THE DEFINIT PLAN REPORT
OF
AGRICULTURAL DEVELOPMENT PROJECT
IN CEYLON
FOR
DEWHUWA COMMUNITY

NOVEMBER 1969

OVERSEAS TECHNICAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

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M.A.F. = Ministry of Agriculture and Forestry

O.T.C A. = Overseas Technical Co-operation Agency

Chapter I Introduction

Chapter I Introduction

1–1 Background Information

This Technical Report deals with the planning design and construction of the Dewahuwa Community Development Project.

The aim of this Project is the over-all agricultural development of Dewahuwa which is expected to provide some guidelines for the future in the improvement of rural life in the Dry-Zone.

In July 1968, a team of Japanese experts headed by Dr. Hiroshi Nasu visited Ceylon in pursuance of the discussions held between Prime Minister Mr Dubley Senanayake of Ceylon and Mr. Eisaku Sato, Prime Minister of Japan, and proposed a "Community Development Program" that would combine the three aspects of improvement of the irrigation systems, introduction of modern agricultural technology, and the development of farmers' organizations.

In February 1969, the second team led by Dr. Hitoshi Fukuda in the early part and Mr. Motonaga Ohto later, made a feasibility survey in Ceylon so as to provide the necessary information with a view of implementating Dr. Nasu's proposals. As the result of the investigations, Dewahuwa was selected from 8 candidate villages designated by the Ceylon Government.

On July 9, 1969, the survey and design team headed by Mr. Kooichi Imoto arrived in Ceylon and stayed at the Dewahuwa Project site for 50 days for the purpose of making the comprehensive and grass-roots investigation necessary for undertaking detail designs.

In this Report are assimilated the Comprehensive results of these surveys.

1–2 Project Area

1 - 2 - 1 Location

Dewahuwa is located roughly in the center of Ceylon, in the Dry-Zone. The Project site in the Dewahuwa Colony lies 6 miles north of Galewela midway along the Colombo-Trinicomalee National Highway, being divided into two administrative districts: the Central Province and the North-Central Province. The Project area consisting of Tracts 1 to 4, of a total of 9 Tracts, comprises approximately 770 acres of paddy fields and 460 acres of highlands, the highland being allotted for colonists' homesteads, orchards and farms.

1 - 2 - 2 Physical Features

The outline of the Dewahuwa Colony forms the shape of a "U", with the open and facing north and the closed end south, connected to a narrow strip containing the Dewahuwa Tank, formed by daming the Hevanella Oya. The project-area is about one third of the entire area of the Colony and is located at the closed south end of the U shape. The irrigation channel originating at the Dewahuwa Tank runs between the paddy fields and the highland, supplying water to each paddy field through the laterals. The Hevanella Oya flows from south to north along the western boundary of the Colony, draining the project area. The land slopes generally westward and its altitudes ranges from 500 feet at the paddy fields to 660 feet at the top fo the hills scattered over the highland.

1 - 2 - 3 Climate

Dewahuwa has an equatorial climate typical of Ceylon. According to the observation records at Maha-Illuppalama, the monthly average maximum daily temperature is highest in April, at 92.3°F., and lowest in January, at 69.0°F. The monthly average mean daily temperature is highest in September, 83.2°F., and lowest in January, at 76.7°F.

Wet north eastern monsoons blow during the Maha season (from November to March) bringing rains to this region, while dry south western monsoons come during the Yara season (from May to September) which is responsible for the devastating dehydration there.

Precipitation from October to September for the last 15 years averages 70.28 inches. Over the same period the maximum daily rainfall reached 8.83 inches and the minimum 2.93 inches.

1 - 2 - 4 History and Settlement

During the second Century B.C., Dewahuwa Tank is said to have been built by King Dutugamunu for the purpose of cutting off the water supply to a downstream enemy stronghold as well as for securing irrigation water for the production of food stuff needed to sustain his own army.

In the 10th Century, the bank of Dewahuwa Tank was destroyed by an extroadinary flood, at the same time ruining the elaborate irrigation system. After being buried in oblivion, the remains of this tank were discovered by the colonial government in 1883, since which time proposals for its restoration have been repeatedly made. Yet, it was only after the enactment of the Land Development Ordinance in 1935 for agricultural development in the Dry-Zone that the colonization scheme centering on the restoration of Dewahuwa Tank came to be worked out.

In September 1949, the upper stream area consisting of Tracts 1 to 4 was

completed and an allottment of parcels of 5 acres of paddy field plus 3 acres of highland was made to 139 colonist families.

According to the survey, February 1969 the Dewahuwa Colony was made up of 311 households with a population of 1,993, grouped in 4 categories: (1) Colonists and their legal successors, (2) Descendants of "Permit-Holders", (3) Bulanawewa Villagers, and (4) Squatters.

1–3 Project Features

1 - 3 - 1 General

1) Basic Plan

The planning and design described in this Report conform to the basic plan in the Feasibility Report.

The basic plan comprises the following seven major programs:

(1) Farm-management improvement plan
(2) Infra-structural improvement plan
(3) Pilot farm scheme
(4) Agro-industry development plan
(5) Better-living program
(6) Maintenance and operation program
(7) Agricultural co-operative development plan

This Report deals with the technical aspects of the construction work in the above programs. The main facilities as proposed are:

(i) Designs concerning "(1) Farm-management improvement plan"
Buildings of the Agricultural Mechanization Center

(ii) Designs concerning "(2) Infra-structural improvement plan"
Facilities of the paddy-field irrigation system Facilities of the field irrigation system in the upland
Farm roads
Drainage system
Paddy-field rearrangement

(iii) Designs concerning "(3) Pilot-farm scheme"
Paddy-field pilot farm
Upland-field pilot farm

(iv) Designs concerning "Better-living scheme"
Facilities for the domestic water supply

Between this Report and Feasibility Report, there is no radical change in the planning other than some differences in scale and location.

2) Outline of Proposed Work

(i) Paddy Field Irrigation Works

The existing paddy field irrigation system in the project area consists of the Dewahuwa Tank, the main channel, laterals and related structures. As far as the Tank and intake facilities are concerned, there is no particular defect to be corrected, but the main channel and laterals which are unlined have insufficient capacity for the designed discharge because of silting caused by erosion of the slope. Therefore, desilting work along the full length of the main channel and laterals is planned to maintain their gradients: for the main channel, 1/3000, and for the laterals, 1/2000. The collapsed slopes of the main channel are designed to be revetted with rubble massonry.

For stabilization of the designed intake water level, 8 check gates are to be installed along the total length of the main channel.

Two parshall flumes as water measurment device are designed to be installed at the beginning and the end points (tract 4) of the main channel.

Outlets along the main channel equipped with concrete shutters, a source of heavy leakage, are to be reinstalled with metal slide gates.

Lateral outlets which are of the open type and not controllable are to be equipped with wooden stoppers.

Paddy fields are to be rearranged to the purpose of facilitating mechanization: Farm roads 6 feet in width are proposed for the use of cultivators and small channels along this proposed roads are designed to convey irrigation water into each plot regularly. Improvement is to be made of existing paddy field farm roads which are at times submerged because the surface elevation at some points is comparatively low. Farm roads are to be embanked with earth obtained from the proposed borrow pit. A new farm road 12 feet in width is designed to run along Hevanella Oya so as to link each of the exsisting farm roads.

(ii) Upland Field Irrigation Work

Field irrigation water to be taken from Hevanella Oya by the weir to be built is to be pumped up into the regulating pond through a steel pipe line. Then the water is to be delivered to the proposed fields through the pipe line system which is to consist of the main pipe line from the pond to the location of the Bandaranaike statue and the lateral pipe lines.

Poly vynil chloride pipes are designed to be used for the main and lateral pipe lines.

(iii) Domestic Water Supply Facilities

The domestic water facilities are designed to have sufficient capacity to supply 2000 residents in Tracts 1 to 4. According to the water quality test, the water

obtained from Hevanella Oya, the same source as that of the field irrigation water, was recognized to be suitable for domestic use.

Taking additional safety measures, a filtration gallery intake facility is to be built and sterilization equipment installed at the regulating pond and the reservoir of the Booster Station. The pumping station is designed to boost the water to the area covered by lateral J, but all other laterals deliver the water by gravity.

(iv) Pilot Farm

Through implementation of this Project, new technology little known and scarcely practised in this area is to be introduced. For this purpose, two pilot farms of paddy field and upland field are planned to be established in order to facilitate adaption and acceptance by the farmers.

The paddy field pilot farm is to be of approximately 3.2 acres in area of the 6 acres of land reclaimed from the abandoned tank near the left bank of main channel STA. 68.

The upland field pilot farm of 3 acres is designed to be established from the reserved land on the right bank of main channel STA. 57, to be divided into two areas: a Sprinkler irrigation area and a furrow irrigation area.

(v) Agricultural Mechanization Center

For the purposes of repair of and training for farmmachinery, especially the cultivators, a Center to consist of eight buildings is to be built on the same reserved land as the upland field pilot farm.

3) Alterations from the Feasibility Report

The designs of these facilities, as previously stated, were done in compliance with the basic plan established by the Feasibility Report. However, as a result of the most recent survey, the Feasibility Report has been altered in the following points.

(i) Main Channel, Laterals and Related Structures

The unit duty of water for paddy fields was altered form 14.2 mm/day (0.56 in/day) in the Feasibility Report to 20.0 mm/day (0.8 in/day). Accordingly, the amount of desilting work for the channel was increased. As a result of the most recent survey, the total length of channel maintenance work, 5,000 ft. of which was advocated in the Feasibility Report, was also increased to 6,106 ft. and the section of embankment with channel maintenance work was increased to 735 ft.

Check-gates were planned to be installed at 10 points at 1 mile intervals in the Feasibility Report. As a result of final studies on non-uniform flow, the sill

height of the intake and the gradient of the channel, it was clarified that checkgates at 8 points will be sufficient. Accordingly, the number of check-gates were decreased from 10 to 8. Also, the type of check-gate was changed from the hand-operated radial-gate proposed in the Feasibility Report to a steel slide gate with frame.

In the Feasibility Report, an outlet was designed with a concrete box at its down-stream portion and an outlet valve installed on the concrete box. This was altered to renovation work on the inlet side of the intake with a circular slide gate to be installed there. On the down-stream side of the intake, the concrete box is to be provided and a rectangular weir is to be set at the portion where the water drops into the channel from the box, with the capability of lmeasuring the discharge.

Intakes planned to be installed at 50 points in the Feasibility Report were increased by 4 to total 54 points.

The water measurement device was planned to include a self-recording water gauge to be provided at 4 points, in the Feasibility Report. This was altered to provide a self-recording water gauge at only one point near the intake tower, and to provide Parshall Flumes at 2 points, one near the beginning point of the main channel and the other at the end point of the main channel in Tract 4.

Bridges to be provided at 5 points remain unchanged from the Feasibility Report, however, their structures are altered form T girders to P.S. concrete slabs at 4 points, and composite girders using steel 1 beams at 1 point.

It was planned to excavate another line lateral channel along the existing laterals, in the Feasibility Report. This was altered to cancel the excavation of the additional lateral, but instead to desilt the bottom of the existing laterals and, by doing so, discharge the designed discharge through the existing laterals. At the same time, the 25 turn-outs which were to be provided in the Feasibility Report were cancelled.

(ii) Upland Field Irrigation Facilities and Domestic Water Supply Facilities

In the Feasibility Report, the upland field irrigation Facilities and the domestic water supply facilities were planned separately. Based on the result of the water quality test and considerations for economy and further expansion, this was altered so as not to separate these facilities but to use one facility for both purposes. For this reason, sterilization equipment are to be installed at the regulating pond and at the reservoir of the Booster Station.

The intake weir was planned by the Feasibility Report to have a length of 150 ft. and a height of 14 ft. This was altered to 100 ft. in length and 12 ft. in height. The mode of intake planned by the Feasibility Report was to collect surface water of the river through a screen, but from the stand-point of collecting domestic water, this was altered to adopt the infiltration gallery method so as to collect once filtered

water.

The equipment of the pumping station was altered from 2 units of pumps with a suction bore diameter of 7" and a capacity of 40 h.p. to 2 units of pumps with a suction bore diameter of 8" and a capacity of 55 kw. A Diesel engine was planned to be used for driving pumps in the Feasibility Report. This was changed to an electric motor because of the availability of an electric power supply for the Dewahuwa Area.

Conveyance pipe lines are to be of steel pipes and their total length was altered form 4,500 ft. to 1,800 ft. Distribution pipe lines from the regulating pond included in the Feasibility Report were 9,000 ft. of main line and 5,000 ft. of lateral lines; however, this was altered to 6,800 ft. of main line and 34,800 ft. of lateral lines, all consisting of polyvynil chloride pipe. Further, pipe. Further, pipe aqueducts at 3 points and 1 booster station were added.

(iii) Farm Roads

The plan for farm roads remains unchanged from that of the Feasibility Report with the exception of the addition of one farm road of a width of 12 ft. and a total length of 12,300 ft. to be newly constructed along the Hevanella Oya. Accordingly, culvert works at 17 points have been added.

(iv) Paddy Field Rearrangement

In compliance with the basic plan established in the Feasibility Report, 3 to 4 existing plots are to be consolidated into one sizable plot. By doing so, the existing 14,004 plots are to be consolidated to 4,767 plots. Concrete field outlet blocks for each plot planned in the Feasibility Report were altered to wooden field outlet blocks.

(v) Pilot Farms

It was planned in the Feasibility Report to develop 4.0 acres of land as a paddy field pilot farm and 10.0 acres of land as an upland field pilot farm. As a result of reconnaissance made by the last survey mission and by an indication given by Dr. I. Tanaka, the plan was altered to develop 3.2 acres of land as a paddy field pilot farm and 3.0 acres of land as an upland field pilot farm so as to provide more opportunity for the farmers to receive the direct guidance of agronomy experts.

(iv) Broadcasting Facilities

In the Feasibility Report, wire broadcasting equipment was planned to be installed in the project area as a part of the activities of the Agricultural Cooperative. This was altered to provide 2 Publicity Cars equipped with public-address systems for the publicity activities of the Agricultural Cooperative.

(vii) Agricultural Mechanization Center

The scale and number of the facilities and buildings for the Agricultural Mechanization Center remain unchanged from the Feasibility Report. The buildings were planned to be of steel frame structure and asbestos roofing in the Feasibility Report. This was altered to brick structures with asbestos roofing.

1 - 3 - 2 The Main Features of the Project

(1) Main Channel

a) Channel

Total length of desilting	51,300 ft
Slope protection Random rubble masonry	6,106.0 ft
Embankment & random rubble masonry	735.0 ft
Embankment	7,060.0 ft
Proposed channel gradient	1/3,000

b) Related structure

Improved outlet	ϕ4"	11 Nos.
	ϕ6"	14 "
	ϕ9"	13 "
	ϕ12	3 "
	ϕ18	3 "
	Gate type	2 "
	Total	46 "
Proposed outlet	ϕ4"	1 "
Check structure		8 set
Parshall flume		2 "
Crossing Bridge	Width 10'	5 "

(2) Lateral

a) Channel

Total length of desilting	4,295.0 ft
Proposed channel slope	1/2,000

b) Related structure

Improved outlet	ϕ4"	1 Nos.
	ϕ6"	4 "
	ϕ12"	1 "
	ϕ18"	1 "
	Total	7 "

(3) Upland field irrigation and domestic water supply

a) Weir

Length	100 ft
Height	12 ft

b) Gallery

Collecting pipe	ϕ500mm x 136 ft
Intake pipe	ϕ500mm x 13 ft

c) Sump well

Diameter ϕ3,000 (corrugated steel pipe)

Depth 23' - 11"

d) Pumping station

Pump capacity	210 ft^3/min
Bore 200mm x 150mm 2 set, Dauble suction volute pumps	
Actual lift	141.00 ft
Motor power	55.00 kw

e) Pipe lines

Total length of Main pipe	6,789.2 ft
Total length of Lateral	34,827.0 ft
Total length of Conveyance pipe	1,789.9 ft

f)	Pipe aqueduct	3 set
g)	Regulating pond	Capacity 6,000 cuft 1 set
h)	Reservoir for booster station	Capacity 2,000 cuft 1 set Depth 6 ft

i) Booster

Capacity	1.42 ft^3/min
Total lift	30 m (98.4 ft)
Bore	ϕ40 mm, 1 set
Motor power	2.2 kw

j) Tap stand 48 Nos.

(4) Farm roads

a)	Improved Main Farm Roads (width 12', Height 2.0')	9,102.1 ft
b)	Improved Lateral Farm Roads (width 12', Height 1.0')	12,400.0 ft
c)	Proposed Main Farm Roads (width 12', Height 2.0')	12,254.0 ft
d)	Proposed Lateral Farm roads (width 6', Height 1.5')	45,530 ft
e)	Culvert 17 Nos.	

(5) Paddy field rearrangement

Total area	771.1	ac
Existing paddy field	14,004	plots
Consolidated paddy field	4,767	plots

(6) Pilot farm

Paddy field	80' x 220'	8 plots	= 3.2 ac
Upland field	66' x 166' x	12 plots	= 3.0 ac

(7) Pilot farm building-cum-Agricultural Mechanization Center

Total floor space of buildings 21,600 ft^2

Chapter Ⅱ Design

Chapter II Design

2–1 Irrigation Facilities

2 - 1 - 1 Improvement of Main Channel and Laterals

1) Duty of Water

i) Water Requirement in Depth:

The consumption of water for the paddy fields in the project area could have been estimated by actually measuring the variation of water surface in the paddy fields, but this method was not applicable because they had been rendered dry for the non-irrigation period at the time of the investigation, in July and August, 1968.

Consequently another practical method of setting two iron cylinders in a paddy as illustrated in the Appendix was adopted. By this method, the water requirement in depth was measured at 3 spots selected in each of Tracts 1, 2 and 3 for a period of one week. The results showed 30 to 50 mm/day under normal conditions. These data are included in the Appendix. On the other hand, the value was approximately 20 mm/day when straw mats were placed on the cylinders so as to determine the ratio of evaporation and percolation. As the results of these surveys, it is estimated that evaporation is 10 to 30 mm/day and percolation is approximately 20 mm/day. These values are considered to be too excessive to be adopted as the net water requirement in this planning because the extreme dry condition around and under the measuring spots caused more excessive evaporation and percolation than would be true under the conditions of the paddy fields in the irrigation period. As both downward and border percolation depend on the soil conditions and ground-water, the actual percolation from the paddy field is appropriately estimated at 7 mm/day, which is 30 percent of the above measured value, in accordance with data available in Japan: the water requirement in depth in paddy fields of mature soil is approximately 30 percent of that of paddy fields just reclaimed. According to the data in the Feasibility Report, the monthly evaporation at Kalawewa is a minimum of 0.38 ft. in November, a maximum of 0.75 ft. in July, and a total of 7.39 ft.

This pan evaporation averages 6 mm/day. The average evaporation from the paddy field is estimated to be about 50 percent of the average pan evaporation because rice growing limits evaporation caused by sunshine and wind. The average transpiration during the irrigation period is said to be about 6 mm/day, regardless of differences in area. According to the data in the Feasibility Report, rainfall is at a minimum in July· the minimum available rainfall is 0.5 mm/day in monthly average.

ii) Net Water Requirement

The amount of irrigation water per unit area of paddy field is determined by the use of the following formula and the obtained valued given above.

Net Water Requirement = [(average evaporation from paddy field) + (average transpiration) + (percolation from paddy field)] x 1.6 - (minimum available rainfall)

= [(3.0 mm + 6.0 mm)] x 1.6 - 0.5

= 20.9 mm/day

= 20 mm/day

iii) Gross Water Requirement

The amount of irrigation water needed at the head of the irrigation system per unit area is calculated according to the following formula:

$$Q = \frac{d \times A \times 43,560}{(1-r)(24 \text{ hr.} \times 60 \text{ min.} \times 60 \text{ sec.})}$$

where, d: net water requirement (ft.)

20 mm/day, 0.666 ft./day

A: irrigation area (acres)

r: conveyance loss of 0.40

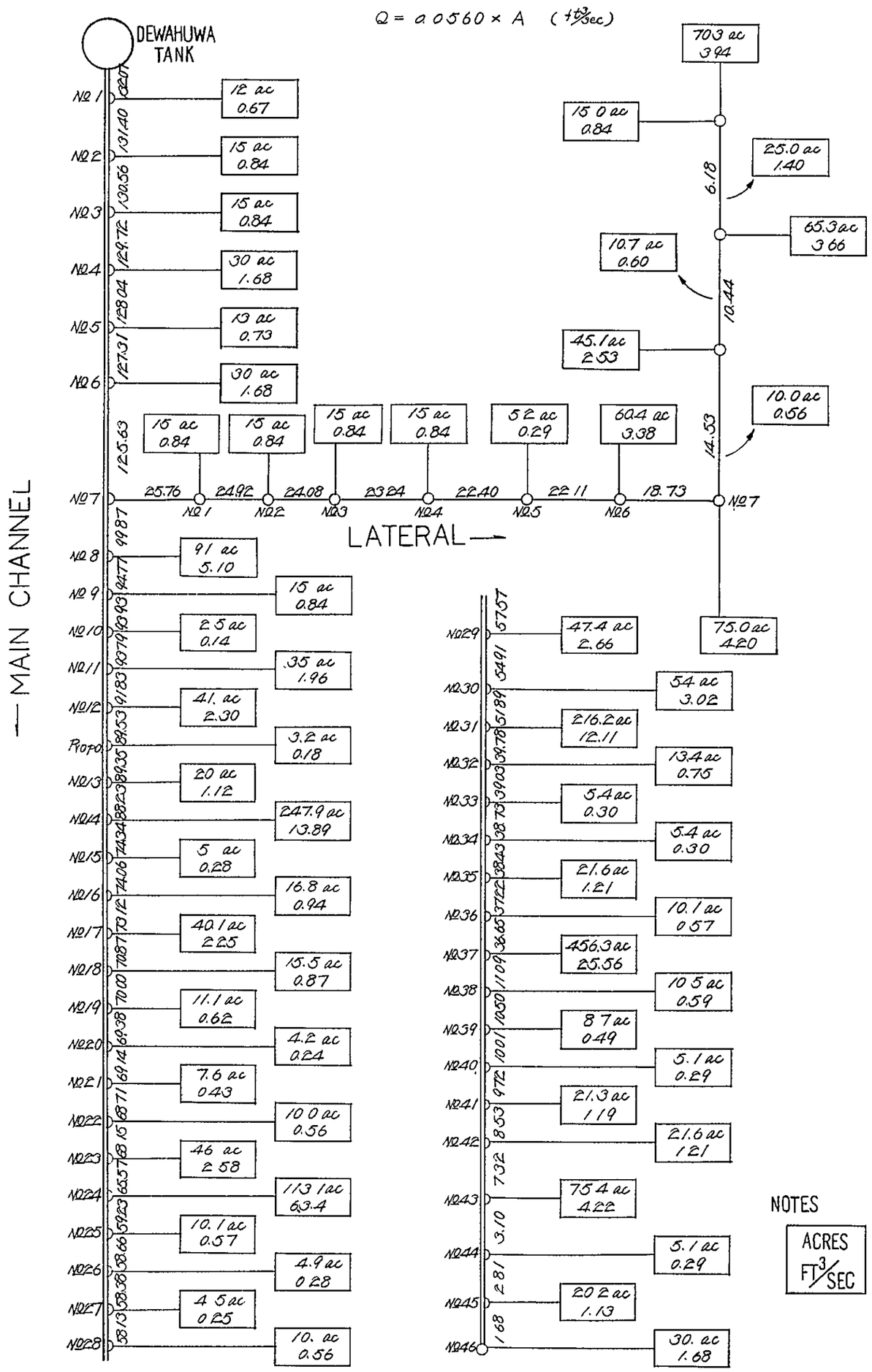
therefore,

$$Q = \frac{0.0666 \times 43,500 \times A}{(1 - 0.40) \times (86,400)} = 0.0560 \text{ cu.ft./sec.} \times A$$

vi) The designed discharge of the main channel at each interval and the designed discharge of outlet:

According to the above formula and the surveys of the area irrigated by exsisting outlets, the designed discharges of the main channel at each interval and of the outlet are determined as follows:

DESIGN DISCHARGES OF MAIN CHANNEL



2) Desilting Work

The differences of altitude between the channel bed in the original and that in the present at the station of each outlet were surveyed to be as follows:

Table 2 - 1 The Estimated Depth of Silting at the Main Channel

Outlets No.	Exist. Sill of Main Channel	Original Sill of Main Channel	Depth of Silting	Location
No. 1	571.3	569.8	1.5 ft	650 ft
No. 2	570.6	569.7	0.9	1020
No. 3	570.8	568.3	2.5	2650
No. 4	570.8	569.2	1.6	2720
No. 5	567.7	567.5	0.2	5600
No. 6	567.7	567.4	0.3	8630
No. 7	567.1	566.7	0.4	11600
No. 8	567.0	566.5	0.5	12160
No. 9	565.9	564.5	1.4	15950
No.10	565.3	564.1	1.2	17150
No.11	564.5	563.5	1.0	18270

Because silting to an average depth of one foot has occurred as seen in the above table, the main channel is required to renovate by removal of silt on its bed. The main channel is designed to be 571.7 Feet in its bed elevation at the beginning point (STATION O) and to keep 1/300 longitudinal gradient through.

In an unlined channel, the velocity should be such as to prevent scouring and deposition. The maximum velocity allowable, to prevent scouring or the minimum allowable to prevent silt deposition will depend on soil characteristics. According to the judgement based on empirical data, the velocity of the main channel should be kept from 1.0 ft/sec to 2.0 ft/sec, because the main channel bed consists of silt loam that has the above limit.

In addition to the channel bed excavation, the excavation and embankment for the side slope is to be designed within the range of the general limits of the velocity, in reference to the hydraulic calculation previously made. The side slope protection is to be provided with a random rubble masonry for those sections in a state of extreme damage.

3) Improvement of Outlets

Forty six outlets have been located along the full length of the main channel and six outlets along the branch channel to irrigate TRACT 3. A acst iron circular

gate is to be installed at the entrance of each outlet, to provide water-tightness and off-take regulation. A recutangular notch is to be installed at the exit of each outlet as a water measurement device. The location and main items of the outlets to be improved are as follows:

Table 2 - 2 List of Outlets on Main Channel

Outlet No.	Irrigable Area	Diameter of Pipe	Outlet Sill	Station
No. 1	12	6	570.07	650
No. 2	15	6	569.85	1020
No. 3	15	6	570.80	2650
No. 4	30	9	569.38	2720
No. 5	13	6	568.82	5600
No. 6	30	9	569.91	8630
No. 7	442	2 Bay 1"6"x1'6"	566.71	11600
No. 8	91	12	566.50	12160
No. 9	15	6	565.80	15950
No.10	2.5	4	565.20	17150
No.11	35	9	565.06	18270
No.12	41	9	564.41	19250
No.13	20	6	563.91	21550
No.14	247.9	18	563.25	22288
No.15	5.0	4	563.34	23192
No.16	16.8	6	563.03	23820
No.17	40.1	9	560.88	25665
No.18	15.5	6	561.20	27300
No.19	11.1	6	560.63	28106
No.20	4.2	4	559.96	29300
No.21	7.6	4	559.78	30212
No.22	10.0	6	559.30	31438
No.23	46.0	9	559.21	32135
No.24	113.1	18	558.73	33513
No.25	10.1	6	558.76	33623
No.26	4.9	4	558.43	33920
No.27	4.5	4	558.40	34200
No.28	10.0	6	558.00	35650
No.29	47.4	9	556.67	36900
No.30	54.0	12	555.40	37800
No.31	216.2	18	556.53	38100
No.32	13.4	6	555.79	39117
No.33	5.4	4	555.95	39900
No.34	5.4	4	556.00	40030
No.35	21.6	9	555.49	41800
No.36	10.1	9	554.83	42387
No.37	456.3	2 Bay 1'6"x1'6"	555.27	43422
No.38	10.5	6	553.99	44700
No.39	8.7	4	553.60	46000
No.40	5.1	4	553.30	46814
No.41	21.3	9	553.21	47508
No.42	21.6	9	552.80	47940
No.43	75.4	12	553.33	49900
No.44	5.1	4	553.53	49485
No.45	20.2	9	552.87	50621
No.46	30.0	9	551.41	51462

Small outlets with a diameter of 4" to divert the irrigation water to each allotment are provided from TRACT 1 to TRACT 4. A wooden 4" pipe plug is to be provided at each pipe outlet for the effective utilization of the irrigation water. The number of pipe outlets are listed in the following table.

Table 2 - 3 Number of Outlets

TRACT No.	Number of Outlets
1	13
	10
	107
	23
Total	153

4) Check Structures

Ten check structures are provided on the main channel at intervals of approximately one mile in due consideration of the channel slope. The check structures are required to maintain sufficient water head for diverting water at the outlets. The size and general shape of the check structure are determined in consideration of hydraulic, operational requirements and structural economy.

The check controls are of either the overflow type employing stop planks or the underflow type employing gates. The overflow type has better control ability in keeping the water surface, while the underflow type provides better control of the quantity of water flow. In view of this, all check structures combine the two types of control.

The stop planks are provided at either side of a check structure because the velocity of main channel is not so excessive as to cause difficulty in the handling of the planks. Radial gates or slide gates are generally employed as check controls. It is difficult to install the radial gate and in addition, the radial gate is more expensive than the slide gate. Therefore, a slide gate with a ready-made guide frame is installed at the center of the check structures.

A transition of rubble masonry is to be built at upstream and downstream of the check structures. Stations, proposed discharges, controled water surfaces and dimensions of each check structure are shown in the following table.

Table 2 - 4 Check Structures on the Main Channel

No. of Check Structure	Station	Dimension of Gate	Elevetion of Gate Sill	Checked Water Surface
No. 1	STA. 20	1200 x 1800	568.00	572.00
No. 2	STA. 42	1000 x 1400	565.80	569.08
No. 3	STA. 72	1200 x 1000	562.80	566.80
No. 4	STA. 89	1000 x 800	561.30	563.50
No. 5	STA.107	1000 x 8800	558.80	561.00
No. 6	STA.124	1000 x 800	556.90	550.00
No. 7	STA.141	1000 x 800	554.40	557.30
No. 8	STA.160	1000 x 800	553.50	556.30

5) Water Measurement Device

i) Parshall Flume

Two water measurment devices are designed to set at STA. 3 and STA. 74. When hydraulic slopes in a channel are too gentle for water measurement by a weir, a Parshall flume can be employed with advantage in its place. The merit of this device, as compared with other types, lies in its ability to operate with a minimum loss of head and, in addition, to measure the correct discharge of a submerged flow.

Because of the gentle gradient of the main channel, Parshall flume is adopted for the water measurement device. The measurement capacity of the Parshall flume is to be prescribed so as to permit the measure of the designed discharge even in submerged flow. The two Parshall flumes are reinforced concrete structures and their dimensions are shown in the following table.

Table 2 - 5 Parshall Measurement Flumes on the Main Channel

	Parshall Flume No. 1	Parshall Flume No. 2
Station	No. 3+0	No. 74+0
Width of Throat	15. Oft.	6.0 ft.
Length of Flume	27ft - 9 in.	13 ft - 4 in.
Elevation of Throat	571.14 ft.	563.28 ft.
Range of Measurable Discharge	from 10cusec to 150cusec.	from 3cusec to 70cusec.
Max. Head Loss for Water Measurement	0.20 ft.	0.15 ft.

