims are to establish of social infrastructure and irrigation facilities, and to examine the feasibility of crop diversification so as to minimize water use. The Government of Sri Lanka then requested the Government of Japan to establish a pilot demonstration farm under the Development Assistance Programme of Japan.

In response to the above request, the Japan International Cooperation Agency (JICA) which acts as the executing agency of the Government of Japan despatched the Basic Design Study Team headed by Mr. I. Minamiyama to the site from June 25, 1982 to August 6, 1982. The team exchanged views with the officials concerned of the Government of Sri Lanka and conducted a field survey in collaboration with the counterparts of the Government of Sri Lanka. After the team returned to Japan, the basic design study was made and the draft report was submitted in October, 1982.

1-2 Objective of the Study

The objective of the study is to carry out the basic design study on the establishment of a Pilot Demonstration Farm in Block 302 of Zone 3 in Sytem C under the Accelerated Mahaweli Development Programme. The study includes studies on cropping pattern and farming practices, basic design of irrigation and drainage facilities, cost estimate and project evaluation on the establishment of a Pilot Demonstration Farm under the Grant Aid Programme of the Government of Japan.

1-3 Activities of the Study Team

The activities of the study team broadly consist of the field work in Sri Lanka and the basic design study in Japan. The field work includes:

(1) Discussion with the Mahaweli Authority of Sri Lanka on the Pilot Project;

(2) Collection of the necessary information and data for the study;

(3) Reconnaissance in the project area and other similar project area developed under the Mahaweli Accelerated Programme;

(4) Field survey in the project areas;

- Topographic survey
- Survey on rural development and settlement programme
- Soil survey and survey on farming practice
- Meteorological and hydrological surveys
- Survey on irrigation and drainage plan including geological and soil mechanical surveys
- Construction material survey
- Agricultural and agro-economic surveys
- Socio-economic survey including land settlement programme;

(5) Preparation of basic concepts for establishment of Pilot Demonstration Farm;

(6) Preparation of preliminary layout of irrigation and drainage facilities; and

(7) Preliminary cost estimates.

The basic design study in Japan includes:

(1) Formulation of agricultural development plan;

(2) Determination of final layout of the Pilot Farm;

(3) Basic design of irrigation and drainage facilities up to on-farm level;

(4) Cost estimates;

(5) Preparation of construction plan;

(6) Project evaluation; and

(7) Preparation of report.

The team members engaged in this study are listed in ANNEX 3 and their activities are illustrated in ANNEX 4.

2. THE PROJECT AREA

2-1 LOCATION

The Pilot Demonstration Farm area is located within the area of Zone 3 of System C under the Mahaweli Ganga Development Programme. The System C area extends northwards along the right bank of the Mahaweli Ganga from the Minipe Anicut; the total length of its belt-shaped area is 70 km from North to South and its width averages 10 km. It covers a gross area of approximately 67,800 ha, belonging to the three administrative districts of Bandulla, Amparai and Polonnaruwa. It is divided into six zones of Zones 1 to 6 of which the areas of Zone 3 to 6 area are now being developed with the financial assistance of OECF. Among the six zones, the zone 3 area extends immediately north-west of the Ratkinda Reservoir and is further divided into five blocks of 301 to 305. This project area covers the entire land of Block 302 and belongs to the administrative district of Amparai. The Block 302 area is situated north at about 8 km point from a new town called Giranduru Kotte which is under construction. It spreads on the hilly region along the north-west direction from the soon to be completed Ratkinda Reservoir. It has a gross area of about 1,300 ha.

2-2 Topography

Block 302 stands on hilly areas covered by grass and, partly by shrub and forest. Lands are undulating and incised with numerous gullies. Land slopes in this area range from 0.5 to 3%. Elevations of the irrigable area vary from 80 to 100 m in mean sea level.

2-3 Climate

System C lies partly in the intermediate climatic zone and partly in the dry zone. Block 302 is located principally in the intermediate zone. The annual mean rainfall varies between about 1,700 mm and 2,300 mm in the System C area and the annual mean rainfall at Horabora Wewa is about 2,150 mm. About 75% of this rainfall occurs during the NE monsoon period of October to February (Maha season), and the balance, during the SW monsoon period of March to September (Yala season).

The climate is tropical with maximum temperatures ranging from 28 to 34°C and minimum temperatures, from 20 to 24°C. Relative humidities vary from 50 to 92%. Winds are gusty in the Yala season; the maximum is 394 km/day in June and the minimum is 132 km/day in November.

2-4 Population

Most of the northern half of System C has neither infrastructure nor resident population. The southern half is more developed and contains about 95% of the estimated 30,000 inhabitants (1979) within the System; about 23,400 in Zone 1, 5,400 in Zone 2 and 1,200 in Zones 3 to 6. In Zones 1 and 2, the settlement has been completed. The settlement for Zone 3 was started in June 1982 and will be completed in 1983. The project area is inhabited at present.

2-5 Soils and Land Classification

2-5-1 Soils of the project area

The present soil study aims at examining the suitability of each soil group identified in the project area through the review of past studies and by supplementary field investigation. The detailed reconnaissance soil survey of the project area has been carried out by the Land Use Division (LUD), Irrigation Department.

The present field investigation was carried out during the period of the Basic Design Survey. It mostly concentrated on the confirmation of the soil conditions based on the soil map and topo-maps obtained from the Government and test pits dug in the project area. Forty testpits were dug within the envisaged irrigable area as shown in Fig. 2.1.

The project area is predominantly covered with the Reddish Brown Earths (RBEs) in the Sri Lanka System. The most RBEs are correlated with the Ustalfs of the USDA Soil Taxonomy.

These soils have an argillic horizon with a high base saturation. The effective soil depth is generally moderately deep to deep. Throughout the profile, these soils are loamy to clayey in texture.

Most of these soils are moderately suitable for crop cultivation. However, proper fertilization is required for optimum yield of crops under irrigation farming due to their deficiency in essential plant nutrients.

In the light of morphological characteristics and drainage, these soils are classified into three Great Groups, i.e. Well-drained RBEs, Imperfectly-drained RBEs and Poorly-drained RBEs.

Well-drained RBEs (Haplustalfs and Rhodustalfs) mainly extend over the hilly land and are also found along the rivers. These soils occupy about 457 ha or 34.2% of the area.

Imperfectly-drained RBEs (Haplustalfs) extend along the foot of the hilly land. Their characteristics are approximately equal to Well-drained RBEs. These soils occupy about 715 ha of 53.6% of the area.

Poorly-drained RBEs (Phodustalfs) are in the low-lying areas and/or in depressions. These soils have hydromorphic properties. Generally the fertility of these soils are higher than the other two soils. They occupy about 163 ha or 12.2% of the area.

The details of soil classification in the project area are shown in Table 2.1 and the typical soil profile of each Soil Series are described in Table 2.2.

2-5-2 Land classification

Based on the Japanese land capability classification system for rice field reclamation, the land in the gross irrigation area is classified into 7 capability classes as shown in Fig. 2.2 accoring to slope, effective soil depth, soil texture and gravel contents. The following table shows the summary of capability classes. (For details, vide Annex 1).

Capability Class	Description	Gross Irrigation Area (ha)
I	Almost no limitation for reclamation and crop production	264
II	Some limitation for reclamation and crop production	4
IIa		325
IIb		275
III	Many limitations for reclamation and crop production	1
IIIa		31
IVb	Great natural limitations	4
	Total	904

As seen from the above table, most of the gross irrigation area is suitable for rice cultivation.

2-6 Agriculture

2-6-1 Present land use

The following table shows the present land use in the area of System C and in the project area.

Area	Zone	Paddy land	Chena	Forest	Village	Others	Total
System C	1	3,000	8,600	300	1,100		13,000
	2	1,000	12,900	1,000	2,000		16,900
	3	Nil	2,700	1,900	Nil	-	4,600
	4	Nil	1,200	16,000	Nil	2,400	19,600
	5	Nil	1,600	4,700	Nil		
	6	Nil	3,000	1,000	Nil	3,400	13,700
Total		4,000/1	30,000 (3,000)/2	24,900	8,900		67,800
Project Area (Block 302)		0	920	300	Nil	115	1,335

/1 : Estimated for all over the System C area under cultivation.

/2 : Estimated for all over the System C area, but concentrated in Zones 1, 2 and 6 under cultivation.

Note: The areas shown in this table are estimated on the present land use map, System C, Mahaweli Development Project, Feasibility Study, 1979, MMD.

The existing paddy lands predominate in Zone 1. About 50% of the rice fields are irrigated by four tanks, Horabora, Mapakada, Dambarawa and Nagadeepa. The remainings are either irrigated by the minor tanks or rainfed.

The agricultural land development with the construction of the irrigation system and settlement in Zone 2 started in 1980. About 2,900 families have been settled in 1980/81. Chena cultivation is practiced throughout the System C area and mostly concentrated in Zones 1, 2 and 6. The cultivation area is estimated at 3,000 to 4,000 ha, mainly cultivated with sesame, cowpea, grams and maize. The forest lands are mostly covered with secondary forest which covers about 24,600 ha or 36% of the total lands.

The project area is mostly covered with elephant grass or sedge grass, which occupies about 920 ha or 69% of the total land area. Forest lands extend along the banks of rivers and streams, and on some hilly lands. Virtually, negligible lands are illegally cultivated with upland paddy, sesame, maize and cassava in the Chena lands.

2-6-2 Present cropping patterns and farming practices

At present, the following cropping patterns are predominant in the System C area.

i) Double crops of rice in the irrigated rice field
ii) Single crop of rice in the rainfed lands
iii) Single crop of upland crops in the rainfed lands.

In the irrigated paddy lands, the Maha season (wet season) rice is planted from the mid October, and harvested from February to March. In the Yala season (dry season) paddy cultivation commences from May to June. The planting period of paddy is extended over about four months. The harvesting lasts from September to October. Rainfed rice cultivation is practiced from the middle of October, at the onset of the rainy season, to February to March. Upland crops such as maize, sesame, peanuts, cassava and cowpea are planted during the Maha season. Present rice farming practices prevailing in Zone 1 are shown in Table 2.3.

2-6-3 Farm inputs

A few amounts of fertilizers and agro-chemicals are applied for rice cultivation in System C but they are not used for other crops at present. Fertilizer application is very limited to only the well irrigated area. The application amount is recommended by the agricultural extension office, the main fertilizers are about 125 kg/ha of urea, and 50 kg/ha of T.S.P. and of potash in average. Agro-chemicals of about 2ℓ/ha of pesticide are also applied. The farmers commonly use their own seeds.

2-6-4 Crop yield

Present yields of crops in the System C area as well as around the project area are rather low. The rice yield in Zone 1 ranges from 1.8 t/ha to 3.7 t/ha (paddy). Such low yield is mainly attributable to shortage of irrigation water and limited application of inputs. Table 2.4 shows the recent rice yields in the existing major irrigation project area. Table 2.5 presents the recommended varieties of rice released recently and their potential yields. Yields of upland crops such as sesame, cowpea, maize, etc. are very low and fluctuate largely depending on the rainfall distribution.

Table 2.1 Soils in the Project Area

			Unit I		Unit II		Unit III		Total		Proportion	
			Gross/1	Net/2	Gross/1	Net/2	Gross/1	Net/2	Gross/1	Net/2	Gross/1	Net/2
Well drained RBEs	U :	Ulhitiya	102	19	98	19	70	17	170	55	20.2	8.2
	Mn:	Manampitiya	-	-	63	14	39	5	102	19	7.6	2.8
	A :	Alutnuwara	46	12	7	2	32	22	85	36	6.4	5.3
Sub-total			148	31	168	35	141	44	457	110	34.2	16.3
Imperfectly drained RBEs	H :	Horabora Wewa	174	121	119	73	161	91	454	285	34.1	42.4
	Pa:	Padumunda Kulam	-	-	69	37	17	9	86	46	6.4	6.8
	Hm:	Hembarawa	15	13	-	-	-	-	15	13	1.1	1.9
	Up:	Ulpothawewa	76	46	44	10	40	20	160	76	12.0	11.3
Sub-total			265	180	232	120	218	120	715	420	53.6	62.4
Poorly drained RBEs	K :	Kuda Oya	36	33	10	7	-	-	46	40	3.4	6.0
	M :	Moogamana Ela	41	39	46	40	30	24	117	103	8.8	15.3
Sub-total			77	72	56	47	30	24	163	143	12.2	21.3
Total			490	283	456	202	389	188	1,335	673	100.0	100.0

/1 : Gross means the project area.

/2 : Net means the net irrigation area of rice field.

Table 2.2 Principal Characteristics of Each Soil Series in the Project Area

Soil Group	Soil Series		Description	Physiographic Unit : (Sub-Unit)
Well-drained RBEs	U	Ulhitiya	Well-drained, moderately deep, dark reddish brown to dark red, sandy clay loams with gravelly sub-soil containing quartz gravel (dominant), some feldspar and mica underlain by reddish or yellowish D.P.R.	Undulating Plain - Upland : (Convex slope)
	Mn	Uanampitiya	Well drained, moderately deep, dark reddish brown to dark red, sandy clay loams with gravelly sub-soil containing quartz and abundant feldspar gravel and mica, underlain by reddish or yellowish D.P.R.	Undulating Plain - Upland : (Convex slope)
	A	Alutnuwara	Well to moderately well drained, brownish black to dark brown, deep sandy reddish brown, sandy clay loam, usually containing many fine mica grains, and Mn concretions.	Levee
Imperfectly drained RBEs	H	Horabora Wewa	Imperfectly drained, deep, dark grayish brown to yellowish brown, mottled, sandy clay loam with quartz gravel, (dominant), feldspar and mica in sub-soil, sometimes gleyed at depths greater than 75 cm.	Undulating Plain - (Concave lower slope)
	Pa	Padumunda Kulam	Imperfectly drained, deep, dark grayish brown to yellowish brown mottled, sandy clay loam with quartz and feldspar gravel and mica in sub-soil, sometimes gleyed at depth greater than 75 cm.	Undulating Plain - (Concave lower slope*
	Hm	Hembarawa	Imperfectly drained, deep brown to yellowish brown, mottled, clay loams, sometimes gleyed at depths greater than 75 cm.	Mahaweli Valley - (Back slope)
	Up	Ulpothawewa	Imperfectly drained, moderately deep to deep, pale brown to grayish brown, loamy sand and sand underlain by grayish, mottled, sandy clay, sometimes gleyed at depths greater than 75 cm.	Valley of Tributary : (Partly dry steam valley - elevated area)
Poorly drained RBEs	K	Kuda Oya	Poorly drained, deep, greyish or bluish, gleyed, sandy clay loams and clay loams.	Valley bottoms of undulating plain : (Gently sloping)
	M	Moogamana Ela	Poorly drained, moderately deep to deep, grey to dark grey gleyed, sandy clays, occasionally with a thin sand layer at the surface.	Valley of tributary : (Depression)

Source: System C Mahaweli Development Project, Feasibility Study 1979, December 1979, MMD.

Table 2.3 Present Rice Farming Practices in Zone 1 under Irrigation

Operation Item	Operation Method	Required per ha
1. 1st ploughing	Bullock or Tractor	Bullock - 5 days or Tractor - 875 Rs
2. Inundation	Keep water for two weeks under submerged condition	
3. 2nd ploughing	Bullock or Tractor/1	Bullock - 5 days or Tractor - 750 Rs
4. Paddling (Basal fertilization, V_1 mixture)	Bullock, (manpower)	Bullock - 4 days 75 kg/ha
5. Final Paddling (levelling)	Manpower	4 M.D
6. Direct sowing or transplanting	Manpower	2.5 M.D or 40 M.D
7. Field management (Pest control, weeding, fertilizing water management)	Knapsack type Manpower Pesticide Urea	 46 M.D 2 ℓ 125 kg/ha
8. Harvesting	Manpower	25 M.D
9. Threshing	Manpower, bullock or tractor	100 M.D, 8-bullocks-5 days, or Tractor - 750 Rs.

/1: In case of using tractor, 2nd ploughing and paddling are done at once.

Table 2.4 Paddy Yield in Existing Major Irrigation Projects in Recent Years /1

Project	Location System	Maha		Yala		Source
		Year	Yield ton/ha	Year	Yield ton/ha	
Allai	A	76/77	2.8	-	-	1
Major schemes in	C	73/74	2.5	74	2.3	
		74/75	2.3	75	2.1	3
		75/76	3.7	76	2.8	
		76/77	2.6			
		77/78	1.9			
Minipe I, II	E	76/77	3.7	76	3.0	1
Minneriya	D1	76/77	4.4	76	2.8	1
Kaudulla	D1	76/77	-	76	3.5	1
Giritale	D1	76/77	4.3	76	1.5	1
Kantalai	D1	76/77	2.8	76	-	1
Minneriya, Kaudulla Giritale, Kantalai	D1-D2	Pre-Polgolla	3.6	Pre-Polgolla	2.6	2
Parakrama Samudra		Post-Polgolla	4.3	Post-Polgolla	4.1	2
Elahera	G	76/77	3.8	76	3.1	1
Rajangana	H	76/77	3.0	76	2.6	1
Section H1 of	H	76/77	4.2	77	3.9	4
		77/78	4.6	78	2.6	4
Nachaduwa	I	76/77	3.4	76	1.5	1
Vavuni Kulam	J	76/77	2.8	76	2.7	1
Padaviya	L	76/77	2.8	76	2.6	1
Huruluwewa	M	76/77	2.1	76	1.5	1

Source:
1. Department of Agriculture, Agricultural Statistics - Special Projects, Yala 1976 - Maha 1976/77.
2. Japan International Cooperation Agency, Interim Report on the Moragahakanda Agricultural Development Project, May 1979.
3. Hunting Technical Services, Sir Alexander Gibb and Partners, Preece-Cardew and Rider, Victoria, Mahaweli Development Project, Phase I, Preliminary Feasibility Report, November 1976, Pg. T 110.
4. Department of Census and Statistics, Communication to Mahaweli Development Board.

/1: Mahaweli Ganga Development Programme Implementation Strategy Study, Annex F, 1979, MMD.

Table 2.5 Rice Varieties Released and Their Yield Potentials /1

Released in		1960's	Early 1970's	Late 1970's
Varieties with a 4 to 4-1/2 months growth duration	Variety	H-4, H-8	BG 11-11	BG 90-2
	Field potential, tons/ha	5.7	6.5	10.3
Varieties with 3-1/2 months growth duration	Variety	H-7	BG 34-6	BG 94-1
	Yield potential, tons/ha	3.6	6.2	8.8
Varieties with 3 months growth duration	Variety	H-10	BG 34-8	-
	Yield potential, tons/ha	3.1	7.2	-

Source: Central Rice Breeding Station, Batalagoda, for yield potential

/1: Mahaweli Ganga Development Programme Implementation Strategy Study, Annex F, 1979, MMD.

Fig. 2.1 Soil Map

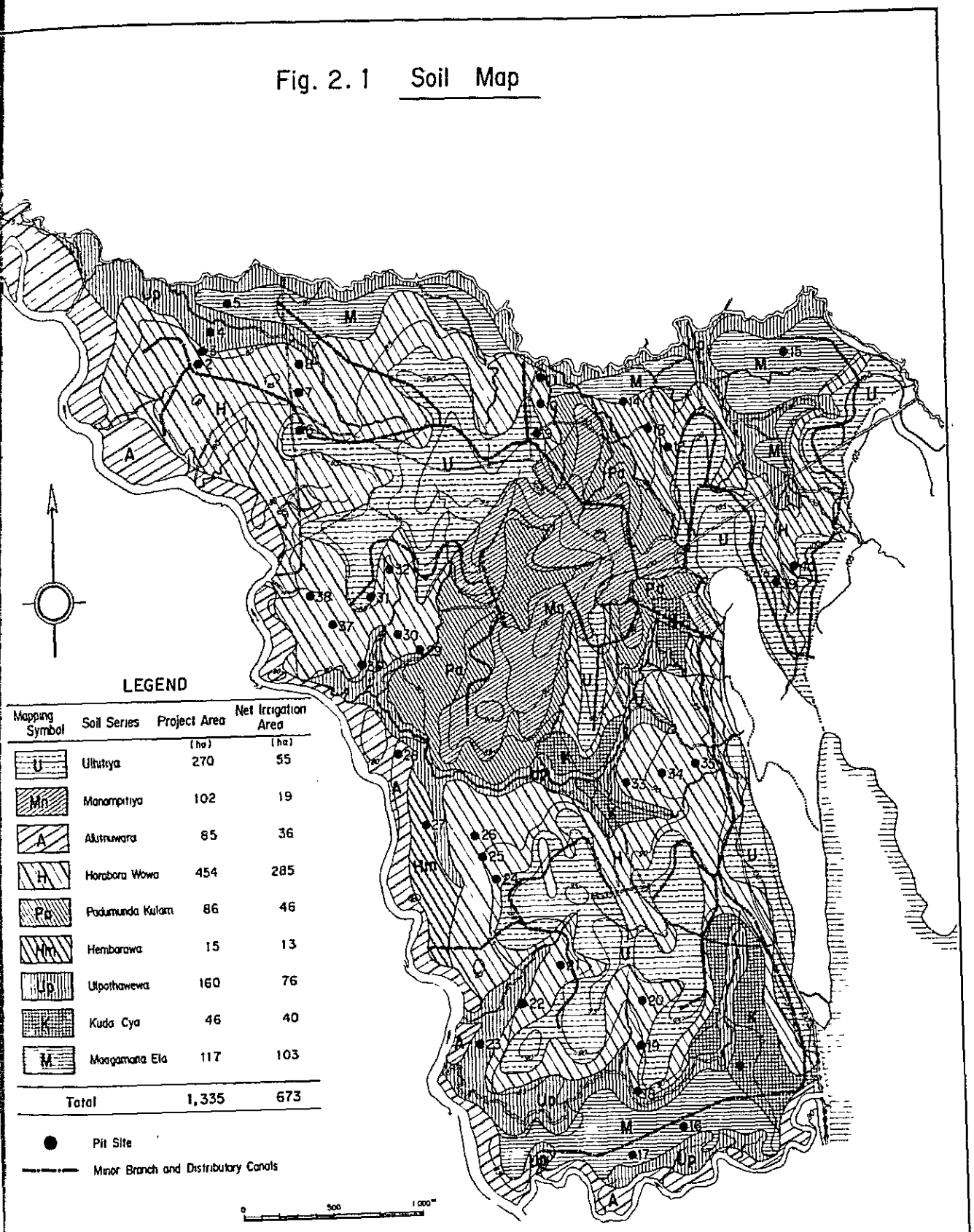
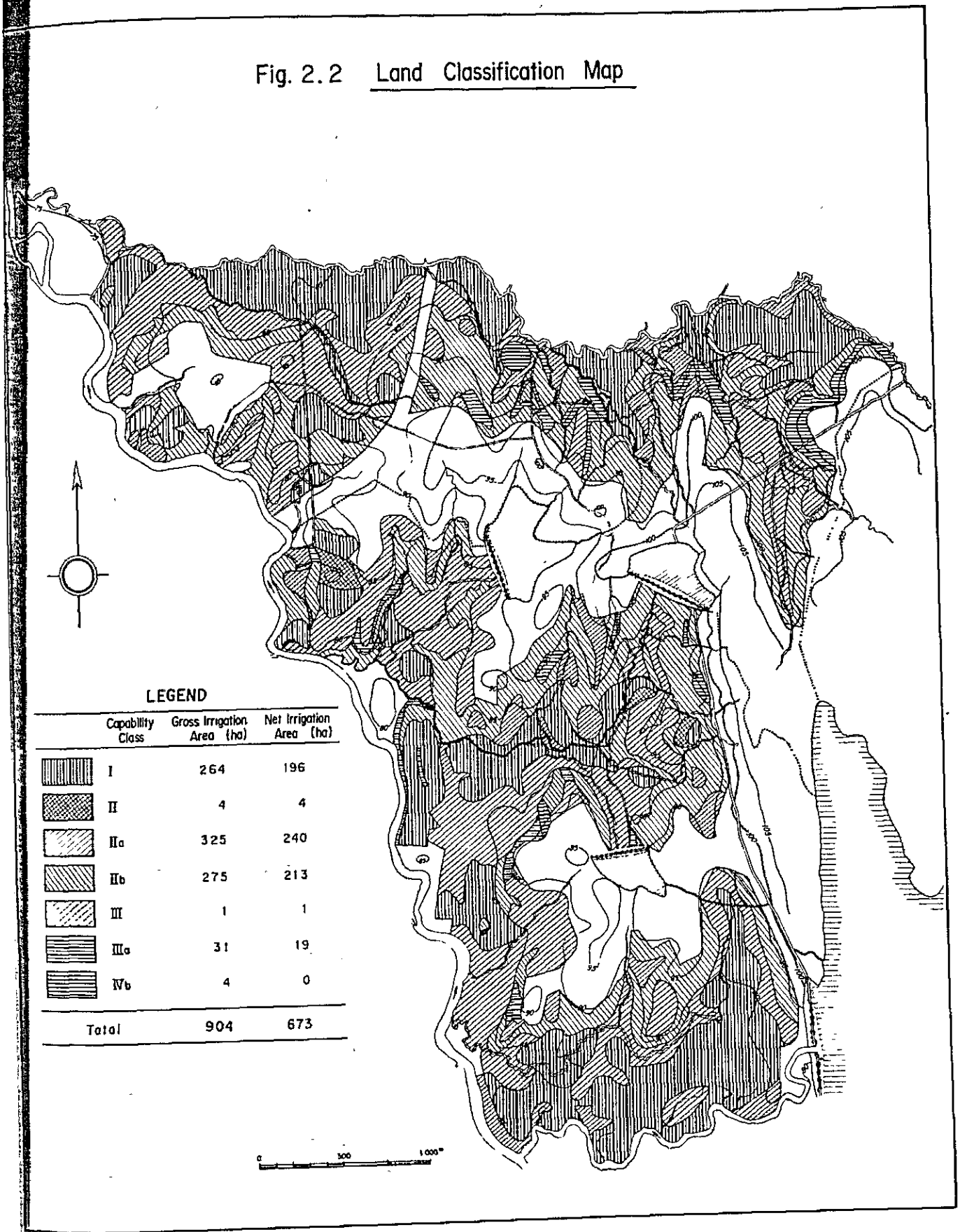


Fig. 2.2 Land Classification Map



3. THE PROJECT

3-1 Project Concept

3-1-1 Agricultural development in System C

The Accelerated Mahaweli Development Programme was embarked upon with a view to providing solutions to three major probelms in Sri Lanka, acute unemployment, substantial drain on foreign exchange for agricultural imports and shortage of power, in 1977.

In 1978, GOSL revised the Accelerated Programme, and confined the initial works of the Programme (1980-85) to four headworks projects, i.e. Kotamale, Victoria, Maduru Oya and Randenigala Reservoirs. The downstream development was to be limited to about 60,000 ha in Systems B and C together with the Minipe Anicut, the Right Bank Transbasin Canal, and the Ulhitiya and Ratkinda Reservoirs.

