water through the main canal but subsistence water for consumption by villagers and livestock industry, and the plan is so worked out as to take into due consideration the above roles.

4.2.2 Water Requirement

(1) The diversion requirement can be estimated using the data obtained through the field investigations, such as the meteorological data, the field water requirements, the conveyance efficiency of canals, and the proposed cropping pattern.
Taking into account the amount of evapo-transpiration from soils and plants, the water requirement for land preparation, the farm loss consisting of percolation and surface run-off, the rainfall and conveyance efficiencies, the water requirements can be calculated on the formula below.

- Crop Water Requirement (ETc)
  = Reference Crop Evapo-transpiration (ETO) x Crop Factor (Kc)

- Field Water Requirement (FWR)
  = ETc + Water Requirement for Land Preparation (LP) + Farm Loss (FL) --- for Lowland

  = ETc + LP --- for Up

- Field Irrigation Requirement (FIR)
  = FWR - Effective Rainfall (Pe) --- for Lowland

  = (FWR - Pe)/Application efficiency (Ea) --- for Upland

- Diversion Requirement (DR)
  = FIR/Conveyance efficiency (Ec)

(2) Crop Water Requirement

Reference crop evapo-transpirations are estimated by the modified Penman-method using the meteorological data at Girandrukotte, shown in Annex Table 5.2.1. The monthly reference crop evapo-transpirations are illustrated in Annex Fig. 5.2.1. The total amount of reference crop evapo-transpiration for each season are estimated as 749 mm in Maha and 1,025 mm in Yala. Crop factors for each growth stage are shown in Annex Table 5.2.2, which has been prepared by the Irrigation Department.

Yala Season

Crops	Growing Periods	Cropping Area	Starting Dates
Paddy	105 days	4,275 ha	11 April
Chilli	150 "	916 "	1st April
Pulse	105 "	916 "	11 May

Maha Season

Crop	Growing Period	Cropping Area	Starting Dates
Paddy	135 days	6,107 ha	26 Sept.

(3) Water Requirement for Land Preparation

Water requirements for land preparation have been taken as 12 mm/day for low land and 2.5 mm/day for up land, in terms of the Irrigation Department Design Notes.

(4) Farm Loss

The farm loss consist of surface run-off from the farms, deep percolation depending on the type of soil and

leakage from dykes. The farm loss for low land is taken as 6 mm/day from the results of the site investigation referred to para 3.6.3. The application efficiency is taken as 50% for upland farm loss.

(5) Effective Rainfall

The effective rainfall can be culculated on the following formula, taking into account such factors as lowland, upland, daily rainfall and monthly rainfall.

Daily Rainfall

For lowland: Effective rainfall (Pe)
= Rainfall (R) x 0.8 where, 5 mm < R < 80mm

For upland : Pe = 0.8 x P

Monthly Rainfall

For lowland: Pe = 0.67 x (R - 25.4)
where, Pe = 0, when P is less than 25.4 mm
Maximum effective rainfall is 229 mm

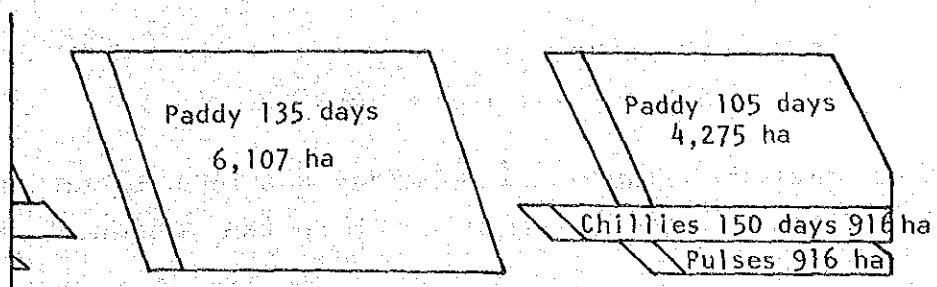
For upland : Pe = 0.67 x (R - 6.4)
Where, Pe - 0, when P is less than 6.4 mm
Maximum effective rainfall is 76 mm

(6) Field Irrigation Requirement

The maximum field water requirement are 13.13 mm/day in Maha and 10.6 mm/day in Yala as shown in Fig. 4.2.1. The field irrigation requirement is estimated as 11.43 mm/day in Maha and 10.6 mm/day in Yala, taking into account effective rainfall of 1.7 mm/day and 0 mm/day respectively.

The above field water requirements have been calculated for the proposed cropping pattern in the final target year, six years after completion of civil works. At present, almost all the area in Minipe Scheme has been cultivated for paddy except only small areas for subsidiary food crop in Stage III and Stage IV.

CROPPING PATTERN



FIELD WATER REQUIREMENT (FWR)

Total FWR in Maha Season --- 1,648 mm

Total FWR in Yala Season --- 1,273 mm

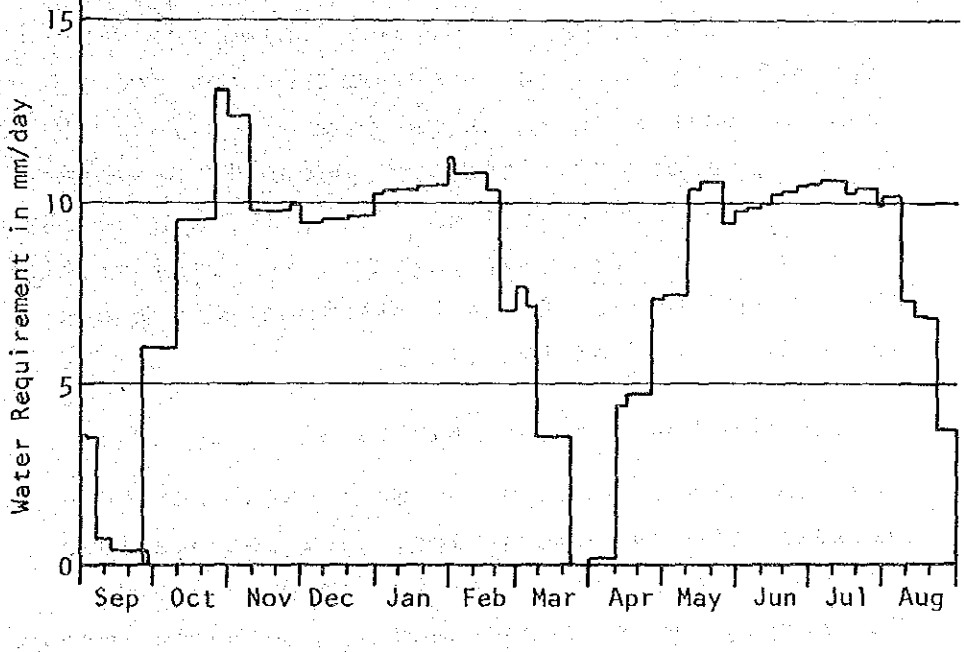


Fig.4.2.1 FIELD WATER REQUIREMENT FOR PROPOSED CROPPING PATTERN

The field water requirement is estimated as 12.8 mm/day for paddy cultivation of the entire irrigable extent in July, i.e.

$$FWR = ETO \times KC + FL$$
$$= 5.7 \times 1.2 + 6.0 = 12.8$$

So a maximum value of 12.8 mm/day has been taken as the field irrigation requirement in the design.

(7) Conveyance Efficiency and Diversion Requirement

Irrigation water diverted from the head sluice gets reduced in quantity by leakage, seepage and evaporation before it reaches the fields. Conveyance efficiency is used to explain the deducting ratio of the above losses.

i) Conveyance Efficiency in the D-canal

The conveyance efficiency in the D-canals has been calculated for the design, using the values obtained by the field investigation and the standard values shown in Annex Table 5.2.5. The conveyance efficiency for D-canals has been taken as 70% in Stage I and Stage II, and as 65% in Stage III and Stage IV, taking into consideration the effectiveness of the tanks located between the main canal and the fields.

ii) Conveyance Loss in the Main Canal

The conveyance loss in the main canal can be divided into two categories, i.e. seepage loss and operation loss, as stated in para 3.6.3. The seepage loss is obtained by the Moriz formula. The Moriz coefficient for the planning stage is taken as the same value as under the present conditions. The basic seepage losses along the canal would be no different as between the period

before, and the period after the proposed rehabilitation since almost identical conditions on the ratio of wetted perimeter and embankment materials would apply in both periods. The operation loss has been estimated as 0.02 cu.m/sec/km under present conditions as stated in para 3.6.3, but can be reduced to 0.01 cu.m/sec/km by good water management.

iii) Diversion Requirements at the head of D-canals

The diversion requirements at the head of D-canals have been taken as 2.15 l/sec/ha in Stage I and Stage II, and 2.3 l/sec/ha in Stage III and Stage IV from the above study.

4.2.3 Water Balance

(1) Irrigation Demand in Yala

Diversion requirements for 6,107 ha in Yala season were calculated on the basis of proposed cropping pattern by using the available data for last 9 years.

IRRIGATION DEMAND IN YALA SEASON

Unit : '000 cu.m

YEAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1976	5,851	31,101	33,147	30,047	21,153	3,667	124,966
1977	4,957	27,709	33,147	33,144	23,421	0	122,378
1978	2,776	27,055	33,147	34,824	23,552	2,532	123,886
1979	6,244	30,239	33,136	30,189	22,058	0	121,866
1980	1,860	29,945	31,925	35,282	22,516	2,609	124,137
1981	8,523	20,359	33,149	25,609	22,636	809	111,083
1982	9,363	24,612	33,147	35,042	21,709	1,922	125,795
1983	11,479	29,999	33,027	30,462	23,552	1,409	129,928
1984	6,898	31,057	33,147	26,078	22,210	0	119,390
						average	122,603

An analysis of the extent cultivated during Yala, namely the basis for 1,000 ha increased cultivation, is given in Fig. 4.2.2 and Annex Table 5.2.8.

(2) Water Availability

(i) Water Source

In Minipe Scheme, irrigation water depends mainly on the Mahaweli River except of inflows from a medium and several small catchment areas along the main canal. Therefore, water availability in the Scheme can be said to rest with operation policies under the whole Mahaweli Development Programme.

Regarding these policies, the Water Management Secretariate under the Ministry of Mahaweli Development indicated that "Studies of Operation Policy Option (SOPO); Draft Final Report January, 1985" was the latest and most reliable among various studies.

Minipe Scheme (System E) was dealt with the following basic policies and future plan.

(ii) Operation Policy (In SOPO)

The Mahaweli River downstream of the Polgolla Barrage, including irrigation Systems A, B, C and E, was modeled as a separate subsystem. The Randenigala and Victoria reservoirs were initially modeled using the same storage zone penalty structure. This structure was subsequently varied to examine drawndown priorities for these two reservoirs.

The priorities that were assigned to meeting the irrigation system demands are as follows.

Irrigation System	Constraints Considered	Relative Priority
System E (Minipe Area)	No storage available within irrigation system	1
System A	No storage available within irrigation system	2
System B	Transbasin canal and link tunnel constrain flow to sytem	3
System C	Transbasin canal constrains flow to system	4

Operational Characteristics - Systems D, G and E

Feature or Irrigated Area	Net Irrigated Area (ha)	Canal Capacity (m 3/sec)	Live Storage Capacity (MCM)
System G	3,600	-	-
System D_1- Giritale	3,000	7.1	23
System D_1- Minneriya	8,900	12.2	136
System D_1- Kaudulla	4,500	13.3	114
System D_1- Kantalai	9,300	17.0	157
Angamedilla Diversion	-	14.2	-
System D_2- Parakrama Samudra	10,100	14.2	116
System E - Minipe LB	6,100	17.0	-

ANTICIPATED IRRIGATION SYSTEM RELIABILITY

Irrigation System	Irrigation Water Use Case A				Irrigation Water Use Case B			
	Cropping Intensity	Yala Irrigation Demand	No. of Years* with deficits Greater Than		Cropping Intensity	Yala Irrigation Demand	No. of Years* with Deficits Greater Than	
		MCM	5%	10%		MCM	5%	10%
A	2.0	117	0	0	2.0	99	0	0
B	2.0	751	0	0	2.0	636	0	0
C	2.0	429	0	0	2.0	348	0	0
D1 & G	2.0	448	4	2	2.0	383	4	0
D2	2.0	137	0	0	2.0	120	0	0
E	2.0	130	0	0	2.0	108	0	0
H	2.0	544	32	32	2.0	468	29	20

Notes: * A simulation period of 32 years was used in the studies

(iii) Review of the basic parameters

The basic policy on the priority among the lower basin areas and the basic parameters were justified excepting Yala irrigation demand in case B & C. The Ministry of Mahaweli Development should assure irrigation water of 130 MCM (case A) in Yala season from the Mahaweli River to the Minipe Area (System E).

	Rehabilitation Scheme	SOPO
Benefited Area	6,107 ha	6,100 ha
Main Canal	16.4 m^3/s	17.0 m^3/s
Yala Irrigation Demand	123 MCM (average)	130 MCM (case A) 108 " (case B,C)

4.2.4 Water Distribution

(1) Irrigation Method

Intermittent irrigation has been adopted at present in Stage I, Stage II and Stage III. This above method could serve a useful purpose in areas affected by the shortage of irrigation water provided the paddy lands in the area have a low percolation value. But in the well drained paddy lands consisting of silty loam or sandy clay, found over the Minipe Area, this method is considered to be ineffective. Furthermore, the water source for the Minipe Area from the Mahaweli River and the Heen Ganga, could become more stable after the rehabilitation of the irrigation facilities. Therefore, the continuous irrigation method would be better suited to the irrigation system in the Minipe Area.

(2) Design Discharge in the Main Canal

The canal discharges for each section have been calculated on the basis of the diversion requirement determined in terms of para 4.2.2 and on the footing that continuous irrigation would be provided for the whole irrigable extent in the area. The canal discharges for each section are shown in Table 4.2.1 and Fig. 4.2.2. Where the turnouts to the D-canal are divided into groups, the areas of authority assigned to the water distributors and the command areas of D-canals have been taken into consideration.

The intake discharge of 16.4 cu.m/sec from the Minipe Anicut and the intake discharge of 3.0 cu.m/sec from the Heen Ganga diversion weir in addition are required to supply water to the whole area 6,107 ha subject to discharge fluctuation at the intake.

The cross-sections of the main canal in Stage III and Stage IV are required to keep enough discharge to fill

Table 4.2.1 CANAL DISCHARGE IN FUTURE PLAN

MINIPE MAIN CANAL * * WATER BALANCE EVALUATION * * CASE 3 FUTURE CONDITION

MORITZ COEFFICIENT -- 1.200 DETERIORATION LOSS - 0.010 CU.M/SEC/KM
INTAKE DISCHARGE FROM MINIPE ANICUT -- 16.400 CU.M/SEC
STATION OF HEEN GANGA JOINT POINT -- 49.000 KM DISCHARGE -- 3.000 CU.M/SEC

STATION IN KM	UNDER D-CANAL NUMBER	UNDER D-CANAL ACREAGE IN HA	UNDER TANK NUMBER	UNDER TANK ACREAGE IN HA	DIVERSION WATER TO D-CANAL IN L/S/HA	DIVERSION WATER TO D-CANAL IN CU.M/S	MAIN CANAL DISCHARGE IN CU.M/S	MAIN CANAL VELOCITY IN M/S	SEEPAGE LOSS IN CU.M/S	SEEPAGE LOSS IN PERCENT/KM	DETERIORATION LOSS IN CU.M/S	DETERIORATION LOSS IN PERCENT/KM
0.000	MINIPE IN	0.000	* * *	0.000	0.000	0.000	16.400	1.000	0.000	0.000	0.000	0.000
8.450	D1 - D12	283.000	NIL	0.000	2.150	0.608	15.233	1.000	0.474	0.355	0.084	0.063
12.450	D13 -D19C	268.000	NIL	0.000	2.150	0.576	14.401	1.000	0.216	0.365	0.040	0.067
15.180	D20 -D24C	217.000	NIL	0.000	2.150	0.467	13.760	0.950	0.147	0.383	0.027	0.071
17.030	D25 - D28	213.000	NIL	0.000	2.150	0.458	13.165	0.650	0.118	0.473	0.019	0.074
21.650	D29-D33AD	197.000	NIL	0.000	2.150	0.424	12.408	0.650	0.288	0.487	0.046	0.078
24.100	D34A-D38A	208.000	NIL	0.000	2.150	0.447	11.788	0.650	0.148	0.500	0.025	0.083
27.420	D39 - D46	344.000	NIL	0.000	2.150	0.740	10.815	0.620	0.200	0.534	0.033	0.088
29.990	D47 - D49	180.000	NIL	0.000	2.150	0.387	10.253	0.620	0.149	0.549	0.026	0.095
33.220	D1 - D3	86.000	NIL	0.000	2.150	0.185	9.854	0.620	0.182	0.560	0.032	0.099
33.830	D4	164.000	NIL	0.000	2.150	0.353	9.462	0.620	0.034	0.572	0.006	0.104
35.800	D5 - D8	233.000	NIL	0.000	2.150	0.501	8.835	0.620	0.107	0.591	0.020	0.109
38.100	D9 - D13	185.000	NIL	0.000	2.150	0.398	8.294	0.620	0.120	0.610	0.023	0.117
42.450	D14 - D24	270.000	NIL	0.000	2.150	0.581	7.449	0.620	0.220	0.643	0.044	0.127
44.100	D25 -D27A	386.000	NIL	0.000	2.150	0.830	6.521	0.580	0.082	0.710	0.016	0.143
47.450	D28B- D30	169.700	WEWARA W	94.300	2.150	0.568	5.764	0.580	0.156	0.756	0.034	0.163
49.000	D31 - D34	201.000	NIL	0.000	2.150	0.432	5.246	0.530	0.071	0.830	0.015	0.182
53.430	D35 - D42	97.000	3 MINOR I	121.000	2.300	0.501	7.476	0.620	0.224	0.642	0.044	0.127
53.610	D43	268.000	MAHAWATEN	170.000	2.300	1.007	6.458	0.580	0.009	0.714	0.002	0.144
55.620	D44 - D47	110.000	NIL	0.000	2.300	0.253	6.092	0.580	0.093	0.736	0.020	0.159
58.200	D48 -D51B	56.000	NIL	0.000	2.300	0.129	5.822	0.580	0.116	0.753	0.026	0.168
61.030	D52 - D55	70.000	NIL	0.000	2.300	0.161	5.503	0.530	0.130	0.811	0.028	0.177
64.210	D56 - D57	212.000	DEVAGIRI	375.000	2.300	1.350	3.979	0.530	0.142	0.941	0.032	0.211
68.250	D58 - D59	20.000	KARAUGAHA	259.000	2.300	0.642	3.134	0.470	0.163	1.133	0.040	0.281
71.400	D1 - D2	159.000	NIL	0.000	2.300	0.366	2.624	0.470	0.113	1.242	0.032	0.347
72.020	D3	271.000	NIL	0.000	2.300	0.623	1.974	0.470	0.020	1.423	0.006	0.435
73.290	FC 76	35.000	TUNGIRIYA	163.000	2.300	0.455	1.466	0.380	0.040	1.835	0.013	0.581
74.190	FC 82	22.000	NIL	0.000	2.300	0.051	1.382	0.380	0.024	1.910	0.009	0.702

