3.1.2 Related Structures

Many kinds of structures are needed in relation with the irrigation canals for the Project. They consist of: crossing structures, turnouts, division structrues, checks, water measurement devices, drop structures, spillways, wasteways and so forth. All the related structures along the proposed canals are listed in Table 6.3.13 to 6.3.15.

Design consideration for these related structures are as follows.

(1) Crossing Structures

The proposed irrigation canals would inevitably cross at some places over or under the tributaries, drainage channels and roads. Aqueducts, bridges and cross drainage structures have been designed for those crossings.

a) Aqueducts

An aqueduct has been provided for the canal to cross the existing tributaries or drainage channels. The design velocity in an aqueduct has been decided 1.5 times as much as that in the upper and lower canals from view point of the economy. In this Project, aqueduct would also serve as road bridge. A reinforced concrete aqueduct which shaped rectangularhas been designed after considering the required scale of aqueduct, durability and economical aspect. Wasteway has been provided with manual-operated slide gate (s) at the just upstream portion of the aqueduct so that can evacuate a part and/or whole of canal water. The typical design of aqueduct is shown in Dwg. No. I-017.

b) Cross drainage structures

The drainage water is conveyed across the proposed canal by under-crossings or is dropped in the canal by drainage inlets. Single or multi-barrel pre-cast circulat concrete conduit(s) has been adopted for the undercrossing. At places where the drainage canal is higher than the proposed canal, drainage inlets into the canal are provided for small catchments, with discharge less than 10 cusecs.

Those drainage structures are illustrated in Dwg. No.I-108.

c) Bridges

Since existing condition of road network in the project area is very poor, the proposed irrigation canals would corss few existing roads. In order to connect separated fields by the canals and to link villages and to also serve for operation and maintenance, however,

bridges have been provided at an interval of half a mile along the canal in this Project. It is proposed to adopt concrete slab bridges are shown in Dwg. No.I-109.

(2) Turnouts and Division structures

Turnouts are used to divert water from a canal to canal/canals. In accordance with the design discharge and the topographic condition where the turnout is located, the following three types of turnouts are adopted.

$Q \leq 20$ cfs Type A: Slide gate + Single barrel concrete pipe + Measuring device (M.D.)

$20 \leq Q \leq 130$ Type B; Slide gates + Double barrel concrete pipes + M.D.

$Q \geq 130$ cfs Type C; Slide gate + Concrete box current + M.D.

Water measuring devices should be provided at turnout on canals. As a general rule, the Cipolletti weir is adopted for measuring device in this project because this type is a most common and the least costly. If an adequate water head loss is unavailable or the discharge is large, the broad-crested weir should be adopted.

The standardized designs of the turnouts are shown in Dwg. No. I-20.

Division structures combined with gate regulater(s) are used to divide the flow from a supply canal among two or more canals. Typical division structures are designed as shown in Dwg. No. I-021 and I-022.

(3) Checks

Checks are provided for maintaining a certain water depth in order to feed the fluctuating needs of different offtake canals and to prevent high flow velocity. Two types of checks to be used in this Project are standardized: one is a combined type of the fixed overflow weir and manually operated slide gate(s) and the other one has been designed as a flumed section and combined with a drop structure. They are illustrated in Dwg. No. I-023.

(4) Water Measuring Devices

Water measuring devices have been provided at the intake site and at each turnouts on the canals. In this Project, the type of Cipolletti weir is adopted as the device in view points of economical aspects and considering operation and maintenance. In case of that an adequate water head loss is unavailable or the discharge is large, however, the broad-crested

weir will be adopted. These devices are used in combination with other canals structures.

(5) Drop Structures

Drop structures are used in canals to dissipate surplus energy. As the number of drops to be provided in the canal system of this Project is fairly large, it is desirable to standardized the design. After considering the required drop height, the topographical condition and other factor, vertical drop type has been adopted for this Project. In this type, the dissipation of energy is effected by the diffusion of water, as the water enters the pool of water downstream. Check structures are often combined with the drops to prevent racing and scouring upstream of the structure.

Vertical drops are standardized as in Dwg. No. I-024.

(6) Spillways and Wasteways

In order to automatically eliminate excess flow discharge due to floods or to unproper canal intake gate operation, spillways have been provided at the beginning or in adequate location along the more important canal system. Spillways are usually combined with wasteways which consist of mannally operated slide gates to provide means of removing the entire flow in the canal in cases of breakdown or desilting.

In this Project, the side channel overflow spillway has been adopted being combined with the wasteway as in Dwg. No. I-025.

(7) Washing and Bathing Places

Due to the intensive use of the exsiting canals for washing purposes special access points for people are provided in the canals incorporating steps and a bathing place. The number of these will be roughly two for every 3 miles length of canal.

The typical design is shown in Dwg. No. I-026.

Table 6.3.13 List of Proposed Related Structures in System D-1

Canal Type	AQ.	C.D.	D.I.	BR.	T.O.	D.S.	C.G.	M.D.	DR.	S.W.	W.P.
* M.C.	-	-	-	4	-	-	-	1	-	-	2
* 1-1	-	-	-	1	-	-	1	1	-	-	1
* 1-2	-	-	-	2	-	-	-	-	-	-	1
* 1-3	-	-	-	2	-	-	-	-	-	-	1
1-4	-	-	-	3	2	-	-	1	-	1	1
1-5	-	-	1	3	3	-	1	-	-	-	1
1-6	-	-	-	4	4	-	2	-	1	-	1
1-7	-	-	-	2	1	1	2	-	4	-	-
2-1	-	3	4	6	2	-	1	1	-	1	2
2-2	-	3	2	4	4	1	2	-	-	-	1
2-3	-	-	-	4	3	-	1	1	3	1	1
2-4	-	-	-	4	5	-	3	-	3	-	1
2-5	-	-	1	4	1	1	2	-	3	-	1
3-1	-	-	1	3	6	-	1	1	2	1	1
3-2	-	-	-	6	6	-	3	-	5	-	2
3-3	-	-	-	4	2	1	2	-	3	-	1
Total	0	6	9	56	39	4	21	6	24	4	18

Notes; AQ. = Aqueduct, C.D. = Cross Drain, D.I. = Drainage Inlet
BR. = Bridge, T.O. = Turnout, D.S. = Division Structure
C.G. = Check Gate, M.D. = Water Measuring Divice, DR. = Drop
S.W. = Spillway & Wasteway, W.P. = Washing & Bathing Place

Table 6.3.14 List of Proposed Related Structures in System D-2

Canal Type	AQ.	C.D.	D.I.	BR.	T.O.	D.S.	C.G.	M.D.	DR.	S.W.	W.P.
* M.C.	-	-	-	3	-	-	-	1	-	-	2
* N-1	-	-	-	1	-	-	1	1	-	-	1
* N-2	-	-	-	3	-	-	-	-	-	-	2
* N-3	-	-	-	1	-	-	-	-	-	-	-
* N-4	-	-	-	4	-	-	-	-	-	-	2
N-5	1	-	-	2	1	1	-	-	-	1	1
N-6	-	-	-	3	2	-	-	1	1	-	1
N-7	-	-	-	3	-	1	1	-	1	-	1
N-6-1	-	-	-	2	2	-	-	1	-	-	-
N-6-2	1	-	-	2	2	-	1	-	-	-	-
N-6-3	-	-	-	2	-	1	1	-	-	-	1
* E-1	-	-	-	3	-	-	1	1	-	-	1
* E-2	-	-	-	2	-	-	-	-	-	-	1
* E-3	-	-	-	2	-	-	-	-	-	-	1
* E-4	-	-	-	2	-	-	-	-	-	-	-
* E-5	-	-	-	2	-	-	-	-	-	-	-
E-6	1	-	-	3	2	-	-	-	-	1	1
E-7	-	-	-	3	2	-	2	-	-	-	1
E-8	-	-	-	2	-	1	-	1	-	-	-
Total	3	0	0	45	11	4	7	5	2	2	16

Notes; AQ. = Aqueduct, C.D. = Cross Drain, D.I. = Drainage Inlet
BR. = Bridge, T.O. = Turnout, D.S. = Division Structure
C.G. = Check Gate, M.D. = Water Measuring Divice, DR. = Drop
S.W. = Spillway & Wasteway, W.P. = Washing & Bathing Place

Table 6.3.15 List of Proposed Related Structures in System A/D

Canal Type	AQ.	C.D.	D.I.	BR.	T.O.	D.S.	C.G.	M.D.	DR.	S.W.	W.P.
1	5	1	1	13	6	-	2	1	-	1	4
2	-	-	-	1	-	1	1	-	-	-	-
3	1	1	2	6	4	-	3	1	2	1	2
4	-	1	-	3	4	-	3	-	1	-	1
5	-	-	-	4	2	1	2	-	-	-	1
1-1	-	1	-	6	1	1	1	-	1	-	2
2-1	-	1	1	2	3	-	1	1	1	-	-
2-2	-	1	1	5	2	1	-	-	1	-	1
Total	6	6	5	40	22	4	13	3	6	2	11

Notes; AQ. = Aqueduct, C.D. = Cross Drain, D.I. = Drainage Inlet
BR. = Bridge, T.O. = Turnout, D.S. = Division Structure
C.G. = Check Gate, M.D. = Water Measuring Divice, DR. = Drop
S.W. = Spillway & Wasteway, W.P. = Washing & Bathing Place

3.2 Drainage Plan

(1) General

As has been mentioned in the chapter of the present condition of the Project area, the problem of drainage in the Project area concentrates itself mainly on the discharge of excess water from frequently occurring storms of high rainfall intensity.

The purpose of a drainage system is to remove the excess water from the ground surface or subsoil. A drainage system should always be considered when an irrigation project is envisaged. Generally, open or underground drains or combination thereof are used as the means of drainage. In case of this Project, existing natural streams will be used as main drainage channel. When the existing natural stream section is unable to carry the design flood discharge, without backing up and inundating the irrigation system, it would be necessary to excavate and embank the natural drainage lines and/or to make smooth drainage by deviations or short cuts.

Seven tributaries to be improved have been selected for use as main drainage channels, which will mostly drain into the flood plain of the Mahaweli Ganga. The selected tributaries to be improved among System D-1, D-2 and A/D within the newly reclaimed lands are shown in the following table and the proposed drainage system is illustrated in Fig.6.3.8

Name	System	Length(miles)
Kalu Ganga	D-1	11.5
Thimbri Ela	D-1	7.5
Ambagaha Oya	D-1	8.4
Periya Aru	D-2	11.2
Sinna Ganga	D-2	9.0
Uppu Aru	A/D	4.8
Karappankadawela Aru	A/D	4.4

The design requirements for the main drainage channels are explained in the following paragraphs.

(2) Design Discharge

a) Planning of year of frequency occurence

According to "MAHAWELI GANGA IRRIGATION AND HYDRO-POWER SURVEY" by UNDP/FAO, 5-year frequency would be enough as the basis of design of drainage facilities in Sri Lanka. In this Project, it is also decided that 5-year frequency flood is taken as the design discharge.

b) Design discharge

The discharge capacity of main drainage channel will be provided to cater to a flood of 5-year frequency, as was stated previously.

For the estimation of the discharge, it will be assumed the lands have been developed as per the Project proposals. The flood discharge has been calculated according to the formula given below, which belongs to the category of formulae based on experience and is prevailing in Sri Lanka.

$$Q = C \times A \times R_t$$

$$t = (11.9 \times L^3 / H)^{0.385}$$

where, Q ; flood discharge in cusec,

A ; catchment area in acres,

L ; max. length of channel in miles,

H ; max. differnce in elevation in feet,

R_t; Rainfall intensity in inches within duration t hours,

t ; time of concentration in hours (travel time from the most distant point in the catchment to the point of interest), and

C ; coefficient of runoff

Assumption L = 1.5 A (A in sq.miles)

The rainfall intensity to be adopted for this drainage plan is as for Anuradhapura and is shown in Fig.6.3.9 which is given in the above Report.

The runoff coefficient to be applicable in this Project is proposed as follow.

Classification of area	Runoff coefficient for drainage discharge for 5-year frequency
Jungle area	0.2
Paddy field	0.3
Cropped land	0.4

The calculation of the flood discharges/design discharges for each drainage channel proposed, which was carried out according to the method described above, have been summarized in Table 6.3.16.

(3) Standard Cross Sections of Main Drainage Channels

As for the standard cross section, 11 types are designed for the main drainage channels.

The seciton proposed for the drainage channel is such that 2/5 of 5-year frequency flood will be carried by the portion excavated below from the ground level, and 3/5 of 5-year flood will be taken care of by the section above ground level and formed by embankments on the both sides. The bank top-width and berm width shall be provided at least 12 ft. and 10 ft., respectively. Freeboard in the main drainage channel is decided 3 ft. On the outside of the embankments, drainage ditches will be excavated.

For the purpose of the hydraulic design, the Manning formula has been adopted in the same manner as the irrigation canal. The value of roughness coefficient or 'N' for the design has been taken as 0.040.

The hydraulic calculations for determining standardized cross sections are tabulated in Table 6.3.17. The proposed standard channel sections for the drainage system are illustrated in Fig. 6.3.10 and 6.3.11.

Fig. 6.3.8 General Plan of Drainage System

Drainge Channel		Catchment Area (Acres)
Kalu Ganga	①	16 780
	②	14 040
		30 820
Thimbri Ela	③	4 110
	④	2 740
		6 850
Ambagaha	⑤	4 650
Oya	⑥	17 350
		22 000
Periya Aru	⑦	17 800
	⑧	26 500
		44 300
Sinna Ganga	⑨	4 300
Uppu Aru	⑩	12 920
Karappan-Kadawela Aru	⑪	19 030

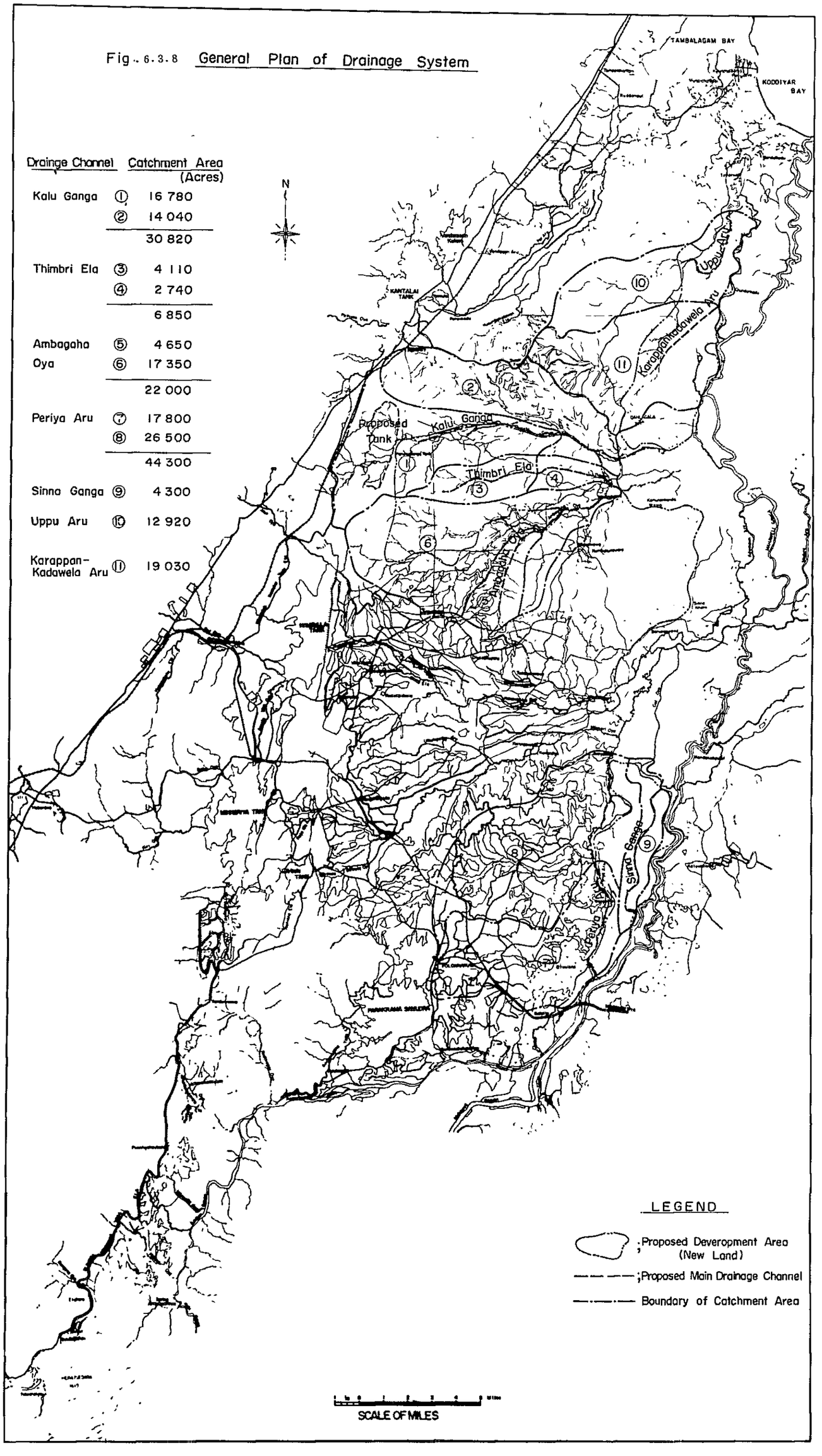


Fig 6.3.9 Rainfall Intensity — Duration Curve
(Anuradhapura)

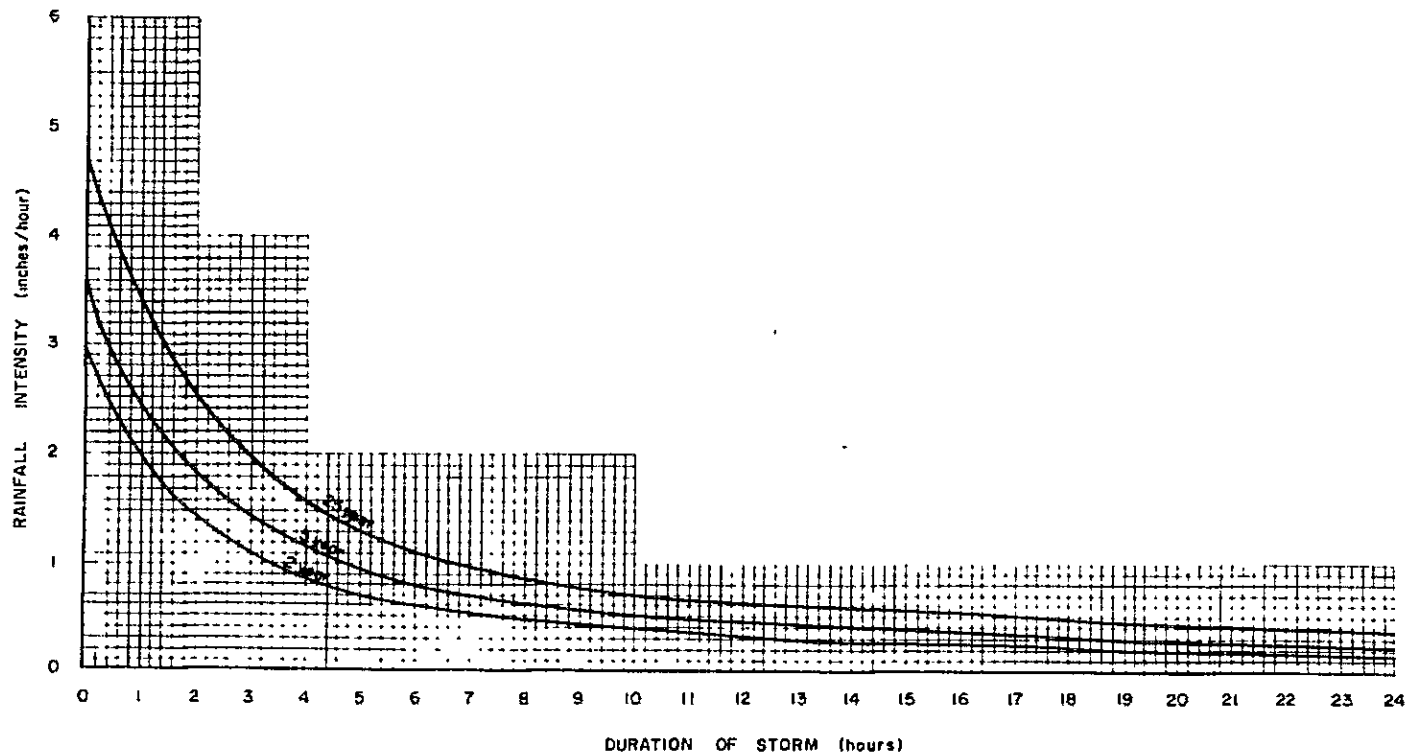


Fig. 6.3.10 Standard Cross Sections of Drainage Main Channels (1)

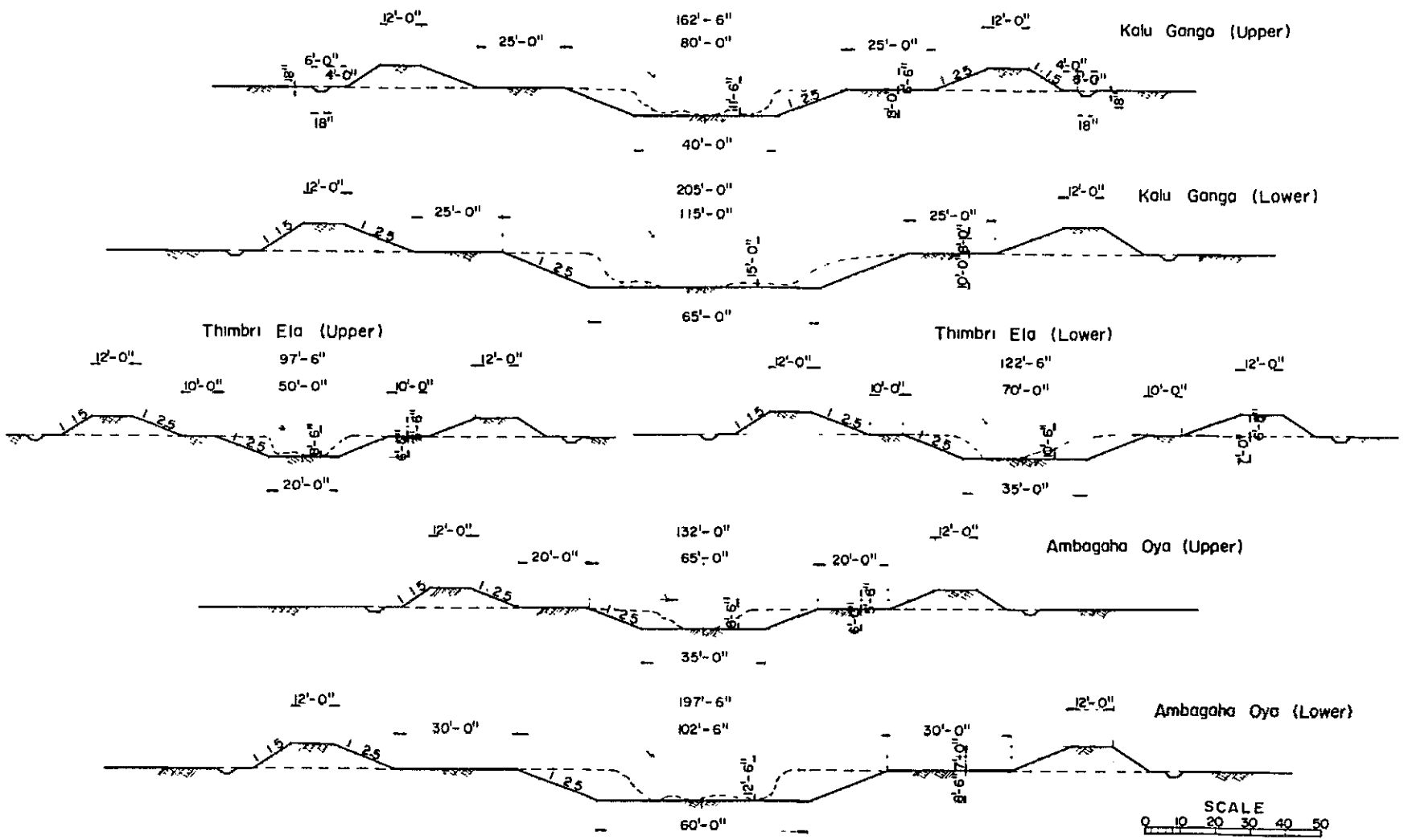


Fig. 6.3.11 Standard Cross Sections of Drainage Main Channels (2)

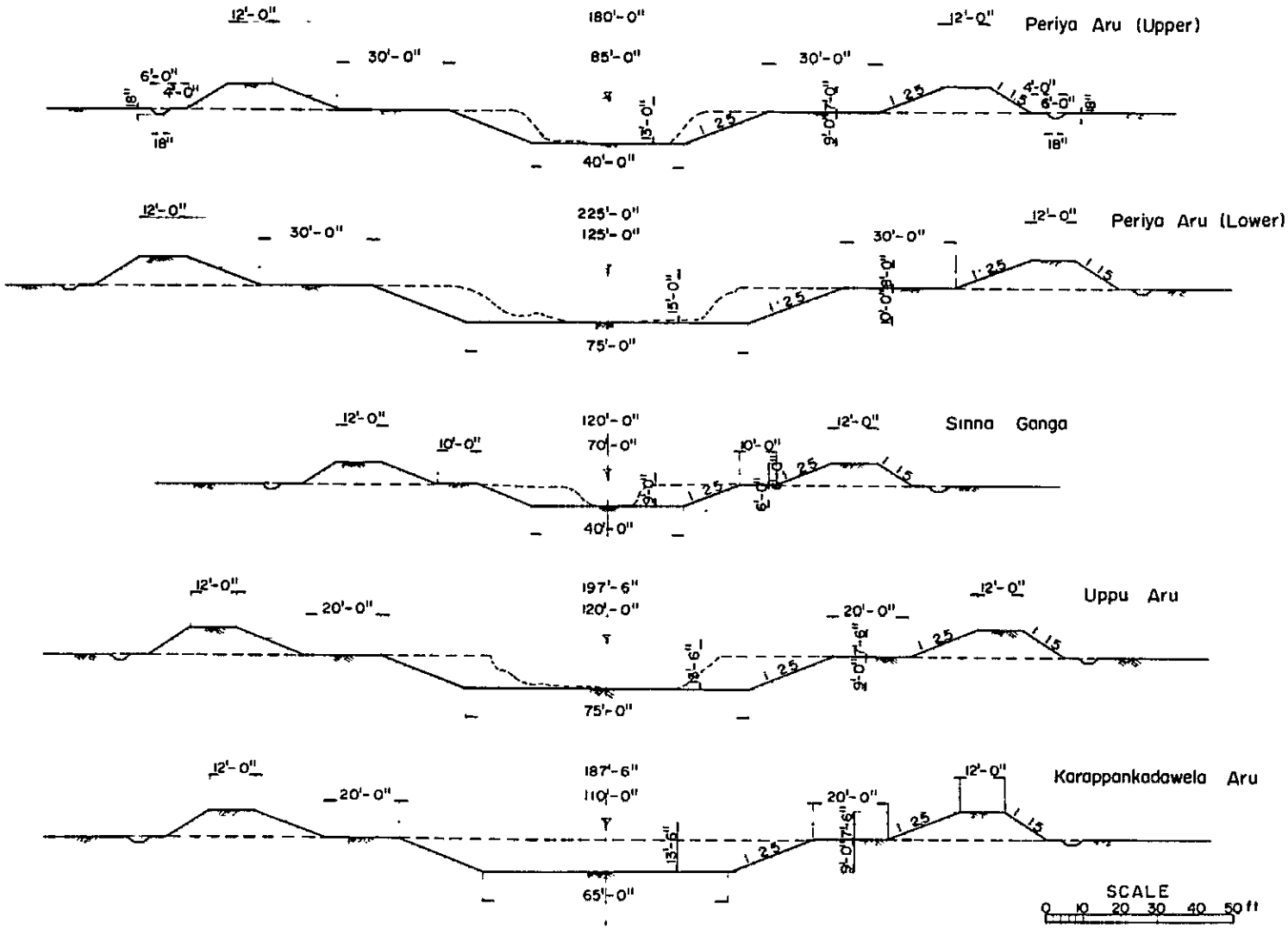


Fig. 6.3.12 Standard Cross Sections of Ditch Drain & Road

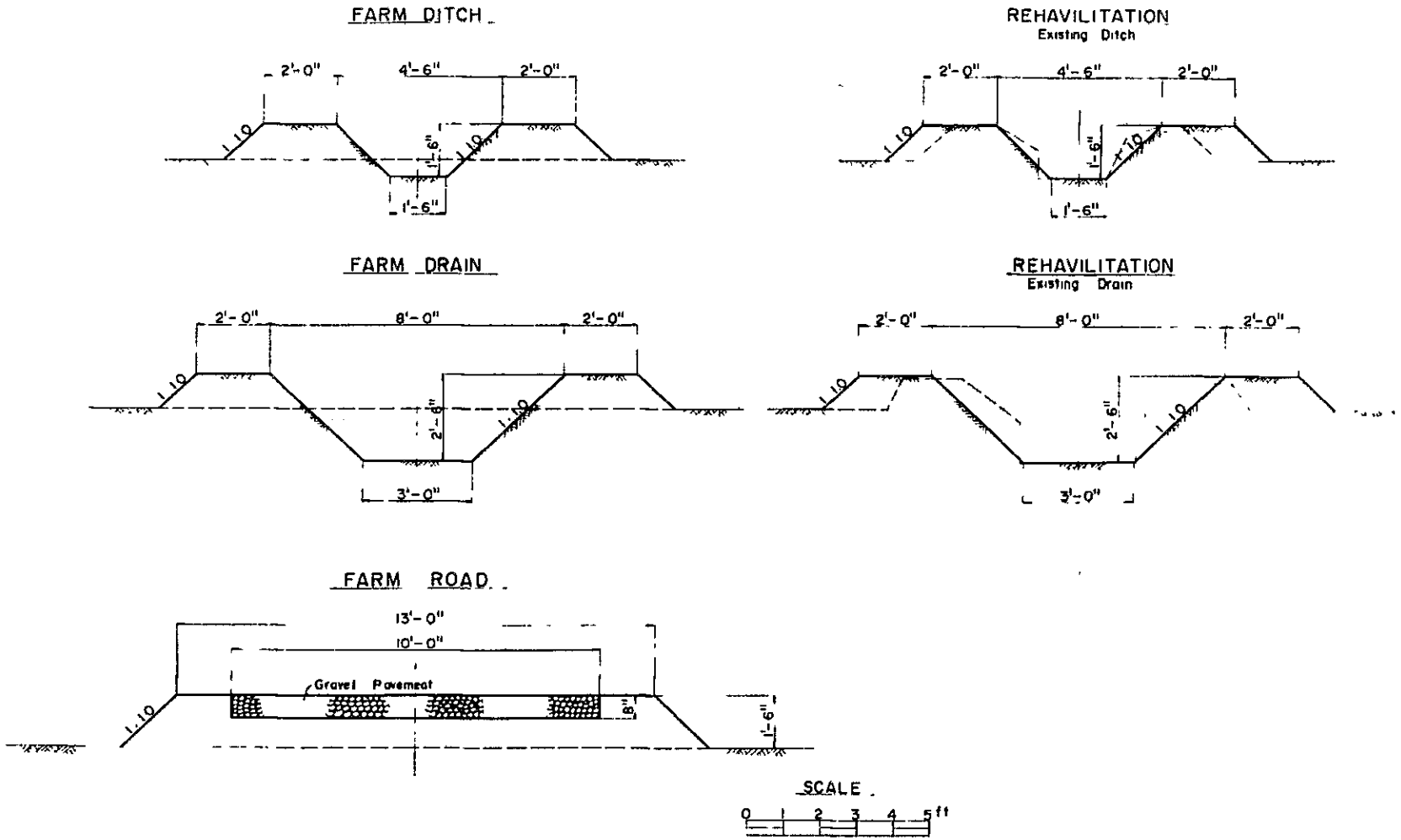


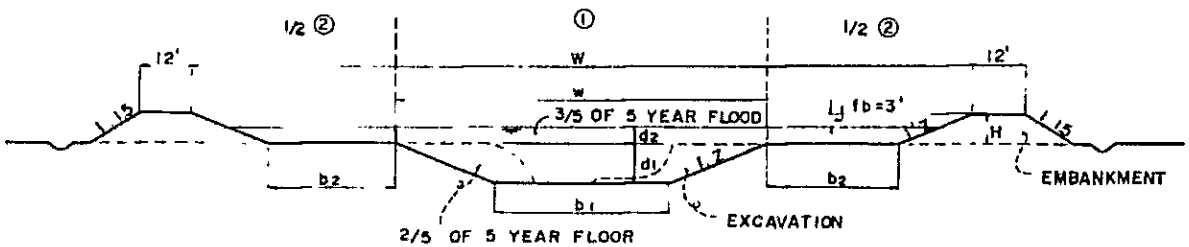
Table 6.3.16 Estimation of 5-year Frequency Flood Discharge for Drainage System

System	Drainage Channel	Reach of Channel	Length (miles)	Gradient (ft/mi)	Catchment area (Acs)	Classification of area	Run off Coefficient	Average Run off Coefficient	t (hr)	Rt (in)	Q (cfs)
D - 1	Kalu Ganga	Upper	7 7	23	16 780	Crop 10 080	0 4	0.36	37	1 2	7250
						Paddy 6 700	0 3				
		Lower	10 4	19	30 820	Crop 22 700	0 4	0 37	5 1	0 9	10260
						Paddy 8 120	0 3				
	Thimbri Ela	Upper	3 8	24	4 110	Crop 2 050	0 4	0 35	2 1	1 8	2590
						Paddy 2 051	0 3				
		Lower	4 9	26	6 850	Crop 3 150	0 4	0 35	2 5	1 6	3840
						Paddy 3 700	0 3				
	Ambagaha Oya	Upper	4 0	19	4 650	Crop 1 860	0 4	0 34	24	1 7	2 690
						Paddy 2 790	0 3				
		Lower	8 9	20	22 000	Crop 8 800	0 4	0 34	4 4	1 1	8230
						Paddy 13 200	0 3				
D - 2	Periya Aru	Upper	7.9	8	17 800	Crop 8 900	0.4	0 35	5 7	0 8	4980
						Paddy 8 900	0 3				
		Lower	12 5	5	44 300	Crop 18 200	0 4	0 34	9 8	0 5	7530
						Paddy 26 100	0 3				
	Sinna Ganga	Entire	3 9	5	4300	Crop 400	0 4	0 31	4 0	1 2	1600
						Paddy 3900	0 3				
A/D	Uppu Aru	Entire	6 7	15	12 920	Crop 8 400	0.4	0 37	4 0	1 2	5740
						Paddy 4 520	0.3				
	Karappankadawala Aru	Entire	8 2	13	19 030	Crop 9 500	0.4	0 35	4 9	0 8	5330
						Paddy 9 530	0 3				

Note Length is Max Channel length assumed

Table 6.3.17 Hydraulic Calculation of Standard Cross Section for Main Drainage Channels

Channel	Q (cfs)	$\frac{2}{5}$ Q (cfs)	S	n	b or b_2 (ft)	Z	d or d_2 (ft)	$\frac{1486}{n}\sqrt{S}$	A or A_2 (sq ft)	P or P_2 (ft)	R or R_2 (ft)	$R_1^{2/3}$ or $R_2^{2/3}$	V or V_2 (ft/sec)	Q_1 or Q_2 (cfs)	Q (cfs)	w (ft)	W (ft)	H (ft)	L (miles)
Kalu Ganga (Upper)	7250	2900	0.00273	004	40.0	25	8.0	1941	480	83.1	5.78	3.22	6.25	3000	7280	80.0	162.5	6.5	5.9
					40.0		8.0		760	83.1	9.15	4.37	8.49	6452					
					25.0		3.5		206	68.8	2.99	2.07	4.03	828					
Kalu Ganga (Lower)	10260	4100	0.00105	004	65.0	25	10.0	1204	900	119	7.57	3.86	4.64	4178	10476	115.0	205.0	8.0	5.6
					65.0		10.0		1475	119	12.4	5.36	6.45	9518					
					25.0		5.0		313	76.9	4.06	2.55	3.06	958					
Thimbri Ela (Upper)	2590	1040	0.00307	004	20.0	25	6.0	2058	210	52.3	4.01	2.53	5.20	1092	2590	50.0	97.5	5.5	3.6
					20.0		6.0		335	52.3	6.4	3.45	7.10	212					
					10.0		2.5		66	33.5	1.96	1.57	3.23	2378					
Thimbri Ela (Lower)	3840	1540	0.00151	004	35.0	25	7.0	1444	368	72.7	5.06	2.95	4.25	1563	3935	70.0	122.5	6.5	3.9
					35.0		7.0		613	72.7	8.43	4.14	5.98	3661					
					10.0		3.5		101	38.8	2.59	1.89	2.72	274					
Ambagaha Oya (Upper)	2690	1080	0.00155	004	35.0	25	6.0	1463	300	67.3	4.46	2.71	3.96	1188	2728	65.0	132.0	5.5	4.1
					35.0		6.0		463	67.3	6.87	3.61	5.29	2445					
					20.0		2.5		116	53.5	2.16	1.67	2.45	283					
Ambagaha Oya (Lower)	8230	3590	0.00145	004	60.0	25	8.5	1415	691	10.6	6.53	3.49	4.94	3413	8322	102.5	197.6	7.0	4.3
					60.0		8.5		1101	10.6	10.4	4.77	6.74	7420					
					30.0		4.0		280	8.15	3.43	2.28	3.22	902					



The Manning Formula

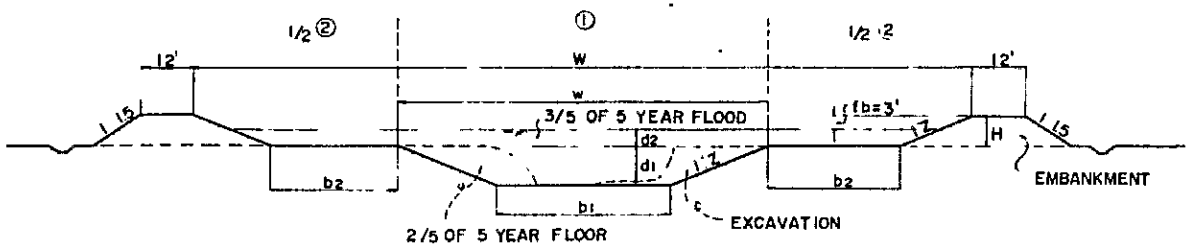
$$V = \frac{1486}{n} \times R^{2/3} \times S^{1/2}$$

$$Q = A\,V$$

excavated portion
① Portion
② Portion

Table 6.3.17 Continue

Channel	Q (cfs)	$\frac{2}{3}$ Q (cfs)	S	n	b or b_2 (ft)	Z	d or d_2 (ft)	$\frac{1486}{n}\sqrt{S}$	A_1 or A_2 (sq ft)	P_1 or P_2 (ft)	R_1 or R_2 (ft)	$R^{2/3}$ or $R_2^{2/3}$	V_1 or V_2 (ft/sec)	Q_1 or Q_2 (cfs)	Q (cfs)	w (ft)	W (ft)	H (ft)	L (miles)
Periya Aru (Upper)	4980	1990	0.00077	0.04	40.0	2.5	9.0	1.031	563	88.5	6.36	3.43	3.54	1990	5033	85.0	180.0	7.0	4.9
					40.0		9.0		903	88.5	10.2	4.70	4.85	4376					
					30.0		4.0		280	81.5	3.43	2.28	2.35	657					
Periya Aru (Lower)	7530	3010	0.00045	0.04	75.0	2.5	10.0	0.788	1000	129	7.76	3.92	3.09	3089	7678	125.0	225.0	8.0	6.3
					75.0		10.0		1625	129	12.6	5.42	4.27	6938					
					30.0		5.0		363	86.9	4.17	2.59	2.04	740					
Sinna Ganga	1600	640	0.00042	0.04	40.0	2.5	6.0	0.761	330	72.3	4.56	2.75	2.09	691	1680	70.0	120.0	6.0	9.0
					40.0		6.0		540	72.3	7.47	3.82	2.91	1571					
					10.0		3.0		82.5	36.2	2.28	1.73	1.32	109					
Uppu Aru	5740	2300	0.00040	0.04	75.0	2.5	9.0	0.743	878	123	7.11	3.70	2.75	2410	5762	120.0	197.5	7.5	4.8
					75.0		9.0		1418	123	11.5	5.09	3.78	5360					
					20.0		4.5		231	64.0	3.59	2.34	1.74	402					
Karappankada Wela Aru	5330	2130	0.00043	0.04	65.0	2.5	9.0	0.770	788	113	6.94	3.64	2.80	2207	5393	110.0	187.5	7.5	4.4
					65.0		9.0		1283	113	11.3	5.04	3.88	4976					
					20.0		4.0		231	64.2	3.59	2.34	1.81	417					



The Manning Formula

$$V = \frac{1486}{n} \times R^{2/3} \times S^{1/2}$$

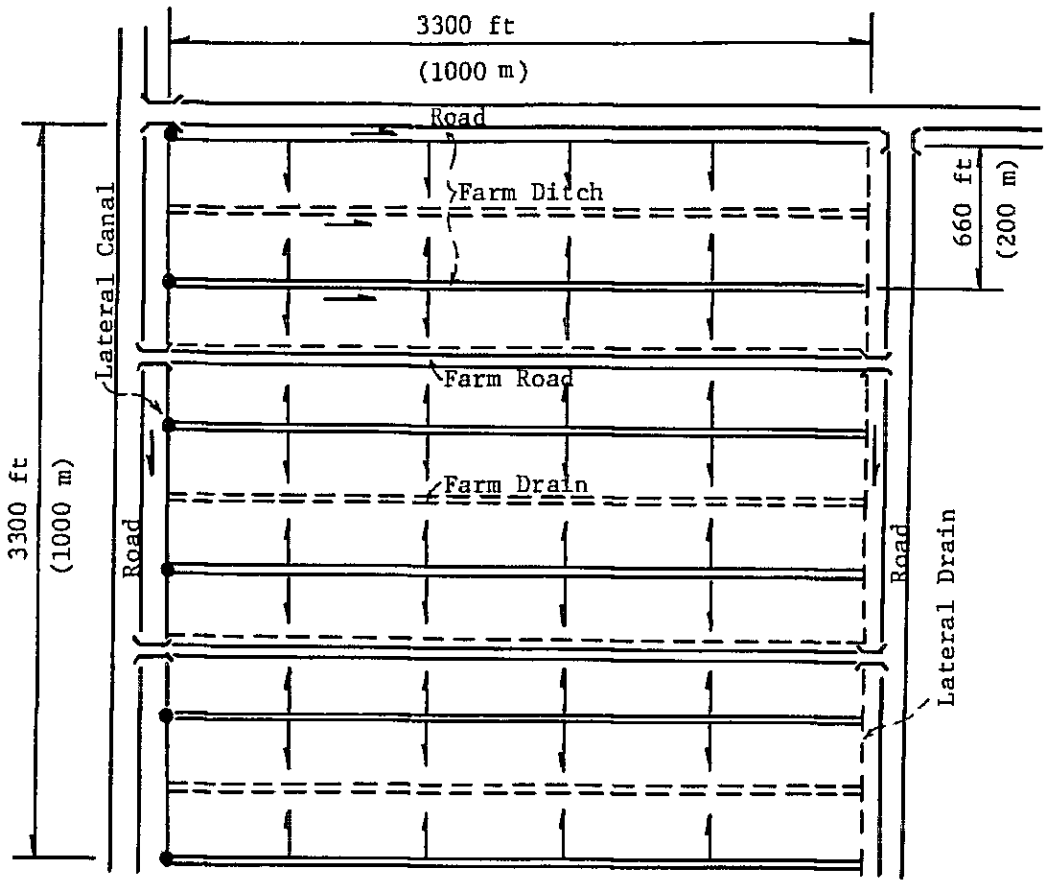
$$Q = A\,V$$

excavated portion
① portion
② portion

3.3 Land Reclamation

Density of Canals and Roads is illustrated on page VI-114, and the standard cross-sections of ditch, drain and road are shown in Fig.6-3-12.