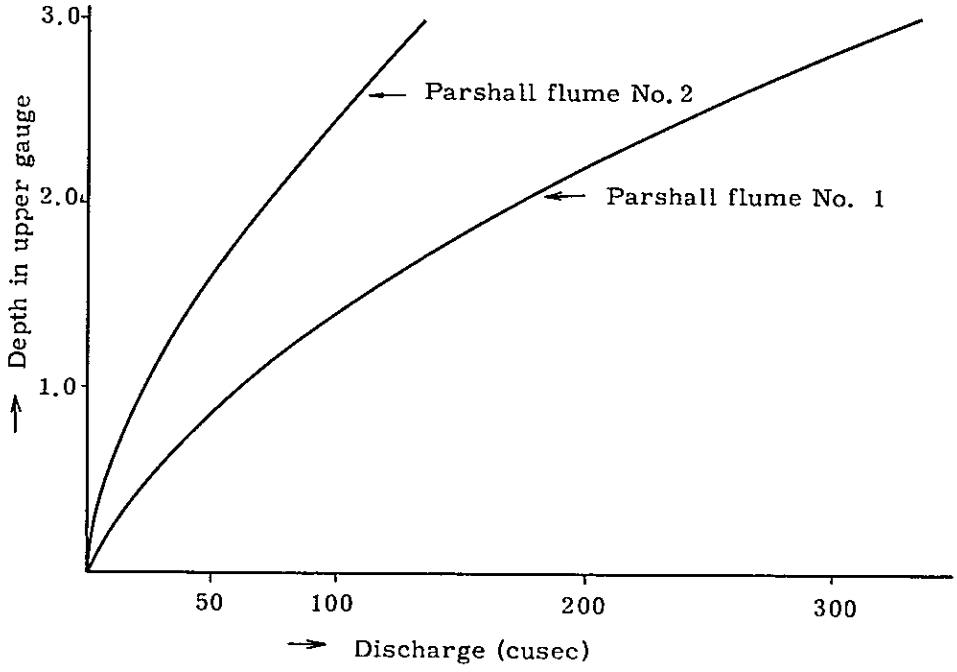
In a free flow condition, as long as the depth measured on gauge Hb (depth in down gauge) is not greater than 70% of the depth measured on gauge Ha (depth in upper gauge), the discharge of each flume is as given in the following formula.

Parshall flume No. 1 $Q = 57.8\ Ha^{1.6}$

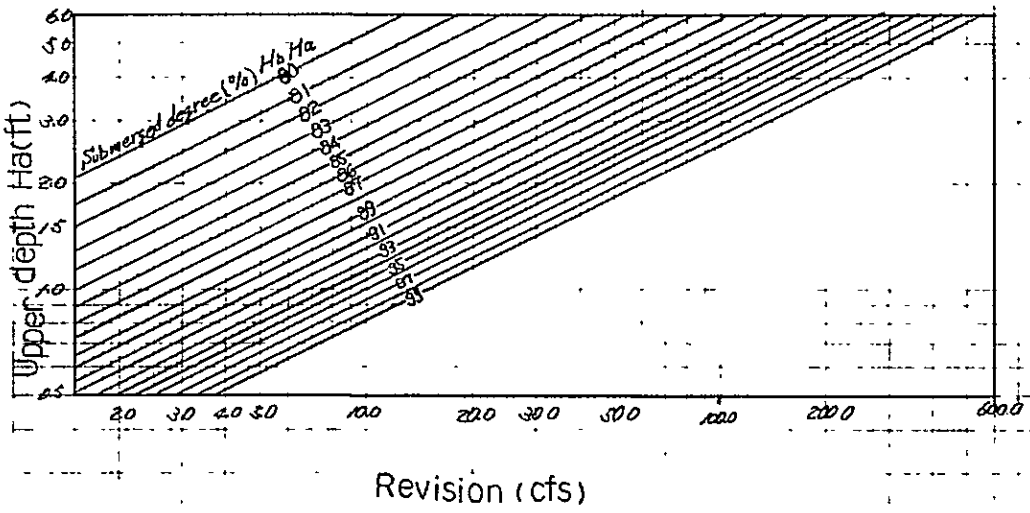
Parshall flume No. 2 $Q = 24\ Ha^{1.594}$

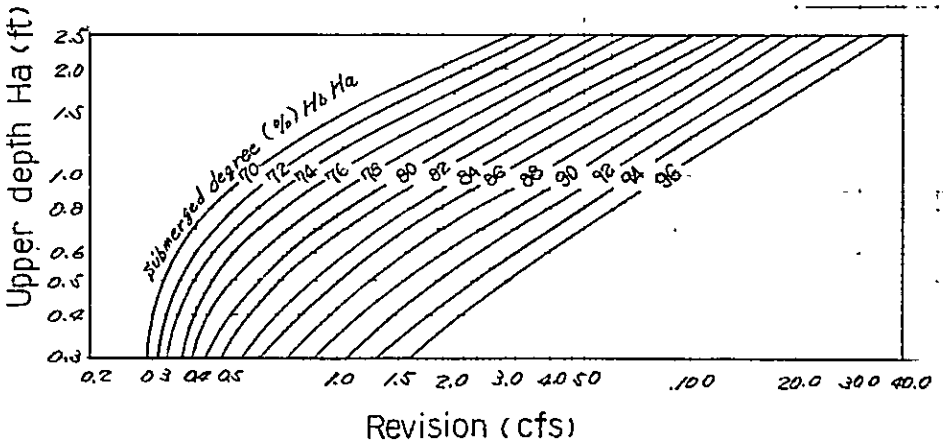
A diagram of these formula is as follows:

Fig. 2 - 2



In a submerged flow condition, when Hb is greater than 0.70 Ha but less than 0.95 Ha, the true discharge can be obtained by subtracting figures of the following diagram from figures of the above diagram.


Upper depth Ha(ft)
Submerged degree (%) Hb/Ha
Revision (cfs)


Upper depth Ha (ft)
Submerged degree (%) Hb/Ha
Revision (cfs)

The hydraulic loss for the designed discharge at each Parshall flume is estimated at about 0.2 ft and 0.15 ft respectively, from "the diagram for determining the loss of head".

6) Bridges

Five bridges are to be built over the main channel. One of them, Bridge No. 5, is to be located at STA. 57 to permit the transport of a number of materials to the Upland Pilot Farm Building-Cum-Agricultural Mechanization Center. This bridge is to be 12 ft in whidth and 25 ft in length.

Four other bridges are set for the convenience of traffic within the project area. These bridges of a width of 8 ft and a span of 23 ft are to be constructed of P.C. slabs. Reinforced concrete abutments are constructed at each bridge and handrails are set along both sides of the bridges. The location and dimensions of each bridge are as follows:

Table 2 - 6 Location and Dimensions of Bridges on Main Channel

Bridge No	Location	Span	Width	Remark
No. 1	3 + 100	23 ft	8 ft	P.C.
No. 2	10 + 200	23	8	P.C.
No. 3	34	23	8	P.C.
No. 4	38 + 100	23	8	P.C.
No. 5	57	25	12	H-Beam

2 - 1 - 2 Upland Field Irrigation Facilities

1) Source of Irrigation Water

Even in the Dry-Seasons, Hevanella Oya does not lose its water which consists of seapage water from Dewahuwa Tank and drainage water in the project area and nearby. Although small amount of water sources kept in wells and trickled in some streams are found in the project area, they are insufficients in quantities for field irrigation. Consequently, Hevanella Oya is considered to be only the source of irrigation water in the project area. According to the survey carried out in August 1969, the discharge was approximately 0.6 cusec.

2) Selection of proposed areas

As the discharge of Hevanella Oya is not always sufficient for the irrigation water, it is necessary to keep its water by a weir. In consideration of the capacity

of the reservoir and the discharge, it is possible to irrigate approximately 100 acres field except only some periods in the Dry-Seasons. Consequently the areas of 100 acres covered by lateral-C, lateral-G and lateral-H are proposed for field irrigation by reason of their flatness and arable lands. The upland field pilot farm of 3 acres is also proposed. Consequently the total irrigation area amounts to 103 acres.

Table 2 - 7 Proposed irrigation areas are as follows:

Pipe Line System	Allotment	Total Area	Irrigable Area
Lateral C	15	45.0 ac	30.0 ac
" G	23	70.4 "	60.0 "
" H	12	36.6 "	10.0 "
Pilot Farm	-	- "	3.0 "
Total	50	152.0 "	103.0 "

3) Duty of Water

i) Peak Consumptive Use Rate

There is scarcely data which determine the peak consumptive use rate in this area. However, the data for several kinds of upland crops in Japan indicate an approximate peak consumptive use rate of rom 3 mm/day to 5 mm/day. Therefore, taking into account of the local climatic conditions, the rate of 5 mm/day is sonsidered to be reasonable.

ii) Irrigation Efficiency

The irrigation efficiency is calculated by the following formula:

$$E = c \times a \times m$$

whereas, E: irrigation efficiency

c: water conveyance efficiency

a: water application efficiency, 60% in case of irrigation depth once 25mm, peak consumptive use, 5mm/day and wind speed 4m/sec.

m: water maintenance efficiency, 95% in case of pipe line system.

therefore, $E = 0.95 \times 0.60 \times 0.95 = 0.54$

iii) Designed Duty of Water

Designed duty of water is calculated as follows:

$$Q = \frac{Dm/E}{8.64} \times \frac{24}{T} \times \frac{0.03532}{2.471}$$

where, Q : designed duty of water

Dm: peakconsu mptiveus e rate, 5 mm

E. irrigatione fficiency, 54 %

T: number of irrigation hours per day, 12 hrs,

A: irrigable area, 103 acres.

therefore, Q = 3.2 cusec

= 192 cu. ft/min.

iv) Pump Capacity

The pump set at the weir site is designed to convey the wat er for both irrigation and domestic supply. As the domestic water supply is planned to be extended to be extended to Tracts (5, 6, 7, 8, 9) in the near future, the designed pump capacity is determined by the three requirements which need for irrigation, basic domestic water and its extension.

The designed pump capacity is as follows·

Q = I + D + E

Whereas, Q: pump capacity

I: designeddu ty of water for irrigation
192 cu. ft/min.

D: Water requirement for domestic water

E: Water requirement for extension
10 cu. ft/min.

therefore, Q = 192 + 8 = 10 = 210 cu. ft/min.

4) Application Scheme

i) Soil Features

The upland soil is meade of sandy clay loam called as "Reddish Brown Earth". According to the soil surveys carried out in the fields of Tract 3 - 88 (A area) and Tract 3 - 40 (B area), the soil in the upland has following features:

Field Capacity (Fc): 19.1% (gravity percentage)

Wilting point (Wp): 6.9%

Apparent Specific Gravity (Sa): 1.36

ii) Total Readily Available Moisture

Total available moisture is calculated as follows:

$$T.A.M. = \frac{1}{100} (Fc - Wp) \times Sa \times D$$

where, T.A.M. : total availabe moisture

Fc : field capacity 19.1%

Wp : wilting point 6.9%

Sa : apparent specific gravity 1.36

D : effective root zone 400 mm

therefore

$$T.A.M. = \frac{1}{100} = (19.1 - 6.9) \times 1.36 \times 400$$

$$= 66.4 \text{ mm}$$

Then, total readily available moisture can be calculated on the assumption that moisture extraction pattern is shown as following table.

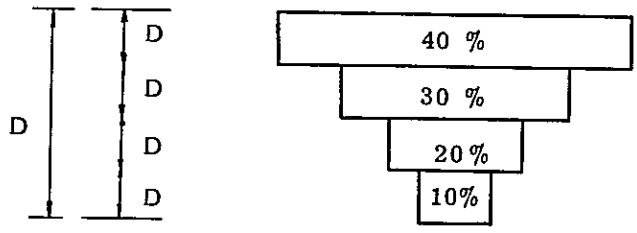


Table 2-8

Classified Zone	Depth	M.E.P.	A.M.	Consumptive Use of Water	Consumptive Use of Water in T.A.R.M.
	(mm)	(mm)	(mm)	(mm)	(mm)
1	100	40	16.6	41.5	16.6
2	100	30	16.6	55.33	12.45
3	100	20	16.6	83.0	8.3
4	100	10	16.6	166.0	4.15
Total	400	100	66.4	345.8	41.5

Total readily available moisture obtained from the above table is 41.5 mm.

iii) Water Requirement for Each Irrigation Water requirement for each irrigation is decided by the following formula.

$$D = \frac{Dn}{Ea} \times 100$$

where, D: water requirement for each irrigation

Dn: total readily available moisture 41.5 mm

Ea: water application efficiency 60%

therefore,

$$D = \frac{41.5}{60} \times 100 = 69.2 \text{ mm } (2.72 \text{ in.})$$

Iv) Application Frequency

On the assumption of the peak consumptive use of 5 mm, 8 days are required to use the moisture from the effective root zoone. Therefore, the irrigation at 8 day intervals is applied for the upland fields.

5) Weir and Intake Facility

i) Selection of the site.

The Havanella Oya, the main water source of the upland irrigation and the domestic water supply, starts just below Dewahuwa Tank and flows down along the boundary of the dproject. At a point of about half mile from the Tank, the Havanella Oya joints a stream which equals in discharge during the dry seasosns. This confluence is located near the hill on which the regulating pond is designed to be built.

For above reasons, the just downstream of the confluence is the most suitable site for the intake facility. The elevations of the Oya bed and the top of the bank at this site are EL. 535.2 ft, and EL. .547.3 ft, respectively.

ii) Weir

The weir to collect the water from the Havanella Oya is designed to be constructed of crushed stone concrete, from the point of structural economy as well as local conditions.

The weir is equipped with a sluice way for the purpose of discharging big floods and a spill way for small floods occoured once a year. The capacity of the sluice way was estimated from the catchment area of the Havanella Oya. The sluice way is to have a pair of prefabricated slide gates installed in guide frames.

iii) Infiltration gallery

A gallery of perforated reinforced concrete pipes is to be constructed at the river site of the Havanella Oya for the purpose of filtering the domestic water. The infiltration gallery consists of an intake pipe, collecting conduits and junction wells.

The collecting conduit galleries are to be located at a right angle to the flow of ground water and two laterals branch from it. The depth of placement of the collecting conduits is 6 ft. below the river bed. The diameter of each perforation in 4/5 in. and there are 20 perforations per square meter of collecting conduit surgace. The gallery is placed level and the inside velocity of collecting conduits should not be more than 1.0 m/sec.

Gallery dimensions are as follows:

a) Collecting conduits

Material: reinforced oncrete pipe

Diameter: 500 mm (1'8")

Total length: 136 ft.

b) Intake pipe

Material: Reinforced concrete pipe

Diameter: 500 mm (1'8")

Total length 12'2".

c) Junction well

Size: 1m x 1m x 1m ('4" x 3'4" x 3'4")

Number: 2.

Material: Reinforced concrete

6) Pumping Station

i) Pump

The design of the pumping station is to take into consideration the fluctuation of the water level, particularly the prevention of cavitation. Based on compartive studies made on various types of pumps and the required number of units two units of double suction volute pumps are adopted for their low initial cost and easy operation and maintenance as well as dependability.

Each pump with a suction and discharge bore of 200mm x 150mm has a capacity of 3.0 m^3/min. and total lift of 52.6 m, driven by a 55 kw electric motor. In addition, a check valves and sluice valves of a diameter of 150 mm are installed for stopping water flow at the pump house to be constructed.

The confluence pipe, which joins the dischage of the above two pumps, . is provided at the end of the delivery pipes. From the confluent pipe, one dischage pipe line with a diameter 300 mm and a length of about 500 m is extended to the regulating pond.

ii) Sump

A sump with a diameter of 3000 mm and a depth of 7.3m is provided, set back from the band redge to avoid the damage caused by large drift during the flood period. The lining of the sump is of angle iron reinforced corrugated steel pipe in consideration of economy of construction.

iii) Pump house

A pump house is to be constructed on the right bank, about 25 ft. from the sump. It consists of a single rectangular structure about 25 ft. long and 17 ft. wide and 8 ft. high.

The pump and motor base are located in the center of the structure and the vacuum pump and switch-board in a corner. Just adjacent to the pump house, 450 sq. ft. parking area is provided. The pump house is of brick wall construction with a concrete floor and corrugated sheet iron roofing.

The electric power source for the motor and the lighting of the house is supplied directly from outside electeic pole. There is no need to install a transformer because the electricity is supplied at 230 v.

iv) Pumping station specifications

Proposed capacity	6.1 m^3/min (210 cult/min)
Number of pumps	2 units
Type of pump	Double suction volute pums
Suction bo e and discharge bore	200mm & 150mm
Proposed water surface for suction	EL. 536.0ft.
Proposed water surface for suction	EL. 670.0ft.
Proposed actual head	134.0ft.
Proposed total head	172.6ft.
Diameter of suction pipe and delivery pipe	200mm & 150mm
Proposed suction lift	19.0ft.
Motor power	55kw

7) Regulating Pond

To facilitate operation of the pumps and permit effective use of pump water and domestic water supply, a regulating pond is provided at the outlet of the conveyance pipe line.

This pond has an available capacity of about 150m^3, between Low Water Surface of EL 665. 0 ft. and High Water Surface of EL 670.0 ft. which are based on about one and half days of domestic water supply. A circular sluice gate with a diameter of 300 mm is installed at the beginning of the distribution pipe and a spillway is provided on the ridge of the pond. The spillway is of the overflow type with a crest length of 15 ft. to discharge the full capacity of the inflow from the convedyance pipe.

8) Piple Line System

The pipe lines for the upland irrigation and the domestic water supply, consist of three systems, i. e. the conveyance pipe, the main pipe and the lateral.

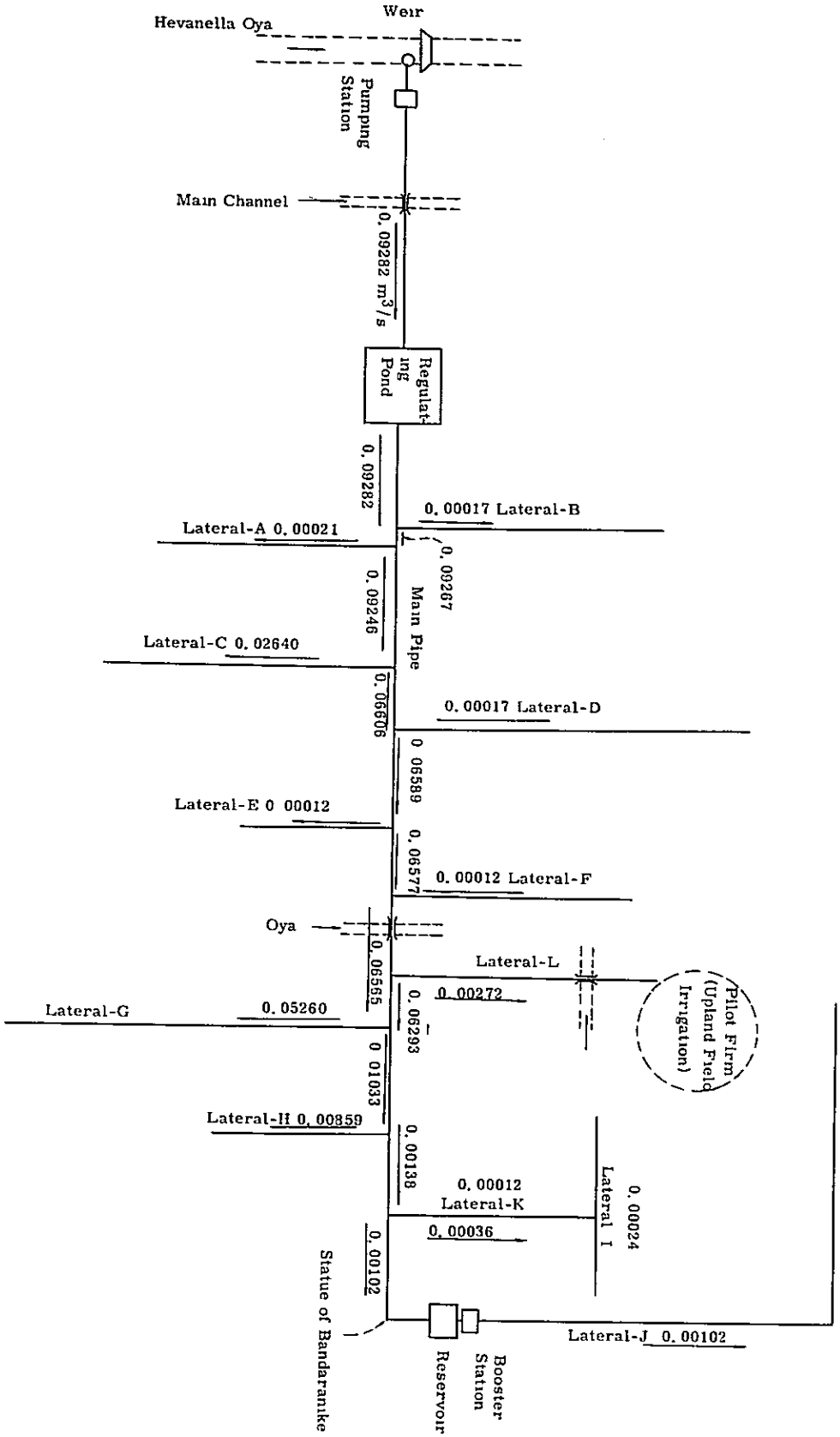
The conveyance pipe is to be extended from the pumping station on the right bank of the Hevanella Oya, to the regulating pond on the summit of the hill which is close to Main Channel STA 27, The main pipe starts from the regulating pond and ends at the junction, where the statue of Bandaranike is located by way of the existing Cooperative Society. A certain number of lateral pipes are to branch out from the main pipe, along village roads.

Hydraulic calculations indicate that the pressure at Lateral-J is not sufficient to supply the required water, therefore a pumping station is to be provided at the junction near the Bandaranike statue, STA. J-2, to boost the water up to the entire duty area

of Lateral-J.

Table-2-9 Pipe Line Dimensions

Name of Pipe Line	Pipe Lingth (ft)	Allotments to be Supplied	Irrigable Area (ac)	Irrigation Water (m^3/sec)	Domestic Water Supply (m^3/sec)	Proposed Discharge (m^3/sec)	Pipe Diameter (in)
Conveyance pipe	1,789.90	147(including Pilot F.)	103.0	0.089349	0.003472	0.09282	12
Main pipe	6,789.12	147(")	103.0ac	0.089349	0.003472	0.09282	12,6,4
Lateral-A	1,126.67	9	-	-	0.000214	0.00021	1
Lateral-B	1,663.59	7	-	-	0.000165	0.00017	1
Lateral-C	2,335.84	16	30.0	0.026026	0.000378	0.02640	8
Lateral-D	1,817.92	7	-	-	0.000165	0.00017	1
Lateral-E	858.50	5	-	-	0.000118	0.00012	1
Lateral-F	2,071.00	5	-	-	0.000118	0.00012	1
Lateral-G	2,962.66	23	60.0	0.052052	0.000543	0.05260	10
Lateral-H	1,155.76	12	10.0	0.008666	0.000283	0.00895	6
Lateral-I	1,533.00	10	-	-	0.000236	0.00024	1
Lateral-J	7,781.82	43	-	-	0.001016	0.00102	4, $1\frac{1}{2}$, 1
Lateral-K	1,584.00	5	-	-	0.000118	0.00036	$1\frac{1}{2}$
Lateral-L	2,817.68	5	3.0	0.002605	0.000118	0.00272	4
Total	36,287.46						



PIPE LINE SYSTEM

A polyvinyl chloride pipe is adopted for the main pipe the laterals and a steel pipe of the comveyance pipe. Valves, taps and other equipments are also of polyvinyl chloride.

9) Tap Stand

In order to supply simultaneously for both the upland irrigation and the domestic water, separate taps for the former and the latter are to be clearly designated.

The tap for the upland irrigation is to be equipped with a sluice valve with a lock for effectivew ater utilization and is to be operated under the supervision of the Agricultural Cooperative Society. The tap for the domestic water supply should be designed for free and frequent use.

The tap stands are of two types, Type A and Type B. Type A is equipped with two kinds of taps for both the irrigation and the domestic water supply. Type B is equipped with a tap for exclusive use for the domestic water suplly.

Number of tap stands:

On Lateral - C	4
G	6
H	1
L	1
Total	12

2—2 Farm Roads

2 - 2 - 1 Improvement of Farm Roads

Existing farm roads in project area are to be abondoned. The road surfaces are of alomost the some geight as the redges around the fields and are not passable by feeps in either the Maha or the rainy season. The original road surface should be raised by approximately two feet by fill. The crossfall is taken as 3 percent and the maximum longitudinal slope, as 10 percent, in considaration of both local conditions and standard criteria in Japan. These roads are to be of an unpaved type with a total width of 12 ft. The surface of the roads is, however, to be well compacted.

The improved roads consist of the main roads and the lateral roads. The dimensions of the improved roads are as follows:

Table-2-9 List of Main & Lareral Farm Roads

Name of M.F. Roads	Total Length	Remarks
No. 1	2,904.1 ft	
No. 2	3,488.0 "	
No. 3	2,710.0 "	
Sub total	9,102.1 "	
Name of L.F. Roads		
No. 1	2,000.0 "	
No. 2	3,400.0 "	
No. 3	1,700.0 "	
No. 4	2,200.0 "	
No. 5	1.800.0 "	
No. 6	1,300.0 "	
Sub total	12,400.0 "	
Total	21,502.1 "	

Culverts are proposed under the Main Road-3, STA. to overpass riverlets or Oyas. Culverts are to be of double pi pe sections of corrugated steel pipe with a diameter pf 1,000 mm.

2 - 2 - 2 Proposed Farm Roads

The proposed farm roads consist of two main farm roads and number of lateral farm roads. One of the proposed main farm roads is to be located along Havanella Oya for the conveninece of the irrigation farming, and the other, along the boundary between Tracts 1 & 2, for the maintenance ofthe intake facility for field irrigationa and domestic water supply

Approximatly two feet of fill is to be provided and a crossfall of 3 percent and maximum longitudinal slope of 10 percent is to be proposed. These roads are of an unpaved bype with a width of 12 ft. The dimensions of the roads are as follows:

Table-2-10 List of Proposed Main Farm Roads

Name of road	Total Length	Remarks
Proposed Main Farm Road-1	11,490.0ft.	
Proposed Main Farm Road-2	764.0ft.	
Total	12,254.0ft.	

Table-2-11 List of Proposed Lateral Farm Roads

Tract	Road No.	Allotment No. the Road Extended	Length of Road	Longitudinal Slope
Tract 1	P.R-1	1 &	520	
	P.R-2	2 & 3	790	
	P.R-3	4 & 5	590	
	P.R-4	6 & 7	690	
	P.R-5	8 & 9	480	
	P.R-6	10 & 11	360	
	P.R-7	12 & 13	520	
		Sub Total	3,950	
Tract 2	P.R-1	1 & 2	660	
	P.R-2	3 & 4	820	
	P.R-3	5 & 6	660	
	P.R-4	7 & 8	910	
	P.R-5	9 & 10	620	
		Sub Total	3,610	
Tract 3	P.R-1	1 & 2	460	
	P.R-2	3 & 4	820	
	P.R-3	5 & 6	890	
	P.R-4	7 & 8	890	
	P.R-5	9 & 10	920	
	P.R-6	11 & 12	890	
	P.R-7	13 & 14	560	
	P.R-8	15 & 16	360	
	P.R-9	17 & 18	500	
	P.R-10	19 & 20	530	
	P.R-11	21 & 22	360	
	P.R-12	23 & 24	1590	
	P.R-13	25 & 26	730	
	P.R-14	29 & 30	590	
	P.R-15	31 & 32	230	
	P.R-16	33,34,37 & 38	990	
	P.R-17	34,35,36 & 37	1060	
	P.R-18	38 & 39	200	
	P.R-19	43 & 44	400	
	P.R-20	45 & 46	430	

Tract	Road No.	Allotment No. the Road Extended	Length of Road	Longitudinal Slope
Tract 3	P.R-21	47 & 48	600	
	P.R-22	49 & 50	730	
	P.R-23	50 & 51	760	
	P.R-24	53,54,63 & 63	1420	
	P.R-25	54,55,61 & 60	1250	
	P.R-26	55,56,58 & 59	1190	
	P.R-27	72,73,74 & 75	990	
	P.R-28	70,71,76 & 77	1450	
	P.R-29	68,69,78 & 79	1490	
	P.R-30	66,67,80 & 81	1920	
	P.R.-31	65 & 64	590	
	P.R.-32	87,88,89 & 90	1450	
	P.R.-33	85,86,91 & 92	1680	
	P.R.-34	83 & 84	860	
	P.R.-35	93 & 94	720	
	P.R.-36	96 & 97	590	
	P.R.-37	94 & 95	330	
	P.R.-38	99	760	
	P.R.-39	101 & 102	560	
	P.R.-40	102 & 103	660	
	P.R.-41	104 & 105	560	
	P.R -42	106 & 107	230	
		Sub Total	34,190	
Tract 4	P.R.-1	1 & 2	560	
	P.R.-2	5 & 6	560	
	P.R.-3	7 & 8	460	
	P.R.-4	9 & 10	590	
	P.R.-5	12 & 13	530	
	P.R.-6	14 & 15	290	
	P R.-7	19 & 18	460	
	P.R.-8	16 & 17	460	
	P.R.-9	21 & 22	230	
		Sub Total	4,140	
		Total	45,530	

A number of the 1,000 mm corrugated steel pipe culverts are proposed under Main Road-1, to pass riverlets The dimensions of the culverts are as follows:

Table-2-12

Culvert No.	STA	Type	Remarks
1	No. 0 + 45 ft.	A	
2	No. 3 + 170	A	
3	No. 5 + 200	A	
4	No. 11 + 10	A	
5	No. 13 + 100	A	
6	No. 14 + 75	A	
7	No. 16 + 275	A	
8	No. 17 + 75	A	
9	No. 21	A	
10	No. 23 + 110	A	
11	No. 24 + 250	A	
12	No. 29	A	
13	No. 30 + 150	A	
14	No. 30 + 200	B	
15	No. 34 + 30	A	
16	No. 35 + 270	A	

*Type A: single barrel
Type B: double barrel

A number of 7 ft. wide lateral farm roads are proposed for every other boundary of each allotment. A fill of approximatly 1.5 ft. should be made on the original ground furface. The crossfall and longitudinal slope are to be 3 percent and 10 percent, respectively.

A number of farm road bridges of a 5 ft. width and a 10 ft. span are to be constructed of wood on the lateral roads over field channels. The dimensions of these bridges are as follows:

Table-2-13 List of Farm Road Bridges

Tract	Farm Road Bridge No.	Road No. of Bridges	Field Channel to be Bridged
Tract-1	B_1-1	P.R.-1	FC1 - 1
	B_2-2	P.R.-5	- 3
Tract-2	B_2-1	P.R.-2	FC2 - 1
	B_2-2	P.R.-3	- 2
	B_2-3	P.R.-4	- 2
Tract-3	B_1-1	P.R.-3	FC3 - 2
	B_3-2	P.R.-4	- 3
	B_3-3	P.R.-7	FC3 - 5
	B_3-4	P.R.-8	- 5
	B_3-5	P.R.-9	- 5
	B_3-6	P.R.-10	- 5
	B_3-7	P.R.-13	- 6
	B_3-8	P R.-12	- 7
	B_3-9	P.R.-14	- 7
	B_3-10	P.R.-15	- 7
	B_3-11	P.R.-17	- 6
Tract-3	B_3-12	P.R.-16	- 6
	B_3-13	P.R.-18	- 6
	B_3-14	P.R.-19	- 6
	B_3-15	P.R.-20	- 6
	B_3-16	P R.-21	- 8
	B_3-17	P.R.-26	- 8
	B_3-18		- 8
	B_3-19	P.R.-24	- 8
	B_3-20	P.R.-31	- 8
	B_3-21	P.R -27	- 9
	B_3-22	P.R.-28	- 9
	B_3-23	P.R.-29	- 9
	B_3-24	P.R.-30	- 9
	B_3-25	P.R.-32	- 10
	B_3-26	P.R.-33	- 10
	B_3-27	P.R.-35	- 10
	B_3-28	P.R.-38	- 10
	B_3-29	P R -39	- 10
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	B_3-31	P.R.-41	- 10
	B_3-32	P.R.-42	- 11
Tract-4	B_4-1	P.R.-1	
	B_4-2	P.R.-3	FC4 - 1
	B_4-3	P.R.-4	- 1
	B_4-4	P.R.-5	- 2
	B_4-5	P.R -9	- 3
	B_4-6	P.R.-6	- 2

2–3 Paddy Field Rearrangement

1) Consolidation of Plots

Two or three paddy field plots of almost same surface elevations should be consolidated into a sizable field by eliminating separating ridges.