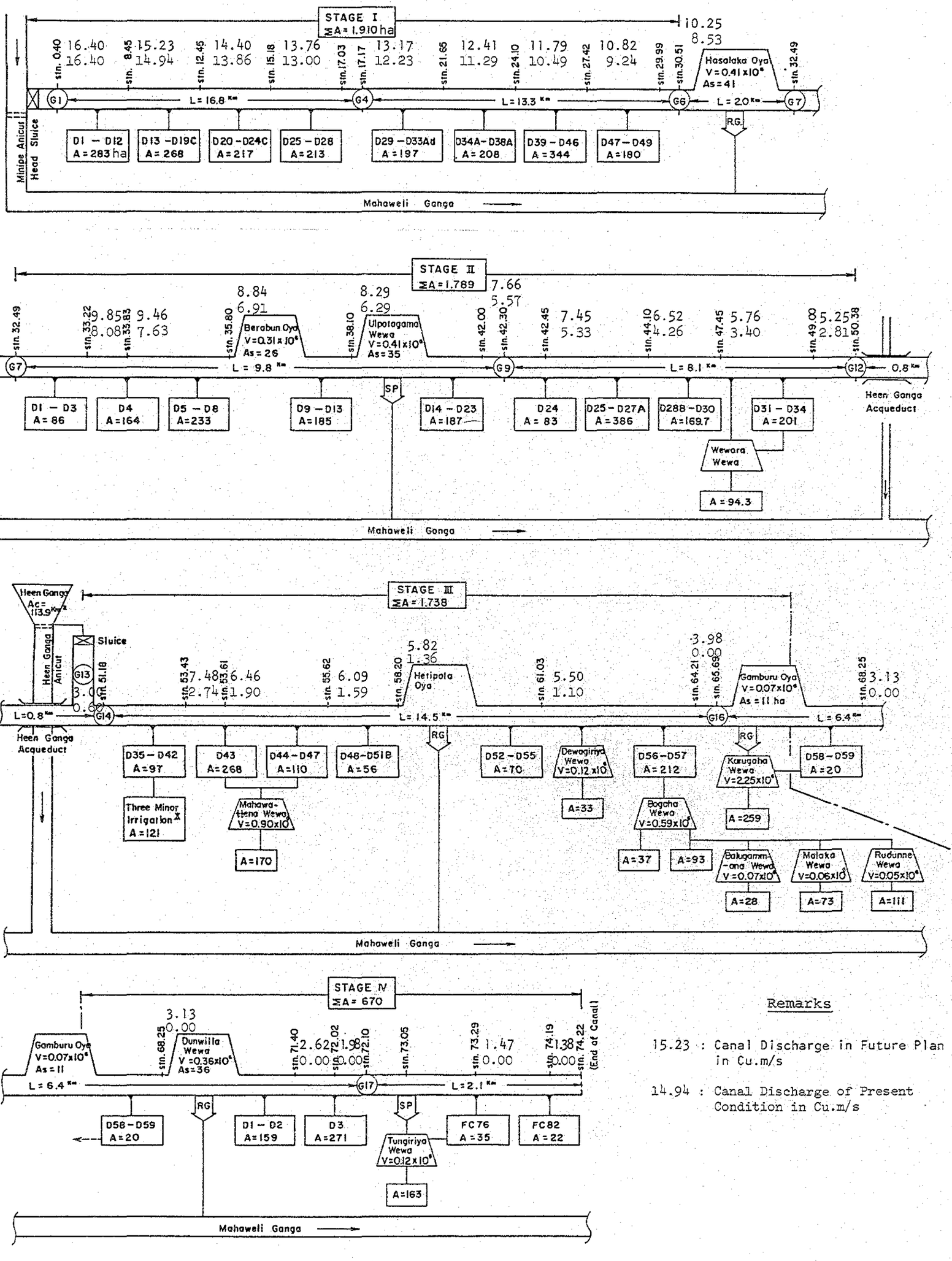


Fig. 4.2.2 CANAL DISCHARGE IN MAIN CANAL

Remarks

15.23 : Canal Discharge in Future Plan in Cu.m/s

14.94 : Canal Discharge of Present Condition in Cu.m/s

with all the tanks in Stage III and Stage IV within ten days at the end of Maha. The net water requirement is estimated as 4.8 cu.m/sec under such conditions on the base of the total net capacity of 4.16 million cu.m. The main canal discharge at the beginning of Stage III is estimated at 7.5 cu.m/sec, taking into account the conveyance efficiency in the main canal and D-canals.

The canal discharges in the future plan are illustrated in Table 4.2.1 and in Fig. 4.2.2, upper figures are designed discharge and lower ones are present discharge when all turnouts are kept open. From the above study, the design discharge of the main canal is given in Table 4.2.2.

Table 4.2.2 CANAL DISCHARGE OF MAIN CANAL

Station in km	Discharge in cu.m/s
0.00 - 17.53	16.40
17.53 - 29.90	13.50
29.90 - 42.03	10.50
42.03 - 49.00	8.00
49.00 - 68.25	8.00
68.25 - 74.20	3.50

(3) Design Discharge of D-canals

The design discharge of D-canals can be ascertained from the unit diversion requirements in Table 4.2.3. The unit diversion requirement for the D-canals in Stage III and Stage IV have been estimated after taking into account the difference of conveyance efficiency between the upstream and downstream portions from the existing tanks.

Table 4.2.3 UNIT DIVERSION REQUIREMENT OF D-CANAL

Discription	Discharge in cu.m/s
For D-canal in Stage I, II	2.15
For D-canal supplied from the main canal in Stage III, IV	2.40
For D-canal supplied from Tanks in Stage III, IV	2.15

4.2.5 Rehabilitation Plan on Irrigation Facilities

(1) Main Canal

i) Rehabilitation Method

The canal is earth canal. Three methods are proposed for rehabilitation as shown in Fig. 4.2.3

Type A: Desilting sediments, restoration of material lost by erosion and construction of masonry retaining walls for embankment protection.

Type B: Desilting sediments, restoration of material lost by erosion and protection of side slopes with dry rubble packing.

Type C: Desilting sediments, restoration of material lost by erosion and/or excavation of canal section.

Type B': Protection of up- and down-stream portion of structures by wet rubble pitching.

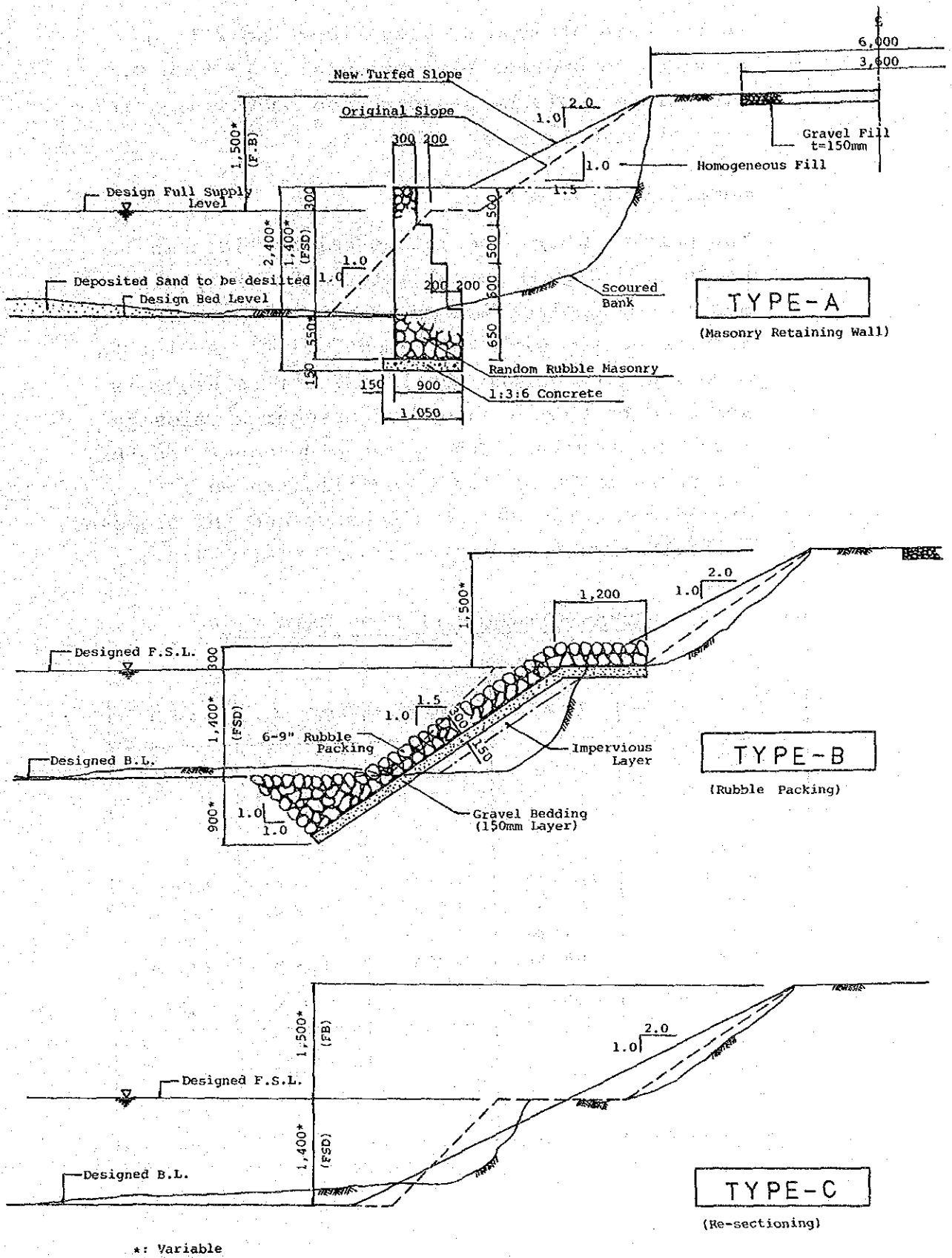


Fig.4.2.3 METHOD OF CANAL REHABILITATION

In the case of Type B, gravel bedding will be provided to protect base material. In Type C, side slope could be steeper than such design in case of stability expected.

ii) Rehabilitation Plan

The portion where the main canal is widen in parts so designed as to restore the original section by application of linings proposed. Simultaneously with the removal of the sediments deposited inside the canal, the bottom slope is designed to keep gradient of discharge velosity less than 1 m/sec. The stage-wise canal lengths are shown in Table 4.2.4 and illustrated in Fig. 4.2.4. The design discharge and the proposed typical cross-section are shown in Fig. 4.2.5.

Table 4.2.4 REHABILITATION PLAN OF MAIN CANAL

Section / Rehabilitation Method	STAGE I	STAGE II	STAGE III	STAGE IV
Total Length	30.70 km	19.68 km	17.04 km	6.80 km
Right Bank				
Type A	2.27 km	-	-	-
Type B	12.08 km	7.42 km	0.75 km	1.98 km
Type B'	0.98 km	1.19 km	0.86 km	0.08 km
Type C	6.49 km	4.72 km	13.84 km	2.66 km
No repair	8.88 km	6.35 km	1.59 km	2.08 km
Gravel pavement for O/M Rd.	5.00 km	-	0.30 km	1.20 km
Left Bank				
Type A	0.30 km	-	-	-
Type B	0.80 km	-	-	-