Density of Canals and Roads



Farm Ditch Intervals 200m

Lateral Canal $\frac{3300 \text{ ft}}{247 \text{ ac}}$ = 13 ft/ac

Farm Ditch $\frac{19800 \text{ ft}}{247 \text{ ac}}$ = 80 ft/ac

Irrigation Canal Density = 93 ft/ac

Lateral Drain $\frac{3300 \text{ ft}}{247 \text{ ac}}$ = 13 ft/ac

Farm Drain $\frac{16500 \text{ ft}}{247 \text{ ac}}$ = 67 ft/ac

Drainage Canal Density = 67 ft/ac

Road $\frac{9900 \text{ ft}}{247 \text{ ac}}$ = 40 ft/ac

Farm Road $\frac{6600 \text{ ft}}{247 \text{ ac}}$ = 27 ft/ac

Road Density = 67 ft/ac

IV. CONSTRUCTION PLANS

4.1 General

Construction plan has been worked on the following assumptions:

4.1.1 Preparatory Period

Detailed design work will be commenced as soon as the required topographical maps will be completed by the end of 1979. Detailed design work will be completed within one year or so, from 1980 to 1981. About six months would be necessary for procurement of the construction machinery and the construction work will follow in 1982.

4.1.2 Construction Period

Total construction period will be seven years including the work which will be influenced by construction of reservoir and storage period thereof. Preparatory period inclusive, it would be about nine years. The whole construction work would be completed by the end of 1988.

4.2. Contents of the Work

Construction of the field offices and camps will be the first item of preparatory work. Two field offices for System D1 and each one field office for System D2 and System A/D will be established. Each field office will have two field camps. These offices and camps will be useful for improvement work in the existing land.

Construction work will be commenced from the improvement of the irrigation/drainage facilities in the existing land which shall be completed by the time the reservoir would have been built. Main features of the improvement work in the existing land are as follows:

(a) Repair Work of the Existing Canals

Erahera-Minneriya Yoda Ela (6 - 19.5 mi)	.....	13.5 miles
Kaudulla H.L.B Main & Branch (No.1) Canals	.....	10.18 "
Parakrama Samudra D1 Main & Branch Canal	.....	20.8 "

Additional restoration work would include bridges, measuring devices, regulating gates, washing ghats, etc.

(b) Angamedilla Anicut (Amban Ganga) Restoration ..... One

(c) Adjustment Work in the Existing Fields

Restoration of irrigation/drainage facilities and repair of water management structures in the acreage under specification, and provision of irrigation/drainage facilities, farm roads, and water management structures upon consolidation of the farm plots. Adjustment work in the existing field would be done as follows:

Acreage under specifications	.....	75,400 ac (excluding 4,800 ac in System G)
" " unauthorized cultivation	.....	18,700 ac

Land reclamation work in Systems D1 and A/D would be completed by the time storage period of the newly built reservoir ends in 1987. That in System D2 will be commenced after land reclamation work in Systems D1 and A/D would have been finished. It is expected that the flood control function of the upper stream dams and reservoirs in the Mahaweli basin would be felt in System D2 new land by that time.

Principal construction works in the Newland will comprise the following:

(a) Irrigation Water Source for System A/D

Kalu Ganga Tank, Diversion Weir across Minneriya-Kantalai Yoda Ela, and Kalu Ganga Anicut.

(b) Irrigation Canals

System D1	L =	36.18 miles
" D2	L =	32.84 "
" A/D	L =	21.25 "
		90.27 miles

(c) Drainage Canals

System D1	L =	27.4 miles
" D2	L =	20.2 "
" A/D	L =	9.2 "
		56.8 miles

(d) Farming and Housing Plots (ac)

System	Farming Plot	Housing Plot	Total
D1	22,400	4,480	26,880
D2	5,400	1,080	6,480
A/D	6,600	1,320	7,920
Total	34,400	6,880	41,280

(e) Settlement Facilities and Infrastructure

For about 15,160 newly settling farm families.

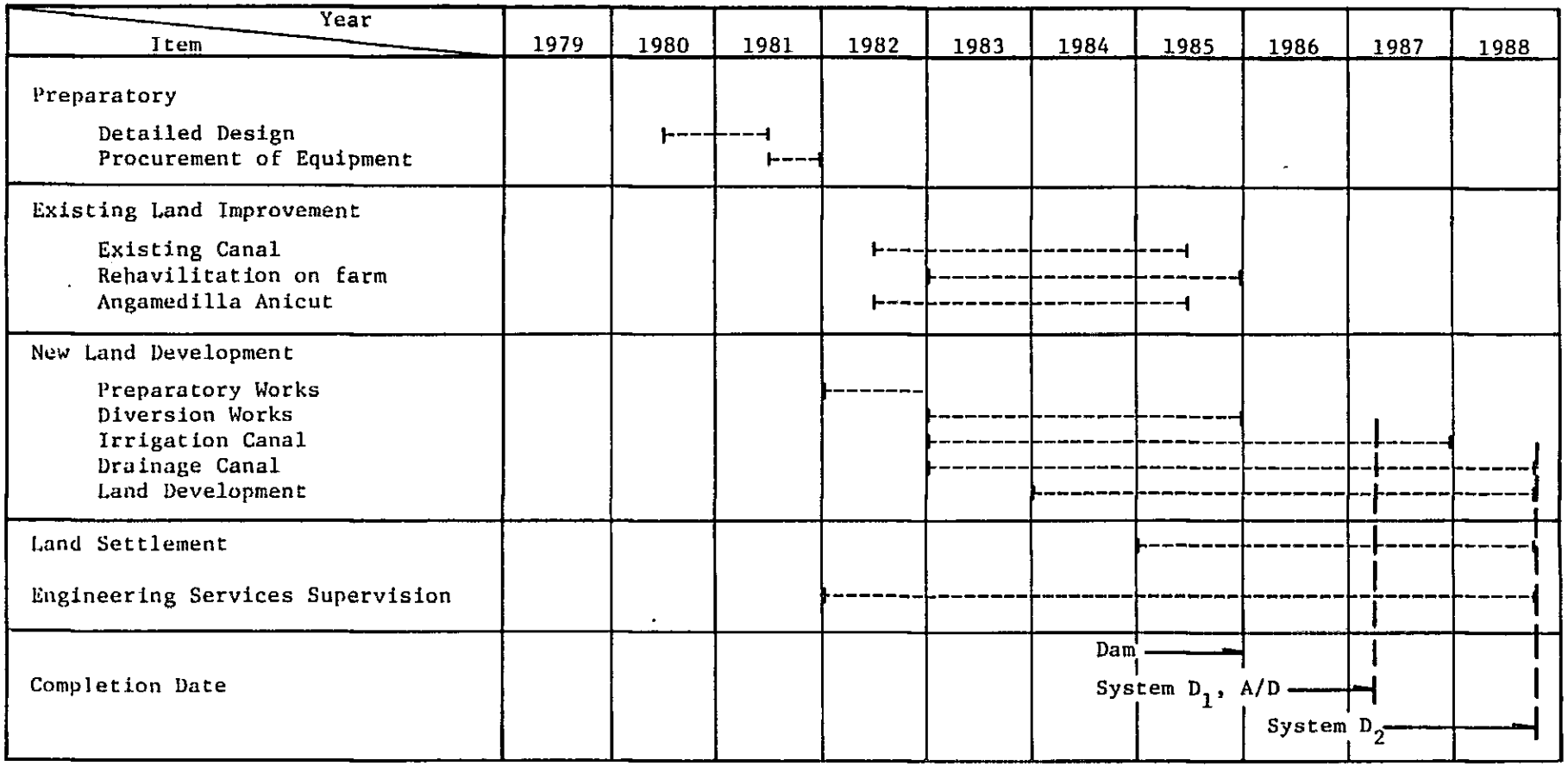
4.3 Construction Machinery

Kinds and numbers of the construction machinery have been decided in accordance with the directions given in 'Caterpillar Performance Handbook' which is adopted by the Irrigation Department. They are shown in Table 6-5-4.

4.4 Construction Time Schedule

Reference is to be made to Fig. 6-4-1.

Fig. 6-4-1 Construction Time Schedule



PRODUCTION ANALYSIS

P. A. 1 Clearing and Grubbing

(Equipment) crawler Tractor (200 or 300 HP) and Streight Blade Dozer

For 200 HP Tractor - Light jungle at 4.5 ac per day (8hr)

" - Medium - do - 3.1 ac - do -

For 300 HP Tractor - Common - do - 3.75 ac - do -

" - Heavy - do - 3.4 ac - do -

P. A. 2 Land Levelling

(Equipment) crawler Tractor (300 HP) and Streight Blade Dozer

1. production for Land Levelling at average dozing distance of 50 ft. for ripped and cross-ripped soil

   = 286.9 cu per hour

2. Average soil movement assumed in land levelling

   = 90 cu per ac of farm

3. production time for land levelling

   = $\frac{90}{286.9}$ = 0.31 hr per ac

P. A. 3. Ripping

(Equipment) crawler Tractor (300 HP) and Single Shank Ripper

1. Spacing = 3 ft penetration = 2 ft

   Distance = 300 ft

2. Ripping 0.86 ac per hr (85% efficiency)

3. Cross Ripping

   Time taken for cross ripping = 1.21 hr

   Production at 85% efficiency = 744.8 cu

   $= \frac{744.8}{1.21}$ = 615.5 cu per hr

   $= \frac{615.5 \times 100}{2 \times 43560}$ = 0.71 ac per hr

4. Ripping and Cross Ripping

0.78 ac per hr

P. A. 4. Compaction

(Equipment) Sheep foot roller (Twin drum)

Compacted Volume for dam embankment

at 85% effy 97 cu per hr

Compacted Volume for main canals/major roads

at - do - 129 cu per hr

P. A. 5 Excavation/Borrow by Excavator with Dragline

(Equipment) Crawler mounted crane (15T) with dragline

Bucket C

	Nature of Excavation	Production
1.	Earth in foundation/canal	164
2.	Common in " /"	148
3.	Gravel in quarry	136
4.	Gravel in foundation/canal	128
5.	Sand in quarry	148
6.	Soft rock in foundation/canal	74

P. A. 6 Load and Haul with Front End Loader

(Equipment) Front End Loader (2.1/4 to 3.1/2 c. yd) 130 HP

Total Lift	Production in Cu per hr	% production
5	55.0	100.0
10	47.5	86.4
15	40.5	73.6
20	33.5	80.9
25	27.0	49.1
30	21.5	39.1
35	17.0	30.9
40	13.5	24.5
45	10.5	19.1

P. A. 7 Lift and Haul with Front End Loader

Range for cut	Production Addl Rate for cut = fR	Lift Emb	Lift Ex	Production for Addl Rate for lift End	Production for Addl Rate for lift Ex
Over 5 upto 10'	0.053 R	10'	10'	0.157R	0.157R
10 15'	0.058 R	20'	15'	0.485R	0.201R
15 20	0.065 R	25'	20'	0.395R	0.283R
20 25	0.074 R		25'		0.395R
25 30	0.083 R		30'		0.521R
30 35	0.095 R		35'		0.679R
35 40	0.110 R		40'		0.845R
40 45	0.128 R		45		1.154R

P. A. 8 Excavation/Borrow with Screper

(Equipment) Motorised Scraper 14/20 c. yd, 330 HP

production in cu per day from Unit of 3 Scrapers and 1 Tractor

Haul distance	Excavation Earth	Common	Gravel	Soft Rock	Stripping Top Soil	Borrow Earth	Borrow from Spoil Dump
1000 ft	996	896	697	398	1,245	1,145	1,494
1/4 ml	948	853	664	379	1,185	1,090	1,422
1/2 ml	798	718	559	319	998	918	1,197
3/4 ml	630	567	441	252	788	725	945

P. A. 9 Excavation/Borrow by Excavator and haul by Rear Dumper

(Equipment) Crawler Mounted Crane (15T) with dragline bucket (3/4 c. yd)

Haul dist	Earth excavation	Common excavation	Gravel Excavation	Soft-Rock Excavation
1/4 ml	262	247	188	111
1/2 ml	217	203	158	94
3/4 ml	216	163	125	74
1 ml	195	183	146	68
1.1/2 ml	183	171	137	64
2 ml	194	181	135	75

P. A. 10 Compaction of Roadway Courses with Road Roller

(Equipment) Smooth Wheeled, 3 Roll Type Road Roller 10T

1. Base Course

Assume loose section of 6-9" Rubble 22' x 9" 10.89 cu

" 10 passes required for compaction 3.75 hrs

production 0.34 hr per cu or 2.9 cu per hr

2. Surface course

Assume loose section of 2" metal 22' x 3" 3.63 cu

" 6 passes required for compaction 2.25 hrs

production o.62 hr per cu or 1.60 cu per hr

3. Blinding Course

Spread area of 1/4" to 1/2" metal 14.52 sq

Assume 2 passes for compaction 0.75 hrs

production 0.05 hr per sq or 19.4 sq per hr

P. A. 11 Quantities for Nominal Mix Concrete

Quantities per cube of concrete

Measure Volume for batching (Ve)

	1:4:8 mix	1:3:6 mix	1:2:4 mix
Cement (42 kg) bag	12.5 bags	15.8 bags	21.6 bags
Sand	0.51 cu	0.49 cu	0.44 cu
Coarse Aggr gate	1.02 cu	0.98 cu	0.88 cu
Water	63.2 gl	80.0 gl	109.1 gl

V. CONSTRUCTION COST ESTIMATES

The total construction cost is estimated at 900.6 million rupees (US$60.0 m), of which 453.4 million rupees (US$30.2 m) is in foreign currency and 447.2 million rupees (US$29.8 m), in local currency (see Table 6-5-1). Distribution of the cost into foreign and local currencies has been done according to the standards adopted by the Irrigation Department.

5.1 Unit Price

Unit prices have been taken from December 1978 values given in 'Data for Costing, January 1979' prepared by the Department of Irrigation. In order to isolate the construction machinery costs, the unit costs involving machinery have been extracted.

5.2 Construction Machinery Cost

All the kinds and numbers of the construction machinery will be procured at the estimated prices, and the total amount thus arrived at has been accounted for as the Construction Machinery Cost.

5.3 Contingencies

10 per cent of the construction cost has been accounted for contingencies.

5.4 Annual Disbursement of Construction Costs

Shown in Table 6-5-2.

Table 6.5.1 Summary of Construction Cost

Unit 1000 Rs

Item	Total	Foreign	Local
A. Civil Works	403,959	157,387	246,572
1. Existing Land (Improvements)			
Existing canal	21,203	8,576	12,447
Rehavilitation on farm	120,280	36,532	83,748
Angamedilla Anicat	22,531	13,374	9,157
Sub. Total	164,014	58,662	105,352
2. New Land (Development)			
Preparatory works	15,360	7,680	7,680
Diversion works (A/D)	37,256	25,941	11,315
Irrigation canal	46,635	26,543	20,092
Drainage canal	17,323	3,709	13,614
Land development	123,371	34,852	88,519
Sub. Total	239,945	98,725	141,220
B. Construction Machinery	271,533	175,744	95,789
1. Existing Land	14,681	9,716	4,965
2. New Land	256,852	166,028	90,824
C. Land Settlement (Only new land)	68,800	34,400	34,400
D. Engineering, Administration (A+B+C) x 10%	74,428	44,656	29,772
1. Existing Land	17,869	10,721	7,148
2. New Land	56,559	33,935	22,624
E. Physical Contingency (A-D) x 10%	81,871	41,219	40,652
1. Existing Land	19,656	7,910	11,746
2. New Land	62,215	33,309	28,906
Total	900,591	453,406	447,185
Existing Land	216,220	87,009	129,211
New Land	684,371	366,397	317,974

Table 6.5.2 Annual Disbursement of Cost

Unit: 1000 Rs

Item		Cost	Year 1980	1981	1982	1983	1984	1985	1986	1987	1988
Detailed Design		34,000	14,000	20,000							
	F/C	25,000	10,000	15,000							
	L/C	9,000	4,000	5,000							
Machinery & Equipment		271,533			85,380	100,082	21,518	21,518	21,518	16,138	5,379
	F/C	175,744			80,590	85,714	2,360	2,360	2,360	1,770	590
	L/C	95,789			4,790	14,368	19,158	19,158	19,158	14,368	4,789
Existing Land Improvement		164,014			8,746	49,204	49,205	56,859			
	F/C	58,662			4,425	17,600	17,600	19,037			
	L/C	105,352			4,321	31,604	31,605	37,822			
New Land Development		239,945			15,360	23,623	51,382	55,107	40,205	40,199	14,069
	F/C	98,725			7,680	13,759	21,601	24,196	13,819	13,814	3,856
	L/C	141,220			7,680	9,864	29,781	30,911	26,386	26,385	10,213
Land Settlement		68,800						17,200	17,200	17,200	17,200
	F/C	34,400						8,600	8,600	8,600	8,600
	L/C	34,400						8,600	8,600	8,600	8,600
Engineering Survies Supervision		40,428			5,778	5,775	5,775	5,775	5,775	5,775	5,775
	F/C	19,656			2,808	2,808	2,808	2,808	2,808	2,808	2,808
	L/C	20,772			2,970	2,967	2,967	2,967	2,967	2,967	2,967
Sub Total		818,720	14,000	20,000	115,264	178,684	127,880	156,459	84,698	79,312	42,423
	F/C	412,187	10,000	15,000	95,503	119,881	44,369	57,001	27,587	26,992	15,854
	L/C	406,533	4,000	5,000	19,761	58,803	83,511	99,458	57,111	52,320	26,569
Physical Contingency		81,871	1,400	2,000	11,526	17,868	12,788	15,645	8,470	7,931	4,243
	F/C	41,219	1,000	1,500	9,550	11,988	4,437	5,700	2,759	2,699	1,586
	L/C	40,652	400	500	1,976	5,880	8,351	9,945	5,711	5,232	2,657
Total		900,591	15,400	22,000	126,790	196,552	140,668	172,104	93,168	87,243	46,666
	F/C	453,406	11,000	16,500	105,053	131,869	48,806	62,701	30,346	29,691	17,440
	L/C	447,185	4,400	5,500	21,737	64,683	91,862	109,403	62,822	57,552	29,226

Table 6.5.3

Foreign Exchange Component of the Construction Cost

Item	Quant-ity	Total		Foreign		Local	
		Unit	cost	Unit	cost	Unit	cost
		RS	1000RS	RS	1000RS	RS	1000RS
1. Construction Machinery							
Important Machinery	Item		93.500		93.500		-
Tyre replacement	"		5.468		5.468		-
spares	"		64.976		64.976		-
Sub total			163.944		163.944		-
2. Cement	bag 287.957	18.5	5.327	6.66	1.918	11.84	3.409
3. Reinforcement	ton 949	5.200	4.935	2184	2.073	3016	2.862
4. Gate							
slide Gate	nos 219		23.118		15.258		7.860
Radial Gate	nos 5		17.500		16.625		875
Sub total			40.618		31.883		8.735
5. Concrete pipe & pile	Item		3.707		2.224		1.483
6. Fuels							
Disel	ge 2624.000		14.432	3.91	10.260	1.59	4.172
Engine oil	140.000	25.8	3.612	18.32	2.565	7.48	1.047
Sub total			18.044		12.825		5.219
7. Other Materials	Item		140.804		140.804		-
8. Labour, Field Service Overhead (Machinery)	Item		11.860		11.860		-
9. Engineering Survice	Item				44.656		
10. Contingencies	Item				41.219		
Total					453.406		

Table 6.5.4

C.I.F. Prices (Dec. 78) of Machinery and Equipment

	Equipment & Machinary	Size & Capacity	Quantity	C.I.F. Prices	Amounts
1.	Crawler Tractor	180 to 200 H.P.	6	95,000	570,000
2.	- do -	300 H.P.	16	150,000	2,400,000
3.	Attachments to Crawler Tractor				
	a. Straight Blade Dozer	Av for both classes of Tract	14	13,000	182,000
	b. Ripper	"	6	17,600	105,600
	c. Pusher Cup		1	3,900	3,900
	d. Sheep Foot Roller	Twin drum	2	8,500	17,000
4.	Motorized Scraper	14/20 cu. yd.	1	165,000	165,000
5.	Water Truck with Sprinkler	1200 gls	2	25,000	50,000
6.	Crawler Mounted Crane (15T) with Drag Line Bucket	3/4 cu. yd.	17	115,000	1,955,000
7.	Rear Dump	15 T	3	50,000	150,000
8.	Farm Tractor (60H.P.) with Trailer (5T)		3	8,000	24,000
9.	Lorry	5T	1	13,000	13,000
10.	Motor Grader	120 to 150 H.P.	2	80,000	160,000
11.	Air Compressor	600 C.F.M.	5	20,000	100,000
12.	- do -	365 C.F.M.	5	17,000	85,000
14.	Pneumatic Jack Hammers	50 lb.	5	500	2,500
15.	Wheeld Crushing and Screening Plant	1/2" to 2.1/2"	1	33,800	33,800
16.	Concrete Mixer	14/10 cft.	9	9,000	81,000
17.	Engine Mounted Vibrator		18	725	13,050
18.	Road Roller	8 to 10T	1	22,500	22,500
19.	Front End Loader	130 H.P.	2	50,000	100,000
	Total				$6,233,350 Rs93,500,250

Table 6-5-5

A.			100%
B.	Duty, Commission and Clearance	C.I.F. x 10%	0
C.	Interest and insurance	(A + B) x 33%	0
	(Repairs)		
D.	Spares	A x 50%	95
E.	Customs Duty for Spares	E x 10%	0
F.	Labour for repairs	(A + B) x 25%	20
G.	Field Survices	(A + B) x 5%	25
H.	Overheads	(A + B) x 10%	25

* * * * * * * *

Tyre Replacement

Motorised Scraper	4 Nos.	All Plant	10,000 hr.
Water Truck	4 "	Rear Dumpers, Compressors	12,000 hr.
Motor Grader	1.5 "		
Rear Dump	4 "	Jack Hammers, Engine Mounted Vibretors	5,000 hr.
Farm Trailer	4 "		
Front End Loader	4 "		
Wheeled Crushing and Screening Plant	4 "		

Table 6-5-6

Labour

Daily Wage (8 Hour Day)

	Labour Grade	Basic (B)	Casual (17xB)	Long Team (1.45x1.7xB)	Category
1.	Casual Cl. III	5.00	8.50	12.33	Unskilled labour
2.	Semi-skilled Cl. II	8.00	13.60	19.72	Supervisors Greasors and Cl anors
3.	Skilled Cl. I - Gr. II	10.00	17.00	24.65	Masons, Carpenters B/smiths, pump Operators and Mechanics
4.	Skilled Cl. I - Gr. I	11.50	19.55	28.35	Operators of heavy equipment
5.	Watchers	8.00	13.60	19.72	Watchers, Messengers, Office Aides, etc.

Table 6-5-7

Cost of Materials at Sources of Supply

	Item	Unit	Cost	Local		Foreign	
				%	Rs	%	Rs
1.	Cement per bag Ex-Factory	42 kg	18.50	64	11.84	36	6.66
2.	Reimforcement - Mild Steel	ton	5,200.00	58	3,016.0	42	2,184.0
3.	Reimforcement - Tor Steel	"	5,600.00	58	3,248.0	42	2,352.0
4.	Petrol - Ordinary	gl	12.80	18	2.3	82	10.5
5.	Petrol - Super	"	13.80	18	2.48	82	11.32
6.	Auto Diesel	"	5.50	29	1.59	71	3.91
7.	Heavy Duty Diesel	"	5.50	29	1.59	71	3.91
8.	Engine Oil	"	25.80	29	7.48	71	18.32
9.	Sand (with plant)	Cu	30.27	36.6	11.08	63.4	19.19
10.	Metal 2" (with plant)	"	202.36	40.2	81.32	59.8	121.04
	" 1.1/2" (")	"	217.54	39.9	86.79	60.1	130.75
	" 1" (")	"	248.67	39.4	97.99	60.6	150.68
	" 3/4" (")	"	280.17	39.0	109.33	61.0	170.84
	" 1/2" (")	"	331.36	38.6	127.76	61.4	203.60

Table 6-5-8

SUMMARY OF HOURLY PLANT RATES (DEC 1978)

Rate No	Discription	Basic Rate per hr. Rs	Foreign Rs	%	Labour Rs	%	Fuel Rs	%
PR 1	Crawler Tractor 180 to 200 HP-	54.0	31.0	57.4				
PR 2	Crawler Tractor 300 HP	82.0	50.0	61.0				
PR 7	Motorised scraper 14/20 cu-yd-330HP	68.0	40.0	58.8				
PR 8	Water Truck with sprinkler 1200 gls	20.0	10.0	50.0				
PR 9	Crawler mounted crane 157 with dragline buket (3/4 cu-yd)	42.0	22.0	52.4				
PR 10	Motor Grader 120 to 150 HP	38.0	20.0	52.6				
PR 11	Air Compressor 600 cfm	13.0	5.0	38.5				
PR 12	Penumatic Jack Hammer 50lbs	8.0	5.0	62.5				
PR 13	Farm Tractor (60MP) with Trailer (5T)	19.0	12.0	63.2				
PR 14	Lorry 5T without load	15.0	6.0	40.0				
	with load	21.0	11.0	52.4				
	idle	6.0	-					
PR 15	Rear Dump 15T (10/12 cu-yd) with load	38.0	20.0	52.6				
	idle	10.0	-					
PR 16	Weeled crushing and screening plant (15T 25HP)	15.0	6.0	40.0				
PR 17	Road Roller 10T	11.0	4.0	36.4				
PR 18	Front End Loader (2 1/4 to 3 1/2 c yd)	27.0	15.0	55.6				
PR 19	Concrete Mixer (14/10 c ft)	7.0	3.0	42.9				
PR 20	Engine Mounted Vibrator	4.0	2.0	50.0				

Table 6-5-9

SUMMARY OF UNIT RATES

Rate No	Analy No	Discription	Unit	Basic Rate in Rs	Foreign Rs	%	Labour Rs	%	Fuel Rs	%
		(Machinery)								
1	U.R. 1	Clearing and grubbing with Crawler Tractor	ac	200.19	117.71	58.8				
		Heavy jungle	"	181.51	106.73	"				
		common "	"	147.31	79.99	54.3				
		medium "	"	101.48	55.10	"				
		light "								
	M.R. 1	(Manual) clearing and grubbing								
		heavy jungle	ac	1,763.19	48.09	2.7				
		common "	"	1,424.12	38.84	2.7				
		medium "	"	1,017.23	27.74	2.7				
		light "	"	610.00	16.65	2.7				
2	U.R. 15	Land Levelling (Machinery)								
		Ripping farmland prior to levelling	ac	99.06	58.15	58.7				
		Ripping and Cross Ripping farmland prior to levelling	"	111.94	64.14	57.3				
		Land Levelling	"	25.75	15.50	60.2				
		Forming soil Conservation bund	"	16.05	7.99	49.8				
		Ripping,Cross-ripping, levelling and forming soil conservation bund for farms	"	153.74	87.63	57.0				

Rate No	Analy No	Discription	Unit	Basic Rate in Rs	Foreign Rs	%	Labour Rs	%	Fuel Rs	%
3		Excavation (canal/road/foundation) (Manual)								
	M.R. 2	Earth - lift 0 to 5' haul 100'	cu	27.13	0.74	2.7				
		as in foundation	"	29.84	0.81	2.7				
	"	Gravel - -do-	"	33.91	0.92	2.7				
		"	"	37.30	1.01	2.7				
	"	Soft Rock- -do-	"	61.04	1.67	2.7				
		"	"	67.14	1.84	2.7				
	"	Common- -do-	"	30.51	0.83	2.7				
		"	"	33.56	0.91	2.7				
		(Machinery)								
	U.R. 2	Earth - lift 0 to 5' haul 100'	cu	2.12	1.07	50.5				
		Common -do-	"	2.35	1.19	50.5				
	"	Gravel (quarry) -do-	"	2.56	1.29	50.5				
		(foundation) -do-	"	2.72	1.37	50.5				
		Quarrying sand	"	2.35	1.19	50.5				
		Soft Rock (foundation)	"	4.71	2.38	50.5				
4		Excavation/Borrow by Scraper								
	U.R. 3	Earth excavation Haul 1000'	cu	2.68	1.53	57.0				
		" 1/4ml	"	2.81	1.60	"				
		" 1/2 "	"	3.34	1.90	"				
		" 3/4 "	"	4.23	2.41	"				

Rate No	Analy No	Discription			Unit	Basic Rate in Rs	Foreign Rs	%	Labour Rs	%	Fuel Rs	%
	"	Common excavation	Haul	1000'	cu	2.98	1.70	57.0				
			"	1/4ml	"	3.13	1.78	"				
			"	1/2 "	"	3.71	2.11	"				
			"	3/4 "	"	4.70	2.68	"				
	"	Gravel excavation	"	1000'	"	3.82	2.18	"				
			"	1/4ml	"	4.02	2.29	"				
			"	1/2 "	"	4.77	2.72	"				
			"	3/4 "	"	6.05	3.45	"				
	"	Soft Rock	"	1000'	"	6.70	3.82	"				
			"	1/4ml	"	7.03	4.01	"				
			"	1/2 "	"	8.36	4.77	"				
			"	3/4 "	"	10.58	6.03	"				
	"	Strripping Top Soil	"	1000'	"	2.14	1.22	"				
			"	1/4ml	"	2.25	1.28	"				
			"	1/2 "	"	2.67	1.52	"				
			"	3/4 "	"	3.38	1.93	"				
	"	Borrow Earth	"	1000'	"	2.33	1.33	"				
			"	1/4ml	"	2.45	1.40	"				
			"	1/2 "	"	2.90	1.65	"				
			"	3/4 "	"	3.68	2.10	"				

Rate No	Analy No	Discription			Unit	Basic Rate in Rs	Foreign Rs	%	Labour Rs	%	Fuel Rs	%
	U.R. 3	Borrow Earth Spoil	Haul	1000'	cu	1.78	1.01	57.0				
		Dump	"	1/4ml	"	1.87	1.07	"				
			"	1/2 "	"	2.23	1.27	"				
			"	3/4 "	"	2.82	1.61	"				
	U.R. 5	Rock Excavation - lift by Front end Loader (Air Compressor)										
		Blaeting in quarry/foundation/canal and piling			cu	72.94	51.72	70.9				
		-do-										
		without piling			"	102.12	72.43	70.9				
	U.R. 6	Embankment and Backfill										
		dam embankment			cu	1.81	0.58	31.8				
		main canal and major road embankment			"	1.36	0.43	31.8				
		back fill about structures			"	1.43	0.45	31.8				
		Production of Riprap, Fubble, - Air Compressor										
		18" Riprap			cu	96.94	53.37	55.1				
		12" "			"	108.92	54.42	50.0				
		6-9" Rubble			"	126.66	55.62	43.9				
		Concrete										
	U.R. 26	1:3:6 (1 1/2")lift 0 to 5' haul without formwork 50 mls roads + 125 mls rail			cu	623.58	319.27	51.2				

Rate No	Analy No	Discription	Unit	Basic Rate in Rs	Foreign Rs	%	Labour Rs	%	Fuel Rs	%
		1:3:6 (1 1/2") as in with formwork	cu	841.01	371.67	44.2				
		1:3:6 (1") as in without formwork	"	626.38	320.34	51.1				
		1:3:6 (1") as in with formwork	"	843.81	372.74	44.2				
	U.R. 27	1:2:4 (1 1/2") as in without formwork	"	846.14	398.09	47.0				
		1:2:4 (1 1/2") as in with formwork	"	1,136.05	467.96	41.2				
		1:2:4 (1") as in without formwork	"	848.66	399.05	47.0				
		1:2:4 (1") as in with formwork	"	1,138.57	468.92	41.2				
		Cement plastering								
	U.R.33	1/2" thick 1:3 mix rough ct. plastering	sq	77.02	22.28	28.9				

VI. OPERATION AND MAINTENANCE COST

Annual operation and maintenance cost of the agricultural facilities has been estimated at Rs 150/ac which is being adopted by the Irrigation Department in the similar project. 4,800 ac existing land and 10,000 ac new development area in System G has been excluded. Thus, the total O&M cost for 139,000 ac would be:

139,000 ac x Rs 150 = Rs 20,850,000

Operation and Maintenance Cost (Irrigation Facilities)

Staff Requirements for 6000 ac Module Area

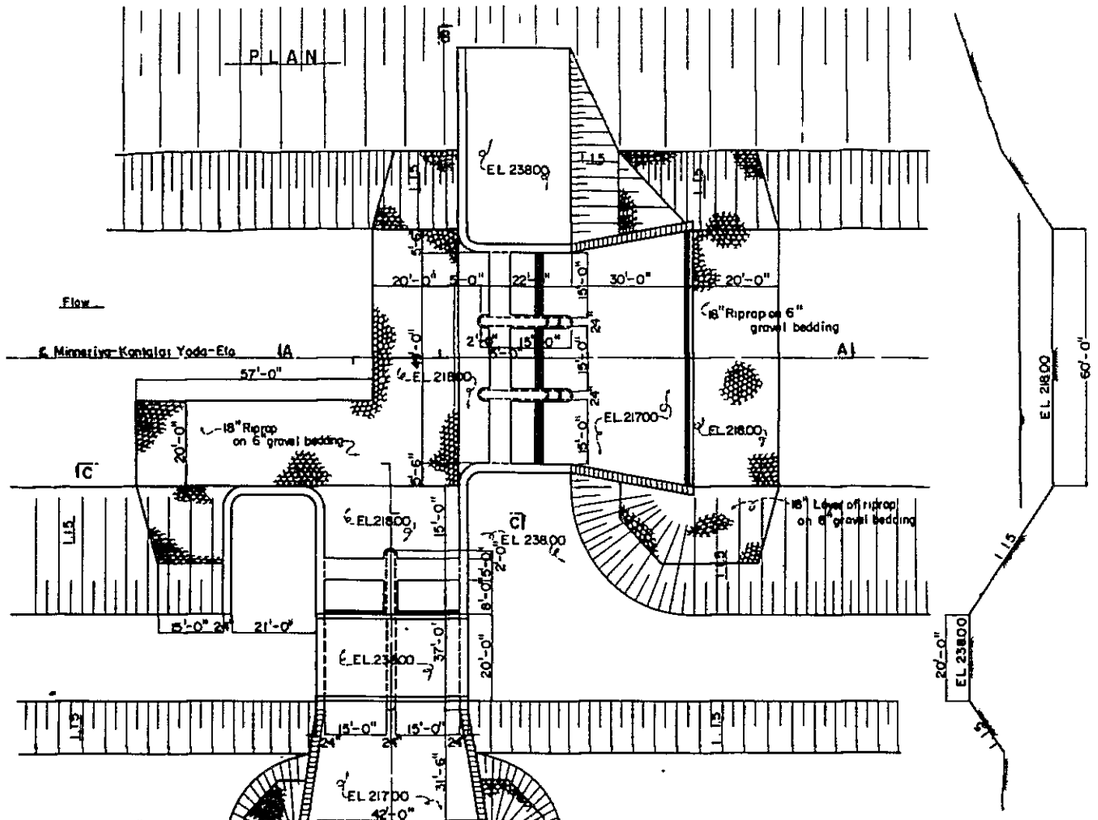
Staff Position	No	Salary/yr (Rs)	Total Cost (Rs)
Engineer	1	15,000	15,000
Technical Assitant	2	10,000	20,000
Maintenance Overseer	4	5,000	20,000
Maintenance Laborer & Irrigators	40	4,000	160,000
Driver	7	6,000	42,000
Store Keeper	1	5,000	5,000
Clerk	1	4,000	4,000
Sub-total			266,000
Leave and Travel	20%		53,200
Total			319,200
			≒ 320,000

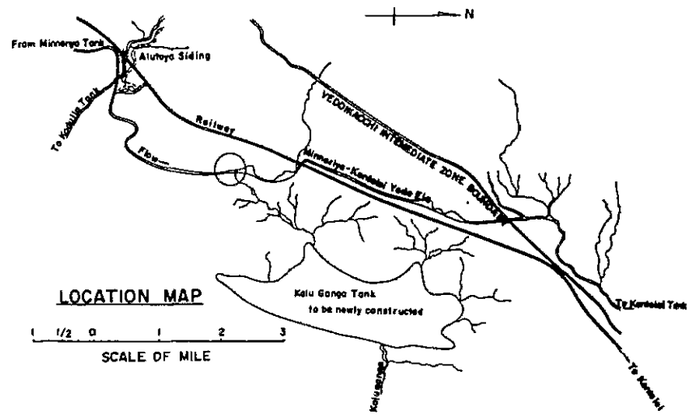
Equipment Requirements for 6000 ac Module Area

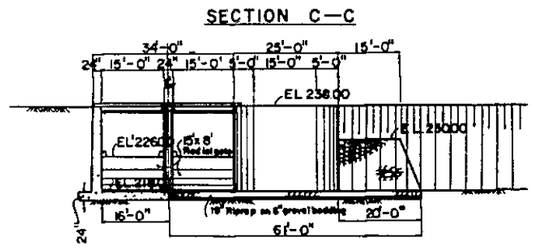
Item	No	Hrs/year	Cost/hour (Rs)	Total Annual Operating Cost (Rs)
5-ton Truck	1	2,000	54	108,000
Agricultural Tructor	3	2,000	19	114,000
Dump Truck	2	2,000	38	152,000
4-Wheel Drive Field Car	1	2,000	25	50,000
Motorcycle	5	2,000	8	80,000
Pedestrian Roller	1	1,500	15	22,500
Total Annual Operating Cost				526,500
Contingencies 10 %				53,000
Total				579,000
				≒ 580.000
Grand Total				900,000

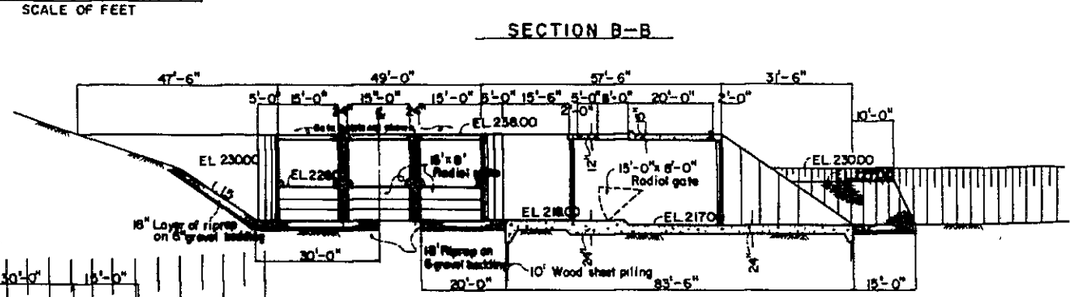
900,000 Rs/6,000 ac = 150 Rs/ac

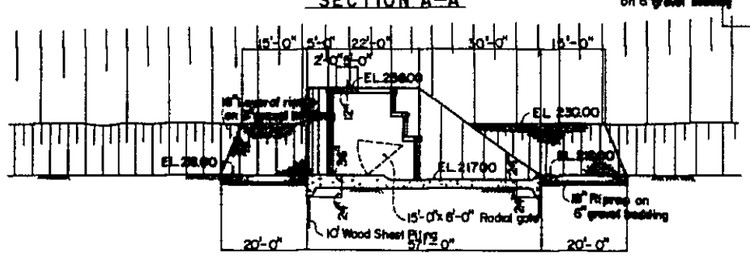
PLATE NO. 24









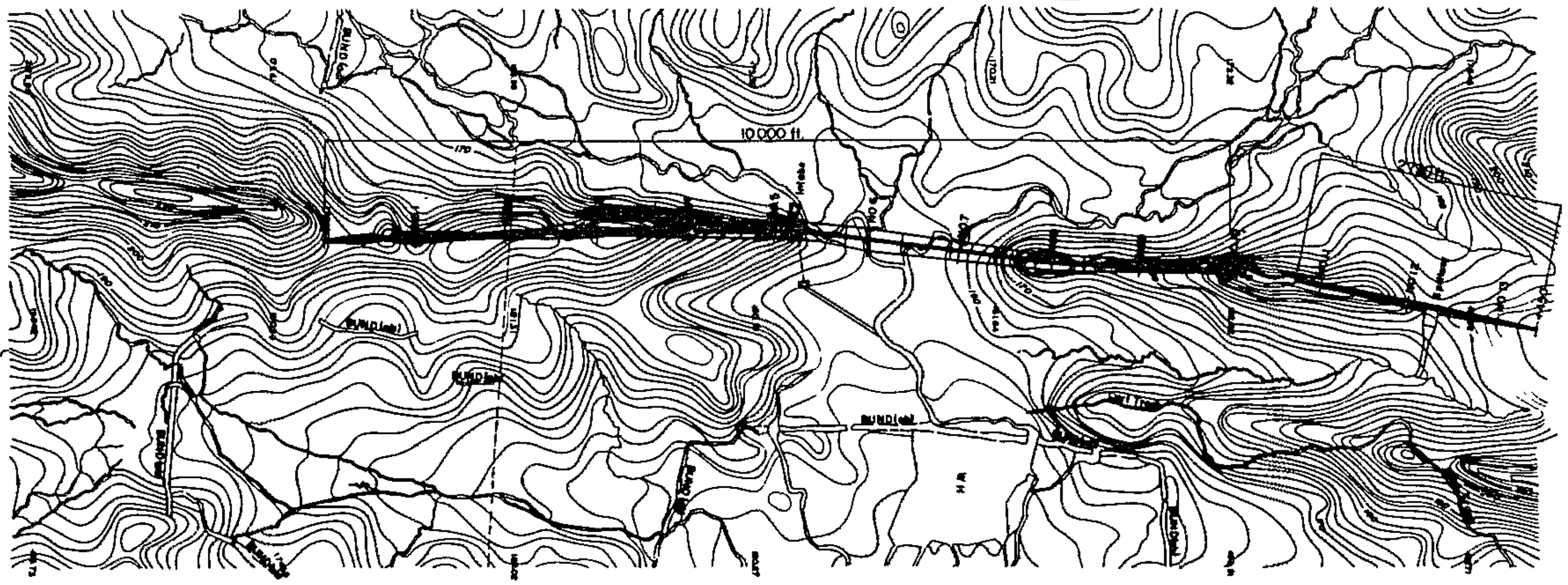


GOVERNMENT OF SRI LANKA MINISTRY OF MAHAWELI DEVELOPMENT MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
SYSTEM A/D YODA ELA INTAKE			
DATE	AUG 1979	D.W.G. No.	1 - 001
JAPAN INTERNATIONAL COOPERATION AGENCY			