The System C Irriation Project officially gazetted in June 1979 as a special area under the Mahaweli Authority, is the first downstream development project to be undertaken under the Accelerated Programme.

The objectives of System C in the Mahaweli Development Programme are;

a) to raise agricultural production, especially rice, to attain self-sufficiency and, if possible, produce a surplus for export; and

b) to create employment.

The implementation of the development of System C and the farmer-family settlement programme for the area are carried out simultaneously with the establishment of new agricultural village. The net irrigable area in System C is about 24,520 ha, of which about 21,860 ha would be newly developed. Out of 21,860 ha, about 16,700 ha are in Zones 3-6. About 21,780 farmer-families would be settled in System C.

The main crop to be developed in System C is double-cropped wetland rice with limited Yala upland crops. GOSL also has intention

to promote crop diversification by introducing some upland crops such as vegetables, chilies, soyabeans, groundnuts, etc. in order to minimize water use.

It is estimated that the production of rice in System C after the full development of the project would be 175,000 tons (paddy) or 10% of the total quantity of the rice production in Sri Lanka.

3-1-2 Pilot demonstration farm

The water consumption by rice and other crops cultivated in irrigation schemes in Sri Lanka has shown to be much excessive. Since water in Sri Lanka is limited, minimizing water losses and maximizing water use through the introduction of new techniques on land development as well as development of irrigation infrastructure are of paramount importance in the country. In this sense, the establishment of a pilot demonstration farm in System C is envisaged.

The main purpose of the project is to establish a pilot demonstration farm having appropriate irrigation and drainage facilities to demonstrate the following:

a) New techniques of land development for maximizing water use;

b) Minimize water losses through surface run off, vertical and horizontal percolations, etc.;

c) Establishment of irrigation and drainage facilities suitable for local topographical and climatic conditions that would assist farmers to maximize crop production; and

d) Examine the feasibility of crop diversificaton in order to minimize water use.

3-2 Agriculture

3-2-1 Land use

The future land use in the project area is determined in conformity with the System C land use policy, and based on the land capability confirmed through the results of soils and land classification studies.

The following table shows the proposed land use in the project area by dividing the area into 3 units.

Land use	Unit 1	Unit 2	Unit 3	Total
	(ha)	(ha)	(ha)	(ha)
Gross area	490	456	389	1,335
Irrigation area (Gross)	348.2	286.5	269.2	903.9
Irrigable area (Net)	282.9	202.2	188.2	673.3
Settlement area	104.7	98.4	89.0	292.1
Conservation forest area	-	35.2	-	35.2
Plantation forest area	13.2	-	28.8	37.0
Grazing area	16.5	6.5	7.0	30.0
Tank area	16.5	29.4	-	36.8

3-2-2 Cropping patterns

(1) Selection of crop

The selection of crop to be developed in the project area is made by complying with the development policies of System C, and in due consideration of climatological and soil conditions, familiarity to farmers to be settled in the area, and stable yield and price. In this context, the proposed main crop to be developed is double-cropped wetland rice as shown in Fig. 3.1. Although the introduction of upland crops such as soyabeans, groundnuts and chilies are anticipated for the Yala season cultivation, a larger proportion of the labour-intensive cultivation particularly chilies would probably lead to competition for labour with wetland-rice and may also lead to overproduction.

(2) Varieties

Sri Lanka has a farily wide range of locally adapted high yielding varieties of rice which vary in growing period between 3 and 4.5 months. In line with the recommendations for System C, Maha season rice with 4.5 months growing period and Yala season rice with 3.5 months growing period are proposed to be introduced. For the Maha season such as H4 and BG90-2 are suitable, and for the Yala season, such as BG34-8, BG94-1 are adaptable.

(3) Crop diversification

Some upland crops mentioned in the preceding section are anticipated to be grown only in the Yala season. In the Maha season infection of diseases and insects are feared for these crops. Because of less familiarity with upland crops in the project area, it will take some longer period of time to attain those target yield. For the introduction of such crops, it is essential to carry out agronomic test such as variety selection, fertilizer application, cultivation techniques, insects and diseases control, water management, etc. in the project area. After the building up of cultivation techniques of these crops as well as the establishment of sufficient agricultural support services, those upland crops would be gradually introduced into the project area.

3-2-3 Farming practices

Proper farming practices are the most essential factor realizing the full exploitation of the agricultural potentiality in the area.

The proposed development of crop in the project area is principally of double-cropped rice with small holding farmers. Each farmer-family is to be provided with 1 ha of rice field and a potential labour supply of each family is assumed to be 45 labour days per month. The available family labour is not sufficient to cultivate 1 ha of rice twice a year without the use of either draught animal or machinery power mainly for field preparation.

The Maha crops are to be planted by end-November to make the most effective use of Maha rains. For this purpose each farmer is required to have sufficient farm equipments to carry out field preparation during a period of about 6 weeks in both the Maha and Yala seasons. Since such necessary farm items would not be available from the farmer's own resources during the early stages of the project, a tractor hire services or other appropriate measures with suitable tillage implements are required to be provided. The group farming system equipped with appropriate capacity of farm machinery and draft animals is proposed to be introduced eventually into the project area.

The traditional threshing practices using animal power would not be applicable to the projec ıarea. Threshing machines should be provided not only to solve the above power problems but also to improve the quality control of the crop products.

A portable powered sprayer equipped with levee-nozzle type operated by the grouped farmers would be more effective for insects and disease control than the individual farmer's operation with knapsack type sprayer. Transplanting, weeding and other operations except heavy material transportation would be done by labour without mechanization. Proposed operation practices and input requirements are summarized in Table 3.1.

3-2-4 Anticipated yield and production

With the introduction of improved farming practices as well as proper water management, the crop yield is expected to increase remarkably. The time required to attain the target yield mainly depends on the progress of agricultural support services. The anticipated build-up period after the implementation of the project would require about 5 years for rice and about 8 years for upland crops to reach its anticipated yield. The following table shows the anticipated yield of the respective crops during the build-up period.

	Rice			Upland crops (Yala only)			
Year afrer 1st cultivation	% of target yield	Maha	Yala	% of target yield	Soya-beans	Ground-nut	Chilies
1	60	3.0	2.7	60	0.9	1.2	0.9
2	70	3.5	3.2	63	0.95	1.25	0.9
3	80	4.0	3.6	67	1.0	1.3	1.0
4	90	4.5	4.0	72	1.1	1.4	1.1
5	100	5.0	4.5	77	1.2	1.5	1.2
6				85	1.3	1.7	1.2
7				94	1.4	1.9	1.4
8				100	1.5/2	2.0/1	1.5/3

/1 : with shell
/2 : shelled
/3 : dried

The production of rice at the full devleopment stage in the case of double crops of rice a year is expected to be approximately 6,000 tons of paddy a year.

3-3 Irrigation and Drainage

3-3-1 Irrigation water requirements

(1) General

In the planning of irrigation projects, a full knolwedge of irrigation requirements of crops from the time of seeding until harvest is needed. The peak irrigation requirement by crop must be known in order to determine the capacity of the irrigation system.

Since the field measurement of consumptive use of water by crops, the percolation rate and the irrigation efficiency was not carried out in the stucy period becuase of shortage of time, the study was made mainly based on the results of the "System C Final Designs and Detailed Cost Estimates, Development Plan" by MASL in June, 1981.

(2) Evapotranspiration

The evapotranspiration is the sum of the volumes of water used by the vegetative growth in a given area, i.e. the transpiration for the building of plant tissue and that evaporated from the adjacent soil or the intercepted precipitation on the area in any specified time. In the case of rice cultivation where a water level is maintained above the ground surface, evaporation from the water surface be substituted for evaporation from the soil surface. Then, the evapotranspiration can be calculated by the following formula and the calculated results are shown in Table 3.2.

$$ETc = Kc \times ETo$$

where, ETc : evapotranspiration
ETo : reference crop evapotranspiration
kc : crop coerricient

1) Reference crop evapotranspiration(ETo)

The reference crop evapotranspiration is defined as the rate of

evapotranspiration from an extensive water surface covered by green grass of uniform height, completely shading the ground.

The mean reference crop evapotranspiration in this area is calculated using the meteorological data at Maha Illuppallama by the modified Penman method as presented in the previous study report. The following is the calculated result.

Unit:mm

J	F	M	A	M	J	J	A	S	O	N	D	Total
140	139	171	160	176	186	192	206	200	151	108	101	1,930

2) Crop coefficient (kc)

Crop coefficients are employed to relate the reference crop evapotranspiration to the evapotranspiration. Values of crop coefficients vary with the crop charactristics, time of planting and/or sowing and climatic conditions. The crop coefficients for rice after transplanting used for this study are as follows.

	1st month	2nd month	3rd month	4th month	
Paddy in Maha (4-1/2 Month variety)	1.10	1.05	1.025	0.95	(3/4 m)
Paddy in Yala (3-1/2 Month variety)	1.20	1.28	1.05	(3/4 m)	

(3) Gross crop water requirement (CWR)

After knowing the evapotranspiration, the gross crop water requirements for each crop are calculated by using the following equation and the calculated results are shown in Table 3.2.

$$CWR = ETc + NW$$

where, CWR : gross crop water requirement
ETc : evapotranspiration
NW : nursery water requirement

1) Nursery water requirement by paddy (NW)

The nursery water requirement for rice is estimated on the following assumptions.

- Area required for nursery bed : 1/10 of main field

- Nursery period : 21 days

(4) Field irrigation requirement (FR)

Field irrigation requirements are obtained by adding percolation losses, farm wastes and water requirements for land preparation to the gross crop water requirements, and by deducting the effecitve rainfall from them. To calculate the FR, the following equation is applied and the calculated results are shown in Table 3.3. The peak field irrigation requirement is 1.76 ℓ/s/ha.

$$FR = CWR + PL + FW - ER + LR$$

where, FR : field irrigation requirements
CWR : gross crop water requirements
PL : percolation losses
LP : water requirements for land preparation
FW : farm waste
ER : effective rainfall

1) Percolation losses (PL)

Percolation losses largely vary from place to place with the characteristics of soils. The previous study report presented the following results.

Soil type	Percolation rate (mm/day) Maha	Yala
LHG	1	3
ID/RBE (imperfectly drained)	5	5
WD/RBE (well drained)	10	10

As the result of soil classification in this area, percolation rates of 5.0 mm for the Maha season and 5.4 mm for the Yala season are used in this calculation on an average.

2) Farm waste (FW)

Farm wastes are defined as the water losses due to improper irrigation farming and unskilled water management in the field, and leakage from dykes. Farm waste on rice fields is assumed

at 10 % of the water requirement (CWR + PL).

3) Effective rainfall (ER)

The effective rainfall for the crop water requirement is taken as only about 40 percent of the Maha rainfall recorded at Horabora Wewa station, based on the result of the water balance study made in the previous study report. No effective rainfall is considered for the Yala season crop.

4) Water requirement for land preparation (LP)

The water requirment for land preparation for wetland rice varies with the soil types in the study area. The previous study report presented the following results.

Soil type	Land preparation water requirement, wetland rice	
	Maha	Yala
LHG	250 mm	200 mm
ID/RBE (imperfectly drained)	300 mm	250 mm
WD/RBE (Well drained)	350 mm	300 mm

Taking into consideration the proportion of soil type, water required for land preparation are calculated to be 300 mm for the Maha wetland rice crop and 250 mm for the Yala rice crop on an average.

(5) Diversion irrigation requirement (DIR)

Diversion irrigation requirements to be conveyed by each canal are calculated by the following equation.

$$DIR = FR/Ei$$

where, DIR : diversion irrigation requirements
FR : field irrigation requirements
Ei : combined irrigation efficiency on each canal level

The combined irrigation efficiency is the product of canal conveyance efficiency (Ec) and canal operation efficiency (Eo). The assumed canal conveyance and operation efficiencies for each canal duty are as follows:

	Ec (%)	Eo (%)	Ei (%)
Field Canal Duty	95	95	90
Distributary Canal Duty	90	90	73
Minor Branch Canal Duty	95	95	66

The calculated results of diversion irrigation requirements on each canal level are shown below.

Canal	Diversion irrigation requirement (canal duty)
Field Canal	2.0 ℓ/s/ha
Distributary Canal	2.4 ℓ/s/ha
Mimor Branch Canal	2.7 ℓ/s/ha

(6) Irrigation requirements for upland crops

Upland crops i.s. chilies, soyabeans and groundnuts are proposed as alternative crops for the Yala season. Irrigation requirements of the upland crops are calculated and the calculated results are shown in Table 3.4 and summarized as follows:

	Field Irrigation Requirement (ℓ/s/ha)					
	M	A	J	J	A	S
Soyabean (105 days)	0.09	0.81	1.28	1.29	0.58	
Groundnuts (110 days)	0.15	0.80	1.16	1.26	0.60	
Chilies (150 days)	0.28	0.96	1.24	1.33	1.38	0.61

3-3-2 Drainage water requirement

(1) General

To provide a suitable drainage facility is one of the most important factor for increasing agricultural production. The project area is drained by a well defined network of natural drains and/or streams. The natural drainage system is useful for the drainage of an irrigation scheme but improvement works to clear and to smooth the natural drains

are essential in order to function properly.

(2) Drainage water requirement

The study on drainage requirement in the project area was made mainly based on the previous study. According to the results of the previous study, the drainage requirement for storm runoff of 1 in 5 year frequency is reasonable for the project area. In the analysis, daily rainfall records at Horabora Wewa are used. It has been assumed that an average of 50 mm storage would be available in the rice field. The drainage requirement is assessed at 15 ℓ/sec/ha for wetland rice field and 25 ℓ/sec/ha for contour bunded upland.

3-3-3 Basic design of irrigation canal system

The major feature of the project is to supply irrigation water of about 1.8m^3/sec at the maximum to a net area of 673 ha in Block 302 in System C. The distribution of irrigation water to the Block 302 area would be made through the turn-out located at the most upstream (at 0.35 km point) of the Right Bank Main Canal No.2 extending from the Ratkinda Reservoir. The construction work for this main canal is scheduled to be commenced at the end of this year to serve an irrigable area of about 17,000 ha after its completion. Water supply to the Ratkinda Reservoir would be made through the link canal connected with the Ulhitiya Reservoir after the river water of the Mahaweli Ganga was diverted at the Minipe Anicut into the Ulhitiya Reservoir through the about 31 km-long Transbasin Canal.

Layout planning and designs of canals and related structures which are basically depending on the basic layout plan of Block 302 prepared by the Mahaweli Authority of Sri Lanka. The following topographical maps are also available for this project: (1) E.S.S. maps with a scale of 1:5,000, (2) B.O.P. maps only for the Block 302 area with a scale of 1:5,000, and (3) the same as (2) but with a scale of 1:2,000. In addition, the maps in a scale of 1:2,000 for the strip surveys of distributary canals and sub-distributary canals in Block 302 are available. These maps have been prepared by the Survey Department for the development of the System C area.

The principal features for canals and strucrures are shown in Table 3.6. The layouts and configurations of canals and structures are shown in the DRAWINGS attached hereto.

(1) Function and requirement of irrigation canal

The irrigation canal system in the project area includes a minor branch canal, distributary and sub-distributary canals and field canals. The layout planning of these canals is done after understanding their respective functions and requirements mentioned below. The principal features for each canal are shown in Table 3.5.

1) Minor branch canal

The function of the minor branch canal is to deliver irrigation water to development area (Block 302) from the Right Bank Main Canal up to Tank No.1 in the shortest or in the most economical way. Since the minor branch canal runs through rather well-drained RBE soils, the canal is lined with concrete in order to minimize the canal conveyance losses due to leakage of water from the canal. The operation and maintenance road with a width of 5 m gravel-metalled with a width of 3 m are provided alongside the minor branch canal.

2) Disbributary and sub-distributary canals

The distributary canal is branched off from the minor branch canal or diverted from regulations Tanks to distribute water up to the head of turnout area commanded by field canals. The sub-distributary canal leads irrigation water from the distributary canal to the field canal. The covering areas of distributary and sub-distributary canals vary from about 10 to 300 ha. Approximately 65% of these canals are lined with concrete. The operation and maintenance road is provided alongside these canals. All roads have a width of 4 m and are gravel-metalled with a width of 3 m.

3) Field canal

The filed canal covering about 10 ha delivers irrigation water from the distributary and/or sub-distributary canals to the farmlands.

The canal gradient varies from 1/100 to 1/300 depending upon the topography. These canals are lined with concrete in order to minimize the canal conveyance losses. Non-paved operation and maintenance roads with a width of 4 m are also provided alongside the field canals.

(2) Design condition of irrigation canals

1) Design discharge

Based on the irrigation water requirements calculated in Section 3-3-1 hereof, the design unit discharges for the respective canals are obtained as the peak unit irrigation water requirements, as follows:

- Minor branch canal ; 2.7 ℓ/sec/ha
- Distributary and sub-distributary canals ; 2.4 ℓ/sec/ha
- Field canals ; 2.0 ℓ/sec/ha

2) Velocity

The canal velocity is determined according to Manning's Formula as follows:

$$V = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/2}$$

where, V = mean velocity in m/sec
R = hydraulic mean radius in m
S = canal bed slope (gradient)
n = roughness coefficient

The maximum permissible velocity in unlined canals is determined within a non-erosive velocities. Considering the charateristics of soil materials, the maximum permissible velocity in unlined canals (capacity up to 0.8 m^3/sec) are determined to be 0.45 m/sec. The maximum velocity in concrete lined canals is determined to be 0.8 m/sec and 1.0 m/sec for canal capacity below and above 0.8 m^3/sec respectively.

3) Roughness coefficient

The roughness coefficients of the canals for determination of their hydraulic properties are as follows:

	n-value in Manning's Formula
- Earth canal	0.025
- Concrete-lined canal	0.015

4) Side slope

The side slopes of 1:1 and 1:1.5 are adopted for the design of the concrete lined canals and unlined canals respectively.

5) Canal section

Lined canal sections are principally designed on the basis of hydraulically most effective cross-sections. Considering the FSDs (full supply depth of water) in the lined canals, unlined canal sections are determined to be applied in view of the above conditions.

Gradients of 0.00035 and 0.0004 are applied for the design of the minor branch canal and the distributary canals respectively.

Designed canal sections are shown in DRAWING.

(3) Function and configuration of related structures

A number of canal structures of various types are required to be provided for the irrigation canals. The configurations of these structures are selected properly considering their functions, canal layout, operational programme and social conditions in the project area. The related structures to field canals are planned to be precast concrete structures as much as possible. The principal features of related structures are shown in Table 3.6.

1) Sluice

A sluice is provided at the head of distributary canals to divert irrigation water from the Tank to the irrigation area. This structure is of tower type and of free flow type.

2) Turnout

A turnout is constructed to divert the required water from a parent canal to its branch canal. The pressure flow type of turnout is introduced. The precast concrete pipe to cross the road or canal embankment is adopted. All the turnouts are designed for full capacity at every water surface checked by the regulators. Some of the turnouts are combined with regulators and/or drops depending on the topography along the canals.

3) Regulator

When irrigation water flow partially, regulators are operated to maintain the water surface elevation to the required level for upstream deliveries. The water surface in the supply canal is controlled between the full supply level at the regulator and 2/3 of full supply level at the last upstream turnout served by the regulator. All the regulators are to be provided at just downstream of the turnouts. Some of the structures of regulator cum turnout are combined with drop structures depending on the topography. This structure is of gated type which is adopted with vertical wooden gates with screw lift hoist.

4) Spillway

A spillway is constructed in the canal system for the purpose of spilling out excess flow and/or flushing off all water in the canal to the nearby drainage canal in case of emergency, and repairing of canal. The structure is of uncontrolled overflow spilled type and is corporated with a causeway. The overflow type spillway is to be provided where fairly large discharge is diverted or at mid-course of major distributary canals. The design capacity of the spillway is the difference between the design discharge at the site of the structure and the design discharge in the canal downstream from the structure.

5) Culvert

A vulvert is provided at the site where a road corsses over the canal. All culverts are strong enough for the increase of heavy

traffic after the project implementation. The rectangular box barrel or precast concrete pipe to cross the road is provided depending on the discharge. The rectangular box barrel type is applied for discharge of more than 1.0 m^3/sec.

6) Drop

A drop is provided in the canal system depending on the topography. In order to make the canal gradient mild, two types of drops are provided. One is of vertical type and the other is of chute type. The vertical type of drop is applied for discharge less than 0.5 m^3/sec.

7) Drainage undercrossing

The drainage undercrossing is placed across and under the canal to convey the drainage or storm flow of a nutural stream or depressed land corssed by the canal. As the drainage undercrossing structure, a precast concrete pipe (600 mm in. dia) is laid under the canal with at least 0.6 m of clearance below the invert of the canal.

8) Measuring device

There is not doubt that the conventional use of water for agriculture is, to some extent, wasteful. There is considerable room for economy in water use, and harmful irrigation practices which give rise to waterlogging. An accurate and reliable measurement of water is essential. Water measurement is also needed to establish the operation and maintenance practices. In this context, the installation of the following measuring devices is proposed for the respective canal systems.

	Place of Installation	Measuring device
- for distributary canal	at the head of the canal	weir type (combined with sluice structure)
- for sub-distributary and field canals	at the head of the canal	flume type (combined with turnout structure)

9) Terminal structure

A terminal structure is provided at the end of canal. Two types of terminal structure are constructed. One is the structure as an inlet structure for the Tanks. The other type is provided at the end of distributary canal having one turnout area.

This type is equipped with a slide gate to control inflow to the field canal.

3-3-4 Basic design of drainage canal system

(1) Function and requirement of drainage canal

A drainage canal system shall be provided to remove properly excess rainfall and irrigation water from the farm lands as well as from the project area. The drainage canal system in the project area includes field drains and natural streams and riverts to be used as the secondary drains and main drains. These canals will be laid out as described below:

1) Field drains

Field drains are provided mainly in-between the farm plots to drain out excess water in the fields or drainage water from the end of field canals, and to lower or control the subsurface water level in fields. These will be newly excavated.

2) Secondary drains

The location of secondary drains is dominated by natural streams and rivers crisscrossing the area, so that these natural streams and rivers will be used as much as possible as secondary drains by clearing and smoothing. Secondary drains are served by the filed drains.

3) Main drains

As the main drains in this area, three existing rivers i.e. the Ulhitiya Oya, the Ratkinda Oya and the Deeyawidda Oya are used.

The proposed drainage system is planned in such a manner that each farm block has a field drain at least on one side of it. The drainage system is illustrated in Drawings No. 152 and the length of each drain in the area is tabulated below.

Drainage Canal	Length
Field drain	20.6 km
Secondary drain	23.8 km
Main drain	14.0 km

(2) Design conditions of drainage canals

1) Design discharge

Based on the drainage water requirement presented in Section 3-3-2, the design unit discharges for drainage canals for the rice field are estimated to be 15 ℓ/sec/ha for field and secondary drains. Surface runoff from upland farms bunded along the contour line is estimated to be 25 ℓ/sec/ha.

2) Velocity

The maximum velocity in the field drains is determined to be 0.8 m/sec, taking into consideration the soil physical characteristics in the area.

3) Roughness coefficient

The roughness coefficient of field drains is assumed to be 0.03.

4) Base width, height and side slope

The base width of 0.4 m and the height of 0.6 m are applied as the uniform section of field drains. The side slope of 1 : 1.5 is adopted.

(3) Function and configuration of related structures

The configurations of the drainage canal related structures are determined considering their functions, drainage layout, social conditions and topography. The structures related to the drainage canal system are drainage culverts, drops and junctions.

The culvert is planned and designed at the sites where the roads cross over the drains. The precast concrete type of culvert is applied. The drainage drop is of vertical type with rectangular cross section. The junction as the drainage outlet is provided at the end of drainage canals which divert the flow directly into the streams of rivers, in order to prevent the river bed erosion and retrogressive erosion in the drainage canals. The principal features of the related structures are shown in Table 3-6.

3-3-5 Land reclamation

(1) Land forming of the plot

The topography of the project area is undulating with a land slope of about 1/20 to 1/200 and incised with numerous gullies. The net irrigable area is classified into the following four grades in its natural ground slope.

Ground slope	Net irrigable area (ha)
1/200 to 1/100	172
1/100 to 1/70	90
1/70 to 1/25	165
1/25 to 1/20	246
Total	673

Taking into consideration the above topography, the soil depth and efficient farming practices, the typical size of a plot is determined to be 0.1 to 0.2 ha. The plot is reclaimed in parallel to the contour line and to be of rectangular shape, in order to minimize the earth moving volume and the cutting depth as small as possible. The typical shapes of plots and earth moving volumes for the respective grades of slope are summarized below.

Ground slope	Typical shape of plot (m)	Average earth volume (m^3/ha)
1/200 - 1/100	30 x (50 to 70)	450
1/100 - 1/70	25 x "	590
1/70 - 1/35	20 x "	840
1/35 - 1/20	15 x "	1,120

(2) Top soil treatment

Based on the result of the soil survey, the soil depth to be useful for plowing layer is considered to be about 30 cm. In the above land forming plan, the lands of which slopes are more than 1/70, require the top soil treatment that is the fertile top soil will be removed and set aside for re-utilization, since the maximum cutting depth is more than 30 cm. The area which requires the top soil treatment is about 400 ha in net.

(3) Percolation control works

The soils classified into the well drained RBEs are very permeable in the light of morphological characteristics and drainage. The percolation rate of the soils is more than 10 mm/day. The area covered with these soils is about 110 ha out of the net irrigable area. In order to prevent percolation losses and use irrigation water effectively, percolation control works are needed to compact the subsoil layer. These works will be done by bulldozer after land levelling works.

3-3-6 Office

For the implementation of the proposed Pilot Demonstration Farm, a field office is required. The office is proposed to be located along the proposed ADB road at about 700 m northwest from Tank No. 8. The required space of the office is to be about 300 m^2 in net.

3-4 Settlement Programme

The settlement in the project area will be implemented under the programme for System C as shown in Table 3.7. After the implementation of the project, about 21,800 families of farmer would be settled in System C. In addition, about 8,400 non-farm families would be settled. The details of the settlement programme in zones 3-6 are shown in Table 3.8.

In order to select appropriate settlers for the programme, the following categories of people are firstly taken into consideration:

(a) those people living within the Project Area (System C);

(b) those people displaced due to construction work related to the Mahaweli Project; and

(c) Those people living outside the Project Area.

Upon the satisfactory implementation of the irrigation and on-farm development programme, each settler is entitled to one hectare of irrigable land and a homestead allotment of 0.2 hectares. Each settler is supplied with agricultural implements, seed and planting materials, well rings, grant of cash for housing and other specific materials, etc. from the Government. Furthermore, settlers will be employed on the development of the distributary and field canals system up to a miximum period of 12 months. The initial clearing and on farm development of irrigable land allotted are carried out by the Government. The final levelling and bund raising are to be undertaken by the settlers for which a payment is made by the Government. Details of the assistance are shown in Table 3.9.