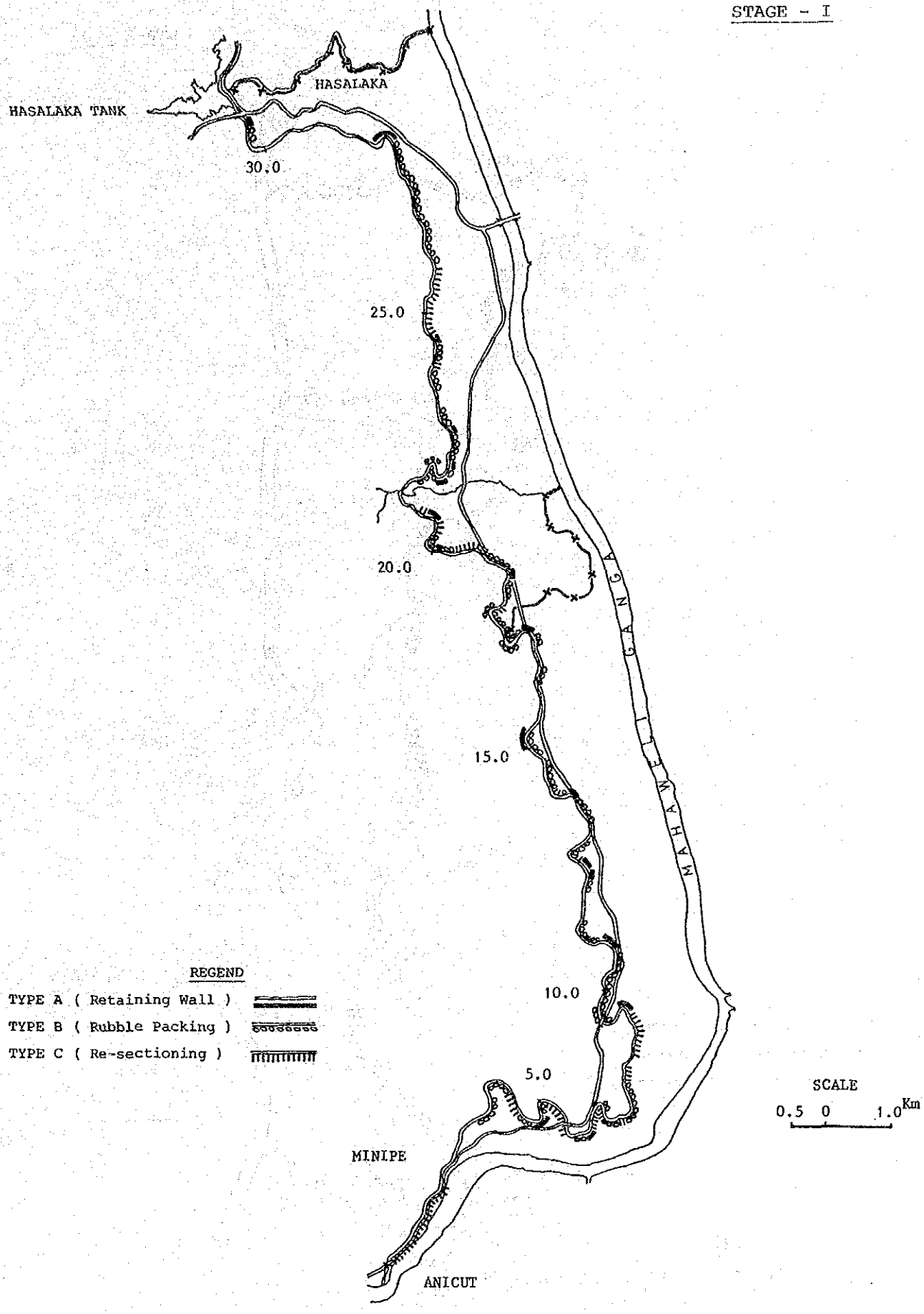


Fig. 4.2.4a PLAN OF CANAL REHABILITATION

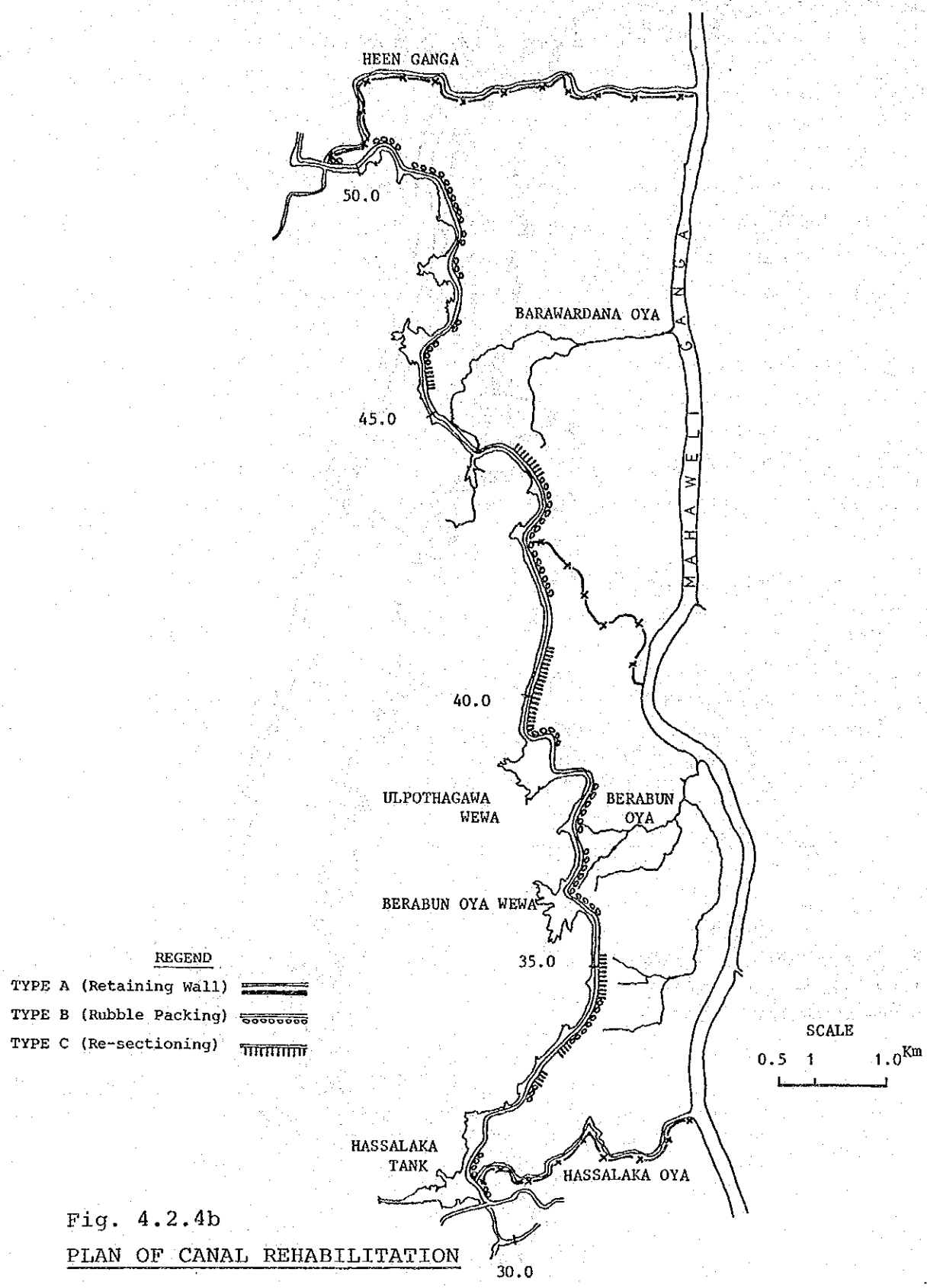


Fig. 4.2.4b

PLAN OF CANAL REHABILITATION

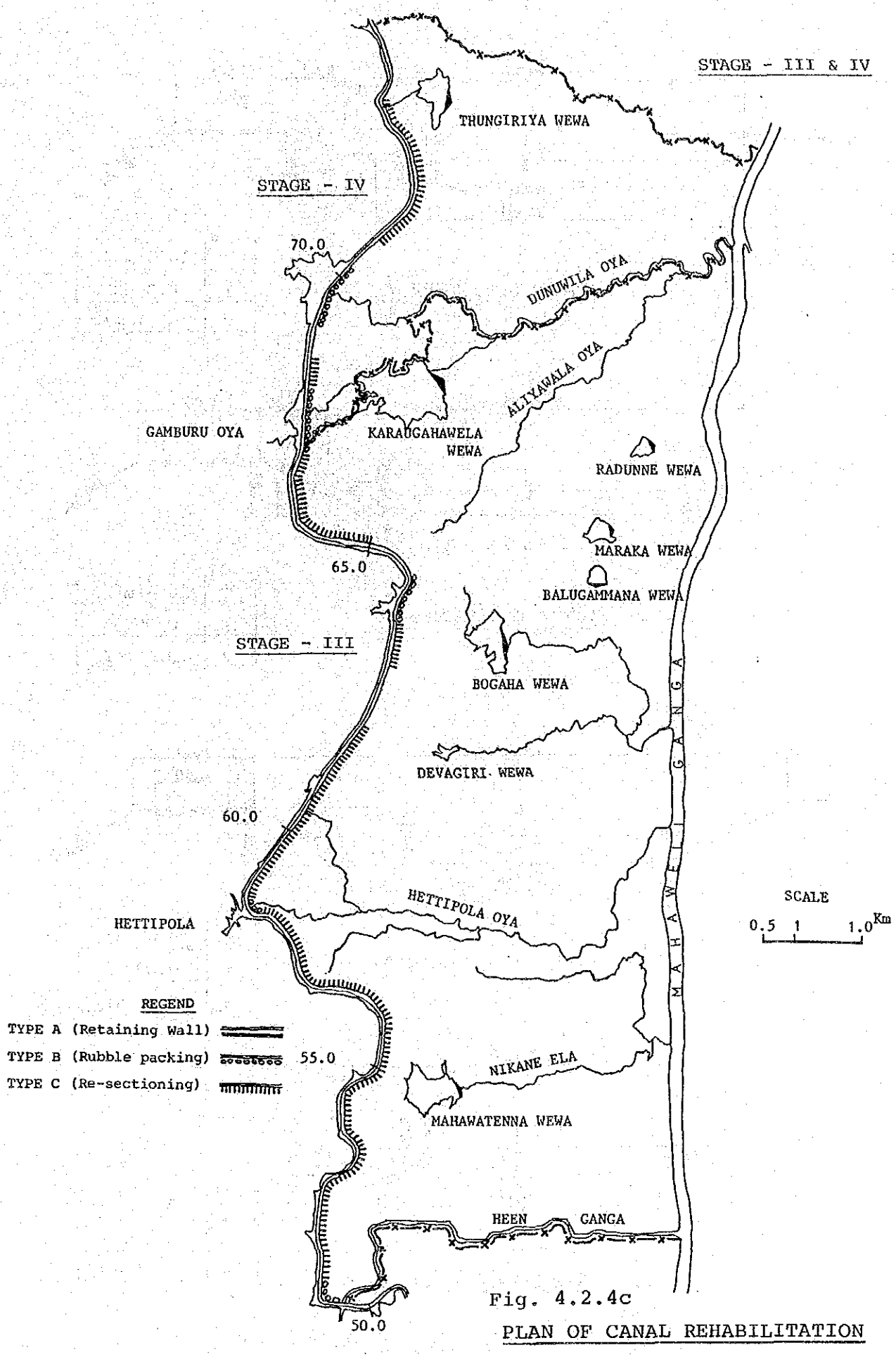
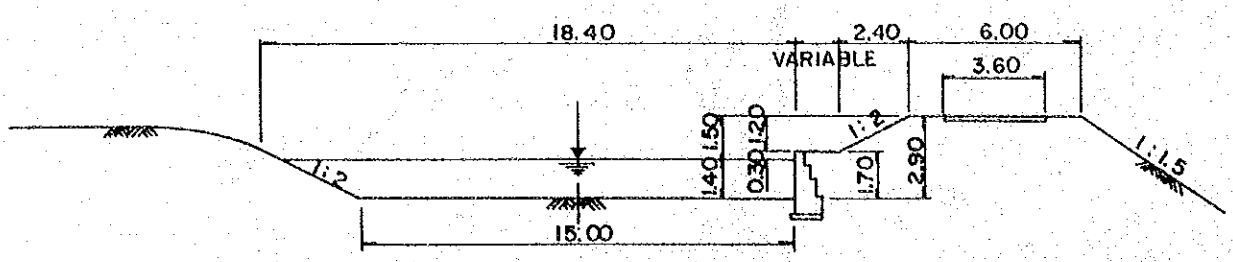


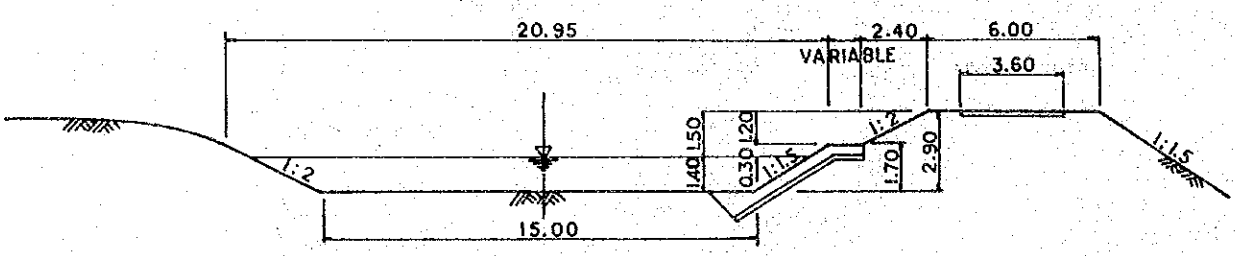
Fig. 4.2.4c

PLAN OF CANAL REHABILITATION



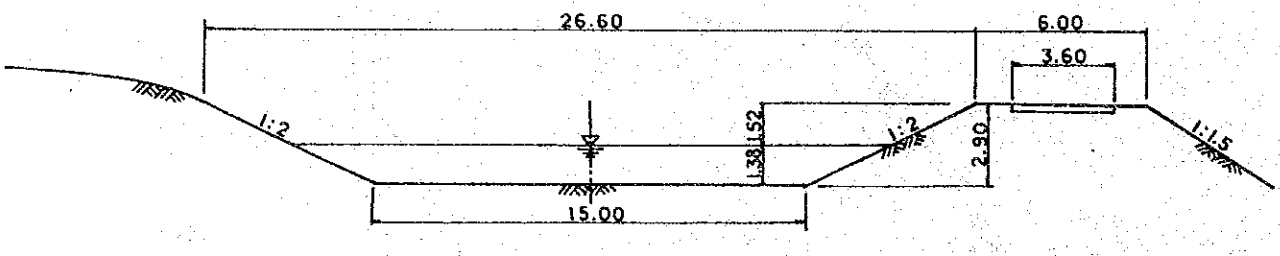
STAGE I-1, TYPE A

Q	16.4 m^3/s
I	0.00033
V	0.72 m/s



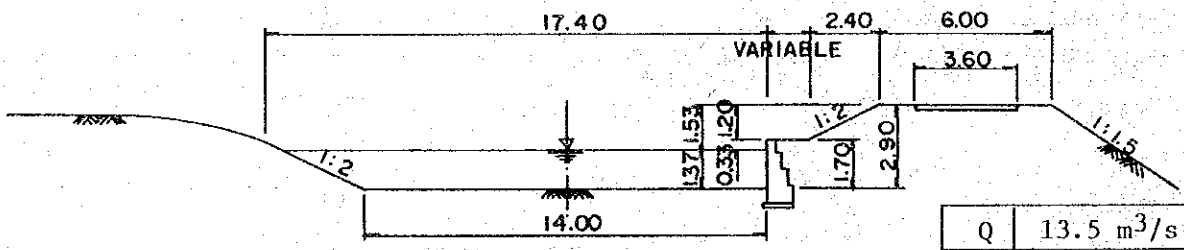
STAGE I-1, TYPE B

Q	16.4 m^3/s
I	0.00033
V	0.68 m/s



STAGE I-1, TYPE C

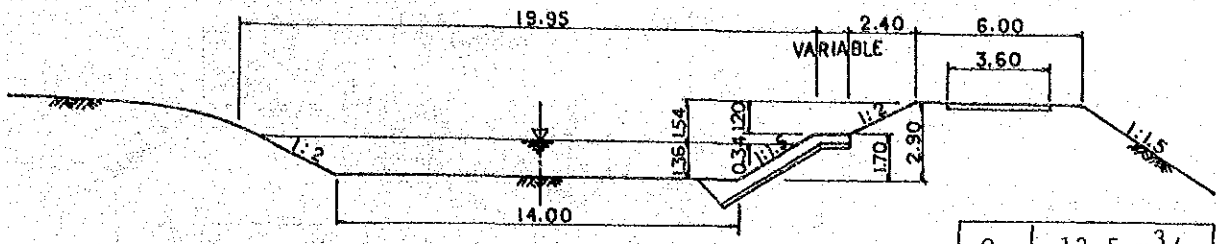
Q	16.4 m^3/s
I	0.00033
V	0.67 m/s



STAGE I-2, TYPE A

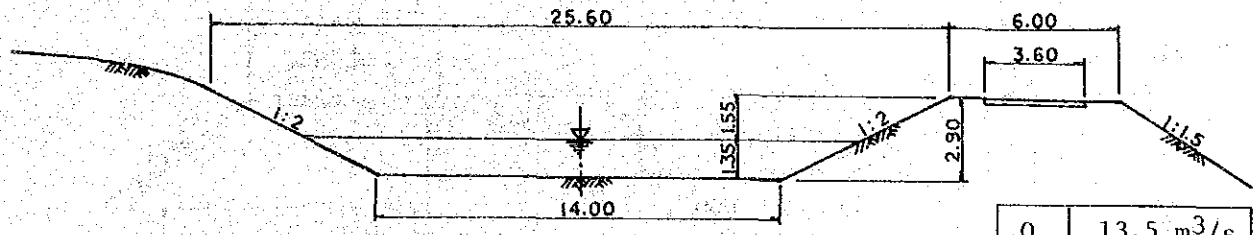
Q	13.5 m^3/s
I	0.00028
V	0.64 m/s

Fig. 4.2.5a STANDARD CROSS-SECTION OF MAIN CANAL(1)



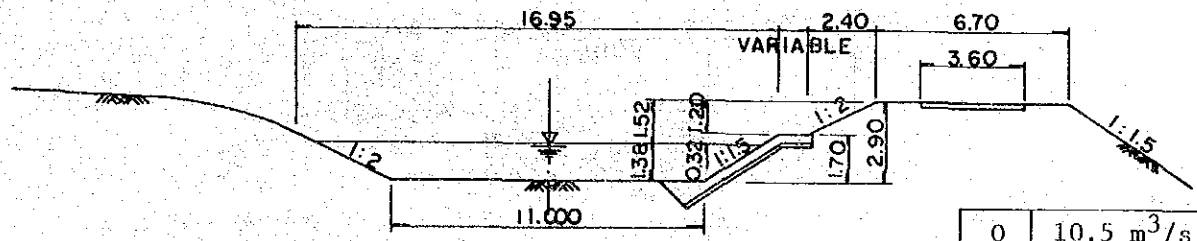
Q	13.5 m^3/s
I	0.00028
V	0.61 m/s

STAGE I-2, TYPE B



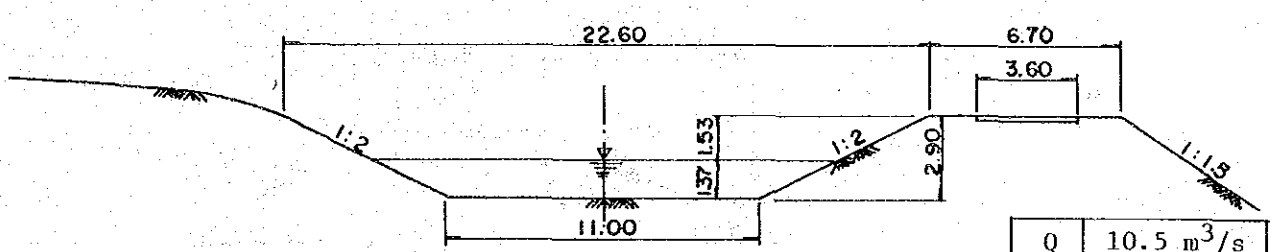
Q	13.5 m^3/s
I	0.00028
V	0.60 m/s

STAGE I-2, TYPE C



Q	10.5 m^3/s
I	0.00025
V	0.57 m/s

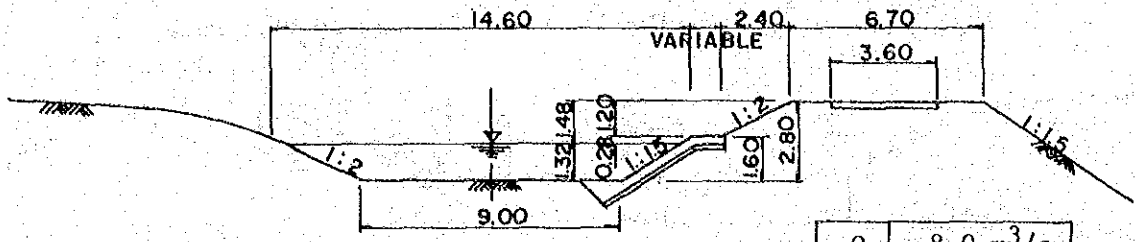
STAGE II-1, TYPE B



Q	10.5 m^3/s
I	0.00025
V	0.56 m/s

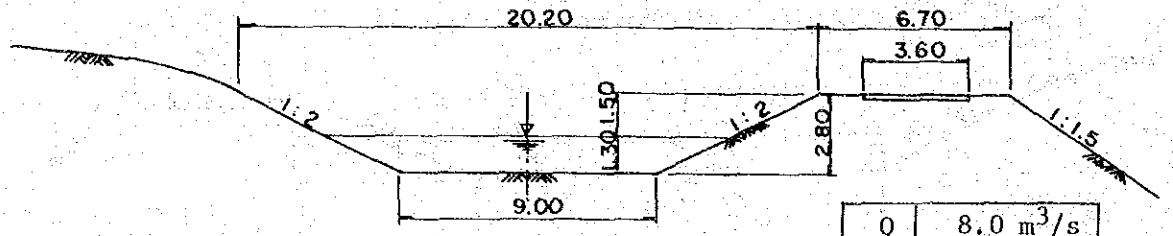
STAGE II-1, TYPE C

Fig. 4.2.5b STANDARD CROSS-SECTION OF MAIN CANAL(2)