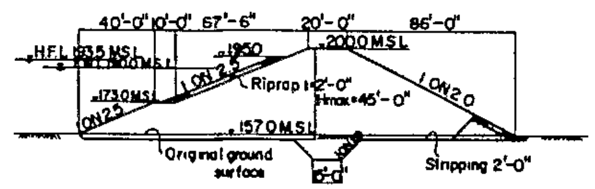
PLATE NO. 25

PLAN

SCALE 0 500 1000 1500 2000 ft

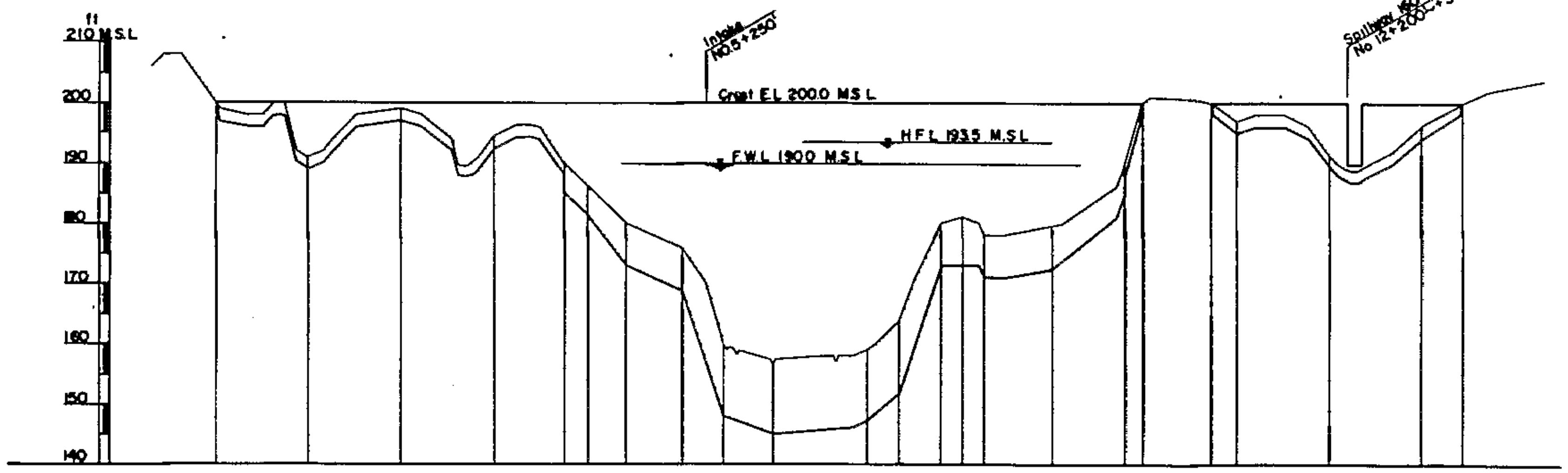


TYPICAL DAM SECTION



PROFILE

HORIZONTAL SCALE 0 500 1000 1500 2000 feet



STATION NUMBER	NO.0	NO.1	NO.2	NO.3	+740	NO.4	+390	NO.5	+440	NO.6	NO.7	+340
BOTTOM OF CUTOFF	200.0	189.0	197.0	192.8	186.0 / 185.0	181.2	173.0	169.0	148.0	145.0	147.0	152.0
EXISTING GROUND ELEVATION	200.0	191.0	199.0	194.8	190.0	186.2	180.0	176.0	160.0	157.0	159.0	164.0
DISTANCE in x 100 ft	0.00	10.00	10.00	10.00	7.40	2.60	3.90	6.10	4.40	5.60	10.00	3.40

STATION NUMBER	+770	NO.8	+220	NO.9	+810	NO.10	+720	NO.11	NO.12	NO.13	+450
BOTTOM OF CUTOFF	173.0	173.0	171.0	172.5	181.0 / 184.0	200.0	200.0	195.0	189.5	194.2	200.0
EXISTING GROUND ELEVATION	180.0	181.0	179.0	179.5	186.0	200.0	200.0	197.0	191.5	196.2	200.0
DISTANCE in x 100 ft	4.30	2.30	2.20	7.80	8.10	1.90	7.20	2.80	10.00	10.00	4.50

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT
SYSTEM A/D
KALU GANGA TANK
PLAN, PROFILE & SECTION

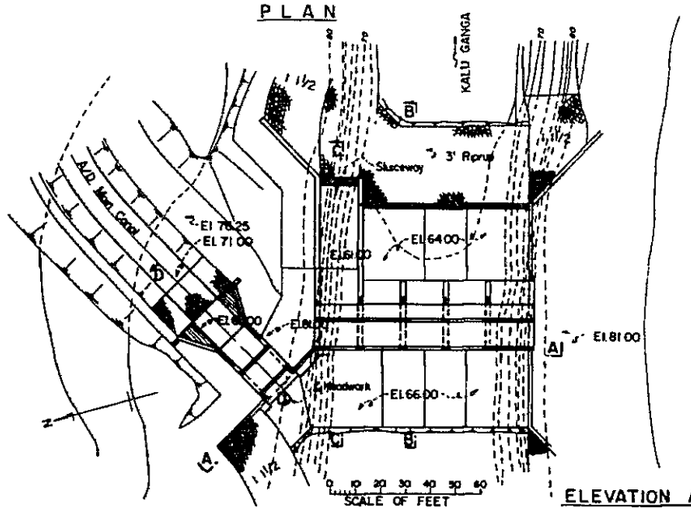
DATE	AUG, 1979	D.W.G.No.	I - 002

JAPAN INTERNATIONAL COOPERATION AGENCY

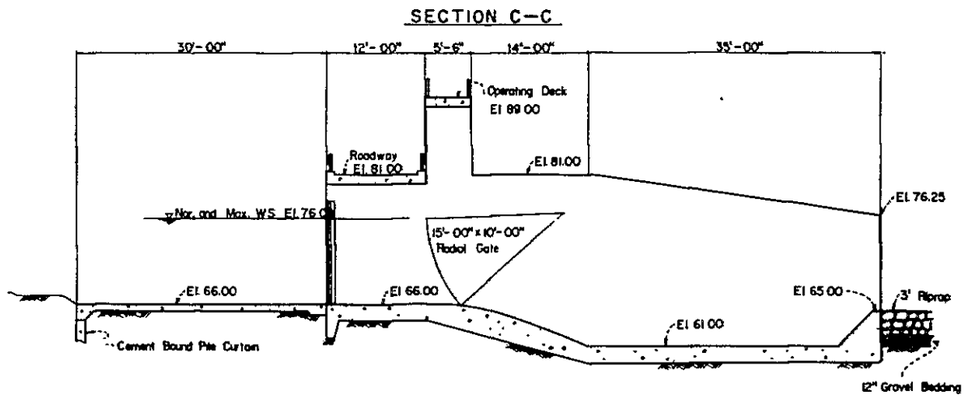
PLATE NO. 26

KALU GANGA ANICUT

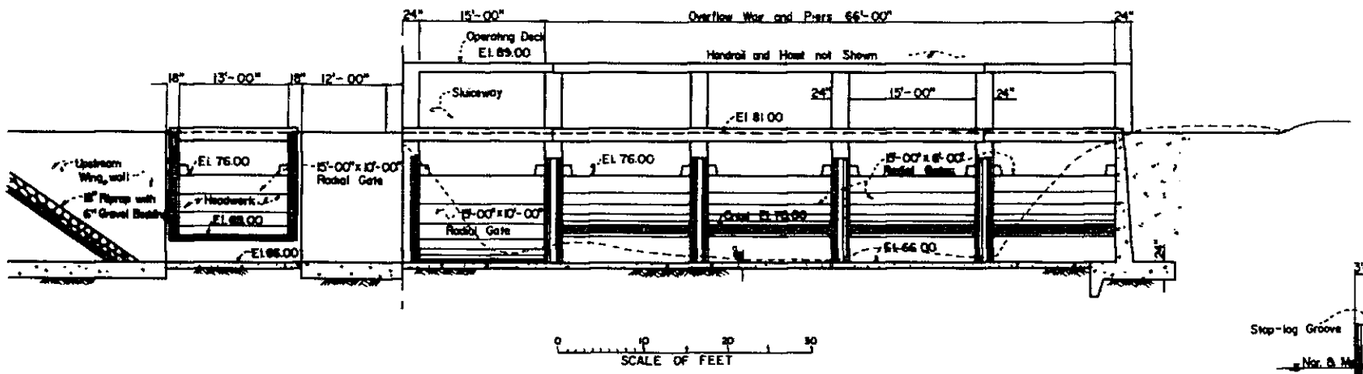
PLAN



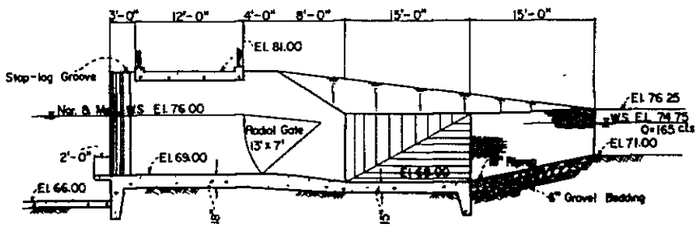
SECTION C—C



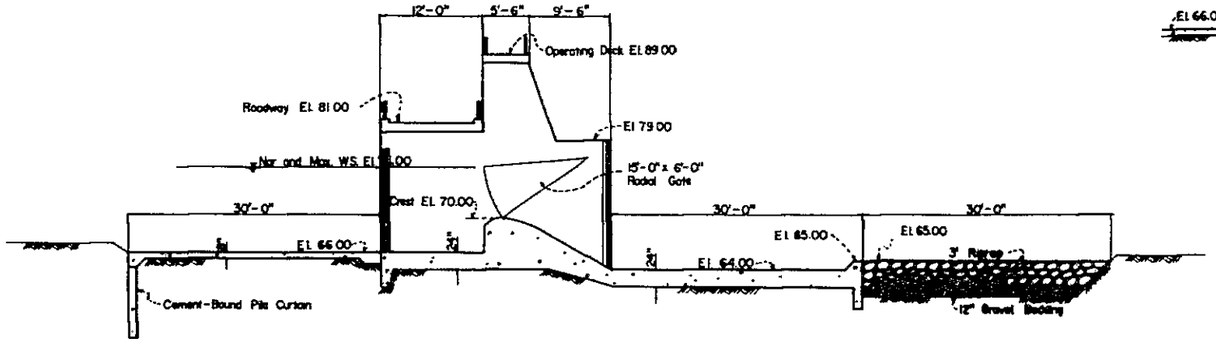
ELEVATION A—A



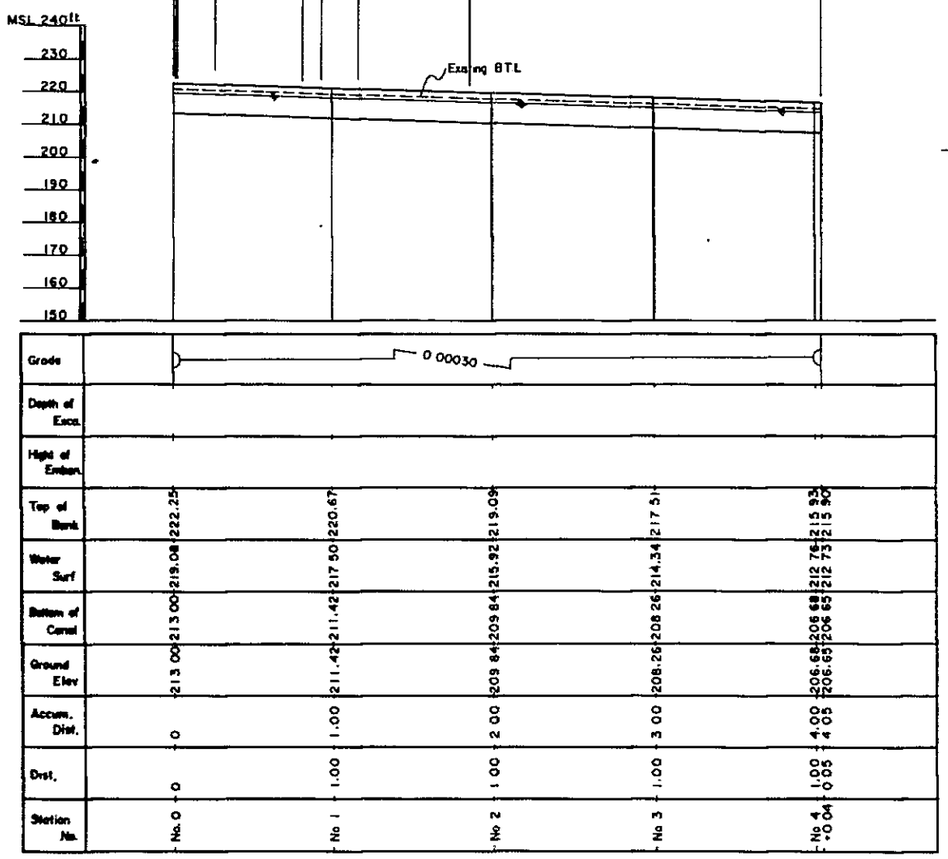
SECTION D—D



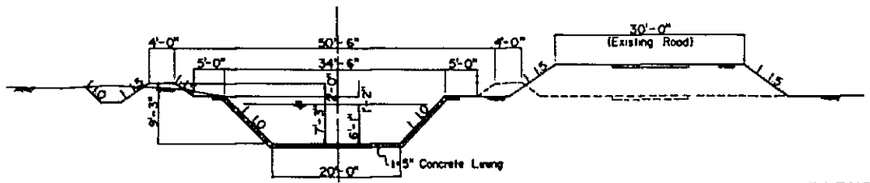
SECTION B—B



GOVERNMENT OF SRI LANKA			
MINISTRY OF MAHAWELI DEVELOPMENT			
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
SYSTEM A/D			
KALU GANGA ANICUT			
DATE	AUG 1979	D.W.G. No.	I - 003
JAPAN INTERNATIONAL COOPERATION AGENCY			



TYPICAL CROSS SECTION OF MAIN CANAL SCALE A



LEGEND

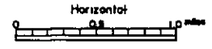
Exis T.O. — Existing Off-take

M.D. — Water Measuring Device

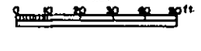
D.S. — Division Structure

SCALE

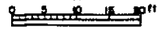
Horizontal



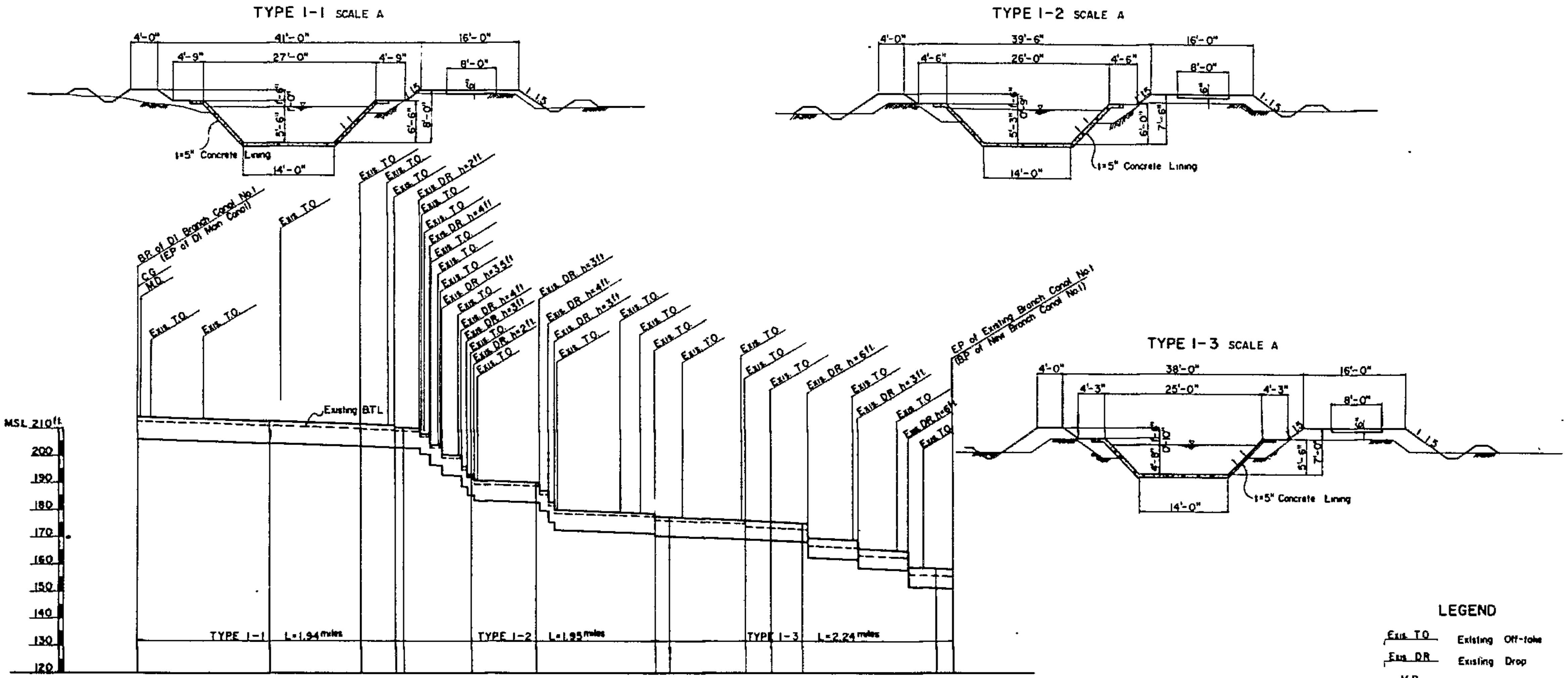
Vertical



A



GOVERNMENT OF SRI LANKA MINISTRY OF MAHAWELI DEVELOPMENT			
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
SYSTEM D1 MAIN CANAL PROFILE (IMPROVEMENT)			
DATE	AUG 1979	D.W.G.No.	1 - 004
JAPAN INTERNATIONAL COOPERATION AGENCY			



Station No.	NO 0	NO 1	+0.68	+0.94 / NO.2	+0.51	NO 3	+0.89 / NO 4	+0.57	+0.77	NO 5	NO 6	+0.13
Grade	0.00030						0.00040					
Depth of Exca												
Hight of Emban												
Top of Bank	214.10	212.52	211.44	211.03 / 210.53 / 210.44	193.14	190.36	178.95 / 177.58 / 177.35	176.13	175.71	175.21	158.09	157.82
Water Surf	211.60	210.02	208.94 / 208.77	208.36 / 208.20 / 208.19	190.89 / 190.72	187.94	176.53 / 175.25 / 175.02	173.80 / 173.38	172.96	172.46	155.34	155.07
Bottom of Canal	206.10	204.52	203.44	203.03 / 202.94	185.64	182.86	171.45 / 170.58 / 170.35	169.13	168.71	168.21	151.09	150.82
Ground Elev	206.10	204.52	203.44	203.03 / 202.94	185.64	182.86	171.45 / 170.58 / 170.35	169.13	168.71	168.21	151.09	150.82
Accum Dist.	0	1.00	1.68	1.94 / 2.00	2.51	3.00	3.89 / 4.00	4.57	4.77	5.00	6.00	6.13
Dist.	0	1.00	0.68	0.26 / 0.06	0.51	0.49	0.89 / 0.11	0.57	0.20	0.23	1.00	0.13

LEGEND

- Exis. TO — Existing Off-take
- Exis. DR — Existing Drop
- MD — Water Measuring Device

SCALE

Horizontal 0 — 0.5 — 1.0 miles

Vertical 0 10 20 30 40 50 ft

A 0 5 10 ft

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT

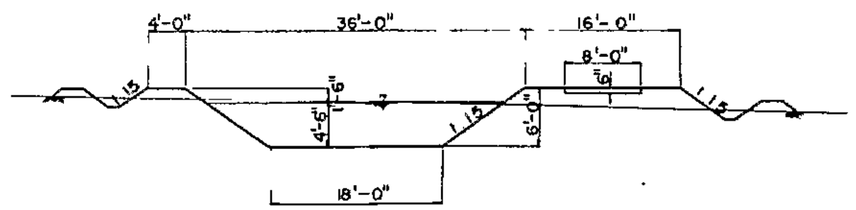
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

SYSTEM D1
BRANCH CANAL No.1
PROFILE (1)
(IMPROVEMENT)

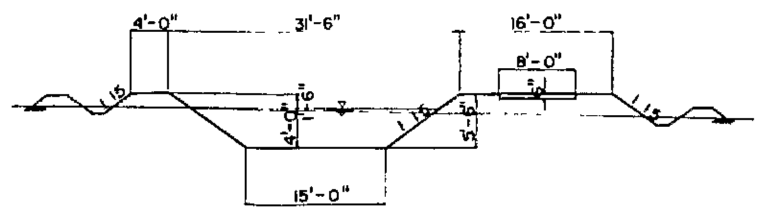
DATE	AUG 1979	D.W.G No.	I - 005

JAPAN INTERNATIONAL COOPERATION AGENCY

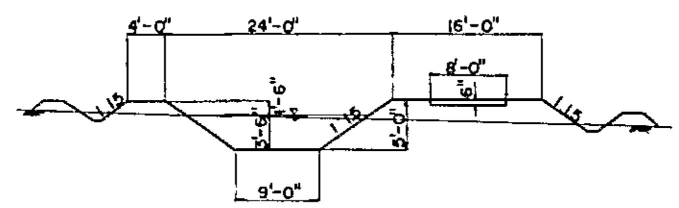
TYPE 1－4 SCALE A

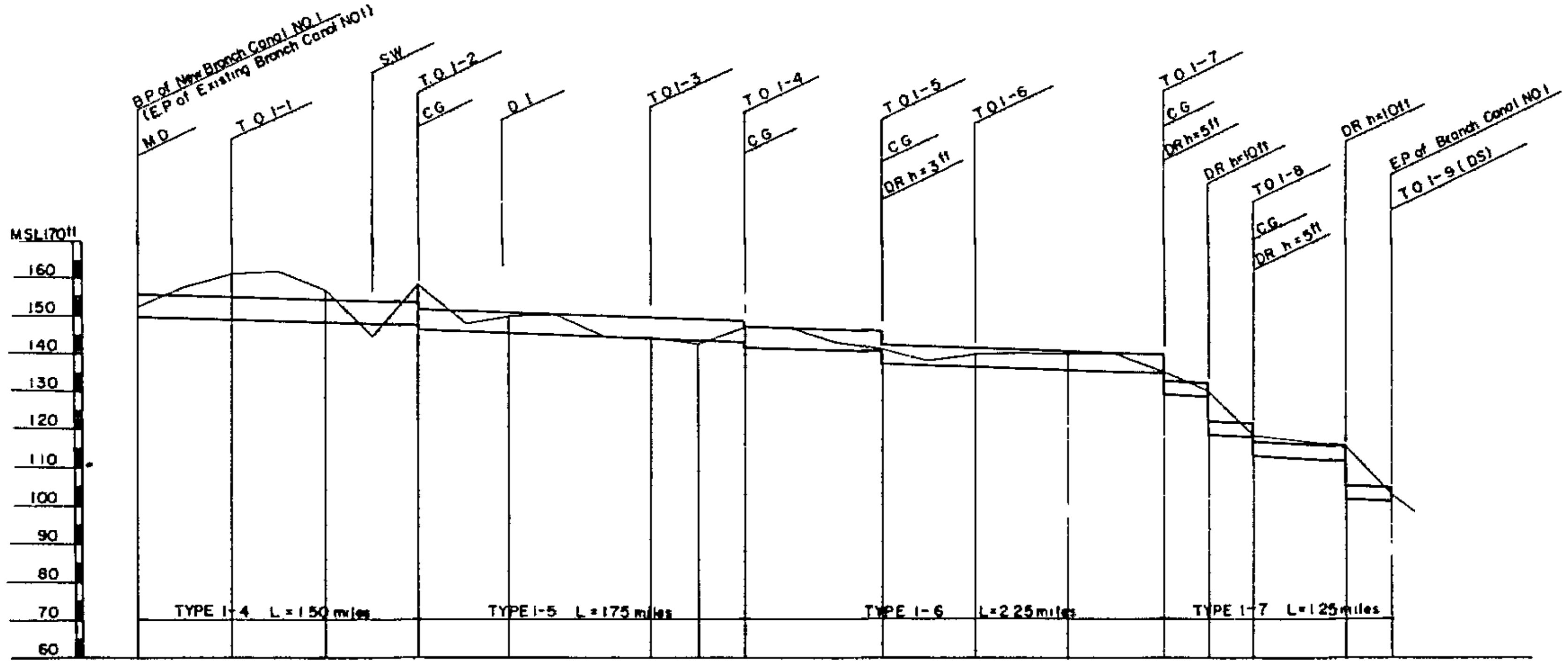


TYPE 1－5 SCALE A

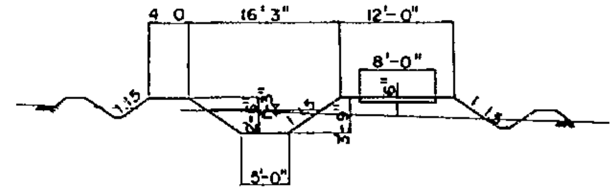


TYPE 1－6 SCALE A





TYPE 1－7 SCALE A

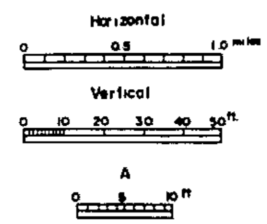


LEGEND

D I	Drainage Inlet
T O	Turnout
D S	Division Structure
C G	Check Gate
M D	Water Measuring Device
D R	Drop
S W	Spillway & Wasteway

Grade	0.00035								0.00040				0.00045			
Depth of Exca	2.2	12.1	9.0	10.9	4.9	0.3		4.2 / 5.2	1.3 / 4.3	3.8	4.9	0.9 / 5.9	1.5 / 11.5	0.1 / 5.1	4.3 / 14.3	1.9
Hight of Embon							1.3									
Top of Bank	155.82	154.90	153.97	153.05 / 151.55	150.63	149.24	148.78	148.32 / 146.82	145.24 / 142.24	141.18	140.13	139.07 / 132.82	132.23 / 122.23	121.64 / 116.64	115.45 / 105.45	104.86
Water Surf	154.32	153.40 / 153.15	152.22	151.30 / 150.05	149.13	147.49	147.03	146.57 / 145.32	143.74 / 140.74	139.68 / 139.18	138.13	137.07 / 131.57	130.98 / 120.98	120.39 / 115.13	113.95 / 103.95	103.36
Bottom of Canal	149.82	148.90	147.97	147.05 / 146.05	145.13	143.74	143.28	142.82 / 141.82	140.24 / 137.24	136.18	135.13	134.07 / 129.07	128.48 / 118.48	117.[illegible] / 112.[illegible]	111.70 / 101.70	101.11
Ground Elev.	152.0	161.0	157.0	158.0	150.0	144.0	142.0	147.0	141.5	140.0	140.0	135.0	130.0	118.0	116.0	103.0
Accum. Dist	0	0.50	1.00	1.50	2.00	2.75	3.00	3.25	4.00	4.50	5.09	5.50	5.75	6.00	6.50	6.75
Dist.	0	0.50	0.50	0.50	0.50	0.75	0.25	0.25	0.75	0.50	0.50	0.50	0.25	0.25	0.50	0.25
Station NO	NO 0	+0.50	NO 1	+0.50	NO 2	+0.75	NO 3	+0.25	NO 4	+0.50	NO 5	+0.50	+0.75	NO 6	+0.50	+0.75

SCALE



GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

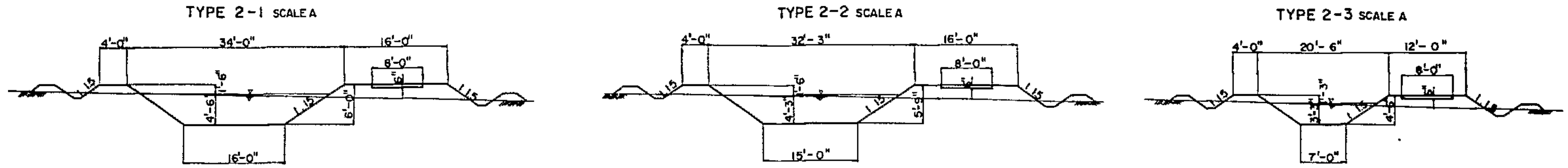
SYSTEM D1

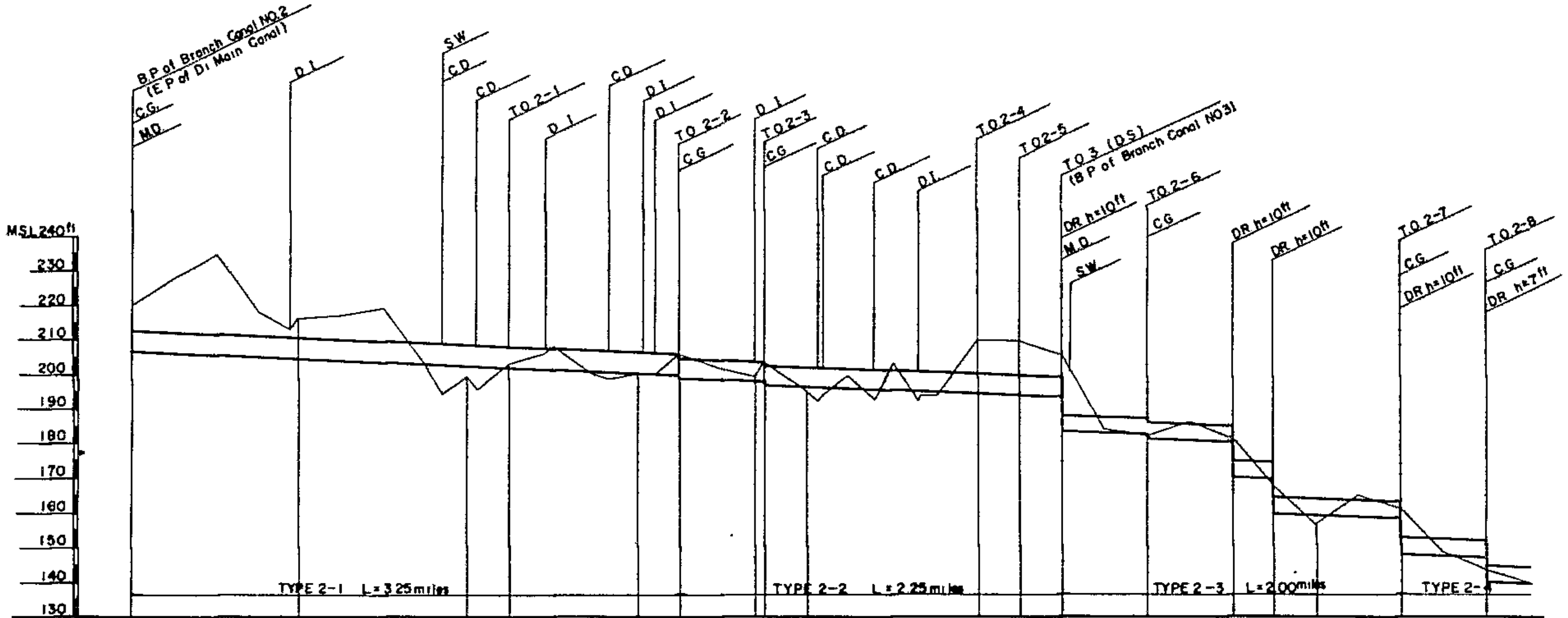
BRANCH CANAL No. 1

PROFILE (2)

DATE	AUG 1979	D.W.G.No.	1 - 006

JAPAN INTERNATIONAL COOPERATION AGENCY





Grade	0.00035										0.00040						
Depth of Exca	14.3	2.2		1.5		6.3 7.3	6.3 7.3		15.6	16.0	12.5 22.5	0.6	0.6 10.6	7.2		2.7 12.7	3.8
Hight of Emban			3.0		0.1			1.3				0.4		2.8	2.3		3.2
Top of Bank	211.65	209.80	127.95	207.50	206.11	205.65 204.40	203.47 202.47	202.01	200.16	199.70	199.24 187.99	186.93 185.93	184.87 174.87	174.34 164.34	163.81	162.76 152.26	151.20 144.20
Water Surf	210.15	208.30	206.45	206.00	204.61	204.15 202.90	201.97 200.97	200.51	198.66 198.41	197.95	197.49 186.74	185.68 184.43	183.37 173.37	172.84 162.84	162.31	161.26 151.01	149.95 142.95
Bottom of Canal	205.68	203.80	121.95	201.50	200.11	199.65 198.65	197.72 196.72	196.26	194.41	193.95	193.49 183.49	182.43 181.43	180.37 170.37	169.84 159.84	159.31	158.26 148.26	147.20 140.20
Ground Elev	220.0	216.0	199.0	203.0	200.0	206.0	204.0	195.0	210.0	210.0	206.0	182.0	181.0	167.0	157.0	161.0	144.0
Accum. Dist.	0	100	200	225	300	325	375	400	500	525	550	600	650	675	700	750	800
Dist	0	1.00	1.00	0.25	0.75	0.25	0.50	0.25	1.00	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50
Station NO.	NO.0	NO.1	NO.2	+0.25	NO.3	+0.25	+0.75	NO.4	NO.5	+0.25	+0.50	NO.6	+0.50	+0.75	NO.7	+0.50	NO.8

LEGEND

C.D	Cross Drain
D.I	Drainage Inlet
T.O	Turnout
D.S	Division Structure
C.G	Check Gate
M.D	Water Measuring Device
D.R	Drop
S.W	Spillway & Wasteway

SCALE

Horizontal 0 0.5 1.0 miles

Vertical 0 10 20 30 40 50 ft

A 0 5 10 ft

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT

MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

SYSTEM D1

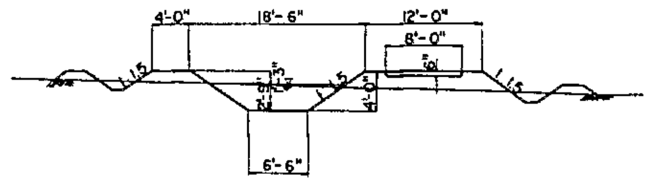
BRANCH CANAL No.2

PROFILE (I)

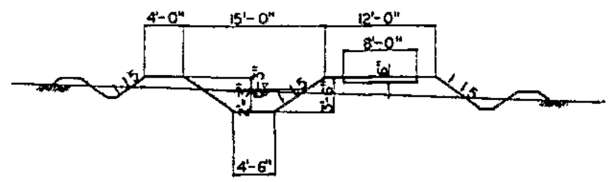
DATE	AUG 1979	D.W.G.No.	I-007

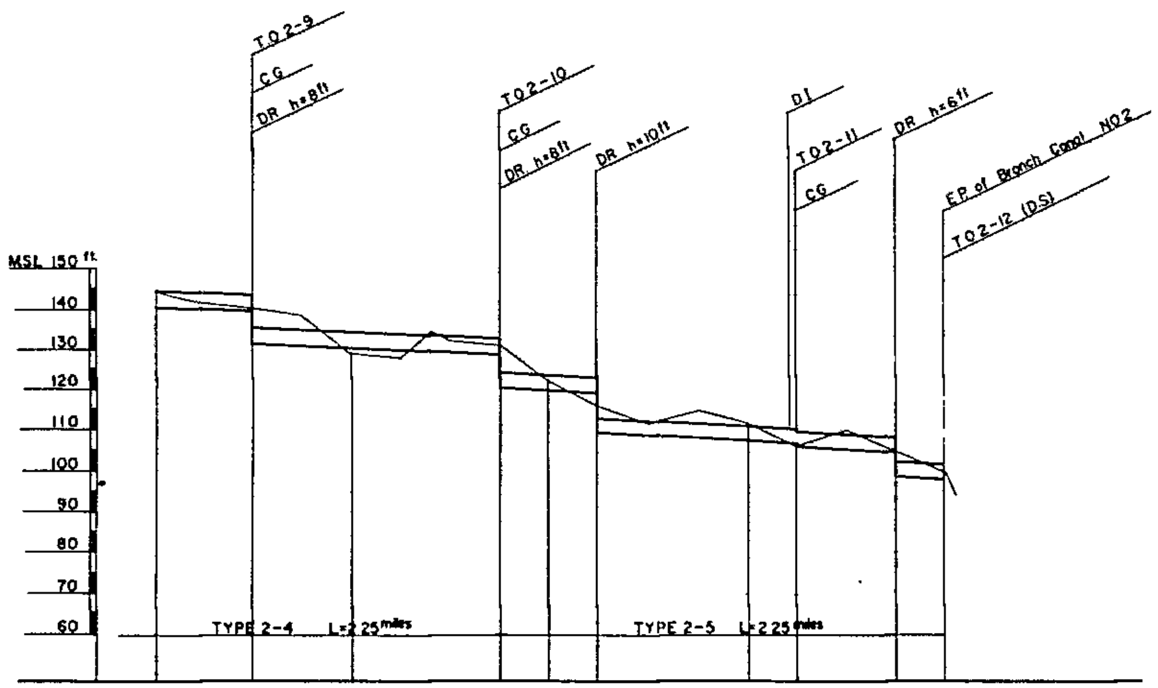
JAPAN INTERNATIONAL COOPERATION AGENCY

TYPE 2-4 SCALE A



TYPE 2-5 SCALE A





Grade	0.0004						0.00045			
Depth of Exca.	3.8	0.9 / 8.9		2.5 / 10.5	2.1	6.7	4.5	0.1	0.3 / 6.3	1.8
Hight of Embon.			1.1			3.1		0.9		
Top of Bank	144.20	143.14 / 135.14	134.08	132.50 / 124.00	123.41	122.81 / 112.81	111.03	110.43 / 109.43	108.24 / 102.24	101.65
Water Surf.	142.95	141.89 / 133.64	132.58	131.00 / 122.75	122.16	121.56 / 111.56	109.78	109.18 / 107.68	106.49 / 100.49	99.90
Bottom of Canal	140.20	139.14 / 131.14	130.08	128.50 / 120.50	119.91	119.31 / 109.31	107.53	106.93 / 105.93	104.74 / 98.74	98.15
Ground Elev.	144.0	140.0	129.0	131.0	122.0	116.0	112.0	106.0	105.0	100.0
Accum Dist	8.00	8.50	9.00	9.75	10.00	10.25	11.00	11.25	11.75	12.00
Dist.	0.50	0.50	0.50	0.75	0.25	0.25	0.75	0.25	0.50	0.25
Station No.	NO.8	+0.5	NO.9	+0.75	NO.10	+0.25	NO.11	+0.25	+0.75	NO.12

LEGEND

- D.I. Drainage Inlet
- T.O. Turnout
- D.S. Division Structure
- C.G. Check Gate
- M.D. Water Measuring Device
- D.R. Drop

SCALE

Horizontal

Vertical

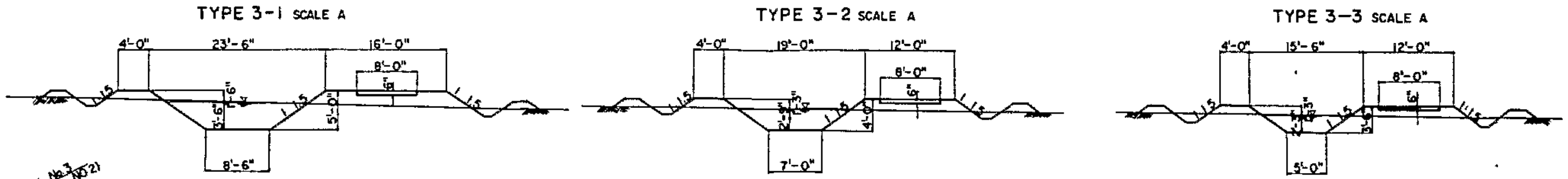
A

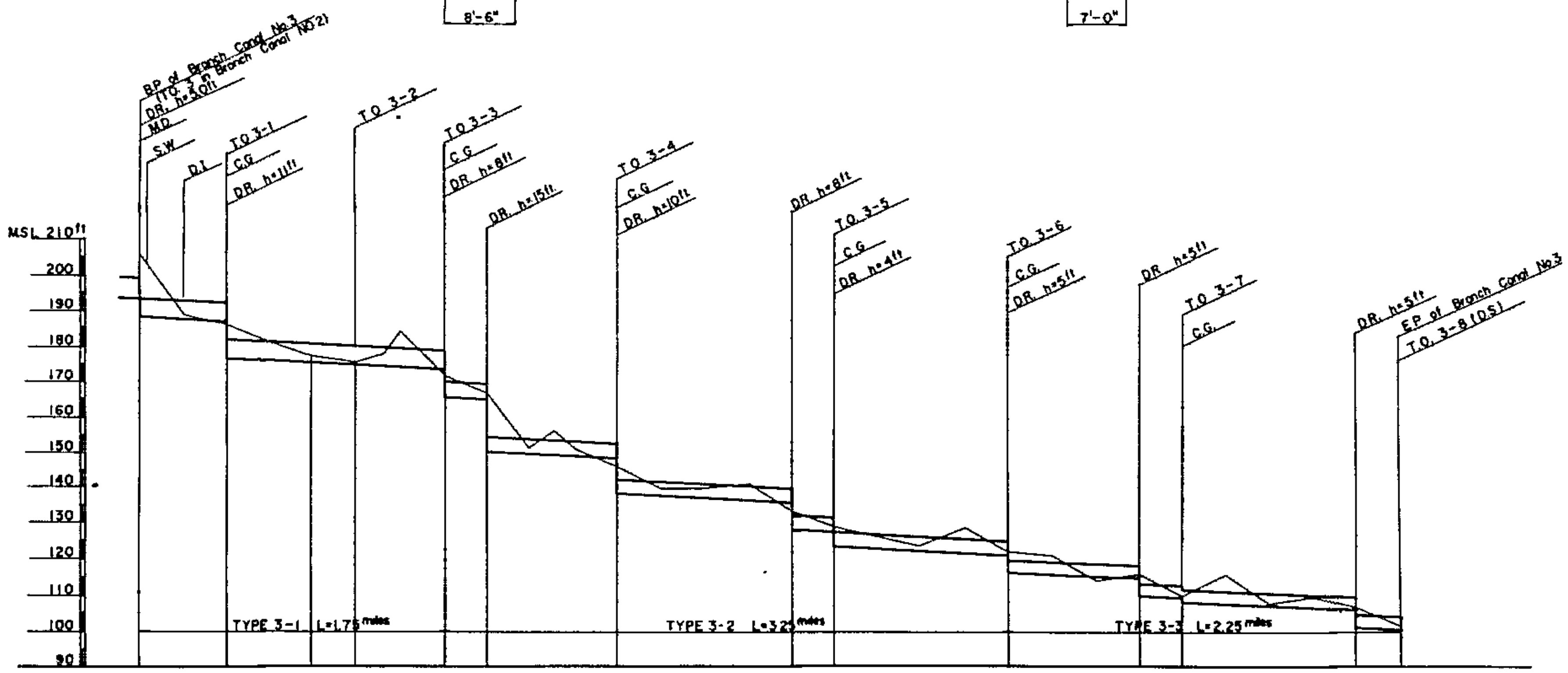
GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

SYSTEM D1
BRANCH CANAL No.2
PROFILE (2)

DATE	AUG 1979	D.W.G. No.	1-008

JAPAN INTERNATIONAL COOPERATION AGENCY





Grade	0.0004											0.00045			
Depth of Exca.	17.5	9.6	1.6	0.7	5.7	1.7 / 16.7	7.3		4.9	1.5 / 5.5	0.1 / 5.1	0.9 / 5.9	0.4 / 1.4	0.8 / 5.8	1.4
Hight of Emban.		1.4			2.3		2.7	1.9	3.1						
Top of Bank	193.49	189.43 / 181.43	180.37	179.85	178.79 / 170.54	169.26 / 154.26	152.68 / 142.68	142.15	140.57 / 132.57	132.04 / 128.04	125.93 / 120.43	118.65 / 113.65	113.06 / 112.06	109.68 / 104.68	104.09
Water Surf	191.99	190.93 / 179.68	178.62	178.10	177.04 / 168.54	168.01 / 153.01	151.43 / 141.18	140.65	139.07 / 131.07	130.54 / 126.29	124.18 / 119.18	117.40 / 112.40	111.81 / 110.56	108.18 / 103.18	102.59
Bottom of Canal	193.49 / 188.49	187.43 / 176.43	175.37	174.85	173.79 / 165.79	165.26 / 150.26	148.68 / 138.68	138.15	136.57 / 128.57	128.04 / 124.04	121.93 / 116.93	115.15 / 110.15	109.56 / 108.56	106.18 / 101.18	100.59
Ground Elev	206.0	186.0	177.0	175.5	171.5	167.0	146.0	140.0	133.5	129.5	122.0	116.0	110.0	107.0	102.0
Accum Dist	0	0.50	1.00	1.25	1.75	2.00	2.75	3.00	3.75	4.00	5.00	5.75	6.00	7.00	7.25
Dist. in Mile	0	0.50	0.50	0.25	0.50	0.25	0.75	0.25	0.75	0.25	1.00	0.75	0.25	1.00	0.25
Station No.	No 0	+0.50	No 1	+0.25	+0.75	No 2	+0.75	No 3	+0.75	No 4	No 5	+0.75	No 6	No 7	+0.25

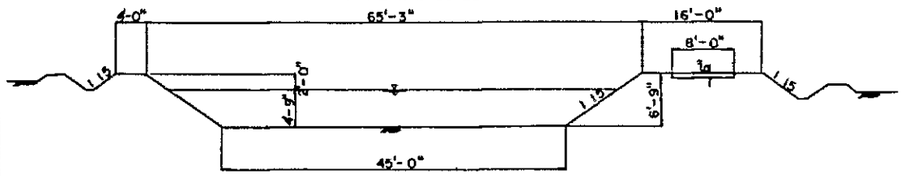
LEGEND

- D.I. — Drainage Inlet
- T.O. — Turnout
- D.S. — Division Structure
- C.G. — Check Gate
- M.D. — Water Measuring Divice
- D.R. — Drop
- S.W. — Spillway & Wasteway

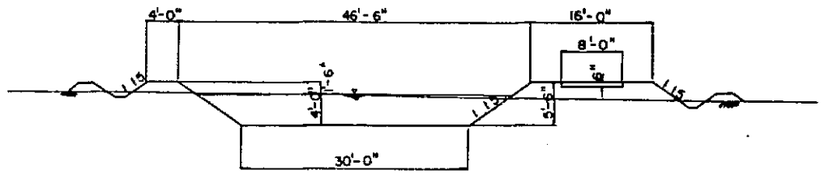
SCALE
Horizontal 0 0.5 1.0 miles
Vertical 0 10 20 30 40 50 ft.
A 0 5 10 ft.