3-5 Organization and Management

3-5-1 Organization and function

MASL have the overall responsibility for coordinating the project implementation and its management in the Mahaweli Ganga Development Programme. The actual execution is carried out through the Mahaweli Development Board (MDB) and the Mahaweli Economic Agency (MEA).

The MDB, responsible for all physical works under the Mahaweli Development project, functions principally as a planning, design, and construction agency for the downstream development (irrigation and social infrastructure).

The MEA is responsible for the post-construction implementation of the Mahaweli Development projects, including:

(a) Settlement and O & M of irrigation system developed under the Mahaweli Programme;

(b) on-farm development;

(c) agricultural development and water management;

(d) community development;

(e) assistance in input/output marketing;

(f) Agricultural and other advisory services;

(g) land allocations; and

(h) promotion of secondary industries.

The MEA's organization structure at the project level of System C is shown in Fig. 3.2. Under the Managing Director, the Project co-ordinator would serve as staff links between the Project Manager and the Managing Director. The Project Manager for System C is stationed in Giranduru Kotte and have six Deputy Project Managers (DPM) to guide and supervise the work of field technical officers as well as to maintain technical contact with MEA headquarters staff. The System C project area is divided into 12 blocks, each having about 2,000 farmer settlers. Each Block Manager would supervise eight Unit Managers, each of whom serve about 250 farmer settlers with the assistance from an agricultural assistant (KVS) and water management assistant (WMA).

3-5-2 Project construction and management

For the successful implementation of the pilot demonstration farm, it is proposed to establish the Project Office under the Project Manager of System C, MEA. The Project Office would carry out detail design and setting out survey according to the said design, preparation of tender documents for civil works, land demarcation and grid surveys, and construction supervision and quality control as well as payment to the contractors.

3-5-3 Agricultural supporting services

As stated in the preceding section (3-5-1), agricultural supporting services including services for settlers would be undertaken by MEA. MEA would build and operate fertilizer stores, and would serve as supplier of last resort within the System C project area, until a retail network based on public and private agencies is fully established. Seeds are produced in the project area under the supervision of the Department of

Agriculture and sold through Agrarion Service Centres. The training centre under construction in Giranduru Kotte would also produce planting materials.

The Giranduru Kotte Training Centre would provide seasonal training for all grades of extension workers and would demonstrate recommended cropping sequences, cultural practices, and other techniques pertaining to improved farm activities. Adaptive researches on crops found from the regional research station would be tested in the area's research farm at this centre.

Basic researches relevant for the project area are currently being carried out in Maha Illupallama (dry zone irrigated crop husbundry), Batalagoda (paddy breeding), and Matale (cacao, coffee, and pepper).

3-5-4 Operation and Maintenance (O & M)

A master planning unit, attached to MASL and communicating with the MEA's headquarters office, would be responsible for allocating Mahaweli Ganga water for power, irrigation, and other uses and for apportioning irrigation water among the various Mahaweli projects. Bulk water issues to each project would be made by MDB, under the direction of the master planning unit. In the case of System C, this would include water issues to Main Canal No. 1 serving Zone 2 and Main Canal No. 2 serving Zones 3-6. The water management unit in the DPM (O & M) office would operate and control water deliveries in the main and branch canals to each block. The Water Management Supervisor in each block office would be charged with making water issues as needed to distribution canals. The Water Management Assitant (WMA) at the unit level would assist farmers within each turnout area (averaging about 10 farmers/turnout) to distribute water equitably on a rotation basis. He would be responsible for communicating information about water requirements and management to the farmers and for recommending farmers for participation in periodic training programmes. The WMA would also organize turnout groups and guide them in maintaining field ditches and drains.

The Maintenance Division under the DPM (O & M) would be responsible for maintaining the irrigation system down to farm turnouts. Division staff would carry out a regular programme of maintenance so that complete system coverage would be achieved at least once every two years. The system would be maintained in proper condition to ensure that it operates efficiently and as planned. Modifications would be made as required to reduce seepage and improve operation.

Water allocations within each block would depend on the localized rainfall and the state of crops at scheduled delivery times. The Water Management Supervisors and Agricultural Officers (AO) at block-level would review block water requirements at least weekly, and this infromation would be conveyed to the DPM (O & M) by Block Managers. The Operations Division would then adjust water issues from intermediate reservoirs or reallocated water within the system according to reported needs and rainfall. MEA would serve as an enforcement as well as advisory agency to ensure that irrigation water is used efficiently by the farmers.

3-5-5 Monitoring and evaluation

A monitoring and evaluation system would be developed under the project to review progress in project implementation and output achievement in terms of increased production, improved living standard, and water management.

The above two specific activities would be carried out under the project-agro-economic surveys and a water management evaluation.

A monitoring and evaluation unit attached to the office of MEA's Managing Director would be responsible for (a) assessing project implementation performance and (b) for undertaking and coordinating proposed evaluation of selected topics mentioned above. Some of these surveys, especially the proposed agro-economic studies could be contracted to one or more qualified research groups (e.g., the Agricultural Research and Training Institute (ARTI) under the supervision of the unit. The proposed monitoring unit would also have responsibility for similar reviews under other Mahaweli projects and for establishing general evaluation standards and criteria. In addition, at the field level, the

Project Manager would have a small monitoring staff linked to the headquarters unit. Finally, monitoring of water management, irrigation deliveries, and system losses would be the responsibility of the water management staff in the office of DPM (O & M), under the direct supervision of a senior irrigation engineer. A special unit would be established for this purpose.

3-5-6 Demonstration and training of water management

In view of the importance of efficient water use to the success of the Mahaweli Programme, demonstration of the improved water management practices is essential, and the water management training is absolutely necessary for all MEA staff and farmers in the System C at the pilot Demonstration Farm.

Basic training in water management practice for irrigation engineers, supervisors and gate operators as well as farmers would be periodically made for both paddy and diversified dry crops in both Maha and Yala seasons. Farmer training from System C particularly, leading farmers selected from the Unit Area basis would be made thoroughly in efficient water management practices and operating rules.

3-6 Construction plan

3-6-1 Detail design and survey works

Before the commencement of the construction works the following works are to be carried out by GOSL for the successful implementation of the project.

i) Survey works

- Final alignment survey up to field canals based on the basic design
- Plot demarcation survey
- Grid survey in the whole irrigable land

ii) Detail design and tender documents under the Grant Aid

- Detail design and bill of quantities

- Preparation of tender drawings

- Preparation of tender documents

3-6-2 Construction schedule

The construction of the project facilities is divided into two categories. One is the construction to be implemented from the local budget of the Government of Sri Lanka, and the other is under the Grant Aid of the Government of Japan. The major construction works of both categories are as follows;

(1) Local budget portion

Works	Q'ty	
(a) Preparatory works		
Centering survey of canals	87.7	km
Demarcation for holding area of farmer	673	ha
20 m Grid survey for land levelling	673	ha
(b) Land clearing	930	ha
(c) Tanks	3	Nos.

(2) Grand aid portion

Works	Q'ty	
	Canal (km)	Structure (Nos.)
(a) Irrigation Canals		
Minor Branch Canal	1.7	14
Distributary Canals	19.1	226
Field Canals	45.8	1,640
(b) Drainage Canals		
Secondary drain	23.8	
Field drain	20.6	230
(c) Land Reclamation	(ha)	
Fop soil treatment	400	
Rough levelling	673	
Final levelling	673	
Percolation control	130	

(d) Construction of office	(m^2)
Field office	300

The construction works in the Grant Aid portion by GOJ shall be carried out on contract basis through competitive bidding in accordance with the procurement procedure of the GOJ.

The construction period is estimated to be 12 months including preparatory works, taking into account the commencement of the partial operation of the Right Bank Main Canal in System C. The construction time schedule is shown in Fig. 3-3.

3-6-3 Construction method

(1) Access road

In the project area, three tanks, Tank Nos. 1, 7 and 8, are being constructed by the Government of Sri Lanka. Access roads for the construction of the Tanks are available. There exist certain cart roads which can be improved and widened as required for the works.

(2) Clearing and grubbing

Since the project area is covered by shrub and light forest, clearing and grubbing would be carried out mainly by bulldozers.

(3) Earthworks

Major earthworks for canals, roads and land reclamation have to be completed during the period of the Yala season from March to September so as to meet effective performance and proper quality control. Taking the above requirements into consideration, most of the earth works will be carried out by heavy equipments.

1) Stripping of top soil

Stripping of top soil along the canals and roads is carried out by bulldozers.

2) Excavation

Excavation for the minor branch canals and distributary canals is mainly carried out by bulldozers with ripper and backhoe. In

canal excavation, excavation of rock and soft rock would partially be required. The excavation of field canals is carried out mainly by backhoe and trimmed by manpower.

3) Embankment

Embankment of the canal and road is carried out by motor scrapers in combination with bulldozers, motor graders, dump trucks, compacting rollers and water tankers. Substantial excavated materials from canals are used for embankment of canals and roads as much as possible.

4) Structures

Since numerous structures related to canals are required, standardization and pre-casting of strucrures are taken into consideration for economizing and expediting the progress of works.

5) Land reclamation

Taking into consideration the topography and farming practice in Sri Lanka, the typical size of plot is determined to be 0.1 to 0.2 ha. As for the top soil treatment, surface soil is removed by a motor scraper and then, spreaded uniformly by the motor grade after the sub surface has been leveled.

6) Percolation control works

Based on the filed investigations, a net area of 110 ha is considered to be permeable. For the maximum use of water, as well as for minimizing waste of plant nutrient, percolation control works are inevitable for the permeable land for which, compaction using bulldozer is required.

3-6-4 Construction materials

Most of the construction materials are available in Sri Lanka except for the gates and other special materials. Such materials as cements, reinforcement bar and metals are expected to be in short supply after the commencement of the construction of System C and other projects in Sri Lanka.

Such materials as coarse aggregates for concrete, gravels for road metalling are available in the project area. The rocks available for coarse aggregates are blocks of andesite, which are exposed at the surface. Fine concrete aggregates will be available in the river bed along every reach of the Ulhitiya river or the Mahweli Ganga.

The major construction materials required for the construction is as follows;

a)	Portland cement	2,730 ton
b)	Aggregates, Sand	6,200 m^3
	Gravel	9,400 m^3
c)	Gravel for road	8,500 m^3
d)	Timbers	250 m^3
e)	Reinforcement bars	60 ton
f)	Steels	10 ton
g)	Precast concrete pipes	
	D = 150 mm - 300 mm	4,950 m
	D = 400 mm - 600 mm	860 m
	D = 800 mm - 1,000 mm	290 m
h)	Fuel	31,000 Gal.
i)	Lubricant	7,200 Gal.

3.7 Construction work quantities

The major construction work quantities to be implemented in the Grant Aid are as follows;

A. Earth work for canal and road

1.	Stripping of topsoil	54,900 m^3
2.	Excavation	94,500 m^3
3.	Earthfill	285,200 m^3
4.	Gravel pavement	7,730 m^3
5.	Sod facing	53,700 m^2

B. Structure work

1.	Foundation excavation and backfill	40,900 m^3

2.	Concrete, Type-A	(350 kg)	810 m^3
3.	Concrete, Type-B	(250 kg)	3,650 m^3
4.	Lining Concrete	(250 kg)	6,120 m^3
5.	Concrete form		26,200 m^2
6.	Concrete pipes	D = 150 mm	2,560 m
		D = 200 mm	2,360 m
		D = 300 mm	40 m
		D = 400 mm	210 m
		D = 600 mm	660 m
		D = 800 mm	150 m
		D = 1,000 mm	130 m
7.	Gates		130 sets

C. Land reclaiming work

1.	Topsoil treatment	411 ha
2.	Foundation of lots	673 ha
3.	Subsoil compaction	411 ha
4.	Bund construction	673 ha
5.	Final levelling	673 ha

D. Percolation control 130 ha

E. Office 300 m^2

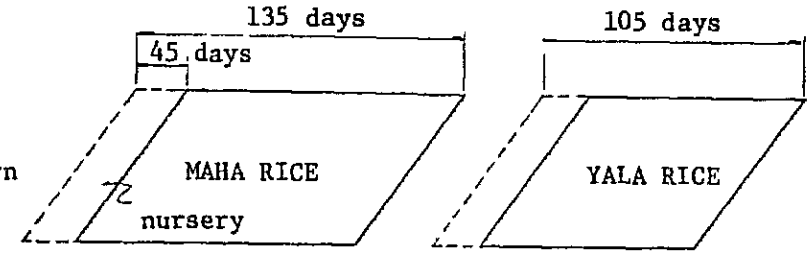
Table 3.1 Proposed Farming Practices

(Transplanted Wetland Rice)

Operation Item	Required Inputs	
	Input	Requirement
1. Seed preparation	Seed	50 kg
	Chemical	250 g/1
2. Nursery/2	Labour	5 M.D.
	Fertilizer	30 kg
	Insecticide	0.2 ℓ
	2-wheel tractor	2 hrs
3. Field preparation		
First ploughing	2-wheel tractor/3	15 hrs
Basal fertilizer	Fertilizer (V_1)	187 kg
Bund maintenance	Labour	10 M.D
Puddling	2-wheel tractor/3	5 hrs
4. Transplanting/4	Labour	40 M.D.
5. Weeding	Labour	20 M.D x 2 times
6. Pest control	Insecticide	1 ℓ x 3 times
	Fungicide	Nil
	Labour	2 M.D x 3 times/5
	Sprayer/6	2 hrs x 3 times
7. Topdressing of fertilizer	Urea	250 kg
	Labour	4 M.D
8. Water management	Labour	10 M.D
9. Harvesting	Labour	20 M.D
10. Threshing	Thresher	8 hrs
	Labour	10 M.D/7
11. Others (Transportation, sacks & miscellaneous)	5% of the above inputs	

/1 : Chemical for seed disinfection.
/2 : Area of nursery is one tenth of main field.
/3 : Two wheel tractor with 7 - 10 HP diesel engine.
/4 : Including uprooting, transportation of seedling & etc.
/5 : Farming group operation with 5 persons.
/6 : Farming group operation.
/7 : Including transportation of paddy, straw and related operations.

Table 3.2 Monthly Irrigated Areas and Gross Crop Water Requirement



	O	N	D	J	F	M	A	M	J	J	A	S	Total
Fied; area cropped (%)	4	56	99	100	90	30	23	86	100	61	5	-	
Nursery; area cropped (%)	3	4	-	-	-	1	4	2	-	-	-	-	
L.P area for /1 Transplanting(%)	20	60	10	-	-	-	50	40	-	-	-	-	
L.P for nursery (%) /2	7	3	-	-	-	4	6	-	-	-	-	-	
ETo (mm)	151	108	101	140	139	171	160	176	186	192	206	200	1,930
Mean Ko	0.04	0.61	1.06	1.03	0.89	0.29	0.28	1.06	1.19	0.61	0.05	-	
ETc (mm)	6	66	107	144	124	50	45	187	221	117	10	-	
ET (N) (mm)	5	5	-	-	-	2	7	4	-	-	-	-	
CWR (mm)	11	71	107	144	124	52	52	191	221	117	10	-	1,100

Notes: L.P = Lnad preparation
ETo = Reference crop evapotranspiration
Kc = Crop coefficient
ETc = Evapotranspiration of transplanted crop
ET(N)=Evapotranspiration of nursery
CWR = Gross crop water requirement
/1 = A 90 per cent of field area
/2 = A 10 per cent of field area

Table 3.3 Field Irrigation Requirement

	J	F	M	A	M	J	J	A	S	O	N	D	Total
CWR (mm)	144	124	52	52	191	221	117	10	-	11	71	107	1,100
PL (mm)	155	126	52	44	147	162	102	8	-	11	90	153	1,050
FW (mm)	30	25	10	10	34	38	22	2	-	2	16	26	215
CWR+PL+FW	329	275	114	106	372	421	241	20	-	24	177	286	2,365
Land preparation area (%)	-	-	4	56	40	-	-	-	-	27	63	10	
LP (mm)	-	-	10	140	100	-	-	-	-	81	189	30	550
Monthly rainfall (mm)/1	349	231	123	157	73	12	37	56	72	226	360	461	2,157
ER (mm)	126	28	15	-	-	-	-	-	-	6	86	181	442
FR (mm)	203	247	109	246	472	421	241	20	-	99	280	135	2,473
" (l/s/ha)	0.76	1.02	0.41	0.95	1.76	1.62	0.90	0.07	-	0.37	1.08	0.50	

Notes: CWR = Gross crop water requirement

PL = Percolation losses
5.0 mm/day for Maha, 5.4 mm/day for Yala

FW = Farm wastes 10% of (CWR + PL)

LP = Land preparation water requirement
300 mm for Maha, 250 mm for Yala

ER = Effective rainfall
40% of Maha rainfall

FR = Field irrigation requirement
CWR + PL + FW - ER + LP

/1 : Horabora Wewa mean rainfall (1940 - 79)

Table 3.4 Irrigation Requirement for Uplands in Yala Season

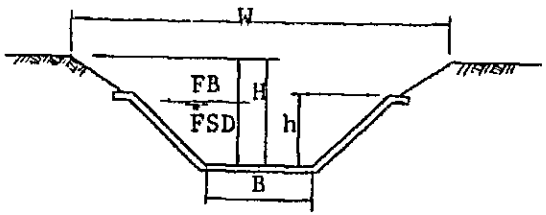
			Apr	May	Jun	Jly	Aug	Sep
Cropping Calendar			105 DAY SOYA 110 DAY GROUNDNUTS 150 DAY CHILIES					
1 ETo		(mm)	160	176	186	192	206	200
2 Mean Monthly Kc	Soya		0.11	0.66	0.99	0.97	0.41	-
	Groundnuts		0.18	0.65	0.90	0.94	0.42	-
	Chilies		0.34	0.79	0.96	1.00	0.96	0.46
3 ETc (1x2)	Soya	(mm)	17	117	185	187	84	-
	Groundnuts		29	115	167	181	87	-
	Chilies		54	139	178	192	198	91
4 Field Water Requirement		(mm)						
(ETc + Farm losses)	Soya		31	210	333	334	151	-
	Groundnuts		52	207	301	326	157	-
	Chilies		97	250	321	346	356	164
5 Field Irrigation Requirement		(mm)						
(FWR-ER)	Soya		23	210	333	334	151	-
	Groundnuts		39	207	301	326	157	-
	Chilies		73	250	321	346	356	159
6 Diversion Irrigation Requirement								
(FIR/0.66)	Soya	(l/s/ha)	0.14	1.23	1.95	1.95	0.88	-
	Groundnuts		0.22	1.21	1.76	1.91	0.92	-
	Chilies		0.43	1.46	1.88	2.02	2.08	0.93
7 Field Canal Duty for Uplands				2.86 l/s/ha for Soya 2.80 " for Groundnuts 3.06 " for Chilies				

Notes:1. No irrigation should be required for land preparation.
2. Farm losses are assumed as 0.8ETc.
3. Effective rainfall levels (ER) for Uplands are taken 49 mm in April and 11 mm in September and ER for May to August are ignored as rainfall is very low.
4. The irrigation of Uplands is day-light period which is assumed as 12 hrs.
5. Field Canal Duty = FIR / 0.9 x 30 x 12 x 60 x 60 $x10^{-4}$

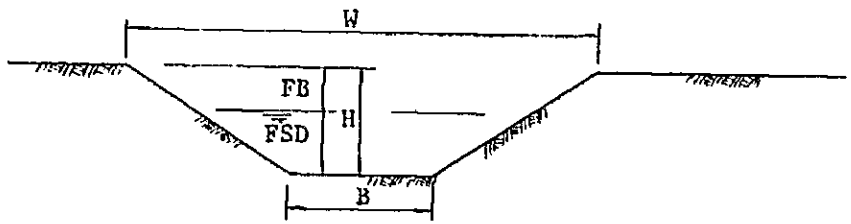
Table 3.5 Dimensions and Hydraulic Properties of Irrigation Canals

Canal Type		Hydraulic Properties						Dimensions							Remarks
		Q	n	S	A	V	Q'	B	FSD	FB	H	h	W	S.S	
Lined Canals	M.B.C	1.85	0.015	0.00035	2.18	0.83	1.82	1.00	1.07	0.50	1.60	1.10	4.90	1.0 on 1	
	D.C I	0.70	"	0.0004	1.02	0.69	0.71	0.70	0.72	0.45	1.20	0.80	3.70	"	
	" II	0.50	"	"	0.79	0.64	0.50	0.60	0.64	"	1.10	0.70	3.40	"	
	" III	0.30	"	"	0.55	0.56	0.31	0.50	0.53	"	1.00	0.60	3.10	"	
	" IV	0.18	"	"	0.37	0.49	0.18	0.40	0.44	"	0.90	0.50	2.89	"	
Unlined Canals	D.C I	0.70	0.025	0.0004	1.57	0.45	0.71	1.10	0.72	0.45	1.20		4.70	1.5 on 1	
	" II	0.50	"	"	1.22	0.42	0.51	1.00	0.63	"	1.10		4.30	"	
	" III	0.30	"	"	0.84	0.37	0.31	0.80	0.53	"	1.00		3.80	"	
	" IV	0.18	"	"	0.57	0.32	0.19	0.60	0.45	"	0.90		3.30	"	

Notes : Mean Velocity $V = 1/n \times R^{2/3} \times S^{1/2}$



Lined Canal



Unlined Canal

Table 3.6 Features of Irrigation and Drainage Facilities

	Canals	Total Length (m)	Command Area (Ha)	Initial Capacity (m^3/s)	Canal Type	Length (m)	Lined Canal (m)	Sluice	T.O.	T/R	T/R/D	T.S.	Drop	Culvert	D.U.C.	Others	Remarks
Minor Branch Canal		1,720	673.3	1.818	M.B.C.	1,720	1,720	-	1	1	-	1T	-	5	5		T: at Tank
Distributary & Sub-distributary Canal	UNIT 1																
	D 1	4,170	282.9	0.679	I	1,360	240	1	1+1d	3	-	-	-	2	4	SP 1	d: both banks
					III	810	230	-	1	1	-	-	-	2	2	-	
					IV	2,000	380	-	-	-	5	1	4	5	-	SP 1	
	SD 1 up	700	154.6	0.371	II	110	40	-	2	-	-	-	-	-	-	-	
					III	590	590	-	-	1	-	1T	-	3	-	-	
	SD 1 dn	1,900	106.4	0.255	III	870	870	1	2	1	-	-	-	2	2	SP 1	
					IV	1,030	1,030	-	2	1+1t	-	-	-	2	1	-	t: at terminal has 2 T.A.
	SD 2	850	29.8	0.072	IV	850	430	-	1	1	-	1	-	3	1	-	
	SD 101	580	37.2	0.089	IV	580	300	-	-	-	1d	1	6	1	-	-	
	UNIT 2																
	D 2	810	110.3	0.265	III	810	810	1	1	-	1	1T	3	1	1	-	
	D 3	600	32.6	0.078	IV	600	180	1	2	1t	-	-	-	2	1	-	
	D 4	1,510	40.9	0.098	IV	1,510	1,510	1	2	2+1t	-	-	2	3+1*	2	-	* L=40m
	D 6	560	27.7	0.066	IV	560	560	-	-	1t	1	-	8	2	1	-	
	D 7	2,370	64.2	0.154	IV	2,370	2,140	-	2	1	3	1	4	4	5	SP 1	
	SD 3	430	22.8	0.055	IV	430	430	-	-	-	1d	1	3	1	-	-	
	UNIT 3																
	D 5	3,490	188.2	0.452	II	1,620	1,620	1	2	2	2	-	2	4	6	-	
					III	370	40	-	-	-	1d	-	4	1*	1	SP 1	* L=95m
					IV	1,500	950	-	3	2	1t	-	3	3+1*	2	SP 1	* L=30m
	SD 4	360	9.9	0.024	IV	360	60	-	-	-	-	1	1	1	1	-	
	SD 5	1,150	45.4	0.109	IV	1,150	430	-	-	1	2	1	12	2+2*	-	-	* L=60m
	SD 6	430	19.3	0.046	IV	430	230	-	-	1d	-	1	9	2	-	-	L=30m
Total		21,630	-	-	-	21,630	14,790	6	23	22	18	11	61	55	35	SP x 6	
Field Canal	UNIT 1		-	-	-	-		-	-	-	-					-	
	UNIT 2		-	-	-	-		-	-	-	-					-	
	UNIT 3		-	-	-	-		-	-	-	-					-	
	Total	45,800	-	-	-	-		-	-	-	-	140	440	430	20	-	farm inlet 610
Drainage Canal	Main*	14,000	-	-	-	-		-	-	-	-	-	-	-	-	-	* minor improvement if necessary
	Secondary*	23,800	-	-	-	-		-	-	-	-	-	-	-	-	-	
	Field	20,600	-	-	-	-		-	-	-	-	-	200	-	-	junction 30	

Notes) T.O.: Turnout T/R: Turnout cum Regulator T/R/D: Turnout cum Regulator cum Drop
T.S.: Terminal Structure SP: Spillway D.U.C: Drainage Undercrossing

Table 3.7 System C Placement and Settlement Programme

Zone	MASC Block	Annual Placement (Settler/Workers) 1980	1981	1982	1983	1984	1985	1986	Total
1/1	-				230/2	890/3	-	-	1,120
2	1	1,400	1,600/4	300/5	-	-	-	-	4,050
	2	(1,806)	(1,177)/4						
3	3	-	-	2,490	-	-	-	-	2,490
4	4				2,150				
	5	-	-		2,020				8,520
	6					2,170			
	7					2,180			
5 and 6	8						2,080		
	9	-	-	-	-	-	1,980	-	5,600
	10						1,740		
Total Placement		1,400	1,600	2,790	4,400	5,240	5,60	-	21,780
Total Placement IDA Project		-	-	2,790	4,170	4,350	5,600	-	16,910
Total Settlement/6		-	-	3,750	2,780	4,400	5,240	5,600	21,780
Total Settlement IDA Project		-	-	-	2,790	4,170	4,350	5,600	16,910

Note: /1 : Excluding existing cultivated area of 2,740 ha in Zone 1 not receiving additional irrigation water.

/2 : Existing irrigation scheme receiving additional water in Yala season from Mahaweli Development Programme.

/3 : Newly irrigated land, 610 ha of which is presently rainfed.

/4 : Settlement accomplished.

/5 : 2,900 settlers have been settled as of May, 1982.

/6 : Establishment of whole family and commencement of cultivation of irrigated holding.

Sources: Implementation Plan, System "C" Zones 3-6, December 1981, Settlement Division Mahaweli Authority.

System "C", Final Design and Detailed Cost Estimates, Development Plan, June, 1981, MMD.