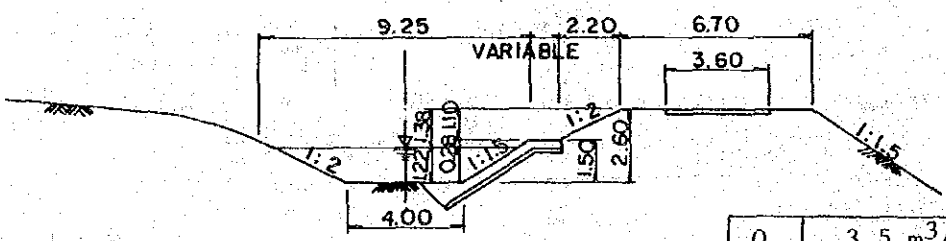
Q	8.0 m^3/s
I	0.00025
V	0.54 m/s

STAGE II-2, TYPE B



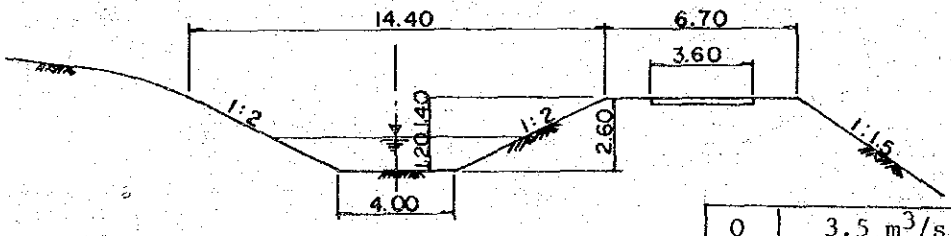
Q	8.0 m^3/s
I	0.00025
V	0.53 m/s

STAGE II-2, TYPE C



Q	3.5 m^3/s
I	0.00025
V	0.47 m/s

STAGE IV, TYPE B



Q	3.5 m^3/s
I	0.00025
V	0.46 m/s

STAGE IV, TYPE C

Fig. 4.2.5c STANDARD CROSS-SECTION OF MAIN CANAL (3)

(2) Related Structures of Main Canal

i) Basic Policy on Rehabilitation Plan

The related structures of the main canal are proposed to be rehabilitated in accordance with the following basic policy guidelines:

a) The whole system is to be brought into proper operation by correcting its malfunction through rehabilitation or reconstruction of the structures which have deteriorated seriously at present or have defects.

b) The effective use of water is to be secured preventing water leakage from the structures.

c) The effective use of water is to be ensured improving water management and rationalizing water distribution through improvement of the facilities necessary for carrying out proper water management.

d) The construction of additional structures is to be effected since the main canal is utilized for the supply of subsistence water for consumption by villagers and for the use of buffalos.

Guideline (c), in particular, is of paramount importance in this rehabilitation plan. The main canal should be equipped with the following three facilities for this purposes:

(1) measuring devices having the function of measuring the water discharge of the main canal accurately; (2) regulators by which the water discharge can be fully controlled and (3) turnouts having the function of distributing the required amount of water accurately.

ii) Rehabilitation Plan

The rehabilitation plan on each structure worked out in accordance with these basic policy guidelines the results of the field survey are shown below. A summary is given in Table 4.2.5 and the location of each structure is shown in the DWG. No. 2, Profile of main canal.

Intake facilities

The existing diversion weir and its intake would be left as they are; however, the intake would be so designed as to facilitate smooth intake through removal of the sediments deposited on the upstream and downstream portions.

The inlet channel is to be provided with rataining walls incorporating with leak-prevention on the right bank, and with dry rubble packing on the left bank, along with the removal of the sediments accumulated on the canal bottom.

Rehabilitation on the head sluice is considered necessary only for replacement of gate seals. It is proposed that the scour sluice would be replaced by steel slide gates.

Measuring Devices

The flume type measuring devices are proposed to be built at nine points in all, including upsteam and downstream ends each water management block and inside the Heen Ganga feeder canal. The proposed locations of the measuring devices are given in DWG. No. 2.

Regulator

The existing regulators which are of the stop-log type are simple devices but difficult to

operate. Since this difficulty of operation would be a drawback unfavourable from the water management point of view, gated regulators should be installed for this project. For the purpose of ensuring the designed intake water level at each turnout, the installation of new regulators would be made mainly at points such as the terminal of each water management block and the outlets major tanks located on the way of the main canal, the distribution points for small tanks within the area, and the drop structures to be newly provided.

Turnouts

The existing gates themselves have been recently installed. Since about 1/2 of the total number of the gates are still usable, they could be used for the new structures. Furthermore, the existing conduit pipes crossing the canal bund could also be used except those which have deteriorated seriously and/or have no enough capacity.

Measuring flume with baffle would be provided at each outlet.

Spillways

Six spillways, five in Stage I and one in Stage II, which have become obsolescent, would be demolished and then re-constructed. Repairing/reinforcing would be done for the damaged portions of the other canal spillways. Moreover, those which have the additional function of serving as the outlets for the tanks in the project area are to be modified by the substitution for the existing stop-log gates of slide gates with measuring devices.

The spillway equipped with the radial gates would be rehabilitated by repairing the hoist which is out of order and also by replacing the gate seals. Out of the total of seven points, one gated spillway where the top elevation is about 15 cm lower than the full water level needs to have its elevation lifted.

Syphons

Since the existing a syphon out of three in the Stage I has deteriorated seriously and there are some inherent problems in the syphon, it would have demolished and replaced by box culvent type undercrossings.

Bridges

No rehabilitation is required for the existing bridges along the canal because of having been maintained in good condition. The canal crossing road bridges are mainly made of concrete so that complex rehabilitation is not required. Accordingly, some work would be done on those which require some modification such as reinforcement revetment for the bridges. The three bridges across the canal will be rehabilitated by concrete bridges. The construction of a new bridge across the canal is not proposed under this project. The existing 28 wooden foot bridges would be replaced by concrete ones. Additionally, the existing temporary bridges including log bridges would be converted into concrete foot bridges at 24 points in the order of priority on higher public interests and higher degree of importance.

Other Structure

Out of four overcrossing built in the Stage I section, two have become obsolescent and,

require replacement. Only repairs would be needed for the abutments of the aqueduct-cum-road bridge across the Heen Ganga. It would also be necessary to pave the road surface anew.

Apart from the above facilities, bathing and washing places and access pass on the slope to buffalos would have to be provided for the convenience of the villagers and to protect the canal slopes.

O & M Roads

The paved sections of the existing bund roads would be left as its is because its condition is adequate for the operation and maintenance of the main canal.

O & M Roads are planned to be rehabilitated as gravel roads or as earth road.

(3) Heen Ganga Diversion Weir and its Feeder Canal

The water utilization plan shows that the supply of water from the Heen Ganga occupies a central position in the rehabilitation plan for the Minipe Scheme. Its designed intake discharge is 3 cu.m/sec, but the existing diversion weir and feeder canal have at water supply capacity rated at only some 0.6 cu.m/sec due to their obsolescence as described in 3.6.4. The Heen Ganga intake facilities as a whole would therefore have to be improved. The construction of a new weir would be undertaken after the demolishing existing weir. The new weir has been designed to be of concrete fixed type taking into consideration geological and topographical factors. It would be equipped with scour sluice having a manual lifting gate together with the intake sluice having the same type of manual operated gate on the left bank. This would, make it

Table 4.2.5 LIST OF CANAL RELATED STRUCTURES TO BE REHABILITATED

Structure	Number of Exist. Str.	No. of Str. to be repaired	No. of Str. to be re-constructed	Remarks
Intake Facilities	1 No.	1 No.	- No.	
Measuring Device	17	-	9	
Regulator	39	1	20	
Turnout	143	71	67	5 T/O will be syntesized
Spillway	37	31	6	
Gated Spillway	7	7	-	
Syphon	3	2	1*	* Undercrossing
Overcrossing	4	2	2	
Undercrossing	2	1	-	
Bridge cum Aqueduct	1	1	-	
Canal Bund Bridge	9	-	-	
Road Bridge	47	31	3	
Foot Bridge	51	21	28	
Temporary Log Bridge	64	-	24*	* Concrete Foot Bridge
Drain Inlet (Culvert)	6	4	-	
Bathing & Washing Place	-	-	75*	* New strucyure
Access Slope for Buffalos	-	-	44*	* - do -

possible to remove the sediments deposited in front of the intake and to control the intake discharge.

The existing earthen feeder canal, which has large conveyance losses, would be converted into concrete-lined canal to minimize the losses as far as possible. Further, the O/M road is designed to be 6 m wide to facilitate traffic accessibility.

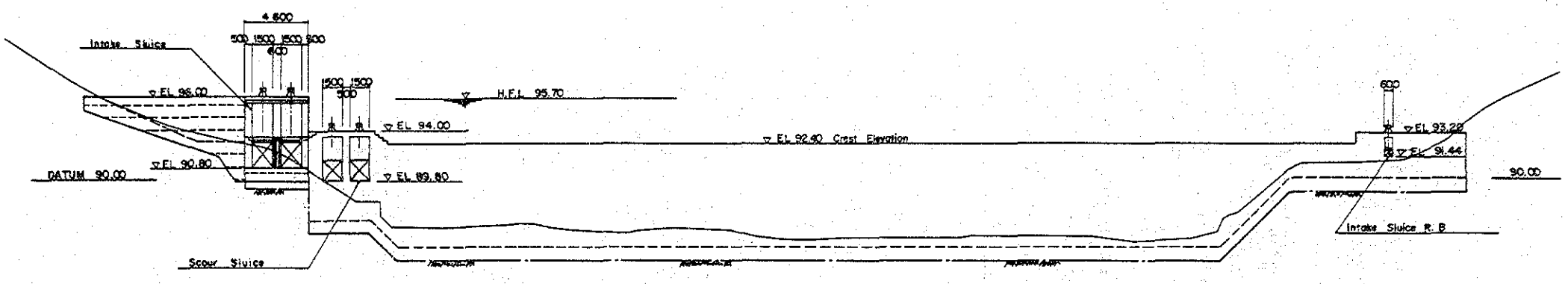
In order to measure accurately the rates of inflow into the main canal, a measuring device would be built on the canal. The spillway-cum-waste way,

drainage canal undercrossing and canal crossing road bridges are to be built at separate points, while there would be two foot bridges.

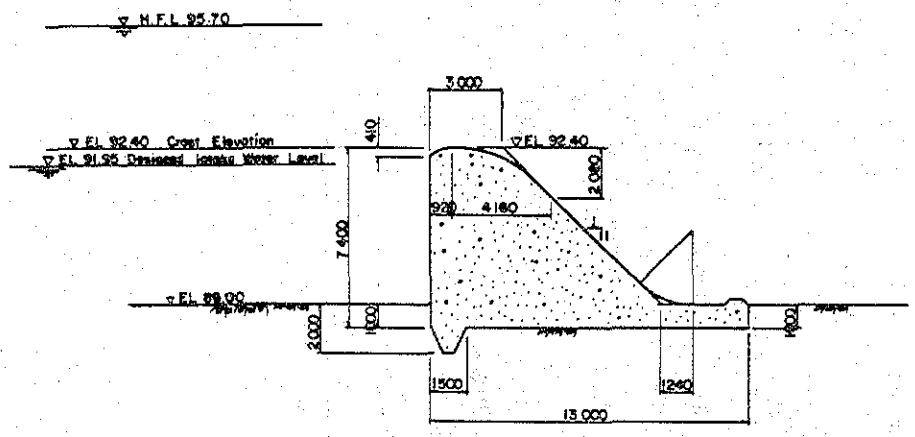
Technical features on the proposed diversion weir and the feeder canal are shown in Table 4.2.6 and Fig. 4.2.6 and DWG. No. 10 show their sectional and structural drawings.

Table 4.2.6 PRINCIPAL FEATURES OF PROPOSED HEEN GANGA INTAKE FACILITIES

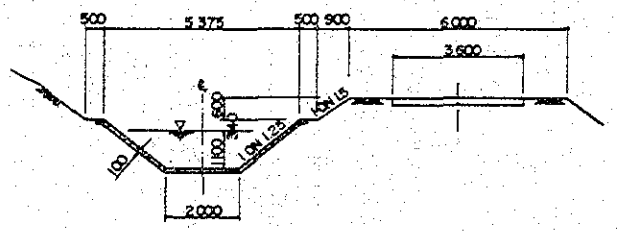
DIVERSION WEIR	
Type of Weir	Concrete fixed weir
Length	74.0 m
Height	7.4 m
Crest Elevation	El. 92.40 m MSL
Intake Gate (L.B)	W 1.50 m x H 1.70 m x 2 Nos.
(R.B)	ø 600 mm x 1 No.
Scour Gate	W 1.50 m x H 1.50 m x 2 Nos.
FEEDER CANAL	
Canal Type	Concrete lined canal R.B. Single Bund
Length	1,900 m
Gradient	0.00035
Design Discharge	3.0 m^3/sec (Max. 5.0 m^3/sec)
Inside Slope	1 on 1.25
Bund Top Width	6.0 m



Elevation of Diversion Weir



Weir Section



Typical Section of Feeder Canal

Fig. 4.2.6 HEEN GANGA DIVERSION WEIR AND FEEDER CANAL

(4) Distributary Canals and Field Canals

The construction of new canals would not be required, because the canal density in the project area attains as high as 52 m/ha even without taking the main canal into a ratio account, as already shown in sub-para 3.6.2. While the distribution of canals is sufficient, the distributary and field canals in the Stages I and II are becoming obsolescent to an extent equal to, or greater than, that of the main canal. Rehabilitation would be proposed to be done along the total length of the canals, inclusive of their O/M roads.

The rehabilitation programme to be adopted for the D-canals and F-canals in Stages I and II areas includes the following features:

i) The portions where erosion and scouring are acute at present should be rehabilitated in part by the provision of retaining walls.

ii) The D-canals and F-canal would be, as a rule, provided with stable slopes and desilting.

iii) The bund roads of the D-canals are designed to be 4 m wide, with a 3 m- wide gravel pavement.

v) 50% of the total number of the existing related structures would need reconstruction.

All the D-canals and F-canals in the Stages III and IV have been rehabilitated under the Integrated Rural Development Programme (I.R.D.P.) except some areas adjacent to the Tungiriya Wewa, and there are no points where urgent rehabilitation is needed at present. Nevertheless, because the rehabilitation being done under the above programme involves lower specifications than the specifications for the Stages I and II areas, the extra construction quantities

required to upgrade to the equivalent level of specifications proposed for the Stages I and II areas would be included in calculating the cost estimates.

The construction quantities and the construction costs estimated for rehabilitation of the tributary and field canals have been estimated on the basis of certain assumptions made after taking into due consideration the results of the field survey in the sample areas.

Stage-wise bills of quantities on the distributary and field canals are given in Table 4.2.7.

(5) Minor Tanks

Since seven tanks in the Stage III area have been rehabilitated under the Integrated Rural Development Programme mentioned in sub-para 3.6.4, the Tungiriya Wewa located in the Stage IV would only be required to rehabilitate. It would be deemed adequate that the riprap treatment takes place only on the upstream slope of the Tungiriya Wewa. The tank is equipped with intake facilities on each bank, but it is not necessary to rehabilitate the intake facilities on the right bank which have been well maintained. But the facilities on the left bank would have to be demolished and be re-constructed because there is the danger of leakage from the structure.