Data on existing plots and plots to be consolidated in each tract are as follows:

Table -2-14

Tract	No. of Existing Plots	No. of Consolidated Plots
Tract 1	1,372	514
2	1,301	416
3	9,892	3,152
4	1,439	685
Total	14,004	4,767

2) Field Outlet Blocks

Plank-made field outlet blocks are provided at every consolidated plot for the maintenance of an adequate flooding water depth in the paddy field and for the regulation of the discharge of irrigation water.

3) Small Outlets

Small outlets of a diameter of 4" to divert irrigation water to each allotment have been provided. A wooden plug is to be provided at each 4" pipe outlet for the effective utilization of irrigation water.

The Number of plugs for each tract are listed in the following table·

Table-2-15 Number of Plugs for 4" Pipe Outlet

Tract	No. of Plugs
Tract 1	13
2	10
3	107
4	23
Total	153

2–4 Domestic Water Facilities

1) Selection of the Proposed Area

One hundred forty seven (147) allotments of TRACT 1, 2, 3, and 4 with an estimated population of 2,000 are to be supplied with domestic water. In addition, the Upland Pilot Farm-Cum Agricultural Mechnization Center is to be supplied from Lateral-J.

A list of the number of houses and the population is as follows:

Table-2-16 List of the Number of Houses to be Supplied with Domestic Water

Pipe Line System	Number of Houses	Approximate Population	Remarks
Lateral - A	9	123	
Lateral - B	7	95	
Lateral - C	16	218	
Lateral - D	7	95	
Lateral - E	5	68	
Lateral - F	5	68	
Lateral - G	23	313	
Lateral - H	12	163	
Lateral - I	10	136	
Lateral - J	43	585	
Lateral - K	5	68	(Upland Pilot Farm-Cum Mechanization Center to be added)
Lateral - L	5	68	
Total	147	Total 2,000	

2) Water Requirment for Domestic Water Supply

The duty water of 50 liters/day per capita is adequate for the domestic water supply, therefore the gross duty of water for the population of 2,000 is as follows:

50 liters/day x 2,000 = 100,000 liters/day

Assumed that the domestic water is to be supplied for 12 hours, the same as for field irrigation, the mean discharge to be conveyed is

$$100,000/12 \times 60 = 138.6 \text{ liters/min} = 4.9 \text{ ft.}^3/\text{min}$$

$$\text{or } 5.0 \text{ ft.}^3/\text{min.}$$

Moreover, the proposed discharge is adjusted by multiplying it by 1.5.

$$Q = 5.0 \times 1.5 = 7.5 \text{ or, } 8 \text{ ft.}^3/\text{min.}$$

(Whereas Q: proposed discharge)

Table 2-17 Accordingly, the planned maximum demands for each lateral are as follows:

Lateral	Number of Allotments	Population	Max. Demand/Day m^3/day	Max. Demand/Hour m^3/hr.	Max. Demand/Second m^3/sec
Lateral A	9	123	6 15	0.769	0 000214
" B	7	95	4 75	0.594	0.000165
" C	16	218	10.90	1.362	0.000378
" D	7	95	4.75	0.594	0.000165
" E	5	68	3.40	0.425	0.000118
" F	5	68	3.40	0.425	0.000118
" G	23	313	15 65	1.956	0.000543
" H	12	163	8.15	1.019	0.000283
" I	10	136	6.80	0.850	0.000236
' J	43	585	29.25	3.656	0.001016
" K	5	68	3.40	0.425	0.000118
" L	5	68	3.40	0.425	0.000118
Total	147	2,000	100.00	12.500	0.003472

The estimated population is 2,000 and the number of allotments is 147. Accordingly, the population per allotment is· 2,000/147 = 13.6

The totals in the above table are converted into the foot unit as follows:

Maximum demand/day 100.00 m^3/day = 3,531.47 ft^3/day

Maximum demand/hour 12.500 m^3/day = 441.43 ft^3/day

Maximum demand/second 0.003472 m^3/sec = 0.1226 ft^3/sec = 7.36 ft^3/min

3) Relation to Upland Field Irrigation Facilities

In the Feasibility Report, the Upland Field Irrigation Facilities and the Domestic Water Facilities were planned to be designed separately. However, both irrigation water and domestic water are dependent on the Hevanella Oya as the source Moreover, if gravity distribution of water to each pipe line is to be planned, the location of a regulating pond for both irrigation water and domestic water would have to be located at the same spot since only a limited a limited amount of high land is available in the project area. For this reason, the intake facilities from the Hevanella Oya and the conveyance pipe line from the intake to the regulating pond are to be of a single facility serving for both irrigation water and domestic water.

If it were to be planned to distribute irrigation water and domestic water separately, 2 lines of pipes would be required which would obviously increase the cost of construction. On the other hand, water at the proposed site of the weir on the Hevanella Oya

and the conveyance pipe line from the intake to the regulating pond are to be of a single facility serving for both irrigation water and domestic water.

If it were to be planned to distribute irrigation water and domestic water separately, 2 lines of pipes would be required which would obviously increase the cost of construction. On the other hand, water at the proposed site of the weir on the Hevanella Oya was tested for quality and the result of this test has proved, based on the Japanese standard of water quality, that the water is potable. The only problematical point in this water quality test is that it was made during the Yara season when the water of the Oya was comparatively clear. It can not be predicted as to the results of a similar water quality test should be made during the Maha season (rainy season) when there is torrential rains. Therefore, it is considered that the water of Hevanelly Oya, even during the Maha season, can be used for domestic water with no fear for its quality, if it is collected through an infiltration gallery by which the water will be filtered once. Based on these considerations, the collection of water was designed to be done through the infiltration gallery, and its distribution system was designed with a single pipe line for both irrigation and domestic water to each block. By way of precaution, dis-infection equipment is to be provided at the regulating pond for disinfecting of the water periodically, and whenever there is the danger of infections disease.

4) Booster Pumping Station

As a rule, water distribution is to be done by gravity. However, a portion along Galewela-Kalawewa Road of IP. J2-J14 in Lateral J is of comparatively high elevation, so that the differnce in the elevations of the regulating pond and this portion is only about 30 ft. Accordingly, distribution of water to this point is impossible by gravity and a booster pump must be provided at IP J2 point so as to render the Lateral J line a pump distribution line. Specifications of the pump are as follows:

Type	Volute pump ϕ 40 mm	1 unit
Total lift	30 m	
Discharge	$Q = 0.001016\ m^3/sec = 60.96\ l/min$	
	$= 2.15\ ft^3/min$	
Motor output	2.2 kw	

Water distributed through the main pipe line is to be dropped into a reservoir tank by the booster pumping station. The dimensions reservoir tank is as follows:

Capacity: 16 ft. x 20 ft. x 6 ft. = 1,920 $ft.^3$ = 54.4 m

Structure: Non-reinforced concrete gravity type provided with a roof. One unit of disinfection equipment is to be provided

A spillway with a warning device which will ring a bell in the operation room is to be installed at this reservoir tank. When the water level in the tank rises above the crest of the spillway, the warning device is to function. The control valve on the inlet pipe from the main pipe line is to be operated manually.

5) Distribution Pipes

Descriptions of distribution pipes are omitted here since they are described in the paragraph on Upland Field Irrigation.

6) Tap Stand

The number of tap stands to be provided is determined by a general rule of 1 tap stand to each 2 - 4 allotments. There are to be three kinds of tap stands, A type, B type and Shower tap. The A type tap stand is for dual purpose of irrigation water and domestic water and the B type tap stand is only for domestic water. The number of each type of tap stand to be provided is as follows:

A type tap stand	12
B type tap stand	36
Shower tap stand	4

2–5 Pilot Farms

2 - 5 - 1 Paddy Field Pilot Farm

The abandoned tank with an area of approximately 6 acres, near the left bank of Main Channel STA. 68, is to be reclaimed as a paddy field pilot farm of 3.2 acres. The farm is to be divided into 8 plots of 0.4 acres (80'x) each.

The bottom of the abandoned tank slopes slightly from west to east, the arrangement of paddy field plots is to be designed stepwise, to follow the slope of the land. The resulting difference in height from the upper plots to the lower is to be 1.0 ft. For the farm use two roads of a width of 20 ft are to be provided. One of them runs along one side of the farm and the other divides the farm into two blocks of 1.6 acres each. In addition, a 10 ft wide road is to be provided around three sides of the farm. Three underdrains of clay tile and relief wells are placed under one of the farm blocks, dilineated by the road.

Farm irrigation channels along the 20 ft road and farm drainage channels along the 10 ft road, of a trapezoidal section, the bottom width being 1.0 ft and the side slopes 1 to 0.5 (vertical to horizontal), are to be provided. An outlet with a slide gate, a p.v.c. pipe and a water measurement device are to be located near STA. 68 on the main channel to divert irrigation water from the main channel. For machinery storage and rest, a farm station is to be located in front of the maintenance road of the main channel.

The dimensions and main items of the farm facilities are as follows·

1. Farm road A:

   Width: 20 ft, approximate length: 970 ft.

2. Farm road B:

   Width: 10 ft, approximate length: 1,200 ft.

3. Farm irrigation channel:

   Bottom width: 1.0 ft, Depth: 2 ft,
   Approximate length: 570 ft, Trapezoidal section: unlined.

4. Farm drainage channel A:

   Bottom width: 1.0 ft, Depth: 3.0 ft, Approximate length: 1,000 ft, Trapezoidal section: unlined.

5. Farm drainage channel B:

   Bottom width: 1.0 ft, Depth: 5.0 ft, Approximate length: 200 ft, Trapezoidal section: lined with random rubble masonry.

6. Foot plank A:

   Width: 3 ft Length: 3.5 ft Nos: 4

7. Foot plank B:

   Width: 3 ft Length: 4.5 ft Nos: 6

8. Foot plank C:

   Width: 20 ft Length: 8.5 ft Nos: 1

9. Foot plank D:

   Width: 10 ft Length: 8.5 ft Nos: 1

10. Check drops:

    Four, to be made of concrete.

11. Under drain:

    495ft, lengths of 6" clay pipe. Twelve relief wells.

12. Intake pipe A.

    Four, approximate length: 2 ft, 4"P.V.C. pipe.

13. Intake pipe B:

    Four, approximate length: 23 ft, 4" P.V.C. pipe.

14. Farm outlet block

    Eight, to be made of plank.

15. Outlet:

    Four in 4" P.V.C. pipe. Slide gate of 4" dia.
    Rectangular notches.

16. Farm station building:

Area: 30 ft x 80 ft, Brick wall, Corrugated asbestos sheet roofing.

2 - 5 - 2 Upland Field Pilot Farm

The approximately three acres of the reserved land on the right bank of Main Channel STA. 57, is to be developed as an upland field pilot farm, adjoining the Pilot Farm Building-Cum-Agricultural Mechanization Center.

A main farm road combined with the center access road is proposed through the central part of the farm and with which the lateral farm roads are to cross.

One acre of the pilot farm is furnished with sprinkler, and the remaining two acres with furrow, irrigation.

The farm is to be divided into 12 plots of one quarter acres (66" x 166") each. the irrigation water source will depend primarily on the pipe line system, Lateral-L. In addition, a reservoir created by a check weir is to be provided across the small riverlet which flows along the farm, as a precautionary measure for insufficient irrigatio irrigation water from the pipe line system. The irrigation water will be supplemented with a portable centrifugal pump from the reservoir, to meet the water requirement.

The main farm pipe with a number of valves for irrigation is to be laid along the central road.

Dimensions and main items of the facilities and equipment for the farm are as follows:

1. Main farm road:

   Width: 20 ft. Approximate length: 420 ft.

2. Lateral farm road:

   Width: 6 ft. Approximate length: 2,200 ft.

3. Main farm pipe:

   Four, (4") P.V.C. Approximate length: 500 ft.

4. Control valves:

   Six(6) 4" in diameter.

5. Distribution pipe with sprinklers:

   4 sets, Diameter: 2" P.V.C. Approximate total length : 350

6. Delivering pipe for furrow irrigation:

   4 sets, Diameter: 4". Approximate total length: 680 ft.

7. Check weir:

   Approximate height: 7': Approximate width: 50' :

   Width of sluice way: 10'.

8. Portable centrefugal pump with motor:

   s Suction bore: 50" Delivery bore: 40"

   Motor power: 3.7 Total lift: 100 ft

Capacity: 6 ft^3/min.

2–6 Agricultural Mechanization Center

The center is to be located on the land reserved on the right bank of Main Channel STA. 57 in Tract 4., and consists of eight buildings, including the Cooperative Society to be removed from its present site.

Each building is provided with rooms and space as follows:

Building No. 1 :	Class Room, Office, Conference Room, Measuring Room.
Building No. 2 :	Working Space, Seed Repository and Store, Fertilizer Shed, Work Yard.
Building No. 3 ·	Machinery Depot, Repair Shop, Parts Store.
Building No. 4 :	Two wheeled Tractor Depot.
Building No. 5 :	Thrasher Space, Machinery Depot.
Building No. 6 :	Granary.
Building No. 7 :	Garage.
Building No. 8 :	Office, Conference Room, Cooperative store.

To facilitate the approach from the maintenance road to the Center, Crossing road No. 5 (see 'crossing road of a width of 20 ft are proposed. A land area of 4 ac. is to be allotted for the Center, and the building site is to be enclosed with a fence. The domestic water supply for the Center is to be extended from Lateral-J.

Floor space and materials are listed for each building in the following table:

Table 2 - 18 Floor Space and Materials for Buildings

Bldg No.	Name of Room	Size of Room	Walls	Materials		Roof
				Pillars	Floor	
No. 1	Class Room	33' x 50'	Brick work	Reinf. concrete	Brick work	Calcutta tile
	Office	33' x 20'	"	"	"	"
	Conference Room	33' x 20'	"	"	"	"
	Measuring Room	33' x 30'				
No. 2	Work Room	33' x 80'	"	"	Rubble masonry	Corrugated Asbestos Sheets
	Fertilizer Shed	30' x 15'	"	"	"	
	Seed Repository	30' x 25'	"	"	"	"
No. 3	Machinery Depot	30' x 80'	"	"	Crushed stone	"
	Repair Shop	30' x 30'	"	"	"	"
	Parts Store	30' x 10'	"	"	"	"
No. 4	Two-wh. Tractor Depot	30' x 100'	" "	"	"	"
No. 5	Thresher-Mach. Depot	30' x 50'	"	"	"	"
No. 6	Granary	20' x 40'	Brick work	Timber	Brick	Corrugated asbestos sheets
No. 7	Garage	15' x 25'				
No. 8	Office	33' x 20'	Brick work	Reinf. concrete	Brick	Calcutta tile
	Conference Room	33' x 40'	"	"	"	"
	Cooperative Store	33' x 40'	"	"	"	"

Several kinds of equipment installation are to be made for each building, as follows:

Table- Equipment Installation for Buildings

Bldg. No.	Equipment Installation
No. 1	Toilet, Shower bath, Lavatory sink, Flower bed, Electric lighting, lighting, etc.
No. 2	Work yard, Ventilation fan, Electric lighting, etc.
No. 3	Electric lighting,
No. 4	Wash yard, Tap stand, Electric lighting
No. 8	Toilet, Lavatory sink, Flower bed, Electric lighting.

2–7 Broadcasting Facilities

It was planned by the Feasibility Report that a wire broadcasting system to cover entire project area to be provided. However, as a result of the final survey of the present situation of the project area, the following conclusion was derived. That is to say the fact that the entire project area is covered by tall coconut goves and, on top of this, undulated topography of the area are attributing to prevent the sound wave from good propagation. There are many problems to be solved not only on the technical aspect but also on the aspects of economic efficiency as viewed from the entire projet basis and on a capability of the inhabitants for proper usage of the new facilities. Therefore, the plan was altered to balance with the rest of the project. That is to provide 2 vehicles specifically designed for publicity activities.

Facilities to be provided:

2 Publicity cars (1,000 cc Class with 1 set of public-address system)

Chapter III Construction Schedule

Chapter III Construction Schedule

3–1 Meteorological Conditions and Construction Schedule

All the construction works including temporary works and all other related works of this project are scheduled to be completed within approximately a 4 year period.

The mean annual precipitation over the past 15 years for this project area is 70 28 in. (1,785 mm), while the day precipitation of the 10 year probability is 6 36 in. (162 mm), both of which resemble that of Japan Distribution of precipitation by months over the past 15 years is as follows

Table 3 - 1

Month	Monthly Precipitation		
	Maximum	Minimum	Mean
October	19.90 in	3.33 in	12 64 in
November	23.75	5.29	12.57
December	39.79	1.70	11.93
January	9.72	2.35	5.89
February	8.90	0	3.63
March	12.05	0.72	4.53
April	17.98	2.20	7.70
May	10.96	0.04	4.16
June	4.97	0.05	1.67
July	10.99	0	2.12
August	3.76	0	1.17
September	9.37	0.06	2.27

As shown in the above table, the precipitation is least during the months from January to September. On the other hand, harvesting of paddy rice is usually continued till March. Accordingly, major construction works, particularly those related to the paddy fields, are to be concentrically scheduled to be carried out during the period from April to September. The discharge of Hevanella Oya actually measured at the end of August was about 15 liters/sec. therefore, it is considered that there is not a great deal of fluctuation in the discharge during the months of August and September, which probably approximates this figure. Construction schedules drawn up taking into consideration these meteorological conditions, the volume

of work, social conditions, etc. are as indicated in the following diagram.

3–2 Construction Program

1) Main Channel, Laterals and Related Structures

Desilting work and slope protection work is to be carried out from April of the First Year to the Fourth Year during the period of non-irrigation, with a total 21 months. Finishing work and slope protection work of the embankment is to be carried out almost in parallel with the above works and be completed by the Third Year during the 9 months of the non-irrigation periods. These works are planned to be carried out mostly by manual labor, with no use of construction facilities, machinery or equipment.

Improvement of intake and construction of check structures is to be begun, because of their importance, in April of the First Year and be completed by April of the Second Year. All the earth work are to be done by manual labor, while the concrete work is to be done with the use of small portable mixers, push carts and stick type vibrators, etc. Water Measuring Devices and Bridges across the Main Channel are scheduled to be constructed in the latter part of the entire work period from April and March of the Third Year and to be completed within a 3 month and a 1 month period respectively. Earth work and concrete work are to be carried out similarly to that of the intake structures. Spanning of bridge girder is to be done with the use of chain blocks.

2) Upland Field Irrigation Facilities and Domestic Water Supply Facilities.

i) Weir and Collecting Gallery

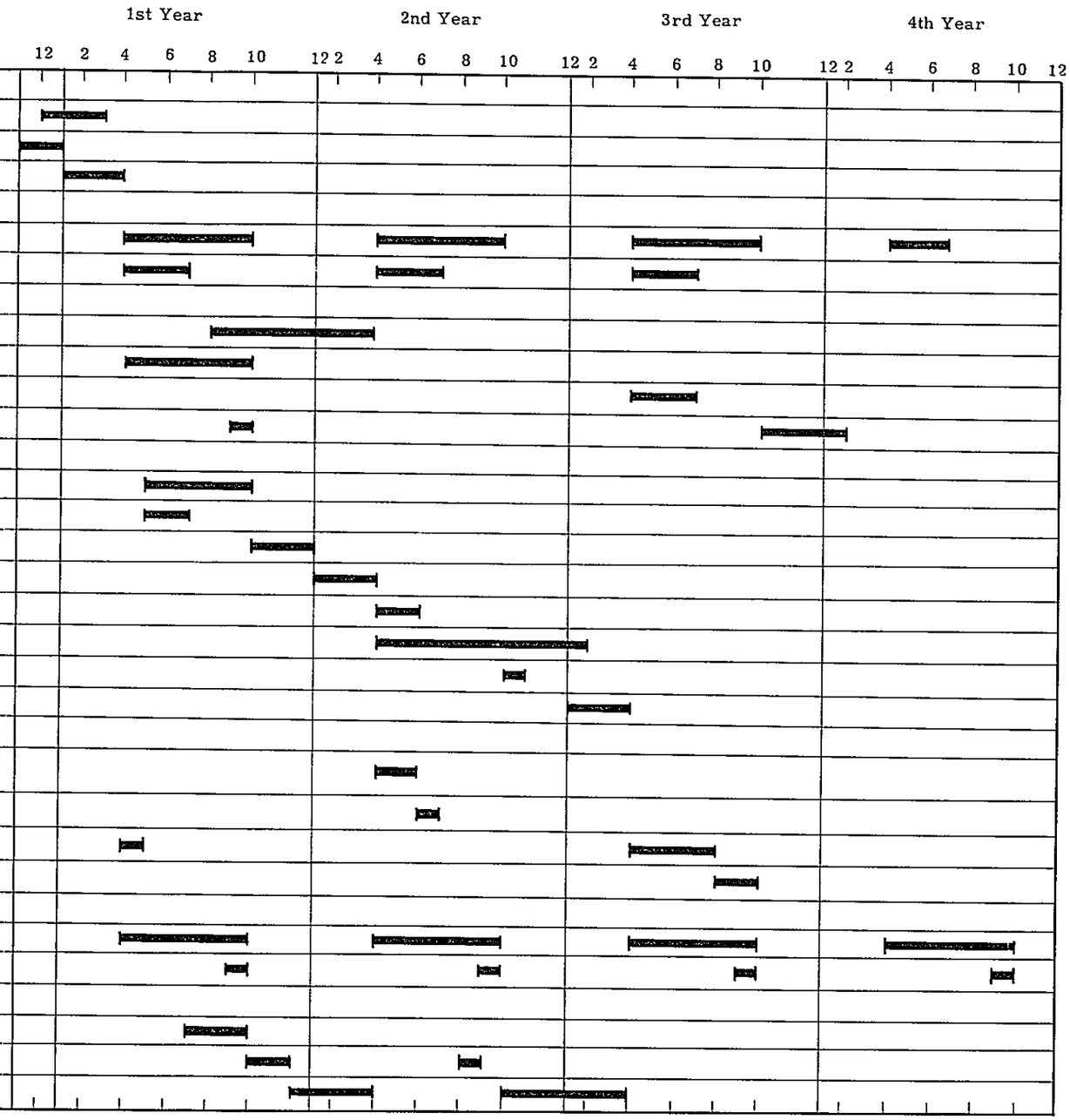
The Discharge of Hevanella Oya at the end of August is about 15 liters/sec and provided that weir discharge is about 10 $m^3/sec/km^2$, the flood discharge basin once a year is assumed to be about 1.0 m^3/sec. Therefore, a diversion channel with a capacity of 1.0 m^3/sec discharge is to be excavated on the left bank side. As the gradient of the Oya is 1.1,000, the required cross section of this diversion channel is to be as follows:

The newly proposed Main Farm Road No. 2 is to be constructed within a 1 month period from April of the First Year and this road shall be used as a construction work road.

For driving of sheet pile for water blockage, wooden tripod and drop hammer are to be used. Earth work and concrete work are to be carried out similarly to that of the related structures of the water channel. Simple scaffolding is to be set up for the concrete work of the weir.

Table 3 - 2

	Unit	Quantity
1. Preparatory works		
(1) Purchase of equipment	set	1
(2) Construction of head office	"	1
(3) Supplementary survey	set	1
2. Main channel and lateral		
(1) Desilting work	ft	55,595
(2) Slope preservation work(Embankment & Masonry)	ft	13,901
3. Channel related structures		
(1) Improvement of outlets	nos	53
(2) Check structures	nos	8
(3) Water measurement devices	nos	3
(4) Bridges	nos	5
4. Upland field irrigation and domestic water supply		
(1) Weir (L x H)	ft	100x12
(2) Infiltration gallery	set	1
(3) Pumping station	set	1
(4) Conveyance pipe	ft	1,790
(5) Regulating pond	ft^3	6,000
(6) Pipe line system (main pipe & laterals)	ft	34,827
(7) Booster station (including sump)	set	1
(8) Tap stands & Shower-bath stands	nos	52
5. Farm roads		
(1) Improvement of main farm roads (including culverts)	ft	9,102
(2) Improvement of lateral farm roads		
(3) Proposed main farm roads (including culvert)	ft	12,254
(4) Proposed lateral farm roads (including bridges)		
6. Paddy field rearrangement		
(1) Consolidation of plots	ac	771.1
(2) Installation of field outlet blocks	nos	
7. Pilot farms		
(1) Reclamation of paddy field irrigation	ac	3.2
(2) Reclamation of upland field irrigation	ac	3.0
8. Agricultural mechanization center	set	1



ii) Pumping Station, Conveyance Pipe, Regulating Pond

Pipe lines and other materials for the pumping station and conveyance pipe shall be hauled into the site over Main Farm Road No. 2 which is to be newly constructed. Chain blocks are to be used for installing all pumps and steel pipes. Wooden scaffolding is to be set up for the brick work of the pumping station building. Hauling of materials for the Regulating Pond shall have to be done mostly by manual labor from the side of House No. 3-99 because of the steep hill which prevents the passage of trucks. Mixers and other machinery are to be hauled into the site with the use of a winch and rollers. Materials and aggregate for masonry and concrete work is to transported by a belt conveyor. Excavation, placement, back-filling, etc. of pipe lines is to be done by manual labor while all P.V.C. pipe is to be hauled in on trucks, with the exception of short hauls which may be done by manual labor.

3) Farm Roads.

The top portion of a small hill which is located along the lateral is to be used as the borrow pit. Excavation, loading and hauling is to be done by a combination of a tractor shovel and dump track. For compaction of embankment roads, a roller is to be used. Improvement of existing main and lateral farm roads is to be carried out in the Second Year, structed in the Third Year.

4) Paddy Field Rearrangement

Consolidation of plots is to be carried out from the First Year to the Forth Year during all the non-irrigation periods, dividing the entire work into 4 terms. Bulldozers are to be used for levelling and earth moving work.

5) Pilot Farms

The Paddy Field Pilot Farm is to be completed before October of the First Year to permit planting that year. Bulldozers are to be used for the development work of the paddy fields. The work on the Upland Field Pilot Farm is to be initiated after the Paddy Field Pilot Farm is completed and it is to be completed by the end of the First Year. The weir to be constructed on the Oya is to be constructed during the August draft period of the Second Year to advert floods. For hauling of materials, No. 5 bridge on the main channel is to be used.

6) Agricultural Mechanization Center

Work on the Center is to be initiated form the beginning of the Second Year taking into consideration the distribution of machinery and the balance of the entire construction works. Bulldozers for ground levelling and asphalt paving equipment for the pavement of connecting roads are to be used. Construction of buildings is to

be started from Building No. 1 and end with Building No. 8, the headquarters for the Agricultural Cooperative, during the period from October of the Second Year to April of the Third Year.

3–3 Construction Machinery and Equipment

Construction machinery and equipment to be utilized for this project and their types, numbers and standards are to be as follows:

Items	Standard	Quantity
1. Earth work		
Bulldozer	15 ton class	2
Universal Excavator	Wheel Type 0.75 m^3	1
" "	Crawler Type 0.35 m^3	1
Dump Truck	6 ton	5
2. Concrete work		
Mixer	0.11 m^3/cycle	3
Vibrator	Stick type	6
Belt Conveyor	80 m x 70 m 10 p.s.	1
Wheel Barrows		20
3. Hauling & Installation		
Truck	6 tons	2
Chain Block	1.0 tons	2
4. Quarrying		
Jack Hammer	Cylinder ϕ 60 mm	5
Compressor	Pressure 7 kg/cm^2	2
5. Pile & Sheet Pile Driving		
Winch	1.0 tons 7.5 kw	1
Drop Hammer		1
6. Compaction and Paving		
Road Roller	8.0 tons	1
Asphalt Paving Equipment		

Chapter Ⅳ Cost Estimation

4 - 1 Cost Lay-out

Item	Description of Items	Total Cost	Currency Foreign	Component Domestic
Infra-Structural Renovation	1. Paddy Field Irrigation	608	131	477
	2. Upland Irrigation	539	378	161
	3. Drainage Improvement	22	-	22
	4. Farm Road	420	31	389
	5. Paddy Field Rearrangement	309	-	309
	6. Construction Machinery & Equipments	681	681	-
	Sub-Total:	2,579	1,221	1,358
Initial Input for Better Farm Management	7. Farm-Machinery	631	631	-
	8. Fertilizers	207	207	-
	9. Farm Chemicals	43	43	-
	10. Chemicals (for Snakes & Rats)	36	36	-
	Sub-Total:	917	917	-
Pilot Farm	11. Paddy Field Pilot Farm	111	26	85
	12. Upland Pilot Farm Cum-Agri. Mechanization Center	856	243	613
	13. Farm Machinery for Pilot Farms	273	273	-
	Sub-Total:	1,240	542	698
Operation and Maintenance	14. Operation Facilities & their Maintenance	558	240	318
	15. General Supervision & Control	293	167	126
	16. Others	207	57	150
	Sub-Total:	1,058	464	594
Office Space & Experts' Accommodations	17. Office Space & Experts' Accommodations	677	163	514
	Sub Total:	677	163	514
Better-Living Programme	18. Conventional Domestic Water Supply	(to be included at the Upland Irrigation)		
	19. Co-operative Head-quarters Building & Facilities	27	13	14
	20. Transport Facilities	186	140	46
	21. Broadcasting Apparatus	66	66	-
	Sub-Total:	279	219	60
Agro-Industry Development	22. Concrete Product Machinery	62	57	5
	23. Wood-Working	41	23	18
	24. Poultry Facilities	6	5	1
	Sub-Total:	109	85	24
Others	Landing & Inland Transportation Cost	141	-	141
	Grand Total:	7,000	3,611	3,389

4 - 2 Break down of Estimated Cost

Item	Description of Items	Q'ty	Unit	Rate	Total Cost Rs	Currency Foreign	Component Domestic	Remark
INFRE-STRUCTURAL RENOVATION								
I. Paddyfield Irrigation	Main Channel, lateral & related structures							
	1) Desilting work & slope protection				329,157	0	329,157	
	2) Parshall flume No. 1				7,230	831	6,399	
	" " No. 2				2,583	323	2,260	
	3) Check structure (No. 1, 2, 3, 4, 5, 6, 7 & 8)				86,344	52,287	34,057	
	4) Crossing bridge (No. 1, 2, 3, 4 & 5)				26,627	4,911	21,716	
	5) Improvement of outlet (54 Nos)				76,703	55,669	21,034	
	Contingencies		%	15	79,280	17,100	62,180	
	Sub Total				607,924	131,121	476,803	
II. Upland Irrigation & Domestic water Supply								
	1) Weir				58,910	27,261	31,649	
	2) Infiltration gallery				28,796	2,591	26,205	
	3) Pumping station				107,225	86,916	20,309	
	4) Regulating pond				25,348	5,996	19,352	
	5) Pipe line system				221,456	194,947	26,609	
	6) Booster station				19,704	6,436	13,268	
	7) Pipe aqueduct				7,696	4,752	2,944	
	Contingencies		%	15	70,370	49,320	21,050	
	Sub-Total				539,505	378,119	161,386	
III. Drainage-Improvement								
	Improvement of Existing Drainage	6,600	ft.	2,000	13,200		13,200	
	Drainage Outlet	6	No.	1,000	6,000		6,000	
	Contingencies		%	15	2,800		2,800	
	Sub-Total				22,000		22,000	
IV. Farm Road								
	1) Improved Road				78,054	847	77,207	
	2) Proposed Road				282,702	26,555	256,147	
	3) Farm Bridge				4,847	74	4,773	
	Contingencies				54,847	4,120	50,727	
	Sub-Total				420,450	31,596	388,854	
V. Paddy Field Re arrangement								
	1) Earth Work for Consolidation				111,800		111,800	
	2) Field Outlet Block & Small Outlet				156,529		156,529	
	Contingencies				40,249		40,249	
	Sub-Total				308,578		308,578	