Table 3.8 Settlement Programme in Zones 3-6

Zone No.	Block No.	No. of Units	Total No. of Farmer Families	Arrival of Worker-Settlers	Arrival of Families	Time Required for Irrigation
3	3	12	2790	June 1982	Jan. 1983	Maha 1983/84
4	4	09	2150	June 1983	Dec. 1983	Maha 1984/85
	5	08	2020	June 1983	Dec. 1983	Maha 1984/85
	6	09	2170	June 1984	Dec. 1984	Maha 1985/86
	7	10	2180	June 1984	Dec. 1984	Maha 1985/86
5	8	08	2080	June 1985	Dec. 1985	Maha 1986/87
5 & 6	9	07	1780	June 1985	Dec. 1985	Maha 1986/87
6	10	07	1740 (16910)	June 1985	Dec. 1985	Maha 1986/87

Source: Implementation Plan, System "C" Zones 3-6, December 1981, Settlement Division, Mahaweli Authority of Sri Lanka.

Table 3.9 Assistance to Settlers

The following form of assistance is provided to the settlers:

(a) A grant of Rs. 1500/- for housing;

(b) 6-8 well rings valued at Rs. 1800/- and a sum or Rs. 750/- in cash to each settler to construct a well for drinking water. The well will be constructed according to specifications laid down by the MEA;

(c) Water by bowser during the dry spells;

(d) Employment on the development of the distributory and field canals system. During this period food assistance (single) will be provided under the World Food Aid Programme, up to a maximum period of 12 months. After the arrival of their families, family rations will be provided up to the time of their first irrigated crop but, subject to maximum period of 15 months.

(e) Planting materials up to a maximum value of Rs. 150/- and agricultural guidance in setting up home garden plots.

(f) Initial clearing and on-farm development of the irrigable allotments will be done by the MEA. The cost of fine levelling and bund raising is to be undertaken by the settlers for which a payment will be made by the MEA.

(g) Initial ploughing of the settlers paddy plots and the free issue of seed at a cost of Rs. 800/- by the MEA.

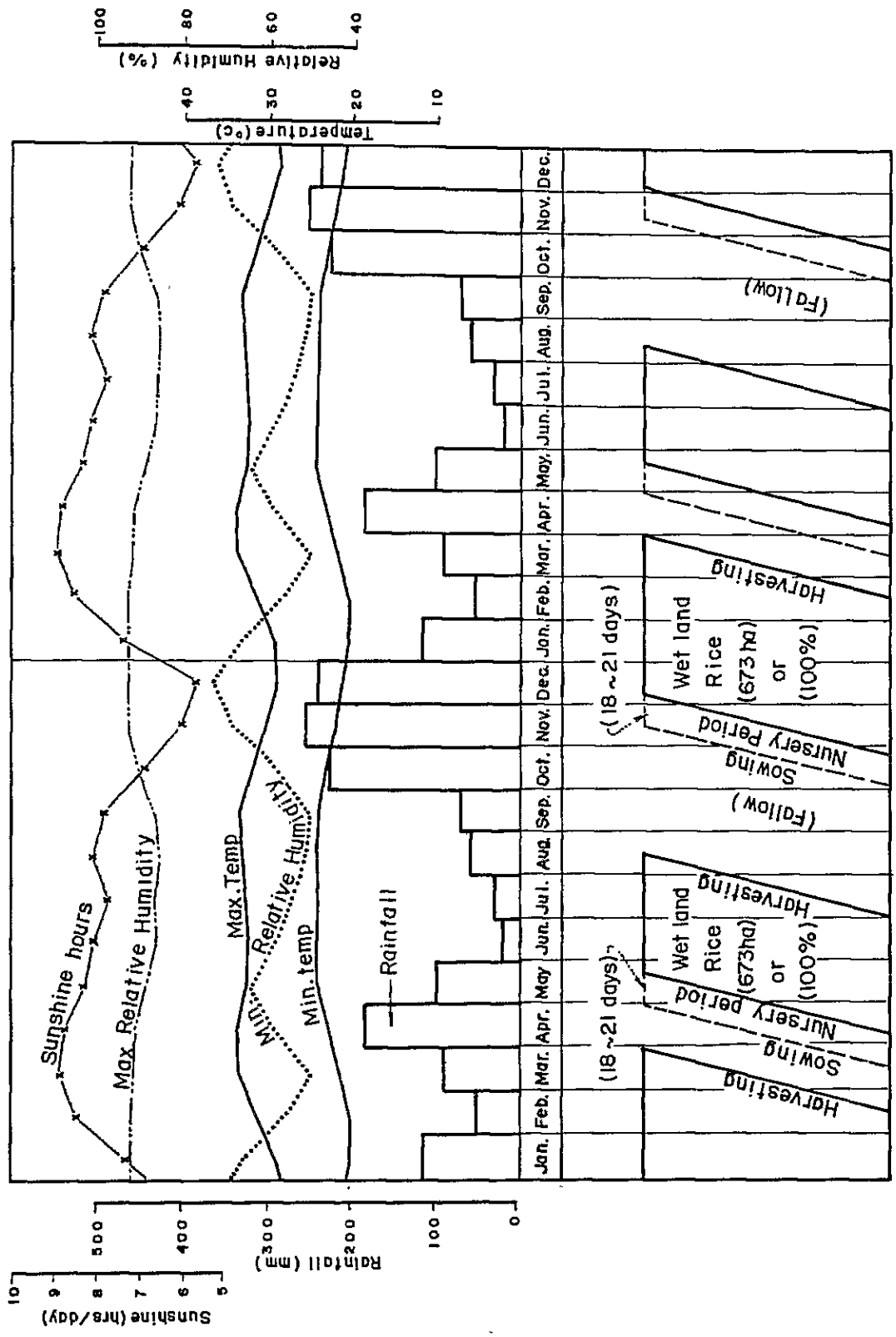
(h) Initial issue of agricultural implements to the value of Rs. 350/-.

(i) Services, such as, drinking water, health, postal services, during the worker-settler phase and later extended to meet the needs of the settler families.

(j) A squatting plate valued at Rs. 150/- and a grant of Rs. 150/- per settler, to construct their own lavatories.

Source: Implementation Plan, System "C" Zones 3-6, December 1981, Settlement Division, Mahaweli Authority of Sri Lanka.

Fig. 3.1 PROPOSED CROPPING PATTERNS



SRI LANKA

Fig. 3.2 MAHAWELI GANGA DEVELOPMENT PROJECT III
ORGANIZATION STRUCTURE

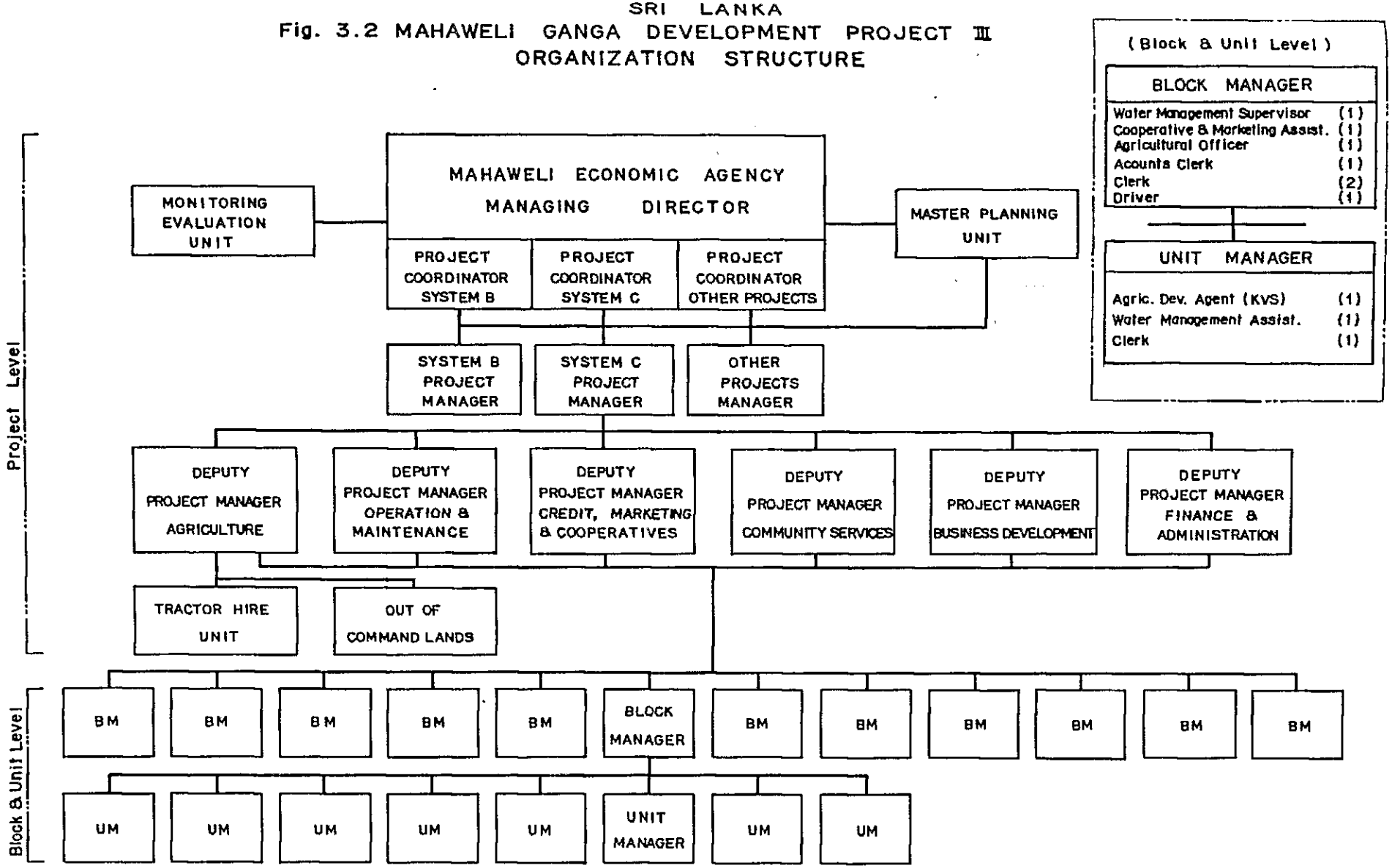
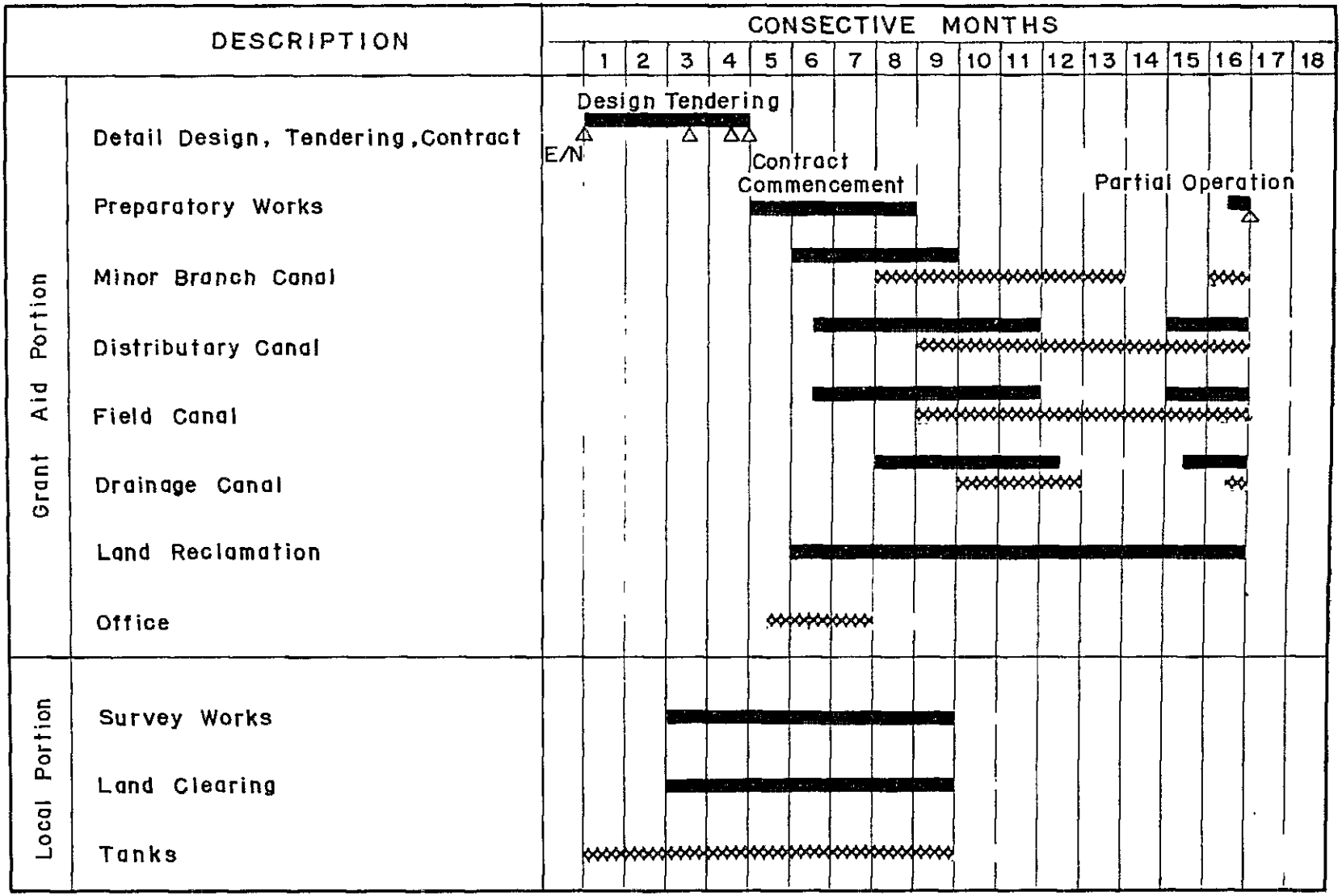


Fig. 3.3 CONSTRUCTION TIME SCHEDULE



4. PROJECT EVALUATION

After the implementation of the project and its proper operation, the project would benefit not only in terms of economic aspects but also from indirect and intangible aspects. Particularly, the pilot farm operation would make it possible to provide an intensive agricultural production and to promote the application of improved cultural practices and the use of inputs to the surrounding System C area.

The economic benefits of the project would come mainly from the increased production of rice and other crops. The operation and demonstration of the project would provide for the following indirect benefits and intangible effects in the entire System C development and others through periodical training of the Government staff and farmers.

i) Minimizing water losses through proper water management including rotation irrigation practices,

ii) Efficient farming practices and saving farm inputs through land consolidation,

iii) Determination of the most adaptable and beneficial cropping pattern as well as introduction of adaptable varieties of crops,

iv) Distribution of seeds of recommended varieties multiplied,

v) Maximizing crop production through introduction of above farming activities,

vi) Minimizing operation and maintenance costs of irrigation and drainage system,

vii) Extension of appropriate pre-cast concrete structures for on-farm development resulting in the saving in costs and construction time, and

viii) Increase of unit rice yield per annum to 4.5 - 5.0 t/ha from present yield of 1.8 - 3.7 t/ha, and annual total rice production amounting to about 6,000 ton in the Project area.

5. CONCLUSION AND RECOMMENDATION

The irrigation development and land settlement programme of System C, one of the highest priority project in the Accelerated Mahaweli Development Programme, is being progressively implemented by the GOSL in cooperation with IDA, the GOJ and the Government of Kuwait. The on-farm development in the settlement area is the vital key to this successful development programme. In this connection, the establishment of a pilot demonstration farm including the improved on-farm development would be of paramount importance for the successful implementation of the said programme.

The project area of the pilot farm is located at an attractive site for the demonstration on improved irrigation farming to the area of System C. The on-farm development method and its procedure proposed in the project would provide a particular example and guide on the future development of similar irrigation projects. Furthermore, the project scale is attractive from the view points of the costs and time required for its development.

In view of the effects and benefits of the pilot demonstration farm after its implementation as mentioned in the preceding section and its development scale, it is recommended that the project be implemented as soon as possible under the Grant Aid of GOJ.

Since the study on irrigation and drainage requirements and agronomic study have been made based on the meteorological data obtained from both the Horabora Wewa Station located about 20 km south of the project area, and Maha Illuppalama, about 90 km northwest of the project area, more reliable measurement data with longer period in the project area are required. In this context, it is recommended to conduct meteorological observations and to measure the actual consumptive use of water by various crops proposed in the project area.

In order to operate properly the pilot demonstration farm and to train the Government staff and farmers, some specific expatriate experts under the technical assistance programme or similar programme are recommended to be assigned to the project for the first several years.

In order to demonstrate the new techniques of cultivation and improved agricultural practices as well as produce multiplicated seed, it is recommended that the Government of Sri Lanka establish the Governmental Model Farm in the project area.

In addition, based on the operation and maintenance plan of System C, the detailed operation and maintenance mannual on the irrigation facilities is recommended to be prepared to perform the efficient operation and maintenance.

A N N E X

ANNEX 1 Land Classification

1-1 General

The major land classification system for the irrigation development are described as follows:

The USDA system is mainly used for rainfed agriculture in general. The basic concept of the USBR system is generally to assess the lands under arid climate and/or to assess the land productivity for dry field crops. The FAO system is more flexible than the US one, however, it is still under development and does not serve the detailed criteria for suitability assessment on the irrigated rice cultivation. The Japanese system is devised originally for rice cultivation and its classification criteria are detailed for land capability assessment on the irrigated rice cultivation.

In view of the above consideration, the Japanese system seems to be most suitable for land capability classification for the rice field reclamation.

In the Japanese system, lands are classified into 4 capability classes, i.e., I, II, III and IV. Each class is defined as follows:

(1) Class I : Land has almost no limitation for reclamation, crop production and/or no risk of soil conservation.

(2) Class II : Land has some limitations for reclamation, crop production and/or some risks of soil conservation.

(3) Class III : Land has many limitations for reclamation, crop production and/or is likely subject to risks of soil conservation.

(4) Class IV : Land has great natural limitations than these in Class III.

1-2 Specification of Land Capability Classification

In the Japanese system, there are 4 factors for assessment of Land capability as shown below:

(1) Slope

Steepness of Slope	Class
Less than 1/100	I
1/100 to 1/35	IIa
1/35 to 1/20	IIb
1/20 to 1/10	IIIa
1/10 to 1/7	IIIb
more than 1/7	IV

(2) Effective soil depth

Effective Soil Depth (cm)	Class
more than 100	I
100 to 70	II
70 to 40	III
40 to 25	IVa
less than 25	IVb

(3) Soil texture

Soil Texture	Class
Loam, Clay loam, Clay	I
Sandy loam, Loam (Volcanic), Clay loam (Volcanic)	II
Sand, Sandy loam (Volcanic), Heavy clay, Low or transitional moor	III
Gravel, Volcanic ash, Lapili, High moor	IV

(4) Gravel content

Gravel Content (%)	Class
less than 5	I
5 to 10	II
10 to 30	III
more than 30	IVa
stony and rocky	IVb

1-3 Land Capability

The land is evaluated by using the assessment factors mentioned above. The land capability class is determined at the lowest class of the factors, as shown in the following example:

Factor	Class
(1) Slope	IIIa
(2) Effective soil depth	II
(3) Soil texture	I
(4) Gravel content	II

Land capability class: IIIa

Based on the specification of the Japanese land capability classification system, the land in the gross irrigation area is classified into 7 classes as shown in Table A-1.

Table 1.1 Land Capability in the Irrigation Area

Capability Class	Unit I		Unit II		Unit III		Table		Proportional Extent	
	Gross/1	Net/2	Gross/1	Net/2	Gross/1	Net/2	Gross/1	Net/2	Gross/1	Net/2
I	124	103	63	43	77	50	264	196	29.2	29.1
II	2	2	2	2	-	-	4	4	0.4	0.6
IIa	135	106	98	67	92	67	325	240	36.0	35.7
IIb	79	69	108	80	88	64	275	213	30.4	31.7
III	-	-	-	-	1	1	1	1	0.1	0.1
IIIa	7	3	16	10	8	6	31	19	3.5	2.8
IVb	1	0	0	0	3	0	4	0	0.4	0.0
Total	348	283	287	202	269	188	904	673	100.0	100.0

/1: Gross means the gross irrigation area.

/2: Net means the net irrigation area of rice field.

ANNEX - 2

MINUTES OF DISCUSSION ON THE DRAFT REPORT OF THE BASIC DESIGN STUDY

ON

THE ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

The Government of Japan has sent, through Japan International Cooperation Agency ("JICA"), a Basic Design Survey Team ("the Team") to the Democratic Socialist Republic of Sri Lanka from 1st to 10th October, 1982 for the purposes of the submission and the explanation of the Draft Final Report ("the Report") of the Basic Design Study on the project for the Establishment of Pilot Demonstration Farm in Mahaweli ("the Project").

The Team had a series of discussions with the authorities concerned of the Government of the Democratic Socialist Republic of Sri Lanka to explain and discuss on the Report.

This minutes records the following major points of understanding reached between both parties regarding the Project, subject to further review and approval of the respective Governments for the implementation of the Project.

1. The Report principally satisfied the Sri Lankan side and appropriate alterations in design agreed during the discussions will be incorporated in the Final Report.

2. The Final Report (10 copies in English) on the Project will be submitted to the Government of the Democratic Socialist Republic of Sri Lanka by the end of November, 1982.

3. The Sri Lankan side has newly proposed to utilize a part (approximately 200 hectares) of the Project area as a Governmental Model Farm ("the Model Farm") where the Government of the Democratic Socialist Republic of Sri Lanka would demonstrate new techniques of cultivation and improved agricultural practices as well as produce multiplicated seed and so on under the guidance of Japanese experts requested in 6 below.

4. The Government of the Democratic Socialist Republic of Sri Lanka will take necessary measures and undertake the following on the condition that the grant assistance by the Government of Japan is extended to the project.

(1) to carry out the detailed survey of the final alignment of canals and plot demarcation and grid survey in the irrigable lands.

(2) to clear the lands necessary for the construction of facilities.

(3) to provide plot ditch and construct three tanks.

(4) to make all settlement programme in accordance with the progress of the Project.

(5) to clear any trouble claimed by the settlers in the responsibility of the Sri Lankan side.

(6) to provide data and information required for the detail design and preparation of tender documents for civil works.

(7) to provide counterpart personnel for detail design and construction supervision during the construction period.

(8) to provide facilities for distribution of electricity, water supply and other incidental facilities for the project office.

(9) to provide office and quarters with necessary facilities for the consultant during the period of the detail design and construction supervision.

(10) to ensure prompt unloading and customs clearance at ports of disembarkation in Sri Lanka and prompt internal transportation therein of equipment, plants and materials required for the construction of the project.

(11) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Sri Lanka with respect to supply of the products and the services under the Grant.

(12) to accord Japanese nationals whose services may be required in connection with the services under the Grant such facilities as may be necessary for their entry into Sri Lanka and stay therein for the performance of their work.

(13) to provide timely all such funds, personnel and facilities as will be necessary for ensuring the facilities under the Grant be maintained and used properly and effectively.

5. The Sri Lankan side will take all the responsibilities for operation and maintenance of the Model Farm referred to in 3 above including the provision of buildings and other related facilities such as office, staff quarters and garage necessary for the management of the Model Farm.

6. The Sri Lankan side requested the dispatch of some Japanese experts as the technical assistance for the Model Farm and will provide all the living facilities for their accomodation at Alutharama.

7. The Team will convey the proposal and the request made by the Sri Lankan side in 3. and 6. above to the Government of Japan.

8th October, 1982

Isamu Minamiyama.

ISAMU MINAMIYAMA
TEAM LEADER
JICA BASIC-DESIGN SURVEY TEAM
FOR ESTABLISHMENT OF PILOT
DEMONSTRATION FARM.

LALITH GODAMUNNE
SECRETARY GENERAL
MAHAWELI AUTHORITY
OF
SRI LANKA.

ANNEX 3 Member List of Basic Design Study Team and Government Staff Concerned to the Project

Basic Design Study Team

Position	Name
1. Team Leader	Isamu MINAMIYAMA
2. Pilot Farm Planner	Tomiro UOMOTO
3. Irrigation Engineer	Kazuyuki KOBAYASHI
4. Project Coordinator	Senichi KIMURA
5. Pilot Farm Planner	Shinichi YANO
6. Irrigation Engineer	Tsuneo AMANO
7. Irrigation Engineer	Etsuji YAMAUCHI
8. Survey Engineer	Nichio YAMASAKI
9. Soil Improvement Engineer	Akio MAEDA

Government Staff Concerned to the Project

1. External Resources

   Mr. Ronnie WEERAKOON, Director
   Mr. Senarat WEERAPANA, Asstt. Director

2. Mahaweli Authority (M.A.)

   Mr. N.G.P. PANDITHARATNE, Director General
   Mr. Lalith GODAMUNNE, Secretary General

3. Ministry of Mahaweli Development

   Mr. Ivan SAMARAWICKREMA, Secratary

4. Mahaweli Development Board (MDB)

   Mr. R.U. FERNANDO, Chairman
   Mr. D.V.W. ABEYGUNAWARDENA, General Manager
   Mr. K. SATHGUNASINGHAM, Addl. G.M. (desings)
   Mr. N.G.R. DE SILVA, Addl. G.M. (const.)
   Mr. T.R. RANASINGHE, Asstt. G.M. (System C)

5. Mahaweli Economic Agency M.A.

   Mr. M.L.J. WICKREMERATNE, Executive Director
   Mr. Dulan DE SILVA, Project Coordinator System C
   Mr. D.W. KANNANGARA, Manager, Production Marketing & Credit
   Mr. W. LIYANAGE, Agronomist
   Mr. J. KOTALAWALA, Agronomist
   Mr. W.W. UDUBIHILLE, Chief Equipment Engineer

6. System H Nochiyagama

   (1) MDB
      Mr. M. RAVINDRA FERNANDO
      Mr. R.B.COOMARASAMY, Project Engineer
      Mr. S.A. SARANASENE, W:S (Thambuthegama)

(2) M.A.S.L.