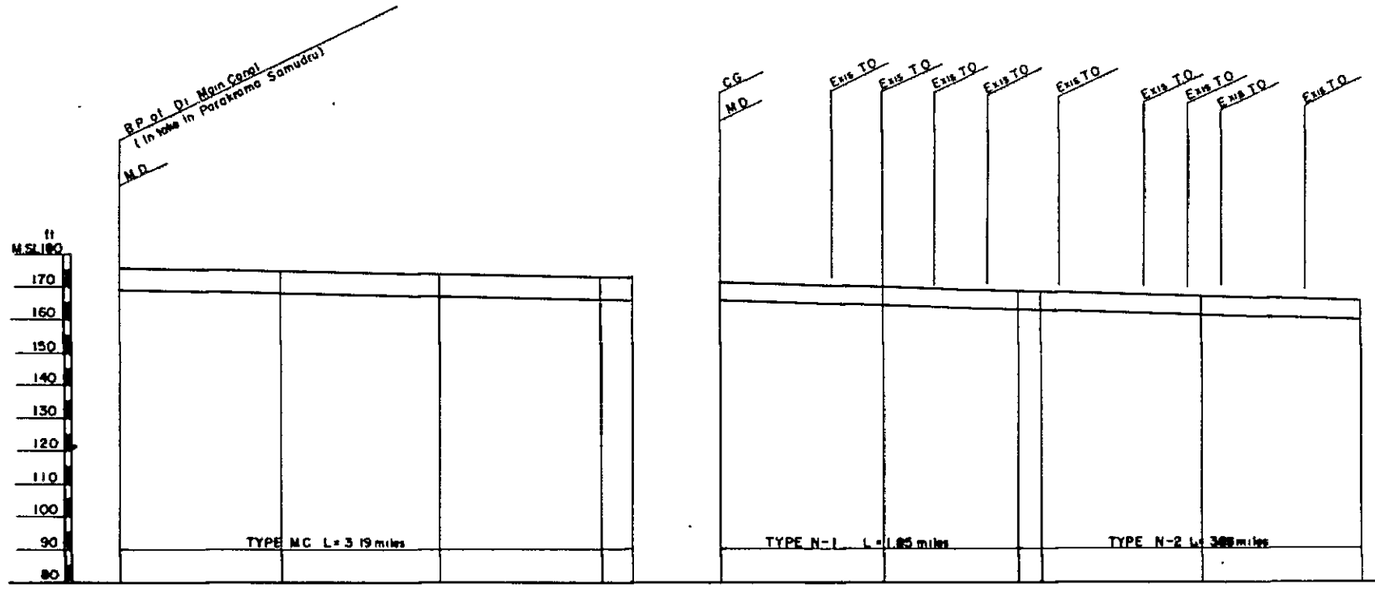
GOVERNMENT OF SRI LANKA			
MINISTRY OF MAHAWELI DEVELOPMENT			
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
SYSTEM D1 BRANCH CANAL No.3 PROFILE			
DATE	AUG 1979	D.W.G. No.	I - 009
JAPAN INTERNATIONAL COOPERATION AGENCY			

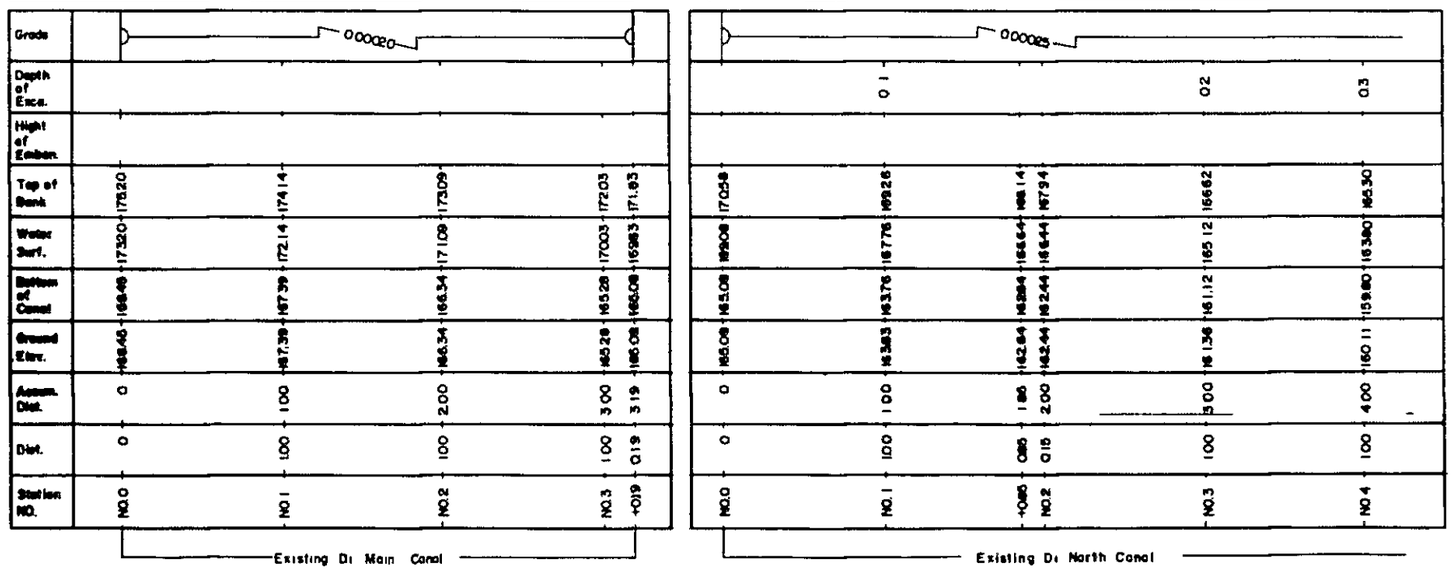
TYPE MC SCALE A



TYPE N-1





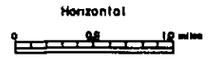


LEGEND

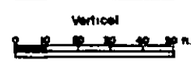
Exis T.O	Existing Off-take
C.G.	Check Gate
M.D.	Water Measuring Divice

SCALE

Horizontal



Vertical



A

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

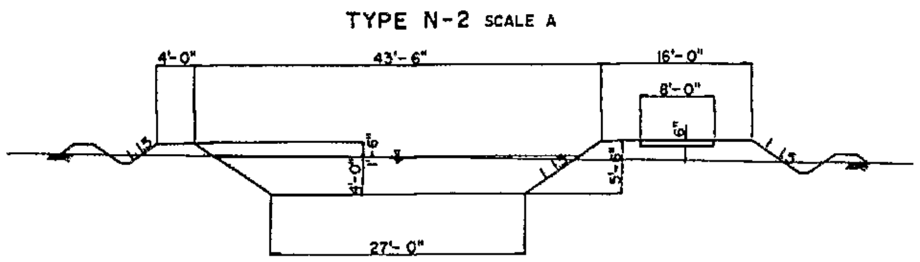
SYSTEM Di

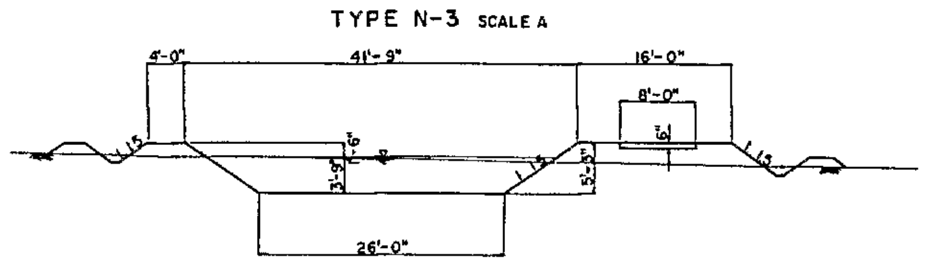
Di MAIN CANAL, NORTH CANAL & R.B.M.

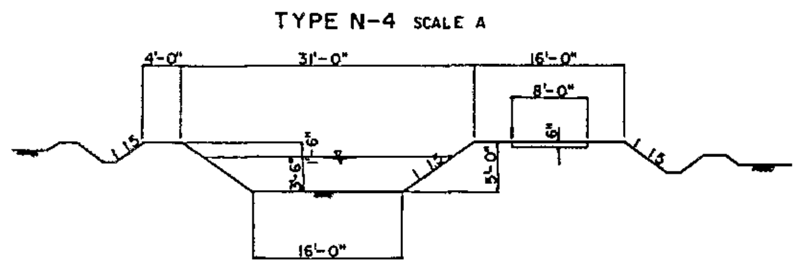
PROFILES (I) (IMPROVEMENT)

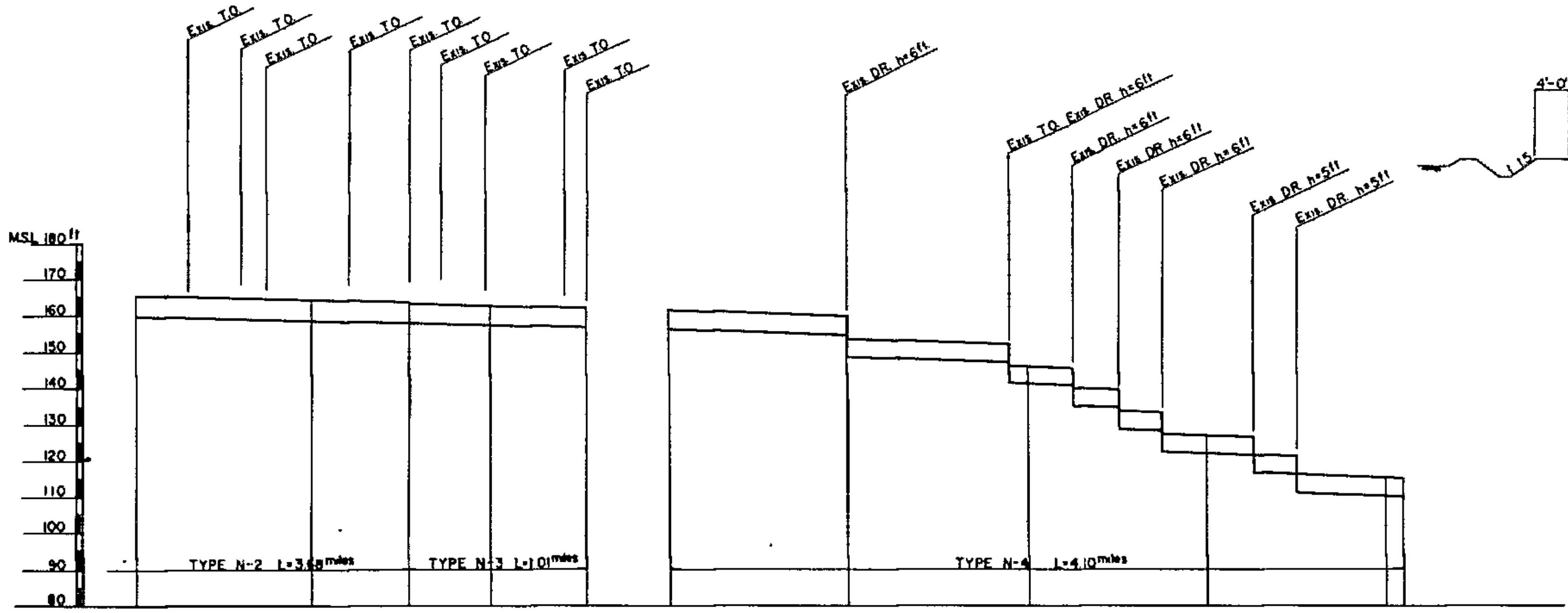
DATE	AUG. 1979	D.W.G.No.	1-010

JAPAN INTERNATIONAL COOPERATION AGENCY









Grade	0.00025				
Depth of Exca.	0.3	0.3		0.3	
Hight of Emban.					
Top of Bank	165 30	163 98	163 28 / 163.03	162 41	161 70
Water Surf	163 80	162.48	161.78 / 161 53	160 91	160.20
Bottom of Canal	159 80	158.48	157 78	157 16	156 45
Ground Elev	160 11	158.76	157 78	157.50	156 45
Accum. Dist.	4 00	5 00	5.53	6.00	6 54
Dist.	1.00	1 00	0 53	0 47	0 54
Station No.	NO.4	NO.5	+0 53	NO 6	+0.54

Existing DI North Canal

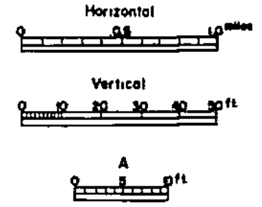
Grade	0.00030					
Depth of Exca.						
Hight of Emban.						
Top of Bank	161 00	159 42 / 153 42	145 83	126 25	114 67	114 51
Water Surf	159.50	157 92 / 151 92	144 33	124 75	113.17	113 01
Bottom of Canal	156.00	154 42 / 148 42	140 83	121 25	109 67	109 51
Ground Elev	156.00	154 42 / 148 42	140 83	121.25	109 67	109.51
Accum. Dist.	0	1 00	2 00	3.00	4.00	4 10
Dist.	0	1.00	1.00	1 00	1 00	0.10
Station No.	NO.0	NO 1	NO 2	NO.3	NO.4	+0.10

Existing RB 18

LEGEND

Exis TO — Existing Off-take
Exis DR — Existing Drop
C G — Check Gate
M.D. — Water Measuring Device

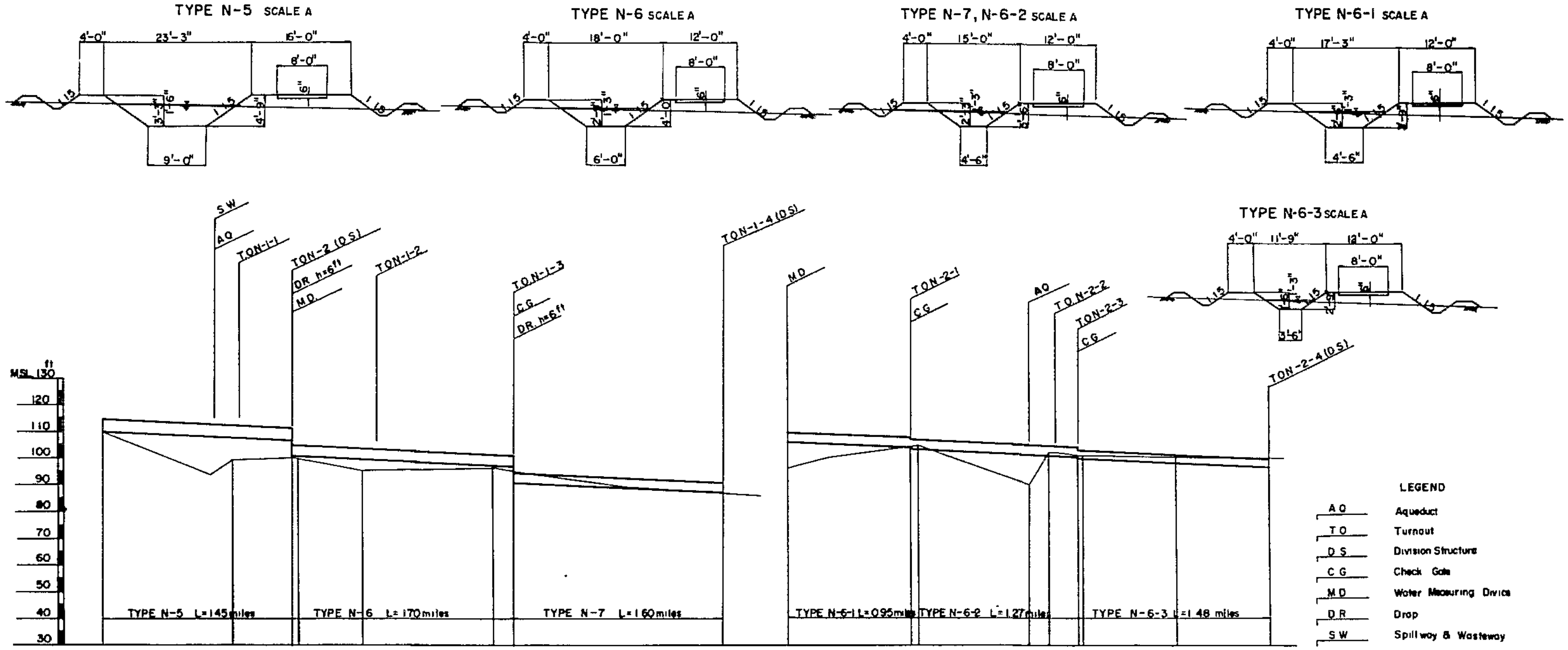
SCALE



GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT
SYSTEM D2
D1 MAIN CANAL, NORTH CANAL & R.B.18
PROFILES (2)
(IMPROVEMENT)

DATE	AUG 1979	D.W.G. No.	I-011

JAPAN INTERNATIONAL COOPERATION AGENCY



Grade	0.0040				0.00045			
Depth of Exca.						41	02	
Hight of Embkm.		109	55 05	43	12	19		01
Top of Bank	11426	11215	11120 10445	10329	10118	10086 9436	9234	9056
Water Surf.	11276	11065	10970 10320	10204	9993	9961 9311	9109	8931
Bottom of Canal	10951	10740	10645 10045	9929	9718	9686 9086	8884	8706
Ground Elev.	1095	965	1000	950	960	950	890	870
Accum. Dist.	0	100	145	200	300	315	400	475
Dist.	0	100	045	055	100	015	085	075
Station NO.	NO 0	NO 1	+045	NO 2	NO 3	+015	NO 4	+075

Grade	0.00045					
Depth of Exca.		03 [illegible] 01	13	03 08	27	39
Hight of Embkm.	105 100					
Top of Bank	11020 10970	10744 [illegible] 10657	10420	10367 10242	10057	9890
Water Surf.	10895 10845	10819 10443 10332	10295	10242 10117	9932	9765
Bottom of Canal	10645 10595	10369 10319 10307	10070	10017 9967	9782	9615
Ground Elev.	960	1040 1045	1020	1005	1005	1000
Accum. Dist.	0	095 100	200	222	300	370
Dist.	0	095 005	100	022	078	070
Station NO.	NO 0	+095 NO 1	NO 2	+022	NO 3	+070

LEGEND

AQ	Aqueduct
TO	Turnout
DS	Division Structure
CG	Check Gate
MD	Water Measuring Device
DR	Drop
SW	Spillway & Wasteway

SCALE

Horizontal 0 0.5 1.0

Vertical 0 10 20 30 40 50

A 0 5 10 ft

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

SYSTEM D2

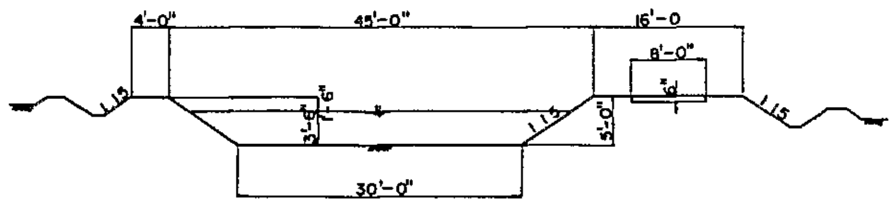
D1-NORTH NEW BRANCH CANAL

PROFILES

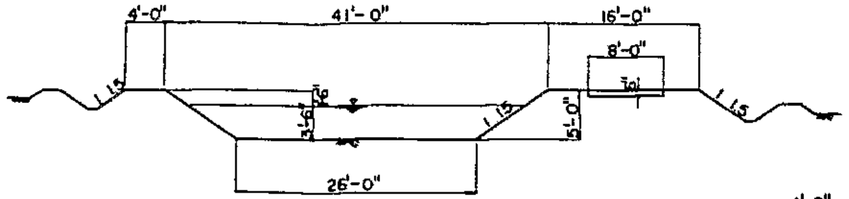
DATE	AUG 1979	D.W.G. No.	1-012

JAPAN INTERNATIONAL COOPERATION AGENCY

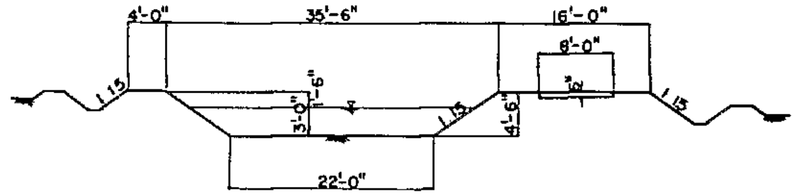
TYPE E-1 SCALE A

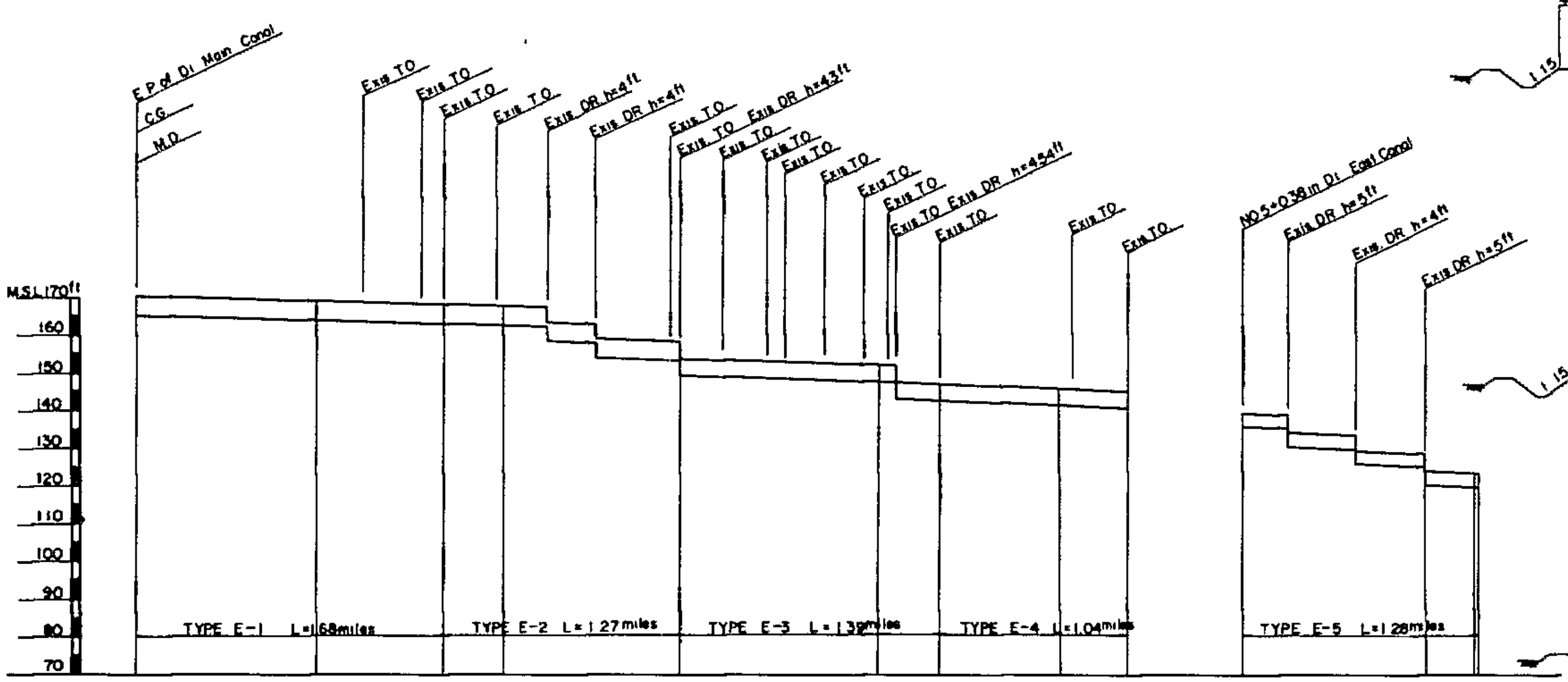


TYPE E-2 SCALE A

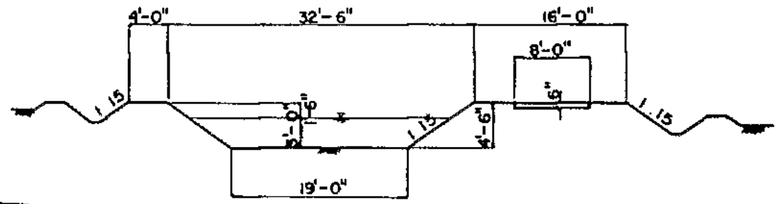


TYPE E-3 SCALE A

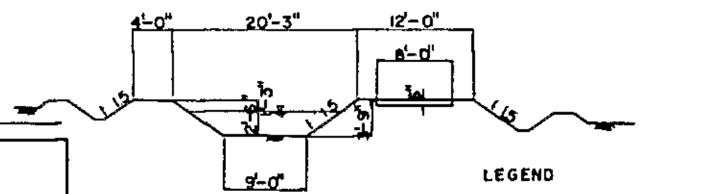




TYPE E-4 SCALE A



TYPE E-5 SCALE A



Grade	000025				000035		0000235		
Depth of Exca.									
Hight of Emban									
Top of Bank	17002	16870	16760	16738	15813 [illegible] 15326	15189	14688	14606	14559
Water Surf.	16852	16720	16630	16588	15663 [illegible] 15176	15039	14538	14456	14409
Bottom of Canal	16502	16370	16280	16238	15313 [illegible] 14876	14739	14238	14156	14109
Ground Elev.	16502	16370	16280	16238	15313 [illegible] 14876	14739	14238	14156	14109
Accum. Dist.	0	100	168	200	2.95 3.00	400	434	500	538
Dist.	0	100	068	032	095 005	100	034	066	038
Station NO.	N0.0	N0.1	+068	N0.2	+095 N0.3	N0.4	+034	N0.5	+038

Existing D1 East Canal

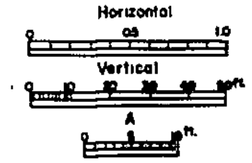
Grade	0000347		
Depth of Exca.			
Hight of Emban			
Top of Bank	13965	12882 12382	12331
Water Surf.	13840	12737 12237	12206
Bottom of Canal	13590	12507 12007	11956 11500
Ground Elev.	13590	12507 12007	11956 115.00
Accum. Dist.	0	100	128
Dist.	0	100	028
Station NO.	N0.0	N0.1	+028

Existing R.B.10 Canal

LEGEND

Exis T.O.	Existing Off-take
Exis DR	Existing Drop
C.G.	Check Gate
M.D.	Water Measuring Divice

SCALE



GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT

MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

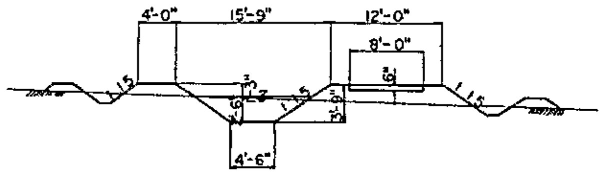
SYSTEM D2

D1-EAST CANAL & R.B.10 CANAL
PROFILES
(IMPROVEMENT)

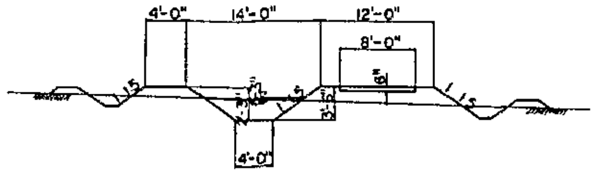
DATE	AUG 1979	D.W.G. No.	1-013

JAPAN INTERNATIONAL COOPERATION AGENCY

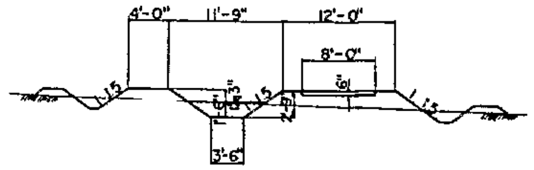
TYPE E-6 SCALE A

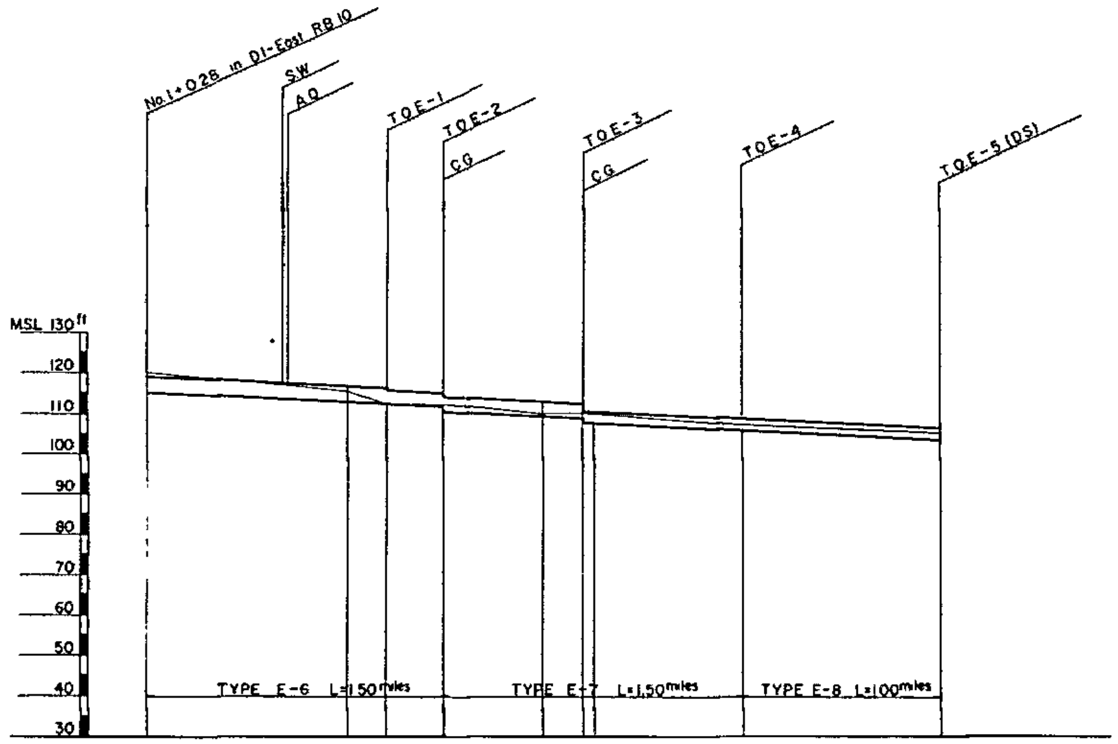


TYPE E-7 SCALE A



TYPE E-8 SCALE A





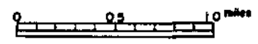
Grade				0.00045				
Depth of Exca.	5.0	2.4		0.6 / 1.6	0.8	1.2 / 2.2	1.1	1.5
Hight of Emban.			0.2					
Top of Bank	118.75	116.37	115.90 / 115.65	114.94 / 113.94	112.75	112.28 / 110.53	108.63	106.25
Water Surf	117.50	115.12	114.65 / 114.40	113.69 / 112.69	111.50	111.03 / 109.28	107.38	105.00
Bottom of Canal	115.00	112.82	112.15	111.44 / 110.44	109.25	108.78 / 107.78	105.88	103.50
Ground Elev	120.0	115.0	112.0	112.0	110.0	110.0	107.0	105.0
Accum Dist.	0	1.00	1.20	1.50	2.00	2.20	3.00	4.00
Dist		1.00	0.20	0.30	0.50	0.20	0.80	1.00
Station No.	NO 0	NO.1	+0.20	+0.50	NO 2	+0.20	NO 3	NO 4

LEGEND

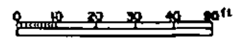
- AQ — Aqueduct
- TO — Turnout
- DS — Division Structure
- CG — Check Gate
- MD — Water Measuring Device
- SW — Spillway & Wasteway

SCALE

Horizontal



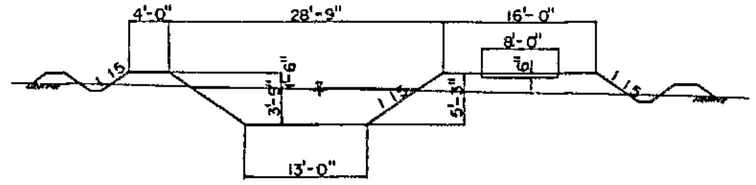
Vertical



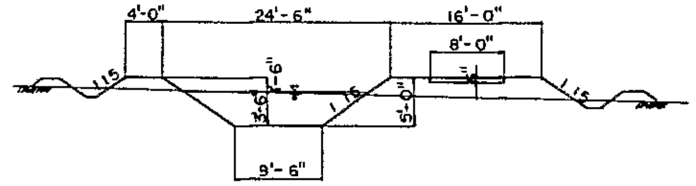
A

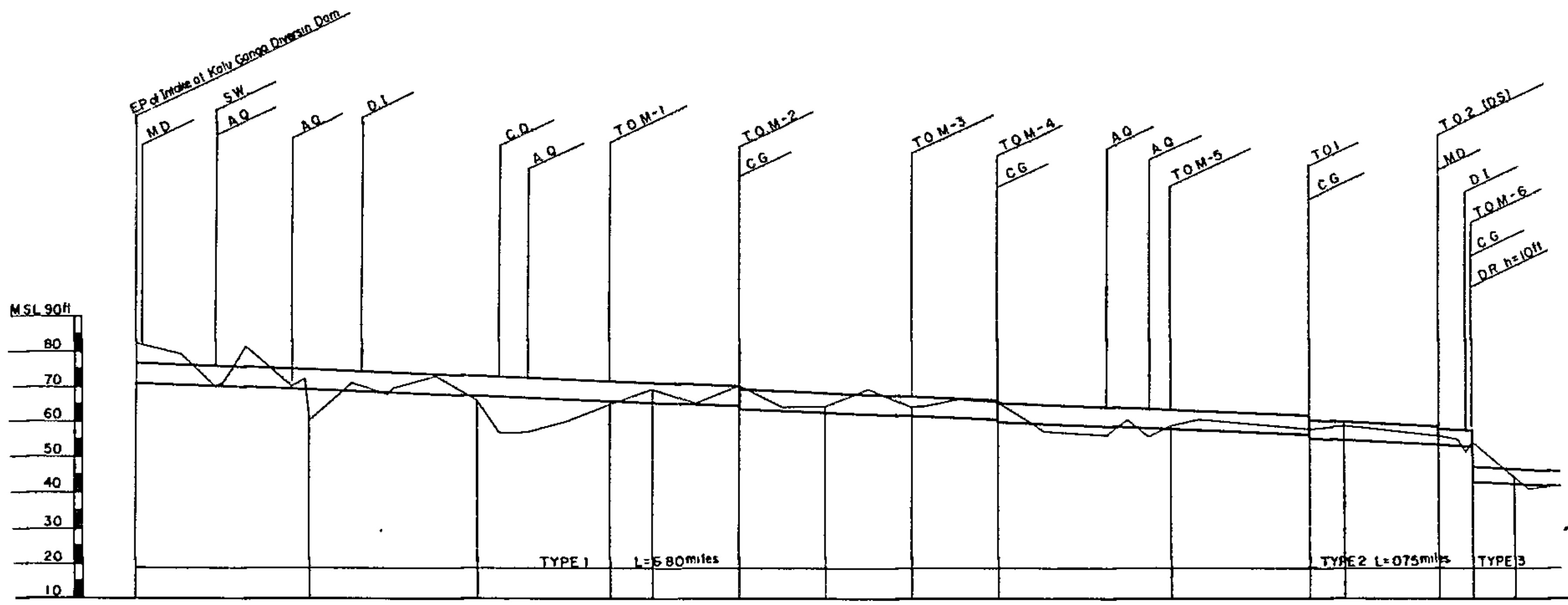
GOVERNMENT OF SRI LANKA MINISTRY OF MAHAWELI DEVELOPMENT			
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
SYSTEM D2			
D1-EAST NEW BRANCH CANAL PROFILE			
DATE	AUG 1979	D.W.G. No.	1-014
JAPAN INTERNATIONAL COOPERATION AGENCY			

TYPE 1 SCALE A



TYPE 2 SCALE A



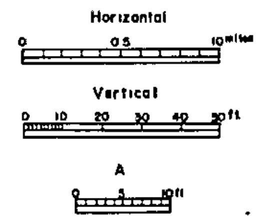


Grade					000035								000040		
Depth of Excd.					35	55 65	14	23	42 52	01	06 16	30	12	01 00	01
Hight of Emban	1030	92	13	09											
Top of Bank	7625	7440	7255	7117	7071	6978 6878	6786	6693	6601 6501	6316	6168 6043	6001	5885 5810	5767 4767	4714
Water Surf	7475	7290	7105	6967	6921	6828 6728	6636	6543	6451 6351	6166	6018 5893	5851	5735 5685	5642 4642	4589
Bottom of Canal	7100	6915	6730	6592	6546	6453 6353	6261	6168	6076 5976	5791	5643 5543	5501	5385	5342 4342	4289
Ground Elev.	813	600	660	650	690	700	640	640	650	580	570	580	550	535	430
Accum. Dist	0	100	200	275	300	350	400	450	500	600	680	700	755	775	800
Dist	0	100	100	075	025	050	050	050	050	100	080	020	055	020	025
Station NO	NO0	NO1	NO2	+075	NO3	+050	NO4	+050	NO5	NO6	+080	NO7	+055	+075	NO8

LEGEND

A Q	Aqueduct
C D	Cross Drain
D I	Drainage Inlet
T O	Turnout
D S	Division Structure
C G	Check Gate
M D	Water Measuring Divice
D R	Drop
S W	Spillway & Wasteway

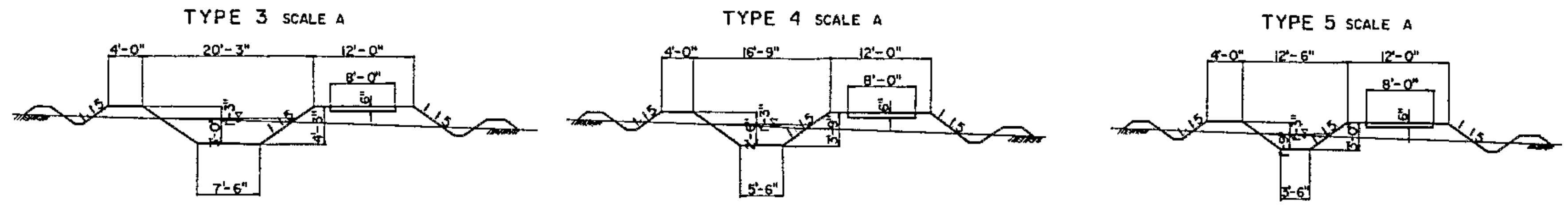
SCALE

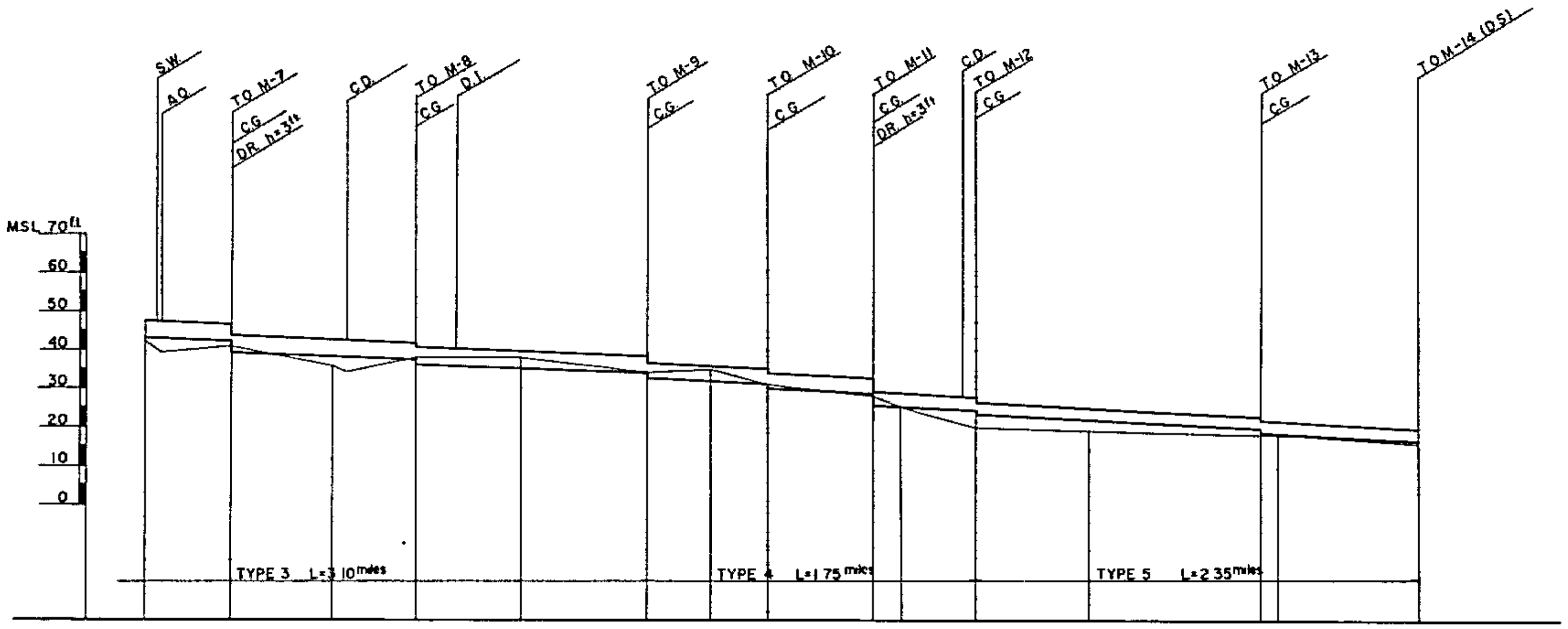


GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT
SYSTEM A/D
MAIN CANAL
PROFILE (I)

DATE	AUG 1979	D.W.G. No.	1-015

JAPAN INTERNATIONAL COOPERATION AGENCY





Grade: 0.00040 … 0.00045

Station No.	Dist	Accum Dist.	Ground Elev	Bottom of Canal	Water Surf	Top of Bank	Hight of Embon.	Depth of Exca.
NO. 8	0 25	8.00	43.0	42 89	45 89	47 14		0 1
+0.45	0.45	8 45	41.0	41 94 / 38.94	44 94 / 41.94	46 19 / 43 19	0 9	2 1
NO. 9	0 55	9 00	36 0	37 78	40 78	42 03	1 8	
+0 45	0 45	9 45	38 0	36 83 / 35 83	39 83 / 38.83	41 08 / 40 08		1 2 / 2 2
NO 10	0 55	10 00	38 0	34 67	37 67	38 92		3 3
+0 65	0 65	10 65	34 0	33 30 / 32 30	36 30 / 34 80	37.55 / 36 05		0 8 / 1 7
NO 11	0 35	11 00	35 0	31 47	33 97	35 22		3 5
+0 30	0 30	11 30	31 0	30 76 / 29 76	33 26 / 32.26	34.51 / 33.51		0 2 / 1 2
+0.85	0 55	11 85	28.0	28 45 / 25 45	30 95 / 27.95	32 20 / 29 20	0 5	2 6
NO.12	0 15	12 00	25.0	25 09	27 59	28 84	0 1	
+0 40	0 40	12 40	20 0	24 14 / 23 14	26 64 / 24 89	27 89 / 26 14	4 1 / 3 1	
NO.13	0.60	13 00	19 0	21 72	23 47	24 72	2 7	
+0 90	0.90	13 90	18 0	19 58 / 18 58	21 33 / 20 33	22 58 / 21 58	1 6 / 0 6	
NO.14	0 10	14 00	18.0	18 34	20 09	21 34	0 3	
+0 75	0 75	14 75	15 0	16 56	18 31	19 56	1 6	

LEGEND

- A.Q. — Aqueduct
- C.D. — Cross Drain
- D.I. — Drainage Inlet
- T.O. — Turnout
- D.S. — Division Structure
- C.G. — Check Gate
- M.D. — Water Measuring Device
- D.R. — Drop
- S.W. — Spillway & Wasteway

SCALE
Horizontal 0 — 0.5 — 1.0 miles
Vertical 0 — 10 — 20 — 30 — 40 — 50 ft.
A 0 — 5 — 10 ft.