(6) Drainage Facilities

As mentioned in sub-para 3.6.5, there is no particular section within the project area where the drainage facilities are necessary to rehabilitate or reconstruct the drainage canals as a whole. Nevertheless, the portions where scouring and collapse are found on the slopes at the confluences of the

Table 4.2.7 PROPOSED REHABILITATION PLAN FOR D.& F. CANALS

Item	Stage			
	I	II	III	IV
Existing				
Irrigation Area (ha)	1,910	1,789	1,738	670
No. of D. Canal (No.)	60	36	36	6
Total length of D. Canal (Km)	43	39	51	8
No. of F. Canal (No.)	27	182	200	85
Total length of F. Canal (Km)	14	60	56	44
Rehabilitation of D. Canal				
Masonry Flume (km)	0.6	1.0	0.7	0.2
Concrete Lining (km)	1.5	1.0	0.6	0.1
Retaing Wall (km)	1.1	1.0	-	0.1
Earthen Canal (km)	32.1	29.9	-	0.4*
Gravel Pavement (km)	6.2	9.8	14.2	2.8*
Drop Structure (No)	100	100	-	2*
F.T.O Structure (No)	90	50	-	6*
Other Structure (No)	50	35	-	2*
Pipe Outlet (No)	100	270	-	-
Rehabilitation of F. Canal				
Concrete Lining (km)	1.4	6.0	-	1.0*
Earthen Canal (km)	5.6	24.0	-	4.0*
Structures (No)	110	760	-	40*

(* only for D4)

secondary drainage canals (tributaries of small natural streams) would be rehabilitated by the provision of dry rubble pitching for slope protection. Such treatment would be done at one point per 100 ha on an average.

Such drainage related facilities as canal spillways, spillways with radial gates, undercrossings, over-crossings, syphons and so forth would be included in the main canal related structures in the rehabilitation plan.

4.3 WATER MANAGEMENT

4.3.1 Basic Policy

The present organisation on Water Management in the Minipe Scheme is based on the "Pilot Area Water Management (PAWM) Project" started from 1979/80 Maha in Stage I Section 1. The administrative Agencies involved in the Project were the Irrigation Department, Agrarian Services Department and Agriculture Department.

Within the experience gained from the PAWM Project, the modified Water Management Organisation was established in July 1980 at three levels of operation, i.e. the first level was called the Fram Level Committee, the second level, the Sub-Project Committee and third level, the Project Committee. In addition to the above committees, the organisation also included a committee that functioned at the district level as an advisory body.

The current water management programme in the Minipe Scheme are being replaced in 1985 by the INAMS Programme which is mainly sponsored by the Irrigation Management Division (IMD). The IMD will function as the administering authority for the Programme on the basis of policy guidelines and direction from the Central Co-ordinating Committee on irrigation management. Some of the principal functions of the IMD are:

- Administering the O & M collection funds and allocating funds for maintenance work in irrigation schemes.
- Allocation of funds voted to the Ministry for O & M in major irrigation schemes, and
- Monitoring, in major irrigation schemes, the use of irrigation water to optimise its use, and agricultural production activities to increase agricultural productivity respectively.

The INMAS Programme will operate at four levels, as illustrated in Fig. 4.3.1.

- National Level at which the Central Co-ordinating Committee will function,
- District Level at which the implementation is done by the District Agricultural Committee (DAC) Sub-Committee,
- Project Level comprising a Project Committee of field staff of all agencies associated with agricultural production. The farmer representatives will determine the programme for implementation in the Scheme.
- A Sub-project Level is based on the turn-out groups of farmers.

The water management activities in the Minipe Scheme including "Pilot Area Water Management Project" stated in para 3.8.2, have been continued for over five years and the degree of farmers participation has been increased. Therefore, the present organisation and operation on water management in the Scheme is required to be continued by the modified organisation under the IMD.

4.3.2 Farmer Organisation

(1) System Features

Almost all existing discharge measuring structures in the main canal and at the beginning of D-canals are so deteriorated that irrigation water cannot be distributed accurately to meet irrigation demands. In addition, lack of data on irrigation requirements in each D-canal makes it more difficult to supply water adequately for the system.

These structural impediments will be excluded by rehabilitation and improvement of the related structured as in Table 4.2.5.

The system features as disadvantages to water management, however, will remain unchanged in the following aspects:

- The main canal length per unit command area (12.15 km/ha) is distincitively longer than those in other projects.
- Numerous D-canals stem from the main canal (138 Nos).
- High and medium percolation paddies are scattered in the Scheme area.

Under these conditions, the specific attention should be paid for establishment of systematic organisation based on D-canal and operation methods coping with such difficulties.

(2) Modification of Farmer Organisation

As the layout of canals and blocking out of farm plots in the Scheme were not laid on the basis of 50 ac Turn-out Area as in other projects, farmer representative has been selected from an average area of about 80 ha at Stage I.

In consideration of regularization of encroachment and the results of investigations at the field study as given in Annex 5, Table 5.1.4, farmer organisation is proposed to be modified by establishment on representation of farmer leaders according to the following basis:

- To select one farmer representative from command area of about 100 ha as one standrd sub-area.
- To select one assistant from about 20 ha as one standard unit (Turn-out Area).

- One representative shall be selected among assistants who belong to a D-canal and/or a D-canal group incorporated as one sub-area.

Details on farmer representatives and their assistants are proposed according to blocking out in each Stage as shown in Table 4.3.1.

As a result of modification, the present organisation can be succeeded by the proposed one as shown in Fig. 4.3.1. However, the present farmer organisation and function in principal are to be continued in future.

4.3.3 Water Management and Operation

(1) Manual Programme

The provision of a water management and operation manual is indispensable to use irrigation water effectively to meet demands in the fields and establishment of system operation as well.

This manual would be required to cover the following aspects:

- Complete diagrams of the irrigation network specifying the number of D-canals, F-canals, related structures, farm plots including encroachment.
- Field water requirement in each D-canal (turnout discharge).
- Basic plan of the network operation including
  - (a) discharge check in the main canal measuring points,
  - (b) operation methods of the control structures and measuring devices, and
  - (c) control principles of the main canal in each of sections and stages.

The water management and operation manual programme is proposed to start immediately after completion of rehabilitation works and continue for three years by

Table 4.3.1a PROPOSED FARMER REPRESENTATIVES AND ASSISTANTS

	Sub-Area No.	D-Canal	Extent Area in ha	Representatives	Assistants
	Stage I				
Section 1	1	D1 - D7	139.7	1	14
	2	D8 - D12	143.4	1	9
	3	D13 - D16	132.5	1	7
	4	D17 - D20	155.2	1	8
	5	D21	149.8	1	6
	6	D22 - D25	150.8	1	10
	7	D26 - D28	108.9	1	6
Section 2	8	D29 - D31	89.6	1	5
	9	D32 - D34A	110.0	1	9
	10	D34 - D34B	121.1	1	6
	11	D35 - D38	81.0	1	6
	12	D39 - D40	119.4	1	5
	13	D41 - D43	99.2	1	4
	14	D44 - D46	125.3	1	5
	15	D47	107.0	1	4
	16	D48 - D49	76.1	1	2
Sub-total			1,909.1	16	106
	Stage II				
Section 1	1	D1 - D3	86.3	1	5
	2	D4	163.6	1	7
	3	D5 - D6	61.5	1	2
	4	D7	129.6	1	5
	5	D8 - D11	151.4	1	7
	6	D12 - D16	106.5	1	5
	7	D17 - D23	156.6	1	9
Section 2	8	D24	83.4	1	3
	9	D25	283.5	1	13
	10	D26 - D29	162.7	1	8
	11	D30	203.3	1	9
	12	D31 - D34	200.5	1	9
Sub-total			1,788.9	12	82

Table 4.3.1b PROPOSED FARMER REPRESENTATIVES AND ASSISTANTS

Sub-Area No.	D-Canal	Extent Area in ha	Representatives	Assistants
Stage III				
1	D35 - D42	97.0	1	7
2	D43	268.1	1	12
3	D44 - D54	126.3	1	11
4	D51 - D56	136.4	1	8
	(Dewagiriya Wewa)	(32.8)		(1)
5	D57	184.7	1	8
Sub-total		812.5	5	46(47)
Stage IV				
1	D58 - FC8	95.2	1	4
2	D2	83.8	1	3
3	D3	271.7	1	13
4	FC76 - FC82	57.1	1	2
Sub-total		507.8	4	22

Sub-Area Minor Tank	Tank	Extent Area in ha	Represent-atives	Assistants
Stage III				
1	Mahawatenna Wewa	170.1	1	8
2	Dewagiriya Wewa*	32.8	0	1
3	Bogaha Wewa	129.7	1	6
4	Balugammana Wewa Malaka Wewa	101.2	1	4
5	Raddunne Wewa	111.4	1	5
6	Karangahawela	259.3	1	12
Sub-total		804.5	5	36
Stage IV				
1	Tungiriya Wewa	162.8	1	7

* Included in Stage III, Sub-Area No.4

Fig.4.3.1 PROPOSED ORGANISATION CHART FOR WATER MANAGEMENT

DISTRICT ADVISORY COMMITTEE

PROJECT COMMITTEE

6 No - SUB PROJECT COMMITTEES

	STAGE I		STAGE II		STAGE III	STAGE IV	TOTAL
	SECTION 1	SECTION 2	SECTION 1	SECTION 2			
FARMER LEADER	01	01	01	01	01	01	06
TECHNICAL ASSISTANT	01	01	01	01	01	01	06
WORKS SUPERVISORS	02	02	01	01	03	01	10
CULTIVATION OFFICERS	03	03	04	04	07	02	23
AGRICULTURE EXTENSION WORKERS (KVS)	02	03	02	03	03	03	16
FARMER REPRESENTATIVES	07	09	07	05	10	05	44

44 No - FARM LEVEL COMMITTEES

FARMER REPRESENTATIVE

FARMER ASSISTANT

WATER DISTRIBUTOR

AGRICULTURE EXTENSION WORKERS (K V S)

the Irrigation Department associated with the line agencies and consultants.

Before proceeding this programme, high percolation paddies investigation including remedy plans would be required to execute so as to identify the areas and the irrigation demands in each D-cana.

Costs for these programmes are estimated in the Project Support and Engineering Services.

(2) Training

In order to operate the system efficiently by use of the O & M manual, the staffs in charge of water management shall have enough knowledge by training.

The training courses should be organized by the IMD and the related agencies.

These expenditures including construction of a training centre, the INMAS Stations and strengthening INMAS Programme are provided in the Project Support costs (administrative overhead).

4.4 AGRICULTURAL PLAN

4.4.1 Basic Policy

The Project aims at increasing agricultural production by rehabilitating the existing irrigation and drainage facilities. It is characterized by the reorganization of the prevalent agricultural activities in the area, as distinct from a new development scheme. In the proposed Project Area, however, the land has been fully developed and cultivated by a large number of farmers over the years. The basic concept for this project is to understand the present conditions completely and then make the optimum plan.

The main constraint on agricultural development in the area is the shortage of irrigation water in the Yala season, especially at the canal tail-end areas. Accordingly, the agricultural development plan for the Project should aim at the most effective utilization of the limited resource of water.

In the Minipe area, paddy is the main crop during both Maha and Yala. During the Maha season, subsidiary food crops and vegetables are cultivated in some small extents under irrigation, but in Yala season, almost all the irrigated area are found to be only under paddy cultivation.

In the rainfed area, during Maha season paddy is dominant, but in Yala only fruit trees can be grown.

In recent years, the cultivation of subsidiary crops under irrigation has been extended gradually.

The agricultural plan has been evolved on the basis of an irrigated agriculture, after taking into consideration both the present agricultural conditions and the project concept.

The present water shortage is mainly caused by the expansion of the irrigated area by encroachers, and the deterioration of irrigation facilities. Therefore, care should be taken not to expand paddy fields after the implementation of the Minipe Project under the INMAS Program.

Through the discussions with the officials in the related agencies and the field investigations, paddy, chillies and pulses (cowpea, green gram and soya bean) have been chosen as the proposed crops for irrigated agriculture.

Paddy is the main crop in Sri Lanka and most farmers adhere to its cultivation. Under irrigated condition, productivity of paddy is relatively high and its yield is stable compared with other crops. The increase of paddy production is still ranked as the top priority of the national policy, though the import of rice has decreased in recent years.

In order to save and use the limited water effectively, it is recommended that the cultivation of chillies and pulses should be introduced in paddy lands for which irrigation water is to be made available in Yala. Though the production of these crops has increased in recent years, it has still not satisfied the domestic demand. In view of the fact that the prices of these crops are kept at relatively high levels, the cultivation of chillies and pulses will contribute to the increase of farmers' income. It should also be made acceptable to the farmers under the national policy of promoting agriculture diversification.

4.4.2 Cropping Pattern

As described in the previous section, paddy, chillies and pulses (cowpea, green gram and soya bean) are the main crops under the Project. The cropping pattern of these crops should be as follows:

(1) In Maha season, paddy is to be cultivated in the entire Project Area.

(2) In Yala season, the cultivation of subsidiary food crops is to be gradually increased up to 30% of the total area. Paddy is to be grown on the remaining 70% of the area.

(3) The ratio of cultivation of subsidiary food crops should be chillies 50% and pulses 50%. The cultivated areas of cowpea, green gram and soya bean should be the same.

(4) In and after the target year, the cropping patterns should be (i) double crops of paddy annually on 70% of the irrigated land, (ii) paddy-chillies on 15% and (iii) paddy-pulses on the remaining 15% of the land.

(5) The present practice of farmers being exclusively engaged in the cultivation of paddy should be changed

within two years after the completion of construction works. The cultivation of subsidiary food crops should be increased gradually and within five years of the completion of construction works, the cultivated area of such crops should reach to the target area.

For the cultivation of the proposed crops, the following cultivation methods are recommended.

(1) Certified seeds made available by the Government should be used, as a rule, once in four years for paddy and every year for subsidiary food crops.

(2) New improved variety of paddy should be used. The long and short growing period varieties should be used in Maha and Yala seasons, respectively.

(3) Seedlings of paddy and chillies should be transplanted Pulses are to be grown by direct sowing.

(4) Application of fertilizer and agro-chemicals should be in accord with the recommendations by the Government.

(5) Farmers should follow the decisions on farming practices by each Committee and accept the advice given by the agricultural instructors and agricultural extention workers concerned.

(6) Improvement of cultivation methods concerning the variety of crops, establishment method, application of fertilizer and agro-chemicals should be accomplished within six years after the completion of the construction works.

The proposed cropping patterns are shown in Fig. 4.4.1.

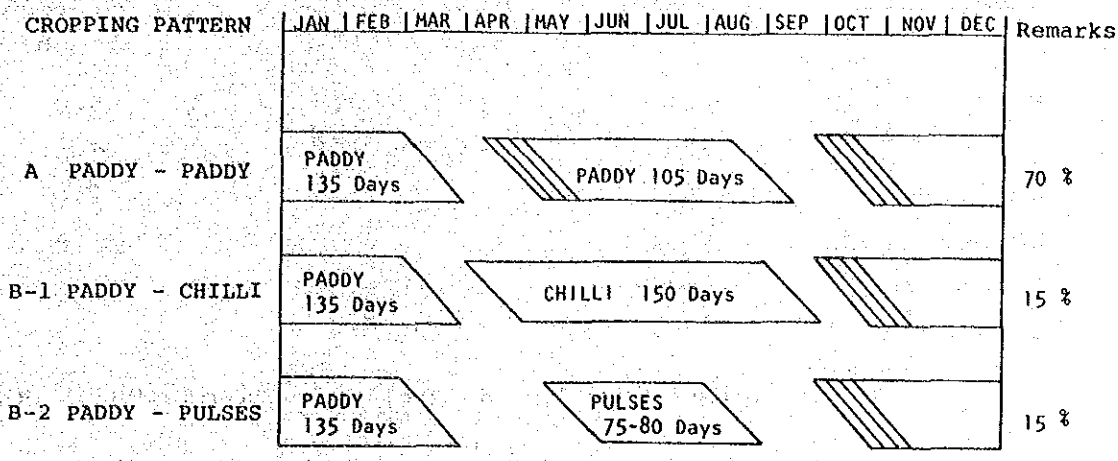


Fig. 4.4.1 PROPOSED CROPPING CALENDER

4.4.3 Target of Production

(1) Targets of Yields

At the completion of the proposed rehabilitation works, the yield of each crop in a normal year in the Minipe Scheme has been estimated, taking into consideration the existing agricultural conditions, the effective use of irrigation water, the introduction of improved cultivation methods and the results of experimental farming.

The target yield of each crop is expected to be achieved within five years after the completion of construction works. (see Table 4.4.1) The estimated yields during the transitional years are shown in Annex 6.

(2) Traget of Production

The crop productions in Minipe Scheme in, and after, the target year have been estimated, as shown in Table 4.4.2.

Table 4.4.1 TARGET YEILD OF EACH CROP

Name of Crop	Season	Present Yield (t/ha)*	Target Yield (t/ha)
Paddy	Maha	3.4 - 3.3	5.0
	Yala	3.3 - 1.8	4.5
Chilli	Yala	0.9	1.6
Cowpea	Yala	1.0	1.8
Green Gram	Yala	0.9	1.6
Soya Bean	Yala	0.6	1.7

*: The figures show the average values of 1981 - 85.