Mr. B.K.D.S. SAMARASINGHE, Project Manager, Pilot Project H-5

Mr. P. WEEPAKKODY, Irrigation Engineer

7. Mahiyangana M.D.B.

Mr. M.M. GUNATILAKA, Asstt. G.M. (System C)

Mr. GUNASEKARA, Office Engineer (Zone 3)

8. Girandurukotte M.A.

Mr. P.V. PATHIRANA, Resident Project Manager (R.P.M.) (System C)

Mr. D.H.H.B. DIVARALNE, Deputy R.P.M. (Lands)

Mr. L.T.P. DE SOYSA, Agronomist in charge of Demonstration Farm

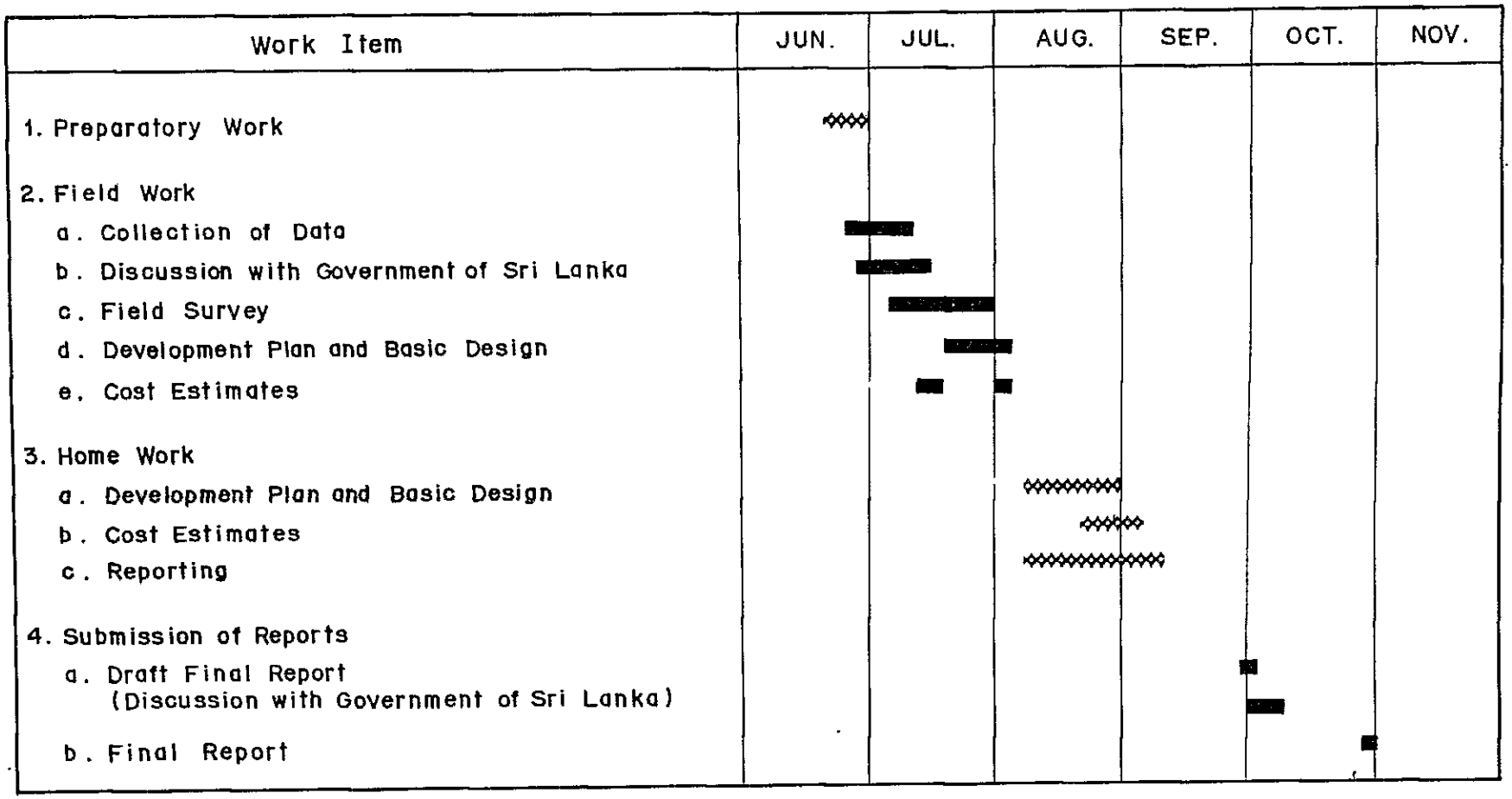
9. Girandurukotte M.D.B.

Mr. Ananda SELLAHEWA, Irrigation Engineer

10. Victoria Dam Site (Kandy)

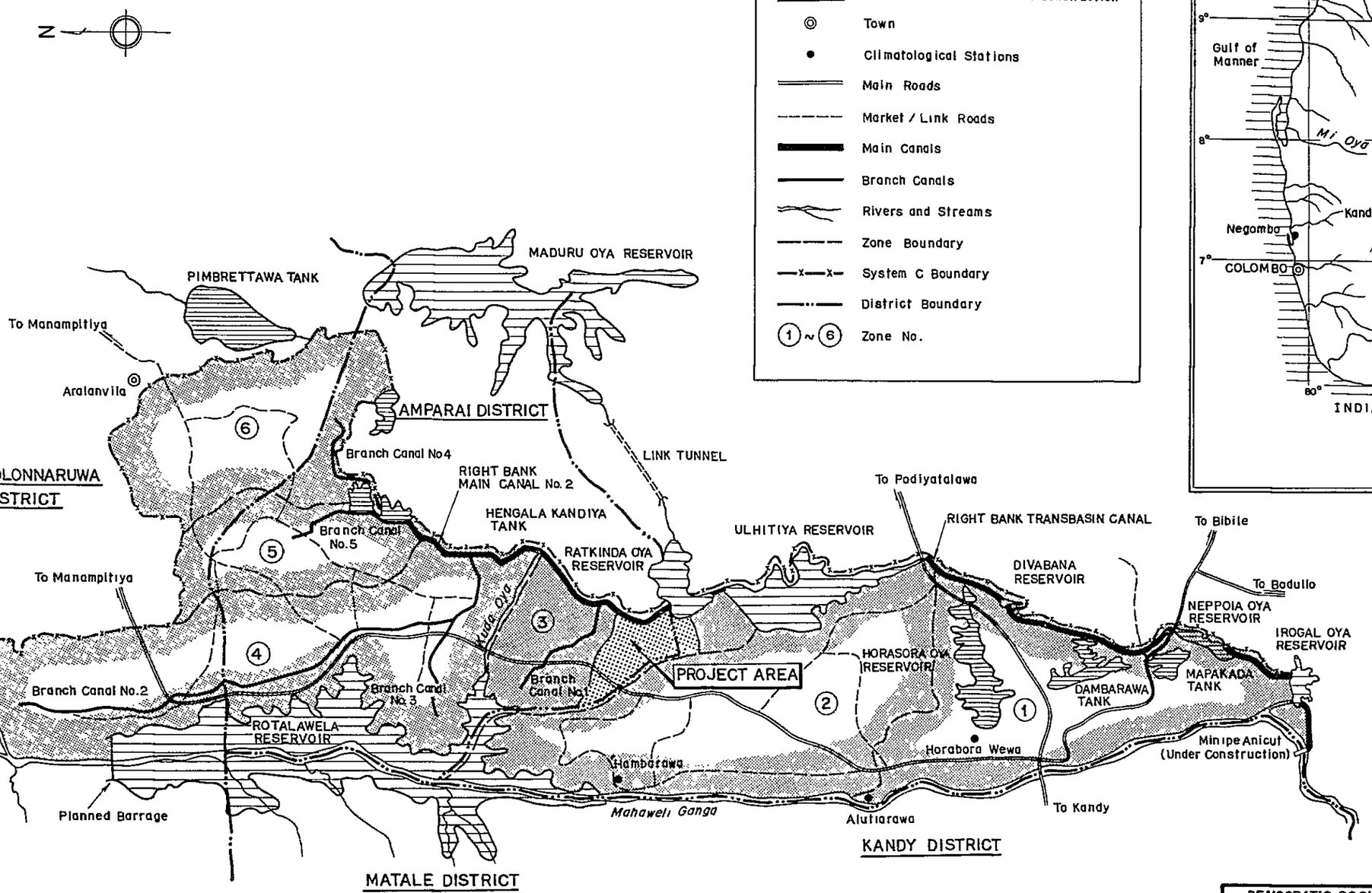
Mr. Gamini WETTEWA

ANNEX 4 Activities of Basic Design Study Team



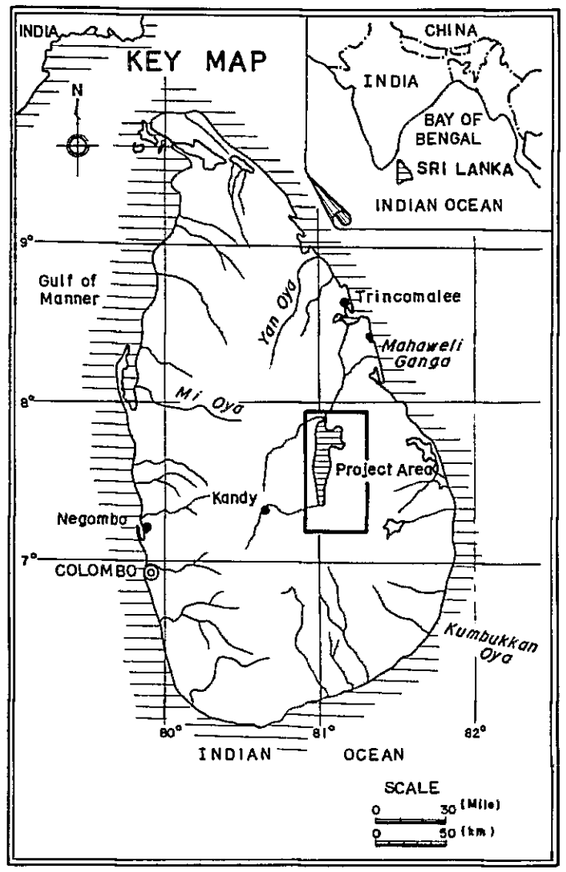
Note : Home Work
Field Work

DRAWING



LEGEND

- Project Area
- Existing Tanks
- Tanks and Reservoir Under Construction
- Town
- Climatological Stations
- Main Roads
- Market / Link Roads
- Main Canals
- Branch Canals
- Rivers and Streams
- Zone Boundary
- System C Boundary
- District Boundary
- (1) ~ (6) Zone No.

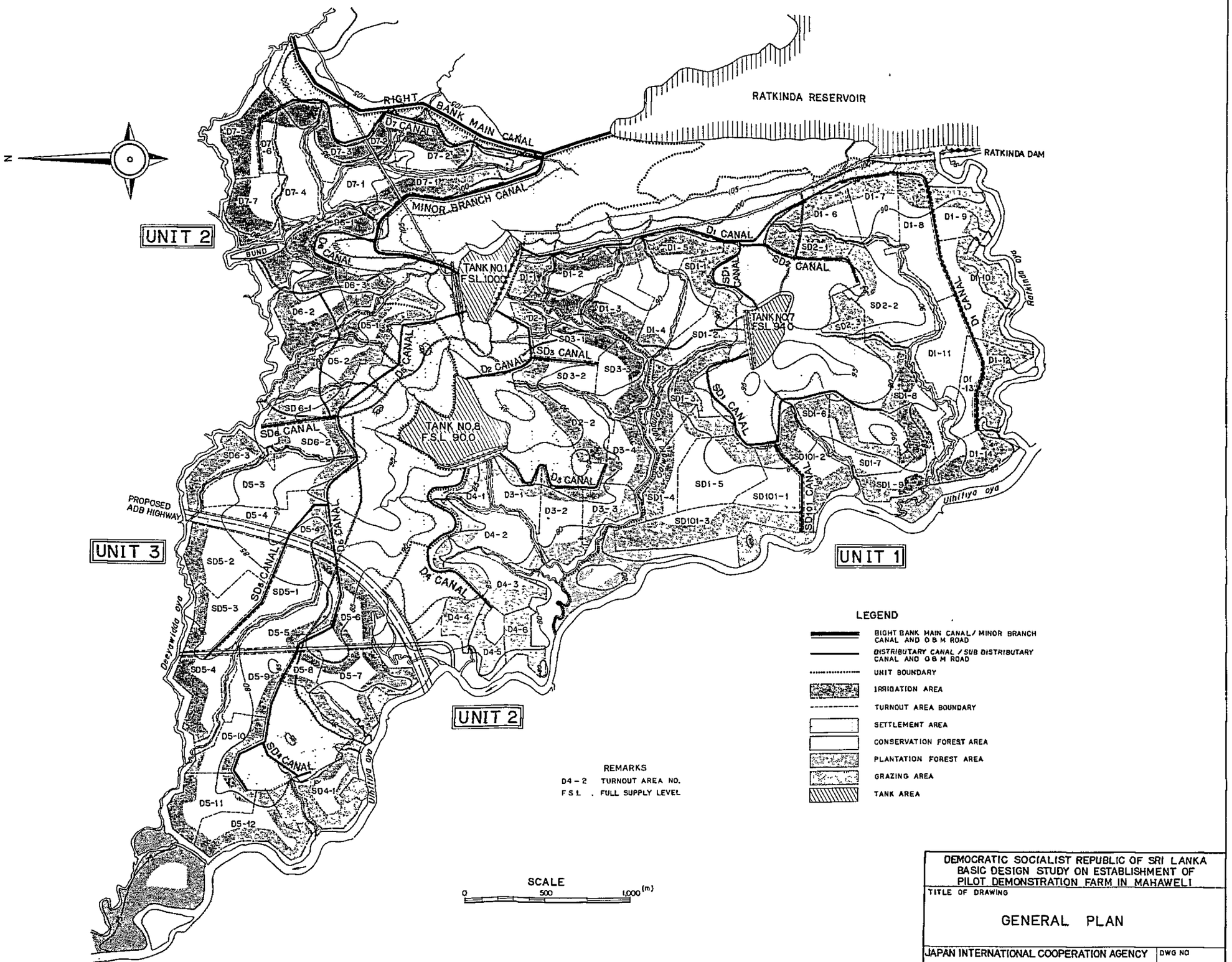


DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

GENERAL MAP

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

100

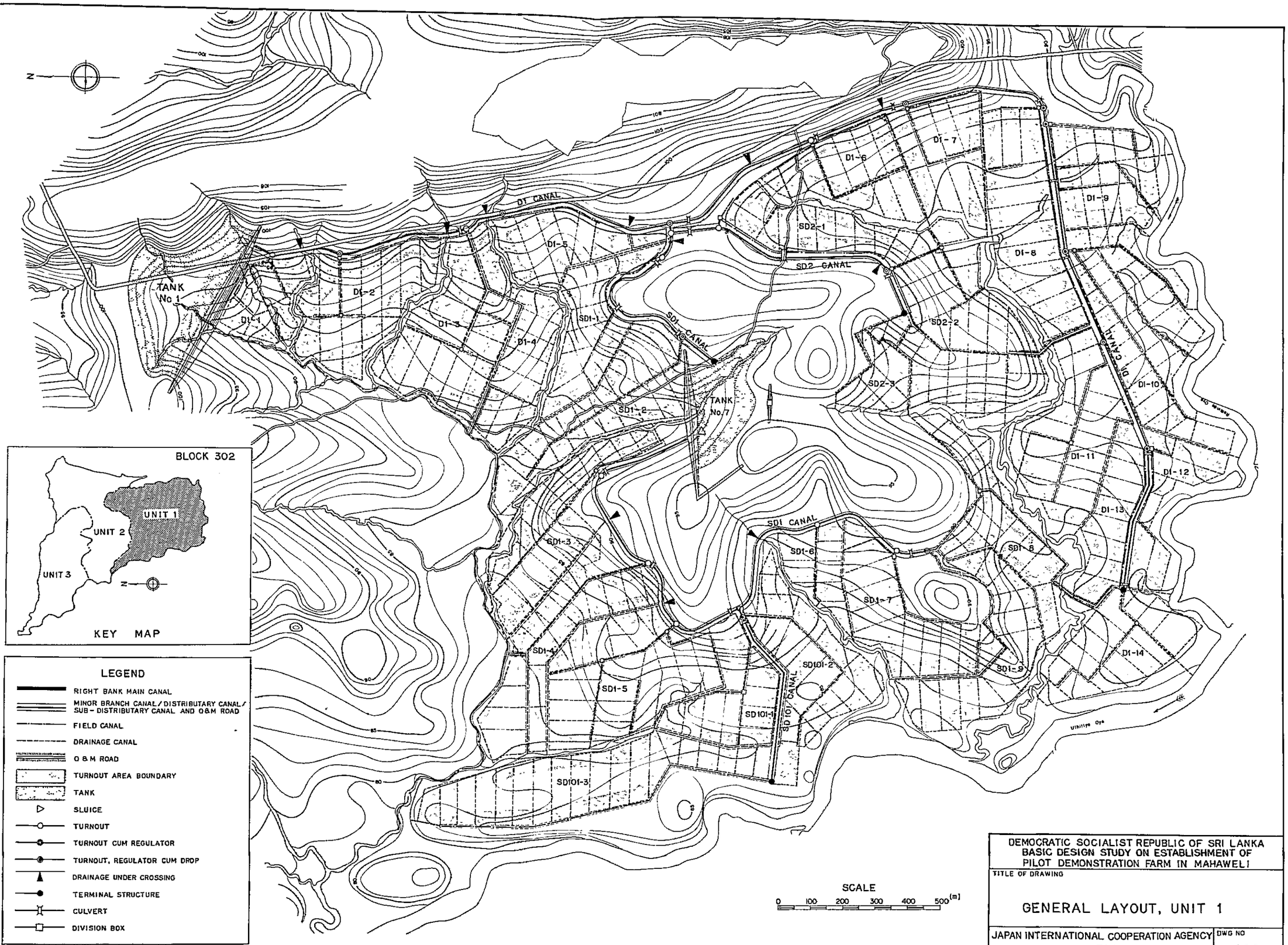


DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

GENERAL PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY	DWG NO
TOKYO	101



DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

GENERAL LAYOUT, UNIT 1

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
102

LEGEND

- RIGHT BANK MAIN CANAL
- MINOR BRANCH CANAL / DISTRIBUTARY CANAL / SUB - DISTRIBUTARY CANAL AND O&M ROAD
- FIELD CANAL
- DRAINAGE CANAL
- O & M ROAD
- TURNOUT AREA BOUNDARY
- TANK
- SLUICE
- TURNOUT
- TURNOUT CUM REGULATOR
- TURNOUT, REGULATOR CUM DROP
- DRAINAGE UNDER CROSSING
- TERMINAL STRUCTURE
- CULVERT
- DIVISION BOX

N

D7-5
D7-7
D7-6
D7-4
D6-1
D6-2
D7-3
D6-3
D6 CANAL
D7-1
D7-2
MINOR BRANCH CANAL
RIGHT BANK MAIN CANAL
TANK No 8
TANK No 1
D4-4
D4-5
D4-6
D4 CANAL
D4-3
D4-1
D4-2
D3-1
D2 CANAL
D2-1
D1-1
D3-2
D3 CANAL
SD3 CANAL
D2-2
SD3-2
SD3-1
D1-2
D3-3
SD3-3
D3-4
D1-3
From Ginigathena

SCALE
0 100 200 300 400 500(m)

BLOCK 302
UNIT 3
UNIT 2
UNIT 1
N
KEY MAP

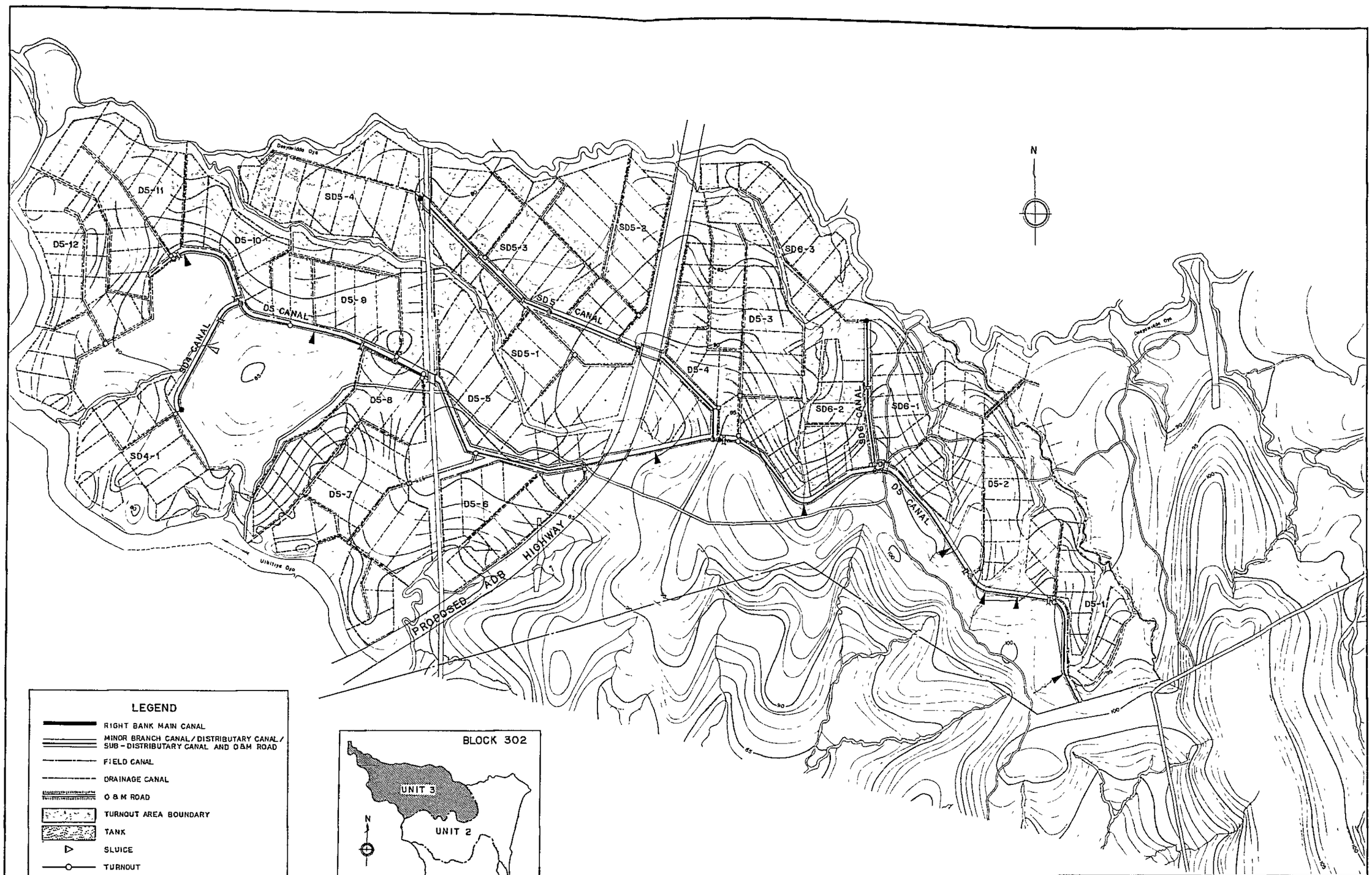
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

GENERAL LAYOUT, UNIT 2

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
103



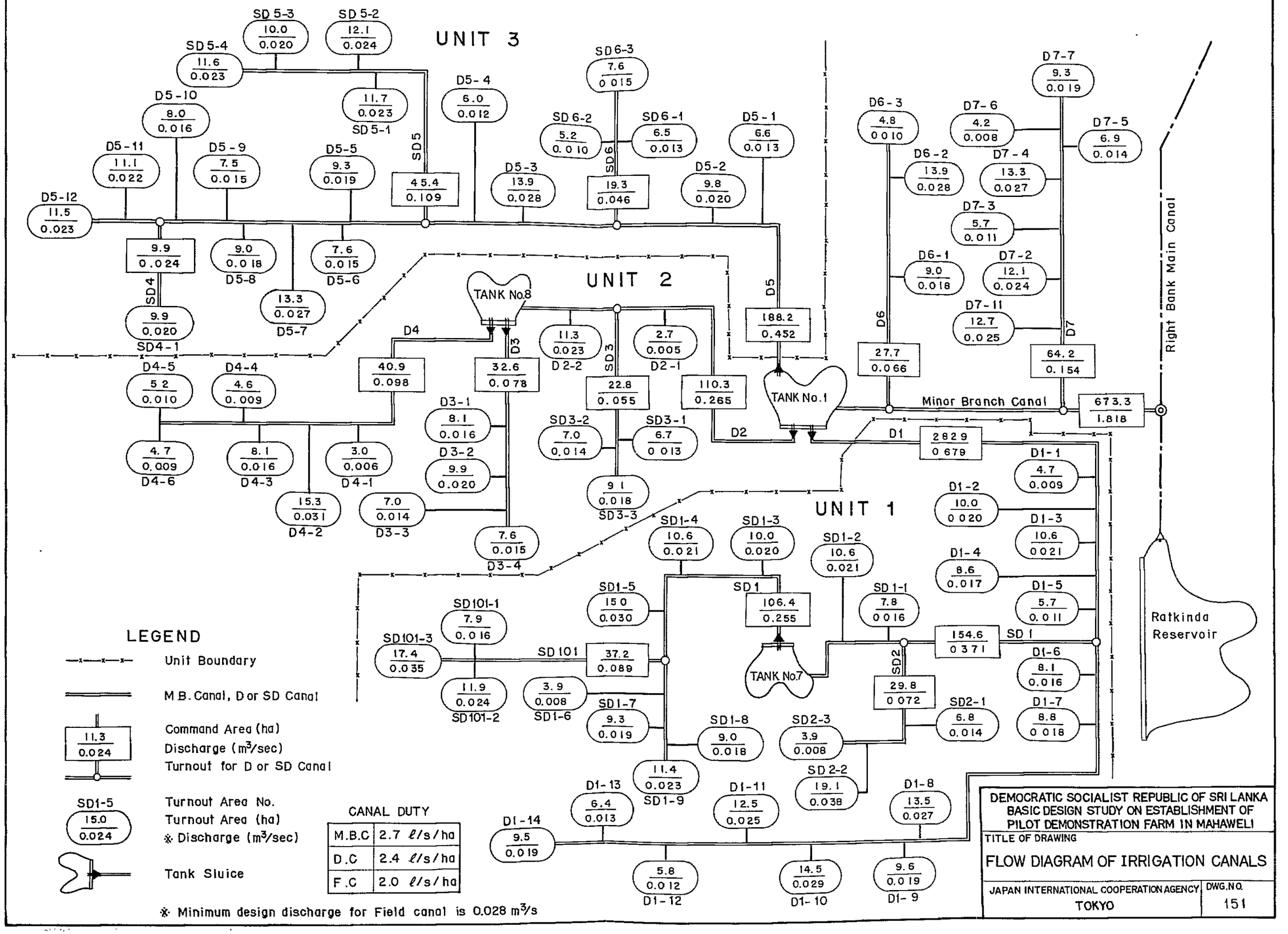
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