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT
SYSTEM A/D
MAIN CANAL
PROFILE (2)

DATE	AUG 1979	D.W.G. No.	I - 016

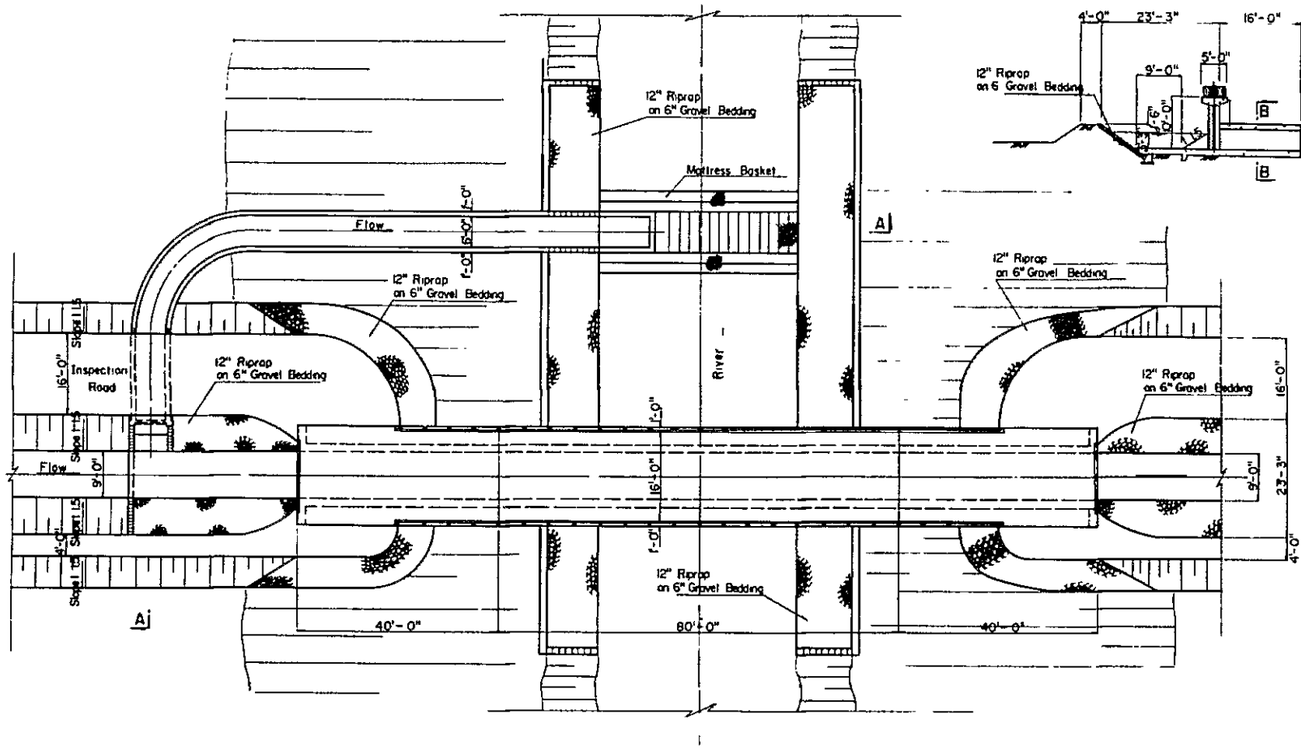
JAPAN INTERNATIONAL COOPERATION AGENCY

111

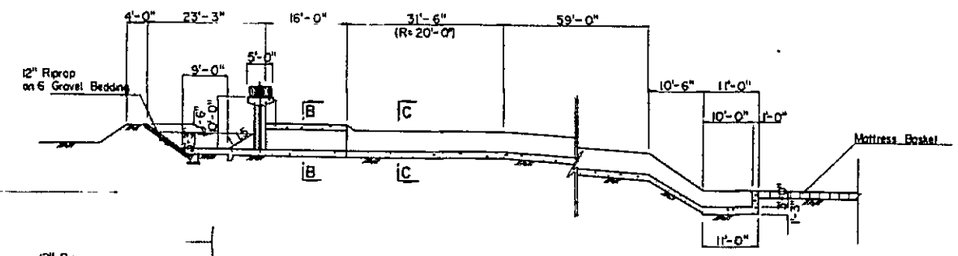
PLATE NO. 27

AQUEDUCTS

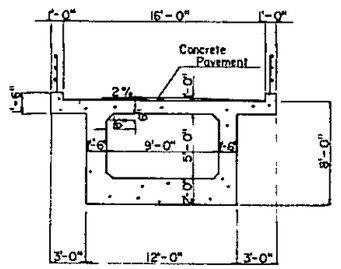
PLAN SCALE A



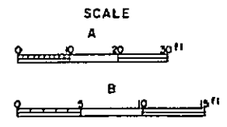
WASTE WAY (SECTION A–A) SCALE A



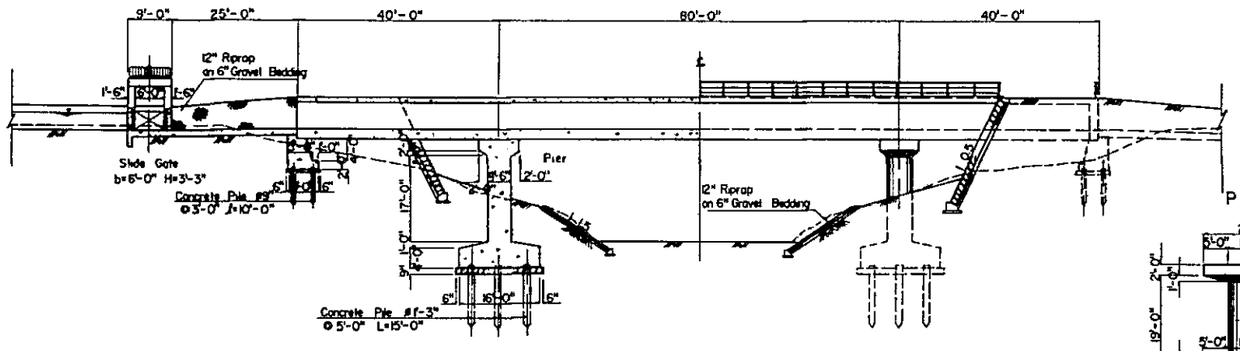
AQUEDUCT SECTION SCALE B



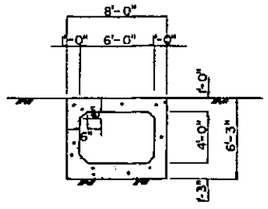
SCALE



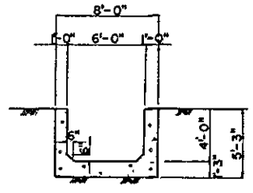
PROFILE SCALE A



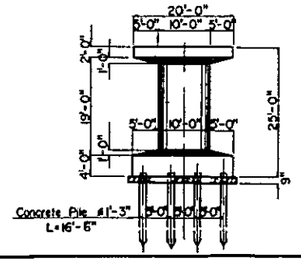
SECTION B–B SCALE B



SECTION C–C SCALE B



PIER SCALE A



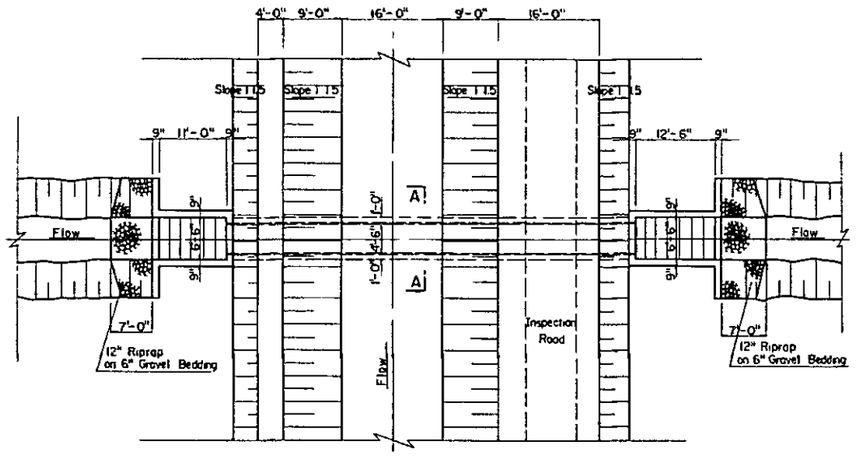
GOVERNMENT OF SRI LANKA	
MINISTRY OF MAHAWELI DEVELOPMENT	
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT	
AQUEDUCTS	
DATE	AUG 1979 D.W.G.No. 1-017
JAPAN INTERNATIONAL COOPERATION AGENCY	

PLATE NO. 28

CROSS DRAINS & DRAIN INLETS

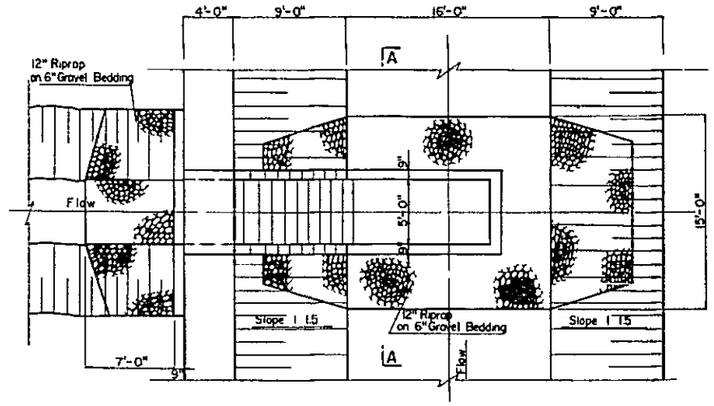
CROSS DRAINS SCALE A

PLAN

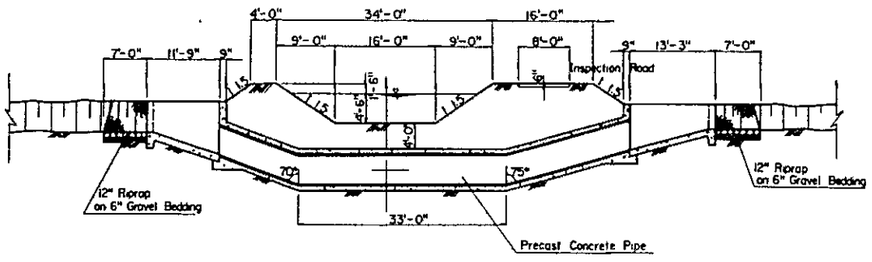


DRAIN INLETS SCALE B

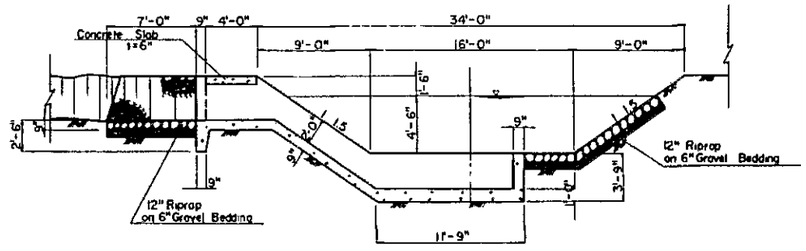
PLAN



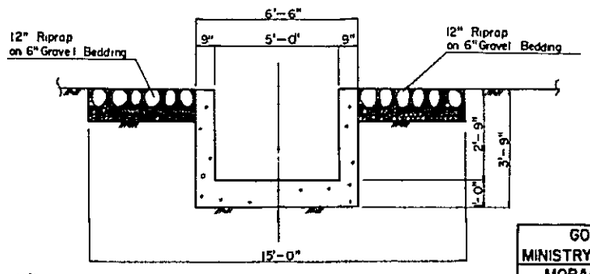
PROFILE SCALE A



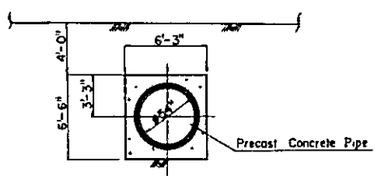
PROFILE SCALE B



SECTION A–A SCALE C

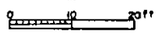


SECTION A–A SCALE B

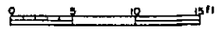


SCALE

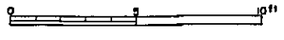
A



B



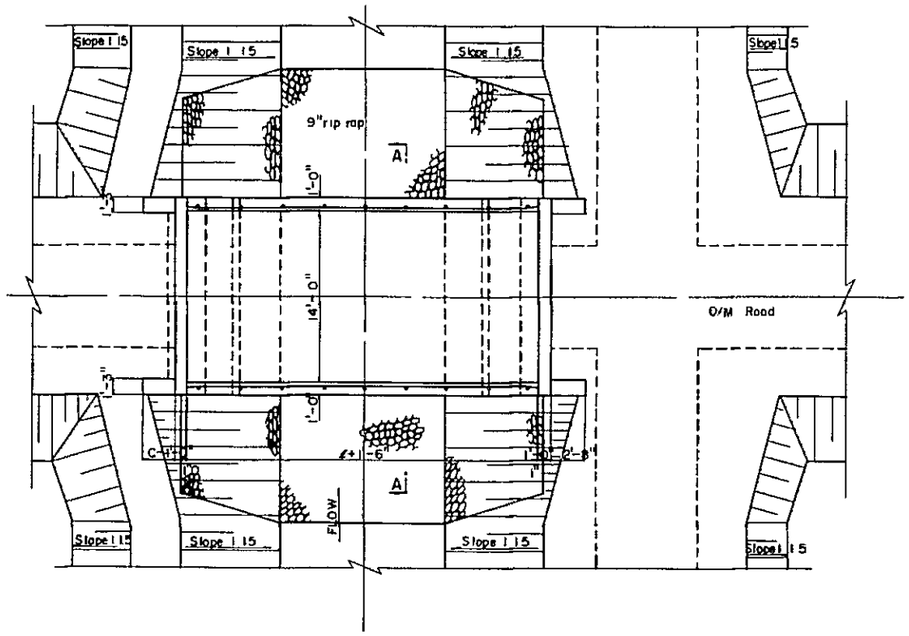
C



GOVERNMENT OF SRI LANKA	
MINISTRY OF MAHAWELI DEVELOPMENT	
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT	
CROSS DRAINS & DRAIN INLETS	
DATE	AUG 1979
D.W.G. No.	1-018
JAPAN INTERNATIONAL COOPERATION AGENCY	

BRIDGES

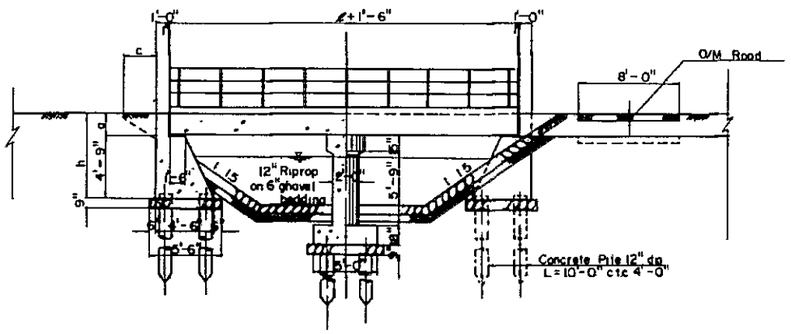
PLAN



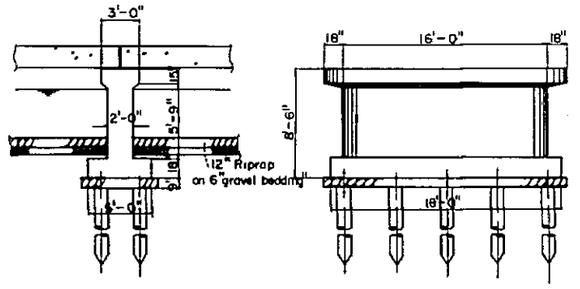
DATA TABLE

TYPE	ℓ	t	a	h	c
A	25'-0"	1'-9"	1'-9"	6'-6"	3'-0"
B	20'-0"	1'-6"	1'-6"	6'-3"	2'-9"
C	15'-0"	1'-3"	1'-3"	6'-0"	2'-3"
D	10'-0"	1'-3"	1'-3"	6'-0"	2'-3"

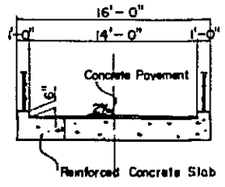
PROFILE



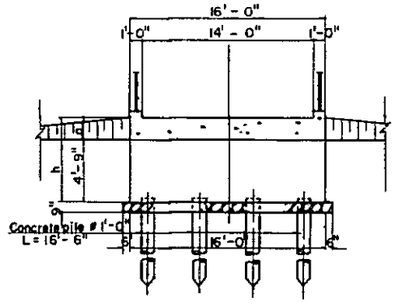
PIER



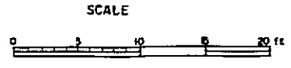
SECTION A–A



ABUTMENT



SCALE

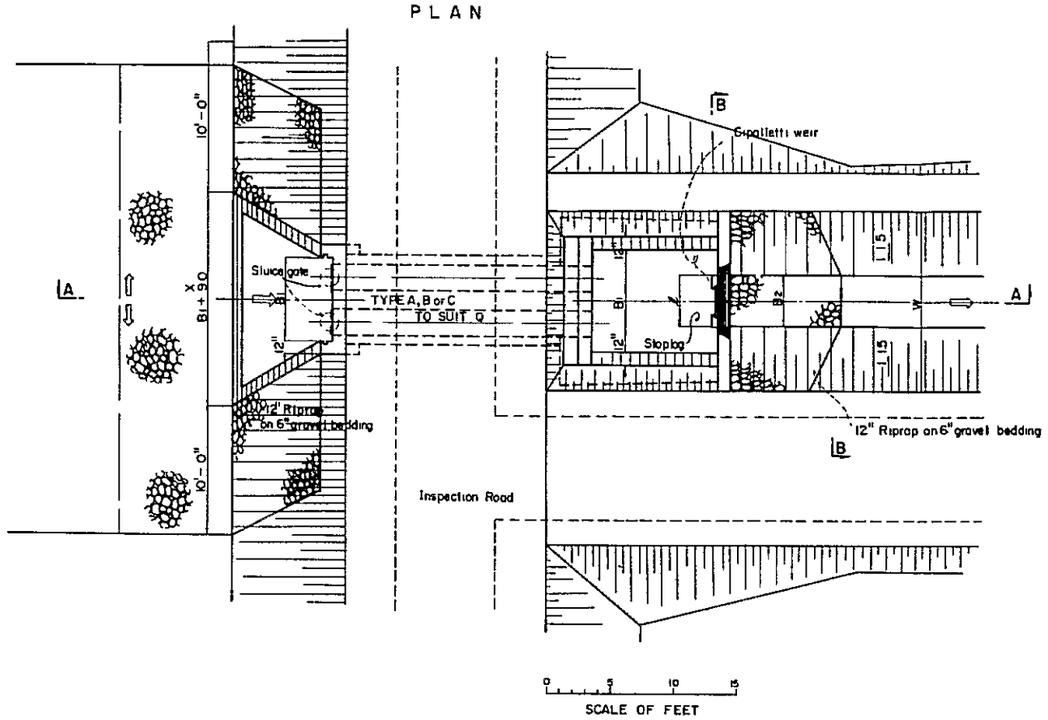


GOVERNMENT OF SRI LANKA MINISTRY OF MAHAWELI DEVELOPMENT			
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
BRIDGES			
DATE	AUG 1979	D.W.G No.	I - 019
JAPAN INTERNATIONAL COOPERATION AGENCY			

PLATE NO. 29

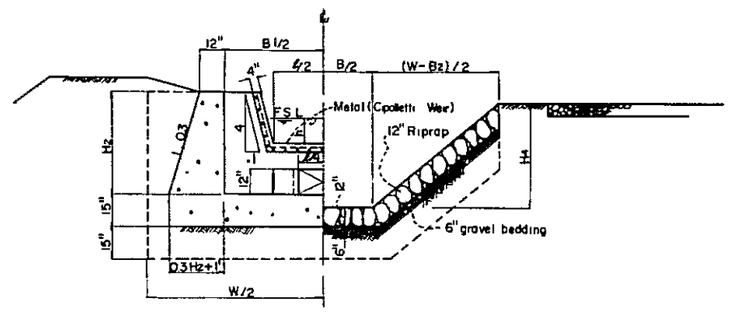
TURNOUTS

PLAN



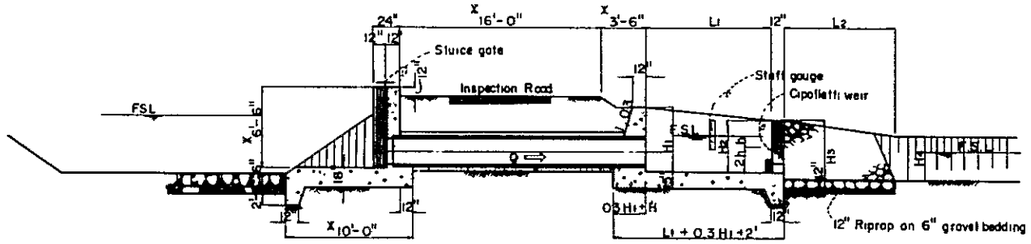
SCALE OF FEET

SECTION B—B

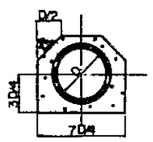


SECTION A—A

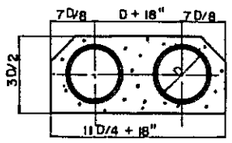
Note X varies with canal type



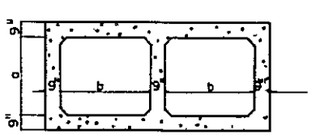
TYPE A



TYPE B



TYPE C



DIMENSIONS (Feet)

TYPE NO		Q (CFS)	D	b x a	ℓ	h	H1	H2	H3	H4	B1	B	W	L1	L2
A	1	3	1.00	—	2.0	0.6	2.75	2.75	3.00	2.0	5.0	2.0	8.0	6.0	6.0
	2	5	1.25	—	3.0	0.7	3.00	3.00	3.25	2.0	6.0	3.0	9.0	8.0	8.0
	3	10	1.50	—	3.5	0.9	4.00	4.00	4.25	2.75	6.5	3.5	11.75	8.0	8.0
	4	20	2.50	—	4.0	1.3	5.25	5.25	5.50	3.25	7.0	4.0	13.75	9.0	9.0
B	1	40	2.50	—	5.0	1.8	6.50	6.50	6.75	3.75	9.0	5.0	16.25	11.0	11.0
	2	60	3.00	—	7.0	1.8	6.75	6.75	7.00	4.00	11.0	7.0	19.0	14.0	14.0
	3	80	3.50	—	8.0	2.0	7.25	7.25	7.50	4.25	12.0	8.0	20.75	15.0	15.0
	4	100	4.00	—	9.0	2.3	8.25	8.25	8.50	4.75	13.0	9.0	23.25	16.0	16.0
	5	130	4.50	—	10.0	2.5	9.00	9.00	9.50	5.00	14.0	10.0	25.0	17.0	17.0
C	1	160	—	5.0x4.0	12.0	2.5	9.00	9.00	9.50	5.25	16.0	12.0	27.75	20.0	20.0
	2	200	—	5.0 4.0	14.0	2.7	9.50	9.50	10.00	5.50	18.0	14.0	30.5	22.0	22.0

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

TURNOUTS

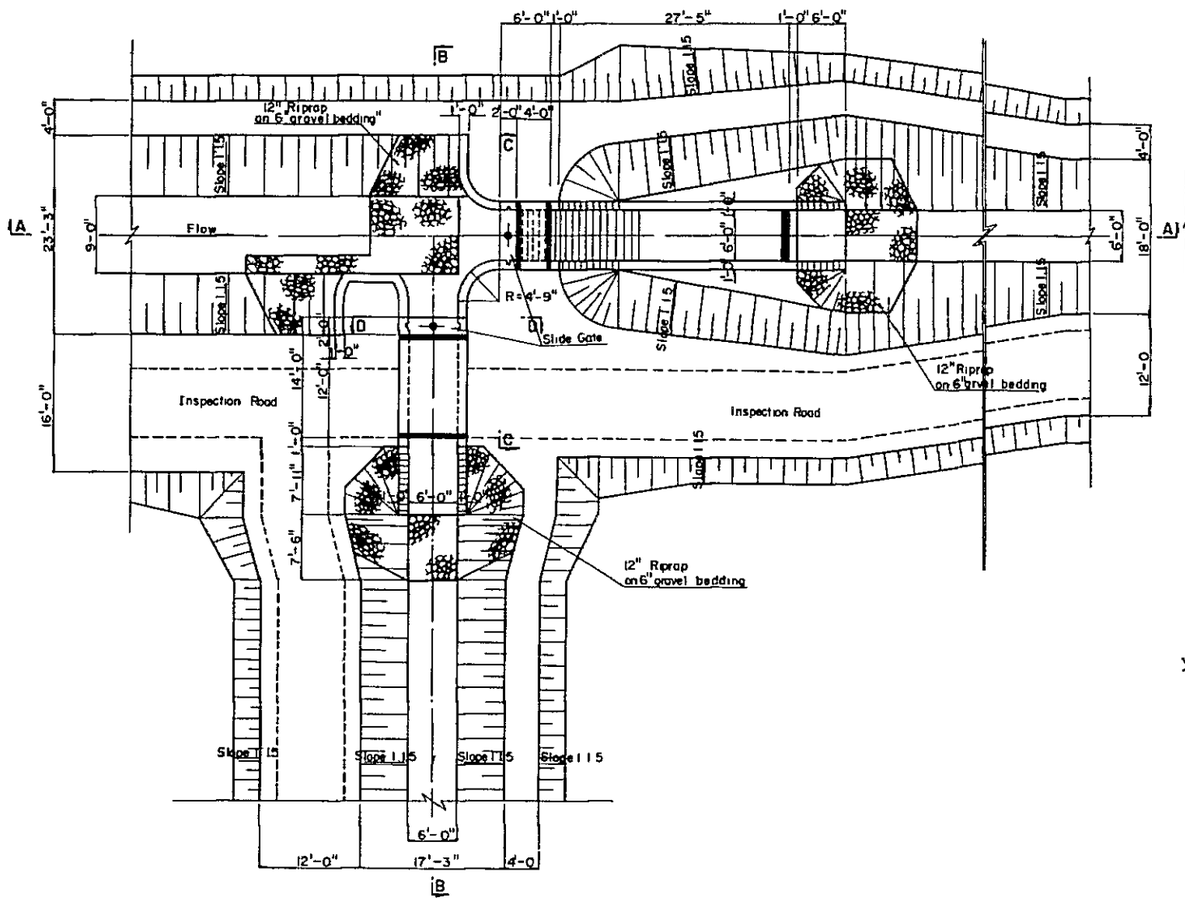
DATE	AUG 1979	D.W.G. No.	I - 020

JAPAN INTERNATIONAL COOPERATION AGENCY

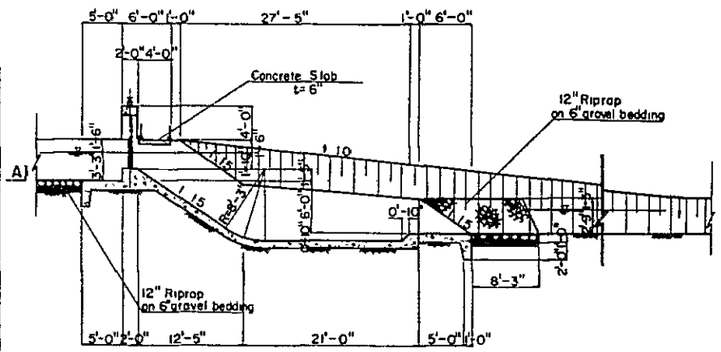
PLATE NO. 31

DIVISION STRUCTURES TYPE A

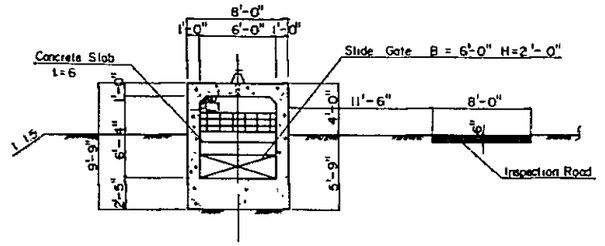
P L A N SCALE A



SECTION A—A SCALE A



SECTION C—C SCALE B



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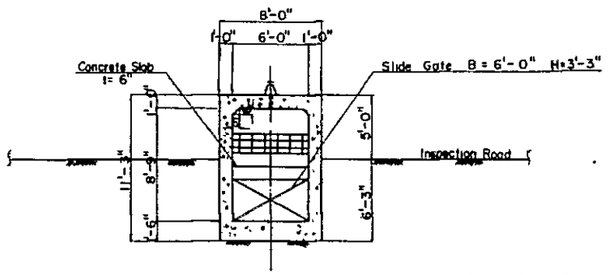

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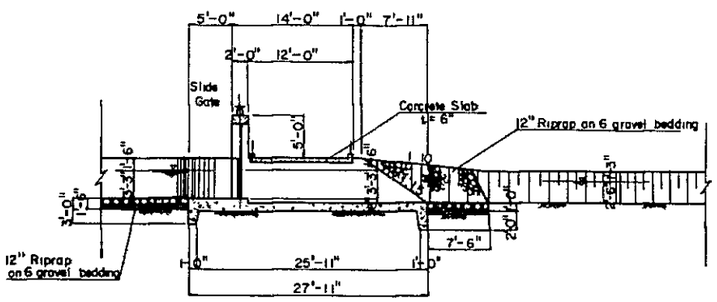

SCALE

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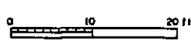

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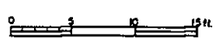


GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT
DIVISION STRUCTURES TYPE A

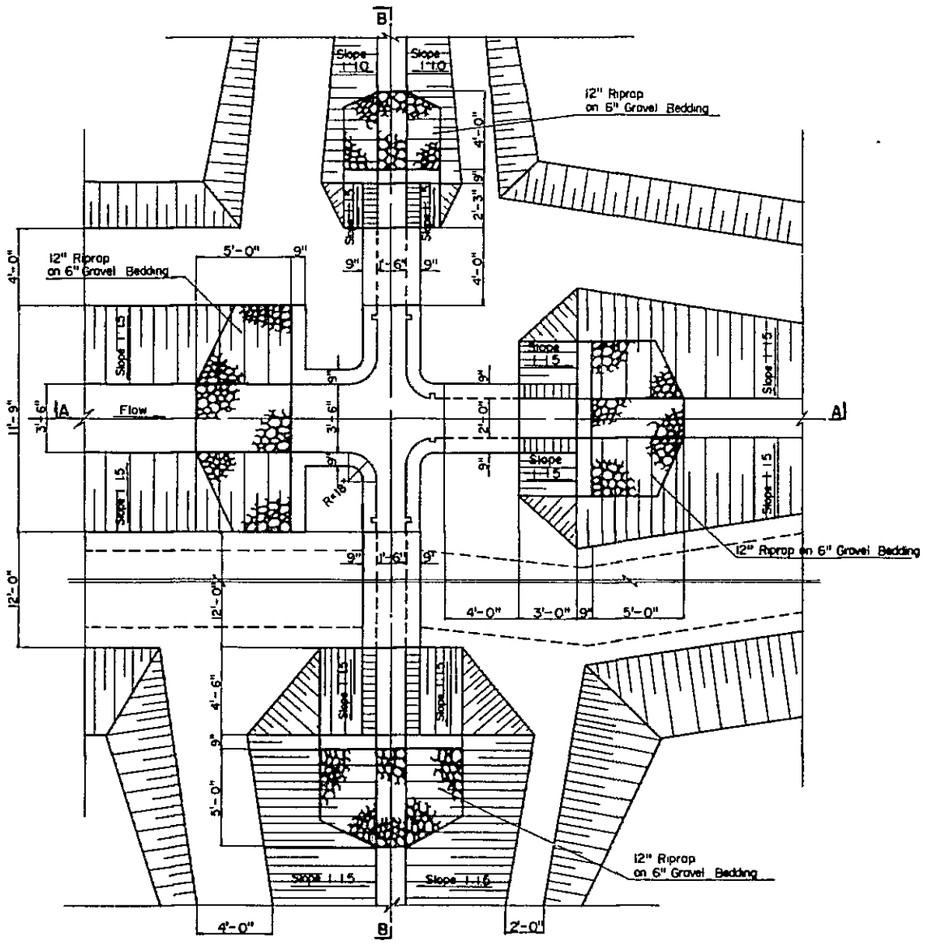
DATE	AUG 1979	D.W G. No.	1-021

JAPAN INTERNATIONAL COOPERATION AGENCY

PLATE NO. 32

DIVISION STRUCTURES TYPE B

PLAN SCALE A



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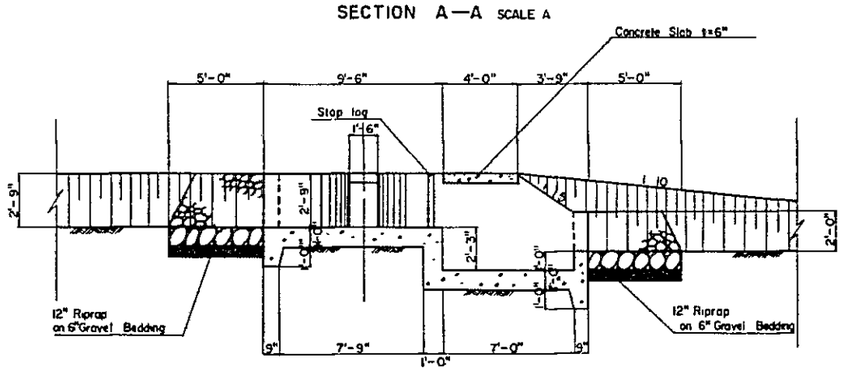

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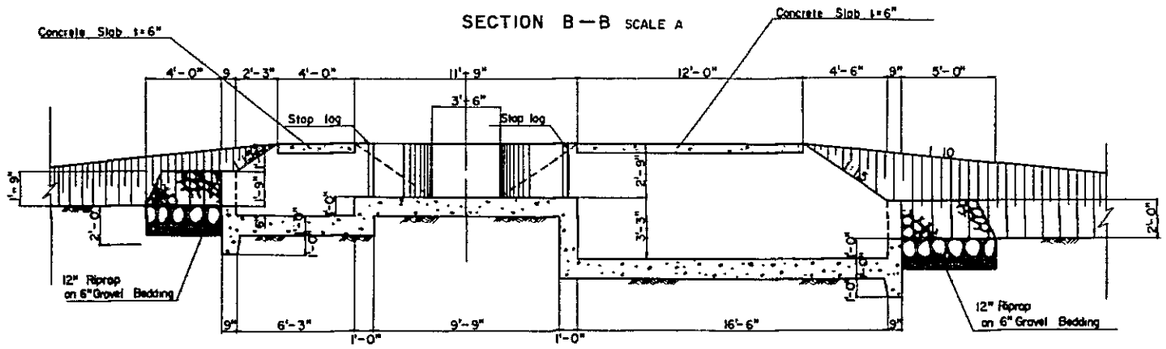

SCALE
A
0 1 2 3 4 5 10ft

GOVERNMENT OF SRI LANKA MINISTRY OF MAHAWELI DEVELOPMENT MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
DIVISION STRUCTURES TYPE B			
DATE	AUG. 1979	D.W.G.No.	1-022
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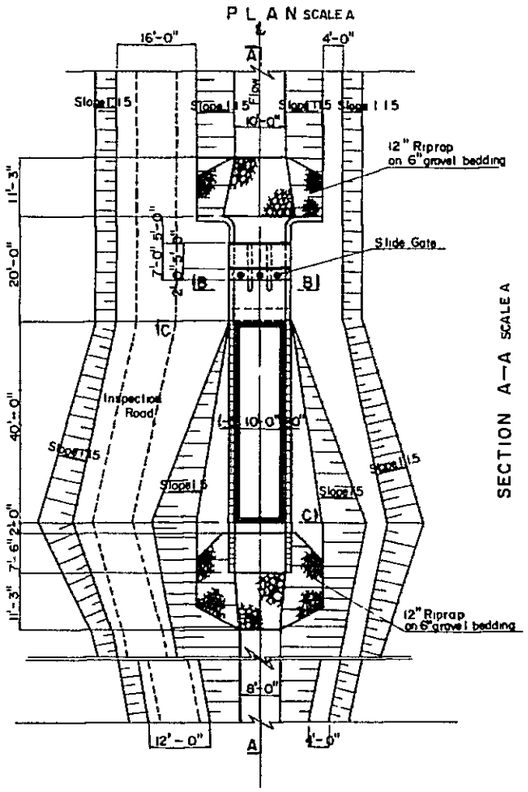
PLATE NO. 33

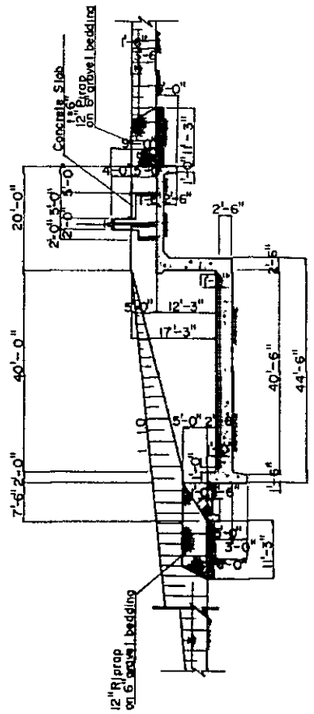
CHECK STRUCTURES

TYPE 1

PLAN SCALE A

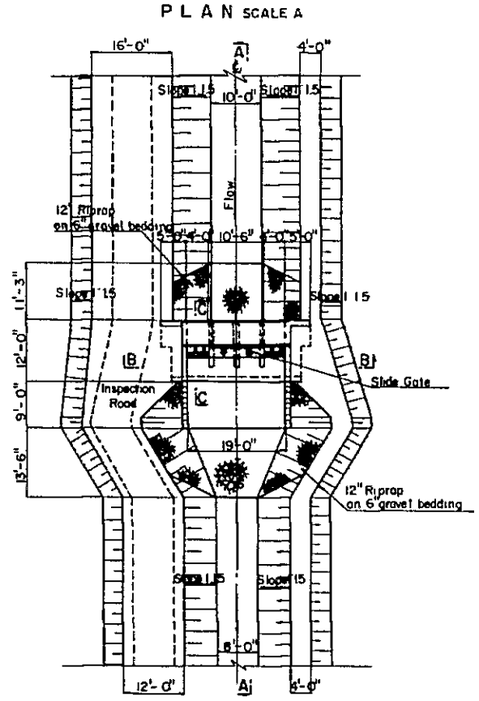


SECTION A—A SCALE A



TYPE 2

PLAN SCALE A



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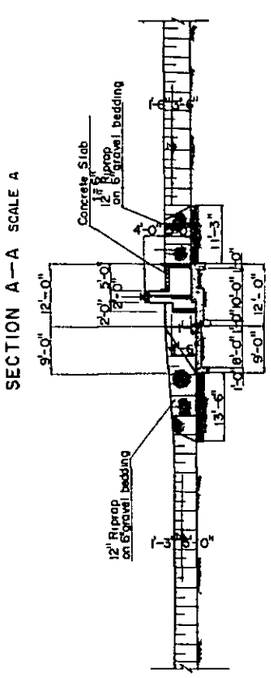

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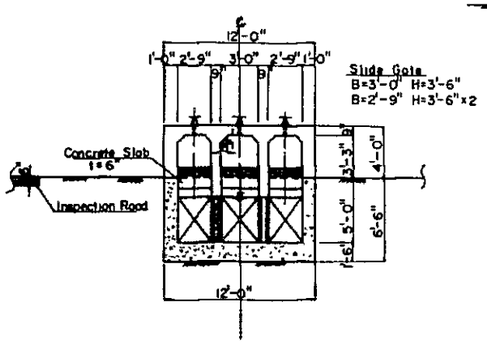

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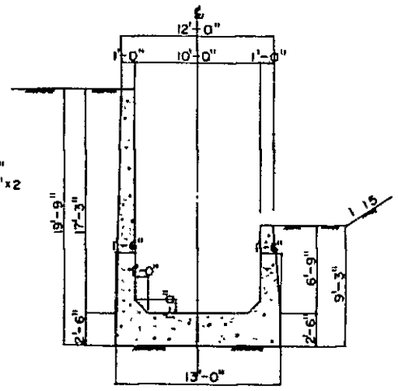

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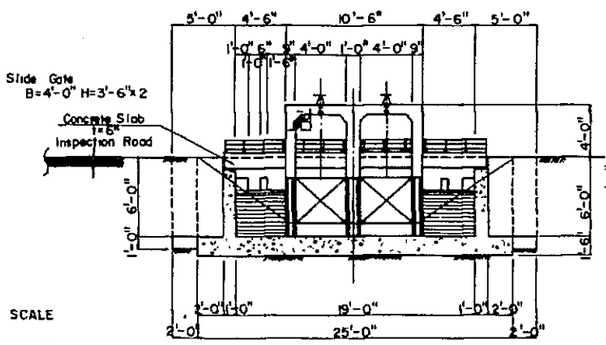

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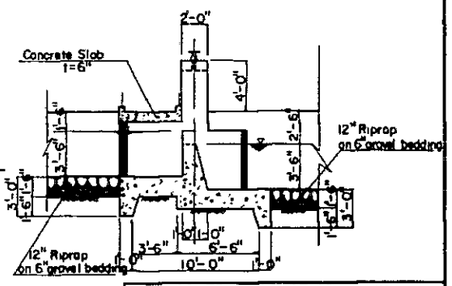
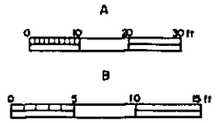