Item	Description of Items	Q'ty	Unit	Rate	Total Cost Rs.	Currency Foreign	Component Domestic	Remark
VI. Construction Machineres & Equipment								
	1) Bulldozer (15 ton class)	2	No.	114,600	229,200	229,200		With standard tolls & accessories
	2) Universal Excavator (Wheel type, 0.7 m^3 Bucket Capacity)	1	No.	25,920	25,920	25,920		
	(Crawler type, 0.35 m^3 Bucket CapacityO	1	No.	96,000	96,000	96,000		
	3) Dump Truck (6 ton)	5	No.	30,420	152,100	152,100		
	4) Concrete Mixer (0.11 m^3/cycle)	3	No.	2,100	6,300			With 3 p.s. gasoline engine
	5) Vibrator (Stick type)	6	No.	3,700	22,200	22,200		
	6) Belt Conveyor	1	No.	2,100	2,100			With 3 p.s. gasoline engine
	7) Wheel Barrows (Capacity 50 Kg)	20	No.	185	3,700			
	8) Chain Block (Capacity 1 ton)	2	No.	390	780			Lifting power 32kg Min.distance 370mm
	9) Jack Hammer (Cylinder dia. 68mm)	5	No.	1,040	5,200			
	10) Compressor (No. of cylinder: 2 Max. used pressure 7 kg/cm^2).	2	No.	7,500	15,000			With 2 cycle diesel engine
	11) Winch (Single Drum type, Cap. 1 ton Drum dia. 300 mm)	1	No.	10,850	10,850	10,850		With a 2 cycle diesel engine
	12) Road Roller	1	No.	47,380	47,380			
	13) Asphalt tools (Hand Operated asphalt sprayor)	1	Set	4,150	4,150	4,150		Oil burnner & 5 m rubber hose
	14) Welder (Portable type)	1	Set	6,000	6,000	6,000		With standard accessories & gasoline engine
	15) Truck (6 ton)		No.	27,300	54,600	54,600		
	Sub Total				681,480	681,480		
	Total			2,579,937	1,222,316	1,357,621		
INITIAL IN-PUT FOR BETTER FARM-MANAGEMENT								
VII) Farm-Machinery								
	1) Two-Wheel Tractor (6-8 p.s)	50	No.	2,295	114,750	114,750		-
	2) Thresher (500 mm)	50	No.	1,063	53,150	53,150		-
	3) Trailor (0.50 ton)	50	No.	566	28,300	28,300		-
	4) Sprayer (Knap-sack type)	50	No.	1,191	59,550	59,550		-
	5) Binder (Harvester)	50	No.	5,866	293,300	293,300		-
	6) Contingencies		%	15	82,360	82,360		-
	Sub Total				631,410	631,410		-

Item	Description of Items	Q'ty	Unit	Rate	Total Cost Rs	Currency Foreign	Component Domestic	Remark
VIII. Fertilizers								
	1) Ammonium Sulphate	257	Ton	Rs 320	82,000	82,000	-	
	2) Concentrated Superphosphate	132	Ton	Rs 460	61,000	61,000	-	
	3) Muriate of Potash	74	Ton	Rs 500	37,000	37,000	-	
	Contingencies		%	15	27,000	27,000	-	
	Sub-Total				207,000	207,000	-	
IX. Farm Chemicals								
	1) C.N.P	13,280	Kg		25,200	25,200	-	
	2) M.C.P	14,280	Kg		18,000	18,000	-	
	Sub-Total				43,200	43,200	-	
X. Chemicals (for Snakes & Rats)								
	Phostoxin	110,000	Tablets		36,350	36,350	-	
	Total				917,960	917,960	-	
PILOT FARM								
XI. Paddy-Field Pilot Farm					96,255	11,557	84,698	
	Contingencies				14,400	14,400	-	
	Sub-Total				110,655	25,957	84,698	
XII. Upland Pilot Farm Cum-Agri.								
	Mechanization Center				719,218	106,439	612,779	
	Office Equipments & Accessories				15,000	15,000	-	
	Measuring Apparatus				9,750	9,750	-	
	Contingencies				111,595	111,595	-	
	Sub-Total				855,563	242,784	612,779	
XIII Farm-Machinery, Fertilizers & Farm-Chemicals for Pilot Farms								
	Farm-Machinery Two-Wheel Tractor (6.5-8.0 p s)	4	No.	2,295	9,180	9,180	-	
	Accessories for above Tractor	4	Set		5,400	5,400	-	
	Thresher (600 mm)	1	No.	1,063	1,063	1,063	-	
	Sprayer (Knap-sack type)	3	No.	1,191	3,573	3,573	-	
	(Trailed)	1	No.	10,000	19,000	10,000	-	
	Four-Wheeled Tractor	2	No.	14,000	28,000	28,000	-	
	Tractor Accessories (Dump trailer 2 ton)	1	No.	6,000	6,000	6,000	-	
	(Rotary tiller)	1	No.	3,400	3,400	3,400	-	
	(Plough)	1	No.	1,700	1,700	1,700	-	
	(Disc plough)	1	No.	3,400	3,400	3,400	-	
	(Disc harrow)	1	No.	3,400	3,400	3,400	-	
	(Tooth-harrow)	1	No.	1,700	1,700	1,700	-	
	(Cultipacker)	1	No.	1,700	1,700	1,700	-	
	(Leveller) Paddy	1	No.	500	500	500	-	
	- do - Upland	1	No.	900	900	900	-	

Item	Description of Items	Q'ty	Unit	Rate	Total Cost Rs	Currency Foreign	Component Domestic	Remark
	(Drill)	1	No.	7,000	7,000	7,000	-	
	(Cultivator)	1	No.	3,400	3,400	3,400	-	
	(Ridger)	1	No.	3,400	3,400	3,400	-	
	(Duster)	1	No.	3,400	3,400	3,400	-	
	Transplanter (Paddy)	2	No.	2,500	5,000	5,000	-	
	Power Scythe	5	No.	900	4,500	4,500	-	
	Binder	1	No.	7,000	7,000	7,000	-	
	Combine-Harvester	1	No.	80,000	80,000	80,000	-	
	Drier (15 sq.yd plate type)	1	No.	3,500	3,500	3,500	-	
	Husker	1	No.	1,700	1,700	1,700	-	
	Rice polisher	1	No.	1,700	1,700	1,700	-	
	Chain-saw	2	No.	1,700	3,400	3,400	-	
	Cutter (straw)	1	No.	900	900	900	-	
	Engine (10 ps)	2	No.	2,500	5,000	5,000	-	
	Pump (engine mounted)	2	No.	1,700	3,400	3,400	-	
	Winnower	2	No.	900	1,800	1,800	-	
	Parts for the above machines	Item	%	10	22,000	22,000	-	
	Contingencies		%	15	35,600	35,600	-	
	Sub-Total				272,616	272,616	-	
	Total				1,238,834	541,357	697,478	
OPERATION & MAINTENANCE								
XIV. Operation Facilities & Their Maintenance								
	Automatic Water Gauge for Dam	1	Set	62,000	62,000	49,000	13,000	
	Automatic Water Gauge for Channel	4	Set	26,000	104,000	83,000	21,000	
	Wireless Facilities-Operation Service	1	Set	25,000	25,000	13,000	12,000	
	Electric Facilities (Diesel Generator 25 KVA)	1	No.	38,350	38,350	38,350	-	
	(Fuel Tank 1.5 m^3)	1	Set	5,300	5,300	5,300	-	
	(Wire, Switches, Accessories, etc.)	1	Set	20,000	20,000	20,000	-	
	(Generator House)	1	Set	6,000	6,000	-	6,000	
	Operation							
	(Labour)	5	Years	20,000	100,000	-	100,000	
	(Material)	5	Years	25,000	125,000	-	125,000	
	Contingencies		%	15	72,800	31,300	41,500	
	Sub-Total				558,450	239,950	318,500	
XV. General Supervision & Control								
	Repairing of Facilities	5	Years	10,000	50,000	25,000	25,000	
	Repairing of Equipments	5	Years	30,000	150,000	100,000	50,000	

Item	Description of Items	Q'ty	Unit	Rate	Total Cost Rs	Currency Foreign	Component Domestic	Remark
XVI. Others	Material for Office-Use	5	Years	5,000	25,000	20,000	5,000	
	Labour	5	Years	6,000	30,000	-	30,000	
	Contingencies		%	15	38,250	21,750	16,500	
	Sub-Total				293,250	166,750	126,500	
	Transportation Charges & Vehicles Fuel etc.	5	Years	10,000	50,000	-	50,000	
	Transport Allowance	5	Years	10,000	50,000	-	50,000	
	Vehicle Maintenance	5	Years	15,000	75,000	25,000	50,000	
	Jeep	2	No.	16,000	32,000	32,000	-	
	Sub-Total				207,000	57,000	150,000	
	Total				1,058,700	463,700	595,000	
OFFICE SPACE & EXPERTS' ACCOMMODATIONS XVII. Office Space & Expert Accommodation								
	Head Office (Office)	500	Sq.yd	Rs.100	55,000	-	55,000	
	(Storage)	100	Sq.yd	Rs. 80	8,000	-	8,000	
	(Medical facilities & Office facilities)	1	Allow	20,000	20,000	20,000	-	
	Experts' Living Quarters (Consturction)	@150.- 250	Sq.yd	Rs 120	360,000	-	360,000	
	Domestic facilities	10	Set	6,000	60,000	60,000	-	
	Domestic Water Supply	1	Set		360,000	36,100	-	
	Class-room facilities	1	Allow	50,000	50,000	26,000	-	
	Contingencies	Item	%	15	88,365	21,315	67,050	
	Total				677,465	163,415	514,050	
BETTER-LIVING PROGRAMME XVIII. Conventional Domestic Water Supply	....to be included at the Upland Irrigation							
XIX. Co-operative Headquarters Bldg. & Facilities	.....To be included at the Agricultural Mechanization Center							
	Office Facilities	Item	Allow		15,000	10,000	5,000	
	Material for Information & Education				2,000	1,000	1,000	
	Miscellaneous items & Maintenance	Item	Allow		10,000	2,000	8,000	
	Sub-Total				27,000	13,000	14,000	

Item	Description of Items	Q'ty	Unit	Rate	Total Cost	Currency Foreign	Component Domestic	Remark
XX. Transport facilities								
	Motor-Vehicles (1 ton Truck)	5	No.	8,000	40,000	40,000	-	
	(6 ton Truck)	1	No.	30,000	30,000	30,000	-	
	(Micro-Bus)	1	No.	25,000	25,000	25,000	-	
	(Light-Van)	2	No.	7,000	14,000	14,000		
	Garage	300	Sq.yd	Rs, 80	24,000	-	24,000	
	Gasoline-Stand	1	Set	25,000	25,000	25,000	-	
	Spare-Parts & Accessories	Item	%	10	6,000	6,000	-	
	Maintenance	Item	Allow	Sum	5,000	-	50,000	
	Contingencies	Item	%	10	17,000	-	17,000	
	Sub-Total				186,000	140,000	46,000	
XXI. Broad-casting Apparatus								
	Broadcasting Car	2	No.	33,000	66,000	66,000	-	
	Total				279,000	219,000	60,000	
AGRO-INDUS-TRY DEVE-LOPMENT								
XXII. Concrete Product Machinery								
	Concrete Mixer (8 cuft capacity)	1	No.	2,000	2,000	2,000	-	
	Belt Conveyer	1	No.	1,500	1,500	1,500	-	
	Table Vibrator (3'x3'1)	2	No.	4,000	8,000	8,000	-	
	Steel Pannel Form (Feed channel plate)	300	Pcs	Rs.33	10,000	10,000	-	
	(Field block)	150	Pcs	Rs.83	13,000	13,000	-	
	(Tools)	2	Set	1,000	2,000	2,000	-	
	(Forming oil)	3		333	1,000	1,000	-	
	Fork-lift (4-wheeled)	1	No.	13,000	13,000	13,000	-	
	Contingencies	Item	%	20	11,000	6,000	5,000	
	Sub-Total				62,000	57,000	5,000	
XXIII. Wood-Working								
	Wood-Working Machinery	Item	Allow		41,000	23,000	18,000	
XXIV. Poultry Facilities								
	Poultry Facilities	Item	Allow	sum	6,000	5,000	1,000	
	Total				109,000	85,000	24,000	

Specifications

SECTION 1

GENERAL SPECIFICATIONS

1 - 1 Location

This project site Dewahuwa is located at 6 miles' distance north from Galewela in the middle of Colombo-Trincomalee National Highway.

1 - 2 Purpose

This project is aimed at an overall agricultural development through seven major programmes: Farm-management improvement plan, Infra-structural improvement plan, Pilot farm shceme, Agro-industry development plan, Better living programme, Maintenance & operation programme and Agricultural co-operative development plan.

1 - 3 Project Features

(1) Main Channel

a) Channel

Total length of desilting	51,300 ft
Slope protection	
Random rubble masonry	6,106.0 ft
Enbankment & random rubble masonry	735.0 ft
Embankment	7,060.0 ft
Proposed channel slope	1/3,000

b) Related structure

Improved outlet	¢4"	11 Nos.
	¢6"	14 "
	¢9"	13 "
	¢12"	3 "
	¢18"	3 "
	Gate type	2 "
	Total	46 "
Proposed outlet	¢4"	1 "
Check structure		8 set
Parshall flume		2 "
Crossing bridge	Width 10'	5 "

(2) Lateral

a) Channel

Total length of desilting	4,295.0 ft
Proposed channel slope	1/2,000

b) Related sturucture

Improved outlet	¢4"	1	Nos.
	¢6"	4	"
	¢12"	1	"
	¢18"	1	"
	Total	7	"

(3) Upland field irrigation and domestic water supply

a) Weir

Length	100 ft
Height	12 ft

b) Gallery

Collecting pipe	¢500mm x 136ft
Intake pipe	¢500mm x 13 ft

c) Sump well

Diameter	¢3,000 (corrugated steel pipe)
Depth	23' - 11"

d) Pumping station

Pump capacity	210 ft^3/min
Bore	200mm x 150m, 2 set, Dauble suction volute pumps
Actual lift	141.00 ft
Motor power	55.00 kw

e) Pipe lines

Total length of Main pipe	6,789.2 ft
Total length of Lateral	34,827.0 ft
Total length of Conveyance pipe	1,789.9 ft

f) Pipe aquiduct 3 set

g) Regulating pond Capacity 6,000 cuft 1 set

h) Reservoir for booster station

Capacity	2,000 cuft	1 set
Depth	6 ft	

i) Booster

Capacity	1.42 ft^3/min
Total lift	30 m (98.4 ft)
Bore	¢40 mm, 1 set

Motor power 2.2 kw

j) Top stand 48 Nos.

(4) Farm roads

a) Improved Main Farm Roads (Width 12', Height 2.0')
9,102.1 ft

b) Improved Lateral Farm Roads (Width 12', Height 1.0')
14,100.0 ft

c) Improved Main Farm Roads (Width 12', Height 2.0')
12,254.0 ft

d) Proposed Lateral Farm Roads (Width 6', Height 1.5')
45,530 ft

e) Culvert 17 Nos.

(5) Paddy field rearrangement

Total area	111.1 ac
Existing paddy field	14,004 plots
Consalidated paddy field	4,767 plots

(6) Pilot farm

Paddy field	80' x 220' x 8 plots = 3.2 ac
Upland field	66' x 160' x 12 plots = 3.0 ac

(7) Pilot farm building Cum Agricultural Mechanization Center

Total floor space of buildings 21,600 ft^2

1 - 4 Construction Machinery

1 - 4 - 1 General

The construction equipments shall have such sufficient performance capacity and durability as to secure the execution of the works.

1 - 4 - 2 Construction Machinery

The following equipment necessary for construction shall be prepared.

(Equipment)	(Description)	(Number)
Bulldozer	15 tons	2
Dump Truck	6 tons	5
Truck	6 tons	2

(Equipment)	(Description)	(Number)
Universal Excavator	6 tons	2
Jackhammer	ϕ60mm	5
Compressor		2
Concrete Mixer	0.11 m^3	3
Road Roller	8 tons	1
Winch	1.0 tons	1

1 - 5 Construction Materials

1 - 5 - 1 General

All materials used in the works, other than natural or pretreated materials, shall be new and of the kinds and qualities specified herein or on the drawings.

1 - 5 - 2 Standards

The Japan Industrial standard (JIS) is used throughout these specifications. Other national or international standards may be accepted as occasion demands.

1 - 5 - 3 Cement

Cement for concrete, mortar shall be a show-setting portland cement conforming to the standard.

Consigment of cement shall be taken into use in the order of delivery to the site and the use of cement of more than 6 months of age after production shall not be permitted unless otherwise approved by the Engineer after quality test.

The cement to be furnished shall be packed in waterproofed bags on which trademark, type of cement and date of manufacture shall be clearly marked.

Not more than 13 bags of cement shall be permitted to be piled up and it shall be limited to pile less than 7 bags, when the storage is expected to be longer than 60 days.

1 - 5 - 4 Timber

Timber species both for temporary and permanent works shall be the most suitable for each particular purpose, and shall in all cases be thoroughly seasoned, sound, dry, straight, and free from sap, shakes, deadknots or defects of any kind.

Timber for centering or false work, temporary bridges may not be new, but shall be of suitable quality for each particular purpose.

1 - 6 Temporary Works

Prior to commencement of constructing the works, warehouses for construc-

tion materials shall be built at the places directed by the Engineer.

1 - 7 Earth Works

1 - 7 - 1 Clearing and Grubbing

The area to be occupied by the works and temporary works shall be cleared of all trees, bush, rubbish and other objectionable materials, and cleared materials shall be burned or otherwise disposed of, so as to give satisfaction to the Engineer.

Grubbing shall mean the removal and disposal of all stumps, roots, vegetation and other objectionable matter. All materials resulting from grubbing operations shall be collected, piled and burned or otherwise disposed of in a manner acceptable to the Engineer.

1 - 7 - 2 Stripping of Topsoil

Topsoil is defined as all material which is being or can be used for the cultivation of agricultural crops.

The depth stripped of topsoil shall be indicated by the Engineer in accordance with the Drawings.

1 - 7 - 3 Excavation

The work under this section shall consist of excavating and trimming the following features: channel, pipe lines, pumping station, intake weir, farm roads, regulating pond, and all other excavation shown on the Drawings or required by the Engineer.

All materials removed in "Excavation" will be classified as follows:

Rock - Rock excavation shall include all solid rock in place which cannot be removed until loosened by blasting, barring, or wedging, and all boulders and detached pieces of solid rock more than one cubic yard in volume. Solid rock is defined as sound rock of such hardness and texture that it connot be loosened or broken down by hand drifting picks.

Common- All other materials not falling under above classifications of "Rock" will be classified as "Common".

Excavation shall be performed to the lines, grades, and dimensions shown on the Drawings or as required by the Engineer. The excavation shall be finished in a workmanlike manner to the prescribed lines, grades and dimensions are shown on the Drawings.

All excavated materials moved from "Excavation" which are suitable for filling materials as determined by the Engineer w ill be used for enbankment, di dikes, or used as backfill for structures.

1 - 7 - 4 Earthfill

Earthfill shall mean all earthfill for the channel embankment, road embankment and for other parts of the works, built with material obtained both from excavation as specified in clause 1 - 7 - 3 hereof and borrow pits as specified in clause 1 - 7 - 4 - 2 and hauled to the fill site, and compacted.

1 - 7 - 4 - 1 Foundation preparation

The whole of the base area of earthfill or embankment upon which any kind of material will be placed, shall be cleared as specified in clause 1- 7 - 1 hereof, and stripping topsoil and excavation shall be carried out to a depth determined by the Engineer.

The level at which this excavation is finished is hereafter referred to as the "level of acceptable foundation".

If earthfill is to be built on sloping ground, the surface of the ground shall be deeply plowed or stepped.

Before the first layer of filling is compacted, its foundation shall be thoroughly saked or plowed over the whole surface to the depth 5 inches, and if necessary, such measures as moistening with water shall be taken so that the filling to be compacted will join firmly and neatly with the foundation materials.

1- 7 - 4 - 2 Borrow pits

All fill materials for incorporation in the works which are not available in the excavation site, shall be taken from the designated borrow pits (the hills in Tract 3) shown on the Drawings.

Borrow pits shall be cleared and grubbed or stripped as directed to remove all unsuitable materials. Ditches and outlets shall be provided as necessary for drain.

The surface borrow pits shall be left in reasonably smooth and even condition in satisfactory to the Engineer.

1 - 7 - 4 - 3 Placing fill material

Prior to the commencement of any earthfill, the foundation executed on the areas where earthfill is to be made as specified in clause 1 - 7 - 4 - 1 hereof, shall be checked and accepted by the Engineer.

All earthfill shall be made according to the measured lines and slopes shown on the Drawings.

Fill material shall not contain any clod, turf, stump, animal or vegetable debris, or any other objectable material.

The layer of earthfill, when placed, shall be horizontal of uniform thickness as specified in clause 1 - 7 - 4 - 4, and shall extend to the full width of filling.

The rate of settlement shall be observed and the placing of the following layer shall be started only after the approval of the Engineer is obtained. No cobbles or rocks of more than 8 inches in size shall be placed in the 20 inches thick upper layer of the fill.

Unless otherwise specified, the following extra filling or available material for settlement allowance shall be added according to the condition of original ground:

Height of Embankment (feet)	Extra Filling (Percentage to Embankment Hight)
0 - 10	9 - 7 %
10 - 20	8 - 6 %

1 - 7 - 4 - 4 Compaction of Fill Material

Prior to the commencement of embanking works, a series of field tests to determine the optimum conditions of compaction shall be carried out under the direction of the Engineer.

In order to maintain or achieve the requisite moisture content, if necessary, facilities for spraying fill material with water or allowing it to dry out shall be provided.

The compaction equipment shall be capable of achieving the specified densities in parts of Road works.

At the end of each day or whenever embanking at any particular point is interrupted, the surface of the fill shall be rolled to give a slightly cambered surface to facilitate drainage. At all times during dry period, whether embankment is taking place or not, the surfaces of the earthfill shall be watered as directed by the Engineer to prevent the fill from drying out.

1 - 7 - 5 Backfilling

Backfilling shall be carried out with such appoved material on the front and the side of outlying structures and elsewhere as shown on the Drawings or as directed.

Topsoil, vegetation or other organic material shall be excluded from backfilling material extracted from required excavation fr structures.

Prior to the commencement of placing fill material, the places to be backfilled shall be cleared of all remaining concrete form and other temporary works.

Backfilling material shall be placed in a continuous horizontal layer of not more than 8 inches thick, measured after compaction.

Backfilling material adjacent to structures shall be placed in such a manner as will ensure that it can be satisfactorily compacted without damage to the structures, and compaction adjacent to all structures shall be carried out by approved hand tools.

1 - 8 Concrete Works

1 - 8 - 1 General

The work required under this section includes all labour, materials, and services necessary for and reasonably incidental to the completion of all concrete work as shown on the Drawings.

Unless specifically provided in these specifications, concrete shall be produced, placed, cured, finished and tested in accordance with the provisions of JIS or equivalent.

1 - 8 - 2 Cement

All cement used shall be Portland Cement and shall be furnished as prescribed in Clause 1 - 5 - 3.

1 - 8 - 3 Aggregates

All aggregates shall be washed and shall consist of natural sand, gravels or crushed rock.

1 - 8 - 3 - 1 Fine Aggregate

Fine aggregate, used in the composition of concrete, mortar, shall consist of sand, stone screening or other inert materials with similar characteristics or combination thereof, having clean, hard, strong, sound, durable, uncoated grains, and free from injurious amount of dust, lumps, soft or flaky particles, shale, loam or other deleterious substances.

The fine aggregate shall be well graded from coarse to fine and shall conform to the following requirements:

	(Percentage by weight)
Passing 3/8" sieve	100
Passing No. 4 sieve	95 - 100
Passing No. 8 sieve	65 - 85
Passing No. 16 sieve	45 - 70
Passing No. 30 sieve	25 - 45
Passing No. 50 sieve	15 - 30
Passing No. 100 sieve	3 - 8

Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above.

1 - 8 - 3 - 2 Coarse Aggregate

Coarse aggregate shall consist of crushed stone, gravel, or ther approved inert materials with similar characteristics, or a combination thereof, having clean, hard, sound, strong, durable, uncoated particles, free from injurious amout of soft, friable, thin, or laminated pieces, alkali, organic or other deleterious matter.

The coarse aggregate shall be well graded from fine to coarse.

It shall be separated into the following specified size or designated groups.

	No. 1	No. 2	No. 3
passing 3" sieve			100
passing 2.1/2" sieve			100 - 90
passing 2" sieve		100	75 - 35
passing 1.1/2" sieve		90 - 100	15 - 0
passing 1" sieve	100	20 - 55	5 - 0
passing 3/4 sieve	90 - 100	0 - 15	
passing 1/2" sieve		0 - 15	
passing 3/8" sieve	20 - 55		
passing No. 4 sieve	0 - 5		
passing No. 8 sieve	0 - 3		

1 - 8 - 4 Water

Water used in mixing concrete shall be clean and free from injurious amount of oil, alkali, organic matter or other deleterious substance.

1 - 8 - 5 Roinforcing Steel

Steel reinforcing bars shall be kept clean and shall be free from pitting, loose rust, oil, grease, earth or paint, or any other material which may impair the bond between the concrete and the reinforcement.

Bend, cranks and other shapes of reinforcement shall be to the dimensions specified, otherwise all bars shall be truly straight.

Bending and cutting shall be done by such method as not to injure the bar qualities and as approved by the Engineer.

1 - 8 - 6 Preparing Foundations for Concrete

Before placing concrete on foundation, oil, objectionable coatings, loose or unsound fragment of rock, earth, mud, debris, and standing water shall be removed from the surfaces placed.

Where concrete abuts against earth or any other material liable to come loose or to slip, care shall be taken to avoid falls of material on to the surface of the wet concrete either by leaving timbering in place or by cutting away or removing timbering in small lengths or depths at a time.

1 - 8 - 7 Placing Reinforcement

The greatest care shall be taken that the steel is laid out correctly, that the bars are tightly and securely fixed by means of iron binding wire in position to prevent any displacement before or during concreting and so that the concrete may be consolidated firmly around the steel and against the forms. Metal chairs, metal hangers, metal spacers mortar blocks or other satisfactory supports may be used for supporting the steel, however, steel blocks or wooden wedges to keep the steel away from the forms will not be allowed.

Where iron binding wires are used for suspension of the bars in position, the number of binding wires to be used shall be sufficient for hanging each bar in position as prescribed in the Drawings.

Reinforcement in place shall be cleaned of all set or partially set concrete which has been deposited on it during previous concreting operations.

Reinforcing bars in structures shall be so placed that the reinforcement, any anchor bolts or other embedded metal works, and the surface of form will be at least two centimeters (0.02 meter) apart from each other. Intersection point of the reinforcing bars placed shall be securely tied with an annealed iron wire of not less than 0.9 millimeters in diameter.

Jointing of the reinforcing bars shall be made in the type of overlap joint.

The length of overlapping shall not be less than twenty five (25) times the diameter of the bars, and the overlapping joint shall be tied at several points by annealed iron wire of diameter as specified above.

1 - 8 - 8 Proportioning Concrete

The proportions of aggregate to cement shall be such as to produce a workable mixture which can be thoroughly compacted and which will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surface.

The following table gives the different types of structures, and for each minimum compressive strength at 28 days the maximum size of aggregates and the cement content per cubic meter of concrete placed

Mix Type Mix Type	Minimum compressive strength at 28 d ays (kg cm^2)	Maximum size of aggregates (mm)	Slump (cm)	Maximum water cement ratio (%)	Cement content (kg m^3)
A	200	40	8 - 10	60	300
B	180	80	8 - 10	70	250
C	130	80	8 - 10	80	180

The actural propotions of the various gradings of coarse aggregate and sand will be determined from analysis and t ests by the Engineer, who may vary these propotions from time to time.

The following types of m ix shall in principle be used in the various structures specified below:

Mix type

A .....Reinforced concrete for main body in structures

B ..... Plain concrete for foundation bed, footing, etc.

C ..... Blinding concrete

The water-cement ratio of the concrete shall not exceed 0.8 in weight for concrete to be used in any structures.

The amount of water added at the mixer shall take into account the moisture contents of the agregates at the time of mixing and shallbe changed as required to secure concrete of proper consistency. Uniformity in concrete consistency from batch to batch will be required, and no addition of water shall be permitted to compensate for stiffening of the concrete resulting from excessive overmixing or objectionable drying before placing of the concrete.

1 - 8 - 9 Batching of Concrete

The batching equipment shall be capable of combining the aggregates, cement, and water into a uniform mixture within the time limit specified and be capable of ready adjustment to compensate for the varying moisture content of the aggregate and the cange the weight of the materials being batched. The combined accuracy of the batching equipment in feeding and measuring shall not exceed the following limit:

Water and cement ..... 1.5 per cent

Aggregates ..... 3 per cent

Each ingradient that goes to the making of the concrete shall be determined by weighing, except water which may be measured by volume.

The mixing time for each batch shall not be loss than the minimum mixing time specified as follows:

Capacity of mixer	Minimum mixing time
2 cubic meters to 1.5 cubic meters	2 minutes
1.5 cubic meters or less	1.5 miniutes

The mixing time shall start when all the ingredients are in the mixer. The main charge of water shall be added prior to, during and after the charging operation for a moment.

The mixer shall not be loaded beyond its rated capacity. The mixer shall produce a concrete of uniform consistency and appearance.

All mixing equipment shall be clean before comencing mixing and shall be kept free from set concrete.

Where approved by the Engineer, concrete and mortare may be mixed by hand.

Ingredients shall be thoroughly mixed at least four times, while dry, on a clean watertight iron mixing sheet with mixing scoops, until the cement colour can no longer be distinguished from the sand in any part of the mass. The mixture shall then be wetted gradually and uniformly while undergoing further mixing until it is thoroughly uniform and homogeneous.

1 - 8 - 10 Transporting and Placing Concrete

Concrete and mortar shall be conveyed from the mixer to its place in the works as rapidly as possible by methods which will prevent segregation, consolidation or drying out.

Before placing concrete, all equipment, forms, reinforcement, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned

of all debris and water, and the forms shall be wetted or oiled.

The preparation of the foundation is extremely important, and shall be provided. The surface of the rock shall be thoroughly cleaned, and all standing water removed before pouring concrete.

Concrete shall be deposited to the spot by vertical dropping so as to prevent segregation, but shall not be dropped freely through a vertical height greater than 1.5 meters nor allowed to strike hard reinforcing bars or forms assembled.

Chutes, if used, must have a section with round corner and a proper slope so that there is no segregation, loss of mortar or reduction in slump, and shall be provided with a drop chute not less than 0.6 meter long to prevent segregation at transfer points and to ensure that the concrete is discharged vertically into place.

Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing.

When concrete once started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.

1 - 8 - 11 Compaction of Concrete

All concrete shall be placed with the aid of mechanical vibrating equipment approved by the engineer. Vibrating equipment shall be operated byexperienced help and overvibrating shall be aboided. Vibration shall be supplemented by hand spading adjacent tot he forms and the parts approved by the Engineer.

1 - 8 - 12 Finishing Concrete

Forms shall be so constructed that a smooth appearing concrete will result. No rubbing will be permitted unless deemed necessary by the Engineer.

The top surfaces of floor slabs shall be screeded, floated with a wood float and then steel troweled to a smooth, dense finish.

Steel troweling shall not be begun until all surface water has disappeared and shall be done in such a manner that no water or excess fine material is brought to the surface. However, steel troweling shall not be postponed until initial set has taken place.