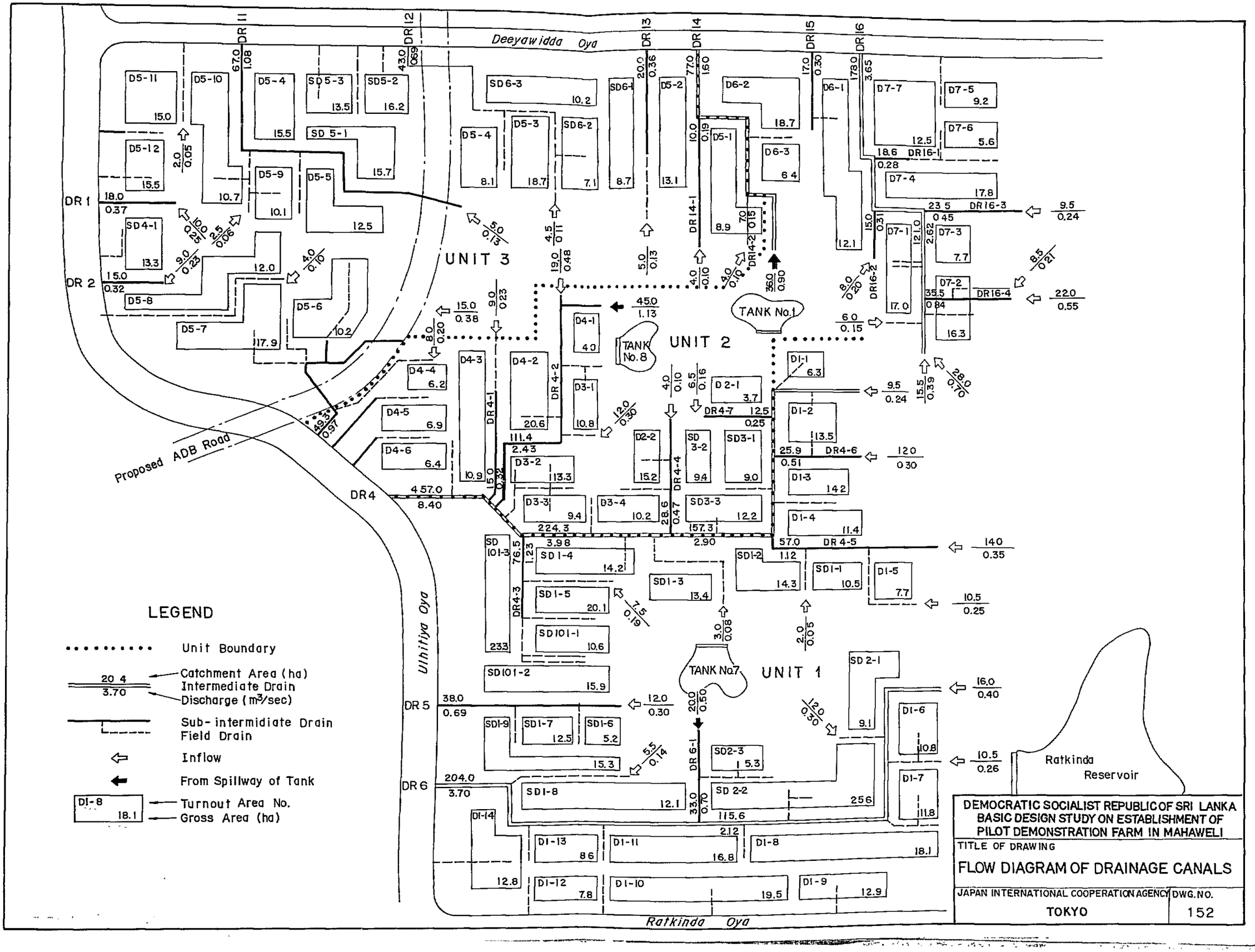
TITLE OF DRAWING

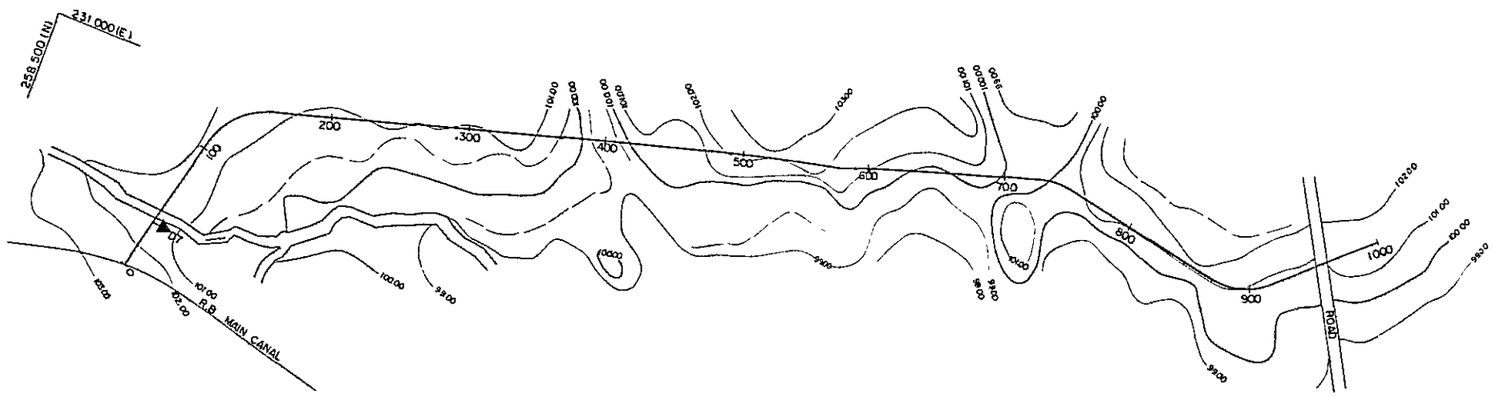
GENERAL LAYOUT, UNIT 3

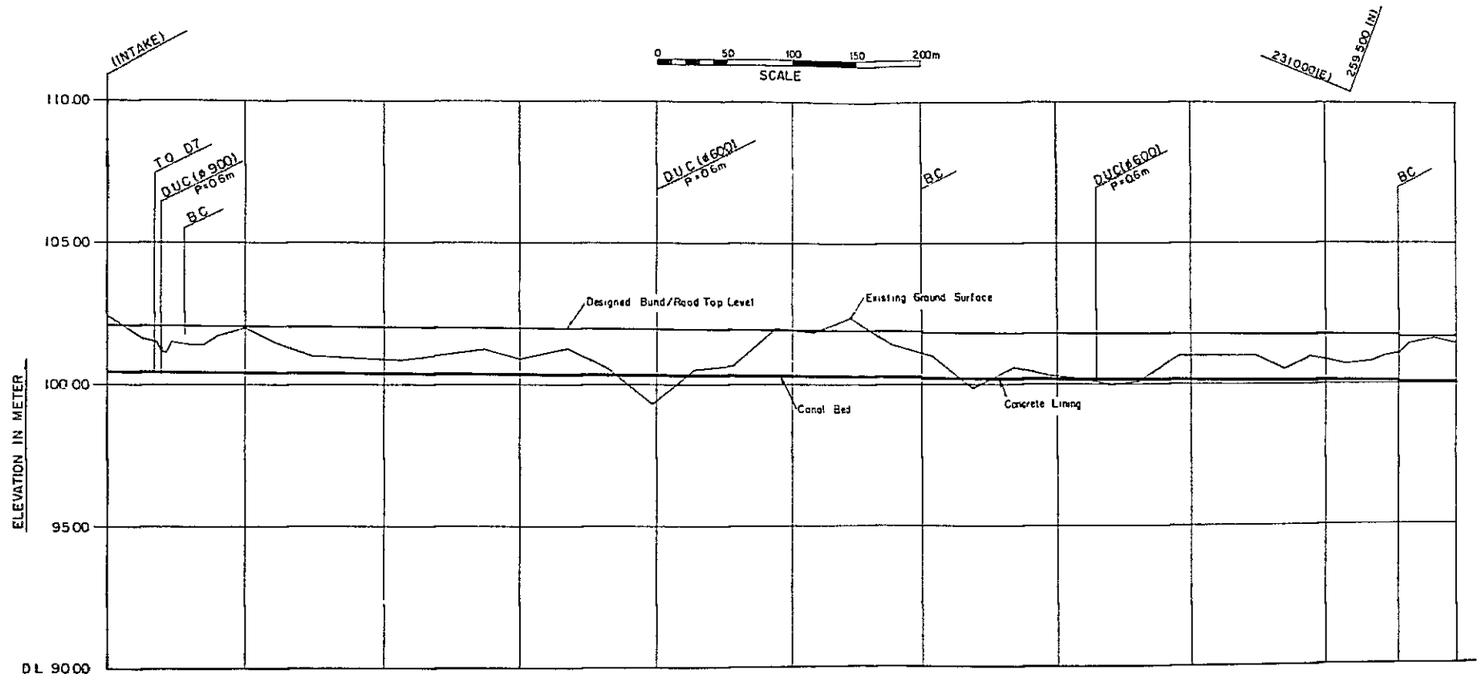
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
104


UNIT 3
UNIT 2
UNIT 1
SD 5-3 10.0 / 0.020
SD 5-2 12.1 / 0.024
SD5-4 11.6 / 0.023
D5-10 8.0 / 0.016
11.7 / 0.023 SD 5-1
D5-4 6.0 / 0.012
SD6-3 7.6 / 0 015
SD 6-2 5.2 / 0. 0 10
SD6-1 6.5 / 0.013
D5-1 6.6 / 0.0 13
D5-11 11.1 / 0.022
D5-9 7.5 / 0.0 15
D5-5 9.3 / 0.019
SD5
45.4 / 0.109
D5-3 13.9 / 0.028
SD6
19.3 / 0.046
D5-2 9.8 / 0.020
D5-12 11.5 / 0.023
9.9 / 0.024
9.0 / 0.0 18 D5-8
7.6 / 0.0 15 D5-6
SD4
13.3 / 0.027 D5-7
9.9 / 0.020
SD4-1
TANK No.8
D4
D3
11.3 / 0.023 D2-2
SD3
2.7 / 0.005 D2-1
D5
188.2 / 0.452
40.9 / 0.098
32.6 / 0.078
22.8 / 0.055
110.3 / 0.265
TANK No.1
D4-5 5 2 / 0.010
D4-4 4.6 / 0. 009
D3-1 8.1 / 0.016
SD3-2 7.0 / 0.014
SD3-1 6.7 / 0 013
D2
4.7 / 0. 009 D4-6
8.1 / 0.0 16 D4-3
3.0 / 0.006 D4-1
D3-2 9.9 / 0.020
9 1 / 0.0 18 SD3-3
15.3 / 0.031 D4-2
7.0 / 0.014 D3-3
7.6 / 0.015 D3-4
SD1-4 10.6 / 0.0 21
SD1-3 10.0 / 0.020
SD1-2 10.6 / 0.021
SD1
106.4 / 0.255
SD1-1 7.8 / 0 0 16
SD1-5 15 0 / 0.030
SD101-1 7.9 / 0. 0 16
SD101-3 17.4 / 0.0 35
SD 101 37.2 / 0.089
11.9 / 0.024 SD101-2
3.9 / 0.008 SD1-6
SD1-7 9.3 / 0.019
SD1-8 9.0 / 0.0 18
SD2-3 3.9 / 0.008
TANK No.7
SD2
29.8 / 0 072
154.6 / 0 3 7 1
SD 1
SD2-1 6.8 / 0.014
11.4 / 0.023 SD1-9
SD 2-2 19.1 / 0.038
D1-13 6.4 / 0.013
D1-11 12.5 / 0.025
D1-8 13.5 / 0.027
D1-14 9.5 / 0.019
5.8 / 0.0 12 D1-12
14.5 / 0.029 D1-10
9.6 / 0.0 19 D1-9
D6-3 4.8 / 0 0 10
D7-7 9.3 / 0.0 19
D7-6 4.2 / 0.008
D7-5 6.9 / 0.014
D6-2 13.9 / 0.028
D7-4 13.3 / 0.027
D7-3 5.7 / 0.0 11
D6-1 9.0 / 0.0 18
D7-2 12.1 / 0.024
D7-11 12.7 / 0.0 25
D6
D7
27.7 / 0.066
64. 2 / 0. 154
Minor Branch Canal
673.3 / 1.818
Right Bank Main Canal
D1
2829 / 0 679
D1-1 4.7 / 0.009
D1-2 10.0 / 0 0 20
D1-3 10.6 / 0 0 21
D1-4 8.6 / 0.0 17
D1-5 5.7 / 0. 0 11
D1-6 8.1 / 0.0 16
D1-7 8.8 / 0 0 18
Ratkinda Reservoir
LEGEND
Unit Boundary
M.B. Canal, D or SD Canal
11.3 / 0.024
Command Area (ha)
Discharge (m³/sec)
Turnout for D or SD Canal
SD1-5 15.0 / 0.024
Turnout Area No.
Turnout Area (ha)
※ Discharge (m³/sec)
Tank Sluice
CANAL DUTY
M.B.C 2.7 ℓ/s/ha
D.C 2.4 ℓ/s/ha
F.C 2.0 ℓ/s/ha
※ Minimum design discharge for Field canal is 0.028 m³/s
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI
TITLE OF DRAWING
FLOW DIAGRAM OF IRRIGATION CANALS
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO
DWG.NO.
151


Deeyawidda Oya
DR 11
DR 12
DR 13
DR 14
DR 15
DR 16
UNIT 3
UNIT 2
UNIT 1
TANK No.1
TANK No.8
TANK No.7
Proposed ADB Road
Ulhitiya Oya
Ratkinda Oya
Ratkinda Reservoir
DR 1
DR 2
DR 4
DR 5
DR 6
LEGEND
Unit Boundary
Catchment Area (ha)
Intermediate Drain
Discharge (m³/sec)
Sub-intermidiate Drain
Field Drain
Inflow
From Spillway of Tank
Turnout Area No.
Gross Area (ha)
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI
TITLE OF DRAWING
FLOW DIAGRAM OF DRAINAGE CANALS
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO
DWG. NO.
152





	0	100	200	300	400	500	600	700	800	900	1000
DESIGNED BUND/ROAD TOP LEVEL	102.10	102.07	102.03	102.00	101.96	101.93	101.89	101.81	101.77	101.74	101.72 101.67	101.65
CANAL BED	100.50	100.47	100.43	100.40	100.36	100.33	100.29 100.24	100.21	100.17	100.14	100.12 100.07	100.05
EXISTING GROUND SURFACE	102.40	102.00	100.90	100.90	99.40	101.90	101.10	100.30	101.00	100.90		101.40
REDUCED DISTANCE												

0 5 10m
VERTICAL SCALE
0 50 100 150 200m
HORIZONTAL SCALE

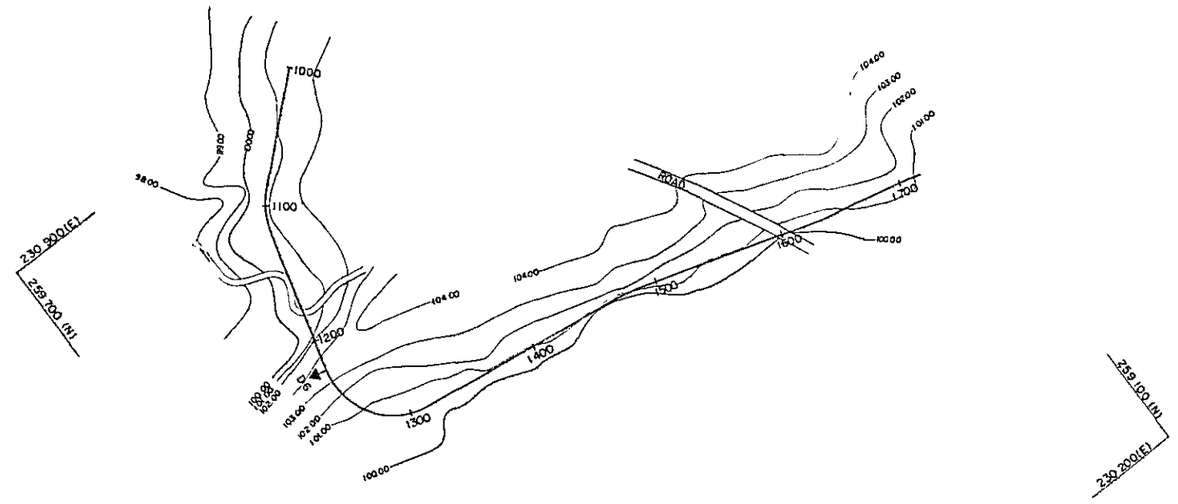
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

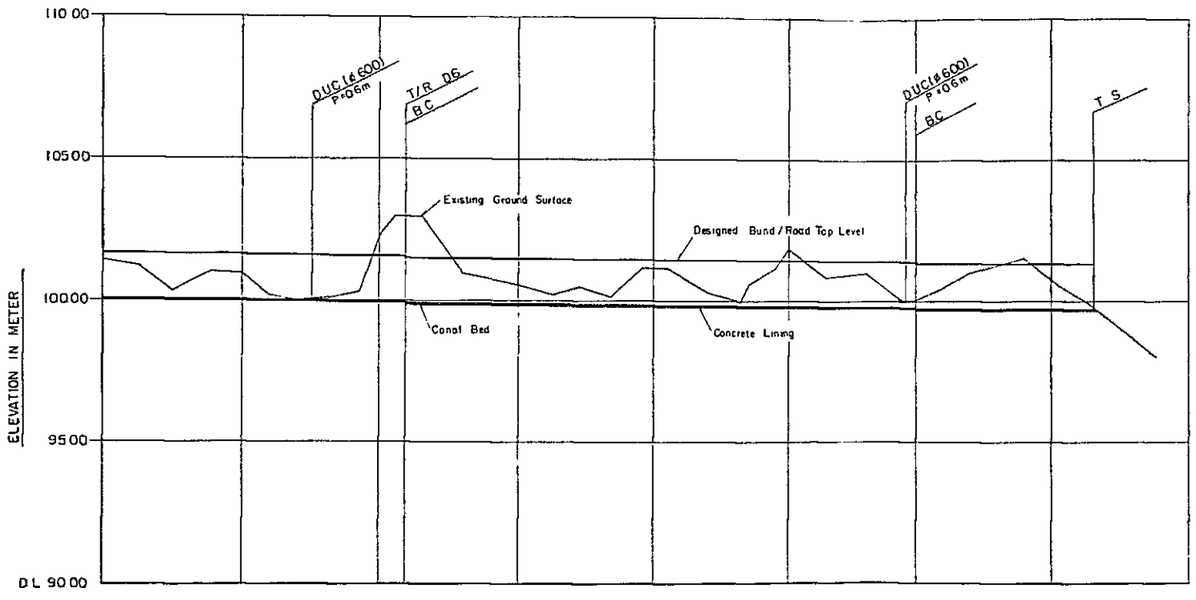
TITLE OF DRAWING

LONGITUDINAL PROFILE OF MINOR BRANCH CANAL (1/2)

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO 153





	1000	1100	1200	1300	1400	1500	1600	1700
DESIGNED BUND/ROAD TOP LEVEL	10165	10162	10158	10157 10152	10150	10146	10143	10139 10134	10131
CANAL BED	10005	10002	9998	9997 9992	9990	9986	9983	9979 9974	9971
EXISTING GROUND SURFACE	10140	10095	10230	10060	10110	10180	10080	10075
REDUCED DISTANCE								

0 5 10m
VERTICAL SCALE
0 50 100 150 200m
HORIZONTAL SCALE

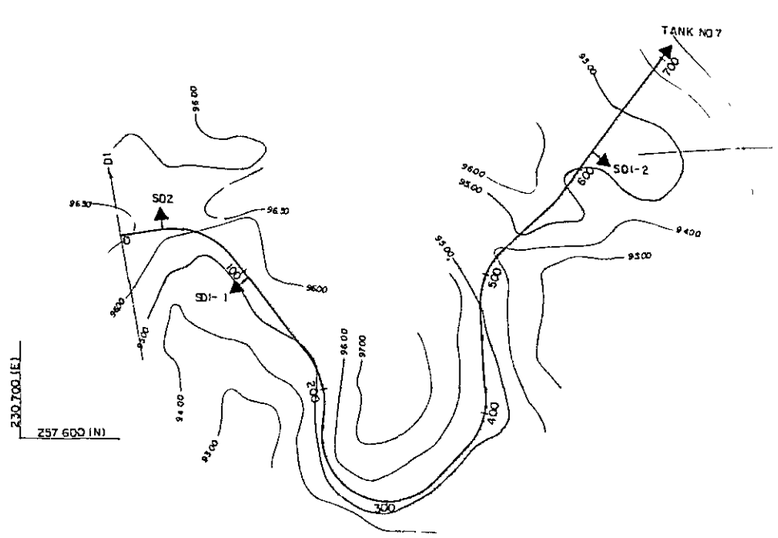
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

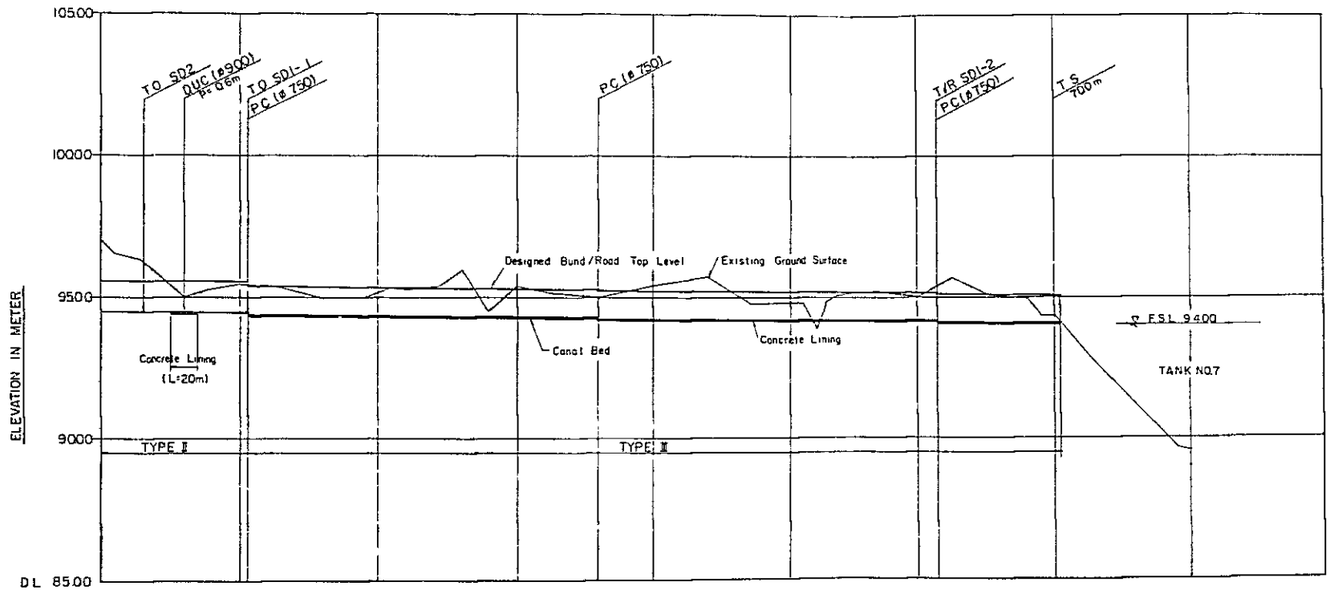
LONGITUDINAL PROFILE OF MINOR
BRANCH CANAL (2/2)

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
154



0 50 100 150 200m
SCALE



	0	100	200	300	400	500	600	700	800	900
DESIGNED BUND/ROAD TOP LEVEL	95.60	95.56 95.56 95.41	95.37	95.33	95.31 95.26	95.24	95.20	95.16 95.15 95.10	95.07	
CANAL BED	94.50	94.46 94.46 94.47	94.37	94.33	94.31 94.26	94.24	94.20	94.16 94.15 94.10	94.07	
EXISTING GROUND SURFACE	97.00	95.50	95.20	95.40		95.40	94.80	95.00 95.40	94.35	
REDUCED DISTANCE	0	100	200	300	400	500	600	700	800	900

0 5 10
VERTICAL SCALE
0 50 100 150 200
HORIZONTAL SCALE

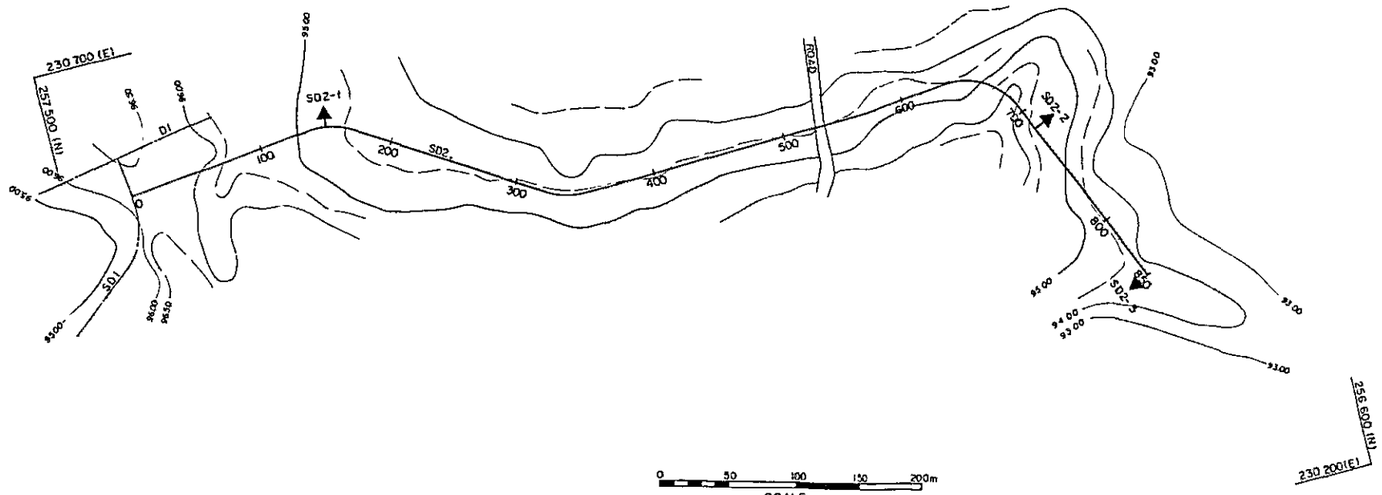
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