Table 4.4.2 YIELD WITH/WITHOUT PROJECT

Crop	Season	Stage	Actual(1981-1985)* Area (ha)	Yield (t/ha)	Production (t)	Target Year Area (ha)	Yield (t/ha)	Production (t)
Paddy	Maha	I,II	3,699	3.35	12,392	3,699	5.00	18,495
		III,IV	2,408	3.32	7,995	2,408	5.00	12,040
		Sub Total	6,107	3.34	20,387	6,107	5.00	30,535
	Yala	I,II	3,159	3.26	10,298	2,589	4.50	11,651
		III,IV	997	1.80	1,795	1,686	4.50	7,587
		Sub Total	4,156	2.91	12,093	4,275	4.50	19,238
		Total	10,263	3.16	32,480	10,382	4.79	49,773
Chilli	Yala	I,II	63	0.9	57	555	1.6	888
		III,IV	10	0.9	9	362	1.6	579
		Total	73	0.9	66	917	1.6	1,467
Cowpea	Yala	I,II	36	1.0	36	185	1.8	333
		III,IV	11	1.0	11	120	1.8	216
		Total	47	1.0	47	305	1.8	549
Green Gram	Yala	I,II	32	1.1	35	185	1.6	296
		III,IV	13	0.5	7	120	1.6	192
		Total	45	0.9	42	305	1.6	488
Soya Bean	Yala	I,II	12	0.6	7	185	1.7	315
		III,IV	2	0.8	2	120	1.7	204
		Total	14	0.6	9	305	1.7	519

* Source: Kachcheri Office at Kandy, Mataie A G A Office, and A.I. Office at Project Area.

4.4.4 Market Prospects and Prices

After the implementation of this rehabilitation project, the agricultural products will be purchased by the co-operatives and private traders. Agricultural products could easily be transported out from the Project Area with the implementation of the road rehabilitation programme. Access to markets would become considerably better. Paddy, chillie, cowpea, green gram and soya bean would then be extensively transported to other districts.

Government has laid down guaranteed prices for these products. It is expected that this price support scheme will be continued in the future. The prices cannot be decided through this project. The supply and demand of highland products are apt to be tight. There would be no price decrease with the implementation of this project.

4.4.5 Input Supply

The present agricultural input supply for paddy such as seed, fertilizer and agro-chemicals is summarized in Table 4.4.3 and the details are given in Annex 6.

Table 4.4.3 MAIN INPUT SUPPLY FOR PADDY CULTIVATION

Item	Rate	Price	Reamrk
Seed	52.0 kg/ha	4,630 Rs/kg	Transplanting Culture(1bu/ac)
Fertilizer			
Nursery Basal Vl	62.5 kg/ha	2,955 Rs/kg	
Nursery Urea	12.5 kg/ha	2,875 Rs/kg	
Field Basal Vl	185.0 kg/ha	2,955 Rs/kg	
Field Urea	124.0 kg/ha	2,875 Rs/kg	For Maha
	93.0 kg/ha	2,875 Rs/kg	For Yala
Field TDMl	124.0 kg/ha	2,956 Rs/kg	
Agro Chemical (Ex.)			
Chlorpuripos 20% EC	1.65 ml/ha	360.0 Rs/ha	For Leaf Roller

4.4.6 Labour Requirements

The labour required for cultivating each crop is summarized in the following table. Considering the existing conditions of farm families in the Minipe Scheme, it is estimated that the required labour would be available within the farm family itself.

Table 4.4.4 LABOUR REQUIREMENTS FOR THE CULTIVATION OF CROPS (man-day/ha)

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Paddy	10	7	77	12	86	10	50	40	17	79	10	10	363
Chillie			15	106	124	81	81	193	114				714
Cowpea					60	27	25	45					157
Green gram					60	27	25	45					157
Soya bean					63	34	32	45					174

4.4.7 Farm Power

Many buffaloes and cattle are bred by farmers in the Minipe area and almost all farmers cultivate by animal power. The present agricultural plan envisages the intensive use of paddy fields in Yala season. The time of operations of such crops differs from each other, but the present animal power would be adequate for the farming practices of the propsed agricultural plan.

4.4.8 Farm Budgets

Based on the agricultural plan, the gross income of an average farmer from a holding of 0.8 ha (2 Acs) of paddy land has been estimated as shown in Table 4.4.5. The farm budgets for the respective crops are summarized in Annex 6.

Table 4.4.5 ESTIMATED GROSS INCOME FOR STANDARD FARMERS IN MINIPE

(Irrigated Area: 2ac=0.8ha)

Item	State I,II Area (ha)	Yield (kg)	Unit Cost (Rp)	Gross Income (Rp)	Stage III, IV Area (ha)	Yield (kg)	Unit Cost (Rp)	Gross Income (Rp)
Status								
Maha Paddy	0.80	2,680	2.99	8,013	0.80	2,656	2.99	7,941
Yala Paddy	0.68	2,217	2.99	6,629	0.41	738	2.99	2,207
Chilli	0.01	9	37.0	333	0.00	0	37.0	0
Pulse	0.02	18	13.5	243	0.01	8	13.5	108
Sub Total	0.71	2,244		7,205	0.42	746		2,315
Total (A)	1.51	2,244		15,218	1.22	3,402		10,256
Target								
Maha Paddy	0.80	4,000	2.99	11,960	0.80	4,000	2.99	11,960
Yala Paddy	0.56	2,520	2.99	7,535	0.56	2,520	2.99	7,535
Chilli	0.12	192	37.0	7,104	0.12	192	37.0	7,104
Pulse	0.12	204	13.5	2,754	0.12	204	13.5	2,754
Sub Total	0.80	2,916		17,393	0.80	2,916		17,393
Total (B)	1.60	6,916		29,353	1.60	6,916		29,353
(B)/(A)				1.9times				2.9times

4.4.9 Credit

The demand for the agricultural credit is expected to increase with the widespread utilization of agricultural inputs and the diversification of the farm practices. Interest rate and other credit conditions are not envisaged to be different after project implementation.

The credit supplying organisations like the Bank of Ceylon and a the People's Bank should increase lending capability. The mortgage system should be re-examined with the alteration of land ownership system.

4.4.10 Organisation

The relationship of the four kinds of committee in the Project Area should be strengthened in order to achieve the high target of production of agricultural products.

The Project Area where the new products would be introduced requires the new technology and new agricultural input. The organisation of the management should play an important role for agricultural production matters.

4.4.11 Extension and Training

(1) Basic Concept

In Minipe Scheme, agricultural extension and training are carried out by two Agricultural Officers, three Subject Matter Officers, three Agricultural Instructors and twenty one Agricultural Extension Workers.
The present agricultural plan envisages the promotion of irrigated paddy cultivation and gradual introduction of chillies and pulses under the rehabilitated irrigation and drainage facilities. In order to achieve the targets of the plan, it is imperative to give adequate technical guidance and training to the farmers regarding through the recommendable measures as follows:

a) Executive of joint training for agricultural extension works in the Minipe Scheme;

b) Arrangement of Subject Matter Officer (SMD) specialized in cultivation of upland crops and soil and fertilizer;

c) Setting up demonstration farms for paddy, chillies and pulses cultivations;

d) Distribution of a guidebook for cultivating paddy, chillies and pulses to the farmers;

e) Commending farmers' accomplishment, and

f) Exchange of opinions between personnel concerned to the agricultural extention works in the nearby areas.

(2) INMAS Station

Training, education and agricultural supporting services to the farmers are to be executed at the INMAS Station proposed and a training center by participation of related officials, farmer leaders, water distributors, contact farmers and farmer representatives. The INMAS Station will provide opportunities of official-farmer dialogue through meetings and training. Carriculum on training and education will extend not only to water management but also to agricultural development aspects.

The Project Manager will have a jurisdiction of INMAS Station. Among officials in line agencies, 4 or 5 persons will be selected and do duty at INAMS Station to accomplish the planned carriculum for the farmers at the Stage. The main staffs of the Station will consist of technical assistant, agriculture instructor, and divisional officer.

The INMAS Station will have a function of office, meeting room and warehouse. A meeting room will be used for education and training and the meeting of Sub-project committee. A warehouse next to a office will keep agricultural input materials such as fertilizer, seeds and chemicals in temporary before delivery to farmers. The water management instruments are also kept in the warehouse.

The proposed staffs to a INMAS Station will be selected among the following members shown in Table 4.4.6. General plan is illustrated in Fig. 4.4.2.

4.4.12 Livestock

(1) Livestock development in the Scheme should be focused primarily on ensuring animal power for cultivations at the outset and then developed into dairy to meet the future demands and for marketing in the large economic

Table 4.4.6 NOMINESS TO INMAS STATION

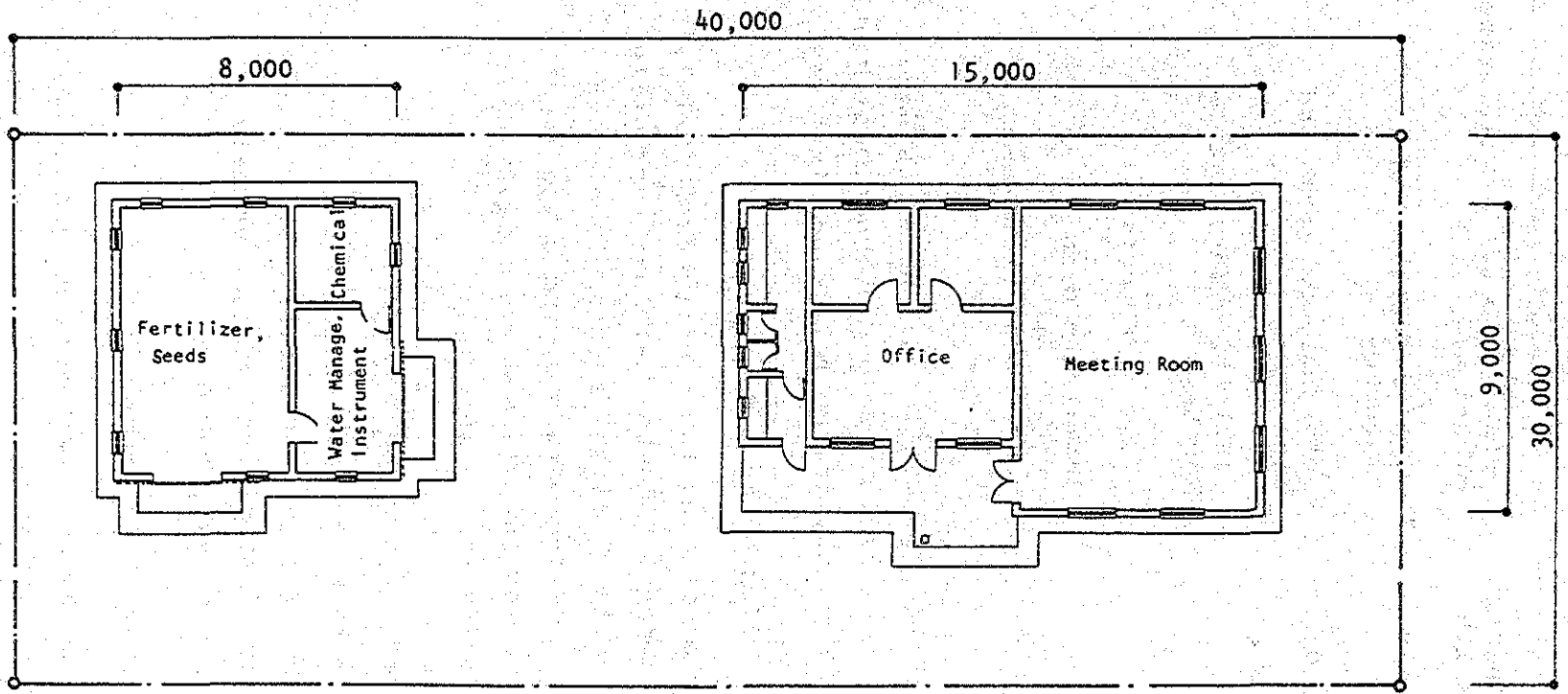
Description	Number of Staffs				
	Total	Stage I	Stage II	Stage III	Stage IV
Irrigable area in ha	6,107	1,910	1,789	1,738	670
Farmer Leader	7 (6)	2	2	2 (1)	1
Technical Assistant	7 (6)	2	2	2 (1)	1
Water Distributor	24	8	8	6	2
Work Supervisor	10	4	2	3	1
Agricultural Instructor	3	1	1	1	
Agriculture Extension Worker (KVS)	16	5	5	3	3
Divisional Officer	3	1	1	1	
Cultivation Officer	23	6	8	7	2
Colonization Officer	27				
Farmer Representative	(77)	(21)	(24)	(26)	(6)
Co-operative	4				

Figures in parenthesis show present number of staffs

sphere that is envisaged. In planning livestock development for the Project Area, one should not confine oneself to the Scheme only.

The Ministry of Rural Industrial Development (MRID) has since September 1978 been responsible for the overall development of the livestock sector.

The departments under the MRID has the functions as follows.



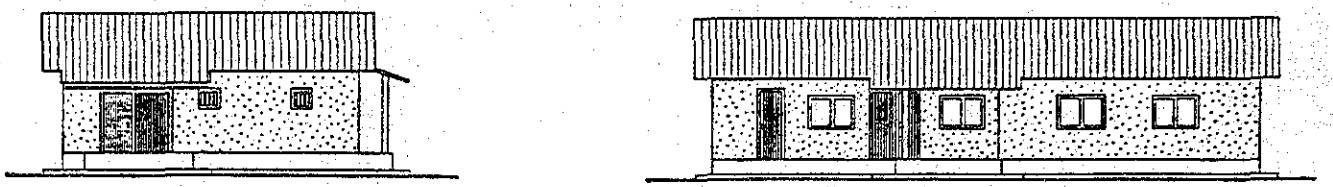


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Fig. 4.4.2 GENERAL PLAN OF INMAS STATION

Department & Statutory Institutions	Subjects and Functions
Department of Animal Production & Health	Animal diseases & quarantine of animals
National Milk Board	Milk production and Distribution
National Livestock Development Board	Veterinary Services and Research
Ceylon Oils & Fats Corp.	Cattle breeding, Cattle Vouchers
	Buffalo Protection
	Animal Breeding
	Development of Livestock Industry

Programmes regarding neat cattle and buffaloes have been proceeding under assistance of international banks and bi-lateral aid mainly in the following districts.

(a) Cattle/Dairy Improvement Program

This program covering the districts of Jaffua, Kegalle, Gampaha, Colombo, Kalutuara and Galle will provide facilities for strengthening the artificial breeding services, including importation of breeding animals and the establishment of Dairy Producers' Associations.

(b) Draught Animal Improvement Program

The Program in Kurunegara District will strenghthen the livestock farm at Nikaweratiya and increase the capacity of supply the draught animals required in and neaby the District.

(c) Dairy Development Programme

An all-island dairy development programme has been to cover all aspects of dairy development.

In addition to these, the Mahaweli Authority of Sri Lanka commenced the Draught Animal Programme in the middle of 1981 in order to combat the escalating costs of mechanized power and the spiralling cost of fuel which in consequence constrained the rapid development of the Settlement Programme of the Mahaweli Accelerated Programme. Livestock farms were set up in each of the Systems.

In the middle of 1984, the activities of the Draught Animal Program were combined with Dairy Development Programme (DDP) under a Mini Dairy Project.

The DDP was initiated at Niraviya Farm in System H and similarly at the Girandurukotte Livestock Farm in System C, a milk collection program has been commenced as a Pilot Project in March, 1984 now covering Zones 2 & 3.

It is reported that in the initial year about Rs. 150,000 /- have been earned by farmers contributing surplus milk to this program.

(2) Development Animal Husbandry

There are a large number of cattle and buffaloes in the area which have been used for draught as well as for the production of meat and milk. The main constraints for the development of animal husbandry in the area have been listed as follows:

i. Non availability of permanent grazing land for cattle and buffaloes in these areas;

ii. Inadequate transport facilities;

iii. Inadequate veterinary services;

iv. Lack of marketing facilities for produce like milk;

v. Out break of infectious diseases like Haemorrhagic Septicaemia (HS) and Foot and Mouth Disease (FMD);

The Project should take necessary steps, for the removal of these constraints and thus improve services to the farmers. The major proposals for improving animal husbandry in the Project Areas are as follows:

i. Demarcation of grazing lands'
ii. Upgrading of cattle and buffaloes through an intensified breeding programme;
iii. Control of infectious diseases prevalent in the area;
iv. Strengthening of veterinary services;
v. Improved marketing of milk produced in the area;

Expenditures for these proposals are estimated in the Project Support Costs.

(3) Posture Land Development Plan (Work II)

In order to proceed with livestock development in the area under the overall MRID's Programmes, it is also recommended that the uncultivated high land along the Mahaweli River should be reclaimed and converted to pasture land so as to lay the foundation for livestock development in the Area in the future.

(a) Area

The proposed posture land of 100 ha has been selected from the uncultivated land of 200 ha in Stage III along the Mahaweli River.

(b) Plan

It is proposed that a weir made of rubber should be built across the Hettipola Oya, at a point about 400 m upstream from its confluence with the Mahaweli, to supply water to the selected area of 100 ha by gravity.