Immediately after removing forms, all concrete surface shall be inspected and any poor joints, voids, stone pockets or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than one (1) inch with the edges perpendicular to the surface. The area shall be thoroughly wetted, brushed with grout and patching mortar placed to slightly overfill the recess.

After partial set has taken place, the excess mortar shall be removed flush with the surface of the concrete, using a wood float.

All patching shall be protected and covered as specified for concrete.

All crecks, leaks or moist spots which appear shall be repaired to the satisfaction of the Engineer.

1 - 8 - 13 Curing Concrete

Provision shall be made for maintaining concrete in a moist condition for a period of atleast 5 days after the placement of the concrete except that for high early strength concretes, moist curing Shall be provided for at least the first two days.

Appendix

1. DETAILED BREAK-DOWN OF ESTIMATED COST (Civil)

Item	Cost	Currency component		Remark
		Foreign	Domestic	
I Main channel, lateral & related structures	Rs	Rs	Rs	
1. Desilting work & slope protection	329,157	0	329,157	
2. Parshall flume No. 1	7,230	831	6,339	
Parshall flume No. 2	2,583	323	2,260	
3. Check structure No. 1	12,671	8,764	3,907	
" " No. 2	11,035	7,258	3,777	
" " No. 3	11,169	6,156	5,013	
" " No. 4	10,842	6,138	4,704	
" " No. 5	10,330	6,044	4,286	
" " No. 6	10,607	6,066	4,541	
" " No. 7	9,953	5,961	3,992	
" " No. 8	9,737	5,900	3,837	
4. Crossing bridge (No. 1, 2, 3, 4)	19,457	2,302	17,155	
Crossing bridge No. 5	7,170	2,609	4,561	
5. Improvement of outlet				
No. 1	1,039	719	320	
No. 2	1,039	719	320	
No. 3	1,039	719	320	
No. 4	1,277	829	450	
No. 5	1,039	719	320	
No. 6	1,277	827	450	
No. 7	8,188	7,676	512	
No. 8	1,331	882	449	
No. 9	1,039	719	320	
No. 10	1,012	692	320	
No. 11	1,277	827	450	
No. 12	1,277	827	450	
No. 13	1,039	719	320	
No. 14	1,636	1,025	611	

Item	Cost	Currency component		Remark
		Foreign	Domestic	
	RS	RS	RS	
No. 15	1,012	692	320	
No. 16	1,039	719	320	
No. 17	1,277	827	450	
No. 18	1,039	719	320	
No. 19	1,039	719	320	
No. 20	1,012	692	320	
No. 21	1,012	692	320	
No. 22	1,039	719	320	
No. 23	1,277	827	450	
No. 24	1,636	1,025	611	
No. 25	1,039	719	320	
No. 26	1,012	692	320	
No. 27	1,012	692	320	
No. 28	1,039	719	320	
No. 29	1,277	827	450	
No. 30	1,331	882	449	
No. 31	1,636	1,025	611	
No. 32	1,039	719	320	
No. 33	1,012	692	320	
No. 34	1,012	692	320	
No. 35	1,277	827	450	
No. 36	1,277	827	450	
No. 37	8,188	7,676	512	
No. 38	1,039	719	320	
No. 39	1,012	692	320	
No. 40	1,012	692	320	
No. 41	1,277	827	450	
No. 42	1,277	827	450	
No. 43	1,331	882	449	
No. 44	1,012	692	320	
No. 45	1,277	827	450	
No. 46	1,277	827	450	
Lateral No. 1	1,039	719	320	
No. 2	1,039	719		
No. 3	1,039	719	320	
No. 4	1,039	719	320	
No. 5	1,012	692	320	
No 6	1,331	882	449	
No. 7	1,636	1,025	611	
Proposed outlet	1,012	692	320	
Sum up	76,703	55,669	21,030	
Contingencies	79,297	17,103	62,193	Approx. 15%
Sub-total	608,000	131,000	477,000	

Item	Cost	Currency component		Remark
		Foreign	Domestic	
	Rs	Rs	Rs	
II. Upland irrigation & domestic water supply				
1. Weir	53,910	27,261	31,649	
2. Infiltration gallery	28,796	2,591	26,205	
3. Pumping station	107,225	86,916	20,309	
4. Regulating pond	25,348	5,996	19,352	
5. Pipe line system	221,456	194,847	26,609	
6. Booster station	19,704	6,436	13,268	
7. Pipe aqueduct	7,696	4,752	2,944	
Sum up	496,135	328,799	140,336	
Contingencies	70,370	49,320	21,050	
Sub total	540,000	378,000	161,000	
III. Farm road				
1. Improved road				
Main No. 1	12,068	0	12,068	
No. 2	17,337	0	17,337	
No. 3	27,553	847	26,706	
Lateral road	21,096	0	21,096	
Sum up	78,054	847	77,207	
2. Proposed road				
Main No. 1	154,689	26,555	128,134	
No. 2	3,419	0	3,419	
Lateral	124,594	0	124,594	
3. Farm Bridge	4,847	74	4,773	
Sum up	287,549	26,629	260,920	
Congingencies	54,840	4,121	50,714	
Sub total	420,000	32,000	389,000	
IV. Pilot farm-cum-agri. mechanization center				
1. Paddy field pilot farm	96,255	11,557	84,698	
2. Agri. mechanization center	719,218	106,439	612,779	
Sum up	815,473	117,996	697,477	
Contugencies	122,321	17,699	104,622	
Sub-total	938,000	136,000	802,000	

Item	Cost	Currency component		Remark
		Foreign	Domestic	
	Rs	Rs	Rs	
V. Paddy field rearrangement	268,329	0	268,329	
Contingencies	40,249	0	40,249	
Sub total	309,000	0	309,000	
VI. Automatic Water-gauge	62,000	62,000		
Total	2,877,000	739,000	2,138,000	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Main ch. & lateral						
Desilting						
Main	Excavation class-D	5,417.50	Cube	8.88	48,107	
	Embankment	1,050.80	"	8.88	9,331	
	Random Rubble masonry	547.28	"	186.00	101,794	
	Timber piling	3,673.80	Cuft	45.60	167,525	
				Total	326,757	
Lateral	Excavation class-D	270.25	Cube	8.88	2,400	
				Total	2,400	
Parshall F.						
No. 1	Excavation class-D	18.49	Cube	8.88	164	
	Embankment	11.20	"	8.8	99	
	Fill	5.39	"	5.00	27	
	Class-A concrete	8.86	"	432.00	3,828	
	Shuttering for concrete	10.71	Squ.	105.60	1,131	
*	Reinforcement bar	471.00	kg	1.10	518	
*	Angle (40 x 40 x 3)	28.00	"	1.10	31	
*	P.V.C. pipe (12" x 4000)	2	Nos	138.33	277	
	(1/2" x 4000)	1	"	2.57	3	
	Class-B concrete	0.01	Cube	342.00	3	
	Random rubble masonry	0.84	"	186.00	156	
	Timber piling	18.80	Cuft	45.60	857	
	Metal spreading and rolling	0.76	Cube	32.40	25	
	Breaking 6" to 9" rubble piling and transporting	2.40	Cube	45.60	109	
*	Miscellaneous metal	1	set		2	
				Total	7,230	
No. 2	Excavation class-D	5.88	Cube	8.88	52	
	Embankment	1.16	"	8.88	10	
	Fill	2.67	"	5.00	13	
	Class-A concrete	2.23	"	432.00	963	
	Shuttering for cencrete	3.70	Square	105.60	391	
*	Reinforcement bar	151.99	kg	1.10	167	
*	Angle (40 x 40 x 3)	12.00	kg	1.10	13	
*	P.V.C. pipe (12" x 4000mm)	1	Nos	138.33	138	
*	P.V.C. pipe (1/2"x4000mm)	1	"	2.57	3	
	Class-B concrete	0.01	Cube	342.00	3	
	Random rubble masonry	0.58	"	186.00	108	
	Braking 6" to 9" rubble, piling and transporting	1.20	"	45.60	55	
	Metal spreading & rolling	0.25	"	32.40	8	
	Timber piling	14.50	Cuft	45.60	657	
*	Miscellaneous metal	1	set		2	Round rod washer
				Total	2,583	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Cross. bridge (No. 1--4)						
	Excavation in found.	60.69	Cube	12.00	728	
	Embankment	1.56	"	8.88	14	
	Back fill	50.18	"	5.00	251	
	Class-A concrete	9.26	"	432.00	4,000	
	Shuttering for concrete	15.32	Squ	105.60	162	
*	Reinforcement bar	560.00	kg	1.10	616	
	P.C beam					
	(Center b. 2' x 9" L=23.0)	12.	Nos.			
	(Side b. L=23.0")	8	"			
	(Hand rail supporter)	56	"		12,000	
*	Galvanized iron pipe (¢ 40mm)	134.20	ft	12.50	1,678	Hand rail
*	Miscellaneous material	1	set		8	
				Total	19,457	
No. 5	Excavation in found.	29.15	Cube	12.00	350	
	Embankment	3.30	"	8.88	29	
	Back fill	22.25	"	5.00	111	
	Class-A concrete	2.21	"	432.00	955	
	Shuttering for concrete	11.51	Squ.	105.60	1,215	
	Crushed stone concrete	6.12	Cube	260.00	1,591	
*	Reinforcement bar	1,266.00	kg	1.10	1,393	
	Cement mortar rending (3/4" thick, 1 : 2)	2.92	Square	48.00	140	
	Painting for rust resisting	314.15	sqft	0.30	94	
*	P.V.C. pipe (40mm x 4000mm)	1	Nos	7.90	8	
	Breaking 6" to 9" rubble piling and transporting	1.67	Cube	45.60	76	
*	H-beam (500 x 200 x 10 x 16 L=7.4m)	2	Nos	531.70	1,063	Cutting & welding to be included
*	Channel beam (250 x 90 9 x 13, L=2.1m)	3	"	48.30	145	
				Total	7,170	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Check Structure No. 1	Excavation class-D	9.94	Cube	8.88	88	
	Embankment	3.01	"	8.88	27	
	Back fill	2.12	"	5.00	11	
	Class-A concrete	4.28	"	432.00	1,849	Rein. con-
	Class-B concrete	0.20	"	342.00	68	crete Coping
	Shuttering for concrete	4.13	Squa	105.60	436	
*	Reinforcement bar	0.38	ton	1,100.00	418	
	Random rubble masonry	1.20	Cube	186.00	223	
	Breaking 6"to 9" rubble piling and transporting	1.60	Cube	45.60	73	Riprap
	Timber piling	22.80	"	45.60	1,040	
	Plank	4.62	"	20.00	92	Stop plank Foot plank
*	Galvanized iron pipe (¢40mm)	73.70	ft	12.50	921	Hand rail
*	Miscellaneous metal	1	set		18	Anchor bolts
*	Slide gate(5'11"x4')	1	set		7,407	and stair
				Total	12,671	
No. 2	Excavation class-D	10.03	Cube	8.88	89	
	Back fill	1.39	"	5.00	7	
	Class-A concrete	4.10	"	432.00	1,770	Rein. concrete
	Class-B concrete	0.20	"	342.00	68	Coping
	Shuttering for concrete	4.05	Squa	105.60	428	
*	Reinforcement bar	0.35	ton	1,100.00	385	
	Random rubble masonry	1.09	Cube	186.00	203	
	Breaking 6"to9"rubble piling and transporting	1.50	Cube	45.60	68	Riprap
	Timber piling	22.80	cuft	45.60	1,040	
	Plank	5.22	"	20.00	104	Stop plank Foot plank
*	Galvanized iron pipe (¢ 40mm)	77.54	ft	12.50	969	Hand rail
*	Miscellaneous metal	1	set		10	Anchor bolt
*	Slide gate (4'-7"x3'-3")	1	set		5,894	stair
				Total	11,035	
No. 3	Excavation Class-D	17.17	Cube	8.88	152	
	Embankment	-	"	8.88	-	
	Back fill	-	"	5.00	-	
	Class A concrete	4.53	"	432.00	1958	Rein. concrete
	Class B concrete	0.30	"	342.00	103	Coping
	Shuttering for concrete	4.95	Squ	105.60	523	
*	Reinforcement bar	0.40	ton	1,100.00	440	
	Random rubble masonry	2.40	Cube	186.00	447	
	Breaking 6" to 9"rubble piling & transporting	1.89	"	45.60	86	Rip rap
	Timber piling	35.30	cuft	45.60	1,610	
	Plank	6.72	cuft	20.00	134	Stop plank Foot plank

Item	Description	Quantity	Unit	Rate	Cost	Remark
Check Structure No. 3 *	¢40mm Galvanized iron pipe	24.24	ft	12.50	303	Hand rail
*	Miscellaneous metal	1	set.		5	Anchor bolts stair
*	Slide gate (3'-3"x4'-0")	1	"		5,408	
				Total	11,169	
No. 4	Excavation class D	12.72	Cube	8.88	113	
	Embankment	-	"	8.88	-	
	Back fill	-	"	5.00	-	
	Class A concrete	4.38	"	432.00	1893	Rein. concrete
	Class B concrete	0.30	"	342.00	103	coping
	Shuttering for concrete	4.10	"	105.60	433	
*	Reinforcement bar	0.38	ton 1,	100.00	418	
	Random rubble masonry	1.70	Cube	186.00	315	
	Breading 6"to 8"rubble piling & transporting	2.22	"	45.60	101	Rip rap
	Timber piling	35.40	cuft	45.60	1,614	
	Plank	6.58	"	20.00	132	Stop plank Foot plank
*	¢40mm Galvonized iron pipe	53.86	ft	12.50	673	Hand rail
*	Miscellaneous metal	1	set		5	Anchor bolts, stair
*	Slide gate (2'-7"x3'-3")	1	set		5,042	
				Total	10,842	
No. 5	Excavation class D	12,69	Cube	8.88	113	
	Embankment	-	"	8.88	-	
	Back fill	-	"	5.00	-	
	Class A concrete	3.72	"	432.00	1607	Rein. concrete
	Class B concrete	0.30	"	342.00	103	Coping
	Shuttering for concrete	3.24	Squ	105.60	342	
*	Reinforcement bar	0.34	ton 1,	100.00	374	
	Random rubble masonry	1.67	Cube	186.00	311	
	Breaking 6"to 9" rubble piling & transporting	1.77	Cube	45.60	81	Rip rap
	Timber piling	35.50	cuft	45.60	1,619	
	Plank	5.50	cuft	20.00	110	Stop plank Foot plank
*	¢40mm Galvanized iron pipe	49.86	ft	12.50	623	Hand rail
*	Miscellaneous metal	1	set		5	Anchor bolt stair
*	Slide gate (2'-7"x3"-3")	1	set		5,042	
				Total	10,330	
No. 6	Excavation class D	13.21	Cube	8.88	117	
	Embankment	-	"	8.88	-	
	Back fill	-		5.00	-	
	Class A concrete	4.09	"	432.00	1766	Rein. concrete
	Class B concrete	0.30	"	342.00	103	Coping

Item	Description	Quantity	Unit	Rate	Cost	Remark
Cross. bridge No. 6	Shuttering for concrete	3.92	Squ	105.60	414	
*	Reinforcement bar	0.36	ton	1,100.11	396	
	Random rubble masonry	1.78	Cube	186.00	331	
	Breaking 6"to 9" rubble piling & transporting	1.77	"	45.60	81	Rip rap
	Timber piling	35.50	cuft	45.60	1,619	
	Plank	5.50	"	20.00	110	Stop plank Foot plank
*	¢40mm Galvanized iron pipe	49.86	ft	12.50	623	Hand rail
*	Miscellaneous metal	1	set		5	Anchor bots, stair
	Slide gate (2'-7"x 3'-3")	1	"		5,042	
				Total	10,607	
No. 7	Excavation class D	11.10	Cube	8.88	99	
	Embankment	-	"	8.88	-	
	Back fill	-	"	5 00	-	
	Class A concrete	3.22	"	432.00	1389	Rein. con-crete. Coping
	Class B concrete	0.30	"	342.00	103	
	Shuttering for concrete	3.23	Squ	105.60	341	
*	Reinforcement bar	0.31	ton	1,100.00	341	
	Random rubble masonry	1.54	Cube	186.00	286	
	Breaking 6"xto 9" rubble piling & transporting	1.47	"	45.60	67	Rip rap
	Timber piling	35.50	cuft	45.60	1,619	
	Plank	4.42	"	20.00	88	Stop plank Foot plank
*	¢40mm Galvanized iron pipe	45.86	ft	12.50	573	Hand rail
*	Miscellaneous metal	1	set		5	Anchor bolts stair
*	Slide gate (2"-7"x3'-3")	1	set		5,042	
				Total	9,953	
No. 8	Excavation class D	9.11	Cube	8.88	81	
	Embankment	-	"	8.88	-	
	Back fill	-	"	5.00	-	
	Class A concrete	3.06	"	432.00	1321	Rein. con-crete Coping
	Class B concrete	0.30	"	342.00	103	
	Shuttering for concrete	3.13	Squ	105.60	331	
*	Reinforcement bar	0.30	ton	1,100.00	330	
	Random rubble masonry	1.32	Cube			
	Breaking 6"to 9" rubble piling & transporting	1.54	"	45.60	70	Rip rap
	Timber piling	35.30	"	45.60	1,610	
	Plank	3.76	"	20.00	75	Stop plank Foot plank
*	¢40mm Galvanized iron pipe	41.86	ft	12.50	523	Hand rail
*	Miscellaneous metal	1	set		5	Anchor bolts, stair
*	Slide gate	1	"		5,042	
				Total	9,737	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 1	Excavation class D	1.69	Cube	8.88	15	Second stage concrete
	Class A concrete	0.01	"	432.00	4	
	Class B concrete	0.47	"	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble, piling	0.05	"	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1			23	Rectangular, notch, baffle, anchor&lock
				Total	1039	
No. 2	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	"	432.00	4	Second stage concrete
	Class B concrete	0.47	"	342.00	161	
	Shuttering for concrete	1.03	squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	"	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1			23	Rectangular notch, baffle anchor&lock
				Total	1039	
No. 3	Excavation class D	1,69	Cube	8.88	15	
	Class A concrete	0.01	"	432.00	4	Second stage concrete
	Class B concrete	0.47	"	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	"	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellangeous metal	1	"		23	Rectangular notch, baffle anchor&lock
				Total	1277	
No. 4	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	"	432.00	4	Second stage concrete
	Class B concrete	0.68	"	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	"	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 4	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
				Total	1,277	
No. 5	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	"	432.00	4	Second stage concrete
	Class B concrete	0.47	"	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	"	45.60	2	Rip rap
*	Slide gage ¢6"	1	set		696	
*	Miscellaneous metal	1	"		23	Rectangular notch, baffle anchor & lock
				Total	1039	
No. 6	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	"	432.00	4	Second stage concrete
	Class B concrete	0.68	"	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	"	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
				Total	1277	
No. 7	Excavation class D	2.64	Cube	8.88	23	
	Class A concrete	0.01	"	432.00	4	Scond stage concrete
	Class B concrete	0.48	"	342.00	164	
	Shuttering for concrete	1.56	squ	105.60	164	
	Random rubble masonry	0.42	Cube	186.00	79	
	Breaking 6" to 9" rubble & piling	0.51	"	45.60	23	Rip rap
*	Slide gate (1'-6" x 1'-6")	2	set		7,666	
*	Miscellaneous metal	1	set		10	Rectangular notch, baffle, anchor & lock
			Total		8188	
No. 8	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 8	Shuttering for concrete	1.45	Squ	105.60	153	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢12"	1	set		852	
*	Miscellaneous metal	1	set		30	Rectangular noctch, baffle, anchor & lock
			Total		1331	
No. 9	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Secons stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1039	
No. 10	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Secon stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Misellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1012	
No. 11	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1277	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 12	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellanous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1277	
No. 13	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1039	
No. 14	Excavation Class D	3.53	Cube	8.88	31	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	1.01	Cube	342.00	345	
	Shuttering for concrete	1.74	Squ	105.60	184	
	Random rubble masonry	0.22	Cube	186.00	42	
	Breaking 6" to 9" rubble & piling	0.12		45.60	5	Rip ra
*	Slide gate ¢18"	1	set		980	
*	Miscellaneous metal	1	set		45	Rectangular notch, baffle, anchor & lock
			Total		1636	
No. 15	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1012	

Outlet No.	Description	Quantity	Unit	Unit	Cost	Remark
No. 16	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Mescellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	
No. 17	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cune	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	
No. 18	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	
No. 19	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remak
No. 20	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 21	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 22	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	
No. 23	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle anchor & lock
			Total		1,277	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 24	Excavation class D	3.53	Cube	8.88	31	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	1.01	"	342.00	345	
	Shuttering for concrete	1.74	Squ	105.60	184	
	Random rubble masonry	0.22	Cube	186.00	42	
	Breaking 6" to 9" rubble & piling	0.12	Cube	45.60	5	Rip rap
*	Slide gate ¢18"	1	set		980	
*	Miscellaneous metal	1	set		45	Rectangular notch, baffle, anchor & lock
			Total		1,636	
No. 25	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concfete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 6" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	
No. 26	Excation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 27	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 28	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	
No. 29	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	
No. 30	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.45	Squ	105.60	153	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢12"	1	set		852	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,331	
No. 31	Excavation class D	3.53	Cube	8.88	31	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	1.01	Cube	342.00	345	
	Shuttering for concrete	1.74	Squ	105.60	184	
	Random rubble masonry	0.22	Cube	186.00	42	
	Breaking 6" to 9" rubble & piling	0.12	Cube	45.60	5	Rip rap
*	Slide gate ¢18"	1	set		980	
*	Miscellaneous metal	1	set		45	Rectangular notch, baffle, anchor & lock
			Total		1,636	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 32	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, Baffle, anchor & lock
			Total		1,039	
No. 33	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 34	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 35	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		979	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 36	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.00	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	
No. 37	Excavation class D	2.64	Cube	8.88	23	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	164	
	Shuttering for concrete	1.56	Squ	105.60	164	
	Random rubble masonry	0.42	Cube	186.00	79	
	Breaking 6" to 9" rubble & piling	0.51	Cube	45.60	23	Rip rap
*	Slide gate (1'-6"x1'-6")	2	set		7,666	
*	Miscellaneous metal	1	set		10	Rectangular notch, baffle, anchor * lock
			Total		8,188	
No. 38	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masosnry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	
No. 39	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 40	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 41	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	
No. 42	Escavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, ancheor & lock
			Total		1,277	
No. 43	Excavation class D	2.50	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.45	Squ	105.60	153	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢12	1	set		852	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,331	

Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 44	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masosnry	0.16	Cube	186.00	109	
	Breaking 6"to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 45	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	432.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		797	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	
No. 46	Excavation calss D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.46	Squ	105.60	154	
	Random rubble masonry	0.18	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢9"	1	set		979	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,277	

Lateral Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 1	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle anchor & lock
			Total		1,039	
No. 2	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle anchor & lock
			Total		1,039	
No. 3	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢6"	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle anchor & lock
			Total		1,039	
No. 4	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate	1	set		696	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,039	

Lateral Outlet No.	Description	Quantity	Unit	Rate	Cost	Remark
No. 5	Excavation class D	1.69	Cube	8.88	15	
	Class A concrete	0.01	Cube	432.00	4	Secodnd stage concrete
	Class B concrete	0.47	Cube	342.00	161	
	Shuttering for concrete	1.03	Squ	105.60	109	
	Random rubble masonry	0.16	Cube	186.00	29	
	Breaking 6" to 9" rubble & piling	0.05	Cube	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		659	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle, anchor & lock
			Total		1,012	
No. 6	Excavation class D	2.51	Cube	8.88	22	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.68	Cube	342.00	233	
	Shuttering for concrete	1.45	Squ	105.60	153	
	Random rubble masonry	0.1	Cube	186.00	34	
	Breaking 6" to 9" rubble & piling	0.07	Cube	45.60	3	Rip rap
*	Slide gate ¢12"	1	set		852	
*	Miscellaneous metal	1	set		30	Rectangular notch, baffle, anchor & lock
			Total		1,331	
No. 7	Excavation class D	3.53	Cube	8.88	31	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	1.01	Cube	342.00	345	
	Shuttering for concrete	1.74	Squ	105.60	184	
	Random rubble masonry	0.22	Cube	186.00	42	
	Breaking 6" to 9" rubble & piling	0.12	Cube	45.60	5	Rip rap
*	Slide gate ¢18"	1	set		980	
*	Miscellaneous metal	1	set		45	Rectangular notch, baffle, anchor & lock
			Total		1,636	
Proposed Outlet No.	Excavation class D	5.31	Cube	8.88	47	
	Class A concrete	0.01	Cube	432.00	4	Second stage concrete
	Class B concrete	0.63	Cube	342.00	219	
	Shuttering for concrete	2.02	Squ	105.60	213	
	Random rubble masodnry	0.07	Cute	186.00	13	
	Breaking 6" to 9" rubble & piling	0.04	Cute	45.60	2	Rip rap
*	Slide gate ¢4"	1	set		669	
*	Miscellaneous metal	1	set		23	Rectangular notch, baffle anchor & cock
			Total		1,190	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Upland irrig. & domestic water supply						
Weir	Excavation in found.	184.45	Cube	12.00	2,237	
	Back fill	148.43	Cube	5.00	742	
	Class-A concrete	10.80	Cube	432.00	4,666	
	Crushed stone concret	74.90	Cube	260.00	19,473	
*	Reinforcement bar	404.22	kg	1.10	445	
	Shuttering for concrete	31.30	Squ	105.60	3,305	
	Plank	2.01	cuft	20.00	40	Walk way
*	Galvanized iron pipe (40mm)	513.40	ft	12.50	6,418	Hand rail
*	Steel sheet pipe(L.S.P-1)	3.66	ton	1,470.00	5,380	
*	Sluice gate(6'x6')	2	set	7,500.00	15,000	
*	Miscellaneous metal	18.00	kg	1.00	18	Ladder, etc
	Breaking 6" to 9" rubble, piling and transporting	26.00	Cube	45.60	1,186	
			Total		58,910	
Infil. gallery	Excavation in found.	651.73	Cube	12.00	7,821	
	Back fill	34.29	Cube	5.00	171	
	Class-A concrete	1.65	Cube	432.00	713	
	Shuttering for concret	3.41	Squ	105.60	360	
*	Reinforcement bar	235.00	kg	1.10	259	
	Breaking 2" to 3 rubble, piling and transoprting	35.94	Cube	96.40	3,465	Filter
	Breaking 1' to 1-1/2" rubble, piling & transporting	46.72	Cube	110.80	5,177	" "
	Collecting sand, piling and transporting	202.96	Cube	28.00	5,683	" "
*	Multi-perforated concrete pipe	17	Nos.	125.50	2,134	Collect. c
*	R.C. pipe	2	Nos.	83.0	167	Intake p.
	Laying pipe and jointing	152.00	ft	2.28	347	
	Plank	123.40	cuft	20.00	2,468	
*	Miscellaneous metal	1	set		31	
			Total		28,796	
Pumping Station	Excavation in found.	16.99	Cube	12.00	204	
	Back fill	11.52	Cube	5.00	58	
	Class-B concrete	4.75	Cube	342.00	1,625	
	Shuttering for concrete	2.26	Squ.	105.60	239	
*	Corrugated steel pipe (¢300mm)	24.00	ft	166.70	4,001	
*	Steel pipe(Linear 8"x 4.0m)	18	Nos	134.70	2,425	
	(Elbow 8")	1	"	90.00	90	
	(Tee 8")	1	"	105.70	106	
	(Bend 8")	6		68.75	413	
	(Strainer 8")	2	"	50.00	100	
*	Fence	137.00	ft	7.90	1,082	Type-A
	Random rubble masonry	14.55	Cube	186.00	2,706	
*	Miscellaneous metal	1	set		105	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Pumping Station *	Pump equipment					
	Main pump	2	set		52.000	
	Vacuum pump	1	"		11.100	
	Control eq.	1	"		14.500	
*	Pump house	1	"		16.471	
			Total		107.225	
Regulat. pond	Excavation in found.	88.75	Cube	12.00	1,065	
	Embankment	78.58	Cube	8.88	698	
	Back fill	39.70	Cube	5.00	199	
	Crushed sto	44.65	Cube	260.00	11,609	
	Cement mortar	0.01	Cube	432.00	4	
	Shuttering for concrete	27.01	Squ.	105.60	2,852	
	Breaking 3/4"metal, piling and transporting	9.35	Cube	124.00	1,159	
*	Fence	224.00	ft	11.50	2,576	Type-B
*	P.V. Cpipe(12"x400mm)	8	Nos.	138.33	1,107	
*	Transh rack	1	set		70	
*	Sluice gate (12")	1	"		853	
*	Chlorinator	1	"		1,000	
*	Chlorinator booth	1	"		2,156	
			Total		25,348	
Pipe line system	Excavation class-D	759.66	Cube	8.88	6,746	
	Fill	683.61	Cube	5.00	3,418	
	Class-B concrete	7.21	Cube	342.00	2,466	
	Crushed stone concrete	13.01	Cube	260.00	3,383	
	Brick work in cement mortar	9 23	Cube	248.00	2,293	
	Shuttering for concrete	4.06	Squ.	105.60	429	
	Wooden board	167.48	cuft	20.00	3,350	
	Breaking 6" to 9" rubble piling and transporting	0.88	Cube	55.60	49	
*	Steel pipe (Linear 12") x4000mm)	137	Nos.	361.90	49,580	
	(Bend 12")	6	Nos.	162.50	975	
	(Tee 12")	1	Nos.	150.60	151	
*	P.V.C pipe (L=400mm)(Linear 12")	315	Nos.	140.00	44,100	
	(" 10")	226	"	116.00	26.216	
	(" 8")	179	"	93.00	16.647	
	(" 6")	156	"		10,452	
	(" 4")	581	"	34.00	19,754	
	(" 2")	12	"	11.20	134	
	(" 1-1/2")	353	"	8.00	2,824	
	(" 1")	743	"	4.60	3,418	
	(" 1/2")	51	"	2.60	133	
	(Ben)	73	"	75.50	5,512	
	(Y-type. p)	5	"	93.75	469	
	(Tee)	71	"	19.50	1,385	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Pipe line system *	P. V. C pipe (L=400mm)(Elbow 2"1" 1/2")	106	Nos.	0.40	42	
*	P. V. C sluice vale	26	"	116.20	3,021	
*	C. I. sluice valve(8"10"12")	4	"	996.70	3,867	
*	Air valve	1	"	218.70	219	
*	Blow off	2	"	150.70	301	
*	Socket	34	"	31.80	1,081	
*	Saddle	8	"	18.55	148	
*	Frange (1"4"6"8"10")	62	"	14.00	868	
*	Cap(4"6"8"10")	4	"	39.70	159	
*	Tap(/2")	43	"	10.30	443	
*	Shower head (1/2")	24	"	34/00	443	
*	Adhesive for joints of P. V. C pipe	150.00	kg	16.70	2,505	
	Laying steel pipe and jointing	1,789.90	ft	2.50	4,475	
			Total		221,456	
Booster station Pond	Excavation class-G	71.36	Cube	10.20	728	
	Embankment	24.04	Cube	8.88	213	
	Back fill	25.97	Cube	5.00	130	
	Crushed stone concrete	28.60	Cube	260.00	7,436	
	Shuttering for concrete	20.19	Squ.	105.60	2,132	
*Pump & pipe eq.	Pump (¢ 40mm, 2.2kw centrifugal pump)	1	Set		3,330	
	Steel pipe L=4000mm (Linear 40mm)	2	Nos.	17.80	36	
	(Bend 40mm, 90)	1	"	16.90	17	
	P. V. C pipe L=4000mm (Linear 4")	2	"	34.10	68	
	(Bend 4", 90)	2	"	30.00	60	
	P. V. C sluice valve	1	"	186.60	187	
	Fence	182.00	ft	11.50	2,093	Type-B
*Housing		1	set		3,724	
			Total		19,704	
Pipe aqueduct No. 1	Class-B concrete	4.79	Cube	342.00	1,638	
	Shuttering for concrete	3.52	Squ	105.60	372	
*	Sluice valve (12")	1	Nos.	1,166.70	1,167	
*	Victaulic joint (12")	1	"	98.00	98	
*	Air valve (12")	1	"	218.70	219	
*	Shoe	47.28	kg	1.30	61	
*	Steel pipe (12"x4000mm)	3	Nos.	361.90	1,086	
	Layin steel pipe	39.50	ft	2.50	99	
			Total		4,740	