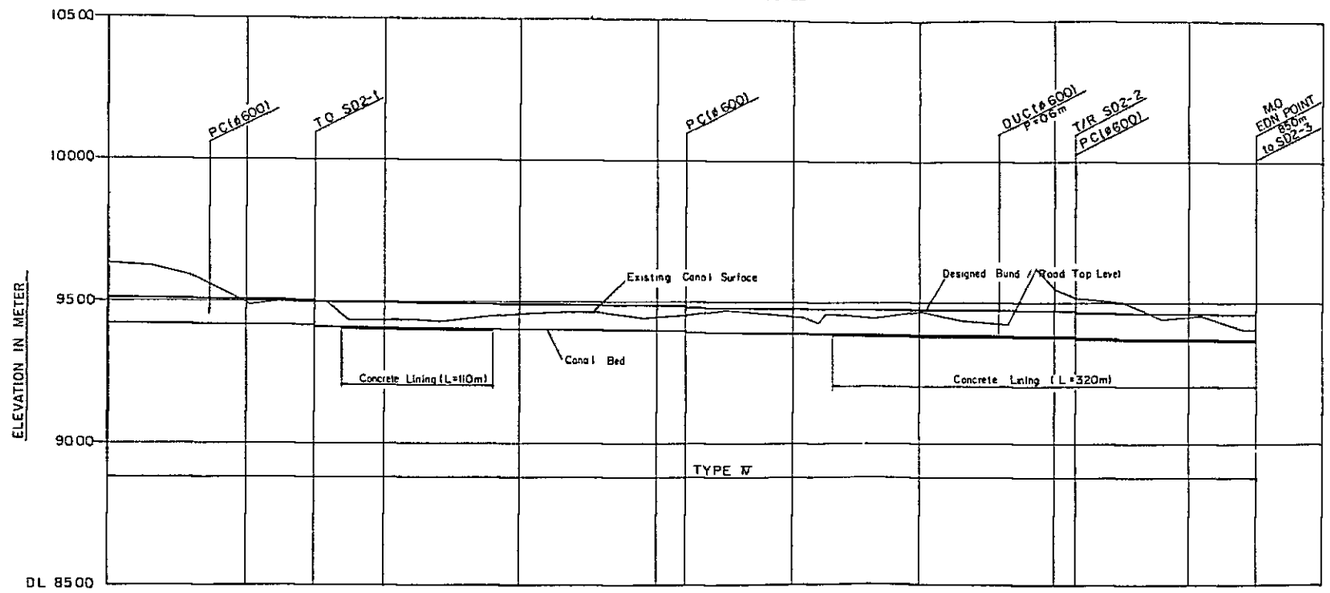
LONGITUDINAL PROFILE OF SD1 CANAL

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
155



SCALE 0 50 100 150 200m



	0	100	200	300	400	500	600	700	800
DESIGNED BUND/ROAD TOP LEVEL	95.10	95.06	95.04 95.09	94.97	94.93	94.89 94.88 94.83	94.80	94.76	94.72 94.71 94.66	94.63	94.61
CANAL BED	94.20	94.16	94.14 94.09	94.07	94.03	93.99 93.98 93.93	93.90	93.86	93.82 93.81 93.76	93.73	93.71
EXISTING GROUND SURFACE	96.35	94.95	94.30	94.55	94.50	94.50	94.70	95.50	94.50	94.10
REDUCED DISTANCE											

VERTICAL SCALE 0 5 10m

HORIZONTAL SCALE 0 50 100 150 200m

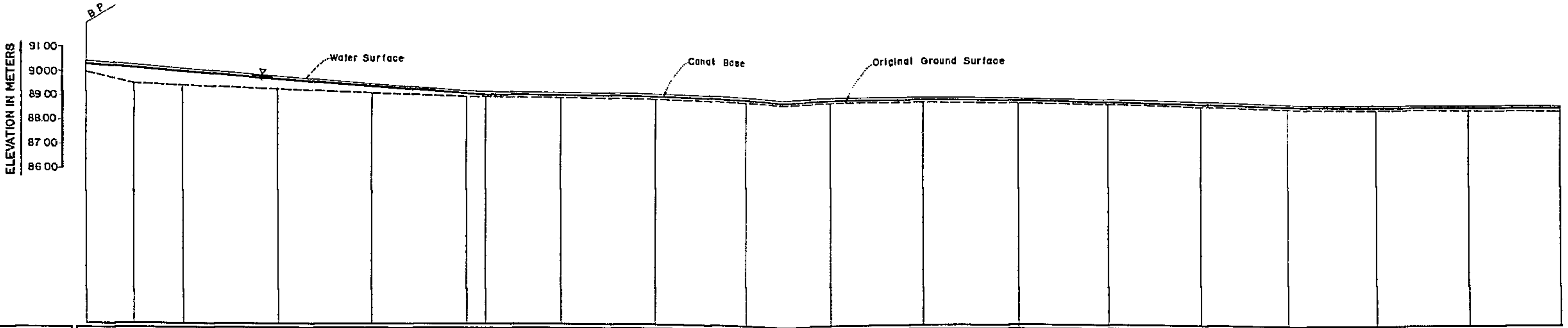
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

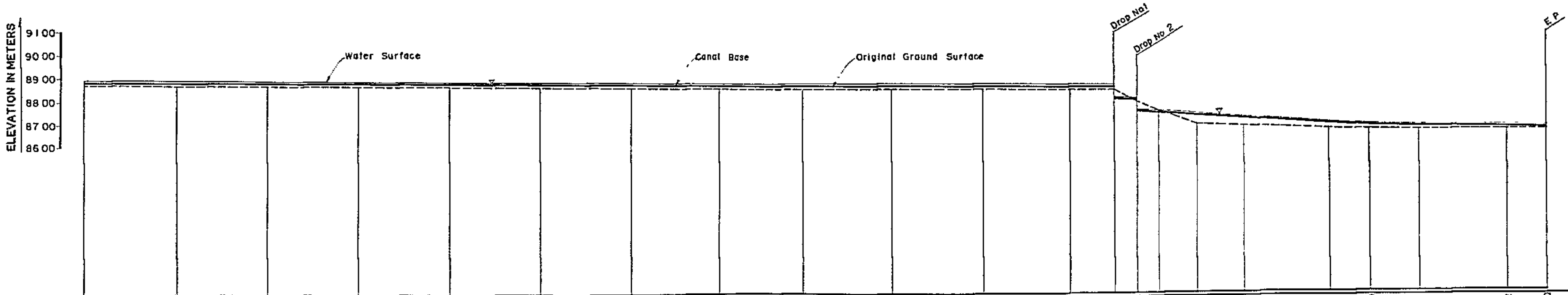
LONGITUDINAL PROFILE OF SD2 CANAL

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO 156



WATER SURFACE ELEVATION	90.40	90.26	90.11	89.83	89.54	89.26	89.20	89.18	89.16	89.14	89.12	89.10	89.08	89.05	89.03	89.01	88.99	88.97	88.95
GROUND SURFACE ELEVATION	90.00	89.50					89.00												
REDUCED DISTANCE	0.0	+10.0	20.0	40.0	60.0	80.0	84.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0	300.0	320.0
DISTANCE	0.0	10.0	20.0	20.0	20.0	20.0	4.0	16.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
STATION	No 0	+10.0	No 1	No 2	No 3	No 4	+4.0	No 5	No 6	No 7	No 8	No 9	No 10	No 11	No 12	No 13	No 14	No 15	No 16



WATER SURFACE ELEVATION	88.95	88.93	88.90	88.88	88.86	88.84	88.82	88.80	88.78	88.75	88.73	88.71	88.70 (88.20)	88.15 (87.65)	87.60	87.59	87.50	87.36		87.00	86.97	86.92	86.90
GROUND SURFACE ELEVATION													88.50	88.00	87.50		87.00			86.75			86.70
REDUCED DISTANCE	320.0	340.0	360.0	380.0	400.0	420.0	440.0	460.0	480.0	500.0	520.0	540.0	550.0	555.0	560.0	561.0	569.0	580.0	600.0	609.0	620.0	640.0	649.0
DISTANCE	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	10.0	5.0	5.0	1.0	8.0	11.0	20.0	9.0	11.0	20.0	9.0
STATION	No 16	No 17	No 18	No 19	No 20	No 21	No 22	No 23	No 24	No 25	No 26	No 27	+10.0	+15.0	No 28	+1.0	+9.0	No 29	No 30	+9.0	No 31	No 32	+9.0

SCALE

VERTICAL : 0 — 5 — 10(m)

HORIZONTAL : 0 — 10 — 20 — 30 — 40 — 50(m)

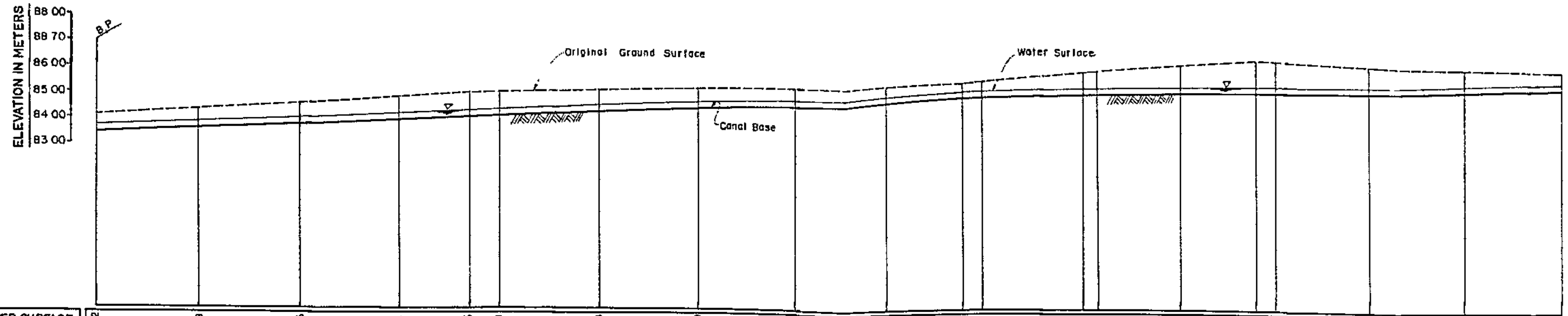
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

LONGITUDINAL PROFILE OF FIELD CANAL

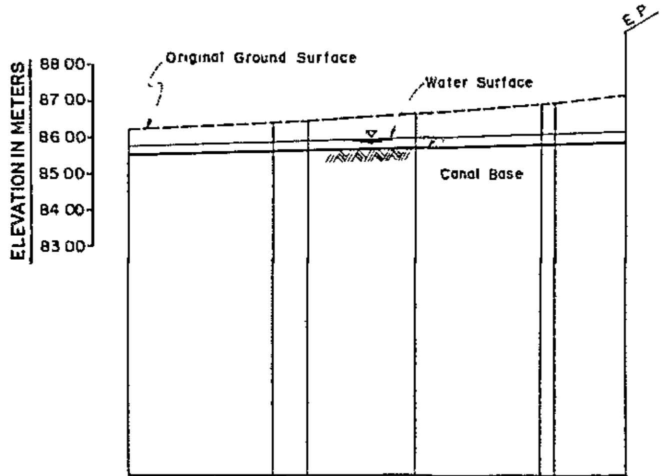
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
157



WATER SURFACE ELEVATION	83.72	83.89	84.05	84.21	84.35	84.38	84.54	84.70	84.87	85.03
GROUND SURFACE ELEVATION	84.06				85.00					
REDUCED DISTANCE	0.0	20.0	40.0	60.0	77.0	80.0	100.0	120.0	140.0	160.0
DISTANCE	0.0	20.0	20.0	20.0	17.0	3.0	20.0	20.0	20.0	20.0
STATION	No 0	No 1	No 2	No. 3	I P	No 4	No 5	No 6	No 7	No 8

WATER SURFACE ELEVATION	85.20	85.22	85.32	85.34	85.42	85.50	85.52	85.62	85.72	85.82
GROUND SURFACE ELEVATION	85.50			86.00		86.50				
REDUCED DISTANCE	176.0	180.0	200.0	203.0	220.0	236.0	240.0	260.0	280.0	300.0
DISTANCE	16.0	4.0	20.0	3.0	17.0	16.0	4.0	20.0	20.0	20.0
STATION	+16.0	No 9	No 10	+3.0	No 11	+16.0	No 12	No 13	No.14	No 15



WATER SURFACE ELEVATION	85.82	85.83	85.92	85.95	86.02	86.11	86.12	86.17
GROUND SURFACE ELEVATION		86.25		86.50		87.00		87.20
REDUCED DISTANCE	300.0	301.0	320.0	325.0	340.0	358.0	360.0	370.0
DISTANCE	20.0	1.0	19.0	5.0	15.0	18.0	2.0	10.0
STATION	No 15	+1.0	No 16	+5.0	No 17	+18.0	No 18	E P

SCALE

VERTICAL : 0 5 10 (m)

HORIZONTAL : 0 10 20 30 40 50 (m)

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

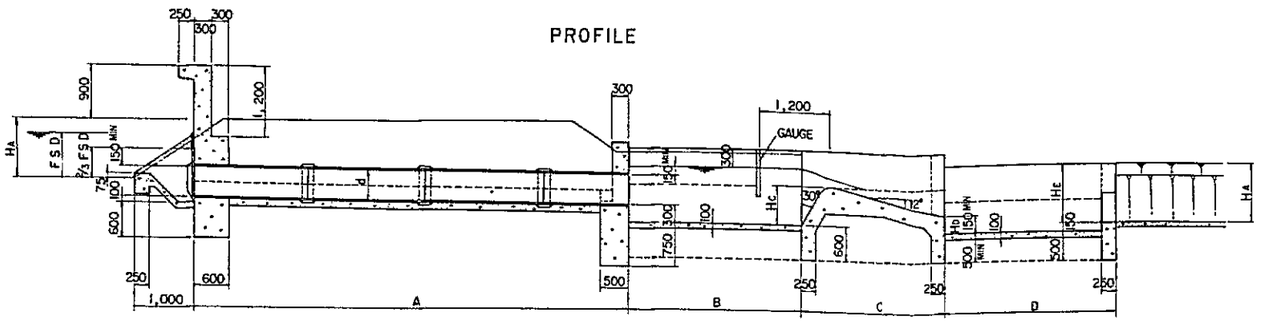
LONGITUDINAL PROFILE OF FIELD DRAIN

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

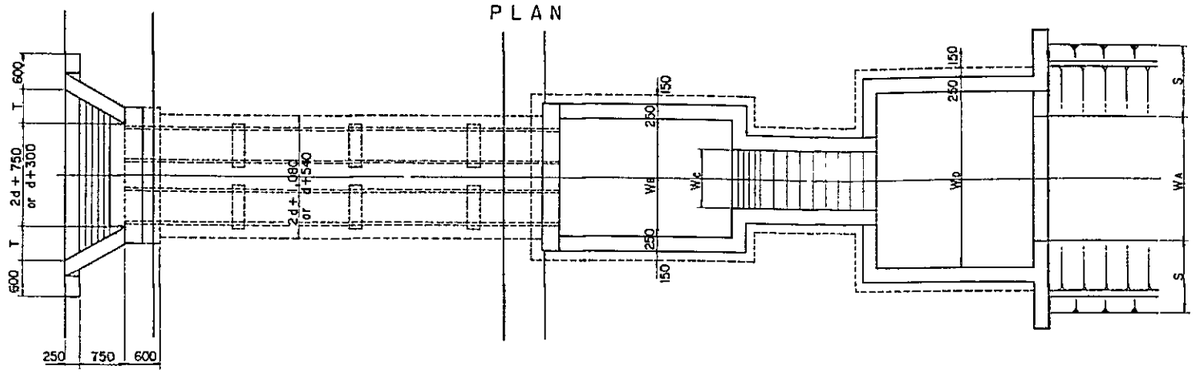
DWG NO 158

TURNOUT

PROFILE

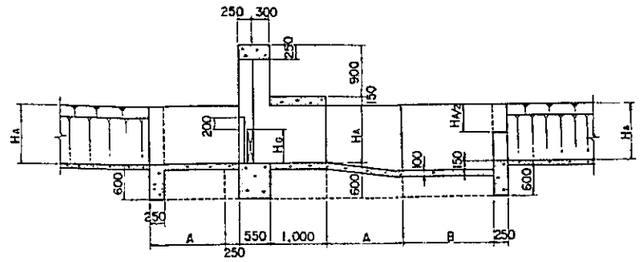


PLAN

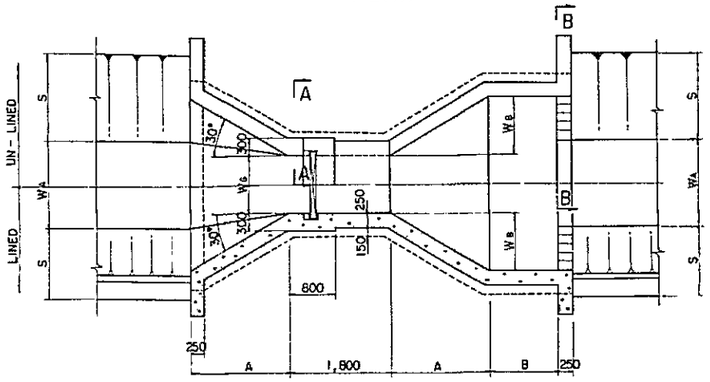


REGULATOR

PROFILE

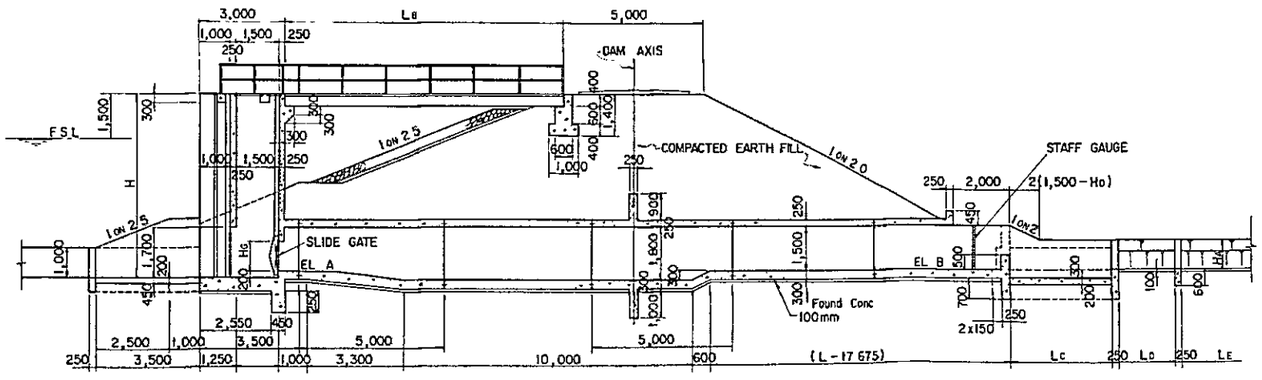


PLAN

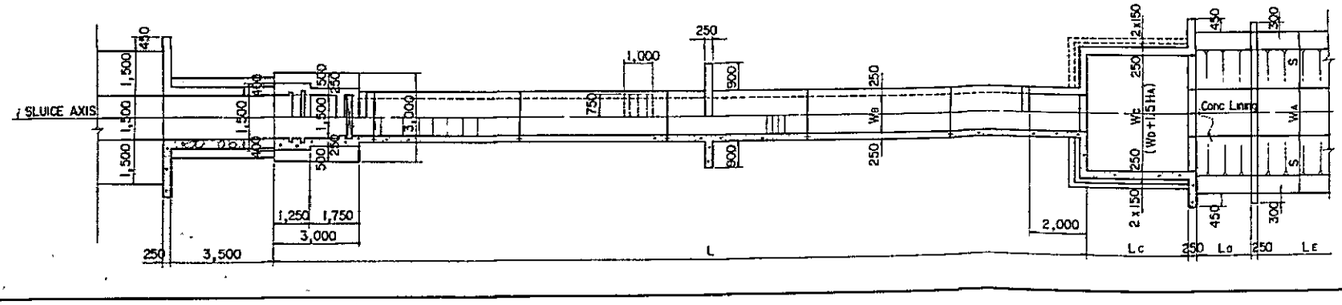


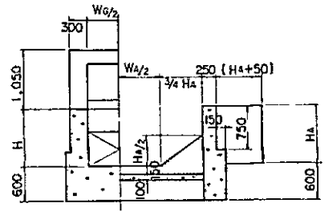
SLUICE STRUCTURE FOR DISTRIBUTARY CANALS

PROFILE



PLAN





SECTION A-A SECTION B-B

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

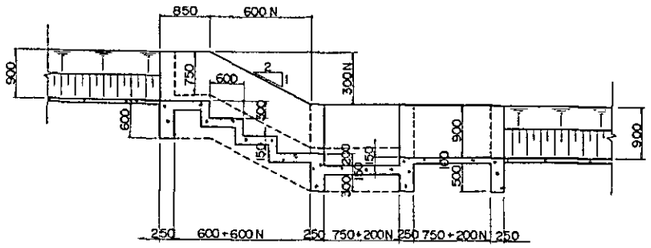
TITLE OF DRAWING

TURNOUT, SLUICE AND REGULATOR

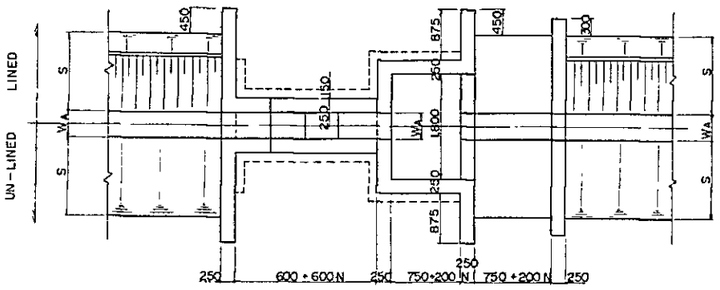
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO 201

DROP FOR CANAL TYPE Ⅳ

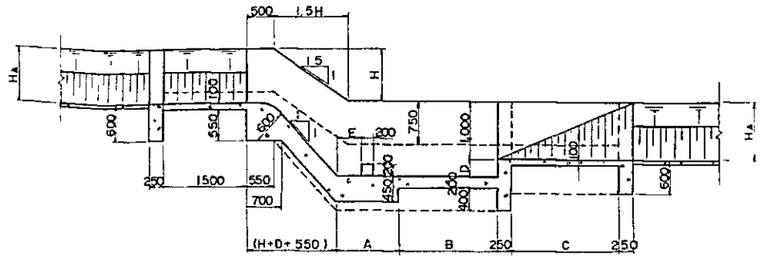


PROFILE

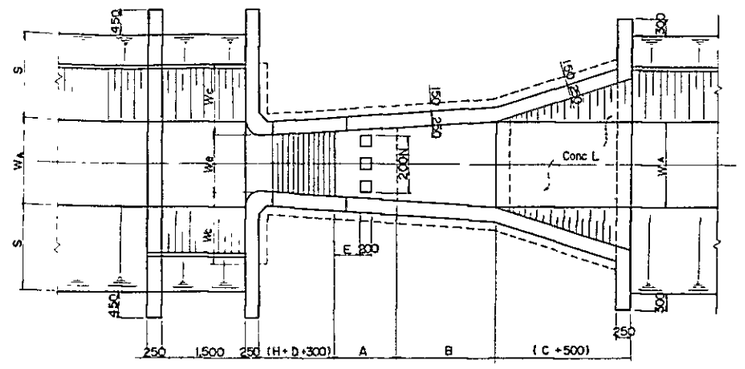


PLAN

DROP FOR CANAL TYPE Ⅰ~Ⅲ

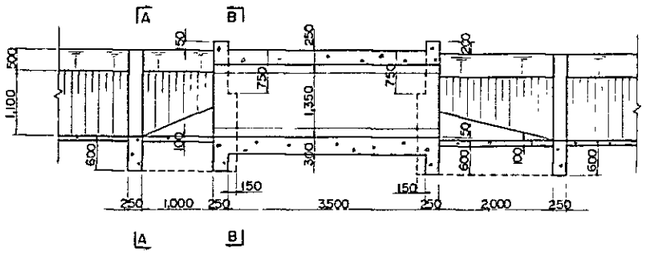


PROFILE

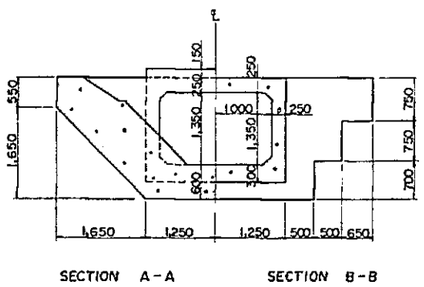


PLAN

BOX CULVERT FOR MB CANAL

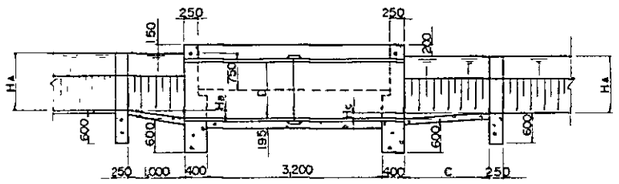


PROFILE

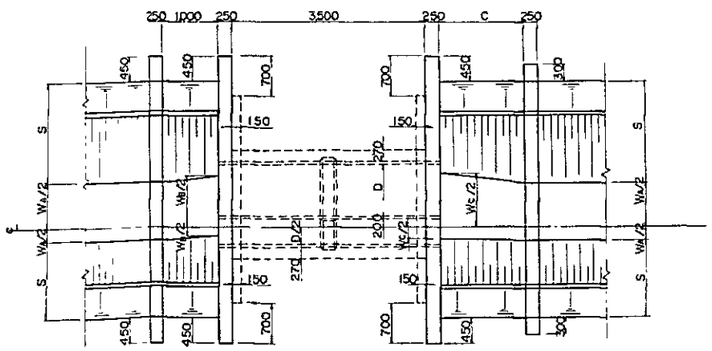


SECTION A-A SECTION B-B

PIPE CULVERT FOR D CANAL



PROFILE



PLAN

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

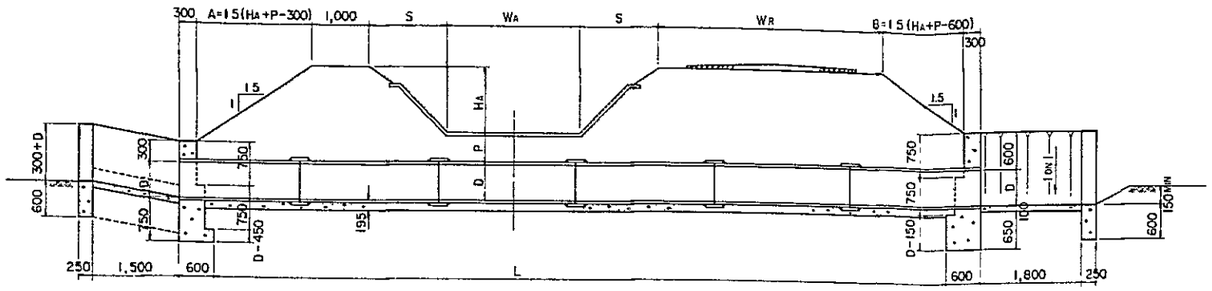
DROP AND CULVERT

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

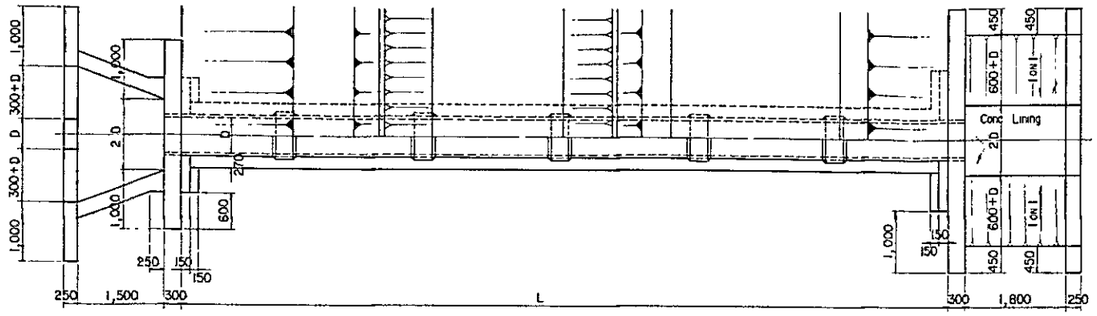
DWG NO 202

DRAINAGE UNDER CROSSING

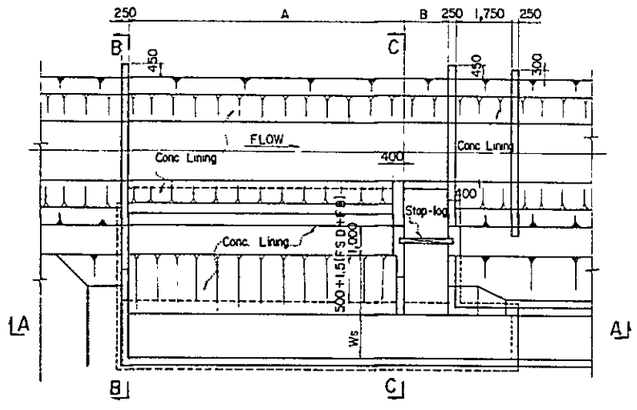
PROFIE



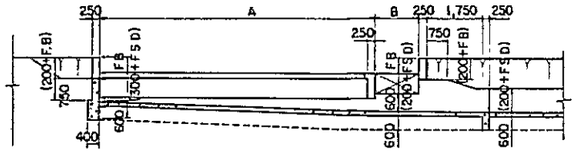
PLAN



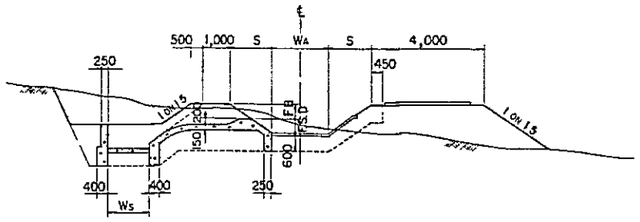
SPILLWAY STRUCTURE FOR DISTRIBUTARY CANALS