SCALE



GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

CHECK STRUCTURES

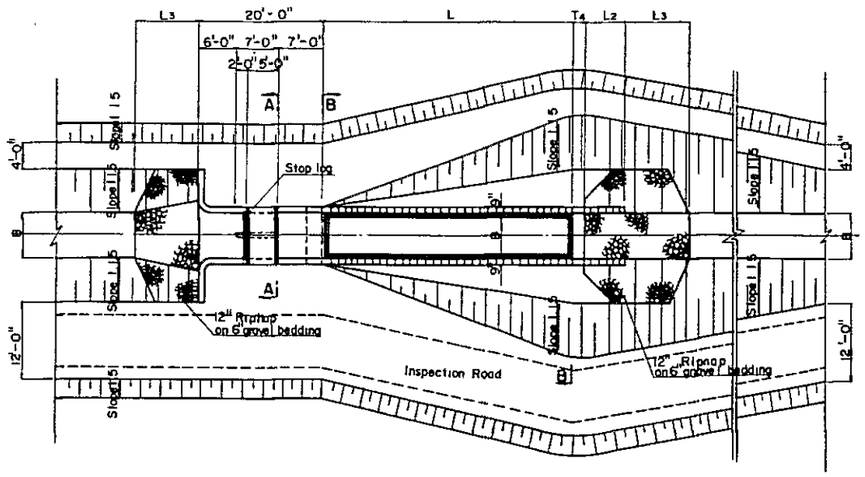
DATE	AUG 1979	D.W.G.No.	1- 023

JAPAN INTERNATIONAL COOPERATION AGENCY

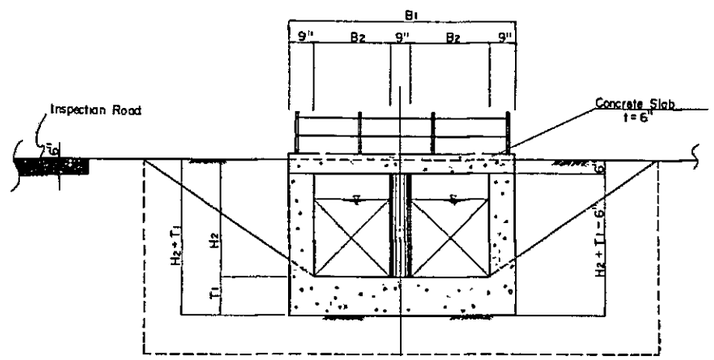
PLATE NO. 34

DROP STRUCTURES

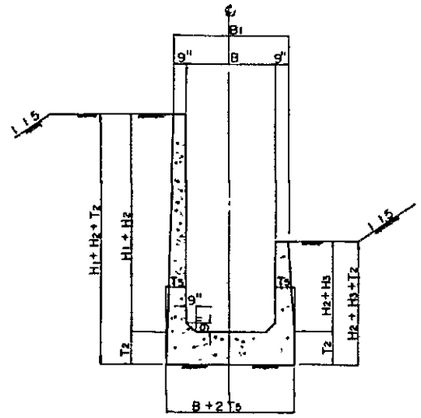
PLAN SCALE A



SECTION A—A SCALE B



SECTION B—B SCALEC



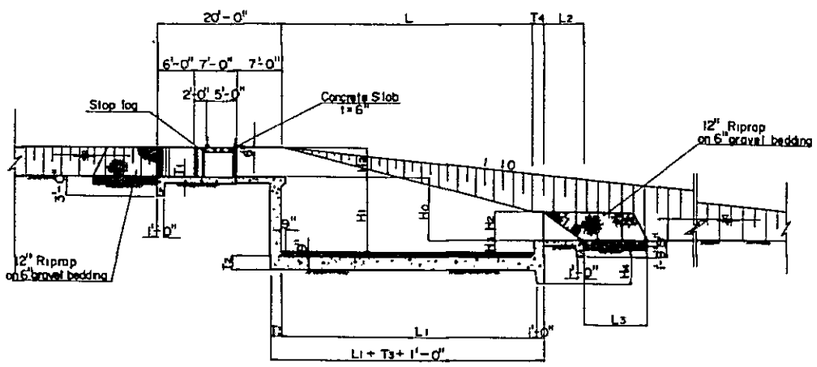
SCALE

A

B

C

PROFILE SCALE A



DIMENSION (Feet)

TYPE NO.	Ho	B	B1	B2x2	H1	H2	H3	H4	L	L1	L2	L3	T1	T2	T3	T4	T5
I	5'-0"	5'-0"	6'-6"	4'-3"	6'-3"	3'-6"	1'-3"	5'-0"	20'-0"	20'-3"	5'-3"	7'-11"	9"	1'-3"	1'-0"	9"	1'-3"
II	8'-0"	7'-0"	8'-6"	6'-3"	10'-0"	4'-0"	1'-9"	6'-0"	30'-0"	30'-3"	6-0"	9'-0"	1'-0"	1'-9"	1'-6"	1'-3"	1'-9"
III	10'-0"	7'-0"	8'-6"	6'-3"	11'-6"	4'-6"	1'-9"	6'-3"	40'-0"	40'-3"	6'-9"	10'-2"	1'-0"	2'-0"	1'-9"	1'-6"	1'-9"

GOVERNMENT OF SRI LANKA	
MINISTRY OF MAHAWELI DEVELOPMENT	
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT	
DROP STRUCTURES	
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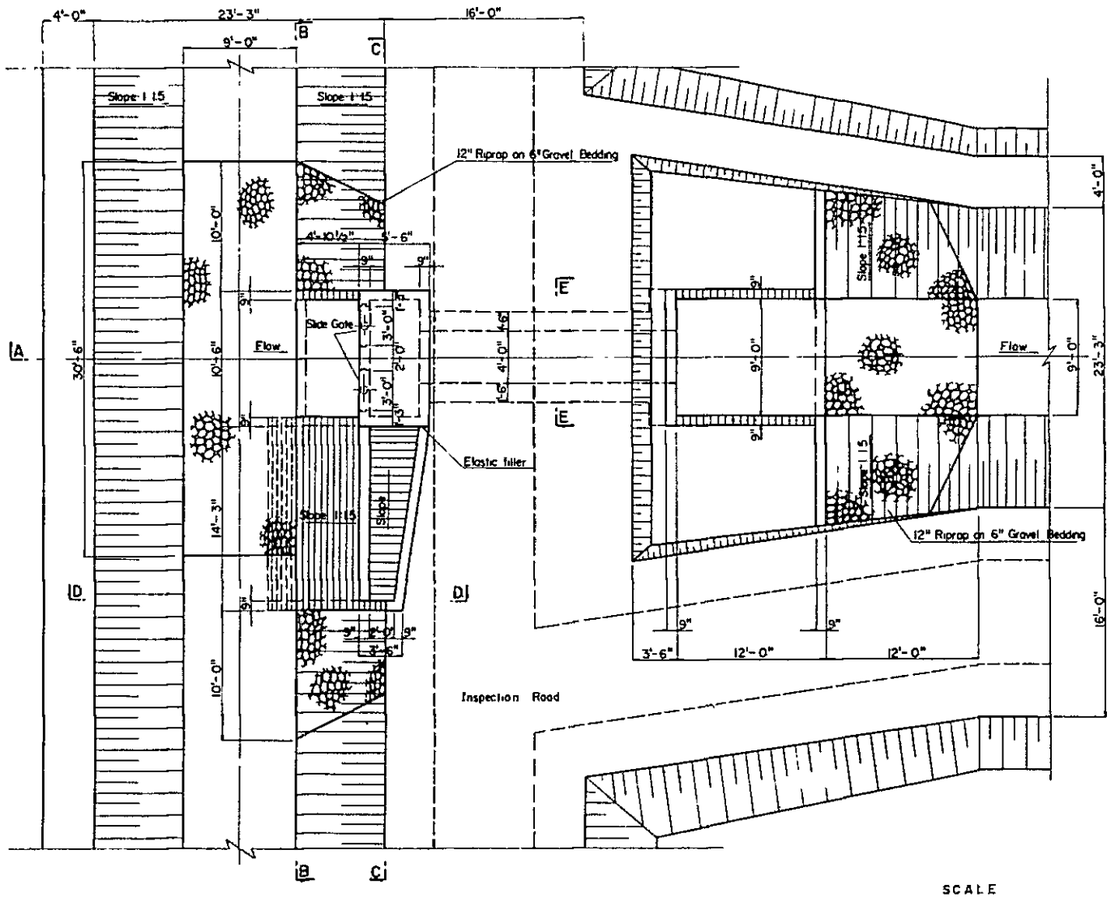
D.W.G. No.	I - 024
JAPAN INTERNATIONAL COOPERATION AGENCY	

PLATE NO. 35

SPILLWAYS & WASTEWAYS

PLAN SCALE A



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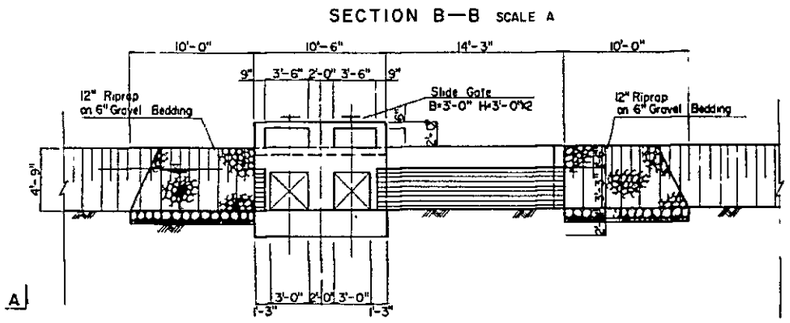
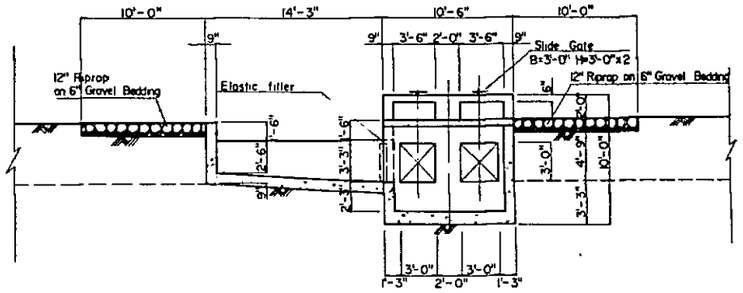


SECTION C—C SCALE A

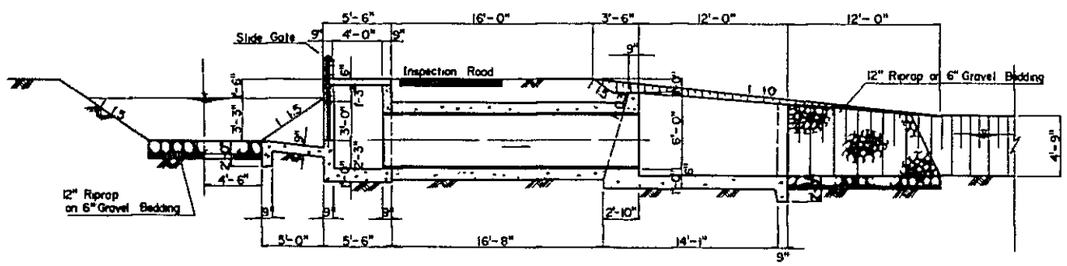


SCALE

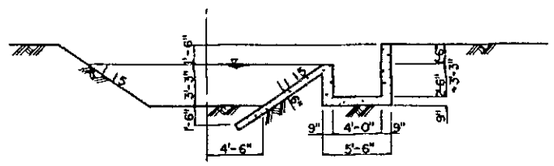
A

0 1 2 3 4 5 10 15 ft

SECTION A—A SCALE A



SECTION D—D SCALE A



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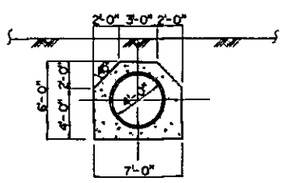
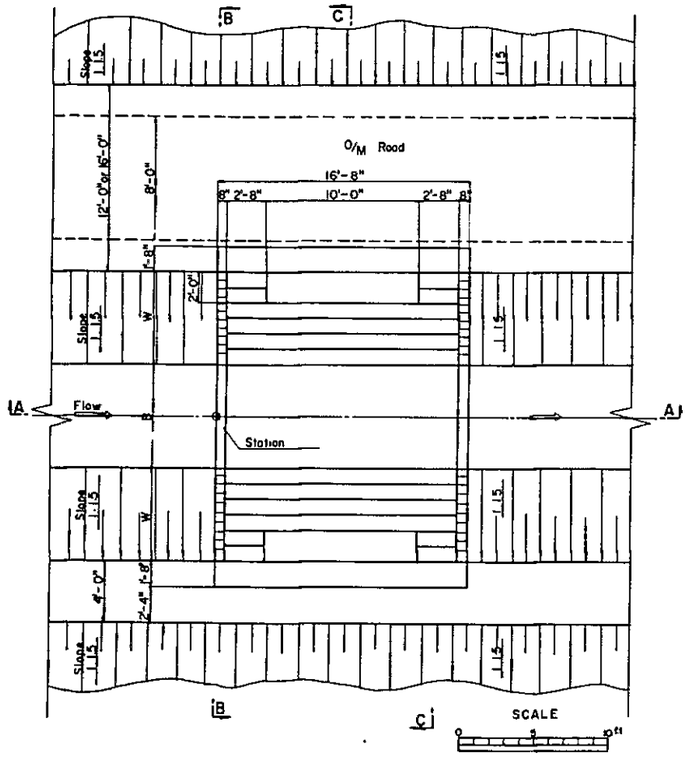


GOVERNMENT OF SRI LANKA MINISTRY OF MAHAWELI DEVELOPMENT MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT			
SPILLWAYS & WASTEWAYS			
DATE	AUG 1979	D.W.G.No	I - 025
JAPAN INTERNATIONAL COOPERATION AGENCY			

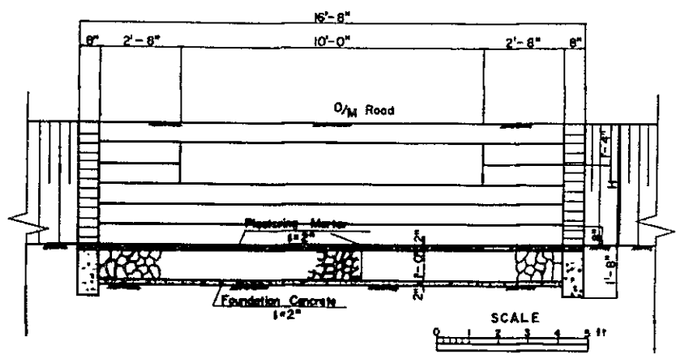
PLATE NO. 36

BATHING & WASHING PLACES

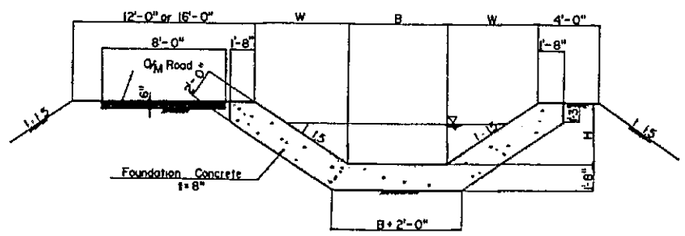
PLAN



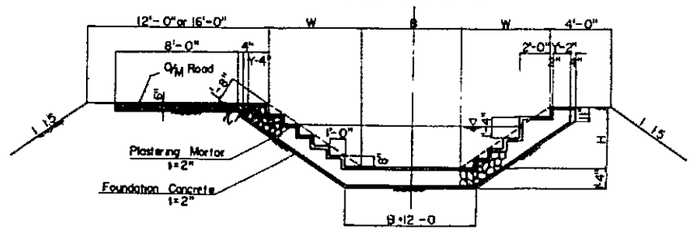
SECTION A—A



SECTION B—B



SECTION C—C



DIMENSIONS

CANAL TYPE	B	H	W
SYSTEM-D1 TYPE 1-5	15'—0"	5'—6"	8'—3"
SYSTEM-D2 TYPE E-3	22'—0"	4'—6"	6'—9"
SYSTEM-A/D TYPE 3	7'—6"	4'—3"	6'—4½"

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

BATHING & WASHING PLACES

DATE	AUG 1979	D.W.G.No.	I - 026

JAPAN INTERNATIONAL COOPERATION AGENCY

PLATE NO 37

LAYOUT IN SAMPLE AREA SYSTEM D1

SCALE
FEET
METRES

LEGEND

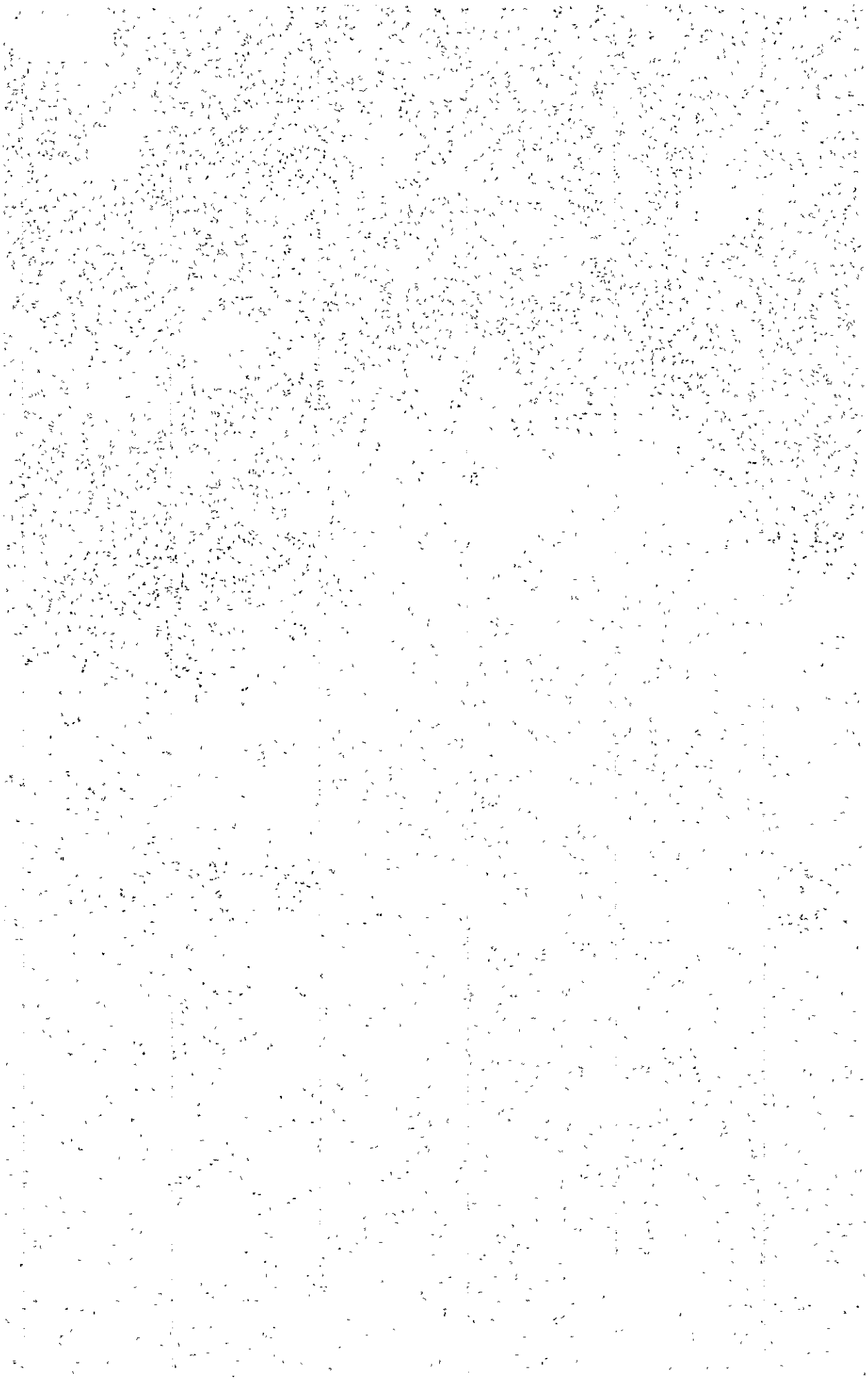
- Distributary
- Field Channel
- Check Gate
- Turnouts
- Roads
- Secondary Drainage
- Field Drains

GOVERNMENT OF SRI LANKA
MINISTRY OF MAHAWELI DEVELOPMENT
MORAGAHAKANDA AGRICULTURAL DEVELOPMENT PROJECT

LAYOUT IN SAMPLE AREA
SYSTEM D1

DATE	AUG 1979	D.W.G.No.	I - 027

JAPAN INTERNATIONAL COOPERATION AGENCY



ANNEX VII : AGRICULTURE AND ANIMAL HUSBANDRY

Contents

ANNEX VII AGRICULTURE AND ANIMAL HUSBANDRY

VII-1 Rice Production

Effect of High Yield Varieties

In relation to the paddy rice, which is most important crop in Sri Lanka as well as in the proposed cropping patterns, the improvements of their varieties have been playing very important role on the development of rice production.

Therefore, in this item, the breedings of rice have been reviewed and recommendable varieties to the project area are summarized as follows.

Effect of High Yield Varieties of Rice (Historical Review)

(Yield potential-ton/ha)

Year / Variety	1940	1950	1960	1979	1970 (early stage)	1970 (later stage)
6 months	MAWI MUTUSAMBA (2.1)	PODIWIE A-8 (2.6)	PTB 16 (2.6)	H-9 (4.7)	BG 3-5 (6.5)	-
4-4 1/2 months	MURUNGAKAYAN (2.1)	MURUNGAKAYAN M-302 (2.6)	MAS REMADJ (3.1)	H-4 (5.7)	BG 11-11 (Engkatek x H-8) x H-8 (6.25)	BG 90-2 (6.25)
3 1/2 months	HEENATI VELLAIPERUNAL (1.6)	-	-	H-7 (3.6)	BG 34-6 (red rice) (6.25)	BG 94-1 (BG 94-2) (6.25)
3 months	PACHICHAI PERUMAL (P.P) (2.1)	-	-	H-10 62-355 *(3.0)	BG 34-8 (6.25) BG 33-2 (7.0)	
Note	Old Indica, 6 months variety (only for wet zone)			*62-355 (for High-land Lift Irrigation H = Hybrid	BG = Batagonia Breeding Center BG 33-2 (wet zone only)	BG 90-2 BG 94-2 (only for good farmer)

* Crossing and characteristics of varieties.

. Pachichai Perumal (P.P.) = Old Indica. Not improved.
. H-4 = M302 x Mas. Strong resistance to diseases (blast)
. H-7 = H5 x (Mas P.P 2462/11)
. H-9 = Pandurwee x (C 104 x Mas)
. H-10 = Same cross method with H-7.
. 62-355 = H5 x PP 2462/11
. BG 11-11 = (Engkatek x H-8) x H-8 (back cross)
. BG 34-8 = (IR8-246 x PP 2462/11) x Mas x H 501
. BG 33-2 = IR8-246 x H-10 (Wet zone only)
. BG 90-2 = IR262 x Remadja (Need good disease and insect control- blast, stem borer, etc.)

Old Improved Variety (Old HYV) = Variety up to 1960

New Improved Variety (New HYV) = Variety after 1970

Recommendable Varieties for the Project Area

Variety	MAHA	YALA
4-4 1/2 months	BG 11-11 BG 90-2 * *Need much pest controls	BG 11-11 (In case of enough irrigation water is available)
3 1/2 months	BG 94-1	BG 94-1 BG 94-2 * * for good farmer only
3 months	BG 94-1 BG 34-8 BG 34-6 (red rice)	BG 34-8

VII-2 Productive Inputs

Adequate inputs supply with reasonable price is essential element to succeed in the agricultural development project. The price list of fertilizers (50% subsidy), Agro-chemicals and seeds associated with their requirement per ha as well as total requirements with project are listed in the following tables.

(1) Fertilizers

The price list of fertilizer which effective from 17th November, 1978 published by Ceylon Fertilizer Corporation and released to all authorized fertilizer dealers is as follows. The list shows 50% subsidised selling price. These prices will be renewed in future.

A) Price of fertilizer

1) Paddy Fertilizer

	Rs	Per
Urea	1,638	MT
N. P. K. 5/15/15	1,548	"
N. P. K. 3/30/10	1,695	"
V - 1 with S.A. (Sulphate of Ammonia)	1,460	" (dry zone)
V - 2 "	954	" (wet zone)
V - 3	1,482	" (")
T.D.M - 1 with Urea	1,557	"
T.D.M - 2 "	1,515	"
T.D.M - 3 "	1,430	

2) Straight fertilizer

Sulphate of Ammonia	1,179	MT
Muriate of Potash	1,132	"
Rock Phosphate Apatite	783	"
Sulphate of Potash	1,674	"
Triple Super Phosphate	1,556	"

Commercial Epsom Salt	1,230	MT
Zinc Sulphate	2,916	"

3) Mixture with T. S. P.

	Rs	Per
Vegetable Mixture	1,336	MT (Home Garden)
Leafy Vegetables	1,277	"
Chillie	1,313	"
Soya Beans	1,365	"
Groundnuts	1,404	"
Onion	1,366	"
Sugar Cane Basal - 1	1,346	"
Sugar Cane - I	1,326	"
Sugar Cane - II	1,350	"

4) General Mixtures with R. P.

	Rs	Per
Onion	1,056	MT
Beans & Cowpea	1,025	"
Chillies	1,135	"
Banana	1,137	"
Papaw	1,076	"

5) Special Mixture (Effective 7th July, 1978 col. 2)

	Rs	Per
Veg. Mixture	1,181	MT
Leafy Vegetable	1,284	"
Beans	1,206	"
Yam Special	1,244	"
Root Vegetable	1,329	"
Chillie	1,409	"
Soya Beans	1,470	"
Sugar Cane - I	1,419	"
Sugar Cane - II	1,480	"

B) Application of fertilizer in the dry zone (with Project per ha) *

1) Paddy (3 - 3 1/2 varieties)

Name	Application		Amount	Unit Price	Total (Rs)
V_1	Basal		3.75 cwt	82/cwt	307.50
Urea	Top dressing	(1)	1.25	84/cwt	104.00
Urea	"	(2)	1.875	"	157.50
				(Total)	569.00

* Amount of fertilizers will vary according to the soil conditions of each field and the ideal amount of fertilizer will be decided by both soil and foliar analysis of each field and crop at the same time. (Foliar analysis is common in case of plantation crops)

2) Paddy (4 - 4 1/2 varieties)

					Total (Rs)
V_1	Basal		3.75 cwt	82 Rs/wct	307.50
Urea	Top dressing	(1)	1.25	84 "	104.00
Urea	"	(2)	"	"	104.00
T. D. M. (*)	"	(3)	1.875	80	150.00
				(Total)	665.50

(*) Another application method practiced in Polonnaruwa District is as follows:

3rd top dressing	cwt		Total (Rs)
Urea	1.875	84 Rs/cwt	150.-
T.D.M. (or Potash)	1.25	80	100.-

. Application of "K" fertilizer at last top dressing increase resistance to plant disease and can be expect more yield.

3) Soya beans

				(Total) Rs
		cwt		
V_1	Basal	3.75	82 Rs/cwt	307.50
Urea	Trop dressing	0.625	84	73.00
			(Total)	380.50

(*) If the field shows deficiency of "P" and "K", the following fertilizers are recommended.

(Basal)

2.5 cwt of Conc. Superphosphate (225^{Rs})

1.24 cwt of muriate of Potash (47.5^{Rs})

(Top dressing)

2.5 cwt of Urea (210^{Rs})

(Total) 482.5^{Rs}

4) Pulses (Cowpea/Grams)

a) Average soils

				Total (Rs)
V_1	Basal	3.75^{cwt}	82 Rs/cwt	307.50

b) Soils with deficiency of P & K

(Basal)

2.5 cwt of Conc. Superphosphate (225^{Rs})

1.25 cwt of muriate of Potash (47.5^{Rs})

1.25 cwt of Sulphate of Ammonia (58.0^{Rs})

(Top dressing)

0.625 cwt of Urea (53^{Rs})

(Total) 383.50^{Rs}

5) Groundnuts

				Total (Rs)
		cwt		
Urea	Basal	0.625	84 Rs/cwt	
Conc. Superphosphate	"	2.5	90	53
Muriate of Potach	"	1.25	38	47.5
Urea	(Top dressing)	1.25	84	105
			(Total)	430.50

6) Maize and Sorghum

		cwt		Total (Rs)
Amm. Sulphate	Basal	2.5	46 Rs/cwt	115
Conc. Superphosphate	"	2.5	90	225
Muriate of Potash	"	1.25	38	47.5
Urea	(Top dressing)	3.125	84	263
			(Total)	650.50

7) Chillie

				Rs
V_1, Urea	Nursery	cwt		15
V_2	Basal	3.75	82 Rs/cwt	307.5
Urea	"	0.625	84	53
V_1	Top dressing	3.75	82	307
Special mixture	"	5	72	360
			(Total)	1,042.50

* Another application method in Polonnaruwa is as follows.

Amm. Sulphate	Basal	1.25 cwt	46 Rs/cwt	57.5
Triple Super-phosphate (or special mixture)	"	2.5	90	225.-
Muriature of Potach	"	0.625	38	23.75
Amm. Sulphate	(Top)	7.5	46	345
			(Total)	651.25

8) Red Onions

		cwt		Rs
Special Mixture	Basal	5	84 Rs/cwt	420
"	(Top)	5	84	420
			(Total)	840

9) Bombey Onions

Urea	Basal	3.125 cwt	84 Rs/cwt	262.5 Rs
Conc. Super-phosphate	"	2.5	90	225
Muriate	"	1.25	38	47.5
			(Total)	535.-

* 10 tons of manure per ha is necessary as basal organic fertilizer (2,000 Rs/ha) in case of Red Onions, Bombey and Chillies.

10) Vegetables (1) Brinjal, Capsicum, (etc).

Special Mixture (Basal & Top dressing)	12.5 cwt	83 Rs/cwt	Total 1,037.5 Rs

* 10 tons of manure is recommendable in addition. (per ha)

11) Vegetables (2) Beet, Carrot (etc).

Special Mixture	12.5 cwt	83 Rs/cwt	Total 1,037.5 Rs

* 10 tons of manure is recommendable in addition. (per ha)

12) Sugar Cane

UK Mulika Mixture	Basal	6.25 cwt	70 Rs/cwt	437.50 Rs
Urea	Top	3.75	84	315.-
UK Deveri	"	7.5	70	525.-
			(Total)	1,277.50

* For stubble shaving of Ratoon crop, additional top dressing is necessary according to the growth condition of plant.

(2) Agro-chemicals

The prices of Agro-chemicals for sale including new products authorized by the Ceylon Petroleum Corporation are given in the list below. These prices are effective from 4th December, 1978. This price will be renewed in future.

A) Price

Item	Name of New Product	Package	Price (Rs) (Wholesale)	Price (Rs) (Retail)
Insecticide	B.H.C. 10% dust	2 Kg	6.00	7.15
(pesticide)	Thiodan 35%	450 ML	42.50	52.50
		200 ML	19.50	24.00
		100 ML	10.50	13.00
"	M.E.M.C.	1 oz pkt	2.00	2.50
		1 lb. pkt	15.20	19.20
"	Trichlorphon 80%	1/2 lb. pkt	13.50	15.00
"	Dimethoate 40%	100 ML	7.70	9.70
		200 "	13.50	16.90
		450 "	26.00	32.50
"	Monocrotophos 60%	100 ML	16.40	21.10
		200 ML	30.70	39.50
		450 ML	60.50	78.00
"	Furadan 3G	500 Gm	7.25	8.35
		2 Kg	22.50	26.00
		25 Kg	260.00	290.00
"	Parathion E 50	100 ML	7.30	9.75
		200 "	12.70	17.00
		450 "	24.30	32.40
"	Folpet 50%	200 Gm	9.20	11.50
		500 Gm	22.05	27.55
"	Chloropyriphos 40%	100 ML	15.00	16.80
		200 "	28.30	35.50
		450 "	60.00	75.00

Item	Name of New Product	Package	Price (Rs) (Wholesale)	Price (Rs) (Retail)
Insecticide	Dicofol 42%	450 ML	30.00	37.50
		4.5 L	275.00	344.00
	Carbaryl 85%	200 Gm	13.70	17.20
		500 "	29.00	36.25
		25 Kg	1,364.18	1,543.21
Weedicide	Trithion 2 E	100 ML	9.95	11.45
		200 "	18.45	21.20
		450 "	39.80	45.80
"	M.C.P.A. 40%	450 ML	14.00	17.00
		4.5 L	114.00	140.00
"	Ramrod	1/2 lb. pkt	10.00	12.00
"	Machete 5 G	1 lb. pkt	4.70	5.00
		5 lb. pkt	18.75	21.50
		44 lb. bag	149.60	165.00
"	Machete 50% EC	16 oz bot.	27.25	33.00
		1 Lit.	47.00	55.00
"	Linuron	1/2 lb. pkt	11.50	13.50
"	3 - 4 D.P.A. 36%	450 ML	19.50	22.00
		3.375 L	130.25	147.00
		4.5 L	170.00	191.80
"	Paraquat 24% EC	450 ML	33.00	38.50
		4.5 L	305.00	335.00
"	2 - 4 D.N.A. Salt	1 lb pkt	12.75	15.00
		88 lb bag	924.00	1,056.00
Fungicide	C.O.C. 50% mp	200 Gm	8.00	10.00
		500 Gm	19.20	24.00
		25 Kg	620.00	775.00
"	Sulphur mp	500 Gm	9.40	11.00
"	Cuprasan	1 lb pkt	7.75	9.50
"	Dithane	1/2 lb pkt	7.60	9.50

Item	Name of New Product	Package	Price (Rs) (Wholesale)	Price (Rs) (Retail)
Fugicide	Mancozeb 75%	200 Gm	8.80	11.00
		500 Gm	16.70	20.00
"	Maneb 80% mp	200 Gm	8.80	11.00
		500 Gm	16.20	20.00
Rodenticide	Marfarin	1/4 lb pkt	2.00	2.50
		1 lb pkt	5.20	6.50
"	Aliminium Phosphide	Tablets	0.40	0.45

B) Application of Agro-chemicals (per ha. with project)

* Amount and timing of spraying will be decided according to the conditions of actual outbreak of diseases and injurious inspects.

1) Paddy

Name of Disease & insect	Name of Agro-chemicals	Amt/ha	Unit Price (Rs)	Total (Rs)
Stem borer and Gall Midge	Diazinon 6% Granules	50 lbs	120 Rs/20 lbs	300 Rs
	* (Carbo-fradan is also effective for stem borer)			
Leaf eating Catapillars	Tamaron	75 fl. ozs	144/30 fl.	360 Rs
	or Thiodan	75 fl. ozs.	124/30 fl.	310 Rs
	(*) Penthion and Polinate are also available.			
Brown Plant Hopper	Furadan (or Curater)	50 lbs	120/20 fl.	300 Rs
	(*) Lebacide and Polimat are also available.			
Paddy bugs	B.H.C. 10% dust	20 Kg	7.15/2 Kg	71.5 Rs
			Total	1,341.5

(Note)

. Fenthion or Monocrotophos for Leaf rollers

. Bacterial leaf blight is partly increasing. To control this disease, the disinfection of seed paddy is necessary (by Seresan).

2) Soya beans

Name of Disease & Insect	Name of Agro-chenicals	Amt/ha	Unit Price (Rs)	Total (Rs)
Leaf eating Caterpillars	Tamaron or	75 fl. ozs	144/30 fl.	360 Rs
Pod-hoeing Caterpillars bean fly, etc.	(Azodrin)			(400 Rs)

3) Pulses (Cowpea/grams)

Leaf eating Caterpillars and flies	Thiodan or Azodrin	75 fl. ozs	124/30 fl.	310 Rs (400 Rs)

4) Groundnuts

(Same as other pulses)

	Thiodan or Tamaron	50 fl. ozs	124/30 fl	210 Rs

5) Maize and Sorghum

Stem borer	Azodrin 60%	75 fl. ozs	160/30 fl.	400 Rs

6) Chillie

Mites, flies, hopper and others	Acetellic	180 fl. ozs	4.76/fl	857 Rs

(*) Sumithion, Fenthion, Elsan, Trithion, Sulpher and Tamaron are also available.

7) Red Onions and Bombey Onions

Thrip, Caterpillars and others	Tamaron	25 fl. ozs	144/30 fl	173 Rs

(*) Ambush is also available.

Name of Disease & Insect		Name of Agro-Chemicals	Amt/ha	Unit Price (Rs)	Total (Rs)
8) Vegetables					
Cut worms, Caterpillars and others		Tamaron	25 fl. ozs	144/30 fl	173 Rs
		Acetellic	20 "	5/fl	20
	or	Aldrin 20 EC	20 "	18/8 fl	45
	or	Lannate	20 "	24/8 fl	60
	or	Lebaycide	20 "	30/8 fl	75
				Total	223 Rs

(3) Seeds

Crop	Seed/ha	Unit Price (Rp)	Total (Rp)	
1) Paddy (a)	2.5 bushel	52/b.	130	Transplant
(b)	5.0 "	"	260	Broadcast
2) Soya beans	150 lbs	3/lbs	450	
3) Cowpea/grams	50 "	4/lbs	200	
4) Groundnut	225 "	3	675	
5) Chillie	2.5 "	40	100	
6) Maize & Sorghum	40 "	3	120	
7) Red Onions	1,700 Kg	1	1,700	
8) Bombey Onions	20 lbs	12	240	
9) Vegetables (Average)	12 lbs	25	300 *	

(*) Amount and price of vegetable seeds will vary according to their species and varieties.

(4) Total input requirements with project (Rs)

Concerning with fertilizers, agro-chemicals and seeds, the total requirements with project in full development conditions have been estimated as follows.

(4)-1 Fertilizers

In the project area about 60 - 70% of farmers have been practiced adequate fertilizer applications for paddy fields and very few farmers are using fertilizers for upland crops. The total requirements of fertilizers are estimated in the following table.

Fertilizer requirements (Rs)

Crop *	Acreage (ha)	Cost/ha (Rs)	Total Cost (Rs)	Note
Paddy (Maha)	48,798	700	34,158,600	4-4 1/2 variety
Paddy (Yala)	36,430	600	21,858,000	3-3 1/2 variety
Onions	2,400	1,400	3,360,000	Red Onion and Bombey Onion
Pulses	2,400	400	960,000	Cowpeas Grams and Soyabeans
Chillies	2,400	1,000	2,400,000	
Vegetables	2,400	1,500	3,600,000	
Maize & Sorghum	2,400	650	1,560,000	
Sugar Cane	5,960	1,200	7,152,000	including 1st ratoon
Total			75,048,600Rs	

* Classification of crops are same as Agro-chemicals.

(4)-2 Agro-chemicals

Fungicides, Insecticides and Weedicides are included as Agro-chemicals. It is very difficult to estimate the costs of Agro-chemicals because it would be fractuated by the facts, namely, resistant variety, adequate fertilizer application, weeding, land cleaning, equipment

cleaning, degree of diseases and insect's outbreak and their kinds, frequency of spraying of different chemicals, weather conditions, etc. In this estimate, all these-factors have been considered and calculated as an average datas.

Agro-chemicals requirements (Rs)

Crop	Acreage (ha)	Cost/ha (Rs)	Total Cost (Rs)	Assumed spraying time
Paddy (M.Y)	85,228	1,300	110,796,400	3
Onions	2,400	900	2,160,000	3
Pulses	2,400	600	1,440,000	2
Chillies	2,400	1,600	3,840,000	4
Vegetables	2,400	800	1,920,000	3
Maize and Sorghum	2,400	500	1,200,000	3
Sugar Cane	5,960	500	2,980,000	3
Total			124,336,000Rs	

(4)-3 Seeds

Qualified seeds with sufficient supply in time is first step of crop cultivation. It is expected that self-supply of seeds will be made in the full development stage except F-1 Hybrid varieties.

Seed requirements (Rs)

Crop	Acreage (ha)	Cost/ha (Rs)	Total Cost (Rs)	Note
Paddy (M.Y.)	85,228	130	11,079,640	/1
Soybeans	800	450	360,000	
Cowpea/Grams	800	200	160,000	
Groundnuts	800	675	540,000	Shelled
Chillies	2,400	100	240,000	
Maize	1,200	120	144,000	
Sorghum	1,200	120	144,000	
Red Onion	1,500	1,700	2,550,000	Seed onion

Crop	Acreage (ha)	Cost/ha (Rs)	Total Cost (Rs)	Note
Bombey Onion	900	240	216,000	
Vegetables	2,400	300	720,000	
Sugar Cane	5,960	-	-	/2
Total			16,153,640Rs.	

/1 In the project area, about 7-8 percents of total agricultural credit loan had been applied by farmers. (1978) This means that the farmers have been endeavouring toward the self supply of seeds, especially in case of paddy.

/2 Sugar cane seedling would be supplied by plantation at the beginning stage. Usually, cost of planting materials per hectare is assumed as 1,500 Rs.

VII-3 Labour Requirements

(1) Year round cropping patterns both for the existing fields and the newly reclaimable lands proposed under the project is summarized as follows.

(a) Existing Field (ha)

MAHA	Paddy	35,080	ha
	Sugar cane	3,400	
	Total	38,480	
YALA (*)	Paddy	25,580	
	Subsidiary Food Crops	9,500	*
	Total	35,080	

(Note)

1. Percentage of S.F.C/Total acreage is 27%
2. Percentage of each S.F.C. in yala

Onion	26%	(Red and Bombey)
Chillies	21%	
Pulses	27%	(Cowpea, Gram, Groundnuts, Soyabeans)
Vegetables	26%	
Total	100%	

(b) Newly reclaimable land (ha)

Paddy - Paddy	10,950	ha
Sugar cane (N.S.E.)	2,200	
Sugar cane (Out growers)	360	
Paddy - Upland crops	2,480	*
Total	15,990	

(Note)

1. Upland crops are Subsidiary crops same as existing field plus maize and Sorghum.
2. Percentage of upland crops/Total acreage excluding Sugar cane is 19%.

(2) Labour availability

In the Polonnaruwa District, total potential supply of farm family labours was assumed to 2.5 unit per family as mentioned in the main report. Assuming 25 working days per month over a 6 month seasons, this meant that Polonnaruwa farm had, on average, 375 man days available per farm. According to the Report of Victoria Scheme, Maharveli Development Project, it was found that out of 330 man-day used, only 111 man-days were family labours, the balance being hired. This means that 64% was hired labour. In the Sogreah report, in 1973, the hired labour was only 17%.

Total possible availability of farm family labor in the Polonnaruwa district is assumed to 600 Unit Per year under the future Project, that is assumed as follows.

(a)	6 months (peak)	2.5 unit/family x 6 months x 25 days/ month = 375 units/family
(b)	6 months	2.5 unit/family x 6 months x 15 days = 225 units/family
	Total	600 units/family/year (50 working days/ month in average)

In the related report of A.R.T.I. (1976-1977) is showing the additional labor requirement in case rice cultural operations.

Operation	Average duration (days)	Potential family labour/farm (man days)	Total labour use (man days)	Additional requirement (man days)
Land Preparation and nurseries	30	75	91	16
Transplanting	5	13	95	82
Crops care	100	250	31	(219)
Harvesting, threshing, transport	7	18	112	94

This shows that increase of hired labourers, that was influenced by expansion of irrigated farming and shortage of labor at peak season as well as difficulty to use sufficient animal Powers and Agricultural machineries.

On the other hand, the National Science Council was found that majority of family had 2 Labor Units and Sogreah assumed that 2.2 Units in the existing farm and 1.5 Units in case of new settlers.

In Conclusion, labor problem is a bottle neck for the future development program which associating with wide ranged socio-economic conditions including unemployed. However, every countermeasures to ensure hired labors as well as full time work of farm labour is essential to solve the problem and also it is very urgent to expand the Utilization of draught power and Machineries. In the existing farm, the hired labour is approximately 50% of total labour in average on paddy and subsidially food crops cultivation which should be reduced to under 30% of total labour requirements in future.

(3) An estimate and proposal on labour requirements

For the implementation of development project, the following estimates and proposal would be considered.

(3)-1 Seasonal peak is shown in the following table,

Labour requirements (Man/months days per ha)

	Crop/month	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	Sugar cane													200
2	Paddy (M)	3	45	35						27	50	20	10	190
3	Paddy (Y)		15	50	25	15	3	3	54	20				185
4	Soyabeans (Y)				8	32	22	5	27	41				135
5	Groundnuts (Y)			17	18	22	5	3	46	22				133
6	Cowpea/Gram (Y)				3	42	20	18	32					115
7	Maize (Y)			16	25	15	3	27	62					148
8	Sorghum (Y)			11	20	18	12	25	63					148
9	Chillies (Y)		20	67	78	22	78	63						328
10	Red Onions (Y)			10	46	60	53	35	67	57				327
11	Bonbly Onions (Y)		25	25	87	95	55	18	75					380
12	Vegetables (Y)			15	35	37	28	28	18	47	17			245

Note (1) M = Maha, Y = Yala

(2) Labour should be distributed evenly in each moth as possible in future with more improvement of cultural practices.