Item	Description	Quantity	Unit	Rate	Cost	Remark
No. 2	Class-B concrete	1.11	Cube	342.00	380	
	Shuttering for concrete	0.90	Squ.	105.60	95	
*	Sluice valve (12")	1	Nos.	1,167.70	1,167	
*	Victaulic joint (12")	1	"	98.00	98	
*	Shoe	47.28	kg	1.30	61	
*	Steel pipe(12"x4000mm)	1	Nos.	361.90	362	
	Timber pipling	1.57	cuft	45.60	72	
	Laying steel pipe	12.25	ft	2.50	31	
			Total		2,266	
No. 3	Class-B concrete	0.29	Cube	342.00	99	
	Shuttering for concrete	0.56	Squ.	105.60	59	
*	Sluice valve(4")	1	Nos.	202.70	203	
*	Victaulic joint (4")	1	"	13.80	14	
*	Shoe	10.80	kg	1.30	14	
*	Steel pipe (4"x4000mm)	3	Nos.	67.40	202	
	Laying steel pipe	39.50	ft	2.50	99	
			Total		690	
Improved road Main-R No. 1	Borrow & embankment	684.23	Cube	12.50	8,553	
	Compaction	139.02	"	9.00	1,251	
	Turfing	215.62	Squ	10.50	2,264	
			Total		12,068	
No. 2	Borrow & embankment	1,030.96	Cube	12.00	12,372	
	Compaction	176.16	"	9.00	1,585	
	Turfing	321.95	Squ	10.50	3,380	
			Total		17,337	
No. 3	Borrow & embankment	780.51	Cube	12.50	9,756	
	Compaction	122.71	"	9.00	1,104	
	Turfing	283.81	Squ	10.50	2,980	
Culvert	Tandom rubble masonry	11.47	Cube	186.00	2,133	
	Concrete class-B	1.32	"	342.00	451	
	Shuttering for concret	0.61	Squ	105.60	64	
	Breaking 6"to 9"rubble, piling and transporting	3.40	Cube	45.60	155	
	Crushed stone concrete	37.78	Cube	260.00	9,823	
*	Corrugated steel pipe (¢1000mm)	20.35	ft	41.60	847	
	Excavation class-D	24.13	Cube	8.88	214	
	Fill	5.10	"	5.00	26	
			Total		27,553	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Lateral road (No. 1-6)	Borrow & embankment	1,122.20	Cube	12.50	14,028	
	Compaction	357.12	"	9.00	3,214	
	Turfing	367.04	Squ	10.50	3,854	
			Total		21,096	
Farm road Proposed road Main-R No. 1	Borrow & embankment	5,907.11	Cube	12.50	73,839	
	Compaction	597.48	"	9.00	5,377	
	Turfing	1,737.74	Squ	10.50	18,246	
	Excavation class-D	264.27	Cube	8.88	2,347	
	Embankment	264.27	"	8.88	2,347	
Culvert (No. 1-16)	Random rubble masonry	128.46	"	186.46	23,894	
	Breaking 6"to9"rubble, piling and transporting	24.75	"	45.60	1,129	
*	Corrugated steel pipe (¢1000mm)	636.81	ft	41.70	26,555	
	Laying C.S. pipe and Jointing	636.81	"	1.50	955	
			Total		154,689	
No. 2	Borrow & embankment	191.08	Cube	12.50	2,389	
	Compaction	22.00	"	9.00	198	
	Turfing	50.12	Squ	10.50	526	
	Excavation class-D	17.19	Cube	8.88	153	
	Embankment	17.19	"	8.88	153	
			Total		3,419	
Lateral road	Borrow & embankment	4,553.00	Cube	12.00	56,913	
	Compaction	778.56	"	9.00	7,007	
	Turfing	2,312.92	Sqi	10.50	24,286	
	Excavation class-D	2,048.84	Cube	8.88	18,194	
	Embankment	2,048.84	"	8.88	18,194	
			Total		124,594	
Farm bridge (11 Nos)	Excavation in found.	18.15	Cube	12.50	218	
	Embankment	0.44	"	8.88	4	
	Back fill	17.27	"	5.00	86	
	Class-B concrete	3.34	"	342.00	1,142	
	Shuttering for concrete	6.88	Squ	105.60	727	
	Timber	129.80	cuft	20.00	2,596	
*	Miscellaneous metal	1	set		74	
			Total		4,847	

Item	Description	Quantity	Unit	Rate	Cost	Remark
Pilot farm Paddy						
	Excavation class-D	1,416.39	Cube	8.88	12,578	
	Embankment	897.26	"	8.88	7,968	
	Fill	5.93	"	5.00	30	
	Class-B concrete	0.73	"	342.00	250	
	Shuttering for concrete	2.03	Squa	105.60	214	
	Plank	74.10	Cuft	20.00	1,482	
	Collecting sand, and transporting	4.95	Cube	28.00	139	
*	P.V.C pipe(1"x4000mm)	4	Nos.	4.50	18	
	(2"x4000mm)	7	"	11.20	79	
	(6"x4000mm)	1	"	67.00	67	
	Clay pipe(6", L=600mm)	252	"	3.67	925	
*	Miscellaneous material	1	set		64	Bolt, brush
*	Fence and gate	514.00	ft	7.90	4,061	
*	Farm station	1	set		68,380	
			Total		96,255	
Upland						
	Excation class-E	2,094.67	Cube	12.90	27,021	
	Embankment	1,722.86	"	8.88	15.229	
	Back fill	3.06	"	5.00	15	
	Crushed stone concrete	11.47	"	260.00	2,982	
	Class-B concrete	0.81	"	342.00	277	
	Shuttering for concrete	7.90	Squ	105.60	834	
	Plank	36.00	Cuft	20.00	720	
	Tarring road	386.50	Squ	7.56	2,922	
*	P.V.C pipe(12"x4000mm)	7	Nos.	140.00	980	
	(4"x4000mm)	91	"	34.00	3,094	
	(2"x4000mm)	23	"	11.20	84	
*	P.V.C Tee	7	"	12.10	85	
*	P.V.C Elbow	2	"	8.40	17	
*	P.V.C Cap	1	"	6.20	6	
*	P.V.C sulice valve	8	"	195.00	1,560	
*	P.V.C flange	16	"	11.70	187	
*	Sprinkler	4	set	2,630.00	10,520	
*	Fence(type-A)	2,610	ft	7.90	20,619	
*	Dissipation valve(2")	4	Nos	66.70	267	
*	Building	8	house		631,555	
			Total		719,218	
Paddy F. rearrange						
	Earth work for consolidation	55,900.00	Cube	2.00	111,800	By bulldozer
	Boad, plank, timber for field outlet B.	7,817.88	cuft	20.00	156.353	
	Timber for small outlet	8.55	cuft	20.00	171	lug
			Total		268,329	

Item	Unit	Cost	Remark
Upland Pilot Farm			
Buildidng No. 1	1 set	164,884	
" No. 2	1 "	98,151	
" No. 3	1 "	85,947	
" No. 4	1 "	68,506	
" No. 5	1 "	45,440	
" No. 6	1 "	13,342	
" No. 7	1 "	13,915	
" No. 8	1 "	141,370	
Sub total		631,555	
Paddy Field Pilot Farm			
Farm Station	1 set	68,380	
Upland Irrigation and Domestic Water Supply			
Pumping Station	1 set	16,471	
Chlorinator Booth	1 "	2,156	
Booster Station	1 "	3,274	
Sub total		21,901	
Total		721,836	

Item	Description	Quantity	Unit	Cost
Building No. 1	Temporary work	1.00	set	19,000
	Earth work	1.00	set	2,460
	Concrete work		set	31,235
*	Reinforcement work	1.00	set	7,330
	Brick work	1.00	set	11,204
	Carpentry work	1.00	set	50,568
	Roofing work	1.00	set	14,540
*	Metal work	1.00	set	1,055
	Plastering work	1.00	set	14,156
*	Fitting work	1.00	set	5,148
	Glazing work	1.00	set	1,605
	Painting work	1.00	set	1,687
	Interior work	1.00	set	4,620
*	Miscellaneous work	1.00	set	275
	Total			164,884
Building No. 2	Temporary work	1.00	set	12.100
	Earth work	1.00	set	2,688
	Concrete work	1.00	set	19,466
*	Reinforcement work	1.00	set	4,890
	Brick work	1.00	set	6,207
	Carpentry work	1.00	set	28,013
	Roofing work	1.00	set	7,370
*	Metal work	1.00	set	4,590
	Plastering work	1.00	set	7,785
*	Fitting work	1.00	set	3,789
	Glazing work	1.00	set	504

Item	Description	Quantity	Unit	Cost
Building No. 2	Painting work	1.00	set	769
	Total			98,151
Building No. 3	Temporary work	1.00	set	11,250
	Earth work	1.00	set	1,710
	Concrete work	1.00	set	18,168
*	Reinforcement work	1.00	set	4,008
	Brick work	1.00	set	5,000
	Carpentary work	1.00	set	26,455
	Roofing work	1.00	set	7,370
*	Metal work	1.00	set	3,987
	Plastering work	1.00	set	6,533
*	Fitting work	1.00	set	1,016
	Glazing work	1.00	set	60
	Painting work	1.00	set	390
	Total			85,947
Buildidng No. 4	Temporary work	1.00	set	5,548
	Earth work	1.00	set	1,918
	Concrete work	1.00	set	14,823
*	Reinforcement work	1.00	set	3,350
	Brick work	1.00	set	3,125
	Carpent y work	1.00	set	21,887
	Roofing work	1.00	set	5,960
*	Metal work	1.00	set	4,777
	Plastering work	1.00	set	6,375
	Painting work	1.00	set	743
	Total			68,506
Building No. 5	Temporary work	1.00	set	10,098
	Earth work	1.00	set	755
	Concrete work	1.00	set	8,250
*	Reinforcement work	1.00	set	1,913
	Brick work	1.00	set	3,050
	Carpentry work	1.00	set	11,798
	Roofing work	1.00	set	2,980
*	Metal work	1.00	set	2,790
	Plastering work	1.00	set	3,184
	Painting work	1.00	set	622
	Total			45,440
Building No. 6	Temporary work	1.00	set	1,777
	Earth work	1.00	set	143
	Concrete work	1.00	set	1,049
*	Reinforcement work	1.00	set	107
	Brick work	1.00	set	2,025
	Carpentry work	1.00	set	5,728
	Roofing work	1.00	set	161
*	Metal work	1.00	set	43
	Plastering work	1.00	set	1,324
*	Fitting work	1.00	set	864

Item	Description	Quantity	Unit	Cost
Building No. 6	Painting work	1.00	set	121
	Total			13,342
Building No. 7	Temporary work	1.00	set	1,773
	Earth work	1.00	set	329
	Concrete work	1.00	set	2,696
*	Reinforcement work	1.00	set	596
	Brick work	1.00	set	820
	Carpentry work	1.00	set	1,787
	Roofing work	1.00	set	1,289
	Plastering work	1.00	set	2,314
*	Fitting work	1.00	set	1,990
	Painting work	1.00	set	321
	Total			13,915
Building No. 8	Temporary work	1.00	set	29,204
	Earth work	1.00	set	1,905
	Concrete work	1.00	set	23,501
*	Reinforcement work	1.00	set	5,665
	Brick work	1.00	set	8,840
	Carpentry work	1.00	set	35,546
	Roofing work	1.00	set	11,460
*	Metal work	1,00	set	1,080
	Plastering work	1.00	set	10,671
*	Fitting work	1.00	set	5,019
	Glazing work	1.00	set	1,013
	Painting work	1.00	set	2,835
	Interior work	1.00	set	4,356
*	Miscellaneous work	1.00	set	275
	Total			141,370
Booster Station	Temporary work	1.00	set	477
	Earth work	1.00	set	41
	Concrete work	1.00	set	573
*	Reinforcement work	1.00	set	262
	Brick work	1.00	set	299
	Carpentry work	1.00	set	608
	Roofing work	1.00	set	281
*	Metal work	1.00	set	18
	Plastering	1.00	set	298
*	Fitting work	1.00	set	365
	Painting work	1.00	set	52
	Total			3,274
Farm station for paddy pilot farm	Temporary work	1.00	set	15,158
	Earth work	1.00	set	1,140
	Concrete work	1.00	set	12,529
*	Reinforcement work	1.00	set	3,245
	Brick work	1.00	set	3,694
	Carpentry work	1.00	set	16,628
	Roofing work	1.00	set	6,451
*	Metal work	1.00	set	2,980

Item	Description	Quantity	Unit	Cost
Farm station for paddy pilot farm *	Plastering work	1.00	set	4,249
	Fitting work	1.00	set	1,043
	Glazing work	1.00	set	180
	Painting work	1.00	set	1,078
	Total			68,380
Chlorinator booth	Temporary work	1.00	set	410
	Earth work	1.00	set	28
	Concrete work	1.00	set	413
*	Reinforcement work	1.00	set	187
	Brick work	1.00	set	192
	Carpentry work	1.00	set	340
	Roofing work	1.00	set	162
*	Metal work	1.00	set	5
	Plastering work	1.00	set	185
*	Fitting work	1.00	set	171
	Fainting work	1.00	set	36
*	Miscellaneous work	1.00	set	27
	Total			2,156
Pumping Station	Temporary work	1.00	set	1,002
	Earth work	1.00	set	316
	Concrete work	1.00	set	2,962
*	Reinforcement work	1.00	set	217
	Brick work	1.00	set	1,042
	Carpentry work	1.00	set	7,187
	Roofing work	1.00	set	1,340
	Plastering work	1.00	set	1,188
*	Fitting work	1.00	set	777
	Glazing work	1.00	set	120
	Painting work	1.00	set	320
	Total			16,471

Rate Abstract Number.	Specification.	Per Unit.	All inclu-Sive Rate
1	Excavation class-A	Cube	12.90 Rs
2	Excavation class-B	Cube	11.52
3	Excavation class-C	Cube	11.52
4	Excavation class-D	Cube	8.88
5	Excavation class-E	Cube	12.90
6	Excavation class-F	Cube	11.52
7	Excavation class-G	Cube	10.20
8	Excavation in founds	Cube	12.00
9	Embankment	Cube	8.88
10	Borrow and embankment	Cube	12.50
11	Back fill	Cube	5.00
12	Compaction	Cube	
13	Brickwork in cement moratar 1:6	Cube	248.00
14	Random rubble masonry in cement mortar 1:6(6"to9")	Cube	186.00
15	Breaking 6" to 9" rubble and piling	Cube	45.60
16	Breaking 4" to 6" rubble and piling	Cube	55.20
17	Breaking 2" metal and piling	Cube	86.40
18	Breaking 1 1/2" metal and piling	Cube	100.80
19	Breaking 3/4" metal and piling	Cube	114.00
20	Gravel flooring 6" thick	Square	24.00
21	Brick flooring laid flat in lime mortar 1:2	Sauare	84.00
22	Cement rendering 1/2 " thick 1:2	Square	39.60
23	Cement rendering 3/4 " thick 1:2	Square	48.00
24	Cement rendering 1/2 " thick 1:2	Square	32.40
25	Cement rendering 3/4" thick 1:3	Square	40.20
26	Turfing to carthwork	Square	10.50
27	Collecting sand and transporting	Cube	18.00
28	Class-A concrete 1:2:4	Cube	432.00
29	Class-B concrete 1:3:6	Cube	342.00
30	Crushed stone concrete	Cube	260.00
31	Shuttering for concrete	Square	105.60
32	Reinforcement bar	kg	1.10
33	Wooden board	cuft	20.00
34	Metal spreading and rolling	Cube	32.40
35	Turfing road	Square	7.56
36	Calicut tiled roofing	Square	240.00
37	Corrugated iron roofing	Square	210.00
38	Roofing of corrugated Asbestos Sheets-Purlins and other timber not included	Square	180.00
39	White washing 1 coat	Square	2.94
40	White washing 2 coat	Square	4.68
41	Ceiling of Lunumidella planking	Square	156.00
42	Seiling of asbestos sheets flat	Square	216.00
43	Painting woodwork 1st coat	Square	18.00
44	Painting woodwork 2nd coats	Square	12.00
45	Rust resisting painting 1st coat	Square	45.60
46	Eaves guttering	ft	4.44
47	Down piping	ft	3.90
48	Laying R.C. Hume Pipe and jointing	ft	2.28
49	Laying steel pipe and jointing	ft	2.50
50	Laying C.S. pipe and jointing	ft	1.50
51	Timber piling	cuft	45.60

2. BILL OF QUANTITY

1. Bill of Quantity

I. Main channel and lateral

Item	Description	Unit	Quantity	Remark
1. Main channel	Excavation, class-D	Cube	5,417.50	
	Embankment	Cube	1,050.80	
	Random rubble masonry	Cube	547.28	
	Tiber piling	cuft	3,673.80	Footing for masonry
2. Lateral	Excavation, class-D	Cube	270.25	
3. Parshall flume No. 1	Excavation in foundation	Cube	18.49	
	Embankment	Cube	11.20	
	Fill	Cube	5.39	
	Reinforced concrete class-A	Cube	8.86	
	Shuttering for concrete	Sqyare	10.71	
	Reinforcement bar	kg	471.00	
	Angle (40 x 40 x 3mm)	kg	28.00	
	P.V.C. pipe (12")	Nos	2.	
	Round rod (3/3")	it	15.25	
	Washer (3/8")	Nos	2.	
	Concrete class-B	Cube	0.01	Plug for gauging well
	P.V.C. pipe (1/2")	Nos	1.	Inlet tube
	Random rubble masonry	Cube	0.84	
	Breaking rubble, piling and transporting (6"-9")	Cube	2.40	
	Timber piling	cuft	18.80	Footing for masonry
	Breaking rubble, piling and transporting (3/4")	Cube	0.76	Pavement
No. 2	Excavation in foundation	Cube	5.88	
	Embankment	Cube	1.16	
	Fill	Cube	2.67	
	Class-A concrete	Cube	2.23	Reinforced concrete
	Shuttering for concrete	Square	3.70	
	Reinforcement bar	kg	151.99	
	Angle (40 x 40 x 3mm)	kg	12.00	
	P.V.C. pipe (12")	Nos	1.	
	P.V.C. pipe (1/2")	Nos	1.	Inlet tube
	Class-B concrete	Cube	0.01	Plug
	Random rubble masonry	Cube	0.58	
	Breaking rubble, piling and transporting	Cube	1.20	
	Metal spreading and rolling	Cube	0.25	Road pavement
	Timber piling	cuft	14.40	
	Miscellaneous metal	set	1.	Round rod and Washer

Item	Description	Unit	Quantity	Remark
Crossing bridge				
No. 1, 2, 3, 4 (P.C. bridge)	Excavation in foundation	Cube	60.69	
	Embankment	Cube	1.56	
	Back fill	Cube	50.18	
	Class-A concrete	Cube	9.26	
	Shuttering for concrete	Square	15.32	
	Reinforcement bar	kg	560.00	
	Pre-stressed concrete beam			
	Center beam (L=23")	Nos.	12	
	Side beam (L=23")	Nos.	8	
	Hand rail supporter	Nos.	56	
	Galvanized iron pipe (40 mm)	ft	134.20	Hand rail
	Miscellaneous material	set	1	
No. 5 (H-beam bridge)	Excavation in foundation	Cube	39.15	
	Embankment	Cube	3.30	
	Back fill	Cube	22.25	
	Class-A concrete	Cube	2.21	
	Crushed stone concrete	Cube	6.12	
	Shuttering for Concrete	Square	11.51	
	Reinforcement bar	kg	1266.00	
	Cement mortar rendering (3/4" thick, 1:2)	Square	2.92	
	Painting for rust resisting	sqft	314.15	
	P.V.C. pipe (40mm x 4000mm)	Nos.	1	
	Breaking rubble 6" to 9" piling, and transporting	Cube	1.67	
	H-beam (500 x 200 x 10 x 16mm)	Nos.	2	
	Channel beam (250 x 90 x 9 x 13 mm)	Nos.	3	

Bill of quantity (check structure)

Description	Unit	Check No. 1	Check No. 2	Check No. 3	Check No. 4	Check No. 5	Check No. 6	Check No. 7	Check No. 8	total	Remark
Excavation class-D	Cube	9.94	10.03	17.17	12.72	12.69	13.21	11.10	9.11	95.97	
Embank-ment	Cube	3.01	-	-	-	-	-	-	-	3.01	
Back fill	Cube	2.12	1.39	-	-	-	-	-	-	3.51	
Class-A concrete	Cube	4.28	4.10	4.53	4.38	3.72	4.09	3.22	3.06	31.38	Reinforced concrete
Class-B concrete	Cube	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.30	2.20	Coping concrete
Shuttering for concrete	Square	4.13	4.05	4.95	4.10	3.24	3.92	3.23	3.13	30.75	
Reinforce-ment bar	ton	0.38	0.35	0.40	0.38	0.34	0.36	0.31	0.30	2.82	
Random rubble ma-sonry	Cube	1.20	1.09	2.40	1.70	1.67	1.78	1.54	1.32	12.70	
Breaking 6" to 9" rubble, piling and transport-ing	Cube	1.60	1.50	1.89	2.22	1.77	1.77	1.47	1.54	13.76	Rip rap
Timber piling	cuft	22.80	22.80	35.30	35.40	35.50	35.50	35.50	35.30	253.10	
Plank	cuft	4.62	5.22	6.72	6.58	5.50	5.50	4.42	3.76	42.32	Foot plank and stop plank
Galvaniz-iron pipe (¢40mm)	ft	73.70	77.54	24.24	53.86	49.86	49.86	45.86	41.86	416.78	Hand rail
Miscel-laneous metal	set	1	1	1	1	1	1	1	1	-	Stair and bolts
Slide gate	set	5'11"x4' 1	4'7"x3'3" 1	3'3"x4' 1	2'7"x3'3" 1	2'7"x3'3" 1	2'7"x33" 1	2'7"x3'3" 1	2'7"x33' 1	-	

BILL OF QUANTITY (QUTLET)

O. L. No.	Excavation Class D	Class A concrete	Class B concrete	Shuttering for conc.	Random rubble masonry	Breaking 6" to 9" rubble, piling, trans.	Miscellaneous metal	Slide gate
	Cube	Cube	Cube	Square	Cube	Cube	set	set.
No. 1	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 2	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 3	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 4	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 5	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 6	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 7	2.64	0.01	0.47	1.56	0.42	0.51	1	2(1'6"x1'6")
" 8	2.51	0.01	0.68	1.45	0.18	0.07	1	1(¢12)
" 9	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 10	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 11	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 12	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 13	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 14	3.53	0.01	1.01	1.74	0.22	0.12	1	1(¢18)
" 15	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 16	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 17	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 18	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 19	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 20	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 21	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 22	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 23	2.51	0 01	0.68	1.46	0.18	0.07	1	1(¢9)
" 24	3.53	0.01	1.01	1.74	0.22	0.12	1	1(¢18)
" 25	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 26	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 27	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 28	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 29	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 30	2.51	0.01	0.68	1.45	0.18	0.07	1	1(¢12)
" 31	3.53	0.01	1.01	1.74	0.22	0.12	1	1(¢18)
" 32	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 33	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 34	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 35	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 36	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 37	2.64	0.01	0.47	1.56	0.42	0.51	1	2(1'6"x1'6")
" 38	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 39	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 40	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 41	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 42	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 43	2.51	0.01	0.68	1.45	0.18	0.07	1	1(¢12)
" 44	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 45	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
" 46	2.51	0.01	0.68	1.46	0.18	0.07	1	1(¢9)
	Lateral							
No. 1	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 2	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 3	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 4	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢6)
" 5	1.69	0.01	0.47	1.03	0.16	0.05	1	1(¢4)
" 6	2.51	0.01	0.68	1.45	0.18	0.07	1	1(¢12)
" 7	3.53	0.01	1.01	1.74	0.22	0.12	1	1(¢18)
	Proposed							
No. 1	5.31	0.01	0.63	2.02	0.07	0.04	1	1(¢4)

II. Upland field irrigation and domestic water supply

Item	Description	Unit	Quantity	Remark
Weir	Excavation in foundation	Cube	186.45	
	Back fill	Cube	148.43	
	Class-A concrete	Cube	10.80	Reinforced concrete and second stage
	Crushed stone concrete	Cube	74.90	
	Reinforcement bar	kg	404.22	
	Shuttering for concrete	Square	31.30	
	Plank	cuft	2.01	
	Galvanized iron pipe (40mm)	ft	513.40	
	Steel sheet pipe	ton	3.66	
	Sluice gate (6' x 6')	set	2	
	Miscellaneous metal	kg	18.00	Ladder
	Breaking 3/4" metal piling and transporting	Cube	26.00	
Infiltration gallery	Excavation in foundation	Cube	651.73	
	Back fill	Cube	34.29	
	Class-A concrete	Cube	1.65	
	Shuttering for concrete	Square	3.41	
	Reinforcement bar	kg	235.00	
	Breaking rubble 2" to 3" piling and transporting	Cube	35.94	Filter
	Breaking rubble 1" to 1-1/2" piling and transporting	Cube	46.72	Filter
	Collecting sand, piling and transporting	Cube	202.96	Filter
	Multi-preforated concrete pipe (500mm x 2,430mm)	Nos.	17	Collecting conduit
	Reinforced concrete Hume pipe (500mm x 2430mm)	Nos.	2	Intake pipe
	plank	cuft	123.40	Footing of pipe
	Miscellaneous metal	set	1	Bolts, 117
	Laying R.C pipe and jointing	L.ft	151.44	
Pumping staion	Excavation in foundation	Cube	16.99	
	Back fill	Cube	11.52	
	Class-B concrete	Cube	4.75	Anchor Block
	Shuttering for concrete	Square	2.26	
	Corrugated steel pipe (300 mm)	ft	24.00	Sump well
	Steel pipe			
	linear 8" x 4000mm	Nos.	18.	
	elbow 8"	Nos.	1	
	tee 8"	Nos.	1	
	bend 8"	Nos.	6	
	strainer	Nos.	2	
	Fence	ft	137.00	A-type

Item	Description	Unit	Quantity	Remark
	Randomrubble masonry	Cube	14.55	
	Miscellaneous metal	set	1	Angle, plate bolt, anchor bol
	Pump equipment			
	main pump (200mmx150mm)	set	2	Motor to be included
	vacuum pump	set	1	Motor to be included
	electric eq.	set	1	Control eq. to be included
	Pump house	set	1	
Regulating pond	Excavation in foundation	Cube	88.75	
	Embankment	Cube	78.58	
	Back fill	Cube	39.70	
	Crushed stone concrete	Cube	44.65	
	Cement mortar	Cube	0.01	
	Shuttering for concrete	Square	27.01	
	Metal spreading and rolling	Cube	9.35	
	Fence	ft	221.00	B-type
	Entrance gate	ft	3.00	
	P.V.C. pipe (12"x400mm)	Nos.	8	
	Trash rack	set	1	
	Sluice gate (12")	set	1	
	Chlorinator booth	set	1	
	Chlorinator	set	1	
Piple line system	Excavation class-D	Cube	759.66	
	Fill	Cube	683.61	
	Class-B concrete	Cube	7.21	
	Crushed stone concrete	Cube	13.01	
	Brick work	Cube	9.23	
	Shuttering for concrete	Square	4.06	
	Wooden board	cuft	167.48	
	Breaking 6" to 9" rubble, piling and transporting	Cube	0.88	
	Steel pipe (12")			
	linear L = 400mm	Nos.	137	
	Bend 79	Nos.	1	
	47	Nos.	1	
	45	Nos.	1	
	24	Nos.	1	
	14	Nos.	1	
	10	Nos.	1	
	Tee (12" x 3")	Nos.	1	
	P.V.C. pipe			
	Linear (12"x4000mm)	Nos.	315	
	(10"x4000mm)	Nos.	226	
	(8"x4000mm)	Nos.	179	
	(6"x4000mm)	Nos.	156	
	(4"x4000mm)	Nos.	581	
	(2"x4000mm)	Nos.	12	
	(1-1/2"x4000mm)	Nos.	353	

Item	Description	Unit	Quantity	Remark
	(1"x4000mm)	Nos.	743	
	(1/2"x4000mm)	"	51	
	Bend (12", 90)	"	1	
	(12", 64)	"	1	
	(12", 59)	"	1	
	(12", 38)	"	1	
	(12". 36)	"	1	
	(12", 26)	"	1	
	(12", 19)	"	1	
	(12", 15)	"	2	
	(12", 13)	"	1	
	(10", 27)	"	1	
	(10", 25)	"	1	
	(10", 15)	"	1	
	(8", 60)	"	1	
	(8", 31)	"	1	
	(8", 30)	"	1	
	(8", 26)	"	1	
	(8", 23)	"	1	
	(8", 15)	"	2	
	(8", 14)	"	1	
	(8", 11)	"	1	
	(6", 45)	"	1	
	(6", 25)	"	2	
	(6", 13)	"	1	
	(6", 11)	"	1	
	(4", 90)	"	1	
	(4", 54)	"	1	
	(4", 43)	"	1	
	(4", 39)	"	1	
	(4", 33)	"	1	
	(4", 27)	"	1	
	(4", 23)	"	1	
	(4", 21)	"	1	
	(4", 18)	"	1	
	(4", 16)	"	2	
	(4", 15)	"	1	
	(4", 14)	"	2	
	(4", 13)	"	1	
	(4", 12)	"	1	
	(4", 10)	"	6	
	(1-1/2", 49)	"	1	
	(1-1/2", 44)	"	1	
	(1-1/2", 20)	"	1	
	(1-1/2", 19)	"	1	
	(1-1/2", 16)	"	1	
	(1-1/2", 10)	"	1	
	(1", 90)	"	1	
	(1", 88)	"	1	
	(1", 85)	"	1	
	(1", 75)	"	1	
	(1", 37)	"	2	
	(1", 30)	"	1	
	(1", 26)	"	1	
	(1", 23)	"	1	
	(1", 22)	"	2	

Item	Description	Unit	Quantity	Remark
	(1", 18)	Nos.	1	
	(1", 17)	"	2	
	(1", 15)	"	2	
	(1", 12)	"	1	
	(1", 10)	"	1	
	Y-type (12" x 4" 54)	"	1	
	(12" x 1" 71)	"	1	
	(12" x 1" 62)	"	1	
	(12" x 1" 55)	"	1	
	(12" x 1" 45)	"	1	
	Tee (12" x 10")	"	1	
	(12" x 1-1/2")	"	2	
	(12" x 1")	"	1	
	(10" x 2")	"	6	
	(8" x 2")	"	4	
	(8" x 1/2")	"	1	
	(6" x 6")	"	1	
	(4" x 1-1/2")	"	2	
	(2" x 1/2")	"	12	
	(1-1/2" x 1/2")	"	1	
	(1" x 1")	"	16	
	(1" x 1/2")	"	24	
	Elbow (2")	"	12	
	(1")	"	7	
	(1/2")	"	87	
	Sluice valve (12")	"	2	(C. I)
	(10")	"	1	(C. I)
	(8")	"	1	(C. I)
	(6")	"	2	(P. V. C)
	(4")	"	2	(P. V. C)
	(1-1/2")	"	2	(P. V. C)
	Stop valve (1")	"	8	(P. V. C)
	Air valve (12")	"	1	
	Blow off (12 " x 3")	"	1	
	(4" x 1")	"	1	
	Socket (12" x 10")	"	2	
	(10" x 8")	"	2	
	(8" x 6")	"	1	
	(6" x 5")	"	1	
	(5" x 4")	"	1	
	(1" x 1/2")	"	9	
	(12" x 12")	"	2	
	(10" x 10")	"	2	
	(8" x 8")	"	2	
	(6" x 6")	"	2	
	(4" x 4")	"	2	
	(2" x 2")	"	2	
	(1-1/2" x 1-1/2")	"	2	
	(1" x 1")	"	2	
	(1/2" x 1/2")	"	2	
	Saddle (6" x 2")	"	1	
	(6" x 1/2")	"	3	
	(4" x 2")	"	1	
	(4" x 1/2")	"	3	
	Flange (12")	"	6	
	(10")	"	2	