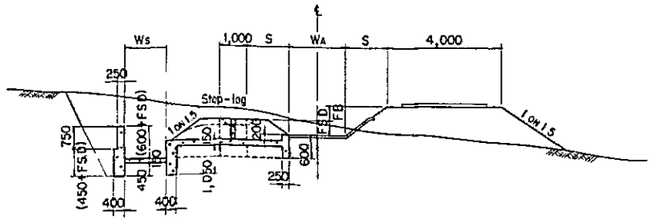
PLAN



SECTION A-A



SECTION B-B



SECTION C-C

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

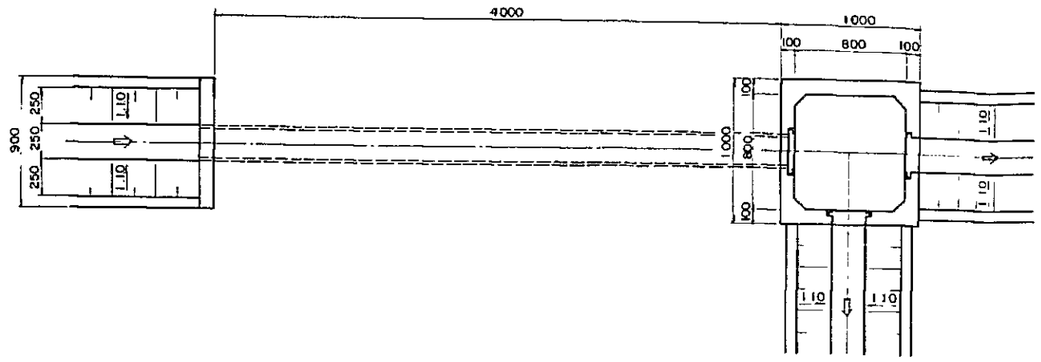
TITLE OF DRAWING

DRAINAGE UNDER CROSSING
AND SPILLWAY

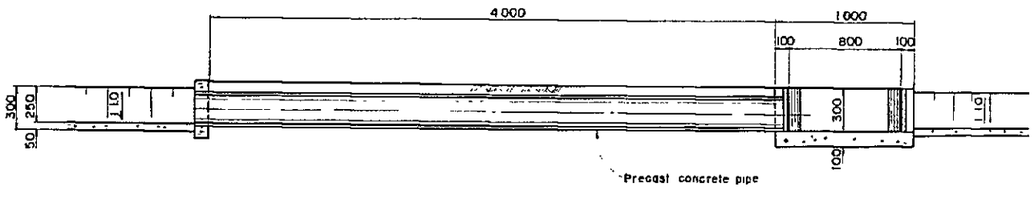
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO.
203

DIVISION BOX

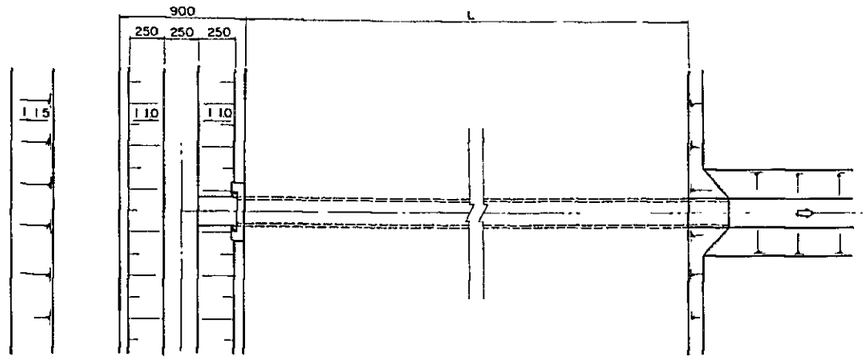


PLAN

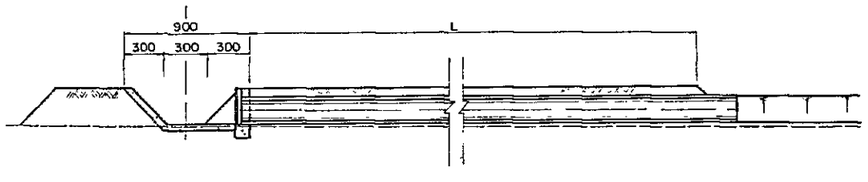


PROFILE

FARM INLET



PLAN



PROFILE

SCALE
0 10 20 (m)

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF
PILOT DEMONSTRATION FARM IN MAHAWELI

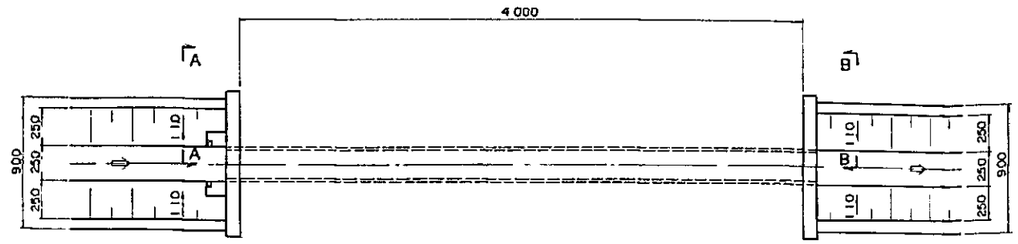
TITLE OF DRAWING

DIVISION BOX, FARM INLET

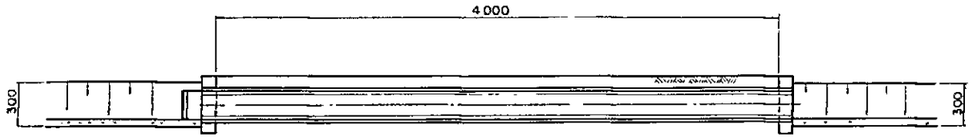
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
221

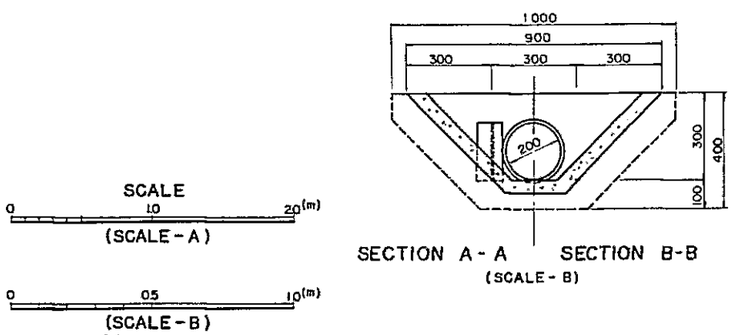
CULVERT
(SCALE - A)



PLAN

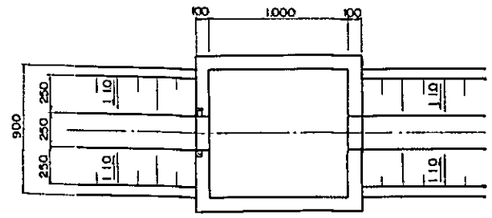


PROFILE

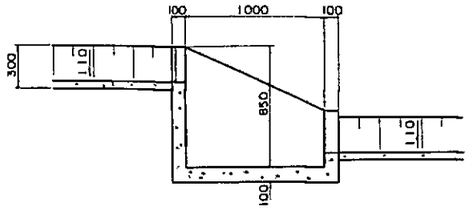


SECTION A - A SECTION B-B
(SCALE - B)

DROP (SCALE - A)

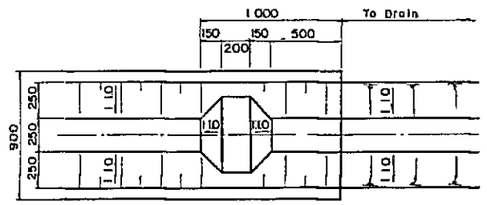


PLAN

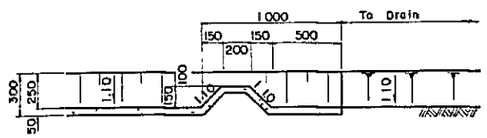


PROFILE

TERMINAL STRUCTURE (SCALE - A)



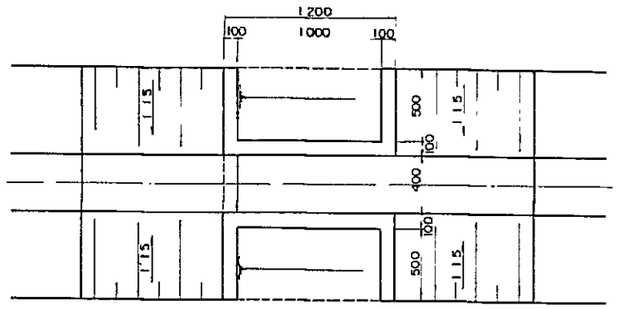
PLAN



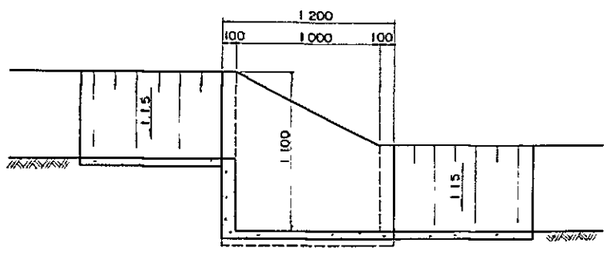
PROFILE

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI	
TITLE OF DRAWING CULVERT, DROP, TERMINAL STRUCTURE	
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	DWG NO 222

DRAINAGE DROP
(SCALE-A)

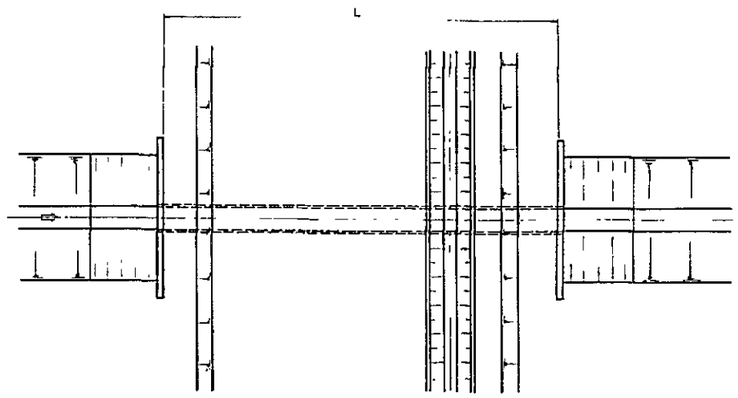


PLAN

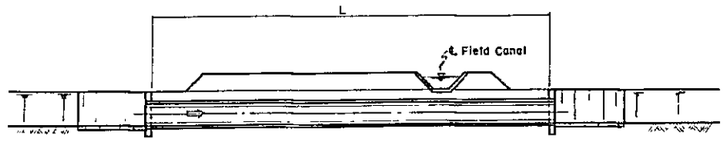


PROFILE

DRAINAGE UNDER CROSSING
(SCALE-B)



PLAN



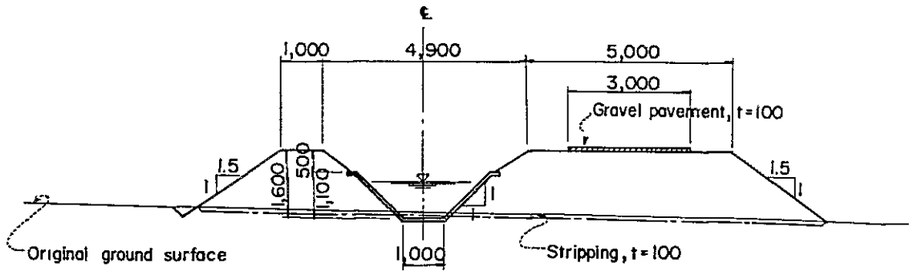
PROFILE

SCALE
0 10 20 (m)
(SCALE-A)

0 10 20 30 40 50 (m)
(SCALE-B)

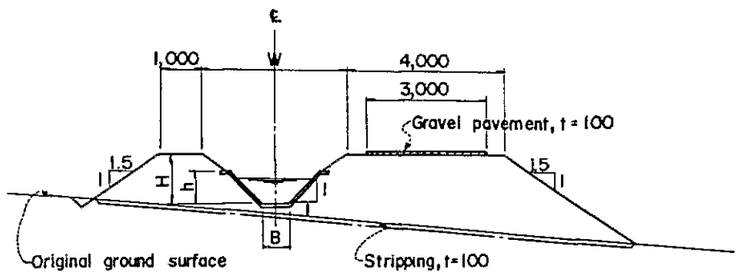
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI	
TITLE OF DRAWING DRAINAGE DROP, DRAINAGE UNDER CROSSING	
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	DWG NO 223

MINOR BRANCH CANAL

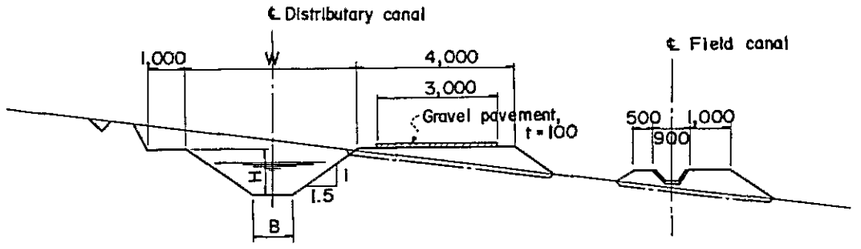


DISTRIBUTARY CANAL

LINED



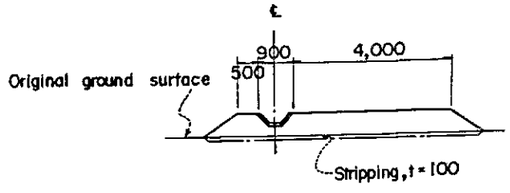
UN-LINED



DIMENSION TABLE OF DISTRIBUTARY CANAL

Type	B	W	h	H
Concrete lined				
I	700	3,700	800	1,200
II	600	3,400	700	1,100
III	500	3,100	600	1,000
IV	400	2,800	500	900
Un-lined				
I	1,100	4,700		1,200
II	1,000	4,300		1,100
III	800	3,800		1,000
IV	600	3,300		900

FIELD CANAL



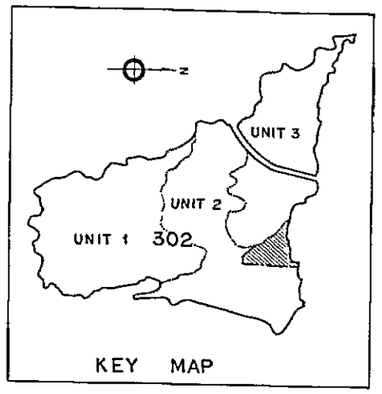
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

TITLE OF DRAWING

TYPICAL SECTION OF CANALS AND ROADS

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
251



LEGEND

- DISTRIBUTARY CANAL / SUB DISTRIBUTARY CANAL AND O & M ROAD
- FIELD CANAL AND O & M ROAD
- DRAINAGE CANAL
- TURNOUT
- DIVISION BOX
- FARM INLET
- TURNOUT AREA BOUNDARY
- LOT BOUNDARY

Remarks

M B CANAL MINOR BRANCH CANAL
B M BENCH MARK

SCALE

50 0 50 100m

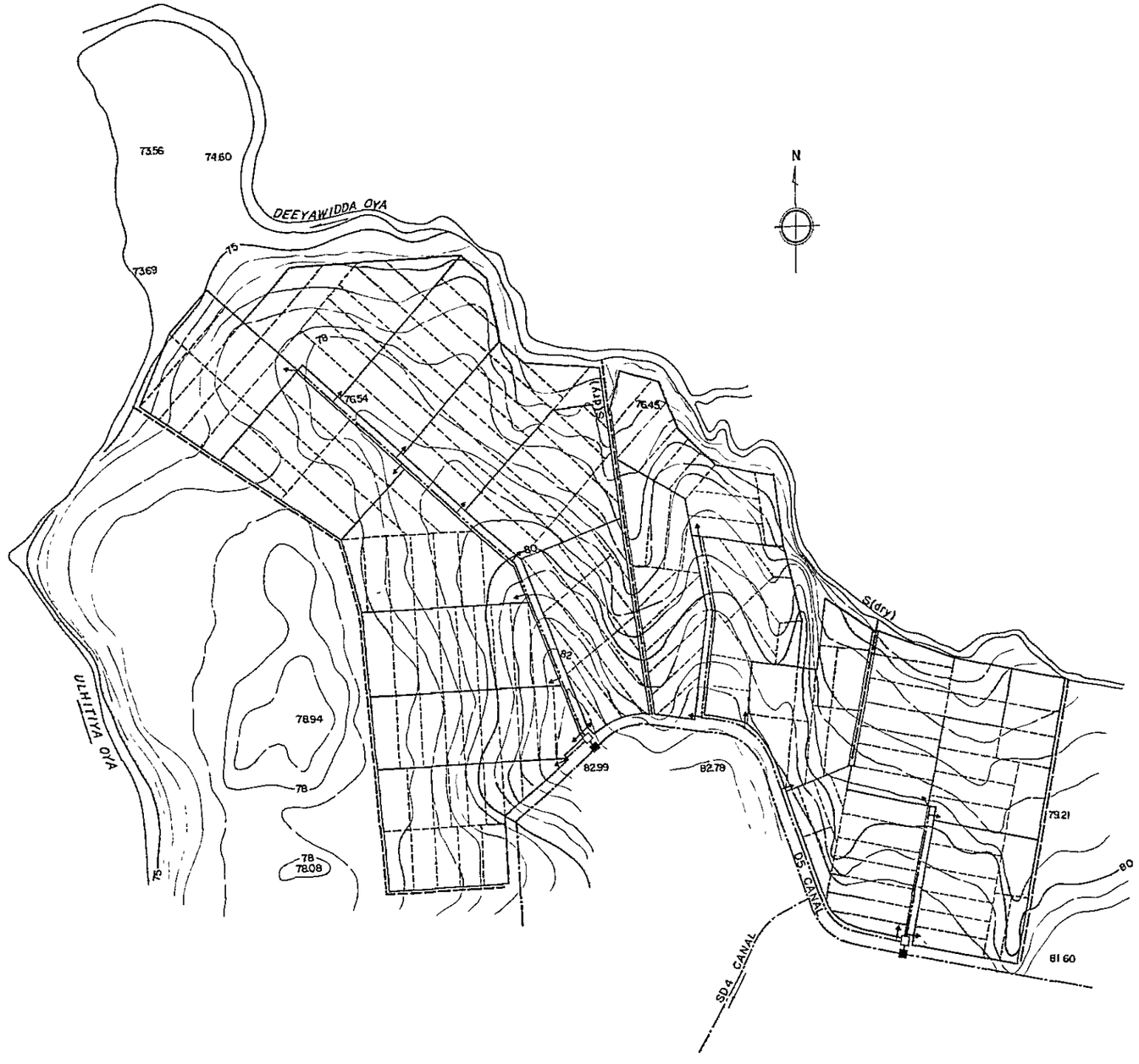
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

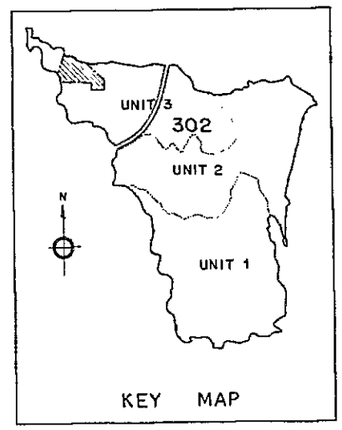
TITLE OF DRAWING

TYPICAL LAYOUT (1/2)

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO 252





LEGEND

- DISTRIBUTARY CANAL / SUB-DISTRIBUTARY CANAL AND O & M ROAD
- FIELD CANAL AND O & M ROAD
- DRAINAGE CANAL
- TURNOUT
- DIVISION BOX
- FARM INLET
- TURNOUT AREA BOUNDARY
- LOT BOUNDARY

SCALE
50 0 50 100m

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI

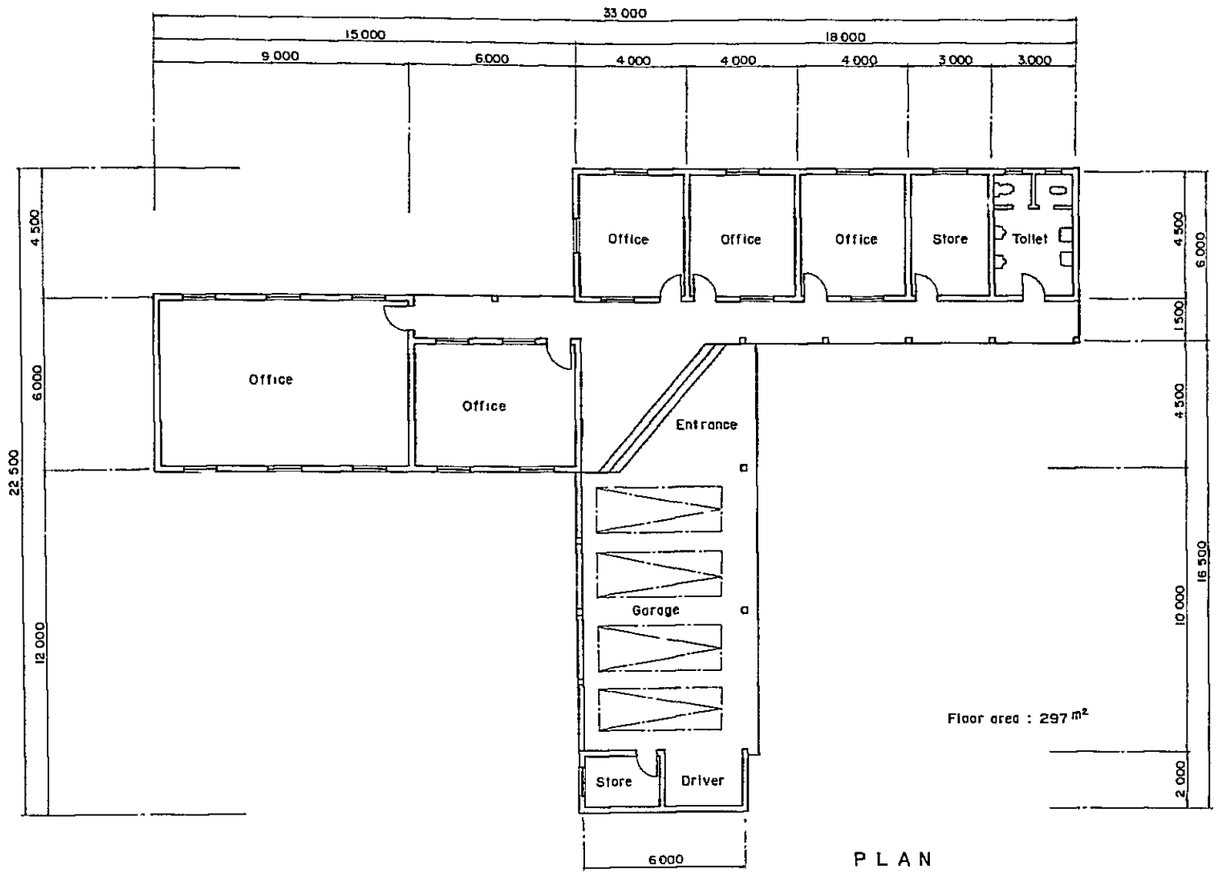
TITLE OF DRAWING

TYPICAL LAYOUT (2/2)

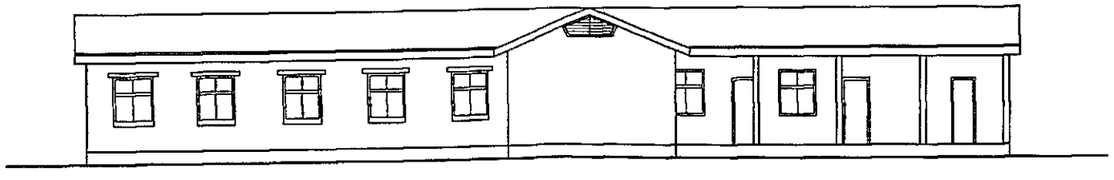
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

DWG NO
253

CONSTRUCTION OFFICE



PLAN



ELEVATION

SCALE
0 5 10 (m)

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI	
TITLE OF DRAWING OFFICE	
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	DWG NO 301