(3)-2 Total labour requirements in the proposed cropping patterns

a) Existing fields

(Maha)

Paddy	35,080 ha x 190 unit	= 6,665,200 units
Sugar Cane	3,400 ha x 200 unit	= 680,000 units
	Total	(7,345,200) units

(Yala)

Paddy	25,580 ha x 185 unit	= 4,732,300 units
S.F.C.	9,500 ha x 210 unit /1	= 1,995,000 units
	Total	(6,727,300) units

/1 : average unit

b) Newly reclaimable lands

1)	Paddy-paddy	19,950 ha x 190 unit	= 2,080,500 units
		19,950 ha x 185 unit	= 2,025,750 units
		Total	(4,106,250) units
2)	Sugar cane (N.S.E.)	2,200 ha x 200 unit	= 440,000 units
3)	Sugar cane (Outgrowers)	360 x 140	= 50,400 units
		Total	(490,400) units
4)	Paddy-Upland Crops	Paddy 2,480 ha x 190 unit	= 471,200 units
		Upland 2,480 ha x 210 /2	= 520,800 units

/2 : Average labour requirement for all crops.

Total labour requirements by seasons

(Maha)

Paddy (1)	2,080,500 units		
" (2)	471,200	(paddy total)	2,551,700 units
Sugar Cane (total)			490,400 units
(Total			3,042,100 units

(Yala)

Paddy (1)	2,025,750		
Upland crop	520,800		
		(Total)	2,546,550 units

(3)-3 Estimated labor requirements with project in relation to farm labours and hired labours

	Estimated Supply by Family Labour (Man-days)		Estimated Farm Units		Estimated Hired Labours (Man-days)		Estimated Number of Labours	
	50%	70%	50%	70%	50%	30%	50%	30%
a) Existing farms								
MAHA	3,672,600	5,141,640	12,242	17,139	3,672,600	2,203,560	36,726	22,035
YALA	3,363,650	4,709,110	11,212	15,697	3,363,650	2,018,190	33,637	20,182
b) Newly reclaimable								
MAHA	1,521,050	2,179,470	5,070	7,098	1,521,050	912,630	15,210	9,126
YALA	1,273,275	1,782,585	4,244	5,941	1,273,275	753,965	12,732	7,539

(Notes)

(1) Total labour requirements

a) Existing farms

MAHA	7,345,200 units
YALA	6,727,300

b) Newly reclaimable lands

MAHA	3,042,100
YALA	2,546,550

* Sugar cane is a perennial crop but included in MAHA in this calculation.

(2) Estimated supply by family labours

Percents (50/70%) mean potential figure against total requirements and expect 70% with project.

(3) Estimated farm units

It is assumed that each farms may have 600 Mandays/year and distributed evenly to MAHA/YALA with project.

(4) Estimated hired labours

Percents (50/30%) mean pontential figure against total requirements and expect 30% with project.

(5) Estimated Number of labourers

Assumed that one labourer could work 200 days/year and may able to be distributed evenly through MAHA and YALA seasons.

(6) Relation with development stages

Targets yields will be completed within 6 years and 8 years in existing farms and newly reclaimable lands, respectively.

Total labour requirements will be reduced by expansions of draught powers as well as agricultural mechanization with project.

Assumed reduction rate of labours in this connection is assumed approximately 20-50%, which vary according to the crops and difficulty of cultivation practices. For example, picking of chillies and vegetables are very hard to mechanize and need much labours. New machineries should be developed to transplanting, harvesting and threshing of rice.

In the early stage of new settlers (Mostly younger generations), total family labour availability is assumed to about 80% of ordinary farms, which is approximately 480 man-days per year/family.

VII-4 Farm Mechanization

In this annex , it is reviewed that the present status of, and future needs for, farm power in relation to proposed developments in the project area. Farm mechanization is the way of agricultural modernization in Sri Lanka, which concerned with labour availability, potential of animal power, land development and creating the new employment opportunities. Agricultural machineries have been developed to meet various and special type of work and still need improvements in details for the efficiential and economical utilizations. 2 wheel tractors, that are mostly Japan made is more suitable for paddy cultivation because it is originated in an intensive paddy cultivation country with small holders. 4 wheel tractors, that are mostly produced in European and American Countries with larger size of farm and suitable for large scaled cultivation as well as threshing of Paddy rice and Cultivation of Sugar Cane field.

(1) Present status of farm powers in the project area

(1)-1 Cropping system of paddy rice

Main crop in the existing fields is paddy rice. Buffaloes, tractors (2 wheeled and 4 wheeled) and other small machineries have been introduced but it is not sufficient for the intensive farm management. In case of upland crops including subsidiary food crops, mechanization is far delayed compared with paddy cultivation.

Cropping system of paddy rice.

1. Land Preparation

   Ploughing, puddling, leveling etc.
   (manpower, buffaloes, tractors)

2. Seeding, Transplanting , Multing.

   (manpower, partly seeding machine)

3. Weeding, Fertilizer application

   (manpower, rotary weeder, partly weedicide sprayer)

4. Plant protection (agricultural chemicals)

(Manpower, sprayer (hand, powered)

5. Harvesting

(manpower) (Harvesters have not been introduced.)

6. Drying (Sun-dried) (Dryer is not used.)

7. Threshing *(Need Thresher urgently.)

(Manpower, tractor (mostly 4 wheeled) and partly thresher)

8. Winnowing and cleaning

(Manpower, fan (manpower, or engine powered)

9. Parboil (processing)

(With steamed iron pot or at rice mill)

10. Drying

(Sun-dried, partly dryer)

11. Hulling and Milling

(Manpower, Hulles, Milling machine)

(1)-2 Working hours for different cultivation practices

Necessary hours (average)	Buffalo pair	2 wheel tractor	4 wheel tractor
First plowing	16hrs/AC /1	8hrs/AC	4hrs/AC
Second plowing	8hrs/AC	4hrs/AC	-
Puddling	8hrs/AC	4hrs/AC	-
Leveling	2hrs/AC	-	-
Threshing	8 B.P/ one night /AC	-	4hrs/AC

/1 Good Buffalo Pairs

(1)-3 Cost of Baffaloes and Tractors when hired or Contracted (per Acre)

	Buffalo pair	2 wheel tractor	4 wheel tractor
First plowing	150^{Rp}	200^{Rp}	200^{Rp}
Second plowing	100	150	150
Puddling	75	100	-
Leveling	50	-	-
Threshing	80		100
(Total)	455^{Rp} (1138^{Rs}/ha)	450^{Rp} (1125^{Rs}/ha)	450^{Rp} (1125^{Rs}/ha)

(Notes)

1. Farm gate price at present (January, 1979)
   Buffalo Pair (over 4 years old) with Plough 2,500^{Rs}
   2 wheel tractor 20,000 - 25,000^{Rs}
   (Kubota, Iseki, etc)
   4 wheel tractor 10,000 - 150,000^{Rs}
   (MF 135, International)

2. Ploughing - Buffalo 35%, 2 wheel tractor 30%
   4 wheel tractor 35% (approximately)
   Puddling - Buffalo 85-90% 2 wheel tractor 15-10%
   Threshing - 4 wheel tractor 85% Buffalloes 13%
   2 wheel tractor 2%

(1)-4 Denticy of present buffaloes and tractors

a. Total population of Baffaloes 15,000 heads (approximately)

b. Available buffalo pairs 3,000 B.P. (approximately)
   (more than 4 years.
   Assumed that 40% x total population.
   * Present national wide average is 20-25% of total buffaloes)

c. 2 wheel tractors 1,000 (approx.)

d. 4 wheel tractors 400 (")

e. Denticy for 38,080 ha of existing farms

Buffalo pairs	One B.P per 13 ha
2 wheel tractor	One set per 38 ha
4 wheel tractor	One set per 95 ha

f. Assumed balance of shortage of farm powers

1. Total cultivable areas in case of 30 working days of plowing (one time)

Buffalo Pairs /1

3000BP x 0.3AC/day x 30days = $27,000^{Acs}$ = $10,800^{ha}$

2 wheel tractor

1000sets x 1AC/day x 30days = $30,000^{Acs}$ = $12,000^{ha}$

4 wheel tractor

400 sets x 2Acs/day x 30days = $24,000^{Acs}$ = $9,600^{ha}$

Total $32,400^{ha}$

2. Shortage of farm powers

Total cultivated acreages	38,080 ha
Assumed available powers	32,400
(Balance)	5,680 ha (-)

This balance have been covered by manpowers and extending the working period of both Baffaloes and tractors and the above estimated power availability is only for one plaughing. To make good paddy field, 2nd plaughing is necessary at present. These conditions have been resulting the delay of planting, that is one of the important reasons of crop failure.

/1 Buffalo Pairs

Possible to cultivate 0.25 AC - 0.5 Ac/day, but actually they can work only 4 - 5 hours/day for their poor ability, which need improvement by breeding. Improved single Buffalo in Philippines can plow twice much compared with indigenous Sri Lanka's Buffaloes.

(2) Future requirement of farm mechanization

(2)-1 Proposed cropping patterns

Total cultivated acreages both existing fields and new lands are divided into three groups such as 1 paddy-paddy 2 paddy-upland crops (Subsidiary Food Crops are included, and Sugar Canes, maximum acreage of each crop group per season is as follows, which would be considered as a basic element to estimate the quantity of machineries.

a. Paddy/season (Maximum is MAHA) 48,510 ha

b. Upland crops (S.F.C.)/season (Maximum is YALA) 11,980 ha

c. Sugar cane (NSE, out growers) (perennial crops) 5,960 ha

(2)-2 Estimated requirements of bufalloes and tractors

(2)-2-1 Farm powers to be introduced

In this Project Area, number of 4 wheel tractors is numerous than other places especially in Kantalai Tank area. Main reason is lack of labourers caused by competition with high wages of Sugar Cane plantation workers. Another reason is threshing is being done by 4 wheel tractors for lack of Buffaloes and threshing machines as well as land preparation should be finished in a short period after issued water, otherwise cause crop failure. To accerate the Project implementation, powerful 4 wheel tractor (40-70 H.P.) will play important role in future too, especially in case of sugar cane.

However, 2 wheel tractors, that are Japan made (6-7 H.P.) is most suitable for paddy field. Main reasons are cheaper than 4 wheel tractors, suitable for wet field, easy to operate in the small block of paddy field. It is also workable in the small size field,upland crops or S.F.C., too. Even the sugar cane field, it will be used for weeding and inter-cultivating.

Buffalo Pairs (including Cattles in future) is also available for wetfield rice and increased its importance because of higher expenses

of tractors as well as shortage of li estock products and manures.

Threshing, weeding, spraying, harvesting, drying, processing and other working should be mechanized in future, which save labour requirements.

(2)-2-2 An proposal of estimated number of buffaloes and tractors

a . Paddy

Percentage of each farm powers
Buffalo Pairs - 30%, 2 wheel tractor - 50% and 4 wheel tractors 20% are assumed.

1. Buffalo Pair

$48{,}510^{ha}$ x 30% = $14{,}553^{ha}$ (Paddy field)
0.25 Acs/day x 30 = 7.5 Acs = 3ha/season (Ability of B.P.)
$14{,}553^{ha}$ ÷ 3ha = 4,851 B.P.
4,851 x 120% = 5,821 B.P. *

* 20% is for reserve. Ability of B.P. will be 0.5Acs/day in future by breeding and increase of feeds.

2 . 2 wheel tractors

$48{,}510^{ha}$ x 50% = $24{,}255^{ha}$
1 Ac/day x 30 days = 30 Ac = 12^{ha}/season
24,255 ha ÷ 12 ha = 2,021 tractors
x 120% 2,425 tractors

3. 4 wheel tractors

$48{,}510^{ha}$ x 20% = $9{,}702^{ha}$
2 Ac/day x 30 days = 60 Ac = 24^{ha}
$9{,}702^{ha}$ ÷ 24 ha = 404 tractors
404 x 120% = 485 tractors

Note :
At the starting period, 2 wheel tractor would be 60-70% because of scarcity of Buffaloes.

Summary : Number of powers to be newly introduced
(estimated number-present)

Buffaloes	2,821 B.P.	(5,821 B.P. - 3,000 B.P.)
2 wheel tractor	1,425	(2,425 - 1,000)
4 wheel tractor	85	(485 - 400)

b. Upland and S.F.C.

2 wheel tractor - 90%, 4 wheel tractor - 10% (B.P. could be used partly.)

1 2 wheel tractors

$11{,}980^{ha} \times 90\% = 10{,}782^{ha}$

$10{,}780^{ha} \div 12^{ha} = 899$ tractors

$899 \times 120\% = 1{,}079$ tractors

2 4 wheel tractors

$11{,}980^{ha} \times 10\% = 1{,}198^{ha}$

$1{,}198^{ha} \div 24^{ha} = 50$ tractors

$50 \times 120\% = 60$ tractors

c. Sugar Cane

(Not estimated because of the following reasons.)

Present Kantalai Sugar plantation have equipped with approximately 140 sets of 4 wheel tractors of 40 - 70 H.P. to operate the farm.[1] Additional 4 wheel tractor set of about 100 may be required.

1) About 50% of these heavy machineries need repairs.

Summary :

Total additional number of farm powers were assumed as follows.

Buffalo pairs	2,821 B.P.
2 wheel tractors	2,504 sets
4 wheel tractors	145 sets

(Note)

1. Necessity number of present tractors to be replacement in relation to their completion of depreciation was not calculated.
2. 20% of reserve is sickness or accident of Buffaloes or out of order, repair and accidents related to tractors.

(2)-2-3 Initial investments for the additional farm powers

(A) Unit prices and credit

1. Buffalo pairs with plough 2,500 Rs
2. 2 wheel tractor (6 HP) with rotaly filler 25,000 Rs
3. 4 wheel tractor with 9 tine filler 110,000 Rs
4. Retail Prices (Rs), Oct. 1978 were as follows. (Consultant estimate)

Item	Source	Retail Price Oct. 1978 in Rupees
6/7 HP Two-wheeled tractor	Imported	20,000 - 25,000
-rotary cultivator	Imported	5,900
-levelling rake	Locally made	300
-puddling wheels	Locally made	700
-two-wheeled trailer	Locally made	4,200
-fan winnower	Locally made	500
-ridger (single row)	Imported	700*
-toolbar hoe	Imported	1,300*
-sprayer with hand lances	Imported	2,400
	Total	36,600

		Retail Price Oct. 1978 in Rupees
42 HP Four-wheeled tractor	Imported	110,000 - 150,000
-9 tine tiller	Locally made	6,000
-rotary cultivator	Imported	19,000*
-puddling cage wheels	Locally made	1,600
-3-farrow disc plough	Imported	18,000
-2-wheeled tractor	Locally made	16,500
	Total	163,000

Credit system

Present credit terms offered in Mahaweli Development are as follows.

a. Buffaloes/Bullochks Plus Carts
3,500Rs

Repayable over 5 years in ten equal installments.

14% interest/annum.

b. 2 wheel tractor

10,000Rs (Same repayment as a)

c. 4 wheel tractors

50,000Rs (Same repayment as a.)

(B) Tentative estimates in Rs for new B.P. and tractors

1. Buffalo pair

2,821 B.P x 2,500Rs = 7,052,500Rs

2. 2 wheel tractors

2,504sets x 25,000Rs = 62,600,000Rs

3. 4 wheel tractor

145 x 150,000Rs = 21,750,000

(Total) 91,402,500Rs

(2)-2-4 Problems to be solved for the successful farm mechanization

It was found that various problems to be solved on farm mechanization, which are mainly as follows.

1. Expand the size of blocks of field as possible as can to save the movement loss of tractors which reduce the working hours and fuel cost of tractors.
2. Provide efficient irrigation and drainage systems combined with better water management.
3. Organize effective training programs for operation and maintenance of machineries.
4. Expand the farm roads as well as related infrastructures are necessary.
5. Adequate supply of spair parts and repair services in time is required.
6. Uniformity of cultivation practices is necessary.
7. Ensure the supply of fuels with lubricants.
8. Reduce the farm gate prices of machineries as possible. Government subsidiy system would be considered in this connection.
9. Expand the credit system available for mechanization.
10. Establish cooperative holding and utilization of expensive machineries in connection with the expansion of the Extension Services.
11. Secure the prices of agricultural products to be possible to repay the credits.
12. For the long ranged planning, enlarge the domestic manufacturing of agricultural machineries with the international cooperations.

VII-5 Crop Production Costs

The following table is the Production Costs of each crops in comparison with current & with project.

Note:

1. W/out Project (w/out P) means estimated costs in 1991.
2. With Project (with P) means estimated Costs in 1991. (Full development)
3. Table Costs were divided into two groups.
   (A) Mostly concerned with foreign currency.
   (B) Mostly concerned with local currency.
4. (A)-1 Fertilizers = Chemical fertilizers
5. (A)-2 Agro-Chemicals = Fungicide, Insecticide, Weedicide.
6. (A)-3 Machineries = Mainly tractor cost and partly other machineries.
7. Grand Total = (omitted fractions)
8. Yields, Unit Prices, GPV, Production Costs and NPV with and without project are summarized in the Annex VIII.

Table Production Costs of Crops (Rs)

	Item of Cost	Paddy		Soya Bean		Cowpeas/Grams	
		with P	w/out P	with P	w/out P	with P	w/out P
(A)							
1.	Fertilizers	788	-	361	-	318	-
2.	Agro-Chemicals	635	-	340	-	200	-
3.	Machineries	1,075	100	875	870	855	720
	(Total A)	2,498	100	1,576	870	1,393	720
(B)							
1.	Labours						
	MAN	948	756	516	300	108	120
	WOMAN	780	180	730	350	500	410
	(Sub total)	1,728	936	1,241	650	608	530
2.	Seeds	130	260	450	450	200	200
3.	Composts or Manures	-	-	-	-	-	-
4.	Draught Animals	518	1,038	-	-	-	-
5.	Miscelleneous	125	62	32	32	20	20
	(Total B)	2,501	2,296	1,728	1,132	828	750
	(Grand Total)	5,000	2,400	3,300	2,000	2,200	1,470

	Groundnuts		Maize		Sorghum		Chillies		Red Onions	
	with P	w/out P	with P	w/out P	with P	w/out P	with P	w/out P	with P	w/out P
(A)										
1.	431	-	586	-	586	-	1,090	750	1,750	1,000
2.	300	-	160	-	160	-	1,790	900	900	700
3.	875	875	875	600	600	600	1,250	1,250	1,325	1,250
	1,606	875	1,621	600	1,346	600	4,130	2,900	3,975	2,950
(B)										
1.	252	216	312	288	312	276	720	492	720	552
	770	510	650	410	570	250	2,110	1,540	3,860	3,360
	1,022	726	962	698	150*	526	2,830	2,032	4,580	3,912
					1,032					
2.	675	600	120	120	120	120	100	100	1,700	1,700
3.	-	-	-	-	-	-	2,000	1,200	2,000	1,700
4.	-	-	-	-	-	-	-	-	-	-
5.	-	-	-	-	-	-	-	-	-	-
	1,697	1,326	1,082	818	1,152	646	4,930	3,332	8,280	7,312
	3,300	2,200	2,700	1,420	2,500	1,250	9,060	6,230	12,255	10,262

* Boy's worker for bird scaring

	Bombay Onions		Vegetables		Sugar Cane (NSE)		Sugar Cane (out Growers)	
	with P	w/out P	with P	w/out P	with P	w/out P	with P	w/out P
(A)								
1.	1,300	900	1,600	1,000	664	300	564	300
2.	800	300	800	400	100	-	-	-
3.	1,250	1,250	1,250	1,250	1,475	1,000	1,375	980
	3,350	2,450	3,750	2,650	2,239	1,300	1,939	1,280
(B)								
1.	408	396	444	324	1,140	924	1,020	924
	2,500	2,170	2,900	2,080	130	-	150	
	2,908	2,566	3,344	2,404	1,270	924	1,170	924
2.	240	240	300	300	-			
3.	1,500	750	1,500	800	-			
4.	-							
5.	-				100	100	100	100
	4,648	3,356	5,144	3,504	1,370	1,024	1,270	1,024
	8,000	6,000	8,900	6,150	3,600	2,320	3,200	2,300

VII-6 Rainfed Cropping

In case of rainfed agriculture, it is better to cultivate the crops of relatively shorter growth period as mentioned in the main report.

The followings Tables are (1) Growth period of crop variety in rainfed agriculture, (2) List of the drought tolerant crops in general. (Reference data for the selection standards of crops into the rainfed agriculture.) and (3) General crop budget in rainfed agriculture.

Table (1) Growth period of crop variety in rainfed agriculture

Crops	Variety	Average growth period (days)	Note
Chillie	MI-1	150 days	SANTAKA (Japanese variety) is recommendable in YALA for its sensibility to rain.
	MI-2	150	
	SANTAKA	105	
Caspsicum	Hangarian yellow wax	105	
Brinjal	(Local)	105	
Soya bean	TK No. 5	90	
	(others)	105	
Green grams	M_1- 1	90	
	M_1- 4	75	Could be 60 days in case of new variety.
Black gram	M_1- 1	90	
	Type 9	75	
Cowpea	Bombay	90	
	Arlington	90	
	M_1- 35	75	
Groundnut	M_1- 1	105	
	Red spanish		

Crops	Variety	Average growth period (days)	Note
Red onion (shallot)	(Local)	75-90 days	
Bombay onion	Poona-Red	90-105	
Spring onion		60	
Vegetables		45-60	Short variety
Cotton	HC 101	120-150	
Tabacco	Cigarette Tabacco	120-135	
Maize	Hybrid	100-120	
Sorghum	15,941	100-120	
Manioc		150-180	

Table (2) List of the drought tolerant crops in general (*)

a) Food crops

Barley, Grain sorghum, Millet, Maize, Groundnut, Mung beans, Broad beans, Kidney beans, Cowpeas, Sweet potato, Sugar cane, Manioc.

b) Industrial crops

Cotton, Seseme (Gingelly), Safflower, Sunflower, Castor bean.

c) Fodder crops

Alfalfa, Sudan grass, Rhodes grass, Bermuda grass, Napier grass, Vetch.

d) Vegetables

Tomato, Melon, Spinich, Asparagus, Turnip, Onions (dry onion), Watermelon, Lettus, Cabbage, Carrot, Broccoli.

e) Fruits

Fig, Pomegranate, Citrus, Banana, Mango, Papaw, Grapevine, Olive, Pineapple, Dates, Guava.

(*) —— Underline shows high drought tolerant.

Table (3) General crop budget in rainfed agriculture

Crop	Yield/ha ton	Unit price Rs/ton	GPV Rs/ha	Production cost Rs/ha	NPV Rs/ha
Paddy	1.6	3,240	5,184	1,920	3,264
Soya bean	0.9	4,140	3-726	1,773	1,953
Groundnut	1.0	6,510	6,510	2,200	3,310
Cowpea/gram	1.0	5,000	5,000	2,200	3,530
Sorghum/Maize	1.6	1,700	2,720	2,200	450
Chillie (dried)	1.1	17,600	19,100	6,230	13,130
Red Onion	8.1	4,000	32,400	10,100	22,330
Sugar Cane	35	290	10,150	2,700	7,450

VII-7 Animal Husbandry

7-1 Animal Husbandry in the Dryzone

7-1-1 Consumption of Animal Proteins

The requirement of animal proteins of high biological value found in Milk, Meat and Eggs per capita is estimated as follows.

Product		Present	Recommendable
Milk & Milk Products		45.6 lbs (2 ozs/day)	5.49 ozs/day
Meat		7.4 lbs	152 lbs
Beef	5 lbs		* Total recommended Protein/day by Medical Institute of Sri Lanka is 62 grams in which 14.6 grams from animals.
Mutton	1.23		
Pork	0.56		
Chicken	0.51		
Total:	7.4		
Egg		2.05 lbs (22 eggs)	200 - 250 eggs

7-1-2 Importance of ZEBU Type Cattles in the Tropics

Most of the developed countries in Animal Husbandry are located on Temperate Zone, therefore we should avoid to copy it as it is when apply the technics to the Tropical Zone, where entirely different conditions. Except the Highland or Up Country where is more than 4,000 ft. from sea level and temperature is under 70°F, the Cattle Breeds of Temperate Zone could not be raized.

ZEBU and ZEBU Mixed Cross Breeds are best in the tropics for its high tolerance for high temperature, high moisture or draught, poor nutrient contented indigeneous grasses and

resistant to communicable diseases and parasites in the topics. The Cattle with less than 50% of Indian blood show unsuitability to the Tropics. (Both Dairy and Beef Cattle.) Same principle, which means to select tropical breeds, should be considered for smaller livestocks raising (pig and others) and poultry management.

7-1-3 Unusual Drop of Livestock and Poultry Population

Serious food crisis happened in around 1973 caused serious drop of population of livestock and poultry as follows by unusual slanghtering, which made slow down of regular development of animal husbandry. The unusual slanghtering should be stopped for the future development.

Livestock and Poultry Population

	1970	1973		Balance (1970-1973)
Cattle	1,593,000 heads	989,000 heads	(-)	604,000 heads
Baffaloes	736,000	387,000	(-)	349,000
Goat & Sheep	556,000	284,000	(-)	272,000
Pig	180,000	42,000	(-)	138,000
Poultry	6,856,000	3,668,000	(-)	3,188,000

7-1-4 Shortage of Draught Animal

More than 50% of paddy is being produced in the dry zone. Shortage of draft animals is serious problem at present, it is estimated that maximum number of potential draft powers that consist of Cattles and Baffaloes is 134,000 pairs. About 30-40% of total population of Baffaloes could be used for draft power (only 20-25% of Baffalo is available sometime.) and it is very difficult to use Cattle for cultivation at present condition. So that, the possible cultivated area is assumed as follows.

a)	Total number of possible animal pair	134,000 pairs
b)	Acreage to be cultivated by one pair/season	5 Acs
c)	Estimated cultivated area by draft animals	670,000 Acs
d)	Actual cultivated area (Cattles not available easily)	approx. 340,000 Acs

Rice cultivation area in the dry zone (800,000 Acs at present) will be expanded to more than one million Acs in total by Mahaweli Projects. Hence, the available draught power will be far short of the future needs of the extent of paddy land in the dry zone, combined with expansion of subsidiary food crops.

7-1-5 Agro Climatics in Relation with Animal Husbandry

In Sri Lanka, three agro-climatic zones are classified as follows.

		Elevation	Rainfall	Temperature
a)	Up country	above 4,000'	50" - 60"	50F - 85F
b)	Mid country	1,500 - 4,000'	"	70F - 90F
c)	Low country	0 - 1,500'	40" - 70"	70F - 100F

a) Mild climate is suitable for high producing temperature breeds of dairy Cattles such as Friesians, Ayshires and Shorthorn, etc. by KIKUYU grasses, clovers and other improved pastures.

b) Almost same as up Country. Giant Pusa, Pangola, Setaria and Brachiaria can gow also. 10-12 pints of milk/day/cow could be produced in the above two zones. Conservation of roughages in the forms of hay or silage is necessary in the dry season.

c) ZEBU Type (Indian Blood) and its hybrid Breeds with Indigenous is most suitable. According to the Department of Agriculture, about 0.8 million Acs in the dry zone are suitable for pasture land of Villu Damana at present and could be introduced Brachiarias and other improved pastures.

7-1-6 Current Situations

a) Cattle & Baffaloes

90% of Cattle are of indigenous type referred to as "Sinhala Cattle". 350-400 lbs of weight will be reached after 4 years age. Its Caracass weight is about 135-150 lbs. Baffaloes of same age will reach 600 lbs and 300 lbs is approximate Caracass weight. In the up land and mid-country, around 100 lbs of green grass with D.M. contents of 15-20% and concentrates 6-8 lbs are offered dairy per cow to produce 12-16 pints of milk/day/cow. In the dry zone, Cattle and Buffaloes produce 2-4 pints per day/cow by only milking once a day and grazed by natural grasses and 7-8 pints/day/cow by feeding Brachiarias.

b) Goat & Sheep

Ingineous goats' weight is 55-70% lbs and 20-25 lbs of Caracass weight at 1.5 years. They can breed twice annuary. Goat are mainly kept for meat production and few are being milked.

Sheeps are small with mature weight of 25-50 lbs and mainly for meat and manuring purpose.

c) Pig

There are few pigs in the dry zone. Mostly 40-50 lbs of live weight at 6 months and 70-80 lbs in 12 months. Another improved type such as Landrace or Large Black were partely introduced and fed with concentrates. These improved pig reach to 200 lbs at about 8 months.

d) Poultry

Poultry is also small size of operation in the dry zone under laying percentage of approximately 15%. Only intensive layer is 50%.

7-1-6 Improved Breed of Cattles

Indigenous Sinhala Cattle only produce 100 lbs of milk per lactation and very difficult to improve it by selective Breeding. Maximum possibility of improvement of this method is estimated as 0.5-1.0% per year. It will take nearly 100-200 years to double the productivity of Sinhala Cow. There is also difficulty caused by in-breeding in Cattle and Baffaloes at present. Cross Breed is main method of improvement. Indian blooded Breeds such as Scindhi, MURRAH and other ZEBU Milch Breeds should be expanded to raise. Santa Gertrudes and its cross breed may produce 1-2 lbs of gain weight per day by only pasture.

7-2 Potential and Development of Animal Husbandry

7-2-1 Future Outloook for the Development of Livestock Industry in Sri Lanka

There is no doubt that the potential for the expantion of the livestock industry in Sri Lanka in view of its favoured climate, land, labour and stock resources available. Agricultural by-products in the form of rice bran, rice straw, coconut poonac, rubber seed meal, gingelly cake, wheat bran, fish meal, etc.) are available and can be utilized for concentrates or compound feeds.

Future increase of output of rice, maize, sorghum, manioc, soya bean, groundnuts, wheat bran and coconut poonac which can be produced domestically will no doubt reduce dependence on feed imports. Another incentive is second oil shock. To import oil and machineries has abstacles of these international situations and has to utilize draft animals as well as organic fertilizers which are by-products of animal husbandry to keep soil fertility.

In the short time, animal protein can be increased by expanding piggery and poultry that consume more concentrates than the ruminants, largely depending on well managed pastures and process it by themselves to milk and meat.

A supporting program for the improved grasses, cereals and other subsidiary food crop production as well as expansions of concentrates will meet the needs of livestock industry. Thus, major limiting factor, namely, availability of animal feeds will be resolved by well planned integrated agricultural production program linked with livestock production, which is urgently necessary in Sri Lanka.

7-2-2 Proposal of New Five Year Plan

New five year plan shown in "Some proposals for livestock Development in Sri Lanka" (Dr. M.E. Perera) is quite a reasonable planning to be realized, which is introduced as follows.

	Nutritional requirements per caput/annum in lbs (M.R.I.)	Required production levels to meet nutritional needs in M lbs/annum	Estimated production levels at present time in M lbs/annum	Possible production levels through breed feed & management improvement	Compounded feed required in 1000 tons	Minimum time period in years for achieving goals
Milk	114.00	3.4 M* pints/day	0.6 M* pints/day	1.5 M	97	20
Beef	4.24	58.5	41.90	45.40	-	10
Goat & Sheep Mutton	0.68	9.4	-	9.40	-	6
Pork	0.37	5.1	44.55	17.0	25	
Poultry Meat	0.71	9.8	5.90	15.0	14	
Eggs	6.00	662 M*	213 eggs	343.2 M* eggs	63	

* Pig meat, poultry meat and eggs could be increased to any level provided the required feed stated is supplied to the Industry. Increase in pig meat and poultry meat in the short term will compensate for the slow progress in the production of milk, eggs and beef in the long term.

M* = million

Source: Dr. M.E. Perera
"Some Proposals for Livestock Development in Sri Lanka"

7-2-3 Feeds

The major constraint to develop the livestock industry in Sri Lanka is the insufficiency of livestock feeds.

The present production level by local produce is around 65,000 tons which need to be raised to over 160,000 tons in five year to get the target production. All kind of by products of crops which is mentioned in the previous items should be used to maximum advantage.

7-2-4 Grasses

It is apparent that ruminants require roughages as the fundermental feeds as well as cheapest source of energy. Production of grasses and fodder crops should be given first priority and maximize domestic production of concentrates for Cattle, Pig and Poultry.

By using Brachiaria brizantha or B, mutica (for imperfectly drained area), the grazing capacity of Cattle will raise up to one cow/1.5-2 acres (Cow equivalent) and twice much when intensive farming. Regarding the Milk production, the following estimate could be made in case of pasturing system.

Milk . Present production 450,000 pints/day/cow

. Future production 960,000 - 1,600,000 pints/day/cow

* (1) Potential grassland 800,000 Acres

(2) Grazing capacity one cow/1.5-2 Acres (one cow/1 Ac in future)

(3) Cattle number (Extensive pasturing system) 400,000-500,000 heads

(4) (3) × 40% (milking cow) 160,000 heads

(5) Unit production/day/cow

ZEBU	6-7 pints
Improved Milch Baffalo (MURRUH)	8-10 pints
ZEBU × European Cross Breed	over 10 pints

(6) Total production 960,000 - 1,600,000 pints/day/cow

Note: Problems of over maturing of grasses and necessity of rotational grazing are already discussed in the main report.

The average yield of improved grasses are as follows. (Trial in the Agricultural Research Station, Maha-Illuppallama)

Grasses	Dry matter yields lb/ac./yr.
Setaria sphaccalata	16,875
Digitaria documbens (Pangola grass)	16,397
Branchiaria ruzizionsis	13,581
Branchiaria miliformis	13,145
Branchiaria brizantha	12,560
Brachiaria mutica (good for imperfectly drained area)	12,456

LSD. (P = 0.05) = 1570 lbs/acre.

C.V. = 7.2%

Additional test on the effect of Nitrogen application for the above grasses shows that the yield increased about 50% in case of 120 pounds of Nitrogen/Acre.

- Improved pasture versus purchased concentrates

As soon as reasonable pasture can be developed, an effort should be made to graze with less or no supplement to prevent heavy concentrates supplements, that is shortage of supply in Sri Lanka.

Another test on the effect of supplementary feeding of concentrates shows the result that 10 lbs of increase of milk/day/cow which made not significant difference compared without concentrates. However, reduction of milk in February and March are significant. In this period and dry reason, the concentrates are especially necessary and the hight productivity cross breeds need some concentrate always. Poor stand of grasses of higher fibre and moisture of tropical zone reduce sufficient energy contents. Under rainfed conditions, shortage of roughages during dry season is major problem and have to provide hay or silage by using very simple facilities for the continuous development of animal husbandry.

It is suggested that grassland agriculture must be the basis of an integrated system of crop and animal industry which link up with use of cattle manure for the arable crops and improving the soil fertility.

7-2-5 Concentrates and Supplementary Feeds

The Chemical Composition of feed staffs used in Sri Lanka is shown in the following table.

CHEMICAL COMPOSITION

OF CEYLON FEEDSTUFFS USED IN CEYLON

Feedstuff	Dry Matter	Crude Protein	Fat	Crude Fibre	Ash	NFE
Blood meal	91	82.2	1.0	1.0	4.8	2.0
Bone meal	95	12.1	3.2	22.0	71.8	-
Coconut meal, chekku	90	21.2	15.3	15.4	1.9	40.2
" " expeller	93	20.4	8.6	12.0	6.9	45.2
" " solv. extr.	92	21.3	1.8	15.0	5.6	48.3
Cotton seed hulls	90	3.9	1.4	42.9	2.5	39.6
Cotton seed meal	93	39.6	6.6	15.7	5.1	26.4
Cowpea seed	89	23.1	1.3	5.1	3.2	55.8
Dhal	94	22.9	4.3	0.3	4.7	61.8
Dhal husk	91	10.6	0.2	15.9	0.5	63.8
Fish meal	92	63.2	4.4	1.0	21.7	1.6
Kapok seed meal	88	27.0	8.2	23.0	6.3	47.8
Kurakkan	88	7.6	1.3	1.6	2.3	75.2
Gingelly meal	93	47.9	5.1	5.0	9.3	25.7
Naioc meal	87	2.2	1.6	1.9	1.2	80.1
Maize meal	94	13.1	3.3	2.9	1.8	72.9
Meat meal	93	53.4	9.9	2.4	25.2	2.6
Milk, fresh	12	3.1	3.7	-	0.8	4.4
Milk, whole dried	94	25.2	26.4	0.2	5.4	36.4
Milk, dried skimmed	94	33.5	0.9	0.2	7.6	51.8
Rice polish	90	11.8	13.2	3.0	8.0	54.0
Rice bran, No. 1 (raw)	89	12.5	14.6	8.9	10.6	42.4
" " No. 1 (parboiled)	90	12.8	20.3	10.0	10.7	36.2
" " No. 2 (raw)	89	8.9	6.5	19.1	19.6	34.9
" " No. 2 (parboiled)	90	9.1	10.3	17.1	21.2	32.3
Rice, whole (polished)	87	6.3	0.4	0.3	1.6	78.4
" " (unpolished)	87	7.4	0.7	0.3	1.0	77.6
Sorghum	91	10.6	3.9	2.3	1.3	72.9
Soya bean meal	89	45.8	0.9	6.0	5.8	30.5
* Wheat bran	89	16.0	4.1	10.0	6.1	52.8
Wheat flour	89	15.8	2.9	3.0	2.1	65.0
Wheat grain	89	12.7	1.7	3.0	1.6	70.0

Compiled by
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(Remarks)

* Wheat bran will be produced in Trincomalee by new factory of the Flour Milling Corporation, and it is better to consume the bran domestically while it may exported.

Total requirements of the concentrates in five year plan is as follows.

Feed ingredient	Daily	Poyltry	Total required	Estimated local production end of plan period	Amount need to be imported
	(All in tons)				
1. Coconut cake, gingelly cake & rubber seed meal	50,000	30,000	80,000	60,000	20,000
2. Rice bran & wheat bran	26,000	18,000	44,000	35,000	9,000
3. Grains and wheat flour	20,000	40,000	60,000	13,000	47,000
4. Others (energy feeds, leaf meal, bagasse)	-	-	-	35,000	-
5. Fish meal & meat meal	1,000	9,000	10,000	-	10,000
6. Milk powder	1,000	1,000	2,000	-	2,000
7. Mineral mixture	2,000	2,000	4,000	-	4,000
			200,000	144,000	92,000

Source: Dr. M.E. Perera

Notes

(1) Coconut Cake

It is estimated that could be raise to 80,000 tons/year domestically by mixed farming with Cattles under coconut triangle.

(2) Rice Bran

Improvement of quality is necessary. (Fiber content should be no more than 10-15%.)

(3) Other Potential Feeds

Rubber seed meal, Fruits cannery wastes, Bagase, sugar cane tops and molassess, grass meal (ipil-ipil included), Gingey poonac, Soya bean and groundnut oil cakes; Wheat Bran (Trincomalee) maize & sorghum, manioc, sweet potato and others.

* Reference:

Importation of animal feeds to Japan (1976)

Feed	Quantity (ton)	Price (C&F, Tokyo)/ton
Corn	6,261,000	195 U.S.$
Grain Sorghum	3,975,000	182 "
Wheat Bran	181,527	182 "
Beet Pulp	266,711	197 "
Soya Bean Cake	192,884	322 "

7-2-6 Samples of Fattening Cattles for Beef Production

It is not familiar to raise Cattle for meat production only and not confirmed its economicall feasibility in case of commercial production. However, by introducing ZEBU Type or mixed beef Cattle to Sri Lanka and Keep them by grazing system with some salt/minerals and vaccination, it may be succeeded in this country in future.

In Japan, beside the special Beef Cattles, the castrated steers of dairy Cattle have been used for fattening. At present, about 30% of Beef in the market is from fattened steers of dairy Cattle.

Here is some samples that shows fattening Cattle projects in Phillippines and Paraguay in Private Sector which were succeeded.

a) Phillippines (private sector)

ZEBU blooded cross breeds fed by only grasses operated by an private sector is as follows.

Breed - Draught Master, A.I.S. Brangus, Shorthorn-Brahman, Red Sindhi (all Zebu blooded)

Grass - Brachiaria, Para grass, ipil-ipil, Guatemala Grass, African blue grass and others.

Grazing Capacity - 1 ~ 2 heads/ha
(Special case - Grazing in the forest area)

Caracus - 300 lbs - 400 lbs

b) Paraguay (private sector)

Breed - (1) ZEBU × local breeds.
(2) Santa Gertaludes × local

Grass - Same as Phillippines and Pangola, Jaragua, Napiel, Colonia, etc.

Grazing Capacity - 6 heads/ha (Summer) - wet
3 " /ha (Winter) - dry

Dressing percent - 60% Caracus 240-250 kg

Finished live weight - 410 kgs (900 lbs)

Mortality - 3% (snake bite)

Fettering period	- 6 months
Gain weight/day	- 800 grams/day in average (maximum 1 kg/day)
Net income/head (1973)	- 50 US$/head ~ 60 US$
Net income/50 heads (1973)	- 2,500 US$ (37,500 Rs) ~ 3,000 US$ (45,000 Rs)

(2)-7 Other Countermeasures

Artificial Insemination, Livestock Breeding Center, compound feed factory, Silage, Vaccination Services combined with vaccines and biological products factory, fertilizer application to pastures, rotational greezing system, More milk Collection Center, warehouses and effective extension services are necessary to the development of livestock Industry in Sri Lanka.

ANNEX VIII : AGRICULTURAL ECONOMIC, MANPOWER AND SETTLEMENT

Contents:

VIII-1: Projected Inputs & Outputs

VIII-1 will consist of the following Tables:

(1) Existing Land

Table 8-1 Yields and Production Costs as assumed w/out Project and w/Project in the Existing Fields, and

Table 8-2 Yields, Unit Prices, Gross Production Values, Production Costs and Net Production Values in the Existing Fields as assumed w/out Project and under the Project (per ha).

(2) Newly Reclaimed Land

Table 8-3 Yields and Production Costs Proposed for the Newly Reclaimable Lands, and

Table 8-4 Yields, Units Prices, Gross Production Values, Production Costs and Net Production Values Proposed for the Newly Reclaimable Lands (per ha).