Item	Description	Unit	Quantity	Remark
	(8")	"	2	
	(6")	"	4	
	(4")	"	4	
	(2")	"	24	
	($1^1/2$")	"	4	
	(1")	"	16	
	Cap (10")	"	1	
	(8")	"	1	
	(6")	"	1	
	(4")	"	1	
	Adhesive	kg	150	
	Tap (1/2")	"	43	
	Shower head (1/2")	"	24	
	Valve (2")	"	12	Tap stand-A
Aqueduct No. 1	Class-B concrete	Cube	4.79	Unreinforced concrete
	Shuttering for concrete	Square	3.52	
	Sluice valve (12")	Nos.	1	
	Victaulic joing (12")	Nos.	1	
	Air valve (12")	Nos.	1	
	Shoe	kg	47.28	
	Steel pipe (12" x 4000mm)	Nos.	3	
No. 2	Class-B concrete	Cube	1.11	Unreinforced concrete
	Shuttering for concrete	Square	0.90	
	Sluice valve (12")	Nos.	1	
	Victaulic joing (12")	Nos.	1	
	Shoe	kg	47.28	
	Steel pipe (12" x 4000mm)	Nos.	1	
	Timber piling	cuft	1.57	
No. 3	Class-B concrete	Cube	0.29	Unreinforced concrete
	Shuttering for concrete	Square	0.56	
	Sluice valve (4")	Nos.	1	
	Victaulic joint (4")	Nos.	1	
	Shoe	kg	10.80	
	Steel pipe (4" x 4000mm)	Nos.	3	
Booster station				
Pond	Excavation Class-G	Cube	71.36	
	Embankment	Cube	24.04	
	Back fill	Cube	25.97	
	Crushed stone concrete	Cube	28.60	
	Shuttering for concrete	Square	20.19	
	Pump eq. 400mmx2.2kw	Set	1	Motor to be included
	Steel pipe, Linear			
	(40mm x 4000mm)	Nos.	2	
	Bend (40mm, 90)	Nos.	1	
	P.V.C. pipe Linear			
	(4" x 4000mm)	Nos.	2	
	Bend (4", 90)	Nos.	2	
	Sluice valve (4")	Nos.	1	
	Fence	ft	182.00	Type-B
	House (8" x 8")	set	1	

Item	Description	Unit	Quantity	Remark
Farm road				
Improved main farm road				
No. 1	Borrow and embankment	Cube	684.23	
	Compaction	Cube	139.02	
	Turfing	Square	215.62	Side-slope protection
No. 2	Borrow and embankment	Cube	1,030.96	
	Compaction	Cube	176.16	
	Turfing	Square	321.95	
No. 3	Borrow and embankment	Cube	780.51	
	Compaction	Cube	122.71	
	Turfing	Square	283.81	
Culvert	Excavation class-D	Cube	24.13	
	Fill	Cube	5.10	
	Random rubble masonry	Cube	11.47	
	Class-B concrete	Cube	1.32	
	Shuttering for concrete	Square	0.61	
	Breaking 6" to 9" rubble, piling and transporting	Cube	3.40	
	Crushed stone concrete	Cube	37.78	
	Corrugated steel pipe (100 mm)	ft	20.35	
Improved lateral farm road	Borrow and embankment	Cube	1,122.20	
	Compaction	Cube	357.12	
	Turfing	Square	367.04	
Proposed main farm road				
No. 1	Borrow and embankment	Cube	5,907.11	
	Compaction	Cube	597.48	
	Turfing	Square	1,737.74	
	Excavation class-D	Cube	264.27	Side ditch
	Embankment	Cube	264.27	" "
Culvert	Random rubble masonry	Cube	128.46	
	Breaking 6" to 9" rubble, piling and transporting	Cube	24.75	
	Corrugated steel pipe (100mm)	ft	636.81	
No. 2	Borrow and embankment	Cube	191.08	
	Compaction	Cube	22.00	
	Turfing	Square	50.12	
	Excavation Class-D	Cube	17.19	Side ditch
	Embankment	Cube	17.19	" "

Item	Description	Unit	Quantity	Remark
Proposed lateral farm road	Borrow and embankment	Cube	4,553.00	
	Compaction	Cube	778.56	
	Turfing	Square	2,312.92	
	Excavation	Cube	2,048.84	Field channel
	Embankment	Cube	2,048.84	" "
Farm bridge (11. Nos.)	Excavation in foundation	Cube	18.15	
	Embankment	Cube	0.44	
	Back fill	Cube	17.27	
	Class-B concrete	Cube	3.34	Abutments
	Shuttering for concrete	Square	6.88	
	Timber	cuft	129.80	
	Miscellaneous metal	set	1	Bolts
Paddy field rearrangement	Earth work for consolidation	Cube	55,900.00	By bulldozer
	Board, Plan, Timber for field outlet block (4,767 Nos.)	cuft	7,817.88	
	Timber for small outlet ¢4" (153 Nos.)	cuft	8.55	
Paddy field pilot farm	Excavation	Cube	1,416.39	By bulldozer
	Embankment	Cube	897.26	
	Fill	Cube	5.93	
	Class-B concrete	Cube	0.73	
	Shuttering for concrete	Square	2.03	
	Plank	cuft	74.10	
	Collecting sand and transporting	Cube	4.95	
	P.V.C. pipe (1"x4000mm)	Nos.	4	
	(2"x4000mm)	Nos.	7	
	(6"x4000mm)	Nos.	1	
	Clay pipe (6")	ft	495.00	
	Miscellaneous material	set	1	Plan, anchor bolts, brushes etc.
	Fence and gate	ft	514.00	Type-A
	House	set	1	Farm station
Upland pilot farm-cum-mechanization center	Excavation	Cube	2,094.67	By bulldozer and mannual
	Embankment	Cube	1,722.86	
	Back fill	Cube	3.06	
	Crushed stone concrete	Cube	11.47	
	Shuttering for concrete	Square	5.26	
	Plank	cuft	36.00	
	Tarring road	Square	386.50	
	P.V.C. pipe (4"x40000mm)	Nos.	40	

Item	Description	Unit	Quantity	Remark
	(2"x4000mm)	Nos.	23.	
	(12"x4000mm)	"	7	
	P. V. C. pipe Tee 4" x 4"	"	6	
	4" x 2"	"	1	
	P. V. C. elbow (4")	"	2	
	P. V. C. cap (4")	"	1	
	P. V. C. sluice valve (4")	"	7	
	(2")		1	
	Flange (4")	"	14	
	(2")		2	
	Sprinkler	set	4	
	Perforated P. V. C pipe (4" x 4000mm)	Nos.	51	Delivery for furrow irrig.
	Dissipation valve (2")	Nos.	4	
	Fence	ft	2, 500.	Type-A
	Entrance gate	ft	110.	
	Class-B concrete	Cube	0. 81	Valve box
	Shuttering for concrete	Square	2. 64	
	Buildings	Houses	8.	

3. COMPUTATION OF NON-UNIFORM FLOW

4. DECISION OF PUMP CAPACITY

5. EXAMINATION OF WATER-HAMMER

6. DATA OF WATER EXAMINATION

7. MEASUREMENT OF ELECTRIC-RESISTANCE AND INTAKE RATE

8. " "WATER REQUIREMENT IN DEPTH

9. " DATA OF VELOCITY AND DIRECTION OF WIND

10. INVESTIGATION OF GROUND WATER LEVEL

11. LIST OF DRAWINGS

3. Computation of non-uniform flow

The proposed water surface on every stations of channels is essential for the decision of hydraulic dimension of related structures and the improvement of main channel and lateral.

The computation will be carried out in following specified manner by means of I.B.M computor.

a) Roughness coefficient 0.020

b) Channel sections, which will be able to convey the proposed discharge, after desilting and embankment.

c) Water surface elevation on down stream end.

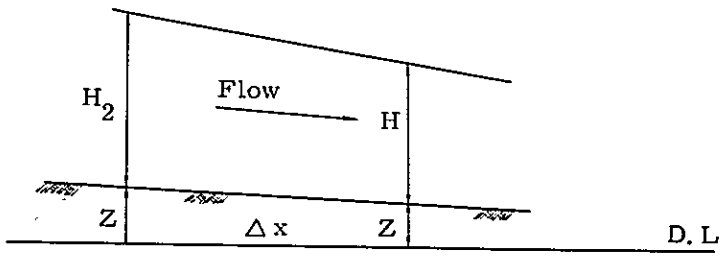
Main channel; The water stage of EL. 168.80m, will be estimated, taking paddy field surface around STA.171 and distribution loss into consideration.

Lateral, The water stage of EL.172.95m will be estimated at STA 31 and the iterations are carried out, untill the water stages at the junction between main channel and lateral, will balance

d) All dimensions and elevations are specified in metric system. So the elevation of water surface in foot system can be obtained by multiplying metric elevations by 3.28084

The formula of non-uniform flow computation

$$\Delta h = H_1 - H_2 = Z_2 - Z_1 + \alpha \frac{Q^2}{2g}\left(\frac{1}{A_2^2} - \frac{1}{A_1^2}\right) - \frac{1}{2}\left(\frac{1}{R_1^{4/3} A_1^2} - \frac{1}{R_2^{4/3} A_2^2}\right) n^2 Q^2 \Delta x$$



Where,

α ; Coefficient of velocity distribution, 1.10

Q ; Discharge

n ; Coefficient of roughness, 0.020

A_1, A_2 ; Water area (m^2)

R_1, R_2 ; Hydraulic radius (m)

Δx , Interval (m)

Program Symbol

NO ; Station

DX , Interval

H ; Water stage

DH ; Difference of upstream W.S. and downstream W.S. (Δh)

A ; Water area

R ; Hydraulic radius

V ; Velocity

N ; Coefficient of roughness

ENE ; Height of energy

Q , Discharge

J ; Judgment of ordinary flow or jet flow

4. Decision of Pump Capacity

1) Feature of Pump

Proposed Capacity	0.100 m^3/sec (6.0 m^3/min)
Number of sets	2
	Proposed Capacity par set 0.05 m^3/sec (3.0 m^3/min)
Kind	Double Suction Volute Pump
	200 mm x 150 mm x 55 KW
Proposed Suction Stage	EL. 536.00'
Proposed Delivery Stage	EL. 670.00'
Actual Lift	134.0' (40.843m)
Suction Bore	200 mm
Conveyance Bore	300 mm

2) Head Loss

* Intake loss

Bore 200 mm

Velocity in pipe $V_1 = \frac{Q/2}{\pi/4 \times D^2} = \frac{0.05}{3.14/4 \times 0.200^2} = 1.592$ m/sec

Velocity Head $\frac{V^2}{2g} = \frac{1.592^2}{19.6} = 0.129$

$h_1 = f_1 \frac{V^2}{2g} = 0.2 \times 0.129 = 0.026$ m

* Friction loss

Friction loss is calculated by Williams-Hazen formula,

C = 100

Friction loss par meter is 0.021 m

Length of pipe L = 17.0 m

$h_2 = 0.021 \times 17.0 = 0.357$ m

* Bend loss

$h_3 = f_3 \frac{V^2}{2g} = 0.130 \times 0.129 = 0.017$ m

* Valve loss

Coefficient of valve loss $f_4 = 1.50 + 0.13 = 1.63$

Velocity in delivery pipe V = 2.50 m/sec

Velocity head $\frac{V^2}{2g} = 0.319$ m

$h_4 = 1.63 \times 0.319 = 0.520$ m

* Gradual extention loss

150 mm ⟶ 200 mm

Velocity head (150 mm) ⟶ 0.319

" " (200 mm) ⟶ 0.129

$f_5 = 0.4$

$h_5 = 0.4 \times (0.319 - 0.129) = 0.076$ m

* Junction loss

Velocity in pipe (300mm) V = 1.416 m/sec

Velocity head (300mm) $\frac{V^2}{2g} = 0.102$

$f_6 = 0.28$

$h_6 = 0.28 \times 0.102 = 0.029$ m

* Friction loss of conveyance pipe

Friction loss is calculated by Williams-Hazen formula,

C = 100

Friction loss par meter is 0.0102 m

Length of pipe L = 570 m

$h_7 = 0.0102 \times 570 = 5.814$ m

* Bend loss of conveyance pipe

Velocity head 0.102

$f_8 = 1.739$

$h_8 = 1.739 \times 0.102 = 0.177$ m

From the result of calculations, Total Head Loss is,

$$\sum_{1}^{8} h = 0.026 + 0.357 + 0.017 + 0.520 + 0.076 + 0.029 + 5.814 + 0.177 = 7.016 \text{ m}$$

Therefore, Total Lift is,

$H = 40.843 + 7.016 = 47.8$ m

and, it is given 10 % of total head for safety.

$47.8 \times 1.10 = 52.6$ m

3) Decision of Motor Power

Water power $P_w = 0.163 \times r \times Q \times H$

$= 0.163 \times 1.0 \times 0.05 \times 60 \times 52.6$

$= 26$ KW

Axis power $P_m = \dfrac{pw\ (1 + \alpha)}{\eta p \times \eta t}$

α ; Safety coefficient 20 %

ηp ; Pump efficiency 59%

ηt , Transmission efficiency 100 %

Therefore,

$$P_m = \frac{26 \times 1.20}{0.59 \times 1.00} = 53 \text{ KW}$$

5. Examination of Water-hammer

1) Water-hammer wave velocity a

$$a = \frac{1.420}{\sqrt{1 + \frac{h}{E}\frac{D}{t}}} = \frac{1,420}{\sqrt{1 + 0.01 \times \frac{300}{6}}} = 1,154.4 \text{ m/sec}$$

2) Velocity in pipe

$$V_o = \frac{Q}{60 \times \frac{\pi}{4} \times D^2} = 1.416 \text{ m/sec}$$

3) Pipe line constant P

$$2P = \frac{aVo}{gHo} = \frac{1.154.4 \times 1.416}{9.8 \times 52.6} = 3.171$$

4) Coefficient of inertia K

$$K = \frac{1.76 \times 10^6}{60} \times \frac{Ho}{G\ D} \frac{Qo}{No^2} \times 1.10$$

$$= \frac{1.76 \times 10^6}{60} \times \frac{52.6 \times 3.0}{10 \times 0.59 \times 1,800^2} \times 1.10$$

$$= 0.271 \text{ sec}^{-1}$$

5) Suddenly Closure ($To < \frac{2L}{a} = \frac{2 \times 550}{1,154.4} = 1.0$ sec)

$$\Delta Hmax = \frac{a\ Vo}{g}$$

To ; Valve closure time (sec)

L ; Length of pipe line (m)

a ; Wave velocity 1,154,4 m/sec

Δ Hmax ; Maximum pressure rise (m)

Vo ; Initial velocity in pipe 1.416 m/sec.

Therefore, $\Delta Hmax = \frac{1,154.4 \times 1.416}{9.8} = 167$ m

6) Grandual Closure ($To > 1.0$ sec)

Valve Closure time To = 5 sec

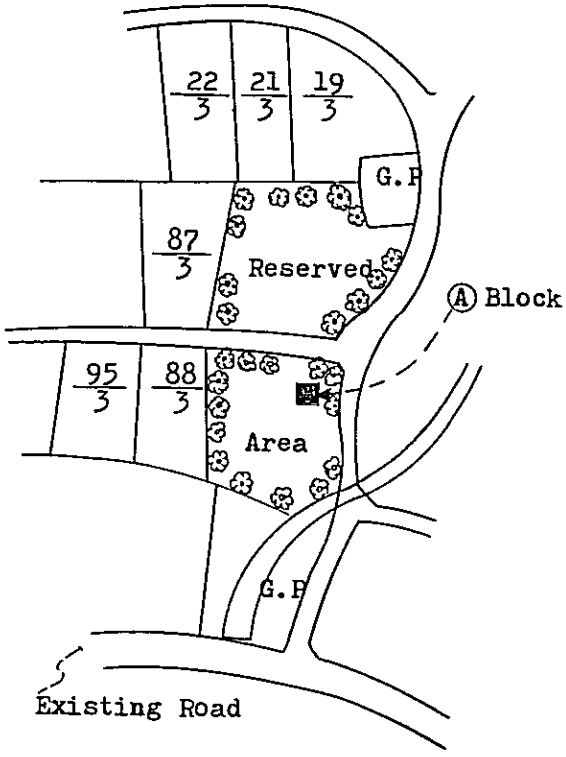
$$\Delta Hmax = \frac{L\ Vo}{g\ To} \cdot \frac{1}{1 - \frac{L}{a\ To}} = \frac{550 \times 1.416}{9.8 \times 5} \times \frac{1}{1 - \frac{550}{1,154.4 \times 5}} = 18 \text{ m}$$

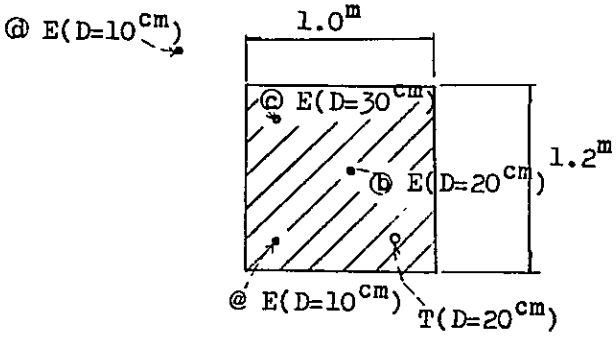
6. Date of Water Examination

	No. 1	No. 2
Place	Dam Site	Well (near Head Office)
Date	9 Aug. '69	9 Aug. '69
Weather	Fine	Fine
Temperature	31°C	31°C
Temperature of Water	30°C	27°C
Turbidity	12.5	-
Colour	25.0	-
Odor	Marshy	-
Taste	-	-
pH Value	7.4	7.3
Alkalinity (ppm)	248	173
Acidity (ppm)	20	9
Ammona Nitrogen	+	-
Nitrite Nitrogen	-	+
Nitrate Nitrogen	-	-
Chlorine	23	20
Potassium Permanganate Consumed	16	-
Hardness	190	120
Date of Examination	10 Aug. '69	10 Aug. '69
Place of Examination	Maha-Illpalluma S.B.	Maha-Illpalluma S.B.

7. Measurement of Electric-resistance and Intake Rate

Location of Ⓐ Block



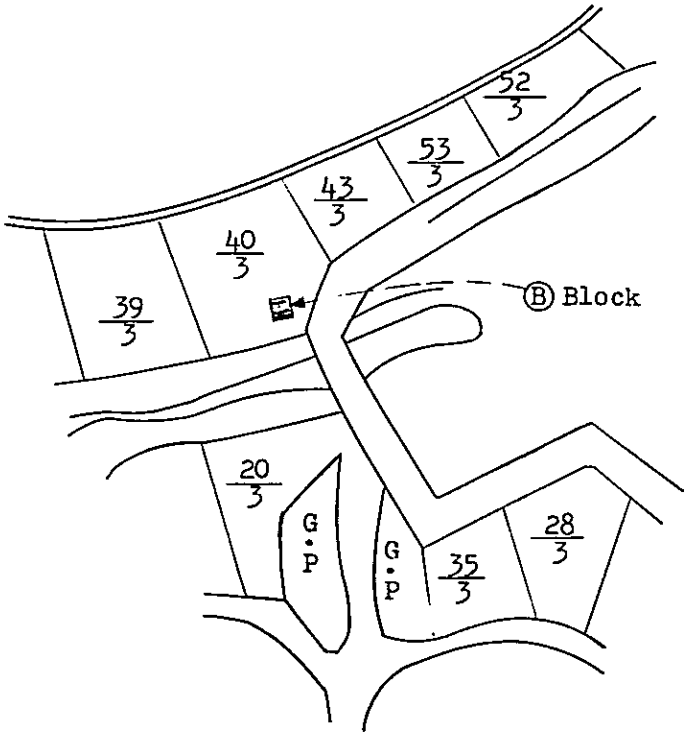


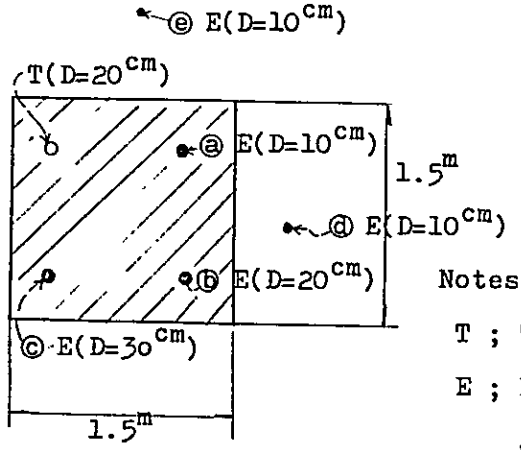
Notes

T ; Tension meter

E ; Electric-resistance moisture meter method

Location of Ⓑ Block





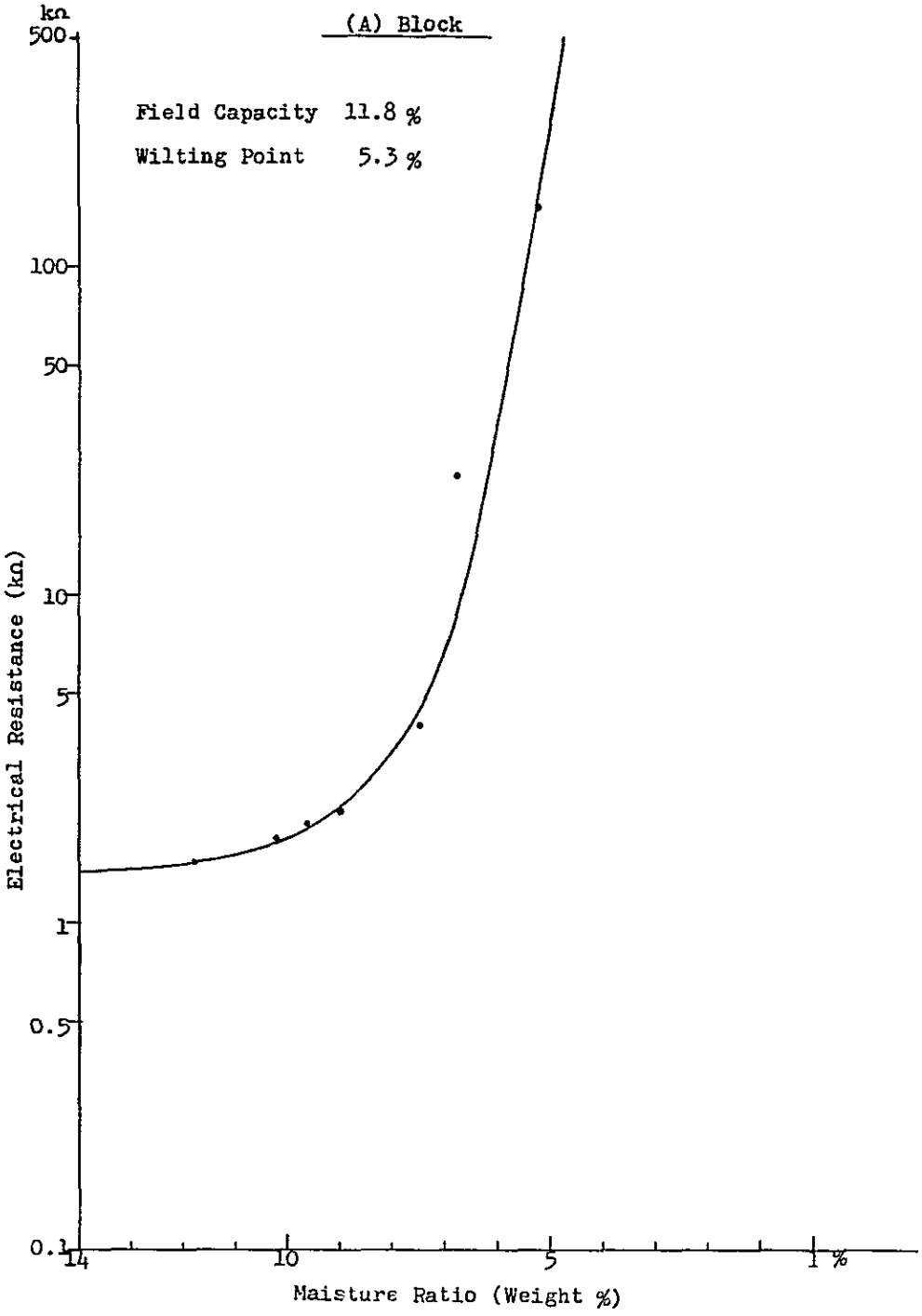
Notes

T ; Tension meter

E ; Electric-resistance moisture meter method

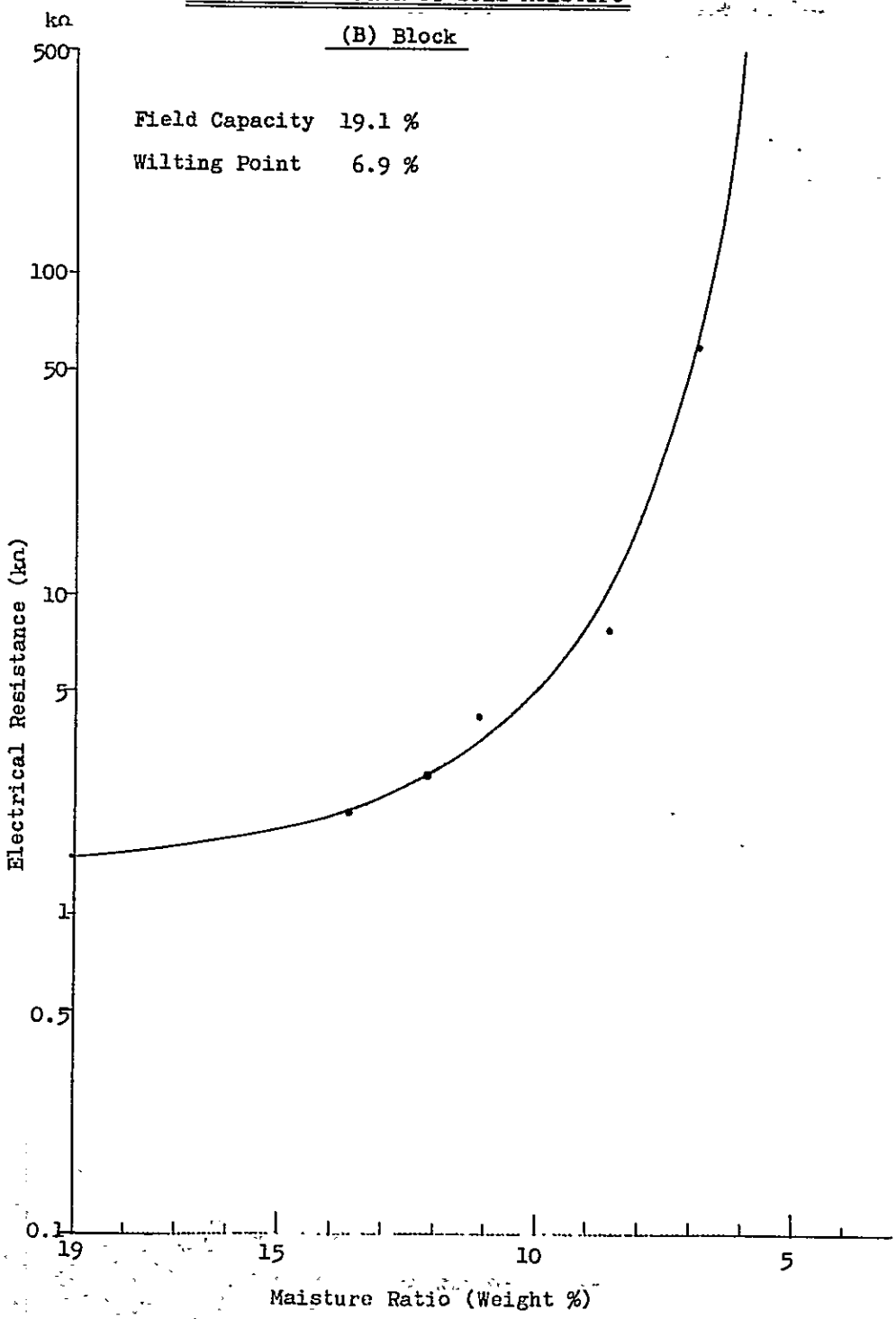
Measurement Data of Soil Moisture

(A) Block



Measurement Data of Soil Moisture

(B) Block



A - block Measurement Table

Date	Time	Measurement by Tensio-meter		Measurement by Electric-resistance Method				Apparent-spesific Gravity		Moisture Ratio			
										Percentage by Gravity Weight		Percentage by Capacity	
				a	b	c	d	D=10cm	D=20cm	D=10cm	D=20cm	D=10cm	D=20cm
8. 1	9:30AM			1.5	1.1	0.95		1.40	1.38	11.8	12.8	16.5	17.7
2	9:20AM			1.7	1.2	1.0							
"	4:00PM	21	PF=2.3	1.7	1.2	1.0							
"								1.34		5.3		7.1	
3	10·00AM	32	PF=2.6	1.8	1.3	1.1		1.44	1.56	10.2	10.2	14.7	15.9
4	8·35AM	34	PF=2.6	1 9	1.4	1.3	190						
6	11:25AM	14		1.9	1.5	1.4	140						
"	2:10PM	Water supply		2.0	1.6	1.5	130	1.41		9.6		13.5	
7	3·00PM	14	water supply	2.2	1.6	1.8	150	1.43		9.0		12 9	
"	5:20PM	16	PF=2.2										
8	11:00AM	13	PF=2.0	2.7	1.7	1.8	170						
"	2:00PM	15	PF=2.1	2.7	1.7	1.9	170						
9	2:15PM	35	PF=2.6	3.3	1.8	2.0	190						
10	10·00AM	35.5	PF=2.6	3.8	1.8	2.2	220						
11	9.40AM	36	PF=2.6	4.0	1.8	2.2	250	1.41		7.5		10.6	
12	9:00AM	32	PF=2.6	4.6	2.0	2.3	280						
13	2.20PM	45	PF=2.7	4.3	1.9	2.3	330						
14	11:00AM	35	PF=2.6	3.9	2.1	2.4	230	*1.38		*6 8		*9.4	
	(Water supply)												

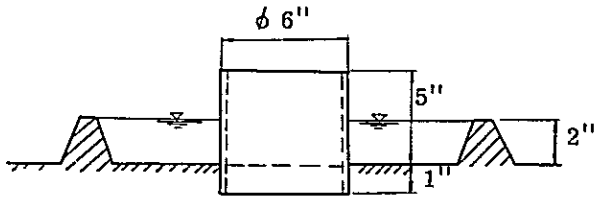
* Natural Condition Field Capacity

B - block Measurement Table

Date	Time	Measurement by Tensio-meter		Measurement by Electric-resistance Method					Apparent-spesific Gravity		Moisture Ratio			
											Percentage by Gravity Weight		Percentage by Capacity	
				a	b	c	d	e	D=10cm	D=20cm	D=10cm	D=20cm	D=10cm	D=20cm
*8. 1									1.37		6.9		9.5	
2	2:00PM	14	PF=2.1	1.5	1.5	1.3			1.35	1.35	19.1	18.3	25.8	24.7
3	11:10AM	15	PF=2.1	1.7	1.8	1.5								
"	2:15PM	15	PF=2.1	1.8	2.0	1.7								
4	8:45AM	17.5	PF=2.2	1.9	2.2	1.8	67	48						
6	11:45AM	26.5	PF=2.5	2.0	2.3	1.8	80	59						
"	3:15PM	28.5	PF=2.5	2.1	2.3	1.8	82	60	1.37		13.7		18.8	
7	2:00PM	24	water supply	2.7	2.6	2.0	85	65	1.35		12.2		16.5	
"	5.15PM	28	PF=2.5											
8	10·00AM	33	PF=2.6	2.8	2.8	2.1	90	70						
"	2:20PM	34	PF=2.6	2.9	2.8	2.1	93	73						
9	1:50PM	36.5	PF=2.6	3.2	3.2	2.1	120	88						
10	9:00AM	34	PF=2.6	4.1	3.6	2.2	160	130	1.36		11.2		15.2	
11	9·00AM	38	PF=2.7	4.7	3.7	2.2	170	140						
12	9:10AM	33 5	PF=2.6	5.8	3.8	2.2	190	165						
13	2:00PM			7.8	3.8	2.2	180	150	1.35		8.7		11 7	
14	10:30AM	26	PF=2.5	6.4	4.5	2.3	98	60						
	(Water supply)													