In the near future, this system could be extended to the whole of the uncultivated area along the Mahaweli River by setting up associated pumping systems.

(c) Parameter

i)	Pasture land	100 ha
ii)	Rubber dam	
	Unit	One
	Height x Length	3.0 x 8.0 m
	Operation	Air Expansion
iii)	Pond (concrete)	
	Capacity	20 cu.m
	Unit	20

4.5 ROAD SYSTEM PLAN

4.5.1 Basic Policy

The existing road network corresponds to the canal system, namely the O & M road for the main canal and D-canal O & M roads serve both as the main public road in Stage II, III, IV and as village roads respectively. The present road network does not provide adequate among the villages due to lack of connection at the tail ends of D-canal roads. Encroachment and poor maintenance have impaired the function of the operation and maintenance roads for D-canals and many parts of them are not passable by cars. Existing roads should basically be rehabilitated, and a new main road is proposed to be constructed on the flood plain along the Mahaweli River and it is planned to connect it with the existing roads to improve the efficiency of the road network. The proposed road network would make it possible not only to implement effective operation and maintenance for the canal system, but to transport easily agricultural inputs and agricultural products both into, and out of, the scheme. Consequently, economic activity in the Project Area would be given a considerable impacts.

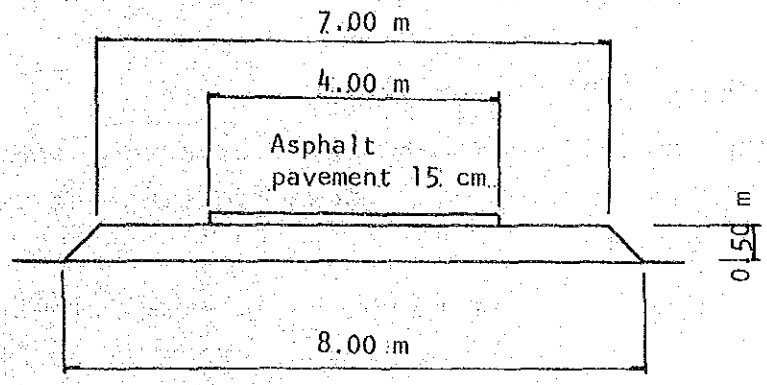
The main road starts from Weragama and ends at the downstream end of Stage IV. The new road is proposed to run through the flood plain away from the existing cultivated area and connect with the existing road system. New bridges of the proposed road are to have enough clearance to keep motor passage even during rainy season. (Work (II))

4.5.2 Rehabilitation of Roads

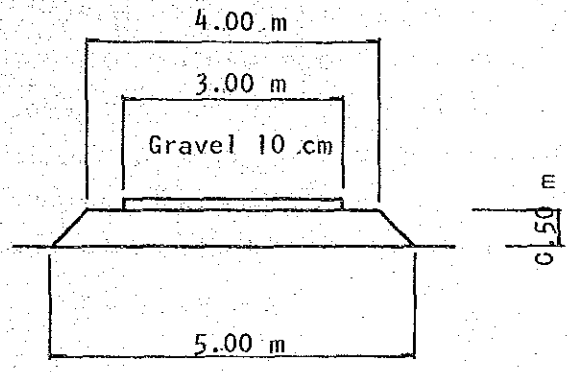
The roads in the area can be grouped into three types; main public road, village road and operation and maintenance road for the canals. The crest of the main canal bund is used as the main public road downstream from the Stage II. Maintenance condition of the main road is poor in Stage III and the main road is not paved from the end of Stage III through Stage IV except on the crest of Dunuwila Wewa. The construction of the main road from the Maraka at Stage III to Madakanda at Stage IV is being implemented by the Highway Department under the Integrated Rural Development Project (IRDP).

At present village roads maintained by the Land Commissioner are generally gravel roads and are paved with asphalt in only 10% of its length. It is recognized that neither Kandy nor Matale District have any implementation plan for pavement for the existing village roads. Operation and maintenance roads for the irrigation system are maintained by the Irrigation Department. The O/M roads have been encroached at considerable portions of D-canals and have an uneven surface as a result of lock of proper maintenance. Motor passage conditions in the road network is shown in Fig. 3.10.1.

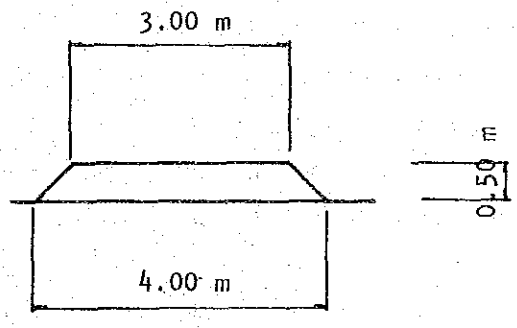
Rehabilitation of road is divided into three grades; Road I, Road II and Road III in terms of their importance and utilization. Typical cross sections of each category are depicted in Fig. 4.5.1. Operation and maintenance road for the distributary and field canals are planned to be rehabilitated as Road II and III in the course of canal



(a) Road I



(b) Road II



(c) Road III

Fig.4.5.1 TYPICAL CROSS SECTION OF ROAD

rehabilitation. The village roads are planned to be rehabilitated as Work (I). The location of village road rehabilitation is shown in Fig. 4.5.2.

4.5.3 Improvement of the System

The present road network affords poor communication to villagers due to lack of bridges crossing the streams and drainage canals.

Villagers living along the Mahaweli River have to travel 2 to 3 km in Stage II and 4 to 5 km in Stage III and IV to reach the main road used both as O & M for the main canal. Therefore, the new main road running the flood plain along the Mahaweli River is proposed as Road I grade to improve transportation to the big market of Mahiyangana. The proposed new road accompanies planned roads as Road II connecting with the existing village roads and O/M roads of canals. Improvement of the road system will be implemented as Work (II). Details of the road network is given in Annex V. The proposed road network is shown in Fig. 4.5.3.

4.5.4 Future Plan

It is expected that improvement of the system would accelerate economic activities in the area, however Stages III and IV, however, would still lay behind the development in Stages I and II due to lack of access road to the expanding economic sphere. Under the Mahaweli Development Programme System C starting from 1980, construction of towns and infrastructures are in progress on the opposite bank side of the Stages III and IV. Predicted population of 1990 accoriding to the settlement schedule of System C is shown in Fig. 4.5.4. Economic development in the Minipe area, especially Stages III and IV, should be linked with the development in System C both of which come within the same economic sphere. In this context, a bridge crossing the Mahaweli River at Hembarawa would have an important role to play in joining