Table 8-1 Yields and Production Costs as Assumed w/out Project and w/Project in the Existing Fields

Yields (tons/ha)

	Project Year A.D.	0 1979	1 1980	2 1981	3 1982	4 1983	5 1984	6 1985	7 1986	8 1987	9 1988	10 1989	11 1990	12 1991
Paddy	W/out P	1.5	1.52	1:53	1.6	1.65	1.7	1.75	1.79	1.83	1.87	1.91	1.96	2.0
	With P								2.2	2.6	3.0	3.4	3.8	4.2
Soya-beans	W/out P	0.75	0.76	0.77	0.8	0.82	0.84	0.9	0.92	0.94	0.95	0.97	0.99	1.0
	With P								1.0	1.1	1.2	1.3	1.4	1.5
Ground-nuts	W/out P	0.75	0.76	0.77	0.8	0.82	0.84	0.9	0.92	0.94	0.95	0.97	0.99	1.0
	With P								1.0	1.1	1.2	1.3	1.4	1.5
Maize	W/out P	0.8	0.81	0.82	0.85	0.87	0.9	0.93	0.94	0.95	0.97	0.96	0.99	1.0
	With P								1.1	1.3	1.4	1.6	1.7	1.9
Sorghum	W/out P	0.8	0.81	0.82	0.85	0.87	0.9	0.93	0.94	0.95	0.97	0.98	0.99	1.0
	With P								1.1	1.3	1.5	1.6	1.8	2.0
Cowpeas/grams	W/out P	0.75	0.76	0.77	0.8	0.82	0.84	0.9	0.92	0.94	0.95	0.97	0.99	1.0
	With P								1.0	1.1	1.2	1.3	1.4	1.5
Chillies	W/out P	0.9	0.91	0.93	0.95	0.98	1.0	1.03	1.04	1.05	1.07	1.08	1.09	1.1
	With P								1.1	1.2	1.3	1.4	1.5	1.6
Red Onions	W/out P	7	7.1	7.2	7.4	7.6	7.9	8.1	8.2	8.3	8.5	8.6	8.7	8.8
	With P								8.6	9.1	9.5	10.0	10.5	11.0
Bombay Onions	W/out P	7	7.1	7.3	7.5	7.7	8.0	8.2	8.3	8.5	8.6	8.7	8.9	9.0
	With P								8.8	9.5	10.0	10.7	11.4	12.0
Veget-ables	W/out P	6	6.1	6.2	6.4	6.6	6.8	7.0	7.1	7.2	7.3	7.4	7.5	7.6
	With P								7.7	8.3	9.0	9.7	10.3	11.0
Sugarcan (NSE)	W/out P	40	41	42	44	46	48	50	51.3	52.7	54.0	55.3	56.7	58
	With P								55	60	65	70	75	80
Sugarcane (Out-growers)	W/out P	30	30.5	31	32	33	34	35	35.5	36.0	36.5	37.0	37.5	38
	With P								39	43	47	52	56	60

Production Costs (Rs/ha)

	Project Year A.D.	0 1979	1 1980	2 1981	3 1982	4 1983	5 1984	6 1985	7 1986	8 1987	9 1988	10 1989	11 1990	12 1991
Paddy	W/out P	1,785	1,824	1,840	1,920	1,980	2,040	2,100	2,130	2,180	2,225	2,275	2,330	2,400
	With P								2,980	3,095	3,570	4,050	4,520	5,000
Soya-beans	W/out P	1,500	1,520	1,540	1,600	1,640	1,680	1,800	1,840	1,880	1,900	1,940	1,980	8,000
	With P								2,000	2,300	2,640	2,860	3,080	3,300
Ground-nuts	W/out P	1,650	1,622	1,700	1,760	1,800	1,850	1,980	2,025	2,068	2,100	2,134	2,178	2,200
	With P								2,000	2,300	2,640	2,860	3,080	3,300
Maize	W/out P	1,080	1,150	1,170	1,210	1,240	1,280	1,320	1,335	1,350	1,378	1,390	1,406	1,420
	With P								1,560	1,847	1,990	2,274	2,416	2,700
Sorghum	W/out P	1,000	1,013	1,025	1,063	1,087	1,125	1,160	1,175	1,188	1,213	1,225	1,238	1,250
	With P								1,375	1,625	1,875	2,000	2,250	2,500
Cowpeas/grams	W/out P	1,100	1,117	1,130	1,175	1,200	1,235	1,320	1,352	1,382	1,397	1,426	1,455	1,470
	With P								1,468	1,613	1,760	1,907	2,053	2,200
Chillies	W/out P	5,080	5,160	5,245	5,350	5,420	5,680	5,880	5,960	5,920	6,030	6,090	6,185	6,200
	With P								6,200	6,760	7,323	7,890	8,453	9,060
Red Onions	W/out P	7,745	7,880	8,000	8,120	8,240	8,360	9,000	9,100	9,215	9,400	9,510	9,600	9,770
	With P								9,550	10,100	10,550	11,100	11,660	12,255
Bombay Onions	W/out P	4,670	4,735	4,870	5,000	5,136	5,336	5,470	5,530	5,667	5,733	5,800	5,933	6,000
	With P								5,867	6,333	6,667	7,133	7,600	8,000
Veget-ables	W/out P	4,860	4,940	5,020	5,180	5,340	5,500	5,670	5,745	5,826	5,907	5,990	6,070	6,150
	With P								6,230	6,716	7,280	7,850	8,335	8,900
Sugarcan (NSE)	W/out P	1,600	1,640	1,680	1,760	1,840	1,920	2,000	2,050	2,110	2,160	2,210	2,270	2,320
	With P								2,475	2,700	2,925	3,150	3,375	3,600
Sugarcane (Out-growers)	W/out P	1,600	1,627	1,640	1,700	1,750	1,800	2,120	2,150	2,180	2,210	2,240	2,270	2,300
	With P								2,470	2,290	2,505	2,775	2,990	3,200

Table 8-2 Yields, Unit Prices, GPV, Production Costs and NPV in the Existing Fields as Assumed without Project and under the Project (per ha)

Kind of Crops	With or W/out Project	See Foot Notes	1986	1987	1988	1989	1990	1991
Paddy	W/out Project	*1	1.79	1.83	1.87	1.91	1.96	2.0
		2	3,240	3,240	3,240	3,240	3,240	3,240
		3	5,800	5,929	6,059	6,188	6,350	6,480
		4	2,130	2,180	2,225	2,275	2,330	2,400
		5	3,670	3,749	3,834	3,913	4,020	4,080
	With Project	1	2.2	2.6	3.0	3.4	3.8	4.2
		2	3,240	3,240	3,240	3,240	3,240	3,240
		3	7,128	8,424	9,720	11,016	12,312	13,608
		4	2,980	3,095	3,570	4,050	4,520	5,000
		5	4,148	5,329	5,970	6,960	7,792	8,608
	Project Benefit		388	1,580	2,136	3,053	3,772	4,528
Soyabeans	W/out Project	1	0.92	0.94	0.95	0.97	0.99	1.0
		2	4,140	4,140	4,140	4,140	4,140	4,140
		3	3,809	3,892	3,933	4,016	4,099	4,140
		4	1,840	1,880	1,900	1,940	1,980	2,000
		5	1,969	2,012	2,033	2,076	2,119	2,140
	With Project	1	1.0	1.1	1.2	1.3	1.4	1.5
		2	4,140	4,140	4,140	4,140	4,140	4,140
		3	4,140	4,554	4,968	5,382	5,796	6,210
		4	2,000	2,300	2,640	2,860	3,080	3,300
		5	2,140	2,254	2,328	2,522	2,716	2,910
	Project Benefit		171	242	295	446	597	770
Groundnuts (shelled)	W/out Project	1	0.92	0.94	0.95	0.97	0.99	1.0
		2	6,510	6,510	6,510	6,510	6,510	6,510
		3	5,989	6,119	6,185	6,315	6,445	6,510
		4	2,200	2,068	2,100	2,134	2,128	2,200
		5	3,789	4,051	4,085	4,181	4,267	4,310
	With Project	1	1.0	1.1	1.2	1.3	1.4	1.5
		2	6,510	6,510	6,510	6,510	6,510	6,510
		3	6,510	7,161	7,812	8,463	9,114	9,765
		4	2,000	2,300	2,640	2,860	3,080	3,300
		5	4,510	4,861	5,172	5,603	6,034	6,465
	Project Benefit		721	810	1,087	1,422	1,767	2,155
Sorghum	W/out Project	1	0.94	0.95	0.97	0.98	0.99	1.0
		2	2,000	2,000	2,000	2,000	2,000	2,000
		3	1,880	1,900	1,940	1,960	1,980	2,000
		4	1,175	1,188	1,213	1,225	1,238	1,250
		5	705	712	727	735	742	750
	With Project	1	1.1	1.3	1.5	1.6	1.8	2.0
		2	2,000	2,000	2,000	2,000	2,000	2,000
		3	2,200	2,600	3,000	3,200	3,600	4,000
		4	1,375	1,625	1,875	2,000	2,250	2,500
		5	825	975	1,125	1,200	1,350	1,500
	Project Benefit		120	263	398	465	608	750

1 = Yield in tons/ha; 2 = Unit Price in Rupees per ton;

3 = Gross Production Value in Rupees; 4 = Production Cost in Rupees per ha;

5 = Net Production Value in Rupees/ha.

			1986	1987	1988	1989	1990	1991
Cowpeas/ grams	W/out Project	1	0.92	0.94	0.95	0.97	0.99	1.0
		2	5,000	5,000	5,000	5,000	5,000	5,000
		3	4,600	4,700	4,750	4,850	4,950	5,000
		4	1,352	1,382	1,397	1,426	1,455	1,470
		5	3,248	3,318	3,353	3,424	3,495	3,530
	With Project	1	1.0	1.1	1.2	1.3	1.4	1.5
		2	5,000	5,000	5,000	5,000	5,000	5,000
		3	5,000	5,500	6,000	6,500	7,000	7,500
		4	1,468	1,613	1,760	1,907	2,053	2,200
		5	3,532	3,887	4,240	4,593	4,947	5,300
	Project Benefit		284	569	887	1,169	1,452	1,770
Chillies (dried)	W/out Project	1	1.04	1.05	1.07	1.08	1.09	1.1
		2	17,600	17,600	17,600	17,600	17,600	17,600
		3	18,304	18,480	18,832	19,008	19,184	19,360
		4	5,860	5,920	6,030	6,090	6,145	6,200
		5	12,444	12,560	12,802	12,918	13,039	13,160
	With Project	1	1.1	1.2	1.3	1.4	1.5	1.6
		2	17,600	17,600	17,600	17,600	17,600	17,600
		3	19,360	21,120	22,880	24,640	26,400	28,160
		4	6,200	6,700	7,323	7,890	8,453	9,060
		5	13,160	14,420	15,557	16,750	17,947	19,100
	Project Benefit		716	1,860	2,755	3,832	4,908	5,940
Red Onions	W/out Project	1	8.2	8.3	8.5	8.6	8.7	8.8
		2	4,000	4,000	4,000	4,000	4,000	4,000
		3	32,800	33,200	34,000	34,400	34,800	35,200
		4	9,100	9,215	9,440	9,550	9,660	9,770
		5	23,700	23,985	27,560	24,850	25,140	25,430
	With Project	1	8.6	9.1	9.5	10.0	10.5	11.0
		2	4,000	4,000	4,000	4,000	4,000	4,000
		3	34,400	36,400	38,000	40,000	42,000	44,000
		4	9,550	10,100	10,550	11,100	11,660	12,255
		5	24,850	26,300	27,450	28,900	30,340	31,745
	Project Benefit		1,150	2,315	2,890	4,050	5,200	6,315
Bombay Onions	W/out Project	1	8.3	8.5	8.6	8.7	8.9	9.0
		2	3,600	3,600	3,600	3,600	3,600	3,600
		3	29,880	30,600	30,960	31,320	32,040	32,400
		4	5,530	5,667	5,733	5,800	5,933	6,000
		5	24,350	24,933	25,227	25,520	26,107	26,400
	With Project	1	8.8	9.5	10.0	10.7	11.4	12.0
		2	3,600	3,600	3,600	3,600	3,600	3,600
		3	31,680	34,200	36,000	38,520	41,040	43,200
		4	5,867	6,333	6,667	7,133	7,600	8,000
		5	25,813	27,867	29,333	31,387	33,440	35,200
	Project Benefit		1,463	2,934	4,106	5,867	7,333	8,800

			1986	1987	1988	1989	1990	1991
Vegetables	W/out Project	1	7.1	7.2	7.3	7.4	7.5	7.6
		2	2,000	2,000	2,000	2,000	2,000	2,000
		3	14,200	14,400	14,600	14,800	15,000	15,200
		4	5,745	5,826	5,907	5,990	6,070	6,150
		5	8,455	8,574	8,693	8,810	8,930	9,050
	With Project	1	7.7	8.3	9.0	9.7	10.3	11.0
		2	2,000	2,000	2,000	2,000	2,000	2,000
		3	15,400	16,600	18,000	19,400	20,600	22,000
		4	6,230	6,716	7,280	7,850	8,335	8,900
		5	9,170	9,884	10,720	11,550	12,265	13,100
	Project Benefit		715	1,130	2,027	2,740	3,335	4,050
Sugarcane (NSE)	W/out Project	1	51.3	52.7	54.0	55.3	56.7	58
		2	290	290	290	290	290	290
		3	14,877	15,283	15,660	16,037	16,443	16,820
		4	2,050	2,110	2,160	2,210	2,270	2,320
		5	12,827	13,173	13,500	13,827	14,173	14,500
	With Project	1	55	60	65	70	75	80
		2	290	290	290	290	290	290
		3	15,950	17,400	18,850	20,300	21,750	23,200
		4	2,475	2,700	2,925	3,150	3,375	3,600
		5	13,475	14,700	15,925	17,150	18,375	19,600
	Project Benefit		648	1,527	2,425	3,323	4,202	5,100
Sugarcane (Out-growers)	W/out Project	1	35.5	36.0	36.5	37.0	37.5	38
		2	290	290	290	290	290	290
		3	10,295	10,400	10,585	10,730	10,875	11,020
		4	2,150	2,180	2,210	2,240	2,270	2,300
		5	8,145	8,260	8,375	8,490	8,605	8,720
	With Project	1	39	43	47	52	56	60
		2	290	290	290	290	290	290
		3	11,310	12,470	13,630	15,080	16,240	17,400
		4	2,470	2,290	2,505	2,775	2,990	3,200
		5	8,840	10,180	11,125	12,305	13,250	14,200
	Project Benefit		695	1,920	2,750	3,815	4,645	5,480

Table 8-3 Yields and Production Costs Proposed for the Newly Reclaimable Lands

Kind of Crops	Yield (tons/ha)								Production Cost (Rs/ha)							
	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year
Paddy	1.0	1.2	1.4	2.0	2.5	3.0	3.5	4.2	1,190	1,430	1,670	2,380	2,980	3,570	4,165	5,000
Soyabeans	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5	1,100	1,320	1,540	1,760	2,200	2,640	2,860	3,300
Groundnuts (shelled)	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5	1,100	1,320	1,540	1,760	2,200	2,640	2,860	3,300
Maize	0.5	0.6	0.7	0.9	1.2	1.4	1.6	1.9	710	850	995	1,280	1,700	1,990	2,270	2,700
Sorghum	0.5	0.6	0.7	1.0	1.3	1.5	1.7	2.0	625	750	875	1,250	1,625	1,875	2,125	2,500
Cowpeas/ grams	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5	740	880	1,030	1,170	1,470	1,760	1,910	2,200
Chillies (dried)	0.5	0.6	0.7	0.9	1.1	1.3	1.4	1.6	2,850	3,420	3,980	5,100	6,230	7,360	7,940	9,060
Red Onions	5	5.5	6.0	7.0	8.0	9.5	10.0	11.0	5,570	6,130	6,690	7,800	8,915	10,585	11,140	12,255
Bombay Onions	5	5.5	6.0	7.5	8.5	10.0	11.0	12.0	3,400	3,670	4,000	5,000	5,670	6,670	7,340	8,000
Vegetables	5	5.2	5.8	7.0	8.0	9.0	10.0	11.0	4,000	4,210	4,700	5,670	6,480	7,290	8.100	8,900
Sugarcane (NSE)	30	32	38	45	55	65	70	80	1,500	1,610	1,710	2,025	2,480	2,930	3,150	3,600
Sugarcane (Out-growers)	20	22	28	30	42	47	50	60	2,000	2,200	1,490	1,860	2,230	2,500	2,650	3,200

Table 8-4 Yields, Unit Prices, GPV, Production Costs and NPV Proposed for the Newly Reclaimable Lands (per ha)

		1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
Paddy	Yield	1.0	1.2	1.4	2.0	2.5	3.0	3.5	4.2
	Unit Price	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240
	GPV	3,240	3,888	4,536	6,480	8,100	9,720	11,340	13,608
	Production cost	1,190	1,430	1,670	2,380	2,980	3,570	4,165	5,000
	NPV	2,050	2,458	2,866	4,100	5,120	6,150	7,175	8,608
Soyabeans	Yield	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5
	Unit Price	4,140	4,140	4,140	4,140	4,140	4,140	4,140	4,140
	GPV	2,070	2,484	2,898	3,312	4,140	4,968	5,382	6,210
	Production cost	1,100	1,320	1,540	1,760	2,200	2,640	2,860	3,300
	NPV	970	1,164	1,358	1,552	1,940	2,328	2,522	2,910
Groundnuts (shelled)	Yield	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5
	Unit Price	6,510	6,510	6,510	6,510	6,510	6,510	6,510	6,510
	GPV	3,255	3,906	4,557	5,208	6,510	7,812	8,463	9,765
	Production cost	1,100	1,320	1,540	1,760	2,200	2,640	2,860	3,300
	NPV	2,155	2,586	3,017	3,448	4,310	5,172	5,603	6,465
Sorghum	Yield	0.5	0.6	0.7	1.0	1.3	1.5	1.7	2.0
	Unit Price	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	GPV	1,000	1,200	1,400	2,000	2,600	3,000	3,400	4,000
	Production cost	625	750	875	1,250	1,625	1,875	2,125	2,500
	NPV	375	450	525	750	975	1,125	1,275	1,500

		1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
Cowpeas/ grams	Yield	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5
	Unit Price	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
	GPV	2,500	3,000	3,500	4,000	5,000	6,000	6,500	7,500
	Production cost	740	880	1,050	1,170	1,470	1,760	1,910	2,200
	NPV	1,760	2,120	2,470	2,830	3,530	4,240	4,590	5,300
Chillies (dried)	Yield	0.5	0.6	0.7	0.9	1.1	1.3	1.4	1.6
	Unit Price	17,600	17,600	17,600	17,600	17,600	17,600	17,600	17,600
	GPV	8,800	10,560	12,320	15,840	19,360	22,880	24,640	28,160
	Production cost	2,850	3,420	3,980	5,100	6,230	7,360	7,940	9,060
	NPV	5,950	7,140	8,340	10,740	13,130	15,520	16,700	19,100
Red Onions	Yield	5	5.5	6.0	7.0	8.0	9.5	10.0	11.0
	Unit Price	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	GPV	20,000	22,000	24,000	28,000	32,000	38,000	40,000	44,000
	Production cost	5,570	6,130	6,690	7,800	8,915	10,585	11,140	12,255
	NPV	14,430	15,870	17,310	20,200	23,085	27,415	28,860	31,745
Bombay Onions	Yield	5	5.5	6.0	7.5	8.5	10.0	11.0	12.0
	Unit Price	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
	GPV	18,000	19,800	21,600	27,000	30,600	36,000	39,600	43,200
	Production cost	3,400	3,670	4,000	5,000	5,670	6,670	7,340	8,000
	NPV	14,600	16,130	17,600	22,000	24,840	29,330	32,260	35,200

		1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
Vegetables	Yield	5	5.2	5.8	7.0	8.0	9.0	10.0	11.0
	Unit Price	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	GPV	10,000	10,400	11,600	14,000	16,000	18,000	20,000	22,000
	Production cost	4,000	4,210	4,700	5,670	6,480	7,290	8,150	8,900
	NPV	6,000	6,190	6,900	8,330	9,520	10,710	11,900	13,100
Sugar Cane (NSE)	Yield	30	32	38	45	55	65	70	80
	Unit Price	290	290	290	290	290	290	290	290
	GPV	8,700	9,280	11,020	13,050	15,950	18,850	20,300	23,200
	Production cost	1,500	1,610	1,710	2,025	2,480	2,930	3,150	3,600
	NPV	7,200	7,670	9,310	11,025	13,470	15,920	17,150	19.600
Sugar Cane (Out-growers)	Yield	20	22	28	35	42	47	50	60
	Unit Price	290	290	290	290	290	290	290	290
	GPV	5,800	6,380	8,120	10,150	12,180	13,630	14,500	17,400
	Production cost	2,000	2,200	1,490	1,860	2,230	2,500	2,650	3,200
	NPV	3,800	4,180	6,630	8,290	9,950	11,130	11,850	14,200

VIII-2: Net Production Values

VIII-2 will consist of the following Tables:

(1) Existing Land

Table 8-5 NPV., Areas and Total NPV of Paddy (w/Project and w/out Project) in the Existing Fields,

Table 8-6 NPV., Areas and Total NPV of Sugarcane (w/Project and w/out Project) in the Existing Fields, and

Table 8-7 NPV., Areas and Total NPV of Subsidiary Food Crops (w/Project and w/out Project) in the Existing Fields.

(2) Newly Reclaimed Land

Table 8-8 Agricultural Benefits in the Newly Reclaimed Lands in Systems D1 and A/D, and

Table 8-9 Agricultural Benefits in the Newly Reclaimed Lands in System D2.

(3) The Whole Project Area

Table 8-10 Moragahakanda Downstream Development Project Benefit.

Table 8-5 NPV., Areas and Total NPV of Paddy (With & W/out the Project) in the Existing Fields

	1986			1987			1988			1989			1990			1991		
	NPV /1	Area /2	Total NPV /3	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV
With Project	4,148	68,310	283,350	5,329	66,850	356,244	5,970	65,280	389,722	6,960	63,850	444,396	7,792	62,110	483,961	8,608	60,660	522,161
W/out Project	3,670	62,684	230,050	3,749	62,604	234,702	3,834	62,537	239,767	3,913	62,456	244,390	4,020	62,387	250,796	4,080	62,317	254,253
Project Benefit			53,300			121,542			149,955			200,006			233,165			267,908

Table 8-6 NPV., Areas and Total NPV of Sugarcane (With & W/out Project) in the Existing Fields

	1986			1987			1988			1989			1990			1991		
	NPV 1	Area 2	Total NPV 3	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV
With Project	13,475	3,400	45,815	14,700	3,400	49,980	15,925	3,400	54,145	17,150	3,400	58,310	18,375	3,400	62,475	19,600	3,400	66,640
W/out Project	12,827	2,890	37,070	13,173	2,890	38,070	13,500	2,890	37,015	13,827	2,890	39,960	14,173	2,890	40,960	14,500	2,890	41,905
Project Benefit			8,745			11,910			15,130			18,350			21,515			24,735

/1 : NPV in Rupees;
/2 : Area in ha;
/3 : Total NPV in Thousand Rupees.

Table 8-7 NPV., Areas and Total NPV of S.F.C. (With & W/out Project) in the Existing Fields

		1986			1987			1988			1989			1990			1991		
		NPV [1]	Area [2]	Total NPV [3]	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV	NPV	Area	Total NPV
Bombay Onions	With Project	25,813	150	3,872	27,867	300	8,360	29,333	500	14,667	31,387	650	20,402	33,440	850	28,424	35,200	1,000	35,200
	W/out Project	24,350	60	1,461	24,933	68	1,695	25,227	75	1,892	25,520	85	2,169	26,107	90	2,350	26,400	100	2,640
	Project Benefit			2,411			6,665			12,775			18,233			26,074			32,560
Red Onions	With Project	24,850	300	7,455	26,300	550	14,465	27,850	780	21,411	28,700	1,000	28,700	30,360	1,280	38,835	31,945	1,500	47,918
	W/out Project	23,700	175	4,148	23,985	193	4,557	24,560	205	5,035	24,850	220	5,467	25,140	235	5,908	25,430	250	6,378
	Project Benefit			3307			9,908			16,376			23,233			32,927			41,540
Chillies (dried)	With Project	13,160	400	5,264	14,420	700	10,094	15,557	1,000	15,557	16,750	1,300	21,776	17,947	1,700	30,510	19,100	2,000	38,200
	W/out Project	12,444	250	3,114	12,560	273	3,391	12,892	290	3,713	12,918	310	4005	13,037	330	4,303	13,160	350	4,606
	Project Benefit			2,153			6,703			11,844			17,770			26,207			33,594
Groundnuts (shelled)	With Project	4,510	150	677	4,861	280	1,361	5,172	400	2,069	5,603	500	2,802	6,034	630	3,801	6,465	750	4,849
	W/out Project	3,789	68	258	4,051	75	304	4,085	80	327	4,181	88	368	4,267	95	405	4,310	100	431
	Project Benefit			419			1,057			1,742			2,434			3,396			4,418
Pulses & Soyabeans, etc.	With Project	2,056	350	720	2,242	600	1,345	2,414	900	2,173	2,465	1,180	2,909	2,824	1,480	4,180	3,037	1,750	5,315
	W/out Project	1,880	250	470	1,922	265	509	1,941	280	543	1,980	300	594	2,020	315	636	2,040	330	673
	Project Benefit			250			836			1,630			2,315			3,544			4,642
Vegetables	With Project [1]	9,170	500	4,585	9,884	880	8,698	10,720	1,300	13,936	11,550	1,680	19,404	12,265	2,110	25,879	13,100	2,500	32,750
	W/out Project [2]	8,455	60	507	8,574	75	643	8,693	80	695	8,810	88	775	8,930	95	848	9,050	100	905
	Project Benefit			4,078			8,055			13,241			18,629			25,031			31,845
S.F.C. Total	With Project																		
	W/out Project																		
	Project Benefit			12,618			33,224			57,608			82,814			117,177			148,317

1 : NPV: Net Production Value in Rupees;

2 : Area in ha'

3 : Total NPV in Thousand Rupees:

(a) Under the Project, vegetables will be grown as post-crops of groundnuts, soyabeans, sorghums, cowpeas/grams, etc. Accordingly, the cropped area of vegetables will equal to those of the latter.

(b) Without the Project, vegetables will continue to be grown as independent crops.

Table 8-8 Agricultural Benefits in the Newly Reclaimed Lands in Systems D1 and A/D (including Kaudulla, Kantalai, MDB Farm and A/D Land)

		Paddy	Sugarcane NSE	Sugarcane Outgrower	Chillies	Sorghum	Cowpeas grams	Red Onions	Bombay Onions	Soyabeans	Ground nuts	Vegetables	Total
1st year	NPV [1]	2,050	7,200	3,800	5,950	375	1,760	14,430	14,600	970	2,155	6,000	
	Area [2]	20,821	2,200	360	20	17	12	6	5	12	8	49	
	Total [3]	42,683	15,840	1,368	119	6	21	87	73	12	17	294	60520
2nd year	NPV	2,458	7,670	4,180	7,140	450	2,120	15,870	16,130	1,164	2,586	6,190	
	Area	20,784	2,200	360	30	28	20	10	6	18	13	79	
	Total	50,974	16,874	1,505	214	13	42	157	97	21	34	489	70,442
3rd year	NPV	2,866	9,310	6,630	8,340	525	2,470	17,310	17,600	1,358	3,017	6,900	
	Area	20678	2,200	360	43	37	25	15	10	23	17	102	
	Total	57,263	20,482	2,387	359	19	62	260	176	31	51	704	83,794
4th year	NPV	4,100	11,025	8,290	10,740	750	2,830	20 200	22,000	1532	3,448	8,330	
	Area	20,604	2,200	360	55	47	32	17	12	32	20	131	
	Total	84476	24,255	2,984	591	35	91	343	264	50	69	1,091	114,249
5th year	NPV	5,120	13,470	9,950	13,130	975	3,530	23,035	24,840	1940	4,310	9,520	
	Area	20,529	2,200	360	65	57	40	20	14	40	24	161	
	Total	105,108	29,634	3,582	853	56	141	462	348	78	103	1,533	141,898
6th year	NPV	6,150	15,920	11,130	15,520	1125	4,240	29 415	29,330	2,328	5,172	10,710	
	Area	20,461	2,200	360	75	67	45	25	15	45	30	187	
	Total	125,835	35,024	4,007	1,164	75	191	685	440	105	155	2,003	169,684
7th year	NPV	7,175	17,150	11,850	16,700	1275	4,590	28,860	32,260	2522	5,603	11,900	
	Area	20,385	2,200	360	87	77	50	30	18	53	35	215	
	Total	146,262	37,730	4,266	1,453	98	230	866	581	134	196	2,559	194,375
8th year	NPV	8,608	19,600	14,200	19,100	1500	5,300	31,795	35,200	2,910	6,465	13,100	
	Area	20,303	2,200	360	100	87	60	33	20	60	40	247	
	Total	174,768	43,120	5,112	1,910	131	318	1,048	704	175	259	3,236	230,781

1 : Net Production Value in Rupees; 2 : Area in ha; 3 : Total Net Production Value in Thousand Rupees.

Table 8-9 Agricultural Benefits in the Newly Reclaimed Lands in System D2 (including Downstream of Parakrama Samudra)

Year		Paddy	Chillies	Sorghum	Cowpeas grams	Red Onions	Bombay Onions	Soya-beans	Ground-nuts	Veget-able	Total
1st year	NPV [1]	2,050	5,950	375	1,760	14,430	14,600	970	2,155	6,000	
	Area [2]	3398	5	4	3	2	1	3	2	12	
	Total NPV [3]	6966	30	2	5	29	15	3	4	72	7124
2nd year	NPV	2,458	7,140	450	2,120	15,870	16,130	1164	2,586	6,190	
	Area	3373	8	7	6	3	2	5	4	22	
	Total NPV	8291	57	3	13	48	32	6	10	136	8598
3rd year	NPV	2,866	8,340	525	2,470	17,310	17,600	1358	3,017	6,900	
	Area	3356	10	10	7	4	2	7	5	29	
	Total NPV	9618	84	5	17	69	35	10	15	200	10053
4th year	NPV	4,100	10,740	750	2,830	20,200	22,000	1552	3,448	8,330	
	Area	3341	14	12	8	4	3	8	6	34	
	Total NPV	13698	150	9	23	81	66	12	21	283	14303
5th year	NPV	5,120	13,130	975	3,530	23,085	24,840	1940	4,310	9,520	
	Area	3321	17	15	10	5	3	10	7	42	
	Total NPV	17004	223	15	35	115	75	19	30	400	17916
6th year	NPV	6,150	15,520	1125	4,240	27,415	29,330	2328	5,172	10,710	
	Area	3300	20	18	12	6	4	12	8	50	
	Total NPV	20295	310	20	51	164	117	28	41	536	21542
7th Area	NPV	7,175	16,700	1275	4,590	28,860	32,260	2522	5,603	11,900	
	Area	3284	23	20	13	7	4	13	10	56	
	Total NPV	23563	384	26	60	202	129	33	56	666	25119
8th Area	NPV	8,608	19,060	1500	5,300	31,745	35,200	2910	6,465	13,100	
	Area	3268	25	22	15	8	5	15	10	62	
	Total NPV	28131	477	33	80	254	176	44	65	812	30072

1 : Net Production Value in Rupees; 2 : Area in ha; 3 : Total Net Production Value in Thousand Rupees.

Table 8-10: Moragahakanda Downstream Development Project Benefit

(in Thousand Rupees) (in Financial Prices)

Year	Existing Fields	Newly Reclaimed Lands		Whole Project Area
		Systems D1 & A/D	System D2	
1986	67,197			67,197
1987	150,008	60,520		210,528
1988	200,424	70,442	7,126	277,992
1989	271,053	83,794	8,596	363,443
1990	334,673	114,249	10,053	458,975
1991	396,866	141,898	14,343	553,107
1992	396,866	169,684	17,916	584,466
1993	396,866	194,375	21,562	612,803
1994	396,866	230,781	25,119	652,766
1995	396,866	230,781	30,072	657,719
1996	396,866	230,781	30,072	657,719

VIII-3: Agricultural Manpower Training

(1) Outline of the Proposed Training Project

(a) Introduction

MDB's Training Farm plan is to provide a 100 ac Farm under the year-round irrigation and dormitory facilities on behalf of about 120 youngmen so to give them chance to engage at cultivation of paddy (during Maha) and subsidiary food crops (during Yala), under the circumstances similar to those currently prevailing in the Mahaweli Area; after one year experience they will be qualified as KVS, and/or agricultural development workers primarily meant for extension services being attached to other institutions, in the Mahaweli Area.

However, the irrigated agriculture, to be a success, needs an overall attention and care which cannot be confined to the practical agronomic know-how and its extension alone, but methods of organising, operation and management of the farmer services such as rural credit, input supply and marketing also. It is essential, therefore, that the trainees will be given lessons, both theoretical and practical, on the minimum necessary scientific knowledge and its application, for instance, botany and plant pathology including optimal application of irrigation water, fertilizers and agro-chemicals; veterinary medicine for upkeeping and multiplying draught animals and poultry; mechanism of farm machinery including their operation and maintenance; civil engineering called for irrigation/drainage, etc. At the same time, they need to be taught about the proper function and operation of rural credit and savings together with their coordination with rational distribution of input supplies and their link-up with marketing services.

For this purpose, the original MDP plan should be substantially expanded. The Training Farm-turned-Rural Development Training Centre would require permanent lecturer-cum-demonstrators on those subject-matters of additional lessons to be introduced in RDTC, lecture-rooms and workshops as well as teaching aids and other relevant facilities, machinery and vehicles, etc.

(b) Concept of the Rural Development Training Centre

Rural Development Training Centre, whose establishment has been designed on the concept of the MDB's Training Farm plan, will be one of the tripartite scheme being incorporated with the Pilot Project and the Integrated Rural Development Project (IRDP), and is intended for bringing up two kinds of development staff: one is the junior staff with one year integrated training who has been referred to as the Farm Guidance Worker (FGW) and the other is the intermediate staff (members of the Agrarian Service Team or AST) who undergo 2.5 years' training in addition to FWG training.

Some 150 youngmen with the minimum necessary qualifications, preferably from the Mahaweli Program area, Moragahakanda Project area in particular, would be admitted into RDTC for integrated training for one year. About half of the trainees (70-75) would be sent out as so many FGW immediately upon completing this one year course, while the remaining half (70-75) would be given additional 6 months' intensive course which is divided into seven different classes, each consisting of 10, of (i) water management, (ii) agronomy, (iii) farm mechanization, (iv) livestock (and poultry), (v) rural credit, (vi) input supply and marketing, and (vii) community development.

(2) RDTC's Pilot Project

(a) Purpose of the RDTC's Pilot Project

This Pilot Project would be staged in about 500 ha year-round irrigable area situated preferably nearby the Rural Development Training Centre for configurative rural development activities as taught in RDTC. The area identified as for the Pilot Project will be equipped with good infrastructure including land consolidation, irrigation/drainage facilities and others.

Under these circumstances, the farmers who have been already cultivating or newly settled there would be trained in the optimal farm management practices including high-level water management/control and cultivation of paddy and other possible crops - from the land preparation and nursery stage through post-harvest stage.

(b) Field Training on Behalf of the AST Members

Those candidate-trainees for AST members who would have successfully completed the 6 months' specialized training in RDTC would be sent, in 10 batches of 7 - one from each of 7 different classes - to the Pilot Project for one year field training.

(3) Integrated Rural Development Program

IRDP Model Area would cover the rural community where 2,000 to 3,000 farmhouseholds are actually engaged in farm production. IRDP in this Model Area would be centred around the following:

(i) Strengthening of the resident farmers' organizations and rural institutions and creation of any other voluntary units as desired;

(ii) Acceleration of agricultural productivity increase among the resident farmers by encouraging them to follow the farm management methods as successfully adopted in the RDTC's Pilot Project area, through the coordinated provision of rural credit, input supply, extension and marketing services through the strengthened farmer organizations;

(iii) Mobilization of local youngmen and young women for joint activities aimed at community development;

(iv) Safeguarding of the 'Owner Farmer Establishment Policy' of the Government of Sri Lanka by preventing undesirable socio-economic stratification and alienation of cultivation-rights from respective allottees of the farmland, through liquidation of rural indebtedness by providing debt liquidation credit from a Special Fund to be established in the Central Bank of Ceylon, and

(v) General upliftment of the farmers' living standards.

The candidate-trainees for AST members who would have undergone one year field training in the Pilot Project would be transfered to this IBDP Model Area for another year's initiation training. After this, we shall have 10 Teams of full fledged Agrarian Service staff.

VIII-4: Settlement

(1) Planning Approach

a) Settler Selection

The basis for selection of settlers into the newly reclaimable lands has been discussed in 6.4.2 Settlement Policies in the Main Report where the broad principle of selection based on social need being felt in the project area is recommended.

b) The Pattern and Hierarchy of Settlement

The MDB standards have been broadly adopted as for the pattern and hierarchy of settlement.

c) Standards for Infrastructure and Facilities

The MDB current policies for the provision of facilities have been generally followed.

(2) Settlement Policies

a) The Process and Phasing of Settlement

The British Victoria Team's recommendations as regards the process and phasing of settlement are broadly acceptable by the JICA's F/S Team on the Moragahakanda Project. Instead of bringing in settlers just three months before the availability of water, a gradual placement of settlers and utilizing them as members of a direct labour group for area development seems to be a wise idea. From one-half to three-quarters of the selected settlers would be brought into the new land as labour force for land development and preparation of the basic infrastructure of the settlement area.

For this purpose, the Village Service Centre would have to be constructed as the first element after the access road is completed, together with the primary school or the primary education unit to provide them temporary accommodation and basic amenities of living.

(3) Building, Equipment and Infrastructure Requirements

a) Land Clearance

Quantitative aspect of land clearance for both the farming plots and housing plots has been dealt under 'Downstream Development Construction Plan'.

b) Project Management Units, Agricultural and Social Infrastructure

Standards have been shown in the relevant Tables included in the Main Report, and their unit construction costs will be given in the attached Table 8.12.

Table 8.12 Costs of Building, Equipment and Infrastructure

		Unit Cost (Rs. million)	Foreign Exchange %
(1)	Project Management Unit:		
(a)	Office		
	Production Circle Office	0.17	
	Production District Office-cum-Agricultural Service Centre	0.3	30
	Production Zone Office	0.27	
	Project Management HQ	0.4	
	RDTC + PP + IRDP	3.0	40
(b)	Vehicles		
	Jeeps	0.14	96
	Motor Cycles	0.014	86
	Bicycles	0.0006	90
(c)	Staff Housing (prefabricated)		
	FGW Quarters (12 bed unit)	0.16	
	AST Quarters (10 bed unit)	0.2	
(2)	Agricultural Infrastructure		
(a)	Paddy Handling		
	Village Hullers	0.365	86
	Paddy Store	0.06095	30
(b)	Cooperative		
	Co-op. Depot or Butique	0.063	
	Branch Co-op.	0.078	
	Primary MPCS	0.232	
	Fertilizer Store	0.129	
	Lorries	0.19	97
(c)	Market Areas	0.1	
(3)	Social Infrastructure		
(a)	Cultural		
	Village Service Centres	0.257	
	Township Cultural Centres	0.25	
(b)	Education		
	Primary Education Units	0.215	
	Senior Secondary Education Units	1.065	

		Unit Cost (Rs. million)	Foreign Exchange %
(c)	Health		
	Visiting Dispensary	0.070	30
	Central Dispensary/Maternity Wards	0.238	
(d)	Postal		
	Post Box	0.0001	
	Sub Post Office	0.061	
	Post Office	0.195	
(e)	Administrative		
	Town Council Office	0.2	
	Police Station	0.626	

VIII-5: Alternative Development Plan of the Kantalai Downstream

1. Background

Sri Lanka relies very heavily on sugar imports at the level of annual imports of 246,000 tons (1968-1973 average). This was reduced to 209,000 tons in 1976, due to a sharp rise of sugar price in the world market. Yet this stands for per-capita sugar intake of about 6 kg/year which is far below the recognizable minimum nutritional requirement of 10.35 kg/capita/year. Climates and soils being originally suitable for sugarcane cultivation, it is not only desirable but necessary to encourage domestic production of sugar in Sri Lanka.

2. Present Condition of Kantalai Sugar Factory

The existing factory, which is claimed to have been equipped with cane crushing capacity of 1,200 tons/day, started operation since 1960. To supply material cane for optimal operation of the factory, about 2,200 ha of land was reclaimed as sugarcane plantation, out of some 3,000 ha. The results so far obtained may be summarized as follows:

1)	Original capacity	1,200 MT/day	
2)	Actual working capacity	600 "	
3)	Maximum cane harvested area (1977)	4,908 ac	
		(3,558 ac - planted)	
		(1,350 ac - ratooned)	
4)	Maximum production of cane (1974)	102,343 MT	
5)	Average yield of cane/ac	21,5 MT	(53.8 MT/ha)
6)	Maximum sugar produced (1978)	9,946 MT	(average annual production being 9,000 MT)
7)	Average sugar extraction ratio	9%	

The following causes and reasons are attributable to this poor performances:

i) The factory has not been operated adequately due to shortage of spare parts and difficulty of repairing because of a lack of uniformity in model or type of machinery and equipment;

ii) Low sugar cane yield due to serious shortage of irrigation water, inadequate supply of agricultural inputs and shortage of labour inspite of high wages.

Abnormality of the performance of Kantalai Sugar Project derives from a complex of low yield of sugarcane plantation on the one hand, and poor operation of the factory, on the other. As a normal yield of sugarcane would be 34 ton/ac, 5,500 ac (2,200 ha) should produce about 187,000 tons, while the Kantalai case resulted at 21 ton and 4,800 ac, respectively. The optimal case of a sugar factory would be: utilization ratio 95%; working days, 180 days of a year; and the sugar extraction ratio, 10%. Kantalai resulted at 50%, 164 days and 9%, respectively.

Kantalai could have attained the following performance:
Original capacity 1,200 tons/day x 0.95 = 1,140 tons/day
1,140 tons x 0.1 = 114 tons day x 164 Days = 18,700 tons/year (sugar)
187,000 tons of sugarcane = 5,500 ac x 34 tons

This shows that the current sugar production could have been doubled from 9,000 MT/year to 18,700 MT/year, out of the sugarcane harvestable from the present plantation extending over 5,500 ac, provided that the cane crushing capacity could recover its normal operating capacity of 95% of the installed plant and an average sugar extraction ratio of 10%, on the sugar factory side, and the cane yield of 34 tons/ac, on the plantation side.

3. Future Expansion Plan of Kantalai Sugar Project

The Kantalai Stage II Sugar Project involves investment to increase the production of sugar to 25,000 MT (maximum 27,000 MT) per year, against the present production of 9,000 MT, by expanding the factory capacity to 2,500 MT/day instead of 1,200 MT at present and the reclamation of a new land of 9,500 ac (3,800 ha), in addition to 5,500 ac (2,200 ha) of Stage I. It is proposed to provide an additional capacity of 1,300 MT/day, after doing all the best to recover rull capacity of the existing factory, to make a total capacity of 2,500 MT. Expansion of the factory capacity and the plantation size is not an easy job and will require a very careful and in-depth survey, which will also cover the adequacy of developing 2,800 ha sugarcane area, 400 ha of which under the outgrower system and diverting 1,000 ha out of the total 3,800 ha into paddy/paddy area, as suggested in 'Conclusions and Recommendations' in the concluding part of this Annex.

4. Production of Sugarcane by Combination of Plantation and Small Holdings

International experiences give us an assurance of its success if the undermentioned care would be taken in right earnest :

1) Irrigability of the cane fields;
2) Provision of technical assistance including input supply of seedlings, fertilizers, agro-chemicals and others as well as ploughing services with 4-wheel tractors and transportation service of the harvested cane to the factory-site, by the factory management, and
3) Determination of cane price not unfavourable to the outgrowers and liquidation of all factory service charges from the sales price on the outgrowers' delivery of their produce.

5. Conclusions and Recommendations

In the downstream of the Kantalai Tank, Sri Lanka Sugar Corporation is planning to develop, on and above the current 2,200 ha sugar cane plantation area, an additional 3,800 ha as Stage II program, and its cost has been estimated. Judging from the nature of soils, however, about a quarter of the land (1,000 ha) which is proposed for sugarcane plantation would be more suitable for paddy/paddy. Furthermore, learning from the poor performance of sugarcane production in the present 2,200 ha plantation area which is very much due to shortage of available labour and which is partly responsible for the low rate of the sugar factory operation, it is proposed under this Project to introduce the 'outgrower system' of sugarcane production in 400 ha out of 2,800 ha land which is believed to be precisely suitable for sugarcane production. Consequently, the 3,800 ha in the downstream of the Kantalai Tank would be devoted for different kinds of farming as follows:

2,400 ha	..... Sugarcane plantation
400 ha	..... Outgrowers' sugarcane farm, and
1,000 ha	..... Paddy/paddy cultivation
3,800 ha	

400 ha outgrowers' sugarcane farm would be combined with 100 ha paddy/paddy area to be distributed among 500 newly settling families at the rate of 0.8 ha for outgrowing of sugarcane and 0.2 ha for paddy/paddy cultivation, per family. The remaining 900 ha paddy/paddy land would be allocated among 900 settlers. The total strength of the settling families would, therefore, be about 1,400. Their number has been tentatively estimated at 1,260,

because of the uncertainty of the border-line between the sugar producing area and paddy/paddy area.

It is very difficult to visualize at present how best to combine the sugar factory capacity and sugarcane production in future, without undertaking a specific survey, which we propose to be carried out by the qualified experts as mentioned below:

Formation of the Survey Team:

a.	Irrigation Engineer	1
b.	Civil Engineer	1
c.	Sugar Plant Expert	1 (Machinery)
d.	Sugar Plant Expert	1 (Process and chemical)
e.	Sugar Plantation/Agronomist	1
f.	Field Equipment Expert	1
g.	Factory Management & Development	1
h.	Economist	1 (Economic evaluation)
		8

Additionally, each one expert for Finance/Accounting and Training Planning would be desirable to guarantee technoeconomic viability of the project.

Consultants' Services (After Appraisal)

Irrigation and Civil Engineering	38 man-months	(24 x 2)
Plantation and Farm Management	48 "	(24 x 2)
Factory	96 "	(12 x 8)
Management	24 "	(12 x 2)