* Natural Condition Field Capacity

Intake Rate



Ⓐ Block

(Measurement Date, 31 July '69)

Time	Intake Rate	Time	Intake Rate
1 min	5 mm = 0.197 inch	20 min	54 mm = 2.126 inch
2	9 = 0.354	25	63 = 2.480
3	13 = 0.511	30	71 = 2.795
4	16 = 0.630	40	86 = 3.386
5	19 = 0.740	50	99 = 3.898
7	25 = 0.984	60	111 = 4.370
9	30 = 1.181		
11	35 = 1.378		
13	39 = 1.535		
15	43 = 1.693		

Ⓑ Block

(Measurement Date, 2 Aug. '69)

Time	Intake Rate	Time	Intake Rate
1 min	3 mm = 0.118 inch	30 min	38.5 mm = 1.516 inch
3	6.5 = 0.256	40	46.5 = 1.831
5	10 = 0.394	50	54 = 2.126
7	13 = 0.512	60	61 = 2.402
9	16 = 0.630	75	70 = 2.756
11	19 = 0.748	90	78 = 3.071
13	21.5 = 0.846	105	85 = 3.346
15	24 = 0.945	120	91.5 = 3.602
20	29.5 = 1.161		

(Measurement Date, 3 Aug. '69)

Time	Intake Rate	Time	Intake Rate
1 min	10 mm = 0.394 inch	20 min	62 mm = 2.441 inch
3	18 = 0.709	25	69.5 = 2.736
5	24 = 0.945	30	76 = 2.992
7	31 = 1.220	40	88.5 = 3.484
9	38 = 1.496		
11	44 = 1.732		
13	49 = 1.929		
15	53 = 2.087		

Measurement Data of Cylinder Intake Rate

A-block

(Measurement 7/31)

$K=11.8$

$n=-0.318$

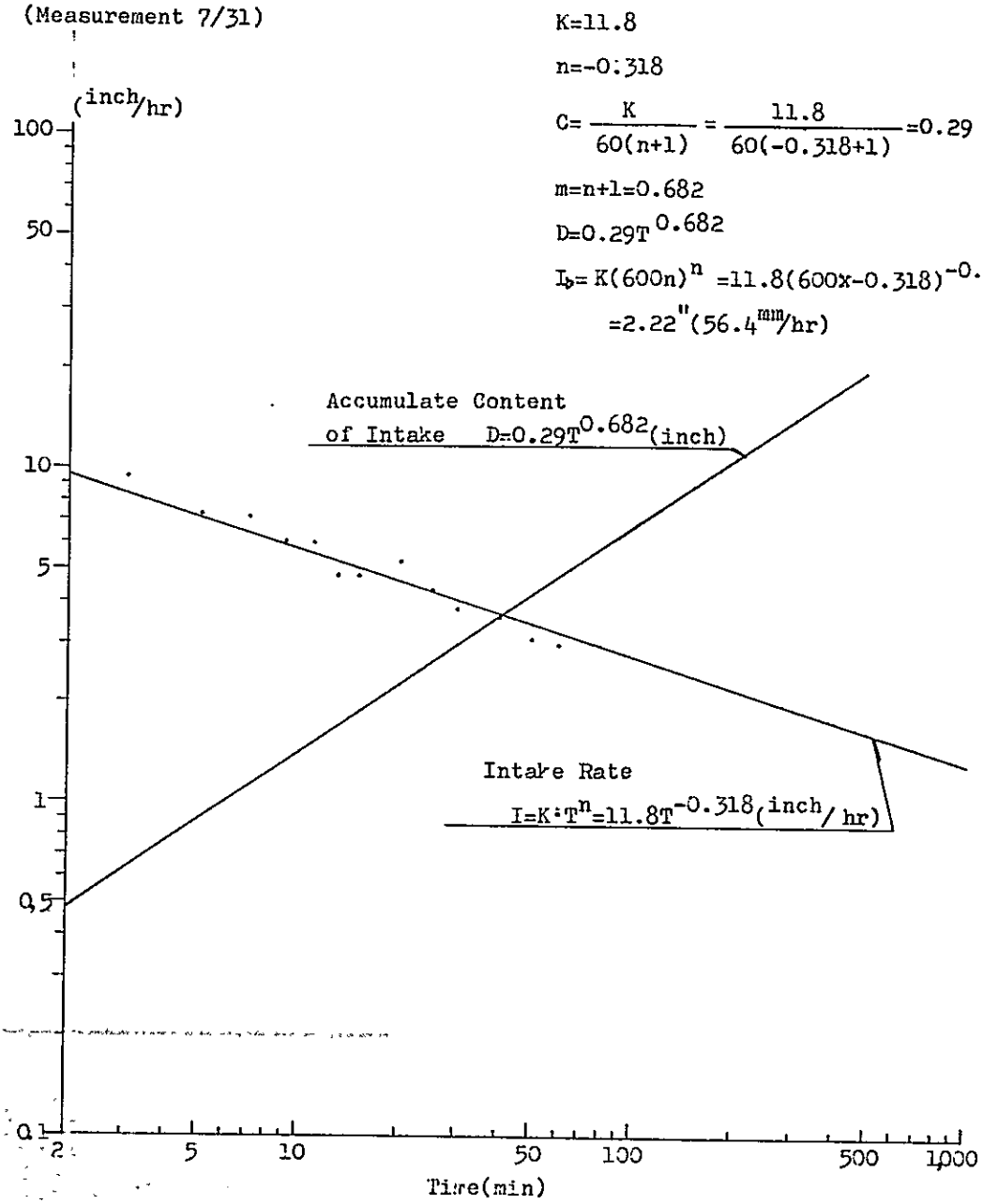
$C=\frac{K}{60(n+1)}=\frac{11.8}{60(-0.318+1)}=0.29$

$m=n+1=0.682$

$D=0.29T^{0.682}$

$I_b=K(600n)^n=11.8(600x-0.318)^{-0.318}$

$=2.22''(56.4^{mm}/hr)$



Measurement Data of Cylinder Intake Rate

B-block

(Measurement 8/2)

$K=7.1$

$n=-0.357$

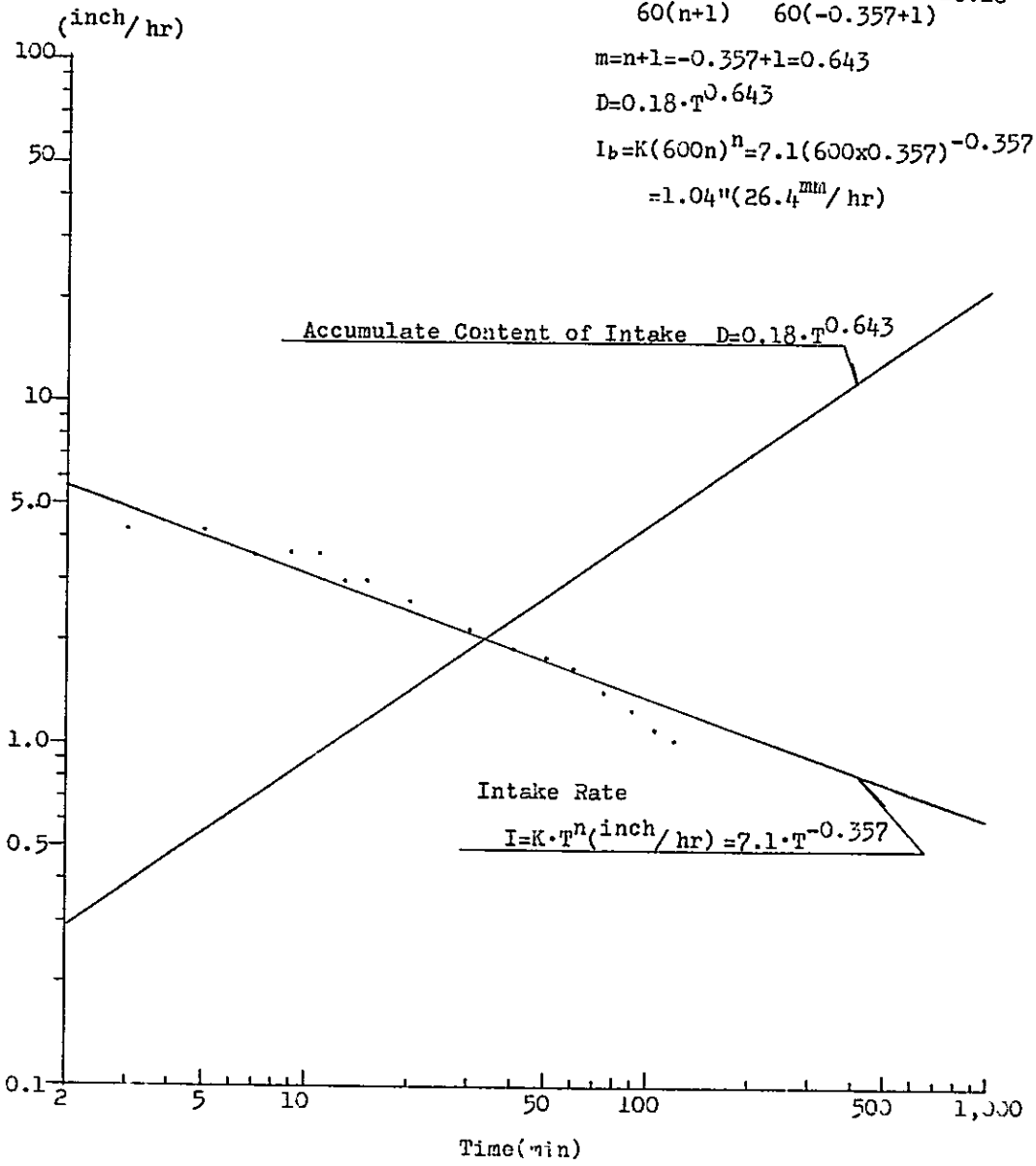
$$C=\frac{K}{60(n+1)}=\frac{7.1}{60(-0.357+1)}=0.18$$

$m=n+1=-0.357+1=0.643$

$D=0.18\cdot T^{0.643}$

$I_b=K(600n)^n=7.1(600\times0.357)^{-0.357}$

$=1.04''(26.4^{mm}/hr)$



Measurement Data of Cylinder Intake Rate

B-block

(Measurement 8/3)

$K=18.0$

$n=-0.478$

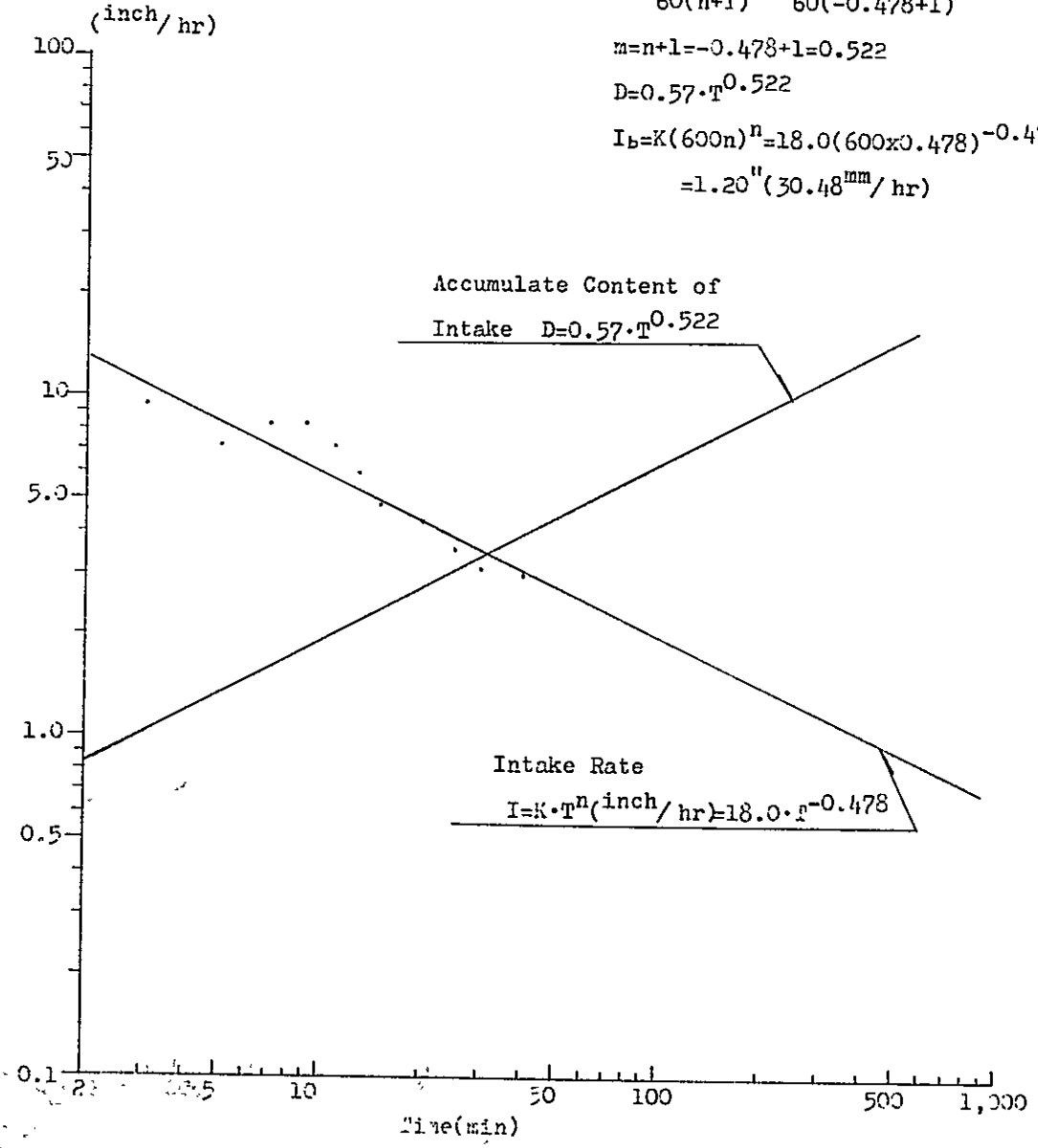
$C=\frac{K}{60(n+1)}=\frac{18.0}{60(-0.478+1)}=0.57$

$m=n+1=-0.478+1=0.522$

$D=0.57\cdot T^{0.522}$

$I_b=K(600n)^n=18.0(600\times0.478)^{-0.478}$

$=1.20''(30.48^{mm}/hr)$



8. Measurement of Water Requirement in Depth

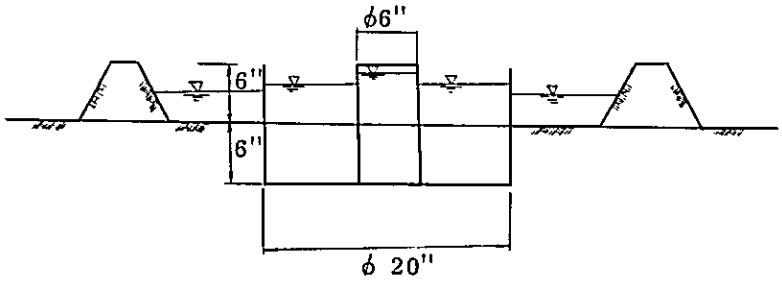
Date	No. 1 (Tract 2 No. 2)	No. 2 (Tract 3 No. 8)	No. 3 (Tract 1 No. 6)
8. 7	30 mm	57 mm	mm
8	31	46	
9	30	34	52
10	37	○ 74	○ 76
11	○ 126	44	● 122
12	○ 90	44	* 20
13	○ 98	○ 55	* 18

Note :

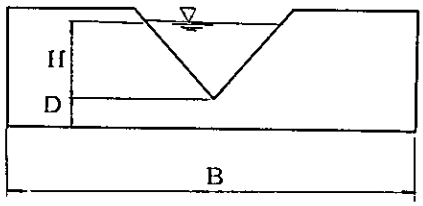
○ : The water in outside cylinder was quite percolated

● : Water buffalos and cows could not be kept from measurement

* : The instrument was covered by straw mat in order to measure the percolation only



Discharge Measurement Date of Hewanella Oya Barrage
by Triangle Notch



D = 0.05^{m}
B = 4.00^{m}

Date	Overflow Depth	Discharge
8. 6	0.135^{m}	9.3 /sec
7	0.176	17.7
8	0.145	11.0
9	0.153	13.1
10	0.151	12.0
11	0.136	9.3
12	0.145	11.0
13	0.145	11.0

9. Measurement Data of Velocity and Direction of Wind

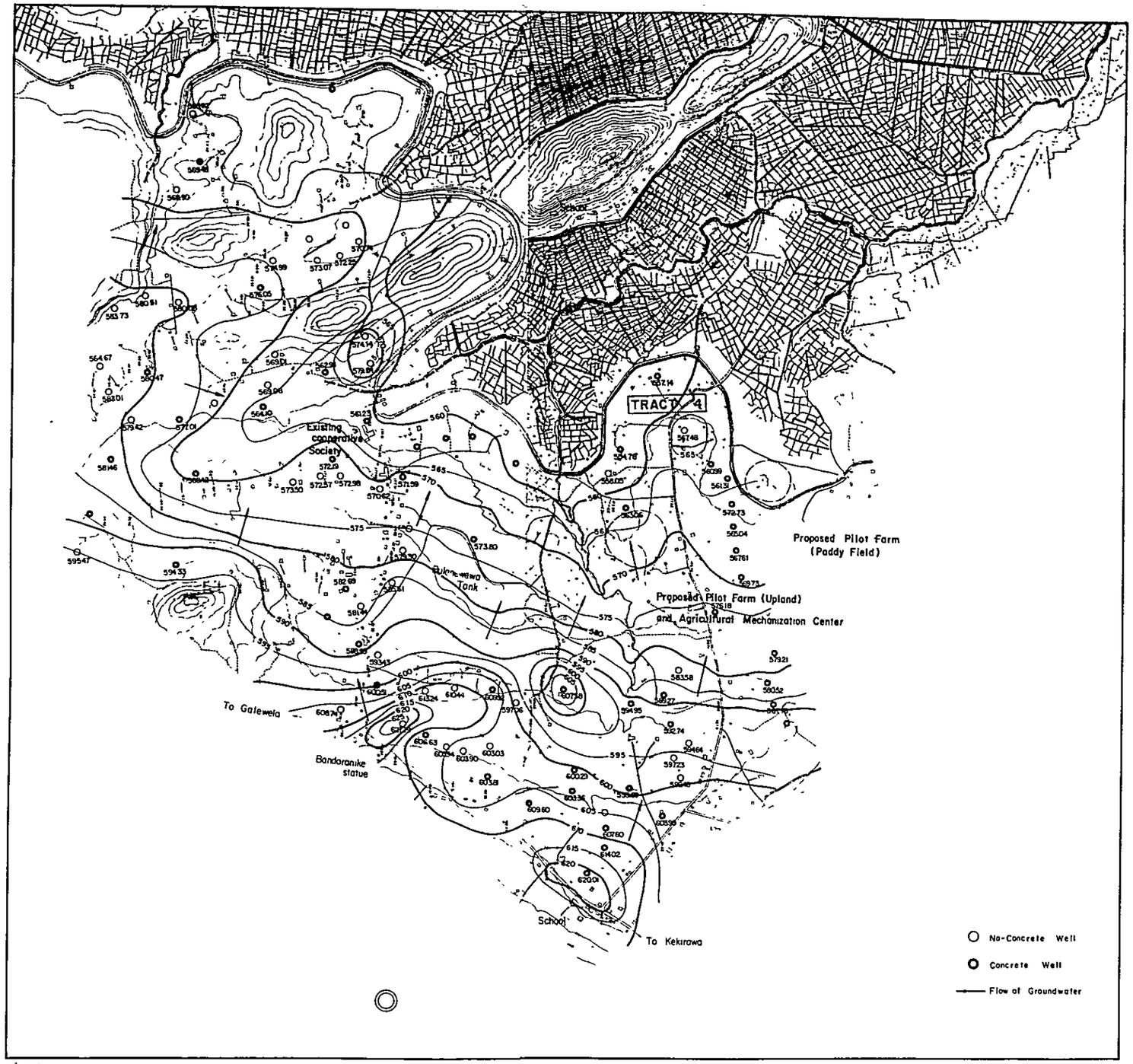
Date	Time	Place	Wind Direction	Wind Velocity (m/sec)				
				1	2	3	4	Average
8. 3	9:20AM	T.A. Bungalow	SSW	3.00	3.16			3.08
"	9:40AM	P.IP.5	"	2.42	4.20	3.64		3.42
"	10:00AM	A-Block	"	1.19	1.40	1.55		1.38
"	11:10AM	B-Block	"	3.59	3.90	2.69	2.58	3.19
"	2:00PM	"	"	3.89	2.65	2.20		2.91
6	9:00AM	T.A. Bungalow	"	2.96	3.41	3.10		3.16
"	10:00AM	P.IP.5	"	3.65	3.26	3.08		3.33
"	11:25AM	A-Block	"	1.08	1.28	0.80		1.05
"	11:45AM	B-Block	"	2.54	2.36	2.95		2.62
"	2:00PM	A-Block	"	1.36	2.12			1.74
"	4:00PM	B-Block	"	2.44	2.40	3.18		2.67
7	8:55AM	T.A. Bungalow	"	2.70	2.33	2.44		2.49
"	10:05AM	P.IP.5	"	3.41	2.80	4.23	3.69	3.53
"	10:40AM	Tract 3.No.8	"	4.74	4.96	5.08	5.26	5.01
"	2:00PM	B-Block	"	1.91	2.24	2.55		2.23
"	3:00PM	A-Block	"	1.36	1.54	1.66		1.52
8	10:00AM	B-Block	"	1.99	2.16	2.81	3.00	2.49
"	11:00AM	A-Block	"	0.72	1.50	1.40		1.21
9	9:30AM	"	"	1.30	1.37	1.85	1.31	1.46
"	10:30AM	Tract 3.No.8	"	3.46	3.78			3.62
"	10:45AM	Tract 2.No.2	"	3.64	3.57			3.61
"	11:15AM	Tract 1.No.6	"	3.60	3.83			3.72
10	11:00AM	T.A. Bungalow	"	2.60	1.70	2.30	2.73	2.33

10. Investigation of Ground Water Level

House No	Elev. of Basic point	Depth from Basic P. to W.S.	W.S.	Notes
(40)	573.40	12.17	561.23	
(7)	584.59	13.00	571.59	
3 - 19	582.62	12.00	570.62	
3 - 21	585.48	12.50	572.98	
3 - 18	585.44	13.25	572.19	
3 - 22	585.82	13.25	572.57	
3 - 16	590.75	17.25	573.50	
3 - 10	601.09	32.67	568.42	
3 - 4	599.46	18.00	581.46	
4 - 8	610.89	15.42	595.47	
1 - 2	604.72	28.67	576.05	
1 - 9	600.83	20.75	580.08	
2 - 7	585.59	5.08	580.51	
2 - 7	585.46	5.33	580.13	
2 - 6	587.15	3.42	583.73	
2 - 5	584.26	7.25	577.01	
2 - 3	595.14	14.67	580.47	
2 - 2	584.17	4.75	579.42	
2 - 1	597.88	13.42	584.46	
1 - 13	591.81	8.80	583.01	
1 - 12	595.00	10.33	584.67	
3 - 98	594.68	8.25	586.43	
1 - 2	596.32	21.33	574.99	
3 -102	573.65	4.75	568.90	
3 -103	586.90	17.42	569.48	
3 -107	583.42	17.50	565.92	
3 - 43	619.92	12.75	607.17	
3 - 43	622.02	16.50	605.52	
3 - 40	579.36°	16.42	562.94	
1 - 11	589.03	19.42	569.61	
3 - 39	584.08	15.00	569.08	
2 - 10	578.68	14.58	564.10	
3 - 50	585.24	14.50	570.74	
3 - 44	585.25	13.00	572.25	

House No	Elev. of Basic point	Depth from Basic P. to W.S.	W.S.	Notes
3 - 51	586.07	13.00	573.07	
1 - 3	583.21			
1 - 4	583.29			
1 - 3	576.19			
(2)	603.11	20.42	582.69	
(3)	592.61	7.00	585.61	
(4)	594.32	15.02	579.30	
(2')	595.86	14.42	581.44	
( )	603.25			
( )	600.99	12.00	588.99	
( )	598.18	4.75	593.43	
3 - 86	608.68	8.17	600.51	
( )	609.74			
3 - 93	615.79	12.00	603.79	
4 - 17	629.80	23.17	606.63	
4 - 14	629.19	23.25	605.94	
4 - 10	625.32	21.42	603.90	
3 - 74	626.48	22.67	603.81	
4 - 23	615.11	11.75	603.36	
3 - 75	623.03	20.00	603.03	
3 - 72	614.04	13.75	600.29	
3 - 85	615.48	18.42	597.06	
3 - 76	625.30	17.92	607.38	
3 - 27	627.27	17.75	609.52	
3 - 73	621.94	11.50	610.44	
( )	610.51			
3 - 94	625.28	12.04	613.24	
( )	615.97			
( )	608.83			
4 - 22	624.77	15.17	609.60	
4 - 15	631.28	16.67	614.61	
(Mos)	636.21			
4 - 16	636.34	16.33	620.01	
4 - 21	626.60	12.58	614.02	
4 - 13	621.77	14.17	607.60	
4 - 20	621.20	17.25	603.95	

House No	Elev. of Basic point	Depth from Basic p. to W.S.	W.S.	Notes
4 - 19	610.28	10.80	599.48	
4 - 12	609.94	10.25	599.69	
4 - 11	605.23	8.00	597.23	
4 - 9	603.70	8.75	594.95	
(118)	626.63	22.25	501.38	Park
3 - 57	605.89	11.25	594.64	
3 - 82	604.74	12.00	592.74	
3 - 68	594.48	6.80	587.68	
3 - 59	592.32	11.80	580.52	
3 - 78	606.02	16.75	589.27	
3 - 37	590.88	11.67	579.21	
(119)	595.50	11.92	583.58	Pasture
3 - 56	591.35	15.17	576.18	
3 - 60	580.73	11.00	569.73	
3 - 31	577.41	9.80	567.61	
3 - 79	576.37	11.33	565.04	
3 - 80	579.45	6.67	572.78	
3 - 33	581.06	18.00	563.06	
3 - 81	576.73	15.42	561.31	
3 - 61	577.32	16.33	560.99	
3 - 63	584.48	17.00	567.48	
3 - 64	573.14	16.00	557.14	
3 - 66	572.42	17.42	554.78	
3 - 67	571.72	13.67	558.05	
(39)	582.80	9.00	573.80	
3 - 34	576.43			
3 - 29	573.76			
3 - 28	573. 95			
3 - 35	575.22			



s (1)
(2)
(3)
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nd sections

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ns

11. LIST OF DRAWINGS

Plan No.	Title		
C-1	Main channel		General plan
C-2	" "		Profile (1)
C-3	" "		" (2)
C-4	" "		" (3)
C-5	" "		" (4)
C-6	" "		" (5)
C-7	" "		" (6)
C-8	" "		" (7)
C-9	" "		" (8)
C-10	" "		" (9)
C-11	" "		" (10)
C-12	" "		" (11)
C-13	" "		Cross sections (1)
C-14	" "		" (2)
C-15	" "		" (3)
C-16	" "		" (4)
C-17	" "		" (5)
C-18	" "		" (6)
C-19	" "		" (7)
C-20	" "		" (8)
C-21	" "		" (9)
C-22	" "		" (10)
C-23	" "		" (11)
C-24	" "		" (12)
C-25	Lateral		Profile (1)
C-26	"		" (2)
C-27	"		Cross sections (1)
C-28	"		" (2)
C-29	Parshall flume	No.1	Plan, profile and sections
C-30	" "	"	Reinforcement
C-31	" "	No.2	Plan, profile and sections
C-32	" "	"	Reinforcement
C-33	Check structure	No.1	Plan and sections
C-34	" "	No.2	" " "

Plan No.	Title	
C-35	Check structure No.3	Plan and sections
C-36	" " No.4-8	" " "
C-37	Outlet Type A	Plan and sections
C-38	" Type B	" " "
C-39	Proposed outlet	" " "
C-40	Crossing bridge (P.C.) No. 1-No. 4	Plan and sections
C-41	" " (H-bean)	" " "
W-1	Weir, infiltration gallery & pumping station	General plan
W-2	Weir	Plan and sections
W-3	"	Sections & reinforcement
W-4	"	Detail of sluice gate
W-5	Pumping station	Plan and sections
W-6	" "	Details of housing
W-7	" "	Details of fences
W-8	Infiltration gallery	Detail of collecting conduit
W-9	" "	Details of junction wells
P-1	Pipe lines & roads	General plan
P-2	Main pipe line	Plan of pipe arrangement
P-3	Main pipe line	Details of pipe arrangement
P-4	" " "	Profile (1)
P-5	" " "	" (2)
P-6	" " "	" (3)
P-7	" " "	" (4)
P-8	Lateral A	"
P-9	" B	"
P-10	" C	"
P-11	" D	"
P-12	" F	"
P-13	" G	"
P-14	" G & E	"
P-15	" H	"
P-16	" I	"
P-17	" J	" (1)
P-18	" J	" (2)
P-19	" J	" (3)

Plan No.	Title	
P-20	" K	Profile
P-21	" L	" (1)
P-22	" L	" (2)
P-23	Regulating pond	Pland and sections
P-24	" "	Details
P-25	Reservoir and booster station	Plan, sections and details
P-26	Pipe aqueduct No.1	Plan, profile and sections
P-27	" " No.2	" " "
P-28	" " No.3	" " "
P-29	Pipe lines	Detail of tap stands
R-1	Improved Road No.1	Profile and sections (1)
R-2	" " "	" " (2)
R-3	" " No.2	" " (1)
R-4	" " "	" " (2)
R-5	" " No.3	" "
R-6	" " "	Detail of culvert
R-7	Proposed road No.1	Plan (1)
R-8	" " "	" (2) & detail of culverts
R-9	" " "	Profile and section (1)
R-10	" " "	" " (2)
R-11	" " "	" " (3)
R-12	" " "	" " (4)
R-13	" " "	" " (5)
F-1	Paddy field pilot farm	General plan and sections
F-2	" " " "	Details
F-3	" " " "	Detail of housing
F-4	Upland pilot farm	General plan and section
F-5	Paddy field rearrangement	General plan
F-6	" " "	Details
B-1	Pilot farm building-cum-agricultural mechanization center	Building No.1 (1)
B-2	"	" " (2)
B-3	"	" " (3)
B-4	"	" No.2
B-5	"	" No.3

Plan No.	Title			
B-6	Pilot farm building-cum-agricultural mechanization center	Building	No. 1	
B-7	"	"	No. 5	
B-8	"	"	No. 6	
B-9	"	"	No. 7	
B-10	"	"	No. 8	(1)
B-11	"	"	"	(2)
B-12	"	"	"	(3)