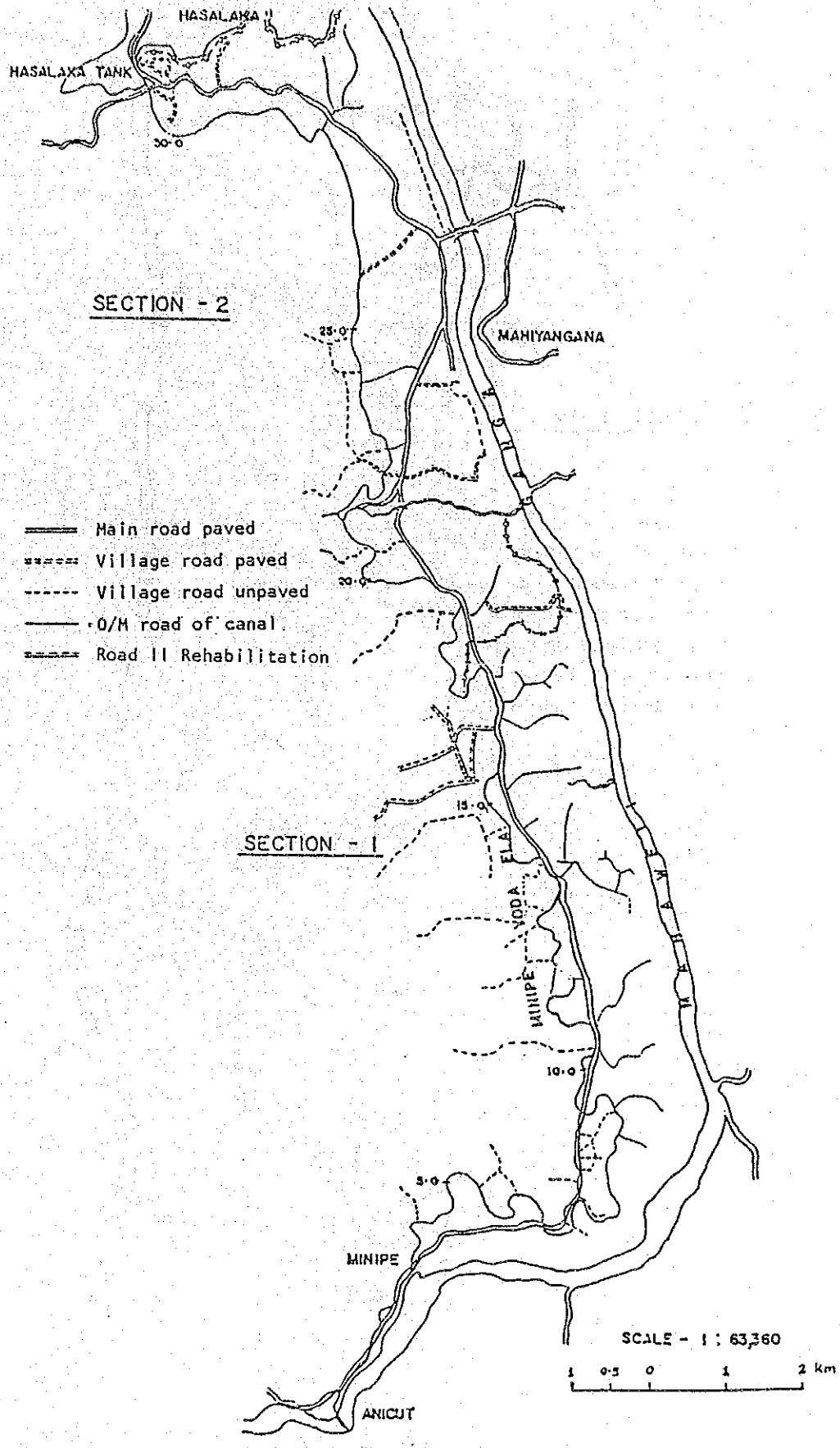


Fig. 4.5.2a ROAD NETWORK IN MINIPE STAGE I

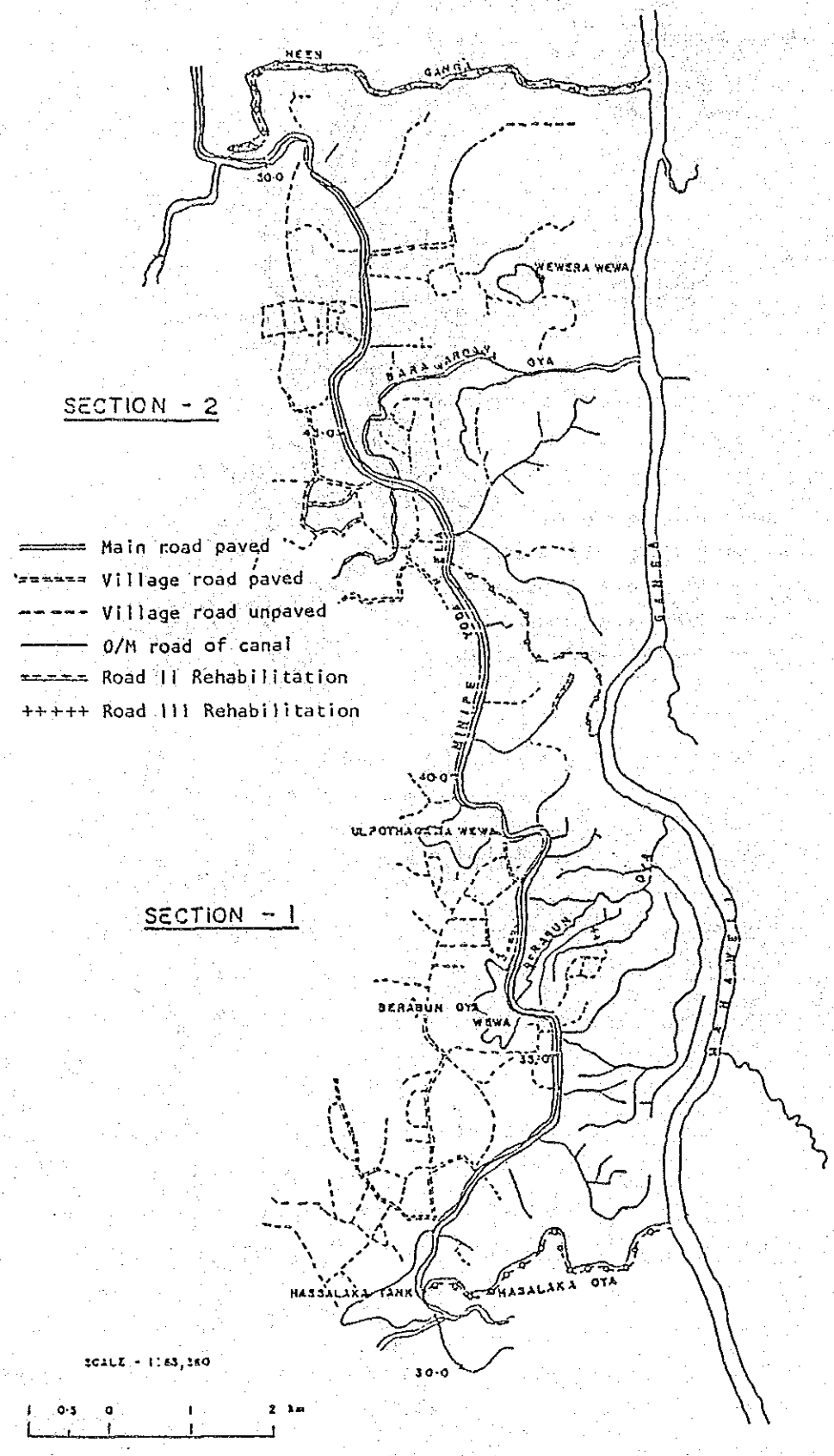


Fig. 4.5.2b ROAD NETWORK IN MINIPE STAGE II

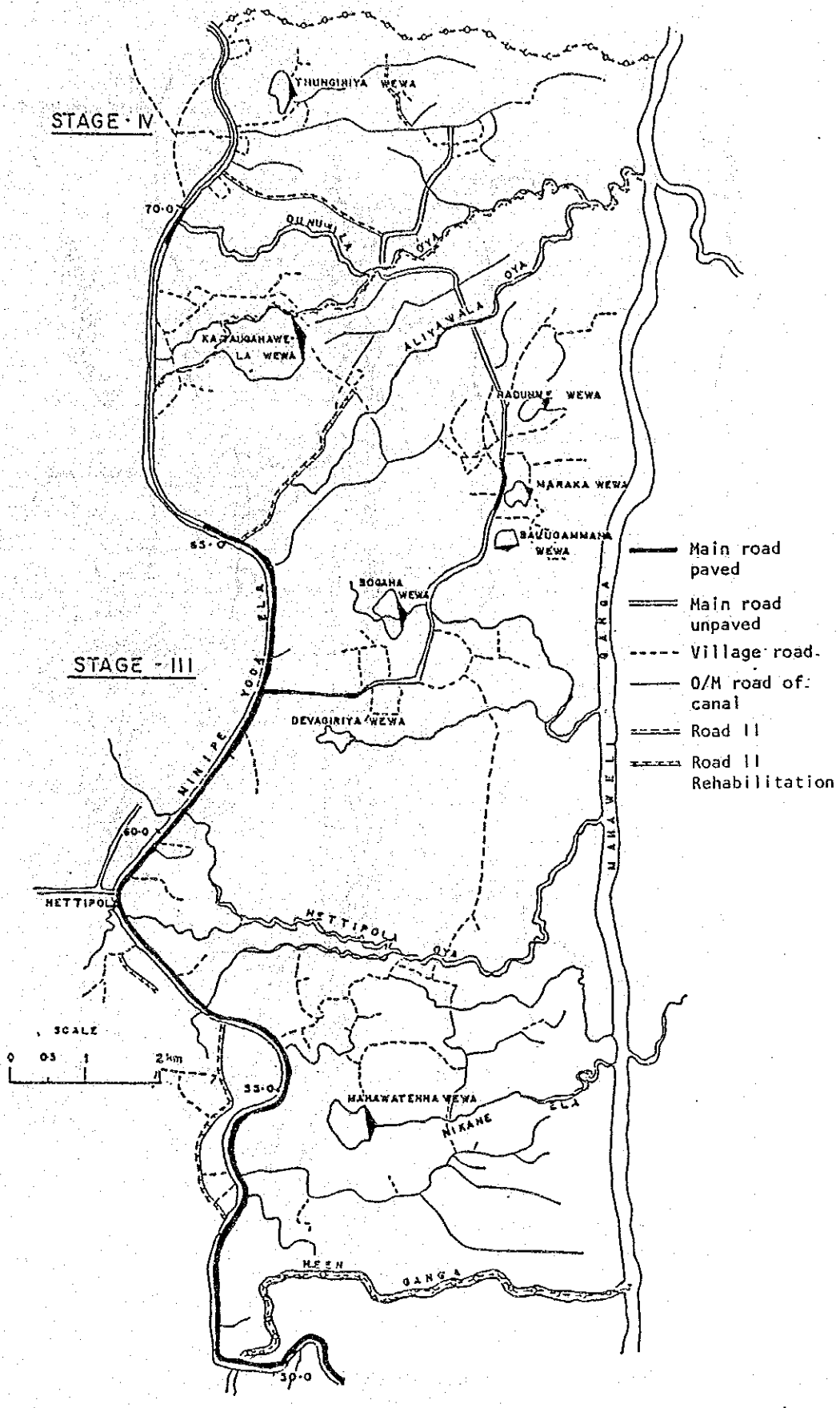


Fig. 4.5.2c ROAD NETWORK IN MINIPE STAGE III & IV

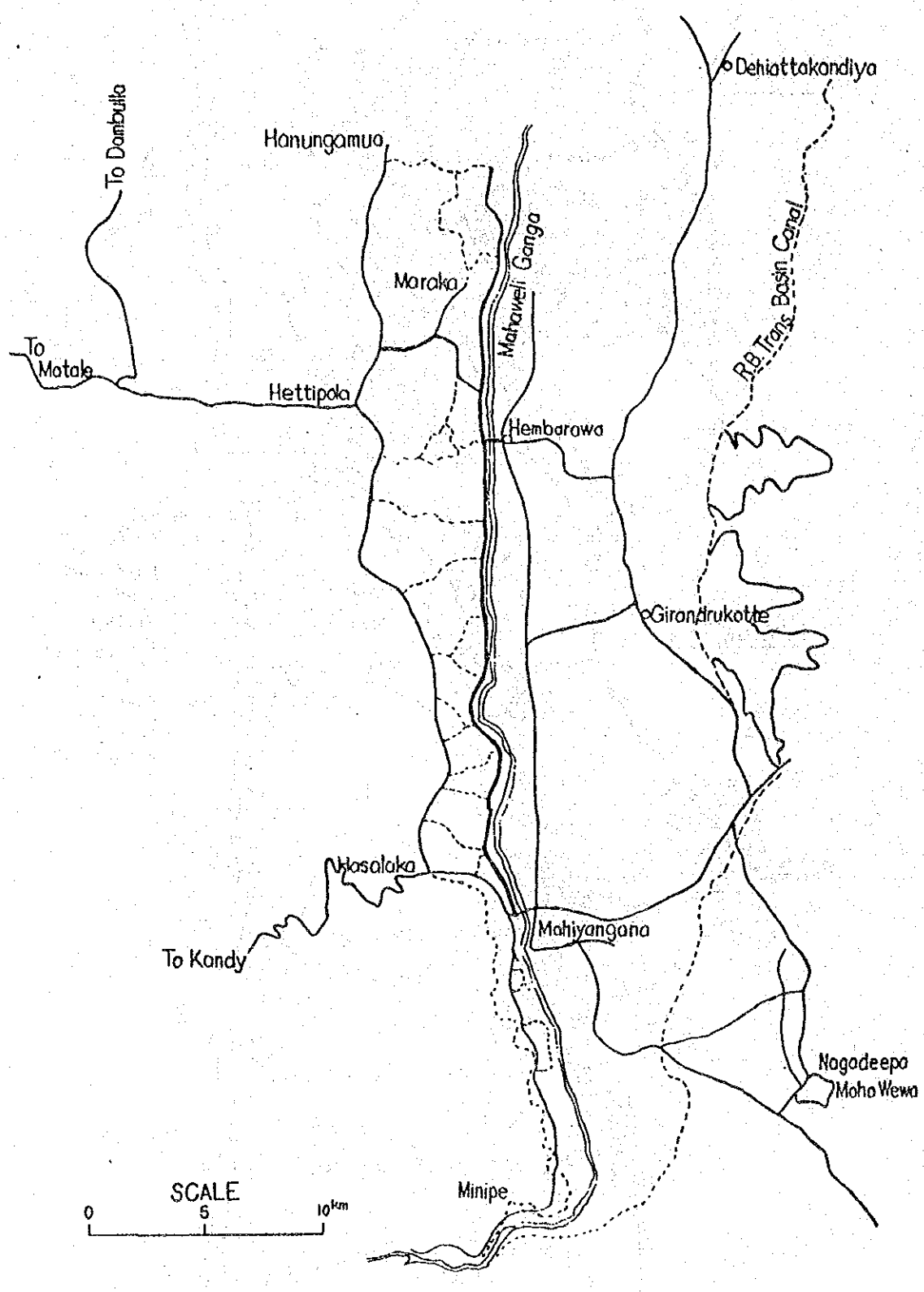


Fig.4.5.3 ROAD NETWORK

these to areas. Mileages from Maraka, the centre of Stages III and IV, to Girandrukotte (projected population of 61,000) and to Dehiattekandiya (projected population 103,000) are as follows:

		Proposed Network	
	Present	Without New Bridge	With New Bridge
Maraka - Girandrukotte	63.1 km	50.1 km	21.6 km
Maraka - Dehiattekandiya	86.2 km	73.2 km	35.6 km

A new bridge crossing the Mahaweli River will combine Stages III and IV with the economic sphere of the System C, as the result it is expected to bring noteworthy benefits. The free movement of agricultural products and input supply would be enhanced and job opportunities for the second and third generation settlers in the area would increase especially with the development of sugar cultivation in Dehiattekandiya. New demand in the sphere would provide an incentive for agricultural diversification to farmers in the Minipe area. A new bridge crossing the Mahaweli River is classified as the Work (II) Programme.

4.6. RURAL WATER SUPPLY PLAN

4.6.1 Basic Policy

Sources of domestic water in this area are mainly wells. Many wells run dry with of closure of the sluice on the main canal. Practically all well water cannot meet the microbiological standards of the World Health Organization (WHO). Exisitng pit wells should be improved to prevent the entry and seepage of polluted surface water. They should be dug deeper to provide access to ground water even in the dry season. Disinfection should be carried out for all wells to secure the villagers to some extent of the microbiological standards of WHO. Rural water supply plan will be implemented as the Work (II) Programme.

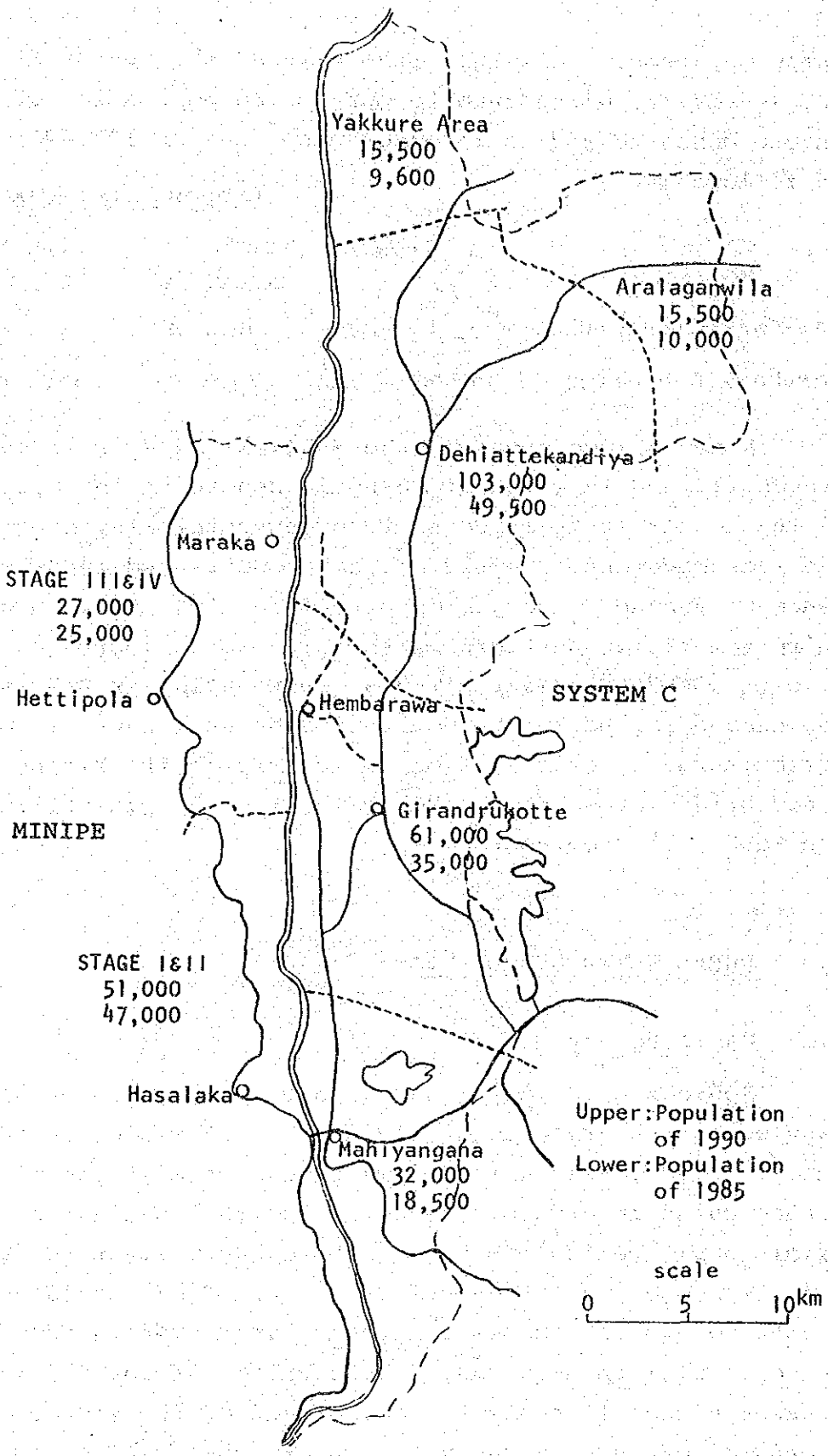


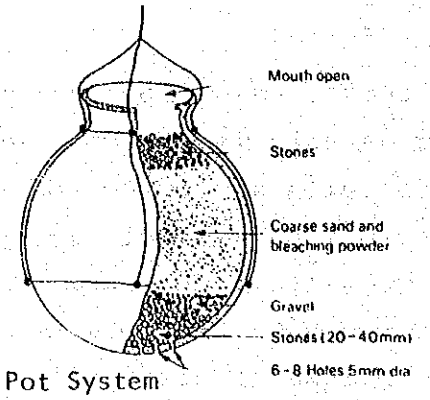
Fig.4.5.4 SETTLEMENT SCHEDULE - MAHAWELI GANGA DEVELOPMENT SYSTEM C

4.6.2 Improvement of Water Quality

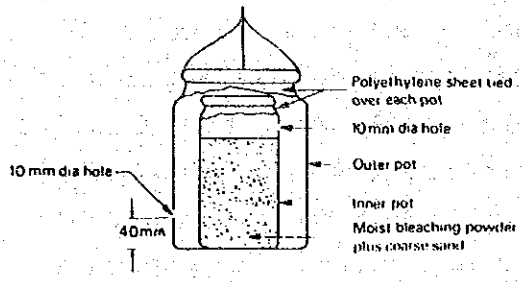
The quality of water in the main canal is polluted in proportion to flow down and usually is not used as drinking water. Water quality of all wells as sources of domestic water is under the WHO's maximum permissible level for chemical and physical characteristics but does not pass the microbiological standard of the WHO. For all wells disinfection should be executed because of difficulty in preventing completely intermix of coliform organisms. Disinfection method has to be simple enough for farmers to effective control by themselves. Adding chlorine to water by use of tablets of calcium hypochlorite is convenient and easy to operate but tablets are more costly than hypochlorite powder and sometimes it will be difficult to get the tablets. Pot chlorinator method by use of powder will be suitable for this area; two types of pot chlorinator are shown in Fig. 4.6.1. The single pot can cover sixty people and the double pot is suitable for serving up to twenty people. In the light of average families for a well in the area, the simple pot is proposed with the stipulation that materials of sand and bleach contained therein should be replaced in the same quantity at regular intervals.

4.6.3 Rehabilitation of Wells

Existing wells in the area can be classified into three types; pit well of 69%, concrete lining of 25% and brick made well of 6%. Existing pit wells should be dug deeper to reach groundwater the level of which gets lower during the dry season after closure of the sluice for the main canal. Hume pipes are inserted to prevent erosion inside the well and backfill is made of gravel in space between hume pipes and wall. Upper portion is backfilled by clayey soil to stop seepage from the surface. Wall and concrete slab is made at the outside portion of well and its prototype is shown in Fig. 4.6.2.



(a) Single Pot System



(b) Double Pot System

Fig.4.6.1
POT CHLORINTORS FOR DISINFECTING WELLS

All pit wells in Stages III and IV require improvement but rehabilitation of pit wells in Stages I and II will not be necessary to the same extent as in Stages III and IV. Furthermore, new 110 wells in Stages III and IV are proposed so as to attain the same level in Stage II. The number of existing wells and their rehabilitation are shown in Table 4.6.1.

Table 4.6.1 REHABILITATION PLAN

Number	Stage I	II	III & IV	Total
Existing Wells	1,240	1,100	514	2,854
Pit Wells	855	759	355	1,969
Wells Made of Concrete or of Bricks	385	341	159	885
Wells to be Rehabilitated	266	352	355	973
New Wells	-	-	110	110
Tube Wells			50	50

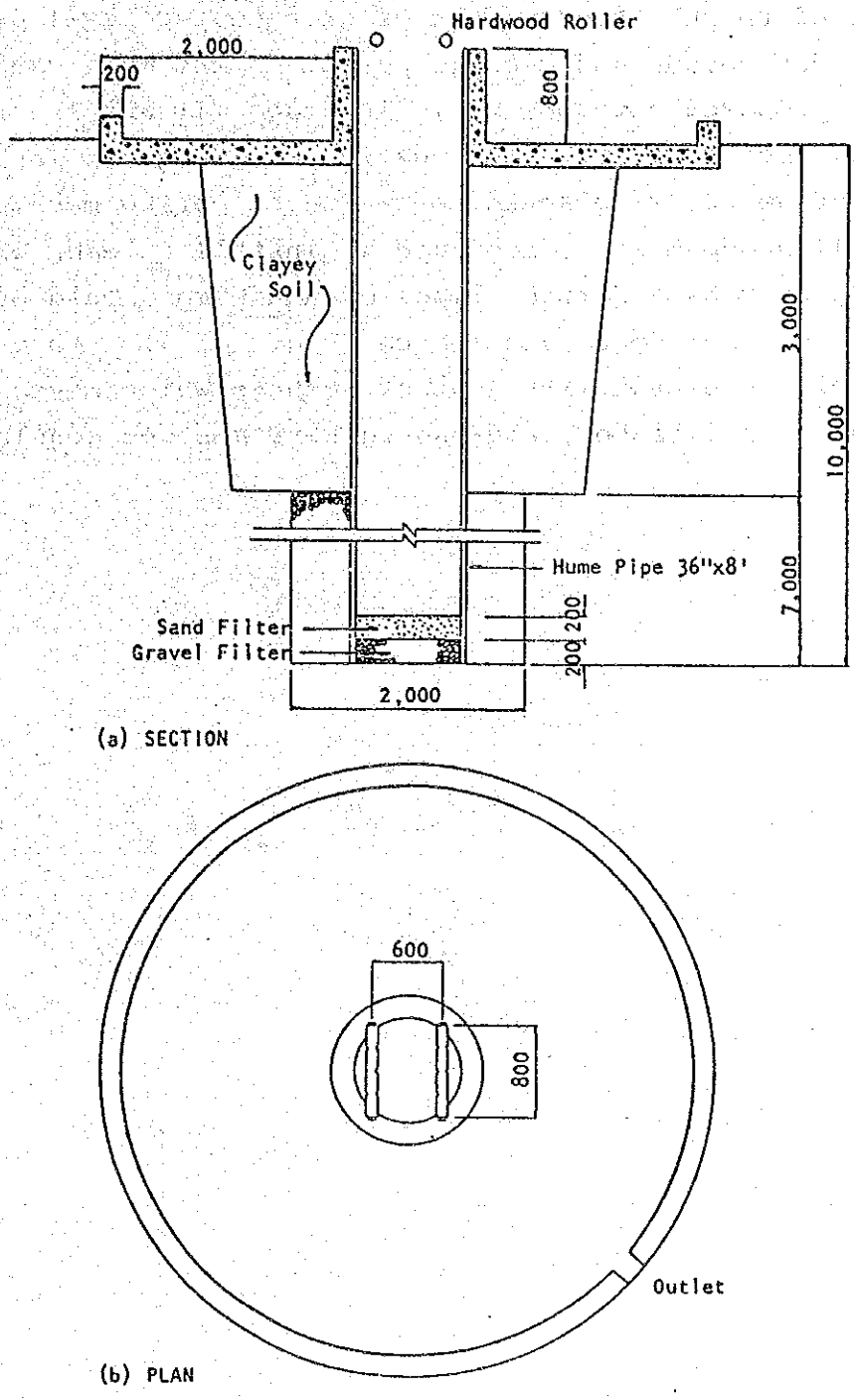


Fig.4.6.2 PROTOTYPE WELL